Integrating Pacific Northwest Aquatic Ecosystem Climate Change Preparation Efforts into Regional Planning

Coordination in a multi-sector world

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OUTLINE

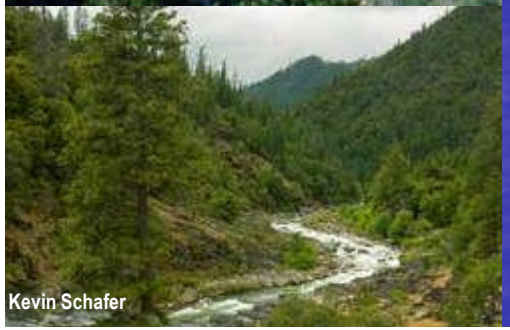
- **What we tried to integrate …and why**
- **Why we downscaled …and how we did it**
- **What the future holds for the Rogue Basin**
- **What that climate future means**
- **How we can prepare**

CLIMATE FUTURES FORUMS - PILOT BASINS

Gary Halvorson, Oregon State Archives

Gary Halvorson, Oregon State Archives

Mike Hentz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CLIMATE FUTURES FORUMS:
A Framework For Integrating Preparation Within Natural, Human, Built & Economic Systems

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A Framework For Integrating Preparation Within Natural, Human, Built & Economic Systems

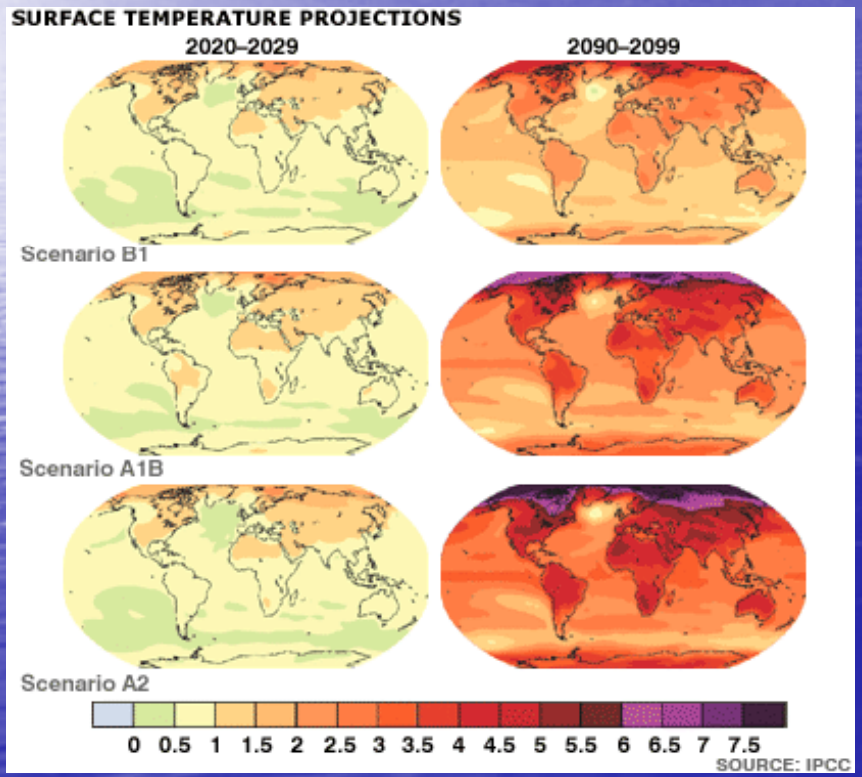
WHY DID WE TAKE THIS APPROACH?

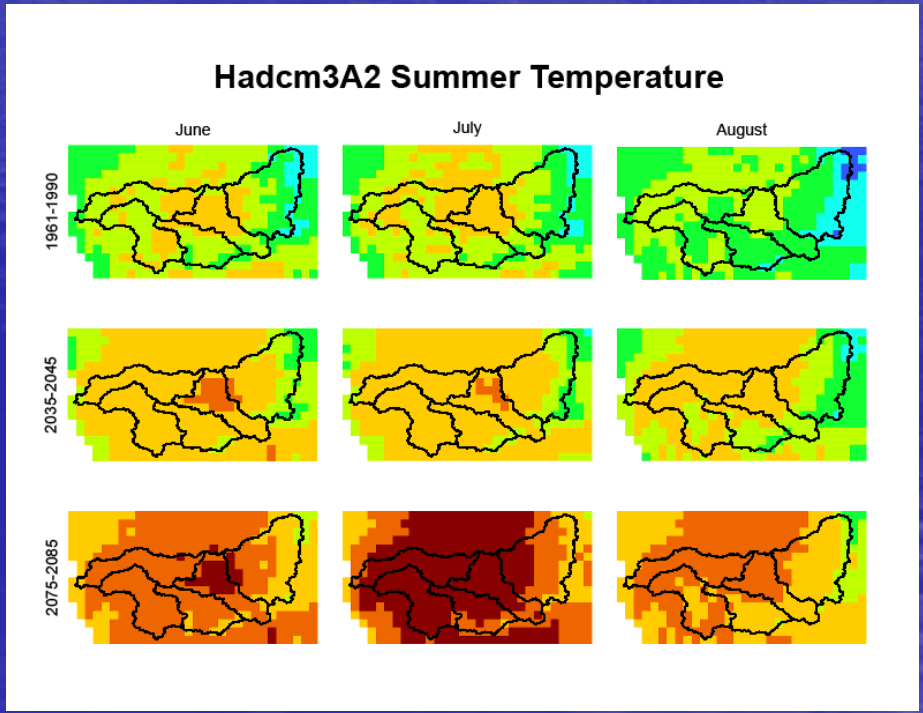
…or do we *really* have to care about the buildings & people, too

