Preserving Biodiversity

Mapping Habitat Threat in the Rockies

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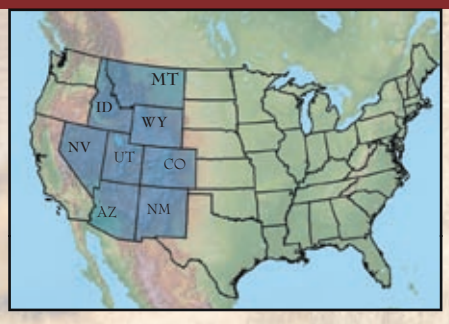
THE 2006 COLORADO COLLEGE STATE OF THE ROCKIES REPORT CARD



Human survival and way of life depend upon the functioning of various Earth systems that are often taken for granted. For example, a temperate atmosphere provides a suitable and comfortable space in which to live and, along with rich soil and clean water, creates a productive environment for growing food. An abundance of biodiversity, or variety of life on the planet, is critical to sustaining such systems. However, biodiversity is diminishing around the globe. According to E. O. Wilson, prominent American biologist, if the current rate of extinction continues, close to half of the Earth's plant and animal species will be lost by the end of the 21st century.[1]

Biodiversity is of special concern in the eight-state Rocky Mountain West. Biologist Paul Paquet explains:

> What we have in the Rocky Mountains is rare - an almost complete representation of all native large mammals that roamed the great hills before Europeans arrived. From the perspective of the great mountain ecosystems of the world, it's the last of the last... It is the last great refuge for many species, a Noah's ark of functioning populations still left of many species. If we can't save them here we can't save them anywhere.[2]

Not only is this Noah's ark ecologically crucial, but it is a major trait of the Rockies' wild, natural character, which is so important to the region's history, identity, and economy. However, Western biodiversity faces a number of threats today as wild lands are developed or otherwise adversely impacted to accommodate a rapidly growing population, to cater to more tourists and recreationalists, and to support booming energy development.

This is a crucial moment, because we are irreversibly losing species at an alarming rate. Will the Rockies relatively unaltered

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natural lands make it through the flood of development? There are a variety of ways we can protect biodiversity including slowing growth, softening its impact, and focusing its impact on certain concentrated areas, but will we do enough?

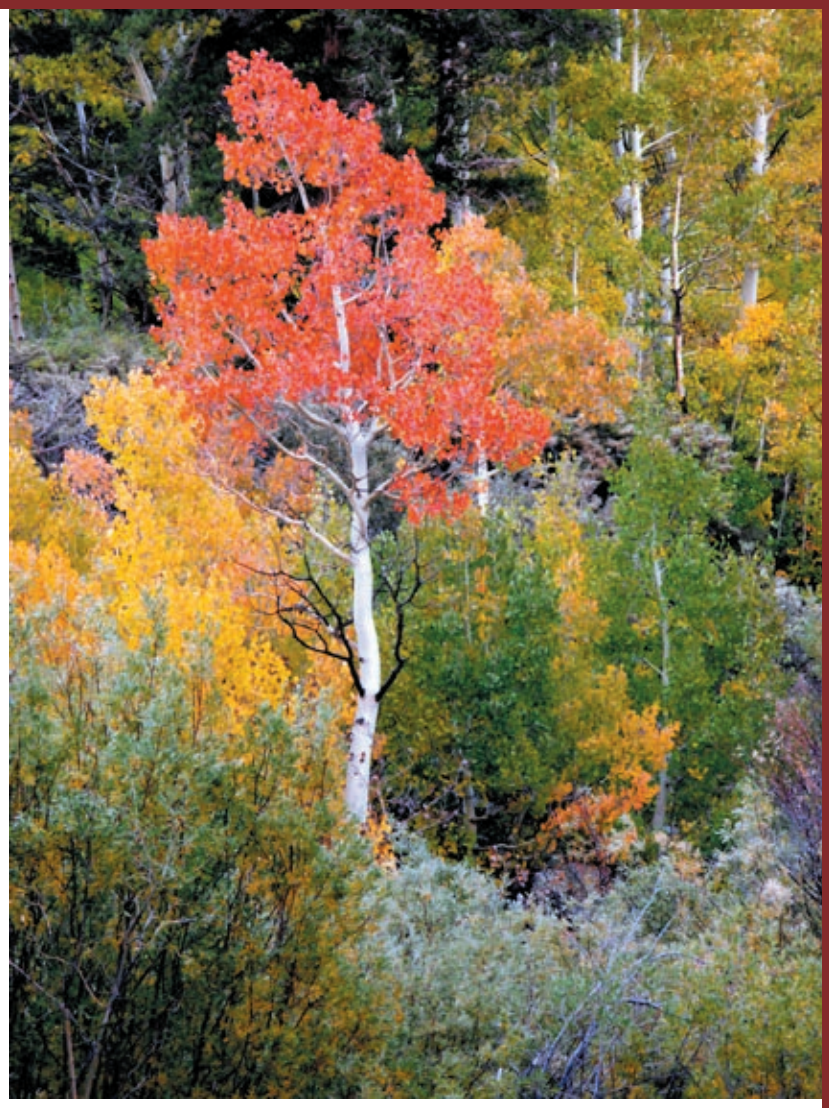
This section of the *2006 State of the Rockies Report Card* explores the importance of biodiversity, assesses its current state, and documents its biggest threats. In addition, this section maps the level of human threats to biodiversity now and in the future on a county level through current and future habitat threat indices. Finally, mainstream and alternative biodiversity protection efforts are presented and assessed.

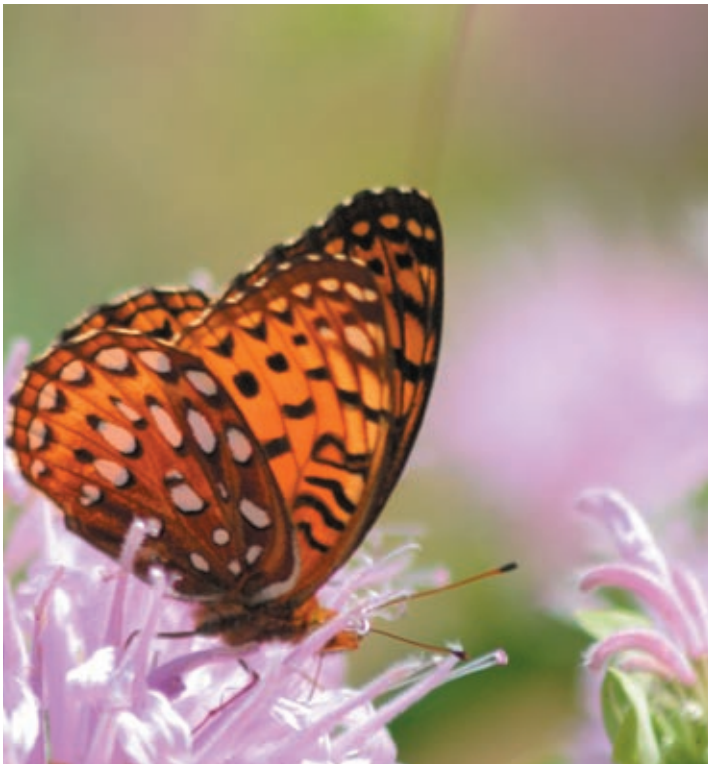
Biodiversity

Intact, dynamic ecosystems depend on rich biodiversity for a variety of reasons. First, different species play unique and vital roles in supporting ecosystem function. For example, plants provide the "ecosystem service" of locking soil into place with their root systems, which curbs soil erosion into streams. This critical service of soil stabilization could potentially be provided by one plant species; however, it is best carried out by a diversity of individual species. A mix of plant species with different root structures reaching different soil depths creates more stability than the presence of just one type of plant. Plants, of course, are not trying to keep soil in place for other organisms. They are simply planting roots so they can grow. But in the end, aquatic life that depends upon water without too much sediment, larger mammals that feed on aquatic life, and farmers who use the stream to irrigate crops all benefit from a diverse community of plants preventing erosion.

Further, biodiversity is important in creating ecosystems that are resilient to environmental stress. Different species in an ecosystem tolerate stresses differently. As vulnerable species succumb to an environmental stress, other species that are unaffected by the stress help buffer the ecosystem from environmental devastation. Consider the above example of plant roots stabilizing a stream bank. If a drought occurred in a diverse enough environment, certain species might die from lack of water while other drought-tolerant species would survive, maintaining a stable soil structure. In a single-species environment, the death of one species would mean the end of that ecosystem function.

Services provided by diverse ecosystems allow humans to thrive. In addition to soil stabilization, other ecosystem services include pollution assimilation, converting carbon dioxide to oxygen, converting sunlight to food, cycling nutrients and water, and many, many more. Diverse ecosystems will usually beget diverse ecosystems, because as species compete with one another, they ensure that one individual does not completely take over. But human actions are altering, and often irreversibly decreasing, the diversity of life on Earth.

