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USGS Chesapeake Bay Activities

Contaminant Effects on Biological and Ecological Resources/Use of the Tree Swallow (*Tachycineta bicolor*) to Assess the Bioavailability and Effects of Contaminants in the Chesapeake Bay Watershed

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Collaborators: National Park Service and Fish and Wildlife Service

Statement of Problem: Anacostia River sediment is highly contaminated with polycyclic aromatic hydrocarbons, organochlorines such as PCB's, and various heavy metals. Two tidal wetlands, Kingman Lake and Kenilworth Marsh, reconstructed with these sediments, attract wildlife that may be exposed to harmful levels of contaminants from the sediments. For instance, tree swallows consume emergent aquatic insects from their immediate surroundings and may be bioaccumulating contaminants. To evaluate contaminant bioavailability and possible toxic effects, this study, utilizing the Tree swallow as a sentinel species, will measure 1) organic and inorganic contaminants in sediments, prey items, eggs, and tissues, 2) biochemical responses to different chemical classes, and 3) reproduction and growth. Two reference sites will represent baseline contamination at an Anacostia River site and no contamination at the Patuxent Research Refuge (that has previously been used as a clean reference site for Tree Swallow studies).

Objectives: To determine whether the contaminants present in the sediments used to reconstruct the Kenilworth Marsh and Kingman Lake wetlands are a source of contamination and possible harm to wildlife using the reconstructed wetlands. To accomplish this by using the Tree Swallow as a sentinel species – placing nest boxes in the areas of interest and studying the uptake of organic and inorganic contaminants and their impacts on tree swallows, particularly on reproduction and the nestlings. Develop and improve nonlethal biomarker techniques.

Approach: Tree Swallows feed heavily on aquatic insects and are exposed to contaminants that the insects may accumulate from sediments. It has been shown that Tree Swallows can accumulate both organic and inorganic contaminants by this route. They are readily attracted to nest boxes placed in appropriate habitats, feed in a limited area, and can be easily handled. Tree Swallows are a middle-trophic level species, and

can serve as sentinel species for the bioavailability and impact of contaminants in the sediments in a defined area. This is valuable both in identifying areas of high sediment contaminant bioavailability and in assessing possible toxic effects.

Methods: Nest boxes suitable for Tree Swallows will be fabricated. At least forty will be installed at each of the selected areas along the shoreline of the Anacostia River (Kingman Lake, Kenilworth Marsh, and the Dueling Creek-Anacostia River reference site) and at the USGS Patuxent Wildlife Research Center (PWRC). Fieldwork will be done each spring as necessary to obtain statistically sound sample sizes. The arrival and nesting of Tree Swallows each spring will be monitored. Feeding activity will be observed for several periods at each site to determine the typical range of feeding activity, and thus assess how much of the feeding occurs at the area of interest.

Correlations will be examined between contaminant levels in sediment, diet, egg and nestling, biological responses and biochemical responses. One egg each will be taken from a maximum of ten nests at each of the four sites over the duration of the study. To prevent a drop in numbers of offspring, the sampling will be done before clutches are complete to ensure that the hens lay complete clutches. Each collected egg's contents will be analyzed for organochlorine contaminants, and the shells will be analyzed for heavy metals. Reproductive and growth parameters will be obtained for each active nest. From each nest where an egg was collected, one nestling will be collected before fledging (approximately day 16). Clutches are typically five to six young birds, so this would have minimal impact. Blood will be collected for ALAD assay (lead inhibits ALAD activity). Gall bladder bile will be collected for PAH metabolite analysis.

Livers will be collected for cytochrome P450-associated enzyme assay. Two wing feathers will be collected for assessment of cytochrome P450 by immunohistochemistry. (Cytochrome P450 is a biomarker for certain classes of organic contaminants.) Remaining feathers will be removed for heavy metal analysis. Heads will be collected for later brain removal and cholinesterase assay (a biomarker for exposure to cholinesterase-inhibiting insecticides). Each carcass will be analyzed for organochlorines. Sediment samples and pooled crop plus stomach contents from each site will be analyzed for heavy metals, organochlorines and polycyclic aromatic hydrocarbons. Nest quality of all nests will be assessed, as will the growth and development of all nestlings.

Tree Swallows appear to be little impacted by such studies. Nest boxes have a hinged side allowing nests to be checked readily. Parents return to the nest as soon workers move away. Eggs are collected after clutches are complete, so the nest will not be abandoned. Only one nestling out of a typical clutch size of five to six birds is collected per nest, and no adults are collected. There is little impact on the population. Feathers have previously been used to monitor for metal contaminants and we have shown in ducks that feather cytochrome P450 can be monitored by immunohistochemistry so we will evaluate monitoring for both metals and some organics in tree swallows via collection of emerging feathers without having to sacrifice the birds.

Selected Reports and Other Products:

Meeting presentation and abstract, 2 manuscripts, master's thesis, final assessment/report

Relevance and Benefits: This project addresses the following goals—Assess the occurrence of toxic constituents and emerging contaminants, and/or assess the factors

affecting the health of fish, wildlife and their habitats. At specific NPS locations – assess possible harmful impact of contaminants to terrestrial wildlife when wetlands are reconstructed using contaminated sediments.