EVALUATION OF MERCURY AND TOXIC METAL CONCENTRATIONS IN THE TISSUES OF OSPREYS ADMITTED TO THE SOUTH FLORIDA WILDLIFE CENTER

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Introduction

The osprey is a bird of prey that feeds mainly on fish and is recognized as a bio-monitor. These birds are cosmopolitan inhabitants of coastal wetlands.[1, 2]

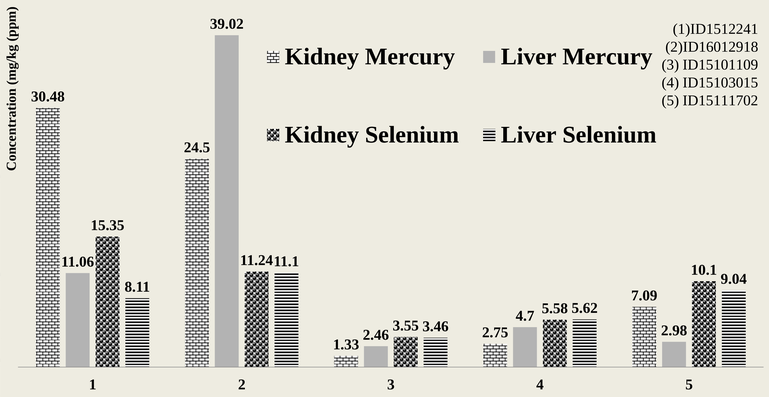
Ospreys are presently protected under the Migratory Bird Treaty Act. The U.S. Fish and Wildlife Service defined the osprey as a species of special emphasis due to its importance as an environmental bio-monitor.

Osprey admissions were recorded at the South Florida Wildlife Center (SFWC), a center involved in wildlife rescue, rehabilitation and release in the tri-county area of Palm Beach, Broward and Miami-Dade. Moribund ospreys showing suspicious debilitation were considered for analysis to check toxic metal levels in the kidney and liver.

Methods

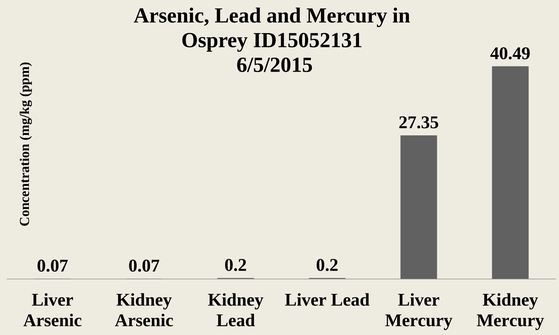
Laboratory analysis for mercury and selenium using spectrometry was provided by Karyn L. Bischoff of the Animal Health Diagnostic Center at Cornell University. Samples were dissolved by microwave using a nitric acid/hydrochloric acid mixture and hydrogen peroxide. The resulting solution was reduced, then further reacted with sodium borohydride to generate selenium hydride and elemental mercury. These solutions were then analyzed using inductively coupled argon plasma optical emission spectrometry.

Results

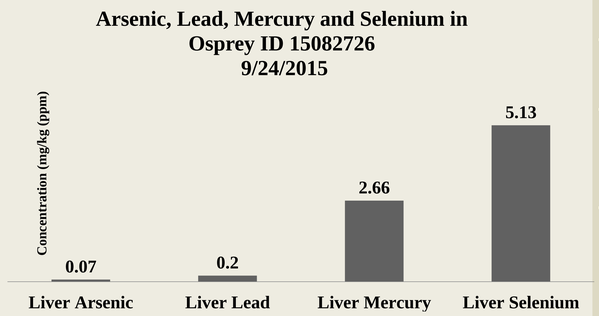


Five specimens were analyzed in the first week of April, 2016. One specimen's kidney had a mercury concentration of 30.48 mg/kg (ppm) and a selenium concentration of 15.35 mg/kg (ppm). This specimen's liver had a mercury concentration of 11.06 mg/kg (ppm) and a selenium concentration of 8.11 mg/kg (ppm). A second specimen had mercury concentrations of 24.5 mg/kg (ppm) in the kidney and 39.02 mg/kg in the liver, with a selenium concentration of 11.1 mg/kg (ppm) in the liver. Three specimens had mercury concentrations below 6 mg/kg (ppm) in the liver, while one had a mercury concentration of 7.09 mg/kg in the kidney.

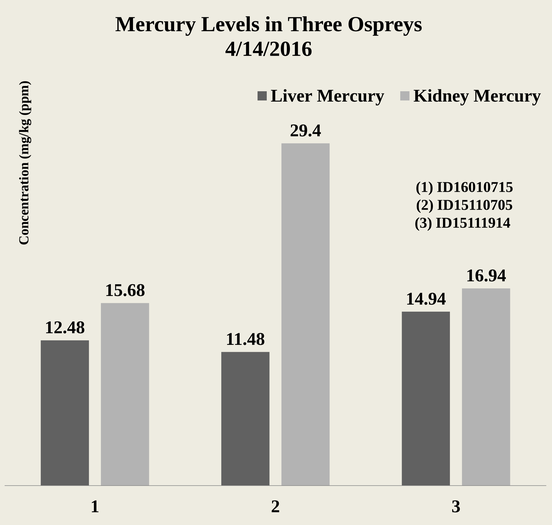
The osprey feeds mainly on fish. This bird is considered a bio-monitor, a sentinel for the bioaccumulation of heavy metals contaminating bodies of water.