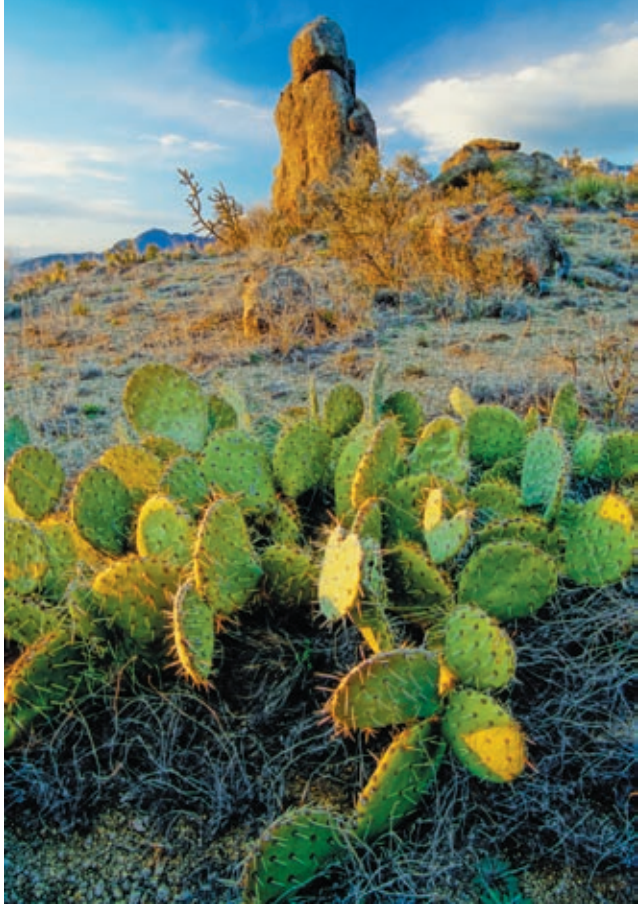




Threats to Biodiversity

On global, national, and regional scales species diversity is rapidly declining as a result of human actions. Globally, the majority of species' populations and/or ranges are declining. As part of this process, genetic diversity is decreasing, leaving species that are less able to adapt to potentially threatening environmental and human forces. Within the well-studied higher taxonomic groups (mammals, birds, amphibians, conifers, and cycads) 10 to 50 percent of species are currently threatened with extinction across the globe. In the U.S., at least one-third of native species are considered imperiled. In the Rockies, 11 percent of the native species are at-risk of extinction.[3]

Scientific evidence shows that this decline, worldwide and in the Rockies, is taking a toll on ecosystems and can be attributed to humans. One such study by the Millennium Ecosystem Assessment (MA) finds that in the



past 50 years ecosystems have faced more change than any other comparable period of human history. Sixty percent of the ecosystem services studied in the project were being degraded or used unsustainably. While many people have benefited from developing natural ecosystems and exploiting natural resources, the MA argues that these actions are primarily responsible for the current period of unusually high ecosystem change and will ultimately be detrimental to human welfare.[4]

In response to the alarming rise in species and ecosystem devastation, scientists are trying to understand the leading threats to species and ecosystems. Seven main threats to species diversity both nationally[5] and internationally[6] have been established: habitat destruction, invasive species, climate change, pollution, overexploitation, habitat fragmentation, and disease.

The biggest threat, habitat destruction, is primarily caused by urbanization, agriculture, running water diversions, and other side-effects of human development.[7] The U.S. human population is projected to increase 23 percent by 2030, and the Rocky Mountain region, currently the fastest growing region in the U.S., is expected to grow from about 20 million residents to 30 million residents from 2000 to 2025.[8] As the human population increases, development, urbanization, and resource demand will consequently increase, raising the likelihood of more habitat destruction.[9] Habitat destruction is further explored the analysis below.

The introduction and spread of non-native species is the second largest threat to biodiversity nationwide. Although some nonnative species are able to coexist with native species without any harm, many introduced species are noxious, meaning they detrimentally affect nearby organisms and hurt the ecosystem as a whole. Because noxious species often completely take over a community, creating a monoculture, they decrease the resistance of that community to outside stresses. Some invasive species are aggressive competitors with native flora and fauna, and those that excel at dispersal and reproduction in their new territory are rapidly spreading. For example, spotted knapweed was introduced on the San Juan Islands in 1883, and by 1920, the plant was found in 24 counties in three northwestern states. Spotted knapweed now has established communities in every county in the western U.S. It has eliminated seven rare, native species and diminished the population of six other native species in Glacier National Park alone in just three years.[10] For further information on invasives, see "The Invasion of Our Rockies," by Anna Sher, on page 47 of the *Report Card*.

Climate change is identified as the third largest threat to biodiversity. The Intergovernmental Panel on Climate Change predicts a 0.9-3.5° C global mean temperature increase over the next century.[11] The scientific community theorizes that a change in climate will rapidly shift species' habitat, causing increased species extinctions.[12] The Nature Conservancy estimates that with a 3° C increase in temperature, seven to eleven percent of North America's vascular plant species will no longer be living in their correct "climate envelope," the conditions in which populations of species currently exist. Because of their small habitat ranges and weak dispersal abilities, already imperiled plants are expected to be the most affected by a changing climate.[13] For more information on climate change, see "Climate Change," by the State of the Rockies, on page 89 of the *Report Card*.

Pollution, the fourth largest threat to biodiversity, is the primary source of habitat degradation, the process by which species are driven to extinction by external factors without changing the structure of the biological community. Pollution from pesticides and herbicides, common to Western farms and ranches, is harmful to wildlife populations. Water pollution damages aquatic communities and destroys important food sources for aquatic plants and animals. Ninety percent of endangered fishes and freshwater mussels in the United States are threatened by pollution.[14] Also, air pollution changes species composition, harms trees, and even eliminates certain sensitive species.[15]

The fifth largest threat, overexploitation by humans, threatens one quarter of all endangered vertebrates and approximately half of all endangered mammals in the U.S.[16] In the West, logging and mining are two of the primary forms of resource exploitation. Removing large stands of trees destroys wildlife habitat and changes natural variables of ecosystems such as atmospheric temperature and soil moisture. Mining changes the natural landscape while affecting water tables and releasing chemicals that potentially pollute bodies of water. A shift from hunting, harvesting, and collection for local sustenance to providing for a commercial market has drastically increased the occurrence of resource exploitation.[17]

Habitat fragmentation, which is the division of large tracts of continuous land, is the sixth largest threat to biodiversity. Fragmentation not only reduces the original area of habitat but also increases the amount of fragment edge and decreases the nearest distance to the edge, which has drastic effects on wildlife and plant populations. Edges are where the intact environment comes in contact with the altered area. The microclimate at the fragment edge changes in light, temperature, soil, wind, humidity, and incidence of fire. Fragmentation occurs at varying time scales. Continental drift and glaciations fragment habitats for thousands of years. Fragments are being created much more quickly across the West as humans build things like power lines, roads, and dams.[18] For more on habitat fragmentation, see "Fragmenting Our Western American Landscape," by The Colorado Nature Conservancy, on page 75 of the *Report Card*.

Disease transmission in species, the final major threat to biodiversity, has increased significantly as a result of human activities and species interactions with humans. For example, human-caused habitat destruction can increase disease-carrying vectors and wild animals can acquire diseases from nearby populations of domestic animals or humans. Such disease can spread through and devastate an entire population, such as the recent transmission of the West Nile Virus that swept across the continental U.S., devastating bird populations and affecting humans.[19]

The Habitat Threat Index

To gain a more comprehensive understanding of biodiversity threat in the Rockies region, the State of the Rockies Project developed a county-level Habitat Threat Index. Using data on a variety of major threats to species and species habitat, the index highlights the most and least hospitable counties for supporting a natural diversity of wildlife in three categories: current habitat threat, future habitat threat, and overall habitat threat. Current threat measures the existing negative human impact on species and species habitat in each county, whereas future threat measures the anticipated increase in human impact on species and species habitat. Overall threat is a combination of current and future threat.

All threats in the index classify as human-caused habitat destruction. As stated earlier in this section, habitat destruction is primarily caused by urbanization, agriculture, running water diversions, and other side effects of human development.[20] Although residents of a county do not completely control these threats to biodiversity in and around their communities, the indicators are fairly representative of the way communities are choosing or not choosing to live, handle growth, recreate, and develop resources. Counties that understand their current level of, and future potential for, habitat destruction, will be better able to plan for healthy ecosystems.

Introduction to the Findings

Counties with the highest current habitat threat by these measures tend to be counties with large cities and/or a lot of agriculture, like the eastern plains. Counties with the lowest current habitat threat are clustered along the highly protected Continental Divide, and other fairly remote and/or well-protected areas, including much of Nevada and southern Utah (Figure 1). The future habitat threat findings are similar; however, there are many counties with relatively unthreatened habitat today facing high habitat threats in the future. These are primarily counties that are projected to experience high population growth. But remember, county residents can mitigate these future threats.

