# Kaibab National Forest Monitoring Plan Transition to the 2012 Planning Rule

## Introduction

The 2012 Planning Rule (hereafter referred to as the Rule or 2012 Rule) laid out an adaptive management framework for monitoring, assessing, revising, and amending forest plans. It emphasizes collaboration, requires improved transparency, and strengthens the role of public involvement and dialogue throughout the planning process to better support ecological, social, and economic sustainability. The Rule provides a scientifically supported foundation for addressing uncertainty and understanding changes in conditions that are the result of management actions or others factors. The monitoring requirements of the 2012 Rule are intended to help the Forest Service to take into account new information, adapt to changing conditions, and to keep plans current and responsive to meet current and future needs.

Unlike previous planning rules, the 2012 Rule requires that all forest plans follow the monitoring requirements of the 2012 Rule, regardless of which rule they were developed under. The Kaibab Forest Plan (2014) was approved under the 1982 Rule provisions. As a result, the revised plan must be brought in-line with the 2012 Rule monitoring requirements within the specified four-year transition period, or as soon as practicable (36 CFR 219.12(c)). While the Kaibab Forest Plan was approved using the 1982 Rule provisions, it was developed recently, and proactively incorporated many of the new planning rule concepts.

To bring the Kaibab National Forest Plan in-line with the 2012 Rule and better address the substantive requirements and associated indicators specified in Section (219.12(a)(5)), an administrative change is needed to the Forest Plan in Chapter 5, “Monitoring and Evaluation” The changes include: a shift from Management Indicator Species to Focal Species, additions to and minor modifications of the plan monitoring questions, and more clear linkages between the requirements and existing plan monitoring questions. The new monitoring questions are focused on watershed conditions, select ecological conditions that support species viability of at-risk species, climate change effects, and recreation use and visitor satisfaction.

This white paper lays out the 2012 Rule requirements and shows how the Kaibab National Forest Plan monitoring program meets those requirements. It will be posted to the web. Notification of the posting will be sent to key stakeholders that have previously expressed interest in the Forest Monitoring Plan and related aspects of the Kaibab Forest Plan revision process. Following a period of review and consideration of comments received, the Kaibab will make an administrative change to the plan in accordance with the 2012 Planning Rule (36 CFR 219.13(c) (2)), whereby changes to content that are not plan amendments or revisions may be made following public notice.

## 2012 Rule Monitoring Requirements

The Rule requires the following be addressed by each Forest (unit):

- Monitoring is to be developed utilizing the best available scientific information (BASI) (219.3)
- The Plan Monitoring Program is to be developed collaboratively with other agencies, organizations, and individuals (219.12(c)(3)(i & ii)), in consultation with tribes (219.12(c)(3)(iii)), while coordinating with FS Research and State and Private Forestry (219.12(a)(1)).
- Monitoring is to be developed to inform forest management of the status of resources in the plan area, "…including by testing relevant assumptions, tracking relevant changes, and measuring management effectiveness and progress toward achieving or maintaining the plan's desired conditions or objectives."(219.12(a)(2)).
- The unit's Plan Monitoring Program is to be coordinated and integrated with the broader scale monitoring strategy developed by the Region/Regional Forester (219.12(a)(3)).
- The unit's Plan Monitoring Program is to at a minimum contain one or more monitoring questions and associated indicators specified in Section (219.12(a)(5)). The final rule provides direction for a set of monitoring questions and associated indicators that must be part of every plan monitoring program.

## Best Available Science

Section 219.3 of the Rule requires the responsible official to document how the best available scientific information (BASI) was used to inform the design of the monitoring program. Documentation must identify what information was determined to be the best available scientific information, explain the basis for that determination, and explain how the information was applied to the issues considered. This requirement is intended to provide transparency and an explanation to the public as to how the best available scientific information was used. The responsible official must determine what information is the most accurate, reliable, and relevant with regard to the issues being considered. In some circumstances, the BASI is developed using the scientific method, includes clearly stated questions, well designed investigations, logically analyzed results, clear documentation, and is peer reviewed. However, sometimes the BASI may be information from analyses of data obtained from a local area, studies to address a specific question in one area, the result of expert opinion, panel consensus, or observations. This information may constitute the BASI as long as the responsible official has a reasonable basis for relying on that information.

During the Kaibab NF plan revision process, BASI was used to help inform the development of desired conditions and other plan components, and also to assess species viability. During this iterative process, key monitoring themes emerged representing habitat or ecological systems potentially at risk. BASI was fundamental to the

development of clearly defined monitoring questions, as well as the scientific methodology necessary to answer them. BASI will also be integral to the forest's biennial monitoring reports which will evaluate if the Forest Plan is effectively maintaining or improving desired conditions, and will also inform adaptive management. Some monitoring plan questions rely on methods long established in the literature; while others were developed specifically for the Kaibab NF to support the monitoring program (see below: modelling tools and approaches; partnerships).

BASI also serves as a common platform through which multiparty monitoring can be enabled. Some aspects of the monitoring plan already support multi-party monitoring (see Kaibab NF Forest Plan Chapter 5; rapid plots) and the forest continues to work with stakeholders to facilitate that aspect of the 2012 planning rule (see partnerships below). Finally, certain monitoring questions and data in the Kaibab NF monitoring plan can be scaled up to complement the broad scale monitoring strategy. BASI will be used to integrate these two complementary approaches. Key scientific resources and processes are elaborated on in detail below.

## Literature

The Forest Service maintains access to two separate but associated online libraries. The National Agricultural Library is one of four national libraries of the United States. It houses one of the world's largest and most accessible agricultural information collections and serves as the nexus for a national network of state land grant and U.S. Department of Agriculture field libraries: http://www.nal.usda.gov/. Within this context, the National Forest Service Library provides information services, access to e-journals and bibliographic databases, current literature alerting services, and a full range of document delivery and interlibrary loan services to Forest Service employees: http://www.fs.fed.us/library/.

Using these resources, the forest consulted and considered peer reviewed publications as well lesser known documents including non-published "gray literature" such as technical reports, white papers, internal reports, theses, systematic reviews, and meta-analyses. Many of these documents are maintained through the Rocky Mountain Research Station library and locally based academic institutions, including the School of Forestry and Ecological Restoration Institute at Northern Arizona University.

## Databases and Data Management Systems

NatureServe, a nonprofit conservation organization whose mission is to provide the scientific basis for effective conservation action was consulted primarily during identification of the "forest planning species". The forest planning species list provided the foundation for the forest's viability analysis, helped to focus plan components as needed, and helped to identify monitoring questions and associated indicators.

NatureServe and its network of natural heritage programs are the leading source for information about rare and endangered species and threatened ecosystems. NatureServe represents an international network of biological inventories—known as natural heritage programs or conservation data centers—operating in all 50 U.S. states, Canada, Latin America, and the Caribbean. Detailed information is collected and managed on plants, animals, and ecosystems. Information products, data management tools, and conservation services are also developed to help meet local, national, and global conservation needs. The objective scientific information about species and ecosystems developed by NatureServe is used by all sectors of society—conservation groups, government agencies, corporations, academia, and the public—to make informed decisions about managing our natural resources. More information on NatureServe can be found here: http://www.natureserve.org/.

Additionally, databases and species lists managed by the U.S. Fish and Wildlife Service and the Arizona Game and Fish Department were consulted regarding threatened, endangered, and sensitive species as well as other local species of concern (e.g., narrow endemics and/or species likely to be affected by local processes). The Heritage Database Management System (HDMS) managed by the Arizona Game and Fish Department, is part of a global network of more than 80 natural heritage programs and conservation data centers. HDMS was primarily referenced for its species abstracts and species distribution maps. It was used to assess viability of species during the plan revision process and also for part of the forest's literature review in determining MIS and focal species. The HDMS species abstracts are a synthesis of multiple information sources, contain information on the taxonomy, life history, and habitat use, range of occurrence and protection status for each species of concern. Distribution maps are visual representations of the distribution of species of concern or sites within a selected geographic area. http://www.azgfd.gov/w_c/edits/species_concern.shtml
In addition to HDMS species, biologists also considered species listed under the State Wildlife Action Plan (SWAP) for helping to develop desired conditions and guidelines. SWAP species consist of species of greatest concern (SGCN) or species of economic and recreation importance (SERI). The SWAP also developed range maps for these species using wildlife models that broadly represent where a species habitat exists, and where the species itself may occur. More information on these species lists and planning tools can be found here: http://www.azgfd.gov/w_c/edits/species_concern.shtml, http://www.azgfd.gov/w_c/cwcs.shtml, http://www.fws.gov/southwest/

The SEINet data portal, supported by the National Science Foundation, was consulted for up to date information on plant species. The data portal was created to serve as a gateway to distribute data resources of interest to the environmental research community within Arizona. Through a common web interface, this portal offers tools to locate access and work with a variety of data. SEINet is more than just a website; it is a suite of data access

technologies and a distributed network of collections, museums and agencies that provide environmental information.

