Injury to birds in the Southeast Missouri Lead Mining District

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Abstract

The US Fish and Wildlife Service is pursuing a Natural Resource Damage Assessment in the Southeast Missouri Lead Mining District, in both the Old Lead Belt and New Lead Belt, where lead mining dates back over a hundred years. Residues from smelting, tailings and chat have contaminated soils and water. This study will investigate whether trust species have been injured from hazardous substance contaminants associated with mining. We will collect songbirds in mist nests and take blood samples. The blood will be analyzed for lead, protoporphyrin, and ALAD activity. A subset of the collected birds, mainly ground feeders, will be sacrificed and examined for signs of lead poisoning. In the following year, waterfowl will be collected and the same variables studied as in the songbirds. Soil and earthworms will also be collected and analyzed, to understand the route of exposure. The work is designed to meet the needs of the FWS and will include a report as well as scientific publications.

Background and Justification:

The Southeast Missouri Lead Mining District (SEMOLMD) has been mined for a hundred years and has the largest source of lead ore in the U.S. As a result of mining and smelting, the land and water within the District has become contaminated with hazardous substances. In SEMOLMD, lead is the contaminant that is most likely to be toxic to migratory birds, although zinc, cadmium and possibly other metals associated with the ores are possibly toxic. In a previous study, Niethammer et al. (1985) found that bullfrogs, muskrats and green-backed herons from the area had elevated concentrations of lead and zinc compared to those animals collected from reference sites. Schmitt et al. (2009) found that lead and cadmium were elevated in tissues of northern hog suckers collected in areas contaminated by the mining. The U.S. Fish and Wildlife Service is pursuing a Natural Resource Damage Assessment in SEMOLMD and wants to know whether injury to avian trust resources has occurred.

Our work will take place in St. Francois County in the “Old Lead Belt,” about 60 miles southwest of St. Louis, and in the Viburnum Trend, or “New Lead Belt,” about 50 miles west of the Old Lead Belt. Biologists from the US Fish and Wildlife Service office in Columbia will provide their expertise about the local

sites. We have conducted similar studies in the Coeur d'Alene River Basin and in the Tri-State Mining District and will use similar methods (see Beyer et al. 2005). Lead has been well studied in birds and we know how to identify lead poisoning. There are also adequate studies published in the literature to interpret the lead residues we will measure.

Objectives:

1) To determine whether migratory birds have been injured from releases of lead or other metals related to mining in the Southeast Missouri Lead Mining District.
2) To relate any injury detected to soil contamination at the sites.

Procedures:

Methods and techniques –

Songbirds

We will select sites based on the advice of local FWS biologists familiar with the area. The extent of soil contamination will be measured with a portable X-ray fluorescence detector (Niton®) before precise locations are selected. The pathology of lead poisoning is well understood in birds. We will use a combination of tissue concentrations (liver, kidney, blood) histology (renal acid-fast nuclear inclusion bodies), and biomarkers (red blood cell δ-aminolevulinic acid dehydratase activity, ALAD, Burch and Siegel, 1971;blood protoporphyrin, Roscoe et al., 1979) to determine whether songbirds are being exposed and adversely affected (poisoned) by lead or other metals related to mining activity. We will use similar methods to those used previously on songbirds in the Coeur d'Alene River Basin and in the Tri-State Mining District, which resulted in clear evidence of injury at those sites. Specimens of a few songbird species (robins, cardinals, thrashers) will be mist netted and blood will be drawn. Some of these birds will be released and some will be euthanized and dissected to collect tissues for metals analysis and histopathology. Our approach requires some birds being taken in a reference area, for comparison. Approximately 120 songbirds would be captured in nets and approximately 40 of them would be euthanized. We will be working with Kate Healy, of the Upper Columbia River FWS office, who has extensive expertise in collecting blood from songbirds for lead analysis. We will be following the protocols previously developed at her office for NRD assessment work.

There are many contaminated sites within the SEMOLMD and we will select a few representative areas where we would expect exposure to heavy metals to be high. We will measure soil metal concentrations at more sites than we will include in the songbird work. Therefore, we will be able to say something about

injury across the area, even if we do not collect songbirds at each of those sites. The soil sampling will not be detailed, but will include the minimum necessary to document the degree of contamination. Earthworms, if present, will also be collected and analyzed for metals to help determine possible routes of exposure.

Birds associated with aquatic resources

Birds that are dependent on the aquatic resources may also be exposed to high concentrations of metals. Lead is likely to be ingested by these birds mainly with sediment, but metals such as zinc or cadmium might come through the diet. Most likely we will collect waterfowl, preferably geese or swans. However, our selection will depend on requests from the trustees, who may need information on herons, egrets, kingfishers. During the first year of the study, we will make preliminary observations on which birds might be feeding at sites containing the most contaminated sediments. This work would take at least two years to complete.

Experimental Design and Analysis – The possibility of lead poisoning will be evaluated by comparing birds collected from contaminated sites with birds collected from reference sites. Tissue concentrations, ALAD activity and protoporphyrin concentrations of birds from various locations will be tested for homogeneity of variance and compared by parametric (ANOVA) or nonparametric procedures (if appropriate).

Good Laboratory Practices – We will depend on three standard operating procedures for the field work: mist netting, collecting blood, and dissecting birds. In addition, we will be analyzing blood for ALAD activity and protoporhyrin using standard operating procedures of the PWRC. See appendices.

Animal Care and Use Committee – Form attached

Veterinary Services – None requested. Field collected birds will be released or euthanized in the field.

PWRC Science Support – No special facilities will be required.

Work Areas: Work will be conducted in the field. Collecting permits and any permissions required will be handled by the Columbia, MO, Office of the FWS, whose biologists routinely work in the study areas.

Work Schedule: Preliminary visits to the potential sites will start in May, 2009.

Hazard Assessment: The study requires field work and driving to sites that are close to roads. Special care will be used in securing a container of liquid nitrogen when it is transported to a site.

Expected Products: At least one peer-reviewed paper and a report to the trustees. .

Reporting Schedule: The report on songbirds to the trustees should be written by June, 2010.

Records Management: An official archive for each study plan is maintained by the Research Manager and administrative staff. The file is kept for five years after the completion or termination of the study or completion of all publications, whichever comes first. Files for studies not completed must be maintained indefinitely or until the final manuscripts have been published. In addition, because this work involves a Natural Resource Damage Assessment, samples will be collected under chain of custody and all records and correspondence will be preserved for the trustees. Due to the possibility of litigation, files may need to be kept longer than the five years typically employed by Patuxent. If this is the case, the solicitor's office will provide official notice to maintain official archives for a longer period of time.

Personnel:

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