STUDIES ON NUTRIENT FLUX IN TERRESTIAL ECOSYSTEMS

Summary

Two opposite systems of matter flux have been found in forest ecosystems: an oligotrophic system typical of pine forests and a eutrophic system typical of alder woods. The oligotrophic system is characterised by intensive withdrawal of nutrients (N, P, K) during leaf ageing in autumn, whereas in the eutrophic system these processes are weak. The system of nutrient flux determines the degree of the contribution of heterotrophic organisms to detrification processes, the rate and efficiency of nutrient release in the litter-soil system, and, consequently, the type of soil (mor or mull).

It has been found that during the flow of rainwater through the canopy, nutrients are absorbed by as well as released from the vegetation, depending on the modifying effects of some ions ($NH4^{+}$, Ca2+), the activity of phytophages, and soil fertility. It has been found that atmospheric $NH4^{+}$ is absorbed by the canopy at a high rate, and this absorption accounts for ion exchange in leaves (most often K^{+} and $Mg2^{+}$, occasionally Na+ and Zn^{2}+).

It has been found that marshlands do not function as barriers in the landscape. They only change the form of nutrient (N, P) transfer from inorganic to organic, whereas the total pool of nutrients remains unchanged. Drainage of marshland can yield a number of negative consequences such as very intensive nitrogen mineralization in soil leading to soil acidification, competition of $NH4^{+}$ ions with K^{+} leading to a potassium deficit followed by a decrease in the productivity of grassland ecosystems, and to the loss of metallic cations (Ca^{2+}, Mg^{2+}) from the ecosystem.

It has been found that the dying of spruce forests in the Karkonosze mountains is caused by trophic perturbations such as deficiency of some nutrients, disproportional supply of other nutrients (N-P, P-K), or toxic effects of such ions as Pb^{2+} and Al^{3+}. These trophic disturbances account for a reduction of chlorophyll production in spruce needles, for an increase in the production of secondary metabolites (polyphenols), and in the case of an extreme Mg^{2+} deficit they cause the death of leaves/needles and of the whole stands. The experiments with artificial leaves showed that trophic disturbances were due to a very large surface area of spruce leaves, capable of very effective capture of aerosol-gaseous forms of nutrients/elements from the atmosphere. As a result, spruce stands receive from the atmosphere high loads of nutrients that can eutrophicate (N, S), acidify (H+), or poison (Pb^{2+}).