LEAD SHOT POISONING IN SWANS: SOURCES OF PELLETS WITHIN WHATCOM COUNTY, WA, USA, AND SUMAS PRAIRIE, BC, CANADA

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EXTENDED ABSTRACT.—Over the past nine years (1999–2008), swan populations in northwest Washington State and on Sumas Prairie, British Columbia (Figure 1) have declined by over 1,500 birds due to lead poisoning caused by ingestion of lead pellets. The large majority of mortalities involved Trumpeter Swans (*Cygnus buccinator*) and most have occurred in Whatcom County, Washington State. Swan mortalities in Skagit and Snohomish Counties (Figure 2) of Washington State have also been included in the study total as these individuals may have ingested lead pellets in Whatcom County and Sumas Prairie prior to moving south.

Lead shot use for waterfowl hunting has been banned in northwest Washington State since 1989 (WDFW 2001) and in the Sumas Prairie area of British Columbia since 1990 (Wilson et al. 1998). Lead shot is still permitted for upland bird hunting and target shooting in most of both areas. Swans are at risk from lead poisoning because of their method of feeding (Blus et al. 1989). Large amounts of plant and sediment material are consumed whole, along with small pebbles (grit) to aid in the grinding of food in the birds' gizzards. Because of their size, lead pellets may be unintentionally ingested when birds eat grit or seeds. The grinding action and acidic environment of the gizzard break down the pellets, allowing lead to enter the bloodstream (Shillinger et al. 1937, Bellrose 1975, WDFW 2001). Symptoms of lead poisoning in waterfowl (e.g., lethargy, muscular weakness) can appear as early as four days after ingestion of as few as two or three pellets, with death occurring in 17-21 days (USGS-NWHC, pers. comm.). If more pellets are ingested, less time may be required before mortality occurs (Bellrose 1975, Pain 1990).

In 2001, an international effort was initiated to locate the source(s) of the lead. Participants included the Washington Department of Fish and Wildlife, US Fish and Wildlife Service, Environment Can-

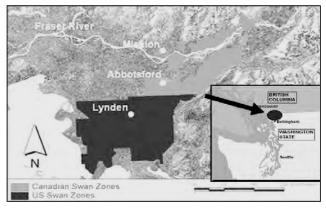


Figure 1. A map of the study area encompassing the lead related swan mortalities in Whatcom County, Washington State, and Sumas Prairie, British Columbia. The study area is ~100,000 ha, 58% in the United States and 42% in Canada.

ada, The Trumpeter Swan Society, and the University of Washington (Washington Cooperative Fish and Wildlife Research Unit). Rocket propelled nets were used to capture a total of 249 Trumpeter and 42 Tundra Swans between 2001 and 2005. A blood sample was collected from each captured swan and analyzed for blood lead content (BC Ministry of Agriculture and Lands, Animal Health Centre, Abbotsford, BC.). Trumpeter Swans were fitted with either a VHF (n=243) or satellite (n=6) transmitter attached to a coded neck collar. Tundra Swans were fitted with a coded neck collar. Sick and dead swans were collected throughout the winter, and carcasses examined to determine cause of death, measure liver lead residues, and recover shot from gizzards. Results suggest that swans arrive on the wintering grounds with low blood lead levels, but some birds subsequently become exposed to lead after ingesting lead shot.

During the winter months (October-February) of 2001–2006, telemetry surveys were conducted each day and night to document locations of marked individuals. Population surveys were also conducted semi-weekly from November to January to obtain additional detail on population movements and to validate telemetry data. The locations of collared swans were used to identify forage areas and roost sites. Telemetry data for swans that died from lead poisoning after radio-collaring were used to identify and prioritize areas for lead shot density as-



Figure 2. A schematic of county boundaries in northwestern Washington State.

sessment (shot collected from soil/sediment sampling).

Lead shot has been found in fields and water bodies where hunting and target shooting have occurred. Relatively high densities of lead shot were found on the US side of Judson Lake, a ~100 acre lake spanning the US/Canada border. Waterfowl hunting still occurs on the US side of Judson Lake, but this activity has not occurred on the Canadian side for at least 30 years because of a landowner ban.

