

Vulnerability of Wyoming's Terrestrial Wildlife and Habitats



WHY ASSESS VULNERABILITY?



ECOSYSTEMS

are changing, which affects wildlife species and their habitats.

Vulnerability assessments are useful for highlighting species or habitats that may be susceptible to changes or emerging threats. A vulnerability assessment is a proactive approach for identifying targeted and efficient conservation strategies that can help to prevent declines in sensitive species and the habitats they depend on.

Vulnerability is a function of a species' or habitat's exposure to changes and its resilience to those changes.

Exposure is a measure of how much change is likely to be experienced, while resilience is the ability of a species or habitat to survive and recover from change.

Key Challenges

Wyoming's 2010 State Wildlife Action Plan (SWAP)¹ identified the five leading challenges to wildlife conservation as residential development, energy development, climate change, invasive species, and disruption of historic disturbance regimes. This

Vulnerability assessments are useful for highlighting species or habitats that may be susceptible to changes or emerging threats.

vulnerability assessment analyzed wildlife vulnerability to three of those challenges: residential development, energy development, and climate change. The assessment also highlighted wildlife disease, which was identified as an important conservation issue in the 2010 SWAP.

Project Objectives

- Highlight which of Wyoming's sensitive species are most vulnerable to development, climate change, and wildlife disease in the future.
- Identify which terrestrial wildlife habitats and priority areas are most vulnerable to future development and changes in climate.
- Provide new information about Wyoming's wildlife and habitats that can help to guide wildlife management and prioritize conservation efforts.

This report provides an overview and summary of key findings from a technical vulnerability assessment report² completed by The Nature Conservancy, Wyoming Game and Fish Department and Wyoming Natural Diversity Database.

ON THE COVER Wetlands and sagebrush in central Wyoming © *Joe Kiesecker*. Inset photos left to right: Plains Spadefoot © *Chris Helzer*, Bighorn Sheep © *Russ Schnitzer*, Burrowing Owl © *Ian Abernethy*

THIS PAGE LEFT TO RIGHT Bighorn Sheep in the Wind River Mountains © *Amy Pocewicz*; Aerial view of natural gas development in southwest Wyoming © *David Stubbs*; White-faced Ibis © *Scott Copeland*

WILDLIFE SPECIES

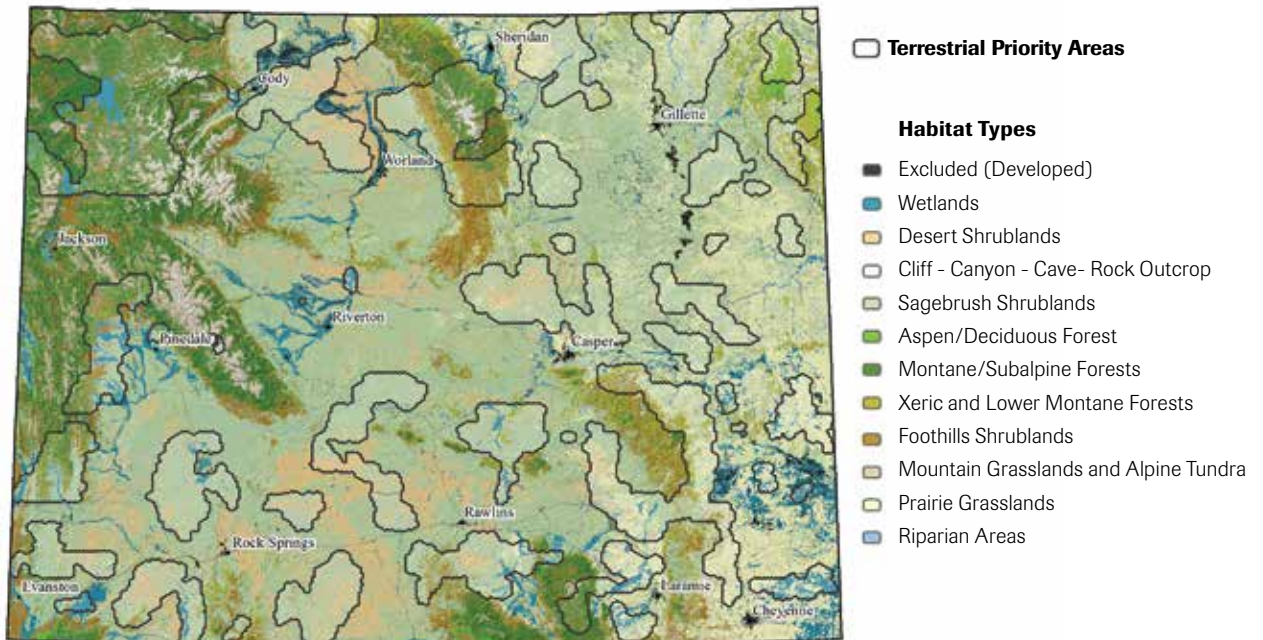
WE ASSESSED

the future vulnerability of 131 terrestrial Species of Greatest Conservation Need (SGCN) that were identified in the 2010 SWAP. SGCN are species whose conservation status warrants increased management attention and funding, as well as consideration in conservation, land use, and development planning. These species included 56 birds, 46 mammals, 21 reptiles, and 8 amphibians.



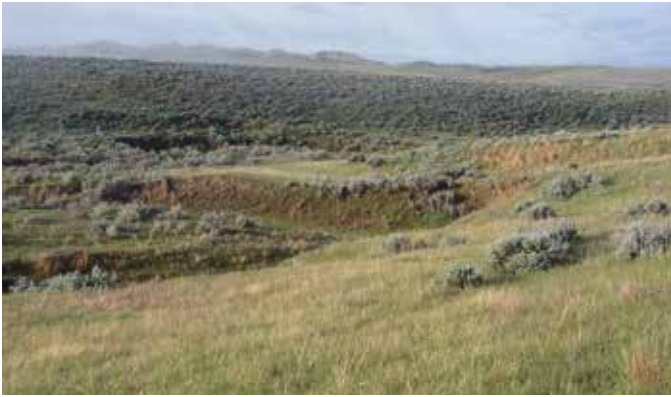
HABITATS & PRIORITY AREAS

The future vulnerability of 11 terrestrial habitat types and 44 priority areas were also assessed. These major habitat types included grasslands, shrublands, forests, and wetlands. Terrestrial priority areas were identified in the 2010 SWAP as the places that best meet conservation goals in the smallest areas of land for the most terrestrial SGCN and their habitats.



