2010 ROMO Resource Assessment Workshop:
Preparing for Surprise and Opportunity

"[We] are making choices about resources and visitor-use issues in a complex context, and often in a divisive atmosphere. By mandate and necessity, science is a part of the decision-making equation. As decision-makers, our jobs are made much easier, and the results are better, when the science is relevant, readily available, and clearly communicated."
                    - Suzanne Lewis, superintendent, Yellowstone NP (2007)

Introduction

The past half-century has seen tremendous advances in humanity's capacity to support its basic needs and even improve human well being in spite of a rapidly growing global population. However, achieving these advances has required sweeping changes in both human and natural systems, and the consequences of these changes in an ever-more-complex world are still only dimly understood. A striking feature of 21st century living is the frequency with which we experience natural events of unprecedented severity or previously unknown and unpredicted processes such as global climate change.

Such "surprises" are of particular concern to organizations whose role in society is to sustain natural ecosystems and processes. A key to building sustainable conservation organizations and policies in an era of increasing unpredicted shocks is to find ways to build resilience into management systems. In this report we describe one approach to doing so: the development and testing of an *adaptive framework* at Rocky Mountain National Park that we believe will assist the park's Resource Stewardship staff in achieving a more resilient management system that can anticipate and respond more quickly to changes of unprecedented type or scale.

This approach creates guidance for responding to "surprises" that may arise, so that the organization can best combine and apply resource stewardship staff expertise in the face of unknown. As such it functions primarily as a priority-setting tool for resource managers. It may differ from traditional approaches because it draws upon insights of key personnel to learn about the system. It creates a new forum to merge management and scientific understanding on a day-to-day basis. It is not intended to be prescriptive, but offers a useful way to organize thoughts and identify priorities. Applying an adaptive framework can increase flexibility and opportunities for greater communication between scientist and managers by incorporating feedback and interactions between biophysical and social systems.

In this report we describe a Resource Assessment Workshop at Rocky Mountain National Park (ROMO) during ROMO Resource Stewardship employees shared and built upon their various experiences and expertise to identify situations where surprises could have greatest impact and/or knowledge about appropriate response does not exist. We present pre-workshop materials, a summary of the workshop itself and the products arising from it, and discuss potential uses of those products in day-to-day management of Rocky Mountain and potentially other national park units.

Pre-workshop events and materials

Prior to the workshop, fulltime employees on ROMO's Resource Stewardship staff were asked to do the following:
- To learn about the management context for the workshop, read an article by Suzanne Lewis in *George Wright Forum:* "The Role of Science in National Park Decision-Making."
- To help workshop participants hit the ground running, begin thinking ahead of time about the workshop tasks, involving other members of work teams as appropriate. For example, they were invited to:
    o Make a list of valued ecosystem components, using last year's list as a guide. Were any key resources missed? Could any categories efficiently be combined?
    o Make a list of influential processes, whether positive or negative (e.g., non-native plant invasions, recreation visitors, wildfire, bark beetles, economic stimulus funds).
    o Begin thinking about connections among resources, or between specific resources and potentially influential processes, and how much confidence you have in your understanding of those connections and influences.
- For those interested in learning more about adaptive management, the Research Learning Center staff was able to provide electronic copies of several articles that describe further how adaptive management can work in national parks and protected areas. [For a list of references and definitions, see Appendix A.]

Following is the text of a two-page handout provided to each Resource Stewardship employee prior to the workshop:

Resource stewardship in the national parks is an artful blend of scientific information and management expertise. We are best prepared to manage well when we have a solid understanding of what we know, what we do not know, and the potential consequences of not knowing. The 2010 ROMO Natural Resource Assessment Workshop, scheduled for October 5-6, is an event where park staff can share their expertise to increase our understanding in all three areas.

The goal of the workshop is to create an *adaptive framework* that identifies how highly valued Rocky Mountain National Park resources (lakes, air, historic structures, elk, Douglas-fir, climbing opportunities, soil, etc.) are related to the biological, climatic, physical, social, and managerial processes that shape park ecosystems. For those who participated in an exploratory assessment process in May 2009, this year's workshop will represent an extension and refinement of that initial activity.

