Adapting to Climate Change at Olympic National Forest and Olympic National Park

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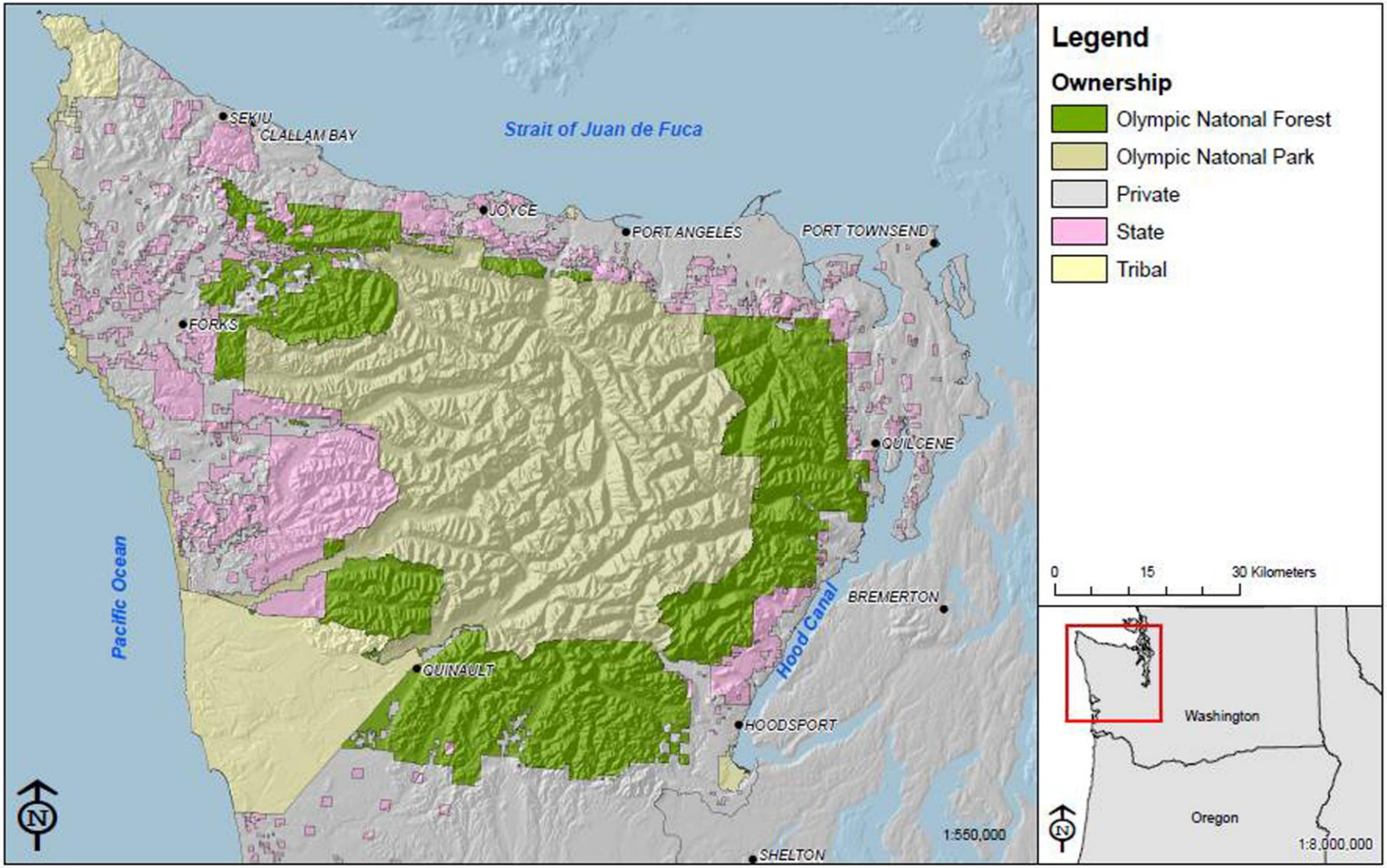
A framework for adapting to climate change

1. Establish a science-management partnership
2. Identify scenarios for future conditions
3. Evaluate vulnerability and risk
4. Make “climate smart” decisions
5. Monitor, evaluate, and review

This adaptation framework…

- Used by 12 National Forests and 5 National Parks.
  - Olympic National Park/National Forest
  - North Cascadia Adaptation Partnership
- Documented in the peer-reviewed literature.
- Incorporated in the national process used by the U.S. Forest Service.

