



**Preserving our wildlife conservation  
and hunting heritage**















# History



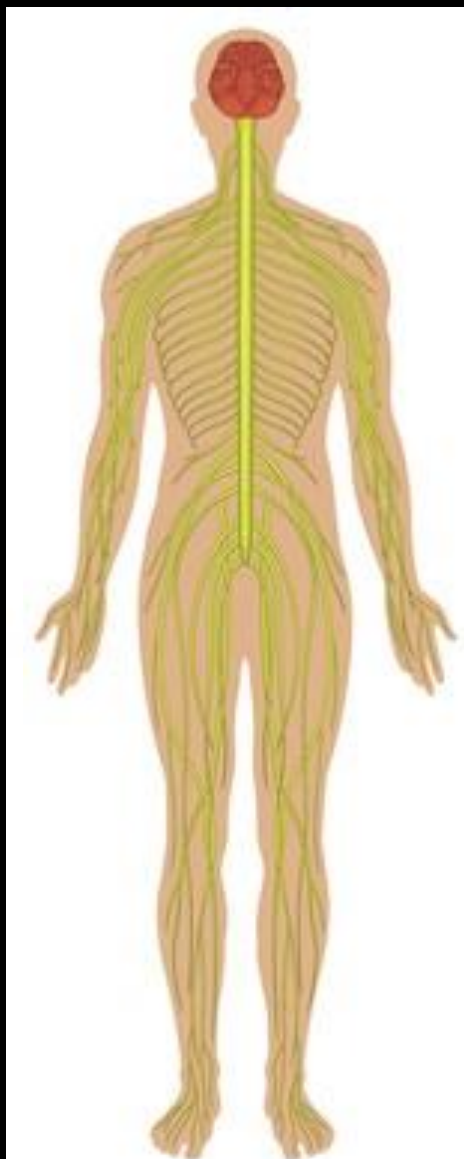




# About Lead

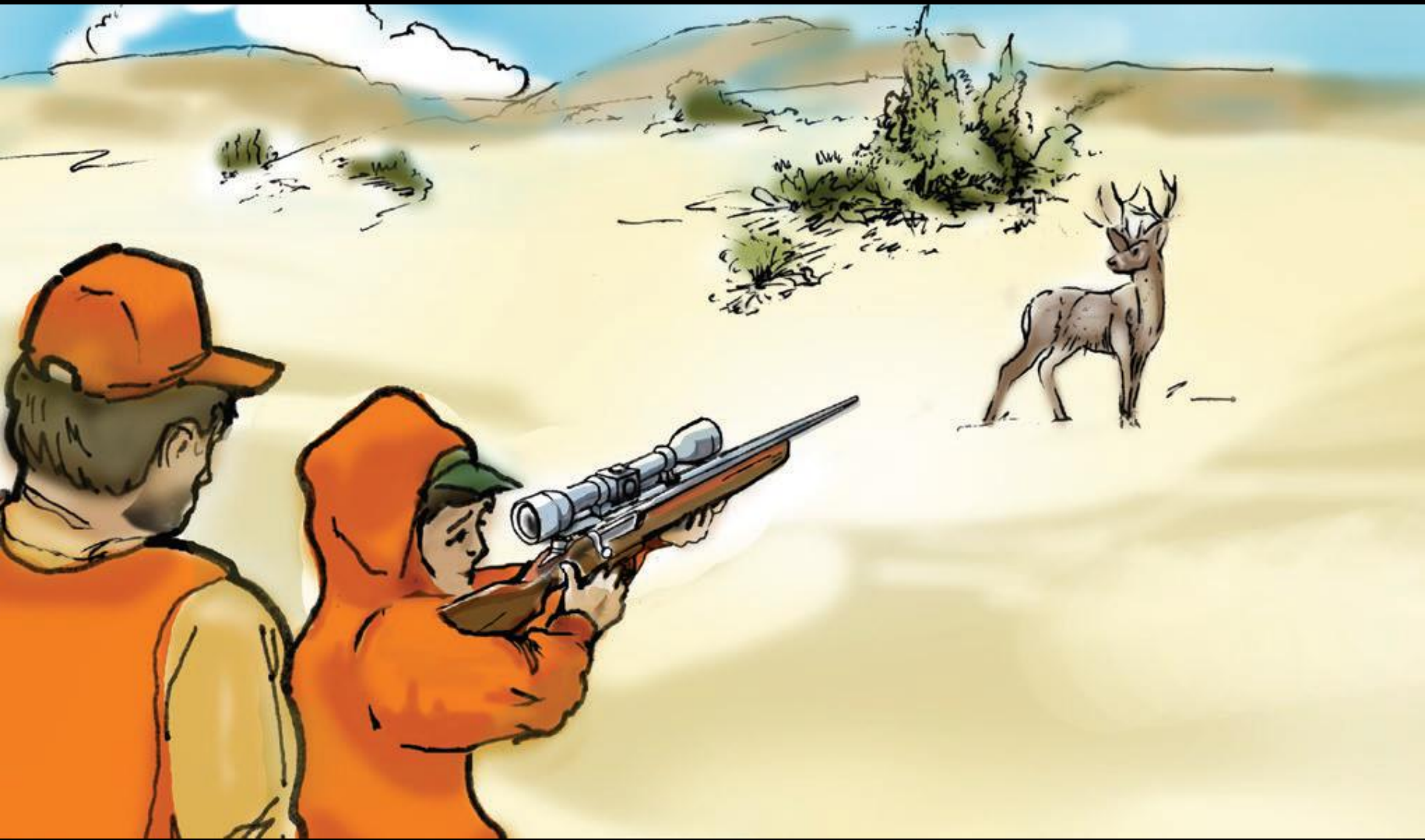
Lead stays  
in the blood  
for 1-3  
weeks

Replaces  
calcium in  
bone and  
remains for  
life



Enters the  
soft tissue  
Liver, disrupts  
the nervous  
system,  
especially in the  
young. there  
Exposure can  
cause decreased  
IQ, behavioral  
issues, long term  
health problems  
and death.











Birchwood Casey

Hornady SST  
12 gauge  
300 gr

Federal Trophy  
Copper  
12 gauge  
300 gr

Shoot-N-C® Target









# Projectile Development







# Terminal Performance

Optimum Performance Velocity:

Minimum: 1800 fps (549 mps)

Maximum: Unlimited

30 Cal 165gr

1800 FPS  
90% WR



2400 FPS  
77% WR



3050 FPS  
60% WR



ACCUBOND

Optimum Performance Velocity:

Minimum: 1800 fps (549 mps) / Maximum: 3200 fps (975 mps)

