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Quantitative and qualitative damage caused by mammals and birds to the planting and natural seeding

M. SANIGA

Institute of Forest Ecology, Slovak Academy of Sciences, Research Station Staré Hory, Slovak Republic

ABSTRACT: In the years 1999–2000, I studied damage to transplants in the planting and wildlings in the natural seeding at the locality Zamrlô in the Starohorské vrchy Mts. (750–1,000 m a.s.l., NE exposure, forest type *Abieto-Fagetum*). Damage to the woody plants by the mammals and birds in the planting was much higher (14%) than in the natural seeding (7%). All woody plant species were also more damaged in the planting (spruce 16%, larch 9%, fir 24%, beech 10%, and sycamore 10%) than in the natural seeding (spruce 7%, larch 6%, fir 10%, beech 7%, and sycamore 9%). There were found 8 mammals that damaged woody plants both in the planting and natural seeding (*Apodemus* sp., *Capreolus capreolus* L., *Cervus elaphus* L., *Clethrionomys glareolus* SCHREB., *Lepus europaeus* L., *Microtus agrestis* L., *Microtus arvalis* PALL., *Sciurus vulgaris* L.). Only one bird species was found to damage woody plants in the planting and natural seeding (*Tetrao urogallus* L.).

Keywords: woody plants; damage; mammals; birds

Mammals and birds, being an important component of forest ecosystems, have also an important role in the food chains in these ecosystems. Both the animal groups belong to the most mobile ecosystem components and are considerably abundant in the forests (TURČEK 1953).

From the viewpoint of feed relations in forest ecosystems, the function of vertebrate animals is both phytophagous and zoophagous. TURČEK (1953) puts a dividing line between the destructive and creative (constructive) activities of mammals and birds in forest ecosystems. In our country we have only a low number of data connected with this topic (TURČEK 1953, 1961, 1967).

Phytophagous vertebrate animals represent a fairly heterogeneous group of pests on forest tree species. This heterogeneity is evident from peculiarities of their life activities as well as from the ways and intensities of attacking the individual tree species. All these animals are characterised by high mobility and variable radius of activities. Considering the ecological stability of forest ecosystems, each species is characterised by the ecological and ethological peculiarities of its life style and of the demands for the nutrition type and amount – the factors determining the detrimental impact of each individual species (STOLINA 1982).

In our country, the role of mammals and birds in forest ecosystems has not been studied with sufficient attention yet (TURČEK 1953, 1961, 1967; NOVÁKOVÁ, STOLINA 1961; STOLINA 1982).

In this contribution I give the results of research on damage caused by mammals and birds to both seedlings and wildlings at a locality situated in the Starohorské vrchy Mts.

MATERIAL AND METHODS

I observed the damage to transplants and wildlings at the locality Zamrlô in the Starohorské vrchy Mts. The young plantation was established in 1996 by forestation of a narrow clear-cut strip situated at 750–950 m a.s.l. (exposed to NE) with the following species: Norway spruce (*Picea excelsa* LAM.) (30%), beech (*Fagus sylvatica* L.) (30%), fir (*Abies alba* MILLER) (20%), larch (*Larix decidua* MILLER) (10%) and sycamore (*Acer pseudoplatanus* L.) (10%). The site with wildlings was situated near the just described plantation at 800–1,000 m a.s.l. Natural regeneration took place under a 100–120 year old paternal stand with the following composition: Norway spruce (*Picea excelsa* LAM.) (35%), beech (*Fagus sylvatica* L.) (25%), fir (*Abies alba* MILLER) (20%), sycamore (*Acer pseudoplatanus* L.) (15%) and larch (*Larix decidua* MILLER) (5%). The research plots were classified as belonging to the geobiocoenological forest type group *Fageto-Abietum* (RANDUŠKA et al. 1986).

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I carried out research on trees in the established plantation as well as on wildlings in 1999–2000. In both years the numbers of small forest rodents (*Clethrionomys glareolus* SCHREB., *Microtus arvalis* PALL., *Microtus agrestris* L., *Apodemus* sp.) were very similar (10–20 individual animals per one hectare).

