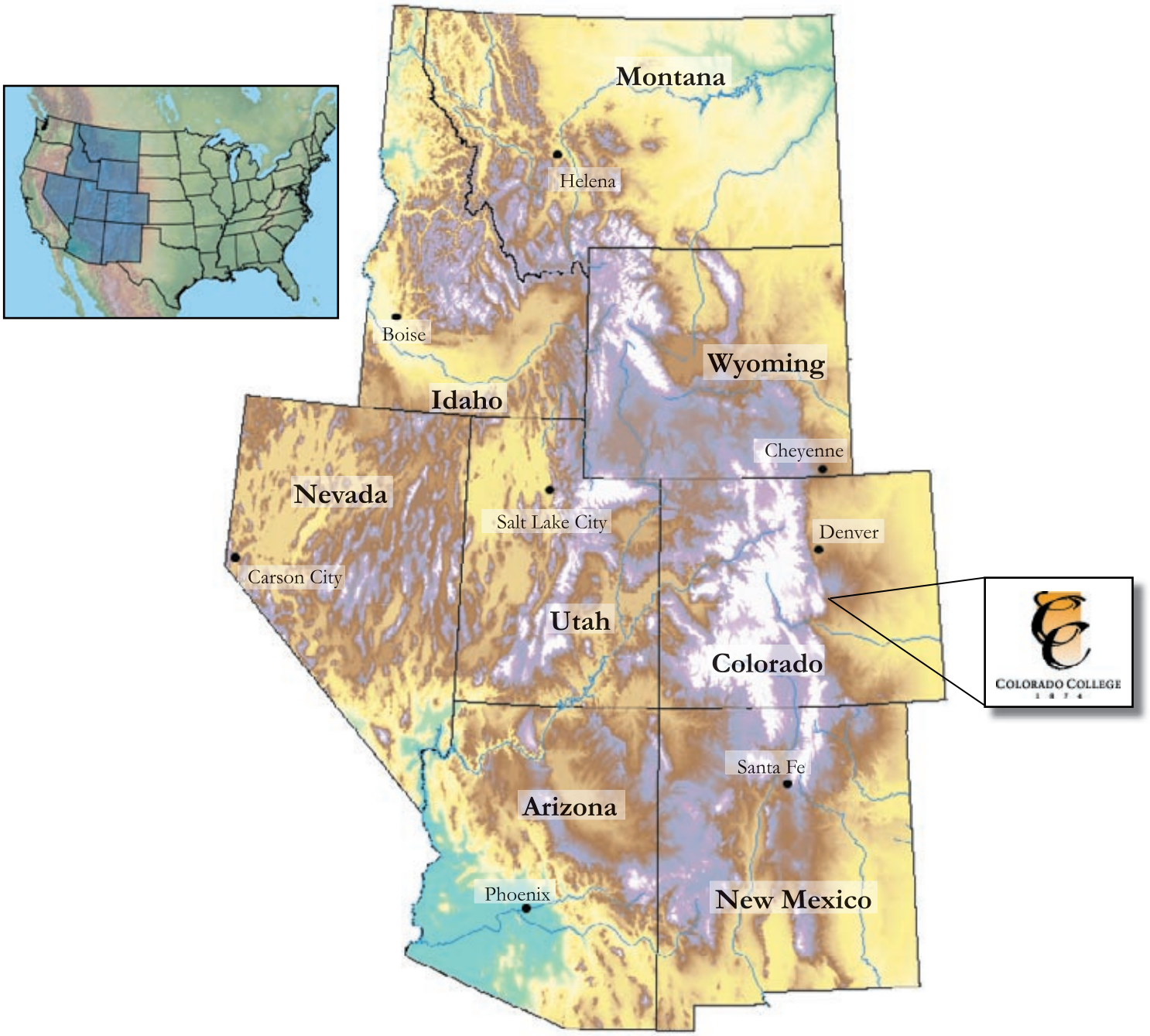
The 2006

Colorado College

State of the Rockies Report Card

An Outreach Activity of
Colorado College:
Vision 2010

Colorado College's Rocky Mountain Study Region



The Colorado College State of the Rockies Project is designed to provide a thoughtful, objective voice on regional issues by offering credible research on problems faced by the Rocky Mountain West, and by convening citizens and experts to discuss the future of our region. Each year, the State of the Rockies provides:

- Opportunities for collaborative student-faculty research partnerships;
- An annual *State of the Rockies Report Card*;
- A companion State of the Rockies Conference.

Taken together, these three arms of the State of the Rockies Project offer the tools, forum, and accessibility needed for Colorado College to foster a strong sense of citizenship for both our graduates and the broader regional community.

THE COLORADO COLLEGE
STATE OF THE ROCKIES PROJECT

AN OUTREACH ACTIVITY OF
COLORADO COLLEGE
VISION 2010

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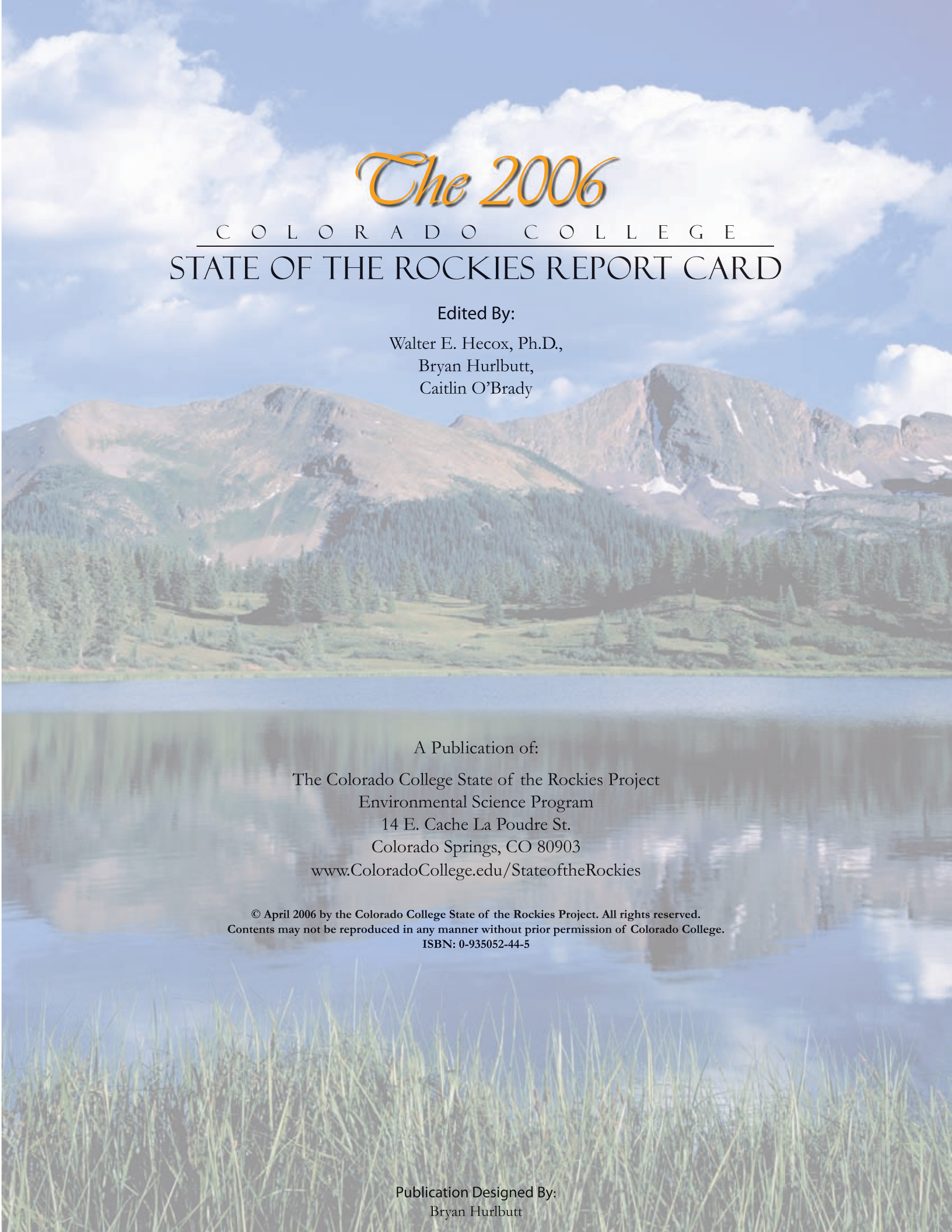
Stephen G. Weaver



The 2006

COLORADO COLLEGE

STATE OF THE ROCKIES REPORT CARD

Edited By:

Walter E. Hecox, Ph.D.,
Bryan Hurlbutt,
Caitlin O'Brady

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Research, Report, Engage!

THE 2006 COLORADO COLLEGE STATE OF THE ROCKIES REPORT CARD

An Introduction from the President

Welcome to Colorado College's third *State of the Rockies Report Card*. Building upon a strong start in 2004 and continuing through 2005, the Rockies Project this year provides a fresh look at key challenges to this beautiful but fragile region. This *Report Card* and the companion April 2006 State of the Rockies Conference are significant outreach activities of Colorado College: Vision 2010, an agenda to strengthen our college and our engagement in the region.

Over the decades, our college has both prospered in and contributed to our Rockies "backyard." Since our founding in 1874, we have responded to the constant change in this region of 281 counties with a population that in recent decades has grown at over three times the national average. Colorado College is a private, four-year liberal arts and sciences college enrolling 1,900 students, located on a 94-acre campus in downtown Colorado Springs near the base of Pikes Peak. Our mission statement speaks to our unique intellectual adventure:

> *At Colorado College our goal is to provide the finest liberal arts education in the country. Drawing upon the adventurous spirit of the Rocky Mountain West, we challenge students, one course at a time, to develop those habits of intellect and imagination that will prepare them for learning and leadership throughout their lives.*

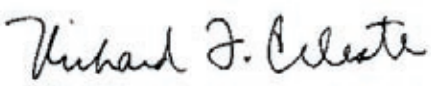
To achieve these goals, Colorado College offers first and foremost an excellent education in the liberal arts and sciences. The college encourages a spirit of intellectual adventure: critical thinking, hands-on learning, and personal responsibility within an environment of small learning communities where education and life intertwine. Stronger student involvement in this year's State of the Rockies Project is one way we have sought to connect with the challenging issues around us!

The inaugural *2004 State of the Rockies Report Card* and Conference successfully charted a new course to engage our students, the community, and the region in meaningful dialogue on regional issues. Off campus, it generated national and state attention, reaching a combined circulation of 2.3 million. The *2005 State of the Rockies Report Card* continued to identify, assess, and communicate key issues and problems in this unique region of spectacular natural beauty and cultural wealth, abundant resources and fragile environment, including: energy, the condition of the national parks, urban sprawl, toxic waste, creative occupations, and civic engagement. Again media attention helped us connect to national and regional audiences, reaching a combined circulation of more than 4.4 million.

This *2006 State of the Rockies Report Card* explores a new set of issues important to our region, including: overlapping and linked issues of ranching, land conservation, and threatened and endangered species; climate change in the Rockies; prospects for a Western presidential primary and enhanced political voice; environmental justice; monitoring of Rockies vital signs; and assessment of regional health of our families and kids. For the first time, during summer 2005, student-faculty teams collaborated in studying the Rockies and preparing materials for this report card. Classroom and textbook theory were linked to Rockies field study and engagement. And students were challenged to sharpen their research and writing skills and actively participate.

The release of this *Report Card* coincides with the third State of the Rockies Conference, April 10-13, 2006. Some of the sessions at the conference, addressing parts of the *Report Card*, include: Land Conservation - Protecting Unique Landscapes and Habitats; Preserving Biodiversity – Addressing Threatened, Endangered, and Invasive Species; Ranching in the Rockies – Threats and Signs of Hope; Conservation in Action – Success Stories; Environmental Justice – Equal Protection for all Humans and the Environment; New Approaches to Governing the Rockies – Can our Political Voices Be Heard?; Climate Change – What Happens in a Warmer Rockies?; and Rockies' History Comes Alive: a cameo appearance by John Wesley Powell, portrayed by Clay Jenkinson, cultural commentator for National Public Radio.

I invite you to explore the Rockies through the material in this *Report Card* and am confident that it will inform, challenge, and stimulate your knowledge and thinking. We welcome you to a growing number of people who care to learn more about and contribute to protecting the unique features and character that make the Rockies region everyone's special "backyard."



Richard F. Celeste
President of Colorado College

Colorado College, The Rocky Mountain West, and

The State of the Rockies Project

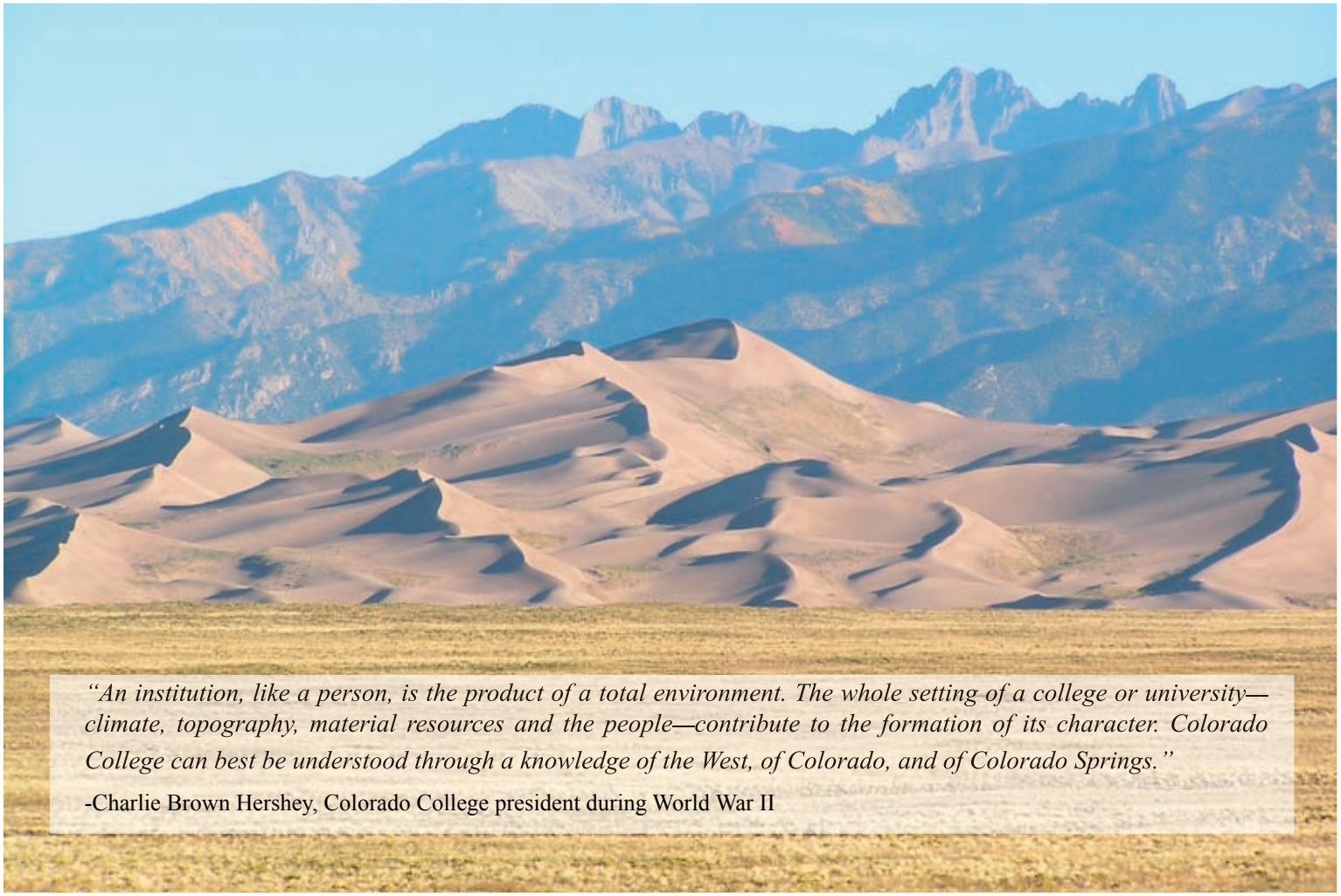
The 2006 Colorado College State of the Rockies Report Card

By Walter E. Hecox

Colorado College (CC) today, as it has been for the past 130 years, is strongly defined by location and events of the 1800s. Pikes Peak abruptly rises out of the high plains that extend from the Mississippi and Missouri Rivers towards the west. This eastern-most sentinel of the Rocky Mountain chain of 14,000 ft. peaks first attracted early explorers and then was the focus of President Jefferson's call for the southern portion of the Louisiana Purchase to be mapped by Zebulon Pike in 1806. Gold seekers in 1858 spawned the start of the "Pikes Peak or Bust Gold Rush" of prospectors and all manner of suppliers to the mining towns. General William Jackson Palmer, while extending a rail line from Kansas City to Denver in 1869, camped near what is now Colorado City and fell in love with the view of Pikes Peak and red rock formations now called the Garden of the Gods. An entrepreneur and adventurer, he selected that site to found a new town with the dream that it would be a famous resort — complete with a college to bring education and culture to the region. Within five years, both Colorado Springs and Colorado College came into being in Colorado Territory, preceding Colorado statehood in 1876.

Early pictures of present day Cutler Hall, the first permanent building on campus that was completed in 1882, speak volumes to the magnificent scenery of Pikes Peak and the lonely plains. Katherine Lee Bates added an indelible image of the region. In 1893 she spent a summer teaching in Colorado Springs at a CC summer program and on a trip up Pikes Peak was inspired to write her "America the Beautiful" poem. It helped spread a celebration of the magnificent vistas and grandeur of Pikes Peak and the surrounding region — and provided bragging rights for CC as "The America the Beautiful College."

The last quarter of the 18th century was challenging both for Colorado Springs and Colorado College. Attempts to locate financial support in the East and ease the travails of a struggling college were grounded on the unique role of Colorado College in then-President Tenney's "New West" that encompassed the general Rocky Mountain region. His promotion of this small college spoke of Colorado College being on the "very verge of the frontier" with a mission to bring education and culture to a



"An institution, like a person, is the product of a total environment. The whole setting of a college or university—climate, topography, material resources and the people—contribute to the formation of its character. Colorado College can best be understood through a knowledge of the West, of Colorado, and of Colorado Springs."

-Charlie Brown Hershey, Colorado College president during World War II

State of the Rockies student research at Great Sand Dunes National Park, Colorado (opposite page), Yellowstone National Park, Wyoming (above), the Hideout Ranch, Wyoming (bottom left), Colorado College, Colorado (bottom middle), and Rocky Mountain Biological Lab in Gothic, Colorado (bottom right).

rugged land. Even then, Tenney saw the college as an ideal place to study anthropology and archeology, use the geology of the region as a natural laboratory, and serve the mining industry by teaching the science of mineralogy and metallurgy. In the early 1900s, a school of engineering was established at CC that offered degrees in electrical, mining, and civil engineering. General Palmer gave the college 13,000 acres of forest land at the top of Ute Pass, upon which a forestry school was built, the fifth forestry school created in the U.S. and the only one with a private forest.

Subsequent decades brought expansion of the college, wider recognition as a liberal arts college of regional and national distinction, and creation of innovative courses, majors, and programs. The unique Block Plan, implemented in 1970, consists of one-at-a-time courses that facilitate extended course field study, ranging across the Rockies and throughout the Southwest. Thus, CC has a rich history indelibly linked to the Rockies.

Today is no different. CC has new programs that meet evolving challenges in the Rockies, including environmental science and Southwest studies programs, a sustainable development workshop, and exciting field work offered by a variety of disciplines. Students can thoroughly explore the Rockies through the Block Plan.

The State of the Rockies Project

The Colorado College State of the Rockies Project is designed to provide a thoughtful, objective voice on regional issues by offering credible research on problems faced by the Rocky Mountain West, and through convening citizens and experts to discuss the future of our region. Each year, the project provides:

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Editor's Preface and Executive Summary

The 2006 Colorado College State of the Rockies Report Card

By Walter E. Hecox, Bryan Hurlbutt, and Caitlin O'Brady

Editor's Preface

In our third year of the State of the Rockies Project, we still find ourselves working to better understand an incredibly diverse and complicated region facing a variety of unique challenges. Learning from past years, we have refined our research methods and recruited more students. We seek to take a fresh approach to putting together a credible written report and conference on pressing issues of community and environment in Colorado College's backyard—the eight-state Rocky Mountain West.

Thanks to generous funding, we were able to select a team of five exceptional student researchers to launch an early start on this year's research along with the State of the Rockies staff during summer 2005. To supplement their academic work in Colorado Springs, the research team took an extended field trip throughout the northern Rockies to visit ranches, communities, and natural areas, connecting their academic research with on-the-ground experience. Since the summer, the student researchers have met with scientists and community leaders and have continued fine-tuning their research projects with the help of the State of the Rockies staff to produce the *2006 State of the Rockies Report Card* and organize the 2006 State of the Rockies Conference.

This year's research topics take a new perspective on and delve deeper into critical topics we have studied generally in past report cards and conferences. Our aim is to cultivate a new vision of our shared home and to challenge the Mountain West to decide where we are coming from and where we want to go as a region.

We kick off the *Report Card* with the "Rockies Baseline," which examines key, annually updated demographic indicators for the U.S., the Rockies region, and each of the eight Rockies states, to lay out basic facts and track trends in this rapidly changing region. Next, "A Common Western Voice" suggests how the region can and must increase its national political influence through a shared, yet diverse vision of what matters in the West.

Population growth is still the main driver of change in the Rockies region, as the influx of people spurs development of once open land and increases the demand for limited water supplies among a variety of other impacts. In "Ranching in the Rockies" and "Conservation Easements," we focus on how private lands, which are so susceptible to development and other impacts of growth these days, are being preserved as agricultural and natural lands. In "New Resource Management" and "Experiments in Managing the Federal Estate: The Case of the Valles Caldera," we document specific cases around the Rockies where innovative, collaborative land management strategies are effectively protecting the landscape while supporting adjacent communities.

In additional reports, we move further into the realm of environmental science to assess human influence on ecosystems and other natural systems in the Rockies region. In "Climate Change," we evaluate potential future climate scenarios for the Rockies region and assess the influence such changes could have on ecosystems, agriculture, tourism, and water supply. In "Preserving Biodiversity," we explore the importance of biodiversity to both ecosystems and humans, measure habitat threat across the region, and highlight creative ways groups are working to support biodiversity. Guest contributors add their thoughts on what biodiversity is, how much it is at risk, and what can and should be done to protect these key natural systems. A companion guest contribution, "Fragmenting the Western American Landscape," measures the degree and impact of habitat fragmentation in the region.

The final two sections of the *Report Card* bring attention to community in the Rockies. In "Environmental Justice," we document the history of this movement for equal protection of all humans from environmental harm in the U.S., and we uncover the disproportionate burden certain demographic groups bear in the Rockies' metro areas. In "Grading the Rockies: Nurturing the Youth," we continue our tradition of assigning county grades to highlight communities that should serve as positive examples for other cities and towns throughout the region. This year's community assessment uses data on teen involvement, family support, educational opportunity, healthy surroundings, safe neighborhoods, and community engagement to grade all 281 counties in the region on their success at creating supportive environments for their youth—who may be our region's most vital asset in the future.

Central to this year's project activities, as in the past, are the three goals of the Colorado College State of the Rockies Project:

- To produce an annual research book, the *State of the Rockies Report Card,* on critical issues of community and environment in the Rocky Mountain West;
- To host an annual conference at Colorado College, the State of the Rockies Conference, bringing regional experts together with concerned citizens; and
- To involve Colorado College students as the main contributors to the *Report Card* and conference.

Through these goals, the project aims to inspire conference attendees and *Report Card* readers to creatively think about, discuss, and engage in shaping the future of our beloved region—the Rocky Mountain West.

About the editors: Walter E. Hecox is professor of economics and environmental science at Colorado College and project director of the Colorado College State of the Rockies Project. Bryan Hurlbutt (Colorado College class of 2004) is program coordinator and Caitlin O'Brady (Colorado College class of 2005) is research manager for the Colorado College State of the Rockies Project.

Executive Summary

"Rockies Baseline: Vital Signs for a Region in Transition"
State of the Rockies - Bryan Hurlbutt

Each year, the State of the Rockies updates a set of key demographic indicators—the Vital Signs—to take the pulse of the Rockies region. To track trends in the rapidly changing eight Rockies states, this year's stats are compared to the baseline year 2000. The Vital Signs dispel common myths that the Rocky Mountain West is still a lawless, backward land of rugged cowboys roaming remote locations, fending for themselves, and living off the land. The Vital Signs show that we are diverse, well-educated, and mobile, and for better or worse, most of us work in offices. Perhaps the most critical indicator of all, the region's population is still growing swiftly—over three times faster than the U.S. population.

"A Common Western Voice: Can the Rockies Be Heard in Washington, D.C.?"
State of the Rockies - Jared Kapela, Andrew Yarbrough, Caitlin O'Brady, and Bryan Hurlbutt

The Rocky Mountain region's distinctive features—its vast open space, large proportion of federal lands, aridity, small population coupled with rapid population growth, abundance of natural amenities and natural resources, and popularity to vacationers—create a unique set of challenges for the region, which are often ignored in national politics. As a result, critical regional issues do not receive the national attention and support that they need. The State of the Rockies shows that during the 2004 presidential election, little money and time were spent by Bush and Kerry in the region. State of the Rockies urges the region to find a strong political voice and explores hosting a presidential primary and/or presidential debate in the Rocky Mountain West.

"Ranching in the Rockies: Threats and Signs of Hope"
State of the Rockies - Andrew Yarbrough, Jared Kapela and Caitlin O'Brady

Changes in the agriculture industry have made it tougher for traditional ranchers to make a profit in the Rockies region, and rapid population growth has increased the price developers are willing to pay for ranchland. As a result, many ranchers are cashing out, and their productive agriculture land is being converted into "trophy" ranches and subdivisions. Once a main-stay of the opening up of the West and of the rural economy, the role of ranching in the Rockies region has undergone a dramatic change. In the face of sprawl, environmental groups, who once viewed ranching as one of the biggest environmental threats, now see ranching as a protector of open space and wildlife habitat. Here, the State of the Rockies examines the economic challenges to ranching in the Rockies region, showing that more farms and ranches are losing money than in the past and that the amount of farmland and ranchland is declining across much of the region. However, this report highlights innovative ranchers who are diversifying their operations and making ends meet by targeting niche consumer markets with their products or by turning their ranches into destinations for hunters, artists, and vacationers.

"Conservation Easements: Preserving Private Land in the Rockies"
State of the Rockies - Jared Kapela, Bryan Hurlbutt, and Andrew Yarbrough

Nearly half of the land in the Rockies region is federally owned, and although these public lands still face a variety of environmental threats, private land is being altered at a faster rate. As a result, conservation groups are devoting more time and energy to protecting private land. Land trusts are leading the way through conservation easements. By placing a conservation easement on land, a private property owner sacrifices the right to develop that land in the future in exchange for tax relief. The State of the Rockies finds that conservation easements are successfully protecting private land in the region and their use is on the rise, but depending on the resolution of a few controversies involving easements, the movement's pace could lose steam. County-level analysis shows that although private land is being well protected by easements along the Continental Divide, there is relatively little easement activity elsewhere in the region. Furthermore, the eastern Rockies states (Colorado, Montana, New Mexico, and Wyoming) have a much higher percentage of their private land under easement than do the western Rockies states (Arizona, Idaho, Nevada, and Utah).

"New Resource Management: Innovative Approaches in the Rockies"
State of the Rockies - Chris Jackson

Resource management in the Rocky Mountain West is often mired in bitter conflict between competing interest groups in the realm of law and politics. Today, however, ground is being broken in managing limited, highly valued resources through cooperative approaches that harness market incentives and, when necessary, implement tools to compensate resource loss. Here, the State of the Rockies highlights several successful examples of creative collaboration in managing land, water, and wildlife around the region.

"Experiments in Managing the Federal Estate: The Case of the Valles Caldera National Preserve and Trust"
F. Patrick Holmes, guest contributor

Patrick Holmes, former program coordinator of the State of the Rockies, takes an in-depth look at experimental federal land management of the Valles Caldera National Preserve in New Mexico. The preserve is managed by a nine-member board of trustees as a government-owned corporation of the U.S. Forest Service in an attempt at consensus-based public land management. Holmes sees hope in this new type of management but documents some flaws in the program. He notes that conditions specific to the Valles Caldera may make it better suited for this type of management than other federally owned areas.

"Biodiversity: A Coat of Many Colors"
Tass Kelso, guest contributor

Tass Kelso, Colorado College biology professor, explains the importance of biological diversity to human life. Not only does the variety of life forms in the Rockies region provide food and energy, shield against natural disasters, and support functional ecosystems, but they are a vital component of the Rockies' unique, beloved natural landscape.

Challenge Essay: "The Invasion of Our Rockies: Hype or Management Priority?"
Anna Sher, guest contributor

Anna Sher, an invasive plant ecologist at the University of Denver and the Denver Botanic Gardens, addresses the issue of invasive species as a threat to biodiversity. Sher argues that simply removing invasive weeds, which she calls the strip malls of nature, is too limited of an approach to solving the problem. The ultimate goal is to restore functioning ecosystems, which will require more research into the mechanisms responsible for the invasion. She challenges residents of the Rockies region to see invasive species not as necessarily "bad" or "good," but rather to understand their broader ecosystem implications. How are invasives introduced to the Rockies region? How do they spread? How do they affect whole ecosystems? Upon answering these questions, the region can then begin to ask, "How can management strategies best deal with the problem?"

Challenge Essay: "Myths Versus Realities Concerning Threatened and Endangered Species in the Rockies"
Randy T. Simmons, guest contributor

Randy T. Simmons, senior fellow at the Property and Environment Research Center (PERC) and professor of political science at Utah State University, challenges a number of common beliefs about endangered species and "nature" in the Rocky Mountain West. Simmons questions assumptions, including that nature is highly structured and balanced, that wilderness has always been free from human impacts, and that ecosystems will return to normal if disturbances are removed. He illustrates the ways in which these assumptions have resulted in limited, inadequate approaches to saving species. Simmons challenges the region to look beyond these assumptions and argues for a stronger state role in ecosystem protection.

"The Endangered Species Act of 1973: An Overview"
Phillip M. Kannan, guest contributor

Phillip M. Kannan, distinguished lecturer and legal scholar-in-residence in the Colorado College environmental science program, introduces the Endangered Species Act (ESA), the federal government's tool for protecting species and biodiversity. Kannan outlines the workings of the ESA and suggests that, although the individual species protection approach that the Act takes is limited, the ESA can play an important role in a larger plan to protect entire ecosystems.

"Preserving Biodiversity: Mapping Habitat Threat in the Rockies"
State of the Rockies - Amanda Strauss, Caitlin O'Brady, and Bryan Hurlbutt

Fresh air, productive agricultural land, and clean water are just a few of the many invaluable "services" that the biodiversity, or variety of life on Earth, provides for humans. But biodiversity is being devastated globally, nationally, and within the Rockies region. The State of the Rockies measures human-caused current and future habitat threat in every county in the region. The report finds that habitat destruction is taking place, it is on track to continue throughout the entire region, and the threat is much higher in some counties than in others. The report also outlines groundbreaking ways scientists, communities, nonprofits, and government agencies are working together to take a broader, scientifically sound approach to preserving biodiversity through whole ecosystems management.

"Fragmenting the Western American Landscape"
Chris Pague, Tyrone Guthrie, and Christina Supples, guest contributors, The Nature Conservancy

Habitat fragmentation—the breaking up of large areas of habitat into isolated parcels—is a leading contributor to the loss of biodiversity nationwide. As humans further develop the Western landscape, roads, subdivisions, fences, and power lines lock plants and animals into isolated pockets, which decreases the resilience of an ecosystem. The Colorado Nature Conservancy maps "natural" and "not natural" land across the region and uses sophisticated GIS analysis to rank every county in the region on the degree of habitat fragmentation within its boundaries.

"Regional Challenges of Future Climate Change: Endless Summer or Business as Usual?"
Matthew Reuer, guest contributor

Matthew Reuer, technical director of the Colorado College environmental science program, introduces climate change from a scientific perspective. Reuer presents data documenting the recent rise in global CO_2 concentrations and the corresponding rise in global temperature. Reuer suggests that, although the study of climate change is rife with uncertainty, further study and analysis of historic and projected climate warming is essential, because of the many environmental, social, economic, and political implications of climate change.

"Climate Change: Modeling a Warmer Rockies and Assessing the Implications"
State of the Rockies - Gregory Zimmerman, Caitlin O'Brady, and Bryan Hurlbutt

Will the Rockies region still be the world's prime skiing destination? Will the region's already limited water supply dwindle and further ignite water rights conflicts? Will our ecosystems wither and be overrun by invasive species? Recently, devestating hurricanes and floods, melting ice caps, and species extinctions have made humans aware that global climate is changing, and it is expected to continue changing into the future. The State of the Rockies acquired temperature, precipitation, and snowpack projections from state-of-the art climate models to understand how the region could be affected by climate change. The analysis both projects changes in temperature, precipitation, and snowpack, and assesses potential impacts on the region's ecoregions, river basins, and skiing communities. To maintain the current human way of life, people must understand and be prepared to adapt to these changes.

"Environmental Justice: Income, Race, Ethnicity, and Toxic Pollution in the Rockies' Metro Areas"
State of the Rockies - Angela Banfill, Bryan Hurlbutt, and Caitlin O'Brady

Environmental justice is hailed as the confluence of the two great movements of the 20th century, the civil rights movement and the environmental movement. Towards the end of the 20th century, it became apparent that certain demographic groups tend to bear a disproportionate share of environmental harm. Although the environmental justice movement has made some headway, there is still a long way to go, especially in the Rockies region where mainstream environmental issues tend to focus on "nature" while overlooking social issues related to environment. The State of the Rockies maps sources of toxic pollution in the 23 largest metro areas in the region and analyzes the income, race, and ethnicity of neighborhoods near these polluters. The study finds that environmental inequity is indeed a reality in the Rockies and environmental justice issues deserve equal attention to mainstream environmental issues.

"Grading the Rockies: Nurturing the Youth"
State of the Rockies - Caitlin O'Brady and Bryan Hurlbutt

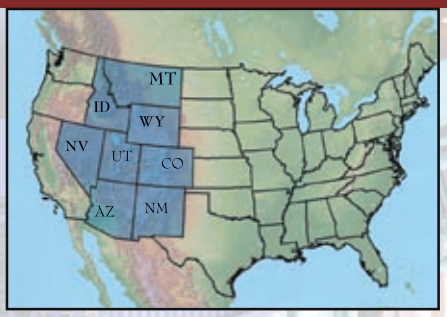
The State of the Rockies continues its tradition of assigning grades to all 281 counties in the region on critical community issues. This year the topic is nurturing the youth. Although data can hardly speak to the most important ways the youth can be supported—like loving, appreciating, and believing in them—the 24 indicators used to grade the counties shed light on community efforts to create a positive environment in which the youth can develop into the future leaders of the region. The indicators are divided into six categories: teen involvement, family support, educational opportunity, healthy surroundings, safe neighborhoods, and engaged communities.

Rockies Baseline

Vital Signs for a Region in Transition

By Bryan Hurlbutt

The 2006 Colorado College State of the Rockies Report Card



Each year, we update a set of key demographic indicators—the Vital Signs—to take the pulse of the Rockies region. This year's updated stats, which come from 2004 data, are compared to the baseline year 2000 to track trends in the rapidly changing eight Rockies states. The Vital Signs set the stage for the rest of the *State of the Rockies Report Card* by defining certain characteristics of our unique region and, thus, providing a regional context through which the *Report Card* topics can be better understood.

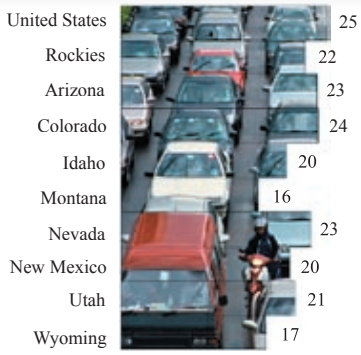
What traits distinguish the Rockies region from the rest of the U.S.? How do trends vary from state to state within the region? How has the Rockies region changed over the years? These questions and others are answered in the Vital Signs.

The Vital Signs dispel common myths that the Rocky Mountain West is still a lawless, backward land of rugged cowboys roaming remote locations, fending for themselves, and living off the land. As in years past, this year's Vital Signs show that we are diverse, well-educated, and mobile, and for better or worse, most of us work in offices. And, perhaps the most critical indicator of all, the region's population is growing swiftly—over three times faster than the U.S. population.

All data, unless otherwise indicated, come from the 2000 Census and the 2004 American Community Survey, both of which were conducted by the U.S. Census Bureau. The data are available at http://www.census.gov/.

About the author: Bryan Hurlbutt (Colorado College class of 2004) is program coordinator for the Colorado College State of the Rockies Project.

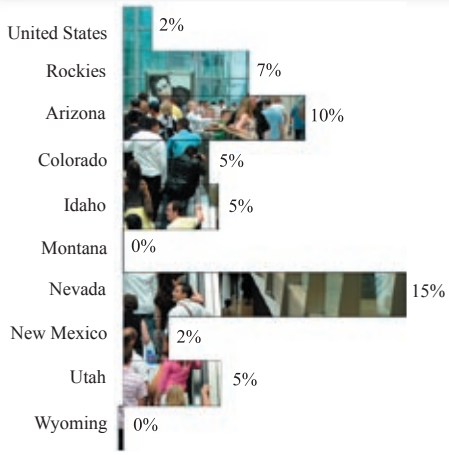
Minutes of Mean Travel Time to Work, 2004



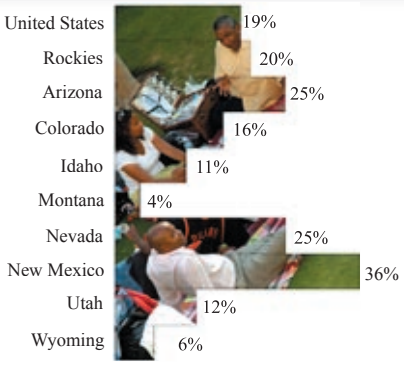
Population & Age, 2004

	Population	Population, Growth since 2000	Percentage of Population Age 0-19	Percentage of Population Age 65+	Median Age	Median Age, Change since 2000
United States	285,691,501	2%	28%	12%	36	3%
Rockies	19,400,701	7%	30%	11%	34	2%
-Arizona	5,633,997	10%	30%	13%	34	0%
-Colorado	4,498,611	5%	28%	10%	35	1%
-Idaho	1,360,152	5%	30%	11%	34	3%
-Montana	901,901	0%	26%	13%	40	6%
-Nevada	2,301,197	15%	28%	11%	35	0%
-New Mexico	1,862,837	2%	29%	12%	36	3%
-Utah	2,349,472	5%	34%	8%	28	3%
-Wyoming	492,534	0%	26%	12%	38	6%

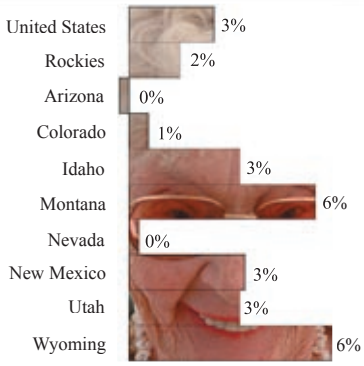
Population Growth, 2000 to 2004



Percentage of Population Who Speak a Language Other than English at Home, 2004



Change in Median Age, 2000 to 2004



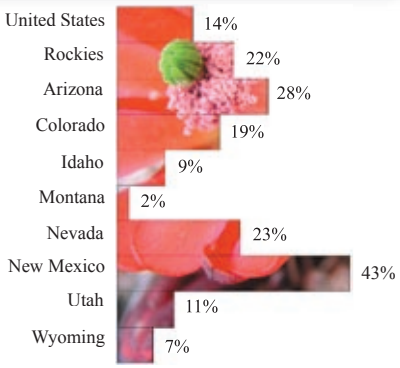
Language, 2000 and 2004

Percentage of the Population Age 5 and Older Who Speak the Following Language at Home	English Only 2004	Language other than English 2004	Language other than English 2000
United States	81%	19%	18%
Rockies	80%	20%	20%
-Arizona	75%	25%	26%
-Colorado	84%	16%	15%
-Idaho	89%	11%	9%
-Montana	96%	4%	5%
-Nevada	75%	25%	23%
-New Mexico	64%	36%	37%
-Utah	88%	12%	13%
-Wyoming	94%	6%	6%

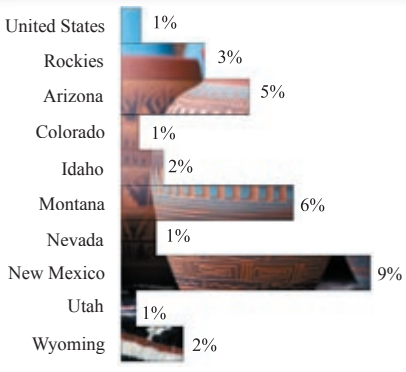
Race & Ethnicity, 2004

Percentage of Population Who Identifies as the Following	American Indian and Alaska Native	Black or African	White	Hispanic or Latino (any race)
United States	1%	12%	76%	14%
Rockies	3%	3%	82%	22%
-Arizona	5%	3%	77%	28%
-Colorado	1%	4%	83%	19%
-Idaho	2%	0%	92%	9%
-Montana	6%	0%	90%	2%
-Nevada	1%	7%	78%	23%
-New Mexico	9%	2%	71%	43%
-Utah	1%	1%	91%	11%
-Wyoming	2%	1%	93%	7%

Percentage of Population Who Identify as Hispanic or Latino, 2004



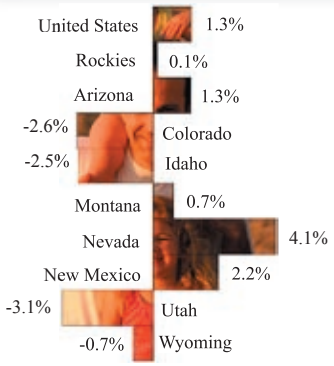
Percentage of Population Who Identify as American Indian or Alaska Native, 2004



Families, 2004

	Family Households as a Percentage of all Households	Non-family Households as a Percentage of all Households	Average Family Size in Number of People	Average Family Size, Change since 2000
United States	67%	33%	3.2	1.3%
Rockies	67%	33%	3.2	0.1%
-Arizona	67%	33%	3.2	1.3%
-Colorado	64%	36%	3.0	-2.6%
-Idaho	71%	29%	3.1	-2.5%
-Montana	65%	35%	3.0	0.7%
-Nevada	64%	36%	3.3	4.1%
-New Mexico	65%	35%	3.3	2.2%
-Utah	76%	24%	3.5	-3.1%
-Wyoming	65%	35%	3.0	-0.7%

Change in
Family Size, 2000 to 2004



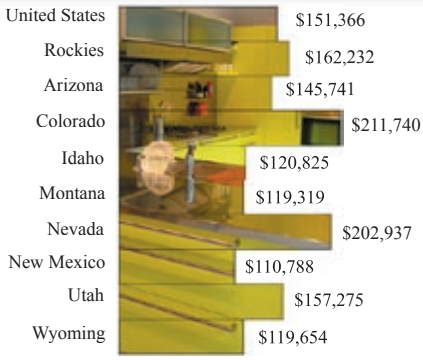
Housing Units, 2004

	Occupied Housing Units	Owner-occupied Units as a Percentage of Occupied Housing Units	Renter-occupied Units as a Percentage of Occupied Housing Units	Average Number of Residents in Owner-occupied Units	Average Number of Residents inRenter-occupied Units
United States	109,902,090	67%	13%	2.7	2.4
Rockies	7,431,821	68%	12%	2.7	2.4
-Arizona	2,131,534	69%	12%	2.7	2.5
-Colorado	1,850,238	69%	13%	2.6	2.2
-Idaho	515,252	72%	10%	2.7	2.4
-Montana	368,530	69%	13%	2.5	2.3
-Nevada	871,915	61%	15%	2.7	2.5
-New Mexico	711,827	69%	12%	2.7	2.4
-Utah	780,029	70%	10%	3.2	2.7

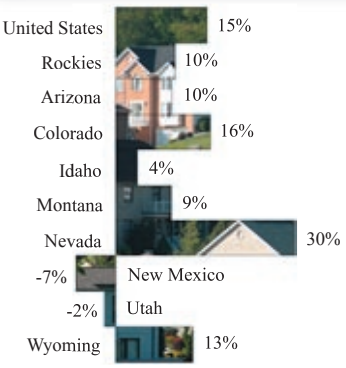
Home Values & Costs, 2004

	Median Home Value	Median Home Value, Change since 2000	Median Monthly Costs for Housing Units with Mortgage	Median Monthly Costs for Housing Units without Mortgage	Median Rent	Median Rent, Change since 2000
United States	$151,366	15%	$1,212	$345	$694	5%
Rockies	$162,232	10%	$1,161	$297	$672	0%
-Arizona	$145,741	10%	$1,130	$284	$691	2%
-Colorado	$211,740	16%	$1,355	$325	$724	-2%
-Idaho	$120,825	4%	$953	$271	$566	0%
-Montana	$119,319	9%	$974	$301	$520	6%
-Nevada	$202,937	30%	$1,274	$341	$787	3%
-New Mexico	$110,788	-7%	$935	$249	$546	-1%
-Utah	$157,275	-2%	$1,164	$291	$662	1%
-Wyoming	$119,654	13%	$954	$275	$534	11%

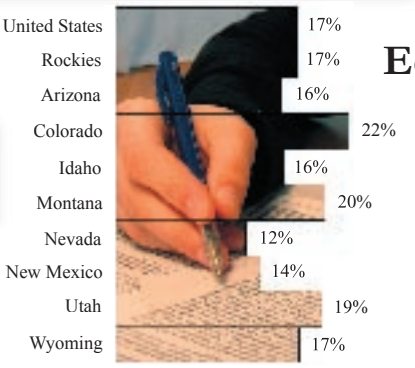
Median Home Value, 2004



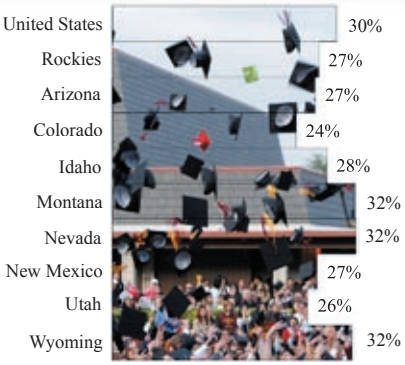
Change in
Median Home Value, 2000 to 2004



Percentage of Population 25 and Older Who
Earned Bachelor's Degree, 2004



Percentage of Population 25 and Older Who
Graduated High School, 2004



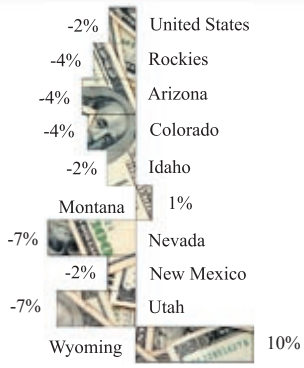
Educational Attainment, 2000 and 2004

Percentage of Population 25 & Older Who	Graduated High School (including equivalency), 2004	Graduated High School (including equivalency), 2000	Earned Bachelor's Degree, 2004	Earned Bachelor's Degree, 2000	Earned Graduate/ Professional Degree, 2004	Earned Graduate/ Professional Degree, 2000
United States	30%	29%	17%	16%	10%	9%
Rockies	27%	26%	17%	17%	9%	9%
-Arizona	27%	24%	16%	15%	9%	8%
-Colorado	24%	23%	22%	22%	12%	11%
-Idaho	28%	28%	16%	15%	8%	7%
-Montana	32%	31%	20%	17%	8%	7%
-Nevada	32%	29%	12%	12%	7%	6%
-New Mexico	27%	27%	14%	14%	10%	10%
-Utah	26%	25%	19%	18%	9%	8%
-Wyoming	32%	31%	17%	15%	8%	7%

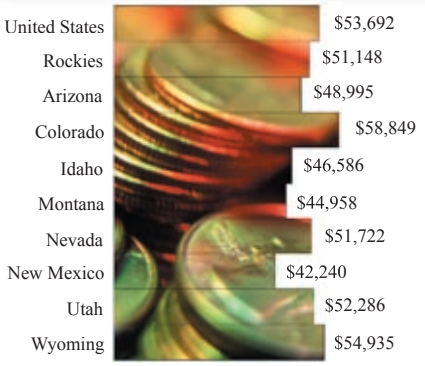
Income, 2004

	Median House-hold Income	Median House-hold Income, Change since 2000	Mean Household Income	Median Family Income	Median Family Income, Change since 2000	Mean Family Income	Per Capita Income	Per Capita Income, Change since 2000
United States	$44,684	-3%	$60,070	$53,692	-2%	$69,593	$24,020	1%
Rockies	$43,391	-5%	$57,020	$51,148	-4%	$65,172	$22,460	0%
-Arizona	$41,995	-6%	$56,984	$48,995	-4%	$64,784	$22,105	-1%
-Colorado	$48,198	-7%	$63,004	$58,849	-4%	$74,147	$25,945	-2%
-Idaho	$39,934	-3%	$50,200	$46,586	-2%	$56,552	$19,269	-2%
-Montana	$35,239	-3%	$45,779	$44,958	1%	$54,291	$19,565	4%
-Nevada	$44,646	-9%	$59,825	$51,722	-7%	$67,450	$23,938	-1%
-New Mexico	$36,043	-4%	$49,114	$42,240	-2%	$55,613	$20,234	7%
-Utah	$47,074	-6%	$57,696	$52,286	-7%	$63,398	$19,584	-2%
-Wyoming	$44,275	7%	$55,751	$54,935	10%	$65,334	$24,036	15%

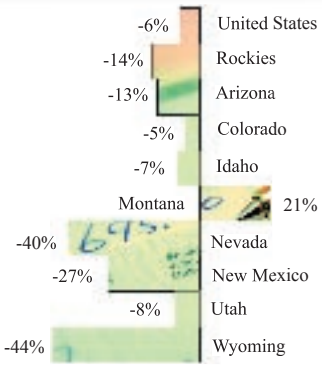
Change in Median Family Income, 2000 to 2004



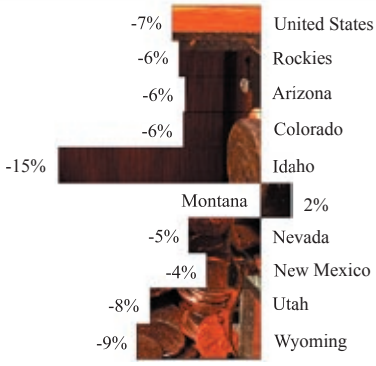
Median Family Income, 2004



Change in Mean Cash Public Assistance Income, 2000 to 2004



Change in Mean Retirement Income, 2000 to 2004



Poverty, 2000 & 2004

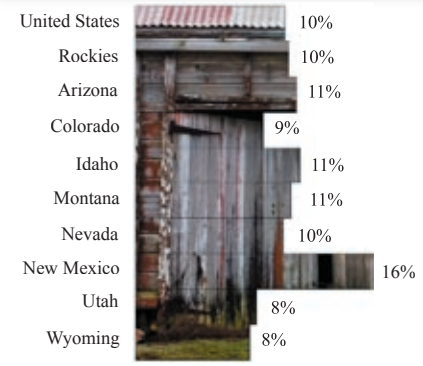
Percentage of the Following Groups Whose Income in the Past 12 Months is below the Poverty Level	All Families, 2004	All Families, 2000	All People, 2004	All People, 2000
United States	10%	9%	13%	12%
Rockies	10%	9%	13%	12%
-Arizona	11%	10%	14%	14%
-Colorado	9%	6%	11%	9%
-Idaho	11%	8%	14%	11%
-Montana	11%	10%	14%	14%
-Nevada	10%	8%	13%	10%
-New Mexico	16%	15%	19%	18%
-Utah	8%	6%	11%	9%
-Wyoming	8%	8%	10%	11%

Income by Type, 2004

	Mean Earnings	Mean Earnings, Change since 2000	Mean Social Secu-rity Income	Mean Social Security Income, Change since 2000	Mean Retirement Income	Mean Retirement Income, Change since 2000	Mean Supplemental Security Income	Mean Supplemental Security Income, Change since 2000	Mean Cash Public Assistance Income	Mean Cash Public Assistance Income, Change since 2000
United States	$61,341	-1%	$13,046	5%	$17,798	-7%	$6,907	0%	$3,116	-6%
Rockies	$56,557	-2%	$13,071	4%	$18,680	-6%	$6,969	0%	$2,420	-14%
-Arizona	$57,283	-1%	$13,689	4%	$18,892	-6%	$7,472	4%	$2,484	-13%
-Colorado	$62,499	-4%	$12,604	4%	$19,992	-6%	$6,473	-6%	$2,530	-5%
-Idaho	$50,624	0%	$13,034	5%	$14,699	-15%	$6,546	-2%	$1,869	-7%
-Montana	$44,871	2%	$13,101	8%	$16,983	2%	$7,073	5%	$3,232	21%
-Nevada	$58,966	-3%	$12,728	2%	$19,368	-5%	$7,564	1%	$1,856	-40%
-New Mexico	$47,975	0%	$11,800	2%	$19,514	-4%	$6,748	5%	$2,288	-27%
-Utah	$56,479	-6%	$13,729	6%	$17,805	-8%	$6,734	-7%	$2,920	-8%
-Wyoming	$53,351	7%	$13,585	9%	$16,193	-9%	$5,904	-18%	$1,476	-44%

Families in Poverty, 2004

As a Percentage of All Families



Employment by Occupation, 2004

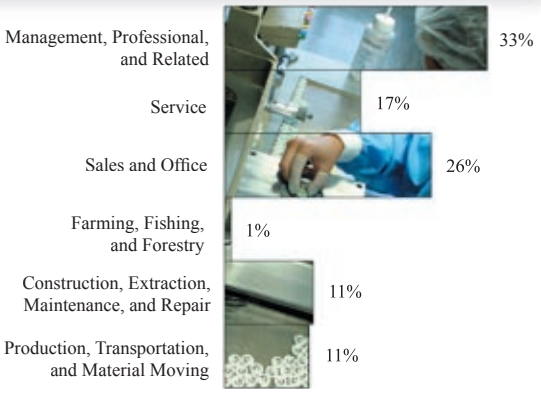
Percentage of Civilian Population 16 and Older Employed in the Following Occupations	Management, Professional, and Related	Service	Sales and Office	Farming, Fishing, and Forestry	Construction, Extraction, Maintenance, and Repair	Production, Transportation, and Material Moving	*Employed Civilian Population 16 and Older*
United States	34%	16%	26%	1%	10%	13%	*134,259,460*
Rockies	33%	17%	26%	1%	11%	11%	*9,132,410*
-Arizona	32%	17%	28%	0%	11%	11%	*2,497,460*
-Colorado	37%	15%	26%	1%	11%	10%	*2,253,357*
-Idaho	33%	15%	25%	3%	10%	15%	*636,533*
-Montana	35%	18%	24%	2%	11%	9%	*453,643*
-Nevada	26%	25%	26%	0%	12%	10%	*1,090,563*
-New Mexico	36%	17%	24%	1%	12%	9%	*839,881*
-Utah	34%	16%	28%	0%	10%	12%	*1,099,283*
-Wyoming	32%	17%	22%	2%	15%	13%	*261,690*

The United States

Employment by Occupation, 2004

The Rockies Region

Employment by Occupation, 2004



The United States

Employment Growth by Occupation, 2000 to 2004

Employment Growth by Occupation, 2000 to 2004

Percentage Growth of the Number of Civilians16 and Older Employed in the Following Occupations	Management, Professional, and Related	Service	Sales and Office	Farming, Fishing, and Forestry	Construction, Extraction, Maintenance, and Repair	Production, Transportation, and Material Moving	*All Occupations*
United States	5%	13%	1%	-5%	7%	-8%	*3%*
Rockies	9%	15%	4%	-0%	11%	3%	*8%*
-Arizona	10%	20%	10%	-13%	14%	9%	*12%*
-Colorado	2%	7%	-3%	3%	11%	-1%	*2%*
-Idaho	10%	4%	5%	3%	-1%	9%	*6%*
-Montana	13%	14%	1%	-2%	7%	-11%	*6%*
-Nevada	20%	21%	11%	13%	22%	11%	*17%*
-New Mexico	16%	13%	3%	46%	15%	-3%	*10%*
-Utah	9%	19%	1%	-68%	3%	-5%	*5%*
-Wyoming	16%	12%	-2%	19%	9%	7%	*9%*

The Rockies Region

Employment Growth by Occupation, 2000 to 2004

Employment by Industry, 2004

Percentage of Civilian Population 16 and Older Employed in the Following Industries	Agriculture, Forestry, Fishing, Hunting, and Mining	Construction	Manufacturing	Wholesale Trade	Retail Trade	Transportation, Warehousing, and Utilities	Information	Finance, Insurance, Real Estate, Rental, and Leasing	Professional, Scientific, Management, Administrative, and Waste Management Services	Educational Services, Health Care, and Social Assistance	Arts, Entertainment, Recreation, Accommodation, and Food Services	Other Services (except public administration)	Public Administration	*Total Employed Civilian Population 16 and Older*
United States	2%	7%	12%	4%	12%	5%	3%	7%	10%	20%	9%	5%	5%	*134,259,460*
Rockies	3%	9%	8%	3%	12%	5%	2%	7%	10%	19%	11%	5%	5%	*9,132,410*
-Arizona	1%	10%	9%	4%	12%	6%	2%	8%	10%	19%	10%	5%	5%	*2,497,460*
-Colorado	3%	9%	8%	3%	12%	5%	4%	8%	13%	17%	9%	5%	4%	*2,253,357*
-Idaho	5%	9%	12%	4%	12%	4%	2%	5%	10%	20%	7%	5%	5%	*636,533*
-Montana	7%	8%	5%	3%	12%	5%	2%	6%	7%	22%	11%	5%	6%	*453,643*
-Nevada	1%	10%	5%	3%	11%	5%	2%	7%	9%	13%	25%	4%	5%	*1,090,563*
-New Mexico	5%	8%	5%	3%	11%	5%	2%	5%	9%	23%	10%	5%	9%	*839,881*
-Utah	1%	8%	10%	4%	13%	4%	3%	7%	11%	20%	9%	5%	6%	*1,099,283*
-Wyoming	12%	9%	4%	2%	11%	7%	2%	5%	6%	20%	11%	5%	7%	*261,690*

Employment Growth by Industry, 2000 to 2004

Percentage Growth of the Number of Civilians16 and Older Employed in the Following Industries	Agriculture, Forestry, Fishing, Hunting, and Mining	Construction	Manufacturing	Wholesale Trade	Retail Trade	Transportation, Warehousing, and Utilities	Information	Finance, Insurance, Real Estate, Rental, and Leasing	Professional, Scientific, Management, Administrative, and Waste Management Services	Educational Services, Health Care, and Social Assistance	Arts, Entertainment, Recreation, Accommodation, and Food Services	Other Services (except public administration)	Public Administration	*All Industries*
United States	-0%	14%	-11%	8%	3%	-0%	-14%	7%	8%	6%	12%	3%	7%	*3%*
Rockies	4%	16%	-4%	15%	6%	10%	-18%	12%	13%	11%	7%	11%	9%	*8%*
-Arizona	-24%	29%	-6%	21%	11%	31%	-23%	17%	9%	16%	9%	14%	11%	*12%*
-Colorado	27%	5%	-5%	2%	1%	4%	-26%	6%	12%	4%	-4%	5%	-1%	*2%*
-Idaho	-15%	19%	0%	11%	1%	0%	1%	11%	27%	12%	-10%	21%	-5%	*6%*
-Montana	0%	20%	-11%	7%	-1%	-7%	11%	8%	16%	9%	10%	5%	15%	*6%*
-Nevada	-9%	28%	31%	28%	15%	6%	-1%	19%	24%	18%	13%	7%	18%	*17%*
-New Mexico	35%	12%	-12%	19%	0%	11%	3%	3%	6%	15%	8%	13%	22%	*10%*
-Utah	-31%	-1%	-9%	26%	7%	-9%	-18%	10%	18%	9%	17%	14%	6%	*5%*
-Wyoming	24%	11%	-20%	11%	1%	10%	-6%	12%	8%	1%	19%	12%	23%	*9%*

How Various Groups Rank the Rockies States

	Best Digital Government, 2005[1]	Best Return on Federal Tax Dollar, 2003[2]	Most Expensive Residential Electricity, 2003[3]	Smartest States, 2004[4]	Best Elementary Schools, 2003[5]	Best Middle Schools, 2003[6]	Healthiest States, 2004[7]	Best Business Tax Climate, 2004[8]	Best Technology and Science, 2004[9]
Arizona	28	21	22	48	43	41	23	19	17
Colorado	13	41	25	21	16	9	13	8	3
Idaho	15	18	49	29	29	25	18	31	30
Montana	26	8	35	10	17	6	26	17	38
Nevada	10	46	14	49	45	44	37	6	43
New Mexico	45	1	15	50	50	50	38	40	14
Utah	1	22	44	28	28	23	5	26	9
Wyoming	50	25	42	16	8	11	28	7	41

Sources, Ranking the States

[1] http://www.brown.edu/Administration/News_Bureau/2005-06/05-023.html.
[2] http://www.nemw.org/fundsrank.htm.
[3] http://www.eia.doe.gov/neic/rankings/stateelectricityprice2003.htm.
[4] http://www.infoplease.com/ipa/A0931043.html.
[5] http://www.psk12.com/rating/USthreeRsphp/STATE_US_level_Elementary_CountyID_0_year_2003.html.
[6] http://www.psk12.com/rating/USthreeRsphp/STATE_US_level_Elementary_CountyID_0_year_2003.html.
[7] http://www.unitedhealthfoundation.org/shr2004/Findings.html.
[8] http://www.taxfoundation.org/research/topic/90.html.
[9] www.milkeninstitute.org/pdf/nstech_index04.pdf.

Government Performance Project

Grading State Government, 2005

http://results.gpponline.org/

	Overall	Money	People	Infrastructure	Information
Arizona	B	B	B	B-	B-
Colorado	C+	C-	C+	C+	C+
Idaho	B-	B+	B	C+	C+
Montana	C+	C+	C+	B-	C
Nevada	B-	C+	C+	B+	B-
New Mexico	C+	B	C+	D+	B
Utah	A-	A	B+	A	A-
Wyoming	C	B	D+	C	C

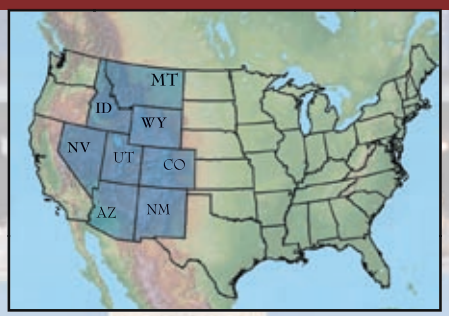
A Common Western Voice

Can the Rockies Be Heard in Washington, D.C.?

By Jared Kapela, Andrew Yarbrough,
Caitlin O'Brady, and Bryan Hurlbutt

THE 2006 COLORADO COLLEGE STATE OF THE ROCKIES REPORT CARD

"The widespread support for a Western primary comes from a basic instinct for democratic self-determination, coupled with a sense of identity."
–Daniel Kemmis, *Headwaters News*, September 8, 2005



The Rocky Mountain region's distinctive features—its vast open space, large proportion of federal lands, aridity, small population coupled with rapid population growth, abundance of natural amenities and natural resources, and popularity to vacationers—create a unique set of challenges for the region. Aspects of these general characteristics can be found elsewhere in the United States, but the way in which they all converge in the Rockies creates a number of issues that are either nonexistent in other regions or are not as urgent. Although these Rockies-specific issues can be addressed to some degree at the local and regional level, national attention is needed to adequately address the Rockies' concerns. But, the region's political voice is hardly audible and is often ignored.

The eight-state Rockies region covers 24 percent of the U.S. landmass, but less than seven percent of the nation's population lives in the region, rendering its influence in national politics weak. Even as the region's population has grown at over three times the national rate (2000 to 2004) and continued population growth may increase the region's strength in the Electoral College, projected population gains through 2030 still leave the total Rockies' population low in comparison to the rest of the nation.

In presidential primaries and national elections, the particular issues and needs of Rockies states are rarely addressed except by a few stops during flights from coast to coast as candidates solicit

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votes in more populous parts of the nation. In response to continuing neglect of Western issues at the national level, various entities in the Rockies are working to draw more attention to our regional needs in national politics.

How can the Rockies region strive for a more influential voice in national politics?

The Rockies Project explores three related dimensions to this question. First, can the region articulate a common set of issues worthy of national attention? Second, is an early Mountain West primary and/or a Rockies-based presidential debate a viable option for drawing more attention to the West? And third, what role do regional partnerships play in focusing and vocalizing our common Western needs?

Finding our Voice

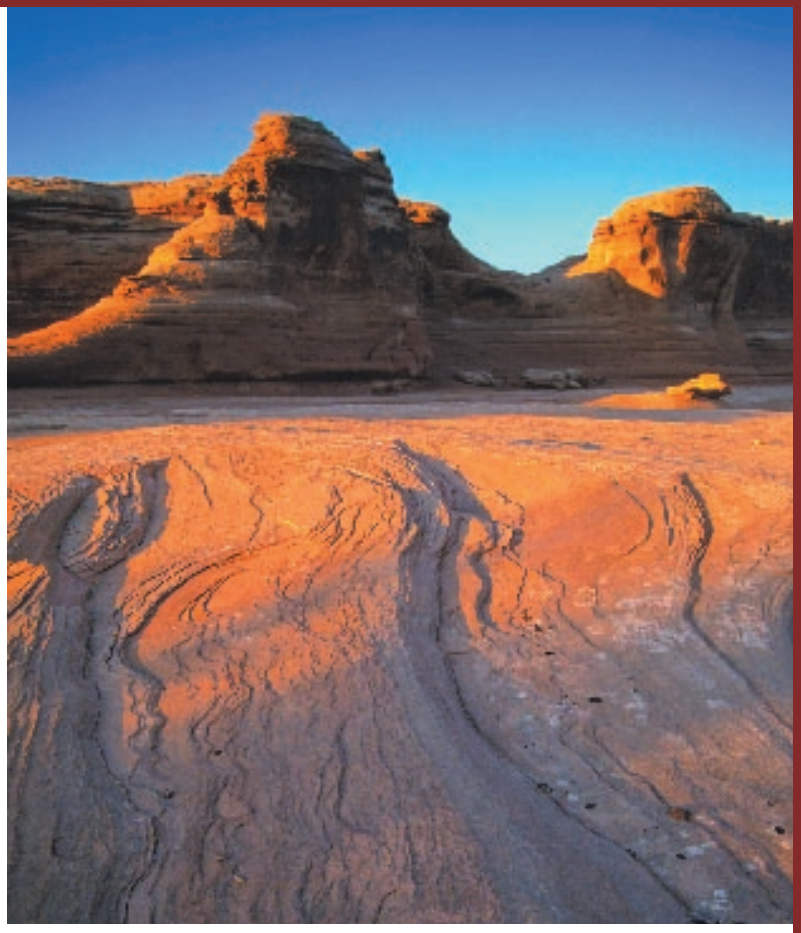
The December 6, 2004 issue of *High Country News* (HCN) published a cover story on "The 10 Biggest Challenges Facing the West." As explained in the editor's note by Paul Larmer, executive director of HCN, the paper stumbled upon this cover story after asking its staff, "What stories are the most important for us to follow? And how can HCN help set a positive agenda that is not mired in the morass of partisan politics?" After lengthy debate, HCN identified energy, global warming, water, nuclear energy, endangered species, private lands, healthy forests, agency openness, making it local, and solidarity as the ten most important topics to cover. Larmer admits that "we left out many critical issues, including those three large elephants in the room—population growth, immigration, and sprawl."

The editors at *High Country News* may not have conclusively settled on the most important issues in the Rockies, but they have taken the first step. HCN recognizes that the Mountain West faces a common set of challenges and that those challenges need to be thoughtfully presented to be part of a common Western voice.

Keep in mind that the eight-state Rockies region is not entirely homogenous, and one must be careful when urging a common voice for this diverse region. However, a common voice does not require settling on one side of an issue. Rather, developing a common Western voice involves deciding on which issues are of greatest concern, with each issue having a complex variety of views and perspectives.