30 Cal 168gr

1800 FPS  
86% WR



2400 FPS  
74% WR



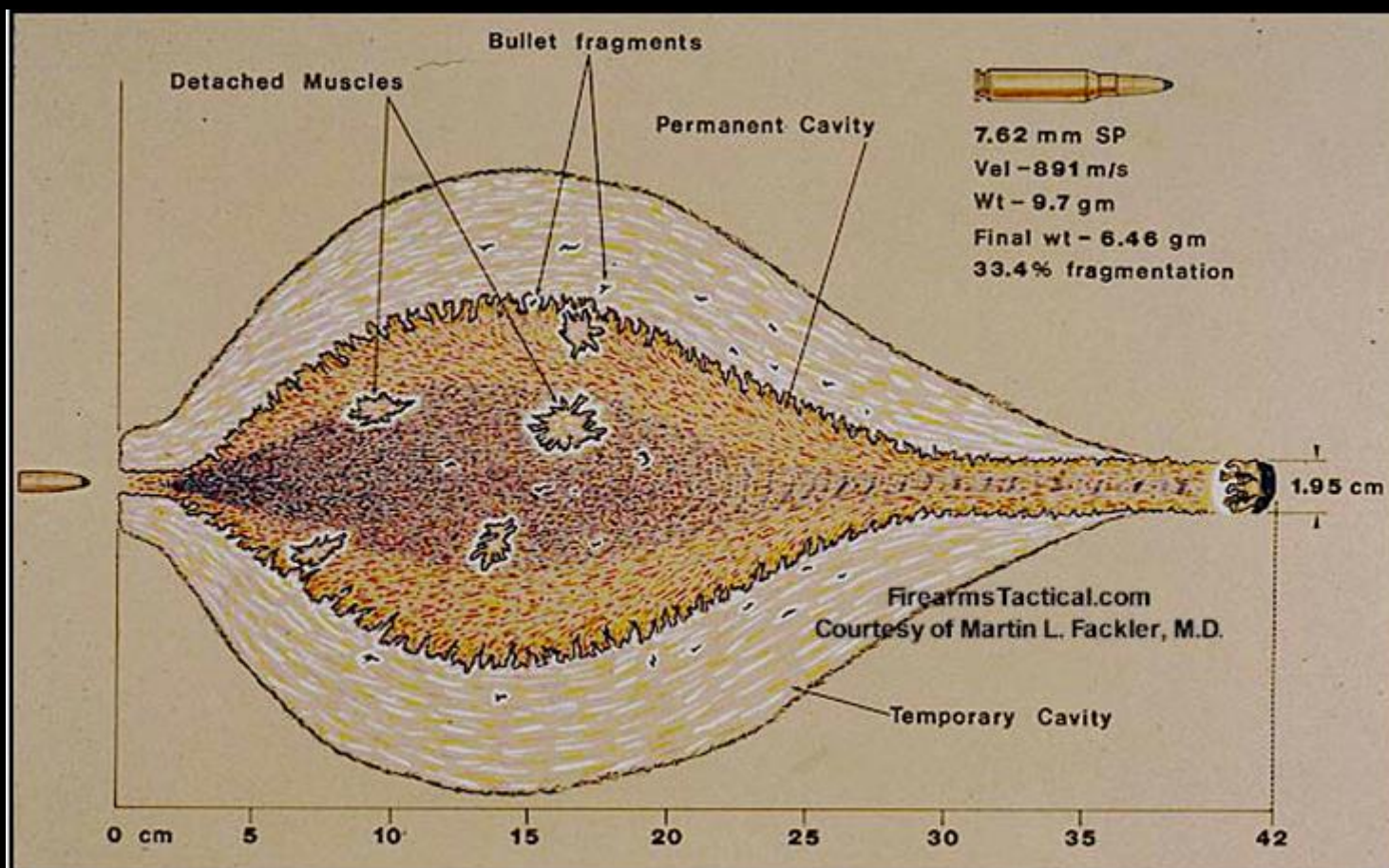
3050 FPS  
60% WR



BALLISTIC TIP



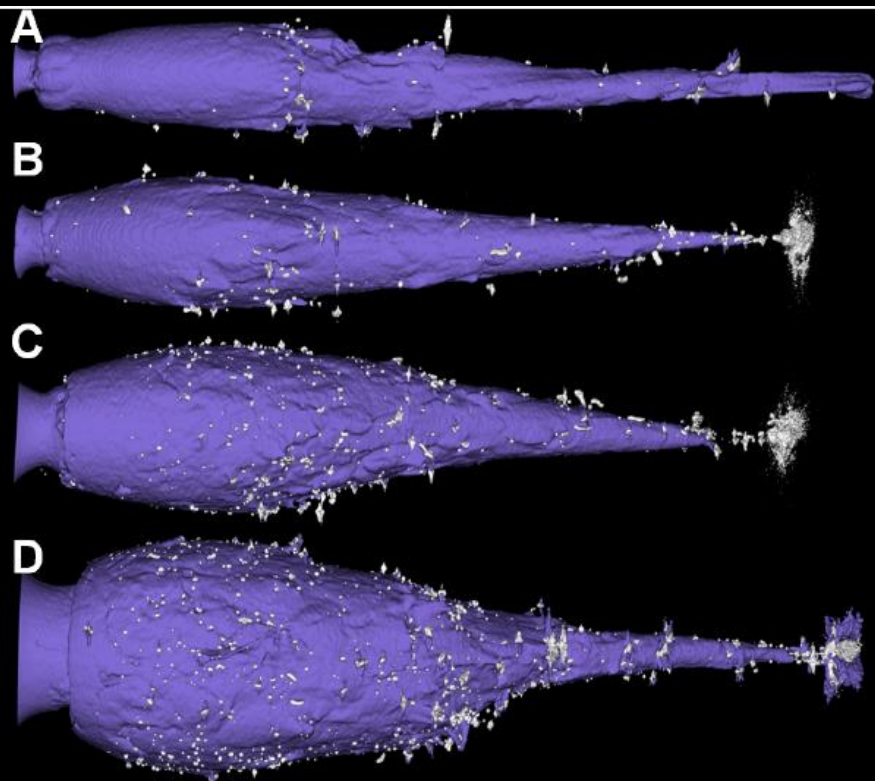
# Terminal Performance



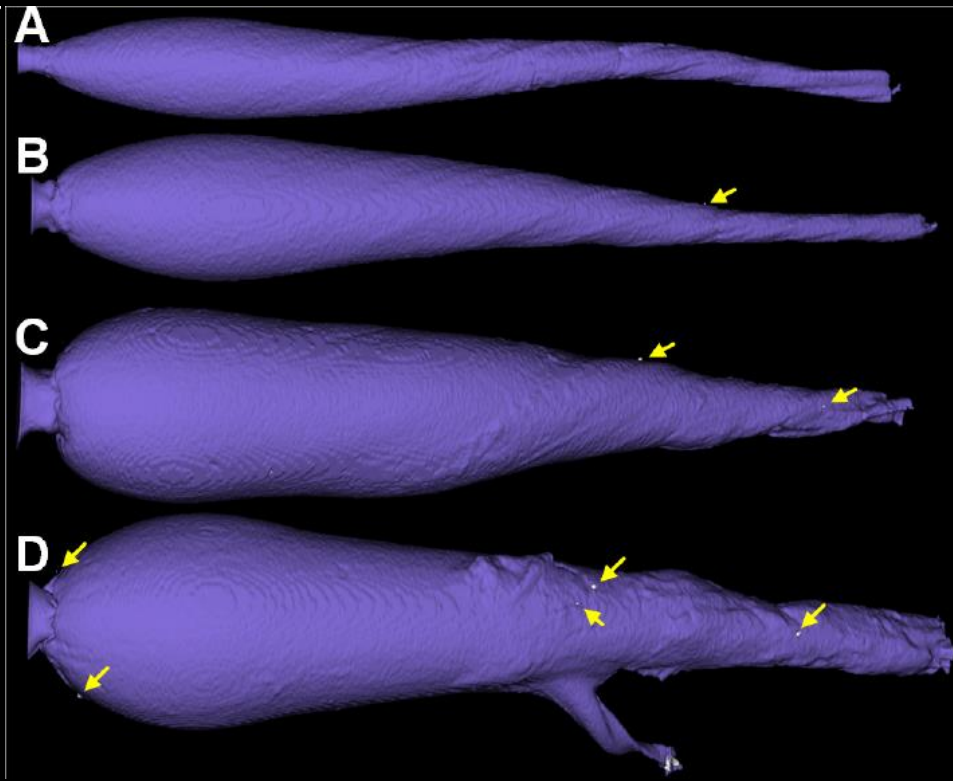




# Terminal Performance



Lead Bullet:  
Norma Vulcan



Non-Lead Bullet:  
Barnes TSX



# Terminal Performance

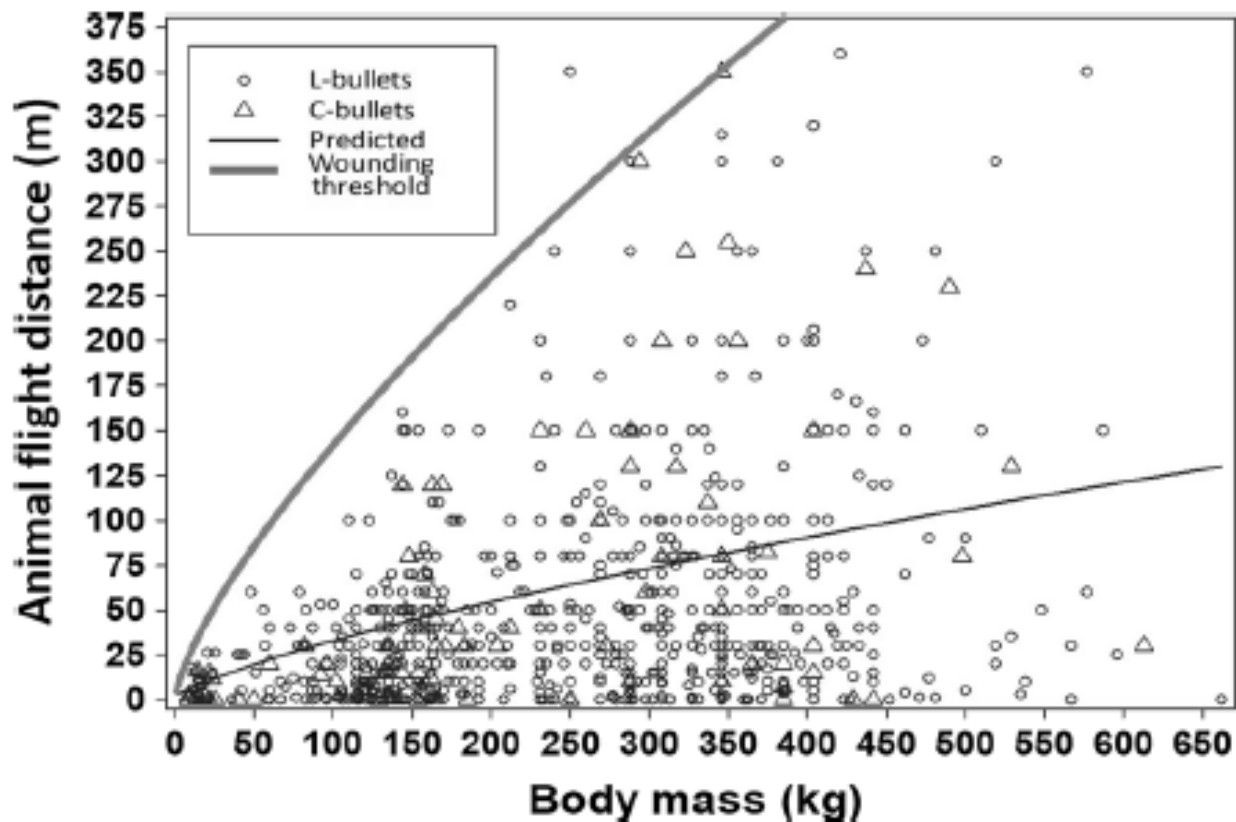


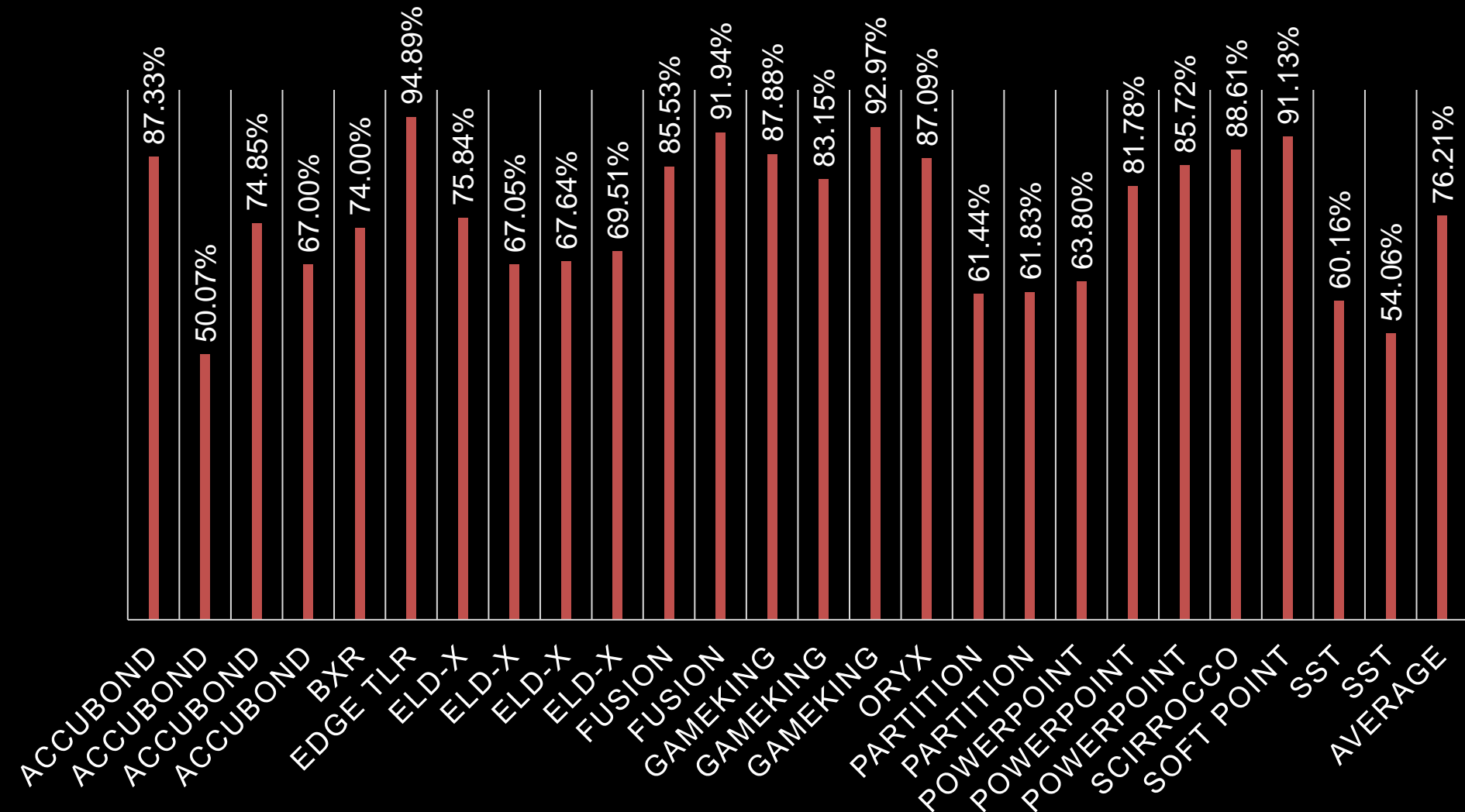
Fig. 5 Distribution of animal flight distances of C- and L-bullets compared to predicted animal flight distances (thin lower line) and wounding threshold (bold upper line) derived from the model (Stokke et al. 2018)





# Terminal Performance

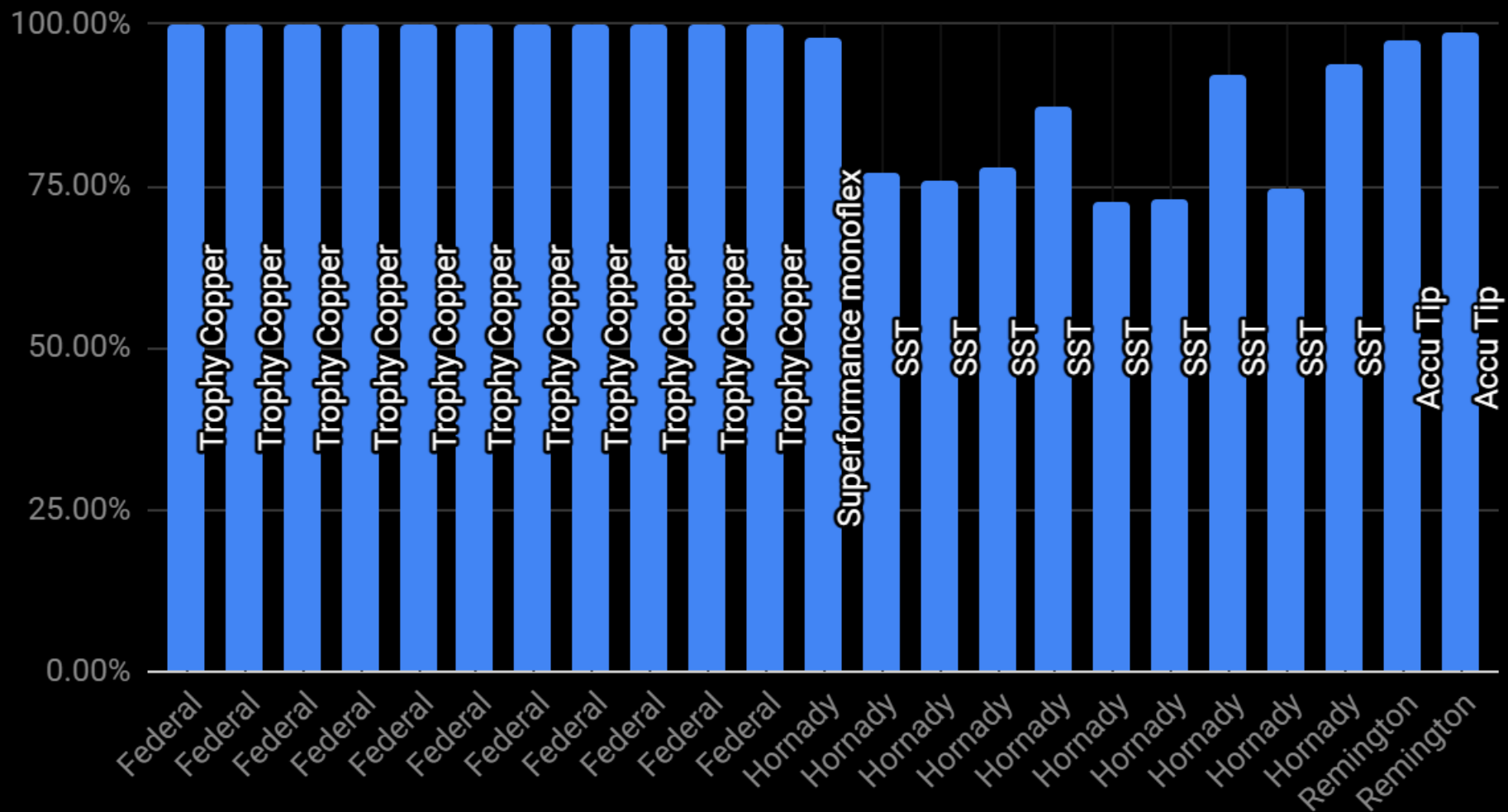
## LEAD-CORE HUNTING BULLET WEIGHT RETENTION





# Terminal Performance

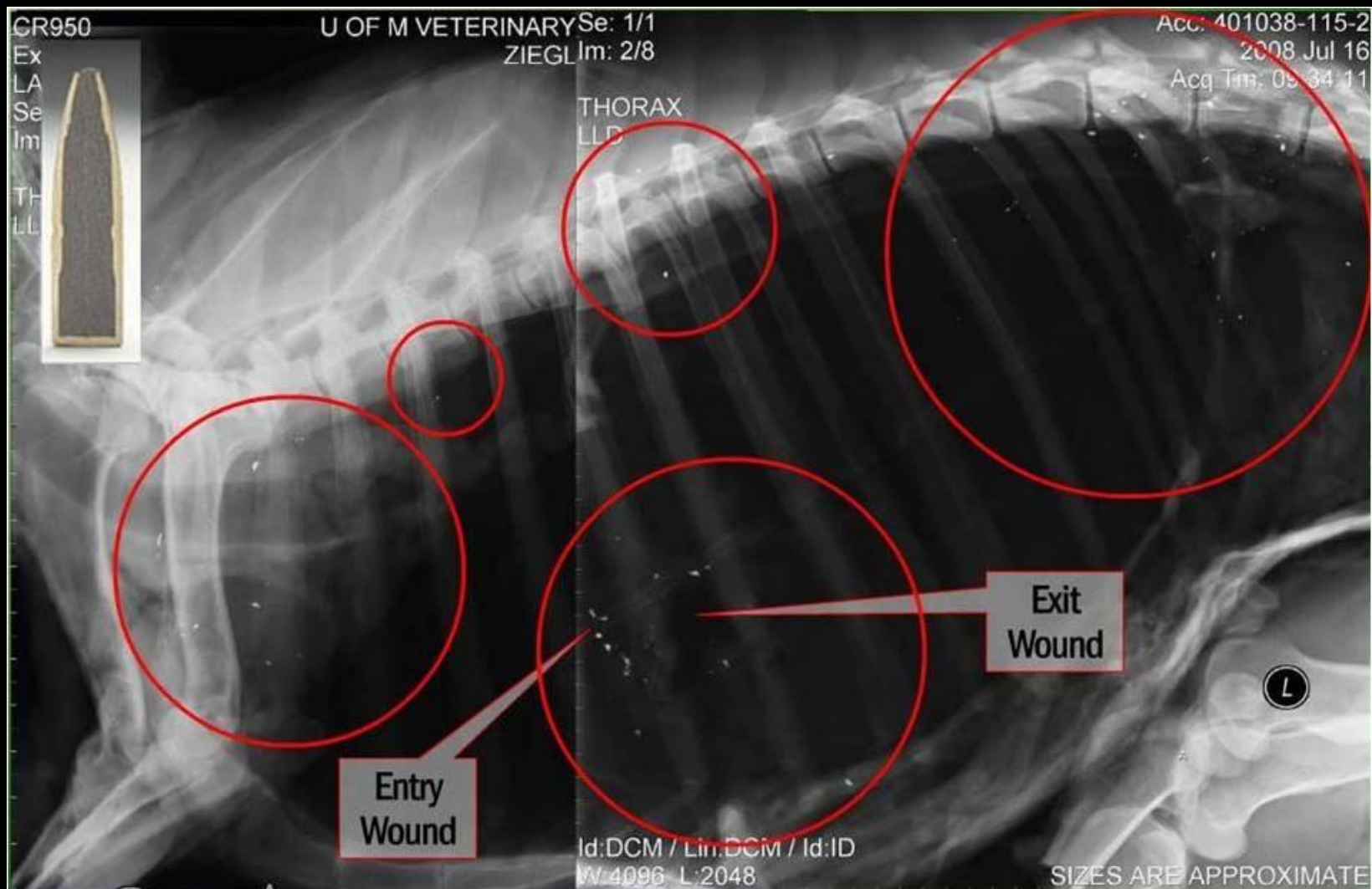
12 gauge slug weight retention







# Terminal Performance



**Table 2.** Average number of fragments counted (SD) within white-tailed deer and domestic sheep in various treatment groups using ventral-dorsal view radiographs. (Bullet types: RE = rapid expansion; CE = controlled expansion; Cu = copper; MZ = muzzle-loader).

