ROZDIELY V TOLERANCII DOMINANTNÝCH DRUHOV BYSTRUŠKOVITÝCH (COLEOPTERA, CARABIDAE) V ZÁPADOKARPATSKÝCH SMREKOVÝCH PORASTOCH K DÔSLEDKOM POLOMOV A NÁSLEDNÝM ZÁSAHOM DO POŠKODENÝCH PORASTOV

DIFFERENCES IN TOLERANCE OF THE DOMINANT CARABID SPECIES (COLEOPTERA, CARABIDAE) IN WEST CARPATHIAN NORWAY SPRUCE FORESTS TO WINDSTORMS AND SUBSEQUENT MANAGEMENT OF DAMAGED STANDS

Zbyšek Šustek

Institute of Zoology, Slovak Academy of Sciences,
Dúbravská cesta 9, 845 09 Bratislava, Slovakia, e-mail: zbysek.sustek@savba)

ABSTRACT

The nine-year research carried out in 2007-2016 showed that the Carabid assemblages reacted on the extensive damaging of Norway spruce forest on southern slopes of High Tatra by the windstorm on the 19th November 2004 in three ways: (1) in the sites, where the timber was left *in situ*, the species composition remained almost intact and only abundance and frequency of species was reduced; (2) in the sites, from which the timber was extracted, only more tolerant forests species survived, but they were even able to increase their abundance in comparison with the intact site or site with timber left *in situ*; (3) in the sites, which were additionally damaged by fire by turn of July and August 2005, also invasions of open landscape species were recorded. However, within next five years the Carabid assemblages in the burned sites fully converged to those in other sites with extracted timber.

Independently on the damaging degree and succession stage all assemblages were subjected to strong periodic fluctuations of number of species and individuals that followed with about 1-2-year delay after occurrence of longer dry of humid seasons. In addition the more termophilous forest species (*Carabus hortensis, C. nemoralit* and *C. coriaceus*) started to occupy some places with extracted timber.

Within these processes the species *Carabus linei, Carabus auronitens, Cychrus caraboides, Pretostichus burmeisteri, Pterostichus unctulatus* and *Trechus striatulus* appeared as most sensitive or even intolerant to the deforestation and subsequent silvicultural management. In contrast, *Carabus violaceus, C. glabratus. Pterostichus aethops* and *Molops piceus* were tolerant. A considerable tolerance was also observed in the Carpathian endemics *Pterostichus foveolatus*.

Key words: ecology, West Carpathians, High Tatra, Carabidae, ecological tolerance, windstorms**,** ecosystem restoration, nature conservation, forestry.

INTRODUCTION

The windfall in High Tatra in November 2004, the subsequent two-year lasting timber exploitation, incidence of fire on a considerable part of the damaged area in July/August 2005, attempts at planting larches, maples or Norway spruces in some places and protecting them by cutting the expansively spreading stands of *Chamerion angustifolium* and *Calamagrostis* spp. formed conditions for an extensive and long-termed ecological investigation of the process of spontaneous and artificially managed restoration of the damaged forest ecosystems (FLEISCHER, 2008, FLEISCHER & HOMOLOVÁ 2011, RENČO et al. 2015, URBANOVIČOVÁ et al. 2013). In this frame, attention was also paid to succession of Carabid assemblages since spring 2007. This study, however, focused rather on global and more instructive aspects (species diversity, secondary productivity, representation of different ecological groups) generally characterizing the succession in the damaged stands (ŠUSTEK

2015, 2017, ŠUSTEK & VIDO, 2013, ŠUSTEK et al. 2017) and its relations with the climatic fluctuations. Less attention was paid to individual Carabid species and to their tolerance to the major factors influencing the succession in damaged area, their mutual relations a survival in this area.

The aim of this contribution is to show more in details how individual species reacted on the observed changes and how they participate in restoration of the damaged ecosystems.

MATERIAL AND METHODS

The investigations were carried out since spring 2007, when the area had been opened to investigatin, six study plots representing an intact Norway spruce stand and a habitat with fallen timber in situ, two habitats with extracted timber and two habitats with extracted timber additionally damaged by a large scale fire. The plots were selected by the staff of the Investigation Station of the High Tatra National Park (FLEISCHER, 2008) to coordinate the international investigations started after the windstorm. The sites (Table 1) are characterized to the Zlatník´s phytocoenological system of forests ecosystems (RAUŠER & ZLATNÍK, 1966; ZLATNÍK, 1975).

Locality	Vyšné Hágy reference plot	Tatranská Lomnica, Jamy,	Tatranská Polianka, Danielov dom	Nový Smokovec, Vodný les	Tatranské Zruby lower plot	Tatranské Zruby upper plot
Locality abbreviations	R	N	E 1	E 2	F 1	F 2
Geographical coordinates	49°07′17.5″N 20°06′15.0″E	49°09'33.7"N 20°15'07.9" E	49°07′15.3″N 20°09′46.0″E	49°08'07.6"N 20°12'24.8" E	49°07′49.3″N 20°11′49.1″E	49°08′02.7″N 20°11′30.1″E
Altitude [m] Vegetation tier	1233 Spruce	1062 Spruce	1060 Spruce	1022 Spruce	1015 Spruce	1095 Spruce
Trophical series	Acidophilou mesophilous	Acidophilou mesophilous	Acidophilou mesophilous	Acidophilou mesophilous	Acidophilou mesophilous	Acidophilou mesophilous
Geobiocoen types group	*Sorbi Piceeta*	*Sorbi Piceeta*	*Sorbi Piceeta*	*Sorbi Piceeta*	*Sorbi Piceeta*	*Sorbi Piceetum*
Degree of damaging	Intact mature spruce forest	timber *in situ*	timber extracted, unburned	timber extracted, unburned	timer extracted, burned	timber extracted, burned