## Science Based Monitoring Partnerships and Collaborations

In collaboration with diverse partners, the forest has been developing applications and methods that integrate robust, transparent, and repeatable sample designs, data collection methods, statistical analyses, and predictive modelling tools. The use of BASI to develop these tools will allow the forest to more effectively respond to emerging issues such as climate change and associated landscape scale disturbances (e.g. wildfire, insect and disease outbreaks), and, in the spirit of the 2012 Forest Service planning rule, to better engage in multi-party monitoring efforts by leveraging multiple data sources and collaborative resources. The new planning rule " provides a process for planning that is adaptive and science-based, engages the public, and is designed to be efficient, effective, and within the Agency's ability to implement…..the planning rule requires the use of best available scientific information to inform planning and plan decisions".

- The Springs Stewardship Institute (SSI), a global initiative of the Museum of Northern Arizona, works to improve communication among land managers, to survey, rehabilitate, and steward springs systems across the southwestern U.S. The SSI has an ongoing working relationship with the Kaibab NF, providing springs inventory and monitoring data and applied research using established protocols. Data is managed in a user friendly database so that the most up to date information is available and accessible to all partners. Springs data collected through this effort supports the Kaibab NF's monitoring plan and also helps the forest to prioritize future management goals and climate adaptation strategies for select ecological conditions. More information can be found here: http://springstewardshipinstitute.org/

- Bird Conservancy of the Rockies (BCR, formerly known as Rocky Mountain Bird Observatory) is a non-profit organization chartered to conserve birds and their habitats through monitoring, research, stewardship, and education. The partnership between the Kaibab NF and BCR implements science based monitoring and allows BCR to compile data on birds that contributes to forest plan monitoring while also contributing to BCR's greater mission of conserving Rocky Mountain, Great Plains and Intermountain West birds and their habitats. The data contributes to BCR's efforts to establish a regional database that compiles point count data at an international scale. This collaboration drives consistent and comparable monitoring and data sets throughout the western United States. These data are available to southwestern U.S. Forest Service wildlife and land managers to assist in evaluating trends on management units compared to a larger region. The overall end goal of these databases is to provide a venue to store regional point count data and apply consistent techniques to

collect point count data. These data are then analyzed using statistically sound and rigorous methods, allowing managers to understand, investigate, and assess avian population trends and status. The forest has been collecting data on songbirds in collaboration with BCR since 2007 and these data are widely available on a user friendly website. Annual reports, survey locations and occupancy and density trends can all be downloaded from the web. More recently, BCR has also implemented regional surveys for Northern goshawk and Mexican spotted owl using peer reviewed protocols, these data will contribute to the broader scale monitoring program and support monitoring recommended by the recovery plan for the Mexican spotted owl. More information on this effort can be found here: http://www.birdconservancy.org/

- The Nature Conservancy (TNC) is a private; non-profit organization incorporated in the District of Columbia whose mission is to conserve the lands and waters on which all life depends. TNC works with a wide-range of landowners, agencies and organizations to achieve this goal, and also acquires and manages lands for this purpose. TNC has significant scientific and management expertise, and conducts eco-region and site conservation planning, while building partnerships with land management agencies to put science into practice. The Forest service maintains a national Memorandum of Understanding with TNC that formally acknowledges a desire to work together to accomplish mutually beneficial conservation goals. More specifically through a cooperative agreement on the Kaibab NF,TNC is currently helping the forest develop and implement several landscape scale monitoring applications using LiDAR and vegetation structural data that will facilitate large-scale restoration and monitoring and adaptive management projects across Arizona's forests. Habitat connectivity models have already been already developed for pronghorn and Abert's squirrels (Hurteau and Smith 2012). These models can be updated over time and will help inform project planning as well as project outcomes, and also provide baseline data for monitoring pronghorn desired conditions.
  http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/arizona/

- Northern Arizona University's Lab of Landscape Ecology and Landscape Conservation Initiative (LLECB and LCI) address challenges associated with policy, land use, and the conservation and management of species and ecosystems across the West. They use basic and applied applications in conservation biology and landscape ecology to educate students, conduct community outreach, and inform land use planning, forest management, and public policy. By engaging students, decision makers, and the public in meaningful dialog grounded in robust science, the LCI and LLECB forge solutions at scales that make a difference to western ecosystems and the people who depend on them. The LLECB and LCI have been working with the Kaibab NF to develop several habitat based modeling

approaches to establish a “baseline” for future monitoring of focal and other species. A “monitoring toolbox” has also been developed to address plan monitoring questions that relate to landscape scale forest structural changes, while a “rapid plot” monitoring design was developed and piloted in 2014 to focus on ecological indicators better collected at the plot level (Dickson et al 2011, Ray et al. 2012, Wang et al. 2013, Horncastle and Dickson 2015). These tools provide the forest with an empirically based platform for assessing ecological change over time, provide a basis for refining future management, and were designed to complement and support broad scale monitoring strategies that are currently in development for the region, as well as landscape scale restoration projects such as the Four Forest Restoration Initiative, a 1.6 million acre project which spans the Kaibab, Coconino, Apache-Sitgreaves, and Tonto National Forests. For more information see https://nau.edu/LCI/Research/

- An existing collaboration between the Kaibab NF, the Museum of Northern Arizona (MNA), The Arboretum at Flagstaff (the Arboretum) and the Desert Botanical Garden (DBG) seeks to document floristic and faunal diversity, including range expansion or contraction of rare and invasive plants and invertebrates This monitoring is especially critical to prevent extirpation of restricted and endemic species, and to prevent colonization by non-native plants. Increased scientific documentation of the floristic diversity on the Kaibab NF through inventory and monitoring, and the collection of plant specimens from priority areas will provide the forest and its partners with more accurate and detailed geographic information which will enable better management and will increase scientific capacity. These organizations share mutual concerns for the conservation of natural habitats and native species in northern Arizona and on the Colorado Plateau. DBG, MNA, and The Arboretum, have the expertise and facilities available to conduct plant inventories over time over large areas of land, identify and curate the voucher specimens, conduct common garden experiments, and train volunteers to assist the project coordinators with future inventory and monitoring. Further, the Arboretum contains two Southwest Experimental Garden Array (SEGA) sites (funded by the National Science Foundation) which can be leveraged for this type of work and also used to advance climate change driven monitoring questions and adaptive monitoring and management based approaches. This collaboration helps the Kaibab NF meet several desired conditions for threatened and endangered, restricted and narrow endemic, and non-native invasive species under its new forest plan. For more information: https://musnaz.org/research/ecology-and-conservation/;https://www.dbg.org/species-habitat-conservation; http://www.thearb.org/about.php

- Kane and Two Mile Research and Stewardship Partnership (RSP) is a formal partnership established in 2012 by an Memorandum of Understanding between the Grand Canyon Trust, Bureau of Land Management, US Geological Survey, US Forest Service - Kaibab National Forest, Arizona Game and Fish Commission, Northern Arizona University, and University of Arizona. The work of the RSP is guided by an Applied Research Plan, collaboratively developed in 2011, which includes a suite of management-relevant research foci including arid lands restoration, cheatgrass and wildfire feedbacks, wildlife habitat, and livestock grazing interactions. The Applied Research Plan also specifically highlights landscape-scale monitoring as an essential tool. The RSP meets annually or biannually to check in on the progress of research and stewardship goals, meetings which also include researchers and representatives from other groups, including ranching partners, in addition to those on the MOU. This partnership facilitates scientific inquiry on actual projects and management actions, helping to inform real world on the ground action.

