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CONTENT / INHALT

The millipedes and centipedes (Diplopoda, Chilopoda) of the river banks and the stream islands at the northern Upper-Rhine in Germany

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Abstract. This work presents the fauna of millipedes and centipedes of a floodplain near Ingelheim at the Rhine in Germany to support the knowledge of the myriapod fauna in Central European floodplains and faunistic research of the Rhine-Main area, investigated by pitfall traps and tree eclectors. Structure of dominance, evenness and diversity is given. Seasonal activity on the ground and the lower stem region of the dominant species *Julus scandinavius* LATZEL, 1884 and *Polydesmus denticulatus* C. L. KOCH, 1847 were investigated which showed also high constancy at the lower stem region. Furthermore an overview of the Diplopoda and Chilopoda of various stream islands in the Rhine and river banks from pitfall traps during the years 2002 to 2005 are presented and discussed.

Zusammenfassung. Die Tausend- und Hundertfüßer (Diplopoda, Chilopoda) der Ufer und Rheininseln am nördlichen Oberrhein in Deutschland. Die vorliegende Arbeit gibt eine Zusammenstellung der Tausend- und Hundertfüßer aus Bodenfallen und Stammeklektoren in einem fragmentarischen Auwald bei Ingelheim am Rhein aus den Jahren 2003 bis 2005 als Beitrag zur Kenntnis der Myriapoden in mitteleuropäischen Auwäldern und zur Faunistik des Rhein-Main-Gebietes. Die Dominanzstruktur, Evenness und die Diversität wurden für den Boden und den unteren Stammbereich berechnet. Die Aktivitätsdichten der dominanten Arten *Julus scandinavius* LATZEL, 1884 und *Polydesmus denticulatus* C. L. KOCH, 1847 am Boden und im Stammbereich wurden näher untersucht. Es konnte eine hohe Konstanz beider Arten im unteren Stammbereich gezeigt werden. Des Weiteren wird eine Übersicht der durch Bodenfallen gefangenen Diplopoden und Chilopoden von verschiedenen Rheininseln und Uferstandorten aus den Jahren 2002 bis 2005 gegeben.

Keywords. Myriapoda, floodplain, Rhine, stem region, inundation

1. Introduction

Floodplain forests are characterised by an alternation of terrestrial and aquatic phases and thus constitute very dynamic ecosystems. The chilopods and diplopods of Central European lowland floodplains have been investigated by several authors (DUNGER 1958, HANDKE & HANDKE 1989, RIPPLINGER & ALBERTI 1993, TUF 2000, 2003, TUF & OŽANOVÁ 1999, STERZYŃSKA et al. 2015, TUFOVÁ 2003, TUFOVÁ & TUF 2005, WYTWER 1997, ZERM 1997a, 1997b, 1999, ZULKA 1990, 1991, 1992, 1996), the numerous floodplains of the northern Upper Rhine, however, having been overlooked until now. The aim of the following study was to investigate the composition of the millipede and centipede fauna of a fragmented hardwood floodplain near Ingelheim on the Rhine, Germany, and several floodplain forests of the Rhine islands and

river banks. The following arthropod groups have been investigated so far in this floodplain forest near Ingelheim: Collembola (MARX 2005, 2007, 2011), Carabidae (LESSEL & EISENBEIS 2008), Opiliones (MARX & SCHÖNHOFER 2005), Pseudoscorpiones (MARX et al. 2008a) and Araneae (MARX et al. 2008b).

The diplopods of the Rhine-Main area have only been investigated by very few authors since HAACKER (1968a, 1968b), but especially the faunistic knowledge on the chilopods of this area is still very sketchy.

2. Material and Methods

2.1 Location and characterisation of the investigation sites

The floodplains study area „Heidenfahrt" (Fig. 1) is located in the Mainz Basin, approx. 7 km to the west of Mainz and 1.2 km from Heidenfahrt (Heidesheim on the Rhine) and is part of the nature reserve "Sandlache". It is a fragmented hardwood floodplain forest of the northern Upper Rhine area and is dominated in the tree layer by *Fraxinus excelsior*, *Quercus robur* and *Acer campestre*.

In the past, the floodplain forest has been flooded regularly for shorter periods of a few weeks. In recent years, such flood events have become increasingly rare due to lower precipitation. The last flooding across the whole area took place in March and April of 2002 with the floodplain forest almost completely underwater. The stream islands in the Rhine and the river banks were also largely flooded. During the investigation period, there was a flood in March and April of 2006. Primarily, the sinks of the floodplains forest were underwater in the following periods: 11 March to 15 March 2006, 31 March to 6 April 2006 and 13 April to 15 April 2006.

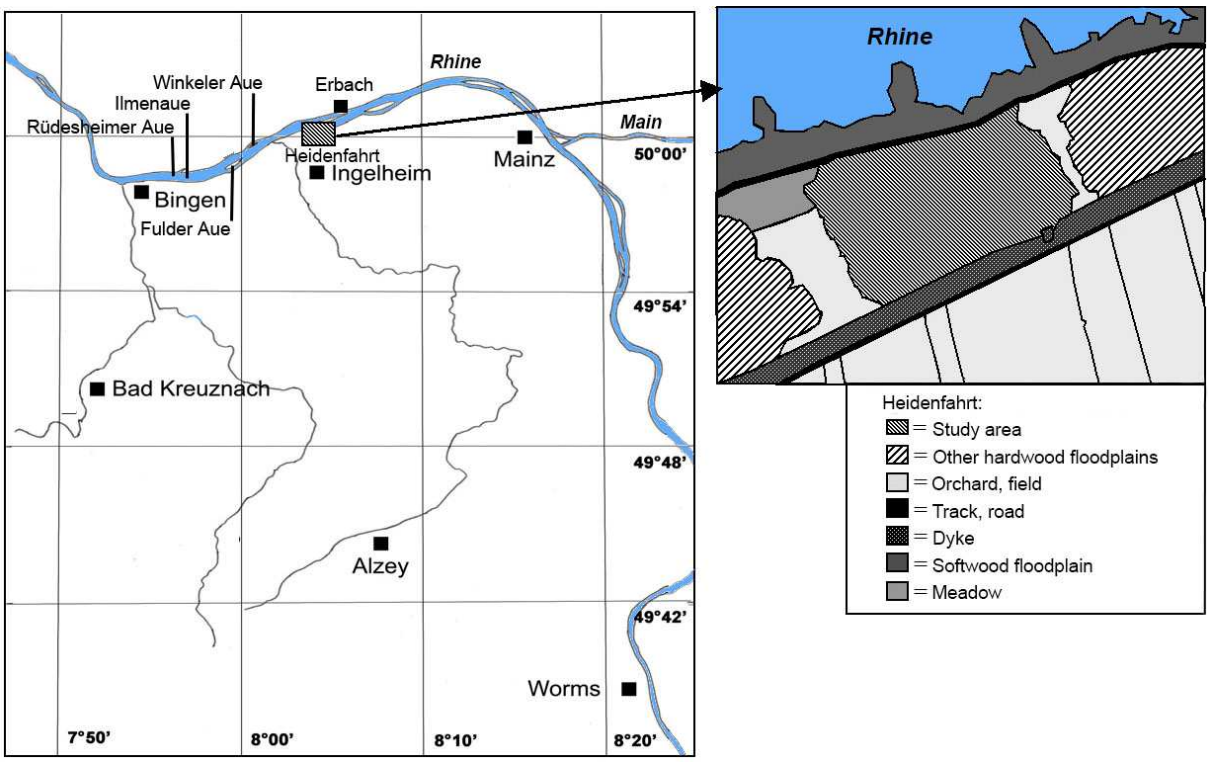

Figure 1: Map of the study area with investigations sites and outline of the investigation site „Heidenfahrt" (map modified after Marx & Schönhofer 2005).