Findings: Current Habitat Threat

Humans are currently harming species and species habitat in two main ways: by converting natural habitat into human habitat and by harming remaining natural habitat. As the Rockies population has grown, more natural land has been developed into homes, roads, and farms. Some species are directly killed in the process as their natural habitat is converted for human use, but many more are seriously threatened by the continued existence of human development as they are forced to either adapt to the new, often inhospitable landscape or leave familiar areas in search of suitable new territory, which is getting to be harder and harder to find. Humans harm intact, non developed land as well, as we divert water from, pollute, and recreate in wild areas. Every county in the eight-state Rockies region is ranked on its current threat to habitat (Figure 1) based on the following four indicators:

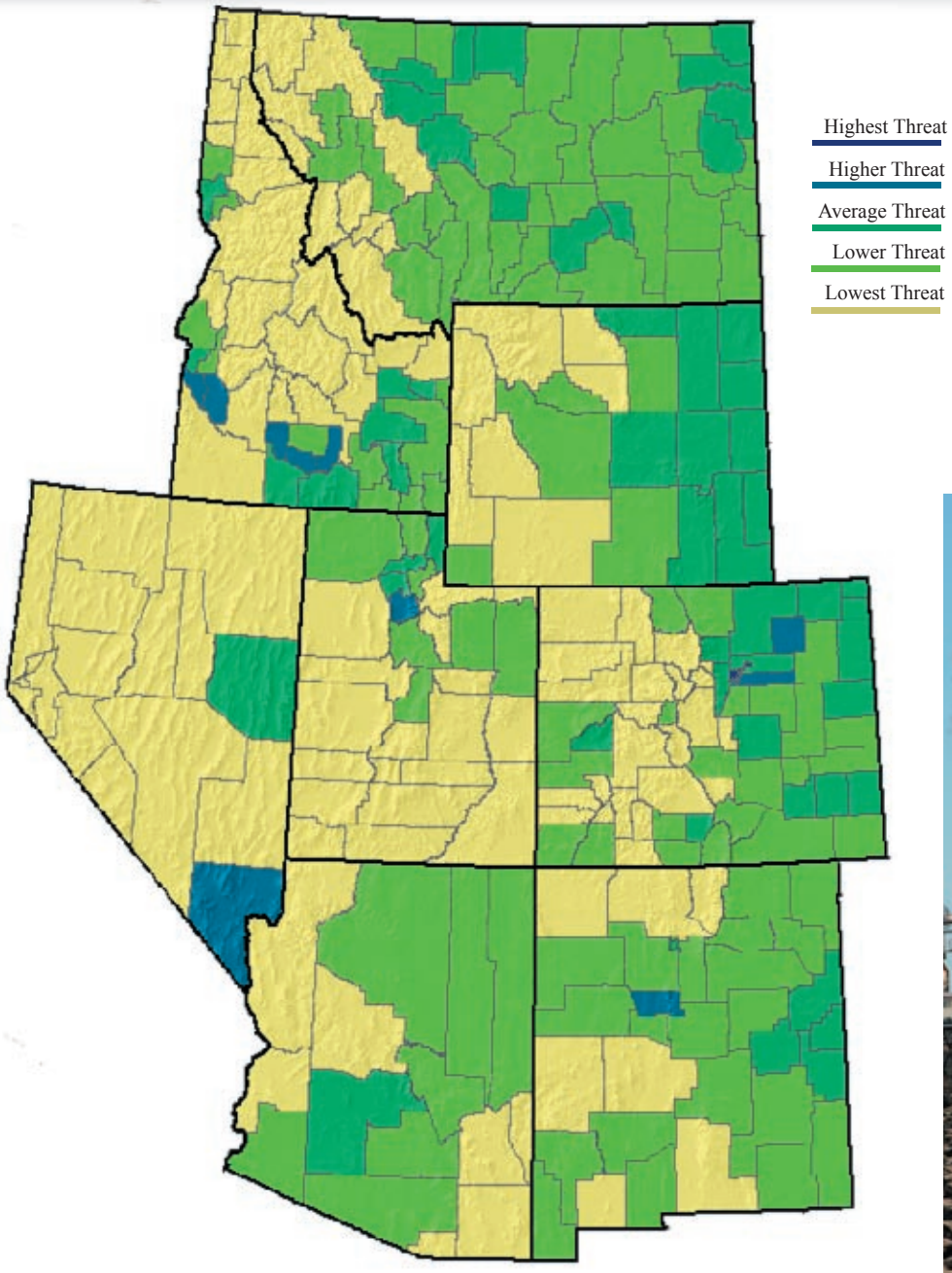
- Percentage of county area covered by significant human development, which include urban areas, highways, interstates, and large mines. (Figure 2)
- Percentage of county area covered by agricultural lands, which include farmland and ranchland. (Figure 3)
- Daily water withdrawals from the county's water bodies per square mile. (Not displayed)
- Pounds of toxic chemicals released per square mile by industry and the federal government to air, water, and land. (Not displayed)

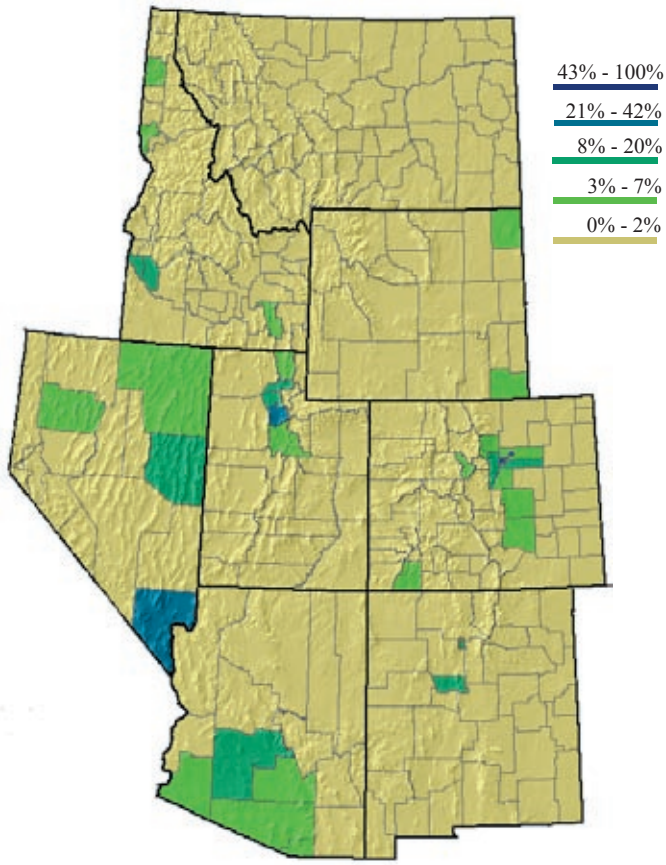
Habitat Threat Index

County-Level Current Habitat Threat Rankings

Figure 1

Source: See "About the Index and the Indicators"





Current Habitat Threat Indicator

Percentage of County That Is Significantly Developed

Figure 2

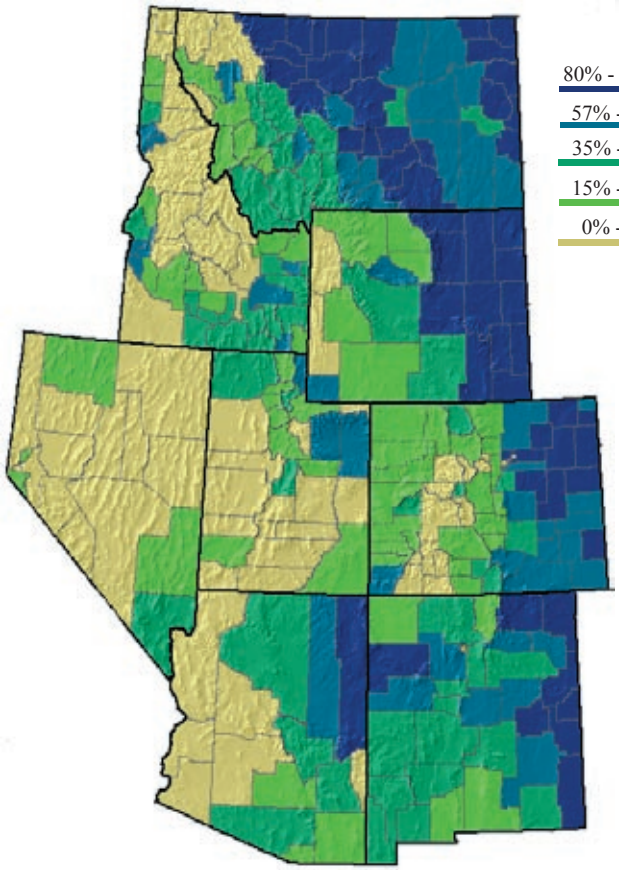
Source: See "About the Index and the Indicators"

Current Habitat Threat Indicator

Percentage of County That Is Agricultural Land

Figure 3

Source: See "About the Index and the Indicators"



About the Index and the Indicators

Each indicator is weighted differently to calculate the current threat index. The percentage covered by major human development accounts for 44 percent of the index score. The percentage of agricultural land in a county accounts for 22 percent of the index score. The percentage agricultural land is not weighted as heavily as the percentage of major human development, because even though agricultural land can be as inhospitable as urban land it can also be relatively supportive of species. The remaining 34 percent of the index score is evenly distributed among the other two indicators: daily water withdrawals and toxic pollution. Water withdrawals deplete natural water supplies that are essential to maintaining functioning wildlife habitat. Toxic pollution to air, water, and land can be directly lethal or disabling when encountered by a species, and certain toxic chemicals bioaccumulate, or build up to lethal levels, as toxins are passed up the food chain or from generation to generation. See the methods section on page 129 of the *Report Card* for an explanation of how indices are calculated.

