

Western Ecological Research Center

Publication Brief for Resource Managers

Release:

January 2007

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Abundance and Distribution of Selected Elements from Tortoise Habitats in the Mojave and Colorado Deserts

Desert tortoises are herbivores that spend much of their lives in contact with dust, soil, and sediments. Adaptations that enable them to live in drought conditions may contribute to concentrations of potentially toxic substances in their tissues during droughts, potentially exacerbating diseases such as upper respiratory tract disease and shell diseases. In a recent study in the *Journal of Arid Environments*, USGS scientists Maurice Chaffee and Kristin Berry conducted a baseline and background chemical survey in southeastern California to identify potential sources of toxicants in natural and human-altered habitats of the threatened desert tortoise.

The researchers collected soil, stream sediment, and plant samples from six tortoise study areas in the Mojave and Colorado deserts (Western Mojave Northern and Southern sections, Goldstone, Goffs, Chemehuevi Valley, Chuckwalla Bench) and analyzed them for up to 66 different elements. In addition to undisturbed lands, the six areas included some disturbed by mining activity, some subjected to military maneuvers, as well as some transected by paved roads or railroads. Soil, stream-sediment, and plant analyses showed distinct variations in bulk chemistries from locality to locality. Variations were, in general, consistent with the many types of exposed rock units in the region, their highly variable bulk mineralogies, and chemical contents. Of elements in soils that might have been toxic for tortoises, only As appeared to be anomalous region-wide.

Some soil and plant anomalies were clearly anthropogenic. In the Rand and Atolia mining districts of the western Mojave Desert, soil anomalies for As, Au, Cd, Hg, Sb, and/or W and plant anomalies for As, Sb, and/or W extended about 15 km outward from the main areas of mining; soils containing anomalous concentrations of As and Hg may have been the source of elevated levels of these elements found in ill tortoises from that region. In the Goldstone

Management Implications:

- Potential surface contamination of dust may be redistributed a considerable distance by wind, vehicles, and rainfall.
- Only arsenic seemed to be anomalous region-wide.
- The source of elevated levels of arsenic and mercury in ill desert tortoises from the western and central Mojave Desert may be from soils and plants near mines that contained anomalous concentrations of these elements.
- Future studies need to evaluate the distribution and abundance of elements in tortoise forage plants for the respective roles of dust and systemic uptake.
- Additional chemical data from tortoise necropsies and nutritional studies are needed to determine the effects of potentially toxic elements in tortoise habitats on their health, immune systems, susceptibility to diseases, and mortality.

mining district of the central Mojave Desert, soil anomalies (e.g., ≥ 11 ppm As) also extended several km from the immediate area disturbed by mining. These areas with anomalous elements probably represent anthropogenic surface contamination from dust redistributed by wind, vehicles, and rainfall. One of two study areas transected by a paved road (Chemehuevi Valley) showed weakly elevated levels of Pb, which extended about 22 m from the pavement edge and were probably related to vehicle exhaust. No soil or plant samples from historically used military areas (Goldstone, Goffs, Chemehuevi Valley, Chuckwalla Bench) contained anomalous concentrations of the elements As, Cu, Cr, Fe, Pb, or Zn that could be ascribed to military maneuvers, vehicles, or ordnance.

Chaffee, M. A., and K. H. Berry. 2006. Abundance and distribution of selected elements in soils, stream sediments, and selected forage plants from desert tortoise habitats in the Mojave and Colorado deserts, USA. Journal of Arid Environments 67:35–87.