

Species and Habitat Vulnerability to Climate Change in the Upper Gunnison Basin

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Introduction

- **Part of a rapid climate vulnerability assessment for the Upper Gunnison Basin**
 - **Determine what ecological systems/habitats are most at risk to climate change predicted for 2050**
 - **Determine which rare plants and animals are most at risk**

Gunnison Basin

2040-2060 Climate Scenario 1 (A1 emissions), Moderate Change

Season	Precipitation %	Temp C	Temp F
Annual	0.0	+2.0 to +3.0	+3.6 to +5.4
Winter	+15.0	+2.0	+3.6
Spring	- 12.0	+2.5	+4.5
Summer	-15.0	+3.0	+ 5.4
Fall	+4.0	+2.5	+4.5

Winters are wetter and warmer

Springs are drier and warmer

Summers are drier and warmer

Falls are wetter and warmer

Gunnison Basin 2040-2060 Climate Scenario 2, More Extreme Change

Season	Precipitation %	Temp C	Temp F
Annual	-10.0	+3.0	+5.4
Winter	0	+3.0	+5.4
Spring	-15.0	+3.0	+5.4
Summer	-20.0	+4.0	+7.0
Fall	+3.0	+3.0	+5.4

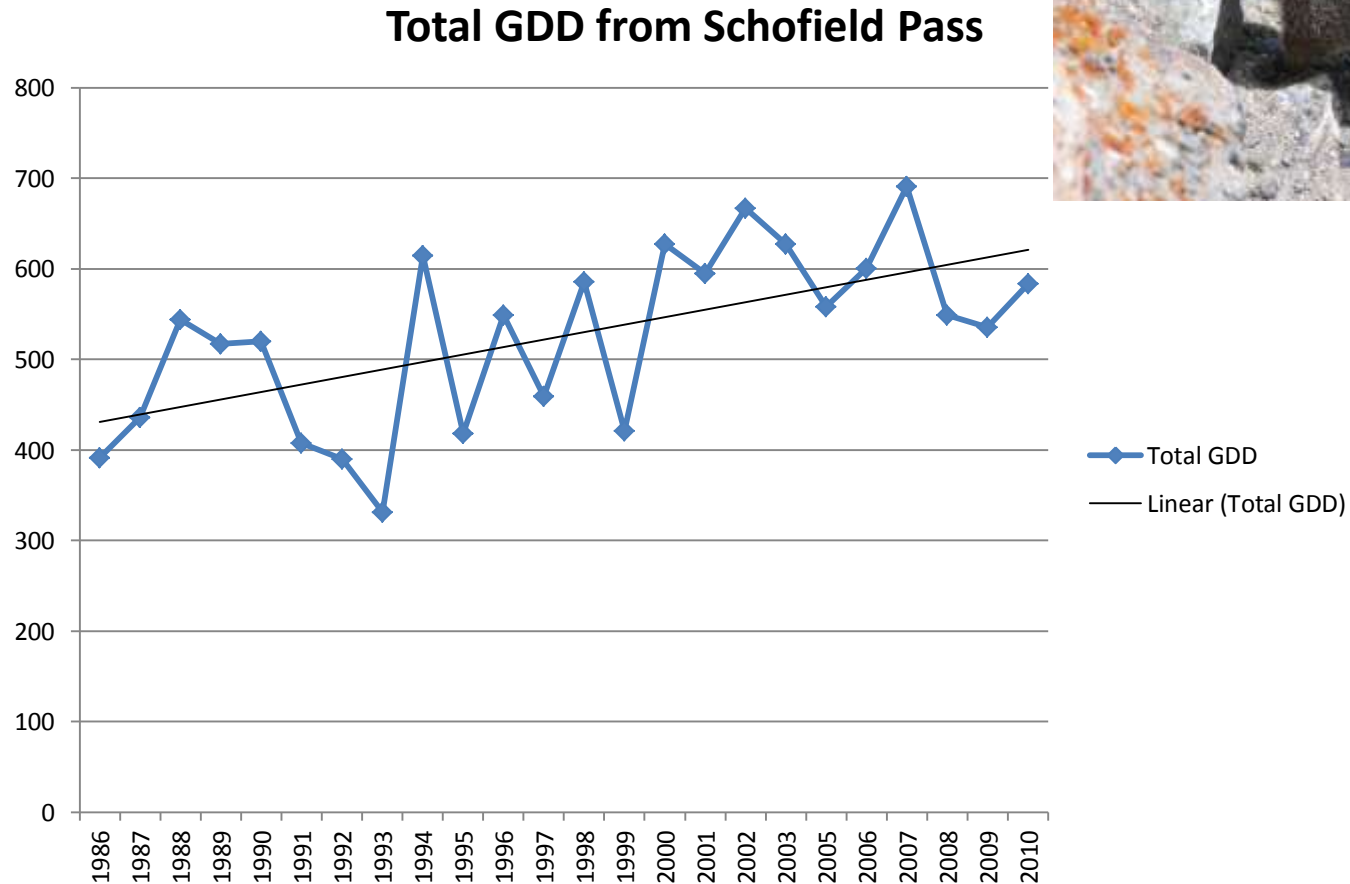
Winters are warmer

Springs are drier and warmer

Summers are drier and warmer

Falls are wetter and warmer

Summer Temps are Warming at High Elevations

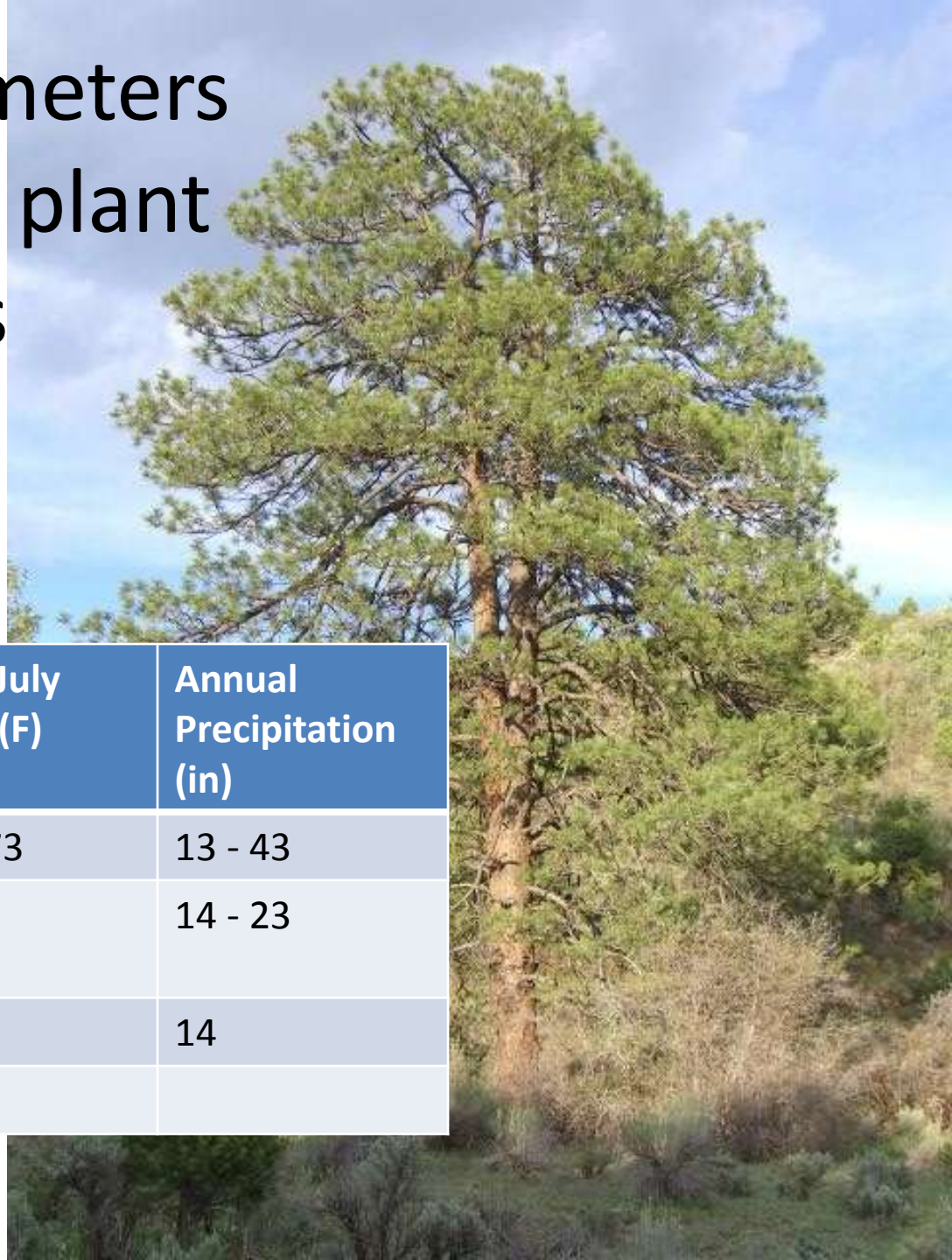


Ecosystem Responses to Climate Change

- The primary determinant for the overall geographic ranges of plant species and vegetation patterns is **climate, primarily temperature and precipitation**
- However other important abiotic factors include:
 - CO²
 - Nutrient input
 - Disturbance regimes

Important parameters associated with plant tolerances

Ponderosa Pine



	Mean January Temp (F)	Mean July Temp (F)	Annual Precipitation (in)
Range wide	16 to 45	57 to 73	13 - 43
Gunnison Basin			14 - 23
Lake City	16	60	14