CONTEXT MATTERS!

WHY DOWNSCALE CLIMATE PROJECTIONS?

- Highlight the problems at a meaningful scale
  - Generational – mid and end century
  - Seasonal vs. annual averages
  - Spatial – basin vs. global





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- Help identify local info gaps
- Foster proactive governance

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- Engage local experts, stakeholders, and decision makers in identifying *and* implementing specific opportunities for integrated preparation

HOW DID WE DOWNSCALE?

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
United Nations

MAPSS Team
U.S.D.A. Forest Service
Pacific Northwest Research Station

- Used three Atmosphere-Ocean General Circulation Models (Australia, Japan, U.K.)
  - Based on equations rooted in laws of physics
  - Provide wide range of possible scenarios
  - Tested against observations (back-casting)
- Incorporated vegetation model (MC1)

Water vapor and ice feedbacks are difficult to model

so…

Temperature predicted more consistently than precipitation

HOW DID WE DOWNSCALE?

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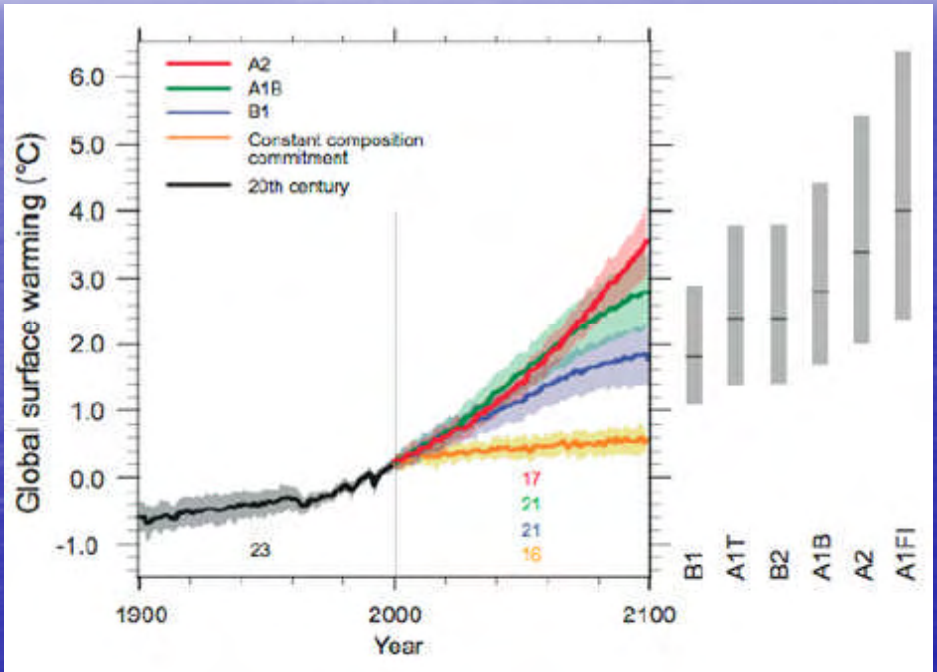
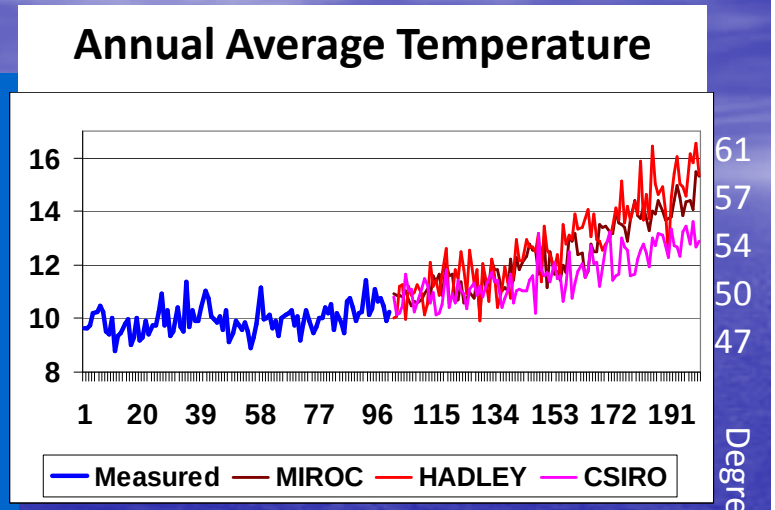


