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Site characteristics and ecological stability of forest ecosystems on permanent monitoring plots in the Protected Landscape Area – Biosphere Reserve Poľana

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Abstract

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The paper deals with habitat characteristic and ecological stability of forest ecosystems in the Protected Landscape Area Poľana in working-plan area Slovenská Ľupča and Osrblie. Ecological stability means that ecosystem is able to return to its dynamic equilibrium or to normal evolution state by means of its own internal mechanisms. There are two components of ecosystem stability: ecosystem resistance and ecosystem resilience. To determine ecological stability there is used the method presented in this thesis. The quantification and classification of the forest ecostability is very important for planning of the ecosystem management, especially in protected areas. Bad condition of forest ecosystems in Poľana requires effective measures, ways and methods to prevent the ecological destruction and preserve ecological balance.

Key words

forest ecosystem, ecological stability, ecosystem management

Introduction

Inappropriate measures and methods applied in forest management and in wood harvesting, together with changes in natural conditions and with disturbance of ecological equilibrium because of human influence, have negative impacts on forest ecosystems and cause their devastation and degradation. That is why the present state of things requires enforcing an intensive care over the ecosystems, applying effective management measures, ways and methods that can their protection and ecological balance. Equally important is to restore the disturbed ecological stability through restoration, regulation and revitalization.

Since the last years of the 20th century, the ecological stability has become one of core problems in ecology. Ecological stability of forests is the capacity of forest ecosystems to maintain, under influence of external factors, its own dynamic homeostasis by means of internal auto-controlling mechanisms (resistance) and to return, after a disturbance, to the original dynamic equilibrium (elasticity – resilience) or to resume the original normal developmental trend. The faster is the given ecosystem capable to return and the lesser are deviations from the normal state; the higher is its stability (Vološčuk 2000b).

The original natural ecosystems are being replaced by new, artificially created ecosystems with a low auto-controlling capacity. That means they are ecologically unstable.

The preservation of these ecosystems requires an artificial control by man. The necessary condition for success of such a control is a high amount of energy and human labour. However, the idea about restoration of the "original" forests is not realistic, because of immense changes in climate, site and intra-system conditions and relations. Different from this static understanding, it is possible to mean under the ecological

term "forest close to nature" the forests best corresponding to the current site conditions. The nature would need very long periods to create these ecosystems. The man can, in process of secondary succession, in relation to the rapid changes, to help the nature to reduce (mainly form the viewpoint of time relations) the consequences of his negative activities (KRIŽOVÁ et al. 1992).

The understanding of ecosystems as the unity between the abiotic and living nature requires, apart from others, their unambiguous spatial identification according to the main criterion – ecological stability. The synthetic criterion of the ecological homogeneity of an ecosystem is in structural properties of the vegetation. The only correct reference basis, in terms of natural sciences, for ecological evaluation of changes in the land performed by human generations are the types of natural vegetation (both potential and actual) connected with certain types of ecotops (VOLOŠČUK 2000a).

In the Protected Landscape Area – Biosphere Reserve Poľana (PLA – BR), was designed a network of permanent monitoring plots (PMP) 2 x 2 km, linked up to the network 4 x 4 km. This network is intended for long term and full-area monitoring of forests providing us with information about the state and development of forest ecosystems followed by proposal of practical measures in the management (ŠMELKO in MIDRIAK et al. 1997).

Material and methods

The research into the ecological stability of forest ecosystems run in the territory of the Protected Landscape Area – Biosphere Reserve Poľana (CHKO – BR Poľana) on 8 permanent monitoring plots (PMP), belonging to the Forest Management Units Osrblie (PMP A5, PMP B5, PMP A6, PMP B6) and Slovenská Ľupča (PMP B2, PMP B4, PMP C3, PMP C4). These monitoring plots were established in July–October 2001.

All the plots have the same area of 0.1 ha. The woody plants with diameter more than 6 cm were numbered and subjected to biometric measurements and to the assessment of physiological characteristics: species; d. b. h. diameter ($d_{1.3}$) – accuracy 2 cm; height (h) – accuracy 1 m; crown height – accuracy 0.5 m; health state or damage type and degree; defoliation (SAO) and depigmentation – only visually, without special methods included in the ICP-Forests program. The values obtained by dendrometrical measurements were evaluated statistically. We calculated weighted arithmetical mean, mean deviation and the coefficient of variation (ŠMELKO 1995).

