United States
Department of
Agriculture

Forest
Service

**Southwestern
Region**

Month Year

Ecological Sustainability: Developing a Framework for Ecological Sustainability on National Forest Lands and National Grasslands in the Southwestern Region

Version 6.0 – June 2008

Ecological Sustainability: Developing a Framework for Ecological Sustainability on National Forest Lands and National Grasslands in the Southwestern Region

Submitted by the
Ecological Sustainability Work Group

USDA Forest Service
Southwestern Region

Version 6.0
June 2008

Operational Draft: This document is prepared to provide guidance to forest plan revision teams. As this guidance is implemented we expect to learn improved ways to do this work. As we learn, this document will be updated. This document was reviewed and revised as appropriate in June 2008 to conform with the requirements of the 2008 Planning Rule and Directives.

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Introduction

With implementation of the 2008 Forest Planning Rule (hereafter shortened to the Rule; Federal Register, Vol. 73. No. 77, April 21, 2008), the Forest Service is charged with developing management plans that create a framework for contributing to sustainability on National Forests and Grasslands. Implementation of the 2008 Rule is detailed through directives issued in Forest Service Manual (FSM 1920) and Forest Service Handbook (FSH 1909.12). A thorough review of the Rule and the directives is essential to tracking the logical sequence contained within the processes in this document.

The Southwestern Region is unique in that all of our plan revisions will be conducted under the Rule. The region has been preparing for over 2 years for a concerted plan revision effort to maximize efficiency and effectiveness. This preparation has been fostered by the formation of regional workgroups to develop standardized plan revision processes. The goal of these workgroups is to provide standardized approaches through processes developed at the regional level to ensure that when applied at the individual Forest level, that resulting plans will be consistent, based on a need for change, strategic in nature, developed in a collaborative environment, and scientifically credible, while at the same time being on time and on budget (Southwestern Region Forest Plan Revision Strategy).

Ecological sustainability is recognized as one of the three interdependent components of sustainability, social and economic being the other two components (FSH 1909.12, chap. 40). The planning rule and directives defines ecological sustainability as providing for the diversity of plant and animal communities using a multi-scale approach that evaluates and provides guidance for ecosystem and species management. The primary focus for assessing ecological sustainability in the current Rule is to provide for ecosystem diversity which contributes to a diversity of native plant and animal species (36 CFR 219.10(b)). A complimentary and necessary approach focuses on additional provisions if needed for specific threatened and endangered (T&E) species, species-of-concern (SOC), and species-of-interest (SOI) (36 CFR 219.10(b) (2)). In these cases, a species-specific approach to establishing and evaluating plan components may be necessary (FSM 1921.7 and FSH 1909.12, ch. 40).

Two separate workgroups were initially formed to address the contributions of ecosystem diversity (ecosystem diversity workgroup) and species diversity (species diversity workgroup) to ecological sustainability. The processes developed by these workgroups, to assess ecological sustainability (ecosystem/species diversity); will be carried out during plan revision in the comprehensive evaluation report (CER) in two phases.

CER Phase I involves evaluating the impact of the existing forest plan on current conditions and trends of sustainability. Once the need for change of ecological elements has been identified in the CER Phase I, the responsible official conducts a management review to determine which need for change elements will be carried forward into the plan revision at this time (36 CFR 219.6). CER Phase II involves evaluating the anticipated impacts, risks, and uncertainties to sustainability by the Proposed Plan. The focus of the CER Phase II is a more concise evaluation of the major trends and conditions and risks regarding ecological sustainability that would be expected under the proposed plan.

Ecosystem diversity is defined (36 CFR 219.16) as the variety and relative extent of ecosystem types including their composition, structure, and processes (FSH 1909.12, ch. 40, sec. 43.1). The process developed by the ecosystem diversity workgroup to assess ecosystem diversity can be described by (1) selection of appropriate characteristics and scales for analysis (CER Phase I); (2)

describing a range of variation and current condition of ecosystem characteristics (CER Phase I); and (3) analyzing the status of ecosystem diversity, including assessing risk in the development of forest plan components (CER Phase II). The range of variation under historic disturbance regimes (HRV) provides important context in which to evaluate current and desired conditions; however, HRV will not always directly dictate desired conditions (FSH 1909.12, ch. 40, sec. 43.13).

The species diversity workgroup's process identifies Federally T&E species, SOC, and SOI whose ranges include the plan area (FSH 1909.12, ch. 40, sec. 43.22). The process reviews the tentative lists of species to determine which species warrant more detailed consideration. The process also involves information collection and synthesis in order to assess potential threats, identify opportunities to manage the threats, and determine whether existing plan direction adequately protects species or whether additional plan components will be needed.

Ecological conditions that provide for ecosystem diversity are the context for the evaluation of species diversity (FSH 1909.12, ch. 40, and sec. 43.21). Plan components for ecosystem diversity may contribute to ecological conditions that may or may not support species diversity.

After completion of the ecosystem/species diversity workgroup tasks, an ecological sustainability workgroup was formed to develop the regional process to be used to address ecological sustainability by integrating the revision processes developed by the two previous working groups. The products developed by the ecosystem diversity and species diversity workgroups have been incorporated into this ecological sustainability process document and no longer exist as stand alone products.

The steps for assessing the contribution towards ecological sustainability on national forests and national grasslands in the Southwestern Region include:

1. Identification of ecosystem and species attributes for analysis and initial analysis of ecosystem characteristics for CER Phase I.
2. Species information collection and identification of species groups and surrogates for CER Phase I.
3. Status, risk assessment, and identification of ecological needs for change for CER Phase I.
4. Analysis/development of plan components for ecosystem diversity, effects of ecosystem diversity plan components on species and species plan components for CER Phase II.
5. Determination of combined plan components on ecosystem and species diversity that leads to the conclusion of CER Phase II and the initial development of plan option(s).

The steps above are displayed in figure 1 (with the above step 1 corresponding to figure 1, steps 1a and 1b, step 2 above corresponding with figure 1, step 2, etc.). These steps also form the outline of the individual chapters of this report (i.e. step 1 is described in chapter 1, step 2 is described in chapter 2, etc.).

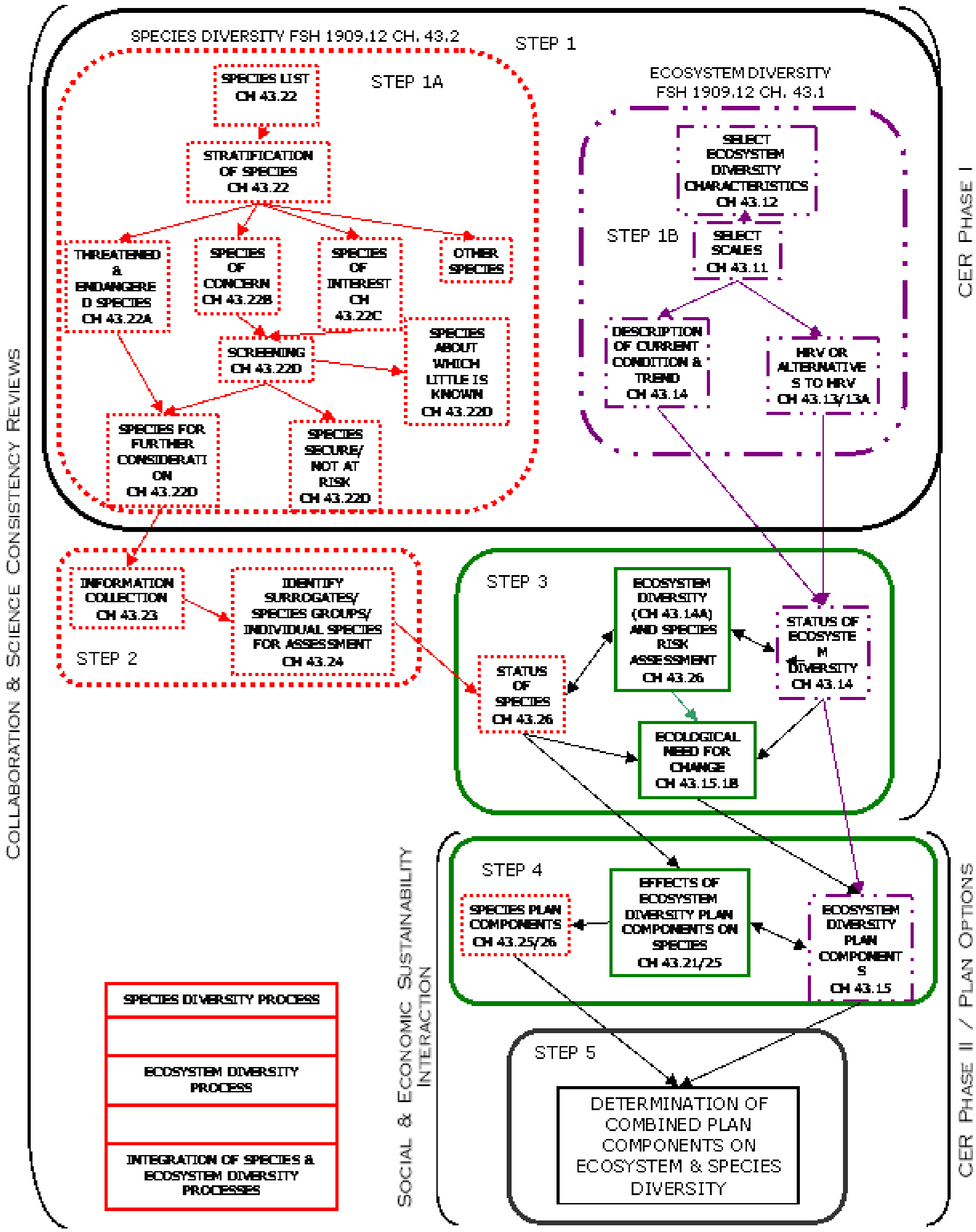


Figure 1. Flowchart Depicting the Ecological Sustainability Process.

Chapter 1. Ecological Sustainability Process Step 1

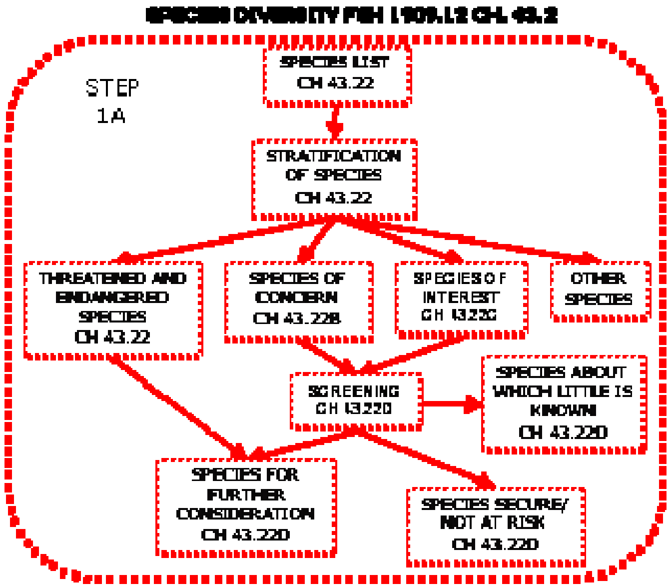
Process Introduction

Chapter 1 consists of a series of stepwise processes intended to initiate the assessment of ecological sustainability. The chapter is broken into two distinct sections, section 1a (process step 1a, figure 1) and section 1b (process step 1b, figure 1). Section 1a walks the user through the identification, stratification and selection of specific species for later use in the analysis of species diversity. Section 1b walks the user through the selection of characteristics of ecosystem diversity including the selection of scales and initial analysis.

The strategy for developing the plan framework for ecological sustainability involves consideration of both ecosystem and species diversity. A hierarchical approach (FSM 1921.73) is used to provide effective guidance for ecosystem diversity and supplement it with additional guidance as needed for species diversity. Evaluations of ecosystem and species diversity provide information on the need to change direction from current forest plans, and they focus on selected ecosystem characteristics and species. The characteristics of ecosystem diversity are selected because they provide for meaningful evaluation of ecosystem composition, structure and process and are significant to the decisions that are to be made in the plan. Species are selected because they are of concern or interest, and there is reason to believe that their needs will not be fully accommodated through provisions for ecosystem diversity.

The ecosystem diversity and species diversity approaches are often hierarchical and they are not always sequential. Information developed at the ecosystem level may result in the need to modify the species evaluation and visa versa. It is important to understanding of how the information developed through one approach will affect the other. Current ecosystem status and plan direction will influence the selection of species for evaluation. However, one of the criteria for selection of ecosystem characteristics should be the ability to meaningfully characterize habitat of species to be evaluated.

Process Step 1a - Species Diversity (FSH 1909.12 Chapter 43.2) Identification of Species for Analysis



See figure 1 in the Introduction for the schematic diagram of the ecological sustainability process in its entirety.

Figure 2. Ecological Sustainability Process Step 1A

The following Process Step 1a outlines the steps for identifying the species for analysis during plan revision:

- Develop Species List within the Plan Area (FSH 1909.12, ch. 40, sec. 43.22)
- Stratify Species List (FSH 1909.12, ch. 40, sec. 43.22)
  - Threatened and Endangered Species (FSH 1909.12, ch. 40, sec. 43.22a)
  - Species of Concern (FSH 1909.12, ch. 40, sec. 43.22b)
  - Species of Interest (FSH 1909.12, ch. 40, sec. 43.22c)
  - Other Species
- Screen Out Species (FSH 1909.12, ch. 40, sec. 43.22d)
  - Species Secure/Not at Risk (FSH 1909.12, ch. 40, sec. 43.22d)
  - Species about Which Little is Known (FSH 1909.12, ch. 40, sec. 43.22d)
- Species for Further Consideration to be carried forward (FSH 1909.12, ch. 40, sec. 43.22d)

Develop Species List within Plan Area (FSH 1909.12, Chapter 40, Section 43.22)

Development of the initial species list facilitates the identification of species which will be the focus of the species diversity evaluation and potential development of plan components.

Conceptually, the process starts with the full list of plant and animal species that occur in the plan area. In addition to species in the plant and animal kingdoms, the directives (FSH 1909.12, ch. 40, sec. 43.22b) require that macro-lichens be considered.

Developing comprehensive plant, animal and lichen species lists for most forests can be challenging. A more practical strategy is to identify species that will be the focus of planning efforts. However, an underlying assumption is that species not identified for detailed analysis will be provided for by ecological plan components.

Stratify Species List (FSH 1909.12 Chapter 40, Section 43.22)

Three categories for species to be selected for evaluation are:

- Species that are Federally listed as T&E under the Endangered Species Act (ESA).
- Species of Concern (SOC) – these are species for which management actions may be necessary to prevent listing under the ESA.
- Species of Interest (SOI) – these are species for which management actions may be necessary to achieve ecological or other multiple-use objectives. They may be species for which there are local concerns resulting from declines in habitat, population, and/or distribution, species that are of public interest, or species such as invasive for which control measures may be desirable.

The processes for identifying T&E species and SOC are relatively straightforward as they are based on lists maintained under the ESA and species ranks that are maintained by NatureServe. The criteria for identifying SOI are more flexible, and the process for identifying those species involves an additional screening process. Each of these categories is discussed in more detail below.

Threatened and Endangered Species (FSH 1909.12, Chapter 40, Section 43.22A)

The list of T&E species is maintained by the U.S. Fish & Wildlife Service and can be found at http://www.fws.gov/endangered/. Lists by county can be found at:

- For Arizona: http://ecos.fws.gov/tess_public/StateListing.do?status=listed&state=AZ
- For New Mexico: http://ecos.fws.gov/tess_public/StateListing.do?state=NM&status=listed
- For Oklahoma: http://www.wildlifedepartment.com/endanger.htm
- For Texas: http://www.tpwd.state.tx.us/huntwild/wild/species/endang/index.phtml

Developing the forest or grassland list of T&E species that occur on a forest should be completed cooperatively with the U.S. Fish & Wildlife Service and carefully documented. Some categories of occurrence may raise questions about which species should and should not be retained on the list.

- If an occurrence is thought to be an “accidental”, i.e., an occurrence of a species well outside its normal range, then consideration of the species in the forest plan revision process may not be warranted as determined by the responsible official.

- In some situations, a T&E species occurred on the forest historically but there are no current occurrences. In this case, for a species which has been absent from a forest for a long period of time, and there is no expectation that it would be reestablished, consideration of the species in the forest plan revision process may not be warranted.

Species-of-Concern (FHS 1909.12, Chapter 40, Section 43.22b)

Criteria for identifying SOC are specified in FSH 1909.12, ch. 40, sec. 43.22b as follows:

- Species identified as proposed and candidate species under ESA.
- Species ranked G-1, G-2 and G-3 by NatureServe.
- Subspecific taxa ranked T-1, T-2 and T-3 by NatureServe.
- Species that have been petitioned for federal listing and for which a positive "90-day finding" has been made.
- Species that have been recently delisted including those delisted within the past 5 years and other delisted species for which regulatory agency monitoring is still considered necessary.

