

Jun 21st, 10:30 AM - 11:30 AM

## Keynote Address: Consider the Upstream Habitat: Providing Passage while Protecting Streams from Channel Incision

Michael Love  
*Michael Love & Associates*

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# Consider the Upstream Habitat

## Providing Passage while Protecting Streams from Channel Incision



Humboldt State University

Hwy 96, Klamath River Tributary, California

**Michael Love P.E.**  
Arcata, California  
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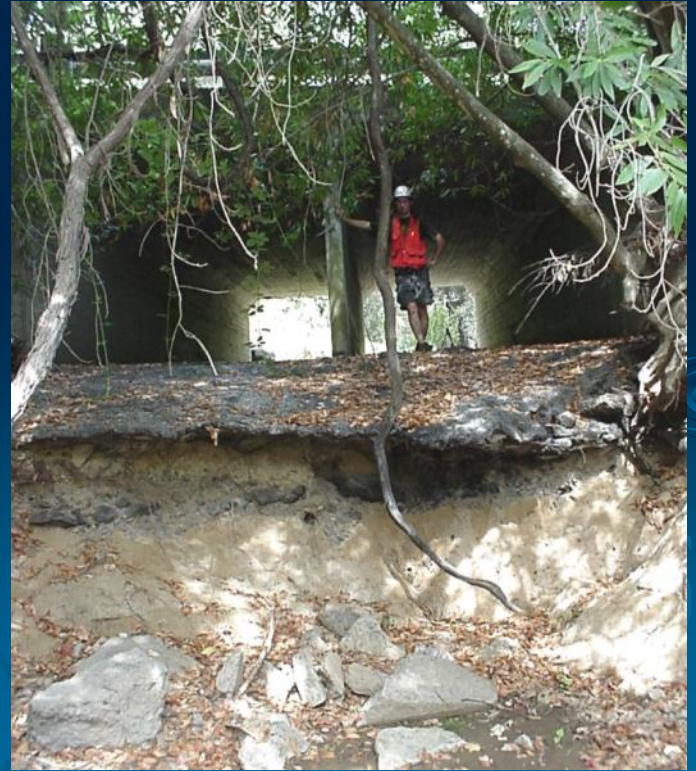


