FINAL

Report on the Selection of Management Indicator Species and Ecological Indicators [a/]

for Forest Plan Revision Apache-Sitgreaves National Forests (ASNFs)

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[a/] Information in this report provides background for and supports the terrestrial Wildlife Specialist Report for forest plan revision

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Background – NFMA, 1982 Rule Provisions

The National Forest Management Act (NFMA) regulations require that "Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area." For planning purposes, "a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area." Management Indicator Species (MIS) is a concept adopted by the agency (1982 rule provision 219.19) to serve, in part, as a barometer for species viability at the Forest level. In 1983, the Department of Agriculture issued a departmental regulation (9500-4) that expanded the viability requirement to include native and desired non-native plants.

The 1982 regulations to implement the NFMA require that MIS be identified as part of the forest plan. Indicator species serve multiple functions in forest planning by focusing management direction developed in the alternatives and providing a means to analyze effects on biological diversity. Forest plan alternatives must establish objectives that maintain and improve habitat for indicator species, to the degree consistent with overall multiple use objectives of the alternative (1982 rule provision 219.19 (a)). Upon plan implementation, monitoring MIS population trends in relationship to habitat changes serves as a reliable feedback mechanism about the consequences of land management. Where practicable, such monitoring will be done in cooperation with state fish and wildlife agencies (1982 rule provision 219.27 (g)).

Monitoring of habitat trend is equally important because of the direct dependence of wildlife on it and together, changes in habitat conditions and population trend function as indicators of ecological change. Departmental regulations at 9500-4 also acknowledge a strong tie between many vertebrate populations and habitat and provide the option to monitor habitat relationships in lieu of direct population trends. This is often necessary for non-game wildlife species that are difficult to detect and seldom have established protocols for population monitoring. In addition, Forest Service Manual (FSM) direction supplements the concept of management indicators with "ecological indicators" or EIs. The indicator selection process for forest planning in Region 3 follows that prescribed in the manual (FSM 2621.1), which uses the expanded principles of ecological indicators.[1]

In summary, forest planning for the fish and wildlife resources must meet several requirements, including the following:

1) To estimate the effects of planning alternatives on fish and wildlife populations, certain vertebrate and/or invertebrate species shall be selected as MIS and the reasons for their selection stated (1982 rule provision 219.19 (a)(1)). These species are to be selected because their population changes are believed to indicate the effects of management (1982 rule provision 219.19 (a)(1));

2) [Forest] Planning alternatives must be evaluated in terms of both amount and quality of habitat and of animal population trends of MIS (1982 rule provision 219.19(a)(2)), and evaluated relative to effects on diversity (1982 rule provision 219.26), including suitable food and cover for MIS (1982 rule provision 219.20 (a)).

3) Population trends of the MIS will be monitored and relationships to habitat changes determined (1982 rule provision 219.19 (a)(6)).

4) Other indicators such as plant communities or habitats can serve as a barometer of ecological conditions and are monitored for habitat trend (FSM 2620.5).

[1] Ecological Indicators (EIs) are defined in FSM 2620.5-2 as"(P)lant or animal species, communities or special habitats that have a narrow range of ecological tolerance" including limited structural or successional vegetation states; these elements are assumed to be good indicators of change to their ecological niches or fluctuating presence over time.

Region 3 Guidance

Regional guidance for selection of indicators is found at http://fsweb/r3/fs/fed/us/eap/nfma/tech-guides/1982/r3/index.shtml. Biologists on the Apache-Sitgreaves National Forests evaluated a wide range of vertebrate, invertebrate, and plant species in consideration of several principles (below) derived from agency regulations for indicator species and from the science of environmental monitoring (Vesely et al. 2006, Lindemayer and Likens 2009). Biologists from other forests, Arizona Game and Fish Department, The Nature Conservancy, universities, and individuals or groups with wildlife interests were also contacted for input to the selection process. The following principles guided the selection process.

- Choose MIS to reflect major management issues and challenges because MIS are intended to "indicate the effects of management activities."
- Choose MIS that function to improve the agency's ability to evaluate the effects of management activities and differences between alternatives.
- Consider MIS for which population data is readily available.
- Consider whether employing MIS is the best approach to evaluate the management problem; including other tools such as Ecological Indicators (EIs).
- Choose an adequate but limited number of species: MIS should represent the collection of indicators necessary to effectively monitor the forest plan and consequences of management.

Besides the above principles, biologists considered other information in order to identify potential MIS or other indicators at the appropriate spatial and temporal scales, as follows. Species more influenced by activities outside of the planning unit, as well as non-native species, were generally not considered.

- Vegetation types ubstantially departured from plan revision desired conditions (DCs) and, hence,
- Level and extent of need for change and restoration efforts within PNVTs addressed by plan alternatives;
- Dominant and common species within PNVTs or those with well-understood, narrow habitat associations or those non-game species of special interest;
- Ecological stressors related to active resource management, ecological succession, or disturbance (human and natural);
- Habitat components (composition, structure, ecological processes) that would be affected by restoration or management; and
- Estimates of type and magnitude of effects upon population and habitat trends as a consequence.

This document functions to 1) detail the ASNFs' indicator selection process and rationale, 2) meet agency obligations for full disclosure under NEPA and NFMA, and 3) assure continuity in Forest Plan implementation over time.

Indicator Selection Considerations

The 2008 Ecosystem Sustainability Report (ESR) identified certain vegetation types[2] well beyond their historic range of variability (HRV). This is a concern for ecosystem and habitat sustainability because it is assumed that habitat condition similar to that which supported associated species historically, will likely contribute to their maintenance in the future (Haufler 1999). In order to restore ecosystems on the ASNFs to desired conditions (more similar to HRV), alternative plan revision management is proposed across the landscape to recover the resiliency of these ecosystems. This will affect many ASNFs vegetation types and extensive amounts of habitat, varying by plan alternative. This became a major factor in directing the selection of appropriate indicators.

