ARCH Architecture and roadmap to manage multiple pressures on lagoons

The relevance of sediments in eutrophic systems: a comparison of two European coastal lagoons (Óbidos and Lesina)

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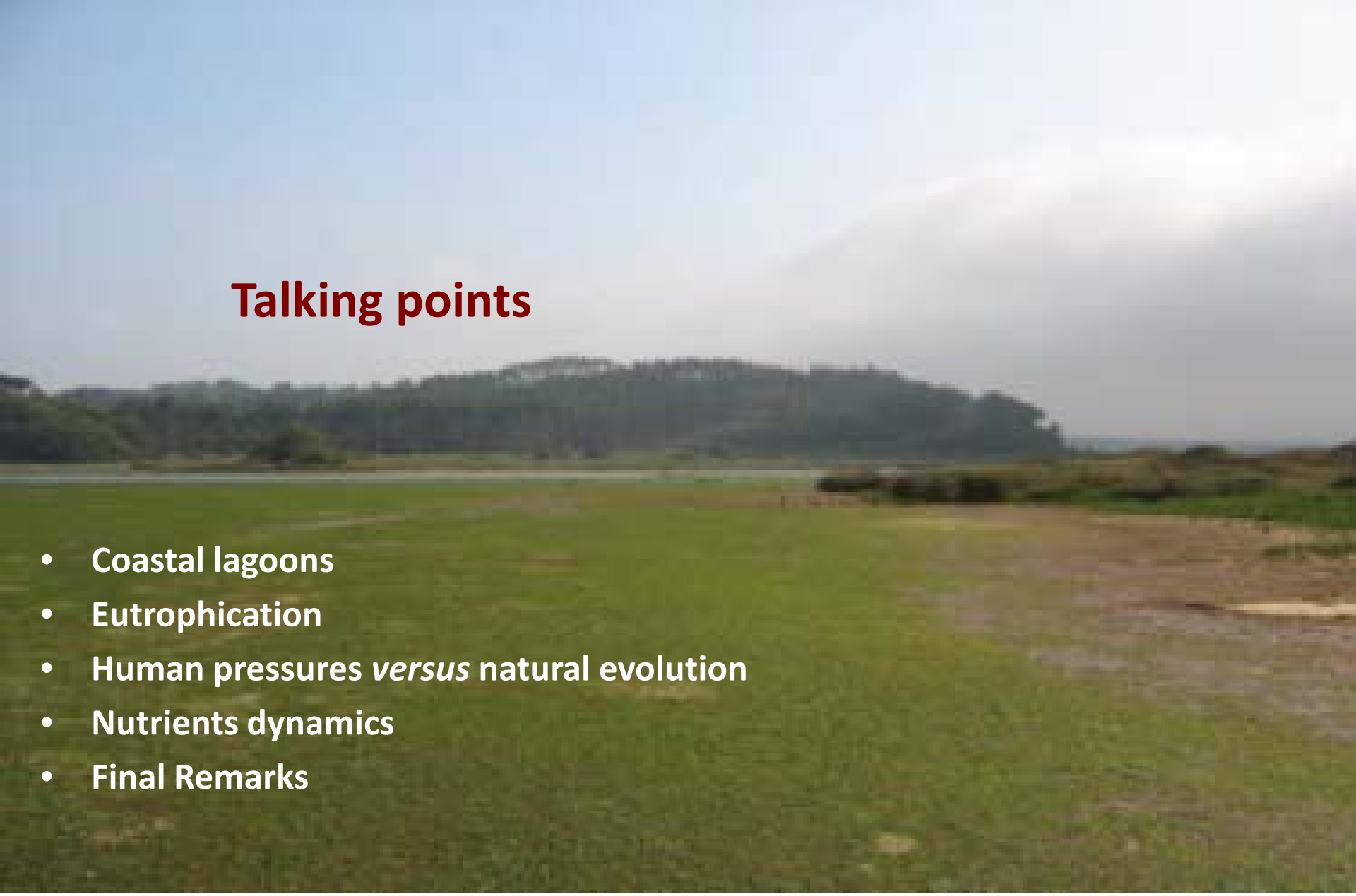

Talking points

- Coastal lagoons
- Eutrophication
- Human pressures *versus* natural evolution
- Nutrients dynamics
- Final Remarks

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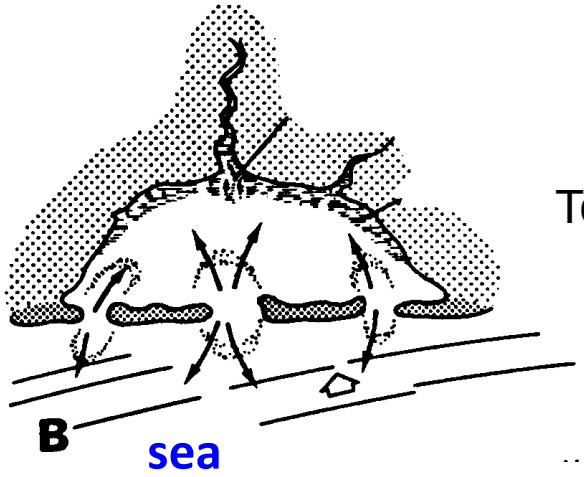
Coastal lagoons: current and future problems



