

Threats and Stressors to Species at Risk and Ecological Systems, Practical Implications, and Management Strategies for Installations in Colorado and the Western U.S.



Lee Grunau, Karin Decker, Michelle Fink (*CO Natural Heritage Program – CNHP*)
Dave Jones, Roy Cook (*Center for Ecological Management of Military Lands – CEMML*)



Study Objectives

1. **Analyze vulnerability of species and ecosystems** to stressors at local and regional scales;
2. **Identify potential species declines** that could adversely affect future training operations;
3. **Incorporate spatial data** to evaluate possible distribution shifts and other species/ecosystems responses in relation to destabilizing events;
4. **Develop recommendations** to scale down the ecosystem management concept and help halt species declines both on and off installations; and
5. **Document our process** and lessons learned to facilitate similar analyses by other installations for their species and ecological systems.



Utah juniper (*Juniperus osteosperma*); photo by Stan Shebs



Focal Species & Ecological Systems

Fort Carson & Piñon Canyon Maneuver Site (PCMS)

- Pinyon-juniper
 - Pinyon Jay
 - Gray Vireo
- Shortgrass Prairie
 - Burrowing Owl
- Cliffs, Canyon, & Outcrops
 - Golden Eagle

U.S. Air Force Academy (USAFA)

- Preble's meadow jumping mouse*

*Due to its extremely restricted distribution, information about PMJM is not broadly applicable to other installations, and thus is not a topic of this presentation.



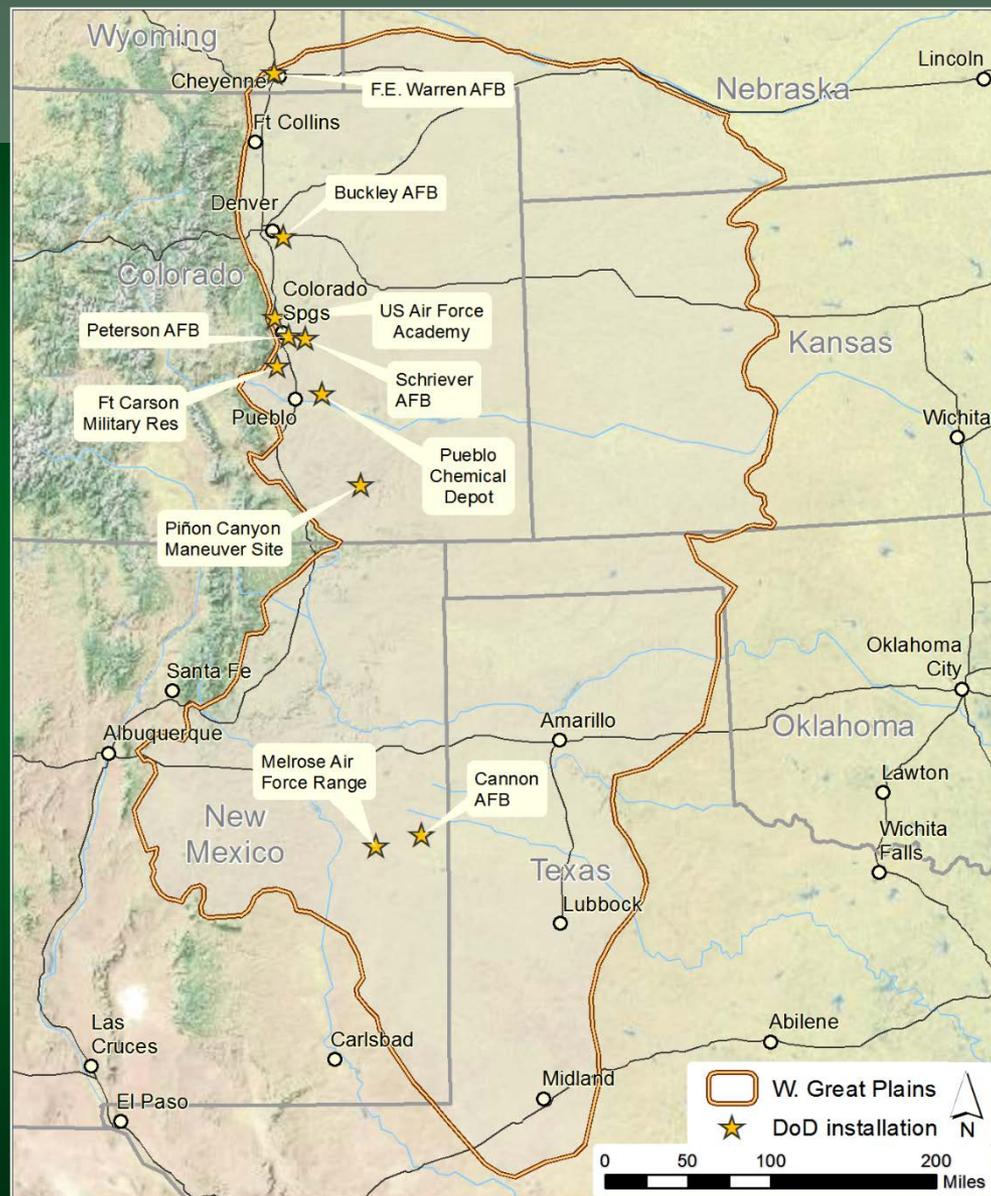
Riparian habitat for Preble's meadow jumping mouse; photo by R. Schorr.



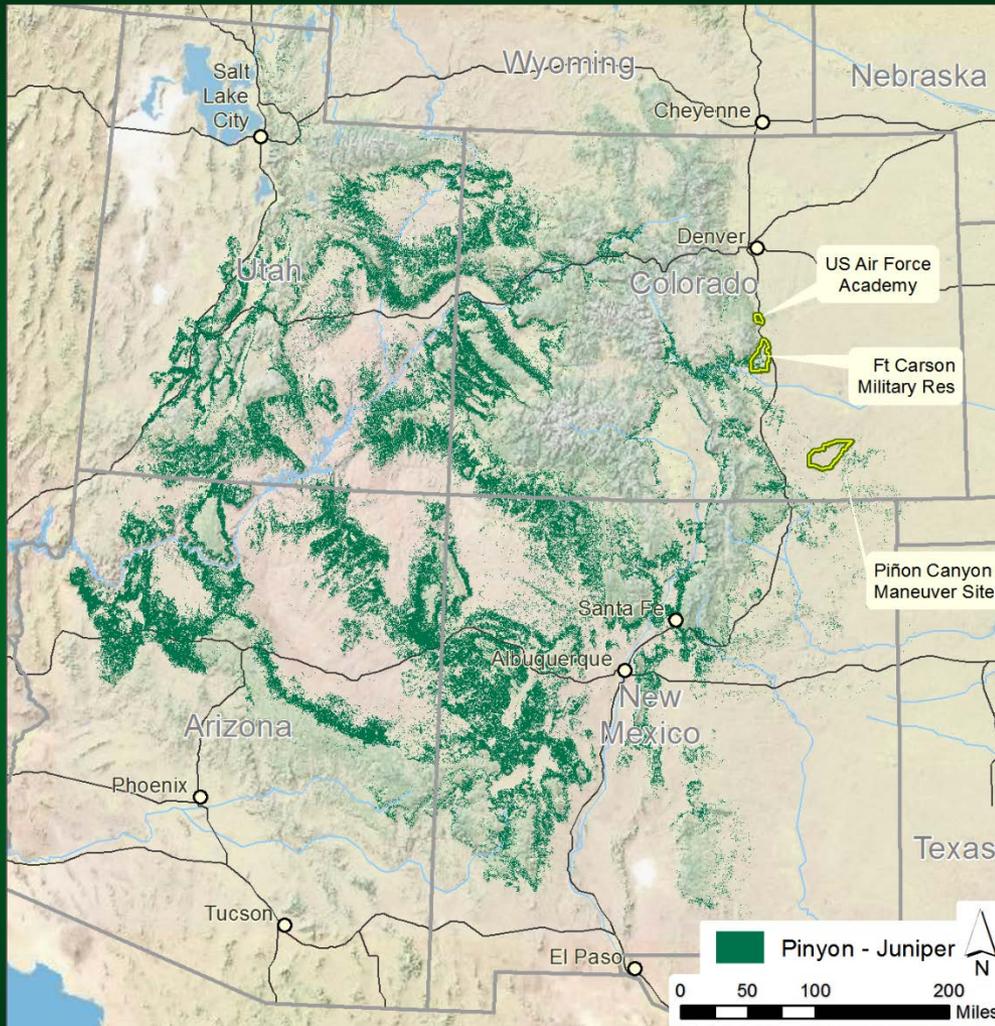
Study Area 1

Primary Study Area = Western Great Plains

- Central Shortgrass Prairie (CSP) and Southern Shortgrass Prairie (SSP) ecoregions
- Fort Carson, PCMS, and USAFA along western edge of CSP
- Significant portion of the shortgrass prairie ecosystem and western burrowing owl distributions.



Study Area 2



Secondary Study Area = Four Corners region

- Distribution of Two-needle pinyon pine (*Pinus edulis*)
- Pinyon Jay
- Gray Vireo



Fort Carson and Piñon Canyon Maneuver Site (Army)



Mission

- “to train, house, mobilize, deploy, and sustain combat-ready, multi-component integrated forces”¹.
- Trains units that require land and airspace to practice combat skills and operations on a year-round basis.
- Supports multiple units (infantry, special forces, ordnance, CO National Guard, Army Reserve).

1. Directorate of Public Works, Fort Carson (DPW). 2015. Integrated Natural Resources Management Plan for Fort Carson and Piñon Canyon Maneuver Site 2013 2017.