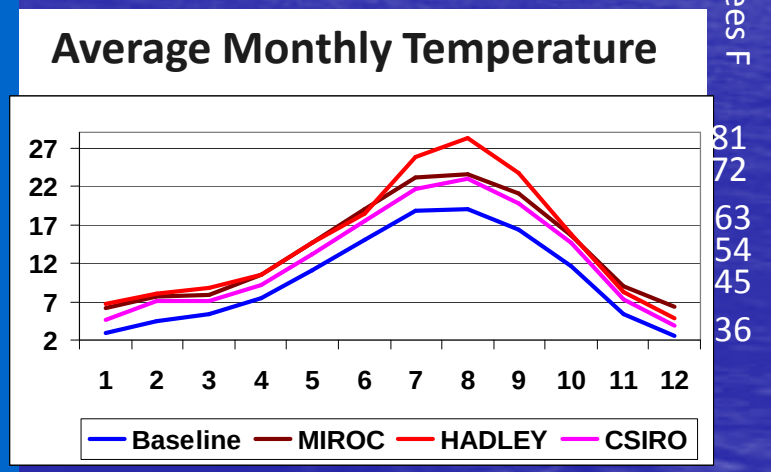
Operated AOGC Models under the 'A2" emission scenario

ROGUE RIVER BASIN

TEMPERATURE

- **Annual Average Temperatures**
  - **Up 1 to 3° F (0.5 to 1.6° C) by mid-century (~2040)**
  - **Up 4 to 8° F (2.2 to 4.4° C) by end century (~2080)**
- **Summer Temperatures**
  - **May increase dramatically**
  - **Up 7 to 15° F (3.8 to 8.3° C) above baseline by 2080**
- **Winter Temperatures**
  - **Up 3 to 8°F (1.6 to 3.3° C) Above baseline by 2080**





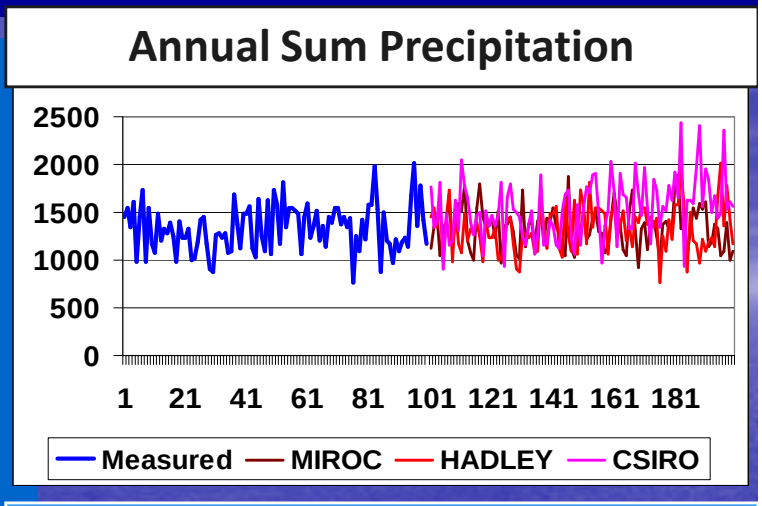
Baseline (1961-1990) vs. 2075-2085

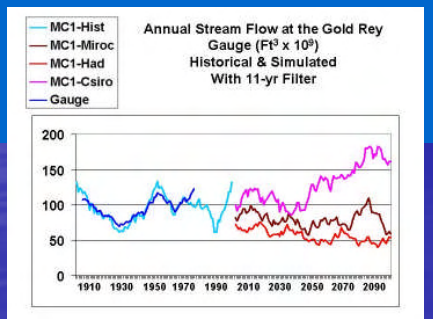
The Rogue River Basin is likely to see regional temperature increases slightly above the global average

ROGUE RIVER BASIN

PRECIPITATION AND STREAM FLOW

- Total precipitation may remain roughly similar to historical levels
- Increasingly likely to fall in mid-winter months rather than in spring, summer and fall
- Rising temperatures will cause snow to turn to rain in lower elevations
- Average January snowpack will decrease significantly
- Will produce corresponding decline in runoff & stream flows





