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Environmental Contaminant Exposure Data and Monitoring Priorities for Wild Terrestrial Vertebrates at National Parks in Coastal and Estuarine Habitat

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Introduction

The Biomonitoring of Environmental Status and Trends (BEST) Project of the U.S. Geological Survey (USGS) assesses the exposure and effects of environmental contaminants on select species and habitats in the United States. One of the many BEST Project activities entails the development of decision-support tools to assist in the identification of chemical threats to species and lands under the stewardship of the Department of the Interior. Although there are many ecotoxicological monitoring programs that focus on aquatic species and habitats, there are currently no large-scale efforts that are focused on terrestrial vertebrates in the United States. Nonetheless, organochlorine contaminants, metals, and new pollutants continue to pose hazards to terrestrial vertebrates at many spatial scales (ranging from small hazardous-waste-site point sources to entire watersheds). To evaluate and prioritize pollutant hazards for terrestrial vertebrates, a “Contaminant Exposure and Effects—Terrestrial Vertebrates” (CEE-TV) database (www.pwrc.usgs.gov/contaminants-online) was developed (Rattner et al. 2000). The CEE-TV database has been used to conduct simple searches for exposure and biological effects information for a given species or location, identification of temporal contaminant exposure trends, information gap analyses for national wildlife refuge and national park units, and ranking of terrestrial vertebrate ecotoxicological information needs based on data density and water quality problems (Cohen et al. 2003). Herein we provide scientists and natural resource managers with some findings that may aid in the prioritization of terrestrial vertebrate contaminant biomonitoring in the national park units in coastal and estuarine habitats of the United States.

Methods

Retrospective contaminant exposure and effects data for wild terrestrial vertebrates living in U.S. estuarine and coastal habitat were compiled using scientific literature search tools

(e.g., BIOSIS, Wildlife Review), various federal and state governmental databases (e.g., U.S. Environmental Protection Agency Ecological Incident Information System, USGS National Wildlife Health Center Mortality Database, data managed by the New York Department of Environmental Conservation), and through communication with approximately 500 scientists in government agencies, conservation organizations, and academic institutions. Source documents were reviewed, and unless obvious errors in data quality were apparent, information was entered into the CEE-TV database. All data were referenced with geographic collection coordinates. If samples were collected across an entire county or a state, the coordinates of the county seat or state capital were assigned to the record. Data were compiled in Microsoft Access 2000 version 9.0 with information fields describing taxonomy, collection date, study location, geographic coordinates, sample matrix, contaminant concentration, biomarker or bioindicator response, and source of information (for details, see the above-mentioned website and Rattner et al. 2000, 2005).

The CEE-TV database was sorted for phylogenetic, temporal, spatial, contaminant exposure, and response patterns or endpoints using query search features of Access. Maps of sample collection locations were created using ArcGIS 8.2. Spatial information gap analyses were conducted by overlaying locations of CEE-TV records on boundary maps of national park units. To avoid potential bias of records with coordinates assigned to a county seat or state capital, only records with known collection coordinates were used in this analysis. Data gaps were defined as recent if there were no records with data collected from 1990 to 2003. To account for possible imprecision and uncertainty of sampling coordinates, and for animal movement, maps with 1-km buffers and 10-km buffers were created around each national park property boundary.

The Index of Watershed Indicators (IWI; U.S. Environmental Protection Agency 1997, 2000) classifies watershed water quality from “better” to “more serious,” and watershed vulnerability (i.e., potential for discharges and other stressors to affect water quality) from “low” to “high.” The IWI rankings were joined by hydrologic unit codes to the watershed map to identify watersheds of concern (i.e., IWI classifications of more serious water quality problems and/or high vulnerability to pollution). In order to identify the information data gaps that are of greatest concern, buffered national park units were overlaid on the IWI. Each national park unit that intersected with watersheds of concern was placed into a separate map for further information gap analysis.

