Newsletter

National Park Service
U.S. Department of the Interior

The Klamath Kaleidoscope

Preserving Complexity in the Klamath Parks

By Daniel Sarr
Klamath Network

The Klamath parks steward landscapes of uncommon complexity and diversity that are imperiled by an unprecedented host of new threats such as climate change, invasive species, and compounded or disrupted disturbance regimes. Like our neighbors, we are worried about the effects of these changes and desire to limit their effects on species and ecosystems. Yet we know that all ecosystems are dynamic and things will, indeed must, change. What we can and should preserve has emerged as a central question both for the parks and for society as a whole.

The National Park Service goal of preserving unimpaired conditions has traditionally been interpreted to mean that conditions should remain stable and unaffected by humans. Unfortunately, there are surprisingly few benchmarks that provide an unambiguous measure of when natural conditions such as climate, nutrient cycling, and decomposition are becoming "impaired." Most are linked to short-term observations and personal opinion, or historical reconstructions and speculations about a pre-European landscape that may or may not be obtainable under current conditions. Upon analysis, even statistical "normals," such as, say, the 1970-2000 precipitation at Whiskeytown, provide useful, but possibly arbitrary frames of reference. Viewed at larger spatial and temporal scales, paloecological research demonstrates that the Klamath region has seen large changes in the past, and no climate, vegetation type, or species assemblage has persisted through time at all locations. Yet, as a whole, the land has prospered. The uniquely heterogeneous climates, geology, and topography of the Klamath region have allowed the evolution, capture, and retention of species over many millions of years. We know that such biophysical complexity has been both the cradle and steward of our ancient and rich heritage, but preserving complexity is not an intuitive assignment. And unlike fighting to save old growth redwood stands, the blue of Crater Lake, or a "tuft of the month" of the globally-rare Howell's alkali grass, complexity plucks few heart strings.

Complexity in habitat, vegetation, and geology is the secret to maintaining biodiversity. Photo of proposed Oregon Caves National Monument expansion area, taken by Sean Mohren.

In a recent issue of the George Wright Symposium, Cole et al. (2008) address similar issues in a discussion of preserving "naturalness" in such a time of change. In their discussion, they explore the relative strengths and weaknesses of a number of important ecological topics that have developed in parallel to guide preservation. In the end, Cole et al. (2008) propose a tetrad of concepts to challenge wilderness and park managers: biological diversity, ecological integrity, resilience, and historical fidelity. While biological diversity and historical fidelity lend legitimacy to our natural tendency to care for native species and historic scenes, all will demand that we increase our knowledge of the science behind ecosystems and their responses to change.

Long-term monitoring provides one means for us to gain a scientific understanding of the concepts put forward by Cole et al. (2008). Among the first and most interesting observations will be how species coexist and interact in real-time (biodiversity). With paleoecology and fire history work, we will gain a better view of how park ecosystems looked in the past (historical fidelity). Given time and the opportunity to observe natural disturbances and their aftermath, we will gain a better knowledge of how they function together and adapt to change (ecological integrity and resilience). Taken together, these concepts seem particularly relevant to the interpretation of monitoring and for preserving complexity in the Klamath parks.

Reference:

Cole, D., L. Yung, E. Zavaleta, G. Aplet, F. Chapin, D. Graber, E. Higgs, R. Hobbs, P. Landres, C. Millar, D. Parsons, J. Randall, N. Stephenson, K. Tonnesson, P. White, and S. Woodley. 2008. Naturalness and beyond: Protected area stewardship in an era of global environmental change. George Wright Forum 25(1):36-57.

National Park Service
U.S. Department of the Interior

The National Park Service has implemented natural resource inventory and monitoring on a servicewide basis to ensure all park units possess the resource information needed for effective, science-based managerial decision-making, and resource protection.

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The National Park Service cares for the special places saved by the American people so that all may experience our heritage.