Fort Carson and Piñon Canyon Maneuver Site (Army)



Mission and Natural Resources

- The mosaic of communities, varied topography, and temporally diverse climate ranging from hot summers to cold winters provides U.S. Armed Forces with a variety of training scenarios.
- Training is nearly continuous year-round.



Types of Military Training & Their Impacts

Maneuver

- Collective training conducted by multiple units involving the movement of troops and live or simulated firing.



Strykers at Fort Carson; Photo by Colorado Springs Gazette, 2017

M1A2 Abrams tanks conducting maneuver training at Fort Carson; Photo by Staff Sgt. Andrew Porch ,US Army



- Tends to be patchy, with small areas of intense impact surrounded by large areas with little to no damage.



Types of Military Training & Their Impacts

Maneuver Impacts

- Reduced vegetative cover; increased bare ground.
- Increased erosion



Strykers at Fort Carson; Photo by Colorado Springs Gazette, 2017

M1A2 Abrams tanks conducting maneuver training at Fort Carson; Photo by Staff Sgt. Andrew Porch ,US Army



- Soil Compaction
- Noise, vibration, smoke, dust
- Pollution from spills



Types of Military Training & Their Impacts

Live Fire Training Impacts

- Fire
- Noise
- Toxins leeching into soil and groundwater (historically, has been mostly stopped by DoD environmental programs)



Live Fire Training; Fort Carson 2013 2017 INRMP



Types of Military Training & Their Impacts

Bivouac

- Temporary encampments used during training and/or operations

Impacts

- Loss of ground cover
- Soil compaction
- Localized erosion



Bivouac site; Photo by Staff Sgt. Chelsea Clark, Vermont Army National Guard



Types of Military Training & Their Impacts

Aviation Impacts

- Noise
- Disturbance to landing and drop zones (minor)
- Dust
- Disturbance to nesting birds
- Fires from live fire training



AH 64 Apache training at Grafenwoehr Military Airfield; Photo by Vincent Kok

U.S. Air Force F 15E Strike Eagles; Photo by Tech. Photo by Sgt. Michael B. Keller, U.S. Air Force



Types of Military Training

Maneuver

- “educate and train cadets to be future leaders of the USAF [U.S. Air Force] and provide direct support for cadets and the base community”².
- Design based around the need for airspace, future expansion, viewshed protection, and recreation.
- Little land-based training occurs on natural surfaces.



Colorado Springs Gazette, 2017

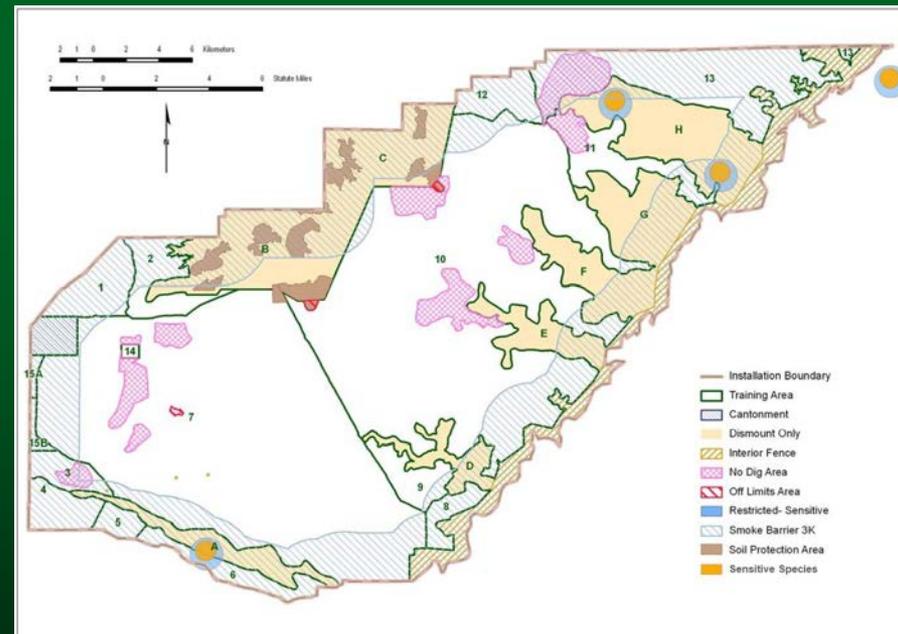
2. U.S. Air Force Academy. 2008. Final Integrated Natural Resources Management Plan Environmental Assessment for the U.S. Air Force Academy, Colorado Springs, CO.



Military Training Constraints for Natural Resource Protection

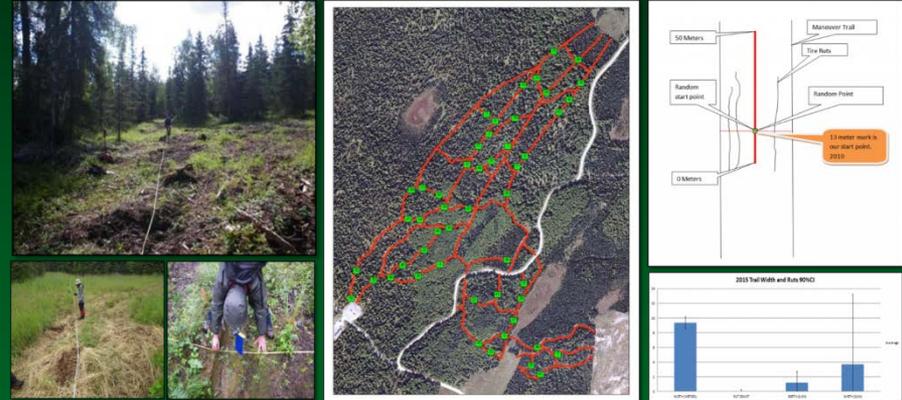
- Off-Limits Areas
- Limited-Use Areas
- Maneuver Damage Program
- Wet Weather Deferment
- Rest/Rotation/Deferment Program
- Rare Species Restrictions

Sensitive resource areas and associated training constraints on PCMS; Doe et al. 2008.



Military Training Constraints for Natural Resource Protection

- Integrated Training Area Management (ITAM) Program
 - Range and Training Land Assessment (RTLTA)
 - Training Requirements Integration (TRI)
 - Sustainable Range Awareness (SRA)
 - Land Rehabilitation and Maintenance (LRAM)
 - Geographic Information Systems



A CEMML Range and Training Lands Assessment team is assessing landscape conditions to support development of a new maneuver corridor at Joint Base Elmendorf Richardson, Alaska.



CEMML Land Rehabilitation and Maintenance team repairing maneuver area gullies at Fort Polk, Louisiana.



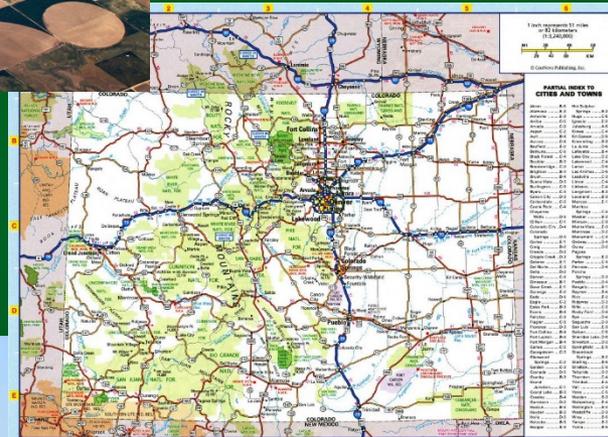
Methods

1. Map distributions
2. Literature synthesis
3. Conceptual ecological models
4. Spatial analysis of incompatible land uses and climate change
5. Narrative analysis of un-mappable threats
6. Recommendations and information needs

