Scientific Activities and Research in NPS Wilderness: Guidelines for Wilderness Managers

*"Except as otherwise provided in this Act, each agency administering any area designated as wilderness shall be responsible for **preserving the wilderness character** of the area and shall so administer such area for such other purposes for which it may have been established as also to preserve its wilderness character. Except as otherwise provided in this Act, wilderness areas shall be devoted to the public purposes of recreational, scenic, **scientific**, educational, conservation, and historical use."*

Wilderness Act Section 4(b)

According to the Wilderness Act (1964), science is one of the purposes of wilderness. Wilderness is important to science as it enables often crucial research in unmodified landscapes. For example,

"Because wilderness receives minimal hands-on management, it provides the best baseline we have for monitoring to understand how the full range of ecological systems, from grassland to alpine tundra, function and respond to a changing climate. This understanding includes, for example, how changing demography and distribution of plant and animal species, severity and timing of fire, and spread of insect and disease outbreaks are correlated with changing climate conditions."

Landres and FS Wilderness Monitoring Team, 2010

Wilderness provides unique opportunities and unique challenges with respect to scientific activities and research. Scientific activities may result in some loss to wilderness character, such as through trammeling or development, or loss of natural quality. Managers are expected – and no doubt will continue to be expected – to make difficult decisions on how to balance the benefits and impacts of each situation. Sometimes, science and research may have advantages that are uncertain in the present; here too, managers may be faced with difficult decisions to determine whether or not a scientific activity is necessary and appropriate in wilderness.

Fortunately, a number of tools and guidelines exist to help managers make these decisions in a transparent, efficient, and timely manner. By following a set of prescribed steps, parks can help ensure that baseline information is available to park staff, scientists are aware of the process of obtaining permission for conducting activities in parks, and scientific research is used to better inform practices and plans for wilderness stewardship. **In the following document, we synthesize guidelines that have been proposed and/or enacted in NPS wilderness areas to help managers integrate scientific activities and research with wilderness stewardship**. Where relevant, a list of useful documents has been provided; some are documents produced by parks for internal decision-making, which can be used as guides by other parks for producing similar documents. Others are directives or guidelines that pertain to all wilderness areas.

Some of the examples used here are scenarios that may present themselves in the course of evaluating research proposals related to climate change, one of the most significant issues facing parks today. The NPS Climate Change Response Strategy [CCRS] (NPS 2010) clearly indicates that science is one of the key components to be considered in climate change-related park management. Along with adaptation, mitigation, and communication, science is seen as a key element in the effort to understand and potentially reduce the impacts of climate change in the future. In particular, the CCRS indicates that one of the goals of parks should be to "acquire, provide, and apply scientific information" (pg 14) and use "the best available science" (pg 15) to make decisions on park management, park planning, and carbon footprint reduction. Therefore, examples of climate change-related activities have been specifically used to illustrate key points in this paper. Such research will likely provide invaluable information on wilderness and natural systems in general in the coming years. As wilderness managers may increasingly receive proposals for conducting research on climate change impacts, we hope the examples here will help managers become familiar with some of the ways climate change research can be integrated successfully into the larger goals of wilderness stewardship.

However, the guidelines here are not restricted to climate change research only; they pertain to a spectrum of science-related work ranging from research driven by a hypothesis to be tested, to inventory work and routine data-gathering activities and surveys of natural and cultural resources, and other management activities. This includes research proposed by non-NPS scientists, Park researchers, and monitoring teams collecting any sort of natural, social, or cultural scientific data.

These guidelines are primarily assembled from three major sources:

- *A Framework to Evaluate Proposals for Scientific Activities in Wilderness* (Landres et al. 2010)
- *Cumulative Effects of Science in Wilderness* (AKRO 2010)
- *Keeping It Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System* (Landres et al. 2008)

