Indicator Species in the INRMP

Indicator species are a subset of species of the full suite of species historically present in an area who tell something about the ecological conditions and function of that area. These species should be those most sensitive to impairment or loss of the ecological attributes or whose loss would negatively influence many other species. These species may provide an umbrella function for other species or represent large groups of other species, they may be "ecosystem engineers" in that they are responsible for the shape, form, and function of major ecological processes, and/or they may provide an efficient way to represent a planning goal – such as biodiversity protection.

Selection of ***indicator species*** may depend on what the species are needed to indicate – habitat condition, land-use effects, changes due to natural disturbance. The species need to be linked to particular habitats or ecosystem types and changes in those habitats and ecosystems. An ideal ***indicator species*** should inform management decision-making that affects the species, other species, and the habitats in which the species lives.

Selected indicator species will be needed to meet multiple planning, representation and sensitivity needs Planning needs include criteria that are very specific to the objectives that are set for any given conservation plan, project, or program (such as the INRMP). Certain species may rank high for planning needs, but rank lower for biodiversity needs. Other species may rank higher for biodiversity needs, but lower for social and economic (e.g., planning) needs. Finally, certain species may be more sensitive to climate change and land uses. It is unlikely that any one, or small set of, species will rank highly for all planning needs. The goal is to come up with a suite of species that ranks high for all needs and therefore meets the multiple demands put on the species by the INRMP.

Limitations and benefits of indicator species approach

The primary benefits of using indicator species are that they provide an efficient way to characterize the potential and/or actual ecological values of a particular place. When used in combination with land cover information (e.g., vegetation types) and wildlife occurrence data, indicator species distributions can inform land-use, transportation, and conservation planning. Vegetation information can be used to determine the potential presence or absence of individual species or groups of species. Aquatic and terrestrial surveys can provide useful information about the actual occupancy of species in specific areas.

The limitations of using the indicator species approach are primarily 1) the use of a subset of all species for planning and 2) the tendency to use potential presence and absence of indicator species rather than actual presence or absence. (1) Selecting just a fraction of the plant and animal species present in an area (e.g., western El Dorado County) runs the risk of neglecting the needs of species that are not selected. There is a balance between choosing few species and many indicator species to ensure complete representation of the issues and other species to meet planning needs. (2) Most projects using indicator species will model the potential distribution of animal and plant species across the landscape, primarily because of the perceived expense with mapping actual distributions. This limitation is easily overcome by carrying out extensive surveys in aquatic and terrestrial habitats.

Needs and Goals

Indicator species are most useful when they are chosen to indicate conditions in an ecosystem, to serve particular goals for a planning process, monitoring requirement, restoration program, conservation, or to understand the impacts of various human activities. For example, for the Sierra Nevada National Forests, the US Forest Service has a list of 13 individual "management indicator species" (MIS) and aquatic invertebrates that, as a group, can be used to understand the effects of legacy and future decisions and actions on National Forest ecosystems, in similar ways that the County could use in conservation planning under the INRMP. These MIS species and groups of species were chosen from a list of 62 individual species and 8 species groups (e.g., riparian bird assemblages) that were considered important by individual National Forests and most of which occur in El Dorado County. Some of these species may be useful as indicator species in the INRMP process.

<u>Examples of needs and goals for indicator species</u>

- To indicate changes in condition of habitats and landscape in response to land-use and transportation
- To efficiently represent a broad selection of other species and their needs by utilizing a small suite of species with similar life-cycle requirements
- Could themselves be important to ecosystem structure and function
- Could be a species with narrow, yet crucial, habitat needs not represented by wide-ranging species

Indicator species often are needed for multiple planning goals, including biodiversity protection, meeting social goals, and responding to economic needs. Within each of these goals there may be corresponding objectives that help with selection criteria and choice of species.

For suites of indicator species to meet biodiversity, social and economic needs criteria must be established that summarize how each species can meet multiple needs. This process is a hierarchical and stepwise process that should first define the objectives and goals of the conservation/planning process, then identify the corresponding selection criteria, and finally select the suite of species that can meet these needs. This suite of species will need to meet multiple overlapping needs, as well as specific needs that will require particular species to be considered.

Selection Criteria

In order to select appropriate indicator species from the full suite of species present in an area, the full array of potential impacts to biodiversity in that area should be catalogued. Once these impacts have been identified, the species present in western El Dorado County can be assessed for sensitivity to these impacts. For each potential impact, the species most sensitive should be considered an indicator species in the planning process.