All species that meet these criteria and whose ranges include the plan area should be identified as SOC. Identified SOC may include listable entities such as distinct population segments or evolutionarily significant units that may be listed under ESA.

Species-of-interest (FSH 1909.12, Chapter 40, Section 43.22C)

The process for identifying SOI includes two major steps. The first is development of a list of potential SOI. Second is determining which species merit consideration as SOI based on a set of predetermined criteria.

The list of potential SOI should be developed based on the following:

- Species with ranks of S-1, S-2, N-1 or N-2 on the NatureServe ranking system.
- State listed threatened and endangered species.
- Species identified as species of conservation concern in State Comprehensive Wildlife Strategies.
- Species on the U.S. Fish & Wildlife Service Birds of Conservation Concern National Priority List.
- Additional species that may be of regional or local conservation concern due to:
    - Significant threats to populations or habitat
    - Declining trends in populations or habitat
    - Rarity
    - Restricted ranges (e.g., narrow endemics, disjunct populations, species at the edge of their ranges)
- Species hunted or fished.
- Other species of public interest.
- Invasive or other species for which control measures are needed.

Species that occur on the forest, meet any of these criteria, and are not already identified as SOC may be considered potential SOI. Some sources, not otherwise mentioned above, for species that may meet the above criteria are:

- The Regional Forester Sensitive Species List.
- The Nature Conservancy (TNC) Challenge Cost Share Agreement
- BISON (Biota Information System of New Mexico).
- State plant lists.
- Regional assessments.
- State Heritage databases.
- Field guides.
- Natural Resource Information System (NRIS) Fauna.
- ReGAP.

The list of potential SOI will likely contain many species for which there is not significant local risk or high public interest. The potential list should be reviewed based on the following set of criteria to determine those that merit identification as SOI:

- Species habitat or population has declined significantly in the plan area.
- Species and its habitats are not well-distributed in the plan area.
- Species population numbers are low in the plan area.
- Species is dependent on a specialized habitat or one that is limited in the plan area.
- There is some imminent threat to the species.
- Species habitat or population is not generally secure in the planning area, and NFS lands act as an important refuge.
- Species is of public interest, including those species identified cooperatively with state fish and wildlife agencies consistent with the Sikes Act.
- Species is invasive.
- Species poses a threat to ecosystem or species diversity.

If a potential SOI meets any of the above criteria, it may be appropriate to identify that species on the final SOI list.

The preceding three steps are finalized when the responsible official has determined that the species lists are no longer in development and can be finalized for further analysis.

Other Species

Following completion of the three preceding steps, finalized by the responsible official, the lists of T&E species, SOC, or SOI are established. Other species that occur on the forest and are not included on these lists are considered to be secure in the plan area, not of high public interest, and not a significant threat (i.e., not an invasive or otherwise a threat to ecosystem or species diversity). Documentation of the process for identifying T&E species, SOC, and SOI must be of high quality so that those choices can be supported.

Screen Out Species (FSH 1909.12, Chapter 40, Section 43.22d)

Most of the species that are identified as T&E, SOC, or SOI will be carried forward for more detailed consideration in the planning process. However, further consideration in the planning process may not be necessary for some SOC and SOI. Species-of-concern and SOI that meet any of the following criteria do not require detailed consideration in the process:

- Species for which there are no known occurrences or suitable habitat in the plan area
- Species which are secure in the plan area based on knowledge of its occurrence, distribution, availability of habitat, and responses to any management of natural disturbances that might occur.
- Species which are not affected by any current or potential form of management or lack of management in the planning area.
- Species for which there is too little information known to complete a reliable assessment. In these cases, the lack of critical information should be disclosed and actions towards acquiring that information should be highlighted.

Species that meet these criteria may be eliminated from further detailed consideration in the planning process. Documentation of this step is essential[1]. Exhibit 1 displays a suggested process for the screening. Even if species are eliminated from further consideration in this step, they remain on the original lists of SOC and SOI. However the comprehensive evaluation report will disclose the reasons why they were not given detailed consideration.

[1] See Exhibit 3.

Exhibit 1. Screening of Species-of-Concern (SOC) and Species-of-Interest (SOI)

The following set of steps may be used for screening each SOC and SOI:

a. Determine species occurrence on NFS lands
   a1. If there is no documentation of occurrence, go to *Sub-task b.*
   a2. If species occurs go to *Sub-task c.*

b. Determine potential habitat on NFS lands
   b1. If potential habitat exists go to *Sub-task c.*
   b2. If potential habitat does not exist, drop the species from further evaluation and document rationale. However, if there is uncertainty about the occurrence of the species or habitat on NFS lands, consult species experts from State/Federal wildlife agencies (including the FS) to determine if further consideration is warranted. If a determination is made that further consideration is warranted, go to *Subtask c.* If further consideration is not considered warranted, drop from further evaluation and document rationale.

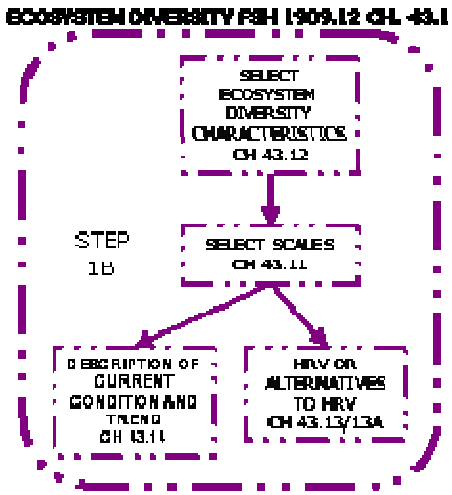
c. Is there adequate information known about the species to allow the completion of a credible assessment?
   c.1. If yes, go to *Sub-task d.*
   c.2. If no, drop from further evaluation and document rationale.

d. Can the species be affected (positively or negatively) by current or potential FS management, or lack of management?
   d.1. If yes, go to Sub-task e.
   d.2. If no, drop species from further evaluation and document rationale.
   e.1. Is the species' population stable?
   e.2. Is the species currently well-distributed?
   e.3. Is the species' habitat stable?
   e.4. Is the species' habitat well-distributed (see FSH 1909.12, 43.26.7 for the definition of well-distributed)?
   e.5. Are the numbers of individuals adequate to maintain the population?
   e.6. Are existing plan components adequate to maintain species population and required ecological conditions?
   e.7. Are plan components adequate to deal with outside threats? *For example: exotic species invasions, disturbance from road systems, etc.*
   - If no to any of *Sub-tasks e.1. - e.7.*, keep species on list for further evaluation.
   - If yes to all of *Sub-tasks e.1. - e.7.,* drop from further evaluation and document rationale.

Species for Further Consideration (FSH 1909.12, Chapter 40, Section 43.22d)

Completion of the preceding section allows for the finalization of the list of species that will be further considered in the planning process. This includes T&E species, as well as SOC and SOI which were not screened out in the preceding step.

Process Step 1b - Identification of Ecosystem Diversity Characteristics (FSH 1909.12, Chapter 40, Section 43.1) and Preliminary Analysis



See figure 1 in the Introduction for the schematic diagram of the ecological sustainability process in its entirety.

Figure 3. Ecological Sustainability Process Step 1b.

The following Process Step 1b outlines the steps for identifying the ecosystem diversity characteristics considered necessary for analysis during plan revision:

- Selection of Ecosystem Diversity Characteristics (FSH 1909.12, ch. 40, sec. 43.12)
- Determine the Appropriate Spatial Scales (FSH 1909.12, ch. 40, sec. 43.11)
- Determine HRV or Alternatives to HRV (FSH 1909.12, ch. 40, sec. 43.13 and ch. 40, sec. 43.13a)
- Description of Current Condition and Trend (FSH 1909.12, ch. 40, sec. 43.14)

Selection of Ecosystem Diversity Characteristics (FSH 1909.12, Chapter 40, Section 43.12)

The Directives (FSM 1909.12, ch. 40, sec. 43.12) require that ecosystem characteristics be meaningful to describe structure, composition, and/or process including disturbance regimes. Ecosystem characteristics chosen for evaluation should be appropriately matched to the scales of evaluation (the procedure for which is discussed in the following section). In addition, characteristics that have been significantly altered by past management actions should be strongly considered, and, to the degree possible, ecosystem characteristics should serve as descriptors of habitats for T&E species, SOC, and SOI. However, it is not intended that characteristics be identified solely to address habitat needs for species on the lists developed in previous sections of this chapter.

Selection Criteria for Appropriate Ecosystem Characteristics

Selection of ecosystem characteristics should be guided by the following:

- The ecosystem structural or compositional characteristic must be describable; or must be an identifiable ecological process, either natural or human induced, which maintains, creates, or modifies composition and structure. Examples of composition are dominant species for vegetation, or soil erosion rating. Examples of structure are mean diameter (dbh [diameter at breast height] or drc [diameter at root crown]) for forest vegetation types, or density (miles per square mile) of stream channels in an area. Examples of processes are fire and succession for vegetation, frequency and severity of flooding for streams, or erosion rates for soils.
- The characteristic must be analyzable at the scale appropriate to the planning area, both to allow the planning area to be placed in the larger context as well as allowing for description of the status of the ecosystem character at the planning unit scale and/or smaller scales. See the following section for a discussion of the selection of appropriate scales for analysis.
- The characteristic should be subject to direct or indirect manipulation or modification.
- The data are readily available or obtainable.

It is desirable, but not necessary, that the characteristic meet the following additional criteria:

- The characteristic is quantifiable, in the sense that the characteristic is measurable or mapable.
- The characteristic has been influenced by past management activities.
- The characteristic describes or reflects habitat needs for T&E species, SOC, or SOI.
- The characteristic is a determiner of, or is important to, the functions and processes which create or maintain ecosystems.

Ecologically important characteristics should be identified through collaborative consideration of ecological sustainability. Note that selection of additional ecosystem diversity characteristics may be identified through collaboration, the social and economic assessments and the Attitudes, Beliefs and Values (ABV) assessments.

Regionally Consistent Data Elements of Ecosystem Characteristics for Evaluation of Ecosystem Diversity

The following section provides a list of ecosystem characteristics for which there is regionally consistent data. These characteristics should be considered in the forest planning process for every forest and grassland[2]. The basic divisions within this list are terrestrial characteristics (vegetation/soils), aquatic characteristics, air characteristics, and disturbance/process characteristics. In addition to these, other characteristics may be selected for analysis using the criteria outlined above, if additional ecosystem characteristics are needed to fully represent important planning issues on the forest. Each characteristic should be analyzed at scales from the appropriate hierarchy (see table 3 and the accompanying text).

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[2] This is the list of ecosystem characteristics for which there is regionally consistent data. The responsible official may consider additional ecosystem characteristics to fully represent important planning issues on the forest.

Table 1. Regionally Consistent Data Elements to be used for Ecosystem Diversity Analysis

Category	Characteristic	Data Source
Terrestrial (Vegetation)	Potential Natural Vegetation Types (PNVTs)	Forest Ecosystem Diversity Reports, Terrestrial Ecosystem Survey (TES) and General Terrestrial Ecosystem Survey (GTES), TNC diversity reports by forest
	Vegetative Dominance Type (including patch size, distribution and extent)	Mid-Scale Existing Vegetation
	Canopy cover class	
	Vegetative structure class	
	Successional stages, Fire regime	LandFire, Fire Regime Condition Class (FRCC) Assessment
	Tree mortality	FIA & Forest Health
Terrestrial (Soils)	Soil loss	TES, GTES
	Soil productivity	
	Organic matter (surface & soil)	
	Microbiotic crusts	
Aquatic	Miles of streams	GIS (1:24,000)
	Stream types (perennial, intermittent, or ephemeral)	
	Fishes (native and non native by stream or reach)	GIS (1:24,000), state data, FS data & biologists: FS, F&WS, AGFD, NMDGF, BOR
	Fish species richness	
	Fish community	GIS and National Wetland Inventory (1:24,000), Fisheries Biologists, ADEQ, NMED
	Water quality	
	Location and type of wetlands by 5th HUC	
Air	Particulate matter aerosols without chemical species	State air quality monitoring data and attainment status reports
	Particulate matter aerosols with chemical species	IMPROVE visibility monitoring network (Class I)
	Acidity (aquatic and terrestrial)	Wilderness aquatic and terrestrial AQRV monitoring
	Acid deposition	State air quality monitoring data reports National Atmospheric Deposition Network
	Ground-level ozone	State air quality monitoring data and attainment status reports Ozone-injury studies
Disturbance/ Process	Fire regimes by PNV type	TNC assessments, LandFire, FRCC
	Short-term climatic fluctuations	
	Herbivory	
	Fragmentation	Transportation plans, WRAPS
	Erosion hazard	TES, GTES
	Flooding	USGS
	Insect and Disease Infestations	Forest Health Surveys
	Fire Occurrence	KC GIS DATA

Terrestrial Characteristics (Vegetation)

Vegetation is the primary terrestrial ecosystem characteristic for analysis for two reasons. First, it represents habitat for wildlife and provides the required link to species diversity. Second, it is the primary terrestrial and biological ecosystem component manipulated through management and affected by natural processes.

The primary information available for analysis of dominant vegetation types will be provided by the mid-scale existing vegetation products. The following process discusses only the mid-scale vegetation information collected as this will represent the regionally consistent information available to each Forest.

If a Forest has a unique situation requiring some additional data, the responsible official may consider the use of additional vegetation information where available to address Forest-specific issues. These may include forest inventory and analysis (FIA) data and other information sources that contain information on fine-scale vegetation characteristics such as snags, invasive plant infestations, and areas of tree mortality due to bark beetle infestations.

The framework for vegetation analysis should be potential natural vegetation types (PNVTs) (see appendix A). The PNVTs can be considered the vegetation ecosystems which have composition, structure, and process characteristics. Models of vegetation change are being developed for representative PNVTs in order to facilitate comparison of current vegetation to vegetation under historic conditions. PNVTs can be correlated with habitat types used in the Southwest Wildlife Information System (SWIS) (see appendix A). All PNVTs occurring within the planning area and those that extend beyond will be analyzed in this process.

Terrestrial Characteristics (Soils)

Soil resources also constitute essential terrestrial ecosystem characteristics for analysis of ecosystem diversity. Anthropogenic disturbances including vegetation management and natural disturbances often have the potential for alteration (improvement or degradation) of soil properties through erosion and other impacts affecting soil quality (condition) (Dumroese et al. 2000, Herrick et al. 2002, Karlen et al. 2003, Lal 1999, Powers et al. 1998). Protection and maintenance of soil condition through sustaining proper soil functions is critical to ensure diversity of biotic and abiotic soil properties for current and future generations.

The primary information available for analysis of soil quality (soil condition) will be provided by the General Terrestrial Ecosystem Survey (GTES) and where available Terrestrial Ecosystem Survey (TES) reports. These reports provide information related to factors for assessing soil productivity, one of the most critical ecosystem characteristics for the maintenance of ecosystem diversity and long term sustainability.

Potential soil productivity is estimated through the combined factors of site characteristics, climate, kind of soil (taxonomic) and potential vegetation (climax, disclimax). Potential soil productivity values are published in GTES and TES reports.

Existing soil productivity can be assessed through direct measurements or evaluations of soil condition (FSH R3 2509.18-99-1).

Ecosystem diversity of soil resources includes the combined assessment of soil productivity, erosion and organic matter. Risk to soil productivity is assessed through determinations of erosion hazard.

Aquatic Characteristics

Characteristics of streams and rivers reflect variations in local geomorphology, climatic gradients, spatial and temporal scales of natural disturbances, and are some of the best indicators of watershed vitality (Naiman et al. 1992). Delivery and routing of water and sediment are key processes in non-forested ecosystems, along with the delivery of down woody material into the water courses of the Southwestern Region's forested ecosystems. The Southwestern Region has a variety of natural streams, wetlands, riparian areas, and springs. Many of these have been severely altered by watershed and landscape scale activities such as grazing, roads, uncharacteristic wildfire, fire exclusion, non-native invasive species, urban development, stock pond development, timber harvest and consumptive water uses. Many of the characteristics presented for consideration in forest plan revision include aquatic species processes, including community structure and dynamics of fishes and aquatic macroinvertebrates.

The regionally consistent information available for analysis of aquatic ecosystems is limited by what is commonly available across the national forests and grassland units of the region. The majority of this information is associated with existing local corporate databases, and from other research and administrative studies.

