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WATER MITES (ACARI, HYDRACHNIDIA) FROM THE VÂNĂTORI NEAMȚ NATURE PARK (ROMANIA)

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INTRODUCTION

Water mites are among the most abundant and diverse benthic arthropods in many habitats (Davids et al, 2006). Water mites have co-evolved with some of the dominant insect groups in freshwater ecosystems, especially nematocerous diptera, and typically interact intimately with these insects at all stages of their life histories (Smith, 1983, 1988; Lanciani, 1983; Proctor and Pritchard, 1989). Numeros laboratory studies have demonstrated reduced survival or longevity of various insect hosts parasitized by larval water mites, including mosquitoes (Lanciani and Boyt, 1977; Lanciani, 1987), ceratopogonid midges (Lanciani, 1986a), chironomid midges (Weiberg and Edwards, 1997), juvenile water striders (Smith, 1989), backswimmers (Lanciani, 1982), and damselflies (Forbes and Baker, 1990, 1991; Leung and Forbes, 1997).

The parasitic larvae and predaceous deutonymphs and adults of water mites have direct and almost certainly significant effect on the size and structure of insect populations in many habitats (Smith and Oliver, 1976, 1986). Unfortunately, their impact has rarely been measured accurately because of the routine neglect of mites in ecological studies of freshwater communities (Smith et al, 1991). Due to their small size and often cryptic habitats, mites are usually absent or seriously under-represented in samples that are collected using standard techniques for capturing insects and crustaceans. Failure to include realistic assessment of the roles played by water mites often results in seriously flawed analyses of the structure and dynamics of freshwater communities (Smith et al, 2001).

Species of water mites are specialized to exploit narrow ranges of physical and chemical regimes, as well as the particular biological attributes (including physico-chemical constraints) of the organisms they parasite and prey upon. Consequently, water mites should be

exceptionally sensitive indicators of habitat conditions and the impact of environmental changes on freshwater communities (Cantonati et al, 2009). Preliminary studies of physico-chemical and pollution ecology of the relatively well-known fauna of Europe have demonstrated that water mites are excellent indicators of habitat quality (Schwoerbel, 1959; Pieczynski, 1976; Biesiadka, 1979; Kowalik and Biesiadka, 1981; Kowalik, 1981; Bagge and Merilainen, 1985; Cicolani and di Sabatino, 1991; Steenbergen, 1993). Regarding the water mite fauna of Romania, the latest studies carried out on the Retezat Mountain (Cîmpean and Gerecke, 2006), Someşul Rece (Cîmpean et al, 2003; Avram et al, 2005), Someş Mic (Cîmpean and Tudorancea, 2003), Someş Cald (Bates et al, 2000-2001) and Crişul Repede Rivers (Pavelescu and Cîmpean, 2002-2003), show a great number of water mite genera mentioned for the first time in Romania.

The present study deals with the Vânători Neamț Natural Park's (VNNP) rivers water mite fauna. We focused mainly on qualitative sampling using a procedure that requires a net with a fine mesh size (250μm). Deutonymphal and adult mites preserved in alcohol, must be cleared in 10% KOH, dissected and mounted in glycerin jelly (Gerecke et al, 2007). The Vânători Neamț Natural Park has been established in 1999 as a part of "Biodiversity Conservation Management Project" (financed by World Bank, Romanian Government and National Forest Administration – Romsilva) as a protected area designated for the sustainable management of forests, conservation of landscape and local traditions, reintroduction of bison in its natural habitat and encouragement of tourism activities based on these values (V IUCN).

Placed in the north-eastern part of Romania 47.15.17 N, 26.12.14 E., the VNNP covers a 30.818 ha total surface, from which 26.322 ha consists of mixed forests (coniferous and deciduous species).

It is situated on the north side of Neamt County, bordering Suceava County, and locally it has borders with Vânători-Neamț, Agapia, Bălțăteşti and Crăcăoani communes and the town of Targu Neamt. Geographically, the Park lies on the East slope of the Stanisoarei Mountains, which belong to the Neamțului Mountains, covering part of the drainage basins of the Ozana and Cracău Rivers.