## Scientific Conferences and Collaborative Workshops

Forest Service staff attended and made contributions to several scientific conferences and workshops during the forest plan revision process that also helped to support development of the monitoring plan. These conferences provide opportunities to exchange information and ideas among peers, and to establish dialogue for future collaborations. They frequently provide a first look or preview of emerging science and cutting edge research that can be used for planning and management. These forums helped to facilitate several of the modelling tools and approaches discussed above that were used in monitoring plan development. Conference highlights included:

- Flagstaff Climate Change Adaptation Workshop (2010)
- 2010 Society of American Foresters Conference
- National Workshop on Climate and Forests: Planning Tools and Perspectives on Adaptation and Mitigation Options (2011)
- The 11th Biennial Conference of Research on the Colorado Plateau: “Cultural and Natural Resource Management on the Colorado Plateau: Science and Management at the Landscape Scale” (2011)
- Southwest Tribal Climate Change Workshop (2011)
- Society for Conservation Biology North American Conference for Conservation Biology. Bridging the Gap: Connecting People, Nature and Climate. Oakland, CA (2012).
- 12th Biennial Conference of Science and Management on the Colorado Plateau: “Effects of Rapid Climatic, Social, and Technological Changes on the Colorado Plateau” (2013)

• 13th Biennial Conference of Science & Management on the Colorado Plateau "Multi-disciplinary Approaches to Assess and Respond to Climatic, Social, and Technological Changes" (2015)

## Public Involvement

The Kaibab NF engaged with the public, stakeholders, tribes, and other agencies throughout the plan revision effort that began in 2006 with initial public meetings and continued through the appeal resolution process, which was completed in May of 2015. The forest sponsored four locally based workshops specific to monitoring and the wildlife viability and management indicator selection process. Attendees included ecologists and biologists from other Federal agencies, nonprofit organizations, academia, the Forest Service Rocky Mountain Research Station, and State and Private Forestry with a wide range of expertise in the fields of forestry, fire, restoration, wildlife, and spatial ecology, among others. Recommendations from these collaborations were integrated into various aspects of the draft forest plan and/or wildlife viability analysis. The Kaibab NF interdisciplinary team also engaged in several locally held "collaborwriting" sessions focused on group and public involvement. Plan content was developed in conjunction with this process which involved a variety of "expert" representatives from local stakeholder groups, academia, and other agencies.

Because the monitoring plan had fairly extensive public involvement during its initial development, the public involvement for the transition to the 2012 Rule focuses on the proposed changes and is targeted toward those that provided input, expressed interest, and/or participated in the development of the initial monitoring plan. Key partners participating in the monitoring plan development include the Fish & Wildlife Service, Arizona Game and Fish Department, local tribal representatives, Northern AZ University's Landscape Conservation Initiative and Ecological Restoration Institute, Springs Stewardship Institute, Grand Canyon Trust, The Wildlands Council, The Nature Conservancy, Grand Canyon National Park, Camp Navajo (Department of Defense), Forest Service Rocky Mountain Research Station, State and Private Forestry. More information on the Kaibab's monitoring transition strategy, as well as opportunities to provide feedback are posted to the Kaibab Forest Planning webpage at http://www.fs.usda.gov/detail/kaibab/landmanagement/planning/?cid=stelprdb5106605

## Tribal Consultation

Local tribes and tribal members use the forest as they did traditionally and also in more contemporary contexts. As a result, the Kaibab's forest plan development and review included extensive tribal consultation and scoping throughout the process. Tribal consultation and collaboration included formal government to government settings as well as community events. Tribal input led to the development and/or refinement of many plan components. Several monitoring questions were developed specifically in response to tribal input, and many other questions address resources of tribal interest. The Kaibab NF continues to have regular meaningful dialogue with tribal representatives and

individuals about the inventory and management of culturally important resources. Existing partnership agreements with local tribes and others (as noted above) are in place to conduct inventories of plants and waters that are culturally significant to native people, provide technical support to tribal members in botany, ethnobotany, biology, geographic information systems, and other technical areas, and restore culturally important resources such as springs.

### Broad- scale Monitoring Coordination

Under the 2012 planning rule, the unit's Plan Monitoring Program is to be coordinated and integrated with the Broader scale Monitoring Strategy (BSMS) developed by the Region/Regional Forester (219.12(a)(3)). The Regional Broad-scale strategy being developed for Regions 2 and 3 of the U.S. Forest Service will include the appropriate BSMS monitoring questions, indicators, and associated parameters (scale, databases, and potential governance approaches). The framework will be an initial outline of the BSMS for the two regions but will be adjusted over time as new priorities and information emerge. The Kaibab has participated in and will continue to be engaged in dialogue that will shape the framework currently under development. As such, the unit monitoring will be coordinated and integrated with the Broader scale Monitoring Strategy when it comes on-line.

## Plan Monitoring Program

The final rule provides direction for a set of monitoring questions and associated indicators that must be part of every plan monitoring program. The responsible official can consider additional factors and add questions and indicators. The unit's Plan Monitoring Program is to contain, at a minimum, one or more monitoring questions and associated indicators addressing each of the following eight factors listed below (219.12(a)(5)). One additional requirement was included in the Forest Service Handbook to address plan contributions to the social and economic sustainability of communities. See Appendix A. Forest Plan Chapter 5 Monitoring and Evaluation," which includes a crosswalk for how each question in the monitoring plan addresses the following nine factors.

I. The status of select watershed conditions (219.12(a)(5)(i)
II. The status of select ecological conditions (including key characteristics of terrestrial/aquatic ecosystems) (219.12(a)(5)(ii)
III. The status of Focal Species to assess ecological conditions (219.12(a)(5)(iii)
IV. The status of select ecological conditions that contribute to the recovery of T&E species, conserve proposed & candidate species, and maintain a viable population of species of conservation concern (219.12(a)(5)(iv)
V. The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives (219.12(a)(5)(v)

VI. Measureable changes on the plan area related to climate change and other stressors (219.12(a)(5)(vi)
VII. Progress toward meeting desired conditions and objectives (including those for multiple uses) (219.12(a)(5)(vii)
VIII. The effects of management systems so that they do not substantially and permanently impair the productivity of the land (219.12(a)(5)(viii) and 16 U.S.C. 1604(g)(3)(C) – NFMA)

FSH 1909.12 sec 32.13(f) Indicators addressing the plan contributions to communities, social and economic sustainability of communities, multiple use management in the plan area, or progress toward meeting the desired conditions and objectives related to social and economic sustainability.

Below is an introduction to each of the factors and a description of how the Forest Plan monitoring chapter addresses each. Most of the monitoring questions address more than one factor (e.g. watershed conditions and desired conditions or ecological conditions and climate change effects). To streamline the section below, the questions are generally only listed once under the key factor that they address.

## 1. The status of select watershed conditions.

One of the original purposes for establishing the NFS was to protect our Nation's water resources and the restoration of watersheds and forest health is a key management objective of the national forests. The plan monitoring questions focus on variables used to assess conditions specified in the "Watershed Condition Classification Technical Guide" (USDA 2011) and draw upon data from the ground based rapid plots, and existing sources of information such as the National BMP Monitoring database and the Forest Service Watershed Condition Framework dataset. The key questions addressing watershed conditions: s include:

- *What is the percent of effective ground cover? What is the proportion of live and dead vegetation, litter, rock, and bare ground?*
- *Is there evidence of erosion (pedestalling of vegetation, rills, sheet flow, or deposition)?*
- *Are there any waterbodies not meeting Arizona water quality standards? Are there existing TMDLs or are there any in prep? What aspect of the TMDL has been implemented?*
- *How many 6$^{th}$ code watersheds were moved to an improved condition this year?*
- *Did any project or site require corrective action in the BMP monitoring database?*
- *Was adaptive management recommended for any BMP monitoring item and what were the monitoring results?*

- *Were at least half of the composite ratings for BMP effectiveness "excellent"?*
- *Is there downcutting and/or embeddedness in intermittent or ephemeral drainages?*

## 2. The status of select ecological conditions (including key characteristics of terrestrial/aquatic ecosystems)

The concept of ecological conditions as defined in the proposed rule and the final rule includes more than vegetation composition and structure: it is designed to encompass those factors as well as others, including stressors that are relevant to species and ecological integrity. Examples of ecological conditions include the abundance and distribution of aquatic and terrestrial habitats, connectivity, roads and other structural developments, human uses, and invasive species. Exhibit 1 (Page 16) highlights select ecological conditions and the relationship to several other key indicators.

