Coping with uncertainty and change: Research, Monitoring and Adaptive management in Ecosystem-scale Restoration

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Today’s roadmap

• The Ideal: The adaptive management framework
• The real: the Exxon Valdez Oil Spill Restoration Program for pink salmon
Large oil spill
Returning Adults

Wild stock

Hatcheries

Spawning

Overwintering

1 fry in 1500

Every fry

OIL
Wild stock streams

Hatcheries

Plankton food

Predation

OIL

Early marine fry

Maturation in Gulf of Alaska

ABUNDANT SPRING ZOPLANKTON

- More food: faster growth, less time as prey
- Other fish prey: less predation on salmon
- Better sheltered habitats
- Good Year Class

WEAK SPRING ZOPLANKTON

- Less food: slower growth, more as prey
- Less alternative prey for predators
- Poorer sheltered habitats
- Poor Year Class

ABUNDANT DAHLNITES

- Short, efficient food web
- Larger, more efficient food web

WEAK DAHLNITES

- Longer, less efficient food web
- Smaller, less efficient food web
Pink salmon Monitoring, Research, Restoration and Management

**Monitoring**—large increases in effort after spill
1. Adult returns in fishery (test fishery, weirs, aerial surveys)
2. Oil injury to wild embryos in streams, all fry in saltwater
3. Oil in stream gravels
3. Oil in adults

**Research**—Little research funds before spill; large increases after spill
1. Toxicity in lab and field
2. Straying, genetic structure of wild populations
3. Ecosystem studies of survival; age class strength

**Restoration**—What was done
1. Close fishery during spill
2. Restore geomorphology
3. Otolith mass marking better discrimination of returning hatchery and wild stocks

**Management**
1. Local closures to harvest
2. Adjust timing of fry release from hatcheries
3. Adjust management districts
Conclusions

Successful restoration depended on a variety of scientific efforts, including:

- routine monitoring by resource management agencies
- injury determination by Trustees
- recovery monitoring by Trustees*
- basic ecosystem-based research
- implementation of new management techniques (adaptive management)

*participation by mother nature is gratefully acknowledged
Questions ?