

**SALMON RESILIENCE
DEPENDS ON
MAINTAINING DIVERSITY**

Topics

Ecological considerations

Life history diversity

Habitat diversity

Resilience implications

Conclusions

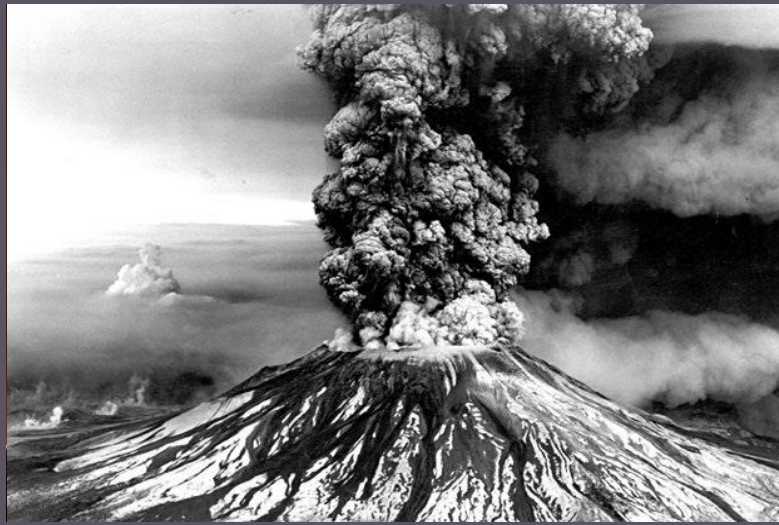




“TO KEEP EVERY COG
AND WHEEL IS THE
FIRST PRECAUTION
OF INTELLIGENT
TINKERING”

Aldo Leopold 1949

Resilient Ecosystems



THE NATURAL
LANDSCAPE OF THE
PACIFIC
NORTHWEST IS
VERY DYNAMIC

HABITATS ARE DIVERSE AND VARIABLE ACROSS LANDSCAPES

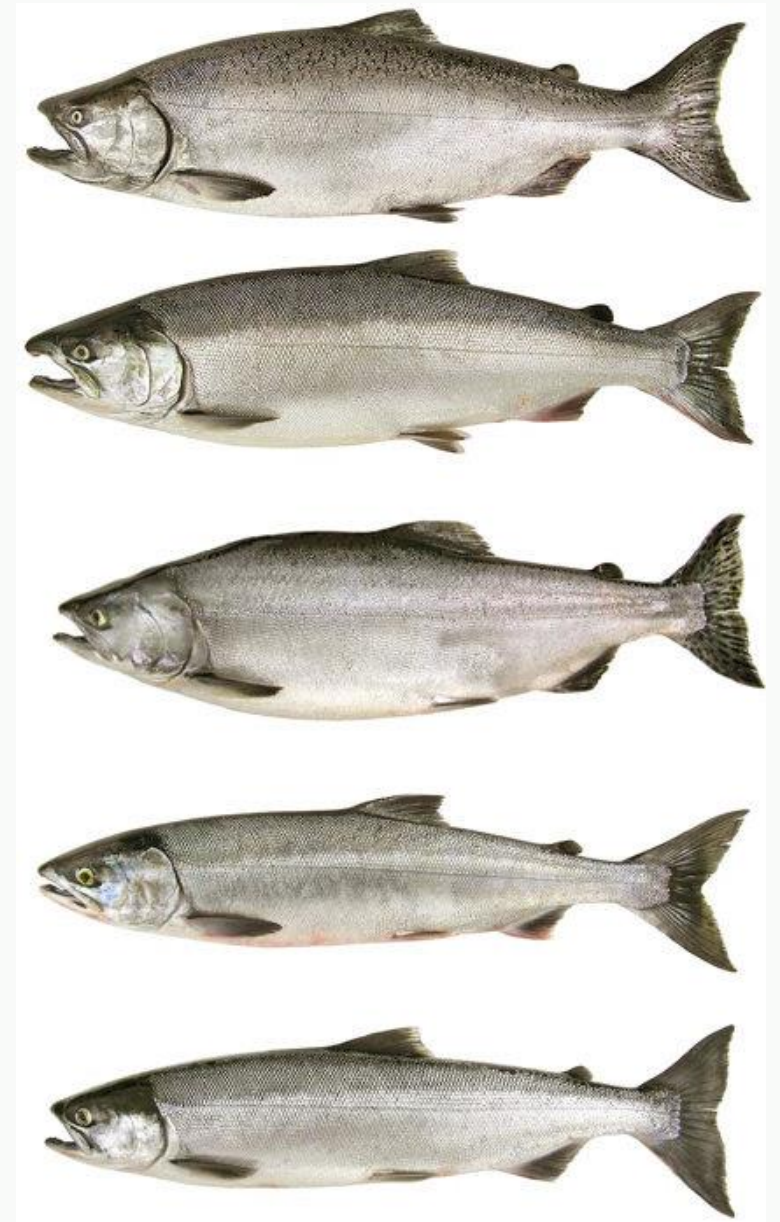
Above: natural wildfire in Queets River valley.
National Park Service