Terrestrial habitat types and priority areas, as identified in Wyoming's 2010 State Wildlife Action Plan.

ASSESSMENT METHODS



WE ANALYZED

vulnerability of 1) species and 2) habitats and priority areas.

Additional details can be found in the technical report for this assessment². We used these two approaches in order to capture species-specific traits as well as landscape patterns that affect habitats, priority areas and the many species that use these places.

Species Vulnerability

We ranked each wildlife species to reflect their anticipated overall future vulnerability, and their vulnerability to development, climate change and disease. For climate change, we used Nature Serve's Climate Change Vulnerability Index, and for disease we used a similar evaluative framework developed as part of this assessment. For development, we used a relative exposure index based on existing and projected (2030) oil and gas, wind, and residential development. These analyses resulted in tabular data, in the form of scores and categorical rankings of low, moderate or high. We then combined these individual rankings into an overall rank. A total vulnerability score was determined by summing the three individual ranks, by assigning values to low (1), moderate (2) and high (3) categories. These summed scores were then categorized into overall ranks of low (3-4), moderate (5), high (6-7), or very high (8-9).

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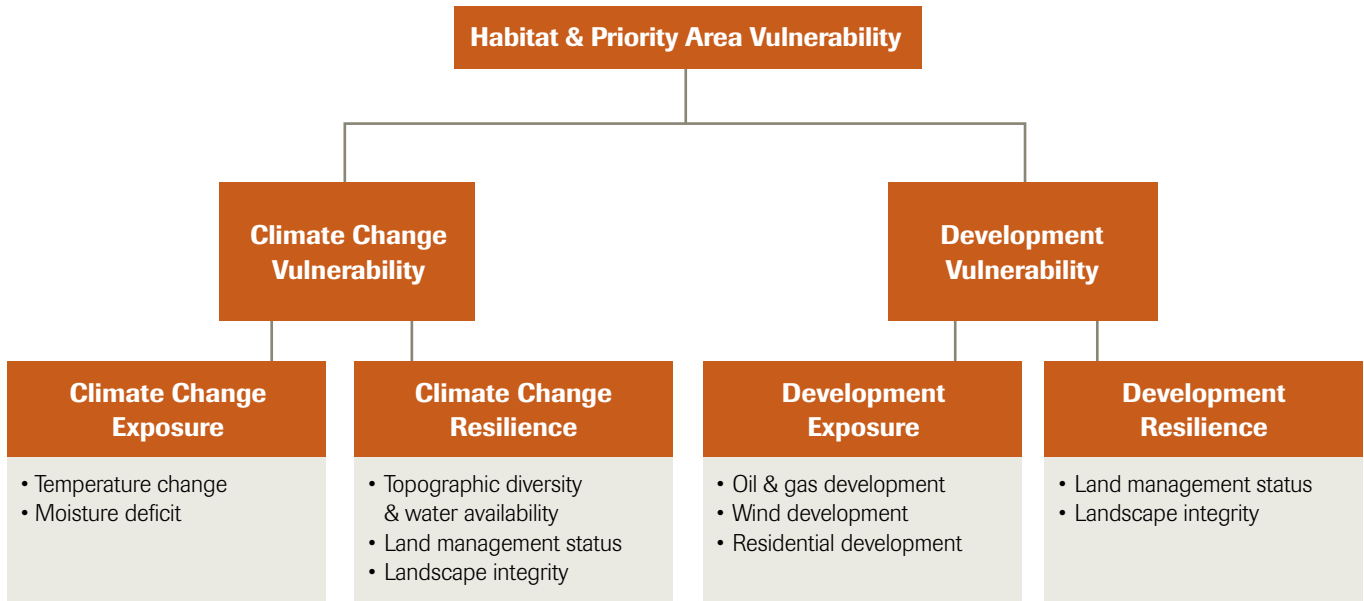
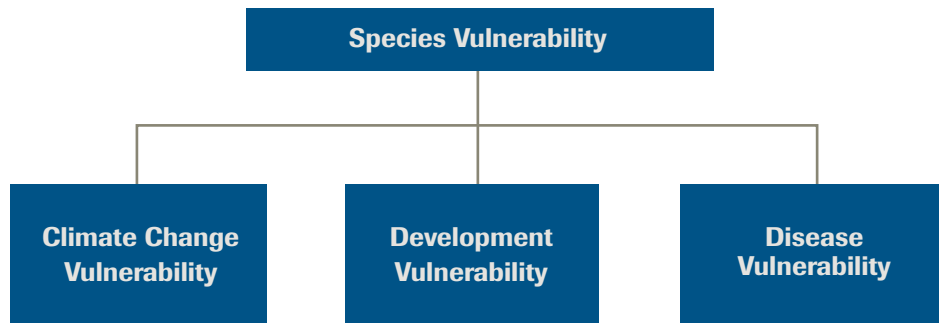
Habitat & Priority Area Vulnerability

To describe the vulnerability of habitat types and priority areas, we first created spatial datasets across Wyoming to represent climate change vulnerability, development vulnerability, and overall vulnerability (development + climate change)

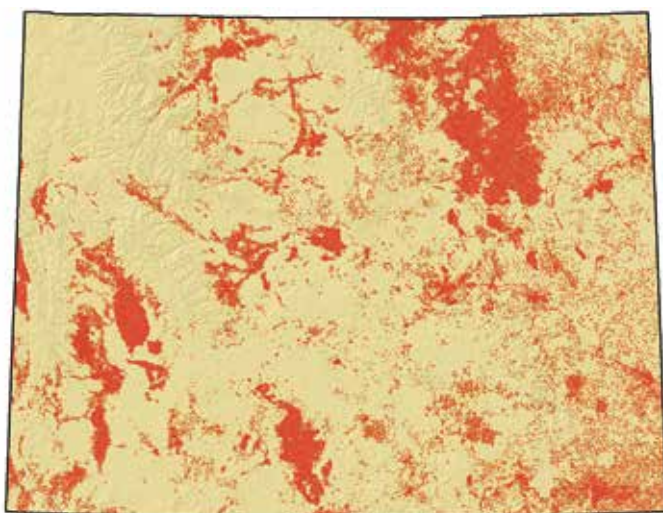
Exposure to development represents the relative impact of development on the landscape. Development exposure included oil and gas, wind energy, and residential housing development, and included existing (2010) and projected (2030) development. Exposure to climate change represents the relative impact of changes in temperature and moisture. We used the annual mean temperature change rate from 1951-2006 and projected moisture deficit to evaluate the exposure of Wyoming's habitats to climate change.

