TOWARDS NEW APPROACHES OF RIPARIAN VEGETATION ASSESSMENT IN EUROPEAN COUNTRIES

WG 1, Madrid, 29-30 January 2020

Indicators of vegetation responses to global changes: A multi-scale approach

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OBJECTIVES

1. Summarize the multi-scale framework for characterization and assessment of Riparian Vegetation

2. Integrate the different approaches presented by you in this Seminar, to validate the proposed framework

3. Advance towards next steps within CONVERGES Cost, feeding WG2 and WG3 with WG1 final remarks

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WG1 CONTEXT

- Recognization of the Water Framework Directive (WFD) as an important driver of river hydromorphology development
- Detection of the small relevance of Riparian Vegetation within the WFD, which emerged before clear scientific evidences of its key role in river hidromorphology
- A wide dispersion of methodologies and approaches to characterize and assess Riparian Vegetation (frequent mis-understanding between them)
- Need for new approaches to monitor and assess Riparian Vegetation within the WFD, to support understanding of responses to global changes

CONTENT

- Proposal of multi-scale process-based indicators of Riparian Vegetation to characterize current status
- Develop understanding of vegetation responses to multiple disturbances (natural and human-induced changes)
- Guidelines to characterize and assess Riparian Vegetation
- Attempt to integrate other methodological approaches within the proposed multi-scale framework
- Further steps towards WG2 and WG3

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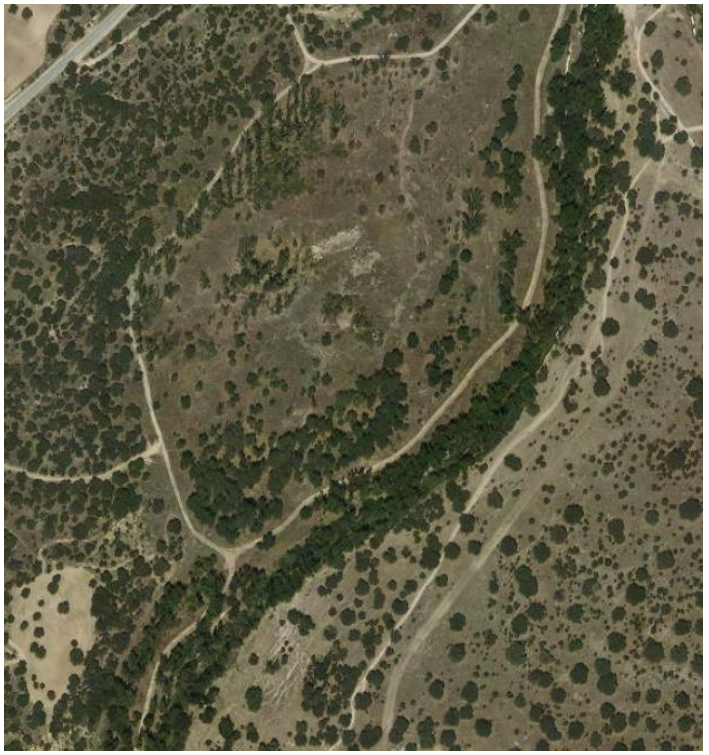
TYPES OF RIPARIAN VEGETATION INDICATORS



PLANTS:

- Species
- Size, Age
- Location

VEGETATION PATCHES:

- Composition
- Diversity
- Spatial structure
- Age classes
- Functional traits

RIPARIAN CORRIDORS:

- Dominant formations
- Width, Height
- Continuity
- Patch structure
- Functional zones
- Landscape complexity

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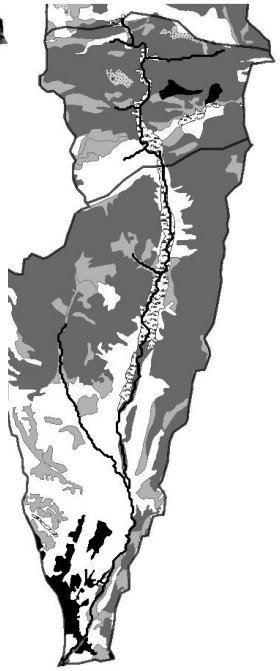
MULTI-SCALE APPROACH

(Gurnell *et al*., 2016, REFORM Proyect)

- Catchment
- Landscape unit
- River segment
- **RIVER REACH**
- Geomorphic units