Species	Bullet type	<i>N</i>	$\bar{x} \pm \text{SD}$	Minimum	Maximum
Deer	RE1	8	60 ± 84	7	261
Sheep	RE1	9	141 ± 135	74	498
Sheep	RE2	10	86 ± 34	28	138
Sheep	CE1	10	9 ± 7	2	28
Sheep	CE2	10	82 ± 62	21	28
Sheep	Cu	10	2 ± 1	1	4
Sheep	Slug	10	28 ± 41	3	127
Sheep	MZ1	6	3 ± 3	1	9
Sheep	MZ2	6	34 ± 36	6	105





# Terminal Performance



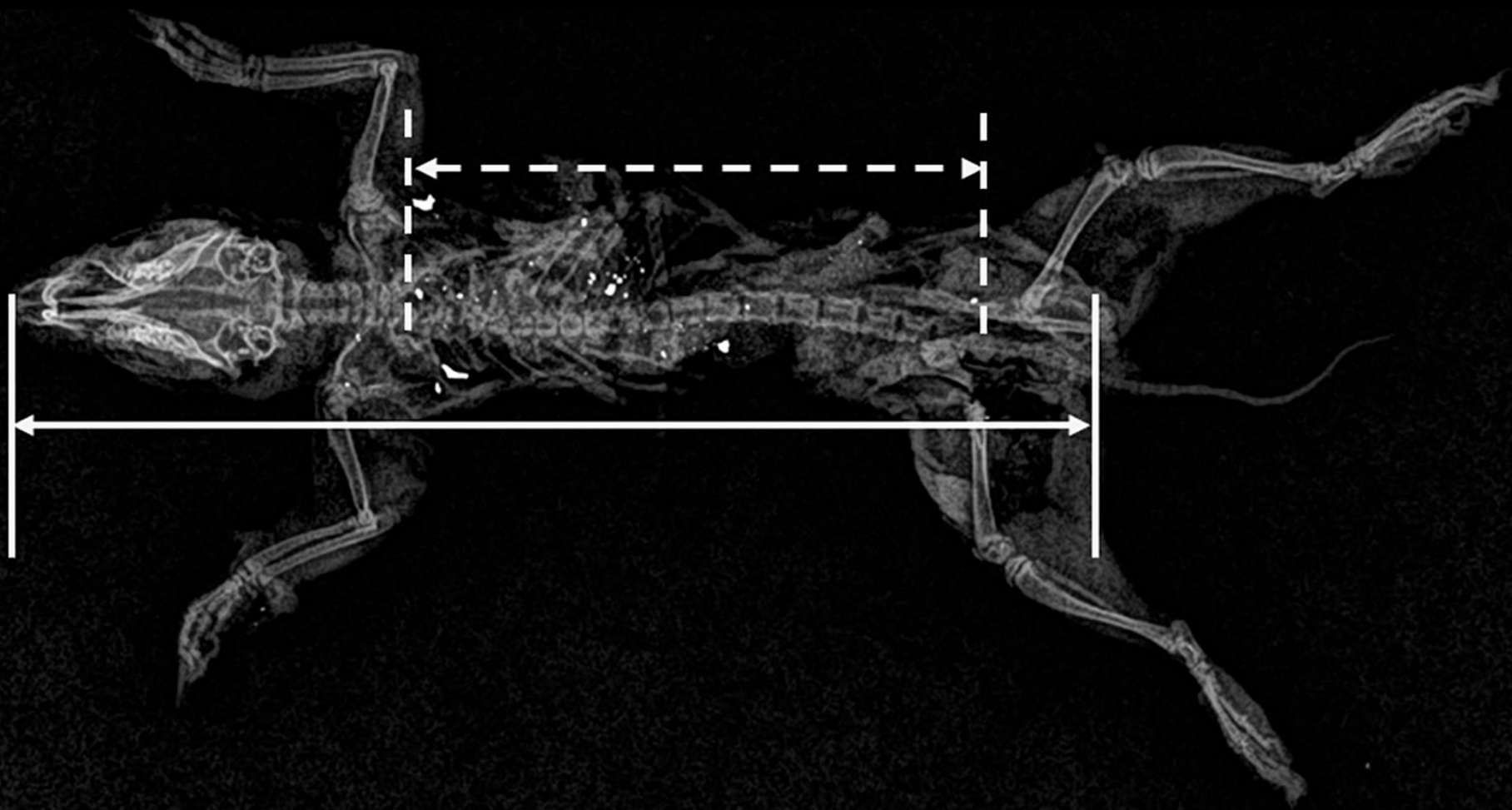
12 ga. 2 3/4"  
HORNADY SST  
300gr. , 262.4 rec. 87.4%  
GEL - 50 yds.  
RACHAEL CARSON NWR  
13 SEP '23



12 ga. 2 3/4"  
FEDERAL  
TROPHY COPPER  
300gr. , 301.1 rec. 100%  
GEL - 50 yds.  
RACHAEL CARSON NWR  
13 SEP '23



# Terminal Performance













# Identifying Exposure

- Live animals
  - Blood Lead Levels
  - Feather Lead
  - Radiographs
- Mortalities
  - Organ Lead Levels
  - Bone Lead Levels
  - Feather Lead





# Pathways of Exposure

**Coyote shot with  
lead ammunition**





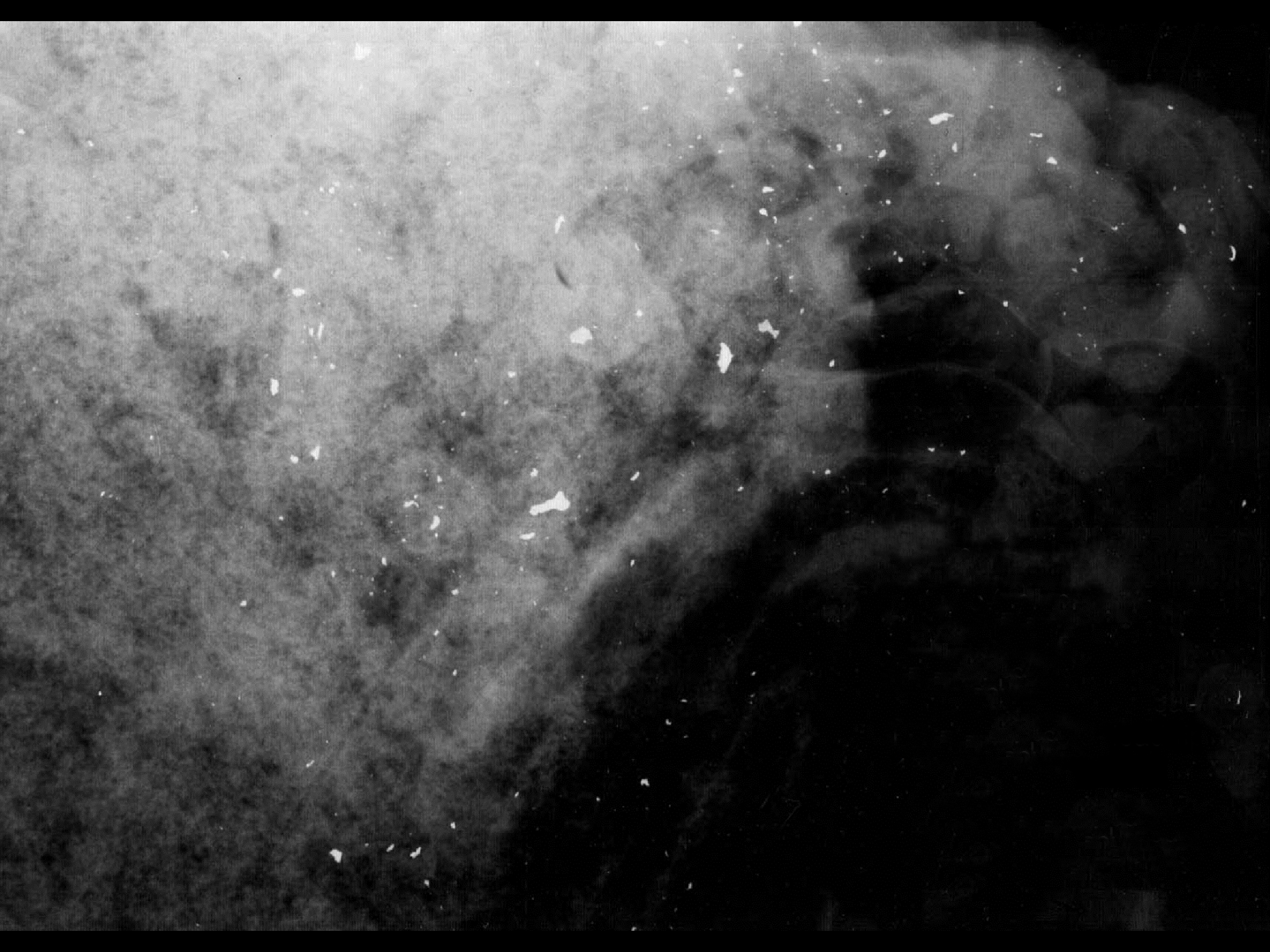


# Pathways of Exposure

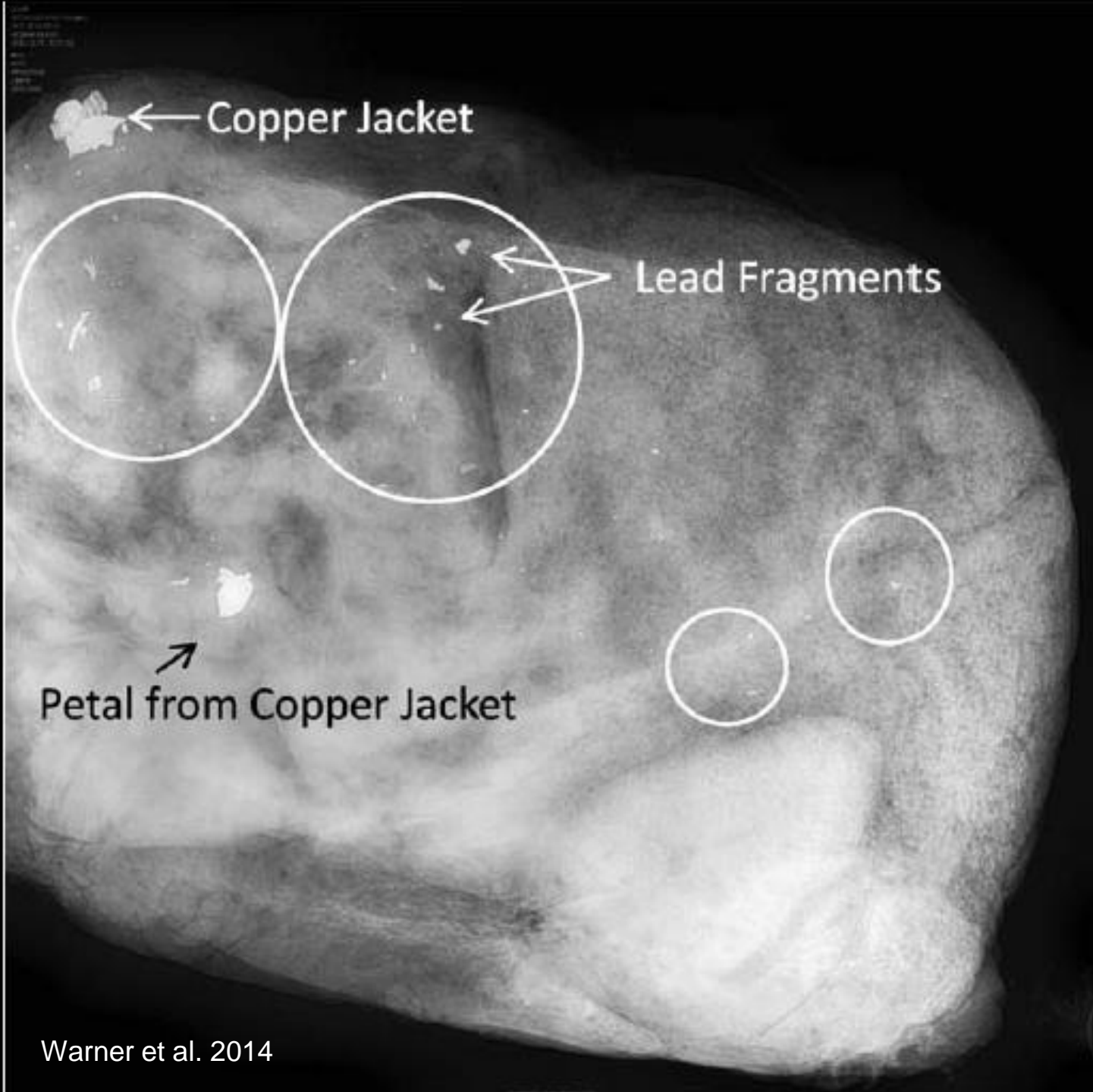
Richardson Ground Squirrel  
Shot with .22 Caliber Rim Fire