The studied area is located at the contact zone between the eastern mountain border of the

Stânişoarei Mountains and the western border of the Ozana Depression, area rich in underground waters and surface watercourses. The local watercourses belong to the basins of Ozana and Cracau Rivers, right side tributaries of Moldova and Bistrita Rivers.

The Ozana River Basin, covering an area of 427km ², is fed partially from underground springs, but the water level in the river, low for the most of the year, depends mostly on snow melts and spring rains. Cracau River Basin is smaller and the river is fed mostly by rainfalls in the beginning of summer and by melting snow in spring. Especially during the winter, the amount of water is very low (Vanatori Nature Park Management Plan, 2002).

MATERIAL AND METHODS

Water analyses and biological sample collecting were simultaneously carried out in the 18-22 of September, from 19 collection points situated on the Cracău and Neamț Hydrographic Basins (figure 1). The samples were collected by thoroughly stirring the substrate, for approximately 3 minutes using a benthos net, with a mesh size of 250 µm, while the net is positioned and secured so that the current will carry dislodged organisms and particles of substrates into it. Then, the samples were preserved in 70% alcohol, and the containers were labeled. The specimens are then cleared in 10% KOH, dissected and mounted in glycerin jelly (glycerin- 20ml, chloral hydrate- 200g, Arabic gum- 30g and distilled water- 50 ml).

The identification of different genera was made especially by using the determination key from: R. Gerecke, with correction of Harry Smith, 1996. Several general physico-chemical indicators were measured in each of the 19 sampling stations: thermal conditions (air and water temperature), pH, oxygenation conditions given by dissolved oxygen depletion (DO depletion), Total Dissolved Salts (TDS), salinity, dissolved inorganic nitrogen forms (N-ammonium, N-nitrite and N-nitrate) and soluble reactive phosphorous (SRP).

These indicators were recorded by *in-situ* measurements with WTW and HACH Lange DR field equipment.

After the taxonomic identifications, the resulted water mite fauna list for every collecting point was grouped as a unitary fauna table. This table also renders the geographical coordinates of the sample collection points and there relative altitude.

The water mite genera are being arranged alphabetically for easier processing. Based on the dataset for the physico-chemical indicators and water mite distribution in the investigated hydro-basins, Cluster Analysis were used in order to discriminate among sampling sites having similar characteristics and between the identified water mite genera.

The maps were modified using Inkscape version 0.46.0.0, and for the Cluster Analysis, the statistics program STATISTICA version 7.0 was used.

RESULTS

After de taxonomic determinations, the number of identified taxa includes 4 families and 4 genera. *Sperchon sp.* has a significant presence, while *Torrenticola sp.* has a more sporadic presence, being identified in only one sample. The detailed results are introduced in table I. Table 2 shows the variation ranges of the general physico-chemical indicators measured in the two basins under investigation.

