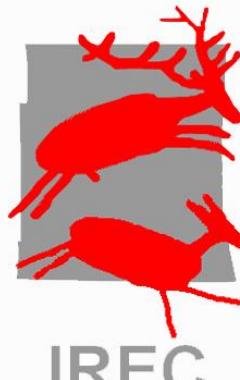


Lead poisoning: effects on wildlife and birds of prey and impact on population viability

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CSIC - UCLM - JCCM

IREC

International Symposium on lead poisoning, Life GypHelp, 28-09-2015, Annecy, France

Food with embedded lead ammunition



Driven shooting of red-legged partridge by F. Franco

Small game with embedded shot



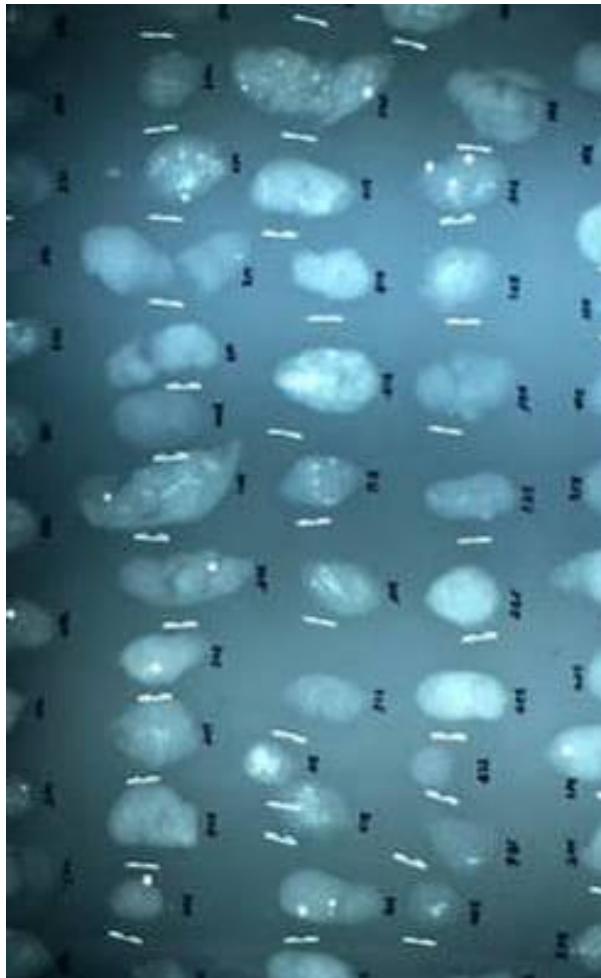
Embedded shot
in prey

Presence of embedded shot

Species	Collection	n	%
Pink-footed goose	Trapped	2259	9.2-36.0
Greylag goose	Trapped/ Dead	94	44.4-65.3
Common teal	Trapped	3809	4.4-9.6
Mallard	Trapped	6499	14.2-68.0
Common eider	Trapped/ Dead	729	15.1-29.0
King eider	Dead	114	11.3-20.0
Red-legged partridge	Shot	64	87.5

Lumeij and Scholten 1989, Tavecchia et al. 2001, Falk et al. 2006, Merkel et al. 2006,
Guillemain et al. 2007, Mateo et al. 2007, 2011, Noer et al. 2007

