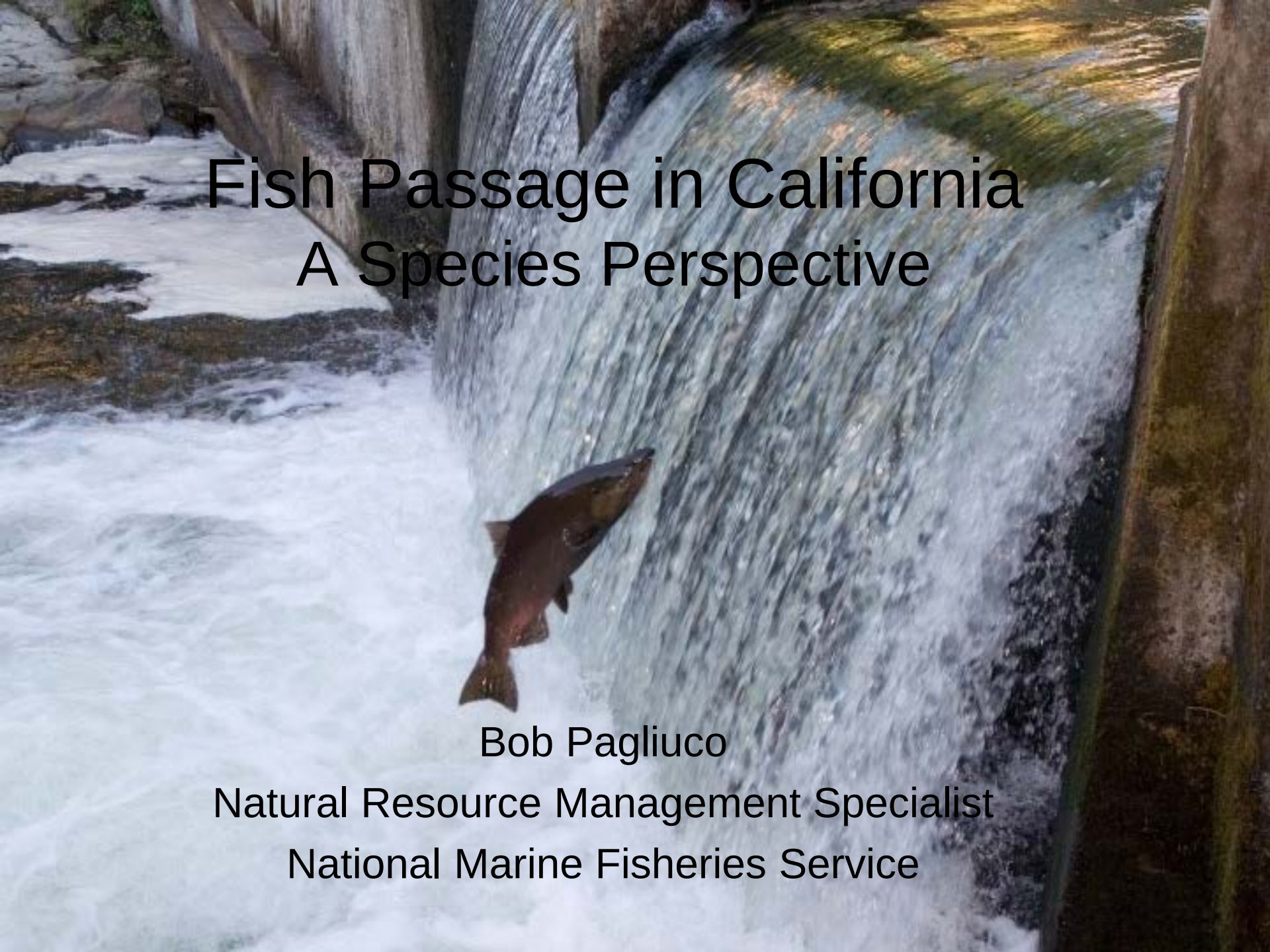
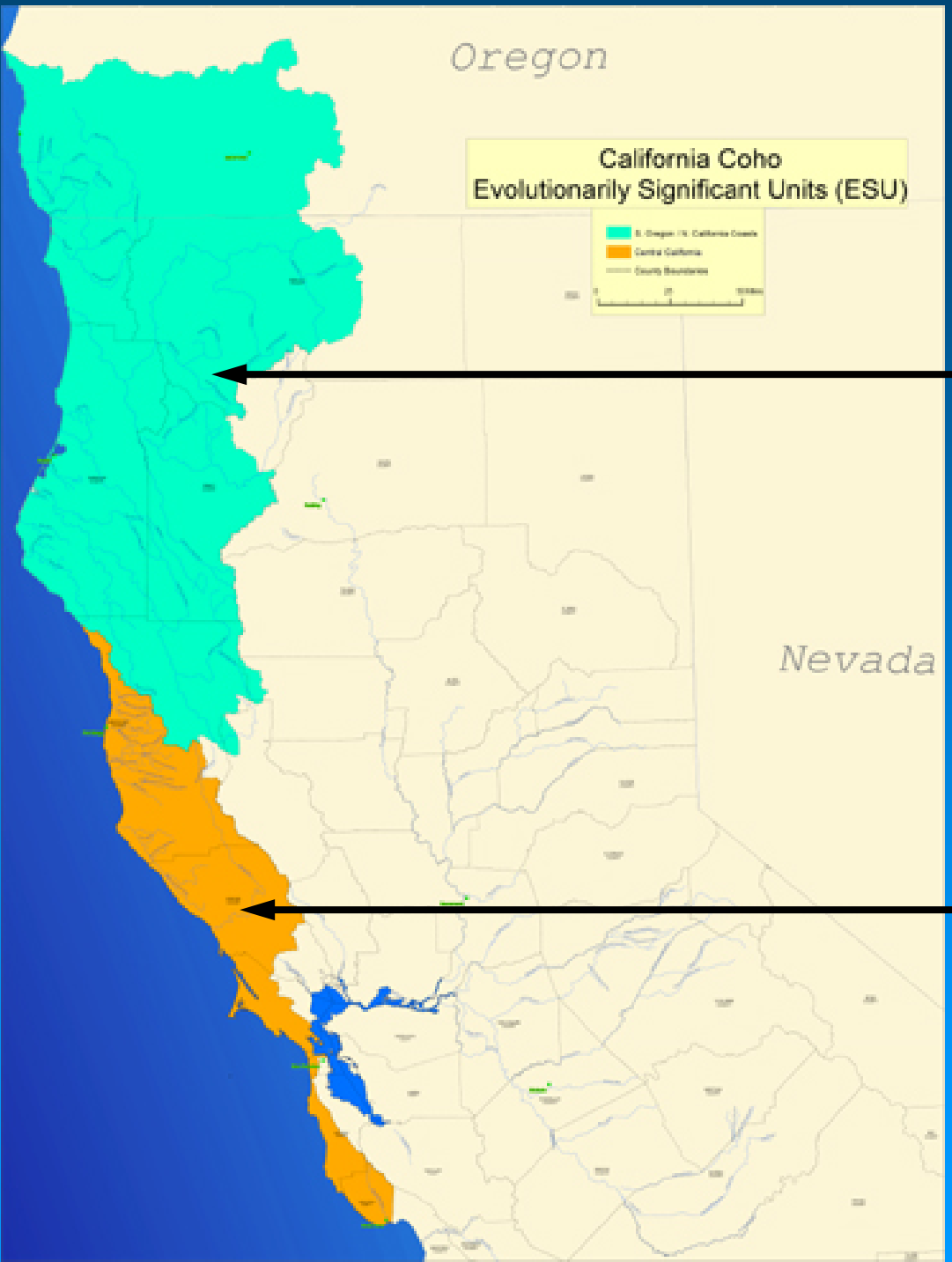


Fish Passage in California
A Species Perspective

Bob Pagliuco
Natural Resource Management Specialist
National Marine Fisheries Service

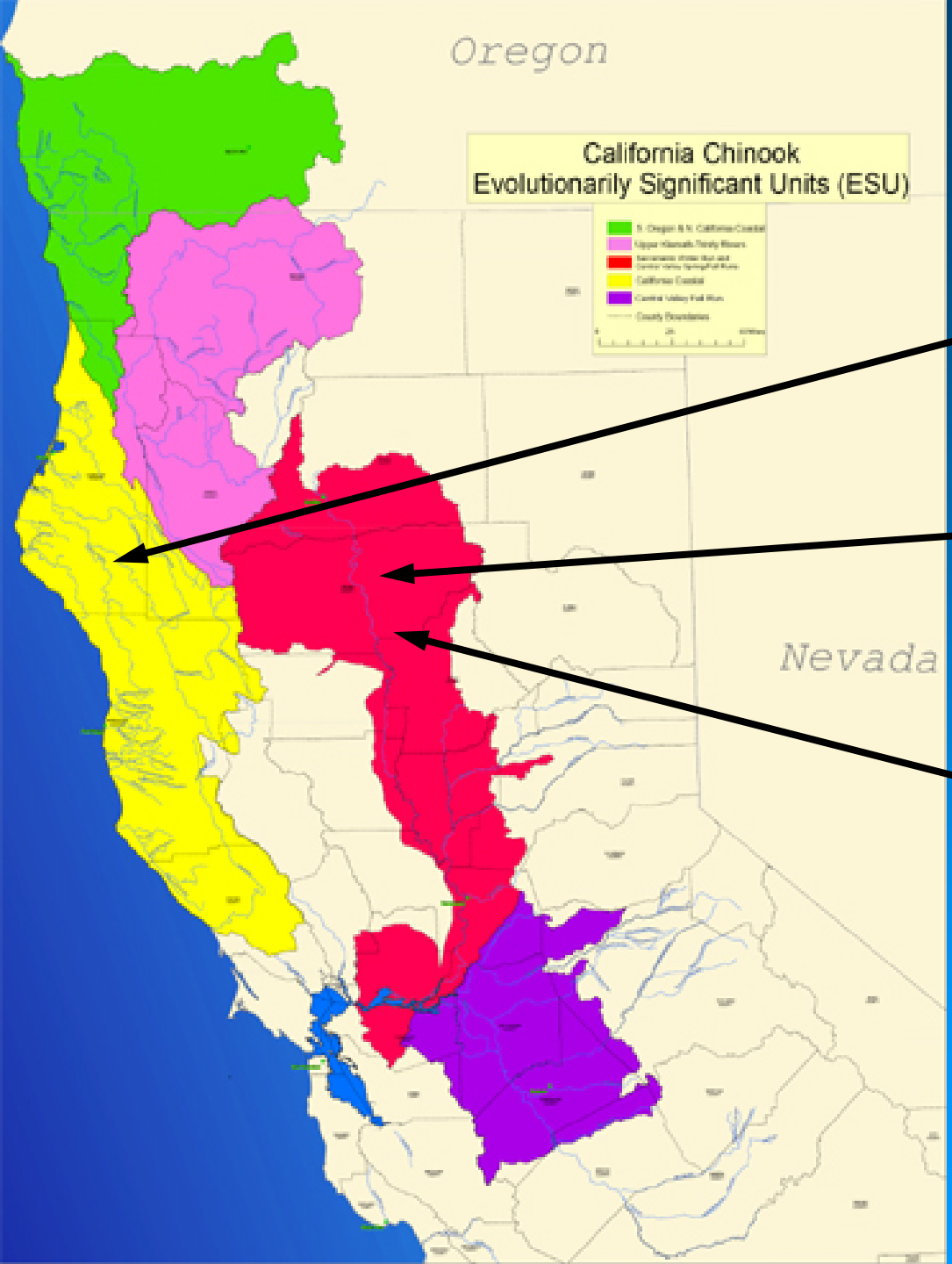
Federally Listed Anadromous Salmonids in California

