Developing procedures to establish baseline environmental contaminant levels for small mammals in Alaska Parklands

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Introduction


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Heavy metals accumulate in biological ecosystems from both natural and anthropogenic sources. Erosion, weathering, pH or salinity changes, and organic matter decomposition can divorce heavy metals from their original sediment, dispersing them into the surrounding environment (Han et al. 2017). Soil acts as a pollutant sink, holding released toxins that are spread via waterways, absorbed by plant roots, and passed up the food chain (Khan et al. 2010). Upon entering the food chain, heavy metals bioaccumulate in organic fatty tissue and trophic magnification occurs.


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Some heavy metals are essential to biological processes, but in significant quantities, they can hinder nutrient intake, cause immune system weakness, inhibit intrauterine growth, and cause malnutrition-related disabilities and gastrointestinal cancer (Khan et al. 2010).

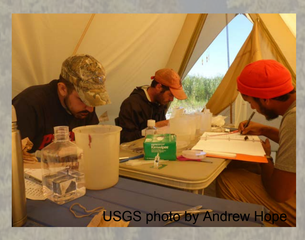
Overall ecosystem health can be estimated by assessing heavy metal levels in foundational species. We worked with Dr. Angela Matz in the U.S. Fish and Wildlife Service Environmental Contaminants lab to develop a protocol for testing contaminants in small mammals, with the goal of establishing baseline measurements for relatively undisturbed ecosystems. This was accomplished by processing hair samples from small mammals collected in Gates of the Arctic National Park and Preserve (GAAR), Kobuk Valley National Park (KOVA), and Denali National Park (DENA) to be tested for a variety of heavy metals.

Methods

Sampling Locations

Specimens for this study were collected through two projects:

- Small mammal survey along Kobuk River between Walker Lake and Kiana, conducted by Andrew Hope and crew.
- Incidental mortalities from Central Alaska Network small mammal monitoring in Denali National Park, conducted by Melanie Flamme and crew.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These two projects totaled over 500 specimens.

Hair Collection

1. Place specimen on a clean sheet of aluminum foil, dull side up
2. Use a sterile instrument to cut and collect 0.5-1g of clean body hair, place in a weighboat
3. Measure weight of hair sample to three decimal points (thousandth of a gram)
4. Place cut hair sample in a Teflon, paper, or glassine envelope labeled with species, sex, location (lat/long), collector, processor, date collected, date processed, and specimen type (i.e. frozen or study skin)


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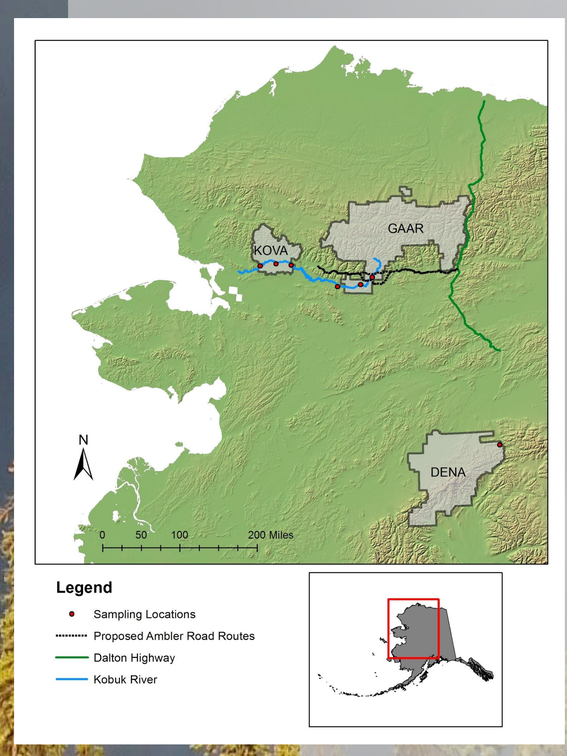
5. Store samples in a clean and dry environment until shipped to the analytical laboratory

Samples will be tested for a variety of heavy metals, including silver, arsenic, barium, cadmium, chromium, mercury, lead, and selenium.



Future Directions

Natural Comparisons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Results from this analysis have a number of valuable applications. First, an establishment of a baseline contaminants level in sampled areas would allow for a more thorough understanding of natural fluctuations, and the relationship between the biotic and abiotic environments.

Ambler Industrial Access Road

Baseline measurements along the Kobuk River could also be valuable if the Ambler Mining District road is built, connecting an area with gold, silver, copper, lead, and zinc deposits to the Dalton Highway. This proposed road would enable ore transport through ~200 miles of the southern Brooks Range, 20 miles of which lie in Gates of the Arctic National Preserve.

In northwestern Alaska, along the route connecting Red Dog mine with the Chukchi Sea, high concentrations of zinc, lead, and cadmium deposited by trucks transporting ore were found up to five kilometers from the road (Neitlich et al., 2017).

Similar disruption could challenge the area surrounding the Ambler road corridor, which crosses numerous water bodies and other fragile ecosystems. Knowledge of pre-development levels would allow for effective assessment of impacts, and could be used for future management decisions.


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Conclusion

With increasing expansion and development of infrastructure, it is vital that we develop a strong understanding of the interaction between heavy metals and the surrounding environment. This protocol will aid in this effort, allowing for more accurate monitoring of a valuable ecosystem while maintaining wilderness character in parklands.

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