

TERRESTRIAL ECOLOGY



Widespread changes in biophysical conditions and disturbance patterns, coupled with increased human activity, have altered habitat available for diverse plant and animal species. The ICBEMP compiled the first catalog of biodiversity of the Basin, revealing diverse communities of fungi, lichens, plants, invertebrates (species without backbones, including insects and mollusks), and vertebrates. However, most species groups are unstudied.

Over 43,000 species of macroorganisms are estimated to occur in the assessment area and 17,186 species are known to occur. Micro-organisms, critical to ecosystem health and function, probably tally at least several hundred thousand species. This biodiversity results from the wide variety of habitats, topographic conditions, and prehistoric events within the study area. Over 14,000 species of macroorganisms were studied, and 1,339 individual species and 143 species groups were included in a database on species-environment relations (SER). Just under 300 species (excluding fish) were identified that are of particular interest to American Indian tribes.

Products from the terrestrial assessment of greatest potential interest to land managers include: (a) lists of habitats and associated species with greatest declines in area or distribution since historic times; (b) Species-Environment Relations databases listing species by habitats and ecological functions for use in determining potential effects of ecosystem management activities and in proactively crafting such activities to emphasize or restore specific habitats or functions; (c) 528 Geographic Information System (GIS) maps of species

distribution and additional maps on areas of high biodiversity and species rarity and endemism; and (d) descriptions of key ecological roles of fungi, lichens, bryophytes, and invertebrates for maintaining ecosystem health and long-term productivity and sustainable use of resources.

Species at Risk

There are 19 endangered, 10 threatened, and 7 candidate terrestrial and aquatic species within the Basin listed under the Federal Endangered Species Act (**table 4**). The FS and BLM list 538 species (excluding fish) as sensitive. Some of the threatened and endangered species and many of the additional species of potential conservation concern are dependent on environmental or habitat components not evaluated at the broad scale.

A number of other taxa, especially plants and invertebrates, are worthy of additional attention: 394 fungi species, 40 functional groups of lichen species, sundry types of microbiotic crusts (not classified), at least 400 apparently regionally rare bryophyte species, 280 individual vascular plant species and 82 rare plant communities, 144 rare and endemic invertebrates (gastropods and insects), and various vertebrates. Basic inventories are needed for many of these species to determine their true rarity.

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Table 4— Numbers of taxa (species, subspecies, fish stocks) by Federal listing status, and of special interest to American Indian tribes.

Class	U.S. Fish and Wildlife Service					Forest Service and Bureau of Land Management				
	Candidate	Threatened	Endangered	Federally Proposed Threatened	Federally Proposed Endangered	FS Sensitive	BLM Sensitive	Joint FS/BLM Sensitive	Total FS/BLM Sensitive	Tribal
Nonvascular Plants	0	0	0	0	0	3	10	1	12	4
Vascular Plants	2	1	3	0	1	371	113	45	439	205
Invertebrates	0	1	5	0	0	0	25	0	25	16
Fish	3	4	7	0	0	(...see <i>Component Assessment, Aquatic Species and Habitats</i> chapter...)				
Amphibians	1	0	0	0	0	2	5	2	5	0
Reptiles	0	0	0	0	0	1	5	0	6	2
Birds	0	3	2	0	0	22	23	12	34	34
Mammals	1	1	2	0	0	11	12	6	17	35
TOTAL	7	10	19	0	1	410	193	66	538	296

Listing status classes: Forest Service sensitive (in at least one state within the assessment area); Bureau of Land Management sensitive (in at least one state within the assessment area); Joint FS/BLM sensitive = same species listed by both FS and BLM as sensitive; TRIBAL = species identified by the ICBEMP Science Integration Team as of particular interest to American Indian tribes.

Species-Environment Relations

The SER database identified species closely associated with condition affected by management including forest canopy, mistletoe brooms, dead parts of live trees, trees with exfoliated bark, snags, down wood, litter and duff, fire, insect outbreaks, recreation, roads, and trails.

Native grasslands (*Fescue* bunchgrass, *Agropyron* bunchgrass), shrublands (big sagebrush), and old single-stratum and multi-strata stages of many forest types, especially lower montane ponderosa pine forests, have declined in total area and shifted in distribution since historic times. Declines are on both Federal and non-Federal lands, with most declines on non-

Federal land. Many native species of fungi, lichen, plants, invertebrates, and vertebrates are associated with these types. Vertebrate species associated with the decline of old-growth forests include primary cavity excavators, predators and other species with large home ranges, and largely-unstudied species groups associated with forest canopies. Vegetation types (along with associated species) that have increased in total area and

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distribution since historical times include young successional stages of forests, conifer-encroached sagebrush, disturbed riparian conditions, and exotic plant communities.