Key Monitoring Plan questions that represent select ecological conditions include:

- *Are snags, downed logs and large old trees at desired levels at the midscale (100-1,000 acre average)?*
- *Is the coarse woody debris within the desired range?*
- *Does crown height to live crown and crown bulk density put the forest at risk for uncharacteristic high severity fire at the mid-scale and above?*
- *What is the frequency of areas occupied of noxious weeds by species?*
- *How many acres of the Kaibab NF are in an uneven aged open state, at the midscale (above 100 acres)?*
- *How many acres are predicted to support active crown fire as modeled under typical peak fire danger conditions at the midscale?*
- *Is the stand density within a range that will allow for a robust understory?*
- *What is the total area within the desired range for basal area and openings?*
- *What is the areal extent and configuration of aspen on the Kaibab NF?*
- *What percent of the grassland PNVT has <10 percent canopy cover?*
- *What is the relative composition and cover of grasslands?*
- *What is the functional condition of the lakes and wetlands on the Kaibab NF?*
- *In treated/ protected areas, are water flow patterns and vegetation intact?*

## 3. The Status of Focal Species to Assess Ecological Conditions

Focal Species are defined by the 2012 Rule as "A small subset of species whose status permits inference to the integrity of the larger system to which it belongs and provides meaningful information regarding the effectiveness of the plan in maintaining or restoring ecological conditions to maintain the diversity of plan and animal communities… commonly selected based on their functional role in ecosystems (36 CFR §219.19, emphasis added).

In the final rule, Management Indicator Species (MIS) monitoring has been replaced with monitoring of focal species. When making the shift to focal species, the final rule considered the challenges the Forest Service faced in monitoring MIS under the 1982 rule. MIS monitoring has been the subject of much of the legal debate around the species provisions of the 1982 rule. The 2012 Rule does not include requirements to designate MIS or monitor their population trends. The concept of MIS as a surrogate for the status of other species is not supported by current science, and population trends are difficult and sometimes impossible to determine within the lifespan of a plan.

The concept of focal species, however, is well supported in the scientific literature and community. Focal species are not surrogates for the status of other species. Focal species monitoring provides information regarding the effectiveness of the plan in providing the ecological conditions necessary to maintain the diversity of plant and animal communities and the persistence of native species in the plan area. The Committee of Scientists Report (USDA 1999) said focal species may be indicator species, keystone species, ecological engineers, umbrella species, link species, or species of concern. Agency directives provide guidance for considering the selection of a focal species from these or other categories (FSH 1909.12 chapter 30 § 32.13c). Criteria for selection may include: the number and extent of relevant ecosystems in the plan area; the primary threats or stressors to those ecosystems, especially those related to predominant management activities on the plan area; the sensitivity of the species to changing conditions or their utility in confirming the existence of desired ecological conditions; the broad monitoring questions to be answered; factors that may limit viability of species; and others. This does not preclude the use of an invasive species as a focal species, whose presence is a major stressor to an ecosystem.

The rule does not require managing habitat conditions for focal species, nor does it confer a separate conservation requirement for these species simply based on them being selected as focal species. The 2012 Rule does not require or prohibit monitoring of population trends of focal species. Instead, it allows the use of any existing or emerging approaches for monitoring the status of focal species that are supported by current science. This allows managers greater flexibility for monitoring focal species than was afforded MIS under the 1982 rule requirements. Further, it facilitates better and more meaningful data that will allow for improved efficiencies and more responsive management within plan time frames (approximately 15 years). Monitoring methods for evaluating the status of focal species may include measures of abundance, distribution, reproduction, presence/ absence, area occupied, survival rates, or others. The objective is not to choose the monitoring technique(s) that will provide the most information about the focal species, but to choose a monitoring technique(s) for the focal species that will provide useful information with regard to the purpose for which the species is being monitored. The expectation is that monitoring key ecosystem and watershed conditions along with monitoring the status of a set of well-chosen focal species will provide timely

information regarding the effectiveness of plan components related to plant and animal diversity.

Focal species are not selected to make inferences about other species. Focal species are selected because they are believed to be responsive to ecological conditions in a way that can inform future plan decisions. Forest Service handbook direction (FSH 1909.12 chapter 30 § 32.13c) for focal species further specifies that every plan monitoring program must identify one or more focal species and one or more monitoring questions and associated indicators addressing the status of the focal species. The purpose for monitoring the status of focal species over time is to provide insight into the following:

1. Integrity of ecological systems on which focal species depend,
2. Effects of management on those ecological conditions,
3. Effectiveness of the plan components to provide for ecological integrity and maintain or restore ecological conditions, and
4. Progress towards achieving desired conditions and objectives for the plan area. It is not expected that a focal species be selected for every element of ecological conditions.

Focal species represent a part of the monitoring requirements for ecological sustainability and diversity of plant and animal communities. “It is not expected that a focal species be selected for every element of ecological conditions” (77 FR 21233, April 9, 2012). Focal species should be selected to monitor when doing so is feasible and they are the best way to track whether ecological integrity and ecosystem diversity is being maintained or improved. Monitoring focal species is intended to address situations where they provide more useful information or are more efficiently monitored than monitoring other potential indicators. Focal species are to be carefully selected and monitored when the key ecological indicators of composition, structure, function, and connectivity are either unavailable or difficult to monitor. There may be situations where key ecological indicators could be monitored directly, but monitoring focal species as an overall measure of composition, structure, function, and connectivity may be a more appropriate indicator of integrity.

The requirement for the responsible official to monitor focal species allows discretion to determine the most appropriate method and geographic scale for monitoring, within the financial and technical capabilities of the unit. Some focal species may be monitored at scales beyond the plan area boundary, while others may be more appropriately monitored and assessed within the plan area. Monitoring focal species is intended to address situations where they provide more value than monitoring other potential indicators.

Key Considerations for selecting focal species:

- Does the species provide feedback that is necessary to inform management?
- Are focal species abundant enough to measure change in status?

- Are there 'off-site' stressors that would mask the response to activities / conditions on NFS lands?
- Can the species be effectively monitored?
- Is the species cryptic, rare, or otherwise difficult species to monitor?
- Is it within financial capability of the unit(s)?
- Do standardized monitoring approaches exist?
- Are species responses to management activities and other stressors well known?
- Sampling design: how to monitor effectively
- Potential to monitor focal species across multiple units
- Opportunities for multi-party monitoring

When the Kaibab National Forest revised its plan in 2014, it identified four MIS that were used in the analysis and comparison of plan alternatives in the Final Environmental Impact Statement (FEIS). Management Indicator Species were chosen to represent those vegetation types which have the greatest risk to species viability, as discussed in the Wildlife Effects Analysis in chapter 3 of the forest plan revision FEIS (KNF 2014). Knowing that the Kaibab Forest Plan would eventually need to transition to the 2012 Monitoring requirements, MIS were selected that were believed would also serve as good focal species. That is, the Kaibab NF selected those species for which population changes were most likely to indicate the effects of management. Species response to management effects is a common theme between the 1982 and 2012 planning rules ((36 CFR 219.19 (a)(1) (1982 Rule); 219.12, and 219.9; FSH 1909. 12 §32.13c (2012 Rule)). In review of the considerations for selecting focal species, we determined that three of the four management indicator species would serve as good focal species (western bluebird, Grace's warbler, ruby-crowned kinglet) and one would not (American pronghorn). See Appendix B for other Focal species considered, but not selected.

### Focal Species Overview

The following section describes the Kaibab NF's recommended focal species and how they will inform management in terms of maintaining ecological integrity and ecosystem diversity. See Exhibit 1 (page 17) for additional ecological condition indicators that support the 2012 requirements for monitoring ecosystem diversity and integrity. Three species were identified that we believe will serve well as focal species for the Kaibab NF: Grace's warbler, western bluebird, and Ruby-crowned kinglet.

