RESOURCE NOTES

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Emergency Rehabilitation and Restoration Planning in a Variable Environment

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Background

Water availability is a primary determinant of successful plant establishment on western rangelands. Two major factors that determine water availability are seasonal and annual patterns of precipitation and the presence of competitive annual weeds. In the Intermountain West, the most prolific invasive weed has been cheatgrass (*Bromas tectorum* L.), which now dominates millions of acres of sagebrush and bunchgrass rangeland. Restoration practices in systems affected by cheatgrass have generally been limited to emergency rehabilitation procedures (primarily soil stabilization) in the year after wildfire. Species selected for fire rehabilitation have historically included highly productive and competitive non-native grass species. Present policies include objectives for plant community restoration and encourage the use of native plant materials. The high level of climatic variability in both time and space, and the presence of highly competitive annual weeds, however, may preclude simultaneous achievement of both soil stability and native plant–biodiversity objectives in most years. Recent research at the USDA Agricultural Research Service, Northwest Watershed Research Center (NWRC; Boise, Idaho) provides a probabilistic framework for making species selection decisions and for incorporating knowledge of climate variability and forecasting into revegetation and restoration planning.

Discussion

The NWRC operated a seedbed-microclimatic monitoring network in the Snake River Plain of Idaho for most of the 1990s. Staff measured soil temperature and moisture and hourly weather variables of air temperature, humidity, solar radiation, wind speed, and precipitation. These data were used to calibrate a seedbed-microclimatic model that predicted water availability and temperature at seeding depth and ran simulations with 38 years of weather data from southern Idaho. These simulations yielded hourly estimates of seedbed microclimate, which were used as input into a hydrothermal germination-response model for cheatgrass; bluebunch wheatgrass, *Pseudoroegneria spicata* (Pursh) A. Löve; and big squirreltail, *Elymus multisetus* M.E. Jones. Scientists were then able to ask the question: What would have happened if we had planted these seedlots on any particular day in the last 38 years? The data from these model simulations not only let us develop new indices for evaluating seedlots, but also let us establish probabilistic descriptions of potential establishment success in different types of precipitation years.

The data supported some obvious and expected conclusions. Cheatgrass germinated more rapidly under almost any climatic scenario. In general, the most favorable periods for rapid germination occurred in spring when both water and temperature were favorable for cheatgrass establishment. Temperature patterns were relatively consistent from year to year, and germination success was mostly determined by the pattern of water availability at seeding depth, which was highly variable. These results were not unexpected. The new information generated by these data, however, resulted from quantifying the relative effect of different weather patterns on establishment success and in providing insight into the incorporation of climate information into revegetation and restoration decision making.

In an idealized scenario of perfect weather foreknowledge, these modeling tools could be used to assist in the following decisions for both rehabilitation planning in fire years and restoration planning in non-fire years: 1) In an extremely dry year, is it prudent to use cheatgrass control measures when it would be difficult to establish either native or non-native perennial grasses for soil stabilization? 2) In a relatively dry year, is it prudent to seed native species that would be difficult to establish regardless of cheatgrass control measures? 3) Should a combination of cheatgrass control and native plant seeding be limited to wet-establishment years when there is a relatively high probability of success?

Conclusion

Weed competition and drought considerations have previously served as justification for use of non-native plant materials as a generic prescription for rangeland revegetation and rehabilitation.

A new generic prescription for exclusive use of native plant materials for fire rehabilitation may not be realistic in many years. Unfortunately, weather forecasting models for Intermountain rangelands presently consist of synoptic descriptions of historical climate probabilities and are not based on either physical or empirical predictions of future weather patterns. As weather forecasting tools improve, it may be possible to establish climatic criteria for choosing between native and non-native plant materials for fire rehabilitation, and to decide when to initiate contingency plans for restoration of native-dominated plant communities in nonfire years. As we await better forecasting tools, it would be extremely useful for revegetation and restoration planners to include detailed local and regional weather information when they document present and historical patterns of establishment success. It is especially important to include documentation of seeding failures. Additional field data are also needed to determine the relative feasibility of transitioning from cheatgrass to a native-dominated system through the intermediate step of a non-native perennial plant community. Present restoration planning strategies tend to focus on the—perhaps more difficult—direct transition between a cheatgrass and native-plant system state.

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Additional Literature

Hardegree, S. P., G. N. Flerchinger, and S. S. Van Vactor. 2003. Hydrothermal germination response and the development of probabilistic germination profiles. Ecological Modeling 167(2003): 305–322.