Initially, many species and, later, a few plant communities were offered as possible indicators. These included the 17 MIS[3] identified by the current ASNFs Plan. These and numerous other species were evaluated to determine if they might reflect differences among forest plan alternatives and reflect population trends upon plan implementation. After extensive discussion, about two dozen (see Appendix A) were chosen to receive more

[2] For planning, vegetation types are characterized as potential natural vegetation types or PNVTs. The terminology of "vegetation types" and "PNVTs" are used interchangeably in this report.

[3] A number of the existing plan MIS did not fit the above selection principles so they were not suitable as MIS under the new plan.

detailed consideration. After further evaluation, eight of these were identified as potential indicators (Appendix A includes rationale for those dropped).

Appendix B is a worksheet showing some initial (2011) considerations for the potential indicators based on expected alternative outcomes related to diversity and the amount and quality of habitat. Cost, practicality, and efficiencies of monitoring were also noted. The following MIS and EI sections provide a more updated synthesis of Appendix B. These sections are followed by monitoring considerations for MIS and EIs, and then by ASNFs leadership selection of the final indicators for forest plan revision.

Management Indicator Species (MIS) Selection Considerations

Mexican spotted owl and Northern goshawk. Three large PNVTs, comprising approximately 46% of the ASNFs, are the ponderosa pine and the dry and wet mixed conifer forests; the goshawk using the former and the owl using the latter two. Forest plan alternatives address extensive thinning and burning treatments to move these vegetation types toward desired conditions (see Appendix B). The northern goshawk and Mexican spotted owl were evaluated as MIS because they are known to respond to changes in forest density and structure such as those proposed for alternative plan revision management (thinning and burning). Differences among alternatives include the amount of acreage treated and by what method. Standard monitoring protocols for both species are available, have been in use for many years, and prior monitoring data is readily available (see monitoring sections below).

Pronghorn and Mule deer. Other large scale areas for forest plan revision management include restoration of grasslands and thinning of increasingly dense woodlands, comprising about 48% of the ASNFs. Pronghorn were evaluated as most responsive to tree removal within grasslands, especially the Great Basin Grassland, which provides year long habitat on the ASNFs. While mule deer occur across the forest in many vegetation types that will receive various thinning and burning treatments, the most limiting habitat is their winter range. Mule deer were evaluated as most responsive to tree thinning and resulting understory herbaceous and shrub response within the Madrean-Pine oak Woodland PNVT, their primary winter habitat on the forest.[4]

While these two species are hunted, their habitats would be extensively influenced by alternative plan revision management and activities. In addition, there have been numerous discussions about these two species as MIS with the State. Arizona Game and Fish Department (AZGFD) strongly supports either or both species as appropriate MIS.

Ecological Indicators (EIs) Selection Considerations

Considering other vegetation types where alternative plan revision management and activities will take place or where there are questions about diversity, forest biologists, with input from ecologists and range specialists, discussed indicators other than MIS. The following ecological indicators (EIs) were evaluated.

Aspen. Aspen respresents an important and susceptible vegetation state (successional stage) across the landscape. The 2008 ESR identified the loss of aspen within forest vegetation types as a major concern due to uncharacteristic mortality from insect, disease, browsing,[5] and sudden-aspen-death. Concerns exist as well for its persistence after large scale ecological disturbance, such as major wildfires (e.g., 2011 Wallow Fire), and into the future with climate change. Aspen itself is not considered a PNVT but rather an important transitional state within other forest types such as mixed conifer and spruce-fir where wildfire was the historic regenerating factor, and where forest management activities can also play a role in regeneration and maintenance . Whether in smaller patches, mixed with conifers, or in extensive pure stands, aspen provides unique habitat features and supports a highly diverse suite of wildife and plants. Because aspen within forest types will be affected by alternative plan revision management (thinning and burning), it was evaluated as an ecological indicator. In addition, the vegetation dynamic development (VDDT) modeling for forest plan analysis has indicated some differing responses of aspen across plan alternatives within the Wet Mixed Conifer and Spruce-Fir PNVTs.

Riparian types. There are four riparian PNVTs on the ASNF comprising just 3% of forest acreage. However, riparian areas (including wetlands, fens, bogs, and riparian forests) are a continuing challenge for management because of the rarity or location of water across the landscape, their unique hydrological-land functions, susceptibility to impacts from forest activities and management, and the multitude of dependent species, including

[4] AZGFD surveys deer across the forest; they also track deer on winter range separately through aerial surveys.

[5] The impact of ungulate browsing is factored into some modeling states for the Wet Mixed Conifer and Spruce-Fir PNVTs.

humans and their livestock. This complexity makes it difficult to select a single riparian MIS, especially a fish or wildlife species. However, riparian communities have a narrow range of ecological tolerance and they readily respond to management so they can provide effective ecological indicators. Three riparian PNVTs were evaluated as follows.

Cottonwoods and Willows. Woody species within riparian forest types represent a limitied ecological niche on the ASNFs. Two riparian forest PNVTs (Cottonwood-Willow and Montane Willow) were evaluated as potential ecological indicators. Cottonwood and/or willows within these riparian forest types are readily impacted by thinning, burning, and grazing. They have been shown on the ASNFs to be sensitive to management and are therefore effective indicators of change. Depending on elevation within these two PNVTs, narrowleaf cottonwood or Fremont cottonwood, along with a variety of willows (e.g., Geyer's or Bebb's), are representative.