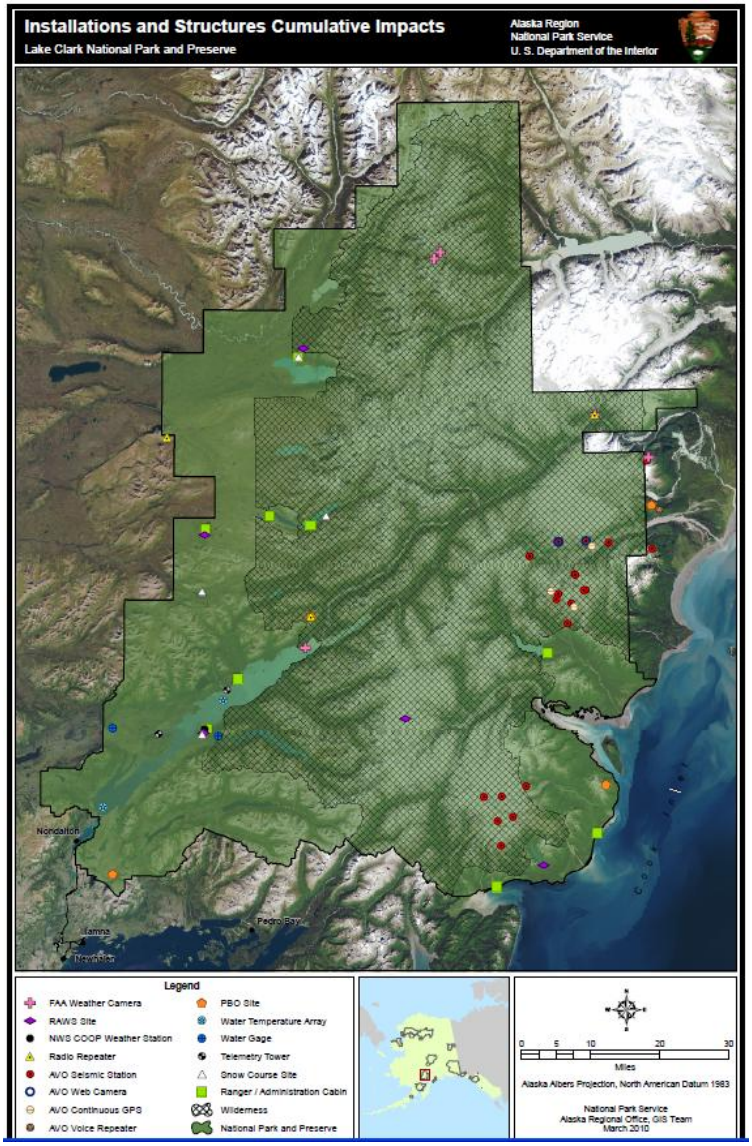
Intended Audience:

This paper is intended primarily for Park wilderness coordinators or staff in any other position fulfilling the role of coordinating wilderness activities. It is also aimed at the chief of natural resources, any other natural resource staff, and personnel in charge of research and permitting. It is particularly crucial for wilderness coordinators and natural resource managers (hereafter referred to as "wilderness managers") to read through this document carefully. Additionally, the guidelines are relevant for some cultural resource research activities in wilderness, even if the details contained in this paper are set in the context of, and are more specific to, natural and social science activities.

An overview of steps involved in managing scientific activities and research in wilderness

DOCUMENT

current wilderness character, current installations and projects



Documentation of wilderness character and inventorying existing activities and installations prior to the start of new scientific studies can be an invaluable step in quantifying how proposed activities and installations will affect wilderness.

Currently, wilderness character assessments (WCAs) are underway in a number of parks. These assessments are an important documentation process that will aid tremendously in establishing wilderness character baselines and increasing managers' knowledge about the benefits, impacts, and future needs of research. WCAs use measurable indicators to answer key monitoring questions about the four wilderness qualities (untrammeled, natural, undeveloped, opportunities for solitude or a primitive and unconfined type of recreation) to describe wilderness character. A better understanding of wilderness character will ensure better-informed conclusions on how new scientific studies may impact each of these qualities differently. Documentation could include information about the number of tagged animals in the wilderness, number of overhead access flights per year, number of person-hours spent in collecting data, and information on many other indicators.

Another important tool for documenting impacts is a complete, up-to-date and regularly updated GIS layer of installations and facilities in wilderness areas. In Alaska, this has been cited as a "critical starting point for improving cumulative impacts analysis" (AKRO Implementation of Science in Wilderness Working Group, 2010). This process may entail a substantial initial commitment of time and staff. However, maintenance of the GIS database can be easily integrated into routine

management activities. Monitoring is necessary not only for its importance to research-related concerns, but in general for wilderness planning and stewardship.

For example, you may receive proposals to collect scientific data by means of certain activities and uses (for example, the installation of Remote Automated Weather Stations [RAWS]), which are nonconforming uses (i.e., uses of wilderness that are incompatible with the list of allowable activities according to Wilderness Act), that will impact wilderness character. In the absence of baseline data on the current number of installations in a wilderness, managers would not be able to realistically evaluate how five new RAWS will impact wilderness. In this case, are five RAWS an insignificant number? Or will these five installations, in addition to many others, negatively impact wilderness quality? Are there alternative locations for their placement that will reduce their impacts? If baseline studies are completed and the locations of current installations are known, it may be possible to consolidate or combine new stations with old ones to minimize their impact. Activities such as completing and maintaining baseline inventories and monitoring trends are very helpful when considering the impacts of proposed installations on wilderness.