The state of the natural regeneration was assessed on ten randomly selected non-fixed mini-plots with dimensions 1 x 1 m. The trees on these plots were recorded according to two diameter categories: a) less than 30 cm; b) 30–130 cm. We also recorded the number, length and diameter of lying trees (windfalls and dead stems). The stands were characterised and the phytocoenoses were described according to KRIŽOVÁ (1991) et al.

The data were obtained in the field research running in 2001–2002. They were used for the evaluation of the ecological stability of PMP following the methods by VOLOŠČUK (2000a). It was necessary to obtain quantitative values of the following indices:

1. deviation of the current wood species composition from the original (potential) – approximation (a),
2. degree of static stability expressed through crown index (ci) and slenderness coefficient (sc),
3. sanitary quotient (sq),
4. deviation of the current vertical structure from the three-layer structure model, determined using the classification scale by Zlatník – coefficient of layering (cl),
5. deviation of the current natural regeneration from the potential natural regeneration according the vegetation tiers and ecological orders.

To obtain the approximation, it is necessary to know both the current stand composition and original stand composition on the relevant monitoring plot. The species composition of the stands was given in per-cents converted per volume. The original (potential) stand composition was deduced from the valid forest management plans (FMP) documenting the presences of individual forest types in the individual compartments. The validity period for the FMP for the FMU Slovenská Ľupča: is 2000–2009, for the FMU Osrblie: 1995–2004. The layout of stand composition for each forest type in per-cents was used as in VOLOŠČUK (2000b). Because one forest compartment in general contains several forest types, at first it was necessary to calculate the areas in the compartment covered by the separated forest types. Then, the original stand composition was converted according to the proportions covered with the corresponding types. The sums of areas belonging to the separate target species in the individual forest types in a compartment served as the base for calculating the total percentual composition of the original woody plants over the whole compartment area.

The per-cent of approximation "a", that means the degree of suitability of the current stand composition in relation to the original species composition was expressed through the following relation as in Papánek (VOLOŠČUK 2000b):

$$a = 100 \cdot \left(1 - \frac{SD}{200}\right)$$

where SD is sum of deviations.

Based on the per-cent of approximation, the forest stands were classified to the following degrees of ecological stability:

1. high stable over 91%
2. very stable 71–90%
3. medium stable 51–70%
4. low stable 31–50%
5. unstable less than 30%

Static stability of woody plants was expressed through the crown index (ci) and slenderness coefficient (sc). The sanitary quotient is the ratio of ill, pest-attacked, dry and mechanically damaged trees to the total number of trees on the plot. Coefficient of layering expressed the deviation of the current stand structure from the three-layer model of the stand that is ecologically the most stable on the relevant PMP. The final value of the ecological stability was obtained as the sum of indices of the individual relative scales of ecological stability according to approximation (a), crown index (ci), slenderness coefficient (sc), sanitary quotient (sq) and coefficient of layering (cl). Because the ecological stability of forest ecosystems is primarily determined by the original stand composition and the health state, the approximation index was provided with a weight 5 and the sanitary index with the weight 3. The final ecological stability was obtained according to the formula (Vološčuk 2000b):

$$IES = \frac{\sum n_i \cdot x_i}{N}$$

where:

IES – final index of ecological stability,
n_i – weight of the i-th index of ecological stability (5a, 3 sq, 1ci, 1sc, 1cl),
x_i – value of the partial index of ecological stability (1, 2, 3, 4, 5),
N – sum of the weights of partial indices of ecological stability (N = 11) (Table 1).

Table 1. Degrees of ecological stabilty

Final index	Ecological stability
to 1.5	high
1.6–2.5	good
2.6–3.5	medium
3.6–4.5	low
above 4.6	labile ecosystem

Assessment of restoration capacity of a forest ecosystem is an ancillary index for the assessment of autoregulation capacity of the ecosystem in its climax phase. The field data found on the PMP about the natural regeneration in each woody plant were converted to the number per one m^2 and the number per one ha, as to obtain the data comparable with the published data about potential natural regeneration of the principal woody species according to the individual forest vegetation tiers, ecological orders and groups (Vladovič et al. 1998).