For example, look at the issue of energy development in the Rockies. Making energy development part of the common Western voice does not require a regional stance for or against this or that type of energy development. The recognition that developing certain Rocky Mountain energy resources versus not developing them, or that developing them in one way versus another way, has a major impact on the region's economy, environment, and society is what we mean by deciding energy development is a critical Western issue. Asking the nation and its politicians to give the issue its deserved attention with the region's perspective in mind is what we mean by making energy development part of our common Western voice, not asking them to take a particular stance on one side of energy development or the other.

Other regional groups, including the Western Charter Project, *Headwaters News*, and the Western Governors' Association, are

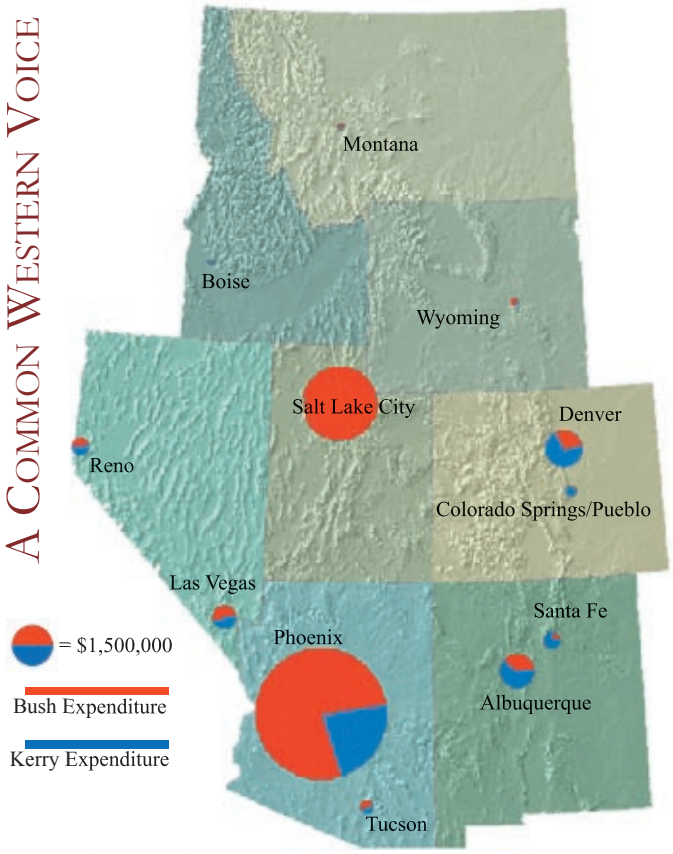


also working hard to define Western issues and, thus, speak with an articulate and strong voice on concerns unique to the Rockies.

The Western Charter Project, spearheaded by The Center for the Rocky Mountain West and The Center for Resource Management, aids local and state government leaders and constituents in creating a regional consensus and a powerful voice on the national stage. This is achieved by outlining key Western issues. In November 1999, at a Western Charter conference in Colorado Springs, Colorado, the project crafted a set of draft principles for the charter:[1]

- *Western Character and Outlook*: the region embodies unique dimensions of hope, possibility, and optimism based upon its history, grandeur, and vast landscapes.
- *Landscape and Natural Resources*: the defining characteristic of the region, especially biodiversity, public lands, and open spaces.
- *Governance*: a desire to seek local solutions even as government jurisdictions and a preponderance of public lands complicate communities' efforts.
- *The Economy*: once based upon natural resource extraction and use, global trends are fast converging on the region to bring about fundamental changes to rural communities and the rural way of life that has been integral to the West, including impacts on the quality of life, scale of commerce, and a diminished role for agriculture.
- *Growth*: rapid increases in both population and commerce challenge traditional ways communities and states have addressed growth, often leaving political entities overwhelmed by impacts beyond the capacity at which they can be absorbed.
- *Education*: competitiveness in a global arena requires a commitment to high quality, lifelong education and training, even as the financial and political commitments are strained.

The Center for the Rocky Mountain West continues to support Rocky Mountain regionalism through *Headwaters News*, an online news source which assembles daily news articles on the most



*One of Bush's media producers was based in Salt Lake City and the large amount of spending by Bush in the city does not correlate to his single stop there during his campaign.

Presidential Campaign Expenditures in the Rockies, 2004
Figure 1

Source: The Center for Responsive Politics

Trends from the 2004 Presidential Campaigns

Presidential candidates focus most of their campaigns on a very small proportion of American voters. Within the Rockies region, only four states saw most of the region's campaign spending and stops: Arizona, Colorado, New Mexico, and Nevada (Figures 1 and 2). And campaign travel records for the 2004 presidential race show that both George W. Bush (R) and John Kerry (D) rarely stopped in the Rockies states compared to other regions of the U.S. (Figure 2).

With ten electoral votes and a contentious race, Arizona received the most campaign spending of any state in the region. Colorado and New Mexico were also "battleground" states, providing nine and five electoral votes respectively, so they received some attention. Idaho, Montana, Utah, and Wyoming were essentially conceded to Bush, before the campaign even began, and as such, received no attention from either candidate.

pressing issues in the Rockies and supports an open forum on the issues. *Headwaters News* provides "a daily snapshot of news and opinion in the Rocky Mountain region of North America, giving the changing mountain West a tool to understand itself and a platform for the exchange of ideas."[2] Daniel Kemmis, senior fellow at the Center for the Rocky Mountain West and contributing writer to *Headwaters News*, leads innovative blogs on the Headwaters Web site on defining regional issues and building regional strength.

The Western Governors' Association (WGA), a bipartisan organization of governors which discusses Western issues and implements related policy, identified ten nationally relevant issues of particular importance to the West: energy, global warming, water, nuclear energy, endangered species, private lands, healthy forests, agency openness, making it local, and solidarity.[3]

Attracting National Attention

As the Rockies develops its regional voice, it must strive to make that voice heard. The Rockies can accomplish much at regional and local levels, but national decisions also have a huge impact, especially since the federal government owns and manages nearly half of the region. Innovative methods of drawing national attention to the Rockies must be developed if the region is to successfully protect and make use of its social, environmental, and economic assets.

Regional Presidential Primary

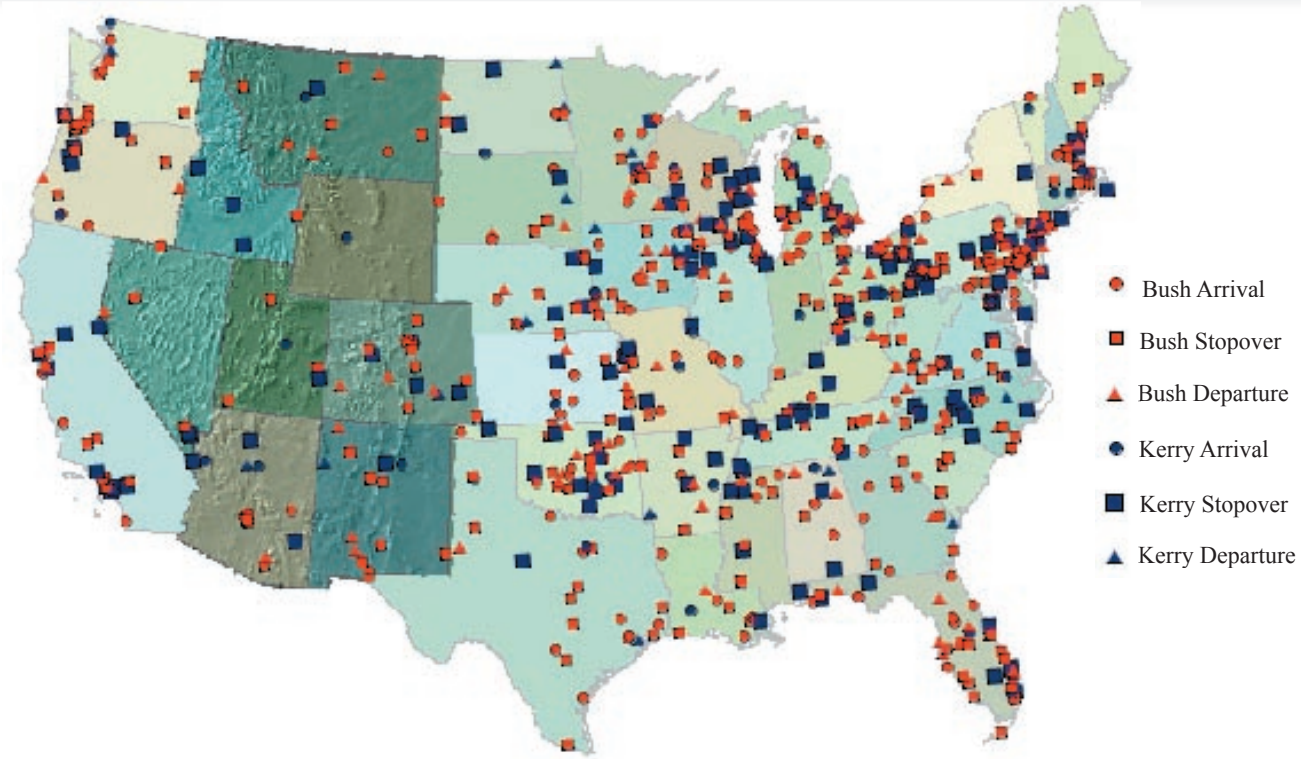
Holding an early-season, same-day presidential primary for the whole eight-state Rockies region is an often discussed and disputed method of bringing greater national awareness of and attention to Western issues. A Mountain West primary held early in the presidential primary season will force candidates to take a stance on Western-specific issues and will bring these issues to the national forefront. Much of the primary's outcome is determined early in the campaign, and although the Rockies states are weak individually, together they can build enough clout to be heard. From a regional viewpoint, such a primary has many advantages and much support, but on a national scale, opposition is mounting against the trend toward earlier and earlier primaries each election cycle.

Michael Stratton, a member of the Democratic National Committee's Commission on Presidential Nomination Timing and Scheduling and a strong supporter of a Mountain West primary, explains, "As the system works now, presidential candidates can easily ignore Western issues. They simply fly over the Rocky Mountains to get to the major media markets on the coasts, or visit the early primary states."[4] Under the current system, candidates are not encouraged to adopt views on Western issues, like a federal water management strategy, clean energy technology, protection of natural resources, and land conservation. Advocates for a regional primary argue that a pivotal and strategic primary position for the Mountain West would encourage candidates to take positions on these issues and later be accountable for such positions when elected.

Presidential Campaign Stops, 2004

Figure 2

Source: The Center for Responsive Politics



*John Kerry's few stops in Idaho were attributed to vacation time he took from the campaign at his ranch in Ketchum.

Making Rockies-specific issues more prominent in presidential elections may lead to more attention to these issues throughout the whole government. Issues taken up by presidential candidates are often discussed by all national politicians and are debated by citizens nationwide. As a result, Rockies politicians will gain greater influence in setting political agendas and drafting legislation.

Early primary dates have been shown to attract significant candidate attention. For example, when New Mexico moved its primary date forward, it received far more media coverage and visits from presidential candidates.[5] In 1996, Republican candidates spent a combined $100 million in the early primary states of Iowa and New Hampshire.[6] Supporters hope that an early-season primary in the Rockies would attract similar attention.

However, Curtis Gans, director of the Committee for the Study of the American Electorate, argues that front-loading and grouping primaries undermines the whole presidential nominating system. Pushing a Mountain West primary early in the primary season would further shorten an already jammed schedule, leaving voters little time to get to know candidates and excluding voters with late-season primary dates.

Historically, the decision for each party's candidates was made at their national conventions during the summer months before the November election, giving voters more time to weigh the merits of each candidate in their party and, theoretically, make better choices. Today, however, the press determines the nomination in an *ad hoc* fashion in early spring.

For example, in the 2004 Democratic Primary, most of the news media had declared John Kerry the likely democratic nominee by mid-February, whereas in 1960, John Kennedy's nomination was not known until the convention in July. Polls showed that 20 to 30 percent of American voters in the 2004 elections did not know enough about John Kerry or his running mate, John Edwards, to be able to form an opinion of them. Gans suggests that candidates may be negatively affected by a trend towards early primaries as illustrated in 2000 and 2004 when Democrats chose their candidates the earliest in history and lost in November.

Additionally, according to Gans, grouping several state primaries together puts an emphasis on television advertising rather than grassroots campaigning and personal contact and therefore does not increase voter turnout.[7] Indeed, since 1988, voter turnout was higher in individual primaries than grouped primaries in every year except 1992.[8]

Blocked primaries do reduce candidates' ability to pay attention to other states. A very small percentage of Americans receive attention from nominees during presidential elections. The majority of American people, including most people in the Rockies, is left out of the democratic process. As evidenced by the Commission on Federal Election Reform's recent, well-publicized suggestions, there is a need to empower more Americans in selecting presidential candidates. Thus the conundrum: blocked primaries would give a greater number of states more candidate attention, but if every state joins into appropriate blocks, the on-the-ground type of campaigning of the past would give way to new paces and styles.

National concerns over blocked primaries and front-loading are legitimate, but it is something that is already happening. Certain states and regions are taking advantage of it, providing incentive for others to do so as well. Colorado, Utah, and Wyoming held their 2000 primaries and caucuses on the same day. The initiative's sponsor, then-Utah Governor Mike Leavitt (R), commented that:

> The Mountain West is on the brink of a monumental breakthrough, poised to become a player for the first time in American presidential politics. Given the strategic early timing of the Western presidential primary and the combined delegates at stake, candidates will be hard pressed to overlook the region. Western issues will be discussed and Western concerns will be elevated in importance.[9]

Despite initial support by the other states for a common primary, Arizona, Idaho, Montana, Nevada, and New Mexico opted out of the agreement, weakening the initiative. After the 2000 primaries the agreement between Colorado, Wyoming, and Utah was abandoned and in the 2004 primaries all of the Rockies states held separate primaries or caucuses.

Though states like Colorado and Arizona may have more Electoral College votes than other Rockies states, they are not large enough to compete for attention with California, New York, Ohio, Pennsylvania, and Florida. As an eight-state Rockies region we are large enough to attract national attention and small enough to support a common set of priorities.

On June 22, 2004, The Western Governors' Association (WGA) adopted a resolution supporting a Western States Presidential Caucus/Primary early in the primary season.[10] Leading the initiative is New Mexico Governor Bill Richardson (D), who has stated that Arizona, Colorado, Montana, New Mexico, Utah, and Wyoming have all expressed interest in joining this partnership. Utah Governor Jon Huntsman (R) supports the primary, explaining, "Utah can benefit from the economic development that goes with being part of major national campaigns, and the enthusiasm that is created for both parties around national candidates coming to our region."[11]

Rockies-Based Presidential Debate

Another way to draw national political attention to Western issues is to host a presidential debate in the Rockies. Although Western issues were not addressed in Arizona's 2004 presidential debate, a debate with the backing of a coherent regional voice could force candidates to take a stance on Rockies' issues and address them when elected.

Logistically, a Rockies presidential debate may be easier to organize than a regional primary, since it does not require legislative or gubernatorial action. It would, however, hinge on successful negotiations with candidates, campaign staff, and the Commission on Presidential Debates. The Rockies region must convince campaign staffs and their candidates that much is at stake in the region and that speaking directly to Rockies citizens will have a large influence on voting. Although Bush won in every Rockies state in 2004, the presidential race was close in many states, and Democrats did well in other races. Each party has a lot at stake in the Rockies.

Future Regional Partnerships

In the Rockies' ongoing efforts to develop a coherent Western voice and to make its voice heard, regional partnerships will play a critical role. The region is learning to shed some of its lonesome cowboy image, an image that hinders regional cooperation and progress. As detailed earlier, it is regional organizations like the Western Governors' Association and the Center for the American West that are leading the way. Regional partnerships across state boundaries are important both because they focus on local and regional actions to effectively define and address regional issues and because they can attract national attention.

Our Western issues are largely affected by decisions made on a national level. Our region is sometimes treated as an inland colony

of the U.S. The rest of the country extracts water and energy resources and builds vacation homes, but leaves behind dry, toxic, and cold-bed communities. Many decisions are made without much Western participation and without even much consideration of Western perspectives.

By pooling resources, sharing successful strategies, and exchanging ideas through regional partnerships, the Rockies can do more to address its common regional problems. Our differences throughout the region—urban/rural, eastern slope/western slope, newcomer/native, and many more—must not be simply means of internal conflict. Rather, our varied needs and experiences must be the source of strength from which we decide what issues most impact our region, the source of our regional voice. These differences should not drive us apart, but should instead bring us together to give the issues their deserved attention through collaborative resolution.

A blocked primary and a presidential debate in the eight Rocky Mountain states are not perfect solutions to making our voice heard, but they will give the region more national political clout and attention. They are two tangible steps we can take towards self-determination, but they will not be easy. They both require strong regional leaders, commitment and cooperation from disparate groups across the Rockies, and agreement on a clear set of issues. Whether we can rise to these challenges hints at whether we are indeed worthy of such national attention.

Endnotes

[1] Center for Resource Management, *The Western Charter Project: Initiating A Regional Conversation*, (November 1999), 16-17.
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[4] Patrick O'Connor, "Democratic Strategist Urges Western Focus," *The Hill*, March 9, 2005, http://www.thehill.com/thehill/export/TheHill/News/Frontpage/030905/brief.html.
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[7] Curtis Gans, "The Primary and Caucus System in U.S. Elections," speech to the Foreign Press Center, Washington, D.C., November 14, 2003.
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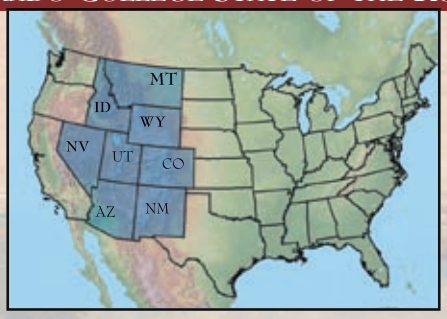
[11] Michael Coleman, "Governor Pushes for One Primary Day for the West," *Albuquerque Journal*, February 25, 2004.

Ranching in the Rockies

Threats and Signs of Hope

By Andrew Yarbrough, Jared Kapela, and Caitlin O'Brady

The 2006 Colorado College State of the Rockies Report Card



Ranchers and farmers working in the Rockies today help connect us to the region's past and tie us to the land. As the epicenter of many rural economies, ranchers and farmers are an integral part of Western culture. Furthermore, ecologically sound ranchlands are essential to wildlife migration, winter habitat, riparian areas, and ecological diversity. Preserving the Rockies ecosystems depends on maintaining profitable agricultural lands that can withstand residential development pressure.

The rise of non-working "conservation" ranches, the consolidation of the agriculture industry, a reduction in public grazing permits, and population growth continue to put pressure on traditional ranches in the Rockies. As a result, it remains to be seen how many ranches will be sold or how many will adapt their practices to meet the demands of new times. This report documents the current economic status of agriculture and ranching in the Rockies and examines the forces challenging traditional ranching. Also, this report presents a number of ways ranchers are diversifying their operations and altering their management techniques to make a profit.

Ranching is often blamed as a cause of environmental degradation, because excessive cattle grazing can be ecologically destructive to the land. Overgrazing and other unsustainable ranching practices result in short-term economic gain at the expense of long-term ecological harm. Environmentalists have engaged in frequent struggles with ranchers over grazing rights on federal lands, and they have criticized the production and consumption of meat as inefficient uses of the Earth's resources. But this has changed in recent years. Sprawl and exurban development are now viewed as greater environmental threats than cattle ranching, and the environmental movement has shifted focus from eliminating ranching to preserving it. In addition, ranchers have

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implemented more ecologically sensitive techniques, realizing that productive ranching depends on healthy land.

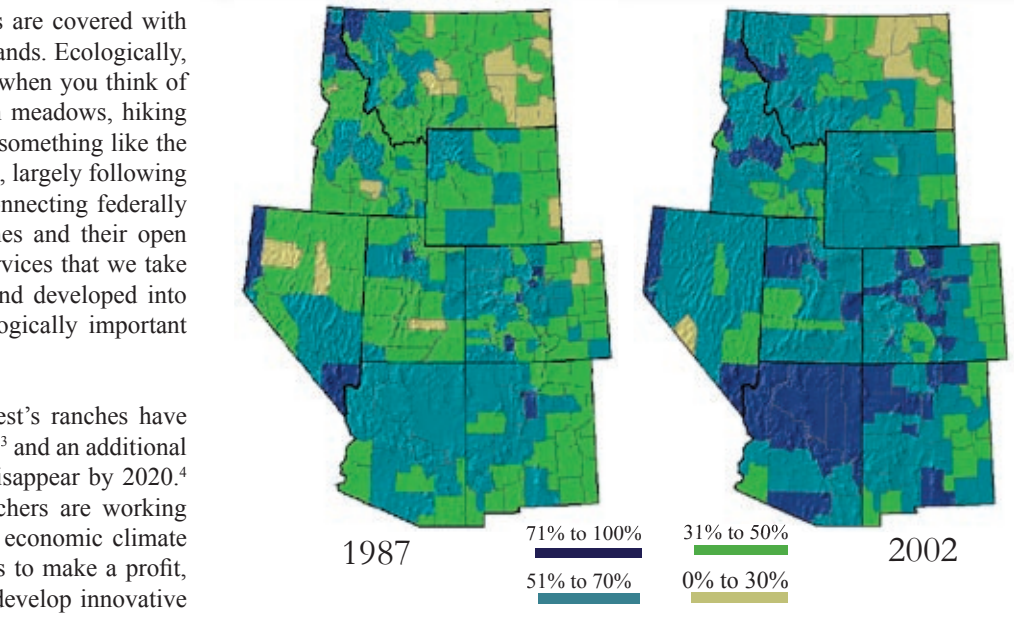
Ranches in the Rockies also tend to be located on the most ecologically productive lands. Fertile river valleys are covered with ranches between more rugged tracts of public lands. Ecologically, ranches help "support everything you think of when you think of the West: elk, deer, running streams, mountain meadows, hiking [and] hunting..."[1] These lands act as and "look something like the veins and arteries in the living body of the West, largely following the branching structure of watersheds."[2] By connecting federally protected lands throughout the Rockies, ranches and their open ranges provide a vast number of ecosystem services that we take for granted. However, when a ranch is sold and developed into smaller ranchettes or resort towns, these ecologically important roles are undermined.

Reports show that almost a quarter of the West's ranches have been converted to other uses in the last 30 years,[3] and an additional 24 million acres of ranchland is expected to disappear by 2020.[4] For this reason, conservation groups and ranchers are working together to curb these trends. In the declining economic climate of ranching, ranchers must adopt new practices to make a profit, and conservation groups are helping ranchers develop innovative ways to do so. Leading by example, conservation-minded ranching organizations, like the Quivira Coalition or Alan Savory's Holistic Resource Management (HRM) movement, are earning a profit through sustainable ranching. Nonprofit land trusts are also helping to preserve ranchlands through conservation easements, as more than two million acres of private land in the Rockies is now protected from development in perpetuity. For more information on easements, see "Conservation Easements," by the State of the Rockies, on page 27 of the *Report Card*.

Status of Ranching and Farming in the Rockies

Agriculture in the U.S. has been significantly transformed by increases in both efficiency and output in the 20th century. Technological advances over the past 25 years have improved productivity, allowing ranchers to produce much more with less. For example, the U.S. beef industry produced 14 percent more beef in 1999 than in 1980 with almost 5.5 million fewer cows. But these advances have been negated due to rising costs without corresponding higher prices. And today, agricultural production is concentrated on a few large, specialized farms which employ a very small number of workers. In comparison, at the beginning of the 20th century the majority of farms and ranches were small, family run, labor intensive, and diversified.[5] As commodity prices decline and input costs rise, small farms which cannot achieve economies of scale are at a severe disadvantage compared to large operations.

In addition, the economic significance of agriculture has steadily declined during the 20th century. Nationally, farm output as a share of total Gross Domestic Product (GDP) has declined from 11 percent in 1945 to 2.2 percent in 2004, and overall farm employment in the U.S. has fallen from 6.5 percent in 1940 to 0.65 percent today.[6] The percentage of farmers and ranchers forced to earn off-farm income to make ends meet has increased from 30 percent in 1930 to 93 percent today, and the proportion of the U.S. population living in rural areas has simultaneously declined from 68 percent of the total U.S. population in 1900 to 21 percent in 2000.[7]



County Percentage of
Farms and Ranches with Net Losses, 1987 and 2002
Figure 1
Source: 2002 Census of Agriculture

More than ever before, the majority of ranchers are struggling to meet their costs. The number of ranches in the Rockies experiencing net losses has increased sharply from 1987 to 2002 (Figure 1). Agricultural studies in the Rockies show that revenue was barely enough to cover management and labor costs, and returns on total investment were often negative.[8] In addition, over the past decade the cost of ranchers' inputs have increased greatly while ranchers' commodity prices have remained stable.[9] Beef prices in 1991 were $1.06 a pound, and in 2001 that price had only risen to $1.11, a mere five cent increase. On top of that, between 1991 and 2001 prices for beef per pound fell as low as $0.60.[10] Because smaller ranches are price takers, or businesses assumed to have no effect on the market, in standard auctions, they have no control over what price they receive. As a result, farmers and ranchers receive only 19 cents of every consumer dollar spent on food, amounting to a 12 cent decrease from 1980.[11]

Massive ranches which achieve economies of scale, meaning they lower production costs by mass production, tend to be more economically competitive than many traditional ranches. Cow/calf operations with 250 or more bred cows have significantly lower average operating and ownership costs than smaller operations, because as the size of a farm or ranch increases, operating costs decrease. Average costs for concentrates and other feed, harvested forage, veterinary services and medicine, bedding and litter, custom operations, fuel, lube, electricity, repairs, and interest on operating outputs all decline as the size of the operation grows. The same is true for ownership costs. Average operating costs are lower on larger ranches because they have the ability to get volume discounts on inputs and can better manage those inputs. Ownership costs are also lower because the cost of machinery, buildings, and equipment are spread over more units

of production. Statistics indicate that average costs for storage facilities, tractors, vehicles, and equipment also decline.[12]

Even with large operations, earning a living from raising livestock in the Rockies is difficult. A 300-cow breeding herd, for example, typically requires a $1 million investment, including land costs, grazing permits, buildings and improvements, machinery, and livestock, and yields approximately a two percent return on their investment. In other words, for that $1 million investment on average, the ranch owner will only receive a $20,000 profit.[13]

Ranches at Risk in the Rockies

Rising input costs, higher land values leading to sizeable estate taxes, and the industrialization of livestock industries, among other factors, put pressure on traditional ranches. As a result, agricultural land in the eight Rockies states has declined by approximately one million acres per year since 1964, falling from 268 million acres to 228 million by 1997.[14] Population growth, changing ownership patterns, consolidation of the livestock industry, public land use permits, and government subsidies are some of the major stresses to ranching operations in the Rockies.

Population Growth

The Rockies population is growing at around four percent annually. Most counties and municipalities have minimal policies in place to curb subdivision sprawl, resulting in towns and cities that are growing outward quickly. To grow outward, agricultural lands must be purchased and developed. The demand for subdivision is high, driving up the price of agricultural lands on the edge of town. This gives the rancher incentive to sell his or her land to a developer. Rising estate taxes, which add to the financial stress many ranchers already face, create even more incentive to cash in and sell the land.[15] This is not only occurring on the fringes of municipalities but also in more remote locations where second homes are popular. As a result, ranches face strong development pressure. The Center for the Study of Rural America estimates that farmland and ranchland property values across the West have increased almost 15 percent in real value since the mid-1980s. Consequently, from 1992-2002, 140,000 acres were lost each year,[16] and each day more ranchland and farmland are sold (Figure 2).[17]

Innovative Ranches

The Flitner Ranch: Cowboy Adventure Vacations with Luxury Accommodations

Shell, Wyoming

On the Flitner Ranch, owned and operated by Dave Flitner and his son, Greg, in the Bighorn Mountains of northwestern Wyoming, one will find not only cattle, but tourists as well. Founded in 1906 by Arthur Flitner with only 160 acres and 60 cattle, the ranch has expanded with each generation to nearly 300,000 acres of private and leased land and 1,200 head of black angus cows. As input costs for land, labor, equipment, and maintenance grew, the Flitners saw their profits begin to disappear. By the early 1980s, the Flitners realized that they could not survive by being just a livestock-producing business. To diversify their cattle business, the Flitners decided to bring tourists to the ranch.

The Flitners started a small hunting operation on their property in the mid 1980s, which generated a "bit of income," as Dave Flitner explains, but they needed to diversify their operations further to cover the rising costs of the ranch. The Flitners created the Cowboy Adventure Program in 1990, a luxury guest outfit accommodating approximately 50 guests at a time. Now called The Hideout, guests pay an all-inclusive fee of $2,400 per week to have a "once-in-a-lifetime cowboy adventure vacation … on an authentic Old West working cattle ranch." The Hideout has been a success, luring customers from all over the world back year after year (90 percent of their business is repeat business) to experience a traditional ranching experience plus luxury accommodations and gourmet cuisine.

The key to the success, according to Flitner, was finding the specific niche market the Flitner Ranch could best accommodate. The Flitners urge others to proceed cautiously when diversifying a traditional ranching operation. Ranchers must understand the market they are entering and ensure that their ranch can reach that market. And, because diversifying a ranch is costly, requiring advertising, marketing, and various fixed costs, the rancher must be confident that, in the long run, the revenue generated will be enough to cover those costs.

Additionally, population growth and the corresponding development of agricultural lands have a variety of indirect impacts on communities. In rural-turned-suburban communities, new employers compete with ranch owners for local labor, leading to higher wages and more competition for employees. New residents also require improved public services, like wider roads, more water, more sewage capacity, and new schools, which are expensive and must be funded by higher property taxes.

"Conservation" Ranchers

Wealthy individuals who are not interested in developing land are also buying ranches, which has both positive and negative effects on rural areas. On one hand, "conservation" or "amenity" owners, as they are often called, are saving large parcels by placing conservation easements on their new ranches and prohibiting development in perpetuity. On the other hand, these new owners, who rely on sources of income other than ranching, are displacing traditional ranching operations and taking away community economic bases while driving the price of land up by increasing the demand for agricultural land.

Ted Turner, the largest private landowner in the United States, is one example of a conservation owner. Turner states that he strives to manage his land in an "economically sustainable and ecologically sensitive manner while conserving native species" and has spent millions of dollars reviving endangered species, revolutionizing grazing techniques, and helping to reintroduce wolves into the West.[18] Turner uses holistic resource management on his properties and emphasizes the importance

of linking his land-management efforts with federal land management and conservation movements.

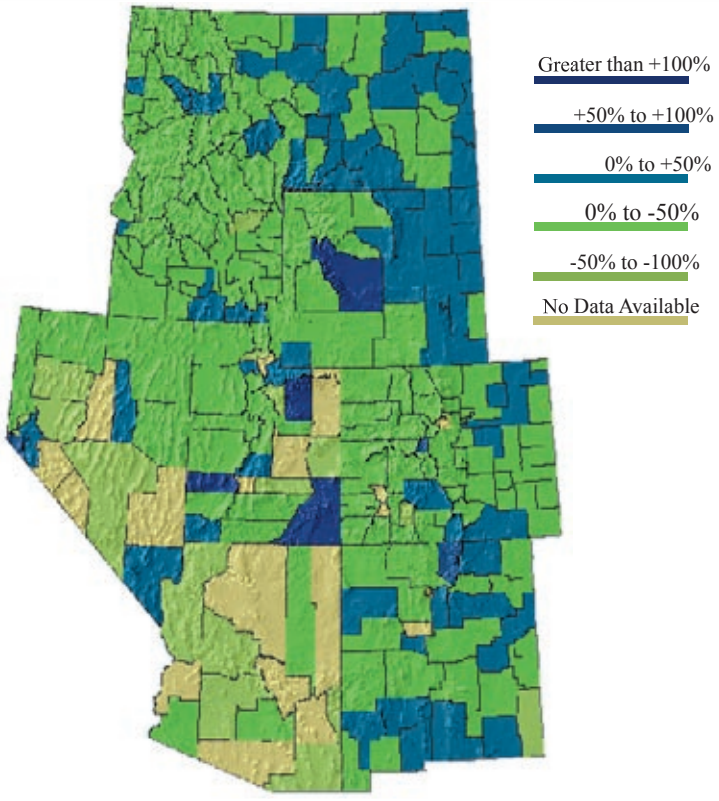
To prove that responsible land stewardship can pay off in profits, Turner has created Turner Enterprises, a for-profit organization that earns money ranching bison and running big-game hunts.[19] Typical of ranch owners who integrate conservation efforts with their ranchlands, Turner's ranching practices have been controversial. For example, many ranchers oppose his effort to reintroduce wolves into the region, because wolves sometimes prey on livestock.

Consolidation of the Livestock Industry

Consolidation at all levels of the livestock industry has changed the structure of ranching in the Rockies, as the biggest ranches and companies are controlling a larger and larger share of the market. Since 1900, the number of farms has fallen by 63 percent and the average farm size increased by 67 percent (Figure 3).[20] More than half of all cattle operations in the U.S. are relatively small with less than 50 head of cattle each; however, these ranches make up a very small percentage of the market share, accounting for only 22 percent of bred cows. Conversely, the six percent of operations with 250 or more head of cattle account for 29 percent of bred cows.[21] At the feedlot level, fewer than 15 percent of the feeding companies account for 70 percent of all fed cattle. At the packer level, 80 percent of cattle are harvested by the four largest companies. At the retail level, five companies account for 50 percent of all grocery store sales of beef.[22] Although production costs are lower for a consolidated livestock industry, leading to lower prices and a more competitive position for the U.S. in the world agricultural market and results in lower consumer prices, these gains have a severe impact on rural areas. Communities that were once home to a diversity of locally rooted traditional ranches are finding a single agricultural producer in their place.

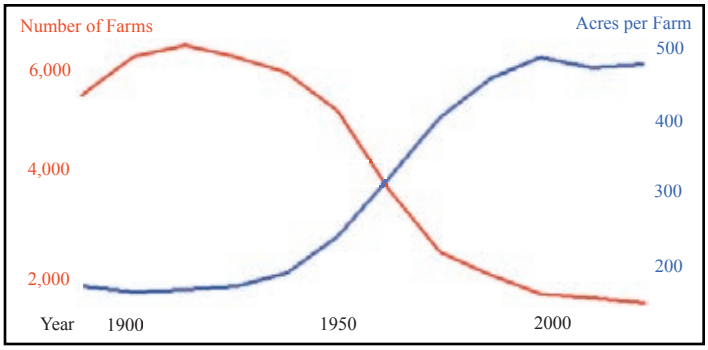
County Percentage Change in Acres of Farm and Ranch Land, 1987 to 2002
Figure 2

Source: 2002 Census Agriculture



Number of Farms and Farm Size, 1900 to 2000
Figure 3

Source: Census of Agriculture



Shortage of Federal Grazing Permits

Raising livestock in the arid West requires more land for grazing than it does in lush environments. For this reason, federal grazing permits provide important supplemental grazing land to ranchers. However, in the last several decades there has been a large effort to reduce the number of permits allowed by groups and individuals who argue that the environmental damage ranching causes to federal land should be stopped.[23] More than 20,000 ranchers in 11 Western states, or about 50 percent of all Western ranchers, hold federal grazing permits.[24] In 1997, 98 million acres of agricultural land, or 43 percent of all land in production, were held in grazing permits, down from 103 acres in 1992.[25]

Under the Taylor Grazing Act of 1934, the majority of federal grazing permits are administered by the U.S. Forest Service and the U.S. Bureau of Land Management. Permit holders pay fees for grazing rights on a head month basis, or a month's use and occupancy of federal rangeland by one adult cow, bull steer, heifer, horse, burro or five sheep/goats as set by Congress. In Western states, the average fee is $1.35 per head month, which is considerably cheaper than grazing cattle on private land. A U.S. Department of Agriculture (USDA) report in 1994, which examined the importance of public land grazing for ranchers in the West, determined that ranches which held federal grazing permits received better net returns.[26]

Many ranches in the Rockies rely almost entirely on these permits and hold very little of their own private land. But even where permits only make up one tenth of a ranch's total land, the revenue earned from that extra land may be essential to staying in business. If the decline in grazing permits continues, many ranchers will be forced to sell their land, or at least a large portion of it, to cash in on the development value and make ends meet.

Government Subsidies

Government subsidies to farmers and ranchers have played a crucial role in shaping U.S. agriculture for centuries, but subsidies, which distort the market, face strong criticism. Subsidies to dairy farmers, for example, create an incentive to produce an oversupply of milk, thus producing an oversupply of dairy cows. Because subsidies to corn farmers keep cattle feed prices extremely low, it is financially possible to feed dairy cows to reach the same meat grades as beef cattle, which then increases beef supply and reduces the price beef producers can gain for their cattle. Although beef producers receive monetary assistance from the government, they do not receive direct commodity subsidies like many other

farm commodities do. Consequently, the Rockies' beef-producing ranches struggle in the face of the current structure of government subsidies.

Economically Viable Ranching in the Rockies

For the average small ranch, rising costs have lowered the profitability of an already marginal and unstable enterprise. Ranching as a commodity producing business has become challenging, and in most cases, ranchers are forced to generate other forms of income to create and maintain an economically viable enterprise. Small, traditional ranches in the Rockies must seek creative ways to make a profit.

Ranchers are taking two noteworthy approaches to creating profitable traditional ranches. One approach is to diversify the operation by utilizing other valuable assets of the ranch and ranchland. The other approach is to employ more efficient and sustainable ranching management practices. Through diversification and new management techniques, ranchers are finding ways to make a profit.

Diversifying the Operation

Ranchers in the Rockies are employing "value-added practices" to make more on the ranch. Leading hunting and fishing adventures, accommodating dude ranching, and niche-marketing specialty products, like organic and natural beef or buffalo, are common ways in which ranchers are adding value to their ranches. These practices do not guarantee success. Niche markets for alternative ranch products are often slim, and small ranch operations do not have sufficient access to them.[27] But ranchers are making them work.

In response to the growing variety of products ranches are offering, small ranchers are creating partnerships to develop larger markets for their products, achieve economies of scale, and jointly market their product. Through partnerships, small producers create marketing leverage and can give a brand name to their product. For diversifying ranchers, "Economic Survival of Western Ranching" by Larry Butler suggests it is important to evaluate whether or not there is actually a market for the product, learn about the market, ensure the estimated sales are enough to cover costs, ensure the ranch has access to the market, establish partnerships with other ranches and businesses, practice responsible land stewardship, and focus on service and product quality.[28]

Innovative Ranches

Ucross Ranch: Artists-in-Residence Program and Holistic Resource Management

Sheridan, Wyoming

Raymond Plank, chairman of Apache Corporation, operates his oil company with social responsibility. He believes that energy development companies need to use the best available technology to decrease their impact on the land and need to invest more profit back into the local communities in which they drill or dig. Putting his money where his mouth is, Plank bought ranchland around Sheridan, Wyoming, from 1967 to 1981 and established a $10 million endowment for a nonprofit organization. On June 1, 1981, the Ucross Foundation was established. The Ucross Ranch includes a 22,000-acre working ranch, a historical preservation center, and an artists-in-residence program.

The artists-in-residence program gives artists from around the world the opportunity to live on the quiet ranch in its natural setting for two to eight weeks at a time. During this time, artists work uninterrupted with first-class accommodations and a personal chef. Artists come from different stages of their careers and from different disciplines, including painters, poets, sculptors, writers, photographers, and filmmakers. The ranch has a gallery where locals and tourists can view work by the visiting artists. Much of the art that is created on the Ucross Ranch has been showcased in national galleries or published by renowned companies. Ucross alumna, Olive Ayhens, displayed her paintings at the Watkins Gallery at American University in Washington, D.C., and Josip Novakovich's book, "April Fool's Day," was recently published by HarperCollins.

The Ucross Foundation's ranching operation is an excellent example of culturally and environmentally sound ranching. Ranch manager, Mark Gordon, practices Holistic Resource Management, which he views as the most effective approach to economical and sustainable pasture management. In 1999, the foundation worked with the Wyoming chapter of The Nature Conservancy to place a conservation easement on half the ranch, protecting that portion of the ranch from development in perpetuity.

The ranch has faced its challenges. Ucross does not own the mineral rights to portions of the ranch. The mineral owners have exercised their rights to develop the minerals, resulting in 20 wells, three pipelines, and numerous roads on the Ucross Ranch. Plank describes the coalbed methane exploration taking place on the ranch as a "disaster." Plank is not an opponent of coalbed methane drilling. His company has plans for 2,000 wells in Canada this year, but he argues the industry's best practices, which he strives to follow, are not being used on the ranch.

Management Techniques for Improving Profitability

Ranchers are also turning their businesses around by adopting new management techniques and practices for raising traditional livestock. Historically, ranchers employed damaging grazing practices, like overgrazing, which eventually lowered productivity. Ranchers now realize the importance of healthy rangeland in minimizing costs and maximizing output. As a result, sustainable ranching techniques are being developed and utilized.

One prevalent management style is Holistic Resource Management (HRM). To follow HRM's specific grazing style, ranchers must be willing to alter their management approach, the way they make decisions, their interaction with the land, and their operational plans.[29] Many ranches using HRM, such as the Lasater Ranch in Matheson, Colorado, have cut costs and increased production. Other new management practices for traditional ranches, like conservation easements and grassbanking, have had similar positive results. For more examples of innovative management techniques, see "New Resource Management," by the State of the Rockies, on page 35 of the *Report Card*.

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Innovative Ranches

Lasater Grasslands Beef: Grass-finished Beef, Rotational Grazing, and Direct Marketing

Matheson, Colorado

The Lasater Ranch in Matheson, Colorado, produces grass-finished beef under the watchful eye of fourth generation rancher, Dale Lasater. Lasater cattle are born and raised on the 25,000 acres of private land and an additional 5,000 acres of leased land that make up the ranch. The cattle only eat pasture grass and are not confined or grain fed. During the 1990s, the Lasaters recognized that they needed to add some sort of value to their traditional ranching operation to make it profitable. In 1996, the Lasater Ranch launched its grass-finished beef venture and registered Lasater Grasslands Beef as a limited liability company. The Lasaters were already raising their cattle naturally (no hormones) and without pesticides or fertilizer on their land for half a century, so switching to grass-finished beef was an appropriate option for adding value to their operation without large costs.

The strategy is working. The ranch is a profitable business, and the Lasaters have established a strong brand name for their product in the natural beef market. Because of their unique style of ranching, which uses no chemicals and fosters forage biodiversity, Lasater beef has emerged as an option for consumers seeking high-quality beef with minimal environmental impact. Lasater estimates that the cost of raising grass-finished cattle as 30 to 40 percent higher than grain-finished cattle, but the return has been more than enough to cover those costs. The Lasaters sell their product directly to consumers from their Web site. Dale Lasater says the Internet has been the most useful tool in establishing a reliable customer base.

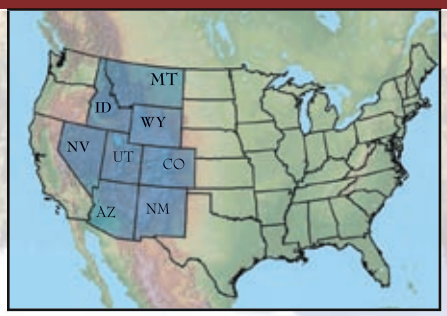
Lasater also attributes his success to the Holistic Resource Management (HRM) approach he employs on the ranch to maintain healthy land and reduce costs. The ranch operates on a 70-day rotational grazing period, allowing vegetation to regrow on unused parcels of land. Labor costs are also reduced, as the ranch does less haying and less time is needed to feed and manage the herd during the winter months.

Conservation Easements

Preserving Private Land in the Rockies

By Jared Kapela, Bryan Hurlbutt, and Andrew Yarbrough

The 2006 Colorado College State of the Rockies Report Card



The most prominent characteristic of land in the Rockies is that so much of it is relatively untouched by human development. This remote, rugged setting defines the West's historical identity and is the source of inspiration for the Western imagination. Even today, as the most remote pockets of the West have been tamed, the Rockies region is still open, wild, and untouched compared to the rest of the country. Although human impact has increased to some degree on every stretch of land in the Rockies, less than two percent of the region is actually covered by highways, housing developments, or large urban footprints.[1] The rest of the land is publicly and privately held natural forest, desert, and grassland or partially developed agriculture and ranch lands.

Nearly half (46 percent) of the Rockies' land is owned by the federal government, which administers these public lands through different government agencies, such as the Bureau of Land Management, Forest Service, and National Park Service. We tend to think of public lands, which are often the most visually impressive parts of the region, from stark desert to towering mountains to deep canyons, as the region's characteristic wild lands. The other half of the Rockies is mostly private ranch and farmland. Although private land may seem like a less integral component of what defines the West, agriculture lands, especially ranches, play a vital role in creating the West's scenic vistas, protecting its abundant wildlife, and giving the region a rugged character. Private ranches and farms cover most of the Rockies' fertile lands, following the wide river valleys that were homesteaded and serving as key arteries that link the public lands together. This complex interplay between public and private land forms the mosaic of the West that we know and love.

Western public lands face a variety of threats, from booming energy development and recreation to weapons testing and nuclear waste storage, but the development of private lands is altering the greatest percentage of the Rockies landscape. Between 1970 and

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2001, the Rockies' population grew 124 percent, or three times faster than the U.S.[2] And from 2000 to 2004, the Rockies' population has grown at over three times the national rate.[3] Agricultural lands are being converted to subdivisions at a rapid rate, as home seekers drive development and sprawl. This unprecedented growth is causing a significant impact in the rural West where open agricultural lands are being converted to residential uses as fast as, and sometimes faster than, the population growth rate.[4]

Multi-thousand acre ranches, that once represented a significant part of the rural economy, maintained scenic view sheds, and provided numerous ecosystem services, are losing their traditional value as they are developed into ranchettes and subdivisions. As a result, the Western heritage, natural lifestyle, scenic beauty, and recreational opportunities provided by the region's mountain landscapes, vast open spaces, and remote populations are being lost. Consequently, threatened and endangered species are declining at a much faster rate on private lands than on federally protected public lands.[5] As the Rockies region continues to attract new residents and second-home buyers, the cultural and environmental integrity of the wide open private ranches and agricultural lands will continue to decline.

Land trusts are leading the way in protecting the Rockies' private land by developing and implementing tools to impede the suburban race to the range and to preserve key undeveloped or lightly developed private land in the Rockies. Conservation easements are the tool used by these preservation groups and landowners nationwide to preserve cultural, historical, and ecological sites.

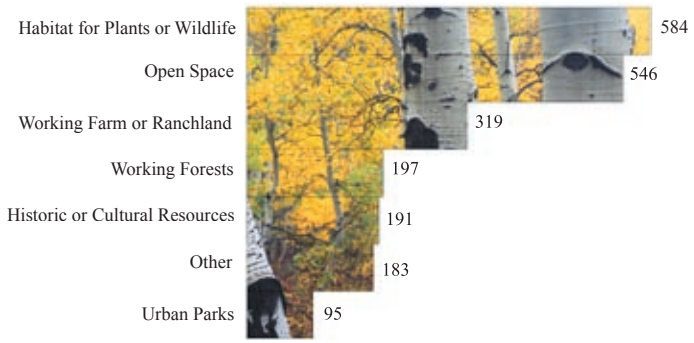
Gaining prominence during the 1970s, conservation easements allow landowners to capitalize financially by forever forfeiting some of their development rights, ensuring the land's conservation values will not be degraded by development or subdivision. Many in the conservation movement consider easements one of the most successful methods of preserving environmentally important private lands in the country. It is estimated that more than two million acres of private land—about the size of Yellowstone National Park—have already been protected in the Rockies, a number that is expected to grow rapidly as the easement movement gains popularity among landowners and legislators.

But how successfully do conservation easements prevent unplanned, rampant growth? How widespread are easements in the Rockies and where are they being used? And what role can they play in the future considering some of their controversial elements? This report addresses these critical questions by tracking the rise of land trusts and conservation easements in the U.S., critiquing conservation easements in general, and geographically tracking the use of easements throughout the Rockies.

Land Trusts and Conservation Easements in the United States

According to Land Trust Alliance (LTA) President Rand Wentworth, "The [collective] mission of land trusts is not just to save land, but to protect the traditional lifestyles of a community, a way of life that remains connected to that land." The LTA, an umbrella organization representing small, local trusts, defines a land trust as "a nonprofit organization that, as all or part of its mission, actively works to conserve land by undertaking or assisting in land or conservation easement acquisition, or by its stewardship of such land or easements."[6] Although different land trusts have different missions, a survey of approximately 1,350 land trusts suggests the primary purpose of most trusts is to protect habitat for plants or wildlife or to preserve open space. Figure 1 shows the primary purposes of land trusts outlined in their mission statements or activities of the entire survey field.[7]

Survey of 1,350 Land Trust Alliance Land Trusts:
Primary Conservation Purpose of Land Trusts, 2003
Figure 1 Source: Land Trust Alliance



Land trusts preserve private land either by accepting a conservation easement donation from a private landowner or by purchasing land themselves via fee-simple ownership and then either placing an easement on it or committing it to little or no development. Private property comes with a set of bundled rights such as agriculture, mineral, water, timber, and development rights that can be kept in aggregate or unbundled and sold separately. Landowners can give up the current and future development rights on their land in perpetuity and donate the land for a "conservation purpose" as defined by the Internal Revenue Service (IRS) to a certified nonprofit land trust. This is a conservation easement. In return, the federal government and, often, state and local governments, recognize the transaction as a charitable donation worthy of income-tax relief. Additionally, once the development rights are held by a nonprofit land trust, the property value significantly decreases, which reduces capital gains, estate, and gift taxes for the landowner.

In certain cases, preserving private land through fee-simple ownership still serves an important role, but preserving with conservation easements is becoming the preferred method for land trusts because of lower acquisition and monitoring costs and an evolving federal tax-incentive program.[8] Easements are, in turn, increasingly attractive to large-scale, private landowners because each agreement is tailored to a specific case, giving the landowner much control over the process. Additionally, easements give cash-poor, land-rich ranchers a means to generate needed revenues, combat development pressures, and most importantly, preserve their way of life for many generations.

Development of Land Trusts

In 1891, the Massachusetts Trustees of Reservations became the first land trust founded to preserve land free of taxes. Within a decade, similar land trusts were established in New England, but nationwide, the land trust movement remained stagnant until the middle of the 20th century.[9] In the U.S., approximately 53 land trusts were operating in 1950; 308 in 1975; 867 in 1990; and 1,263 in 2000.[10] Today, more than 1,500 nonprofit land trusts operate across the country with a general mission to preserve natural landscapes.

Conservation Success Stories
Montosa Ranch, New Mexico

West of Magdalena, New Mexico, at the edge of the sandy Plains of San Agustin, lays the Montosa Ranch. Co-owner and manager of the ranch, B.W. Cox, proudly states, "This old country promises less and delivers more than any country I've ever been in… It's because of the sand." The ancient lake bed that makes up the Plains of San Agustin carries silt onto the ranch, creating a soil complex where root depths reach 60 inches, runoff and erosion are subdued, and healthy wild grasses thrive. These unique natural features make the land ideal for raising cattle.

After years of working on ranches, Cox and his wife, along with a friend, bought the Montosa Ranch in 1989. Through his previous ranching experience, Cox developed an appreciation and keen understanding of the intimate relationship between a successful ranch and the health of its land. As a result, he works hard to know his land and to preserve a vibrant ecosystem. He knows the first spot where the sun hits the ranch and where the warmest place is for calving. Cox rotates his herd on a daily basis to ensure the native grasses continue to flourish.

As Cox considered retiring, he and his wife looked into how they could generate monetary wealth from their land without completely developing the ranch. They considered passing the land on to their sons, but one is unable to run the ranch and the other is unwilling. Cox was initially hesitant about conservation easements, because easement donations are forever. But eventually, Cox and his ranching partner worked through a variety of easement options with a land trust to create a more flexible type of easement, called a development conservation easement. The final plan would generate a fair amount of revenue by allowing regulated development on portions of the ranch while placing 27,000 acres under easement.

Five thousand acres of the ranch were carefully surveyed and split into seven 640-acre lots to be sold. Each lot carries its own easement and other development restrictions. Once sold, the lot owner can only build on a predetermined, five-acre development site and can only fence in a 50-acre plot around the development. The development sites were carefully positioned to minimize ecological impact and to ensure that no building at one site is visible from another site. This creative, intricately tailored plan meets Cox's needs. The easement forever preserves much of the ranch and gives Cox the opportunity to pass the wealth from selling the ecologically sensitive ranchettes down to his children without compromising Cox's conservation values.

The largest operating land trust in the U.S. is The Nature Conservancy (TNC), a global nonprofit organization founded in 1950 "to preserve the plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive."[11] TNC holds more acres under conservation easement or through fee-simple ownership than any other land trust, operates with a targeted area greater than the entire U.S., and has a budget larger than any environmental organization in the world.[12] TNC is currently protecting 14.2 million acres in the U.S. through all conservation methods, which include but are not limited to easements. TNC holds around 2,000 conservation easements throughout the nation that protect an estimated two million acres.

In addition to seven other major national or international land trusts, the rest of the nation's conservation easements are represented by 1,500 local and regional land trusts that often focus on conservation in a single valley, county, or group of adjacent counties. LTA, based in Washington, D.C., "promotes voluntary land conservation and strengthens the land trust movement by providing the leadership, information, skills, and resources land trusts need to conserve land for the benefit of communities and natural systems."[13] LTA provides helpful services, like technical and operational assistance, to small land trusts. LTA trusts have cumulatively protected over nine million acres as of 2004. Of those protected acres, 5.1 million are protected by conservation easement as of 2003, up from 1.4 million easement acres in 1998. In just five years, LTA nearly quadrupled the number of acres preserved by easement.

A survey of LTA's constituency of land trusts by region shows that the Northeast has the most conserved acres in the U.S. at nearly three million. Next are the Pacific, Mid-Atlantic, and Southwest regions, each with around 1.5 million conserved acres. The Northwest, Southeast, and Midwest regions each reported less than one million conserved acres.[14]

National land trusts and local land trusts have different strengths and fulfill complementary roles important to sustaining the growing conservation easement movement. Sandy Pew, a rancher in Belgrade, Montana, used TNC to place easements on parts of his 7,000-acre ranch, but now, Pew indicates he will use a local land trust headquartered in nearby Bozeman for his future easement plans. Sandy thinks the local trust is more personal and better understands local ecology in this case.[15] But in other instances, national trusts may be equally or more personal and knowledgeable of local conditions, and national trusts tend to have the advantage of firmer financial footing and stronger assurances that they can maintain the easement into the future.

Land trusts represented by LTA outpaced TNC in conservation easement acreage growth from 1984 to 2000,[16] and local land trusts are being formed at a rate of two per week across the country.[17] The increasing presence of local land trusts is good for the conservation movement. Local trusts have the means to adequately meet the conservation needs of many local landowners. This takes some burden away from TNC, allowing them to focus more on large-scale easements and other conservation projects that are beyond the scope of local trusts.

Conservation Success Stories
Hilger Hereford Ranch, Montana

Nicholas Hilger immigrated to the United States from Luxemburg at the age of 26. He homesteaded a ranch on the Missouri River outside Helena, Montana, built the ranch's first cabin in 1867, and became a thriving cattle rancher. Hilger faced his share of hardships, like in 1908 when a dam broke upstream from the ranch and a 30 foot wall of water destroyed everything he owned and nearly killed him and his family, but Hilger rebuilt and passed his ranch on to his four children. They continued to work the land and made it through the Great Depression.

Nobody in the family married or had children, so there were no heirs in line to take over the ranch as Nicholas Hilger's four children receded into old age. Across the Missouri River they watched neighboring ranchers sell to developers, who built several estate homes on what was once open ranchland. Hoping to preserve the character of their land, the surviving family members made an oath to resist daily offers from developers and other ranchers to buy the land.

When the Hilger family was no longer physically able to ranch, they donated all the land's development rights to the Montana Land Reliance in a conservation easement. No new home sites are allowed to be built, except within a small parcel of the property at the ranch's headquarters. The family's dying wish was to keep the land as a cattle ranch forever. People passing by the ranch today may not see the Hilgers, but they will always see open pastures and thick cow bellies.

Current Controversies

Although the future of using conservation easements to protect private land in the U.S. looks promising, it is important to note that there are a few controversial elements of easements that may weaken the movement. These controversies are being dealt with at local and national levels, and the outcome of these dealings could largely determine whether or not easements continue to play a growing role in protecting private land in the U.S.

The most significant controversy is the overvaluation of a donated easement. Valuing the sacrificed development rights of land placed under an easement at more than their conservation value gives the property owner more tax benefits than deserved and leads to significant costs for taxpayers. In recent years, some notable instances of overvaluation were uncovered, generating public opposition to conservation easements. Third party appraisers with an incentive to overvalue a property's development value are largely responsible for this problem. LTA, other land trusts, and the IRS are leading a movement to identify and exorcise dishonest appraisers. These organizations have worked with Congress to update the easement legislation discussed below.

Other controversies arise from shady dealings with land trusts (not involving overvaluation) where land trust board members are paid or insider transactions take place, which tarnish the image of land trusts and conservation easements.

Another controversy with easements is that, in certain cases, easement donations benefit wealthier landowners more handsomely than poorer landowners, even if they were to place the exact same land under easement. A rancher with valuable land, but low income, cannot capitalize on the full tax relief of placing an easement on his/her land, whereas a rancher earning a higher income (potentially outside of ranching) with a similar easement deal will realize larger benefits. The federal laws enabling conservation easements give particular authority to individual states to mandate stricter standards. Some states have enacted more progressive easement policies that address the wealth discrepancy and boost the incentive for cash-poor, land-rich property owners to put an easement on their land.

The Senate recently passed the Tax Reconciliation Bill (S. 2020) to deal with the aforementioned easement controversies. Section 307 of the bill expands the limits on an easement donor's tax deductions. It raises the percentage of the maximum deduction a donor can take on his/her income from 30 to 50 percent. Recognizing the importance of agriculture and the threats facing the industry, the bill allows farmers and ranchers to deduct 100 percent of their income. The bill also increases the time span over which easement donors can take tax deductions from six years to 16 years. Section 302 of the bill addresses the overvaluation controversy by setting higher restrictions on easement appraisers and increasing the penalty for dishonest appraisals.

Land trusts and the conservation movement generally support this bill, because it increases the beneficial aspects of easements for landowners while addressing the most significant problem: appraisal abuse. At the time of this writing, the bill must pass the House and be signed by the president before it becomes a law. If assimilated into law, it is estimated this bill will cost the government $69 million in lost tax revenue.[18] That price tag must be considered together with the positive value of land conservation and the beneficial externalities associated with easements.

Conservation Success Stories

Blackfoot River Valley, Montana

The Blackfoot River Valley is home to one of the most prestigious conservation programs in the country, and is a classic example of regional cooperation conservation easements. Because of the valley's "blue ribbon" trout fishing, big-game hunting, and other world-class outdoor activities, the recreation industry took off during the 1960s. At the same time, subdivisions started popping up, replacing ranches that once kept the area open and rural. A number of remaining ranch owners in the valley organized to slow the growth and subsequent development of the pristine valley.

The ranchers considered a variety of conservation options. Seeking a Wild and Scenic River designation was rejected because of opposition to bringing in the federal government. Zoning regulations were dismissed, because they take too much power away from landowners. In the end, conservation easements were the right fit. Piece by piece, a 30-mile stretch of the Blackfoot River and its surrounding lands were placed under easement with the help of three land trusts: The Montana Land Reliance, Five Valleys Land Trust, and The Nature Conservancy.

Most easements in the Blackfoot Valley focused on prohibiting subdivision, mining, and building industrial facilities while allowing farming and ranching to continue. Ranchers Edna Brunner and her son, Paul, filed the first easement in the valley in 1974. Other landowners quickly followed suit. Fanny Steele, champion horseback rider and movie star, donated land on The 5 Star Double R Ranch. Then, easements were placed on the Blackwood Ranch, a purebred cattle operation whose glacial ponds are popular with migratory birds. Otto and Jean Eder, who owned a 1,280-acre parcel of prize real estate, donated all the land's development rights to raise cattle for the rest of their lives.

Although landowners had addressed the development issue, another problem loomed in the valley. The steady flow of outdoor recreators led to a variety of access problems as recreators tromped across private land to get to the Blackfoot River. Eventually, a limited access plan to the private Blackfoot was worked out in the valley, which put in place an access reevaluation program to ensure that landowners continue working together to maintain an effective and satisfying access plan. Today, over 35,000 acres are under easement in the Blackfoot River Valley, allowing the ranching community to coexist with recreators.

About the Data

Figure 2 through Figure 7 present state- and county-level acres held under conservation easement by The Nature Conservancy (TNC) and the Land Trust Alliance (LTA). TNC data on conservation easement acres by county were updated in August 2005 and obtained directly from TNC. LTA conservation easement and fee-simple ownership acres by county in 2000 were obtained from the Property and Environment Research Center (PERC). LTA's fee-simple ownership acres cannot be separated from the data. Other sources of data were considered, and for Colorado, the other data were incorporated to make the figures more accurate. The additional Colorado data is from Colorado Conservation Trust's (CCT) 2005 report for the state of Colorado. Acres under easement outside of TNC and LTA (and CCT in Colorado) are not included in the study.

The accuracy of the data varies with the source. The TNC and CCT data is very accurate. The LTA dataset is less accurate, because PERC had to make some generalizations and assumptions to extrapolate county-level acres from the multi-county regional acres reported by LTA. But the PERC data have been checked against other sources and are deemed sufficiently accurate.

State and county conservation easement acres are normalized by the privately owned acres in the geographic area to generate more meaningful figures. Private acres were generated in GIS using the GAP Analysis.

Land Trust Alliance Conservation Easement Acres by State
Figure 2
Source: See "About the Data"

The Nature Conservancy Conservation Easement Acres by State
Figure 3
Source: See "About the Data"

Conservation Success Stories
Local/Regional Land Trusts

In addition to national organizations, like The Nature Conservancy, more than 1,500 local land trusts operate around the country. These nonprofits generally target local, and therefore smaller, conservation areas.

Ochs Ranch, Colorado – Colorado Open Lands Land Trust

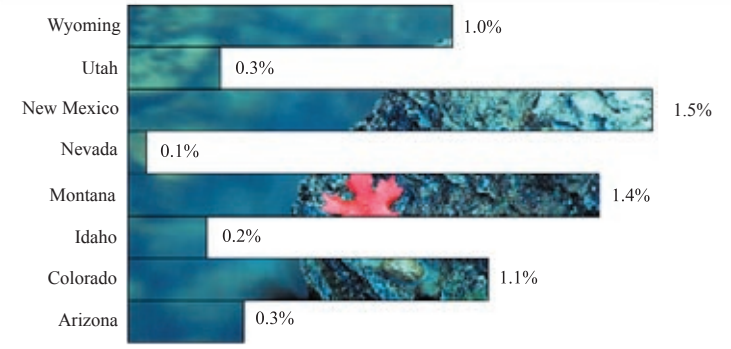
In Gunnison County, Colorado, seven neighboring ranching families joined together to create Ochs Ranch. In 1988, Bill Trampe, president of Gunnison Ranchland Conservation Legacy (GRCL), and Susan Lohr, a GRCL Board member, designed this unique cooperative operation, which calls for the landowners to donate 2,770 aggregate acres toward a conservation easement.

The area's lower elevation ungulate habitat contains a diversity of meadow vegetation, which is important to the surrounding ecosystem, and provides seasonal migratory bird habitat. GRCL worked closely with Colorado Open Lands and a number of other nonprofits and government agencies to meet their conservation goals.

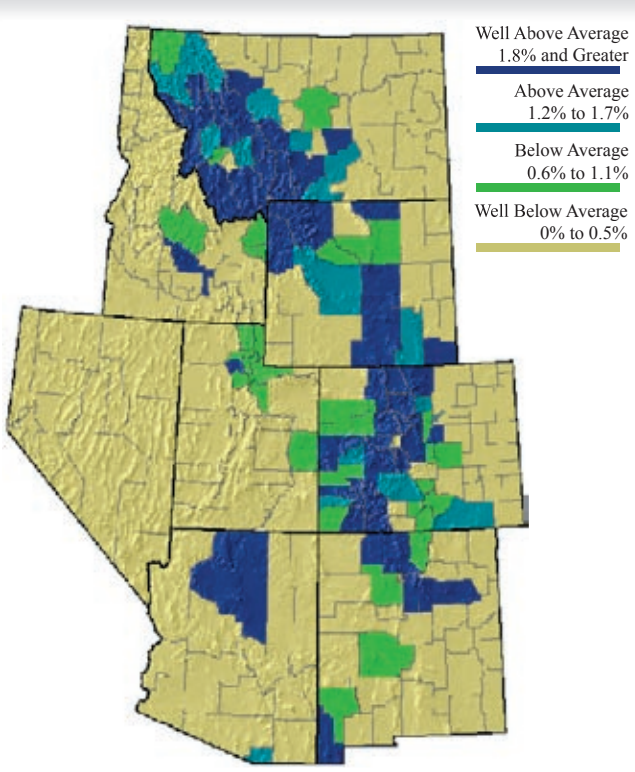
Benson Ranch, New Mexico – Taos Land Trust

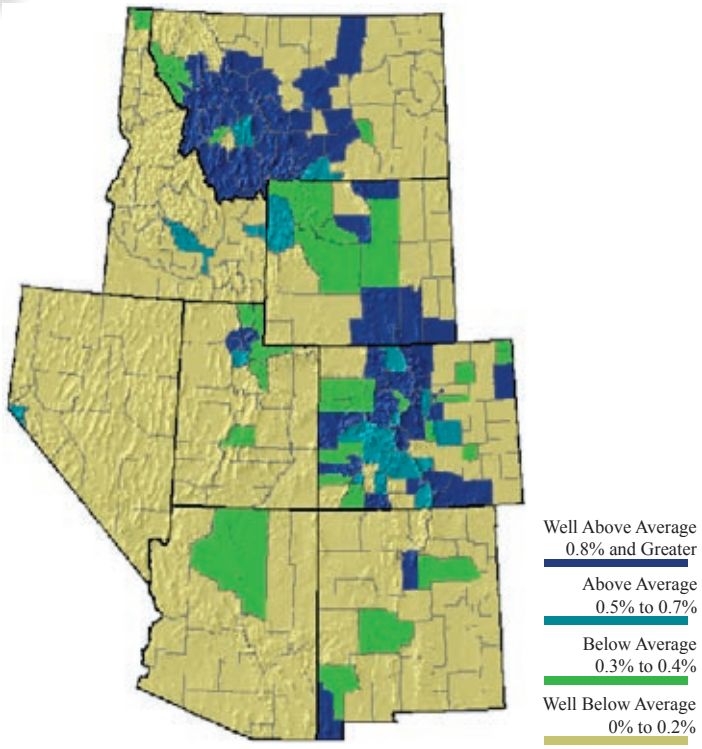
Below the Taos Volcanic Field, Tony and Holly Benson's working ranch is a natural corridor for wildlife moving between protected public lands to the ranches north, west, and south. Elk, antelope, bears, eagles and peregrine falcon move through and live off of the ranch's pinon-juniper forests. The Taos Land Trust helped the Bensons donate 960 acres, which is not the entire ranch but is enough to ensure a major portion of the wildlife corridor stays intact and undeveloped into the future.

Land Trust Alliance and The Nature Conservancy Easement Acres
As a Percentage of All Privately Owned Acres
Figure 4
Source: See "About the Data"



County Acres Eased
As a Percentage of Privately Owned County Acres
Source: See "About the Data"
Figure 5





County Acres Eased
As a Percentage of All County Acres
Figure 6
Source: See "About the Data"

Tracking Conservation Easements in the Rockies

Ninety-nine local land trusts operate in the eight-state Rockies, along with seven land trusts that operate across the nation and/or internationally. Over one third of the local land trusts, or 34, operate in Colorado alone. The rest of the states in the Rockies have four to 13 local land trusts each.

Easement Acres by State
Acres under easement vary dramatically from state to state. Over 90 percent of LTA's easement acres are in just Colorado, Montana, and New Mexico (Figure 2). Over 70 percent of TNC's easement acres are in just Montana, New Mexico, and Wyoming (Figure 3).

Combining the TNC and LTA conservation-easement acres clearly breaks the Rockies' states into two groups. The Eastern Rockies, which are Colorado, Montana, New Mexico, and Wyoming, are home to over 90 percent of the region's easement acres. Less than 10 percent of the region's easement acres are in the Western Rockies, which are Arizona, Idaho, Nevada, and Utah.

