ManForest - Ecosystem functions and biodiversity in managed forest landscapes: Czech Republic - basic data on forests and forestry

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This report was prepared as a basic comprehensive report on forest in the Czech Republic for the international program ManForest (part of ALTER-Net, Work package WP R3).
The ALTER-Network provides a most suitable platform for assessment of long-term effects monitoring of forests and land use on ecosystem functions and biodiversity. In the proposed ManForest project, forest socio-economic services and silviculture are Drivers. Various forestry measures are Pressures, influencing the site and surrounding land and waters (State) and determining the Impacts on landscape functions such as biogeochemical links in the soil-water-biota system. Results from monitoring, assessments and consecutive modeling have the potential to alter management practices (Response) in a beneficial way considering a long-term perspective for maintenance of biodiversity.
Comparison of drivers and pressures on the national level can be possible using following basic information set. It can be useful in any other field too.

Climate

Prevailing part of the area has zone VI - typical moderate climate (the zone with deciduous broadleaf forests), accompanied by zone X - mountain climate - see KONDRACKI ET BOHN (2003).

Potential vegetation

A potential vegetation unit integrates environmental conditions of the site. The map of potential vegetation in the Czech Republic distinguishes 51 units (NEUHÄUSLOVÁ ET AL. 1998). It was processed on the same principles as map of European natural vegetation (BOHN ET AL. 2003).

	Potential vegetation unit	**Relative share (%)**
1	Bird cherry-ash woodland (*Pruno-Fraxinetum* Oberdorfer 1953), partly in complex with alder carrs (*Alnion glutinosae* Malcuit 1929).	3.344
2	Bird cherry-pedunculate oak or -alder woodland (*Quercus robur-Padus avium* comm., *Alnus glutinosa-Padus avium* comm.) with *Carex brizoides*, partly in complex with alder carrs (*Carici elongatae-Alnetum* Schwickerath 1933) reed swamps and tall-sedge communities (*Phragmito-Magnocaricetea* Klika in Klika et Novák 1941).	0.725
3	Spruce-alder woodland (*Piceo-Alnetum* Rubner ex Oberdorfer 1957).	0.058
4	Poplar-pedunculate oak woodland (*Querco-Populetum* Neuhäuslová-Novotná 1965), partly in complex with elm-pedunculate oak woodland (*Querco-Ulmetum* Issler 1926).	0.173
5	Elm-pedunculate oak woodland (*Querco-Ulmetum* Issler 1926).	1.545
6	Pannonian elm-ash woodland (*Fraxino pannonicae-Ulmetum* Soó in Aszód 1936 corr. Soó 1963) in complex with poplar-ash woodlands (*Fraxino-Populetum* Jurko 1958).	0.553
7	Oak-hornbeam woodlands with *Melampyrum nemorosum* (*Melampyro nemorosi-Carpinetum* Passarge 1957).	18.965
8	Lime-oak woodland (*Tilio-Betuletum* Passarge 1957).	1.079
9	Pannonian oak-hornbeam woodland with *Primula veris* (*Primulo veris-Carpinetum* Neuhäusl et Neuhäuslová ex Neuhäuslová-Novotná 1964).	2.400
10	Carpathian oak-hornbeam woodland with *Carex pilosa* (*Carici pilosae-Carpinetum* Neuhäusl et Neuhäuslová 1964).	4.025
11	Lime-rich oak-hornbeam woodland (*Tilio-Carpinetum* sensu Traczyk 1962).	2.633
12	Lime-pedunculate oak woodland with *Stellaria holostea* (*Stellario-Tilietum* Moravec 1964).	0.090
13	Scree and ravine woodlands of colline to montane sites (*Aceri-Carpinetum* Klika 1941, *Lunario-Aceretum* Schlüter in Grüneberg et Schlüter 1957, *Mercuriali-Fraxinetum* [Klika 1942] Husová 1982, *Scolopendrio-Fraxinetum* Schwickerath	0.035