Resilience represents the relative ability of habitats within a landscape to survive or recover from a change. Resilience was calculated separately for development and climate change from three datasets: topographic diversity and water availability, land management status, and landscape integrity. Resilience to development was represented using land management status and landscape integrity, while resilience to climate change was represented using all three datasets.

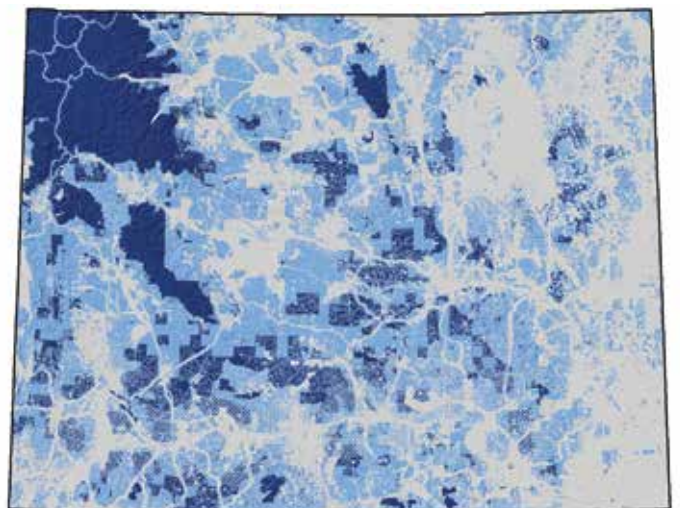
For each vulnerability dataset, scores in each location ranged in value from 0 to 1 (1 = highest vulnerability) and were assigned to categories as follows: low (<0.33), moderate (0.34-0.66), and high (>0.67). For each habitat type and priority area, we calculated the percentage of its area occurring in the high category and categorized each habitat or priority area as low, moderate or high vulnerability based on the percent of its land area categorized as "high" as follows: low (<10%), moderate (10-33%), and high (>33%).



The vulnerability assessment included separate analyses to evaluate individual wildlife species and terrestrial habitats and priority areas. For each species, vulnerability to climate change, development and disease were evaluated and synthesized into one species vulnerability ranking. For each habitat or priority area, vulnerability to climate change and development were evaluated and combined to represent overall vulnerability. Climate change and development vulnerability were each calculated as exposure minus resilience using the datasets shown in the bulleted lists.



Development Exposure Low Moderate High



Development Resilience Low Moderate High

Development exposure included current and projected (2030) oil and gas, wind and residential development. Resilience to development was represented using land management status (level of legal or management protection) and landscape integrity (amount of fragmentation). The exposure and resilience datasets were combined to represent development vulnerability across Wyoming.

OVERALL VULNERABILITY

Species Vulnerability

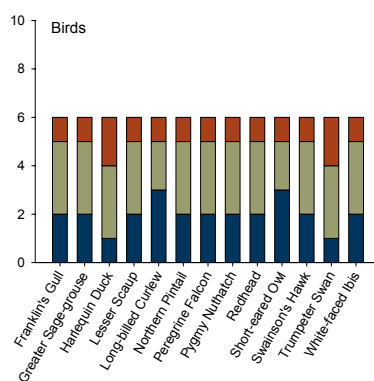
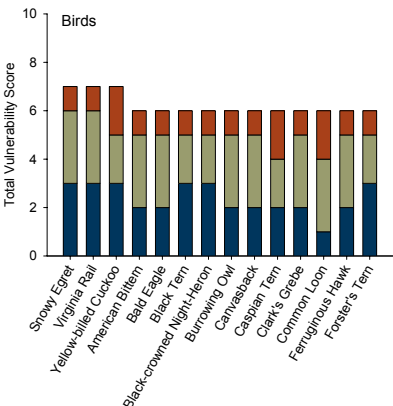
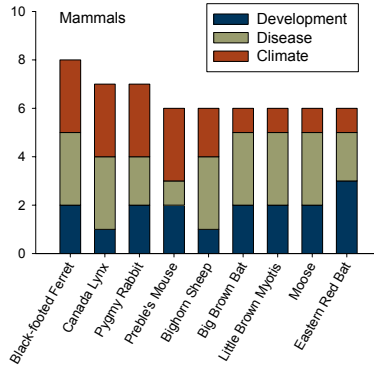
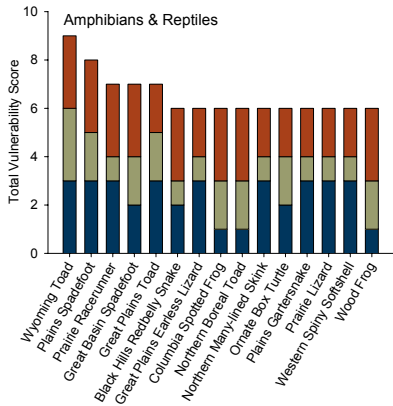
THREE SPECIES

were ranked as very highly vulnerable: Wyoming Toad, Plains Spadefoot, and Black-footed Ferret. Amphibians were the most vulnerable group, followed by birds. The relative contribution of climate change, development or disease to overall vulnerability varied among the highly

vulnerable species and among taxonomic groups, as shown in the figure below. While this assessment considered climate change, development and disease separately, the potential interactions among these threats should also be considered when developing strategies.

