Heavy metal pollution in the Yancheng Biosphere Reserve, Jiangsu, China

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- Methods
- Results
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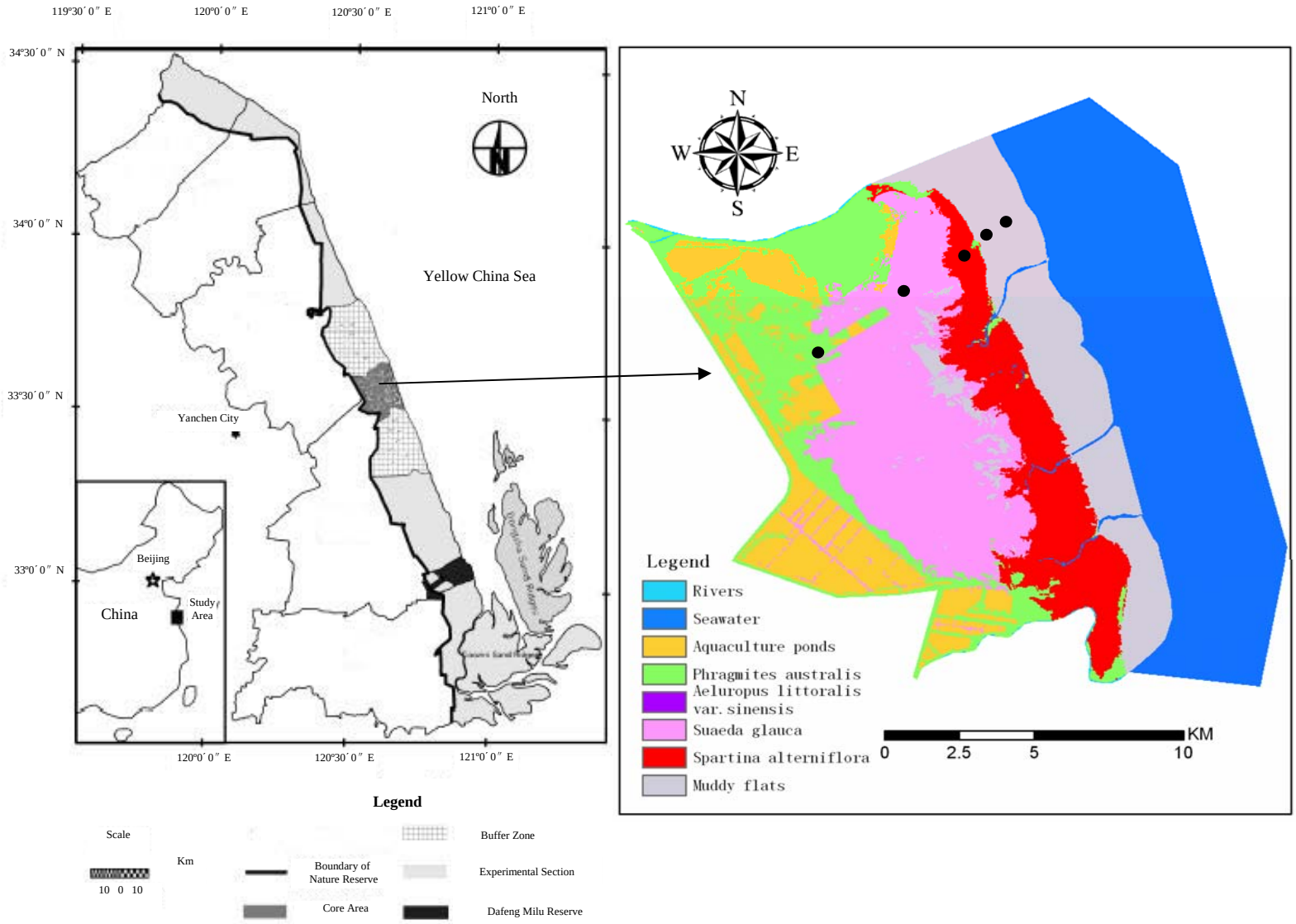
Study site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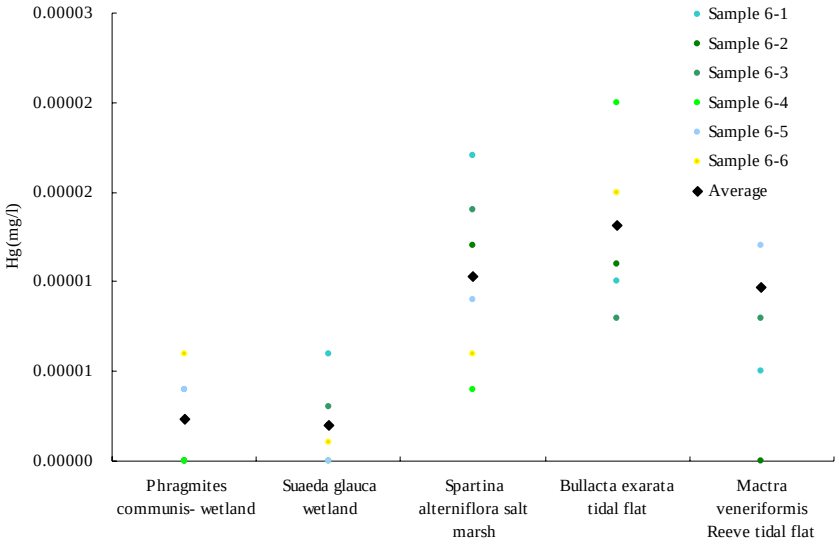
North
Yellow China Sea
Yanchen City
Beijing
China
Study Area
Legend
Scale
Km
10 0 10
Boundary of Nature Reserve
Core Area
Buffer Zone
Experimental Section
Dafeng Milu Reserve
N
W
E
S
Legend
Rivers
Seawater
Aquaculture ponds
Phragmites australis
Aeluropus littoralis var. sinensis
Suaeda glauca
Spartina alterniflora
Muddy flats
KM
0
2.5
5
10

