

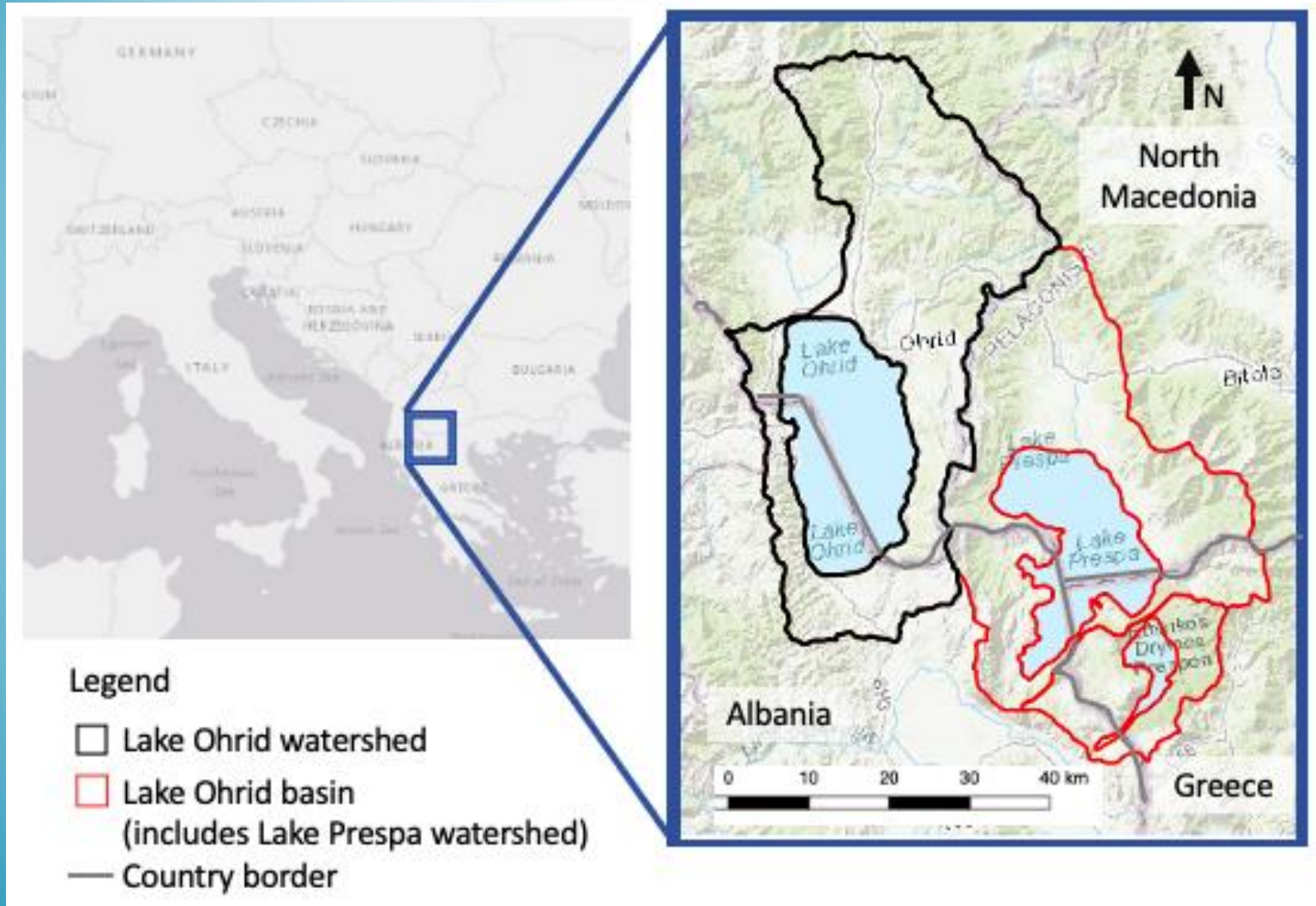
Soil Conservation and environmental protection
(Imola, Italy)
8th September 2021

*Session 5:
Environmental management of waterways and riparian
strips for the ecosystems conservation*

Watershed based Shorezone Functionality Index: A new approach to support the Water Frame Directive

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Lake Ohrid



Watershed: 1,129 km²

80% North Macedonia

20% Albania

Shoreline length: 87.8 km (2/3 NM)

- Ancient Lake (Pliocene)
- Biodiversity richness
- Oligotrophic
- Eutrophication process
- UNESCO site (1979+2019)

The need of a new Index

- 60% of surface water bodies failed to achieve good status¹
- Reasons^{2,3}:
 - Difficulty in managing the Programme of Measures at the watershed scale.
 - Identification of causes of degradation;
 - Limited progress in reducing nutrient loads;
 - Insufficient restoration measure;



