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Changing Plant Life of La Frontera: Observations on Vegetation in the U.S./Mexico Borderlands, edited by Grady L. Webster & Conrad J. Bahre

Peter G. Rowlans

disagreement in this book and throughout the environmental field. Finally, the volume points out that once a plan has been made, finding ways to maintain interest and enthusiasm through the implementation, and year after year of management and maintenance, can be very challenging, especially if the project relies on volunteers.

For those interested in ecological restoration—as intellectuals, researchers, educators, activists, policymakers, consumers, or volunteers—this book is likely to be of great interest. At times the language is a bit obtuse—there is a certain amount of repetition across the chapters; they are not of equal quality—but overall, this volume succeeds in raising many important issues and in providing the reader with a rich pool of information, themes, and concepts. *Restoring Nature* succeeds, in short, in achieving the goals set by its editors.

RICHARD A. MATTHEW
University of California Irvine
www.gechs.uci.edu
rmatthew@uci.edu

Changing Plant Life of La Frontera: Observations on Vegetation in the U.S./Mexico Borderlands. Edited by Grady L. Webster & Conrad J. Bahre. Albuquerque: University of New Mexico Press, 2001. Pp. 260. $34.95 hardcover.

Detection of environmental change is one of the most important aspects of my job, which is that of Chief of the Division of Natural and Cultural Resources Management at Organ Pipe Cactus National Monument in southern Arizona. We here at Organ Pipe have an established ecological monitoring program that is almost 11 years old now and we are part of a biological inventory and ecological monitoring network of 11 parks, mostly in southwestern Arizona. Change-detection and attribution of changes in environmental response variables to control variables (*i.e.*, stressors), both natural and anthropogenic, is very much our day-to-day business. Therefore, I approached this book with a feeling of anticipation. After assimilating the contents I discovered elements of both satisfaction and disappointment.

The editors and authors of this book have compiled a large quantity of both historic and and current information. Many citations are dated from the mid to late 1990s and represent some of the latest research in the field. On the other hand, the book really doesn't cover much, if any, new ground. Most researchers conversant in the field will already be acquainted with the cited literature and will make their own interpretations of its relevance and

reliability based upon the primary sources. Lay people and even some professional resource and land-use managers, however, may be intimidated by long species lists and occasional "deep-jargon." For example, chapter two, by Webster, "Reconnaissance of the Flora of La Frontera," with its many references to "geofloras"[1] and long lists of component species may be interesting to those like me with a bent toward phytogeography and paleoecology of the Southwest; however, many land-use managers and laypersons may find this (and some of the other chapters) tedious going. On the positive side, this could be a valuable source book and a good starting point for newcomers to the field and those endeavoring to conduct research on borderlands vegetation change who need an excellent literature review as a starting point.

On the subject of geofloras, which constitute a prominent component of chapter 2, I should point out that one must be careful in the use and interpretation of the geoflora concept, which has come under considerable criticism over the years. What, for example, constitutes maintenance of an "essential identity"? As early as the beginning of the1960s, Ehrlich and Holm characterized the geoflora, among other ecological concepts, as not being biologically meaningful. "At best they are superficial descriptions of places and situations. At worst they obscure the intricate patterning of nature and lead to a mystical approach to problems of community structure, community migration, evolution of communities and the like."[2] Floras can and do change through time, even drastically, like the so-called "redwood flora"; they are not clearly distinct groupings of forms that can be traced back to the tertiary. Each plant population in the flora has had its own evolutionary history dependent, in part, on its own genetic processes. Whatever continuity can be ascribed to such floras, either spatially or temporally, is merely the result of the overlapping ranges of tolerance of its species components. Although the preceding reference may appear to be an overly harsh indictment, it is nevertheless instructive. Geofloras are not "superorganisms," they are, like the term "ecosystem," mental constructs[3] and not concrete entities. Although the editors may be aware of this distinction, most land-use managers and laypersons generally are not. To his credit, Webster points out the gist of these criticisms, but then attempts to save the concept by stating, "vegetation formations can be pragmatically described as migrating in response to climatic change."[4] The problem is, how do basically physiognomically defined vegetation formations relate to basically floristically defined geofloras?

Chapter 4 by Van Devender on "Deep History and Biogeography of La Frontera" concentrates on paleobotany and vegetation paleoecology since the late Pleistocene as revealed by numerous research efforts, many by Van Devender himself, centered on the macrofossil contents of ancient (≈ 40,000–4,000 years ybp) packrat middens. The chapter is a well-written compendium and is fairly accessible to the layperson or resource manager.

Again, researchers in this field, or closely related fields, will probably want to consult the primary sources and thus will find this chapter valuable for its bibliography.