Agricultural development; photo by Soil Science, Creative Commons



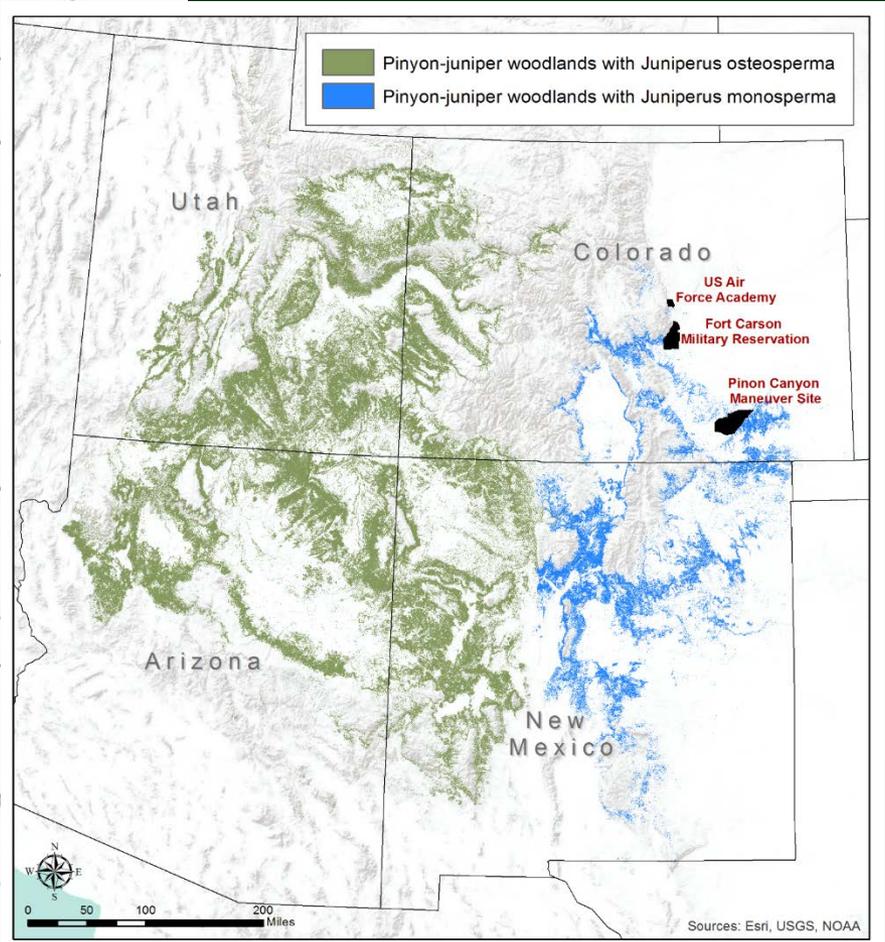
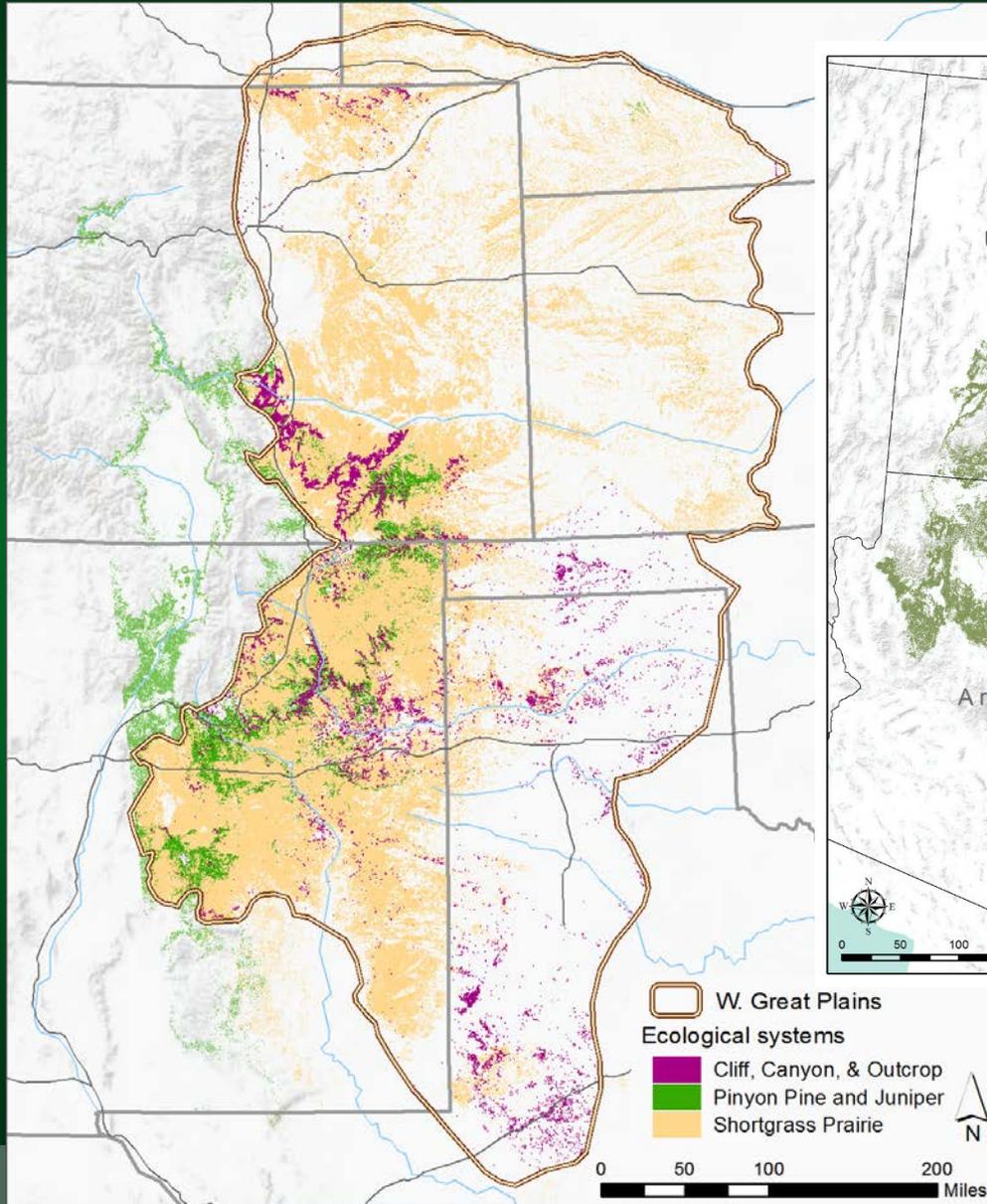
Colorado highways; image by Maps of the U.S.A



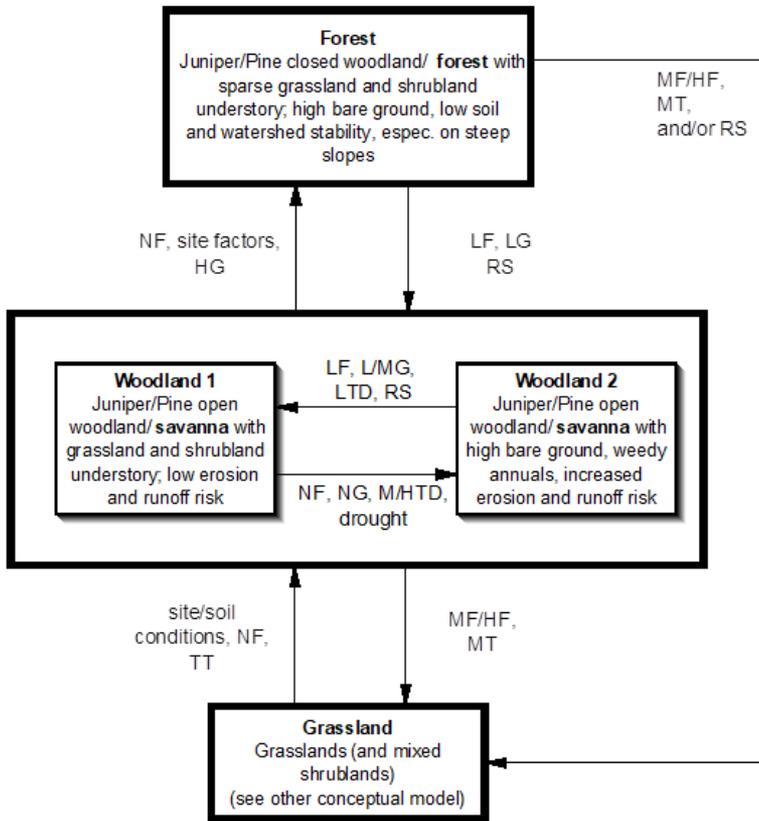
Oil pump; photo BLM Wyoming



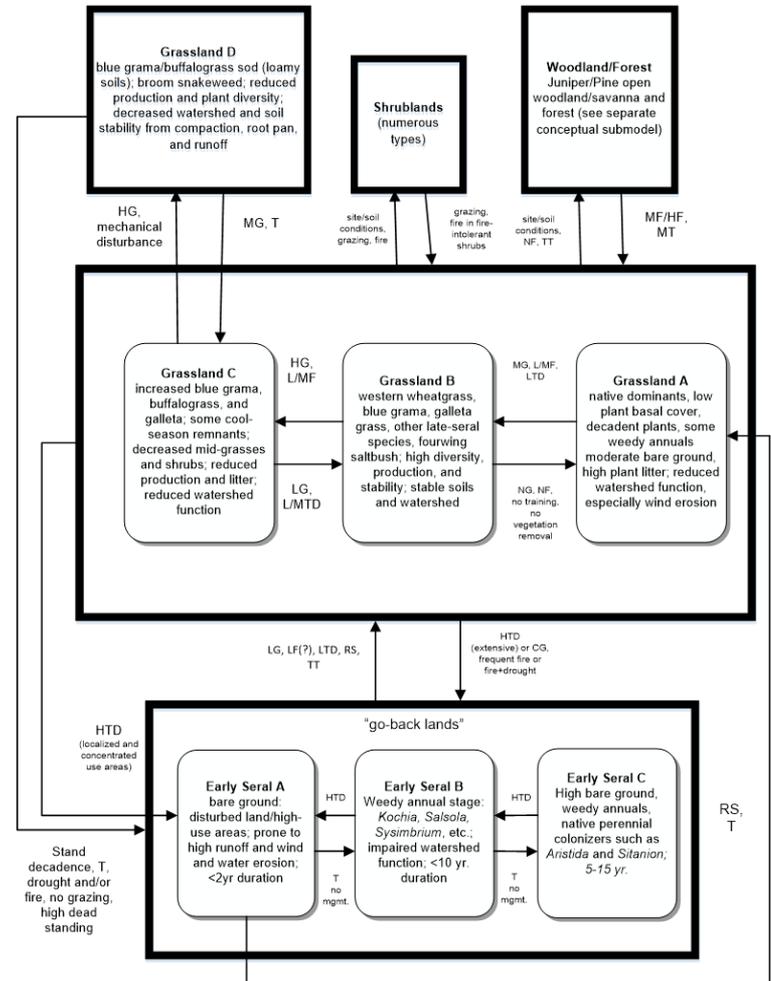
Mapping Ecosystem Distributions



Conceptual Ecological Models



Pinyon juniper



Shortgrass prairie

Spatial Analysis of Incompatible Land Use Threats

Data Layer	Source(s)
Ecological system distribution	USGS GAP Land Cover v2.2 (USGS 2013)
Residential and commercial development <ul style="list-style-type: none">• High intensity• Low intensity	USGS GAP Land Cover v2.2 (USGS 2013)
Crop agriculture	CropScape - Cropland Data Layer (USDA-NASS 2015)
Energy production and mining <ul style="list-style-type: none">• Oil and gas• Wind	U.S. Oil and Gas production data (Biewick 2008)
Transportation and service corridors <ul style="list-style-type: none">• Major roads• Minor roads	US Census Bureau TIGER/Line roads (USCB 2015)