Table 1. Survey of study plots in the area damged by the windstorm in High Tatra on 19 November 2004

The beetles were pitfall trapped. Six formalin traps (0.75 l plastic jars with 90 mm opening) were exposed in a line in 10 m distances in each plot from end of May until early November 2007–2014 and emptied approximately in one month intervals. The beetles from each set of traps were summed to obtain one-season samples (see the table 2 and 3 in supplements) that were used at further analyses.

Scientific names of species are adopted according to HŮRKA (1996). The ecologic characteristics of the species were taken mainly from (BURMEISTER, 1939, DESENDER 1986A - 1986D, LINDROTH 1949 and ŠUSTEK 2004).

The tolerance of species to windfall and next management measures was expressed in three simple ways: (1) in all species as trends in abundance of each species in the gradient ranging from the intact reference site to the most damaged burned plots, (2) in forests species as frequency of occurrence in one-season samples in each site (= percentage of one season samples positive for the respective species) and (3) as percentages of the total of individuals of 12 stenotopic or at least preferably forests species caught in the damaged plots in relation to the number of individuals caught in the reference site. Thus the frequency of the tolerant species surviving successfully in all damaged plots is 100% and lower than 100% in the less tolerant species. Correspondingly, number of individuals of each species in the references site amounts 100% and in the damaged plots it is higher in the tolerant species and lower in the intolerant species. According these two parameters the species were arranged in diagrams from the most tolerant to the less tolerant.

RESULTS AND DISCUSSION

In the whole investigation period altogether 50 species (5,329 individuals) were recorded in all study plots (Tab. 2 and 3 in supplements). They include two sharply differing ecological groups – the stenotopic forest species unable to fly and requiring permanent shadowing by closed tree canopy and heliophilous, mostly well flying species preferring non-forests, natural and artificial ecosystems and several species showing obvious preference for forests, but known to tolerate substitution of the closed forest vegetation with high grassy stands, like *Carabus violaceus* and *Carabus glabratus* (MAGURA, 2002).

Since the beginning of investigation in spring 2007 six simultaneous processes were observed (ŠUSTEK 2015, ŠUSTEK et al. 2017): (1) initial sharp differentiation of the Carabid assemblages according to damaging degree, (2) invasions of the species characteristic for open landscape and arable land, (3) strong fluctuations of all species in all sites related to occurrence of dry or humid periods, (4) later a slow convergence of assemblages on the burnt plots to assemblages on the plots with extracted timber, (5) very slow succession to restoration of the original assemblages, (6) in some sites spreading of more thermophilous forests species with optimum of vertical distribution at lower vegetations tiers. Some of the processes are illustrated in Fig. 1.

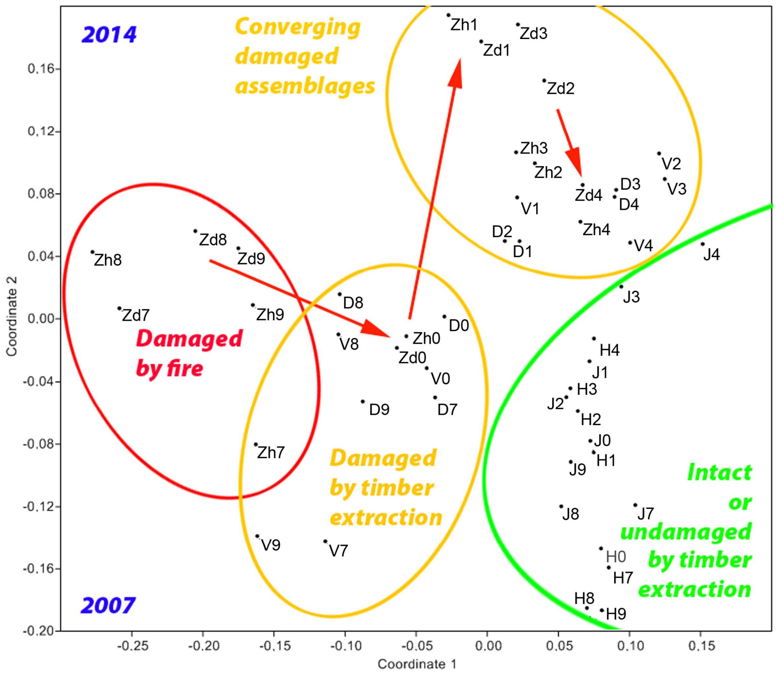

Fig. 1. NMS ordination (Horn´s index) of one-years samples of Carabids in six sites in the windstorm area in High Tatra in 2007-2014 (abbreviations H – reference plot in Vyšné Hágy , J – plot with fallen timber *in situ* in Jamy, D – unburned plot with extracted timber near Danielov dom, V – unburned plot with extracted timber Vodný les, Zd and Zh – two burned plot with extracted timber in Tatranské Zruby. The arrows show succession direction of assemblages in the burned plots. Abscissa shows damage degree, the ordinate shows direction of succession from 2007 to 2014. The years are indicated by the last digit (7 = 2007. 4 = 2017), the intact site and site with timber *in situ* are marked by green, the site with extracted timber by yellow and the burned sites by red.

