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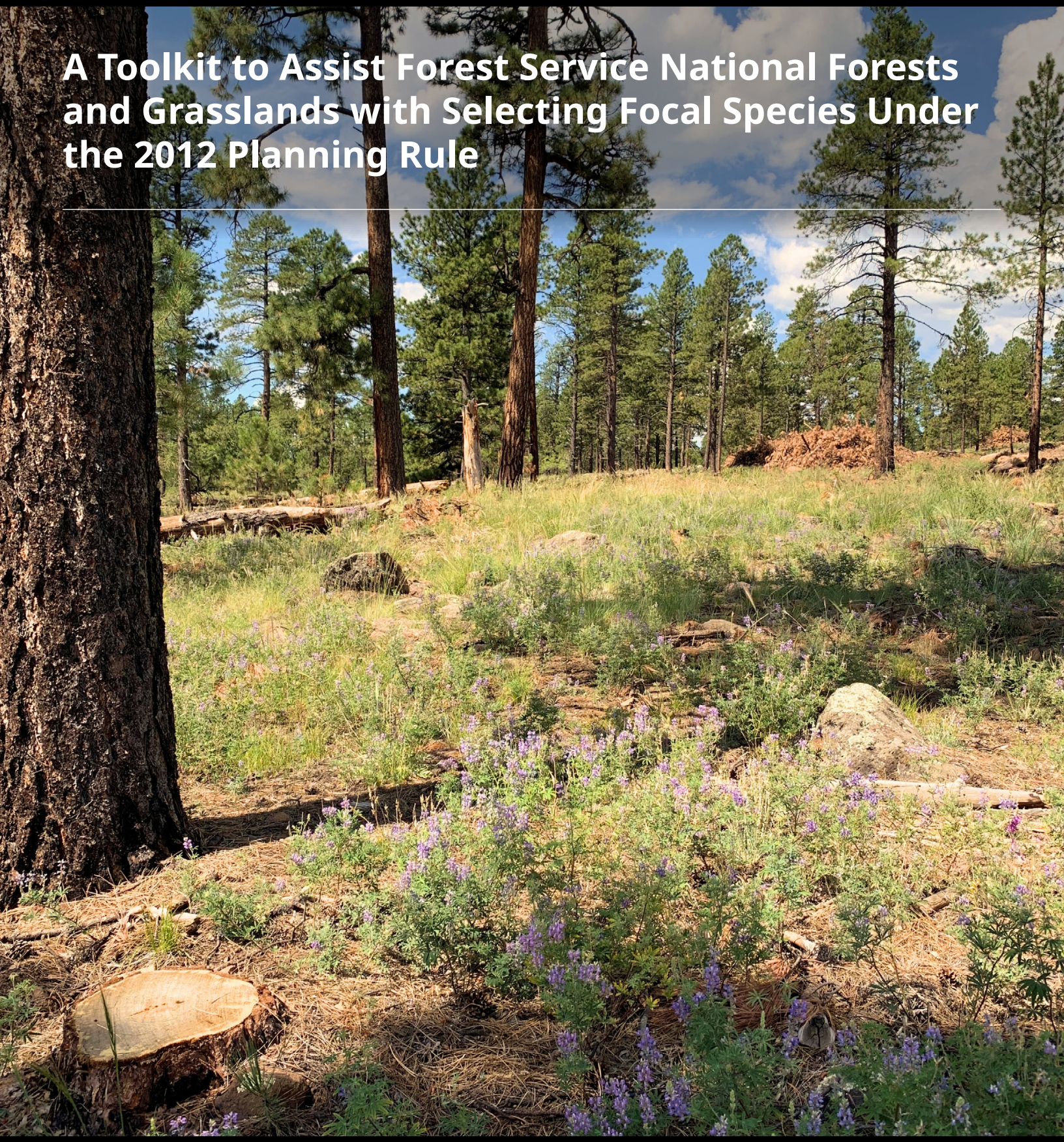
# A Toolkit to Assist Forest Service National Forests and Grasslands with Selecting Focal Species Under the 2012 Planning Rule



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**Abstract:** The U.S. Department of Agriculture, Forest Service is required to monitor National Forest System (NFS) lands to assess whether management plans are maintaining or restoring ecological integrity. As part of this monitoring effort, each planning unit is required to select at least one focal species—or one focal species assemblage—that represents a specific aspect of ecological integrity or management plan effectiveness. The planning unit can then make inferences about ecological integrity by monitoring this focal species or assemblage. Although selecting a focal species may seem simple, it can be a complex process, and it is important to consider the necessary steps to make an effective focal species choice. It is important that the selection process carefully rules out complex factors that can make potential focal species unsuitable and even misleading.

This technical support document includes a flow chart illustrating the structured focal species selection process and offers planning units six additional resources to assist them in the process: (1) a worksheet that guides users through a stepwise process and a method for transparent documentation of focal species selection; (2) examples of real decisions about focal species selection; (3) a table illustrating step alignment with the Forest Service Handbook; (4) background about species' designations; (5) a table of potential analyses to address information needs; and (6) considerations for designing a focal species monitoring program. These resources are intended to support ongoing efforts to develop, transition, and revise National Forest System land and resource management plans and their monitoring programs to align with the 2012 Planning Rule, which requires monitoring of focal species.

**Keywords:** 2012 Planning Rule, ecological integrity, flow chart, focal species monitoring, worksheet

**Cover:** Forest management with the Four Forest Restoration Initiative at Chimney Springs, Coconino National Forest, Arizona. USDA Forest Service photo by Jamie Sanderlin.

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# Contents

## Key Definitions

**Ecological integrity**—The quality or condition of an ecosystem when its dominant ecological characteristics (for example, composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence (36 CFR 219.19).

**Focal species**—A small subset of species whose status permits inference to the integrity of the larger ecological system to which it belongs and provides meaningful information regarding the effectiveness of the plan in maintaining or restoring the ecological conditions to maintain the diversity of plant and animal communities in the plan area. (36 CFR §219.19).

**Plan (land management)**—A document or set of documents (also commonly referred to as a "forest plan" or "land and resource management plan") that provide management direction for an administrative unit of the national forest or grassland developed under the requirements of the land management planning regulation at 36 CFR part 219 or a prior planning rule (36 CFR 219.19).

**Plan area**—The area encompassed by a particular land management plan (i.e. a particular national forest or national grassland, also known as a planning unit)

**Plan components**—Standards, guidelines, and desired conditions that are stated in a land management plan and that are designed to maintain or restore ecological integrity, structure, function, composition, and connectivity of terrestrial and aquatic ecosystems and watersheds in the plan area (§219.8(a)).

## Why Monitor Focal Species?

**The 2012 Planning Rule compels units to ask, "Is the plan area maintaining or increasing ecological integrity? Is the land management plan effectively providing for species diversity?**

Focal species (which hereafter encompasses both individual species and focal species assemblages) are animals, plants, and/or fungi (or groups of organisms) that are specifically chosen to represent an aspect(s) of ecological integrity and measure the effectiveness of management plan implementation in the area covered by a plan. If focal species are selected properly, then monitoring metrics for the species (e.g. abundance, distribution, reproduction, presence/absence, area occupied, survivorship, or other demographic parameters; table 8.1 in Sanderlin et al. 2019) can yield information about the ecological conditions of the plan area. This can inform land management planning by testing assumptions, tracking changes, and measuring progress toward achieving or maintaining plan goals, desired conditions, or objectives. However, if focal species are chosen improperly, then monitoring them to understand ecological integrity can be ineffective or misleading, which can result in inefficient use of resources. This means that it is very important to outline a clear process for selecting focal species.

In the Forest Service, monitoring of focal species is required by the 2012 Planning Rule (36 CFR §219). This regulation "promote[s] the ecological integrity of National Forests and Grasslands through the collaborative, science[1]-informed development, revision, or amendment of land management plans". Under the 2012 Planning Rule, each national forest and grassland (each of which may be referred to as a "planning unit") has a land management plan that must contain components designed to maintain or restore ecological integrity, structure, function, composition, and connectivity of terrestrial and aquatic ecosystems and watersheds in the plan area (§219.8(a)). These components include standards, guidelines, and desired conditions and they are monitored at the scale of individual planning units (through the "plan monitoring program") and across multiple units or a Forest Service region (through a "broader-scale monitoring strategy"). Monitoring "the status of focal species to assess the ecological conditions required under §219.9" (FSH 1909.12, ch. 30) is one of eight required plan monitoring program components (§219.12(a)(5)). According to the 2012 Planning Rule, "*every plan monitoring program must identify at least one focal species and one or more monitoring questions and associated indicators to track the status of the identified focal species.*" (FSH 1909.12, ch. 30, 32.13c, p.18), because focal species act as ecological condition indicators (219.12(a)(5)(iii)).

[1] Science includes: (1) peer reviewed articles; (2) scientific assessments; (3) Indigenous Knowledge; (4) expert opinion, panel consensus, inventories or observational data; (5) data prepared and managed by the Forest Service or other Federal agencies; (6) data prepared and managed by universities, national research networks, and other reputable scientific organizations; and (7) data or information from public, governmental, and Tribal and Indigenous participation (FSH 1909.12-2024-1 Zero Code 7.13). FSH 1909.12-2024-1 Zero Code 7.13 clarifies that Indigenous Knowledge (as defined in 36 CFR § 219.19) is a source of best available science.