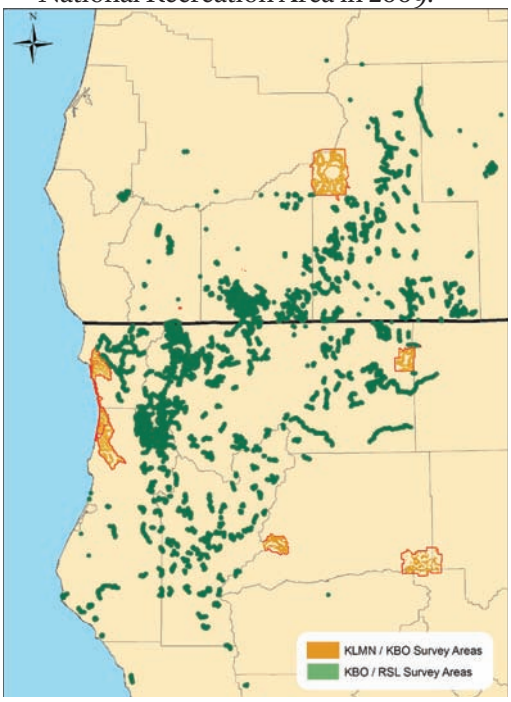
Monitoring Landbirds in the Klamath Region

By Sean Mohren
Klamath Network

Landbird monitoring makes up a key component of the vital signs monitoring program that has been developed by the Klamath Network. Network and park staff ranked bird communities fourth as a vital sign of importance for all parks in our Network. While one of the goals of the Klamath Network is to implement a scientifically sound monitoring program that tracks the status and trends of landbirds throughout the six park units in our Network, it has long been understood that birds know no boundaries. It would take a substantial amount of funding to be able to monitor landbirds at a network (versus park) scale, which the Klamath Network does not currently possess. Therefore, it made perfect sense to develop a partnership with the Klamath Bird Observatory (KBO).

Klamath Bird Observatory

Since 1992, KBO has been collaborating with the US Forest Service Redwood Sciences Laboratory and many partners implementing landbird monitoring, inventories, and research throughout the Klamath region. In 2002, the Klamath Network approached KBO with a request to partner for inventory and monitoring of landbirds. Since then, KBO has provided assistance with each of the network steps for the development of its inventory and monitoring program. Through this collaboration, the Klamath Network has been able to meet park management objectives and become an active contributor to KBO's conservation objectives at the regional and continental scales. In 2008, the Klamath Network and KBO implemented a draft version of our landbird monitoring protocol at Lava Beds National Monument, Oregon Caves National Monument, and Redwood National and State Parks. In total, 55 point count routes and one ecological monitoring station were completed with 148 species being documented and a new species, the Northern Waterthrush (*Seiurus noveboracensis*) being added to the Oregon Caves species list. We expect to finalize the landbird protocol and plan on implementing the protocol in Lassen Volcanic National Park, Oregon Caves National Monument, and Whiskeytown National Recreation Area in 2009.



Klamath Network (KLMN) and Klamath Bird Observatory/US Forest Service Redwood Sciences Laboratory (KBO/RSL) bird community inventory, monitoring, and research locations in the Klamath region.

Welcome Sean Smith, the Klamath Network's new Botanist!

Sean earned a Bachelor's degree in Biology, with a Chemistry minor, in 2001 from Western Washington University, in Bellingham, WA, where he grew up. Sean left the rain behind and moved to Ashland in 2003 to work for the Klamath Network inventorying rare plants. In 2005, he began an intensive inventory of the vascular plants of Lava Beds National Monument, for a master's project at Southern Oregon University in conjunction with the Klamath Network. This work culminated in receiving his Master's degree and creating a flora of Lava Beds National Monument in 2008. Sean started working as the Klamath Network Botanist in February 2009.

When not playing the role of a rabid botanist, Sean likes to telemark ski, cook, trail run, and explore the beauty and biodiversity of the State of Jefferson.

