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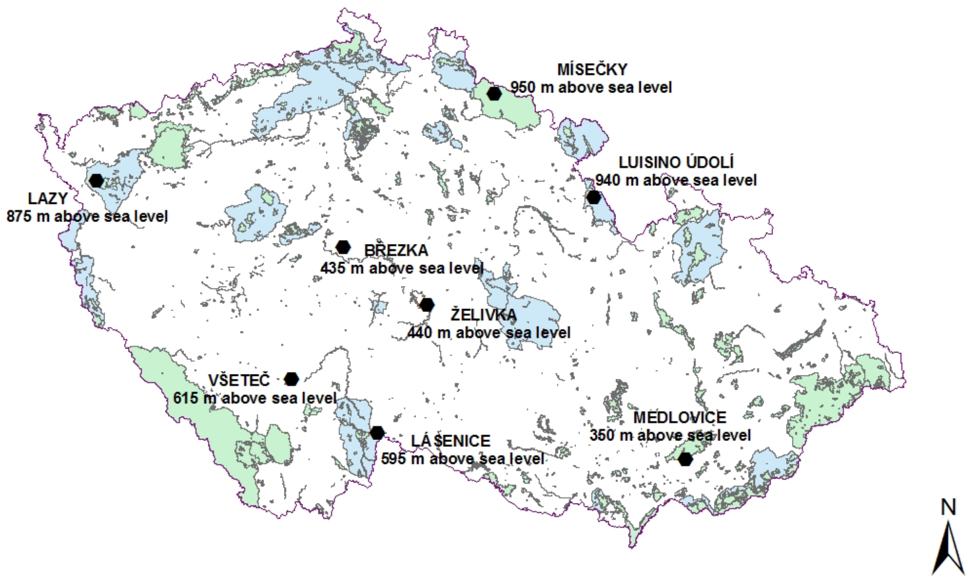
Introduction

The aim was to compare nitrogen atmospheric deposition to biodiversity in the eight forest plots of intensive monitoring (level II) included in the International Cooperative Programme for Forests (Figure CZ.1). The plots in question are Mísečky, Želivka, Lásenice, Všeteč, Lazy, Luisino údolí, Medlovice, and Březka. Monitoring of the forest plots operated by the Forestry and Game Management Research Institute has provided data on the environmental properties of the forests since 1994 (Boháčová et al. 2010). The evaluation of the relationships between nitrogen (N) depositions and biodiversity are partial results of the grant project entitled "Forest soil state as a determining factor of health state development, biodiversity and filling productivity and outside productivity functions of forests", which is performed under the sponsorship of the Ministry of Agriculture of the Czech Republic (Novotný et al., 2013). Atmospheric sulphur (S), oxidized and reduced N depositions, meteorological characteristics and soil properties, including soil solution chemistry, have been related to the forest ground vegetation (herbal floor). The data set incorporated into four tables was prepared for the last Call for Data 2012/14 and processed with the use of measurement data only.

Figure CZ.1 Location of the forest plots included in the Call for Data. Blue and green background areas in the figure belong to Nature 2000 and national protected areas, respectively. Source: Agency of Nature and Landscape Protection (2013).



Forests of the Czech Republic, indicated by the selected plots in Figure CZ.1, fall into four forest habitats according to typological classification. These are mostly beach wood forests characterized by classes L5.1 or L5.4 of the Catalogue (Chytrý et al. 2001), which comprise mountain acidophilous spruce-beech woodland Callamagrostio-villosae ass. (Mísečky), acid oak-beech woodland with Deschampsia flexuosa (Želivka), fresh beech woodland with Galium odoratum (Všeteč), acid fir-beech woodland of Deschampsio-flexuosae-Abietinum ass. (Lásenice) and acid spruce-beech woodland of Luzulo-Fagetum montanum ass. (Lazy). These habitats can be summarized as G1.7 Medio-European acidophilous beech forests in the EUNIS classification. Acid beech-oak woodland with Carex sp. (Březka) and fresh beech-oak forest with Luzula luzuloides and Galium odoratum (Medlovice), characterized by classes L7.1 and L6.4, respectively, can be compared with the category G1.8 Medio-European acidophilous oak forests. Another category consists of climax spruce stands with beech and maple admixture (L9.1) and can be classified into the EUNIS system as G3.2 Hercynian subalpine spruce forests (Luisino údolí). The transfer of typology of forests to EUNIS classes was carried out according to the above-mentioned catalogue (Chytrý et al. 2001).

Methodology

Table CZ.1 presents the main characteristics of the examined forest plots such as soil types and textures, background rocks, the main tree species and their average annual growth. The soil texture is represented by a soil layer of 40 centimetres from the surface. Annual growth of trees is represented by wood increments (in dry mass) calculated on the basis of tree height and thickness measurements (thickness of trees must be greater than 7 cm). Tree growth monitoring has been performed in five year intervals since 1999 (Mísečky, Želivka, Březka, Lazy) or 2004 (Všeteč, Lásenice, Luisino údolí, Medlovice). Most of the data was acquired on a monthly basis by a uniform methodology (Clarke et al. 2010). The data on precipitation, temperature and radiation were taken from continuous measurements. Their daily data were used and processed by the MetHyd model.

