Lead Exposure in Namibia: A Comparative Analysis Among Captive Cheetahs (*Acinonyx jubatus*), Wild Cheetahs, and Wild Leopards (*Panthera pardus*)

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Cheetah Facts

- Classified as Endangered in Namibia (MEFT Red List, 2022)
- They are hunters

Leopard Facts

- Classified as vulnerable (IUCN 2022)
- They are solitary hunters and opportunistic scavengers

Lead exposure in wildlife

- Lead is a real One Health issue
- **Lead ammunition** → One of the major unregulated sources of lead within the environment (Arnemo et al. 2016)
- The main contributor to environmental lead contamination that wildlife could potentially encounter (Pain et al., 2015)
- How does it work??

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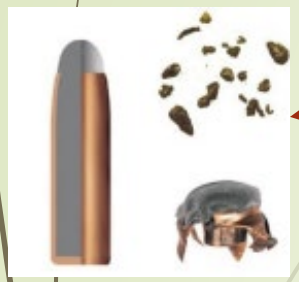
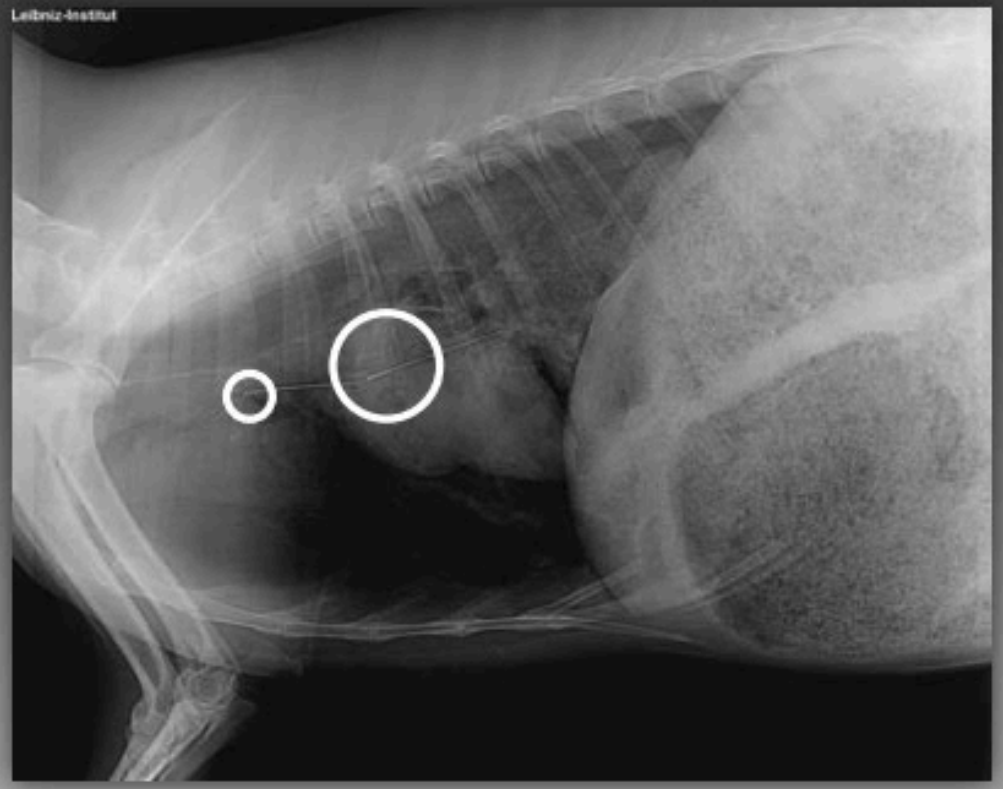
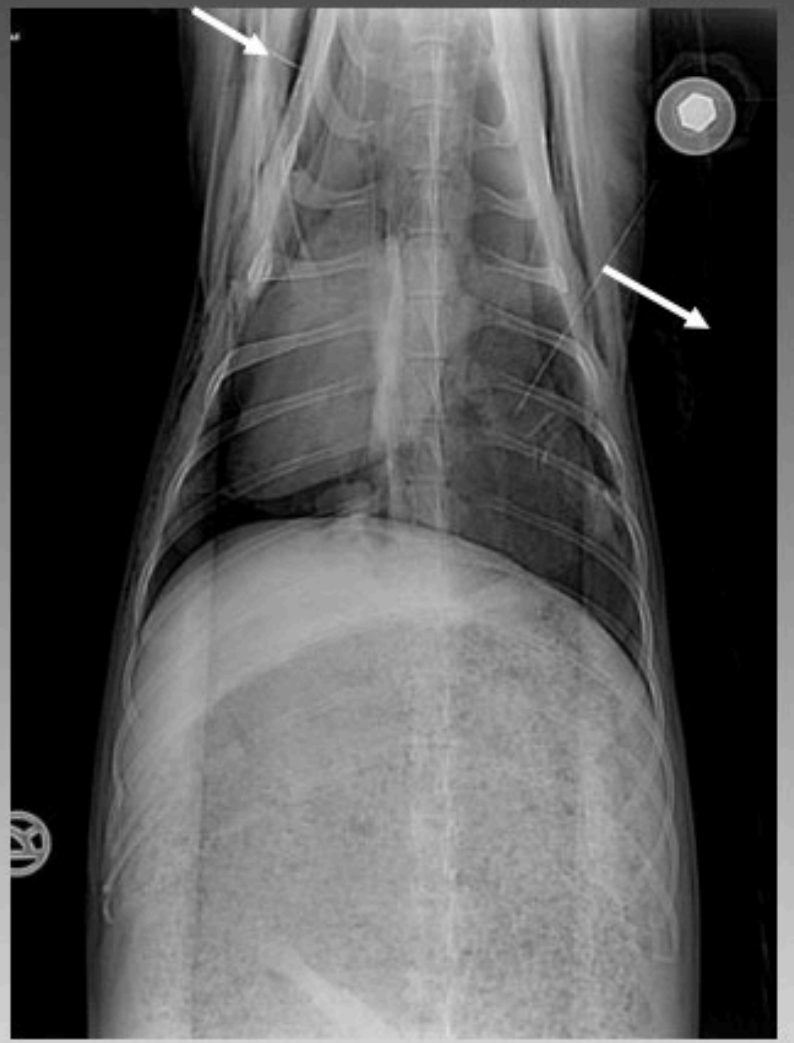