**Michael Love & Associates**

*Hydrologic Solutions*



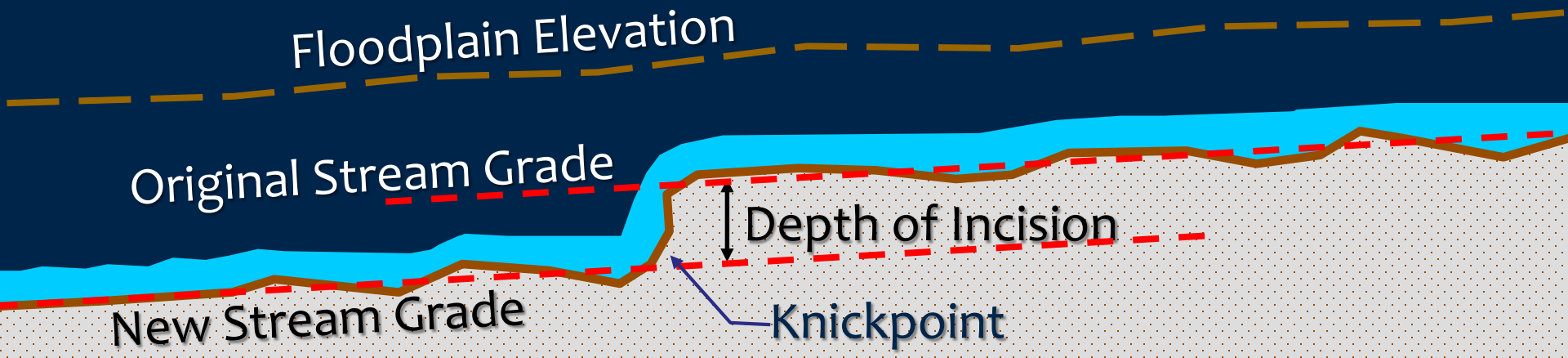




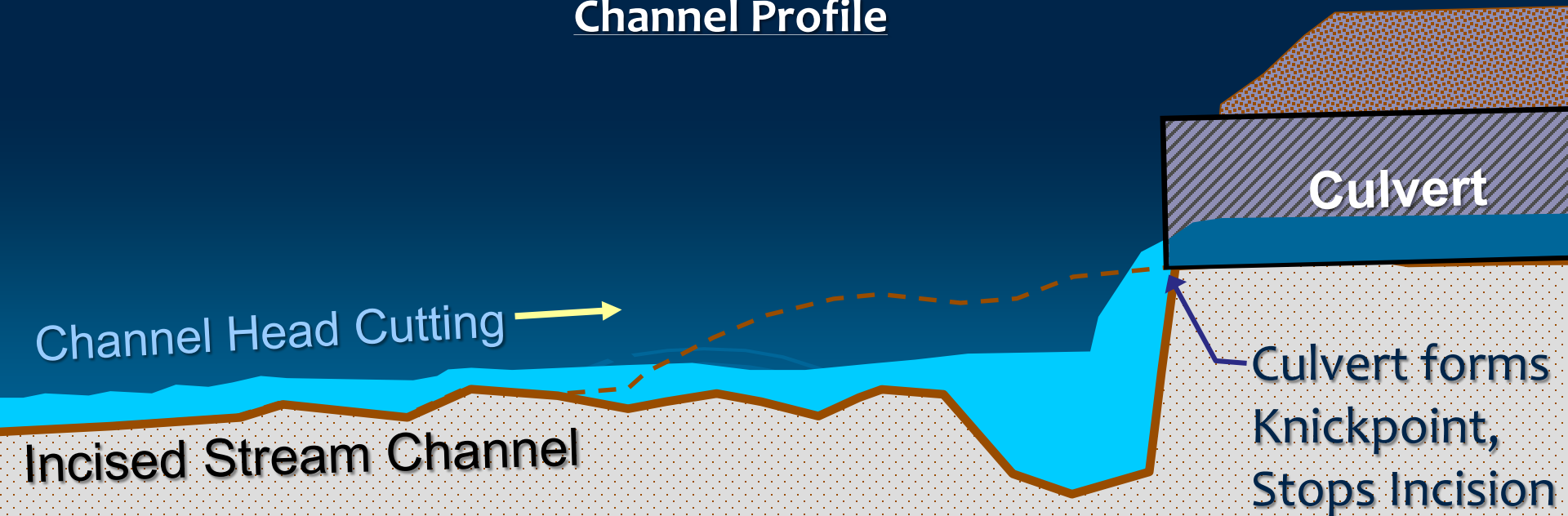
Photos: Ross Taylor



# Process of Incision: Headwater Migration



## Channel Profile



# Channel Incision is a Natural Process, but...



Eagle Canyon, Battle Creek, California

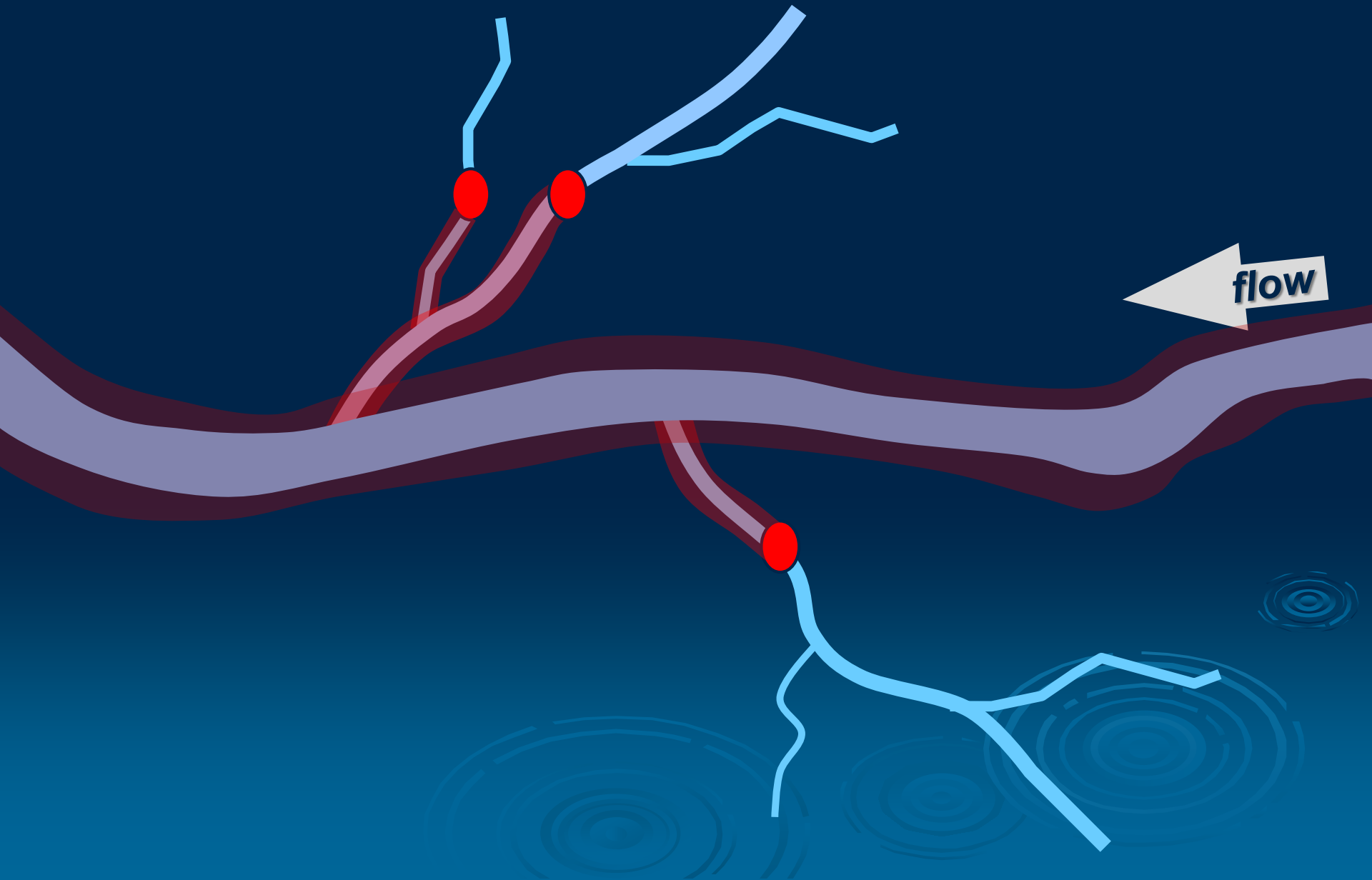


# We Initiate of the Incision More often then Not



Photo from US Army Corps of Engineers

# Incision Often Moves Headward into Tributaries





# Knickpoints Create Fish Barriers

## Culverts



1979 – Siegel Creek, LNF

1998 – Siegel Creek, LNF





# Knickpoints Create Fish Barriers

## Utility Crossings



Arroyo Trabuco, California



# Knickpoints Create Fish Barriers

## Bridges with Aprons



*Napa River, California*