Residential development; Image by Sam Beebe/Ecotrust



Natural gas development; National Geographic



Climate Change

Shortgrass Prairie

- Adapted previously developed model
- Ensemble average Global Circulation Model (GCM)
- Representative Concentration Pathway (RCP) 8.5 & 4.5
- 30-year period centered on 2050 (i.e., 2035 – 2064)

Pinyon-Juniper

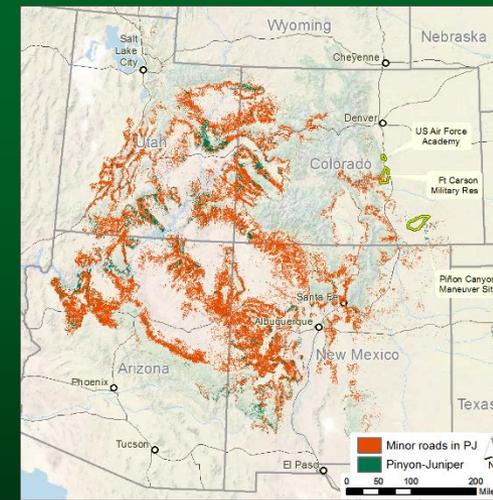
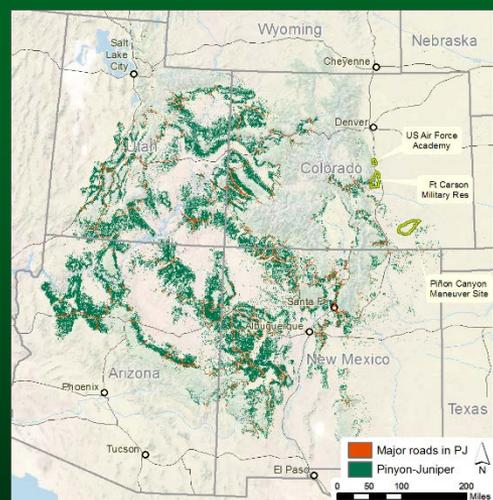
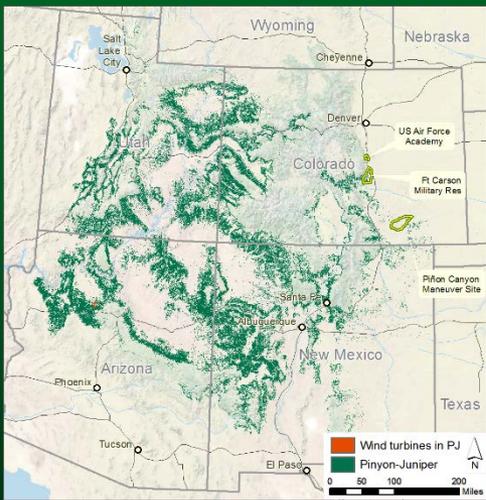
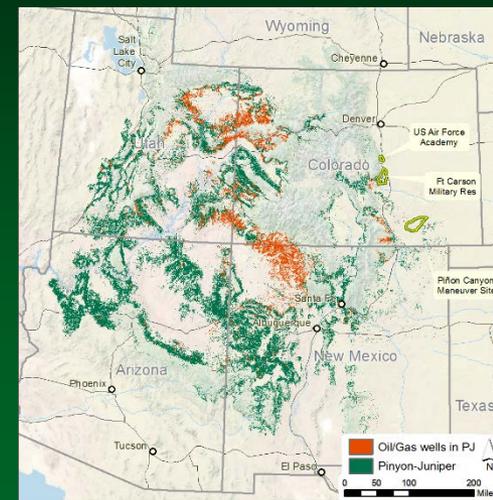
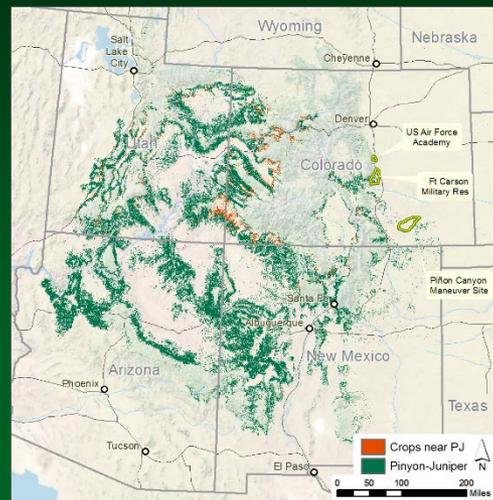
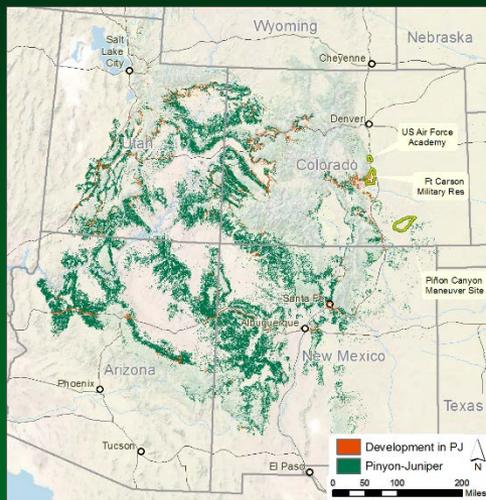
- Adapted previously developed model
- Scenario approach (Hot & Dry, Warm & Wet)

Species

- NatureServe's Climate Change Vulnerability Index



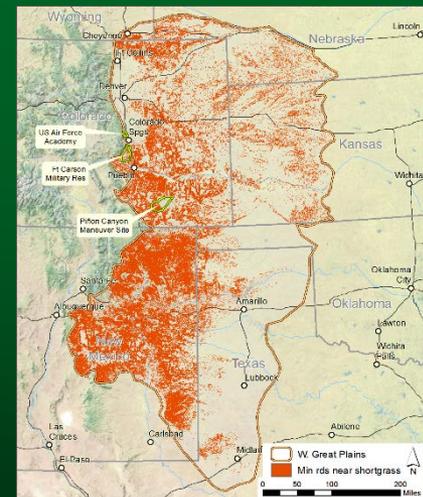
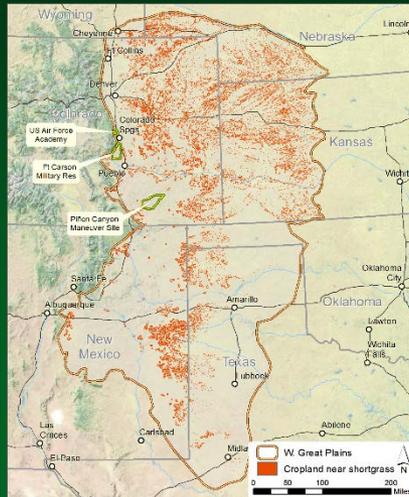
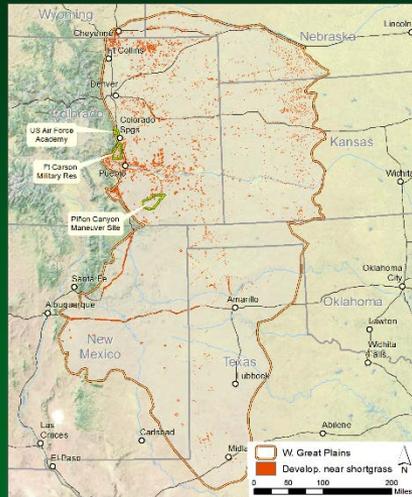
Results PJ: Total % *not* vulnerable = 11%



Distribution of pinyon-juniper in relation to incompatible land uses.



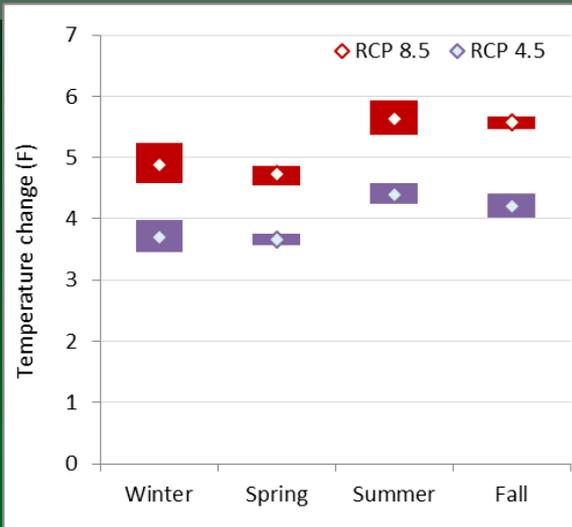
Results Shortgrass: Total % *not* vulnerable = 7%



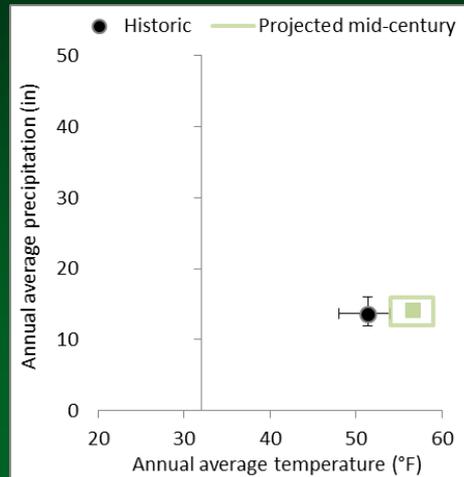
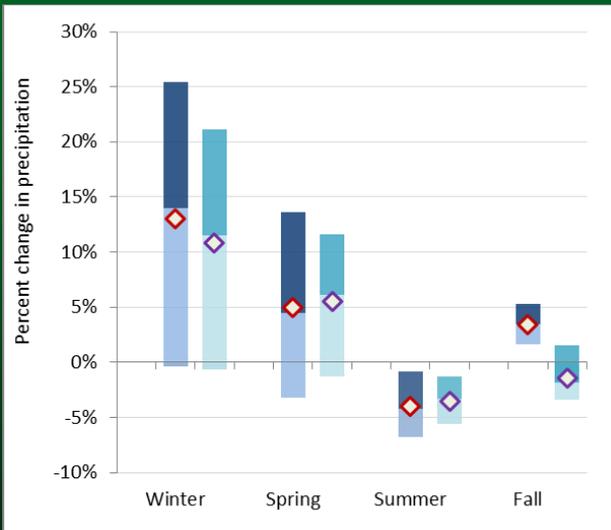
Distribution of shortgrass prairie in relation to incompatible land uses.