Catchment
Water divide

Landscape unit
Topography
Geology
Land cover



River segment
Between confluences

River reach
Assemblage of geomorphic units

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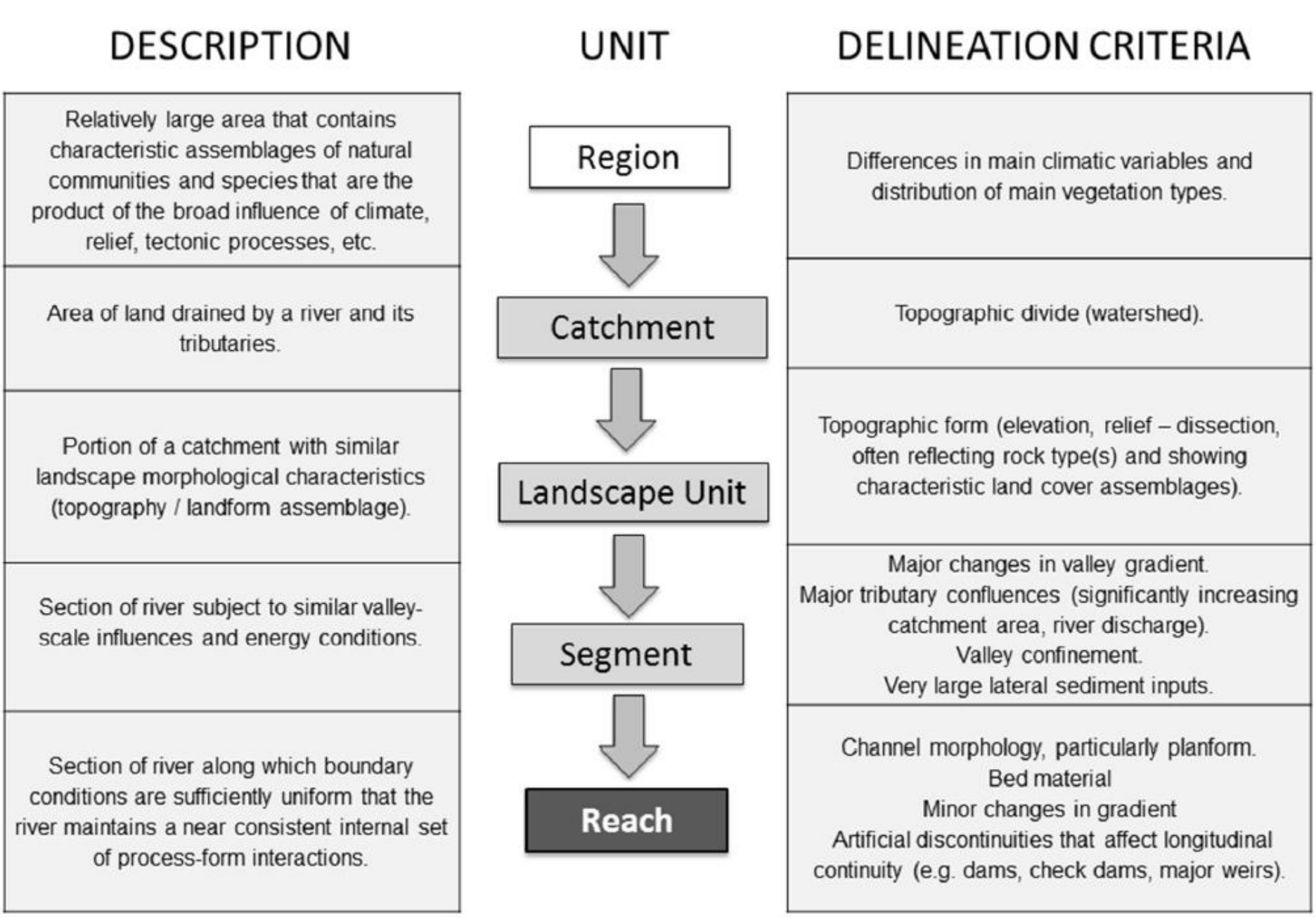

From England & Gurnell. (2016)

MULTI-SCALE VEGETATION UNITS/INDICATORS

ANALYSIS APPROACH *(MAIN DATA SOURCE)*	**PLANT / PATCHES** RIVER REACH (0,1-1 km)	**RIPARIAN CORRIDOR** RIVER SEGMENT (1-10 km)	**CORRIDOR / FOREST TYPES** LANDSCAPE UNIT / CATCHMENT (10-100 km)
Taxonomy based *(field work)*	Species composition, Abundance, Diversity	Plant formations, Plant communities	Phytosociological classes, Habitat types, Dominant species
Landscape-mosaic approach *(GIS analysis)*	Size, shape, coverage, Relative location to channel, Spatial distribution	Riparian corridor width, coverage, Connectivity, Fragmentation,	Corridor types, Spatial assemblage of patches, Landscape diversity
Functional approach (process-based) *(field work + GIS analysis)*	Pioneer Recruitment areas, Plant functional traits, Genetic diversity	Functional zones based on dominant fluvial processes, Vegetation guilds,	Broad Longitudinal /Transversal zonation of Plant communities, Broad location of Pioneer / Late-seral species

