

Setting the Stage:

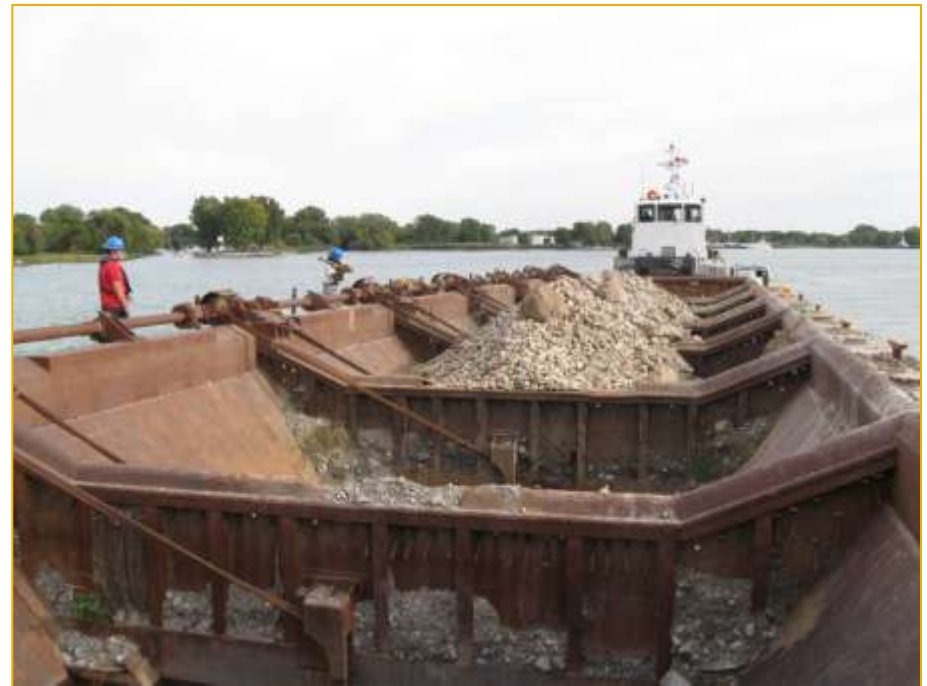
Cornerstones of Scientifically Defensible and Cost-effective Fisheries Restoration Strategies



Restoration of Habitat / Native Fishes

Common Concepts

- How much is enough?
- Where do we get the “biggest bang” for our buck?
- Scientifically defensible frameworks for sustainable fisheries and restoration



**Detroit River - Spawning substrate
(HECI Habitat Restoration Project)**

Background: why is habitat protection/restoration important?

Pacific Coast Examples

- 1991 AFS Report
 - 214 stocks at risk
- Served as a wake up call
- Led to:
 - Clarifications on what is a species?
 - Distinct Population Segment (DPS)?
 - Intense investigation in population structure



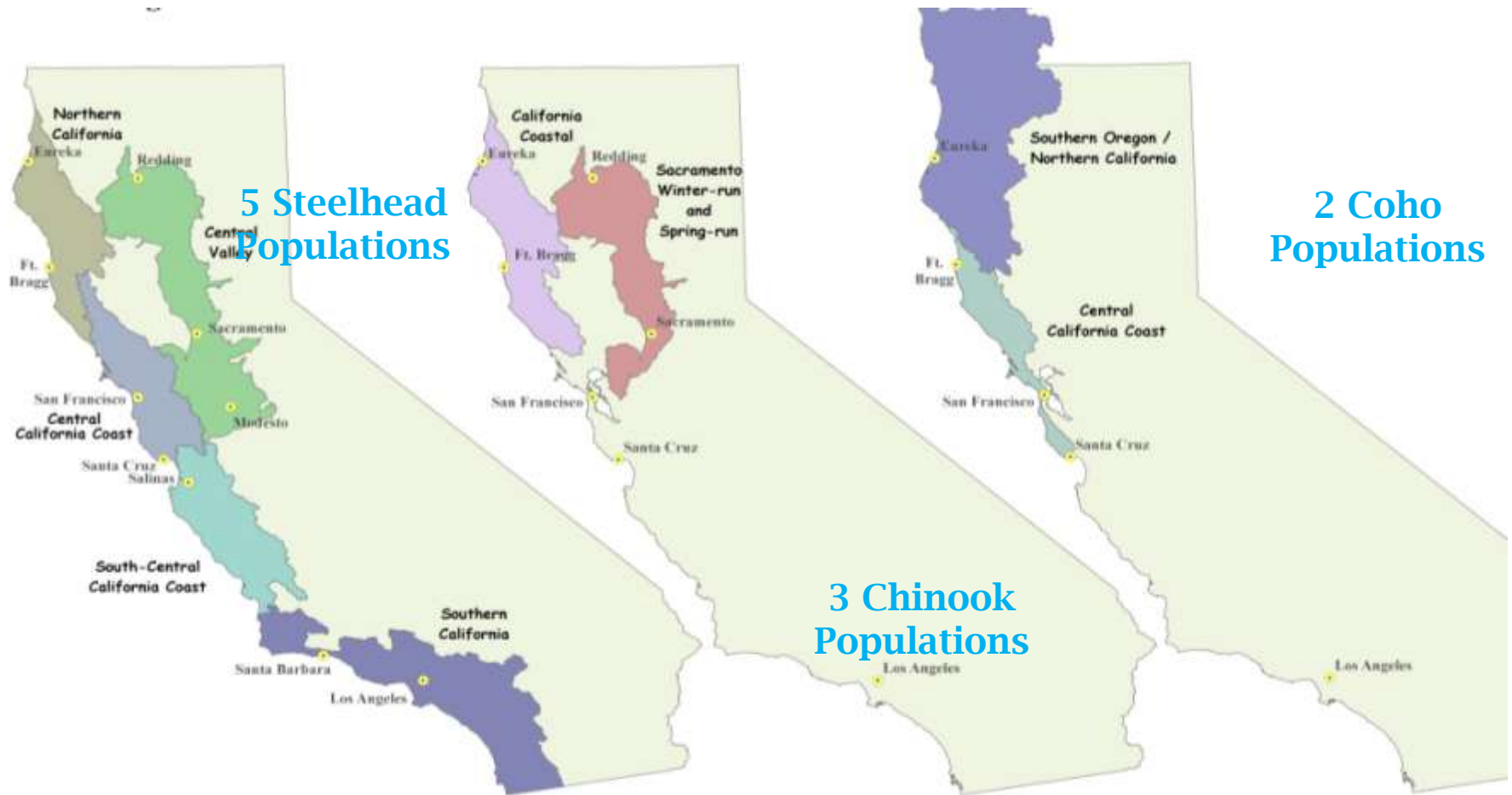
Background: why is habitat protection/restoration important?