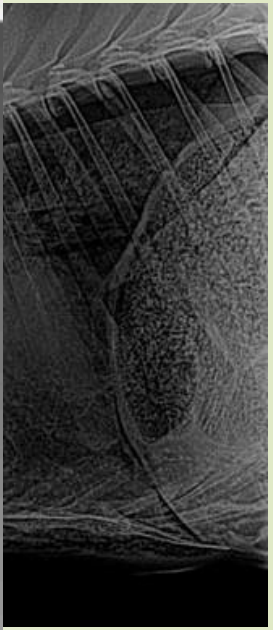
Lead free deforming bullet



Barnes XLC / Lapua Naturalis,
n=122

min.: 0, max.: 0





(A) Roe deer (C deer
(Dama dama)

Ref: Hampton, J. f lead-based bullets for wildlife

How does it affect us and wildlife?

These carcasses can contain lead pellets/lead bullet scatters!

- **Affects humans** : Game meat
- **Affects wild scavengers**: HOW? Often, visceras are discarded on the floor by hunters, and scavengers eat those visceras

LEAD POISONING!

→ No biological significance, no metabolization!
Neurological, reproductive and cardiovascular signs and more!

Mostly researched in birds (scavenging/prey/waterfowl)
→ Little literature exists on lead in wild mammalian carnivores!

Some studies on bears…

- A study conducted in the Greater Yellowstone Ecosystem revealed that grizzly bears (*Ursus arctos horribilis*), which are the predominant scavengers among carnivores in that area, exhibit higher blood lead levels (BLLs) compared to black bears (*Ursus americanus*), wolves (*Canis lupus*), and cougars (*Puma concolor*) (Rogers et al., 2010).
- In a separate study conducted in Scandinavia, brown bears (*Ursus arctos*) —characterized as opportunistic omnivores with diverse dietary habits encompassing hunting, scavenging, and plant consumption— demonstrated notably elevated BLLs. This increase in lead exposure has been attributed to their varied feeding behaviours spanning multiple trophic levels (Fusch et al. 2021).