This toolkit is intended to provide National Forest System (NFS) units with a streamlined, user-friendly process for transparent documentation using a worksheet (Resource 1) for selecting focal species. To date, units have relied on the general guidance in the Forest Service Handbook (FSH 1909.12), which is helpful but may not be detailed enough to consistently yield an appropriate focal species (see Resource 2 for real examples).

## Who is This Toolkit Designed to Assist? When Should it be Used?

We designed this toolkit for three specific user groups within the NFS, each of which is updating a plan monitoring program under a different context (fig. 1). The toolkit is intended to be used during both land management plan revision processes and during plan monitoring program transitions and updates by providing resources for transparent documentation of focal species selection.

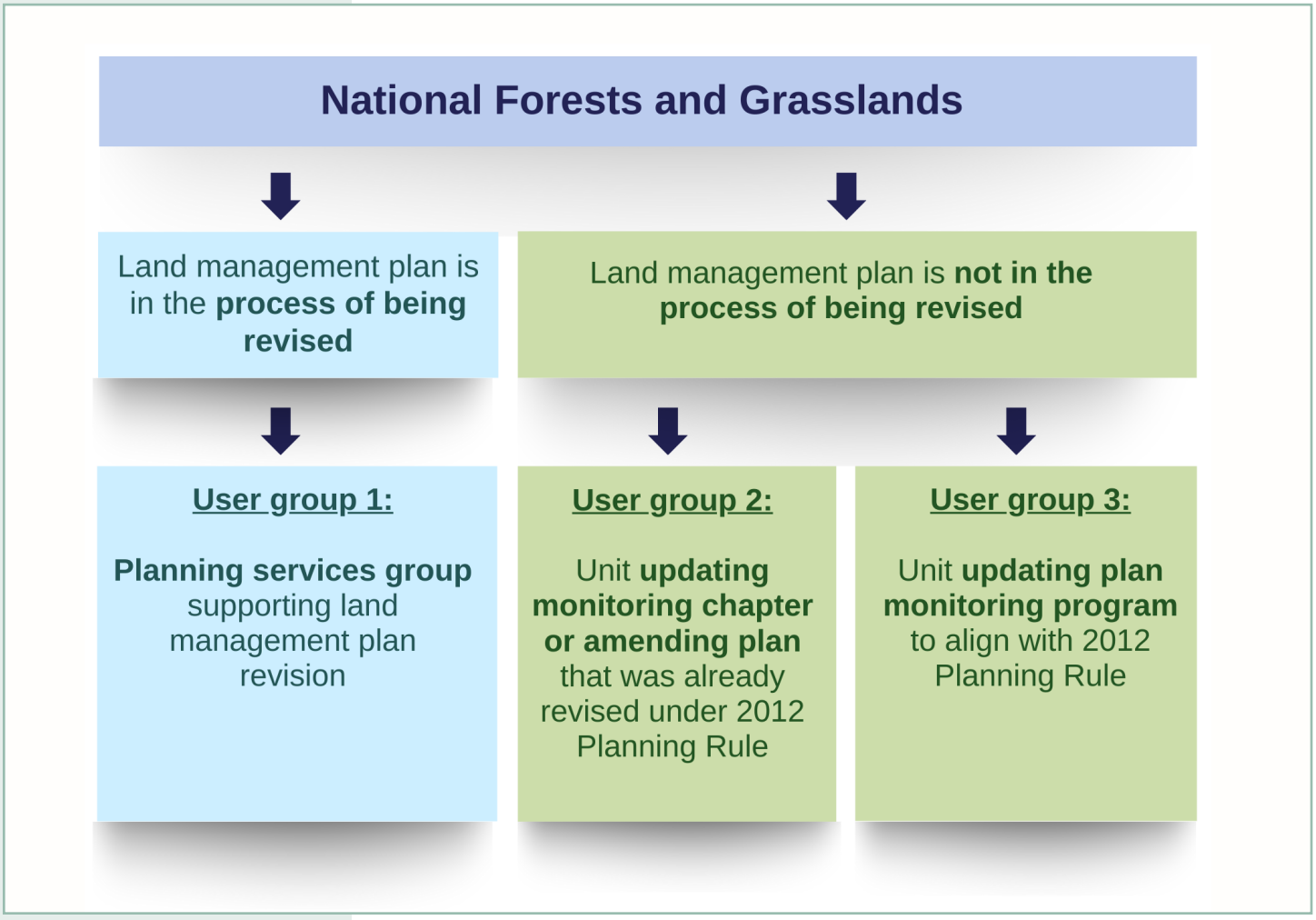



**Figure 1—**The three user groups for whom this technical support toolkit is designed.

# How to Select an Effective Focal Species Under the 2012 Planning Rule

## Eight Steps That Guide Focal Species Selection

Units can use the following eight sequential steps to select focal species. At each step, we provide actions to assist the planning unit team with working through the process, along with a user-friendly worksheet (Resource 1) to document answers and supporting information for each step. We also present additional information sources to assist the planning unit teams through the process: (1) a detailed flow chart (fig. 2) illustrating the process, (2) policy underpinnings of the process in Resources 3 and 4, and (3) a table of potential analyses to address information needs at different steps in Resource 5. After completing the steps, teams may identify a single focal species, a focal species assemblage, or no focal species that is appropriate for monitoring the aspects of ecological integrity and associated set of plan components. We provide options for proceeding in the last section, depending on the potential outcomes.

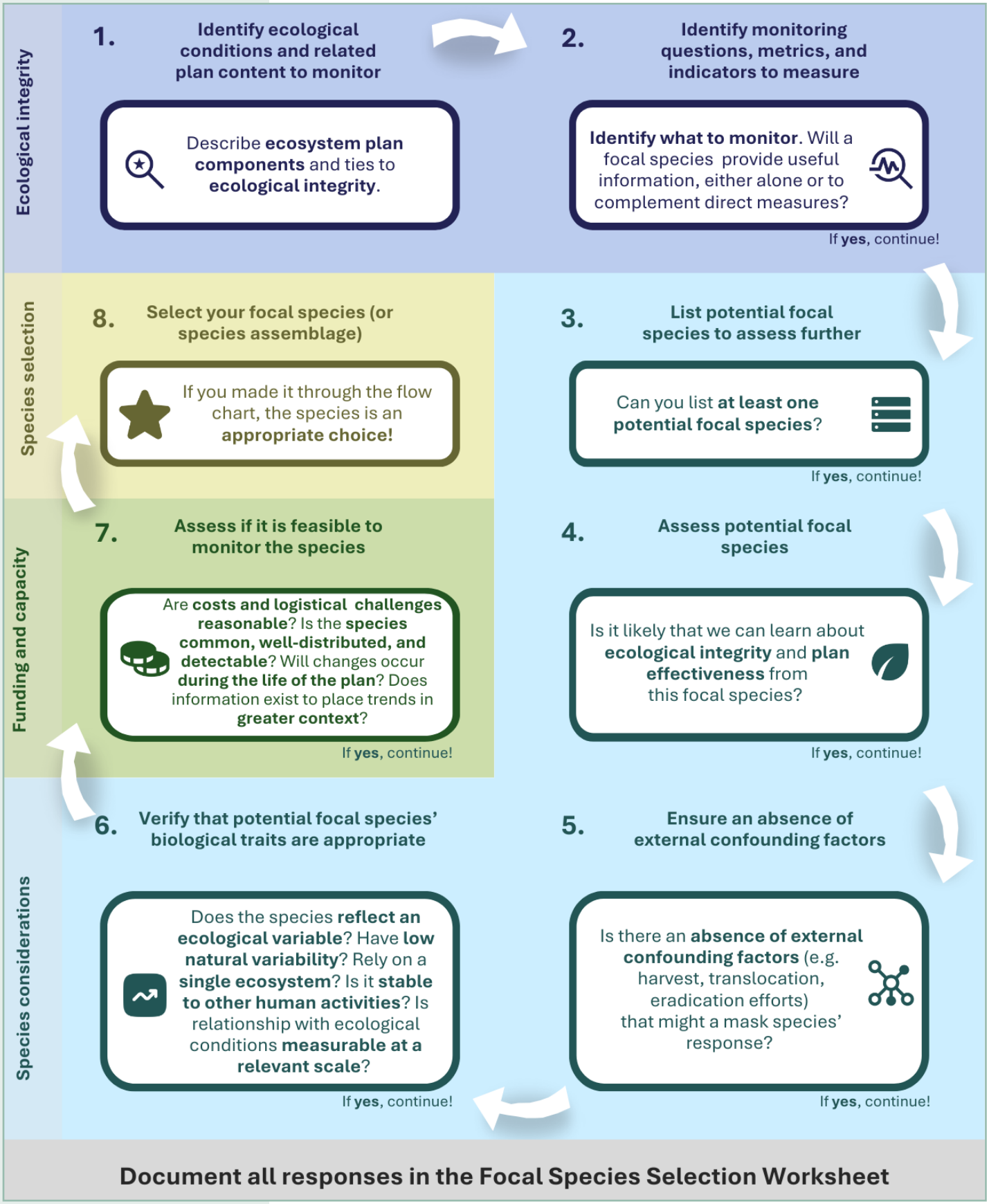



**Figure 2—**A detailed flow chart describing the focal species selection process.

## Step 1. Identify ecological conditions and related plan content to monitor.

In consultation with the Responsible Official, identify the ecological conditions and related plan content (e.g. desired conditions) that are of high risk and/or high importance and are therefore a monitoring priority[2]. This sets the foundation for focal species selection and explicitly ties the plan monitoring program to ecological integrity.