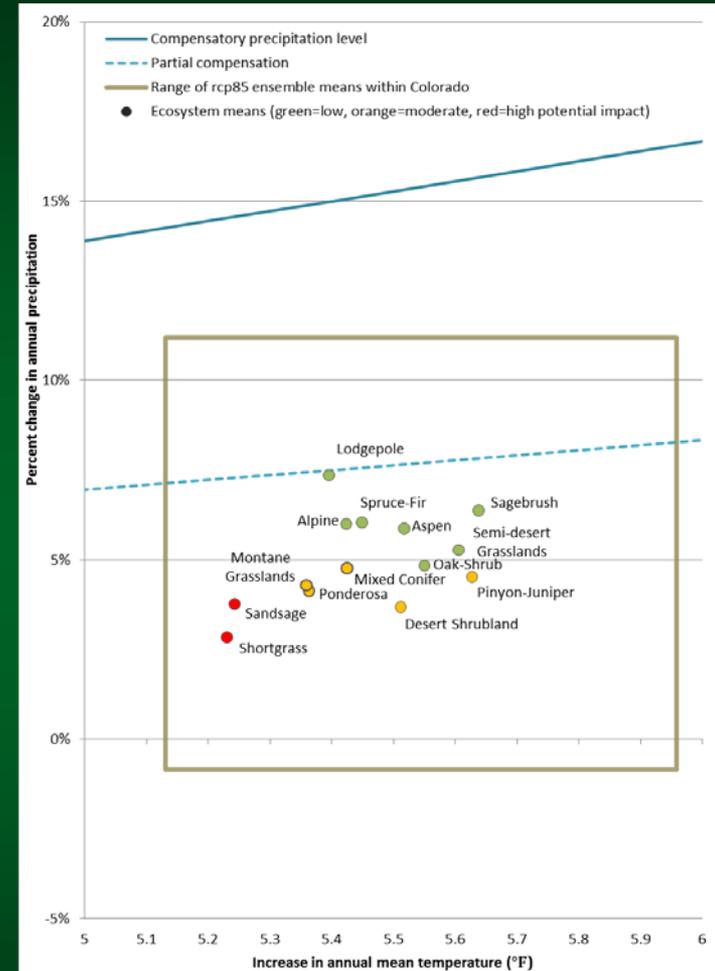
Climate Change: Shortgrass = Highly Vulnerable



Projected change in mean temperature (above) and precipitation (below) for two emissions scenarios. Source: CNHP



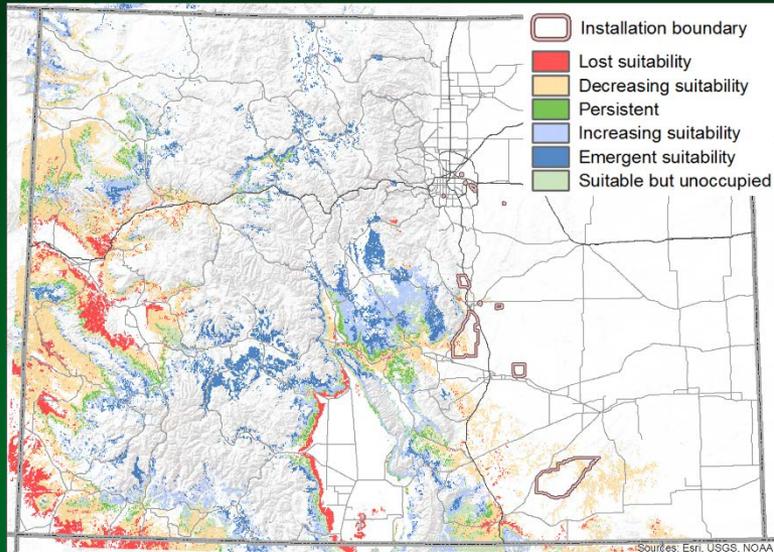
Current and projected future bioclimatic envelopes for shortgrass prairie, based on mean and 80th percentile for temperature (x axis) and precipitation (y axis). Source: CNHP 2015



Projected annual change in Colorado for upland ecosystems. Ecosystem means are colored to indicate the degree to which the ecosystem is projected to experience conditions that are out of range of those in its current statewide distribution. Source: CNHP 2015



Climate Change: PJ = Highly Vulnerable

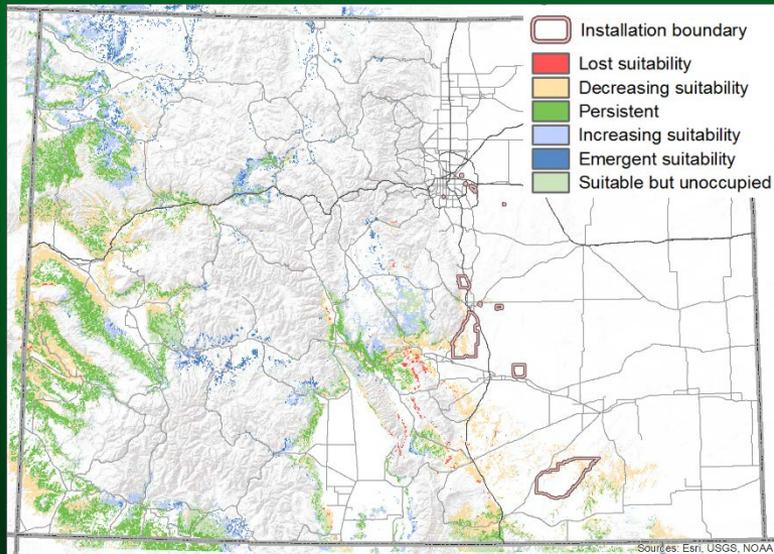
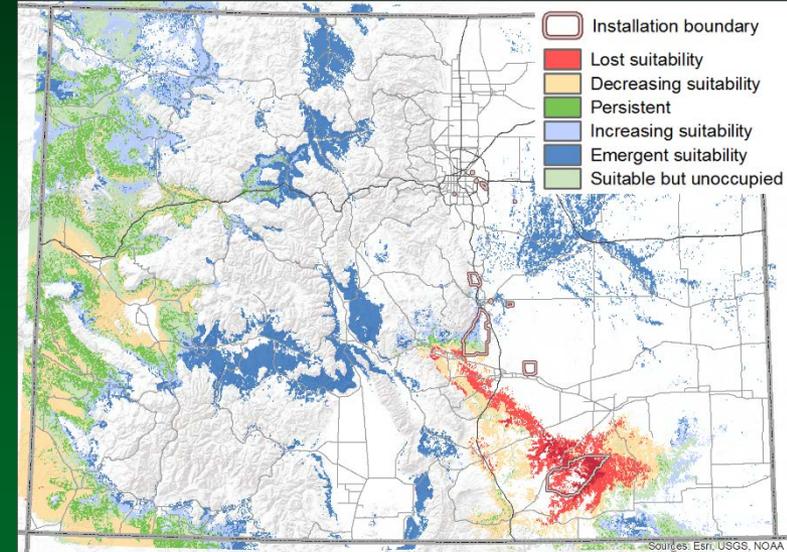