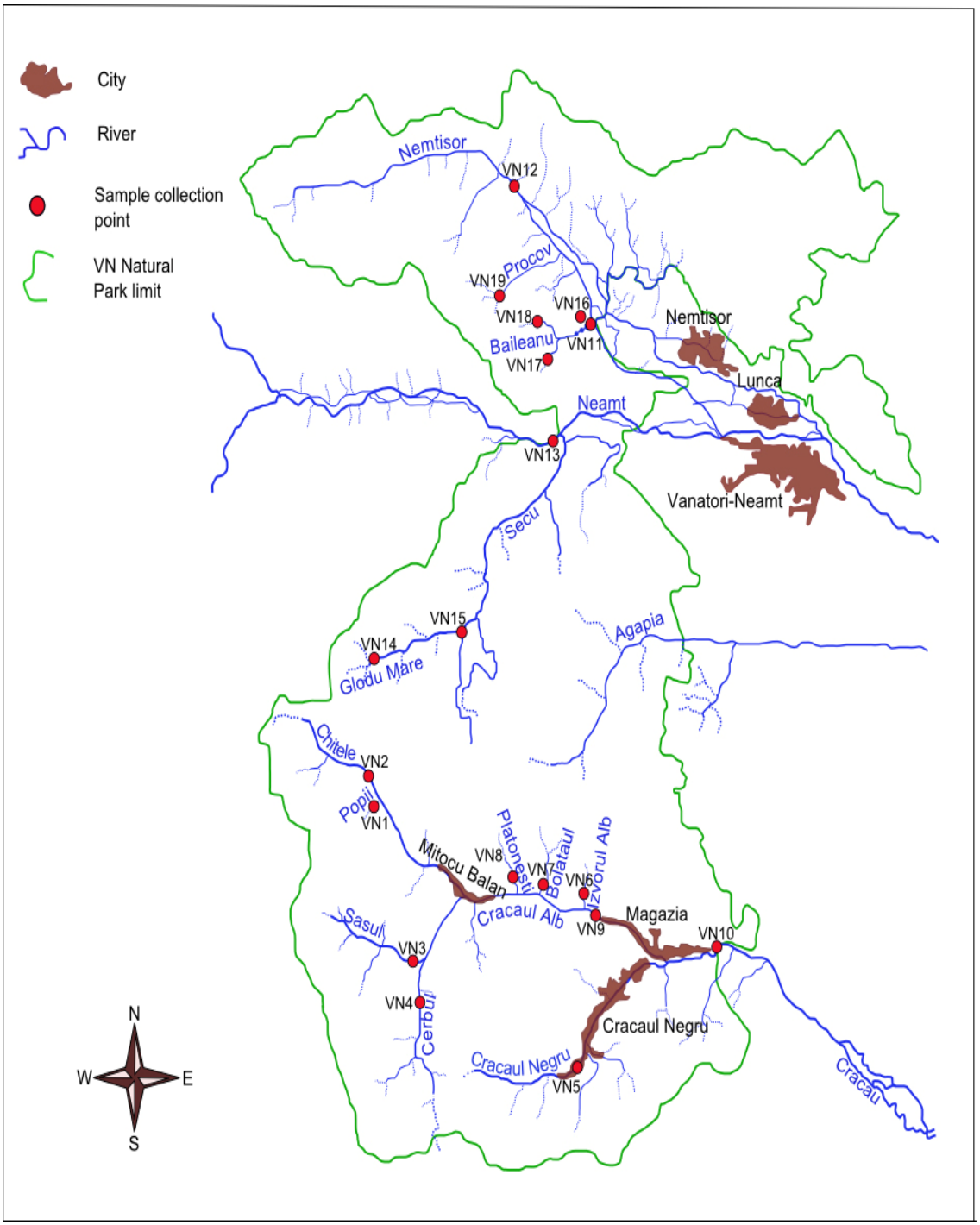

Fig. 1. The location of the study area on the VNNP and the sample collection points:
Popii -**VN1**, Chitele -**VN2**, Sasul -**VN3**, Cerbul -**VN4,** Cracăul; Negru -**VN5**, Izvorul Alb -**VN6**, Bolătăul -**VN7**, Platoneşti -**VN8**, Cracău upstream Magazia-**VN9**, Cracău downstream Magazia –**VN10**, Trepezia -**VN11**, Nemţişor -**VN12**, Neamţ -**VN13**, Glodu Mare -**VN14**, Sihăstria -**VN15**, Drinking place for the zoo bisons –**VN16**, Băileanu 1 –**VN17**, Băileanu 2 –**VN18**, Procov –**VN19**.