Air Resource Characteristics

Particulate matter aerosols and sulfate and nitrate acidic deposition compounds serve as the primary measures of air quality, visibility and atmospheric deposition in the Southwest. Particulate matter affects human health and impairs visibility regardless of chemical species or emission sources. Acidic compounds that deposit on landscapes alter the chemistry of surface and ground waters, soils, vegetation, and cultural resources. Uncharacteristic chemical changes also affect aquatic and soil biota. Resource sensitivities to atmospheric deposition are greater in watersheds dominated by bedrock types with low acid-buffering capacity.

Particulate matter, Class I visibility, and acidic deposition data are available from the States, the Interagency Monitoring of Protected Visual Environments (IMPROVE) program, and/or the National Atmospheric Deposition Program (table 1). Few forests, however, have monitored the recommended air quality-related values for aquatic and terrestrial ecosystems in the Region's Class I wildernesses.

Ground-level ozone is another indicator of air quality. Ozone is a seasonal (spring through fall) phenomena that affects human health and the foliage, growth and vigor of ozone-sensitive plant species. Ambient ozone data are available from the states. Ozone-injury data, however, are found on relatively few forests and typically indicate relatively minor impacts to sensitive vegetation. Nonetheless, responsible officials for national forests in Arizona and northwest New Mexico where ozone levels are higher may consider the use of existing or request additional ozone-injury data from forest health specialists and research scientists.

Additional Ecosystem Characteristics for Consideration

There are additional ecosystem characteristics which could be analyzed in the forest planning process. However, these characteristics are too variable between Forests to adequately describe conditions except at the individual forest; or these characteristics may not be applicable to all forests in the region. At the discretion of the responsible official, these additional characteristics may be considered for analysis if they are relevant to a particular forest's revision issues or topics and data are available. These ecosystem characteristics are presented in table 2. Selection of characteristics should also be guided by direction provided earlier in this chapter.

Table 2. Regionally Consistent Data Elements to be used for Ecosystem Diversity Analysis

Category	Characteristic	Data source
Terrestrial Vegetation		
Unique ecological features (rare/endemic species habitat)	Varies	FS data
Invasive exotics	Species, infested area, extent of occurrence (Contributing factors: road network, recreation use, livestock use, etc.)	INFRA, FS data
Aquatic		
Riparian (miles)	Vegetative community, stream & floodplain indicators (i.e. width: depth ratio, entrenchment, bank stability, etc.)	Various (FS ecologists, range, fisheries, watershed, research & other agencies)
Macroinvertebrates (stream reaches or sites)	Community index or other measure (i.e. number of tolerant or intolerant species), temperature, dominant stream substrate, water chemistry (i.e. N, P, pH, dissolved O, etc.)	State & FS collections and reports
Stream fish habitat (gradient, width:depth ratio, dominant & sub-dominant substrate (reaches))	Percent pool, pool frequency, residual pool depth, amount of large woody instream material, Rosgen type, discharge at time of survey, temperature with thermograph, etc.	FS data, various streams on the Santa Fe, Coconino, Carson, Lincoln based on Regional protocol (R6 Modified Level 2 Survey)
Stream water quality (site samples)	Temperature, N, P, dissolved O, turbidity, etc.	State 303(d) lists, FS hydrologists & fisheries biologists
Water availability & flow regime		USGS gauging stations
Stream classification by reach (Rosgen or Montgomery & Buffington)	Rosgen type or Montgomery & Buffington (source, transport, depositional), watershed condition indicator, etc.	FS data, some data from RMRS for Prescott & A-S

Determining the Appropriate Spatial Scales for Analysis of Ecosystem Characteristics (FSH 1909.12, Chapter 40, Section 43.11)

The scales used to characterize ecosystem diversity should be selected subject to the guidelines and restrictions discussed in FSH 1909.12 ch. 40, sec. 43.11, and fit within the *National*

Hierarchical Framework of Ecological Units (Cleland et al. 1997, Maxwell et al. 1995). Considerable flexibility exists within the required use of this framework. It is clear from the directives that a scale larger than the forest (ecoregion or subregion) is desirable to understand the environmental context, opportunities and limitations of National Forest System lands to contribute to ecological sustainability. At the same time, smaller scales (subregion or landscape) are necessary to allow for broad characterization of the planning unit; to address rare, poorly distributed, or unique landscape elements important to ecosystem diversity; and to allow the formulation of plan components and description of current, historical, and desired conditions (FSH 1909.12, ch. 20, sec. 43.1).

The appropriate scales for evaluation of ecosystem diversity can be found in table 3.

Table 3. Appropriate Scales for Ecosystem Characteristics Analysis

Characteristic	Scale		
	Subregion		Landscape
Terrestrial	Section: Puts planning unit into a larger context; large enough to describe broad-scale trends & processes	Subsection: Characterizes the planning unit (potential & current conditions); is the scale for evaluation of planning unit trends and processes	Landtype Association: Allows assessment of landscape features within the planning unit that are small &/or of limited extent; provides information on ecological potentials & capability to achieve desired conditions
Aquatic	Subbasin: Puts planning unit into a larger context; large enough to describe physiography & species groups (HUC 4)	Watershed: Characterizes the planning unit (current condition); is the scale for analysis of stream networks, geomorphology, & fish genetics (HUC 5)	Subwatershed: Allows for assessment of finer scale features such as valley segment or stream reaches; & provides information on potential & capability to achieve desired conditions (HUC 6)
Atmospheric	Airshed: Corresponds to the subbasin level defined above. Puts the planning unit into a larger context; large enough to describe & distinguish physiography & air mass & wind patterns.	Class I Airshed: Corresponds to portions of watersheds as designated by wilderness areas, national parks & monuments.	

Terrestrial Ecosystems

hierarchy, are the section and subsection (for subregion scale, as required in FSH 1909.12, ch. 40, sec. 43.11), and the landtype association (for landscape scale, as required in FSH 1909.12, ch. 40, sec. 43.11) (Cleland et al. 2005). Scales broader than the Section will probably not be necessary in most cases unless there is a much broader management concern or issue. Scales smaller than the landtype association can be selected on rare occasions as needed based on the ecosystem characteristic being analyzed and the resolution of available data. In either case, it is at the responsible official's discretion and the rationale for the selection of other scales should be documented and included in the analysis. The terrestrial scales recommended for use in the Southwestern Region are shown in table 3.

Biotic and abiotic factors in defining ecosystem characteristics are not equally important at all spatial scales. At coarse scales the important factors are largely abiotic (climate, geomorphology), while at fine scales both biotic and abiotic factors are important (Cleland et al. 1997). The conditions and processes occurring across larger ecosystems affect and often override those of smaller ecosystems, and the properties of smaller ecosystems emerge in the context of larger systems (Rowe 1984)

The section scale analysis is intended to place the planning unit into a broader ecological context; that is, to what degree does the planning unit contribute to maintaining a given ecosystem characteristic and the ecological processes associated with that ecosystem characteristic. Most planning units in the region will be within two or more sections, and each section will include lands outside the administrative planning area. When an ecosystem type or characteristic is found to occur across adjacent planning units, cooperation is essential to assess its range of extent and condition. The basic information that would be required at this spatial scale is the proportional extent and location of each characteristic present within the planning unit or across multiple planning units in comparison to the Section as a whole.

The subsection scale analysis is intended to provide the broad characterization of the planning unit. Most planning units will contain several subsections and some adjacent planning units will share similar subsections. Cooperation in analyzing common ecosystem characteristics between planning units is essential. This allows for a consistent, detailed description of the current condition for comparison to the HRV as provided by the TNC through the Challenge Cost Share Agreement. This comparison will assist in the development of the desired conditions (DC) as well as comparison to the projected future condition of the existing plan to determine the need for change.

The landtype association scale is the appropriate scale to assess landscape features of limited extent (which may not be apparent at larger scales), and to assess the capability of areas within the administrative planning boundary for uses and potential contribution to the DC. The landtype association scale information for terrestrial characteristics is equivalent to GTES mapping units. Distribution of ecosystem characteristics and area of extent are important; not all characteristics or the compositional and structural elements within those characteristics should be present in one or just a few areas, but should be distributed across the landscape according to the ecological capability of the landscape to support these types.

Aquatic Ecosystems

The scales which should be used for analysis of aquatic related characteristics are based on *A Hierarchical Framework of Aquatic Ecological Units in North America* (Maxwell et al. 1995). A major precept of aquatic hierarchical systems is that each component is a discrete functional entity and also part of a larger whole. As with the terrestrial characteristics, we advocate analysis of aquatic ecosystem characteristics at the scales from the national hierarchy; the subbasin, watershed, and subwatershed (table 3). Larger or smaller scales may be used on rare occasions, as needed depending on specific issues and availability of information. However, it is at the responsible official’s discretion, and the rationale for the selection of other scales should be documented and included in the analysis.

Aquatic ecological units are constructed by describing the aquatic system(s) in the context of geoclimatic and zoogeographic settings in which they are immediately nested (Maxwell et al.

1995). The patterns at the three aquatic scales govern aquatic system structure, chemical and hydrologic regimes. The subsection and landtype association of the terrestrial hierarchy are functionally linked to the subbasin, watershed, and subwatershed scale (see figure 1 in Maxwell et al. 1995). The zoogeographic setting is described by hydrologic units that have affected speciation because their boundaries have isolated aquatic populations at the river basin scale or subbasin scale.

Some national forests in the Southwestern Region have not defined or finalized subwatershed scale units. In this case, the watershed scale will be sufficient. The scales proposed here allow for coarse- and some fine-scale ecosystem assessments, based on limited data that may be available to the region for aquatic ecosystem characteristics.

The subbasin scale analysis helps define physical-chemical habitat patterns inhabited by distinct species groups and is crucial to sound fisheries management programs that recognize population diversity among watersheds (species) and within watersheds (stocks) (Maxwell et al. 1995). The watershed and/or subwatershed scale analyses are used to assess biodiversity; native species distribution; non-native species distribution; stream flow, sediment, and thermal regimes; as well as surface and ground water quality and fish habitat.

Atmospheric Ecosystems

The atmospheric or air scales which should be used for analysis are based on the states' regulatory structure for managing air quality impacts and smoke effects. Airsheds have been defined for this purpose, which correspond to the fourth code watershed delineations, which follow a hierarchical system in that each component is a discrete functional entity and also part of a larger whole. Due to the transitory nature of air masses, we advocate analysis of atmospheric ecosystem characteristics at two scales; the Airshed (corresponds to subbasins) and Class I airshed (corresponds to watersheds). Larger or smaller scales may be used as needed on rare occasions depending on specific issues and availability of information. However, it is at the responsible official's discretion, and the rationale for the selection of other scales should be documented and included in the analysis. The atmospheric scales recommended for use in the Southwestern Region are shown in table 3.

Determine Historic Range of Variation or Alternatives to Historic Range of Variation (FSH 1909.12, Chapter 40, Section 43.13 and Chapter 40, Section 43.13a)

The Historic Range of Variation (HRV) describes how the ecosystem characteristic varies through time and space. Each characteristic will change as a result of varying environmental (climate), age (genesis) and disturbance related processes. Detailed descriptions of HRV are provided by TNC through the Challenge Cost Share Agreement. Because disturbance regimes are considered characteristics of ecosystem diversity themselves, this process step requires identifying and evaluating the interactions between characteristics. Establishing the appropriate time frame is needed to begin the characterization of the reference period and or reference conditions. The time frame can vary according to what has been recorded and published in the literature. Reference periods should be long enough to encompass the full HRV in disturbance often several centuries or more. Typically most reference periods begin prior to European settlement. No single widely applicable period of time for assessing HRV exists in North America (Landres et al. 1999). It is important to recognize the influence of aboriginal and contemporary periods.

Forest Service Handbook 1909.12, ch. 40, sec. 43.13, provides an excellent foundation for applying the concepts of the HRV to forest planning. Climatic cycles and recurring disturbances such as floods, fire, disease and insect outbreaks are some of the disturbance factors that have led to changes in ecosystem characteristics and their appearance on the landscape over time. The range of these changes is referred to as HRV.

Characterization of HRV should be carried out using the selected ecosystem diversity characteristics, assuming the information exists or can be developed in a timely and economic manner. An initial assessment of the HRV for the selected PNVTs will be available at a subregional level above the scale of the individual national forest. If a forest has a unique situation requiring some additional data, these initial assessments can be augmented with local, credible historic information at the forest scale such as repeat photography, archival reports and administrative studies describing ecological trend.

In the process for developing and reviewing the HRV, utilize the following approach:

1. For each characteristic conduct a literature review, weigh applicability of literature to plan area, and rank the credibility of the literature:
   a. Peer-reviewed.
   b. Non peer-reviewed.

   Synthesize the literature to establish relationships between the ecological characteristic and its variability as influenced by disturbance regimes and climate.

   The literature review process and application is iterative. Following synthesis evaluate the need for additional scientific review. The Southwestern Region science consistency review process will be utilized in making this determination.

2. Determine the reference period.
   a. The temporal scale may vary by ecosystem characteristic and should be long enough to incorporate return intervals of dominant natural disturbances and thus represent the full HRV associated with disturbances.
   b. The reference period should generally be a period of time prior to European settlement.
   c. The patterns and magnitudes of human influences during the reference period should be described..
3. Provide estimates of the HRV of selected characteristics. Estimate the distribution of selected ecosystem characteristics, including disturbance frequencies and severities, over the selected reference period. A number of approaches can be applied to develop these estimates. Suggested approaches include:
   a. Use knowledge about present species composition and their ecosystems to infer past conditions.
   b. Use ecological understanding and models of disturbance effects to simulate and estimate past variation.

c. Use historic accounts, photographs, early surveys, pollen records, midden analysis, and tree rings, etc. to help establish the range of past conditions.

d. Use modern reference areas that may not have been heavily influenced by human disturbances (i.e. wilderness areas, Research Natural Areas, grazing exclosures and National Parks).

Consider data that establishes trend from long-term data to estimate initial conditions in disturbed areas. Initial conditions may provide clues into the HRV.

The HRV should be represented by a frequency distribution of ecosystem conditions and processes.

4. Characterize the HRV of disturbance regimes. Disturbances that create the HRV are generally large-scale phenomena, for which the most appropriate description of variation is provided at the ecoregional and subregional (down to landscape) scale. Include those disturbances important to explaining the HRV of the selected ecosystem characteristics. Detailed description of the HRV of disturbance regimes are provided by the TNC through the Challenge Cost Share Agreement

Alternatives to the Range of Variation Approach (FSH 1909.12, Chapter 40, Section 43.13A)

In some situations, too little information is available to thoroughly document and understand the HRV of selected ecosystem characteristics. In these cases, an understanding of the general ecological conditions needed to sustain a given characteristic of ecosystem diversity can be used as the basis for plan components to determine ecosystem context for characteristics. There are six different conceptual approaches, which can be used for evaluation of current conditions:

- Representativeness.
- Understanding of possible stressors.
- Redundancy.
- Understanding of habitat associations of particular species.
- Biotic integrity.
- Resiliency.

These approaches are not mutually exclusive; each approach should be used with the other approaches, as appropriate, for the ecosystem characteristic being considered.

Representativeness: This approach is designed to represent the full array of potential “states” or conditions of an ecosystem characteristic on the landscape. For example, if little is known about the historic range in an ecosystem characteristic, one approach might be to simply identify the full array of ecosystem characteristic conditions to compare current and projected future status of an ecosystem condition. The amount of each ecosystem characteristic condition that should occur (its proportional representativeness) can be determined by evaluating proportional occurrence of an ecosystem characteristic at scales above the planning unit (the section or subbasin scales), and then evaluating whether these characteristics are under or over-represented in the planning unit or at the landtype association scales. The assumption of a representativeness approach is that providing a wide range of habitat conditions will sustain the greatest percentage of the component species which utilize that characteristic. For example, the *Northern Great Plains Plan* (USDA

Forest Service 2001)[3] proposes to provide a range of levels of residual grass cover, based on the knowledge that some species are dependent on heavily grazed sites and others require higher levels of residual cover for nesting.

Understanding of Possible Stressors: This approach is designed to represent and try to understand the full array of potential human-induced and natural stressors that may be present across the landscape. For example; edge effects, habitat fragmentation, isolation effects, hunting pressure, and/or invasive species. The interplay between spatial and temporal heterogeneity in wildlife population structure and spatial and temporal patterns of stressors is a major factor controlling the severity of effects on wildlife populations (e.g., Kareiva 1990; Turner et al. 1995; Hanski 1998).

Redundancy: This approach involves ensuring that there are multiple occurrences of the representative conditions across the landscape. The occurrence of a characteristic in multiple places increases the likelihood of maintaining representativeness by decreasing the risk of eliminating the characteristic through a single disturbance event.