An adaptive management approach was initiated in October 2006 to test the hypothesis that Judson Lake is a primary source of lead shot. Swans were discouraged from using Judson Lake by both passive (windsocks, effigies) and active (noise makers, laser light, airboat) deterrent methods. Hazing activities ceased in late January 2007 and swans were allowed on the lake as the water depth at that time was believed to be sufficient to preclude swans from accessing sediments. The number of lead poisoned swans in 2006-2007 decreased by >50% compared to the average of the five previous years. However, population surveys showed that fewer swans foraged in an agricultural area near Judson Lake. Heavy snow and freezing temperatures forced most swans to leave the study area for up to two weeks during the predicted lead exposure period. Therefore, it was unclear if the decreased lead mortality was due to the exclusion of swans

from Judson Lake, reduced use of the nearby agricultural area, or because swans departed the area during adverse weather.

Hazing at Judson Lake was repeated from October 2007 to January 2008. Preliminary results from visual inspections (liver lead tests to confirm cause of death are pending) indicate that swan lead mortality again decreased by >50% compared to the average of the five years previous to the hazing activity. During the winter of 2007–2008, there were no weather events forcing swans to depart the study area. However, as in 2006–2007, population surveys showed that fewer swans foraged in the agricultural area near Judson Lake. Lead shot density assessment of these fields is currently underway.

Lead related swan mortalities in Skagit and Snohomish Counties of Washington State have been included in this study. During years prior to hazing Judson Lake, nearly 78% of the lead mortalities have occurred in Whatcom County/Sumas Prairie. In both 2006–2007 and 2007–2008 there was a southward shift in mortalities with over 50% of the estimated lead mortalities occurring in Skagit and Snohomish counties. It is unclear if these individuals ingested lead pellets in Whatcom County and Sumas Prairie prior to moving south or accessed new source(s) in either Skagit or Snohomish County.

At this time conclusions are preliminary. Because mortalities have declined by 50% during the two years of hazing, we conclude that Judson Lake is a source of lead shot but it clearly is not the only source. Cooperators are continuing to analyze data to clarify the relative contribution of Judson Lake versus other possible sites in northwest Washington State and Sumas Prairie, British Columbia. Following this analysis, cooperators will determine the best course of action to reduce the availability of lead shot to swans during 2008–2009 and subsequent wintering periods. *Received 31 May 2008, accepted 28 July 2008*.

SMITH, M. C., M. A. DAVISON, C. M. SCHEXNIDER, L. WILSON, J. BOHANNON, J. M. GRASSLEY, D. K. KRAEGE, W. S. BOYD, B. D. SMITH, M. JORDAN, AND C. GRUE. 2009. Lead shot poisoning in swans: Sources of pellets within Whatcom County, WA, USA, and Sumas Prairie, BC, Canada. Extended abstract *in* R. T. Watson, M. Fuller, M. Pokras, and W. G. Hunt (Eds.). Ingestion of Lead from Spent Ammunition: Implications for Wildlife and Humans. The Peregrine Fund, Boise, Idaho, USA. DOI 10.4080/ilsa.2009.0201

Key words: Lead poisoning, lead shot, lead shot sampling, swan, waterfowl, waterfowl hazing.