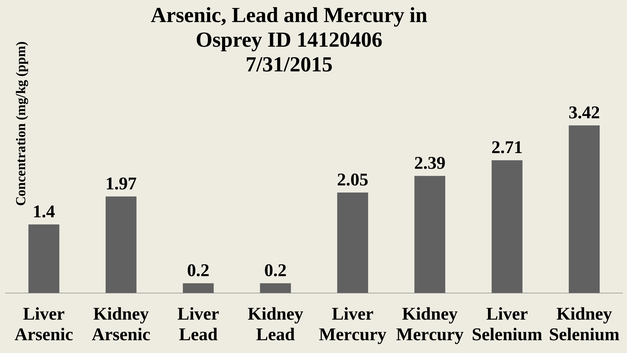
In this specimen, there was a mercury concentration of 40.49 mg/kg (ppm) in the kidney and 27.35 mg/kg (ppm) in the liver. A mercury concentration value of 0 is considered normal for these tissues. In both the kidney and liver samples, lead was found with a value of 0.2 mg/kg (ppm). The kidney and liver also had arsenic concentrations of 0.07 mg/kg (ppm).



A specimen tested in the month of September, 2015, presented toxic metal concentrations below the average detected in this study. In addition, the third specimen tested on 4/4/16 and the specimen tested on 7/31/15 also had lower concentrations..



Three ospreys were tested in the second week of April, 2016. One of the three specimens had mercury concentrations of 29.40 mg/kg (ppm) in the kidney and 11.48 mg/kg (ppm) in the liver. The other two specimens presented mercury concentrations in the kidney and liver of > 10mg/kg (ppm).



In July, 2015, one specimen presented with high concentrations of arsenic at 1.4 mg/kg (ppm) in the kidney and 1.97 mg/kg (ppm) in the liver. Mercury concentrations in the liver and kidney were > 2 mg/kg (ppm) and lead concentrations in the kidney and liver were 0.2 mg/kg (ppm).

Discussion

- Ospreys are bio-monitors. Therefore, it is advisable to perform toxicological studies when ospreys are admitted to rescue centers due to unknown circumstances. North American ospreys migrate to the tropics each fall; however, they can be found year round in Florida. As many of these ospreys are stationary, tagging is recommended.
- The ospreys in this study had severely compromised health, were moribund or had to be euthanized. We speculate that the compromised health of some of the ospreys with high mercury concentrations can be attributed to their exposure to this toxic metal.
- Toxic levels of mercury were found in ospreys admitted to the SFWC. Tested samples showed > 20 mg/kg (ppm) of mercury in the livers and kidneys. Ospreys with high concentrations of mercury were weak, emaciated and presented with anemia, and some had open fractures possibly due to physical inability to avoid collisions.
- In the present study, the highest recorded mercury concentration was 39.02 mg/kg (ppm) detected in April, 2016. This is higher than the > 10 ppm reported by Wiemeyer et al. (1987) for Osprey of Eastern United States. The lower limits of detection for mercury in ppm wet weight can be 0.02 or 0.05.[3]
- According to the Department of Interior, in other birds, liver mercury contamination of > 6 mg/kg (ppm) is associated with mortality from chronic diseases.
- In our study, the lowest mercury concentration found in a kidney was 1.33 mg/kg (ppm). The lowest found in a liver was 2.05 mg/kg (ppm).
- Exposure to mercury is especially debilitating during the reproductive season. Mercury compromises not only hatchling survivability, but the breeding pairs themselves by possibly rendering the birds unable to produce chicks.
- Due to the protective function of selenium against mercury toxicity tissue samples from some specimens were also evaluated for selenium. It was noted that selenium concentrations showed an increase in specimens with increased mercury concentrations.
- For two of the three ospreys analyzed for lead and arsenic in this study, there were no significant concentrations of these elements found. However, in one specimen arsenic levels in kidney and liver were > 1 mg/kg (ppm). According to Karyn Bischoff of Cornell's Animal Health Diagnostic Center, this level of arsenic could have been lethal for this osprey.

Conclusion

Necropsies and toxicological studies on osprey carcasses admitted to the SFWC should continue in order to obtain further information on exposure to toxic metals. New contaminant threats should also be considered for study.

The practice of performing laboratory tests for cause-of-death determinations and contaminant investigations should be continued and coordinated with local academia. This will help with the development of conservation strategies as these data can serve as starting points for future studies. This includes helping to identify stressors on osprey health and data gaps that need to be addressed. Ultimately, this will help affect optimal environmental impact and improvement on the health of ospreys in the Everglades.

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LITERATURE CITED: 1. Grove RA, Henny CJ, Kaiser JL. Osprey: worldwide sentinel species for assessing and monitoring environmental contamination in rivers, lakes, reservoirs, and estuaries. J Toxicol Environ Health Part B 2009;12: 25-44.

2. Henny CJ, Grove RA, Kaiser JL, Johnson BL. North American osprey populations and contaminants: historic and contemporary perspectives. J Toxicol Environ Health Part B. 2010; 13:579-603.

3. Wiemeyer SN, Schmeling SK, Anderson A. Environmental pollutant and necropsy data for ospreys from the eastern United States, 1975-1982. J Wildl Dis. 1987.23(2):279-291.