Non-invasive monitoring: pellets



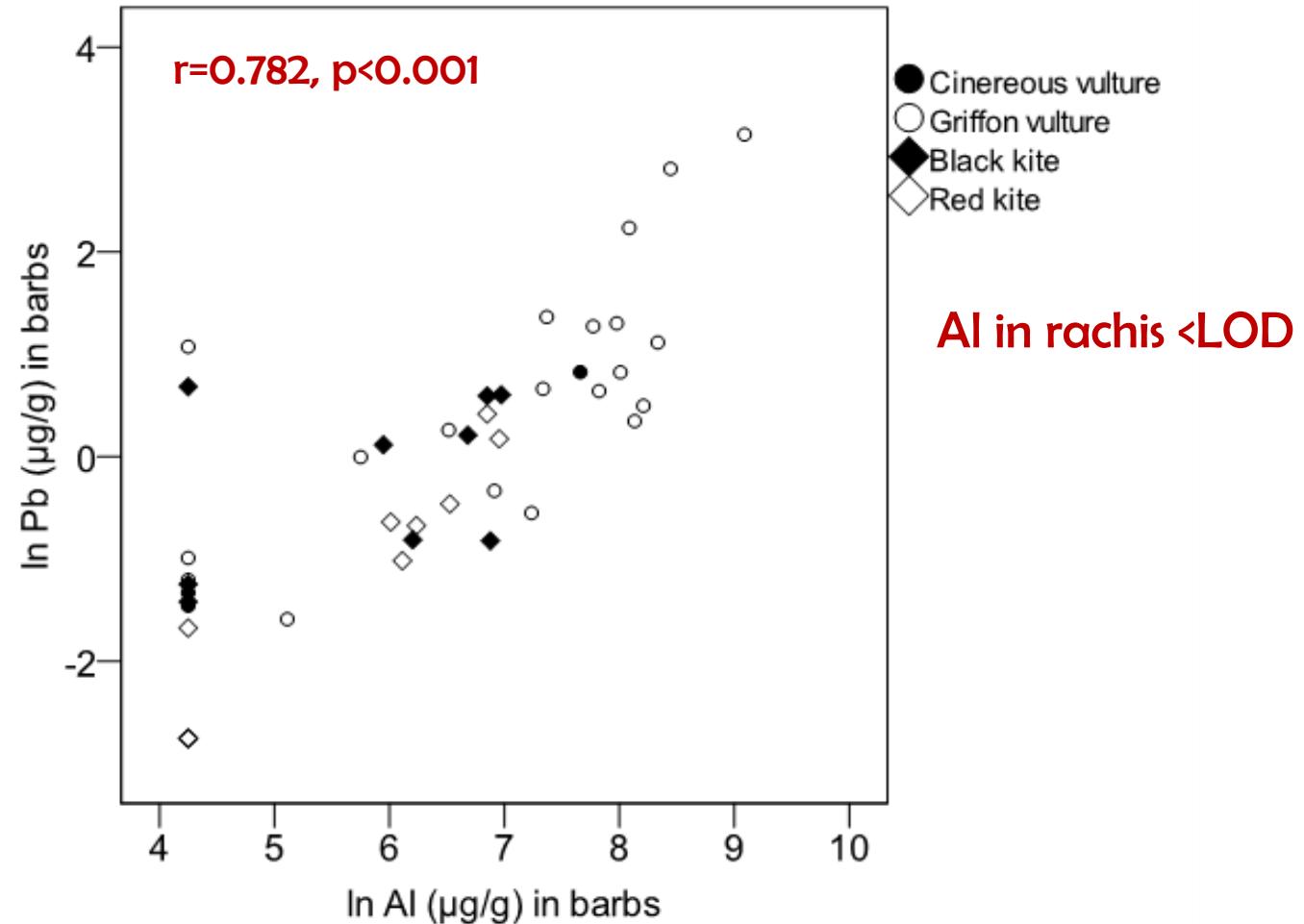
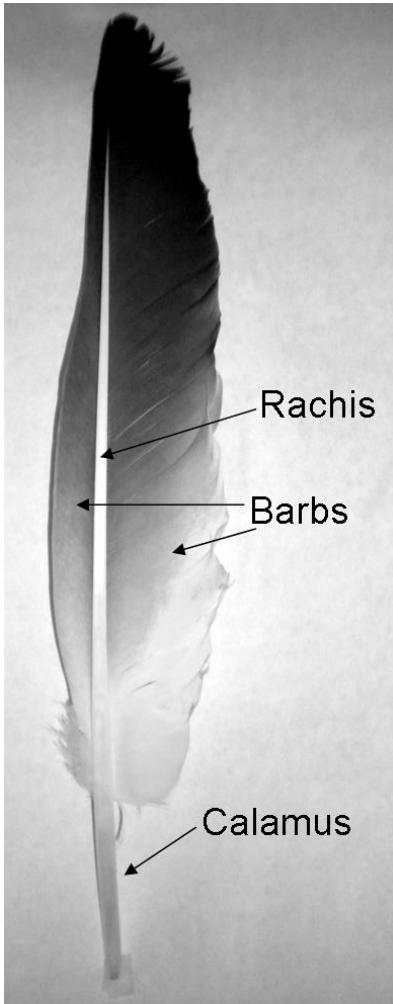
Pellets of marsh harrier