	Potential vegetation unit	Relative share (%)
	1938).	
14	Lime-beech woodland with *Tilia platyphyllos* (*Tilio platyphylli-Fagetum* Klika 1939).	0.039
15	Lime-beech woodland with *Tilia cordata* (*Tilio cordatae-Fagetum* Mráz 1960 em. Moravec 1977).	0.613
16	Beech woodland with *Melica uniflora* (*Melico-Fagetum* Seibert 1954).	0.521
17	Beech woodland with *Carex pilosa* (*Carici pilosae-Fagetum* Oberdorfer 1957).	0.696
18	Beech woodland with *Dentaria enneaphyllos* (*Dentario enneaphylli-Fagetum* Oberdorfer ex W. et A. Matuszkiewicz 1960).	11.968
19	Beech woodland with *Dentaria glandulosa* (*Dentario glandulosae-Fagetum* Matuszkiewicz ex Guzikowa et Kornas 1969).	0.232
20	Beech woodland with *Festuca altissima* (*Festuco altissimae-Fagetum* Schlüter in Grüneberg et Schlüter 1957).	1.517
21	Beech woodland with *Viola reichenbachiana* (*Violo reichenbachianae-Fagetum* Moravec 1979).	0.715
22	Beech woodland with *Cephalanthera* species (*Cephalanthero-Fagetum* Oberdorfer 1957).	0.037
23	Silver fir woodland with *Sanicula europaea* (*Saniculo europaeae-Abietetum* Husová 1998).	0.101
24	Woodrush-beech woodland (*Luzulo-Fagetum* Meusel 1937).	16.561
25	Spruce-beech woodland (*Calamagrostio villosae-Fagetum* Mikyška 1972).	2.080
26	Waterlogged pedunculate oak-beech woodland with *Carex brizoides* (*Carici brizoidis-Quercetum* Neuhäusl in Mikyška et al. 1968).	0.717
27	Silver fir woodland with *Deschampsia flexuosa* (*Deschampsio flexuosae-Abietetum* Husová 1968).	0.111
28	Oak woodland with *Lathyrus pannonicus* and/or *Buglossoides purpurocaerulea* (*Lathyro versicoloris-Quercetum pubescentis* Klika [1928] 1932, *Torilido-Quercetum* Blažková 1997).	0.026
29	Oak woodland with *Cerasus mahaleb* and/or *Cornus mas* (*Pruno mahaleb-Quercetum pubescentis* Jakucs et Fekete 1957, *Corno-Quercetum* Máthé et Kovács 1962).	0.042
30	Undetermined basiphilous thermophilous woodland (*Brachypodio pinnati-Quercetum* Klika 1953 nom. inv. and others).	0.110
31	Oak woodland on loess with *Quercus petraea*, *Q. pubescens*, *Q. robur* (*Quercetum pubescenti-roboris* [Zólyomi 1957] Michalko et Džatko 1965).	1.032
32	Subcontinental pedunculate oak woodland with *Carex fritschii* (*Carici fritschii-Quercetum roboris* Chytrý et Horák 1997).	0.137
33	Oak woodland with *Potentilla alba* (*Potentillo albae-Quercetum* Libbert 1933).	0.809
34	Oak woodland with *Sorbus torminalis* and *Vincetoxicum hirundinaria* (*Sorbo torminalis-Quercetum* Svoboda ex Blažková 1962).	0.082
35	Oak woodland with *Asplenium cuneifolium* on serpentine substrate (*Asplenio cuneifolii-Quercetum petraeae* Chytrý et Horák 1997).	0.002
36	Woodrush-oak and/or silver fir-oak woodland (*Luzulo albidae-Quercetum petraeae* Hilitzer 1932, *Abieti-Quercetum* Mráz 1959).	20.454
37	Oak woodland with *Molinia arundinacea* (*Molinio arundinaceae-Quercetum* Neuhäusl et Neuhäuslová-Novotná 1967).	0.280
38	Pine-oak woodland with *Vaccinium vitis-idaea* (*Vaccinio vitis-idaeae-Quercetum* Oberdorfer 1957).	3.240
39	Pine-oak woodland with *Festuca ovina* (*Festuco ovinae-Quercetum roboris* sensu F. Šmarda 1961).	0.335
40	Pine woodland with *Thlaspi montanum* on serpentine substrate (*Thlaspio montani-Pinetum sylvestris* Chytrý in Chytrý et Vicherek 1996).	0.005
41	(Sub)montane spruce-pine and spruce woodland on stony substrates (*Betulo carpaticae-Pinetum* Mikyška 1970, *Anastrepto-Piceetum* Stöcker 1967).	0.026
42	Other acidophilous pine woodlands (*Dicrano-Pinion* [Libbert 1933] Matuszkiewicz 1962 excl. *Betulo carpaticae-Pinetum* Mikyška 1970, *Vaccinio uliginosi-Pinetum sylvestris* Kleist 1929).	0.008
43	Spruce woodland with *Calamagrostis villosa* (*Calamagrostio villosae-Piceetum*	0.412

	Potential vegetation unit	Relative share (%)
	Hartmann in Hartmann et Jahn 1967).	
44	Waterlogged spruce woodland with *Bazzania trilobata* (*Mastigobryo-Piceetum* [Schmid et Gaisberg 1936] Braun-Blanquet, Sissingh et Vlieger 1939), partly in complex with *Sphagnum*-rich spruce woodland (*Sphagno-Piceetum* sensu Sofron 1981).	0.907
45	Spruce woodland with *Athyrium distentifolium* (*Athyrio alpestris-Piceetum* [Hartmann 1959] Hartmann et Jahn 1967).	0.014
46	A complex of *Pinus mugo* communities (*Pinion mughi* Pawlowski in Pawlowski, Sokolowski et Wallisch 1928) and alpine vegetation (*Juncetea trifidi* Hadač in Klika et Hadač 1944, *Mulgedio-Aconitetea* Hadač in Klika et Hadač 1944, *Salicetea herbaceae* Braun-Blanquet in Braun-Blanquet et Jenny 1926 and others).	0.059
47	Complex of brown-moss rich fens (*Caricetalia fuscae* Koch 1926).	0.008
48	Complex of sedge-*Sphagnum* communities of minerotrophic mires (*Scheuchzerietalia palustris* Nordhagen 1936 excl. *Leuco-Scheuchzerion palustris* Nordhagen 1943).	0.009
49	Complex of submontane *Pinus rotundata*- and *Pinus sylvestris*-mires (*Pino rotundatae-Sphagnetum* Kästner et Flössner 1933 corr. Neuhäusl 1969, *Eriophoro vaginati-Pinetum sylvestris* Hueck 1931 em. Neuhäusl 1984, *Vaccinio uliginosi-Pinetum sylvestris* Kleist 1929).	0.097
50	Complex of montane raised bogs (*Sphagnetalia medii* Kästner et Flössner 1933 excl. sub 49), partly with *Pinus mugo* agg. and/or *Sphagnum*-rich spruce woodland (*Sphagno-Piceetum* sensu Sofron 1981).	0.037
51	Complex of successional stages on anthropogenic sites (*Betula pendula-Calamagrostis epigejos* community).	0.271

Basic data on the forest area

Prevailing data source is Report on the state of forests and forestry in the Czech Republic by 2005 (compiled by Forest Management Institute).

Country size 7 887 406 ha
Forest estate area 2 652 941 ha (34 %)
Forest stand area 2 590 904 ha (33 %);
Forest stand area according to national forest inventory is 2 704 904 ha. This difference consists in situation that a part of forests growths on estates which are not primary designated for forestry (agriculture and other land). These plots are under natural secondary succession. They represent important area in preservation of biodiversity.

