ACTA SCIENTIARUM POLONORUM
Acta Sci. Pol.
Silv. Colendar. Rat. Ind. Lignar. 6(2) 2007, 21-44

ROVE BEETLES (*COLEOPTERA*, *STAPHYLINIDAE*) AS AN ELEMENT OF MONITORING OF FOREST ECOSYSTEMS IN THE KARKONOSZE NATIONAL PARK PART I. THE AUTUMN SEASON ASPECT

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Abstract. In the course of forest management works in the Karkonosze National Park a total of 630 circular sample plots arranged in a 200 × 300 m graticule were established using the mathematical statistical method. Litter samples were collected from the centres of these plots in the autumn of 2002 and 2003 in order to determine the species composition of groups of rove beetles (*Staphylinidae*) and to prepare their zoocenological characteristics. A total of 136 beetles, belonging to 32 taxa, were found in samples. Identified groups were analysed using zoocenological indexes for montane and subalpine forests. It was found that the dominant species were *Othius subuliformis* Steph., *Geostiba circellaris* (Grav.), and *Amischa analis* (Grav.). In the groups of the montane forest 15 taxa were distinguished with a distinct domination of *Othius subuliformis* and *Geostiba circellaris*. *Staphylinidae* groups of the subalpine forest consist of 26 taxa and indicate a domination structure characteristic for undisturbed ecological systems with high frequencies of *Othius subuliformis*, *Amischa analis* and *Geostiba circellaris*.

Key words: ecological monitoring, forest ecosystems, the Karkonosze National Park, *Coleoptera*, *Staphylinidae*

INTRODUCTION

Changes in the natural environment of the Karkonosze Mountains caused by anthropogenic factors, especially the pictures of dying tree stands, provoke reflection on the current state of the environment, potential for its regeneration and directions of future development.

In terms of their zoogeography the Karkonosze are not treated as a separate region. However, due to the height of the massif (the highest mountain range of the Sudeten) and its parallel location, the formation of all plant layers and the specific climate (the climate characteristic for high-mountain areas of Central Europe, the tundra and alpine

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regions) [Fabiszewski and Jeník 1994, Jeník 2001] they may be treated as a unique area in terms of its nature and fauna.

Beetles in the Karkonosze have been investigated for more than 150 years now. Two stages may be distinguished in this process. The first stage was the period of pioneer faunal work on beetles in Silesia and the Sudeten. Starting with the first faunal studies of mid-1800 until the end of World War II several hundred scientific publications were written on beetles in Silesia. They include numerous faunal fragmentary contributions, as well as valuable and extensive faunal monographs [Letzner 1871, 1886, Gerhardt 1910].

The second stage is connected with contemporary inventories and lists of species [Noskiewicz et al. 1961, Borkowski 1985, Burakowski et al. 1979, 1980, 1981, 2000, Mazur 1998, Boháč et al., in print], faunal studies [Mazur 1993, Mazur et al. 2004], as well as publications on ecology and environmental transformations in the Karkonosze [Boháč and Fuchs 1995, Boháč 2001, Grodzki 1997, Mazur 1995, 2004, Nowosad 1990].

In spite of the numerous publications, the specification of the number of *Staphylinidae* species found in the Karkonosze has not been possible. It results from many reasons: most historical data are very general, pertain to Silesia and rarely to the Karkonosze, preserved specimens in museum collections are given very general locations, e.g. "Schlesien", "Riesengebirge", contemporary studies do not cover e.g. subfamily *Aleocharinae* [Mazur 1995]. There is also some justification for the hypothesis that fauna of the northern and southern part of the Karkonosze differ naturally and the degree to which we have investigated the fauna varies as well, which is the effect of the intensity of entomological studies in the Czech and Polish sections of the mountains [Mazur et al. 2004, Bohač et al., in print].

The aim of the study was:

– to determine the species composition of epigeic groups of rove beetles inhabiting forest habitats in the Karkonosze National Park based on the network of permanent monitoring points,
– to prepare zoocenological characteristics of distinguished groups.

Thus obtained data will be used in the future in the evaluation of forest ecosystems in the Karkonosze National Park based on the structure of *Staphylinidae* groups using the geographical information system (GIS).

AREA OF THE STUDY

Monitoring work was conducted in forest ecosystems within the Karkonosze National Park.

It was assumed that monitoring studies would be based on the network of permanent circular sample plots, established in the course of forest management works conducted in 2001 in the Karkonosze National Park using the statistical mathematical forest management method. Circular sample plots were arranged in the 200 × 300 m graticule system. On site these plots were marked by buried witness marks and wooded pegs painted in vivid colours and placed over those marks. A total of 630 such plots were established on forest areas in the Karkonosze National Park, with data described concerning soils, sites, vegetation and tree stands [Danielewicz et al. 2002].

A complete characteristic of natural conditions of each plot is found at the GIS Laboratory of the Karkonosze National Park.

Below basic information on the location and site and stand conditions presented in Table 1 pertains only to those plots, on which rove beetles were recorded.

Table 1. A characteristic of monitoring plots in the Karkonosze National Park, in which rove beetles (*Staphylinidae*) were recorded in the autumn season of 2002 and 2003
Tabela 1. Charakterystyka powierzchni monitoringowych na obszarze Karkonoskiego Parku Narodowego, na których stwierdzono chrząszcze kusakowate (*Staphylinidae*) w okresie jesiennym 2002 i 2003 roku

Plot number Numer powierzchni	Subcompartment Pododdział	Altitude, a.s.l., m Wysokość n.p.m., m	Age of stand Wiek drzewostanu	Type of site Typ siedliskowy
1	2	3	4	5
Szrenica Protected Zone – Obwód Ochronny Szrenica				
3-78	207c	1 169.2	174	BWG
9-78	205c	1 168.4	164	BWG
12-72	204f	1 207.6	196	BWG
12-80	205b	1 137.4	174	BWG
12-82	205a	1 104.5	49	BWG
15-72	203b	1 184.3	174	BWG
18-76	195f	1 113.4	184	BG
27-80	190c	1 001.3	17	BWG
30-66	211a	1 234.6	174	BWG
30-72	194f	1 133.2	174	BWG
30-74	193g	1 101.8	194	BWG
30-86	185	881.6	54	LMG
33-72	200f	1 175.2	154	BWG
33-78	200d	1 064.9	194	BWG
33-84	187a	918.5	49	LMG
39-74	199a	1 177.4	194	BWG
39-84	181a	896.8	31	LMG
42-76	180i	1 043.4	8	BWG
42-78	180f	978.9	20	BWG
48-68	177d	1 013.7	22	BWG
48-70	177f	986.2	214	BWG
48-72	178h	982.3	49	BWG
51-60	196b	1 208.5	194	BWG
51-62	196b	1 154.7	194	BWG
51-66	176b	1 077.6	17	BWG
51-70	168b	991.1	18	BWG
54-66	168a	1 073.1	28	BWG
54-68	168d	1 023.3	30	BWG
Śnieżne Kotły Protected Zone – Obwód Ochronny Śnieżne Kotły				
75-60	164c	1 163.0	22	BWG
81-62	162b	1 103.6	10	BWG
90-62	151g	1 105.3	37	BWG
90-64	151g	1 083.2	37	BWG
90-66	152a	1 076.8	25	BWG
90-68	147d	1 049.2	10	BWG
93-74	147a	898.3	74	BMG
96-68	143d	920.0	72	BMG
96-76	144a,b	842.5	99/10	LMG
96-82	133g	757.3	104	BMG
96-88	121g	703.1	149	LMG
99-86	119f	951.7	45	LMG

Table 1 – cont.

