Buying Time in a Warmer Climate: From Restoration to Resilience

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UWBG 2018 Restoration Symposium: Restoration in a Changing Climate
No laughing matter, yet humor inspires climate change activism

Date: March 1, 2018

Source: Cornell University

Summary: Melting icecaps, mass flooding, megadroughts and erratic weather are no laughing matter. However, a new study shows that humor can be an effective means to inspire young people to pursue climate change activism.
New Climate Change Study Just 400 Pages Of Scientists Telling Americans To Read Previous Climate Change Studies

1/14/15 8:42am • SEE MORE: SCIENCE & TECHNOLOGY
Drinking from the data fire hose
No, we don’t need more research

At least not for restoration and climate-informed management and planning
It’s time to change the paradigm from **restoration** to **resilience ecology**
“It’s time to change the paradigm from restoration to resilience ecology”

“We need to embrace change, not resist it, in order to help ecological systems remain viable and adaptable in a warmer climate.”

Don Falk, Univ. Arizona
First director of SER
Our Mission

SER advances the science, practice, and policy of ecological restoration to sustain biodiversity, improve resilience in a changing climate, and re-establish an ecologically healthy relationship between nature and culture.
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Changing the paradigm: Resilience ecology

Old concepts

- Equilibrium
- Linear succession
- Natural (historic) range of variation
- Species as management targets
- Small-scale projects
Changing the paradigm: Resilience ecology

New concepts

- Equilibrium
- Linear succession
- Natural (historic) range of variation
- Species as management targets
- Small-scale projects
Changing the paradigm: Resilience ecology

New concepts

• Non-equilibrium, dynamic systems
• Linear succession
• Natural (historic) range of variation
• Species as management targets
• Small-scale projects
Changing the paradigm: Resilience ecology

New concepts

- Non-equilibrium, dynamic systems
- Multiple trajectories
- Natural (historic) range of variation
- Species as management targets
- Small-scale projects
Changing the paradigm: Resilience ecology

New concepts

- Non-equilibrium, dynamic systems
- Multiple trajectories
- Future range of variation
- Species as management targets
- Small-scale projects
Changing the paradigm: Resilience ecology

New concepts

- Non-equilibrium, dynamic systems
- Multiple trajectories
- Future range of variation
- Structure and function as targets
- Small-scale projects
Changing the paradigm: Resilience ecology

New concepts

• Non-equilibrium, dynamic systems
• Multiple trajectories
• Future range of variation
• Structure and function as targets
• Large-scale projects (linked if possible)
CONTEXT
U.S. Drought Monitor

August 25, 2015
(Released Thursday, Aug. 27, 2015)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

<table>
<thead>
<tr>
<th>Current</th>
<th>None</th>
<th>D0-D4</th>
<th>D1-D4</th>
<th>D2-D4</th>
<th>D3-D4</th>
<th>D4</th>
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<td>0.00</td>
<td>100.00</td>
<td>100.00</td>
<td>99.99</td>
<td>64.64</td>
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<tr>
<td>Last Week</td>
<td>0.00</td>
<td>100.00</td>
<td>100.00</td>
<td>99.99</td>
<td>50.80</td>
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<tr>
<td>3 Months's Age</td>
<td>9.77</td>
<td>90.23</td>
<td>51.81</td>
<td>23.76</td>
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<tr>
<td>Start of Year</td>
<td>51.87</td>
<td>43.13</td>
<td>36.15</td>
<td>14.83</td>
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<tr>
<td>Start of Water Year</td>
<td>34.22</td>
<td>65.78</td>
<td>40.27</td>
<td>20.17</td>
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<tr>
<td>One Year Age</td>
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<td>67.33</td>
<td>40.32</td>
<td>19.99</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Intensity:
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Anthony Artusa
NOAA/NWS/NCEP/CPC

http://droughtmonitor.unl.edu/
The 2015 drought in Washington State: a harbinger of things to come?