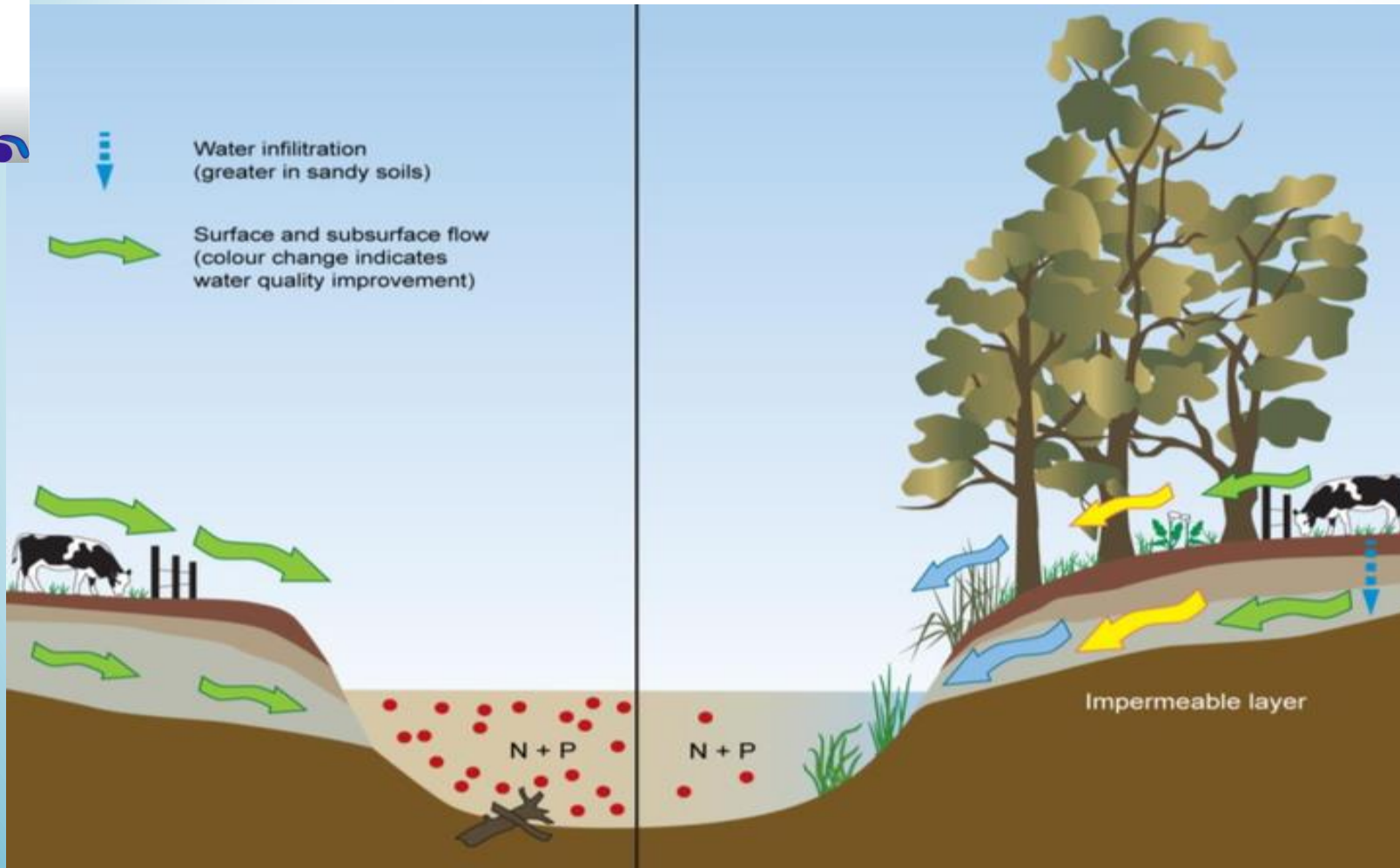
The need of a new Index

- 60% of surface water bodies failed to achieve good status¹
- Reasons^{2,3}:
 - Difficulty in managing the Programme of Measures at the **watershed scale**.
 - Identification of **causes of degradation**;
 - Limited progress in **reducing nutrient loads**;
 - Insufficient **restoration measure**;
- Actions to reduce nutrients input⁴:
 - Land Use Mitigation
 - Riparian Restoration



Riparian restoration

Buffer effect of riparian restoration⁵



Nitrogen removal
by shorezone
width⁶

Shorezone width (m)	Nitrogen removal (%)
0	0
1-5	-15
5-10	50
10-30	72
30-50	80
>50	85

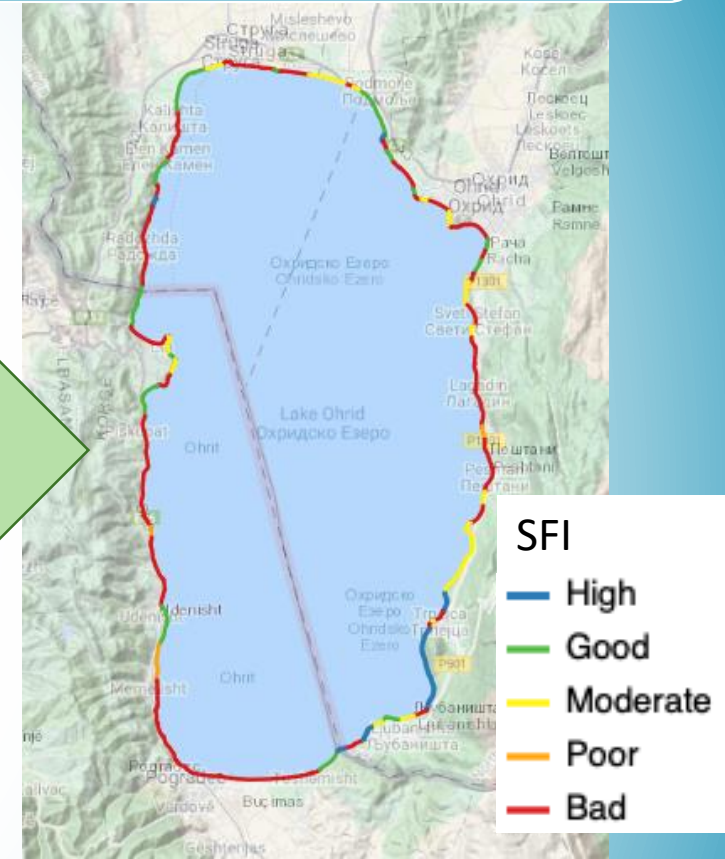


Shorezone Functionality Index (SFI)⁷

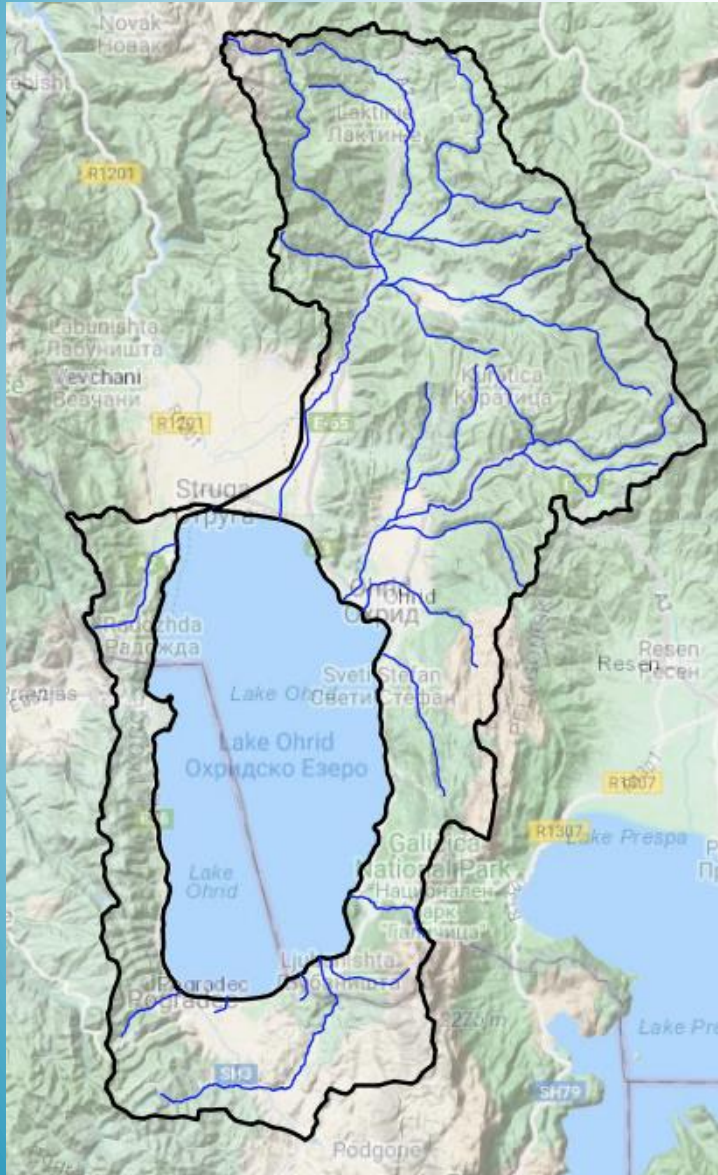
Evaluates:

- Buffering capacity of the riparian vegetation
- Complexity and artificiality of the shoreline
- Anthropogenic use of the surrounding territory

LEVEL	SCORE	COLOR
I	High	BLUE
II	Good	GREEN
III	Moderate	YELLOW
IV	Poor	ORANGE
V	Bad	RED



Watershed-Based Shorezone Functionality Index (WASFI)



1. Shorezone Functionality Index (SFI)
Shorezone width used to draw inland sub-watersheds
2. Sub-watershed characterization
3. Correlation with existing data



External
Input

Land Use Mitigation



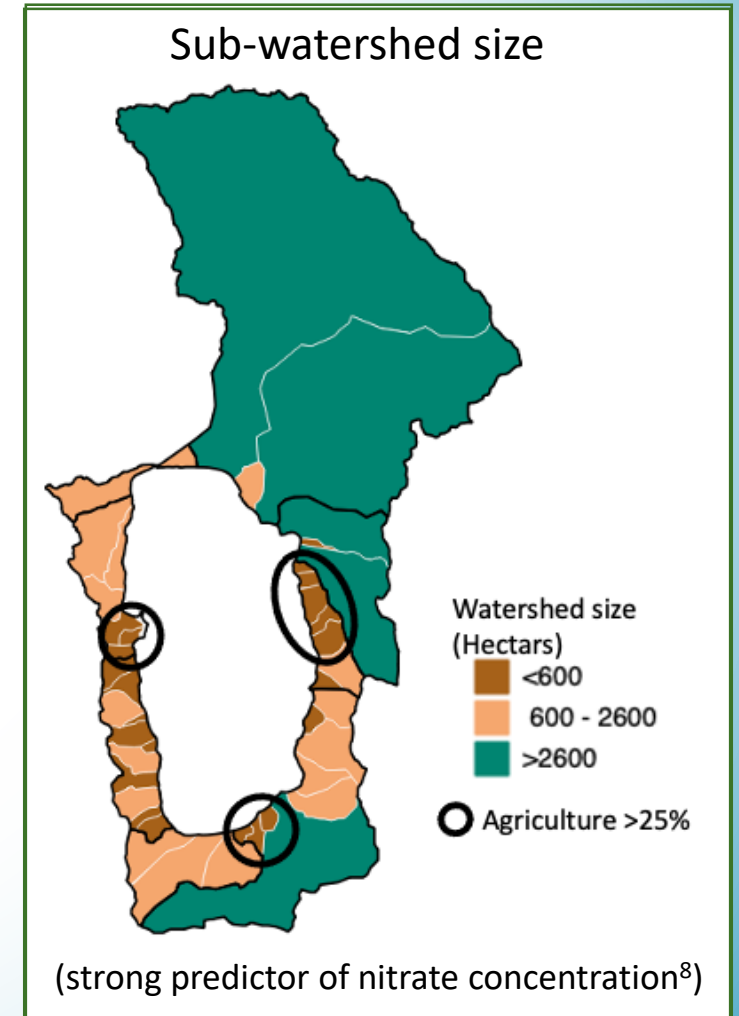
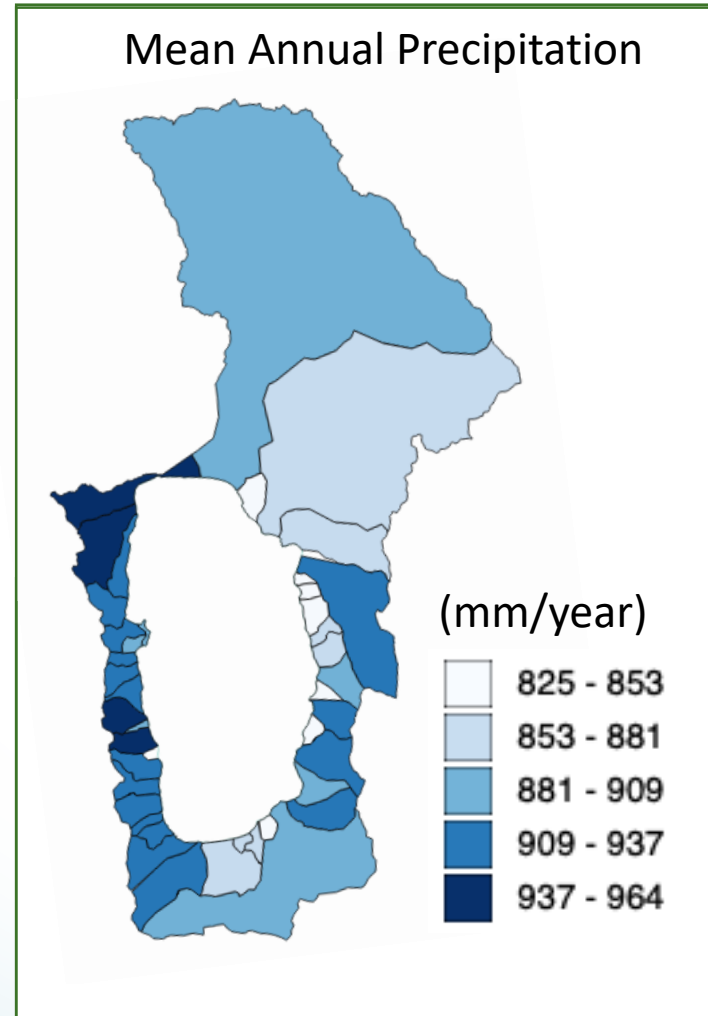
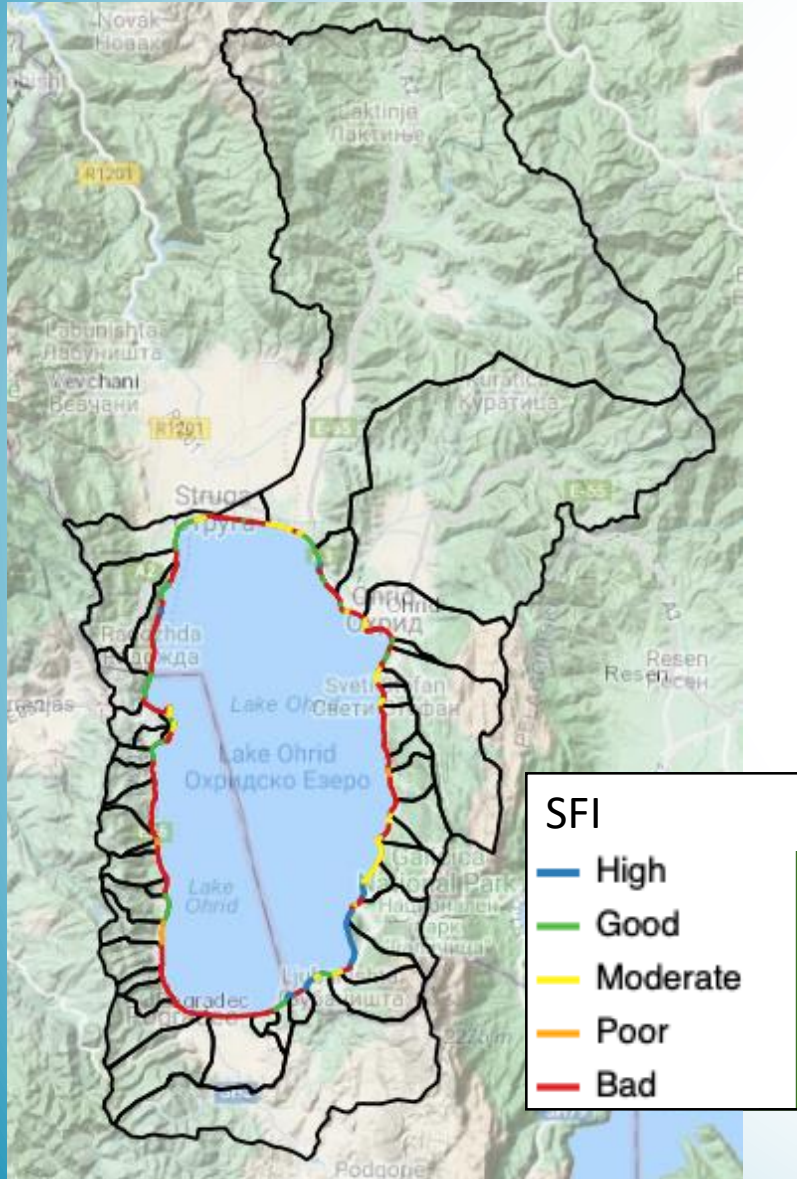
Shorezone
Buffering