Furthermore, the following islands in the Rhine were investigated (Fig. 1): Fulder Aue "West", Fulder Aue "East", Winkeler Aue, Rüdesheimer Aue and Ilmenaue. The Rhine islands near Mainz almost completely belong to the European nature reserve "Inselrhein" and offer very good living conditions for many migratory and passing birds. After the expansion measures of the Rhine, they are among the last few islands of the entire Upper-Rhine region and are therefore very important refuges for many animal and plant species.

In addition, the following river banks were investigated (Fig. 1): Erbach, Mainz-Mombach, Bingen-Gaulsheim, Ingelheim "Ufer" (Shore) and Ingelheim "Große Heide" (Great Heath).

At this point, the "extreme summer" of 2003 should be mentioned. A spring with low precipitation was followed by an extremely hot and dry summer. There was 40 % less rain (351.6 mm) in this year compared with the long-term average (585.8 mm per year).

In MARX (2011) you will find detailed information on the study area "Heidenfahrt", such as vegetation, soil geographic classification, climate and hydrology as well as information on the investigated Rhine islands and the river banks.

2.2 Collection and material

In the study area "Heidenfahrt" twelve pitfall traps and six tree eclectors were used on living trees (*Quercus robur*, *Tilia cordata*, *Acer campestre*, *Acer platanoides*) at a height of approx. 1.5-2.0 m. The traps were emptied at 14-day intervals. The pitfall trap (287 samples) and tree eclector (149 samples) catches over a period of one year from 19 May 2005 until 23 May 2006 were investigated. Additionally, the late autumn/early winter catches from pitfall traps from 14 October 2004 until 17 February 2005 (120 samples) were examined. A total of 11 samples from pitfall traps and 13 samples from tree eclectors could not be analysed due to sabotage and drying out of the traps.

The number of pitfall traps and the sampling period during the vegetation period (begin of May until end of October) of the Rhine islands and river banks can be found in Tables 4 and 5.

Further information on the applied methodology can be found in MARX (2011).

2.3 Determination

For the determination of the animals, the following literature was used.

Diplopoda: SCHUBART (1934) and BLOWER (1985); Chilopoda: EASON (1964, 1982) and KOREN (1986, 1992);

Non-determinable specimens (fragments and juveniles in early development stages, n = 35) were not further considered for this study.

2.4 Ecology

Classification of the dominance ratios (dominance values) and dominance classes was done according to ENGELMANN (1978), frequency (percentage of samples with species present to total number of samples), Shannon-Weaver-Index H_S (diversity) and species evenness E (distribution of individuals over species) according to MÜHLENBERG (1989). The calculation was based on the sampled millipedes and centipedes of one whole year from 19 May 2005 until 23 May 2006 in the study area "Heidenfahrt".

3. Results

3.1 The diplopod and chilopod fauna in the study area "Heidenfahrt"

A total of 4,133 animals, 3,800 diplopods and 333 chilopods, were determined. Eleven diplopod species (3 orders, 5 families) and 7 chilopod species (2 orders, 3 families) could be determined (Table 1). For the sake of completeness, the samples of *Archiboreoiulus pallidus* (BRADE-BIRKS, 1920) and *Schendyla nemorensis* (C. L. KOCH, 1836) from unpublished investigations within the study area (soil corer) from 2002, 2007 and 2008 are mentioned here. *Polydesmus angustus* (LATZEL 1884) was found by hand sampling (7 May 2008 and 24 May 2008, leg. P. Decker).

In the pitfall traps *P. denticulatus* (53 %) and *L. forficatus* (66 %) were the eudominant species, *J. scandinavius* (17 %), *P. superus* (12 %), *C. caeruleocinctus* (12 %), *S. crassipes* (15 %), and *L. microps* (15 %) were dominant (Table 2). In the stem eclectors *P. denticulatus* (61 %) and *L. forficatus* (86 %) were also eudominant and *J. scandinavius* (30 %) was dominant.

Diversity and Evenness were for both Chilopoda and Diplopoda higher on the ground than on the stem and generally higher in Diplopoda (Table 3).

P. denticulatus occurred with a frequency of 85 %, *J. scandinavius* with a frequency of 72 % in the lower stem region.

Table 1: Species spectrum and total number of individuals of the Diplopoda and Chilopoda at the investigation site „Heidenfahrt".

Species	Pitfall traps			Stem eclectors		
	♂♂	♀♀	Juveniles	♂♂	♀♀	Juveniles
Chilopoda						
Lithobius crassipes L. KOCH, 1862	–	–	–	–	7	–
Lithobius forficatus (LINNAEUS, 1758)	16	34	3	82	86	24
Lithobius melanops NEWPORT, 1845	1	–	–	9	10	3
Lithobius microps MEINERT, 1868	14	18	–	–	–	–
Lithobius tricuspis MEINERT, 1872	–	–	–	–	1	–
Geophilus flavus (DE GEER, 1778)	1	–	–	–	–	–
Strigamia crassipes (C. L. KOCH, 1835)	10	12	2	–	–	–
Diplopoda						
Proteroiulus fuscus (AM STEIN, 1857)	–	–	–	–	1	–
Nemasoma varicorne C. L. KOCH, 1847	–	3	–	4	10	1
Julus scandinavius LATZEL, 1884	141	138	187	35	52	298
Cylindroiulus caeruleocinctus (WOOD, 1864)	130	125	34	–	2	2
Cylindroiulus punctatus (LEACH, 1815)	4	5	6	31	25	42
Brachyiulus pusillus (LEACH, 1815)	55	32	5	–	–	–
Ommatoiulus sabulosus (LINNAEUS, 1758)	–	–	–	1	2	1
Melogona voigti (VERHOEFF, 1899)	16	9	3	–	–	–
Brachydesmus superus LATZEL, 1884	289	127	22	–	–	–
Polydesmus denticulatus C. L. KOCH, 1847	624	282	266	219	253	316
Propolydesmus testaceus (C. L. KOCH, 1847)	2	–	–	–	–	–

Table 2: Dominance ratios (in %) and dominance classes of the Diplopoda and Chilopoda on the ground and stem region in the investigation site „Heidenfahrt": (**********) = eudominant, 32.0-100 %; (*****) = dominant, 10.0-31.9 %; (****) = subdominant, 3.2-9.9 %; (***) = recedent, 1.0-3.1 %; (**) = subrecedent 0.32-0.99 %; (*) = sporadic, <0.32 %.

Taxon	Pitfall traps	Stem eclectors
Chilopoda		
Lithobius crassipes	–	3.2 (***)
Lithobius forficatus	66.7 (**********)	86.5 (**********)
Lithobius melanops	–	9.9 (****)
Lithobius microps	15.2 (*****)	–
Lithobius tricuspis	–	0.5 (**)
Geophilus flavus	1.5 (***)	–
Strigamia crassipes	16.7 (*****)	–
Diplopoda		
Proteroiulus fuscus	–	0.1 (*)
Nemasoma varicorne	0.1 (*)	1.2 (***)
Julus scandinavius	17.3 (*****)	29.7 (*****)
Cylindroiulus caeruleocinctus	12.9 (*****)	0.3 (**)
Cylindroiulus punctatus	0.5 (**)	7.6 (****)
Brachyiulus pusillus	3.1 (**)	–
Ommatoiulus sabulosus	–	0.3 (*)
Melogona voigti	0.6 (**)	–
Brachydesmus superus	12.5 (*****)	–
Polydesmus denticulatus	53.1 (**********)	60.9 (**********)

Table 3: Diversity (H_S) and Evenness (E) of the Diplopoda and Chilopoda on the ground and stem region in the investigation site „Heidenfahrt".