Below: urban and agricultural development in
Fraser River valley. Fraser Valley Salmon
Society



Resilient Species

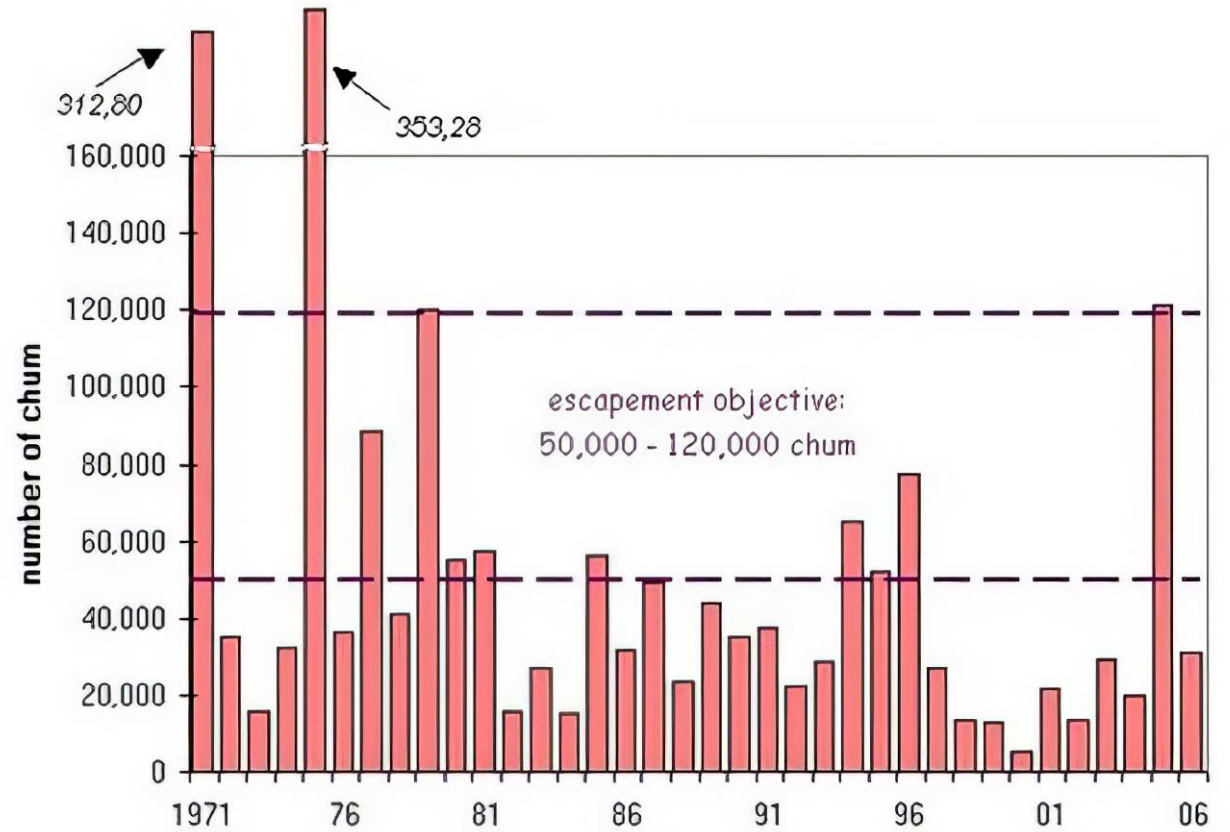
PACIFIC SALMON POSSESS