Sedges. The Wetland-Cienega riparian area PNVT is characterized by grass and grasslike herbaceous cover, not woody riparian vegetation. Wetlands and cienegas are a highly unique and sensitive vegetation type within Arizona and these areas on the ASNFs represents almost two-thirds of its occurrence within our eco-region (TNC 2004). Because of the importance of native vegetation cover and density (and associated root depth and density) and susceptibility to management impacts, sedges can provide an effective ecological indicator for alternative plan revision management for this vegetation type. In addition, response of sedge (cover) to management alternatives has been clearly demonstrated with ongoing riparian monitoring on the forest.

Population Trend and Habitat Monitoring Considerations

The 1982 rule provision at 219.12(k) requires a monitoring protocol (or plan for developing a monitoring protocol), including a discussion of data collection/frequency, data analysis, data storage, and reporting methods. This information is used to detect changes in indicator trends. FSM 1922.7 and FSH 1909.12 Ch. 6 provide direction for conducting monitoring and evaluation of indicators (see Appendix C).

Management Indicator Species (MIS) Monitoring Considerations

Mexican spotted owl monitoring. Monitoring protocol for this species and its habitat is described in the 1995 Recovery Plan. Population monitoring is conducted at the Forest Service research level (by the Rocky Mountain Region Research Station, Flagstaff Lab). Presence/absence and breeding surveys are conducted across the ASNFs, typically by project area; monitoring may be expanded beyond project, depending on future regional direction and funding. Some microhabitat monitoring associated with forest treatment projects has been conducted on the forest to verify whether treatments (silviculture, fire) are meeting their stated objectives. Data is maintained in the NRIS Fauna stewardship module. A new MSO recovery plan is under development. Once finalized, the forests will conduct annnual Mexican spotted owl monitoring according to protocol therein (if changed).

Northern goshawk monitoring. Monitoring protocol for this species is described in the 2006 Northern Goshawk Inventory and Monitoring Technical Guide (USDA WO Gen. Tech. Report WO-71). This includes conducting annual area inventories and project surveys using survey design detailed in this technical guide. Data is maintained in the NRIS Fauna stewardship module. The forests will continue to conduct annual Northern goshawk monitoring under this protocol by project area; monitoring may be expanded beyond project, depending on future regional direction and funding. Monitoring for both northern goshawk and Mexican spotted owl would be tracked in the Wildlife, Fish and Rare Plant (WFRP) database.

Pronghorn monitoring. This species is found across the forest in grassland types, primarily in Game Management Units 1, 3B&C, and 4A&B, within the Great Basin grassland PNVT. Pronghorn are surveyed annually by Arizona Game and Fish Department (AZGFD) which monitors population parameters such as buck:doe ratios, doe:fawn ratios, and population trends. This information along with annual hunter success are shared at yearly hunting recommendation meetings with forest biologists. Management goals for game management units on the forest include increasing numbers and minimizing developments impacts from roads, fences, and structure locations. Cooperation with AZGFD for pronghorn monitoring meets the requirements of NFMA (1982 rule provision 219.27 (g)). The AZGFD, not the ASNFs, maintains the database for pronghorn.

AZGFD states that hunt strategies for pronghorn have essentially no impact to the population potential (AZGFD 2011). All hunts are stratified and buck only permits are issued and, in some units, for muzzleloader only. Where buck:doe ratios are within guidelines, permits issued reflect a desired harvest of only 15-25% of the available bucks

in the population. The 2007 Pronghorn Management Plan contains objectives to pursue large scale habitat improvement projects (covering Springerville, Lakeside and Black Mesa Ranger Districts) and maintain or improve (in part, through fence modifications) travel corridors across all pronghorn habitat.

Mule deer monitoring. This species is found across the forest in many vegetation types especially during the summer. Winter habitats are more restricted to those at lower elevations in grassland and woodland PNVTs. Mule deer are surveyed annually by Arizona Game and Fish Department (AZGFD), including a separate survey while deer are in winter habitat. While alternative plan revision management will especially benefit winter habitat, it will be difficult to separate out the influence of management across all habitat types on population trends. As such, this species is less likely to adequately function as an indicator species.

Ecological Indicators (EIs) Monitoring Considerations

Aspen monitoring.
Use of aerial photos and subsequent midscale assessments are long term monitoring techniques. Dr. Paul Rogers, USU, and lead for the Western Aspen Alliance is under agreement with the USFS Southwestern Region to provide assistance with aspen considerations in Arizona and New Mexico. He made an initial assessment of aspen regeneration after the 2011 Wallow Fire. He is seeking grants to collect data on aspen persistence after this wildfire. He, along with AZGFD have provided the ASNFs input on monitoring aspen as an EI across the forest in terms of sample method and relevant data to collect. Monitoring data would be tracked in the NRIS FSVEG database.

Riparian monitoring.
Cottonwoods and willows within the Cottonwood-Willow and Montane Willow PNVTs. The composition, age class distribution, cover, and condition of these woody riparian species are determined during project (typically range) analysis per current plan direction. MIM or *Multiple Indicator Monitoring of Stream Channels and Streamside Vegetation* (BLM 2011), provides a thorough suite of methods to sample various riparian sub-components. Monitoring data can be tracked in the NRIS FSVEG database. Other resources or potential partners for riparian EI monitoring include the National Riparian Service Team, Ranching Heritage Alliance, and University of Arizona.

Sedges and other native riparian herbaceous species within the Wetland-Cienega PNVT. Based on AZGFD's ongoing elk monitoring and some district monitoring in riparian locations (critical areas for grazing), the forest has information about annual impacts of herbivory and observations about change in sedge cover and density in riparian areas over time; however, this level of monitoring is not adequate to inform adaptive forest-wide management. The Winward cross-sectional method for measuring woody species attributes (Winward 2000 or, as modified, Burton et al. 2008) may be an appropriate monitoring method.