The last cited work contains data about ecological stability of forest stands on two permanent monitoring plots: B5 and C3. PMP B5 is situated in the locality Chata pod Veprom, Stand No. 349, altitude 1080 m a. s. l, exposure NW, inclination 15°, stocking 0.6. PMP C3 is situated in Ponická Bukovina, Compartment No. 5043, altitude 1140 m a. s. l., exposure NNW, inclination 5°, stocking 0.5.

We also ascertained area and percentage composition of forest types in the FMU Slovenská Ľupča and FMU Osrblie, according to the formula:

$$P_{FT} = \sum_{i=1}^{n} p_{FTi}$$

where:

P_{FT} – area covered with the forest type (FT) in all the stands,
p_{FTi} – area FT in the i-th stand where the type FT occurs.

The percentage is obtained in the following way:

$$\%p_{FT} = \frac{P_{FT}}{p} \cdot 100$$

where:

P_{FT} – area covered with the forest type (FT) in all the stands in the FMU,
p_{FT}% – percentage of the given FT,
P – total area of all the FT in the FMU.

Calculating approximation values for both FMU Slovenská Ľupča and Osrblie, it was necessary to determine the mean percentage of approximation for each forest type occurring in the FMU:

$$\bar{a}FT = \frac{\sum_{i-1}^{n} a_i \cdot p_{FTi}}{P_{FT}}$$

where:

a_{FT} – mean percentage of approximation for the FT,
a_i – percentage of approximation of the i-th compartment in that the FT occurs,
p_{Fti} – area FT in the i-th stand where the type FT occurs,
P_{FT} – total area of the FT in the whole FMU.

The final percentage of originality for the whole FMU is determined as:

$$A = \frac{\sum_{i-1}^{n} a_i \cdot p_i}{\sum_{i-1}^{n} p_i}$$

where:
a_i – approximation of the i-th stand,
p_i – area of the i-th stand.

Results and discussion

The assessment of state of forest ecosystems on permanent monitoring plots resulted in finding that the highest ecological stability had the stand on PMP B5 in FMU Osrblie. The stand was classified as Forest Type No. 6401 – Fageto-Aceretum superiora with the phytocoenosis type *Galium odoratum – Mercurialis perennis – Petasites albus*. The present stand composition is: *Fagus sylvatica* (69%), *Acer pseudoplatanus* (20%), *Picea abies* (6%), *Abies alba* (5%). The characteristics measured on PMP B5 are in Table 2. The final index of ecological stability is 2.36, which is a very high stability, primarily reflecting the appropriate stand composition (a = 89%). The highest presence was found in beech trees (69%). From the allochtonous species occurs only spruce (6%), on the other hand, elm is lacking (5% in the original composition). There is practically no difference between the current and the potential percentage in beech, maple and fir. As for the static stability, the tree crowns should also have lower set branches (ci = 4), the slenderness coefficient value is 3, which is an average value (Table 3). The vertical structure of the stand is also average (cl = 3). The health state is relatively good according to sanitary quotient. Sound regeneration is in beech (11 000 ts per ha) and sycamore maple (21 000 ts per ha), however, up to 30 cm only. There is no remarkable regeneration over 30 cm. Under 30 cm is also found regenerating rowan. There is full absence of regenerating fir trees.

A moderate restoration measure would be suitable – to reach gradually the appropriate diversity in the height and age structure of the stand. In the same manner, it is also possible to force regeneration in fir and to reach more intensive regeneration in beech by improving the conditions in the crown layer for natural seeding.

IŠTOŇA (2000), studying the natural regeneration in forest stands on research plots in the PLA Poľana, found that the regeneration of rare broadleaved species in the understorey in the stand type beech forest was in general good. Consistent protection against the game and stand opening can ensure whole-area natural regeneration in these stands. In such a way, the immense value of the original genetic material will be used with profit and, at the same time, the overall diversity of the natural ecosystems will be preserved.