The number of species and percent of each group that had high or very high overall vulnerability

Taxonomic group	High Overall Vulnerability
Amphibians	7 (88%)
Birds	27 (48%)
Mammals	9 (20%)
Reptiles	8 (38%)
Total	51 (39%)



The 51 species categorized as highly or very-highly vulnerable are shown above. The bars show the relative contribution of development, disease, and climate change vulnerability to the total vulnerability score.

THIS PAGE Pygmy Rabbit © Wendy Estes-Zumpf; Greater Sage-Grouse © Joe Kiesecker.

Habitat & Priority Area Vulnerability

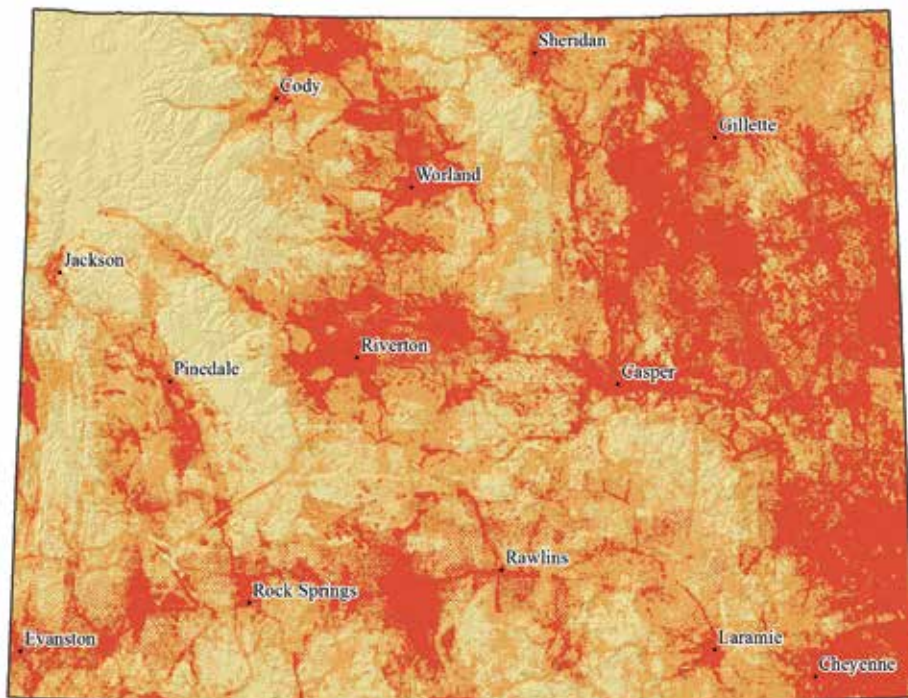
OVERALL landscape vulnerability included both climate change and development vulnerability. Overall vulnerability was high for five habitat types and was highest for wetlands and prairie grasslands. These two habitat types had high or moderate

vulnerability to both climate change and development, low resilience to development, very limited legal protections and some of the greatest numbers of associated highly vulnerable species. Priority area vulnerability was highest in eastern Wyoming.

Habitat Types

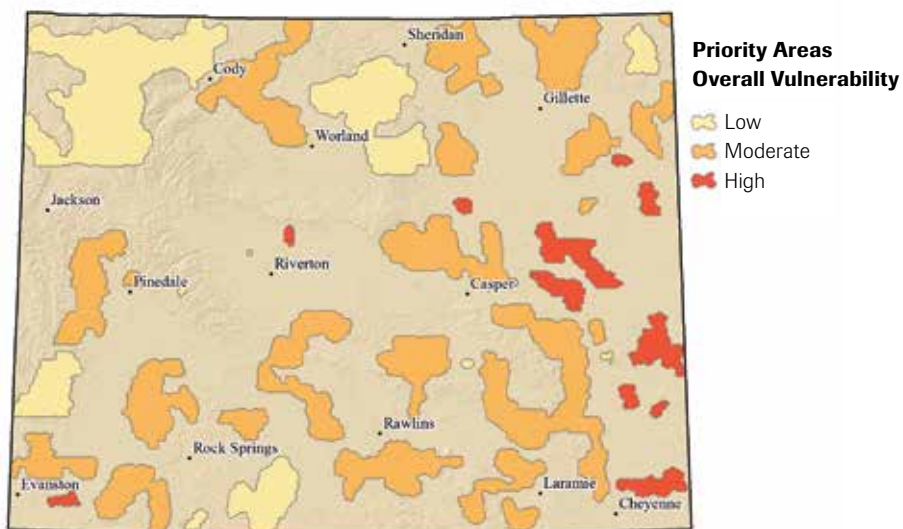
Red = high vulnerability
Green = low vulnerability

- Mountain Grassland
- Prairie Grassland
- Sagebrush Shrubland
- Desert Shrubland
- Foothills Shrubland
- Montane/Subalpine Forest
- Aspen/Deciduous Forest
- Xeric Forest
- Riparian Areas
- Wetlands
- Cliff/Canyon/Rock Outcrop



Overall Vulnerability ■ Low ■ Moderate ■ High

Overall vulnerability was high in 30% of Wyoming and low in 27% of the state.



Priority Areas Overall Vulnerability
■ Low
■ Moderate
■ High

Eleven (25%) of the terrestrial priority areas had high overall vulnerability.

CLIMATE CHANGE VULNERABILITY

Species Vulnerability

FOUR SPECIES were ranked as “Extremely vulnerable” to climate change: the Canada Lynx, Northern Tree Lizard, Midget Faded Rattlesnake, and Wyoming Toad. Seventeen species were ranked as highly vulnerable to changes in climate, and an additional 25 species were ranked as moderately vulnerable. Amphibians and reptiles were most vulnerable to a changing climate.