Pacific Coast Examples

- For the purposes of the **Endangered Species Act** a "species" is defined to include "*any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature.*"
- However, the Act does not define what constitutes a "distinct population segment," but this is generally considered to be synonymous with an evolutionarily significant unit, so that it must:
 1. be substantially **reproductively isolated** from other conspecific populations, and
 2. represent an important component in the **evolutionary legacy** of the biological species

Background: why is habitat protection/restoration important?

Pacific Coast Examples - 10 Species of Salmon and Steelhead Listed as Federally Threatened or Endangered in California



Background: why is habitat protection/restoration important?
Pacific Coast Examples

PCSRF Funding (\$Millions)

	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	Total
WA	\$18	\$30.2	\$34	\$27.8	\$26	\$24.6	\$23.7	\$24.1	\$23.8	\$27.6	\$259.8
AK	\$14	\$19.5	\$27	\$27.9	\$20.6	\$23.7	\$21.7	\$16.7	\$14.6	\$19.3	\$189.0
CA	\$9	\$15.1	\$17	\$13.9	\$13	\$12.8	\$6.4	\$7.9	\$9.6	\$16.5	\$121.3
OR	\$9	\$15.5	\$17	\$13.9	\$13	\$12.8	\$6.4	\$7.3	\$9.2	\$14.6	\$118.3
ID	--	--	--	--	\$4.9	\$4.4	\$2.2	\$2.8	\$2.4	\$2.8	\$19.5
Coastal Tribes	\$6	\$7.4	\$11	\$8.9	\$8.4	\$7.9	\$4.9	\$6.1	\$5.5	\$6.5	\$72.6
Columbia River Tribes	\$2	\$2.5	\$4	\$3	\$3.1	\$2.5	\$1.2	\$1.7	\$1.9	\$2.6	\$24.4
Total	\$58	\$89.8	\$110	\$89.4	\$89	\$88.7	\$66.5	\$66.6	\$67.0	\$79.9	\$804.9

Background: why is habitat protection/restoration important?

Pacific Coast Examples – Headlines

- **San Francisco Chronicle**
Salmon arriving in record low numbers
The numbers of salmon returning to spawn are well below what fishermen expected. Chronicle file photo by Kim Komenich, 2001
- **Associated Press**
AP Newsbreak: Officials warn of salmon population "collapse"
- **Modesto Bee**
Salmon run in big trouble
Dan Kleinman unloads his catch in bodega Bay in this August 2005 photo. The number of chinook salmon returning to the Central Valley has reached a near-record low that could lead to severe restrictions on West Coast salmon fishing this year.
- **Sacramento Bee**
Salmon run verges on a collapse
Sport and commercial fishing are in jeopardy.
The Sacramento River's fall chinook salmon population is headed for a collapse, according to new federal data, threatening the upcoming commercial and recreational fishing season on one of the country's most important runs.

Background: why is habitat protection/restoration important?

Pacific Coast Examples – Headlines

- **Sacramento Bee**
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Sport and commercial fishing are in jeopardy.
The Sacramento River's fall chinook salmon population is headed for a collapse, according to new federal data, threatening the upcoming commercial and recreational fishing season on one of the country's most important runs.
- **Los Angeles Times**
Regulators issue the warning as the number of chinook in the Sacramento River falls to historic lows
SACRAMENTO -- -- Faced with an "unprecedented collapse" of California's Central Valley salmon population, federal regulators warned Tuesday that the West Coast fishing industry is on course toward steep restrictions this year.
- **Central Valley**
Fishery Managers Alarmed at Unprecedented Collapse of Central Valley Salmon
An internal memo of the Pacific Fishery Council obtained today disclosed an "unprecedented collapse" of Central Valley chinook salmon populations, based on preliminary data from state and federal fishery biologists.

Background: why is habitat protection/restoration important?

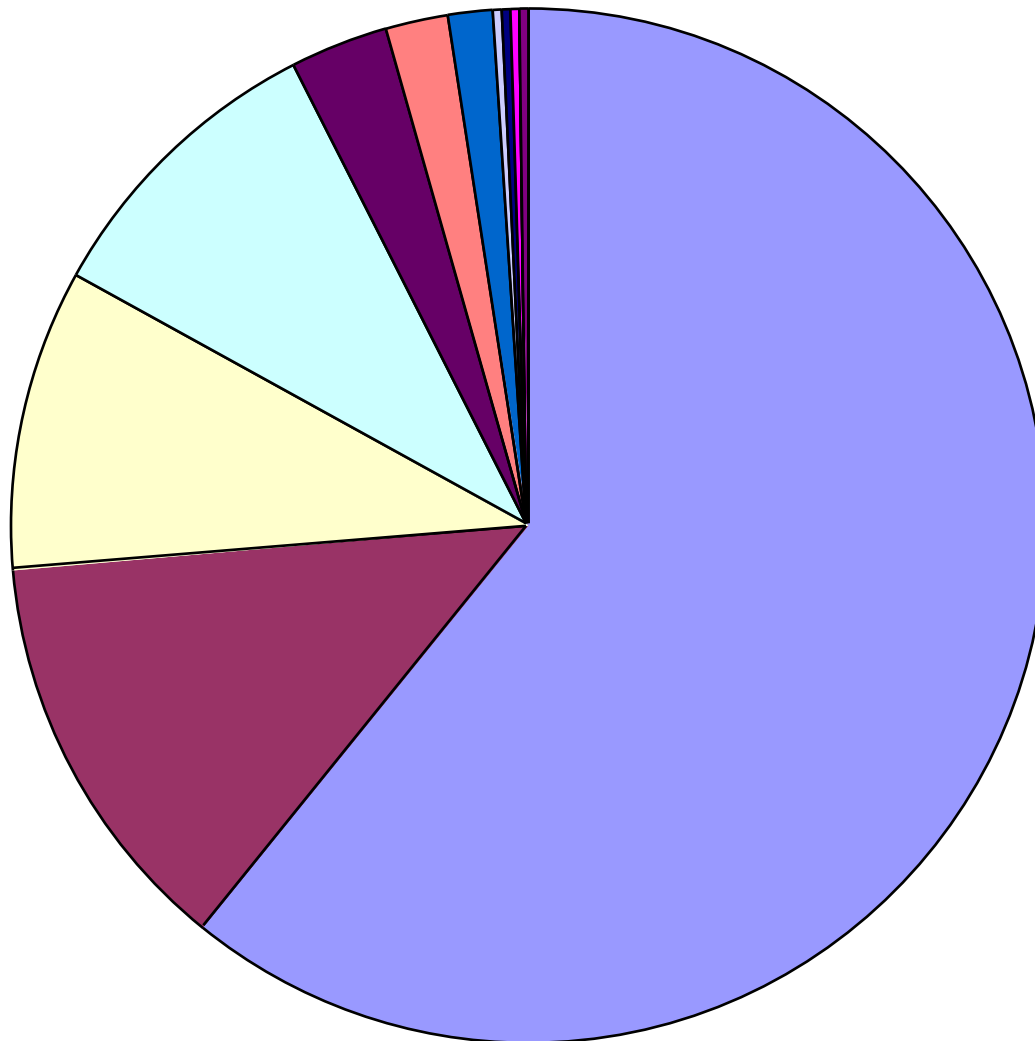
Pacific Coast Examples

- 2000 – Restoration planning initiated
 - Sustainable concepts starting to be conceived
- 2005 – Tremendous progress:
 - Sustainable fisheries (GSI)
 - Watershed-level
 - Regional planning
 - State-driven
 - Threats Assessment (CAP)

Background: why is habitat protection/restoration important?

