FOLIA MALACOLOGICA
Vol. 15(2): 59–64
ISSN 1506-7629
The Association of Polish Malacologists
& Faculty of Biology, Adam Mickiewicz University
Poznań 2007

RUTHENICA FILOGRANA (ROSSMÄSSLER, 1836) (GASTROPODA: PULMONATA: CLAUSILIIDAE) IN MALACOCOENOSES OF DECIDUOUS FORESTS IN VARIOUS REGIONS OF POLAND

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ABSTRACT: Malacocoenoses containing *Ruthenica filograna* (Rossm.), a forest-dwelling clausiliid, were studied in two localities in Poland: the nature reserve Dębno nad Wartą (Wielkopolska region) and the Valley of Pieniński Potok (Pieniny Mts). The malacocoenoses were composed of 20 and 42 species, respectively. In Dębno nad Wartą *R. filograna* was the most frequent and abundant species; in the Valley of Pieniński Potok the most frequent and abundant species was *Vitrea diaphana*. The structure of the two communities differed also in other respects. The gastropod density in the two localities was similar (168 and 185 individuals · m^{-2}, respectively), but their species composition was not, with only six species in common (Nei index 0.22).

KEY WORDS: terrestrial gastropods, malacocoenoses, Clausiliidae, ecology, *Ruthenica filograna*

INTRODUCTION

In Poland *Ruthenica filograna* (Rossmässler, 1836), one of the three ovoviviparous clausiliid species found in the country, is a rare and receding species (RIEDEL 1988). LIKHAREV (1962) regarded it as an E. European component of the fauna, inhabiting the eastern part of Central Europe, including all the Carpathians and Eastern Alps. Its scattered localities in the western part of Europe reach the Harz, Thuringian Forest and Frankish as well as Swabian Jura.

The species occurs in entire Poland but in its central and northern parts it is fairly rare. Likewise, it is rare in the Tatra and the W. Beskid Mts. Also recent studies in the Świętokrzyskie Mts (PIECHOCKI 1981) did not confirm the presence of *R. filograna* in that area. In Wielkopolska it is known from only a few sites: the region of Promno and Kociołkowa Górka and nature reserve Dębno nad Wartą (KORALEWSKA-BATURA 1992). In the nature reserve Dębno nad Wartą the population seems to be stable, since the species was recorded by other authors on earlier occasions (MŁODZIANOWSKA-DYRDOWSKA 1928, SZYBIAK 1996).

The snail prefers humid deciduous and mixed deciduous-coniferous forests, in both lowlands and mountains where it reaches the upper forest zone. It stays in leaf litter and under stones. It prefers calcium-rich substratum and is rather difficult to find because it does not climb tree trunks (KERNEY et al. 1983).

R. filograna as a component of malacocoenoses has been mentioned in few papers (DZIĘCZKOWSKI 1972, 1988, SZYBIAK 1996, 2000, CAMERON & POKRYSZKO 2004, SULIKOWSKA-DROZD 2005). The aim of this study was to check if its proportion in malacocoenoses and the composition of its accompanying species varied with geographical location of the site.

MATERIAL AND METHODS

The material came from two sites in different geographical regions of Poland. Site I is the valley of the stream Pieniński Potok in the Pieniny National Park. The sources of the Pieniński Potok and its initial section are located within a Carpathian beech forest, poor variant – *Fagetum carpathicum* (*Dentario glandulosae-Fagetum*) *oxalidetosum*. In the mid section there is typical variant of Carpathian beech forest *Fagetum carpathicum* (*Dentario glandulosae-Fagetum*) *typicum* which is the dominant plant community of the valley bottom. The lowest/terminal part of the valley is grown, besides the Carpathian beech forest, with a sycamore forest *Phylitido-Aceretum,* fragments of *Carici-Fagetum,* and near the outlet of the Pieniński Potok to the Dunajec river – a Carpathian alder forest *Alnetum incanae* occurs. Site II is the nature reserve Dębno nad Wartą in Wielkopolska. The southern part of the reserve, located on moraine hills, is occupied by artificial pine stands. Natural forests occur on the steep margin of the hills – *Galio silvatici-Carpinetum* and on the flat terrace of the Warta river – *Ficario-Ulmetum campestris*. *Galio silvatici-Carpinetum* is formed by a multi-species and multi-storey forest with the dominance of oak (*Quercus robur* L.), elm (*Ulmus campestris* L.), ash (*Fraxinus excelsior* L.), alder (*Alnus glutinosa* L.) and hornbeam (*Carpinus betulus* L.). *Ficario-Ulmetum campestris* consists of stands of pedunculate oak (*Quercus robur* L.) with a slight admixture of ash (*Fraxinus excelsior* L.).