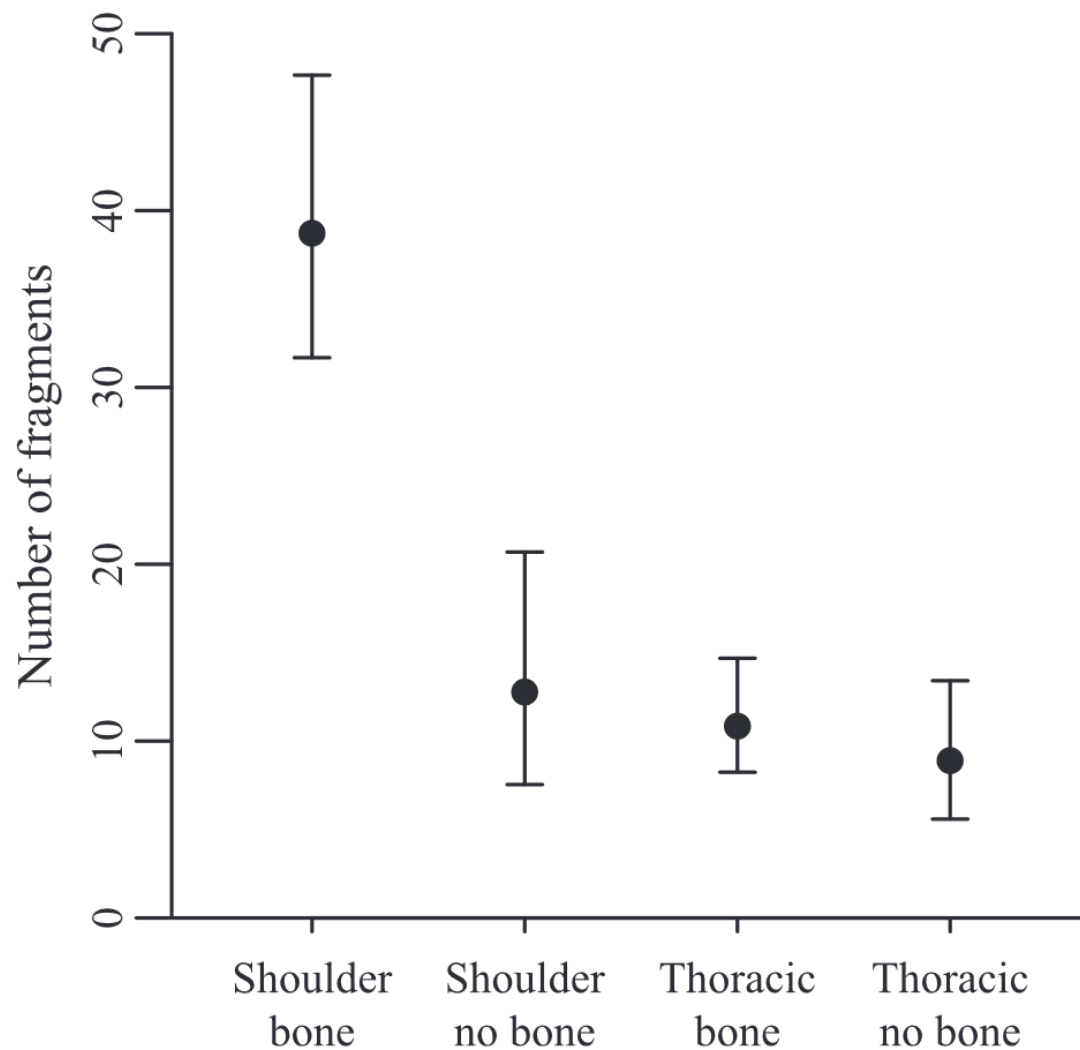
10 mm





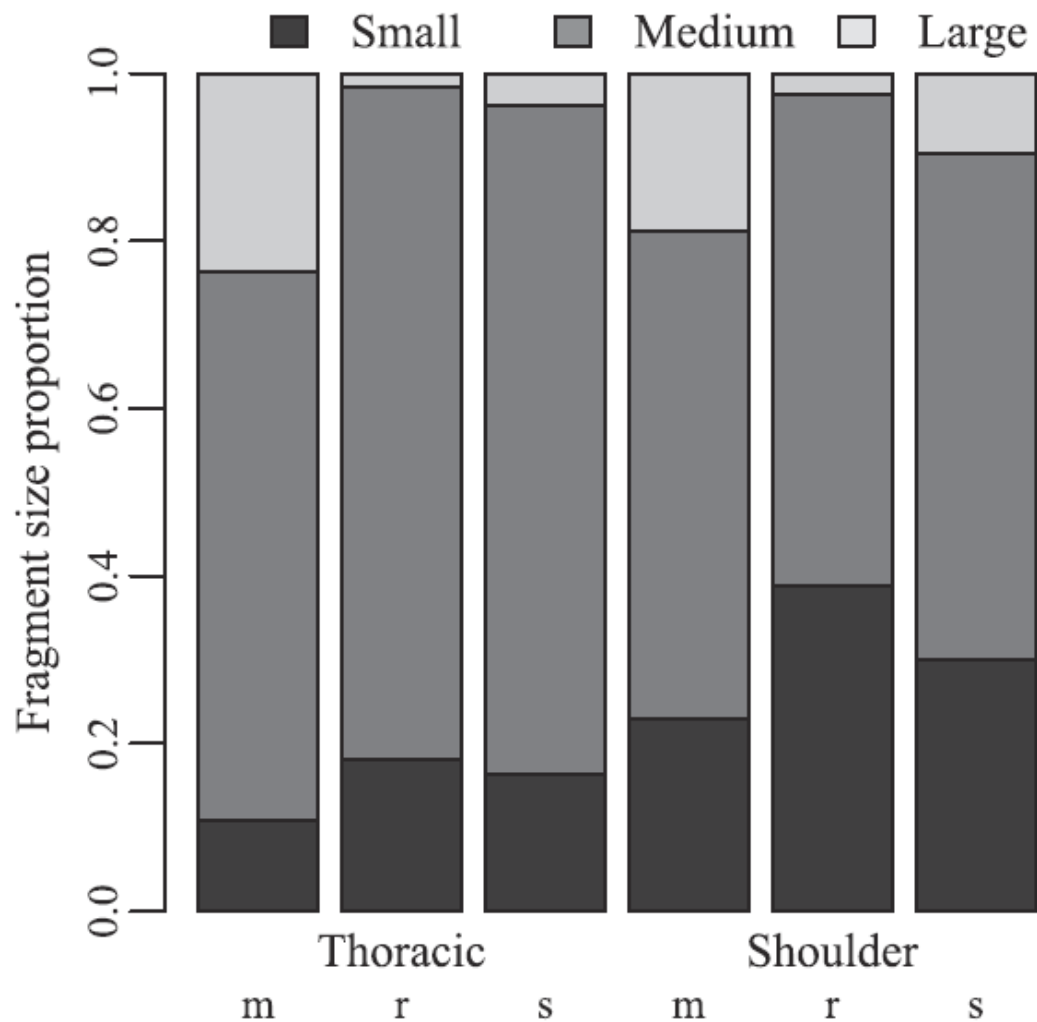






**Figure 1.** Geometric mean number of lead fragments (with bootstrapped 95% CI) in white-tailed deer carcasses shot post-mortem with low-velocity ammunition from May–September 2009, Indiana, USA. Number of fragments were greater when deer were shot in the shoulder compared to the thoracic cavity, and when projectiles struck bone. Data from ammunition treatments were pooled because there was not a significant difference between ammunition types.



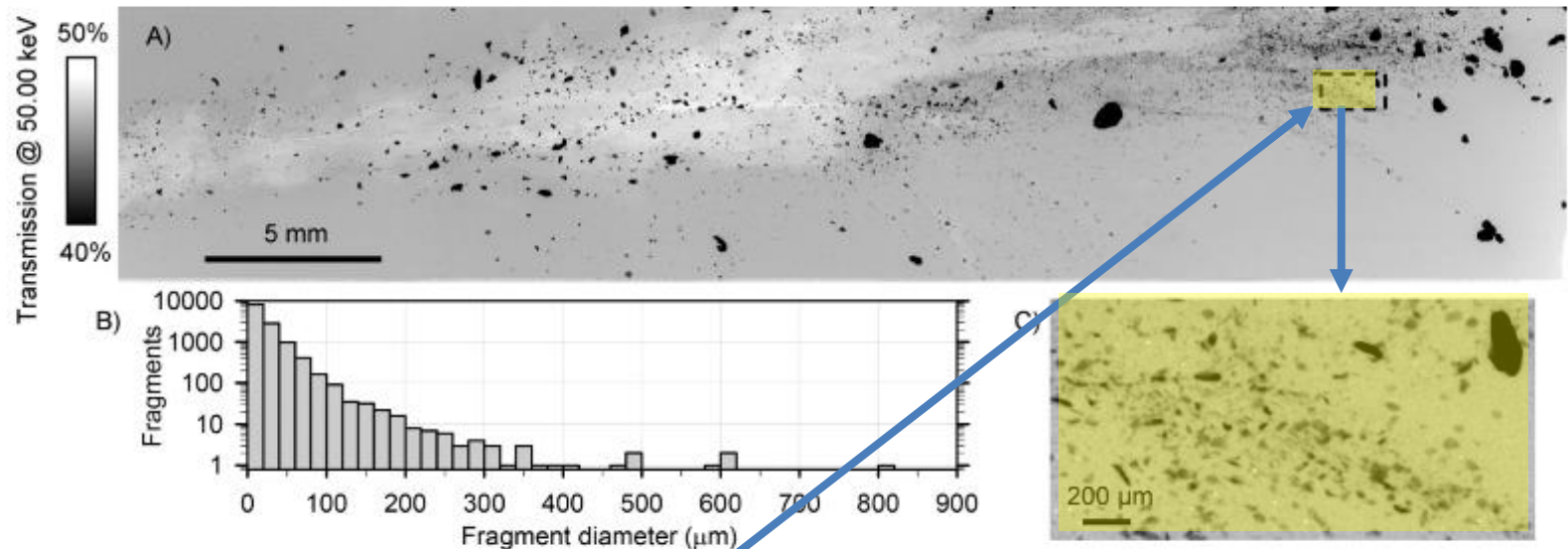


**Figure 2.** The mean proportion of small (<1 mm), medium (1–5 mm), and large (>5 mm) lead fragments present in white-tailed deer carcasses shot post-mortem with 3 types of low-velocity ammunition from May–September 2009, Indiana, USA. Deer shot with muzzleloader rifles (m) had relatively fewer small- and medium-sized lead fragments than those shot with rifled (r) or sabot (s) shotgun slugs. Deer shot in the thoracic cavity had relatively fewer small fragments than those shot in the shoulder.

# What we thought we knew

PLOS ONE

Lighting up the source of a lesser-known lead exposure pathway using synchrotron radiation



**Fig 5.** (A) High resolution X-ray transmission image of a select region of the lead-core bullet with bone sample. (B) Histogram of fragment diameters, derived from (A). (C) Zoomed in region, 2 mm × 1 mm, indicated by the dashed box in (A), revealing thousands of sub-100 μm diameter fragments.

<https://doi.org/10.1371/journal.pone.0271987.g005>

12,000+ fragments

2022 Leontowich et al. *Fragmentation of hunting bullets observed with synchrotron radiation: Lighting up the source of a lesser-known lead exposure pathway.* PLOS ONE