Once a primary analysis has been completed, the database can be managed to reflect installation removals and additions over time.

Useful references:

- *Keeping It Wild: An Interagency Strategy to Monitor Trends in Wilderness Character across the National Wilderness Preservation System* (Landres et al 2008)
- *Considering cumulative effect under the National Environmental Policy Act* (CEQ 1997) http://ceq.hss.doe.gov/nepa/ccenepa/toc.pdf
- Alaska's *Cumulative Impacts Analysis*
  Available at http://inside.nps.gov/regions/custommenu.cfm?lv=3&rgn=1329&id=9533

Tools and expertise required: a multidisciplinary team capable of collecting, preserving, and analyzing data to evaluate wilderness character; a GIS team

Potential products: Wilderness character evaluation; GIS layer of installations

DEVELOP

a procedural strategy within the Park for reviewing activities in wilderness

There are a number of steps and duties associated with reviewing proposals for scientific activities in wilderness. Each park will have to consider how to streamline the process of ensuring compliant scientific activity.

Parks may want to consider the following when planning workflow for the review process:

- Who will be responsible for initiating the review process? Who will be on the review committee and in what capacity? How will the activities of different committee members be coordinated? How will the committee communicate with scientists? How often?
- What will be the timeline for review? When will the major steps (acceptance of proposals, evaluation using the Landres Framework, NEPA, etc.) be conducted? How much time will be allowed between receiving a proposal, reviewing the proposal, and communicating with the proposer?

While answers to these questions will depend on number of staff available to take part in review and the number of proposals the park anticipates receiving, care should be taken to ensure that all required tasks are distributed and completed according to the timeline that is decided upon for execution. Key roles will include coordination of evaluation and compliance processes, liaisons between wilderness and scientists, coordinators of monitoring activities and installations, etc. To the greatest extent possible, scientists should be made aware of the tentative timeline for the evaluation of their proposals, and should be informed of the correct person to contact in case they have questions about specific steps or requirements.

COMMUNICATE

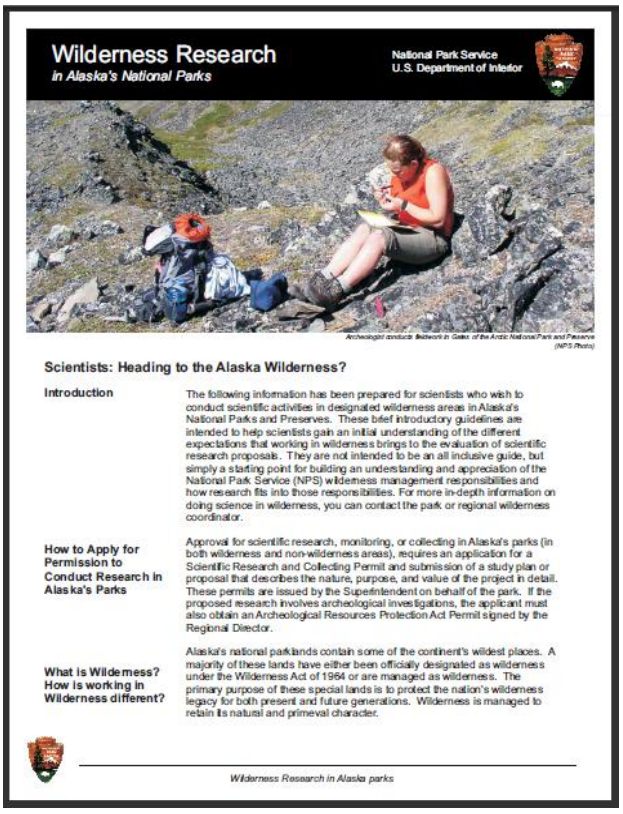
the specific challenges and requirements of wilderness research to potential researchers

As research permit requests increase, managers will often need to communicate with scientists who are unfamiliar with working in wilderness.

While concepts such as minimum requirements may be very familiar to wilderness managers, scientists may be more likely to plan studies based on maximum efficiency, not minimum impact. Such gaps in communication about policy and requirements can lead to strained relations between scientists and parks. On the other hand, timely communication can reduce frustration on both sides and help build better relationships between parks and researchers.

To protect the wilderness resource, it is critical for parks to adhere to the standards of wilderness stewardship outlined in NPS policy. To achieve adherence, wilderness managers must facilitate collaboration, strengthen the relationship of scientific and wilderness communities, and maximize scientific value while initiating appropriate and sensitive projects. It is the responsibility of the park and the wilderness manager to improve and maintain a high level of dialog, decision transparency, and access to information, and to make a concerted effort to ensure educated, respectful discourse.