*Western bluebird* (*Sialia mexicana*): Western bluebird serves as an indicator of understory development within openings in ponderosa pine stands. Adequate ground cover—including the presence of fine fuels—is integral to maintaining the kind of low-intensity fires characteristic of presettlement conditions. Therefore, it is also necessary to evaluate the post-restoration understory response to overstory removal in ponderosa pine forests. Western bluebird, a ground-foraging species which depends largely on the understory for capture of invertebrate prey, has shown a strong response to burning and thinning in ponderosa pine forest (Wightman and Germaine 2006, Hurteau et al. 2008, Guinan et al.

2008, Russell et al. 2009, Dickson et al. 2009, Chambers and Kalies 2011). Wightman and Germaine (2006) found that western bluebird productivity and nest success were significantly affected by tree density (ponderosa pine and Gambel oak) and adequate ground cover (grasses, forbs, and bare ground combined total of at least 20 percent). Occupancy models have further demonstrated a strong relationship of bluebirds with ponderosa pine forest and canopy cover of less than or equal to 35 percent (Dickson et al. 2011). A resident species, western bluebirds can be found forest wide.

*Grace's warbler* (***Setophaga graciae***): Grace's warbler serves as an indicator of clumps of mature ponderosa pine/pine-oak forests, yellow pine, and open parklike forest such as the reference condition. This species.is a neotropical migrant and breeding resident in ponderosa pine forest across all three ranger districts on the Kaibab NF (Birek et al. 2010). It is strongly associated with forest structure having well-developed canopy and pine-oak forest indicative of the open park-like conditions found historically in northern Arizona (Szaro and Balda 1986, Stacier and Guzy 2002, Saab et al. 2007, Kalies et al. 2010). Occupancy models developed for the forest plan revision process further demonstrate the strong association this species has with ponderosa pine-oak habitat, including structural variables such as basal area, canopy cover, and density (Dickson et al. 2011), likely to be affected by forest restoration treatments. Basal area and decreased canopy cover were strong positive predictors of occupancy for Grace's Warbler. Local research has also demonstrated a strong response to fire by this species (Chambers and Kalies 2011). A return to presettlement (defined as prior to 1890) conditions should have a positive influence on population trends for this species. This species would allow the forest to assess overstory management by assessing its response to fuel treatments and fire management goals. Grace's warbler is a USFWS Species of Conservation Concern (USFWS 2008) and there has been stakeholder interest in monitoring this particular species (K. Crumbo pers. comm. 2010).

*Ruby-crowned kinglet* (***Regulus calendula***): Ruby-crowned kinglet serves as an indicator of mixed conifer (frequent fire) mature forest, with denser overstory. This species is a year-round resident that occupies mature, well developed mixed coniferous forest (Corman-Gervais 2005). This species may be sensitive to forest logging and wildfire (Swanson et al. 2008). Occupancy model results developed locally for this species show a strong association with mixed conifer forest (Dickson et al. 2011).

One MIS identified in the FEIS for the Kaibab Forest Plan was not carried forward as a focal species. American pronghorn served well as a MIS because one of the priorities needs for change in the revised plan was to restore grassland habitats upon which the pronghorn depend. Plan components including desired conditions, objectives, and guidelines were developed to improve grassland habitat and facilitate pronghorn movement. Pronghorn's dependency on connectivity of quality grassland habitat helped with the evaluation of the plan alternatives with regard to this priority need.

While pronghorn served well as a MIS, they were not carried forward as a focal species for several reasons: 1) they are difficult to effectively monitor, 2) they are managed as a game species by the AZ Game & Fish Department, and this outside influence would likely mask a detectable response to forest management activities, and 3) they occur in limited numbers on the North Kaibab (small herd of about 20 in House Rock Valley) and adjacent lands. We believe there is no single species that would serve as a key ecological indicator for grassland condition. Rather, there are a suite of indicators that are good indicators of grassland health including vegetative ground cover, evidence of erosion, tree density, presence of invasive species, and habitat connectivity. All are responsive to management activities, relatively easy to effectively measure and are accounted for in the monitoring plan through ecologically based questions.

### Strategy for Monitoring Focal Species

Songbirds are relatively easy to survey because data can be collected on many species at one time without additional effort. Forest wide breeding bird surveys have been conducted on the Kaibab NF by the forest and Bird Conservancy of the Rockies (formerly Rocky Mountain Bird Observatory or RMBO) since 2005. Survey data are analyzed using widely accepted statistical methods. The methodology yields robust and statistically sound density and or occupancy estimates for the recommended focal species, as well as other bird species of interest. Existing breeding bird survey data suggest a stable to increasing trend for all three bird species across the forest (Birek et al. 2010). This data serve as a solid baseline for future analyses. Spatially explicit occupancy models developed for these species should further assist with project planning and analysis of management outcomes by incorporating information on environmental correlates (e.g. aspects of vegetation structure) in a statistically valid manner (Dickson et al. 2011). Finally, existing land bird survey methodology also incorporates data collection on fine scale vegetation variables at each point count station. These data can be incorporated into species habitat models to discern which predictor variables are most tightly linked to each focal species, allowing for more detailed assessment of habitat management in the future.

The following monitoring plan questions support the status of focal species:

- *What is the area of forest occupied by Grace's warbler and western bluebird (Ponderosa Pine Forest)? Indicator: occupancy (proportion of grid cells occupied across the forest).*
- *What is the area of forest occupied by ruby-crowned kinglet (Mixed Conifer Forests)? Indicator: occupancy (proportion of grid cells occupied across the forest).*

## 4. The status of select ecological conditions that contribute to the recovery of T&E species, conserve proposed & candidate species,

## and maintain a viable population of species of conservation concern

The Responsible Official has discretion to choose a select set of ecological conditions to be monitored for ecosystems and at-risk species. The "select set" should be important ecological conditions, including key ecosystem characteristics that may be monitored in a direct and efficient way. Monitoring questions are not required for every plan component for at-risk species, nor are species-specific monitoring questions required for every at-risk species. Monitoring a select set of important ecological conditions required by a select set of species at risk, along with monitoring for ecosystems and watershed conditions, will give the Responsible Official information about the effectiveness of the ecosystem and species-specific plan components related to the ecological conditions monitored.

The monitoring indicators should measure the effectiveness of plan components (both ecosystem and species-specific components) designed to maintain or restore the ecological conditions and key ecosystem characteristics necessary to provide for diversity of plant and animal communities and contribute to the recovery of, conserve, or maintain the viability of at risk species within the plan area.

Ecological conditions may relate to habitat requirements for at-risk species (FSH 1909.12, ch.10, sec. 12.5 and Ch. 20, sec. 23.13). Monitoring questions and associated indicators for the status of select ecological conditions and key ecosystem characteristics (36 CFR 219.12(a)(5)(ii)) may overlap with those needed for at-risk species (36 CFR 219.12(a)(5)(iv)). These two planning rule requirements for monitoring should be considered together when developing monitoring questions and associated indicators. The same monitoring question and associated indicator(s) may be able to support both requirements.

Species of Conservation Concern (SCC) is a new concept under the 2012 Rule to be developed during the "assessment phase" of the plan revision process. Monitoring SCC is not required, however, monitoring the ecological conditions that maintain their viability is. Because the Kaibab NF recently revised its plan under a prior planning rule, it did not develop a list of SCC, but instead used a forest planning species concept to identify, monitor, and provide for the ecological conditions upon which at-risk species depend. The forest planning species list was, however, developed using a similar process as that used to develop SCC under the 2012 planning rule, and includes the same categories for at risk species as SCC, primarily species ranked by NatureServe as having G1-G2 status, as well as many restricted and narrow endemic species with limited distributions on the forest To demonstrate that the 2012 Rule requirement is being met, the Kaibab NF used the Forest Service Handbook criteria (FSH 1909.12 chapter 30 § 32.13b ) to identify ecological conditions upon which species with potential viability concern depend so they may be tracked and adaptively managed as necessary.

**Exhibit 1. Example of how the Kaibab Plan monitoring of select ecological conditions meets the 2012 Rule monitoring requirements for ecosystem diversity and integrity**

The following information shows how monitoring for Select Ecological Conditions(36 CFR 219.12(a)(5)(ii)), Proposed Focal Species(36 CFR 219.12(a)(5)(iii)), and Select Ecological Conditions for At Risk Species(36 CFR 219.12(a)(5)(iv)) integrates to support monitoring requirements for ecosystem diversity and integrity for the Ponderosa pine and Frequent fire Mixed conifer vegetation types.