In the first five years, when the *Chamerion angustifolium* dominated in all plots with extracted timber, in particular in the burned ones, among the invading open landscape species *Poecilus cupraeus* and later *Poecilus versicolor* highly predominated (Fig 2). They continue to occur in these sites also later, but in much lower numbers. A similar role was played by four *Amara* species, but they were much less abundant. The obvious decline of these species in 2000–2001 indicates that they were not able to invade the reference site and the site with laying timber, where they absented at all. In addition they showed a low tolerance for the spreading of pioneer wooden plants, especially willows and aspens that reached, at that time, a height of about 3 m.

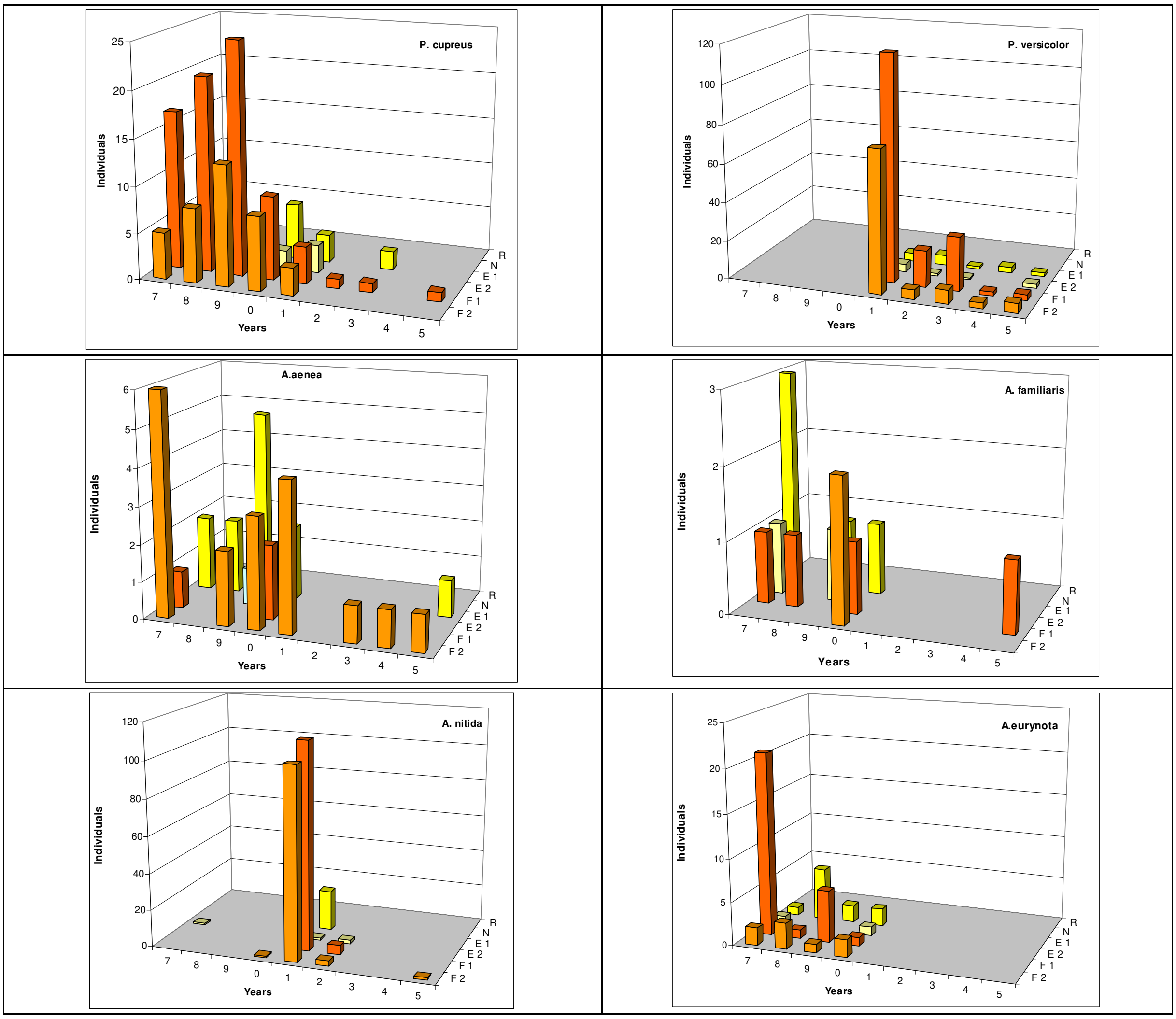

Fig. 2. Time and spatial distribution of six open landscape Carabid species (*Poecilus cupreus, P. versicolor, Amara aenea, A, familiaris, A. nitida* and *A. eurynota*) in six study plots in High Tatra in 2007 – 2014 (site abbreviations as in Tab. 1, colors as in Fig. 1).