1	2	3	4	5
Przełęcz Protected Zone – Obwód Ochronny Przełęcz				
93-62	150h	1 015.7	122	BWG
102-60	157b	1 143.7	49	BWG
105-72	128g	856.3	97	LMG
108-68	127i	921.8	79	BMG
111-46	169c	1 251.6	144	BWG
114-54	138b	1 089.9	25	BWG
114-60	123c	981.7	79	BWG
114-68	124c	852.2	104	LMG
114-70	125a	825.8	115	LMG
129-114	213h	446.9	104	LMG
Wang Protected Zone – Obwód Ochronny Wang				
129-34	81o	1 250.7	174	BWG
135-36	80a	1 129.4	25	BWG
141-38	78f	1 150.2	190	BWG
144-34	98b	1 273.7	194	BWG
144-38	78g	1 123.8	134	BWG
147-38	78g	1 123.1	134	BWG
150-36	77j	1 171.7	17	BWG
150-38	77j	1 159.8	17	BWG
153-36	77g	1 197.1	17	BWG
153-38	77a	1 141.5	59	BWG
180-38	36d	978.8	15	LMG
186-36	47h	867.6	114	LMG
Stanica Protected Zone – Obwód Ochronny Stanica				
180-30	55i	1 009.0	139	BMG
183-46	33c	938.3	17	LMG
189-22	68a	1 106.5	99	BWG
189-34	52t	861.5	49	LMG
192-24	58g	1 027.7	32	BMG
192-26	58c	966.2	30	LMG
192-32	45k	894.6	64	LMG
Śnieżka Protected Zone – Obwód Ochronny Śnieżka				
201-20	38h	1 042.1	7	BMG
204-20	37k	963.5	27	LMG
204-24	40b	934.9	44	LMG
207-12	22c	1 186.4	164	BWG
207-22	37g	902.2	162	LMG
207-26	39b	860.6	79	LMG
219-16	20a	1 177.6	144	BWG
222-12	19a	1 220.1	169	BWG
231-18	16g	1 105.5	59	BWG
231-20	15b	1 122.7	32	BWG
231-22	14a	1 169.6	10	BWG
234-22	13h	1 239.0	159	BWG
234-24	13f	1 165.9	59	BWG
237-20	10f	1 272.3	159	BWG
237-24	12d	1 129.3	99	BWG
246-22	9f	1 257.4	119	BWG
252-28	7a	1 083.7	15	BWG

METHODOLOGY

Experimental material was collected from a series of litter and humus samples gathered on 630 circular plots established in the Karkonosze National Park. The adopted volume of litter samples was 20 × 20 cm, while samples were always collected 1 m west of the peg marking the centre of the circular plot. Litter samples were collected starting from 23.09.2002 by gathering approx. 20 samples a week from the protected zone. In total after 6 weeks of sample collection on site one sample was taken from each circular sample plot. The assumed sample dimensions (20 × 20 cm) were a compromise between relatively small samples, in terms of their volume, gathered for studies on small soil fauna (springtails *Collembola*, mites), and most samples collected to catch beetles and spiders.

In 2003 the experiment was repeated, by collecting from each plot (except for the Wang Protected Zone) a sample with the litter and humus area increased to the dimensions of 40 × 40 cm.

Samples were collected on site from 1.10 to 15.11.2003. Sample substrate was packed in plastic bags and labelled on site. Samples were transported to the Department of Forest Entomology, the Agricultural University of Poznań, where substrate was sorted under laboratory conditions. The flushing process was divided into two stages. Flushing of invertebrates of bigger dimensions (beetles, spiders) occurred during manual sorting and sifting of sample contents, while invertebrates of small dimensions (*Acari, Colembolla*) were flushed using Tullgren funnels. Material obtained in this way was fixed in alcohol, systematic groups were separated and given to specialists to be identified.

Fixed beetle specimens are gathered in the collection of Andrzej Mazur at the Department of Forest Entomology, the August Cieszkowski Agricultural University of Poznań. The following zoocenological indexes were used to characterize groups of rove beetles:

1. **Constancy of occurrence (C)** – the ratio of the number of samples in which a given species was found to the total number of samples collected in a given habitat, expressed in per cent. Based on the value of this index species were classified as accidents C < 2.5, accessory species C = 2.5-6.0, subconstants C = 6.1-15.0, constants C = 15.1-25.0, and euconstants C > 25.

2. **Individual domination (D)** – the ratio of the number of specimens in a given habitat (n) to the number of all specimens (N), expressed in per cent. Species were classified according to the following index values: subrecendents D < 1.5, recendents D = 1.5-2.0, subdominants D = 2.1-10.0, dominants D = 10.1-30.0, eudominants D > 30.

3. **Estimated fidelity index** – a synthetic index in relation to the consistency of occurrence and individual domination. Classes of estimated fidelity were adopted after Szujecki [1983], adapting them to mountain conditions of the Karkonosze: R – relict species, F_4 – exclusive characteristic species – found regularly in a given habitat, appearing occasionally in others; mountain and boreal mountain species were included in this class, F_3 – selective characteristic species – found in abundance in a given habitat, although found also in others; first of all forest species connected with coniferous forest sites were included in this class, F_2 – accessory (accompanying) species – found in a given habitat in smaller numbers than in others or not exhibiting a preference for any habitat, F_1 – species alien for the habitat, F_0 – ubiquitous species.

4. **The Margalef species richness index (d)**

$$d = \frac{S - 1}{\log N},$$

where:

S – the number of species in a given association,
N – the number of specimens in a given association.

The Margalef species richness index is a measure highly sensitive to sample size, thus this index is suitable for comparative analyses of similar (e.g. forest) ecosystems.

5. **The Shannon-Weaver species diversity index (H')**

$$H' = \sum_{i=1}^{S} Pi \log Pi ,$$

where:

S – the number of species in a given association,
Pi – denotes function $\left(\frac{n_i}{N}\right)$,
n_i – the population size of *i*-th species in a given association (habitat),
N – the number of specimens in a given association.

6. **Group fidelity index (Q)** [according to Smoleński and Szujecki 2001]

$$Q = \sqrt{d(F_4 + F_3)(R + 1)} ,$$

where:

d – the Margalef species richness index,
F_4 – the percentage of the number of specimens in the domination structure of exclusive characteristic specimens,
R – the number of relict species, faunal pecularities.

7. **The Boháč index (S_i)** – consistency of analysed groups with the model group

$$S_i = 100 - \left(\sum_{i-1}^{N} Ue + 0.5\sum_{i-1}^{N} UF_1\right),$$

where:

Ue – the share of specimens belonging to eurytopic species in the association,
UF_1 – the share in the association of specimens belonging to non-forest accompanying species (fidelity class F_1) in relation to analysed habitats.

8. **Group ecological value index (Q_2)** [following Szujecki 1995]

$$Q_2 = \sqrt{dS_i} ,$$

where:

d – species richness index,
S_i – Boháč index.

PRESENTATION AND ANALYSIS OF RESULTS

In the collected and sorted samples the number of beetles was surprisingly low. Table 2 presents the number of sorted samples and collected beetles in terms of individual protected zones of the Karkonosze National Park.

Species from family *Staphylinidae* constituted a significant share of reported beetles (Tables 2 and 3). In the years 2002 and 2003 a total of 136 rove beetles were reported, found in 87 samples.

