The Everglades ecosystem of South Florida may appear to be a wild, untouched landscape. However, there is a long history of human impacts—from attempts to drain the river of grass in the 1920s to pollution from agricultural and urban development and the introduction of invasive plants and animals. Currently, there are large-scale efforts to restore water flow and habitat in this unique ecosystem, but human impacts—both small and large—are still apparent.

J. Matthew Hoch, Associate Professor in the Department of Marine and Environmental Sciences at Nova Southeastern University, conducts research in the Everglades. He says that during outings with a field course, the group noticed areas that are illegally used for firearm target practice. These unregulated illegal shooting ranges are littered with bullet casings and other trash. Hoch and his students wondered if these shooting ranges were contaminated with metal—from the soil and water to the plants and animals—and Hoch and co-author Megan Bruce decided to investigate further. The results of this initial survey were recently published in the *Journal of Environmental Quality* (https://doi.org/10.2134/jeq2018.08.0319).

In 2017, Hoch and colleagues took survey samples at sites in the Everglades ecosystem. They sampled water, sediment, plants, and invertebrates and tested for lead, copper, and aluminum. Samples were collected at two unregulated shooting sites, three reference sites in the Everglades that did not show evidence of ammunition accumulation, and at a regulated shooting range.

The samples revealed that the unregulated shooting areas are contaminated by copper and lead. The levels of lead and copper in the sediment at the unregulated sites were greater than the reference sites and similar to the levels found at the regulated shooting range. Lead levels in plants were also greater at the unregulated sites compared with the reference sites. Additionally, the average lead levels in grass shrimp at target sites was 416.1 µg/g compared with levels averaging 18.9 µg/g at the reference sites.

This initial work documents the contamination associated with these unregulated target practice areas and leads to new questions. Hoch and his lab recently obtained grant funding to purchase new equipment that will enable them to do more in-depth analyses. He would like to do a more detailed sampling of plants and animals to test for bioaccumulation of lead and copper in the food chain that may originate at these sites. Understanding how these metals move through the ecosystem is important considering the Everglades ecosystem is critical habitat for many threatened and endangered species, including the Florida panther, American crocodile, wood stork, and snail kite.

The problems with illegal firearm use go beyond contamination as these areas can pose a risk to other people using public lands who are unaware of the existence or exact location of these illicit shooting ranges. For example, Hoch described how during this study, a fisherman was accidentally killed by target shooters at one of the study sites. In the western U.S., target shooters have also started wildfires on public land, resulting in damage to structures and costly firefighting efforts.

It will likely take a combination of efforts, including education and increased law enforcement, to reduce illegal target practice on public land in the Everglades and on other sites across the U.S. Increasing law enforcement presence can be expensive, but it is probably the most effective strategy. After the shooting accident mentioned earlier, Hoch says a law enforcement agent was stationed near the target shooting site. This resulted in a decrease in target shooting at the site and suggests that increased law enforcement presence can reduce these activities on public land.

**Dig Deeper**

View the *Journal of Environmental Quality* article, “Metal Contamination Hotspots at Unregulated Firearm Target Shooting Sites in the Everglades” at: https://doi.org/10.2134/jeq2018.08.0319.