The main thrust of the volume, historical and current vegetation change, is contained in chapters 5 through 11. In chapter 5, Bahre and Hutchinson review the progress and causal factors of post-European-settlement vegetation changes as revealed by historical documents and, especially, repeat photography studies. They include much of Bahre's work in their review. The authors take great pains to point out the shortcomings of the classical research by Hastings and Turner, who argued for climate change as the primary stressor effecting vegetation change in the Southwest, with livestock grazing as a secondary, exacerbating factor.[5] Bahre and Hutchinson argue for the reverse, that anthropogenic factors have been the most important post-settlement stressors, especially cattle grazing and fire suppression during the Anglo-American settlement period. They are probably quite correct, and I doubt that very many southwestern ecologists and resource managers would disagree with them. But, in criticizing Hastings and Turner, they are beating a dead cow. Hastings and Turner wrote their book in the mid-sixties, the field research took place somewhat earlier, and it is therefore a product of its time. Ecology has progressed considerably in the past 40 years. Among other advantages conferred by the passage of time, Hastings and Turner did not have access to repeat ground or aerial photographs with as long a time interval in between as the current authors do. They also lacked other, more modern analytic tools and devices. Furthermore, they did not have access to relatively modern ecological theory and concepts. For example, strict Clementsian successional theory was still very much in vogue at that time, especially in government land-management agencies. If their research had taken place today, perhaps their conclusions would have been more compatible with Bahre's and Hutchinson's. Like other vegetation-dynamical processes, rates and direction of vegetation change are multifactorial, nonlinear processes and are functions of both physical and biological control or stressor variables such as presence or absence of livestock and other human-induced activities, soil parent material, climate, fire, and many others. Which one of these controls is dominant over the others during any one time interval (inter or intra-annual, inter or intra-decadal, millenial, etc.) is probably both scale-dependent and subject to confounding dynamical equilibrium fluxes. I think this is self-evident. Over the long long-term, solar system processes (*e.g.*, minor variations in the solar constant, precession, nutation, other dynamics of earth's orbit, etc.) may be the primary driving factors.

I found myself considerably more comfortable with Swetnam, Baisan, and Kaib's general summing up of the situation, as conveyed in Chapter 7 on the fire-history of La Frontera. These authors identify the primary value of historical reconstructions and perspectives in terms of

usefulness in identifying extreme, unsustainable changes and their causes and relate how these perspectives can play a critical role in educating the public and land managers about the nature and causes of ecological change.

For me, the most interesting and informative section of this book was Chapter 6, "Climate and Herbivory in Structuring the Vegetation of the Malpais Borderlands." This chapter is a highly instructive synopsis of manipulative experiments and aerial imagery centered on vegetation change detection and attribution. The authors' use of objective phraseology such as "ecosystem restructuring" or "ecosystem reorganization" is also to be commended. Curtin and Brown succinctly articulate the nonlinear, multifactorial nature of vegetation change and development. While acknowledging that patterns do emerge—for example, wet winters and dry summers encourage expansion of shrubs and woody vegetation—they observe that "[t]he interaction of climate, [domestic livestock] grazing and herbivory by native species leads to a series of complex, nonlinear interactions in which the precise outcome is probably impossible to determine." The authors also recognize that "when one is looking at processes such as herbivory and climate, they must be observed in the context of the system." Southwestern ecosystems have lost historical organizing components (Pleistocene megafauna, natural fire, prairie dogs) and as a result "shrubs have come to dominate the system and livestock have come to mediate." They make perhaps what is the most insightful statement of the entire volume and, at least to me, the most useful for resource managers, when they conclude that "to maintain the borderlands ecosystem, particularly in the face of current climatic patterns, an understanding of the fundamental structural processes, without getting bogged down in the management of the current actors on the scene, is crucial to the maintenance of the long-term health and integrity of dynamic, physical, biological, and economic systems."

In Chapter 8, "Fire and Elevational Zonation of Chaparral and Conifer Forests," Richard Minnich continues the discussion of the relationship between fire and vegetation change that began in chapter 7. This time, the action takes place in the peninsular ranges of Southern California, extending to the San Pedro Martir range in northern Baja California. Once again, the information given is well documented and the chapter is both well written and interesting. Discussions of historical vegetation change appear to be incidental and the approach is more one of physical geography. The author has provided some superb vegetation maps of the San Jacinto Mountains and has an excellent presentation of plant community variation along latitudinal and elevational gradients with fire as a mediating factor.

