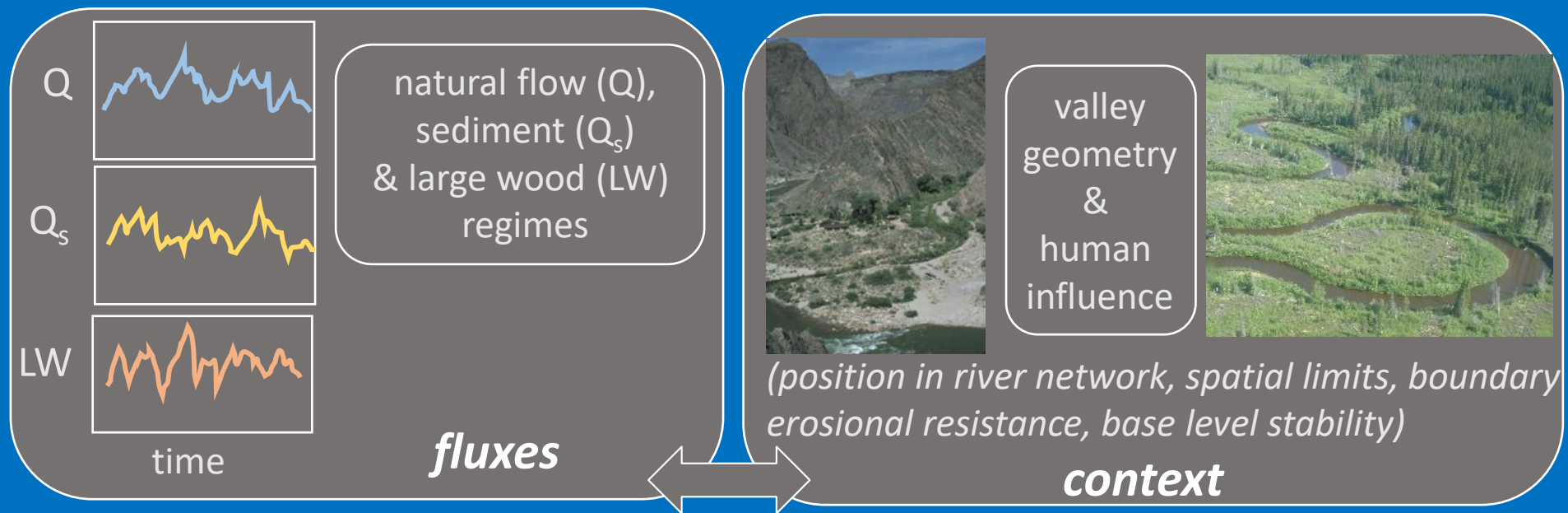


# Physical Drivers of River Health: Water, Sediment, & Large Wood



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*spatial heterogeneity, connectivity, resilience, geomorphic & ecological integrity*

gradient



planform



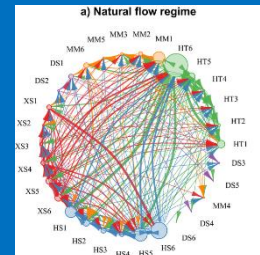
flood inundation



high water table



biodiversity



carbon stock



**RIVER CORRIDOR**

## The Natural Flow Regime (*Poff et al., 1997*)

The integrity of flowing water systems depends largely on their natural dynamic character

Stream flow – quantity & timing – as the master variable that limits the abundance & distribution of riverine species