Taxon	Shannon-Weaver-Index		Evenness	
	Ground	Stem	Ground	Stem
Diplopoda	1.34	0.95	0.64	0.49
Chilopoda	0.58	0.49	0.42	0.35

The activity abundances of *J. scandinavius* on the ground were highest for adults from February to June, while juveniles were also very active in summer (Fig 2A). Ratio between males (141), females (138) and juveniles (187) was more or less balanced (Table 1). On the stem *J. scandinavius* adults were found throughout the year with slight peaks in spring and autumn, while juveniles showed very high activity abundances from September to November and in April (Fig. 2B). Females (52) were a bit more numerous on the stem than males (35), but juveniles were nearly 3.5 times more abundant than mature specimens (Table 1).

The activity abundances of *P. denticulatus* on the ground were highest from April to July, both in adults and juveniles (Fig. 3A). Males were two times more active (624) than females (282) or juveniles (266). On the stem *P. denticulatus* showed high activities from April to June and very high activities, especially of juveniles, in October and November (Fig. 3B). The ratio of males (219) and females (253) was balanced, but juveniles (316) were slightly more abundant (Table 1).

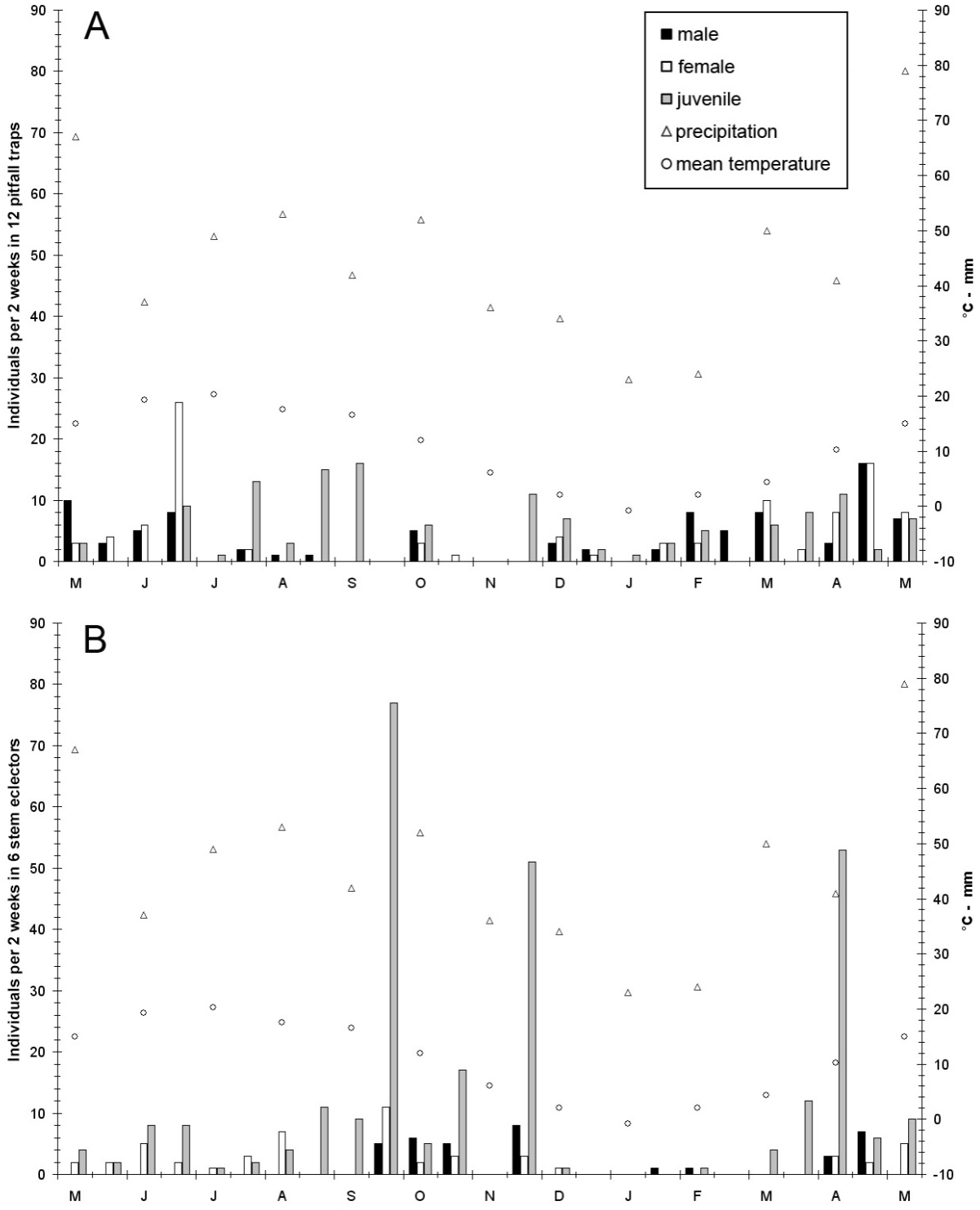

Figure 2: Activity abundance of *Julus scandinavius* in pitfall traps (A) und stem eclectors (B) for the period 19 May 2005 to 23 May 2006 in the investigation site „Heidenfahrt" and meteorological data from the weather station Heidesheim. Source: Agrarmeteorologie Rheinland-Pfalz.