Land cover data were generated in GIS and, except for road data, come from the USGS Gap Analysis Program (GAP). Road data come from the Federal Highway Administration's Highway Statistics (1999). Water data come from the USGS (1995). Toxic pollution data come from the EPA's 2003 Toxics Release Inventory (TRI).

Findings: Future Habitat Threat

Future threat to species and biodiversity depends on both the human demand to further develop and otherwise impact natural habitat and the availability of land that can be developed or impacted. Areas of high population growth will further increase the demand to develop land and resources, simultaneously increasing the demand to draw water from, pollute, and recreate on remaining wild lands nearby. Although communities can accommodate growth in a variety of ways and with different impacts on ecosystems, it is assumed that more growth means more impact. However, not all land can be developed, as some land is legally protected, like public wilderness areas and private lands under conservation easement. But other types of land are relatively open to development and impact. Every county in the eight-state Rockies region is ranked on its future threat to habitat (Figure 4) based on the following three indicators:

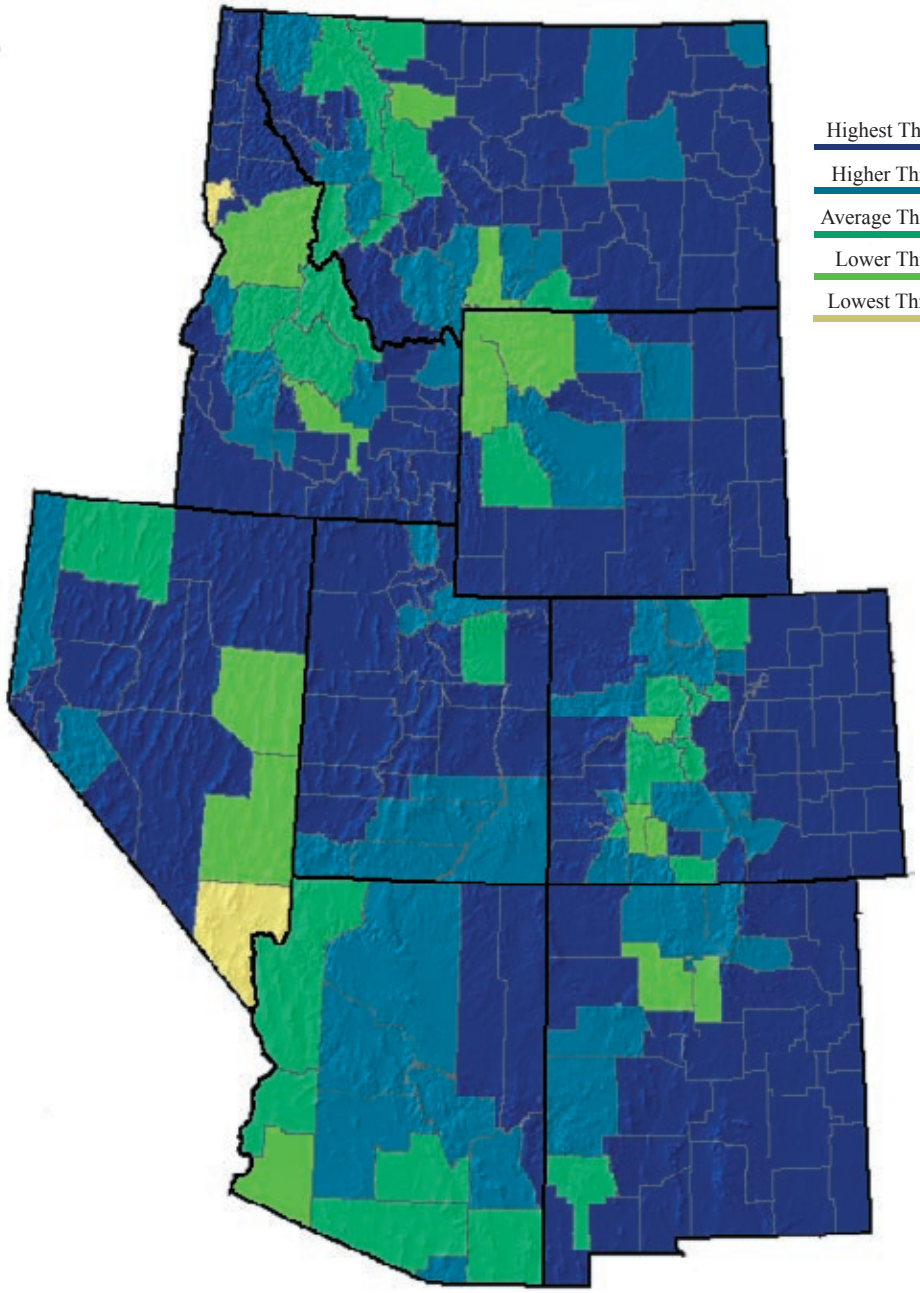
- Projected percentage of population growth from 2000-2010. (Figure 5)
- Percentage of county area protected as wilderness. (Figure 6)
- Percentage of county area protected as non-wilderness, which includes land protected by the U.S. National Park Service, the U.S. Fish and Wildlife Service, and private property owners. (Not displayed)

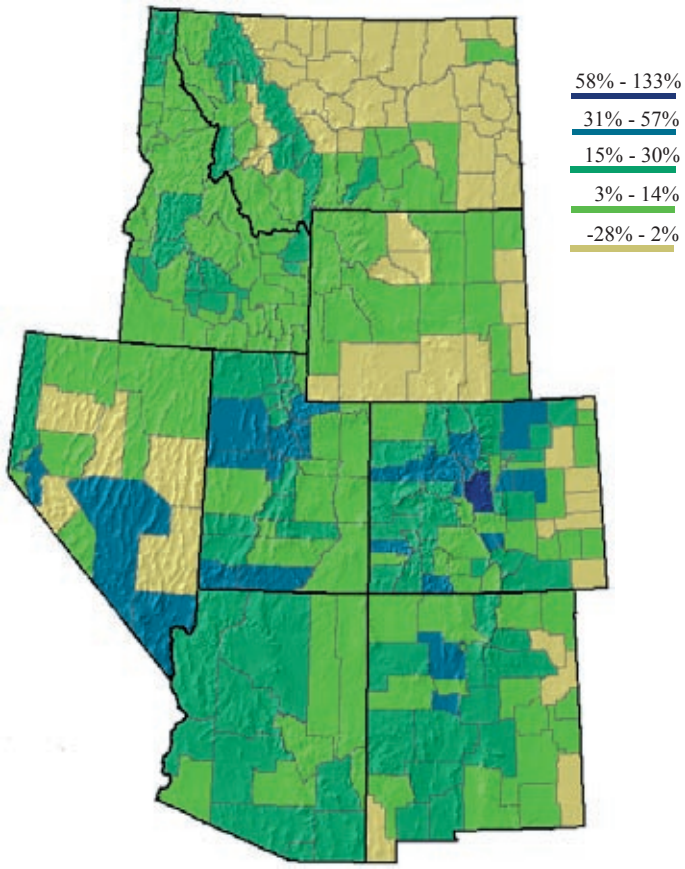
Habitat Threat Index

County-Level Future Habitat Threat Rankings

Figure 4

Source: See "About the Index and the Indicators"





Future Habitat Threat Indicator

County Population Growth Projections, 2000 - 2010

Figure 5

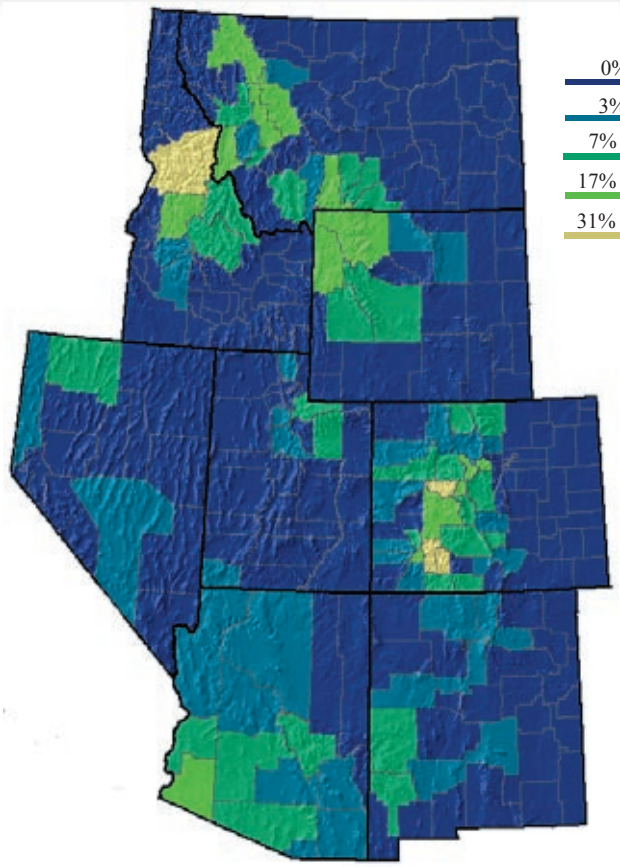
Source: See "About the Index and the Indicators"

Future Habitat Threat Indicator

Percentage of County Land Protected as Wilderness

Figure 6

Source: See "About the Index and the Indicators"



About the Index and the Indicators

To calculate the future threat index, each indicator is weighted differently. Projected population growth by 2010 accounts for half of the index score. The amount of county land protected as wilderness and as non-wilderness each account for one quarter of the score. For an explanation of how all scores are computed, see the methods section on page 129 of the *Report Card*.

