Engaging with Rivers:
by thinking outside the channel

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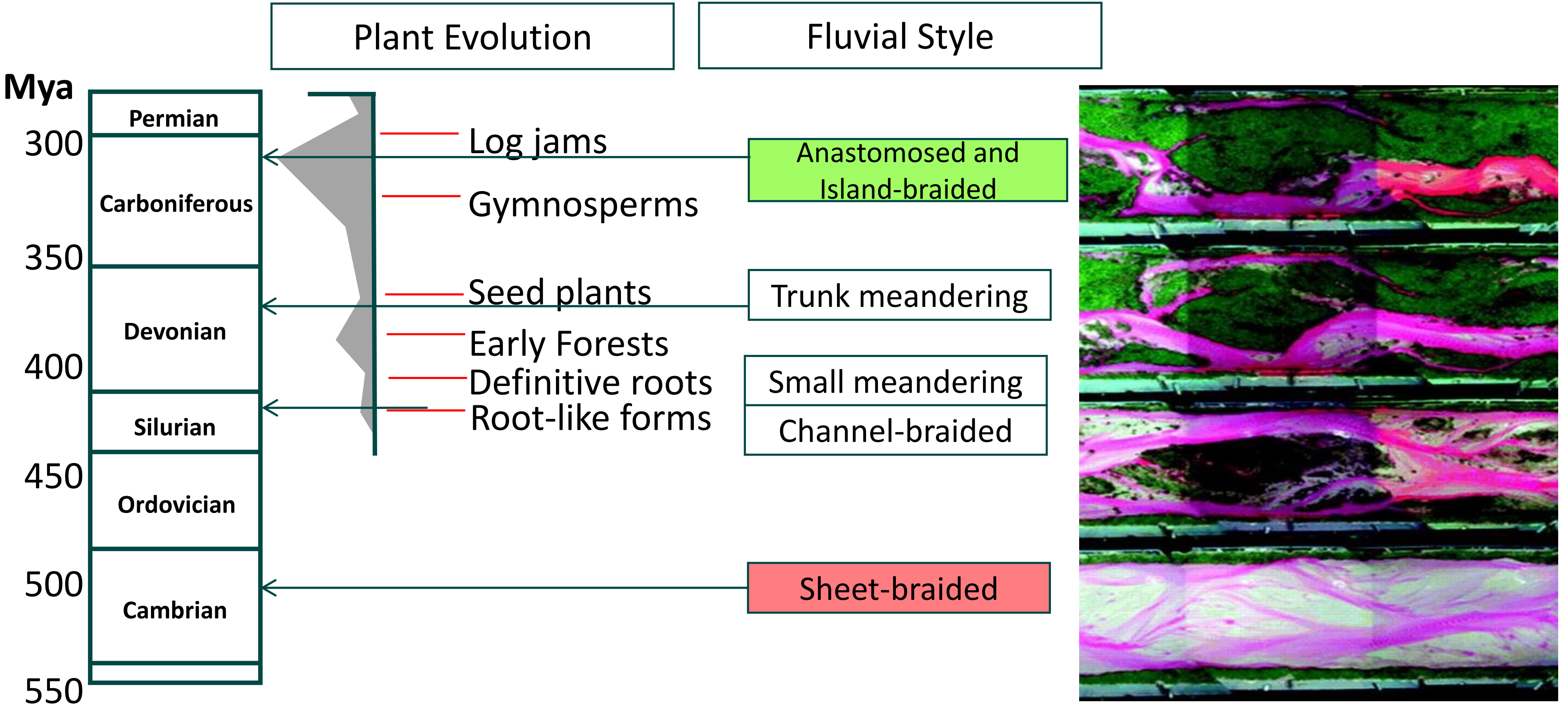
River Planforms over Geological Time

