

# ANTS (HYMENOPTERA, FORMICIDAE) OF THE GLADES IN THE TATRA MTS (THE CARPATHIANS)

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**Abstract.** Fourteen species of ants have been found within the area of 23 glades in the Polish part of the Tatra Mts. The number of ant species and the density of nests are greater in sheep-grazed glades than in the other, non-grazed glades. The number of species is positively correlated with increasing altitude. Hitherto two ant species: *Myrmica lobicornis* and *Formica picea* have not been recorded from the Polish Tatra Mts. The preservation of Tatra glades, artificially cleared in natural forest, by moderate grazing seems to keep a greater variety of habitats and simultaneously greater diversity of ant species.

*Key words:* ant community, open habitat, glade utilization.

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## Introduction

Data concerning the distribution of ants in the Polish part of the Tatra Mts are scarce and were often compiled either in the 19th c. (Nowicki, 1864, 1867; Wierzajski, 1868, 1874) or at least 60 years ago (Kulmatycki, 1920; Lomnicki, 1931). Only few information on the distribution of previously recorded species can be found in later works (Dluski and Pisarski, 1971; Pisarski, 1971, 1975).

The distribution of ants in the Tatra Mts is limited mainly to open habitats. In forest associations, ant nests can be found almost exclusively in the vicinity of non-forest associations or, temporarily, in windfall areas.

The Tatra glades were created artificially on land formerly occupied by lower (up to ca. 1250 m a.s.l.) and upper (up to ca. 1550 m a.s.l.) mountain forest associations. Their presence there was stabilized by regular grazing or mowing, combined with organic fertilization. However, such utilization of most of the glades was abandoned in the sixties of this century. As a result, most of the glades started to become overgrown with forest relatively soon (in ca. 30 years) (Dziewolski, 1985; Michalik, 1986), thus diminishing the area of open habitats, infrequent in the mountain forest associations and primarily limited to rocks, screes or peat-bogs.

The aim of the present study was to 1) assess the species composition and quantitative relationships of the ant in glades of the Polish part of the Tatra Mts; 2) assess the influence on those insects of environmental conditions connected with the altitude and the mode of utilization (grazing, mowing) or its lack.

## Study area and methods

The research on the ants was conducted between June and August in 1982-1984. It took place in 23 of the several dozen glades situated within mountain forest associations of the Polish part of the Tatra Mts (Western Carpathians) (Fig. 1). Single stones, rocks, small, man-made mounds of stones and fallen trees were included in the study area. On the other hand, ants collected from plant associations of rocky turf-on-sprees type glades or their vicinity were not included.

The glades were selected according to their distribution within the various plant association zones and their utilization or its lack. The latter criterion helped to divide them into three groups: grazed glades, mown glades and non-utilized glades. Pasture (mostly sheep) was re-introduced in the glades of the grazed category only several years ago. Those mown were thus treated regularly in most of