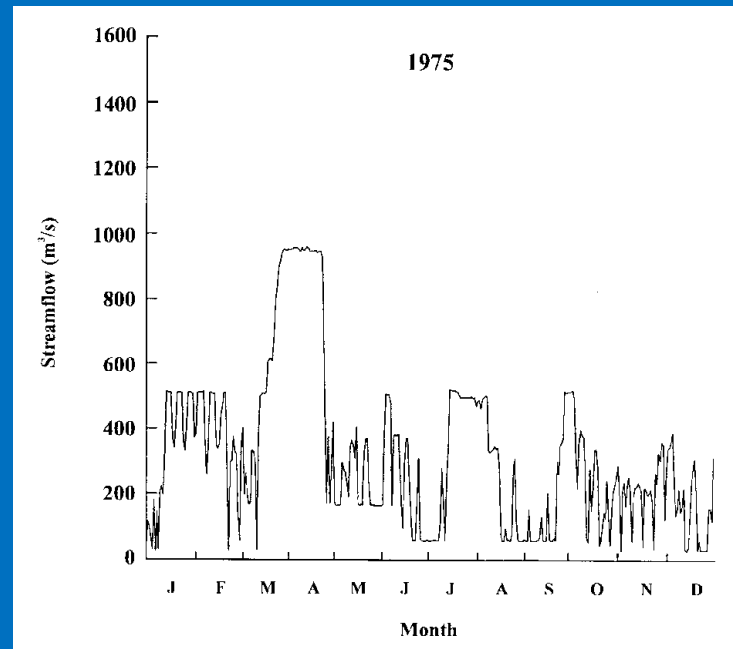
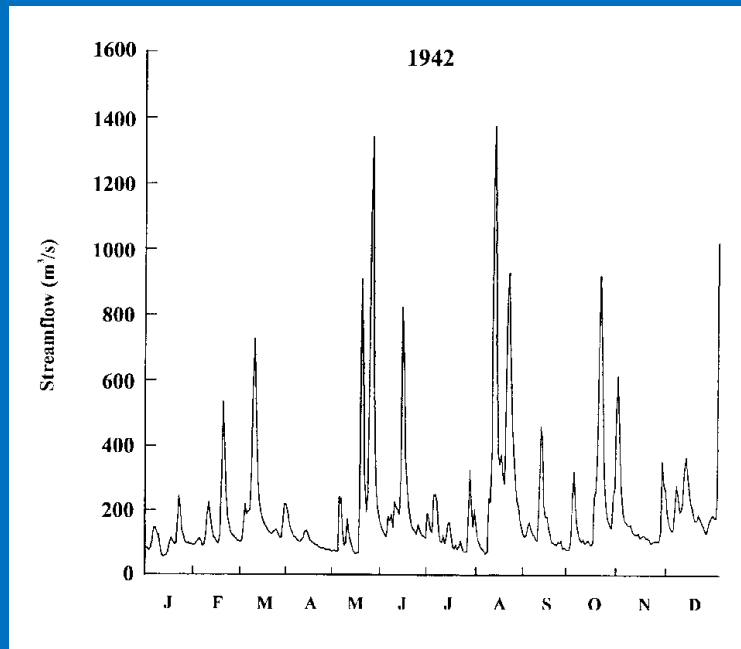
Key characteristics of stream flow are:

- magnitude
- frequency
- duration
- timing
- rate of change

# Indicators of Hydrologic Alteration (IHA)

32 flow parameters organized into five groups ecologically relevant to surface & ground water regimes:

- magnitude of monthly water conditions (mean value for each month)
- magnitude & duration of annual extreme water conditions (high & low)
- timing of annual extreme water conditions (date)
- frequency & duration of high & low pulses
- rate & frequency of water condition changes



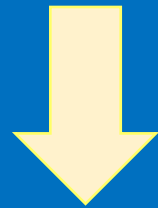
Roanoke River, North Carolina  
pre-dam (1942) & post-dam (1975)  
(Richter et al., 1996,  
Figure 1)

# The Natural Sediment Regime (*Wohl et al., 2015*)

“Water *and* sediment supplied to & transported by river systems are fundamental drivers of river condition, affecting water quality, thermal regime, habitat & aquatic communities, river stability, & natural hazards. Effective management of river systems thus requires knowledge of water and sediment interactions.”