Olympic Case Study



Olympic Case Study Process

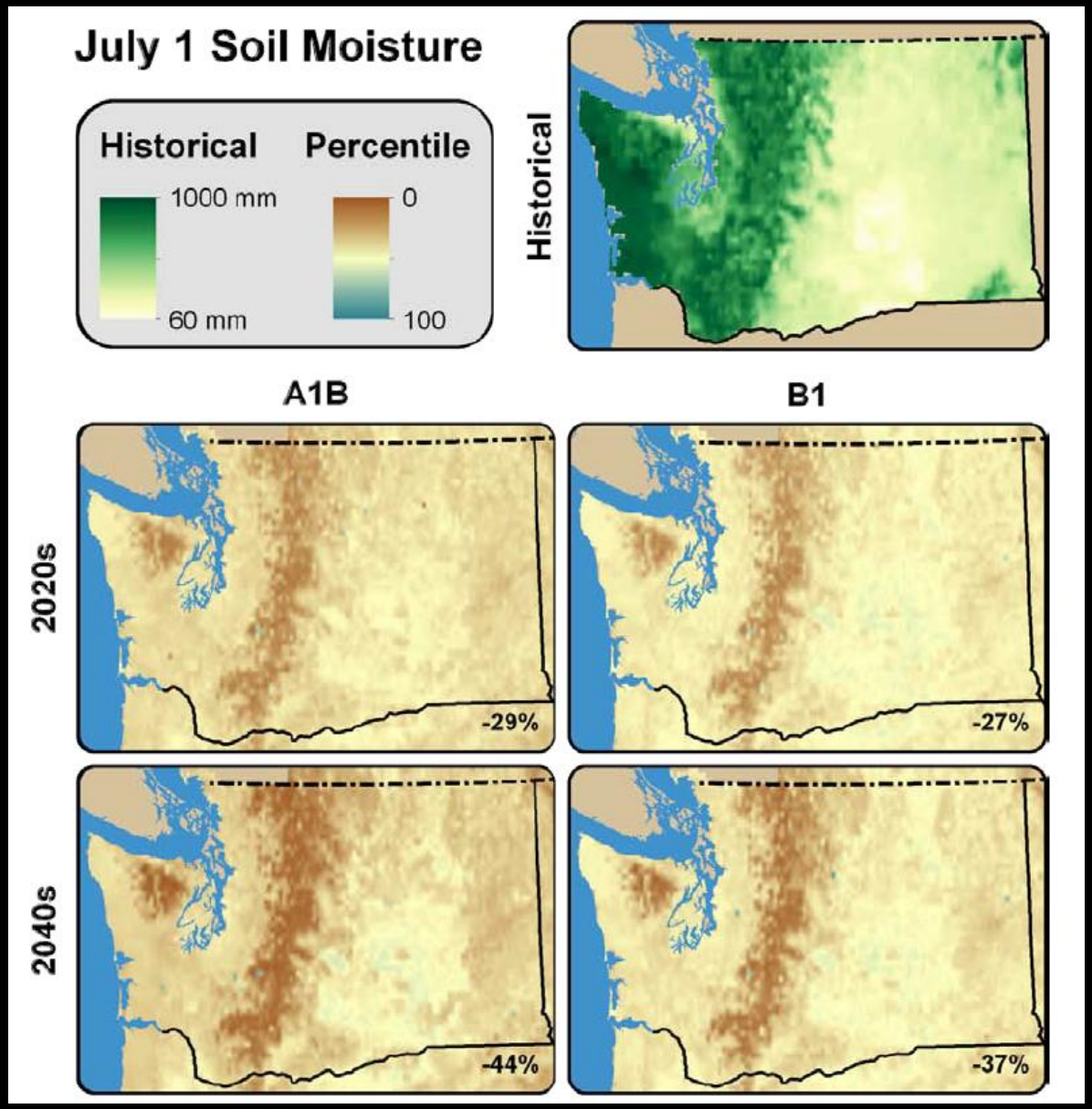
1. Education: Science Days
2. Resource-sector specific workshops to identify resource sensitivities and brainstorm adaptation options (science-management).
3. Write final report and implement adaptation options into current management plans.