Regurgitated pellets with lead shot

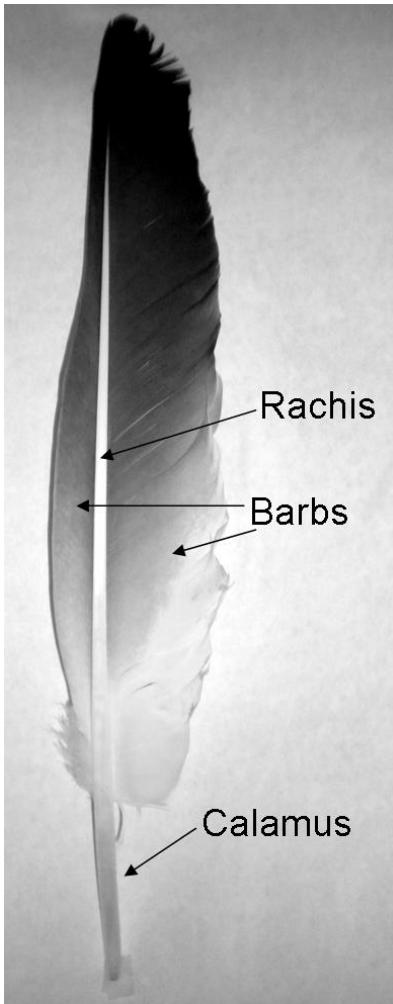
Species	n	%
Red kite <i>Milvus milvus</i>	2459	1.05-2.3
Egyptian vulture <i>Neophron percnopterus</i>	747	0-3.1
Marsh harrier <i>Circus aeruginosus</i>	1493	2.1-14.8
Spanish imperial eagle <i>Aquila adalberti</i>	3015	0.54-4.2
Golden eagle <i>Aquila chrysaetos</i>	-	70
Booted eagle <i>Hieraetus pennatus</i>	76	0
Peregrine falcon <i>Falco peregrinus</i>	117	0.9

González and Hiraldo 1988, González 1991, Pain and Amiard-Triquet 1993, Pain et al. 1993, 1997, 2007, García and Viñuela 1999, Mateo et al. 1999, 2001a, 2007a, Donázar et al. 2002, Gangoso et al. 2008