On the other hand, the lowest ecological stability was found on PMP C3, belonging to the FMU Slovenská Ľupča. The forest type is No. 6304 – Abieto-Fagetum superiora (nitrophilous), phytocoenosis: *Filices – Galium odoratum – Senecio fuchsii – Petasites albus*. In the present stand composition dominates *Picea abies* (99%), admixed is *Fagus sylvatica* (1%) (Table 4). The final index of ecological stability was 4.64, so the system was classified as unstable. The low ecological stability is primarily caused by improper wood species composition. According to the original composition of the forest type at the site, the spruce should not exceed 10%, what is in sharp contradiction to the present state of 99%. There are lacking precious broadleaved species and beech, which presence should be 40%, reaches 1% only. The slenderness coefficient and crown index (sc = 2, ci = 4), indicate poor vertical structure of the stand (Table 5). The health state of the stand is bad (sq = 5). The mechanical damage to trees is a consequence of cutting followed by a rot attack. The natural regeneration lower than 30 cm consists mainly of spruce (48 000 ts per ha), which reflects the far highest percentage of this woody plant on the plot. We can also observe the regeneration in sycamore maple and in fir. The last two species are not present in the current stand composition; however, they are present in its potential composition. The seeds of these species have probably been transported by wind from the surrounding stands. Beech trees are completely absent in the regeneration. The regeneration higher than 30 cm is scarce, probably because game browsing.

A restoration measure is necessary to remove the great spruce proportion. It is equally important to support the natural regeneration in beech and precious broadleaved species.

The static or better the whole ecological stability of the BR Poľana is a consequence of three crucial presumptions. The first factor is a high stock of red deer and subsequent damage to forest stands. The second is insufficient ecological stability connected with height differentiation of young stands (younger than 50 years) which is further reflected on wind and, to some extent, also snow damage. The third factor is rather homogeneous species composition with dominant spruce – explicitly predicting extensive damage. It is evident that it is necessary to increase the biodiversity, mainly in the woody plants composition, by increasing the proportions of beech, fir, maple, elm and ash (SANIGA 1997).

Further, in both forest management units, for each stand belonging to the territory of the PLA-BR Poľana, we determined the deviations "SD" of the current stand composition from the original and calculated aproximation percentage "a", that means the degree of correspondence of the current species composition to the potential species composition according to the formula discussed in "Methods".

Table 2. Diameter classes, standardised height, production indices and their statistical characteristics on PMP B5

Species	$d_{1.3}$	N	h (m)	V_1 (m^3)	g (m^2)	V (m^3)	G (m^2)	N/ha	V/ha (m^3)	G/ha (m^2)
beech	10	3	9	0.03	0.00785	0.09	0.02355	30	0.9	0.2355
	12	3	10	0.05	0.01131	0.15	0.03393	30	1.5	0.3393
	14	4	12	0.08	0.01539	0.32	0.06156	40	3.2	0.6156
	16	2	13	0.12	0.02011	0.024	0.04022	20	2.4	0.4022
	18	1	15	0.17	0.02545	0.17	0.02545	10	1.7	0.2545
	20	3	16	0.23	0.03142	0.69	0.09426	30	6.9	0.9426
	22	1	17	0.29	0.03801	0.29	0.03801	10	2.9	0.3801
	24	3	19	0.39	0.04524	1.17	0.13572	30	11.7	1.3572
	26	2	20	0.48	0.05309	0.96	0.10618	20	9.6	1.0618
	30	2	21	0.68	0.07069	1.36	0.14138	20	13.6	1.4138
	32	4	22	0.81	0.08042	3.24	0.32168	40	32.4	3.2168
	36	3	23	1.09	0.10179	3.27	0.30537	30	32.7	3.0537
	40	2	24	1.41	0.12566	2.82	0.25132	20	28.2	2.5132
	42	2	24	1.57	0.13854	3.14	0.27708	20	31.4	2.7708
	48	1	25	2.17	0.18096	2.17	0.18096	10	21.7	1.8096
	50	2	25	2.36	0.19365	4.72	0.3927	20	47.2	3.927
	60	1	26	3.63	0.28274	3.63	0.28274	10	36.3	2.8274
	62	1	26	3.89	0.30191	3.89	0.30191	10	38.9	3.0191
	64	1	26	4.16	0.32170	4.16	0.32170	10	41.6	3.2170
Sum:		41				36.5	3.33572	410	365	33.3572
x:	28.59		18.44	0.890	0.0814					
sx:	14.79		5.62	1.062	0.0810					
sx%:	51.74		30.47	119.4	99.58					
syc. map	64	1	29	4.63	0.3217	4.63	0.32170	10	46.3	3.2170
	84	1	23	6.36	0.55418	6.36	0.55418	10	63.6	5.5418
Sum:		2				10.99	0.87588	20	10.99	8.7588
spruce	58	1	2	3.17	0.26421	3.17	0.26421	10	31.7	2.6421
fir	14	1	8	0.05	0.01539	0.05	0.01539	10	0.5	0.1539
	50	1	30	2.44	0.19635	2.44	0.19635	10	24.4	1.9635
Sum:		3				2.49	0.21174	20	24.9	2.1174
Total		46				53.15	4.68755	460	531.5	46.8755