Probably no terrestrial vertebrate has become regionally extinct in recent historic times, with the possible exception of the purple martin. Information on extinction of most non-vertebrate taxa is lacking. Some wide-ranging carnivores have greatly decreased in abundance and distribution and become locally extirpated (but not regionally extinct) in the Basin. Also, some small-bodied, less widely-vagile species may be at greater risk of declines or local extirpations. Edges of ranges are important for species conservation.

Fungi—The fungal flora and the effects of management activities on fungi are poorly known. Some species are important to recreational and commercial gatherers. Many kinds of fungi occur in the Basin, including species with narrow distributions, that fruit after fire, that fruit in dung, and that are mycorrhizal and saprophytic and



Lichen serve many ecosystem functions and roles. Basic lichen surveys and studies of management effects are needed to supplement our currently poor knowledge base.

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thus depend on host plants. These fungi vitally contribute to plant and soil productivity. Fungi conservation can include protection of type localities in small, site-specific mycological (fungi species) preserves, inventory or survey of potentially rare species, and further study of biology and ecology of species.

Lichens—The key ecological roles of lichens include contributing mass and nutrients to litter and duff, increasing canopy and soil moisture-holding capacity, fixing atmospheric nitrogen, serving as food for animals, and acting as bioindicators for air quality. Some species are important to American Indians. The 736 lichen species were divided into 40 functional groups based on ecological relations. The groups occur on four main substrates: dead organic matter; corticate and decorticate wood; rock; and soil. Lichens are major components of native rangelands and provide critical soil functions, but have been threatened by exotic grasses, increased fire frequency, conversion of rangelands, and livestock trampling. Lichens are part of microbiotic crusts and are susceptible to damage from livestock grazing and trampling. One lichen, *Texosporium sancti-jacobi*, is listed as a Category 2 (C2) candidate species. Providing clumps of old trees and uneven-aged stands for their legacy of lichens can improve conservation of lichens.



The diversity of the Basin's native flora reflects the complexity of its biophysical environments.

Bryophytes—Most bryophytes have wide, Arctic-alpine and boreal distributions. Others are coastal and north Pacific or occur in arid environments as part of soil crusts; four taxa are endemic to the ICBEMP assessment area. Eleven ecological groups of bryophytes were identified based on common use of substrates. Changes in water quality affect aquatic submerged and wet-rock species. Forest canopy openings often adversely affect mycorrhizal species associated with decaying wood and forest humus and duff. Commercial collection of bryophytes may affect some of the humus and duff species. Other species in bogs, fens, and other environments are poorly studied. Dry soil species are critical to soil protection. Many species, at least 400, may be regionally rare but may need inventory to better determine their status, especially those occupying arid habitats,

peatlands, floodplains, geothermal areas, isolated canyons, and on calcareous rocks and mineralized deposits. Bryophyte conservation can include training for identification, adding bryophyte identification to field vegetation plot data, and inventory of bryophytes in protected areas.

Vascular Plants—Vascular plants in the assessment area number at least 8,000 species, which include at least 154 local or regional endemics (found only in the area). This diversity results from complex biophysical environments along gradients of elevation, bedrock and soils, temperature, and moisture. Native plant communities have declined significantly in the assessment area, prompting concerns about future conservation of rare species and rare plant communities. Of particular concern are communities affected by grazing, introduction of exotic species, and timber

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harvesting. The sustained harvestability of some 205 plant taxa are of concern to American Indians. Conservation measures for all plants could include: monitoring of rare species and plant communities; off-site collection of pollen, seeds, and rare plants; and protection of key areas of high species rarity, endemism, and diversity.

Invertebrates—No terrestrial invertebrate species is listed as Threatened, Endangered, or Candidate (although five aquatic invertebrates are threatened or endangered). The FS does not list any as sensitive, whereas the BLM lists 25 as sensitive. Some 95 terrestrial mollusks would benefit from conservation attention singly or as groups; many of these are confined to calcareous substrates. Invertebrates are critical components of many ecosystem functions including detritivory (breakdown of matter) and nutrient cycling. There are 104 rare and endemic species that bear further watching. Functional roles of invertebrates include: detritivory and nutrient cycling; maintaining soil structure, chemistry, and productivity; wood decomposition; herbivory; pathogenic effects on other organisms as well as control of disease-causing organisms. Invertebrates can make excellent bioindicators of soil and vegetation health.