Pacific Coast Examples – GSI Results for California commercial fishery May 2007

Stock proportion estimates from 1075 fish



CVFall	60.9%
CoastalCA	12.7%
Rogue	9.6%
Klamath	9.2%
Mid-Oregon	3.1%
Chetco	2.1%
CVSpring	1.4%
WashingtonCoast	0.3%
UpColumbia	0.2%
NPugetSound	0.2%
LowColumbia	0.1%
SPugetSound	0.1%
SEAlaska	0.1%
Nass	0.1%

Background: why is habitat protection/restoration important?

Pacific Coast Examples – Conservation Assessment Planning (CAP)

Target	Attribute	Indicator	Cottaneva	Ten Mile	Pudding	Noyo	Caspar	Big	Albion	Big Salmon	Navarro	Garcia	Gualala	Russian	Walker	Lagunitas	Pine Gulch	Redwood	Pescadero	Gazos	Waddell	Scott	San Vicente
Spawning Adults	Hydrology	Passage Flows	VG	G	G	G	VG	G	G	VG	F	G	F	F	G	VG	G	G	F	F	VG	G	G
Spawning Adults	Passage	Physical Barriers	G	VG	VG	G	VG	G	G	VG	G	VG	VG	G	F	F	G	VG	F	F	VG	VG	F
Spawning Adults	Passage	Passage at Mouth	G	F	G	VG	G	VG	VG	VG	G	G	G	G	VG	VG	VG	G	G	G	F	F	VG
Spawning Adults	Sediment	Amount of Gravel	VG	G	G	G	VG	VG	VG	F	VG	F	F	G	F	G	G	G	P	F	VG	VG	G
Spawning Adults	Viability	Freshwater Harvest	F	F	G	G	VG	G	G	G	F	P	P	F	G	G	G	G	P	G	G	F	G
Eggs	Hydrology	Instant. Condition	VG	G	G	G	VG	G	F	VG	F	G	F	P	F	G	G	G	G	VG	VG	VG	G
Eggs	Hydrology	Redd Scour	VG	G	G	F	VG	F	F	G	P	F	F	P	G	G	VG	G	F	F	F	P	F
Eggs	Sediment	Gravel Quality	F	P	P	F	P	F	F	P	F	F	P	G	P	G	G	G	P	F	G	P	F
Summer Rearing	Hydrology	Baseflow	G	G	F	F	G	F	F	F	P	F	F	P	F	F	F	F	F	G	G	F	F
Summer Rearing	Pool Habitat	Shelter Rating	P	P	P	P	P	P	P	F	P	P	P	P	P	G	F	P	P	F	P	P	P
Summer Rearing	Pool Habitat	Primary Pools	P	P	F	P	P	P	P	F	P	P	P	P	P	G	P	P	P	F	F	P	P
Summer Rearing	Water Quality	Temperature	F	P	F	P	G	P	F	F	P	P	P	P	P	P	G	G	P	F	F	F	G
Winter Rearing	Floodplain	Complex Habitat	P	P	F	P	F	P	P	F	P	P	G	P	P	P	F	P	P	P	F	P	P
Smolts	Estuary	Estuary	G	G	VG	F	G	F	F	G	F	F	G	F	F	F	P	P	P	P	F	P	P
Smolts	Hydrology	Passage Flows	VG	G	G	G	G	G	G	G	F	G	F	P	F	VG	G	G	F	F	G	F	G
Smolts	Passage	# of Diversions	VG	VG	VG	G	VG	G	F	VG	F	G	F	F	F	G	VG	F	G	G	F	VG	G
Smolts	Pool Habitat	Shelter Rating	P	P	P	P	P	P	P	F	P	P	P	P	P	G	F	P	P	P	P	P	P
Mult. Life Stage	Floodplain	Connectivity	G	G	F	F	G	F	F	F	F	G	G	P	F	P	F	P	P	P	F	G	G
Mult. Life Stage	Hydrology	Stand Age	G	G	G	G	G	G	G	G	G	G	P	P	P	G	P	P	G	G	G	G	G
Mult. Life Stage	Hydrology	Impervious Surfaces	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Mult. Life Stage	Land Disturb.	Agriculture	VG	VG	VG	VG	VG	VG	VG	VG	F	F	G	P	G	F	G	F	F	G	G	F	F
Mult. Life Stage	Land Disturb.	Timber Harvest	F	P	F	G	VG	G	P	G	G	G	G	VG	G	G	VG	G	G	VG	VG	VG	G
Mult. Life Stage	Pool Habitat	LWD	P	P	P	P	F	P	P	F	P	P	P	F	P	P	F	VG	P	P	P	P	P
Mult. Life Stage	Pool Habitat	LWD	P	P	P	P	F	P	P	F	P	P	P	P	P	F	F	VG	P	P	P	P	P
Mult. Life Stage	Riparian Veg.	Sp. Composition	G	G	G	G	F	F	G	G	F	F	F	F	P	G	G	F	F	G	VG	G	G
Mult. Life Stage	Riparian Veg.	DBH	G	P	P	F	G	P	F	P	P	F	P	P	P	F	P	P	G	G	G	VG	G
Mult. Life Stage	Riparian Veg.	Canopy Cover	G	F	G	VG	VG	G	VG	F	F	P	F	G	P	G	F	P	F	G	VG	VG	G
Mult. Life Stage	Sediment Trans.	Road Density	P	P	P	P	P	P	P	P	P	P	P	P	VG	G	VG	P	F	G	G	F	P
Mult. Life Stage	Sediment Trans.	Road Density 100	P	P	P	P	P	P	P	P	P	P	P	P	P	P	F	P	P	P	P	P	P
Mult. Life Stage	Water Quality	Turbidity	P	P	P	F	F	F	P	P	P	P	P	P	F	F	F	P	F	F	F	F	F
Mult. Life Stage	Water Quality	Toxicity	VG	VG	G	G	G	F	G	G	G	G	G	F	P	G	F	G	G	G	G	G	G
Spawning Adults	Viability	Adult Density	P	P	F	F	F	P	F	F	P	P	P	P	P	G	P	F	P	P	P	P	F
Summer Rearing	Viability	Juvenile Density	F	P	F	F	F	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Summer Rearing	Viability	Juvenile Distribution	F	F	G	F	VG	F	G	G	F	P	P	P	P	G	P	F	P	F	F	G	G
Smolts	Viability	Productivity	P	P	F	P	F	P	F	F	P	P	P	P	P	G	P	P	P	P	P	P	F

Background: why is habitat protection/restoration important?