Understanding of Habitat Associations of Particular Species: Using information regarding species habitat requirements allows one to determine the range of ecosystem characteristics or specific habitat features needed in order to sustain those species. This range of specific habitat features becomes the context in which current and projected status of that ecosystem characteristic can be evaluated. This is similar to the representativeness approach in that the entire range of ecosystem characteristic conditions necessary for the selected species would be maintained on the landscape. However, this approach differs from the representativeness approach in that the proportional amount of the characteristic to be maintained would be determined based on the sustainability of the species selected for this approach. For example, the management strategy developed by Reynolds and others (1992) for northern goshawks in the southwest is based on providing habitat needs of the goshawk's primary prey species. As another example, for some species protection of key, but perhaps uncommon, habitat features is necessary. Examples include springs and sphagnum bogs for some rare insects (LaBonte and others 2001); caves and sandhills are examples of habitat features in the northern Great Plains that sustain rare species (Sieg and others 1999). Another example would be to look at the array of fish species currently present in the planning unit, and what aquatic conditions are necessary for their survival. Threshold conditions could then be developed for what is considered sustainable; these threshold conditions could then be used to determine the extent of the aquatic conditions necessary for sustainable populations of the fish assemblage.

Biotic Integrity, Particularly as it Applies to Aquatic Systems: "Biotic or Biological Integrity" is a term that first appeared in the Clean Water Act of 1972. Biological integrity is defined by Frey (1977) and Karr et al. (1986) as the capacity of an ecosystem to support and maintain a biota that is comparable to that found in natural conditions. Development of a biological indicator in this framework requires an objective definition of reference conditions and of the measures that are used to describe the biota.

Biota are affected by environmental conditions at multiple levels of organization including individuals, species, assemblages, communities, and populations (Karr 1991). Since different stressors can have variable effects on biota, response to changes in environmental conditions can

[3] Northern Great Plains Plan Web site: http://www.fs.fed.us/ngp/plan/feis.htm.

be reflected at any of these levels and perhaps simultaneously at multiple levels. Because of this complexity, it is desirable to use a method of characterizing components of the community or assemblage that integrates and composites multiple, quantitative descriptors of that assemblage.

As an example, longitudinal measures of water chemistry and biological integrity can be collected in order to elucidate influences of landscape features (e.g., land cover, soils, hydrology) of the surrounding catchment on in-stream water quality. This helps relates stream water quality and biotic integrity to the landscape and geophysical features of surrounding landscapes.

Resiliency and Thresholds: Resiliency is the capacity to recover and return from a disturbance (whether natural or anthropogenic) to its predisturbance state and sustain ecosystem function (Herrick et al. 1999, Whitford 2002). Some ecosystem characteristics are more resilient than others. For example, most riparian vegetation is capable of rapid regeneration, while flood plain and channel morphology may change over decades depending on frequency and magnitude of disturbance events. Riparian vegetation is generally resilient; channel morphology is not as resilient. Implicit in the discussion of resiliency is the concept of a threshold; for most, if not all systems, there is a threshold of disturbance which, once passed, leads to either a loss of the ability to recover or transition to a new ecosystem state. As an example, the resilience of riparian vegetation is dependent on the presence of water. If a disturbance removes the water (through downcutting of the channel, groundwater pumping, or surface water impoundment) then the resiliency is impaired and riparian vegetation will recover slowly, if at all.

Thresholds are most important to physical characteristics (Alexander 1988, Kral and Hawkins 1982) since these often have low resiliency. However, it should be recognized that resiliency and thresholds must be discussed in tandem and not in isolation since the resiliency of ecological systems has limits.

For the purposes of forest planning, understanding the resiliency and thresholds of an ecosystem characteristic can be important in that it leads to an understanding of vulnerability to disturbance regimes (Davenport et al. 1998). If a characteristic is not very resilient, or has a low threshold to disturbance, then the persistence of that characteristic on the landscape must have been the result of the absence or limited extent and occurrence of disturbances. This can lead to identification of the sorts of disturbances which were uncharacteristic of the landscape in its reference state.

Description of Current Condition of the Selected Characteristics (FSH 1909.12, Chapter 40, Section 43.14)

Current conditions are a critical measure of ecological diversity, and provide a necessary framework for comparisons to both past and predicted future conditions. In order to effectively manage for ecological sustainability, current conditions of ecosystem diversity must be established. This process step is designed to develop information about current conditions of the selected characteristics of ecosystem diversity (FSH 1909.12, ch. 40, sec. 43.14). It assumes that individual characteristics of ecosystem diversity have already been selected and includes the characteristics displayed in tables 1 and 2.

Process for Describing Current Conditions of the Selected Ecosystem Characteristics

The following is a general outline of the process for describing the current conditions for each selected characteristic of ecosystem diversity. This process should be implemented for each characteristic at all applicable scales. Wherever possible, use larger-scale assessments to provide context for smaller-scale information at the plan level.

1. State the characteristic. Determine available data sources. Sources of available data will vary for each ecosystem characteristic. While data are available Region-wide for the characteristics outlined in table 2, some characteristics selected by the responsible official may need to rely on subregional and local information for the development of existing conditions.
2. Describe current location(s) of the characteristic given the available data. Location of each characteristic should be described at all applicable scales. When necessary and to the extent possible, this should include location(s) of each characteristic both within and beyond the administrative boundary for which the plan is being prepared. For example, a characteristic's distribution may overlap several administrative units, which occur within a larger ecological unit. Therefore, a description of location in the context of both scales is appropriate.
3. Describe the abundance of the characteristic. The measure for this description will vary by characteristic but the focus should be on describing how much of a given characteristic is present at each appropriate scale. For example, soil condition can be described in terms of acreage and percentage.
4. Describe the spatial configuration of the characteristic. For each characteristic, describe and (where possible) display how it is laid out. For example, perennial stream reaches can be described in terms of connectivity to each other across the landscape.
5. Describe the relative extent of the characteristic. Each characteristic should be described in the context of associated characteristics. For example, the extent of aspen (Populus tremuloides) stands can be described in relation to their associated mixed-conifer stands and forest types in general.

Geospatial representation of each of the above listed items is recommended in order to facilitate effective communications with the public and ensure effective collaboration and cooperation**.**

Wherever possible, regionwide sources of information should be utilized in describing existing conditions of the selected characteristics. This approach will ensure consistency across administrative boundaries and help foster effective cooperation among forests.

The following describes process considerations for utilizing available data specific to various characteristic types:

Terrestrial Characteristics

Existing conditions for both structural and compositional vegetative characteristics (excluding rare and endemic characteristics or characteristics of limited extent) can be developed using products from the Mid-Scale Existing Vegetation Mapping Project. This project will develop location, size and configuration of the following existing vegetation attributes for each forest or grassland within the region:

1. Dominance Type (for all vegetative dominance types covering approximately 1 percent or greater of the forest).
2. Canopy Cover Class.
3. Stand Structure Class (in average tree size class for woodland types and in average height class for shrubland types).

These products will allow forests to calculate numerically and display spatially the size, location, and relative extent of existing vegetation dominance types. This should be addressed both in narrative form and through geospatial representation (i.e. describe and display the locations of existing vegetation dominance types relative to one another).

Structural elements of ecosystem diversity for dominant vegetation characteristics should be described using products from the mid-scale existing vegetation project, specifically the canopy cover class and stand structure class products. Again, the description of these characteristics of ecosystem diversity should focus not only on amounts (abundance) of each class, but on proportional coverage, patch size, and location relative to other characteristics.

The products developed from the mid-scale existing vegetation project will provide the major source of information regarding current conditions of dominant vegetation characteristics. However, some important vegetative characteristics including ecologically unique features, such as invasive species and riparian characteristics, may not be adequately described using this tool. For this type of analysis, planning teams will have to rely on local or subregional information to develop current conditions.

Existing conditions for selected ecosystem characteristics relating to soils should be developed using forest TES where available, and the region's GTES on Forests where TES has not yet been completed. Where they are available, TES provides comprehensive data for describing a multitude of soil characteristics including soil condition, soil stability, erosion hazard, etc.

Hydrologic and Aquatic Characteristics

Regionally available data for aquatic ecosystems is limited primarily to: (1) fish species by stream or reach; (2) location of streams, lakes, ponds, reservoirs, and springs on the landscape; and (3) interagency delineated Hydrologic Unit Code (HUC) at the subbasin, watershed, and subwatershed scales (4^{th}, 5^{th}, and 6^{th} code HUCs, where available). The location of the water features can be obtained from forest or regional GIS layers. Regionally consistent core data for 1:24,000 scale stream coverage is currently being developed and should be completed within the next few years. Presently many national forests keep their own stream layers, which can be used for assessment of aquatic characteristics.

Fish species data are generally available regionwide and are from a variety of sources, including Forest Service biological assessments, the BISON database of New Mexico Department of Game and Fish (NMDGF), the native fish database of AGFD, from aquatic assessments by TNC, and from professional knowledge of individual state, academic, and Federal biologists.

Water quality data are available regionally from state regulatory agencies at the subbasin scale for selected streams, river segments, lakes and reservoirs (303d). Monitoring of water quality data at the watershed or subwatershed scale may also be available through written state reports and TMDL assessments from the states. Aquatic macroinvertebrate data which also describes water quality exists for many stream and river segments in the region and is available through both state agencies and individual national forests. Stream inventory data, that also meets NRIS protocols, are available for the Carson, Santa Fe, Lincoln, and Coconino National Forests and can be used to help with assessments of water quality and fisheries habitat.

Process Considerations for Characteristics where Regional Data are not Available

Expectations for forest plan revision are to use a foundation of the regionally consistent and available data such as mid-scale existing vegetation, GTES, TES, and streams at the 1:24,000 scale, to help describe ecosystem characteristics and processes. At the responsible official's discretion, use of forest-level data for sustainability analysis may be allowed. This should be limited and focused on specific situations that must be strategically addressed on the Forest and are within budget, time constraints and are not adequately described using regional data sources. Local data and expertise can be used and are acceptable within the constraints of the Southwestern Region's science consistency review. In these situations the following direction is recommended:

- Use the interdisciplinary team to review and discuss the utility and need for the information as part of the forest plan revision. This interdisciplinary team should focus efforts on identifying and obtaining existing local data that addresses the specific ecosystem characteristics for which regionally available data are lacking.
- In the rare cases where existing data cannot be identified, or are insufficient to analyze the characteristic's condition at the scales and scope identified in this document, limited data collection needs may be identified and their value to the planning process carefully addressed. The responsible official makes the final call on whether further data collection is warranted.
- Document and discuss the limitations and purpose of the data. Once the data has been identified, proceed through items 1 thru 6 in *Process for Describing Current Conditions of the Selected Ecosystem Characteristics* from above.

Specific Recommendations for Describing Current Condition for Characteristics Representing Disturbance Regimes

Given the unique nature of disturbance regimes as characteristics of ecosystem diversity, additional guidance follows for describing current conditions. An understanding of current disturbance regimes and how they differ from historic disturbance regimes is critical to developing strategies to sustain ecosystem characteristics. A disturbance regime is the aggregate behavior of disturbances over a particular area and time period (FSH 1909.12, ch. 40, sec. 43.15) and is considered a characteristic of ecosystem diversity. Alterations of disturbance regimes as well as the introduction of new disturbances, including those human-induced, can have profound affects on ecosystem characteristics. Disturbance regimes are defined not only by the type of disturbance, but also by other attributes that influence community structure, composition and function including the frequency, size and shape of patches, severity and seasonality (Pickett and

White 1985, Agee 1993). Synergism, or the interaction of more than one disturbance, can be another important consideration, as their effects might be totally or partially additive (Leach and Givnish 1996, Frelich 2002). For example, the interaction of favorable climatic conditions and dramatic land use changes such as the introduction of sheep contributed to altered forest structures in the southwest (Savage and Swetnam 1990).

Disturbance regimes are best characterized at broader scales (FSH 1909.12, ch. 40, sec. 43.15), yet those that occur at small scales can be equally important to maintaining some ecosystem characteristics (Everett and Lehmkuhl 1999). Disturbances operate with no adherence to political boundaries, but rather their occurrence may actually amplify ecological boundaries such as the extent of ponderosa pine attributed to frequent lightning-caused ignitions. Forest Service Handbook 1909.12, ch. 40, sec. 43.11 states the ecosystem characteristic being evaluated will determine the selection of appropriate spatial scales for analysis. However, the initial scale of reference should be consistent with those outlined in this document under section 43.11, Spatial Scales for Ecosystem Diversity, in which smaller scales are necessary to allow for broad characterization of the planning unit, while larger scales should be used to understand the environmental context within which national forest lands contribute to ecological sustainability.

The process for identifying the current condition of disturbance regimes follows:

1. Identify major disturbance regimes in the area of consideration, including those introduced by humans, those altered from historical regimes, and those that are continuing to function within the range of natural variation.
2. A list of major disturbance regimes to consider may be obtained by reviewing those natural disturbances inherent to the maintenance of the PNVTs. For example, periodic flooding is required to sustain cottonwood-willow riparian forest (Minckley and Brown 1994), and frequent, low intensity surface fires maintain the ponderosa pine/Arizona fescue PNVT. In addition, a number of disturbances new to these systems since European influence, such as introduced ungulates and herbivory should be considered. By paying close attention to the interaction of disturbance regimes, you can follow these pathways of interaction to discover others to consider. For example, dam building may now prevent the necessary periodic flooding, while grazing has removed the light surface fuels required to maintain frequent low intensity fires.
3. Describe historic and current range, frequency, variation, size, seasonality, spatial configuration, magnitude, synergism for each disturbance type.

Type and frequency of disturbance regimes can be found in products developed through the forest plan revision TNC Challenge Cost Share Agreement. For some disturbance regimes in some vegetation types, published papers describing current conditions are available. Ponderosa pine forest types are particularly well-studied in the Region (for example, Cooper 1960, Covington and Moore 1994, Swetnam and Baisan 1996, Fulé and others 1997, Brown and others 2001, Fulé and others 2002, Moore and others 2004).

Some published information is available for most other forest and grassland types as well. For example, Wolf and Mast (1998) and Fulé and others (2003) provide information on current fire frequency in mixed-conifer forests on the north rim of the Grand Canyon; Floyd and others (2004) information on current conditions in piñon-juniper woodlands; and McPherson and Weltzin (2000) is a source of information on current conditions in southern Arizona types. Brown (1994) describes historic conditions and changes that lead to current conditions in the biotic communities of the Southwestern United States and Northwestern Mexico. Table 4 illustrates one way to describe historic and current ranges in variability for disturbances.

The science surrounding climate change in relationship to disturbance regimes is slowly maturing and statements regarding the uncertainty of the effects of climate trends relative to the analysis of disturbance frequencies and magnitudes; current conditions, and the Forest plan should be acknowledged. The effects of climate change on ecological characteristics and disturbance processes will likely be understood over the next several decades. These assumptions must be stated when analyzing disturbance regimes, current conditions, trends and assessing risk to ensure the adaptability of Forest plan desired conditions, objectives and guidelines for potential climate change.

Table 4. Example of One Way to Describe Historic and Current Ranges in Variability for Disturbances.

Disturbance Type[1]:								
Range	Characteristic							
	FREQUENCY[2]	VARIATION[3]	SIZE[4]	SEASONALITY[5]	SPATIAL CON-FIGURATION[6]	MAGNITUDE[7]	SYNERGISM[8]	SCALE[9]
Historic (FSH 1909.12 CH 43.13)								
Current (FSH 1909.12 CH 43.15)								

[1]Disturbance type: Examples include fire, herbivory, flooding, etc.

[2]Frequency: Frequency is the average number of events per time period. Forest records of fire occurrences and livestock stocking levels are other potential sources of information for assessing the current frequency of fires (such as the number of fires per year) and livestock grazing (such as the number of animal unit months (AUMs)/ year. Other sources might include big game harvest records from state game agencies (to infer about population levels of big game), and flow data for some streams from USGS records (number of flooding events per year could be estimated).

[3]Variation: If data are adequate to calculate an average frequency or size, a measure of variation, such as standard error or standard deviation, should also be calculated, as well as the range (most frequent and least frequent) in the mean. Fires occurring every two years will have a different ecological effect than a fire regime where fires occur three years in a row and the area is fire free for several years; yet, both regimes might have a similar average fire frequency.

[4]Size: Forest records can provide information on the area disturbed in a given event. Average fire sizes or average allotment sizes are examples.

[5]Seasonality: Records on dates of grazing and timing of fires can be used to determine the proportion of the disturbances that occur by month or season.

[6]Spatial configuration (landscape pattern): Describe the spatial configuration of the disturbance. For example, fires might burn in mosaic patterns or might burn quite continuously across the landscape. Sometimes information is available on the proportion of the area that is undisturbed or lightly disturbed which can be useful in assessing landscape patterns.

[7]Magnitude (Severity/intensity): Information on severity, a measure of the effect of a disturbance on an organism or ecosystem, is sometimes available in post-fire reports (e.g., BAER); quantified as number of acres burned by severity class). Magnitude of flooding is often captured in reports on maximum flow at the peak of the flooding period.