Most arthropods (insects, spiders, and crustaceans) are poorly known, and many are unnamed. Arthropod predators may control other invertebrate populations including some defoliator pests, and require a mix of habitat types, down wood, and vegetation substrates. Invertebrate pollina-

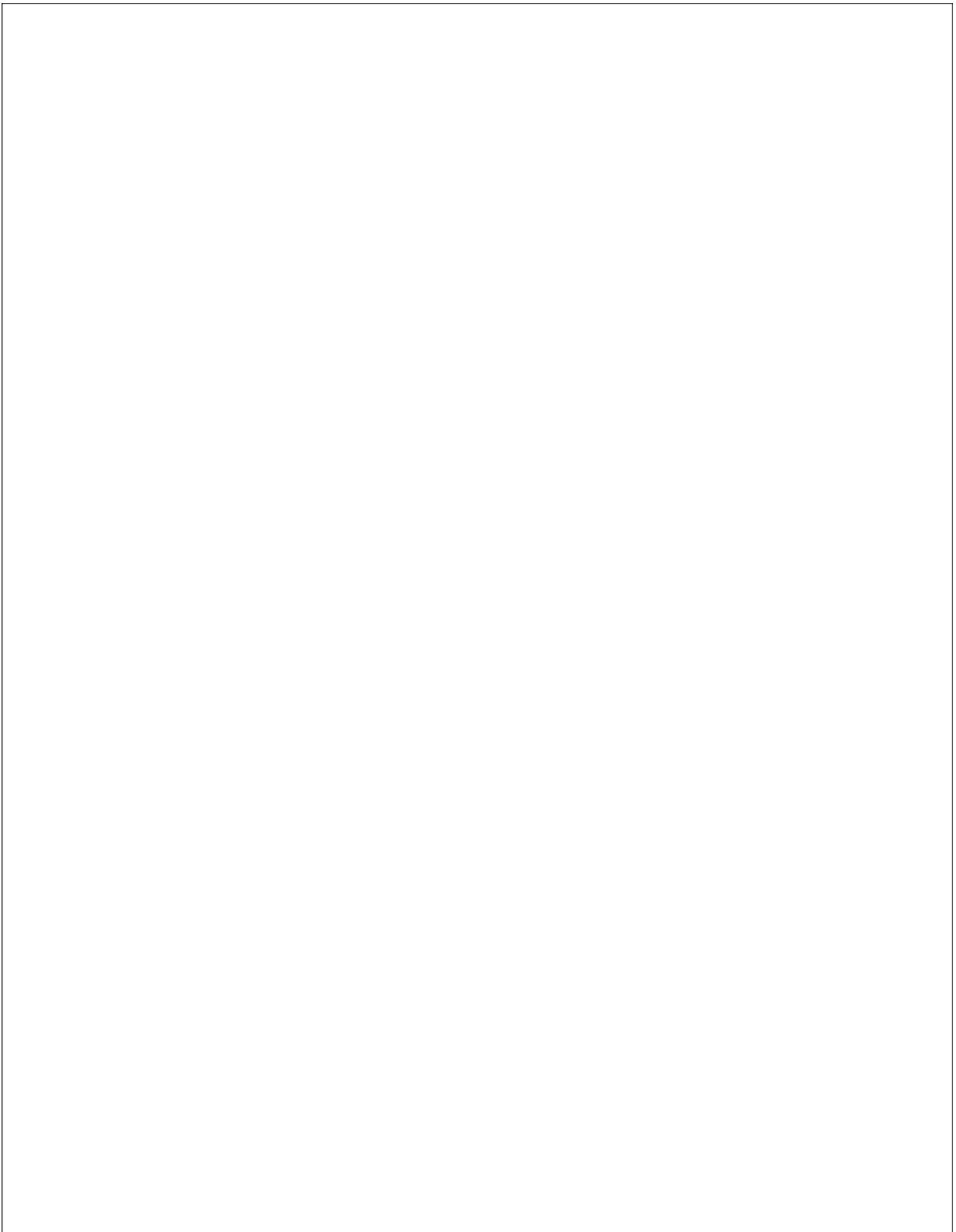
tors, critical to maintaining the flora, are showing recent drastic declines. In grasslands and forests, species groups, particularly herbivores, are important links in food webs and affect vegetation succession. A few are agricultural or forestry pests. Fire and changes in soil chemistry directly affect invertebrates, especially in range and forest conditions altered from historic structures.

Other activities potentially harmful to desirable invertebrates include overgrazing, some recreation, loss of sphagnum bogs, exotic plants or arthropods, pesticide use, and other activities that compact or mix soils. Providing a diversity of habitats, maintaining soil structure and soil chemistry, and preventing or eradicating exotic species could enhance conservation of invertebrate species.