Pacific Coast Examples – Conservation Assessment Planning (CAP)

Threat	Cottaneva	Ten Mile	Pudding	Noyo	Caspar	Big	Albion	Big Salmon	Navarro	Garcia	Gualala	Russian	Walker	Lagunitas	Pine Gulch	Redwood	Pescadero	Gazos	Waddell	Scott	San Vicente	San Lorenzo	Aptos	
Agricultural Practices	M	M	M	M	M	M	M	M	H	M	H	VH	M	H	M	M	H	M	M	H	M	M	H	
Channel Modification	M	M	M	M	M	H	M	M	M	M	M	H	M	H	VH	VH	H	M	H	H	M	H	H	
Climate Change	M	M	M	M	M	M	M	M	M	M	M	M	M	H	VH	H	M	M	H	H	H	H	H	
Disease, Predation, and Competition	M	M	L	L	L	M	M	M	M	M	M	M	M	L	L	L	H	H	M	M	H	H	H	
Droughts	H	H	H	H	M	H	H	H	H	H	H	VH	H	VH	VH	VH	VH	VH	H	H	VH	VH	VH	
Fire and Fuel Management	M	M	M	M	M	M	M	M	M	M	M	M	M	M	H	H	M	M	M	M	M	M	H	
Fishing and Collecting	M	M	L	L	L	L	L	L	M	M	M	H	L	L	L	L	H	M	L	L	M	H	M	
Hatcheries and Aquaculture	L	L	L	L	L	L	L	L	L	L	M	M	M	L	L	L	M	L	L	L	L	M	L	
Livestock Farming and Ranching	M	M	M	M	M	M	M	L	M	M	M	M	VH	M	VH	M	H	M	M	M	M	M	M	
Logging and Wood Harvesting	H	VH	H	VH	H	VH	H	H	H	H	H	H	M	M	H	M	H	M	M	VH	M	H	H	
Mining	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	L	M	M	VH	M		
Recreational Areas and Activities	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	H	H
Residential and Commercial Development	M	M	M	M	M	M	M	M	M	M	M	H	M	VH	H	M	H	M	M	M	M	VH	VH	
Roads and Railroads	VH	VH	H	H	VH	H	H	VH	VH	H	VH	H	H	H	M	VH	H	H	H	H	VH	VH	VH	
Storms and Flooding	M	M	M	M	M	H	M	M	H	M	M	M	M	M	M	M	H	M	H	H	M	H	H	
Water Diversion and Impoundment	M	M	M	M	M	M	M	M	M	M	M	H	M	H	H	M	H	M	M	M	H	H	M	

Background: why is habitat protection/restoration important?
 Pacific Coast Examples – Population diversity & stability in variable environments

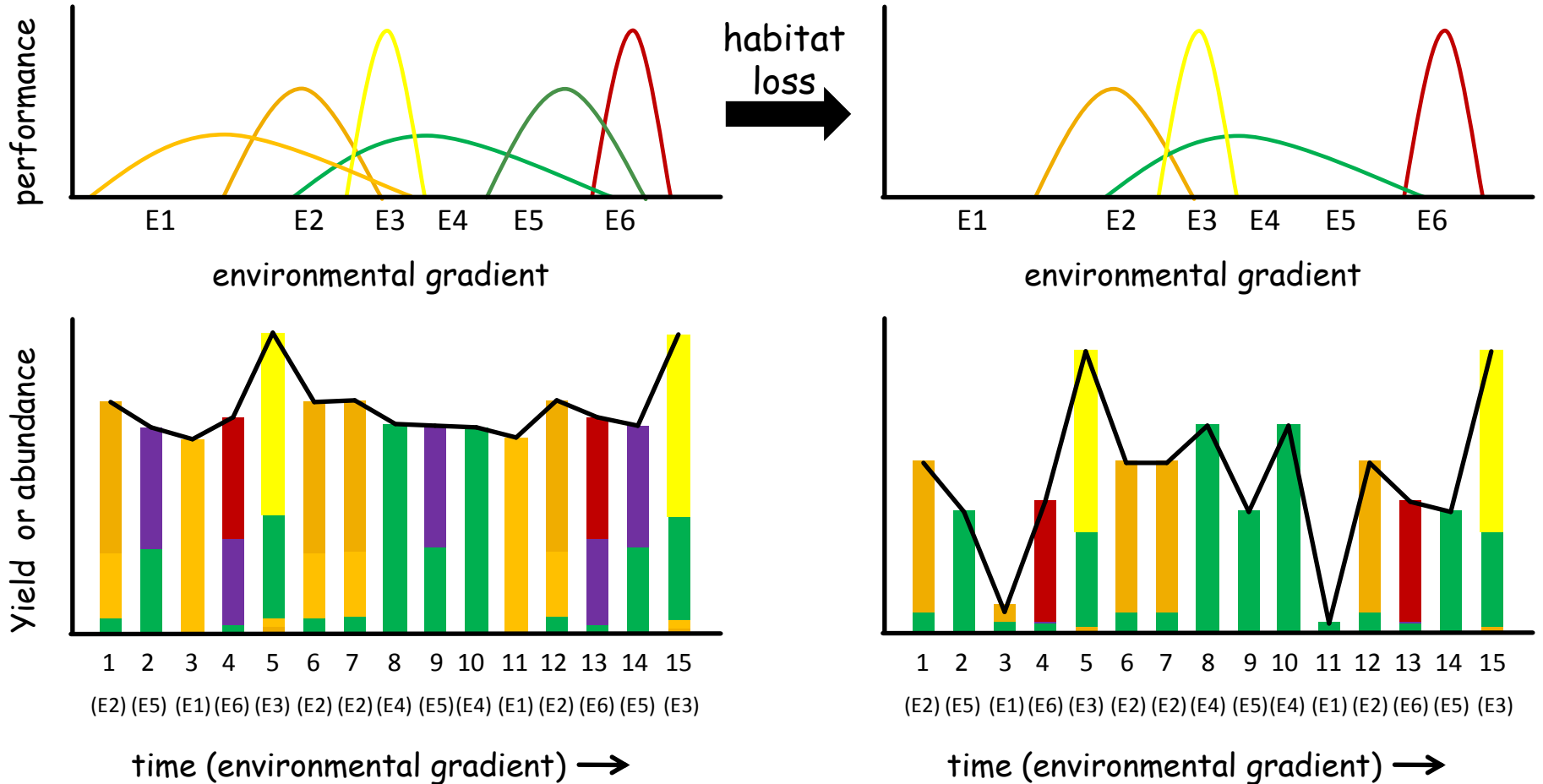


Figure 3.8 of Liss et al. (2006)

Background: why is habitat protection/restoration important?