[8]Synergism: The occurrence of a disturbance can influence subsequent disturbances of the same type or different type in the future. To the extent possible, examine interactions among disturbances. For example, data might be available to indicate the average time burned areas were not grazed by livestock.

[9]Scale: Disturbances operate with no adherence to political boundaries, but rather their occurrences may actually amplify ecological boundaries such as the extent of ponderosa pine attributed to frequent lightning-caused ignitions. FSH 1909.12, ch. 40, sec. 43.11 states the ecosystem characteristic being evaluated will determine the selection of appropriate spatial scales for analysis. However, the initial scale of reference should be compliant with those outlined in this document under Section 43.11 - Spatial Scales for Ecosystem Diversity in which smaller scales are necessary to allow for broad characterization of the planning unit, while larger scales should be used to understand the environmental context within which National Forest lands contribute to ecological sustainability.

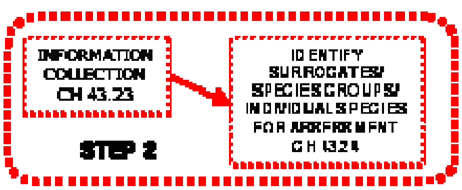
Chapter 2. Ecological Sustainability Process Step 2

Process Introduction

Chapter 2 consists of a stepwise process that emphasizes the collection and summarization of existing information. One of the key points is to identify critical information that is essential to management but is currently lacking, especially for the evaluation of SOI and SOC. Collection of such information, as feasible or appropriate, should be a high priority.

It is also important to identify T&E species, SOC, and SOI in the plan area and to gather existing information about them. However, in many cases it may be impractical to consider each species individually in the planning process. Therefore, the responsible official may identify a manageable subset of species on which to focus species conservation measures and evaluation in the plan, plan amendment, or plan revision. For this purpose, species groups and/or surrogate species may be used as an evaluation and analysis tool to improve planning efficiency and for development of plan components. When groups of species have been identified, one or more species within each group may be selected to serve as surrogates for the ecological condition for other species in the group, or surrogate species may be selected based on other concepts such as umbrella species, keystone species, ecological indicators, and so forth.

Process Step 2 – Species information Collection (FSH 1909.12, Chapter 40, Section 43.23) and Identification of Species Groups and Surrogates (FSH 1909.12, ch. 40, sec. 43.24)



See figure 1 in the Introduction for the schematic diagram of the ecological sustainability process in its entirety.

Figure 4. Ecological Sustainability Process Step 2.

The following outlines the steps for collecting species information, and for identifying species groups and surrogates to be utilized for analysis during plan revision:

- Information Collection (FSH 1909.12, ch. 40, sec. 43.23)
- Identify Surrogates/Species Groups/Individual Species for Assessment

Information Collection (FSH 1909.12, Chapter 40, Section 42.23)

The intent of this step is the collection and summarization of existing information for species identified as a result of the process in chapter 1. This information will be used throughout the analysis of species diversity, including describing the status of species and developing the ecological need for change described in chapter 3. A key point in this process is the identification of essential but lacking information important to management of individual species. Species for which certain information (population or habitat) is lacking need to be addressed during the analysis. This is not to be confused with the species screened out in Chapter 1 because little information is known.

Ecological sustainability is provided through a hierarchical approach that combines considerations for ecosystem and species diversity. To make this hierarchical approach work, it is necessary to collect and synthesize existing information on T&E species, SOC, and SOI. That information may come from a variety of sources including literature, local information on occurrence and population status, subbasin analyses, large-scale assessments, and information gathered from local species experts and other organizations.

The responsible official may consider information related to current taxonomy, distribution; abundance; demographics and population trends including population effects resulting from hunting, fishing, trapping, and natural population fluctuations; diversity, including phenotypic, genetic, and ecological; habitat requirements at appropriate spatial scales; habitat amount, distribution, and trends; ecological function; key biological interactions; limiting factors; and risk factors including various natural and human disturbances, e.g., wildland fire, trails, roads, and dams.

Important to this process is information necessary to show where ecosystem diversity characteristics describe habitat for species under consideration.

Much of this information may have already been collected during development of species lists and the initial screening process described chapter 1. Sources of information that may be useful include the following:

- BISON-M (http://www.bison-m.org/)
- NatureServe (http://www.natureserve.org/)
- U.S. Fish & Wildlife Service, Threatened and Endangered Animal and Plant Species Information (http://www.fws.gov/endangered/wildlife.html)
- Amphibian Research and Monitoring Initiative website (http://armi.usgs.gov/)
- Desert Fishes Council Information Site (http://www.utexas.edu/tmm/sponsored_sites/dfc//index.html)
- State Comprehensive Plans (http://fws-nmcfwru.nmsu.edu/cwcs/default.htm)
- State Plant Lists
- Regional Assessments
- State Heritage Databases (http://www.gf.state.az.us/w_c/edits/species_concern.shtml)
- Field Guides
- NRIS Fauna
- ReGAP
- Regional Habitat Relationship Models

Species Groups and Surrogate Species (FSH 1909.12, Chapter 40, Section 43.24)

It is important to identify T&E species, SOC, and SOI in the plan area and to gather existing information about them. However, in some cases it will be impractical to consider each species individually in the planning process. Therefore, the responsible official may identify a manageable subset of species on which to focus species conservation measures and evaluation in the plan, plan amendment, or plan revision. For this purpose, species groups and/or surrogate species may be used as an evaluation and analysis tool to improve planning efficiency and for development of plan components. When groups of species have been identified, one or more species within each group may be selected to serve as surrogates for the ecological condition for other species in the group, or surrogate species may be selected based on other concepts such as umbrella species, keystone species, ecological indicators, and so forth. If species groups and/or surrogate species are used, clearly describe the process for identifying groups or surrogates including critical assumptions and the uncertainty of conclusions. Explain why assumptions are reasonable and why the degree of uncertainty is acceptable. Identification and use of surrogate species is strictly an analysis and evaluation tool that may be used to improve planning efficiency. There are no population monitoring or inventory requirements for any surrogate species.

Because the utility of groups may change with the scale of evaluation, a hierarchical approach may be used to identify species groups and surrogate species for efficient evaluation. Under a hierarchical approach, a set of groups consisting of species with very similar ecological requirements may be identified for fine-scale evaluation at the plan level. For broad-scale evaluations, these sets may then be combined into a smaller number of groups, each containing more species, but with less similarity in ecological requirements.

As a basic approach, initial grouping may be based on macrohabitat use, including both vegetation type and successional or structural stage of vegetation. Such grouping should consider the full set of vegetation type and structural stage combinations used by each species.

Once macrohabitat groups are identified, ecological conditions of species in each group may be further described using attributes such as:

- Fine-scale habitats used.
- Home range.
- Dispersal capability.
- Additional ecological requirements such as the need for frequent fire, minimizing human disturbance, or susceptibility to invasive and exotic species.
- Geographic range.

Based on the above attributes, one or more species within each macrohabitat group may be selected as surrogates if they can be demonstrated to represent the ecological conditions for all species in the group. If the needs of surrogate species are met, then most needs of other species within the habitat group should also be met. Several species may be necessary to represent the requirements of all species within the macrohabitat group.

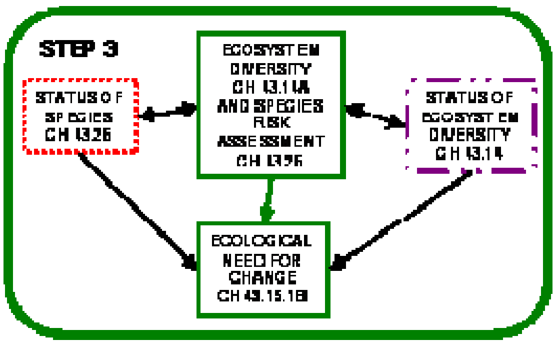
If surrogates are identified, they would be used as analytical tools to evaluate the potential effects of management and development of proposed plan components for those species or the habitat that they represent. A combination of approaches including the use of species groups, surrogate species, and individual species considerations may be appropriate. There are no population monitoring or inventory requirements for surrogate species.

Chapter 3. Ecological Sustainability Process Step 3

Process Introduction

The intent of chapter 3 is to walk the user through processes to describe the status of ecosystem characteristics and species, perform a risk assessment and develop the ecological need for change. This section is a transition from accomplishing tasks that were strictly for CER Phase I and preparing to begin CER Phase II tasks. The Phase I tasks that are addressed here are determining the status for ecosystem and species diversities. Ecosystem diversity and species diversity risk assessments are performed. Finally, ecological needs for change are determined. At the conclusion of this step, the planning process moves into CER Phase II, Plan Option(s) development.

Process Step 3 – Status, Risk Assessment, and Identification of Ecological Need for Change



See figure 1 in the Introduction for the schematic diagram of the ecological sustainability process in its entirety.

Figure 5. Ecological Sustainability Process Step 3.

The following outlines the steps for identifying status, risk assessment, and identification of ecological need for change considered necessary for analysis during plan revision:

- Status of Ecosystem Diversity (FSH 1909.12, ch. 40, sec. 43.14)
- Status of Species (FSH 1909.12, ch. 40, sec. 43.26)
- Ecosystem Diversity (FSH 1909.12, ch. 40, sec. 43.14a) and Species Risk Assessment (FSH 1909.12, ch. 40, sec. 43.26)
- Ecological Need for Change (FSH 1909.12, ch. 40, sec. 43.15.1b)

Status of Ecosystem Diversity (FSH 1909.12, Chapter 40, Section 43.14)

Principle to the analysis of ecological sustainability, this section describes the stepwise process for evaluating, interpreting, and documenting the status of ecosystem diversity. Previous sections (chapter 1) outline processes to establish characteristics of ecosystem diversity for analysis including disturbance regimes, current conditions, and HRV or alternative HRV evaluation approach. This process is intended to draw on all these elements in the analysis of the status of ecosystem diversity (FSH 1909.12, ch. 40, sec. 43.16). The primary questions answered through this process are:

1. What ecosystem characteristics have declined in the past or are currently declining?
2. What ecosystem characteristics are rare or at risk or are otherwise inherently vulnerable to change?
3. What characteristics may require adjustment in management?
4. What ecosystem characteristics are functioning and will likely continue to function in a way that contributes to ecosystem resiliency and diversity over time?

This document outlines two separate processes for answering these questions and ultimately describing the status of ecosystem diversity. One process should be used for characteristics that have a definable HRV while the other is intended for characteristics lacking definable HRV. Regardless of the process followed, the analysis should be conducted at all appropriate scales. Section 43.11 includes a discussion regarding the various appropriate scales for analysis in forest plan revision.

Process for Characteristics with Definable HRV

The following is a general outline of the process for describing the status of ecosystem diversity for characteristics with a definable HRV. This process assumes that ecosystem characteristics have been selected for analysis, and have both current conditions and HRV defined. It is essential that this process be implemented at all appropriate scales.

The process for determining the status of Ecosystem Diversity for characteristics with a definable HRV is as follows:

1. State the characteristic.
2. Compare the current condition of the characteristic (described in FSH 1909.12, ch. 40, sec. 43.14) with the HRV for the characteristic (described in FSH 1909.12, ch. 40, sec. 43.13). This should include both a quantitative comparison of current to HRV as well as a qualitative discussion of their relationship to one another. If the characteristic currently exists outside of the HRV, then the discrepancy should be explicitly addressed with a discussion of probable reasons for the change.
3. Describe the projected future status of the ecosystem characteristic assuming management consistent with current land and resource management planning (LRMP) direction. Determine extent of ecosystem characteristic within the planning area relative

to ecological sections or subsections (table 3). This step involves projecting the condition of the characteristic into the future if the management direction outlined in the unit's current LRMP were continued. For vegetative characteristics it is recommended that the VDDT (Vegetation Dynamics Development Tool)[4] state and transitional model be used in this process.

4. Compare the projected future status of the characteristic to the HRV. This step is designed to display the direction in which characteristics of ecosystem diversity are headed and is essential in determining the status of ecosystem diversity. Focus should be on describing whether current management is sufficient to maintain and/or move characteristics towards HRV.
5. Describe the proportional occurrence of the ecosystem characteristic within the planning unit and at each of the applicable scales:
    a. Compare the occurrence of the characteristic at the planning unit to the occurrence at the Section scale. If there are multiple sections on the forest, compare to the aggregate of the sections as well to each individual section.
    b. Determine what characteristics are over or under represented on the planning unit.
    c. Compare the occurrence of each characteristic on the planning unit to occurrence at the Subsection and where appropriate the LANDTYPE Association scale to identify patterns in the occurrence of the characteristic. Comparison of occurrence within landtype association and subsections can be helpful in determining where potential for restoration exists if the characteristic deviates from HRV.
    d. Identify any characteristics which are limited to few subsections or landtype associations (i.e. characteristics which have limited spatial distribution); even if these characteristics are proportionally represented within the planning unit.
6. Identify whether the comparisons between HRV, current conditions (including the distribution at different scales), and projected future status indicate one or more of the following are true for the characteristic being analyzed:
    a. The characteristic has declined in the past or is currently declining.
    b. The characteristic is rare or at risk, either within the planning unit or at the scale above the planning unit.
    c. The characteristic may require change in management..
    d. The characteristic is functioning in a way that contributes to ecosystem resiliency and diversity over time.

Table 5 illustrates one possible way to display this information for comparisons.

[4] Projecting changes in vegetation structure and composition over time is an important part of landscape-level analyses. Vegetation can change for a variety of reasons such as human activity, fires, insects, pathogens, mammals, weather, or growth and competition. The interaction of these factors can be quite complex and it can be difficult to project the combined effects over long periods of time. The vegetation dynamics development tool (VDDT) is a user-friendly, Windows-based computer tool that provides a modeling framework for examining the role of various transition agents and management actions in vegetation change.

Table 5. Status of Ecosystem Diversity for Characteristics With a Definable Historic Range of Variability (HRV)

Charac-teristic	Historic or Natural Range of Variation	Current Condition	Are the current conditions within or outside HRV?	Projected Future Status	Is current management moving the charac-teristic towards or away from HRV?

Process for Characteristics lacking Definable HRV

This process assumes that ecosystem characteristics have been selected for analysis, have current conditions defined, and have been addressed using the representativeness, redundancy, resilience and thresholds process described in FSH 1909.12, ch. 40, sec. 43.13a (and chapter 1 of this write-up). Again, it is essential that this process be implemented at all appropriate scales.

The process for determining the status of ecosystem diversity for characteristics without a definable HRV is as follows:

1. State the characteristic.
2. Describe the current conditions of the characteristic in relation to its representativeness, redundancy, resiliency and relationship with threshold. Specifically, this step is intended to identify whether the characteristic has sufficient representativeness, redundancy, or resiliency in order to be sustainable. It is also intended that this will include a discussion of possible ecological thresholds related to the characteristic.
3. Describe the projected future status of the ecosystem characteristic assuming management consistent with current LRMP. This step involves projecting the condition of the characteristic into the future if the management outlined in the unit's current LRMP were continued. For vegetative characteristics it is recommended that the VDDT be used in this process.
4. Describe the projected future status of the characteristic in relation to its representativeness, redundancy, and resiliency. This step is critical in determining whether current management will increase or decrease the characteristic's representativeness, redundancy, or resiliency. Also important in this discussion is whether current management is likely to move characteristics beyond ecological thresholds.
5. Describe the proportional occurrence (both currently and projected future status) of the ecosystem characteristic within the planning unit and at each of the appropriate scales.
    a. Compare the occurrence of the characteristic at the planning unit to the occurrence at the Section scale. If there are multiple sections on the forest, compare to the aggregate of the sections as well to each individual section. Determine what characteristics are over or under represented on the planning unit.

b. Compare the occurrence of each characteristic on the planning unit to occurrence at the subsection and where appropriate the landtype association scale to identify patterns in the occurrence of the characteristic. Comparison of occurrence within landtype associations and Subsections can be helpful in determining where potential for restoration exists in the absence of HRV (see section below).
c. Identify any characteristics which are limited to few subsections or landtype associations (i.e. characteristics which have limited spatial distribution); even if these characteristics are proportionally represented within the planning unit.

6. Given the analysis in steps 1-5 above, document whether any of the following statements are true for the characteristic being analyzed:
   a. The characteristic has declined in the past or is currently declining.
   b. The characteristic is rare or at risk, either within the planning unit or at the scale above the planning unit..
   c. The characteristic may require change in management.
   d. The characteristic is functioning in a way that contributes to ecosystem resiliency and diversity over time.

Table 6 illustrates one possible way to display this information for comparisons.