❖ *What information needs to be communicated?*


Wilderness Research
in Alaska's National Parks
National Park Service
U.S. Department of Interior

Archeologist conducts fieldwork in Gates of the Arctic National Park and Preserve (NPS Photo)

Scientists: Heading to the Alaska Wilderness?

Introduction

The following information has been prepared for scientists who wish to conduct scientific activities in designated wilderness areas in Alaska's National Parks and Preserves. These brief introductory guidelines are intended to help scientists gain an initial understanding of the different expectations that working in wilderness brings to the evaluation of scientific research proposals. They are not intended to be an all inclusive guide, but simply a starting point for building an understanding and appreciation of the National Park Service (NPS) wilderness management responsibilities and how research fits into those responsibilities. For more in-depth information on doing science in wilderness, you can contact the park or regional wilderness coordinator.

How to Apply for Permission to Conduct Research in Alaska's Parks

Approval for scientific research, monitoring, or collecting in Alaska's parks (in both wilderness and non-wilderness areas), requires an application for a Scientific Research and Collecting Permit and submission of a study plan or proposal that describes the nature, purpose, and value of the project in detail. These permits are issued by the Superintendent on behalf of the park. If the proposed research involves archeological investigations, the applicant must also obtain an Archeological Resources Protection Act Permit signed by the Regional Director.

What is Wilderness? How is working in Wilderness different?

Alaska's national parklands contain some of the continent's wildest places. A majority of these lands have either been officially designated as wilderness under the Wilderness Act of 1964 or are managed as wilderness. The primary purpose of these special lands is to protect the nation's wilderness legacy for both present and future generations. Wilderness is managed to retain its natural and primeval character.

Wilderness Research in Alaska parks

From the outset, it is imperative to communicate to researchers that wilderness research will not be approved unless there is clear indication that wilderness values and needs are thoroughly considered in the research design. Consideration will not guarantee approval, but lack of consideration may lead to rejection of a research proposal.

It must also be clearly communicated to researchers that wilderness-specific requirements and expectations must be met not only in the proposal process, but also during all stages of project, from project evaluation, revision, implementation to the reporting of research results. Park staff will need to work with scientists to make sure there is a clear understanding of these fundamental requirements and the value of these requirements for protecting wilderness

resources. Consequences of not following requirements or meeting expectations will lead to a review process, possible termination of the study, or denial to future research permits.

Reducing Impacts: what scientists should know

Scientists must be prepared to describe in their proposals the potential wilderness benefits, potential wilderness impacts, possible mitigation methods, and how results will be communicated to park management. Further, researchers interested in conducting activities that involve prohibited uses in wilderness must be prepared to complete a Minimum Requirements Analysis to determine 1) if the action (research) is indeed necessary in wilderness, and 2) what specific activities are the minimum necessary to complete the action, in order to help preserve wilderness character. Researchers can be directed to the Arthur Carhart National Wilderness Training Center's MRA e-test (http://www.eppley.org/elearning/course-catalog/wilderness-resources/carhart-interagency-wilderness-training-minimum-requirements-analysis) so they can familiarize themselves with the process before submitting their proposals.

Research projects may include different elements that influence wilderness character, or contribute to the incremental impacts of the study. These can include permanent and temporary installations, and one-time or recurring activities. A number of well-documented examples already exist, which describe the ways in which biophysical impacts of installations can be minimized and their visual and auditory imprint significantly reduced. The same is true of recurring or one-time activities which may cause disturbance (such as constructing installations), activities that require the involvement of multiple individuals, or involve permitted use of vehicles. Scientists should undertake minimum tools analysis (Arthur Carhart National Wilderness Training Center, 2009) to help them evaluate what activities will have the least impact. For example, when transporting equipment, the use of a helicopter sling load could possibly be substituted with use of pack stock. Instead of physically marking a research site with prominent visible markers, photographs, GPS coordinates, and unobtrusive markers can be used to locate a site.

Questions to be asked include but are not limited to: how can sensory impact to visitors be diminished? How will impacts influence different species differently? Will actions have the same impact at different times of year, and over the course of multiple years? For example, will an installation be more noticeable when foliage is shed, or will certain activities lead to more erosion in spring than summer? Can activities be combined to minimize impact? For example, could a scientist in Alaska combine a site selection helicopter flight with another researcher's approved flight? Could the activity inadvertently introduce invasive species or promote the growth of invasive species through erosion?