A list of recorded species of *Staphylinidae* is given in Table 4. Nomenclature of species was adopted following a study by Assing and Schülke [2001].

Table 2. A list of quantities of sifted samples and numbers of found beetles (*Coleoptera*) in terms of protected zones of the Karkonosze National Park in 2002-2003
Tabela 2. Zestawienie przebranych prób i liczebności pozyskanych z nich chrząszczy (*Coleoptera*) w rozbiciu na obwody ochronne Karkonoskiego Parku Narodowego w latach 2002-2003

Protected zone Obwód ochronny	Number of sorted samples Liczba przesortowanych prób	Number of found beetles Liczba pozyskanych chrząszczy
Szrenica	168	123
Śnieżne Kotły	137	56
Przełęcz	236	52
Wang	68	48
Śnieżka	174	69
Stanica	87	35
Total – Ogółem	870	383

Table 3. A list of numbers of found rove beetles (*Staphylinidae*) in samples in terms of protected zones of the Karkonosze National Park in 2002-2003
Tabela 3. Zestawienie liczebności stwierdzonych chrząszczy kusakowatych (*Staphylinidae*) w próbach w rozbiciu na obwody ochronne Karkonoskiego Parku Narodowego w latach 2002-2003

Protected area Obwód ochronny	Number of samples with *Staphylinidae* Liczba prób ze *Staphylinidae*	Number of found *Staphylinidae* specimens Liczba pozyskanych osobników *Staphylinidae*
Szrenica	28	48
Śnieżne Kotły	12	19
Przełęcz	10	16
Wang	12	24
Śnieżka	17	20
Stanica	8	9
Total – Ogółem	87	136

Table 4. A list of species of rove beetles (*Staphylinidae*) recorded in the Karkonosze National Park during monitoring of forest ecosystems in 2002-2003
Tabela 4. Lista chrząszczy kusakowatych (*Staphylinidae*) stwierdzonych na obszarze Karkonoskiego Parku Narodowego w czasie monitoringu ekosystemów leśnych w latach 2002-2003

Staphylinidae species Gatunek *Staphylinidae*	Number and locations in protected zones (**n**/plot number) Liczebność i stanowiska w obwodach ochronnych (**n**/numer powierzchni)						Total of specimens Suma osobników (n)	Domination Dominacja (D)	Number of samples Liczba prób (q)	Constancy of occurrence Stałość występowania (C)	Fidelity class Klasa wierności	Faunal element Element faunistyczny
	Stanica	Śnieżka	Wang	Przełęcz	Śnieżne Kotły	Szrenica						
1	2	3	4	5	6	7	8	9	10	11	12	13
Aleocharinae	**1**/180-30			**1**/111-46			2	1.47	2	2.29		
Amischa analis (GRAVENHORST, 1802)	**1**/183-46			**2**/105-72	**3**/90-66	**1**/3-78 **2**/51-60 **1**/30-72 **1**/15-72 **8**/18-76	19	13.97	8	9.19	F2	P
Atheta (*Atheta*) sp.			**2**/144-38				2	2.20	2	2.29		
Atheta (*Microdota*) sp.					**1**/81-62		1	0.73	1	1.15		
Atheta sp.		**1**/231-22 **1**/204-24 **1**/234-24				**1**/30-74	4	0.03	4	4.60		
Atheta fallaciosa (SHARP, 1869)						**1**/54-68	1	0.73	1	1.15	F3	E
Atheta fungi (GRAVENHORST, 1806)				**2**/129-114			2	1.47	1	1.15	F2	H
Atheta tibialis (HEER, 1839)		**1**/222-12		**2**/114-60		**1**/12-72	4	2.20	3	3.45	F4	BG
Eucnecosum brachypterum (GRAVENHORST, 1802)		**1**/231-20	**2**/129-34				3	2.20	2	2.29	F4	P, BG
Gabrius sp.		**1**/201-20					1	0.73	1	1.15		
Geostiba circellaris (GRAVENHORST, 1806)	**1**/192-24	**1**/204-20 **1**/219-16 **1**/207-26	**1**/186-36	**2**/114-54 **2**/93-62	**1**/90-66 **1**/96-76 **1**/93-74 **1**/96-88	**2**/42-78	18	13.23	14	16.09	F3	EK

Table 4 – cont.

1	2	3	4	5	6	7	8	9	10	11	12	13
					1/96-68							
					2/90-68							
Heterothops dissimilis (GRAVENHORST, 1802)					**1**/90-68		1	0.73	1	1.15	F2	P
Lathrobium fulvipenne (GRAVENHORST, 1806)						**1**/3-78	1	0.73	1	1.15	F2	ES
Lathrobium longulum GRAVENHORST, 1802						**1**/42-76	1	0.73	1	1.15	F2	ES
Mniusa incrassata (MULSANT et REY, 1852)			**1**/150-38		**2**/75-60		4	2.94	3	3.45	F4	E, G
					1/90-62							
Mycetoporus mulsanti (GANGLBAUER, 1895) = *Mycetoprus tenuis* (MULSANT et REY, 1853)	**1**/189-34						1	0.73	1	1.15	F4	BG
Othius angustus STEPHENS, 1833		**1**/237-24	**1**/144-34			**1**/54-66	5	3.67	5	5.75	F3	EK
		1/234-22				**1**/9-78						
Othius subuliformis STEPHENS, 1833 = *O. myrmecophilus* KIESENWETTER, 1843	**1**/189-34	**1**/252-28	**1**/150-36	**1**/108-68	**1**/90-64	**1**/33-84	44	32.35	29	33.33	F3	EK
	1/189-22	**1**/204-24	**1**/147-38	**1**/114-70		**1**/48-70						
	1/192-26	**1**/207-12	**1**/141-38	**1**/102-60		**1**/42-76						
	2/192-32	**1**/231-18	**2**/153-38			**1**/51-70						
			2/153-36			**2**/30-66						
			2/186-36			**2**/48-68						
			3/144-38			**2**/48-72						
			4/180-38			**2**/51-66						
						3/12-82						
Oxypoda funebris KRAATZ, 1856		**1**/207-22			**1**/96-82	**1**/12-72	3	2.20	3	3.45	F4	BG
Philonthus nigrita (GRAVENHORST, 1806)						**1**/12-80	1	0.73	1	1.15	F2	ES
Quedius fuliginosus (GRAVENHORST, 1802)						**1**/30-86	3	2.20	3	3.45	F2	P
						1/39-84						
						1/33-78						

Table 4 – cont.

1	2	3	4	5	6	7	8	9	10	11	12	13
Quedius fulvicollis (STEPHENS, 1833)						**1**/27-80	1	0.73	1	1.15	F3	H
Quedius paradisianus (HEER, 1839)			**1**/135-36	**1**/114-68	**1**/90-66	**1**/33-72 **1**/51-66	5	3.67	5	5.75	F4	EK, G
Quedius punctatellus (HEER, 1839)				**1**/102-60			1	0.73	1	1.15	F4	E, G
Quedius umbrinus ERICHSON, 1839						**1**/51-62	1	0.73	1	1.15	F2	E
Quedius unicolor KIESEWETTER, 1847						**1**/33-78	1	0.73	1	1.15	F4	E, G
Stenus glacialis HEER, 1839		**1**/237-20					1	0.73	1	1.15	F4	BG
Stenus humilis ERICHSON, 1839		**1**/231-20					1	0.73	1	1.15	**F2**	ES
Syntomium aeneum (MÜLLER, 1821)		**1**/234-24 **1**/246-22	**1**/246-22				2	1.47	2	2.29	R	E
Tachinus fimetarius GRAVENHORST, 1802						**1**/30-74	1	0.73	1	1.15	F0	EK
Tachyporus nitidulus (FABRICIUS, 1781)					**1**/99-86		1	0.73	1	1.15	F2	P
Total – Ogółem	9	20	24	16	19	48	136					

Legend:

Faunal element: ES – Euro-siberian, E – European, P – Palearctic, BG – boreal-mountain, G – mountain, EK – Euro-Caucasian, H – Holarctic.

