

# Role of wood in modified rivers



# Overview

- **Functions, accumulations, distribution**
- **Comparison of placed wood and natural wood**
- **Effects of design modifications on performance**



# Wood works by redirecting water and sediment



# Wood performs many critical functions that create habitat

## River

Flow splitting

Meander geometry

Pool scour

Bank stabilization

Slope, width, elev.

Avulsions

Side channel cnx

Bar formation

Sediment trapping

## Forest

Island formation

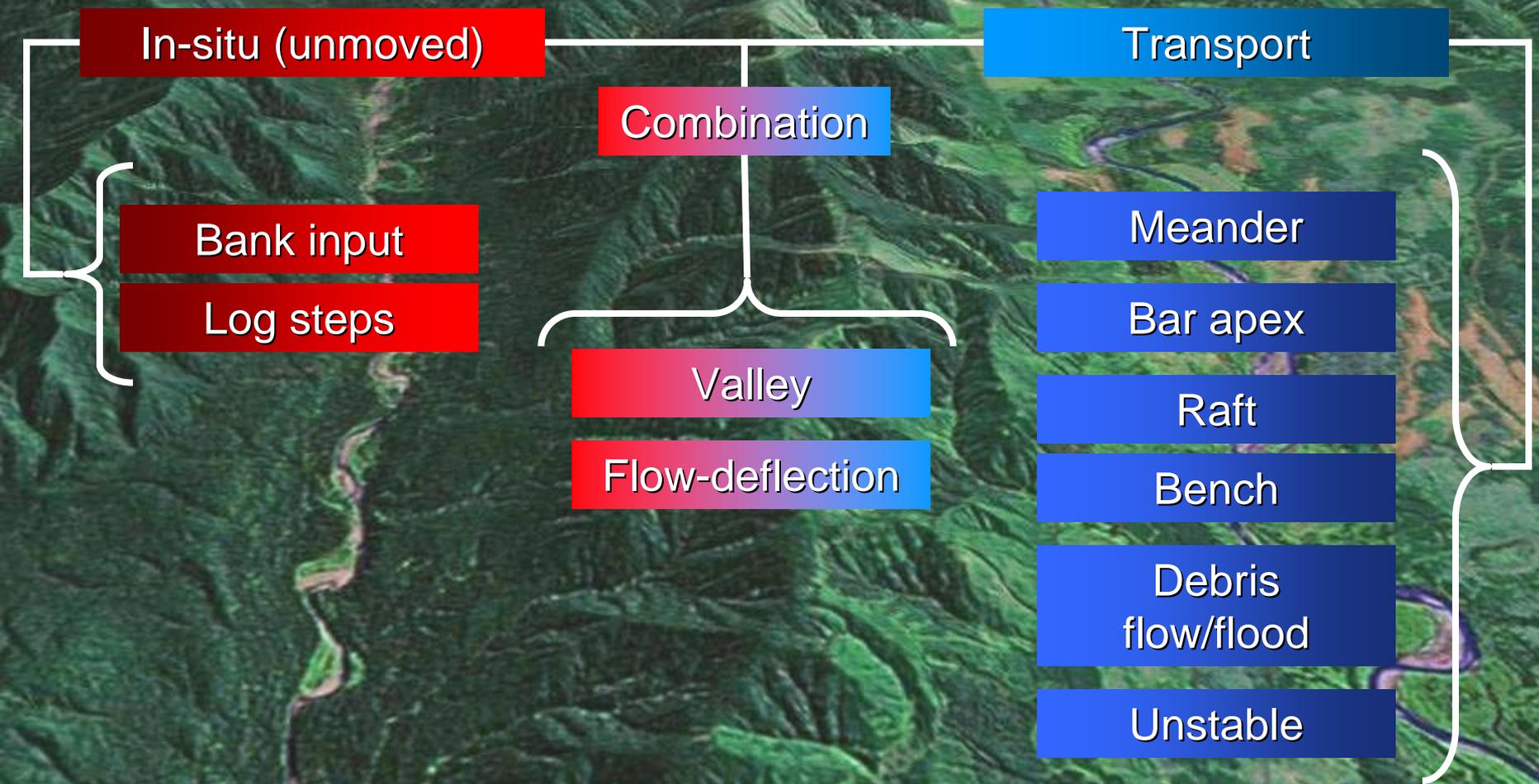
Topography

Regeneration

Forest longevity

Soil formation

# Wood accumulates in different ways in different places



Wood is usually found on channel margins in *straight* reaches



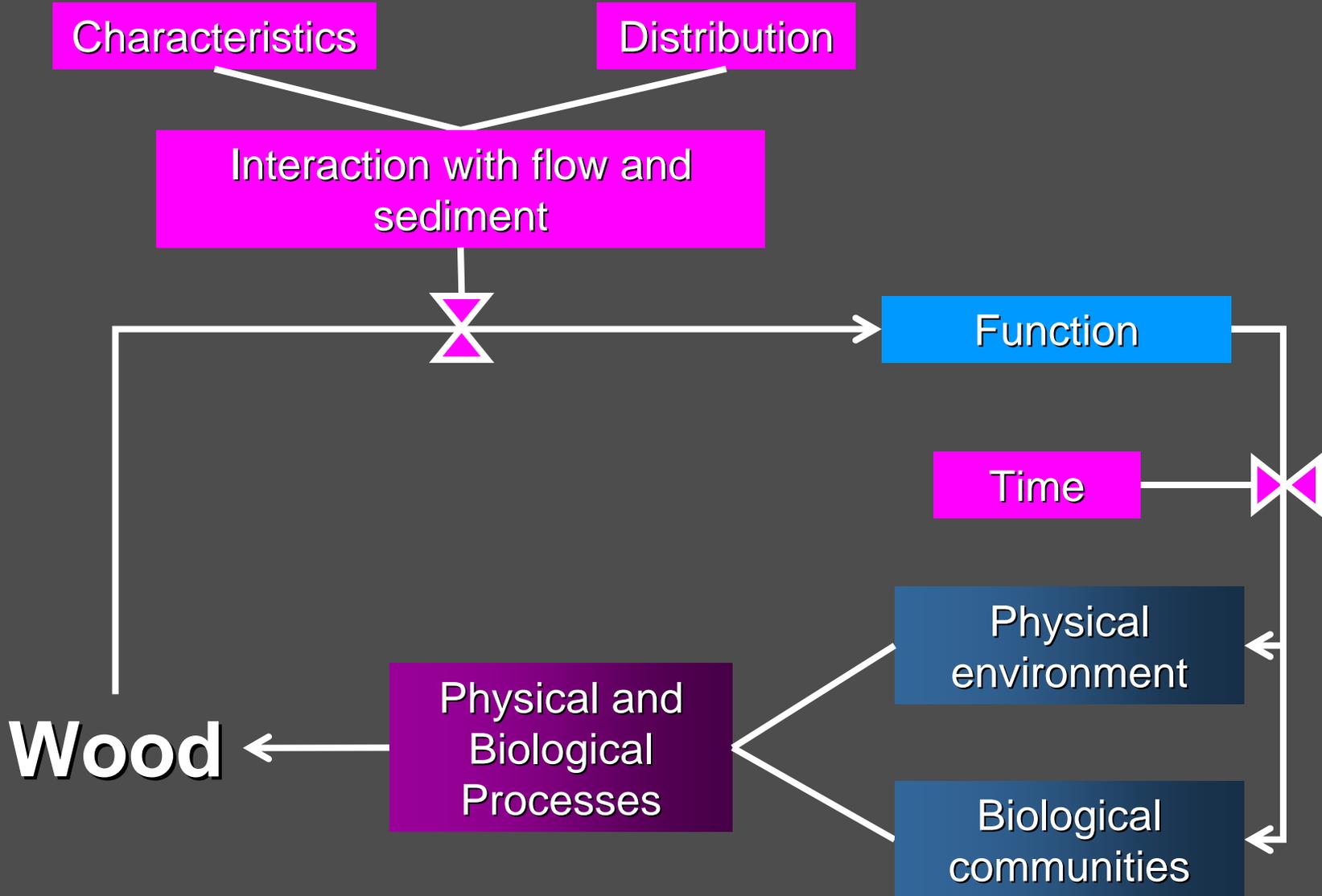
Wood is usually found on bends and bars in *meandering* reaches



Wood is found almost everywhere in *braided* reaches



# What influences wood function in natural settings?



What constrains wood function in modified settings?

**Land conversion & channelization**

An aerial photograph showing a residential development with several long, grey-roofed buildings and parking lots. A stream, which has been channelized, flows through the center of the image. The stream is bordered by a dense line of trees and vegetation. The surrounding area is a mix of grassy fields and paved roads. The text "Land conversion & channelization" is overlaid on the image in a bold, white font.

What constrains wood function in modified settings?

