

Fluxes of inorganic nitrogen in forest ecosystems from Romania



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Introduction/Aim

High levels of nitrogen depositions to forests can determine nutrient unbalances and move the ecosystem toward nitrogen saturation in the long term.

The paper presents the results of the annual fluxes of total inorganic nitrogen, monitored in forests from Romania in the period 1998-2007, analyses the trends and compare the levels to those considered critical in Europe.

Method

Inorganic nitrogen fluxes at three levels (bulk deposition, throughfall and percolation water) were studied at 4 intensive monitoring (level II) plots (fig. 1), established as a part of ICP Forests program in Romania.

Bulk deposition (BD) and throughfall deposition (TH) were collected every month during winter and spring and twice a month during summer and autumn, using 2 collectors in the open field (BD) and 6 collectors under the wood canopy (TH). Soil percolation water (PW) was collected twice a month during the snow-free period using 2 zero tension lysimeters located on each plot at a depth of 60 cm from the ground surface (excepting Ștefănești plot, where lysimeters were installed at 20 cm).

Samples were filtered through white box filter paper. NH_4^+ and NO_3^- were determined by spectrometry (Nessler's method and respectively the sodium salicylate method).

The monthly fluxes of NH_4^+ and NO_3^- were calculated by multiplying the amount of precipitation on each sampling occasion by the corresponding (volume weighted) concentrations and the annual deposition fluxes were determined as the sum of the monthly deposition fluxes.



Fig 1. Map of the sample plots

Table 1. Main characteristics of the plots

Plot name	Coordinates		Altitude (m)	Main tree species	Soil type
	Lat. N	Long. E			
Ștefănești	443034	+261038	90	Pedunculate Oak	Mollic Pre-luvisol
Mihăești	+450147	+245933	573	Sessile Oak	Luvisol
Rarău	+47 2654	+253351	1100	Coniferous + beech	Rendzic Leptosol
Fundata	+452559	+251611	1461	Beech	Eutric Cambisol

Results

The highest total nitrogen fluxes in bulk deposition were registered at Ștefănești, located close to the agglomeration of Bucharest, the capital of Romania, at the lowest altitude. Values exceeded 10 kg N/ha/year. For the other three plots, the inorganic nitrogen fluxes were comparable and generally lower than 10 kg N/ha/year. Increasing trends were significant (Fisher's test) at the plots located at low altitude (less than 600 m) and decreasing trends were significant at the plots situated at more than 1000 m.

Fluxes of inorganic nitrogen in throughfall showed no significant trends at Rarău and Fundata, plots located at more than 1000 m altitude. At Ștefănești, N fluxes significant increased, following the same trends as in bulk deposition. On the other hand, at Mihăești, significant decreasing N fluxes registered in throughfall, in opposition to the trends observed in bulk deposition. This might be determined by an increase in canopy nitrogen uptake, caused by the evolution of the forest health.

At the two plots, situated at less than 600 m altitude, the inorganic fluxes were low, compared to those registered in BD and TH. The soil type did not allow water to percolate the soil profile down to 60 cm (Ștefănești) or only very low water fluxes were registered (Mihăești: between 0-52 mm/year). For this reason, the results concerning the trends of inorganic N fluxes in percolation water for these two plots must be carefully interpreted. For the plots located at more than 1000 m altitude, a distinct significant decreasing trend of inorganic nitrogen fluxes was observed in percolation water collected at 60 cm.

Conclusions

A first factor indicating adverse impacts of nitrogen inputs in forest is elevated leaching of nitrogen, which may cause acidification of ground and surface water (WGE, 2004). Measurements at more than 100 ICP Forests level II plots concluded that leaching of nitrogen is generally negligible at sites where total input is less than 10 kg/ha/year.

Also, unbalanced nutrition hardly occurred on plots with such levels of deposition. This is the case of the plots of this study, located at more than 100 m altitude (Mihăești, Fundata, Rarău). Previous studies, realized by Ulrich et al. (1998), concluded that a constantly input of nitrogen above 5 kg N/ha/year could be considered as important.

At N inputs above 20 kg N /ha/year, nitrogen leaching is mostly elevated and sometimes is near or even above the N deposition. In these cases, unbalanced nutrition frequently occurs. Levels of N inputs above 20 kg N /ha/year were registered at Ștefănești (in 2004 and 2005), the plot located at less than 100 m altitude, but nitrogen leaching was not elevated, because water does not percolate the soil profile. In this case, nitrogen is accumulating in soil and can produce unbalanced nutrition on long term.

The results are in accordance with Barbu et al. (2002), which concluded that mean inorganic nitrogen fluxes are controlled by altitude and decrease with altitude increasing. The variability of precipitation and N fluxes were also higher at lower altitudes.

References

Working Group on Effects, 2004: Review and Assessment of Air Pollution Effects and their Recorded Trends. Working Group on Effects, Convention on Long-range Transboundary Air Pollution. National Environment Research Council, United Kingdom 68 pp.

Barbu, I., Iacoban, C., Popa, I., 2002: Researches on modeling of pollutant ions fluxes from the atmosphere in the main forest ecosystems from Romania. *Analele ICAS* 45: 187-198. (In Romanian).

Ulrich, E., Lanier, M., Combes, D., 1998: Dépôts atmosphériques, concentrations dans les brouillards et dans les solutions du sol (sous-réseau CATAENAT) – Rapport scientifique sur les années 1993 à 1996. Ed: Office National des Forêts, Département des Recherches Techniques, 135 pp.

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