Total acres under easement is not the best gauge of state success in protecting private land, because states come in different sizes and have different amounts of private versus government land, meaning they each have different quantities of land available for protection by conservation easement. It is more meaningful to look at easement acres per acre of private land.

In the Rockies region, about one percent of all private acres are protected by conservation easement region-wide. Figure 4 shows New Mexico and Montana, with 1.5 and 1.4 percent of private acres conserved by easement respectively, are well above average for the region. Colorado and Wyoming, 1.1 and 1.0 percent, are close to average. Arizona, Idaho, Nevada, and Utah are significantly below average with only somewhere from 0.1 to 0.3 percent. By this measure, the Eastern Rockies states again have more easement acres than the Western Rockies states.

Easement Acres by County
In the average Rockies county, 1.2 percent of all private land is under TNC or LTA conservation easement, but these acres are not evenly distributed throughout the region and tend to be clustered in counties along the Continental Divide.

Figure 5 shows that most counties with above-average and well-above-average acres as a percent of all private land trace the Continental Divide from the Montana-Idaho border south through central Wyoming, Colorado, and New Mexico. Away from the Continental Divide, almost every county falls into the well-below-average classification.

Looking at easement acres as a percentage of all county land, not just private land, reveals similar results. On average, each Rockies county has 0.5 percent of its total acres (private and public) under easement. Figure 6 shows again that most above-average counties follow the Continental Divide, but by this measure there are more above-average counties away from the Continental Divide. The metro, micro, and rural counties with the most eased acres as a percentage of all private land are displayed in Figure 7.

Conservation Success Stories

The Nature Conservancy (TNC)

TNC is the single largest nonprofit land trust in the country with jurisdiction over 15.4 million acres of preserved land throughout the United States.

Sylvester Ranch, Arizona

Through the collaborative work by TNC, the U.S. Bureau of Land Management (BLM), and the U.S. Fish and Wildlife Service, Charles and Evelyn Sylvester donated an easement on their 909-acre ranch in Cochise County, Arizona, in 2000. TNC designed the easement to prevent subdivision and development and to turn over 200 million gallons of annual groundwater rights to the Fish and Wildlife Service. The BLM helped fund the easement and facilitate communication between TNC and the Fish and Wildlife Service. As a result of the easement, more water flows down the San Pedro River, critical wildlife migration routes are protected, and more land is preserved adjacent to the San Pedro Riparian National Conservation Area.

Meadow Vue Ranch, Idaho

Next to pristine Henry's Lake, Dennis Moedl's 400-acre Meadow Vue Ranch is a dream spot for development. Instead of selling the ranch for offers of up to $2.5 million, Moedl donated 380 acres to TNC. Moedl explained to the community, "I never want to look out there and see a hundred houses on that meadow. If it gets built down there, it'll take away the scenic value of the whole valley."

TNC designed the easement to ensure Moedl can still raise 800 Black Anguses and keep 90 horses on the property as he has done for 66 years. The Land and Water Conservation Fund purchased Moedl's development rights, giving him enough money to donate the easement and still manage the ranch's mortgage and work the land. To raise additional revenue, the ranch now has a summer camp for school children interested in learning about the cowboy tradition.

Bar J Ranch, Utah

Dan Jorgensen is the fourth generation in his family to own and manage the 5,776-acre Bar J Ranch in Utah. Because of ranch debt and high inheritance taxes, Jorgensen feared he would have to sell the land and not be able to pass it on to his children. Instead, he donated a significant portion of the ranch's development rights to TNC: "I would hate to see this property, which has meant so much to me and my family, have to be sold and developed. Today our Christmas wish has come true. The Bar J Ranch will remain intact forever." Jorgensen's donation helps Utah's biologically important Fishlake National Forest. The ranch serves as important lowland, winter habitat for deer, elk, and sage grouse. Bears, cougars, raptors, and endangered Bonneville cutthroat trout also use the natural resources of Jorgensen's land.

Eagle Ridge Ranch, Wyoming

Near Casper Mountain, Wyoming, Oliver and Deborah Scott's Eagle Ridge ranch includes unique forest and river habitat for bald and golden eagles. In 1981, the Scotts donated 8,561 acres of their ranch that abuts the Jackson Canyon Eagles Area of Critical Environmental Concern to TNC. Because of the easement, Oliver was able to pass the land on to his son, Stacey, who now manages the ranch. To further promote conservation on Eagle Ridge, Stacey practices Holistic Resource Management. He credits this practice and his parents' easement donation with making his ranching lifestyle economically sustainable into the future: "The conservation easement has had a very positive impact because my children and future generations can continue ranching without fear of housing developments threatening their livelihood."

Conclusions

Private land is a vital component of the open and wild character of the Rockies region. This Western ruggedness plays a large role in attracting more and more people to the region, which is a critical driver of economic growth but which, ironically, takes away from that very character. Population growth does not require the rapid conversion of natural and open lands into subdivisions and strip malls, but that is what is happening today at a swift rate.

The region must strive to accommodate growth in ways that reap its benefits while mitigating its harm. To do so requires sensible, comprehensive growth management both within communities and across the landscape. Conservation easements are one tool for slowing down rapid private-land development. As more private land is placed under easement, less developable land remains, forcing developers and communities to craft more efficient growth policies.

The conservation-easement movement is firmly rooted in the Rockies and shows signs of strong growth. Local land trusts are being rapidly established and developing support, while large, national land conservation organizations continue to play a large role in protecting private land. Together, these groups are amassing a large portfolio of land in the Rockies, where around one percent of all private land has been placed under easement by TNC or LTA.

One limitation to the conservation-easement movement in the Rockies region is that it is geographically isolated (Figures 2 and 3). Much more private land is protected along the Continental Divide percentage-wise than elsewhere. Even along the Continental Divide, certain regions have hardly any easements, and the discrepancy in easement acres from state to state is large. The conservation-easement movement can grow by expanding its geographic coverage.

Another challenge the movement faces is ensuring conservation easements are a possibility in the future. It is critical that supporters of conservation easements participate in resolving the current controversies surrounding easements. They must do what they can to curb abuse of the system and must play an active role in drafting legislation and policy to ensure that any changes curtail abuse without taking away from the value and convenience of placing land under easement.

Conservation Success Stories

Colorado Conservation Easement State Tax Program

In 2000, Colorado implemented one of the most progressive conservation easement tax programs in the country. Landowners with conservation worthy property are permitted to take a dollar-for-dollar state tax credit for development rights they donate up to $100,000. For donations above $100,000, a second tier of tax credits at 40 percent of the dollar value is applied. The maximum state tax credit is capped at $260,000. With the two-tiered program, a $500,000 donation would be required to receive the full $260,000 tax credit limit.

What makes Colorado's easement program unique is the flexibility it provides landowners. Landowners can either apply the donation directly to their state taxes, or, if their income is insufficient to capture much financial benefit, they can sell the credits to businesses around the state. The program has allowed cash-poor, land-rich ranchers and farmers to significantly increase the financial benefits they receive from an easement, which has consequently increased the number of easements across the state. The Colorado Conservation Trust estimates this state tax credit program has led to the protection of more than 220,000 acres of private land via easements since 2000.

The program has received some criticism, however. Most notably, because the value captured by an easement donation is capped at $260,000, there has been a trend to donate a series of easements to maximize tax credits for the landowner. When land is donated in a piecemeal fashion, many conservation goals are sacrificed. It also decreases the efficiency to land trusts and landowners when five separate easements are negotiated in five years.[19]

Counties with the Most Eased Acres
As a Percentage of Privately Owned County Acres
Figure 7

Top 10
Metropolitan Counties

Of 61 Metropolitan Counties	Percentage of Private Acres Eased
1 - Santa Fe, New Mexico	29.8%
2 - Park, Colorado	5.2%
3 - Mesa, Colorado	4.9%
4 - Missoula, Montana	4.6%
5 - Clear Creek, Colorado	2.8%
6 - Davis, Utah	2.8%
7 - Larimer, Colorado	2.8%
8 - Gilpin, Colorado	2.6%
9 - Natrona, Wyoming	2.2%
10 - Douglas - Colorado	2.2%

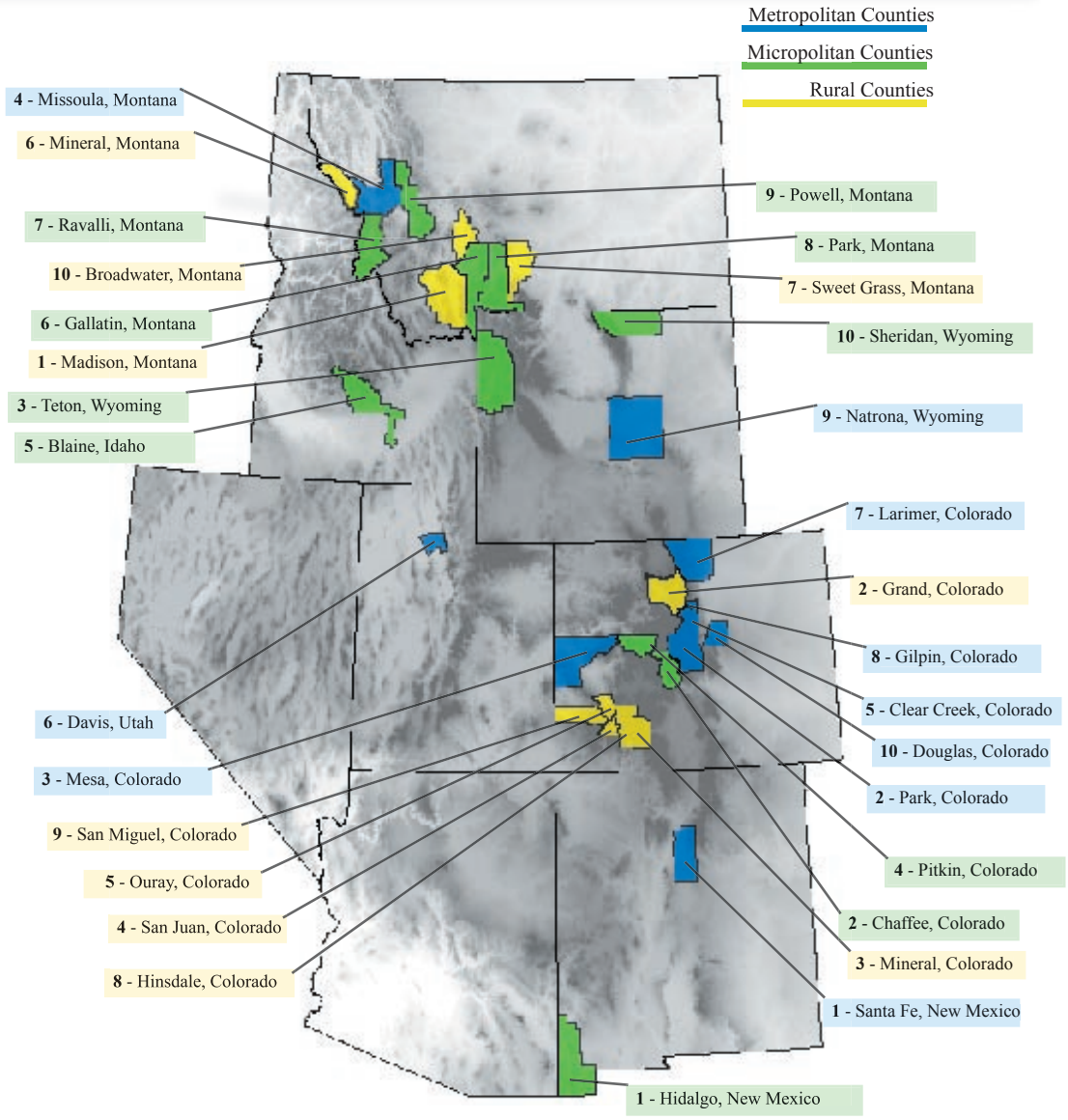
Top 10
Micropolitan Counties

Of 138 Micropolitan Counties	Percentage of Private Acres Eased
1 - Hidalgo, New Mexico	104.8%*
2 - Chaffee, Colorado	12.9%
3 - Teton, Wyoming	11.3%
4 - Pitkin, Colorado	6.7%
5 - Blaine, Idaho	6.6%
6 - Gallatin, Montana	5.7%
7 - Ravalli, Montana	5.6%
8 - Park, Montana	5.3%
9 - Powell, Montana	5.1%
10 - Sheridan, Wyoming	4.8%

*Some federal land associated with the Malpai Borderlands was likely included in acres eased for Hidalgo, New Mexico.

Top 10
Rural Counties

Of 81 Rural Counties	Percentage of Private Acres Eased
1 - Madison, Montana	13.9%
2 - Grand, Colorado	7.8%
3 - Mineral, Colorado	7.7%
4 - San Juan, Colorado	4.7%
5 - Ouray, Colorado	4.6%
6 - Mineral, Montana	4.4%
7 - Sweet Grass, Montana	4.0%
8 - Hinsdale, Colorado	4.0%
9 - San Miguel, Colorado	3.6%
10 - Broadwater, Montana	3.0%



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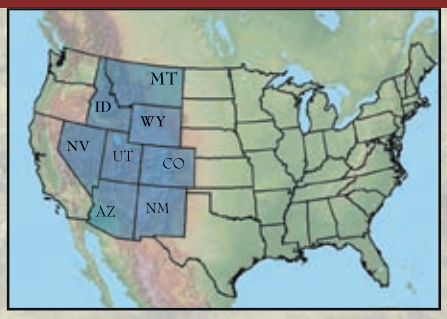
New Resource Management

Innovative Approaches in the Rockies

By Chris Jackson

The 2006 Colorado College State of the Rockies Report Card



The Rocky Mountain region is characterized by its unique natural resources: land, water, wildlife, spectacular beauty. Conflict over these scarce resources is inevitable and traditionally disputes over allocation of resources have involved various levels of government and the courts. Fortunately, a new wave of resource management approaches reflects the fact that more Rockies residents are recognizing the failure of government regulation and lawsuits alone to determine the best use for and control of resources. Instead, the region is seeking out and experimenting with new, innovative management techniques.

State and federal regulation and litigation often provide one-sided solutions and therefore cause dissent among people within the region and throughout the nation. For example, ranchers and wildlife conservationists are often at odds over the best use of public land. Conservationists recognize that predators such as wolves and grizzly bears are necessary for a healthy ecosystem. Consequently, they seek to expand predator habitat on public lands and use regulation to impose heavy fines for killing protected animals. Ranchers of lands adjacent to the public domain, on the other hand, see predators as a threat to their livestock and thus, their way of life. Because predators do not recognize boundaries between protected habitat and grazing lands, they often end up on public grazing land and private ranches where they kill livestock. Ranching is an industry that operates on a very thin margin, and the loss of a single calf or cow to a wolf or grizzly means hundreds of dollars in lost revenue. Conservation and livestock production are both legitimate claims to the best use of the land, but litigation often pits environmentalists against ranchers. Such conflict inhibits productive dialogue and prevents long-term solutions. Divisiveness is detrimental to a region struggling to define its common voice.

Recently there has been a movement away from traditional management techniques. Individuals and organizations have recognized that regardless of the outcome of lawsuits and government regulation, prolonged conflict is economically

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unsustainable. Consequently, interest groups from all sides of the resource management issue have gradually shifted toward using more innovative techniques that address the needs of all parties involved. The goal is to seek compromises that are acceptable to all positions. In general, these new management policies and programs attempt to harness market incentives or recognize conflicting financial needs and compensate for any resource loss. This more thoughtful approach avoids much of the animosity generated from lawsuits and regulation. In addition, programs that bring all sides to the table and evolve into adaptive management tend to be more dynamic, easily reacting to new breakthroughs in research and quickly responding to unanticipated problems. A new emphasis on compromise serves to unify the region and encourages stakeholders to replace conflict with cooperation, effectively protecting the Rockies' environment and economy at the same time. The following case studies highlight just a few of the many new, innovative management techniques that have recently emerged.

Predators on the Range

The National Wildlife Federation's Grazing Allotment Retirements, Idaho, Montana, and Wyoming

The conflict over predator habitat is one of the most heated and publicized issues in the West; since the rise of ranching in the West in the 1880s, few topics have evoked more emotion or stronger opinions. Simply put, it is an issue over the best use of public land. The value of predators is undeniable—wolves and grizzly bears are an essential element to healthy and balanced ecosystems in the Rocky Mountains. But these predators threaten livestock and subsequently jeopardize the economic viability of ranches. Sheep and cattle lost to wolves and grizzlies represent hundreds of dollars in lost income. For an industry that operates on a thin margin, such losses are devastating.

For over a century, the battle over predator habitat versus livestock grazing was fought through litigation and government regulation, yet the problem still remains, illustrating the shortcomings of traditional "confrontational" resource management techniques. The early part of the 20th century found the government condoning the extermination of predators in favor of growth in ranching.[1] It wasn't until 1973 that the Endangered Species Act made it illegal to kill wolves and grizzly bears. Then, in 1995, conservationists won another major legal battle, allowing for the reintroduction of wolves into Yellowstone National Park. Within the boundaries of national parks and other protected wildlife sanctuaries, where grazing is prohibited, there is little dispute between livestock producers and conservationists. But the success of the predator reintroduction program in Yellowstone National Park has again sparked intense conflict. As the number of wolves and grizzlies grows, so do their habitat requirements, and predators that wander out of the park pose a threat to livestock on nearby public and private grazing land.

The reintroduction and protection of predators help reestablish ecological balance within the protected public lands. But its very success leads to new conflicts between ranchers and conservationists. Current laws that protect predators hurt ranchers, who rightly assert that the reintroduction of wolves puts at risk their very livelihoods adjacent to the public lands. Faced with few options, some ranchers feel they must kill predators to protect their livestock. Many conservationists at the same time call for tighter enforcement and heavier fines for killing predators. But increased regulation will do little as a long-term solution; as long as ranchers are threatened, the problem will remain. Both conservationists and ranchers lose in this situation—predator mortality rates rise significantly outside of protected areas as a result of livestock interactions, and ranchers continue to suffer losses and incur fines.

In 1987, recognizing the reality of the situation, Defenders of Wildlife took a progressive step toward a long-term solution. The group proposed a wolf compensation program to work with ranchers by paying them for losses due to predators. In 1998, the program was extended to include compensation for grizzly bear kills. Although the compensation program went far toward improving dialogue and relations between ranchers and conservationists, conflict over predators on the range still persisted. Ranchers were still dealing with kills, Defenders of Wildlife was continuously paying, and government agencies still had to conduct costly removals and relocations of predators on public grazing allotments. The program did little to actually stop livestock mortality.

Looking at the example of the compensation program, The National Wildlife Federation took a more drastic step toward a permanent solution through the Grazing Allotment Retirement Program. The National Wildlife Federation went to the root of the problem by actually cutting off the interaction between predators and livestock. The retirement process begins with the National Wildlife Federation researching which parcels of public grazing land are most vital to adjacent protected habitat and which parcels experience the most livestock kills. The next step is to contact the rancher who holds the grazing lease and negotiate a deal to purchase the grazing permit to that land. If the rancher agrees, then the permit is waived back to the managing agency—either the Bureau of Land Management or Forest Service, with the assurance that the permit will not be turned over to any other livestock producer. The National Wildlife Federation then pays the livestock producer an agreed amount, sufficient to permanently waive the grazing permit. Finally, the managing agency issues a decision notice permanently retiring the allotment, complete with the rationale for doing so. Retiring grazing allotments results in a buffer zone between grazing lands and predator habitat, and the livestock producer may then use the proceeds from the transaction to purchase grazing rights in a safer area. Like the compensation program, the allotment retirement program recognizes the financial needs of the rancher to facilitate a long-term solution. Both conservationists and ranchers stand to gain as predator and livestock mortality is decreased. Since its inception in 2002, the National Wildlife Federation

has purchased nearly 300,000 acres of grazing allotments and received no complaints from ranchers with whom they have made deals.[2] Expansion of the program is limited only by funding, as the money to purchase grazing allotments comes solely from private donations. Nevertheless, word about the success of the grazing allotment retirements has spread and other organizations are considering similar programs in Oregon and in the U.S. Southwest.[3]

The Grazing Allotment Retirement Program represents a creative, new, voluntary, long-term solution to the problems associated with predator habitat expansion. By simultaneously recognizing the needs of both ranchers and conservationists, the National Wildlife Federation has been able to devise an innovative program that benefits livestock producers, conservationists, and the citizens of the West who enjoy the services of both.

Fee Hunting

The White Mountain Apache Hunting Program, Arizona

With the decline of natural predators on the range, deer and elk populations are rapidly growing, and consequently, the animals are eating riparian plant life to the point of permanent damage. Traditionally, wildlife managers have used private hunting as a management tool to thin deer and elk populations. By issuing large numbers of affordable licenses, the Division of Wildlife seeks to ensure enough kills to keep herds under control. This method, however, has had an unforeseen consequence. Hunters prefer to take bulls, leaving a higher number of cows in the herd, resulting in poor genetic diversity in the herd. Many states are beginning to adapt their hunting programs by issuing greater numbers of cow licenses or forcing hunters to take a cow before they are allowed to take a bull. However, high numbers of hunters and low numbers of trophy game have diluted the experience for many hunters, and some are willing to pay much more for a premium animal kill, creating a market for high-end hunting trips.[4] On many private lands, where landowners can take advantage of the burgeoning "fee hunting" market, wildlife can be managed more effectively than on state-managed public lands.

The White Mountain Apache Tribe, located in White River, Arizona, is at the forefront of the fee hunting market. The organization caters to hunters who are seeking a premier hunting experience in an intimate setting and the opportunity for a trophy bull. Recognizing the market value of trophy elk, the tribe altered its cattle-grazing operation to maximize the benefits from the elk herd. The tribe also severely limits the number of licenses issued on the land, allowing for a healthier herd with bigger elk. With less pressure on the herd, bulls can grow much larger than on public land. Fewer kills also maintains a better bull-to-cow ratio in the herd.[5] The price of a hunting trip reflects the quality of the experience, costing up to $16,000 for a guided trip. The waiting list for a permit on the land is several years, and there is an 80 - 90 percent hunter return rate.[6] In addition to providing jobs for members of the tribe, the large income from guiding fees and licenses is reinvested into conservation programs on the tribe's land.[7]

Private fee hunting is by no means the panacea for all wildlife management problems in the West. There are far fewer herds on private land compared to public land. It is difficult to justify

private management of herds on public lands, especially when there remains a market for low cost hunting; hunting on public lands should be available to everyone, regardless of wealth. But where there is a herd on private land, the market solution can be the best for both business and conservation.

The White Mountain Apache fee hunting program demonstrates that there are often market-based solutions to conservation problems. In this case, the wildlife is managed well, while hunters who are willing to pay for a premium experience have the opportunity to do so, and the White Mountain Apache Tribe has an enhanced source of revenue. The private hunting industry is also catching on among ranchers on private lands, who have recognized the opportunity to supplement their cattle operation with private hunting trips.

Water Rights for Conservation

The Colorado Water Trust, Colorado

The West's semi-arid climate makes water one of the region's most sought-after resources. It is fundamental to the growth of cities, the survival of farms and ranches, and industrial operations ranging from mines to manufacturing. To satisfy various water needs, rivers and streams are diverted to allow for easy access. The privilege of using the water and the quantity of water used are dictated by individual water rights. Early water rights in most Western states developed under a legal regime called prior appropriation, meaning the party that can prove it was the first to use the water has the first priority, or most senior right, to use that water each year. Establishment of the right was predicated upon appropriating water by diverting it and putting it to a beneficial use.[8] The requirement for water diversion, however, ignores the biological and recreational value of leaving water in a river or stream as what are called "in-stream flows." This changed in the state of Colorado in 1973 with legislation that created minimum stream flow levels meant to ensure a certain amount of water remaining in the river or stream. But, as with other states, minimum flow rights in Colorado are junior rights, and are, therefore, largely ineffective at keeping water in streams as they must yield to other higher priority water uses.

The Colorado Water Trust, a nonprofit conservation group, is working within the parameters of Colorado water law to acquire more rights for in-stream flows. In 2002, the organization supported legislation to allow the Colorado Water Conservation Board to maintain some water rights simply as "in-stream flow rights" above the minimum stream flow level dictated by the 1973 legislation. Before 2002, the legal environment was not conducive to water assignment maintaining higher in-stream flows. The holder of a water right, such as a rancher or a town, could not dedicate any water rights to support the ecological integrity of a watershed because it was not recognized as a protected beneficial use.

After helping to create a legal way to keep water in streams, the Colorado Water Trust switched focus to acquiring water rights for in-stream flows. The trust acquires water rights by purchasing them from willing sellers or donors and assigns the rights to the Colorado Water Conservation Board, the only entity in Colorado allowed to hold in-stream flow rights. Now, parties looking to sell their rights to ensure in-stream flows can seek out the Colorado Water Trust to make a deal.

In-stream flow deals are completely voluntary and market-driven. When a particular water right comes on the market, the Colorado Water Trust can compete with any other potential buyer to purchase the right. More often, a seller who has a conservation interest will approach the Colorado Water Trust first to negotiate a fair price. For example, in June 2005, the Colorado Water Trust purchased 800 acre feet of water from the Slate Creek Ranch in Summit County for $130,000. To the delight of local fishermen, kayakers, and conservationists, the deal keeps water levels high in Boulder Creek and the Blue River. The additional water will be used for agriculture again once it reaches the Colorado River.[9]

Similar to land trusts, the greatest challenge facing the Colorado Water Trust is financial security. Funding for water rights purchases comes mostly from grants and private donors. But as more people see how effective in-stream flow transactions are in ensuring water rights for conservation, more donations and grants are expected. Support is also coming from mountain towns that rely on in-stream flows for recreational tourism and scenery in the parched region.[10] In a realm of the law that has been slow to recognize the value of conservation, the Colorado Water Trust is an innovative and dynamic organization that is working hard to satisfy the needs of water users and conservation alike.

The Undaunted Stewardship Program

Montana

It is a common misconception in the West that agricultural practices conflict with environmental values. As agricultural and land-use research have progressed, it is fast becoming apparent that both ranching and conservation can work in concert. To achieve this harmony, however, it is essential that ranchers, conservationists, and researchers collaborate and seek out information about economically and environmentally viable ranching practices.

The Undaunted Stewardship Program (USP) is a collaborative project geared toward educating both the public and livestock producers about the compatibility of ranching and environmental values. The program is managed by Montana State University, the Montana Stockgrowers Association, and the Bureau of

Land Management, and is aided by 16 other conservation, agricultural, historic, and tourist organizations.[11]

One important facet of the USP is a certification program that recognizes ecologically sound ranching practices. To qualify for "good steward" certification, ranchers must demonstrate compliance with a set of standards, which include: providing for the needs of fish and wildlife on the property, grazing plans that emphasize maintaining the ecological capacity and diversity of the land, control of noxious weeds, and limited runoff from corrals and dry lots into adjacent streams.[12] Although these conservation objectives have traditionally been seen as contrary to economic survival in the agriculture industry, in reality, ranchers rely on healthy ecosystems to provide long-term sustainability of their operations. Conservation efforts will ultimately be fiscally advantageous.[13]

In addition to recognizing those ranchers who comply with the sound management criteria, the USP also helps interested ranchers—those not quite conforming to the certification criteria—implement environmentally sound ranching practices. The USP provides educational seminars and workshops, as well as individual technical assistance to ranchers who are working toward certification.[14]

The USP is working to help ranchers take advantage of the potential tourist value of their land. Many ranches have historical sites located on their land, specifically, landmarks from the Lewis and Clark Trail. In the past, tourists have trespassed on ranch land to view the sites. With the help of the Forest Service, historical grants, and the USP, facilities have been built to help ranchers manage tourists. The program also gives advice on potential opportunities for "heritage tourism" as yet another source of income for ranchers.[15]

Although the popularity of the program is growing rapidly, there has been an unforeseen obstacle. Ranchers in Montana are a fervently communal group, often unwilling to stand out in comparison to their fellow ranchers. Many view the Undaunted Stewardship Program certification as a symbol of "individualism" that cuts against the grain of their fellow ranchers, a type of break in their valued solidarity.[16] To solve the problem, the program is encouraging groups of ranchers to enlist in the program together, resulting in equal recognition throughout the community.[17]

The Undaunted Stewardship Program is a unique, voluntary collaboration that works hard to strengthen rural economies while maintaining the ecological sustainability of the land. By emphasizing conservation, economics, heritage, and education, the program is effectively preserving the unique culture of the West.

Trading Forage for Conservation

The Rowe Mesa Grassbank, New Mexico

Much of the forest land throughout the West is severely mismanaged. Overgrazing and strict suppression of naturally occurring, low-intensity fire on public land has led to dense, unhealthy stands of trees. Thick forests are vulnerable to uncontrollable catastrophic fire, and susceptible to disease epidemics. The grassy areas of woodlands are a key fuel source for the natural fires that rejuvenate forests. Overgrazing limits the amount of grass available to burn, as well as allowing bushes and shrubs to encroach, further reducing the total area of grasslands.[18] Yet, grazing on public land is a necessity for the livestock industry. Few ranchers can afford to own all the land it takes to raise livestock over the seasons of a year, so they rely on grazing leases of public land to provide the necessary summer forage. Many conservationists call for the elimination of public grazing leases, citing the damage caused by overgrazing. Yet, ranchers provide many landscape-wide conservation benefits through management of their private land such as open space, wildlife habitat, and migration corridors. If ranchers were cut off from public grazing leases and forced out of business, then the conservation benefits on their private land would be impaired or lost, especially as land subdivision fragments the landscape further.

To reconcile the needs of both ranchers and conservationists on public lands, an innovative trend in land management has been implemented—the Grassbank. Grassbanks are parcels of land that provide livestock forage on one piece of land in exchange for conservation efforts on other grazing allotments. Ranchers can voluntarily send their cattle to graze at the grassbank, thus allowing restoration of traditional grazing lands, wildlife habitat, wetlands recovery or other conservation objectives. The first grassbank is attributed to the Malpai Borderlands Group in Arizona in 1994, and since then several more have been established throughout the West.[19]

The Rowe Mesa Grassbank is located in northern New Mexico. Ranching in the region is both a necessary source of income and a deep-seated root of the community's cultural heritage and identity. Local ranchers depend on grazing permits on public land in the Carson and Santa Fe National Forests to provide forage for their cattle. Unfortunately, decades of overgrazing and fire suppression have given rise to the same dense forests that plague the West. The Rowe Mesa Grassbank seeks to absolve the conflict between ranching and conservation needs by exchanging forage for grassland restoration and prescribed burns to mimic the natural thinning of forests. In addition, in order for ranchers to qualify to use the grassbank, they must commit to range improvements on their

own particular public grazing allotment. This commonly entails repairing communal fences and corrals that have suffered from overuse.[20]

Funding for the Rowe Mesa Grassbank comes from grants and donations. It generates no revenue from providing forage, yet must pay for its own ranch facilities, as well as a ranch manager. Relying on grants and donations is risky, as they are not guaranteed sources. In an effort to generate a more stable source of income, the grassbank will soon be starting a program called "Cows for Conservation," in which they will manage a small herd for profit while continuing to provide forage for other ranchers.[21]

In addition, the Rowe Mesa Grassbank is limited by its small size. Currently, the plot is only large enough to accommodate several hundred cows and their calves. While there is no anticipated growth in the physical size of the grassbank, the operation is planning to expand by hosting clinics on responsible grazing ethics. That way, the Rowe Mesa Grassbank can teach every rancher who uses Forest Service land for grazing how to manage for forage restoration. Clinics and technical advisors focus on both conservation and economic benefits of sustainable grazing plans.[22]

Cooperation is fundamental to the success of the grassbank system. From its outset, the Rowe Mesa Grassbank has made it a point to demonstrate that "ranchers, conservationists, and agency personnel can work together for the good of the land and the people who depend on it."[23] Ranchers need healthy public lands for grazing, and conservationists can help ranchers understand how to keep the land healthy, which is coincidentally the conservationist's goal. Conservationists, in turn, rely on ranches for open space, wildlife habitat, and migration corridors. Furthermore, cooperation and compromise are more conducive to long-term management solutions. Grassbanks like the Rowe Mesa Grassbank in northern New Mexico are tools for resource management that serve economic and environmental interests and build bridges among the people of the West.

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The Case of the Valles Caldera National Preserve and Trust

By F. Patrick Holmes, guest contributor

Federal land management in the Rocky Mountain West has been characterized for decades by an often bitter conflict between national and local interests. As Matthew Lee-Ashley notes in the *2005 State of the Rockies Report Card*, "from defense contracts to oil and gas leases, Washington's pen can lift communities to boom or leave them to bust." Lee-Ashley's essay, addressing the lack of regional sovereignty here in the Rocky Mountain West, concluded by asserting that experiments in consensual politics would be needed to lead the region to more responsible governance.

Indeed, while many of us remain content to embrace the seemingly fundamental Western predisposition towards conflict, pockets of the Rockies have turned their attention to collaborative solutions, fostering institutions like watershed and resource advisory councils in attempts to reconcile our differences over the public lands. Collaboration has, in fact, become such a buzzword among those with vested interests in the federal estate that it too has now been imposed from on high.

In 2000, Congress agreed to purchase the Baca Ranch in northern New Mexico in order to establish the Valles Caldera National Preserve, a 95,000-acre land management pilot project aimed at bridging the ideological gap between preservation and traditional multiple-use objectives. The preserve is to be managed by a nine-member board of trustees as a government-owned corporation of the U.S. Forest Service, with a specific mandate to preserve the area's unique resources while becoming financially self-sufficient within 15 years of operation. If viable, this trust model could simultaneously resolve many of the fiscal crises facing our federal land managers, while also creating the institutional catalyst the American West needs for consensus-based resolutions to public lands management.

Organizational Structure

The Valles Caldera Trust can be described more as an experiment in "top down" community management of public lands, rather than a devolution of authority to engaged local interests as in the case of a watershed group.[1] The Valles Caldera Act creates full stakeholder participation through the trust's nine-member board of trustees. Two of the trustees earn their board positions by virtue of their respective jobs: the supervisor of the Santa Fe National Forest and the superintendent of Bandalier National Monument, while the other seven members reflect the diverse management goals Congress has outlined for the landscape. They include a representative appointed by the president of the United States from each of the following areas of expertise:

1. Domesticated livestock management, production, and marketing, including range management and livestock business management;
2. Management of game and nongame wildlife and fish populations, including hunting, fishing, and other recreational activities;
3. The sustainable management of forest lands for commodity and noncommodity purposes;
4. Nonprofit conservation activities concerned with the Forest Service;
5. Financial management, budget and program analysis, and small business operations;
6. The cultural and natural history of the region; and
7. State or local government activities in New Mexico, with expertise in the customs of the local area.[2]

In addition, at least five of the seven appointed members must be New Mexico residents. Together, this deliberately inclusive board must meet the trust's fiduciary obligation to preserve the area's unique ecological, cultural, and geologic resources as well as the requirement that financial operations become self-sufficient within 15 years of operation. Thus, the Valles Caldera Trust becomes a useful experiment in management goals and constraints

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that respond to the unique geographical and ecological setting of a given region; communities having an active, participatory stake in management; and the role of market-based tools in public lands management.

Management Principles

The Congressional Act creating the Valles Caldera Preserve charges the trust with six ostensibly equal goals for management, none of which are to be pursued to the detriment of any of the others. Figure 1 lists these goals as they appear in the enabling legislation. Much like the diverse interests represented on the board, the management principles governing the Valles Caldera Trust broadly characterize the varied perspectives that have plagued the traditional multiple-use management paradigm for decades.[3] Still, the fact that the Valles approach is a decentralized version of this paradigm suggests that the impact of local management viewpoints may go a long way to alleviate the longstanding conflict over federal land management.

The first goal, which maintains that the trust will continue to manage the landscape as a working ranch, was instituted to ensure that the dominant use of the land for the past century would remain the same. While ranching represents just one way the trust can generate revenue, including this use as a management goal could help the preserve to meet its obligation to become financially self-sufficient. It also allows for opportunities for management within the preserve to positively impact adjacent landscapes. For similar private ranches, the value of the land is the most significant and costly investment. The removal of this factor as part of the economic equation for the ranch, whether it is in taxes, mortgage debt, or opportunity costs, is already a huge step towards Valles Caldera self-sufficiency. Additionally, the preserve might be used as a grassbank. Under the grassbank approach, grass on one ranch is made available to another rancher's cattle in order to accomplish one or more mutual goals such as landscape restoration, drought relief, or prevention of subdivision.

The Six Management Goals Outlined by Congress in the Valles Caldera Preservation Act
Figure 1

1. Operation of the preserve as a working ranch, consistent with goals 2 through 4;
2. Protection and preservation of the scientific, scenic, geologic, watershed, fish, wildlife, historic, cultural, and recreational values of the preserve;
3. Multiple use and sustained yield of renewable resources within the preserve;
4. Public use of and access to the preserve for recreation;
5. Renewable resource utilization and management alternatives that, to the extent practicable—
   a. Benefit local communities and small businesses;
   b. Enhance coordination of management objectives with those on surrounding National Forest Service land; and
   c. Provide cost savings to the trust through the ex change of services, including, but not limited to, labor and maintenance of facilities for resources or services provided by the trust; and
6. Optimizing the generation of income based on existing market conditions, to the extent that it does not unreasonably diminish the long-term scenic and natural values of the area or the multiple use and sustained yield capability of the land.

The second goal of the trust is to preserve the area's unique resources. The trust's interpretation of this management goal is clear: "The members acknowledge the richness of the land's cultural and ecological character, and they implicitly conclude that the best way to respect and conserve that richness is by approaching the challenges of management with an ethic of restraint. In general, this means starting programs on a small scale, expanding them carefully, and monitoring their impacts alertly as development proceeds."[4] The trust's interpretation further establishes its commitment to monitor the impacts of management and use the learning thus gained to inform subsequent management decisions. This kind of active, adaptive management policy is new for the Forest Service, which generally relies on one-size-fits-all approaches rather than attempts to take into account the ecological conditions of a particular landscape.

While the third goal of multiple-use is included to provide the trust with full discretion over the use of its natural resources, little in the trust's strategic management framework suggests that they will emphasize timber or mineral resource production from the preserve. Some forest thinning is anticipated as the trust looks to return the traditional fire regime to the landscape; however, this thinning is the only marketable timber production the trust cites in its management plans through 2009.

The fourth goal for preserve management, recreational use, has followed much of the "ethic of restraint" that the trust has adopted as part of its preservation mandate. Limited numbers have been allowed to hike, hunt, fish, and bike within the preserve. Pricing for these programs has been one way in which the preserve has experimented with market mechanisms for generating revenue, while

still restricting the number of participants to a safe capacity for the preserve's resources. Relatively high prices are charged for activities like hiking ($25), snowshoeing ($10), and cross-country skiing ($10), when one compares the cost of these activities at a national park that charges a one-time entrance fee for up to a week of enjoyment, or the cost of these activities in a national forest where there are generally no user-fees. Charging variable prices per activity rather than simply for admission to the Valles, has enabled the trust to manage diverse activities that have variable impacts to the landscape. Permits for activities like fishing and hunting are acquired through a lottery system whereby a user pays $25 for the chance to hunt or fish on a specified day. A computerized drawing allots permits to a limited number of users determined to be within the resource capacity for that recreational use. The lottery system presents one way the trust has opted to maintain equitable access to the preserve, while still generating profitable revenues.

The fifth goal of the trust is generally thought of as a stipulation to promote participatory management. While the participation and authority of neighbors are built into the administrative structure in terms of representation on the board of trustees, this goal also recognizes that resources must be utilized in a manner that is connected to the surrounding ecological and social landscape. It calls for the return of benefits to the communities that lie close to the preserve and the coordination of management with surrounding agencies, private groups, and Native American tribes.[5] While it remains to be seen whether this integration with neighboring landowners will result in lasting management innovations, the potential for natural resource management to function beyond the narrow boundaries of political ownership is one of the most significant prospects of the Valles paradigm.

Finally, the sixth goal of optimizing income is meant to encourage the trust to conduct rigorous economic evaluation of all its activities. Again the trust is clear in its interpretation of this guideline– this goal must not be pursued to the detriment of the other goals.[6] This goal's inclusion is intended to create management incentives that will guide the trust in establishing an efficient mix of activities and infrastructure. Years of a predominant "use it or lose it" policy governing federal land agency budgets, whereby land managers must put their full appropriation to use each fiscal year to avoid any savings being reverted back to the federal treasury, have created perverse incentives within the Forest Service. Certainly the goals of optimizing income and becoming financially self-sufficient aim to change that pattern by providing incentives for managers to make efficient decisions and seek savings in their expenditures.

Progress To Date

A recent report written by the U.S. General Accounting Office (GAO) reviewing the Valles Caldera Trust's progress to date sheds early insight on the merits and obstacles created by this bold new management paradigm. Specifically, the evaluation finds that the trust has made progress in meeting its statutory obligations including establishing a staff, drafting policy and procedures, engineering infrastructure improvements, establishing interim grazing and recreational programs, and implementing an adaptive management approach that makes decisions based upon scientific data.[7]

Still, the report finds that the trust is a long way from reaching its management goals, including achieving a financially self-sustaining operation. GAO notes that the trust has not yet developed strategic and performance plans with measurable objectives, plans to manage significant program risks such as fire or drought, and mechanisms for monitoring its progress, especially the preparation of annual financial audits. In this regard, the trust has functioned as a wholly owned government corporation in a way that more closely resembles another federal agency, rather than a small business enterprise.[8]

To become financially self-sustaining by 2015, the trust needs to generate enough revenue to pay for its operations and maintenance as well as infrastructure development costs. The trust's main revenue-generating activities to date include hunting, fishing, mountain biking, and grazing. Figure 2 shows the revenue generated, by program activity, for fiscal year 2004. Managers estimated that the grazing program operated at a loss of about $55,000 in 2004, but have not calculated the expenditures by program activity for the other activities listed. With expenditures totaling over $5 million in 2004, clearly the trust's programs are operating at a substantial loss.[9]

While the trust maintains that it clearly has the tools it needs to operate "commercially" as a working ranch, obligations not found in the private sector, including the high and legally obligatory standard of performance, may prevent the trust from reaching financial self-sufficiency. Costs such as research, inventory, and monitoring; archaeological assessments; compliance with the National Environmental Policy Act; outreach and dialogue with the public; and cultural interaction and compliance with the pueblos constitute what the trust has come to understand as "federal overhead" costs. Ultimately they would like to see congressional appropriations support this federal overhead indefinitely.[10]

Evaluating the Management Paradigm

Several circumstances make the Valles an ideal location for a land management experiment and may ultimately be indicative of the types of conditions that are needed for land management to follow this paradigm. First, the headwaters of the streams that flow out from the preserve are entirely contained within its boundaries, making the Valles Caldera a self-contained watershed unit. With no other lands and no other land managers upstream, any changes in the quality of water leaving the preserve or in the ecological condition of its aquatic and riparian communities are wholly attributable to the interplay of human activities, ecological succession,

Revenue Collected, by Program Activity, Fiscal Year 2004
Figure 2

Program	Revenue
Hunting	$245,885
Fishing	$62,793
Special events	$45,699
Grazing	$42,728
Hiking	$28,744
Souvenirs, books, maps	$13,256
Donations	$841
Other activities	$60,137
Total	$500,083

geology, climate, and other natural processes occurring within the preserve. This condition is vital to the preserve's science-based, adaptive-management approach. Also, the fact that the landscape originally operated as a private ranch and then was acquired by the USDA means that the preserve was never involved in significantly polarizing political debate or previous public participation in its management processes. This fresh start may be critical to the ability for the diverse board members to function cohesively in their management directives.

While the GAO report harps on the slow developmental process of the trust, delays in implementing programs and the trust's inability to develop a strategic and performance plan with measurable objectives may be attributed to the turnover of board members and other key staff. Without a more analytical approach to strategic planning, the timely appointment of board members, and better management of its human resources, the trust may ultimately fail in meeting many of its management objectives. However, the merits of an active community role in management, adaptive science-based approaches that respond to local conditions, and market-based principles for setting efficient resource uses indicate that the Rocky Mountain region has much to benefit from success at the Valles Caldera.

For more information, please visit:
www.vallescaldera.gov

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Biodiversity: a Coat of Many Colors

By Tass Kelso, guest contributor

"Biodiversity" is shorthand for "biological diversity"—a term covering a broad array of contexts from the genetics of individual organisms to ecosystem interactions. The daily news tells us of ongoing threats from the loss of biodiversity on global and regional levels as humans extend their influence across the face of the earth and into its sustaining processes. On a regional level, biologists look for measures of biodiversity, celebrate when they find sites where those measures are high, and mourn when they diminish; conservation organizations and, in some cases, legal statutes try to protect biodiversity, and communities often struggle to balance human needs for social infrastructure with desirable elements of the natural landscape.

What different meanings can biodiversity encompass, and why might we care about them? Some of these meanings may be purely practical. For example, biodiversity includes different genetic strains: a particularly drought-tolerant plant, an animal that is resistant to a virus or pathogen that may jump to other species. History is rife with such plagues, and we know with certainty that our future well-being, from sustainable agricultural systems to human health, will depend on having a thriving bank of diverse organisms whose genetic wealth we may need to draw upon. Similarly, having many different species, the most common definition of biodiversity, may provide us with the raw materials of future foods or medicines or energy: economists speak of "opportunity costs" that may result from decisions that remove options or solutions for the future. At its highest level, biodiversity covers ecosystem processes. A functional ecosystem is one in a kind of balance where the interaction of parts, its species and processes, make it resilient to crisis and stable across time. Destabilized ecosystems create problems for human societies: we depend on their functional abilities to minimize floodwater, fires, or landslides, and to cleanse our

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groundwater or air. None of these processes are simple ones, so loss of biodiversity elements, from species to communities, may contribute ultimately to profound human costs.

To many, these concepts of biodiversity may seem abstract and relevant only to a future time—perhaps a distant future irrelevant to the here and now. Another more immediate and personal definition of biodiversity may help make sense of its importance for most of us. Biodiversity, even for those who know not a single name of a native organism, is all of those colors, shapes, and patterns that infuse our sense of home landscape. Here in the West, the landscape is grand and multi-faceted, a source of inspiration to artists and writers from the early exploring days, an economic draw to bring new citizens from the 19th century to the 21st. For those of us who call this home, the color, shape, and pattern of our natural landscape with its species and communities provide underlying connections and reasons why so many of us want to live here. A uniform landscape holds far less appeal than one of rich texture. Our wild species, the true natives of the plant and animal kingdoms, shape the texture of this place: aspens against a fall sky, antelope across a grassland, trout in the stream, meadowlark song on a spring morning. In its simplest essence, devoid of scientific or economic contexts or abstract future potentials, biodiversity infuses a landscape with unique aesthetic characters that connect people to place, and connected citizens create communities that thrive. For this relatively simple reason, as well as the multitude of scientific and economic reasons, biodiversity does matter on a local and regional scale. Thus, biologists count and measure, conservationists reach into their pockets, and communities grapple with finding a balance between the imprint of development and the maintenance of natural elements, patterns, and processes.

The Invasion of Our Rockies: Hype or Management Priority?

By Anna Sher, guest contributor

We've all heard how bad invasive plants are, how they crowd out wildflowers, waste our precious water, and poison our livestock. Scientists in Colorado and Montana made news in science not long ago for presenting evidence that invasive spotted knapweed was releasing toxins into the soil.[1] And yet, the cover of a recent issue of *Discover* magazine read, "Are invasive species really so bad?"[2] Closer to home was a feature article in *BioScience*, "Tiff over tamarisk: Can a nuisance be nice, too?"[3] The most inflammatory articles were a series published in the nineties, charging invasion scientists with "nativism" and even Nazism.[4] The thesis of these papers is that the recent "hype" over species invasions is misguided at best and, at worst, a symptom of xenophobia.

All of this press has been in the wake of the pronouncement by leading scientists, the USDA, the Rio Convention on Biological Diversity, and now even NASA, that invasive species are a national priority, second only to habitat destruction as the most serious threat to native species, which costs the U.S. as much as $300 billion dollars a year.[5,6,7] The early statistics were enough to prompt then-President Clinton to issue Executive Order 13112, creating the National Invasive Species Council.

And now we are seeing the (inevitable?) backlash. Invasive species are not the problem, the recent articles charge. They say that the public has been misled to engage in witch-hunts targeting nonnatives, with various incentives for doing so.

So, should we be concerned about invasions in the Rocky Mountain region or not? Should you panic at the sight of a Russian olive seedling in your yard, or should you enjoy that patch of purple loosestrife you found by the creek? As a plant ecologist who has specialized in invasion biology for over a decade, I will attempt to clarify this issue, with a challenge to the reader to consider.

My challenge is to consider the problem of invasions (particularly plant invasions) in a new light that casts the offending species as neither villain nor victim. I challenge us to shift our focus away from the species and toward the underlying issue: ecosystem disturbance. Therefore, I agree in part with those who are against blaming invasions for species extinctions; they point to the fact that many so-called invaders are actually poor competitors and therefore hardly at fault. My own research on invasive tamarisk trees supports this view: healthy native cottonwoods can easily over-top tamarisk.[8,9] Considering this and other research, the scientific community has been looking for causes other than competitive exclusion by tamarisk for the decline in cottonwood forests in the Western U.S., such as decreased over-bank flooding. However, to ignore the role of tamarisk completely would mean disregarding the terrible fires they promote that clearly kill native cottonwoods. Thus, I argue here that we must focus on the flood and the fire, i.e., the ecosystem disturbances, and what role the invader plays in responding to, promoting, or even preventing these disturbances. Understanding this can then guide effective management. With this approach we can better concentrate on solutions and goals, rather than finger-pointing and bickering over semantics.

Tamarisk flowers are a testament to their ornamental uses. Very few ornamentals become invasive, but some of our worst invasion problems were once ornamentals. Photo by Tim Carlson.

Terminology

Within the field, it is generally understood that the words weed, invasive, noxious, adventive, and exotic are related but not necessarily synonymous. The term "weed" simply reflects a judgment that a particular plant is undesirable in a given location. Thus, tamarisk trees may be weeds in Western watersheds of the U.S., at the same time as they are a benign feature of the landscape in Israel and Iran. Whether a lone ornamental tamarisk in a xeriscape qualifies as a weed will depend on the eye of the beholder. Sometimes a distinction is made between agricultural/horticultural weeds and "wildland weeds," the former requiring human disturbance and sometimes maintenance, whereas the latter is more synonymous with the term "invasive species," as used by ecologists.

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To be labeled "invasive," many would argue that a species has to be able to spread aggressively beyond its native range while actively displacing natives and changing ecosystem processes. By this definition, the dandelion in your lawn is not invasive, although it is considered a weed by most homeowners. Some weed biologists prefer the classifications "transformer species" and "landscape transformers," i.e., spreading beyond a native range makes a species invasive, but only some of these invasives alter ecosystems, or worse, ecosystem processes. The qualifier "noxious" is also used, primarily by managers, to identify the priority placed on the problem species; that dandelion may not be aggressive enough to earn the title "noxious weed," but the bindweed taking over your garden might, as does the leafy spurge dominating the pasture next door. As an ecologist I am primarily concerned with the latter, but I acknowledge the economic importance of invaders of human landscapes. In this essay I will be referring to species that are of the greatest concern because of the extent of their impact on native ecosystems, which may be referred to interchangeably as "invasives," "transformer species," "wildland weeds," and "noxious," even if these terms are not necessarily equivalent.

In contrast with the more technical jargon above are the labels "exotic," meaning nonnative or introduced, and "adventive," meaning a naturalized exotic. Many use the term "exotic" interchangeably with "invasive"; however, not all invasive species are nonnative, and by no means are all exotics invasive. By some estimations, only one percent of introduced species become invasive, and many argue that this is usually only after repeated introductions. On the other hand, even native species can act invasively when natural checks are removed, usually by human activities. Many animal examples come to mind, including Canada geese that fail to migrate due to artificial food sources and, therefore, destroy plant communities along waterways,[10] and deer whose numbers explode in the absence of natural predators, directly threatening native wildflowers.[11] Although one rarely, if ever, hears the word "invasive" applied to such cases, the impacts and management approaches are the same. Thus, it is not the species itself that is either "bad" or "good" by virtue of being exotic or native, but it is its impact that will earn a population of organisms a label of "invasive."

The lobby against the attention paid to invasions appears to miss the point that it is the plant's behavior and its broad ramifications, not its identity, that make it a candidate for control. Many invasive species are or were ornamental plants: those that were brought to this country for their beauty, and presumed to be benign. Some seem to fear that invasion biologists intend to demonize exotics, when in fact we agree that most *are* benign, requiring a helping human hand to start the invasion ball rolling, usually through alteration of historic disturbance regime.[12]

Natives are usually adapted to a particular type, intensity, timing, or frequency of disturbance, and therefore will be displaced by changes to any of these aspects, making a niche for better-adapted (sometimes nonnative) species to come in.[13] If these new species

Tamarisk draws down water tables, making conditions difficult for natives. Photo by Tim Carlson.

An example of a severe Russian olive invasion. Photo by Tim Carlson.

are able to maintain dominance even after the initial ecosystem change (perhaps by perpetuating a change in disturbance regime), they will be considered invasive. Why some species require disturbance to become invasive and others do not is still a mystery. Even if the invasion didn't require disturbance, the invasion may promote or prevent disturbance. This linkage between invasion and disturbance is the crux of my argument in favor of invasion biology as a scientific and management priority and will be discussed in more detail below with two examples from the Rocky Mountain region.

Invasion in the Rocky Mountain Region (RMR)

The states of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming have, in total, identified approximately 162 different species as noxious in state weed lists. Fortunately, alpine and subalpine regions have few, if any, invaders. Generally speaking, those habitats that are most intensely used or otherwise impacted by human activity tend to be the ones that are most seriously invaded.[14] For the RMR, these would be primarily the grasslands of the foothills and plains and also the river corridors. Indeed, the degree to which we use these for development, grazing, agriculture, recreation, and other purposes tends to be correlated with the level of infestation.

This bulldozer is equipped with a HydroAx to mow down woody invaders. Removing invasives at this site in Florence, Colorado, will not be enough. Active revegetation is likely needed. Photo by Anna Sher.

For our grasslands, responsible herders know that "overgrazing" is not simply a conservationist's political term; rotating cattle or sheep is critical for sustainability of a pasture and the health of the herd. It is easy to identify the numerous areas of the RMR where this has not been done: depression of native grasses has led to invasive cheatgrass (and other species) invasions.[15] Cheatgrass is arguably the most pervasive invader of the West (reported as invasive in five of the eight RMR states), and is credited with displacing native grasses and degrading rangelands through aggressive competition for water.[16] Indeed, it was likely ranchers who named *Bromus tectorum* "cheat": although *B. tectorum* and related exotic grasses provide green shoots for grazing early in the season before the native perennial grasses have begun growing, the cattlemen were cheated by late season when the cattle become endangered by the awns on the seeds that painfully stick in their gums and nostrils.[17]

Once cheatgrass has a foothold in a grassland, it can promote wildfires that further displace natives and other desirable fodder.[18,19] Cheatgrass does this by finishing its life cycle early in the season (June), becoming dry tinder for wildfires when they would be most detrimental for native perennial grasses that do not mature until late August and September. Native grasses are adapted to fire, but not when they are still setting seed. That is, while an initial anthropogenic disturbance (e.g., overgrazing) may give the initial advantage to the invasive species, the species itself is able to maintain dominance as the new climax species through competition for resources and by further changing the fire disturbance regime.[20] While fire is historically important for maintaining the diversity of our rangeland plant communities, cheatgrass changes the role of fire by altering its timing.

A similar role of disturbance can be seen with invasion of our Western watersheds by invasive tamarisk (aka saltcedar, *Tamarix spp*.). Throughout the RMR, riparian forests, or *bosque*, have been transformed from narrow cottonwood-willow bands hugging the riverbanks to wide swaths of this shrubby invader from Eurasia. This species has been charged with wasting water, elevating soil salinity, decreasing biodiversity, and altering river hydrology.[21] Within the RMR, it is found on the state weed lists of Colorado, Nevada, and New Mexico, but tamarisk can be found in every state of the region. Although controversy around this species is still raging, it seems clear that alteration of flooding disturbance plays a critical role, both as a cause and an effect of tamarisk invasion.[22,23,24,25] It has been necessary to dam and channelize our rivers to reduce flooding threats to farmlands, residences, and rangelands. However, without periodic spring floods, the native cottonwood cannot regenerate from seed, leaving adult stands with no future generation to replace them.[26] Mild floods later in the season are ideal for tamarisk establishment, however, and with no competition from native trees they can easily gain dominance.[27]

In this way, tamarisk is an invader that responds well to anthropogenic changes in the disturbance regime (flooding), but it is also a promoter of ecosystem disturbance change itself. It was widely planted in some areas as a stream-bank stabilizer, and it fills this role well, narrowing the stream channel and in some cases actually increasing the off-season flooding that does nothing to promote native species. As mentioned earlier, tamarisk also played an important role in promoting the hot fires in the Southwest in 1998,

which also killed native trees while stimulating vigorous tamarisk regrowth. Thus, like cheatgrass, a change in disturbance caused by humans (i.e., reduced and ill-timed flooding), has promoted invasion that in turn helps sustain a change in the historic disturbance regimes (i.e., in flooding and fire).

Weed Control Triage

And so the question remains: Are cheatgrass and tamarisk "bad" species that must be eliminated? If the source of the problem is mismanaged disturbance, is eradication still the objective? Is eradication even a possibility? I (and other experts) would argue that even though eradication is not realistic, we must pay particular attention to these and other specific Western invaders because of the key role they play in ecosystem dynamics. This does not make them bad; it makes them important players in dictating land management practices. But how do we identify these key species? This is far from an exact science, but generally the range or spread of a species attracts attention.

Several states compile a list of noxious weeds, prioritizing by category according to the current threat and our ability to contain it (see Appendix A). Acknowledged, therefore, is the fact that we have reached a triage situation in which there are inevitable lost causes. For Colorado (as well as New Mexico and Nevada), such lost causes are labeled "List C" (in Montana, "Category 3"), and includes such annoyances as field bindweed (*Convovulus arvensis*) and puncture vine (*Tribulus terrestris*). On the other end of the spectrum, "List A" (or "Category 1") includes species that are still rare in the state and may actually be prevented from gaining a significant foothold. These are the highest priority "Wanted," and in Colorado include those species that have wrought havoc in nearby states, including yellow starthistle (*Centaurea solstitialis*) and the beautiful purple loosestrife (*Lythrum salicaria*). The majority of the species, then, fall in the "List B"—species that are already widespread, but that cause enough trouble to warrant state plans for at least local control. Both cheatgrass and tamarisk fall into this category, meaning that it is most likely not possible to exterminate either from the state, much less the RMR.

Although these lists and their management plans tend to focus attention on the species themselves, they are useful if we consider them as a starting rather than ending point. These lists are valuable in drawing the attention of scientists and lawmakers on those issues important to land managers. They help point the way to identifying the ecosystem dynamics that underlie some of our most persistent problems, including wildfires, drought, flood and groundwater issues, and diminished biodiversity. In some cases, studying the invasives will lead us to solutions.

When the problem (including the weed problem itself) appears to have started with a changed disturbance regime, the solution may best incorporate a return to historic disturbance conditions. Controlled burns are an example of attempts to reinstate disturbance, and there is promising evidence that it may control cheatgrass.[28] However, most changes to historic disturbance regimes were done to protect lives or property of human populations, and therefore are unlikely to be reversed.

This means that we must use the scientific and management tools available to us to do the best that we can. Understanding which aspects of the disturbance regime are important for our land management goals will be critical. In the landscape we are attempting to manage, is disturbance important because it suppresses dominant species to allow for greater total diversity? Does it stimulate nutrient cycling, break seed dormancy of desirable species, or make other resources such as light more available? Most of these outcomes can be promoted in multiple ways and do not depend on an exact replication of historic disturbance. In the case of tamarisk, we have seen some success in simulations of the effects of large historic floods without their detrimental effects; bulldozers rip up trees and calculated flows are gently released from dams during native seed dispersal.[29] The resulting *bosque* from a project that did this has prevented reinvasion of the site by tamarisk, even ten years later.[30] This is an excellent example of the principle that if the underlying disease (altered ecosystem process) is treated, the symptoms (weeds) are likely to subside.

Conclusion: Looking to the Future

Just as we are losing the distinguishing characters of our urban centers, invasive weeds are the strip malls of nature, transforming once unique communities into carbon copies found throughout similar climate and moisture zones. And yet, the weeds themselves may or may not be responsible for the initial damage, and so simply removing them is unlikely to solve the problem. Restoration of functioning ecosystems should be the ultimate goal, which is likely to require a consideration of the disturbance regimes to which the native community is adapted. This, in turn, will require study and management of the weeds that prevent, promote, and/or alter disturbance. It is our responsibility as stewards of the environment to find these mechanisms and thus (we hope) solutions to the underlying problems.

As inciting as the titles are of the articles that appear to proclaim that the invasive species problem is overstated, their content is generally less provoking. That thousands of species, both exotic and native, have had direct and indirect negative effects on ecosystems and economies is indisputable. Even in the *Discover* magazine article ("Are invasive species so bad?"), the author acknowledges

Tamarisk will grow where native species may not; in this case they are unlikely to have displaced native plants. Photo by Tim Carlson.

Invasions are often associated with human activity, like tamarisk at this picnic site in Moab, Utah. Photo by Tim Carlson.

the scourge that the Australian brown tree snake, bird diseases in Hawaii, and the fire-promoting melaleuca tree in Australia have been. His main point, as it turns out, is that invasive species are generally less competitive than we have given them credit for. On this point I agree; we have allowed invasions to start primarily by displacing natives through disturbance regime changes. However, arguments such as his ignore the fact that once a new species has a foothold, the species itself is often a problem. This is why creating state weed lists is still an important strategy, but we must also consider the species lists as indicators of larger problems that may need to be addressed. Effective weed control will necessarily be an ecosystem approach.

As a final note, I also agree with those authors[31,32] who argue that the way that we as scientists present our issues to the public is a sensitive matter, and that overstating our causes with loaded language can backfire in many ways, including triggering references to xenophobia. By keeping our focus, both internally and in our public discourse, on the impacts of invasions rather than the species itself, we are more likely to arrive at solutions to ecosystem problems, rather than stalling in rhetoric.

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Appendix A:
COLORADO DEPARTMENT OF AGRICULTURE
Plant Industry Division

8 CCR 1203-19 RULES PERTAINING TO THE ADMINISTRATION AND ENFORCEMENT OF THE COLORADO NOXIOUS WEED ACT

Part 3 List A Noxious Weed Species

3.1. List A of the Colorado noxious weed list comprises the following noxious weed species:

African rue (*Peganum harmala*)
Camelthorn (*Alhagi pseudalhagi*)
Common crupina (*Crupina vulgaris*)
Cypress spurge (*Euphorbia cyparissias*)
Dyer's woad *(Isatis tinctoria*)
Giant salvinia (*Salvinia molesta)*
Hydrilla (*Hydrilla verticillata*)
Meadow knapweed (*Centaurea pratensis*)
Mediterranean sage (*Salvia aethiopis*)
Medusahead (*Taeniatherum caput-medusae*)
Myrtle spurge *(Euphorbia myrsinites*)
Purple loosestrife (*Lythrum salicaria*)
Rush skeletonweed (*Chondrilla juncea*)
Sericea lespedeza (*Lespedeza cuneata*)
Squarrose knapweed (*Centaurea virgata*)
Tansy ragwort (*Senecio jacobaea*)
Yellow starthistle (*Centaurea solstitialis*)

3.2. All populations of List A species in Colorado are designated by the commissioner for eradication.

3.3. It is a violation of these rules to allow any plant of any population of any List A species to produce seed or develop other reproductive propagules.

Part 4 List B Noxious Weed Species

4.1. List B of the Colorado noxious weed list comprises the following noxious weed species:

Absinth wormwood (*Artemisia absinthium*)
Black henbane (*Hyoscyamus niger*)
Bouncingbet (*Saponaria officinalis*)
Bull thistle (*Cirsium vulgare*)
Canada thistle (*Cirsium arvense*)
Chinese clematis (*Clematis orientalis*)
Common tansy (*Tanacetum vulgare*)
Common teasel (*Dipsacus fullonum*)
Corn chamomile (*Anthemis arvensis*)
Cutleaf teasel (*Dipsacus laciniatus*)
Dalmatian toadflax, broad-leaved (*Linaria dalmatica*)
Dalmatian toadflax, narrow-leaved (*Linaria genistifolia*)
Dame's rocket (*Hesperis matronalis*)
Diffuse knapweed (*Centaurea diffusa*)
Eurasian watermilfoil (*Myriophyllum spicatum*)
Hoary cress (*Cardaria draba*)
Houndstongue (*Cynoglossum officinale*)
Leafy spurge (*Euphorbia esula*)
Mayweed chamomile (*Anthemis cotula*)
Moth mullein (*Verbascum blattaria*)
Musk thistle (*Carduus nutans*)
Orange hawkweed (*Hieracium aurantiacum*)
Oxeye daisy (*Chrysanthemum leucanthemum*)
Perennial pepperweed (*Lepidium latifolium*)
Plumeless thistle (*Carduus acanthoides*)
Quackgrass (*Elytrigia repens*)
Redstem filaree (*Erodium cicutarium*)
Russian knapweed (*Acroptilon repens*)
Russian-olive (*Elaeagnus angustifolia*)
Salt cedar (*Tamarix chinensis, T.parviflora, and T. ramosissima*)
Scentless chamomile (*Matricaria perforata*)
Scotch thistle (*Onopordum acanthium*)
Scotch thistle (*Onopordum tauricum*)
Spotted knapweed (*Centaurea maculosa*)
Spurred anoda (*Anoda cristata*)
Sulfur cinquefoil (*Potentilla recta*)
Venice mallow (*Hibiscus trionum*)
Wild caraway (*Carum carvi*)
Yellow nutsedge (*Cyperus esculentus*)
Yellow toadflax (*Linaria vulgaris*)

4.2. List B noxious weed species are species for which the commissioner, in consultation with the state noxious weed advisory committee, local governments, and other interested parties, will develop and implement state noxious weed management plans designed to stop the continued spread of these species. Until such time as these plans are developed and implemented by rule, all persons are recommended to manage List B species but are not required to do so by these rules (although other state or local jurisdictions may require such action).

Part 5 List C Noxious Weed Species

5.1. List C of the Colorado noxious weed list comprises the following noxious weed species:

Chicory (*Cichorium intybus*)
Common burdock (*Arctium minus*)
Common mullein (*Verbascum thapsus*)
Common St. Johnswort (*Hypericum perforatum*)
Downy brome (*Bromus tectorum*)
Field bindweed (*Convolvulus arvensis*)
Halogeton (*Halogeton glomeratus*)
Johnsongrass (*Sorghum halepense*)
Jointed goatgrass (*Aegilops cylindrica*)
Perennial sowthistle (*Sonchus* arvensis)
Poison hemlock (*Conium maculatum*)
Puncturevine (*Tribulus terrestris*)
Velvetleaf (*Abutilon theophrasti*)
Wild proso millet (*Panicum miliaceum*)

5.2. List C noxious weed species are species for which the commissioner, in consultation with the state noxious weed advisory committee, local governments, and other interested parties, will develop and implement state noxious weed management plans designed to support the efforts of local governing bodies to facilitate more effective integrated weed management on private and public lands. The goal of such plans will not be to stop the continued spread of these species but to provide additional educational, research, and biological control resources to jurisdictions that choose to require management of List C species.

Hot fires promoted by tamarisk invasion kill natives but promote regrowth of tamarisk. Photo by Tim Carlson.

Challenge Essay on Endangered Species

Myths Versus Realities Concerning Threatened and Endangered Species in the Rockies

By Randy T. Simmons, guest contributor

The Rockies is a place where the Endangered Species Act (ESA) has huge effects. Wolf reintroduction is proceeding, the grizzly range is expanding, and the Preble's meadow jumping mouse is listed and then delisted. Utah prairie dogs have more rights than landowners. Desert tortoises make some people rich and others poor, depending on whether the tortoise has taken up residence on their land. Endangered fish change dam management and recreation policies.

Most of us believe that saving endangered species is a good thing. But good analysis requires us to ask some questions such as what is a species, should subspecies and populations have the same standing as a species, are some species more equal than others, what is natural, and how should scarce species protection dollars be spent? I address these and other questions by considering what modern science tells us about the assumptions underlying the ESA.