Towards **land-locked** systems

Nutrient enrichment

Shift on **biodiversity**

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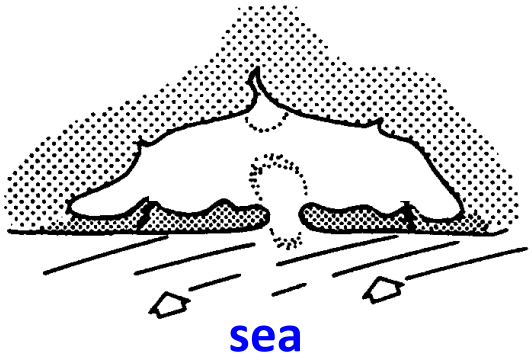


Climate changes: accentuation of current problems?

Inlet channel: vulnerable to wind storms

Pulse input of nutrients: runoff

Eutrophication

- **Eutrophication** is the most worldwide problem in transitional and coastal waters resulted from human pressures

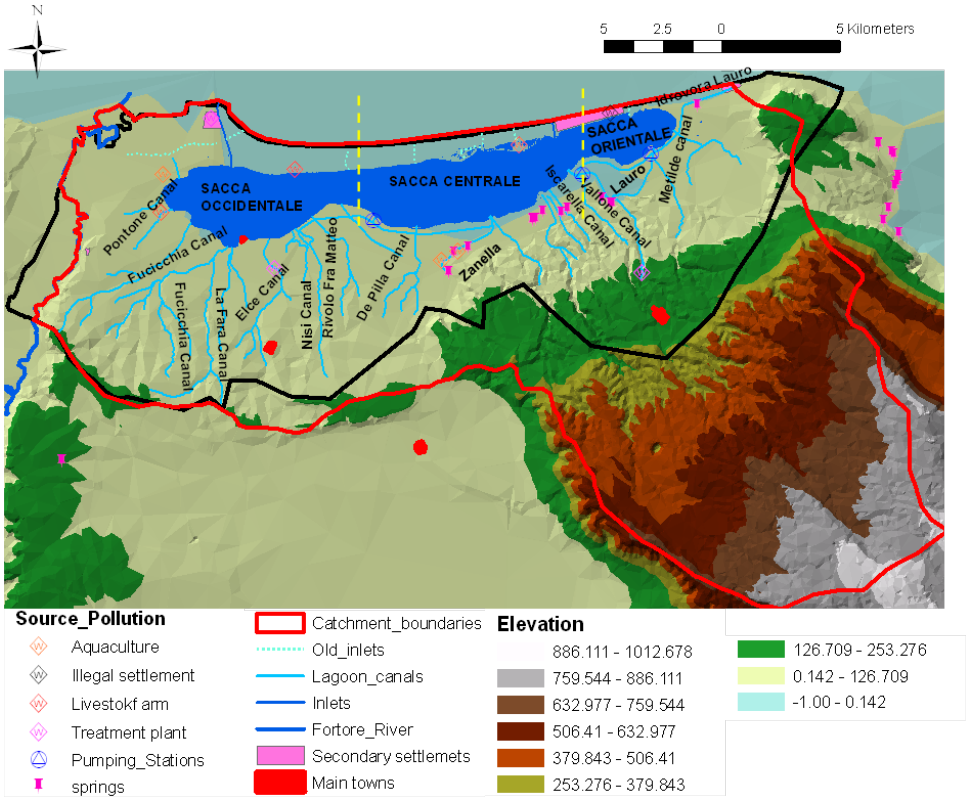
- **Human-induced eutrophication** is a Descriptor of Good Environmental Status of Marine Strategy Framework Directive (MSFD)

- **Eutrophication** is a process driven by the enrichment of water by **nutrients**, especially compounds of nitrogen and phosphorus, leading to:
  - increased growth, primary production and biomass of **algae;**
  - changes in the **balance** of organisms;
  - water quality **degradation**.