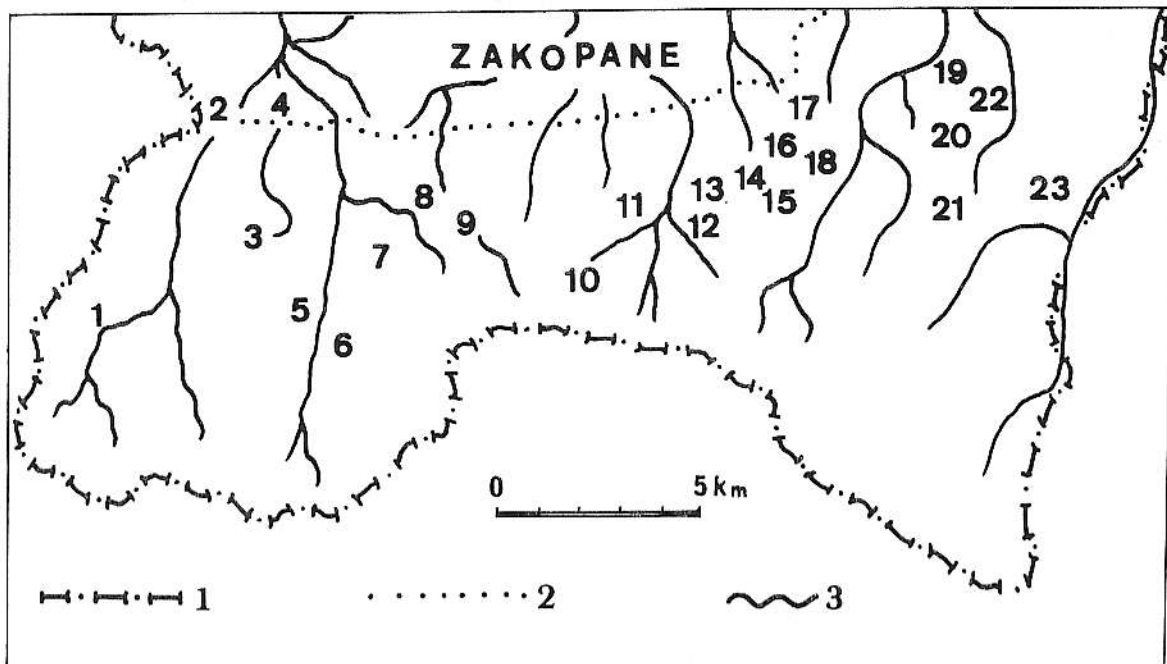


Fig. 1. The distribution of the studied glades in the Polish part of the Tatra Mts. 1 - country border, 2 - border of the Tatra National Park, 3 - streams (the number describe the glades as listed in Table 1).

their area, usually once a year. The non-utilized glades have been left non-grazed or unmown for at least a dozen or so years and were overgrown with at most single tree seedlings. Only two glades, situated outside the Tatra National Park (Fig. 1) have been mown and grazed (mostly by cattle) with no interruption for many years.

The ants were collected in 10 to 30 plots (10 m<sup>2</sup>) in each glade, according to the size of the glade. The plots were combed as precisely as possible for all ant nests. This method was used in 13 glades of a total of 3100 m<sup>2</sup>. Additionally, in all the 23 glades, it was attempted to find as many nests as possible on the whole area of each glade, with particular care in the places where the probability of discovering them was the greatest. It is latter method that yielded a qualitatively richer material. The altitudes were recorded for each nest found. Also, foraging ants were collected during the search for nests. If a species was represented in a glade by foraging individuals only, this information was treated as if one nest of the foraging species were found, without any data on its altitude. Single representatives of sexual castes were not included in the results.

## Results

A total of 14 ant species was recorded from 23 Tatra glades. Of those, *Myrmica ruginodis*, *Formica lemni*, *M. scabrinodis* and *M. rubra* were the most numerous and present in the greatest number of the glades. Nests of the remaining species were found in lesser numbers and in less than a half of the glades studied (Table 1.).

Two of the species recorded, *M. lobicornis* and *F. picea* have not been reported so far from the Tatra Mts. *M. lobicornis* was found in seven glades. Two nests of *F. picea* were found in a tall peat-bog called Molkowka.

It was established that the number of ant species present in the glades is positively correlated with the area of the glades (Sperman test;  $r_s=0.586$ ,  $df=20$ ,  $P<0.01$ ; Table 1.). The Bialy Potok glade was excluded from the evaluation of this correlation, as its area was greater than almost twice that of the other large glades, and because of its situation in the vicinity of busy roads and settlements.

The greatest number of ten species was recorded in the non-utilized Przyslop Mietusi glade, standing apart from the other glades because of its

greatest habitat differentiation. The nests of most of those species were found on the southern slopes of the glade, among scant vegetation covering dry, shallow, rocky terrain. Excluding this glade from the considerations, the average number of species

found in all grazed glades was 6.1, in mown glades 4.8 and in non-utilized glades 3.1. The difference in the number of species inhabiting the three glade groups is of statistic significance (Kruskal-Wallis test;  $T=6.392$ ,  $df=2$ ,  $P<0.05$ ).

Table 1. Percentage of ant species and number of nests (N) found in the Tatra glades (each glade with its approximated area in ha, type of utilization: g - grazed, m - mown, n - non-utilized, and the average altitude of nests found, respectively).