Snowpack and Melt

HADLEY

- 75% less snow accumulation and melt by 2040
- Another 75% decline by 2080

MIROC

- 75% less snow accumulation and melt by 2040
- 50% less snow melt by 2040

CSIRO

- 25% less snow accumulation and melt by 2040
- Another 25% decline by 2080

CHANGE IN GROWING CONDITIONS

Maritime Evergreen Needleleaf (Coastal spruce and fir)

Dramatic reduction in suitable conditions
60% → None

Temperate Evergreen Needleleaf (Douglas-fir, true firs, ponderosa pine savannahs)

Essentially unchanged in suitable conditions
30% → 15-30%

Temperate Deciduous Broadleaf (Oaks, maples, ash and other deciduous trees)

Significant increase in suitable conditions
Negligible → 25-50%

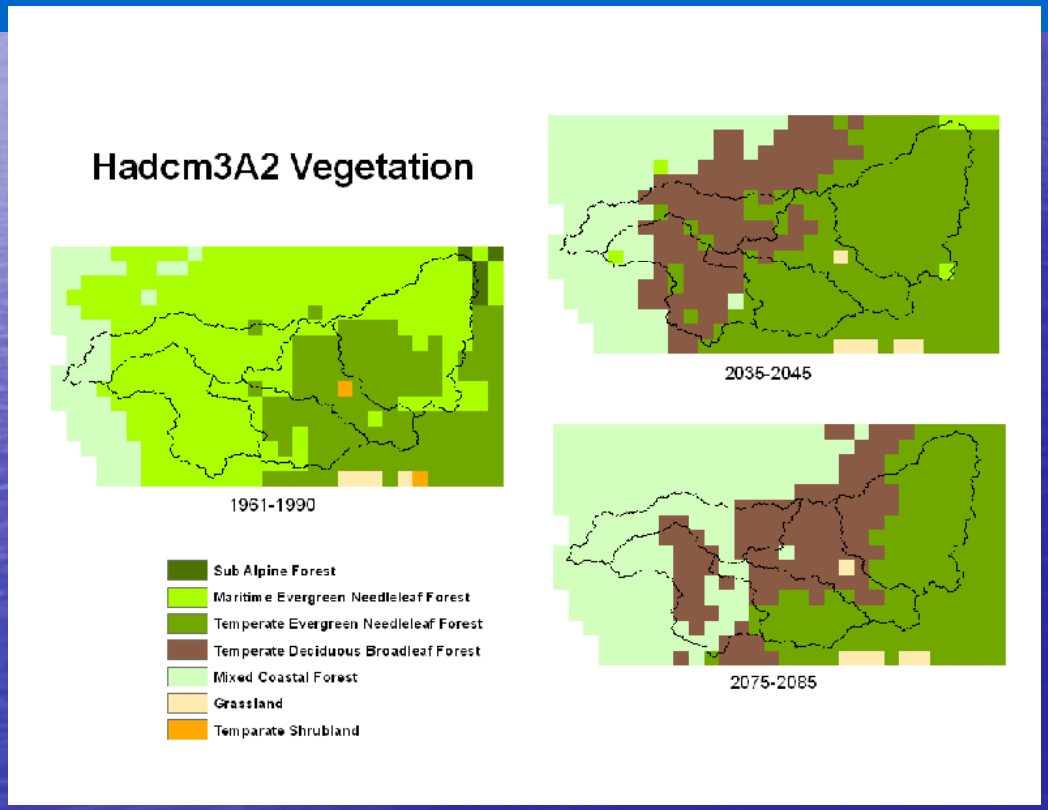
Warm Maritime Evergreen Needleleaf (Diverse mixed pines and hardwoods)

Significant increase in suitable conditions
5% → 50%

ROGUE RIVER BASIN

CHANGES TO VEGETATION PATTERNS

- **Vegetation patterns likely to change as growing conditions shift in response to temperature increases and altered precipitation patterns.**



WILDFIRE and DISEASE are likely catalysts

ROGUE RIVER BASIN

STORM, FLOODING, DROUGHT & FIRE

- The Basin is likely to experience more severe storm events, variable weather, higher and flashier winter and spring runoff events, and increased flooding.