Table 6. Status of Ecosystem Diversity for Characteristics Which Lack a Definable Historic Range of Variability (HRV)

Charac-teristic	Current Condition Repre-sentative-ness	Current Condition Redun-dancy	Current Condition Resiliency	Projected Future Status (PFS) Repre-sentative-ness	PFS Redun-dancy	PFS Resiliency

Status of Ecosystem Diversity Summary

In order to effectively document the status of ecosystem diversity in the evaluation report, it is important to bring together the analysis of each individual characteristic and relate them to one another. Specifically, those characteristics which are not sustainable except through management or change in management need to be highlighted, as do those characteristics which currently contribute to ecosystem resiliency and diversity over time. The need to change current management may be recognized when the current conditions or projected future status of characteristics indicate that they are not moving towards the desired conditions under current management. These characteristics should be discussed in detail, and carried through the risks assessment described in the following section.

Status of Species (FSH 1909.12, Chapter 40, Section 43.26 in part)

Species information collected in chapter 2 and the status of ecosystem diversity, developed in the preceding step, are used here to evaluate the effects of current management on status of species (FSH 1909.12, ch.40, sec. 43.26). This analysis should address current species status and the ecological conditions that support the species. The emphasis should be on those conditions that can be influenced through management of National Forest System (NFS) lands.

This process will address only those species identified for further consideration in Process Step 1a or surrogate species/species groups identified in chapter 2. FSH 1909.12, ch. 40, sec. 43.26 offers guidance for this evaluation:

1. Evaluate habitat conditions and the connection between habitat (terrestrial and aquatic) and species populations.
2. Assess consequences over a range of time frames from short-term to long-term. Short and medium-term assessments are needed to determine whether any bottlenecks would be created while moving toward desired conditions. For example, in some cases the short-term loss of habitat might exceed habitat gain even though the long-term desired condition calls for substantial increases in habitat. The timeframe for long-term consequences should be based on the biology of the species (generation time, response time to changed conditions, recolonization capability) and on the time needed for the ecosystem to respond to management. For example, it can take many decades to determine long-term negative consequences to long-lived species because the continued presence of older individuals masks changes in birth rates, emigration rates, and death rates of younger individuals.
3. Evaluate distribution based on the species' natural history and historical distribution and on potential distribution of its habitat.
4. Conduct the evaluation at the scale of biological populations. If the appropriate scale for the evaluation extends outside the plan area, consider effects of other land ownerships and actions outside of NFS lands.
5. Evaluate current condition (where possible), projected future condition, and historical condition.
6. Recognize that evaluations of a surrogate apply to the species represented by the surrogate.

Forest Service Handbook 1909.12, ch. 40, sec. 43.26, further suggests that, to the degree that information is available, evaluations should focus on the following factors including trends in the factors over time:

- Amount, quality and distribution of habitat.
- Habitat dynamics.
- Species distribution (at all analysis scales).
- Species known locations (at all analysis scales).
- Population trends (at all analysis scales) and dynamics.
- Biological interactions (e.g., diseases, predator/prey relationships).

- Other threats and limiting factors (at all analysis scales).

The following questions serve as drivers in evaluating the effect of current management on the status of species:

1. How have the amount, quality and distribution of habitat changed from historic range to current conditions? How are they expected to change in the future under current management?
2. What processes (fire, succession, drought, flooding, etc.) are necessary to produce and maintain species habitat? How have those processes changed from historic range, and how are they likely to change in the future?
3. What is the species distribution within the area of analysis? How has it changed from historic range, and how is it expected to change in the future?
4. If the species is known from only a relatively few, discrete locations, what is the status of those locations and how are they expected to change?
5. How has the species population changed from historic range, and how is it expected to change in the future?
6. What is the status and expected trend of biological interactions that are either necessary to maintain the species or that threaten the species? For example, projected status of prey species may be a significant consideration for goshawk, or status and location of cowbirds may be important to southwest willow flycatchers.
7. What is the status and expected trend of other threats and limiting factors (e.g., road-related disturbances, livestock grazing, recreational use, etc.)?

The following process steps may be used to respond to these questions. The resulting information and status determination may be documented in table 6 for each species.

1. State the species or surrogate group.
2. Define the habitat requirements at appropriate scales for the species or surrogate group and link those requirements to the selected characteristics of ecosystem diversity. (Table 11 provides a plant community crosswalk for PNVTs and SWIS habitat types.).
3. Using the characteristics identified in step 2, determine historic range and current condition and future trend of habitat amount, quality, and distribution.
4. Describe the HRV and current condition and future trend of ecological processes that are important to create and sustain habitat for the species or the surrogate group.
5. Describe the historic range and current range of the species or the surrogate group and expected future trend of the range.
6. Where possible, describe current condition, historical range and trend for the following:
    a. Species or the surrogate group distribution in the plan area including proportional occurrence.
    b. Size of populations.
    c. Known locations if the species or the surrogate group is restricted to relatively few, well-defined locations.
    d. Species diversity (phenotypic, genetic and ecological).

7. Describe key biological interactions that support and/or threaten the species or the surrogate group and the trend of those interactions.
8. Describe the status of other threats that are within the jurisdiction of the Forest Service.

The effect of each of these factors on species or the surrogate group status should be described in simple terms such as the level of resulting vulnerability and the trend in that vulnerability. For example, population distribution that has gone from highly interactive to moderately isolated, but that is projected to be stable into the future, might be summarized as creating moderate vulnerability that won't change significantly in the future.

The overall status resulting from all above factors should be summarized with explanations of which factors weighed most heavily in determining status. For example, the status of Abert squirrel on a particular forest might be described as low vulnerability that is increasing due to disruption of fire regimes that were key to creation and maintenance of the squirrel's habitat. These conclusions should be stated in a way that is helpful in identifying need for ecological change.

Table 7. Determining, Analyzing, and Documenting the Status of Species or the Surrogate Group within the Plan Area

Species Name:					
Factor	**Possible descriptors**	**Historic range**	**Current**	**trend**	**Status**[1]
Habitat					
Amount	High				
	Moderate				
	Low				
Quality	High				
	Moderate				
	Low				
Distribution	Even				
	Restricted				
	Highly fragmented				
Processes that create/sustain	Functioning				
	Disrupted				
Population					
Range	Provide geographic description				
Distribution within range	High degree of interaction				
	Moderate isolation				
	High isolation				
Size of population(s)	Large				
	Moderate				
	Small				
Known locations	Provide geographic description and estimate of protection/loss				
Phenotypic, ecological and genetic diversity	High				
	Medium				
	Low				
Other Factors					
Biological interactions	Describe degree species is supported or threatened by key interactions				
Other threats	Describe status of threats				
STATUS SUMMARY[2]:					

[1]This column summarizes current and projected future status for each factor. It is suggested that this be stated in terms of the species vulnerability, e.g., low but increasing.
[2]This summaries current and projected status across all factors

Ecosystem Diversity and Species Risk Assessment (FSH 1909.12, Chapter 40, Section 43.14A in part)

Ecosystem Diversity Risk Assessment

The purpose of this step is to determine risk to the selected characteristics of ecosystem diversity. The analysis accomplished in developing the status of ecosystem diversity provided the following measures of departure:

1. Characteristic's departure from HRV.
2. Characteristic's projected future departure from HRV.

In determining the risks to selected characteristics of ecosystem diversity, an analysis of the reversible or irreversible nature of the departures is developed to highlight potential negative outcomes. This risk assessment also includes analysis of potential threats to selected characteristics of ecosystem diversity. Examples of threats are shown in appendix B.

FSH 1909.12, ch. 40, sec. 43.14a discusses risk as having two components; the likelihood of a negative outcome, and the potential severity of a negative outcome. Throughout this process it is important to distinguish between potential likelihood and likely severity. A threat which has low likelihood but high severity may require equal attention to one that has a high likelihood and lower potential severity. The evaluation of risk should also take into account the following components of severity: geographic extent, duration, intensity, consequences of a threat and reversibility of the outcome to a given ecosystem characteristic. Exhibit 2 provides an example of the above risk components.

Exhibit 2. FSH 1909.12, ch. 40, sec. 43.14a – Risk Assessment.

	Risk Link to Severity		**Example**
	Likelihood (probability)	**Quantifiable**	**Flooding (100 year)**
Characteristic	**Severity**	Duration	Time dependent (range of values)
		Timing	When (seasonal)
		Extent	Geographic
		Consequences (values)	Quantifiable (economic)
			Non quantifiable (aesthetics)
		Reversible?	Erosion (not); infrastructure

Uncertainty, both of predictions and of the likelihood of outcomes (such as infrequent disturbances occurring in this planning period), should be disclosed.

There are many approaches to assessing risks to components of ecosystems, appendix C provides one example of such a process which is modified from Salafsky et al. (2003); further information on this approach, with examples, can be found in Margolius and Salafsky (2001). The NMDGF adopted this modified approach for use in their Comprehensive Wildlife Strategy (NMDGF 2005).

Species Risk Assessment

The risk assessment for species takes the information from the determination of species status and translates it into an explicit risk statement that expresses both the likelihood of an outcome and the likely consequences of that outcome. Table 8 could be used to structure the risk assessment. The specific timeframe considered in this assessment should be the future trend described in table 7.

Table 8. Documentation of Species Risk Assessment

Species Name:	
Likelihood	**Consequence**
	Widespread declines in population in the plan area, and new isolation of populations within the area.
	Widespread population decline but without isolation of populations.
	Localized population declines that may be accompanied by some minor restrictions in population interactions.
	Populations and their distribution are stable or improving.

Likelihood could simply be a subjective rating of low, moderate and high. It would be most appropriate to rate each consequence for each species. For example, there might be high likelihood of widespread population decline without isolation, moderate likelihood of widespread population decline with isolation, and low likelihood of the other two consequences.

Ecological Need for Change (FSH 1909.12, Chapter 40, Section 43.15, Subsection 1.a)

The intent of this section is to describe a process for determining the ecological need for change utilizing information and analysis developed in the preceding sections. The ecological need for change should be developed in order to provide the ecological rationale for developing plan components and allow for early integration of species diversity needs with those of ecosystem diversity. It is recognized that during the development of plan components, trade-offs may need to be made in order to facilitate the needs of economic and social sustainability. Developing the initial ecological need for change in isolation from the economic and social needs allows for consideration of the potential ecological consequences of those trade-offs made during the development of plan components. This section provides transition from CER Phase I into CER Phase II and facilitates the incorporation of ecological needs into the development of plan components described in chapter 4.

The following process is intended to assist the user in developing the ecological need for change:

1. Summarize information developed in status of ecosystem diversity and the status of species diversity as well as the ecosystem diversity and species diversity risk assessment.
2. Utilize the above information to identify if any of the following statements are true for each characteristic or species:

   a. Characteristic of ecosystem diversity or species status (and associated habitat relationships) demonstrates an unacceptable trend in relation to HRV or alternative to HRV
   b. Characteristic of ecosystem diversity or species status (and associated habitat relationships) is currently outside the HRV.
   c. Characteristic of ecosystem diversity or species status (and associated habitat relationships) displays an unacceptable risk or uncertain threat of moving outside HRV.
   d. Characteristic of ecosystem diversity or species status is considered at significant risk based on some analysis other than HRV.
   e. Characteristic of ecosystem diversity or species status (and associated habitat relationships) displays significant opportunity for restoration.
3. Document which of the above are true for a given characteristic and species as an ecological need for change.
4. Rank the ecological needs for change in terms of priority. This ranking should be based on the following driving questions:
   a. Is the characteristic outside the desired conditions under the current plan, or is there a risk of it deviating from the current plan desired conditions?
   b. What is the level of risk to the species or characteristic?
   c. What level or degree of management is needed to provide a positive outcome, and how much positive change is attainable?
   d. Are there potential competing resources, and what can be done to overcome contradicting needs towards achieving the greatest positive outcome?

Having developed the ecological need for change, incorporating the status of and risks to both ecosystem diversity and species diversity the ecological sustainability considerations for CER Phase I have been met in conjunction with science consistency review. It is now appropriate to transition into the development of a plan option(s) in CER Phase II. Ecological considerations for the development of a plan option(s) and specific plan components will be addressed in chapter 4.

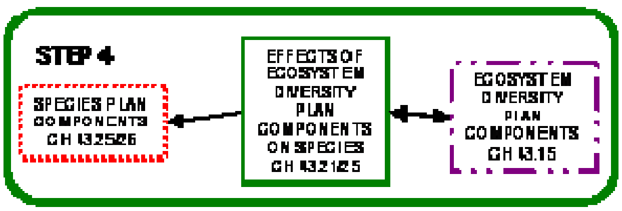
Chapter 4. Ecological Sustainability Process Step 4

Process Introduction

The intent of chapter 4 is to utilize the information and analysis developed in previous chapters to develop plan components within a rolling plan option(s) context. This process begins with developing plan components tailored to the needs of ecosystem diversity (in conjunction with those of social and economic needs). These plan components are then assessed for their contribution to species diversity. In the event that plan components developed for ecosystem diversity do not fully address the needs for specific species, then additional species specific plan components will need to be developed.

Plan components for ecological sustainability can not be developed alone; components should be integrated with those for social and economic sustainability (36 CFR 219.7).

Process Step 4 – Analyze and Develop Ecosystem Diversity Plan Components (FSH 1909.12, Chapter 40, Section 43.15)



See figure 1 in the Introduction for the schematic diagram of the ecological sustainability process in its entirety.

Figure 6. Ecological Sustainability Process Step 4.

The following outlines the steps for analyzing and developing ecosystem diversity plan components considered necessary during plan revision:

- Ecosystem Diversity Plan Components (FSH 1909.12, ch. 40, sec. 43.15)
- Effects of Ecosystem Diversity Plan Components On Species (FSH 1909.12, ch. 40, sec. 43.21/25)
- Species Plan Components (FSH 1909.12, ch. 40, sec. 43.25 and ch. 40, sec. 43.26)

Ecosystem Diversity Plan Components (FSH 1909.12, Chapter 40, Section 43.15)

Throughout the development of plan components, it is important to incorporate the ecological needs identified in the preceding chapter to ensure that the components provide for the selected characteristics of ecosystem diversity and contribute to ecological sustainability. Plan components are developed utilizing an approach which incorporates ecological sustainability with social and economic sustainability. While certain plan components will likely be developed to more specifically address the needs of ecological sustainability, it is critical to describe the ecological rationale for all components developed (FSH 1909.12, ch. 40, sec. 43.15). Social and economic concerns may provide the motivation and resources through the incorporation of multiple use concepts to best provide for a framework that maintains ecological sustainability.

It is important to incorporate components of the existing plan which were identified during the processes outlined in chapter 3 that contribute to maintaining ecological sustainability.

Development of plan components including desired conditions and objectives should include provisions for the following elements of ecosystem diversity:

- Major vegetation types and their successional stages.
- Dominant disturbance processes for the plan area.
- Ecosystems and specialized habitats which are rare or otherwise at risk.
- Invasive Species.
- Soil resources and soil productivity.
- Air resources.
- Water quality and quantity, stream and other natural water flows, stream and lake morphology, wetlands, riparian areas, and floodplains.

There are five plan components: desired conditions, objectives, guidelines, suitability of areas, and special areas. To some extent, these components are hierarchical in organization. Objectives are the measurable steps in reaching desired conditions. guidelines, suitability of areas, and special areas are essentially “tools” used to achieve objectives and desired conditions.

There are extensive discussions of these components in both the manual and handbook (see individual references below); the reader is referred to the appropriate sections for the individual components. The following discussions are considerations for evaluating plan components during CER Phase I of the current plan, and in establishing plan components for ecosystem diversity for the proposed plan (CER Phase II).

Desired Conditions (FSM 1909.12, ch. 10, sec. 11.11)

The desired conditions for the planning unit should contribute to ecological sustainability as well as social and economic sustainability. Thus, the desired conditions should be developed collaboratively with consideration for ecological, social, and economic factors.

Desired conditions need to be developed in a manner which contributes to detailed, measurable, and attainable outcomes towards improving or maintaining ecological sustainability. The detail of desired conditions needs to be such that effects on species diversity can clearly be articulated and measured. Appendix D contains an example of detailed and measurable desired conditions and objectives aimed at meeting the needs of Mexican spotted owls and Northern goshawks.

Desired conditions should be developed around ecosystem characteristics, with a particular focus on those characteristics identified as being at risk, outside of the HRV, or otherwise rare in the plan area. Additional focus should also be given to characteristics that are important socially and economically; and characteristics identified in chapter 1 for which opportunities exist for maintenance or restoration to some desired level. The following considerations should be kept in mind when developing the desired condition of each characteristic:

1. The potential for maintenance, restoration or enhancement of the characteristic, and the time frames under which these changes would be observed.
2. Identification of ecosystem characteristics which do not have the potential for maintenance, restoration or enhancement, but should be protected to provide for ecological sustainability.
3. If the ecosystem characteristic is at risk, the level of risk reduction required for sustainability. This is similar to considering a “threshold” amount, distribution, or occurrence of a given ecosystem characteristic.
4. For those ecosystem characteristics which are important socially or economically, the level of economic or social use of an ecosystem characteristic that can be tolerated and sustained.