The second group of species includes *Carabus violaceus* and *C. glabratus* (Fig. 3). Their abundance had increased in all study plots about five years after the windstorm. This increase in damages site coincides with decline of the invading open landscape species (Fig. 2). Comparison of abundance of *C. violaceus* and *C. glabratus* in the intact site and site with timber *in situ* indicates that they were even favored by the conditions offered by damaged plots with sparse pioneer wooden vegetation and, possibly, also by elimination of competition of the congeners. Obviously, the decline of *C. violaceus* in 2012–2014 is compensated by increase of abundance of *C. glabratus*. It can be interpreted in two ways: as manifestation of competition between these two species and/or as indication of a slightly higher tolerance to deforestation in *C. violaceus*, which was able to occupy the deforested area already before the beginning of development of pioneer wooden vegetation supplying shadowing. It corresponds with its large amplitude of vertical distribution and also with much larger area of geographical distribution. Later it was partly substituted by *C. glabratus*. A similar tendency can be also observed in somatically smaller *Pterostischus aethiops* and in *Molops piceus*).

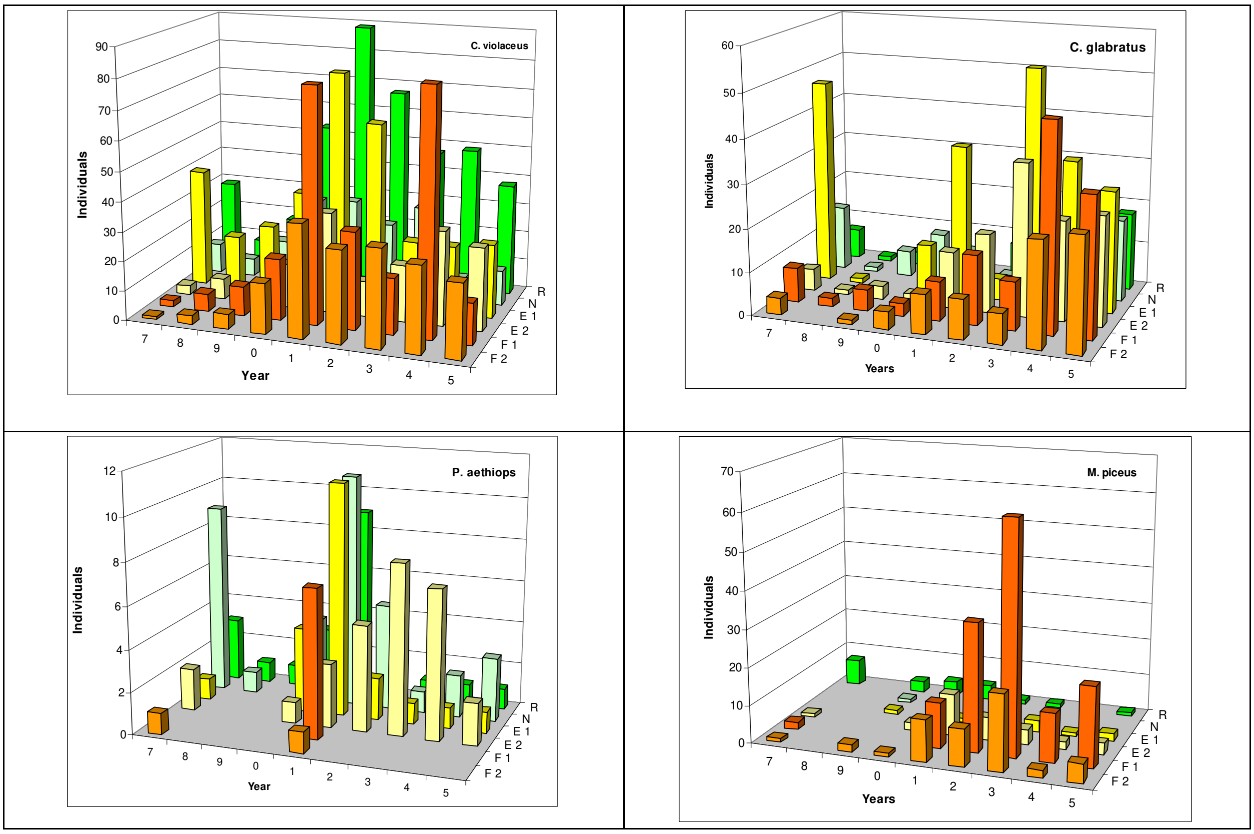

Fig. 3 Time and spatial distribution of two preferably forests, obviously tolerant Carabid species (*Carabus violaceus, C. glabratusa, Pterostichus aethiops* and *Molops piceus*), P in six study plots in High Tatra in 2007 – 2014 (site abbreviations as in Tab. 1, colors as in Fig. 1).

The third group of species includes eight species (*Cychrus caraboides, Carabus auronitens, C. linnei, Pterostichus burmeisteri, P. unctulatus. P. foveolatus, Calathus micropterus, Trichotichnus laevicollis*) that obviously did not tolerated the deforestation and penetrate the damaged sites only sporadically (Fig. 4). In this group almost all species survived in the damaged plots still in the third year after the windstorm (and the first year of investigation) in a very low number of individuals. Only *Calathus micropterus* was not recorded in any of the damaged site in 2007. In 2008, when a strong drop in abundance occurred in all sites due to the drought in summer 2007 (ŠUSTEK & VIDO 2013, ŠUSTEK 2015, ŠUSTEK et al. 2017), these species, except for *Pterostichus burmeisteri*, were not recorded in any damaged site, but some of them (Fig. 4) reappeared in some damaged plots in 2009 and 2010. It was obviously connected with the more humid period in these years and subsequent restoration of the earlier population sizes (ŠUSTEK, 2015). But later they occurred in the deforested plot sporadically. Their occurrence was observed especially in the sites situated closer to remnants of undamaged stands. In this situation somatically larger and more moveable species were more able to penetrate the damaged sites (site F 2). Besides the obvious intolerance to deforestation, these species were handicapped by their inability to fly.