Olympic Case Study: four focus areas

- Vegetation management
- Wildlife and wildlife habitat management
- Hydrology and roads management
- Fish and fish habitat management

Climate Change Sensitivities: Vegetation

1. Increased forest drought stress and decreased productivity at lower elevations



Source: Halofsky et al. 2011

Adaptation Options: Vegetation

Reduce tree density

- Increase thinning in young-growth stands and alter thinning prescriptions.
- Use girdling, falling and leave trees, prescribed burns and wildland fire.

Favor more drought tolerant species

- Maximize early successional tree species diversity by retaining minor tree species
- Consider including larger openings in thinning prescriptions and planting seedlings in openings.

Climate Change Sensitivities: Vegetation

2. Potential for mortality events and regeneration failures, particularly after large disturbances.

Adaptation Options: Vegetation

- Develop a gene conservation plan for ex situ collections for long-term storage.
- Identify areas important for in situ gene conservation.
- Maintain a tree seed inventory with seed for a range of species, particularly species that may do well in a hotter, drier conditions.
- Increase production of native plant materials for post-flooding plantings.

Climate Change Sensitivities: Vegetation

3. Increased opportunity for exotic species establishment.

Adaptation Options: Vegetation

- Continue to implement early detection/rapid response for exotic species treatment (ONF).
- Increase exotic species control efforts (ONP).
- Continue to exchange information on exotic species spread and control between ONF and ONP.

Climate Change Sensitivities: Wildlife

1. Limited connectivity of late successional forests.

2. Limited ability of species to respond to climate change owing to current stressors, such as habitat loss and fragmentation.

Olympic marmot
Photo by B. Howell, USFS

Adaptation Options: Wildlife

- Collaborate with neighbors on priority areas for treatments and increase extent of protected areas.
- Promote late-successional forest conditions:
  - Increase thinning treatments in young-growth forests.
- Increase landscape connectivity:
  - Focus thinning treatments around existing late-successional forests (ONF).
  - Increase restoration treatments in and protection of headwater streams.
  - Add a climate layer to ONF's 10-year plan that shifts priorities for thinning treatments and road decommissioning.

Climate Change Sensitivities: Wildlife

3. Reduced late-successional habitat area and habitat quality

Adaptation Options: Wildlife

- Continue to create and protect legacy structures at ONF (i.e. snags).
- Increase density of legacy structures in younger forest near late-successional forest to increase habitat quality and connectivity (ONF).
- Continue to thin stands to promote tree vigor and produce future legacy structures (ONF).
- Continue to restore degraded sites.