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Reach features | Segment features | Catchment features

MULTI-SCALE VEGETATION UNITS/INDICATORS

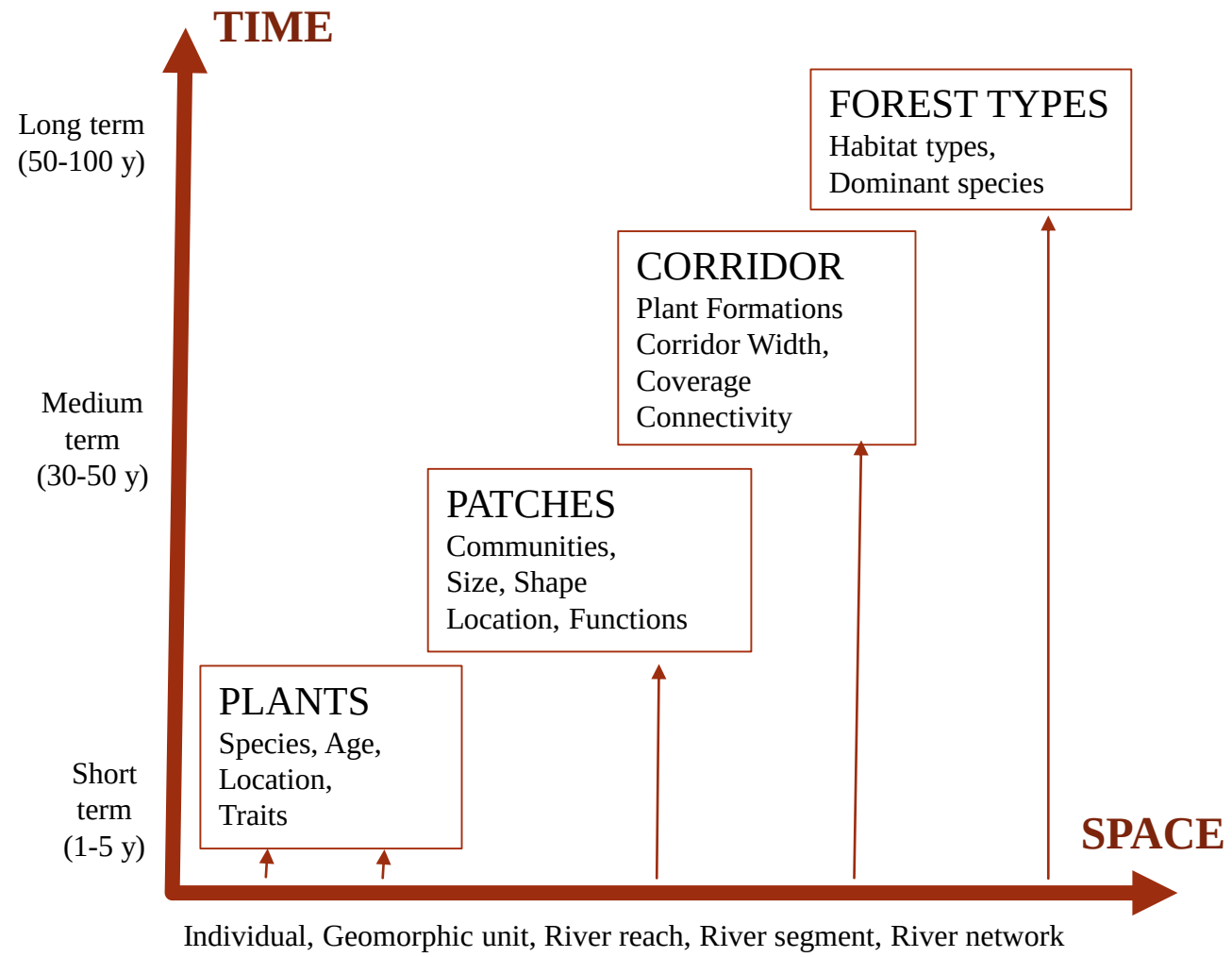
Catchment

Landscape unit

River segment

RIVER REACH

Geomorphic units



PROCESS-BASED FRAMEWORK

SPATIAL SCALE	HYDROMORPHOLOGICAL PROCESS / VARIABLES	VEGETATION INDICATORS	DISTURBANCES / PRESSURES
CATCHMENT **LANDSCAPE UNIT**	Precipitation, Evapotranspiration, Topography/Landforms Land Cover, Land Uses Hillslope Runoff, Aquifer storage Erosion processes, Sediment supply	Phytosociological classes, Habitat types, Dominant species Longitudinal /Transversal zonation of Plant formations	Global (climatic) changes, Warming, Land Cover changes, Wildfires, Road construction, Irrigation, Overgrazing
RIVER SEGMENT	Valley settings interactions Flow regime, Sediment budget Channel size and planform Channel adjustments Sediment size, Alluvial depth Floodplain sediment erosion /deposition Water table fluctuation,	Plant communities, Corridor width, coverage, Connectivity, Functional zones based on dominant fluvial processes. Patch structure, Landscape complexity	Flow regulation, Water abstraction Channelization, Dredging, Gravel mining, Floodplain occupation Groundwater depletion
RIVER REACH	Flood frequency and duration, Shear stress, Riparian soil texture, Soil moisture Burial and scour processes	Species composition, Diversity Size, Location to channel, Recruitment areas, Plant functional traits, Genetic diversity	Embankments, Dredging, Channel revetments, Weirs, check-dams, Floodplain sealing, Debris filling, Plantations

CONTENT

