PART 4

Managing under Climate Change

Parts 2 and 3 of the book are largely based on climate and ecological sciences. Large data sets derived from both satellite and ground-based sensors are used to parameterize sophisticated simulation and statistical models to understand how global stressors are experienced locally by managers of protected areas. These analyses are carefully crafted to address spatial and temporal scales that would best provide insights into local dynamics in the context of regional to continental trends. Interestingly, as complicated as these analyses and results may be, they are much more tractable than the steps of the Climate-Smart Conservation framework that involve management. As clearly elucidated in this final part of the book, resource management is the product of a complicated social system that involves science, education, policy, budgets, economics, interagency cooperation, communication, and complex stakeholder partnerships. Thus, it is not surprising that progress on the science components of the Climate-Smart Conservation framework has outpaced that of the management components.

Be this as it may, the infrastructure and capacity for climate adaptation is in a state of rapid evolution. Chapter 13 overviews the advances that have been made by federal land management agencies over the past five-year period of activities that we cover in this book, and it highlights several specific case studies illustrating recent progress in climate adaptation. Chapter 14 covers similar topics but from the perspective of resource specialists in Rocky Mountain National Park. This chapter might be considered a "must read" for managers elsewhere who are just beginning to work in the climate adaptation planning arena. One conclusion from chapter 14 is that at least ten years of team and capacity building are needed to begin to handle the extreme climate and disturbance events that are becoming more frequent under climate change.

Chapter 15 focuses on one such extreme event in the Greater Yellowstone Ecosystem: the massive mortality of mature whitebark pine, the keystone subalpine species in that ecosystem. It is in chapter 15 that all the steps of the Climate-Smart Conservation framework are demonstrated. Despite challenges to park planning, interpretive programs, budgets, and interagency collaboration, park resource managers have developed, implemented, and evaluated active management to restore this species in the face of climate change. The prognosis for success is unknown at this time. However, the approach that has been pioneered for this "early responder" to climate change provides a road map for active management for the many other species that will be responding to climate change in the years and decades ahead.

The final chapter in this part returns to the overarching mission in conservation that was introduced early in the book: sustaining the ecological integrity of ecosystems. The Climate-Smart Conservation framework is an approach for attempting to sustain elements of ecosystems that are most vulnerable to climate change. Chapter 16 asks a fundamental question of the ecological science conducted to date in the Greater Yellowstone Ecosystem: how well are we sustaining ecological integrity in this iconic wildland ecosystem within a humanizing planet? The answer is perhaps surprising, given that this is one of our best studied wildland ecosystems. Essentially, we observe that it is very difficult to know how well ecological integrity is being sustained, largely because of a lack of monitoring on the private lands throughout the ecosystem.

This realization is a wake-up call for the need to foster broader partnerships among federal, state, and private lands and to better use our vast remote sensing and scientific analyses capabilities to quantify the condition of our wildland ecosystem and communicate the results to stakeholders and decision makers in ways they find meaningful.