Pacific Coast Examples - Contrast SRFC with Bristol Bay, AK sockeye salmon

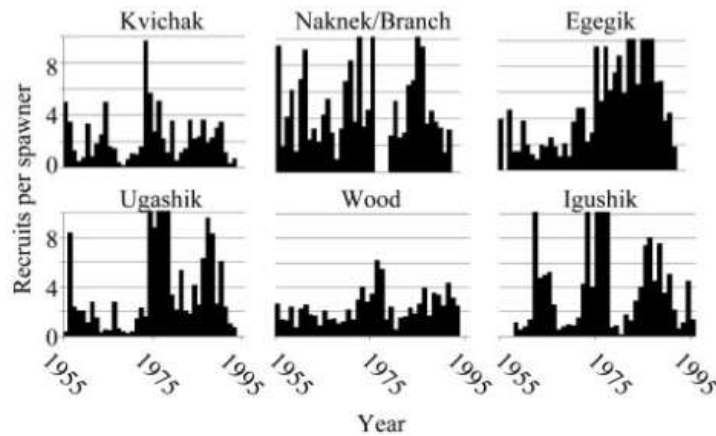


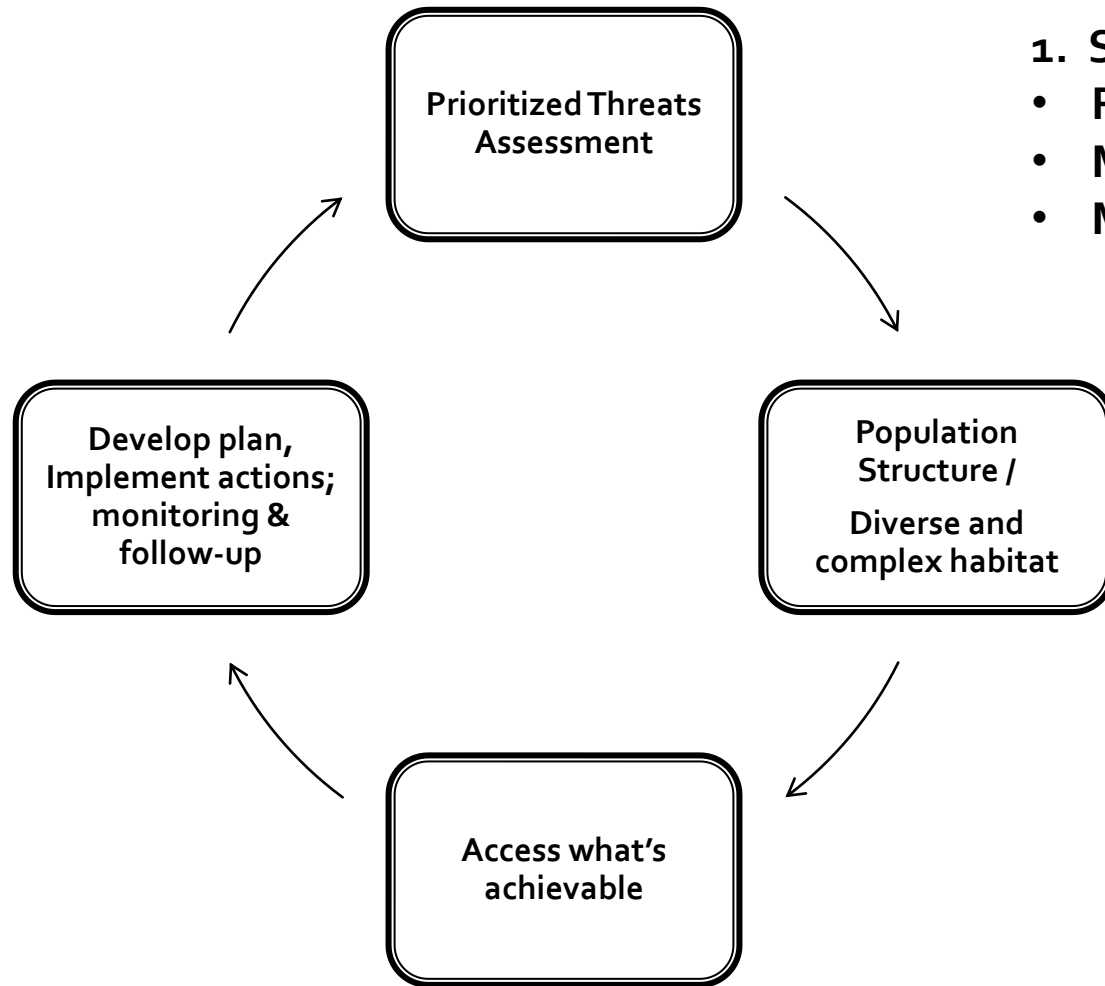
Fig. 4. Number of recruits per spawner for different Bristol Bay sockeye salmon stocks. Values >10 were truncated; the maximum was 27.4 for the Ugashik River in 1978.

- Retained diverse life histories among populations
- Uncorrelated dynamics among populations
- Non-synchronous shifts in population productivity
- Dampened overall variation in stock abundance and harvest



Background: why is habitat protection/restoration important?

