Environmental Disasters, Natural Recovery and Human Responses

Natural disasters destroy more property and kill more people with each passing year. Volcanic eruptions, earthquakes, hurricanes, tsunamis, floods, landslides, fires and other natural events are becoming more frequent and their consequences more devastating. Del Moral and Walker provide a comprehensive summary of the diverse ways in which natural disasters disrupt humanity and how humans cope. Burgeoning human numbers, shrinking resources and intensification of the consequences of natural disasters have produced a crisis of unparalleled proportions. Through this detailed study, the authors provide a template for improving restoration to show how relatively simple approaches can enhance both human well-being and that of the other species on the planet. This book will appeal to ecologists and land managers, as well as anyone curious about the natural world and natural disasters.

ROGER DEL MORAL is Professor of Biology at the University of Washington. His research includes the mechanisms of vegetation response to disturbances caused by volcanoes, glaciers, grazing and urbanization. He has practiced wetland restoration for over 20 years and has experience with dune and subalpine meadow restoration. He has studied volcanoes on four continents, including detailed studies of Mount St. Helens that started in 1980.

LAWRENCE R. WALKER is Professor of Biology at the University of Nevada, Las Vegas. His research focuses on ecological plant succession and the theoretical and practical lessons for restoration. His research in succession and restoration has encompassed work on volcanoes, dunes, glacial moraines, floodplains, landslides, cliffs, hurricanes, reservoir drawdown zones, abandoned roads and mine tailings.

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ROGER DEL MORAL
University of Washington, Seattle

LAWRENCE R. WALKER
University of Nevada, Las Vegas

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Preface and acknowledgements

Each day we are bombarded with news of natural disturbances. Volcanoes rain unimaginable destruction down on mountain villages, hurricanes and tsunamis ravage coastal communities and fires turn lush forests into ashen specters. Such violent events are fundamental, unavoidable parts of the global environment that in the long term restore and rejuvenate the landscape. In the short term, societies must respond to mitigate the devastation.

Human societies are also assailed by silent disturbances that rarely merit mention in the media. Dunes creep out of a desert to swallow an oasis. Exotic species of shrubs invade grazing land. Lake levels slowly fall, eliminating unique biota and cultures. As our numbers increase, humans have unavoidably become a new form of disturbance. We rival volcanoes, floods, dunes and glaciers in the intensity of our impacts. Our actions magnify other disturbances. Grazing gradually turns steppes to deserts and agriculture impoverishes the land. Our industries pollute in both subtle and more blatant ways that merely reduce productivity or poison ecosystems.

Unlike most natural disturbances, human impacts continue to intensify and become more widespread. Worse, as populations burgeon into ever more sensitive habitats, the effects of natural disasters are becoming increasingly devastating.

We are both academic plant ecologists who have spent most of our careers studying ecosystems damaged by nature and by man. We worry greatly that the natural world is shrinking, losing its ability to sustain biodiversity and, indeed, the human species. This book was born of our desire to translate the many lessons biologists have learned by studying natural recovery processes following disasters. We know that this knowledge has direct, practical value for improving the landscapes that support us.

While humans increasingly inflict disasters upon the environment and upon themselves, this book is focused on natural disturbances – events that cause loss of plant and animal life across landscapes – and how humanity interacts to intensify both these events and their effects. We will, however, discuss how human actions can create severe, often novel, disturbances. Many of these new disturbances create surfaces analogous to natural disturbances (pavement resembles lava, for example), but other surfaces are new (toxic mine wastes, heavy metal depositions). Rather than presenting a hand-wringing litany of disasters, we apply lessons gleaned from nature to the restoration of landscapes damaged by both natural and human-created disasters. We will describe many of nature's most dramatic forces that initiate what ecologists call *primary succession*. In addition, we will explore how ecosystems recover from less intense forces in a process called *secondary succession*. The recovery process requires several mechanisms that permit a series of species to establish on newly formed land, often against severe odds. Landscapes not managed by humans will normally recover and, eventually, reconstitute a functioning ecosystem. An understanding of how this happens and what limits the degree and rate of recovery is the foundation of *restoration ecology*. Restoration ecologists seek to redress both natural and anthropogenic destruction of ecosystems. They employ both biological and engineering tools. An understanding of successional processes and the limits of the biota to develop under hostile conditions guide their efforts.

During the last century, humans became more aware of the expanding threats to the environment and to the health of individuals and societies. The insightful writings of scientists such as Edward O. Wilson and Steven J. Gould, humanists such as Wendell Berry and Bill McKibben and economists such as Lester Brown have together addressed these many problems and guided us toward solutions. Our goal is more humble. We seek to demonstrate the awesome powers of disturbances and the splendor of the recuperative powers of the biota. We will demonstrate how natural processes can form the basis for the restoration of sites damaged or destroyed by humans.

In a rapidly changing world, there are severe constraints on effective ecosystem recovery. Exact re-creation of a damaged ecosystem is now recognized as very unlikely. Introduced species are ubiquitous and they can strongly inhibit restoration efforts, particularly if they establish before restoration efforts begin. Modern disturbances are often either more intense or so different from natural counterparts that

natural recovery is unlikely. Copper smelters spew metallic fogs that create extensive toxic wastelands which are far more difficult for organisms to colonize than, for example, lava or sand dunes. Most plants have had little evolutionary experience of adapting to heavy metals, so it is manifestly clear that restoration of such landscapes requires intensive, creative effort. Unfortunately, the lack of money often increases the chances that recovery in the aftermath of such disasters will be neither swift nor effective.

In this book, we will demonstrate the lessons natural systems have to teach us about coping with human-inflicted disasters, including how to most efficiently conduct restoration efforts. We will compare the large variety of natural disturbances and recovery and the smaller variety of their human analogues, thereby demonstrating that we can improve our long-term responses to disasters. The restoration of any given landscape requires the recognition that the landscape is damaged, the will to address the problem, and the tools to effect a rational solution. We will establish that there is a critical need for restoration in many circumstances and thus foster and nourish the will to act. We will reveal that by using a natural model with attainable goals, the tools are both available and practical. The time for effective action is now.

The present volume is a summary of natural succession processes that can be applied in order to significantly improve restoration. We wish to show that applying ecological perspectives to restoration can foster a more secure world with fewer limits on human potential. Any failure to accelerate the return of destroyed lands to productivity will only make existing problems worse.

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