Climate Change Sensitivities: Wildlife

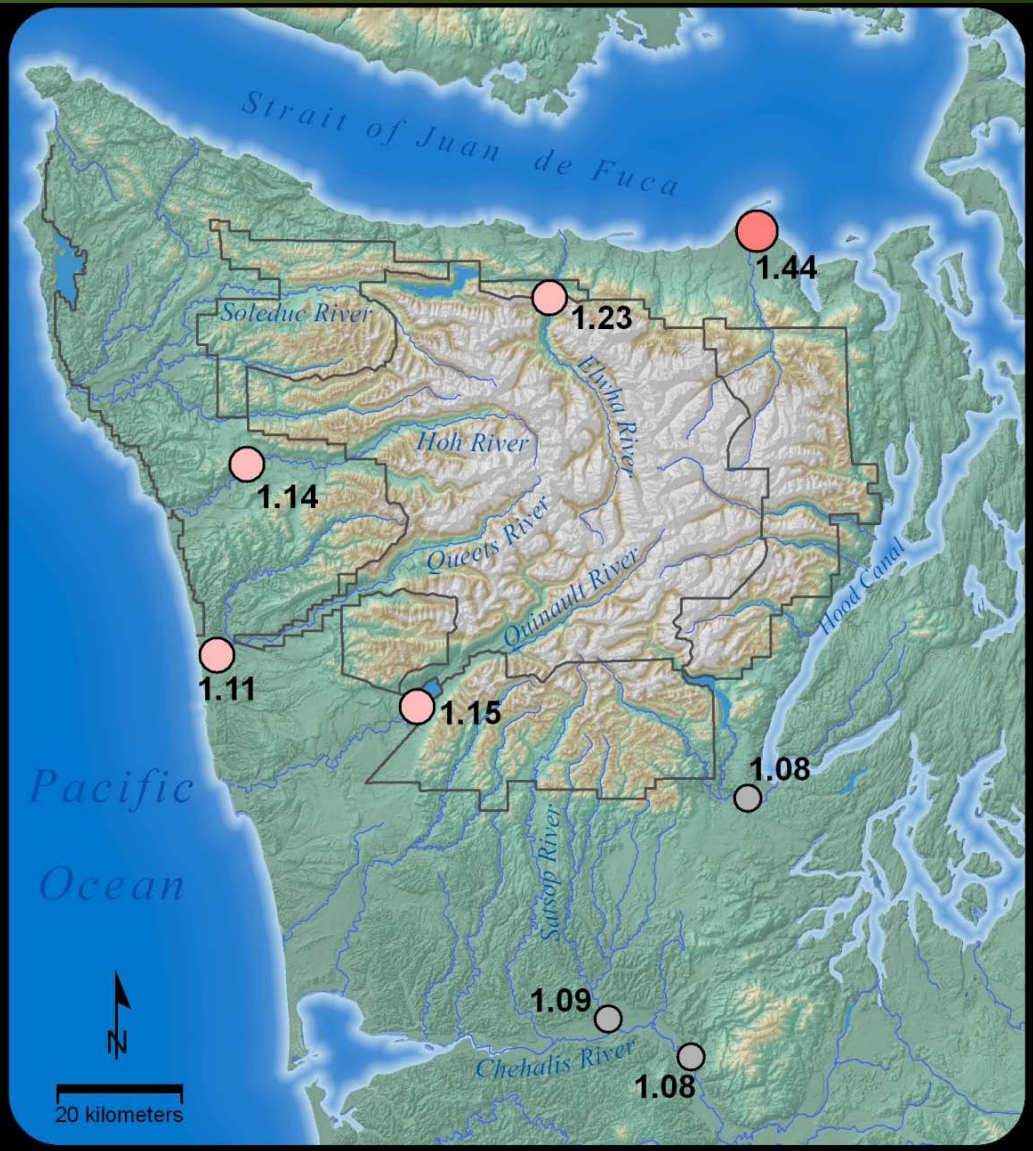
4. Reduced habitat quality in riparian areas and wetlands.
5. Loss of cold-water refugia for cold water adapted amphibians.
6. Change in wetland, bog, and fen distribution.

Adaptation Options: Wildlife

- Restore habitat in degraded headwater streams that are expected to retain adequate summer streamflow (ONF).
- Consider creating wetland habitats.