HIGH INTERSPECIFIC AND
INTRASPECIFIC
DIVERSITY



WDFW

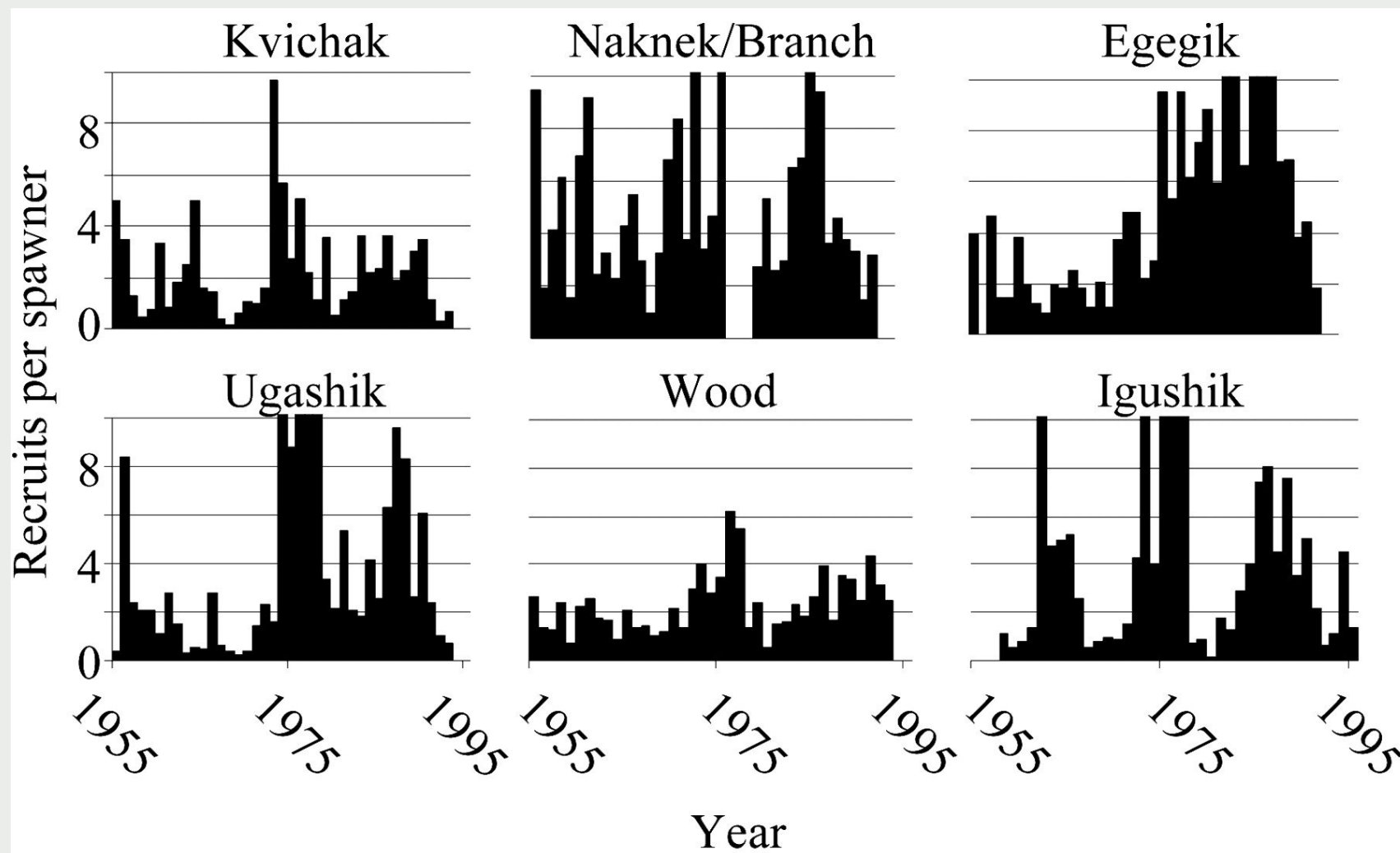
NATURAL
VARIATION IN
RUN SIZE IS
HIGH

Fishing Branch River, B.C.