Snails were collected with quantitative methods in three series, 16 samples in each (each sample of 1/16 m^2). A total of 48 samples were taken from each study plot.

The material is kept in the collection of the Faculty of Biology, Adam Mickiewicz University in Poznań.

The similarity of communities of snails was calculated with the Nei index of similarity (POKRYSZKO & CAMERON 2005). To estimate the statistical significance of investigated species abundance in the study plots a U Mann-Whitney test was employed.

RESULTS

CHARACTERISTICS OF GASTROPOD COMMUNITIES IN THE STUDIED SITES

The malacocoenosis in the Valley of Pieniński Potok was twice richer and included 42 species (Table 1). The most frequent and abundant species was *Vitrea diaphana*. Other abundant and rather frequent species were *Carychium tridentatum* and *Aegopinella pura*. Like in the nature reserve Dębno nad Wartą, *Ruthenica filograna* was among the rather abundant and frequent species.

The malacocoenosis in the nature reserve Dębno nad Wartą was composed of 20 species (Table 2). *Ruthenica filograna* was the most frequent and the most abudant. It constituted nearly 18% malacocoenosis and its frequency in the samples was 50%. Other frequent and abundant species in the locality were *Cochlodina laminata*, *Clausilia bidentata* and *Perforatella incarnata* as well as *Cochlicopa lubricella*.

Both localities, at the same number of samples taken, yielded a similar number of gastropod specimens. Also the density in both localities was similar (Tables 1, 2). However, the similarity of species composition in the two malacocoenoses was small (N=0.22) since only six species were shared by the two localities. The dominance structure according to the three dominance classes was also different (Fig. 1). The greatest differences pertained to species with the proportion in the malacocoenosis exceeding 10% and species of negligible proportion (<1%). In the nature reserve Dębno nad Wartą the proportion of the former category was rather high, while in the malacocoenosis in the Valley of Pieniński Potok species of dominance below 1% formed a majority.

HABITAT PREFERENCES AND POPULATION ABUNDANCE OF *R. FILOGRANA* IN THE STUDIED LOCALITIES

In the nature reserve Dębno nad Wartą *R. filograna* was found only in the oak-hornbeam forest (*Galio Silvatici-Carpinetum*), in the Valley of Pieniński Potok the snail occurred in the Carpathian beech forest *Fagetum carpathicum*, clearly preferring its poor variant *Fagetum carpathicum* (*Dentario glandulosae-Fagetum*) *oxalidetosum*. Single specimens were found in the syca-

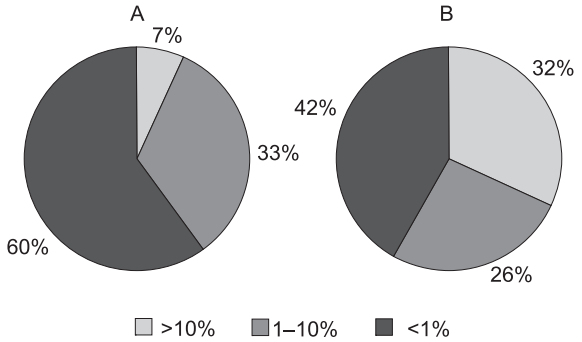

Fig. 1. Percentage of gastropod species from three dominance classes in the malacocenosis of: A – Valley of Pieniński Potok, B – nature reserve Dębno nad Wartą

Table 1. Characteristics of the snail community in the Valley of Pieniński Potok: N – number of specimens, D % – dominance, F % – frequency, X – average number per sample, SD – standard deviation, A – abundance (specimens · m^{-2})