**Action:** Record the ecosystem plan components of interest and aspects of ecological integrity in the Focal Species Selection Worksheet under Step 1 in **Resource 1**.

## Step 2. Identify monitoring questions, metrics, and indicators to measure.

Develop monitoring questions that address information needs related to ecological conditions and ecosystem plan components identified in Step 1. For each monitoring question, brainstorm potential metrics and indicators for which you can collect data to answer the monitoring questions. Would monitoring these metrics using focal species provide useful information about ecological conditions and ecological integrity? *If yes, complete actions below and move on to next step.*

**Actions:** Record the monitoring questions, metrics, and indicators in the Focal Species Selection Worksheet under Step 2 (**Resource 1**). Assess potential direct measures to answer identified monitoring questions and associated data sources for cost-effectiveness and accuracy.


If there is a more direct way to answer the monitoring question than using a focal species, that is OK! Explore direct measures too (e.g. canopy cover, burn severity, or species composition). These may be more efficient measures of ecological integrity than a focal species. If you indentify direct measures, continue to Step 3 only if you think monitoring a focal species would provide additional necesary supporting information. Start over with a different set of ecological conditions if a focal species will not be helpful with monitoring the first set.

[2] Additional guidance is found in FSM 2000–National Forest Resource Management, Chapter 2040–National Forest System Monitoring and online at: https://usdagcc.sharepoint.com/sites/fs-nrm-imac/SitePages/National-Forest-System-Monitoring-Policy.aspx

## Step 3. List potential focal species to assess further.

Combine monitoring questions, metrics, and indicators to identify potential focal species you could use to monitor the ecological conditions. Under the 2012 Planning Rule, focal species are defined as a species (or a group of species) that (1) permits inference to ecological integrity, and (2) provides meaningful information about the effectiveness of a plan at maintaining or restoring ecological conditions. If one species cannot address both needs, consider multiple focal species that together can address both. Be sure to consider species that could provide data for both the plan monitoring program and the broader-scale monitoring strategy. Make sure the taxonomic status of each potential species is well established (Noon et al. 2009). Can you list at least one potential focal species? *If yes, complete actions below and move on to next step.*

**Actions:** Record the list of potential focal species in the Focal Species Selection Worksheet under Step 3 (See **Resource 1**).


If you cannot identify any potential species, return to Step 1 or Step 2 to explore other questions and/or indicators to monitor ecological integrity and ecological conditions related to plan components.

### Did you know?

Focal species are only one of multiple potential indicator types for monitoring in a plan monitoring program or a broader-scale monitoring strategy (**Resource 4**). Focal species are selected and monitored when other indicators of composition, structure, function, and connectivity are either unavailable or difficult to monitor (FSH 1909.12, ch. 30, 32.13c, p.18).

## Step 4. Assess potential focal species.

Get clarity on how well monitoring of the focal species will provide information about ecological integrity and plan effectiveness as identified in Step 1 and answer questions identified in Step 2: (a) What can we likely learn about ecological integrity from this species? and (b) What can we likely learn about plan effectiveness from this species? Can you learn about at least one of these elements from monitoring the focal species? *If yes, complete the actions below and move on to the next step.*

**Actions:** Record your answers to the above questions in the Focal Species Selection Worksheet under Step 4 (See **Resource 1**). Gather evidence (e.g., literature review) to show the species link to ecological integrity and the intended effect of the plan on the species. If needed, seek support from the research community to conduct analyses (See **Resource 5**).

STOP

If you are not able to gain valuable insights about either of the two questions on the Focal Species Selection Worksheet, then the potential focal species you are considering is not likely an appropriate option. Return to your potential focal species selection list from Step 3 and restart Step 4 with a new species.

### Did you know?

A focal species' presence or abundance can indicate either high or low ecological integrity. For example, cheatgrass presence may indicate low ecological integrity at invaded sites due to its known associations with fire vulnerability and an inability to recover from disturbance (Progar et al. 2009; Krokene 2015) whereas abundance of native bunchgrasses may represent high ecological integrity due to the resilience these species may provide to invasion.

Artwork: Jamie Sanderlin, USDA Forest Service.

## Did you know?

Even managed species may be appropriate focal species in some circumstances. For example, units may remove invasive species or manage a forest pest at endemic levels (Hood et al. 2016; Fettig et al. 2022); these species could still be used as a focal species since they represent an aspect of ecological integrity. However, in other cases, managed species should be avoided. For example, pronghorn was deemed an inappropriate focal species on the Kaibab National Forest because it is hunted, and population information may be more indicative of hunter success than response to forest management (USDA Forest Service 2016a). Similarly, the Ozark-St. Francis National Forests deemed black bears as not suitable focal species due to the high impact that hunting could have on their populations (USDA Forest Service 2016b).

Artwork: Jamie Sanderlin, USDA Forest Service.

### Step 5. Ensure an absence of external confounding factors.

In this step, consider whether any external factors (e.g., translocations, hunting/trapping, disease, off-forest land use) could mask a focal species' trend response to plan implementation or alter its ability to indicate ecological integrity. Is there an absence of external confounding factors? *If yes, complete below actions and move on to next step.*

**Actions:** Record any potential external confounding factors in the Focal Species Selection Worksheet under Step 5 (See **Resource 1**). Check if plan components or management directives exist for the species and review those plans. If needed, seek support from the research community.

STOP

If any external confounding factors would affect inferences in the plan area, then the potential focal species you are considering is likely not an appropriate option. Return to your potential focal species list from Step 3 and restart Step 4 with a new species.

## Step 6. Verify that potential focal species' biological traits are appropriate.

This step clarifies potential drivers of focal species' status and trends. We suggest answering five questions to determine if a potential focal species' biological traits are appropriate for this purpose (drawn closely from Schwartz et al. 2015):

A. Does the species' trend reflect an aspect of ecological integrity (i.e. its trend is related to some ecological variable of interest)?

B. Does the species exhibit a low range of natural variability?

C. Does the species rely on a single ecosystem to ensure that changes in another ecosystem do not mask a species' response?

D. Is the species' response relatively stable to human activities (e.g., cultivation, development) outside of the Plan area?

E. Is there existing scientific evidence that the association between the species and Step 1 conditions is measurable at relevant scales?

*If you answer yes to all five questions, complete the actions below and move on to the next step.*

**Actions:** Conduct a literature review for all five questions (A–E) to ensure you are familiar with existing information. If needed, seek support from the research community, especially where answers are not readily found in existing literature (see **Resource 5** for analysis ideas). Record your responses to the five questions in the Focal Species Selection Worksheet under Step 6 (**Resource 1**).


If you answered "no" to any of the five questions about species' relevant bioogical traits, then the potential focal species you are considering is likely not an appropriate option. Return to your potential focal species list from Step 3 and restart Step 4 with a new species.

Artwork: Jamie Sanderlin, USDA Forest Service.

## Did you know?

It is important to be able to identify statistically and biologically meaningful relationships between desired conditions and a focal species' metrics of interest at relevant spatial (Nichols et al. 2008; Pavlacky et al. 2012) and temporal scales. A focal species' metric of interest will increase or decrease in relation to changes in one specific stressor that is assumed to be representative of ecological conditions. As such, it is important to start with scientific evidence about trend drivers and relationships between focal species and desired conditions at the correct scales (i.e., plan, area, or local scale vs. regional).

### Step 7. Assess if it is feasible to monitor the species.

This step identifies logistical, financial, and methodological constraints that would affect a unit's ability to monitor a potential focal species by clearly identifying data limitations and assumptions. We suggest answering six questions to determine if there is funding and capacity to adequately monitor the species in question (drawn closely from Schwartz et al. 2015):

A. Would the cost of monitoring this species (or assemblage) be reasonable for the unit?

B. Would the logistics and technical challenges of monitoring this species be reasonable for the unit?

C. Is the species common enough, well-distributed enough in the plan area, and easy enough to detect to ensure that monitoring costs would not be too high?

D. Is it feasible to detect changes during the life of the plan?

E. Do standardized monitoring methods exist to ensure defensible conclusions can be drawn?

F. Is there background knowledge about regional, national, or global status and/or trends for this species, making it easier to place the status and trend of the focal species on the planning unit in a broader context?

*If you answer yes to all six questions, complete the below actions and move on to next step.*

**Actions:** Conduct a literature review for all six questions (A-F) to ensure you are familiar with existing information. For (A) and (B), consider potential partnerships with Forest Service Regional Offices, Forest Service Research and Development, and/or other organizations to leverage ongoing monitoring efforts. Also, consider the use of existing datasets to detect trends and generate funding efficiencies. For (A), (C), and (D), power analyses using existing datasets that investigate costs (which change through time) and available monitoring methods may be warranted to assess feasibility. For (C), analyses may be needed to identify rare (low occupancy/abundance) and cryptic (low detection probability) species. For (F), consider availability of large-scale datasets such as the North American Breeding Bird Survey (Peterjohn 1994) or the Forest Service's Forest Inventory and Analysis Program to evaluate regional, national, or global status and trends. Record your responses to the six questions in the Focal Species Selection Worksheet under Step 7 in **Resource 1**. If needed,

seek support from the research community to conduct analyses (**Resource 5**).