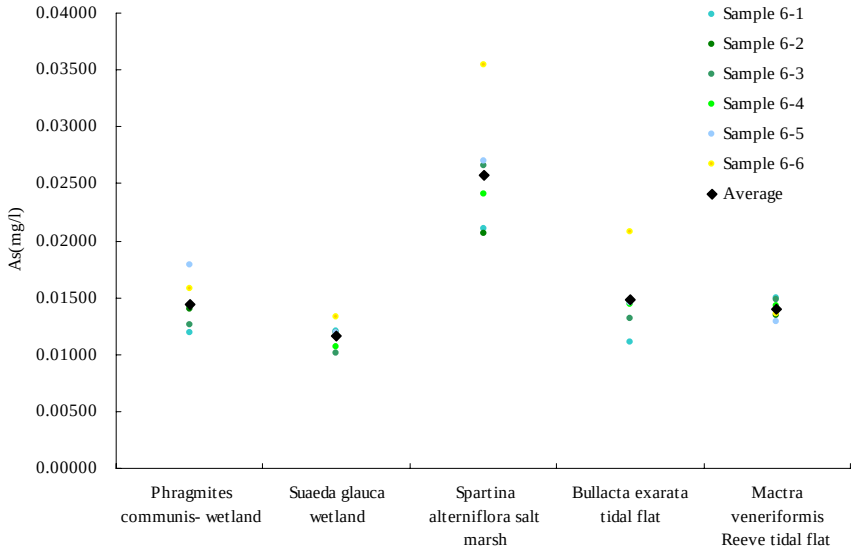
Methods

- Data collection: Content of Cu, Pb, Zn, Cr, Ni, Cd, Hg, As analyzed in economic macrobenthos, sedimentary, wetlands plants. In water samples, only Hg and As were measured
- Sampling done and data distribution using stakeholders
- Ecological pre-warning assessment. Levels compared with national standard and historical data (1978-1979) acting as background data, to assess environmental impacts caused by recent economic development and the possible food safety implications
- Information exchange and awareness to public media. Information exchange with governments, local stakeholders, and information transfer to public media

Background data from: Monitoring Group on Pollution in Coastal Zone and Estuaries in Jiangsu Province.