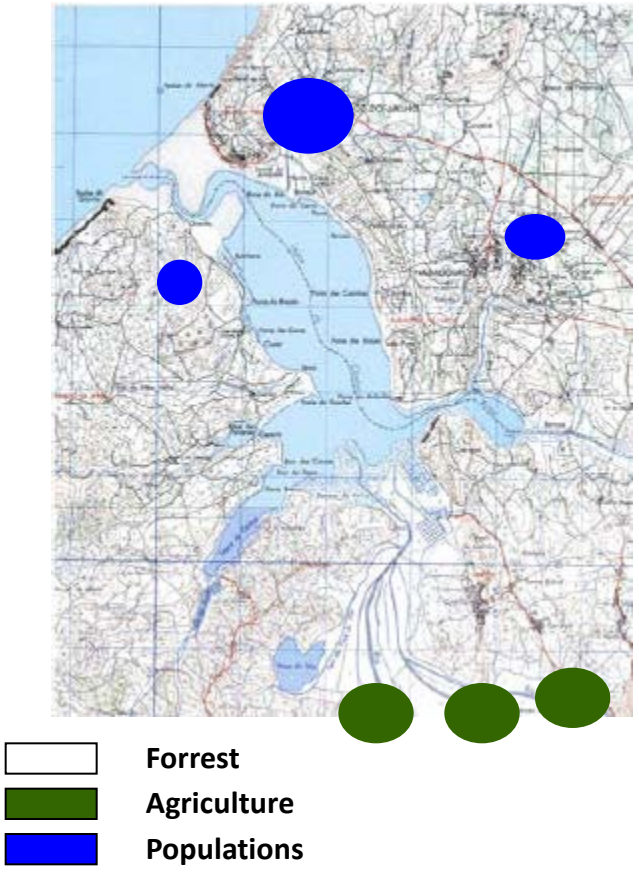
- **Consequences** are undesirable if they appreciably degrade
  - ecosystem **health** and **biodiversity;**
  - sustainable provision of **goods** and **services**.

Two case studies: Óbidos lagoon and Lesina lagoon

Lesina: Italy, southern Adriatic coast, Med

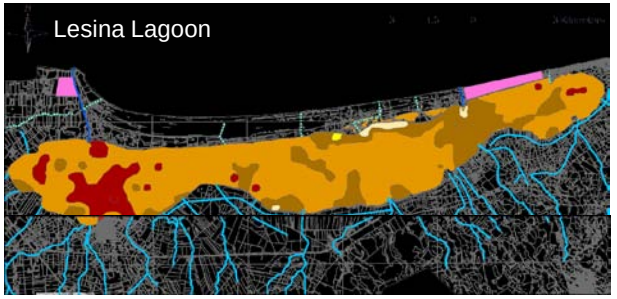


Óbidos: Portugal, Atlantic coast



Morphologies of Óbidos and Lesina
similarities and **differences**

	Óbidos Lagoon	Lesina Lagoon
Location	West Portugal	Italy, Adriatic coast
Area	**7 km²**	**51 km²**
Depth	< 3.5m	< 1.5m
Freshwater inputs	**< 1m³/s**	**12 m³/s** (river and canals)
Tidal regime	mesotidal (**3m**)	microtidal **(<0.2m**)
Connection to sea	1 narrow inlet	2 narrow inlets
Residence time	1-22 days	70-100 days

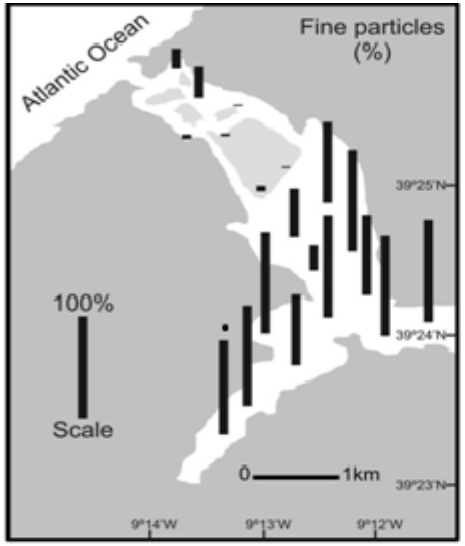


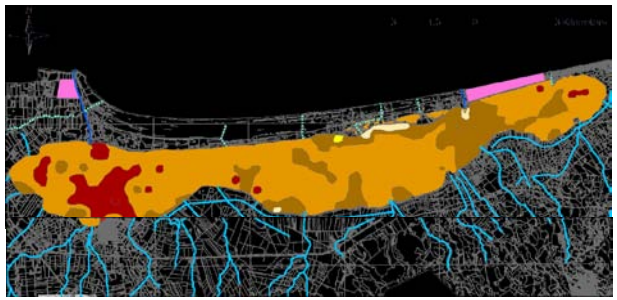
Constraints of Lesina and Óbidos: similarities and differences

	Óbidos Lagoon	Lesina Lagoon
Major constrains	Eutrophic conditions	Dystrophic crises
Macroalgae cover	Yes (eg. *Ulva* spp)	Yes (several species)
Sediments	Sand, mud in upper area	Sand, mud spots
Human activities	Clam harvesting	Fishing
	Fishing	Aquaculture (on land)
	Bathing waters, tourism and leisure	Bathing waters, tourism and leisure
	Agriculture	Agriculture