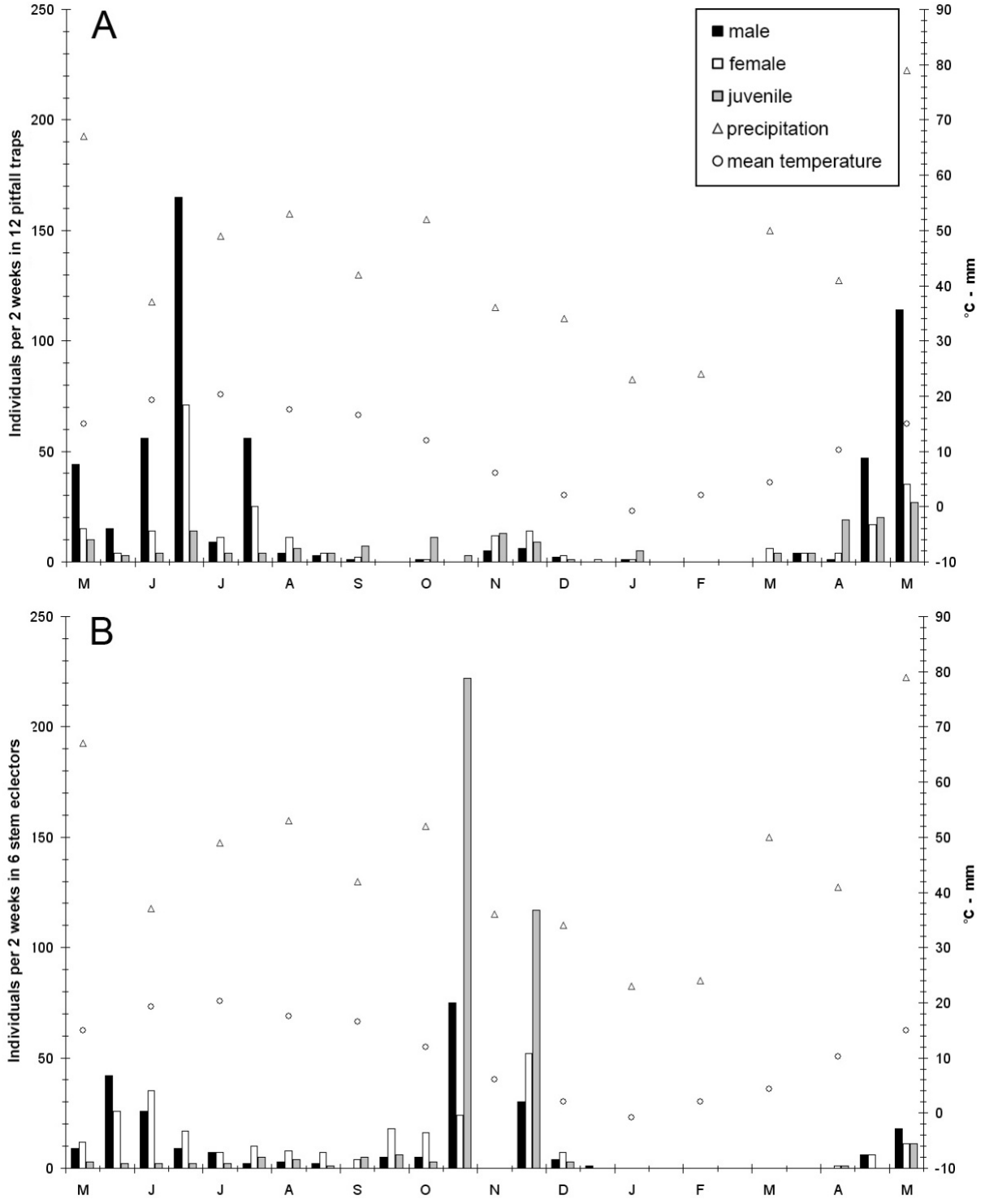

Figure 3: Activity abundance of *Polydesmus denticulatus* in pitfall traps (A) und stem eclectors (B) for the period 19 May 2005 to 23 May 2006 in the investigation site „Heidenfahrt" and meteorological data from the weather station Heidesheim. Source: Agrarmeteorologie Rheinland-Pfalz.

3.2 The diplopod and chilopod fauna of the Rhine islands and the river banks

A total of 5,398 animals were determined, 5,047 diplopods (11 species) and 351 chilopods (6 species) (Tables 4, 5).

In contrast to the investigated floodplain forest near Heidesheim, in some sites the species *Craspedosoma rawlinsi* Leach, 1815, *Lamyctes emarginatus* (Newport, 1844) and *Pachymerium ferrugineum* (C. L. Koch, 1835) were also recorded. *P. denticulatus* was by far the most frequent millipede with 3,691 individuals, followed by *J. scandinavius* (881 individuals). The most frequent centipede was *L. forficatus* with a total of 315 specimens.

4. Discussion

4.1 The millipedes and centipedes in the study area "Heidenfahrt"

The diplopod fauna mainly consists of euryoecious species. It was found that the composition of species on the ground and the lower stem region shows significant differences. The diversity and evenness of diplopods on the ground was more than twice as high as in the lower stem region (Table 3). On the ground as well as on the stem, there is a clear dominance of *P. denticulatus*, followed by *J. scandinavius*.

While *P. denticulatus* is classified as a hygrobiont wood species of very damp sites, the latter species is classified as an euryoecious species of very dry to very damp habitats (VOIGTLÄNDER 2011). RIPPLINGER & ALBERTI (1993) could show a high dominance of *P. denticulatus* in a floodplain forest (*Populus canescens*) and this species is also known from other floodplain areas (DUNGER 1958, HANDKE & HANDKE 1989, SCHUBART 1934, SPELDA 1999c, TUF & OŽANOVÁ 1999, ZULKA 1991).

So far, only very little is known about the stem region as activity area of millipedes in Central Europe, especially since stem eclectors are only rarely used (BRONEWSKI 1991, POSER 1991, SPELDA 1999a, 1999b) and the stem region is only rarely investigated comprehensively (FRÜND 1987).

The high frequencies of *P. denticulatus* (85 %) and *J. scandinavius* (72 %) in the study area "Heidenfahrt" very clearly show that the lower stem region is an integral part of the activity area of both species. For *P. denticulatus*, there is so far no information about the colonisation of the stem region and it seems to be differing from other native species of the family Polydesmidae by a high climbing activity.

The results of *J. scandinavius* on the ground in the study area "Heidenfahrt" are consistent with the literature references (SCHALLNASS et al. 1992, SCHUBART 1934, SPELDA 1993). However, it was shown that the juveniles were significantly more active in the lower stem region than the adults.

SCHUBART (1934), BLOWER (1985) and THIELE (1968) also observed a high activity of *P. denticulatus* during the summer months. In Brandenburg, however, their peak activity was in May and October (SCHUBART 1957). THIELE (1968) observed peaks in May/June and August for field shrubs in Asbruch near Velbert-Nerviges. An interruption of activity in the investigated floodplain forest was observed in early June which is most likely due to that month's low precipitation. VERHOEFF (1929) and ZULKA (1991) also suspected drought to be the cause for the summer break. After observing the juvenile stages, it is to be assumed

Table 4: Species spectrum and activity abundance (individuals per 2 weeks per trap) of the Diplopoda and Chilopoda of the stream islands of the northern Upper-Rhine with short characterization of the investigation sites and methods.

Investigation site	Fulder Aue "West"				Fulder Aue "East"				Winkeler Aue				Rüdesheimer Aue	Ilmenaue
German federal state	Rhineland-Palatinate				Rhineland-Palatinate				Hesse				Hesse	Rhineland-Palatinate
Biotope	Softwood floodplain forest				Hardwood floodplain forest				Softwood floodplain forest				Softwood flood. for.	Softwood flood. for.
Dominating trees	*Ulmus*, *Salix*				*Ulmus*, *Salix*				*Ulmus*, *Salix*				*Ulmus*, *Salix*	*Ulmus*, *Salix*
Number of pitfall traps	4	3	3	3	4	3	3	3	4	3	3	3	4	4
Trap exposition per year (days)	169	85	135	169	169	85	135	169	169	85	135	169	169	169
Year	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005	2002	2002
Diplopoda														
Julus scandinavius	0.35	–	0.55	0.99	–	–	0.03	0.22	0.50	0.33	0.42	1.80	0.21	2.50
Cylindroiulus caeruleocinctus	–	–	–	–	–	0.05	0.03	–	–	–	–	–	0.14	0.81
Cylindroiulus punctatus	–	–	–	–	–	–	–	–	–	–	–	–	0.06	0.04
Brachyiulus pusillus	0.04	–	0.10	0.03	–	–	0.07	0.03	0.02	0.44	0.14	0.17	–	0.08
Ommatoiulus sabulosus	–	–	0.07	–	–	–	–	–	–	–	–	–	–	–
Craspedosoma rawlinsi	–	–	–	–	–	0.11	0.03	0.06	–	–	–	–	–	0.02
Brachydesmus superus	–	–	–	–	–	–	–	0.08	–	–	–	0.08	0.02	0.02
Polydesmus denticulatus	3.23	0.16	1.04	8.95	–	–	0.14	0.14	1.14	0.05	0.42	1.19	0.08	0.74
Chilopoda														
Lamyctes emarginatus	–	0.05	–	–	–	–	–	–	0.10	0.05	–	–	–	–
Lithobius forficatus	0.29	0.22	0.24	0.03	–	0.43	0.28	0.14	0.87	0.93	0.90	1.19	1.26	0.43
Lithobius microps	–	–	–	0.03	–	–	0.03	–	–	–	–	–	0.04	0.02
Geophilus flavus	–	–	–	–	–	–	–	–	–	–	–	0.06	–	–
Pachymerium ferrugineum	–	–	0.03	–	–	–	–	–	–	–	–	–	–	–
Σ Individuals per year and site	189	8	53	363	–	11	18	24	127	33	54	139	88	226

Table 5: Species spectrum and activity abundance (individuals per 2 weeks per trap) of the Diplopoda and Chilopoda of the river bank sites of the northern Upper-Rhine with short characterization of the investigation sites and method.