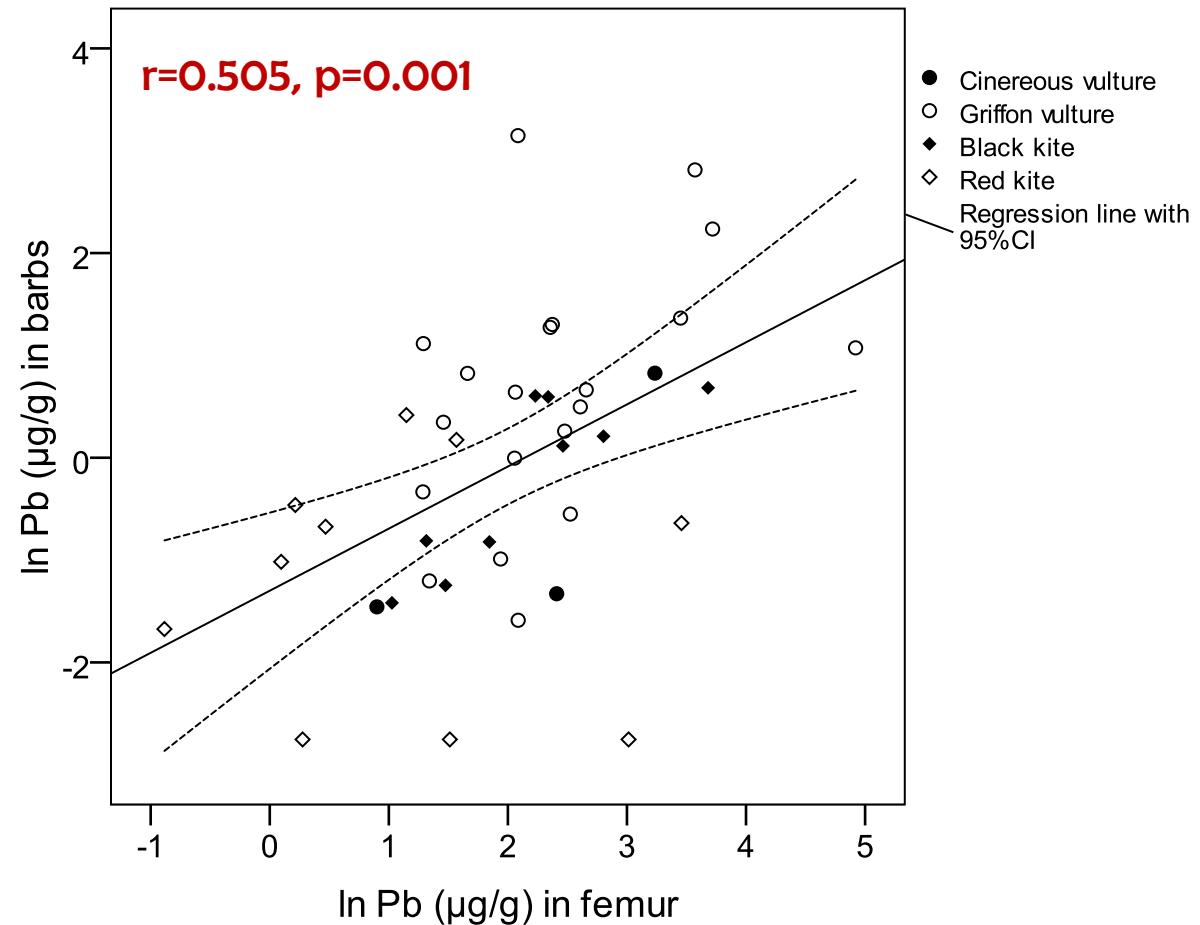
Non-invasive monitoring: feathers



Non-invasive monitoring: feathers

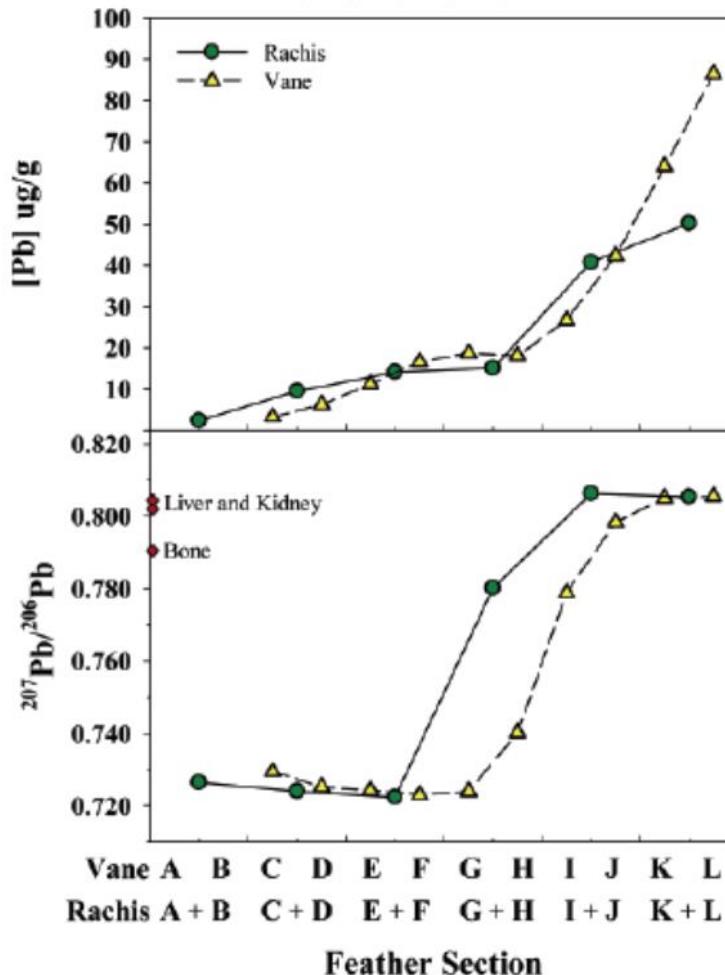
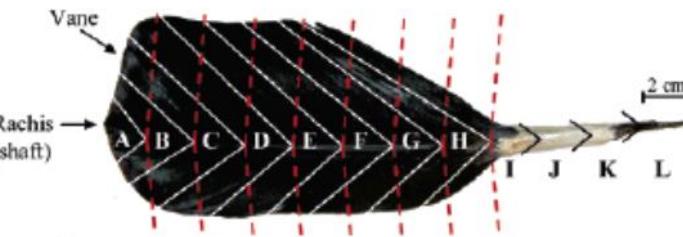
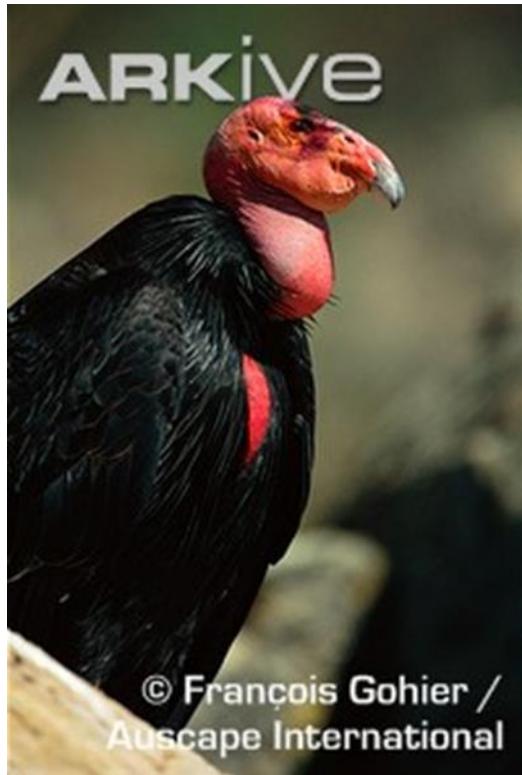


