

Natural Resources and Environmental Issues

Volume 4 *Biodiversity on Rangelands*

Article 2

1995

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Recommended Citation

West, Neil E. (1995) "Biodiversity on rangelands: Definitions and values," *Natural Resources and Environmental Issues*: Vol. 4 , Article 2.

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Biodiversity on Rangelands: Definitions and Values

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Abstract

Biodiversity is not just one phenomenon but is a concept cluster that involves many facets of biological variety. These facets include taxonomic richness; genetic differences within each taxon; the communities, ecosystems, and landscapes organisms occupy; and the knowledge of nature local people living on the land possess. Biodiversity is prized for a variety of intertwined moral, aesthetic, and practical reasons. The role of biodiversity in the globe's life-support systems is poorly understood but probably pivotal. The world's rangelands possess biodiversity out of proportion to their area or productivity. Livestock grazing may influence biodiversity either positively or negatively depending on what is being valued. It is impossible to maximize simultaneously all features of biodiversity. Therefore, management of rangelands to favor certain aspects of biodiversity will require compromise.

INTRODUCTION

I predict that the biodiversity issue will heavily influence rangeland management during the coming decades (West 1993). If the profession is not to be totally reactionary in its stance, it needs to become better versed in how others view biodiversity. Action is best preceded by education. I have organized this volume to help educate the profession about this issue.

In this brief first paper, I have only two objectives: first, to outline the different definitions of biodiversity and, second, to explain why biodiversity has become so topical. Subsequent papers will then take up subsets of the broad topic and will present rangeland examples.

DEFINING BIODIVERSITY

In simplest terms, diversity is synonymous with variety. In the natural world, variety can exist both in the environment and in the biota. I am here interested primarily in biological diversity, which I refer to in the shortened form as *biodiversity*.

Biodiversity has been defined as the variety of living organisms; the genetic differences among them; and the communities, ecosystems, and landscapes in which they occur (Noss 1990, West 1993). There is also gathering momentum to include the local people engaged in sustainable lifestyles. Their culture and indigenous knowledge could be considered as part of total biodiversity (Figure 1). The interactions among these components should not be overlooked.

Biodiversity is not one phenomenon but is what Peters (1991) calls a *concept cluster*. Viewing biodiversity from different perspectives leads to different perceptions of what is involved and of what is important.

Because of natural human tendencies to prefer different perspectives, I see no hope for ever tightening the definition of biodiversity. Thus, in order for us to have a respectful and productive discussion of biodiversity, we need to understand where each of us prefers to stand and on what temporal and spatial scales we are focusing. There is no single position that is best for all problems or questions addressed. One should choose his approaches based on the level or levels at which the problem or question lies (Allen and Hoekstra 1992). If one has trouble expressing what his focus is, ask his choice of methods for inventory and monitoring tools (Noss 1990). The answer will be very telling about which levels of integration and spatial and temporal scales are favored. Furthermore, without a tightly stated purpose for estimating biodiversity, one cannot easily decide on the most relevant measure(s) of biodiversity. Failure to make objectives explicit ensures continued frustration because what constitutes ecological good remains as much a matter of human opinion and value systems as it is a subject of science.

Patterns and processes at one spatial or temporal scale affect those at other scales. For instance, diminishment of small neotropical migratory birds, which could be largely due to loss of winter habitat in the tropics, may eventually influence ecosystem structure and function at higher latitudes. Possible mechanisms of change are (1) altered predation on insects and seeds, (2) propagule dissemination, and (3) pollination.

