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Publication Brief for Resource Managers

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Lead in Wetlands

Lead shotgun pellets are shot into the American landscape at a rate of over 39,000 metric tons per year. In wetlands that are former skeet ranges or popular hunting areas, lead pellet density may be quite high. Because lead has no known biological function and is toxic to plants at higher concentrations and to animals at lower concentrations, wetlands may suffer serious impairment from past shooting practices. Understanding the distribution of lead throughout wetlands biota will help in management and remediation decisions. In recent publications, USGS scientist Dr. Clifford Hui investigated the distribution of lead in the soil, flora, and fauna of a wetland that had been used as a skeet range.

Sampling soil, plants, and invertebrates at different distances from the shooting position, Hui found that lead was thoroughly integrated throughout the biological community. Shotgun pellets occurred primarily in the top 6 inches of soil. Over time, metallic lead in pellets combines with various chemical components in soil, leading to significant correlation between the density of shotgun pellets and the amount of trace lead dissolved in the soil. The components have various degrees of bio-availability. Plants of different species at the same location had different amounts of lead in their leaves, possibly due to different uptake capability of the root systems or root depths. Invertebrates that were examined had extraordinarily large lead burdens. The California horn snail had lead concentrations 100 times greater than the plant with the most lead at the same location. The lined shore crab had lead burdens over 20 percent greater than the plant with the most lead at the same location. Escape behavior tests showed that crabs with larger burdens are not more susceptible to predation than those with low lead burdens.

Wildlife that forages at contaminated sites may be exposed to lead without ingesting any pellets. Through ingestion of plant material, invertebrates, and soil (incidentally), wildlife may be subject to significant exposure to lead, although the calcium-rich exoskeletons of some invertebrates may mediate physiological absorption. Embryonic exposure can affect avian immune systems, brain development, and hatchability. Early post-hatch exposure can affect behaviors critical to survival, brain development, and growth. In adult birds the effects of lead exposure include anemia with its potential detriment to migration capability, increased mortality due to environmental temperature stress and immunotoxicity, behavioral deficits, and reduced egg production.

Management Implications:

- Lead pellets, when present, can be the primary source for lead in the soil.
- Because lead pellets can remain in the soil for up to 300 years, reducing the exposure of plants and wildlife to lead at contaminated sites requires deliberate efforts.
- Lead pellets are primarily in the top 6 inches of soil, so deeper remediation efforts should be considered carefully.
- Different plants and different invertebrates can carry very different lead burdens when located at the same site, so examining only a few species may not provide an accurate picture of potential exposure to their predators or of the habitat.

Hui, Clifford A. 2002. Lead distribution throughout soil, flora, and an invertebrate at a wetland skeet range. Journal of Toxicology and Environmental Health, Part A 65:1093–1107.

Hui, Clifford A. 2002. Lead burdens and behavioral impairments of the lined shore crab Pachygrapsus crassipes. *Ecotoxicology 11:417–421.*