Investigation site	Mainz-Mombach				Bingen-Gaulsheim				Ingelheim "Shore"				Ingelheim "Große Heide"				Erbach
German federal state	Rhineland-Palatinate				Rhineland-Palatinate				Rhineland-Palatinate				Rhineland-Palatinate				Hesse
Biotope	Softwood floodplain forest				Softwood floodplain forest				Softwood floodplain forest				Softwood floodplain forest				Hardwood fl. for.
Dominating trees	*Populus*, *Salix*				*Populus*				*Populus*, *Salix*				*Populus*-planting				*Ulmus*, *Tilia*
Number of pitfall traps	4	3	3	3	4	3	3	3	4	3	3	3	4	3	3	3	4
Trap exposition per year (days)	128	85	141	167	165	85	141	167	167	85	141	167	165	85	141	167	169
Year	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2002	2002
Diplopoda																	
Proteroiulus fuscus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.03	–	–
Julus scandinavius	0.55	0.05	0.50	0.12	0.04	–	–	0.11	0.04	–	0.10	1.57	0.21	–	0.96	10.29	0.37
Cylindroiulus caeruleocinctus	–	–	–	–	0.06	–	–	0.06	–	–	–	–	–	–	–	–	0.12
Cylindroiulus punctatus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.02
Brachyiulus pusillus	–	–	1.62	0.70	0.76	0.05	0.13	0.56	–	–	0.07	0.08	–	–	0.03	0.25	0.19
Ommatoiulus sabulosus	–	–	–	–	–	–	–	–	–	–	0.03	–	–	–	–	–	–
Craspedosoma rawlinsi	–	–	0.03	0.08	–	–	–	–	–	–	0.03	0.03	–	–	0.03	–	–
Brachydesmus superus	–	–	–	–	–	–	–	0.25	–	–	–	–	–	–	0.03	–	0.06
Polydesmus angustus	–	–	–	–	–	–	–	–	–	–	0.03	0.36	–	–	–	–	0.70
Polydesmus denticulatus	1.58	0.16	0.89	6.82	1.72	–	0.20	4.75	0.34	0.11	6.26	35.58	0.13	–	2.68	24.06	0.02
Propolydesmus testaceus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.17	2.63
Chilopoda																	
Lamyctes emarginatus	–	–	–	–	0.06	–	–	–	0.13	–	–	–	0.08	–	–	–	–
Lithobius crassipes	–	–	–	–	–	–	–	–	–	–	–	0.03	–	–	–	–	–
Lithobius forficatus	0.22	0.38	0.73	0.42	0.11	0.22	–	0.08	0.04	0.05	0.30	0.14	–	–	0.03	–	0.06
Lithobius microps	0.03	–	–	–	0.02	–	–	–	–	–	–	–	–	–	0.03	–	0.04
Geophilus flavus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.02
Pachymerium ferrugineum	–	–	–	–	0.02	–	–	–	–	–	–	–	–	–	–	–	–
Σ Individuals per year and site	86	7	114	330	130	5	10	208	26	3	206	1,352	20	–	115	1,244	202

that this species only produces one generation per year in the study area, that the development is possible within a period of one year and that the species hibernates as adults or subadults. This is also assumed by ZULKA (1991) for the March area in Austria. In the lower stem region, *P. denticulatus* had reached its activity peak not during the summer months, but in autumn. In a floodplain forest near Leipzig, *P. denticulatus* and *P. inconstans* (LATZEL, 1884) also had a peak in autumn, whereas there was no noticeable activity peak in the summer (DUNGER 1958).

The high ♂♂/♀♀ ratio (624:282) on the ground has already been determined by BLOWER (1985) for a forest in Cheshire, England. By contrast, the ♂♂/♀♀ ratio in the lower stem region was almost 1:1 (219:253) and there was a high number of subadult animals which presumably reach maturity not until the next year.

The species *B. pusillus*, *M. voigti* and *B. superus* seem to colonise the stem region above 1.5 to 2 m only to a lesser extent. By contrast, *N. varicorne* and *C. punctatus* are more active on the stem which is due to living under bark and especially the latter species living in the wood (SPELDA 1999c, HAACKER 1968a). There was only one specimen of *P. fuscus* in the lower stem region which is usually found under bark (SPELDA 1999c). In subsequent traps and square samplings, further specimens of this species were found.

The findings of *O. sabulosus* in the tree eclectors are not surprising, as this species is known for high climbing activity (BLOWER 1985, KÖPPEL & SPELDA 1994, SCHUBART 1934).

For the chilopods, diversity was higher on the ground than in the lower stem region, evenness was, by contrast, only slightly higher on the ground (Table 3). *L. forficatus* was eudominant on the ground as well as in the lower stem region. TUF (2003) stated that *L. forficatus* and *Lithobius mutabilis* (L. KOCH, 1862) were dominant in not regularly flooded floodplain forests in the Czech Republic. The high dominance values of this species also reflect the low equal distribution values (E) for the chilopods. *Strigamia crassipes* occurred dominantly in the pitfall traps. The species is an inhabitant of the litter layer (SPELDA 1999c), but does not seem to colonise the stem region in the study area, in contrast to *Strigamia acuminata* (LEACH, 1814), which was also found in the stem region (SPELDA 1999a). On the ground, *L. microps* occurred dominantly, which is found in the litter layer and the topmost layer of soil (DUNGER 1989), and which is seen only rarely above the surface (BARBER 1992). In the lower stem region *L. melanops* occurred subdominantly which, according to BARBER (1992), prefers to colonise the stem region. *L. crassipes* occurred only recedently in the stem region and not at all on the ground. This species is found in the litter layer, on the surface as well as above the ground floor (BARBER 1992). The small amounts of geophilids are due to the fact that they rarely get into the pitfall traps (SPELDA 1999b) and, therefore, cannot be collected adequately with the trapping methods used for this study.

4.2 The millipedes and centipedes of the Rhine islands and the river banks

The range of species of the different Rhine islands and river banks is mainly dominated by the three species *P. denticulatus*, *J. scandinavius* and *L. forficatus* with the range of species of the islands and river banks showing no significant differences. The four species *Proteroiulus fuscus*, *Polydesmus angustus*, *P. testaceus* and *Lithobius crassipes* could not be found on the Rhine islands which might be explained by a low tolerance against flooding.

There are strikingly low activity abundances in the year of the flooding 2002 and the extreme summer of 2003, the number of captured specimens slightly increasing in 2004, and abruptly rising in 2005,

especially for *L. forficatus*, *J. scandinavius* and *P. denticulatus*. This shows very clearly that centipede and millipede populations can recover from such extreme events within just a few years. The pioneer species *Lamyctes emarginatus*, which was recorded e.g. in the regularly flooded Oder regions (ZERM 1997a, 1997b, 1999), occurred in this study only shortly after the flooding in the pitfall traps, presumably as a result of the quick population growth. The same is true of *Pachymerium ferrugineum* which only occurs in dry biotopes and habitats characterised by water, such as peatland, floodplain forests, river banks and alder swamps (DECKER et al. 2009). SPELDA (1999c) assumes that the strictly local occurrence in such habitat types (exposed to disturbances) may be due to a lack of competition from other predatory arthropods.

