**Objective:** Develop improved or modify existing ecologically based decision-support tools to aid land managers in selecting utilization, conservation and restoration strategies for hay and grazinglands in mixed-land use areas of the Great Plains.

**Hypothesis:** With modification for regional variation, estimates of plant species richness and diversity can be used as an indicator of rangeland health in the Great Plains. We hypothesize that: (i) sites with greater exotic species presence will have reduced plant species diversity; and (ii) plant community (functional group) composition will depart significantly from ecological site descriptors with increased disturbance or more recent land-use changes.

**Introduction:** The unique design of the Whitaker method reduces autocorrelation among subplots, which is common in standard transect methods (Goslee, 2006). Grassland scientists worldwide use this standard technique to quantify and monitor plant diversity on, for example, Serengeti grasslands (Anderson et al., 2006), South African serpentine grasslands (Reddy et al., 2009), and rangelands in Turkey (Firinciglu et al., 2007) among many other environments. In addition, Sanderson at the NGPRL and Goslee at ARS University Park have developed a large database on plant species diversity of grazing lands in the U.S. (nearly 300 sites sampled using the Whitaker plot method). The use of the standardized Whitaker plot method allows us to combine data from the northern Great Plains with other databases worldwide for larger-scale meta-analyses. The multiscale technique also enables comparison of vegetation dynamics at multiple scales.

**Study Sites:** Plant species inventories of grazing lands were conducted at the Northern Great Plains Research Laboratory, Mandan, ND. Rangeland pastures were chosen to represent different ecological sites and land-use history. Sampling sites were on toeslope, midslope, and summit positions in each of four pastures that vary in age and invasion by cool-season exotic grasses (NGPRL, ND). These sites were chosen because the management history and previous vegetation composition are known.

**Data Collection**

**2011**: 33 Modified Whittaker plots were measured at USDA-ARS Northern Great Plains Research Laboratory (NGPRL). Soil chemistry analysis was performed by Ward labs.

**2012**: 12 plots at NGPRL and soil chemistry analysis was performed by Ward labs.

At each site a multiscale plot sampling approach with plot sizes of 1, 10, 100, and 1000 m2 (the modified Whittaker plot technique; Stohlgren et al., 1995; Stohlgren, 2007; Tracy and Sanderson, 2000; Goslee and Sanderson, 2010; Figure 3) was used to quantify plant species cover, richness, and pattern diversity. Plots were georeferenced. All species present within a 20 by 50 m area were recorded, and percentage canopy visually estimated within ten 1 m2 quadrats (2 by 0.5 m) distributed in the larger plot. Species richness was also recorded in subplots of two intermediate sizes (2 by 5 m and 5 by 20 m) at the entire 1000 m2 plot. We focused on species abundance from the 1 m2 quadrats, and species richness at the 1 m2 and 1000 m2 scales.