- SONC Coho - Threatened
- CCC Coho - Endangered
- California Coastal Chinook - Threatened
- Sacramento Winter Run Chinook - Endangered
- Central Valley Spring Run Chinook - Threatened
- Northern California Steelhead - Threatened
- Central California Coast Steelhead - Threatened
- California Central Valley Steelhead - Threatened
- South-Central Coast Steelhead -Threatened
- Southern California Steelhead - Endangered



Southern Oregon
Northern California Coho
Threatened

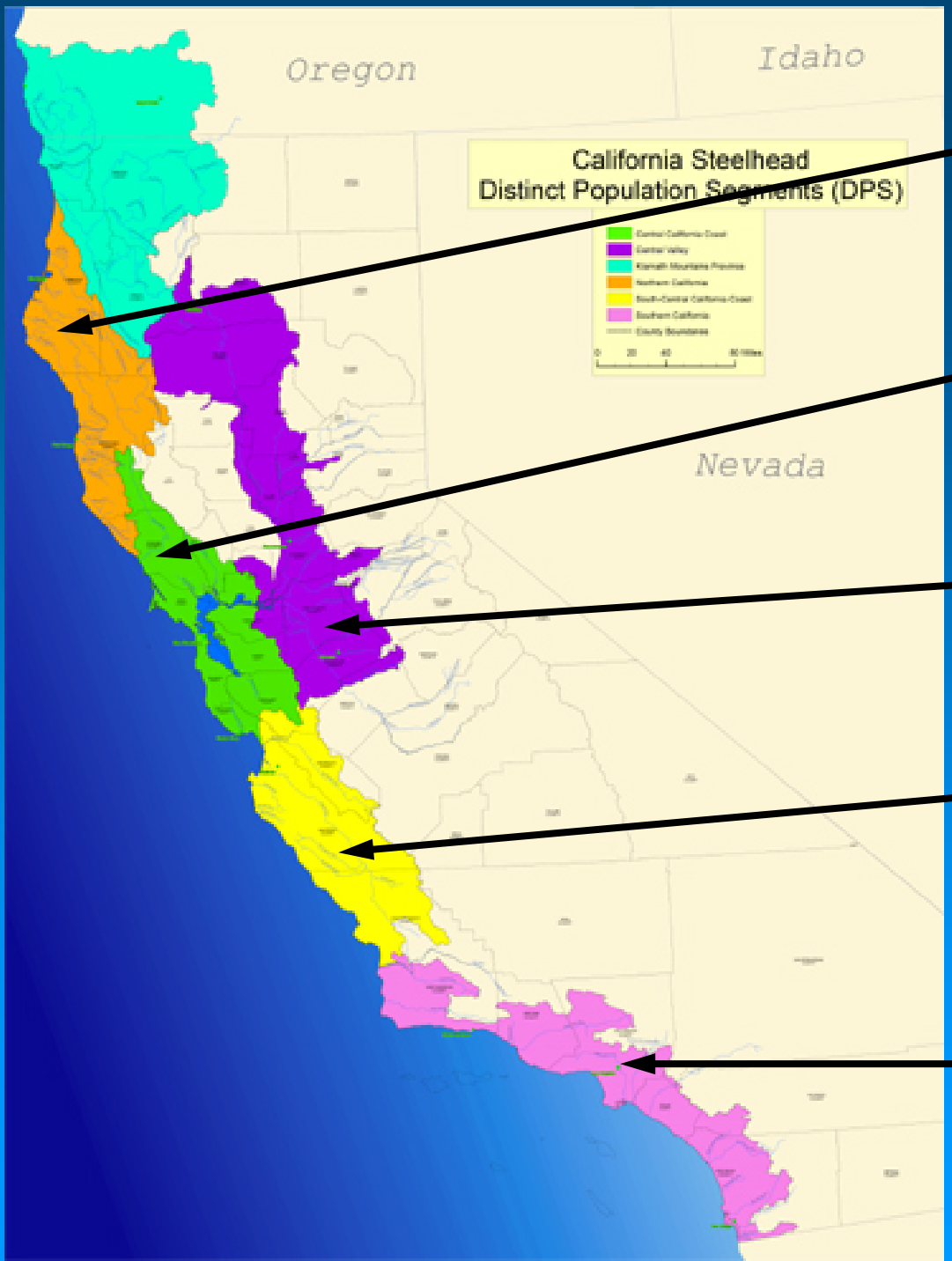
Central California Coast
Coho
Endangered



California Coastal Chinook
Threatened

Central Valley Spring Run Chinook
Threatened

Sacramento Winter Run Chinook
Endangered



Northern California Steelhead
Threatened

Central California Coast Steelhead
Threatened

California Central Valley Steelhead
Threatened

South-Central Coast Steelhead
Threatened

Southern California Steelhead
Endangered

Salmon and Steelhead Trout Life Cycle

1 - 9% survival

11 – 30% survival

10 – 20% survival

Stressors

- Altered Sediment Supply
- Lack of Floodplain and Channel Structure
- Degraded Riparian Forest Conditions
- Impaired Water Quality
- Altered Hydrologic Function
- Adverse Hatchery-related Effects
- Increased Disease/Predation/Competition
- Commercial and recreational harvest
- Barriers

Coho - *Oncorhynchus kisutch*

- Typical 3 year life history
- Needs to spend at least 1 year in freshwater
- Enters coastal streams October – January
- Spawns in low to moderate gradients of 3% or less (5% max)

Coho Decline

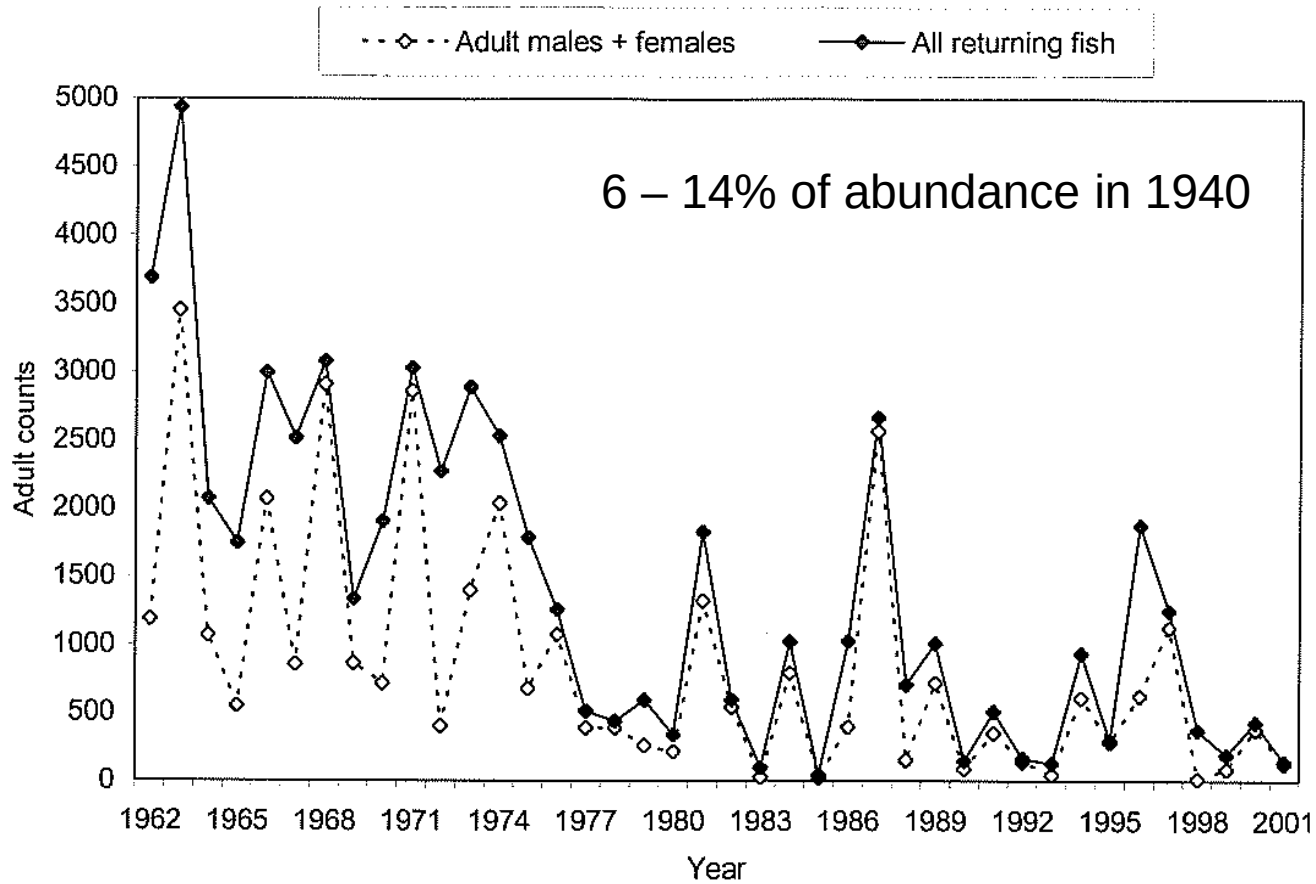


Figure 208. Counts of adult coho salmon at Noyo Egg Collecting Station, 1962–001. Solid line with closed symbol indicates total fish captured (including grilse); dashed line with open symbols indicates adult males and females only. Counts are partial counts and thus are only a crude index of adult abundance. Source: Grass (2002).