Sediment composition:

fine particles: red hotspots and height of bars





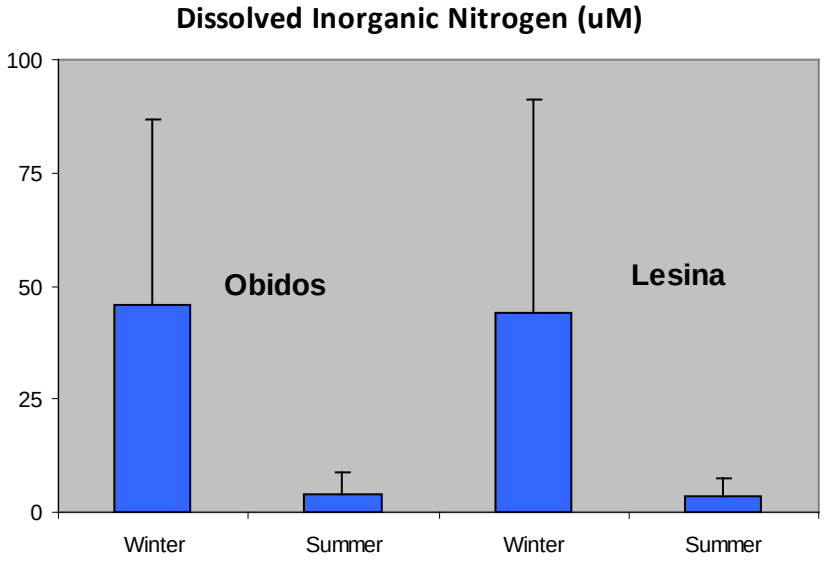
Estimation of Pressures/Impacts

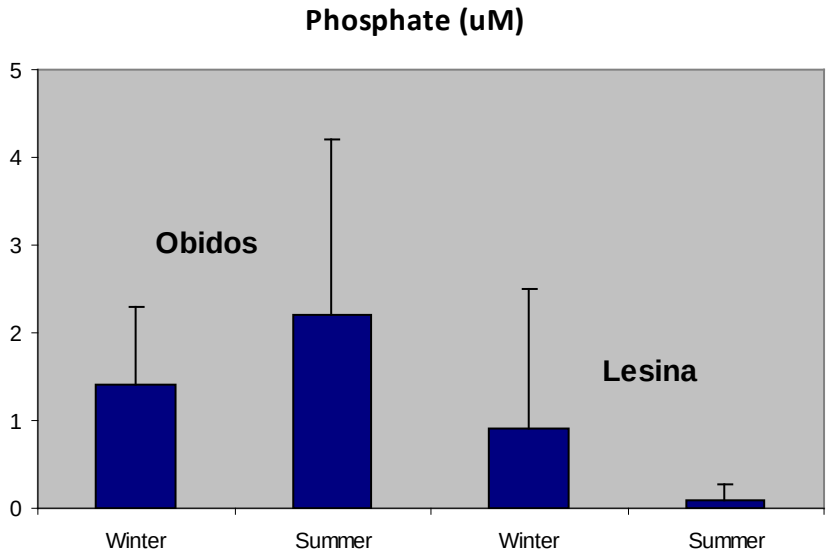
Pressures/Impacts	Lesina lagoon*	Óbidos lagoon
Non-point contamination sources		
• diffuse agriculture impacts	2	1
• freshwater inputs	2	1
Point-contamination sources		
• domestic discharge	2	1
• industrial discharges	2	0
Dredging	0	1
Fisheries		
• fin-fisheries	1	1
• shell-fisheries	1	2
Tourism	1	1
Total pressure	***11***	***8***
Average of pressure scores	***1.6***	***1.0***

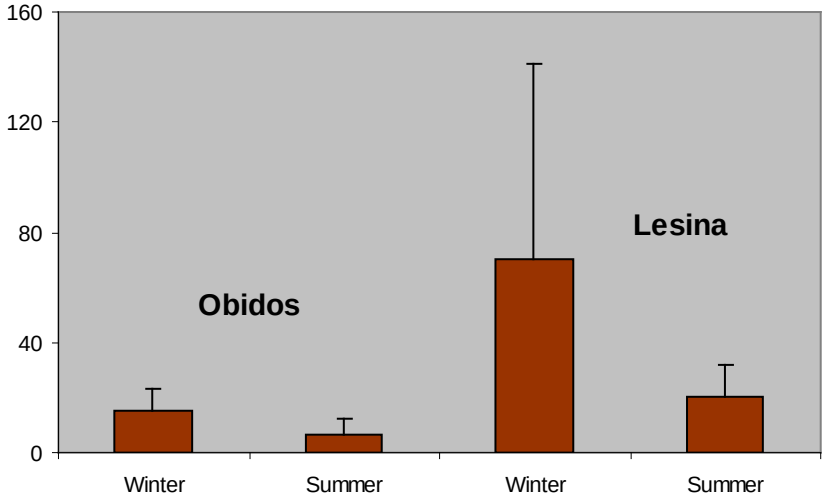
Scale (0: absent; 1: low; 2: medium; 3: high)

*** L. Roselli *et al.*/ Estuarine, Coastal and Shelf Science 117 (2013) 29-36**

Nutrient concentrations (mean œsd)







