



The role of prescribed burn associations in the application of prescribed fires in rangeland ecosystems



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ABSTRACT

Risk and liability concerns regarding fire affect people's attitudes toward fire and have led to human-induced alterations of fire regimes. This has, in turn, contributed to brush encroachment and degradation of many grasslands and savannas. Efforts to successfully restore such degraded ecosystems at the landscape scale in regions of the United States with high proportions of private lands require the reintroduction of fire. Prescribed Burn Associations (PBA) provide training, equipment, and labor to apply fire safely, facilitating the application of this rangeland management tool and thereby reducing the associated risk. PBAs help build networks and social capital among landowners who are interested in using fire. They can also change attitudes toward fire and enhance the social acceptability of using prescribed fire as a management practice. PBAs are an effective mechanism for promoting the widespread use of prescribed fire to restore and maintain the biophysical integrity of grasslands and savannas at the landscape scale. We report findings of a project aimed at determining the human dimensions of using prescribed fire to control woody plant encroachment in three different eco-regions of Texas. Specifically, we examine membership in PBAs as it relates to land manager decisions regarding the use of prescribed fire. Perceived risk has previously been identified as a key factor inhibiting the use of prescribed fire by landowners. Our results show that perceived constraints, due to lack of skill, knowledge, and access to equipment and membership in a PBAs are more important factors than risk perceptions in affecting landowner decisions about the use of fire. This emphasizes the potential for PBAs to reduce risk perceptions regarding the application of prescribed fire and, therefore, their importance for restoring brush-encroached grasslands and savannas.

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1. Introduction

The combined effects of increasing population densities, excluding fire, extending fire intervals, overgrazing, and drought have produced an increase in woody plant species, thereby altering the grass dominated nature of grassland and savanna ecosystems (Archer, 1994; Archer et al., 1995; Higgins et al., 2000; Langevelde et al., 2003). Fire suppression and the resulting increase of woody species generally result in a series of associated cascading biophysical effects, including decline in the quality of wildlife habitat, reduced herbaceous biomass production, reduced surface water infiltration, increased surface water runoff, increased soil erosion,

and altered biogeochemical cycles (Brown and Rollins, 2005; Holechek and Hess, 1994; Martin and Morton, 1993; Bhark and Small, 2003; Archer, 2001; Backer et al., 2004; Davenport et al., 1998; Reid et al., 1999). These deleterious effects may extend across spatial boundaries and influence not only local areas but also watersheds and whole regions.

Although the ecological thresholds for restoring these fire-adapted ecosystems back to their original state are better understood than in the past, the key hurdle to reintroducing historical fire regimes at landscape scales is a social one (Dombeck et al., 2004). Prescribed fires have not been used as a restoration tool to the extent needed, mostly because of safety and legal liability concerns (Kreuter et al., 2008). These constraints increase as wildlands become encroached by urbanization (Smeins et al., 2005). Perceptions of risk are not only affected by education and experience but also by individual and societal values (Slovic, 1987; McCaffrey, 2008). From an individual's standpoint, motivation and perceived self-efficacy are important determinants of behavior (Grothmann

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and Patt, 2005). Landowners rarely have sufficient labor, equipment, and insurance to carry out prescribed burns on their own, which potentially increases the perception that applying fire is risky. In order to achieve landscape-scale fire-driven ecosystem changes across boundaries, individual constraints to applying prescribed burns must be understood and overcome (Toledo et al., 2012).

Cooperation in addressing landscape-scale environmental problems combines individual efforts to achieve an outcome that exceeds the sum of individual efforts (Ostrom, 1990; Yaffee, 1999). Prescribed burn associations (PBAs) are a promising tool to address individual constraints and achieve landscape-level outcomes (Toledo et al., 2012, 2013; Taylor, 2005). PBAs are non-profit entities started by, and composed of volunteers who seek to collectively and cooperatively restore or maintain rangelands through the application of prescribed fire (Taylor, 2005; Kreuter et al., 2008). Members are mostly comprised of landowners with properties that are sufficiently large to apply fire but other private citizens and state and federal employees, may be also be members (Taylor, 2005). PBAs reduce the risk of applying fire through the collaborative efforts of neighboring landowners, and in some cases also the provision of supplemental liability insurance for their members. As institutions PBAs can also generate trust at broader scales. For example, owing to their demonstrated safety record, some PBAs have been permitted to burn during burn bans, when fires often produce their greatest restorative effect (Twidwell et al., 2012).