**Altered flow & sediment regime**

An aerial photograph showing a large concrete dam on the left side of a valley. The dam is a curved structure with a grey, segmented surface. Below the dam, a river flows through a narrow channel, creating white water rapids. To the right of the river, a paved road curves along the edge of a steep, rocky slope. In the foreground, a large pile of dark, jagged rocks is visible. The background is filled with dense green forest covering the surrounding hillsides. The text "Altered flow & sediment regime" is overlaid in the center of the image.

# What constrains wood function in modified settings?



**Multiple uses**



What constrains wood function in modified settings?

**Availability of suitably sized logs**



What constrains wood function in modified settings?



**Risk aversion**

**What is the river's  
'potential'?**

**How do natural  
structures work?**

**Placement objectives**

**What  
is the river  
expected to  
provide?**

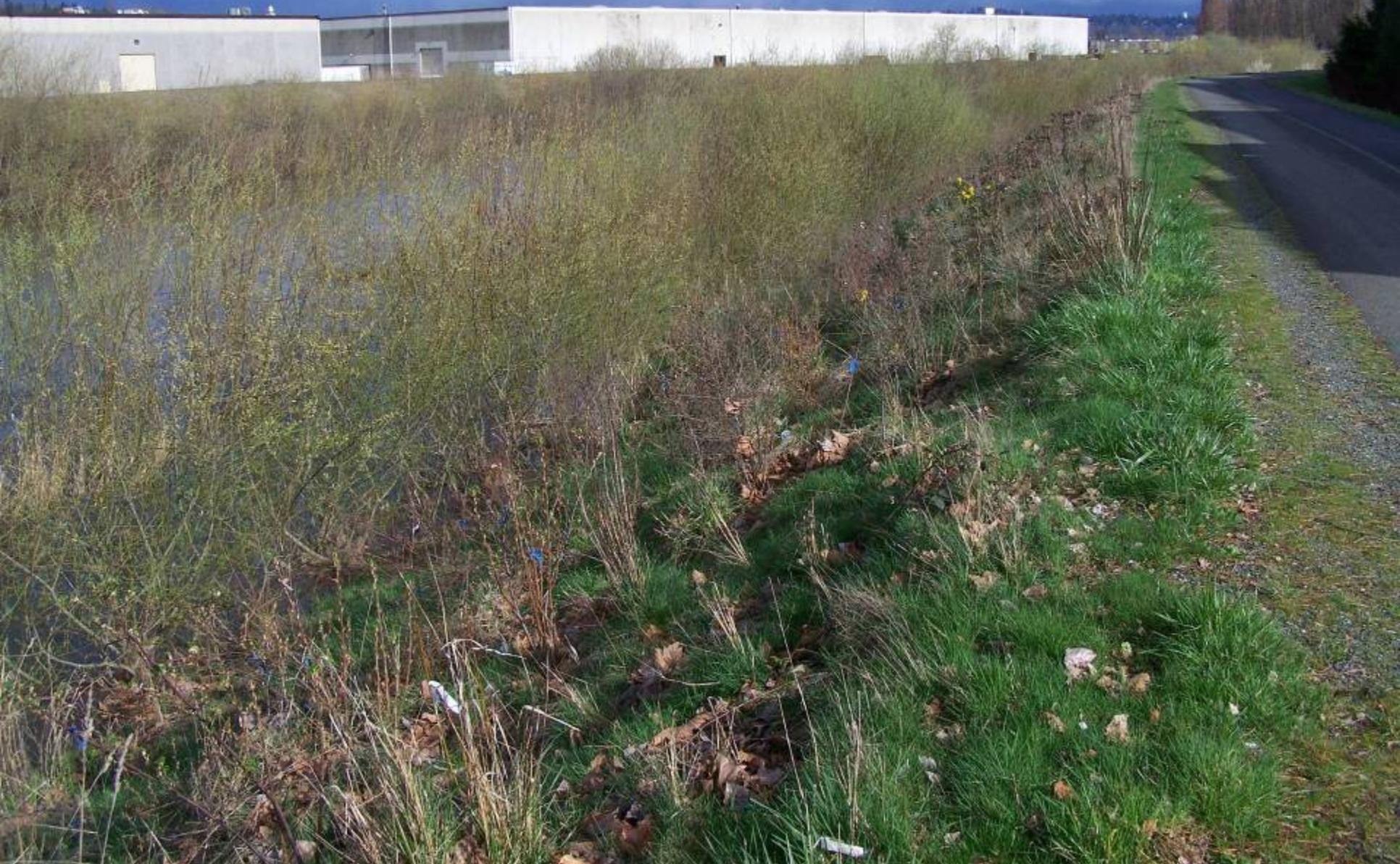


## Comparison of natural and placed wood



OBJECTIVE: Stabilize levee toe, enhance edge habitat...

