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Evaluation of heavy metal accumulation in birds using opportunistic samples

Chieh-Yu Chan (1), Yu-Pin Lin (1), Joy R. Petway (1), and Te-En Lin (2)

(1) Department of Bio-environmental Systems Engineering, National Taiwan University, Taiwan (spaden01323@gmail.com), (2) Endemic Species Research Institute, Nantou, Taiwan

Exposure to heavy metals present in the environment due to natural or anthropogenic activities, adversely affects human and biodiversity health. When heavy metals in soil bioaccumulation in tertiary consumers, these specific species can be seen as biological indicators of the environmental pollution availability of heavy metals. This research investigates bioaccumulation levels in the study species and contaminant distributions in soil throughout Taiwan. Specifically, Amaurornis phoenicurus and Gallinula chloropus roadkill samples are analyzed for seven heavy metals, Cd, Cr, Cu, Zn, Pb, Ni and As.

Opportunity roadkill avian samples collected by volunteers included: internal organs (i.e. heart, liver, and kidney); bones (i.e. sternum and femur); and feathers (i.e. breast feather and primary flight feathers). Samples were then treated using a microwave digestion method and analyzed for heavy metals with a ICP-MS (VG Elemental PQ3) in solution method. Additionally, this study simulated "polluted" soil distributions of the target heavy metals for Taiwan, performed uncertainty analysis for the simulated realizations, and used a geographic information system (GIS) to combine avian roadkill site spatial data with official spatial data on heavy metal concentrated soil sites provided by the Taiwan Council of Agriculture, Executive Yuan. Sites were classified as "polluted" using Taiwan's Environmental Protection Administration (EPA) classification standards wherein, of the five classes of heavy metal soil concentrations, sites with concentration values within or above the range of the fourth class were regarded as polluted.

By statistically analyzing heavy metal bioaccumulation levels of target species associated with simulated heavy metal distributions, our results indicated that Principal Component Analysis (PCA) and Canonical Correlation Analysis (CCA) are efficient to obtain the associations among soil heavy metals and the heavy metal concentrations of bird samples. The Zn/Cu concentration levels in bird's organs, bones, feathers/organs were higher than those in soil/bones and soil. The PCA and CCA results illustrated that Zn in bird's internal organs and Cr in soil are significantly different. We conclude that heavy metal in soil transfer through bio-accumulation, however, it is critical to consider the tolerance of species, trophic level, taxa and location on heavy metal accumulation. Keep collecting samples of target species, we expect to see more exciting outcome and more interaction among those complex factor by PCA, CCA and advanced approach.

Keywords: Heavy metals, Birds, Bio-accumulative, CCA, Simulation.