

Introduction: A Eurasian Invasion

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When I began my journey researching Northern Great Plains (NGP) natural areas in 1992, I knew little about prairie ecology but was enthusiastically learning all I could regarding the natural systems in the region I called home. Little did I realize, I was in the middle of an invasion which would change the trajectory of NGP ecosystems forever. One concept that I was introduced to during this time was what Range Ecologists referred to as the Historic Climax Plant Community (HCPC) of an Ecological Site, which focused on the strictly historic native plant community of a particular soil type within an ecoregion. My research was focused in the Prairie Pothole Region (PPR), and as I searched for these HCPCs, I actually never saw one of these plant communities fully intact. The primary species which was dominating many of these sites, especially the deeper soils, was Kentucky Bluegrass (*Poa pratensis* L.). I spent much of my early career researching plant community differences of wetlands in the PPR within a number of different land management scenarios like cropland, urban areas, hay fields, Conservation Reserve Program (CRP) lands, native prairie under different fire and grazing regimes, etc. I noticed much of CRP, roadside revegetation, and hay fields were being planted with Smooth Brome (*Bromus inermis* Leyss.) as a primary component. At the same time, I noticed Smooth Brome would invade native prairie rangelands, often starting along roads and slowly progressing inwards. I was also fortunate to conduct research in the western PPR and south and west of the Missouri River. In those areas, I was seeing vast areas which were planted into Crested Wheatgrass (*Agropyron cristatum* (L.) Gaertn.), and wherever it was established, little else grew. It was evident, when I encountered one of these three species dominating an area, there was a lack of diversity and an overall lack of ecosystem functioning. A number of other people within the NGP were noticing the same invasive species, and seeing similar consequences of their invasion.

By the 2000s, it was widely accepted there were indeed introduced invasive cool-season perennial grasses which had changed NGP native prairies. A great deal of the initial research on these species was focused on the extent of invasion and the impacts of invasion on species diversity, nutrient cycling, and physical parameters. We noticed Smooth Brome was invading native prairies which had a long history of rest (i.e., no grazing, no fire, no mowing), and Kentucky Bluegrass was invading native prairies with a long history of grazing and especially ecological sites with deeper soils (e.g., loamy). Several individuals came together during this time from academia and the federal government (i.e., USFWS, NRCS, USDA, USGS, NPS) of North and South Dakota to discuss issues behind these two species. A number of research directions unfolded during this time including: extent of invasion; impact on native diversity; genetic background of invasive species; role of climate, plant-soil feedbacks, physiological mechanisms, socio-economic impacts; and, most importantly, possible management scenarios to protect the remaining native prairie in the NGP (i.e., fire, grazing, herbicides, mowing, combinations).

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Many from the aforementioned group of people decided in 2013 it would be beneficial to come together and report on the progress being made on the understanding of these species. Thus, the “Cool-Season Invasive Grasses of the Northern Great Plains Workshop” was developed and held in Fargo, North Dakota, in March 2014. The Workshop was open to all in the NGP and a total of 177 people attended, spanning the NGP of the United States and Canada. Presentations at the Workshop covered Kentucky Bluegrass, Smooth Brome, and Crested Wheatgrass in relation to much of the research which was being conducted in the 2000s. At the end of the Workshop, attendees were surveyed about what they learned, and future research and educational directions. The main areas of interest for future research and education were use of prescribed fire (timing and frequency), grazing impacts on private and federal lands, impacts of invasion on wildlife habitat (especially species of concern), and potential of restoration by seeding native species.

After the Workshop, many delved into researching the areas of interest discussed, and our knowledge of these species increased, and of course new questions arose. After several years of exploring these areas, it was decided we needed to come together again, and thus we developed “The Second Perennial Cool-Season Invasive Grasses of the Northern Great Plains Workshop” which was held in Fargo, North Dakota in March 2023. The Workshop hosted 199 attendees from throughout the NGP. There were 19 oral presentations and 7 poster presentations on research related to the research and educational areas from 2014. At the end of the Workshop there was a roundtable discussion where all attendees could participate to help steer future research on these species. All felt the Workshop was highly successful, and there was a need to keep getting findings out to a larger audience. Fortunately, we were approached by “The Prairie Naturalist” to develop a special issue based on the Workshop. This is that issue.

Our opening paper is an overview of Kentucky Bluegrass, Smooth Brome, and Crested Wheatgrass based on a desire to understand plant-soil feedbacks, which was a primary need identified at the roundtable discussions. The next 5 articles are related to fire, grazing, and a combination of fire and grazing. We tackle the questions: what is proper timing of fire to impact Smooth Brome, can we change plant community composition through fire and grazing, how is Monarch Butterfly habitat affected by fire and grazing, can interseeding improve prairie with active grazing and burning, and can fire and grazing along with herbicide improve species composition? We finish the special issue with a discussion of the role of climate change in the invasion dynamics of these species, and what we should consider moving forward in relation to future climate trends. We thank *The Prairie Naturalist* for this special issue, and we hope this will be a valuable resource to practitioners now and into the future.