Table 1. The distribution of the water mites collected from the Vânători Neamț Natural Park Rivers

Col. pts.	Location	Geographical coordinates N/E	Relative altitude	*Atractides sp.*	*Lebertia sp.*	*Sperchon sp.*	*Torrenticola sp.*
	Cracău basin						
VN1	Popii	47°08'12"/ 26°08'03"	770 m				
VN2	Chitele	47°08'18"/ 26°08'05"	765 m	●			
VN3	Sasul	47°06'18"/ 26°07'51"	695 m				
VN4	Cerbul	47°05'44"/ 26°09'07"	700 m			●	●
VN5	Cracăul Negru	47°04'29"/ 26°12'32"	610 m		●		
VN6	Izvorul Alb	47°06'49"/ 26°13'27"	620 m		●		
VN7	Bolătăul	47°06'59"/ 26°12'18"	630 m				
VN8	Platonești	47°07'01"/ 26°11'41"	760 m				
VN9	Cracău upstream Magazia	47°06'44"/ 26°13'37"	595 m				
VN10	Cracău downstream Magazia	47°06'13"/ 26°16'34"	535 m	●	●	●	
	Neamț basin						
VN11	Trepezia	47°14'48"/ 26°13'22"	465 m			●	
VN12	Nemțișor	47°17'07"/ 26°10'18"	540 m			●	
VN13	Neamț	47°13'18"/ 26°12'37"	460 m	●		●	
VN14	Glodu Mare	47°10'18"/ 26°08'44"	680 m			●	
VN15	Sihăstria	47°10'30"/ 26°10'12"	600 m	●			
VN16	Drinking place for the zoo bisons	47°14'46"/ 26°13'11"	470 m				
VN17	Băileanu 1	47°14'42"/ 26°12'50"	495 m				
VN18	Băileanu 2	47°14'37"/ 26°12'50"	495 m				
VN19	Procov	47°14'27"/ 26°11'42"	665 m				

Table 2. Variation ranges for the selected physico - chemical indicators measured for the identified genus of water mites in the two water basins under investigation, in September 2008

