Ecological Approach to Design and Restoration of Montane Meadows in the Sierra Nevada

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Overview

1. Traditional restoration approaches for meadows
2. Design criteria for meeting ecological goals
3. Ecological restoration approaches
High Gradient Meadows
Stage zero systems — (Cluer and Thorne 2014)
- Complex habitat structure
- Shifting habitat mosaic, dynamic change over time

Low Gradient Meadows
- Water Storage
- Carbon Storage
- Wetland Habitat
“ecosystem functions did not improve at pond-and-plug restoration sites relative to nearby unrestored meadows” (Pope et al., 2015)
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Source Problems or Symptoms?

Connectivity – Transfer of materials between system components (Wohl et. al., 2018)
Ecological Restoration

Relaxing human constraints on natural development of patterns of diversity. NOT focus on directly recreating natural structures or states but on reestablishing the conditions under which natural states create themselves (Palmer et. al, 2005)

Process-based Restoration

Correct anthropogenic disruptions to stream-floodplain processes, such that ecosystem recovery progresses along a recovery trajectory with minimal corrective intervention (Beechie et al. 2010).

A dynamic ecological endpoint initially guides the restoration. Address the root causes of degradation.
Design Criteria
“Vehicle for transfer of science into practice”
(Miller and Skidmore 2001)

1. How will the project be undertaken?
2. What will it achieve?
Engineering Design Criteria for Eco-Process Based Stream Restoration
(US Fish and Wildlife Service, 2018)

1. Space
2. Time
3. Energy
4. Material

Source: Michael Baker Corporation; Photo by Will Harman
SPACE Criterion

Stream Evolution Corridor Analysis integrates:

- Erodible Corridor
- Channel migration zone
- Geomorphic recovery analysis

Delineate

- Fluvial process space
- Channel migration zone
- Immediate hillslopes tribs
- Confluences
- Geomorphic features
- Infrastructure
- Disconnectivity
- Land management (e.g. grazing)

“Relax Constraints”
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“Relax Constraints”
Yellow Creek
2 year flood event
24 hrs
4400 ga diesel fuel
149 days of backhoe operation
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24 hrs
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**Material**

**Degrading**

**Recovered**

**Recovered?**

**TIME**

**TIME**

**Recovered Trajectory**

**Recovery Trajectory**
“Relaxing Constraints”

Sun Creek (Klamath Basin)

- Instream flow
- Infrastructure
- Cattle management

Figure 3. Pre-project and 2017 project conditions, including land ownership boundaries, management structures, and stream and irrigation networks, in Sun Creek, Oregon.
“Relaxing Constraints”

Sun Creek (Klamath Basin)

- Instream flow
- Infrastructure
- Cattle management

Figure 3. Pre-project and 2017 project fish screens and irrigation networks, in Sun Creek.
Address Source Problems
Assume Process Will Work

Restoration Design Pathway

Initial Habitat

Ecosystem Recovery

Process Based Restoration

Constructed Habitat

Fryirs et al., 2016
*Assessing the Geomorphic Recovery Potential Rivers*
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