Fidelity class: R – relict species, F_4 – exclusive characteristic species – found regularly in a given habitat, appearing occasionally in others; mountain and boreal mountain species were included in this class, F_3 – selective characteristic species – found in abundance in a given habitat, although found also in other habitats; first of all forest species connected with coniferous forest habitats were included in this class, F_2 – auxiliary (accompanying) species – found in a given species in lower numbers than in other habitats or exhibiting no preference for any habitat, F_1 – alien species in a given habitat, F_0 – ubiquitous species.

Objaśnienia:

Element faunistyczny: ES – eurosyberyjski, E – europejski, P – palearktyczny, BG – borealno-górski, G – górski, EK – eurokaukazki, H – holarktyczny.

Klasa wierności:

R – gatunki reliktowe, F_4 – gatunki charakterystyczne wyłączne – występujące regularnie w danym środowisku, w innym pojawiające się przypadkowo; zaliczano do tej klasy gatunki górskie i borealno-górskie, F_3 – gatunki charakterystyczne wybierające – występujące licznie w danym środowisku, jednak znajdowane także w innych środowiskach; zaliczano do tej klasy przede wszystkim gatunki leśne związane ze środowiskami borowymi, F_2 – gatunki pomocnicze (towarzyszące) – występujące w danym środowisku mniej licznie niż w innych środowiskach lub niewykazujące skłonności do żadnego środowiska, F_1 – gatunki obce dla środowiska, F_0 – gatunki wszędobylskie, ubikwistyczne.

Analysis of domination structure and frequency of occurrence. In the collected material the dominant species included *Othius subuliformis* (D = 33%) classified as a eudominant and *Amischa analis* (D = 14%) and *Geostiba circellaris* (D = 13%), considered to be dominants. Specimens of these three species constitute almost 60% all collected rove beetles. Eight taxa were classified as eudominants. They were *Atheta* sp., *Atheta tibialis*, *Eucnecosum brachypterum*, *Mniusa incrassata*, *Othius angustus*, *Oxypoda funebris*, *Quedius fuliginosus*, and *Q. paradisianus*. The other 20 taxa were classified as subrecendents.

The structure of the consistency of species occurrence is similar. *Othius subuliformis* is a euconstant. Only one species, *Geostiba circellaris*, was classified as a constant. *Amischa analis* is a subconstant. Seven taxa were considered accessory species, i.e. *Atheta* sp., *Atheta tibialis*, *Mniusa incrassata*, *Othius angustus*, *Oxypoda funebris*, *Quedius fuliginosus* and *Q. paradisianus*.

Distribution of dominant species. The species found in biggest numbers and occurring most frequently in forest habitats of the Karkonosze National Park was *Othius subuliformis*.

In forest habitats in the Karkonosze the mentioned species was reported in all protected zones (Table 4), being found in biggest numbers in the Szrenica zone (9 plots), while it was rarest in the Śnieżne Kotły zone (1 plot).

These plots represent mixed mountain forest (31% locations), mixed mountain coniferous forest (7% locations) and high-mountain coniferous forest (62% locations). The age of stands in these plots ranges from 8 to 214 years, mean age being 69.61 years. The frequency of occurrence of *Othius subuliformis* specimens in plots in terms of age classes of stands is presented in Figure 1.

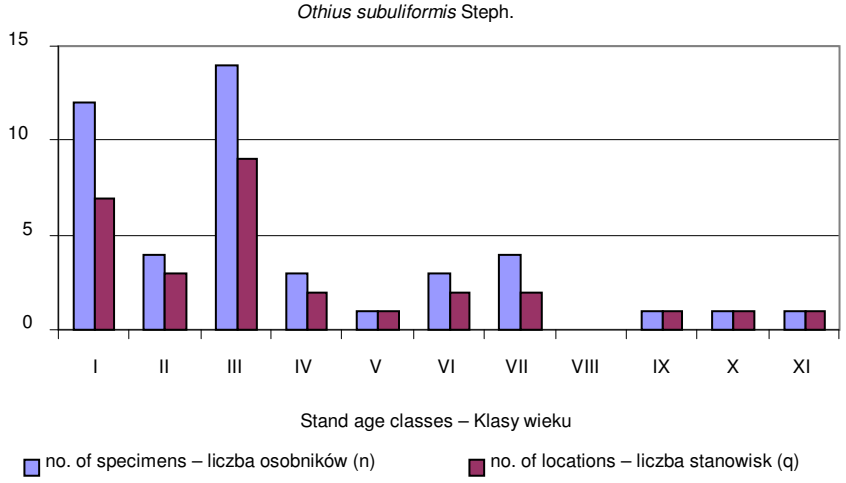

Fig. 1. Frequency of *Othius subuliformis* STEPH. in stands of the Karkonosze National Park in terms of stand age classes
Rys. 1. Frekwencja *Othius subuliformis* STEPH. w drzewostanach Karkonoskiego Parku Narodowego z rozbiciem na klasy wieku

Geostiba circellaris and *Amischa analis* were dominants in the collected material. *Geostiba circellaris* was the more frequent species (C = 16.09%).

In forest habitats of the Karkonosze National Park *G. circellaris* was found in mixed mountain coniferous forest (with a frequency of 28.6%), mixed mountain forest (with a frequency of 35.7%) and high-mountain coniferous forest (with an identical frequency of 35.7%). Most locations of occurrence in case of the analysed species (64%) are situated in the montane forest zone. Age of stands in these locations ranged from 10 to 149 years, with the mean age for all locations of 71 years. The frequency of *G. circellaris* specimens in stands of different age classes is presented in Figure 2.

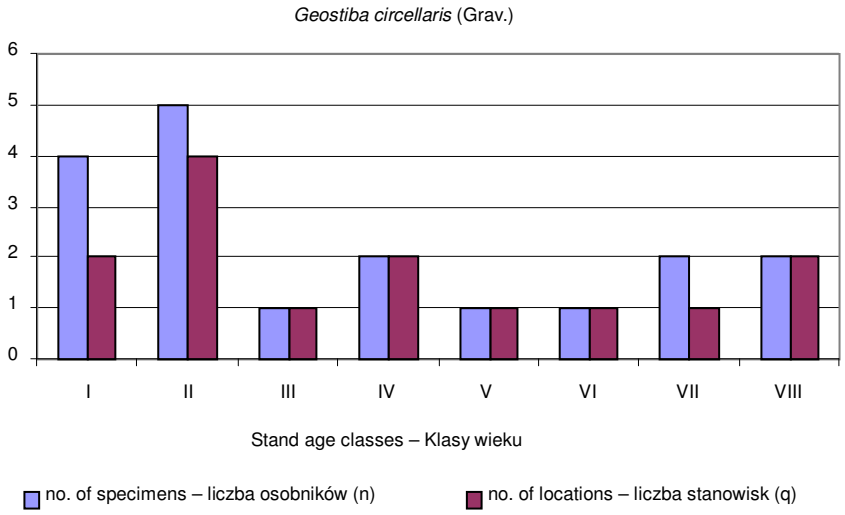

Fig. 2. Frequency of *Geostiba circellaris* (GRAV.) in stands of the Karkonosze National Park in terms of stand age classes
Rys. 2. Frekwencja *Geostiba circellaris* (GRAV.) w drzewostanach Karkonoskiego Parku Narodowego z rozbiciem na klasy wieku

Another species included in the class of dominants was *Amischa analis*. In the collected material 19 specimens of this species were recorded, which were found in 8 plots (Table 4). In forest habitats of the Karkonosze *Amischa analis* was reported in single locations in the Stanica, Przełęcz and Śnieżne Kotły protected zones. Only in the Szrenica protected zone 5 locations with this species were found. These locations represent mixed mountain forest and high-mountain coniferous forest sites. In the mixed mountain forest *A. analis* was found with a frequency of 16%, while in high-mountain coniferous forest sites it was with a frequency of 84%. It should be pointed out that 15 out of the 18 specimens of this species were found in samples coming from stands aged at least 170 years (Fig. 3).

