

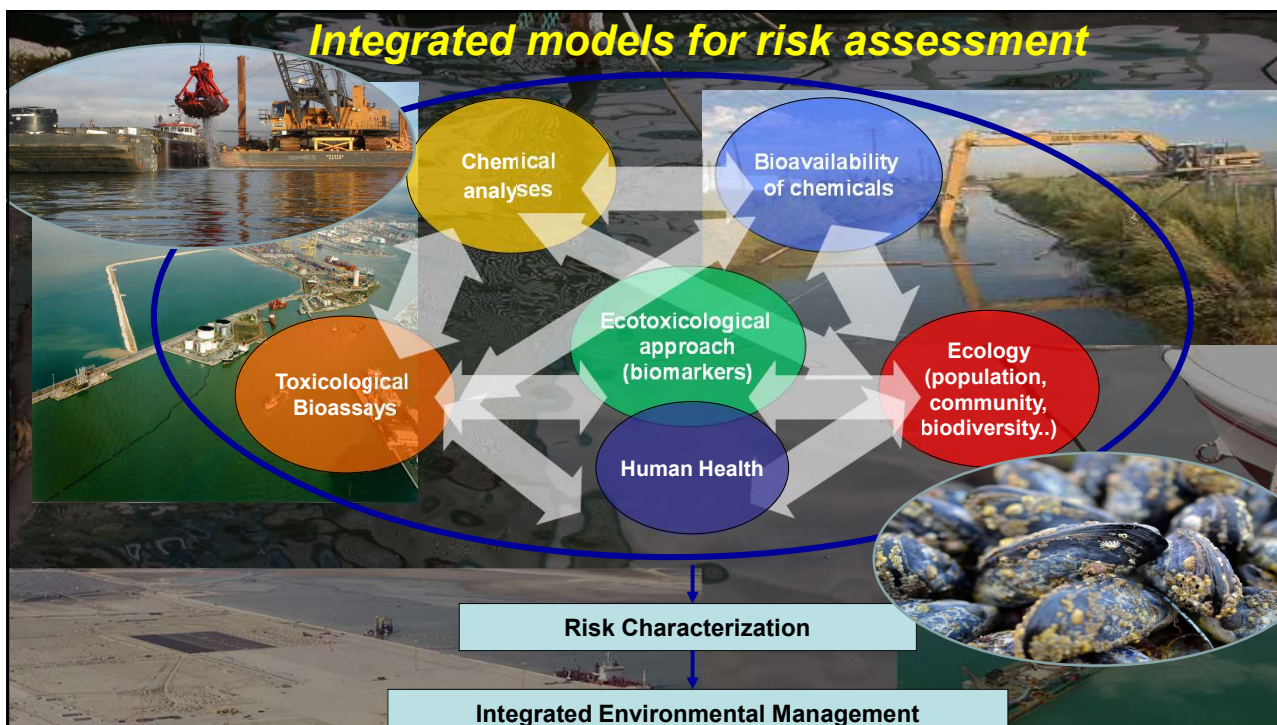
Weight Of Evidence (WOE) approaches for Ecological Risk Assessment (ERA) in the marine environment

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Critical issues in risk assessment