Glade	a	b	c	d	e	f	g	h	i	j	k	l	m	n	N		
1. Chochołowska	19 g	1139	21	38	15	2		2			15		7		47		
2. Molkowka	15 g	940	57		17			10			8		9	9	23		
3. Niznia Kominiarska	8 g	1144	3	5	52	10					5		15		40		
4. Biały Potok	40 g	920		20	60						20				5		
5. Stara	3 n	1100	100												1		
6. Smytnia	5 n	1125	17		50								33		6		
7. Uplaz	12 n	1280			50								50		4		
8. Przysłop Mietusi	11 n	1152	4	4	50	4	4	4	4	4	11		4		26		
9. Małej Laki	12 n	1183		4	64			4			8		4	16	25		
10. Kondratowa	13 m	1367		4	32	4	7	14	4				35		28		
11. Kalatowski	13 g	1179	2	2	45	30	17						4		53		
12. Kasprowa	4 n	1231	11		89										9		
13. Jaworzynka	10 n	1091	11	22	56								11		9		
14. Olczysko	8 m	1075		38	8	4	4	8					21	17	24		
15. Krolowa	4 n	1300			100										1		
16. Sucha	5 g	1130			61	8	8	8					15		13		
17. Szalasiska	2 g	1115	9	9	37			27					18		1		
18. Kopieniec	9 g	1249		3	67		3						6	18	33		
19. Wawrzeczkowa Cyrhla	9 m	915	8		25	50							8	42	24		
20. Przednia Soltysia	5 n	1314	4		8	25	13						8	42	24		
21. Waksmundzka	12 m	1358			69	8							23		13		
22. Szalasiska Kopy	2 n	1140			57		42								7		
23. Rusinowa	17 g	1235		17	44	14	3			8	3	8	3		36		
Total number of nests			10	51	189	57	4	19	4	15	1	6	16	14	62	2	450

a - *Manica rubida*; b - *Myrmica rubra*; c - *M. ruginodis*; d - *M. scabrinodis*; e - *M. rugulosa*; f - *M. lobicornis*; g - *M. sulcinodis*; h - *Leptothorax acervorum*; i - *L. muscorum*; j - *Camponotus herculeanus*; k - *Lasius niger*; l - *L. flavus*; m - *Formica lemani*; n - *F. picea*

The evaluation of ant nest density was performed for 13 glades (Table 2.); only 9 species, of which 4 were represented by single nests, were found on 3100 m<sup>2</sup>. 39 nests of the most numerous species, *M. ruginodis*, were found in 7 grazed glades over a total of 1540 m<sup>2</sup>. Only 20 nests of that species were found in the other glade categories

over a total of 1560 m<sup>2</sup>; this would point to a significant difference of their density in both types of the glades ( $\chi^2 = 5.360$ ,  $df = 1$ ,  $P < 0.05$ ). As the number of the nests of the other ant species was insignificant, they were treated jointly; thus, only 7 nests were found in the non-grazed glades, while 52 in the grazed ones. In view of the study area, this

Table 2. Density of ant nests per 100 m<sup>2</sup> and total number of nests found (N) in the Tatra glades (each glade with its type of utilization - as in Table I. - and area in which the search was conducted, in m<sup>2</sup>).

Glade	a	b	c	d	e	f	g	h	i	N
1. Chochołowska	g 300	1.7	2.0	1.7		0.3		0.3	0.3	20
3. Niznia Kominiarska	g 240	0.4	1.7	1.3						8
8. Przysłop Mietusi	n 300	1.0	2.7							11
9. Małej Laki	m 300		1.7							5
10. Kondratowa	m 300		1.3			0.3			0.7	7
11. Kalatowski	g 300	0.3	5.3	4.3	3.0					39
13. Jaworzynka	n 130		0.3							1
14. Olczysko	m 130									0
15. Krolowa	n 100									0
16. Sucha	g 100									0
18. Kopieniec	g 300	0.3	3.0						1.3	14
21. Waksmundzka	g 300		0.7						0.3	3
23. Rusinowa	g 300	0.7	1.3	1.0	0.3					10

a - *Myrmica rubra*; b - *M. ruginodis*; c - *M. scabrinodis*; d - *M. rugulosa*; e - *M. lobicornis*; f - *M. sulcinodis*; g - *Leptothorax acervorum*; h - *Lasius niger*; i - *Formica lemani*.