Guidance on wilderness procedures must be communicated to researchers prior to their proposal submittal, and considered by researchers throughout the process of proposal writing. While modification and revisions of proposals are always expected, pre-emptive consideration of wilderness specific concerns is crucial. Therefore, site-specific integration should be stressed in early communications to researchers. Managers should consider including them in any informational documents distributed to scientists.

❖ ***How can this information be communicated?***

It is the responsibility of researchers to educate themselves about the special requirements of working in wilderness, but it is also the duty of managers to ensure that this information is readily available to the scientific community. Parks must be clear and upfront about research requirements and proposal evaluation, and must include it in any information sent to researchers about research application process and proposal requirements.

Ideally, parks should also have the information readily accessible on the park's public website so researchers can incorporate requirements from the earliest possible stages of research planning and design. A starting point is for each park to provide a web page addressing the most fundamental issues.

Currently, AKRO has directed all of its parks to provide an easily accessible web link from each park website, with guidelines for conducting research in Alaska's wildernesses. Similar internet resources are available for Yellowstone and Everglades. The websites provide information to scientists within and outside of NPS, and explain how research work in wilderness will be evaluated differently from research in other non-wilderness areas. The sites also promote early communication between scientists and park managers, and prepare researchers for some of the discussions they will encounter. Other parks can use these web pages for guidance on building their own.

Useful references:

Wilderness research factsheet web pages:
http://www.wilderness.net/toolboxes/documents/resSciAct/EVER_research_factsheet_wilderness.pdf
http://www.wilderness.net/toolboxes/documents/resSciAct/YELL_research_factsheet_wilderness.pdf
http://www.wilderness.net/toolboxes/documents/resSciAct/Alaska_research_factsheet_wilderness.pdf

MRA teaching tool:
http://www.eppley.org/elearning/course-catalog/wilderness-resources/carhart-interagency-wilderness-training-minimum-requirements-analysis

Tools and expertise required: Staff to modify existing guidelines for scientists to suit the requirements of individual wildernesses; web development personnel

Potential products: informational webpage directly accessible from National Park website; informational content to be distributed by CESUs.

EVALUATE

all new projects on the basis of "A Framework to Evaluate Proposals for Scientific Activities in Wilderness" and any other relevant policy

"A Framework to Evaluate Proposals for Scientific Activities in Wilderness" (Landres et al 2010) provides a "consistent and comprehensive approach for thinking through and documenting how the four federal wilderness managing agencies may evaluate proposals for scientific activities in wilderness". It allows transparent decision-making based on whether benefits of the research justify its impacts.

The Framework is comprised of four "filters" that lead to a recommendation. Each proposal must pass through every step of the filter in order to be recommended. In brief, these steps are:

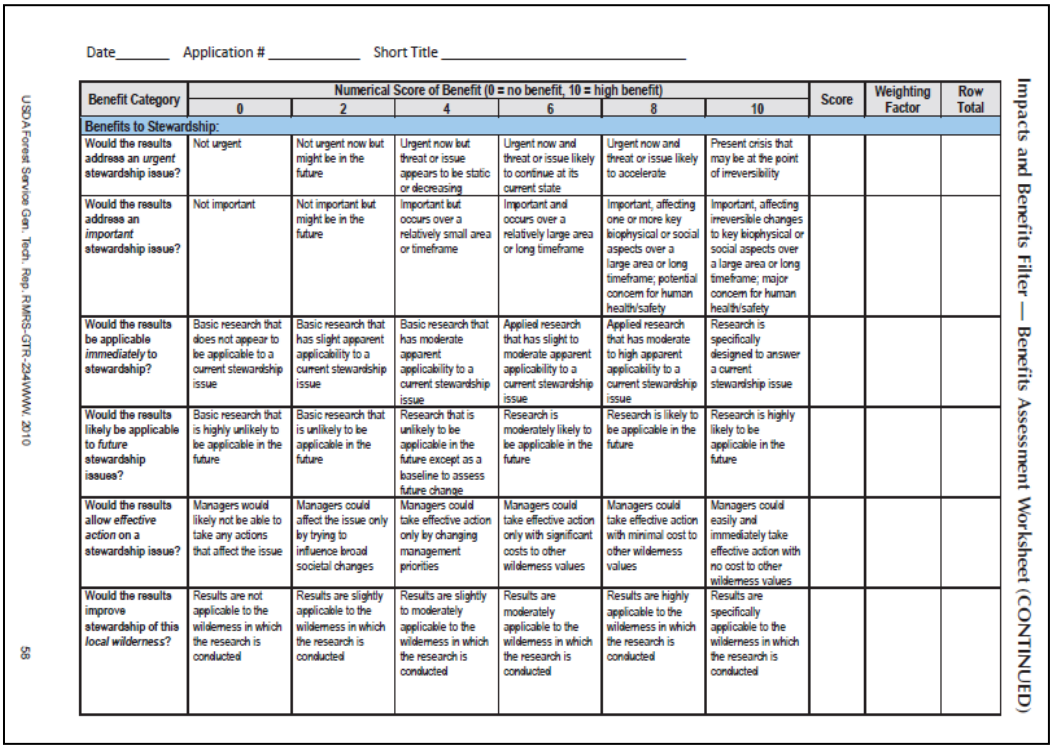
Initial Review Filter to identify obvious problems in the proposal.