- Proposal of **multi-scale process-based indicators** of Riparian Vegetation to **characterize current status**

  - **Identify spatial scales:**
    1º. Recognize landscape units within the catchment
    (topography, land cover assemblages, geological features …)
    2º. Delineate "river segments" along the main channel
    (valley features, significative tributary confluences …)
    3º. Identify distinct "river reaches" within the river segments
    (assemblage of geomorphic units …)

  - **Measure and quantify indicators of Riparian Vegetation**
    at the respective spatial scales
    (plants, vegetation patches, riparian corridor …)

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CONTENT

- Proposal of multi-scale process-based indicators of Riparian Vegetation to characterize current status

- **Develop understanding** of vegetation responses to multiple disturbances (natural and human-induced changes)

TYPE OF DISTURBANCES AND VEGETATION RESPONSES

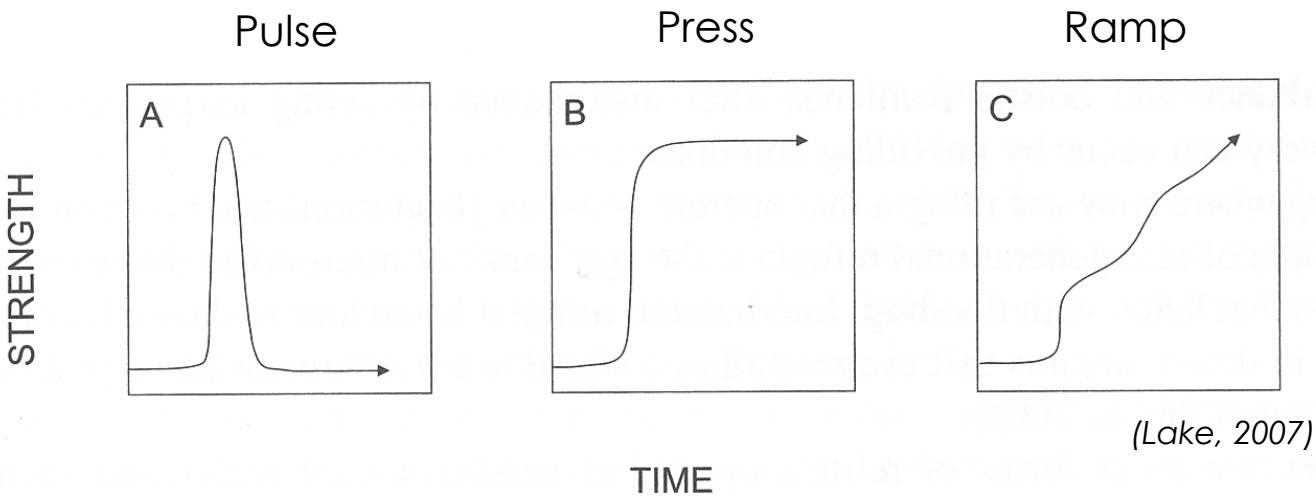
(From Garófano Gómez, 2019)

DISTURBANCES	REPORTED VEGETATION CHANGES
Hydrological alteration *(Flood magnitude and frequency, Sediment supply)*	Changes in types of vegetation, Recruitment, Aging, Simplification, Homogenization Encroachment, Terrestrialization
Morphological alteration *(Channelization, Disconnectivity, Revetments,*	Regeneration, Genetic Exchange, Increase of species more prone to vegetative reproduction
Pollution *(Water pollutants, Nutrients)*	Change in Species composition, structure Encroachment by nutrient releases from dams
Land Cover/Use changes	Reduction of riparian vegetated area
Climatic change *(Hydrologic decline)*	Change in riparian corridors dimensions Change in fluvial landscapes