Pacific Coast Examples – 4-Step Approach



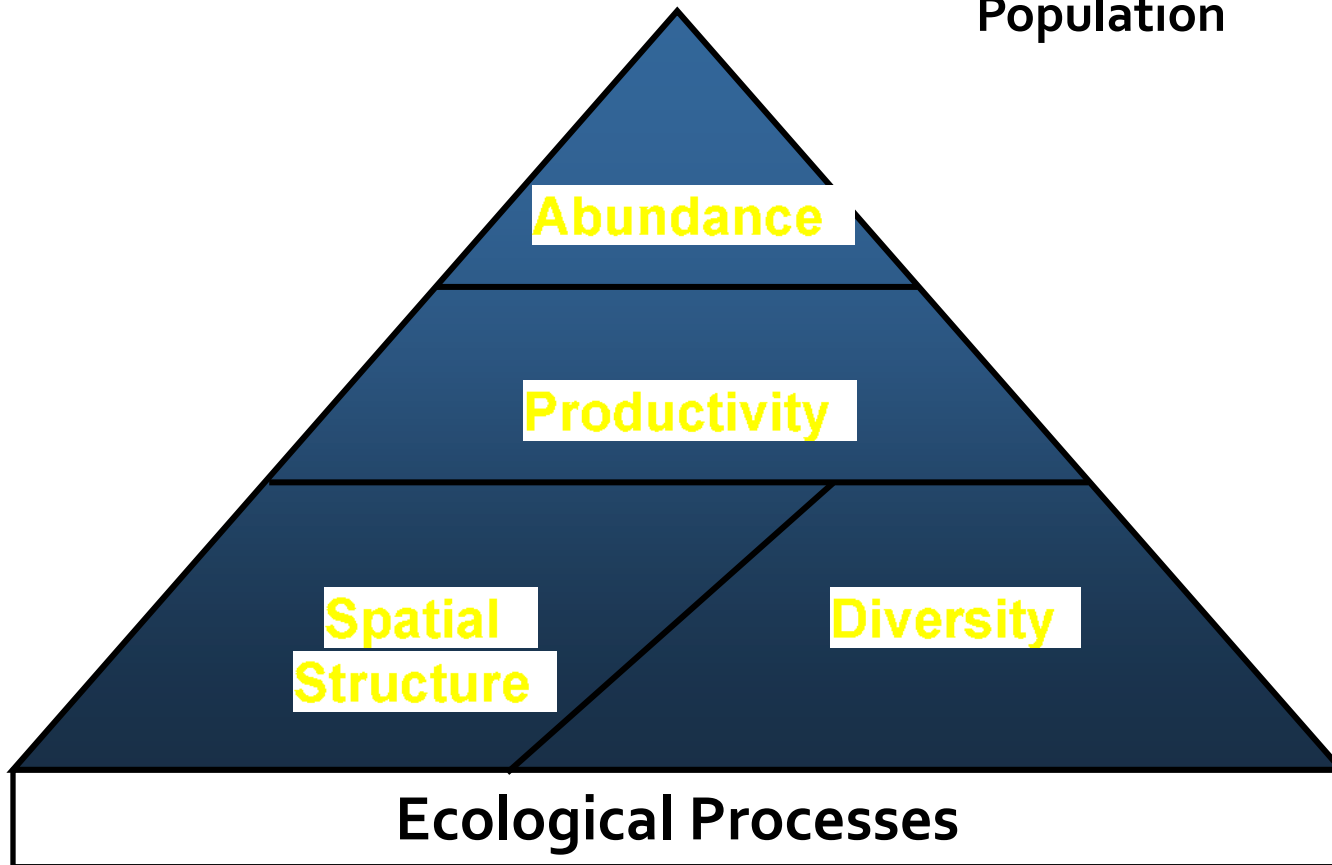
1. Species ESU:

- Populations
- Meta-populations
- Major population groups

Background: why is habitat protection/restoration important?

Pacific Coast Examples – *Ecological processes*

“VSP” = Viable Salmonid
Population



Fisheries Restoration Strategies in the Great Lakes

More re tough Questions

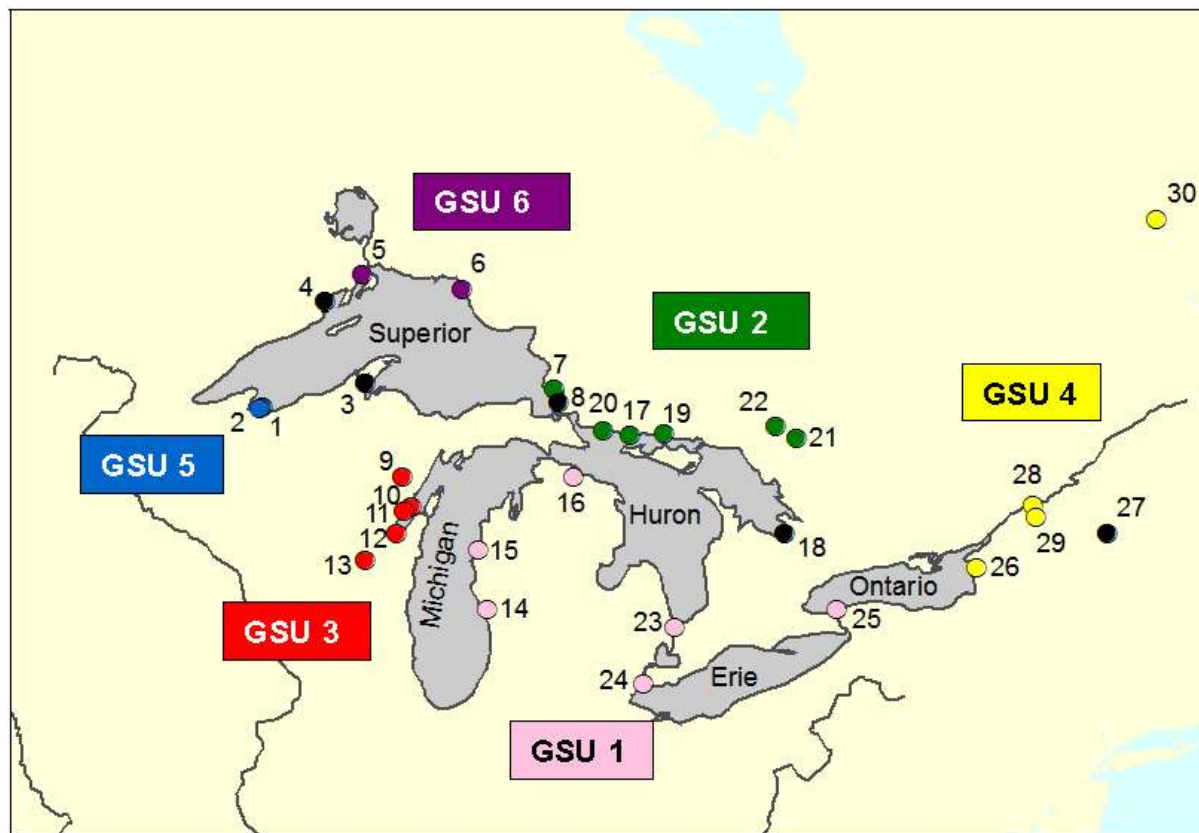
- For which populations , major population groups, DPS, and species assemblages are we directing our restoration efforts?
- How much is enough?
- How do we avoid practicing “Random Acts of Restoration?”