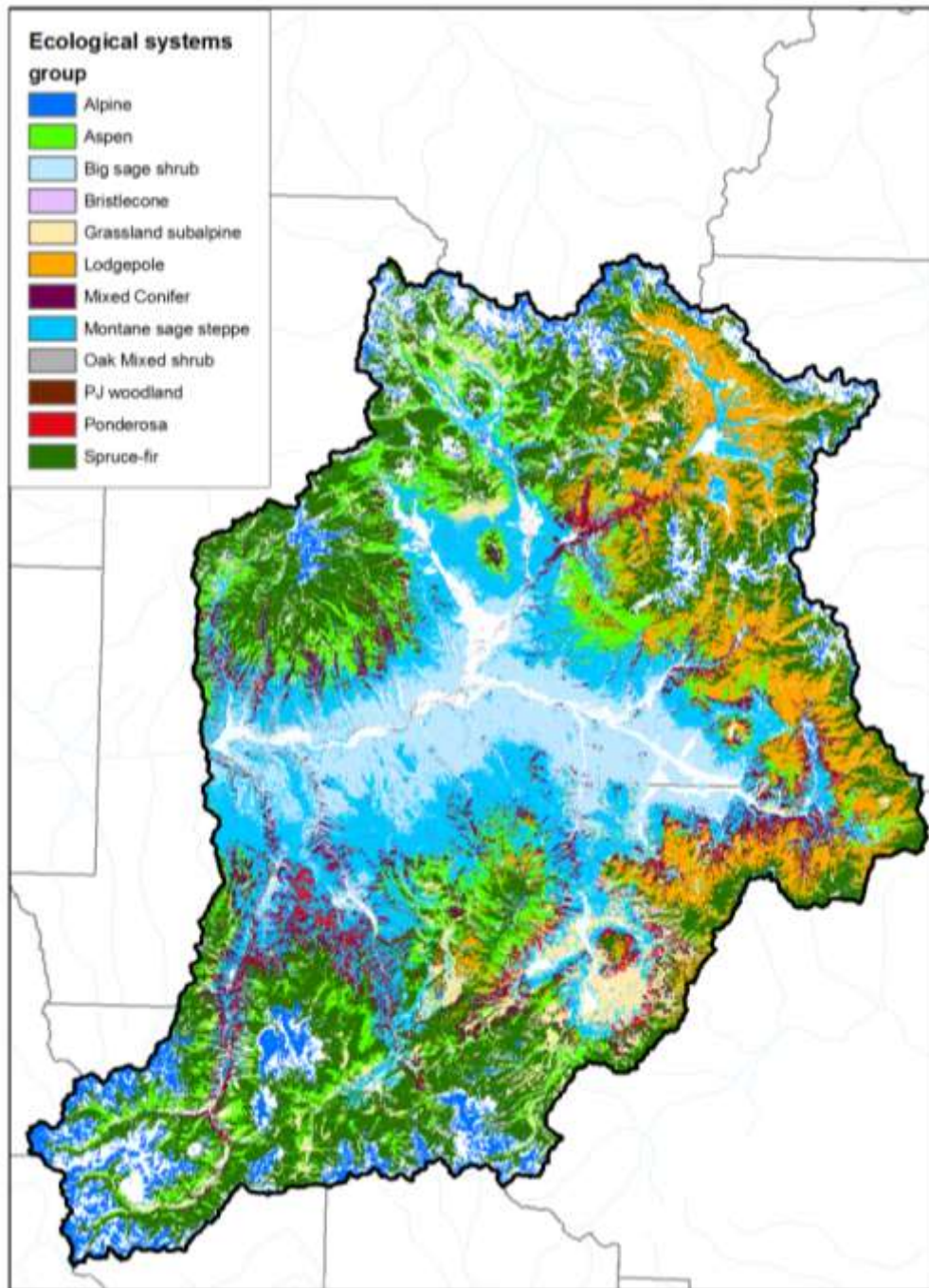
Disturbance Regimes

- The harder determinant of vegetation dynamics are **events, e.g.**,
 - Drought
 - Fires
 - Snowmelt
 - Insect outbreaks



Gunnison Basin Ecological Systems Evaluated

1. Tundra (mesic and xeric)
2. Spruce-fir
3. Mixed-conifer
4. Aspen
5. Lodgepole pine
6. Ponderosa pine
7. Pinyon-Juniper
8. Bristlecone pine
9. Montane sagebrush
10. Low elevation sagebrush
11. Oak and mixed mountain shrubland
12. Montane grassland
13. Wetlands (groundwater and riparian)



Approach

- Major questions:
 - How will the representation of these ecological systems in Gunnison Basin be altered by a changing climate predicted for 2050 (utilizing Barsugli and Mearns, predications for Basin)
 - What degree of confidence can be assigned to the above predictions

Approach continued:

- Develop a list of variables likely to affect vulnerability to climate change.
- Develop ecological system/habitat vulnerability scoring system.
- Develop confidence evaluation scores.
- Provide brief description of each ecological system and their current climate tolerances and their most vulnerable variables.

Vulnerability Variables

- Elevation
- Bioclimatic envelope
- Vulnerability to increased attack by biological stressors
- Intrinsic dispersive rate
- Vulnerability to increased frequency of intensity of extreme events (fire, drought, windstorms, floods)
- Vulnerability to phenologic change
- Likely future impacts of non climate stressors

Vulnerability Variable Definitions

- **Elevation:** Is current elevation range in upper elevations?
- **Bioclimatic Envelope:** Is the current temperature and precipitation ranges narrow?
- **Biological stressors:** Will climate change increase frequency or intensity?
- **Intrinsic Dispersive Rate:** Can the system quickly shift their ranges?

Vulnerability Variable Definitions, cont.

- **Vulnerability to increased extreme events:** Will increased frequency and intensity of fire, drought, floods, windstorms, dust on snow, etc., negatively impact?
- **Vulnerability to phenologic change:** Will a change in timing of frost, snowmelt, precipitation, etc. negatively impact?
- **Likely future impacts of non-climate stressors:** Will the system be highly vulnerable to non-climate stressors?