TYPE OF DISTURBANCES AND VEGETATION RESPONSES

Type of disturbances:

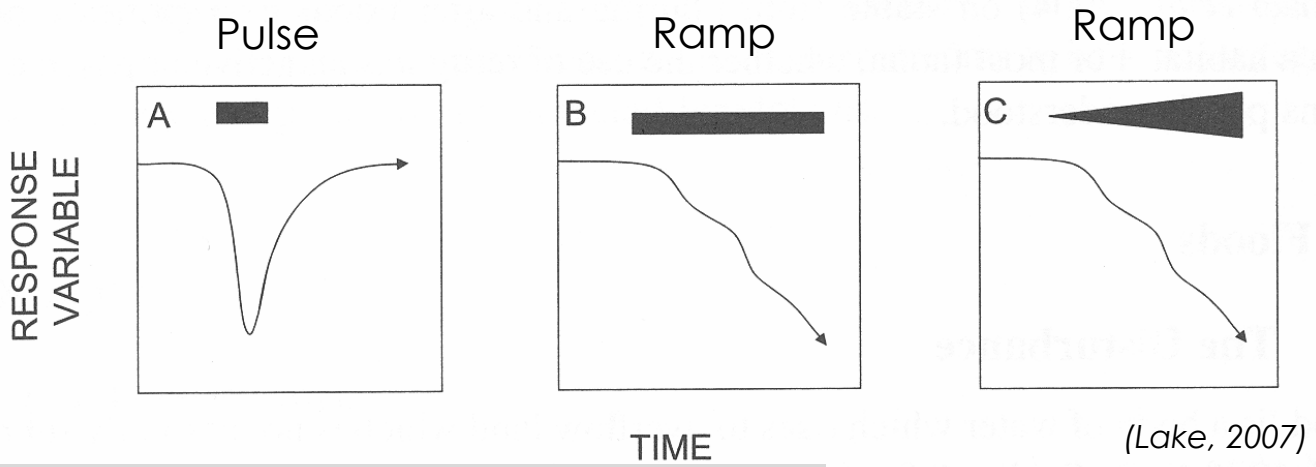
- Floods, Drought
- Dams, Reservoirs, Channelization
- Land cover changes
- Hydrologic decline



(Lake, 2007)

Type of responses:

- Removal, Recruitment
- Invasive species
- Encroachment,
- Aging, Mortality
- Terrestrialization
- Homogenization



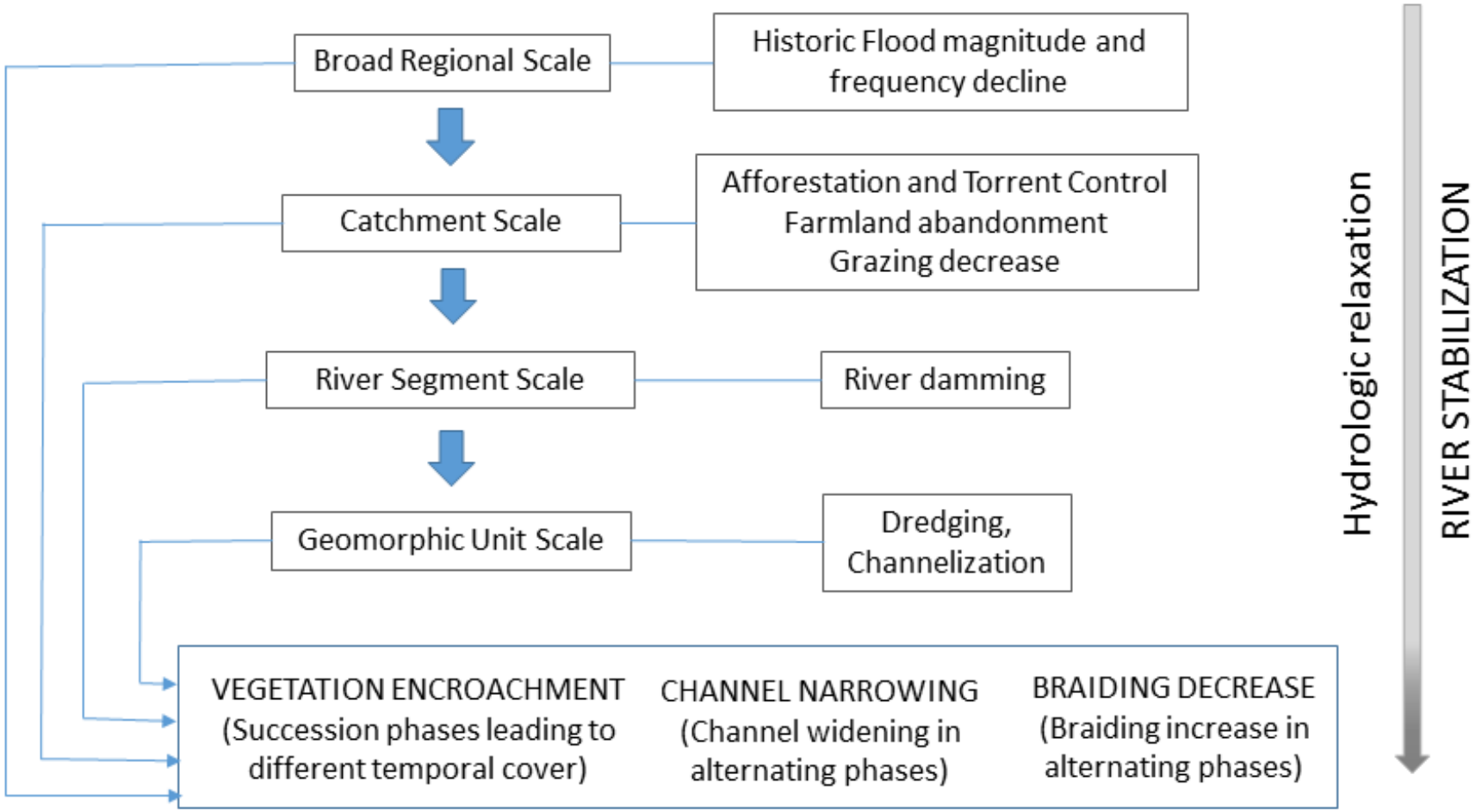
(Lake, 2007)