RESEARCH ARTICLE | FEBRUARY 12 2024

A Global Systematic Review of Lead Exposure and Its Health Effects in Wild Mammals

Helle B. Hydeskov ; Jon M. Arnemo; Chris Lloyd Mills; Louise K. Gentle; Antonio Uzal

J Wildl Dis (2024)

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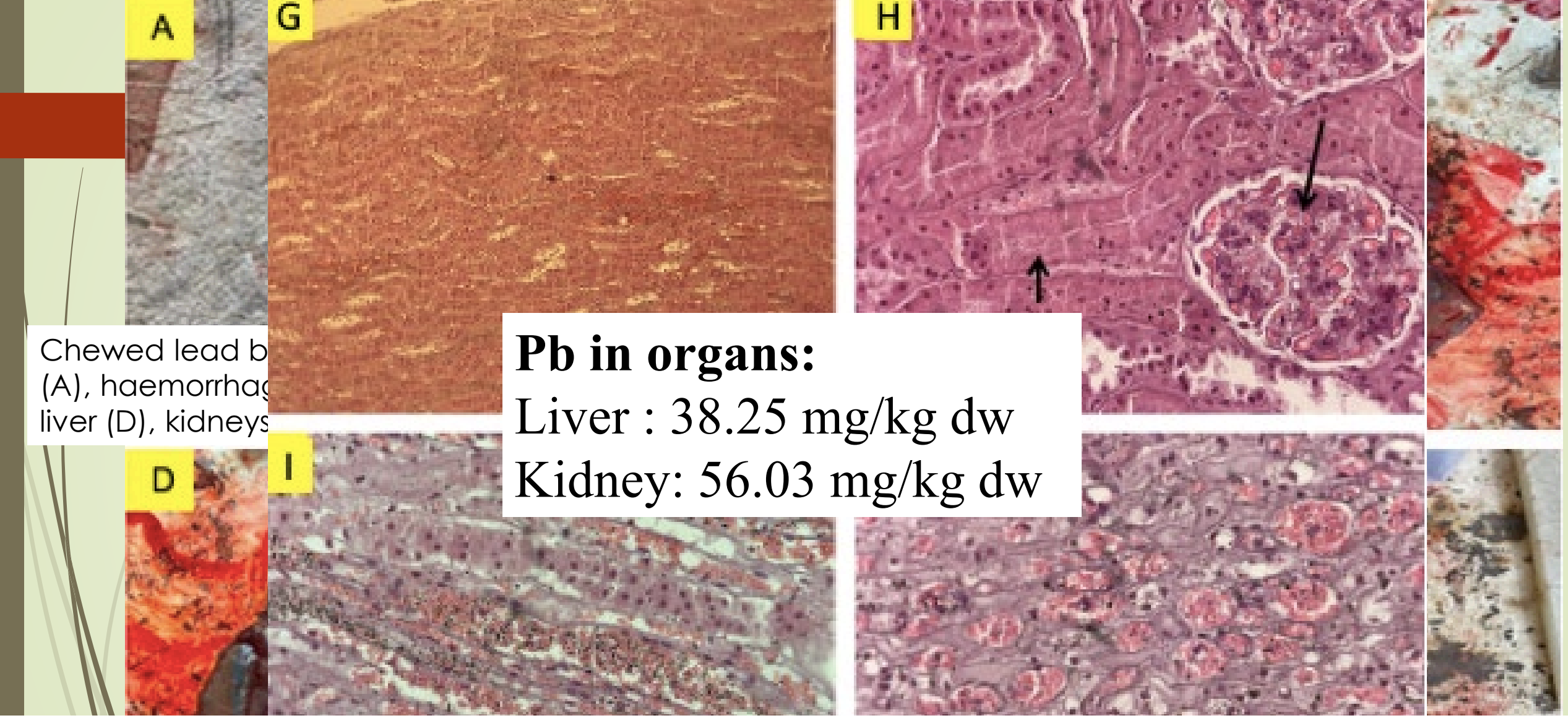
- **There is a need for more carnivorous and scavenger mammal species studies**
- **Sentinel Role**: Highlight how certain species act as indicators of environmental lead contamination from sources like lead mines and polluted rivers, reflecting ecological health and potential human impact.
- **Apex Predators as Indicators**: Emphasize the importance of apex predators in bioaccumulating lead across trophic levels, serving as powerful indicators of environmental lead levels.
- **Scavengers as Long-term Monitors**: Discuss how scavenging mammals consuming contaminated remains can survive yet exhibit long-term clinical effects (neurological, cardiovascular, etc.), providing insights into the impacts of lead exposure.