Humans and Nature

There are four core assumptions underlying the ESA and other federal environmental statutes:[1] First, that there is a "balance of nature" where ecosystems achieve a constancy or equilibrium that persists through time. Second, that North America was a "wilderness" unharmed by human activity, prior to the arrival of Europeans. Third, that this "wilderness" teemed with wildlife, especially large herds of bison, elk, moose, antelope, and deer.[2] Fourth, that Native Americans were either so few in number and so primitive that they had no impact on the "pristine" landscape or native peoples were children of nature and original conservationists who were too wise to overuse their environment.[3]

These assumptions lead many to conclude that pre-Columbian America and especially the Rockies were a Garden of Eden filled with uncountable numbers of ungulates (hoofed mammals such as deer, elk, antelope, and bison), wolves, and other wildlife. According to this view, Europeans destroyed this idyllic state of nature.[4] Restoring American ecosystems to their original conditions and saving endangered species require eliminating European influences. The preferred policy, then, is to "let nature take its course" and is often called hands-off or natural regulation management.

If these underlying assumptions about nature are false, then policies and management based on them are unlikely to create conditions that protect species and may even create harmful conditions. If the "balance of nature" is not supported by modern ecology, then endangered species management must be hands-on instead of hands-off. If the American continent was not heavily populated by large ungulates, then policies that attempt to create conditions that never existed will not provide the conditions that allowed North American species to emerge and survive. If, instead of having little effect on landscapes, Native Americans were both the ultimate keystone predator and the ultimate keystone species that created North America's landscapes and habitats, then policies ought to be structured that mimic some of what actually happened before European contact.

The "Balance of Nature"

In his book about reinventing nature, Cronin[5] claims that, "Many popular ideas about the environment are premised on the conviction that nature is a stable, holistic, homeostatic community capable of preserving its natural balance more or less indefinitely if only humans can avoid 'disturbing it.'" This assumption, which he calls "problematic," descends from the work of botanist Frederic Edward Clements, for whom the "landscape is a balance of nature, a steady-state condition maintained so long as every species remains in place."[6]

Central to this belief is the presumption that nature is highly structured, ordered, and regulated, and that disturbed ecosystems will return to their original states once the disturbance is removed. This view of nature is an integral part of successional theory, which assumes that species replace one another in ordered procession, culminating in climax communities.

Rachel Carson, in her book "Silent Spring" (1962), perhaps best popularized the idea of a balance of nature. Although she noted that, "The balance of nature is not a *status quo*; it is fluid, ever shifting, in a constant state of adjustment,"[7] she also claimed that it is no more possible to ignore the balance of nature than a "man perched on the edge of a cliff" can defy the "law of gravity."[8] "Silent Spring" promoted the notion that there is a delicate balance of nature that stands in danger of being upset by humans. Carson wrote that it took "eons of time" for life to reach "a state of adjustment and balance with its surroundings."[9]

The belief in a balance of nature continues to animate many modern activists. In 1999, the Nobel Prize Peace laureates attempted to start a worldwide movement under the banner of "Manifesto 2000." The goal was to present 100 million signatures to the United Nations General Assembly meeting at the turn of the millennium in September 2000. The signers of Manifesto 2000 pledged to "promote consumer behavior that is responsible, and development practices that respect all forms of life and *preserve the balance of nature on the planet*" (italics added).[10]

Many environmental laws are based on a supposed balance of nature. As ecologist Norman Christensen, dean of Duke University's

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Nicholas School of the Environment and chair of the Ecological Society of America's panel that reviewed the 1998 Yellowstone National Park fires, explains,

> Everything from the Endangered Species Act to the Clean Water Act has implicit in it the notion of an equilibrium ecology, the idea that systems tend toward these stable end points and that they are regulated by complex feedbacks—a sort of balance of nature that is almost Aristotelian.[11]

A belief in a balance of nature gives strong moral content to environmental protection. From Rachel Carson to Barry Commoner ("everything is connected to everything else"),[12] Paul Ehrlich,[13] E.F. Shumacher ("small is beautiful"),[14] the Club of Rome,[15] Al Gore ("various parts of nature interact in patterns that tend toward balance and persist over time"),[16] and the deep ecologists,[17] there is an acceptance of not only the existence of a balance of nature but of a belief that upsetting it is morally wrong.[18]

Although the balance of nature is the basis of environmental law, environmental activists' belief systems, and is promoted by Nobel Peace Prize laureates, it is widely rejected by ecologists,[19] and by many in the environmental community.[20,21] Rather than constancy and stability, disturbance and change have characterized the earth's evolutionary history. Glaciers that covered large portions of North America advanced and retreated only to continually repeat the cycle over the last three million years. The climate has fluctuated so widely that what we in the United States view as "normal," that which we have experienced during our lives or since the birth of our nation, is, when viewed from a perspective of the last several hundred thousand years, an abnormally warm, dry period. The "normal" climate for most of Canada, for instance, is several thousand feet of ice, not what we see today.[22] As one might expect, the distributions of plants and animals have also contracted and expanded over time. Local extinctions are a fact of life, as is the extinction of entire species.[23] Disturbance and change are the only ecosystem constants.

Christensen suggests that this modern understanding of nature raises difficult problems for the ESA, which "assumes that we can know what a minimum viable population of a plant or animal is in a very predictable way." He says,

> The nonequilibrium approach to ecology suggests that species populations fluctuate constantly. Species may go locally extinct in a given area. They may appear and reappear. That's very frustrating for managers of endangered species and for a public that expects much more deterministic answers from science.[24]

Wilderness, Wildlife, and Native Americans

If there is no "balance of nature," there is no ecological stasis, there is only change. Insofar as the ESA tries to maintain stability, it is out of step with the processes of nature and it is doomed to fail. Daniel Botkin in his 1991 book, "Discordant Harmonies," reviewed the research that contradicts "nature knows best." Botkin explained that the views underlying the 1970s laws and resulting policies "represented a resurgency of prescientific myths about nature blended with early 20th century studies that provided short-term and static images of nature undisturbed."

"Nature undisturbed" assumes the Americas were a wilderness teeming with untold numbers of bison, passenger pigeons, and other wildlife until despoiled by Europeans. "Nature undisturbed" also assumes that Native Americans were primitive savages who were the original conservationists—"ecologically noble savages."

My colleague Charles Kay, a wildlife ecologist, quantified all the wildlife observations and encounters with native people recorded in the Lewis and Clark journals. He found more than 40,000 journal entries and plotted the abundance of wildlife and native people day by day for the entire 863 day journey. The only places Lewis and Clark observed significant numbers of wildlife were in buffer zones between competing tribes. If it had not been for buffer zones, Lewis and Clark would have found little wildlife anywhere in the West. Kay's research, along with new research in ecology, archeology, and anthropology, clearly contradicts the "nature undisturbed" vision and demonstrates that humans were the apex predator in the pre-Columbian Americas.

If humans were the top predator that structured western ecosystems, then the current efforts to restore wolves in the northern Rockies are based on myth. Because humans out-compete wolves for prey, at Columbian contact there were few wolves in the West—there was not a prey base sufficient to support them. Restoring wolves will not return ecological processes to a mythical or mystical or even pre-Columbian balance of nature.

Consider the efforts to reintroduce wolves to Yellowstone National Park. The plan was predicated, in part, on the premise that large numbers of wolves inhabited that ecosystem before the Park Service eliminated them from the park.[25] According to some, "[wolves] were a relatively common sight in Yellowstone when it was declared the nation's first national park in 1872."[26] Defenders of Wildlife's Dick Randall claimed that "when trappers and explorers reported on the Yellowstone region in the mid-1800s, they sang [of] a land teeming with bison, elk, mule deer, bighorn sheep, and antelope. The great carnivores—grey wolf, grizzly bear, and mountain lion—flourished."[27]

As part of Kay's research in the Yellowstone ecosystem, he conducted a continuous-time analysis of journals left by early explorers. He systematically recorded all observations of ungulates and other large mammals, including wolves. Between 1835 and 1876, 20 different expeditions spent a total of 765 days traveling through the Yellowstone ecosystem on foot or horseback, yet,

no one reported seeing or killing even a single wolf. Wolf sign, primarily howling, was reported on only three occasions. Since these early observers lacked scientific training, they could have easily mistaken coyote howls or other animals' calls for wolves. Besides, when these journals were written, even trained scientists called coyotes wolves or prairie wolves. There certainly is no evidence in historical journals that suggests that large numbers of wolves were common in Yellowstone during the 1835-1876 period.[28]

Other records indicate that wolves were also not particularly common even after Yellowstone Park was established. During the late 1800s and early 1900s, few observations were recorded of wolves in the park. "Wolves inhabited the area in unknown but seemingly low densities."[29] From 1914 to 1926 when the Park Service was actively working to eradicate wolves from Yellowstone, they killed 136 wolves. This may seem like a lot, but it included only 56 adults over a 13-year interval. Park Service records also suggest that during this time there were, at most, only four wolf packs in the park and possibly only two.[30] So, available information does not support the belief that large numbers of wolves inhabited Yellowstone at any point in recorded history. There is no historical support for the belief that restoring wolves would re-establish natural conditions. In fact, the data suggest that wolves were always rare in Yellowstone. As explained above, native hunting was so intense that historical and pre-Columbian ungulate populations were very low, which, in turn, accounts for the relative scarcity of carnivorous species, like wolves.[31]

Clearly, Yellowstone and the rest of the Rockies were not a wilderness waiting to be discovered but instead were home to thousands of aboriginal peoples before the arrival of Europeans and their diseases. Wilderness was not even a concept understood or used by native peoples as no native language even contains a word for "wilderness."[32]

These arguments are central to thinking about endangered species policies because they provide clues about the condition of America prior to European contact. The now-extinct passenger pigeon, for example, is often cited to support claims that pre-Columbian America teemed with wildlife before Europeans drove that and other species to extinction. But if we could visit the eastern United States in 1400 A.D., we would find relatively few passenger pigeons and certainly no flocks that darkened the skies. As archaeologist Thomas Neumann[33] chronicled, pre-Columbian native populations were so large that they consumed most of the nuts, fruits, and berries, collectively called mast, which passenger pigeons needed for food. That is to say, human competition for the annual mast crop was so intense that there was little food left for passenger pigeons and other wildlife. It was only after European diseases decimated Native American populations, and thereby freed the mast crop for wildlife, that passenger pigeons increased to unprecedented numbers. So, the large flocks of passenger pigeons reported during the 1700s and 1800s were an artifact of decimated Native American populations, not an example of how America teemed with wildlife before Europeans arrived.

A similar situation exists with grizzly bears in the West, an animal that has been on the Endangered Species list in the lower 48 states since 1973. Those who maintain that there were tens of thousands of grizzly bears in the West before that species was driven to near extinction, often cite the abundance of grizzlies on Alaskan salmon spawning streams, where the bears are not hunted, as an example of what the West was like before it was despoiled by Europeans. It turns out, though, that Alaska's concentrations of grizzlies are not natural, but an artifact of European conquest.

Ted Birkedal of the National Park Service points out vast archaeological complexes where many of Alaska's bears now fish for salmon. Research at those sites shows that there were few bears in pre-Columbian times for the natives simply killed and ate them. Before European diseases arrived and decimated native populations, grizzlies were rather scarce in Alaska, and probably throughout western North America, as well. Speaking of the present concentrations of grizzlies along the Naknek River in Alaska's Katmai National Park, Birkedal noted that, "This 'bear heaven' is not a creation of Mother Nature, [but instead] it is a cultural artifact of national park management," which has excluded Native Americans to create an Alaskan "wilderness."[34]

But what is natural? If Native Americans determined the structure of entire plant and animal communities by burning the vegetation and limiting wildlife numbers, then they created completely different situations than what we have today.[35] A hands-off, let-nature-take-its-course approach by modern land managers will not duplicate the ecological conditions under which those communities developed.[36] Since aboriginal predation and burning created those communities, we believe they will be best maintained by replicating aboriginal influences and processes.[37]

As paradoxical as it may sound, nature has to be managed. Setting aside an area as "wilderness" today, as has been suggested to protect various endangered species, will not preserve some remnant of the past but will instead create conditions that have not existed for the last 10,000 years.[38] North Americans, for instance, view the Amazon as a wilderness to be saved and protected, but to indigenous peoples it is a home—a home they modified to suit human needs.[39]

A new ESA would recognize that a balance of nature or nature undisturbed is an impossible goal. It would also shift the finger of blame from what we have done or have not done since 1491 to more serious questions about managing for change, risk, and complexity.

Species Act or Subpopulation Act?

Today, wolves as a species are not threatened with extinction. There are thousands of grey wolves in Canada and Alaska. Yet, of the list of 1,264 endangered or threatened U.S. species, the gray wolf ranks 24th in terms of expenditures. We spend millions of dollars to protect a non-threatened species and justify it by arbitrarily

creating distinct population segments. What that means is that if a grey wolf wanders south to where Interstate 70 bisects Utah and manages to cross the road, he immediately changes legal status. He has moved into the Southwest distinct population segment and must receive extra protection. Biologically he is the same animal. Legally he is not.

The same is true of 70 percent of the ESA's listing of mammals in the United States—a distinct subpopulation of subspecies is endangered but not the species itself. Examples of non-endangered species whose populations are listed under the ESA include grizzly bear, wolf, and lynx in the lower 48 states; salmon and steelhead stocks on the Pacific Coast, the Eastern stock of Stellar's sea lions; and Southwest Alaska's stock of sea otters. Non-endangered species whose subspecies are listed include northern spotted owls, coastal California gnatcatcher, Mexican wolf, woodland caribou in Idaho and Washington, and the Sonoran pronghorn antelope.

This all suggests that distinct population segments (DPS) and subspecies have little scientific meaning. The grizzly, wolf, and lynx are listed under the ESA as DPS in the Western states but not in Canada or Alaska. As noted above, these species are not endangered, although there are some small local populations.

Another myth that should be abandoned is the belief that all species are equally important. This is often phrased as "saving all the pieces." According to current interpretations of the Endangered Species Act, we must save not only all endangered species, but all endangered subspecies, and even unique or endangered subpopulations as well. But biologically, not all species, subspecies, and populations, were created, nor did they evolve, equal. There are, however, what are called keystone species whose loss will completely alter or change an ecosystem[40]—there will still be an ecosystem but it will be a different ecosystem. Beaver is an excellent example of a keystone species.[41]

Beaver not only create and maintain riparian areas that are critical to hundreds of other species, but they also alter the hydrology, energy flow, and nutrient cycling of aquatic systems. Beaver dams impound water and trap sediments that raise the water table, increase the wetted perimeter, and allow the extension of riparian communities into former upland sites. In addition, beaver dams regulate stream flow by storing water, reducing peak or flood flow, and augmenting low flows during summer. During dry periods, 30 to 60 percent of the water in a stream system can be held in beaver ponds. By trapping silt behind their dams over thousands of years, beaver actually created many of the West's fertile valleys.[42] Therefore, protecting beaver makes a lot more biological sense than protecting species like the grizzly bear or kangaroo rat, which are not critical to ecosystem control or function.

Moreover, some species, subspecies, and populations are naturally rare, especially those on the edge of their ranges, the geographical areas throughout which they exist. Lynx and wolverine are examples, and a campaign has been mounted to have both listed as endangered species in the northern Rockies.[43] These species are clearly very rare today, but they have been rare in the lower 48 states for the past several thousand years. Lynx and wolverines normally inhabit boreal forests, a habitat type that barely extends into the lower states.[44] Even if all people of European ancestry were removed and the West returned to its pre-Columbian state, lynx and wolverines would still be rare.

These species are also predators and predators are always less abundant than their herbivorous prey which, in turn, are less abundant than the plants they consume. When species at one level of a food chain consume species at a lower level, there is generally a 90 percent loss in energy. Thus, 100 units of plants can support only 10 units of herbivores, which, in turn, can support only one unit of carnivores; a trophic pyramid, with a large plant base and a small apex of carnivores. This explains why top predators, species that are not normally prey for other species and, thus, are on top of the food chain, will always be rare, especially at the edge of their ranges. In addition, as the weather varies and the climate changes, the ranges of these species will contract and expand. Again, there is no constancy in nature.

Trying to save top predators on the edges of their ranges, like lynx or wolverines, will always be a losing battle. Saving endemic species—species that for one reason or another have a very restricted natural distribution—should have a much lower priority than saving keystone species. These species are usually rare in a particular area because long-term climatic changes now favor other species. Biologically, saving these remnant populations makes little sense because large numbers of the same species are usually found in other areas where the habitat and climate are more favorable. While lynx and wolverine are rare in the northern Rockies, those species are common in Canada and Alaska.

Old-Growth Myths

In their campaigns to save this or that endangered species, environmental activists are usually quick to invoke visions of pristine America cloaked in climax, old-growth forest from sea to shining sea. Not only is this too a myth, but it ignores the actions of indigenous peoples. It is often claimed, for instance, that the eastern United States was blanketed in climax deciduous forests before Europeans landed. Early accounts depict a forest of widely spaced trees with little understory, a park-like forest through which one could easily ride a horse or drive a wagon. What they described as natural had really been crafted by Native Americans.[45] Aboriginal burning created the open, park-like forest that the first Europeans mistook for natural. The tangled undergrowth common in our eastern deciduous forests today is certainly not representative of pre-Columbian conditions.[46]

Native Americans determined density and composition of forests by repeatedly burning the vegetation. Repeating historical photographs by finding the original camera position and making a new photograph of the original scene as well

as analyzing the age of forests in the West show that there was little old-growth forest prior to the elimination of native burning and active fire suppression. Moreover, the little old-growth forest that existed ca.1850 was entirely different structurally and ecologically from what we have today. In the past, a few large, widely-spaced trees were surrounded by a lush understory of grasses and flowering plants called forbs. Arizona's ponderosa pine forests, for instance, had just 20 to 60 trees per acre prior to European settlement while today 300 to 900 trees per acre are common.[47] A team and wagon could drive through the areas of Yellowstone where lodgepole pine stands are so thick today that a human can barely walk through.

Historically, most Western forests would not support high-intensity, stand-replacing crown-fires because frequent ground-fires, set by native peoples, kept the forests open and park-like. Now that our forests have both grown-up and thickened-up, large-scale crown-fires are becoming the rule, something that never happened before. Fire certainly structured most North American forests, but they were not lightning-caused infernos that totally consumed forests. Moreover, by changing fire regimes, our forest ecosystems today are nothing like they were in the past, and ecological integrity has been compromised.[48]

This is true even in the coastal forests of the Pacific Northwest. In fact, plans to save the endangered northern spotted owl are all, to one degree or another, based on the assumption that the entire region was blanketed with old-growth forests, defined as trees more than 200 years old, before Europeans arrived.[49] But historical photographs and old stand maps show that in 1840, when large numbers of Europeans first began to physically occupy the Pacific Northwest, only 20 percent to 40 percent of the area supported old-growth forests. Although, it may be hard to believe, there is more old-growth forest today, despite a century of logging, than there was in 1800.[50] The reason is that for thousands of years, native peoples structured all the Northwest's plant communities by repeatedly burning the vegetation.[51] The burning was so persistent that it created grasslands and open valleys in what would otherwise have been forested environments.[52]

The West's forests are not self-perpetuating, climax forests, but instead most are born of fire. Even many of the forests in the Pacific Northwest need fire to regenerate.[53] Douglas fir, which presently dominates huge tracts of old-growth forests, will not regenerate in its own shade. That is to say, new Douglas fir trees are physically incapable of growing under an overstory of mature Douglas fir. The only way to maintain coastal Douglas fir forests is to burn them so Douglas fir can then seed-in on the burned sites. In these forests, stand-replacing crown fires occurred at infrequent intervals.[54]

During the 1980s and 1990s, large-scale, stand-consuming fires raged throughout the West. On Idaho's Boise National Forest, for instance, high-intensity crown fires blackened nearly 800,000 acres during 1993 and 1994. Never in the history of this area have crown fires burned so large an area in such a short time. Clearly, conditions today are outside the range of historical variability. One reason is that activists have worked to protect old-growth forests and old-growth dependent species, while in reality both were always rare. Another reason is that the U.S. Forest Service's fire suppression program has caused a huge build-up of fuels that would not exist under a regime of aboriginal burning.[55]

Conclusions

The conclusions I draw from the data reported here can be disconcerting: stopping logging in the Pacific Northwest's forests will not restore the forests to their pre-Columbian state, saving an endemic species makes less biological sense than saving truly endangered species, nature must be managed, ecosystems (however defined) are not delicately balanced, today's ecosystems did not result from nature "taking its course;" and modern environmental policies are based on a series of myths and wrong assumptions about so called "natural" processes.

Given the generally accepted goals of protecting and saving species, what ought to be done? I suggest the following: First, forget the 1970s mythology and romanticism of the "balance of nature" and concentrate on real problems. Global extinctions are what really matter for a species. It makes little sense to spend scarce money to protect a marginal distinct subpopulation of a species already thriving elsewhere if it means you cannot protect another actual species from extinction. Thus, the ESA should be amended to be an endangered species, not subspecies, or distinct subpopulation segment act. Then, the national government can allow states to decide whether or how to protect subspecies.

American federalism is supposed to encourage experimentation, trial and error, and sequential learning. Relying on national rules to manage local species violates that system. National rules forbid experimentation. National rules turn trial and error systems from learning about how to manage species into systems that learn how to follow the national law. Managers can use time- and place-specific information to craft a management plan only if that information fits into the national rules. Thus, the question under today's management system is not "is the status of the species improving?" It is, "does the management plan follow federal rules?"

Some will object to environmental federalism, claiming states will engage in a race to the bottom in an attempt to promote development. In fact, the opposite tends to be true. State forests are better managed, both environmentally and economically, than federal forests. Some states have stricter laws than those imposed by the federal government. States have time and place-specific information that allows them to react more quickly and more creatively than federal agencies.

Endnotes

[1]These assumptions underlie nearly three decades of environmental legislation and some scientists continue to use them. For a thoughtful discussion of this issue, see Rubin 1994. For an example of scientists relying on these assumptions for their scientific work, see "The Science of Overabundance" edited by McShea, Underwood, and Rappole (Smithsonian Institution Press 1997), especially Chapter 2 by McCabe and McCabe. It unconsciously summarizes and relies on these four assumptions.

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[45]MacCleery, D. (1994). *Understanding the role that humans have played in shaping America's forest and grassland landscapes*. Washington, D.C.: U.S. Forest Service.
[46]Budiansky, 1995, op. cit.
[47]U.S. Forest Service. (1993). "Changing conditions in southwestern forests and implications on land stewardship." U.S. Forest Service, Southwest Region.
[48]MacCleery, 1994, op. cit. Kay, C. E. (I996). "Ecosystems then and now: A historical approach to ecosystem management." Pages 89-87 in Willms, W. D. and J. F. Dormarr (Eds.), Proceedings of the Fourth Prairie Conservation and Endangered Species Workshop. Edmonton, AB: Provincial Museum of Alberta Natural History, Occasional Paper No. 23.
[49]Bonnicksen, 1993, op. cit.
[50]Teensma, P. D. A., Rienstra, J. T. & Yeiter, M. A. (1991). "Preliminary reconstruction and analysis of change in forest stand age classes of the Oregon coast range from 1850 to 1940." BLM Technical Note T/N OR-9. Filing code:9217. BLM-OR-PT-92-01-6320. Zyback, B. (1993). "Native forests of the northwest, 1788-1856: American Indians, cultural fire, and wildlife habitat." *Northwest Woodlands*, 9(2), 14-15, 31. Zyback, B. (1993). "Forest history and FEMAT assumptions: A critical review of President Clinton's 1994 northwest forest plan." Unpublished report to American Forests and Paper Association and the Northwest Forest Reserve Council.
[51]Boyd, T. (1986). "Strategies of Indian burning in the Willamette Valley." *Canadian Journal of Anthropology*, 5, 65-86.
[52]MacCleery, 1994, op. cit.
[53]Bonnicksen, 1993, op. cit.
[54]In most western forests, frequent low-intensity ground fires were once the norm while stand-replacing crown fires generally occurred only at higher elevations and in wetter environments, such as the Pacific Northwest (Bonnicksen 1993). With fire suppression and fire exclusion, however, forest fuels have both grown up and accumulated to unprecedented levels. Thus, crown fires are now common where they never occurred in the past, while in other areas, the size and intensity of the crown fires have increased since earlier times. Even in wet coastal environments, though, aboriginal burning was once widespread.
[55]Pyne, S. J. (1982). *Fire in America: A cultural history of wildland and rural fire*. Princeton, NJ: Princeton University Press.

The Endangered Species Act of 1973: An Overview

By Phillip M. Kannan, guest contributor

The Endangered Species Act of 1973 (ESA) was enacted to prevent the disappearance of species from existence, that is, to prevent the irreversible loss of biodiversity. The model adopted by Congress to achieve this objective is quite straightforward. "Endangered species" is defined to mean "any species which is in danger of extinction throughout all or a significant portion of its range," and "threatened species" is defined as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." The ESA then specifies a process which the secretary of interior must use to list a terrestrial or freshwater species; there is no protection of a species unless it is listed. The Fish and Wildlife Service (FWS) has been delegated the authority to make final decisions regarding listing under the ESA. The listing of a species triggers four categories of obligations.

First, the FWS must designate the critical habitat of the species. This includes areas where physical or biological features essential to conservation of the species are found. The designation and protection of critical habitat should be an integral part of efforts to "conserve" the species. The term "conserve" has major significance under the ESA; it is defined to mean "to use … all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to [the ESA] are no longer necessary." Thus, the FWS must develop a recovery plan and designate critical habitat once a species is listed. This has been done for very few listed species.

Second, all federal agencies are prohibited from any action that is likely to jeopardize the continued existence of a listed species and from modifying its critical habitat. Thus, the Environmental Protection Agency (EPA) cannot issue a permit allowing the discharge of pollutants into a river and the Forest Service cannot sell timber in a national forest if doing so would jeopardize the continued existence of a listed species or degrade the critical habitat of a listed species.

Third, all federal agencies are obligated "to utilize their authorities in furtherance of the purposes of [the ESA] by carrying out programs for the conservation of [listed species]." The word conserve here has the same meaning as given above regarding the FWS; all federal agencies are obligated "to use … all methods and procedures which are necessary to bring any [listed] species to the point at which the measures provided pursuant to [the ESA] are no longer necessary." The goal is full recovery of the "patient," not perpetual life support, and this provision of the ESA enlists all federal agencies in the effort to accomplish this. There is limited data regarding the compliance with this obligation by the various agencies; however, it appears to be uneven and disappointing.

Fourth, all persons are prohibited from taking a listed species. Taking is defined very broadly; it includes harming, harassing, killing, or modifying critical habitat if the modification results in actual harm to an essential function (such as breeding or feeding) of the species.

The four restrictions have caused much opposition to the ESA, not because of the limits on hunting or other direct exploitation of listed species. Almost all of the resistance to the enforcement of the ESA comes from its limitations that apply to both federal agencies and to all persons on modification of critical habitat. The famous northern spotted owl case arose not from a desire of the local population in Oregon to hunt the owls, but from their desire to log, and hence modify, the owls' critical habitat. These disputes reflect a conflict between the possible value to the public of protecting biodiversity and the immediate economic benefit to a local community from exploiting critical habitat.

In a famous case involving a small fish called the snail darter, the Supreme Court held that when the ESA was enacted in 1973, Congress intended for the public's interest in protecting biodiversity to prevail over economic interests in exploiting critical habitat of the listed species.

Since that case, Congress has amended the ESA to allow some taking of listed species under certain circumstances. First, Congress amended the ESA to create a committee, informally called the "God Squad," that can approve a federal agency's request to take action that will result in the taking, even the elimination, of an endangered species. Second, Congress added a provision that allows any person to apply for a permit for action that will result in the incidental taking of some specimens of an endangered species. The taking must be "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity." An incidental taking permit cannot be issued unless the person seeking it submits a habitat conservation plan detailing the impact which will likely result, the steps the applicant will take to minimize and mitigate such impacts, and the funding that will be available to implement the plan, what alternative actions to such taking the applicant considered, and the reasons why such alternatives are not being utilized. The FWS can approve the application only if it finds that the applicant will minimize the harm to the endangered species, the taking will not appreciably reduce the likelihood of the survival and recovery of the species, and that the applicant has adequate funds to carry

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out the plan. A person who wants to develop a thousand-acre parcel that is included in the critical habitat of an endangered species can develop a habitat conservation plan under which 600 acres will be set aside and enhanced as habitat for the species; development would take place only on the remaining 400 acres, and that development might cause the taking of a stated number of members of the species. The developer might create and fund a trust to be administered by an environmental organization for the perpetual management of the 600-acre preserve.

Habitat conservation plans are becoming more popular; however, there is little data on their effectiveness. They have been criticized by some environmental groups as no less than a license to kill. Supporters of habitat conservation plans and similar policies claim they are a reasonable way to balance economic development with protecting listed species. They assert that such balancing is one way to prevent the government from converting their private property into a nature preserve. This logic is based on the assumption that the restrictions on the use of private property when it is included as critical habitat of a listed species amounts to a taking of the private property for a public use. From this assumption it follows that the government must either compensate the owner of the property or provide a balanced approach that allows some economic benefits to remain with the owner.

In 2005, a bill to amend the ESA was introduced in the House by Representative Richard Pombo, a Republican from California, with 97 cosponsors, 23 Democrats and 74 Republicans. This bill, if it becomes law, would remove the authority of the federal government to designate critical habitat under the ESA. It was passed by the House on September 29, 2005, by a vote of 229 in favor to 193 opposed; however, the Senate has not taken any action on the bill.

The conflict between property owners' interest in their land and the public's interest in protecting biodiversity stems from the basic approach taken by Congress in the ESA. Although Congress stated one of the purposes of the ESA was "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved," the focus of the ESA is otherwise. The ESA's approach is based on the assumption that species can be protected one at a time, and thus the ESA is focused on individual species.

An alternative approach would have been to focus the law on protecting habitat. The famous biologist E.O. Wilson has stated, "The reduction of wildland habitats to less than the critical amount necessary for the survival of a species is by far the greatest cause of modern extinctions." Daniel M. Bodansky reached the same conclusion: "The bigger threat to species, however, is not overharvesting by humans but rather habitat loss." These are but reformulations of John Muir's teaching that to manage animals, you manage their habitat. The modern name for this model is ecosystem management.

That ecosystem management is a powerful model to protect species can be understood by considering the major causes of extinction. First on this list, as Wilson has observed, is habitat loss. Other causes include climate change, pollution, over exploitation, and invasive species. This list is not exhaustive, nor are the categories mutually exclusive; however, the list makes it clear that the focus of the problem is habitat, and this strongly suggests that habitat should be also the focus of the solution.

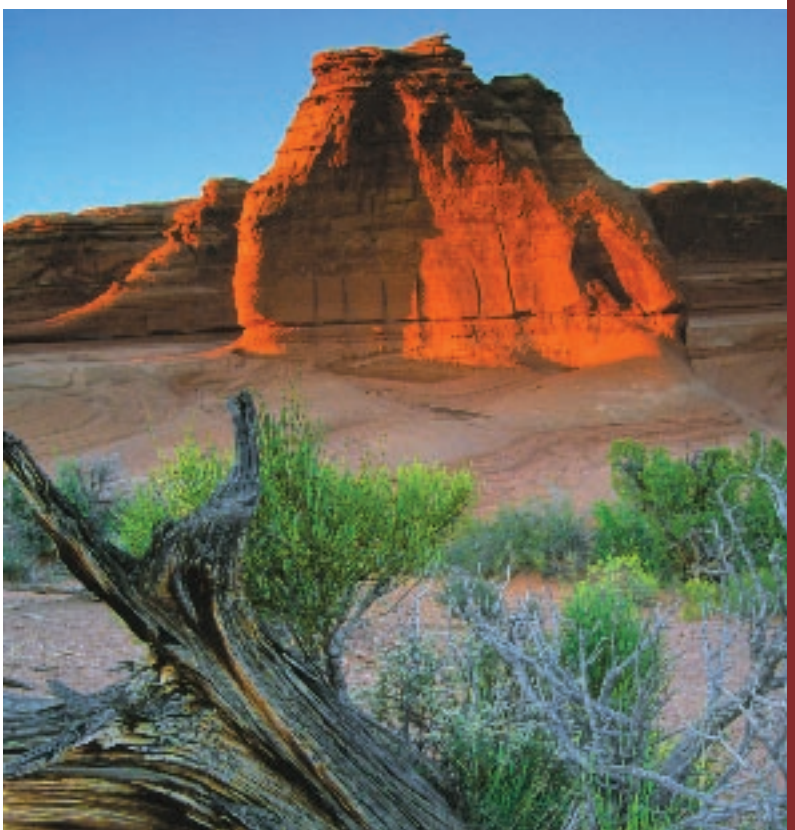
The ESA does not completely ignore ecosystem management. It authorizes the secretaries of agriculture and interior to expend funds to purchase interests in land and water to "conserve fish, wildlife, and plants, including those which are listed as endangered species or threatened species." These can be purchases of title to land or less expensive interests such as conservation easements. Moreover, the habitat conservation plan process discussed above reflects the ecosystem management approach.

There are political as well as ecological advantages to the ecosystem management approach to protecting species. The basic premise in this approach is the government will protect land through its rights as the owner of that land or the owner of conservation easements in that land; the authority of the government as owner of interests in property, rather than the regulatory power of the government as sovereign, is the basis of protection. This should reduce greatly the complaints of private property owners that by including their property in critical habitat of listed species the government has taken their land.

The fact that the ESA is not focused on ecosystem management does not mean that it cannot become a powerful complement to the species approach that is the focus. The careful coordination of all the powers given to the FWS could raise the ESA to a higher level. Coordinating the powers to designate critical habitat, to require the FWS to develop recovery plans, to enter into cooperative agreements with states, to purchase title to land, to acquire conservation easements, to negotiate habitat conservation plans, and to require all federal agencies to use their authority to conserve listed species, would result in a mutually reinforcing, synergistic process.

Endnotes

[1]Unless otherwise noted, all quotations in this overview are from the ESA.
[2]The ESA authorizes the secretary of commerce to perform these tasks for marine species. This overview considers only terrestrial and freshwater species; for marine species, National Marine Fisheries Service (NMFS) has been authorized to act for the secretary of commerce. For marine species, the NMFS performs functions analogous to those performed by the FWS for terrestrial and freshwater species.

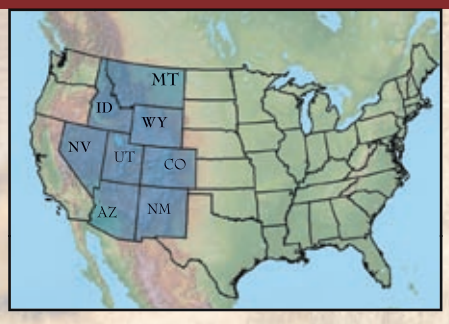


Preserving Biodiversity

Mapping Habitat Threat in the Rockies

By Amanda Strauss, Bryan Hurlbutt,
and Caitlin O'Brady

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?

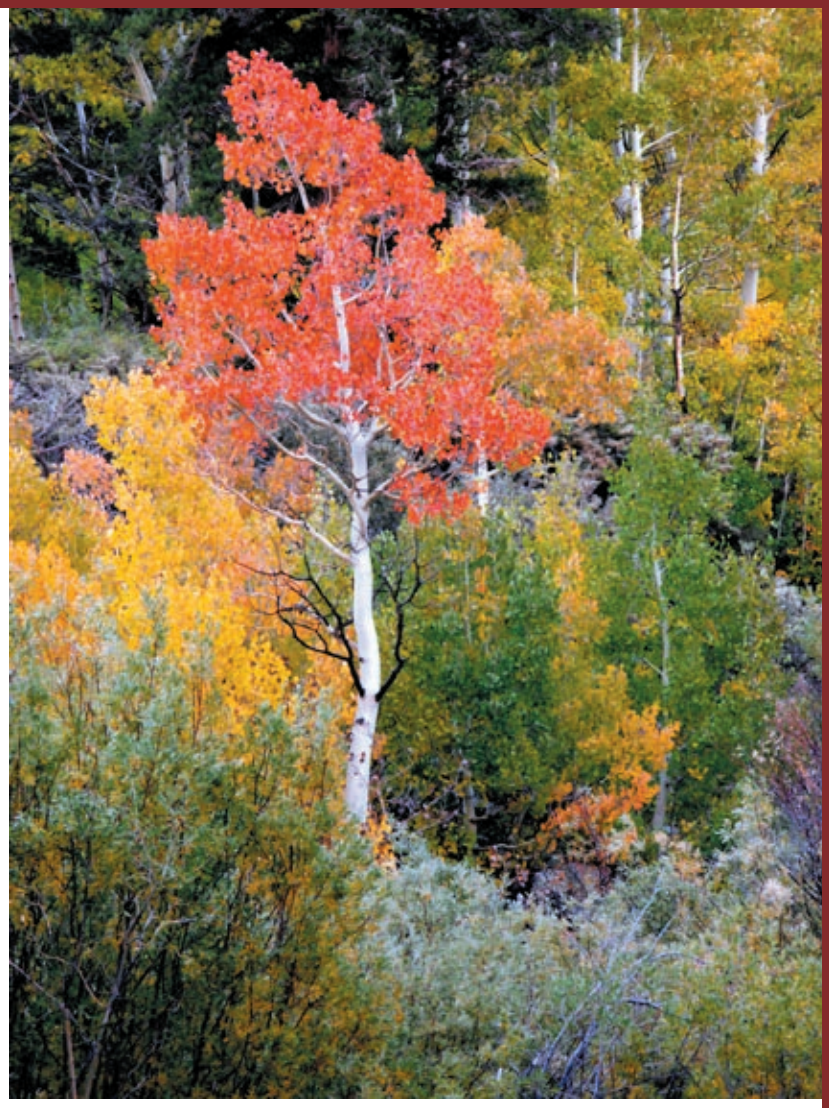
This section of the *2006 State of the Rockies Report Card* explores the importance of biodiversity, assesses its current state, and documents its biggest threats. In addition, this section maps the level of human threats to biodiversity now and in the future on a county level through current and future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

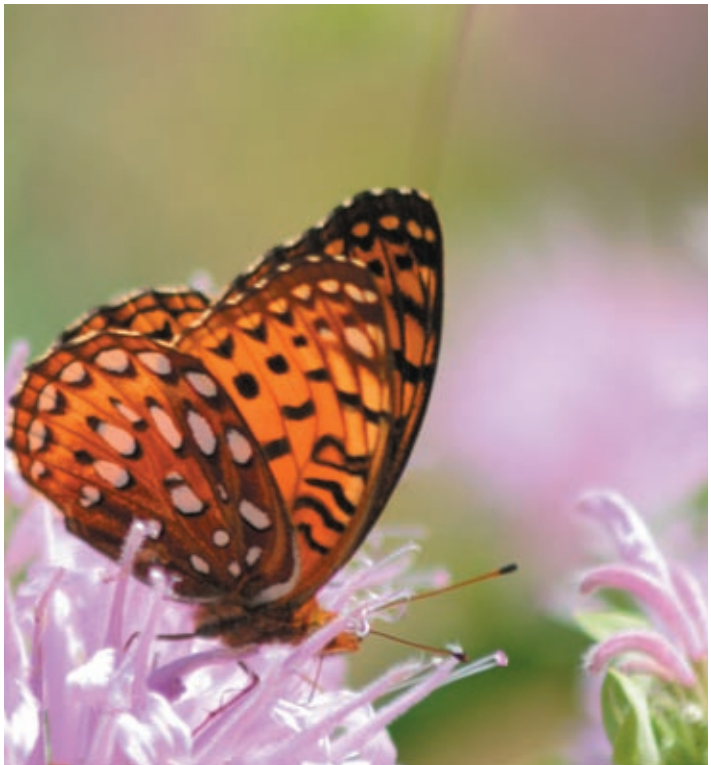
Biodiversity

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.

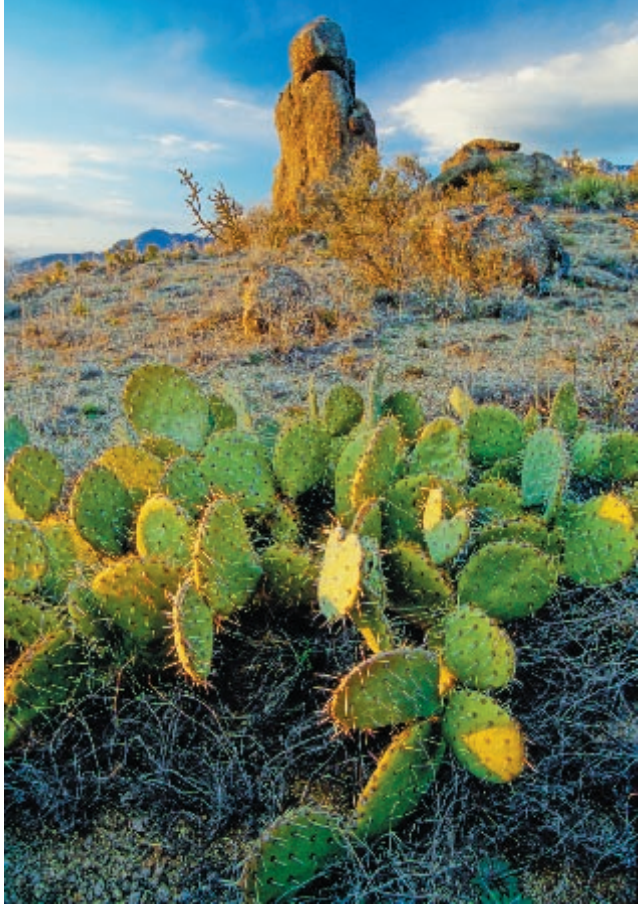




Threats to Biodiversity

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:

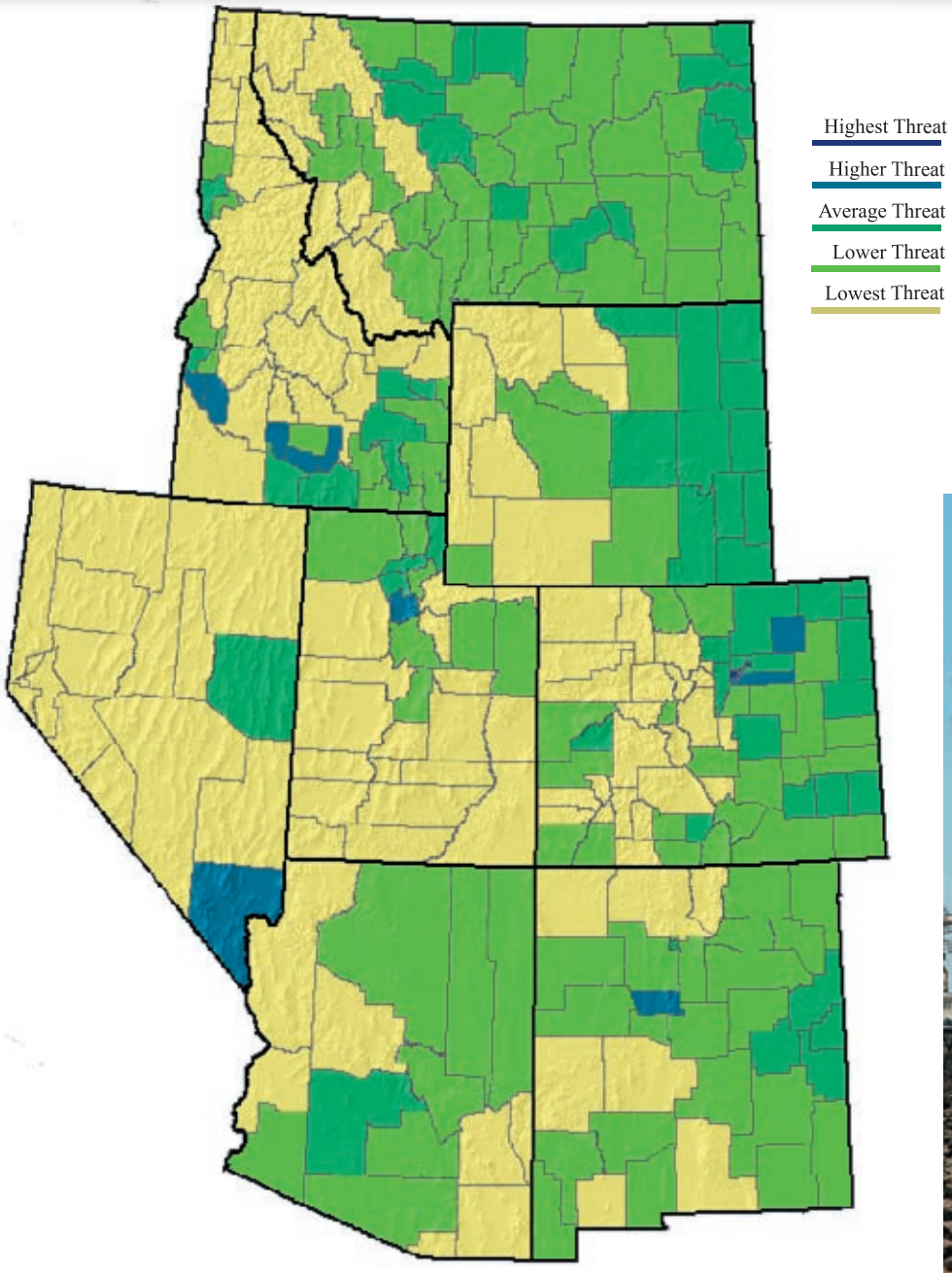
- Percentage of county area covered by significant human development, which include urban areas, highways, interstates, and large mines. (Figure 2)
- Percentage of county area covered by agricultural lands, which include farmland and ranchland. (Figure 3)
- Daily water withdrawals from the county's water 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)

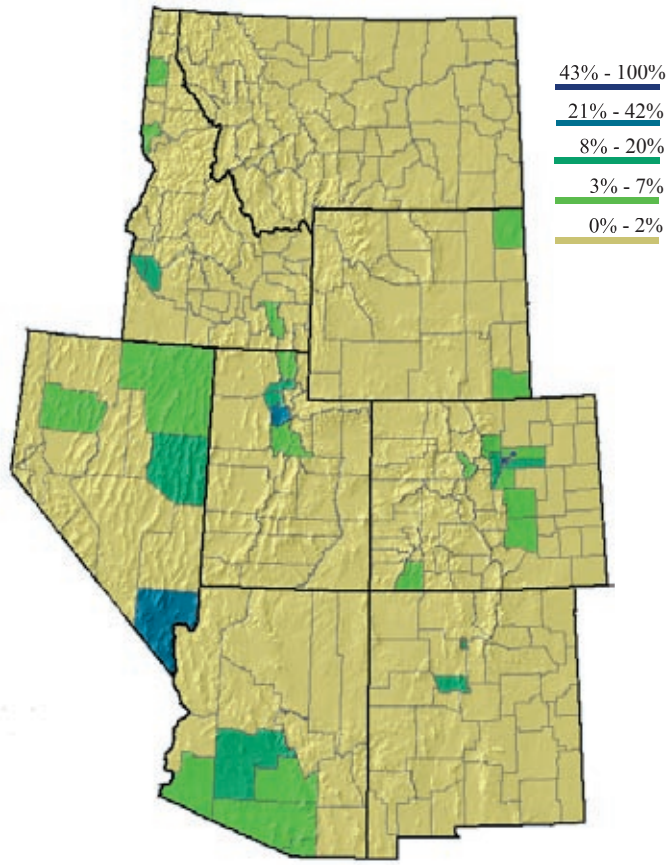
Habitat Threat Index

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

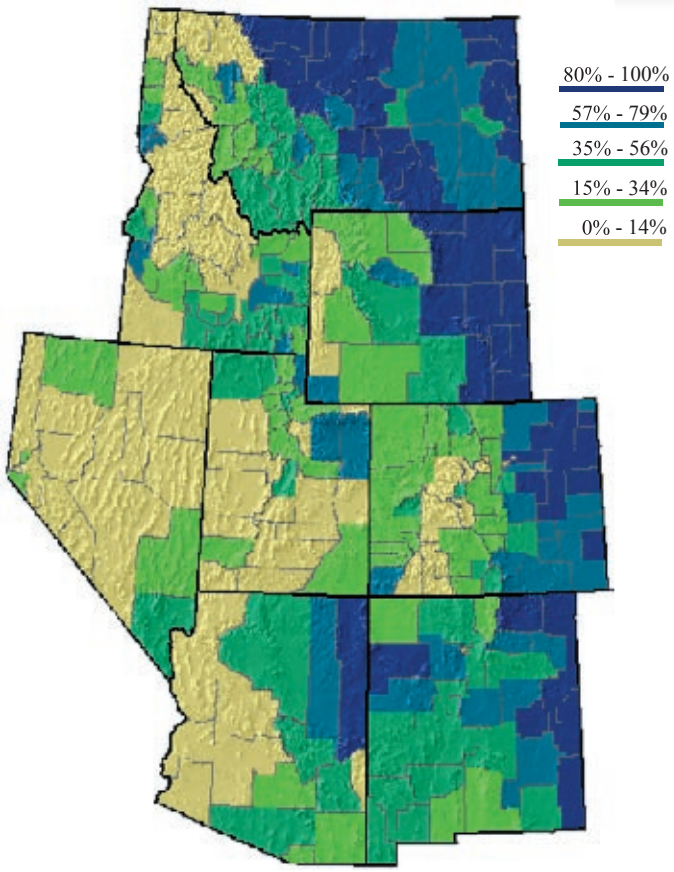
Source: See "About the Index and the Indicators"

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:

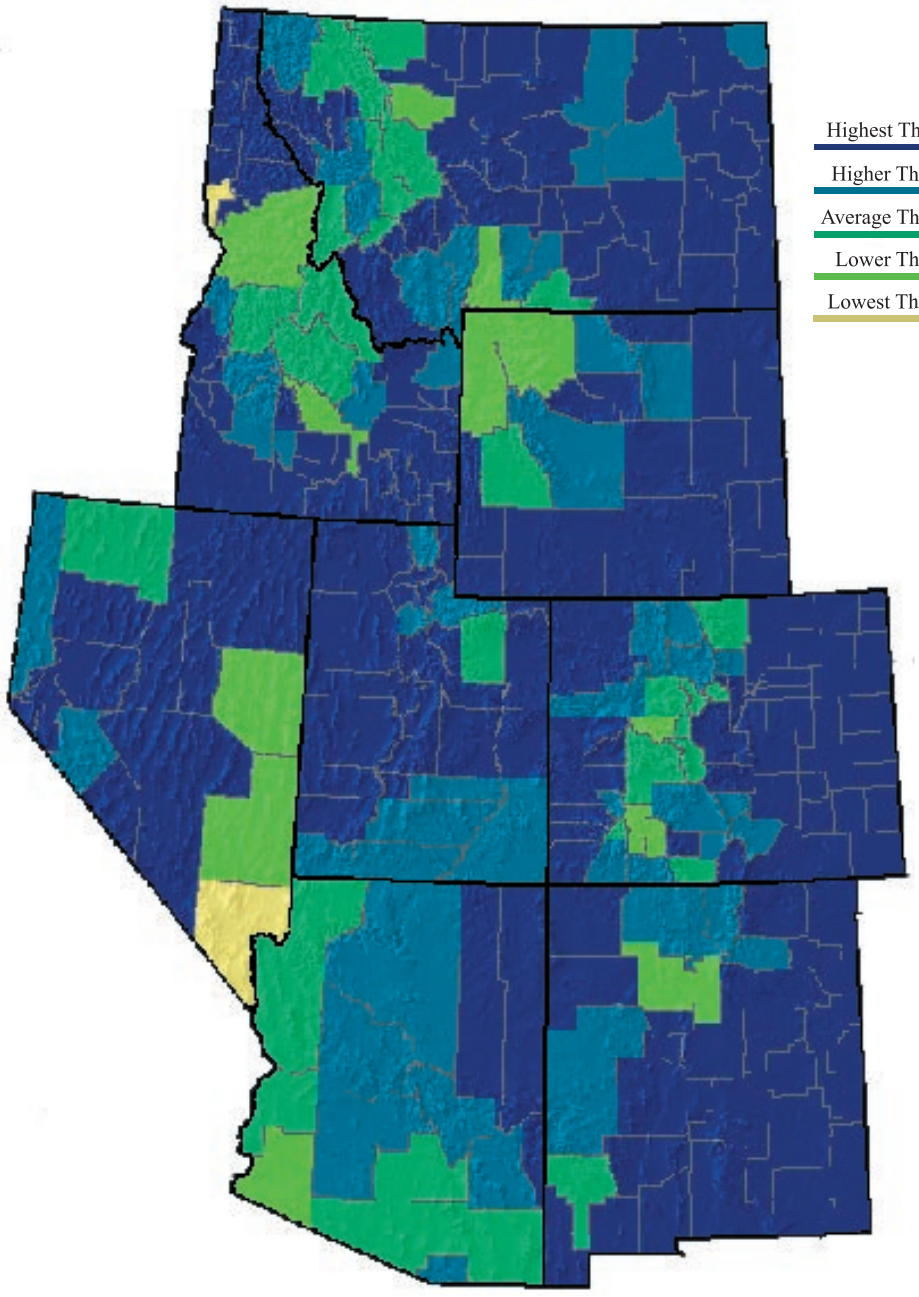
- Projected percentage of population growth from 2000-2010. (Figure 5)
- Percentage of county area protected as wilderness. (Figure 6)
- Percentage of county area protected as non-wilderness, which includes land protected by the U.S. National Park Service, the U.S. Fish and Wildlife Service, and private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

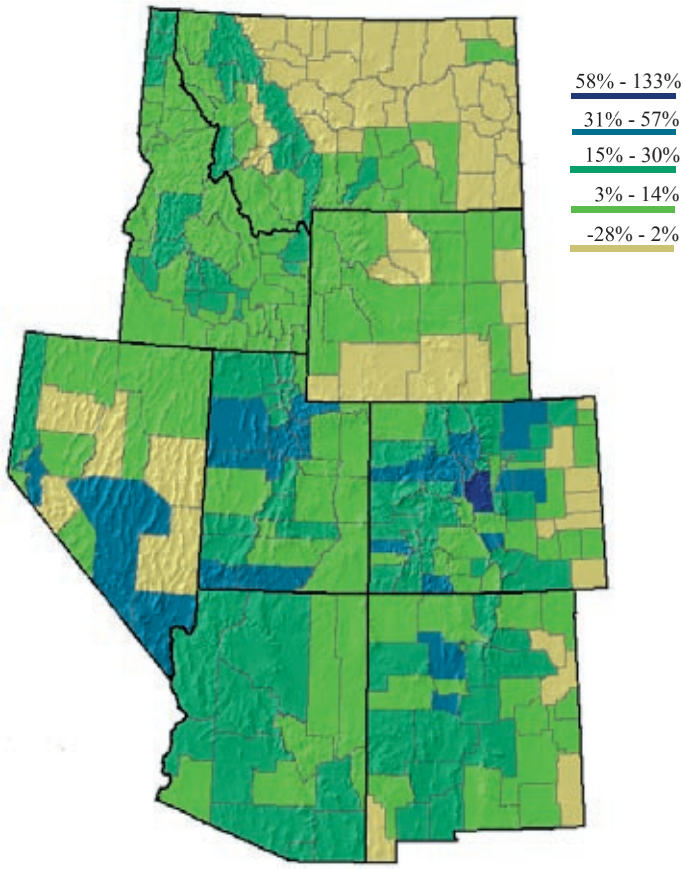
Habitat Threat Index

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

Source: See "About the Index and the Indicators"

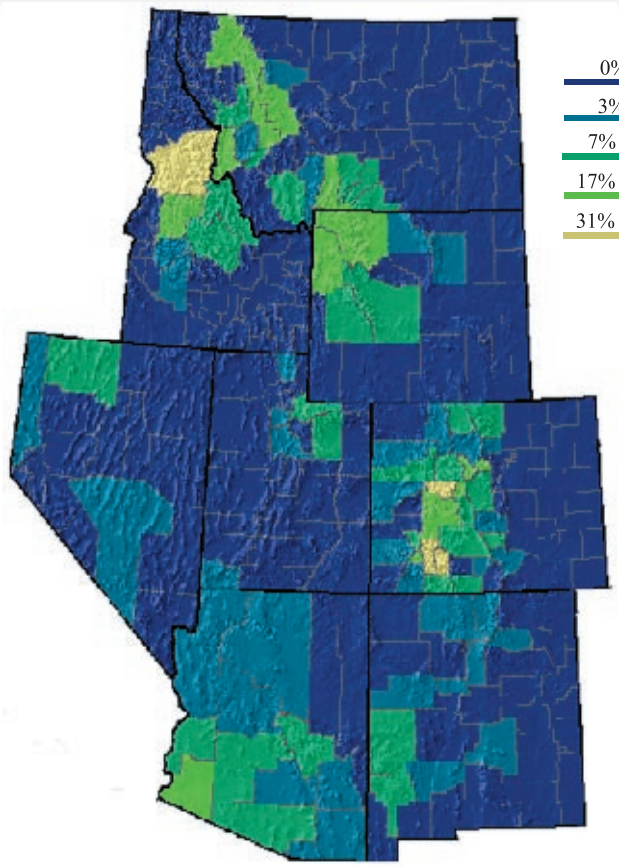
Figure 5

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

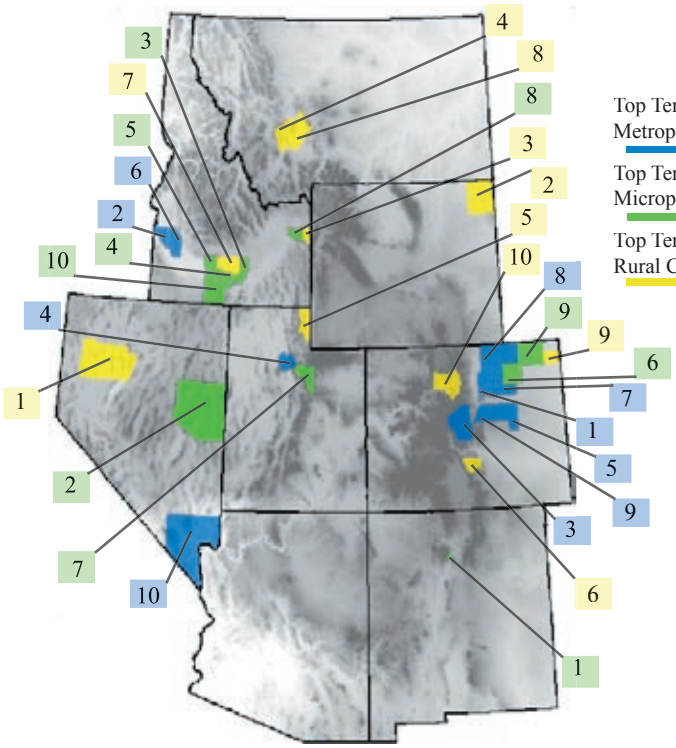
Source: See "About the Index and the Indicators" on pages 66 and 68.

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

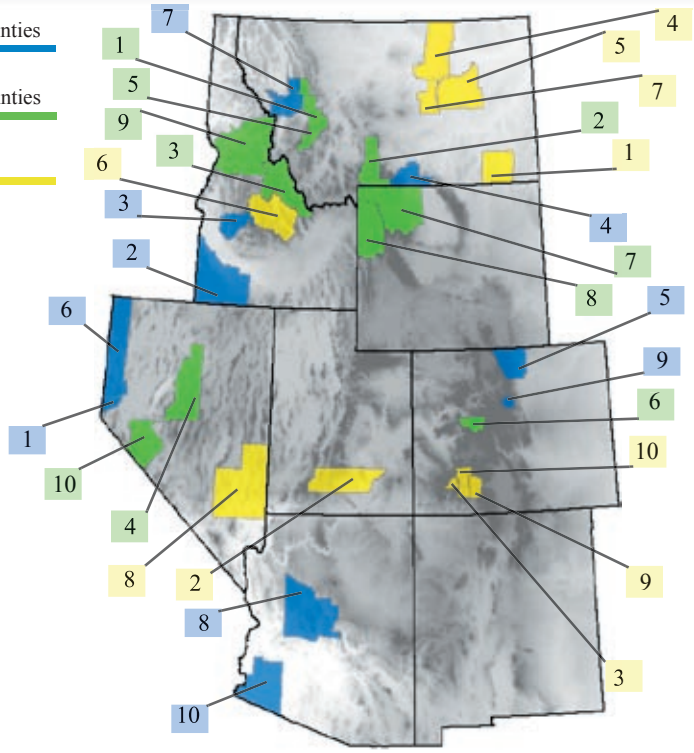
Source: See "About the Index and the Indicators" on pages 66 and 68.



Top Ten Metropolitan Counties

Top Ten Micropolitan Counties

Top Ten Rural Counties



Habitat Threat Index
Counties with the Highest Overall Threat

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

Figure 10

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]

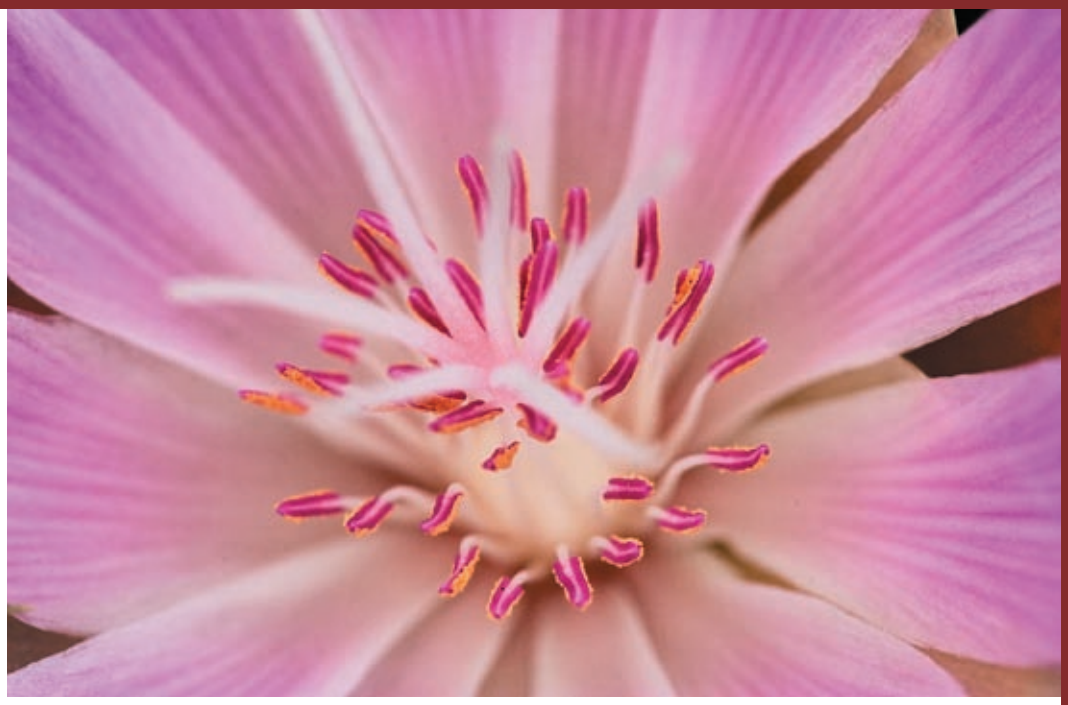
Declining sage grouse numbers were first noted publicly in 1994 when state governments and the federal government worked with the WGA to focus sage grouse conservation efforts into local, small-scale working groups in each sage grouse state. Now there are 60 working groups involving about 500 landowners 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.

Endnotes

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Fragmenting the Western American Landscape

By guest contributors: Chris Pague, Tyrone Guthrie, and Christina Supples

The Natural Heritage of the American West

West of the 100th meridian, the North American landscape supports vast, biologically rich, and ecologically intact places. The complex natural landscapes of the eight-state Rocky Mountain region—from snow-covered peaks, old growth forests, and wildflower meadows, to endless prairies, and sweetly scented sagebrush shrublands—provide homes for a wealth of biological diversity.

From the east, a tapestry of prairie grasses and shrubs, broken only by lonely buttes and rugged canyons, sweep up and finish their final ascent towards the mountains. Abutting the prairie, the relatively young Rocky Mountains form the rugged and lofty backbone of the West. As the mountains rise up from the plains to heights above 14,000 ft., contrasts in elevation, temperature, and moisture support a number of diverse natural communities. The transition from the piñon-juniper and ponderosa pine woodlands of the foothills, to the higher elevation mixed conifer, spruce, fir, and lodgepole pine forests, and then to the treeless, high alpine tundra, provide habitats for a wide array of plant and animal species. Sweeping down the western slope of the Rockies, the landscape becomes an arid place dominated by dry basins, smaller mountain ranges, and vast expanses of desert and sagebrush shrubland. Approximately 200 years post-settlement, the region still supports this vision of the "West"—a place for biodiversity to persist and for communities and visitors to appreciate, use, and enjoy.

A remarkable array of wildlife exists within these natural places, including wide-ranging populations of bison, ferruginous hawks, pronghorn, Rocky Mountain elk, bald eagles, mountain lions, wolves, and grizzly bear, along with habitat for the smaller but equally important sage grouse, sandhill crane, and prairie dog. These ecosystems also protect clean air and water, provide raw materials, and preserve agricultural and rangelands. The Rocky Mountains are also alluring to people. Prior to European settlement, native people hunted, farmed, and otherwise used the land. Approximately 200 years ago, early European explorers, trappers, miners, and settlers came to make a living managing the resources of the open western territories. Today, the West still entices ranchers, farmers, speculators, developers, and recreationalists to make their home among the region's rich natural resources. Yet, the Rocky Mountain states are changing.

Photo courtesy of The Nature Conservancy photo archives.

How Does Human Settlement Challenge the Biological Diversity of the Rockies?

Rapid growth and development are changing the natural character of the West by altering patterns of land ownership and use.[2] To meet the demands of the region's growing population, farmlands and rangelands are being quickly converted to urban areas, transportation networks are spreading, and many millions of people now leave an impact in what was, until recently, a mostly rural place.[3] The solitude once common is now harder to find (Figure 1). There is little reason to expect that this growth will not continue and, consequently, human pressures on the environment are reasonably predicted to increase.

Human settlement patterns today are more dispersed and require more land per person than in the past.[5] The land-use changes most often associated with human settlement include urban expansion, the subdivision of agricultural and rangelands, and the creation of roads, highways, and other human infrastructure. These patterns and the associated land conversion have wide-ranging regional impacts on the regional character of the West.[6] As the

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Illustrating the Effects of Development on Natural Areas - Monument, Colorado

Rapid growth and development are replacing native ecosystems in some areas at a rapid rate. The two photographs below provide an aerial overview of land use changes in Monument, Colorado (Douglas County in Colorado's Front Range) between 1929 (left) and 2006 (right). As levels of human development begin to dominate the landscape, natural habitat patches become increasingly fragmented by roads and exurban development.[4] The remaining natural areas are disconnected, smaller in size, and may experience ecological conditions outside of the normal range of experience. The species living within the area may face significant difficulty in meeting their life history requirements, including finding food, raising young, and avoiding predation.

Figure 1

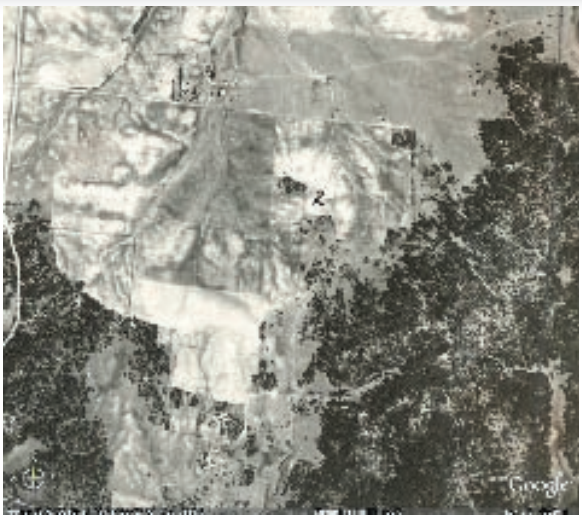

Photo courtesy of the Jerry Crail Johnson Earth Sciences and Map Library, University Libraries, University of Colorado at Boulder (BOV 20, Aug. 19, 1927, U.S. Forest Service).

Photo courtesy of GoogleEarth.

demands of an expanding human population and the associated development pressures increase, significant ecological consequences such as habitat loss, landscape fragmentation, and the isolation of populations also increase.[7]

What is the Relationship between Biological Diversity, Human Expansion, and Fragmentation?