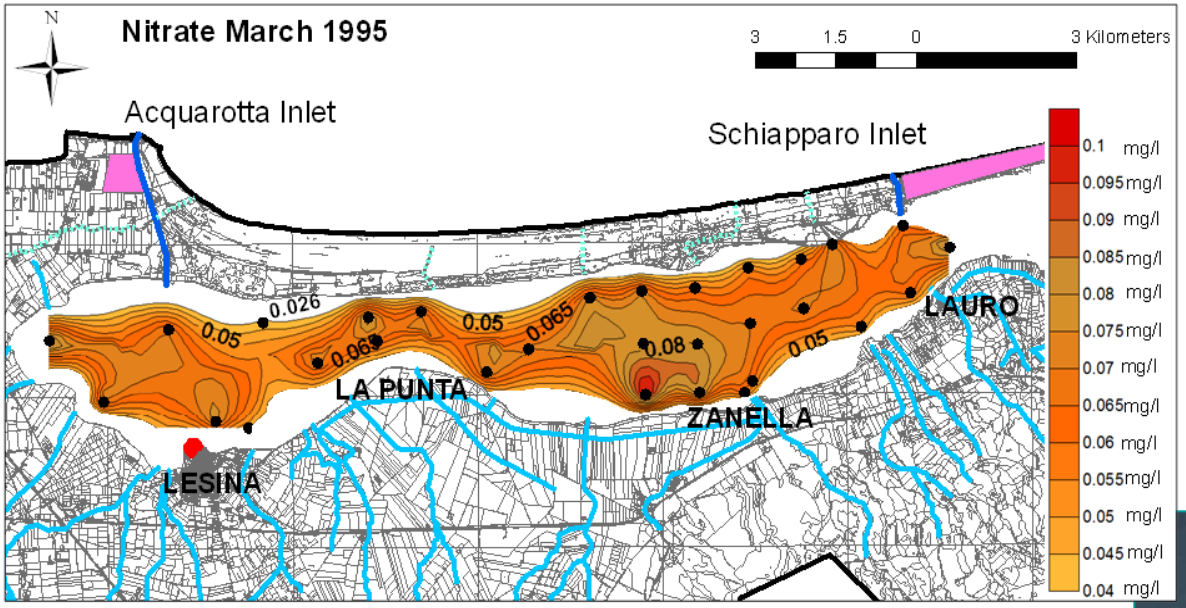
Nitrogen: **Seasonality** reflects inputs *versus* consumption (Lesina and Obidos)

Silicate: **Higher** values in Lesina and evidence of markedly **external** input in winter

Phosphate: **Internal** input in summer at Óbidos exceeds largely consumption

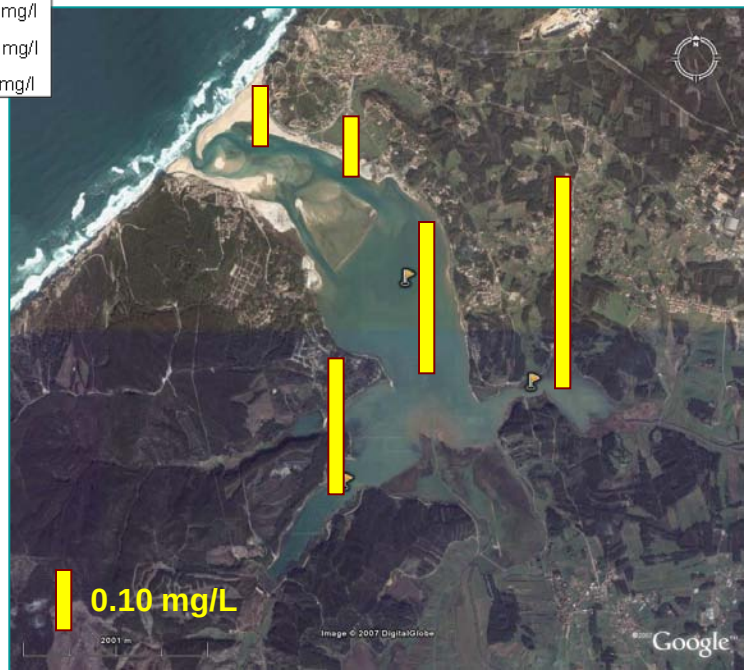
All nutrients: Elevated **spatial** variation in two seasons (Lesina and Óbidos)