**STEALTH CAM**™

04:27PM 09/21/18 64F



STEALTH CAM





# Wildlife Exposure



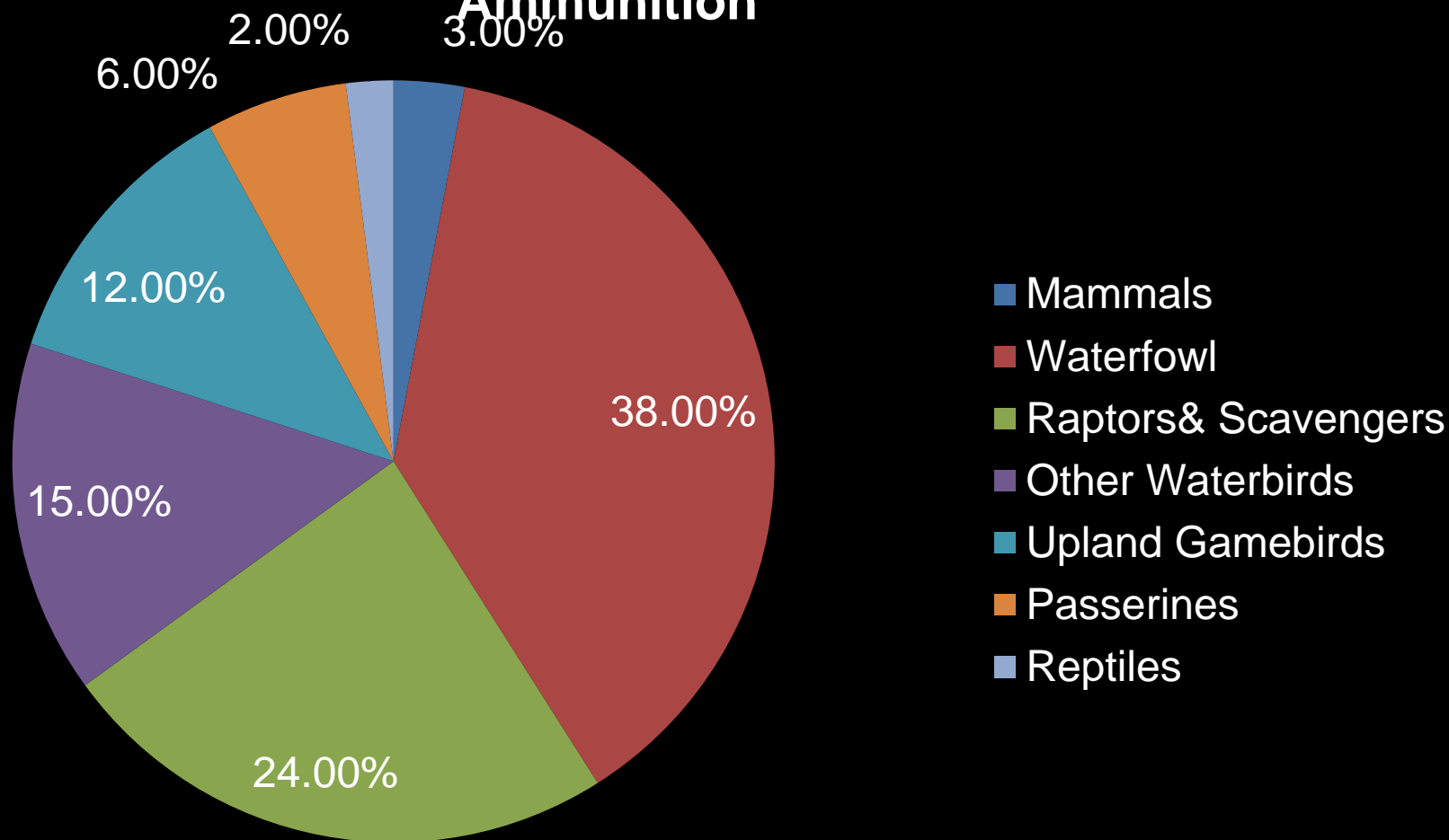
©Soarraptors.org





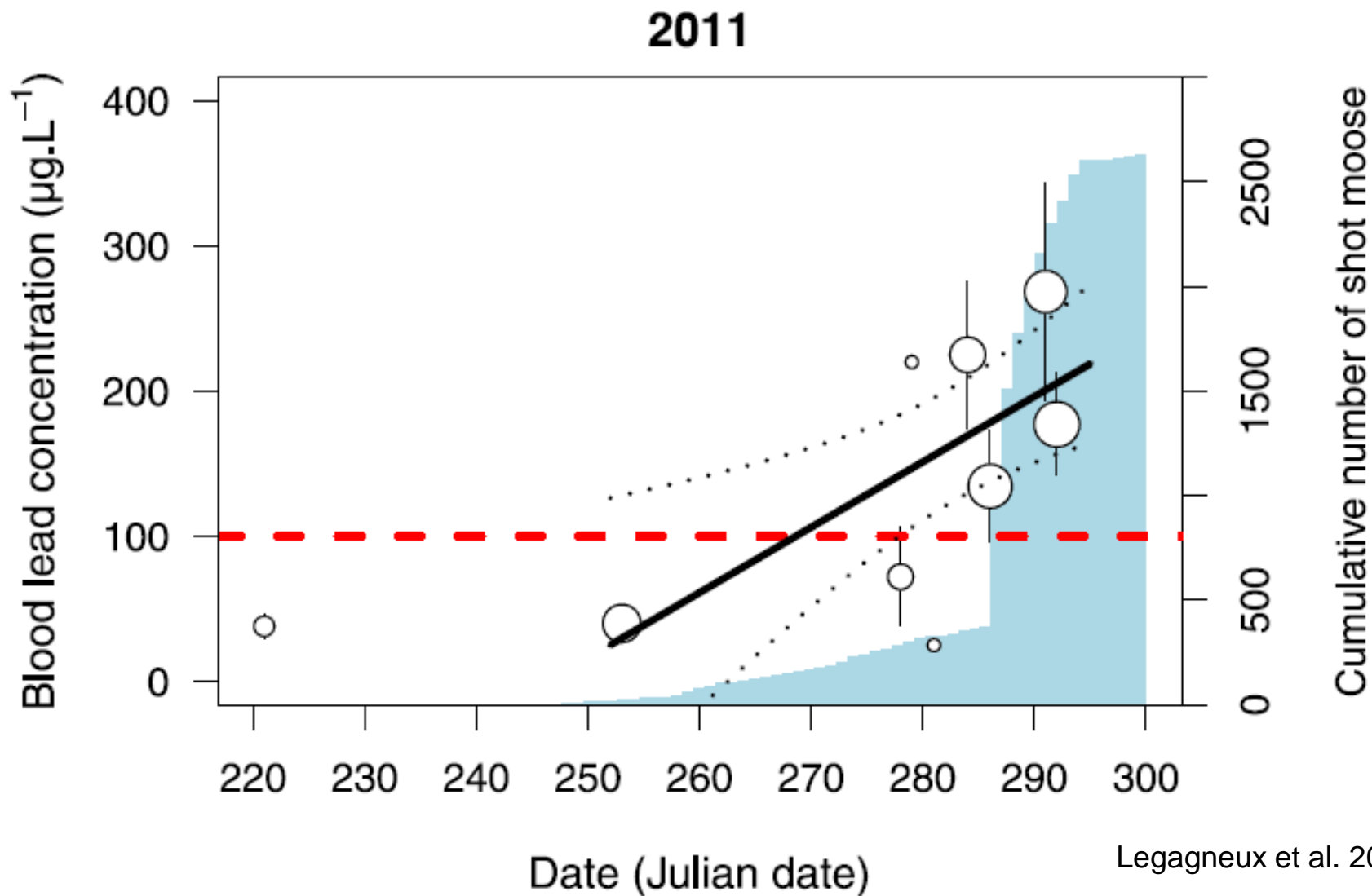
# Wildlife Exposure

Categories of 130 Species affected by Lead Ammunition





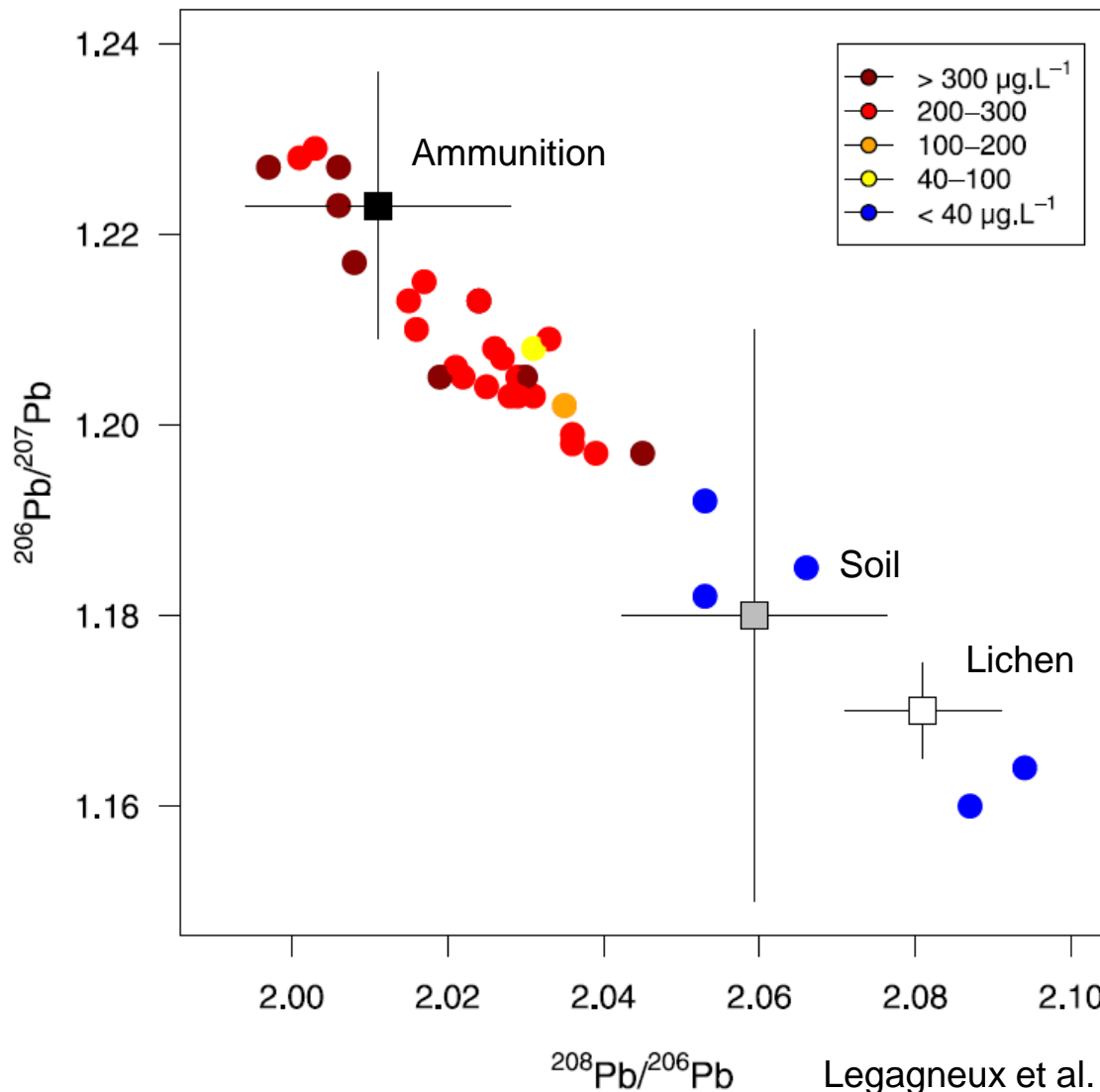
# Raven Lead Exposure



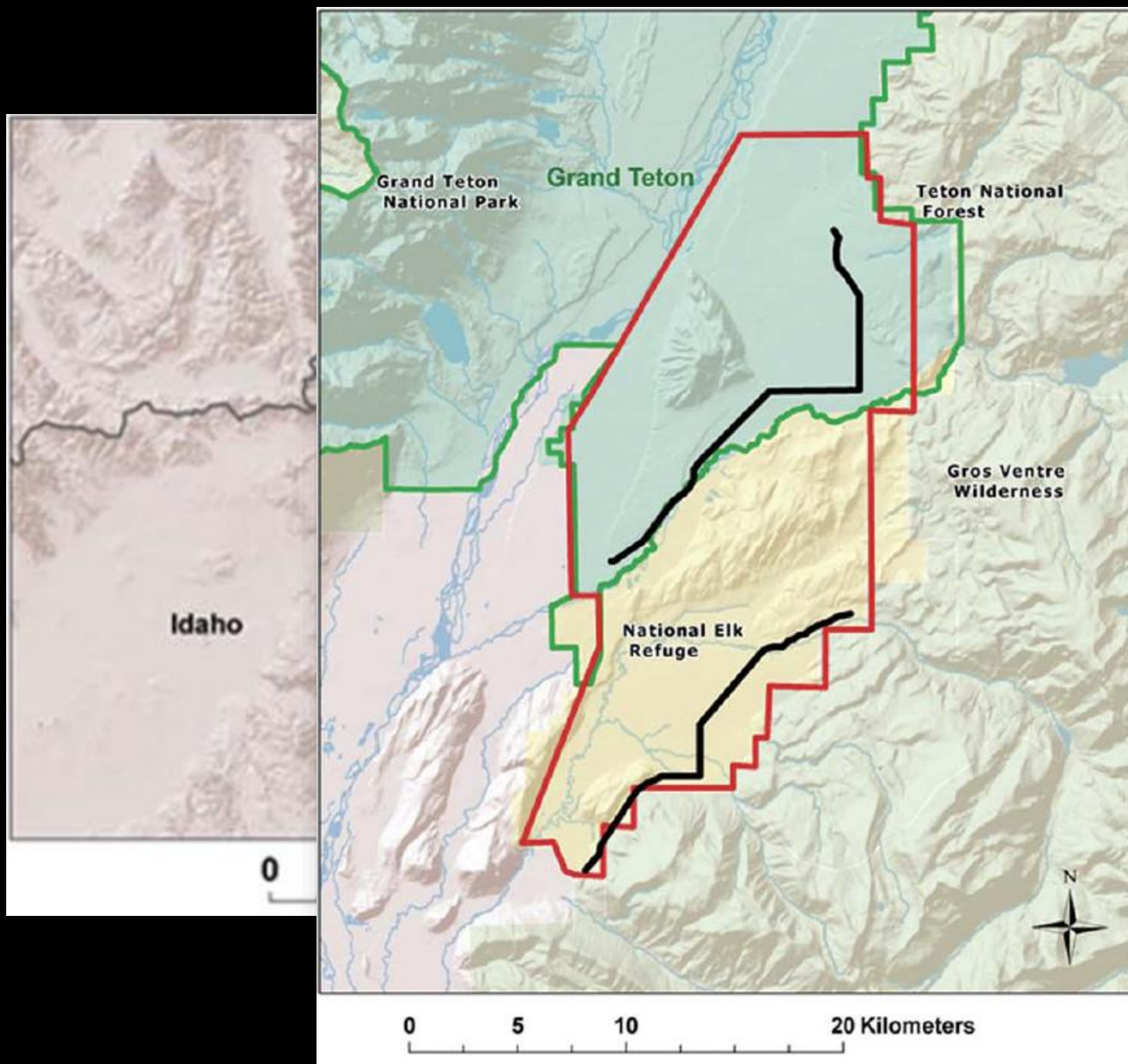




# Raven Lead Exposure



Legagneux et al. 2014





# Bald Eagle Exposure

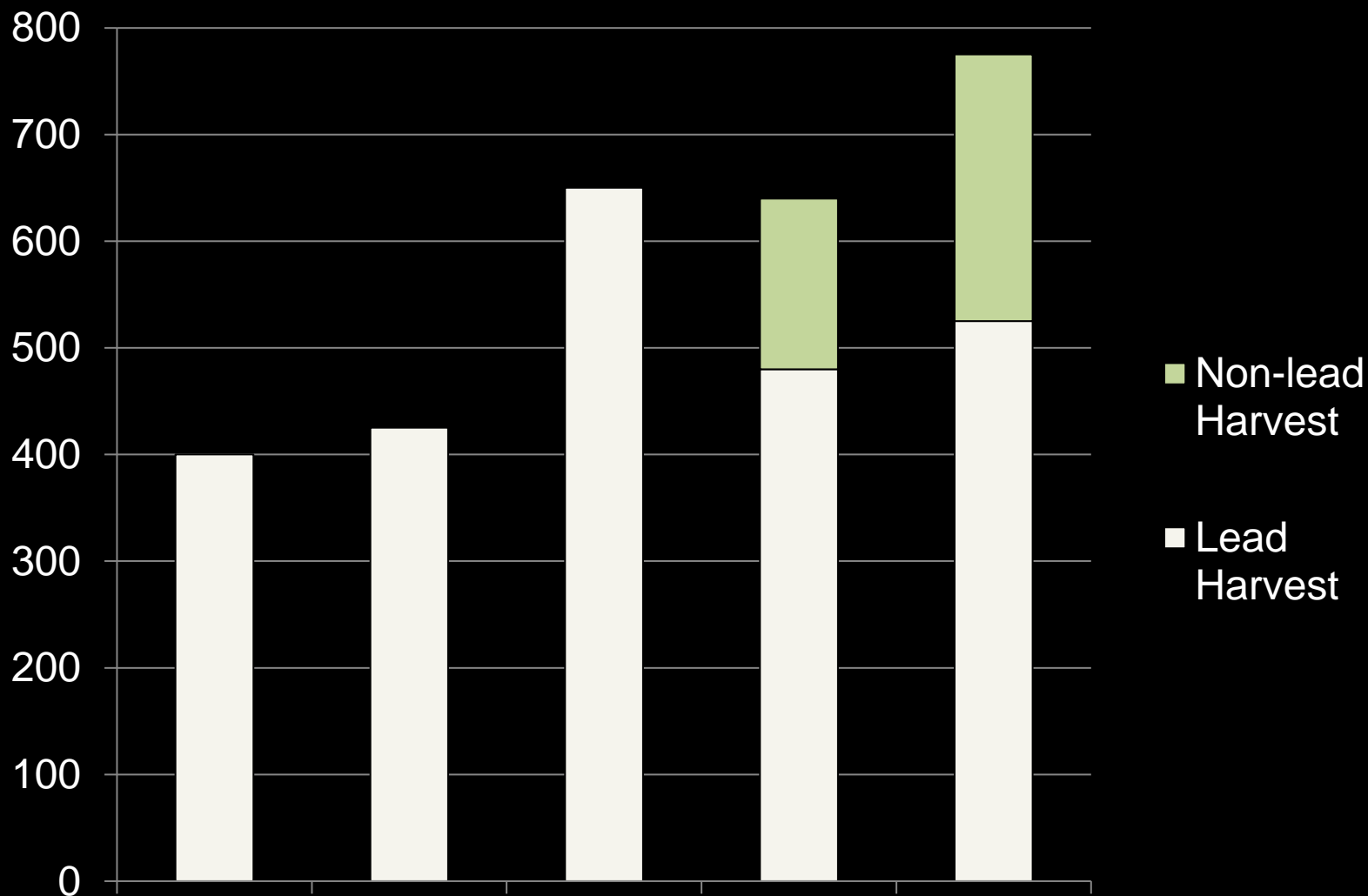
	Background (<10 ug/dL)	Sub-Clinical Exposure (10-59 ug/dL)	Clinical Exposure (60-100 ug/dL)	Acute Exposure (>100 ug/dL)
<b>Nestlings</b>	<b>100 %</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>All non-nestlings</b>	<b>7%</b>	<b>60%</b>	<b>14%</b>	<b>19%</b>
<b><i>Non-hunting season</i></b>	<b>22%</b>	<b>78%</b>	<b>0</b>	<b>0</b>
<b><i>Hunting season</i></b>	<b>2%</b>	<b>55%</b>	<b>18%</b>	<b>25%</b>

