MASTER'S THESIS

# Toxicological assessments of PAHs, OCPs and heavy metals in sediments at Mai Po and Deep Bay, Hong Kong

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# Toxicological Assessments of PAHs, OCPs and Heavy Metals in Sediments at Mai Po and Deep Bay, Hong Kong

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# Abstract

The main objective of this study was to investigate heavy metal (As, Cd, Cr, Cu, Pb and Zn), polyaromatic hydrocarbon (PAH) and organochlorine pesticide (OCP) contaminations in sediments, fish (crucian carp [*Carassius carassius*], grey mullet [*Mugil cephalus*], tenpounder [*Elops saurus*], Indo-pacific tarpon [*Megalops cyprinoids*], tilapia [*Oreochromis mossambicus*], snakehead [*Channa maculata*] and mud carp [*Cirrhinus molitorella*]), shrimps (*Metapenaeus ensis*) and eggs of ardeids (such as little egrets [*Egretta garzetta*]) of Mai Po Ramsar site as well as in sediments of the nearby Shenzhen River (SZR) and Kam Tin River (KTR). Sediments of 66 locations at Mai Po Ramsar site and the rivers were collected between 2003 and 2006. Concentrations of heavy metals, PAHs and OCPs in sediments were found to decrease in the order of SZR > KTR > mangrove and mudflat > seaward side of gei wais > landward side of gei wais, suggesting discharges from SZR and KTR were major sources of the pollutants in Mai Po. Sediments of Mai Po were also subjected to a more severe heavy metal contamination over the past 10 years when compared to a previous study conducted in 1997. Bioaccumulations of As, Cd, PAHs and OCPs were detected in fish and shrimps of Mai Po, as reflected by the high bioaccumulation factors (BAFs) (about 130 and 700% for As and Cd respectively) and biota-sediment

accumulation factors (BSAFs) (3.83-45.8 for OCPs; 1.7-6.3 for PAHs). Among different fish species, tilapia was subjected to a higher degree of bioaccumulation of the pollutants and this is probably related to the sediment-feeding nature of the species. Significant ($p < 0.01$) linear regressions were found between pollutants in different biota samples, including OCPs in eggs of ardeids and prey fish as well as Cr, Ni, Pb and Zn in bird eggs and eggshells. Estimated concentrations of OCPs, Cr, Ni, Pb and Zn in ardeids eggs of Mai Po were within ranges reported in Hong Kong, China and Pakistan. Results of toxicity tests (Microtox® solid-phase test, *Daphnia* mortality test, algal growth inhibition test and ryegrass seed germination/root elongation test) revealed differential toxicities among sediments collected in different locations of Mai Po, with the highest toxicity found in mudflat sediments while sediments of gei wai 24g the lowest. Different biomarker studies were also used to evaluate toxicity of heavy metal and organic pollutions in Mai Po. Hepatic metallothionein (MT) was induced in tilapia fed with artificial fish feed that included 30% (w/w) of dried sediment from the mudflat, suggesting induction of MT could be responsive to heavy metals in the diets. Glutathione (GSH), 7-ethoxyresorufin-*O*-deethylase (EROD), and MTT assays were also used to evaluate organic contaminations in Mai Po sediments. GSH, in particular, was found to be closely related to concentrations of total PAHs and OCPs in sediments and the

corresponding regressions can hopefully be used to predict PAH and OCP contaminations in sediments of Mai Po.

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