County population growth figures come from state census bureaus projections. Land cover data were generated in GIS using data from the USGS Gap Analysis Program (GAP).

Findings:

Overall Habitat Threat

For every county in the eight-state Rockies region, current and future threat index scores are combined to rank the top and bottom 10 counties on overall habitat threat. For this analysis, the counties are divided into and ranked amongst three groups—metropolitan, micropolitan, and rural—to compare similar types of counties. See the methods section on page 129 of the *Report Card* for definitions of these county groupings and an explanation of the rankings.

Figures 7, 8, and 9 list the top and bottom counties for overall habitat threat along with their overall, current, and future threat index values as well as threat indicator data. A ranking of one corresponds with the most threat. Positive index values indicate more threat than average for that type of county, and negative index values indicate less threat than average for that type of county.

Metro County Overall Habitat Threat Rankings

Figure 7 Source: See "About the Index and the Indicators" on pages 66 and 68.

Rank - County, State	*Overall Threat Index*	Significantly Developed Acres as Percentage of Total	Farm/Ranchland Acres as Percentage	Pounds of Toxic Air Emissions Per Square Mile, 2003	Pounds of Toxic Surface Water Discharges Per Square Mile, 2003	Pounds of Toxic Land Releases Per Square Mile, 2003	Daily Water Withdrawals Per Square Mile, 1995	*Current Threat Index*	Wilderness Acres as Percentage of Total	Projected County Percentage Population Growth, 2000 - 2010	*Future Threat Index*
1 - Denver, Colorado	*4.8*	100%	0%	742	3	563	118	*9.9*	0%	9%	*-0.4*
2 - Canyon, Idaho	*2.4*	10%	72%	1,148	580	134	106	*4.4*	0%	23%	*0.5*
3 - Park, Colorado	*2.4*	0%	21%	0	0	0	0	*-1.4*	11%	134%	*6.1*
4 - Salt Lake, Utah	*1.7*	27%	17%	1,098	71	260,114	49	*3.8*	6%	20%	*-0.4*
5 - Elbert, Colorado	*1.4*	0%	90%	0	0	0	2	*0.3*	0%	55%	*2.5*
6 - Ada, Idaho	*1.3*	14%	33%	175	0	4	105	*2.0*	0%	24%	*0.6*
7 - Adams, Colorado	*1.1*	7%	92%	360	38	0	11	*1.4*	0%	28%	*0.8*
8 - Weld, Colorado	*1.1*	1%	71%	107	71	0	29	*0.5*	0%	40%	*1.6*
9 - Douglas, Colorado	*1.0*	3%	37%	0	0	0	3	*-0.8*	0%	58%	*2.7*
10 - Clark, Nevada	*0.9*	42%	46%	91	0	254	5	*3.2*	1%	43%	*-1.5*
52 - Storey, Nevada	*-0.9*	0%	20%	0	0	0	1	*-1.5*	0%	12%	*-0.2*
53 - Owyhee, Idaho	*-0.9*	0%	12%	1	0	3,956	6	*-1.6*	0%	12%	*-0.2*
54 - Boise, Idaho	*-0.9*	0%	4%	0	0	0	1	*-1.9*	6%	28%	*0.1*
55 - Carbon, Montana	*-1.0*	0%	58%	0	0	0	22	*-0.2*	12%	10%	*-1.7*
56 - Larimer, Colorado	*-1.0*	1%	31%	13	0	258	10	*-0.9*	10%	21%	*-1.0*
57 - Washoe, Nevada	*-1.0*	2%	4%	27	0	0	2	*-1.7*	4%	17%	*-0.4*
58 - Missoula, Montana	*-1.1*	1%	16%	602	11	16	4	*-1.1*	8%	14%	*-1.0*
59 - Yavapai, Arizona	*-1.1*	2%	14%	2	0	155	1	*-1.5*	7%	18%	*-0.6*
60 - Clear Creek, Colorado	*-1.7*	0%	2%	0	109	1,221	2	*-1.6*	18%	20%	*-1.9*
61 - Yuma, Arizona	*-2.4*	4%	7%	1	1	5	25	*-1.0*	26%	7%	*-3.8*
Metro County Median		*2%*	*34%*	*25*	*0*	*2*	*10*	-	*0%*	*18%*	-
Metro County Average		*6%*	*39%*	*149*	*20*	*4,610*	*19*	-	*3%*	*23%*	-

Micro County Overall Habitat Threat Rankings

Figure 8 Source: See "About the Index and the Indicators" on pages 66 and 68.

Rank - County, State	*Overall Threat Index*	Significantly Developed Acres as Percentage of Total	Farm/Ranchland Acres as Percentage of Total	Pounds of Toxic Air Emissions Per Square Mile, 2003	Pounds of Toxic Surface Water Discharges Per Square Mile, 2003	Pounds of Toxic Land Releases Per Square Mile, 2003	Daily Water Withdrawals Per Square Mile, 1995	*Current Threat Index*	Wilderness Acres as Percentage of Total	Projected County Percentage Population Growth, 2000 - 2010	*Future Threat Index*
1 - Los Alamos, New Mexico	*3.9*	16%	0%	2	1	58	5	*8.3*	1%	4%	*-0.5*
2 - White Pine, Nevada	*2.7*	20%	5%	1	0	37	1	*10.6*	2%	-24%	*-5.3*
3 - Minidoka, Idaho	*2.3*	1%	47%	1,304	2,171	28	69	*4.3*	0%	9%	*0.2*
4 - Jerome, Idaho	*2.0*	1%	49%	0	0	0	182	*3.4*	0%	13%	*0.6*
5 - Gooding, Idaho	*1.9*	1%	42%	0	0	624	175	*3.1*	0%	16%	*0.6*
6 - Morgan, Colorado	*1.7*	1%	92%	39	1,917	276	26	*2.4*	0%	16%	*0.9*
7 - Wasatch, Utah	*1.6*	0%	9%	0	0	0	8	*-1.1*	0%	51%	*4.3*
8 - Madison, Idaho	*1.4*	2%	63%	0	0	0	62	*1.7*	0%	17%	*1.0*
9 - Logan, Colorado	*1.4*	0%	94%	0	0	0	18	*0.8*	0%	26%	*1.9*
10 - Twin Falls, Idaho	*1.1*	1%	36%	247	0	1	99	*2.0*	0%	9%	*0.2*
129 - Powell, Montana	*-1.2*	0%	42%	0	0	0	9	*-0.6*	18%	2%	*-1.9*
130 - Park, Montana	*-1.3*	0%	47%	0	0	0	13	*-0.4*	29%	9%	*-2.2*
131 - Lemhi, Idaho	*-1.4*	0%	6%	0	0	0	3	*-1.5*	16%	7%	*-1.3*
132 - Lander, Nevada	*-1.4*	0%	1%	34	0	500	2	*-1.5*	0%	-7%	*-1.3*
133 - Deer Lodge, Montana	*-1.4*	0%	29%	0	0	0	6	*-0.8*	10%	-6%	*-2.0*
134 - Pitkin, Colorado	*-1.6*	0%	4%	0	0	0	5	*-1.4*	44%	24%	*-1.7*
135 - Park, Wyoming	*-1.8*	0%	18%	0	0	0	13	*-1.0*	23%	5%	*-2.5*
136 - Teton, Wyoming	*-2.1*	0%	2%	0	0	0	2	*-1.6*	26%	13%	*-2.5*
137 - Idaho, Idaho	*-2.4*	0%	12%	0	0	0	0	*-1.4*	40%	5%	*-3.3*
138 - Mineral, Nevada	*-2.5*	0%	1%	0	0	0	1	*-1.5*	0%	-28%	*-3.4*
Micro County Median		*0%*	*38%*	*0*	*0*	*0*	*5*	-	*0%*	*9%*	-
Micro County Average		*1%*	*44%*	*30*	*37*	*468*	*13*	-	*4%*	*11%*	-

