Establishment of links between sediment properties and lobsters

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The Investigation

Sediment and pollutants carried in the sediment are 2 of the potentially interlinked factors that may be responsible for the degradation of the seabed habitat and the decline of the crustacean population.

Heavy metals are present in a variety of minerals both natural and man made. At elevated levels, they can be toxic to biota.

This element of the CHASM project aims to:

i. Start providing a baseline map of the sediment size across Bracklesham Bay.
ii. Identify and map the distribution of heavy metals in the sediment of Bracklesham Bay.
iii. Assess the level of heavy metals in Bracklesham Bay lobsters.

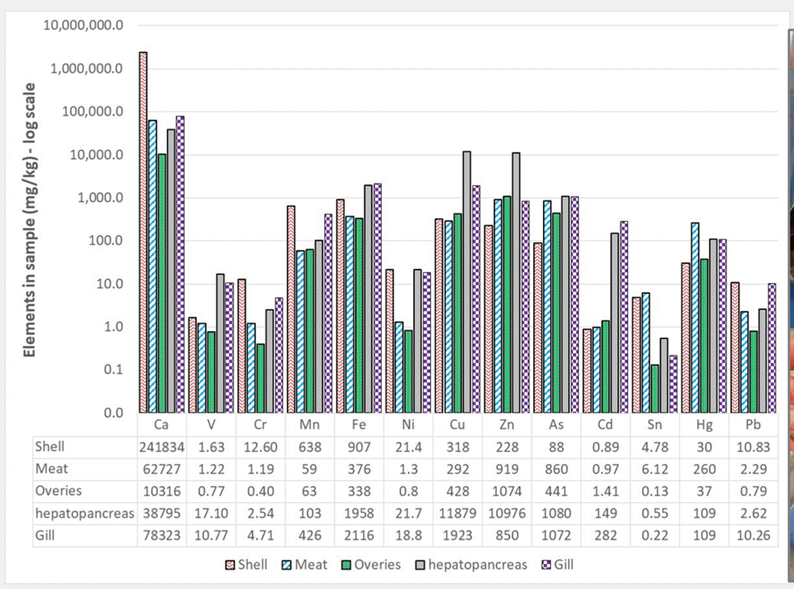
<u>Potential</u> sources of heavy metals in coastal sediment

- Land runoff (agriculture, road, wastewater, industrial waste)
- Remobilisation of sediment (storm events, disposal of dredgings, MR sites, trawling)

<u>Potential</u> causes of sediment balance change (size and volume)

- Natural passage of underwater dunes
- Changes from opening of Medmerry MR
- Dredged material dumping at Nab Tower