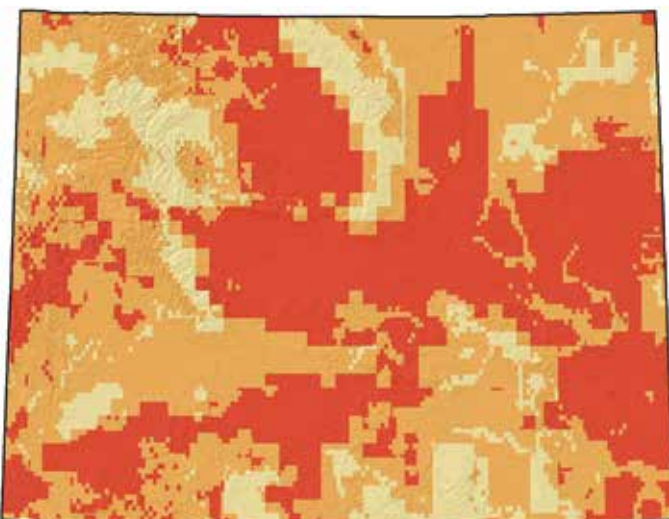


The number of species and percent of each group that had high climate change vulnerability

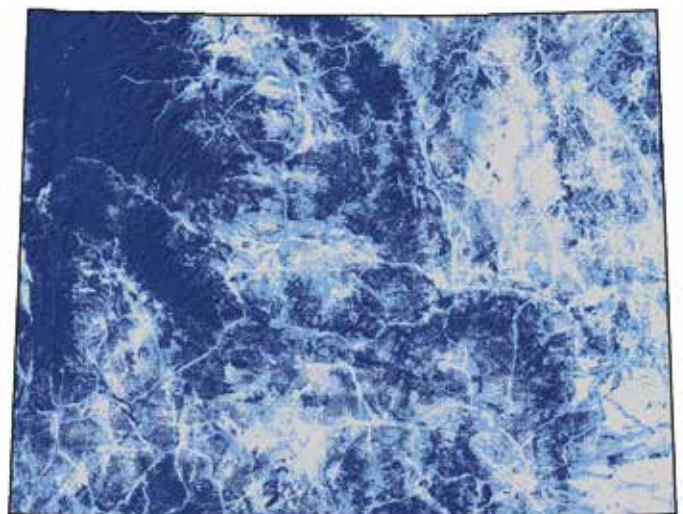
Taxonomic group	High Climate Change Vulnerability
Amphibians	6 (75%)
Birds	0 (0%)
Mammals	6 (13%)
Reptiles	5 (24%)
Total	17 (13%)



Climate Change Exposure and Resilience



Climate Change Exposure Low Moderate High



Climate Change Resilience Low Moderate High

Climate change exposure included annual mean temperature change rate from 1951-2006 and projected moisture deficit. Resilience to climate change was represented using land management status, landscape integrity, and topographic diversity and water availability. The exposure and resilience datasets were combined to represent climate change vulnerability across Wyoming.

Habitat & Priority Area Vulnerability

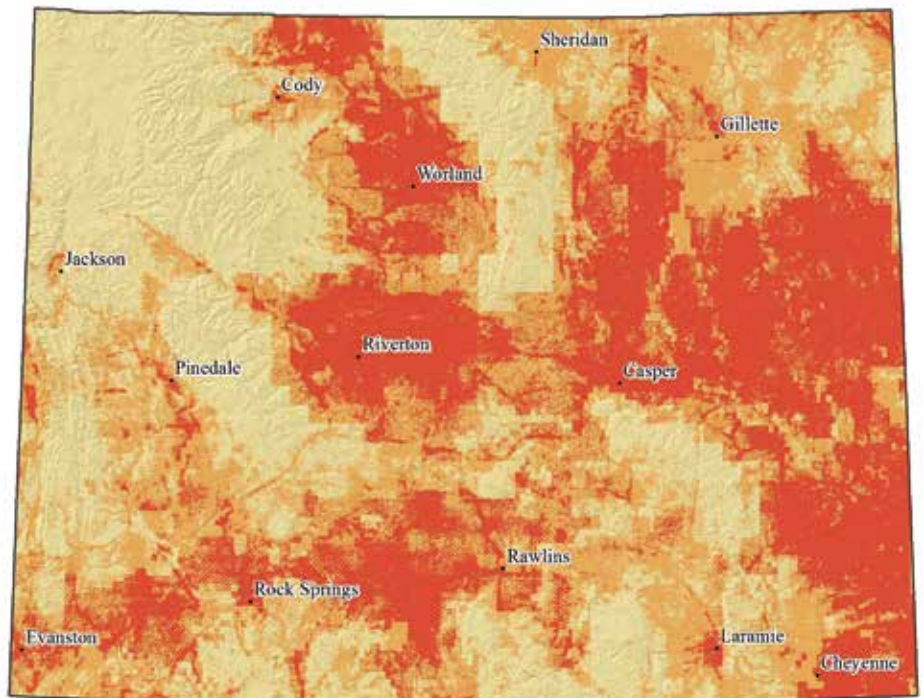
WYOMING'S basin areas that are dominated by grasslands and shrublands are most vulnerable to climate change. These lower elevation areas are expected to experience decreases in available moisture, which may also dry naturally occurring basin wetlands. Additionally, climate changes are likely to occur faster in these lower elevation areas than in higher

elevation montane systems, due to the buffering effects of complex topography in the mountains. The major basin habitat types—prairie grasslands, sagebrush shrublands, desert shrublands, and the wetlands and riparian areas associated with these systems, should be the focus of efforts to manage for and adapt to changes in climate.

Habitat Types

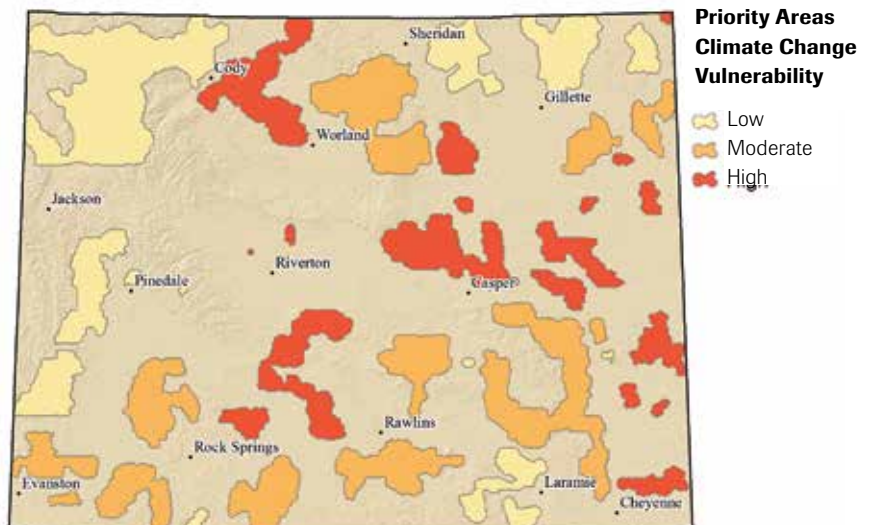
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- Desert Shrubland
- Foothills Shrubland
- Montane/Subalpine Forest
- Aspen/Deciduous Forest
- Xeric Forest
- Riparian Areas
- Wetlands
- Cliff/Canyon/Rock Outcrop