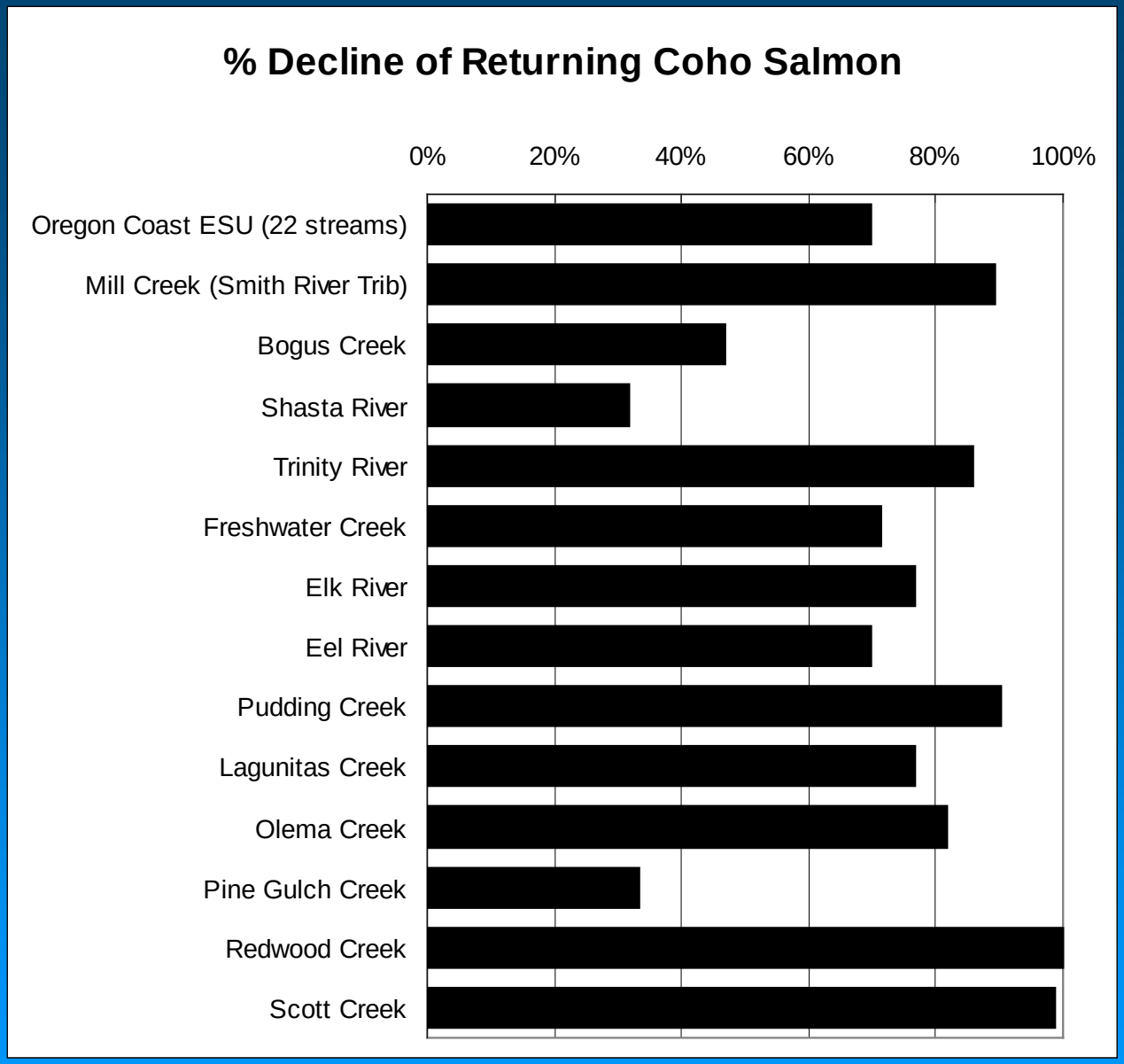


Figure 1. Percent decline of returning coho salmon to streams in California and Oregon 2007/08 relative to returns in 2004/05. Streams listed from north to south.

Chinook

- Spends 1-6 years in the ocean
- Ocean type – leaves freshwater in the Spring
- Stream type – leaves freshwater the following Spring

- Early spawning in coastal streams
- California large rivers have different run timing (Spring Run, Winter Run, Fall Run, Late Fall Run)
- Spawns in low gradient (4% max) mainstems and larger tributaries

Chinook Decline

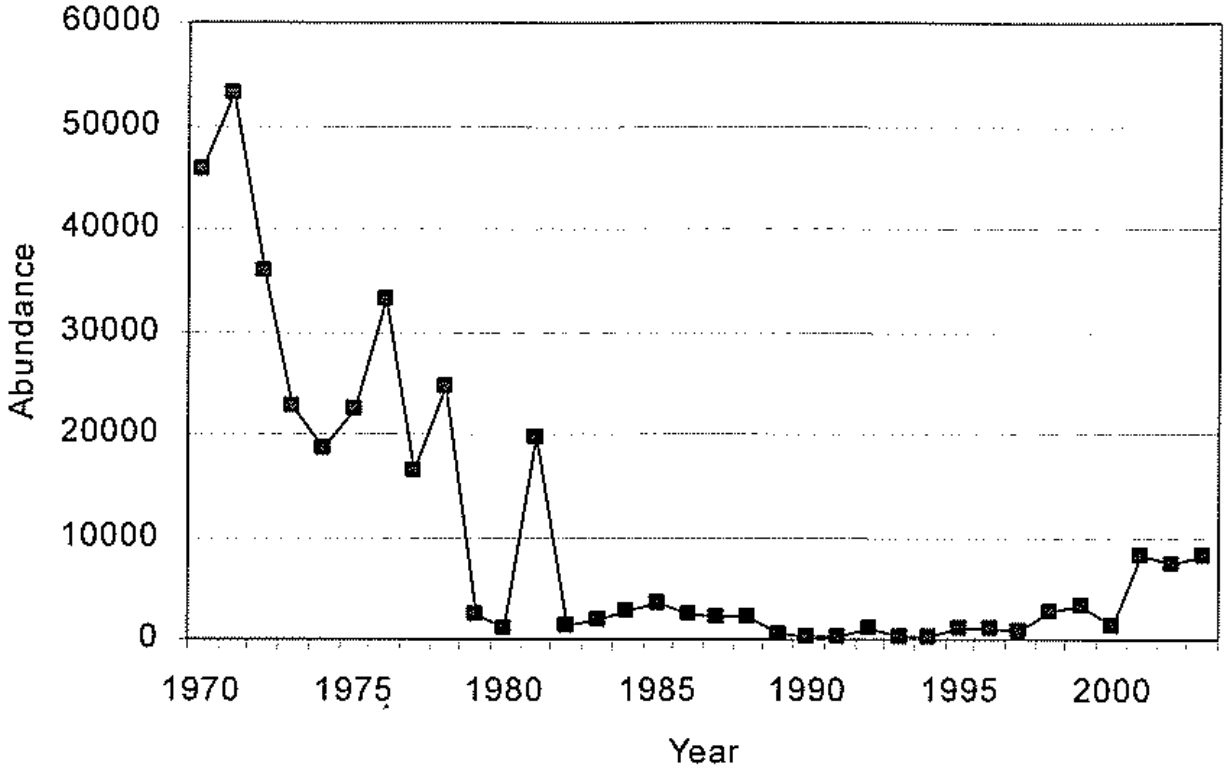


Figure 115. Estimated Sacramento River winter-run Chinook spawner abundance, 1970–2002.