Potential soil-dust exposure

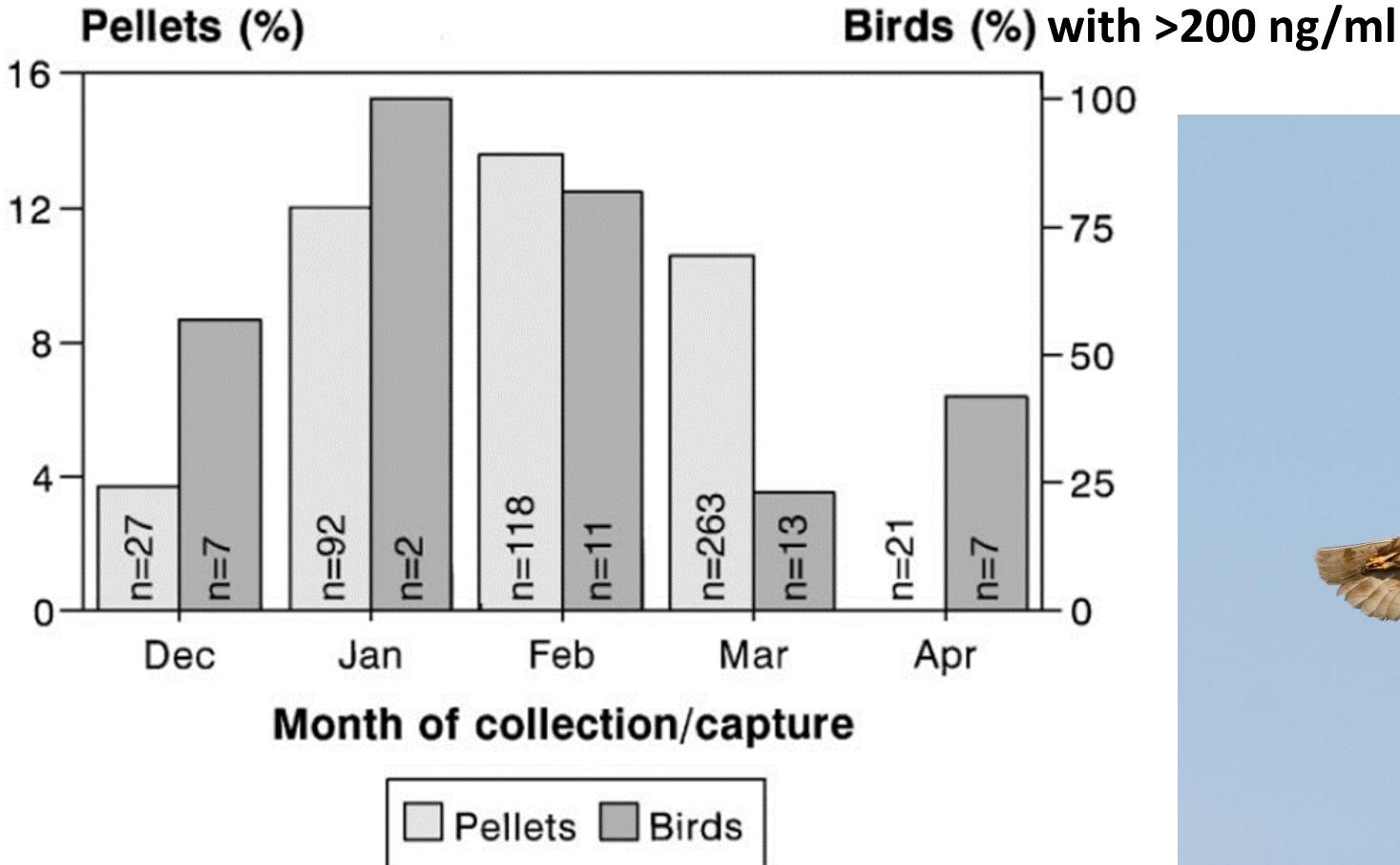


Non-invasive monitoring: feathers

Clean growing feathers



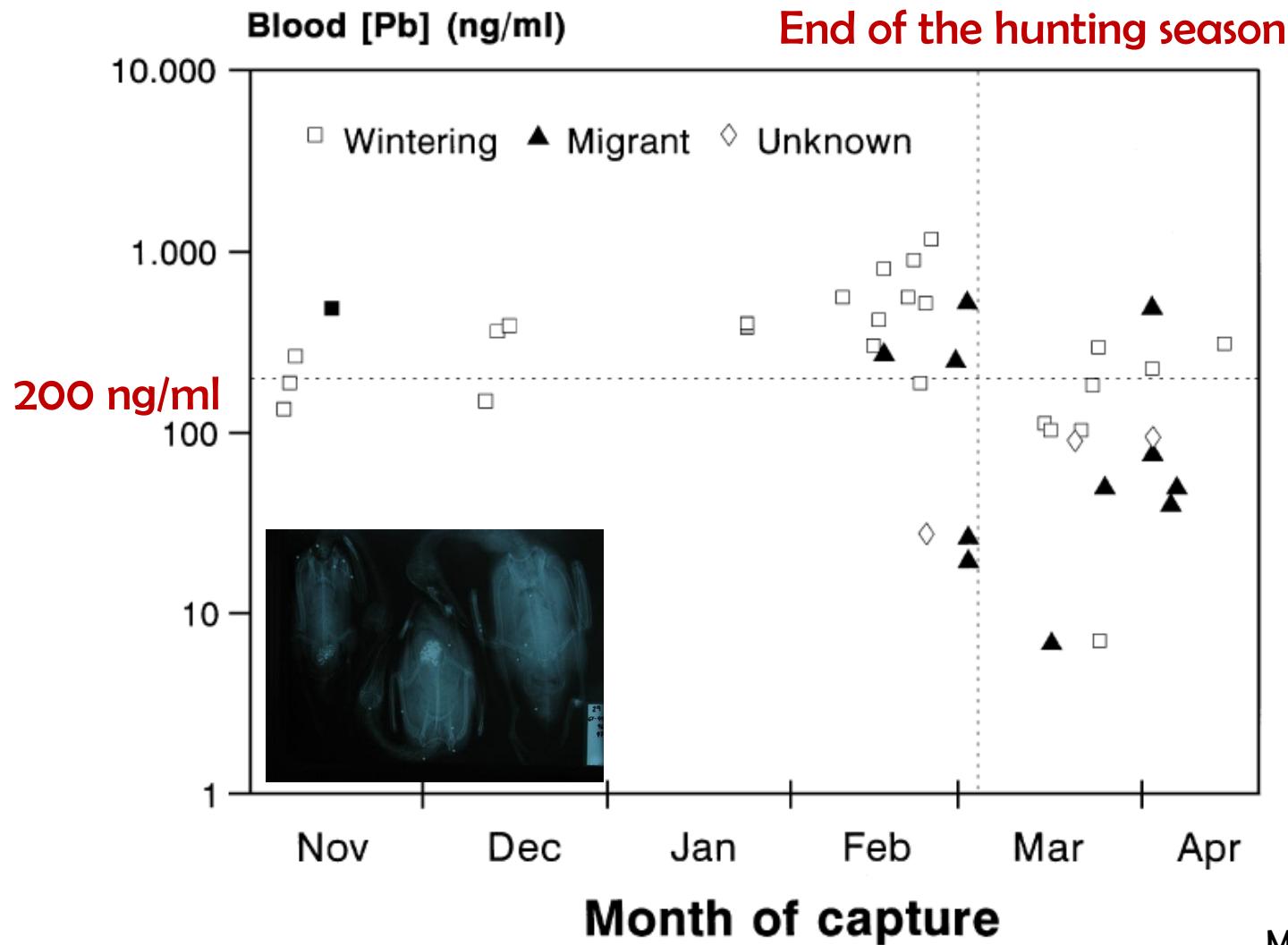
Invasive monitoring: blood



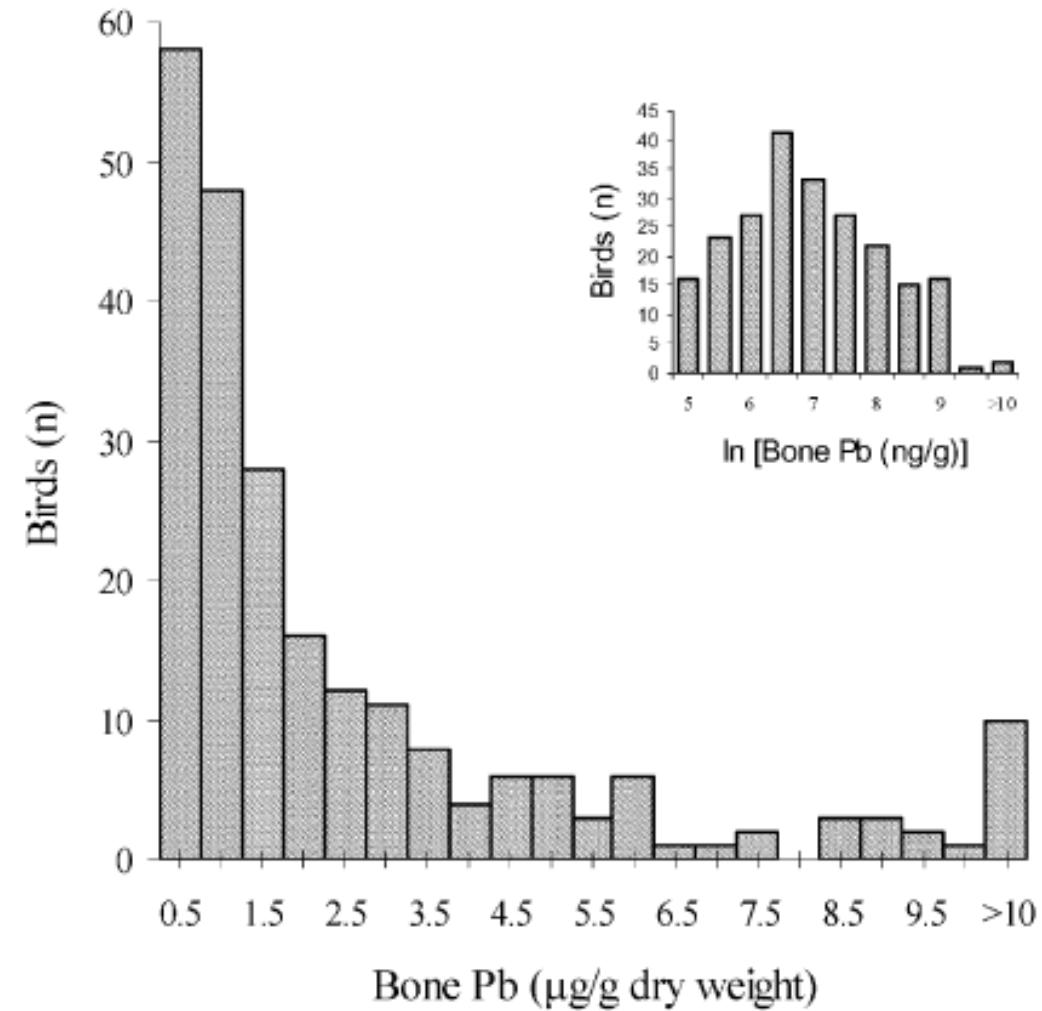