Bedrosian et al. 2012



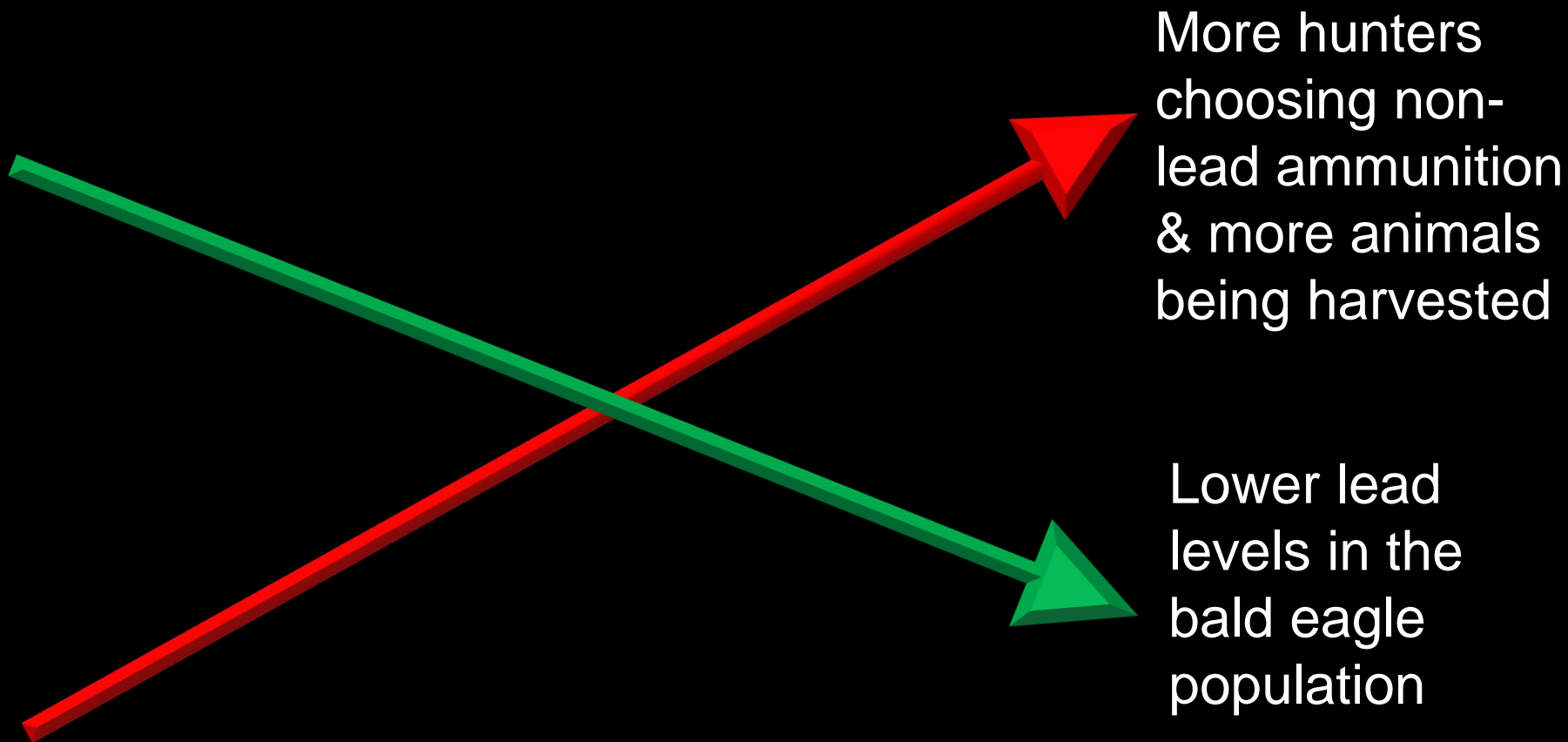


# Bald Eagles in Wyoming



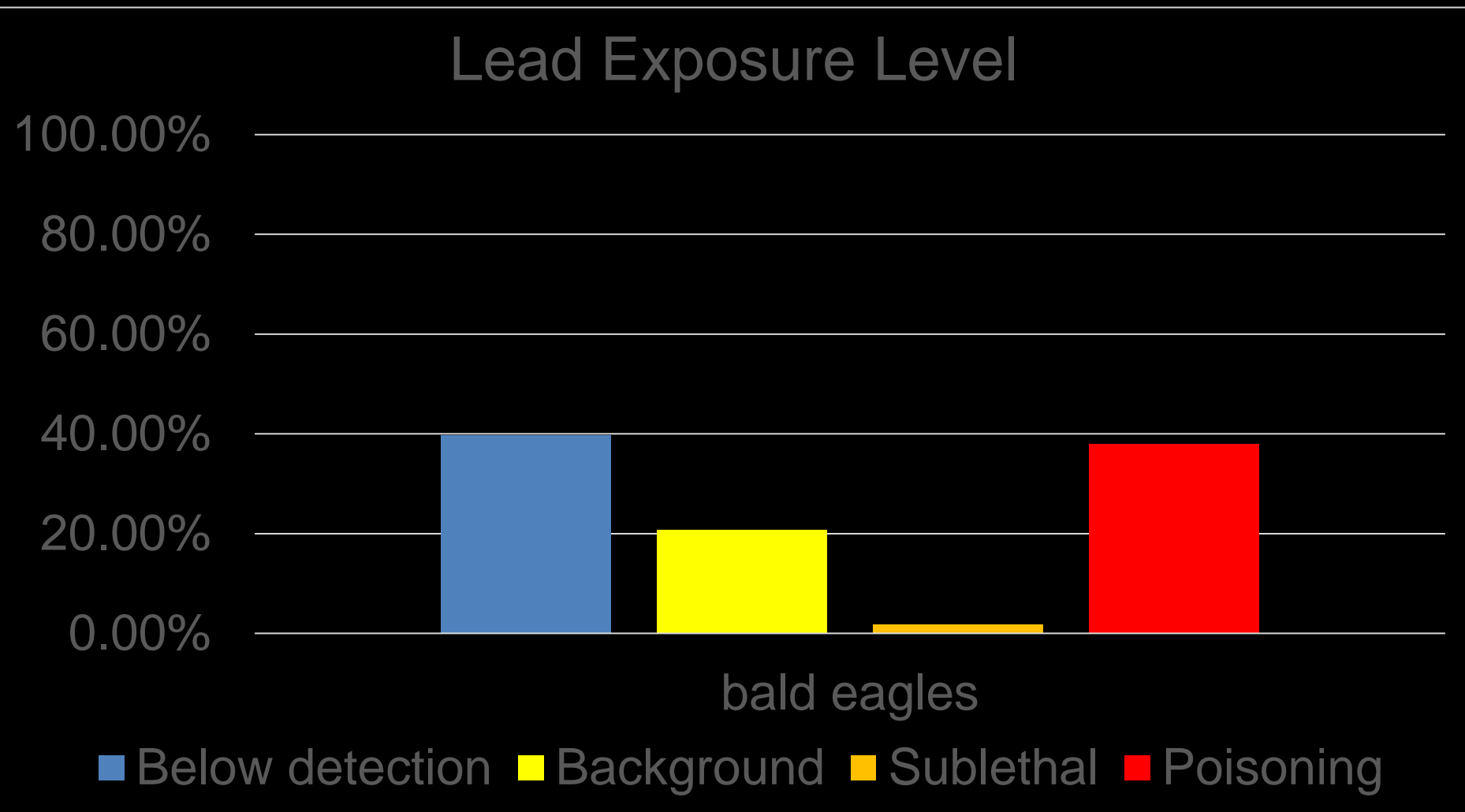


# Bald Eagles in Wyoming



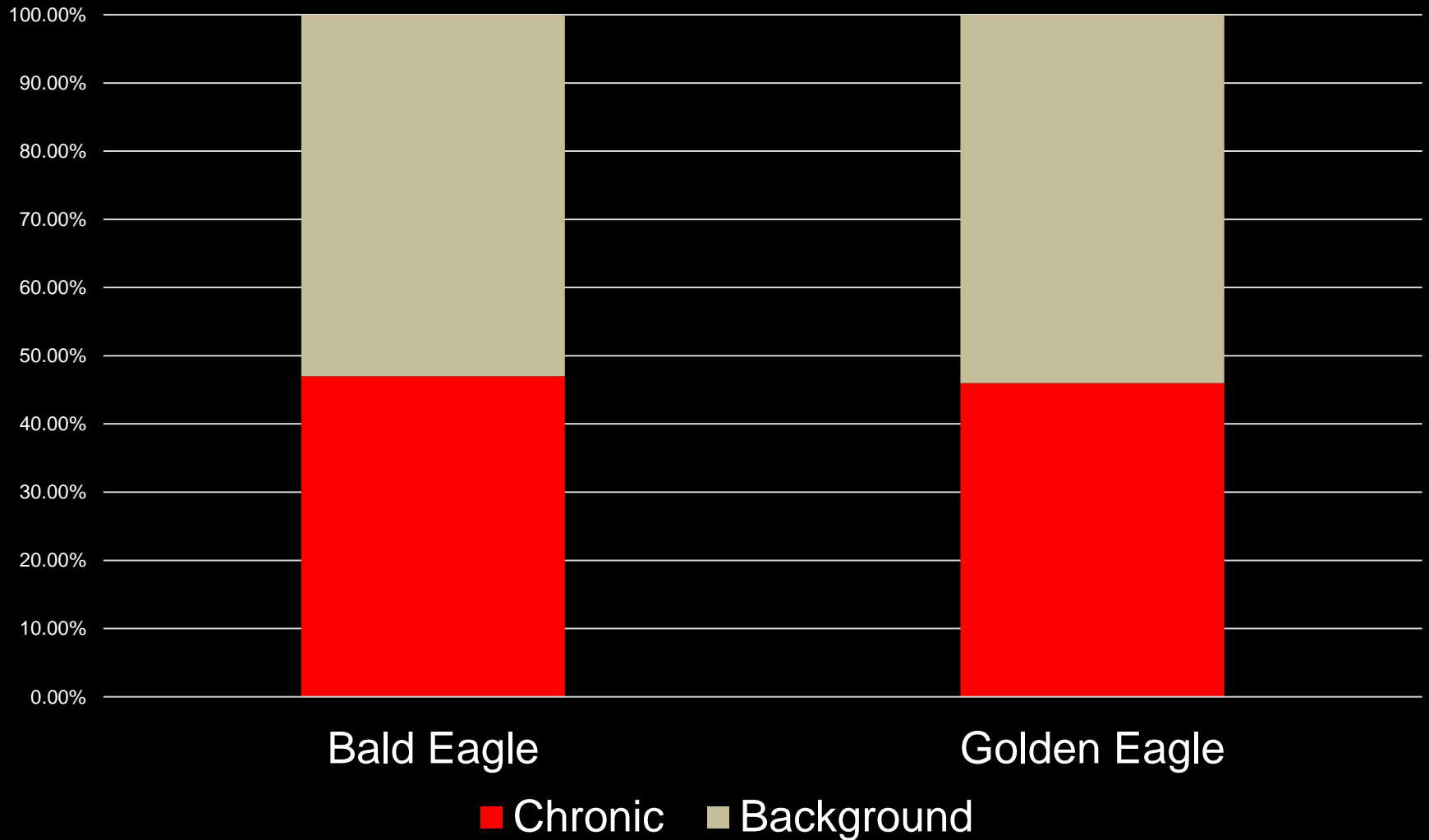


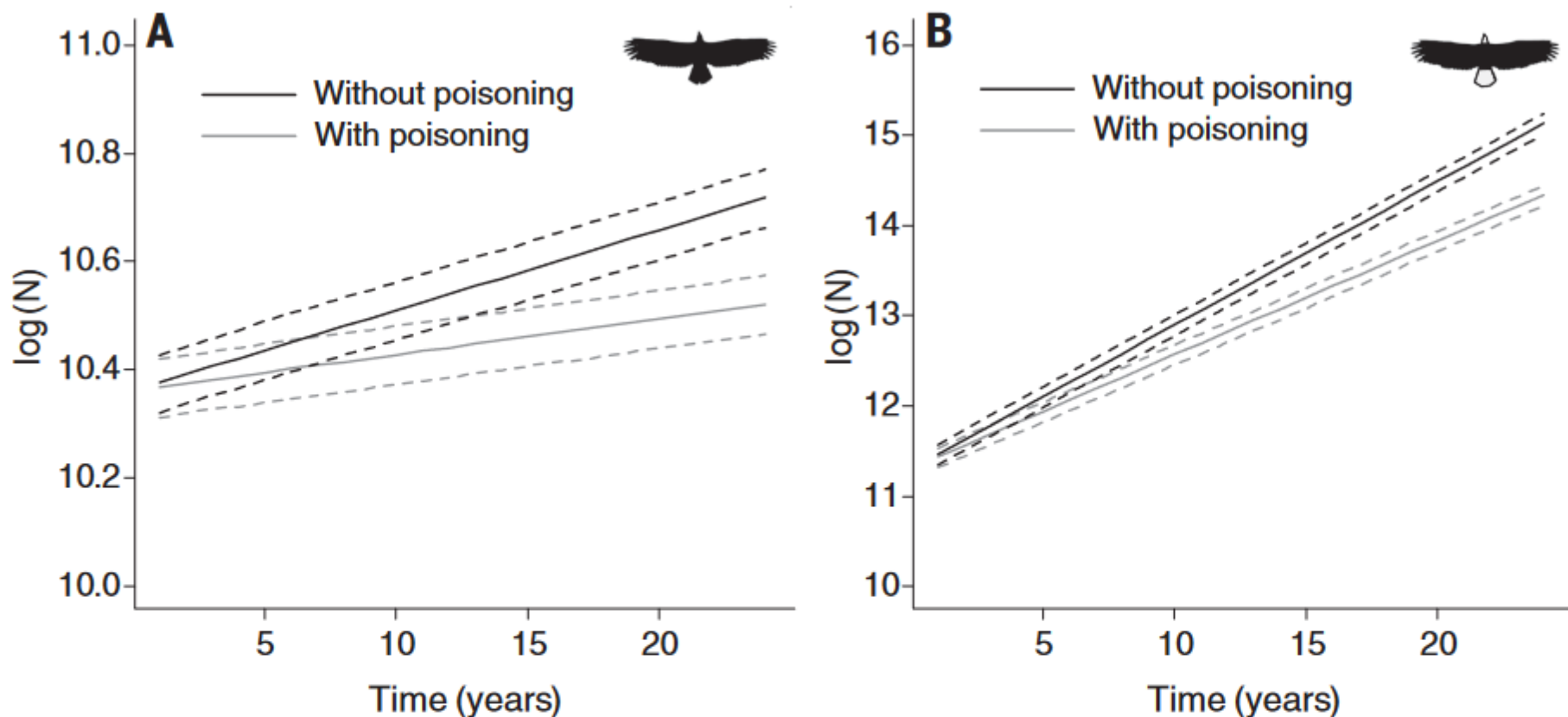
# Bald Eagles in the Mid-west





# Chronic Lead Exposure in Eagles Across North America

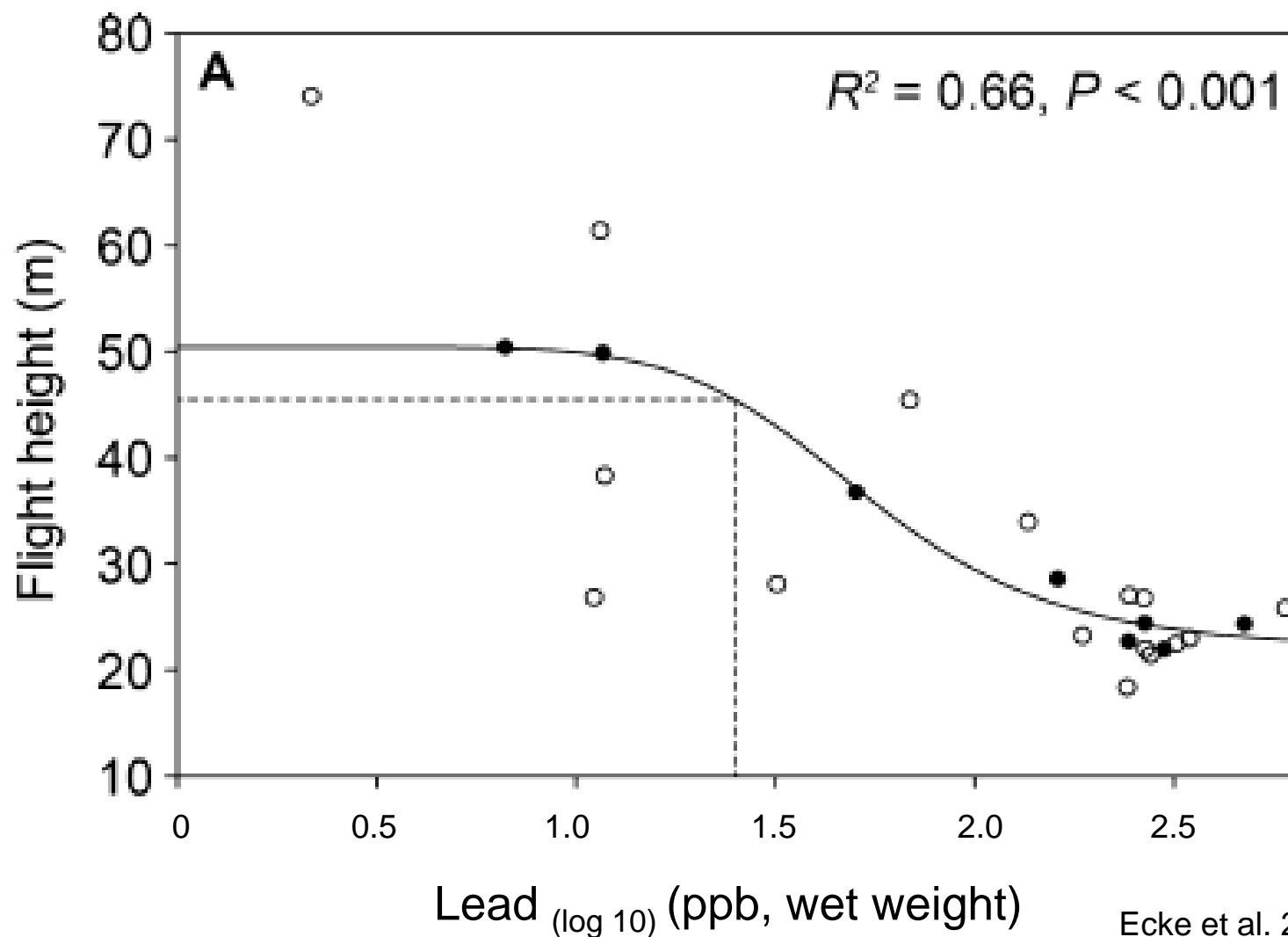




**Fig. 3. Deterministic projections for populations of golden and bald eagles with and without effects to growth rates of lead poisoning.** (A) Hypothetical matrix model projections for populations of golden eagles in scenarios without lead poisoning (upper black line) and with lead poisoning (lower gray line) at levels documented in this study. Solid lines are median estimates; dotted lines are 95% confidence intervals. (B) Same as (A) for bald eagles. The model assumes 100% mortality of individuals with liver lead concentrations above the threshold for severe clinical poisoning [ $33 \mu\text{g/g}$  dry weight (15)]. To isolate the effect of lead-caused mortality on eagle populations, these plots incorporate variation in  $\lambda$  but no stochastic variation in population size.