Climate Change Vulnerability Low Moderate High

Climate change vulnerability was high in 31% of Wyoming and low in 34% of the state.



Priority Areas Climate Change Vulnerability

Low
 Moderate
 High

Eighteen (41%) of the terrestrial priority areas had high climate change vulnerability.

DEVELOPMENT VULNERABILITY

Species Vulnerability

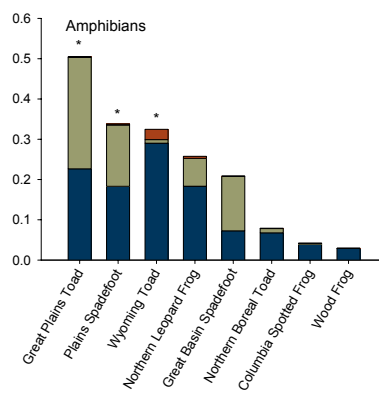
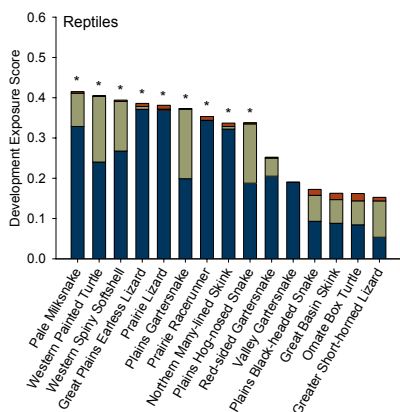
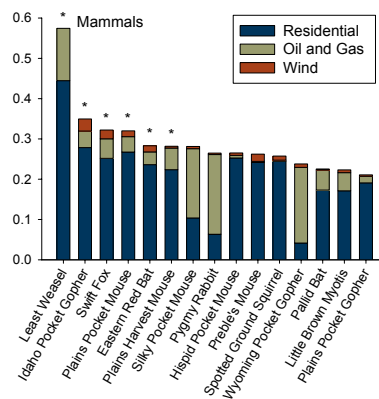
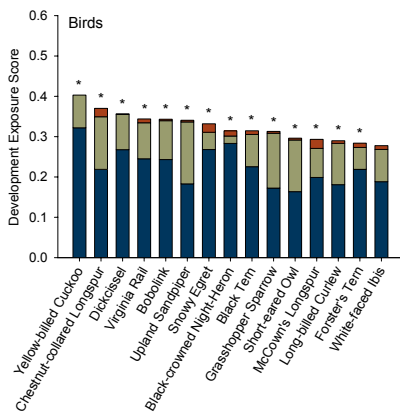
RESIDENTIAL

development resulted in the highest exposure scores across all species, followed by oil and gas development. However, the greatest percent increases in development exposure to species are expected from wind development. Overall, reptiles were the taxa most exposed to development. The Least Weasel,

Great Plains Toad, and Black-footed Ferret had the highest cumulative exposures to residential development, oil and gas development, and wind development, respectively. Considerable increases in development exposure were expected for many species that currently have low development exposure.

The number of species and percent of each group that had high or very high development vulnerability

Taxonomic group	High Development Vulnerability
Amphibians	3 (38%)
Birds	14 (25%)
Mammals	6 (13%)
Reptiles	9 (43%)
Total	32 (24%)



The contribution of residential development, oil and gas development and wind development to cumulative development exposure scores. Only the 15 highest relative exposure scores are shown for birds, mammals, and reptiles. Species with a high development vulnerability rank are denoted with an asterisk.

Habitat & Priority Area Vulnerability

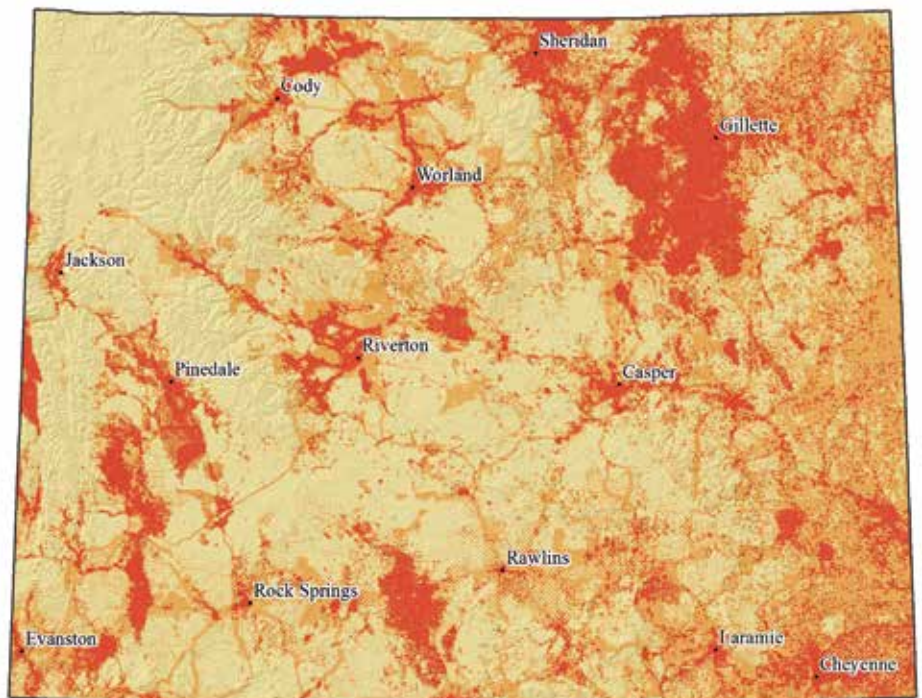
OUR ANALYSIS provides guidance as to which habitats and terrestrial priority areas may be most affected by future development and warrant additional focus for conservation aimed at limiting habitat fragmentation and other possible development impacts. The same basin habitat types

vulnerable to climate change are also vulnerable to development, suggesting that interactions between these two change agents will also be important. Residential development contributed the most to habitat and priority area vulnerability, followed by oil and gas development.

