

The sediment management issue in the Venice lagoon: lessons learned and future perspectives

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... Venice lagoon: lessons learned and future perspectives

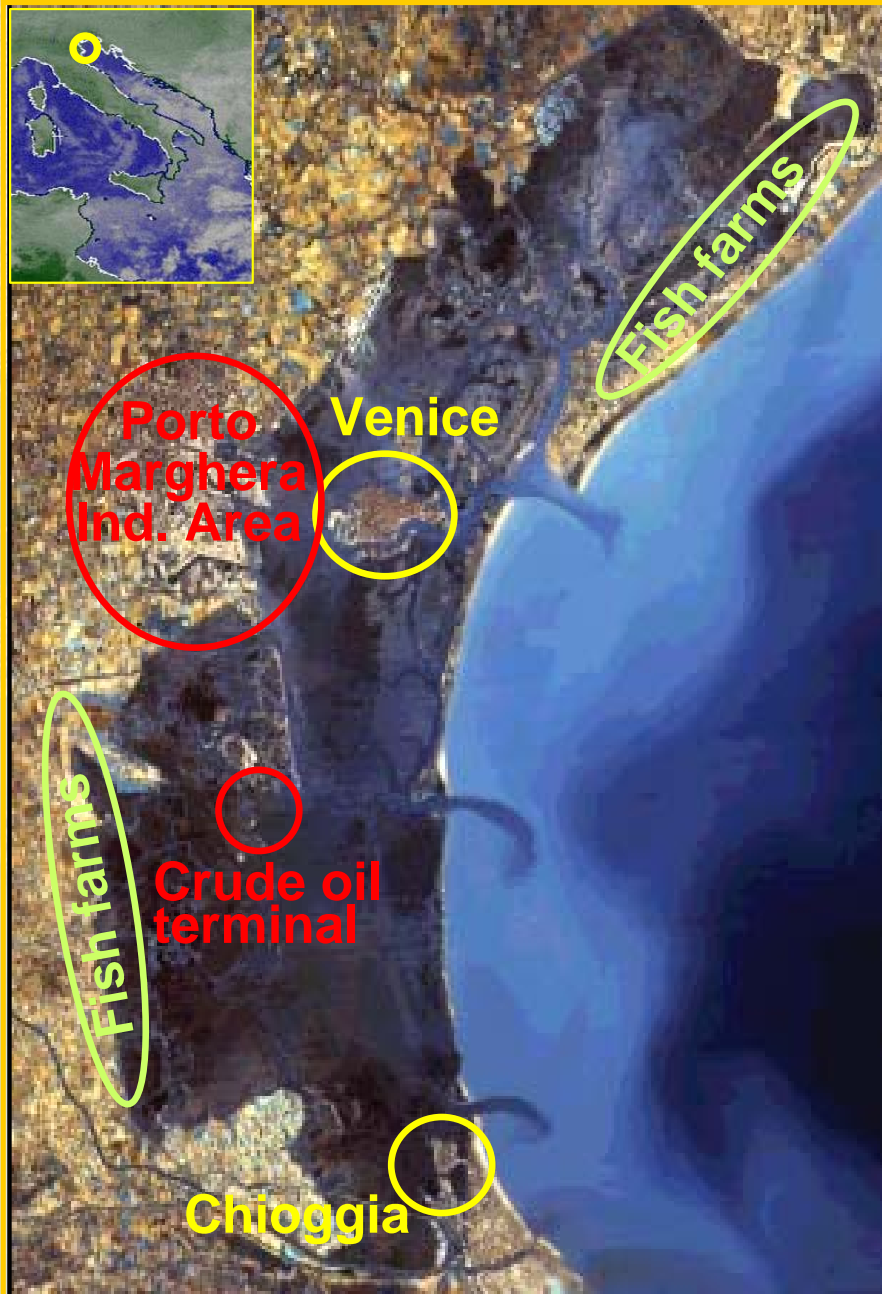
***Venice is a case study
Lessons and perspectives apply beyond Venice,
to Italy and possibly to many other countries***