**Ponderosa Pine and Frequent Fire Mixed Conifer**

**Need for change:** Modify stand structure and density toward reference conditions and restore historic fire regimes.

**Key Desired Conditions for Ponderosa pine**

**Fine-scale:** Trees typically occur in irregularly shaped groups and are variably spaced with some tight clumps. Trees within groups are of similar or variable ages and may contain species other than ponderosa pine. Tree groups are made up of clumps of various age classes and size classes that typically occur in areas less than one acre, but may be larger, such as on north-facing slopes. Crowns of trees within the mid-aged to old groups are interlocking or nearly interlocking and consist of approximately 2 to 40 trees per group. The interspaces between groups are variably shaped, are comprised of a native grass/forb/shrub mix, and may contain individual trees or snags. Regeneration openings occur as a mosaic and are similar in size to nearby groups. Organic ground cover and herbaceous vegetation provide protection for soil and moisture infiltration, and contribute to plant and animal diversity and ecosystem function. Herbaceous vegetation reflects the site potential.

**Mid-scale:** The ponderosa pine forest vegetation community is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. The mosaic of tree groups generally comprises an uneven-aged forest with all age classes and structural stages present. Stands are dominated by ponderosa pine, but other native hardwood and conifer species occur. The more biologically productive sites contain more trees per group and more groups per area. Basal area within forested areas generally ranges from 20 to 80 square feet per acre, with larger trees (i.e. >18 inches in diameter) contributing the greatest percent of the total basal area. Interspaces with native grass, forb, and shrub vegetation are variably shaped and typically range from 10 to 70 percent, with the more open conditions typically occurring on less productive sites.

**Landscape scale:** The ponderosa pine forest vegetation community is a mosaic of forest conditions composed of structural stages ranging from young to old trees. The forest is generally uneven-aged and open. Groups of old trees are mixed with groups of younger

trees. Occasional areas of even-aged structure are present. Denser tree conditions exist in some locations such as north-facing slopes, canyons, and drainage bottoms.

**Key Desired Conditions for Frequent fire Mixed Conifer**

**Fine-scale:** Trees typically occur in irregularly shaped groups and are variably spaced with some tight clumps. Trees within groups are of similar or variable ages, often containing more than one species. Crowns of trees within mid-aged and old groups are interlocking or nearly interlocking. Tree groups are typically less than 1 acre size and consist of 2 to 50 trees per group, but are sometimes larger, such as on north facing slopes. Regeneration openings occur as a mosaic and are similar in size to nearby groups. Interspaces between groups are variably shaped, are comprised of a native grass-forb-shrub mix, and may contain individual trees or snags. Density is variable, with canopy ranging from very open to closed.

**Mid-scale:** The frequent fire mixed conifer forest vegetation community is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. Forest appearance is variable, but generally uneven-aged and open; occasional patches of even-aged structure are present. The more biologically productive sites contain more trees per group and more groups per area. Basal area within forested areas generally ranges from 30 to 100 square feet per acre, with larger trees contributing the greatest percent of the total basal area. Forest conditions in some areas contain 10 to 20 percent higher basal area in mid-aged to old tree groups than in the general forest; these include goshawk post-fledging family areas, Mexican spotted owl nesting/roosting habitat, and north-facing slopes. Interspaces with native grass, forb, and shrub vegetation typically range from 10 to 50 percent of the area. The mosaic of tree groups generally comprises an uneven-aged forest with all age classes and structural stages. Occasionally small patches (generally less than 50 acres) of even-aged forest structure are present. Snags and green snags 18 inches d.b.h. or greater average three per acre. Downed logs (greater than 12 inches diameter at mid-point and greater than 8 feet long) average three per acre within the forested area of mid-scale units. Coarse woody debris, including downed logs, ranges from 5 to 15 tons per acre. Fires burn primarily on the forest floor and typically do not spread between tree groups as crown fire.

**Landscape scale:** At the landscape scale, the frequent fire mixed conifer forest community is a mosaic of forest conditions composed of structural stages ranging from young to old trees. Old growth occurs throughout the landscape, generally in small areas as individual old growth components, or as clumps of old growth. Old growth components include old trees, snags, coarse woody debris, and structural diversity. The location of old growth shifts on the landscape over time as a result of succession and disturbance (tree growth and mortality). Forest appearance is variable but generally uneven-aged and open; occasional patches of even-aged structure are present. The forest arrangement is in small clumps and groups of trees interspersed within variably sized

openings of native grass-forb-shrub vegetation associations similar to reference conditions. The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, and severity of disturbances and to climate variability. The landscape is a functioning ecosystem that contains all components, processes, and conditions that result from endemic levels of disturbances (e.g., fire, insects, diseases, and wind).

**Monitoring Plan Questions:**

*Are snags, downed logs, and large old trees at desired levels at the midscale (100-1,000 acre average)?*
*Is coarse woody debris within the desired range?*
*How many acres of the Kaibab NF are in an uneven aged open state, at the midscale (above 100 acres)?*
*Is the stand density within a range that will allow for a robust understory?*
*What is the total area within the desired range for basal area and openings?*
*How many acres are predicted to support active crown fire as modeled under typical peak fire danger conditions at the midscale?*
*What is the acreage of outbreaks of insects and disease? Does this follow regional patterns?*
*How many acres were burned with desired and undesired fire behavior and effects?*
*What is the acreage of outbreaks of insects and disease?*
*What is the areal extent of priority nonnative invasive plants on the Kaibab NF?*
*Were there any incidences of insect outbreaks in recently treated areas? If so, where?*
*Does height to live crown and crown bulk density put the forest at risk for uncharacteristic high severity fire at the mid-scale and above?*
*Is regeneration occurring at a rate that will support uneven aged forests over time?*
*What is the area of forest occupied by Graces warbler (GRWA), western bluebird (WEBL), and ruby- crowned kinglet (RCKI) and how does this compare to regional trends?*

**Key Ecosystem Indicators**

*Number per acre (snags)*
*Tons per acre (coarse woody debris, downed logs)*
*Acres (uneven aged open state; supporting predicted active crown fire; insect and disease outbreaks; non-native invasive plants)*
*Stand Density index (robust understory)*
*Basal Area, Open Canopy (openness)*
*Presence/Absence, location (invasive weeds)*
*Height to live crown, crown bulk density (fire risk)*
*Seedling and sapling count/per acre (regeneration)*
*Understory development within openings in ponderosa pine stands (WEBL)*
*Clumps of mature ponderosa pine/pine-oak forests, yellow pine, (open park like environments, such as in reference condition) (GRWA)*

*Mature mixed conifer forest, over story (RCKI)*

**Focal Species:** Western bluebird, Graces' warbler, ruby-crowned kinglet

**Threatened, endangered, and sensitive species**: Mexican spotted owl, northern goshawk, Arizona bugbane

**Appropriate Monitoring Scale:** Multiple areas/Forest-wide, fine to landscape scale.

Additional plan monitoring questions that track the status of threatened, endangered, proposed, candidate and at-risk species include:

- *Were the monitoring requirements met as identified in the AZ Bugbane conservation agreement? Were the monitoring requirements met as identified in the Pediocactus paradinei conservation agreement?*
- *What design features were incorporated into project planning to protect restricted and endemic species?*
- *Are Mexican spotted owls present in PACs?*
- *What is the population trend of Pediocactus peeblesianus var. fickeisenii?*

## The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives

Recreation was a common theme throughout the public participation leading to the 2012 planning rule. Americans make over 170 million visits to national forests and grasslands each year. These visits provide an important contribution to the economic vitality of rural communities as spending by recreation visitors in areas surrounding national forests amounts to nearly 13 billion dollars annually. By monitoring visitor use, satisfaction and progress toward meeting recreation desired conditions, the Kaibab can better sustainably manage this important use. The monitoring plan questions responsive to this requirement are:

- *What are the trends in visitor use?*
- *What is the overall satisfaction rating for National Forest visits on the Kaibab?*
- *What was the percent of good and very good rating for visitor safety at Developed Sites, Undeveloped Sites (GFAs) and Designated wilderness?*
- *What are the areas identified as "concentrate here" in the NVUM?*
- *How many acres of the Kaibab NF had a change in ROS or SMS classification and what were the classification changes?*
- *How many miles of trails were maintained to standard?*
- *Were the wilderness trails and campsites monitored? What were the results?*

- *Did we receive any comments that reflect visitor dissatisfaction? Were there common themes?*

## 6. Measureable changes on the plan area related to climate change and other stressors

The plan monitoring program must contain one or more monitoring questions associated with indicators to determine whether there are measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area. Taken together, the planning framework and these requirements will ensure that information related to climate change will be addressed in a consistent and strategic fashion. This monitoring requirement may relate to other monitoring requirements or to interacting stressors that individually or collectively may be affecting the plan area. Interacting stressors may include fire, insects, invasive species, loss of spatial connectivity, disruption of natural disturbance regimes, geologic hazards and water withdrawals and diversions that affect the plan area, among others.