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Keywords: drought, climate change, fire risk, hydrology

Supplementary material for this article is available online

Abstract
Washington State experienced widespread drought in 2015 and the largest burned area in the observational record, attributable in part to exceptionally low winter snow accumulation and high summer temperatures. We examine 2015 drought severity in the Cascade and Olympic mountains relative to the historical climatology (1950–present) and future climate projections (mid-21st century)
It’s official: Seattle breaks record for most consecutive days without rain

Originally published August 9, 2017 at 7:06 am | Updated August 9, 2017 at 1:37 pm

A haze continues to hang over Seattle, as viewed Monday from Kerry Park on Seattle’s Queen Anne Hill. (Ken Lambert / The Seattle Times)

Also, the city's air quality is at unhealthy levels as of Wednesday morning, according to the Department of Ecology.
Global temperature trend

Global Land and Ocean Temperature Temperature Anomalies, March

2016 – record high
2017 – second hottest
2015 – third hottest
2010 – fourth hottest

Source: https://www.ncdc.noaa.gov/cag/time-series/global
Cumulative Drought Severity Index

From U.S. Forest Service drought gallery
Snowpack is decreasing

Snow-water equivalent
1955-2016

Mote et al. 2018
Snowpack is decreasing

Snow-water equivalent
1955-2016

Snow-dominant watersheds

Rain-dominant watersheds

Mote et al. 2018
Mountain pine beetle outbreak since 1990

50 million acres
Wildfire area burned since 1984

Animation by R. Norheim
Washington wildfires — 2015

- 1,541 fires
- 1 million acres burned (387,000 acres in 2014)
- $253 million fire suppression cost
- Large economic losses in rural communities
Interacting disturbances

Map by R. Norheim
FUTURE
Projected temperature in Pacific Northwest

Abatzoglou et al. 2013
Projected summer water-balance deficit

From McKenzie & Littell (2017)
Map by R. Norheim
Wildfire area burned, 2050

In the Northwest, annual area burned will be 2-3 times higher.

From J. Littell
Extreme weather and disturbances will overwhelm gradual changes in ecosystems.
Extremes matter

Frequency, extent, and severity of disturbances may be affected by climate change, altering the mean and **variability** of disturbance properties.

![Graph showing distribution of disturbance properties](image)

A shift of 1 standard deviation changes a 1 in 40 yr event to a 1 in 6 yr event.

A shift in **distribution** of disturbance properties has a larger relative effect at the **extremes** than near the mean.

It’s all about the tail!
How can we manage for resilient systems in a warmer climate?
Vulnerability assessment

- Analysis of the extent to which a species, habitat, or ecosystem is susceptible to being altered by climate change
- Positive, negative, or neutral effects are based on human values
- Qualitative or quantitative
- Three components: sensitivity, exposure, adaptive capacity
Vulnerability assessment

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

Climate Change Vulnerability and Adaptation in the North Cascades Region, Washington
Vulnerability assessment: Fish and aquatic habitat

Gifford Pinchot National Forest

2000s
Vulnerability assessment: Fish and aquatic habitat

Gifford Pinchot National Forest

2000s

2080s
A straightforward approach for risk assessment/management

• Are there challenges to meeting the objectives because of climate change?
• How does the project activity need to be revised when considering climate change?
• How do new or revised approaches compare in effectiveness and feasibility to the proposed activity?
Project goal: Maintain functionality of riparian areas in dry forest

Challenges

- Increased fire risk in riparian areas
- Increased summer drought stress and risk of mortality

Climate-informed actions

- Reduce forest density and surface fuels
- Increase diversity of shrubs and trees
RESILIENCE ECOLOGY: CONCEPTS AND PRACTICES
STRATEGY
Increase landscape diversity

Diversify spatial distribution of vegetation age and structure

Orient the location of treatments in large patches to modify spread of disturbances.

Example: Implement thinning and fuel treatments across large landscapes.
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STRATEGY
Reduce non-climate stressors

Detect and eradicate non-native plant species.

Encourage rapid plant establishment after wildfire.

Keep cattle out of riparian areas.

Manage roads to reduce erosion.
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STRATEGY
Be thoughtful and flexible with genetic guidelines

Douglas-fir seed zone map
STRATEGY
Plan for additional maintenance and monitoring
STRATEGY
Implement risk assessment

Quantify or at least estimate the effects of climate change on natural resources.
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Implement risk assessment

Quantify or at least estimate the effects of climate change on natural resources.

Use risk assessment to guide adaptation responses (risk management).
In summary — What to expect

• **High certainty**: Higher temperature, more wildfire, less snowpack, less water in summer

• **Less certainty**: Distribution and abundance of vegetation, effects on wildlife habitat

• **Extreme events** (drought, wildfire, floods) will have the biggest effects on ecosystems.

• Things may change quickly after 2050.

• There will be surprises.
In summary — What can be done

• Implications of climate change for restoration: mostly fine tuning
• Manage for 30 years from now: warmer temperatures, higher extremes.
• Diversify species, genotypes, and spatial patterns.
• Implement risk assessment and risk management.
• Monitor, learn, and adjust as needed.
The best time to plant a tree was 20 years ago

The second best time is today
The best time to plan for climate change was 20 years ago

The second best time is today