I observed the damage to seedlings and wildlings from March to May, primarily on the days with some new snow layer on which it was possible to identify traces of mammals and birds feeding on the trees. I identified the damaging agents not only through the feed marks but also, if it was possible, from more identification characteristics (tracks on snow, excrements, fur). The feeding marks on the trees were identified using the identification key by TURČEK (1963). For all the species, the sampling numbers were determined in such a way as to enable me quantitative comparisons between the corresponding species of seedlings and wildlings (Table 1).

RESULTS AND DISCUSSION

Quantitative damage caused by mammals and birds to the planting and natural seeding

In the case of cultivated plants, 698 (14%) from the total number of 4,995 examined trees showed certain damage caused by mammals and birds. The most serious damage was observed on fir (24%), followed by spruce (16%), sycamore and beech (both by 10%). The lowest was the number of damaged larches (9%, Table 1).

Classifying the damage according to the individual anatomical parts of trees, most of the trees were found with browsed whole shoots (up to 59% of damaged trees), and up to 48% of the damage were represented by browsed or cut terminal shoots – the organs determining further tree development and also the economic evaluation of the wood raw material produced in the future. The highest numbers of trees damaged by shoot browsing were recorded for fir (81% of the total) and spruce (61%). The lowest was the damage to larch (26%) and sycamore (49%). Then followed the trees with browsed or cut buds (33%). In this case, the highest numbers were those of larches (46%) and sycamores (42%). The lowest was the damage to beech trees (32%). For all the tree species, evidently lower was the damage to assimilatory organs (20%). Browsing of needles or leaves was the most evident on spruce (27%), the lowest on beech trees (13%). The least numerous were the trees with damaged stems (17). In this case the most attacked were sycamores (27%) and the least attacked were spruce trees (14%).

In the case of wildlings, I observed the damage caused by mammals and birds to only 370 trees (7%) from the total number of 5,196 examined trees. Similarly to the cultivated plants, also in this case the highest numbers of damaged trees were observed for fir (10%), beech (7%) and spruce (7%). The least attacked were the larch trees (6%).

Classifying the damage according to the individual anatomic plant organs, the highest numbers of wildlings were again found with browsed or cut shoots (64%), followed by damaged buds (34%) and assimilatory organs (20%). The least frequent was damage to stems (17%). In this case, the most attacked were larches (30%) and the least the spruce trees (12%). The highest damage caused by bud browsing was identified for sycamore (42%) and beech (36%), the lowest for larch (25%). The browsing of needles or leaves was the most frequent for spruce (29%), the least for beech trees (11%). Highly numerous were firs (75%) and beech trees (71%) with browsed shoots; lower numbers were observed for larch (40%) and spruce (56%). In general, simultaneous damage to several organs could be indicated on the individual trees.

Table 1. Quantitative damage caused by mammals and birds to the planting and natural seeding (locality Zamrlô in the Starohorské vrchy Mts., NE exposure, 750–1,000 m a.s.l., Slovakia, 1999–2000)

Study plot	Woody plant	Individuals checked	Individuals damaged											
			Altogether		Stem		Buds		Needles		Shoots		Terminal	
			ind.	(%)	ind.	(%)	ind.	(%)	ind.	(%)	ind.	(%)	ind.	(%)
Planting	spruce	2,032	321	16	45	14	99	31	87	27	197	61	159	50
	larch	421	39	9	7	18	18	46	7	18	10	26	6	15
	fir	498	120	24	26	22	39	33	18	15	97	81	80	67
	beech	1,592	164	10	29	18	52	32	21	13	89	54	70	43
	sycamore	452	45	10	12	27	19	42	7	16	22	49	17	38
Together		4,995	698	14	119	17	227	33	140	20	415	59	332	48
Natural seeding	spruce	2,125	142	7	17	12	43	30	41	29	80	56	49	34
	larch	352	20	6	6	30	5	25	4	20	8	40	6	30
	fir	509	52	10	10	19	18	35	8	15	39	75	32	62
	beech	1,708	113	7	20	18	41	36	12	11	80	71	70	62
	sycamore	502	43	9	9	21	18	42	10	23	29	67	23	53
Together		5,196	370	7	62	17	125	34	75	20	236	64	180	49

We can see from Table 1 that the damage to the transplants was more abundant compared with the wildlings (14% and 7%, respectively) in total, and that the same holds for each individual tree species. The differences between the damage to the individual anatomical parts of the cultivated plants and that to wildlings were not statistically significant.