Results: surface water

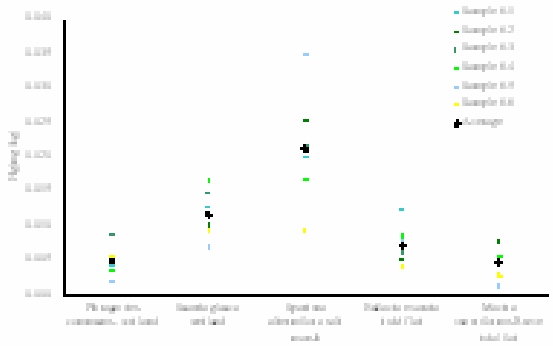


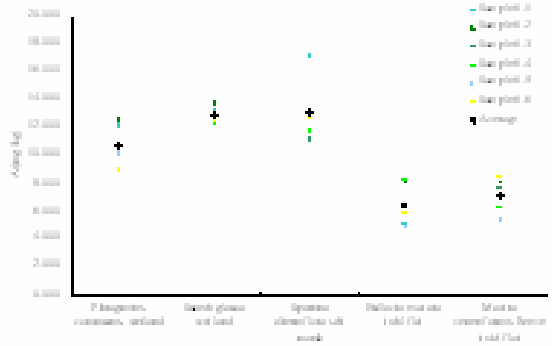


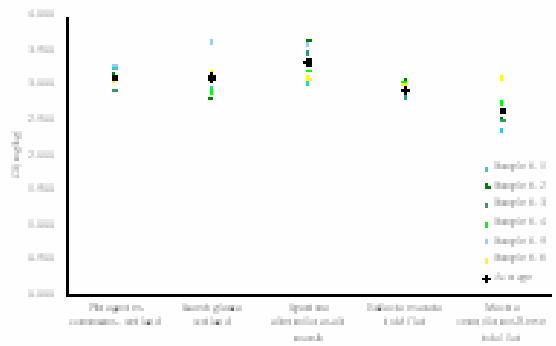
Results: Water

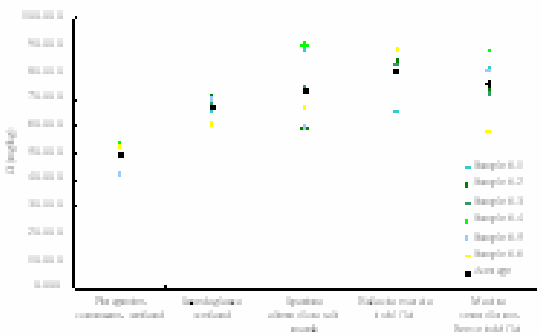
	Phragmites Communis wetland	*Suaeda Glauca* wetland	*Spartina Alterniflora* wetland	*Mactra Veneriformis* Reeve tidal flat	*Bullacta Exarata* tidal flat	GB3097-1997 1st class	GB3097-1997 2nd class	GB3097-1997 3rd class	Background value
Hg	0	0	0.00001	0.00001	0.00001	0.00005	0.0002	0.0005	0.0016
As	0.014	0.012	0.026	0.015	0.014	0.02	0.03	0.05	0.003

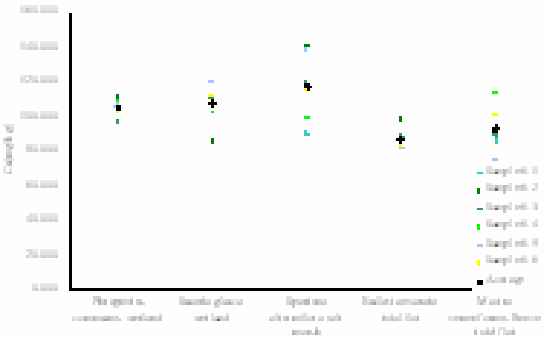
- Water quality was better that 1st class water according to **GB 3097-1997 Sea Water Quality Standard**, with the exception of as concentrations in the surface water in *Spartina alterniflora* wetland that was 2nd class.
- However, concentrations had increased since measurements in 1978-1979 (the background values), which indicates the influence of anthropogenic activities since 1980 with arsenic levels increasing in seawater.