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Hundert- und Doppelfüßer (Myriapoda: Chilopoda, Diplopoda) aus dem Naturpark Wildeshauser Geest (Niedersachsen)

Ergebnisse der Herbstexkursion 2010 der Arbeitsgemeinschaft deutschsprachiger Myriapodologen

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Zusammenfassung. Der Norden Deutschlands gehört zu den myriapodologisch am wenigsten untersuchten Gebieten des Landes. Daher führte eine 2010 durch die Arbeitsgruppe deutschsprachiger Myriapodologen durchgeführte Sammel-Exkursion in den im Westen Niedersachsens gelegenen Naturpark Wildeshausener Geest. Es wurden 45 Standorte, die 13 Biotoptypen repräsentieren, besammelt, wobei 15 Chilopoden- und 13 Diplopoden-Arten nachgewiesen werden konnten. Ökofaunistisch erwähnenswerte Arten traten nicht auf.

Abstract. Centipedes and millipedes (Myriapoda: Chilopoda, Diplopoda) from the Wildeshauser Geest Nature Park (Lower Saxony) – Results of the autumn excursion of the German-speaking Myriapodologist's Working group in 2010. To increase the knowledge about the myriapod fauna of a poorly investigated area in Northern Germany, the Working group of German-speaking Myriapodologists chose the Wildeshauser Geest Nature Park in western Lower Saxony as location for a collecting trip in autumn 2010. In the study area 45 sampling sites representing 13 different biotope types were investigated. A total of 15 chilopod and 13 diplopod species were found, but no faunistic remarkable species.

Keywords. Faunal list, biotopes, Germany

1. Einleitung

Die alljährlich durchgeführte Sammelexkursion der Arbeitsgemeinschaft Deutschsprachiger Myriapodologen führte im Herbst 2010 nach Niedersachsen in den 40 km südöstlich von Oldenburg gelegenen Naturpark Wildeshauser Geest, einem der größten seiner Art in Deutschland.

Der Naturpark Wildeshauser Geest liegt im Norddeutschen Tiefland im Dreieck Oldenburg – Bremen – Osnabrück. Er wurde 1984 ausgewiesen, 1993 erweitert und umfasst heute eine Fläche von ca. 1.532 km² mit einer Ost-West-Ausdehnung von rund 50 km. Zahlreiche Flächen sind als spezielle Schutzgebiete ausgewiesen. Die fast ebene bis schwach wellige Altmoränenlandschaft wird von sandigen Ablagerungen der Saale-Eiszeit geprägt. In den höher gelegenen Teilen (bis ca. 50 m über NN) dominieren auf sandigen, eher trockenen Böden kleinflächige Äcker und Wiesen, Heideflächen bzw. einzelne Waldflächen, hier vor allem Misch- und Nadelwälder, einzelne hiervon sind ehemalige Hudewälder.

Charakteristisch sind zudem zahlreiche Wallhecken, welche die Landschaft kleinräumig gliedern. In den Niederungen und Urstromtälern (z. B. der Hunte) finden sich Feuchtwiesen und Moore, Moorwälder und Brüche.

Die Myriapodenfauna des Naturparks war gänzlich unbekannt, wie auch der nördliche Teil Niedersachsen kaum untersucht worden ist. Für dieses Bundesland existieren einzelne, meist sehr regionale Arbeiten (z. B. POPPE 1891, SCHNEIDER 1900, SCHUBART 1939, RABELER 1951, 1952, JEEKEL 1964, KACHE & ZUCCHI 1993, GOTTHOLD et al. 2007, LINDNER et al. 2010) bzw. Myriapoden-Nachweise, die im Zuge umfassender ökologischer Studien erbracht wurden (z. B. BODE 1973, THIEDE 1977, SPRENGEL 1986 und SCHEU 1990). Die hier vorliegenden Ergebnisse stellen somit einen wichtigen Beitrag zur ökofaunistischen Erfassung und Inventarisierung der Fauna des Naturparks wie auch Niedersachsens dar.

2. Material und Methoden

Die Aufsammlungen im Naturpark Wildeshauser Geest erfolgten vom 3. bis 6. Oktober 2010 an 45 Standorten rein qualitativ (je nach Angebot an Mikrohabitaten in unterschiedlicher Intensität) mittels Handfang in der Laubstreu, unter Steinen und Moos, in Totholz oder unter Rinde. Zusätzlich wurde an den meisten Standorten Laubstreu bzw. Rinde zusammen mit Totholz gesiebt. Folgende Habitattypen fanden Berücksichtigung: Laub-(Misch-)wälder (12 Standorte), Mischwälder (2), Nadelwälder (4), Laubholz-Aufforstungen (3), Birken-Moorwald (5), Erlenbrüche (2), Teich- und Bachufer mit *Alnus*, *Salix* (2), *Calluna*-Heide (1), Offenland (1), Saumbereiche (6), Staudenfluren (1), Ortslagen (6), Eichen-Hudewald (1).

Auch die im Naturpark gelegenen Naturschutzgebiete „NSG Bäken der Endeler und Holzhauser Heide", „NSG Hasbruch", NSG Huntloser Moor", „NSG Pestruper Gräberfeld und Rosengarten", „NSG Pestruper Moor", „NSG Poggenpohlsmoor", „NSG Tannersand und Gierenberg" und „NSG Urwald Baumweg" wurden in die Untersuchungen mit einbezogen, wenn auch nicht gesondert ausgewertet.

Das Material ist den Sammlungen des Senckenberg Museums für Naturkunde Görlitz und der Privatsammlung N. Lindner hinterlegt.

3. Ergebnisse

Die in der Wildeshauser Geest nachgewiesenen Arten sind in Tabelle 1 und 2 erfasst. Auf Zahlenangaben wurde dabei verzichtet, da die Sammelmethodik nur eine qualitative Auswertung ermöglicht.

Am reichsten erwiesen sich die Laub-(Misch-)wälder mit 11 Chilopoden- und 10 Diplopoden-Arten, die allerdings auch am intensivsten beprobt wurden. Die Birken-Moorwälder, von denen nur 5 Standorte untersucht wurden, wiesen 13 Arten (6 bzw. 7) auf und sind damit ebenfalls als sehr gut besiedelt einzustufen. Unter den Diplopoden waren *Cylindroiulus punctatus* und *Proteroiulus fuscus* am individuenreichsten und in sehr vielen verschiedenen Habitaten anzutreffen. Unter den Chilopoden waren dies vor allem *Cryptops hortensis*, aber auch *Lithobius forficatus* und *Geophilus truncorum*.

Tabelle 1: In der Wildeshauser Geest (Niedersachsen) in verschiedenen Lebensräumen nachgewiesene Chilopoda-Arten. Chilopoda species recorded from different habitats in the Wildeshauser Geest (Lower Saxony).