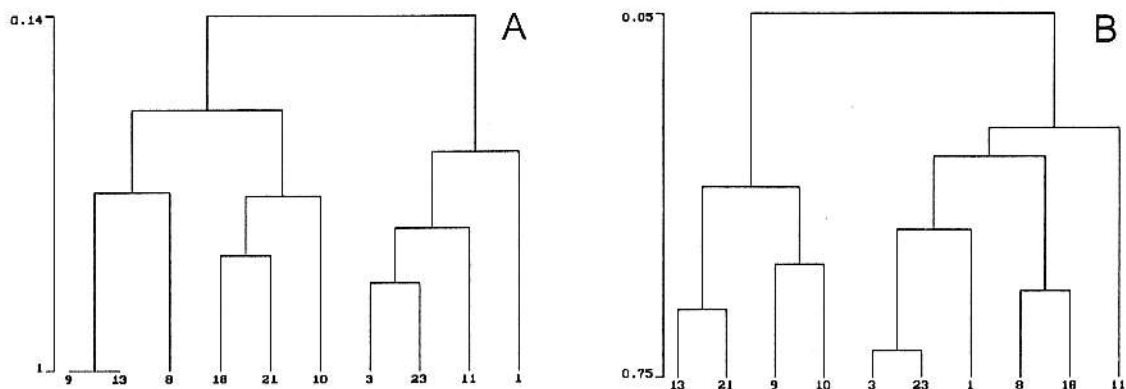


Fig. 2. Similarity of myrmecofauna of 10 Tatra glades evaluated basing on the search of plots, resulting from species presence (A) and nest density (B).

yields a highly significant difference in density ( $\chi^2 = 29.728$ ,  $df = 1$ ,  $P < 0.001$ ).

The results obtained in nest density evaluation (the glades with zero trials were excluded) were used in a dendrogram of glade similarity, calculated basing on the information of the species' presence (Fig. 2A) or on their nests' density per 100 m<sup>2</sup> (Fig. 2B). In both dendrograms, the glades grouped into two categories, the grazed and the non-grazed, with two exceptions: the Kopieniec glade (18), which entered the non-grazed group (Fig. 2A) and the non-utilized Przyslop Mietusi glade (8) among the grazed glades (Fig. 2B).

In order to establish the influence of the altitude on the distribution of the particular species, the nests were categorized according to their situation below or above the altitude of 1250 m a.s.l. (Table 3.). Only the Molkowka glade was excluded from these considerations, its being a natural peat-bog and not an artificially created glade. Of the 13 spe-

cies, all were found below 1250 m a.s.l., while only 9 above that altitude.

### Discussion

Two of the 14 ant species recorded in the glades (Table 1.) were not mentioned in the list of the 16 species reported by Lomnicki (1931) from the Polish part of the Tatra Mts. The first of these is *F. picea* from the Molkowka peat-bog, now utilized as grazing ground, though it is a natural non-forest association, with a preserved, typically peat-bog floras. *F. picea* is rare in Poland, only found in peat-bogs (Dluski and Pisarski, 1971). This species has been so far unrecorded from the Polish part of the Carpathians. The nests of the second species, *M. lobicornis*, were found in almost one in three of the glades. It is thus a species frequent in the glades; it can be surmised that the reports on the presence of the morphologically related *M. schencki*, reported

Table 3. Percentage of ant nests found in the Tatra glades below and above 1250 m a.s.l., with (parenthesized) the number of studied nests of each species (the lowest altitude of a nest was 915, the highest - 1450 m a.s.l.).

