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Effects of Increased *Heteropogon contortus* (Tanglehead) on Rangelands: The Tangled Issue of Native Invasive Species☆

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ABSTRACT

Heteropogon contortus recently and rapidly increased in dominance in grasslands where it once had been a minor component. Ecological effects of this increase are unknown, but land managers are concerned about the potential negative economic and ecological impacts. We examined compositional and structural characteristics of the vegetation community along a gradient of dominance of *H. contortus* to quantify changes, compare the effects to invasions by nonnative grasses, and provide insights about management. As *H. contortus* increased, grass richness decreased across the gradient by 6 species·m^{-2} (95% CI: 2 − 10) in summer and 10 species·m^{-2} (6 − 15) in winter. Cover of other native grasses decreased 8 − 10% in both seasons for every 10% increase in *H. contortus*. Presence of seven individual plant species and cover of five species decreased, but presence of five species and cover of one species increased with *H. contortus*. Canopy cover increased and soil nutrients were higher in dense *H. contortus*, potentially facilitating further ecological changes. We suggest that managing *H. contortus* and other species that become invasive within the ecosystem where they were once native likely requires reducing rather than wholly eliminating the species, which may differ from management strategies for nonnative species.

Introduction

Species invasions have altered the structure and function of ecosystems worldwide (D'Antonio and Vitousek, 1992). Although invasions by nonnative species have been examined most often, population outbreaks can also occur in native organisms (Valéry et al., 2008). Alpert et al. (2000) suggested that an invasive species is any species that "both spreads in space and has negative effects on species already in the space that it enters." Essentially, a species does not need to move from one geographic region to another to become invasive. Likewise, Valéry et al. (2008) stated that invasion could result from a "change OF the environment," such as nonnative invasion from one geographic location to another or a "change IN the environment," meaning anthropogenic changes in native communities could allow a native species to become invasive (e.g., de la Cretaz and Kelty, 1999; Nielsen et al., 2011; Carey et al., 2012). Despite this, many native species may not be recognized as invasive because increases in dominance generally are assumed to be natural shifts in the community (Simberloff and Vitule, 2014).

Heteropogon contortus (tanglehead) is a perennial bunchgrass found in semitropical grasslands throughout the world, including northern Mexico and the southwestern United States (Heuzé et al., 2013). *Heteropogon contortus* forms small stands and typically has been a minor component of the vegetation community (Johnston, 1963; Tjelmeland, 2011). Within the past 15 − 20 years, however, this grass has become the most dominant species in rangelands of southern Texas (Tjelmeland, 2011), resulting in visible changes to rangelands and perceived negative impacts on economic resources. This rapid shift in dominance seems to have originated from a single point and has now spread to > 150 km^2. Although we do not have direct evidence supporting a "change of" or "change in" the environment, the sudden shift may be related to anthropogenic changes, namely a reduction in grazing, given that land management has shifted from cattle production to recreational hunting (Smith, 2009; Tjelmeland, 2011). The change in land management has the potential to help *H. contortus* become invasive because reduced grazing pressure increases seedling recruitment, seed production, and plant survival (Grice and McIntyre, 1995; Orr et al., 2004; Heuzé et al., 2013) and fire, used to improve wildlife habitat, can increase recruitment (Tjelmeland, 2011). Alternatively, a nonnative variety could be responsible for the increased dominance as two phenotypic varieties have been proposed, one that is much more abundant, but we lack supporting genetic evidence (Tjelmeland, 2011).

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We sought to determine if increased dominance of *H. contortus* has negative effects on vegetation composition and structure in grasslands and, therefore, should be managed as a native invasive species or if this grass is simply a native species undergoing population changes. If the increased dominance of *H. contortus* has resulted in ecological effects similar to those documented with other invasive grasses, we predicted that richness and cover of other native plants would be lower and vegetation structure in invaded areas should differ from more diverse communities (D'Antonio and Vitousek, 1992; Sands et al., 2009). We also predicted soil nutrients would differ with *H. contortus*, as has been observed with several other species of nonnative invasive plants (Ehrenfeld, 2003; Dassonville et al., 2007). If the increase in *H. contortus* can be considered an invasion, this grass would add to the scant literature on native invasive species that invade their original range and ecosystem.