Riparian Restoration



Macrophyte
Index

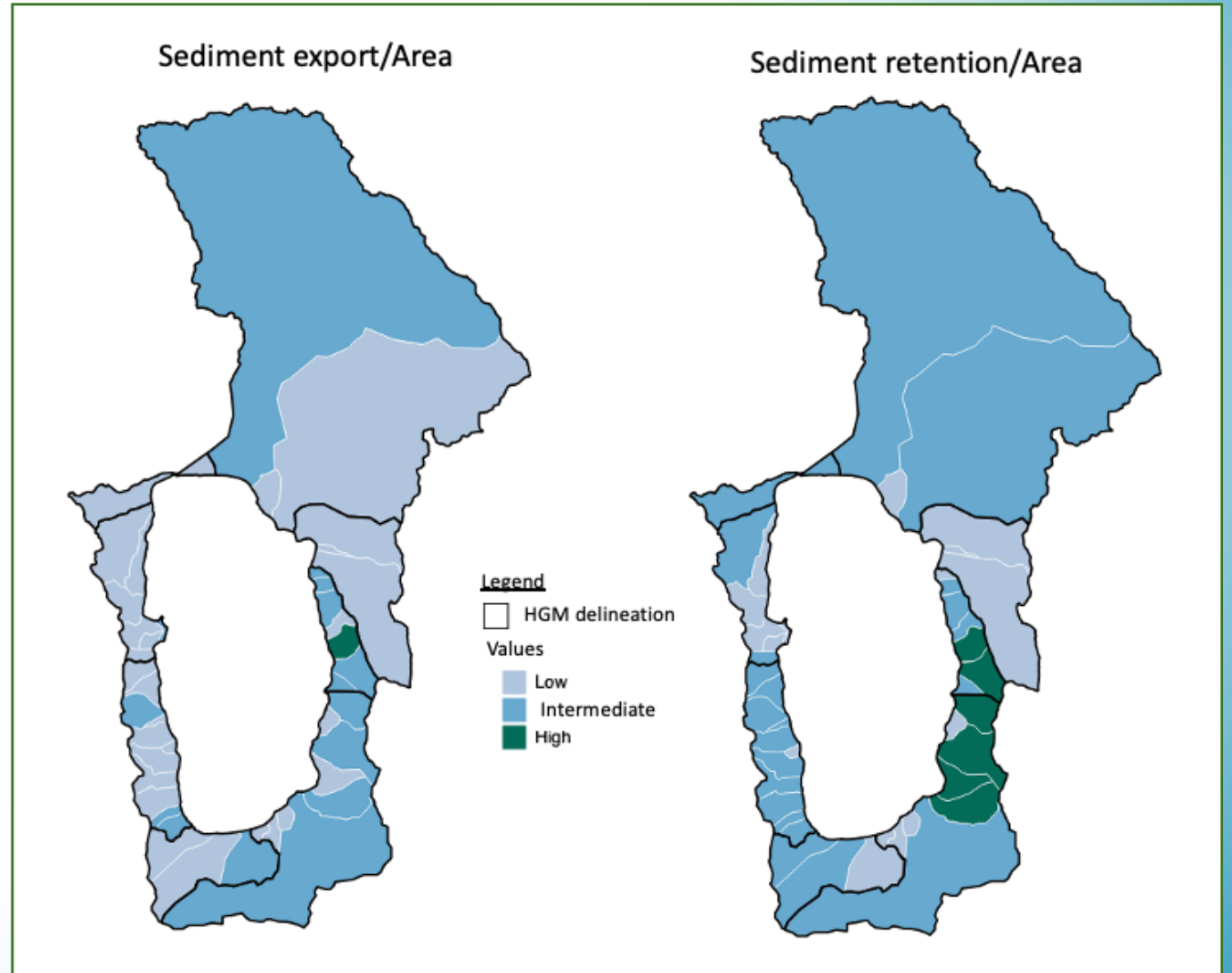
2. Sub-watershed identification



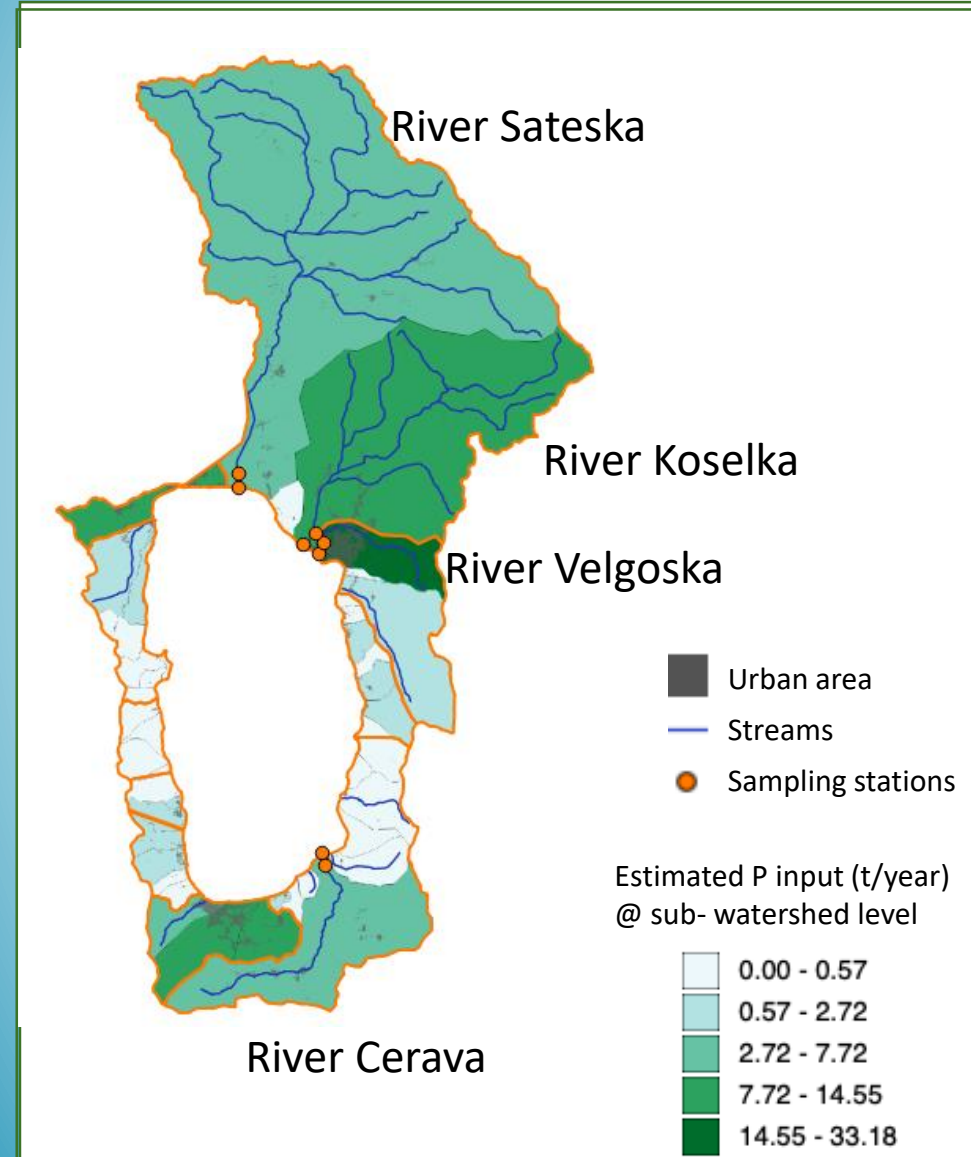