Steelhead

- Spends 1 - 5 years in Freshwater
- Spends 1 - 6 years in the ocean
- Can spawn multiple times
- Can remain in stream (resident)
- Can interbreed with Cutthroat trout
- Found higher in watersheds than salmon (8% grade maximum)

Steelhead Decline

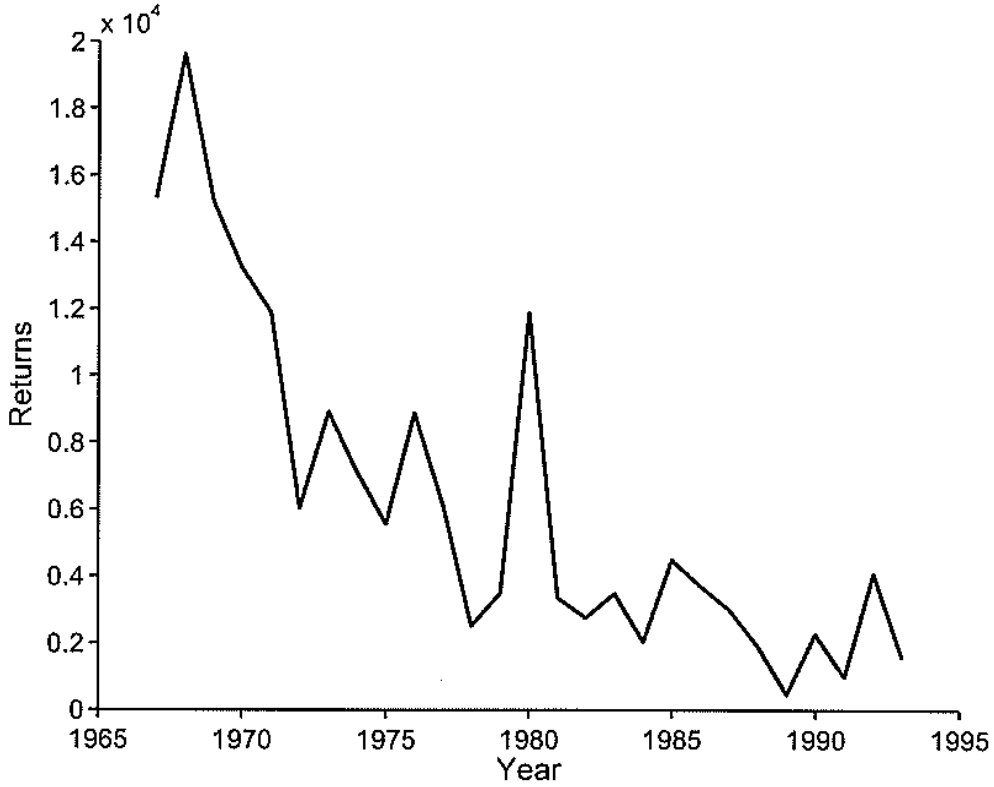


Figure 191. Returns of steelhead passing the Red Bluff Diversion Dam fish ladders, 1966–1994. These fish include hatchery fish from Coleman National Fish Hatchery.

Why Fish Move

Adults

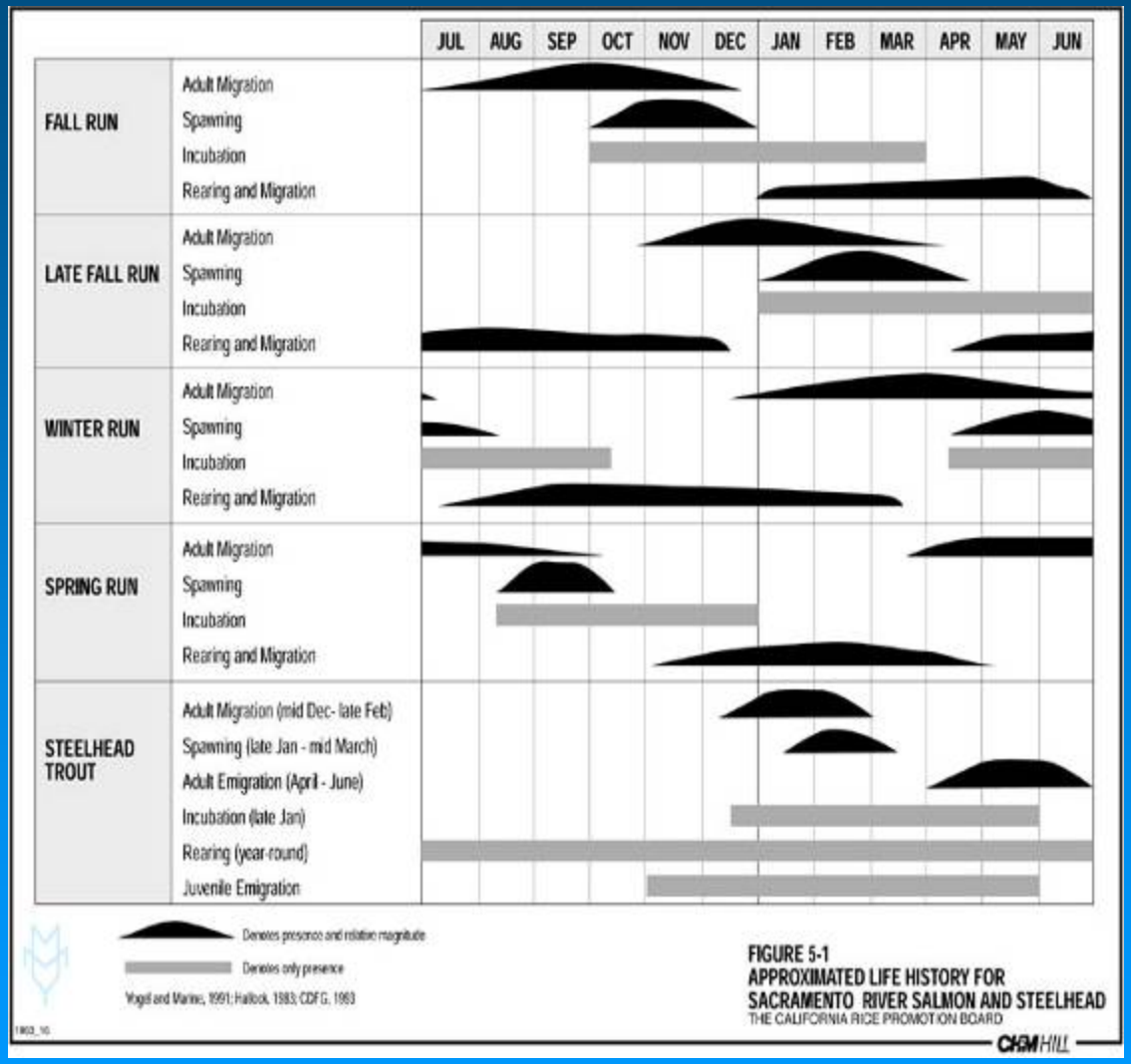
- Migration to spawning habitat
- Spatially separate from competing species and predators
- To avoid superimposition of redds

Juveniles

- Migration to favorable over-wintering habitat
- Following potential food sources upstream
- Summer migration for thermal refugia
- Migration to slower water during storm flows

Migration Timing: Adults and Juveniles

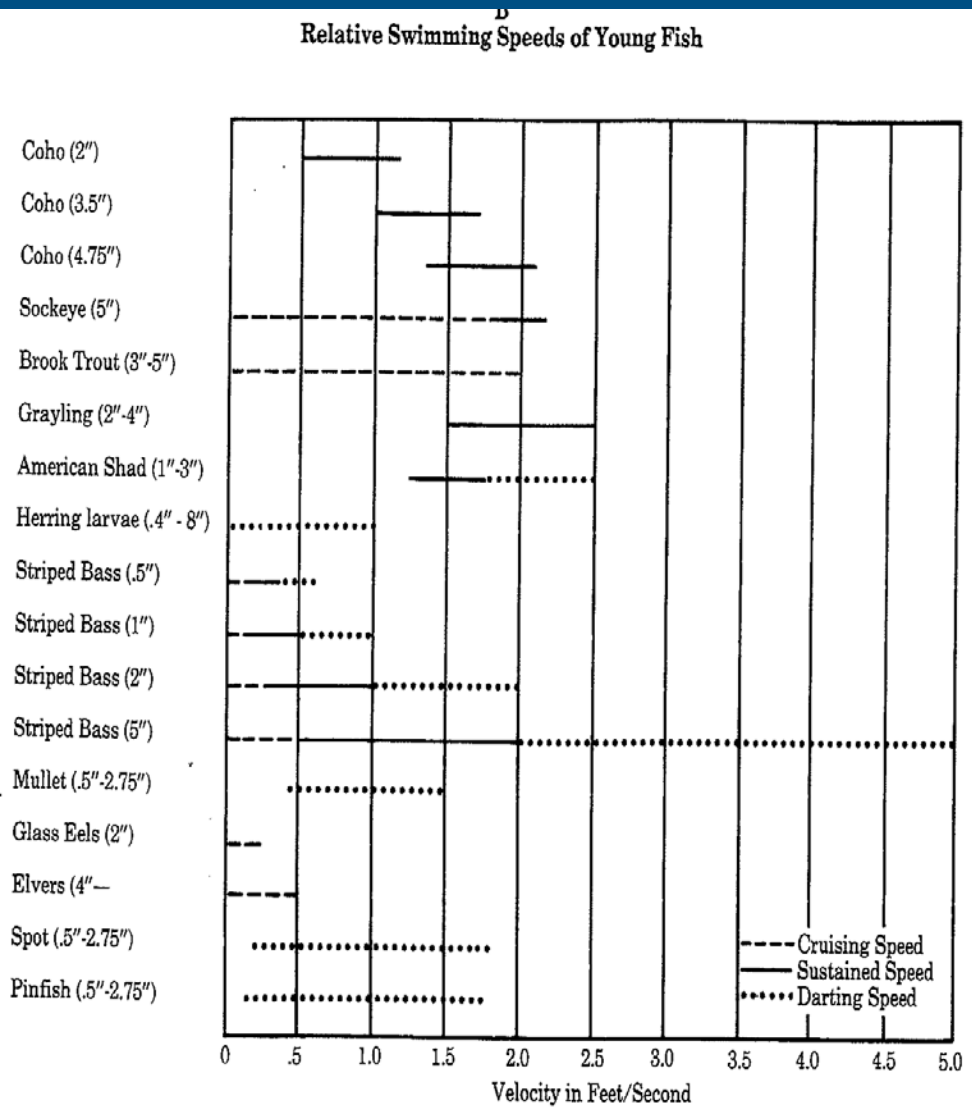
- Triggered by Winter storms and stream discharge
- Migration depends on the magnitude and frequency of storms
- Salmonids tend to migrate on the falling limb of the hydrograph