Rural County Overall Habitat Threat Rankings

Figure 9

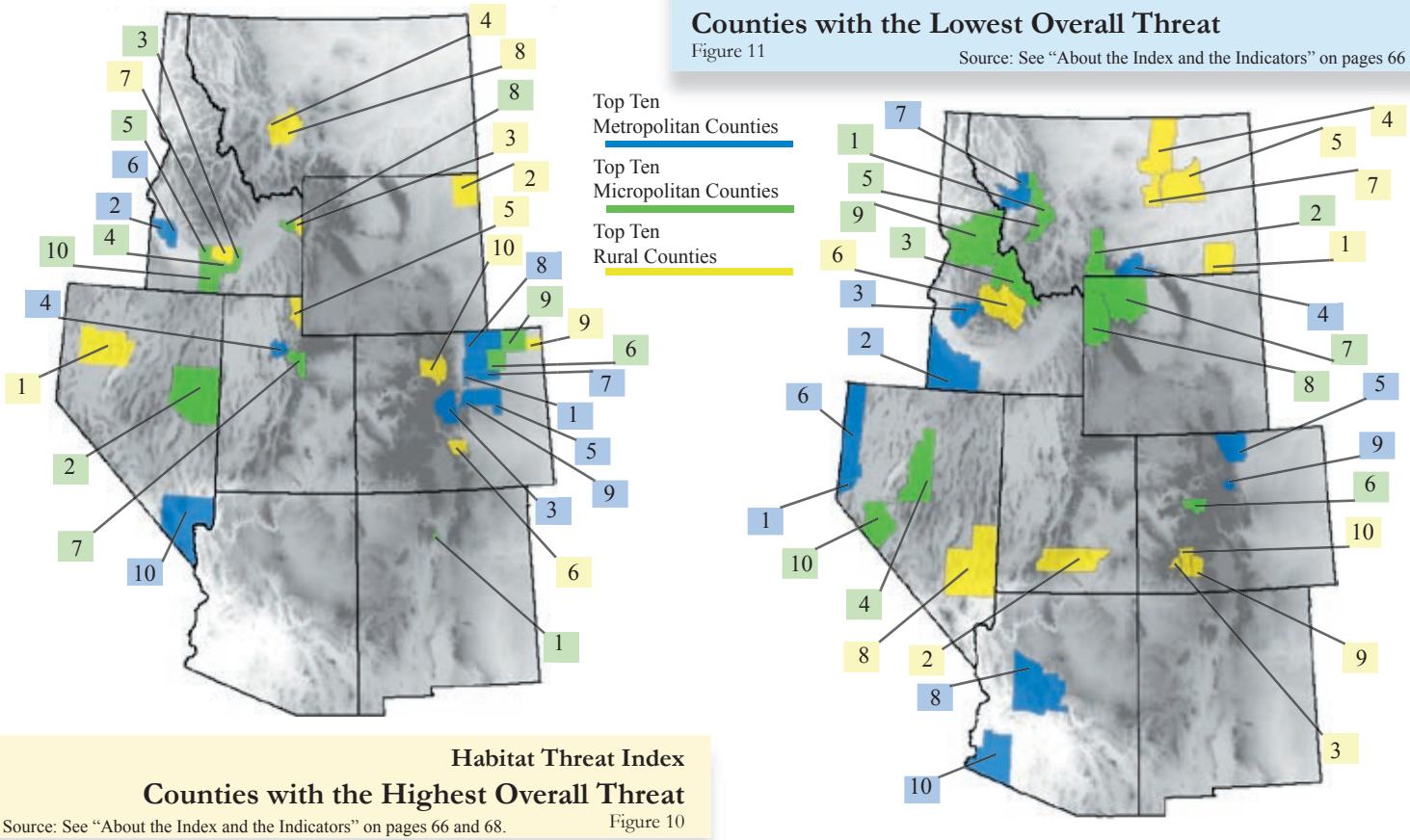
Source: See "About the Index and the Indicators" on pages 66 and 68.

Rank - County, State	*Overall Threat Index*	Significantly Developed Acres as Percentage of Total	Farm/Ranchland Acres as Percentage of Total	Pounds of Toxic Air Emissions Per Square Mile, 2003	Pounds of Toxic Surface Water Discharges Per Square Mile, 2003	Pounds of Toxic Land Releases Per Square Mile, 2003	Daily Water Withdrawals Per Square Mile, 1995	*Current Threat Index*	Wilderness Acres as Percentage of Total	Projected County Percentage Population Growth, 2000 - 2010	*Future Threat Index*
1 - Pershing, Nevada	*4.1*	5%	0%	9	0	1,107	1	*9.5*	0%	-8%	*-1.2*
2 - Crook, Wyoming	*2.1*	2%	83%	1	0	0	2	*4.1*	0%	4%	*0.1*
3 - Teton, Idaho	*1.9*	1%	43%	0	0	0	27	*2.8*	0%	12%	*1.0*
4 - Jefferson, Montana	*1.9*	0%	37%	75	0	13,308	9	*1.7*	0%	21%	*2.0*
5 - Rich, Utah	*1.4*	1%	77%	0	0	0	15	*1.8*	0%	11%	*0.9*
6 - Custer, Colorado	*1.2*	0%	26%	0	0	0	6	*-0.8*	11%	40%	*3.3*
7 - Lincoln, Idaho	*1.1*	0%	17%	0	0	80	36	*0.8*	0%	16%	*1.4*
8 - Broadwater, Montana	*1.0*	0%	62%	0	0	0	19	*0.6*	0%	17%	*1.5*
9 - Phillips, Colorado	*0.9*	0%		0	0	0	12	*1.7*	0%	4%	*0.1*
10 - Grand, Colorado	*0.9*	0%	19%	0	0	1,170	11	*-0.2*	7%	31%	*2.0*
72 - Powder River, Montana	*-0.8*	0%	72%	0	0	0	0	*-0.5*	0%	-7%	*-1.2*
73 - Garfield, Utah	*-0.8*	0%	2%	0	0	0	1	*-1.6*	1%	13%	*-0.0*
74 - San Juan, Colorado	*-0.9*	0%	1%	0	0	0	0	*-1.7*	22%	17%	*-0.1*
75 - Phillips, Montana	*-0.9*	0%	58%	0	0	0	4	*-0.5*	1%	-7%	*-1.3*
76 - Garfield, Montana	*-0.9*	0%	73%	0	0	0	0	*-0.5*	0%	-9%	*-1.4*
77 - Custer, Idaho	*-1.0*	0%	4%	0	0	117	3	*-1.4*	11%	7%	*-0.5*
78 - Petroleum, Montana	*-1.0*	0%	51%	0	0	0	3	*-0.8*	0%	-7%	*-1.2*
79 - Lincoln, Nevada	*-1.6*	1%	18%	0	0	0	1	*-0.6*	0%	-5%	*-2.7*
80 - Mineral, Colorado	*-1.8*	0%	1%	0	0	0	0	*-1.8*	33%	10%	*-1.7*
81 - Hinsdale, Colorado	*-1.9*	0%	1%	0	0	0	1	*-1.9*	46%	17%	*-1.9*
Rural County Median		*0%*	*51%*	*0*	*0*	*0*	*3*	-	*0%*	*5%*	-
Rural County Average		*0%*	*50%*	*6*	*0*	*319*	*7*	-	*4%*	*6%*	-

Habitat Threat Index
Counties with the Lowest Overall Threat

Figure 11

Source: See "About the Index and the Indicators" on pages 66 and 68.



Habitat Threat Index
Counties with the Highest Overall Threat

Figure 10

Source: See "About the Index and the Indicators" on pages 66 and 68.

Protecting Biodiversity

Already, various species and ecosystem protection measures have been used in response to widespread species loss. The federal government uses its national jurisdiction to protect individual species through the Endangered Species Act of 1973 (ESA). Other national environmental laws indirectly protect species as well, but are not specifically designed to preserve biodiversity. The ESA is focused on single species management, which may make some political sense but has its biological flaws. For more information on the ESA, see "The Endangered Species Act of 1973: An Overview," by Phillip M. Kannan, page 59 of the *Report Card*. State and local governments and nonprofits at the national, regional, and local levels have developed a variety of alternative strategies to protect biodiversity. These other measures concentrate on whole system management.

Whole Ecosystem Management

Three decades after its enactment, the ESA remains controversial, and there are efforts to change it on ecological, political, and economic grounds. Much of the scientific community is displeased with the implementation of the ESA, arguing that listing decisions are made based on economic and political considerations rather than on peer-reviewed scientific studies. This politicization of science is exemplified by the decision of the secretary of interior to deny habitat conservation of seven listed species, against the advice of leading scientists. Private property owners are distressed that through the ESA the government has too much control over their property. Most groups calling for ESA reform—whether ecologically or economically driven—find that protecting individual species is far less effective and more costly than whole ecosystem management.