Data source: Fisheries and Oceans Canada

POPULATIONS
RISE AND FALL,
BUT NOT
SYNCHRONOUSLY

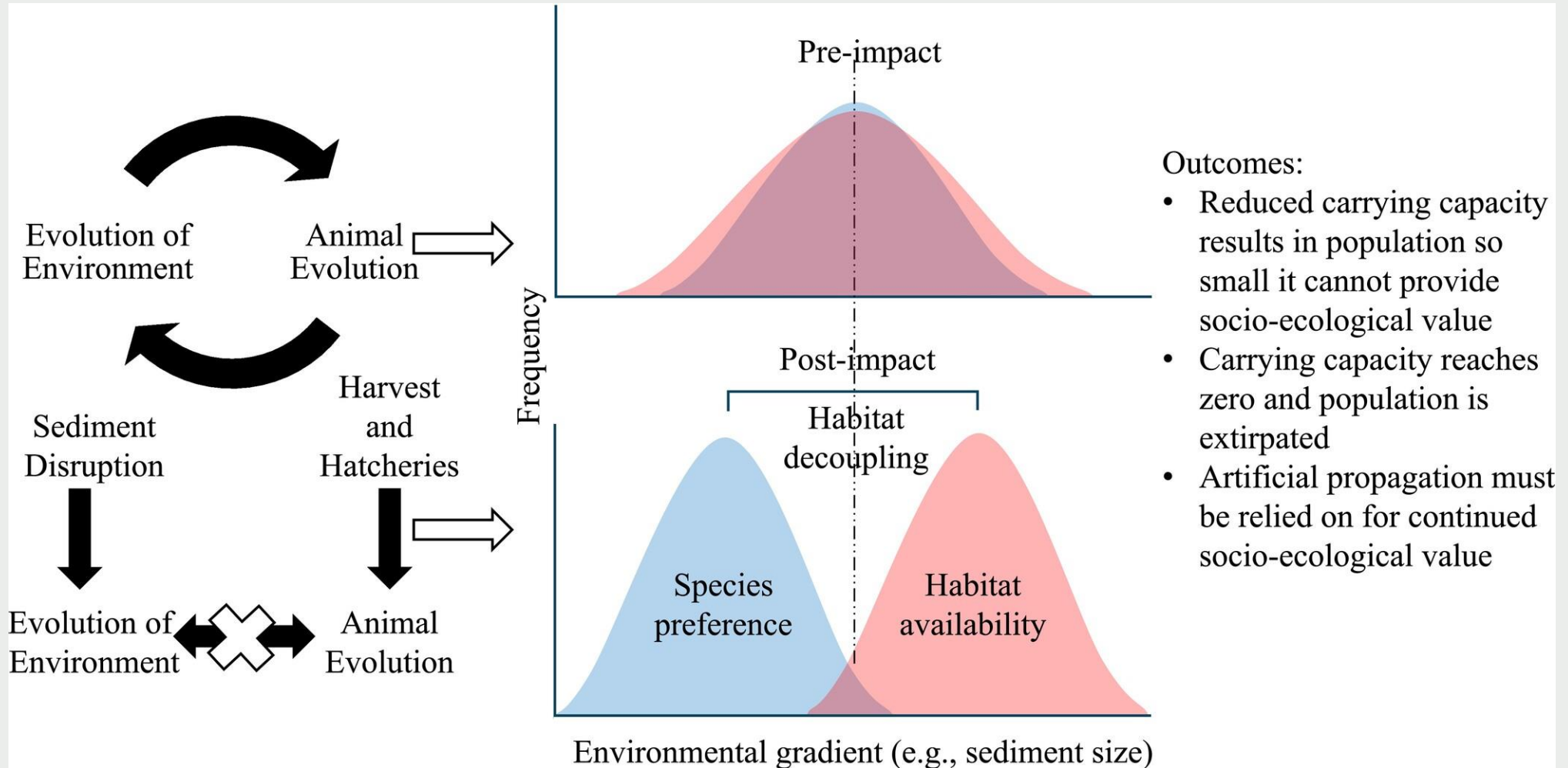


LIFE HISTORY
VARIATION IS
OFTEN
UNDERAPPRECIATED

Table 10. Description of the major types of life histories of juvenile fall chinook salmon in Sixes River, Oregon.