# Knickpoints Create Fish Barriers

## Fishway Entrances





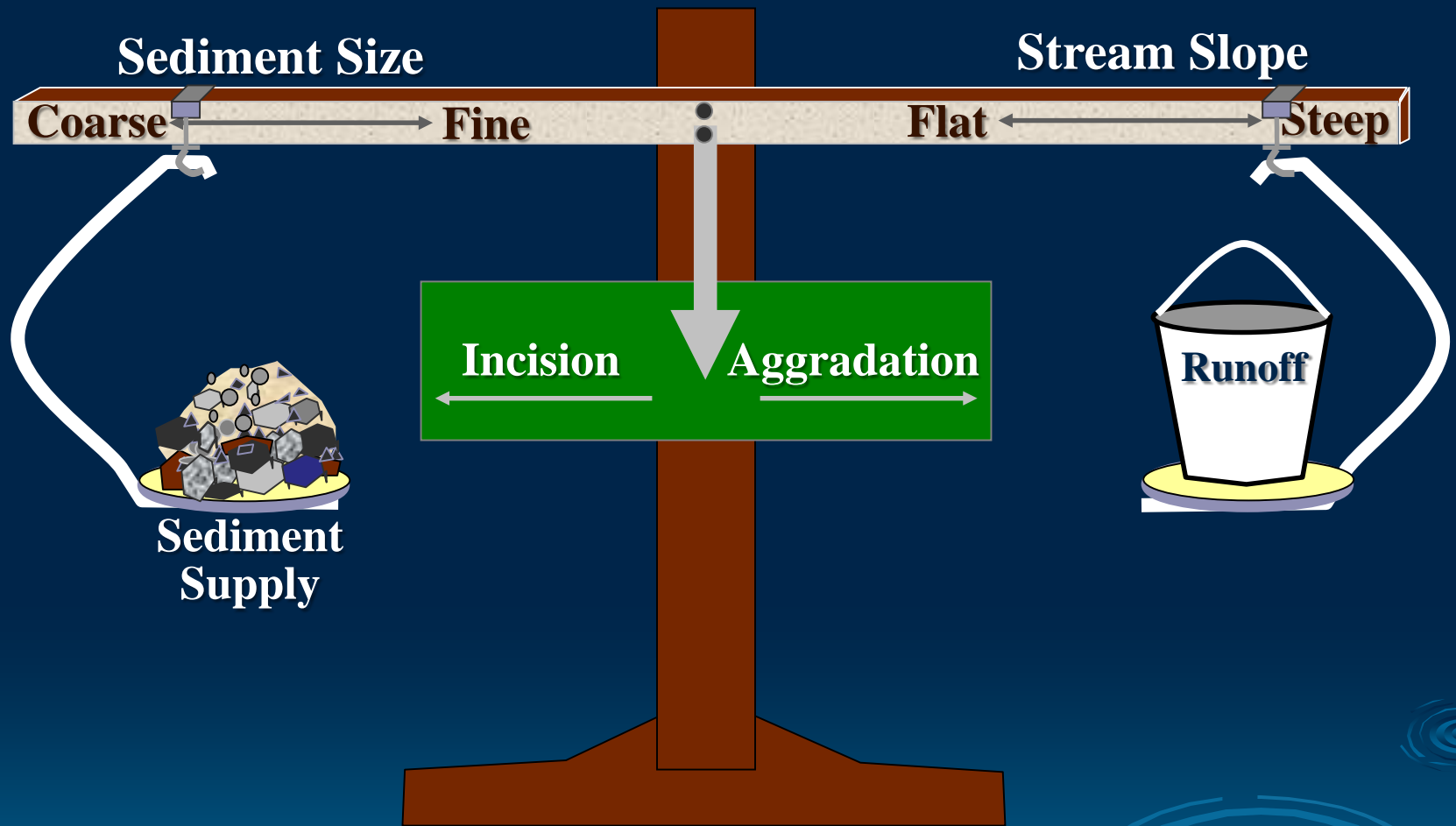
# Knickpoints Create Fish Barriers

## Small Dams



*Santa Barbara County, California*

# Dynamic Equilibrium and Causes of Incision





# Some Causes of Channel Incision

## Channelization (Increased Slope)



from: Yorkshire River Trust



# Some Causes of Channel Incision

## Changes in Hydrology (Increased Runoff)



Urbanization



Conversion to Agriculture



Roads Extending  
Drainage Density  
and “quick-flow”



# Some Causes of Channel Incision

Others

Dams and Debris Basins

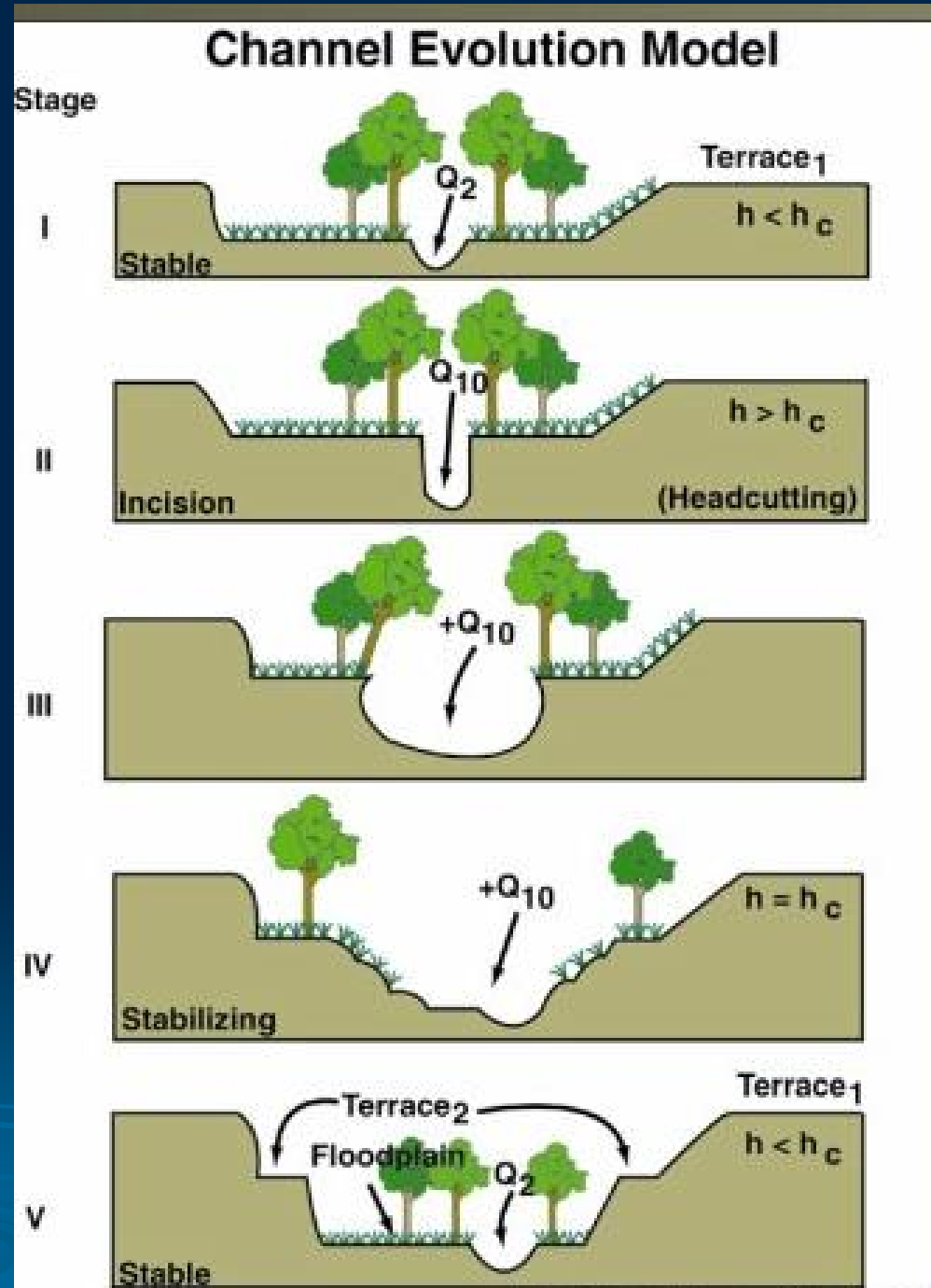
Gravel Extraction

“Stream Cleaning”

Removal of Beavers



# Channel Evolution Model (CEM)



from Schumm, Harvey, and Watson. 1984.