A characteristic of *Staphylinidae* groups in montane and subalpine forest zones in the Karkonosze National Park. The montane forest zone in the Karkonosze is diverse in terms of forest habitats. The basic vegetation type is beech forest (poor mountain beech forest and fertile Sudetic beech forest), replaced over a considerable area by

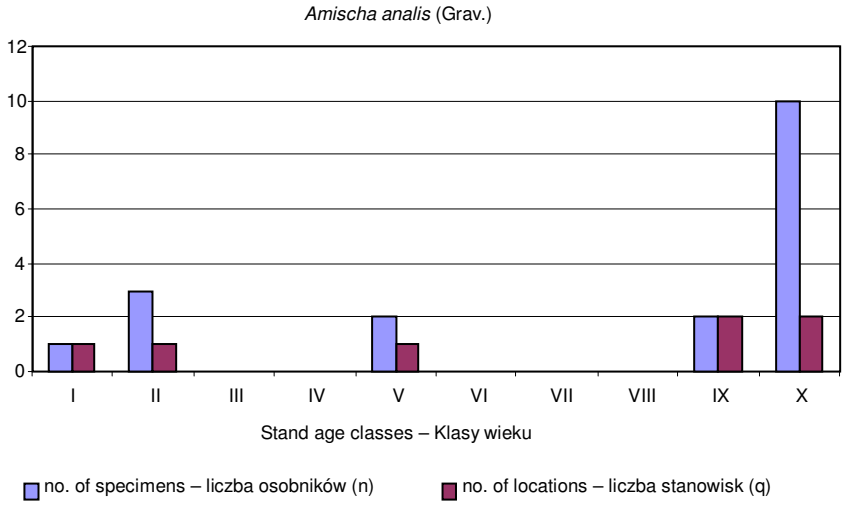

Fig. 3. Frequency of *Amischa analis* (GRAV.) in stands of the Karkonosze National Park in terms of stand age classes
Rys. 3. Frekwencja *Amischa analis* (GRAV.) w drzewostanach Karkonoskiego Parku Narodowego z rozbiciem na klasy wieku

spruce monocultures. The montane fir-spruce coniferous forest is a transitional zone between the montane forest zone and the subalpine forest zone [Danielewicz et al. 2002]. A list of species of beetles found in forest habitats of the montane forest zone is given in Table 5.

Table 5. A list of *Staphylinidae* species found in forest habitats of montane forest zone in the Karkonosze National Park in the decreasing order of domination
Tabela 5. Lista gatunków *Staphylinidae* stwierdzonych w środowiskach leśnych regla dolnego Karkonoskiego Parku Narodowego według malejącej dominacji

Staphylinidae species Gatunek *Staphylinidae*	Total of specimens Liczba osobników (n)	Domination Dominacja (D)	Number of samples Liczba prób (q)	Constancy of occurrence Stałość występowania (C)
1	2	3	4	5
Othius subuliformis STEPHENS, 1833	14	32.6	11	40.7
Geostiba circellaris (GRAVENHORST, 1806)	10	23.3	9	33.3
Amischa analis (GRAVENHORST, 1802)	3	6.9	2	7.4
Atheta fungi (GRAVENHORST, 1806)	2	4.6	1	3.7
Atheta tibialis (HEER, 1839)	2	4.6	1	3.7
Oxypoda funebris KRAATZ, 1856	2	4.6	2	7.4
Quedius fuliginosus (GRAVENHORST, 1802)	2	4.6	2	7.4

Table 5 – cont.

1	2	3	4	5
Atheta sp.	1	2.3	1	3.7
Gabrius sp.	1	2.3	1	3.7
Lathrobium longulum GRAVENHORST, 1802	1	2.3	1	3.7
Mycetoporus mulsanti (GANGLBAUER, 1895)	1	2.3	1	3.7
Othius angustus STEPHENS, 1833	1	2.3	1	3.7
Quedius paradisianus (HEER, 1839)	1	2.3	1	3.7
Tachinus fimetarius GRAVENHORST, 1802	1	2.3	1	3.7
Tachyporus nitidulus (FABRICIUS, 1781)	1	2.3	1	3.7
Total – Ogółem	43			

In the distinguished group the dominant role is played by two species: *Othius subuliformis* and *Geostiba circellaris*. Their populations account for over 50% of the total group. Moreover, mountain species constitute a significant share of the group. In the subalpine forest zone, over the entire area taken up by the phytocenosis of the subalpine Sudetic spruce forest, the recorded group of rove beetles is more abundant in the number of species. A list of *Staphylinidae* species found in subalpine forests of the Karkonosze National Park is given in Table 6.

Table 6. A list of *Staphylinidae* species found in spruce coniferous forests of the subalpine forest zone in the Karkonosze National Park in the decreasing order of domination
Tabela 6. Lista gatunków *Staphylinidae* stwierdzonych w borach świerkowych regla górnego Karkonoskiego Parku Narodowego według malejącej dominacji

Staphylinidae species Gatunek *Staphylinidae*	Total of specimens Liczba osobników (n)	Domination Dominacja (D)	Number of samples Liczba prób (q)	Constancy of occurrence Stałość występowania (C)
1	2	3	4	5
Othius subuliformis STEPHENS, 1833	30	32.26	18	30.51
Amischa analis (GRAVENHORST, 1802)	16	17.20	6	10.17
Geostiba circellaris (GRAVENHORST, 1806)	8	8.60	5	8.47
Mniusa incrassata (MULSANT et REY, 1852)	4	4.30	3	5.08
Othius angustus STEPHENS, 1833	4	4.30	4	6.78
Quedius paradisianus (HEER, 1839)	4	4.30	4	6.78
Atheta (*Atheta*) sp.	3	3.32	2	3.39
Atheta sp.	3	3.32	3	5.08
Aleocharinae	2	2.15	2	3.39

Table 6 – cont.