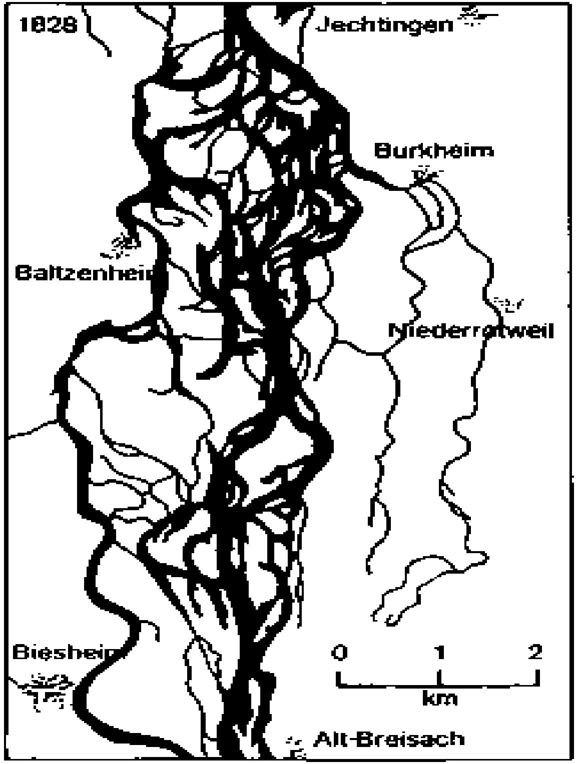


Until global vegetation, most rivers BRAIDED. After plants appeared rivers started MEANDERING and become ANASTOMOSED after modern trees evolved.

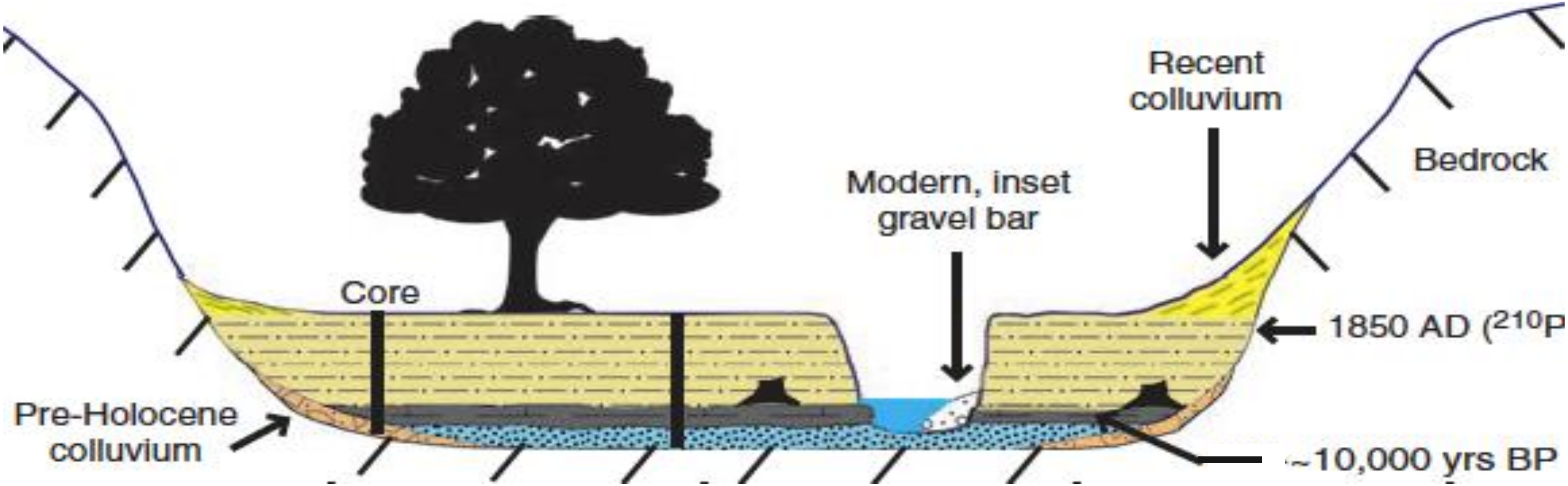
“…expansion of tree habitats led to the crossing of a threshold in vegetative control of floodplain and river morphology.”

Davies, N.S. and Gibling, M.R., 2011. *Nature Geoscience*, *4*(9), pp.629-633

Historical evidence - Upper River Rhine at Breisach Germany



Anastomosed 1828 – Prior to river training



Historical evidence - US East Coast

Walter, R.C. and Merritts, D.J., 2008. Natural streams and the legacy of water-powered mills. *Science*, *319*(5861), pp.299-304.

“…before European settlement, the streams were small, anabranching channels within extensive, vegetated wetlands”

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A STREAM EVOLUTION MODEL INTEGRATING HABITAT AND ECOSYSTEM BENEFITS

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ABSTRACT

For decades, Channel Evolution Models have provided useful templates for understanding morphological responses to disturbance associated with lowering base level, channelization or alterations to the flow and/or sediment regimes. In this paper, two well-established Channel Evolution Models are revisited and updated in light of recent research and practical experience. The proposed Stream Evolution Model includes a precursor stage, which recognizes that streams may naturally be multi-threaded prior to disturbance, and represents stream evolution as a cyclical, rather than linear, phenomenon, recognizing an *evolutionary cycle* within which streams advance through the common sequence, skip some stages entirely, recover to a previous stage or even repeat parts of the evolutionary cycle.

