NUTRIENT NETWORK, OR NUTNET: A WORLDWIDE COLLABORATIVE EFFORT
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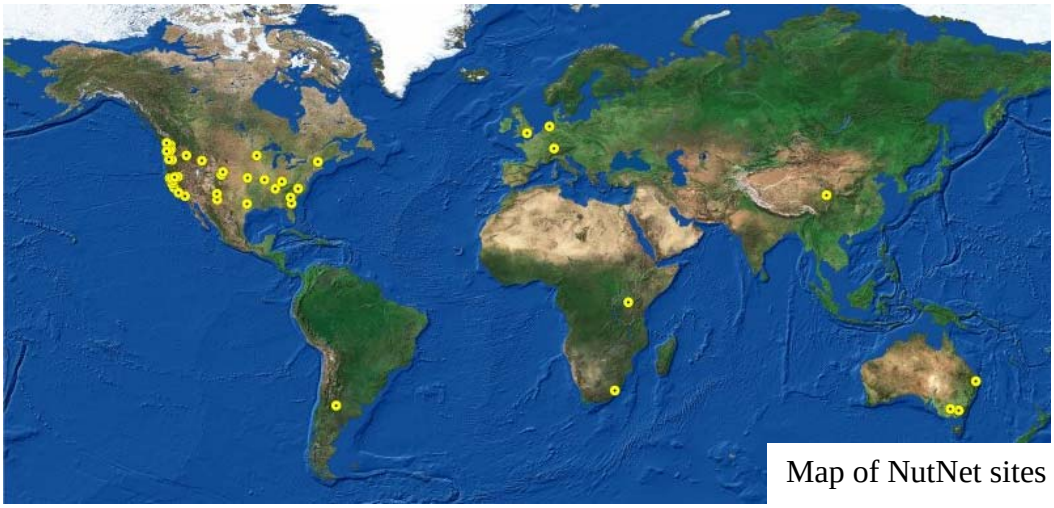
Background and summary

In order to exist and function in a sustainable way, ecosystems rely on a balance of nutrients, such as nitrogen, phosphorus, and carbon, and on a balance of consumers and producers native to the ecosystem. Ecosystems change when the balance of nutrients and organisms change. Over the last 60 years, human activity has affected the global budgets, or amounts, of nutrients available to different ecosystems. The increased use of fertilizers has caused the global pools of nitrogen and phosphorus to quintuple (multiply by 5), and fossil fuel combustion has caused the amounts of nitrogen and phosphorus to double, relative to pre-industrial levels.

At the same time, humans have impacted the organisms that are present in ecosystems around the world. Some organisms have lost habitats due to human development, such as urban growth. Other human activities, such as logging, mining, and pollution, have harmed or changed habitats. Selective hunting and fishing have caused the populations of specific organisms to decline, such as hunting for wolves and overfishing for salmon in Oregon. This has caused the proportion of consumers in food webs to change. Humans have affected ecosystems and foodwebs by adding organisms to various ecosystems to help with conservation, recreation, and agriculture. People have also introduced invasive producer and consumer species by accident. Human activities have unintentionally introduced problematic plants and animals like spotted knapweed, a weed that reduces forage and crop production, and one type of pine bark beetle that has destroyed acres of forests; these organisms are not native to Oregon, but they have become an important part of our ecosystem.

Humans have impacted the balance of nutrients and organisms in ecosystems around the world, including grasslands, an extremely important ecosystem type for grazing and crop production. However, no studies had previously been conducted on a global level to examine how these changes are impacting the world's grasslands. In order to understand and predict how this ecosystem type responds to environmental changes, such as increased amounts of nitrogen and phosphorus and species invasions and extinctions at a continental and global scale, a group of over 70 scientists are participating in a globally-distributed study.

These scientists came together to form the Nutrient Network, or NutNet, which has set the framework to establish identical experiments in grasslands all over the world. Over 70 scientists have set up more than 40 sites across North America, Europe, Australia, South America, Asia, and Africa. They are all working towards understanding the interplay between plants, nutrients, and consumers in this ecosystem using the same methods in each location.



Map of NutNet sites

Summary of study methods – for teaching the experimental details

Each experiment is set up in a grassland ecosystem and consists of 3 sets of 10 square plots. (Hence three trials for each test are conducted.) Each of the 10 square plots in a series is given a different treatment. The scientists want to understand how changes in the amounts of nutrients (nitrogen, phosphorus, and potassium) and grazers (e.g. elk, deer, antelope, or rabbits) affect the grassland ecosystems. To learn about the effects of nutrients on a grassland ecosystem, they have decided to study how the plots respond to different amounts of nitrogen, phosphorus, and potassium. Because they want to study the impact of consumers, they put fences around some of the plots. They plan to collect data from this experiment each year for at least 7 years.

Each year the scientists wait until the plants in the study sites have grown to their fullest capacity. At each site, in each plot, specific data is recorded. In each of the 30 plots at a site, a researcher identifies the species and the percent cover of all the plants growing within a specific area of the plot. The researcher records the amount of light available for photosynthesis above each plot and at ground level beneath the vegetation in each plot. Finally the researcher cuts and collects the vegetation in a measured strip within each plot to determine the amount of biomass produced in the plot in one year. At some sites, researchers are collecting insects within a square meter inside each plot by vacuuming them with an altered leaf blower, then freezing them for identification and counting.

The data from each site will be analyzed and then compared with the data of the other 40+ sites. The NutNet scientists will look for patterns across latitude, amount of precipitation, soil types, and correlations to see how changing the amounts of nutrients in an ecosystem affects the growth of plants and the presence of consumers in that ecosystem. They hope to provide information on a global scale about important societal issues such as how grassland ecosystems respond to eutrophication and grazing.