According to changes of occurrence frequency and comparison of relative abundance of species with the intact reference site (Fig. 5) the forest Carabids can be arranged in decreasing order of their tolerance to deforestation. The less tolerant species seem to bee *Calathus* *micropterus, Carabus linnei* and *Carabus auronitens*. Their regular occurrence in the stand damaged would indicate the approximation of the succession to the state before the windfall.

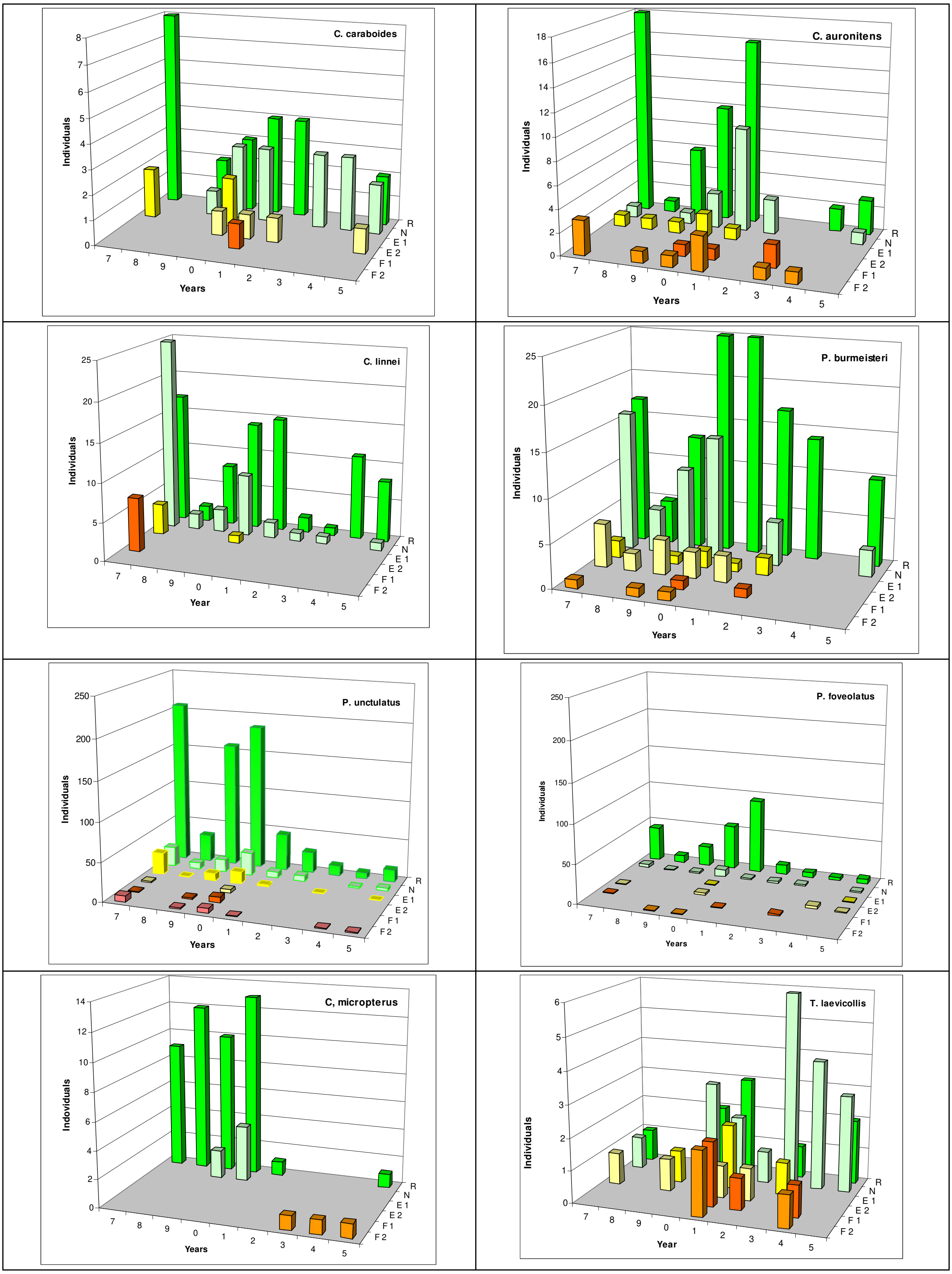

Fig. 4 Time and spatial distribution of eight stenotopic forests Carabid species (*Cychrus caraboides, Carabus auronitens, C. linnei, Pterostichus burmeisteri, P. unctulatus. P. foveolatus, Calathus micropterus, Trichotichnus laevicollis*) in six study plots in High Tatra in 2007 – 2014 (site abbreviations as in Tab. 1, colors as in Fig. 1).