The hydrologic, hydraulic, morphological and vegetative attributes of the stream during each evolutionary stage provide varying ranges and qualities of habitat and ecosystem benefits. The authors' personal experience was combined with information gleaned from recent literature to construct a fluvial habitat scoring scheme that distinguishes the relative, and substantial differences in, ecological values of different evolutionary stages. Consideration of the links between stream evolution and ecosystem services leads to improved understanding of the ecological status of contemporary, managed rivers compared with their historical, unmanaged counterparts. The potential utility of the Stream Evolution Model, with its interpretation of habitat and ecosystem benefits includes improved river management decision making with respect to future capital investment not only in aquatic, riparian and floodplain conservation and restoration but also in interventions intended to promote species recovery.

KEY WORDS: Stream Evolution Model (SEM); channel evolution; freshwater ecology; habitat; conservation; river management; restoration; climate resilience

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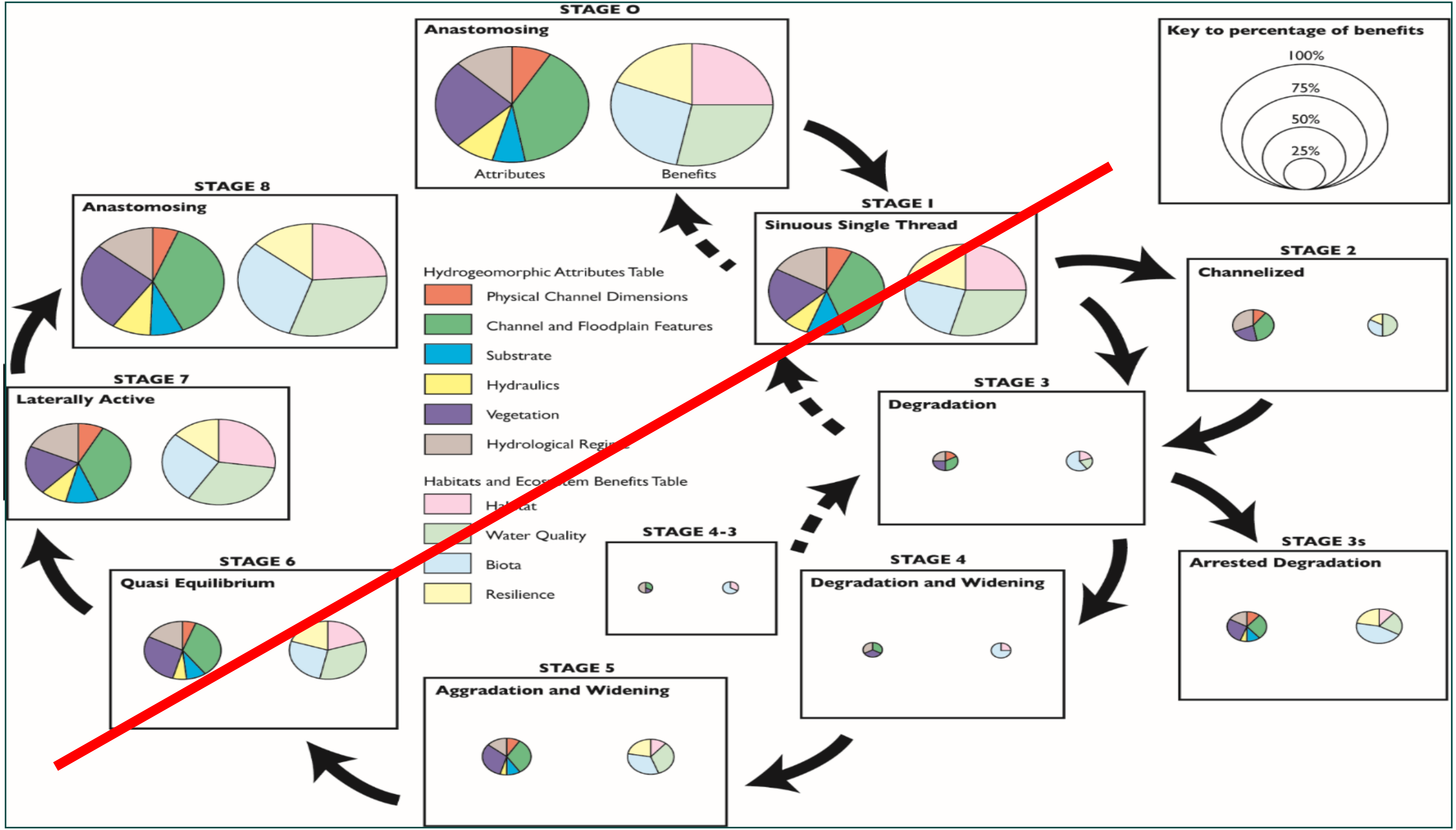
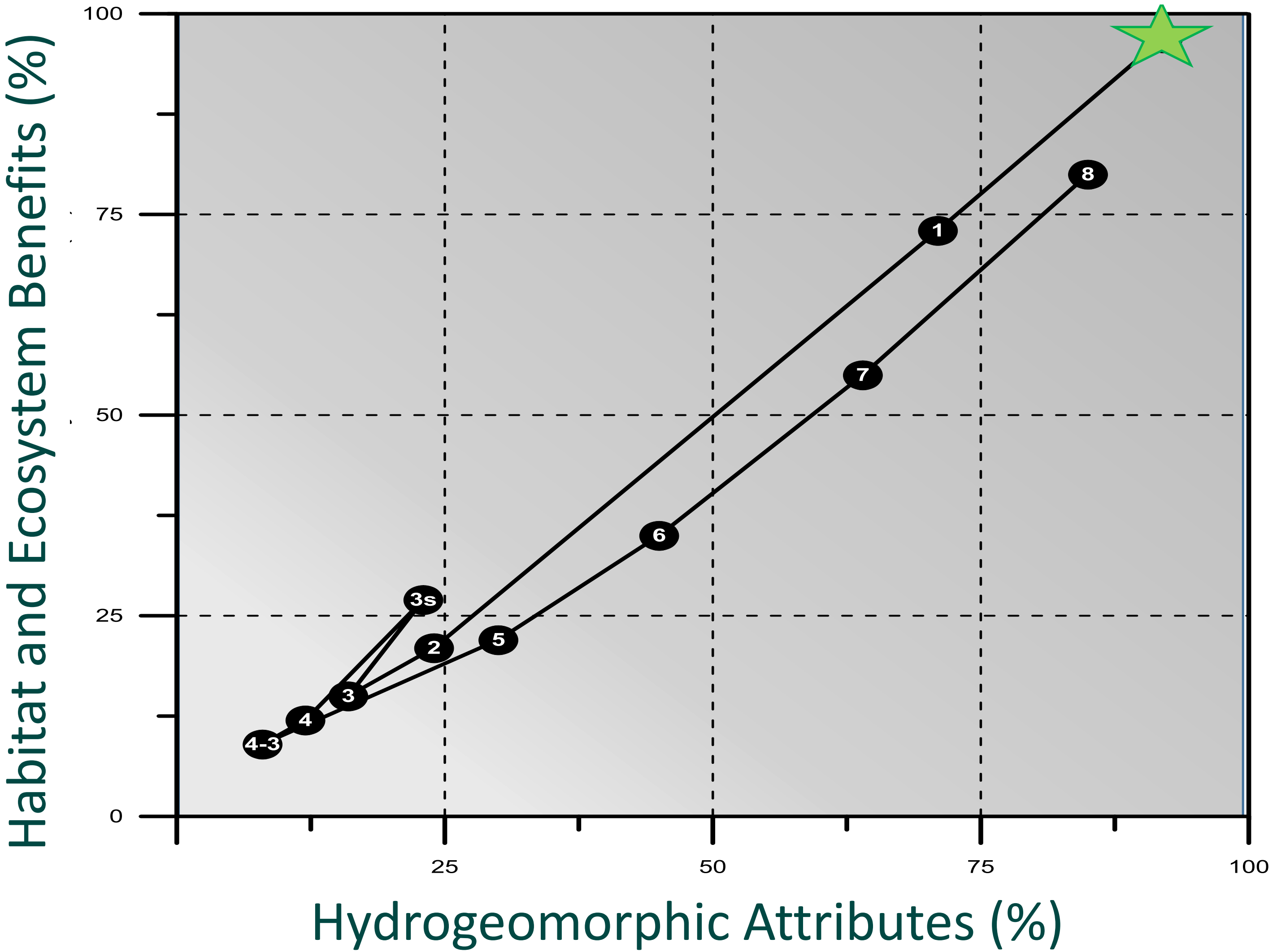
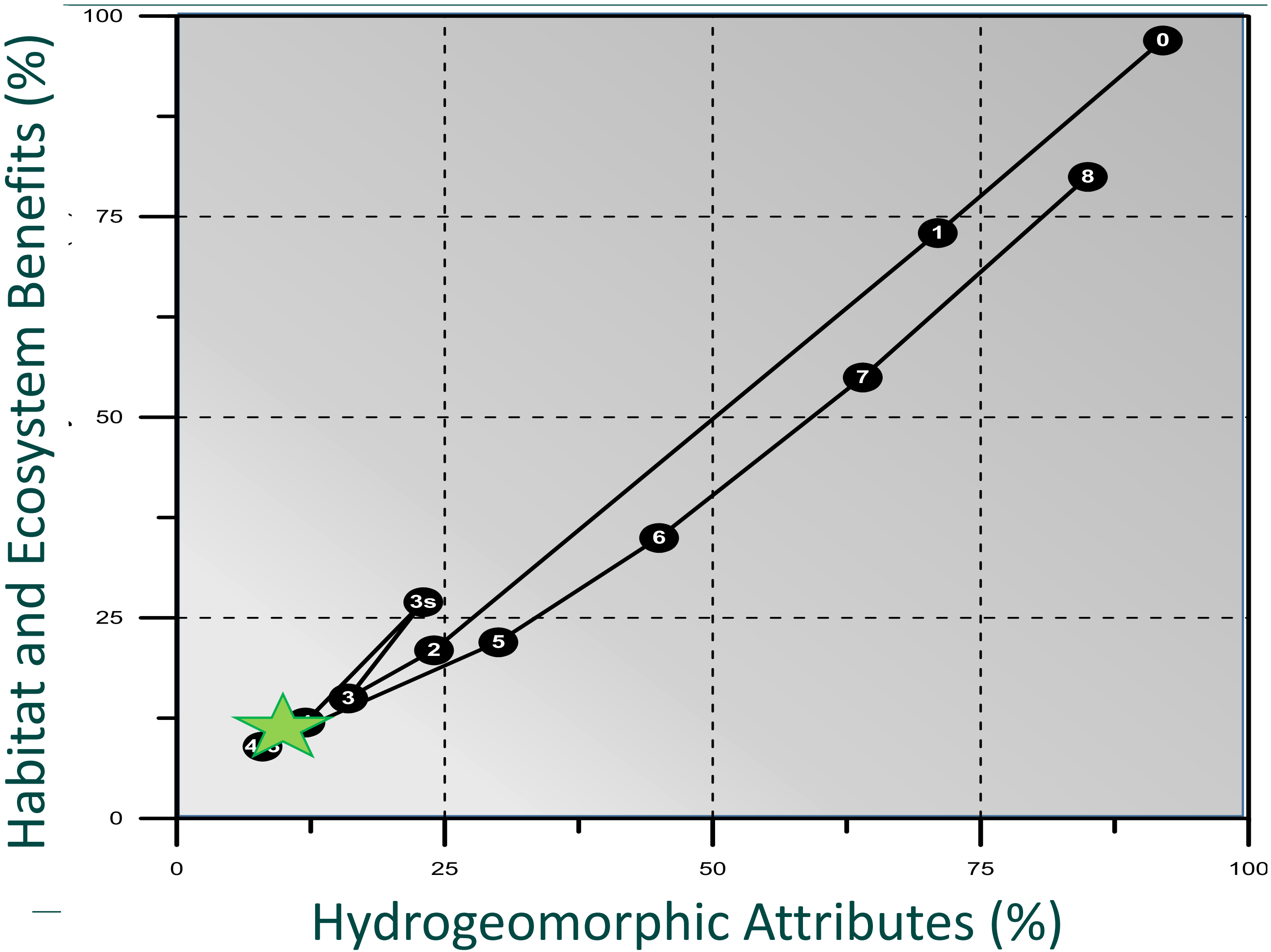