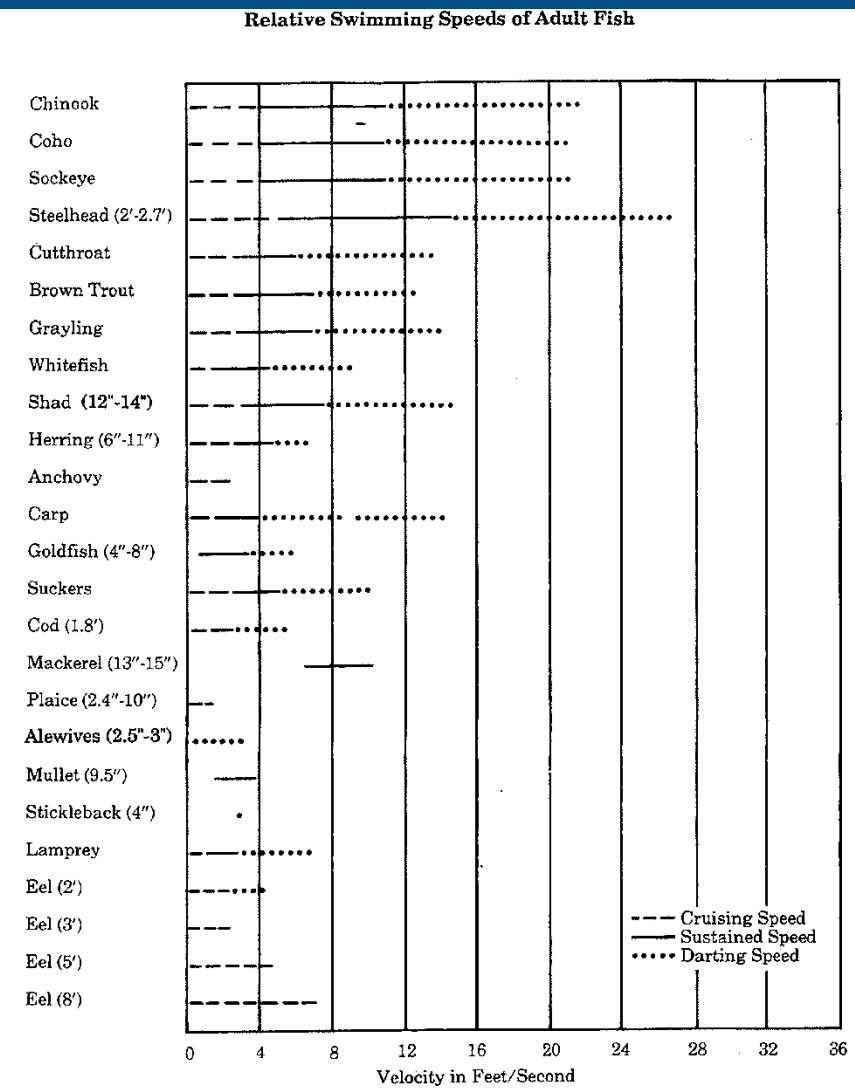


How fish move

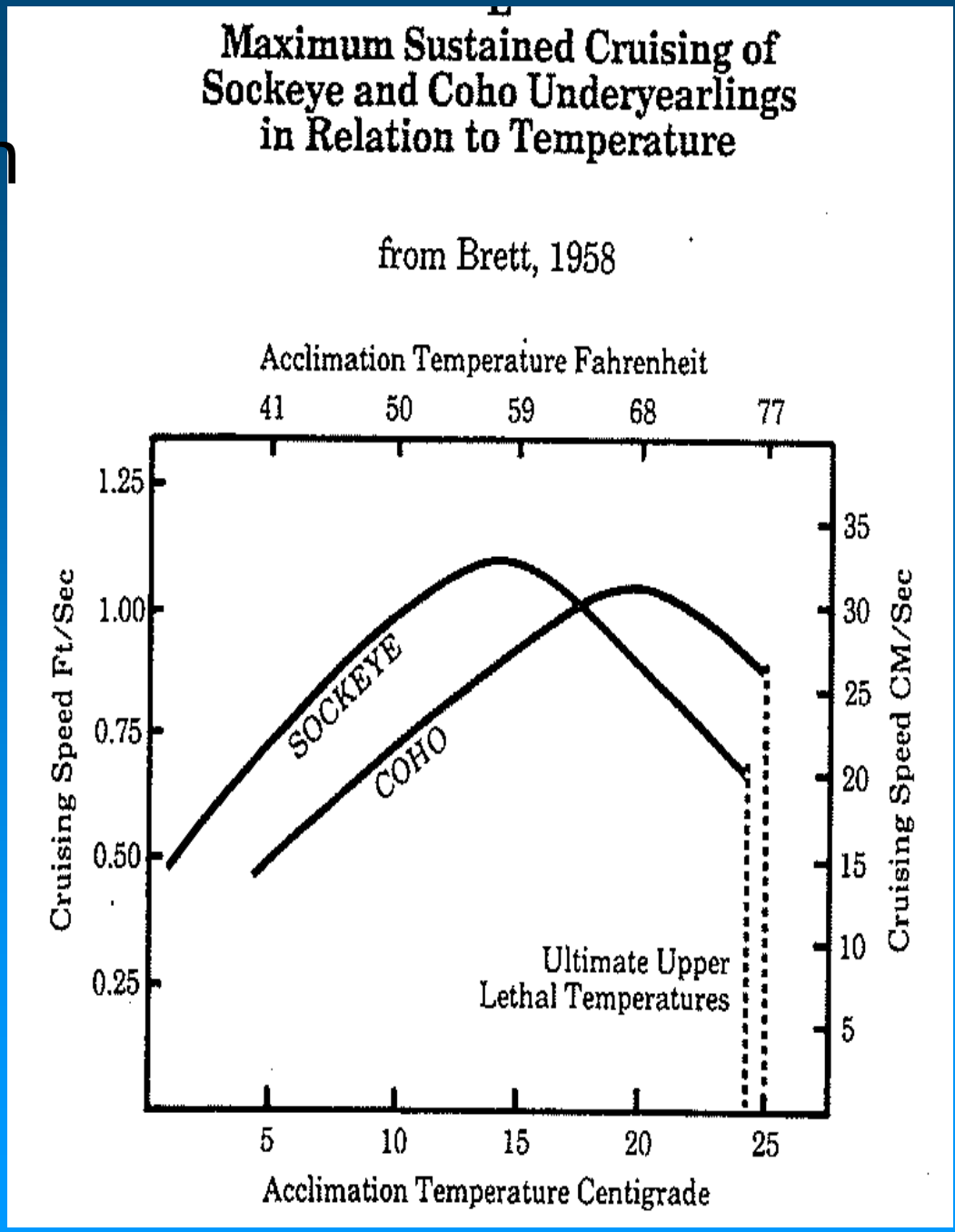
- **Sustained** - speeds that fish can maintain for long periods (>200 minutes)without muscular fatigue
- **Prolonged Swim Speed –** speeds that fish can maintain for 20 seconds to 200 minutes and ends in fatigue. (used for culvert design)
- **Burst** - are the highest speeds attainable by fish and can be maintained for only short periods of time (<20 seconds)
- Velocities must be kept well below the burst speeds to ensure passage
- There is significant variability in swimming speeds and leaping abilities between individual fish

Swimming Speeds (Bell, 1991)





- Recovery time is relatively long for fish with higher burst speeds
- Wood, 1983 found 6 minutes of intensive exercise = 40% mortality
- Swimming speeds are affected by Oxygen levels and temperature



So…What's the problem?

Adults

- Often face multiple barriers within the migration corridor
- Limited tributary access (superimposition)
- Increased occurrence of exhaustion, injury, and predation leading to reduced fitness

Juveniles

- Lack of access to cold water and velocity refugia, food sources, and quality habitat
- Increased predation, decreased fitness

Barrier Types

- Dams (large and small)
- Diversions (pumping, channels)
- Low Flow Crossings
- Grade Control Structures
- Tide gates
- Natural (falls, cascades, log jams)
- Gravel Bars at creek mouths
- Culverts

Barrier Category	Definition	Potential Impacts
Temporal	Impassable to all fish some of the time	Delay in movement beyond the barrier for some period of time
Partial	Impassable to some fish at all times	Exclusion of certain species and lifestages from portions of a watershed
Total	Impassable to all fish at all times	Exclusion of all species from portions of a watershed