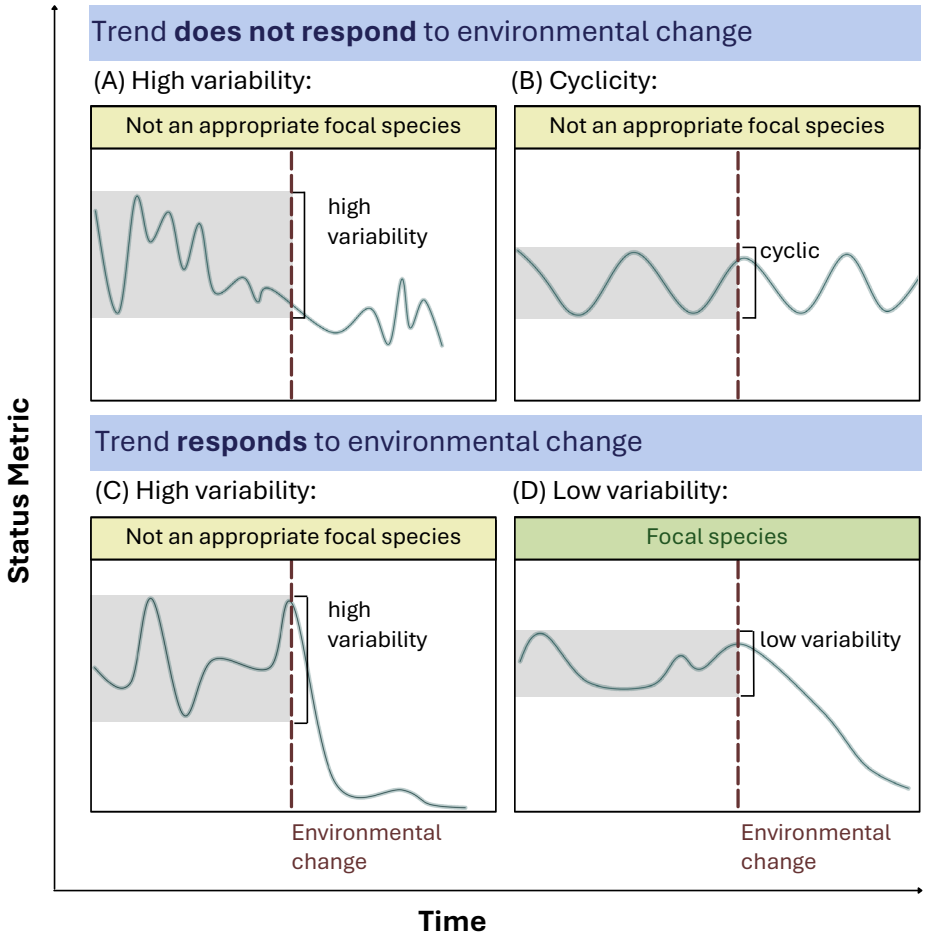
STOP

If you answered "no" to any of the six questions about funding and capacity constraints, then the potential focal species you are considering is likely not an appropriate option. Return to your potential focal species list from Step 3 and restart Step 4 with a new species.

## Step 8. Select your focal species (or species assemblage).

If you answered "yes" to all questions in the worksheet, then your potential focal species is likely an appropriate option to monitor the ecological conditions and/or plan effectiveness.

**Actions:** Save your worksheet responses so they are easily accessible for adaptive management, project records, plan revisions, and/or monitoring program amendments.




## Did you know?

Focal species should have small natural population fluctuations over time to make it easier to evaluate changes in desired conditions (fig. 3). Cryptic (low detection probability) and/or rare (low occupancy probability) species typically involve higher monitoring costs (Thompson 2004). For species with high sampling variability (Noon et al. 2009) or known cyclical trends, e.g., snowshoe hare (*Lepus americanus*; Krebs et al. 1995, 2001; Interagency Lynx Biology Team 2013) it can be challenging to disentangle the species' response to ecological conditions from its natural variation.

Artwork: Jamie Sanderlin, USDA Forest Service.

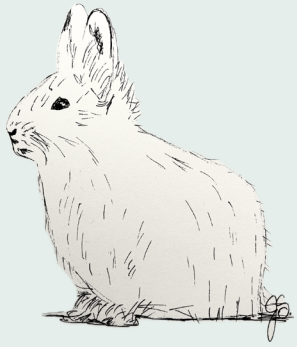


**Figure 3—**Different responses of trends in a potential focal species' metric of interest to an environmental change. Note that in (C), previous monitoring is required to detect the species' response to environmental change due to the high variability in the trend.

## Outcomes and Implications of the Focal Species Selection Process

### Potential Outcomes

After completing the worksheet, teams may identify a single focal species, a focal species assemblage, or no focal species that is appropriate for monitoring the aspects of ecological integrity and associated set of plan components. The worksheet can be used to demonstrate transparent focal species selection and can be included with the planning documentation. If a single focal species or a species assemblage is identified, the team can modify and finalize monitoring metrics and measures, as needed, and then identify thresholds or "trigger points" for adaptive responses, management action(s) if a threshold is surpassed, and a plan for continued monitoring effects of the management response(s) through adaptive management (i.e. Lindenmayer and Likens 2009; Moir and Block 2001; Nie and Schultz 2012; Schultz et al. 2013). We provide some considerations for designing a focal species monitoring program in **Resource 6**. If no focal species is identified as being appropriate, the team may opt to choose a different set of plan-related ecological conditions to monitor and would return to Step 1 on the Focal Species Selection Worksheet to align with the 2012 Planning Rule.

### Management Implications

This standardized process for developing and documenting the focal species requirement of plan monitoring programs will help streamline the focal species selection process across national forests and grasslands. This toolkit guides users through a science-based approach that will help ensure that money and time are allocated toward monitoring the best possible focal species for a given set of plan components.

## Resources

**Resource 1—**Focal Species Selection Worksheet. This fillable PDF form is available at: https://www.fs.usda.gov/rm/pubs_series/rmrs/rn/rmrs_rn104_form.pdf

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# Focal Species Selection Worksheet

**Background:** Selecting a focal species or assemblage to monitor as a proxy for ecological integrity and plan effectiveness under the 2012 Planning Rule is a complex process. Clear documentation ensures that the process can be efficiently justified, reviewed, and revised in the future. This worksheet is intended to support this effort.

**Instructions:** Complete steps 1-3 once for each set of ecosystem plan components for which you are selecting a focal species. Complete steps 4-7 for each potential focal species under consideration. Refer to Taylor et al. 2025 for more information.

### 1. Identify ecological conditions and related plan content to monitor.

**Ecosystem plan component(s)** (include text and references):

**Aspects of ecological integrity:**

1

## 2. Identify monitoring questions, metrics, and indicators to measure.

**Monitoring questions:**

**Metrics and indicators:**

**Would monitoring these metrics using a focal species provide useful information about ecological conditions (even if it simply supports a more direct, affordable, accurate, or existing measure)?**

- ◯ **Yes**……*If "yes", proceed to the next step.*
- ◯ **No**……*If "no", then try Step 2 again. Return to Step 1 if needed.*
- ◯ **Unknown**……*If "unknown", proceed to the next step.*

## 3. List potential focal species to assess further.

**List of potential focal species:**

**Were you able to list at least one species?**

- ◯ **Yes**.....*If "yes", proceed to the next step.*
- ◯ **No.**.....*If "no", then try Step 2 again. Return to Step 1 if needed.*

## 4. Assess potential focal species.

**What focal species are you investigating and documenting below?**

**(A) What can we likely learn about ecological integrity from this species?**

**(B) What can we likely learn about plan effectiveness from this species?**

**Do your answers indicate that you can learn about A and B from this species?**

- ◯ **Yes**……..*If "yes", proceed to the next step.*
- ◯ **No**……*If "no", stop here. Try assessing a different species.*

## 5. Ensure an absence of external confounding factors.

**List any external confounding factors that might mask the species' response.**

**Is there an absence of any confounding factors?**

- ◯ **Yes**……..*If "yes", proceed to the next step.*
- ◯ **No**……*If "no", stop here. Try assessing a different species.*

## 6. Verify that potential focal species' biological traits are appropriate.

**(A) Does the species' trend reflect an aspect of ecological integrity?**

- ◯ **Yes**……..*If "yes", proceed to the next question.*
- ◯ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

**(B) Does the species exhibit a low range of natural variability?**

- ◯ **Yes**……..*If "yes", proceed to the next question.*
- ◯ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

**(C) Does the species rely on a single ecosystem (to ensure that changes in another ecosystem do not mask the species' response)?**

- ◯ **Yes**……..*If "yes", proceed to the next question.*
- ◯ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

**(D) Is the species' response relatively stable to human activities outside the plan?**

◯ **Yes**……..*If "yes", proceed to the next question.*
◯ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

**(E) Is there existing scientific evidence that the association between the species and Step 1 conditions is measurable at relevant scales?**

◯ **Yes**……..*If "yes", proceed to the next question.*
◯ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

## 7. Assess if it is feasible to monitor the species.

**(A) Would the cost of monitoring this species be reasonable for the unit?**

◯ **Yes**……..*If "yes", proceed to the next question.*
◯ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