In 1985, William Newmark published a groundbreaking paper noting the rate of local extinctions was inversely related to habitat area—as species habitat area decreased, extinction increased.

Habitat Conservation Plans:
Desert Tortoise - *Gopherus agassizi*
Status: Endangered, 1990

The terrestrial desert tortoise wears a domed shell and lives to be 80 to 100 years old. The reptile is characterized by flattened front limbs, large, strong back limbs, and sharp claws for digging burrows into desert soil to escape the heat. The tortoise has adapted to go years without drinking any water, ingesting most of its water from plants and then storing it for long periods of time in its bladders. Although their range has greatly decreased, desert tortoise populations are still found in southeastern California, southern Nevada, Arizona, Utah, and Mexico.

Threatened by human contact, predation, disease, and habitat destruction, the Mojave Desert tortoise was listed endangered by the federal government in 1990.[21] Washington County, Utah, which was one of the early 1990s' fastest growing counties, contains one of the densest populations of desert tortoises within the species' range. This sparked arguments among county developers, businesses, and environmentalists, and created a backlash against the federal government and the tortoise, as the endangered listing would likely curb development in the county. In response, a mitigation group, the Washington County Desert Tortoise Steering Committee, was created. The group, which was comprised of government officials, developers, and nonprofit organizations, strove to solve the county's problems by developing a Habitat Conservation Plan (HCP).[22]

An HCP is an arrangement between a nonfederal landowner and the U.S. Fish and Wildlife Service (USFWS). The landowner agrees to take active measures to protect a listed species and in return is given an "incidental take permit." An incidental take permit allows the landowner to harm a certain amount of the species. The Endangered Species Act defines "take" as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any listed species. This includes significant habitat modification.[23]

Washington County's HCP was approved by USFWS in 1996. The plan created the 62,000-acre Red Cliffs Desert Reserve, funded by development impact fees. In exchange, 350,000 acres of surrounding land opened to development; the reserve remains open for running municipal water wells, power lines, and an electric substation; and Red Hill Parkway can expand from two to four miles within the reserve. Additionally, developers were granted an incidental take permit to remove or accidentally kill 1,169 tortoises on the property outside the reserve over a 20-year time span. However, before any development can begin, healthy tortoises must be moved into the reserve. In 20 years, over 400 tortoises have been relocated.[24]

The Mojave Desert tortoise habitat conservation plan and the Red Cliffs Desert Reserve have been successful in protecting and increasing the tortoise population. Development pressures have calmed recently but still threaten the preservation of tortoise habitat. There is interest in building a new highway that would bisect the reserve, splitting the tortoise population, and planners are preparing to push a proposal in 2016 when the current permit expires.[25]

Now, ecologists agree that providing life support to individual species, though maybe politically easier and better than doing absolutely nothing, is an ineffective way of protecting ecosystems and biodiversity.

Not only does it make ecological sense to shift the focus from ensuring the existence of individual species to protecting habitat, but it also makes political and economic sense. The government could reduce conflict with private property owners by focusing on protecting large tracts of habitat on federally owned land instead of focusing on a single species that can move onto private property. Preserving habitat will save more species at less monetary cost, because it is more efficient. When a large area of land is protected, most species within that area will consequently be preserved, and expensive, time-consuming efforts to monitor individual species will be unnecessary.

Challenges to Managing Whole Ecosystems

Though it makes sense to manage entire ecosystems, there are numerous challenges to making that shift here in the Rockies. One major roadblock is getting the federal government, which owns much of the region's intact natural habitat, onboard. Another is creating incentive for private property owners, who control much of the most biologically productive land in the region, to play an active role in managing ecosystems. Strategically managing both public and private land is the best way to protect the Rockies' biodiversity.

Nearly half of the Rockies land is owned by the federal government. It owns and manages much of our region's forests, grasslands, and deserts either as fairly well-protected wilderness areas, national parks, and wildlife refuges, or as less-protected Forest Service, Bureau of Land Management, Department of Energy, and Department of Defense land. In the Rockies, our large, relatively untouched tracts of federally owned land, if properly linked by private land, will do much to preserve biodiversity. However, getting the federal government to give high priority to protecting biodiversity and getting different federal agencies that control different local patches of land to work together on an ecosystem scale pose tough challenges to whole ecosystem management.

Additionally, private lands are crucial to preserving the Rockies' biodiversity as they are often the most hospitable lands (e.g., river valleys and grass prairies), which are essential habitat and migration grounds for many of the Rockies' species. However, habitat on Rockies' private lands appears to face more threat than the region's public lands. A study by Dave Theobald at the National Renewable Energy Lab suggests that threatened and endangered species within Colorado are disappearing much faster on private lands where rural development growth is high, than on government-protected public lands.[27] As the Rockies population continues to grow at over three times the national average, private ranches and farms, which are currently somewhat supportive to species, are being rapidly developed into strip malls and housing developments, which are much less supportive of species.

A number of factors make protecting the Rockies private land through a region-wide ecological plan difficult. First, private property rights are highly valued in this country, so laws forcing property owners to follow such a plan will likely face massive opposition. Second, private property is owned by so many different parties that it will require coordinating the efforts of many people to carry out an ecosystem-level plan. Third, there is much economic incentive for private property owners to develop their land, and there is little incentive or regulation to get them to do so in an ecologically sensitive way.

Some market-based proposals exist to get around these challenges with private property owners. The Thoreau Institute proposes a five-part plan for effective species protection, including the creation of a biodiversity trust fund to support conservation measures, raising the public land use fees to protect endangered species, and experimenting with private ownership of wildlife.[28] Another method of private land protection, which has recently been growing in popularity, is placing private land under conservation easement. A private landowner can forfeit the land's development rights "in perpetuity" in return for income tax, estate tax, and inheritance tax breaks. Without the development rights, large ranches and farms decrease their real estate value. As a result, large parcels of productive lands with an easement restrict development and ensure habitat corridors for biologically significant species. For more information on easements, see "Conservation Easements," by the State of the Rockies, on page 27 of the *Report Card*.

Examples of Whole Ecosystem Management

Despite the immense challenges to protecting biodiversity at the level of whole ecosystems, a number of efforts are underway to do just that here in the Rockies. And, although there is plenty more to be done, some groups are making significant headway.

Some whole ecosystem management models support creating unfragmented tracts of land, or "migration corridors," to link existing large patches of natural habitat together. Isolated islands of habitat do not support biodiversity. Fragmented bits of habitat need to be linked by migration corridors to ensure both the survival of the migrating species and the survival of ecosystems, which depend on migrating species to weather ecological change and crisis. Many animals including wolves, lynx,

Single Species Management for Whole Ecosystem Health and State Management:
Sage Grouse - *Centrocercus urophasianus*
Status: ESA Candidate Species

In the West, there is a push to move species and ecosystem protection into the hands of state governments initiated by the Western Governors' Association (WGA). This is evidenced through the sage grouse local working groups protection program. The sage grouse is one of North America's most spectacular birds. As their name suggests, these birds make their homes in healthy sage grassland habitats. The sage grouse also depends on sagebrush as their primary source of food and shelter and as the setting for their traditional breeding habits.

Almost two centuries ago, as Lewis and Clark journeyed through the West, they recorded a sage grouse population that exceeded two million individuals. Today, the birds' population is remarkably small in comparison (200,000 individuals) and cannot stabilize. The largest threats to the sage grouse are the conversion of sagebrush grassland to cropland, the overgrazing of livestock, and the use of herbicides. Without natural or well-maintained sagebrush landscapes, the birds cannot survive. Habitat fragmentation caused by roads, oil and gas drills, power lines, and other forms of human development also harm the sage grouse.[30]