Species	N	D %	F %	X	±SD	A
Vitrea diaphana (Studer, 1820)	96	17.30	68.75	2.000	2.203	32
Carychium tridentatum (Risso, 1826)	66	11.89	39.58	1.375	2.266	22
Aegopinella pura (Alder, 1830)	63	11.35	52.08	1.313	1.858	21
Balea biplicata(Montagu.1803)	36	6.49	20.83	0.750	2.564	12
Vitrea transsylvanica (Clessin, 1877)	31	5.59	39.58	0.646	1.082	10
Vestia gulo (E. A. Bielz, 1859)	30	5.41	27.08	0.625	1.362	10
Acicula polita (Hartmann, 1840)	22	3.96	27.08	0.458	0.967	7
Laciniaria plicata (Draparnaud.1801)	22	3.96	2.08	0.458	3.175	7
Vitrea subrimata (Reinhardt, 1871)	22	3.96	22.92	0.458	1.110	7
Ruthenica filograna (Rossmässler, 1836)	20	3.60	22.92	0.417	0.846	7
Isognomostoma isognomostoma (Schröter, 1784)	13	2.34	16.67	0.271	0.676	4
Vitrea crystallina (O. F. Müller, 1774)	13	2.34	18.75	0.271	0.644	4
Macrogastra ventricosa (Draparnaud, 1801)	11	1.98	6.25	0.229	1.309	4
Acanthinula aculeata (O. F. Müller, 1774)	10	1.80	8.33	0.208	0.824	3
Macrogastra latestriata (A. Schmidt, 1857)	9	1.62	6.25	0.188	0.842	3
Macrogastra tumida (Rossmässler, 1836)	9	1.62	14.58	0.188	0.532	3
Columella edentula (Draparnaud, 1805)	7	1.26	4.17	0.146	0.714	2
Argna bielzi (Rossmässler, 1859)	5	0.90	4.17	0.104	0.515	2
Discus rotundatus (O. F. Müller, 1774)	5	0.90	6.25	0.104	0.425	2
Eucobresia nivalis (Dumont et Mortillet, 1852)	5	0.90	4.17	0.104	0.592	2
Vestia turgida (Rossmässler, 1836)	5	0.90	6.25	0.104	0.472	2
Bulgarica cana (Held, 1836)	4	0.72	4.17	0.083	0.454	1
Chilostoma faustinum (Rossmässler, 1835)	4	0.72	8.33	0.083	0.279	1
Daudebardia rufa (Draparnaud, 1805)	4	0.72	8.33	0.083	0.279	1
Ena montana (Draparnaud, 1801)	4	0.72	4.17	0.083	0.404	1
Macrogastra plicatula (Draparnaud, 1801)	4	0.72	8.33	0.083	0.279	1
Oxychilus orientalis (Clessin, 1887)	4	0.72	4.17	0.083	0.454	1
Punctum pygmaeum (Draparnaud, 1801)	4	0.72	4.17	0.083	0.454	1
Trichia unidentata (Draparnaud, 1805)	4	0.72	4.17	0.083	0.454	1
Aegopinella epipedostoma (Fagot, 1879)	3	0.54	4.17	0.063	0.320	1
Balea stabilis (Pfeiffer, 1847)	3	0.54	2.08	0.063	0.433	1
Discus perspectivus (Mühlfeld, 1816)	3	0.54	4.17	0.063	0.320	1
Succinea oblonga Draparnaud, 1801	3	0.54	2.08	0.063	0.433	1
Perforatella incarnata (O. F. Müller, 1774)	2	0.36	4.17	0.042	0.202	1
Perforatella vicina (Rossmässler, 1842)	2	0.36	4.17	0.042	0.202	<1
Acicula parcelineata (Clessin, 1911)	1	0.18	2.08	0.021	0.144	<1
Arion subfuscus (Draparnoud, 1805)	1	0.18	2.08	0.021	0.144	<1
Clausilia pumila C.Pfeiffer, 1828	1	0.18	2.08	0.021	0.144	<1
Cochlodina ortostoma (Menke, 1830)	1	0.18	2.08	0.021	0.144	<1
Euconulus fulvus (O. F. Müller, 1774)	1	0.18	2.08	0.021	0.144	<1
Limax cinereoniger Wolf, 1803	1	0.18	2.08	0.021	0.144	<1
Vertigo substriata (Rossmässler, 1859)	1	0.18	2.08	0.021	0.144	<1
Total	554	100.00		12	31	185

Table 2. Characteristics of the snail community in the nature reserve Dębno nad Wartą: N – number of specimens, D % – dominance, F % – frequency, X – average number per sample, SD – standard deviation, A – abundance (specimens · m^{-2})