# Sub-lethal impacts

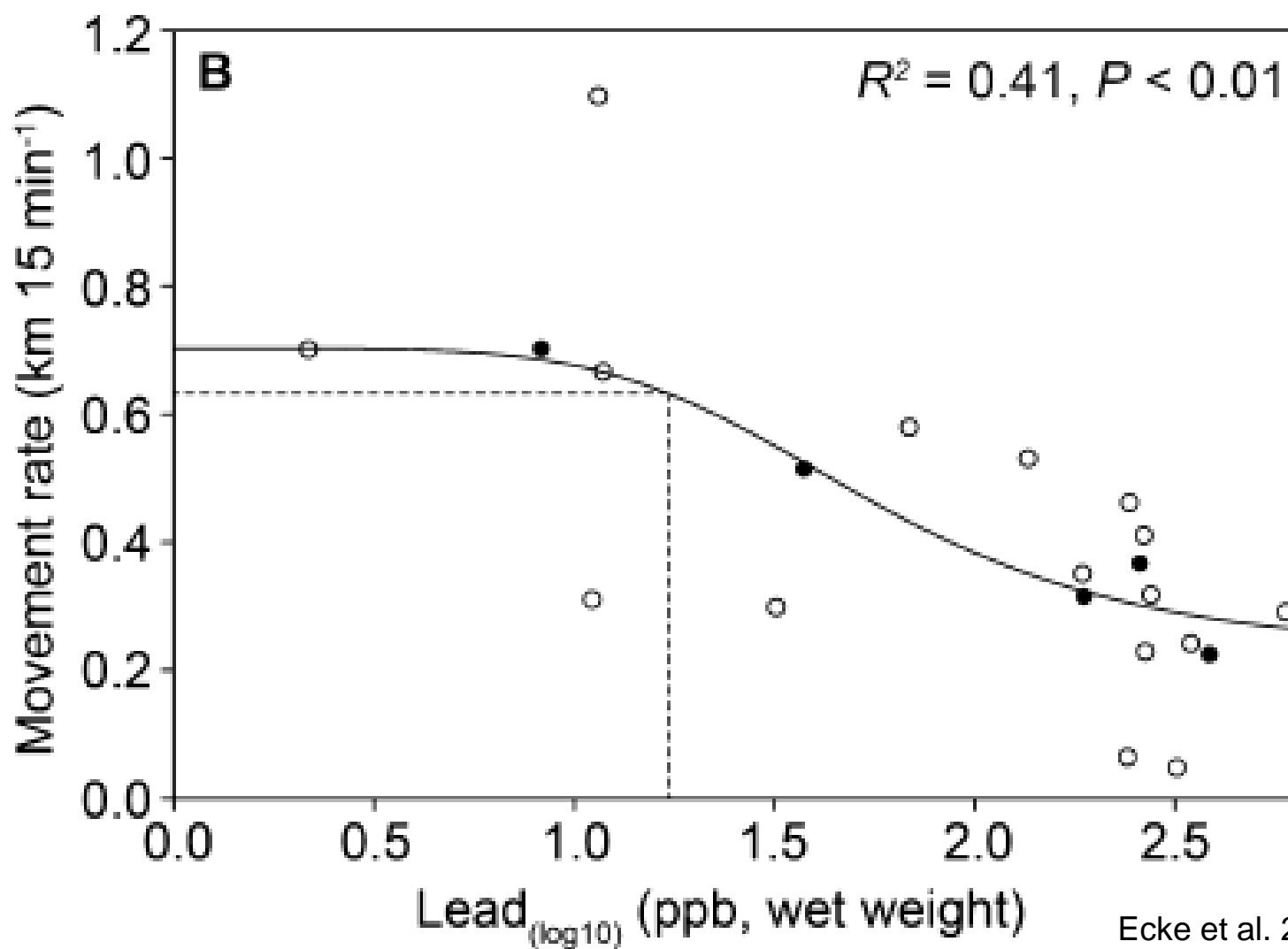


Ecke et al. 2017





# Sub-lethal impacts





# Conservation Opportunity





# Arizona Game and Fish Dept.

## Lead and Wildlife

### Know the facts and make your own choice

- Lead is a naturally occurring element in the environment and has many beneficial uses. However, it is a known toxin and has been removed from many consumer products like pipes, paint and gasoline.
- Lead has been used in the manufacture of ammunition and fishing tackle for centuries because of its unique properties, availability, performance, and ease and low cost to manufacture.
- Spent ammunition, lost fishing tackle and lead fragments in carcasses and gut piles can be ingested by wildlife. In some cases, these lead sources can cause illness or death in individual animals.
- Birds are the most susceptible to lead toxicity, and population-level effects have been documented in waterfowl and California condors.
- State fish and wildlife agencies have primary responsibility for managing fish and wildlife resources and use the best science to implement focused management solutions when population effects are documented. Educating the public about wildlife issues is part of their mission.
- Hunters and anglers have been the primary supporters of wildlife conservation in North America since the early 1900s. Collaboration with industry, conservation organizations and shooting-sports interests is also essential to ensuring continued protection of our wildlife resources and conservation heritage.
- Non-lead ammunition and fishing tackle alternatives are becoming more widely available and reasonably priced. Using non-lead alternatives can prevent lead poisoning of individual wildlife and may offer better performance.
- Hunters who choose to use lead ammunition can still help to reduce lead poisoning in scavenging animals by removing the entire game carcass from the field.

### Availability

Non-lead ammo alternatives are available for big game, varmint and small game hunting. Non-fragmenting solid copper or copper alloy bullets are now loaded in most hunting calibers. Highly frangible non-lead varmint bullets (compressed copper or tin powder) are available in both centerfire and rimfire cartridges. Non-lead shot (steel, tungsten, and bismuth) is also available.

To learn more about lead and wildlife, visit [www.azgfd.gov/lead](http://www.azgfd.gov/lead).

### What hunting magazines and Arizona hunters say about solid copper bullets:

"I was very impressed with the bullet's performance, the buck literally dropped in its tracks." — *Kaiabab deer hunter*

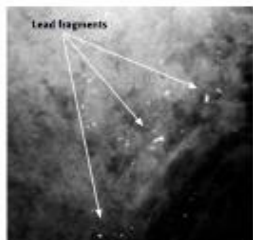
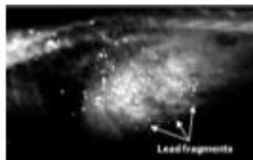
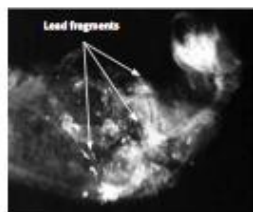
"Accurate, zero bloodshot, no wasted game meat." — *Kaiabab deer hunter*

"I've never seen deadlier performance on game." — *Safari Club International article*

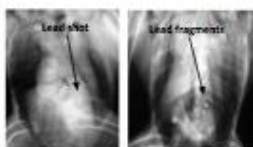
"While their terminal performance is the stuff of legend, they are also capable of remarkable accuracy." — *American Rifleman article*

### LEAD VS. NON-LEAD AMMO COSTS 2012 PRICES FROM ONLINE AMMO RETAILERS

30-06 165 gr. loaded ammo, Box of 20 (big game hunting)	Basic lead: \$17-\$20, Premium lead: \$25-\$40, Non-lead: \$30-\$40
223 loaded ammo, Box of 20 (35-55 gr.) (varmint hunting)	Basic lead: \$6-\$10, Premium lead: \$20-\$27, Non-lead: \$22-\$27
22 long rifle rimfire, Box of 50 (25-40 gr.) (small game hunting)	Basic lead: \$2-\$4, Premium lead: \$5-\$10, Non-lead: \$6-\$11
12 gauge #6 shotshells, Box of 25 (upland game/dove hunting)	Lead: \$7-\$25, Steel: \$7-\$32



X-ray of prairie dog (top), coyote (center) and a deer (bottom) gut pile. All contain lead bullet fragments that could be ingested by wildlife.



Eagles and other raptors feed on game remains and ingest lead shot and bullet fragments. Doves and waterfowl are known to pick up lead shot in the field.

## Condor Country: Why Non-lead Ammunition?

### Hunters are helping

For the past five years, 80 to 90 percent of fall hunters have participated in the Department's voluntary lead reduction program by using non-lead ammunition or removing gut piles from the field in the condor's core range.

The hunting community should be proud of this accomplishment, but we still need more hunters to help. Please help us prove to our critics that we can solve this problem on our own and that mandatory measures are not needed.

Hunters who use non-lead ammunition in condor range carry on sportsmen's proud tradition of wildlife conservation. If you choose to use lead ammunition, you can still help by removing your entire game carcass (including small game and varmints) and gut pile from the field. Local landfills accept and bury animal remains.

### Hunters praise non-lead bullets

Copper bullets have superior penetration, are less toxic, and do not fragment like lead. 93 percent of hunters say that non-lead bullets perform as well as or better than lead bullets on game. Non-lead shot and frangible bullets also are available for varmint and small game hunting.



The Arizona Game and Fish Department and our partners ask you to be part of the solution by using non-lead ammunition when hunting in condor country (Game Management Units 9, 10, 12A, 12B, 13A, and 13B).

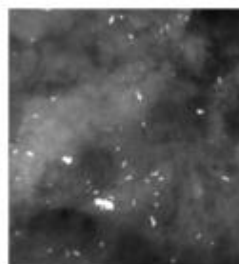
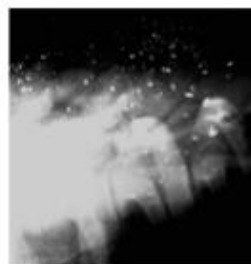
These sportsmen's groups ask you to use non-lead ammunition in condor range:

- Arizona Deer Association
- Arizona Elk Society
- Arizona Antelope Foundation
- Arizona Desert Bighorn Sheep Society
- Arizona Chapter of the National Wild Turkey Federation

Hunters drawn for hunts in condor range will be mailed more information before their hunt.

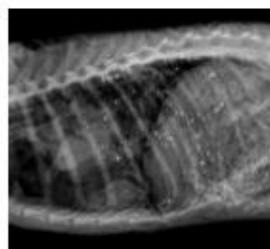


Lead poisoning is the leading cause of death in condors and the main obstacle to a self-sustaining population. There are currently 79 free-flying condors in Arizona and Utah. At least 22 condors have died from lead poisoning – including three in 2012. Several had lead shot and bullet fragments in their digestive tract. More than 450 cases of lead exposure have been documented in the condor population since 1999.



Lead bullet fragments remain in game carcasses and gut piles left in the field by hunters. These X-rays show hundreds of lead fragments (fragments appear bright white in X-ray) in a deer carcass and gut pile. Condors are group feeders, so several birds can ingest fragments from one carcass or gut pile containing lead.

Studies have concluded that lead shot and bullet fragments found in game carcasses and gut piles are the main source of lead in condors. To learn more about the condor program and for a complete list of non-lead ammunition available, visit: [www.azgfd.gov/condor](http://www.azgfd.gov/condor).



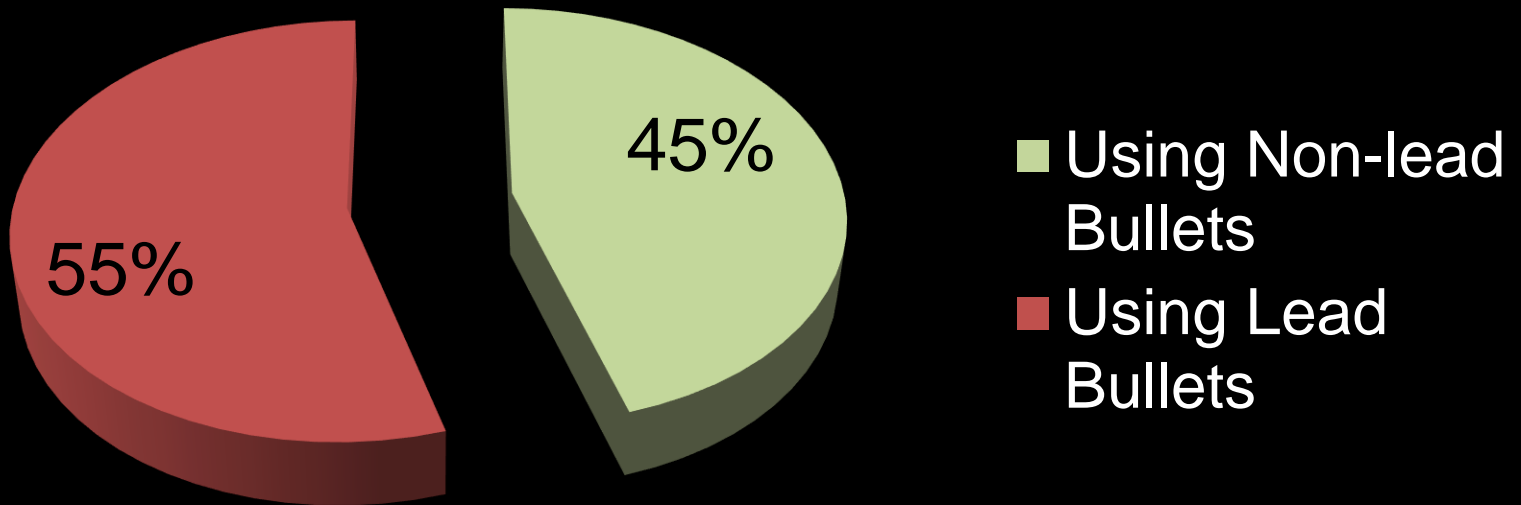
Lead varmint and small game ammunition also fragments significantly. This x-ray of a coyote illustrates the amount of lead (bright white fragments) left in the carcass. Each spring condor lead exposures increase as they forage on animal remains left in the field by hunters. Hunters can help by either using non-lead ammunition OR removing ALL varmint and small game carcasses from the field.





