STATE OF THE SCIENCE ON WILDLIFE DISEASE AND LEAD HUNTING AMMUNITION: A BRIEF OVERVIEW

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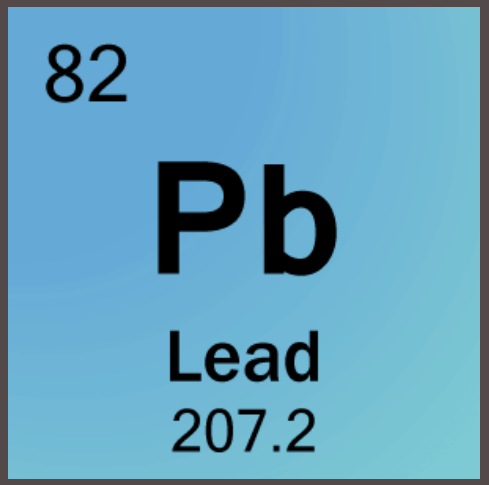

ASSOCIATION of FISH & WILDLIFE AGENCIES

AFWA LEAD AND FISH AND WILDLIFE HEALTH WORKING GROUP

- Sponsored by AFWA Fish and Wildlife Health Committee
- Chaired by state Director (formerly Greg Sheehan, UT)
- "Big Tent" – all perspectives welcome
- Information sharing and discussion
- Wide diversity of perspectives/interests present:
  - State Agencies
  - Federal Agencies
  - Scientists/Researchers
  - Industry
  - Sportsmen's Groups
  - Environmental Groups
  - Animal Welfare/Animal Rights Groups

AFWA'S LEAD SCIENCE REVIEW

- Commissioned by Director Greg Sheehan and the AFWA Lead and Fish and Wildlife Health Working Group in 2014
- Large body of scientific literature on lead and the effects of lead on individual wildlife species
- Concerns expressed by some working group members about the quality of some of the science and the possible biases of some of the scientists
- Also an interest in moving beyond accounts of individual poisoning events to understanding population-level effects

Source: USFWS

Purpose: To identify high-quality peer-reviewed scientific research regarding lead and its effects on fish and wildlife populations

SCIENCE REVIEW PROCESS

- Invited working group members to submit examples of high-quality scientific studies
- Sent invitations to AFWA Fish and Wildlife Health Committee, state agency directors, and AFWA members requesting examples of high-quality scientific studies
- Engaged The Wildlife Society, American Fisheries Society, and USGS (Coop Units, National Wildlife Health Center)
- Solicitation of examples of scientific studies
  - Peer review and critique of draft lists

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THE WILDLIFE SOCIETY

AFS

USGS science for a changing world

SCIENCE REVIEW RESULTS

- Compiled short list of high-quality scientific research studies
  - Major review documents (e.g. TWS/AFS review) as well as major review/synthesis papers
  - Frequently cited studies
  - Studies published in major scientific journals
  - Diversity of taxa
  - Studies that link to more comprehensive databases
- List now posted on AFWA website
  - Google “AFWA Lead Working Group” and click on “Perspectives” item
- Dealing with controversies
  - Lead isotope controversy
  - Present widely-cited studies with differing perspectives

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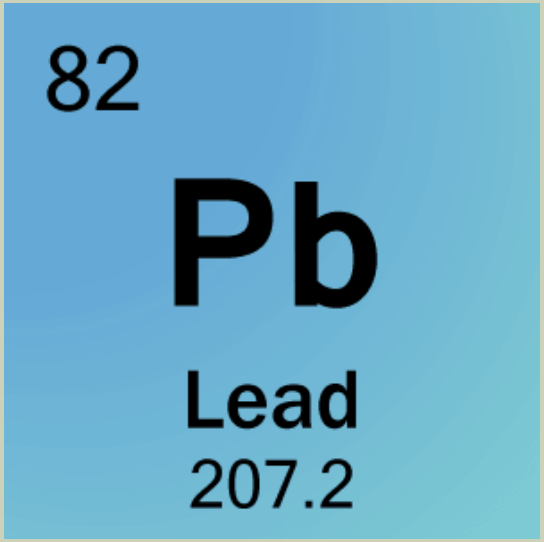
BASIC INFORMATION ABOUT LEAD

- Heavy metal, denser than most other common materials
- Highest atomic number of any stable element
- Ductile, malleable, low melting point
- Highly resistant to corrosion – relative inertness to oxidation
- Relatively abundant, easily mined – low cost
- Commonly associated with silver
- Worked by humans since ~3,000 BCE
- Toxic to humans, vertebrate animals
- Documented instances of lead poisoning
  in humans dating back at least to Roman times



HUMAN USES OF LEAD

- Cosmetics
- Weights
- Fishing Gear
- Ammunition
- Glazes, glasses, enamels
- Currency
- Plumbing
- Roofing
- Waterproofing
- Lining coffins
- Paint
- Printing
- Soundproofing
- Batteries
- Gasoline additive

And many more!