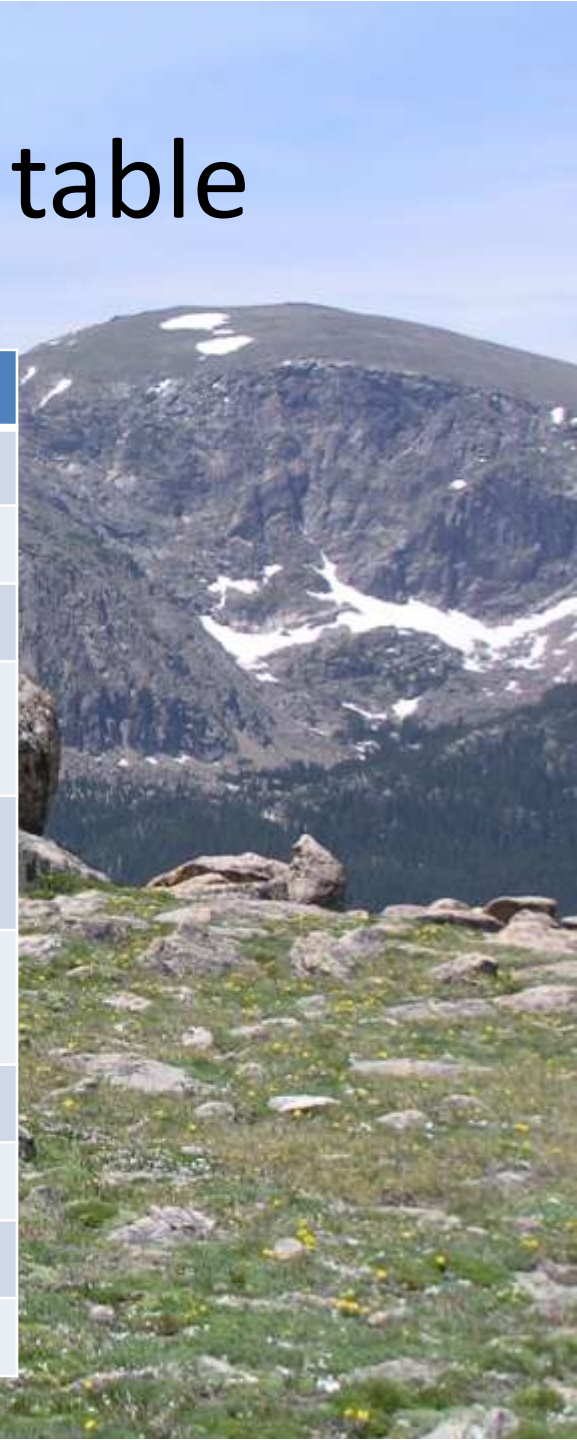
Habitat Vulnerability Scoring System

Score	For year 2050
7/ EV	Habitat at risk of being eliminated from the area as a result of climate change
6/ HV	Majority of habitat at risk of being eliminated (i.e., >50% loss) as a result of climate change, but unlikely to be eradicated entirely
5/ MV	Extent of habitat at risk of being moderately reduced (<50% loss) as a result of climate change
4/ PS	Extent of habitat may not change appreciably under climate change.
3 / NV	Habitat may become established within the state from areas outside.
2/ IL	Extent of habitat may expand moderately (<50% gain) as a result of climate change
1/ IL	Habitat may expand greatly (<50% gain) as a result of climate change
0/ UV	Vulnerability of habitat under climate change is uncertain

EV: Extremely vulnerable, HV: Highly vulnerable, MV: Moderately vulnerable, PS: Presumed stable, NV: Not vulnerable, UV: Uncertain vulnerability; IL: increase likely