Land Cover, Use, & Pattern as a Klamath Network Vital Sign

By Lorin Groshong
Southern Oregon University

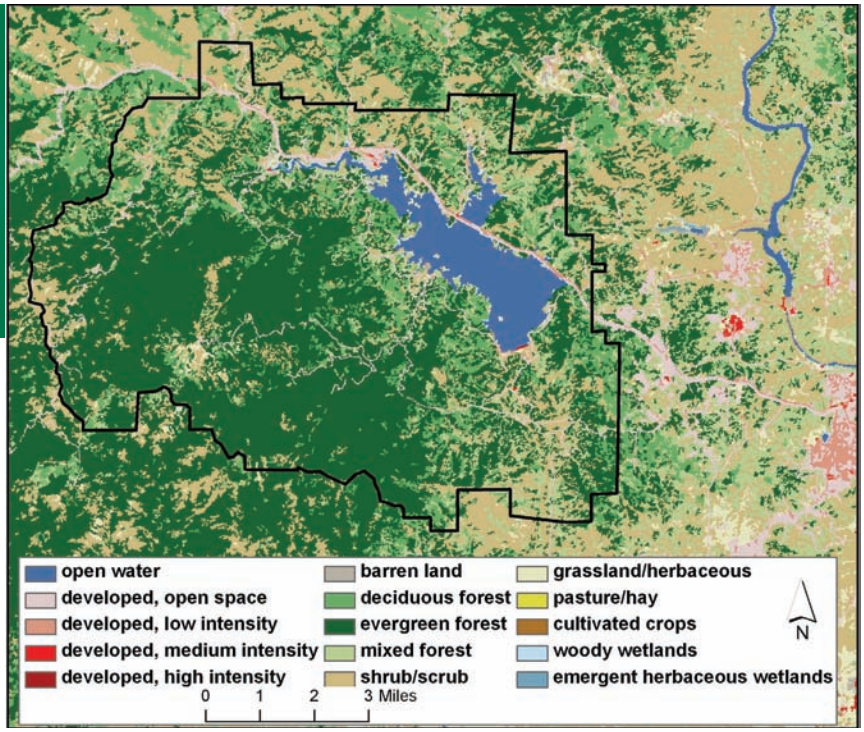


Figure 1. 2001 National Land Cover Database map of Whiskeytown National Recreation Area and surroundings.

One of the Klamath Inventory & Monitoring Network's Vital Signs is Land Cover, Use, and Pattern. This vital sign addresses the mosaic of intact ecosystems and disturbance regimes both within the national park boundaries and outside the parks. Natural resource concerns for each park in the Klamath Network identified during monitoring plan development included boundary issues, disturbed park lands, visitor use, invasive and exotic species, and altered succession and/or species composition. Key aspects of all of these concerns can be addressed by using mapping techniques that show informative landscape-scale variables and their change over time.

A commonly applied method for monitoring land cover change is to utilize remote sensing imagery and software to automate the classification of a region into categories such as Forest, Grassland, Agriculture, or Urban (Figure 1). The results are checked in the field (a process called ground-truthing), corrected, and remapped in an iterative manner. Once acceptable accuracy has been achieved, you can use the map to analyze spatial patterns on the landscape and identify areas of concern such as urban or agricultural encroachment on park boundaries. Repeating this process in subsequent years, comparing the changes, is an extremely powerful tool to bring park managers' attention to places undergoing rapid disturbance or even recovery (Figure 2).

At the national level, the NPS Office of Inventory, Monitoring, and Evaluation; the University of Idaho; and the NPS Cumberland Piedmont I&M Network are beginning to evaluate what it takes to monitor landscape dynamics in and around parks. As part of this effort, they are comparing existing Land Cover data and maps, including the National Land Cover Database (NLCD), LandFire, NatureServe, and the National Gap Analysis Program (Gross et al. 2009).

In a comparison of land cover classifications for Rocky Mountain National Park, the different methodologies employed by these different efforts resulted in significant discrepancies in the amount of area classified as agriculture and wetlands on the final maps. This highlights the importance of choosing a methodology that will remain consistent over time and will at least be comparable to other National Park Service efforts.

The Klamath Network has the choice of either (1) creating our own methodology to construct a current land cover map, or (2) utilizing an existing methodology. There is also the potential of using maps made by other organizations, if they are producing these maps at regular intervals into the forseeable future. Currently, we are comparing methods used for NLCD and the National Gap Analysis mapping of our region. We are also in contact with the National I&M Program's research team, so that we can develop a method that is the most useful for our region and is comparable to results at the larger scale.

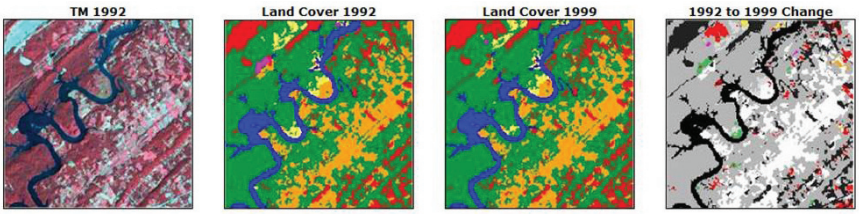


Figure 2. Example of land cover change analysis from the NLCD trend analysis program. This shows a Landsat satellite image from 1992 (TM 1992), Land Cover classifications from 1992 and 1999 and the result of computer analysis designed to highlight where there are differences between the 1992 and 1999 Land Cover classifications.