Taxon	Laub-(Misch)wälder Decidous (mixed) forests	Mischwälder Mixed forests	Nadelwälder Coniferous forests	Laubholz-Aufforstungen Decidous afforestation	Birken-Moorwald Birch-bog forests	Erlenbruch Alder swamp forests	Teich- und Bachufer Pond and brook banks	*Calluna*-Heide *Calluna* heath	Offenland Open land	Saumbereiche Skirts of woods	Staudenfluren Perennial meadow	Ortslage Urban area	Eichen-Hudewald Pasture oak woodland
Anzahl Fundorte **No. of localities**	12	2	4	3	5	2	2	1	1	6	1	6	1
Cryptops hortensis Leach, 1815	x		x		x	x	x			x		x	
Geophilus flavus (De Geer, 1778)												x	
Geophilus truncorum (Bergsøe & Meinert, 1866)	x				x	x	x	x		x			x
Lithobius agilis C. L. Koch, 1847						x							
Lithobius calcaratus C. L. Koch, 1844	x			x				x					
Lithobius crassipes L. Koch, 1862	x		x	x				x					x
Lithobius curtipes C. L. Koch, 1847	x					x							
Lithobius dentatus C. L. Koch, 1844					x	x							
Lithobius forficatus (Linnaeus, 1758)	x	x			x	x	x			x		x	x
Lithobius macilentus L. Koch, 1862	x												
Lithobius microps Meinert, 1868	x	x	x				x			x		x	
Lithobius melanops Newport, 1845	x									x			
Lithobius pelidnus Haase, 1880					x								
Schendyla nemorensis (C. L. Koch, 1837)	x					x	x						x
Strigamia acuminata (Leach, 1814)	x		x		x								x
Artenzahl **No. of species**	11	2	4	2	6	7	5	3	0	5	0	4	5

Tabelle 2: In der Wildeshauser Geest (Niedersachsen) in verschiedenen Lebensräumen nachgewiesene Diplopoda-Arten. Diplopod species recorded from different habitats in the Wildeshauser Geest (Lower Saxony).

Taxon	Laub-(Misch)wälder Decidous (mixed) forests	Mischwälder Mixed forests	Nadelwälder Coniferous forests	Laubholz-Aufforstungen Decidous afforestation	Birken-Moorwald Birch- bog forests	Erlenbruch Alder swamp forests	Teich- und Bachufer Pond and brook banks	*Calluna*-Heide *Calluna* heath	Offenland Open land	Saumbereiche Skirts of woods	Staudenfluren Perennial meadow	Ortslage Urban area	Eichen-Hudewald Pasture oak woodland
Anzahl Fundorte No. of localities	12	2	4	3	5	2	2	1	1	6	1	6	1
Craspedosoma rawlinsii Leach, 1815						x							
Cylindroiulus punctatus (Leach, 1815)	x		x	x	x	x	x	x		x		x	x
Cylindroiulus latestriatus (Curtis, 1845)	x				x				x	x		x	
Glomeris marginata (Villers, 1789)	x		x	x	x	x				x	x		
Julus scandinavius Latzel, 1884	x	x	x		x						x		
Kryphioiulus occultus (C. L. Koch, 1847)												x	
Megaphyllum cf. *projectum kochi* (Verhoeff, 1907)	x												
Ommatoiulus sabulosus (Linnaeus, 1758)											x		
Polydesmus angustus (Latzel, 1884)	x				x					x			
Polydesmus inconstans Latzel, 1884	x				x					x	x	x	
Polyxenus lagurus (Linnaeus, 1758)	x												
Proteroiulus fuscus (Am Stein, 1857)	x		x	x	x		x	x		x		x	
Tachypodoiulus niger (Leach, 1815)	x			x			x						
Artenzahl No. of species	10	1	4	4	7	3	3	2	1	6	4	5	1

4. Diskussion

Es konnten keine faunistischen Besonderheiten nachgewiesen werden. Alle Arten sind für Niedersachsen bekannt oder waren zu erwarten gewesen. Lediglich *Lithobius pelidnus* Haase, 1880 ist in Deutschland selten (DECKER et al. 2016) und kommt nur gebietsweise häufig vor. Dort besiedelt die Art zumeist feuchte Habitate. Im Nordwestdeutschland ist sie ein typischer Bewohner der Birken-Moorwäldern (vgl. LINDNER et al. 2010). Auch in anderen europäischen Ländern, so z. B. in Frankreich, besiedelt die Art frische bis feuchte Wälder (IORIO 2014, CHÉREAU et al. 2016)

Auch in ihrem ökologischen Verhalten zeigen die Arten keine Auffälligkeiten (vgl. VOIGTLÄNDER 2005, HAUSER & VOIGTLÄNDER 2009, VOIGTLÄNDER 2011). Eine Ausnahme bildet hier *Lithobius calcaratus* C. L. Koch, 1844. Die Art ist vor allem von offenen Standorten, unabhängig vom Feuchtegrad, bekannt, jedoch nicht von Wäldern. Der Eichenwald, in dem die Art in den vorliegenden Untersuchungen nachgewiesen wurde, grenzt an eine lichte Aufforstung, die ebenfalls von *L. calcaratus* besiedelt wird, so dass ein temporäres Einwandern in den Wald nicht ausgeschlossen ist.

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Bitten by a blind passenger

Report of a *Scolopendra morsitans* Linnaeus, 1758 bite in Germany (Chilopoda: Scolopendromorpha)

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Zusammenfassung. Gebissen von einem blinden Passagier – Bericht über einen Biss von *Scolopendra morsitans* Linnaeus, 1758 in Deutschland (Chilopoda: Scolopendromorpha). Eine Frau wurde von einem Exemplar von *Scolopendra morsitans* in den Finger gebissen, welcher sich in einem Handtuch im Badezimmer in Frankfurt am Main versteckt hatte. Das Tier stammte aus dem Koffer von Nachbarn, die zuvor den Urlaub in Sri Lanka verbracht hatten.

Keywords. Sri Lanka, Arthropoda, Myriapoda, alien species

A strange case happened in an apartment building in the Savignystr. in Frankfurt am Main, Germany, at 11 PM on Sunday, 28 August 2016. A ca. 30 year-old pregnant woman (28th week of pregnancy) went into her bathroom, used a hand towel and was bitten by something on her right middle finger and saw a strange animal falling down to the ground. There was a reddish itching spot on the finger and it was swollen. Her husband caught the creature (ca. 7 cm long) alive and the couple immediately went to the emergency room at a nearby hospital. The physician only disinfected the wound, due to lack of knowledge of the animal and its toxin and because of the pregnancy of the woman.

The captured specimen was brought to the Entomology section I of the Senckenberg Research Institute and Natural History Museum Frankfurt and then sent to the author by Curator Damir Kovac. The specimen was anaesthetized with carbon dioxide and identified as the non-native chilopod species *Scolopendra morsitans* Linnaeus, 1758 (Fig. 1), a widespread scolopendrid species in the tropics, especially in tropical Africa and Asia, reaching a length up to 12.7 cm (SIRIWUT et al. 2016). The toxin of this species has been recently summarised (UNDHEIM et al. 2015). According to unpublished reports on the internet, bites are often not very painful and have a maximum intensity and reaction similar to a bee sting. The *S. morsitans* specimen was kept in a plastic box and died in the summer of 2017 for unknown reasons. The preserved specimen (in 96 % ethanol) is now in the collection of the Senckenberg Museum of Natural History Görlitz (SMNG VNR17963).

How did this non-native animal come into the bathroom of the woman? The first guess was an escaped specimen kept as pet, as *S. morsitans* is common in the German pet trade of exotic arthropods.

The couple asked in the neighbourhood if anybody lost a pet centipede, but without success. A few days later, upstairs neighbours in the apartment building disclosed the secret. They had spent their holiday on the west coast of Sri Lanka in the Kalpitiya region. One week before they flew out from Bandaranaike International Airport, they had left their suitcases in a car rental station to attend a guided tour. After arriving in Germany they discovered the blind passenger when opening the suitcase. They closed the suitcase immediately and put it on their balcony on the 3rd floor of their building. On the following Monday they took the suitcase to the Frankfurt Zoological Garden where it was opened, but the strange animal was not inside.