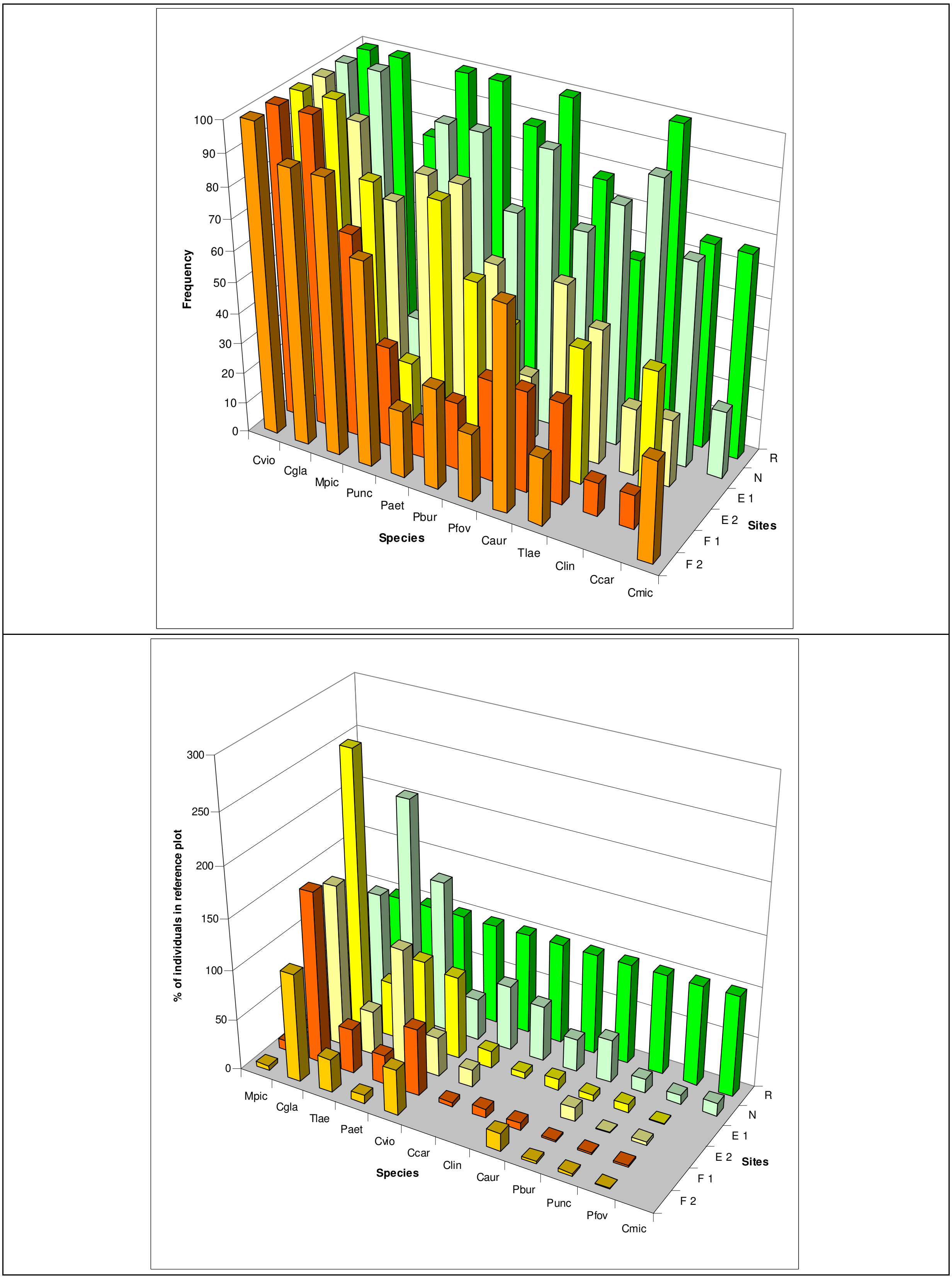

Fig. 5. Changes in occurrence frequency and relative number of individuals of 12 forest Carabid species (*Caur – Carabus auronitens, Cgla – C. glabratus, Clin – C. linnei, Cvio – C. violaceus, Ccar – Cychrus caraboides, Cmic – Calathus mivropterus, , Mpic – Molops piceus, Paet - Pterostichus aethiops, Pbur – burmeisteri, Pfov – P. foveolatus, Punc – P. unctulatus, Tlae – Trichotichnus laevicollis*) according to their tolerance to deforestation in six sites damaged by windstorm in 2004 (site abbreviations as in Tab. 1).

CONCLUSIONS

According to tolerance to deforestation, the Carabid species occurring area damaged by the windfall can be classified into three groups:

1. tolerant and even favored in earlier stages: *Carabus violaceus*
2. Tolerant or favored in later succession stages: *Molops piceus, Carabus glabratus, Pterostichus aethiops, Trichotichnus laevicollis.*
3. Intolerant: *Calathus micropterus, Carabus linnei, Carabus auronitens, Pterostichus burmeisteri, P. unctulatus, Cychrus caraboides.*

The open landscape species stooped their more intensive invasions into the deforested site about five years after the windstorm, when pioneer woody plant vegetation started to shadow at least partly the ground surface. In this stage the more tolerant forests species started to predominate in the damaged forests.

Small wingless species seem to be less tolerant because of limited mobility and ability to overcome small obstacles on soil surface. Position of deforested sites only moderately influences spreading of less tolerant species and recolonization of the damaged stands. Occurrence of less tolerant species in the damaged plots is correlated with climate-provoked fluctuation of populations.

The Carabid assemblages confirm that the laying of the fallen timber *in situ* was beneficent from the view of nature conservation.