Queen Elizabeth I

Ancient Roman Lead Pipes, Chester

Ancient Greek lead sling bullets with a winged thunderbolt molded on one side and the inscription "ΔΕΞΑΙ" ("take that" or "catch") on the other side (*Source: Wikipedia*)

LEAD AND HUMAN HEALTH

"Water conducted through earthen pipes is more wholesome than that through lead; indeed that conveyed in lead must be injurious…" *Vitruvius (Roman), 1st Century BCE*

No confirmed biological role

- Lead salts efficiently absorbed by body
- Enters bloodstream and interferes with enzymes, minerals (Ca, Fe, Zn)
- Affects most organs in body
- Mimics Ca and can cross blood-brain barrier
- Degrades myelin sheath of neurons, decreases number of neurons, interferes with neurotransmitters, decreases neuronal growth

Lead poisoning symptoms/ effects in humans include:

- Nephropathy/Kidney Damage
- Muscle/joint weakness
- Blood pressure increases
- Anemia
- Reduced fertility in males
- In children, lead interferes with:
  - Synapse formation in the cerebral cortex
  - Neurochemical development
  - Organization of ion channels

LEAD AND WILDLIFE HEALTH

- Elemental lead not as easily released into environment as lead salts
- Environmental lead contamination can lead to wildlife mortality *(e.g. pigeons, peregrine falcon example)*
- Main route for wildlife poisoning is through ingestion:
  - Waterfowl ingestion of spent lead pellets
  - Loon ingestion of lead fishing tackle
  - Dove, upland game bird ingestion of spent lead pellets
  - Scavengers (condors, vultures, eagles) ingesting lead from spent hunting ammunition in carcasses

Source: USFWS

LEAD POISONING IN BIRDS

Physiological Effects

- Nervous system damage
- Wasting of internal organs
- Loss of fat
- Muscle wasting, esp. flight muscles
- Swelling/edema
- Lesions, esp. to breast

Field Signs

- Reluctance/inability to fly
- Erratic flight, poor landings
- Unsteady gait
- Emaciation
- Crooked/bent neck
- Change in calls
- Changes in wing posture

POPULATION-LEVEL EFFECTS

- "Gold standard" for possible action by state, federal fish and wildlife agencies, *e.g. current AFWA position statement on lead and fish and wildlife health*
- State, federal agencies generally focus on managing wildlife species at population level, not individual animal level
- Significant burden of proof to conclusively demonstrate population-level effects from lead poisoning
  - Must monitor presence of lead in adequate sample of animals
  - Must have good understanding of population dynamics in that species, including short- and long-term population trends
  - Must be able to attribute mortality within the population to various causes and sources with a reasonable degree of accuracy
- Defining what is meant by a "population-level effect" is not always straightforward…

WATERFOWL

- Lead poisoning observed as early as 1874 in waterfowl
- Many "die-offs" documented in USA prior to 1959 with up to 16,000 birds/incident; primarily mallards and pintails
- Attribution (*Bellrose 1959*):
  - Necropsies and x-rays of dead birds
  - Study of hunter-harvested gizzards
  - Experimental lead poisoning of captive birds

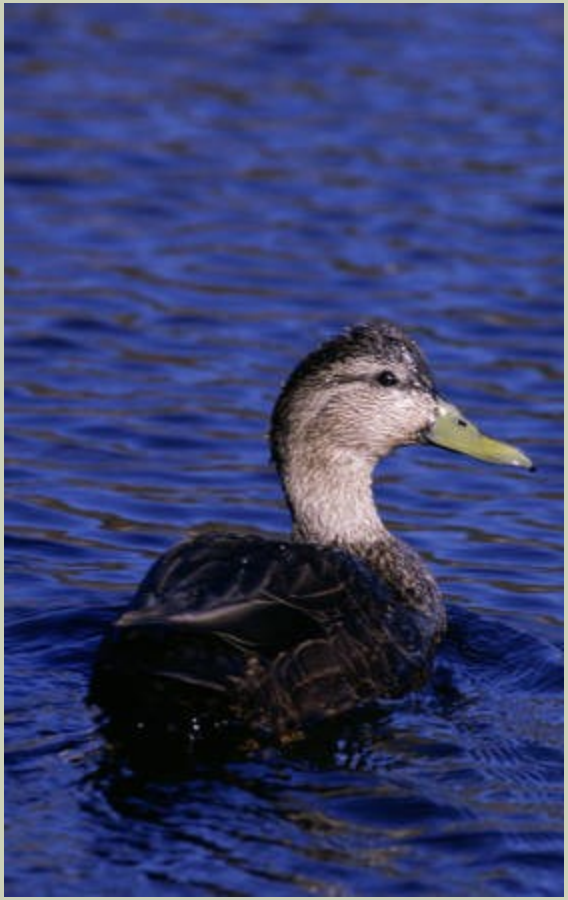
- ***> 25% of some populations sampled had ingested lead***
- Estimation of population effects on mallards (Bellrose 1959):
  - Percentage of hunter-harvested gizzards containing a specific number of shot pellets (1-6 pellets and greater than 6)
  - Correction for hunting bias using band recovery data (since birds with acute lead poisoning are easier to find, kill)
  - Correction for gizzard contents turnover (due to 20-day retention period of pellets in gizzards vs. 120-day hunting season)
  - Total annual mortality population-wide from lead, all flyways: **3.98 %**