A study of the relative effects of different land use patterns, climate, and other stressors on the forest structure of two comparison sites on either side of the U.S.–Mexican border is the subject of Chapter 9 by McPherson

and Villanuéva-Diaz. They report distinct differences in forest structure and composition in the Animas Mountains of New Mexico and the Sierra de Los Ajos of Northern Mexico due to past and current differences in fire and livestock management. For example, the Mexican government has had a fire suppression policy, but it was not effectively implemented in the Sierra de los Ajos. As a result, the latter retains a more "natural," open, "park-like" forest structure comprised of relative shade-intolerant and fire-tolerant tree species than analogous stands in the United States. McPherson and Villanuéva-Diaz also observe that spatial contrasts in vegetation on either side of the Arizona-Sonora boundary indicate a higher degree of grazing in Mexico. These contrasts are claimed to be due to "different perceptions about, and management of, livestock grazing in the United States and Mexico." This finding is relevant to the observations of Curtin and Brown in chapter 6, who could identify a "grazing line" along the border and significant increases in woody shrubs between the 1970s and 1990s. But, their measurements of shrub cover revealed no significant differences in vegetation change across the border. Curtin and Brown do not believe that system changes across the border as reflected in the grazing line are necessarily long-term or irreversible.

The next two chapters discuss current and historical human impacts on specific sites within La Frontera. Joaquin Sosa-Ramirez and Ernesto Franco-Vizcaíno discuss the "Grazing Impacts on Mountain Meadows of the Peninsular Ranges in La Frontera" and Timothy Fulbright discusses "Human-Induced Vegetation Changes in the Tamaulipan Scrub of La Frontera." Fulbright documents the increase, since European Settlement, of woody plants in the Tamaulipan Scrub type and is congruent with similar observations provided in previous chapters. Ramirez' and Vizcaíno's chapter, though interesting, seems somewhat out of place since it is more a range-site analysis and is not a comprehensive analysis of vegetation change over time with attribution of causes. Chapter 12 by Spellenberg on "The Oaks of La Frontera" is of taxonomic and biogeographic interest, but for me, it also seems somewhat out of place in this volume.

The final chapter, number 13, by Espejel, Moreno-Casasola, and Barbour, which covers coastal strand vegetation, is interesting in that the authors discuss potential and actual changes in vegetation with respect to photosynthetic/physiological strategies. According to the authors, La Frontera vegetation is exhibiting an increasing floristic abundance of succulent (*i.e.* CAM plants) or C_4 plant taxa (many of these are summer active rhizomatous grasses) with increasing aridity, which in turn mirrors global trends.[6]

In conclusion, despite some criticisms, I believe this is a valuable book that I, for one, will find very useful as a source book, especially for pertinent literature through 1999. Overall it is well written and illustrated and well organized. As a resource manager, I would have appreciated an

additional chapter on the analytical aspects, philosophies and methods of change determination including vegetation monitoring and identification and verification of long and short-term trends. I say this because land-use and resource managers are interested in establishing desired, future resource conditions for the landscapes under their jurisdictions, especially with respect to vegetation cover and associated wildlife habitat. They are also highly interested in applying the results of vegetation monitoring and change detection research to the formulation of management prescriptions, which will help to reach desired future conditions. Thus, a chapter covering this subject matter would have been valuable.

1. A "geoflora" is a "major vegetation unit that has maintained its essential identity through time and space." Seventy-five million years ago, the southern half of the North American Continent was occupied by the broad-leaved evergreen Neotropical-Tertiary Geoflora, the northern portion by the temperate deciduous Arcto-Tertiary Geoflora, and between them, centered in the area of southwestern North America, the largely evergreen sclerophyllous and microphyllous, Madro-tertiary Geoflora. The latter is the source of many current components of Oak Woodland and Chapparal plant communities. D. Axelrod, *Geological History, in* A CALIFORNIA FLORA AND SUPPLEMENT (P.A. Munz ed., 1966). I refer the interested reader to the chapter citations for additional information on the geoflora concept.

2. P.R. Erlich & R.W. Holm, *Patterns and Populations*, 137 SCIENCE 652-57 (1962).

3. A.G. Tansley, *The Use and Abuse of Vegetation Concepts and Terms*, 16 ECOLOGY 284-307 (1935).

4. A vegetation formation is the general plant cover of an area, which may include several *physiognomic* variations. These variations are inferred to belong to the prevailing climatically controlled physiognomic type. For example, the prevailing physiognomic type may be grassland, though the area may show stands of scrub and open forest. These would still be part of the grassland formation if occurring in the same so-called grassland climate. D. MUELLER-DOMBOIS & H. ELLENBURG, AIMS AND METHODS OF VEGETATION ECOLOGY (1974).

5. J.R. HASTINGS & J.M. TURNER, THE CHANGING MILE: AN ECOLOGICAL STUDY OF VEGETATION CHANGE WITH TIME IN THE LOWER MILE OF AN ARID AND SEMI-ARID REGION (1965).

6. What happens, however, as CO_2 concentrations in the atmosphere continue to climb as developing nations become more industrialized? Increased CO_2 concentrations are thought to shift the adaptive advantage to C_3 plants (the majority of plant species). This question is not addressed.

DR. PETER G. ROWLANDS
Chief
Div. of Natural & Cultural Resources Management
Organ Pipe Cactus National Monument
10 Organ Pipe Dr.
Ajo, Arizona 85321