The primary consideration for evaluating responses to climate change lies with the Kaibab NF's ability to modify social, economic, and ecological conditions on the planning unit. Current conditions and trends described in the FEIS for the Kaibab NF land and resource management plan and alternatives address risks, vulnerabilities, and potential ecological changes that could result from climate change. The plan addresses potential climate change impacts that are most likely to affect ecological systems, goods, and services. Evaluation of climate change impacts may lead to recognition that some conditions may be difficult to maintain over time. Particular attention is given to ecosystems that are most at risk due to climate change and vulnerable ecosystem components, such as aquatic systems, grassland plant diversity, and high-elevation ecosystems. Information from the evaluation of current conditions and trends was used to develop the social, economic, and ecological desired conditions in the plan, with monitoring questions subsequently developed to assess the plan's progress in meeting them. Appendix D, of the Kaibab NF plan further describes the forest's overall approach for integrating climate change with management.

Desired conditions for the planning unit were developed considering potential climate effects to:

- Increased extreme weather related forest disturbances (floods, drought, wind-throw)
- Water stresses (groundwater, runoff, and timing), aquatic biota
- Wildfire risks
- Shifts in major vegetation types for the Southwest
- Threatened, endangered, and sensitive species
- Forest insects and disease
- Weather related stresses on human communities (temperature, air quality)

- Outdoor recreation
- Wildlife movement and biodiversity

These desired conditions support and complement current climate adaptation strategies which include: sustaining functional ecological conditions, (with respect to soil and hydrology), reducing the impact of existing biological stressors (e.g. insects, pathogens, invasives), protecting forests from severe fire and wind disturbance, maintaining or creating refugia, maintaining and enhancing species structural diversity, increasing ecosystem redundancy across the landscape (e.g. areal extent), promoting landscape connectivity, enhancing genetic diversity, and facilitating community adjustments through species transitions (USDA 2014).

The plan monitoring program incorporates provisions that should improve understanding of the relationships between key plan components and climate change. For example, an inventory of the aquatic ecosystems and information about water temperatures and waterflows associated with climate change can be useful for tracking variability within ecosystem condition and trends observed over a prescribed evaluation period. Monitoring the frequency and spatial extent of uncharacteristic wildfire occurrences and insect outbreaks would help the Kaibab NF assess how well management is mitigating for hotter, drier, and more fire-prone conditions, and whether existing management is promoting resilient ecosystems. Along similar lines, monitoring springs that are sensitive to variable precipitation and naturally more predisposed to the effects of prolonged drought would help the Kaibab NF to prioritize protection and restoration focused on those ecosystems while gleaning information about endemic species levels and refugia. It may also be possible to discern climate change-related patterns in habitat use through long-term monitoring of songbirds and their habitat.

The climate change roadmap directs national forests and grasslands to develop climate change vulnerability assessments and identifies monitoring strategies. In a recent draft Climate Vulnerability Assessment (CVA) developed for the Kaibab NF (USDA 2015), 37 % of the plan area is moderately vulnerable, 33 % is highly vulnerable and 29 % is very highly vulnerable to climate change. The report further describes vulnerability by ecosystem type, watershed unit and ranger district across the forest. Within the tree-shrub component, frequent fire mixed conifer, ponderosa pine and pinyon juniper grassland are all moderately to highly departed from reference conditions with both high resistance to, and resilience from disturbance events. Riparian systems, spruce fir forest and mixed conifer with aspen have low resistance to disturbance but are expected to be moderately to highly resilient to these events once they have occurred. Within in the herbaceous component of these systems, the majority of the forest is moderately departed with low resistance to disturbance, and moderate to high resilience from disturbance.

Many of the Monitoring Questions support the Kaibab CVA, plan desired conditions and adaptation strategies as recommended in GTR NRS-87 (USDA 2014). Questions specifically assessing climate change effects include the following:

- *How many acres are at high risk for insect outbreaks?*
- *What is the acreage of outbreaks of insects and disease? Does this follow regional patterns?*
- *What is the trend in Normalized Difference Vegetation Index (NDVI)? How does this compare to regional trends?*
- *For wide ranging species like pronghorn, does habitat configuration provide functional connectivity? Does habitat configuration and availability allow wildlife populations to adjust their movements (e.g., seasonal migration, foraging, etc.) in response to climate related changes?*
- *What is the trend in soil moisture? How does this compare to regional trends?*
- *How many days did fine particle concentrations exceed 10 µgm/ m3?*
- *What is the 10-year trend of particle concentrations?*

## 7. Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.

Desired conditions are foundational to the Forest Plan and carefully devised objectives to make progress towards those desired conditions are essential. These monitoring questions help to track progress toward achieving the desired conditions.

- *How many acres were burned with desired and undesired fire behavior and effects?*
- *How many acres were treated with mechanical thinning by PNVT?*
- *How many acres of invasive plants were treated?*
- *How many springs were protected and restored?*
- *How many acres of wetlands were restored?*
- *What was the total area of aspen fenced?*
- *How many acres were treated for conifer encroachment?*
- *Is aspen regenerating and becoming established in treated areas?*
- *How many miles of fence were modified for pronghorn?*
- *How many miles of trails were maintained to standard?*
- *How many acres of non-project related cultural resource surveys were conducted?*
- *How many days did fine particle concentrations exceed 10 µgm/ m3?*
- *What is the 10-year trend of particle concentrations?*

## 8. The effects of management systems so that they do not substantially and permanently impair the productivity of the land (219.12(a)(5)(viii) and 16 U.S.C. 1604(g)(3)(C) – NFMA)

The National Forest Management Act requires management of products and services at a level that they can be sustained in perpetuity "…without impairment of the productivity of the land, Section 4 (b)." and that achieving the goals and objectives of the Forest Plan and resource management practices "…will not produce substantial and permanent impairment of the productivity of the land (Section 6(g)(3)(c))." These requirements are primarily concerned about impacts to soils productivity and the regeneration and establishment of trees on suitable timberlands. Several questions relating to soil productivity have already been addressed by in the watershed section. The following are some additional questions addressing the long-term productivity of the plan area.

- *Is regeneration occurring at a rate that will support uneven aged forests over time?*
- *How many acres of conifer species were planted? Was planting successful?*
- *What is the percentage and pattern of plots that have evidence of soil disturbance from activities that used mechanical equipment?*
- *How many acres of suitable timberlands were managed (TSI, harvest, etc.) for timber production?*
- *Were there any events or changed circumstances that would indicate a potential change to timber suitability?*

## 9. Indicators addressing the plan contributions to communities, social and economic sustainability of communities (FSH 1909.12 sec 32.13(f))

Social, economic, and cultural sustainability must also be addressed in the monitoring program because sustainability is an inherent part of several of the required monitoring items in the 2012 Planning Rule. To carry out this intent, the plan monitoring program must contain one or more questions and associated indicators addressing the plan contributions to communities, social and economic sustainability, multiple use management in the plan area, or progress toward meeting the desired conditions and objectives related to social and economic sustainability (FSH 1909.12, chapter 30, section 13.13f).

There are multiple plan monitoring questions already discussed that address a range of ecosystem services upon which communities depend. The below questions are those plan monitoring questions focused on plan contributions to social, cultural and economic sustainability.