Habitat Types

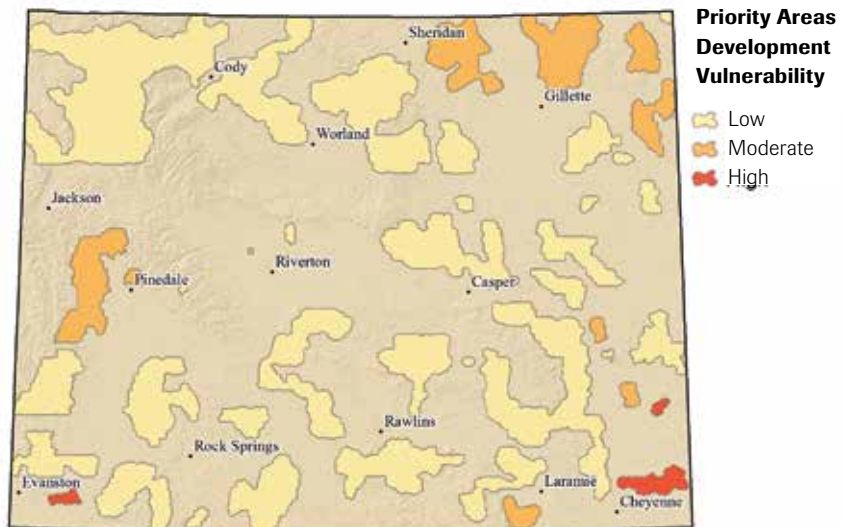
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- Desert Shrubland
- Foothills Shrubland
- Montane/Subalpine Forest
- Aspen/Deciduous Forest
- Xeric Forest
- Riparian Areas
- Wetlands
- Cliff/Canyon/Rock Outcrop



Development Vulnerability Low Moderate High

Development vulnerability was high in 17% of Wyoming and low in 47% of the state.



Priority Areas Development Vulnerability

Low
 Moderate
 High

Only three of the terrestrial priority areas had high development vulnerability.

DISEASE VULNERABILITY

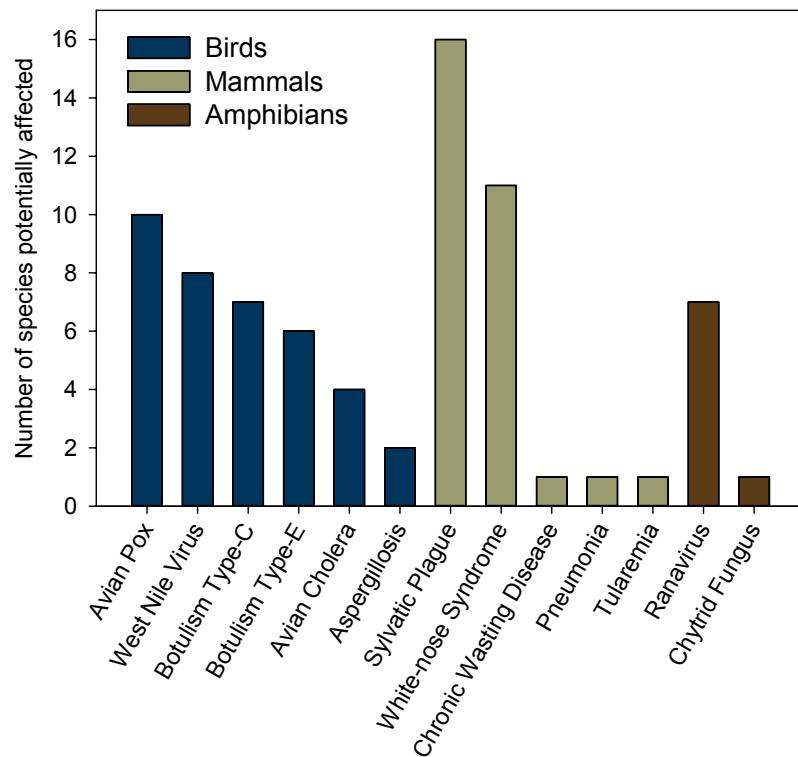
Species Vulnerability

THIS IS THE first statewide vulnerability assessment that included a disease component, and we found that birds were the most vulnerable of the taxonomic groups to disease. The true impacts of diseases are difficult to characterize, as epizootics are stochastic events that are difficult to

predict. Species may go years or decades without being exposed to outbreaks of diseases. However, when outbreaks occur they can quickly devastate local populations, so it is useful to highlight general patterns that can be considered by managers.

The number of species and percent of each group that had high disease vulnerability

Taxonomic group	High Disease Vulnerability
Amphibians	1 (13%)
Birds	21(38%)
Mammals	6 (13%)
Reptiles	0 (0%)
Total	28 (21%)



The number of species potentially affected by each of 13 wildlife diseases.

THIS PAGE Black-footed ferrets have high vulnerability to sylvatic plague. © USFWS; Trumpeter Swans and many other wetland species have high vulnerability to botulism. © Scott Copeland

MANAGING FOR RESILIENCE

Describing Resilience

AS PART OF this assessment, we described resilience of Wyoming's habitats and priority areas using land management status, landscape integrity and topographic diversity and water availability, which are shown in the figure below.

