

Keeping Up with the Mountain: The Challenge and Prospect of an Adjusted Management Paradigm

Sarah Stehn

Background

SOCIETAL COMPREHENSION OF CLIMATE CHANGE has come a long way in the past ten years. As media coverage increases, politicians, scientists, managers, and average citizens now openly discuss how future scenarios may alter their day-to-day lives. While details about the severity of climate change come into view (e.g., IPCC 2007), protected area managers in particular have begun to recognize that changing climatic conditions will require alteration of even their most commonplace management strategies now and into the future (Peterson et al. 2003; Welch 2005; Baron et al. 2008). Management policies will require more flexibility and an increased focus on supporting tenets of ecological resilience rather than maintaining current conditions (Baron et al. 2008). Established, but non-traditional strategies, such as adaptive management, which incorporate trial-and-error learning with management practice (Holling 1978), and scenario-based planning, which involves envisioning and preparing for a variety of possible scenarios (Peterson et al. 2003) will need to take precedence over reactive management strategies. Additionally, since previous practice will no longer be a suitable guide for current management policy, a continued commitment to science-based management will be necessary (Baron et al. 2008).

Elevation and climatic gradients in mountainous areas make them especially vulnerable to climate change as hydrologic patterns in snow-dominated systems are already exhibiting drastic modification (Dyer and Mote 2006). Predicted by some as the harbinger of climate change, increased frequency and intensity of regional storm events (IPCC 2007) has challenged the current structure and response of county and municipal emergency, utility, and wastewater management systems in the United States. Although generally not considered centers of human life or property, federally owned lands are one of America's greatest resources, and given their common proximity to, or enclosure of dramatic natural features, certain areas have experienced striking modification of glacial or hydrological cycles at least partially attributable to climate change, causing unexpected damage to the nation's cultural and natural resource base. As protected area managers work to repair infrastructure damage from past events, and curtail damage from future events, the need for re-evaluation of management goals and procedures specific to each federal unit has become apparent.

Mount Rainier National Park (MRNP), in Washington state, is one federal land unit that has already made strides toward an adjusted management paradigm. Damage by recent unprecedented storm events has humbled National Park Service (NPS) personnel, forcing them to develop creative new solutions to the same problems they had previously success-

fully managed year after year, but which now are increasing in intensity and frequency. Although somewhat limited by the current funding structure, a growing number of employees are committed to making changes, not just for the weather and climate of today, but toward a more sustainable and adaptable management regime.

Management cannot be static

Charged with protecting natural and cultural resources within boundaries that were often set without ecological considerations in mind, protected area managers are well aware of the fact that they must consider forces acting outside of their jurisdiction (Nordstrom et al. 1990; Pringle 2000). For example, many protected areas have partnered with local gardening groups to educate people about the benefits of native plant landscaping instead of using exotic species that may escape into nearby public lands and negatively impact native habitats. In addition to these spatial considerations (e.g., exotic species introduction from outside management boundaries), managers should also have some awareness about how temporal considerations may affect their management strategies, especially in light of projected future climates. Just as scientists from many disciplines have come to view the earth, its habitats and processes, as non-static, protected area managers should also come to view their management strategies as dynamic to allow for in-step adaptation as required by the landscapes and features they protect.

Glacial melting and retreat influenced by a warming climate has been well documented over the past century in MRNP (Veatch 1969; Burbank 1982) and is an excellent example of the acceleration of a natural process that has created an unpredictable and complicated management scenario that will not be resolved by a static management strategy. Rapid glacial retreat has increased sediment available to the five major rivers and their tributaries that drain the Mount Rainier watershed. Debris-rich stagnant glacial ice left behind by retreating glaciers is an important source of sediment for debris flows (Walder and Driedger 1994)—fast-moving flows of saturated, unconsolidated debris resembling wet concrete. Since 2000, the retreating Van Trump glacier on the south side of Mount Rainier has produced multiple catastrophic debris flows that have led to riverbed aggradation. The bed of the Nisqually River, draining the Van Trump glacier, has risen as much as six feet in a single debris flow event as a result of this aggradation (Halmon et al. 2006), which now allows high-flows of debris to spread out of the riverbed and into surrounding forest, causing drastic and unpredictable damage to both natural resources and park infrastructure. The increased potential for catastrophic damage and the increased frequency of debris flows and floods in MRNP has required park personnel to begin to realign their management strategies. MRNP personnel are working on a solution to these difficult problems because park operations depend on it. The storm and flood events of November 2006, for example, required a six-month closure of the entire park to repair road and culvert damage and ensure visitor safety (NPS 2008). Park personnel have found that a status quo strategy is no match for management concerns of this extent.

Collaborations are key

One of the ways in which holders of the current management paradigm have attempted to

deal with unexpected challenges, such as those described above, is through increased collaborations. Recognized as not just an ecological challenge but as a cultural and intellectual one, the scope of climate change and its effects requires developing a shared vision among multiple agencies and regional groups (Baron et al. 2009). With the addition of partners to a management strategy or plan, the potential for active contributions from different perspectives will generally increase, thereby lowering the possibility of maintaining a static management regime. If collaborators are open-minded, the addition of partners from outside the normal realm of operation will especially contribute to new management directions.