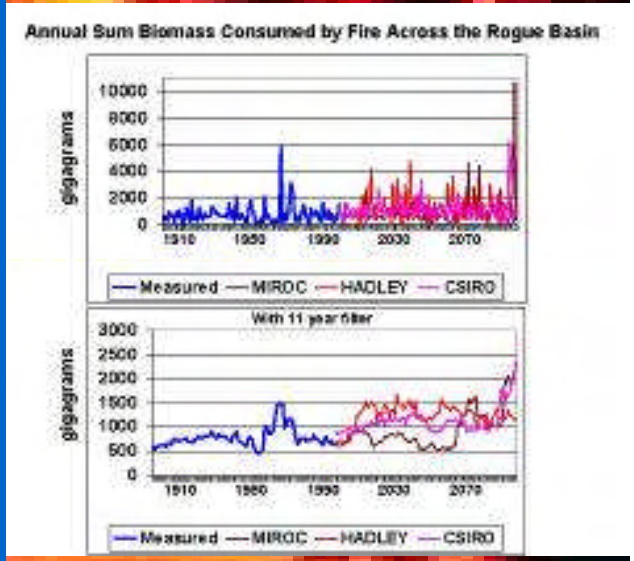
- Both wet & dry cycles are likely to last longer and be more extreme, leading both to periods of deeper drought and those of more extensive flooding.

ROGUE RIVER BASIN

STORM, FLOODING, DROUGHT & FIRE

- Reduced snowpack and soil moisture, hotter temperatures, and longer fire seasons likely will increase significantly the amount of vegetation consumed by wildfire

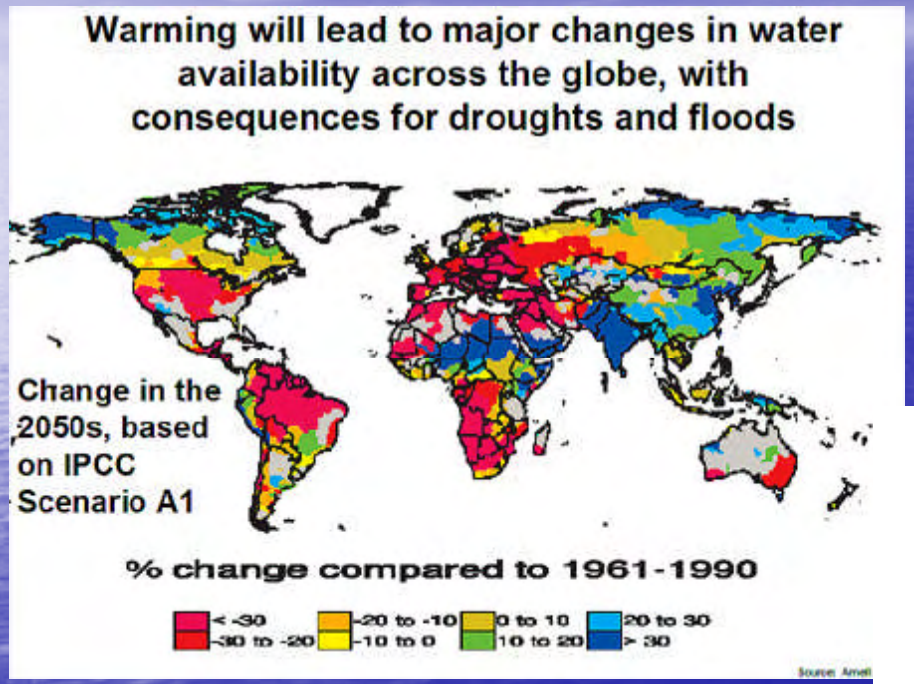
- Burned areas likely to produce sediment flows into streams and rivers following rain events

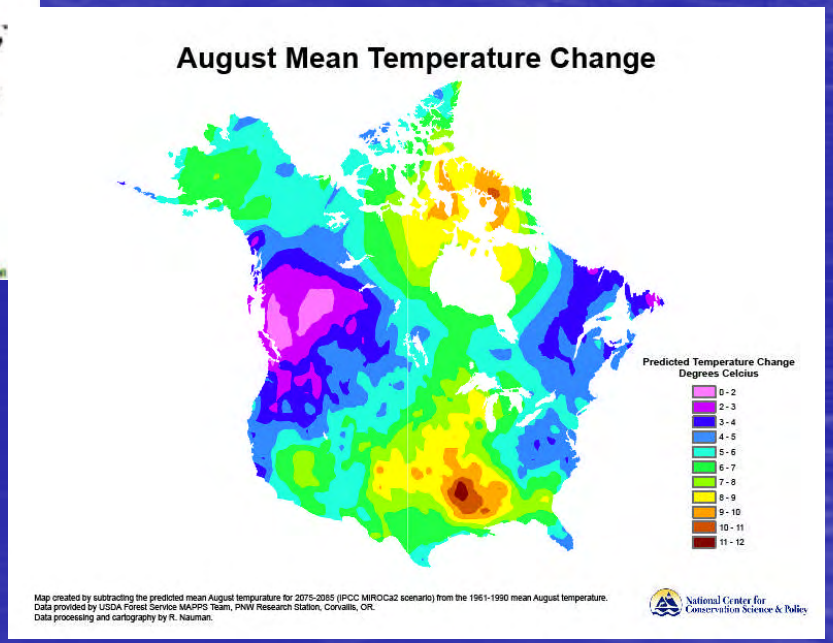


CSIRO & HADLEY: Increased fires 1st half of century

MIROC: Increased fires 1st and last thirds of century

Consequences for Natural Systems





WHAT DOES CLIMATE CHANGE MEAN FOR NATURAL SYSTEMS?

