

## Shrub-Steppe: balance and change in a semi-arid terrestrial ecosystem

W.H. Rickard, L.E. Rogers, B.E. Vaughan and S.F. Liebetrau (Eds). Elsevier, Amsterdam, 272 pp. US \$145.

This book presents a systems level view of a sagebrush-bunchgrass ecosystem and its response to various perturbations. It is based on detailed research done at the Hanford site in south central Washington State, USA, on an area of near original shrub-steppe/grassland in an arid, hot summer/cold winter climate. It is the work of a group of scientists from the Pacific North West laboratory, over a 20 year period, who set out to quantitatively describe this ecosystem, and where possible, to model its response to disturbance. The Hanford site includes a major nuclear production facility, with attendant low-level dispersal of radionuclides, providing an additional source of study on biological redistribution and on the value of bioindicators of environmental disturbance.

The book consists of eight chapters covering a historical introduction to the region and study site, climate, soils and mineral cycling, water balance, spring and stream ecology, plant community characteristics and processes, terrestrial animal habitats and responses, and theoretical perspectives on ecosystem disturbance. Each chapter includes a quantitative description of the topic, with emphasis on energy flow, nutrient cycling and water balance. Nevertheless, some chapters are more quantitative than others, with balance models presented for water, but only general abundance data for terrestrial animals. The largest chapter is the one on plant communities, where studies were made on responses to fire, grazing and ploughing. There was also a study of radionuclides, including strontium, iodine and caesium, as indicators of material transport.

The results show that fire and grazing provide only short-term disturbances, whether it be vegetation or insects. Biomass is lost but other changes are minimal. Burning favoured perennial grasses against perennial forbs and shrubs. In contrast, ground disturbance by trampling or cultivation is more permanent, and involves

change in both composition and abundance. Cheatgrass dominance has been maintained for 40 years after cultivation, perhaps aided by fire which retards the return of sagebrush.

The effect of toxic wastes were small, but the studies show that biological redistribution and bio-concentration are both important factors in determining the long-term impact of such wastes. They conclude, for instance, that barn owl pellets are sensitive indicators of radionuclide contamination. This research has more than passing interest, since there is continuing public controversy about the effects of contamination from Hanford on surrounding towns and farms. Coincidentally a magazine article about this appeared in Australia while I was reading the book. The concluding chapter provides a useful general review of stress and disturbance in a shrub-steppe ecosystem.

The book provides an example of the benefits of interdisciplinary research and will be of interest to those involved in research on the management of disturbances in arid ecosystems. Its value is the breadth of studies conducted at one site. The specific results will be of considerable value to those with an interest in these sagebrush-grassland ecosystems. At a more general level the methods and general conclusions will be of value to those involved in research on disturbance in arid shrub ecosystems. My main disappointment with the content of the book is in the lack of linkages between the chapters. For instance there is little attempt at developing quantitative relationships between animal abundance and vegetation characteristics. Differing scales of time and space make such an objective difficult to achieve, but one that lies at the heart of predicting the ecosystem response to disturbance.

The book is illustrated liberally with figures and tables of data and is written at a level that may be understood by the general biologist. It is a worthwhile purchase for the research library with specialist interest in arid lands, and for those with a specific interest in managing sagebrush-grassland ecosystems.

*A.D. Wilson*