Climate Change Sensitivities: Flood Risk

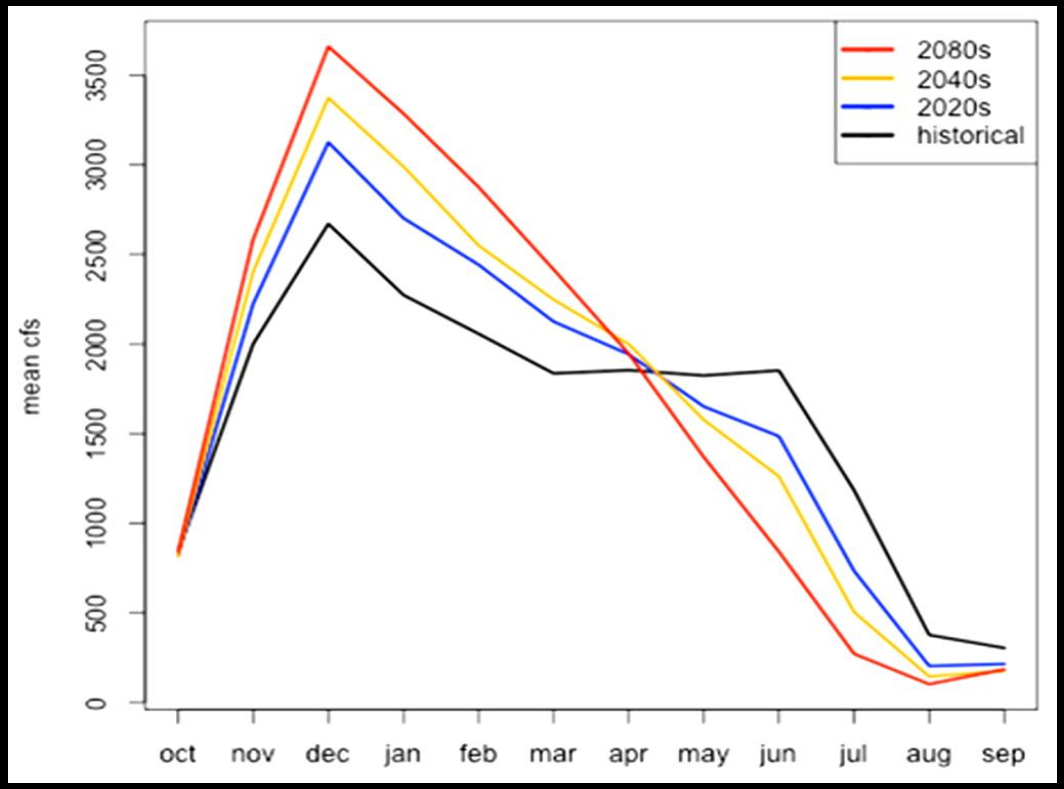
1. Increased flow volume and flood frequency
2. Increased mass wasting/debris flows
3. Increased sediment delivery to culvert inlets and ditches
4. Increased rate and volume of water delivery to channels
5. Increased transport of wood in channels



Numbers indicate the ratio of projected 20-year flood statistics for the 2040s to 20th-century flood statistics. Source: Mantua et al. 2010

Climate Change Effects on Hydrology

- Earlier snowmelt
- Reduced spring snowpack
- Higher peak flows and more flooding in fall and winter
- Lower and warmer summer stream flow



Historical and simulated mean monthly flow for the Elwha River (Olympic Peninsula). Source: A. Hamlet, Climate Impacts Group.

Adaptation Options: Road Management

- Consider relocating high-risk roads (e.g., valley bottom roads).
- Prioritize treatment and decommissioning activities on the most sensitive roads (roads connected to streams and below rain-on-snow zones).
- Increase road maintenance preparation and response (e.g. culvert cleaning, armoring ditches).

Adaptation Options: Road Management

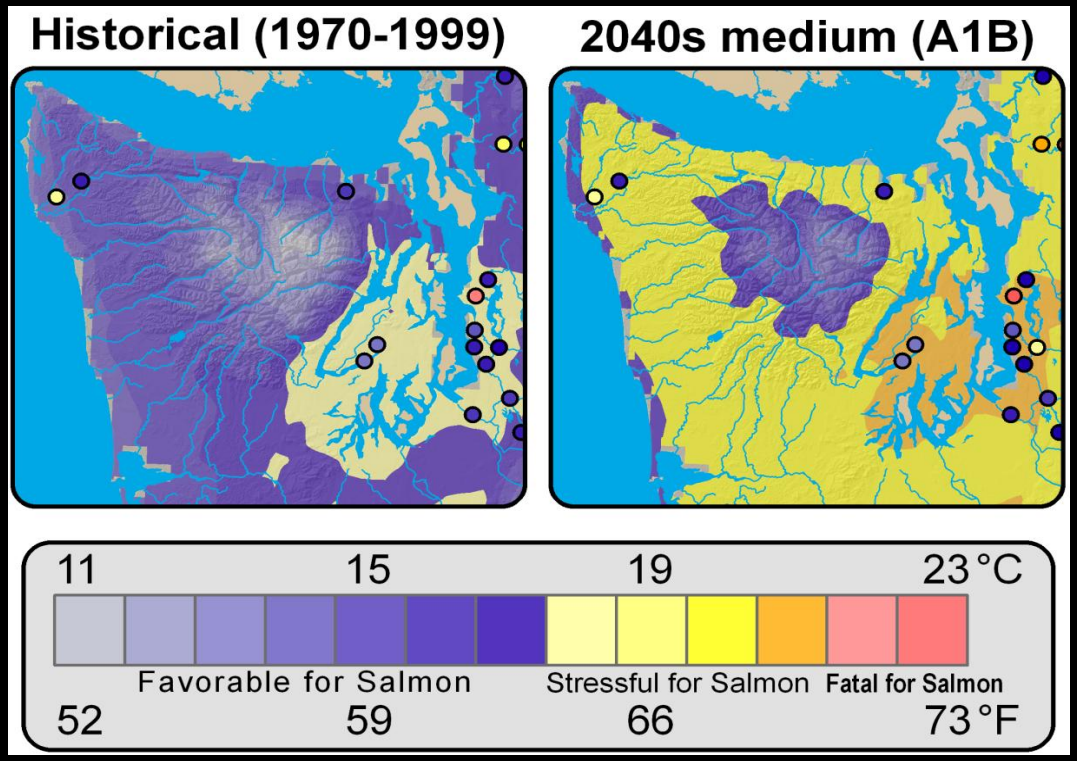
- Design more resilient structures (e.g. larger culverts and bridges)
- Installing retaining walls and other cut bank stabilization (ONP)
- Use alternate methods to calculate future peak flows, Q_{100} (e.g., hydrologic models or the last 30 years of record).