1	2	3	4	5
Atheta tibialis (HEER, 1839)	2	2.15	2	3.39
Eucnecosum brachypterum (GRAVENHORST, 1802)	2	2.15	2	3.39
Syntomium aeneum (MÜLLER, 1821)	2	2.15	2	3.39
Atheta (Microdota) sp.	1	1.10	1	1.69
Atheta fallaciosa (SHARP, 1869)	1	1.10	1	1.69
Heterothops dissimilis (GRAVENHORST, 1802)	1	1.10	1	1.69
Lathrobium fulvipenne (GRAVENHORST, 1806)	1	1.10	1	1.69
Oxypoda funebris KRAATZ, 1856	1	1.10	1	1.69
Philonthus nigrita (GRAVENHORST, 1806)	1	1.10	1	1.69
Quedius fuliginosus (GRAVENHORST, 1802)	1	1.10	1	1.69
Quedius fulvicollis (STEPHENS, 1833)	1	1.10	1	1.69
Quedius punctatellus (HEER, 1839)	1	1.10	1	1.69
Quedius umbrinus ERICHSON, 1839	1	1.10	1	1.69
Quedius unicolor KIESENWETTER, 1847	1	1.10	1	1.69
Stenus glacialis HEER, 1839	1	1.10	1	1.69
Stenus humilis ERICHSON, 1839	1	1.10	1	1.69
Total – Ogółem	93			

The domination structure of the group is more uniform in comparison to that of the montane forest habitats. Similarly as in the montane forest zone the dominant species was *Othius subuliformis*. Accessory species were *Amischa analis* and *Geostiba circellaris*. Basic zooindication indexes were calculated for the distinguished groups of *Staphylinidae* (Table 7).

Table 7. Values of zooindication indexes for groups of rove beetles (*Staphylinidae*) in montane and subalpine forest habitats
Tabela 7. Wartość wskaźników zooindykacyjnych dla zgrupowań chrząszczy kusakowatych (*Staphylinidae*) środowisk regla dolnego i górnego

Zooindication index Wskaźnik zooindykacyjny	Montane zone Regiel dolny	Subalpine zone Regiel górny
Number of specimens (n) – Liczba osobników (n)	45	91
Number of taxa (S) – Liczba taksonów (S)	15	26
Value of index H' – Wartość wskaźnika H'	20.91	41.46
Value of index d – Wartość wskaźnika d	8.46	12.76
Value of index Q – Wartość wskaźnika Q	24.51	35.12
Value of index S_i – Wartość wskaźnika S_i	78.9	73.6
Value of index Q_2 – Wartość wskaźnika Q_2	25.83	30.65

Frequencies of *Staphylinidae* in forest habitats defined by the specific forest site type are given in Table 8. The analysis of the occurrence of beetles depending on the forest site type to a large degree is consistent with the analyses conducted above, since the subalpine forest zone includes high-mountain coniferous forest, while forests of the montane zone consist of mountain coniferous forest, mixed mountain coniferous forest and mixed mountain forest sites.

Table 8. A list of *Staphylinidae* species with frequencies in different forest site types in the Karkonosze National Park
Tabela 8. Lista gatunków *Staphylinidae* wraz z frekwencją w różnych typach siedliskowych lasów Karkonoskiego Parku Narodowego

Staphylinidae species Gatunki *Staphylinidae*	Number of specimens in forest site type Liczba osobników w typie siedliskowym lasu			
	BMG	LMG	BG	BWG
1	2	3	4	5
Aleocharinae	1			1
Amischa analis (GRAVENHORST, 1802)		3	8	8
Atheta (*Atheta*) sp.				2
Atheta (*Microdota*) sp.				1
Atheta sp.		1		3
Atheta fallaciosa (SHARP, 1869)				1
Atheta fungi (GRAVENHORST, 1806)		2		
Atheta tibialis (HEER, 1839)				4
Eucnecosum brachypterum (GRAVENHORST, 1802)				3
Gabrius sp.				1
Geostiba circellaris (GRAVENHORST, 1806)	2	5		11
Heterothops dissimilis (GRAVENHORST, 1802)				1
Lathrobium fulvipenne (GRAVENHORST, 1806)				1
Lathrobium longulum GRAVENHORST, 1802				1
Mniusa incrassata (MULSANT et REY, 1852)				4
Mycetoporus mulsanti (GANGLBAUER, 1895)		1		
Othius angustus STEPHENS, 1833				5
Othius subuliformis STEPHENS, 1833	1	13		30
Oxypoda funebris KRAATZ, 1856	1	1		1
Philonthus nigrita (GRAVENHORST, 1806)				1
Quedius fuliginosus (GRAVENHORST, 1802)		2		1
Quedius fulvicollis (STEPHENS, 1833)				1
Quedius paradisianus (HEER, 1839)		1		4

Table 8 – cont.

1	2	3	4	5
Quedius punctatellus (HEER, 1839)				1
Quedius umbrinus ERICHSON, 1839				1
Quedius unicolor KIESEWETTER, 1847				1
Stenus glacialis HEER, 1839				1
Stenus humilis ERICHSON, 1839				1
Syntomium aeneum (MÜLLER, 1821)				2
Tachinus fimetarius GRAVENHORST, 1802				1
Tachyporus nitidulus (FABRICIUS, 1781)		1		
Total – Ogółem	5	30	8	93

Figure 4 presents an analysis of occurrence of rove beetles depending on the age of stands. The highest frequency of rove beetles was recorded in stands aged up to 60 years and aged 181-200 years. Zooindication indexes, calculated for protected zones of the Karkonosze National Park, are presented in Table 9 and Figure 5.

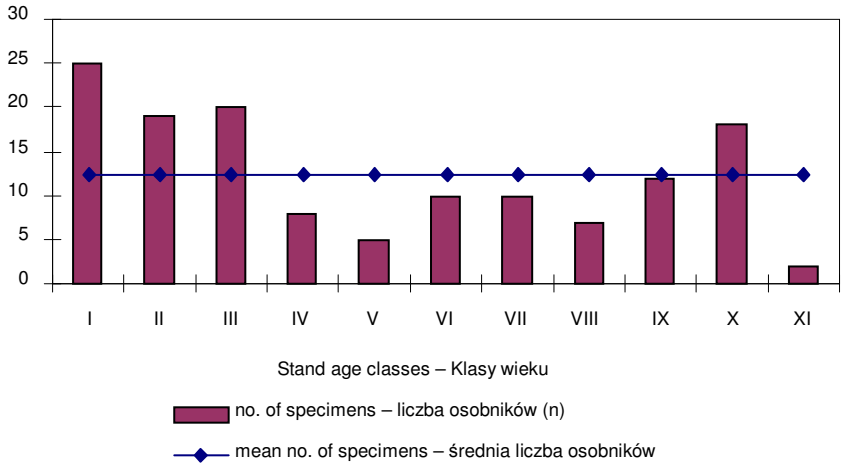

Fig. 4. Frequency of *Staphylinidae* in stands of the Karkonosze National Park in terms of stand age classes for the autumn season of 2002 and 2003
Rys. 4. Frekwencja *Staphylinidae* w drzewostanach Karkonoskiego Parku Narodowego z rozbiciem na klasy wieku dla okresu jesiennego 2002 i 2003

Table 9. Values of zooindication indexes for groups of rove beetles (*Staphylinidae*) recorded for protected zones of the Karkonosze National Park for the autumn season of 2002 and 2003
Tabela 9. Wartości wskaźników zooindykacyjnych dla zgrupowań chrząszczy kusakowatych (*Staphylinidae*) wyróżnionych dla obwodów ochronnych Karkonoskiego Parku Narodowego w okresie jesiennym 2002-2003

Zooindication index Wskaźnik zooindykacyjny	Protected zones – Obwody ochronne					
	Szrenica	Śnieżne Kotły	Przełęcz	Wang	Stanica	Śnieżka
Number of specimens (n) – Liczba osobników (n)	48	19	16	24	9	20
Number of taxa (S) – Liczba taksonów (S)	17	9	8	7	6	11
Value of index H' – Wartość wskaźnika H'	24.91	9.71	6.81	3.16	2.83	10.75
Value of index d – Wartość wskaźnika d	9.52	6.26	5.81	4.34	4.2	7.69
Value of index Q – Wartość wskaźnika Q	22.71	20.69	19.88	19.95	18.07	17.45
Value of index S_i – Wartość wskaźnika S_i	57.3	73.69	75	100	88.89	85
Value of index Q_2 – Wartość wskaźnika Q_2	23.35	21.48	20.87	20.83	19.32	25.57