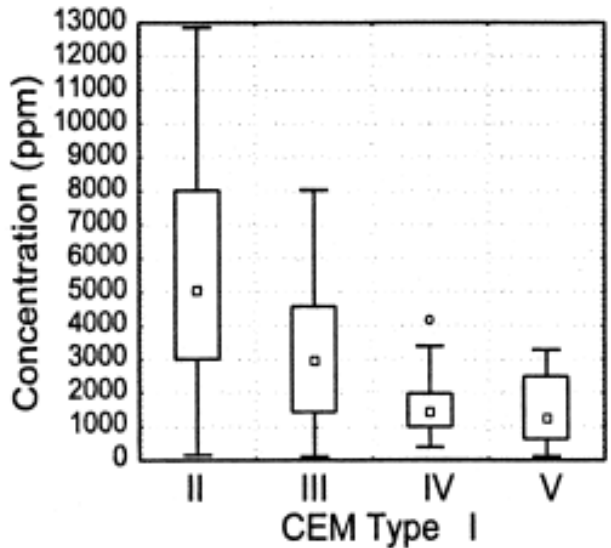
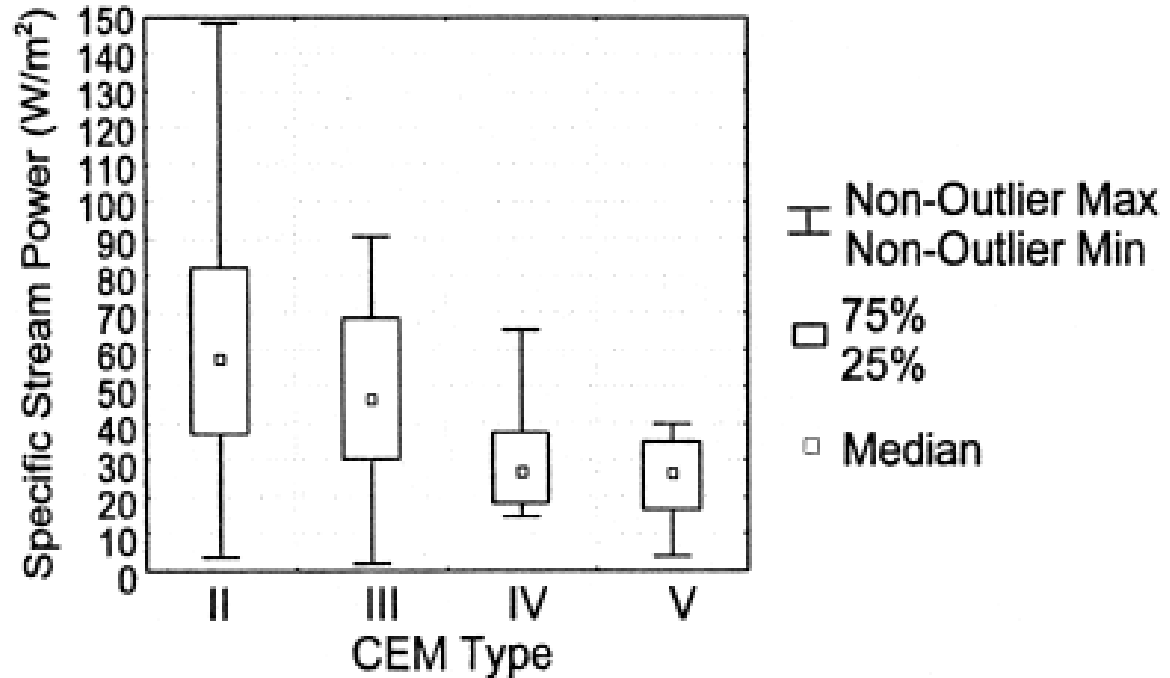
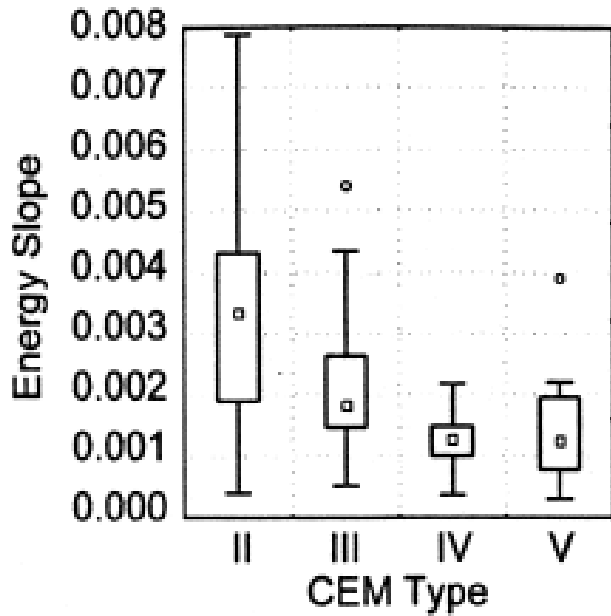




Incising Channel, Toby Tubby Creek Watershed, Mississippi



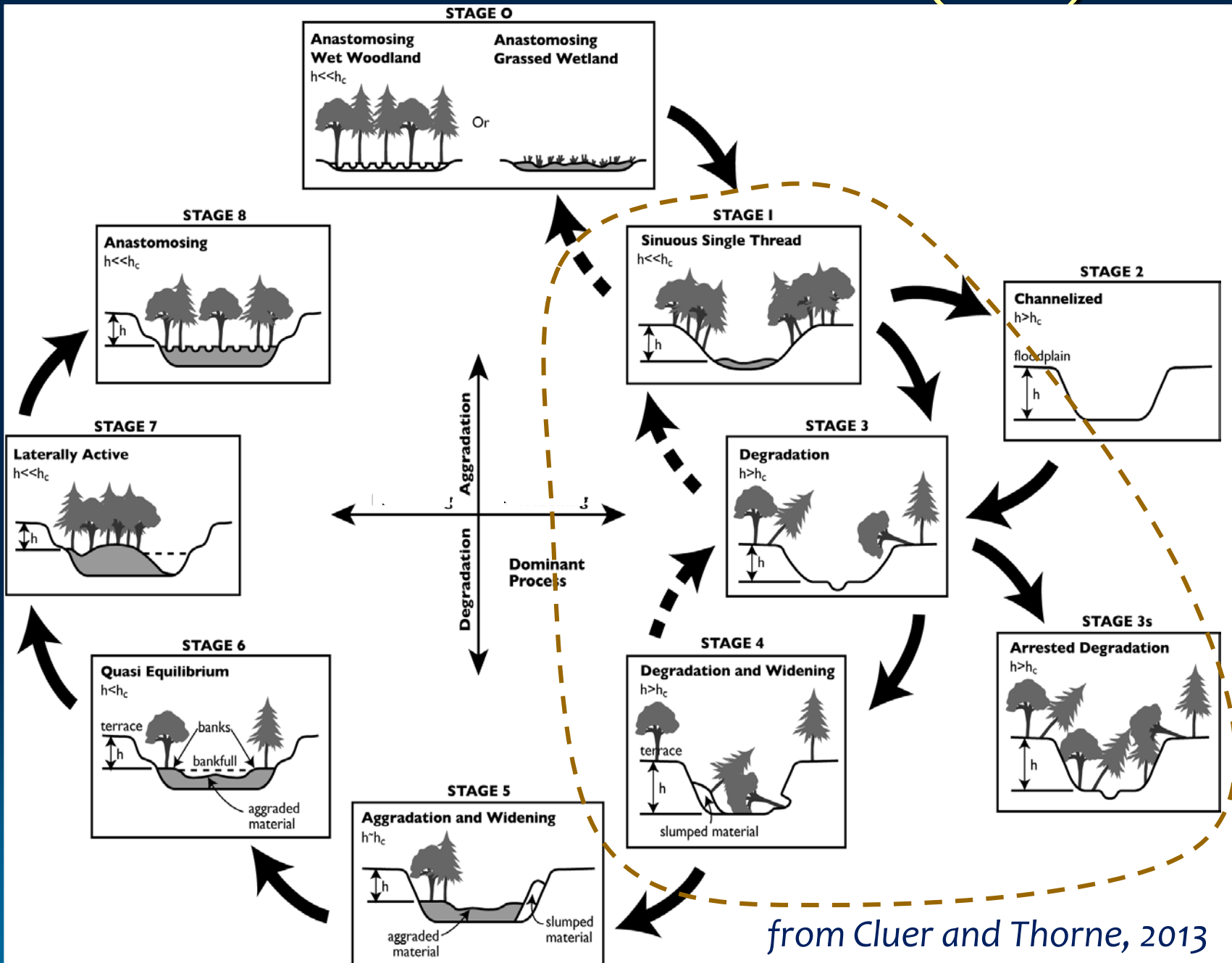
# Water Quality and Hydraulics vs CEM Type