High Velocity

Shallow water depth in culvert

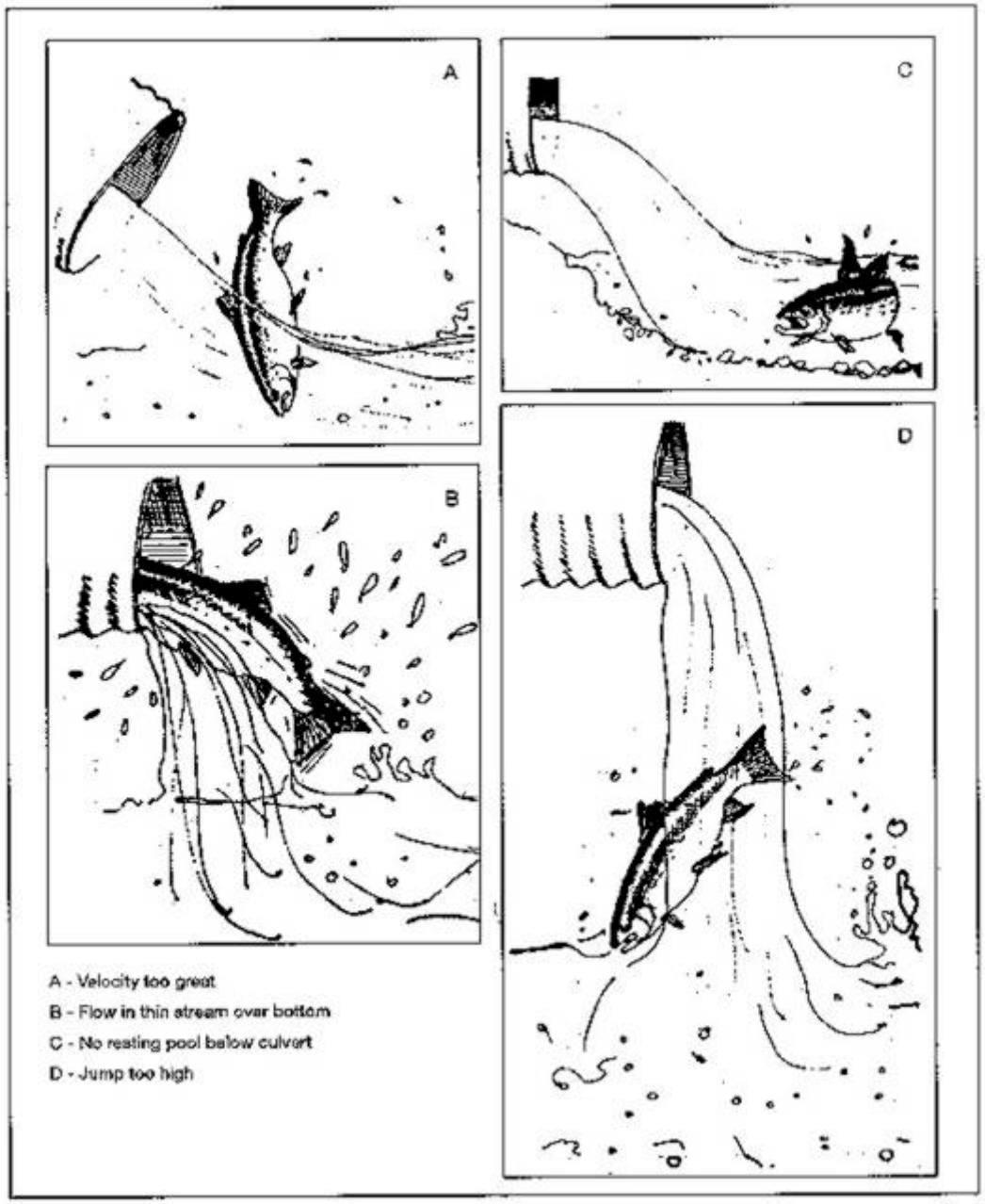


Figure 23. Common conditions that block fish passage. Evans and Johnston, 1980

No jump pool below structure

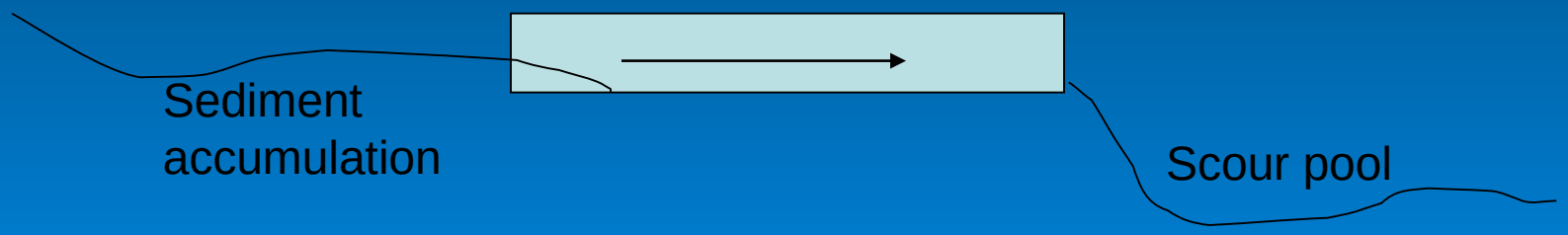
Jump too high

Other problems associated with culverts

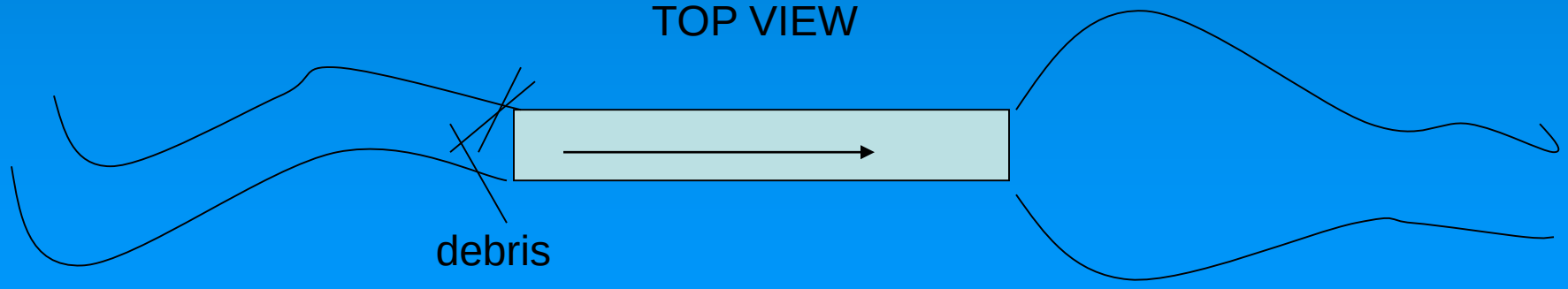
- Interfere with sediment transport processes
  - Debris transport
  - Sediment accumulation at inlet
  - Scour at outlet
- Change channel morphology
- Degrade fish habitat quality
- Interrupt Floodplain connectivity
- Increase flooding and road failure
- Frequent and costly maintenance