Results and discussion

The CEE-TV database contains 17,150 records derived from over 1,850 source documents. There are 483 unique terrestrial vertebrate species in the database, with 78.6% of the records on birds, 18.5% on mammals, 3.8% on reptiles, and <0.7% on amphibians. Sample collection dates range from 1884 to 2003, with 90% of the data records derived from investigations since 1970. The relative amount of information for various species in the database reflects a variety of factors including their abundance and distribution in estuarine and coastal habitat, management status (threatened or endangered), use in monitoring programs, ease of collection, and sensitivity to various contaminants. Clearly, only limited data are available on free-ranging amphibians and reptiles (Sparling et al. 2000). The database records

Park unit name	State	Inventorying & Monitoring network	Park unit area including 10-km buffer (km ²)
<i>I&M national park units lacking data</i>			
Atlantic Coast			
Canaveral NS	FL	Southeast Coast	1485.6
Cape Hatteras NS	NC	Southeast Coast	3021.4
Castillo de San Marcos NMON	FL	Southeast Coast	339.4
Fort Caroline NMEM	FL	Southeast Coast	358.5
Fort Matanzas NMON	FL	Southeast Coast	373.0
Fredericksburg & Spotsylvania NMP	VA	Mid-Atlantic	1081.3
George Washington Birthplace NMON	VA	Northeast Coastal & Barrier	390.5
Manassas NBP	VA	National Capital Region	284.5
Minute Man NHP	MA	Northeast Temperate	437.9
Moorea Creek NB	NC	Southeast Coast	301.7
Saugus Iron Works NHS	MA	Northeast Temperate	325.2
Thomas Stone NHS	MD	Northeast Coastal & Barrier	363.9
Timucuan Ecol and Hist Preserve	FL	Southeast Coast	1488.3
Weir Farm NHS	CT	Northeast Temperate	337.4
Pacific Coast			
Fort Vancouver NHS	OR	National Coast & Cascades	252.3
John Muir NHS	CA	San Francisco Bay Area	290
San Juan Island NHP	WA	National Coast & Cascades	551.1
Gulf Coast			
Big Thicket NPRES	TX	Gulf Coast	957.8
Biscayne NP	FL	South Florida/Caribbean	990.7
Dry Tortugas NP	FL	South Florida/Caribbean	1165
Great Lakes			
Cuyahoga Valley NRA	OH	Heartland	977.9
Grand Portage NMON	MN	Great Lakes	597.5
Pictured Rocks NL	MI	Great Lakes	1914.8
Sleeping Bear Dunes NL	MI	Great Lakes	2524.3
<i>I&M national park units in watersheds with "more serious water quality problems" and "high vulnerability to pollution" lacking data</i>			
Minute Man NHP	MA	Northeast Temperate	437.9
Saugus Iron Works NHS	MA	Northeast Temperate	325.2
John Muir NHS	CA	San Francisco Bay Area	290

Table 1. Inventory and Monitoring national park units in coastal and estuarine drainages of the continental U.S. lacking recent (1990–2003) CEE-TV data.

contain contaminant exposure and concentration information on 209 elements and compounds, including halogenated organics, cholinesterase-inhibiting pesticides, economic poisons, metals and trace elements, and petroleum hydrocarbons, with <10% of the records containing biomarker or bioindicator effects (e.g., eggshell thinning, biochemical responses, histopathology).

Of the 464 coastal watersheds in the United States, CEE-TV data records were found for 270. To identify spatial data gaps, 11,360 database records with specific sampling loca-

tions were combined with the boundaries of national park units. Attempts were made to verify the findings by contacting staff at each management unit. Of 126 national park units, data were available for terrestrial vertebrates at or within 10 km of 80 (63.5%) units, and recent data (1990–2003) were available at 66 (52.4%) units. When these data gaps were overlaid on watersheds exhibiting serious water quality problems and/or high vulnerability to pollution, 59 national park units in the continental United States were found to lack recent data and may deserve priority for further hazard assessment and potentially terrestrial vertebrate contaminant monitoring. There were no data in the CEE-TV database for 24 of the 66 national parks in the Inventory and Monitoring Program. (See Table 1, opposite.)

On-going activities and conclusions

Currently, we are evaluating terrestrial vertebrate contaminant data for Inventory and Monitoring parks in the national park units in the National Capital and Mid-Atlantic networks. In order to identify significant contaminant issues, 10-km buffer maps around each of the units are being overlaid on locations of CEE-TV data, and the locations of Toxic Release Inventory sites, 303(d) Impaired Waters, Superfund National Priority List sites, fish consumption advisories, and solid waste and wastewater treatment facilities. In addition, interviews are being conducted with staff of these park units to identify potential pollution issues. These and other data may be used to prioritize the need for additional ecotoxicological data in an effort to focus monitoring, management, and potential remediation activities.

Despite widespread concerns about environmental contamination, during the past decade only about one-half of the coastal national park units appear to have terrestrial vertebrate ecotoxicological data. Based upon known environmental contaminant hazards, it is recommended that regionalized monitoring programs or efforts focused on lands managed by the Department of the Interior should be undertaken to prevent serious natural resource problems.

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