Interpretation and significance of complex datasets of heterogeneous results

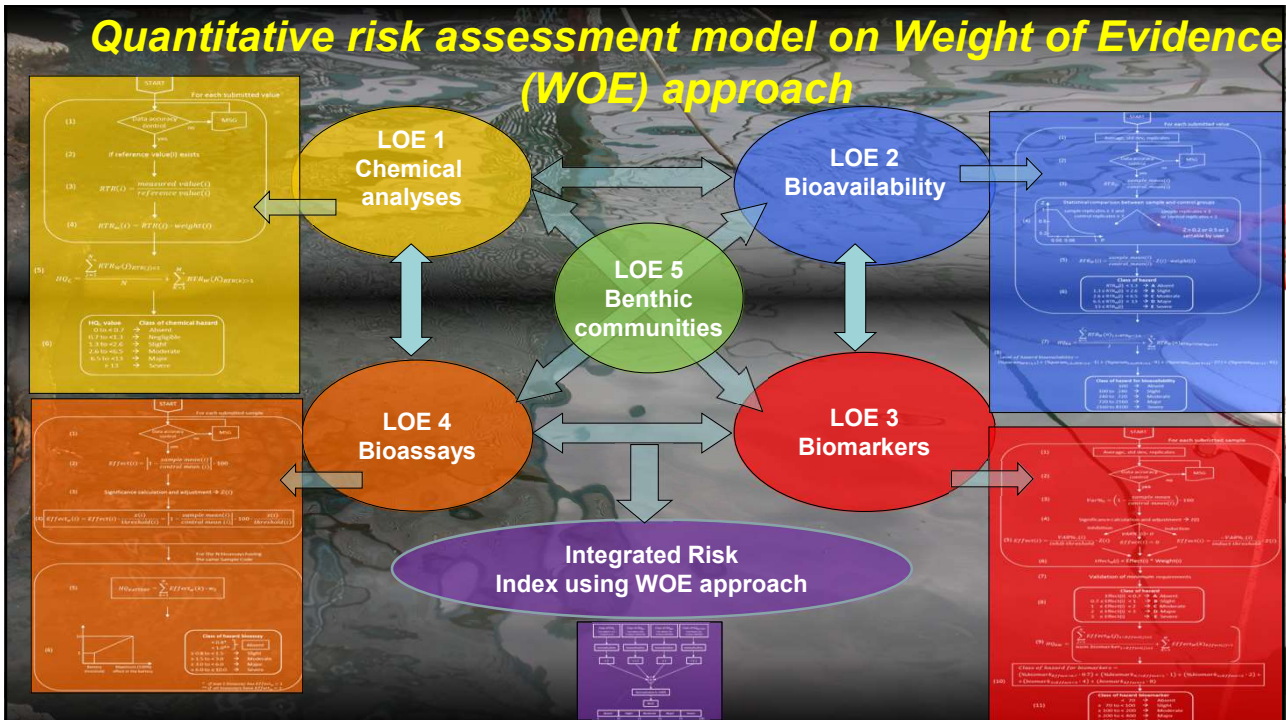
Qualitative and quantitative evaluations: indices and scales development

Integration of different typologies of data

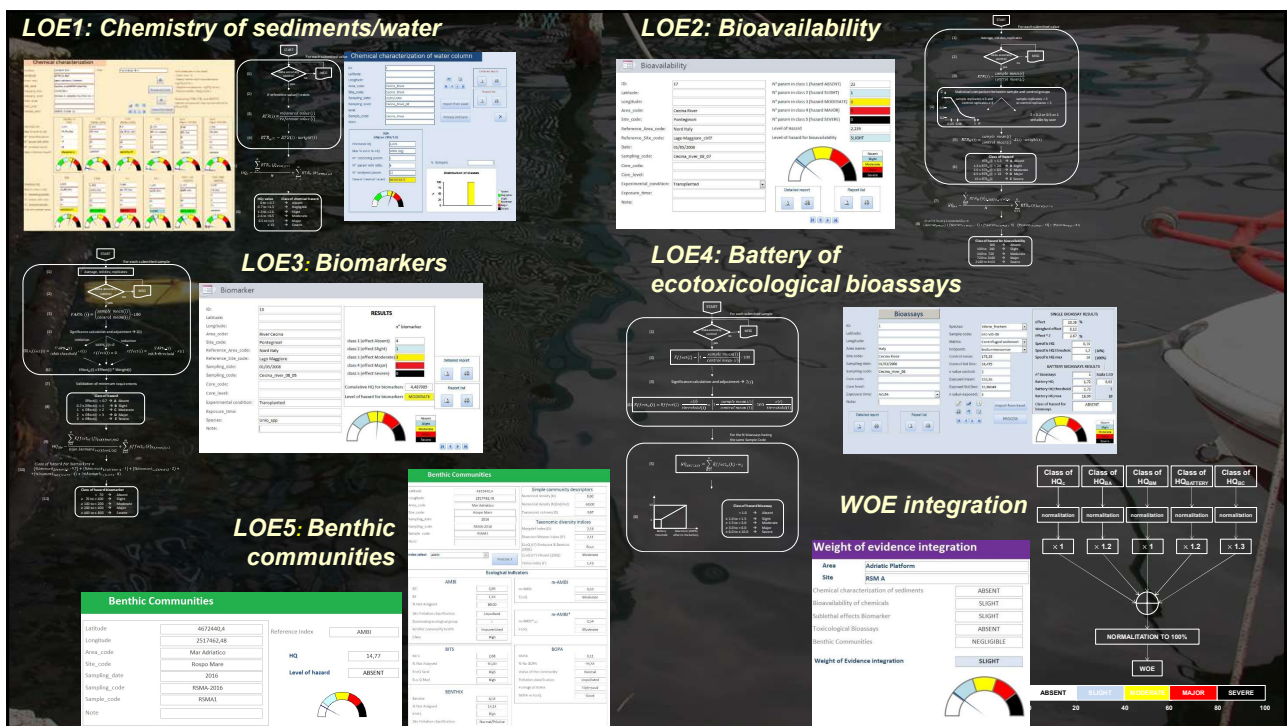
Synthetic risk characterization/communication