For further information:

- USGS Land Cover Institute: http://landcover.usgs.gov/usgslandcover.php
- National GAP Analysis Program: http://gapanalysis.nbii.gov
- LandFire: http://www.landfire.gov
- NatureServe: http://www.natureserve.org/explorer

Reference:
Gross, J., L. Svancara, P. Budde, J. Bennett, B. Frakes, S. McAninch, L. Nelson, T. Philippi, and M. Story. 2009. Monitoring landscape dynamics of U.S. national parks. Poster presented at the George Wright Society Annual Meeting, March 2-6, 2009.

Climate Change Resources for Park Staff

By Rebecca Slosberg
Southern Oregon University

Climate change is a crucial and imminent issue that affects the Klamath Network parks in myriad ways. The Klamath Network has prioritized climate change as an important topic for public outreach. The Network's Strategic Interpretive Plan provides partnerships to bring the scientific research of the Klamath Inventory and Monitoring (I&M) Network to the public through a partnership with Southern Oregon University (SOU) and the Interpretation divisions of the parks. As an SOU graduate student, I was brought on in January 2009 to complete the climate change project.

Cave ice at Lava Beds National Monument. Declining ice levels is a topic of concern for resource managers and interpreters alike at the monument.

In spring 2008, the Klamath Network hosted a climate change conference at SOU. Scientific experts, park resource managers and interpreters, and Network staff came together to discuss climate change in the Klamath Network. As part of the scoping meeting, park resource managers identified key issues related to climate change in each of the six parks. While there is a plethora of information regarding climate change, park interpreters felt that the amount of scientific information used to interpret climate change at the park level was lacking.

In February 2009, the Interpretive Chiefs, Network staff, and SOU faculty met at SOU. After a discussion of how to effectively partner the science relevant to climate change with interpretation, it was decided that I would develop an Intranet web site to provide key scientific information for park interpreters. My background as a park interpreter at Hovenweep National Monument, Grand Teton National Park, Redwood National Park, and Klondike Goldrush National Historical Park and currently as an Environmental Education master's student seemed a good fit for this project.

I am linking the climate change issues that were identified in the scoping meeting to relevant I&M projects. This approach will allow a park interpreter to identify relevant I&M projects by park and topic. For example, an interpreter at Lava Beds might be interested in researching declining cave ice for an interpretive talk. With this tool, they will be able to locate any Klamath Network I&M projects that address this topic, read an overview, determine project status, and link to key documents. This project aims to provide interpreters with up-to-date and relevant scientific information that will enable them to provide quality interpretation, which is especially vital for complex and evolving issues such as climate change.

Aspen Stand Health and Conifer Trends at Lassen Volcanic National Park

By Sarah McCullough
UC Davis

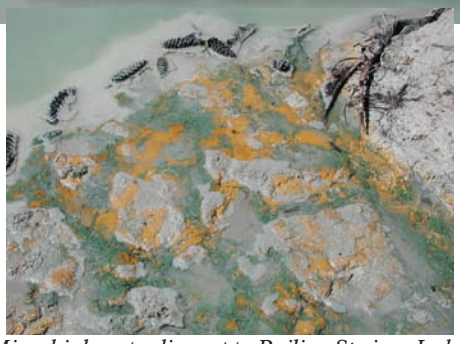
The investigation into the status of aspen (*Populus tremuloides*) at Lassen Volcanic National Park is nearing completion. The study was conducted by Dr. Ken Tate and Sarah McCullough of UC Davis, with support and guidance from the Klamath Network and Lassen NP. We designed the study to measure the amount of conifer encroachment into aspen stands and to evaluate the effect of encroachment and herbivory on ecosystem values associated with healthy aspen stands: high plant diversity, rapid nutrient cycling, and successful renewal of aspen clones through sprouting from the root system. Many studies have focused on the differences between conifer and aspen forests, and increases in conifer have been documented in the Sierra and Southern Cascades. However, no studies have measured the changes in aspen stands along the gradient of conifer encroachment and few studies have focused on aspen in this region. Interpretation of photos from 1952 and 1998 showed that conifer cover is increasing in over half the stands that were evaluated in the Devastated Area, Warner Valley, Butte Lake, and Snag Lake. Conifer cover has increased by an average of 44% in these stands. Data collection conducted over two field seasons found that deer herbivory on aspen sprouts is high, with evidence of browse on 45-100% of sprouts per stand, and evidence of successful aspen regeneration is scarce. We found significant declines in aspen cover, the number of sprouts, and the number of understory plant species with increasing levels of conifer cover. We also found that the depth of the litter layer increases with conifer cover. This evidence supports the suspicion that increases in conifer cover are associated with declines in aspen stand ecosystem values. The results from this project will give park managers a scientific baseline for management decisions, as well as providing baseline data for future study and monitoring.