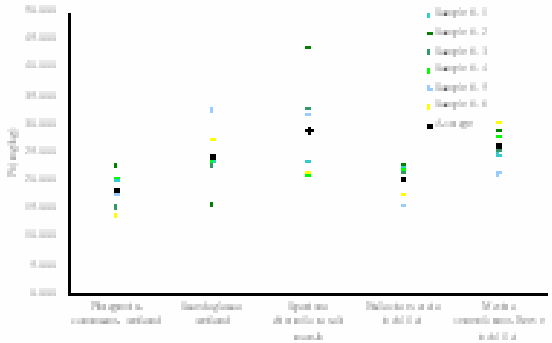


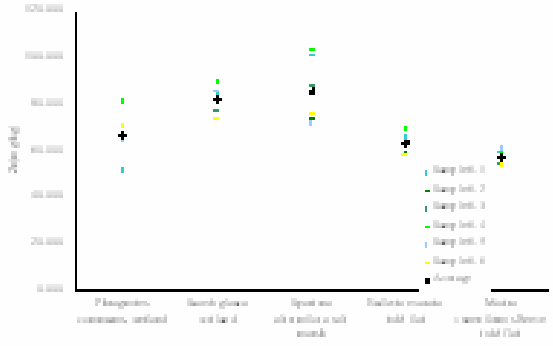


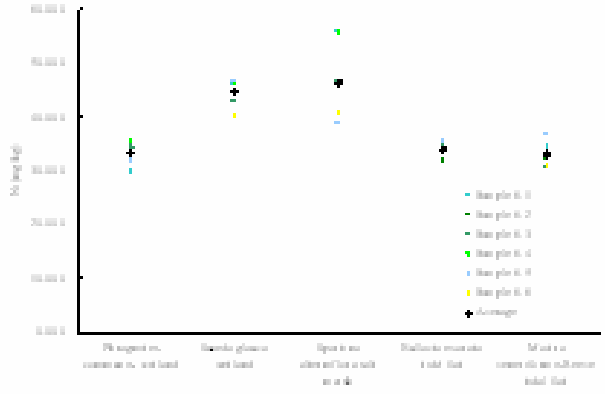












Results: sedimentary

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		Hg	As	Cd	Cr	Cu	Pb	Zn	Ni
Phragmites communis Wetland		0.005	11	3	50	106	18	67	33
Suaeda glauca wetland		0.012	13	3	67	108	24	83	45
Spartina alterniflora wetland		0.021	13	3	73	118	29	86	46
Mactra veneriformis Reeve tidal flat		0.007	6	3	80	87	20	64	34
Bullacta exarata tidal flat		0.005	7	3	76	93	27	57	33
GB18668 -2002	1st class	0	20	1	80	35	60	150	---
	2nd class	1	65	2	150	100	130	350	---
	3rd class	1	93	5	270	200	250	600	---
Background value		0.019	8.59	0.72	28.50	15.99	17.63	78.10	---

Results: sedimentary

- The average concentrations of metals in the sediment samples all exceeded the background values for 1978-1979 in the coastal zone of Jiangsu Province except mercury
- The concentrations of mercury, arsenic, chromium, lead, copper belonged to the first class of sediments, while the concentrations of cadmium belonged to the second class comparing to the Sediments of National Standards
- The absorption capacity of heavy metals in vegetated wetlands with reed, *Suaeda glauca* and *Spartina alterniflora* was higher than that in non-vegetated wetlands with high density of macrobenthos, especially *Bullacta exarata* and *Mactra veneriformis* Reeve wetlands
- *Spartina alterniflora* wetland had a higher absorption capacity for heavy metals than other vegetated wetlands in the study site