## Sediment dynamics

- inputs (uplands, upstream, floodplain, channel) – volume, grain-size distribution, episodicity
- transport – thresholds, frequency, duration, distance
- storage (channel, floodplain) – volume, grain size, residence time



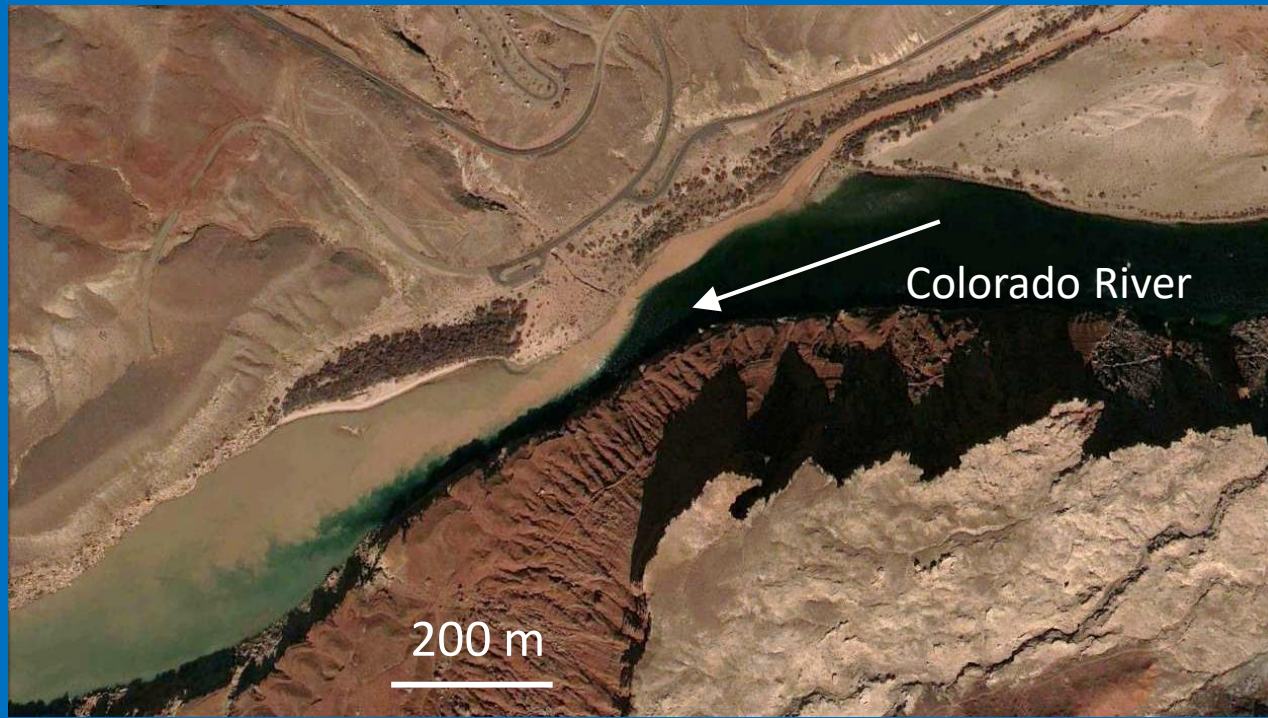
channel geometry, channel stability, habitat abundance & diversity, nutrients, disturbance regime



Rivers respond to changes in  $Q$  &  $Q_s$  at varying temporal & spatial scales, but these scales can be substantially different for  $Q_s$