Cluer and Thorne, RRA, 2013



Habitat and Ecosystem Benefits (%)
100
75
50
25
0
25
50
75
100
Hydrogeomorphic Attributes (%)
1
2
3
3s
4
4-3
5
6
7
8



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100
Hydrogeomorphic Attributes (%)
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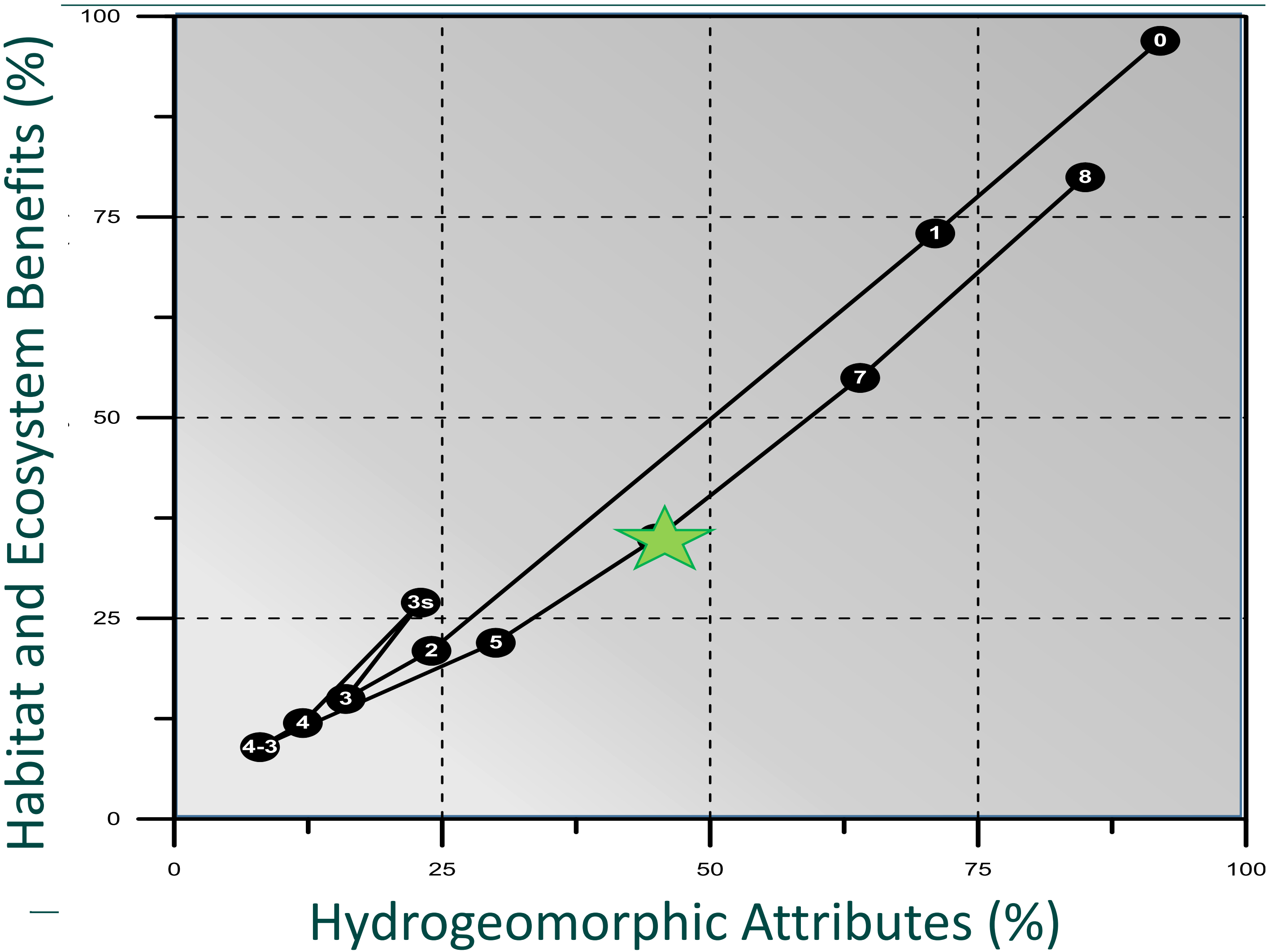
Habitat and Ecosystem Benefits (%)
Hydrogeomorphic Attributes (%)
100
75
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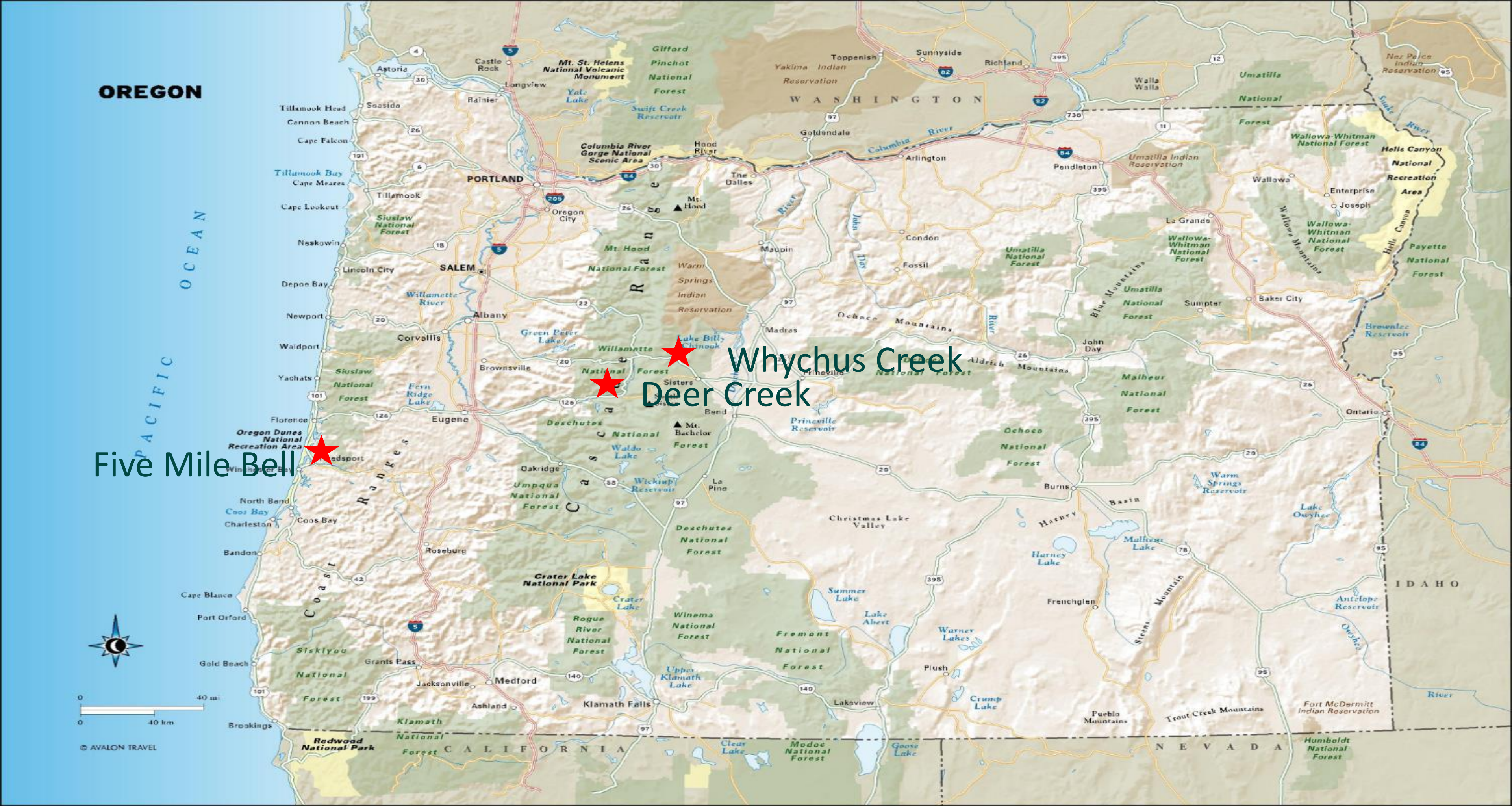
4-3