Synergisms between the effects of climate change and other stressors pose the greatest threat to the world's biodiversity

---International Panel on Climate Change 2001

MAGNIFICATION OF EXISTING STRESSORS

HABITAT LOSS/FRAGMENTATION

WATER DIVERSIONS & GROUNDWATER PUMPING

AIR & WATER POLLUTION

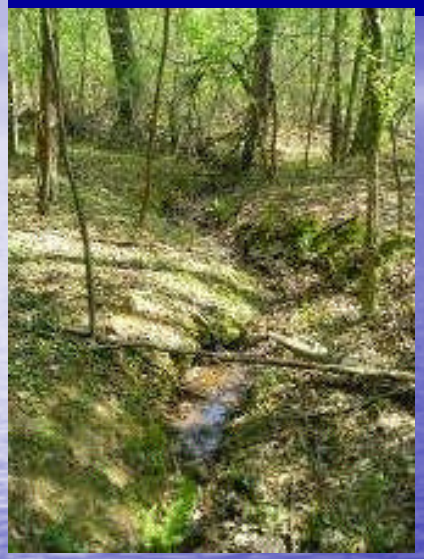
SMALL POPULATION SIZE

LOWERED GENETIC DIVERSITY

DISTURBANCE

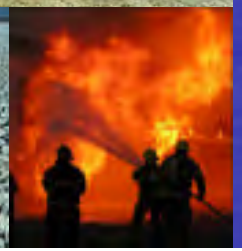
…FOR AQUATIC ECOSYSTEMS?

- Altered flow patterns



- Reduced suitable habitat

- Increased disturbance



- Compromised water quality

EXPECTED RESPONSE OF WILDLIFE

Breeding/migration phenology change

Population declines and contraction

Population increase and expansions

Changes in trophic relationships

Changes in morphology

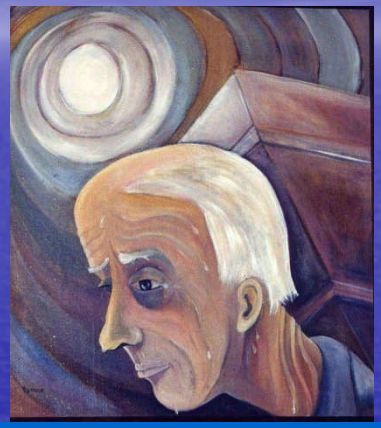
Extinction

Consequences for Built, Economic, and Human Systems

EXISTING SOCIAL/ECONOMIC STRESSORS WILL BE MAGNIFIED BY CLIMATE CHANGE

LIMITED FUNDING & PERSONNEL

SUSCEPTIBLE INFRASTRUCTURE



SUSCEPTIBLE POPULATION

FLOODING

DROUGHT

FIRE

…FOR BUILT SYSTEMS?

INFRASTRUCTURE

FREQUENT STORMS, MORE FLOODING & WILDFIRES

- **Increased disruption and direct damage to transportation systems, buildings, and real estate; possibly even larger indirect costs due to more rapid depreciation**
- **Many roads likely will be impacted, impairing movement of people during emergencies**

…FOR BUILT SYSTEMS?

ENERGY SYSTEMS

REDUCED SNOWPACK AND STREAM FLOW

- Constrained electricity from hydro systems in summer months … just as demand rises due to increased need for air conditioning
- At same time, decreased flows will stress fish and place more pressure on BPA and Pacific Power to spill for fish versus power

INCREASED FIRES, LOADS, AND TEMPERATURES

- Likely to pose increased stress on power lines

…FOR ECONOMIC SYSTEMS?

FORESTRY AND AGRICULTURE

DROUGHT STRESS

- Forest products may further shift to smaller diameter logs … due to increased thinning for "forest health" and to supply new biomass energy or alternative forest products

DECREASED WATER AVAILABILITY/INCREASED TEMPS

- Agriculture will face increased competition between in-stream and municipal users for available water supplies
- Rising temperatures are likely to require more water and/or a shift in crop types and farming practices
- Crops have temperature limits above which they are stressed and can diminish or die

…FOR ECONOMIC SYSTEMS?