Silvicultural systems

High forests 99.73 %
Coppices 0.23 %
Selection forests 1.75 % (38 044 ha)

Protected areas

National parks, protected landscape regions, reserves (all categories: national reserves, protected reserves, national monuments, nature monuments)
Total area 1 115 188 ha (14 %) [not only forested area]

	National parks	Protected landscape regions	National reserves	Nature reserves	National monuments	Nature monuments
Total area (1000 ha)	119.5	1089.8	28.1	36.3	2.8	27.2
Forest area (1000 ha)	104.0	588.5	23.0	16.0	1.6	19.0

Tree species composition

Tree species composition of all forests (2005)

	Relative representation (%)			Mean age
	natural	**current**	**recommended**	
spruce	11.2	53.1	36.5	62
fir	19.8	0.9	4.4	72
pine	3.4	17.2	16.8	71
larch	0.0	3.9	4.5	57
other conif.	0.3	0.2	2.2	
total conifers	**34.7**	**75.3**	**64.4**	**64**
oak	19.4	6.6	9.0	69
beech	40.2	6.6	18.0	71
hornbeam	1.6	1.2	0.9	
ash	0.6	1.2	0.7	
maple	0.7	1.1	1.5	
elm	0.3	0.0	0.3	
birch	0.8	2.9	0.8	45
linden	0.8	1.0	3.2	
alder	0.6	1.5	0.6	
other broadleaves	0.3	1.5	0.6	
total broadleaves	**65.3**	**23.7**	**35.6**	**62**
unstocked	**0.0**	**1.0**	**0.0**	
total				**64**

National forest inventory

	Area (ha)	Share (%)
Norway spruce	1138424	47.68
pine	332685	13.93
oak	176535	7.39
European beech	172924	7.24
birch	101465	4.25
European larch [1)]	91827	3.85
maple	53297	2.23
alder	50392	2.11
hornbeam	45346	1.90
other broadleaved	43704	1.83
ash	40822	1.71
linden	38253	1.60
silver fir	23667	0.99
aspen	17899	0.75
willows	14033	0.59
locust [2)]	13438	0.56
introduced spruce species [2)]	8741	0.37
poplar	6678	0.28
red oak [2)]	5586	0.23
Douglas fir [2)]	5335	0.22
elm	2853	0.12
dwarf pine	2140	0.09
grand fir [2)]	1232	0.05
other conifers	406	0.02
Total	2387682	

1) natural occurrence in a small region of the Czech Republic
2) species planted only

Forest age structure

	Mean rotation period	Area (ha)
Production forests	110.9	1971327
Protection forests	147.7	74937
Special purpose forests	124.1	544640
All	114.7	2590904

A. Report on national forestry 2005

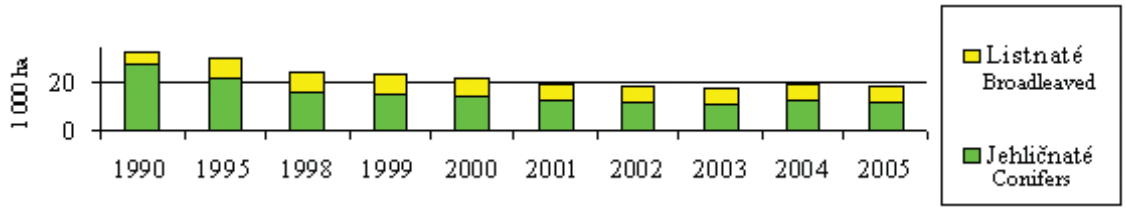
Age class	Age	Area share (%)
unstocked		1.0
I	1-20	17.0
II	21-40	15.0
III	41-60	14.2
IV	61-80	18.7
V	81-100	16.5
VI	101-120	11.2
VII	121+	6.4

B. Forest inventory (10year classes)

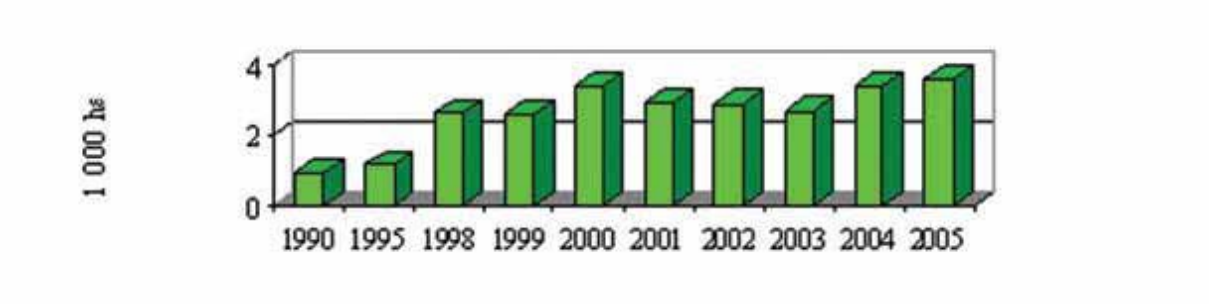
Age class	Area (ha)	Share (%)	
1	228825	9.58	17.65
2	192669	8.07	
3	206794	8.66	
4	226322	9.48	27.11
5	214277	8.97	
6	163497	6.85	
7	200547	8.40	
8	221855	9.29	39.43
9	184851	7.74	
10	170807	7.15	
11	143048	5.99	
12	97405	4.08	
13	64553	2.70	
14	30361	1.27	15.80
15	18484	0.77	
16	9732	0.41	
17	13658	0.57	
Total	2387685		

Other parameters

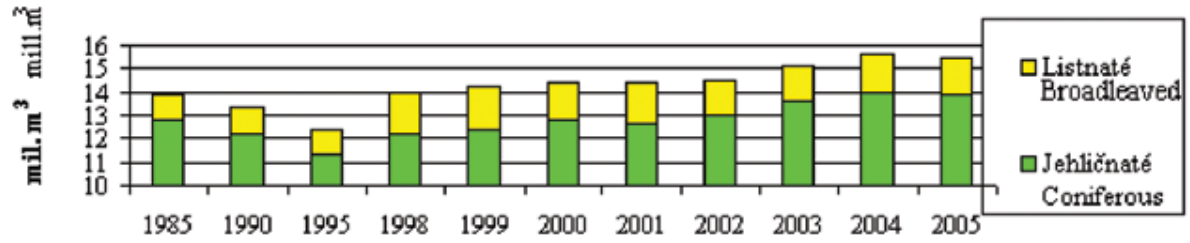
Artificial forest regeneration (2005: 18 318 ha)



