The Vegetation Recovery of Mount St. Helens

A personal view of successional processes

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The eruption of Mount St. Helens in 1980 caught the public imagination like no other natural disaster. Even after more than thirty years, anyone over forty clearly remembers the events that created a unique and memorable landscape. Geologists and ecologists were also drawn to the devastated landscape…first to document, then to study and finally to understand how natural forces combine to reconstruct ecosystems. The author was among the first to put his "boots on the ground" to start a 32-year quest to explore how plants colonize and vegetation develops on ravaged and newly formed habitats. This memoir is for those who wish to understand both the particulars of vegetation recovery on Mount St. Helens and the general principles of succession that have emerged. It provides an overview of recovery after several forms of volcanic damage and a synthesis of how vegetation develops from landscape, biological and physical factors.

Preface

In 1980, few thought that volcanoes in the Pacific Northwest supported unique ecological habitats. Of course, they offered great climbing experiences, challenging hikes and challenging winter sports. However, these opportunities were not too different from those provided on other mountains. Ecologists found many interesting problems mountains such as the geologically complex Olympic Mountains or the granitic Enchantment Lakes Basin, places where I had worked previously. That all changed in May of 1980.

By March of 1980, it was apparent that something big was going on at Mount St. Helens. Several senior scientists developed a plan to start to study the events and aftermath as soon after the eruption as practical. I made my first research visit there in early June of 1980, and my last in August of 2011. For over 30 years, I have observed how vegetation returned to repair the astonishing devastation unleashed on May 18. My observations have been documented in numerous technical papers. The driving force behind this book is to provide a synthesis of the vegetation recovery of landscapes surrounding Mount St. Helens in an interesting and accessible way.

The dramatic eruption of Mount St. Helens was unusual. While the eruption was small compared to many, notorious ones, its destructive force was amplified many fold because it erupted across the landscape. The lateral steam-driven explosion released by a massive landslide created both dramatic contrasts and gradually attenuating impacts. It wreaked havoc in many ways. The resulting landscape was a complex mosaic of habitats and plant communities, ranging from scarcely damaged forests to completely new surfaces devoid of life. A few volcanoes have produced similar eruption patterns and many others have produced astonishingly large eruptions. However, unlike most, Mount St. Helens is near large urban population centers and close to major research centers. Early warnings of an eruption, such as rapid deformation of the north flank, allowed the science community to follow developments closely. Transportation infrastructure due to widespread forestry allowed relatively easy land and aerial access to devastated areas. As a result, the volcano and the unfolding geological and biological stories immediately became the focus for intensive study by a small regiment of environmental scientists. When this volcano erupted, it produced an irresistible force that drew many of us to its slopes. I am among a few ecologists that continued to study the aftermath because each year some new finding simply had to be pursued and some new question came up.

Studies of Mount St. Helens dramatically altered how ecologists understand succession. In this book, I describe the emerging view of primary succession that differs dramatically from what has dominated textbooks and the conventional wisdom. Failure to understand succession properly has serious consequences. Getting it right has practical importance and lessons learned about succession on Mount St. Helens have improved restoration efforts. Throughout much of the 20th Century, the accepted wisdom was that fire prevented forests from reaching maximum development. In the U.S., the concept that disturbances prevented natural successional development to "better" vegetation was a major factor that led to widespread fire suppression efforts in most National Forests and Parks. By the mid-1980s, conflagrations such as that at Yellowstone National Park (1988) made it clear that suppression only permitted fuel to accumulate, and that inevitably intense fire would wreak great havoc. Today, fires tend to be managed as part of the disturbance regime, and succession concepts have been altered to agree more closely with what we have observed.

I was lucky to be in the right place at the right time. My training and experience had prepared me for the unexpectedly tricky challenge of documenting long-term recovery. I had training in experimental ecology, looking at how plants interacted through competition and chemical suppression. I had studied forest vegetation using those mathematical methods that had been evolving since the 1970s as computers became smaller, faster and ubiquitous. I had completed studies of pristine alpine habitats that provided experience in managing extended expeditions into remote areas. I had just started to study how dominant subalpine species could control species composition in the Olympic Mountains. These varied experiences provided me familiarity with many of the species and problems to be encountered on Mount St. Helens.