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Quantitative risk assessment model on Weight of Evidence (WOE) approach



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Main advantages of WOE approaches

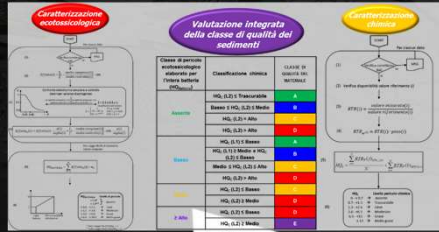
- **Multidisciplinary approach for characterizing environmental quality and risk assessment**
- **WOE models represent a fundamental tool for summarizing and interpreting large datasets of heterogeneous data, singularly or in an integrative approach**
 - They do not use “pass-to-fail” approach, enhancing the capability to discriminate different environmental conditions
- **The developed model is versatile, easy to update or adapt to local or national specificities**

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Weighted criteria are included in the new Italian Law on classification of dredged marine sediments

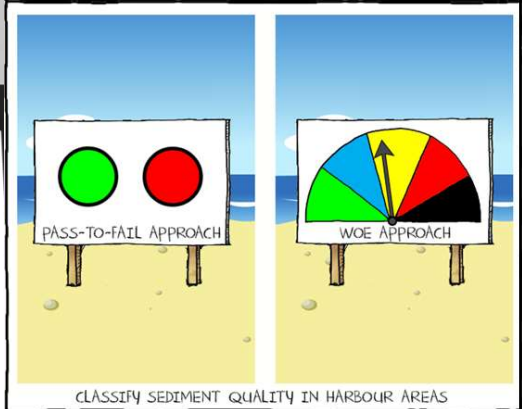
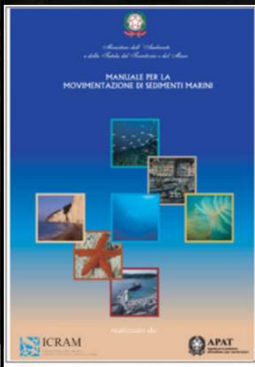
Manual ICRAM-APAT 2007

Classificazione chimica	Classificazione ecotossicologica		CLASSE QUALITA'
	Colonna A	Tossicità eluita	
≤ LCB	A	A	A1
	B	A	A2
	C	B	B1
	D	C	B2
compresa tra LCB e LCL	A	B	B1
	B	B	B2
	C	C	C1
	D	D	C2
≥ LCL	A o B	A	B2
	B	B	C1
	C	C	C2
	D	D	C2



from «pass-fail» to weighted criteria

DM 173/2016

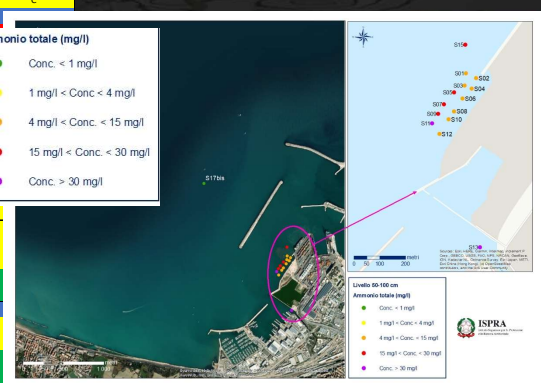


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Ecotoxicology and Chemistry: identification of unknown factors in harbor sediments: the Ancona case-study

Campione	PROFONDITA'	Classe di qualità del materiale	PROFONDITA'	Classe di qualità del materiale
S01	0-50	D	50	D
S01	50-100	D	100	D
S01	100-200	C	200	A
S01	200-400	A	400	A
S01	400-600	A	600	A
S01	600-700	A	700	A
S02	0-50	D	50	C
S02	50-100	D	100	C
S02	100-200	C	200	A
S02	200-400	A	400	A
S02	400-600	A	600	A
S02	600-800	A	800	A
S02	800-1000	A	1000	A
S02	1000-1150	A	1150	A
S03	0-50	D	50	A
S03	50-100	D	100	A
S03	100-200	A	200	A
S03	200-400	A	400	A
S03	400-600	A	600	A
S03	600-700	A	700	A
S04	0-50	D	50	A
S04	50-100	C	100	A
S04	100-200	D	200	A
S04	200-400	A	400	A
S04	400-600	A	600	A
S04	600-800	A	800	A
S04	800-1000	A	1000	A
S04	1000-1150	A	1150	A
S04	1300-1500	A	1500	A