2. Sub-watershed: Sediment Delivery Ratio (NCP⁹)

Includes:

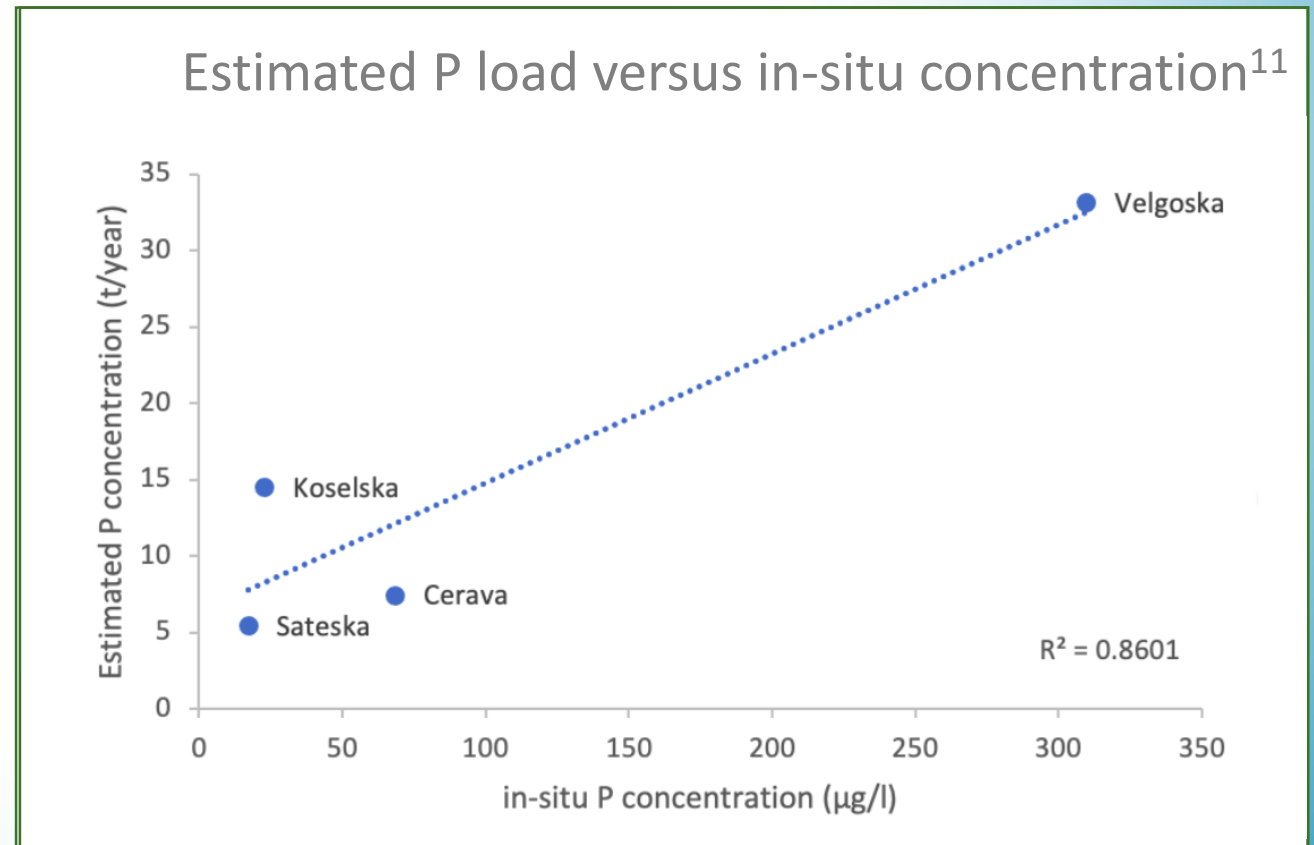
- Morphological data
(elevation & slope)
- Water regime
(precipitation & streams)
- Land Use/Land Cover