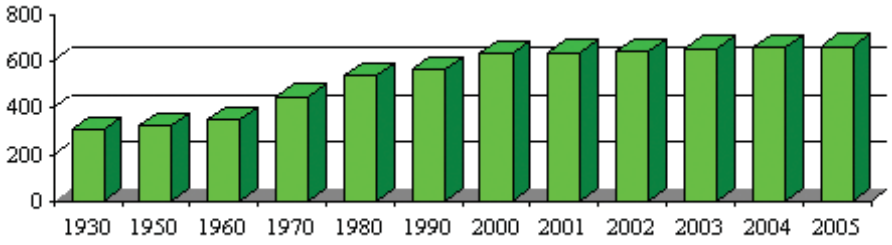
Area of natural regeneration (2005: 3 630 ha)



Total annual felling (2005: 15.51 mil. m^3)



Growing stock volume (2005: 663.2 mill. m^3)



Growing stock

Volume	278 m^3.ha^{-1}

Dead wood volume

All laying wood volume	6.8 m^3.ha^{-1}
- no soft parts	2.8 m^3.ha^{-1}
- partly soft	1.7 m^3.ha^{-1}
- rotten wood	2.3 m^3.ha^{-1}

Forest typology and tree species composition

A specific typological system of sites is applied in the Czech Republic (e.g. VIEWEGH J., KUSBACH A., MIKESKA M. 2003)

System of forest type groups

Forest type group (= forest site complex according to VIEWEGH ET AL. 2003) is combination of forest altitudinal zone (0-9) and edaphic category (capital letter). Several categories are grouped into a series. All numbers are relative share of forested area of the Czech Republic (in per-cents).

Series	**Extremum (extreme)**			**Acidophilum (acidic)**				**Trophicum (fertile)**						**Acerosa (enriched)**			**Fraxinosa (gleyic)**			**Variohumida (water-logged)**			**Paludosa (peaty)**			**Total**
Category	**X**	**Z**	**Y**	**M**	**K**	**N**	**I**	**S**	**F**	**C**	**B**	**W**	**H**	**D**	**A**	**J**	**L**	**U**	**V**	**O**	**P**	**Q**	**T**	**G**	**R**	
0	.00	.23	.09	.60	2.14	.28				.06										.02	.17	.18	.04	.26	.15	4.23
1	.07	.23		.63	.22	.01	.05	.78		.39	.14	.02	.21	.19	.04	.07	1.11	.04	.15	.67	.26	.14	.05	.14		5.61
2	.01	.06	.01	.21	1.93	.08	.93	1.53		.77	.80	.04	1.49	.44	.20		.18		.07	.28	.28	.21	.01	.04		9.59
3	.00	.04	.06	.22	4.85	.32	1.74	5.45	.13	.31	2.30	.06	2.50	1.02	.45	.26	.53	.34	.29	.89	.48	.05	.00	.02	.00	22.32
4	.00	.01	.03	.11	3.14	.28	.49	4.84	.32	.11	3.37	.04	.48	.56	.44				.24	1.37	1.44	.34		.16	.09	17.88
5		.04	.10	.44	6.54	.66	.43	5.64	.58	.04	2.55	.01	.32	.24	.55	.15	.15	.24	.79	1.05	.86	.11	.03	.21	.08	21.78
6		.05	.18	.15	4.50	.84	.27	2.07	.10		.19		.03	.08	.27	.00	.01		1.07	.80	1.29	.10	.01	.45	.09	12.55
7		.05	.05	.14	2.00	.27		.36	.02		.00								.18	.21	.23	.01	.05	.50	.20	4.29
8		.19	.02	.02	.46	.08		.06	.01						.01				.03	.02	.03	.09	.04	.29	.15	1.49
9		.12	.01		.03																				.09	.25
Total	.09	1.02	.55	2.52	25.81	2.82	3.91	20.74	1.16	1.68	9.36	.17	5.03	2.54	1.97	.47	1.98	.62	2.83	5.31	5.05	1.23	.24	2.08	.85	
	1.65			35.05				38.14						4.97			5.43			11.59			3.16			
																	water enriched sites									

Forest fragmentation

According to CORINE land cover data set (state of 2000), forests have following parameters

category	total area (ha)	number of patches
311 - Broad-leaved forest	252740	2054
312 - Coniferous forest	1699292	5644
313 - Mixed forest	604224	5035
All forests	2556256	5806