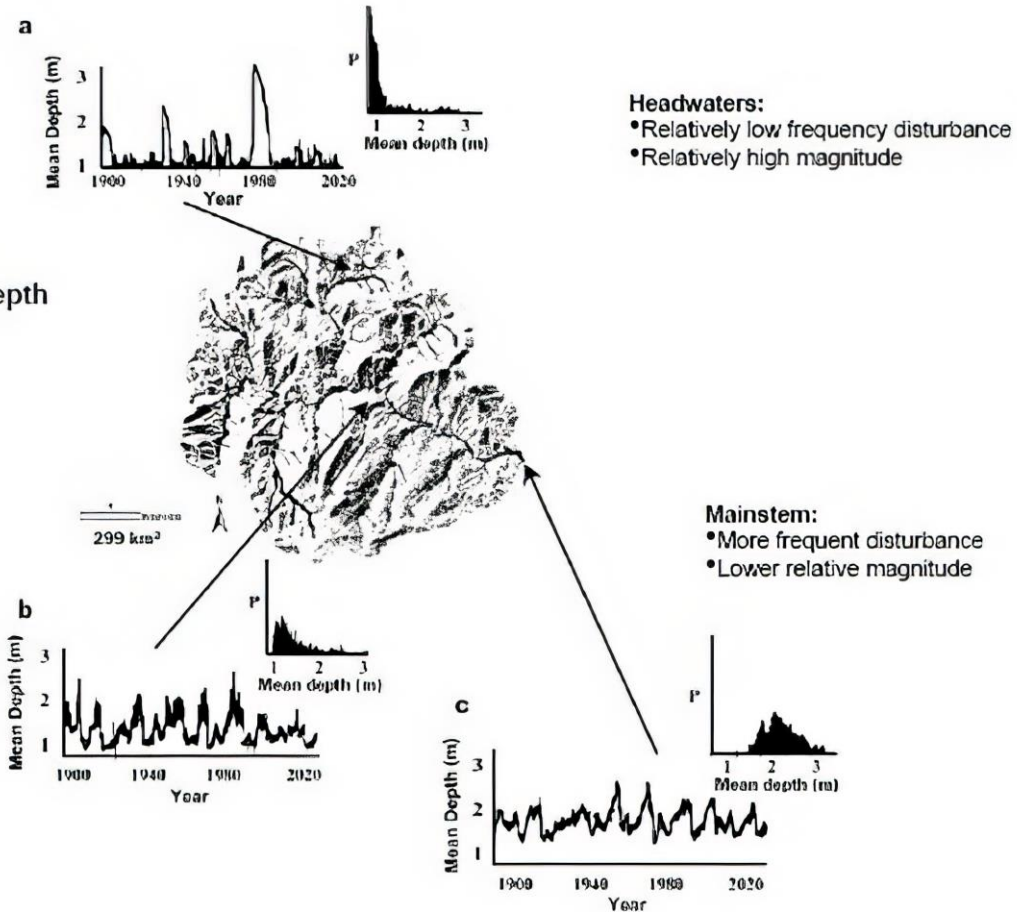
Type	Description
1	Emerge from the gravel, move directly downstream through the main river, estuary, and into the ocean within a few weeks.
2	Emerge from the gravel, move into the main river (or possibly stay in the tributaries) for rearing until early summer, then move into the estuary for a short period, and finally into the ocean prior to the period of improved growth in the estuary during late summer and autumn.
3	Emerge from the gravel, move into the main river (or possibly stay in the tributaries) for rearing until early summer, then move into the estuary for extended rearing, and finally enter the ocean after experiencing improved growth in the estuary during late summer and autumn.
4	Emerge from the gravel, stay in the tributary streams (or rarely in the main river) until the autumn rains, then move directly to the ocean.
5	Emerge from the gravel, stay in the tributary streams (or rarely in the main river) through the summer, autumn, and winter, and then enter the ocean during the following spring as yearlings.