I have been asked many times: Why did you decide to study succession on Mount St. Helens? My short answer: How could I not? The intellectual challenges simply could not be ignored. It was evident that I had to accept them and try to forge something valuable and enduring beyond just describing patterns. The opportunity was unique and the pull of the chance to gain major insights into succession were too great to abandon. Already, in the months after those first eruptions, I was hooked by a deluge of questions as I began to observe the raw landscape.

Global climate change and habitat degradation make understanding how to foster vegetation development crucial. Really understanding how succession works is vital to promoting rapid remediation and restoration in economical ways. Work on Mount St. Helens has been instrumental helping to create a modern paradigm of succession. Restoration ecologists now use many of the findings from Mount St. Helens in planning their projects. We have learned how important surviving vegetation is to accelerating recovery, but also that such legacies work in unpredictable ways. In stressful habitats, early colonists often dictate development for decades, leading to vegetation mosaics even in homogeneous habitats. Such heterogeneity offers stability to restoration projects.

This book is organized into three sections. In Section I, I describe the physical events of the early eruptions and place them into a broader geographic context. Initial responses of vegetation and the course of recovery are discussed. Section I has five chapters, each describing different forms of impact. The first discussed the effects of tephra (both ash and coarser material), which produced significant deposits over hundreds of km^2. The challenges produced by tephra deposits for plant survival and processes that accelerated recovery are discussed. The second chapter is focused on a broad band of trees that were killed outright in the initial blast. These included those in blown-down zone, where standing trees were snapped or uprooted and slammed into the ground and a narrow seared zone, where dead leaves clung to the trees and which soon became the standing dead zone.

I describe the formation of mudflows (lahars) and the development of vegetation on these deposits in the third chapter. These often narrow, always barren habitats are composed mainly of older materials. They are near donor populations, so they may recover quickly. In the fourth chapter, I describe a tree removal zone, part of the blast zone closer to the crater. Here, nearly all vegetation was removed. Finally, the fifth chapter of this section describes recovery in the pyroclastic zone, where deadly pyroclastic flows deposited a fine, deep powder over parts of the debris avalanche that heralded the eruption.

Section II is the scientific core of this book. The introduction to its five chapters describes the ecological forces within these new landscapes and the mechanisms leading to the reassembly of vegetation. By understanding these mechanisms, the reader may gain a greater perspective of how vegetation develops in many circumstances. Relevant studies that I conducted from 1980 to 2010 will be highlighted to exemplify each step in the recovery process, with studies by others augmenting this story. Each chapter on mechanisms contains examples that illustrate the concepts forming its core.

Dispersal is crucial to re-establishment of vegetation. Aspects of how dispersal sets the stage for succession are described in Chapter 6. Once a seed arrives, it must establish if it is to contribute to recovery. The factors that promote establishment are described in Chapter 7, which includes descriptions of safe-sites and biological facilitation. Successful plants develop and community assembly begins. In Chapter 8, I describe how developing vegetation alters the rules of establishment, leading to further vegetation development. The prairie lupine assumes a central role in this chapter because it helps to mold the maturing habitat. Further successional development is investigated in Chapter 9 where I explore patterns of vegetation development (trajectories) in an attempt to determine if vegetation tends to become more homogeneous over time. The ability of environmental factors to predict species composition is explored in the context of searching for alternative states, different plant communities that occupy similar habitats. A concluding chapter summarizes the lessons learned from the study of succession on Mount St. Helens.

About the Author

Roger del Moral is Emeritus Professor of Biology at the University of Washington. His research into how vegetation recovers from natural disasters and the application of lessons learned to restoration of habitats damaged by humans has helped to redefine disturbance ecology and restoration science. He is the co-author of two books on disturbance.

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Guide to the Memoir