Refinement and Selection Summary

Merits and drawbacks of potential indicators were presented to the Forest Leadership Team in 2011. Based on their questions and input and additional consideration by Forest biologists, the evaluation of indicators was further refined. Mule deer were dropped because of the difficulty in discerning management impacts in winter habitat alone when deer are using and being affected by management in other habitats during the rest of the year. One of the four Riparian PNVTs, Mixed Broadleaf Deciduous Riparian Forest, was not considered as an EI because it is extensively affected by a multitude of impacts across large watersheds so this riparian PNVT would not be a suitable ecological indicator. The Cottonwood-Willow, Montane Willow, and Wetland-Cienega PNVTs were grouped under a single riparian EI where the appropriate components in each would be monitored.

In January 2012, a refined list of three MIS and two EIs were presented to the forest leadership. The acting Forest Supervisor made the decision to go forward with these five indicators as shown in the following table. Besides the standard and on-going monitoring protocol used for Mexican spotted owl, northern goshawk, and pronghorn, aspen and riparian EIs monitoring process will be developed. Appendix C contains possible monitoring strategies for the two EIs; final monitoring protocols will be developed by forest teams upon plan decision.

NFMA indicators for ASNFs Forest Plan Revision

Indicator	Indicator Type	Reflecting alternative management and activity in these PNVTs
Mexican spotted owl	MIS	Dry and Wet Mixed Conifer
Northern goshawk	MIS	Ponderosa Pine

Pronghorn	MIS	3 grasslands (Great Basin, Montane-Subalpine, Semi-Desert)
Aspen	EI	All forest types
Riparian	EI	Cottonwood-Willow and Montane willow

Adaptive management through monitoring

As part of the plan's monitoring strategy, a forestwide review of monitoring findings for management and ecological indicators would be conducted every five years. The review would consider initial and subsequent plan monitoring information and assess trends of indicator species.[6] Non-forest management events or activities of consequence would also be evaluated for context. Downward or static trends clearly linked to forest management or activities and linked to induced habitat changes may indicate a need for adaptive management considerations.

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[6] AZGFD would assist in this effort relative to MIS pronghorn.

Appendix A. Species further evaluated as potential ASNFs indicators and brief rationale why not further considered as potential indicator for forest plan revision (# indicates current forest plan MIS)

SPECIES/COMMUNITY EVALUATED	HABITAT TYPE	RATIONALE FOR DROPPING FROM FURTHER CONSIDERATION (otherwise, brought forward as potential indicator)
Yellow-bellied sapsucker #	Forest	Drop: low numbers, uncommon, hard to detect trend
Hairy woodpecker #	Forests	Drop: population irruptions tied to post wild or large scale fire creating excessive snags; other species better
Pygmy nuthatch #	Forests	Drop: preliminary results from WMS landbird monitoring show differences in densities pre and post treatment in ponderosa pine--possibly consider; however, forest wide monitoring (beyond WMS acres) would be cost prohibitive
Turkey #	Forests	Drop: hunted, although compensable; however, weather major is a major factor
Northern goshawk #	Forests	Sensitive; responsive to management for mature forests; planned restoration to some level in all alternatives; lots of baseline info; peer-reviewed and on-going monitoring method already in place
Mexican spotted owl #	Forests	ESA threatened; responsive to management for mature forests; planned restoration to some level in all alternatives; lots of baseline info; peer-reviewed and on-going monitoring method already in place
Red squirrel #	Forests	Drop: specific conditions around middens which can be covered by other plan components and habitat type addressed by Mexican spotted owl
Abert squirrel #	Forests	Drop: needs both open and closed canopies, both will be retained across alternatives; however, not necessary if northern goshawk selected; limited hunting
Mule deer #	Forest/Woodlands	AZGFD monitors summer & winter habitat separately, baseline info; hunting somewhat limited
Elk #	Forest/Woodland/Grasslands	Drop: demonstrated to be extreme habitat generalist based on rumen:body weight ratio; well hunted
Aspen	Forests	Significant decline of concern and concern for long-term persistence after ecosystem disturbance; responsive to restoration treatments within forests;
Juniper titmouse #	Woodlands	Drop: PJ woodlands with low departure from desired conditions; hence limited need for change so not a focus for major restoration treatments
Pronghorn #	Grasslands	High departure from desired and historic conditions (especially Great Basin Grasslands); emphasis for grassland restoration to varying degrees under each alternative; limited hunting; AZGFD strong support
Lincoln sparrow #	Riparian-hi elevations	Drop: very uncommon, hard to detect trend; neotropic migrant* so population trend may not be tied to forest management alone; a riparian vegetation ecological indicator can be more readily monitored
Cottonwoods and Willows	Riparian-low & mid elev.	Important habitat component sensitive to management; shown to respond to riparian area management on the ASNFs
Yellow-breasted chat #	Riparian-low elevations	Drop: not abundant, hard to track and also neotropic migrant*; limited plan alternative objectives for its Mixed broadleaf deciduous riparian forest type
Lucy's warbler #	Riparian-low elevations	Drop: also neotropic migrant*; limited plan alternative objectives for its Mixed broadleaf deciduous riparian forest type
Aquatic macroinvertebrates #	Riparian/water	Drop: sensitive to water quality but which fluctuates greatly beyond just forest management
Cinnamon teal #	Water	Drop: no FS authority on water levels in most forest reservoirs and lakes
Chiricahua leopard frog	Water/Riparian	Drop: ESA threatened with coming critical habitat; uncommon, limited known locations, hard to detect
Southwester willow flycatcher	Riparian-hi elevation	Drop: ESA threatened with critical habitat; uncommon, only 3 known locations and otherwise locations not suitable
NM meadow jumping mouse	Riparian	Drop: ESA candidate; requires healthy, dense vegetation adjacent to water but difficult to detect and trap; a riparian herbaceous vegetation ecological indicator can be more readily monitored
Sedges	Riparian	Shown to respond to riparian area management on the ASNFs