The sediment management issue in Venice is a paradigmatic story on how difficult it is to enhance **connectivity between science and policy making**, with the final goal of having scientifically sound management solutions



knowledge
for a better
environment

Venice Lagoon



Ecosystem Management



Sediment Management

Environmental Quality and
Morphological Restoration

Reconcile
Uses (port, navigation,
fishing, tourism, etc.),

in a very distinctive
environment

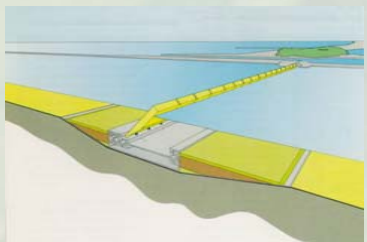
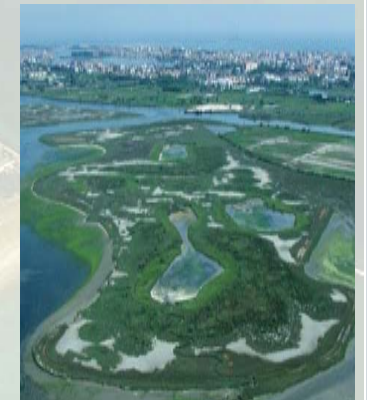
Problem definition



The lagoon needs constant maintenance

- About 1 million m³ y⁻¹ to maintain navigation
- Maintenance of the canals of the historical centre
- Dredging of the industrial canals of Porto Marghera for navigational and environmental purposes
- Dredging for the construction of mobile gates against high tides
- Enlargement of the Port of Chioggia
- Protection of islands and saltmarshes

...



Problem definition



The mix of pressures acting on the Lagoon, now and in the past, are reflected on the **quality** of sediments

In the last 15 years a large number studies have been carried out, mainly promoted and financed by the Venice Water Authority, producing a pool of data and information on different **LoE**

- *Chemistry (total concentration)*
- *Inventories, fluxes, background values*
- *Transport processes (advective, resuspension, bioturbation,..)*
- *Mobility and bioavailability (pore water, SEM-AVS, SSE, elutriates, bioaccumulation)*
- *Bioassays and TIE*
- *Biomarkers*
- *Benthic community*
- *Lab and field scale experiments*

Problem definition



Exposure to COCs in sediment: measured total chemical concentrations vs SQG

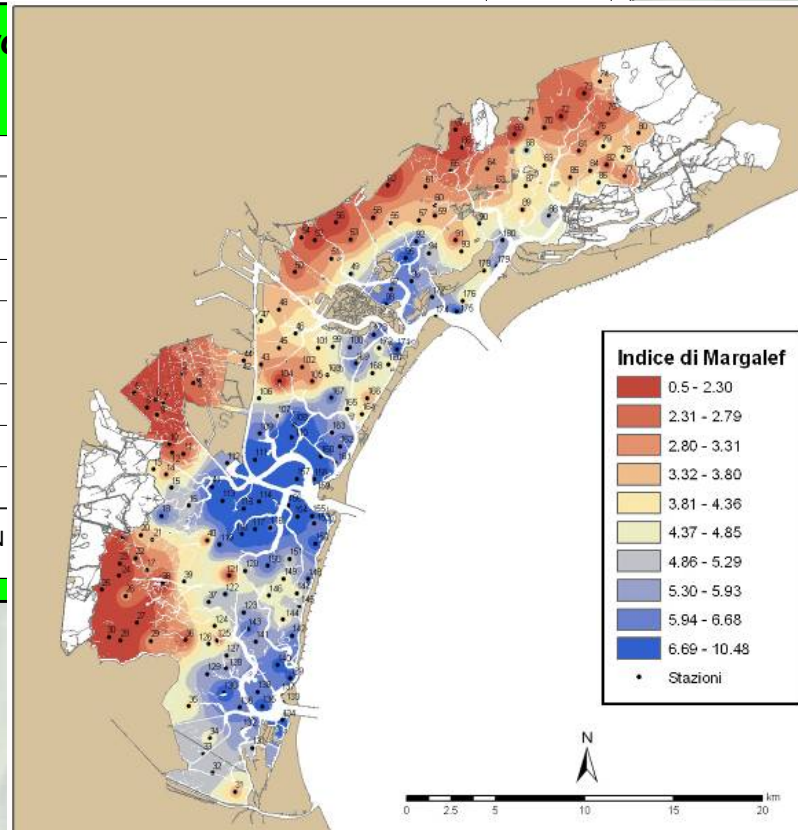
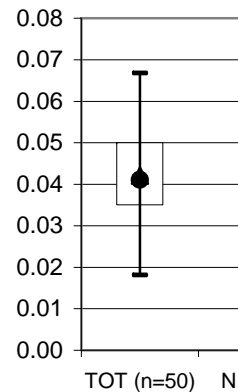
Effects of sediment contamination: laboratory test

Metal bioavailability

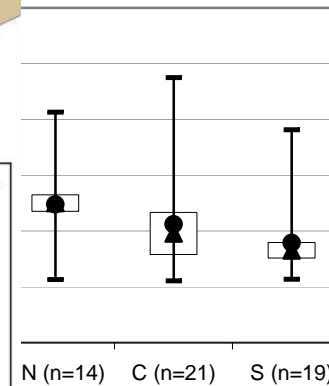
SEM/AVS



Mytilus gallopro



n (mg/kg ww)