from: Bledsoe et al., 2002



# Stream Evolution Model (SEM)



Multiple Paths  
Dead Ends



# Stream Evolutionary Stage vs. Ecological Benefits

STAGE 0

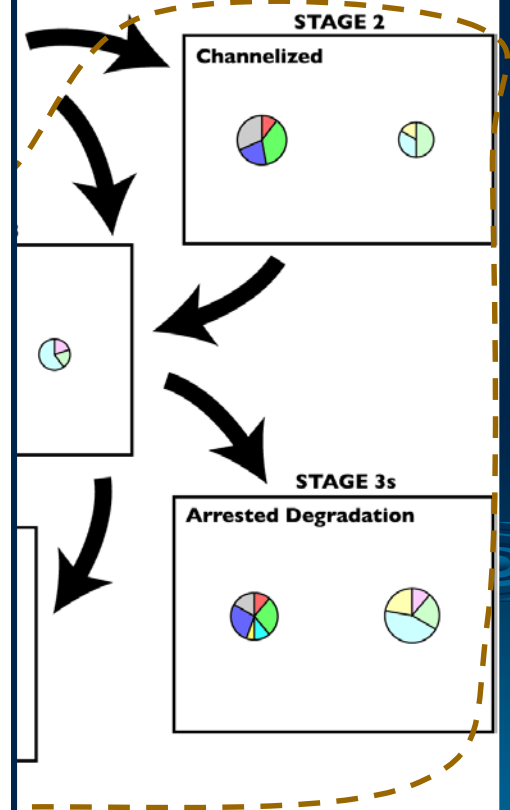
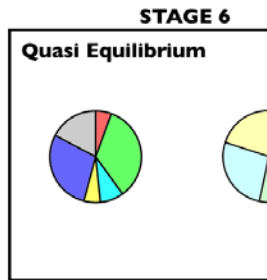
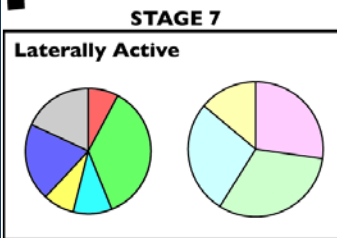
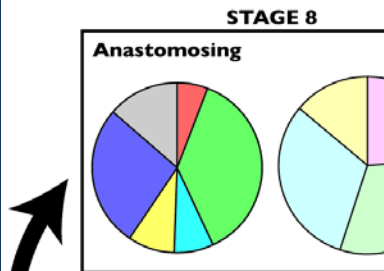
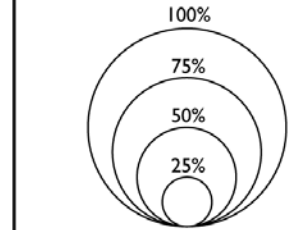
## Hydrogeomorphic Attributes Table

- Physical Channel Dimensions
- Channel and Floodplain Features
- Substrate
- Hydraulics
- Vegetation
- Hydrological Regime

## Habitats and Ecosystem Benefits Table

- Habitat
- Water Quality
- Biota
- Resilience

Key to percentage of benefits



er and Thorne, 2013



# The Stream Channel Incision Syndrome

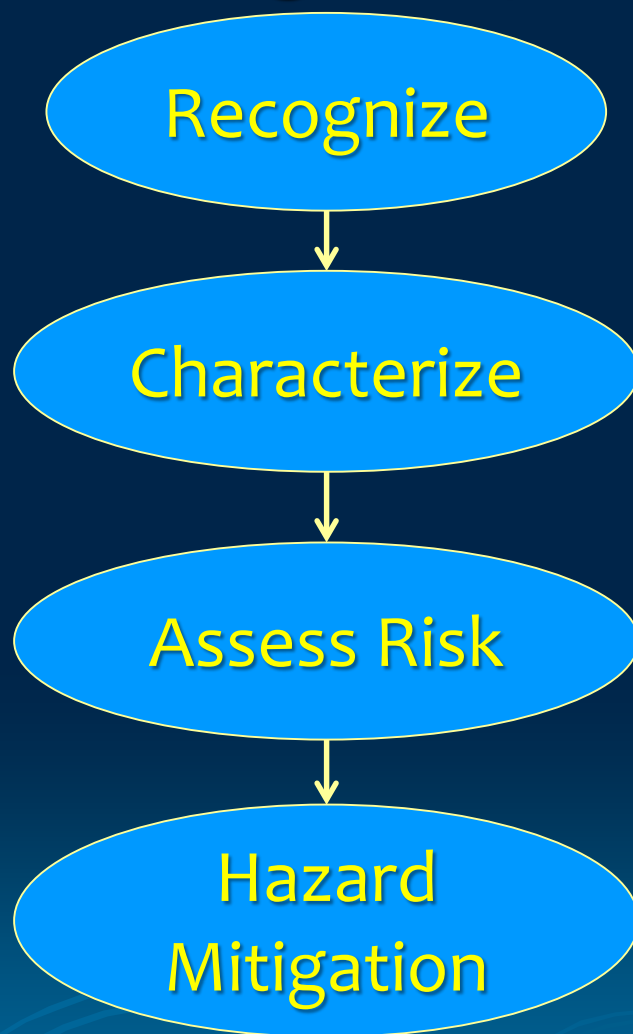
## Loss of Habitat and Ecosystem Benefits

“We conclude channel incision presents a syndrome that is characterized by perturbed hydrology, degraded physical habitat, elevated nonpoint source pollution, and depleted fish species richness and that is extremely deleterious to instream ecosystem services.”