Landscape fragmentation, defined as the breaking up of ecosystems and habitats into smaller and more isolated patches of natural land cover,[8] generally results from land conversion and land use changes that shrink habitat, natural communities, and populations.[9] These changes generally reduce and isolate biodiversity.[10] Conservation science studies indicate that fragmentation, including the loss of ecosystems and habitats, and the separation of large natural blocks of native vegetation, have demonstrable impacts on the distribution and abundance of species and ecological systems.[11] In other words, to the extent that it is occurring, fragmentation could be one of the most pervasive threats to the natural heritage that defines the Rocky Mountain West.

The biological diversity of the West originated with complex interactions of geology, climate, and ecological processes. The structure and composition of the resulting ecosystems influence where a species can live, what it eats and how it avoids being eaten, the size of its population, and its home range and migratory patterns.[12] The survival of a species is dependent on its ability to constantly fine-tune its interactions with the surrounding environment. The loss of ecosystem components, and the resulting landscape fragmentation, can stress this relationship.[13]

Landscape conversion drastically changes the amount and quality of plant and animal habitat.[14] Where roads, fences, and neighborhoods divide a natural landscape, they limit species movement in the region, restricting populations to small and/or isolated pockets of habitat.[15] In the most severe cases, populations of flora and fauna become fragmented and isolated to a level that prohibits individuals from moving within and between their normal habitats.[16] For example, a 15,000-acre grassland, isolated by a major interstate and surrounded by urban centers, will be too small and isolated to support wide-ranging species such as pronghorn. The carrying capacity (i.e., the number of species and individuals that can be maintained) of these disconnected habitat patches is greatly reduced[17] and the species may no longer be able to survive as a functional member of its community.[18]

Habitat Fragmentation and Biodiversity

Ponderosa Pine

The ponderosa pine ecosystem is one of the West's hallmark fire-adapted forests. In the foothills of the southern Rocky Mountains, ponderosa pine woodlands and savannas are found on gentle slopes and valley bottoms below 7,500 ft (2,300 m).[46] The ecosystem was historically characterized by frequent, low-intensity surface fires that typically burn through ponderosa pine stands every eight to fifteen years.[47] The process usually removes understory vegetation and downed material. With periodic fire, these areas will support mature ponderosa pine trees in an open woodland setting and an understory of grasses such as big bluestem and blue grama. The disruption of this process can be disastrous.

Fragmentation often alters the pattern of fire in the ponderosa pine ecosystem. Given the overlap of these woodlands with preferred areas for human development, naturally occurring fires are not allowed to occur at the level necessary to maintain ecosystem processes. Without this periodic disturbance, fire-adapted ecosystems lose an important control mechanism. Today, heavy accumulations of fuel and abundant regeneration of understory species greatly increase the chances for high-intensity, stand-replacing crown fires.[48] The risk to human safety and property, and the potential loss of key elements of biodiversity, challenge us to maintain or restore natural fire regimes in this increasingly less natural and highly fragmented landscape.

Photo copyrighted by Louis Swift.

Habitat Fragmentation and Biodiversity
Greater Sage Grouse

Around the world many species of grouse are in decline, including the greater sage grouse. Once occurring in large numbers throughout the sagebrush country of the western United States, this species is now a candidate for listing as a threatened species throughout its range. Although extensive areas of sagebrush remain, the species does not appear to be thriving. Recent research (as summarized in Rowland 2004) suggests that some disturbances in the Western landscape that are relatively small in area (such as roads, water tanks, human residences, and agricultural lands) have large-scale impacts on the ability of the species to successfully reproduce.[45] The effective habitat for the grouse may be much smaller than what would be expected based on the total acreage of habitat.

These shifts from naturalness can also alter fire regimes, riparian corridors and nutrient cycling, shift species composition, and increase the likelihood of nonnative species appearing in rangelands, forests, and riparian ecosystems.[19] The introduction of nonnative species can modify plant composition (e.g., sagebrush systems may be replaced by exotic-dominated grasslands). Without the appropriate kind of disturbance, the vegetation structure of a forest can shift (e.g., without ground fires, ponderosa pine savannas and woodlands may become dense and susceptible to catastrophic crown fire). As a result, some native species of the Rocky Mountain West may find the network of places they depend on for food and habitat to be remote or to no longer exist.[20] Given that ecosystems are interconnected, if enough pieces of an ecosystem are lost, our natural places will be hard to reconstruct.[21]

How We Assess Habitat Fragmentation in the Rockies

Given the significant adverse impacts of fragmentation on the individual species and ecological systems of the Rocky Mountains, the loss or decreases of this biodiversity could forever alter the character of the West. Recognizing this, The Nature Conservancy embarked on a research effort to explore the current patterns of habitat loss and land fragmentation in the Rocky Mountain region and to consider the conservation costs and opportunities of these trends. We identified land cover patterns across the region and completed a per-county comparison of habitat fragmentation using a set of key indicators.[22]

Specifically, we sought to define:

1. The current amount and distribution of natural habitat patches across the region;
2. The current patterns of landscape fragmentation on a per-county basis; and
3. The conservation costs and opportunities of these trends.

Through this research, we hope to provide interested parties, particularly those responsible for land-use planning, with information for examining trends in the regional land use. An enhanced understanding of regional land-cover patterns will provide information that can be used to evaluate ecosystem changes over time.[23] Our results are important for land use, land management, and conservation planning efforts.

Data Collection

This research applies advancements in satellite imagery and landscape modeling to develop the most up-to-date habitat fragmentation assessment for the region. Our analysis is based on data derived from the Multi-Resolution Land Characteristics (MRLC) Consortium's 2001 National Land Cover Database,[24] 2004 Southwest Regional Gap (REGAP) Assessment,[25] and current commercially available road data. REGAP is based on National Land Cover data derived from 1996; it provides the most current and accurate fine-resolution (30m pixels) land-cover classification available on a statewide basis for Arizona, Colorado, Nevada, New Mexico, and Utah land-cover. The MRCL database is used to obtain data for the remaining states. The spatial arrangement of land cover and land uses, specifically the spatial arrangement of natural land cover, is quantified from these datasets. We recognize the vegetative cover of portions of the landscape may have changed since these vegetative layers were generated. These results should be considered, at best, the lowest estimate for the degree of habitat fragmentation in the region. A new National Land Cover Dataset based on 2001 satellite imagery is expected by the second quarter of 2006 (see http://www.mrlc.gov for current status) and will be used at that time for an assessment of trends in fragmentation.

Model Development and Analysis

To identify regional land-cover patterns, we use the information listed above to create a comprehensive database of county-level road and land-cover data. The information is catalogued in a geographic information system (GIS) and used to develop and map landscape composition in terms of natural and human-modified land cover.[26] In this analysis, roads, development, agriculture, and recently mined, quarried, or drilled areas are considered "human-modified" (i.e., unnatural); all other land-cover types are deemed "natural." Water is not considered in our analysis.

The classification is evaluated in terms of several identifiable and measurable elements of habitat fragmentation using FRAGSTATS,[27] a publicly available computer program created to describe patterns of fragmentation across a landscape.

Indicators of Habitat Fragmentation

In this analysis, habitat fragmentation is evaluated using several indicators, each of which provides different and important information about the landscape composition of Rocky Mountain counties. Each indicator, and our hypothesis about its effects on biological diversity, is interpreted in the table. Counties are ranked based on the sum of the normalized percentage of their landscape occupied by natural land cover and the normalized density of natural land-cover occurrences (these values are shaded in grey). Other indicators provided ancillary information on the degree of habitat fragmentation per county.

Figure 2

INDICATOR	DESCRIPTION	INTERPRETATION
Total Natural Patch Area (ha)	How many hectares of natural land cover are located in the county?	Value indicates the total amount (ha) of natural habitat in the county. Generally, larger natural habitat patches are considered to have greater ecological intactness and to retain more species.
Normalized Total Natural Patch Area (%)	What percentage of the county retains a natural land cover (normalized per-county size)?	Value indicates the percentage of natural habitat in the county (ha). A lower value indicates that a smaller percent of the county retains a form of natural land cover. Counties with a smaller percentage of natural land cover usually experience a greater degree of habitat fragmentation. Thus, they may retain fewer intact ecological processes and fewer species over time.
Total Landscape Area (ha)	How large is the county (ha)?	Value used to normalize other indicators. Normalization of values facilitates comparison of counties across the region.
Normalized Natural Area Patch Density (%)	How many patches of natural area are contained in the county (normalized by county size)?	Value indicates a degree of habitat fragmentation. An unfragmented county will have most of its natural areas contained in a few patches - patch density will be low. If the landscape is highly fragmented- i.e., there are large numbers of disconnected patches, patch density is high. Higher degrees of habitat fragmentation are expected to decrease the diversity of the biota over time.
Largest Natural Patch (ha)	What size (ha) is the largest natural patch in the county?	Value indicates the types and number of species and communities that can persist in the patch and in the county. Larger patches are typical of a less fragmented landscape. These places typically support a more diverse range of species, especially those with larger home ranges.
Largest Natural Patch Index (%)	What proportion of the county is represented by the largest natural patch?	Value indicates the degree of landscape intactness. Higher values signify a county with large, intact natural areas, i.e., less fragmentation. A greater diversity of species will thrive in places containing large concentrations of intact habitat.
Mean Area of Natural Patches (ha)	If you randomly picked a patch in the county, what is the expected natural patch size?	Value indicates the expected size (ha) of a randomly picked natural patch. Larger average patch size suggests that species and communities that require larger areas are more likely to find them in this area. Higher values indicate larger sized natural areas.
Coefficient of Natural Patch Variation (%)	How diverse is the range of natural patch sizes in the county?	Value indicates the level of variation in the size of natural areas. A lower percentage signifies that county is less natural in the sense that natural patches are regular standard size and generally indicates a greater level of human influence on the landscape. A high percentage signifies a greater variation in the size and shape of natural areas, and thus types of species that can be supported by the landscape.

Each of these indicators provides important information about the landscape composition of Rocky Mountain counties.[28] The results from each indicator are combined to create a comparative index of habitat fragmentation for each of the region's counties. This index is used to generate maps and tables that represent the degree of habitat fragmentation on a per-county basis. The specific indicators chosen for this analysis are represented in Figure 2.

Recognizing the difficulty of developing a simple and meaningful ecological index of landscape fragmentation,[29] we assume that greater biological diversity and complexity are present in counties with larger patches of natural vegetation.[30] Given this assumption, we determine the two most important indicators of fragmentation are natural patch size and natural patch density.[31] Counties are ranked based on the sum of the normalized percentage of their landscape occupied by natural land cover ("natural patch size") and the normalized density of natural land-cover occurrences ("natural patch density"). Other indicators provide ancillary information about the landscape composition of each county. We believe this approach yields robust, easily interpreted values relating to ecosystem integrity, and that these measures can be rolled up into a common indicator of fragmentation comparable across counties.[32]

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Habitat Fragmentation and Biodiversity

Pronghorn

The Pronghorn is one of North America's best known symbols of the western prairies and shrublands. In the early 1800s, the number of Pronghorn probably equaled or exceeded that of the bison. However, the Pronghorn population declined to nearly 15,000 individuals during the first half of the 21st century. Subsequently this species made a remarkable recovery, now numbering approximately one million individuals by 1997. However, Pronghorn are beginning to decline again due to habitat loss in areas with growing human populations.[43] The construction of fencing hinders movement in this wide-ranging species. When combined with the encroachment of incompatible land uses such as agriculture, recreation, or exurban development, the remaining natural patches of habitat are often too small to sustain a population or even a herd of Pronghorn. Patches of habitat smaller than about 15,000 acres are not generally used by Pronghorn.[44] The species is highly imperiled in parts of Arizona and New Mexico, those in Colorado's Front Range are restricted to increasingly smaller and more isolated pockets of habitat (e.g., in the area near Pueblo West), and populations in the sagebrush shrublands are being impacted by wheat farming, recreation, and oil and gas development. This species is not likely to disappear from the American West, but as the area of suitable habitat continues to decline, the number of areas in which Pronghorn can successfully occupy will also decline.

Results

The FRAGSTATS analysis demonstrates that there are patterns in both the amount and distribution of natural land cover and in patterns of habitat fragmentation in the eight-state Rocky Mountain region. The results are displayed in the maps and tables below.

The Amount and Distribution of Natural Land Cover in the Rockies

Figure 3 displays a map of region-level patterns of natural habitat in the Rocky Mountain region. Remarkably, with respect to land cover, the vast majority of the West remains relatively natural. Of the 547 million acres of western lands, only 13.4 percent, or 73 million acres (30 million ha), are heavily human modified. The remaining 86.6 percent, or 474 million acres (192 million ha), of the region retain some form of natural land cover.

The portions of the region most heavily impacted by human land uses occur along the Interstate-25 corridor of Colorado's Front Range and the Interstate-70 corridor of Utah. Each of the region's major urban centers, including Salt Lake City, Utah; Flagstaff, Arizona; Las Vegas, Nevada; and Denver and Colorado Springs, Colorado, also exert a strong negative influence on the naturalness of their surrounding landscapes. The availability of native habitat is also reduced in intensely cultivated and irrigated lands, including Colorado's eastern plains and Idaho's southeastern and northwestern plains. In these agricultural areas, nonnative monocultures have replaced native prairie grasslands and shrublands.

Current Patterns of Landscape Fragmentation in the Rockies

Figure 4 displays a map of county-level habitat fragmentation patterns. Using the Jenks method, counties are shaded based on natural groupings in the data (i.e., minimum within class differences, maximum between class differences). Counties identified in green to light green are more likely to contain large and presumably ecologically intact patches of natural habitat. In these places, a greater portion of the native diversity of species should thrive in these large concentrations of intact natural lands. Of the 281 counties in the region, 247 (87 percent) still retain greater than 75 percent of their land area in some form of natural land cover.

The most highly fragmented counties are represented in increasing shades of yellow. In these areas, human modified land-cover types dominate up to 94 percent of the total county area. Resulting from this greater level of human influence on the landscape, natural areas are found in smaller and more disconnected patches, a typical pattern in more fragmented landscapes. Of the five counties with less than 25 percent natural land cover, four are found along the Colorado Front Range. In the counties where habitat fragmentation is greatest, the remaining species and communities may face significant challenges in meeting their life-history requirements.

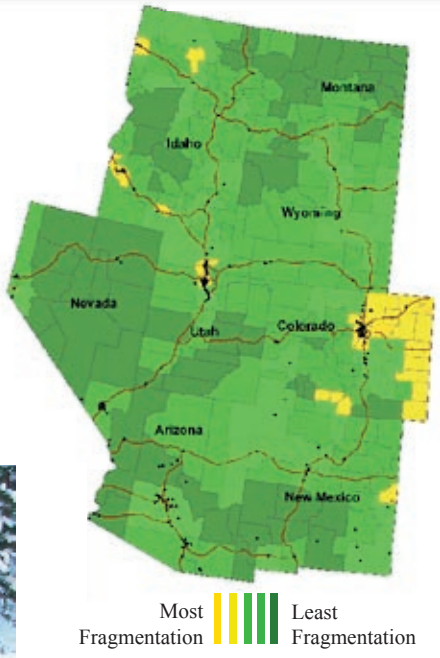
Current Amount and Distribution of

Natural Land Uses

Green areas represent the remaining areas of natural cover contained within the Rocky Mountain landscape. Areas highly impacted by human influence, including urban settlement and agricultural development, are represented in yellow.
Figure 3

County-Level Fragmentation Patterns

The dark green areas represent the counties with the least fragmented landscapes, relative to one another. Yellow represents the most highly fragmented counties.
Figure 4



Top 10

Most and Least Fragmented Counties

This table lists the 10 least and the 10 most highly fragmented counties in the Rocky Mountain region, as well as the indicators and values used to determine their rank. Each of the 10 least fragmented counties retains greater than 93 percent of its landscape in some form of natural land cover and has a natural patch density of less than 0.1 percent (most of its natural areas contained in a few patches). However, greater than 46 percent of the region's counties retain greater than 90 percent of their landscape in some form of natural land cover. On the other hand, the 10 most highly fragmented counties listed in the table provide an accurate representation of the counties where fragmentation levels are greatest. In these counties, the combined effects of landscape conversion and a large number of disconnected patches result in a much more highly fragmented landscape.

Figure 5

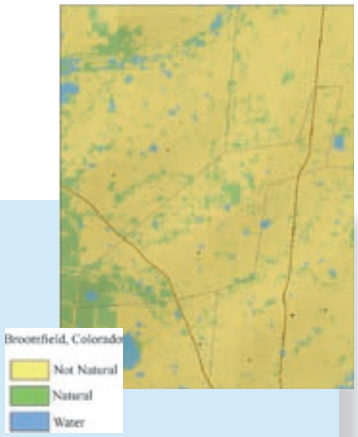
	County Name	Indicators of Fragmentation: Total Natural Patch Area (ha)	Normalized Total Natural Patch Area (%)	Total Landscape Area (ha)	Normalized Natural Area Patch Density (%)	Largest Natural Patch Index (%)	Largest Natural Patch (ha)	Mean Area of Natural Patches (ha)	Coefficient of Natural Patch Variation (%)
Least Fragmented	1 - Fergus, Montana	1,086,264	96	1,126,928	0.03	14.38	162,040	59,145	417
	2 - McCone, Montana	662,917	95	696,265	0.02	7.35	51,185	17,596	186
	3 - Hinsdale, Colorado	266,624	96	279,055	0.06	55.24	154,148	99,446	759
	4 - Chouteau, Montana	974,736	95	1,029,173	0.05	12.07	124,251	30,435	372
	5 - Dawson, Montana	585,120	94	620,523	0.05	7.33	45,505	13,937	265
	6 - San Juan, Colorado	98,490	95	103,791	0.07	49.49	51,368	32,382	469
	7 - Grand, Utah	892,673	94	948,250	0.06	32.75	310,558	118,575	886
	8 - Lincoln, Nevada	2,592,403	94	2,745,001	0.07	5.98	164,239	30,266	467
	9 - Mineral, Colorado	226,705	95	239,418	0.08	56.10	134,304	96,571	887
	10 - Greenlee, Arizona	442,788	94	472,133	0.06	33.65	158,856	71,816	684
Most Fragmented	273 - Alamosa, Colorado	106,504	58	182,250	1.02	6.91	12,585	3,408	763
	274 - Logan, Colorado	242,849	51	479,840	0.88	2.16	10,372	3,409	762
	275 - Sedgwick, Colorado	45,399	31	145,787	0.61	3.24	4,717	2,127	637
	276 - Canyon, Idaho	93,819	60	156,100	1.36	1.14	1,783	327	253
	277 - Arapahoe, Colorado	87,742	42	207,453	1.04	7.18	14,886	3,795	963
	278 - Phillips, Colorado	26,486	15	178,750	0.78	2.68	4,786	1,364	840
	279 - Adams, Colorado	64,846	21	306,264	1.37	2.01	6,161	1,269	900
	280 - Denver, Colorado	2,449	6	40,479	1.08	0.26	104	33	222
	281 - Broomfield, Colorado	1,988	18	11,015	2.02	4.69	517	186	446

Profiling Habitat Fragmentation

Fergus, Montana – Least Fragmented County

Fergus is a large (1,126,928 ha, 2,783,512 ac), micropolitan county (def. a non-metropolitan county with an urban population of 20,000 or more and adjacent to a metropolitan area) with little habitat fragmentation due to roads and other forms of development. Greater than 96 percent of the county retains some form of natural land cover. An extremely low patch density (0.3) indicates that existing habitat loss has not separated the county's natural areas into a large number of smaller patches (see Figure 5).

At just over 162,000 ha (400,000 ac), the largest natural patch in the county may support most native species and natural processes. When considered in the context of other very large patches, this largest patch may include species whose life cycles require large expanses of relatively undisturbed territory. While the largest patch dominates much of the county (14 percent), the remaining natural landscape also contains a high diversity of natural area patch sizes (patch size coefficient of variation = 22.7). The existence of several smaller natural patches within the county's developed areas has the effect of decreasing the average patch area to 3223 ha (7961 ac). However, the average (or expected) patch area of this size is still large enough to support many species and ecological processes.



Profiling Habitat Fragmentation

Broomfield, Colorado – Most Fragmented County

Broomfield is a small metropolitan county (def. a county in a metropolitan area with a population of greater than 250,000) located along the Front Range of Colorado. Only 18 percent of Broomfield County's 11,015 ac are recognized by our analysis as natural (See Figure 5). This dominance of developed areas results in a pattern of highly fragmented natural places. The remaining patches of native ecosystems are small and numerous (patch density = 2.02). While the range and diversity of patch sizes within Broomfield County are high (patch size coefficient of variation = 445.56), the size of the largest natural area, 517 ha, can support a less complex diversity of species. Ecological processes may be highly altered. The average (or expected) patch size of 185.89 ha can support only those species which tolerate or use small patches of natural areas or those which can make use of the county's disconnected patches and the surrounding non-natural matrix.

In the 1990s, Colorado was ranked the third fastest growing state (http://www.censusscope.org/us/s8/chart_popl.html, accessed on 27 Jan. 2006). The state's population is expected to reach seven million by 2030. As a result of this expanding population, thousands of acres of open space are converted to development each year. Surface water extraction threatens native fish and riparian plant communities around the state. Development patterns have been a primary cause of altered fire regimes, leaving many overgrown forests to threaten human life and property.

Conservation Costs and Opportunities – The Impacts of Habitat Fragmentation in the Rockies

This research provides an improved understanding of land-cover patterns, i.e., the distribution of natural and human-modified lands, and the varying levels of habitat fragmentation across the Rocky Mountain region. The western United States still retains the ability to preserve and restore representations of nearly all of its native species and habitats. This analysis demonstrates that 87 percent of the region still retains some form of natural land cover, and that 246 of the region's 281 counties have greater than 75 percent natural land cover. These large, more intact places are critical to the long-term well-being of many of the plants, animals, and ecosystems that represent the vast diversity of life in the Rocky Mountain region.

The Rocky Mountain region is at a crossroads—and the challenges are large. Approximately 67 percent of the region's counties, both urban and rural, grew faster than the national average in the 1990s,[33] and by 2003, four of the nation's top ten fastest-growing states were in the Rocky Mountains (Nevada, Arizona, Idaho, and Utah).[34] When human expansion fragments the landscape to the extent that it limits the reproductive success, mortality, and movement patterns of plants and animals, biodiversity will be negatively impacted.[35] Because of this, the lands and waters of the Rocky Mountain region are being altered in ways that have significant impacts on the plants, animals, natural communities, and our human way of life. Ultimately, the loss of these special places will forever alter the wild character of the West.

Whether small or large, all Rocky Mountain counties can play a role in retaining a network of important areas of potential habitat. Protecting these places will enable the West to maintain its diverse ecosystems and the remarkable array of plants and wildlife that depend on these habitats.[36] It is imperative to recognize the region's collective responsibility in maintaining this network of natural places. However, because development decisions are inherently local,[37] this information can be used by counties to explore their potential role in conserving the region's biological diversity and to design important contributions to the preservation of the region's natural heritage. Using the results of this research, the municipalities of the West can consider current patterns of land-cover and fragmentation, and potential effects of land cover change to biological diversity, when making municipal land use planning decisions.[38] Working together, the region can seek new ways to mitigate growth demands without compromising the quality of life for future generations.

To be successful, the conservation of natural areas must be representative of the Rocky Mountain region's varied mountains, plains, and desert habitats, and of its resident and migratory species. Designing conservation strategies based on ecological principles,[39] adaptive management, and around the region's existing large habitat patches can effectively provide for conservation of ecosystems,

Most and Least Fragmented Metro Counties

Figure 6

	Top Metro Counties (of 62 Total)	Indicators of Fragmentation							
		Total Natural Patch Area (ha)	Normalized Total Natural Patch Area (%)	Total Landscape Area (ha)	Normalized Natural Area Patch Density (%)	Largest Natural Patch Index (%)	Largest Natural Patch (ha)	Mean Area of Natural Patches (ha)	Coefficient of Natural Patch Variation (%)
Least Fragmented	**1 - Yavapai, Arizona**	1,890,375	90	2,096,129	0.13	3.36	70,329	17,013	478
	2 - Yuma, Arizona	1,280,953	88	1,452,080	0.10	8.49	123,209	53,294	776
	3 - Washington, Utah	558,711	90	621,439	0.14	8.04	49,947	19,352	540
	4 - Carbon, Montana	480,885	90	535,043	0.14	19.20	102,720	27,276	651
	5 - Torrance, New Mexico	778,683	90	867,217	0.18	7.58	65,718	11,825	474
	6 - Pima, Arizona	2,088,055	87	2,389,616	0.13	3.36	80,291	22,650	570
	7 - Washoe, Nevada	1,511,256	88	1,711,088	0.15	3.70	63,278	21,172	595
	8 - Juab, Utah	791,071	88	898,072	0.16	3.92	35,216	10,221	413
	9 - Boise, Idaho	438,175	88	496,006	0.17	13.16	65,276	21,093	621
	10 - Coconino, Arizona	4,329,739	90	4,816,675	0.20	12.23	588,935	97,044	1,465
Most Fragmented	**53 - Jefferson, Colorado**	133,679	67	200,009	0.73	6.26	12,511	4,231	671
	54 - Ada, Idaho	186,778	69	271,205	0.86	1.75	4,737	1,062	350
	55 - Boulder, Colorado	122,679	65	189,543	0.87	23.01	43,606	18,159	1,556
	56 - Weld, Colorado	568,623	54	1,050,775	0.81	2.94	30,925	8,260	1,106
	57 - Davis, Utah	31,182	19	164,851	0.09	4.38	7,218	4,691	468
	58 - Canyon, Idaho	93,819	60	156,100	1.36	1.14	1,783	327	253
	59 - Arapahoe, Colorado	87,742	42	207,453	1.04	7.18	14,886	3,795	963
	60 - Adams, Colorado	64,846	21	306,264	1.37	2.01	6,161	1,269	900
	61 - Denver, Colorado	2,449	6	40,479	1.08	0.26	104	33	222
	62 - Broomfield, Colorado	1,988	18	11,015	2.02	4.69	517	186	446

species and their supporting ecosystem processes.[40] Research demonstrates that top priority conservation areas include areas with substantial ecological contributions, large natural patches, and vegetated corridors that provide protection to riparian areas and that facilitate the movement of species between natural areas. Smaller patches and corridors of natural land cover interspersed throughout developed areas are also essential.[41] Conserving large natural patches such that the biodiversity is connected, perhaps through a mixture of smaller natural areas, will ensure a network of natural areas on a scale large enough to build resilience into the region's natural systems and to ensure their ability to be self-sustaining in the longterm.[42]

The natural areas in the Rocky Mountains are a vital natural and economic resource to the region. To maintain our natural heritage, we must balance the conservation of biological diversity, our ever-expanding population, and the resulting development and resource use. Successful conservation must not only protect ecosystems, but also strengthen and diversify the economies of local communities that depend on natural resources for their livelihood. The remaining natural areas provide a grand template from which a successful conservation network can be developed. In the words of John Sawhill, former president and CEO of The Nature Conservancy, "In the end, our society will be defined not only by what we create but also by what we refuse to destroy."

Most and Least Fragmented Micro Counties

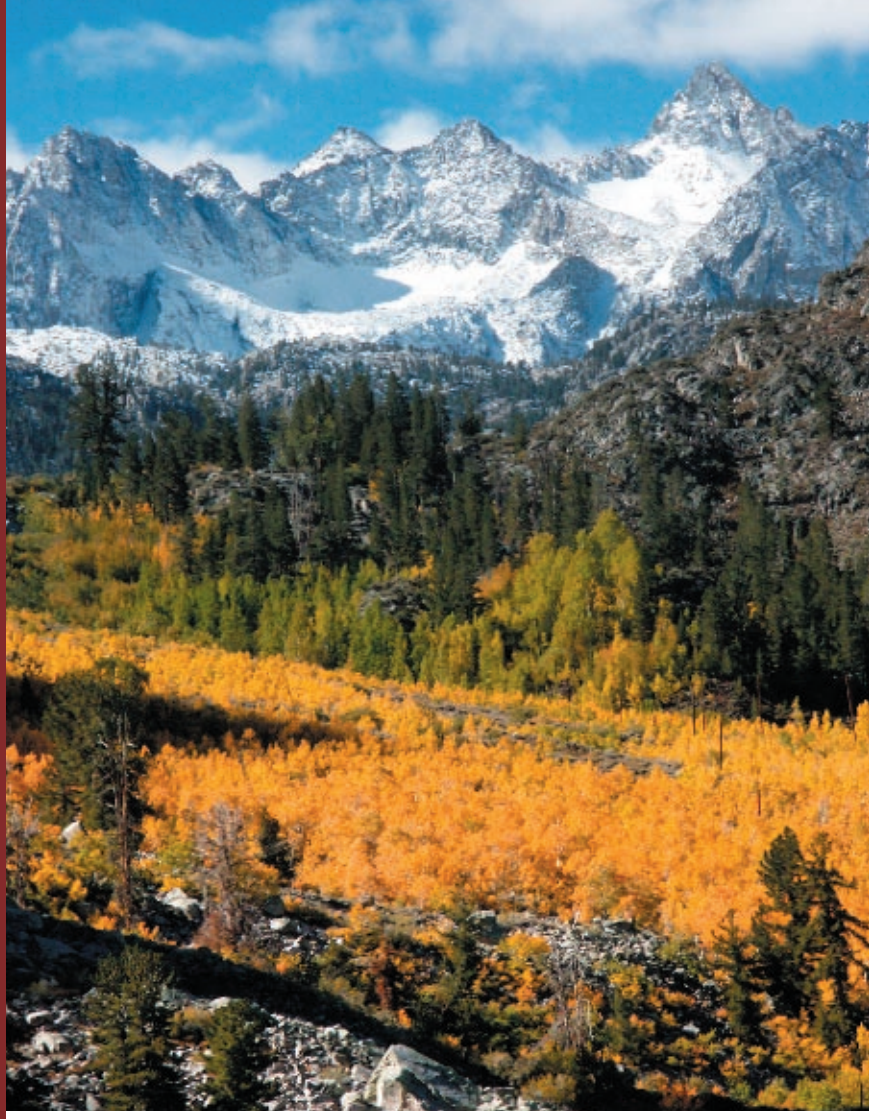
Figure 7

	Top Micro Counties (of 138 Total)	Indicators of Fragmentation: Total Natural Patch Area (ha)	Normalized Total Natural Patch Area (%)	Total Landscape Area (ha)	Normalized Natural Area Patch Density (%)	Largest Natural Patch Index (%)	Largest Natural Patch (ha)	Mean Area of Natural Patches (ha)	Coefficient of Natural Patch Variation (%)
Least Fragmented	**1 - Fergus, Montana**	1,086,264	96	1,126,928	0.03	14	162,040	59,145	417
	2 - Dawson, Montana	585,120	94	620,523	0.05	7	45,505	13,937	265
	3 - Grand, Utah	892,673	94	948,250	0.06	33	310,558	118,575	886
	4 - Lincoln, Nevada	2,592,403	94	2,745,001	0.07	6	164,239	30,266	467
	5 - Greenlee, Arizona	442,788	94	472,133	0.06	34	158,856	71,816	684
	6 - Toole, Montana	466,560	93	503,285	0.08	5	25,355	7,111	227
	7 - Roosevelt, Montana	579,552	93	620,376	0.10	6	34,924	10,668	322
	8 - Valley, Montana	1,205,133	92	1,309,350	0.07	8	98,226	30,952	490
	9 - Gila, Arizona	1,145,717	92	1,245,423	0.07	9	110,633	35,229	525
	10 - Las Animas, Colorado	1,130,542	92	1,225,166	0.08	13	165,005	43,424	614
Most Fragmented	**129 - Payette, Idaho**	86,237	78	109,910	0.72	9	10,252	2,665	485
	130 - Jerome, Idaho	112,716	71	157,946	0.58	6	9,559	1,456	328
	131 - Rio Grande, Colorado	166,081	71	233,953	0.66	28	65,235	32,893	1,750
	132 - Curry, New Mexico	204,566	55	368,644	0.35	3	12,036	2,258	366
	133 - Prowers, Colorado	223,587	54	411,039	0.44	3	11,638	3,301	507
	134 - Yuma, Colorado	326,014	53	611,323	0.49	3	15,715	4,191	611
	135 - Morgan, Colorado	187,233	56	332,729	0.83	8	27,082	6,826	1,001
	136 - Kit Carson, Colorado	232,408	41	561,155	0.55	1	6,685	1,335	409
	137 - Alamosa, Colorado	106,504	58	182,250	1.02	7	12,585	3,408	763
	138 - Logan, Colorado	242,849	51	479,840	0.88	2	10,372	3,409	762

Most and Least Fragmented Rural Counties

Figure 8

	Top Rural Counties (of 81 Total)	Indicators of Fragmentation: Total Natural Patch Area (ha)	Normalized Total Natural Patch Area (%)	Total Landscape Area (ha)	Normalized Natural Area Patch Density (%)	Largest Natural Patch Index (%)	Largest Natural Patch (ha)	Mean Area of Natural Patches (ha)	Coefficient of Natural Patch Variation (%)
Least Fragmented	**1 - McCone, Montana**	662,917	95	696,265	0.02	7.4	51,185	17,596	186
	2 - Hinsdale, Colorado	266,624	96	279,055	0.06	55.2	154,148	99,446	759
	3 - Chouteau, Montana	974,736	95	1,029,173	0.05	12.1	124,251	30,435	372
	4 - San Juan, Colorado	98,490	95	103,791	0.07	49.5	51,368	32,382	469
	5 - Mineral, Colorado	226,705	95	239,418	0.08	56.1	134,304	96,571	887
	6 - Daniels, Montana	347,313	94	368,226	0.07	8.2	30,123	9,219	249
	7 - Wayne, Utah	605,388	94	644,185	0.07	16.8	108,246	59,012	669
	8 - Garfield, Utah	1,256,323	93	1,352,206	0.07	12.6	170,239	56,207	659
	9 - Catron, New Mexico	1,692,875	93	1,815,215	0.08	8.8	159,140	27,237	478
	10 - Wibaux, Montana	215,336	93	232,069	0.08	13.1	30,337	11,842	296
Most Fragmented	**72 - Lincoln, Colorado**	477,727	71	677,498	0.32	3.1	21,020	6,976	557
	73 - Conejos, Colorado	251,959	77	329,351	0.50	16.8	55,267	23,742	1,236
	74 - Crook, Wyoming	557,870	76	737,143	0.56	1.5	11,182	1,981	371
	75 - Baca, Colorado	383,081	58	656,601	0.38	2.8	18,392	4,519	530
	76 - Kiowa, Colorado	250,176	54	463,537	0.29	2.6	11,990	3,400	413
	77 - Cheyenne, Colorado	253,728	56	452,218	0.38	3.8	17,368	4,483	545
	78 - Costilla, Colorado	231,519	73	315,834	1.01	18.3	57,684	15,840	1,471
	79 - Washington, Colorado	286,576	44	646,666	0.54	3.3	21,334	5,494	814
	80 - Sedgwick, Colorado	45,399	31	145,787	0.61	3.2	4,717	2,127	637
	81 - Phillips, Colorado	26,486	15	178,750	0.78	2.7	4,786	1,364	840



Endnotes

[1]The Nature Conservancy is a nonprofit organization whose mission is to preserve the plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. We aspire to the vision articulated more than 50 years ago by Aldo Leopold in A Sand County Almanac: conservation is a state of harmony between man and nature.

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Regional Challenges of Future Climate Change: Endless Summer or Business as Usual?

By Matthew Reuer, guest contributor

Are humans truly warming the planet? If so, what are the consequences for the Rockies, a region dependent on adequate winter precipitation and temperate summers? Since the 19th century scientists have postulated that rising carbon dioxide concentrations from fossil fuels could increase global surface temperatures, as heat reflected from the Earth's surface is trapped by atmospheric greenhouse gasses.[1] The implications for the Rockies region are significant, ranging from the availability of water for an increased population to the economic impact of diminished snowpack to the tourism industry. In the following chapter, Gregory Zimmerman, Caitlin O'Brady, and Bryan Hurlbutt present state-of-the-art estimates of future temperature, precipitation, and snowpack and address key impacts of these model scenarios. Here a brief introduction to the climate change issue is presented, explaining how we arrived at this challenge.

First, the atmospheric signature of our carbon emissions is best demonstrated by atmospheric carbon dioxide measurements from remote locations and prehistoric air trapped in polar ice cores (Figure 1). These records show increased carbon dioxide concentrations throughout the 20th century, which accounts for most of the global warming potential relative to other greenhouse gases, such as methane, nitrous oxide, and halocarbons. The 2004 atmospheric carbon dioxide concentration of 377 parts per million (ppm) greatly exceeds the average prehistoric carbon dioxide concentration of 278 ppm.[2] Because the rise in carbon dioxide concentrations is unprecedented throughout the geological past and coincides with 20th century industrialization, the human impact on the Earth's atmosphere is well-established.

How much will rising carbon dioxide concentrations affect the Earth's surface temperature and future global climate? A global perspective on past temperature variability is shown in Figure 2, but future estimates rely on a variety of complex models that mimic some or all of the Earth's climate system at different resolutions. Scientists often refer to the "climate sensitivity" of a particular model as how much global temperature responds to twice the amount of atmospheric carbon dioxide (i.e., 278 ppm to 456 ppm). Energy Balance Models (EBMs), which calculate global surface temperature from a balance of heat inputs and outputs, were first utilized to calculate this temperature change. Using these models, a U.S. National Research Council report in 1979 suggested a 1.5ºC to 4.5ºC temperature increase, and this range represents a key baseline for future warming estimates.[3] General Circulation Models (GCMs), which approximate the circulation of the Earth's atmosphere and oceans, have also been employed to estimate the climate system's sensitivity to atmospheric carbon dioxide. GCM temperature estimates are quite variable, and some models now predict a 6ºC temperature increase with doubled carbon dioxide concentrations. For example, Morgan and Keith[4] surveyed 16 climate experts for their best estimate of climate sensitivity. The results ranged from 0 to 5ºC, with a mean value and uncertainty of 3±1ºC. The wide range described here reflects the complexity of these circulation models and their different approximations of complex physical processes, akin to the challenges of accurate weather forecasting in the Rockies. However, a 2 to 3ºC increase in global surface temperature would be a reasonable future expectation.

For the Rockies region, a partial answer might be obtained from historical climate records. In the following chapter Zimmerman et al. consider historical temperature records from the U.S. Historical Climatology Network. The mean temperature change for the time period 1989 to 1996 equals +0.60ºC (calculated as the temperature difference relative to the 1940 to 1996 mean). The mean atmospheric carbon dioxide concentration for 1989 to 1996 equals 357 ppm, just 28 percent above the prehistoric background. If one assumes a constant carbon emission rate, the estimated climate sensitivity from the historical record equals 2.1ºC. However,

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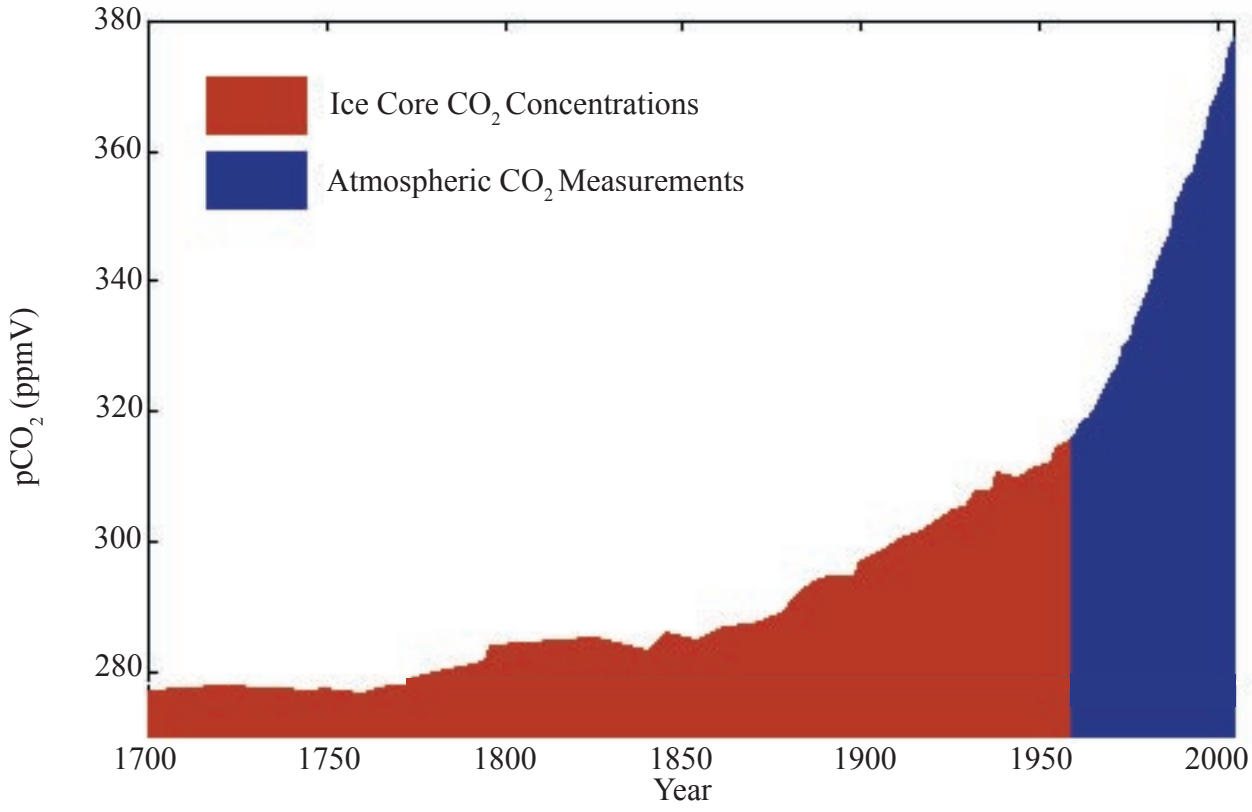
this estimate is likely a lower limit as it does not include anomalously warm years in the meteorological record (1998 and 2005), and constant carbon emission rates are unlikely considering future development rates.

Although model and observational uncertainties are often amplified in public debates, the future behavior of modern societies remains a key unknown. Annual atmospheric carbon emissions from transportation, heating, and electricity equal 6.98 gigatons[5] in 2002.[6] These emissions are ultimately tied to a nation's population, industrialization, and affluence. Second, the nations responsible for global carbon emissions are highly variable due to economic growth and the associated energy requirements. For example, economic development in China increased carbon emissions from 21.5 to 761.6 million metric tons between 1950 and 2000, second only to the United States in 2000 (1528.8 million metric tons).[7] Finally, the availability of future fossil fuel might be limited given inadequate discovery or development of new oil, natural gas, and coal reserves.

Within this context of uncertainty, scientists and policymakers have developed new agreements to mitigate future warming. The multi-national Kyoto Protocol was negotiated in Kyoto, Japan, in 1997, representing an amendment to the United Nations Framework Convention on Climate Change (UNFCCC) developed in 1992. This amendment requires participating countries to reduce their greenhouse gas emissions by at least 5.2 percent below 1990 levels between 2008 to 2012. The nations may also engage in emissions trading if they maintain or increase their emissions. As of fall 2005, 156 countries have ratified the agreement, representing 61 percent of global greenhouse gas emissions. The United States and Australia have signed but not ratified the Kyoto Protocol, leaving the policy non-binding in those countries. Objections to the protocol in the United States include the potential harmful effects on the U.S. economy (supported by economic analyses of the Congressional Budget Office and the Energy Information Administration), the lack of restrictions on developing signatory nations (notably China and India), and the potential transfer of wealth to third-world countries.

Given the marginal success of top-down regulation, local and state governments are addressing carbon emissions within the United States. For example, nine northeastern states are participating in the Regional Greenhouse Gas Initiative (RGGI), which seeks to stabilize carbon emissions by 2015 via a cap-and-trade program. Similarly, Mayor Greg Nickels of Seattle pioneered the U.S. Mayors Climate Protection Agreement, a policy where individual cities must exceed the Kyoto Protocol standards (the agreement calls for 7 percent reduction below 1990 levels,

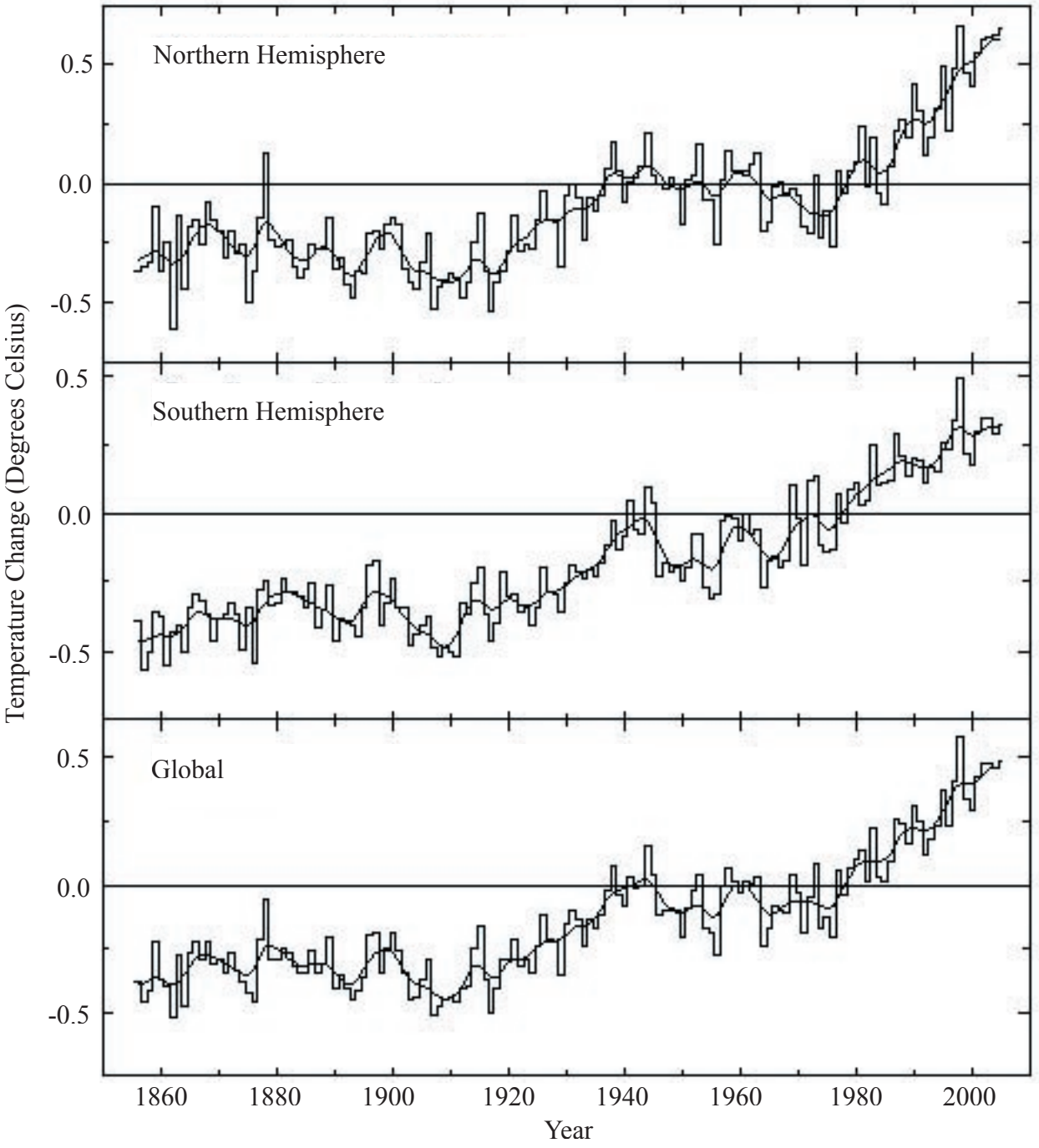


The Human Impact on Atmospheric Carbon Dioxide Concentrations
The red area corresponds to ice core measurements of past carbon dioxide concentrations, collected from Law Dome, Greenland.[8] The blue area reflects the mean annual carbon dioxide concentrations measured at Mauna Loa, Hawaii.[9] The white baseline is the pre-anthropogenic concentration of 278 ppm. Note that the 2004 mean (377 ppm) equals a 36 percent increase in atmospheric carbon dioxide concentrations from the 278 ppm baseline.
Figure 1

Historical Global Temperature Records

Data compiled by Jones and Moberg,[10] including the combined global land and marine surface temperature record from 1856 to 2005. The results are separated by hemispheres. Note the temperature anomaly exceeds 0.5ºC by 2000 in the Northern Hemisphere, and the years 1998 and 2005 were the warmest on record. The temperature increase from 1970 to the present has been largely attributed to human-induced warming, not natural climate variability.

Figure 2



whereas Kyoto mandates a 5.2 percent reduction). Currently 196 mayors have signed the agreement, representing 40 million Americans. Such regional initiatives are a highly useful means to catalyze federal legislation and develop innovative new products.

Unfortunately, the regional scientific analysis has not kept pace with the policy advances, particularly in the Rockies. In the following chapter of the *2006 State of the Rockies Report Card*, Gregory Zimmerman and coworkers from Colorado College address this problem, presenting several future climate change scenarios for the Rocky Mountain West. The method used in this study is an innovative twist on General Circulation Model output developed and produced by Katherine Hayhoe at ATMOS Consulting. Starting with the coarse grid results generated by two GCMs (typically in dimensions of several hundred kilometers), Hayhoe and colleagues scaled the model output to a 12x12 kilometer grid by statistically comparing the model results with historical climate data. By statistically "training" the GCM output with many historical observations, a higher resolution look at future climate change is possible. With this approach Zimmerman et al. considered changes

in temperature, precipitation, and snowpack through 2100, including two models with different sensitivities to atmospheric carbon dioxide forcing and two future carbon emission scenarios.

These high-resolution scenarios demonstrate the different spatial variability, where temperature shows variability on county-to-state scales whereas precipitation might vary on city-to-township scales. This spatial variability could reflect the different climate mechanisms affecting temperature and precipitation in this area (e.g., the impact of El Niño Southern Oscillation on the southwestern monsoonal precipitation) or how these variables are parameterized in General Circulation Models. Because climate forcing mechanisms are treated differently in each model and they respond differently to CO_2 variations, the socioeconomic implications strongly rely on the underlying assumptions and small details. Consider the importance of one inch of precipitation between Flagstaff and Phoenix, Arizona, which receive annual precipitation of 13 and 8 inches, respectively. The next question is what aspect of the models themselves are actually creating this spatial variability, and how can they be tested and improved?

The future climate of the Rockies will likely be dominated by human-induced warming under "business as usual" carbon emissions, so accurately characterizing the regional response is vital to the Rockies' future sustainability. These initial results suggest significant changes will be required in water management, agricultural land use, and tourism under all future climate scenarios, not just the worst-case estimate (model HadCM3, IPCC scenario A1fi). The report presented by Gregory Zimmerman and colleagues is a positive step in the right direction, stimulating an important conversation among the regional stakeholders and climate forecasters.

Endnotes

[1]Svante Arrhenius, the Swedish physical chemist well-known for his pioneering work on electrolytic solutions, first suggested the Earth's surface temperature might be altered by atmospheric carbon dioxide concentrations in 1896. Although the underlying spectroscopic data for carbon dioxide and water vapor has been revised, he qualitatively demonstrated how carbon dioxide concentrations could increase the Earth's surface temperatures.

[2]Keeling, C.D. and Whorf, T.P., 2005. "Atmospheric CO_2 records from sites in the SIO air sampling network, Trends: A Compendium of Data on Global Change. Carbon Dioxide Information Analysis Center," Oak Ridge National Laboratory, Oak Ridge, TN.

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[5]This annual emission equals 6.98×10^9 metric tons, equivalent to 1.5×10^{13} pounds (15 terapounds).

[6]Marland, G., Boden, T.A. and Andres, R.J., 2005. "Global, regional, and national CO2 emissions, Trends: A Compendium of Data on Global Change. Oak Ridge National Laboratory," U.S. Department of Energy, Oak Ridge, TN.

[7]*Ibid*.

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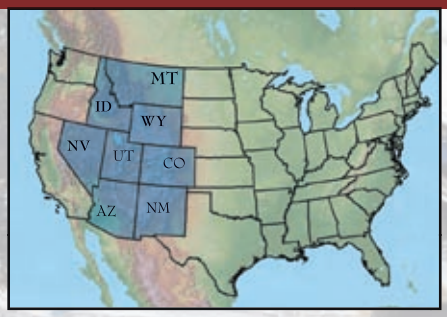
Climate Change

Modeling a Warmer Rockies and Assessing the Implications

By Gregory Zimmerman, Caitlin O'Brady, and Bryan Hurlbutt

The 2006 Colorado College State of the Rockies Report Card

"Human activities are increasingly altering the Earth's climate. These effects add to natural influences that have been present over Earth's history. Scientific evidence strongly indicates that natural influences cannot explain the rapid increase in global near-surface temperatures observed during the second half of the 20th century."
–Statement by the American Geophysical Union: Human Impacts on Climate



Recently, devastating hurricanes and floods, melting ice caps, and species extinctions have all brought human induced climate change into the fore of the scientific and political discourse. And, although there has been some controversy as to the specifics of climate change, most leading scientists have reached a consensus that the Earth's climate is rapidly changing as a result of human activities. Specifically, fossil fuel combustion is increasing atmospheric carbon dioxide (CO_2) concentrations, trapping heat near the Earth's surface, and leading to higher surface temperatures. This is commonly referred to as the "greenhouse effect."[1] Although we cannot say exactly what the resulting climate patterns will be, leading scientists predict that the globe will see an increase in extreme weather events such as drought, flooding, and hurricanes in the relatively near future.[2] In the Rockies, a region known for its natural resources, outdoor recreation and robust agricultural economy, our lifestyles and livelihoods are dictated by the type of weather we have. If overall weather patterns rapidly shift, we must be ready to adapt to those changes, regardless of the reason for the change. Gaining an understanding of what may happen will help us prepare for a future in which the climate is substantially different.[3]

Both future climate predictions and recent historic evidence suggest that the Rockies region is experiencing, and will continue to face, higher air temperatures and diminished amounts of precipitation

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and snowfall. Because we live in a region with minimal water resources, climate change will likely create heavy competition among water stakeholders. As resources diminish, the Rockies' diverse and relatively pristine ecosystems risk modification and damages, while agriculture and tourism industries will be forced to adapt quickly.[4]

In this section of the *2006 State of the Rockies Report Card*, we outline the causes and implications of human-induced climate change on both a global and regional scale. We then use data generated for the Rocky Mountain region from two commonly accepted climate models to understand the possible effects climate change will have on temperature, precipitation, and snowpack throughout our region. Finally, we explore the possible implications of changing climate patterns on ecosystems and on human activities including household water use and the agriculture and tourism industries.

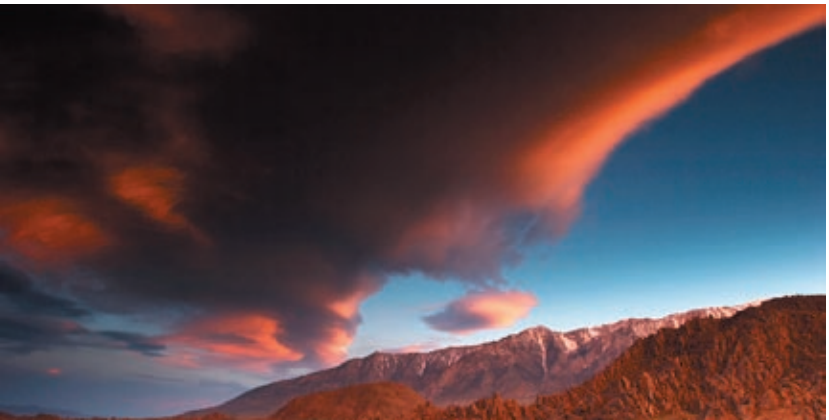
Causes and Implications of Global Climate Change

While it is not out of the ordinary for weather to vary by day, week, or season, shifts in weather patterns over years to centuries indicate a variable, or changing, climate. Historic records from marine sediments, polar ice cores, and other sources show that climatic changes occur naturally through variations in the distribution and magnitude of solar radiation (sunlight), which are then further amplified by ocean-land-atmosphere interactions. Today, however, rapid increases in temperatures and occurrences of extreme weather events cannot be fully explained by these "natural" influences. In 2001, the Intergovernmental Panel on Climate Change (IPCC) released "Climate Change 2001: Impacts, Adaptation, and Vulnerability." The report testified that

> Human activities—primarily burning of fossil fuels and changes in land cover—are modifying the concentration of atmospheric constituents or properties of the Earth's surface that absorb or scatter radiant energy… These changes in atmospheric composition are likely to alter temperatures, precipitation patterns, sea level, extreme events, and other aspects of climate on which the natural environment and human systems depend.[5]

The IPCC predicts that, on average, the Earth will warm by 1.4° to 5.8° Celsius from 1990 through 2100 and the warming will vary regionally.[6]

The primary cause of global climate change is a *greater amount of energy* on the Earth's surface from elevated atmospheric greenhouse gas concentrations.[7] Because the Earth's climate is controlled by a complex system of physical, chemical, geological, and biological processes, a greater energy balance not only creates warmer temperatures, but also alters large-scale weather patterns responsible for the current distribution of precipitation and temperature (thanks to the ocean-atmosphere circulation). Accordingly, in order to understand global climate change, we must consider the sources, dynamics, and potential effects of greenhouse gas emissions on the atmosphere, oceans, terrestrial biospheres, land cover, and the interactions between these complex Earth systems.



Solar energy heats the Earth's surface and the Earth reflects energy back towards space. To the benefit of organisms on Earth, greenhouse gasses in the atmosphere including carbon dioxide (CO_2), water vapor (H_2O), methane (CH_4), nitrous oxide (N_2O), and others serve to trap outgoing heat and reradiate it back to Earth. The greenhouse effect is a "natural" and beneficial process. Greenhouse gasses are released through the decay and respiration of plant material, forest fires, animal digestive processes, wetlands, volcanoes, and natural soil and ocean processes. And they allow life as we know it to flourish by recycling energy and, consequently, maintaining comfortable temperatures on the surface of the Earth.

Over the past 150 years, however, the "natural" rate and quantity of greenhouse gasses cycling from the Earth, into the atmosphere, and back to the Earth has been greatly exacerbated by human activities including fossil fuel combustion, fertilizer and manure application, biomass burning, and soil cultivation. Since the Industrial Revolution, atmospheric concentrations of carbon dioxide have increased by more than 30 percent, methane concentrations have risen by more than 50 percent, and nitrous oxide concentrations have increased about 15 percent (Figure 1).[8]

Increases in Atmospheric Concentrations of
Common Greenhouse Gasses from before the Industrial Revolution to Today[9]
Figure 1

Greenhouse Gas	Preindustrial Atmospheric Concentrations	1998 Atmospheric Concentrations
Carbon Dioxide (ppm)	278	365
Methane (ppm)	0.7	1.745
Nitrous Oxide (ppt)	0.27	0.314

Increasing air and ocean temperatures, resulting from high atmospheric concentrations of greenhouse gasses, alters atmospheric pressure, air and water circulation, and the transport of heat and precipitation between low and high latitudes. This, in turn, changes the Earth's historic climate patterns. The natural cycles of the Earth's climate patterns over time periods of years to decades are called "climate oscillations." Though these oscillations often originate in one region, they have a global impact on weather events. For example, the El Niño Southern Oscillation is a climate oscillation driven by particular wind and ocean conditions in the tropics that occur about every five to seven years. Though El Niño originates in the tropics, its effects are felt throughout the entire Western Hemisphere, making the winters in the U.S. Midwest warmer than usual, and the summers in the intermountain West wetter than usual.[10]

We often think of climate change as a shift from one stable climactic system to another. However, a more accurate definition would explain that, by releasing excess greenhouse gasses into the atmosphere, *humans are introducing a perturbation into an extremely variable climate system* and are increasing the likelihood of historically low-probability weather events.[11] Likely the Earth will see more heat waves, fewer cold waves, more droughts at mid-latitudes, more flooding events at mid- and high-latitudes in the winter, and more intense and frequent El Niño-like events.[12]

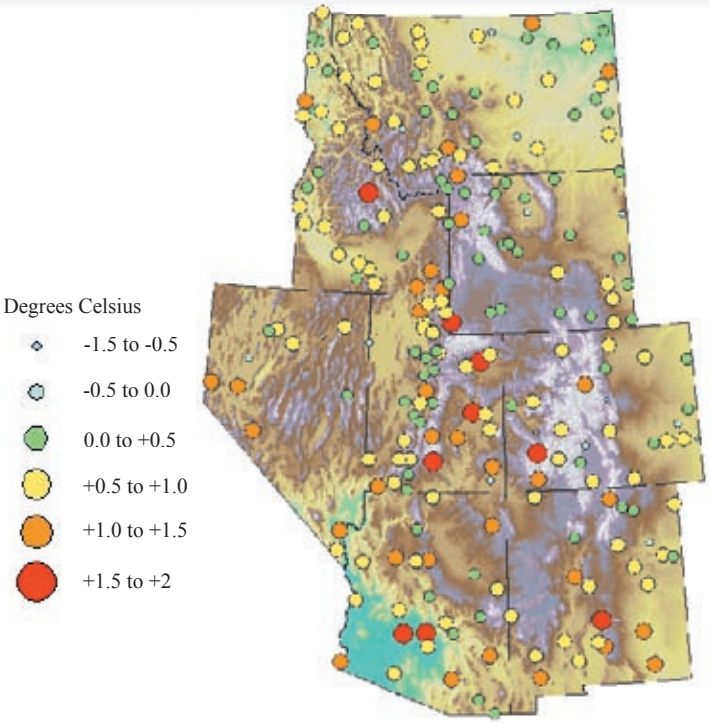
Climate Change in the Rockies

The climate of the Rocky Mountain region is strongly influenced by three important, normally occurring, climate oscillations: the El Niño Southern Oscillation, the Pacific Decadal Oscillation, and the North Atlantic Oscillation.[13] As global atmospheric greenhouse gas concentrations increase, disrupting typical climate oscillation patterns, the intermountain West will see changing climate events; some weather events will become less likely and others will become more likely to occur in our region.

Current Climate Change

In order to understand the ways that the climate has already been changing in the Rocky Mountains as a result of rising greenhouse gas concentrations, we evaluated historic temperatures in the region. The data show that surface temperatures are increasing at most sites throughout the Rockies region (Figure 2) and mean state temperature increases from 1940-1996 are between 0.38°C in Arizona to a 0.79°C temperature increase in New Mexico. The average temperature increase across the eight-state region is 0.6° Celsius (Figure 3). However, there appears to be little pattern in temperature increases throughout the Rockies. For instance, Arizona and New Mexico, both geographically and climatically similar, experienced dissimilar temperature increases through the last half of the 20th century. Such findings reinforce our understanding that climate change is extremely variable.

Temperature Change over the Last Half of 20th Century
Degrees Celsius
Figure 2



About the Data

Temperature records were collected from 226 weather stations across the eight-state region for the last half of the 20th century from the United States Historical Climate Network (USHCN).[14] Each station's yearly mean temperature was calculated from 1940 through 1996 (the end of the data record).[15] Yearly mean temperatures were averaged from 1940-1996 and subtracted from average yearly mean temperatures during the recent 1989-1996 period, giving actual observed temperature increases through the 20th century.

Observed Temperature Increases in the Rockies' States over the Last Half of the 20th Century
Figure 3

Arizona	+0.82°C
Colorado	+0.39°C
Idaho	+0.71°C
Montana	+0.50°C
New Mexico	+0.79°C
Nevada	+0.56°C
Utah	+0.68°C
Wyoming	+0.38°C

Future Climate Projections

To demonstrate the possible future impacts of climate change, the State of the Rockies contracted ATMOS Research and Consulting to produce high-resolution climate model outputs for the Rockies region, which project future changes in temperature, precipitation, and snowpack for the region throughout the 21st century. Climate models can help to illustrate the probable results of human emitted greenhouse gasses, given what we know about dynamic land-ocean-atmosphere processes. While models can give great insight into possible results of complicated interactions, they do not forecast precise temperature or precipitation values at an exact location. Rather, models illustrate possible future climate trends.

About the Climate Models

This is the first time a downscaled climate model has been run on a regional scale for the eight-state Rocky Mountain region! In order to see the potential effects of future global climate change in the Rocky Mountain region, ATMOS Research and Consulting downscaled two different global climate models: the Parallel Climate Model (PCM) and Hadley Centre Climate Model (HadCM3).[16] Both are general circulation models (GCMs), which predict probable future climate patterns on global, rather than regional, levels. To apply these global models to our region, original model grid sizes of several hundred square kilometers were reduced to 12 x 12 kilometer grid sizes.

The main difference between the two models is their different temperature sensitivity to atmospheric pCO_2 variations. The HadCM3 is considered to be a mid-range model in its climactic response to human greenhouse gas emissions, whereas the PCM, which is less sensitive to greenhouse gas concentrations, is considered to produce conservative climate projections. As you can see, the annual temperature increases predicted across the region by the PCM are only from 3°C to 5°C, whereas the HadCM3 shows 5°C to 7°C increases (Figure 4).

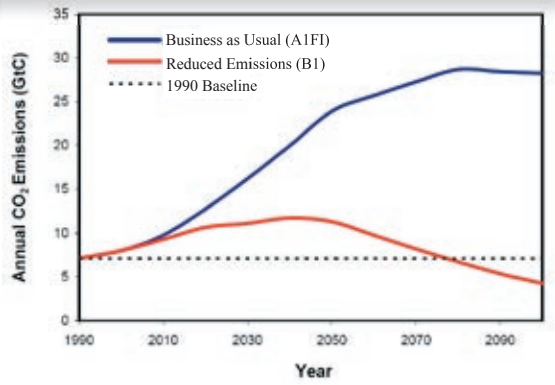
Each model was run for two different greenhouse gas emission scenarios, which were included in the IPCC's Special Report on Emissions Scenarios (Figure 5).[17] The business-as-usual "A1fi" emission scenario assumes a world of rapid economic growth, where global population peaks around 2050 and then decreases. Despite rapid introduction of new and more efficient technologies, A1FI assumes intensive fossil fuel use.[18] The reduced-emissions "B1" emission scenario assumes a fairly smooth transition to alternative energy as fossil fuel resources decline. The scenario assumes extensive use of conventional and unconventional gas as the cleanest fossil fuel during the conversion towards renewable technology.[19]

The climate models generated the temperature, the amount of precipitation, and the depth of snowpack at each of over 15,000 data points across the Rockies evenly distributed across the region. Both models were run in the shorter term future (average from 2020-2049) and longer term future (2070-2099) for both scenarios, relative to the 1961-1990 reference period (Figure 6). Throughout the report, the reference period is referred to as "1976," and the longer term period is refered to as "2085." Snowpack values were generated for April 1 of each year and are in centimeters of snow-water equivalent depth. Temperature is displayed in degrees Celsius (°C). Precipitation is in centimeters per year.

Our analyses below display only the "middle of the road" HadCM3 model to track the change from our reference period to the longer term time period in temperature, precipitation, and snowpack. We first display both the business-as-usual (A1FI) and reduced-emissions (B1) scenarios through a regional overview. We then present more detailed findings within the context of three notable areas of concern: ecosystems, agriculture and municipal water use, and tourism hot spots.

CO_2 Emission Assumptions for Business-as-Usual and Reduced Emissions[20]

Figure 5



Downscaled Climate Model Outputs Generated for the Rocky Mountain Region

Figure 6

Time Period	HadCM3 (Middle-of-the-Road Sensitivity Estimate)		PCM (Low-Sensitivity Estimate)	
	Business-as-Usual (A1FI)	Reduced-Emissions (B1)	Business-as-Usual (A1FI)	Reduced-Emissions (B1)
Reference Period: "1976" (1961-1990)	Generated	Generated	Generated	Generated
Short-Term Future: "2035" (2020-2049)	Generated	Generated	Generated	Generated
Long-Term Future: "2085" (2070-2099)	Generated and Used in This Report	Generated and Used in This Report	Generated	Generated

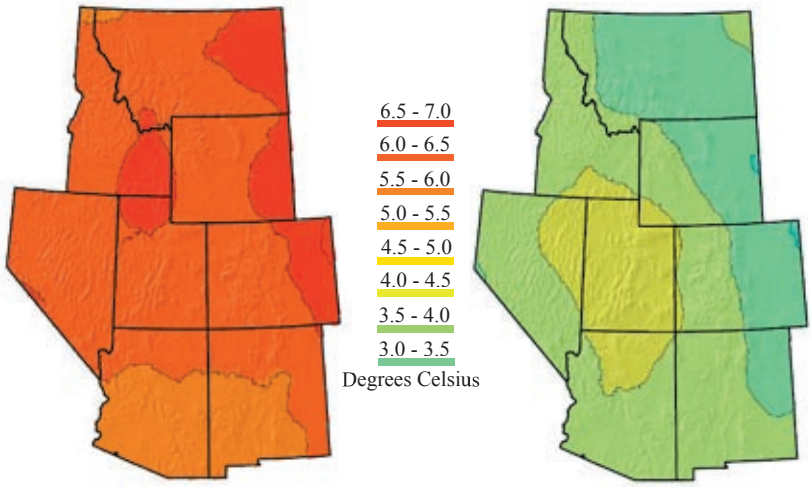
Comparison of the HadCM3 to the PCM

Annual Temperature Increase from 1976 to 2085* in Degrees Celsius

Figure 4

HadCM3: Moderate-Sensitivity Climate Response to Atmospheric Greenhouse Gas Concentrations

PCM: Low-Sensitivity Climate Response to Atmospheric Greenhouse Gas Concentrations



*1976 represents the average from 1961 to 1990, and 2085 represents the average from 2070 to 2099.