Methods

Study Area

Our study area lies in semiarid grasslands within the Tamaulipan Biotic Province, at the convergence of Gulf Coastal Grassland and Tamaulipan Thornscrub (Johnston, 1963; Jahrsdoerfer and Leslie, 1988; Fulbright et al., 1990). We chose several pastures on the Borregos and Alta Vista ranches (~19 km apart) in Jim Hogg County, Texas because natural or mechanical disturbance was minimal, grazing had been maintained at a stocking rate of 0.1 animal unit·ha^{-1} (~3× lower than 30 years ago), and the increase in *H. contortus* was first reported here. A mosaic of grasses and brush characterizes these grasslands, but woody vegetation primarily occurs in 0.02- to 0.24-ha stands of *Prosopis glandulosa* (honey mesquite). Sandy ridges throughout the site are composed of bare ground, semiwoody *Monarda punctata* (spotted beebalm), and short grasses. The climate is both semiarid and subtropical punctuated by rainfall extremes, such as high rainfall in 2009 − 2010 and droughts in 2008 − 2009 and 2010 − 2013 (South Central Climate Science Center, 2013).

Sampling

We randomly selected 70 study plots (125-m radius) in relatively open grasslands with *H. contortus* ranging from 0% to 80% relative cover (0 − 60% absolute cover). Plots were > 325 m apart, > 150 m from large woody thickets, > 125 m from two-tracks/roads, and had minimal woody vegetation and nonnative grasses. We sampled vegetation four times. Summer (June) sampling occurred during a wet (2010) and dry (2011) growing season, and winter (January/February)

Table 1
Estimated linear change in compositional and structural characteristics of the vegetation for every 10% increase in of *Heteropogon contortus*, after accounting for covariates ($n = 70$ plots) along with 95% confidence intervals and *P* values, Jim Hogg County, Texas, 2010 − 2011. To reflect the magnitude of the effect differing between years, estimates are presented in separate rows, with 2010 first and 2011 second. Numbers in bold indicate a significant difference.

Variable	SUMMER		WINTER	
	Estimate (LCI, UCI)	*P*	Estimate (LCI, UCI)	*P*
Richness (number of species)				
Native grasses	**-5.6 (-10.4, -1.6)**	**0.009**[1]	**-10.4 (-14.8, -6.0)**	< **0.0001**[a]
Forbs	**-8 (-14.4, -2.1)**	**0.03**		
	0.6 (-5.1, 6.6)			
Absolute cover (percent)				
Native grasses	**-7.5 (-8.8, -6.2)**	**0.0004**	**-10.1 (-10.9, -9.3)**	< **0.0001**
	-10.4 (-11.5, -9.2)			
Forbs	**-2.1 (-3.2, -1.1)**	**0.0003**		
	0.3 (-0.6, 1.2)			
Non-native	0.3 (-0.3, 0.9)	0.32	0.4 (-0.4, 1.1)	0.31
Bare ground	-2.4 (-3.5, -1.3)	0.07	**-1.1 (-1.9, 0.2)**	**0.02**
	-1.1 (-2.1, -1.7)			
Leaf litter	-0.04 (-0.8, 0.7)	0.9	1.4 (0.3, 2.4)	0.08
			1.0 (-0.7, 1.4)	
Total cover	**1.0 (0.4, 1.5)**	**0.001**[a]	**2.4 (1.8, 3.0)**	**0.02**
canopy-level			**1.6 (1.0, 2.2)**	
Vertical structure (number of contacts)				
Density	**11.0 (5.9, 16.1)**	**0.0009**	2.1 (-1.8, 6.0)	0.29[a]
ground-level	**1.1 (-3.2, 5.5)**			
Density at	**3.6 (2.5, 4.6)**	< **0.0001**	**2.3 (0.1, 3.5)**	**0.0006**[a]
canopy-level	**0.0 (-0.9, 0.9)**			

[a] $df = 68$. For analyses of all other variables, $df = 67$.

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