Hot / Dry

Pinyon



Juniper

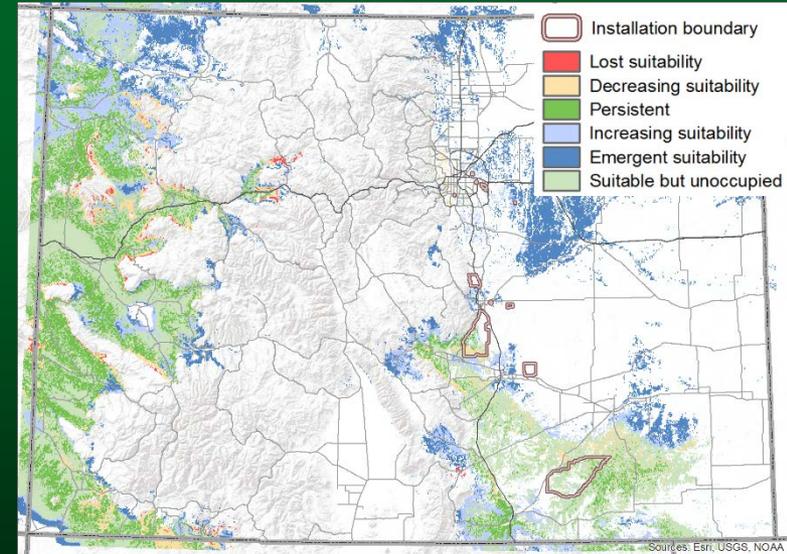


Warm/Wet

Pinyon



Juniper

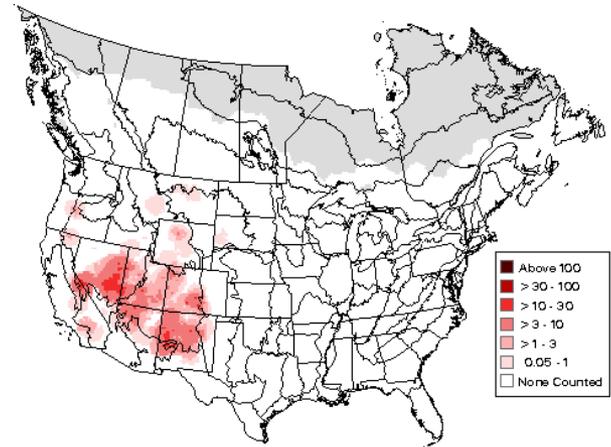


Pinyon Jay

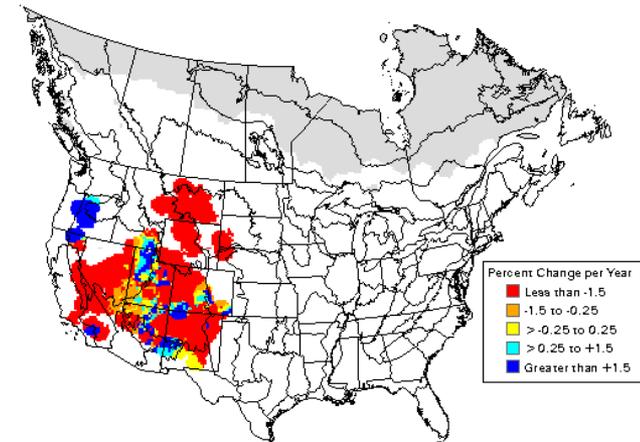


Photo by Chris, Flickr Creative Commons.

- Approx. 84% reduction in continental population 1970-2014
- International Union for Conservation of Nature (IUCN) Threatened, Partners in Flight (PIF) Threatened & Declining, U.S. Fish and Wildlife Service (USFWS) Bird of Conservation Concern, DoD PIF Mission Sensitive Priority Bird Species, Species of Greatest Conservation Need in AZ, CO, NV, NM
- Closely associated with pinyon pine for nesting substrate & food source
- Habitat threats include trees weakened by drought, increases in wildfire and insect outbreaks, among others
- Pinyon pine highly vulnerable to climate change



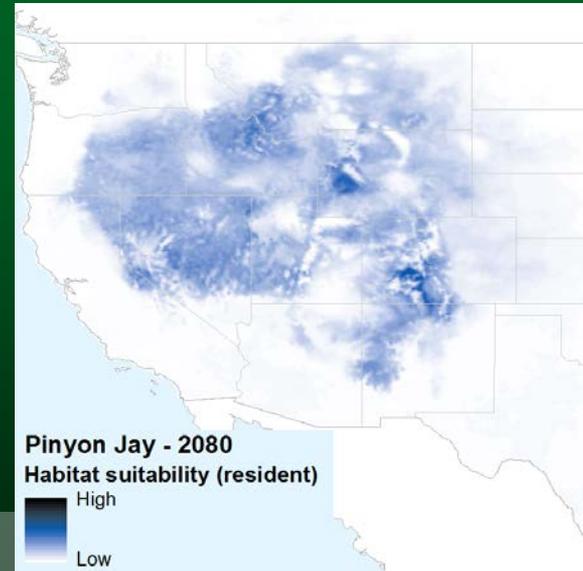
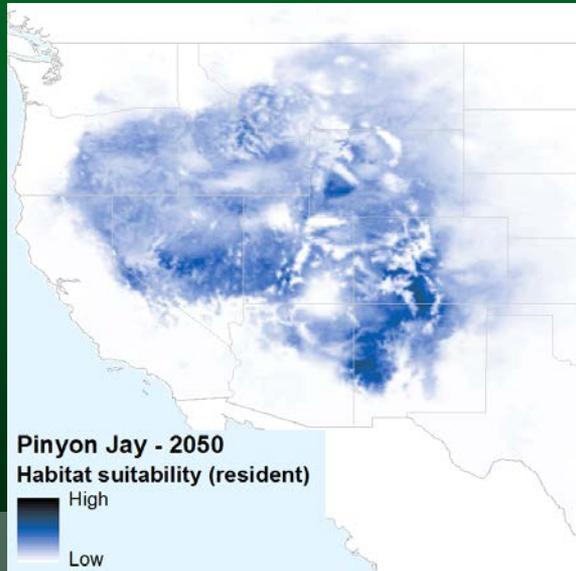
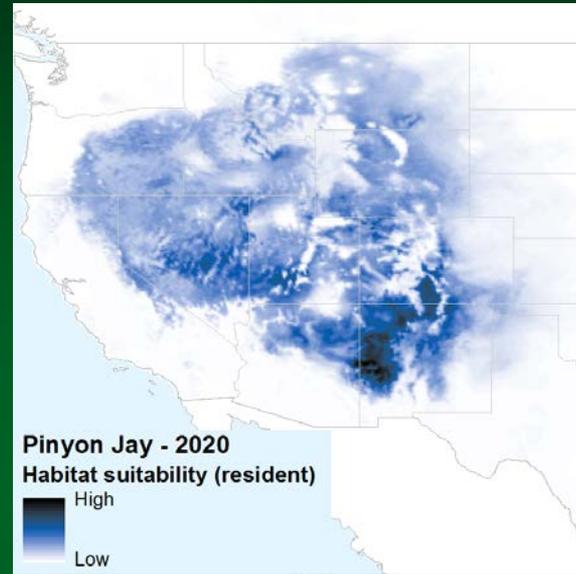
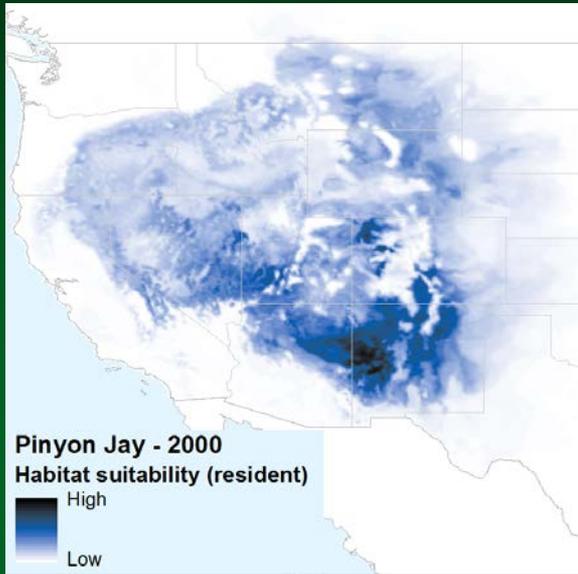
Summer distribution based on BBS data from 2007-2013
<http://www.mbr-pwrc.usgs.gov/bbs/ra2013/ra04920.htm>



Trend based on BBS data from 1966-2013
(Sauer et al. 2014).



Pinyon Jay



Modeled current (2000) and future (2020, 2050, and 2080) habitat suitability (National Audubon Society 2013).

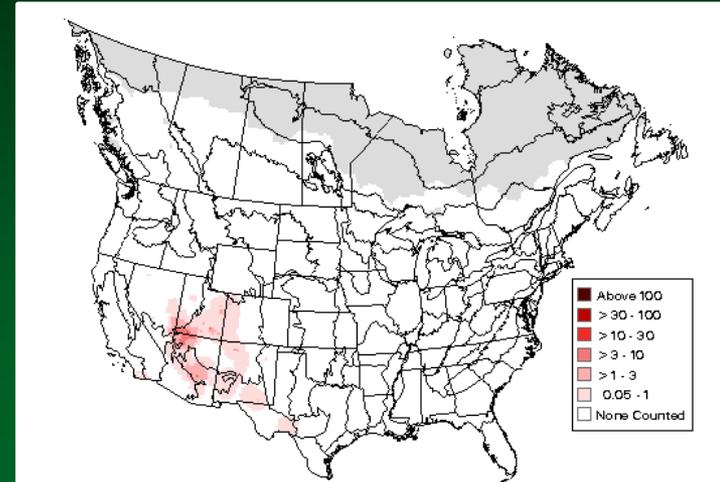


Gray Vireo



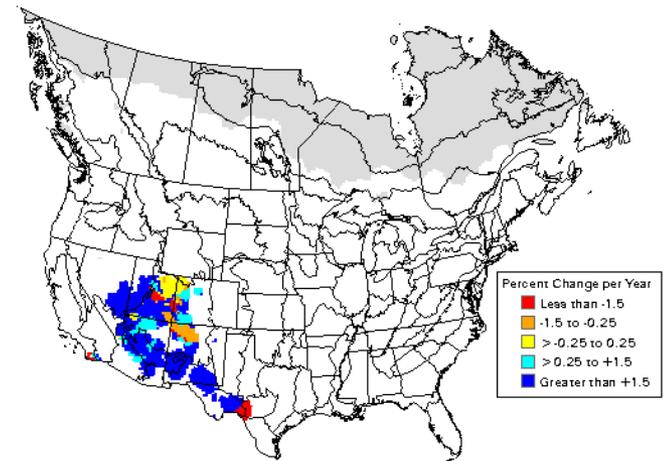
Photo by Roger Staples (birds.netai.net)

- Increasing in some habitats, but population still small
- PIF Watchlist, USFWS Bird of Conservation Concern, DoD PIF Mission Sensitive Priority Bird Species, Species of Greatest Conservation Need in AZ, CA, CO, NM
- Closely associated with pinyon-juniper (especially juniper) for nesting substrate
- Not well studied; threats unclear
- Potential vulnerability to climate change uncertain.



