CRITIQUE #1 Knick and Rotenberry (1997)

Knick, S.T., and J.T. Rotenberry. 1997. Landscape characteristics of disturbed shrubsteppe habitats in southwestern Idaho (U.S.A). Landscape Ecology 12:287-297.

Introduction

Knick and Rotenberry (1997) investigated the influence of agriculture, wildfire, and military training on a shrub-steppe landscape in the Snake River Birds of Prey National Conservation Area and the surrounding region of southwestern Idaho. They focused on the differences between historical patterns and processes in shrub-steppe landscapes and the current anthropogenic-dominated disturbance regimes. The significance of this work is that the authors attempted to contrast differences between historical and current, anthropogenic-dominated disturbance regimes in shrub-steppe habitats by illustrating the fragmentation of shrub patches and the invasion and eventual dominance of an exotic grass species.

Strengths and weaknesses

One of the main strengths of this paper is the illustrative value of the role played by cheatgrass in a shrub-steppe landscape. This invasive, exotic grass affected the structure and function of the vegetative community by increasing the frequency and extent of fire disturbances resulting primarily from military training. Cheatgrass first invadeddisturbed sites, then fostered further disturbance by providing a fuel source to increase fire spread, and then extended the fire susceptibility period by curing earlier than native grasses. The effects on the dominant vegetative structure, sagebrush, were significant in that large shrub patches were fragmented by fire events and these patches were subsequently

eliminated through further cheatgrass facilitated fires. Ultimately, large patches of cheatgrass dominated the vegetation in areas with high fire frequency due to military training. This structural and compositional change altered the dominant vegetation, the disturbance regime, and the resultant flow of animals in response to habitat conditions. The replacement of shrub dominated vegetation with exotic annual grasses has resulted in depauperate fauna (Brandt and Rickard 1994) and could have a long term negative effect on the conservation of shrub-obligate species such as sage thrashers, sage sparrows, and Brewer's sparrows (Knick and Rotenberry 1995). In addition, Fischer et al. (1996) found that fire in sagebrush habitats actually had a short-term negative effect on the availability of grasshoppers, a key food source for brooding sage grouse.

The lack of replication within each type of disturbance greatly limits the opportunity to draw conclusions and extrapolate results. Since the authors are attempting to draw inference into the effects of various combinations of disturbances, it would seem more appropriate to have replicates to study for each of these combinations. Although the authors attempt to deal with this issue by suggesting that individual patches were considered observations in statistical analyses, the characteristics of the disturbance are what is being evaluated and thus the single sample evaluated could be biased by unique training or farming attributes in this area. This is especially important in this study since the "landscapes" described by the authors are actually nested within each other, and therefore the juxtaposition of the "treatment" types could influence analysis results (i.e. effects could vary depending on the surrounding "treatment" type). This limitation would have been of much less concern if the study approach had actually sampled from a continuum of disturbance. For example, disturbances could have been mapped by

frequency and intensity and then these variables used to stratify replicate sampling units for analyses. However, the authors did not describe disturbances in enough detail to discern whether this would have been feasible.

It was unclear to me, after reading the methods section, exactly what period was used for the vegetative assessment. The various data sources mentioned for vegetation and disturbance mapping dated from 1979 to 1993. Reference is made to a remote sensing image, however the year the image was taken was unclear. This created some difficulty in interpreting the results. Disturbance regimes apparently changed over the analysis period (i.e. fires resulting from military training were allowed to burn until 1988 when an immediate suppression approach was adopted), and therefore the period of analysis becomes important in assessing the effects of disturbance. In addition, the differing temporal period of various map products and the above mentioned changes in disturbance regimes raises some concerns over the continuity, or consistency of the assessments.

Finally, I was struck by the lack of information relating to historical disturbance regimes and landscape characteristics prior to European settlement. The authors rely heavily on the assumption that shrubs dominated the sites and the increase in grass coverage was rare, however little is specifically offered to support this. In fact, the authors state that "We do not know the actual fire dynamics in pre-settlement times and before the presence of cheatgrass" (Knick and Rotenberry 1997). They did suggest that large-scale fires were "probably" rare, but provided no other support for the assumptions put forth relating to the dominance of the natural setting by an unfragmented shrub community.

Interpretations and conclusions

The authors have presented a strong case that the invasion of cheatgrass had dramatic, and probably long lasting impacts on the disturbance dynamics of the shrub-steppe landscape studied. They also provided an excellent description of how various disturbances, and combinations of disturbances, can greatly influence the patch characteristics within landscapes. They presented a strong quantitative defense of the later point, however the limitations of the study relative to replication and spatial juxtaposition of study areas reduced the ability to draw conclusions about the overall effects of agriculture and military training on disturbance regimes and resultant patch characteristics.