Working both collectively and in smaller groups, participants will identify the highly valued park resources that require management attention, as well as the processes that positively or negatively influence our ability to protect those resources. A prioritization process will draw upon staff expertise to identify the potential strength of influences on the resource in question, along with a level of confidence in the quality, accessibility, and relevance of scientific information about the effects of each influential process.

We do not consider the workshop a substitute for formal planning processes, nor for ongoing scientific research or resource assessments. It will generate knowledge that is especially useful for informing choices in the "middle ground" between day-to-day management decisions and plan-driven changes in direction. More specifically, we anticipate that it can improve the relevance and availability of scientific information to resource stewardship staff in several ways:

- Focusing attention on the biological, physical, social or managerial processes that are likely to be most influential for highly valued park resources.

- Identifying significant gaps in knowledge where the need is greatest for interpretable, locally relevant scientific information.

- Providing guidance for responding to "surprises" that may arise, so that we can best combine and apply resource stewardship staff expertise in the face of unknowns.

Ideas generated at the workshop will inform adaptive management in situations where a management activity is having an unanticipated and possibly undesirable effect, or when new external factors have created a situation that requires unanticipated management response. Such surprises may be positive, negative or neutral, and may occur in the biophysical system (for example, a sudden outbreak of disease, or new introduction of a non-native species) social system (sharp rise in visitation, land-use change adjacent to park boundaries), or managerial system (new regulations that divert staff attention, unanticipated funds for research or projects). The *adaptive framework* we produce, along with other sources of information and expertise, can help managers respond more quickly and confidently in the face of such surprises.

For example, in June 2009 a wolverine was photographed in the park. It was the first confirmed sighting since the park was established, and the first documented in Colorado since 1919. Meanwhile, in California, another wolverine has been seen regularly since 2008 – the first sighting since 1922. A hypothesis that could arise from these seemingly unrelated events is that wolverines may be expanding their range into suitable montane habitats throughout the West. This leads to a series of resource stewardship questions: How suitable is the habitat found in ROMO? If habitat quality is high, should efforts be made to look for sign of continued wolverine presence in the park? If personnel <u>are</u> diverted, which other related activities can be foregone with the least cost to protection of highly valued park resources? If unexpected funds become available for research, should we consider investing in a study of wolverine habitat? Currently the park website says wolverines are "either extirpated or extremely rare" – if the possibility of wolverines' return were publicized, what would be the potential effects of a sudden increase in wolverine-seeking visitors similar to those who flocked to rural southern Arkansas after a possible ivory-billed woodpecker sighting? The adaptive framework we develop could inform the answers to these questions.

Background and preparatory activities

ROMO's resource assessment workshop process was initiated by Ben Bobowski, the park's chief of Resource Stewardship. During a temporary assignment at Grand Canyon National Park, he learned that the park's science directorate needed a way to highlight and prioritize gaps in knowledge in order to efficiently address a suite of issues confronting the park. To meet that need, Bobowski and colleagues conducted a pilot workshop suggested by then Science Director Jeff Cross PhD, modeled after one developed to evaluate marine environmental monitoring in California (National Research Council 1990). He then used some elements of the process in his work at Grant-Kohrs NHS, Montana, and during a temporary assignment at Rocky Mountain NP. Shortly after becoming ROMO's Resource Stewardship chief in 2008, Bobowski scheduled a workshop primarily to guide priority-setting efforts within the parks' Division of Resource Stewardship.

The process described here was introduced at a 2010 workshop. The 2010 version differed from its predecessors in that it focused on obtaining a thorough synthesis of staff knowledge about park resources and change processes; prioritization was seen as a valued outcome of the workshop rather than its primary purpose. With guidance from Bobowski and Ben Baldwin, a staff member in the park's Continental Divide Research Learning Center, the workshop agenda and procedures were developed by Mark Brunson and Lorien Belton of Utah State University, and facilitated by Brunson, Belton, and a US Forest Service social scientist, Dale Blahna.

As a large and diverse national park located near several universities and a large population center, ROMO has one of the highest rates of research activities in NPS. New discoveries and new questions arise rapidly, and research needs and priorities can change just as rapidly. This means a shorter turn-around time is needed between workshops than might be the case at other NPS units. Because some ROMO staff members already had participated in two earlier versions, the effectiveness of the 2010 workshop was probably enhanced by previous experience.