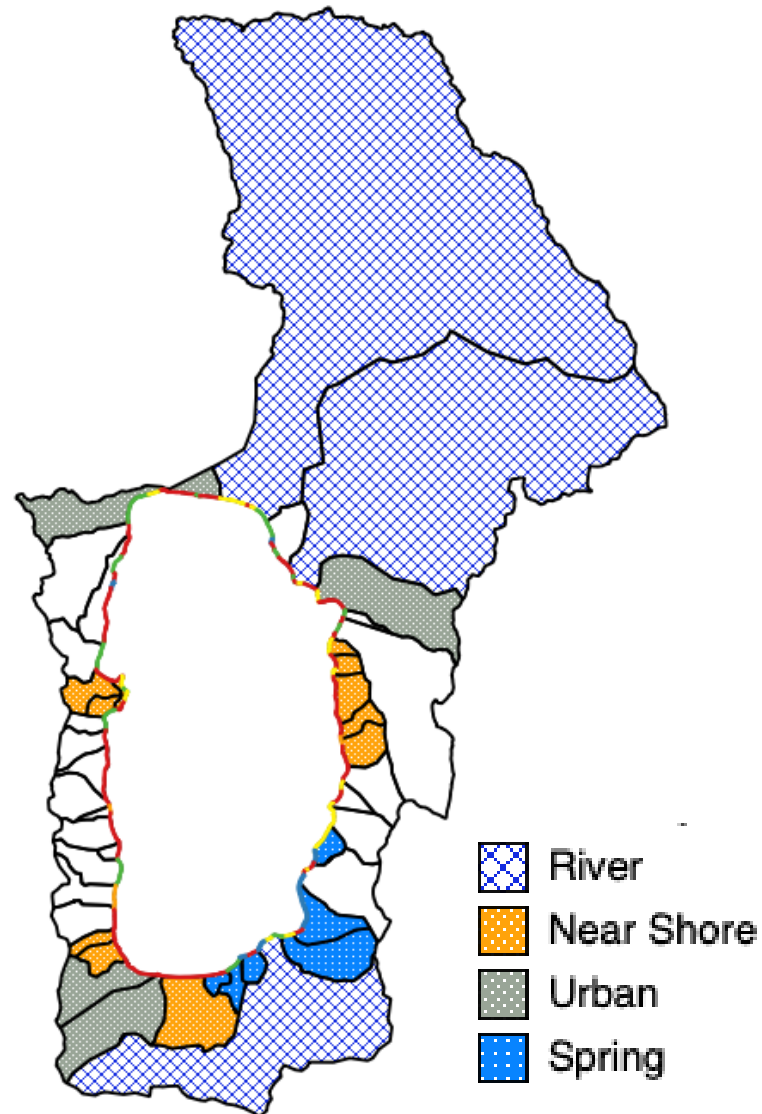
2. Sub-watershed: Anthropogenic Influence



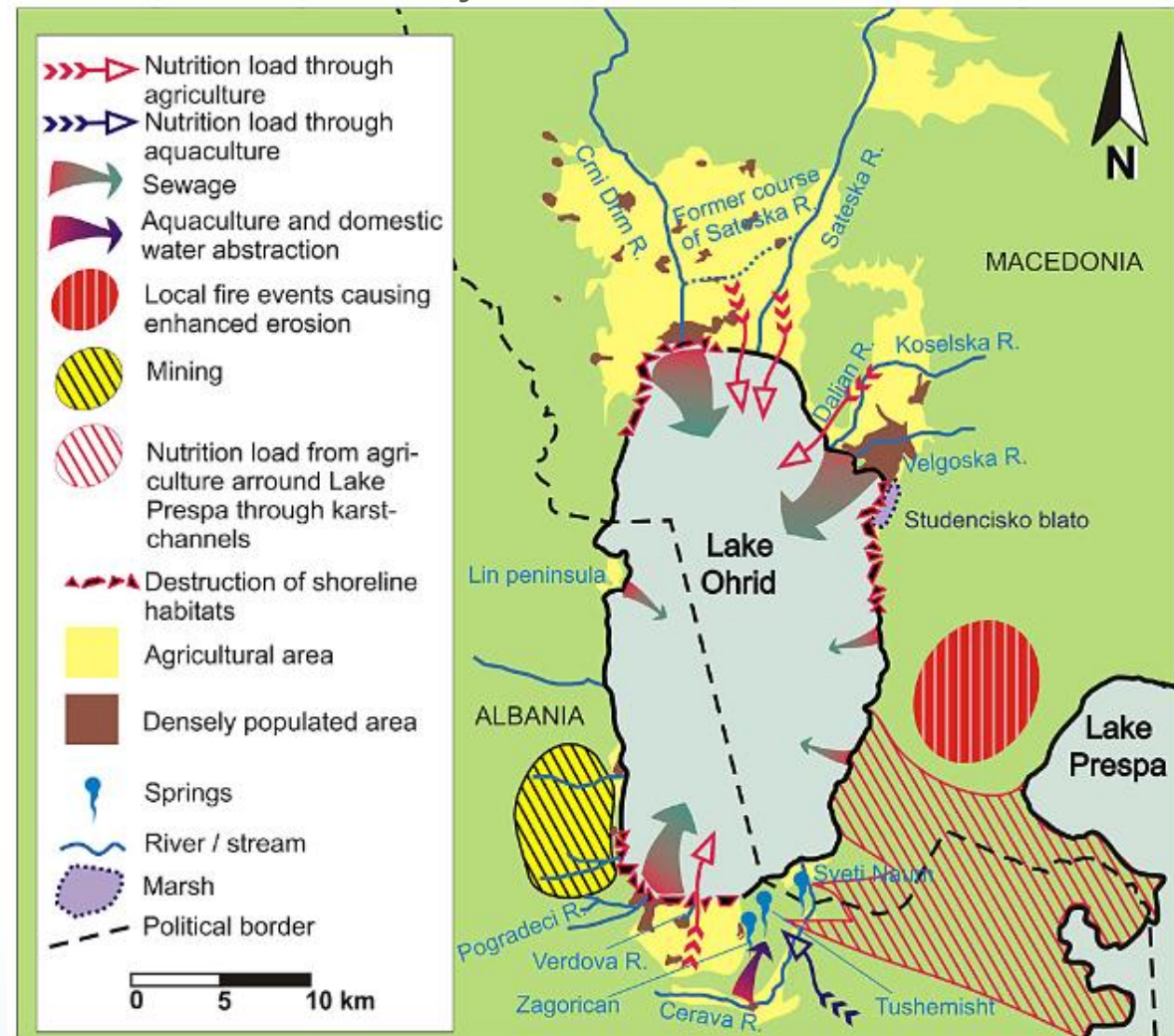
- Limited sewer treatment systems
- P load of 0.1 t/yr for every 100 people¹⁰