$d_{1.3}$ – diameter class
N – tree number
h – standardised height
V_1 – volume of the i-th diam. class
g – basal area of the i-th diam. class
V – total volume
G – total basal area
x – weighed arithmetical mean
sx – mean deviation
sx% – variation coefficient

Table 3. Values of coefficients of relative scales of ecological stability on PMP B5

PMP	Coefficient of approximation		Crown index		Slenderness coefficient		Sanitary coefficient		Coefficient of layering
	value %	index	value %	index	value %	index	value %	index	index
B5	89	2	47	4	70	3	26	2	3

Table 4. Diameter classes, standardised height, production indices and their statistical characteristics on PMP C3

Species	$d_{1.3}$	N	h (m)	V_i (m^3)	g (m^2)	V (m^3)	G (m^2)	N/ha	V/ha (m^3)	G/ha (m^2)
spruce	36	2	28	1.15	0.10179	2.30	0.20358	20	23	2.0358
	40	1	30	1.50	0.12566	1.50	0.12566	10	15	1.2566
	42	1	30	1.64	0.13854	1.64	0.13854	10	16.4	1.3854
	44	2	31	1.85	0.15205	3.70	0.30410	20	37	3.0410
	46	1	32	2.08	0.16619	2.08	016619	10	20.8	1.6619
	48	2	32	2.25	0.18096	4.50	0.36192	20	45	3.6192
	50	3	33	2.51	0.19635	7.53	0.58905	30	75.3	5.8905
	52	1	33	2.70	0.21237	2.70	0.21237	10	27	2.1237
	56	3	34	3.19	0.24630	9.57	0.73890	30	95.7	7.3890
	58	2	35	3.52	0.26421	7.04	0.52842	20	70.4	5.2842
	60	3	35	3.74	0.28274	11.22	0.84822	30	112.2	8.4822
	62	4	35	3.97	0.30191	15.88	1.20764	40	158.8	12.0764
	64	1	36	4.34	0.32170	4.34	0.32170	10	43.4	3.2170
	70	1	37	5.28	0.38484	5.28	0.38484	10	52.8	3.8484
Sum:		27				79.28	6.13113	270	792.8	61.3113
x:	53.04		33.19	2.936	0.2271					
sx:	8.85		2.29	1.042	0.0723					
sx%:	16.69		6.91	35.48	31.85					
beech	10	1	5	0.02	0.00785	0.02	0.00785	10	0.2	0.0785
	22	1	12	0.18	0.03801	0.18	0.03801	10	1.8	0.3801
	28	1	11	0.31	0.06158	0.31	0.06158	10	3.1	0.6158
Sum:		3				0.51	0.10744	30	5.1	1.0744
x:	20.00	9.33	0.17	0.0358						
sx:	7.48	3.09	0.12	0.0220						
sx%:	37.42	33.12	69.77	61.40						
rowan	12	1	6.00	0.01	0.01131	0.01	0.01131	10	0.1	0.1131
Total		31				79.80	6.24988	310	798	62.4988

$d_{1.3}$ – diameter class
N – tree number
h – standardised height
V_1 – volume of the i-th diam. class
g – basal area of the i-th diam. class
V – total volume
G – total basal area
x – weighed arithmetical mean
sx – mean deviation
sx% – variation coefficient

Table 5. Values coefficients of relative scales of ecological stability on PMP C3

TMP	Coefficient of approximation		Crown index		Slenderness coefficient		Sanitary coefficient		Coefficient of layering
	value %	index	value %	index	value %	index	value %	index	index
C3	11	5	45.2	4	64.0	2	67.7	5	5

According to the calculated values of coefficient of approximation, in the FMU Slovenská Ľupča, the majority – 80 stands (540.55 ha, representing 45.52% of the total area of the FMU) are unstable. The second position is occupied by low stable stands – 73 (422.04 ha, 35.54%). Medium stable are 25 stands (158.59 ha, 13.35%) and very stable 8 stands (66.44 ha, 5.59%). Not even one stand could be classified as high stable (Table 6). The final percentage of originality, that means the weighed of approximation coefficient of all the examined stands in the FMU Slovenská Ľupča belonging to the PLA – BR Poľana is 36.13%. It follows that from the viewpoint of relative scale of ecological stability according to the approximation, this forest management unit can be classified as low stable.