Channel problems resulting from stream crossings

SIDE VIEW



TOP VIEW

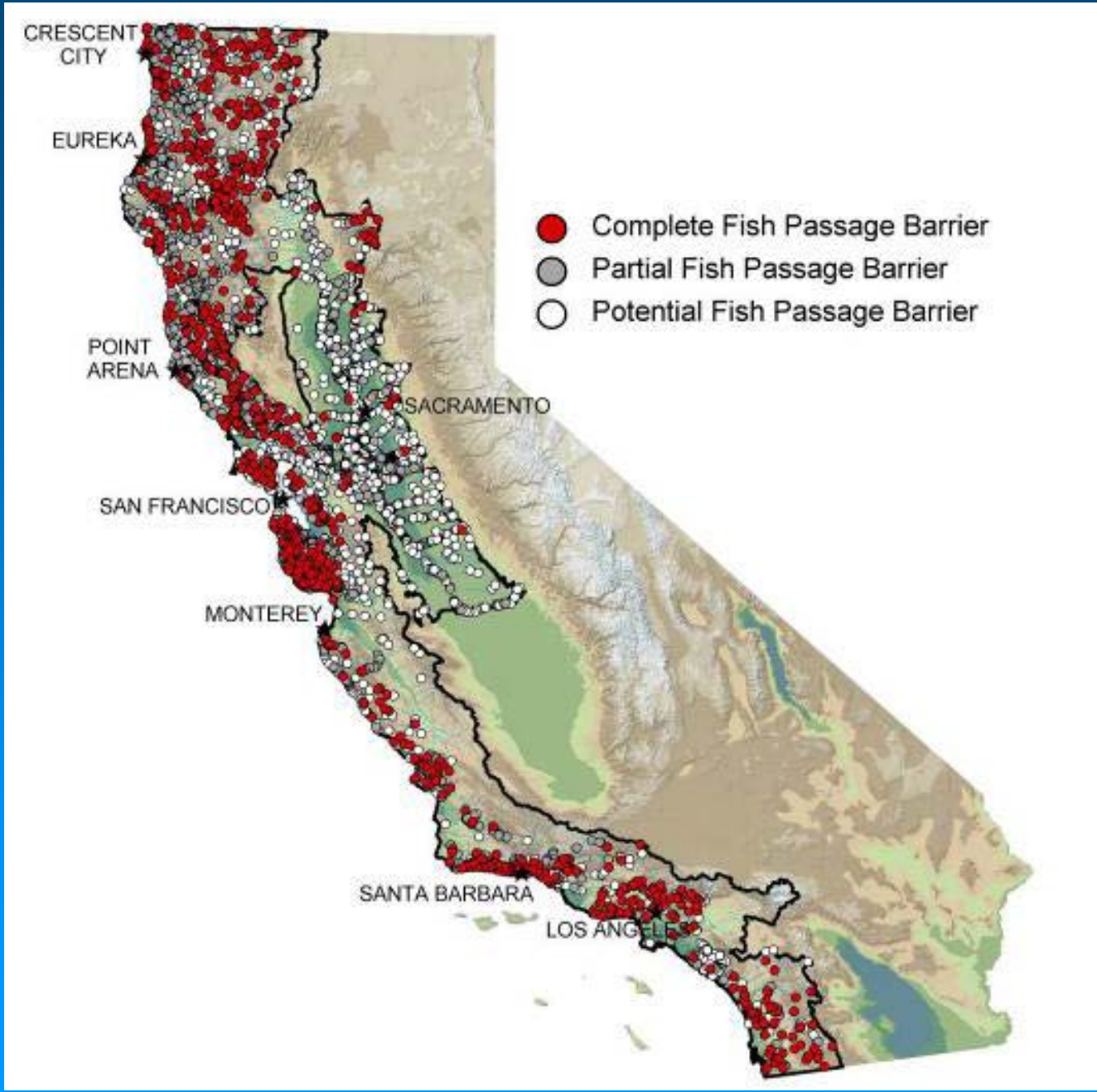


1/22/2001

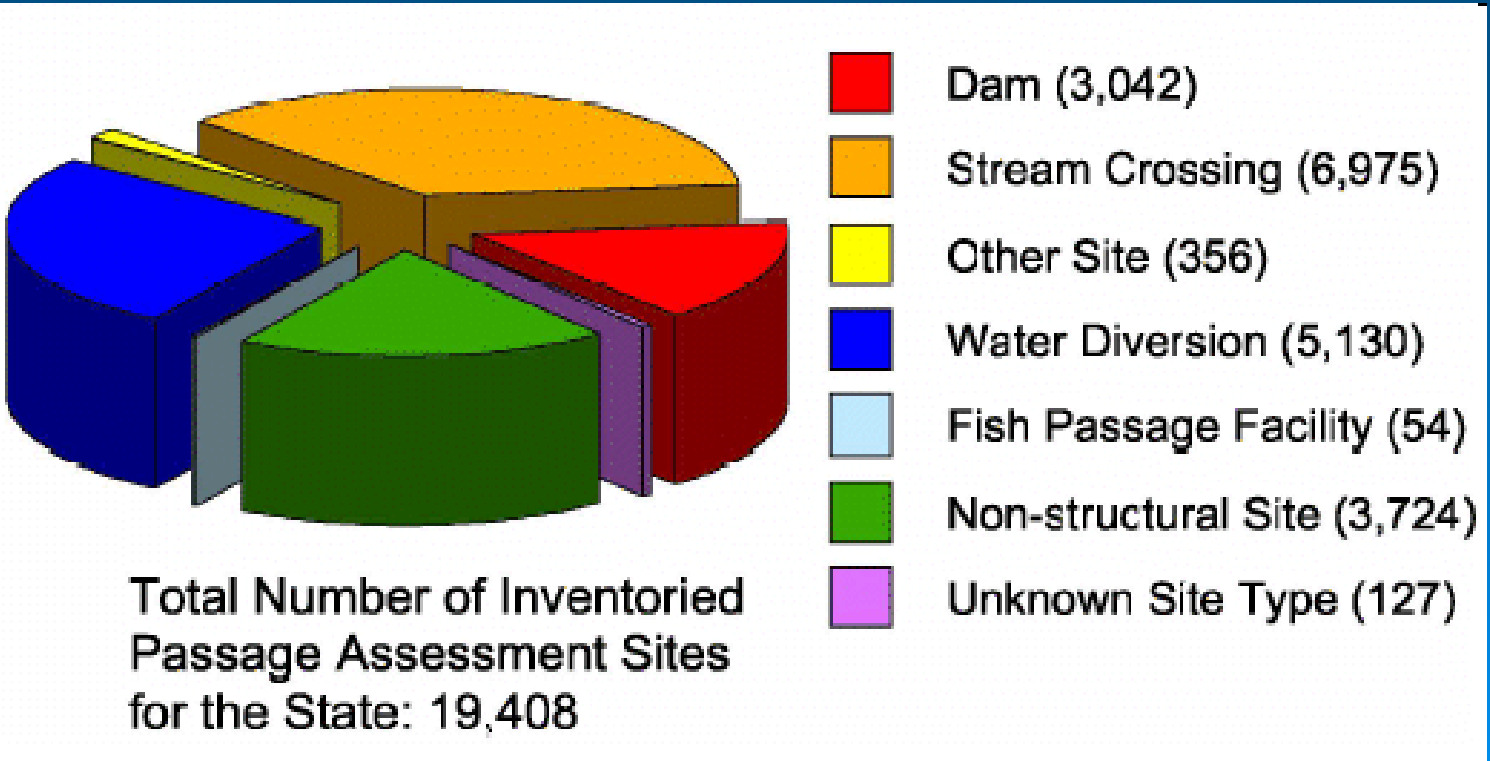
Complete failure due to debris loading

Delivered a massive pulse of fine sediment degrading habitat downstream

How Bad Is the Problem?

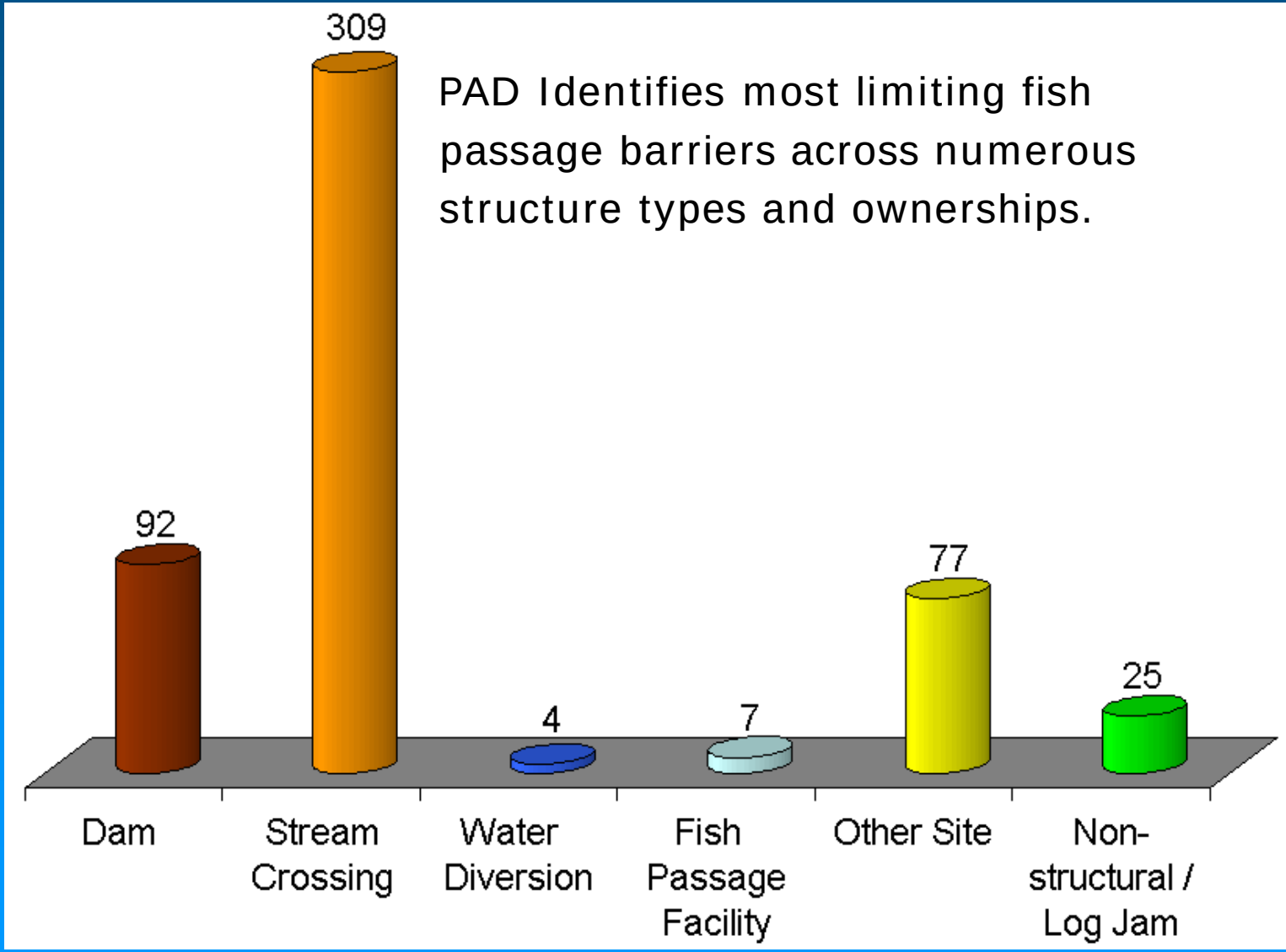


Crossings…A Big Slice of Pie



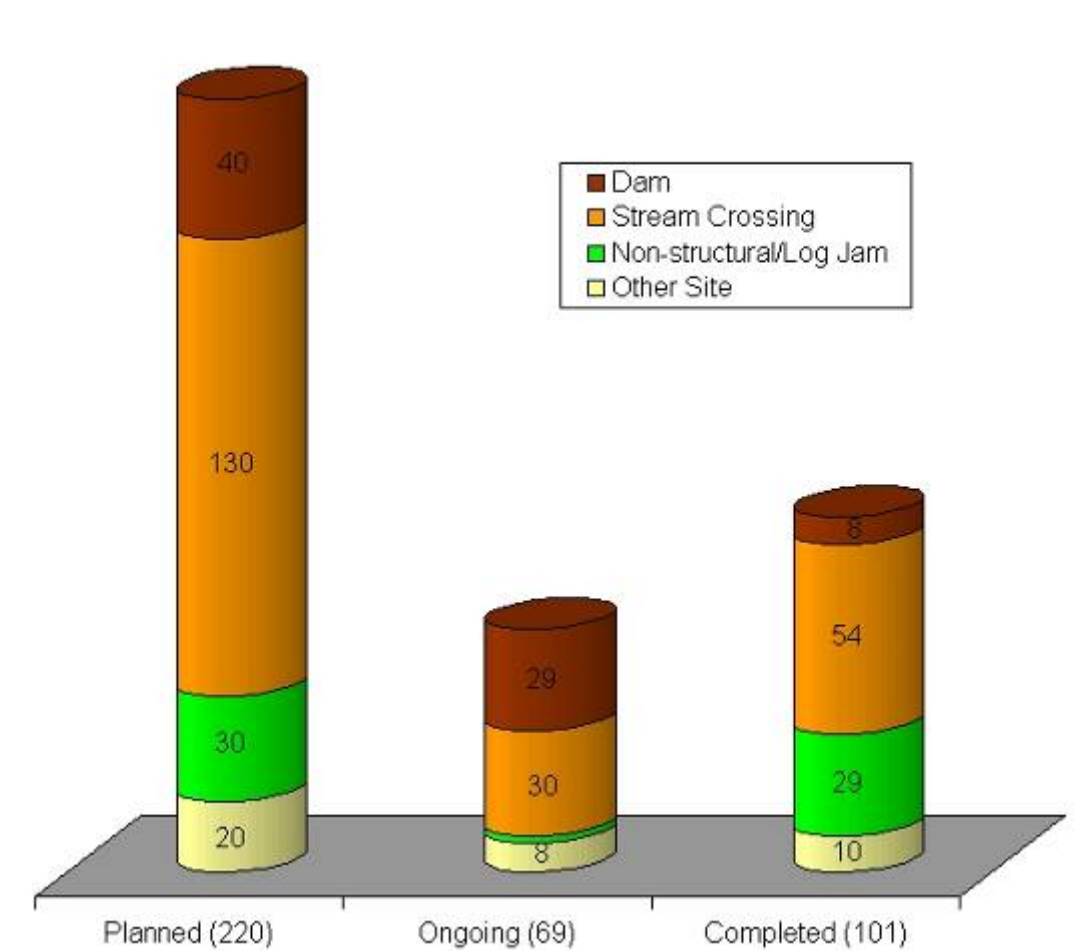
A statewide inventory of known and potential barriers to anadromous fish was initiated as an inter-agency cooperative project by the State Coastal Conservancy, Department of Fish and Game and others.