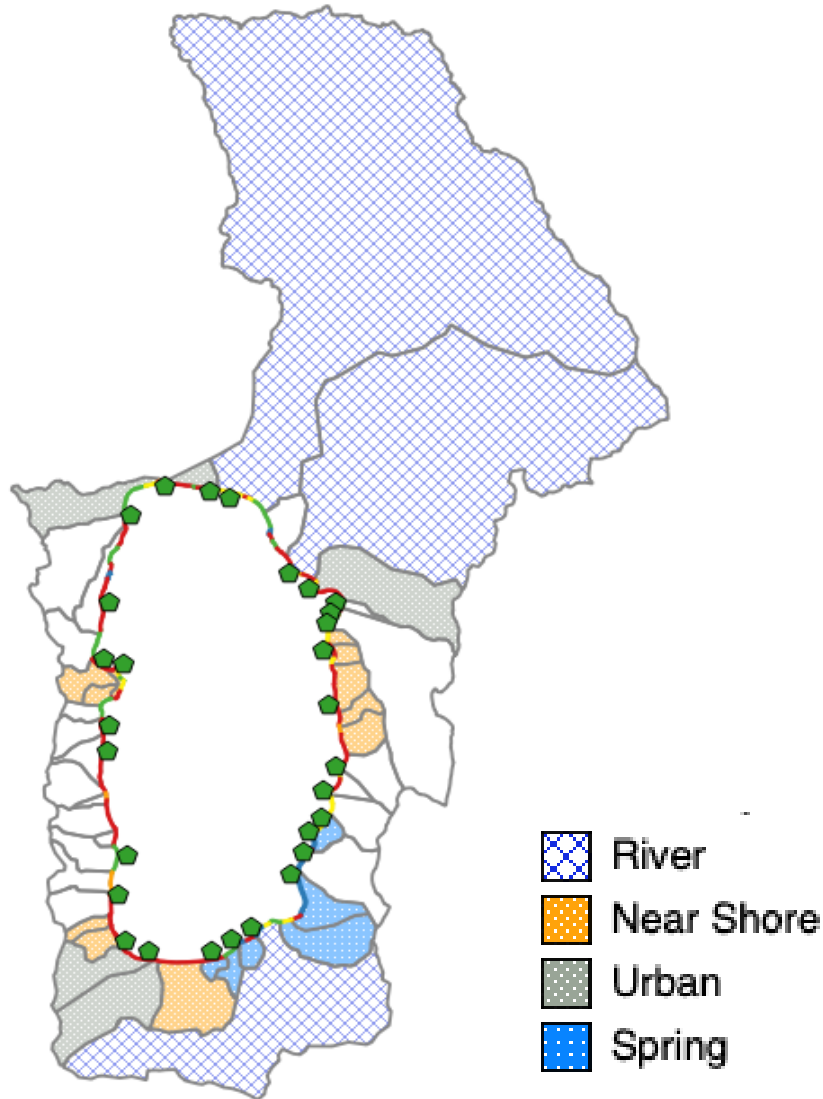
Overall Insights



Land use and spatial distribution of selected major threats to Lake Ohrid¹¹



3. Correlation with macrophyte index



External Input



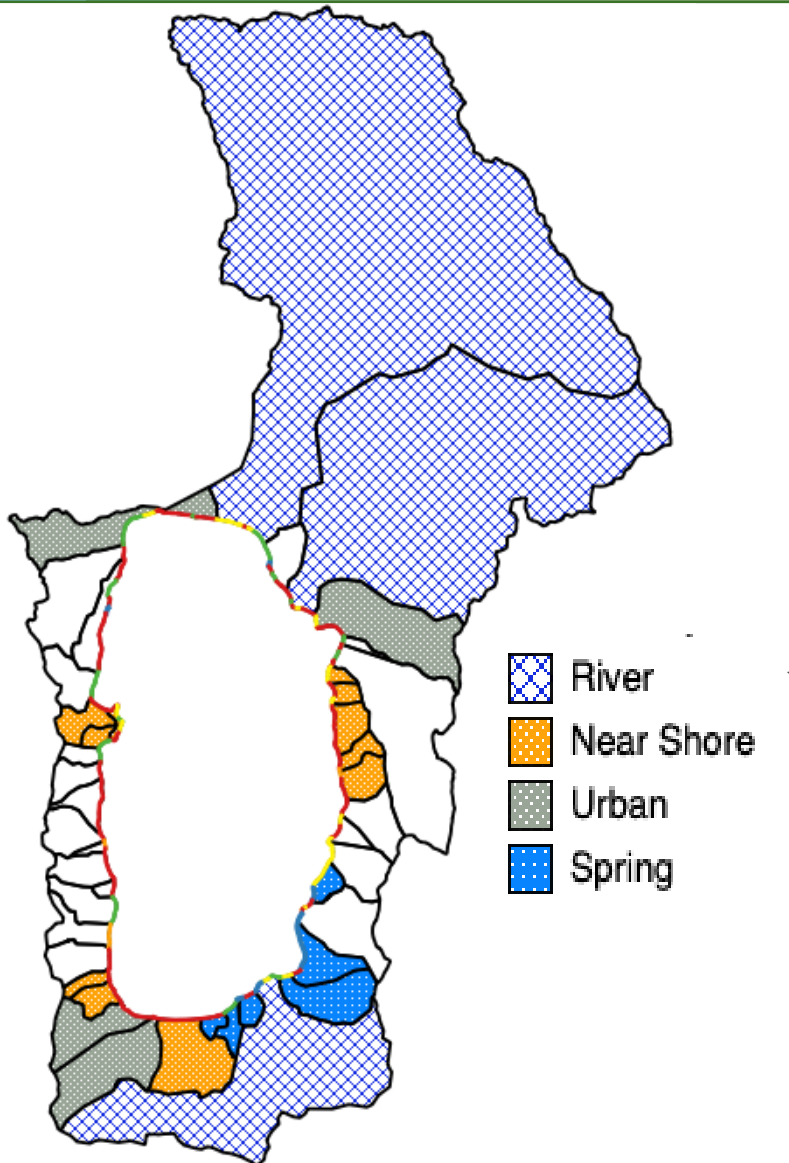
Shorezone Buffering



Macrophyte Index ¹²

Variable		No shorezone	With shorezone buffer
MI (n = 30)	Estimated P input	0.22	0.45
	Sediment export	0.32 *	0.47**
	Usle	0.30	0.36
0-2 m (n = 29)	Estimated P input	-0.19	-
	Sediment export	-	0.18
	Usle	-	0.27
2-4 m (n = 30)	Estimated P input	0.29	0.41*
	Sediment export	0.33*	0.44*
	Usle	0.28	0.45*
4-10 m (n = 30)	Estimated P input	0.41*	0.44*
	Sediment export	0.20	0.22
	Usle	0.16	0.24
>10 m (n = 11)	Estimated P input	-30	-30
	Sediment export	0	0.10
	Usle	0	0.10