Qualitative damage caused by mammals and birds to the planting and natural seeding

In both the cases of transplants and wildlings, the stems, buds and assimilatory organs of all the examined tree species were most damaged by small forest rodents – bank

Table 2. Qualitative and quantitative damage caused by mammals and birds to the planting (locality Zamrlô in the Starohorské vrchy Mts., NE exposure, 750–950 m a.s.l., Slovakia, 1999–2000)

Woody plant	Damage											
	Stem	(ind.)	(%)	Buds	(ind.)	(%)	Needles	(ind.)	(%)	Shoots	(ind.)	(%)
Spruce	Clegla	35	78	Clemic	70	71	Clemic	71	82	Cerela	122	62
	Micarv	25	56	Lepeur	26	26	Lepeur	10	11	Clegla	80	41
	Apodem	12	27	Teturo	25	25	Teturo	49	56	Lepeur	40	20
	Micagr	5	11							Capcap	32	16
										Micarv	20	10
										Teturo	52	26
Together		45	172		99	122		87	149		197	175
Larch	Clegla	5	71	Clemic	13	72	Clemic	4	57	Cerela	7	70
	Micarv	4	57	Teturo	10	56	Teturo	6	86	Clegla	3	30
	Micagr	3	43							Lepeur	2	20
Together		7	171		18	128		7	143		10	120
Fir	Clegla	18	69	Clemic	30	77	Clemic	12	67	Clegla	65	67
	Micarv	9	35	Lepeur	10	26	Lepeur	7	39	Cerela	42	43
				Teturo	14	36	Teturo	10	56	Micarv	20	21
										Capcap	18	19
										Scivul	12	12
										Lepeur	6	6
Together		26	104		39	139		18	162		97	168
Beech	Clegla	18	62	Clemic	42	81	Cerela	10	48	Clegla	59	66
	Micarv	7	24	Lepeur	7	13	Teturo	17	81	Cerela	42	47
	Apodem	7	24	Teturo	25	48				Micarv	40	45
	Micagr	6	21							Micagr	17	19
										Lepeur	10	11
Together		29	131		52	142		21	129		89	188
Sycamore	Clegla	7	58	Clegla	12	63	Cerela	7	100	Clegla	14	64
	Lepeur	6	50	Scivul	9	47				Cerela	10	45
	Micarv	3	25	Lepeur	5	26				Micarv	6	27
										Micagr	4	18
										Lepeur	3	14
										Capcap	2	9
Together		12	133		19	136		7	100		22	177

Abbreviations of the species: Apodem – *Apodemus* sp., Capcap – *Capreolus capreolus,* Cerela – *Cervus elaphus,* Clegla – *Clethrionomys glareolus,* Clemic – *Clethrionomys glareolus* and *Microtus* sp., Lepeur – *Lepus europaeus,* Micagr – *Microtus agrestis,* Micarv – *Microtus arvalis,* Scivul – *Sciurus vulgaris,* Teturo – *Tetrao urogallus*

Table 3. Qualitative and quantitative damage caused by mammals and birds to the natural seeding (locality Zamrlô in the Starohorské vrchy Mts., NE exposure, 800–1,000 m a.s.l., Slovakia, 1999–2000)