Fisheries Restoration Strategies in the Great Lakes

<u>Species</u>	Superior	Michigan	Huron	Erie	Ontario
<i>hoyi</i> (bloater)	X	X	X		X
<i>reighardi</i> (shortnose)		X			
<i>zenithicus</i> (shortjaw)	X	X	X	X	
<i>johannae</i> (deepwater)		X			
<i>kiyi</i>	X	X	X		X
<i>nigripinnis</i> (blackfin)	X	X	X		
<i>artedi</i> (cisco)	X	X	X	X	X

Fisheries Restoration Strategies in the Great Lakes

Lake Sturgeon Population Structure



(Figure 6 of Welsh et al. 2010)

Fisheries Restoration Strategies in the Great Lakes

Native Large river spawners



lake sturgeon *Acipenser fulvescens*



lake whitefish *Coregonus clupeaformis*



walleye *Sander vitreus*

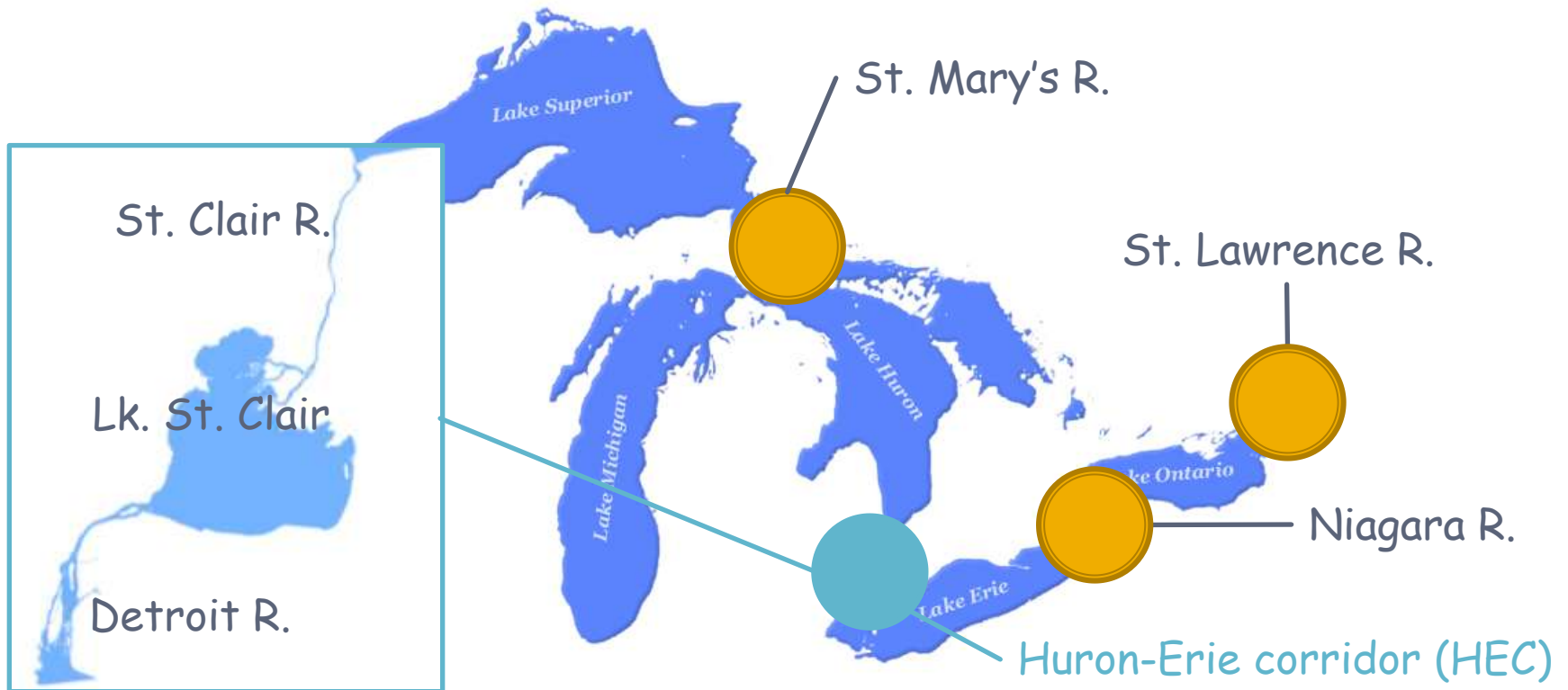


cisco (lake herring) *Coregonus artedii*

Fisheries Restoration Strategies in the Great Lakes

Within species diversity – Lake Sturgeon

- Describe sturgeon metapopulation structure in the Huron-Erie Corridor (HEC)



Fisheries Restoration Strategies in the Great Lakes

Hypothesis – 3 local populations?