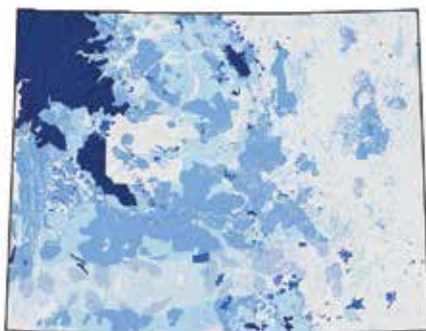
Managing for climate change

Multiple approaches can be used to manage for climate change. Because we cannot affect changing climate conditions directly, these strategies are focused on reducing other stressors that we have greater ability to control, such as habitat fragmentation and invasive species. One strategy is to maintain large areas of high quality habitat that include a variety of bioclimatic conditions (i.e. topographic diversity) and maintain and enhance connectivity among these areas and their wildlife populations. Large, connected habitats can be maintained through a variety of tools, including Wyoming's Sage-Grouse Core Area Policy that limits development on public lands in important sagebrush habitats, incentive and cooperative programs that assist private landowners with conservation actions, and conservation easements. Other strategies focus on adaptation to changing conditions that are specific to habitat types and climate conditions and might include

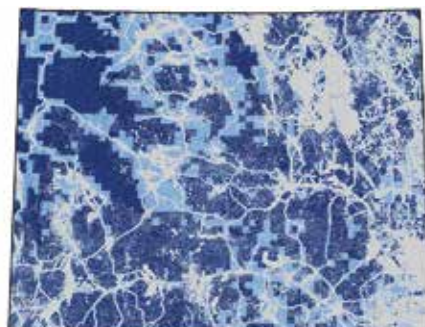
restoring riparian areas with native vegetation, conducting prescribed fires to reduce risk of large wildfires, and preventing and controlling invasive species.

Balancing development and conservation

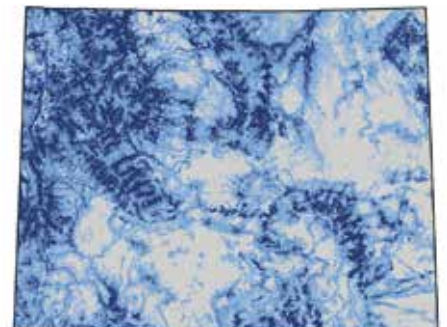
There is a widely recognized need to understand and minimize the trade-offs between development and wildlife conservation in Wyoming. We recommend that conservation efforts related to limiting habitat fragmentation and other impacts from development be focused on the moderately or highly vulnerable priority terrestrial areas that have high landscape integrity. On publicly managed land, special designations are mechanisms that limit habitat fragmentation and can be implemented through the public land management planning process. Enforcing and maintaining Wyoming's Sage-Grouse Core Area Policy will minimize disturbance from development in sagebrush shrublands, primarily on public lands. For vulnerable grassland and wetland habitats on private lands, conservation easements can limit development in critical habitats. Where development does occur, the mitigation hierarchy should be applied to avoid impacts in the most critical habitats, minimize impacts that cannot be avoided, ensure that adequate resources are available for restoration, and use offsite mitigation to compensate for impacts and improve similar habitat elsewhere.



Land Management Status
■ 1 ■ 2 ■ 2b ■ 3 ■ 4



Landscape Integrity
■ Low ■ Moderate ■ High



Topographic Diversity & Water Availability
■ Low ■ Moderate ■ High

Three datasets representing components of resilience were created across Wyoming. Land management status is the level of legal or management protection, where status 1 is the most protected. Landscape integrity represents the amount of development and fragmentation, and topographic diversity and water availability represents microclimate variety, which can buffer against changes in climate.

CONCLUSIONS



Recommendations and Conclusions

Our assessment provides new information about which of three major stressors - climate change, development, and disease - are expected to have the greatest impacts on terrestrial wildlife species, habitats, and priority areas in the future. We hope these results inform the development of conservation strategies aimed at mitigating threats identified in this report. These findings can guide activities of the Wyoming Game and Fish Department, public land management agencies, and conservation

We hope these results inform the development of conservation strategies aimed at mitigating threats identified in this report.

organizations by highlighting which species and habitats have the greatest conservation needs and where additional information may be needed. As resources become increasingly scarce and conservation becomes more complex in the future, this analysis and the results we provide justify expending resources on certain species and habitats based on their anticipated vulnerability and associated conservation needs. Finally, this project provides a template for completing similar analyses and a baseline for interpreting those results when these issues are revisited, as new data becomes available or as conditions change in Wyoming.

Next Steps

This vulnerability assessment should inform and improve the next version of Wyoming's State Wildlife Action Plan (SWAP) and highlight additional focus areas for planning and implementation. There are several ways that this assessment may inform the next SWAP:

- Help to reevaluate and prioritize Wyoming's list of SGCN
- Prioritize terrestrial habitat types and priority areas for conservation action
- Provide additional information about wildlife disease
- Further describe development, climate change and their potential interactions

Invasive species and disruption of historic disturbance regimes were identified in the 2010 SWAP as two of five leading challenges. We included invasive species in the assessment but not to the desired degree because spatial data currently available to represent invasive species are limited. We recommend supporting efforts to improve mapping of invasive species in Wyoming and using updated maps for cheatgrass and other species to inform the next SWAP revision. Disruption of historic disturbance regimes, which includes fire and grazing regimes, was not included

because data representing these regimes and how they may affect wildlife habitats in the future were not available statewide. We considered oil and gas, wind and residential development, but other types of development and native habitat conversion are also occurring in Wyoming. Mining and conversion of grasslands to agricultural crops could also be considered, as datasets representing these stressors become available. In addition to the 131 terrestrial species, the 2010 SWAP also identified 30 fish species and 19 crustaceans and mollusk species or taxonomic groups. We recommend expanding this type of assessment to include these aquatic species and their habitats.

Citations

1. Wyoming Game and Fish Department. 2010. Wyoming State Wildlife Action Plan. Cheyenne, Wyoming. <http://wgfd.wyo.gov>
2. Pocewicz, A., H.E. Copeland, M.B. Grenier, D.A. Keinath, and L.M. Waskoviak. 2014. Assessing the future vulnerability of Wyoming's terrestrial wildlife species and habitats. Report prepared by The Nature Conservancy, Wyoming Game and Fish Department and Wyoming Natural Diversity Database.



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