Implementation: Road Management

- Olympic National Forest and UW CIG working towards implementation.
- Q100 – critical statistic in road management planning.
- Current estimates based on historical records and only precipitation and basin size.
- Model Q100 to reflect projected changes in precipitation and temperature .
- Critical for mixed rain and snow (transient) basins.

Climate Change Sensitivities: Fish

1. Increased thermal stress on cold-water adapted fish species
2. Decreased fish numbers owing to reductions in suitable habitat and productivity
3. Increased sensitivity for species that spawn in late summer



August mean surface air temperature and maximum stream temperature. Source: N. Mantua, CIG

Adaptation Options: Fish Management

- Limit mortality associated with recreational fishing through time and area closures as necessary (ONP).
- Identify and protect cold water refugia and wild fish strongholds.

Climate Change Sensitivities: Fish Habitat

2. Increase in failures of culverts, fill slopes, stream adjacent roads, and encroachment from stream-adjacent roads
3. Major changes in quantity and timing of streamflow in transitional watersheds
4. Increased erosion and sediment delivery to channels

Adaptation Options: Fish Habitat

- Decommission unneeded roads.
- Relocate stream-adjacent roads.
- Remove sidecast, improve drainage, and increase culvert sizing on remaining roads.
- Design more resilient stream crossing structures.
- Make road and culvert designs more conservative in transitional watersheds.
- Consider adding large wood to small headwater channels to restore natural sediment routing (ONF)