Example of summary table

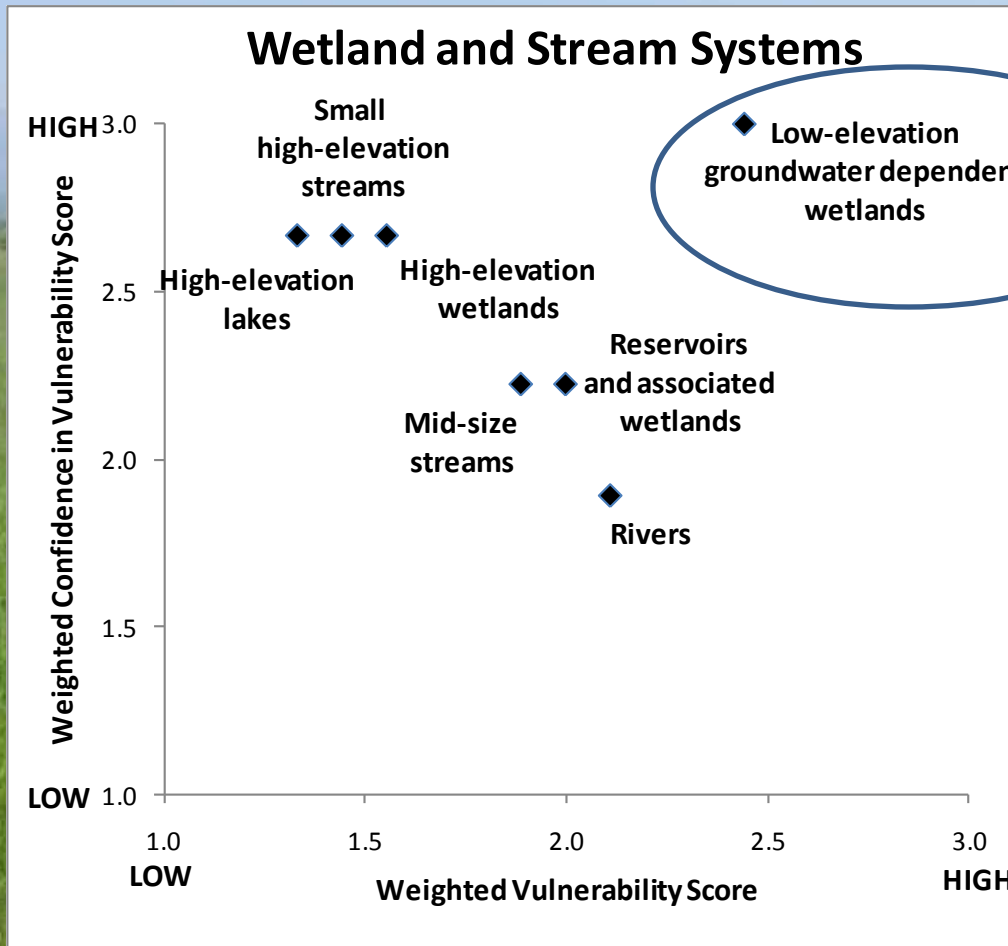
Alpine system (Tundra)	
Overall Vulnerability score	Highly vulnerable
Restricted to High elevation	Yes
Narrow bioclimatic envelope	Yes
Vulnerable to increased pest attacks	No
Vulnerable to increased invasive species	No
Vulnerable to intrinsic dispersal rate	Yes
Vulnerable to fire	No
Vulnerable to drought	Yes
Vulnerable to timing of snowmelt	Yes
Vulnerable to phenologic change	Yes



Draft Vulnerability and Confidence Scores

Ecological System	Vulnerability Score	Confidence in Score
Tundra	6 , Highly Vulnerable	High
Spruce-fir	5, Moderately Vulnerable	Medium
Mixed-conifer	4, Presumed Stable to Increase	Medium
Aspen	4, Presumed Stable	Medium
Lodgepole	5 Moderately Vulnerable	Medium
Ponderosa pine	2 Slight Increase	Medium
Pinyon-Juniper	2,4 Presumed stable to Slight increase	Medium
Bristlecone pine	6, Highly Vulnerable	Medium
Montane sagebrush	2, Increase likely	High
Low-elevation sagebrush	2,4 Presumed stable to increase likely	High
Oak and mixed mountain shrubland	2 Increase likely	Low
Groundwater-dependent wetlands, low elevation	6, Highly vulnerable	Low
Riparian	Presumed stable	?

Aquatic Systems



What does this really mean?

- **The alpine and there obligate species, e.g., Pika and Brown-capped Rosy Finch are extremely vulnerable**
 - By 2050 the pika population and Rosy Finch will most likely be greatly reduced due to increased temperatures
- **Low elevation wetland species are vulnerable, e.g. Gunnison sage grouse**
- **Adaptation is likely for aspen, spruce-fir, sagebrush, ponderosa pine but the placement will be different**
- **May have more sagebrush and less trees**
- **More montane species and less alpine species**
- **Individual sites will most likely change**