Northern Mexican gartersnake	Aquatic	Drop: ESA candidate, sensitive to change multiple factors; hard to detect
Mexican wolf	Multiple	Drop: ESA listed species, heavily managed, greatest mortality beyond FS management (illegal shooting, followed by vehicle collision)
Gunnison's prairie dog	Grasslands	Drop: ESA warranted for listing in NM and CO but precluded by higher priorities; potential to be considered for reintroduction onto ASNFS but currently extremely few present
ESA listed fishes	Aquatic	Drop: all very uncommon; frequent monitoring posses risks

*neotropic migrant indicates the species winters south of the Tropic of Cancer (south of USA, including south of Texas and Florida)

Appendix B. MIS and EIs considerations during 2011 evaluations by ASNFs biologists and others.

(This worksheet is provided solely as documentation of 2011 work and does *not* reflect any subsequential 2012 updates.)

Species	Type	For which PNVTs / On which Districts primarily	PNVT importance, departure from HRV, (need for change)	Strong response to forest mgt?	Common? Managed habitat components?	Known, ~cost-effective method to monitor? By whom?	Concerns re selection?	Comment / other considerations	Input 2/15/11 Bio. Call Input 2/24/11 ecosystem staff/substaff
MSO	MIS	Dry mixed conifer (i.e., frequent fire mixed conifer) All districts	3rd largest PNVT @ 288,840 acres; severely departed; restore open tree density	Yes	Yes & tied to forest structure	Yes, ongoing FWS protocol, regional population and district project monitoring	Reflects endangerment; however, significant habitat treatment to restore fire	81% MSO pac acres in DMC; 19% in WMC would also allow comparison	New MSO recovery plan out 2012; makes no distinction dry vs. wet mixed conifer
NOGO	MIS	Ponderosa pine All districts	Largest PNVT @ 604,577; highly departed; restore open tree density	Yes	Yes & tied to forest structure	Yes, ongoing re-gional protocol; district monitoring by project & limited by RMBO	No, and as sensitive species there is potential concern re viability	Greatest amount of restoration treatments among all the PNVTs	Existing monitoring program; squirrel monitoring would be additive cost given goshawk monitoring
Prong horn	MIS	Great Basin Grassland BlackM, Lakes, Spgv	~ 1/10 of forest @ 177,681 acres; highly departed; tree removal	Yes, much of current woodland is actually grassland	Yes, open grassland conditions (soil cover, grass & forb vigor-esp. cool season species)	Yes, ongoing AGF annual survey	Hunted species but AGF objective is to increase herds so limited buck only harvest & just under certain conditions	restoration = more summer & winter habitat on forest & species has shown will use; hunt strategy does not affect pop.potential; AGF supports as MIS	Comfortable with justification for mule deer and pronghorn as MIS even if hunted; suite of birds of varying densities in grass/woodland-too complex and costly
Deer	MIS	Many and Madrean Pine-oak Woodland PNVT is major winter habitat Clifton, Alpine	2nd largest PNVT @ 396,678 acres; highly departed; restore open tree density	Yes	Yes, forb & cool season grass, forb and shrub response to tree treatments, esp. burning	Yes, ongoing AGF annual survey including separate winter range survey	Hunted species but winter portions of habitat have limited hunting	Hunt strategy does not affect pop. potential; AZGFD supports as MIS	Treatments across all PNVTs affect pop., but hard to ferret out effects from specific veg types
Cotton-wood/ Willow & Montane Willow	Ecol. Indic. (2)	Cottonwood-Willow* Montane-willow** PNVTs *BlackMesa,Lkside **Alp, Spgv	In critical areas, many impacts; currently trending *away* from HRV; woody regeneration with all age classes	Yes, age class & structure affected by mgt	Yes, woody riparian structure & comp	Yes, periodic forest woody species monitoring (comp & condition via allot analysis)	Set up forest wide monitoring (sampling) scheme; impacts from ungulates, recreation	MMIMs methodologies for various riparian components	Critical areas for wildlife and most often the focal point for management impacts, e.g., direct (grazing) and indirect (burning, thinning, etc.)
Aspen	Ecol. Indic.	Transition state within forest types	Important habitat, departed from HRV	Yes, regen affected by mgy.	Yes, forest structure & comp	Difficulty to monitor, however, Kaibab NF may be developing an approach	Monitoring with aerial photos or midscale assessment is problematic	Occurs variably as patches, intermixed, and in pure stands	Detection at level to inform adaptive management is not timely for plan period
Wetland cienega	Ecol. Indic.	Sedge cover, density Alp, Spgv	Critical areas, many impacts; HRV not well understood; converted to Popr, soil compaction	Yes, cover & density affected by mgt	Yes, mix of riparian grasslike species comp responds to mgmt	Yes, ongoing AGF monitoring & periodic forest monitoring under allotment analysis	AGF monitoring not adequate to answer trend forest wide	Green-line and ross-sectional (Winward 2000) for composition and condition; monitoring	Combine with the other riparian PNVTs above.

Appendix C. Plan to develop detailed monitoring protocol for two ASNFs ecological indicators (EIs) per 1982 rule provision at 219.12(k)

ASNFs DRAFT FOREST PLAN REVISION: RIPARIAN
ECOLOGICAL INDICATOR MONITORING – Documentation of Potential Strategy and Approach to Accomplish

Participants in the development of this Strategy/Approach: S.Coleman, D.VanKeuren, J.Ward, C.Nelson, L.WhiteTrifaro, B.Humphrey Monitoring protocol will be further developed by a forestwide riparian team upon plan decision (Ecosystem staff is lead).