Overview of Findings

Assuming that the global community continues to add greenhouse gasses to the atmosphere at, or greater than, the present rate, we in the Rocky Mountain region will see changes from our historic climate patterns. In general, the Rockies will likely see higher temperatures in both winter and summer, variable changes in precipitation across the region, and more precipitation falling as rain rather than snow. Because temperature change is directly related to atmospheric greenhouse gas concentrations, it is the easiest climactic parameter to model. More difficult to understand are the effects of changes in greenhouse gas concentrations on precipitation and snowpack, and the results presented here are possible but less certain than the projections for temperature shifts. We explore the possible precipitation trends and discuss their implications to illustrate the wide-reaching impacts of altering one part of a climate system and to begin suggesting ways we may adapt to an altered climate.

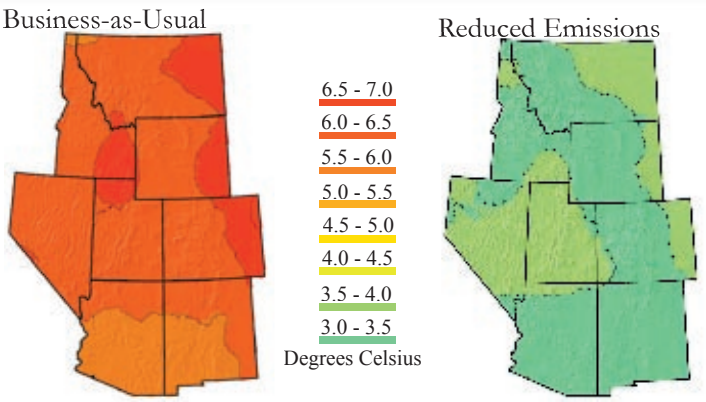
Temperature

When we consider the implications of warmer temperatures, we likely think first of our personal comfort. We remember either the coldest or warmest day of the year and imagine it being several degrees warmer. However, while a slight temperature change may seem tolerable for humans, it can have dramatic effects on other organisms and ecosystem processes. For example, higher or lower temperatures will alter water evaporation rates, the plant and animal make-up of a particular habitat, or the tourism activities that are enjoyable in a location.

Under both business-as-usual and reduced-emissions scenarios, annual average temperature is projected to increase region-wide by the end of the century (Figure 7). Under the business-as-usual scenario, temperature increases by 5°C to 7°C across most of the Rockies, while under the reduced-emissions scenario, temperature increases are only around 3°C to 4°C.

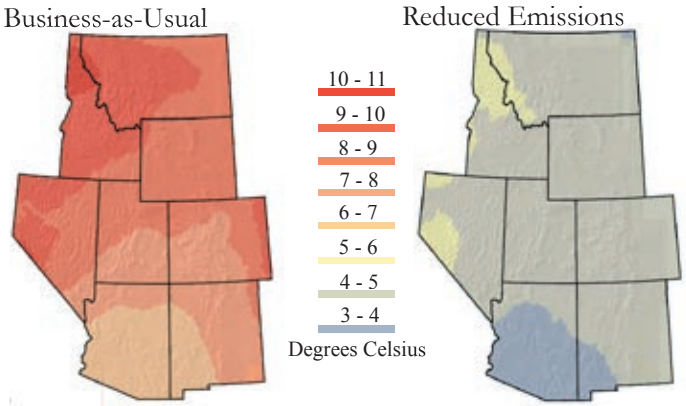
Temperatures will not increase uniformly throughout the year and some seasons will have more extreme temperature changes than others. Under both scenarios, summer temperature increases are greater than winter temperature increases. Summer temperatures increase by 7°C to 10°C across the region for business-as-usual and by 3°C to 6°C for reduced-emissions (Figure 8), whereas winter temperatures only increase by 3°C to 7°C for business-as-usual and by 1°C to 5°C with reduced-emissions (Figure 9).

Annual Temperature Increase, 1976 to 2085*
Degrees Celsius
Figure 7



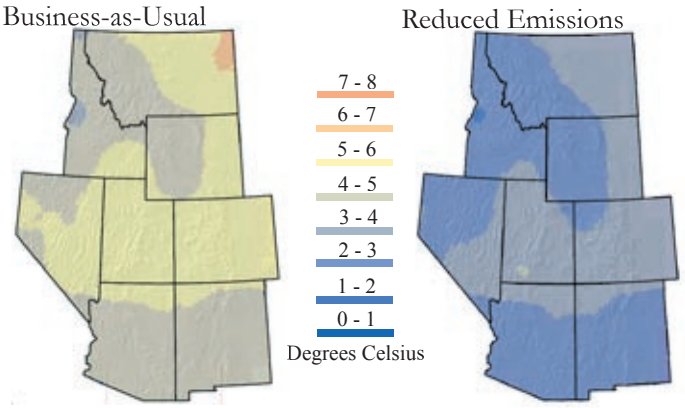
*1976 represents the average from 1961 to 1990, and 2085 represents the average from 2070 to 2099.

Summer Temperature Increase, 1976 to 2085*
Degrees Celsius
Figure 8



*1976 represents the average from 1961 to 1990, and 2085 represents the average from 2070 to 2099.

Winter Temperature Increase, 1976 to 2085*
Degrees Celsius
Figure 9



*1976 represents the average from 1961 to 1990, and 2085 represents the average from 2070 to 2099.

Snowpack

Although the change in winter temperatures is not as extreme as in the summer, increasing winter temperatures may cause several melting periods during the winter, and will have a great impact on the snowpack of the Rocky Mountain region. Because our water resources in the Rocky Mountains come primarily from snowmelt, the state of the springtime snowpack indicates the viability of water resources to supply users. Research has shown that with predicted climate change, snowline will recede to higher elevations, river flow volume will continue to decrease, and spring runoff will move earlier in the spring.[21]

Under both scenarios, most of the Rockies areas that had an April 1 snowpack in 1976 lose snow by 2085. Snowpack losses are greater under the business-as-usual scenario, in which most snowy areas lose more than 50 percent of their snowpack. Under the reduced-emissions scenario, most areas lose some snowpack, with only about half of the snowy areas losing over 50 percent of their snowpack (Figure 10).

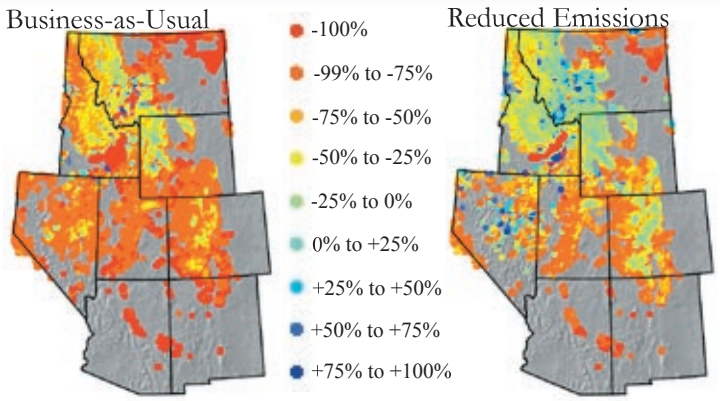
Precipitation

It has been suggested that climate change will bring increased rainfall which will make up for the loss of snowpack. Indeed, Regonda et al. found that in the Rockies there has been a general increase in winter precipitation, without apparent increases in spring streamflows, suggesting that more precipitation has been falling as rain rather than snow in recent years.[22] Most experts agree, however, that with increased atmospheric greenhouse gas concentrations, regional precipitation patterns will simply become more stochastic and variable over time and space. It will be more likely that one year we will experience a drought and the next have flooding.[23] Our results show that annual precipitation will increase in some parts of the Rockies and decrease in others from 1976 to 2085 under both scenarios (Figure 11).

April 1 Snowpack Percentage Change, 1976 to 2085*

Centimeters of Snow Water Equivalence

Figure 10

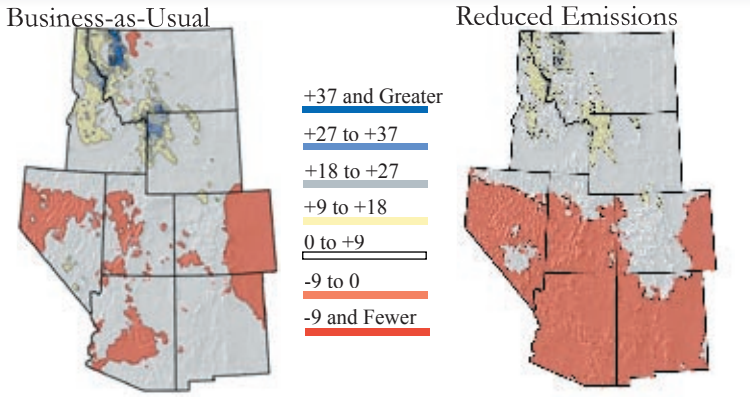


*1976 represents the average from 1961 to 1990, and 2085 represents the average from 2070 to 2099.

Annual Precipitation Change, 1976 to 2085*

Centimeters Per Year

Figure 11



*1976 represents the average from 1961 to 1990, and 2085 represents the average from 2070 to 2099.

Climate Change and the Rockies' Ecoregions

Ecosystem function will undoubtedly change with changes in temperature, precipitation, and snowpack, as these climate properties dictate rates of important, yet often unseen, ecosystem processes. For example, the rate of abiotic (nonliving) processes like rock weathering as well as biotic (living) processes like decomposition, nutrient cycling, reproduction, CO_2 assimilation, and water uptake are all determined by temperature and precipitation conditions. Species that are used to one temperature and precipitation regime and the accompanying ecosystem processes will be stressed by a rapid change in climate properties. Among other impacts, climate change is expected to induce species stress and potentially lead to accelerated extinction. In fact, a recent study in the journal *Nature* directly linked climate change to frog extinction in the tropics.[24] We must ask ourselves, is the Rocky Mountain region far behind?

Here we outline our HadCM3 business-as-usual projected future trends in seasonal temperatures, precipitation, and snowpack: climate properties that are important to ecosystem change. We have divided the Rocky Mountain region into 20 ecoregions in order to compare projected changes in one area of the region to those in another (Figure 12). We compare these climate projections with other studies which look at current and projected ecosystem impacts of climate change.

Overview of Ecoregion Findings

Annual temperature is predicted to increase by 5.8°C to 6.7°C in every ecoregion in the Rockies from 1976 to 2085 (Figure 12). Over that period, summer temperature increases are greater, ranging from plus 6.3°C to 9.6°C (Figure 13). Higher summer temperatures cause greater water loss from surface water bodies and from plant leaves (i.e., evapotranspiration), increasing plant water stress and the likelihood of fire.[25] Winter temperature is predicted to rise by 4.4°C to 5.7°C from 1976 to 2085 (Figure 13). Greater winter temperatures trigger many organisms to react as if it were spring too early in the season or they allow species that require mild winters to survive in previously harsh environments.[26] If new, mild winter-adapted organisms move in, the native flora and fauna will be stressed by competition for resources.[27] Furthermore, warmer winters cause snow to melt several times during the winter months, altering the water regime for the whole year.[28] Indeed, in every ecoregion, springtime snowpack is predicted to decrease by at least 37 percent from 1976 to 2085, and in 14 ecoregions, snowpack will decrease by over 70 percent over the same period (Figure 13).

Effects of Climate Change on Ecosystems

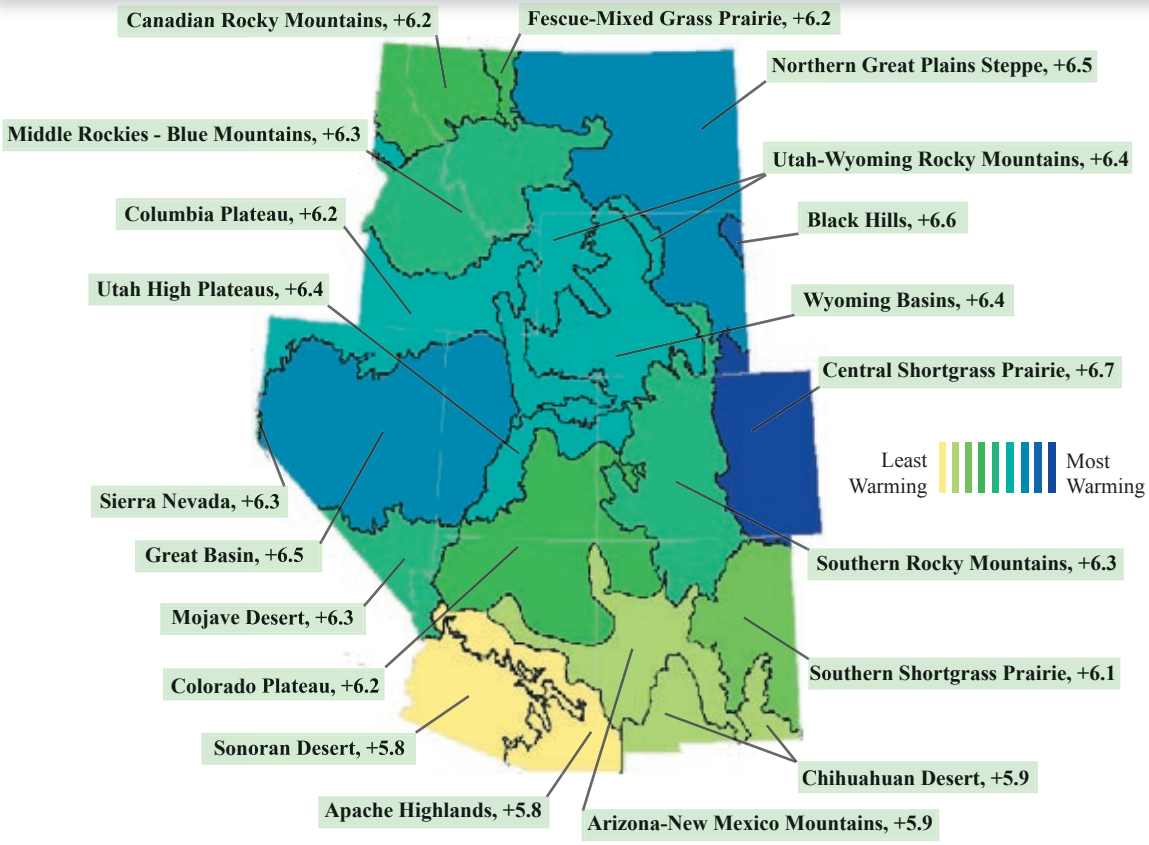
On a species level, changes in seasonal temperatures and springtime snowpack will stress organisms adapted to historic climate properties. Flora and fauna are triggered to change with the sea-

Ecoregion Annual Temperature Increase, 1976 to 2085*

Degrees Celsius

Figure 12

*1976 represents the average from 1961 to 1990, and 2085 represents the average from 2070 to 2099.



sons, given various ecosystem properties; however, not all species are triggered by the same conditions. For example, some organisms may be triggered to act as if it is spring by increased sunlight hours and others by higher temperatures. Because ecosystem components are interdependent upon one another, the rapid shift of one species, without the corresponding shift of species it depends on, can lead to a breakdown of ecosystem function. For example, recent warming trends are causing bloom timing of plants in the Rocky Mountain region to shift earlier in the spring.[29] While a small change in bloom timing may not be disastrous for ecosystems, shifts of several days or weeks can impair ecoregional health. If flowers begin blooming earlier and pollinators do not adjust to climate change in a similar manner, then both species become imperiled. Furthermore, changes in bloom and pollination timing can be detrimental not only to the survival of plants and insects, but also up the food-ladder to birds and mammals.

Similarly, hibernating and migratory species are triggered by altered environmental conditions to react as if it is spring early in the season and are being stressed by shifting temperatures. Because climate change has variable impacts over space and time, species are triggered to migrate or emerge from hibernation and are met with harsh winter conditions. For example, climate change has less drastic effects at higher altitudes than it does at lower altitudes. When temperatures at low elevations rise, triggering migration, species move to their high altitude summer breeding grounds only to find winter conditions. If spring conditions do not occur at high altitudes until after migratory species reach their destinations, these species will not be able to find food, reproduce, or ultimately survive.[30]

Research has shown that bird migration and breeding seasons in the Rocky Mountain region are already moving earlier. David Inouye et al. analyzed historical records of the first appearance of the American robins (from 1974 to 1999) at the Rocky Mountain Biological Laboratory in Gothic, Colorado. Inouye et al. found that robins are appearing from wintering grounds 8.4 days earlier, a value they consider biologically significant. Further, research conducted on the breeding time of the Mexican jay in southeastern Arizona from 1971 to 1998 by J.L. Brown et al. found that the hatching timing of the first clutch in the population was an average of 10.1 days earlier and the date of the first nest was 10.8 days earlier over the 30-year study period. Their research suggests that the birds are responding to warmer minimum temperatures during the months before and during breeding seasons. Brown et al. argue that the results are important for the breeding time of many birds throughout the United States, especially those sensitive to minimum temperatures.[31]

Additionally, Inouye et al. found that the first appearance of hibernating yellow-bellied marmots is occurring 23 days earlier than 30 years ago, triggered by warmer nighttime temperatures. In recent years, when the marmots emerge, the snowpack has often not yet melted, forcing them to live in heavy snow cover for longer than in previous decades, consequently decreasing marmot litter size and reproduction rates.[32]

On larger, ecosystem scales, plant species' range and composition will also change with changing temperature and water regimes. Many scientists predict that as climate changes plant species will redistribute, moving to the climatic zones for which they are adapted. Indeed, some species have large ranges and can live in a variety of longitudes and elevations. However, even these species will be stressed by migration because not all individuals of a species are well adapted to the climate conditions of the entire range of the species. For example, individual plants at the northern range of a

species may be adapted to cooler local conditions than their relatives established in the south. If the climate warms in the north, the individuals there will likely still be within the range of the species; however, the northern individuals are no longer positioned in the cooler climate to which they are adapted.[33]

Imperiled species that live at high elevations are of special concern. General climate models predict that as temperatures increase, vegetation will shift upslope and mountainous wilderness will lose the highest and coolest climatic zones at the top of mountains. As the climate zones shift upward, the habitat on top of the peaks becomes smaller and smaller, putting more spatial and genetic pressure on species populations there.[34] The lynx, a high-elevation feline, depends on the long-lasting snowpack of mature, boreal forests. A reduction in the depth, spatial extent, or duration of snowpack could be devastating to this imperiled species. The Uncompahgre fritillary, a butterfly endemic to high alpine meadows of the San Juan Mountains in southwest Colorado, is another species of concern. The butterfly's existence depends on its principal host plant, the snow willow. If the region experiences warming, the snow willow could be extirpated from the area, consequently eliminating the last Uncompahgre fritillary population.[35]

To compound problems, many species will be prevented from migrating by large roads, cities, farmland, mountain ranges, or other habitat fragmentation. For more on habitat fragmentation, see "Fragmenting the Western American Landscape," by The Nature Conservancy, on page 75 of the *Report Card*. If plants cannot migrate, and instead must stay somewhere with changed climate properties, they may become so stressed that they stop reproducing. This possibility is demonstrated by David Inouye et al. who have discovered in warming experiments that plants responded by producing fewer flowers per plant and fewer plants per warmed plot than the control plots. Moreover, many plants (about 30 percent in 1996 and 1997) completely forwent flowering in warmed soil triggered by increased soil temperature and decreased soil moisture. In the long run, as plants forgo flowering and fail to reproduce due to drought sensitivity, more drought-tolerant species, such as sagebrush, may eventually increase in subalpine environments.[36] Plants that are adapted to warmer climates and can handle variations in precipitation and evapotranspiration will outcompete those species which cannot adapt as quickly. Similarly, John Harte has found a remarkable increase in shrub cover and decrease in forb cover with warming experiments at the Rocky Mountain Biological Laboratory since 1990. Harte concludes that the shrubs will outcompete the forbs with climate warming, likely transforming the alpine ecosystem from forb to shrub dominated.[37] The effects of such rapid ecosystemic changes can fundamentally harm the productivity, vitality, and resilience of the land.

Because of the complexity of climate change and plant migration, the modeling community has started investigating the potential results of climate change on the dispersal of plant communities on regional scales. Andrew Hansen et al. (2001) predict that the forest area in the United States will decrease by 11 percent with a doubling of CO_2. Much of the lost forest will be replaced by savanna and arid hardwood. In the West, ponderosa pine communities are predicted to increase, and alpine, sagebrush, subalpine spruce/fir forests, and aspen-birch communities are expected to decrease or disappear from the Rockies region.[38]

Change in Ecoregion Temperature, Precipitation, and Snowpack, 1976 to 2085*

Figure 13

*1976 represents the average from 1961 to 1990, and 2085 represents the average from 2070 to 2099.

Ecoregions	**Temperature**, Degrees Celsius						**Precipitation**, Centimeters (cm) Per Year				**Snowpack**, Centimeters (cm) of Snow Water Equivalent on April 1			
	Winter			Summer					1976 to 2085				1976 to 2085	
	1976	2085	1976 to 2085	1976	2085	1976 to 2085	1976	2085	(cm)	Percent	1976	2085	(cm)	Percent
Apache Highlands	5.7	10.2	+4.6	24	30	+6.5	42	44	+2	+4%	0.3	0.0	-0.3	-100%
Arizona-New Mexico Mountains	0.3	4.9	+4.6	19	26	+6.9	41	44	+3	+7%	1.2	0.0	-1.2	-99%
Black Hills	-5.8	-0.4	+5.4	18	27	+8.9	47	52	+4	+9%	0.1	0.0	-0.1	-76%
Canadian Rocky Mountains	-6.0	-1.5	+4.4	14	24	+9.9	104	121	+18	+17%	29.6	15.5	-14.1	-48%
Central Shortgrass Prairie	-1.2	4.3	+5.5	21	30	+8.5	39	36	-3	-8%	0.1	0.0	-0.1	-100%
Chihuahuan Desert	5.4	9.9	+4.4	25	32	+7.0	30	34	+4	+12%	0.0	-	-	-
Colorado Plateau	-0.2	5.0	+5.3	22	29	+7.3	28	29	+2	+5%	1.8	0.1	-1.7	-96%
Columbia Plateau	-3.6	1.3	+4.9	18	27	+9.2	36	40	+4	+10%	1.4	0.4	-1.0	-73%
Fescue-Mixed Grass Prairie	-5.5	-0.6	+4.9	16	25	+9.4	39	40	+1	+3%	0.2	0.1	-0.1	-73%
Great Basin	-1.8	3.5	+5.4	19	28	+8.7	27	28	+1	+4%	1.0	0.1	-0.9	-92%
Middle Rockies - Blue Mountains	-7.6	-3.2	+4.4	14	23	+9.6	68	77	+9	+13%	14.9	8.0	-7.0	-47%
Mojave Desert	5.7	10.7	+5.0	26	34	+7.7	18	21	+3	+16%	0.5	0.0	-0.5	-100%
Northern Great Plains Steppe	-6.3	-0.8	+5.5	19	28	+8.9	35	38	+3	+9%	0.1	0.0	-0.1	-95%
Sierra Nevada	-3.3	1.6	+4.9	13	23	+9.4	73	62	-11	-15%	46.1	8.8	-37.3	-81%
Sonoran Desert	11.2	15.9	+4.8	30	36	+6.3	23	24	+1	+2%	0.0	-	-	-
Southern Rocky Mountains	-7.5	-2.2	+5.3	14	21	+7.7	57	60	+2	+4%	11.2	5.0	-6.2	-56%
Southern Shortgrass Prairie	2.7	7.2	+4.5	22	30	+7.6	40	40	+1	+2%	0.1	0.0	-0.1	-100%
Utah High Plateaus	-6.2	-0.5	+5.7	17	25	+7.9	44	44	0	+1%	4.8	0.5	-4.3	-89%
Utah-Wyoming Rocky Mountains	-9.7	-4.7	+5.1	13	22	+8.8	72	84	+13	+18%	18.0	11.4	-6.6	-37%
Wyoming Basins	-7.0	-2.1	+4.9	17	25	+8.5	28	31	+3	+11%	0.3	0.1	-0.2	-81%

Climate Change and Agricultural and Municipal Water Use in the Rockies

To people who live in the Rockies region, diminished water resources may be the most obvious consequence of predicted climate change. The West is expected to be the first region in the United States that will experience significant changes in water yield from climate change (up to 50 percent above or below current water levels in the region).[39] Although future precipitation trends are difficult to predict, most experts agree that as the climate changes, precipitation events will become more unpredictable and variable from year to year, causing many different problems. Agriculture, the largest water user in the region, is built upon current rain and snow patterns, and any major changes will require shifts in the entire industry. Further, the Rocky Mountain region's water resources are already inadequate for the population size of the region and projected future population. Climate change has the potential to create a situation where towns and cities cannot provide water to their citizens, farmers and ranchers cannot adequately water their crops, and conflict over water assignment will be widespread and intense.[40] We have divided the Rockies region into seven major water resource regions in order to understand where water resources will be hardest hit (Figure 14).

Because 85 percent of the region's water originates from snowmelt,[41] winter weather most heavily influences our water supplies. Our analyses found that most river basins will have increased mean winter temperatures, and decreased April 1 snowpack (Figure 15). Earlier runoff, due to higher winter temperatures and decreased springtime snowpack combined with more frequent droughts due to higher summer temperatures (Figure 15), will strain reservoir supplies in the summer, when water demand by irrigated agriculture and municipal use is at its height.[42] Annual precipitation, which could potentially augment the decreased water from less snowpack and reduce water stress, is predicted to be variable over the region (Figure 15). Even if the western U.S. sees slight increases in precipitation, higher temperatures may overwhelm the additional water supply by stimulating greater evapotranspiration. With less groundwater replenishing aquifers and surface water restocking the rivers, the already limited regional water supply will be further reduced.

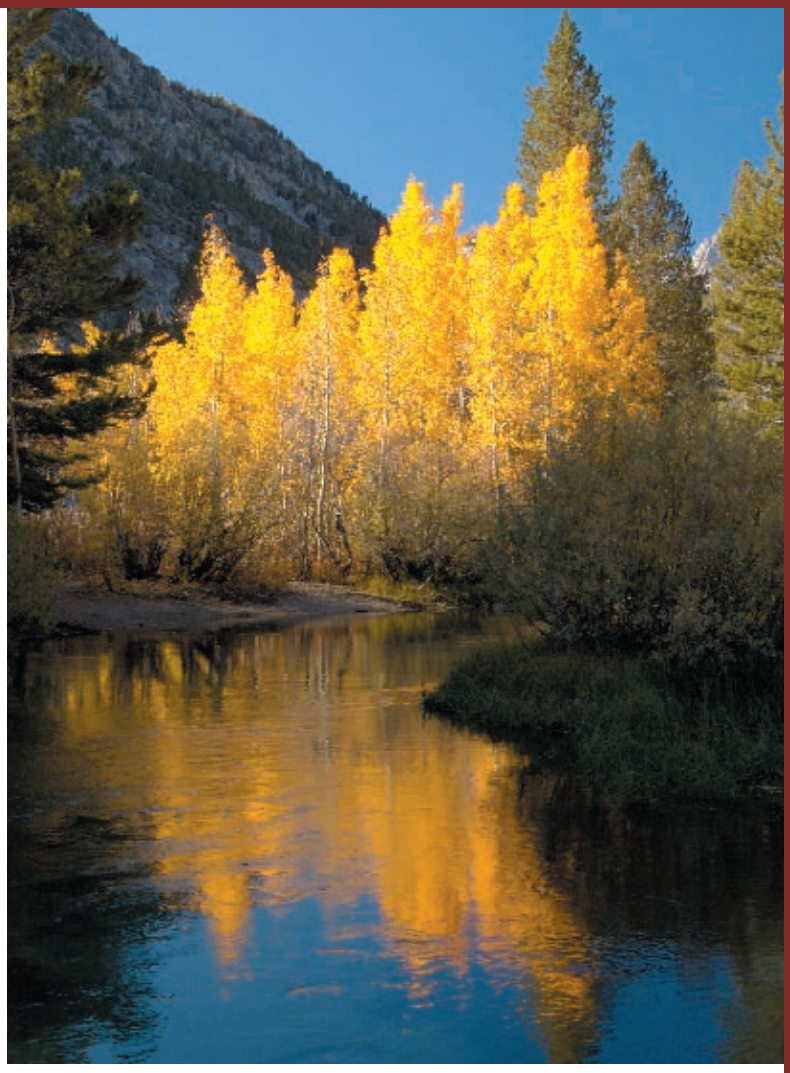
River Basins and Major Rivers
Figure 14

As climate changes, the productivity of farms and ranchlands will also change. Agricultural industries may improve throughout the region with a warmer, wetter, more CO_2 rich climate. Higher temperatures and greater rainfall could allow a longer, more productive growing season. However, without increases in precipitation the agricultural industry will be highly stressed by climate warming.[43]

Because grazing in the Rockies depends upon the availability of natural forage and supplemental cultivated forage crops, the viability of the ranching industry is closely tied to the regional climate. Warmer temperatures would lengthen the growing season and permit cattlemen to hold stock at higher-elevation grazing areas for longer periods of the spring and fall. Furthermore, if precipitation increases in some areas, likely forage production will also increase, allowing more cattle on each plot of land. Increased forage decreases the cost of purchasing cultivated forage, producing hay, and operating irrigated water systems. However, despite increased forage potential, some scientists worry that increased temperatures and moisture in the Rocky Mountain region will have damaging effects on range and farmland because of a shift in the distribution of noxious weeds and invasives. Warmer winters may increase the incidence of pest outbreaks and invasive exotics; such species did not survive the historically cold winters, but now can outcompete native species in the winter and summer months.[44] For a further discussion of invasives, please see "The Invasion of Our Rockies: Hype or Management Priority?" by Anna Sher, on page 47 of the *Report Card*.

If, however, precipitation decreases across the region or is overwhelmed by higher evapotranspiration, the presently distressed ranching industry will become unviable. Hurt (1951) found that calf weights during the drought years of the 1930s decreased by a third from historical averages. Reed et al. reported that the percentage of cows weaning calves in those same years decreased to 73 percent compared with 87 percent in typical precipitation years.[45]

Agricultural water stress will be compounded by future population growth in the region. Municipalities will compete with agriculture for water rights to provide to residents. In the West, the earliest, or most senior, water rights have the ability to extract a specified amount of surface water, before more recent or junior owners. Surface waters are withdrawn from earliest to latest water owners



and a junior right holder cannot withdraw water if it impedes the ability of a senior right holder to extract the entirety of the senior appropriation. Throughout the Rockies region, prior appropriation has created frequent conflict between right holders because the water resources in the West are not sufficient for all citizens to extract and utilize all the water they desire. Given predicted changes in temperature, precipitation, and snowpack, conflict will likely increase as varying interests all compete for decreasing water resources.

Change in River Basin Region Temperature, Precipitation, and Snowpack, 1976 to 2085*

Figure 15

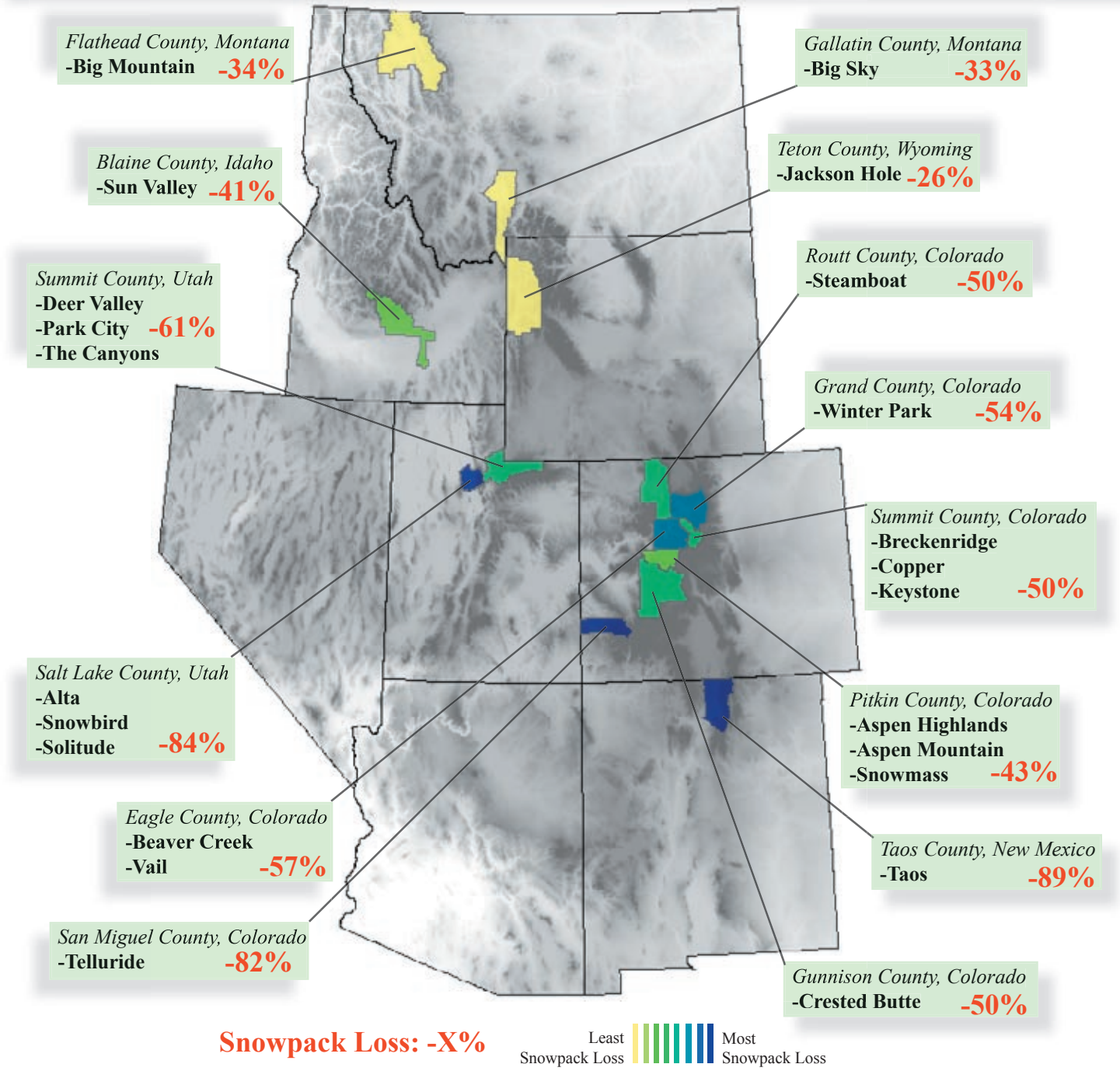
River Basin Regions	**Winter Temperature**, Degrees Celsius			**Precipitation**, Centimeters (cm) Per Year				**Snowpack**, Centimeters (cm) of Snow Water Equivalence on April 1			
	1976	2085	Change, 1976 to 2085	1976	2085	Change, 1976 to 2085		1976	2085	Change, 1976 to 2085	
						(cm)	Percent			(cm)	Percent
Arkansas-White-Red	-0.7	4.4	+5.1	42	40	-2	-5%	4.3	2.0	-2.3	-53%
California	2.7	7.8	+5.1	23	25	+2	+7%	0.6	0.0	-0.6	-100%
Great Basin	-2.4	2.9	+5.3	31	32	+1	+4%	2.8	0.5	-2.3	-83%
Lower Colorado	5.0	9.8	+4.8	32	34	+2	+5%	1.2	0.0	-1.2	-99%
Missouri	-6.3	-1.0	+5.3	42	46	+4	+10%	6.7	4.6	-2.1	-31%
Pacific Northwest	-6.2	-1.6	+4.6	71	82	+11	+15%	20.3	10.7	-9.6	-47%
Rio Grande	1.2	5.8	+4.6	37	40	+3	+7%	9.8	3.5	-6.3	-65%
Texas-Gulf	4.4	8.8	+4.5	43	44	+1	+3%	-	-	-	-
Upper Colorado	-5.7	-0.3	+5.3	39	41	+2	+6%	8.8	4.1	-4.7	-53%

*1976 represents the average from 1961 to 1990, and 2085 represents the average from 2070 to 2099.

Ski County April 1 Snowpack Loss, 1976 to 2085*

Figure 16

*1976 represents the average from 1961 to 1990, and 2085 represents the average from 2070 to 2099.



Tourism

Finally, a change in climate will undoubtedly impact the tourism industry in the Rockies, a region often seen as the nation's playground. Although predicted climatic changes may improve warm weather tourism by lengthening the summer season, a major change in winter conditions that makes snow sports unviable will likely hurt mountain towns dependent upon winter tourism.

Our findings for counties with some of the Rockies' biggest ski areas show spring snowpack drops dramatically from 1976 to 2085. Snowpack loss tends to be lowest in the northern Rockies. Teton County, Wyoming, home to Jackson Hole, is projected to only lose 26 percent of its spring snowpack. Most ski counties in Colorado, however, are predicted to lose around 50 percent (Figures 16 and 17).

Predictions for future mountain climate are warmer winters and shorter snow seasons. Winter sports dependent upon snow: downhill skiing, cross-county skiing, snowshoeing, and snowmobiling, are expected to decrease in popularity with warming because of worsened conditions, potentially becoming unviable as soon as 2050.[46] According to Aspen Ski Company's CEO Patrick O'Donnell, an outspoken advocate of reducing the impact of climate change on the ski industry, if climate change shortens the ski season, it is "going to be an economic disaster."[47] O'Donnell explains that a ski resort like Aspen is open for about 140 days; it takes the resort 100 days to break even and cover costs. If the season is compressed by a few dozen days, then the resort becomes unprofitable. As temperatures warm and snowpack melts earlier, some predict that the ski industry may succumb to climate change and fold.[48]

Other industry experts view climate change as less of a worry for the Rockies' ski resorts. Vail Resort's senior vice president, Bill Jenson, argues that the Rocky Mountain region has an inherent advantage over ski resorts across the world because of its relatively high altitude. Ski areas at lower elevations in Europe, New England, the Pacific Northwest, and the Sierra Nevada will suffer rising snowlines and warmer winters before the Rockies.[49] A study presented at the Fifth World Conference on Sport and the Environment, December 2003, corroborates Jenson's opinion. The study found that resorts below 1,500 meters (4,800 feet) would suffer the worst effects of climate change because of a rise in the "snow-reliability" line, which is defined as snow cover of 30 to 50 centimeters, for at least seven out of every 10 winters. In general, the resorts in the Rocky Mountain region are well above 1,500 meters.[50] It is suggested, however, that many ski resorts are simply afraid to admit the impending problems to the stability of the ski industry because customers may be reluctant to purchase housing or teach their children to ski.[51] While resorts contend that snowmaking can buffer any decreased snowpack across the region, snowmaking is expensive and is not a viable option for smaller ski resorts. Because most skiers learn to ski at smaller resorts, either in the Rockies or elsewhere in the country, as these resorts go out of business, the industry's client base will be greatly diminished. If fewer people learn to ski, large ski resorts will not be able to sell as many passes and may eventually fail.[52]

Our findings show that the region will experience shorter winters and warmer spring and fall temperatures (Figure 17). As result, summer weather tourism across the region will most likely improve. Loomis et al. 1999 attempted to quantify the changes in recreation under climate change. They found that a 2.5°C increase in temperature and a seven percent increase in precipitation would decrease downhill and cross-country skiing by 52 percent and increase reservoir (9 percent), beach (14 percent), golf (14 percent), and stream recreation (3.5 percent) relative to 1990 use levels.[53]

Scott and McBoyle (2001) used a Tourism Climate Index to find that the length and quality of the summer tourism season in the mountains of western Canada would improve substantially under probable climate change.[54]

To estimate the benefits of climate change to summer activities in Rocky Mountain National Park, Richardson et al. surveyed visitors to gather information on recreational experience and willingness-to-pay. This data was projected into the Hadley general circulation model (a predicted increase of 2°F) and the Canadian Climate Center general circulation model (a predicted increase of 4°F). Richardson et al. concluded that the historical mean willingness-to-pay was about $314.95 per trip and $24.47 per day, per person. The model's outcome resulted in a 4.9 to 6.7 percent increase ($330.38 to $336.05 per trip) in willingness-to-pay with the temperature and precipitation changes forecasted by the models. With increases in summer temperatures and precipitation, Richardson et al. predict increases in recreation activities like hiking, climbing, and picnics in the region that may offset the economic losses experienced by winter recreation. Given predicted climate changes, tourists will likely be willing to pay more for a summer recreational experience in the mountains, allowing for further investments into summer recreational facilities.[55]

Change in Ski County Snowpack and Temperature, 1976 to 2085*

Figure 17

*1976 represents the average from 1961 to 1990, and 2085 represents the average from 2070 to 2099.

Ski Resort Counties	**Snowpack**, Centimeters (cm) of Snow Water Equivalence on April 1				**Temperature**, Degrees Celsius					
			Change, 1976 to 2085		Winter			Summer		
	1976	2085	(cm)	Percent	1976	2085	Change, 1976 to 2085	1976	2085	Change, 1976 to 2085
Blaine County, Idaho	14	8	-6	-41%	-8	-3	+5	15	24	+9
Eagle County, Colorado	15	6	-8	-57%	-10	-5	+5	11	19	+8
Flathead County, Montana	35	24	-12	-34%	-8	-3	+5	13	22	+9
Gallatin County, Montana	12	8	-4	-33%	-7	-3	+5	14	24	+9
Grand County, Colorado	13	6	-7	-54%	-10	-5	+5	11	19	+8
Gunnison County, Colorado	15	8	-8	-50%	-12	-7	+5	11	19	+8
Pitkin County, Colorado	26	15	-11	-43%	-11	-5	+5	10	18	+8
Routt County, Colorado	16	8	-8	-50%	-10	-5	+5	13	21	+8
Salt Lake County, Utah	9	1	-8	-84%	-3	3	+6	19	27	+8
San Miguel County, New Mexico	6	1	-5	-82%	-6	-0	+5	15	22	+7
Summit County, Colorado	20	10	-10	-50%	-9	-4	+5	12	20	+8
Summit County, Utah	13	5	-8	-61%	-11	-5	+5	9	17	+8
Taos County, New Mexico	4	0	-4	-89%	-5	-1	+5	15	23	+7
Teton County, Wyoming	45	33	-12	-26%	-12	-8	+5	10	19	+9

Looking to the Future

The Rocky Mountain region is in for fundamental changes to the way our climate functions throughout the 21st century, given humans' patterns of greenhouse gas emissions as projected by both the downscaled HadCM3 and PCM models. Research has show that climactic changes are currently hurting, and will likely further exacerbate threats to ecosystem health, traditional revenue sources of the region, including tourism and agriculture, and the health and comfort of Rockies residents. In order to reduce the negative effects of our changing climate, we may do two things: slow the change by reducing greenhouse gas emissions, and/or adapt to the changing climate.

Mitigation programs that aim to reduce greenhouse gas emissions have been enacted on the national level to lessen the consequences of climate change. Agreements like the Kyoto Protocol, which call for reductions in human-forced greenhouse gasses through a carbon trading market, aim to decrease the amount of carbon dioxide and other greenhouse gasses.

Although mitigation is an important part of minimizing the effects of global changes, greenhouse gasses have a residence time of many decades or centuries, and emissions from the 20th century will be felt well through the 21st century. This does not excuse politicians from creating policy to mitigate greenhouse gasses to reduce impacts on future generations. It demonstrates the importance of adapting to probable changes in climate. Adaptation entails recognizing the effects of climate change and altering management techniques to work with projected changes. The IPCC outlines a few suggestions for adapting to climate change: allow ecosystems to adapt naturally to climate change, ensure that food production is not threatened, and meet the needs of the current generations without impairing the ability of future generations to meet their own needs.[56] In order for the Rockies region to successfully adapt to the outcome of an altered climate, policy makers and residents alike must recognize the probable consequences now and plan for altered climates and resulting altered lifestyles. The national, regional, and local conversations must no longer be centered upon whether the climate is changing, but rather upon what we might do to slow and manage the change.

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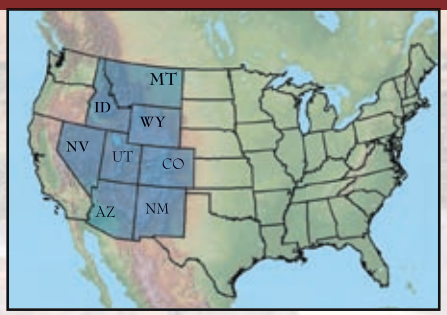
Environmental Justice

Income, Race, Ethnicity, and Toxic Pollution in the Rockies Metro Areas

By Angela Banfill, Bryan Hurlbutt,
and Caitlin O'Brady

THE 2006 COLORADO COLLEGE STATE OF THE ROCKIES REPORT CARD



The environmental movement in the Rockies region has managed to protect and preserve great expanses of open space, wilderness, water, and wildlife in the face of steady pressure to exploit the region's natural riches. However, while environmentalists have devoted much time and energy to protecting other species, they have done less to protect their own. Critics of environmentalism often cite activists' preference for nature over humanity, suggesting they have a blind spot for the welfare of people. While environmentalists have no inherent disregard for people, they may be ignorant of the people that most often need protection, namely minority and low-income groups.

The unfortunate reality that not everyone is equally exposed to environmental harm, and that harm is not randomly distributed, is the driver of a movement towards "environmental justice." Drawing upon both the Civil Rights Movement and the environmental movement, environmental justice is based upon the idea that people of every race, ethnicity, and income group deserve equal rights to clean air, water, and land.

In the Rockies, certain demographic groups are disproportionately exposed to a full quiver of environmental assaults, including air pollution, water pollution, and nuclear radiation, while those reaping the financial benefits of hazardous activities are lightly exposed. Our analysis shows that toxic-polluting industrial facilities in the Rockies are located in neighborhoods where residents earn nearly $3,000 less per capita, are four percent more non-white, and are six percent more Hispanic than in neighborhoods without toxic facilities (Figure 1 through Figure 3). This imbalance in costs and benefits of polluting activities flies in the face of our region's commitment to a healthy environment and healthy citizens. Socioeconomic status and race should not be determining factors in the ability of a Rockies family to lead a healthy and happy life,

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and industry must not use poor or minority communities as the path of least resistance for their negative externalities.

Unless this region is content as the land of opportunity for some, rather than all, we must address the injustices taking place in our communities. The environmental justice movement, of prime importance to disempowered communities in the region, remains in a state of infancy. First, this report explores the environmental justice movement's beginnings, development, and current state in the U.S., taking into consideration obstacles to furthering the movement. Following this background information, the focus shifts to environmental justice issues in the Rockies region. Finally, data on income, race, ethnicity, and proximity to sources of toxic pollution are presented generally for the entire region and in-depth for the region's 23 largest metro areas.

Rockies Region

Per Capita Income and Proximity to Toxic Facilities, 2000

Figure 1

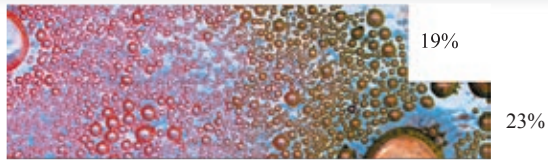
Source: See "Mapping Sources of Toxic Pollution" on page 109.

Percentage of Rockies Region Population Who Identify as

Non-white and Proximity to Toxic Facilities, 2000

Figure 2

Source: See "Mapping Sources of Toxic Pollution" on page 109.



Percentage of Rockies Region Population Who Identify as

Hispanic or Latino and Proximity to Toxic Facilities, 2000

Figure 3

Source: See "Mapping Sources of Toxic Pollution" on page 109.

Environmental Justice in the U.S.

In 1978, Lois Gibbs realized her family and neighbors in Love Canal, New York, lived next to 20,000 tons of hazardous chemicals. While leading her working-class community on a successful three-year struggle to relocate 833 homes, Lois realized that no organization existed in the country to assist and empower communities in protecting themselves from environmental hazards, so she founded what is now called the Center for Health, Environment, and Justice (CHEJ) in 1981. "Neighbor by neighbor, one community at a time… CHEJ helps to harness the power of the grassroots to collectively change the balance of power."[1]

The environmental justice movement emerged as people, like Lois Gibbs, recognized the relatively high exposure of low-income and minority communities to environmental hazards. The movement has produced results over the years, but the cause has a long way to go. A number of strong grassroots organizations, like CHEJ, are effectively addressing specific instances of environmental justice and building general support for regulation, but today, no enforceable regulation preventing inequitable environmental harm is in place at the federal or state level.

Uncovering Environmental Inequality

The federal government first acknowledged disparities in environmental equity in 1971 when the United States Counsel on Environmental Quality declared that low-income groups and people of color are disproportionately exposed to significant environmental hazards.[2] It wasn't until 1982, however, that the plight of the nation's disadvantaged fully emerged into public view. That year, residents of Warren County, North Carolina, which is primarily African-American, staged a non-violent demonstration to protest the siting of a polychlorinated biphenyl (PCB) landfill near their homes. Despite the major opposition, construction of the facility proceeded, but the demonstration was still a success. The more than 500 arrests that resulted attracted national attention to the budding environmental justice movement[3] and spurred a cascade of research on the issue.

A 1983 report by the U.S. General Accounting Office found that three-fourths of off-site, commercial, hazardous wastefills in the southeastern United States were in black communities, even though blacks made up only one-fifth of the regional population.[4] That same year, Robert Bullard determined that waste dumps in Houston were not randomly scattered. Instead, they were disproportionately located in black neighborhoods. The study led to his book, "Dumping in Dixie: Race, Class, and Environmental Quality," one of the founding pieces of literature in the environmental justice movement.[5]

Evidence of environmental injustice continued to mount. In 1987, the United Church of Christ Commission for Racial Justice published "Toxic Waste and Race," finding that race is the most significant factor in siting waste facilities. The paper showed that three-fifths of all blacks and Latinos and half of all Asian Americans and Native Americans lived in communities with at least one toxic waste site. A 1994 follow-up to the study not only confirmed these findings, but also found that environmental conditions had actually worsened for minorities.[6] Early environmental justice studies focused primarily on race and ethnicity, but as the movement grew to encompass low-income groups, researchers expanded their scope to include socio-economic status.

Limited Response to Environmental Justice

In the early 1990s, environmental justice advocates succeeded in putting the movement's objectives on the national agenda thanks to the work of researchers and grassroots organizations in documenting and publicizing environmental inequality. The White House established the Office of Environmental Equity, now the Office of Environmental Justice, as an arm of the United States Environmental Protection Agency (EPA) in 1992. President Bill Clinton

issued Executive Order (E.O.) 12898 in 1994, requesting that federal agencies identify and address the disproportionate health and environmental effects of its actions.[7] Finally, environmental justice gained a foothold in the United States government.

Through E.O. 12898, environmental justice complaints against federal agencies can be taken to the EPA. However, the EPA has heard more than 130 environmental justice cases, and in none of those cases has the agency cited an environmental justice violation. The agency defends its decisions by explaining that Clinton's E.O. 12898 requires only assessment of inequitable environmental effects, not their elimination.[8]

In 2003, the United States Commission on Civil Rights reprimanded the EPA, the U.S. Department of Housing and Urban Development, the Department of Transportation, and the Department of the Interior for failing to implement E.O. 12898 by not incorporating environmental justice into their programs.[9] The following year, an independent auditor criticized the EPA for its poor efforts to improve environmental justice.[10] The EPA's opinion of E.O. 12898 certainly contributes to the agency's sluggish behavior in enforcing it. "The agency can't base what it's doing on an executive order," claims Barry Hill, director of the Office of Environmental Justice. "If someone said we had to, I'd have to say 'Are you on drugs?'"[11]

While government efforts to curb environmental injustices seem to be all talk and little action, there are instances of solid equity enforcement and promotion. In 1998, the Nuclear Regulatory Commission (NRC) killed a Louisiana company's plan to construct a nuclear facility that would require relocating a road between two black neighborhoods. The NRC cited the company for failing "to fully assess the disproportionate socio-economic impacts of the proposal on the adjacent African-American communities."[12]

Additionally, the Environmental Justice Small Grants Program, established in 1994 by President Clinton, survives to this day.[13] Under this program, the EPA annually selects projects across the nation to receive $25,000 grants for the advancement of environmental justice. The number of grants awarded has dropped precipitously. During Clinton's last five years in office, 684 grants were awarded, compared to 296 during President Bush's most recent five years in office.[14]

Obstacles to Environmental Justice

Although the environmental justice movement has had some success in documenting injustice, garnering national attention and support, and paving legislative ground, it still has a long way to go. A variety of obstacles bar advancement of the movement's goals. The impotence of E.O. 12898 at remedying environmental inequities, coupled with a weak legislative framework, provides little support for at-risk communities. Several other factors slow the wheels of the environmental justice movement: industry and worker opposition; tension between environmental justice and mainstream environmentalism; opponents to the fundamental ideas of creating equity through policy or legislating people's private decisions; a small activist base; and difficulty producing relevant risk assessments.

Legal Obstacles

The federal government has laws in place that are intended to mitigate environmental harm and keep people healthy. On paper, they call for equal protection for all, but in action, they do not result in equal protection. There are no national laws that specifically require environmental equity, leaving little legal foundation for victims of environmental injustice to redress their grievances. As a result, environmental justice has a dismal legal case history. Typically, litigation on the grounds of an environmental injustice involves invoking Title VI of the Civil Rights Act of 1964. Title VI requires that the victim prove intentional discrimination, a nearly impossible task. Consequently, no environmental justice suits have been resolved in favor of the victim under the Civil Rights Act.[15]

State governments, which have little experience addressing environmental injustice, often seek guidance from the U.S. EPA.[16] Unfortunately, the EPA has not set a strong example. National civil rights law mandates that every state annually assures the EPA that all state-approved permits do not create environmental injustice. Although states continue to make assurances, a 2002 Public Interest Law Center of Philadelphia survey of environmental justice in state environmental agencies illustrated a general ignorance of

environmental injustices. Of the 31 states that responded, only three had any environmental justice program, suggesting that few states have grounds for their assurances to the EPA.[17]

Other Obstacles

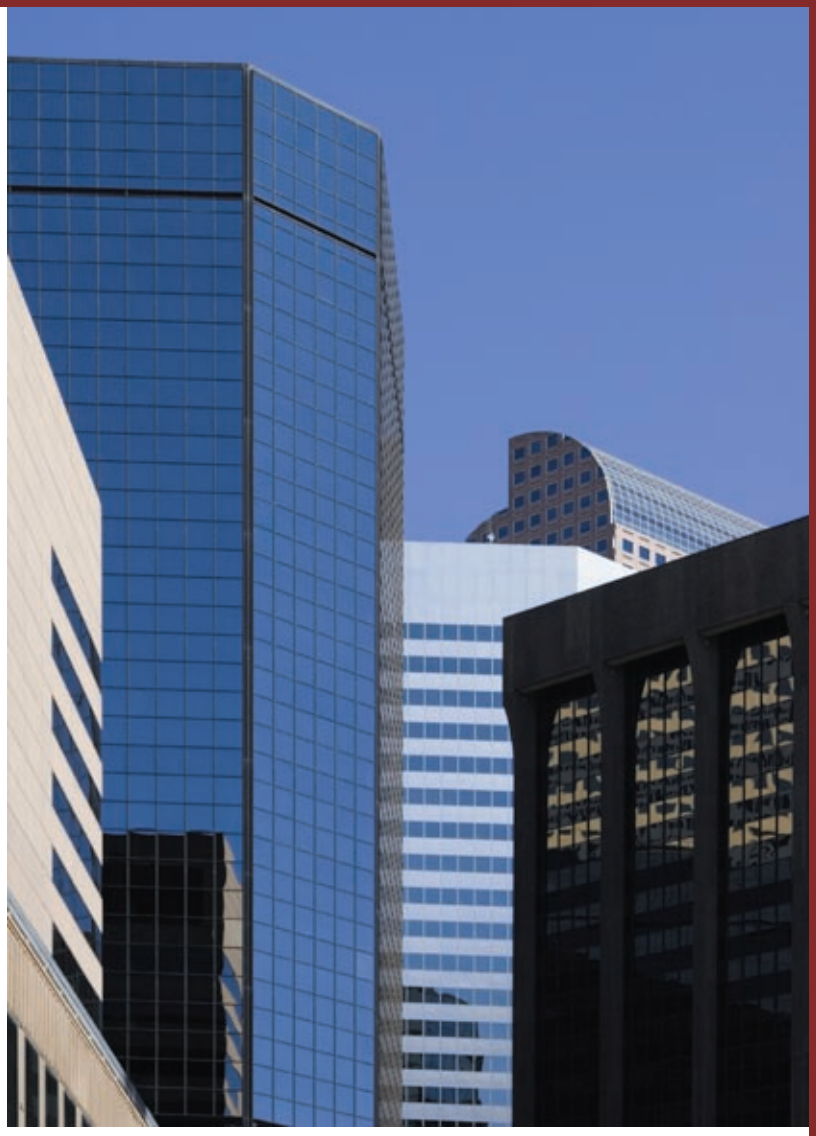
Economic factors give industry incentive to perpetuate environmental inequality. It simply costs less to site toxic facilities in low-income areas where land is cheap. Furthermore, siting a hazardous facility in a poor or minority area can be easier, because these communities may have fewer resources available to devote to understanding the environmental implications of the siting, organizing opposition, and hiring adequate legal representation.

Additionally, some groups argue that environmental regulation and protection injure income potential of workers, many of whom are the poor minorities the environmental justice advocates are working to protect. "Clean air and water is in everyone's best interest," explains John Meredith of the African-American Leadership Network, "but the elitist agenda of the environmental movement hurts… economic well-being."[18] Residents living near a hazardous facility may depend on that facility as a source of empoyment, and, therefore, they may be opposed to any regulations that could potentially lower their wages or cost them their jobs.

A surprising obstacle to environmental justice is mainstream environmentalism itself. Although both activist groups share the goal of preventing environmental degradation, they give priority to very different types of environmental problems. Mainstream environmental activism, especially in the West, is strongly focused on preserving natural landscapes and ecosystems and not on protecting the public from environmental hazards.

It would be unfair and inaccurate to implicate the entire mainstream environmental movement, but there is clearly some conflict between certain mainstream environmentalists and environmental justice advocates. As a result, these groups have had difficulty working collaboratively toward their common goal. Some environmentalists warn that working on environmental justice issues is a drain on their political power and other resources that could be better used to address more important problems, mainly protecting nature. Some environmental justice advocates accuse mainstream environmentalists of being elitists who would devote more care, time, and money to saving one tree than one human being.

In general, the American public has some ideological resistance to the environmental justice movement. Many Americans support policy that is blind to race and class, contending that policy should not provide for one group of people differently than it does for another. They support equality in the legal process rather than effective equality, or equality in the ultimate outcomes of the legal process.[19] Some contend that specifically assisting communities deemed at particular risk of environmental injustice implies that others don't deserve as much justice, thereby marginalizing the very underpinnings of the movement. Also, many Americans believe that people's free choices should remain out of the public purview, and some argue that living in an area exposed to hazardous chemicals is simply one's free choice.[20]



Environmental Justice in the Rockies

The Rockies region bears an inequitably high share of the nation's pollution, as documented in the *2005 State of the Rockies Report Card*. The EPA requires certain industrial and governmental polluters to report details on the emission of hazardous substances from their facilities as part of the national Toxics Release Inventory. TRI emission data show that more toxic pollution is released per square mile in the Rockies, even with its low population density, than the rest of the country. However, the situation is probably even more inequitable than the data show, because mining and agriculture, two of the largest and most environmentally degrading industries in the Rockies region, are not accurately documented in the TRI.

Almost all agriculture is exempt from reporting to the TRI, even though on average, 20 acres of every square mile in the Rockies region are treated with chemical fertilizers and soil conditioners and 15 acres per square mile are treated with chemical pesticides for agricultural use.[21] In 2002, a controversial court decision reaffirmed the mining industry's exemption from reporting the movement and exposure of unprocessed, but still toxic, waste rock material to the TRI.[22] This exemption is staggering, considering mining accounts for nearly half of all toxic emissions to air, land, and water in the United States.[23]

Some of the inequity in the Rockies results as the rest of the nation takes what it wants from the region and leaves behind a mess. Heavily polluting industrial operations, like open-pit mines, extract natural resources from the region for use elsewhere. Additionally, the rest of the nation puts what it does not want in the Rockies. Big pollution sources, like coal-burning power plants supplying electricity to West Coast cities, are sited in the Rockies region, where less opposition is encountered.

Understanding Injustice in the Rockies

Aside from this national environmental injustice against the Rockies region, environmental injustice is taking place within the Rockies itself. The demographic evolution of the region, combined with the above-mentioned regional industrial activities, create the unique growing conditions for its own organic injustices and corresponding movements to remedy them.

Historically, the Rockies have been highly reliant on mineral extraction, timber harvest, and agriculture for income in rural communities. While the image of black smoke from steel and power plants of large Midwest and East Coast cities is readily associated with corresponding health hazards, classic images of gold prospectors, lumberjacks, and potato farmers are not readily viewed as threats to community health. But mining, forestry, and agriculture have modernized into large, highly polluting industries that impact nearby rural communities. And the Rockies region as a whole is more modern than people tend to think. Furthermore, most people in the region live in cities—cities with smokestacks, wastewater pipes, and landfills.

Native Americans have a long-standing history in the region and long-standing environmental injustices to accompany it. Native American culture is intimately tied to place and environment, and tribes have had the time and unity to develop strong environmental justice-related resources, which are only bolstered by tribal sovereignty over reservation land. However, poverty throughout Native American reservations is a strong incentive for tribes to accept environmental risks in exchange for financial prospects. Thus, Native Americans are still common victims of environmental injustice along with other minority groups and people earning low incomes. Other minority groups in the Rockies region are less unified and have not inhabited the region for as long, resulting in less developed civil rights and environmental justice infrastructure, but pockets of successful activism do exist.

One example is the Southwest Network for Environmental and Economic Justice (SNEEJ), based in Albuquerque, New Mexico. SNEEJ is one of the leading environmental justice organizations in the nation. Since it was founded in 1990, SNEEJ has worked "to

strengthen the work of local organizations and empower communities and workers to impact local, state, regional, national, and international policy on environmental and economic justice issues"[24] with the following goals:

- Provide grassroots organizations throughout the region and Mexico with a means of sharing local victories and organizing ideas, as well as promoting solidarity with one another;
- Provide skills, organizing, and technical training and leadership development to local network affiliates relevant to the history and cultures of the Southwest, and involve existent human resources in bringing such efforts to fruition;
- Promote leadership by people of color in an effort to address the poisoning of communities of color;
- Strengthen work which links in practice environmental and economic justice;
- Develop regional perspectives and strategies to address environmental degradation and other social, racial, and economic justice issues;
- Develop a bi-national organization which brings together U.S. and Mexican-based grassroots community, labor, human rights, youth, and student organizations.[25]

Government Response to Rocky Mountain Environmental Injustice

Environmental justice in the Rockies region lacks solid support from the national government, and state government has little infrastructure in place for addressing disproportionate environmental burden in the region. But there are signs of progress. Communities in the Rockies are receiving national grants to address environmental justice problems, and state governments are incorporating environmental justice into their environmental departments.

At the federal level, the EPA is facilitating a handful of projects in the Rockies region under the Small Grants Program and a similar initiative, the Environmental Justice Collaborative Problem-solving Grant Awards. In 2004, two small grants were awarded in the Rockies. One went to a Denver organization to teach youth how to research environmental hazards and how to overcome institutional and policy barriers faced by low-income and minority populations. The other went to improve health on the Wind River Indian Reservation in Wyoming.[26] Also in 2004, Colorado environmental justice advocates received two problem-solving grants. One was awarded to a Pueblo nonprofit for the education of Latino and black communities that are subjected to high levels of air and water pollution. The other went to a Denver community organization to create an information center for Spanish-speaking residents living in a heavily exposed neighborhood.

A 2004 state-by-state survey of environmental justice legislation, policies, programs, and initiatives shows that there is not one formal law or statute in the eight-state Rockies region addressing environmental injustice. Three out of eight Rockies states (Idaho, Nevada, and Wyoming) have no initiatives in place to address unfair environmental hazards, a ratio more than double the 18 percent of states nationwide that lack environmental justice initiatives.[27] Although the other states in the region claim no formal environmental justice policy, they have at least begun to lay some basic foundations that may one day support environmental justice legislation.

The secretary of the New Mexico Environmental Department (NMED) says state government "needs to look at issues of environmental justice—why pollution-creating facilities are too often put in poor, minority communities." Most state government awareness of environmental justice issues is arising in state environmental agencies, such as NMED. Even though New Mexico has no formal environmental justice policies on the books, NMED officials are meeting with environmental justice advocacy groups, and New Mexico has become the only Rockies state to provide in-depth environmental justice information on its Web site. Additionally, NMED's secretary has pledged to "enforce environmental laws that are on the books [to promote environmental justice]."[28]

Arizona's Department of Environmental Quality (DEQ) hired a full-time environmental justice staffer and is required to notify poor and minority communities of proposed hazardous siting plans within 31 days of receiving permitting applications. Colorado's State Environmental Project allows violators of environmental regulations to implement projects to improve environmental justice, like reducing health risk from environmental exposure to low-income communities, in exchange for a penalty reduction.[29]

Rockies' states are also addressing environmental inequity through Performance Partnership Agreements (PPAs) with the EPA. A PPA is an agreement that the state will support EPA's environmental justice efforts, which emphasize the fair treatment of people of all races, incomes, and cultures with respect to environmental programs. Utah, Colorado, and Montana are onboard, but it must be noted that a PPA is only as powerful as the EPA's weak environmental justice program.

Documenting Environmental Inequality in the Rockies' Metro Areas

Environmental justice has a long way to go in the Rockies region. An important step in furthering the movement is increasing awareness of the issue. Environmental inequality is overshadowed by other mainstream environmental issues in the Mountain West. In part, this is because many just do not realize environmental inequality is a widespread reality in the region. The following research shows that environmental injustice is a reality in the Rockies.

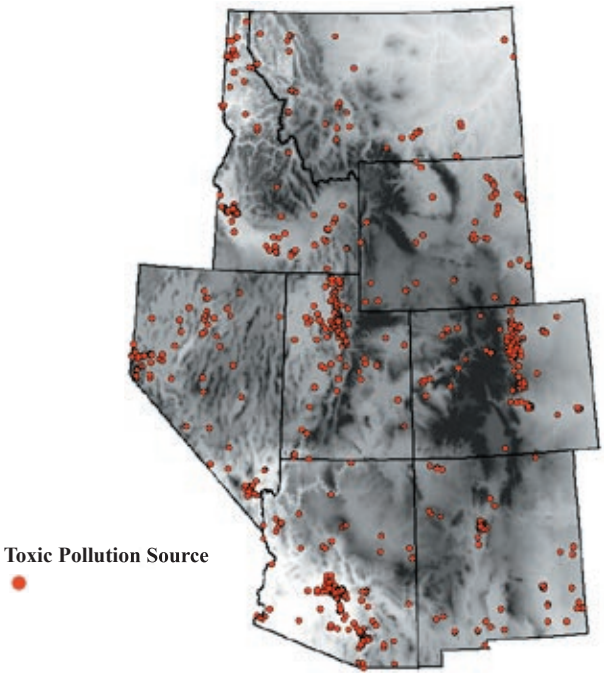
Mapping Sources of Toxic Pollution

Our study analyzes the income, race, and ethnicity of neighborhoods near sources of toxic pollution throughout the eight-state Rocky Mountain West. Over 10 percent of 18 million people living in the region live in neighborhoods near sources of toxic pollution. People living near toxic pollution sources earn 14 percent less income, are four percent more non-white, and are six percent more Hispanic than people not living near toxic pollution sources (Figure 1 through Figure 3).