Shields et al. 2010. *The stream channel incision syndrome and water quality*. Journal of Ecological Engineering



# Incorporating Incision Risk Assessments into Passage Projects



**Resource:** Castro, Janine. 2003. *Geomorphic Impacts of Culvert Replacement and Removal: Avoiding Channel Incision*. USFWS



# Restoring Connectivity **but** Allowing Incision to Migrate Upstream

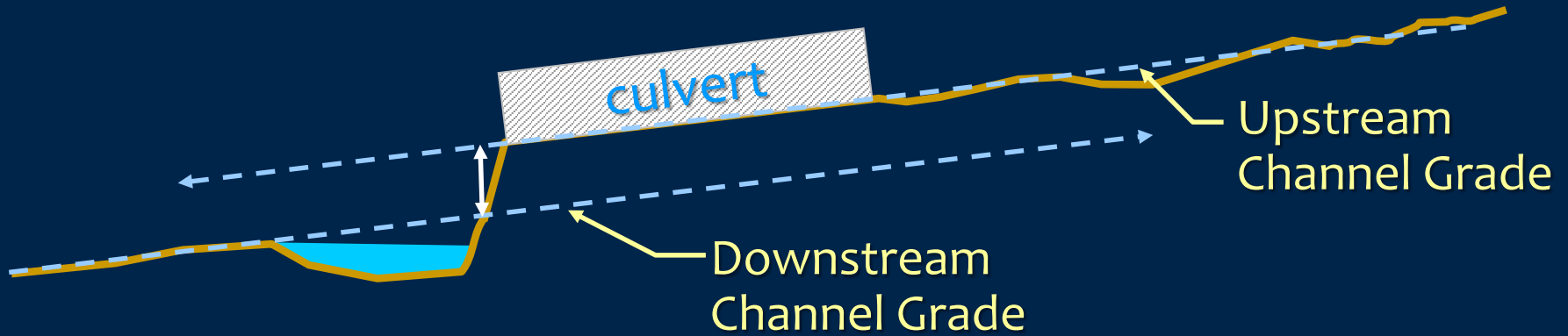


Jordan Creek at  
Parkway Drive



# Incision vs. Local Scour

Drop result of Incising Channel



Drop formed by Plunge Pool  
(Localized Scour)





