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## **Impacts of leafy spurge on local and landscape patterns of plant species diversity in Theodore Roosevelt National Park**

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### **Abstract:**

This study was conducted in the South Unit of Theodore Roosevelt National Park, North Dakota. Five grassland, ten shrubland, and six woodland community types were identified and evaluated in 1997 using the Field Methods for Vegetation Mapping and National Vegetation Classification System documents prepared by The Nature Conservancy (TNC) for the National Vegetation Mapping Program. Seven of the identified communities were found to be currently infested with leafy spurge and were evaluated using TNC procedures. Information on local patterns of diversity were evaluated from Trammell and Butler (1985, *J. Wildl. Manage.* 59(4):808-816). Because the invasion of leafy spurge into the Park is a relatively recent phenomenon, historical species richness for the seven communities was estimated from autecological and phytosociological studies conducted prior to 1985. A similarity matrix using species presence was calculated among 1997 sampled communities for both infested and non-infested communities and pre-1985 sampled communities. Percent foliar cover was used to calculate Shannon Diversity Indices for infested and non-infested communities sampled in 1997.

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**Table. Patterns of local and landscape levels of mean species richness and mean Shannon's Diversity Index in response to heavy infestations of leafy spurge in Theodore Roosevelt National Park. Effects of infestation on mean diversity and richness within each community type were compared using a 2-sample *t*-test (\* =  $P < 0.05$ )**

Community Type	Local Patterns				Landscape Patterns			
	Species Richness		Shannon's Diversity		Species Richness		Shannon's Diversity	
	Infested	Non-infested	Infested	Non-infested	Infested	Non-infested	Infested	Non-infested
Cottonwood	na <sup>1</sup>	na	na	na	15	22*	2.26	2.94*
Silver Sagebrush	13	15	1.96	1.89	8	29*	1.43	2.21*
Green Ash	26	31*	2.68	2.59	14	31*	1.86	3.09*
Juniper Slope	19	24*	2.24	2.18	15	26*	2.08	2.80
Buckbrush	na	na	na	na	6	13*	1.13	1.39
Needle & Thread	12	13	1.64	1.68	10	21*	1.83	2.78*
Western Wheatgrass	na	na	na	na	6	18*	1.08	2.28*

Similarity values averaged 74% (range = 68% to 90%) between 1997 and pre-1985 sampled communities at the landscape level. This suggests that the TNC protocol used in evaluating infested and non-infested communities was adequate for detecting the majority of the species present in each community type. Mean species richness was significantly lower for the two woodland communities evaluated at the local level. However, no difference in mean Shannon diversity values between infested and non-infested communities was observed. These results indicate that species not recorded on infested sites were probably minor constituents of the community type and had little effect on the diversity index. In contrast, mean Shannon diversity values were significantly reduced by heavy infestations of leafy spurge for all seven communities evaluated at the landscape level. The loss of species on infested sites at this level is also reflected in reduced mean diversity values. Further, similarity values among 1997 sampled non-infested communities, pre-1985 sampled communities, and heavily infested communities was reduced to an average of 49%. Consequently, communities infested with leafy spurge are now compositionally less rich compared to their current non-infested counterparts and their historic (pre-1985) non-infested counterparts. Decreases in similarity and diversity values likely reflect a combination of the local extinction of infrequent species and a reduction in frequency and cover for the common species. Several species, identified as consistent components of several non-infested communities, were conspicuously absent from infested communities. Depending on the redundancy of species across the landscape, such a trend strongly suggests that some species may be reduced by heavy infestations of leafy spurge to the point of local extinction in the Park.