Summer distribution based on BBS data from 2007-2013

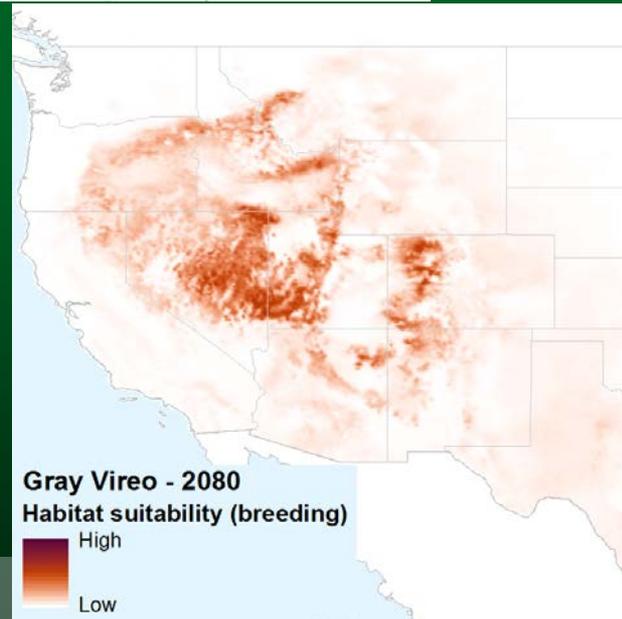
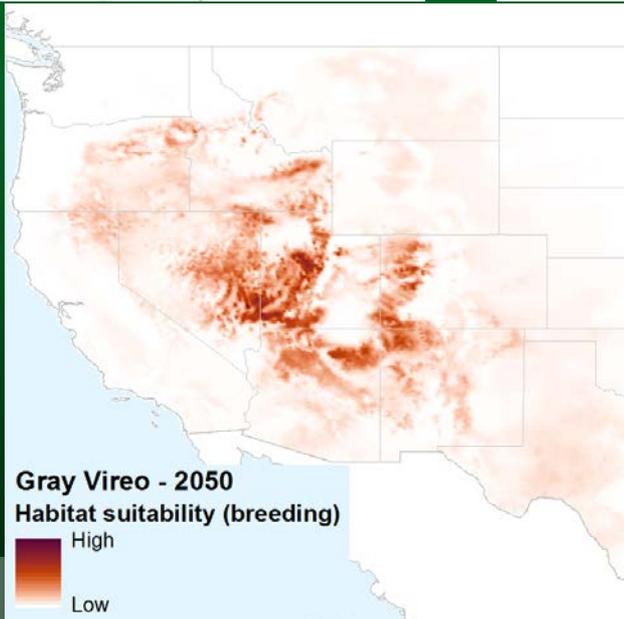
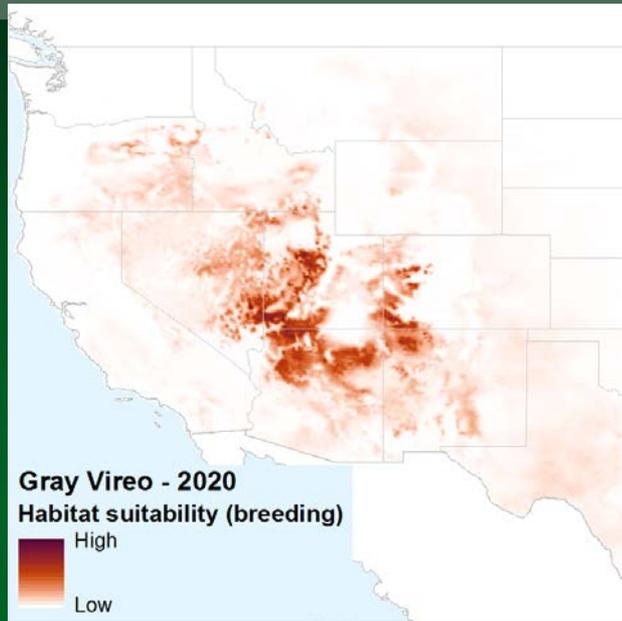
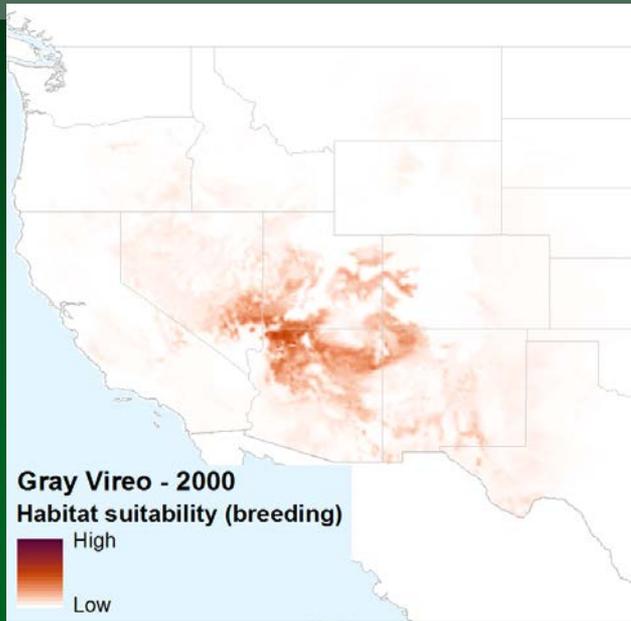
<http://www.mbr-pwrc.usgs.gov/bbs/ra2013/ra06340.htm>



Trend based on BBS data from 1966-2013
(Sauer et al. 2014).



Gray Vireo



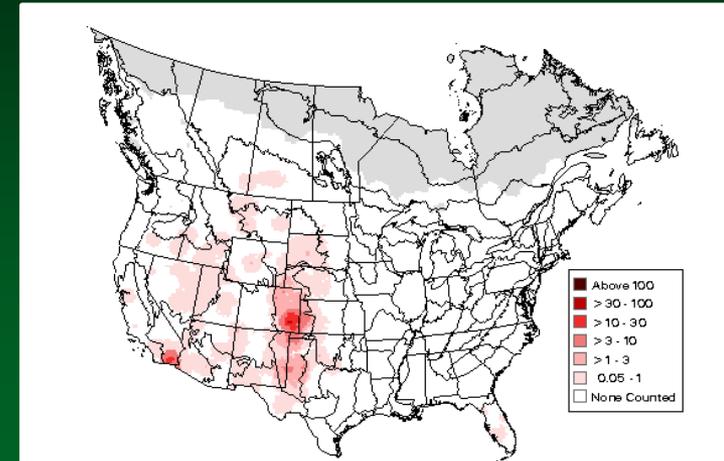
Modeled current (2000) and future (2020, 2050, and 2080) habitat suitability (National Audubon Society 2013).



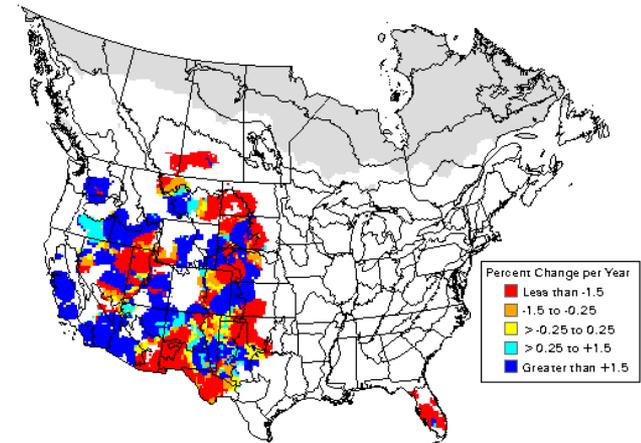
Burrowing Owl



- Status reports differ across range; owls possibly becoming less migratory?
- Endangered in Canada, Threatened in Mexico, USFWS Bird of Conservation Concern, DoD PIF Mission Sensitive Priority Bird Species, Species of Greatest Conservation Need in AZ, CA, CO, ID, KS, MT, OR, NE, NV, NM, ND, OK, SD, TX, UT, WA, WY
- Closely associated with black-tailed prairie dogs in CO
- Primary threats include habitat loss, eradication of burrowing rodents
- Vulnerability to climate change variable across range