Some difficulty in interpreting the results of this study arose from the uncertainty of the period of assessment. In addition, the apparent instability of the disturbance regimes creates some concern over which disturbance regimes were actually quantified. Opportunities to interpret results and draw conclusions would have been improved if it were clearer as to the actual period(s) over which stable disturbance regimes occurred. In addition, an assessment that viewed changes in the vegetative structure in these study landscapes over a period comparable to the recovery period of shrub-steppe systems would have helped understand the relative significance of the changes. This becomes important when considering the dynamics of shrub-steppe systems. West et al. (1979) investigated the plant demographics of sagebrush-grass communities in the Snake River plains. They found that certain years had exceptionally high numbers of seedlings, although they refuted the hypothesis that regeneration was an actually pulse input to the plant community (West et al. 1979). This becomes important when considering the

period of assessment since shrub occurrence could be related to the temporal dynamics of seedling recruitment.

Comparisons with other research

Young and Allen (1997) presented a very thorough review of the ecology and disturbance responses of cheatgrass, which supports the findings of Knick and Rotenberry (1997). West and Hassan (1985) found considerable dominance of cheatgrass after controlled burns in sagebrush-grass habitats in the Great Basin and stated the cheatgrass can quickly assume dominance after a midsummer wildfire. As Knick and Rotenberry (1997) suggested, West and Hassan (1985) stated that burning areas dominated by cheatgrass is likely to promote cheatgrass dominance and lead to more harmful, earlier reburns (West and Hassan 1985).

Allen-Diaz and Bartolome (1998) assessed changes to disturbances in shrub-steppe habitats in southeastern Oregon using classical linear and state-transition models. As suggested by Knick and Rotenberry (1997), Allen-Diaz and Bartolome (1998) found that disturbances such as plowing and burning in shrub-steppe habitats can result in a disturbance threshold being reached after which a different stable plant community dominates. They also found that cheatgrass invasion generally resulted in dominance of cheatgrass by the end of the 20-year study period. On a contrasting note however, Allen-Diaz and Bartolome (1998) found that the prediction of plant community structure is time-sensitive in that the period of evaluation of conditions can greatly influence the interpretation of disturbance effects. For example, they found that plant community structure resulting from disturbances could be interpreted as having significant effects or

no effect at all depending on whether you view the community 10 or 20 years after disturbance. This phenomenon emphasizes the concerns raised above about the temporal pattern of the disturbances and the period of post-disturbance evaluation. The potential long-term effects of cheatgrass dominance are described in a review by D'Antonio and Vitousek (1992). They support the contention of Knick and Rotenberry (1997) that shrub recovery in cheatgrass dominated shrub-steppe habitats is unlikely due to cheatgrass facilitated fire regimes.

The authors' findings also favorably compare with results from a study in a completely different semi-arid shrub community in southwestern California (Stylinski and Allen 1999). Stylinski and Allen (1999) also found functional conversion, or a shift in state, after a community was pushed beyond a threshold of resilience. They found that the invasion of exotic annual grasses, including *Bromus* spp., resulting from disturbances similar to those reported by Knick and Rotenberry (1997) from agriculture and military training, created long term changes in the vegetative and structural characteristics of shrub dominated communities even in the absence of chronic disturbance.

Extrapolation

The predictable effects of cheatgrass invasion and eventual dominance of shrub-steppe habitats (West and Hassan 1985, D'Antonio and Vitousek 1992, Young and Allen 1997) would tend to support the contention that the results of this study are broadly applicable to areas where cheatgrass occurs in shrub-steppe habitats. However, the relatively unique effects of military training (i.e. tracked vehicle movement, ordinance related fire ignition) would somewhat limit the circumstances where comparable disturbance regimes would

occur. Also, the disturbance dynamics reported in this study and the concerns raised above relative to the temporal aspects of the analysis, would somewhat limit the extrapolatability of the results. For example, within the Orchard Training Area the authors discussed a large number of training related fires from 1980 to 1988, after which fires were actively suppressed. Due to the uncertainty of the period of analysis and the lack of any information relating to recovery of the shrub community since 1988, it is unclear how stable the authors' conclusions and predictions may be. This information would have greatly improved the confidence of the reader in the results and facilitated extrapolation to other areas with similar disturbances and vegetative communities.

Management applications and further questions

The results of this study would appear to be very useful in developing management approaches to address the degradation of shrub-steppe habitats in the analyzed landscapes. Although the prognosis appears gloomy in the areas dominated by cheatgrass, understanding the current dynamics of the disturbances, and the resulting vegetative community, may provide managers with an opportunity to rehabilitate these habitats. However, I am left with several questions, answers to which would greatly improve my ability to understand the current dilemma. First, how did patch characteristics changed after immediate fire suppression was implemented in 1988? Did this result in reductions in cheatgrass dominance? This is important in understanding whether the authors are correct in concluding that cheatgrass dominance will result in long term, possibly perpetual loss of shrub communities. This type of information might

allow researchers to investigate the relationship between fire interval and recovery rate of shrub patches.

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