The workshop

The workshop was conducted Oct. 5-6, 2010, at ROMO's research facility at McGraw Ranch. This location is convenient for park personnel, being located just a few miles from Estes Park, but is isolated from other park activities and facilities, creating a venue where participants could concentrate on the workshop without many other work-related distractions. (See Appendix B for a list of participants.)

General Procedures
Participants were reminded at the start that the product of the workshop is an "adaptive framework" in order to underscore the dynamic nature of the task and product. Thus the workshop was not going to produce a mandatory tool that must be consulted when making day-to-day decisions, but rather would bring together the combined knowledge of ROMO professionals to create a document managers *could* use as supporting information, as appropriate, when making those decisions.

The primary output of the workshop would be a spreadsheet (or matrix) that allows users to quickly view whether ROMO staff believe that the resources that they manage might be affected by processes within the park or region, and also whether they believe they know *how* those resources will be affected. Therefore the first critical task of the workshop was to compile a list of "highly valued resources," i.e., components of the park's natural and human environments that warrant protection, and "influential processes," i.e., biological, physical, climatic, social, or managerial factors that can create change in the quality or characteristics of highly valued resources.

Once the resources and processes had been identified, resources were then assigned to categories (e.g., aquatic, alpine, parkwide) to reduce the complexity of the next task – to qualitatively assess two key parameters describing the *interaction* between processes and resources:

- *Information confidence* – the extent to which scientific information exists, is relevant to ROMO, comes from trustworthy sources, and is based on longterm vs. snapshot research, This parameter was measured as high (H), medium (M), or low (L).
- *Strength of influence* – the extent to which a change in the strength or direction of an influential process is thought likely to yield a change in resource quality or character. Participants were asked to measure this parameter as strong (orange), moderate (yellow) or slight (green), although one group subsequently chose to create a very strong (red) category to underscore the importance of a small number of interactions.

Morning session (Day 1): Influential Processes and Highly Valued Resources
We used "emerging issues" affecting management as an initial organizing theme for thinking about highly valued resources and influential processes. The first one of these was protection of alpine tundra, but this quickly grew into higher-elevation areas generally, and as discussion went on we found ourselves also focusing on resources and influences that are seen throughout the park. A second issue was considered (bark beetles), and again it quickly grew from beetle-driven conifer die-off to larger disturbance processes, and then to a discussion of vegetation conditions generally and processes affecting landscape connectivity and change. Thereafter we didn't focus on issues so much as larger classes of components of the park (water, geology, ecosystem processes).

An interesting sidebar was the discussion of data as a resource and some of the factors that determine its usefulness and accessibility. This was not developed into a framework for the afternoon discussion but was presented as an issue everyone should keep in mind as they considered confidence levels in the availability of management-useful knowledge to guide management decisions.

Below is the initial categorization of issues, developed by Mark Brunson as a way to organize input heard during the course of the morning discussion. While these categories appeared to achieve the goal of the session, they're not definitive – in fact, if we were to generate the same kind of list a few days later they probably would be categorized in a

slightly different way. Ultimately, then, it's likely that Resource Stewardship Division staff would reorganize categories to create the most useful document possible.