**(B) Would the logistics and technical challenges of monitoring be reasonable?**

◯ **Yes**……..*If "yes", proceed to the next question.*
◯ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

**(C) Is the species sufficiently common, well-distributed, and easy to detect?**

◯ **Yes**……..*If "yes", proceed to the next question.*
◯ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

**(D) Is it feasible to detect changes during the life of the plan?**

◯ **Yes**……..*If "yes", proceed to the next question.*
◯ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

**(E) Do standardized monitoring methods exist to ensure that defensible conclusions can be drawn from the monitoring data?**

◯ **Yes**……..*If "yes", proceed to the next question.*
◯ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

**(F) Is there background knowledge about the regional, national, or global status and/or trends, making it easier to place trends of the species on the planning unit in a broader context?**

- ◯ **Yes**.....*If "yes", proceed to the next question.*
- ◯ **No**.....*If "no", stop here. Try assessing a different species.*

**Details:**

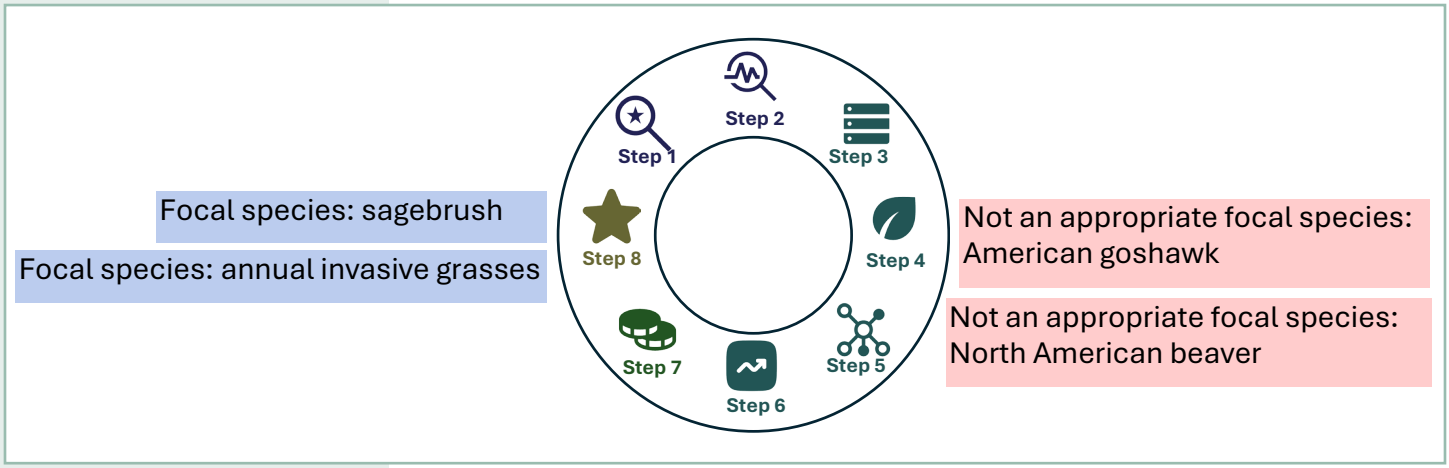
## ★ 8. Select your focal species (or species assemblage).

**If you reached the end of this worksheet, then the potential focal species you assessed may be a good option to address your monitoring questions. Proceed to monitoring method development with the proposed focal species.**

**Additional information or documentation about the species selection process:**

**Resource 2—**Real examples of how the focal species selection worksheet supports the focal species selection process.

Here, we provide four real examples of potential focal species that were considered at different national forests. We selected these species to show a range of outcomes (e.g., focal species, not an appropriate focal species) when applying the logic in the focal species selection process at the specific national forest locations.




We included sagebrush (*Artemisia* spp., deemed an appropriate focal species), annual invasive grasses, such as cheatgrass (*Bromus tectorum*, deemed an appropriate focal species), North American beaver (*Castor canadensis*, not an appropriate focal species), and American goshawk (*Astur atricapillus*, not an appropriate focal species). Example worksheets are provided below for reference. Because these are real examples, worksheet answers have "nothing noted" for sections when information was not provided. Each evaluation is case and location specific and should not be taken to mean that a particular species is either appropriate or not appropriate universally across planning units.

**Sagebrush Example:** An appropriate focal species in this case.

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# Focal Species Selection Worksheet

**Background:** Selecting a focal species or assemblage to monitor as a proxy for ecological integrity and plan effectiveness under the 2012 Planning Rule is a complex process. Clear documentation ensures that the process can be efficiently justified, reviewed, and revised in the future. This worksheet is intended to support this effort.

**Instructions:** Complete steps 1-3 once for each set of ecosystem plan components for which you are selecting a focal species. Complete steps 4-7 for each potential focal species under consideration. Refer to Taylor et al. 2025 for more information.

## 1. Identify ecological conditions and related plan content to monitor.

**Ecosystem plan component(s)** (include text and references):

FW-DC-SPEC-36: Sagebrush ecosystems support the habitat needs of Gunnison sage-grouse and other sagebrush obligate species, with a diversity of age classes, understory species, and lack of soil disturbance that allow them to resist invasion by cheatgrass.

**Aspects of ecological integrity:**

Diversity of age classes
Understory species
Lack of soil disturbance
Lack of cheatgrass

1

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## 2. Identify monitoring questions, metrics, and indicators to measure.

**Monitoring questions:**

Is the sagebrush ecosystem stable or increasing?

**Metrics and indicators:**

A healthy sagebrush ecosystem is represented by a diversity of age classes, presence of understory species, lack of soil disturbance, and a lack of cheatgrass. The trend of these indicators is stable or increasing for a healthy sagebrush ecosystem.

**Would monitoring these metrics using a focal species provide useful information about ecological conditions (even if it simply supports a more direct, affordable, accurate, or existing measure)?**

- (●) **Yes**……..*If "yes", proceed to the next step.*
- ( ) **No**……*If "no", then try Step 2 again. Return to Step 1 if needed.*
- ( ) **Unknown**……*If "unknown", proceed to the next step.*

## 3. List potential focal species to assess further.

**List of potential focal species:**

Sagebrush (Artemisia spp.)

**Were you able to list at least one species?**

- (●) **Yes**.....*If "yes", proceed to the next step.*
- ( ) **No.**.....*If "no", then try Step 2 again. Return to Step 1 if needed.*

2

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## 4. Assess potential focal species.

**What focal species are you investigating and documenting below?**

Sagebrush

**(A) What can we likely learn about ecological integrity from this species?**

A diversity of species and age classes with a lack of cheatgrass represents an intact sagebrush ecosystem. If we are seeing these characteristics on the landscape, then ecosystem integrity is intact.

**(B) What can we likely learn about plan effectiveness from this species?**

The plan aims to maintain diversity and resistance to invasion. If these metrics are not maintained, then the plan is not effective.

**Do your answers indicate that you can learn about A and B from this species?**

- (●) **Yes**……..*If "yes", proceed to the next step.*
- ( ) **No**……*If "no", stop here. Try assessing a different species.*

## 5. Ensure an absence of external confounding factors.

**List any external confounding factors that might mask the species' response.**

None. Direct management of sagebrush is only occurring to maintain ecological integrity.

**Is there an absence of any confounding factors?**

- (●) **Yes**……..*If "yes", proceed to the next step.*
- ( ) **No**……*If "no", stop here. Try assessing a different species.*

3

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## 6. Verify that potential focal species' biological traits are appropriate.

**(A) Does the species' trend reflect an aspect of ecological integrity?**

(●) **Yes**……..*If "yes", proceed to the next question.*
( ) **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

Threats to ecological integrity are the main drivers of change.

**(B) Does the species exhibit a low range of natural variability?**

(●) **Yes**……..*If "yes", proceed to the next question.*
( ) **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

None noted

**(C) Does the species rely on a single ecosystem (to ensure that changes in another ecosystem do not mask the species' response)?**

(●) **Yes**……..*If "yes", proceed to the next question.*
( ) **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

The sagebrush ecosystem is the species assemblage of interest. No other ecosystem is involved.

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**(D) Is the species' response relatively stable to human activities outside the plan?**

(●) **Yes**……..*If "yes", proceed to the next question.*
( ) **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

None noted.

**(E) Is there existing scientific evidence that the association between the species and Step 1 conditions is measurable at relevant scales?**

(●) **Yes**……..*If "yes", proceed to the next question.*
( ) **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

Sagebrush presence and structure may respond at multiple relevant scales because it is common. Monitoring has shown decline.

## 7. Assess if it is feasible to monitor the species.

**(A) Would the cost of monitoring this species be reasonable for the unit?**

(●) **Yes**……..*If "yes", proceed to the next question.*
( ) **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

The unit is already monitoring.

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**(B) Would the logistics and technical challenges of monitoring be reasonable?**

(●) **Yes**……..*If "yes", proceed to the next question.*
( ) **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

The unit is already monitoring.

**(C) Is the species sufficiently common, well-distributed, and easy to detect?**

(●) **Yes**……..*If "yes", proceed to the next question.*
( ) **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

Sagebrush is common, well-distributed, and easily detectable.

**(D) Is it feasible to detect changes during the life of the plan?**

(●) **Yes**……..*If "yes", proceed to the next question.*
( ) **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

Trends are already apparent on the sub-decadal scale.