Quality of proposal Filter to ensure proposed activities will achieve intended outcome.

Legal and Policy Filter to evaluate conformance with applicable policies. This filter incudes a Minimum Requirements analysis. Researchers should be familiar with MRA and other procedures they will encounter when proposing to conduct scientific activities in parks. They will then be able to plan their research to comply with the special requirements of wilderness. As a first step of the MRA, the proposal will be evaluated in order to determine if the activity is necessary to maintain wilderness character. If their research fits this criterion, it will be further evaluated to determine whether the activities involved are the minimum necessary to maintain wilderness character. It should be noted that failure to pass the MRA stage does not neccssarily meant that the proposal must be rejected.

Impacts and Benefits Filter to assess benefits along with incremental and cumulative impacts using numerical scores. This step takes into consideration benefits and impacts to wilderness stewardship in the present, as well as the benefits on larger spatial and temporal scales. For example, the filter asks: "Would the results likely be applicable to *future* stewardship issues?", "How broad *geographically* will the results benefit science?", and "How many different types of *people* will benefit from the results?" (pg 58-62, Landres et al 2010). In total, there are eleven such questions for benefits. However, it is up to park managers to determine the relative importance of each of these questions (based on legislative direction, planning guidance, local ecological and social context, etc.). Once the relative importance of each question has been assessed, managers assign weights to each of the categories to reflect perceived importance. Thus an evaluating team may choose to assign heavier weight to immediate, local benefits, and provide justification for why they chose to do so. Or they may choose to assign heavier weight to long-term benefits, again with justification.

Numerical values are also assigned to negative impacts, and the net value of benefits and impacts is used to inform the final recommendation.



Date_____ Application # _____ Short Title _____

Benefit Category	Numerical Score of Benefit (0 = no benefit, 10 = high benefit)						Score	Weighting Factor	Row Total
	0	2	4	6	8	10			
Benefits to Stewardship:									
Would the results address an *urgent* stewardship issue?	Not urgent	Not urgent now but might be in the future	Urgent now but threat or issue appears to be static or decreasing	Urgent now and threat or issue likely to continue at its current state	Urgent now and threat or issue likely to accelerate	Present crisis that may be at the point of irreversibility			
Would the results address an *important* stewardship issue?	Not important	Not important but might be in the future	Important but occurs over a relatively small area or timeframe	Important and occurs over a relatively large area or long timeframe	Important, affecting one or more key biophysical or social aspects over a large area or long timeframe; potential concern for human health/safety	Important, affecting irreversible changes to key biophysical or social aspects over a large area or long timeframe; major concern for human health/safety			
Would the results be applicable *immediately* to stewardship?	Basic research that does not appear to be applicable to a current stewardship issue	Basic research that has slight apparent applicability to a current stewardship issue	Basic research that has moderate apparent applicability to a current stewardship issue	Applied research that has slight to moderate apparent applicability to a current stewardship issue	Applied research that has moderate to high apparent applicability to a current stewardship issue	Research is specifically designed to answer a current stewardship issue			
Would the results likely be applicable to *future* stewardship issues?	Basic research that is highly unlikely to be applicable in the future	Basic research that is unlikely to be applicable in the future	Research that is unlikely to be applicable in the future except as a baseline to assess future change	Research is moderately likely to be applicable in the future	Research is likely to be applicable in the future	Research is highly likely to be applicable in the future			
Would the results allow *effective action* on a stewardship issue?	Managers would likely not be able to take any actions that affect the issue	Managers could affect the issue only by trying to influence broad societal changes	Managers could take effective action only by changing management priorities	Managers could take effective action only with significant costs to other wilderness values	Managers could take effective action with minimal cost to other wilderness values	Managers could easily and immediately take effective action with no cost to other wilderness values			
Would the results improve stewardship of this *local wilderness*?	Results are not applicable to the wilderness in which the research is conducted	Results are slightly applicable to the wilderness in which the research is conducted	Results are slightly to moderately applicable to the wilderness in which the research is conducted	Results are moderately applicable to the wilderness in which the research is conducted	Results are highly applicable to the wilderness in which the research is conducted	Results are specifically applicable to the wilderness in which the research is conducted			