NMFA direction

- Sec. 219.17 Management Requirements (e) Riparian areas. Special attention shall be given to land and vegetation….to at least the recognizable areas dominated by the riparian vegetation… [to] (6) provide for adequate fish and wildlife habitat to maintain viable populations…
- Sec. 219.11 (d) [The plan shall contain] (m)onitoring and evaluation requirements that will provide a basis for periodic determination and evaluation of the effects of management…
- Sec. 219.12 (k) (Based) on this [monitoring] evaluation, the interdisciplinary team shall recommend to the Forest Supervisor such changes in management direction, revisions, or amendments to the forest plan as are deemed necessary.
- Per the Forest Supervisor (12/12/2011), a Riparian Ecological Indicator is selected for monitoring across the forest upon forest plan implementation in compliance with NFMA.

1/17/12 INITIAL DISCUSSION OF FACTORS TO CONSIDER

1) This is not annual implementation monitoring but rather *long term validation monitoring* to determine if management activities are moving riparian ecosystem structure and function toward desired conditions (see attachment) and determine whether management adaptation is needed.
2) The Riparian Ecological Indicator consists of 3 of the 4 riparian. The fourth, mixed broad-leafed deciduous riparian forest (MBDRF), is not amenable for monitoring the influence of management due to the size and many complicating factors within these very large watersheds (Clifton RD has almost entirely all MBDRP).
3) Focus on primary treatments (acres under management): thinning of trees (includes burning slash), burning of trees with associated vegetation, and grazing herbaceous and woody riparian vegetation.
4) Avoid other influences as much as possible when selecting permanent monitoring plots: roads, insect/ disease, very high potential for severe flooding, etc.
5) The timeframe window for doing monitoring plots within the year needs to be set in order to be able to compare among years (probably May through June).
6) What job code will this be funded from? NFIM? Who should have the lead? Ecosystem/Range/Timber/ Fire/Wildlife Fish? To be decided.
7) Riparian EI monitoring costs need to be as minimal as possible while still being able to determine the effects of management upon structure and function and the need for adaptive management.
8) Numerous monitoring methodologies are available; *MIM* or *Multiple Indicator Monitoring of Stream Channels and Streamside Vegetation* (BLM Tech Ref 1737-23, 2011) is a thorough suite of methods to sample the various riparian sub-components we need to monitor (method training and in use on ASNFs).
9) Sampling is stratified by the Sitgreaves side and the Apache side of the forests because management (without Clifton RD) is administered by one Range staff on each side.
10) Once a riparian sampling strategy framework is worked out with estimated costs, Riparian EI monitoring will be assessed against all the other potential forest plan monitoring requirements, monitoring efficiencies will be evaluated, and a decision made for what specific monitoring the ASNFs can commit to.
11) After a riparian sampling strategy framework is worked out and we go forward with riparian EI monitoring under the new plan, a forest riparian monitoring oversight group will meet. It will consist of one range, one timber/fire, and one wildlife/fish person from each side of the forest, with Ecosystem input. The group will determine specifics of implementation.

1/24/12 SAMPLING STRATEGY FRAMEWORK FOR MONITORING

The Plan Period is 15 years starting the first full year of the new plan implementation;
riparian monitoring is broken up into three 5 year segments as follows:

Segment I - Plan years #1 through #5
Segment II - Plan years #6 through #10
Segment III - Plan years #11 through #15

3 riparian types to have permanent monitoring plots :
Wetland/Cienega=WC, CW=Cottonwood-Willow, Montane Willow=MW
X 8 monitoring plots within each riparian type
24 permanent riparian monitoring plots across the ASNFs

Each monitoring plot is measured once in each 5 year segment, i.e., each plot is measured 3 times during the 15 year plan period to show long term trend in riparian structure and function.

Annually monitor *only* 6 plots/year (3 Sitgreaves side, 3 Apache side) as follows:

Plan years #1-4 monitor 6 plots/year; use the 5th year for picking up any missed plots during the four years or re-doing/replacing any plots as needed (e.g., completely burned up in wildfire, where unexpected treatment change); a Five Year Summary report is completed showing riparian monitoring data for Plan Segment 1.

Plan years #6-9 monitor 6 plots/year; use the 10th year for picking up any missed plots during the four years or re-doing/replacing plots any as needed; a Five Year Summary report is completed showing riparian monitoring data for Plan Segment 2 and which is evaluated against data from Plan Segment I (need for adaptive management?)

Plan years #11-14 monitor 6 plots/year; use the 15th year for picking up any missed plots during the four years or re-doing/replacing any plots as needed; a Five Year Summary report is completed showing riparian monitoring dat for Plan Segment 3 and which is evaluated against data from Plan Segments I and 2 (need for adaptive management?)

Table C1 below contains a Sample Monitoring Scheme by riparian PNVT, treatment type, and side of the forest.
Table C2 below summarizes the 24 permanent riparian monitoring plots by riparian PNVT, side of forest, and type of treatment.

ESTIMATED COST OF RIPARIAN ECOLOGICAL INDICATOR MONITORING

The estimated Annual cost to the ASNFs is as follows.

Sitgreaves-plots/year	Apache-plots/year	
3 plots	3 plots	(i.e., total 6 plots on forest per year)
X 2 people days/year	X2 people days/year	(i.e., 1 day/plot for 2 people with a
6	6	(continency 1.5 days/plot where long travel)

i.e., forest total of 12 people days/year @ $350/person ===> $4200 (up to contingency $6300) cost/year

POTENTIAL MONITORING QUESTIONS TO ASK

These are mainly generalized for now. Specifics will be developed during item 11) above.