**(E) Do standardized monitoring methods exist to ensure that defensible conclusions can be drawn from the monitoring data?**

(●) **Yes**……..*If "yes", proceed to the next question.*
( ) **No**……*If "no", stop here. Try assessing a different species.*

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**Details:**

Need more information about methods, but they do exist.

**(F) Is there background knowledge about the regional, national, or global status and/or trends, making it easier to place trends of the species on the planning unit in a broader context?**

- (●) **Yes**.....*If "yes", proceed to the next question.*
- ( ) **No**.....*If "no", stop here. Try assessing a different species.*

**Details:**

Sagebrush monitoring is occurring at regional and national scales. Global scale is not relevant.

## 8. Select your focal species (or species assemblage).

**If you reached the end of this worksheet, then the potential focal species you assessed may be a good option to address your monitoring questions. Proceed to monitoring method development with the proposed focal species.**

**Additional information or documentation about the species selection process:**

Determined that sagebrush is an acceptable focal species in this case.

**Cheatgrass Example:** An appropriate focal species in this case.

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# Focal Species Selection Worksheet

**Background:** Selecting a focal species or assemblage to monitor as a proxy for ecological integrity and plan effectiveness under the 2012 Planning Rule is a complex process. Clear documentation ensures that the process can be efficiently justified, reviewed, and revised in the future. This worksheet is intended to support this effort.

**Instructions:** Complete steps 1-3 once for each set of ecosystem plan components for which you are selecting a focal species. Complete steps 4-7 for each potential focal species under consideration. Refer to Taylor et al. 2025 for more information.

## 1. Identify ecological conditions and related plan content to monitor.

**Ecosystem plan component(s)** (include text and references):

TERR-SAGE-DC-02: Sagebrush ecosystems are resilient to fire and other disturbances including grazing, recreation, invasive species (including cheatgrass) and climate change.

SPEC-SG-DC-06: The extent and dominance of non-native annual grass species, such as cheatgrass, is limited and does not lead toward reduction in the suitability of sage-grouse habitat.

**Aspects of ecological integrity:**

Resilience to fire, grazing, recreation, invasive species, and climate change
Limited extent of non-native annual grass species' (like cheatgrass)

1

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## 2. Identify monitoring questions, metrics, and indicators to measure.

**Monitoring questions:**

Is the current extent of cheatgrass stable or decreasing? (Note: This depends on the current extent of non-native annual invasive grasses. For example, is the current extent below an acceptable threshold?)

**Metrics and indicators:**

Spatial extent and percent cover of invasive annual grasses such as cheatgrass

**Would monitoring these metrics using a focal species provide useful information about ecological conditions (even if it simply supports a more direct, affordable, accurate, or existing measure)?**

- (●) **Yes**……..*If "yes", proceed to the next step.*
- ( ) **No**……*If "no", then try Step 2 again. Return to Step 1 if needed.*
- ( ) **Unknown**……*If "unknown", proceed to the next step.*

## 3. List potential focal species to assess further.

**List of potential focal species:**

Cheatgrass (Bromus tectorum) (an example of an annual invasive grass)

**Were you able to list at least one species?**

- (●) **Yes**.....*If "yes", proceed to the next step.*
- ( ) **No.**.....*If "no", then try Step 2 again. Return to Step 1 if needed.*

2

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## 4. Assess potential focal species.

**What focal species are you investigating and documenting below?**

Cheatgrass

**(A) What can we likely learn about ecological integrity from this species?**

Increases in area or percent cover of invasive grasses indicate declines in integrity.

**(B) What can we likely learn about plan effectiveness from this species?**

Plan aims to maintain or decrease cover of annual invasive grasses. Thus, if cover is increasing, then plan is not effective.

**Do your answers indicate that you can learn about A and B from this species?**

- (●) **Yes**……..*If "yes", proceed to the next step.*
- ( ) **No**……*If "no", stop here. Try assessing a different species.*

## 5. Ensure an absence of external confounding factors.

**List any external confounding factors that might mask the species' response.**

None. Direct management of cheatgrass (e.g. removal or treatment) is intended to increase ecological integrity.

**Is there an absence of any confounding factors?**

- (●) **Yes**……..*If "yes", proceed to the next step.*
- ( ) **No**……*If "no", stop here. Try assessing a different species.*

3

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## 6. Verify that potential focal species' biological traits are appropriate.

**(A) Does the species' trend reflect an aspect of ecological integrity?**

- (●) **Yes**……..*If "yes", proceed to the next question.*
- ( ) **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

Cheatgrass trend is related to ecological integrity; if cover increases, then integrity decreases. Conversely, if direct management reduces cover, then integrity increases.

**(B) Does the species exhibit a low range of natural variability?**

- (●) **Yes**……..*If "yes", proceed to the next question.*
- ( ) **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

None noted.

**(C) Does the species rely on a single ecosystem (to ensure that changes in another ecosystem do not mask the species' response)?**

- (●) **Yes**……..*If "yes", proceed to the next question.*
- ( ) **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

We are interested in cheatgrass within the sagebrush ecosystem. Cheatgrass invasion into other ecosystems does not change our ability to make inference in the sagebrush ecosystem.

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**(D) Is the species' response relatively stable to human activities outside the plan?**

◉ **Yes**……..*If "yes", proceed to the next question.*
○ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

None noted.

**(E) Is there existing scientific evidence that the association between the species and Step 1 conditions is measurable at relevant scales?**

◉ **Yes**……..*If "yes", proceed to the next question.*
○ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

Monitoring has shown statistically significant increases over years to decades in the plan area and ecosystem of interest.

## 7. Assess if it is feasible to monitor the species.

**(A) Would the cost of monitoring this species be reasonable for the unit?**

◉ **Yes**……..*If "yes", proceed to the next question.*
○ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

We can use freely available satellite imagery to assist. The unit is already monitoring this species.

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**(B) Would the logistics and technical challenges of monitoring be reasonable?**

◉ **Yes**……..*If "yes", proceed to the next question.*
○ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

The unit is already monitoring this species.

**(C) Is the species sufficiently common, well-distributed, and easy to detect?**

◉ **Yes**……..*If "yes", proceed to the next question.*
○ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

Cheatgrass is easily detectable, common, and has a stable to increasing trend.

**(D) Is it feasible to detect changes during the life of the plan?**

◉ **Yes**……..*If "yes", proceed to the next question.*
○ **No**……*If "no", stop here. Try assessing a different species.*

**Details:**

Trends are already apparent on subdecadal time scales.

**(E) Do standardized monitoring methods exist to ensure that defensible conclusions can be drawn from the monitoring data?**

◉ **Yes**……..*If "yes", proceed to the next question.*
○ **No**……*If "no", stop here. Try assessing a different species.*

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**Details:**

There is a remote sensing invasive grass model available that includes cheatgrass.

**(F) Is there background knowledge about the regional, national, or global status and/or trends, making it easier to place trends of the species on the planning unit in a broader context?**

- (●) **Yes**.....*If "yes", proceed to the next question.*
- ( ) **No**.....*If "no", stop here. Try assessing a different species.*

**Details:**

Monitoring is occurring at regional and national scales. Global scale is not relevant.

## 8. Select your focal species (or species assemblage).

**If you reached the end of this worksheet, then the potential focal species you assessed may be a good option to address your monitoring questions. Proceed to monitoring method development with the proposed focal species.**

**Additional information or documentation about the species selection process:**

We determined that cheatgrass was an appropriate focal species in this case.

**Beaver Example:** Not an appropriate focal species in this case.

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# Focal Species Selection Worksheet

**Background:** Selecting a focal species or assemblage to monitor as a proxy for ecological integrity and plan effectiveness under the 2012 Planning Rule is a complex process. Clear documentation ensures that the process can be efficiently justified, reviewed, and revised in the future. This worksheet is intended to support this effort.

**Instructions:** Complete steps 1-3 once for each set of ecosystem plan components for which you are selecting a focal species. Complete steps 4-7 for each potential focal species under consideration. Refer to Taylor et al. 2025 for more information.

## 1. Identify ecological conditions and related plan content to monitor.

**Ecosystem plan component(s)** (include text and references):

FW-DC-RMGD-02: Within the riparian management zones, the biological composition of native plants (flora, e.g., willows and cottonwoods) and animals (fauna, e.g., beaver) support the ecosystem services (e.g., filtering of sediment, modulation of floods, carbon sequestration); providing a dynamic equilibrium of natural structure (e.g., channel morphology, floodplain development, large wood) and connectivity (e.g., periodic flooding, aquatic organism passage).
FW-DC-WTR-01: Watershed conditions and the integrity of the public water supplies are maintained or improved, and priority watersheds achieve or are moving torward a higher functioning condition class as defined by the national watershed condition framework or similar protocol.

**Aspects of ecological integrity:**

Sediment filtering
Flood modulation
Carbon sequestration
Mixture of natural structures (e.g. channels, floodplains, large wood)
Connectivity
Higher-functioning watershed condition classes

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## 2. Identify monitoring questions, metrics, and indicators to measure.

**Monitoring questions:**

Is the watershed condition stable or increasing? (Note: This question depends on the current watershed condition status.)