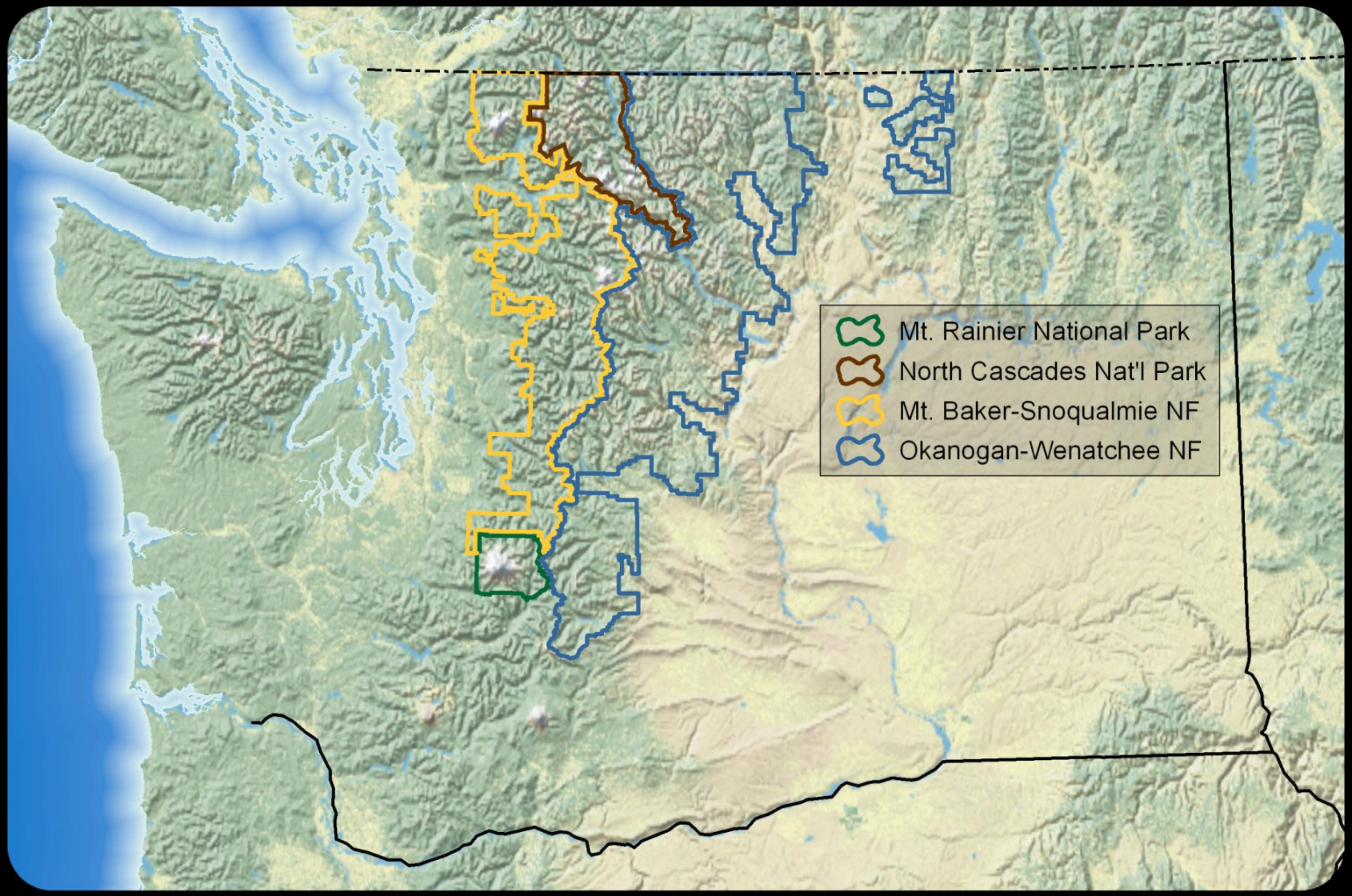
Lessons Learned

- Sharing information is a two-way street
- Scientist-manager partnerships are relationships, which take time and energy
- Ecosystem management is the starting place for the science of adaptation
- The past is relevant but not prescriptive

Products

- USFS General Technical Report
- Peer reviewed articles on the process
- Climate change thinking and awareness
- This was only the beginning …
  - translate strategies to specific tactics
  - develop geospatial references for adaptation concepts
  - synthesize adaptation concepts across disciplines

North Cascadia Adaptation Partnership



www.northcascadia.org

Process

1. Education
Hold workshops that provide an opportunity for employees to explore and discuss climate change.

2. Vulnerability Assessment
Review climate projections and identify sensitivities for selected resource sectors.

3. Adaptation Options
Develop science-based adaptation strategies using discipline-specific workshops that bring scientists and managers together.

4. Implement
Focus on “no regrets” strategies that are consistent with current management and can be incorporated into existing plans.

Questions

Sources of uncertainty

- Emissions scenarios
- Global Climate Models (GCMs)
- Downscaling methods
- Effects models
- Interactions among multiple stressors
- Scale of effects assessment vs. management actions

Uncertainty ≠ ignorance

- Usually high confidence in broad scale projections
- High confidence in mid-21st century projections than late century
- High confidence in projections of some climate variables (temperature vs. precipitation)
- Evaluate the evidence and judge confidence in projected effects for specific areas – look for convergence among effects models

Dealing with Uncertainty

- Focus on changes that have already been observed with recent warming
- Focus on similarities between different future climate and impacts scenarios and most likely and plausible trends
- Use local knowledge to help predict system response to changing climate
- Focus on ‘no regrets’ strategies