# Incision or Local Scour?

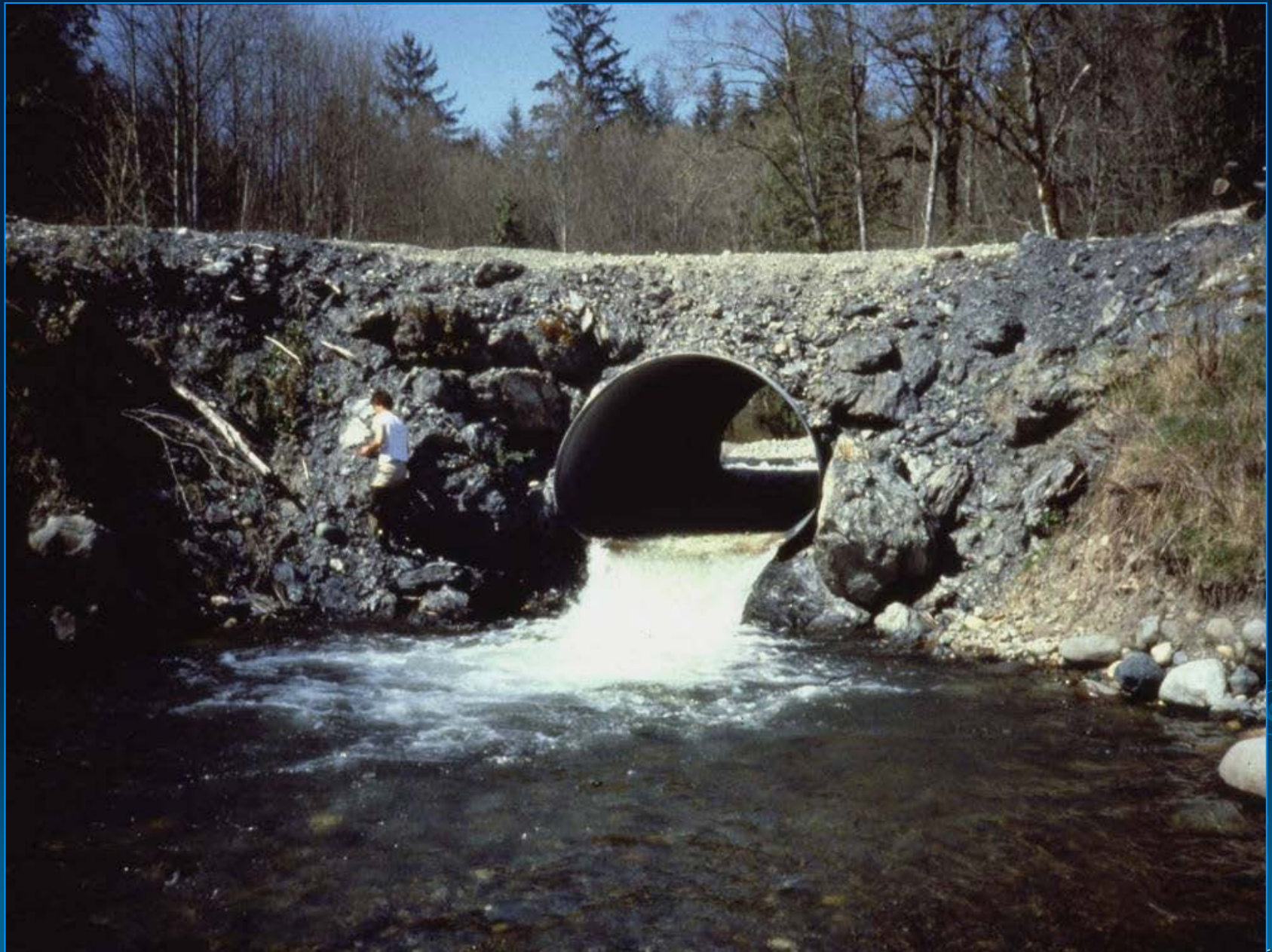


photo: Kozmo Bates



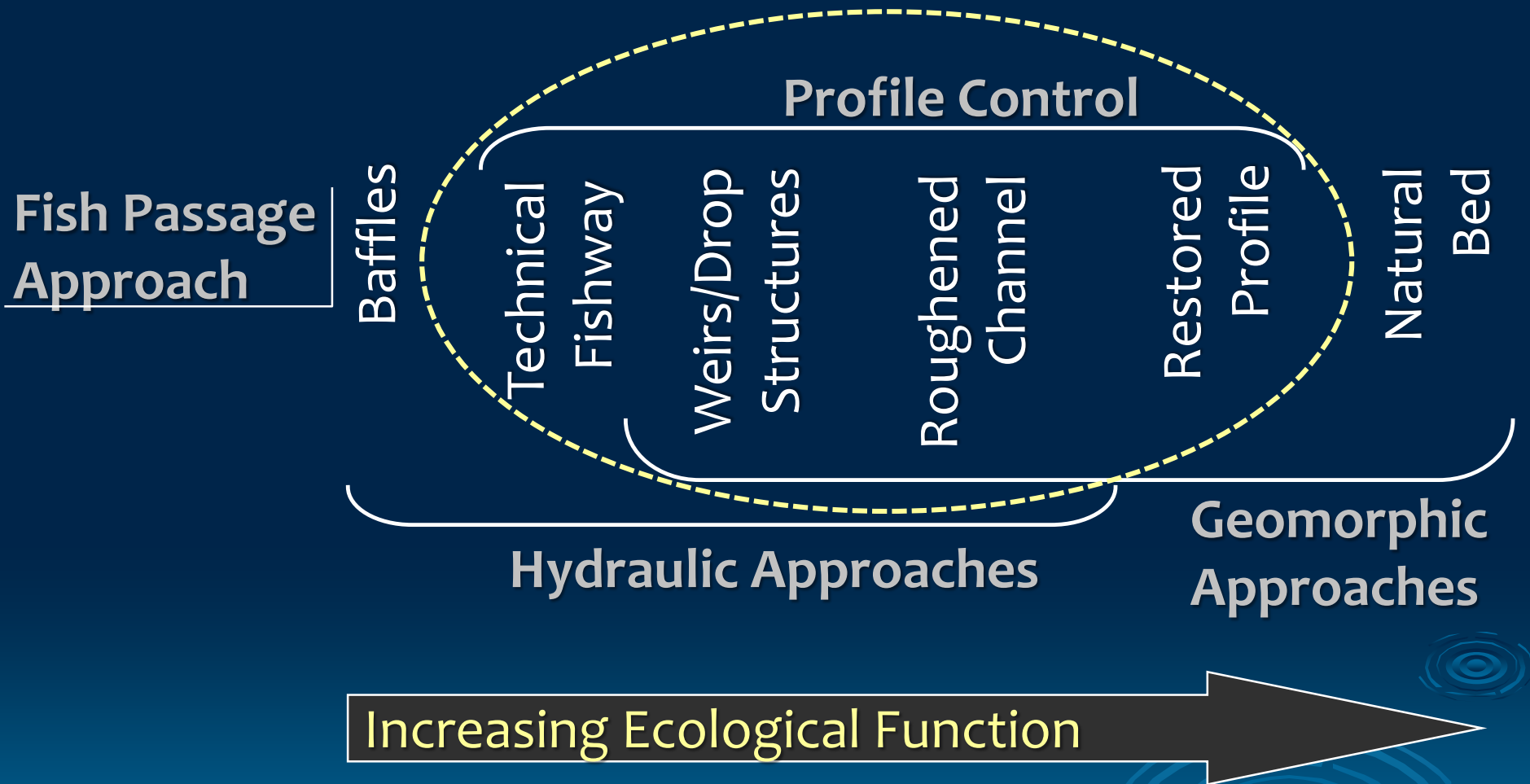
From further downstream



photo: Kozmo Bates



# Tools for Restoring Aquatic Connectivity



# Restoring Incised Channels and Connectivity

## Placing Wood - Profile Restoration



Baker Creek  
photos: Sam Flanagan, BLM



# Restoring Incised Channels and Connectivity

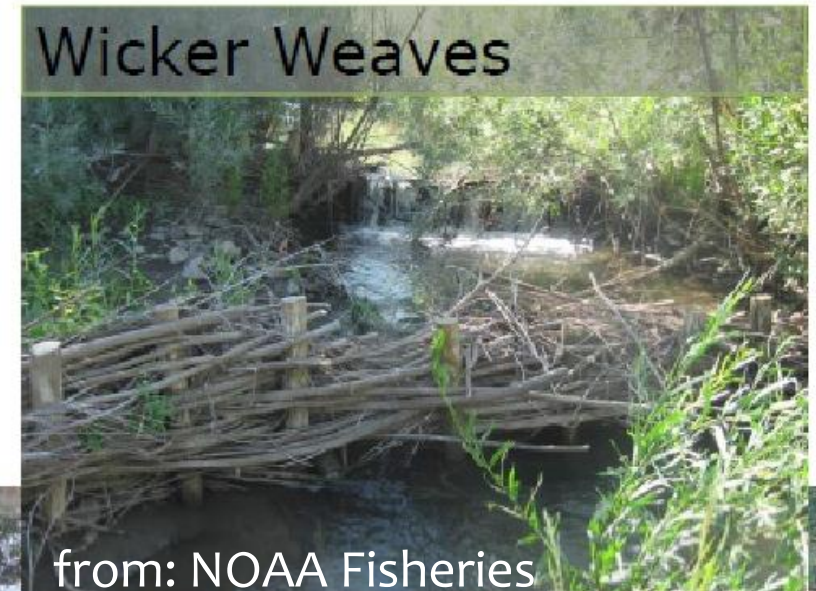
## Beaver Dam Analogs



Post Lines



Reinforced Dams



Wicker Weaves

from: NOAA Fisheries



# Stopping Incision while Restoring Connectivity

## Nature-Like Fishways (Roughened Channels)



Before



After

Penitencia Creek