- Parkwide resources and influences
    - Influential processes: visitor use/trail use; road & trail (re)construction, elk, exotic species; GPRA & planning regulations; employees & volunteers & researchers; visitor crowding; NPS and ROMO mission; mandates of other agencies (e.g., Colorado Division of Wildlife); public perceptions.
    - Highly valued resources: Public goodwill; wildflowers; viewsheds; cultural landscape; Class I airshed; natural soundscape; night skies; wilderness; trails; employees, volunteers and researchers; opportunities for solitude; "the public" as source of support; aspen
- Condition and health of alpine tundra and high-elevation resources
    - Influences: warming; nitrogen deposition; snowmelt timing; mountain goats and other exotic mammals; ozone; particulate deposition; changes in inter-annual variability of temperature and precipitation; anthropogenic sounds (aircraft); anthropogenic light sources; emergency response (SAR).
    - Highly Valued Resources: pika; ptarmigan; glaciers; mountain lakes; permafrost; Trail Ridge Road; vistas; bighorn sheep; alpine willow; water in all its forms; prehistoric, proto-historic and historic cultural resources
- Ecological processes and elements
    - Influences: humans; absence of key carnivores from the system; public perceptions of "naturalness"; changes in societal expectations and values; potential disconnect between ecological realities and public perceptions of how park ecosystems function (or should function); climate-driven shifts in species range; introduced species (e.g., fish, moose, mountain goats); disease
    - Highly valued resources: predator-prey interactions; pollination; nutrient cycling; understanding of species' park-specific habitat needs; wolverine & other potential recolonizers
- Water in its various forms
    - Influences: elk; restoration activities; Grand Ditch; dam removal; major watersheds/Continental Divide; aquatic invasive species; fishing and water-based recreation activities; degradation of rare wetland types; earlier snowmelt peak
    - Valued resources: wetlands; beavers; montane riparian zones; visitor experience; fluvial processes; rare wetland types (fens, bogs); groundwater; hydrologic processes; mountain lakes; water quality; water quantity
- Geologic/mountain setting
    - Influences: Rock climbing; glaciers; erosional processes associated with human activities (recreational trampling/compaction; Grand Ditch)
    - Valued resources: Rock walls for climbing; cultural resources; vistas on summits; soils
- Vegetation condition and landscape connectivity/change
    - Influences: Bark beetles; white pine blister rust; willow fungus; fire; exotic species; human activities along park, wilderness and wildland-urban

interface boundaries; considerations for special protective designations (e.g., Globally Important Bird Area/Class I airshed/International Biosphere Reserve)
- o Highly Valued Resources: Landscape connectivity; globally important bird area; international biosphere reserve

- Data accessibility and validity
  - o Influences: Lack of data; lack of time/money to organize it; out-of-date or inaccurate data; centralization of data → lack of accessibility
  - o Highly valued resources: Data

Afternoon framework-population process
To facilitate the afternoon process, three pairs of frameworks were selected, organized roughly according to their similarity of topic: park-wide resources/influences and ecosystem processes; water and geology; vegetation condition and higher-altitude systems. Each group (self-selected, but with the caveat that there had to be a Branch Chief and a representative of the fire branch (since fire is a significant landscape process). fire person and a branch chief) was responsible for populating two matrices. Each group was assigned a neutral facilitator from the workshop-organizing team.

Each group proceeded according to its own logic and preferences. So, for example, the geology/water group felt there weren't enough resources and influences included, so they began by adding to the scope of their framework. By the time the session was completed, all three groups had added at least one highly valued resource and/or influential process, and a few of the original categories had been combined. Even with these additions, three of the six frameworks were fully populated, and the vast majority of interactions had been classified in the others.

Some groups went through the strength-of-influence exercise all the way first, then went back to evaluate information confidence; others did both at once, filling in the squares more slowly. In general, the second frameworks were easier to populate as people got the hang of the exercise.

Another group-developed modification was to add notations to describe how they thought about a particular set of interactions – for example, when discussing how fire might affect glaciers, a notation was made to indicate that the group was specifically thinking about how ash deposition might change albedo, and thereby increase the amount of glacial melting in an especially active fire season.

The six populated frameworks are presented in Appendix B.

Second day: Post-mortem and "next steps" planning
A much smaller group convened the second day to provide an initial evaluation of the process and identify potential uses of the frameworks developed. Originally we had planned to finish populating the grids by examining the remaining interactions, but that task was postponed for a later meeting of the division leadership team.

There appeared to be general agreement that the process worked well. Participants seemed to enjoy the activity, giving it their full and dedicated attention. Subsequent feedback suggests people look forward to seeing the final internal product and to learning how the collective expertise will be used. A brief discussion of participants concluded that when the exercise is next conducted again (perhaps in 2011, or 2012 at the very latest) other term employees should attend as well as cultural resource personnel in other divisions.

Most of the subsequent morning discussion centered around the relationship of this *ad hoc* product to other planning-related activities such as a General Management Plan, Resource Stewardship Strategy, or Resource Management Plan. It appeared to an outsider that those present prefer this sort of easily produced, easily amended product to some of the larger, more cumbersome and especially more expensive products. Several people suggested that the adaptive framework would be useful in conjunction with a Foundation Document. (NOTE: According to the 2004 Park Planning Program Standards, parks are to prepare a *Foundation for Park Planning and Management* document (Foundation Document), which describes its purpose, significance, primary interpretive themes and special mandates, and identifies/analyzes resources and values that are warrant primary consideration in park planning and management. While a Foundation Document may be developed as the first stage of a GMP process it can also be done independently.)