Impacts and Benefits Filter — Benefits Assessment Worksheet (CONTINUED)

USDA Forest Service Gen. Tech. Rep. RMRS-GTR-234WWW. 2010

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A page from *A Framework to Evaluate Proposals for Scientific Activities in Wilderness,* Impacts and Benefits Filter

This framework is particularly useful for evaluating climate change research as the impacts and benefits filter facilitates a transparent decision-making process. The framework considers long-term influences, allows managers and scientists to discuss the specific points of conflicts, and allows exploration of possible solutions.

In addition to evaluating proposals on the basis of the Framework, all proposals must also fulfill NEPA, Section 106 regulations, and any other applicable compliance requirements. The framework may be useful to help further other compliance requirements, but it does not supersede or replace such requirements.

Useful references: *A Framework to Evaluate Proposals for Scientific Activities in Wilderness* (Landres et al. 2010). http://www.fs.fed.us/rm/pubs/rmrs_gtr234.pdf

Tools and expertise required: an interdisciplinary team to conduct proposal evaluation

Potential products: recommendations on scientific research proposals

INTEGRATE

compliance processes (such as NEPA) into review

An Environmental Assessment (EA) or Environmental Impact Statement (EIS) may be a necessary part of determining whether or not an activity can be conducted in a wilderness. Compared to the evaluation framework, fulfilling National Environmental Policy Act (NEPA) compliance will likely take more time and coordination to complete in a timely manner. Once a proposal has been evaluated using the Landres framework, the park should begin integrating the NEPA process as early as possible. Time and effort can be saved both for the park and for scientists if the NEPA process is initiated as soon as the Park is reasonably sure that the research should be conducted. To this end, the park should begin evaluating potential issues and concerns, who the interested and affected parties will be, etc.

What is NEPA and how do I know if an EA or EIS required?

The National Environmental Policy Act (NEPA) requires federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and the reasonable alternatives to those actions. The level of compliance necessary is related to potential level of impact to the social, economic, and/or natural environment, and the level of controversy a particular action may entail. An interdisciplinary team should use the Environmental Screening Form, available in the NPS Planning, Environment and Public Comment (PEPC) site, to determine the appropriate level of compliance (PEPC steps 3 and 4). Further, the Director's Order #12 also provides guidance on the level of NEPA compliance appropriate for the proposed level of impact and potential amount of controversy.

Useful references:

Director's Order #12 and handbook (DO 12) ON NEPA:
http://www.nps.gov/policy/dorders/dorder12.html
http://www.nature.nps.gov/protectingrestoring/do12site/01_intro/011_intro.htm

Planning, Environment and Public Comment (PEPC) website:
Tools and Training - https://pepc.nps.gov/tools.cfm
Environmental Screening Form - https://pepc.nps.gov/help/pdf/EnvScrFormMay07.pdf

REVISE

research proposals when required; maintain open communication with researchers

There are numerous opportunities for managers and scientists to engage in open communication regarding potential revisions to proposed research plans. It crucial that researchers be aware, from the outset, that revisions may be a necessary part of proposing research in wilderness. The evaluation process should be communicated to scientists as early as possible, so there is plenty of time for discussion and negotiation to achieve the most innovative and satisfactory solutions. The number of revisions needed will likely be inversely proportional to the effort that has been put into the proposal to integrate wilderness concerns.

Often, multiple alternatives may be suggested in the revision process. For example, if a proposal calls for a non-conforming use (or activity), the proposal can be modified to either remove this activity, replace it with an allowed activity, change the site of their research, or demonstrate to the evaluating committee that this use is the minimum necessary through a Minimum Requirements Analysis. In reviewing the analysis a manager may suggest camouflaging an installation, changing its location, or decreasing the number of installations, and will be able to justify why these modifications are recommended based on the Impacts filter analysis. Throughout this process, it is critical that scientists and managers communicate with each other to ensure that the word and spirit of the Wilderness Act is maintained; that is, ensuring that wilderness character is preserved and is usable for purpose of scientific exploration.

MONITOR

projects, installations, benefits, and impacts of research projects

Even after a research proposal has been carefully designed, evaluated, approved, and implemented, changes may occur that impact the study. For example, installations may undergo weathering, sustain damage during storms, or have other problems occur that will require unplanned activities in wilderness. Similarly, the benefits and impacts of a study may change over time. A study of a particular plant or animal species may have greater impact if the species is subsequently listed as endangered. A study involving water sampling along riverbanks may have unforeseen negative impacts on erosion if rainfall is uncharacteristically high.