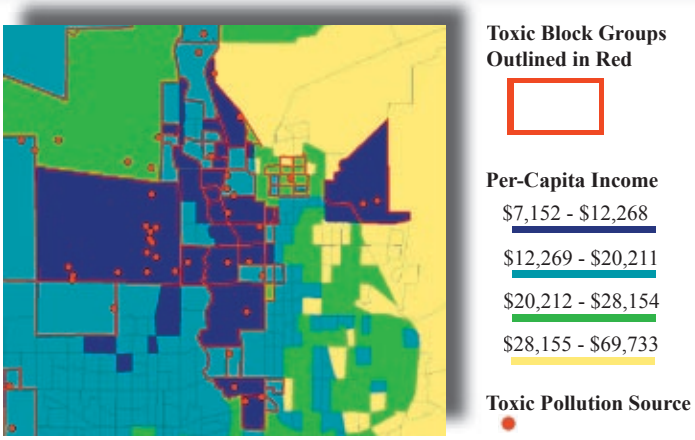
Sources of toxic pollution include all industrial and federal government facilities which were required to report to the EPA's 2003 Toxics Release Inventory (TRI) (Figure 4). The EPA is mandated by law to provide a publicly accessible database, the TRI, on the annual management details of over 600 toxic chemicals released by the more than 25,000 polluting industrial and federal facilities in the United States. Over 1,000 TRI facilities in the Rockies emit toxic pollution to the region's air, water, and land. These facilities include coal-burning power plants, open-pit mines, food-processing plants, and federal military and energy labs and testing grounds. Not all sources of pollution are required to report to the TRI. Visit www.epa.gov/tri for more information.

Data on per-capita income, percentage of the population that identify as non-white, and percentage of the population that identify as Hispanic or Latino of any race come from the 2000 Census. The United States Census Bureau divides counties into finer geographic areas called block groups. These are the "neighborhoods" used in the analysis. In the Rockies region, there are 281 counties and 13,214 block groups, or about 50 block groups per county. Block groups vary in size from just a few city blocks in a densely populated downtown to hundreds of square miles in sparsely populated areas. Block group population in the Rockies ranges from 0 to 14,658 residents.

All 1,066 TRI-reporting Facilities, 2003
Figure 4
Source: See "Mapping Sources of Toxic Pollution" on page 109.



Salt Lake City, Utah
Sources of Toxic Pollution, Toxic Block Groups, and Per Capita Income
Figure 5
Source: See "Mapping Sources of Toxic Pollution" on page 109.



Salt Lake City Per-Capita Income: $20,211

For the analysis, each of the 13,214 block groups in the Rockies has been classified as either "toxic" or "clean" depending on the proximity of that block group to a toxic facility. Figure 5 shows toxic block groups outlined in red, as they are defined below.

Toxic Block Group: Neighborhood either containing a toxic facility within its boundary or with a toxic facility within 1,000 meters of its geographic center.

Clean Block Group: Neighborhood that does not qualify as toxic.

It is important to note that residents of a toxic block group are not necessarily experiencing any negative health effects as a result of the nearby toxic facility. The health threat from a TRI facility varies dramatically from site to site depending on the amount of pollution released, the toxicity of the released chemicals, and the environmental conditions into which the pollution is released. That said, the presence of any facility that handles toxic chemicals elevates the potential toxic health threat to the surrounding area.

Toxic Pollution in the Rockies' Metro Areas

Given the clearly unequal toxic burden of low-income, non-white, and Hispanic neighborhoods regionally (Figure 1 through Figure 3), the analysis is taken further by looking at the Rockies' largest population centers, which are listed in Figure 6. Around 75 percent of all people in the Rockies live in the 23 most populous metropolitan statistical areas (MSA) in the Rockies, which include urban areas and their connected suburbs. About 70 percent of the region's toxic facilities are in these metro areas. The metro areas have been divided into two groups, large and small, to compare similar-sized metro areas. The 12 large metro areas are home to 68 percent of the

Metro Areas and Their Counties Included in the Study

Figure 6

Large Metro Areas

Albuquerque, New Mexico:
Bernalillo County, New Mexico; Sandoval County, New Mexico; Valencia County, New Mexico.

Boise, Idaho:
Ada County, Idaho; Canyon County, Idaho.

Colorado Springs, Colorado:
El Paso County, Colorado.

Denver-Boulder, Colorado:
Adams County, Colorado; Arapahoe County, Colorado; Boulder County, Colorado; Denver County, Colorado; Douglas County, Colorado; Jefferson County, Colorado.

Fort Collins, Colorado:
Larimer County, Colorado; Weld County, Colorado.

Las Vegas, Nevada:
Clark County, Nevada; Mohave County, Arizona; Nye County, Nevada.

Phoenix-Mesa, Arizona:
Maricopa County, Arizona; Pinal County, Arizona.

Provo-Orem, Utah:
Utah County, Utah.

Pueblo, Colorado:
Pueblo County, Colorado.

Reno, Nevada
Washoe County, Nevada

Salt Lake City-Ogden, Utah:
Davis County, Utah; Salt Lake County, Utah; Weber County, Utah.

Tucson, Arizona:
Pima County, Arizona

Small Metro Areas

Billings, Montana:
Yellowstone County, Montana.

Casper, Wyoming:
Natrona County, Wyoming.

Flagstaff, Arizona:
Coconino County, Arizona; Kane County, Utah.

Grand Junction, Colorado:
Mesa County, Colorado.

Great Falls, Montana:
Cascade County, Montana.

Las Cruces, New Mexico:
Dona Ana County, New Mexico.

Missoula, Montana:
Missoula County, Montana.

Pocatello, Idaho:
Bannock County, Idaho.

Santa Fe, New Mexico:
Los Alamos County, New Mexico; Santa Fe County, New Mexico.

Yuma, Arizona:
Yuma County, Arizona.

Rockies' population, and the 11 small metros are home to seven percent of the population.

Findings for per-capita income, percentage non-white, and percentage Hispanic of toxic block groups and clean block groups in the larger and smaller metro areas are displayed on the following three pages. The findings show that in the larger metro areas low-income and minority groups bear a clearly disproportionate burden, but in the smaller metro areas, the results vary.

Of the 12 larger metro areas, toxic block group residents (compared to all block group residents): earn less income in 11 metros, are more non-white in 11 metros, and are more Hispanic in 11 metros. Of the 11 smaller metro areas, toxic block group residents (compared to all block group residents): earn less income in six metros, are more non-white in six metros, and are more Hispanic in five metros. All results are displayed on the following pages (Figure 7 through Figure 15). The biggest inequalities in the larger metros for each category are:

Income (Figure 7 through Figure 9)

-*Salt Lake City, Utah*: Per-capita income is 23 percent lower in toxic block groups than it is in clean block groups.

-*Phoenix, Arizona*: Per-capita income is 21 percent lower in toxic block groups than it is in clean block groups.

-*Pueblo, Colorado*: Per-capita income is 19 percent lower in toxic block groups than it is in clean block groups.

Race (Figure 10 through Figure 12)

-*Phoenix, Arizona*: People living in toxic block groups are 13 percent more likely to be non-white than are people in clean block groups.

-*Salt Lake City, Utah*: People living in toxic block groups are nine percent more likely to be non-white than are people in clean block groups.

-*Colorado Springs, Colorado*: People living in toxic block groups are eight percent more likely to be non-white than are people in clean block groups.

Ethnicity (Figure 13 through Figure 15)

-*Phoenix, Arizona*: People living in toxic block groups are 17 percent more likely to be Hispanic than are people in clean block groups.

-*Pueblo, Colorado*: People living in toxic block groups are 16 percent more likely to be Hispanic than are people in clean block groups.

-*Albuquerque, New Mexico*: People living in toxic block groups are 11 percent more likely to be Hispanic than are people in clean block groups.

Larger Metro Area	All Block Groups (Per-Capita Income)	Toxic Block Groups (Per-Capita Income)	Clean Block Groups (Per-Capita Income)	Percentage Difference in Per-Capita Income of Toxic Block Groups from All Block Groups
Salt Lake City	$19,781	$15,293	$20,396	**-23%**
Phoenix	$21,909	$16,984	$22,682	**-22%**
Pueblo	$17,163	$13,818	$17,454	**-19%**
Albuquerque	$20,025	$16,365	$20,321	**-18%**
Denver	$26,542	$23,096	$26,838	**-13%**
Las Vegas	$21,210	$18,880	$21,314	**-11%**
Colorado Springs	$22,005	$19,717	$22,236	**-10%**
Tucson	$19,785	$18,203	$19,911	**-8%**
Provo	$15,557	$14,587	$15,661	**-6%**
Reno	$24,277	$22,971	$24,364	**-5%**
Boise	$20,280	$19,478	$20,435	**-4%**
Fort Collins	$21,709	$23,393	$21,469	**8%**

Larger Metro Areas

Income of Toxic and Clean Neighborhoods

Figure 7

Source: See "Mapping Sources of Toxic Pollution" on page 109.

Smaller Metro Areas

Income of Toxic and Clean Neighborhoods

Figure 9

Source: See "Mapping Sources of Toxic Pollution" on page 109.

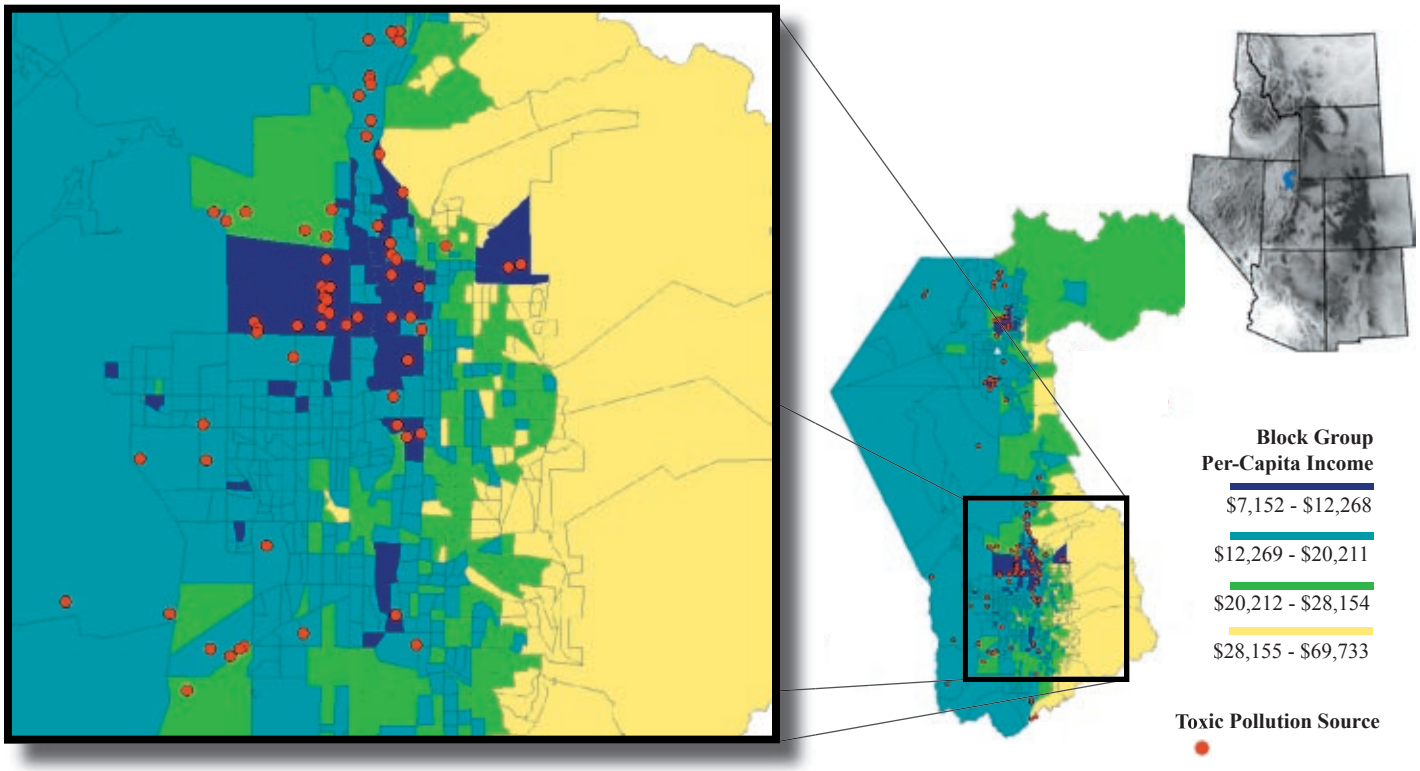
Smaller Metro Area	All Block Groups (Per-Capita Income)	Toxic Block Groups (Per-Capita Income)	Clean Block Groups (Per-Capita Income)	Percentage Difference in Per-Capita Income of Toxic Block Groups from All Block Groups
Billings	$19,303	$15,412	$19,765	**-20%**
Casper	$19,071	$16,733	$19,442	**-12%**
Cheyenne	$19,634	$17,345	$19,974	**-12%**
Grand Junction	$18,715	$16,987	$18,927	**-9%**
Flagstaff	$17,056	$15,908	$17,105	**-7%**
Missoula	$17,809	$16,663	$17,857	**-6%**
Pocatello	$17,148	$17,115	$17,150	**-0%**
Great Falls	$17,566	$18,011	$17,538	**3%**
Yuma	$14,802	$18,653	$14,459	**26%**
Santa Fe	$24,967	$36,089	$24,888	**45%**
Las Cruces	$13,999	$20,346	$13,762	**45%**

Salt Lake City, Utah

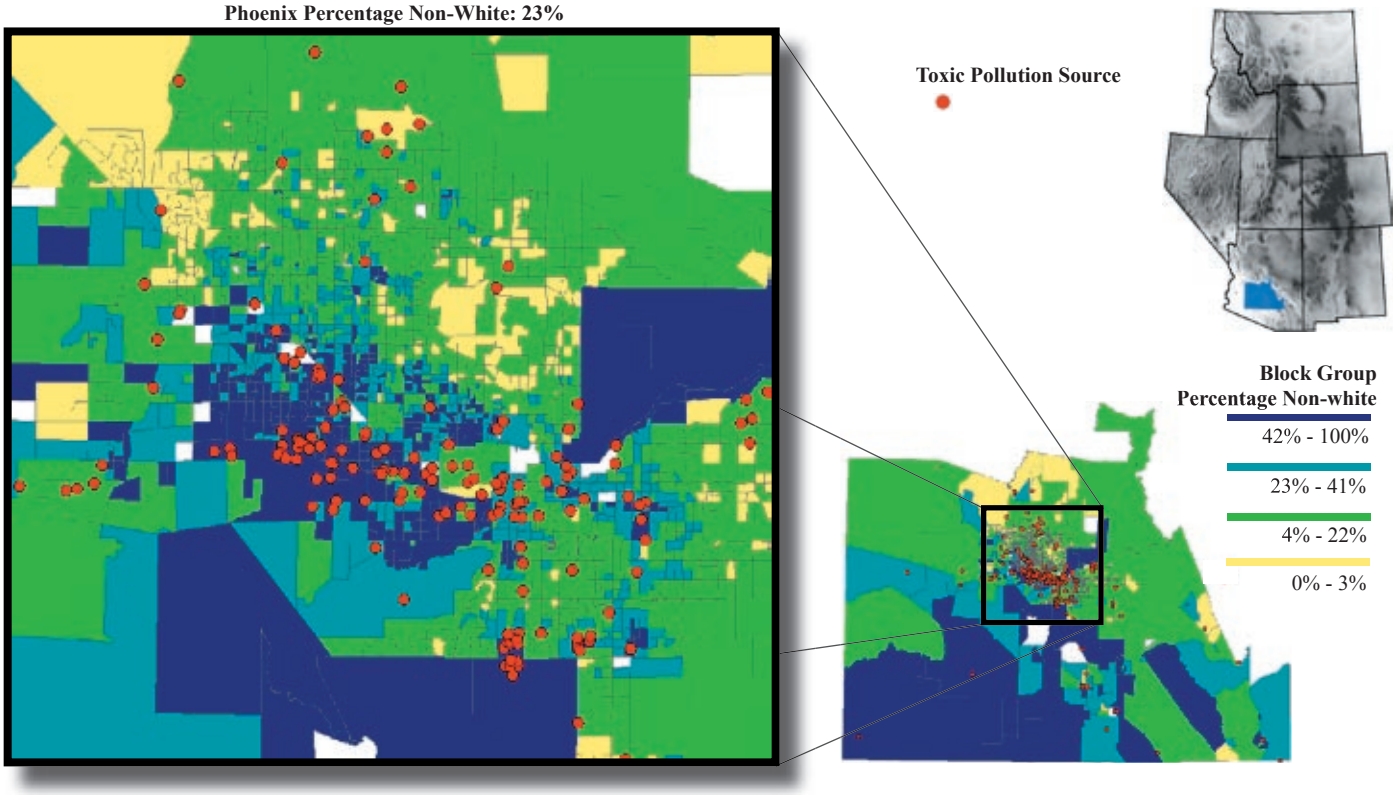
Toxic Pollution Sources and Block Group Per-Capita Income

Figure 8

Source: See "Mapping Sources of Toxic Pollution" on page 109.



Salt Lake City Per-Capita Income: $20,211



Phoenix, Arizona

Toxic Pollution Sources and Block Group Percentage Non-White

Figure 10

Source: See "Mapping Sources of Toxic Pollution" on page 109.

Larger Metro Area	All Block Groups (Percentage Non-white)	Toxic Block Groups (Percentage Non-white)	Clean Block Groups (Percentage Non-white)
Albuquerque	30%	33%	30%
Boise	10%	12%	10%
Colorado Springs	19%	26%	18%
Denver	20%	23%	19%
Fort Collins	13%	13%	13%
Las Vegas	26%	29%	26%
Phoenix	23%	34%	21%
Provo	8%	11%	7%
Pueblo	21%	26%	20%
Reno	20%	17%	20%
Salt Lake City	13%	20%	11%
Tucson	25%	28%	25%

Larger Metro Areas

Percentage Non-White of Toxic and Clean Neighborhoods

Source: See "Mapping Sources of Toxic Pollution" on page 109.

Figure 11

Smaller Metro Areas

Percentage Non-White of Toxic and Clean Neighborhoods

Figure 12

Source: See "Mapping Sources of Toxic Pollution" on page 109.

Smaller Metro Area	All Block Groups (Percentage Non-white)	Toxic Block Groups (Percentage Non-white)	Clean Block Groups (Percentage Non-white)
Billings	7%	10%	7%
Casper	6%	7%	5%
Cheyenne	11%	17%	10%
Flagstaff	35%	55%	34%
Grand Junction	8%	11%	7%
Great Falls	9%	7%	10%
Las Cruces	32%	24%	32%
Missoula	6%	10%	6%
Pocatello	8%	8%	8%
Santa Fe	24%	4%	24%
Yuma	32%	21%	33%

Larger Metro Areas

Percentage Hispanic of Toxic and Clean Neighborhoods

Source: See "Mapping Sources of Toxic Pollution" on page 109. **Figure 13**

Metro Area	All Block Groups (Percentage Hispanic)	Toxic Block Groups (Percentage Hispanic)	Clean Block Groups (Percentage Hispanic)
Albuquerque	42%	52%	41%
Boise	9%	10%	8%
Colorado Springs	11%	13%	11%
Denver	18%	23%	17%
Fort Collins	16%	20%	16%
Las Vegas	21%	23%	20%
Phoenix	25%	40%	23%
Provo	7%	12%	6%
Pueblo	38%	53%	37%
Reno	17%	13%	17%
Salt Lake City	11%	17%	10%
Tucson	29%	30%	29%

Smaller Metro Areas

Percentage Hispanic of Toxic and Clean Neighborhoods

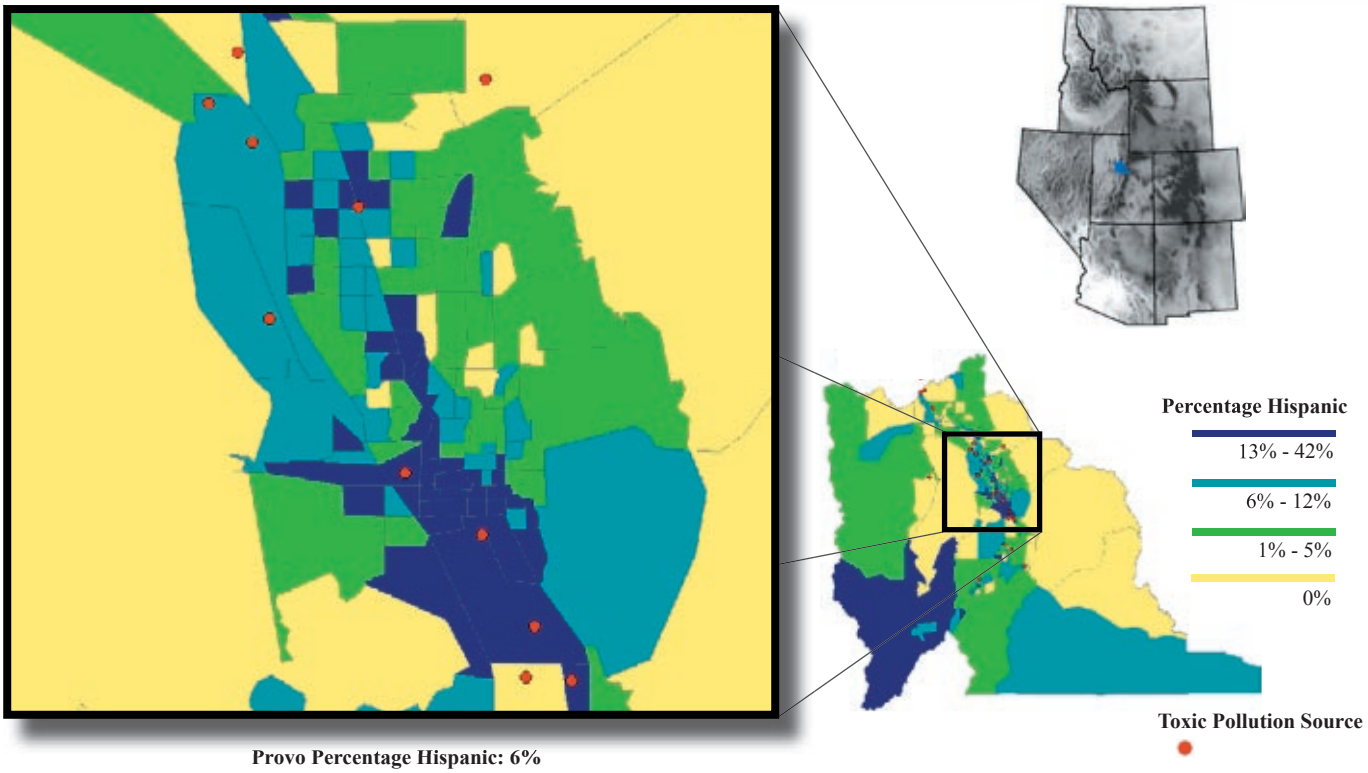
Figure 15 Source: See "Mapping Sources of Toxic Pollution" on page 109.

Metro Area	All Block Groups (Percentage Hispanic)	Toxic Block Groups (Percentage Hispanic)	Clean Block Groups (Percentage Hispanic)
Billings	4%	5%	4%
Casper	5%	4%	5%
Cheyenne	11%	15%	10%
Flagstaff	11%	8%	11%
Grand Junction	10%	14%	10%
Great Falls	2%	1%	3%
Las Cruces	63%	47%	64%
Missoula	2%	2%	2%
Pocatello	5%	6%	5%
Santa Fe	44%	20%	45%
Yuma	51%	22%	53%

Provo, Utah

Toxic Pollution Sources and Block Group Percentage Hispanic

Figure 14 Source: See "Mapping Sources of Toxic Pollution" on page 109.



Provo Percentage Hispanic: 6%

Conclusions

These findings demonstrate a real need for attention to environmental equity in the Rockies region. Low-income and minority neighborhoods are bearing a disproportionate share of the environmental hazard caused by regional economic activities. This unequal burden is clear in the 12 largest metro areas, where over two-thirds of the Rockies' population lives. Keep in mind this metro-oriented study analyzed just one realm of environmental inequality in the Rockies. Another major realm is rural environmental justice. Instances in which small, poor, and remote communities face serious environmental threats are common in this region of large-scale resource extraction.

Upon examining the state of the environmental justice movement, there is much hope in the hard work and success of grassroots organizations in eliminating specific instances of injustice, but much more needs to be done to build a larger network of support. Nationwide, obstacles to environmental justice must be overcome to effectively mitigate current injustices and prevent environmental injustice in the future. Our recommendations for advancing environmental justice in the Rockies include: amending and enacting environmental justice legislation, empowering disenfranchised communities, merging mainstream environmentalism and environmental justice, improving environmental justice research, and confronting the underlying causes of environmental justice.

Endnotes

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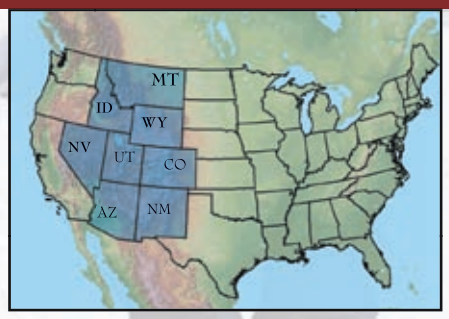
Grading the Rockies

Nurturing the Youth

By Caitlin O'Brady and Bryan Hurlbutt

The 2006 Colorado College State of the Rockies Report Card

"Unless the investment in children is made, all of humanity's most fundamental long-term problems will remain fundamental long-term problems."
-UNICEF, "The State of the World's Children" (1995)

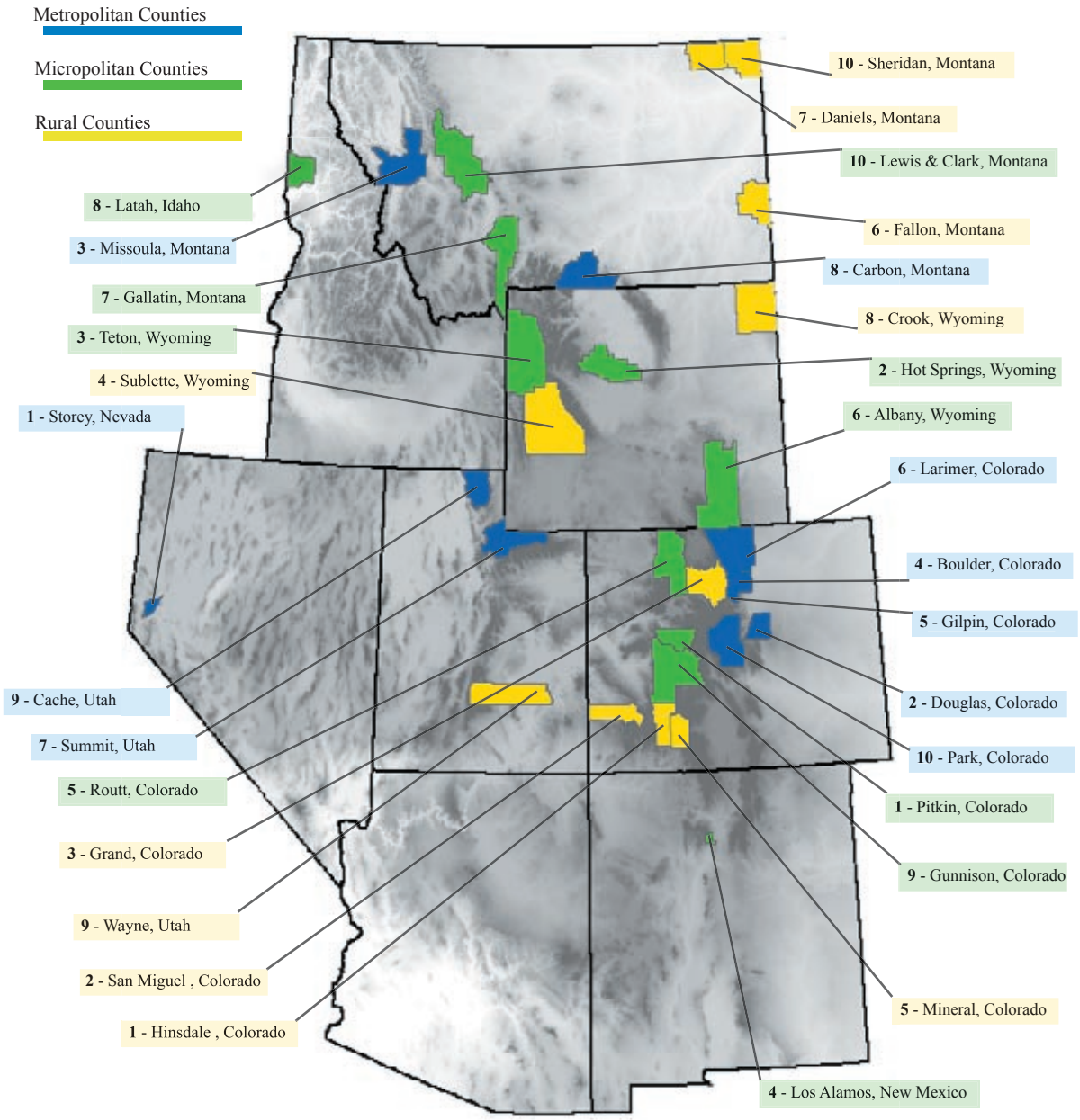


It is not particularly contentious to argue that children are our future and one of our greatest assets. The kids of today will grow up to be the leaders of tomorrow. They will be our doctors, lawyers, teachers, businessmen and women, and policy makers, and a productive future society depends on investing in the wellbeing of our region's children in the present. According to the Annie E. Casey Foundation, a nonprofit that works to support disadvantaged children, "children do best when their families do well, and families do better when they live in supportive neighborhoods."[1]

In general, kids from poor families do worse than their counterparts from wealthier families. The Casey Foundation has found, "compared with their more affluent peers, kids from low-income families are more likely to suffer from preventable illnesses, fail in school, become teenage parents, and become involved with the justice system."[2] And, although the income level of a child's family does not automatically determine his or her future, particular support and attention must be given to our region's poor families in order to help nurture at-risk kids.

We are often thwarted by our American ideology, which insists that all U.S. citizens are created equally and have equal opportunities from birth, regardless of where they are born. Successful people, we are led to believe, create their own success. However, research has shown that kids who live in neighborhoods with several risk factors face a more difficult life and are less likely to grow up to be productive members of society. "The extent of disparity between the 'life starts' of some inner-city kids and the rest of our children amounts to an assault on our national confidence in the principle of equal opportunity."[3]

About the authors: Caitlin O'Brady (Colorado College class of 2005) is research manager and Bryan Hurlbutt (Colorado College class of 2004) is program coordinator for the Colorado College State of the Rockies Project.



Top 10
Metropolitan Counties

Of 61 Metro Counties
1 - Storey, Nevada
2 - Douglas, Colorado
3 - Missoula, Montana
4 - Boulder, Colorado
5 - Gilpin, Colorado
6 - Larimer, Colorado
7 - Summit, Utah
8 - Carbon, Montana
9 - Cache, Utah
10 - Park, Colorado

Top 10
Micropolitan Counties

Of 138 Micro Counties
1 - Pitkin, Colorado
2 - Hot Springs, Wyoming
3 - Teton, Wyoming
4 - Los Alamos, New Mexico
5 - Routt, Colorado
6 - Albany, Wyoming
7 - Gallatin, Montana
8 - Latah, Idaho
9 - Gunnison, Colorado
10 - Lewis and Clark, Montana

Top 10
Rural Counties

Of 81 Rural Counties
1 - Hinsdale, Colorado
2 - San Miguel, Colorado
3 - Grand, Colorado
4 - Sublette, Wyoming
5 - Mineral, Colorado
6 - Fallon, Montana
7 - Daniels, Montana
8 - Crook, Wyoming
9 - Wayne, Utah
10 - Sheridan, Montana

Counties with the Highest Overall Scores for Nurturing the Youth

Figure 1

On the following pages, the State of the Rockies uses 24 different indicators to explore the condition of children and youth in the region. On pages 117 through 122, top 10 and bottom 10 counties are ranked in six categories important to the youth: teen involvement, family support, educational opportunity, healthy surroundings, safe neighborhoods, and engaged communities. On pages 123 through 128, every county is assigned an overall letter grade. Above, Figure 1 highlights counties that are doing particularly well supporting children and teens relative to other Rockies counties. See the methods on page 129 for an explanation of rankings, grades, and county groupings.

These data are not perfect and complete; they cannot gauge a committed parent, an outstanding teacher, or an inspirational coach. And we are not ranking one county against another to incite anger, pride or indignation, but to simply shed what light we can on the state of an important, and sometimes forgotten, group of Rockies residents. Because nurturing the children of a community is an investment in the future health of that community, we encourage Rocky Mountain residents to pay particular attention to this section of the *2006 State of the Rockies Report Card*, and to make an investment in the youth of today, and in the future of our region.

Endnotes

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5: Uniform Crime Index, http://www.fbi.gov/ucr/ucr.htm.

Teen Involvement

Metro Counties

		Percentage of Teens Classified as Idle, 2000	Percentage of Population 18 - 24 Who Did Not Graduate High School, 2000
Top 10	1 - Storey, Nevada	0%	15%
	2 - Gilpin, Colorado	0%	18%
	3 - Missoula, Montana	4%	12%
	4 - Cache, Utah	6%	10%
	5 - Larimer, Colorado	5%	12%
	6 - Boulder, Colorado	5%	15%
	7 - Utah, Utah	8%	11%
	8 - Nez Perce, Idaho	7%	15%
	9 - Bannock, Idaho	8%	14%
	10 - Douglas, Colorado	4%	24%
Bottom 10	52 - Tooele, Utah	17%	27%
	53 - Boise, Idaho	10%	41%
	54 - Gem, Idaho	13%	35%
	55 - Clark, Nevada	14%	35%
	56 - Valencia, New Mexico	12%	39%
	57 - Adams, Colorado	15%	37%
	58 - Denver, Colorado	17%	33%
	59 - Owyhee, Idaho	12%	51%
	60 - Torrance, New Mexico	17%	42%
	61 - Pinal, Arizona	19%	43%
	Metro County Average	*9%*	*27%*

Micro Counties

		Percentage of Teens Classified as Idle, 2000	Percentage of Population 18 - 24 Who Did Not Graduate High School, 2000
Top 10	1 - Madison, Idaho	1%	4%
	2 - Latah, Idaho	2%	4%
	3 - Albany, Wyoming	2%	5%
	4 - Gunnison, Colorado	2%	7%
	5 - Gallatin, Montana	3%	8%
	6 - Iron, Utah	4%	12%
	7 - Routt, Colorado	4%	13%
	8 - Beaverhead, Montana	5%	15%
	9 - Sanpete, Utah	4%	18%
	10 - Custer, Montana	4%	20%
Bottom 10	129 - Mohave, Arizona	16%	40%
	130 - Santa Cruz, Arizona	14%	44%
	131 - La Paz, Arizona	13%	48%
	132 - Navajo, Arizona	16%	40%
	133 - Gila, Arizona	15%	44%
	134 - Boundary, Idaho	17%	41%
	135 - Roosevelt, Montana	16%	43%
	136 - Luna, New Mexico	17%	41%
	137 - Big Horn, Montana	19%	42%
	138 - Apache, Arizona	19%	43%
	Micro County Average	*10%*	*31%*

Rural Counties

		Percentage of Teens Classified as Idle, 2000	Percentage of Population 18 - 24 Who Did Not Graduate High School, 2000
Top 10	1 - Wayne, Utah	2%	17%
	2 - Petroleum, Montana	0%	24%
	3 - Piute, Utah	7%	14%
	4 - Sweet Grass, Montana	2%	25%
	5 - Stillwater, Montana	4%	23%
	6 - Sedgwick, Colorado	5%	24%
	7 - Hinsdale, Colorado	0%	32%
	8 - Fallon, Montana	4%	26%
	9 - Phillips, Colorado	2%	30%
	10 - Oneida, Idaho	7%	21%
Bottom 10	72 - Clark, Idaho	12%	41%
	73 - Broadwater, Montana	13%	38%
	74 - Camas, Idaho	14%	38%
	75 - Pershing, Nevada	10%	48%
	76 - Saguache, Colorado	11%	50%
	77 - Liberty, Montana	16%	44%
	78 - Costilla, Colorado	18%	42%
	79 - Eureka, Nevada	12%	55%
	80 - Meagher, Montana	20%	42%
	81 - Catron, New Mexico	20%	48%
	Rural County Average	*7%*	*34%*

Metro Counties

		Percentage of Population 0 - 17 below the Poverty Level, 2000	K - 12 Public School Students Eligible for Free and Reduced Price Lunch Per 100 0 - 17 Year Olds, 2000	Percentage of Children with Unemployed Parents, 2000
Top 10	1 - Douglas, Colorado	2%	2	2%
	2 - Gilpin, Colorado	3%	5	1%
	3 - Storey, Nevada	5%	4	3%
	4 - Elbert, Colorado	5%	7	3%
	5 - Park, Colorado	6%	11	1%
	6 - Summit, Utah	6%	10	4%
	7 - Jefferson, Colorado	6%	12	5%
	8 - Davis, Utah	6%	17	3%
	9 - Morgan, Utah	6%	15	4%
	10 - Boulder, Colorado	8%	10	5%
Bottom 10	52 - Pueblo, Colorado	20%	36	12%
	53 - Pima, Arizona	20%	36	12%
	54 - Coconino, Arizona	22%	31	14%
	55 - Valencia, New Mexico	23%	44	11%
	56 - San Juan, New Mexico	27%	37	12%
	57 - Denver, Colorado	20%	37	17%
	58 - Pinal, Arizona	26%	38	14%
	59 - Torrance, New Mexico	25%	64	8%
	60 - Yuma, Arizona	28%	53	15%
	61 - Dona Ana, New Mexico	34%	54	17%
	Metro County Average	14%	25	7%

Micro Counties

		Percentage of Population 0 - 17 below the Poverty Level, 2000	K - 12 Public School Students Eligible for Free and Reduced Price Lunch Per 100 0 - 17 Year Olds, 2000	Percentage of Children with Unemployed Parents, 2000
Top 10	1 - Los Alamos, New Mexico	2%	0	1%
	2 - Pitkin, Colorado	4%	1	6%
	3 - Routt, Colorado	6%	7	4%
	4 - Summit, Colorado	5%	11	4%
	5 - Teton, Wyoming	7%	8	6%
	6 - Gunnison, Colorado	10%	13	4%
	7 - Johnson, Wyoming	11%	18	1%
	8 - Gallatin, Montana	11%	12	4%
	9 - Campbell, Wyoming	8%	16	4%
	10 - Wasatch, Utah	6%	19	5%
Bottom 10	129 - Navajo, Arizona	36%	30	20%
	130 - Roosevelt, Montana	41%	44	14%
	131 - Socorro, New Mexico	43%	33	18%
	132 - Guadalupe, New Mexico	24%	56	19%
	133 - Apache, Arizona	43%	16	28%
	134 - San Juan, Utah	35%	39	22%
	135 - Hidalgo, New Mexico	39%	41	19%
	136 - Santa Cruz, Arizona	30%	57	19%
	137 - McKinley, New Mexico	42%	41	25%
	138 - Luna, New Mexico	47%	59	20%
	Micro County Average	*19%*	*28*	*8%*

Family Support

Rural Counties

		Percentage of Population 0 - 17 below the Poverty Level, 2000	K - 12 Public School Students Eligible for Free and Reduced Price Lunch Per 100 0 - 17 Year Olds, 2000	Percentage of Children with Unemployed Parents, 2000
Top 10	1 - Hinsdale, Colorado	0%	13	0%
	2 - Madison, Montana	6%	5	6%
	3 - Daggett, Utah	6%	21	2%
	4 - Jefferson, Montana	11%	14	3%
	5 - Grand, Colorado	8%	14	5%
	6 - Sublette, Wyoming	11%	18	2%
	7 - Powder River, Montana	13%	20	0%
	8 - Stillwater, Montana	13%	14	3%
	9 - Ouray, Colorado	8%	12	7%
	10 - Fallon, Montana	18%	12	2%
Bottom 10	72 - Rosebud, Montana	31%	30	14%
	73 - Catron, New Mexico	39%	33	11%
	74 - Harding, New Mexico	30%	52	8%
	75 - Saguache, Colorado	27%	46	12%
	76 - Conejos, Colorado	28%	51	11%
	77 - Petroleum, Montana	26%	57	11%
	78 - McCone, Montana	47%	54	3%
	79 - Blaine, Montana	36%	38	15%
	80 - Costilla, Colorado	32%	24	26%
	81 - Mora, New Mexico	28%	46	20%
	Rural County Average	19%	28	7%

Educational Opportunity

Metro Counties

		K - 12 Public School Student to Teacher Ratio, 2002	District Expenditures Per K - 12 Public School Student, 2001	Percentage of High School Students Who Dropped Out of High School, 2000
Top 10	1 - Storey, Nevada	12	$9,866	5%
	2 - Gilpin, Colorado	14	$7,828	5%
	3 - Carbon, Montana	12	$7,503	8%
	4 - Park, Colorado	15	$6,684	2%
	5 - Natrona, Wyoming	15	$7,869	9%
	6 - Laramie, Wyoming	15	$7,699	9%
	7 - Nez Perce, Idaho	17	$7,449	7%
	8 - Missoula, Montana	16	$6,779	6%
	9 - Clear Creek, Colorado	15	$7,055	9%
	10 - Power, Idaho	16	$7,328	9%
Bottom 10	52 - Davis, Utah	23	$4,808	7%
	53 - Utah, Utah	23	$4,633	6%
	54 - Yuma, Arizona	22	$5,229	13%
	55 - Clark, Nevada	20	$5,796	18%
	56 - Washington, Utah	22	$4,503	9%
	57 - Maricopa, Arizona	20	$5,326	16%
	58 - Salt Lake, Utah	23	$4,729	11%
	59 - Yavapai, Arizona	24	$5,193	12%
	60 - Pinal, Arizona	21	$5,861	21%
	61 - Tooele, Utah	22	$4,473	14%
	Metro County Average	*18*	*$6,195*	*11%*

Micro Counties

		K - 12 Public School Student to Teacher Ratio,	District Expenditures Per K - 12 Public School Student, 2001	Percentage of High School Students Who Dropped Out of High School, 2000
Top 10	1 - Johnson, Wyoming	12	$9,155	2%
	2 - Valley, Montana	11	$9,259	5%
	3 - Hot Springs, Wyoming	11	$9,864	7%
	4 - Weston, Wyoming	12	$9,854	7%
	5 - Albany, Wyoming	11	$8,203	3%
	6 - Sheridan, Wyoming	11	$8,971	6%
	7 - Guadalupe, New Mexico	12	$9,800	8%
	8 - Mineral, Nevada	14	$10,020	6%
	9 - Roosevelt, Montana	11	$10,628	13%
	10 - Carbon, Wyoming	12	$10,133	10%
Bottom 10	129 - Gila, Arizona	18	$5,734	14%
	130 - Sevier, Utah	20	$5,272	9%
	131 - Wasatch, Utah	21	$5,055	7%
	132 - Santa Cruz, Arizona	20	$5,640	11%
	133 - Eagle, Colorado	15	$8,198	30%
	134 - Grand, Utah	18	$6,012	18%
	135 - Luna, New Mexico	18	$5,932	18%
	136 - Box Elder, Utah	22	$4,704	8%
	137 - Graham, Arizona	22	$5,365	11%
	138 - Mohave, Arizona	24	$4,935	21%
	Micro County Average	*15*	*$7,282*	*10%*

Rural Counties

		K - 12 Public School Student to Teacher Ratio, 2002	District Expenditures Per K - 12 Public School Student, 2001	Percentage of High School Students Who Dropped Out of High School, 2000
Top 10	1 - Eureka, Nevada	10	$18,294	11%
	2 - San Juan, Colorado	10	$13,350	0%
	3 - Esmeralda, Nevada	12	$15,370	4%
	4 - Daggett, Utah	10	$13,564	3%
	5 - Harding, New Mexico	9	$13,686	7%
	6 - Sheridan, Montana	9	$10,555	0%
	7 - Fallon, Montana	10	$11,422	1%
	8 - Mineral, Colorado	9	$9,741	0%
	9 - Daniels, Montana	8	$10,588	4%
	10 - Carter, Montana	9	$9,367	0%
Bottom 10	72 - Meagher, Montana	12	$7,271	15%
	73 - Liberty, Montana	10	$9,427	24%
	74 - Oneida, Idaho	17	$5,681	6%
	75 - Emery, Utah	18	$6,364	7%
	76 - Broadwater, Montana	14	$5,685	12%
	77 - Teton, Idaho	18	$5,240	5%
	78 - Ouray, Colorado	24	$8,318	4%
	79 - Beaver, Utah	21	$5,683	4%
	80 - Clark, Idaho	12	$8,000	27%
	81 - Butte, Idaho	31	$6,900	0%
	Rural County Average	*12*	*$9,083*	*7%*

Metro Counties

		Percentage of Babies Born with a Low Birth Weight, 2003	Average Life Expectancy, 2000	Dentists Per 100,000 People, 1997	Primary Care Physicians Per 100,000 People, 2000	Individuals with Major Depression Per 1,000 People, 2000	Individuals Recently Using Drugs Per 1,000 People, 2000
Top 10	1 - Douglas, Colorado	9%	79	40	50	34	41
	2 - Washington, Utah	5%	79	71	55	39	49
	3 - Cache, Utah	7%	80	59	59	40	52
	4 - Utah, Utah	5%	78	50	57	38	50
	5 - Boulder, Colorado	9%	79	81	115	45	55
	6 - Summit, Utah	10%	78	39	140	41	50
	7 - Yuma, Arizona	6%	77	25	55	37	46
	8 - Davis, Utah	7%	79	46	54	40	52
	9 - Coconino, Arizona	8%	77	64	88	36	55
	10 - Salt Lake, Utah	7%	77	60	98	42	53
Bottom Ten	52 - Owyhee, Idaho	3%	76	10	10	43	55
	53 - Carson City (Independent City), Nevada	8%	75	46	77	46	56
	54 - Gem, Idaho	4%	76	14	48	47	57
	55 - Park, Colorado	16%	79	8	39	44	52
	56 - Valencia, New Mexico	7%	75	19	29	44	55
	57 - Teller, Colorado	10%	77	40	20	47	57
	58 - Clear Creek, Colorado	10%	79	11	22	48	58
	59 - Gilpin, Colorado	17%	79	0	25	44	50
	60 - Power, Idaho	11%	77	24	48	49	62
	61 - Carbon, Montana	14%	77	42	53	50	61
	Metro County Average	*8%*	*77*	*43*	*66*	*43*	*53*

Micro Counties

		Percentage of Babies Born with a Low Birth Weight, 2003	Average Life Expectancy, 2000	Dentists Per 100,000 People, 1997	Primary Care Physicians Per 100,000 People, 2000	Individuals with Major Depression Per 1,000	Individuals Recently Using Drugs Per 1,000
Top 10	1 - Teton, Wyoming	10%	76	79	187	40	47
	2 - Summit, Colorado	9%	79	65	114	42	48
	3 - Madison, Idaho	5%	79	55	81	35	50
	4 - Wasatch, Utah	6%	78	63	70	37	47
	5 - Eagle, Colorado	11%	79	53	91	38	45
	6 - La Plata, Colorado	3%	78	80	102	44	55
	7 - Iron, Utah	7%	78	61	47	36	47
	8 - McKinley, New Mexico	9%	72	40	121	19	48
	9 - Los Alamos, New Mexico	6%	78	77	137	50	61
	10 - Gallatin, Montana	6%	79	59	82	46	55
Bottom 10	129 - Lea, New Mexico	9%	75	18	43	46	58
	130 - Guadalupe, New Mexico	10%	76	0	0	43	51
	131 - Converse, Wyoming	7%	76	16	24	48	60
	132 - Eddy, New Mexico	8%	75	26	34	49	60
	133 - White Pine, Nevada	6%	74	20	78	52	65
	134 - Mineral, Nevada	8%	74	18	87	49	65
	135 - Grand, Utah	23%	75	49	49	46	57
	136 - Lemhi, Idaho	9%	76	12	25	53	63
	137 - Lander, Nevada	9%	74	14	42	52	67
	138 - Hidalgo, New Mexico	12%	75	0	16	49	62
	Micro County Average	*8%*	*76*	*39*	*63*	*44*	*56*

Healthy Surroundings

Rural Counties

		Average Life Expectancy, 2000	Dentists Per 100,000 People, 1997	Primary Care Physicians Per 100,000 People, 2000	Individuals with Major Depression Per 1,000 People, 2000	Individuals Recently Using Drugs Per 1,000 People, 2000
Top 10	1 - Hinsdale, Colorado	78	143	143	51	51
	2 - Grand, Colorado	79	71	51	40	48
	3 - Ouray, Colorado	78	31	156	45	53
	4 - San Miguel, Colorado	78	38	56	42	49
	5 - Meagher, Montana	76	55	166	47	57
	6 - Garfield, Utah	76	48	48	40	51
	7 - Teton, Idaho	77	38	38	40	50
	8 - Rich, Utah	80	0	0	41	51
	9 - Blaine, Montana	76	28	71	36	58
	10 - Catron, New Mexico	76	0	72	40	48
Bottom 10	72 - Eureka, Nevada	74	0	54	55	67
	73 - Wibaux, Montana	76	0	0	56	66
	74 - Treasure, Montana	72	0	0	46	58
	75 - Harding, New Mexico	76	0	0	62	62
	76 - Carter, Montana	76	0	0	59	66
	77 - Prairie, Montana	76	0	0	58	67
	78 - Golden Valley, Montana	76	0	0	58	67
	79 - Petroleum, Montana	74	0	0	61	61
	80 - Garfield, Montana	74	0	0	55	70
	81 - Esmeralda, Nevada	74	0	0	62	72
	Rural County Average	*76*	*21*	*39*	*49*	*58*

Safe Neighborhoods

These data come from the Federal Bureau of Investigation's Uniform Crime Index. Some counties did not consistently report crimes to the Uniform Crime Index, potentially affecting the rankings they are assigned.

Metro Counties

		Reported Aggravated Assaults Per 100,000 People, 2001	Reported Arsons, Per 100,000 People, 2001	Reported Burglaries, Per 100,000 People, 2001	Reported Forcible Rapes, Per 100,000 People, 2001	Reported Motor Vehicle Thefts, Per 100,000 People, 2001	Reported Murders, Per 100,000 People, 2001	Reported Robberies, Per 100,000 People, 2001
Top 10	1 - Missoula, Montana	0	0	0	0	0	0	0
	2 - Jefferson, Idaho	110	5	240	31	52	0	0
	3 - Cache, Utah	53	2	230	32	74	2	2
	4 - Franklin, Idaho	18	0	62	0	26	0	0
	5 - Washington, Utah	106	9	268	33	83	0	1
	6 - Torrance, New Mexico	0	0	118	0	30	0	0
	7 - Juab, Utah	61	0	340	12	24	0	0
	8 - Owyhee, Idaho	319	9	498	66	113	0	19
	9 - Laramie, Wyoming	92	13	495	53	124	1	26
	10 - Elbert, Colorado	25	20	111	20	25	5	0
Bottom 10	52 - Arapahoe, Colorado	269	37	626	51	766	4	109
	53 - Natrona, Wyoming	221	72	893	30	250	5	42
	54 - Pinal, Arizona	559	25	1,095	35	511	2	55
	55 - Santa Fe, New Mexico	343	35	1,646	47	227	5	91
	56 - Pueblo, Colorado	450	45	986	36	279	5	107
	57 - Clark, Nevada	326	30	978	44	937	12	315
	58 - Denver, Colorado	264	62	1,020	57	1,253	8	226
	59 - Pima, Arizona	413	56	1,057	49	1,155	6	227
	60 - Maricopa, Arizona	333	25	1,179	27	1,259	10	212
	61 - Bernalillo, New Mexico	754	48	1,410	48	845	7	326
	Metro County Average	*245*	*22*	*587*	*31*	*273*	*4*	*50*

Micro Counties

		Reported Aggravated Assaults Per 100,000 People, 2001	Reported Arsons, Per 100,000 People, 2001	Reported Burglaries, Per 100,000 People, 2001	Reported Forcible Rapes, Per 100,000 People, 2001	Reported Motor Vehicle Thefts, Per 100,000 People, 2001	Reported Murders, Per 100,000 People, 2001	Reported Robberies, Per 100,000 People, 2001
Top 10	1 - Lewis and Clark, Montana	0	0	0	0	0	0	0
	2 - Park, Montana	0	0	0	0	0	0	0
	3 - Custer, Montana	0	0	0	0	0	0	0
	4 - Lemhi, Idaho	0	0	0	0	0	0	0
	5 - Deer Lodge, Montana	0	0	0	0	0	0	0
	6 - Toole, Montana	0	0	0	0	0	0	0
	7 - Richland, Montana	0	0	0	0	0	0	0
	8 - Roosevelt, Montana	0	0	0	0	0	0	0
	9 - Guadalupe, New Mexico	0	0	0	0	0	0	0
	10 - Big Horn, Montana	0	0	0	0	0	0	0
Bottom 10	129 - Lea, New Mexico	598	4	937	68	151	7	61
	130 - Duchesne, Utah	125	49	494	28	111	35	0
	131 - San Miguel, New Mexico	700	20	860	70	169	3	53
	132 - Curry, New Mexico	369	44	1,372	40	142	9	44
	133 - Cibola, New Mexico	590	16	985	12	195	16	74
	134 - Eddy, New Mexico	434	37	1,332	43	188	6	56
	135 - McKinley, New Mexico	567	8	566	44	214	9	156
	136 - Chaves, New Mexico	728	24	1,267	75	168	7	62
	137 - Mineral, Nevada	217	79	809	99	59	20	20
	138 - Quay, New Mexico	1,684	0	817	20	197	0	217
	Micro County Average	*221*	*14*	*459*	*24*	*125*	*3*	*16*

Rural Counties

		Reported Aggravated Assaults Per 100,000 People, 2001	Reported Arsons, Per 100,000 People, 2001	Reported Burglaries, Per 100,000 People, 2001	Reported Forcible Rapes, Per 100,000 People, 2001	Reported Motor Vehicle Thefts, Per 100,000 People, 2001	Reported Murders, Per 100,000 People, 2001	Reported Robberies, Per 100,000 People, 2001
Top 10	1 - Daniels, Montana	0	0	0	0	0	0	0
	2 - Carter, Montana	0	0	0	0	0	0	0
	3 - Powder River, Montana	0	0	0	0	0	0	0
	4 - McCone, Montana	0	0	0	0	0	0	0
	5 - Fallon, Montana	0	0	0	0	0	0	0
	6 - Liberty, Montana	0	0	0	0	0	0	0
	7 - Petroleum, Montana	0	0	0	0	0	0	0
	8 - Jefferson, Montana	0	0	0	0	0	0	0
	9 - Garfield, Utah	0	0	0	0	0	0	0
	10 - Garfield, Montana	0	0	0	0	0	0	0
Bottom 10	72 - Beaver, Utah	150	50	183	33	133	0	0
	73 - Broadwater, Montana	616	0	228	23	228	0	23
	74 - Big Horn, Wyoming	122	44	349	44	26	0	17
	75 - Eureka, Nevada	909	0	485	0	61	0	61
	76 - Harding, New Mexico	0	123	247	0	0	0	0
	77 - Pershing, Nevada	478	0	837	45	164	15	15
	78 - Sedgwick, Colorado	182	0	400	36	73	0	73
	79 - Valley, Idaho	418	39	980	39	222	0	13
	80 - Daggett, Utah	0	0	651	0	109	217	0
	81 - De Baca, New Mexico	7,768	0	3,661	0	134	0	0
	Rural County Average	*251*	*5*	*302*	*11*	*75*	*4*	*5*

Metro Counties

		Percentage Turnout of the Voter Aged Population for the 2004 Presidential Election, 2004	Total 501c Non-profit Organizations Per 100,000 People, 2000	Education 501c Nonprofits Per 100,000 0 - 17 Year Olds, 2000	Youth Development 501c Nonprofits Per 0 - 17 Year Olds,
Top 10	1 - Santa Fe, New Mexico	64%	230	181	23
	2 - Storey, Nevada	79%	206	153	0
	3 - Natrona, Wyoming	64%	152	46	52
	4 - Missoula, Montana	68%	197	78	23
	5 - Denver, Colorado	54%	204	123	22
	6 - Boulder, Colorado	73%	125	128	11
	7 - Carbon, Montana	72%	105	0	44
	8 - Yellowstone, Montana	67%	131	54	27
	9 - Nez Perce, Idaho	64%	94	56	34
	10 - Cascade, Montana	58%	116	67	29
Bottom 10	52 - Juab, Utah	62%	24	0	0
	53 - Adams, Colorado	52%	36	27	4
	54 - Power, Idaho	62%	13	0	0
	55 - Weber, Utah	51%	44	18	2
	56 - Torrance, New Mexico	58%	24	0	0
	57 - Clark, Nevada	45%	34	25	4
	58 - Pinal, Arizona	42%	32	7	11
	59 - Tooele, Utah	53%	12	0	0
	60 - Owyhee, Idaho	50%	19	0	0
	61 - Yuma, Arizona	32%	36	22	7
	Metro County Average	*61%*	*77*	*41*	*10*

Micro Counties

		Percentage Turnout of the Voter Aged Population for the 2004 Presidential Election, 2004	Total 501c Non-profit Organizations Per 100,000 People, 2000	Education 501c Nonprofits Per 100,000 0 - 17 Year Olds, 2000	Youth Development 501c Nonprofits Per 0 - 17 Year Olds,
Top 10	1 - Pitkin, Colorado	70%	538	367	122
	2 - Hot Springs, Wyoming	70%	205	185	93
	3 - Teton, Wyoming	76%	356	142	28
	4 - Lewis and Clark, Montana	71%	248	154	21
	5 - Gallatin, Montana	70%	196	155	34
	6 - Albany, Wyoming	65%	156	136	51
	7 - Valley, Montana	76%	235	155	0
	8 - La Plata, Colorado	70%	168	131	20
	9 - Park, Montana	68%	159	109	27
	10 - Sheridan, Wyoming	68%	218	140	0
Bottom 10	129 - Bent, Colorado	50%	67	0	0
	130 - Uintah, Utah	57%	12	0	0
	131 - Gooding, Idaho	54%	28	0	0
	132 - Mohave, Arizona	44%	34	20	11
	133 - Nye, Nevada	53%	25	0	0
	134 - Curry, New Mexico	45%	58	22	0
	135 - La Paz, Arizona	33%	30	24	24
	136 - Cibola, New Mexico	43%	43	25	0
	137 - Elmore, Idaho	38%	27	12	12
	138 - Luna, New Mexico	43%	44	0	0
	Micro County Average	*60%*	*96*	*48*	*9*

Engaged Communities

Rural Counties

		Percentage Turnout of the Voter Aged Population for the 2004 Presidential Election,	Total 501c Non-profit Organizations Per 100,000 People, 2000	Education 501c Non-profits Per 100,000 0 - 17 Year Olds, 2000	Youth Development 501c Nonprofits Per 0 - 17 Year Olds, 2000
Top 10	1 - San Miguel, Colorado	57%	531	515	172
	2 - Mineral, Colorado	77%	361	602	0
	3 - Hinsdale, Colorado	78%	759	0	0
	4 - San Juan, Colorado	75%	717	0	0
	5 - Custer, Colorado	73%	343	256	0
	6 - Sublette, Wyoming	76%	270	261	0
	7 - Daniels, Montana	76%	198	223	0
	8 - Carter, Montana	73%	147	279	0
	9 - Powder River, Montana	77%	108	201	0
	10 - Adams, Idaho	85%	58	121	0
Bottom 10	72 - Eureka, Nevada	67%	0	0	0
	73 - Mineral, Montana	64%	26	0	0
	74 - Lincoln, Idaho	64%	25	0	0
	75 - Golden Valley, Montana	65%	0	0	0
	76 - Rich, Utah	63%	0	0	0
	77 - Beaver, Utah	63%	0	0	0
	78 - Clark, Idaho	58%	0	0	0
	79 - Lincoln, Colorado	53%	66	0	0
	80 - Pershing, Nevada	39%	0	0	0
	81 - Crowley, Colorado	34%	54	0	0
	Rural County Average	*70%*	*106*	*47*	*3*

				Teen Involvement		Family Support			Educational Opportunity			Healthy Surroundings					Safe Neighborhoods							Engaged Communities			
	County	Type of County	Nurturing the Youth Overall Grade	Percentage of Teens Classified as Idle, 2000	Percentage of Population 18 - 24 Who Did Not Graduate High School, 2000	Percentage of Population 0 - 17 below the Poverty Level, 2000	K - 12 Public School Students Eligible for Free and Reduced Price Lunch Per 100 People 17 and Younger, 2000	Percentage of Children with Unemployed Parents, 2000	K - 12 Public School Student to Teacher Ratio, 2002	District Expenditures Per K - 12 Public School Student, 2001	Percentage of High School Students Who Dropped Out of High School, 2000	Average Life Expectancy, 2000	Dentists Per 100,000 People, 1997	Primary Care Physicians Per 100,000 People, 2000	Individuals with Major Depression Per 1,000 People, 2000	Individuals Recently Using Drugs Per 1,000 People, 2000	Reported Aggravated Assaults Per 100,000 People, 2001	Reported Arsons, Per 100,000 People, 2001	Reported Burglaries, Per 100,000 People, 2001	Reported Forcible Rapes, Per 100,000 People, 2001	Reported Motor Vehicle Thefts, Per 100,000 People, 2001	Reported Murders, Per 100,000 People, 2001	Reported Robberies, Per 100,000 People, 2001	Percentage Turnout of the Voter Aged Population for the 2004 Presidential Election, 2004	Total 501c Non-profit Organizations Per 100,000 People, 2000	Education 501c Nonprofits Per 100,000 0 - 17 Year Olds, 2000	Youth Development 501c Nonprofits Per 0 - 17 Year Olds, 2000
Arizona	Apache	Micro	D	19%	43%	43%	16	28%	16	$7,755	14%	74	23	63	18	52	193	1	219	9	19	0	0	57%	36	11	0
	Cochise	Micro	D	10%	25%	26%	34	12%	20	$5,676	9%	76	32	47	44	55	334	20	574	23	370	9	42	50%	64	23	3
	Coconino	Metro	C	9%	19%	22%	31	14%	18	$6,497	11%	77	64	88	36	55	425	34	800	52	279	5	58	59%	118	78	6
	Gila	Micro	D	15%	44%	26%	42	14%	18	$5,734	14%	75	29	58	43	56	415	23	990	27	164	6	10	54%	55	62	8
	Graham	Micro	D	13%	28%	30%	30	13%	22	$5,365	11%	76	45	35	38	52	167	0	457	0	69	0	0	47%	48	40	10
	Greenlee	Micro	C+	6%	36%	12%	21	8%	16	$5,711	5%	76	11	53	49	62	23	0	234	0	12	0	0	63%	0	0	0
	La Paz	Micro	D	13%	48%	28%	48	10%	16	$6,587	16%	77	13	0	33	45	172	5	893	10	198	15	15	33%	30	24	24
	Maricopa	Metro	D	12%	32%	16%	32	11%	20	$5,326	16%	77	45	78	42	51	333	25	1179	27	1259	10	212	48%	58	41	5
	Mohave	Micro	D	16%	40%	20%	36	10%	24	$4,935	21%	74	30	44	43	50	246	32	1103	12	331	6	39	44%	34	20	11
	Navajo	Micro	D	16%	40%	36%	30	20%	19	$6,515	13%	73	27	60	26	52	261	39	567	16	131	1	19	47%	50	29	3
	Pima	Metro	D	10%	23%	20%	36	12%	18	$5,584	12%	76	45	99	44	55	413	56	1057	49	1155	6	227	54%	81	51	9
	Pinal	Metro	D	19%	43%	26%	38	14%	21	$5,861	21%	74	16	29	35	45	559	25	1095	35	511	2	55	42%	32	7	11
	Santa Cruz	Micro	D	14%	44%	30%	57	19%	20	$5,640	11%	78	19	66	43	54	190	5	433	5	482	5	18	43%	76	31	8
	Yavapai	Metro	D+	9%	30%	16%	31	8%	24	$5,193	12%	77	44	58	45	53	346	23	821	18	282	5	30	60%	88	105	8
	Yuma	Metro	D	13%	34%	28%	53	15%	22	$5,229	13%	77	25	55	37	46	312	26	665	19	316	3	31	32%	36	22	7
Colorado	Adams	Metro	D	15%	37%	11%	26	11%	19	$6,432	20%	76	37	74	41	50	316	31	659	38	677	3	72	52%	36	27	4
	Alamosa	Micro	B	12%	18%	27%	39	9%	15	$7,475	11%	76	56	125	45	55	307	33	327	53	127	0	13	56%	207	122	24
	Arapahoe	Metro	C+	8%	25%	7%	17	7%	17	$6,845	10%	78	70	72	46	56	269	37	626	51	766	4	109	60%	77	72	5
	Archuleta	Micro	C+	11%	41%	13%	24	4%	17	$6,228	11%	78	35	82	41	51	141	20	1091	20	222	0	30	66%	172	40	40
	Baca	Rural	C	4%	36%	22%	47	7%	11	$8,469	2%	76	23	91	51	60	221	0	44	0	22	0	0	67%	66	0	0
	Bent	Micro	D	11%	37%	27%	34	8%	12	$7,624	9%	76	0	37	45	55	233	33	300	17	133	17	0	50%	67	0	0
	Boulder	Metro	A	5%	15%	8%	10	5%	17	$7,024	8%	79	81	115	45	55	119	66	436	28	146	0	24	73%	125	128	11
	Chaffee	Micro	B	11%	44%	17%	19	6%	14	$6,930	9%	78	53	67	49	57	117	12	234	37	68	0	12	63%	92	126	31
	Cheyenne	Rural	C	8%	36%	14%	20	7%	8	$9,926	9%	77	0	88	49	58	0	45	90	45	90	0	0	67%	0	0	0
	Clear Creek	Metro	B-	5%	30%	7%	12	7%	15	$7,055	9%	79	11	22	48	58	547	11	418	21	279	11	0	71%	75	47	0
	Conejos	Rural	D	7%	30%	28%	51	11%	15	$6,646	7%	76	0	51	43	52	83	12	226	12	83	0	0	66%	24	0	0
	Costilla	Rural	D	18%	42%	32%	24	26%	12	$8,815	11%	76	0	27	49	57	519	0	846	27	27	0	0	65%	55	0	0
	Crowley	Rural	D	10%	38%	24%	37	13%	14	$6,860	8%	76	0	23	40	47	127	0	18	0	0	0	0	34%	54	0	0
	Custer	Rural	C-	6%	46%	20%	17	10%	14	$6,803	8%	76	0	30	49	57	143	29	314	0	114	0	0	73%	343	256	0
	Delta	Micro	D+	12%	41%	15%	32	8%	18	$6,574	10%	76	43	50	48	57	86	40	298	18	119	0	11	62%	93	90	0
	Denver	Metro	D	17%	33%	20%	37	17%	16	$7,241	24%	74	87	210	45	55	264	62	1020	57	1253	8	226	54%	204	123	22
	Dolores	Rural	B	7%	27%	11%	17	4%	11	$7,561	7%	75	0	0	43	54	0	0	217	0	163	0	0	76%	108	0	0
	Douglas	Metro	A	4%	24%	2%	2	2%	18	$6,798	5%	79	40	50	34	41	69	16	406	18	100	3	11	76%	56	47	9
	Eagle	Micro	C+	14%	33%	8%	16	5%	15	$8,198	30%	79	53	91	38	45	91	22	555	22	134	2	19	30%	158	164	10
	Elbert	Metro	B	6%	35%	5%	7	3%	15	$6,496	8%	79	23	17	42	51	25	20	111	20	25	5	0	69%	15	0	0
	El Paso	Metro	C+	9%	20%	10%	18	6%	16	$6,569	11%	77	70	58	44	55	281	36	719	52	306	4	89	59%	101	44	11
	Fremont	Micro	D+	10%	37%	15%	25	6%	17	$5,907	12%	76	30	56	49	59	102	4	184	17	48	4	2	49%	74	32	0
	Garfield	Micro	B	8%	32%	9%	21	7%	15	$6,031	13%	77	61	82	42	50	167	11	258	14	94	0	23	57%	130	67	8
	Gilpin	Metro	A	0%	18%	3%	5	1%	14	$7,828	5%	79	0	25	44	50	336	0	378	42	42	21	0	72%	63	0	0
	Grand	Rural	A	5%	25%	8%	14	5%	13	$7,731	4%	79	71	51	40	48	80	8	209	0	153	0	0	66%	185	185	0
	Gunnison	Micro	A	2%	7%	10%	13	4%	13	$6,395	2%	78	57	41	44	54	179	36	387	14	179	0	7	66%	201	80	0
	Hinsdale	Rural	A	0%	32%	0%	13	0%	9	$12,457	10%	78	143	143	51	51	253	0	380	0	0	0	0	78%	759	0	0
	Huerfano	Micro	C	10%	29%	23%	33	12%	14	$6,831	12%	76	30	89	43	52	242	13	432	0	114	0	13	54%	114	0	0
	Jackson	Rural	B	7%	28%	22%	22	4%	12	$9,249	5%	79	0	0	51	57	63	0	190	0	127	0	0	73%	63	0	0
	Jefferson	Metro	B+	7%	24%	6%	12	5%	18	$7,676	9%	78	64	62	47	56	113	30	463	28	383	2	48	67%	88	89	5
	Kiowa	Rural	B+	1%	39%	11%	23	3%	10	$9,201	3%	77	0	60	49	62	62	0	123	62	0	0	0	76%	62	0	0
	Kit Carson	Micro	C+	3%	37%	17%	33	8%	13	$7,423	5%	77	14	28	44	52	100	0	499	25	212	0	0	60%	87	0	0