Aspen stand at Butte Lake supporting a diverse understory plant community.

Boiling Springs Lake Research

By Patty Siering
Humboldt State University

View from the southwest part of Boiling Springs Lake. In the foreground, several interconnected high temperature springs (70-90˚C) are in close proximity to main body of lake (~52˚ C).



Microbial mat adjacent to Boiling Springs Lake.

The southern end of Boiling Springs Lake. Photograph by Gordon Wolfe, May 2008.

Boiling Springs Lake (BSL) in Lassen Volcanic National Park (LVNP) is the largest hot spring in North America. It is an acidic (pH 2), hydrothermal (52-92°C), 13,000 m² lake containing some of the most extreme habitats on earth. In January 2008, BSL became a National Science Foundation-funded Microbial Observatory, including investigators and students from Humboldt State University (Patricia Siering and Mark Wilson), California State University - Chico (Gordon Wolfe), and Portland State University (Kenneth Stedman). The project investigates basic ecological questions concerning the abundance, diversity, activities, and interactions of microorganisms and viruses in this extreme habitat. We will explore the relative contributions of chemosynthesis and photosynthesis to primary production and begin investigating key processes in nitrogen cycling. The grant will provide independent research opportunities for approximately 100 (mostly undergraduate) students at the three universities and will be integrated into classroom research projects impacting hundreds more.

View of Boiling Springs Lake with Mount Lassen visible in the background.

Sequence-based diversity measurements indicate the presence of several Bacteria and Archaea that are not closely related to known organisms. We have obtained numerous isolates and enrichments of prokaryotic and eukaryotic microorganisms representing diverse physiologies and ecosystem functions. A remotely operated vehicle designed and built by undergraduate engineering students was used to map the lake's physical structure in 2007. It will be modified to sample thermally distinct regions of the lake in order to assess biological and chemical variation at various temporal and spatial scales. In spring 2008, Humboldt State University undergraduates majoring in Natural Resources, Planning, and Interpretation produced a color brochure for the LVNP visitor center that highlights the structure, chemistry, and biology of this unique lake.

In addition to its harboring of novel organisms, BSL provides a unique, entirely microbial, ecosystem. The BSL ecosystem serves as a model for life on early earth and on other planets. The study of the extremophilic microbes in BSL may also yield insights into adaptation and evolution and potentially lead to products for biotechnological applications, including medical diagnostics or novel energy sources.

Klamath Network Recent Events and Upcoming Highlights

- *January 2009*
  - Staffed a Klamath Network Booth at the SOU Science Career Fair
  - Attended Redwood Soils Map Presentation
- *February 2009*
  - Attended Primer Software Training
  - Hired Sean Smith as the Network's Botanist
  - Held Network Climate Change Interpretive Project Meeting
  - Attended Lassen Volcanic's Strategic Planning Meeting
- *March 2009*
  - Presented Eight Oral or Poster Presentations of Klamath Network Activities at the George Wright Society Conference
- *April 2009*
  - Attended Aquatic Pathogens Conference
  - Attended National Data Management Conference
  - Held GIS Training for Klamath Network Park Staff
- *May 2009*
  - Held Stream Protocol Scoping Meeting
  - Implemented Invasive Species Pilot Study at Whiskeytown
  - Taught Wetlands Course at the Siskiyou Field Institute
  - Attended Redwood/USGS Climate Change Meeting
  - Presented Climate Change Paper and Chaired Session at the Siskiyou Field Institute Ecology Conference
- *Summer 2009*
  - Holding GPS Training for Klamath Network Park Staff
  - Submitting Task Agreements and Modifications
  - Implementing Vegetation Monitoring Pilot Study
  - Implementing Streams Monitoring Pilot Study

A Modest Update on Amphibian Declines

By Eric Dinger
Klamath Network

Adult Long-Toed Salamander. Photo by Stephen Corn, USGS.