AGRICULTURE – TEMPERATURE & GHGs

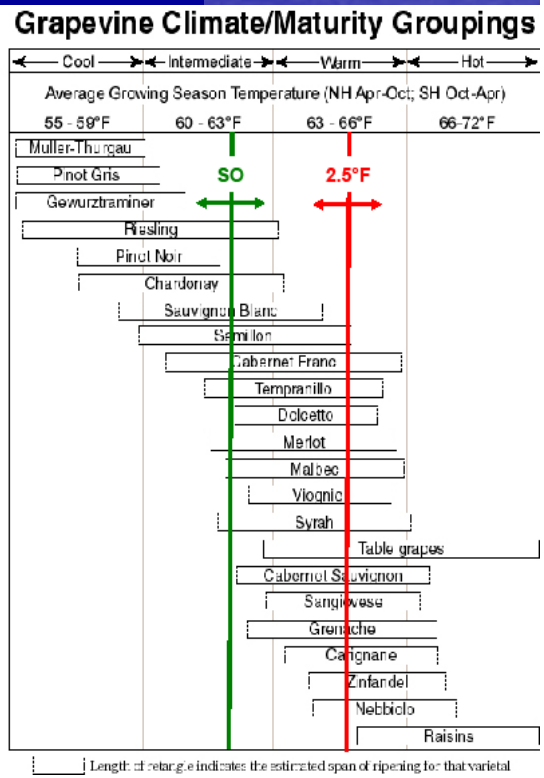
- Suitable locations for certain crops may move north (100 miles in 50 years for grapes) and uphill
- The 4 to 8° F temperature increase now projected by 2040s likely to displace "Brand Oregon" Pinot Noir grapes from Southern Oregon
- Increase in CO_2 levels favors weedy, invasive species

Predicted Changes for:

Willamette Valley

Eastern Oregon

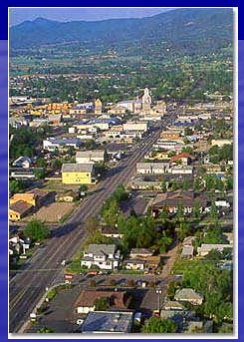
Southern Oregon



…FOR ECONOMIC SYSTEMS?

MANUFACTURING, RETAIL AND SERVICE SECTORS

- Likely to see higher fuel and electrical costs due to reduced summer output from the BPA hydroelectric system
- Disruptions in supply chains and the distribution of goods due to increased storm events, flooding, and fires
- Increased workforce health concerns
- Winter recreation such as skiing and snowmobiling will be reduced as snowpack decreases



…FOR HUMAN SYSTEMS?

EMERGENCY SERVICES & PUBLIC HEALTH

STORM EVENTS, FLOODING, WILDFIRE

- Demands for emergency services are likely to increase --- but the funding needed to support them may be difficult to obtain

SUMMER TEMPERATURES & SMOKE

- Rising summer temperatures will likely increase the incidence and intensity of heat-related illnesses, heart disease and vector- and water-borne diseases such as Lyme disease and West Nile virus
- Rising temperatures and increased smoke from wildfires are likely to increase the incidence of asthma

Recommendations

Efforts to prepare *natural* , *economic*, *built*, and *human* systems for the now unavoidable consequences of climate change must become a priority.

ROGUE FUTURES FORUM

WHAT SHOULD BE DONE?

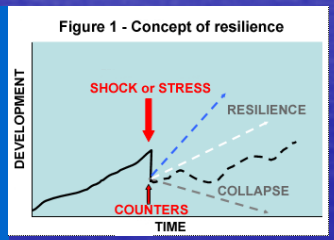
BUILDING RESISTANCE

Pushing back against the effects of climate change

+

BUILDING RESILIENCE

Bouncing back and recovering from climate change impacts



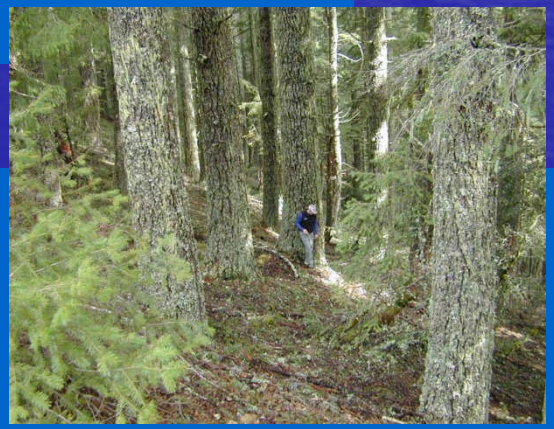
PREPARATION

Getting ready for climate changes

…TO PREPARE NATURAL SYSTEMS

Restore/Maintain Critical Landscapes

- *Aquatic Systems*:
  - Floodplains
  - Tributary junctions
  - High elevation riparian areas
  - North-facing streams
  - Reaches with gravels and topographic complexity
  - Cool-water pools