- Only 1 cheetah case study (2 fatal acute cases)(North et al., 2015)
- No studies on any African mammalian carnivores on lead exposure

Adina Case Study: Suspected Lead poisoning in a cheetah

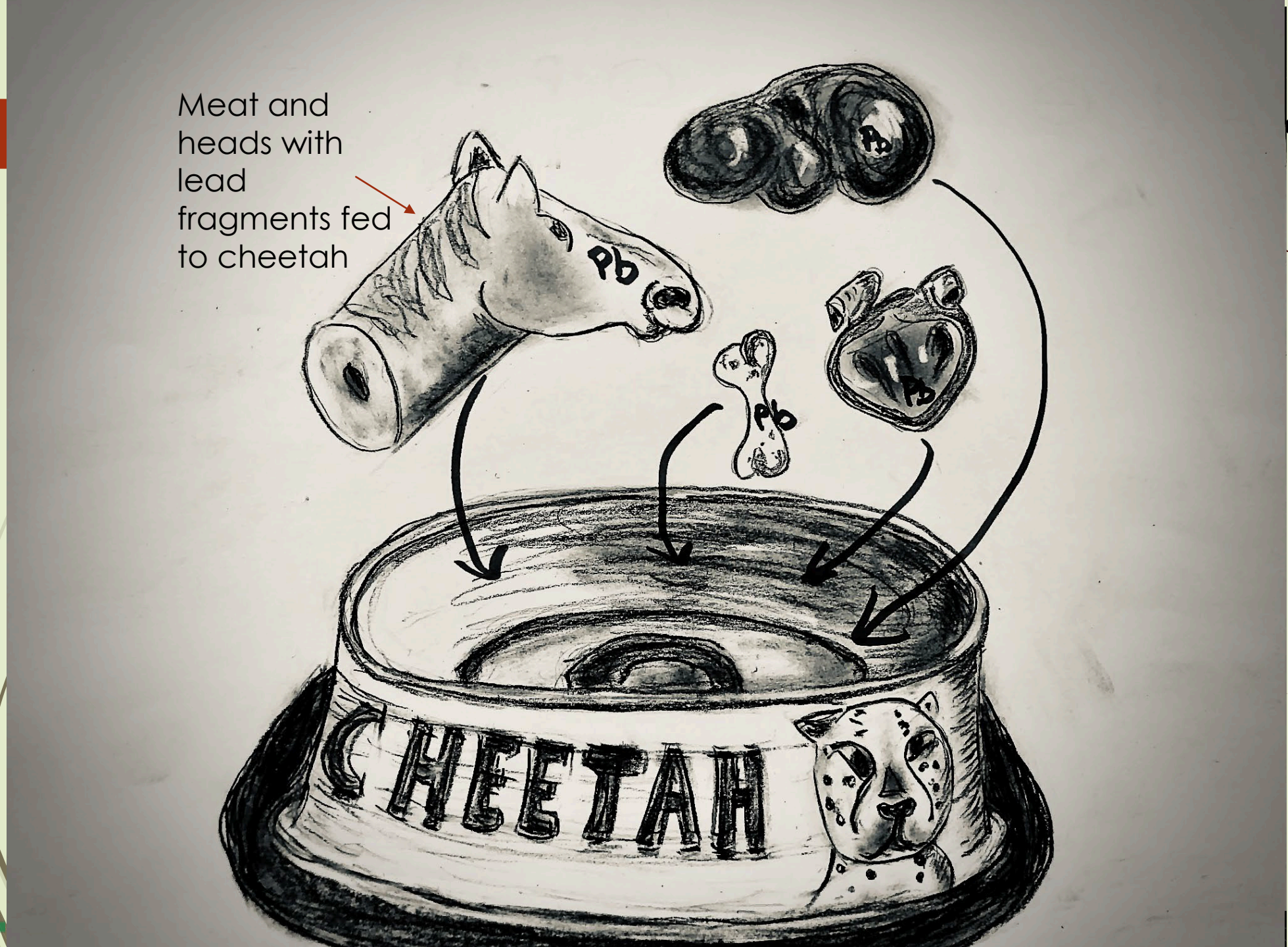
- Captive female cheetah to be reintroduced into the protected wild (2021, CCF Namibia).
- Started exhibiting neurological behavior for three days.
- Sudden death after 72 hours; the bullet was found in the stomach, with high concentrations of lead in her liver and kidneys, plus necrosis and hemorrhages.