Soil properties such as the texture and basic chemical composition were measured in 2006. Soil characteristics in the table 'ecords' represent a soil layer of 40 centimetres measured from the surface. The data on slopes, aspects and altitudes were taken from the geographical map. Information on the values of 'TempC' and 'Theta' represent the annual averages of daily measurements in the period from 2005 to 2010. Parameters of the table 'DRpoint', such as concentrations of N, base cations, pH and alkalinity in the soil solution are observed in samples

Table CZ.1 Site characteristics of forest plots.

Site	Name	Trees	Annual average growth in kg ha^{-1} a^{-1}	Background rocks	Soil type	Soil texture
2015	Mísečky	Beech, spruce	1693.43	Biotitic slate	Podzols	Sandy loam
2161	Želivka	Spruce	3776.31	Paragneiss	Cambisols	Loam
2102	Březka	Oak and other deciduous	5254.66	Biotitic granodiorite with amphibole	Cambisols	Loam
2103	Všeteč	Beech	9506.05	Biotitic paragneiss	Cambisols	Sandy loam
2163	Lásenice	Spruce, beech, fir	6818.22	Dune sands	Podzols	Loamy sand
2251	Luisino údolí	Spruce	3716.73	Gneiss-migmatite	Podzols	Sandy loam
2361	Medlovice	Beech, oak, pine, larch	6542.20	Clay stone to sandstone glauconitic rocks	Cambisols	Sandy loam
2521	Lazy	Spruce	4034.95	Coarse-grained biotitic granite	Podzols	Sandy loam

collected under the soil organic layer in the given year. Values of Cpool, CNrat, bsat and Qle evaluate the top soil layer up to a depth of 10 cm.

Data on deposition measurements used for the elaboration of the table 'DRpoint' were assessed on the basis of bulk and throughfall samples and their analyses. Throughfall and bulk depositions have been measured since 1996 (1997) in four plots (Mísečky, Želivka, Medlovice and Lazy). Deposition data has been provided from the forest plot of Březka since 2000. The monitoring of the remaining forest plots began in 2003 or later (Luisino údolí in 2004). Stem flow samples were collected from the plots of the deciduous forests - in Medlovice, Všeteč, and Mísečky. Procedures for measurements in the forest plots are comparable with other deposition measurements within the ICP Forests and UNECE programmes. Total depositions for the forest ecosystem were calculated according to the methodology published in Draaijers et al. (1995, 1998). Total depositions of reduced N forms are derived from modelled dry depositions of ammonia in gaseous form (Zapletal 2013 in: Novotný et al. 2013).

The state of ground vegetation in the forest experimental plots (in the table 'Composition') is assessed using a semi-quantitative method of phytocenological snaps. The eight-member, modified, combined scale of abundance and dominance from Braun-Blanquet (1965) is used. The presence of all vegetation species in herb layers (used in this evaluation) was registered, and the coverage or respective number was visually estimated and classified within the following scale:

- r: very rare species, mostly only one or few individuals of negligible coverage
- +: rare species (at least two individuals in the plot) or few individuals of low coverage
- 1: frequent species, but of low coverage, or less frequent more dense coverage, 5% maximally (often individual bushes or rarer grasses)
- 2a: very frequent species (abundant) high number of small individuals of about 5% coverage, or lower number of bigger plants of 5-12.5% coverage
- 2b: same as 2a. Coverage always 12.5-25% of total area
- 3: coverage of species 25-50%
- 4: coverage of species 50-75%
- 5: coverage of species 75-100%

These items are considered for the average values of the coverage by the individual species of herbs in the given ranges. Items indicating very rare and rare species are interpreted as being 0.1% and 0.5% of the coverage, respectively. Item "1" represents 2.5% of the coverage in this report.

Biodiversity observations in forest plots were made in 2005 and 2009 in most cases. Some of the phytocenological snaps from localities were carried out earlier. For example, four sets of forest vegetation species snaps are available in the experimental plot of Medlovice (1998, 2001, 2005, and 2009). Similarly, biodiversity data were compiled for the years 1996, 2000, 2005 and 2009 in the forest plot of Želivka. The forest plot of Mísečky provides three phytocenological snaps from 1997, 2004 and 2009. Percentages of ground vegetation species coverage in the forest plots only represent herbs (herb forest layer). The composition of forest ground vegetation species in included in the table 'DRpoints' and its item 'DRpointID'. The table 'RefComposition' contains vegetation species occurring in all phenological observations in the forest plot and in the same density of coverage. They can be considered to be typical vegetation species of the site.

Results

Most of the data were compiled for the years of the phenological survey i.e. 2005 and 2009 with the exception of the plots of Medlovice and Želivka (observed four times), and Mísečky (observed three times). Atmospheric depositions of S and N for the given years were calculated from the measured data based on the average annual throughfall, as well as bulk and wet depositions. In addition to the data on atmospheric depositions, some measured parameters of soil properties and the soil solution of the soil horizon to a depth of 40 cm and the upper soil horizon to a depth of 10 cm, respectively, were also calculated. The forest ground vegetation with the most abundant vegetation types is represented by the herb layer.

