

Fate of nitrogen in Spruce and Pine Ecosystems

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Abstract

Investigation at two permanent forest research plots - spruce - at Brenna (The Beskidy Mountains) and - pine - in Katowice (Upper Silesian Industrial Region) was carried out. The plots were equipped with collectors for bulk deposition, throughfall, and vacuum cup lysimeters (25 and 50 cm depth). The mean year concentration and annual load of NO_3 and NH_4 was calculated. The data obtained by measurements were compared with amounts suggested as critical loads for forest soil.

1. METHODS APPLIED

Collectors for bulk deposition and throughfall, and vacuum cup lysimeters were the same as those used in studies of Integrated Monitoring in Northern Countries. Samples were taken at monthly intervals, and analyzed for nitrates by Ion Chromatography. The concentration of NH_4 was determined using the Nessler method. Loads were calculated as kg/ha/year, based on concentration and volume of deposited rain or snow collected as bulk deposition and as throughfall.

2. RESULTS AND CONCLUSION

Data characterizing both deposition and soil solution are given in Table 1. At both locations, bulk deposition, throughfall and soil solution from both depths are acidic. As compared to bulk deposition, pH decrease by 0.7 units in Brenna, but a slight increase is observed in Katowice. An increase of pH, on both plots has been found in soil solutions. These differences in pH may be explained by soil properties (Godzik et al 1994). Annual mean concentrations of NO_3 and NH_4 in bulk deposition between Brenna and Katowice differ markedly. The increase of both NO_3 and NH_4 in throughfall in spruce stand has been found. The concentration of NO_3 in soil solution (25 cm) increases for both locations, but concentration of NH_4 is 1.6 times lower in soil solution for the Brenna site and 1.14 times higher for the Katowice site, when compared to concentration in throughfall (Table 1). The loads of nitrogen for both sites exceed the value suggested as critical values (Convention

on Long Range Transboundary Air Pollution). Annual loads calculated from bulk deposition were (kg/ha): 25.0 and 16.5 for Brenna, and 30.0 and 13.0 for Katowice, of NO_3 and NH_4 , respectively. Similar values of loads, in spite of significant differences in concentration, are due to amounts of precipitations: Brenna (1300 mm) and Katowice (700 mm). Based on the throughfall data, the following annual loads were found (kg/ha): 51.5 and 22.0 for Brenna, and 24.0 and 13.0 for Katowice, of NO_3 and NH_4 .

A significant decrease in NO_3 , and a smaller decrease in NH_4 concentrations in soil solution from 50 cm depth in Katowice were found.

Soil at the Brenna site has higher concentration of nitrogen than the soil of the Katowice site amounting to 1.8% and 1.0%, respectively [1]. The data indicate that the nitrogen supply from air pollutants is higher than the stands can use. The Katowice pine stand seems to be less saturated with nitrogen as compared to the spruce stand in Brenna.

These data are from a one year long investigation from which no firm conclusion can be made - at this time.

However:

1. Loads of nitrogen to both ecosystems exceed the suggested critical values, and
2. The amount of nitrogen from air pollution, deposited to the forest ecosystems studied is higher than required by ecosystems.

Table 1
pH and concentration [ppm] of nitrogen compounds in collected waters.

	Katowice			Brenna		
	pH	Concentration NO_3 NH_4		pH	Concentration NO_3 NH_4	
Bulk deposition	3.94	6.72	2.95	4.4	2.38	1.68
Troughfall	3.99	5.60	2.99	3.67	6.89	2.59
Soil solution 25 cm	4.09	6.97	3.4	4.22	8.49	1.6
Soil solution 50 cm	4.03	2.95	2.72	4.39	8.53	1.52

3. REFERENCES

- 1 S. Godzik, W. Łukasik, P. Poborski, T. Staszewski, J. Szdzuj, B. Andrzejczek, Oddziaływanie i obieg związków siarki i azotu zawartych w powietrzu i opadach w ekosystemach leśnych - badania w gradiencie stężeń i klimatu. Annual Report of Institute for Ecology of Industrial Air