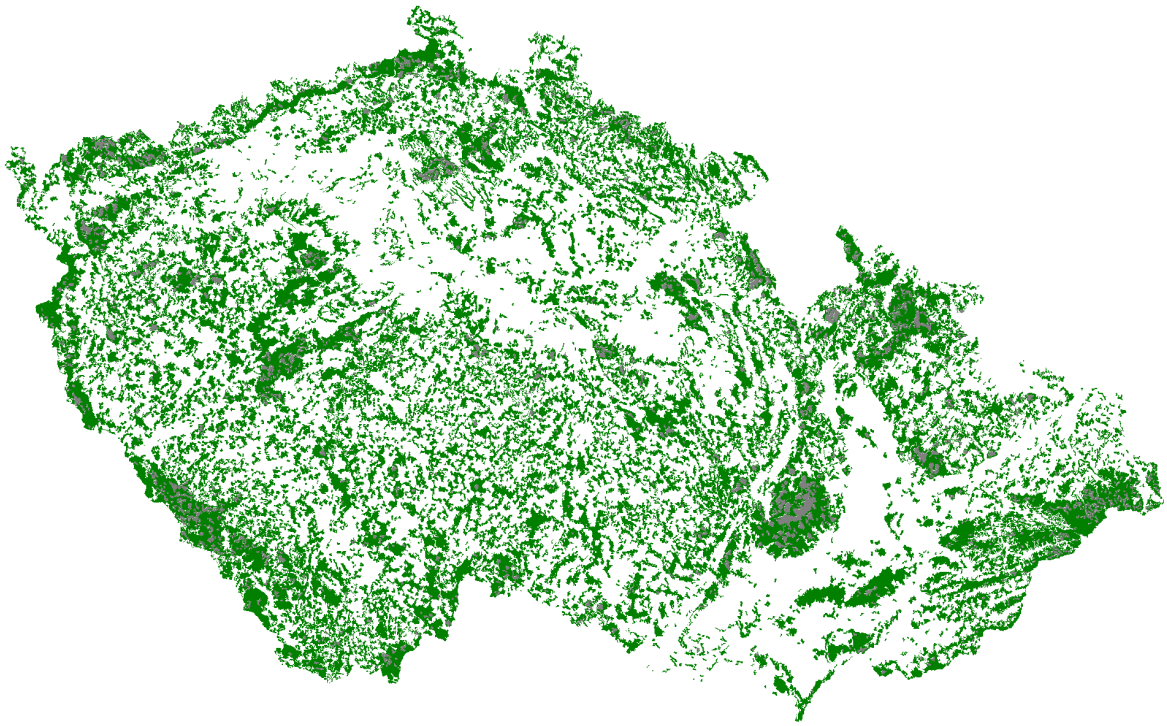


Fig. 1. Distribution forests (green) in the Czech Republic according to the CORINE land cover data in 2000.

Patch shape parameters were calculated according to their area (*P*) and perimeter (*O*).

parameter	average	minimum	maximum
$D = 4\frac{P}{O}$	1626.5	0.4	4086.8
$N = \frac{4P}{\pi D^2}$	64.2	1.1	281.3
$B = \frac{1}{4}\left(O - \sqrt{d}\right)$	830.6	0.2	2088.7
$A/B = \frac{O + \sqrt{d}}{O - \sqrt{d}}$	199.9	1.04	881.80

The auxiliary parameter *d* was calculated according to equation $d = O^2 - 16P$. Averages were weighted by patch size.

Biodiversity assessment in forests

Following text is summary of some sources, which prevailing part was published only in Czech. Monitoring of biodiversity has been developed in several research projects. The author was a main participant in following ones (see www.infodatasys.cz):

- Participative management of protected areas [2003-2005]

- Biodiversity management in Krkonoše Mts. (Giant Mts.) and Šumava Mts. (Bohemian Forest) [2006-2011]

Example of long-time development of species diversity in forests

Data

Approximately 3 thousand plant coenological relevés from selected area of Krkonoše Mts. (Giant Mts.) and their surroundings were used. These relevés were recorded during 50 years in connection with forest typological surveys. First report is actually in press (MATĚJKA 2007)

Results

Average species richness was unchanged but the distribution of values shows different shape. Share of rich relevés with 30 and more species in herb layer was decreased.

We can see some different situation by total diversity (evaluated using Shannon-Wiener index). Average values were significantly growing during last 50 yeas. More distinct growth is demonstrated by functional diversity. The modified Rao coefficient (BOTTA-DUKÁT 2005; modification consists in using of the species hierarchical classification as a source to calculate species distances) indicates changes in species composition - it points to moderate disturbances of forests. Higher functional diversity was observed in the forest communities of moderate acidophilus man-influenced coniferous and mixtured stands at lower or middle altitudes.

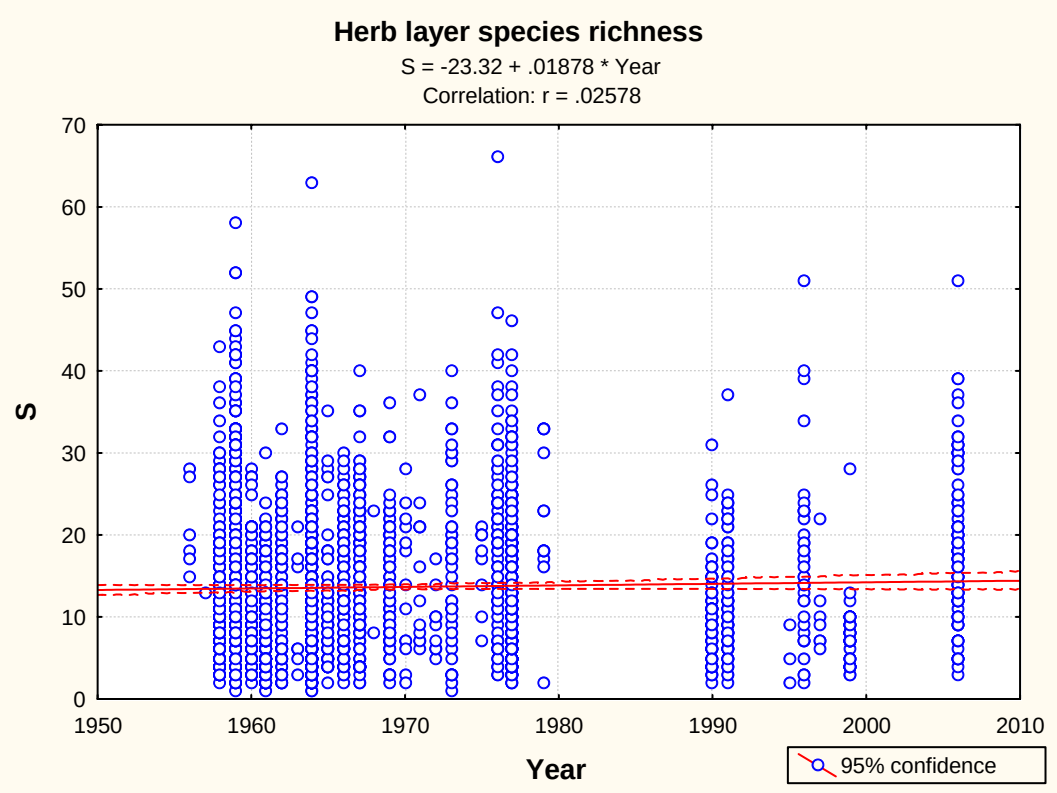


Fig. 2. Species richness of the forest herb layer according to plant coenological relevés in the region of Krkonoše Mts.