Bioavailability of COCs: bioaccumulation in bivalves

Ecology: biodiversity of benthic macroinvertebrates

Problem definition

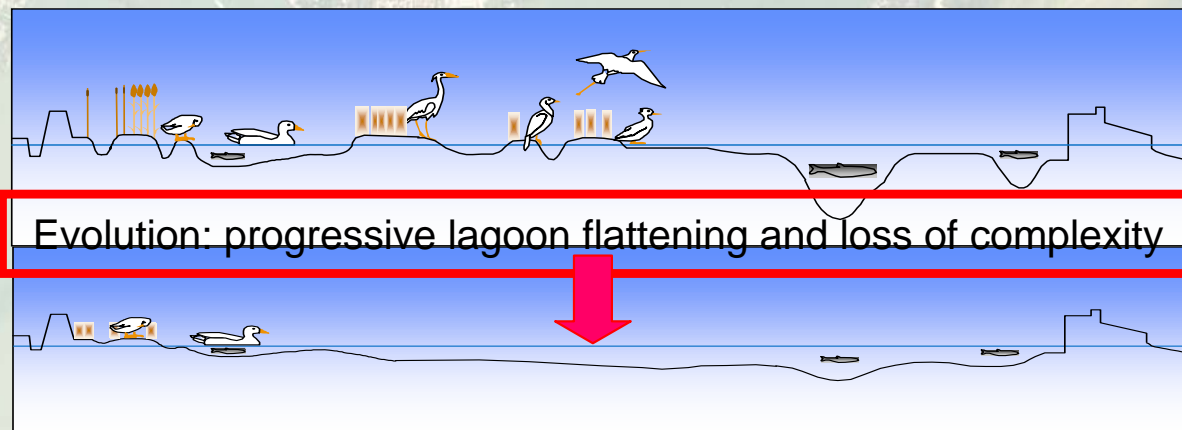


- **Sediment quality assessment suggested no ecological risk in most of the lagoon basin, where low to medium levels of contamination were observed. Hot spots of contamination are related to the Industrial area and the historical centre**
- **It is clear that benthic community structure and function are controlled in most cases by factors others than sediment chemistry**
- **Pilot studies confirmed that there is NO evidence of contaminant risk from subtidal / intertidal structures construction with slightly contaminated sediment**
- **Negative impacts (risks) to lagoon ecosystem, associated with sediment translocation due to pressures (ammonia, smothering) are transient – communities are either resistant or resilient**
- **Positive impacts (benefits) of habitat reconstruction using dredged sediments include reduced Hg methylation, enhanced primary producer communities, reduced erosion and turbidity**

Problem definition



- The sediment issue is only in part driven by sediment chemistry.
- Sediments (and the structures they form) are the substrate / habitat where animal and plant communities live and can be a primary controlling factor on water circulation.
- Hydro-morphology plays a fundamental role in community structure and functioning (i.e. ecological status of water bodies) in the lagoon.



- The lagoon is losing sediments and morphological diversity.
- Measures have been taken to reverse morphological degradation.
- Such measures require adequate volumes of sediments.



Main management options applied over time

- Until 1967 - Disposal of dredged sediment in unconfined DF
- From late '60 to 1995 - Disposal at sea
- From mid '90 to now - Landfills, CDF's, Reuse
(according to the Venice Sediment Management Protocol (April 1993) and the national legislation)



Venice Sediment Management Protocol (08/04/1993)

		VENICE SEDIMENTS MANAGEMENT AGREEMENT (8.4.1993) FOR DREDGED MATERIAL		
		<i>less than</i>	<i>less than</i>	<i>less than</i>
		limit class A	limit class B	limit class C
PARAMETER IN SEDIMENTS [mk/kg] on dry weight		Possible beneficial use for restoration lagoon morphology		
		no restrictions	to be confined with limited contact with the lagoon	to be confined, no contact with the lagoon
As	Arsenic	15	25	50
Cd	Cadmium	1	5	20
Cr	Chromium total	20	100	500
Ni	Nickel	45	50	150
Pb	Lead	45	100	500
Cu	Copper	40	50	400
Zn	Zinc	200	400	3.000
Hg	Mercury	0,5	2	10
PAH	Pol. Arom. Hydrocarb.	1	10	20
POC	Chlorinated Pesticides	0,001	0,02	0,5
PCB	Polychlorinatedbyphen	0,01	0,2	2
HC	Total hydrocarbons	30	500	4.000

- *Need for evolution explicitly declared in the Protocol, but never carried out*

(DM 56/09: Recent national sediment EQS's for selected PP)



There is growing recognition that the Protocol is an **outdated and inadequate tool**, expressed through several documents and papers.

