

## EVIDENCE FOR THE SOURCE OF LEAD CONTAMINATION WITHIN THE CALIFORNIA CONDOR

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ABSTRACT.—The California Condor (*Gymnogyps californianus*) is the largest bird species in North America. Prior to the 20th century these birds were abundant along the western coast of the U.S. However, losses of habitat, natural predation, shooting, and environmental contamination have all been thought to contribute to a precipitous population decline. Early studies suggested that the demise of the condor population was in part the result of incidental Pb poisoning from either direct ingestion of lead fragments from hunter-killed game or indirectly as the result of biologically incorporated Pb from the environment. A recent article for the National Rifle Association (Wright and Peddicord 2007) suggested that although condors are most likely adversely affected by elevated lead in their tissues and lead ammunition is used in condor range, there is little scientific evidence of actual ingestion of lead ammunition by condors, and there is little scientific evidence that the lead in the tissues of condors can be traced to ammunition.

Condors in Arizona were periodically captured and monitored for blood Pb concentrations; subsets of these blood samples were analyzed for Pb isotopic ratios. To date, Pb isotopic ratios have been measured in blood in 47 birds over 3 years. Multiple measurements have been undertaken on 18 birds, including metal fragments collected at the same time from two different birds. Birds with elevated blood Pb levels were isolated, x-rayed and the excrement monitored for metal fragments. Twelve fragments were collected from 6 different birds. Analyses of the metal fragments from these birds determined that the fragments were Pb, Cu, Fe-Cr alloy and Pb-Sn alloy.

We present Pb isotopic evidence that directly links ingested Pb fragments to Pb in the blood of condors. One condor was found to have metal fragments in both 2004 and 2007 and had differing blood Pb isotopic ratios, which were within analytical error of the fragments collected at the same time. In addition to identifying the possible source(s) of Pb in the blood of condors, lead isotopic measurements can be used to discern if the condor has undergone a significant poisoning event between blood collection periods and provide insight into the number of Pb toxicity events over the lifetime of a bird. These results support the hypothesis that bullet fragments are causing increased blood lead levels in condors.

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