Cheatgrass invasion and soil microbial communities

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What about Cheatgrass?

How Cheatgrass Replaces Native Communities

Soil N in Cheatgrass Invaded Sites

Total soil N 796 studies

Nitrogenase/Nitrophilic Potential 23 studies

Soil NO3 - 35 studies

NO3 peaking in summer

Proposed Effects of Cheatgrass Invasion on Soil N Cycling

Aboveground – Belowground Interactions

Soil organisms play an important role in nutrient cycling, decomposition, and net formation. Aboveground plant communities and belowground microbial communities are linked through a variety of feedback mechanisms. Plant litter and dead root material provide resources for decomposition by soil microbes, while decomposers provide a substrate for nitrifying microorganisms which are favored by abiotic edaphic conditions and nutrient availability prior to native plant species such as shrubs and to a certain extent perennial grasses.

Belowground Interactions

Symbioses between plants and below-ground decomposers, while soil microbes recycle nutrients and make them available for plant growth. Plant roots can provide protection for soil microbes via root exudates, while microbes that colonize plant roots can provide protection for plant pathogens or serve a plant growth promoting role.

Soil N cycling in cheatgrass-dominated community

Aboveground biomass

Belowground biomass

Nitrogen fixation

Ammonification

Ammonia oxidation

Nitrate reduction

NO3

NO2

NO2

NO3

Belowground coupling

Aboveground coupling

Nitrogenase+ADP

ADP

ADP

Nitrogenase

Nitrogenase

Plant litter/roots

Dead root material

Decomposers

Nitrolytic bacteria

Nitrogen fixing bacteria

Nitrosomonas

Nitrobitillus

Nitrophilic bacteria

Community Level Physiological Profiles

The Bioloid is located in a sagebrush/bunchgrass community in the Eastern portion of the Great Basin in Utah on an elevation of 1300 m. Soil samples were collected with a 10 cm long core in March, May, July and August of 2014. Soil samples were dried, ground and stored at -20°C prior to extraction. Soil samples were extracted with 2 M KCl or an acid extraction solution, followed by wet chemistry analysis (SMART 2 colorimeter, LaMotte, Chestertown, PA), followed by cell enumeration analysis (BCG 2 colorimetric, LaMotte, Community Level Physiological Profiles). Soil samples were then used for analysis of nitrifying bacteria as follows: NOB (+) and NOB (-) bacteria were incubated in 96 well plates (Biolog, Hayward, CA) followed by incubation at room temperature. Absorbance readings at day 9, were used for Community Level Physiological Profiles (CLPP) were obtained by adding soil extracts in Ringer solution or PBS to ECO 96 well plates (Biolog, Hayward, CA) followed by incubation at room temperature. Absorbance readings at day 9, were used for Community Level Physiological Profiles (CLPP).

Community level physiological profiles of microbial communities in different cheatgrass invaded soil samples.

Soil N Cycling

Invasion of Highly Disturbed Sites

Invasion of Native Communities

The additional biomass provided by the roots of the annual grass Bromus tectorum has invaded substantial areas in the Intermountain West and has potential to have a negative effect on the native plant community. The invasion of cheatgrass has led to increased irrigation, supplemental water, and supplemental grazing. The presence of cheatgrass has been shown to increase the frequency of fires, especially during wet periods, and is a threat to the native plant community. In addition, cheatgrass has been shown to be responsible for its success as an invader (Eviner et al., 2010). However, this does not explain the increased frequency of fires, especially during wet periods, and the invasion of native sites.

The phenology (winter annual) and physiological (prolific seed production, tolerates low water potential for seed germination) characteristics of cheat grass, together with its trait to increase rangeland fire occurrence and intensity, have been suggested to be responsible for its success as an invader (Eviner et al., 2010). However, this does not explain the increased frequency of fires, especially during wet periods, and the invasion of native sites.

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