Advantages: detailed & easily implemented



- Management recommendations on sub-watershed scale:
 - managed more easily;
 - specific insights of the best practise;
 - Provides a picture of the lake at a specific time.
- Supports the the Programme of Measure;
 - Based on open-source software & free data;
 - Quick to apply, relatively inexpensive.

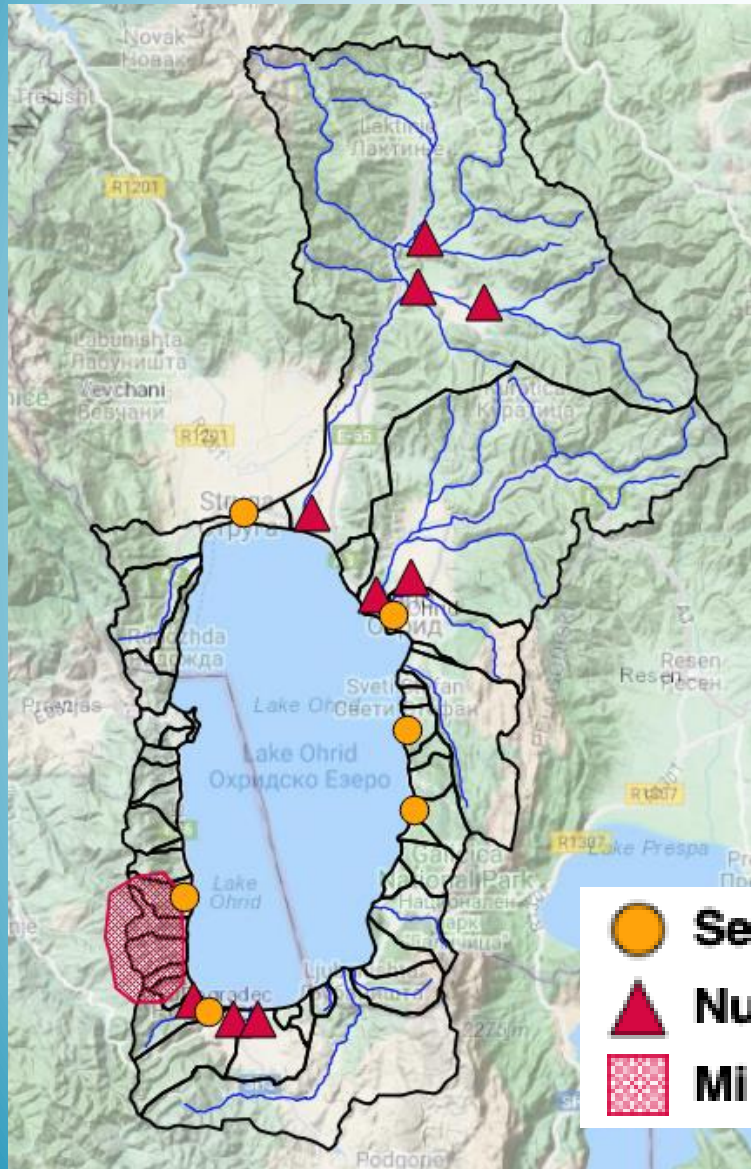
Improve river's riparian vegetation

Act on shorezone & Land Use/Land Cover

Water treatment actions

Act on Lake Prespa watershed

Advantages: participatory approach



- Involvement of local stakeholders;
- Local expertise valued;
- Tailored actions to consider the needs of the local needs;
- Supported by scientific publications.

Advantages: modelling of future scenarios

Scenarios can be modelled based on changes in:

- Climate
- Land Use/Land Cover
- Restoration actions.

Restoration actions: reeds areas¹³



Conclusion

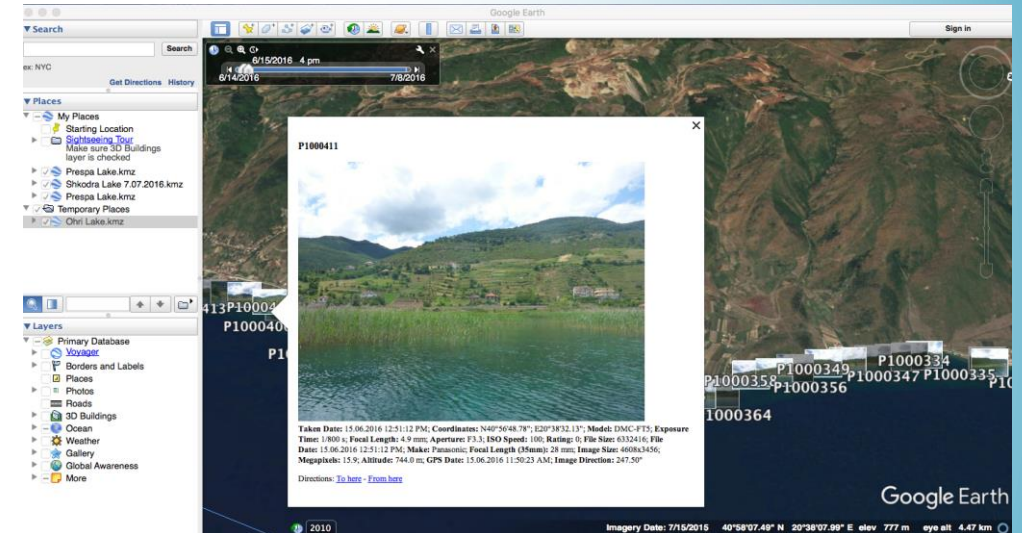
Easily replicable index, based on an existing index (SFI) which also include the whole watershed

Management tool to :

- Identify causes of degradation
- Localizes areas to reduce nutrient loads
- Identify areas and kind of restoration needed

Useful for:

- Local & National management agency
- Writing of Programme of Measures
- Nature Conservation Agency
- Environmental Scientists
- Aiding adaptation for future Climate Changes



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Thank you for your attention



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