Population and Habitat Disconnection



Resilience Over Time

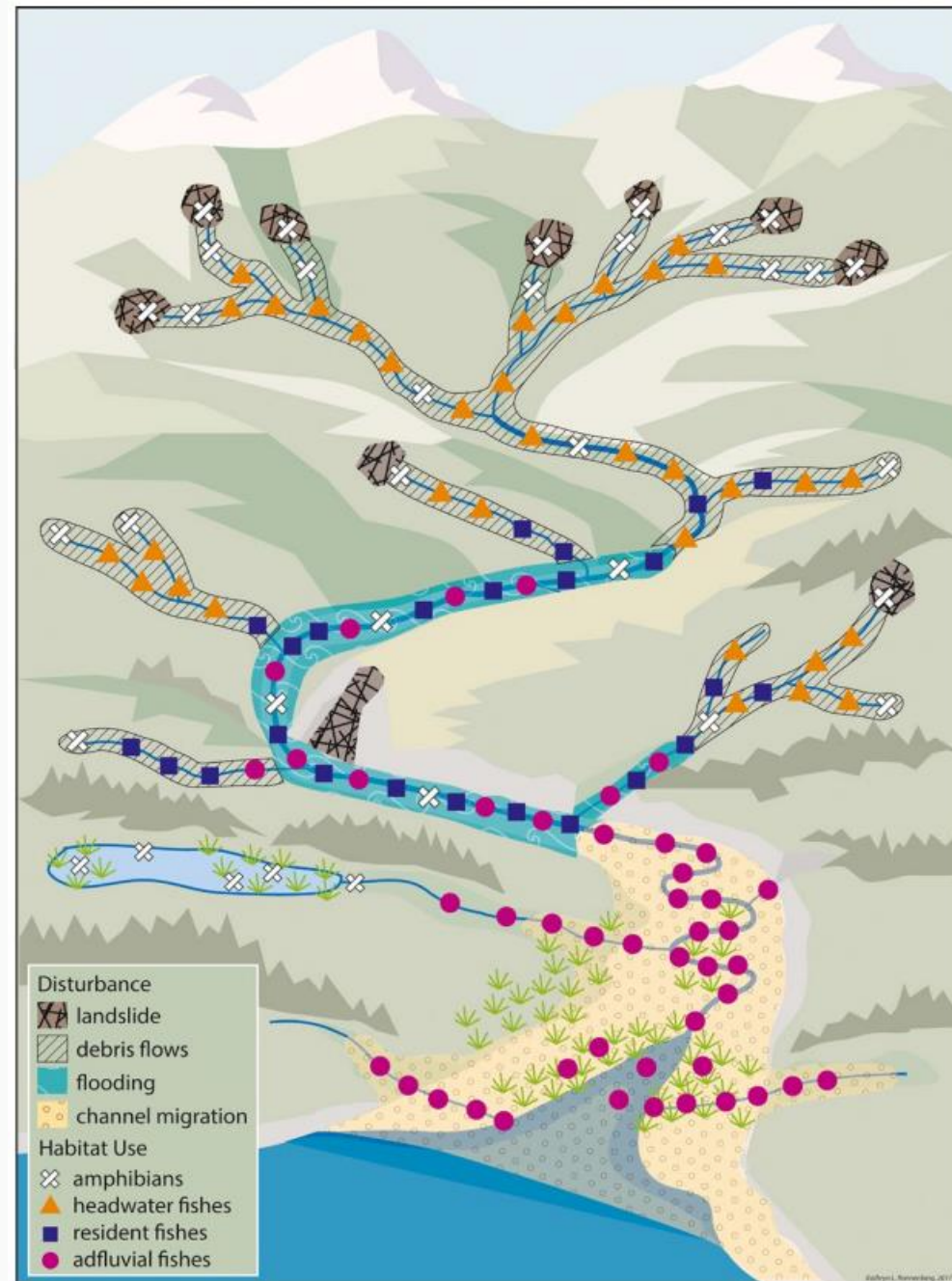
Sediment Depth



Benda et al. 2004

FREQUENCY AND SEVERITY OF DISTURBANCE DEPENDS ON SIZE AND LOCATION

WHOLISTIC
APPROACH TO
WATERSHED
RESTORATION
REQUIRES MATCHING
HABITAT RECOVERY
TO NATURAL
DISTURBANCE
REGIMES



Resilience -- Rivers