**Metrics and indicators:**

Watershed condition class

**Would monitoring these metrics using a focal species provide useful information about ecological conditions (even if it simply supports a more direct, affordable, accurate, or existing measure)?**

- ○ **Yes**……..*If "yes", proceed to the next step.*
- ○ **No**……*If "no", then try Step 2 again. Return to Step 1 if needed.*
- ◉ **Unknown**……*If "unknown", proceed to the next step.*

## 3. List potential focal species to assess further.

**List of potential focal species:**

Beaver (Castor canadensis)

**Were you able to list at least one species?**

- ◉ **Yes**.....*If "yes", proceed to the next step.*
- ○ **No.**.....*If "no", then try Step 2 again. Return to Step 1 if needed.*

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## 4. Assess potential focal species.

**What focal species are you investigating and documenting below?**

Beaver

**(A) What can we likely learn about ecological integrity from this species?**

Beavers are considered an ecosystem engineer because beaver ponds produce dissolved carbon and provide waterbird and fish habitat. These ponds aid sediment removal, floodplain development, and native wetland species.

**(B) What can we likely learn about plan effectiveness from this species?**

Nothing noted.

**Do your answers indicate that you can learn about A and B from this species?**

- (●) **Yes**……..*If "yes", proceed to the next step.*
- ( ) **No**……*If "no", stop here. Try assessing a different species.*

## 5. Ensure an absence of external confounding factors.

**List any external confounding factors that might mask the species' response.**

Beaver trapping is legal in Colorado from Oct 1 - Apr 30 with unlimited bag and possession (updated 7/21/22; https://cpw.state.co.us/Documents/RulesRegs/Regulations/Ch03.pdf). Thus, unless looking at a local scale where trappers cannot access a particular plan area (e.g. far distance or no snowmobile activity), beavers are probably not an appropriate focal species. However, in these cases, the answer below may be modified to a "yes".

**Is there an absence of any confounding factors?**

- ( ) **Yes**……..*If "yes", proceed to the next step.*
- (●) **No**……*If "no", stop here. Try assessing a different species.*

3

**American Goshawk Example:** Not an appropriate focal species in this case.

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# Focal Species Selection Worksheet

**Background:** Selecting a focal species or assemblage to monitor as a proxy for ecological integrity and plan effectiveness under the 2012 Planning Rule is a complex process. Clear documentation ensures that the process can be efficiently justified, reviewed, and revised in the future. This worksheet is intended to support this effort.

**Instructions:** Complete steps 1-3 once for each set of ecosystem plan components for which you are selecting a focal species. Complete steps 4-7 for each potential focal species under consideration. Refer to Taylor et al. 2025 for more information.

## 1. Identify ecological conditions and related plan content to monitor.

**Ecosystem plan component(s)** (include text and references):

FW-GDL-SPEC-07: To minimize habitat impacts and direct disturbance of raptors and migratory birds during nesting and winter periods, utilize buffers and/or timing restrictions.

**Aspects of ecological integrity:**

None noted.

1

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## 2. Identify monitoring questions, metrics, and indicators to measure.

**Monitoring questions:**

Are raptors being disturbed during nesting and winter periods?

**Metrics and indicators:**

Raptor response to disturbance is indicated by reduced adult occupancy or abundance and/or nestling survival. Other status metrics could be considered.

**Would monitoring these metrics using a focal species provide useful information about ecological conditions (even if it simply supports a more direct, affordable, accurate, or existing measure)?**

- ○ **Yes**……..*If "yes", proceed to the next step.*
- ○ **No**……*If "no", then try Step 2 again. Return to Step 1 if needed.*
- ◉ **Unknown**……*If "unknown", proceed to the next step.*

## 3. List potential focal species to assess further.

**List of potential focal species:**

American goshawk (Astur atricapillus)

**Were you able to list at least one species?**

- ◉ **Yes**.....*If "yes", proceed to the next step.*
- ○ **No.**.....*If "no", then try Step 2 again. Return to Step 1 if needed.*

2

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## 4. Assess potential focal species.

**What focal species are you investigating and documenting below?**

American goshawk

**(A) What can we likely learn about ecological integrity from this species?**

Goshawks are a prey generalist and use broad landscapes that incorporate multiple spatial scales for nesting and foraging (Squires and Kennedy 2006). As such, we cannot learn much about ecological integrity from monitoring the metrics and indicators identified for this species in Step 2.

**(B) What can we likely learn about plan effectiveness from this species?**

Goshawk trends can respond to more than nest disturbance (Squires and Kennedy 2006). As such, we cannot learn much about plan effectiveness from monitoring the metrics and indicators identified for this species in Step 2.

**Do your answers indicate that you can learn about A and B from this species?**

- ○ **Yes**……..*If "yes", proceed to the next step.*
- ◉ **No**……*If "no", stop here. Try assessing a different species.*

## 5. Ensure an absence of external confounding factors.

**List any external confounding factors that might mask the species' response.**

**Is there an absence of any confounding factors?**

- ○ **Yes**……..*If "yes", proceed to the next step.*
- ○ **No**……*If "no", stop here. Try assessing a different species.*

3

**Resource 3—**This is a crosswalk between each step in the focal species selection process in this document and the Forest Service Handbook (FSH 1909.12 – Chapter 30). The 2012 Planning Rule requires two types of monitoring—the plan monitoring program and the broader-scale monitoring strategy—and each planning unit must select at least one focal species to provide a baseline for inference to ecological integrity.

| Steps | Forest Service Handbook reference |
|---|---|
| **Step 1.** Identify ecological conditions to monitor. | **FSH 1909.12_32.13c: (a)** Identifying[1] the plan-related ecological conditions or key ecosystem characteristics to be monitored. **FSH 1909.12_32.13c: (b)** The Responsible Official has discretion to choose a select set of ecological conditions to be monitored for ecosystems and at-risk species. |
| **Step 2.** Identify monitoring questions, metrics, and indicators. | **FSH 1909.12_32.13c: (c)** Identifying gaps in monitoring indicators for key ecological characteristics. **(g)** Considering the ability for the species to be a more direct and effective measure of ecological characteristics of interest than other potential monitoring indicators. |
| **Step 3.** List potential focal species to consider further. | **FSH 1909.12_32.13c: (d)** Identifying well-recognized keystone species, ecological engineers, and other species with strong ecological interactions with these ecosystems. |
| **Step 4:** Assess potential focal species. | **FSH 1909.12_32.13c: (h)** Considering the ability of the selected species to provide data for multiple purposes. |
| **Step 5.** List external factors affecting potential focal species. | **FSH 1909.12_32.13c: (e)** Considering the sensitivity of a species to changing ecological conditions or the species' utility in reflecting progress toward or maintenance of desired ecological conditions. |
| **Step 6.** Check potential focal species' relevant biological traits. | **FSH 1909.12_32.13c: (e)** Considering the sensitivity of a species to changing ecological conditions or the species' utility in reflecting progress toward or maintenance of desired ecological conditions. **(f)** Considering efficacy of monitoring the species for determining changes in the ecological conditions or key ecosystem characteristics. |
| **Step 7.** Evaluate monitoring constraints for each species. | **FSH 1909-12_32.13c: (i)** Considering the Agency's ability to effectively and efficiently monitor the species within its technical and financial capabilities. |

[1] FSH 1909.12 Ch. 10, Sec. 12.1 and Ch. 20 Sec. 23.11

**Resource 4—**Background information on focal species and other species designations (U.S. Forest Service designations first, ecological designations second) that species designations may encompass depending on the context (USDA 1999). Ecological designations are often good options for focal species (Committee of Scientists Report USDA 1999).

**U.S. Forest Service Designations**

**At-risk species** (according to the 2012 Planning Rule): A federally-recognized species under the Endangered Species Act (and includes **threatened, endangered, proposed, and candidate species)** and/or a species of conservation concern (SCC).

**Focal species** (according to the 2012 Planning Rule): A species whose status permits inference about ecological integrity and provides meaningful information about plan effectiveness in maintaining or restoring ecological conditions to support plant and animal diversity. A focal species is typically selected based on its ecosystem functional role (36 CFR 219.19)

**Management indicator species** (MIS; according to the1982 Planning Rule): A plant or animal species, community, or habitat that is emphasized during planning and monitored during forest plan implementation. The MIS is used to assess the effects of management activities on a particular population in addition to populations of other species with similar habitat needs (FSM 2620.5).

**Sensitive species** (Regional Forester's List; according to the 1982 Planning Rule): A plant or animal species identified by a regional forester for which population viability is a concern based on: (1) a significant downward abundance or density trend (current or predicted); (2) a significant current or predicted downward trend in habitat that would reduce a species' existing distribution.

**Species of local interest** (not an official designation): A species that may not meet the SCC definition (see below) but is of local interest and/or is culturally significant.

**Species of conservation concern** (SCC; according to the 2012 Planning Rule and Forest Service Handbook): A species (other than a federally recognized threatened, endangered, proposed, or candidate species) that is known to occur in the plan area and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area (36 CFR 219.9(c)).

**Ecological Designations**

**Ecological engineers:** A species that alters its habitat and affects others (Jones et al. 1994).

**Indicator species:** A species that is indicative of a larger functional group (Dufrêne and Legendre 1997).

**Keystone species:** A species that has effects on a critical ecological process or biological diversity that is greater than expected based on its abundance or biomass (Simberloff 1998).