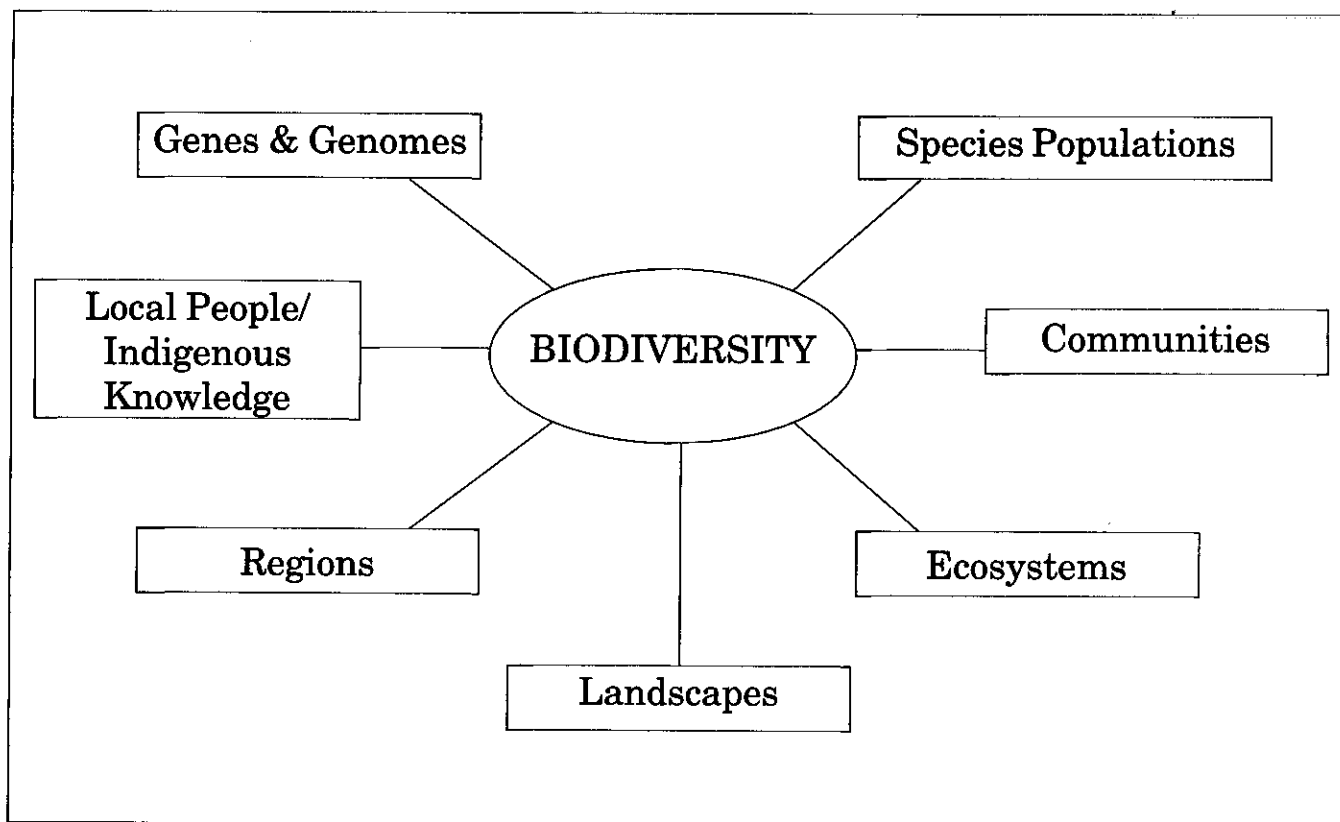


Figure 1. Components of biodiversity

Another example of interactions among levels involves the low relative values of plant community richness (alpha diversity based on taxonomic species) in the Great Basin and in the Great Plains. This impression is gained from using only conventional taxonomic-based descriptors, e.g., vegetation is dominated by a few very widespread species. These species (e.g., *Artemisia tridentata*, *Bouteloua gracilis*), however, have enormous genetic variation within them. They have survived many swings in past environments, largely because of the huge genetic bases of variation invisible to the unaided human eye. Thus, greater or lesser diversity at one scale does not automatically translate to greater or lesser diversity at other scales. Biodiversity will, therefore, have to be considered at all levels relevant to the questions being asked. The choice of questions is driven by human values as well as by curiosity.

VALUES OF BIODIVERSITY

Why has biodiversity become such a "hot" topic of late? I think three major forces are involved: global environmental change, accelerated species extinctions, and changing societal values. These forces are linked, of course, resulting in political activity that leads to legislation, regulation, and changed human behavior. Political action has "leapfrogged" science on this topic, but science is only one contributor to the debate.

The first basic reason to be concerned about biodiversity involves morality (Table 1). Many people believe that humans have a moral obligation to protect fellow creatures on earth, whether any intrinsic value is placed on them or not. The strength of this feeling depends on one's own philosophical and religious orientation, namely, mankind's place in nature (terrified, central, coequal, exterminator, or outside nature).

Some primitive cultures are terrified of nature and develop behavior to appease its demons. This behavior may involve everything from avoiding, to worshiping, to exterminating certain organisms, depending on their place in the culture's mythology.

Under the Judeo/Christian/Muslim heritage, man has been the center of nature; and other forms of life are manipulated to meet the needs and wants of humans. While the older literature portrays Western man as an exterminator, a recent random sampling of public attitudes toward management of forests in the United States in general and in Oregon in particular (Shindler et al. 1993) showed that twice as many people now feel that management actions should consider rather than ignore the needs of rare and endangered species.