# Stopping Incision while Restoring Connectivity

## Boulder and Log Weirs



12 Boulder Weirs upstream  
of Culvert Replacement



Upstream Salmon Habitat Protected from Incision



# Stopping Incision while Restoring Connectivity

## Technical Fishways



Vortex  
Pool & Chute  
Fishway

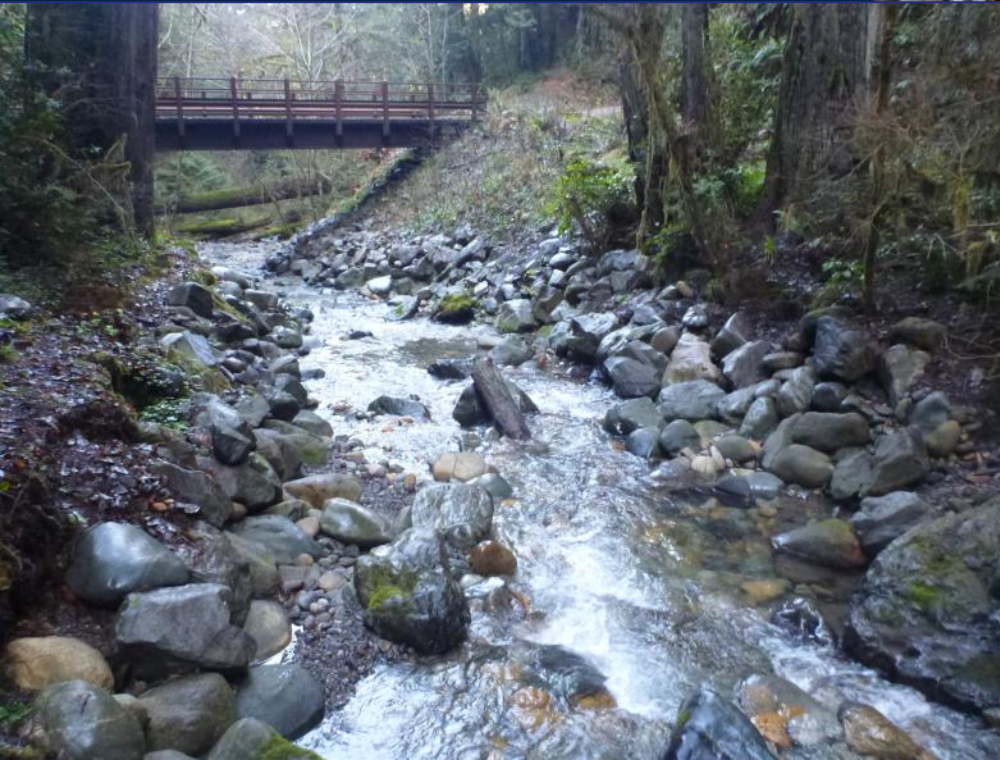
Peacock Creek, Smith River, Calif.



# We Can Protect Existing Habitat from Incision while Restoring Connectivity



Preserved Upstream Habitat



Nature-Like Roughened Channel with Culvert Removal

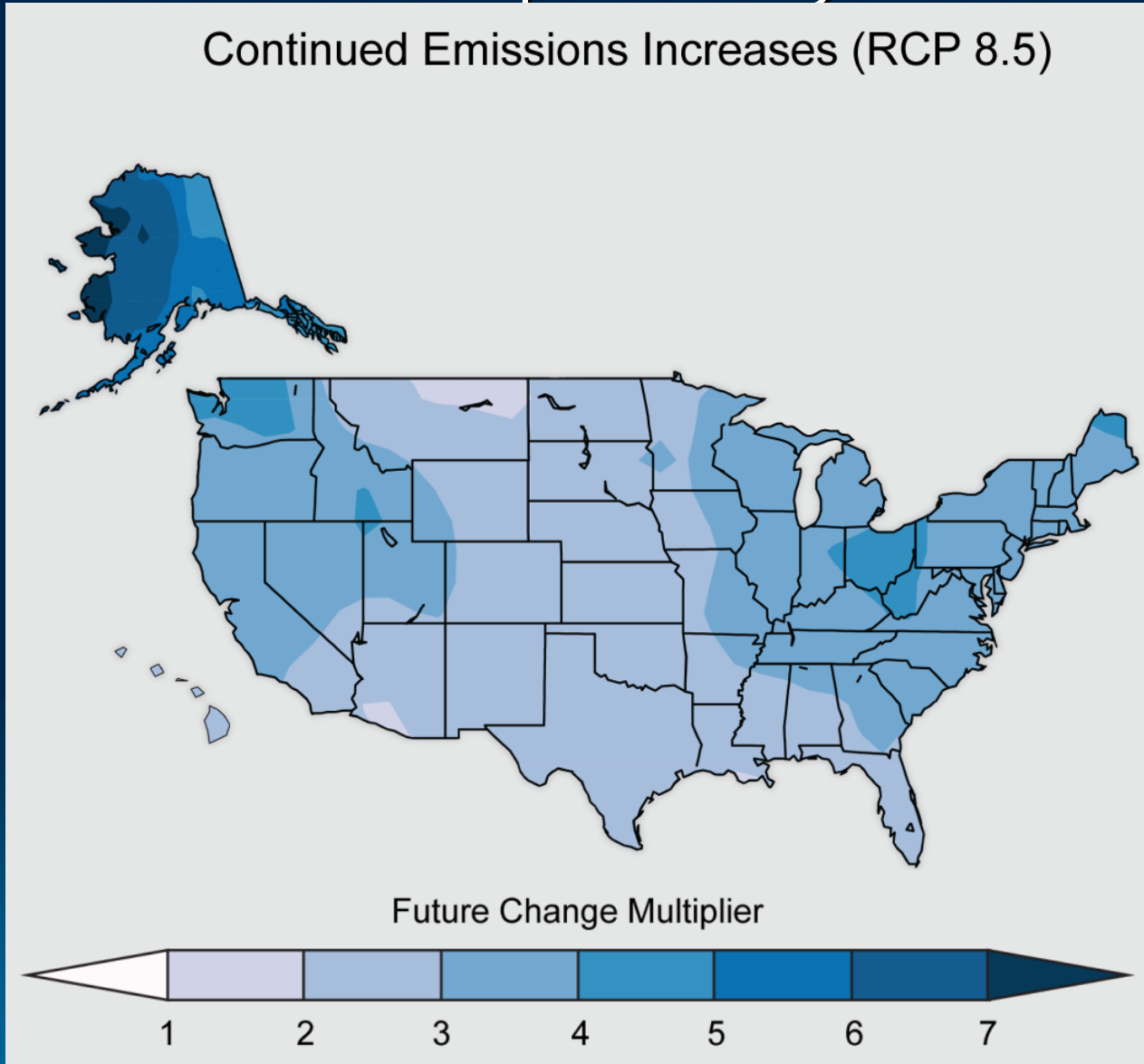
*Clarks Creek, Jedidiah Smith SP*





# Projected Increase in Heavy Precipitation Events 2081-2100 compared to 1981-2000

Continued Emissions Increases (RCP 8.5)



from U.S. National Climate Assessment, 2014