Kidney Histopathology (H & E)

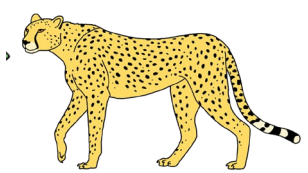
Typical lesions of acute tubular necrosis (ATN) and extensive haemorrhages were seen in the tubules (G, x4). Necrosis of the tubules showing loss of tubular epithelial cells (short arrow) and haemorrhages in the glomeruli (long arrow) were seen (H, x40). The proximal and distal tubules showed marked degeneration and necrosis accompanied by haemorrhages (I and J, x10).

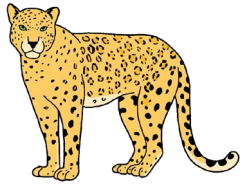
esis


Meat and heads with lead fragments fed to cheetah
Pb
Pb
Pb
Pb
CHEETAH

Methods

Bones: Life Long Exposure!





62 cheetah + **11 leopard** **tibias** were included in the analyses

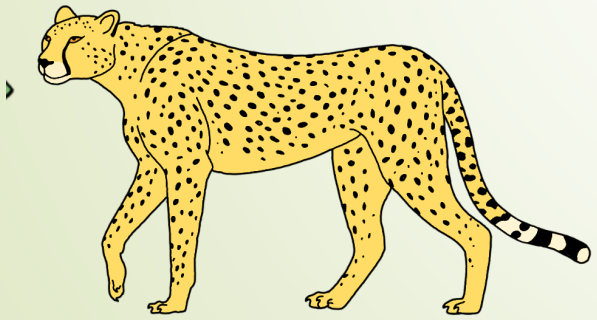
Cheetahs were grouped in function of their time in captivity:

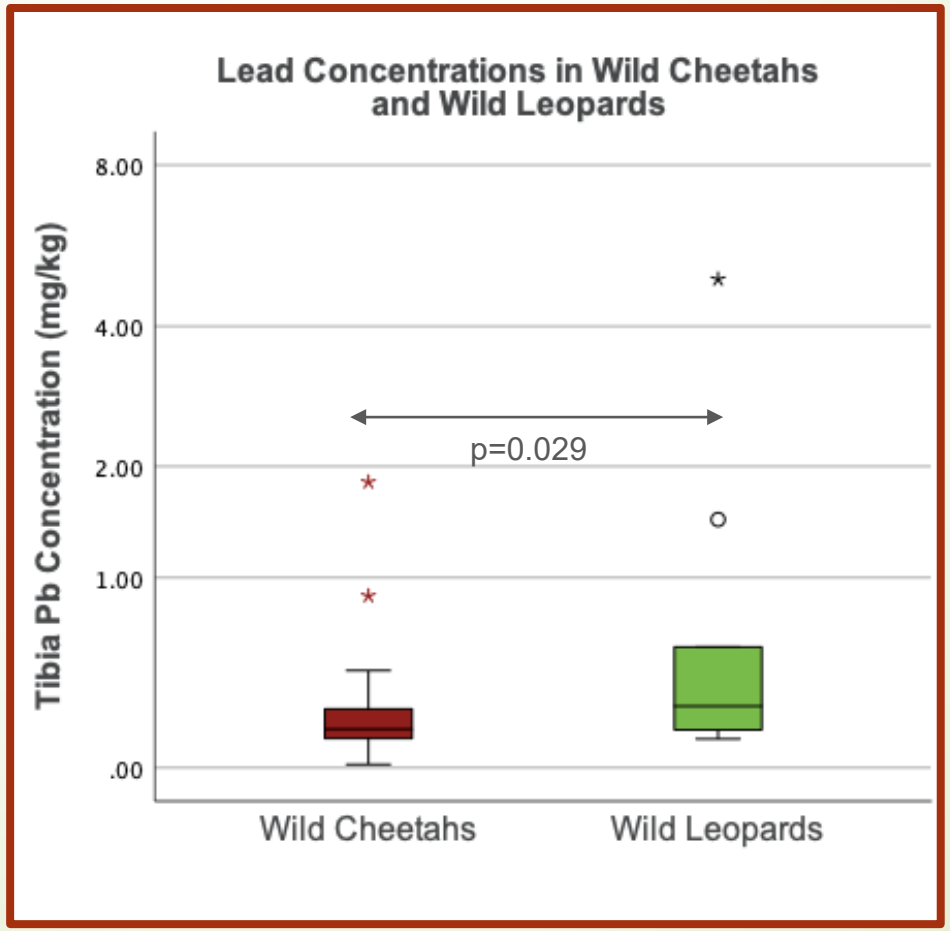
- 21 ”**Captive**” > 80% of their life’s in captivity.
- 19 ”**Wild**” > 91% in the wild
- 22"**Mixed life**” cheetahs had approximately equal time in captivity at CCF and in the wild.