EARLY DAM
REMOVAL
RESULTS ARE
ENCOURAGING

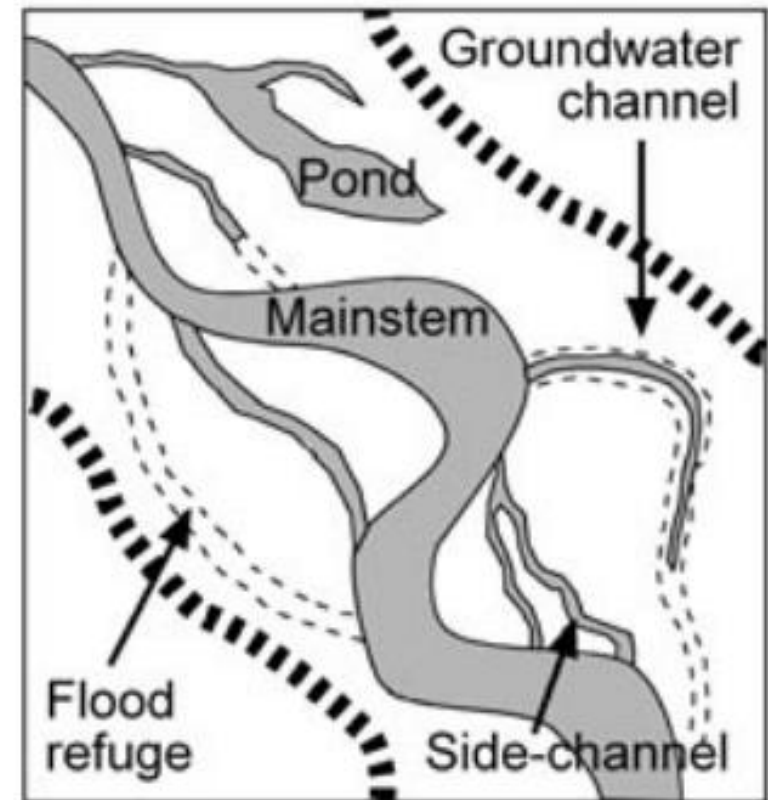
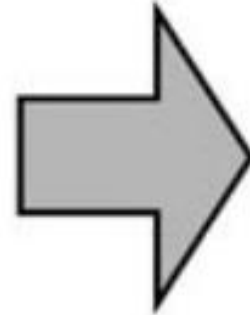
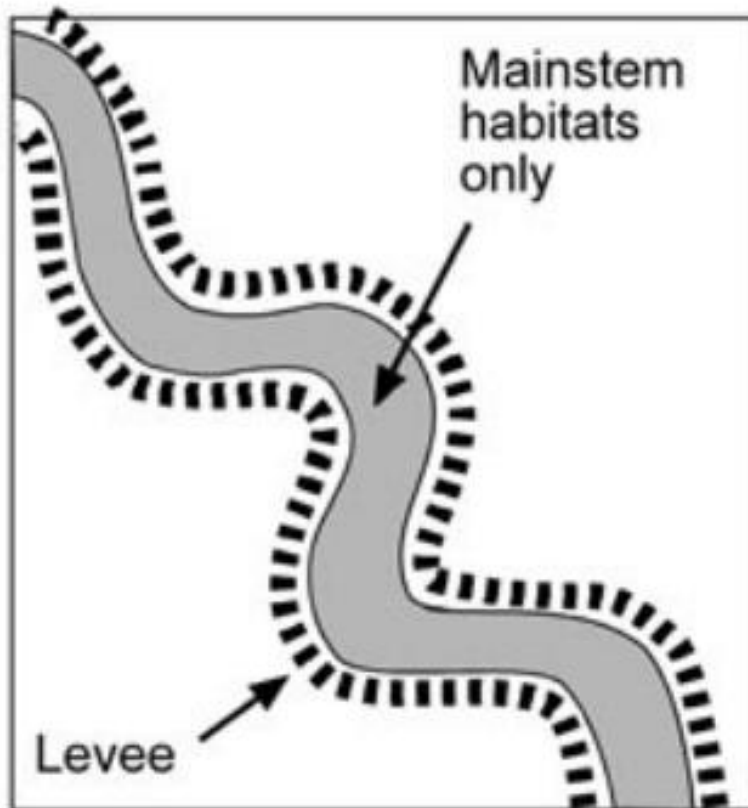
Elwha Dam decommissioning

ROAD CROSSING IMPROVEMENTS

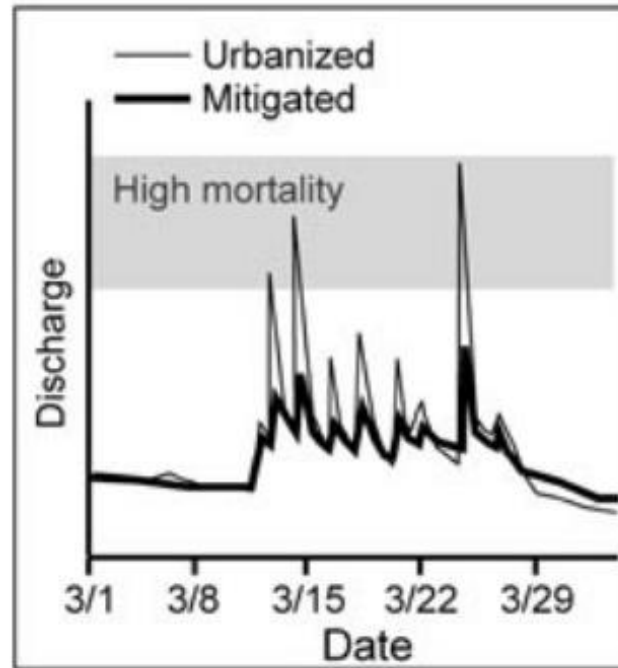
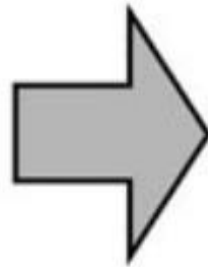
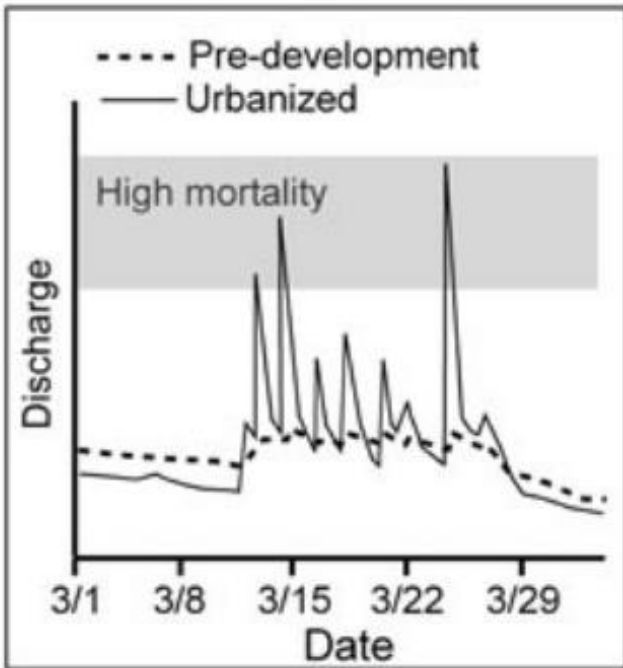