				Teen Involvement		Family Support			Educational Opportunity			Healthy Surroundings					Safe Neighborhoods							Engaged Communities			
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Colorado (Continued)	Lake	Micro	B-	11%	38%	15%	26	9%	14	$10,428	22%	78	63	47	40	47	166	0	218	0	141	0	0	52%	64	48	0
	La Plata	Micro	A-	7%	13%	10%	16	5%	15	$7,055	6%	78	80	102	44	55	98	46	542	84	134	0	16	70%	168	131	20
	Larimer	Metro	A-	5%	12%	7%	15	5%	17	$6,914	7%	78	67	87	44	54	151	36	510	53	158	1	18	70%	93	56	8
	Las Animas	Micro	C	13%	20%	20%	36	14%	14	$7,497	11%	76	41	62	48	58	151	26	427	26	250	0	33	55%	105	81	27
	Lincoln	Rural	C-	8%	46%	14%	22	4%	12	$11,744	11%	76	18	36	49	57	66	0	66	16	49	0	0	53%	66	0	0
	Logan	Micro	B	6%	20%	13%	26	9%	15	$6,391	8%	77	44	61	44	53	273	49	605	39	107	5	0	54%	88	40	20
	Mesa	Metro	C	11%	25%	12%	28	6%	17	$6,249	13%	77	52	98	47	57	166	37	688	19	212	1	24	66%	93	66	10
	Mineral	Rural	A	0%	38%	23%	32	12%	9	$9,741	0%	78	0	0	48	48	0	0	1324	0	0	0	0	77%	361	602	0
	Moffat	Micro	C-	17%	33%	8%	16	5%	17	$6,702	14%	77	33	65	43	53	167	30	485	53	121	0	0	59%	68	0	27
	Montezuma	Micro	C+	10%	29%	23%	32	7%	15	$6,500	10%	75	45	85	42	54	101	4	256	0	88	4	4	62%	84	15	0
	Montrose	Micro	C	10%	40%	17%	27	7%	17	$6,412	14%	77	69	46	45	54	90	21	335	33	123	3	0	60%	99	22	11
	Morgan	Micro	D	10%	49%	15%	35	10%	15	$6,274	17%	76	40	56	44	54	48	4	269	29	136	0	7	51%	77	36	0
	Otero	Micro	C	12%	23%	26%	38	14%	13	$7,391	7%	76	34	86	49	61	231	25	162	34	89	0	0	57%	108	18	0
	Ouray	Rural	B+	1%	48%	8%	12	7%	24	$8,318	4%	78	31	156	45	53	0	0	53	0	53	0	0	74%	241	119	0
	Park	Metro	A-	4%	31%	6%	11	1%	15	$6,684	2%	79	8	39	44	52	83	21	269	14	117	28	0	64%	117	58	0
	Phillips	Rural	B+	2%	30%	14%	24	6%	14	$9,184	4%	77	23	115	49	58	89	0	290	0	89	0	22	69%	67	83	0
	Pitkin	Micro	A	9%	22%	4%	1	6%	13	$9,417	12%	78	81	81	51	58	74	20	726	81	316	7	20	70%	538	367	122
	Prowers	Micro	D+	13%	38%	28%	35	9%	14	$7,445	15%	76	51	44	44	55	48	0	573	7	69	0	14	48%	83	69	0
	Pueblo	Metro	D	12%	29%	20%	36	12%	17	$6,190	14%	76	56	97	46	56	450	45	986	36	279	5	107	60%	79	41	11
	Rio Blanco	Rural	B-	9%	23%	12%	18	3%	14	$8,674	8%	77	64	64	50	62	267	0	434	17	100	0	17	66%	33	0	0
	Rio Grande	Micro	C	11%	36%	19%	37	13%	13	$6,457	14%	76	44	97	44	53	250	8	661	16	81	0	16	63%	137	86	0
	Routt	Micro	A	4%	13%	6%	7	4%	14	$8,827	4%	77	52	81	44	52	203	10	442	10	127	0	5	70%	178	68	23
	Saguache	Rural	D	11%	50%	27%	46	12%	11	$9,058	21%	76	0	17	46	57	304	0	507	17	68	17	17	57%	152	119	0
	San Juan	Rural	A-	0%	33%	30%	35	4%	10	$13,350	0%	75	0	0	54	54	358	0	896	0	358	0	0	75%	717	0	0
	San Miguel	Rural	A	8%	28%	13%	15	5%	12	$9,152	14%	78	38	56	42	49	106	15	637	0	243	0	0	57%	531	515	172
	Sedgwick	Rural	B-	5%	24%	14%	36	5%	11	$9,392	4%	77	77	38	51	58	182	0	400	36	73	0	73	66%	182	0	0
	Summit	Micro	A	8%	14%	5%	11	4%	13	$7,902	11%	79	65	114	42	48	110	8	743	76	276	0	30	63%	166	122	0
	Teller	Metro	C+	9%	31%	7%	13	5%	17	$5,527	7%	77	40	20	47	57	219	24	409	15	44	0	0	70%	112	38	0
	Washington	Rural	B	3%	40%	17%	29	6%	10	$9,005	5%	77	22	0	49	57	0	0	203	0	20	0	0	70%	61	77	0
	Weld	Metro	C	9%	26%	15%	28	9%	16	$6,043	12%	77	34	70	41	50	238	29	670	54	258	6	42	59%	59	39	16
	Yuma	Micro	B	3%	41%	16%	33	6%	12	$7,061	8%	77	32	75	47	57	20	10	254	20	132	0	0	65%	142	0	0
Idaho	Ada	Metro	B+	6%	22%	9%	17	4%	19	$5,990	7%	77	62	88	44	53	214	35	707	37	261	1	33	65%	96	51	18
	Adams	Rural	C-	6%	36%	17%	30	8%	12	$8,406	11%	76	26	52	55	66	259	29	230	0	115	0	0	85%	58	121	0
	Bannock	Metro	B-	8%	14%	16%	23	5%	19	$5,782	7%	77	52	83	45	57	281	26	487	41	110	0	13	65%	65	14	9
	Bear Lake	Micro	B+	4%	28%	11%	24	5%	17	$5,516	1%	77	30	61	45	58	31	0	62	16	31	0	0	74%	62	0	0
	Benewah	Micro	C	9%	38%	19%	32	11%	15	$7,501	9%	74	45	67	46	59	76	11	294	0	131	0	0	64%	76	41	0
	Bingham	Micro	C	7%	31%	16%	30	6%	19	$5,749	7%	76	41	31	41	55	115	14	290	26	120	2	12	60%	29	7	7
	Blaine	Micro	A-	5%	33%	8%	17	5%	14	$9,005	15%	77	70	134	46	54	137	16	437	0	132	0	5	63%	226	66	22
	Boise	Metro	C-	10%	41%	16%	24	8%	14	$6,905	11%	77	0	0	37	45	300	15	195	0	225	15	15	67%	90	0	0
	Bonner	Micro	C-	11%	34%	22%	27	8%	17	$6,141	12%	76	55	49	47	56	157	19	519	14	114	0	5	61%	114	43	11
	Bonneville	Metro	C+	7%	28%	12%	21	5%	20	$5,309	7%	77	75	56	44	55	142	27	576	39	194	5	12	67%	67	23	11
	Boundary	Micro	D	17%	41%	20%	27	8%	17	$6,192	15%	76	30	61	47	59	172	0	405	20	51	10	0	61%	51	69	0
	Butte	Rural	D	9%	30%	28%	32	8%	31	$6,900	0%	76	0	32	48	62	69	0	34	0	0	0	0	70%	69	119	0
	Camas	Rural	C+	14%	38%	10%	29	0%	11	$8,815	9%	77	0	0	40	50	0	0	202	0	0	0	0	72%	0	0	0
	Canyon	Metro	D	14%	32%	15%	35	6%	18	$5,441	15%	77	38	55	42	52	302	24	751	52	317	5	21	53%	48	27	12
	Caribou	Micro	B	6%	36%	11%	25	3%	15	$6,828	5%	77	54	27	45	56	41	14	315	55	110	0	0	68%	41	0	0
	Cassia	Micro	D+	8%	36%	18%	34	7%	18	$5,591	9%	77	51	56	44	56	196	33	523	23	154	0	19	55%	33	14	14

	County	Type of County	Nurturing the Youth Overall Grade	Teen Involvement		Family Support			Educational Opportunity			Healthy Surroundings					Safe Neighborhoods							Engaged Communities			
				Percentage of Teens Classified as Idle, 2000	Percentage of Population 18 - 24 Who Did Not Graduate High School, 2000	Percentage of Population 0 - 17 below the Poverty Level, 2000	K - 12 Public School Students Eligible for Free and Reduced Price Lunch Per 100 People 17 and Younger, 2000	Percentage of Children with Unemployed Parents, 2000	K - 12 Public School Student to Teacher Ratio, 2002	District Expenditures Per K - 12 Public School Student, 2001	Percentage of High School Students Who Dropped Out of High School, 2000	Average Life Expectancy, 2000	Dentists Per 100,000 People, 1997	Primary Care Physicians Per 100,000 People, 2000	Individuals with Major Depression Per 1,000 People, 2000	Individuals Recently Using Drugs Per 1,000 People, 2000	Reported Aggravated Assaults Per 100,000 People, 2001	Reported Arsons, Per 100,000 People, 2001	Reported Burglaries, Per 100,000 People, 2001	Reported Forcible Rapes, Per 100,000 People, 2001	Reported Motor Vehicle Thefts, Per 100,000 People, 2001	Reported Murders, Per 100,000 People, 2001	Reported Robberies, Per 100,000 People, 2001	Percentage Turnout of the Voter Aged Population for the 2004 Presidential Election, 2004	Total 501c Non-profit Organizations Per 100,000 People, 2000	Education 501c Nonprofits Per 100,000 0 - 17 Year Olds, 2000	Youth Development 501c Nonprofits Per 0 - 17 Year Olds, 2000
Idaho (Continued)	Clark	Rural	D	12%	41%	25%	34	4%	12	$8,000	27%	76	0	0	39	49	98	0	294	0	0	0	0	58%	0	0	0
	Clearwater	Micro	C+	10%	28%	20%	33	7%	16	$7,208	4%	78	32	74	55	66	123	0	414	11	90	0	0	65%	34	0	0
	Custer	Rural	C	12%	38%	17%	22	3%	13	$7,928	5%	77	24	47	48	58	138	0	115	46	69	0	0	80%	115	0	0
	Elmore	Micro	C+	14%	15%	15%	22	4%	17	$5,916	9%	76	16	72	39	48	141	3	374	14	100	0	7	38%	27	12	12
	Franklin	Metro	B	6%	22%	8%	32	2%	20	$4,919	8%	77	56	37	41	53	18	0	62	0	26	0	0	69%	35	24	0
	Fremont	Micro	C+	8%	27%	18%	30	4%	17	$5,808	8%	77	25	9	44	56	237	0	169	8	76	0	0	74%	42	26	0
	Gem	Metro	D+	13%	35%	16%	31	7%	19	$5,263	10%	76	14	48	47	57	165	13	316	20	20	0	13	64%	40	0	24
	Gooding	Micro	D+	10%	29%	18%	34	7%	13	$6,454	20%	76	30	22	47	57	113	0	283	0	170	7	0	54%	28	0	0
	Idaho	Micro	C	13%	37%	21%	23	11%	15	$7,398	11%	76	20	80	48	59	103	0	239	32	77	0	0	71%	45	52	26
	Jefferson	Metro	C-	10%	34%	13%	30	3%	19	$5,372	10%	77	26	5	42	54	110	5	240	31	52	0	0	72%	16	0	0
	Jerome	Micro	D	10%	41%	18%	33	8%	17	$5,746	12%	76	17	40	45	56	322	55	720	71	185	0	44	53%	55	34	0
	Kootenai	Metro	C	9%	20%	13%	24	6%	19	$5,460	7%	77	60	62	46	55	227	17	711	40	194	3	26	65%	63	27	17
	Latah	Micro	A	2%	4%	10%	16	5%	15	$8,089	1%	78	40	65	47	57	31	9	386	26	43	3	17	63%	100	99	14
	Lemhi	Micro	B-	10%	23%	20%	28	5%	15	$6,302	3%	76	12	25	53	63	0	0	0	0	0	0	0	72%	90	50	0
	Lewis	Rural	C	7%	26%	13%	47	4%	14	$8,042	4%	76	49	25	53	64	80	0	53	27	53	0	0	67%	53	0	0
	Lincoln	Rural	D+	9%	39%	18%	18	5%	14	$7,221	7%	76	0	26	45	54	124	0	49	25	74	0	0	64%	25	0	0
	Madison	Micro	A-	1%	4%	12%	29	4%	19	$5,386	1%	79	55	81	35	50	66	0	146	15	58	0	0	56%	22	0	0
	Minidoka	Micro	D	12%	41%	19%	42	9%	18	$5,783	13%	77	34	19	46	58	104	15	332	35	74	0	10	57%	20	0	0
	Nez Perce	Metro	B+	7%	15%	16%	21	6%	17	$7,449	7%	77	60	101	49	60	139	27	738	11	144	5	8	64%	94	56	34
	Oneida	Rural	C	7%	21%	13%	24	4%	17	$5,681	6%	77	25	0	44	56	24	24	412	73	24	0	0	76%	48	0	0
	Owyhee	Metro	D	12%	51%	21%	42	8%	16	$6,582	18%	76	10	10	43	55	319	9	498	66	113	0	19	50%	19	0	0
	Payette	Micro	D	7%	35%	17%	30	9%	18	$5,573	12%	76	30	35	47	57	165	15	588	34	180	5	15	56%	29	32	0
	Power	Metro	D+	7%	31%	20%	39	6%	16	$7,328	9%	77	24	48	49	62	212	40	544	13	93	0	0	62%	13	0	0
	Shoshone	Micro	C-	10%	31%	22%	28	9%	15	$8,006	9%	74	64	79	52	62	211	15	741	65	109	7	15	57%	94	63	0
	Teton	Rural	C-	8%	38%	18%	19	11%	18	$5,240	5%	77	38	38	40	50	67	0	483	17	117	0	0	73%	150	0	0
	Twin Falls	Micro	C-	8%	29%	16%	29	5%	18	$5,631	10%	77	49	77	46	56	224	31	940	31	283	3	42	57%	73	50	17
	Valley	Rural	C+	2%	34%	11%	21	5%	16	$8,037	5%	76	74	86	52	64	418	39	980	39	222	0	13	78%	170	0	0
	Washington	Micro	D	9%	45%	17%	35	6%	16	$6,323	14%	76	30	40	49	60	110	10	631	20	160	0	0	62%	40	37	0
Montana	Beaverhead	Micro	A-	5%	15%	19%	14	6%	16	$7,145	4%	76	44	89	48	59	76	0	141	0	141	0	11	64%	98	44	0
	Big Horn	Micro	D	19%	42%	36%	38	13%	11	$10,409	14%	72	32	95	28	54	0	0	0	0	0	0	0	52%	71	0	0
	Blaine	Rural	D	13%	36%	36%	38	15%	11	$10,399	12%	76	28	71	36	58	128	0	243	29	57	0	0	60%	86	0	44
	Broadwater	Rural	D	13%	38%	14%	21	3%	14	$5,685	12%	76	25	74	46	57	616	0	228	23	228	0	23	72%	68	0	0
	Carbon	Metro	A-	7%	30%	14%	18	5%	12	$7,503	8%	77	42	53	50	61	84	0	199	0	84	0	21	72%	105	0	44
	Carter	Rural	B+	0%	51%	16%	20	2%	9	$9,367	0%	76	0	0	59	66	0	0	0	0	0	0	0	73%	147	279	0
	Cascade	Metro	B-	10%	25%	19%	19	6%	15	$6,077	7%	76	62	66	48	59	320	0	518	17	222	2	42	58%	116	67	29
	Chouteau	Rural	C-	10%	39%	30%	18	11%	11	$9,423	9%	76	19	19	44	54	201	0	134	17	84	0	0	79%	117	58	0
	Custer	Micro	A-	4%	20%	19%	16	4%	13	$6,286	3%	76	50	107	52	63	0	0	0	0	0	0	0	62%	137	103	0
	Daniels	Rural	A-	0%	34%	20%	20	5%	8	$10,588	4%	74	0	97	55	64	0	0	0	0	0	0	0	76%	198	223	0
	Dawson	Micro	A-	3%	23%	19%	17	5%	13	$7,669	3%	76	44	77	50	61	320	0	298	0	188	11	0	69%	144	47	47
	Deer Lodge	Micro	C-	12%	32%	22%	26	8%	17	$6,020	12%	76	40	50	55	67	0	0	0	0	0	0	0	67%	181	0	0
	Fallon	Rural	A	4%	26%	18%	12	2%	10	$11,422	1%	76	33	0	53	63	0	0	0	0	0	0	0	75%	106	0	0
	Fergus	Micro	B	9%	27%	20%	23	4%	13	$8,015	8%	76	56	56	54	65	429	0	151	8	42	0	0	69%	118	69	0
	Flathead	Micro	B+	8%	27%	17%	21	6%	17	$6,123	8%	76	61	91	48	58	83	3	149	1	64	1	4	66%	140	73	26
	Gallatin	Micro	A	3%	8%	11%	12	4%	16	$6,163	5%	79	59	82	46	55	155	1	318	40	150	3	6	70%	196	155	34
	Garfield	Rural	D+	11%	33%	29%	17	7%	8	$9,174	4%	74	0	0	55	70	0	0	0	0	0	0	0	72%	78	0	0
	Glacier	Micro	C	15%	39%	33%	45	10%	13	$9,645	17%	75	32	103	25	51	619	0	226	15	83	0	15	53%	68	64	43
	Golden Valley	Rural	D+	6%	38%	15%	23	7%	8	$8,121	8%	76	0	0	58	67	576	0	672	0	96	0	0	65%	0	0	0

				Teen Involvement		Family Support			Educational Opportunity			Healthy Surroundings					Safe Neighborhoods							Engaged Communities			
	County	Type of County	Nurturing the Youth Overall Grade	Percentage of Teens Classified as Idle, 2000	Percentage of Population 18 - 24 Who Did Not Graduate High School, 2000	Percentage of Population 0 - 17 below the Poverty Level, 2000	K - 12 Public School Students Eligible for Free and Reduced Price Lunch Per 100 People 17 and Younger, 2000	Percentage of Children with Unemployed Parents, 2000	K - 12 Public School Student to Teacher Ratio, 2002	District Expenditures Per K - 12 Public School Student, 2001	Percentage of High School Students Who Dropped Out of High School, 2000	Average Life Expectancy, 2000	Dentists Per 100,000 People, 1997	Primary Care Physicians Per 100,000 People, 2000	Individuals with Major Depression Per 1,000 People, 2000	Individuals Recently Using Drugs Per 1,000 People, 2000	Reported Aggravated Assaults Per 100,000 People, 2001	Reported Arsons, Per 100,000 People, 2001	Reported Burglaries, Per 100,000 People, 2001	Reported Forcible Rapes, Per 100,000 People, 2001	Reported Motor Vehicle Thefts, Per 100,000 People, 2001	Reported Murders, Per 100,000 People, 2001	Reported Robberies, Per 100,000 People, 2001	Percentage Turnout of the Voter Aged Population for the 2004 Presidential Election, 2004	Total 501c Non-profit Organizations Per 100,000 People, 2000	Education 501c Nonprofits Per 100,000 0 - 17 Year Olds, 2000	Youth Development 501c Nonprofits Per 0 - 17 Year Olds, 2000
Montana (Continued)	Granite	Rural	D	15%	30%	24%	28	5%	11	$7,920	12%	76	0	0	49	57	424	0	495	0	177	0	0	79%	141	0	0
	Hill	Micro	C+	8%	21%	23%	31	7%	14	$8,847	9%	76	46	40	45	61	618	12	354	12	288	0	24	58%	114	43	0
	Jefferson	Rural	B-	8%	38%	11%	14	3%	14	$5,822	5%	76	20	61	49	59	0	0	0	0	0	0	0	76%	50	0	0
	Judith Basin	Rural	D+	9%	25%	30%	23	12%	9	$8,841	12%	76	0	0	52	60	86	0	86	0	172	0	0	78%	43	0	0
	Lake	Micro	C-	17%	31%	25%	29	9%	14	$7,030	19%	76	43	79	40	57	287	0	362	11	128	0	19	65%	117	81	0
	Lewis and Clark	Micro	A	4%	22%	13%	16	4%	18	$6,395	6%	76	60	111	47	58	0	0	0	0	0	0	0	71%	248	154	21
	Liberty	Rural	D	16%	44%	29%	12	15%	10	$9,427	24%	76	42	126	56	65	0	0	0	0	0	0	0	73%	139	0	0
	Lincoln	Micro	C+	9%	37%	26%	30	12%	15	$6,645	5%	76	43	48	49	59	207	0	313	0	159	0	5	61%	143	84	21
	Madison	Rural	B+	7%	30%	6%	5	6%	14	$8,457	4%	76	15	87	53	63	102	0	102	0	88	0	0	68%	102	64	0
	McCone	Rural	D	10%	38%	47%	54	3%	12	$8,130	8%	74	0	49	51	61	0	0	0	0	0	0	0	80%	101	0	0
	Meagher	Rural	D	20%	42%	27%	33	12%	12	$7,271	15%	76	55	166	47	57	155	0	259	52	259	0	0	66%	207	0	0
	Mineral	Rural	C-	10%	39%	18%	43	8%	12	$8,085	6%	76	81	27	46	57	0	0	0	0	0	0	0	64%	26	0	0
	Missoula	Metro	A	4%	12%	15%	19	5%	16	$6,779	6%	77	63	84	46	56	0	0	0	0	0	0	0	68%	197	78	23
	Musselshell	Rural	D	6%	40%	31%	26	9%	12	$7,283	7%	76	22	43	53	64	556	0	356	67	133	0	0	70%	222	0	0
	Park	Micro	A-	8%	23%	13%	16	5%	14	$6,759	8%	77	63	69	52	62	0	0	0	0	0	0	0	68%	159	109	27
	Petroleum	Rural	C-	0%	24%	26%	57	11%	7	$11,309	14%	74	0	0	61	61	0	0	0	0	0	0	0	79%	0	0	0
	Phillips	Rural	B-	4%	32%	23%	35	5%	10	$9,716	2%	76	20	41	50	63	65	0	261	0	196	0	0	72%	130	80	0
	Pondera	Micro	B	10%	39%	23%	20	14%	12	$9,580	12%	75	31	62	44	58	31	0	62	0	31	0	0	66%	171	105	0
	Powder River	Rural	B+	8%	31%	13%	20	0%	13	$7,473	0%	76	0	0	54	65	0	0	0	0	0	0	0	77%	108	201	0
	Powell	Micro	C	14%	43%	15%	24	5%	13	$7,950	18%	76	42	57	52	61	460	0	251	0	125	0	0	52%	167	0	66
	Prairie	Rural	C+	4%	27%	23%	36	2%	11	$8,957	4%	76	0	0	58	67	0	0	0	0	0	0	0	76%	0	0	0
	Ravalli	Micro	C-	13%	35%	21%	24	6%	15	$5,914	14%	76	49	52	49	58	327	0	169	19	128	8	0	68%	100	54	0
	Richland	Micro	B+	10%	31%	14%	20	3%	13	$7,484	7%	76	29	69	51	62	0	0	0	0	0	0	0	65%	114	38	0
	Roosevelt	Micro	D+	16%	43%	41%	44	14%	11	$10,628	13%	74	18	54	32	58	0	0	0	0	0	0	0	60%	75	0	27
	Rosebud	Rural	D	13%	39%	31%	30	14%	12	$11,231	12%	72	59	29	40	62	171	0	107	43	139	0	11	58%	85	32	64
	Sanders	Rural	D	9%	39%	24%	38	9%	14	$8,024	9%	76	10	49	48	61	821	0	469	20	88	10	0	65%	108	0	0
	Sheridan	Rural	A-	2%	36%	16%	22	2%	9	$10,555	0%	74	23	69	54	66	49	0	244	0	49	0	0	74%	122	109	0
	Silver Bow	Micro	C+	7%	22%	19%	20	6%	16	$6,318	7%	74	47	78	51	62	514	0	616	46	263	3	32	64%	144	49	12
	Stillwater	Rural	B+	4%	23%	13%	14	3%	13	$7,120	2%	77	13	51	49	57	171	0	159	12	24	0	12	67%	24	0	0
	Sweet Grass	Rural	B	2%	25%	15%	15	3%	14	$7,115	1%	77	29	0	50	58	166	0	277	0	249	0	28	74%	83	0	0
	Teton	Rural	D+	8%	37%	25%	21	8%	12	$7,395	8%	75	32	32	48	59	186	0	264	0	62	47	0	75%	93	0	0
	Toole	Micro	B-	12%	43%	15%	19	7%	13	$7,616	16%	76	62	62	46	55	0	0	0	0	0	0	0	62%	95	74	0
	Treasure	Rural	C+	8%	27%	23%	25	5%	10	$9,541	2%	72	0	0	46	58	0	0	0	0	0	0	0	75%	0	0	0
	Valley	Micro	A-	6%	34%	15%	25	5%	11	$9,259	5%	76	36	60	52	66	39	0	208	13	117	0	0	76%	235	155	0
	Wheatland	Rural	B-	11%	20%	14%	30	8%	11	$7,890	5%	76	43	86	53	66	0	0	0	0	0	0	0	64%	89	0	0
	Wibaux	Rural	C+	3%	36%	18%	25	10%	9	$9,242	3%	76	0	0	56	66	0	0	0	0	0	0	0	73%	0	0	0
	Yellowstone	Metro	B+	6%	20%	15%	20	6%	16	$6,234	8%	77	60	83	48	59	102	0	402	12	192	7	29	67%	131	54	27
Nevada	Carson City	Metro	D	9%	34%	14%	24	10%	18	$6,486	16%	75	46	77	46	56	463	36	745	59	208	0	69	54%	78	25	16
	Churchill	Micro	B-	5%	23%	11%	22	5%	17	$7,522	7%	74	31	66	43	55	175	8	459	104	146	0	13	60%	75	14	14
	Clark	Metro	D	14%	35%	14%	27	13%	20	$5,796	18%	75	32	66	38	47	326	30	978	44	937	12	315	45%	34	25	4
	Douglas	Micro	B	9%	29%	10%	16	5%	19	$7,171	7%	77	50	55	43	51	104	0	456	0	116	0	34	71%	46	0	0
	Elko	Micro	D+	10%	41%	10%	19	5%	17	$7,003	14%	76	29	51	42	55	168	42	616	24	177	4	29	52%	51	20	0
	Esmeralda	Rural	C+	3%	34%	7%	18	11%	12	$15,370	4%	74	0	0	62	72	412	0	412	0	103	0	0	76%	103	0	0
	Eureka	Rural	D	12%	55%	13%	15	7%	10	$18,294	11%	74	0	54	55	67	909	0	485	0	61	0	61	67%	0	0	0
	Humboldt	Micro	D+	11%	32%	11%	21	10%	17	$7,208	9%	74	29	63	47	61	341	56	416	56	143	6	6	55%	81	40	0
	Lander	Micro	D+	2%	44%	14%	15	10%	17	$8,119	8%	74	14	42	52	67	621	0	431	69	35	0	35	62%	0	0	0
	Lincoln	Rural	C	5%	39%	18%	30	5%	13	$9,713	3%	75	23	45	48	62	144	0	288	0	96	0	0	68%	24	0	0

				Teen Involvement		Family Support			Educational Opportunity			Healthy Surroundings					Safe Neighborhoods							Engaged Communities			
	County	Type of County	Nurturing the Youth Overall Grade	Percentage of Teens Classified as Idle, 2000	Percentage of Population 18 - 24 Who Did Not Graduate High School, 2000	Percentage of Population 0 - 17 below the Poverty Level, 2000	K - 12 Public School Students Eligible for Free and Reduced Price Lunch Per 100 People 17 and Younger, 2000	Percentage of Children with Unemployed Parents, 2000	K - 12 Public School Student to Teacher Ratio, 2002	District Expenditures Per K - 12 Public School Student, 2001	Percentage of High School Students Who Dropped Out of High School, 2000	Average Life Expectancy, 2000	Dentists Per 100,000 People, 1997	Primary Care Physicians Per 100,000 People, 2000	Individuals with Major Depression Per 1,000 People, 2000	Individuals Recently Using Drugs Per 1,000 People, 2000	Reported Aggravated Assaults Per 100,000 People, 2001	Reported Arsons, Per 100,000 People, 2001	Reported Burglaries, Per 100,000 People, 2001	Reported Forcible Rapes, Per 100,000 People, 2001	Reported Motor Vehicle Thefts, Per 100,000 People, 2001	Reported Murders, Per 100,000 People, 2001	Reported Robberies, Per 100,000 People, 2001	Percentage Turnout of the Voter Aged Population for the 2004 Presidential Election, 2004	Total 501c Non-profit Organizations Per 100,000 People, 2000	Education 501c Nonprofits Per 100,000 0 - 17 Year Olds,	Youth Development 501c Nonprofits Per 0 - 17 Year Olds,
Nevada (Continued)	Lyon	Micro	C-	10%	35%	14%	31	6%	17	$6,582	10%	74	17	24	40	49	209	3	591	32	136	0	20	59%	38	11	21
	Mineral	Micro	D	9%	38%	22%	26	11%	14	$10,020	6%	74	18	87	49	65	217	79	809	99	59	20	20	66%	59	82	0
	Nye	Micro	D	10%	35%	13%	32	10%	15	$7,806	15%	75	11	33	41	50	243	22	1167	0	102	6	18	53%	25	0	0
	Pershing	Rural	D	10%	48%	14%	19	10%	14	$10,062	8%	74	19	19	37	46	478	0	837	45	164	15	15	39%	0	0	0
	Storey	Metro	A	0%	15%	5%	4	3%	12	$9,866	5%	75	0	0	44	53	1030	0	382	0	147	0	0	79%	206	153	0
	Washoe	Metro	D+	10%	27%	13%	23	10%	20	$6,072	14%	75	55	93	43	54	315	16	722	53	413	3	152	56%	85	49	13
	White Pine	Micro	C-	6%	45%	12%	20	10%	17	$8,413	7%	74	20	78	52	65	316	44	305	22	54	11	0	59%	98	90	0
New Mexico	Bernalillo	Metro	D+	11%	25%	18%	30	11%	15	$6,228	12%	76	54	138	46	56	754	48	1410	48	845	7	326	60%	110	76	15
	Catron	Rural	D	20%	48%	39%	33	11%	11	$10,717	17%	76	0	72	40	48	141	0	56	28	56	0	28	72%	85	0	0
	Chaves	Micro	D	12%	39%	29%	41	17%	15	$6,602	14%	75	25	56	48	60	728	24	1267	75	168	7	62	52%	101	51	11
	Cibola	Micro	D	17%	28%	31%	35	19%	15	$6,776	10%	75	27	62	34	57	590	16	985	12	195	16	74	43%	43	25	0
	Colfax	Micro	D+	16%	37%	20%	45	6%	14	$7,998	15%	76	29	117	48	58	324	0	754	35	120	0	28	58%	106	56	0
	Curry	Micro	D	12%	25%	25%	43	12%	15	$6,284	10%	76	45	54	47	60	369	44	1372	40	142	9	44	45%	58	22	0
	De Baca	Rural	D	6%	31%	23%	42	7%	12	$10,344	4%	76	43	0	54	63	7768	0	3661	0	134	0	0	68%	0	0	0
	Dona Ana	Metro	D	10%	26%	34%	54	17%	16	$6,458	11%	78	30	56	45	56	172	5	589	39	125	0	48	50%	69	29	15
	Eddy	Micro	D	12%	35%	22%	40	11%	16	$6,851	12%	75	26	34	49	60	434	37	1332	43	188	6	56	56%	85	7	20
	Grant	Micro	D+	13%	24%	26%	37	14%	14	$7,432	9%	76	22	73	48	59	165	13	926	10	116	10	29	63%	119	62	12
	Guadalupe	Micro	C-	14%	31%	24%	56	19%	12	$9,800	8%	76	0	0	43	51	0	0	0	0	0	0	0	63%	64	0	0
	Harding	Rural	D	7%	34%	30%	52	8%	9	$13,686	7%	76	0	0	62	62	0	123	247	0	0	0	0	83%	0	0	0
	Hidalgo	Micro	D	9%	39%	39%	41	19%	13	$9,611	8%	75	0	16	49	62	135	0	118	17	253	0	17	57%	51	0	0
	Lea	Micro	D	13%	37%	28%	43	17%	16	$6,436	11%	75	18	43	46	58	598	4	937	68	151	7	61	46%	58	36	6
	Lincoln	Micro	D	9%	43%	25%	49	11%	14	$8,172	9%	75	38	75	42	50	927	26	814	26	134	5	15	60%	72	68	0
	Los Alamos	Micro	A	4%	27%	2%	0	1%	15	$8,888	5%	78	77	137	50	61	22	5	207	0	55	0	11	81%	169	84	0
	Luna	Micro	D	17%	41%	47%	59	20%	18	$5,932	18%	75	21	50	46	56	468	40	1051	12	232	0	80	43%	44	0	0
	McKinley	Micro	D	14%	39%	42%	41	25%	16	$7,232	11%	72	40	121	19	48	567	8	566	44	214	9	156	48%	72	11	0
	Mora	Rural	D	14%	28%	28%	46	20%	12	$10,040	7%	76	21	0	44	54	135	0	39	0	19	0	0	68%	77	144	0
	Otero	Micro	D	15%	28%	28%	21	12%	16	$6,145	12%	76	20	48	40	51	273	8	294	50	43	2	13	49%	69	27	16
	Quay	Micro	D	11%	41%	26%	44	14%	13	$8,380	10%	76	20	59	49	60	1684	0	817	20	197	0	217	57%	69	0	40
	Rio Arriba	Micro	D	16%	39%	23%	41	15%	15	$7,746	17%	74	24	34	38	52	87	2	136	0	19	0	0	53%	102	26	9
	Roosevelt	Micro	D	10%	16%	25%	44	13%	15	$7,193	8%	76	16	54	49	61	438	17	1349	17	150	0	39	55%	67	40	0
	Sandoval	Metro	C-	13%	32%	16%	25	13%	16	$6,484	12%	77	18	56	38	54	245	19	478	13	126	2	22	64%	36	26	8
	San Juan	Metro	D	12%	33%	27%	37	12%	15	$6,539	13%	75	38	68	30	50	511	17	634	70	177	5	54	54%	52	19	13
	San Miguel	Micro	D	6%	26%	27%	43	17%	14	$8,023	8%	75	17	80	45	56	700	20	860	70	169	3	53	60%	73	36	0
	Santa Fe	Metro	C	12%	34%	15%	26	12%	16	$6,110	15%	78	55	103	47	57	343	35	1646	47	227	5	91	64%	230	181	23
	Sierra	Micro	D	9%	48%	31%	44	10%	16	$6,858	14%	75	18	55	45	52	90	0	196	8	68	0	0	52%	60	38	0
	Socorro	Micro	D	13%	21%	43%	33	18%	14	$7,899	10%	76	25	55	39	53	996	6	774	11	105	11	50	63%	44	0	20
	Taos	Micro	C	15%	29%	25%	54	13%	13	$8,542	14%	76	64	72	41	52	387	10	344	7	160	3	60	65%	223	82	14
	Torrance	Metro	D	17%	42%	25%	64	8%	15	$6,804	14%	76	14	20	41	50	0	0	118	0	30	0	0	58%	24	0	0
	Union	Rural	C	1%	32%	31%	35	8%	12	$9,445	4%	76	24	49	48	57	48	0	335	24	24	0	0	68%	48	0	0
	Valencia	Metro	D	12%	39%	23%	44	11%	16	$6,436	17%	75	19	29	44	55	627	3	505	38	225	2	50	54%	36	10	5
Utah	Beaver	Rural	D	4%	36%	9%	36	4%	21	$5,683	4%	77	34	51	45	55	150	50	183	33	133	0	0	63%	0	0	0
	Box Elder	Micro	C+	8%	27%	8%	23	4%	22	$4,704	8%	77	54	49	41	52	115	7	498	33	110	0	5	61%	28	6	6
	Cache	Metro	A-	6%	10%	10%	22	3%	21	$4,759	5%	80	59	59	40	52	53	2	230	32	74	2	2	61%	46	28	7
	Carbon	Micro	C	6%	18%	15%	30	9%	20	$6,261	7%	78	53	53	47	59	122	29	1131	54	191	10	0	59%	64	35	0
	Daggett	Rural	B	3%	38%	6%	21	2%	10	$13,564	3%	75	0	0	43	43	0	0	651	0	109	217	0	71%	109	0	0
	Davis	Metro	C+	7%	20%	6%	17	3%	23	$4,808	7%	79	46	54	40	52	75	27	358	35	149	2	14	66%	26	10	1
	Duchesne	Micro	D	14%	32%	20%	31	5%	19	$5,482	11%	75	42	62	40	54	125	49	494	28	111	35	0	59%	28	0	0

				Teen Involvement		Family Support			Educational Opportunity			Healthy Surroundings					Safe Neighborhoods							Engaged Communities			
	County	Type of County	Nurturing the Youth Overall Grade	Percentage of Teens Classified as Idle, 2000	Percentage of Population 18 - 24 Who Did Not Graduate High School, 2000	Percentage of Population 0 - 17 below the Poverty Level, 2000	K - 12 Public School Students Eligible for Free and Reduced Price Lunch Per 100 People 17 and Younger, 2000	Percentage of Children with Unemployed Parents, 2000	K - 12 Public School Student to Teacher Ratio, 2002	District Expenditures Per K - 12 Public School Student, 2001	Percentage of High School Students Who Dropped Out of High School, 2000	Average Life Expectancy, 2000	Dentists Per 100,000 People, 1997	Primary Care Physicians Per 100,000 People, 2000	Individuals with Major Depression Per 1,000 People, 2000	Individuals Recently Using Drugs Per 1,000 People, 2000	Reported Aggravated Assaults Per 100,000 People, 2001	Reported Arsons, Per 100,000 People, 2001	Reported Burglaries, Per 100,000 People, 2001	Reported Forcible Rapes, Per 100,000 People, 2001	Reported Motor Vehicle Thefts, Per 100,000 People, 2001	Reported Murders, Per 100,000 People, 2001	Reported Robberies, Per 100,000 People, 2001	Percentage Turnout of the Voter Aged Population for the 2004 Presidential Election, 2004	Total 501c Non-profit Organizations Per 100,000 People, 2000	Education 501c Nonprofits Per 100,000 0 - 17 Year Olds, 2000	Youth Development 501c Nonprofits Per 0 - 17 Year Olds, 2000
Utah (Continued)	Emery	Rural	D+	6%	32%	14%	30	6%	18	$6,364	7%	75	9	18	41	54	46	0	239	37	28	0	9	68%	18	0	0
	Garfield	Rural	A-	10%	24%	9%	31	4%	16	$7,997	4%	76	48	48	40	51	0	0	0	0	0	0	0	70%	42	65	0
	Grand	Micro	D	15%	38%	21%	30	7%	18	$6,012	18%	75	49	49	46	57	118	0	684	35	236	0	35	58%	141	88	0
	Iron	Micro	B+	4%	12%	21%	28	5%	22	$5,264	5%	78	61	47	36	47	98	12	610	0	130	3	18	63%	62	19	0
	Juab	Metro	C	5%	32%	11%	27	6%	21	$5,620	12%	77	28	83	39	50	61	0	340	12	24	0	0	62%	24	0	0
	Kane	Micro	B	6%	27%	9%	24	7%	18	$6,909	7%	76	17	52	43	55	149	0	314	33	17	0	0	70%	33	0	0
	Millard	Micro	C-	5%	44%	17%	32	6%	19	$6,618	7%	77	65	41	41	53	129	24	379	8	258	8	8	63%	8	22	0
	Morgan	Metro	B	5%	22%	6%	15	4%	21	$4,806	2%	78	15	43	42	53	28	0	463	0	84	0	0	68%	0	0	0
	Piute	Rural	C+	7%	14%	23%	46	3%	14	$9,286	2%	75	0	0	49	56	418	0	488	0	209	0	0	79%	0	0	0
	Rich	Rural	B	7%	30%	11%	33	2%	15	$8,489	4%	80	0	0	41	51	102	0	612	0	0	0	0	63%	0	0	0
	Salt Lake	Metro	C-	8%	24%	9%	22	6%	23	$4,729	11%	77	60	98	42	53	204	21	796	50	479	5	104	56%	72	43	7
	San Juan	Micro	C	12%	28%	35%	39	22%	15	$9,080	6%	76	44	22	25	51	49	7	257	7	97	0	14	55%	56	18	0
	Sanpete	Micro	B-	4%	18%	14%	34	5%	21	$5,691	6%	77	48	77	39	52	101	4	470	44	53	0	9	54%	22	13	0
	Sevier	Micro	C	8%	31%	13%	30	4%	20	$5,272	9%	77	61	28	42	54	85	5	456	42	96	5	5	62%	27	15	0
	Summit	Metro	A-	8%	30%	6%	10	4%	18	$6,144	14%	78	39	140	41	50	17	0	642	13	155	0	20	65%	165	90	0
	Tooele	Metro	D	17%	27%	8%	26	4%	22	$4,473	14%	76	29	35	35	44	125	15	572	29	250	15	25	53%	12	0	0
	Uintah	Micro	D	10%	30%	18%	28	8%	19	$5,741	9%	75	27	59	40	55	115	103	595	48	178	4	4	57%	12	0	0
	Utah	Metro	B-	8%	11%	9%	20	5%	23	$4,633	6%	78	50	57	38	50	66	19	497	30	174	1	14	57%	30	16	2
	Wasatch	Micro	B+	4%	29%	6%	19	5%	21	$5,055	7%	78	63	70	37	47	92	0	480	0	66	0	0	62%	7	0	0
	Washington	Metro	C+	7%	22%	15%	23	4%	22	$4,503	9%	79	71	55	39	49	106	9	268	33	83	0	1	62%	38	7	7
	Wayne	Rural	A-	2%	17%	23%	35	5%	15	$7,605	1%	75	42	42	44	52	120	0	319	0	40	0	0	76%	80	0	0
	Weber	Metro	C-	10%	24%	11%	25	6%	21	$4,947	10%	77	72	68	42	53	171	11	747	42	278	6	64	51%	44	18	2
Wyoming	Albany	Micro	A	2%	5%	17%	17	6%	11	$8,203	3%	77	47	88	47	58	350	25	559	22	178	0	0	65%	156	136	51
	Big Horn	Rural	C	8%	31%	20%	30	5%	11	$10,356	7%	76	45	36	48	58	122	44	349	44	26	0	17	67%	52	0	0
	Campbell	Micro	B+	8%	25%	8%	16	4%	14	$8,083	9%	76	37	69	43	54	297	45	350	27	131	3	12	58%	95	48	0
	Carbon	Micro	B+	9%	34%	17%	21	5%	12	$10,133	10%	77	44	51	50	61	301	13	480	13	83	0	0	61%	96	80	0
	Converse	Micro	C+	9%	29%	16%	20	5%	13	$8,552	9%	76	16	24	48	60	299	25	514	50	100	0	8	65%	141	0	0
	Crook	Rural	A-	3%	33%	10%	19	6%	12	$10,359	3%	76	17	35	48	58	272	0	102	0	68	0	0	77%	119	63	0
	Fremont	Micro	B-	13%	32%	24%	29	9%	13	$10,753	12%	74	61	100	43	59	156	3	430	31	162	0	25	65%	131	41	10
	Goshen	Micro	B+	7%	21%	16%	31	7%	11	$9,129	9%	76	23	47	52	62	144	0	287	48	16	0	0	65%	128	67	0
	Hot Springs	Micro	A	2%	27%	12%	28	3%	11	$9,864	7%	77	64	107	49	59	184	0	184	20	123	0	20	70%	205	185	93
	Johnson	Micro	A-	6%	35%	11%	18	1%	12	$9,155	2%	76	44	118	49	59	155	28	551	42	240	0	0	70%	155	58	0
	Laramie	Metro	B+	8%	21%	12%	21	5%	15	$7,699	9%	76	51	101	48	58	92	13	495	53	124	1	26	64%	110	63	19
	Lincoln	Micro	B+	7%	27%	12%	21	2%	15	$8,050	5%	76	58	65	43	54	288	0	213	21	69	0	0	76%	69	0	0
	Natrona	Metro	B	8%	20%	16%	22	6%	15	$7,869	9%	76	53	97	47	57	221	72	893	30	250	5	42	64%	152	46	52
	Niobrara	Rural	C+	18%	18%	16%	29	2%	11	$10,424	4%	76	38	38	58	66	83	0	291	0	83	0	42	78%	83	0	0
	Park	Micro	A-	6%	18%	17%	16	4%	14	$7,690	5%	77	51	86	50	60	264	58	411	31	74	4	19	73%	132	79	32
	Platte	Micro	B+	4%	39%	16%	18	2%	10	$9,473	11%	76	35	47	49	59	159	23	375	0	34	0	0	71%	79	90	0
	Sheridan	Micro	A-	6%	24%	15%	23	5%	11	$8,971	6%	75	52	103	49	59	83	0	471	19	120	0	15	68%	218	140	0
	Sublette	Rural	A	3%	30%	11%	18	2%	12	$11,322	7%	77	18	105	49	59	321	0	203	0	135	0	0	76%	270	261	0
	Sweetwater	Micro	B+	7%	27%	10%	16	4%	14	$8,954	5%	77	50	45	49	61	269	11	564	29	146	3	8	62%	69	28	9
	Teton	Micro	A	9%	16%	7%	8	6%	14	$8,706	12%	76	79	187	40	47	230	0	416	33	186	0	11	76%	356	142	28
	Uinta	Micro	B-	8%	33%	12%	23	4%	13	$8,545	10%	76	39	30	44	57	51	0	279	25	147	10	10	61%	56	46	0
	Washakie	Micro	B-	13%	30%	20%	27	3%	13	$8,773	10%	76	46	58	52	63	664	0	193	0	60	0	0	72%	121	44	0
	Weston	Micro	C+	16%	30%	12%	16	4%	12	$9,854	7%	76	31	46	48	59	75	15	1249	15	196	0	15	66%	45	63	0

Methods

General Statistics Used

Mean & Median: For a set of data, the mean and median were both used to approximate the value that will be most similar to all data in the set. The mean is the average of the dataset. The median is the middle value of the dataset, if all values are put in order. Depending on the values in the dataset, one method may have been deemed more appropriate than the other.

Standard Deviation: The standard deviation is a measure of the dispersion of a dataset, or how spread out or tightly centered the data is, and was used as part of the method for comparing and combining different sets of data as detailed in the Indicator Rankings method above.

Indicator Rankings

For a given indicator, counties are ranked according to the following methodology:

Each county is assigned a Z-Score for each variable that makes up the indicator in order to normalize and compare numerically different variables. The Z-Score for a county and for a given variable is equal to the value of the variable for that unit minus the mean value of the variable for all counties all divided by the standard deviation of the variable for the group.

$Z = (X - X_{mean})/S_x$, where Z is the Z-Score, X is the value of a variable for a geographic unit, X_{mean} is the mean value of the variable for all units in the group, and S_x is the standard deviation of the variable for all units in the group.

After each county is assigned a Z-Score for each variable that makes up the indicator, each county is assigned an overall Z-Score by averaging the county's different Z-Scores. Sometimes different Z-Scores are given different weight as indicated in that section of the *Report Card*. Then, each unit is ranked in order of its overall Z-Score for the indicator.

Indicator Grades

After the units are ranked for the indicator as outlined above, the following percentage distribution is applied to assign grades to each geographic unit:

Percentile Earning Grade	% of Counties Earning Grade	Letter Grade Earned
100% to 93%	8%	A
92% to 85%	8%	A-
84% to 77%	8%	B+
76% to 70%	7%	B
69% to 64%	6%	B-
63% to 54%	10%	C+
53% to 44%	10%	C
43% to 36%	8%	C-
35% to 28%	8%	D+
27% to 0%	7%	D

County Groups: Metro, Micro, and Rural

The State of the Rockies uses the rural-urban continuum codes developed by the Economic Research Service at the U.S. Department of Agriculture in 2003 based on their metropolitan-nonmetropolitan status and size of their metropolitan or urban populations.Beginning in June 2003, the Office of Management and Budget (OMB) has instructed the Census Bureau to track "micropolitan" areas as well as metropolitan areas. Micropolitan statistical areas must have an urban cluster of at least 10,000 people but fewer than 50,000 people. The designation includes the county where the urban cluster is plus adjacent counties linked by commuting ties. For more information http://www.census.gov/population/www/estimates/metrodef.html and http://www.ers.usda.gov/briefing/rurality/RuralUrbCon/.

Note: Because it was so recently created, and most data sets do not yet include it, Broomfield County, Colorado is not included in our analyses.

State of the Rockies County Label	Code	Census/ USDA Label	Definition	Number of Counties in the Rockies
Metro	1	Metro	County in metro area with 1 million population or more	12
Metro	2	Metro	County in metro area of 250,000 to 1 million population	24
Metro	3	Metro	County in metro area of fewer than 250,000 population	25
Micro	4	Non Metro	Nonmetro county with urban population of 20,000 or more, adjacent to a metro area	14
Micro	5	Non Metro	Nonmetro county with urban population of 20,000 or more, not adjacent to a metro area	14
Micro	6	Non Metro	Nonmetro county with urban population of 2,500-19,999, adjacent to a metro area	38
Micro	7	Non Metro	Nonmetro county with urban population of 2,500-19,999, not adjacent to a metro area	72
Rural	8	Non Metro	Nonmetro county completely rural or less than 2,500 urban population, adj. to metro area	25
Rural	9	Non Metro	Nonmetro county completely rural or less than 2,500 urban population, not adj. to metro area	56

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Cover photo by Stephen G. Weaver. Photo contributions for this report, unless otherwise noted, were made by the Colorado College State of the Rockies staff and the Colorado College Office of External Relations. Other photos came from a contract with Shutterstock.com.

State of the Rockies Contributors

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Walter E. Hecox is professor of economics, director of the Slade Sustainable Development Workshop, and project director for the 2005-06 State of the Rockies Project at Colorado College. Walt received his B.A. degree from Colorado College in 1964 and an M.A. (1967) and Ph.D. (1970) from Syracuse University. He teaches courses in international economics, ecological economics, and sustainable development. He has conducted research and taken leave to work for the World Bank, U.S. Agency for International Development, U.S. Department of Energy, and Colorado Department of Natural Resources. He is author of "Charting the Colorado Plateau: An Economic and Demographic Exploration" (The Grand Canyon Trust, 1996), co-author of "Beyond the Boundaries: The Human and Natural Communities of the Greater Grand Canyon" (Grand Canyon Trust, 1997), and co-editor of the *2004 and 2005 Colorado College State of the Rockies Report Cards*.

Bryan Hurlbutt is 2005-2006 program coordinator of the Colorado College State of the Rockies Project. He co-edited and authored portions of the *2005 State of the Rockies Report Card* while working as 2004-2005 research manager of State of the Rockies. Bryan was born and raised in southern Idaho. He graduated as a trustee scholar from Colorado College with a B.A. degree in May 2004, majoring in physics. During his undergraduate years, he conducted research on supernova luminosity at Colorado College, solar flares at Montana State University, and underwater acoustics for Colorado College in the San Juan Islands, Washington. In his spare time, Bryan enjoys playing classical guitar, recreating in the outdoors, teaching and practicing yoga, and working on Sudoku puzzles. In fall 2006, Bryan will begin law school at Columbia University in New York City.

Chris Jackson is a 2005-06 student researcher for the Colorado College State of the Rockies Project. He will graduate in May 2006 with a major in international political economy. His senior thesis research focuses on the viability of tar sand oil extraction in Canada and the subsequent impacts on relations between the U.S. and Canada. Chris's interest in international relations stems from his extensive travel through central Europe while studying in the Czech Republic in 2004. Growing up in the mountains of Colorado, Chris gained a particular interest in exploring ways to maintain the unique character of the region.

Jared Kapela is a 2005-06 student researcher for the Colorado College State of the Rockies Project. Jared will graduate in May 2006 with a double major in economics and environmental science and has continued his Rockies research into his senior year, working to complete a thesis in economics. Since matriculating to Colorado College from his high school in Hunting Valley, Ohio, Jared has been an intern with the Environmental Protection Agency in Washington, D.C., and has worked on campus to promote various environmental initiatives with students and faculty. After graduation, he plans to pursue a master's degree in business administration and work in the private sector to promote market approaches for solving environmental problems.

Caitlin O'Brady is 2005-06 research manager for the Colorado College State of the Rockies Project research team after working as a student researcher for the Rockies Project during the 2004-05 school year. She graduated *cum laude* from Colorado College in May 2005 with distinction in environmental science. She has a keen interest in social and environmental issues of different regions which she has explored while studying sustainable development and social change in Central America and working for a bioregional nonprofit in the Pacific Northwest. In her time at CC, Caitlin participated in various projects with campus environmental groups, and was awarded several grants to complete and present her senior thesis research on the effects of an invasive, nitrogen-fixing tree on Hawaiian ecosystems. In her spare time, Caitlin enjoys making ice cream, practicing and teaching yoga, and exploring Colorado.

Matthew Reuer serves as the technical liaison for the Colorado College State of the Rockies Project, overseeing tasks including data assimilation, GIS analysis, and logistics management. He received his doctorate from MIT in 2002 and was a Harry Hess postdoctoral research fellow at Princeton University from 2002 to 2004, focusing on global carbon cycle research. Matt's scientific interests in this region include the environmental chemistry of western rivers and watersheds as well as global change impacts on alpine biogeochemical cycles. He is also highly interested in western development issues and the creation of innovative energy policies in the Rocky Mountain West.

Amanda Strauss is a 2005-06 student researcher for the Colorado College State of the Rockies Project. She will graduate from Colorado College in May 2006 with a major in biology. While studying ecology across Ecuador's diverse terrain, she developed a greater understanding and interest in global and regional environmental issues. As an intern for the State of the Rockies Project, she is pursuing her interest and gaining a greater understanding of the interface between biology and economics at the regional level.

Andrew Yarbrough is a 2005-06 student researcher for the Colorado College State of the Rockies Project. He is from Roxbury, Connecticut, and graduated from Taft High School, Watertown, Connecticut, in 2002. Andrew is a senior international political economy major at CC, and recently completed his senior thesis entitled "East Asian Economic Regionalism: A Proposal for Sustained Economic Growth and Stability." After spending his junior year at the London School of Economics and a summer studying at the Universidad de Salamanca in Spain, Andrew focused this year on his thesis research and helping to publish the *State of the Rockies Report Card*. He is passionate about environmental protection and land conservation in the Rocky Mountain region.

Gregory Zimmerman is a 2005-06 student researcher for the Colorado College State of the Rockies Project. He is currently a senior environmental science major at Colorado College interested in water management and water law, specifically how water management shapes development in the American West. Greg spent the summer researching the effects of climate change in the Rocky Mountain region. He is working on his senior thesis about the consequences of climate change on the hydrology of the Arkansas Headwaters Watershed. After graduation, Greg plans to take some time off from academics, after which he expects to return to school and continue his studies in environmental science or environmental law.

Guest Contributors

Tyrone Guthrie manages and develops conservation and geographic information systems (GIS) information for The Nature Conservancy's worldwide and the Rocky Mountain regional offices. He has been with The Nature Conservancy for three years. Tyrone has a Master of Science degree from the University of Victoria, British Columbia, where his research focused on the development of landscape ecology-based indicators to measure the environmental performance of local government. Before joining The Nature Conservancy, Tyrone worked with the Province of British Columbia, managing GIS data and applications for land use and conservation planning.

F. Patrick Holmes served as the program coordinator of the Colorado College State of the Rockies Project from 2003 to 2005. A graduate of Colorado College in May 2003 with a liberal arts and sciences major: environmental economics and policy, he was research assistant at the Sonoran Institute in Montana during the summer of 2003 and involved with the Colorado College Sustainable Development Workshop as an undergraduate. Patrick is co-author of the "Changing Economy of the West," Sonoran Institute, September 2003, "The Colorado Plateau Economy: Shifting Patterns and Regional Disparities," in The Colorado Plateau II, "Does Wilderness Impoverish Rural Regions?" *International Journal of Wilderness*, December 2004, as well as co-editor of the *2004 and 2005 Colorado College State of the Rockies Report Cards*.

Phillip M. Kannan is distinguished lecturer and legal-scholar-in-residence, Colorado College. His education includes a B.S. (1961) and M.A. (1963) in mathematics at the University of North Carolina, Chapel Hill, N. Carolina; and a JD degree (1974) from the University of Tennessee College of Law, Knoxville, Tennessee. He has practiced law for over 30 years as the general counsel for nonprofit and public corporations and has published many articles in the fields of administrative and environmental law. Since 1997 he has taught a variety of courses at Colorado College in the environmental science and Southwest studies programs and the master of arts in teaching program, focusing on environmental policy nationally, internationally, and in the Southwest.

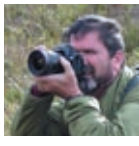
Tass Kelso has been a professor of biology at Colorado College since 1987, after receiving an undergraduate degree from Dartmouth College, and graduate degrees from the University of Colorado and the University of Alaska. She specializes in plant biology and conservation of mountain and plains ecosystems of Colorado and does additional research on issues relating to rare plants and connections between the floras of western North America, the Arctic, and Eurasia. She has been a longtime collaborator with organizations such as The Nature Conservancy, The Palmer Foundation Land Trust, the Colorado Natural Heritage Program, and the U.S. Forest Service on studies about biodiversity in the Pikes Peak region, southeastern Colorado, and the southern Rocky Mountains.

Chris Pague brings 27 years of experience in the study of natural history, conservation planning, and conservation biology to his position as senior conservation ecologist at The Nature Conservancy of Colorado. BS and MS degrees in biology and zoology and advanced training in ecosystem ecology and evolutionary biology, combined with 24 years of field experience, provided him with a strong background for conservation inventory and planning efforts. After working as the zoology team leader in the Virginia Natural Heritage Program, Chris arrived in Colorado in 1992 to revitalize the Colorado Natural Heritage Program, first at the University of Colorado and now a sponsored program at Colorado State University. Chris moved to The Nature Conservancy's Colorado Program in 1997. Chris is the lead for the Colorado Nature Conservancy's Measures of Success Initiative and he provides science guidance on global, regional, state, and local conservation efforts for the Colorado chapter and its partner organizations. Other foci include regional conservation, planning, and strategies for conservation of Colorado's eastern plain and on Colorado's public lands.

Anna Sher is a plant ecologist with a particular interest in conservation issues. She holds a joint position as an assistant professor in the department of biological sciences at the University of Denver and as the director of research, herbaria, and records at the Denver Botanic Gardens. Her area of research expertise is invasive species and ecological restoration of riparian zones. Past work has included a Fulbright Award to do desert research in Israel, and she has taught and done research in Kenya. Currently funded research includes development of IPM for tamarisk removal, use of commercial mycorrhiza for revegetation after weed control, and development of models for predicting invasion impact and restoration success. At DU, she teaches conservation biology and seminars in specialized topics, including ethics in science. She has published her research in such journals as *Ecological Applications* and *Conservation Biology* and to date has been cited over 70 times in the peer-reviewed literature. She currently enjoys supervising three graduate students and five undergraduates working in her lab and a staff of nine at the Denver Botanic Gardens.

Randy T. Simmons is professor and department head of political science and director of the Institute of Political Economy at Utah State University. He is also senior fellow at the Property and Environment Research Center (PERC). He received his Ph.D. in political economy from the University of Oregon. He was a policy analyst in the Office of Policy Analysis at the U.S. Department of the Interior and is mayor of Providence, Utah. He specializes in applying the assumptions and methods of economics to policy questions, especially to environmental and natural resource policy. Simmons is co-author of "Beyond Politics: Markets, Welfare, and the Failure of Bureaucracy" (2nd edition to be published in 2006), author of "Critical Thinking about Endangered Species" (2003), and co-editor of "Wilderness and Political Ecology" (2002). He contributed chapters to the 2005 edition of the *Oxford Companion to the Supreme Court* on "City of Monterey v. Del Monte Dunes at Monterey" and the Fifth Amendment. His articles and op-eds have appeared in *American Political Science Review*, *BYU Law Review*, *Contemporary Policy Issues*, *Journal of Contemporary Studies*, *Policy Review*, *Public Choice*, *The Baltimore Sun*, *Desert Morning News*, *Los Angeles Daily News, Salt Lake Tribune*, and *Washington Post*.

Christina Supples is the conservation science research coordinator for The Nature Conservancy's Colorado field office in Boulder, Colorado. Focusing on landscape-scale ecological issues, Christina uses her knowledge of western ecosystems and their socio-economic context to guide and build technical and scientific leadership, supporting The Nature Conservancy's science-based conservation efforts. Christina comes to The Nature Conservancy as a recent graduate from the Duke University's Nicholas School of the Environment where her master's research focused on the applications of landscape ecology to the conservation of western fire-adapted ecosystems. She brings her combined experience as a researcher and ecologist at the Colorado Natural Heritage Program, Montana State's Big Sky Institute of Science and Natural History, and the Duke University Center for Tropical Studies and Landscape Ecology Laboratory to her current position.



Stephen G. Weaver is an award-winning photographer with over 30 years experience making images of the natural world and serves as technical director for the Colorado College geology department. Educated as a geologist, Steve combines his scientific knowledge with his photographic abilities to produce stunning images that illustrate the structure and composition of the earth and its natural systems. As an undergraduate geology student, he first visited the Rocky Mountains, where he fell in love with the mountain environment and the grand landscapes of the West. Steve currently photographs throughout North America with a major emphasis on mountain and desert environments. His use of a 4x5 large format view camera allows him to capture images with amazing clarity and depth.

The 2006 Colorado College State of the Rockies Report Card

Every year, the *State of the Rockies Report Card* measures economic, demographic, social, and environmental conditions throughout the eight-state Rockies region to track trends on the most critical issues this rapidly changing region faces. Highlights in this year's Report Card are:

State of the Rockies Reports

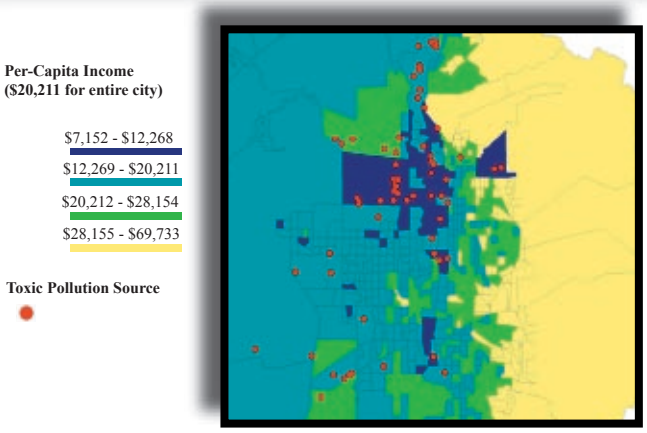
- "Rockies Baseline: Vital Signs for a Region in Transition"
- "A Common Western Voice: Can the Rockies Be Heard in Washington, D.C.?"
- "Ranching in the Rockies: Threats and Signs of Hope"
- "Conservation Easements: Preserving Private Land in the Rockies"
- "New Resource Management: Innovative Approaches in the Rockies"
- "Preserving Biodiversity: Mapping Habitat Threat in the Rockies"
- "Climate Change: Modeling a Warmer Rockies and Assessing the Implications"
- "Environmental Justice: Income, Race, Ethnicity, and Toxic Pollution in the Rockies Metro Areas"
- "Grading the Rockies: Nurturing the Youth"

Guest Contributions

- "Experiments in Managing the Federal Estate: The Case of the Valles Caldera National Preserve and Trust" by F. Patrick Holmes
- Challenge Essay on Invasive Species – "The Invasion of Our Rockies: Hype or Management Priority?" by Anna Sher
- Challenge Essay on Endangered Species – "Myths Versus Realities Concerning Threatened and Endangered Species in the Rockies" by Randy T. Simmons
- "Fragmenting the Western American Landscape" by Chris Pague, Tyrone Guthrie, and Christina Supples
- Colorado College Faculty Overviews by Tass Kelso, Phillip M. Kannan, and Matthew Reuer

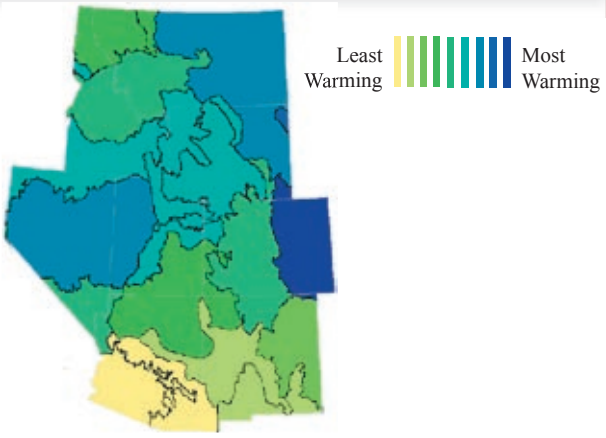
Environmental Justice

Salt Lake City, Utah
Per-Capita Income and Sources of Toxic Pollution by Block Group



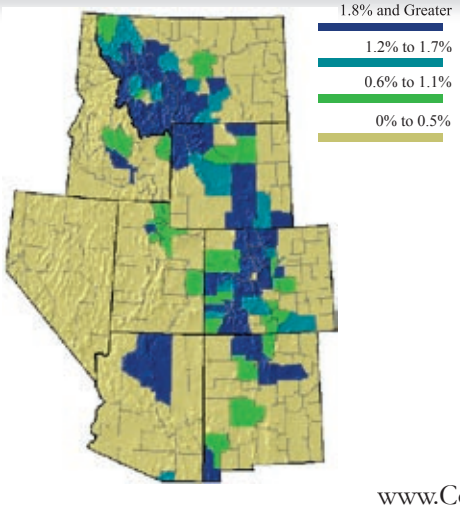
Climate Change

Warming of the Rockies' Ecoregions, 1976 to 2085
Degrees Celsius



Conservation Easements

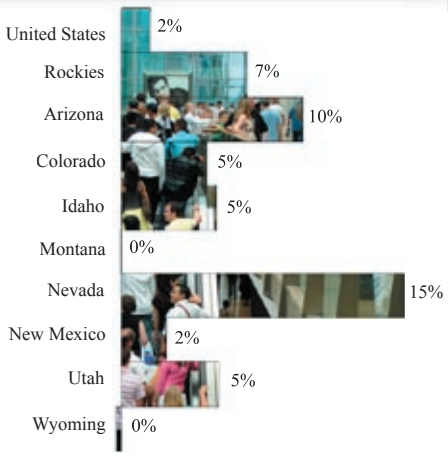
County Acres under Conservation Easement as a Percentage of Privately Owned Acres



COLORADO COLLEGE
1874

Rockies Baseline

Population Growth, 2000 to 2004



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