Indicator	Unit	Minimum		Maximum		Average	Variation range
		Value	Sampling station	Value	Sampling station		
Atractides sp.							
Altitude	m	460	Neamț	765	Chitele	590	305
Water temperature	^{0}C	9	Sihăstria	12	Cracău aval Magazia	10.1	3
pH	-	8.29	Cracău aval Magazia	8.59	Chitele	8.39	3
Dissolved Oxygen	mg.l$^-$	8.13	Sihăstria	8.81	Cracău aval Magazia	8.55	0.68
TDS	mg.l$^-$	147.5	Sihăstria	686	Cracău aval Magazia	415.12	538.5
Salinity	mg.l$^-$	0	Sihăstria	0.3	Cracău aval Magazia	0.1	0.3
Ammonium (N-NH_4^*)	mg.l$^-$	0.012	Cracău aval Magazia	0.142	Chitele	0.049	0.13
Nitrite (N-NO_2^-)	mg.l$^-$	0.003	Chitele	0.016	Cracău aval Magazia	0.007	0,013
Nitrate (N-NO_3^-)	mg.l$^-$	0.2	Cracău aval Magazia	0.4	Chitele, Sihăstria	0.3	0.2
SRP (P-PO_4^{3-})	mg.l$^-$	0,052	Sihăstria	0,717	Chitele	0.384	0,665
Lebertia sp.							
Altitude	m	535	Cracău aval Magazia	620	Izvorul Alb	588.3	85
Water temperature	^{0}C	9.5	Izvorul Alb	12	Cracău aval Magazia	10.5	2.5
pH	-	8.297	Cracău aval Magazia	8.502	Cracăul Negru	8.376	0.205
Dissolved Oxygen	mg.l$^-$	8.81	Cracău aval Magazia	8.91	Izvorul Alb	8.86	0.1
TDS	mg.l$^-$	343	Izvorul Alb	1713	Cracăul Negru	914	1370
Salinity	mg.l$^-$	0.1	Izvorul Alb	0.8	Cracăul Negru	0.4	0.7
Ammonium (N-NH_4^*)	mg.l$^-$	0.012	Cracău aval Magazia	0.09	Izvorul Alb	0.041	0.078
Nitrite (N-NO_2^-)	mg.l$^-$	0.003	Izvorul Alb	0.016	Cracău aval Magazia	0.008	0.013
Nitrate (N-NO_3^-)	mg.l$^-$	0.2	Cracău aval Magazia, Izvorul Alb, Cracăul Negru	0.2	Cracău aval Magazia, Izvorul Alb, Cracăul Negru	0.2	0
SRP (P-PO_4^{3-})	mg.l$^-$	0,084	Izvorul Alb	0,945	Cracăul Negru	0,514	0,861
Sperchon sp.							
Altitude	m	460	Neamț	700	Cerbul	563.3	240
Water temperature	^{0}C	10	Sasul, Glodu Mare	13	Nemțișor	11.25	3
pH	-	7.944	Nemțișor	8.393	Trepezia	8.238	0.449
Dissolved Oxygen	mg.l$^-$	8.65	Neamț	8.85	Glodu Mare	8.73	0.2
TDS	mg.l$^-$	400	Glodu Mare	686	Cracău aval Magazia	525.8	286
Salinity	mg.l$^-$	0.1	Neamț, Glodu Mare	0.3	Cracău aval Magazia	0.18	0.2
Ammonium (N-NH_4^*)	mg.l$^-$	0.012	Cracău aval Magazia	0.043	Cerbul	0.028	0.031
Nitrite (N-NO_2^-)	mg.l$^-$	0.003	Trepezia	0.016	Cracău aval Magazia	0.0065	0.013
Nitrate (N-NO_3^-)	mg.l$^-$	0.1	Trepezia	0.3	Neamț	0.2	0.2
SRP (P-PO_4^{3-})	mg.l$^-$	0,107	Cracău aval Magazia	0,808	Glodu Mare	0,457	0,701
Torrenticola sp.							
Altitude	m	700	Cerbul	700	Cerbul	700	0
Water temperature	^{0}C	10	Cerbul	10	Cerbul	10	0
pH	-	8.26	Cerbul	8.26	Cerbul	8.26	0
Dissolved Oxygen	mg.l$^-$	8.7	Cerbul	8.7	Cerbul	8.7	0
TDS	mg.l$^-$	531	Cerbul	531	Cerbul	531	0
Salinity	mg.l$^-$	0.2	Cerbul	0.2	Cerbul	0.2	0
Ammonium (N-NH_4^*)	mg.l$^-$	0.043	Cerbul	0.043	Cerbul	0.043	0
Nitrite (N-NO_2^-)	mg.l$^-$	0.005	Cerbul	0.005	Cerbul	0.005	0
Nitrate (N-NO_3^-)	mg.l$^-$	0.2	Cerbul	0.2	Cerbul	0.2	0
SRP (P-PO_4^{3-})	mg.l$^-$	0,273	Cerbul	0,273	Cerbul	0,273	0

DISCUSSIONS

Clustering algorithms were used to assess the distances between clusters (sampling sites). Because the different measures included here used entirely different types of scales, the data were standardized so that each variable has a mean of 0 and a standard deviation of 1. The tree plot it's scaled in percentages, specifically, as dlink/dmax*100. Thus, it represents the percentage of the range from the maximum to the minimum distance in the data.

The diagram showing clustering of sampling sites according to the physico-chemical indicators measured in the two basins under investigation shows that there is a cluster consisting of 10 sampling sites (VN1, VN4, VN19, VN7, VN6, VN8, VN2, VN14, VN15 and

VN13) most of which are located on the Cracăul Alb and Secu Rivers. The highest similarity coefficient it's present at the sample collecting points VN4 and VN19 (fig. 2).

There is also a cluster consisting of 7 sampling sites (VN9, VN10, VN11, VN12, VN13, VN18 and VN16), most of which are located on the Nemțișor and Neamț Rivers.Samples VN5 and VN17 are very distantly correlated with the other samples, probably due to the high levels of TDS and salinity discovered in both of the sample collecting points.