- INFLUENCE OF TIME SINCE DISTURBANCE
- POTENTIAL THRESHOLDS CHANGING TRAJECTORIES

UNDERSTANDING OF VEGETATION RESPONSES

RESPONSE TO PRESSURES VS. NATURAL ADJUSTMENT TO GLOBAL CHANGES

- In general, **multiple disturbances** with **cumulative effects** in time and space
- **Converging trajectories** of riparian vegetation over time, as "response" or "natural adjustment" *(García de Jalón et al., 2020)*

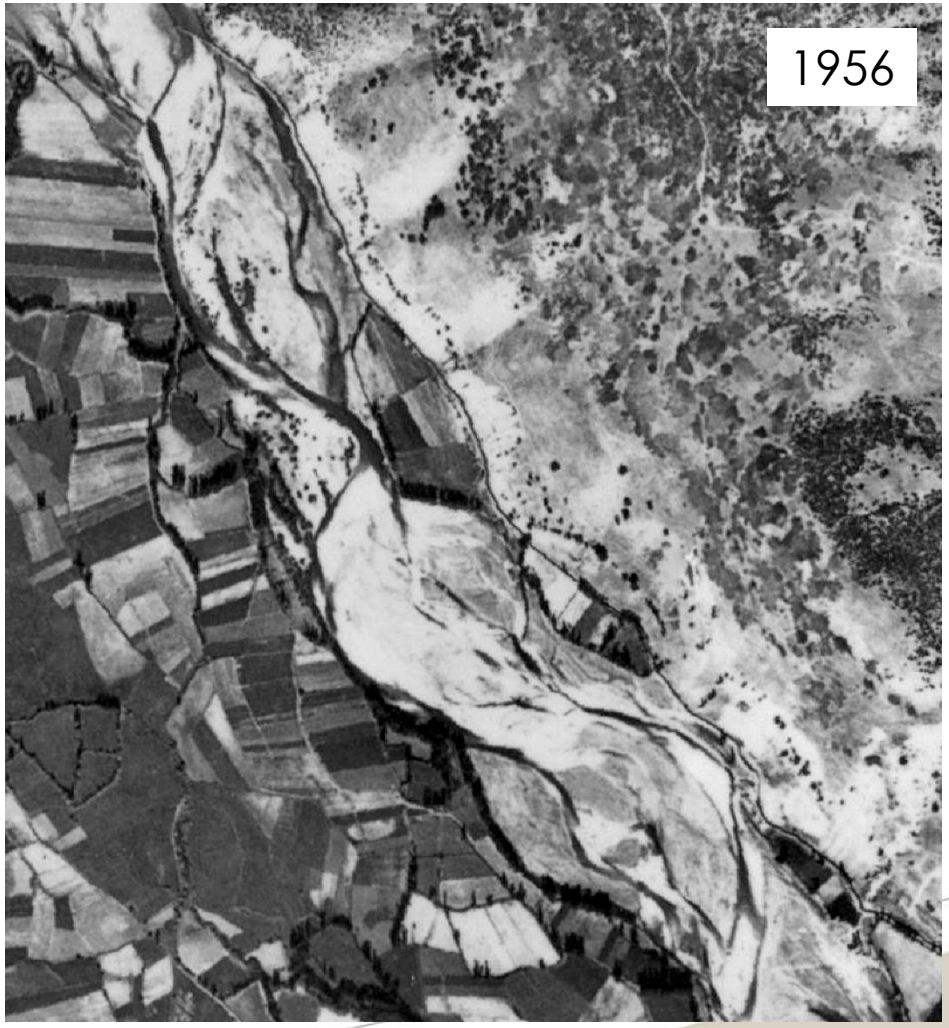


UNDERSTANDING OF VEGETATION RESPONSES

RESPONSE TO PRESSURES VS. NATURAL ADJUSTMENT TO GLOBAL CHANGES

River Curueño (North west Spain)

Free-flowing river
Renaturalization at catchment scale



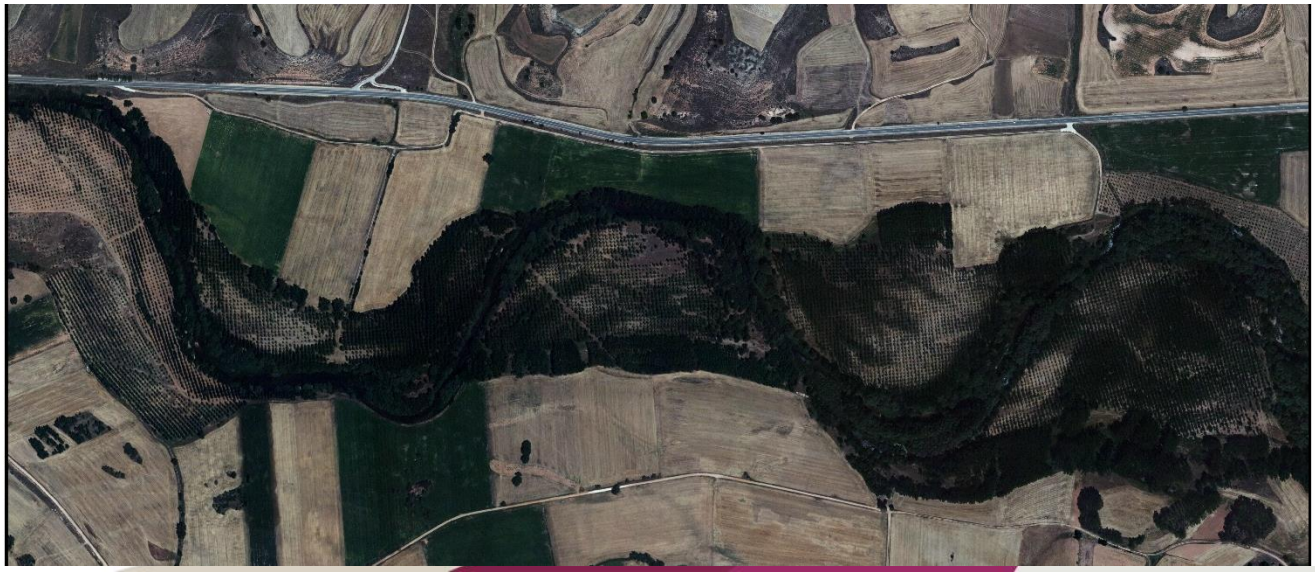
UNDERSTANDING OF VEGETATION RESPONSES

RESPONSE TO PRESSURES VS. NATURAL ADJUSTMENT TO GLOBAL CHANGES

River Arlanza
(North central Spain)

Free-flowing river

Extensive farming and Grazing decrease



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UNDERSTANDING OF VEGETATION RESPONSES

RESPONSE TO PRESSURES VS. NATURAL ADJUSTMENT TO GLOBAL CHANGES

River Guadiana Menor (South East Spain): *Dammed from 1984, Valley agriculture*

UNDERSTANDING OF VEGETATION RESPONSES

RESPONSE TO PRESSURES VS. NATURAL ADJUSTMENT TO GLOBAL CHANGES

- In general, **multiple disturbances** witth **cumulative effects** in time and space
- **Converging trajectories** of riparian vegetation over time, as "response" or "natural adjustment"
- Importance of **enlarging the temporal scales** for understanding vegetation responses

- **Vegetation dynamism**: Need to specify "**time since the last disturbance"**
- **Uncertainty** in linking vegetation **status with intensity** of pressures
- **Lack of replicates** with similar hymo-context but distinct intensity of disturbances

CONTENT

- Proposal of multi-scale process-based indicators of Riparian Vegetation to characterize current status

- **Develop understanding** of vegetation responses to multiple disturbances (natural and human-induced changes)

