

**SEDIMENT-ASSOCIATED POLLUTANTS IN THE MARINE  
ENVIRONMENT: A MULTI-BIOMARKER APPROACH FOR  
ASSESSING SEDIMENT TOXICITY IN TURBOT**

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**EXTENDED ABSTRACT ONLY- DO NOT CITE**

Sediments in the aquatic environment have become an area of concern due to their potential for accumulating toxic compounds and acting as a secondary pollutant source to benthic fauna. Owing to their predominantly benthic life style, fish of the order Pleuronectiformes (flatfish) are particularly vulnerable to sediment-associated pollutants. This and the relative ease of obtaining specimens, from either commercial hatcheries or local estuaries, makes them the preferred choice for studying sediment-water-organism interactions in benthic fish (Courtney *et al.*, 1980; Hartl *et al.*, 2001).

Here we report on the first phase of an ongoing project applying a multi-biomarker approach to the toxicity of field-collected sediments from a polluted estuary to juvenile turbot (*Scrophthalmus maximus*, L.). Laboratory experiments using fish exposed to spiked sediments have been instrumental in establishing

biomarkers for single compounds. The aim of the present study was to determine a suite of biomarkers, in combination with chemical and statistical analysis, capable of establishing cause and effect relationships of exposure to sediments containing complex mixtures of pollutants.

Sediments were sampled at low tide from two sites, Whitegate and Aghada, in Cork Harbour, Co. Cork, Ireland, where sediments have previously been shown to contain elevated levels of organic pollutants, particularly polychlorinated biphenyls and organotin compounds (Boelans *et al.*, 1999) and from a clean reference site at Ballymacoda, Co. Cork, Ireland (Byrne and O'Halloran., 2000). The top layer of the sediments were collected, thoroughly mixed and stored at 4°C over night. Subsamples were frozen (-20°C) prior to chemical analysis. A layer (approx. 5 cm) of sediment was applied to 500 litre aquaculture tanks filled with aerated seawater (S = 35; 15°C).

Following 7 days acclimation, 60 turbot (30g ± 5) were added to each tank and exposed for 21 days. Individuals were sampled at 0, 7, 14 and 21 days and sacrificed. Blood samples were taken from the caudal vein for the analysis of blood osmolality, haematocrit, differential cell counts, serum protein and DNA single strand breaks. A Comet assay, for the analysis of DNA single strand breaks, was also performed on skin, gill, spleen and head kidney cell preparations. The liver and two gill arches from both the upper and the lower gill pouch were removed, shock-frozen in liquid nitrogen and stored at -70°C until further analysis of P450 induction (measured as EROD activity in hepatic S9 post-mitochondrial fractions) and membrane-bound Na<sup>+</sup>/K<sup>+</sup>-ATPase activity, respectively.

Results from preliminary experiments showed that turbot exposed to contaminated sediments displayed an increase in DNA single strand breaks in gill cells, haemocytes and haemopoietic tissues when compared to those exposed to sediments from the clean site. There was also an increase in blood osmolality in fish exposed to the polluted sediments, indicating an increase in membrane permeability, due to the possible interaction of lipophilic organic compounds with gill epithelia, and the resulting osmotic loss of water across the membrane. The blood parameters, haematocrit, differential cell counts and serum protein, remained unchanged during the exposure period in all treatments.

Although sediments spiked with a single compound have aided the understanding of toxicological mechanisms, they generally have limited environmental relevance, in particular by disregarding potential synergistic

and/or antagonistic pollutant effects. By using an array of relevant biomarkers combined with chemical and statistical (e.g. Principal Component Analysis) analysis, we are currently assessing the toxicological effects of field-collected sediments from Cork Harbour and the principle pollutants involved.

### References

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