★ known spawning

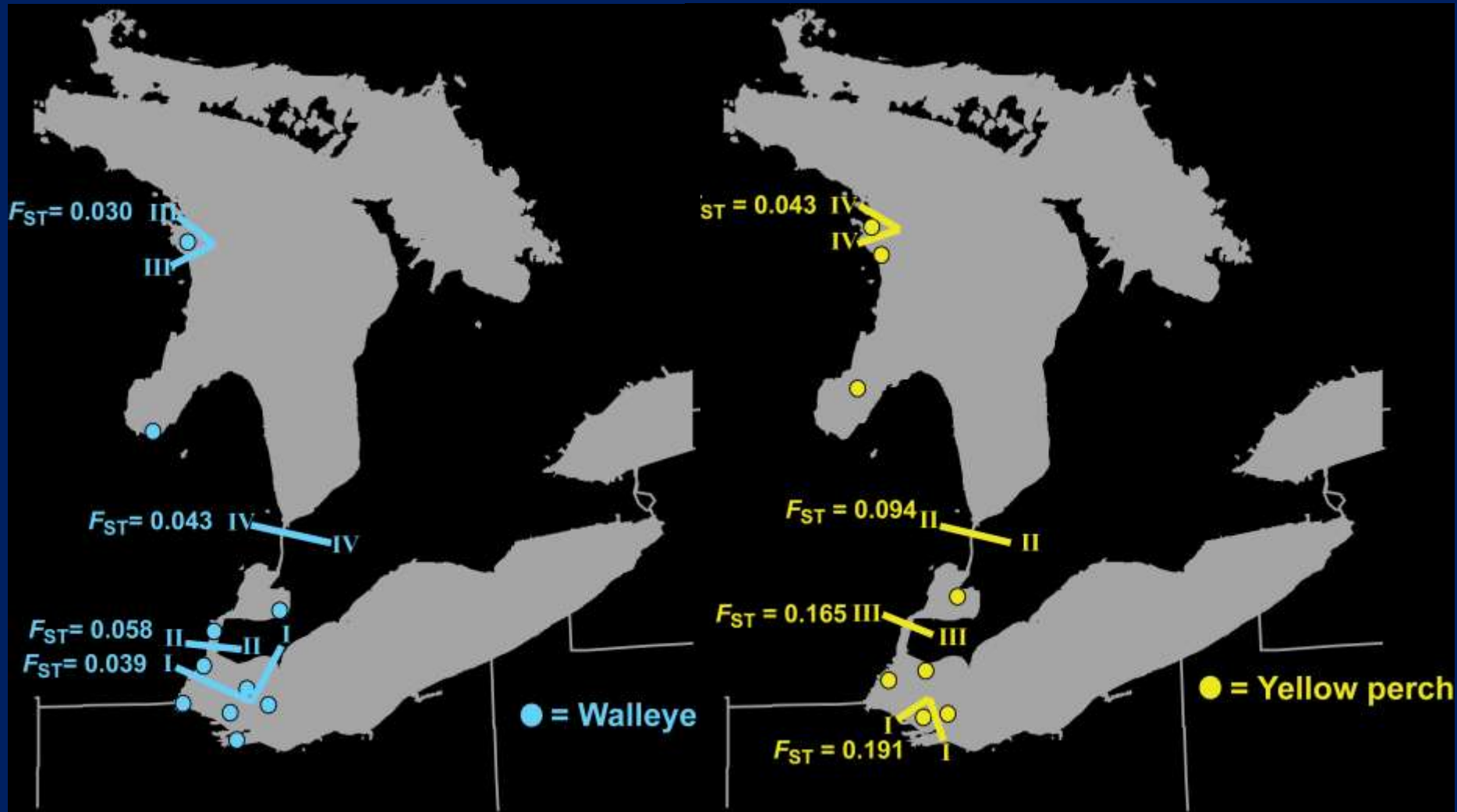


Clair R. - Lk. Huron

- Lk. St. Clair

Fisheries Restoration Strategies in the Great Lakes

Walleye & Yellow Perch – HEC Genetic Barriers



Fisheries Restoration Strategies in the Great Lakes

Risk Spreading - Walleye



Lessons Learned

- Ecosystem approach – range of species
- Process-based, physical-based, complex connected habitats
- Within populations diversity tracks environmental change

Closing Thoughts

- Professionalism to use best available information
- Invest resources wisely to achieve Fish Community Objectives
- Is a systematic threats assessment the way to go?
- Why aren't the species recovered/stable?

Closing Thoughts

- Bring to you innovations and advancements in habitat restoration on front end of Niagara River
- Avoid practicing “Random Acts of Restoration”
- Prepare you all for the tough questions that follow funding this kind of work

Thank-you



Fisheries Restoration Strategies in the Great Lakes

Conceptual foundations of salmon habitat restoration

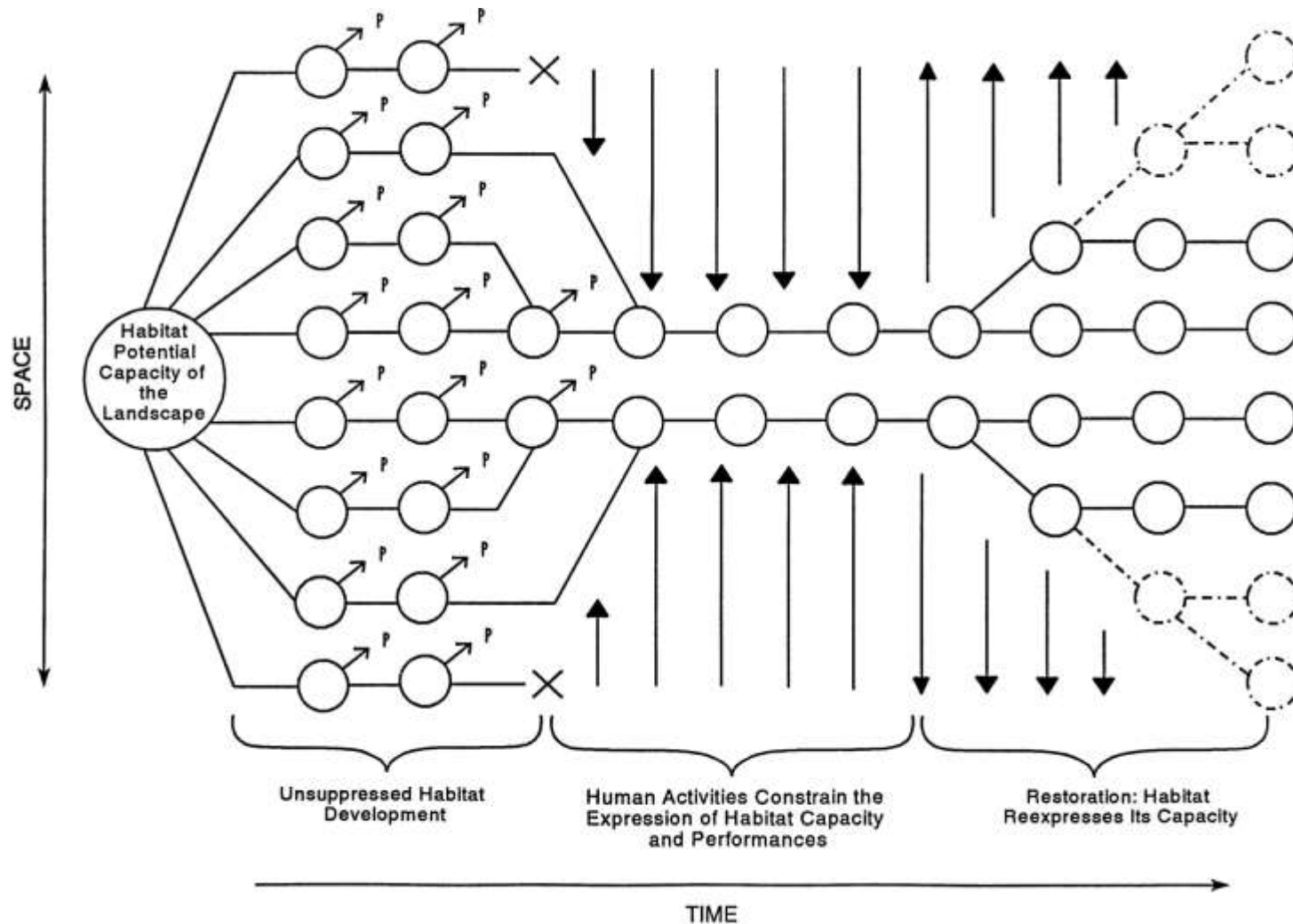


Figure 2 of Ebersole et al. 2007