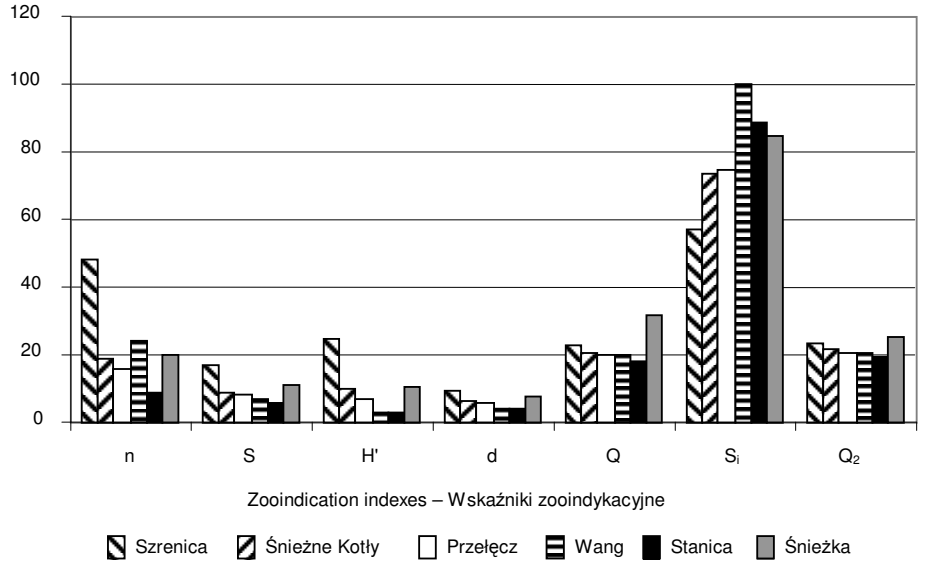

Fig. 5. A list of values of zooindication indexes: n – number of specimens, S – number of taxa, H' – Shannon-Weaver species diversity, d – Margalef species richness, Q – group fidelity, S_i – Bohač index, Q_2 – group ecological value of *Staphylinidae* calculated for protected zones in the Karkonosze National Park
Rys. 5. Zestawienie wartości wskaźników zooindykacyjnych: n – liczba osobników, S – liczba taksonów, H' – różnorodność gatunkowa Shannona-Weavera, d – bogactwo gatunkowe Margalefa, Q – wierność zgrupowania, S_i – wskaźnik Bohača, Q_2 – wartość ekologiczna zgrupowania *Staphylinidae* obliczona dla obwodów ochronnych Karkonoskiego Parku Narodowego

DISCUSSION OF RESULTS

This study presents information concerning three basic problems:
– The occurrence of rove beetles in forest habitats of the Karkonosze.
– Environmental quality assessment based on the character of invertebrate groups.
– The permanent circular sample plot method as a way to obtain data for monitoring purposes.

The Karkonosze Mountains are an area with a relatively well-investigated fauna, although there is a shortage of faunal and ecological characteristics of different habitats in these mountains. The published list of rove beetle species in the Karkonosze [Mazur 1998] includes 184 species, although in the opinion of the authors there may be 250-300 species of *Staphylinidae* in this area. In comparison to the above mentioned data the number of recorded taxa in this study seems small. Such a situation could have resulted from the following factors:
– the sample collection period limited to autumn,
– schematic distribution of circular sample plots on the rectangular graticule, as a result centres of plots, in the vicinity of which litter samples were collected, were sometimes located near roads, at rock outcrops, etc.

In the analysis of the *Staphylinidae* group the domination of forest species characteristic for acidophilous coniferous forest sites needs to be emphasized. These species are *Othius subuliformis* and *Geostiba circellaris*. Their high frequency may be explained by the marked predominance of acidophilous spruce coniferous forest sites in the subalpine forest zone and infertile Sudetic beech forests in the montane forest zone in the Karkonosze. The high frequency of the above mentioned rove beetle species seems also to be affected by the preference of spruce on beech forest sites and its acidifying effect on the soil environment.

The species composition of distinguished groups of rove beetles is characteristic for mountain areas. The share of mountain and boreal-mountain species is significant: these species constitute 1/4 all recorded taxa, while the share of specimens is 14% all collected material. These species were reported both in forests in the montane zone and in spruce forests of the subalpine zone.

While comparing forest habitats in the montane and subalpine forest zones higher values of zoocenological indexes calculated for the subalpine zone need to be emphasized. The number of recorded specimens and taxa, as well as species diversity and species richness indexes are much higher (Table 7) than those indexes calculated for the groups of the montane zone. However, the group fidelity index for a given habitat type (Q) reaches almost identical values for groups of the montane and subalpine zones. The Bohač index defining the consistency of a given group with the theoretical (model) group is higher for groups of the montane zone. This results from the high frequency of *Amischa analis* in subalpine coniferous forests, increasing the share of non-typical species in the group and lowering the value of the Bohač index. In turn, the group ecological value index (Q_2), based on the share of characteristic and relict species in the group, is higher for the subalpine forest habitats.

The occurrence in subalpine forests of two other species considered relicts, i.e. *Eucnecosum brachypterum* and *Syntomium aeneum*, needs also to be stressed [Szujecki 1996, Smoleński 2001].

When comparing forest habitats of montane and subalpine zones in the Karkonosze in terms of *Staphylinidae* groups inhabiting them, it may be stated that:

– forests of the subalpine zone in the Karkonosze with numerous formed peatbogs promote the occurrence of stenotopic and relict rove beetle species connected with these types of habitats; this may explain the frequency of *Eucnecosum brachypterum* and *Philonthus nigrita, Mniusa incrassata* and *Atheta fallaciosa* in *Staphylinidae* groups of the subalpine forest zone,
– the presence of rove beetles in autumn samples collected from the subalpine forest zone was two times higher; moreover, a much larger number of species was recorded (26 in the subalpine zone, 15 in the montane zone), which as a consequence resulted in higher values of zooindication indexes (Table 7) calculated for groups of the subalpine zone.

The observed situation may be explained by the higher share of subalpine coniferous forests than montane forests within the Karkonosze National Park (the share of high-mountain coniferous forests amounted to 60.4% forest communities in the Karkonosze National Park – data after Danielewicz et al. 2002). Montane forest sites were represented more extensively only in the Wang, Przełęcz and Śnieżne Kotły protected zones (the share of mountain coniferous forests was only 8.03 ha – 0.2% forest sites, mixed mountain coniferous forest sites take up 7.9% forest area, while mixed mountain forest sites constitute 31.1% area). Out of the total number of 87 samples with the recorded presence of rove beetles only 27 samples (i.e. 31.4%) came from the montane forest zone.

Moreover, the low frequency of rove beetles in montane forests could have been affected by the deformation of the structure of forest habitats by artificial spruce monocultures, introduced many years ago on potential mixed forest and beech forest sites. The analysis of the frequency of *Staphylinidae* in different forest site types is presented in Table 8.