A growing subculture within Western society considers other organisms as coequals. These "deep ecologists" were, however, preceded in this view by the Jains and by some Native-Americans. Animal rightists are concerned only with sentient animals similar to humans. Thus, their view remains anthropocentric.

Most Western scientists have considered themselves as outside natural systems. The idealism of the leading ecologists, e.g., Frederic Clements, had little room for incorporation of man's influence on ecological processes like succession. Economists also externalized biodiversity as outside the economic system. Fortunately, both ecologists and economists are now realizing these errors and are beginning to be more inclusive in the systems with which they deal (Constanza and Wainger 1991).

Equity among human generations, nations, and classes is beginning to play a more important role in policy formulation about biodiversity. The tension between the nations of the "North" and "South" became very evident at the Conference on Global Environment at Rio de Janeiro in 1992. The developing nations of the Southern Hemisphere are willing to trade access to genetic material if the nations of the Northern Hemisphere will not deny them economic reward for doing so. The equity among generations is at the core of the sustainability issue (Meadows et al. 1992). Which view of man in relation to nature becomes dominant will be settled in the political more than in the scientific arena. We have to face the fact that the morality issue makes biodiversity problems "wicked" (Allen and Gould 1986), and only more or less useful and temporary solutions can be reached.

The second major reason biodiversity is important involves aesthetics and amenities (Table 1). Most humans want to see and appreciate the living fraction of nature. Some are willing to part with some of their material wealth to support ecotourism, zoos, wildlife films, etc. Thus, there is a mix of philosophy and economics in this facet of biodiversity.

The third, major, and so far most recognized value of biodiversity results from the goods humans desire, such as food, medicine, fuel, building material, and industrial products (Table 1). Crops and domestic animals can be viewed as "borrowed" from the "genetic library" of nature (Ehrlich and Wilson 1991). The potential of the "library" has scarcely been tapped. Transgenic (between phyla) gene splicing provides enormous possibilities. Despite the novel and movie *Jurassic Park*, we still cannot resurrect whole organisms. Thus, extinction should still be regarded as a final, irreversible loss of options.

The fourth, least understood, but most important value of biodiversity (in my opinion) is the array of "services" provided by natural ecosystems as life-support systems (Table 1). Essential ecosystem services include maintenance of the gaseous composition of the atmosphere, amelioration of climates, genesis, fertility, and stability of soils, disposal of wastes, cycling of nutrients, and natural control of pathogenic and parasitic organisms. Loss of biodiversity can be assumed to negatively influence both the quality and quantity of ecosystem services and ultimately has unfavorable economic consequences. Although it is logical to expect that reducing the taxonomically based biological variability of a system will lead to a reduction in its resilience and an increase in the probability that rare, extreme events cannot be absorbed, the quality of science so far brought to bear on this topic has not been strong. Dr. Whitford and I will have more to say about these issues in this volume.¹

¹See West and Whitford, this volume.

TABLE 1. REASONS TO BE CONCERNED ABOUT BIODIVERSITY

Morality	<ul style="list-style-type: none"> mankind's place in nature terrified, central, coequal, exterminator, outside equity intergenerational, geographical socio-economic class
Aesthetics and Amenities	<ul style="list-style-type: none"> ecotourism zoos, botanical gardens, films, etc.
Goods	<ul style="list-style-type: none"> foods medicine fuel building material industrial products
Services (Life Support Systems)	<ul style="list-style-type: none"> cleaning up air and water ameliorating climates soils—genesis, fertility, stability energy flow + waste disposal nutrient cycling + waste disposal natural control of parasites and pathogens

Rangelands are untilled lands with self-sown vegetation that have been extensively managed on ecological rather than on agronomic bases. Because the changes on these lands have been largely due to livestock grazing rather than to tillage and tree harvest, most of their biodiversity remains. Accordingly, we may expect increasing focus on preservation and management of that biodiversity (Huston 1993). How to accommodate both biodiversity and human needs will be our challenge.

I hope to have now made it easier for the reader to move to succeeding papers and to take up various facets of the very broad concept cluster that characterizes biodiversity. As you will see, livestock grazing is but one traditional value of rangelands and one influence on the various facets of biodiversity. Grazing management may either positively or negatively influence biodiversity, depending on what is being valued. It is impossible for all features of biodiversity to be simultaneously maximized (West 1993). Therefore, we need some understanding to aid us in reaching compromises. It is in this spirit that this volume was written.

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