Distribution of nitrate concentration in water column



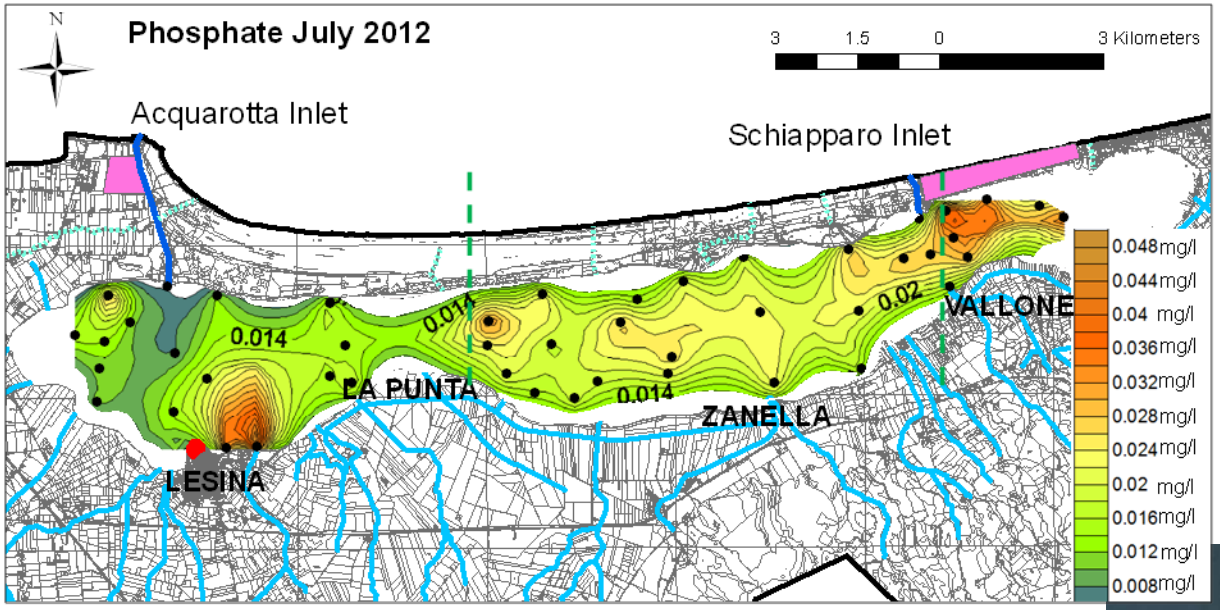
Lesina: concentration isolines evidence localised discharges

September 2009



Óbidos: elevated bars in upper areas evidence agriculture diffuse sources

Distribution of phosphate concentration in water column



Lesina: concentration isolines evidence localised discharges

Óbidos: elevated bars in upper areas evidence agriculture diffuse sources

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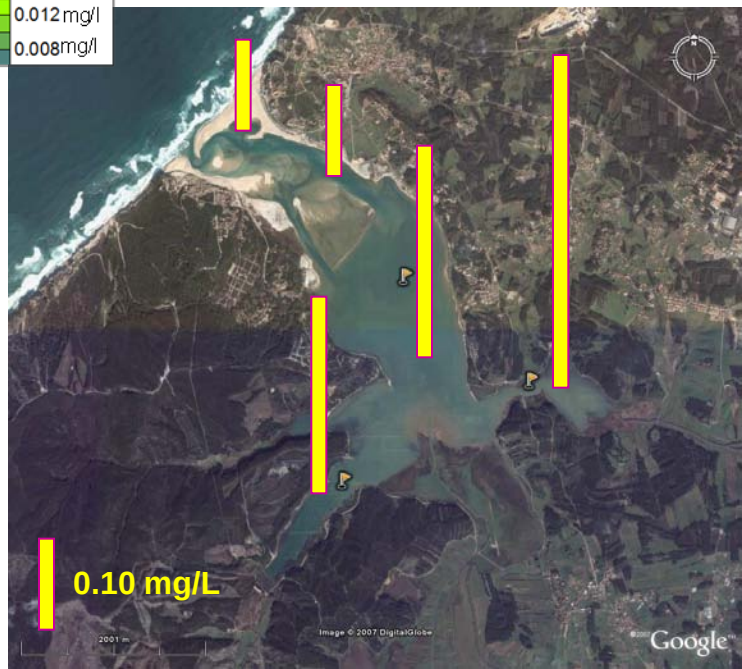
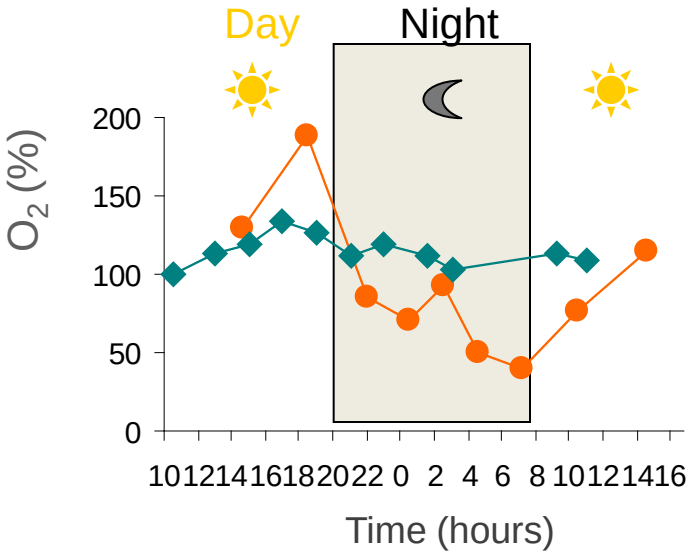
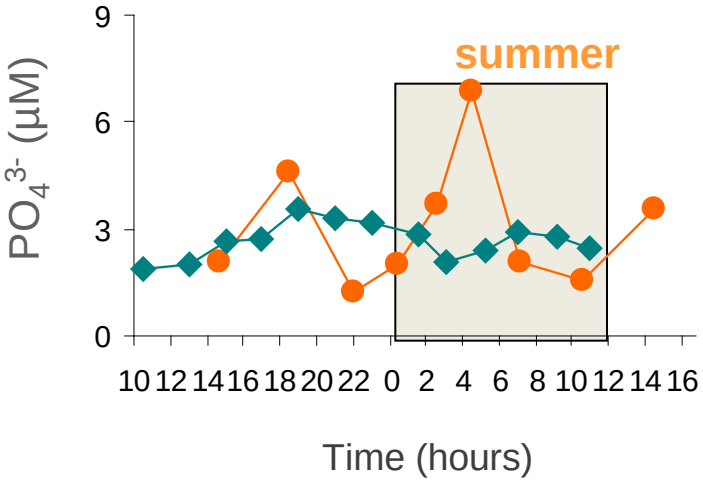