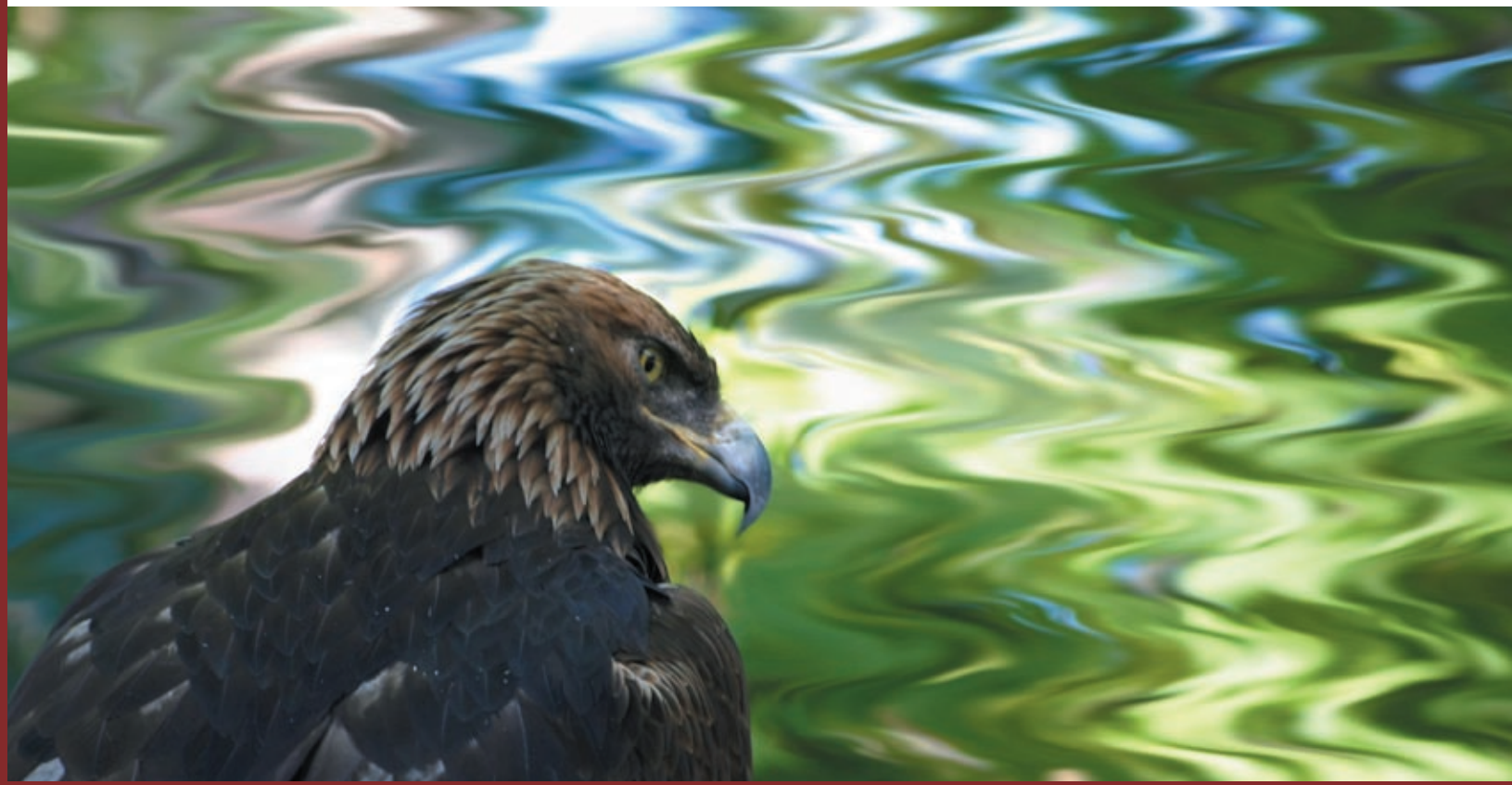
Declining sage grouse numbers were first noted publicly in 1994 when state governments and the federal government worked with the WGA to focus sage grouse conservation efforts into local, small-scale working groups in each sage grouse state. Now there are 60 working groups involving about 500 landowners and numerous government agencies. The U.S. Fish and Wildlife Service argues there is no need to federally list the sage grouse through the Endangered Species Act, because of the capability of the working groups program.[31]

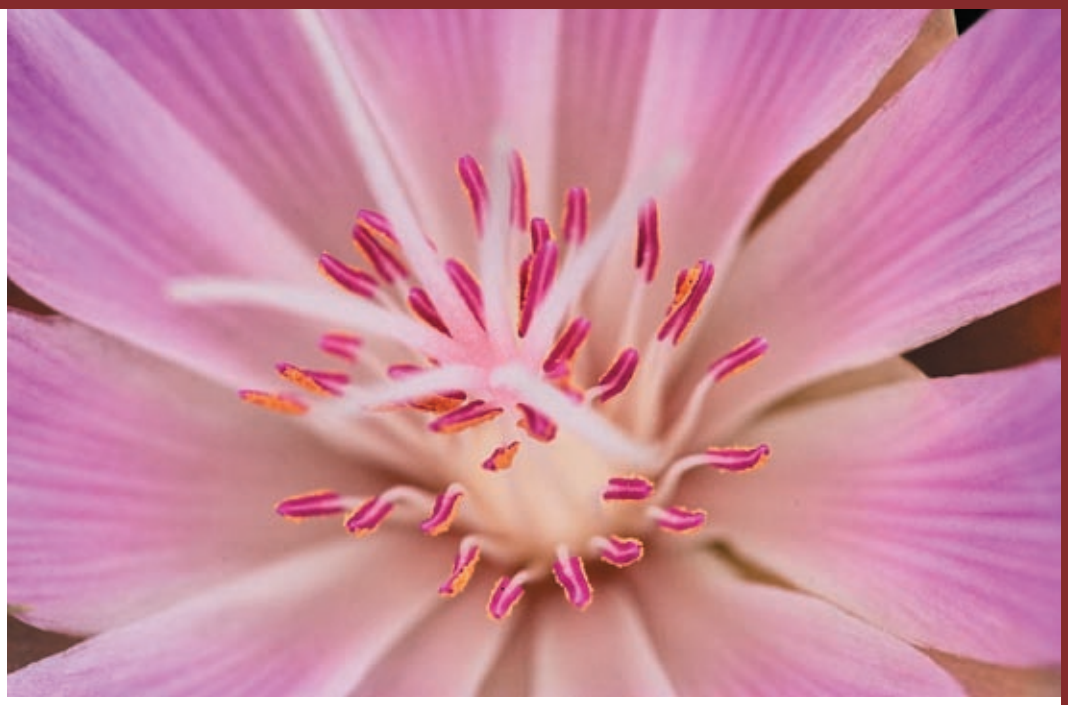
At the National Conference for Sage Grouse Local Working Groups in February 2005, working groups from across the West shared tales of conservation achievements. Members of the Shoshone Basin Local Working Group in southern Idaho spoke of their successful effort to improve habitat in three BLM allotments. The group planted native vegetation favored by the bird, installed water pipelines and troughs to redistribute cattle, and created a 2,000-acre no-grazing zone. Groups also spoke about conservation challenges. For example, in Moffat County, Colorado, a mining and ranching area, the Northwestern Colorado Local Working Group remains without a conservation plan. It is often extremely difficult to reach consensus on conservation plans, because such a diversity of political, social, and economic beliefs and needs are represented in the working groups.

The WGA continues to play an integral role in protecting the sage grouse. In March 2005, the WGA adopted the Sagebrush Conservation Council, a group that coordinates and aids individual working groups. The WGA is using the success of the sage grouse project to support their endangered species protection reformation initiative. The WGA suggests altering the Endangered Species Act to provide more efficient and effective incentives to private landowners to protect species and habitat, collaborate with Congress to establish recovery goals based on success stories, ensure the use of good science, and broaden the states' roles in species protection.[32]

butterflies, antelope, and birds, roam across large areas of land looking for food, mates, and new territory. Plants also travel across the landscape, though at a slower pace, as their seeds are swept up in the wind and carried off by animals. Species and ecosystems depend on their mobility to survive. But they need wild destinations and wild paths to get there.

Even large areas, such as Yellowstone National Park, are not big enough to support every organism's genetic diversity in isolation. Realizing this, the Yellowstone to Yukon conservation initiative (Y2Y) was created in 1993 around the premise that the Rockies functions as one great mountain ecosystem with many islands of wilderness reserves still intact. The project's mission is to "identify biologically critical movement corridors throughout the system and use them to link the reserves together, while preserving and enhancing the social and economic fabrics of communities in and around the corridors." The Y2Y corridor extends from the Greater Yellowstone Ecosystem, centered in northwestern Wyoming, 2,000





miles north to the Mackenzie Mountains in the Yukon.

Y2Y's first step was to identify and map connective priority areas. Seventeen Critical Cores and Corridors (CCC) have been chosen. The next step is to initiate discussions with landowners, governments, corporations, and individuals. The group plans to purchase the land or persuade owners to establish conservation easements to prevent development. Some municipal-growth plans for the establishment and protection of wildlife corridors have passed. Y2Y plans to coordinate efforts with other municipalities and conservation groups to meet their conservation goals.[29]

Another way biodiversity conservation projects have tackled the complex challenges of managing whole ecosystems is by focusing on protecting a single "keystone" species. Unlike the ESA, this kind of management plan does not focus on one species to ensure it survives but to ensure that the whole ecosystem in which it lives survives. If the right kind of species is chosen, ensuring its success can be enough to protect the entire ecosystem.

Conclusions

The Rockies region has large variations in latitude, topography, climate, and geology and is home to the most acreage of publicly owned wilderness of any other region in the U.S. As a result, the region has a wealth of unique ecosystems that still support high species diversity. However, the region also has the fastest-growing population in the country, which triggers the largest threat to species and species habitat—urbanization and other development. No national legislation is currently in place that can effectively preserve biodiversity, but fortunately, organizations around the world, the nation, and the Rockies region are taking innovative approaches to preserving species at local levels, coordinating preservation efforts in larger areas, and supporting national preservation measures. The Rockies region, with its wealth of biodiversity and amplifying threats to it, has the opportunity to lead the nation in brainstorming and implementing creative whole ecosystem management techniques to guide growth and resource development in ways that preserve biodiversity by forging partnerships between government agencies, non-profits, and private-property owners.

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