Mateo et al. 1999



Seasonality: Marsh harrier



Passive monitoring: carcasses

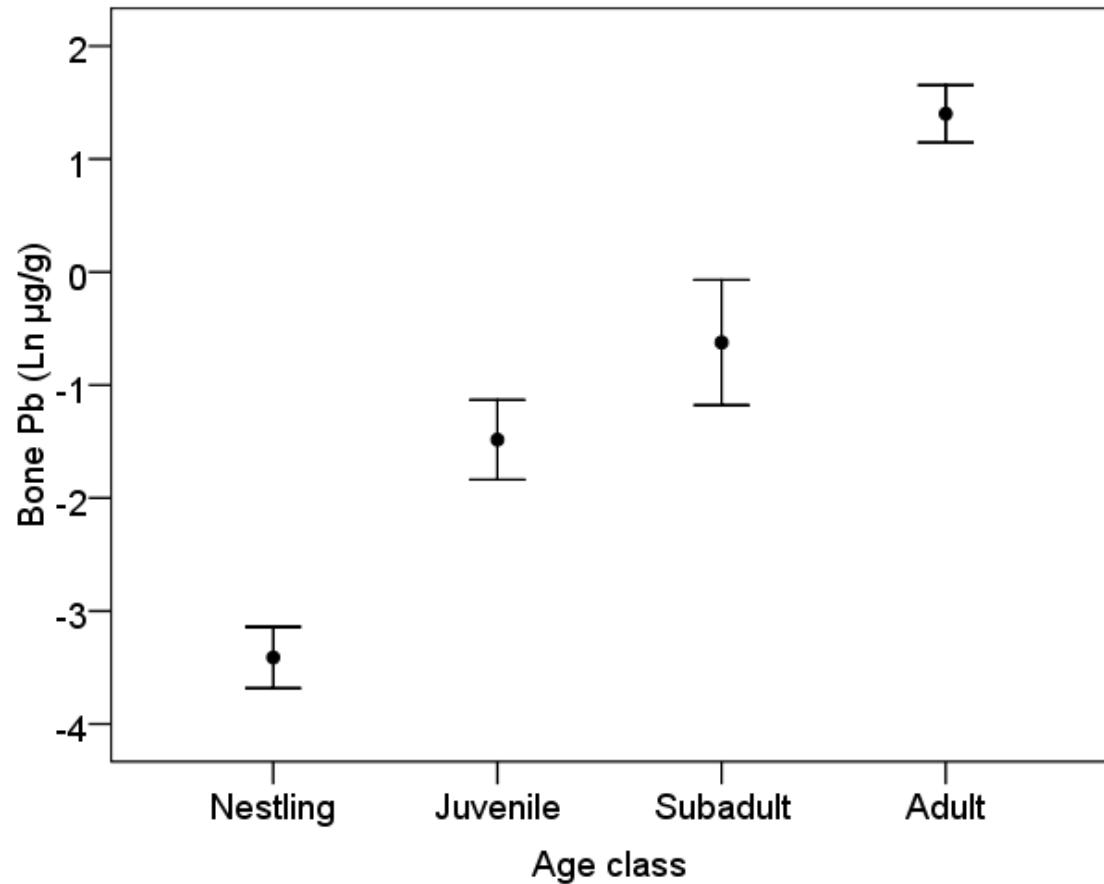


Mateo et al. 2003

Passive monitoring: carcasses

Bioaccumulation
in bones

Increase with age



Lead poisoning in birds of prey