On and off throughout the two-day activity there was discussion of the tradeoffs between the organically generated categorization used in this process, and a more generalized set of categories.

Construction of the overarching categories that drive the adaptive framework was a synergistic process. The categories identified and selected in this stage of the process were a direct result of the perspectives, experience, and insights of those who are working directly with resources. This process creates a unique opportunity for building investment in the process by all participants and increased interdisciplinary discussion and collaboration.

However, it may require a level of comfort with activities where participants "build the plane while it's in the air." Therefore a more structured approach may offer a useful starting point for some park organizations. The Heinz Center, a nonprofit and nonpartisan think tank dedicated to improving the scientific and economic foundation for environmental policy, uses four top-level categories in its framework for ecological condition and trend reporting:

- Extent and Pattern
- Chemical and Physical Characteristics
- Biological Components
- Goods and Services

The first category may not be applicable to developing an adaptive management strategy because it refers to the arrangement of valued resources rather than to the resources

themselves or the processes likely to influence them. However, for parks that are trying this exercise for the first time, this categorization may provide a beginning to a useful framework for organizing participants' thoughts.

This approach varies from that used by the Heinz Center for resource and "state of the nation's ecosystems" assessment processes. While a pre-determined categorization such as the Heinz Center model can be more easily transported from one park to another, or compared across parks, there are also drawbacks. One major limitation to using a pre-set categorization is that park-specific needs may be overlooked if they do not easily fit a category within the model or if their impact is dispersed across multiple categories.

It is important to note the process for constructing categories is an artifact of the staff who participated. . At ROMO, the process of constructing a series of frameworks provided an efficient mechanism for generating discussion, as well as a forum for interdisciplinary collaboration. Park management approached this process as a tool that could support and inform other planning processes, staff education and training needs as well as future technical assistance and research.

As others look to replicate this process, it is essential to emphasize the importance of involving key players. The frameworks and priorities generated through the process are an artifact of a given moment in time, the people involved in the process, and their individual and collective knowledge. As with any planning tool, it is important to refer back to the process and priorities periodically to check for relevance. To maximize the potential usefulness of this process, key decision makers must have a vision for ways in which the framework can support policy and mandates, as well as on-going service-wide goal and initiatives.

Setting Priorities

Perhaps the most immediate use of this tool is for priority-setting. By understanding where field and supervisory personnel see the greatest need for scientific information, managers have a tool that can guide decisions about how best to invest scarce resources in research and data-gathering and staff experience and education. Therefore a critical step is translating the framework into a set of priorities, which may hold potential for increasing capacity within the park unit. We have identified three different approaches that may be used for converting the adaptive framework to management and/or research priorities:

1. **What are the conditions for which employees believe that the interaction between influential process and valued resource may be strong, but we have little confidence in our understanding of those interactions?** This approach matches knowledge gaps with the perceived likelihood that a change in the influential process will necessitate action to protect the resource. To identify these interactions, we made note of every cell in the completed framework for which confidence was assigned a value of L and strength of influence was coded as orange or (in a few cases) red. The list of interactions is shown in Table 1.

Table 1: Prioritization by High Influence/Low Confidence Questions

Parkwide questions
1. How do the activities of park employees, volunteers and researchers affect the status of ponderosa pines?
2. How do decisions consistent with NPS and ROMO missions, as well as those by non-NPS agencies, affect the protection of natural soundscapes and night skies?
3. How do visitor use levels affect wilderness?
4. How does fire influence the ability to maintain cultural landscapes?
5. How is public goodwill affected by the activities of park employees, volunteers, and researchers as well as visitor-use levels?

Tundra
1. How might variations in temperature and precipitation associated with climate change affect tundra resources (mountain lakes, permafrost, tundra vegetation)?
2. How will a change in timing of snowmelt affect permafrost?
3. Will changes in nitrogen deposition affect the quality of scenic vistas?

Ecosystem-scale processes and conditions
1. Will climate change affect the properties of ecosystems in ways that change the habitat needs of highly valued species?
2. Will climate change affect the properties of ecosystems in ways that change the natural fire cycle?
3. Will human activities across the region affect recolonization by wolverine or other species?