The rationale and assumptions in determining the desired conditions of ecosystem characteristics should be fully documented and explained. By considering the above four items, a clear link between the desired conditions and objectives can be established.

Objectives (FSM 1921.13; FSH 1909.12, Chapter 10, Section 11.12)

Objectives are projections of agency activities and program outcomes that will achieve the desired conditions. Objectives should be specific to the ecosystem characteristics being considered and should be clearly framed in terms of the outcomes (for maintenance or restoration of a characteristic); or, for characteristics at risk, the threats which affect the ecosystem characteristics under consideration. The objectives should be clearly based on the ability to maintain or restore the ecosystem characteristic to desired conditions.

A key consideration in framing objectives, and one that will assist in developing further plan components, is determining whether the ecosystem characteristic under consideration needs to be maintained, restored, or enhanced. This determination will depend upon:

1. The distribution and abundance of the ecosystem characteristic within the planning area.
2. The social and economic constraints/desires placed upon the ecosystem characteristic, if applicable.
3. The opportunities and potential for maintenance, restoration or enhancement of the ecosystem characteristic.
4. The level of risk (as determined in FSH 1909.12, ch. 40, sec. 43.16a), if applicable; and the specific threats to the characteristic and the ability to control these threats.

Identification of these factors, in conjunction with the four considerations in establishing desired conditions, will assist in determining what mix of tools (guidelines, suitability determinations, and special area designations or recommendations) is appropriate for the characteristic under consideration.

Guidelines (FSM 1921.14; FSH 1909.12, Chapter 10, Section 11.13)

Procedures for developing guidelines are given in the manual and handbook citations above. For those characteristics having an objective of maintenance of current conditions, consideration should be given to providing guidance on the uses of these lands and the acceptable levels of use to maintain the current condition. For ecosystem characteristics at risk, the key to establishing effective guidelines is fully understanding the specific threats to the characteristic and providing appropriate sideboards for the reduction to those threats to sustainability. For characteristics having an objective of restoration, the potential for restoration of the characteristic should be a primary consideration in developing guidelines.

Review of existing guidance under the current forest plan should be the starting point for developing guidelines for the proposed plan. Guidance that is contributing to meeting the Proposed plan objectives should be carried forward. If existing guidance does not meet objectives, then additional guidance should be proposed and evaluated.

Initial consideration should be given to every ecosystem characteristic under evaluation; however, ecosystem characteristics that undergo similar uses will most likely require similar guidelines. Identification of these similarities can help simplify the guideline development process.

Suitability of Areas (FSM 1921.15; FSH 1909.12, Chapter 10, Section 11.14) and Special Areas (FSM 1921.16; FSH 1909.12, Chapter 10, Section 11.15)

Consideration of suitability and special area designations to achieve ecological sustainability would most likely be considered when:

1. There are limited opportunities to maintain, restore or enhance the ecosystem characteristic and thus protection from specific threats is required.
2. The ecosystem characteristic under consideration can tolerate some level of use, but ecological sustainability of the characteristic requires or is best assured through designation of special sreas.
3. Rare or unique features of the landscape (e.g., caves), especially when these areas function as habitat for endemic species.

There are certainly other circumstances when suitability of uses or special areas could be utilized, especially when there are social or economic considerations.

Consideration should be given to existing suitability of areas or special areas under the current forest plan. If the existing uses and/or special areas are not sufficient to achieve ecosystem objectives, additional special areas or modifications to suitability designations can be proposed.

Analyze Effects of Ecosystem Diversity Components on Species Diversity (FSH 1909.12, Chapter 40, Section 43.25)

FSH 1909.12, Chap, 40, sec. 43.25 contains two separate requirements. The first is to assess the potential effects of proposed components for ecosystem diversity on species diversity (this section). The second is to develop additional components for species diversity as needed (next section).

The process discussed in this section is designed to determine the degree to which plan components for ecosystem diversity meet objectives for T&E species, SOC and SOI. This is simply an iteration of the analyses described in *Process for Determining the Status of Species* and the species portion of *Ecosystem Diversity and Species Diversity Risk Assessment*. In those sections, the focus was on the consequences of existing plan direction. Here the analysis is modified to take into account any newly proposed plan components for ecosystem diversity.

Focus in this assessment should be on changes between current management direction and that management direction proposed in plan components. Results of the assessment should be documented in tables 6 and 7.

Prior analysis steps have determined what the ecological need for change and ecological conditions are and have directly influenced development of ecosystem diversity plan components. If necessary, there may be a need to revisit ecosystem diversity plan components to further provide for species or surrogate species. Again, as is mentioned in the FSM and FSH there may be a need for iterations and re-thinking of ecosystem diversity plan components to further address species needs.

Plan Components for Species Diversity (FSH 1909.12, Chapter 40, Section 43.25)

Should plan components developed for ecosystem diversity fail to provide for the needs of the specific T&E species, SOC, and SOI as identified in the preceding section, additional plan components will need to be developed to address those specific species needs. Development of plan components for ecosystem diversity and species diversity should take place in an iterative manner, and to the extent possible, species habitat needs should be addressed through the development of ecosystem diversity plan components. In certain situations, this will simply not be feasible, and/or there are risks of other potential negative outcomes, which will need to be addressed through the development of additional plan components. In these situations, the following key elements should drive the development of the species specific plan components: (from FSH 1909.12, ch. 40, sec. 43.25):

- Managing for appropriate amounts and distribution of habitats used by species, including habitat restoration if necessary.
- Managing natural and human disturbance factors so that their impacts on the species are acceptable.
- Managing biotic interactions.
- Managing for disturbances that are important to species survival.
- Managing currently known species locations. This may involve all known locations or a subset of those locations.
- Managing newly discovered locations. This could involve all or a subset of locations.
- Maintaining suitable habitat that is not currently occupied, but has a likelihood of being occupied in the near future.

The primary focus of developing plan components for species diversity is on providing for appropriate amounts and distributions of suitable habitat over time. A number of existing documents may be of value in developing plan components for species diversity, including but not limited to recovery plans, existing conservation strategies, and agreements. It may be appropriate to involve consulting agencies in the development of plan components for species diversity.

Chapter 5. Ecological Sustainability Process Step 5

Process Introduction

The intent of chapter 5 is to evaluate the combination of ecosystem diversity components and species diversity components. These evaluations will determine (within the limits of agency authorities, the capability of the plan area and overall multiple-use objectives) the degree to which ecological conditions will be provided for T&E species, SOC, and SOI.

Process Step 5 - Determination of Combined Plan Components on Ecosystem and Species Diversity (FSH 1909.12, ch. 40, sec. 43.26 in part)

See figure 1 in the Introduction for the schematic diagram of the ecological sustainability process in its entirety.

Figure 7. Ecological Sustainability Process Step 5.

The following outlines the steps for the determination of combined plan components contribution to ecosystem and species diversity considered necessary during plan revision:

- Determination of combined plan components for ecosystem diversity and species diversity (FSH 1909.12, ch. 40, sec. 43.26 in part)

Determination of Combined Plan Components for Ecosystem Diversity and Species Diversity (FSH 1909.12, Chapter 40, Section 43.26 in part)

The purpose of this evaluation is to determine whether the combined plan components provide the appropriate framework for contributing to ecological sustainability. This must include an assessment of whether the combined plan components provide for ecological conditions appropriate for T&E species, SOC, and SOI within the limits of agency authorities, the capability of the plan area and overall multiple use objectives.

Analyses conducted throughout this particular process, including the summarization of the iterations of combined plan option(s) need to be displayed and documented in the determination report.

Exhibit 3 includes an example of the responsible official’s determinations to this effect. This information can be used to prepare the plan approval document section about contributions to sustainability (FSM 1921.7)

Exhibit 3. Responsible Official Determinations for Ecological Sustainability Objectives have been met in a Forest Plan

____ National Forest/Grassland

The National Forest is composed of the following ecosystems:

-
-
-

Within those systems, the following ecosystem characteristics were selected for detailed evaluation because they are important to the characterization of the systems and were considered key to decisions that were to be made in this plan revision:

-
-
-

Our evaluation of those characteristics resulted in the following summary findings (following are the topics that should be addressed for each of the characteristics):

- Range of variation under historic disturbance regimes (or other context for characteristics for which range of variation cannot be adequately determined)
- Current condition and trend
- Risk
- Effects of ongoing management including projected future status

Species that are identified as T&E, proposed, SOC, SOI, and of-risk are:

- A table might be useful here listing all species, displaying their status in the plan (e.g., SOC), and indicating the criteria that led to their identification
- A second table could show species that were not carried forward for detailed evaluation because they were considered already secure in the plan area or because too little was known about them

Current status and key risk factors for species evaluated in the plan process are:

- Current habitat and population (to the degree known) condition and trend
- Key risk factors
- Effects of ongoing management including projected future status

Desired conditions for ecosystem and species diversity‡ and the rationale underlying those conditions follow:

- Summarized statements of desired conditions
- Ecological rationale for desired conditions (including rationale where applicable for not identifying HRV as the desired condition)
- How progress toward desired conditions would contribute to resolving risks identified for ecosystem characteristics and for species and contribute to appropriate conditions for species

  ‡ It is not expected that there would be desired condition statements for each species. Desired conditions for species diversity would focus on: 1) species for which provisions beyond those for ecosystem diversity are necessary, and 2) species for which desired conditions would have a strong influence on the plan.

Progress toward desired conditions in the current plan period:

- How the plan strategy (objectives) addresses desired conditions
- How design criteria (guidelines) will contribute to providing desired conditions

Projected future status of ecosystem characteristics and species under proposed plan revision

Exhibit 3 (cont). Responsible Official Determinations for Ecological Sustainability Objectives have been met in a Forest Plan

Summary of reasons for believing that plan meets requirements for ecological sustainability:

- •Ecosystem characteristics and species identified for evaluation
- •Overall summary of evaluations including key risks
- •Desired conditions and their ecological rationale
- •How desired conditions will address risks and provide appropriate conditions for species
- •How plan strategy and design criteria will contribute to achievement of desired conditions

The following table shows an example that could be used to display determinations for SOC. Similar tables could be used for SOI and T&E and proposed species.

Table to Account for TES, Proposed, SOC and SOI in Land and Resource Management Planning.

Species Name	Criteria for Identifying TES, Proposed, SOC & SOI[1]	Occurrence and Status Screens				Ecosystem Diversity Provisions[6]	Species Diversity Provisions	
		No Sites or Habitat[2]	Locally Secure[3]	No Potential Management Effects[4]	Inadequate Knowledge[5]		Group or Surrogate[7]	Individual Species[8]

[1]Possible criterion is: ESA candidate; Natureserve ranking G-1 through 3 or T-1 through 3; ESA positive 90-day finding; or ESA recently delisted.

[2]There are no known species occurrences or habitat on the National Forest or Grassland (provide a citation to administrative record for further information).

[3]Species is considered secure on the Forest or Grassland based on habitat amount, distribution and trend and/or population number, distribution and trend (provide a citation to administrative record for further information).

[4]There is no potential for management activities to affect the species or its habitat (provide a citation to administrative record for further information).

[5]There is inadequate knowledge to complete a credible assessment of the species (provide a citation to administrative record for further information).

[6]Plan components for ecosystem diversity provide conditions that will support self-sustaining populations of the species (provide a citation to administrative record for further information).

[7]The combination of plan components for ecosystem diversity and for a species group or a surrogate for this species provide conditions that will support self-sustaining populations of the species (provide a citation to administrative record for further information).

[8]The combination of plan components for ecosystem diversity and for this individual species provide conditions that will support self-sustaining populations of the species (provide a citation to administrative record for further information).

This process is intended to serve as a final evaluation of combined plan components and their implications to ecological characteristics to ensure they adequately provide for ecological sustainability. In doing so, information developed in previous chapters will be integral to this analysis. Specifically, information developed in the status of ecosystem diversity, status of species, and ecosystem diversity and species risk assessment (chapter 3) is carried forward here and cross-referenced during this analysis with plan components developed throughout chapter 4 to demonstrate how specific characteristics of ecosystem diversity and species needs have been provided for.

A step wise process for completing this process step is outlined below:

1. Utilizing information developed in the status of ecosystem diversity, status of species, and ecosystem diversity and species risk assessment (chapter 3) display characteristics of ecosystem diversity for which an unacceptable status or unacceptable risk was identified. Also display all T&E species, SOC and SOI. See chapter 3 for a discussion of qualifying status and degree of risk.
2. For the characteristics of ecosystem diversity and species displayed in the above step, provide a detailed analysis cross-referencing the characteristic to specific plan components.
3. Using the analysis and cross-reference developed in the preceding step; identify how the individual needs of characteristics of ecosystem diversity and species are being met in the plan option(s). This process was initially started for species in chapter 4 through the effects of ecosystem diversity plan components on species as well as the species plan components sections. However, in this analysis for species and characteristics of ecosystem diversity the implications of the plan components must be projected for the characteristics that have been met through the combined plan option and needs to be clearly articulated here.
4. Document in a sustainability evaluation report (part of the plan set of documents) a summary of analyses (guided by this process document), including the summarization of iterations of the plan option(s). Consider using the template provided in exhibit 3 for this documentation.
5. Given that all needs of species diversity and ecosystem diversity have been met through the developed plan option, the responsible official shall determine that the plan option provides sufficient framework for contributing to ecological sustainability.
6. Document in the plan approval document the responsible official’s identification of the national forest or grassland’s contribution to sustainability.

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Specific links for use in text of this document:

FSH 1909.12, Zero code

___Chapter 10, Land Management Plan

___Chapter 20, The Adaptive Planning Process

___Chapter 30, Public Participation and Collaboration

___Chapter 40, Science and Sustainability

___chapter 50, Objection Process

___Chapter 60, Forest Vegetation Resource Planning

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Appendix A. Plant Community Crosswalk for Potential Natural Vegetation Types (PNVTs) and SWIS Habitat Types

Table 9. Plant Community Cross-Walk for National Forests and Grasslands of the Southwestern Region

R3 Life Zone (TES)	PNVT	SWIS Habitat Type
Bottomland	Cottonwood-willow riparian forest	Low elevation riparian
	Mixed broadleaf deciduous riparian	
	Herb wetland	Marsh/Cienega
Desert	Desert	Desert grassland, Desert shrubland & Rabbitbrush
Grassland, Shrubland	Steppe	
	Grassland savannah (Semi-desert, Great Basin)	Plains grasslands
	Sagebrush	Sagebrush
Chaparral, Woodland	Madrean encinal woodland	Oak woodland
	Madrean pine-Oak woodland	
	Chaparral	Chaparral
	Piñon-Juniper-Utah juniper	Piñon-Juniper
	Piñon-Juniper-One-seed juniper	
Ponderosa pine Forest	Ponderosa pine/Gambel oak	Ponderosa pine
	Ponderosa pine/Arizona fescue	
	Ponderosa pine-Emory oak	
	Ponderosa pine-Alligator juniper	
Mixed Conifer Forest	Mixed conifer-Ponderosa pine	Mixed conifer
	Mixed conifer-Silverleaf oak	Oak-Mahogany
	Subalpine/Montane grassland	Meadow, High elevation riparian
	Montane willow riparian forest	
	Gallery coniferous riparian forest	High elevation riparian
	Aspen	Aspen
Spruce-Fir Forest	Spruce-Fir forest	Spruce-Fir
Alpine	Alpine tundra	Alpine
South Central Plains	Shinnery oak shrubland	
	Bluestem prairie	
	Canyon woodlands	
High Plains	Grama high plains	

Caveats

Due to the availability of information, the crosswalk is currently based on *potential* vegetation classes derived from TES reports. Ideally the crosswalk would be developed for *existing* vegetation classes (composition and structure). As is, the crosswalk is useful for quantitative analyses and is less reliable for spatial analyses given the imprecision involved in using potential vegetation types as inference of wildlife habitat.

The crosswalk was based on habitat types identified for 609 bird, mammal, reptile, and amphibian species. Additional analysis will be necessary to validate the crosswalk for other wildlife species.

A second approximation of the TES crosswalk originally used to define the SWIS habitats may improve the accuracy and precision of this crosswalk (see ‘General Comments’ under ‘Background Documentation’).

Finally, the crosswalk provides a tool for both quantitative and qualitative analyses. The table can be used to indicate, for example, the amount of ‘Oak Woodland’ habitat type based on the amount of area in ‘Madrean Pine-Oak Woodland’ and ‘Madrean Encinal Woodland’ PNVTs. However tabular exercises will not be useful in depicting the spatial distribution of habitat, which can be an important consideration for many species.