Classe di qualità del materiale	Ammonio totale (mg/l)
D	18,03
D	23,95
D	14,04
C	1,38
C	1,84
C	8,18
C	17,64
C	7,07
C	< 0,2
C	0,990
C	1,17
C	2,318
C	22,410
C	31,040
C	15,71
C	0,968
C	0,847
C	18,16
C	5,24
C	10,78
C	1,75
C	1,06
C	0,939
C	0,813
C	8,8



Logos of the following institutions: ISPRa (Istituto Superiore per la Protezione e la Ricerca Ambientale), ARPA (Agenzia Regionale per la Protezione Ambientale delle Marche), Università Politecnica delle Marche, and Autorità di Sistema Portuale del Mar Adriatico Centrale (Porti di Pesaro, Falconara Marittima, Ancona, S. Benedetto, Pescara, Ortona).

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Additional Lines of Evidence for harbors characterization

frontiers in Marine Science

ORIGINAL RESEARCH
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Mussel Caging and the Weight of Evidence Approach in the Assessment of Chemical Contamination in Coastal Waters of Finland (Baltic Sea)

Kari K. Lahtonen^{1*}, Giuseppe d'Errico², Samuli Korpinen¹, Francesco Regoli³, Heidi Ahvola¹, Tuula Kinnunen¹ and Anu Lastumäki¹

FIGURE 1 Study sites along the coast of Finland. The black dots in each site map represent the exact site of the mussel cages.

Lahtonen et al. Contamination and the WOE Approach in the Baltic Sea

TABLE 3 | Elaborations with levels of hazard assigned to the different LOEs and the final WOE.

Site	Chemical characterization	Bioavailability	Biomarkers	Benthic communities	Near-bottom oxygen	Eutrophication	Weight of Evidence integration
Kotka	HQ: 0.284 Absent	HQ: 63.417 Major BaP-DBaP-A- BbF, PER	HQ: 4.229 Moderate CAT-GST	HQ: 67.174 Major	Absent	Major	MODERATE
Porvoo	HQ: 0.311 Absent	HQ: 63.030 Major ANT-FLU; PER	HQ: 4.642 Moderate GST-LPO- CAT; GR	HQ: 46.078 Moderate	Slight	Major	MODERATE
Helsinki	HQ: 2.271 Slight 100% Zn	HQ: 14.842 Slight -	HQ: 2.517 Moderate - GST	HQ: 31.326 Slight	Absent	Major	SLIGHT
Hanko	HQ: 0.28 Absent	HQ: 29.925 Moderate - 1-MeNAPh	HQ: 2.714 Moderate GST-GST-	HQ: 46.377 Moderate	Absent	Moderate	SLIGHT
Parainen	HQ: 1.7 Slight 100% Zn	HQ: 59.329 Major BbF-BaP; PER	HQ: 2.008 Slight LPO-	HQ: 48.291 Moderate	Absent	Major	MODERATE
Naantali	HQ: 2.359 Moderate 100% Zn	HQ: 93.710 Major FLU; PER- OSn	HQ: 2.402 Moderate GST-CAT-	HQ: 49.020 Moderate	Absent	Major	MODERATE
Uusikaupunki	HQ: 1.556 Slight 100% Zn	HQ: 1.985 Slight -	HQ: 2.42 Moderate CAT-GST-	HQ: 9.520 Absent	Slight	Moderate	SLIGHT
Rauma	HQ: 6.18 Moderate 81.5% Zn	HQ: 84.589 Major - PER-BaP	HQ: 2.125 Slight CAT-	HQ: 33.676 Slight	Absent	Moderate	MODERATE
Pori	HQ: 0.293 Absent	HQ: 0 Absent	HQ: 0 Absent	HQ: 50.986 Moderate	Absent	Slight	SLIGHT
Vaasa	HQ: 2.199 Slight 100% Zn	HQ: 4.296 Slight	HQ: 1.0 Slight	HQ: 59.938 Moderate	Absent	Slight	SLIGHT

Hazard Quotient (HQ) is provided for chemical characterization of seawater (showing the percentage of the parameter contributing most to the HQ), bioavailability (parameters showing major or severe effects), biomarkers (parameters showing moderate or major effects), and benthic communities.