- *How much wood was offered?*

- *How many direct jobs does the Kaibab NF support/provide from harvesting and utilization of wood products?*
- *Have there been significant investments in the wood harvesting and utilization infrastructure in the operating area?*
- *Was a robust crop of pinyon nuts produced on any of the districts?*
- *Are there areas of the Kaibab NF where recreation or vehicle use is causing detrimental resource effects that are in need of management? Where is it occurring?*
- *Are cultural resources being protected in place?*
- *Are livestock numbers balanced with forage capacity on each allotment?*
- *Are plant species of known medicinal and cultural value being depleted?*

## Next Steps

Following a period of review and consideration of comments received in response to the proposed changes to the Kaibab Forest Monitoring Plan, the Kaibab will make an administrative change to the plan made in accordance with the 2012 Planning Rule (36 CFR 219.13(c) (2)). The administrative change to the Forest Plan will bring the Kaibab Forest Plan in line with the 2012 Rule monitoring requirements.

The Forest Plan provides the overall monitoring strategy, which is one of three components that comprise the monitoring and adaptive framework. The other two components have complimentary roles that enable the adaptive management loop. The "Monitoring and Evaluation Implementation Guide" provides specific, technical guidance about how, where, and when to accomplish the monitoring prescribed in the plan and provides the specific methods, protocols, and analytical procedures. The guide is not part of the forest plan so that it may be adjusted and responsive to new information, updated procedures, emerging issues, and budgetary considerations without amending the monitoring plan. The "Biannual Monitoring Evaluation Review" provides a regular process for reviewing recent findings and evaluating the need for modifications in the plan, monitoring plan and practices. Together these components provide the framework for organizational learning and adaptive management.

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## Appendix A. Focal species considered, but not selected.

| Species or Group | Taxa | Habitat | T & E[1] | Other[2] | Rationale for not selecting |
|---|---|---|---|---|---|
| **Mexican Spotted Owl** | bird | Late-seral mixed conifer and spruce-fir, canyons | X | | Species is not well distributed in the planning area. Limited to 7 PACs on the Williams Ranger District. Area of inference would be limited. Direct monitoring of vegetation conditions would yield more useful data on ecological integrity. Bird Conservancy of the Rockies will monitor owl occupancy as part of the regional broad scale monitoring strategy. |
| **Apache Trout** | fish | Water | X | | Species is not well distributed in the planning area. Limited to a one mile stretch of 1 perennial stream (North Canyon Creek) on the North Kaibab Ranger District. |
| **California Condor** | bird | Open areas for foraging, cliffs and rocky areas for nesting. | X | X | Species not directly tied to any one specific habitat type, or plan emphasis area. Availability of rocks/cliffs and carrion are the most influential factors making it difficult to parse out management effects. |
| **Northern Goshawk** | bird | Late-seral ponderosa pine | | X | Difficult and costly to effectively assess population data and management response across the forest. Population fluctuations and distribution are heavily influenced by variable weather patterns and the interrelated response of the mammalian prey base. |
| **Pygmy Nuthatch** | bird | Late-seral ponderosa pine, snags | | X | Fairly ubiquitous and not as closely tied to forest structure as Grace's Warbler. Snags are monitored directly. |

[1] T&E: "X" indicates species is listed as threatened or endangered.
[2] Species considered for other reasons in response to internal or external concerns.

| Species or Group | Taxa | Habitat | T & E[1] | Other[2] | Rationale for not selecting |
|---|---|---|---|---|---|
| **Hairy Woodpecker** | bird | Snags (pine, mixed conifer, spruce-fir | | | Ubiquitous species, responds to disturbance and subsequent insect irruptions and availability of snags. Snags are monitored directly. |
| **Northern Flicker** | bird | Openings, savanna, snags and woody debris | | X | Not tied closely enough to a specific habitat type. Some suggestion that the species seems to be on the decline, however reasons are unknown and some may not be related at all to forest management (e.g. pesticides). |
| **Mountain Chickadee** | bird | Mature forest in mixed conifer and ponderosa pine, snags. | | X | Response to forest treatments has been variable, not a clear pattern in the literature. |
| **Olive-sided Flycatcher** | bird | Mixed conifer and spruce-fir forest, snags and woody debris. | | X | Long distance migrant. Dichotomy exists between favorable response to forest treatments and overall population decline that could be linked to other factors such as deforestation on the wintering grounds. Snags and course woody debris are monitored directly in the plan. |
| **Vesper Sparrow** | bird | Grasslands, Sagebrush shrublands. | | X | Habitat generalist which uses a broad range of grassland habitat types. Sagebrush seems to be the critical habitat component—not an area of emphasis in the revised plan. The forest no longer uses sagebrush removal as a management strategy. Sagebrush is limited to Tusayan and North Kaibab Ranger Districts. |
| **Gray Vireo** | bird | Pinyon-juniper communities, Grasslands | | X | Considered rare and uncommon on the forest; cryptic and can be difficult to monitor. Pinyon juniper not a plan emphasis area. |

| Species or Group | Taxa | Habitat | T & E[1] | Other[2] | Rationale for not selecting |
|---|---|---|---|---|---|
| **Pinyon Jay** | bird | Pinyon-juniper communities | | X | Pinyon-juniper not a plan emphasis area. Species would not be influenced by management objectives in the plan. |
| **Virginia's Warbler** | bird | Pine-oak and Pinyon juniper, understory | | X | Management concern on wintering grounds in Mexico a possible confounding factor, could make it difficult to tease out management effects on the forest. |
| **Black-throated Gray Warbler** | bird | Pinyon-juniper and pine-oak forest | | X | Habitat generalist and not tied closely enough to habitat variables of interest to be strong focal species. Information on habitat-related population changes lacking at both local and regional scales. |
| **Brown Creeper** | bird | Snags, old growth | | X | Lack current density estimates for this species on forest. Snags are measured directly in the monitoring plan. |
| **American pronghorn** | mammal | grasslands | | X | A hunted species and difficult to effectively monitor. Population information may be more representative of hunter success than response to forest management activities. Not representative of grasslands across the forest. .Occurs in limited (approximately 20 head) on the North Kaibab Ranger District. |
| **Mogollon Vole** | mammal | Meadows, openings | | X | Small mammals are subject to natural cyclic fluctuations in the short term which may be unrelated to management actions. Hard to tease out these confounding factors. |
| **Abert's Squirrel** | mammal | Early seral ponderosa pine, canopy | | X | Difficult to monitor. Wide inter-annual variations in population estimates which are a normal function of species life history make it difficult to assess management effects. Hunting pressure can further confound results. Hard to tease out these confounding factors. |

| Species or Group | Taxa | Habitat | T & E[1] | Other[2] | Rationale for not selecting |
|---|---|---|---|---|---|
| **Cottontail rabbit** | mammal | Ponderosa pine (openings, understory) | | X | Species is readily adaptable to a wide variety of habitats; may not be sensitive enough to assess specific management actions. Hunting pressure can further confound results. |
| **Mountain lion** | mammal | Varies widely. Includes canyons and rocky areas with dense understory. | | X | Not tied to any one habitat type or plan emphasis area. Better as an indicator of habitat connectivity/fragmentation. Difficult and costly to monitor. Better monitored at a regional scale. |
| **Elk** | mammal | Early-seral ponderosa pine, mixed conifer, spruce-fir | | X | Hunted species w/ high socioeconomic value and needs habitat connectivity. Affected more by habitat connectivity and available forage than any one particular habitat type. Population more sensitive to hunt success than forest management. |
| **Mule Deer** | mammal | Early-seral aspen and pinyon-juniper | | X | Hunted species. Affected more by habitat connectivity (winter/summer range) and available forage. Population fluctuations more sensitive to hunt success than forest management. |
| **Western chorus frog, Northern leopard frog, Red-spotted toad ,Woodhouse toad Canyon tree frog** | herp | Wet moist ground, water, emergent vegetation | | X | These species are likely localized to specific sites and not well distributed throughout planning area. Ecological indicators better for monitoring natural waters and have already been identified in the monitoring plan. |
| **Butterflies** | invert | Understory herbaceous cover | | X | Response varies by species, no one species can be singled out. Difficult and time consuming to monitor and identify. |

| Species or Group | Taxa | Habitat | T & E[1] | Other[2] | Rationale for not selecting |
|---|---|---|---|---|---|
| **Beetles** | invert | Understory and overstory health | | X | Response varies by species, no one species can be singled out. Sorting and identification can be laborious and requires taxonomic expertise. |
| **Cheatgrass, Russian olive, Leafy spurge, Salt cedar** | plants | Invasive response to disturbance | | X | Indicative of disturbance. Invasive species are already being monitored in the forest plan. |