Phase I of the INRMP includes selection of indicator species likely to be useful in Phase II planning and implementation, which includes consideration of the kinds of impacts and conservation opportunities that should be considered. Ecosystem and species-level impacts can be broken into two classes, those to be addressed through management guidelines and those most effectively addressed through conservation and restoration actions. There are fiscal and political

limitations on buying land for biodiversity protection in the Sierra Nevada foothills (Shilling and Girvetz, 2007). For certain critical needs, such as isolated and declining populations or habitats and choke-points for animal movement, fee title protection of lands may be the best option. Most impacts should be dealt with through management guidelines. Species that can be protected through this approach include process-limited species, sensitive to the departure of natural ecological processes from the historical norm or newly introduced processes for which they are not adapted. Examples could be changes in fire regime or presence of invasive species. Other species that are area-limited, dispersal-limited, and resource limited species may also be protected through land management guidelines. Area-limited species are those most at risk from direct habitat loss in the study area. This loss can be overall loss of natural vegetation or reduction in total area of specific types of vegetation required by that species. Generally speaking, these are wide-ranging species that require large, intact areas to meet their resource needs. Dispersal-limited species require the ability to move across the landscape either seasonally (for resource exploitation) or across generations (for genetic exchange and metapopulation dynamics). These species are sensitive to habitat fragmentation rather than habitat loss per se. Finally resource-limited species are at risk from loss of specific resource types, such as food or shelter.

One way to inform selection criteria is by defining important potential impacts to species. In western El Dorado County, these could include:

- Overall loss of native vegetation, including:
    - Loss of oak woodland
    - Loss of grassland
    - Loss of riparian forest
    - Loss of wetlands
    - Loss of chaparral
    - Loss of serpentine outcrop habitat
- Fragmentation of native vegetation
- Reduction in aquatic connectivity
- Impaired water quality
- Alteration of hydrologic regimes
- Impairments related to grazing
- Alteration of fire regime
- Invasive species

Indicator species may be selected based on a number of criteria, which are in turn based upon the needs and goals that the species are intended to serve and the threats that face them. These criteria could include the list below, as well as criteria such as avoiding redundancy with other indicator species and responsiveness to threats and change.

Possible attributes of selected indicator species:

- Wide ranging
- Representative of other species
- Regulatory concern
- Strongly-interactive with other species

- Have large effects on community structure and function
- Have effects that are disproportionately large relative to abundance
- Perform unique roles
- Are habitat (area, resource, process) limited

(Kotliar, 2000; Lambeck, 1997; Noss et al., 1997; Power et al., 1996)

Examples of Use in Decision-Making

The idea of indicator species is used in various management and planning contexts in the US and in our region. The Placer County Planning Department has chosen this definition for focal species, a related concept to indicator species: "…*species that provide insights to the larger ecological systems with which they are associated*". The following is a list of other examples where indicator species are being used:

- USFS Management Indicator Species (aquatic and terrestrial)
- USEPA Indicator Species (primarily aquatic)
- USFWS Migratory Bird Program
- Colorado Division of Wildlife (aquatic and terrestrial)
- Point Reyes Bird Observatory (Placer County & oak woodlands generally)
- Tahoe Regional Planning Agency (Environmental Improvement Program)

Examples of Indicator Species

The following is a summary list of vertebrate species (or groups of species) that may meet criteria based upon potential impacts (species in parentheses):

- Overall loss of native vegetation (mule deer), including:
    - Loss of oak woodland (acorn woodpecker)
    - Loss of grassland (badger)
    - Loss of riparian forest (riparian bird assemblages)
    - Loss of wetlands (CA red-legged frog)
    - Loss of chaparral (mountain lion)
    - Loss of conifer forest (northern goshawk)
    - Loss of serpentine outcrop habitat (serpentine plant communities)
    - Loss of vernal pools (vernal pool community)
- Fragmentation of native vegetation (mule deer, bobcat)
- Reduction in aquatic connectivity (salmonids)
- Impaired water quality (foothill yellow-legged frog, CA red-legged frog)
- Alteration of hydrologic regimes (foothill yellow-legged frog)
- Impairments related to grazing (mule deer)
- Alteration of fire regime (northern goshawk)
- Invasive species (CA red-legged frog)

The following are examples of indicator species that meet one or more INRMP planning goals, meet selection criteria described above, and are responsive to various potential impacts.