Social exchange theory posits that a person's actions are based on the actions of others and that exchanges between people within a group build over time and lead to the development of mutually and rewarding relationships (Cropanzano and Mitchell, 2005). PBAs facilitate cross-boundary adoption of fire through the social networks and social capital generated by the repeated interactions with other landowners (Cropanzano and Mitchell, 2005). Social capital refers to the expected benefits, such as trust, reciprocity and community involvement, derived from interactions and cooperation between individuals (Ostrom, 1990; Cropanzano and Mitchell, 2005; Wagner et al., 2006). According to social exchange theory, PBA membership can lead to the emergence of relationships and a shared identity among members that fosters pride in the group and trust among its members, leading individuals to behave in ways that conform to group rules and norms (Van Vugt and Hart, 2004; Cropanzano and Mitchell, 2005). These social norms (informal rules that guide behavior) are a primary motivator in the adoption of behavior (Cialdini et al., 2006) and can be effectively used as a tool to promote changes in behavior (Biel and Thøgersen, 2007). Further, collaborative groups have become increasingly popular vehicles for promoting natural resource management because their governance structure is often based on a participatory, democratic approach that focuses on shared ownership and responsibility (Wondollock and Yaffee, 2000) and provides peer-to-peer learning opportunities (Kreuter et al., 2008).

The objectives of this study were to assess landowner perspectives regarding the use of prescribed fire and evaluate the role of PBAs in promoting the adoption of prescribed fire at the landscape scale. We hypothesize that landowner decisions to use prescribed fire as a woody plant management tool are negatively related to risk aversion, perceived lack of skill and knowledge, and access to labor and equipment to apply fire safely, and are positively related to PBA membership.

2. Methods

2.1. Study sites

The study was conducted in 12 counties in Texas, consisting of clusters of four counties in each of three ecoregions. The ecoregions

included the Rolling Plains (North), the Edwards Plateau (central), and the South Texas Coastal Plains (South), all of which are located within the Southern Plains of the USA. Study areas were selected to represent a north–south ecological gradient with vegetation transitioning from midgrass prairie/honey mesquite (*Prosopis glandulosa*) dominated savanna in the Rolling Plains; to Juniper (*Juniperus asheii*) and oak (*Quercus* sp.) dominated woodlands in the Edwards Plateau; and to coastal prairie and mixed brush in the South Texas Coastal Plains. All three regions exhibit varying degrees of brush encroachment, primarily by honey mesquite and prickly pear cactus (*Opuntia* sp.). The Edwards Plateau is also encroached by Ashe juniper and the South Texas Coastal Plains by Huisache (*Acacia farnesiana*).

2.2. Mail survey

A self-administered questionnaire was mailed to 1187 landowners to gather information regarding landowner attitudes and perceptions toward the use of prescribed fire as a rangeland management and restoration tool. We selected 100 landowners with 20 or more hectares of land in each of the 12 counties for the study. The 100 landowners in each county included all landowners who were members of a PBA (ranging from 0 to 33) and the rest of the landowners were randomly selected from the county tax mailing list. Although the PBA members were not subsampled, because the number of members in each county was less than 100, the surveyed group nevertheless represents a regionally stratified sample of all members of PBAs in the region.

The mail survey was initiated in June 2008 using a slightly modified multi-phased mailing procedure adapted from Dillman (2000). We used five mailings that included a pre-survey notification letter on day 1; a questionnaire with cover letter and a self-addressed postage paid envelope on day 7; a reminder postcard on day 14, a replacement questionnaire with cover letter and another self-addressed postage paid envelope on day 28; and a final reminder/thank you postcard on day 40. In addition to the mail survey, a non-response bias survey was conducted 6 months after the last mailing of the initial survey. This was accomplished by randomly selecting 50% of the non-respondents and sending them a short questionnaire that included a few key questions from the initial questionnaire and that asked them to indicate why they had not participated in the survey.

2.3. Data collection

Data were obtained mainly through the use of a 7 point Likert-type scale in which subjects were asked to express agreement or disagreement with specific statements. Each degree of agreement was assigned a value (1 = strongly disagree ... 4 = neutral ... 7 = strongly agree).

To address our hypothesis, we conceptualized landowners' decisions to perform a prescribed fire to be influenced by attitudes toward prescribed fire, perception of the risk of using fire relative to that of using other woody plant management options, perceived constraints of applying fire including lack of skill, labor, knowledge and equipment, and whether or not they are a member of a PBA. Questions used to test this hypothesis included: "Have you ever performed a prescribed burn on your land?" and, "Are you a member of a prescribed burn association?" We also asked landowners to express their level of agreement or disagreement with the following statements: I consider the use of prescribed burning to be a beneficial tool for restoring rangelands; I agree in principle with the idea of using prescribed burning on my land when needed; I am in favor of applying prescribed burning on my land whenever it is needed and there is sufficient fuel to burn;

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