Table 6. Stands on FMU Slovenská Ľupča according approximation index

Approximation index	Number stands	Area (ha)	Proportion (%)
1	0	0.00	0.00
2	8	66.44	5.59
3	25	158.59	13.35
4	73	422.04	35.54
5	80	540.55	45.52
Σ	186	1187.62	100.00

In the FMU Osrblie, the majority, 77 stands (433.94 ha, 40.77% of the FMU total area) are low stable. Medium stable are 75 stands (394.78 ha, 37.09%). Unstable are 35 stands (166.00 ha, 15.6%), 10 stands (67.45 ha, 6.34%) are very stable. High stable is one stand (2.11 ha, 0.2%) (Table 7). The final percentage of approximation with the value of 47.16% was obtained in the same way as in the case of the FMU Slovenská Ľupča. The result show that also the forest management unit Osrblie can be classified as low stable.

The obtained results allow us to draw conclusions about causes of lowering the ecological stability in the two given FMU. In the examined stands frequently dominate species that should be present in only a low percentage or even should absent (the species not native for the given stand). One of principal causes can be the inappropriate management applied in these ecosystems in the past. For example: artificially planted woody species with high production value. In this context, we would like to underline the importance of natural regeneration of forest stands.

Representativeness of the PMP in the FMUs Slovenská Ľupča and Osrblie was evaluated based on two criteria:

a) approximation of the current stand composition in relation to the target composition,
b) presence of forest types.

Table 7. Stands on FMU Osrblie according approximation index

Approximation index	Number stands	Area (ha)	Proportion (%)
1	1	2.11	0.20
2	10	67.45	6.34
3	75	394.78	37.09
4	77	433.94	40.77
5	35	166.00	15.60
Σ	198	1064.28	100.00

The FMU Slovenská Ľupča involves 4 permanent monitoring plots: B2, B4, C3, C4. Unstable ecosystems cover 50% of the PMP and 45.52% of the total FMU area. In the case of low stable ecosystems we obtained figures 25% and 35.54%, respectively, for medium stable ecosystems 25% and 13.35%. Very stable ecosystems are not present on PMP, from the total FMU area, they represent only 5.59%. The PMP have the mean approximation value of 30.5%. The whole FMU has the mean approximation 36.13%. Both values indicate low stable forest stands. As we can see, from this viewpoint, the representativeness of the PMP established in the FMU Slovenská Ľupča is excellent.

According to the presence of forest types, the representativeness of the PMP in this FMU is very good. Three monitoring plots (75%) involve three most frequent forest types occurring in the FMU territory: 5303 (21.03%), 5304 (17.93%) and 6304 (9.59%). On plot B2 is present forest type 314 (25%), representing 5% of the given FMU.

In the FMU Osrblie, with mean percentage of approximation 47.16% (low stable ecosystem) are also 4 PMP: A5, B5, A6, B6. Their mean approximation is 58.25% which means medium stable ecosystems. The proportion of low stable stands on PMP is 50%, medium stable 25% and very stable also 25%. In relation to the whole FMU area we obtained the following corresponding ciphers: 40.77%, 37.09%, 6.34%. Unlike the PMP, the whole unit also contains unstable ecosystems (15.6%) and ecosystems with high stability (0.20%). PMP established in the FMU represent the species composition in the whole FMU only to a certain extent.

On the plots occur forest types No. 5301, 5402, 6303 and 6401, each of them in 25%. On one plot is the second the most frequent type in the FMU – 5301 (8.09%), on the second is present the fourth most frequent type – 6303 (5.89%). The type 5402 is in the whole FMU only present in 3.17%, forest type 6401 in 0.82%. The difference between the percentage representation of forest types on the PMP and in the whole FMU is also caused by the considerable difference between the number of forest types present on the

PMP and in the whole FMU. The representativeness of then PMP in relation to the presence of separate forest types in the whole FMU is only average.