Nehalem R., Oregon, tributaries -- ODFW

RELAX CONSTRAINTS ON HABITAT DIVERSITY

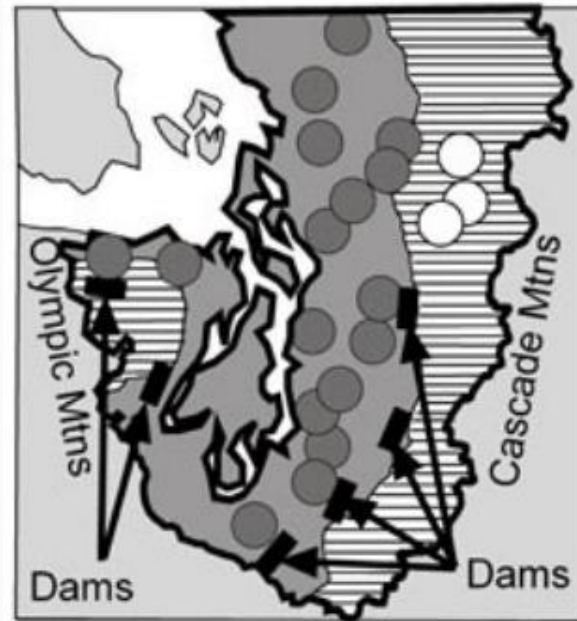


ATTENUATE EXAGGERATED DISTURBANCE REGIMES

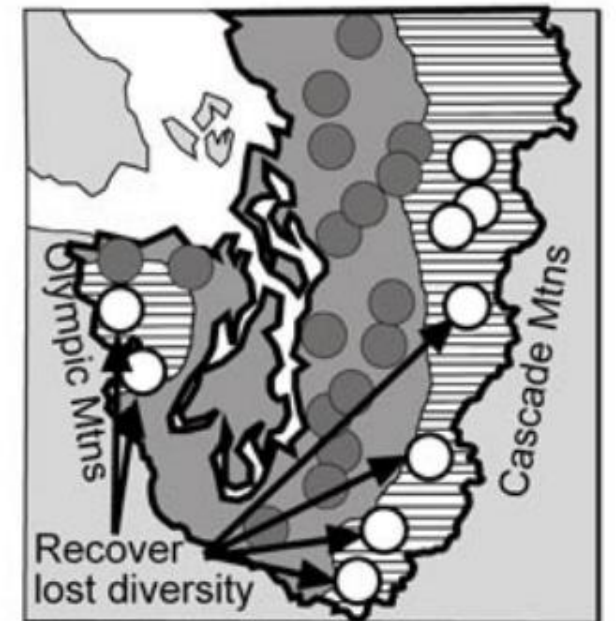
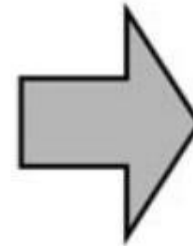


Waples et al. 2009

RESTORE MIGRATION PATHWAYS TO DIVERSE HABITATS



- Rainfall/transitional hydrologic regime
- Ocean-type Chinook population



- ▨ Snowmelt hydrologic regime
- Stream-type Chinook population

KEEP EVERY COG AND WHEEL

Conserve life history diversity (don't write off small populations or unique life histories)

Conserve habitat diversity (provide access to a variety of seasonal habitats and anticipate climate impacts)

THANK YOU

QUESTIONS?

R. Tabor -- USFWS