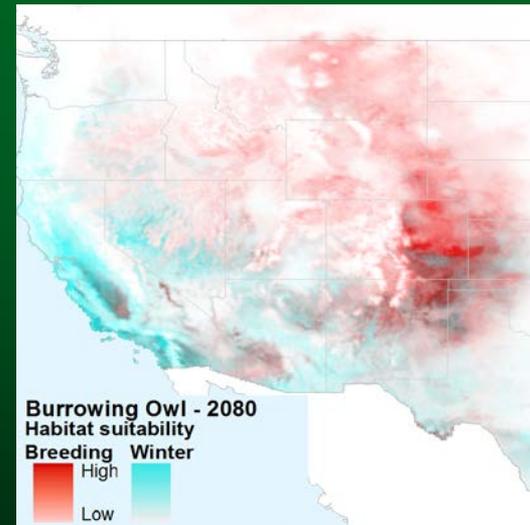
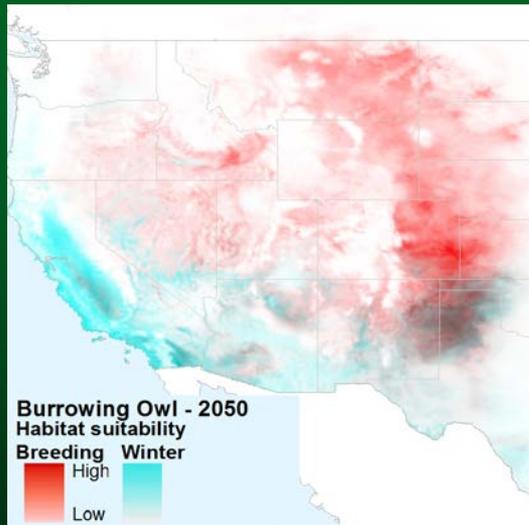
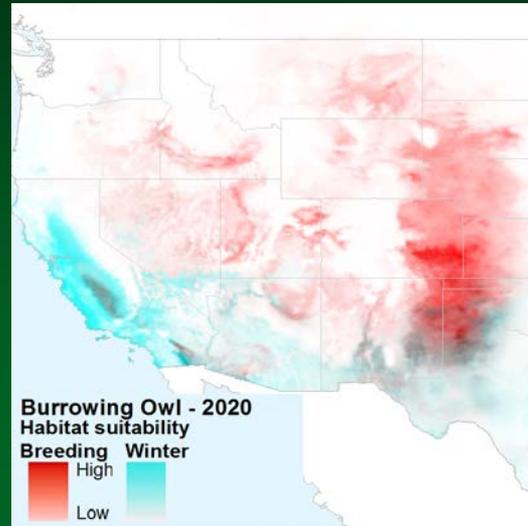
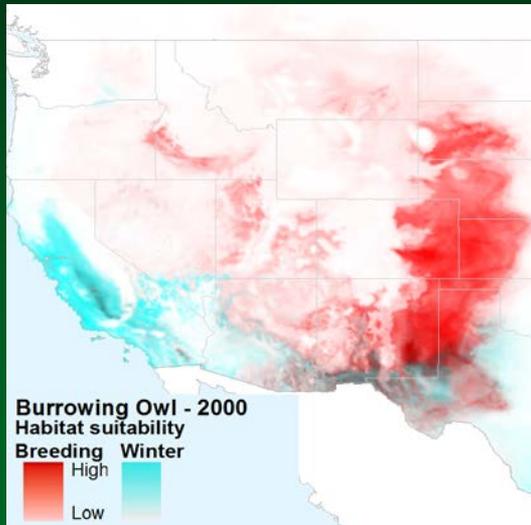
Summer distribution based on BBS data from 2007-2013
<http://www.mbr-pwrc.usgs.gov/bbs/ra2013/ra03780.htm>



Trend based on BBS data from 1966-2013
(Sauer et al. 2014).



Burrowing Owl



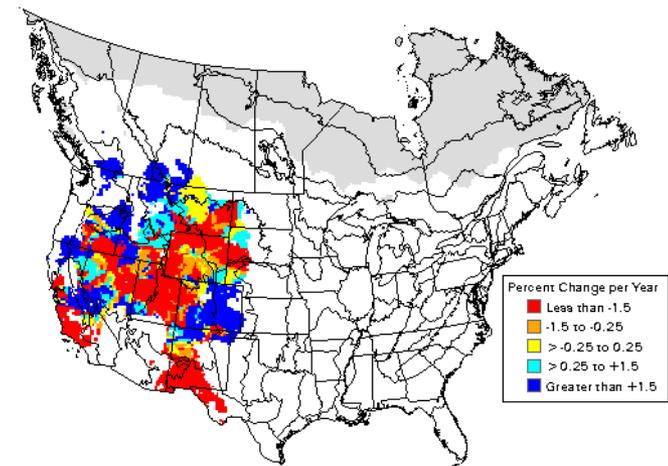
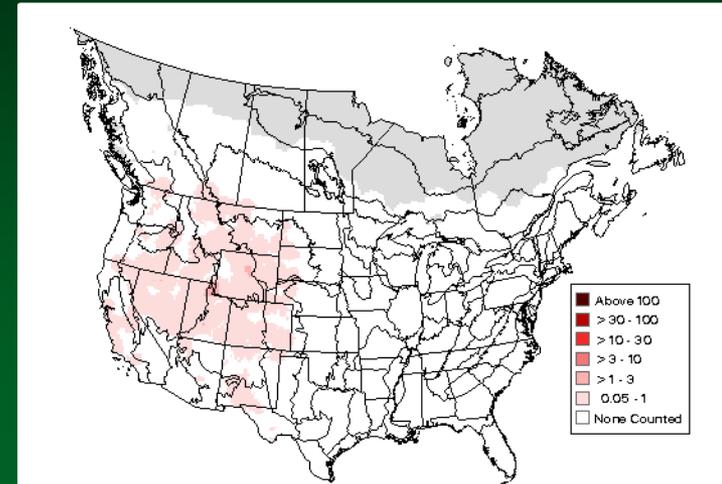
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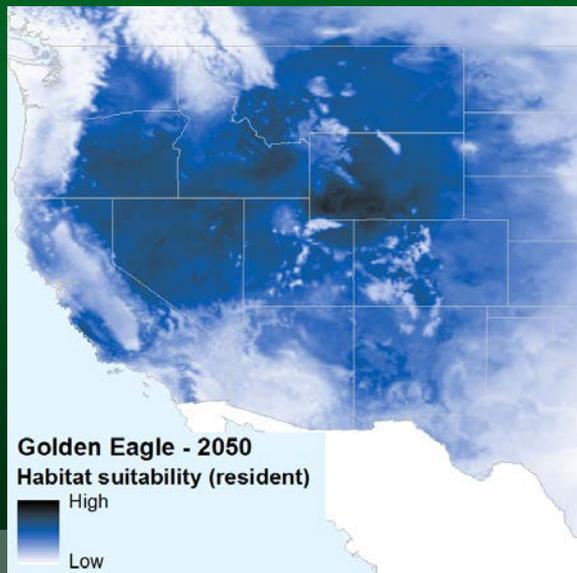
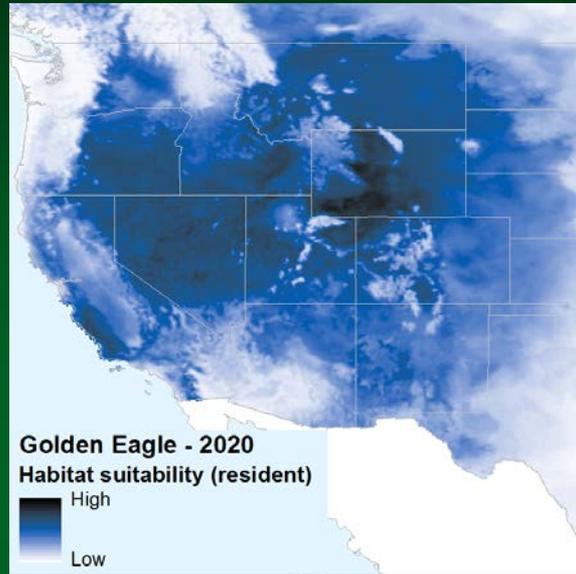
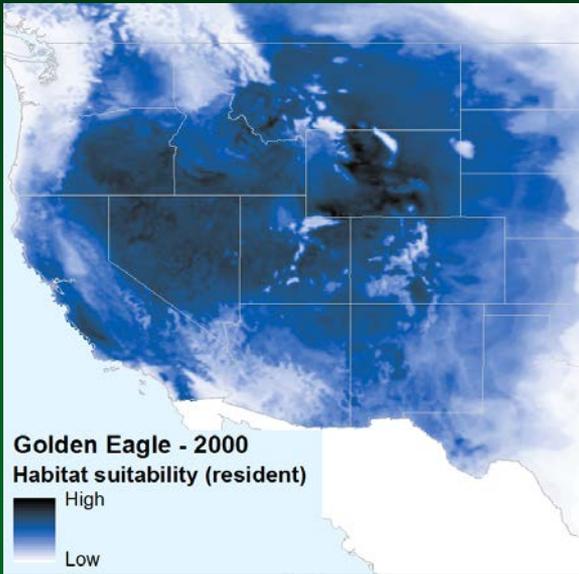
Golden Eagle



- Ongoing debate regarding current status and trends of continental population
- Convention on International Trade in Endangered Species (CITES) Appendix II, USFWS Bird of Conservation Concern, DoD PIF Mission Sensitive Priority Bird Species, Species of Greatest Conservation Need in AZ, CA, CO, ID, KS, MT, NE, NV, ND, TX, UT, WA, WY
- Threats associated with various human activities, possibly also changes to ecological processes
- “Climate Endangered” according to Audubon Society



Golden Eagle



Modeled current (2000) and future (2020, 2050, and 2080) habitat suitability (National Audubon Society 2013).



Management Recommendations

To alleviate system-level threats, we recommend the following:

- Expedite the development of updated/revised management plans to more explicitly address changing stressors such as worsening drought, disturbance events, and climate change.
- Continue to implement management prescriptions to reach desired conservation, safety and mission support objectives. Great care should be taken to avoid degradation of ecological conditions (e.g., creating novel stand structures, altering natural disturbance regimes, reducing habitat suitability for declining obligate species).
- Initiate or continue to implement monitoring for adaptive management, especially for pinyon-juniper systems. Linking monitoring attributes with management prescriptions will help improve the effectiveness and fine-tune best management practices over time.



Management Recommendations

- Develop and use a state and transition framework to facilitate management decisions, monitoring, and adaptive management with respect to prescriptions. A new management objective becomes development and maintenance of a given percentage of the pinyon-juniper acreage in each of the different pinyon-juniper community types.
- Examine and incorporate considerations related to climate change scenarios into management planning. Considerations might include stand replacement considerations, site-specific considerations for forest treatments or planting, anticipated fire behavior under climate change, and identification of refugia (e.g., cooler, moister sites) where species might persist or experience less ecological stress.



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QUESTIONS?



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