Species	N	D %	F %	X	±SD	A
Ruthenica filograna (Rossmässler, 1836)	89	17.59	50.00	1.854	3.307	30
Vitrina pellucida (O. F. Müller, 1774)	86	17.00	33.33	1.792	3.753	29
Cochlodina laminata (Montagu, 1803)	70	13.83	43.75	1.458	2.946	23
Cochlicopa lubricella (Porro,1838)	56	11.07	41.67	1.167	2.127	19
Clausilia bidentata (Ström, 1765)	53	10.47	43.75	1.104	1.741	18
Perforatella incarnata (O. F. Müller, 1774)	51	10.08	43.75	1.063	1.577	17
Discus rotundatus (O. F. Müller, 1774)	27	5.34	27.08	0.563	1.090	9
Nesovitrea hammonis (Ström, 1765)	21	4.15	27.08	0.438	1.009	7
Vallonia costata (O. F. Müller, 1774)	21	4.15	18.75	0.438	1.413	7
Cochlicopa lubrica (O. F. Müller, 1774)	8	1.58	12.50	0.167	0.476	3
Trichia hispida (Linnaeus, 1758)	6	1.19	8.33	0.125	0.444	2
Perforatella bidentata (Gmelin, 1788)	4	0.79	8.33	0.083	0.279	1
Arion subfuscus (Draparnoud, 1805)	3	0.59	6.25	0.063	0.245	1
Vallonia pulchella O. F. Müller, 1774	3	0.59	4.17	0.063	0.320	1
Carychium minimum O.F. Müller, 1774	2	0.40	2.08	0.042	0.289	1
Punctum pygmaeum (Draparnoud, 1801)	2	0.40	4.17	0.042	0.202	1
Columella edentula (Draparnaud, 1805)	1	0.20	2.08	0.021	0.144	<1
Succinea oblonga Draparnaud, 1801	1	0.20	2.08	0.021	0.144	<1
Vertigo angustior Jeffreys, 1830	1	0.20	2.08	0.021	0.144	<1
Zonitoides nitidus (O.F. Müller, 1774)	1	0.20	2.08	0.021	0.144	<1
Total	506	100.00		11	22	168

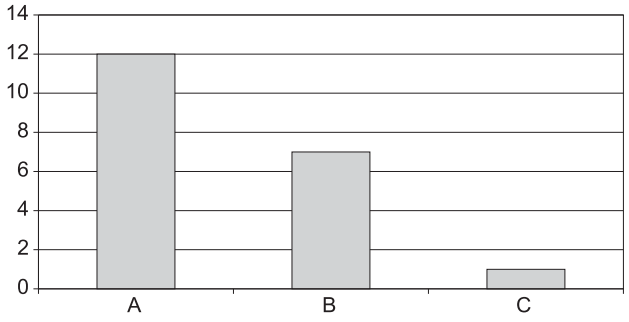

Fig. 2. Abundance of *Ruthenica filograna* in various types of forest in the Valley of Pieniński Potok: A – Carpathian beech forest, poor variant *Fagetum carpathicum* (*Dentario glandulosae-Fagetum*) *oxalidetosum*, B – Carpathian beech forest, typical variant *Fagetum carpathicum* (*Dentario glandulosae-Fagetum*) *typicum*, C – sycamore forest *Phylitido-Aceretum*/Carpathian alder forest *Alnetum incanae*

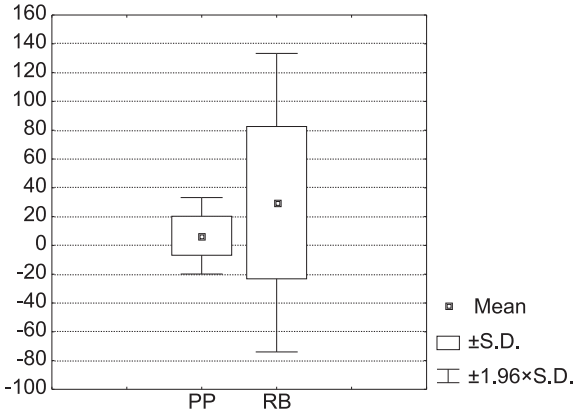

Fig. 3. Mean density of *Ruthenica filograna* in the Valley of Pieniński Potok (PP) and the nature reserve Dębno (RB)

more stand *Phylitido-Aceretum* and Carpathian alder forest *Alnetum incanae* (Fig. 2).

The density of *R. filograna* in the nature reserve Dębno nad Wartą ranged from 27 to 31 indiv. · m^{-2}. In the Valley of Pieniński Potok the snail was much less abundant, and its density was 1–12 indiv. · m^{-2}. The differences between the mean densities of *R. filograna* in the two studied sites were statistically significant, which was confirmed by the Mann-Whitney rank U test; U = 793, z = 2.63; $p < 0.01$ (Fig. 3).