ACKNOWLEDGMENTS

We would like to thank all of the following contributors to this project, where their efforts and expertise and/or financial support made a project of this magnitude and duration possible: British Columbia Ministry of Agriculture and Lands Animal Health Centre (Victoria Bowes and all other reception and post-mortem room staff), British Columbia Ministry of Environment (Jack Evans), British Columbia Waterfowl Society, Ducks Unlimited Canada (Dan Buffet), Environment Canada – Canadian Wildlife Service (Garry Grigg, Sandi Lee, Rick McKelvey, Bob Elner, Saul Schneider, Oliver Busby, Gabriella Kardosi, Patti Dods, Jessica Beaubier, Robin Whittington, Judy Wheeler, Terry Sullivan, Stephen Symes, Tracy Sutherland, Courtney Albert), Monika's Wildlife Shelter (Monika Tolksdorf, Lorne Green, Gloria White), North Cascades Audubon Society (Tom Pratum, Sally Hansberry, Carl Decker, James Duemmel, Sally Hewitt, Anna Marie Bangs, Jeanette Opiela, Michelle Bodtke), Northwest Wildlife Rescue and Rehabilitation (Linda Williamson, Aimee Frazier, Alicia Hartley, Audrey Brocker, Carl Decker, Chris Smith, Cindy Hansen, Darla Arnason, Jerry Farrell, Julie Elsbree, Julie Straight, Kraig Hansen, Krista Unser, Megan Kink, Rachel Strachan, Terry Preston, Wayne Ginter), Pilchuck Valley Wildlife Rehabilitation Center (Sue Murphy, Mike Murphy, Sheena Murphy), Puget Sound Energy (Mel Walters), Sardis Wildlife Centers (Sharon Walters and assistants), The Central Valley Naturalists (Johanna Saaltink, Gerry Powers, Margaret & Richard Bunbury, Jacquie Reznick, Maria Carmen Brackhaus, Annabelle & Walter Rempel, Glenn Ryder, Stan Olson, Henry Savard). The Trumpeter Swan Society (Ruth Shea. Gary Ivey, Paul Fischbach, Mike Schwitters, Connie Schwitters), University of Washington (Loveday Conquest, Dave Manuwal), United States Fish and Wildlife Service (Doug Zimmer, Brad Bortner, Paul Weyland, Bruce Conant), United States Geological Survey (John Takakawa, Alex Westhoff), Veterinarian (Laurel A. Degernes), Volunteers (Lila Emmer, Terry Sisson, Dan Loehr, Sammy Low, Adina Parsley, Andrea Warner, Roy Teo), Washington Cooperative Fish and Wildlife Research Unit (Verna Blackhurst, Morgan Sternberg, Rob Fisk, Megan Horne-Brine, Paul Debruyn, Amanda Winans, Tristen Frum, Don Kruse, Canon Leurkins), Washington Department of Fish and Wildlife (Lora Leschner, Ruth Milner, Doug Huddle, Maynard Axelson, Ron Friesz, Brad Otto, Russ Canniff, Briggs Hall, John Pierce, John Jacobsen, Shelly Snyder, Russ Wright, Tom Cyra, Jed Varney, Ed Argenio, Troy McCormick, Carrie Herziger, Paul Moorehead, Joel Cappello, Don Hubner, Lee Kantar, Kendall Fish Hatchery), Washington Waterfowl Association (Rodney Vandersypen, Ken Miller, Mike Vanderhey, Jill Vanderhey, Stephen Vanderhey), and Wolf Hollow Wildlife Rehabilitation Center. We also express a special thank you to the many landowners who allowed us access to their lands

LITERATURE CITED

- BELLROSE, F. 1975. Impact of ingested lead pellets on waterfowl. Pages 163–167 *in* Proceedings of the First International Waterfowl Symposium (MO). Ducks Unlimited, St. Louis, Missouri, USA.
- BLUS, L. J., R. K. STROUD, B. REISWIG, AND T. MCENEANEY. 1989. Lead poisoning and other mortality factors in Trumpeter Swans. Environmental Toxicology and Chemistry 8:263– 271.
- PAIN, D. J. 1990. Lead shot ingestion by waterbirds in the Camargue, France: An investigation of levels and interspecific differences. Environmental Pollution 66:273–285.
- SCHILLINGER, J. E., AND C. C. COTTOM. 1937. The importance of lead poisoning in waterfowl. Transcripts of the North American Wildlife Conference 2:398–403.
- WDFW (WASHINGTON DEPARTMENT OF FISH AND WILDLIFE). 2001. Report to the Washington Fish and Wildlife Commission: The use of nontoxic shot for hunting in Washington. Washington Department of Fish and Wildlife Non-toxic Shot Working Group, Olympia, Washington, USA.
- WILSON, L. K., J. E. ELLIOT, K. M. LANGELIER, A. M. SCHEUHAMMER, AND V. BOWES. 1998. Lead poisoning of Trumpeter Swans, *Cygnus buccinator*, in British Columbia, 1976–1994. Canadian Field-Naturalist 112:204–211.