  1º. Measure changes of riparian vegetation indicators over time

  2º. Document disturbances at multi-scales

  3º. Establish functional, process-based links between altered physical processes, hydromorphological variables and riparian vegetation indicators

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CONTENT

- Proposal of multi-scale process-based indicators of Riparian Vegetation to characterize current status
- Develop understanding of vegetation responses to multiple disturbances (natural and human-induced changes)
- **Guidelines to characterize and assess riparian vegetion**

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PROPOSED GUIDELINES TO CHARACTERIZE AND ASSESS RIPARIAN VEGETION

A) CHARACTERIZATION AND DIAGNOSIS:

1º. Characterize current, past and historical conditions at multiple scales

2º. Compare and measure occurred changes over time

3º. Document disturbances over time at multiple scales

4º. Identify changes in riparian vegetation units

5º. Establish process-based links with reported disturbances

6º. Understand river trajectories from the past and predict river trajectories towards the future under manament options

PROPOSED GUIDELINES TO CHARACTERIZE AND ASSESS RIPARIAN VEGETION

A) CHARACTERIZATION AND DIAGNOSIS:

Current conditions

Past conditions

Channel changes

Riparian Corridor changes

Damming (1974)

Gravel mining (1960-2000)

Agriculture Urbanization (1970-2010)

PAST → PRESENT → FUTURE

Reconstruct trajectories related with pressures

Predict vegetation trends under future scenarios

PROPOSED GUIDELINES TO CHARACTERIZE AND ASSESS RIPARIAN VEGETION

B) ASSESSMENT:

1º. Define "**natural** (non-human induced) or target conditions" as "**reference**"

2º. **Quantify deviations from** reference conditions

3º Establish **thresholds for asigning "quality status"**

4º . Identify indicators/indices of "**functionality**" and indicators/indices of "**artificiality"** of forms and processes, to explain thresholds between quality status

PROPOSED GUIDELINES TO CHARACTERIZE AND ASSESS RIPARIAN VEGETION

?

B) ASSESSMENT:

Current conditions

Natural (Reference) conditions

Channel deviations

Riparian Corridor deviations

	Status
<<	• Very good
<	• Good
=	• Fair
>	• Poor
>>	• Very poor

CONTENT

- Proposal of multi-scale process-based indicators of Riparian Vegetation to characterize current status
- Develop understanding of vegetation responses to multiple disturbances (natural and human-induced changes)
- Guidelines to characterize and assess riparian vegetion
- Attempt to **integrate** other **methodological approaches** within the proposed multi-scale framework

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INTEGRATING APPROACHES WITHIN THE MULTI-SCALE FRAMEWORK

PARTICIPANT	INDICATORS	SPATIAL SCALE	DISTURBANCES	VEGETATION RESPONSES
W. Bertoldi				
P. Rodríguez				
D. García de Jalón				
E. Politti				
V. Martínez				
M. Liro				
A. Kidova				
T. Okruszko				
T. Kiss				
R. Egozi				
E. Abraham				
P. Zinke				
E. Papastergiadou				
J. Jakubinski				
R. Martínez				

CONTENT

- Proposal of multi-scale process-based indicators of Riparian Vegetation to characterize current status
- Develop understanding of vegetation responses to multiple disturbances (natural and human-induced changes)
- Guidelines to characterize and assess riparian vegetion
- Attempt to integrate riparian vegetation methodological approaches
- **Further steps towards WG2 and WG3**

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LOOKING FORWARDS … TO WG2, WG3

Where we are:

- **Dispersion of methodologies** to characterize riparian vegetation
- Frequent **mis-understanding** of Characterization vs. Assessment
- Proposal of **Multi-scale process-based approach** for riparian vegetation characterization
- **Lack of data to define "natural** (non-human induced) or reference conditions of riparian vegetation, according to river hydromorphological typologies and biogeographic regions

What we propose next:

- Integrate methodologies and **document case studies** across European rivers
- Interdisciplinary groups (expertise on fluvial morphology and botany) to **draft "natural" conditions** of riparian corridors according to river typologies

CONCLUSIONS

1. The Water Framework Directive should be **up-dated** in its hydromorphological background, assuming the interest of **including riparian vegetation** as a key hydromorphological element

2. A **multi-scale process-based** approach for riparian vegetation assessment could **integrate** existing riparian vegetation protocols, and **facilitate understanding** of riparian vegetation responses to disturbances

3. **Converging trajectories** of river corridos are observed in multiple rivers, **which difficult the assessing of** effects of natural disturbances and human-induced changes

4. Interest of collecting data from **case-studies across European rivers,** to **prove** the proposed multi-scale approach, and **document potential references** from the less human-altered rivers


THANK YOU FOR YOUR
ATTENTION i