DISCUSSION

URBAŃSKI (1933) reports that *R. filograna* in Poland is widespread but rare. Our observations seem to indicate that wherever the species occurs, it forms a significant component of the malacocoenoses. According to RIEDEL (1988) *R. filograna* is becoming extinct in the area of the Świętokrzyskie Mts, Wielkopolska and Lower Silesia. PAWŁOWSKA & POKRYSZKO (1998) regard it as endangered because of the decreasing area of adequate woodland. It seems, however, that the rarity of the species is to some extent compensated for by the abundance of local populations in individual sites. During long-term studies no disappearance of this snail or clear decrease in abundance of its populations was observed in the studied sites. An example is the nature reserve Dębno nad Wartą, where the species was first recorded nearly 80 years ago (MŁODZIANOWSKA-DYRDOWSKA 1928), and its population persists till the present (MICHAŁKIEWICZ 1977, SZYBIAK 1996, SZYBIAK unpublished). A similar situation is observed in the Pieniny National Park in the Valley of Pieniński Potok where *R. filograna* was first recorded by URBAŃSKI (1939) and found again by SZYBIAK in 2000.

At present it is difficult to unambiguously determine habitat preferences of *R. filograna*. In the nature reserve Dębno nad Wartą it occurs in the oak-hornbeam forest. However, long-term studies on other oak and hornbeam plots in Wielkopolska (nature reserves Jakubowo and Las Grądowy nad Mogilnicą or a forest complex near Duszniki) showed no presence of the species (KORALEWSKA et al. 2006, KORALEWSKA unpublished).

In the Valley of Pieniński Potok *R. filograna* shows different preferences to various forest communities (SZYBIAK 2000), which may indicate that it is microhabitat conditions and not the forest type that decide about the presence of this species. Further detailed studies are required to solve the problem. In addition to the forest types listed here, CAMERON & POKRYSZKO (2004) reported it from a *Circaeo-Alneum* in Białowieża Forest, as a part of a malacocoenosis including a total of 28 species. In this context it is interesting to compare the similarities in species composition between the sites Pieniński Potok, Dębno and Białowieża. The values of the Nei similarity coefficient (excluding slugs which were not regularly sampled by CAMERON & POKRYSZKO 2004) for the pairs of localities are: Pieniński Potok/Dębno 0.22, Pieniński Potok/Białowieża 0.42 and Dębno/Białowieża 0.48. Thus the malacocoenoses, especially the Pieniński Potok/Dębno pair, are highly dissimilar. For example, the mean value of Nei similarity for the North/East region of Europe according to POKRYSZKO & CAMERON (2005) was only 0.47, the maximum distance between localities in that region being about 1,000 km; all were malacocoenoses of a similar forest type. The differences between the malacocoenoses from Białowieża and Dębno on the one hand and the Pieniński Potok on the other can be at least partly accounted for by biogeographical differences, mainly the presence of numerous Carpathian species in the latter locality; no such explanation is possible in the case of the low similarity between Dębno and Białowieża. This would further support the conjecture that *R. filograna* inhabits a wide range of forest types with an equally wide range of malacocoenoses.

In spite of being very local, populations of *R. filograna* are rather abundant. The reproductive success of the snail may be due to its ovoviviparity. This way of reproduction increases the chances of survival of the youngest development stages. It is noteworthy that in the malacocoenosis in the Pieniny Mts there is another ovoviviparous clausiliid – *Balea biplicata*, which with respect to abundance is also among dominants. On the other hand, in the Białowieża samples, though taken with semi-quantitative method, *R. filograna* constituted only 3.55% total specimens (CAMERON & POKRYSZKO 2004).

It should be stressed that the southern parts of Poland are richer in clausiliids. In the Pieniny 15 clausiliid species were recorded, and only three in the nature reserve Dębno nad Wartą. The lower abundance of *R. filograna* in the Pieniny malacocoenosis agrees with the tendency observed by POKRYSZKO & CAMERON (2005), namely the negative correlation between the number of clausiliid species and the abundance of each of them, and may indicate a competition.

ACNOWLEDGMENTS

The authors are grateful to Prof. BEATA M. POKRYSZKO, Museum of Natural History, Wrocław university, Poland for her valuable comments.

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Received: December 17th, 2006
Accepted: June 2nd, 2007