Woody plant	Damage															
	Stem	(ind.)	(%)	(%p/s)	Buds	(ind.)	(%)	(%p/s)	Needles	(ind.)	(%)	(%p/s)	Shoots	(ind.)	(%)	(%p/s)
	Micarv	11	65	227	Clemic	21	49	333	Clemic	17	41	418	Cerela	52	65	235
	Clegla	10	59	350	Teturo	37	86	68	Lepeur	8	20	125	Clegla	10	13	800
Spruce	Apodem	4	24	300					Teturo	29	71	169	Micarv	10	13	200
	Micagr	4	24	125									Micagr	6	8	0
													Teturo	31	39	168
Together		17	172	264		43	135	230		41	132	212		80	138	246
	Clegla	2	34	250	Clemic	2	40	650	Teturo	4	100	150	Cerela	7	88	100
Larch	Micarv	2	34	200	Teturo	3	60	333					Clegla	1	12	300
	Micagr	2	33	150												
Together		6	100	117		5	100	360		4	100	175		8	100	125
	Clegla	5	50	360	Clemic	7	39	429	Clemic	3	38	400	Cerela	22	56	191
	Micarv	5	50	180	Teturo	11	61	127	Lepeur	2	24	350	Clegla	14	36	464
Fir									Teturo	3	38	333	Micarv	10	26	200
													Scivul	8	21	150
													Lepeur	5	13	120
Together		10	100	260		18	100	217		8	100	225		39	152	249
	Micagr	6	30	100	Clemic	21	51	200	Cerela	5	42	200	Cerela	41	51	102
	Clegla	5	25	360	Lepeur	7	17	100	Teturo	7	58	243	Clegla	18	23	328
Beech	Micarv	5	25	140	Teturo	27	66	93					Micarv	18	23	222
	Apodem	4	20	175									Lepeur	4	5	250
													Micagr	3	4	567
Together		20	100	145		41	134	127		12	100	175		80	106	111
	Clegla	2	22	350	Clegla	5	28	240	Cerela	10	100	70	Cerela	10	34	100
	Lepeur	6	67	100	Scivul	4	22	225					Capcap	10	34	20
Sycamore	Micarv	1	11	300	Lepeur	2	11	250					Clegla	7	24	200
					Teturo	7	39	0					Micagr	3	10	133
													Micarv	3	10	200
Together		9	100	133		18	100	106		10	100	70		29	112	76

Explanatory notes: %p/s – % transplants/wildlings, abbreviations of the species – see Table 2

vole (*Clethrionomys glareolus* SCHREB.), common vole (*Microtus arvalis* PALL.), field vole (*Microtus agrestis* L.) and wood mice (*Apodemus* sp.). Buds and needles were cut also by capercaillie (*Tetrao urogallus* L.) and brown hare (*Lepus europaeus* L.). The most of shoot browsing in both cases was caused by red deer (*Cervus elaphus* L.), however, the damage caused by the small forest rodents (primarily *Clethrionomys glareolus* SCHREB. and *Microtus arvalis* PALL.) was very significant too (Table 2).

The highest numbers of mammal species (7) attacked spruce and sycamore, followed by fir (attacked by 6 species). The larch was attacked only by 5 species. The highest numbers of mammal species attacking the stems were found for both spruce and beech (4). On the other hand, the lowest mammal species numbers were identified damaging fir (2 species), larch and sycamore (by 3 species). The buds were damaged by four mammal and one bird (*Tetrao urogallus* L.) species. The fewest species (3) were feeding on the tree assimilatory organs (needles and leaves). On the other hand, the highest numbers of them damaged tree shoots (6 species). It was the case of fir and sycamore. On the other hand, only 3 mammal species were feeding on shoots of larch tree. We can see from Tables 2 and 3 that most of the damaged trees showed damage caused by several mammal species.

The damage amounts caused by the individual animal species were several times higher for the cultivated plants compared with the seedlings (Table 3). The opposite was true (on spruce, beech and sycamore) only for capercaillie (*Tetrao urogallus* L). This contradiction was caused by the fact that the observed naturally regenerated plot was situated at the centre of both winter and spring territories of this rare bird species.

Besides, I observed also damage to both seedlings and wildlings caused by hazel grouse (*Bonasa bonasia* L.). Nevertheless, due to their very low amount, these can be neglected.

According to PFEFFER et al. (1961) and STOLINA et al. (1986), in the case of beech seedlings, also another two bird species can take part: jay (*Garrulus glandarius* L.) and nutcracker (*Nucifraga caryocatactes* L.). However, I could not detect damage caused by these species on the examined trees during my two-year research period. According to TURČEK (1953), all the five examined tree species have substantially much more (20–39) potential mammal and bird pests. However, the just mentioned numbers are connected with all the phases of tree development. On the other hand, I studied only the trees old from 5 to 8 years.