Sediments as internal source of phosphorus under low oxygenation conditions

• If **biogeochemical** cycles are dominated by internal processes, **sediments** emerge as the major compartment



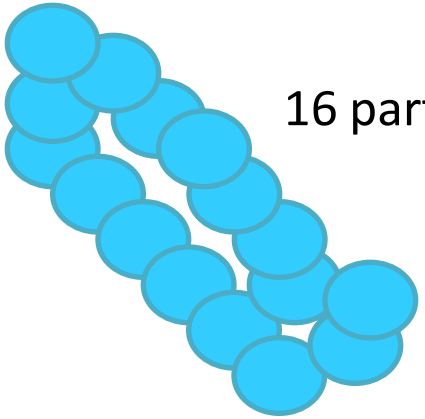


The meaning of nutrient composition

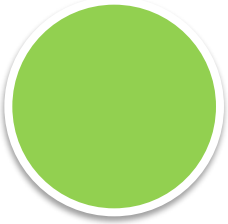
Ratio N:P

Redfield ratio

(optimum diet for algae)

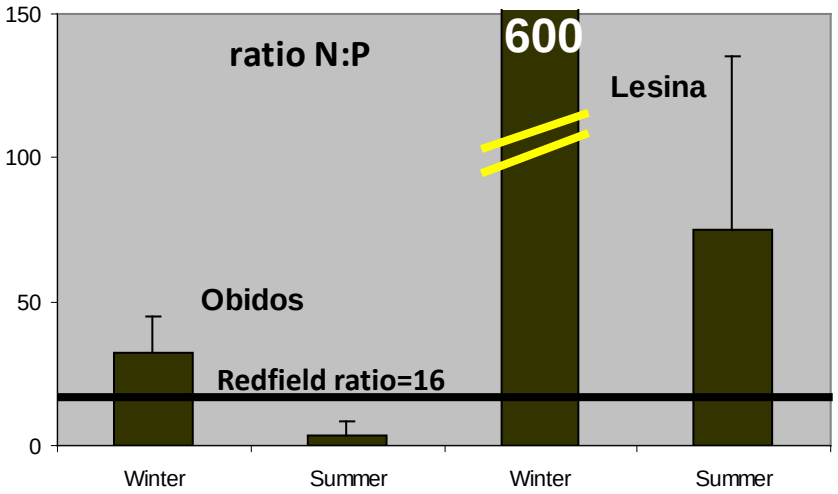


16 parts of nitrogen



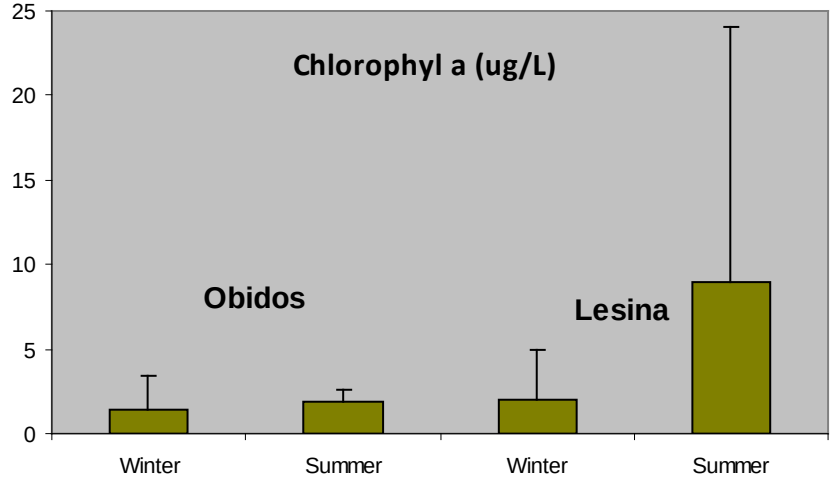
1 part of phosphorous

Ratio Nitrogen: Phosphorus



Lesina:

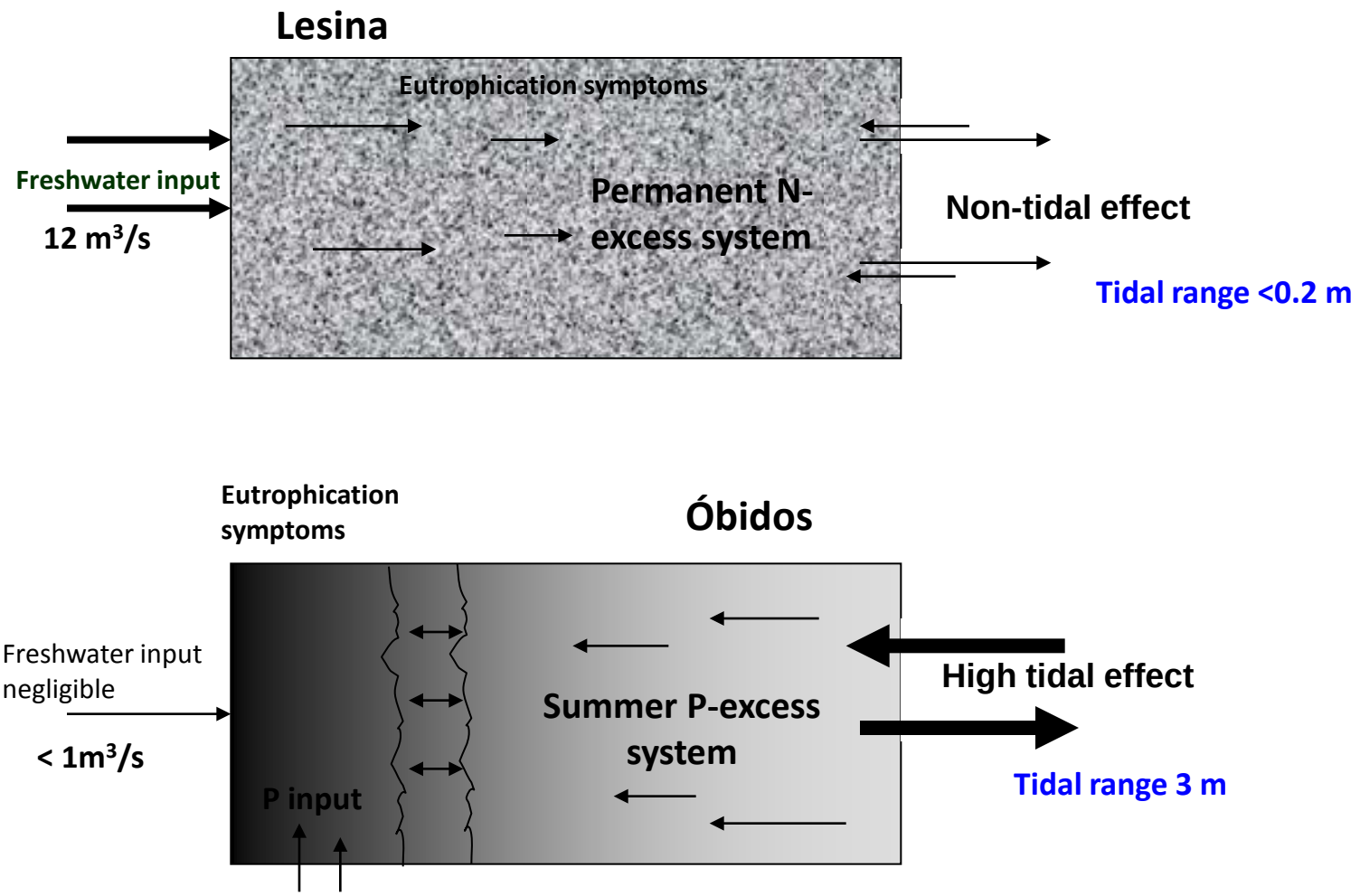
- Ratio N/P >>16 means excess of N (particularly in winter)
- External inputs of N had little effect on production (except in summer)



Óbidos:

- Ratio N/P similar to Redfield value
- Low ratio in summer means regeneration of phosphate in sediments

Schematic representation of Lesina and Óbidos: vulnerabilities



Final Remarks (measures preventing eutrophication)

Actions in Lesina Lagoon Area

- Reduction of localised domestic and urban discharges (on progress)
- Better practices in agriculture and aquaculture
- Maintenance of vegetation in channels

Actions in Óbidos lagoon:

- Improve water circulation preventing low oxygenation in upper areas (dredging channels)
- Maintain sea-lagoon water exchanges
    - Options: stabilise inlet channel and frequent dredging?

Thank you for listening

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