Pathways and Pollinators:
Planting the Seeds of Regional Resiliency

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Threatened and Endangered plants in US

- 939 T&E species
- ~5% of US plant species
- 20% of plants in US are non-native

IUCN Red List

- 13,661 near threatened to extinct
- ~4% of world plant species
Harrison et al., 2010. *Ecology.*
Climatewizard.org, average annual temperature change by 2080s
Solastalgia

• Ecological mourning and grief
• Existential distress caused by environmental change, such as mining or climate change.
  – Glenn Albrecht, 2003
• From grief can come action
Legend

- Floodplain Forest Reforestation III
- New Channel Riparian Restoration
- Turtle Ponds
- Plant Establishment
- Restoration Areas 2002 - Present

USFS Sandy River Delta (1500 ac)
Columbia River Gorge National Scenic Area
• Diversity (richness)
  – genetic, species, habitats
• Connectivity
  – In space and time
• Novel communities
  – Assisted migration
  – New native assemblages
• Restoration for ecosystem service
  – e.g. pollinators, resilience, connectivity
Diversity is the spice of life
Diversity-Stability Hypothesis

Jena Experiment
Scherber et al. 2010.
Bottom-up effects of plant diversity on multitrophic interactions in a biodiversity experiment. *Nature*. 

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**Abundance**

**Species richness**

<table>
<thead>
<tr>
<th>Aboveground</th>
<th>Belowground</th>
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</thead>
<tbody>
<tr>
<td><img src="image1" alt="Graph A" /></td>
<td><img src="image2" alt="Graph C" /></td>
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<tr>
<td><img src="image3" alt="Graph B" /></td>
<td><img src="image4" alt="Graph D" /></td>
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</tbody>
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Standardized organism abundance or diversity

Plant species richness
Diversity can be restored. But what about when the climate changes?
Types of assisted migration: Willamette daisy

- Within historic range
- Within ecoregion
- Beyond ecoregion
Types of assisted migration: Golden paintbrush

- Within historic range
- Within ecoregion
- Beyond ecoregion
Do genetics really matter?
Wyoming Big Sagebrush from 13 Locations Planted in Glenns Ferry, ID in 1987-2010

Mean: 38%

From: Sands, Alan, and Ann Moser. 2013. ID Fish & Game Report
How do we restore diversity?
Restoration tools

- Fire
- Mow/hay
- Livestock grazing
- Herbicide
- Solarization/tilling
- Nutrient changes
Novel Ecosystems

• “Novel ecosystems ... result when species occur in combinations and relative abundances that have not occurred previously within a given biome.”
  – Novelty
  – Human agency

Hobbs et al., 2006. *Global Ecology and Biogeography.*
Novel/Contemporary Ecosystem
Designer communities: from robust natives

<table>
<thead>
<tr>
<th>Species</th>
<th>Frequency (%)</th>
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<tbody>
<tr>
<td>Luzula multiflora</td>
<td>45.1</td>
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<tr>
<td>Achillea millefolium</td>
<td>33.2</td>
</tr>
<tr>
<td>Brodiaea congesta</td>
<td>29.2</td>
</tr>
<tr>
<td>Ranunculus occidentalis</td>
<td>25.1</td>
</tr>
<tr>
<td>Galium aparine</td>
<td>24.7</td>
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<tr>
<td>Lotus micranthus</td>
<td>21.4</td>
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<tr>
<td>Calochortus tolmiei</td>
<td>20.0</td>
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<tr>
<td>Bromus carinatus</td>
<td>19.0</td>
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<tr>
<td>Toxicodendron diversilobum</td>
<td>18.3</td>
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<tr>
<td>Rubus ursinus</td>
<td>13.2</td>
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<tr>
<td>Zigadenus venenosus</td>
<td>12.9</td>
</tr>
<tr>
<td>Symphyotrichum hallii</td>
<td>12.5</td>
</tr>
<tr>
<td>Plectritis congesta</td>
<td>12.2</td>
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<tr>
<td>Lomatium utriculatum</td>
<td>11.9</td>
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<tr>
<td>Iris tenax</td>
<td>10.8</td>
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## Restoration for pollinators

<table>
<thead>
<tr>
<th>Diversity of plants</th>
<th>Nesting substrates</th>
<th>Landscape context (current and future)</th>
</tr>
</thead>
</table>

### Habitat restoration
Pollinators are diverse

Bumblebee  Solitary bee  Flower fly

Butterfly  Bee fly  Bumble flower beetle
Restoring prairie for pollinators: Manage for insect life cycles

1. Plant diversity supports insect diversity
2. Nesting substrates
3. Connectivity and adjacent habitats
4. Manage with fire, mowing, herbicide, etc.
Diversity: continuous floral resources

*Bloom time will vary with site and weather conditions*

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elegant calicoflower</td>
<td><em>Downingia elegans</em></td>
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<tr>
<td>Fragrant popcornflower</td>
<td><em>Plagiobothrys figuratus</em></td>
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<tr>
<td>Strawberry</td>
<td><em>Fragaria virginiana</em></td>
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<tr>
<td>Sea blush</td>
<td><em>Plectritis congesta</em></td>
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<tr>
<td>Meadow checker-mallow</td>
<td><em>Sidalcea campestris</em></td>
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<tr>
<td>Self-heal</td>
<td><em>Prunella vulgaris</em></td>
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<tr>
<td>Puget Sound Gumweed</td>
<td><em>Grindelia integrifolia</em></td>
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<tr>
<td>Hall's aster</td>
<td><em>Symphyotrichium hallii</em></td>
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<tr>
<td>Oregon Sunshine</td>
<td><em>Eriophyllum lanatum</em></td>
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Manage for Nesting Resources

- Ground nest
- Hollow stem (e.g., *Megachile*)
- Cavity (Eusocial bees)
- Old nests – Pre-existing burrows
- Shells (e.g., snail shells)
Connectivity and adjacent habitats
Connectivity and adjacent habitat: Site quality and connectivity matter

• Diversity
  – genetic, species, habitats
• Connectivity
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