Yakama Nation Meadow Vulnerability Assessment

Wildlife Resource Management Program
Reserved Fishing and other rights on 10 Million Acres With Treaty Instream Flow, hunting, fishing, and other Rights

Treaty of 1855 Created Yakama Nation

Reserved 1.4 Million Acre Reservation With Treaty Rights
Integration of tribal values and knowledge, and science

Tribal leadership, elders and enrolled members provide values and knowledge of resources and environment

Program staff integrate tribal and scientific knowledge to protect and restore values and resources

western science and technical knowledge
YN Reservation strong moisture gradients drive vegetation

Mt Adams
12,281 ft
100” precip

YN Reservation

Mabton, WA
781 ft
7” precip.
Mountain Hydrology

- Warming will continue, ~ 5 deg F
- Snowpack will decline
- Timing of spring run-off will advance
- Plant phenology will shift
- Timing of cultural plants is already showing change
- Changes in meadows not known

From Snover et al 2013
Importance of meadows—habitat islands and ecotones

- Traditional use by tribal members
- Wildlife habitat, game and non-game
- Support beavers, ecosystem engineer
- Culturally important and special status plants
- Function as natural water storage areas
Stressors in YN Reservation meadows

- Overgrazing-trampling, compaction, loss of vegetation
- Harvest practices-soil and veg. damage
- Roads, culverts-channel incision, drying of meadow
- Conifer encroachment-type conversion
- Noxious weeds-loss of native vegetation and function
Need for Assessment: manage at watershed scale

- 900 meadows over 600,000 acres (8,600 ac)
- Span 21 basins and a mountain divide
- Multiple types and settings
- Range from healthy to highly degraded
- Desire to understand spatial and temporal patterns in order to improve management and restoration
**Goal: Develop new data and synthesis to support accelerated protection and restoration of Yakama resource values in Reservation meadows**

**Objectives:**

1. Integrate tribal knowledge and on-the-ground rapid assessment with historic remote sensing and climate vulnerability modelling to assess threat for each meadow
2. Develop decision tool to provide a flexible means of sequencing actions using variable criteria
3. Provide means of managing meadows by watershed and geographic zone
Methods - Overview

- Rapid assessment
  - condition and stressors (YN staff)

- Remote sensing
  - historic changes in greenness and soil moisture (CSP)

- Climate modelling
  - future trends in hydroclimate (UW CIG)

- Tribal knowledge
  (YN staff)

Synthesis of present, past, and future condition, changes, and trends in soils moisture and climate for each meadow (sampled in rapid assessment)

*CSP Conservation Science Partners
*UW CIG University of Washington Climate Impacts Group
Methods 1- Rapid Assessment

- Meadows assessed 2007-2011
- Primary goal to understand function and condition of Reservation meadows
- 368 meadows (46%) and 4,905 acres (57%) assessed
- Datasheet developed, information stored in database
- Threat Summary by meadow and watershed

Assessed damage from:
- Overgrazing by cattle
- Conifer encroachment
- Invasive plants
- Hydrologic degradation
- Roads, culverts, harvest practices
Methods 2- Historic Remote Sensing

- Model Normalized Vegetation Difference Index (NVDI), a good proxy for **soil moisture**, using Landsat archive on Google Earth Engine, 1984 to 2011
- Generate time series of NVDI, which show trends and abrupt changes
- **Wet** and **dry** meadows were distinguishable, mesic were variable
- Analysis conducted with and without **tree and water pixels**, potentially confounding elements
- Maps produced of results
Methods 3- Future Climate Modelling

- Variable Infiltration Capacity (VIC) hydrological model used
- Historical and future climate time series as inputs (daily temp, precip., wind speed)
- Output daily water balance variables (soil moisture) until year 2100
- Identified future changes in hydroclimate (timing, quantity) for each meadow
- Changes in type of meadow (wet to mesic, mesic to dry e.g.)
- Models only changes due to climate, cannot see land use
Methods 4- Incorporate Tribal Knowledge

- Interviews with willing participants
- Informed consent form and structured questions
- Asks about significance, resources, and changes in meadows
- Purpose is to help prioritize meadow protection and restoration according to local knowledge