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SUPPLEMENTS

Species	Vegetation cover	Humidity
1. Stenotopic forests species		
Pterostichus nigrita (Fabricius, 1792)	4	8
Pterostichus strenuus (Panzer, 1797)	4	7
Pterostichus niger (Schaller, 1783)	4	6
Carabus coriaceus Linnaeus 1758	4	5
Carabus glabratus Paykull, 1790	4	5
Carabus linnei Dejean, 1826	4	5
Carabus violaceus Linnaeus, 1758	4	5
Cychrus caraboides (Linnaeus, 1758)	4	5
Leistus piceus Frölich, 1799	4	5
Leistus terminatus (Hellwig in Panzer, 1793)	4	5
Pterostichus angustatus (Duftschmidt, 1812)	4	5
Pterostichus burmeisteri (Heer, 1801)	4	5
Pterostichus aethiops (Panzer, 1797)	4	5
Pterostichus foveolatus Duftschmidt, 1812	4	5
Pterostichus oblongopunctatus (Fabricius, 1787)	4	5
Pterostichus unctulatus Duftschmidt, 1812	4	5
Trechus latus Puzeys, 1847	4	5
Trechus striatulus Putzeys, 1847	4	5
Trichotichnus laevicollis Duftschmidt, 1812	4	5
Carabus auronitens Fabricius, 1792	4	4
Carabus hortensis Linnaeus, 1758	4	4
Carabus nemoralis O. F. Müller, 1764	4	4
Loricera caerulescens (Linnaeus, 1758)	4	4
Molops piceus (Panzer, 1793)	4	4
2a. Eurytopic species preferring open landscape		
Calathus metalicus Dejean, 1828	3	5
Calathus micropterus Duftschmidt, 1812	3	3
Carabus arvensis Herbst, 1784	2	5
Agonum micans (Nicolai, 1822)	2	7
Anisodactylus binotatus (Fabricius, 1792)	2	6
Agonum sexpunctatum (Linnaeus, 1758)	2	5
Europhilus gracilipes Duftschmidt, 1812	2	5
Notiophilus biguttatus (Fabricius, 1779)	2	4
Notiophilus palustris (Duftschmidt, 1812)	2	4
2b. Strictly open landscape species		
Trechus amplicollis Fairmair, 1859	2	5
Harpalus quadripunctatus (Dejean, 1829)	2	4
Poecilus cupreus (Linnaeus, 1758)	2	4
Poecilus versicolor (Sturm, 1824)	2	4
Harpalus distinguendus Duftschmidt, 1812	1	4
Harpalus latus (Linnaeus, 1758)	1	4
Pseudoophonus rufipes (De Geer, 1774)	1	4
Harpalus affinis (Schrank, 1784)	1	3
Amara aenea (De Geer, 1774)	1	3
Amara erratica (Duftschmidt, 1812)	1	3
Amara eurynota (Panzer, 1797)	1	3
Amara familiaris (Duftschmidt, 1812)	1	3
Amara lunicollis Schiodte, 1837	1	3
Amara nitida Sturm, 1825	1	3
*Amara ovata (*Fabricius, 1792)	1	3
Bembidion lampros (Herbst, 1784)	1	3
Microlestes maurus (Sturm, 1827)	1	2

Tab. 2. Scientific names of species and characteristics of their demands to vegetation cover (scale 1 – 4 discontinuous herbage stratum, without wooden plants to complete shadowing by trees) and humidity (scale 1 – 8 = strongly xerophilous to strongly hygrophilous). The species are aggregated in major ecologic groups

Species	Vyšné Hágy - REF								Jamy - NEXT							
	7	8	9	0	1	2	3	4	7	8	9	0	1	2	3	4
A. micans																
A. sexpunctatum																
A. aenea																
A. erratica					1								1			
A. eurynota																
A. familiaris																
A. lunicollis																
A. nitida																
A. ovata																
A. binotatus																
B. lampros																
C. metalicus													1			
C. micropterus	9	12	10	13	1						2	4				
C. arvensis				1												
C. auronitens	18	1	6	10	16			2	1		1	3	9	3		
C. coriaceus																
C. glabratus	7	1	3	3	9	8	8	21	15	1	6	11	8	3	6	24
C. hortensis																
C. linnei	17	2	8	14	15	2	1	11	25	2	3	8	2	1	1	
C. nemoralis																
C. violaceus	29	9	18	53	89	67	47	49	10	6	14	30	31	24	31	8
C. caraboides	8		2	3	4	4					1	3	3		3	3
E. gracilipes																
H. affinis																
H. distinguendus																
H. latus																
H. quadripunctatus												3	1		3	4
L. piceus							1									
L. terminatus																
L. caerulescens																
M. maurus																
M. piceus	7		3	4	4	1	1				1	1				
N. biguttatus	4	2	2	1	1	1						1				
N. palustris					1											
P. cupreus																
P. versicolor																
P. rufipes																
P. aethiops	3	1	1	3	9	4	1	1	9	1		4	11	5	1	2
P. angustatus																
P. burmeisteri	17	5	13	25	25	17	14		16	5	10	14		5		
P. foveolatus	44	9	25	57	94	12	6	4	4	1	2	9	2	2	2	
P. niger																
P. nigrita																
P. oblongopuncatus			1	1	1										1	
P. strenuus																
P. unctulatus	208	35	159	186	47	27	13	8	25	8	16	29	8	7		1
T. amplicollis																
T. latus																
T. striatulus					8							2	1			
T. laevicollis	1			2	3		1		1			3	2	1	6	4
Number of individ.	372	77	251	376	328	143	93	96	106	24	56	125	80	51	54	46
Number of species	13	10	13	15	17	10	10	7	9	7	10	15	13	9	9	7

Tab. 3 – part 1. Survey of species and number of individuals caught in six study plots High Tatra in 2007-2014: reference plot and plot with timber in situ (years marked just by the last digit).