Species		Up to 1250	Above 1250
1. <i>Manica rubida</i>	(9)	78	22
2. <i>Myrmica rubra</i>	(37)	97	3
3. <i>M. ruginodis</i>	(189)	85	15
4. <i>M. scabrinodis</i>	(53)	79	21
5. <i>M. rugulosa</i>	(4)	25	75
6. <i>M. lobicornis</i>	(14)	83	17
7. <i>M. sulcinodis</i>	(1)	100	
8. <i>Leptothorax acervorum</i>	(14)	100	
9. <i>Lep. muscorum</i>	(1)	100	
10. <i>Camponotus herculeanus</i>	(6)	100	
11. <i>Lasius niger</i>	(15)	93	7
12. <i>L. flavus</i>	(14)	86	14
13. <i>Formica lemni</i>	(59)	54	46

by Lomnicki (1931) from the Tatra Mts, the region of Zakopane and Toporowa Cyrhla, concern in fact *M. lobicornis*.

The severe climatic conditions of the Tatra Mts are the reason for the poverty of the ant fauna there, in comparison with the other parts of the Carpathians, e.g. with the much smaller Pieniny Mts (46 species; Koehler, 1951; Czechowska, 1976), Male Pieniny Mts (38 species; Woyciechowski, 1985, and unpublished) or Bieszczady Mts (30 species; Parapura and Pisarski, 1971). Four species are the most frequent ones in Tatra glades, whether these are utilized or not: *M. ruginodis*, *F. lemami*, *M. scabrinodis* and *M. rubra*. Both the dominant species and the complete list (Table 1.) are similar to those of the glades in the Bieszczady Mts, which, similarly to the Tatra glades, were created in primarily for the scant forest terrain. The Tatra glades are characteristic for the scant presence of the nests of *L. niger* and *L. flavus*, dominant in glades and pastures of the other regions of the Carpathians (Parapura and Pisarski, 1971; Petal, 1974; Czechowska, 1976; Woyciechowski and Miszta, 1976; Woyciechowski, 1985).

The parts of the glades overgrown with rich grassy vegetation are usually completely deprived of ant nests. This can be observed in most non-utilized and mown glades. Also empty of ants are the fragments of glades covered with compact *Alchemilla* sp. or *Rumex alpinus*, as sheep rarely graze on those species. Such associations can be observed not only in non-utilized glades such as Przyslop Mietusi or mown ones such as Mala Laka, but also in grazed ones such as Niznia Kominiarska. The diversity of habitats of particular importance for the ants was mostly impoverished in the glades mown now or in the past. Large fragments of those glades have been deprived of single rocks or stones and nests of many ant species can be found on mounds made of those stones or on small embankments. In some glades, e. g. Chocholowska, such places yield much higher nest densities, and are the almost sole habitats occupied by the ants in some other ones, e. g. Mala Laka or Olczyńska.

Parts of many glades, especially steep, insulated slopes of shallow, rocky terrain, are convenient habitats for ant nests whether they are presently utilized or not. This is the case in glades such as Przyslop Mietusi, Kopieiniec or Szalasiska Kopy.

The above-mentioned reasons make more difficult a straightforward evaluation of the type of glade utilization on the ants. It can be stated, however, that the number and density of their nests is higher in grazed glades than in mown or non-utilized ones (Table 2, Fig. 2). In spite of that it has not

been determined that there exist species avoiding or preferring glades of any type of utilization. It seems then that the mode of glade utilization or its lack could determine a particular ant species composition (Table 1.). This is due to the fact that grazing increases the area of habitats adequate for the ant nests. The size of the glades and its altitude further complicate the evaluation of the influence of grazing or mowing. The result to the effect that the area of a glade is of some significance for the diversity of the species which inhabit it is not surprising; the probability of finding different type habitats in a given glade increases with its area. Also increase the odds for survival of such local, small populations, endangered with elimination in the extreme environmental conditions. These conditions become worse with the altitude, so that less species are found in higher glades, or even higher parts of glades (Table 3.). Particularly invulnerable to altitude-connected factors is *F. lemami*, a species significantly increasing its domination in higher glades (Tables 1. and 3.).

The preservation of the Tatra glades is of aesthetic, cultural and economic value, and does not strives to preserve the natural biocenoses. The biological factors are significant because of the fact that the glades increase the area of the non-forest habitats, the natural associations of which occupy only a small part of the mountain forest zone. The preservation of the glades would thus increase the diversity of the local ants.

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