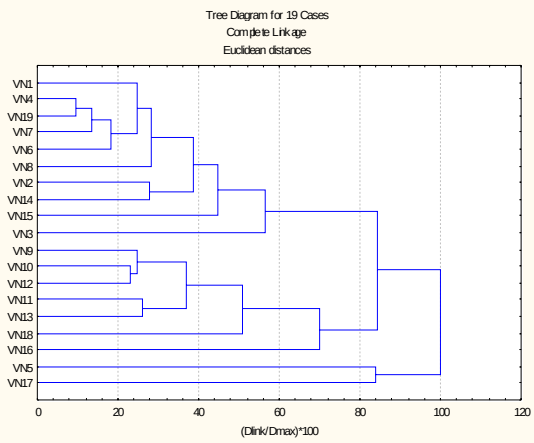

Fig. 2. Tree diagram showing clustering of sampling sites according to the physico-chemical indicators measured in the two basins under investigation

As far as the similarity in the preferences for specific physico-chemical regimes is concerned, no significant links were noticed among the four water mite taxa (figure 3). However, affinities are noticed between the *Atractides sp.* and *Sperchon sp.*, confirmed by the fact that the two water mite taxa are found at almost the same sample collection points.

At the other pole is located *Lebertia sp.*, distantly correlated, probably due to the high tolerance levels for dissolved oxygen, TDS and salinity, in comparison with the other water mite taxa collected.

Regarding the distribution of different water mite genera in the studied area, *Sperchon* genus has the largest distribution area, being found both in Cracău and Neamț Hydrographic Basins, at the opposite side being situated *Torrenticola* genus with only one presence on the Cerbul River.

The *Atractides* genus also has a large distribution, covering part of Cracău (Chitele and Cracăul Alb Rivers) and Neamț (Secu and Neamț Rivers) Hydrographic Basins, while *Lebertia* genus is found only in the Cracău Hydrographic Basin. These differences in water mite distribution are probably due to the differences of the physico-chemical parameters measured in the two hydrographic basins.

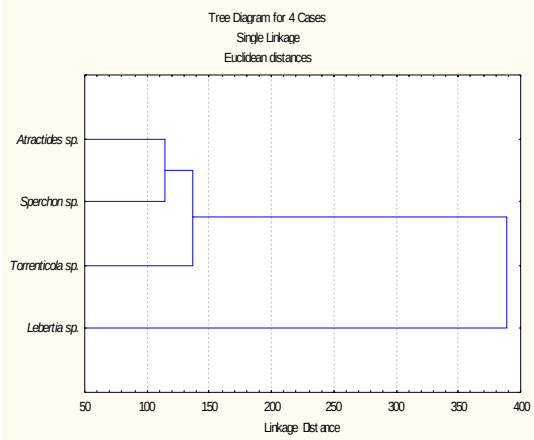

Fig. 3. Treediagramshowingclustering of water mite genera according to the variation ranges for the selected physico-chemical indicators measured in the two water basins under investigation.

ABSTRACT

The list of the water mite species found in Romania is still incomplete.

This is because of the interruption of the studies that had taken place in this country, especially in the first part of the 20-th century regarding the water mite distribution and ecology.

This paper offers a presentation of the water mite fauna from the rivers situated in the Vânători Neamț Natural Park area, as well as a glimpse on the differences in ecology tolerance ranges of the identified water mite taxa.

We used qualitative sampling to obtain specimens required for systematic studies. Several general physico-chemical indicators were also measured in each of the sampling stations: thermal conditions, pH, oxygenation conditions given by dissolved oxygen depletion (DO depletion), Total Dissolved Salts (TDS), salinity, dissolved inorganic nitrogen forms (N-ammonium, N-nitrite and N-nitrate) and soluble reactive phosphorous (SRP).

The results obtained offers a glimpse over the biodiversity of the water mites collected from the studied area, as well as some strong correlations among the measured physico-chemical parameters and the presence or absence of the identified water mite taxa.

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