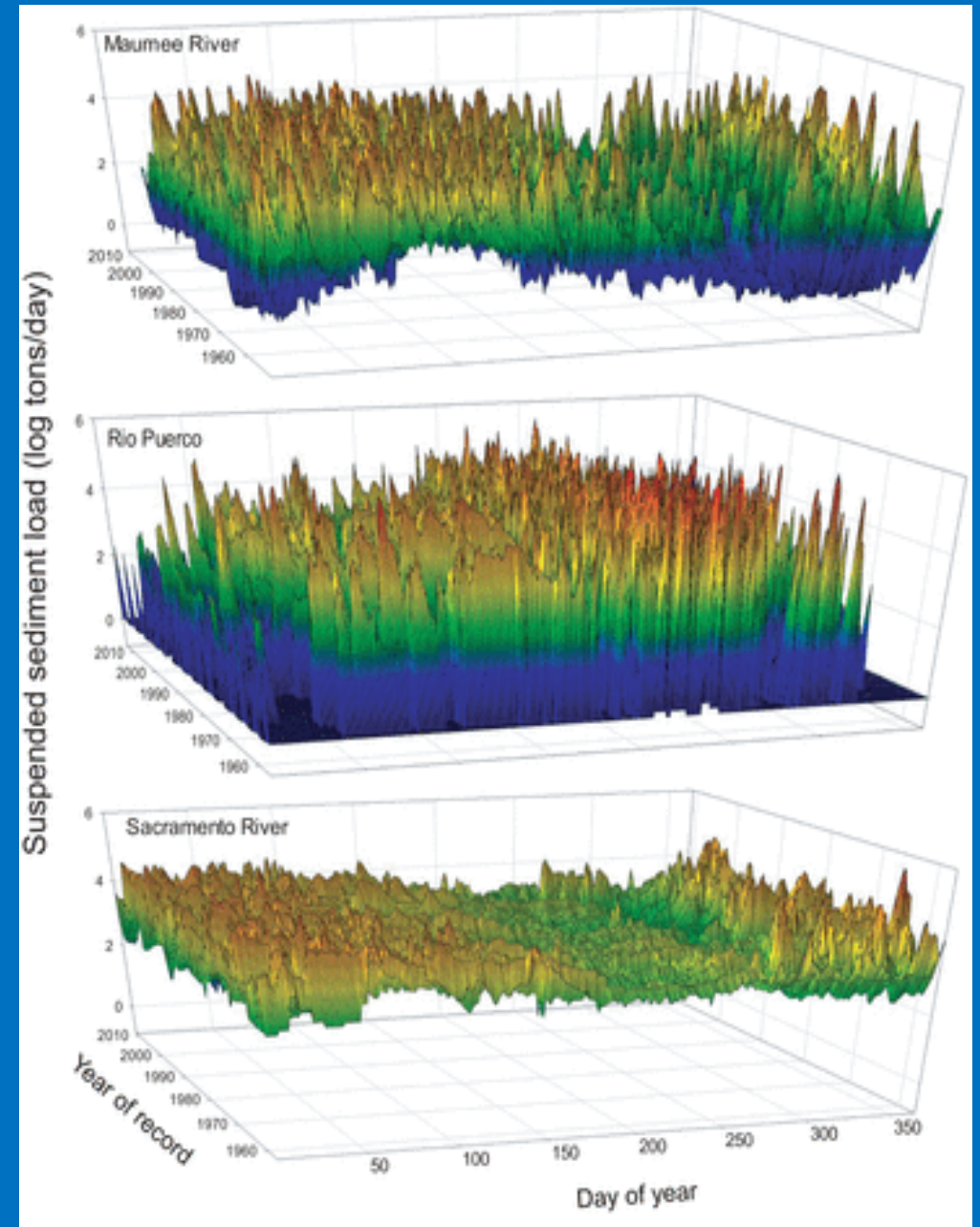
The lack of long-term datasets for sediment makes it difficult to quantify sediment regime or to assess reference conditions

- >23,000 USGS gaging stations with > 10 years of discharge record
- 1640 sites with > 10 years of suspended sediment records
- 0 sites with bedload records



