

Getting the Lead out [of swans]

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Tundra Swans Migrate Through The Bunker Hill Superfund Site

Tundra Swan - day of year: July 02 USGS ASC satellite tracking, doi: 10.5066/P9KBR79C









Every February to April, approximately 10,000 tundra swans feed in the Lower Basin of Bunker Hill in north Idaho

Process History

- Mining and milling began in the 1880s
- Until 1968, mine waste discharged directly to creeks and rivers
- Most tailings piles located adjacent to or in streams
- Estimated over 100 million tons of mine waste discharged
 - 2.4 billion pounds of lead
 - Dispersed over 10,000's acres





Complex river and floodplain interaction

Where the river meets Coeur d'Alene Lake







Tundra swans forage in the mud for water potato and other aquatic vegetation, which exposes them to Pb in sediments 50-400 swans are estimated to die per year

2022 Migration

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- February
 - High ice cover
- High swan use!500+ Harrison Slough

March – High water, but shallow habitat available – Peak waterfowl use

Season Totals

2210-1-

- 153,470 waterfowl observations
 - 24,515 swans

2022 Mortality

- ~390 dead
- Average 52 dead/year
- 145 dead swans prev high (2019)
- 77.6% near Harrison

Why? Will this continue?!



Wetland Cleanup & Restoration



Schlepp – 390 ac clean feeding habitat; high waterfowl abundance & diversity BUT inconsistent swan use

Mortality Prevention





Examination of a Potential Waterfowl Monitoring Tool: Measuring Pb in Swan Fecal Samples



Background

- Unclear how changes in sediment Pb concentrations (increased clean feeding habitat) will affect aggregate swan exposures over time
- Feeding habits differ with vegetation type, which can vary across the site, making sediment sampling protocols an uncertain representation of swan exposures
- Require <u>simple</u> and <u>efficient</u> sampling technique that <u>directly</u> indicates waterfowl exposure

Why Fecal Sampling? • Represents swan's exposure

- Represents swan's exposure directly
- Faster/easier to collect than sediment
- Information about influence of diet on Pb exposure









Key Collaborators



Key Data Gaps So Far Being Addressed by Project

- 1. Does fecal Pb mimic sediment Pb concentration, bioavailability, and origin?
- 2. Is fecal lead and blood lead in swans primarily associated with Bunker Hill mine waste?
- 3. Does plant species influence Pb exposure?
- 4. How do swans use the site?



Study Design

Intended Design

- Control, Low, Medium, High sediment Pb sites
- 40 total birds
 - Blood (Pb)
 - Feces (Pb and DNA)
 - Bone (Pb)
 - BCI + physiology measurements
- 40 wetland collected fecal samples (DNA + Pb)
- 12 sediment (Pb)
- Pore water (Pb)
- Tracking of birds

Ornitela GSM Collar



Colored Neck Collars





Study Design: What we achieved

- 17 captured out of 40 targeted
- Reference: Hepton, n=2, 1 GSM collar
 - 1 GSM is reporting data
- Low: Schlepp, n=7, 2 GSM collars
 - 1 GSM is reporting data; other collar not recovered (dead bird)
- High: Thompson, n = 8, 2 GSM collars
 - Both collared birds have since died and collars retrieved
 - Necropsy of one bird (Pb toxicosis)
 - Tissues will be recovered and analyzed for Pb as possible
- Fecal, sediment, and pore water also collected from these 3 locations

Bird Captured at Schlepp (juvenile female)



3/8/22 through 3/28/22

=22 days at contaminated sites after capture

5/25/22 Now in Alaska



What do they eat?



Relative Abundance of Plant Taxa in Swan Fecal Samples



k__Viridiplantae;p__Streptophyta;c__Magnoliopsida;o__Rosales;f__Rosaceae;g__Potentilla;__

Elevated Consumption of bur-reed at Hepton Lake



k_Viridiplantae;p_Streptophyta;c_Coleochaetophyceae;o_Coleochaetales;f_Coleochaetaceae;g_Coleochaete;__

k_Viridiplantae;p_Streptophyta;c_Magnoliopsida;o_Rosales;f_Rosaceae;g_Potentilla;__

Elevated Consumption of water lily at Schlepp



k_Viridiplantae;p_Streptophyta;c_Coleochaetophyceae;o_Coleochaetales;f_Coleochaetaceae;g_Coleochaete;__

k_Viridiplantae;p_Streptophyta;c_Magnoliopsida;o_Rosales;f_Rosaceae;g_Potentilla;_

Elevated Consumption of horse tail at Thompson



k__Viridiplantae;p__Streptophyta;c__Coleochaetophyceae;o__Coleochaetales;f__Coleochaetaceae;g__Coleochaete;__

k Viridiplantae;p Streptophyta;c Magnoliopsida;o Rosales;f Rosaceae;g Potentilla;

Sample

How do we know the lead is from bunker hill?

Stable Pb isotopes for fingerprinting Pb exposures



Does Bunker hill pb have a unique isotopic signature?

- Yes!
- Lead toxicity in swans is a result of Bunker Hill lead.
- >90% of blood Pb in 14 of 17 swans was from Bunker Hill!





4 naturally occurring stable isotopes ratios of these different Pb isotopes can be used to distinguish between sources of lead

What have we discovered so far?

- Fecal sampling is a promising metric for evaluating both wetland specific and population-wide swan health
- Most Pb in swans was from Bunker Hill
- The swan diet is very diverse
 - Water potato was a small part of their diet
 - Some plants may be riskier than others for Pb exposure
 - Can we nudge the abundance of safe plant species over others as we clean up the site?
- Airboat-based captures are NOT the way to go

Next steps

- Continue to nail down correlation between Bunker Hill blood lead, feces, and sediment
 - Only 3 of 40 had all three measurements
- Design fecal sampling monitoring program
- Determine how reducing lead concentrations increases the health of the Lower Basin swan population
- Figure out a better way to catch and sample swans! No more airboats.
- ORD is helping to fund this and related research and we hope to have another successful field program in 2023.

Your Questions are welcome!



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