# OR Non-lead Hunting Education

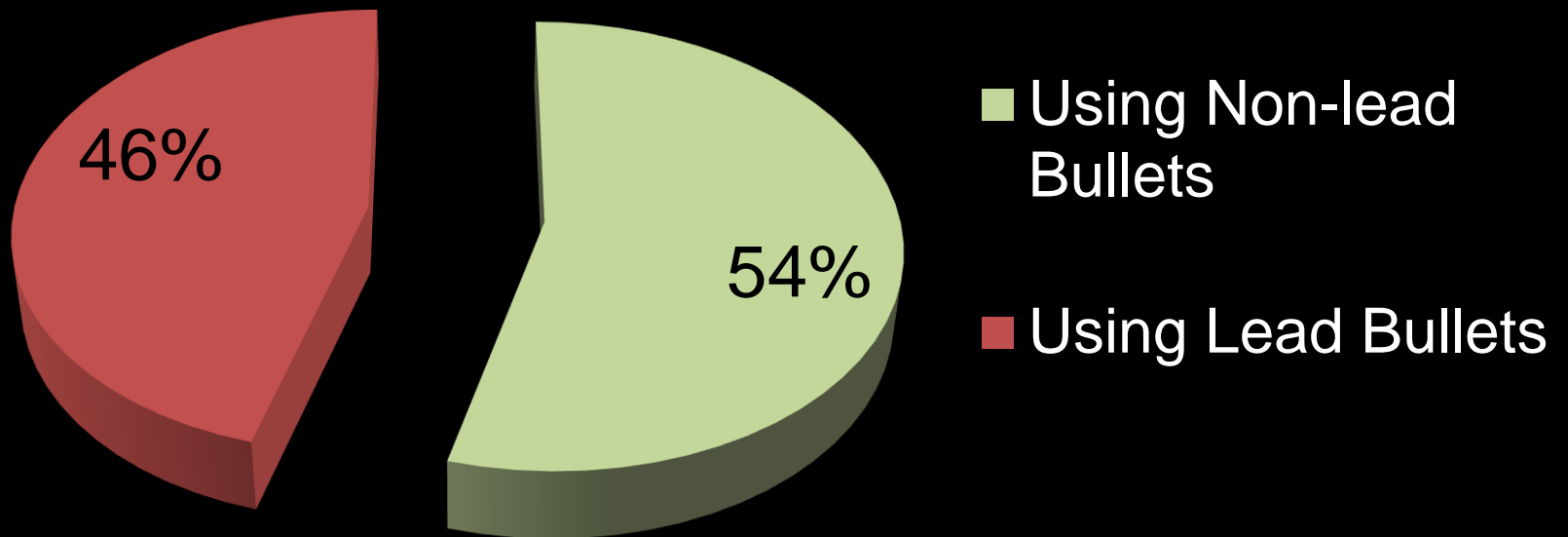
## Zumwalt Prairie Preserve Incentive Participation 2016- 2017





# OR Non-lead Hunting Education

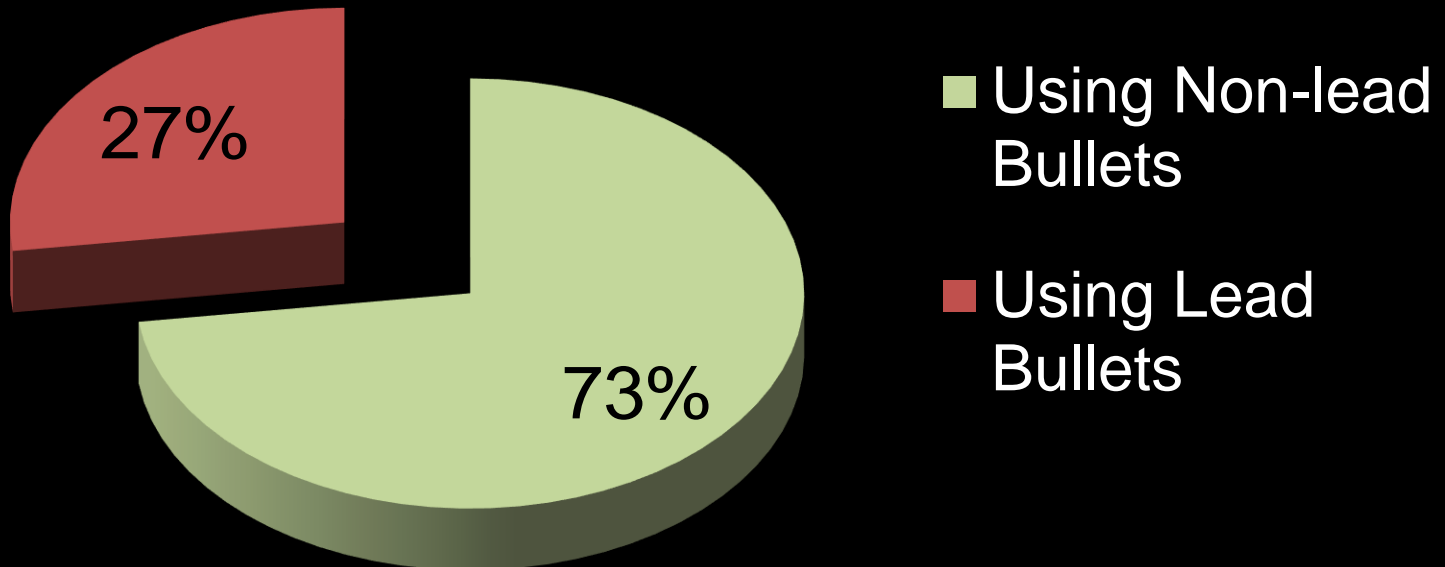
## Zumwalt Prairie Preserve Incentive Participation 2017-2018





# OR Non-lead Hunting Education

## Zumwalt Prairie Preserve Incentive Participation 2018- 2019

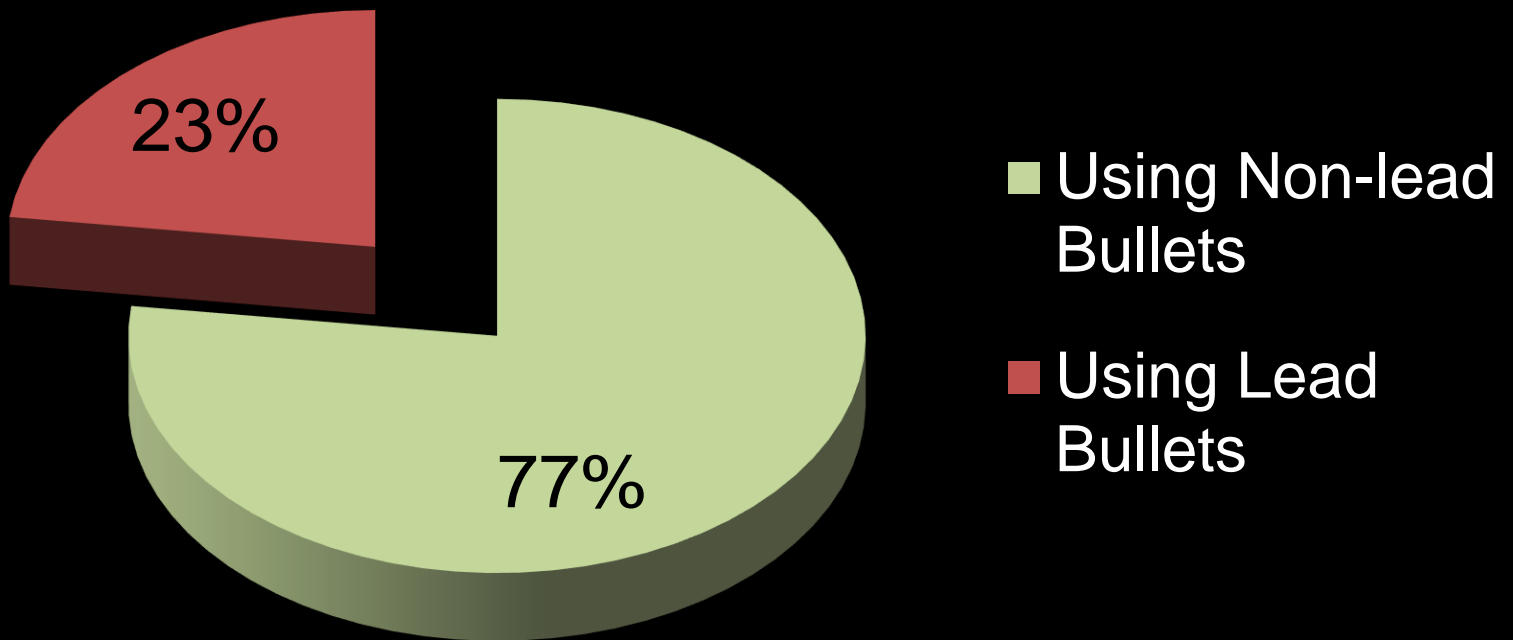






# OR Non-lead Hunting Education

## Zumwalt Prairie Preserve Incentive Participation 2019-2020





# OR Non-lead Hunting Education

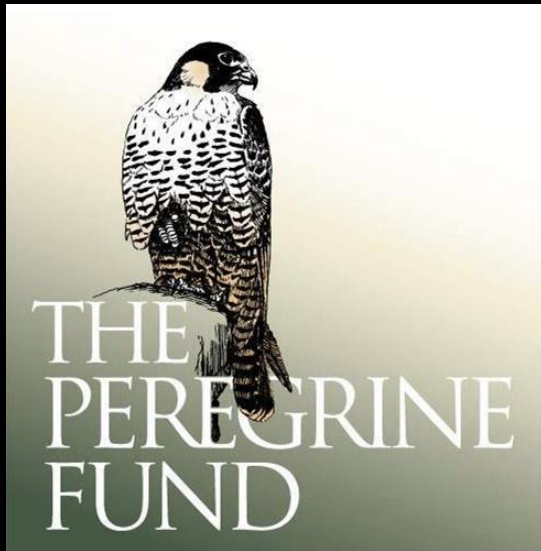


## Welcome to Non-Lead Hunting Education.

There are two different courses on ammunition types, bullet construction and performance, and the benefits of choosing non-lead ammunition. There is a longer course for brand new hunters who are considering what ammunition to use for their first hunt, and a shorter course for experienced hunters who have already chosen ammunition. Please choose the one that fits you. At the end of the courses there will be options to participate in programs that help you access and thank you for choosing non-lead ammunition. If you have any questions or concerns please send a message to [Non-Lead Partnership](#).

**New Hunters**

**Experienced Hunters**







# Non-Lead Partnership



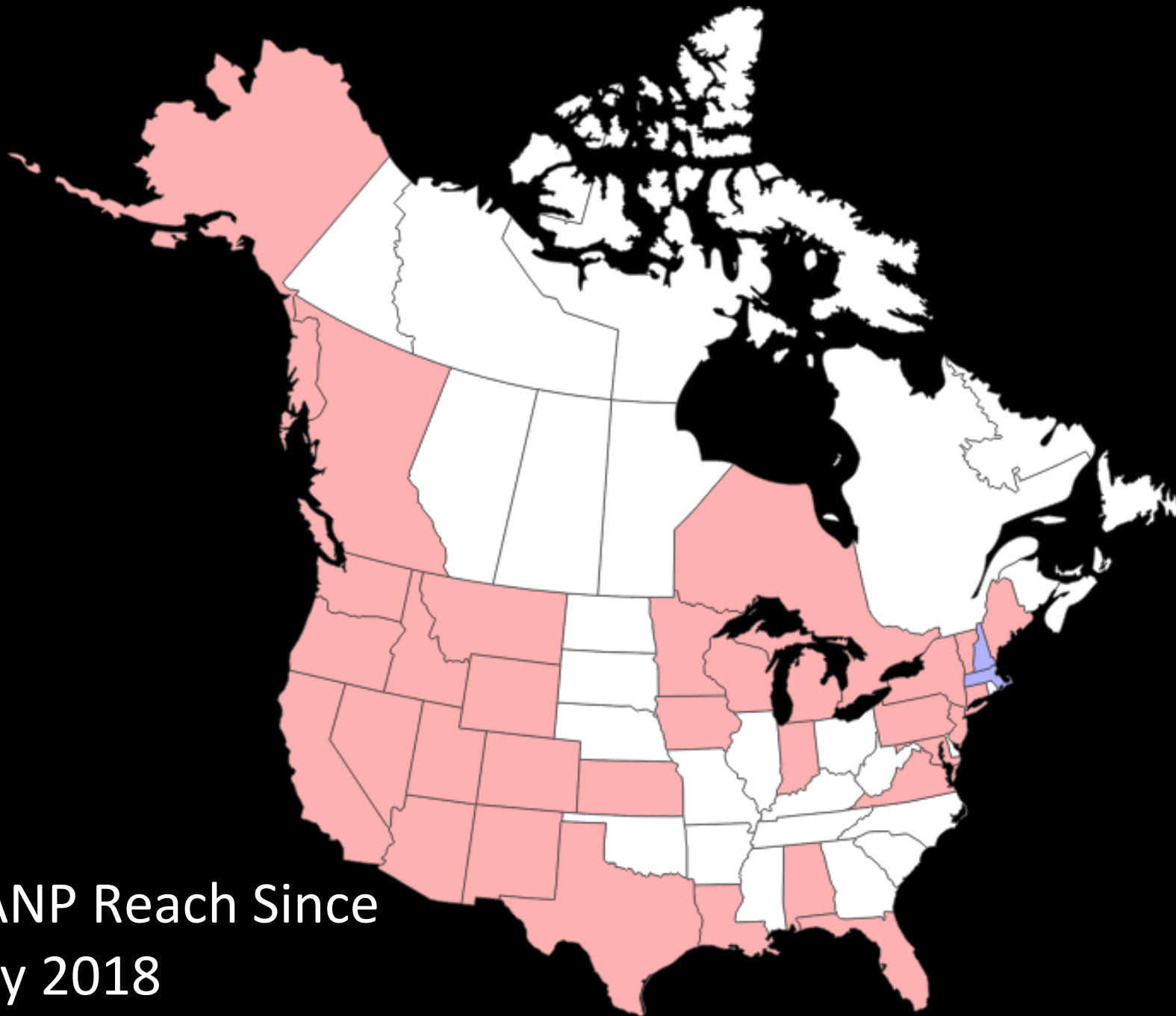


# Connect Research With Values and Benefits





NANP Reach Since  
July 2018



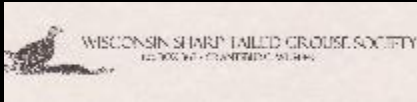


# State Agency Engagements





State Agency Partners



MPG RANCH



MODERN CARNIVORE  
Eating meat responsibly



Partners





<http://nonleadpartnership.org/>

- 1. Partner** - for those who help shape, carry and deliver programs and messaging of the partnership to their constituents in full support of actions fulfilling the effort as defined, but not limited to, the resolution.
- 2. Supporting partner** - for those who support either financially or directly in tasks of outreach, education and/or incentivization of non-lead ammunition for wildlife and ecosystem health, as defined, but not limited to, the resolution.
- 3. In Support of** - for those who support/endorse the formation intent and actions of this partnership as defined by the resolution.



# ZUMWALT

Crafting public-private partnerships for the benefit of hunters and wildlife



PIONEERS OF CONSERVATION  
OUR LEGACY FOR GENERATIONS™

BOONE AND CROCKETT CLUB

SINCE 1887

DONATE TO B&C

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LOGIN

JOIN B&

Google

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B&C ANNU

B&C BOAR

B&C EMAIL NEWSLETTER

to best address them.

B&C HISTO

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SUSTAINA

RECORDS

CANNED S

GENETIC MANIPULATION OF GAME

“the Club believes that if an individual state wildlife agency decides that lead exposure represents a population-level issue for a particular species in a given area, it should be up to that agency to implement targeted solutions that do not unnecessarily restrict hunting or shooting opportunities, including hunter education, voluntary programs, or mandatory programs using suitable ammunition alternatives.”

how

“The Boone and Crockett Club also supports a [Fair Chase](#)® hunting ethic, which includes sportsmen making personal choices to ensure the ethical hunting of game to benefit wildlife conservation in general. Sportsmen should be aware of potential unintended consequences to non-hunted species, and if they feel this may be a concern in the areas where they hunt, the Club supports sportsmen choosing to use alternative ammunition..”

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harvested with lead ammunition, but these elevated levels are below the levels of concern identified by the Center for Disease Control for adults. To date, there is no conclusive evidence of serious illness or death of humans caused by eating game taken with lead





ABOUT US ▾

CONSERVATION ▾

CHAPTERS ▾

HUNTING ▾

NEWS ▾


EVENTS ▾

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## Mule Deer Foundation - Talking Mule Deer Podc...

 <https://muledeer.podbean.com/feed.xml>



**17,386**

Downloads

**44**

Episodes



### S2 E25 North American Non-Lead Partnership

September 16, 2019

#### ***S2 E25 - North American Non-Lead Partnership***

Today's episode of Talking Mule Deer features a conversation with the North American Non-Lead Partnership's Leland Brown (Oregon Zoo) and Chris Parish (The Peregrine Fund). The partnership's two main functions are to preserve our wildlife conservation

### Following



Mule Deer Foundation - Tal...

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# BHA PODCAST & BLAST, EP. 62: CHRIS PARISH AND LELAND BROWN OF THE NORTH AMERICAN NON-LEAD PARTNERSHIP

Posted by *Backcountry Hunters & Anglers* | October 30, 2019



PODCAST & BLAST  
with Hal Herring



BHA PODCAST & BLAST WITH HAL HERRING

**BHA Podcast & Blast, EP. 62: Chris Parish and Leland Brown of the North America...**

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Hal sits down in Montana with Chris Parish and Leland Brown to talk copper bullets, lead fragments, falconry, raptors, condors, Mexico and California, a love of good guns, wild animals and wild meat – all following a long day of rifle shooting with everybody from the Hellgate Hunters and Anglers (a Missoula-based rod and gun club) to former U.S. Army snipers. Chris, director of the global conservation with the Peregrine Fund, is an original Okie from Bakersfield,





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