Results: plants

	Hg	As	Cd	Cr	Cu	Pb	Zn	Ni
Roots of *Phragmites communis*-	0.031	3.488	0.177	14.164	4.989	1.265	12.448	8.465
aboveground part of *Phragmites communis*	0.016	0.201	0.138	1.679	1.545	0.310	4.404	0.746
Roots of *Suaeda glauca*	0.035	1.190	0.059	2.533	9.776	0.736	5.242	3.362
aboveground part of *Suaeda glauca*	0.030	0.757	0.362	1.732	12.979	2.114	18.764	2.135
Roots of *Spartina alterniflora*	0.044	5.552	0.160	11.287	5.462	0.550	35.262	13.228
aboveground part of *Spartina alterniflora*	0.030	0.470	0.235	2.331	0.330	1.068	19.096	1.084

The new leaves of Suaeda glauca provide as a kind of organ vegetables for local stakeholders

Results: plants

- All 8 heavy metals have been detected in the roots and leaves of *Phragmites communis*, *Suaeda glauca*, and *Spartina alterniflora*.
- Results indicate that heavy metal content tended to be higher in the roots of plants compared with the leaves.
- The levels of mercury, arsenic, chromium, zinc, nickel were highest in *Phragmites communis*, *Suaeda glauca*, and especially the aboveground part of *Spartina alterniflora* compared with other plants
- The levels of copper & zinc were highest in the leaves of *Suaeda glauca* than that in other parts of the plants.
- The levels of chromium in the roots of *Phragmites communis* was the highest.

Results: Macrobenthos

	Hg	As	Cd	Cr	Cu	Pb	Zn	Ni
Perinereis aibuhitensis Living in *Suaeda glauca* wetland	0.001	4.286	0.901	3.727	37.126	0.326	84.383	19.193
Perinereis aibuhitensis Living in *Spartina alterniflora* wetland	0.002	6.163	0.691	3.071	47.371	0.177	91.895	19.897
Bullacta exarata Reeve living in tidal flat	0.003	6.511	1.011	6.045	163.353	4.196	55.334	30.227
Mactra veneriformis living in tidal flat	0.001	2.585	1.993	3.871	35.161	0.037	61.019	22.015
NY5073-2006 Pollution-free Food at Seafood Toxic Substances Harm Limited	0. 5	1	1	2	50	1	--	--
Background value	0.04	0.57	0.365	2.33	15.99	0.356	--	--

Results: macrobenthos

- In macrobenthos, the contents of mercury, arsenic, chromium, copper, lead, nickel in the snail, *Bullacta exarata,* living in tidal flat were the highest, which might indicate higher pollution by environments.

- The contents of cadmium in the clam, *Mactra veneriformis* Reeve, was the higher that that in other animals. The snail and clams are consumed locally and both of them are economically harvested by local stakeholders who pick them up during the low tide time.

- Analysis also showed that nearly all the concentrations of heavy metals in the three macrobenthos were far higher the background value. And some of them exceeded the limit for pollution-free food according to ‘NY5073-2006 Pollution-free Food at Seafood Toxic Substances Harm Limited’.

Thus, food safety is very important for those seafood consuming people, especially local stakeholders

Conclusion

- Results showed that concentrations of heavy metals have accumulated in the core area of YBR coinciding with economic development in recent years
- Implies that anthropogenic activities are threatening the ecosystem health in the core area
- Heavy metals are being transferred from water, sediments to plants, animals and microorganism along the food chain
- Thus, there is an urgent need of sewerage treatment before discharge to the Yellow Sea in those areas surrounding the Reserve

Implications: empowering stakeholders

- By working with stakeholders in collecting samples and through the public awareness work we have built trust. This means that when we deliver the results they are ready to believe what we tell them, and providing them with information on the safety of their food and environment empowers the stakeholders to make decisions about how they want their environment to be.
- It gives stakeholders the option to approach local government and ask for changes to the effluent law for example, and provides them with evidence bring about changes. Without this study they may suspect that the environment is degrading but they have no evidence.
- Information is empowering.

Implications: a dim future due to rapid economic growth?

From: http://image.fengniao.com/vision/vision.php?id=122

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Empowering stakeholders through involvement in monitoring and provision of information can be a major force in conservation.

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Photoed by Ping ZUO


Thank you