Evaluating plant biodiversity measurements and exotic species detection in National Resources Inventory Sampling protocols using examples from the Northern Great Plains of the USA

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ABSTRACT

Native plant biodiversity loss and exotic species invasions are threatening the ability of many ecosystems to maintain key functions and processes. We currently lack detailed plant biodiversity data at a national scale with which to make management decisions and recommendations based on current conservation challenges. We collected plant biodiversity and exotic species richness data from 4 sites in the Northern Great Plains using the modified Whittaker (MW) and Natural Resources Inventory (NRI) methods to evaluate any major differences between indicators generated from these methods and offer recommendations based on findings. Our data indicated that the NRI protocols underestimated both total plant species richness and exotic species richness compared with the MW approach. More importantly, however, results show that biodiversity indicators from the two methods showed similar trends. Increasing time spent on making species richness measurements and implementing a more systematic approach to detecting species within a plot could improve biodiversity inventory and monitoring efforts in NRI while also providing a link between existing long-term data and any new information collected. These adjustments would ultimately help those interested in adopting NRI methods and using plant biodiversity data to increase the amount and quality of information collected.

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1. Introduction

Native plant biodiversity loss and exotic species invasions are threatening the ability of many ecosystems to maintain key ecological functions and processes (Hooper et al., 2012). Plant biodiversity data (IPCC, 2007) are needed to make conservation and management decisions and recommendations (Mack et al., 2007; Hooper et al., 2012; Symstad and Jonas, 2011). The National Resources Inventory (NRI) is an inventory of land use and natural resources on U.S. non-Federal lands (Nusser and Goebel, 1997), which provides indicators to estimate plant biodiversity among others. The NRI effort is led by the US Department of Agriculture, Natural Resources Conservation Service (NRCS) but the US Department of Interior, Bureau of Land Management, has also adopted NRI protocols for national implementation through the Assessment, Inventory and Monitoring strategy (Toevs et al., 2011). There is a need for determining how accurate plant biodiversity and exotic species data from NRI methods are, due to their increased adoption and the potential for indicators from these methods to be used for large-scale management decisions.

The NRI biodiversity measurement and exotic species detection methods consist of a combination of line point intercept data and a 15 min timed search in which all species encountered within circular 1642 m^2 plot are recorded. The modified Whittaker plot technique is a multiscale plot sampling approach with nested plot sizes and no specified time limitations (Stohlgren et al., 1995).
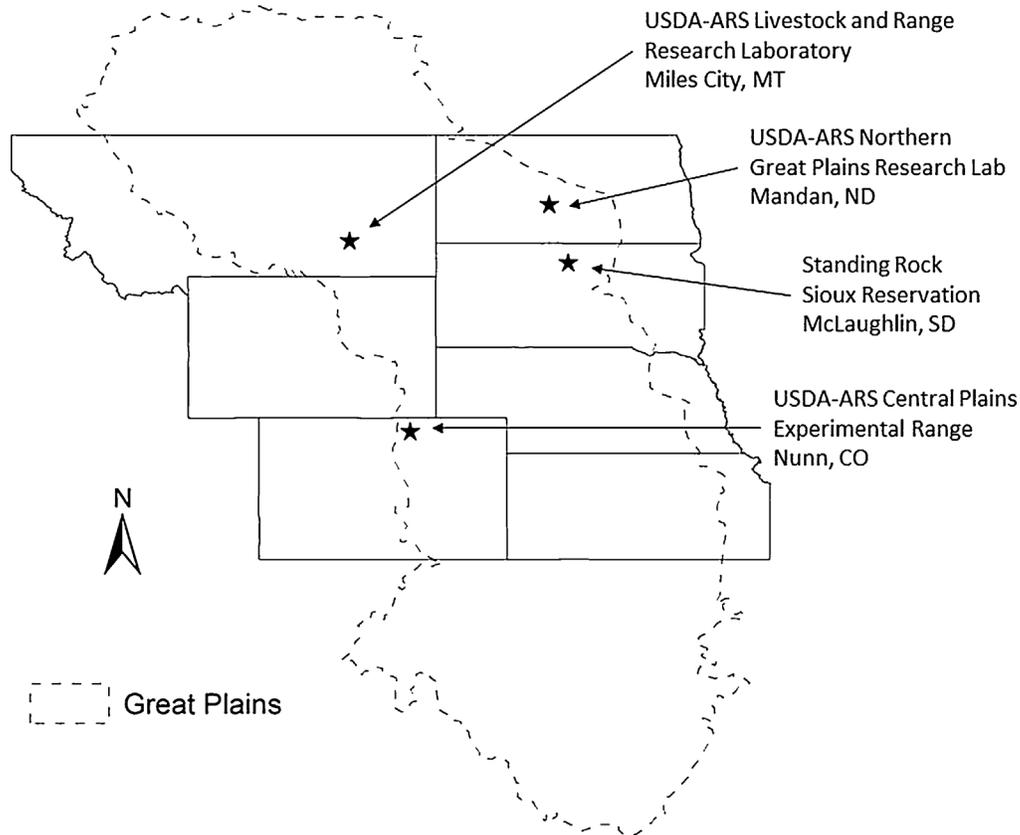
Fig. 1. Map of the Northern Great Plains region marking study locations.