When analysing the species composition and domination relationships of rove beetle groups using the criteria presented by Trojan [1998] it may be stated that:

– groups of *Staphylinidae* forming in forest habitats of the montane forest zone by the marked domination of *Othius subuliformis* and *Geostiba circellaris* and the low number of accompanying species have the structure characteristic for simplified locations with the destroyed mosaic and internal structure,
– *Staphylinidae* groups of the subalpine forest zone with a larger number of accompanying species (forming the so-called tail area of the distribution) may be compared to groups with normal distribution, which are characteristic for homogenous habitats with a properly developed structure.

Interesting data are supplied by the analysis of frequencies of rove beetles depending on the age of stands. It results from the analysis that the highest frequency is found for tree stands of the first three age classes (up to 60 years), and the oldest – aged 181-200 years. In spite of the age difference these stands, especially age class I – up to 20 years, and class X (181-200 years) in terms of environmental conditions may be very similar. It is because stands aged approx. 200 years are found in the phase of decomposition and renovation (renovation processes are both natural and artificially initiated).

The trend towards the higher frequency in younger stands is also found in two dominant species (Figs 1-2). In turn, *Amischa analis* exhibits a higher frequency in stands of age class X (Fig. 3). Exclusive characteristic and relict species exhibit varying

preferences for the age of stand. Species recorded in locations with older stands include *Atheta tibialis*, *Oxypoda funebris*, *Quedius unincolor* and *Stenus glacialis*. In locations with both younger and older stands the recorded species include *Eucnecosum brachypterum*, *Quedius paradisianus*, and *Syntomium aeneum*. A distinct trend towards the occurrence in locations with younger stands was observed in *Mniusa incrassata*. *Mycetoporus mulsanti* and *Quedius punctatellus* were found in single locations with younger stands.

The fact that data may be obtained on resources of the forest environment using the mathematical statistical method and that the circular sample plots are permanent facilitates monitoring projects extending over the period of many years. A study by Starzyk and Wójcik [1985] may be an example of entomological analyses based on the above mentioned method. Moreover, an attempt to use the network of monitoring plots in ecological studies was undertaken in the Gorce National Park [Loch et al. 1994]. The network established in the Gorce Mountains is based on squares with side length of 400 m and is composed of 433 plots. The described system of monitoring plots was used to carry out studies in the field of forestry, botany, lichenology and acarology.

Results of monitoring forest ecosystems in the Karkonosze National Park, based on the network of circular sample plots, may be considered inadequate to the labour input in the collection of litter samples and their sorting. When sorting 870 samples, much higher frequencies of beetles (including first of all rove beetles) had been expected. The observed low frequency of rove beetles may result from:

– the autumn date of sample collection for faunal analyses,
– the size of plots from which litter was collected (in the first year of sample collection it was 0.04 m^2, while in the second it was 0.16 m^2), which is a compromise between the small and big samples collected for analyses of soil micro- and macrofauna,
– the time-consuming sample sorting, which resulted in a situation when samples were analysed within three weeks since collection; this could have caused the death of some specimens found in samples.

In the opinion of the authors, environmental causes of the low frequencies of *Staphylinidae* are less significant.

CONCLUSIONS AND CONCLUDING REMARKS

A very low number of specimens and species of *Staphylinidae* were recorded in the course of monitoring work, conducted using the network of circular sample plots. Low values of these frequencies may be explained by the specific character of the method and the period of sample collection, and only to a lesser degree by the state of the environment.

Dominant species in forest habitats in the Karkonosze National Park were *Othius subuliformis*, *Geostiba circellaris* and *Amischa analis*. The first two are forest species, preferring acidophilous coniferous forest sites. The third dominant, *Amischa analis*, is found in different types of habitats and was considered an accessory species of the groups. Its frequency in the subalpine forest habitat was much higher than in montane forests.

In the group of rove beetles in the montane forest zone a total of 16 species of *Staphylinidae* were recorded with a very high domination of *Othius subuliformis* and

Geostiba circellaris. The domination structure of the group is characteristic for simplified habitats with a destroyed mosaic structure.

In groups of rove beetles of the subalpine forest zone a total of 26 taxa were recorded with the domination of *Othius subuliformis*, *Geostiba circellaris* and *Amischa analis*. The domination structure of the group corresponds to the decomposition characteristic for ecosystems with a properly developed structure.

Acknowledgements

The authors would like to thank very much foresters: Mr. Krzysztof Bizaga, Marek Grzegorz, Michał Makowski, Julian Dybalski, Andrzej Wieczorek and Roman Błaszczyk, for the collection of litter samples from the entire area of the Karkonosze National Park. This required tremendous effort and commitment. Without the participation of the above mentioned persons the collection and analysis of the above results would not have been possible. We express our deepest gratitude to Dr. Andrzej Raj, the originator of these studies, for his kindness and creative encouragement during the chamber analyses.

We also wish to thank very much Mr. Andrzej Melke and Dr. Volker Assing for their verification of determinations of Staphylinidae species, and Professor Jerzy R. Starzyk for his valuable remarks concerning the scope of cited literature.

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CHRZĄSZCZE KUSAKOWATE (*COLEOPTERA, STAPHYLINIDAE*) JAKO ELEMENT MONITORINGU EKOSYSTEMÓW LEŚNYCH KARKONOSKIEGO PARKU NARODOWEGO CZĘŚĆ I. ASPEKT JESIENNY

Streszczenie. W latach 2002 i 2003 w okresie jesiennym z 630 kołowych powierzchni monitoringowych leżących na obszarze ekosystemów leśnych Karkonoskiego Parku Narodowego pobrano próby ściółki z powierzchni 0,04 (w 2002 roku) i 0,16 m^2 (w 2003 roku) w celu rozpoznania składu gatunkowego epigeicznych zgrupowań kusakowatych i ich charakterystyki zoocenologicznej. Chrząszcze kusakowate w liczbie 136 osobników stwierdzono w 87 próbach. Zaliczono je do 32 taksonów. Przeprowadzono analizy wyróżnionych zgrupowań *Staphylinidae* za pomocą wskaźników zoocenologicznych (stałości i dominacji występowania, bogactwa gatunkowego Margalefa, różnorodności gatunkowej Shanonna-Weavera, wierności zgrupowania, wskaźnika Bohača i wartości ekologicznej zgrupowania) dla obwodów ochronnych Karkonoskiego Parku Narodowego oraz regla dolnego i górnego. Stwierdzono, że gatunkami dominującymi są *Othius subuliformis* Steph., *Geostiba circellaris* (Grav.) i *Amischa analis* (Grav.). W zgrupowaniach *Staphylinidae* występujących w lasach regla dolnego wyróżniono 16 taksonów i stwierdzono wyraźną dominację *Othius subuliformis* i *Geostiba circellaris*. Zgrupowania *Staphylinidae* występujące w strefie regla górnego składają się z 26 taksonów i wykazują strukturę dominacyjną charakterystyczną dla niezakłóconych systemów ekologicznych z wysoką frekwencją *Othius subuliformis, Amischa analis* i *Geostiba circellaris.*

Słowa kluczowe: monitoring ekologiczny, ekosystemy leśne, Karkonoski Park Narodowy, *Coleoptera*, *Staphylinidae*

Accepted for print – Zaakceptowano do druku: 12.04.2007

For citation – Do cytowania: Mazur A., Tkocz D., Urban M., 2007. Rove beetles (Coleoptera, Staphylinidae) as an element of monitoring of forest ecosystems in the Karkonosze National Park. Part I. The autumn season aspect. Acta Sci. Pol., Silv. Colendar. Rat. Ind. Lignar. 6(2), 21-44.