The National Park Service prides itself on its efforts toward increased collaborations, and countless projects have been completed nationwide that highlight the importance of partnerships in sustaining the NPS mission (Kempthorne 2007). Although paradigm shifts are always difficult, moving away from traditional reactive management strategies will require special attention to collaborators and their role in the process. However, decreased funding in recent years has altered relationships among collaborators in some areas. Previously, collaborations may have consisted of one agency seeking monetary contributions from other groups to complete its trophy project that would purportedly provide benefit to all groups as a whole. Now, more frequently, agencies and other groups in crisis mode pool their money and resources together to complete the minimum required project. In the following sections, I will look at examples of recent collaborations in MRNP, exploring one set of collaborations that appears to limit potential shifts in management strategies, and one that seems to have fostered them. By examining both scenarios, individual managers may be able to draw attention to and thus harness the positive aspects of collaboration even in perceivably difficult situations.

Fixing what isn't broken: Challenges in preparing for the "new" inevitable

With all collaborations, communication and the development of a shared goal are very important. Collaborators must state their goals clearly and allow discussion of objectives to build consensus among participants (Margerum 2008). In cases where collaborations are by necessity, either because of funding limitations as mentioned above or due to jurisdictional constraints, such as with state or federal highways that may provide access within protected areas, a common goal may be quite difficult to attain. Even when collaborators are in agreement, current funding structures may limit their ability to financially support the action.

Returning to MRNP, where flood and debris flow damage has reached new levels, park personnel have proposed a series of hedging strategies to reduce perceived flood damage potential in a shift towards a more proactive management strategy. Hedging strategies are best employed when you have a limited ability to control variables affecting the resource (Peterson et al. 2003), and in this case would include permanent log jams and other stream betterments. Hedging strategies are proactive measures taken in response to perceived threats. Such strategies have been proposed in MRNP to reduce the potential for catastrophic flooding rather than waiting for the flood to happen and repeatedly cleaning up after it.

The problem is that this type of management action, a forward-thinking solution beyond the status quo, may be difficult to garner support for. Collaborators or other park personnel may view the action as unnecessary, too precautionary, or fixing something that

isn't broken. However, as can be expected with all climate-related changes, managing processes so that they fluctuate only within the historic range of variability is no longer appropriate (Baron et al. 2009) and this type of action, project by project, is exactly where the paradigm begins to shift. Any progress made to allow for extreme events will most certainly be a good investment. However, even though hedging strategies such as those proposed at MRNP are likely to save money and resources over the long run, in the short term they may cost more than the traditional reactive management action, and in fact may not qualify for funding from some sources. For instance, much of the flood and debris-flow damage in MRNP impacts state roads, and state and federal highway commissions are a major funding source and retain jurisdiction on road repairs in many cases. Betterments to road surfaces, culverts, and bridges may be an appropriate hedging strategy in the case of increased repeated floods, but only certain types of improvements qualify for federal funding (USDOT 2005). Additionally, procedures for allocation of funding from upper-level agency offices may not be compatible with needed funding amounts or timing of disbursement that could be necessary for the adjusted management action.

To avoid repeated conflicts and frustration related to attempts at an adjusted management paradigm, a culture of trust between NPS personnel and supporting agencies will be required to implement these non-traditional but increasingly necessary practices (Baron et al. 2009). At MRNP, there has been serious realization and discussion of this challenge, and park personnel recognize that any new management project that does happen should be considered an educational opportunity to encourage other agencies and collaborators to work through the challenges. As a part of the NPS Centennial Challenge (an initiative that offers funding to prepare parks for another century of operation and management), leading other agencies in environmental stewardship and sustainability is a stated goal of the NPS (Kempthorne 2007), so the challenge should be well received. Moreover, because the development and strengthening of regional partnerships will increase in importance due to the multiple scales at which species and processes respond to climate change (Baron et al. 2008), progress toward this point made now will certainly be helpful in inevitable future endeavors.

Volcano preparedness: Success at preparing for the “old” inevitable

The ironic thing about the recent flooding events is that, although MRNP is a headwater park containing multiple glaciers that are likely susceptible to even slight changes in climate, Mount Rainier itself is first and foremost an active volcano, and management preparedness for volcanic hazards is significant. Excellent research projects, monitoring plans, educational programs, and multi-partner collaborations are currently in place to improve the safety of nearby communities in the event of an eruption—one that may not occur for another thousand years. Meanwhile, the next big flood that comes down the Nisqually River may take out the historic Longmire area, the headquarters and base of operations for much of MRNP.