- Is the understory (ground level) vegetation dominated by native herbaceous species?
- Are the appropriate riparian woody species present will evidence of reproduction and all age classes present?
- Are bank or floodplain properties functioning, i.e., operating to maintain or recover from less than desirable conditions? e.g.,
    - Is large coarse woody debris present, were appropriate, and dissipating stream energy associated with high water flow?
    - Is bank vegetation adequate to filter and hold sediment from runoff?
    - Do channel characteristics provide the habitat features (depth, duration, temperatures) adequate

for the dependent riparian aquatic fish and invertebrates?

Table C1. Sample Riparian EI monitoring scheme for Plan Segment I

Which of three times each plot is to be sampled? ↓	Riparian PNVT	Treatment	Side of Forest	Plot No. by PNVT (8 total each)
	YEAR #1: 6 plots X 2 people = 12 days X $350/day = $4,200 annual forest cost (where 1 day/plot; contingency if long travel for 1.5 day/plot = $6,300)			
1st time	Wetland/Cienega	graze *	Sitgreaves	WC-1
1st	Cottonwood-Willow	graze	Sitgreaves	CW-1
1st	Cottonwood-Willow	cut/burn	Sitgreaves	CW-2 #
1st	Wetland/Cienega	graze	Apache	WC-2
1st	Cottonwood-Willow	graze	Apache	CW-3
1st	Montane willow	graze	Apache	MW-1
YEAR #2: same cost as above				
1st	Wetland/Cienega	no cut/burn	Sitgreaves	WC-3
1st	Cottonwood-Willow	no cut/burn	Sitgreaves	CW-4
1st	Montane willow	no cut/burn	Sitgreaves	MW-2
1st	Wetland/Cienega	no cut/burn	Apache	WC-4
1st	Cottonwood-Willow	no cut/burn	Apache	CW-5
1st	Montane willow	no cut/burn	Apache	MW-3
YEAR #3: same cost as above				
1st	Wetland/Cienega	no graze *	Sitgreaves	WC-5
1st	Cottonwood-Willow	no graze	Sitgreaves	CW-6
1st	Montane willow	no graze	Sitgreaves	MW-4
1st	Wetland/Cienega	no graze	Apache	WC-6
1st	Cottonwood-Willow	no graze	Apache	CW-7
1st	Montane willow	no graze	Apache	MW-5
YEAR #4: same cost as above				
1st	Wetland/Cienega	cut/burn	Sitgreaves	WC-7
1st	Cottonwood-Willow	cut/burn	Sitgreaves	CW-8
1st	Montane willow	cut/burn	Sitgreaves	MW-6
1st	Wetland/Cienega	cut/burn	Apache	WC-8
1st	Montane willow	graze	Apache	MW-7
1st	Montane willow	cut/burn	Apache	MW-8 #
YEAR #5: cost for report/evaluation 2 people/2 days x $350 = $1400 for 5th year				
↑REPEAT THE ABOVE MONITORING SCHEDULE FOR PLAN SEGMENT II (YEARS 6-10) for the second time sampled and SEGMENT III (YEARS 11-15) for the third time each plot is sampled				

* select grazed and ungrazed (by livestock) monitoring plot sites where large scale thinning and burning is not likely to occur (elk grazing is a factor outside of our management, so elk use is only noted when monitoring plot)

\# due to the preponderance of CW on Sitgreaves, they have more CW plot than the Apache; conversely, due to the preponderance of MW on Apache, they have more MW plot than the Sitgreaves. See the following plot summary by side of ASNFs.

Table C2. Summary of 24 permanent Riparian EI plots by PNVT, side of forest, and type of treatment

PNVT→	Wetland/Cienega Total # of plots on forest = 8		Cottonwood-Willow # Total # of plots on forest = 8		Montane willow # total # of plots on forest = 8	
Forest side→	Sitgreaves	Apache	Sitgreaves	Apache	Sitgreaves	Apache
Treatment	graze	graze	graze	graze	no cut/burn	graze
	no cut/burn	no cut/burn	cut/burn	no cut/burn	no graze	no cut/burn
	no graze	no graze	no cut/burn	no graze	cut/burn	no graze
	cut/burn	cut/burn	no graze	--	--	graze
	--	--	cut/burn	--	--	cut/burn
# plots by column	4	4	5	3	3	5
Forest side total	Sitgreaves - 12		Apache - 12			

due to the preponderance of CW on Sitgreaves, they have two more CW plots than the Apache; conversely, due to the preponderance of MW on Apache, they have two more MW plots than the Sitgreaves.

ASNFs DRAFT FOREST PLAN REVISION: ASPEN

ECOLOGICAL INDICATOR MONITORING – Documentation of Potential Strategy and Approach to Accomplish

Participants in the development of this Strategy/Approach:_Monica Boehning, Linda WhiteTrifaro, MaryLou Fairweather (Regional forest health and protection) with input from Dr. Paul Rogers, USU and Western Aspen Alliance (WAA), and AZGFD. Monitoring protocol will be further developed by a forestwide aspen team upon plan decision (Timber/Silviculture/Fire staff is lead).

In addition, a meeting to discuss aspen monitoring was held January 2012. The focus of the meeting was monitoring aspen regeneration and persistence after the 2011 Wallow Fire (e.g., ungulate impacts). Participants included individuals representing AZGFD, Arizona Elk Society, those noted above, and others; see meeting notes (M.Boehning). An aspen monitoring session and field review was held during May 2012. AZGFD research branch and Dr. Rogers are developing an aspen monitoring study with ASNFs review that will be submitted for grant and possibly regional funding. In addition, AZGFD Regon 1 is implementing extensive photo monitoring of aspen within the Wallow Fire burn perimeter starting in 2012.