Lobster analyses for Heavy Metals

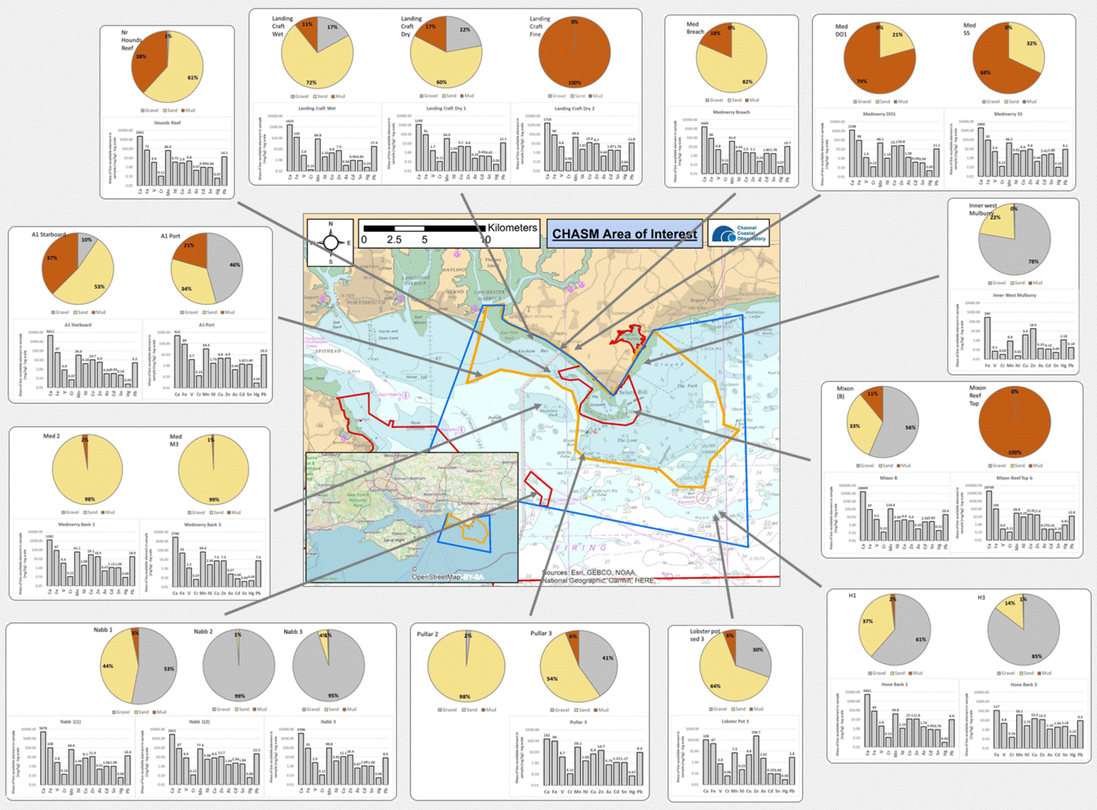


	Ca	V	Cr	Mn	Fe	Ni	Cu	Zn	As	Cd	Sn	Hg	Pb
Shell	241834	1.63	12.60	638	907	21.4	318	228	88	0.89	4.78	30	10.83
Meat	62727	1.22	1.19	59	376	1.3	292	919	860	0.97	6.12	260	2.29
Overies	10316	0.77	0.40	63	338	0.8	428	1074	441	1.41	0.13	37	0.79
hepatopancreas	38795	17.10	2.54	103	1958	21.7	11879	10976	1080	149	0.55	109	2.62
Gill	78323	10.77	4.71	426	2116	18.8	1923	850	1072	282	0.22	109	10.26

Four lobsters from Selsey were dissected and the different parts tested for the same heavy metals as the sediment. The data plot provided are an average of the results based on dried sample weight.

The Study Site

The CHASM study area encompasses the Selsey fishing grounds and the wider coastal area which may be impacting the quality of the water and sediment. Flooded circa 50000 years ago at the end of the last ice age, the bedrock sediment is made up of mixture of Barton and Bracklesham group clay, sand and silt. With many geological bedding planes there is possibility that fresh water springs may rise under the sea. Freshwater inputs into the system come from runoff from the harbours / inlets of Southampton, Portsmouth, Langstone, Chichester, Medmerry and Pagham.



KEY

- CHASM Study Area
- Selsey Fishing Area
- Designated Scientific Areas

Sediment samples were collected by project partners and analysed for size and heavy metals. Results for each location are provided in the plot above.

Inter-elemental relationships

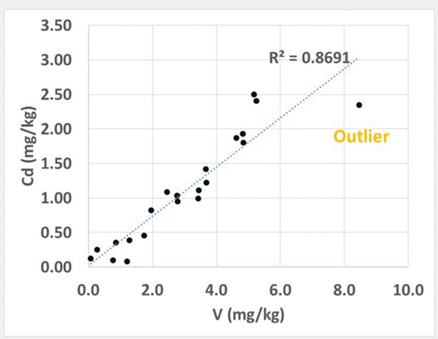
Minerals, both natural and man-made are made up of a variety of elements, all of which bond to each other in different ways. By comparing the ratio of heavy metals at the different sites, strong correlations can infer that the source of the heavy metals is the same. Where there are outliers, no or weak correlations it could be that the source of the heavy metals is different, or natural chemical or biological reactions have altered the ratios.

Inter-elemental relationships in the lobsters are important as they may be attributed to similar biochemical pathways, which may be an indicator to health of an animal.

Table of R^2 values for element correlations extracted from Lobsters - plots are examined visually for trends and outliers

	Ca	*V*	*Cr*	*Mn*	*Fe*	*Ni*	*Cu*	*Zn*	*As*	*Cd*	*Sn*	*Hg*
V	-0.21											
Cr	0.84	-0.05										
Mn	0.90	-0.01	0.91									
Fe	0.14	0.87	0.28	0.38								
Ni	0.74	0.47	0.73	0.80	0.75							
Cu	-0.22	0.91	-0.12	-0.15	0.65	0.35						
Zn	-0.31	0.84	-0.22	-0.28	0.52	0.22	0.99					
As	-0.79	0.50	-0.59	-0.65	0.20	-0.36	0.43	0.44				
Cd	-0.26	0.83	-0.06	0.06	0.86	0.38	0.53	0.42	0.52			
Sn	0.30	-0.34	0.25	0.27	-0.25	-0.03	-0.30	-0.27	-0.25	-0.39		
Hg	-0.54	-0.03	-0.45	-0.54	-0.24	-0.52	-0.02	0.04	0.69	-0.02	0.40	
Pb	0.51	0.04	0.33	0.63	0.23	0.41	-0.05	-0.14	-0.32	0.13	0.32	-0.21

Key of Elements:
Ca = Calcium; V = Vanadium; Cr = Chromium; Mn = Manganese; Fe = Iron; Ni = Nickel; Cu = Copper; Zn = Zinc; AS = Arsenic; Cd = Cadmium; Sn = Tn; Hg = Mercury; Lead



Example of correlation of two element concentrations from the sediment – note the outlier, which is from sample taken at the Nabb Tower disposal ground.

The Results....so far

As with other studies levels of heavy metals vary in the different body parts of a lobster with higher concentrations being found in the Gill and hepatopancreas.

Levels of some Heavy metals such as As, Hg and Pb are higher in the lobsters then in the surrounding sediment – suggesting bio-accumulation and may be impacting on lobster health.

Some metals which alone may be toxic may have in fact come from compounds which are non-toxic (e.g. As is found in arsenobetaine) to human health. Therefore, without knowing the exact source, the risk to human health cannot be ascertained at this stage.

Sediment samples to the north of the area tend to be higher in finer sediment. However, it is suspected that samples collected using a grab from a boat, may have reduced fines, as they may have been lost as the sample was pulled up for the seabed.

Next Steps

- Comparison of the Lobster Chemistry with other lobster populations and published results.
- Continue to monitor the sediment in the CHASM area to understand any changes both in size and chemistry.
- Compare the chemical results with freshwater chemistry.
- Start to identify any significant sources of Heavy Metals by comparing sediment from different sources.