The level of harmful effects of each free-living phytophagous vertebrate species is, besides the kind and amount of its daily food demands, determined primarily by its local abundance and mobility (STOLINA et al. 1986). The vertebrates characterised by fairly constant, but not very high abundance (e.g. red deer, roe deer, brown hare, capercaillie) take the equal part in the damage to trees at the discussed site every year. On the other hand, the small forest rodents whose abundance evidently fluctuates between the years cause remarkable increases in the damage at the locality in the years of gradation. A former, several years lasting research on the damaged cultivated plants and wildlings, performed in the Veľká Fatra Mts., confirmed several times greater damage caused by small rodents in the years of their gradation. On the other hand, the damage caused by higher vertebrates was practically equal in all the years under observation (SANIGA 1998).

From the viewpoint of evaluation of the harmful impact of rodents on further survival of both seedlings and wildlings (possibility of recovery) and on the economic evaluation of the wood raw material in the future, the most negative impact is browsing of shoots and buds, primarily in the case of coniferous trees (STOLINA et al. 1986). At the studied locality the shoots and buds were browsed and cut above all by red deer (*Cervus elaphus* L.), bank vole (*Clethrionomys glareolus* SCHREB.), common vole (*Microtus arvalis* PALL.) and capercaillie (*Tetrao urogallus* L.). The former research at several localities in the Veľká Fatra Mts. (SANIGA 1998) showed that the share of small forest rodents in damage to buds and shoots – organs that are vitally important for the tree vitality and survival – is several times higher in the years of gradation of these animals.

CONCLUSION

The research on damage caused to both seedlings and wildlings by mammals and birds resulted in obtaining very interesting information – the cultivated trees were damaged by mammals to considerably higher degrees compared with the natural seedlings. For each of the individual tree species more severe damage to the seedlings was above all caused by small forest rodents (*Clethrionomys glareolus* SCHREB., *Microtus arvalis* PALL., *Microtus agrestis* L. and *Apodemus* sp.). These species are characterised by considerable fluctuations of frequency between the years as well as by the ability to occupy the favourable sites in large groups. The research showed evidently that the abundance numbers of these mammals are higher from 1.2 to 2.3 times on the afforested clearcuts compared with the wildlings sheltered by paternal stands. In the case of other vertebrates *Cervus elaphus* L., *Capreolus capreolus* L., *Lepus europaeus* L., *Sciurus vulgaris* L., *Tetrao urogallus* L.), there have not been found any significant differences between damage to the seedlings and wildlings.

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Kvantitatívno-kvalitatívne poškodenie sadeníc a semenáčikov z prirodzeného zmladenia cicavcami a vtákmi

M. SANIGA

Ústav ekológie lesa SAV, Výskumná stanica Staré Hory, Slovenská republika

ABSTRAKT: V rokoch 1999–2001 bolo skúmané poškodenie sadeníc cicavcami a vtákmi v umele založených kultúrach a semenáčikov z prirodzeného zmladenia na lokalite Zamrlô v Starohorských vrchoch (750–1 000 m n. m., expozícia severovýchod, lesný typ *Abieto-Fagetum*). Poškodenie drevín cicavcami a vtákmi v založenej kultúre bolo podstatne vyššie (14 %) než v prirodzenom nálete (7 %). Všetky lesné dreviny boli viac poškodzované v založenej kultúre (smrek obyčajný 16 %, smrekovec opadavý 9 %, jedľa biela 24 %, buk lesný 10 % a javor horský 10 %) než v prirodzenom nálete (smrek obyčajný 7 %, smrekovec opadavý 6 %, jedľa biela 10 %, buk lesný 7 % a javor horský 9 %). Zistených bolo osem druhov cicavcov, ktoré sa podieľali na poškodení drevín tak v založenej kultúre, ako aj v prirodzenom nálete (*Apodemus* sp., *Capreolus capreolus* L., *Cervus elaphus* L., *Clethrionomys glareolus* SCHREB., *Lepus europaeus* L., *Microtus agrestis* L., *Microtus arvalis* PALL., *Sciurus vulgaris* L.). Len jeden vtáčí druh (*Tetrao urogallus* L.) bol zaznamenaný ako škodca na drevinách, a to tak v založenej kultúre, ako aj v prirodzenom nálete.

Kľúčové slová: dreviny; poškodenie; cicavce; vtáky

V príspevku sú prezentované výsledky z výskumu poškodenia sadeníc v založenej kultúre a semenáčikov z prirodzenej obnovy cicavcami a vtákmi na lokalite v Starohorských vrchoch (Slovensko).