Water in all its forms
1. If snowmelt peaks earlier in the season, what are the likely effects on wetlands, montane riparian zones, and fluvial processes? What will be the resulting effects of change in snowmelt peak on water- and snow-related visitor experiences?
2. How will restoration activities and/or wildfire affect beavers?
3. What are the implications of the degradation or loss of rare wetland types for the health of the overall wetland resource in the park?

Geologic/mountain setting
1. How will climate change affect soils?
2. How will climate change affect scenic vistas?
3. How will climate change affect geomorphic processes?

Ecological processes and elements
1. How does the spread of willow fungus and/or other novel plant diseases affect the status of globally important bird areas?
2. How do changes in fire intensity, pattern, or frequency affect landscape connectivity?
3. How do special designations affect landscape connectivity?

2. **What are the influential processes for which there is the least confidence that the effects on valued resources are understood?** This approach assumes that if knowledge about the interaction is less well understood, we also know less about the strength of that interaction. For that reason, we counted *all* of the cells within each influential process where a value of "L" was assigned, regardless of current perception about strength of influence. The resulting list (Table 2) is best for directing management and/or research administration attention to those processes that are most likely to generate unpredicted effects. Because resources are often directed to specific change processes (e.g., rising visitor numbers, climate change), this approach may be useful in determining which questions should receive attention when resources do appear.

3. **What are the highly valued resources for which there is the least confidence that the effects of potential process changes are understood?** This approach entailed counting the number of cells assigned a value of "L" for each highly valued resource (Table 3). If there are a large number of interactions for which scientific confidence is low, it may be useful to direct research resources toward those resources. Researchers tend to be experts on elements of the park system – beavers, biogeochemical cycling, visitor experience, mountain pine beetles – more often than on processes that can affect multiple resources differently. Often the scientific literature is organized around those elements as well. Therefore this approach may be most useful for identifying which types of researchers should be invited to work in a park, or which kinds of literature reviews/syntheses may be most effectively solicited and prepared to assist in making management decisions and providing staff education and training.

Lessons Learned

As noted in the last section, outcomes are highly dependent on how the frameworks are developed. By starting with emerging issues, this exercise elicited a listing of influences and valued resources that was highly relevant to management activities and easy to generate because they're what's on people's minds right now. The issue-focused approach also provided a way to build upon similar previous exercises without seeming to be redundant. However some resources or influences didn't appear because they're not prominent at the moment (e.g., aquatic animals, some TES species).

ROMO has now used both interdisciplinary and discipline-specific criteria to assign park staff members to groups that would develop specific frameworks. There are advantages and disadvantages to each approach. Detail and precision are advantages of using discipline-specific groups, but there is less cross-disciplinary expertise to help populate cells and suggest additional missing categories or influences that may cross disciplines.

Because this is the third time this exercise has been conducted at ROMO, we do not know if the apparent success was because of prior experience, or slight differences in how it was conducted. Having neutral outsiders as facilitation team changes the dynamic of the process. For one thing, it requires introductions by all participants, which helps attendees

Table 2: Focus on Influential Processes

Effects on **five or more** valued resources thought to be poorly understood
- Climate change in general
- Climate-driven shifts in ecosystem processes
- Changing timing of snowmelt
- Changes in temperature and precipitation patterns
- Degradation of rare wetland types
- GPRA and planning regs
- Visitor use levels

Effects on **four** valued resources thought to be poorly understood
- Elk

- Park employees, volunteers and researchers
- Aquatic invasive plants
- Rock climbing

Effects on **three** valued resources thought to be poorly understood
- Fire
- Dam removal
- Nitrogen deposition
- Particulate deposition (dust, smoke)
- Anthropogenic sounds
- Visitor crowding
- Public perceptions and goodwill

Table 3: Focus on Highly Valued Resources

Likely to be affected by **six or more** influences of concern
- Water and snow-related visitor experiences
- Beaver

Likely to be affected by **five** influences
- Ponderosa pine
- Alpine willow
- Fluvial processes
- Permafrost

Likely to be affected by **four** influences of concern
- Wolverine and other potential recolonizing species

- Landscape connectivity
- Cultural landscape
- Night skies

Likely to be affected by **three** influences of concern
- Viewsheds
- Natural soundscape
- Bighorn sheep
- Predator-prey interactions
- Montane riparian zones
- Cultural resources
- Soils
- Geomorphic processes
- Permafrost

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focus on what they do that makes their contributions to the process valuable. Also it may change the interpersonal dynamic in unknown ways. If outside facilitation is used, those individuals should have natural and/or cultural resource management knowledge so that they can easily understand suggestions made by participants and transcribe/classify them appropriately.