Although the NRI biodiversity protocols have not been specifically compared with other methodology, Stohlgren et al. (1998) suggested that less intensive, single scale plant biodiversity measurements may miss a relatively large number of species, many of them exotic invasive species in their initial stages of colonization, and many (if not most) rare species. Methods such as the modified Whittaker plot can be time consuming and require a very location-specific set of plant ID skills. However, the quality of the species richness indicators gathered from this method and its ability to detect invasive or exotic species before they become a problem make it a cost-effective method (Stohlgren, 2007; pp.132–135). Our objective is to compare NRI methods used for biodiversity data collection with biodiversity data from the modified Whittaker method. We will compare these two methods to determine if NRI is accurately measuring indicators related to plant species richness and presence of exotic species across the Northern Great Plains and to determine the degree of precision around NRI species richness estimates.

2. Methods

2.1. Study areas

This study included 4 different locations in the Northern Great Plains region of the USA: The Standing Rock Sioux Reservation (SRSR, $n = 12$), the USDA–ARS Northern Great Plains Research Lab (NGPRL, $n = 15$), the USDA–ARS Central Plains Experimental Range (CPER, $n = 8$), and the USDA–ARS Livestock and Range Research Laboratory (LRRL, $n = 8$) (Fig. 1). Study locations represented four different prairies with a variety of vegetation compositions and structures (Table 1). A variety of sites were subjectively chosen within each location to encompass as much within-site variation as possible. At each site within each location a modified Whittaker plot was measured and then an NRI plot was superimposed as described below (Fig. 2). To avoid having parts of a plot or transect being on different ecological sites and potentially confounding our results, care was taken during plot layout to ensure all

Table 1
Study location, historically dominant vegetation, number of plots per location, primary ecological site, average precipitation and geographic position of locations sampled for NRI and modified Whittaker method comparison.

Study location	Historically dominant vegetation	Plots	Primary ecological site	Average precipitation (mm)	Latitude	Longitude	Elev. (m)
Standing Rock Sioux Reservation	*Pascopyrum smithii, Bouteloua gracilis, Nassella viridula*	12	Thin Claypan and loamy	411	45.445530	–100.3978	549
USDA – ARS Northern Great Plains Research Lab	*Pascopyrum smithii, Nassella viridula*	15	loamy	411	46.77887	–100.9064	591
USDA – ARS Central Plains Experimental Range	*Pascopyrum smithii, Heterostipa comata, Koeleria macrantha*	8	loamy	340	40.822588	–104.7115	1626
USDA – ARS Livestock and Range Research Lab	*Nassella viridula, Pascopyrum smithii*	8	silty	353	46.405394	–105.9544	820