Goal: To indicate changes in condition of habitats and landscape in response to land-use and transportation

1) Mule Deer/Black-Tailed Columbia Deer

a) Species description

Family Cervidae, Sub-Family: Capreolinae (New World Deer), *Odocoileus hemionus*

Herbaceous and shrub layer browsers; dwell in oak woodland and other forested areas near open meadows, shrublands, and recently-burned areas. Nearer to the valley, they will occur in riparian zones because of the natural cover there. They tend to stay near (<2 miles) water sources (lakes, ponds, streams).

Mountain populations will usually summer at higher elevations and winter at lower elevations, with migratory pathways between. In milder climates, like the Central Valley and foothills, populations may not migrate. Both populations can co-exist. Female deer do not disperse, but males do. Large groupings can occur in the winter, but during summer, small groups predominate, as opposed to herds.

Natural Predators (in order of importance): mountain lions, coyotes, eagles, bobcats
Other causes of mortality: loss and fragmentation of habitat, wildlife-vehicle collisions, feral/domestic dogs, disease, winter starvation

b) Why are deer important to this ecosystem and the INRMP?

Deer are ecosystem engineers – They can occur in large numbers and browse herbaceous plants and shrubs. Deer over-browsing can cause changes in under-story and shrub diversity and cover (Stockton et al., 2005), resulting in declines in habitat quality for other animals (Allombert et al., 2005a,b). Over-browsing can be controlled through the maintenance or re-establishment of predator-prey relationships. Deer browsing is also responsible for the positive benefit of opening forest floors to light through shrub removal.

Deer in wildlife-vehicle collisions – When vehicles collide with deer there are a variety of possible public safety, vehicle damage, and animal population effects. Collisions occur with fairly consistent timing, with the greatest number occurring in the evening and during fall and early winter.

Deer migration – Many deer populations rely on the ability to move between winter foraging habitat at lower elevations and summer fawning areas at higher elevations. This movement often follows a combination of familiar pathways and least-disturbed areas. Deer can also occupy

habitat without migration, as may be the case in the Sierra Nevada foothills. For these deer, movement will still be required among foraging areas, potentially bringing them into conflict with land-use and transportation infrastructure.

c) What do we know?

i. Meeting Selection Criteria

1. Efficiently represents a broad selection of species:

Because of their reliance and use of many habitat types, deer can carry out an umbrella function, meaning that they cover the needs of other species using similar areas.

2. Indicates changes in condition of habitats and landscapes:

Deer are sensitive to fragmentation from roads and intensive land-uses, but are less sensitive to low levels of development. They can represent the needs of species that are moderately to less sensitive to fragmentation impacts. Deer foraging improves in burned areas due to the growth of herbaceous and shrub types of vegetation. They may decline in the absence of fire, or this type of vegetation.

ii. Knowledge

Deer behavior, life-cycle, and habitat needs are fairly well understood in a general way. Important questions that remain include: differences between migratory and non-migratory deer in the foothills, impacts to foothill deer populations in the absence of significant predator pressure, and actual occupancy and use of specific areas for wintering, fawning, foraging, and migration.

iii. Data Sources

One important source of data about deer distributions is the California Wildlife Habitat Relations (CWHR) model developed by the California Department of Fish and Game (CDFG). This model can be used to show the distribution of habitat quality (from low to high) throughout the county. Another important source of data is mapped occurrences of deer while fawning and in winter ranges. These data are primarily from the CDFG, but may not be recent.

2) California red-legged frog (*Rana aurora draytonii*)

a) Species description:

Status: USFWS Threatened, IUCN Vulnerable

b) Why are they important?

Threats: habitat loss and fragmentation (wetlands specifically), invasive species (bass, mosquitofish), water quality (agrochemical pollution)

Planning activity: Identify enough wetland habitat for protection/restoration for persistence of populations into the foreseeable future, identify barriers to movement between adjacent wetland areas, identify potential sources of pollution in habitat areas

c) What do we know?

i. Data Sources?

Since CRLF is an endangered species, their presence is closely monitored by governmental agencies whose information is made public.

3) Northern goshawk (*Accipiter gentilis*)

a) Species description

Status: BLM Sensitive Species

b) Why are they important?

Threats: Loss of conifer forest (through logging), alteration of historic fire regime (potential for higher severity, stand-replacing fires)

c) What do we know?

Planning activity: identify enough intact conifer forest blocks to support populations into the foreseeable future, identify opportunities for prescribed and managed wildland fires

Citations

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