Background Documentation

Table 10. Current SWIS-TES Cross-Walk (USDA 2005a)

TES	SWIS Habitat Type	Comments
ARTR2	Sagebrush	
ARTR2, JUOS, ROCK OUTCROP	Sagebrush	
BOCU (w/QUEM)	Oak Woodland	Encinal Woodland
BOGR2	Plains Grassland	
BRAN	Mixed Conifer	Meadow
CAHO3	Desert Grassland	Steppe
CAHO3, LATR2, BADLANDS	Desert Shrub	
CAREX, FETH, PIEN	Spruce-Fir	
CEFL2, POFR2	Low Riparian	
CEMI2	Desert Shrub	
CEMI2, LATR	Desert Shrub	
CEMI2, LATR, BADLANDS	Desert Shrub	
CHLI2, POFR2	Low Riparian	
CHNA2 (ERNA10)	Rabbitbrush	Steppe
CORA, ROCK OUTCROP	Sagebrush	Desert Shrub
DOVI, ROCK OUTCROP	Marsh	
FEAR2	Ponderosa Pine	Meadow
FETH	Spruce-Fir	Meadow
FETH, PIEN	Spruce-Fir	
FOSP2, PRVE	Desert Shrub	
FOSP2, QUTU2, ROCK OUTCROP	Oak Woodland	Pine-Oak Woodland
FOSP2, QUEM, ROCK OUTCROP	Oak Woodland	Encinal Woodland

Table 10. Current SWIS-TES Cross-Walk (USDA 2005a)

TES	SWIS Habitat Type	Comments
FRDE	Desert Shrub	
GUSA2, POFR2	Rabbitbrush	Low Elevation Riparian
GUSA2, STNE2, HIJA	Plains Grassland	
HYRI	Plains Grassland	
JUDE2, QUAR	Oak Woodland	Pine-Oak Woodland
JUDE2, QUGR3	Oak Woodland	Pine-Oak Woodland
JUMO	Piñon-Juniper	
JUMO, BADLANDS	Piñon-Juniper	
JUMO, CHNA2	Rabbitbrush	Piñon-Juniper
JUMO, POFR2	Low Riparian	
JUMO, PSME, ROCK OUTCROP	Mixed Conifer	
JUOS	Piñon-Juniper	
JUOS, BADLANDS	Piñon-Juniper	
JUOS, PIPOS	Ponderosa Pine	
JUOS, POFR2	Low Riparian	
JUOS, PSME, ROCK OUTCROP	Mixed Conifer	
JUOS, ROCK OUTCROP	Piñon-Juniper	
KOBE	Alpine	
LATR	Desert Shrub	
PIEN	Spruce-Fir	
PIPOS	Ponderosa Pine	
PIPOS, JUMO	Ponderosa Pine	
PIPOS, PSMEG	Mixed Conifer	
PIPOS, QUAR	Ponderosa Pine	
PIPOS, QUGR3, JUDE2, ROCK OUTCROP	Ponderosa Pine	
PIPOS, ROCK OUTCROP	Ponderosa Pine	
POPR, PIPOS	Ponderosa Pine	
POPR, POAN3	High Riparian	
POPR, POFR4, CALE4	Marsh	
PRGL2, QUEM	Oak Woodland	Encinal Woodland
PRGL2, QUGR3	Oak Woodland	Pine-Oak Woodland
PRGL2, QUGR3, BADLANDS	Oak Woodland	Pine-Oak Woodland
PRGL2, QUGR3, ROCK OUTCROP	Oak Woodland	Pine-Oak Woodland
PRVE	Desert Shrub	
PRVE, QUTU2	Desert Shrub	
PRVE, QUTU2, ROCK OUTCROP	Desert Shrub	
PRVE, CAHO3, BADLANDS	Desert Shrub	
PRVE, QUTU2, ROCK OUTCROP	Chaparral	

Table 10. Current SWIS-TES Cross-Walk (USDA 2005a)

TES	SWIS Habitat Type	Comments
PSMEG	Mixed Conifer	
PSMEG, PIEN	Spruce-Fir	
PSMEG, PIEN, ROCK OUTCROP	Spruce-Fir	
PSMEG, ROCK OUTCROP, BADLANDS	Mixed Conifer	
QUAR	Oak Woodland	Pine-Oak Woodland
QUAR, CUARG, ROCK OUTCROP	Oak Woodland	Pine-Oak Woodland
QUAR, PSMEG, ROCK OUTCROP	Mixed Conifer	
QUAR, ROCK OUTCROP	Oak Woodland	Pine-Oak Woodland
QUEM	Oak Woodland	Encinal Woodland
QUEM, CHLI2	Low Riparian	
QUEM, POFR2	Low Riparian	
QUEM, PRGL2	Desert Shrub	Pine-Oak Woodland
QUEM, PSMEG, ROCK OUTCROP	Ponderosa Pine	
QUEM, ROCK OUTCROP	Oak Woodland	Encinal Woodland
QUGA, POPR, SALA5	Oak-Mahogany	
QUGR3	Oak Woodland	Pine-Oak Woodland
QUGR3, PRGL2	Oak Woodland	Pine-Oak Woodland
QUGR3, PSMEG, BADLANDS	Mixed Conifer	
QUGR3, PSMEG, ROCK OUTCROP	Mixed Conifer	
QUGR3, ROCK OUTCROP	Oak Woodland	Pine-Oak Woodland
QUTU2	Chaparral	
QUTU2, QUAR, BADLANDS	Chaparral	
CEMI2, FOSP2	Desert Shrub	

Current SWIS-GTES cross-walk (USDA 2005a)

Table 11. Current SWIS-GTES Cross-Walk (USDA 2005a)

SWIS HABITAT TYPE	GTES SEQUENCE Number
Meadow	57, 18, 5
Low Elevation Riparian	9, 75, 14, 78, 41, 36
High Elevation Riparian	56
Alpine	44
Spruce-Fir	68, 46, 67, 8, 10, 19
Mixed Conifer	84, 37, 66, 42, 69, 72, 49, 83
Ponderosa pine	55, 51, 52, 53, 50, 78, 47, 35, 40, 48, 54
Piñon-Juniper	31, 38, 34, 32, 39, 43
Desert Grassland	6

Table 11. Current SWIS-GTES Cross-Walk (USDA 2005a)

SWIS HABITAT TYPE	GTES SEQUENCE Number
Desert Shrub	45, 12, 11, 13, 25, 10, 77, 63, 62, 7, 21
Oak Woodland	22, 58, 79, 74, 29, 73, 70, 81, 23, 30, 61, 85, 59, 60, 82, 71
Chaparral	24, 86, 65, 64, 87
Sagebrush	16, 1, 2
Rabbitbrush	3, 15, 26
Oak-Mahogany	80
Plains Grasslands	27, 28, 4
Aspen	
Marsh	

Appendix B. Potential Threats for Evaluation during the Risk Assessment Process

The threats shown here are divided into “anthropogenic” (table 12) and “natural” (table 13). Anthropogenic threats are further subdivided by “generic” and “specific” threats.`

Table 12. Potential Anthropogenic Threats for Evaluation during the Risk Assessment Process

Generic Anthropogenic Threats							
Abiotic Resource Uses	**Consumptive Biological Uses**	**Habitat Conversion**	**Invasive Species**	**Modification of Natural Processes**	**Non-consumptive Biological Uses**	**Pollution**	**Transportation Infrastructure**
Specific Anthropogenic Threats							
Geothermal energy	Deforestation	Agriculture	Disease, parasites, pathogens	Fire suppression	OHV, snowmobiles	Agricultural chemicals (e.g. fertilizers, etc.)	Power transmission lines
Mining	Fuel wood collection	Dams/ Impoundments	Exotic &/or invasive fish & wildlife	Flooding (Dams/ Impoundments)	Military maneuvers	Solid waste	Roads, highways & utility corridors
Oil/Gas development	Livestock grazing	Altered hydroperiod	Exotic &/or invasive plants		Traditional recreation (hiking, camping, etc.)	Toxic waste contamination	
Water withdrawal	Hunting-gathering	Draining of wetlands	Hybridization		Scientific research	Ground water contamination	
Wind farms	Timber Harvest	Fire management	Competition, predation			Sewage, septic	
Hydropower	Predator removal	Ground water depletion (urban, agricultural)					
Generic Anthropogenic Threats							
Abiotic Resource Uses	Consumptive Biological Uses	Habitat Conversion	Invasive Species	Modification of Natural Processes	Non-consumptive Biological Uses	Pollution	Transportation Infrastructure
SPECIFIC ANTHROPOGENIC THREATS							
	Collecting	Industrial recreation					

Table 12. Potential Anthropogenic Threats for Evaluation during the Risk Assessment Process

	(scientific/ non-scientific)	(ski areas, etc.)					
		Urban development					
		Herbicide use					
		Irrigation diversion-return					
		Channelization					
		Flood control					
		Vegetation treatments					
		Sediment load					

Table 13. Potential Natural Threats for Evaluation During the Risk Assessment Process

Generic Natural Threats					
Wildfire	**Drought**	**Herbivory**	**Flooding**	**Erosion, sedimentation (catastrophic)**	**Insect &/or disease outbreaks**

Appendix C. Risk Assessment Process Example (Adapted from Salafsky et. al. 2003)

Construct a list of ecosystem characteristics and threats and consider the following steps;

1. Using the list create a matrix of threat severity by ecosystem characteristics, table 14 displays an example of such a matrix. Note that each cell of the matrix (the intersection of threat and characteristic) is divided in to 4 sub-cells. Each of these cells is for rating (e.g., low, medium and high) the specific measures of risk severity from the directives; i.e. extent, duration, severity, consequences, reversibility.

Table 14. Sample Threat and Ecosystem Characteristic Matrix to Evaluate Severity of Risk‡

Threat	Ecosystem characteristic															RISK	
	SPRUCE-FIR					MIXED CONIFER					PONDEROSA PINE						
	Extent	Duration	Severity	Consequences	Reversibility	Extent	Duration	Severity	Consequences	Reversibility	Extent	Duration	Severity	Consequences	Reversibility	THREAT SEVERITY OVERALL	LIKELIHOOD
Fuelwood collection																	
Logging																	
Fire suppression																	
Wildfire																	
Insect/disease outbreaks																	

‡See table 15 for an explanation of risk ratings.

2. To obtain a measure for severity, assign a rating for each threat to characterize each component of severity. The categorical ratings for use with the matrix are shown in table 15. The class limits or definitions for the specific measures, low, medium or high are developed by the local unit.

Table 15. Example of How Extent, Duration, Severity, Consequences, Reversibility, and Likelihood May be Categorized for Evaluation

Variable	Continuous Measurement
Extent	Area affected, expressed as percent of total, for average event. Units may be area units (e.g. acres, sections) or linear (e.g. miles of stream).
Duration	Time that a given threat, when occurring, actually persists on an annual basis.
Severity	Actual measure of reduction in the composition or structure of the characteristic, expressed as percent.
Consequences	The expression of reduction in viability, integrity, or sustainability to the characteristic.
Reversibility	A determination whether an outcome is reversible or irreversible.
Likelihood	The possibility that a given threat will occur.

3. Summarize the descriptive categories of each threat for each characteristic. Each threat could result in similar or unique ratings.
4. Once the entire table is completed in assigning ratings for all characteristics and threats, tally by rows and columns to obtain relative overall threat severity ratings by characteristic and by threat.

   The row tallies will provide a relative measure of potential effects resulting from threats. A frequent ‘high’ row score could occur for a variety of reasons and equal tallies do not necessarily represent equal threats. Again, inspection of the table elements will allow this to be determined, and consequences should be evaluated along with extent, duration, and severity.

5. Determine the likelihood of the threat occurring for each characteristic. The ranking of likelihoods is shown in the last row of table 14. Evaluation of likelihood is necessary in prioritizing which threats will be addressed in plan components. High severity might not require specific plan components if the likelihood of the threat occurring is low (e.g. rare).

   Inspection of the table is an absolute necessity to assess both the likelihood of a negative outcome and the potential severity of that outcome, including extent, duration, severity, consequences and reversibility.

Information on both likelihood and severity should be considered with the consequences and reversibility of the outcome before being carried over into the development of plan components.

Appendix D. Example[5] of Desired Conditions and Objectives to Address the Needs of Mexican Spotted Owl and Northern Goshawks

The following is provided as an example of detailed and measurable desired conditions and objectives aimed at meeting the needs of Mexican spotted owl as a Federally listed species, and Northern goshawk as a species of interest.

Desired Conditions for Mixed-Conifer (outside of protected habitat)

In all Mexican Spotted Owl recovery units except Basin and Range East, 10 percent of the total stands mixed conifer will have a basal area of 170 square feet/acre, with a minimum of 20 trees that are 18 inches dbh or larger. In addition, 15 percent of the total mixed conifer stands will have a basal area of 150 and a minimum of 20 trees that are 18 inches dbh or larger.

Stands will contain key habitat components, defined as:

-snags 18” + dbh
-down logs >12” diameter at midpoint

Along with these habitat components, stands will have a mosaic of vegetation densities (overstory and understory), age classes and species composition across the landscape. Stands will have high canopy cover and trees of mature to old age to provide for nesting conditions for Northern goshawks. Distribution of these conditions will be present at the ecosystem management area level, at the mid-scale level such as drainage, and at the small scale of the site.

Mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes, into management prescriptions. Maintain all species of native trees in the landscape, including early seral species as well as hardwoods for retention, recruitment, and replacement of existing hardwoods.

Allow natural canopy gap processes to occur, thus producing horizontal variation in stand structure.

Objectives for Mixed-Conifer (outside of protected habitat):

Age distribution of seral stages will be 10 percent grass/forb/shrub, 10 percent seedling/sapling, 20 percent young forest, 20 percent mid-aged forest, 20 percent mature forest, and 20 percent old forest. These percentages will vary by plus or minus 3 percent.

Within Northern goshawk nesting areas, mature and old mixed conifer forest will have a canopy cover of between 50 and 70 percent with mid-aged trees of 200-300 years old.

[5] From the 1996 Record Of Decision for the Regionwide Forest Plan Amendment

Within Northern goshawk post-fledging family areas (PFAs), canopy cover will be 60 percent or greater in mid-seral to old forest.

Outside of nesting areas and PFAs, average canopy cover for mid-seral stands will be a third of the area at 60 percent or greater and two-thirds of the area at 40 percent or greater. For mature forest, canopy cover will average 50 percent or more. In old forest, canopy cover will measure 60 percent or more.

In all the Basin and Range East Recovery Unit, all of the above conditions will apply except that 10 percent of the total stands mixed conifer will have a basal area of 170 square feet/acre, and 10 percent of the total mixed conifer stands will have a basal area of 150 square feet/acre. In either case, these stands will have a minimum of 20 trees that are 18 inches dbh or larger.

Desired Conditions for Ponderosa Pine:

In pine-oak forest on slopes greater than 40 percent where timber harvest has not occurred in the last 20 years, and pine-oak within wilderness or other congressionally designated areas, natural processes will be allowed to function and determine stand structure and age class distribution.

In other pine-oak forests, 10 percent of the total stands will have a basal area of 150 square feet/acre, with a minimum of 20 trees that are 18 inches dbh or larger. In addition, these stands will have an oak basal area of 20 square feet/acre.

All pine or pine-oak stands will contain key habitat components, defined as:

-snags 18”+ dbh
-down logs >12” diameter at midpoint

Along with these habitat components, stands will have a mosaic of vegetation densities (overstory and understory), age classes and species composition across the landscape. Stands will have high canopy cover and trees of mature to old age to provide for nesting conditions for Northern goshawks. Distribution of these conditions will be present at the ecosystem management area level, at the mid-scale level such as drainage, and at the small scale of the site.

All species of native trees in the landscape will be present, including early seral species as well as hardwoods for retention, recruitment, and replacement of existing hardwoods.

Allow natural canopy gap processes to occur, thus producing horizontal variation in stand structure.

Objectives for Ponderosa Pine:

Age distribution of seral stages will be 10 percent grass/forb/shrub, 10 percent seedling/sapling, 20 percent young forest, 20 percent mid-aged forest, 20 percent mature forest, and 20 percent old forest. These percentages will vary by plus or minus 3 percent.

Within Northern goshawk nesting areas, mature and old ponderosa pine forest will have a canopy cover of between 50 and 70 percent with mid-aged trees of 200-300 years old.

Within Northern goshawk Post-fledging family areas (PFAs), average canopy cover for mid-seral stands will be a third of the area at 60 percent or greater and two-thirds of the area at 50 percent or greater. For mature forest and old forest, canopy cover will average 50 percent or more.

Outside of Nesting Areas and PFAs, average canopy cover for mid-aged through old stands will be 40 percent or greater.

Appendix E. USDA Forest Service Ecological Sustainability Work Group Membership

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