Založená kultúra bola situovaná v nadmorskej výške 750–950 m (expozícia severovýchod). Rúbanisko po úzkom pásovom holorube bolo zalesnené v roku 1996 smrekom obyčajným (*Picea excelsa* LAM. 30 %), bukom lesným (*Fagus sylvatica* L. 30 %), jedľou bielou (*Abies alba* MILLER 20 %), smrekovcom opadavým (*Larix decidua* MILLER 10 %) a javorom horským (*Acer pseudoplatanus* L. 10 %). Stanovište s prirodzeným náletom bolo situované v blízkosti založenej kultúry v nadmorskej výške 800–1 000 m. Prirodzené zmladenie sa nachádzalo pod materským porastom vo veku 100–120 rokov so zastúpením smreka obyčajného (*Picea excelsa* LAM. 35 %), jedle bielej (*Abies alba* MILLER 20 %), buka lesného (*Fagus sylvatica* L. 25 %), javora horského (*Acer pseudoplatanus* L. 15 %) a smrekovca opadavého (*Larix decidua* MILLER 5 %). Výskumné plochy patrili geobiocenologicky do slt *Fageto-Abietum.*

Výskum poškodenia drevín v založenej kultúre a v prirodzenom nálete bol uskutočnený v rokoch 1999–2000, pričom obidva roky sa vyznačovali rovnakým stupňom početnosti (10–20 jedincov na ha) drobných lesných hlodavcov (*Clethrionomys glareolus* SCHREB., *Microtus arvalis* PALL., *Microtus agrestris* L., *Apodemus* sp.).

V založenej kultúre z celkového počtu 4 995 vyšetrených stromčekov vykazovalo určitý stupeň poškodenia cicavcami a vtákmi až 698 jedincov (14 %). Najviac boli poškodené sadenice jedle bielej (24 %), potom smreka obyčajného (16 %), javora horského a buka lesného (po 10 %). Najmenej bolo poškodených jedincov smrekovca opadavého (9 %).

Čo sa týka poškodenia jednotlivých orgánov drevín, najviac stromčekov malo odhryznuté celé výhonky (až

59 % poškodených jedincov), pričom až 48 % poškodených jedincov malo odhryznutý, resp. odštiknutý terminálny výhonok, ktorý má z hľadiska ďalšieho rastu stromčeka a ekonomického zhodnotenia drevnej suroviny v budúcnosti rozhodujúci význam. Odhryzom výhonkov bolo najviac postihnutých stromčekov jedle bielej (81 %) a smreka obyčajného (61 %). Najmenej poškodených výhonkov mali jedince smrekovca opadavého (26 %) a javora horského (49 %). Potom nasledovali stromčeky s odhryznutými, resp. odštiknutými púčikmi (33 %). Najviac poškodených púčikov vykazovali jedince smrekovca opadavého (46 %) a javora horského (42 %). Najmenej stromčekov s poškodenými púčikmi vykazoval buk lesný (32 %). Menej početná bola skupina sadeníc s poškodenými asimilačnými orgánmi (20 %). Odhryzom ihlíc, resp. listov trpeli najviac jedince smreka obyčajného (27 %) a najmenej buka lesného (13 %). Najmenej stromčekov vykazovalo poškodenie kmienka (17 %). Poškodením kmienka najviac trpeli jedince javora horského (27 %) a najmenej smreka obyčajného (14 %).

V prirodzenom nálete z celkového počtu 5 196 preskúmaných stromčekov bolo cicavcami a vtákmi poškodených len 370 jedincov (7 %). Najväčšie poškodenie vykazovali podobne ako v založenej kultúre jedince jedle bielej (10 %), potom javora horského (9 %), buka lesného (7 %) a smreka obyčajného (7 %). Najmenej bolo poškodených jedincov smrekovca opadavého (6 %).