AFWA'S LEADERSHIP ON LEAD

- As early as 1970, AFWA called for complete phase-out of toxic shot for migratory bird hunting by 1973
- *Much debate 1970-1986…*
- AFWA approved a position statement in March 1986 that called for a mandatory but gradual phase-in of nontoxic shot nationwide by 1991, starting with the counties or areas of greatest hunting intensity
- "A workable compromise for those who wanted nontoxic shot immediately and those who wanted it not at all" (*Belanger & Kinnane 2002*)
- Interior Department adopted the AFWA policy as its own in June 1986.

EFFECTS OF NON-LEAD SHOT REGULATIONS

- Significant reductions in percentages of ducks in Mississippi Flyway containing lead shot in gizzard (mallards, ring-necked ducks, scaup, canvasbacks); estimated 1.4 million ducks continent-wide spared from fatal lead poisoning (*Anderson et al. 2000*)
- 44% reduction in lead exposure of black ducks in TN based on direct measurement of blood lead levels; conservative estimate of 50% reduction in lead exposure in waterfowl continent-wide (*Samuel and Bowers 2000*)
- 52% to 90% reductions in mean bone lead concentrations in hatch-year ducklings in Canadian studies (*Stevenson et al. 2005*)



SCAVENGING BIRDS

- Numerous published reports of lead poisoning in scavenging birds, particularly vultures, eagles, and the California Condor
- Overall impact on population dynamics not always easily estimated, due to multiple confounding factors
- AFWA review highlights WY eagle study (*Bedrosian et al. 2012*):
  - Measured lead levels in bald eagles before and after implementation of voluntary hunter outreach program that provided non-lead ammunition to big game hunters
  - Moderate levels of hunter compliance (24.5 to 34% use of non-lead ammunition) for big game hunting applications
  - Immediate and significant decrease observed in blood lead levels in eagles

Source: Aberdeen American News

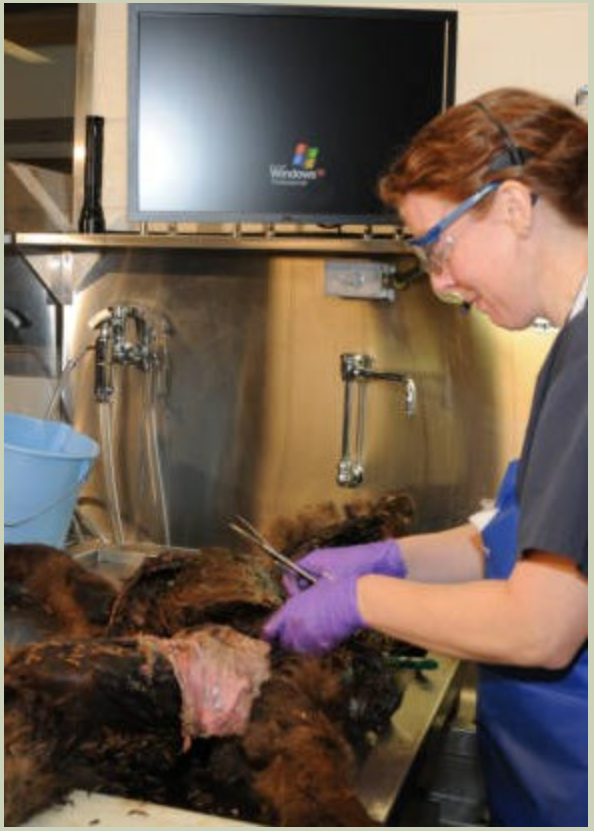
MOURNING DOVES

- Concern about impacts of lead poisoning on mourning doves, upland game birds
- High mortality rates observed in mourning doves ingesting lead shot; virtually all birds ingesting shot die
- 2.5% of birds observed with pellets in system in field studies in 7 states, 1998-2000
- Suggests that there may be effects on mourning dove populations from lead ingestion
- Scale of problem and geographic scope of effects not clear
- Questions ripe for consideration and further research

Source: USFWS

RESEARCH NEEDS

- Better monitoring of lead levels in wild bird populations, particularly species in groups thought to be at greatest risk for lead poisoning (waterfowl, scavenging birds, doves and upland game birds)
- More robust methods for estimating population-level effects of lead poisoning on individual wildlife species
- In states with lead restrictions and voluntary programs, opportunities to examine how/whether lead levels drop within individual wildlife species



Source: USFWS