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frontiers in Marine Science

Application of a Weight of Evidence Approach for Monitoring Complex Environmental Scenarios: the Case-Study of Off-Shore Platforms

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Weight of Evidence

LINES OF EVIDENCE

- LOE 1: Sediments chemistry
- LOE 2: Bioavailability on sentinel organisms
- LOE 3: Biomarkers on sentinel organisms
- LOE 4: Ecotoxicological tests
- LOE 5: Analyses of benthic communities

20 sampling points for each offshore platform

Native and caged mussels

Ecotoxicological test:
V. fischeri
P. tricornutum
A. tonsa
P. lividus

Analyses of benthic communities

Bioaccumulation test with *H. diversicolor*

Bioaccumulation of chemicals

Biomarkers analyses
M. galloprovincialis

Chemical analyses

Sediments collection

FSO-Alba Marina

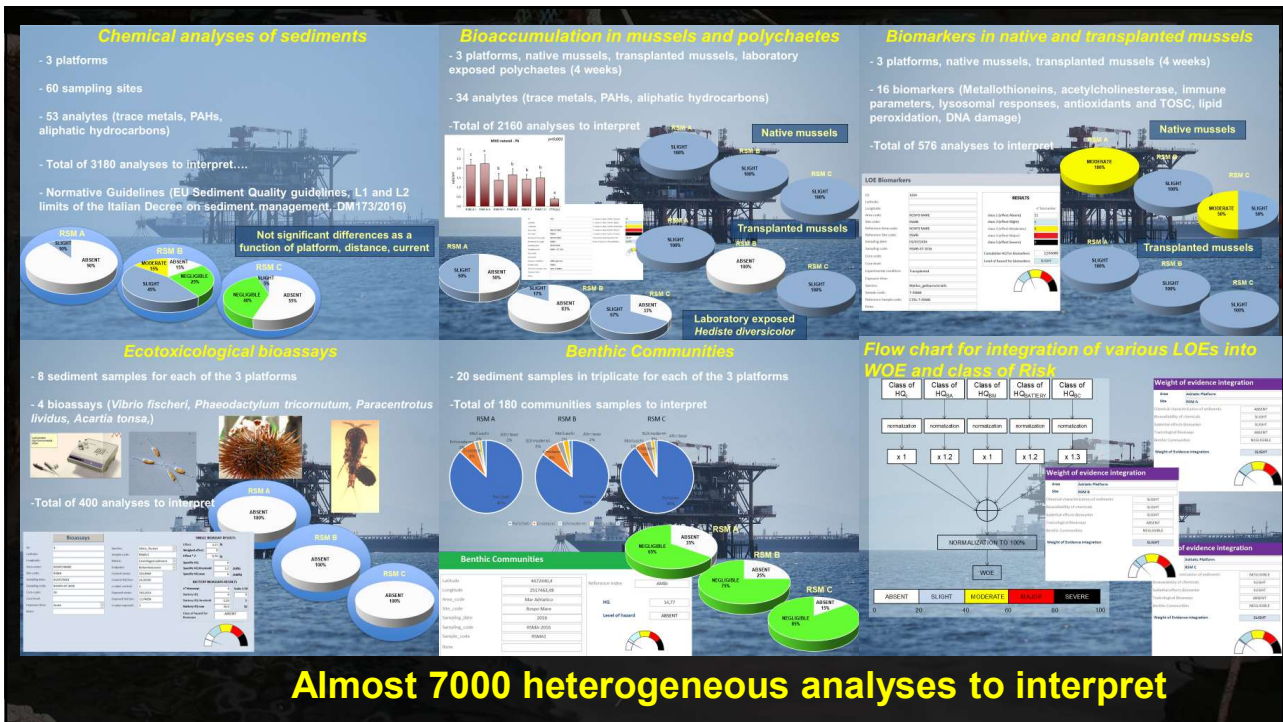
RSM-B

RSM-A

Rospo Field Offshore Platforms

direction of the main sea currents

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Conclusions

- Future development of WOE approach in harbor areas can be based on the evaluation/integration of additional Lines Of Evidence
- Already validated flow-charts elaborate hazard indices for bioaccumulation, biomarkers, benthic communities
 - New LOEs for water circulation in harbor areas
- The developed model is versatile, easy to update or adapt to local or national specificities
- Scientifically sound but user-friendly format, to support a more comprehensive process of risk assessment and “site-oriented” management decisions

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Thanks for the attention



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