## Differentiate natural & balanced sediment regimes:

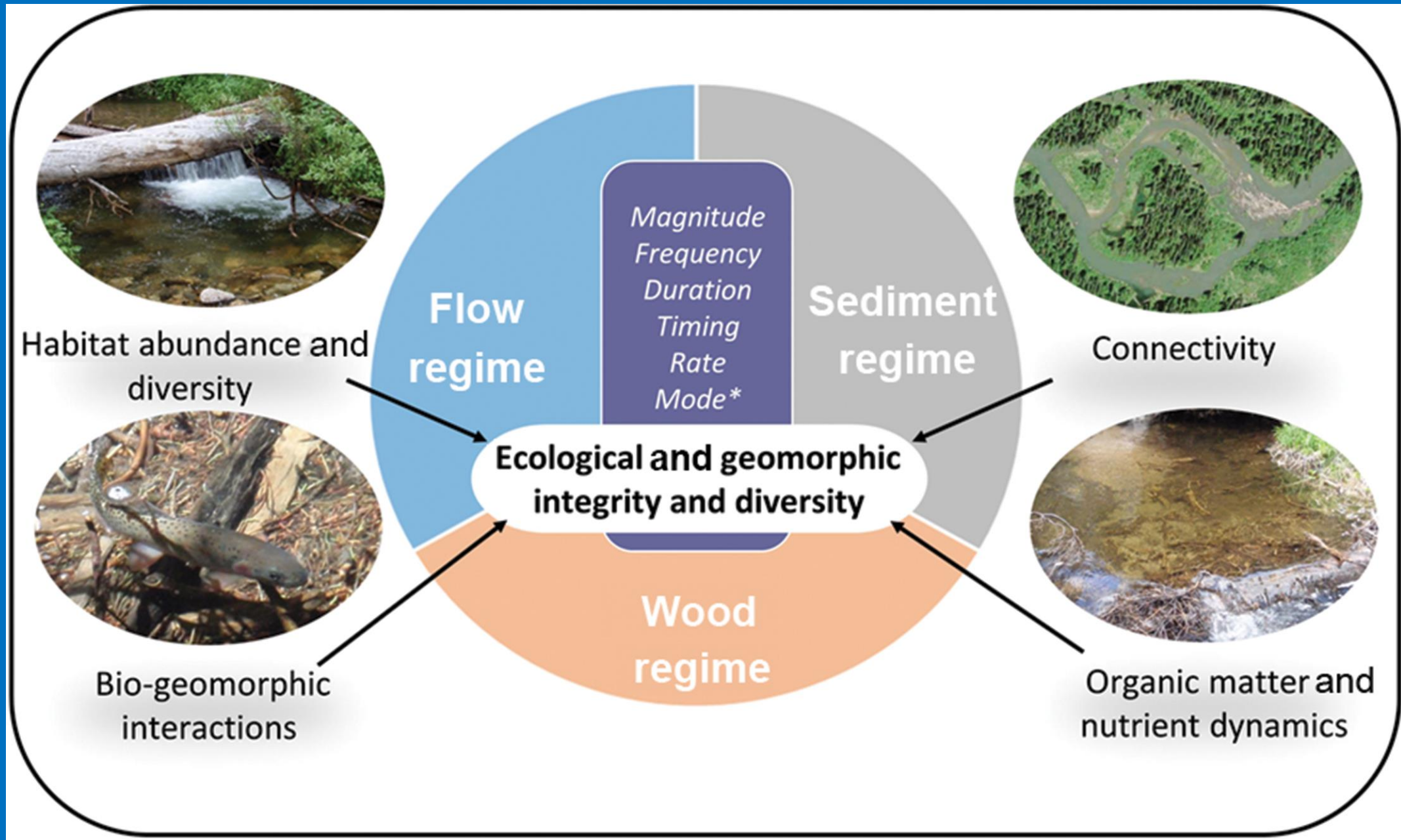
- a balanced sediment regime exists when available flow energy
- is in balance with sediment supply
- river form remains dynamically stable over a specified time