**Link species:** A species with a critical role in matter and energy transfer in complex food webs (Cohen and Briand 1984, Pimm et al. 1991).

**Umbrella species:** A species that requires large areas or multiple habitats.

**Resource 5—**Potential analyses to address information needs at different steps.

Different analysis methods are possible for a subset of steps in the focal species selection process if a literature review (available science) does not yield answers to questions within each of these steps. The following steps do not need analysis: Step 1 (Identify ecological conditions and related plan content to monitor); Step 2 (Identify monitoring questions, metrics, and indicators), Step 3 (List potential focal species to consider further), and Step 5 (Ensure an absence of external confounding factors).

Here are a few quantitative analysis types and further details for initiating analysis discussions among the team or with partners, if needed, for Steps 4, 6, and 7. If you need assistance with analyses, reach out to a Forest Service Regional Office, Forest Service Research & Development, universities, other research organizations, other Forest Service units, the Forest Service Washington Office, or communities of practice.

| Steps | Analysis types | Details |
|---|---|---|
| **Step 4.** Assess potential focal species. | 1. Multi-species community[1]<br>2. Cause and effect | • Multi-species community anyalsis can be used to track trends with other species to select a species assemblage<br>• Experimental designs[2] can be used to determine cause and effect<br>• Before-after control-impact[3] (BACI) quasi-experimental design, if possible, with management actions |
| **Step 6.** Verify that potenital focal species and biological traits are appropriate. | 1. Multi-scale occupancy[4,5], abundance[6], or other status metric[7] with habitat covariates<br>2. Multi-species community[1]<br>3. Trend analysis with 5 or more years of data<br>4. Cause and effect | • Requires continuous spatial data at multiple scales<br>• Multi-species community anyalsis can be used to track trends with other species<br>• Multiple years are needed to evaluate population variability or cyclicity in trend analyses<br>• Habitat covariates include climate, different ecosystems, and human activities (e.g. cultivation, development, noise)<br>• Experimental designs[2] can be used to determine cause and effect<br>• BACI[3] quasi-experimental design, if possible, with management actions |
| **Step 7.** Assess if it is feasible to monitor the species. | 1. Power analysis with costs[8]<br>2. Occupancy[4]<br>3. Abundance[6]<br>4. Trend analysis with 5 or more years of data | • Existing data sets can be used for power analyses<br>• *Ad hoc* observations can contribute to monitoring schemes through data integration[9] approaches to increase species' detections<br>• Large-scale data sets needed to evaluate regional, national, or global status/trends and population variability or cyclicity |

1 Dorazio et al. 2006 ; Iknayan et al. 2014 ; MacKenzie et al. 2006

2 Block et al. 2001

3 Green 1979; Stewart-Oaten et al. 1986; Underwood 1991

4 MacKenzie et al. 2006

5 Nichols et al. 2008; Pavlacky et al. 2012

6 Buckland et al. 2001; Jolly 1965; Otis et al. 1978; Pollock 1982; Royle and Young 2008; Seber 1965

7 Status may include metrics of abundance, distribution, reproduction, presence or absence, area occupied, survivorship, or other demographic parameters. See table 8.1 in Sanderlin et al. 2019 for more examples.

8 Field et al. 2005; Sanderlin et al. 2014; Williams et al. 2018. Also see Resource 6 for an example.

9 Miller et al. 2019; Schaub and Abadi 2011; Zipkin et al. 2020

**Resource 6—**Considerations for designing a focal species monitoring program.

Robust focal species monitoring designs require careful planning and support. Monitoring can be costly; thus, it is important to implement thoughtful study designs to meet objectives. Although the details of designing monitoring programs are beyond the scope of this toolkit (and are further described in FSM 2000—National Forest Resource Management, Chapter 2040 – National Forest System Monitoring), we note a few key points to keep in mind in the context of the information in FSM 2000—National Forest Resource Management, Chapter 2040 – National Forest System Monitoring. If you need assistance, consider reaching out to the applicable Forest Service unit, regional office, community of practice, the Washington Office, or Research & Development program area. They can connect you with technical support, which may include universities or other research organizations.

**Robust monitoring includes eight distinct steps** (Sanderlin et al. 2019):

1. Formulate clear questions and objectives.
2. Select appropriate population metrics to address questions.
3. Determine if there is sufficient statistical power to answer the questions given any logistical or financial constraints.
4. Develop a sampling design that fulfills the four main questions of what, where, when, and how.
5. Ensure data quality controls are in place before monitoring begins. This includes field protocols, a data management plan, observer training, data collection tools, data entry systems, and a data storage, archiving, or backup plan.
6. Conduct quality assurance and quality control alongside data collection.
7. Use appropriate models to analyze data.
8. Modify sampling design or models based on species' statuses.

**Monitoring programs may benefit from creative thinking about data collection**

- ***Who may be able to help?*** Consider engaging partners, stakeholders, tribes, or participatory scientists (otherwise known as citizen scientists, community scientists, and volunteers) to provide monitoring capacity and expertise. Participatory scientists can be important contributors to robust monitoring programs (Sanderlin et al. 2022).
- ***What other sources of data might augment the monitoring program?*** As long as a structured monitoring dataset is the foundation of the monitoring program, there are cases where ad hoc observations may contribute to monitoring schemes through data integration approaches (Miller et al. 2019; Schaub and Abadi 2011; Zipkin et al. 2020). However, these data integration methods are complex, so it is critical to work with a research scientist or statistician if this is of interest.
- ***Know when to say no.*** If there is likely to be inadequate support to achieve monitoring objectives, then monitoring should not be done (Legg and Nagy 2006).

**Optimal monitoring program designs balance costs with precision of species metrics**

- ***Consider the available budget.*** As monitoring effort and associated costs increase, the precision of species' status metrics will increase sharply at first before leveling off. The optimal sampling design occurs at the point where the increases in precision start to become negligible when compared to the cost required to achieve the precision increase. To illustrate the process of selecting an optimal design, consider a scenario where agency leadership and stakeholders have an objective of maximizing precision of a species metric, subject to budgetary and precision constraints. A constrained optimization framework can be used to identify (1) decision variables, (2) an objective function, and (3) constraints (Taha 2011, p. 14). Monitoring is only advised if it is possible to achieve the minimum precision needed to answer the monitoring questions within the existing budgetary constraints.

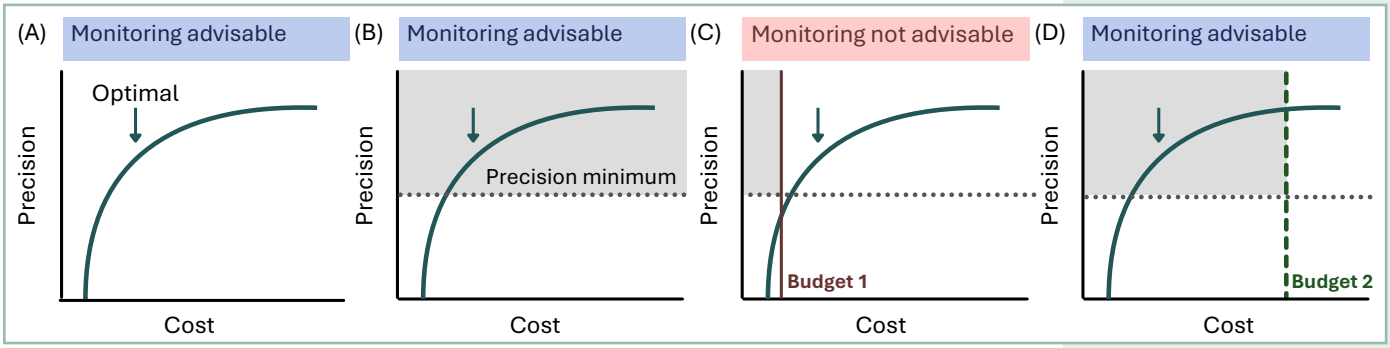


Chart A shows the optimal monitoring design (teal arrow) where increases in precision start to become negligible when compared to the cost. Chart B adds the minimum precision (dashed gray horizontal line) needed for monitoring; monitoring should be limited to the gray shaded area. Chart C adds the constraint of a small budget; since the minimum precision is not met, monitoring is not advisable. This scenario would allow leadership to justify allocating more money to this monitoring program or not to monitor at all. Chart D adds the constraint of a large budget; monitoring should be limited to the gray shaded box. This scenario would allow leadership to reallocate some money elsewhere since spending more money than the optimal design will provide little gain in precision (i.e., minimal return on investment).

**Monitoring programs can serve as a foundation of adaptive management**

- ***The value of power analyses.*** Although it adds another technical step, we recommend conducting power analyses that take costs into consideration (Field et al. 2005; Sanderlin et al. 2014; Williams et al. 2018). This can be done using existing datasets, simulated datasets, or leveraging other monitoring programs to evaluate the practicality of sustained monitoring and the ability to detect change during the life of the monitoring plan. This will help to ensure that data collection is as efficient as possible, and that funding is used responsibly.
- ***Adaptive management.*** Adaptive management, or adaptive decision making, is an iterative process for simultaneously managing and gaining knowledge about natural resources. The design of the monitoring program can form the foundation of an adaptive management framework with clearly defined thresholds or 'trigger points' (Schultz et al. 2013) and by considering data needs (both duration and frequency) for future *plan* revision assessments when evaluating funding and capacity.

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