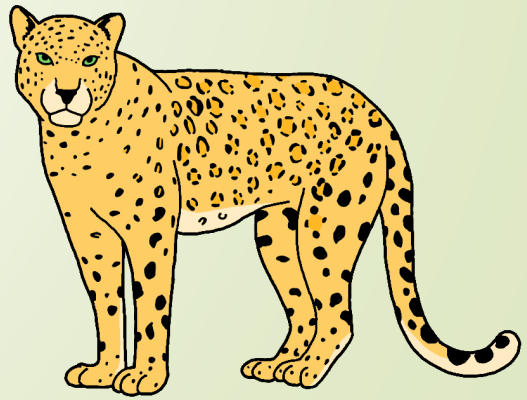
Our findings

1) Bone lead concentration (BLC) of wild leopards is higher than in wild cheetahs

Wild Cheetahs: 0.27mg/kg
Wild Leopards: 0.83mg/kg







Royal Veterinary College University of London

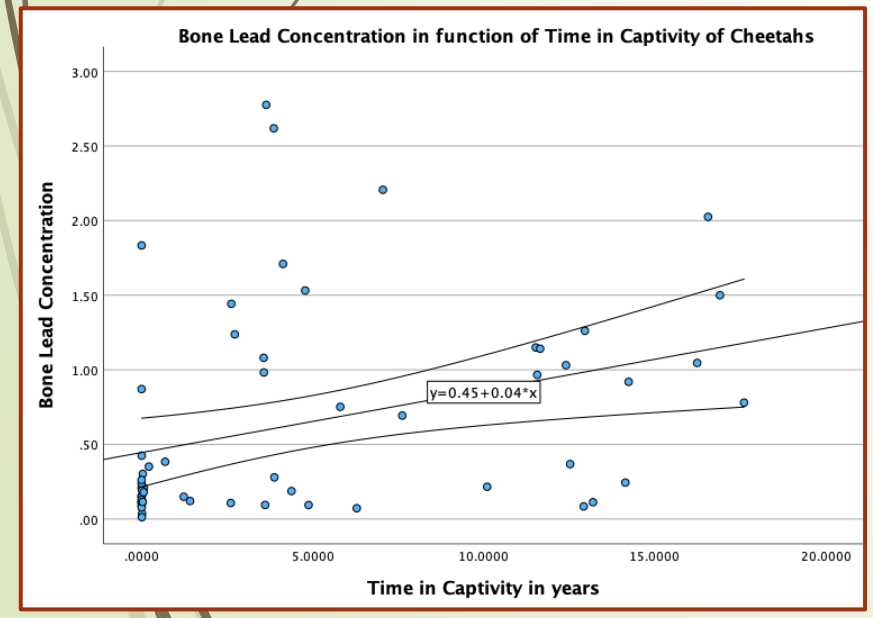
Cheetah Conservation Fund

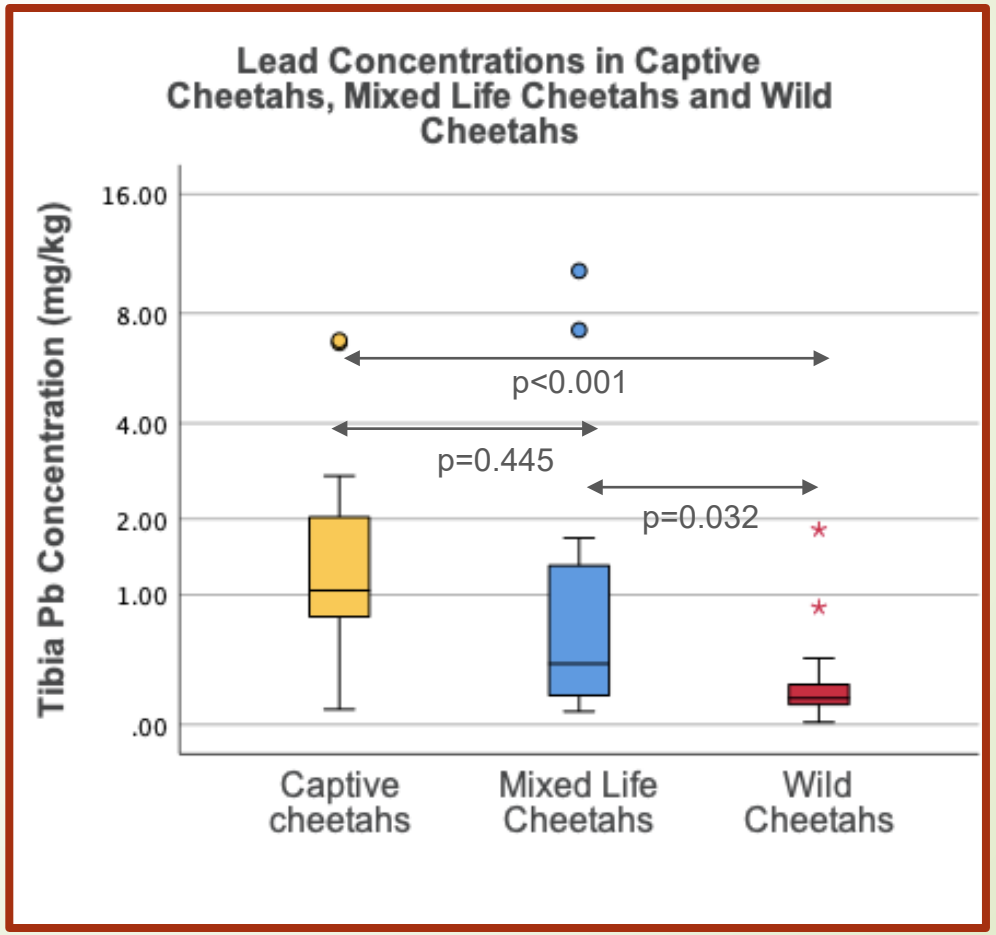
Our findings

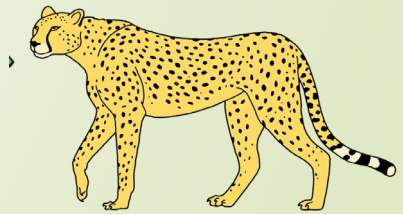
2) BLC of captive cheetahs is higher than in wild or mixed-life cheetahs

Captive Cheetahs: 1.66mg/kg
Mixed Life Cheetahs: 1.47mg/kg
Wild Cheetahs: 0.27mg/kg

Time in captivity had a significant effect on BLC: p<0.001







Discussion

- PROBLEM ! The main source of lead in cheetahs and leopards therefore appears to originate from lead ammunition (captive diet or scavenging). Even minor levels of lead exposure have been shown to detrimentally affect **reproductive rates** (Chen et al. 2018) and **cognitive abilities** (Skerrat et al. 1998) in other species.
- Given that cheetahs have a **slow reproductive rate, a limited population size and are classified as endangered in Namibia**, taking measures to reduce potential sources of lead exposure could contribute significantly to their recovery efforts.

