Polychlorinated Biphenyl Contamination of Tree Swallows in the Upper Hudson River Valley, New York.

Effects on Breeding Biology and Implications for Other Bird Species

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Executive Summary

The Hudson River, from Hudson Falls to New York City, New York, is highly contaminated with polychlorinated biphenyls (PCBs), largely as a result of PCB releases from two capacitor manufacturing plants in Hudson Falls and Fort Edward, New York. The U.S. Fish and Wildlife Service determined to evaluate the effects of Hudson River PCBs on migratory birds, selecting the tree swallow (*Tachycineta bicolor*) as a sentinel species. In 1994, we monitored three tree swallow nesting colonies along the upper Hudson River and one reference colony along the upstream Champlain Canal. Chemical parameters evaluated included total PCBs, congener specific and planar PCBs, metals, dioxins, dibenzofurans, and organochlorine pesticides. We also measured various indicators of reproductive success, as well as nestling growth and development.

Mean PCB concentrations in tree swallow eggs and nestlings from the Hudson River ranged from 377 nanograms per gram (ng/g) in reference area nestlings to 55,800 ng/g in Hudson River nestlings. PCB concentrations in tree swallows were generally correlated with PCB concentrations in sediment from adjacent riverine sediments. Hudson River tree swallow PCB concentrations were the highest ever reported for this species. At the two most contaminated sites, PCB accumulation in nestlings was significant enough to mask the effects of growth dilution. The PCB concentrations were of the same order of magnitude as PCB concentrations in aquatic insects, yellow perch, and cyprinid species from adjacent reaches of the Hudson River.

There was considerable consistency in the PCB congener patterns within and among sites, suggesting that a similar source of PCB contamination provided the strongest influence to PCB body burdens. The congener patterns in tree swallows also resembled the patterns found in upper Hudson River surface water, sediment, fish, and benthic invertebrates and were consistent with a PCB mixture predominated by Aroclor 1242, but amended with a small percentage of more highly chlorinated congeners.

PCB contamination of tree swallows was highly significant as it pertained to dioxin equivalency. The avian based toxic equivalency quotients in Hudson River tree swallows ranged from 1,260 picograms per gram (pg/g) to 11,100 pg/g, compared with 36 pg/g in reference site tree swallows. These toxic equivalency quotients are well above levels associated with adverse impacts in other bird species, such as the common tern (*Sterna hirundo*), Caspian tern (*Sterna caspia*), Forster's tern (*Sterna forsteri*), double-crested cormorant (*Phalacrocorax auritus*), and bald eagle (*Haliaeetus leucocephalus*).

Nestling mass at hatching was lower for Hudson River tree swallows than tree swallows from Ithaca, New York. This warrants further study since reduced mass at hatching has been associated with PCBs and other planar chlorinated hydrocarbons (PCHs) in other bird species. Clutch size, nestling survival, and nestling growth and development were all normal in the Hudson River tree swallows. Feeding studies conducted for this investigation found that tree

swallows nesting adjacent to the Hudson River consumed predominantly insects that develop from benthic aquatic larvae.

Plumage color is associated with several aspects of the social behavior of tree swallows. There were possible abnormalities in the plumage coloration of sub-adult females that warrant further attention. Our data suggest that a larger than normal percentage of sub-adult females in our study population had prematurely developed adult plumage. PCB exposure is one possible cause of altered plumage development.

A large number of nests were observed to be of poor quality in this population, in terms of the thickness of the grass cup, as well as the number of feathers lining the nest. Nest quality can influence reproductive success, particularly during adverse weather conditions, when nestlings depend on the protection provided by a well constructed and well feathered nest. Although nest building behavior in birds has not been shown to be influenced by PCBs, other reproductive behaviors in birds have been linked with PCB contamination.

Tree swallows breeding along the Hudson River in 1994 had lower reproductive success than tree swallows from an uncontaminated site. The primary sources of the lowered reproductive success were a reduced rate of hatchability and a high level of abandonment of eggs during the incubation stage. This lower reproductive success cannot be explained by adverse weather conditions, predation, unusual disturbance, or other contaminants, but is consistent with reduced reproductive success observed in other birds exposed to high concentrations of PCBs. Although this population had a high proportion of sub-adult females, that can be less successful at breeding than adult females, the Hudson River tree swallows still had lower reproductive success when compared to a population of tree swallows near Ithaca, New York, that also consisted of a large proportion of sub-adult females.

The PCB concentrations and toxic equivalency quotients we detected in tree swallows have significant implications for migratory birds, in general, that breed or migrate along the Hudson River. We estimate that if bald eagles, Forster's terns, common terns, Caspian terns, and double-crested cormorants were to nest along the Hudson River, at least between Hudson Falls and Saratoga National Historical Park, they would likely accumulate concentrations of PCBs which generally exceed concentrations associated with severe reproductive and developmental effects. Of these species, only the bald eagle is currently attempting to nest along the Hudson River. There are numerous other Hudson River bird species with feeding strategies that predispose them to high PCB exposures. PCB dose-reponse data are limited or nonexistent for these species, making it difficult to accurately predict PCB-induced risk to other Hudson River birds.