OREGON
Whychus Creek
Deer Creek
Five Mile Bell
PORTLAND
SALEM
Eugene
Bend
Medford
PACIFIC OCEAN
WASHINGTON
IDAHO
CALIFORNIA
NEVADA
© AVALON TRAVEL


First Salmon spawning redds since 1993….


3 months post-restoration


1 year post-restoration
Natural, unchanneled ‘flow paths’ developing in the floodplain

“Monitoring shows 1,600 salmon per km, compared to single-channel systems, which have 30-40 salmon per km in a good year and 5-15 salmon per km most years”

Hydrology

Floodplain reconnection
Flood attenuation
Hyphorheic exchange
Surface+Ground Water storage and release
Base flow maintenance

Morphology

Channel stability
Morph. complexity
Sediment deposition, storage & release
Adaptive capacity
System resilience

Habitat quality

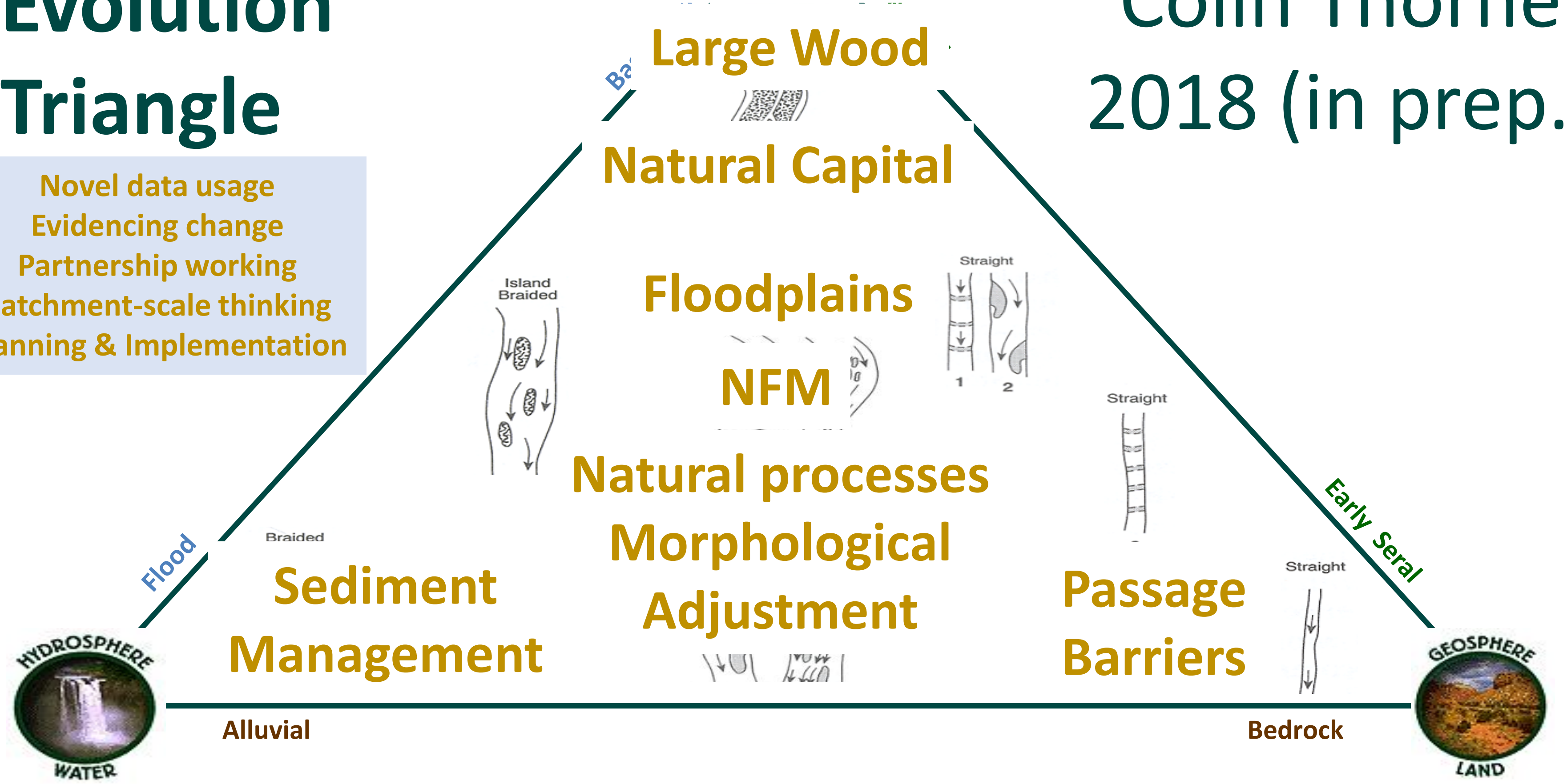
Complex vegetation
Temp. regulation
Fine sediment and Pollution retention
Nutrient cycling
Carbon storage

The Stream Evolution Triangle

Janine Castro & Colin Thorne
2018 (in prep.)

Novel data usage
Evidencing change
Partnership working
Catchment-scale thinking
Planning & Implementation

Biodiversity
Ecosystem Services




When Engaging with Rivers –
Always think Outside the Channel!