Research Interview Questions (Meadow/Plant Knowledge – Ethnographic Inventory)

After introducing the project, with Tribal approval and support, after reviewing the possible risks and benefits and having the interviewee read and sign the Informed Consent Form, and after securing use of an audio recorder for the interview, the following semi-structured questions could be asked:

A. Demographic Information:
   What is your age, gender, and family affiliation? (If applicable)

B. Inventory Information: what is your knowledge of meadows within the closed area?

Possible follow-up questions:
1. How have the meadows you have visited changed over the years?
2. When was the last time you visited some of the meadows?
3. What significance does this meadow or meadows in general have for you?
   Nutrition (food source)
   Potential medical uses
   Cultural Heritage
   Other

4. Do you have information, from remembrances or personal experiences, on meadows you used frequently growing up?
   Are they still areas that you and your family visit?
   If no, what has changed? Has it been a victim or tree encroachment? Is the meadows hydrology changing? Or other?

5. Do you have information, from remembrances or personal experiences, on the changes over time within meadows that are important to you?
Results - Overview

Rapid assessment
-condition and stressors (YN staff)

Remote sensing
-historic changes in greenness and soil moisture (CSP)

Climate modelling
-future trends in hydroclimate (UW CIG)

Tribal knowledge (YN staff)

- 46% overgrazed, 22% affected by roads, 22% channel degradation, 16% conifer encroachment, 15% invasive plants, 9% harvest impacts.
- 58% have threat rating of M, H, or VH

- 23% of meadows showed a trend or abrupt change
- Abrupt changes: 15% wetter, 6% dryer
- Trends: 15% wetter, 9% dryer
- Surprising! Tree encroachment? Less grazing?

- 47% of meadows (73% by area) drying by 2080s
- 15% shift to dryer type (wet to mesic or mesic to dry)
- Meadows above 1000 meters get wetter

- Still in process
Combined threat summary for all meadow basins, by number of meadows

- Combine all threats by watershed to see broad patterns
- Similar maps can be produced of all threat types
- Can be broken down by numbers of meadows or meadow area
Results-Historic Remote Sensing Example

- Shows mostly slight trends, does not explain them
- Local knowledge or further analysis would be necessary
- “Wetter” trend could be tree encroachment, recovery from mid-century heavy grazing
- Suggests directions for future work

Meadows with long term trend

Example of tree encroachment
Results - Climate Model Example

- Projected future shifts will aid in long-term planning
- Strong elevation and longitudinal patterns
- Shifts in timing
- Projections align with regional climate forecasts
- Potential effects on meadow plant species

Projected change in July NVDI for 2080s

Example of projected shift mesic to dry
Synthesis and decision tool

- Brings together the different data sources
- Allows for flexible criteria, e.g. plant species, beaver activity
- Can incorporate future data, e.g. cultural or wildlife habitat
- Will be tested against local knowledge for a reality check
Synthesis and decision tool

- Can drill down to each meadow
- Incorporate historical air photos
- Evaluate potential remedial actions
Conclusion and Takeaways

1. Historic land use, existing threats are of great immediate concern, overgrazing is a leading cause of degradation
2. Past trends in NVID/moisture are surprising and challenge assumptions
3. Tree encroachment emerged as a big concern, could gradually eliminate meadows (Sierra report)
4. Climate change is a threat to YN meadows, should help focus management efforts and clarify priorities
Protection and Restoration Measures

1. Manage grazing with fences and movement of cattle
2. Restore channel function
3. Re-introduce fire and cut trees down
4. Target meadows for invasive plant management
5. Remove/replace roads and culverts
6. Follow forest management guidelines
Next steps

1. Continue efforts to interview enrolled members
2. Compare model and remote sensing results with reality through site visits
3. Use decision tool to plan and sequence watershed restoration
4. Engage partners in Ceded Territories to broaden the scope of assessment
5. Find some funding, get to work!
Thank You!

- Yakama Tribal Council
- Wildlife Program colleagues
- Bureau of Indian Affairs
- Environmental Protection Agency
- U.S. Fish and Wildlife Service
- Bonneville Power Administration
- Yakama Nation Fisheries
- Yakima Basin restoration community