GOLD NUGGET

Regulating Services – Atmospheric Composition And Climate Regulation Part 2

The Nitrogen Cycle

The nitrogen (N) cycle is the process by which nitrogen (N) is converted into its various chemical forms. Nitrogen is necessary for all known forms of life on Earth to produce proteins. A large portion of the N cycle takes place in the soil. The main nitrogen inputs to the soil are made through:

- biological fixation
- industrial fixation (i.e. commercial fertilisers)
- soil organic matter
- rain (deposition of industrial emissions)
- crop residues and animal manure

Nitrogen is present in the environment in a wide variety of chemical forms, including organic nitrogen, ammonium (NH_4^+), nitrite (NO_2^-), nitrate (NO_3^-), nitrous oxide (N_2O), nitric oxide (NO) and inorganic nitrogen gas (N_2). The main processes of the N cycle that transform nitrogen from one form to another are the following:

- nitrogen fixation is the process whereby atmospheric nitrogen is converted into ammonium
- ammonification or mineralisation is the conversion of organic nitrogen into ammonium
- nitrification is the conversion of ammonia into nitrates
- assimilation is the uptake of nitrogen from the soil by plants of either nitrate ions or nitrite ions
- denitrification is the reduction of nitrates back into nitrogen gas

Nitrogen Cycle and Soil Biodiversity

Firstly, bacteria or fungi convert the organic nitrogen from decaying animals or plants into ammonium (NH_4^+). A number of microorganisms (e.g. bacteria and fungi) are able to perform this first ammonification step. After ammonification, the chemical processes are carried out by specialist groups of bacteria. The nitrification process is carried out by bacteria called ammonia-oxidising bacteria (AOB), which convert ammonia into nitrites (NO_2^-) that are toxic to plants. Other groups of bacteria oxidise nitrites into harmless nitrates (NO_3^-) that are useful for plant growth. Nitrification processes are also carried out by groups of archaea called ammonia-oxidising archaea (AOA). Ammonium can also be directly produced from atmospheric nitrogen by nitrogen-fixing bacteria. Some of these microorganisms are free-living in the soil, whereas species of Rhizobium live in a symbiotic association with leguminous plants.

Plants can absorb ammonium or nitrate from the soil via their root hairs, or through symbiotic relationships with rhizobium bacteria. For the nitrates that are not absorbed by plants, denitrification can take place. This converts nitrate into atmospheric nitrogen, is performed by certain bacteria in anaerobic conditions.

Soil engineers, such as earthworms and termites, also influence the N cycle. Earthworm casts and burrows) are rich in microbial diversity and become preferred sites for a number of soil processes, such as nitrogen fixation. In conclusion, all the described steps clearly show the role played by soil biodiversity in regulating the N cycle.

Soil Lovers say: ***A Healthy Biodiverse Soil Needs No Industrial Nitrogen Inputs***

Ref: **A Global Atlas of Soil Biodiversity p105**