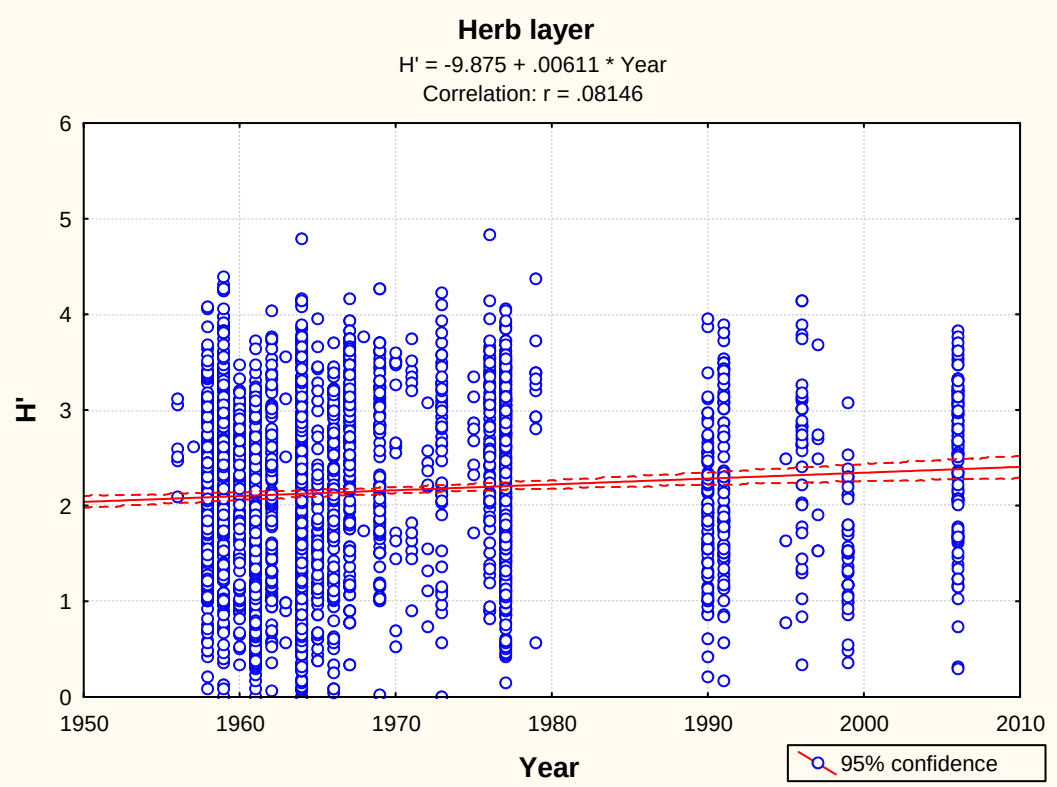


Fig. 3. Total species diversity (Shannon-Wiener index) of the forest herb layer according to plant coenological relevés in the region of Krkonoše Mts.

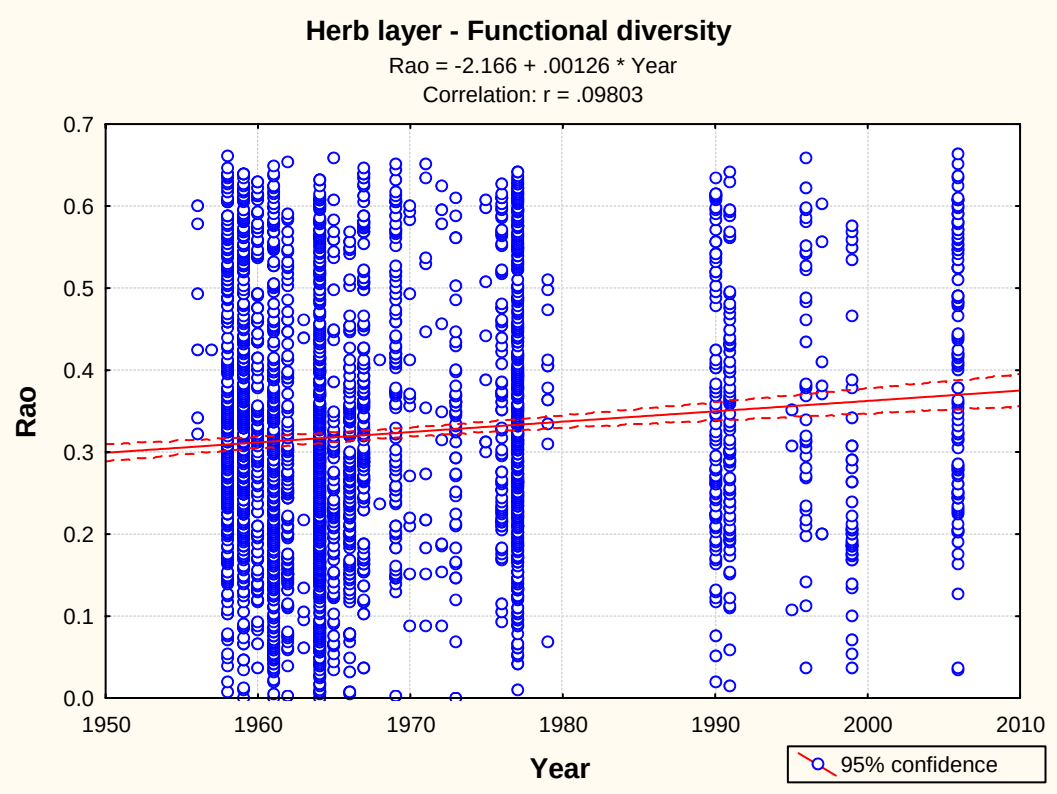


Fig. 4. Functional diversity (modified Rao coefficient) of the forest herb layer according to plant coenological relevés in the region of Krkonoše Mts.

Biodiversity monitoring on permanent plots

Forest monitoring is processed in connection with the serious forest damage caused by air pollution since 70th of the former century. The ICP-Forest monitoring programme is the most important project of this kind (ANONYM, 2004). Evaluation of results from the biodiversity point of view is very problematic - it was carried out only sporadically (MATĚJKA 1995).