What's wrong with it?

- *List of analytes*
- *Values (protection objectives are not clear and some are not properly taken into account)*
- *Single LoE and pass/fail criteria*
- *Only for ex-situ management*
- *Not flexible*
- *Compels the local scale management, despite a need for a comprehensive ecosystem management perspective*
- ...

The result is a sediment management practice that cannot be considered **efficient** (costs, no-action option, sub-optimal / administratively driven solutions, conflicts, delays, ..) and is not **supportive** of adaptive ecosystem management



Approach / Conceptual

Recommendations	Limitations / difficulties
River basin scale - Holistic / Systemic Approach	Not easy linking basin-scale / systemic evaluations (e.g. RBMP ex 2000/60/CE) and site-specific management or single objective management
Prioritize risk and risk mitigation measures	We should explicitly accept that something can be done now and something else (lower priority) will be done later and that some areas will never become pristine environments (“environmental realism”). Someone should take the responsibility of defining priorities and acceptable goals
Economically Sustainable	Who decides what is “sustainable” and when a solution is good enough and sustainable? Again, there is a choice, very difficult to agree on, and a responsibility.

How should we change and why the change is so slow



Approach / Conceptual

Recommendations	Limitations / difficulties
Strong scientific base	Difficulties in transferring good science to decision-makers (language, scientific “competition”, clearly addressing new scientific efforts)
Accept and manage uncertainty <i>(Adaptive Management)</i>	Uncertainty is hard to address and communicate and is not accepted or understood We should formalize an adaptive management strategy



Technical

Recommendations	Limitations / difficulties
Comprehensive Decision Framework (DF) for <i>ex situ</i> and <i>in situ</i> sediment assessment & management	Easier to develop and agree on limited case-specific solutions than on comprehensive solutions
Risk based DF	Decision-makers and Administrators love simple rules Not ready to manage complex and unformalized tools (and frightened of them)
Multiple LoE driving a flexible DF	Effort in the assessment phase Willingness and readiness to manage complexity (technical and administrative) for custom made measures Longer decision process



Technical

Recommendations	Limitations / difficulties
Tiered approach	Again, complexity is introduced It can introduce delays, if not properly managed
Remediation measures depending on management objectives	Tempted by “one size fits all” criteria and solutions; difficulties in accepting, based on technical evidence, site-specific and management-driven solutions Removal and disposal are easy and fascinating solutions Requires technical effort to support the solution
Treatments	Costs, reuse of treated materials
Favour, wherever possible, beneficial reuses	Very conservative focus on single-metric criteria can drive strong preference for disposal Lack of tools to evaluate and balance all pros & cons (no action, environmental benefits of reuse, sustainability of the alternatives,...)



Administrative / Procedural

Recommendations	Limitations / difficulties
In line with national legislation	Legislation is not always clear and complete
Clear rules, responsibilities, procedures and timing	Lack of coordination between Administrations Conflict of competencies
Participatory / Transparent / Communicated Approach & Solutions. Social acceptance of the solutions should be explicitly taken into account	Participatory approaches and public consultation are often perceived as a waste of time or even a danger, while, actually, they provide real added value in the medium term

It's evident that all the above recommendations & limitations (conceptual, technical, administrative, practical,..) are strongly and inextricably interconnected

Where are we and where are we going?



- *In spite of problems, extensive management of the lagoon is underway, even using present rules (mobile gates, dredging of Porto Marghera and Venice canals, artificial salt marshes, etc.)*
- *There is a growing awareness that we need new tools to address sediment management, in Venice and in Italy as a whole*
- *How long it will take is unpredictable*
- *Discussions are underway to revisit the sediment management rules in Venice, taking the results of past studies into account and using state-of-the-art approaches coming from the scientific debate and already being adopted in several countries*
- *In particular, the results from 15 years of studies make a compelling case that a wider reuse of dredged sediments for morphological reconstruction of the lagoon, overcoming the present limitation associated with Class B sediments, should be allowed*

To conclude



- *Extensive research in Venice Lagoon has illustrated the risk and benefits of more sustainable management of the role of sediments in regional ecological and socioeconomic objectives*
- *Over time, experiments and case studies should feed into standard practices and policy*
- *The challenges are great, but it is our objective and obligation to preserve and restore Venice Lagoon and other coastal ecosystems for future generations*

To conclude



Thank you for your attention

for more information

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