High Priority Barriers by Type



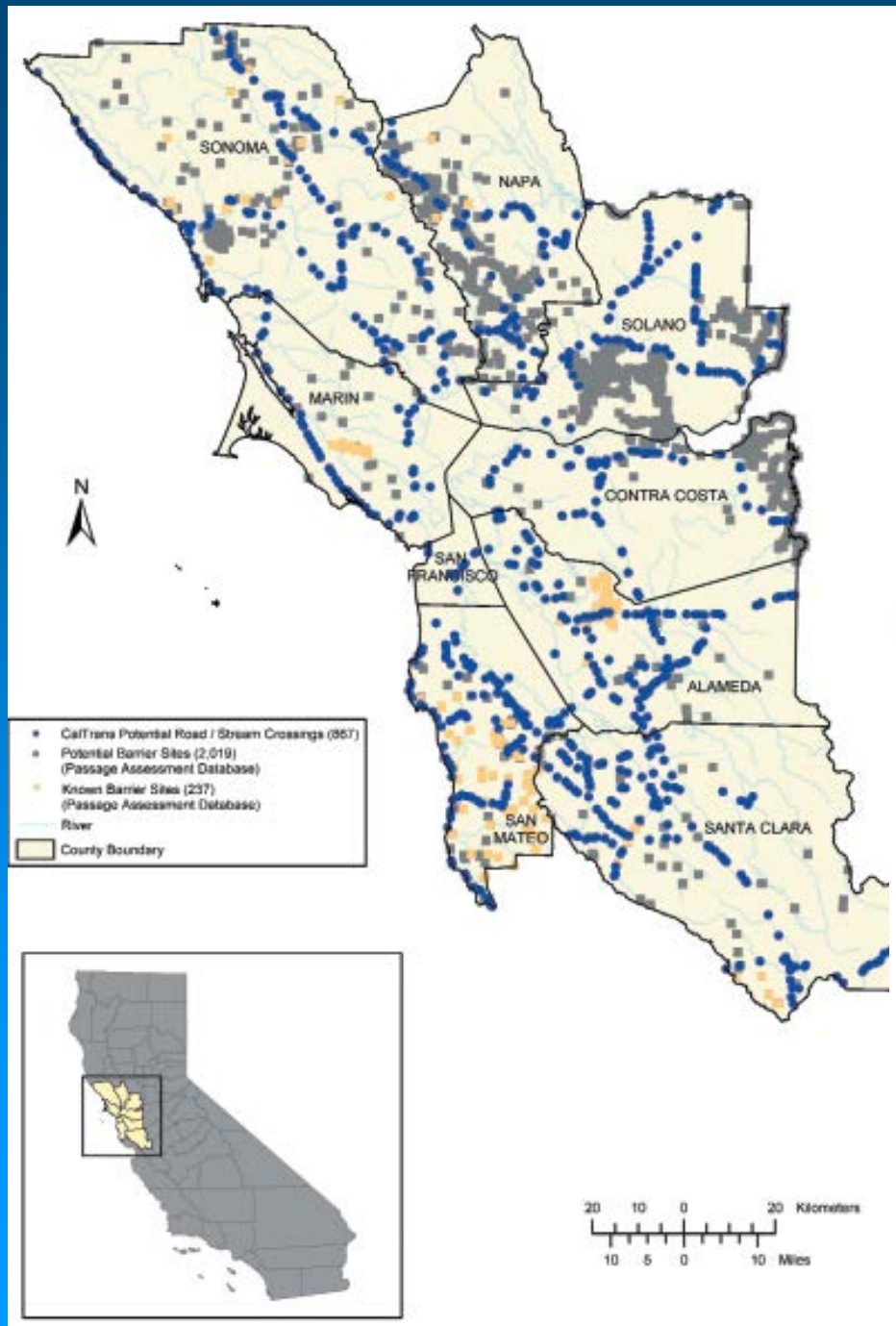
PAD Identifies most limiting fish passage barriers across numerous structure types and ownerships.

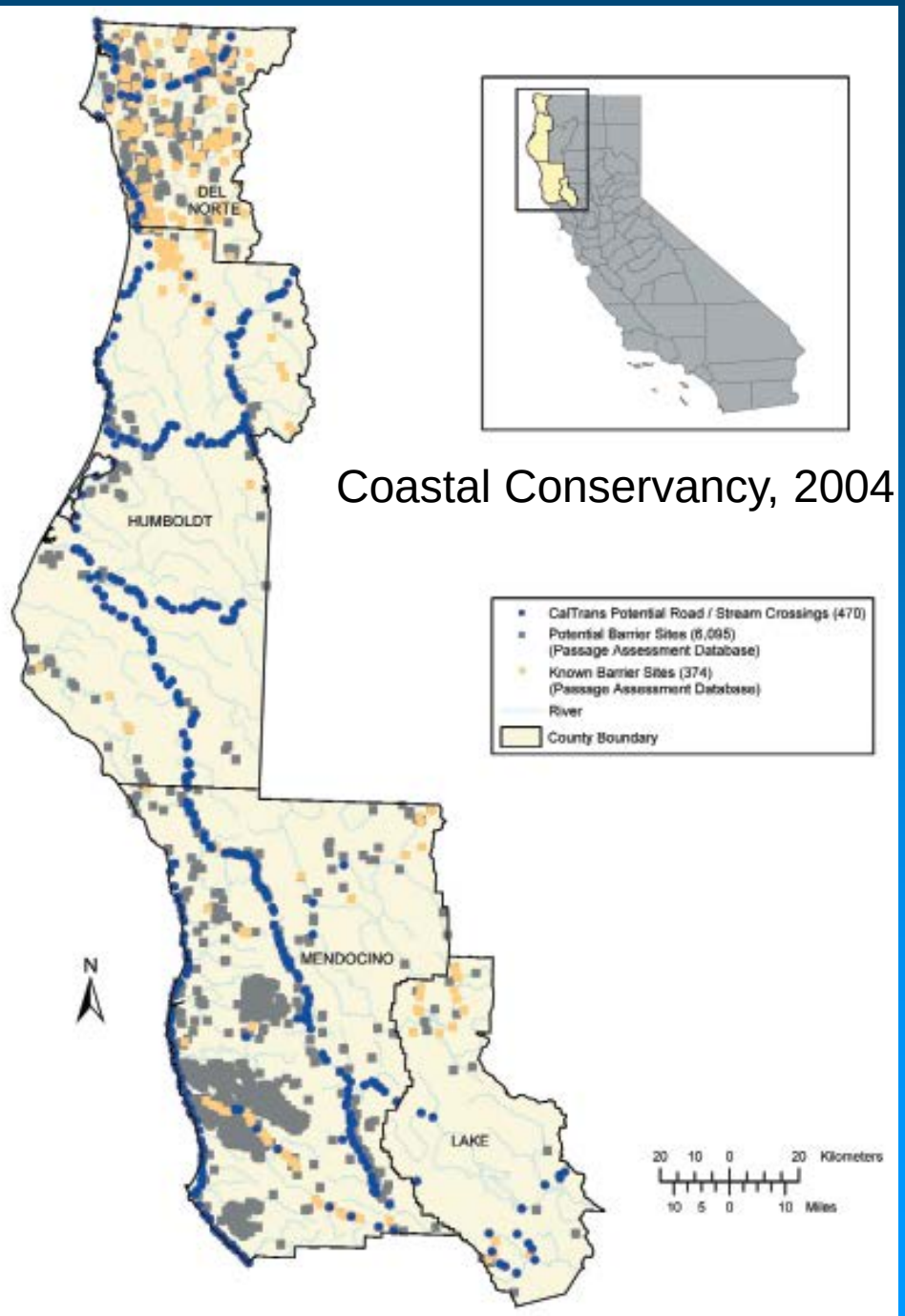
Fish Passage Restoration Projects



Landowner prioritization efforts

- Counties- all CA coastal county road barriers have been assessed and prioritized on a county by county basis
  - Fishnet 4-c and 5- counties salmonid conservation program
  - Most Counties removing 1-3 barriers/year
- US Forest Service
  - Has majority of inventories completed for Northern Forests
- State Parks
  - Northern California has identified, prioritized, and begun removing barriers
- Private
  - Timber Companies
  - small private roads and driveways
- California Department of Transportation (Caltrans)
  - 9,912 stream crossings
  - Working on assessments and prioritization





Coastal Conservancy, 2004

- 9912 anadromous stream crossings
- 8794 Potential Barriers
- 985 Known Barriers

We need your help!

Efforts to Assess and Prioritize Barriers

- SB 857
  - Annual reporting on status of locating, assessing and remediating barriers
  - Complete assessments prior to implementing projects
  - Construction without new barriers
- District 1 Assessment – Completed 2005
- District 2 Assessment – looking for $$$
- District 4 Assessment – DWR is finalizing assessment
- South of the Bay Area – Focusing on high priority watersheds

Funding for Fish Passage Restoration

- NOAA Community-based Restoration Program
- US Fish and Wildlife Service
- California Department of Fish and Game
- California Coastal Conservancy
- FHWA
- Federal Stimulus Plan
- Road Owners

Where are we going?

- Continue to fix barriers while:
- Complete assessments
- Integrate barrier knowledge with
  - Watershed context
  - Population Context
- Further prioritize using integrated data
- Work towards recovery

What Can Caltrans Do?

Encourage natural conditions (open bottom culverts, bridges, etc..) when designing projects

Keep your eyes open for passage issues in the field and coordinate with maintenance crews and agencies

Work early and often with resource agencies and the design team to ensure fish-friendly projects

A new generation of fish friendly stream crossings!