The blind passenger *S. morsitans* had escaped from the suitcase, probably walked on the wall down diagonally to the balcony of the 2nd floor, entered the apartment of the unsuspecting couple who lived there and found a nice dark and slightly moist shelter in the hand towel in the bathroom, where it was later disturbed by a human hand.

This is the second report of a bite in Germany of a scolopendrid which was not kept as a pet. A *Scolopendra cingulata* Latreille, 1829, had hidden in a shoe and bit a man in the foot in Issum, North-Rhine Westphalia (DECKER et al. 2015).

Figure 1: The alive blind passenger *Scolopendra morsitans*. Photograph: Ingo Turre.

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New species of millipedes occurring in the Czech Republic: species discovered in the period 2003–2017

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Abstract. Since the year 2003, six millipede species new for the Czech Republic were announced. All of them were discovered in small populations mostly in natural habitats. They can be divided into two groups. One is represented by rare, relict and stenoecic species (*Hungarosoma bokori*, *Hylebainosoma tatranum* and *Melogona transsylvanica*). The other group is represented by species exhibiting a closer relationship to subterranean habitats in the Czech Republic (*Brachychaeteuma bradeae*, *Macrosternodesmus palicola* and *Geoglomeris subterranea*); their presence in the Czech Republic was revealed by modified pitfall traps used for collecting of deep-living invertebrates and by combination of several methods used during the research in caves. All six species are listed in the Red List of Threatened Invertebrates in the Czech Republic.

Abstrakt. Nové druhy mnohonožek pro Českou republiku: druhy objevené v letech 2003-2017. Od roku 2003 byl v České republice doložen výskyt dalších šesti nových druhů mnohonožek. Podle jejich výskytu v přirozených habitatech je lze rozdělit do dvou skupin. První reprezentují vzácné, reliktní a stenoekní druhy (*Hungarosoma bokori*, *Hylebainosoma tatranum* a *Melogona transsylvanica*). Druhou skupinu představují druhy vázané v České republice na specifické podmínky podzemního prostředí (*Brachychaeteuma bradeae*, *Macrosternodesmus palicola* a *Geoglomeris subterranea*); jejich přítomnost v České republice byla prokázána pomocí hloubkových pastí pro odchyt podzemních bezobratlých a během výzkumů jeskyní. Všech šest druhů je zařazeno na Červeném seznamu ohrožených bezobratlých živočichů České republiky.

Keywords. Distribution, faunistics, threatened species, Diplopoda, Chordeumatida, Glomerida, Polydesmida

1. Introduction

According to current knowledge, 77 millipede species are known from the Czech Republic (TAJOVSKÝ & TUF 2016, KOCOUREK et al. 2017). The checklist of the Czech millipedes was gradually updated by TAJOVSKÝ (2001), KOCOUREK (2001, 2007a, 2013), TUF & TUFOVÁ (2008) and TAJOVSKÝ & TUF (2016). KOCOUREK (2003) reported twelve millipede species new for the Czech Republic in the period 1970–2002. Following this contribution, here we summarize information about six millipede species newly recorded in the Czech Republic between the years 2003–2017; all of them already listed in actualized checklists mentioned above. The aim of this contribution work is thus to provide information about the first collected specimens of these species in the Czech Republic.

2. Material and Methods

Millipedes were collected by repeated hand sampling at various periods throughout the year. Concerning the subterranean and cave habitats, specific methods were used for sampling of invertebrates. Beside modified subterranean traps (SCHLICK-STEINER & STEINER 2000), individual sampling and bait traps in caves were applied. In the annotated list, the orders are arranged according to KOCOUREK et al. (2017), the species are sorted alphabetically. Characterisations of the species are adopted from KOCOUREK et al. (2017), threatened categories from KOCOUREK & TAJOVSKÝ (2017). The numbers of mapping grid squares follow BUCHAR (1982) and PRUNER & MÍKA (1996). Only the first records of the relevant species are listed. Abbreviations: ISB = Institute of Soil Biology, České Budějovice, NNR = National Nature Reserve, NR = Nature Reserve, NNM = National Nature Monument, PLA = Protected Landscape Area, PUO = Palacký University Olomouc.

3. Results and Discussion

Order Glomerida Leach, 1814

Geoglomeris subterranea Verhoeff, 1908

Western and central European species preferably inhabiting subterranean habitats and caves (GRUBER 1985). In Czechia, it was found in the Zbrašovské aragonitové jeskyně (Zbrašov Aragonite Caves) at Hranický kras (Hranice Karst) (grid square 6472), subterranean pitfall traps, 01.II.2005-01.III.2006, 2 ♀♀, leg. J. Mikula (MIKULA 2006), coll. I. H. Tuf, PUO. Critically endangered.

Order Chordeumatida Koch, 1847

Brachychaeteuma bradeae (Brölemann & Brade-Birks, 1917)

Western European species occurring synantropically or in screes and caves (BLOWER 1985, TAJOVSKÝ & MLEJNEK 2007). In Czechia, it was found for the first time in the Zbrašovské aragonitové jeskyně (Zbrašov Aragonite Caves) NNM, the Hranický kras (Hranice Karst) (grid square 6472), bait traps, 01.VI.-21.X.2002, 1 ♂, 1 ♀, leg. R. Mlejnek (TAJOVSKÝ & MLEJNEK 2007), coll. K. Tajovský, ISB. Vulnerable.

Hungarosoma bokori Verhoeff, 1928

Central European endemic species, rarely inhabiting karst areas (MOCK et al. 2016). In Czechia, it was found in the Mokerský les (Forest of Mokrá) near Hostěnice, the Moravský kras (PLA Moravian Karst) (grid square 6766), 13.X.2005, 1 ♀, leg. P. Kocourek & I. Skoumalová, coll. P. Kocourek. This female was misidentified and named provisionally by KOCOUREK (2005) as *Ochogona jankowskii* (Jawlowski, 1938) and later by KOCOUREK (2007a, b) as *Ochogona moravica*. Its true identity was revealed by MOCK et al. (2016) and *Ochogona moravica* was also designated as *nomen nudum* by TAJOVSKÝ & TUF (2016). Critically endangered.

Hylebainosoma tatranum Verhoeff, 1899

Central European endemic species occurring in the West Carpathian mountain forests and alpine meadows. In Czechia, it was found in the Mazácký Grúnik NR, the Beskydy PLA (Beskids) (grid square 6476), 06.XI.1991, 1 ♂, 1 juv., leg. K. Tajovský (TAJOVSKÝ et al. 2014), coll. K. Tajovský, ISB. Endangered.

Melogona transsylvanica (Verhoeff, 1897)

Eastern European species inhabiting moist deciduous and mixed forests. In Czechia, it was found in the Vůznice NNR, the Křivoklátsko PLA (grid square 5949), 22.XI.2009, 5 ♂♂, 6 ♀♀, leg. P. Kocourek (KOCOUREK & TAJOVSKÝ 2011), coll. P. Kocourek. Critically endangered.

Order Polydesmida Leach, 1815

Macrosternodesmus palicola Brölemann, 1908

North-western European species inhabiting mostly calcareous soils at synantropic habitats in western Europe. In Czechia, it was found in cave habitats. The first record came from the Mladečské jeskyně NNM (Mladeč Caves), the Litovelské Pomoraví PLA (grid square 6268), 22.IV.2004, 3 ♂♂, 5 ♀♀, leg. K. Tajovský, J. Tufová & I. H. Tuf (TAJOVSKÝ & MLEJNEK 2007), coll. K. Tajovský, ISB. Critically endangered.

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