*Integrated log toe*



# OBJECTIVE: Avoid channel avulsion, protect banks...

*Embedded logs*



...mimics a natural revetment or bank jam



...mimics buried logs in floodplain



# Natural buried logs vs. placed logs

River function	Natural	Placed
Flow splitting		
Meander geometry		
Pool scour	X	
Bank stabilization	X	X
Slope/width/elev		
Avulsions/cutoffs	X	X
Side channels		
Bar formation	X	X
Sediment trapping	X	X
Rearing/refuge habitat	X	X
Spawning features		

**OBJECTIVE: Stabilize eroding banks, create scour pools....**

***ELJs on outside bends***



...mimics a natural meander jam





# Natural meander jams vs. ELJs

River function	Natural	Placed
Flow splitting		
Meander geometry	X	X
Pool scour	X	X
Bank stabilization	X	X
Slope/width/elev		
Avulsions/cutoffs	X	
Side channels	X	
Bar formation	X	
Sediment trapping	X	
Rearing/refuge habitat	X	X
Spawning features	X	?

**OBJECTIVE:** Activate floodplain, trap gravel, scour pools...

*Full to partially spanning jams*



...mimics flow deflection jams and log steps



# Natural log steps, f.d. jams vs. placed jams

River function	Natural	Placed
Flow splitting	X	X
Meander geometry	X	X
Pool scour	X	X
Bank stabilization		
Slope/width/elev	X	X
Avulsions/cutoffs	X	X
Side channels	X	X
Bar formation	X	X
Sediment trapping	X	X
Rearing/refuge habitat	X	X
Spawning features	X	X

**OBJECTIVE: Split channels, dissipate energy, trap wood...**

*Live pilings/flood fences*



...mimics natural forested islands



# Live pilings vs. forested islands (w/ wood)

River function	Natural	Placed
Flow splitting	X	X
Meander geometry		
Pool scour		
Bank stabilization		
Slope/width/elev	X	X
Avulsions/cutoffs	X	X
Side channels		
Bar formation	X	X
Sediment trapping	X	X
Rearing/refuge habitat		
Spawning features		

# OBJECTIVE: Split channels, deflect and diffuse flow

*Bar apex jams*



...mimics natural bar apex jams



# Natural vs. placed bar apex jams

River function	Natural	Placed
Flow splitting	X	X
Meander geometry		
Pool scour	X	X
Bank stabilization		
Slope/width/elev		
Avulsions/cutoffs		
Side channels		
Bar formation	X	X
Sediment trapping	X	X
Rearing/refuge habitat	X	X
Spawning features	?	?

# Effects of design modifications on performance

**Natural reference**



**Modified but functional**



**Over modified**



- **Location in the river reach**
- **Position/orientation in the channel**
- **Structural complexity**
- **Structural stability relative to channel stability**

# 1. Importance of placement location



## 2. Importance of orientation in channel



### 3. Importance of structural complexity



## 4. Importance of structural stability



# Summary



- Wood can function in many different ways, depending on how and where it accumulates, and its structural features
- Placed wood tends to maximize a small number of desirable functions, relative to natural wood
- Modifications with greatest potential to reduce function are: 1) placement location, 2) piece orientation, 3) structural complexity, 4) stability.





## Acknowledgements



# Fish responses to wood placement

## **When wood is removed....**

- Streams simplify, incise, straighten, and lose sediment and organic matter.
- Fish density declines, likely owing to: emigration, predation (due to loss of cover), over winter mortality (loss of refuge), increased competition (loss of partitioning)

## **When we compare river reaches...**

- Fish abundance and biomass has been correlated with the amount of wood.

## **When we add wood to rivers...**

- Steelhead survival and migrants tend to increase.
- Juvenile coho respond positively in small, low-gradient surface-water fed stream in low to mid-elevation coastal areas, especially during winter.
- Resident trout abundance and biomass increases, though effects on recruitment, survival, or growth are inconsistent.

# Fish responses to wood placement

## Why isn't the fish response more definitive?

- Habitat formed by wood doesn't limit the population, or is only limiting in some years.
- Too little wood was added to make a difference, or was placed in a way that didn't create functioning habitat.
- The population actually benefited, but the response was obscured by migration/emigration, or different responses between age-classes.
- Responses weren't monitored long enough – it make take several large floods (over years) for improved habitat to materialize.
- Fish actually benefited from the wood, but the study didn't enough statistical power to detect it.