It is not a surprise that amphibian populations continue to decline worldwide. With the recent discovery of Ranavirus infecting populations of Long-Toed Salamanders (*Ambystoma macrodactylum*) in Lassen Volcanic National Park, a review of factors implicated in the global decline of amphibians may be in order.

Why?

The prospect of confronting wildlife diseases seems daunting, at least to this fledgling herpetologist (who is really an aquatic entomologist). But it is important to realize that disease isn't the only factor, and many of the other factors, acting in concert with each other, are items we can confront and mitigate. An excellent summary of these is given in a recent publication, from the Partners in Amphibians and Reptile Conservation. A smattering of issues in the Pacific Northwest implicated in amphibian (and reptile) decline:

- Habitat Conversion – The loss of habitat by urbanization is a major threat to amphibians. However, the preservation of patches of undisturbed habitat next to urbanization, with connectivity between patches, can help mitigate habitat loss.
- Roads and Trails – Even remote forest roads and trails can contribute to amphibian declines. Roadway ditches collect water, prompting some amphibians to attempt reproduction – but with no source of ground water, these ditches prematurely dry out, jeopardizing the amphibian breeding. Well designed roads with ample drainage and properly designed culverts can mitigate the presence of the road.
- Highways – Major roads along prime amphibian habitat (i.e., wetlands) contribute to amphibian road kill. Tunnels and fencing can direct migrating amphibians to safe passage underneath roadways, reducing road kill.
- Surface and Groundwater Uses – Groundwater pumping jeopardizes amphibian populations by reducing water quality, changing water availability, and causing water levels and flow rate to fluctuate. Water conservation procedures, like low-flow plumbing and drip irrigation, can reduce the amount of water needed; allowing groundwater sources to be recharged. Other measures, such as artificial ponds to replace lost wetlands, can provide breeding grounds lost to groundwater pumping.

This is a partial list of factors contributing to amphibian decline. A follow-up in the next Klamath Kaleidoscope will continue with other factors and potential mitigation possibilities. Until then, check out:

Pilliod, D. S., and E. Wind (Editors). 2008. Habitat management guidelines for amphibian and reptiles of the Northwestern United States and Western Canada. Partners in Amphibian and Reptile Conservation, Technical Publication HMG-4, Birmingham, AL.

The above is just a brief summary from this publication, which offers many great ideas for mitigation and hope to stopping amphibian declines.

Vegetation Mapping Protocol

By Sean Smith
Klamath Network

A vegetation transect at Crater Lake National Park during the 2008 pilot study. Photo by Devin Stucki.

The Klamath Inventory and Monitoring Network recently received funding from the joint National Park Service, US Geologic Survey National Vegetation Mapping program to prepare a vegetation map of Oregon Caves National Monument. Field sampling to inform the mapping process will begin at Oregon Caves in June 2009 and will be conducted by Klamath I&M Botanist Sean Smith and Southern Oregon University Research Associate Dennis Odion.

The primary objective of the national Vegetation Mapping Inventory is to produce high-quality, standardized maps and associated datasets of vegetation and other land cover occurring within 270 park units. Mapping vegetation resources helps park managers conserve plant biodiversity, manage challenges such as exotic species, insect outbreaks, and diseases, and understand resources and processes such and wildlife habitat relationships and wildland fires.

A vegetation map is a snapshot in time of the plant life covering a portion of the earth. However, this deceptively simple description overlooks limitations that mappers have struggled with since the very first vegetation maps. Unlike political boundaries on maps, vegetation types often blend gradually into one another in space. At Lava Beds, sage-steppe vegetation changes subtly with elevation, eventually becoming Ponderosa pine forest at high elevation. While the two extremes are obviously distinct, at no point along the gradient is there a discrete change. If one is to recognize the two different vegetation types at the extremes, a boundary between them must be drawn. The goal of minimizing unrealistic boundaries creates a tradeoff between over generalizing (creating fewer mappable units) and delineating small patches of transitional vegetation types (creating more often unmappable units). Balancing these tradeoffs to provide the best product for the user is exceptionally challenging, but the National Program has developed guidelines and standards to follow (http://www.umesc.usgs.gov/spatial-tech/umesc_npmap.html). Nonetheless, each park map represents a unique work of science and art because it is fundamentally an abstraction of reality crafted by creative and analytical thinking.