Pokiaľ ide o poškodenie jednotlivých orgánov drevín, podobne ako u stromčekov v založenej kultúre aj tu najviac jedincov malo odhryznuté, resp. odštiknuté výhonky (64 %), za nimi nasledovali stromčeky s poškodenými púčikmi (34 %) a asimilačnými orgánmi (20 %). Najmenej stromčekov z prirodzeného zmladenia vykazovalo poškodenie kmienka (17 %). Poškodením kmienka najviac trpeli jedince smrekovca opadavého (30 %) a najmenej smreka obyčajného (12 %). Najviac poškodených púčikov vykazovali jedince javora horského (42 %) a buka lesného (36 %). Najmenej stromčekov s poškodenými púčikmi vykazoval smrekovec opadavý (25 %). Odhryzom ihlíc, resp. listov trpeli najviac jedince smreka obyčajného (29 %) a najmenej buka lesného (11 %). Odhryzom výhonkov bolo najviac postihnutých stromčekov jedle bielej (75 %) a buka lesného (71 %). Najmenej poškodených výhonkov mali jedince smrekovca opadavého (40 %) a smreka obyčajného (56 %). Poškodené jedince drevín zvyčajne vykazovali známky poškodenia viacerých orgánov.

Poškodenie stromčekov v založenej kultúre bolo podstatne vyššie než v prirodzenom nálete (14 %, resp. 7 %), pričom každá drevina vykazovala významne vyššie percento poškodených jedincov v založenej kultúre než v prirodzenom nálete. Diferencie v poškodení jednotlivých častí stromčekov v založenej kultúre a v prirodzenom zmladení neboli významné.

Tak v založenej kultúre, ako aj v prirodzenom nálete sa na poškodení kmienkov, púčikov a asimilačných orgánov všetkých druhov skúmaných drevín najväčšou mierou podieľali drobné lesné hlodavce – hrdziak lesný (*Clethrionomys glareolus* SCHREB.), hraboš poľný (*Microtus arvalis* PALL.), hraboš mokraďný (*Microtus agrestis* L.) a ryšavky (*Apodemus* sp.). Pri odštipovaní púčikov a ihlíc sa pomerne významne uplatňoval tetrov hlucháň (*Tetrao urogallus* L.) a zajac poľný (*Lepus europaeus* L.). Na odhryze výhonkov stromčekov tak v založenej kultúre ako aj v prirodzenom nálete sa najväčšou mierou podieľal jeleň lesný (*Cervus elaphus* L.), avšak poškodenie drobnými lesnými hlodavcami (najmä druhmi *Clethrionomys glareolus* SCHREB. a *Microtus arvalis* PALL.) bolo tiež veľmi významné.

Najviac druhov cicavcov (7) atakovalo stromčeky smreka obyčajného a javora horského, potom jedle bielej (6). Najmenej cicavcov poškodzovalo jedince smrekovca opadavého (5). Kmienok poškodzovalo najviac cicavcov u smreka obyčajného a buka lesného (po 4 druhoch). Najmenej cicavcov bolo zistených ako škodcov kmienka na stromčekoch jedle bielej (2 druhy), smrekovca opadavého a javora horského (po 3 druhoch). Púčiky poškodzovali štyri druhy cicavcov a jeden vtáčí druh (*Tetrao urogallus* L.). Najmenej cicavcov (3 druhy) sa podieľalo na poškodení asimilačných orgánov stromčekov (ihlice a listy). Naopak najviac druhov cicavcov odhrýzalo výhonky stromčekov (6 druhov). Výhonky jedle bielej a javora horského tvorili potravu až šiestich druhov cicavcov. Naproti tomu jedince smrekovca opadavého trpeli odhryzom výhonkov od najmenej druhov cicavcov (len 3 druhy). Ako je zrejmé z tab. 2 a 3, väčšina poškodených jedincov drevín vykazovala známky poškodenia od viacerých druhov cicavcov.

Výskum poškodenia drevín cicavcami a vtákmi v založenej kultúre a v prirodzenom nálete priniesol veľmi zaujímavý poznatok – dreviny v založenej kultúre trpeli významne vyšším stupňom poškodenia stavovcami než v prirodzenom nálete.

Corresponding author:

Ing. MIROSLAV SANIGA, CSc., Ústav ekológie lesa SAV, Výskumná stanica, 976 02 Staré Hory, Slovenská republika
tel.: + 421 48 419 92 68, e-mail: uelsav@bb.sanet.sk