This is not to suggest that a volcanic event endangering the lives of 80,000 people living in Mount Rainier's lahar zones (the river valleys that would drain volcanic induced mudslides) is necessarily comparable to a debris flow with the potential to damage MRNP's natural and cultural resources. However, it is an interesting case of how scale and perception can influence management paradigms and how multi-partner collaborations over time can work

to foster paradigm shifts. Volcanic events are drastic, quick, and could affect millions of people; thus, they maintain a high public profile. Flooding events are common and to some extent expected in most river systems, whether it be a 10-, 50-, or 100-year flood; thus most communities have developed some sort of emergency plan to deal with the consequences. It is the middle category of events, one step below “not in my lifetime” eruptive or non-eruptive volcanic events, and one step above decadal or multi-decadal flooding, that has sent managers scrambling for solutions and instigated thoughts toward more proactive management approaches at MRNP. Although these locally significant floods and debris flows may not qualify as regional disasters, managers may be able to glean hints for adaptation from larger-scale plans for volcanic hazards.

The *Mount Rainier Volcanic Hazards Plan* was originally published in 1999 and currently is undergoing revision (PCDEM 2008). The first step of developing such a plan was establishing a working group that included representatives from as many affected entities as possible. Working groups serve in many capacities to start discussions necessary for development of specific common goals instrumental in successful and productive collaborations. Publication of the *Mount Rainier Volcanic Hazards Plan*, and others like it, have sparked major increases in public education, the identification and recruitment of additional interested collaborators, and a rise in public awareness and political support, thereby setting a higher bar for future dedicated multidisciplinary efforts. The plan includes sections defining the problem, establishing response scenarios, preparing mitigation strategies, and preparing for community recovery after the event. Although the changing hydrological patterns at Mount Rainier present events of different temporal and spatial scales, managers could take a similar approach to planning for them. Significant attention should be paid to the exhibited usefulness of collaborations, such as the establishment of a working group, which can specifically identify current problems and progress toward a common goal and a future adapted management strategy in whatever capacity possible.

The role of individual managers

The situation at Mount Rainier is just one example of changing conditions requiring adjusted management strategies. Many other protected areas are also experiencing climate-related changes that have overwhelmed previous management policies and required quick thinking to continue operations. In Rocky Mountain National Park for example, severe droughts have weakened conifers (van Mantgem and Stephenson 2007), leaving trees more susceptible to increasingly severe insect outbreaks (Hicks et al. 2006), and large swaths of dead trees now increase fire and windfall hazards, threatening existing structures, facilities, and campsites. NPS personnel have rushed to manage the hazard, routinely having to close campgrounds for hazard tree mitigation (NPS 2009a). However, climate change is by no means the only culprit in the need for an adjusted management paradigm. Shifts in the political and social atmosphere also require consideration towards their potential effect on management practices. For example, shifts in visitor numbers or demographics may make current visitor protection plans inefficient or obsolete, and the increased use of technologies such as computers, cell phones, and video games has already set the standard for how young visitors may expect to engage with park resources.

The good news is that NPS has already shown adaptability to changing paradigms, coming from both inside and outside the agency. Management policies have evolved in response to both newly available knowledge and altered social and political desires. There has been a substantial evolution of management philosophy since NPS's 1916 founding (Baron et al. 2009). For instance, the wildlife feeding, wildlife culling, and strict fire suppression activities that dominated NPS policy for decades are now replaced by more moderate policies backed by current scientific research. Not too far from MRNP, park personnel and numerous collaborators at Olympic National Park are undertaking the largest dam removal in America to date to return salmon to the Elwha River (NPS 2009b). Previously considered a compatible use, the dams are now recognized as a failure to meet the mandates of the park's enabling legislation.

These successful efforts and many others that have encouraged and allowed for previous adjustment of management paradigms are driven by individuals such as George Melendez Wright, who is credited with first bringing scientific research into the realm of park management (Sellars 2000). Wright's work provided new perspective that challenged traditional assumptions and practices, and although it took decades for his vision to be realized fully, and he encountered much resistance, each step he made was significant for the progress of the NPS as a whole (Duncan 2009). This sort of creativity and resolve is what the NPS needs from individuals to make the broad changes necessary to continue to protect and preserve our national parks, and, in the case of MRNP, keep them open to allow for a safe visitor experience.

Conclusion

Climate change effects are becoming easier to visualize on the landscape as research and monitoring continue to take place in protected areas worldwide. Although some climate-related changes are slow and nearly imperceptible on a day-to-day scale, in other areas, such as MRNP, the changes may contribute to a drastic alteration of ecosystem processes or functions that require immediate management action. These locations are leading the charge in adjustment of current management paradigms. Moving toward a more quickly adaptable management regime that consistently considers proactive strategies instead of reactive ones may be necessary for continued resource protection in these particularly susceptible protected areas. Although existing and potential management-related collaborations can present challenges for adapting tried-and-true management strategies, benefits of such collaborations far outweigh the difficulties, and will become increasingly important as climate change progresses. Because it is on the individual level that much regional collaboration occurs, day-to-day interactions between park personnel and collaborators should be laced with gentle educative opportunities that flow both ways to try to reach common understandings (Welch 2005). In this way, trust and a common management goal can be reached so that slowly, if not surely, participating collaborators will be working toward the same type of change, greatly increasing the effectiveness and scope of current management strategies by building a more adaptable and proactive management paradigm suitable for tomorrow's rapidly changing landscapes.

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- Sarah Stehn**, Resources Management Division, Denali National Park and Preserve, Denali National Park AK 99755; sarah_stehn@nps.gov