Conclusions

The results obtained in observation of the studied territory show that the examined ecosystems are low stable or unstable because an intensive human impact. It is evident that the restoration of these ecosystems to the original state, in which they are capable to fulfil their functions, is an imperative. The question remains open if it is necessary to take artificial restoration measures – always adjusted to the given ecosystem or to leave the problems to the natural auto-regeneration and auto-regulation capacity of the discussed ecosystems. We mean that it is necessary to join the appropriate restoration activities on the side of man with natural regeneration capacity of the forest, for example, by providing more favourable conditions for the forest natural regeneration in the changed environment.

References

IŠTOŇA, J., 2000: Odraz drevinového zloženia vo fytocenózach a prirodzenej obnove na plochách VDO Poľana. In: Biosférické rezervácie na Slovensku III. Zborník referátov. Zvolen, 2000.

KRIŽOVÁ, E., NIČ, J., 1991: Fytocenológia a lesnícka typológia. Návody na cvičenia. Zvolen, VŠLD, 113 p.

KRIŽOVÁ, E. a kol., 1992: Všeobecná ekológia. Vysokoškolské skriptá. Zvolen, TU, 180 p.

MIDRIAK, R. A KOL., 1997: Racionálne obhospodarovanie a využívanie územia BR Poľana z krajinnoekologických a lesníckoekologických aspektov. 2. čiastková správa vedecko-technického projektu, FEE TU Zvolen.

NOCIAROVÁ, G., 2003: Analýza súčasného stavu diverzity dendroflóry a ekologickej stability ekosystémov trvalých monitorovacích plôch Biosférickej rezervácie Poľana, ako podklad na spresnenie zónovania pre program UNESCO Človek a biosféra. Diplomová práca, TU Zvolen, 60 p.

Objemové tabuľky, Lesoprojekt Zvolen.

SANIGA, M., 1997: Optimalizácia pestovných opatrení vo vybraných typoch porastov v Biosférickej rezervácii Poľana. In: Racionálne využívanie a obhospodarovanie CHKO – BR Poľana. Zborník referátov z odborného seminára, 1997, Technická univerzita vo Zvolene, Fakulta ekológie a environmentalistiky.

ŠMELKO, Š., 1995: Statistical methods in forestry (in Slovak). TU Zvolen, 279 p.

VLADOVIČ, J. A KOL., 1998: Prehodnotenie cieľového zloženia lesných drevín s dôrazom na využívanie prirodzenej obnovy. ZS RÚ č. 14/98, LVÚ Zvolen, 54 p.

VOLOŠČUK, I., 2000a: Ekologická stabilita lesných ekosystémov. Ochrana prírody, Banská Bystrica, 18, p. 223–237.

VOLOŠČUK, I., 2000b: Lesný ekosystém. Vysokoškolské skriptá. Zvolen, Technická univerzita, 117 p.

Analýza ekologickej stability lesných ekosystémov trvalých monitorovacích plôch Chránenej krajinnej oblasti Biosférickej rezervácie Poľana

Súhrn

Práca sa zaoberá problematikou ekologickej stability lesných ekosystémov v Chránenej krajinnej oblasti – Biosférickej rezervácii Poľana. Výskum prebiehal v lesnom hospodárskom celku (LHC) Slovenská Ľupča a LHC Osrblie na 8 trvalých monitorovacích plochách (TMP). Posúdená bola aj reprezentatívnosť zastúpenia lesných typov na TMP, ako aj aproximácia týchto TMP z hľadiska LHC Slovenská Ľupča a LHC Osrblie. Na základe hodnotenia stavu lesných ekosystémov trvalých monitorovacích plôch možno konštatovať, že prevládajú málo stabilné a labilné lesné ekosystémy. V porastoch sa vyskytujú dreviny, ktoré by tu mali byť z hľadiska pôvodnosti zastúpené iba malým percentom, prípadne by v niektorých porastoch nemali byť zastúpené vôbec. Jednou z hlavných príčin je nesprávne hospodárenie v týchto lesných ekosystémoch, ktoré sa v minulosti uplatňovalo.