NMFA direction

- Sec. 219.17 Management Requirements (e) Riparian areas. Special attention shall be given to land and vegetation….to at least the recognizable areas dominated by the riparian vegetation… [to] (6) provide for adequate fish and wildlife habitat to maintain viable populations…
- Sec. 219.11 (d) [The plan shall contain] (m)onitoring and evaluation requirements that will provide a basis for periodic determination and evaluation of the effects of management…
- Sec. 219.12 (k) (Based) on this [monitoring] evaluation, the interdisciplinary team shall recommend to the Forest Supervisor such changes in management direction, revisions, or amendments to the forest plan as are deemed necessary….
- Per the Forest Supervisor, an aspen Ecological Indicator is selected for monitoring across the ASNFs (12/12/2011) upon forest plan implementation in compliance with NFMA.

INITIAL DISCUSSION OF FACTORS TO CONSIDER

1) This is not annual implementation monitoring but rather *long term validation monitoring* to determine if management activities are moving aspen forested ecosystem structure and function toward desired conditions (see attachment) and determine whether management adaptation is needed.
2) Focus on primary forest plan treatments: thinning of trees (includes burning slash), burning of trees and associated vegetation, and livestock grazing of herbaceous and woody riparian vegetation.
3) Avoid other influences as much as possible when selecting permanent monitoring plots: roads, heavily used recreation areas, etc.
4) The timeframe window for doing monitoring plots within the year needs to be set in order to be able to compare among years (probably September through October)
5) What job code will this be funded from? NFIM? Who should have the lead? Timber/Silviculture? To be decided.
6) Aspen EI monitoring costs need to be minimal while still being able to determine the effects of management upon structure and function and the need for adaptive management.
7) Numerous monitoring methodologies are available: stand data base (CSE), FIA plot
8) Sampling is selected not only by the main forest plan treatments (thin, burn, and livestock grazing), but also by whether the site has been within a large wildfire within the last several years.
9) Once an aspen sampling strategy framework is worked out with estimated costs, aspen EI monitoring will be assessed against all the other potential forest plan monitoring requirements, monitoring efficiencies will be evaluated, and a decision made for what specific monitoring the ASNFs can commit to.
10) After an aspen sampling strategy framework is worked out and we go forward with aspen EI monitoring under the new plan, a forest aspen monitoring oversight group will meet. It may consist of representatives from these program areas - timber, silviculture, fire, wildlife, range or others, as needed. The group will determine specifics of implementation.

1/24/12 SAMPLING STRATEGY FRAMEWORK FOR MONITORING

Plan Period: 15 years starting the first full year of the new plan implementation

Tentative number of permanent aspen monitoring plots forest-wide: 60* by major plan treatment as follows:

10 in thinning treatments
10 in non thinning treatments
10 in burn treatments
10 in non burn treatments
10 in livestock grazing treatments
10 in non livestock grazing treatments

Frequency of measurement: Monitoring plots are measured every other year, i.e., 30 plots are sampled each year over the course of the 15 year plan period. Hence, each plot is measured 7 or 8 times over this period in order to show long term trend in aspen structure and function as a consequence of forest management. * Per Dr. Rogers, minimum sample size across forest is 50-100 plots.

ESTIMATED COST OF RIPARIAN ECOLOGICAL INDICATOR MONITORING

Dependent. A number of potential partners have expressed interest to participate (AZGFD, AES) which can lower data collection cost. American Conservation Experience (ACE non-profit) is already being used by the Forest. Dr. Paul Rogers of USU and WAA is available for assistance through an R-3 agreement.

POTENTIAL MONITORING QUESTIONS TO ASK

These are mainly generalized for now, see below. Specifics will be developed during item 10) above.

- Are aspen successfully regenerating and persisting? What are the influencing factors upon that regen?
- Are aspen seeding after large disturbance events?
- What are the conditions under which aspen seeding occurs, if found to be happening?
- What are the impacts of large scale BAER rehab (e.g., post-fire rehab seeding of annual grasses for soil stabilization) upon aspen regeneration? upon aspen seeding establishment?
- What are the effects of forest management upon reestablishing aspen (e.g., salvage, burning, livestock grazing)?
- What are the effects of damaging agents upon aspen and aspen regeneration (e.g., insect, disease, ungulate browsing, small mammals foraging)?

POTENTIAL PLOT DATA TO BE COLLECTED

Plot Size
> 1/100 acre for trees ≤5" dbh
> 1/20 acre for >5" dbh

Plot location/General site information
> UTM, aspect, slope, elevation,

>PNVT
-herbaceous and shrub species list by dominance
-noxious weeds and/or native annuals
-down logs, snags (number)

>TEU soil type
-wildfire or prescribed fire in last (specified number of) years (fire name and date)? severity?
-% plot rockiness
other obstacles (e.g., jack-strawed down fall)
-BAER activities (e.g., annual grass seeding)
-erosion, runoff

>Animals impacting aspen
-species (including livestock, gophers, elk, etc.)
evidence: tracks, droppings, etc. (quantify)

Data to record
>Aspen present, dead or alive (number)
-note if wildfire or prescribed fire kill in last specified number of years (fire or project name and date)
>Other trees present, dead or alive (number)
-note if wildfire or prescribed fire kill in last specified number of years (fire or project name and date)
>Individual tree height, crown ratio
>Aspen suckers (number)
-ungrazed height (range and average)
-grazed height (range and average)
-single or multiple suckers
-aspen seedlings (% of plot, density estimate)
>Aspen damage and agents
-wildlife, see above
-insects
-disease
-other (e.g., lightning or fire, see above)