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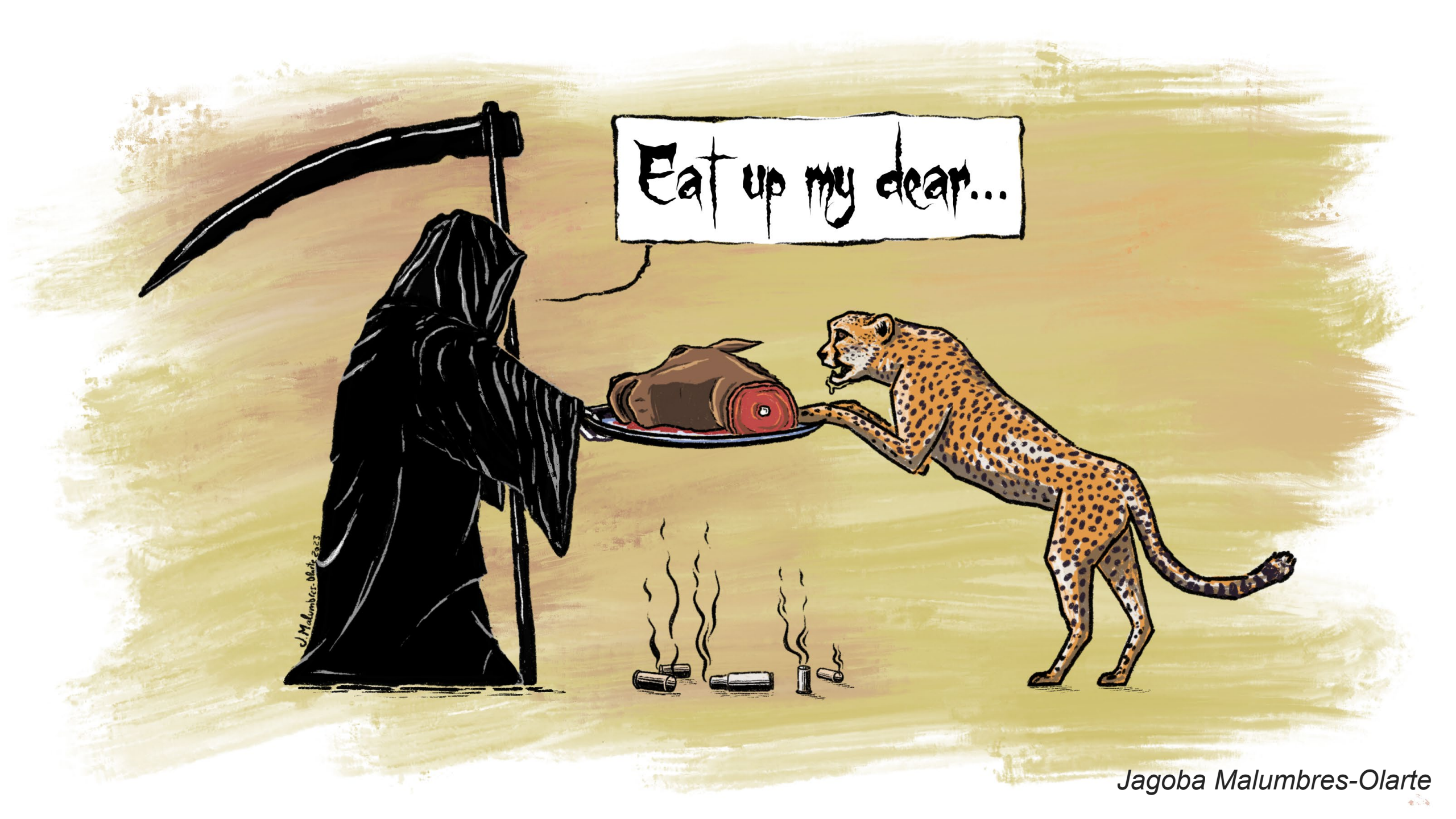
Conclusion

- For captive cheetahs: Importance of **education** on the dangers of lead of **key stakeholders of wildlife sanctuaries** in southern Africa.
  - For the daily feeding in captivity
  - For reintroduced animals in bomas
- For wild mammalian scavengers : Emphasis on the importance of transitioning to **non-leaded ammunition** for slaughtering and hunting, to protect wild scavenging carnivores and minimize lead pollution.



Jagoba Malumbres-Olarte

PhD project

- **Pb Exposure in carnivores of Southern Africa**

  - Investigating the impact of lead on mammalian carnivores through in vivo studies, focusing on clinical pathology and clinical symptoms
  - Examining bones and other organs of carnivorous and scavenging species in function of environmental lead (mining) and hunting areas,
  - Adopting a OneHealth approach to understand these issues more comprehensively with game meat and humans.
  - And way more!

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Thank you!!

Any questions??