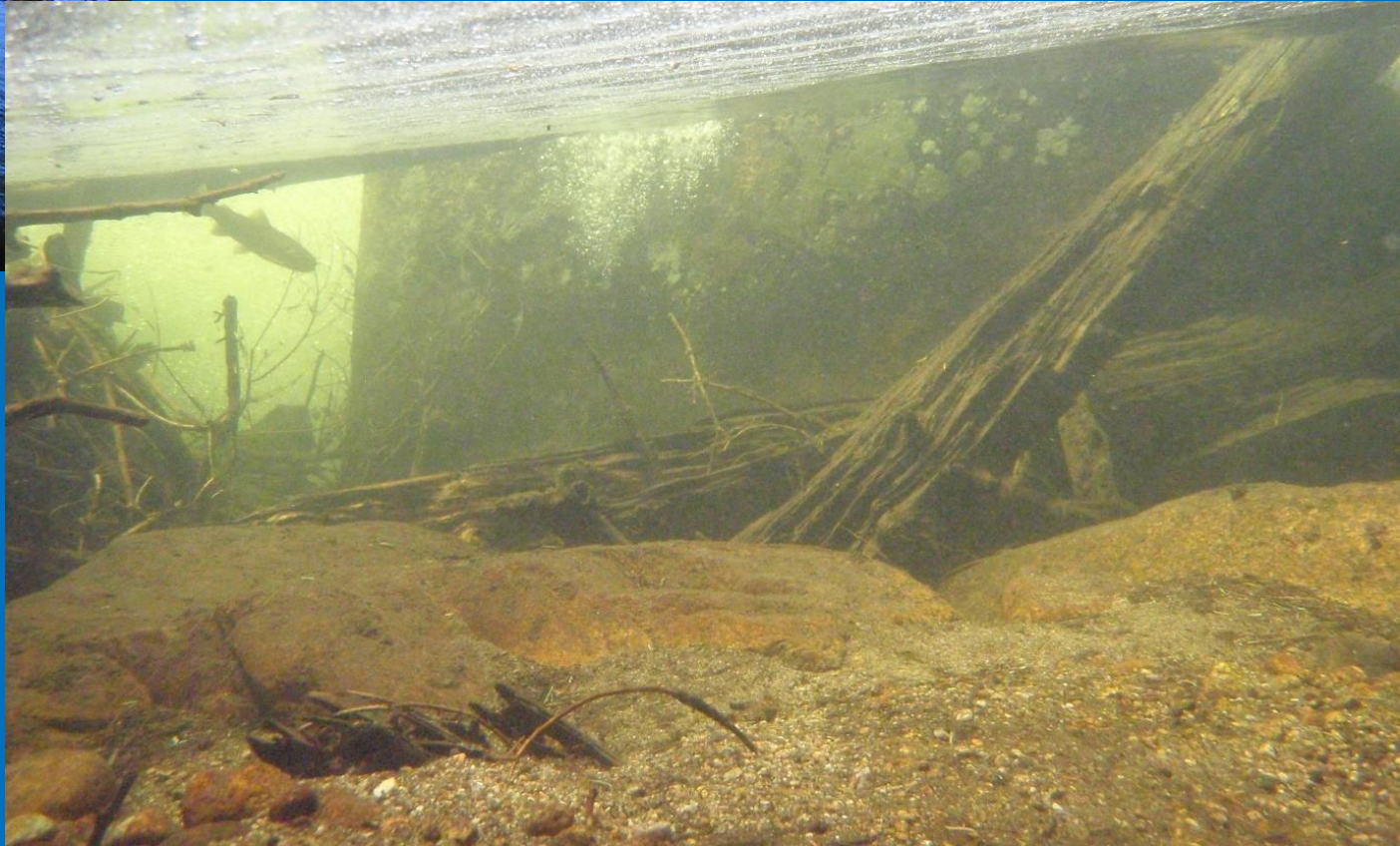


# The Natural Wood Regime

Wohl et al., 2019, BioScience









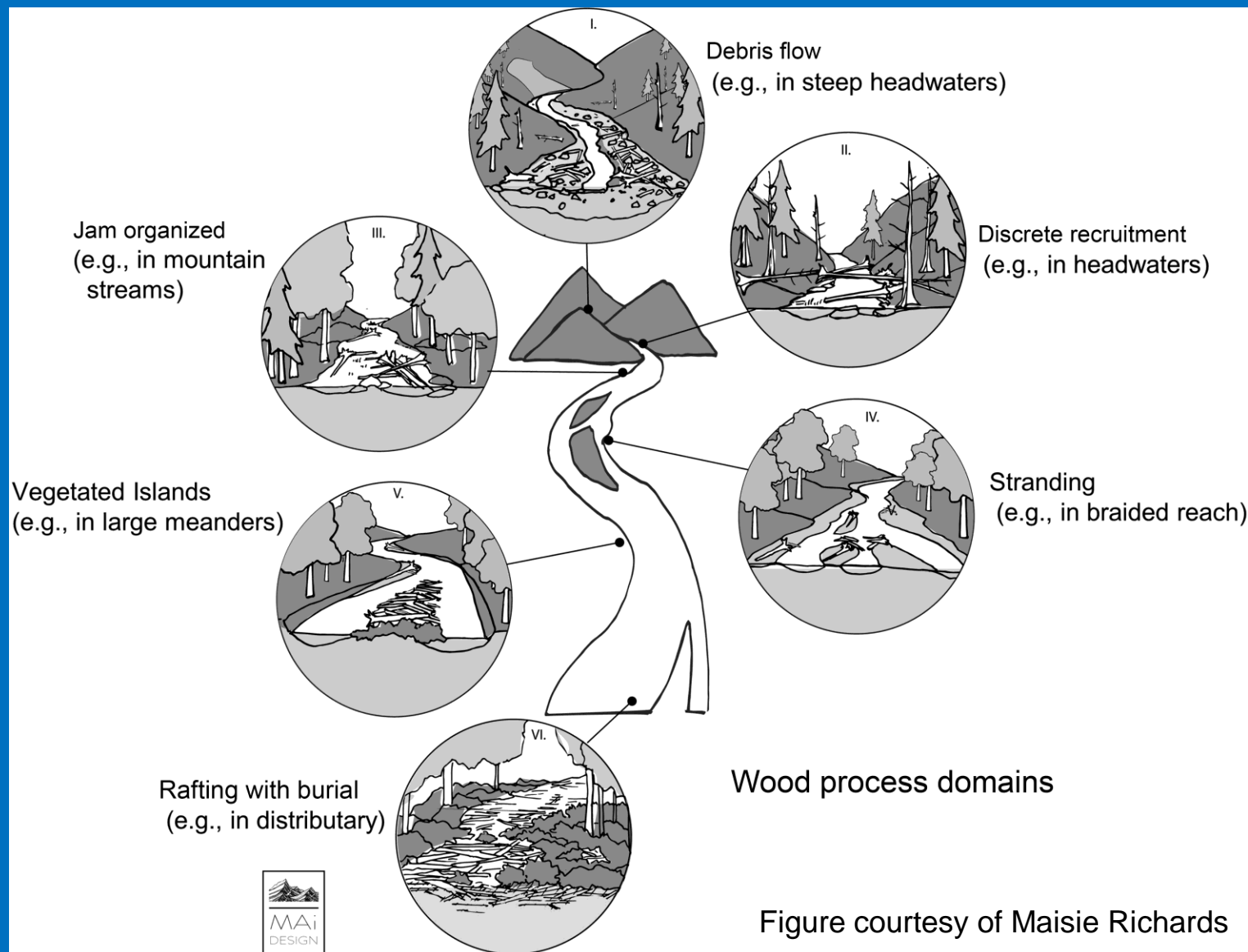


Figure courtesy of Maisie Richards

Hypothetical wood process domains along a river continuum. Each example domain has defining wood regime characteristics for wood recruitment, transport, & storage that result in a distinct regime over a specified time.