- *Terrestrial Systems*:
  - Intact habitats
    - Old growth/mature forests
    - Unroaded areas
    - Migration corridors

Think "structure & function" as well as longitudinal & latitudinal connectivity

…TO PREPARE NATURAL SYSTEMS

Protect Genetic Diversity

- *Aquatic*: manage to protect "weak" stocks of salmon and steelhead
- *Terrestrial*: manage to protect viability

Protect/Restore Ecosystem Services

- Identify, protect, and restore areas that provide critical support and help to:
  - Moderate flood and drought
  - Supply clean water
  - Support recreational and economic opportunities

EASY CHOICES – HARD CHOICES

HABITAT

- Protect
- Restore
- Reconnect

- Rehabilitate

SPECIES

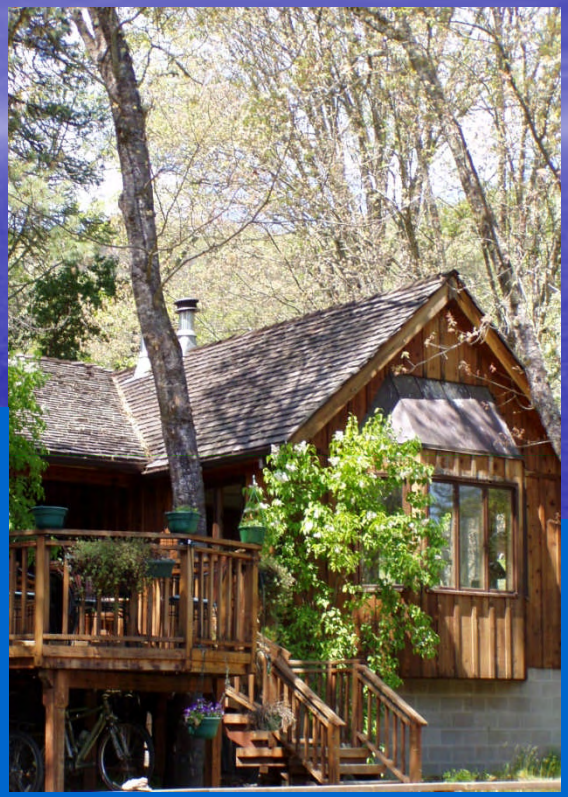
- Conserve
- Recover

- Document Extirpation/Extinction
- Maintain "Zoo" Population
- Translocate

…TO PREPARE HUMAN SYSTEMS

- Upgrade vector control programs for emerging diseases
- Strengthen and expand water quality protections
- Anticipate climate-induced health service needs and provide them to the most vulnerable populations

...TO PREPARE BUILT SYSTEMS



- Concentrate human populations in less risky areas
- Redirect cost of emergency services to those that choose to locate in high risk areas
- Link public transportation systems to facilitate movement in emergency situations

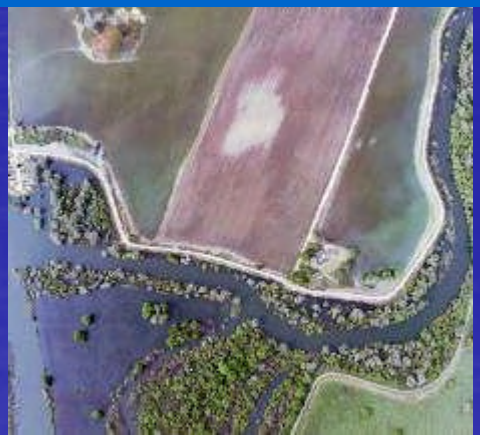
…TO PREPARE ECONOMIC SYSTEMS

- **Link climate preparation with economic development (e.g., job creation through fuels reduction aimed at establishing defensible space around homes in the U-W interface)**
- **Re-examine the surface water allocation system and groundwater use to eliminate over-appropriation**
- **Expand the use of on-site renewable energy systems**
- **Expand energy/water conservation & efficiency**
- **Expand sustainable agricultural practices; initiate agricultural research into new crops and markets in advance of the need to transition to new products**
- **Identify ways to expand tourism to shoulder seasons**

PREPARE THE LAND TO HELP

Functional Floodplains Serve As a Sponge
(Floodplains soak up "flood waters" *and* release them slowly)

Constrained Floodplains Exacerbate the Effects of Floods *and* Droughts



PREPARE THE LAND TO HELP

BENEFITS ACCRUE ACROSS ALL SYSTEMS:

HUMAN

BUILT

ECONOMIC

NATURAL

CHANCE FAVORS A PREPARED MIND

…….Louis Pasteur