What It Takes to Test Hypotheses Concerning Ecosystem Restoration and Species Recovery

CEER – Evidence Based Evaluation

New Orleans; July 29, 2014

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ESSA Technologies Ltd., Vancouver B.C.
Key points

1. Testing ecosystem restoration hypotheses needs **rigorous** adaptive management (AM) experiments.

2. Technical **and** institutional feasibility of rigorous AM decreases with spatial scale.
   - *difficult* when river basin size > 100,000 km²
   - *impossible* when river basin size > 250,000 km² ??

3. AM / restoration / recovery success most likely with <15 people involved in making key decisions
What is Adaptive Management (AM)?

a rigorous approach for designing and implementing management actions

  to

maximize learning about critical uncertainties that affect decisions

while simultaneously

striving to meet multiple management objectives
What technical and institutional factors enable or inhibit AM?
Can we detect the effects of restoration actions in the presence of confounding factors?
Technical Feasibility of AM Experiments

- How many years to test hypotheses?
  - Farm Plots
  - Stream Reaches / Forest Stands
  - Single Salmon Stocks (CU)
  - Large River Basins
  - Global climate change

- How easy to replicate treatment / controls?
  - Easy
  - Difficult
  - Impossible

- Increasing # of entities & value conflicts, system inertia

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Scales map of Trinity AM Experiment

How many years to test hypotheses?

How easy to replicate treatment / controls?

- Flow-Temp
- Sediment & Riparian margin
- Channel Rehab Sites
- Fry prod’n
- Adult Salmon prod’n
- Smolt prod’n
- Turtles
- Frogs
- System-wide habitat

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Key Institutional Factors Enabling AM

- Problem Context / Trust
- Leadership
  - Executive Direction
  - Problem Definition
  - Communication
  - Organizational Structure
- Community Involvement
  - Planning
  - Funding
  - Staff Training
  - AM Science

6 river basin AM studies

- Okanagan (BC, WA)
- Columbia (BC, WA, OR, ID, MT)
- Platte (NE, WY, CO)
- Trinity (CA)
- Russian (CA)
- Rio Grande (CO, NM, TX, Mexico)
Basin areas span 3.3 orders of magnitude.
Russian River Basin (4000 km²)

- **Context:** 2 Dams, water supply & flood control for 600,000 people in Santa Rosa area (wine country)

- **Executive Direction:** 2008 Biological Opinion on CA coho and steelhead (7 yrs negotiation)

- **Leadership:** NMFS, Sonoma County Water Agency (SCWA)

- **AM:** Create 6 miles of low velocity, coho rearing habitat in Dry Ck ($50M) from 2008-2023 or build a pipeline ($100M)
Russian R - AM Actions and Evaluation

- Low Velocity Backwater Pools, Alcoves Side Channels
- Monitoring of physical habitat suitability, spawning, rearing, fish movement (PIT-tags), smolt production (RST)
- **Incremental AM** implementation of 1-mile reach restorations

Greg Koonce, Inter-fluve
Gregg Horton, SCWA

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Trinity River (7500 km²)

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Trinity River Restoration Program
Trinity River

- **Context:** 90% Trinity R flow diverted to Sacramento R, Chinook ↓, 11 lawsuits over tribal trust (~15 yrs negotiation)

- **Executive Direction:** 2000 Record of Decision (AM)

- **Leadership:** US Bureau of Reclamation, USFWS, Hoopa & Yurok tribes, USFS

- **AM:** Restore habitat forming processes in top 40 miles by flow scheduling, adding gravel, channel rehabilitation (~$10M/yr)
Trinity R - AM Actions and Evaluation

Trinity River Restoration Program
Trinity

47 bank rehabilitation sites

Trinity River Restoration Program
Recent trends in Trinity R natural fall Chinook smolts and spawners

- B. Pinnix, USFWS, Arcata CA
- W. Sinnen, CDFW, Arcata CA
Okanagan Basin (21,000 km²) Sockeye
Okanagan River Sockeye

- **Context:** Sockeye, kokanee, flooding, agriculture. First Nations focused on sockeye.
- **Executive Direction:** FERC licenses PUD dams; require mitigation; best opportunities in Canada (~2-3 yrs negotiation)
- **Leadership:** Okanagan FN, DFO, BC MOE, PUDs
- **AM:** Fish Water Management Tool (FWMT), Re-introduction of sockeye into Skaha lake, habitat restoration
Total Columbia R Sockeye Adult Returns 1970 - 2011

Preseason Forecast
Observed Returns
Mean Returns 1970-2007

FWMT & Skaha Re-intro projects begin in 2003.

Kim Hyatt, DFO
Factors Contributing to Rebuilding of Okanagan Sockeye Salmon Since 2000

1. Revised escapement objectives
2. FWMT “fish friendly” flows reduce density independent mortality, and mitigate oxygen-temperature “squeeze” in Osoyoos Lake
3. Supplemental production of hatchery-origin sockeye from Skaha Lake (< 10% returns)
4. Improvements for juvenile fish-passage in Columbia R
5. Improved ocean survival for southern sockeye stocks
Platte River (221,000 km²)

Platte River Recovery Implementation Program

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Platte River

• **Context:** Endangered whooping cranes, least terns, piping plovers; water users vs ESA

• **Executive Direction:** USFWS
  ESA Biological Opinion, Settlement Agreement, AM Plan (20 years!)

• **Leadership:** Governance Committee (NE, CO, WY); USFWS; USBR; NGOs

• **AM:** 13-yr plan to test 2 ways of creating habitat: in-river and off-channel in sand pits, have bought 10,000a land
• **Context:** 92 dams, Endangered Chinook and steelhead

• **Executive Direction:** NMFS Biological Opinions (20+ years)

• **Leadership?:** NMFS, USFWS; USBR; BPA NGOs, NPCC, State and Tribal fish agencies

• **AM:** well-designed habitat restoration projects; hard to change hydro & hatchery operations
Spill increases Snake River Chinook smolt to adult survival rates (PIT-tags)

Smolt to adult survival rate

- Positive PDO (poor survival)
- Neutral PDO (intermediate survival)
- Negative PDO (good survival)

USFWS, Comparative Survival Study
Rio Grande (870,000 km²)

- **Context:** Endangered silvery minnow, SW willow flycatcher vs. agriculture
- **Executive Direction:** USFWS ESA Biological Opinion (but no AM)
- **Leadership?:** Middle Rio Grande Collaborative Pgm
- **AM:** *V1 Plan* but no action; due to lack of flexibility in dam operations, very limited water and extremely litigious environment
# My Basin Report Card

<table>
<thead>
<tr>
<th>Factor</th>
<th>Russian (4,000)</th>
<th>Trinity (7,500)</th>
<th>Okanagan (21,000)</th>
<th>Platte (220,000)</th>
<th>Columbia (660,000)</th>
<th>Rio Grande (870,000)</th>
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<tr>
<td>Problem Context/Trust</td>
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<td>D</td>
<td>A</td>
<td>B-</td>
<td>C</td>
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<td>Overall AM Grade</td>
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<td>B-</td>
<td>A</td>
<td>A-</td>
<td>C</td>
<td>D+</td>
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What insights apply to other large scale ecosystem programs?

1. Map out both technical *and* institutional feasibility of testing a small number of key restoration hypotheses.
2. Recognize scale challenges and manage expectations.
3. Use nested spatial scales and smaller AM experiments as proof of concept tests; then scale up.
For more information

Applying decision analysis to AM / species recovery:


Factors enabling / inhibiting rigorous AM

