

Mercury Bioaccumulation in Terrestrial Vertebrates Residing in U.S. Coastal and Estuarine Habitat

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Abstract

We searched 10,828 records in the Contaminant Exposure and Effects—Terrestrial Vertebrates database (CEE-TV; www.pwrc.usgs.gov/ceetv) and found that about 20% of the records contained information on mercury in amphibians, reptiles, birds, and mammals residing in Atlantic, Gulf, Pacific, Alaska, and Hawaiian coastal and estuarine habitats. The majority of the data describes mercury concentrations in birds (shore birds, ducks, wading birds and birds of prey) and carnivorous mammals from FL, CA, AK, NY, and GA. Mercury exposure was quantified in 28 matrices, most commonly, in descending order, liver > egg > muscle > kidney > feather. Greatest mercury concentrations (> 200 ug/g dry weight) were found in liver of marine mammals from the Pacific coast, although moderately high concentrations (>20 ug/g) were also found in several species in Florida (American alligator *Alligator mississippiensis*, Florida panther *Felis concolor coryi*, great white heron *Ardea herodias occidentalis*). Based on 108 records for bald eagle and osprey, levels of mercury in eggs have not decreased in the past 30 years on the Atlantic Coast. In addition, Hg concentrations in eggs exceeded the threshold for reproductive effects (1 ug/g wet weight) for at least 3 threatened or endangered species collected in the past decade, including roseate tern (*Sterna dougallii*) samples. These findings suggest that chronic exposure to mercury is an ongoing and pervasive problem in coastal and estuarine habitat in the United States.

Introduction

The Biomonitoring of Environmental Status and Trends program is examining the threat of environmental contaminants to terrestrial vertebrates in the U.S. We created a “Contaminant Exposure and Effects—Terrestrial Vertebrates” database (CEE-TV; www.pwrc.usgs.gov/ceetv) by search of published literature, review of existing databases, and solicitation of unpublished reports from conservation agencies, private groups, and universities. The CEE-TV database has numerous applications including focusing biomonitoring efforts to generate critically needed ecotoxicological data in the numerous gaps along the coast, reducing uncertainty about contaminant risk, identifying areas for mitigation, restoration or special management, and ranking ecological conditions of estuaries.

Mercury is a widely distributed nonessential element that has been well recognized as an environmental pollutant for quite some time. Over the past decade, environmental surveys in the U.S. have revealed widespread mercury contamination in streams, wetlands, reservoirs, and lakes. To date 33 states have issued fish consumption advisories because of mercury burdens. Mercury contamination appears to pose a threat to many terrestrial vertebrate species. We report findings of a systematic search of the CEE-TV database that examined temporal, phylogenetic, and spatial trends of mercury contamination in terrestrial vertebrates residing in Atlantic, Gulf, Pacific, Alaska, and Hawaiian coastal and estuarine habitats.

Methods

We searched 10,828 records in the CEE-TV and found around 20% of the records contained information on mercury in amphibians, reptiles, birds, and mammals residing in Atlantic, Gulf, Pacific, Alaska, and Hawaiian coastal and estuarine habitats. These records were examined for temporal, spatial and phylogenetic trends in mercury concentrations and effects using Microsoft Access, parametric statistical analysis, and Geographic Information Systems.

Results and Discussion

Total Number of CEETV Records: 10,828

Total Number of Hg Records: 2,174

Detectable Quantities of Hg: 2052 Records (94.4%)

Biological Effects/Response Data: 130 Records (6.0%)

Threatened and Endangered Species (Top 5)

Bald Eagle (*Haliaeetus leucocephalus*): 139 Records

Florida Panther (*Felis concolor coryi*): 81 Records

Brown Pelican (*Pelecanus occidentalis*): 49 Records

Roseate Tern (*Sterna dougallii*): 14 Records

American Crocodile (*Crocodylus acutus*): 12 Records

Total Number of Records in Sample Matrices:

Liver: 751

Egg: 489

Muscle: 247

Kidney: 170

Feather: 148

Temporal Trends:

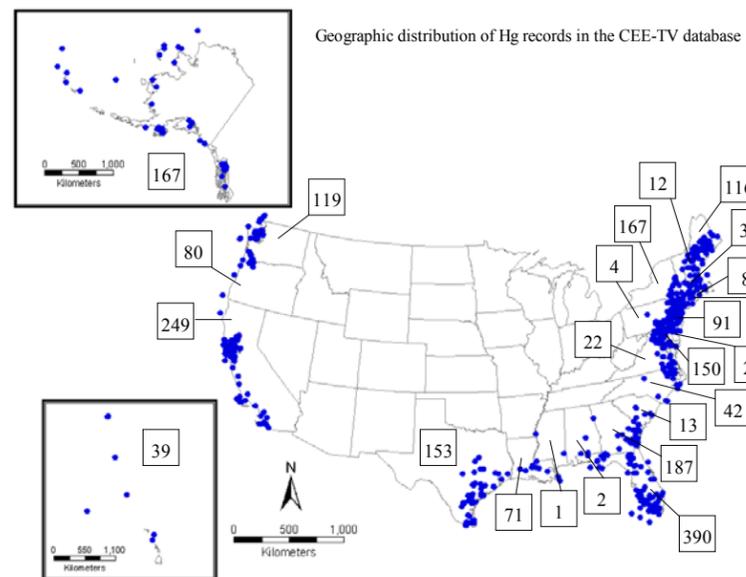
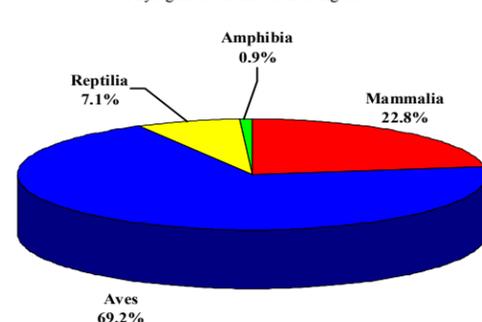
1960's 83 Records

1970's 657 Records

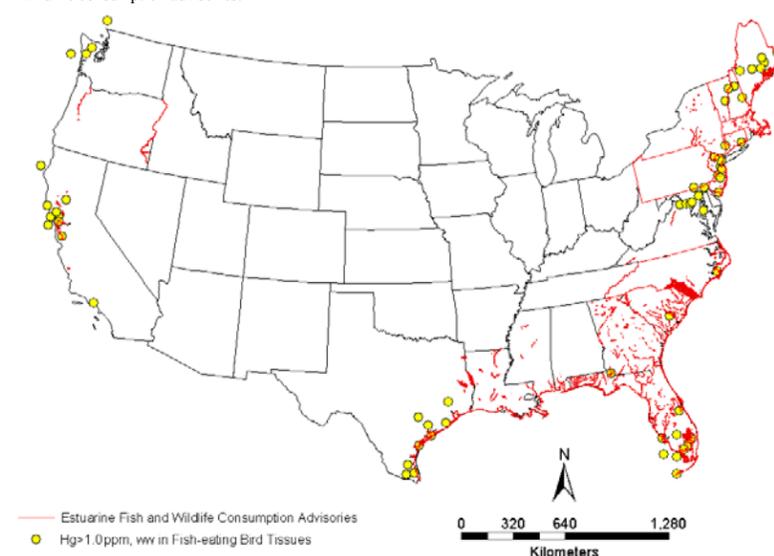
1980's 699 Records

1990's 631 Records

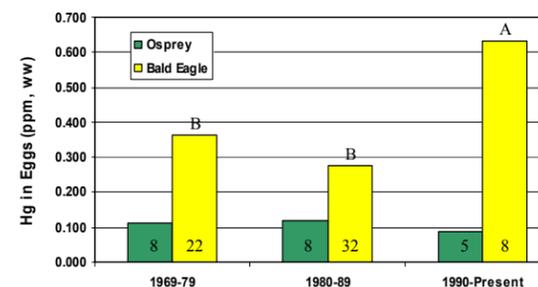
Phylogenetic distribution of Hg data



Records with mercury concentrations > 1 ppm ww in fish-eating bird tissues and corresponding estuarine fish and wildlife consumption advisories.



Concentrations of mercury in osprey and bald eagle eggs from the Atlantic coast



Bars with different level superscripts are significantly different by ANOVA and the SNK multiple range test ($\alpha=0.05$). Number of records indicated within bar.

Conclusions

Mercury pollution problems exist in wetlands along the coasts of the Atlantic and Gulf of Mexico, and San Francisco Bay

Despite extensive data on mercury concentrations in terrestrial vertebrates, there are critical data gaps in polluted regions (e.g. AL, MS, NC, SC, OR)

Greatest concentrations of mercury in biota correspond to geographic areas with fish and wildlife consumption advisories due to mercury pollution

Mercury concentrations in osprey and bald eagle eggs have not decreased on the Atlantic Coast over the last forty years

There are coastal areas within the United States where mercury concentrations are high enough to pose a risk to wildlife