Vertebrates—Amphibians require water or moist environments, are susceptible to exotic species, and are associated more with substrates such as down wood or talus than with vegetation types or stages. Amphibians transfer nutrients from aquatic to terrestrial environments, are prey for predators, and contribute major biomass in forest ecosystems. Studies are needed to determine the effects of water quality changes, canopy closure, pesticides, livestock grazing, eutrophication, and



Most amphibian species require either standing or flowing water for egg laying and larval development. Riparian habitat is important for most adult forms.



Map 14—Hot spots for biodiversity and endemism.

ultraviolet radiation on amphibians and on their dispersal and distribution.

Distribution of reptiles is more closely associated with elevation, aspect, and substrate than with vegetation. Reptiles are susceptible to dams, off-road vehicle use, loss of wetlands, livestock grazing, and fire suppression. Better survey techniques for reptiles are needed.

Birds are susceptible to management-induced changes in vegetation, especially historic declines in old, single-stratum, interior ponderosa pine forests and grasslands dominated by *Agropyron* bunchgrass. In particular, changes in grasslands have caused declines in Columbian sharp-tailed grouse numbers. Neotropical migrants would benefit from conservation and restoration of riparian, old forest, shrub-steppe, grassland, and juniper habitats. Population or habitat declines of mammals include some bat species and predators. Few locations still contain all top predators.

Biogeography, Endemism, and Biodiversity

Broad-scale biogeography of species is poorly studied in the assessment area. Distributions of locally endemic species can result from habitat loss, overall scarcity of suitable environments, or other factors. Apparent peripheral, disjunct, and scattered distributions of some species may be an artifact of the location and size of the area of interest. Species such as boreal owl appear as disjunct populations because of breaks in distributions of suitable environments or incomplete sampling; smaller and more isolated disjunct populations are likely more susceptible to local declines or extinctions. Locally endemic species or subspecies often are highly habitat-specific, such as Coeur d'Alene salamander. Most geographic areas in the Basin have at least some unique species although many species overlap several areas. Some species are closely associated with single biophysical factors, although many species are likely correlated with multiple factors.

Identifying groups of species with such ecological functions may be more useful for management of Federal lands in the assessment area than attempting to identify individual keystone species.



Butterflies constitute a portion of the biodiversity in the Basin.

The project mapped centers of concentration of species rarity and endemism and high biodiversity. Centers of concentration were mapped separately for plants and for animals. Locations with three or more centers of concentration of the two types mentioned defined smaller “hot spots” for plants and animals combined (**map 14**). Twelve hot spots of species rarity and endemism and seven hot spots of high biodiversity were mapped. Additional hot spots may be identified at finer levels of geographic resolution than we used in this project; several likely occur in southern Idaho.

Implications for Ecosystem Management

Understanding functions is critical to crafting appropriate ecosystem management guidelines; the fate of individual species is only one facet of terrestrial ecology conservation. Identifying groups of species with such ecological functions may be more useful for management of Federal lands in the assessment area than attempting to identify individual keystone species. The major ecological functions that managers may wish to address in ecosystem management pertain to species that contribute to major biomass, herbivory, nutrient cycling, interspecies relations, soil productivity, wood decomposition, and water quality. The species-environment relations database provides a means of identifying such species by vegetation type, as well as a means of prioritizing species for study.

Natural areas on Federal lands total nearly 29 million acres in 26 land allocation categories. The size of existing natural areas might be suitable for supporting at least small populations of at least 70 percent of vertebrate species. Natural areas of various kinds might be “realigned” or enhanced to better coincide with hot spots of species rarity and endemism and hot spots of high biodiversity. Criteria for selection of new natural areas might be based on consistent ecological themes. The hot

spots identified highlight only major locations, so conserving these areas alone should not be assumed to meet the needs of species endemism, rarity, and biodiversity in the Basin.

A species-by-species approach to management of all at-risk species is not advocated, nor is a coarse-filter approach that assumes all associated species are conserved if very gross vegetation features are provided. Many of the species on lists can be assessed in groups or included in broader considerations of ecosystem processes and functions. Inventories, where desired, could aim at gathering information for many species simultaneously, and management guidelines could address their collective habitat and environmental requirements or locations of joint occurrence.

Some policy questions and issues cannot be addressed at the broad regional scale. Additional work is necessary for (1) further describing historical trends and current conditions and threats for species at finer scales of resolution than this current study affords, and (2) collecting basic scientific knowledge on life history, ecology, and distribution of many species. About 86 percent of arthropods, 67 percent of fungi, and 51 percent of mollusk species estimated to occur in the assessment area have not been studied, surveyed, or, in some cases, even identified. Much inventory and basic systematics work remains to be done on these groups. Soil micro-organism groups and microbiotic (soil) crusts of the assessment area, although critical for maintaining soil productivity, are poorly known and little studied.