Species	Danielov dom EXTd								Vodný les EXTv							
	7	8	9	0	1	2	3	4	7	8	9	0	1	2	3	4
A. micans																
A. sexpunctatum												1	1			
A. aenea	2	2	5	2							1					
A. erratica	102	12	26	18	7	5			14	9	12	8	2			
A. eurynota	1	6	2	2					1			1				
A. familiaris	3		1	1					1		1					
A. lunicollis						1										
A. nitida				23	22				1				1	2		
A. ovata																
A. binotatus											1	1				
B. lampros										1	1					
C. metalicus																
C. micropterus																
C. arvensis																
C. auronitens	1	1	1	2	1											
C. coriaceus											1	2	4	5	6	2
C. glabratus	47	1		11	35	5	54	34	5	1	3	2	13	18	35	23
C. hortensis												1	3	3		2
C. linnei	4			1												
C. nemoralis													5	5	3	2
C. violaceus	40	18	23	36	78	62	23	23	3	7	4	15	34	12	19	32
C. caraboides	2			2								1	1	1		
E. gracilipes																
H. affinis									1		2					
H. distinguendus								1								
H. latus													1		2	
H. quadripunctatus					3		1					1				1
L. piceus																
L. terminatus													1			
L. caerulescens				1	1				5	1	2	1				
M. maurus												1				
M. piceus			1		1	1	3	1	1			2	11	6	4	2
N. biguttatus						1			5		2					
N. palustris				1												
P. cupreus	1	3	2	6	3		2			1		2	3			
P. versicolor				7	4	5	1	3					4	1	1	
P. rufipes	1	2	1	1							1					
P. aethiops	1			4	11	2	1	1	2			1	3	5	8	7
P. angustatus					3								2			
P. burmeisteri	2		1	2	1	2			5	2	4	3	3			
P. foveolatus				1					1			2				4
P. niger									1		2	1				
P. nigrita									2		3	1				
P. oblongopunctatus	1						1					1	2			
P. strenuus									1		1					
P. unctulatus	28	1	9	15	3		1		2			4				
T. amplicollis									4		2					
T. latus									1							
T. striatulus															1	3
T. laevicollis			1	1	2		1		1		1		1	1		
Number of indiv.	236	46	73	137	175	84	88	63	57	22	44	52	95	58	79	78
Number of species	15	9	12	20	15	9	10	6	20	7	18	21	19	11	9	10

Tab. 3 – part 2. Survey of species and number of individuals caught in six study plots High Tatra in 2007-2014: unburned plots with extracted timber (years marked just by the last digit).

Species	Tatranské Zruby lower FIRl								Tatranské Zruby upper FIRh							
	7	8	9	0	1	2	3	4	7	8	9	0	1	2	3	4
A. micans						1										
A. sexpunctatum	1								1					1		
A. aenea	1			2					6		2	3	4		1	1
A. erratica	6	4	3	5	1		4	1	8	2	2	4	1	1	2	
A. eurynota	21	1	6	1					2	3	1	2				
A. familiaris	1	1		1								2				
A. lunicollis						1										
A. nitida					112	5						1	103	3		
A. ovata													2			
A. binotatus	2								1							
B. lampros	26	1	4			1			4	9	3					
C. metalicus																
C. micropterus															1	1
C. arvensis																
C. auronitens				1	1		2		3		1	1	3		1	1
C. coriaceus														1		
C. glabratus	8	2	5	3	9	16	11	47	4		1	4	9	9	7	24
C. hortensis	1															
C. linnei	7															
C. nemoralis																
C. violaceus	2	6	10	21	79	33	19	82	1	3	5	17	38	31	33	29
C.caraboides					1											
E. gracilipes							2								1	3
H. affinis																
H. distinguendus																
H. latus							1									
H. quadripunctus	2				2	1	1	2					1			1
L. piceus																
L. terminatus																
L. caerulescens	1			1									1			
M. maurus	1	2	4							2	2					
M. piceus	2				12	34	61	13	1		2	1	11	10	20	2
N. biguttatus	4	3	6	2					1			1				
N. palustris					1									1		
P. cupreus	17	21	25	9	4	1	1		5	8	13	8	3			
P. versicolor					117	19	28	2					74	5	7	3
P. rufipes				1					2	1	2	1				
P. aethiops					7				1				1			
P. angustatus																
P. burmeisteri				1		1			1		1	1				
P. foveolatus	1				1		2				1	1				
P. niger					3	16		8								
P. nigrita																
P. oblongopunctus	3								1							
P. strenuus																
P. unctulatus	1		2	7					8		2	6	1			1
T. amplicollis																
T. latus																
T. striatulus																
T. laevicollis					2	1		1					2			1
Number of individ.	108	41	65	55	352	130	132	156	50	28	38	53	254	62	73	67
Number of species	20	9	9	13	15	13	11	8	17	7	14	15	15	9	9	11

Tab. 3 – part 3. Survey of species and number of individuals caught in six study plots High Tatra in 2007-2014: burned plots with extracted timber (years marked just by the last digit).