Wilderness managers need to be aware that research installations and activities will need to be monitored past the evaluation process in order to ensure that they remain compliant with wilderness policy. Similarly researchers must be informed of their duties to adhere to wilderness policies once their projects have commenced, especially in the face of any unforeseen project changes. Researchers should notify park managers of any alterations to original plans. Any change to the approved project must be evaluated and approved by the park manager before they are implemented. Further, any approved projects (and any revisions to the projects) should be added to the documentation (GIS database or wilderness character database) in Step 1 of this paper.

APPLY

relevant results of research to wilderness management wherever suitable

The application of scientific results to wilderness stewardship is a crucial and often overlooked step in the process of conducting science in parks. In many instances, results whose value is not immediately apparent prove to be invaluable to wilderness managers at a later date. For example, the results may serve as a basis to inform decisions and plan climate-change related actions for adaptation, mitigation and restoration. Such results may also be fundamental in informing decisions about desired conditions.

Research results can take many forms, and may or may not always be immediately applicable to wilderness. Examples of applicable results may include, but are not limited to:

- trends in local climate
- species range, distribution, movements and potential range shifts in the face of climate change
- Geological and hydrological changes (such as lowering water tables or melting glaciers)
- The presence of invasive species

It is the researcher's responsibility to provide timely presentation of the results to park managers, or provide timely updates of activities and ongoing findings in the case of long-term projects. It is also important that the results be presented in such a way that managers understand how the results may be relevant to the management decisions. Research Learning Centers (RLCs) are an excellent example of parks translating and connecting research with management. Explore opportunities to partner with an RLC to facilitate connection and application of results.

Useful references: *Beyond Naturalness: Rethinking Park and Wilderness Stewardship in an Era of Rapid Change.* (Cole and Yung 2010). Chapter 13, Planning in the Context of Uncertainty: Flexibility for Adapting to Change (pp 216-233)

Useful links for RLCs
http://www.nature.nps.gov/learningcenters/
http://www.nature.nps.gov/learningcenters/map.cfm

Tools and expertise required: park scientists to help interpret results from completed or ongoing research projects; established means of communicating regularly with non-park researchers

Potential products: updated management plans and climate change adaptation, mitigation and restoration plans based on scientific knowledge

ESTABLISH

long-term goals and desired conditions to be maintained in wilderness

It is important to establish clear goals of desired conditions for wilderness in the long term. Using research products such as wilderness character evaluations and historical data, as well as park-specific directives, desired conditions can be established that will inform park management. Having a transparent definition of desired conditions can greatly facilitate open discussions about science in wilderness, and the impacts of research in meeting those desired conditions.

Establishing desired conditions can be difficult. A number of different approaches have been proposed to help managers formulate "desired" conditions. This may be based on:

- Natural conditions that avoid artificiality and maintain specific biological, geological, or archeological functions (Robbins et al. 1963)
- Conditions prior to Anglo-European settlement (Leopold 1963)
- Maintaining present conditions
- Desired future conditions (NPS 2006); in particular, adaptive planning for future climate change scenarios (Cole and Yung 2010).

Parks may already have legal administrative directives that help them make decisions regarding desired conditions, in the form of GMPs or other internal directives. It is important to have a clear idea of what these conditions are, in order to be able to thoroughly evaluate the benefits and impacts of research on maintaining or achieving those conditions.

It should be noted that some scientists may also be able to play an invaluable role in helping define and work towards desired conditions. For example, if planning will require a careful understanding of potential climate change scenarios, the involvement of scientists can help ensure that future plans are based on the best available scientific data.

Useful references:
Beyond Naturalness: Rethinking Park and Wilderness Stewardship in an Era of Rapid Change. (Cole and Yung 2010). Chapter 13, Planning in the Context of Uncertainty: Flexibility for Adapting to Change (pg216-233). Note that this includes a useful scenario-planning example from Joshua Tree National Park.

Tools and expertise required: a multidisciplinary team capable of evaluating and discussing the potential merits and demerits of each potential definition of "desired conditions"

Potential products: GMP or other comprehensive plan for management

Summary:

Scientific activities in parks can benefit both wilderness and the growing body of scientific literature that will help us make informed decisions on our changing world. Wilderness is an unique resource, intended to be enjoyed for generations by all. To achieve this, it is essential that wilderness managers work together to find optimal, mutually beneficial solutions for wilderness and science.

References:

Alaska Regional Science in Wilderness Working Group. 2010. *Cumulative Effects of Science in Wilderness* (report). NPS Alaska region, Anchorage AK.

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