Setting the purpose and context of the exercise through pre-workshop materials as well as introduction discussions on the day of the workshop appeared to help set the tone of the activity. For example, giving a park-specific example of how the input could be used can encourage participation and demonstrate the long-term value of the activity. To help participants perform their own internal cost/benefit analyses for the day's activity, we also introduced what co-facilitator Dale Blahna calls the "80-20 rule," – that is, for about 20 percent of the effort, a process such as this can capture about 80 percent of the collective wisdom of participants.

This process may work best for units that have some component of bottom-up approach to leadership. A truly "command-and-control" leadership style doesn't lend itself to this process, which is really about assembling and then *using* field-level expertise.

Scale was a complicating factor in the exercise, especially in the description of influential processes (e.g., connections between human activities and certain resources depend on whether the activities occur on-site, as by visitors or managers or researchers, or whether they are generated outside the park, for example through dust-generation that deposits particles at higher elevations), and also in the breadth of applicability of the product. This particular exercise might work at a higher level than ROMO, but scaling up adds complications that may make the process unwieldy.

Flexibility may be the chief value of this approach. If unanticipated funding opportunities arise, or researchers seek access for new studies, the framework can help the staff prioritize requests "on the fly." By focusing on strength of influence upon valued resources, and a qualitative assessment of confidence in scientific information about the direction and consequences of that influence, there was explicit avoidance of any "importance" to particular resources. If priorities are set, they're determined by the need for information or vigilance, but not on whether a particular resource is more or less valued than any other.

Conclusions and Next Steps

The framework is a dynamic tool that is best utilized when it can be frequently revisited and revised. Not every category of resources will be important or even relevant to all park staff. Each branch should conduct an internal evaluation to better understand and identify which components are most relevant to their mission and goals. Some offices may want to use the tool to set priorities or identify way in which they can collaborate to learn more about the areas in which they feel least confident or knowledgeable.

The framework can be a powerful tool for exploring interactions. Managers can begin by determining which elements fall within their sphere of influence and drawing connections to other offices and components of park ecosystems. The framework may also serve as a method of identifying conflict between goals. Managers can also use the framework to guide staff training or planning activities, such as accessing technical assistance and support, conducting literature reviews, tightening feedbacks to improve internal communication, and seeking opportunities for building science literacy within the park.

APPENDIX A

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APPENDIX B: Participants

- Jeff Albright, Coordinator, Natural Resource Condition Assessment Series (WO)
- Ben Baldwin, Student Trainee, Ecologist
- Ben Bobowski, Chief, Resource Stewardship Division
- Jim Cheatham, Biologist/Phy Scicentist
- Jeff Connor, Natural Resource Management Specialist
- Matt Dutton, Supv Wildland Fire Operations Specialist
- Nina Dutton, Fire Program Assistant
- Scott Esser, Lead Bio Science Tech (Restore)
- Larry Gamble, Natural Resource Management Specialist (Land Use)
- Therese Johnson, Biologist
- Mike Lewelling, Fire Management Officer
- John Mack, Natural Resource Program Manager
- Paul McLaughlin, Ecologist, Grand Ditch
- Ron Thomas, Biologist
- Judy Visty, Ecologist (Research Administration)
- Karen Waddell, Cultural Resource Specialist
- Doug Watry, Fire Management Specialist
- Mary Kay Watry, Biologist
- Nate Williamson, Ecologist

On the second day, those present included two newcomers, Chris Dahl, forester in the Resource Management branch, and Mike Britten, program manager for the NPS Rocky Mountain Inventory and Monitoring Network based in Fort Collins. Other second-day attendees were branch-level staff: Larry Gamble, Mike Leweling, John Mack, Paul McLaughlin, Judy Visty; Ben Baldwin; Jeff Albright; Ben Bobowski and the facilitation team (Lorien Belton, Dale Blahna, Mark Brunson).

APPENDIX C: ADAPTIVE FRAMEWORKS