There are three examples of regional systems of the long-term ecological research based on permanent plots in the Czech Republic (VACEK, MATĚJKA 2007). They are localized in the Krkonoše (Giant) Mts. (VACEK, MATĚJKA 1999; VACEK ET AL., 2007), Orlické hory Mts. (VACEK, MATĚJKA 2003) and Šumava Mts. (Bohemian Forest; VACEK, PODRÁZSKÝ, MATĚJKA 2006). Plant coenological relevés were made together with description of the tree layer structure, tree damage monitoring (defoliation assessment) and some other parameters. Several problems with interpreting of results consist in prevailing existence of plots in the age-classes forests growing during period of unstable environmental conditions and changing silviculture practices. **Results from a set of plots with growing age of tree stand must not be interpreted as development of forest biodiversity in some area.**

Distinct pictures appear connecting with development of different etages - e.g. the moss layer can go along to another trajectory comparing the herb layer, as shown by decline of the moss diversity in the Krkonoše plots. Structure of herb/moss layer need not be significantly affected by decline of tree layer in Norway spruce forests. Changes in tree defoliation and tree layer decline are brought by the Šumava example.

Another example of long-term study is monitoring of whole catchments of mountain lakes in Šumava Mts. (KOPÁČEK, VRBA 2006)

Main topics threatening biodiversity and stability of forests in the Czech Republic

Besides factors threatening forests in the Czech Republic (air pollution, long-term acidification) which are fully accepted by official subjects (Ministry of agriculture, Ministry of environment, State enterprise Forests of the Czech Republic), there is set of factors stressed by some scientists and foresters which are partly incorporated in the documents on governmental level in different manner. These factors are discussed in several documents and publications (HRUŠKA, CIENCIALA, 2001; ANONYM, 2006). State of forests and forestry in the Czech Republic are periodically reported (for last report see FMI, 2007a). The biggest field study carried out during 2001-2004 as the first national forest inventory (FMI, 2007b).

Structure of contemporary forests

It is a group of the state parameters of prevailing part of forests (forest ecosystems) describing a forest as dynamic biological system. These parameters are diverted (shifted from "normal" values) by prevailing long-term practices.

Tree species composition

Actual share of coniferous species (mostly Norway spruce) is very high comparing the natural composition. These forests are not stable, they are endangered by drought, insects (mainly bark beetle – *Ips typographus*), and they are sensitive to air pollution. Stability of forest monocultures is decreased.

Forests of age classes: age and spatial structure

Forests of age classes arise as result of clear cuts and related management practices. Such forests are instable, more endangered by pests, wind, snow etc. Biogeochemical cycles are interrupted and element fluxes are rapidly changed during whole cycle. It leads to narrowing of the species spectrum of organism living in the ecosystem.

Dead wood deficiency

Volume of dead wood (DW) in sample plots varies between 100 and 450 $m^3.ha^{-1}$ in forests of the natural-close structure (e.g. JANKOVSKÝ in VACEK ET AL., 2007). Average DW volume in whole Czech forests is extremely low (6.8 $m^3.ha^{-1}$). Similar situation can be visible in natural parks: 0 to 12 $m^3.ha^{-1}$ DW is lying in the Krkonoše NP according to forest altitudinal zone; less than 10% of forest area represents stands with 10 $m^3.ha^{-1}$ DW or more (SCHWARZ, VACEK, KUŚ, MATĚJKA, 2007).

Forest fragmentation

Forests are highly fragmented: According to the CORINE data, most of forest patches has less than 1000 m in diameter. Their area represents one quarter of total forest area in the republic. Real fragmentation is higher because of the CORINE layer is generalized. An example was carried out on the base of forest management database in Central Bohemia: 99 % of patches has diameter less than 1000 m, they represents 40 % of total forested area (Matějka, unpublished data, www.infodatasys.cz).

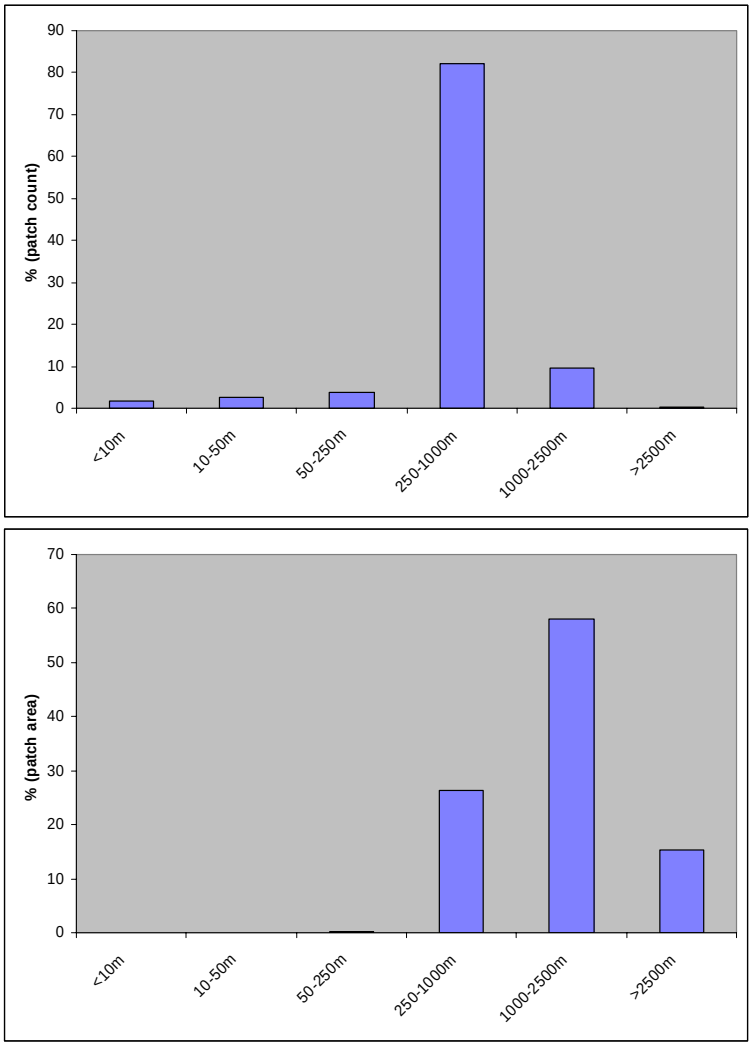


Fig. 5. Forest fragmentation in Central Bohemia. Shares of forest patches according to patch counts and total patch area.