This layer includes species sensitive to N as well as nitrophilous species. Some herbs are present only on a few less monitored plots and there is either a relatively small number of values for the evaluation or the species occur only sporadically. The maximum occurrence of herb species of vegetation (25-31) can be seen in the forest plot of Všeteč (site ID 2103) with an atmospheric N deposition of about 1280 eq ha^{-1} a^{-1}. Forest plots Želivka (site ID 2161) and Březka (site ID 2102) also show a high occurrence of vegetation species. The number of vegetation species in these plots was in the range of 22 to 26 in the period from 2005 to 2009, with atmospheric depositions of N in the range of 980 to 1230 eq ha^{-1} a^{-1}. On the contrary, the lowest number of ground vegetation species (7 species) was observed in the plot of Lásenice (site ID 2163) with atmospheric N depositions between 1170 and 1250 eq $ha^{-1}a^{-1}$. Ground vegetation species seem to be without a response to atmospheric deposition (both N and S). The relationship of total N depositions and total species coverage shows that vegetation coverage increases with an increase in atmospheric deposition of N (Figure CZ.2). Therefore, the influence of the site environment to dose-response relationships should also be included. If we select a site with a relatively long time series of measurements such as Želivka, for example, we observe a decrease in the number vegetation species at the site with an increase in atmospheric N deposition (Figure CZ.3).

Conclusions

There is an insufficient number of observations to exactly evaluate the extent of atmospheric N deposition. The relatively short time series of measurements and uncertainties in the current total

Figure CZ.2 Relationships between atmospheric N depositions and total coverage by ground vegetation species in the herb layer of forests (the item BIODIVINDEX in the table "DRpoint").

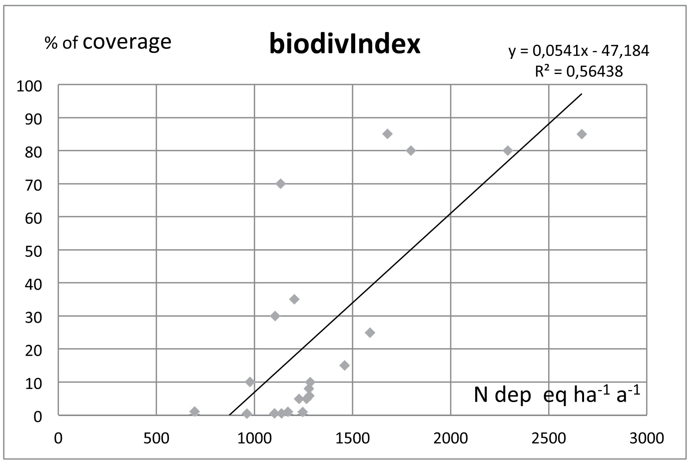
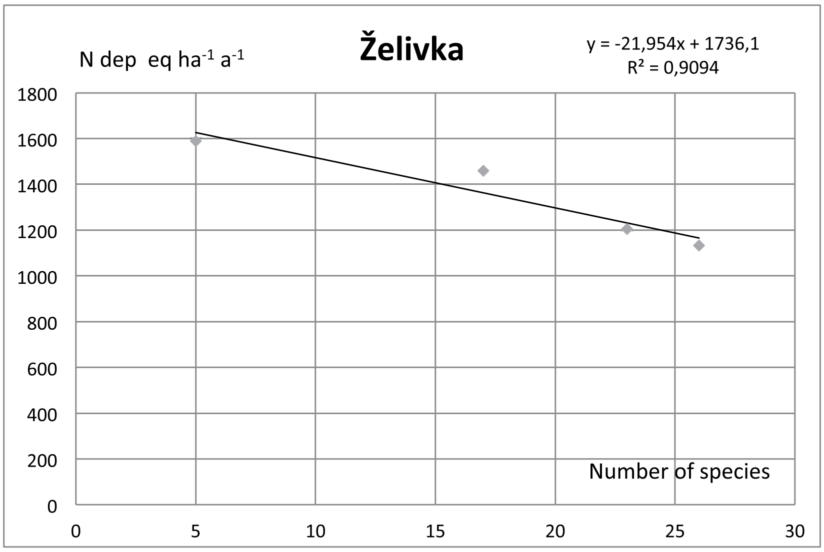


Figure CZ.3 Number of ground vegetation species in the forest plot of Želivka in relation to atmospheric N deposition (in 1996 » 2000 » 2005 » 2009).



atmospheric N depositions also create many obstacles to correct assessment. Biodiversity observations fall in the period with a relatively small gradient of atmospheric depositions of both N and S. The influence of delay in the effect of atmospheric deposition on ground vegetation species was not included in the evaluation. Ground vegetation species should be divided into species sensitive to N and N demanding species for future evaluation. Dose-response functions should also include the environment of the site summarised in the values of critical loads, for example.

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