Clear cutting

It is prevailing management method. Consequences of clear cutting are serious: temperature is more fluctuating, soil degradation, elimination of some species, changes in tree species composition, changes in genetic (population) structure of trees etc.

High number of game

Game density can be seeing as the most serious fact limiting afforestation on prevailing part of the Czech Republic.

Unsuitable management practices of "revitalization" in damaged areas

Liming is applied in several regions as basic revitalization praxis in whole country measure. It can be dangerous e.g. from soil biology point of view: Cycles of nutrients (mainly nitrogen) in the ecosystem are disbalanced. Humus stock in soil decreases. Organisms adapted to naturally acidic soils are eradicated.

An regional example of bad praxis: Soil preparation before tree planting is realized as deep soil homogenization in Krušné hory (Ore Mts.) - the area with the air-pollution-based forest damage in the second forest generation (first generation was represented by substitutive tree species as birch, rowan, blue spruce etc.). It causes destabilization of a young fragile ecosystem which has been formed after air-pollution calamite (compare Slodičák et al., in preparation).

Recreation influence in areas of relatively good state

Recreation is serious problem in areas of high importance from nature conservation point of view (National park Šumava Mts. – Bohemian Forest, NP Krkonoše – Giant Mts., all landscape protected areas, and valuable regions of Central Bohemia etc.). There is pressure to construct recreation buildings, ski runs, paths and others in these regions. Touristic activities are not limited in important part of these regions.

Lack of unmanaged forests

Forests in national parks (Šumava – Bohemian Forest NP for instance) are managed on prevailing area (more than 90%): most activities are connected with processing of bark beetle gradation (since begin of 1990's). The situation in other protected areas is similar.

Discrepancy between foresters and biologists (ecologists)

A rough discussion proceeds among foresters, environment protectors and different scientists on the topics of further forest practices, although a consensus should be required for state improve (Anonym, 2006).

Comments on forest management and biodiversity pressures

Soil treatments, scarification

It is very rarely used treatment sometimes used for natural regeneration of pine forests and whole-area site preparation in the floodplain forests. In the pine forests, it enables contact of seeds with mineral soil for better germination and growth of seedlings. In the floodplain forests, one is used for centuries. Sustainable application of this treatment results in a state different from natural, without any current change in biodiversity. Both pine monocultures, even more floodplain forests with oaks and ashes are artificial ecosystems.

Drainage

Drainage is limited to very small extends, more prominent after big calamities as temporary treatment to prevent water logging. In the past (until 1970ies), it was used more often to replant spruce monocultures after large calamities and clear-cuts. Today, on the contrary, sometimes even ditch elimination is provided. In sites with high soil water table it can increases the tree/forest (mechanical) stability. On wet sites, the shift to less water demanding communities can be observed. More wanted as a part of forest road construction. From ecological point of view, drainage is very dangerous regarding to possible climate change, water dynamics in the landscape and nature conservation. The treatment should be strictly eliminated in all protected areas and in valuable localities (biodiversity preservation).

Stump removal

Almost not existing, the use of stumps is non-economical. In more large extent it is part of the floodplain forest regeneration, sometimes used also at whole-area mechanized regeneration of pine monocultures on sands. Extraordinary part of the silvicultural treatments limited to minimum extent. Stumps are normally left as the only source of rough wood in forest ecosystems under ordinary management.

High intensity forestry, short rotation

Not on the forest land, eliminated on forest soil by legislation. It is new factor in the Czech Republic.

Fertilization

Fertilization is used in several cases:
Large area liming in the regions under (historical) air pollution (Krušné hory Mts.-Ore Mts., Jizerské hory Mts., Krkonoše Mts.-Giant Mts. as an example): It is more negative for biodiversity, soil organic matter preservation, nutrient disbalancing etc.
Mg-fertilization in yellowing especially spruce stands of higher age, vital in some extent yet: Increases vitality and stand stability, Mg-fertilization is used in more extent. Convenient for stabilization of older stands, the matter of dispute regarding to impact on the biodiversity (without evidence).
Support of forest plantation (clear-cuts, underplantings) of more demanding species (beech, fir) in the monocultures of spruce and pine: Convenient highly, increasing the effect of re-introduction stabilizing and site improving species.
Nutrient import on the bulldozed localities in the Ore Mts. (Krušné hory Mts.): Highly recommended on sites with lowered nutrient pool in the region with extraordinary high damage of forests under air-pollution since 1950ies.
Commercial fertilization is not provided.
The fertilization (with the past exception of large liming) is probably neutral in the most cases for biodiversity.

Storm damage

Wind is the main factor of salvage felling in the spruce monocultures. The intensity and frequency of storms determines to large extent "forest management" – the process of stand sanitation and regeneration. The stability of forests decreases with their age, the admixture of stabilizing species (beech; Douglas fir, larch in areas without protection) has the opposite positive impact. The clear-cut communities and wilderness value increases accordingly to ecological activist after storms.

Air pollution

Air pollution and soil acidification are determining factors in the mountain region approximately since the half of 20th century. Now, the intensity and composition pollutants change. Instead of SO_2, the N-compounds and ozone can be the main pollutant. The load (especially acid) in the past is determining to some extent the chemical properties of the forest soils.

Climate change

This factor is with no clear consequences for the forestry. The measure used as strategy – the increase of tree-stand-diversity (species, structural) of the forests. In the Czech conditions, increase of temperature and changes in precipitation can be expected according to different scenarios in various measure.

Insects

Factor multiplying the impact of other factor – air pollution, dry periods, nutrient disbalances. It is the more important secondary factor. Insect damages can be normally controlled by forest management. Different situation can be observed in Šumava Mts. (Bohemian Forest) National Park. The bark beetle (Ips typographus) shows a gradation with culmination in 1997 and 2006 (prolonged to nowadays).

Vehicles

Transportation is important source air pollution (see above).
Vehicles as part of the recreational load of the forests – the amount, discipline of visitors. Proper strategy, education and management is needed – question not solved up to date.
In the case of forestry machinery, the good education and preparation of workers is needed to prevent soil mechanical damage. The soil damage can be problem on wet and not-stable sites.

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