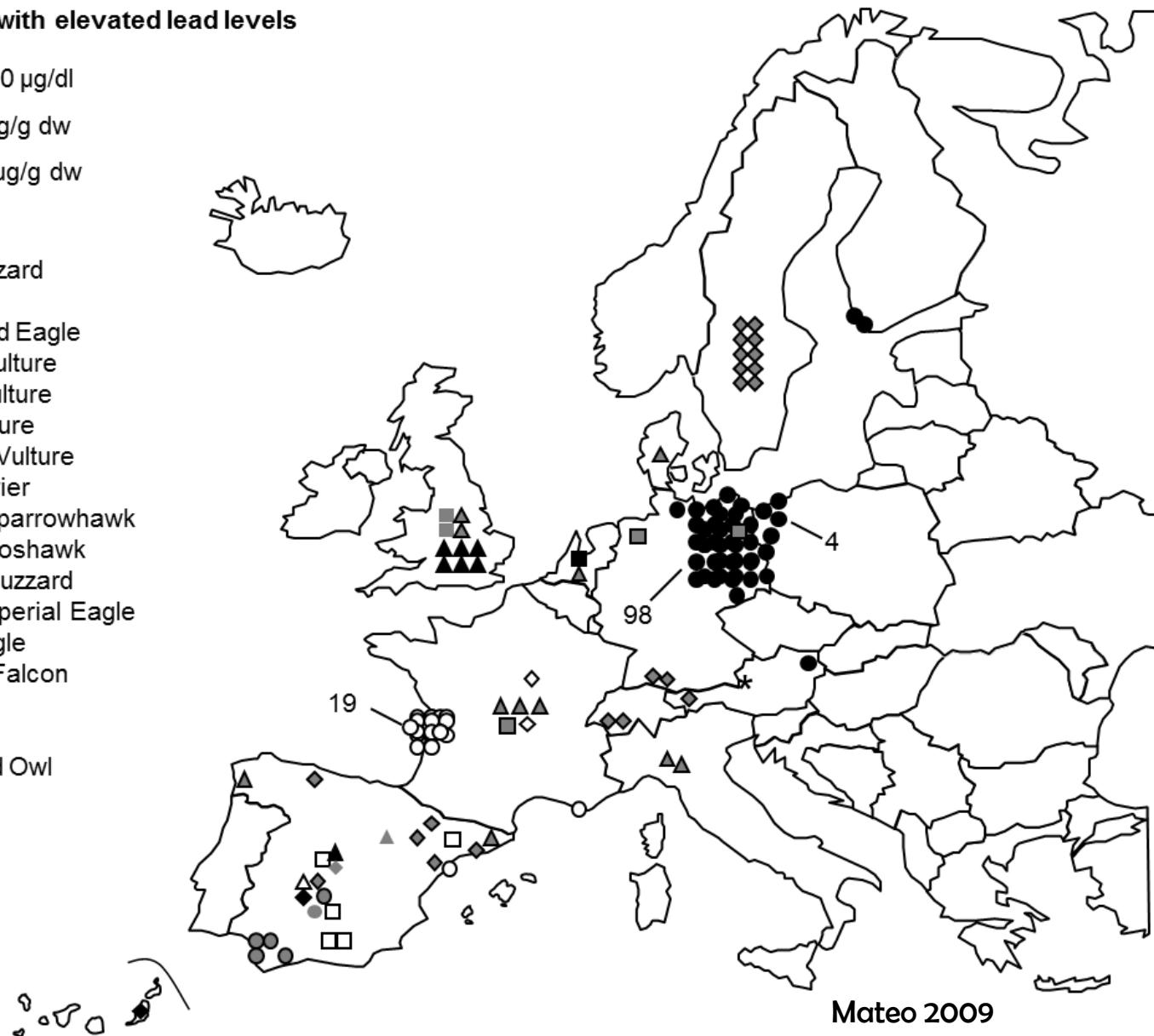
Birds of prey with elevated lead levels

Blood > 100 µg/dl

Liver > 15 µg/g dw

Bone > 20 µg/g dw

- Honey Buzzard
- ▲ Red Kite
- White-tailed Eagle
- ◆ Egyptian Vulture
- * Bearded vulture
- Griffon Vulture
- △ Cinereous Vulture
- Marsh Harrier
- ◊ Eurasian Sparrowhawk
- Northern Goshawk
- ▲ Common Buzzard
- Spanish Imperial Eagle
- ◆ Golden Eagle
- Peregrine Falcon
- ▲ Barn Owl
- Eagle Owl
- ◆ Long-eared Owl



Mateo 2009



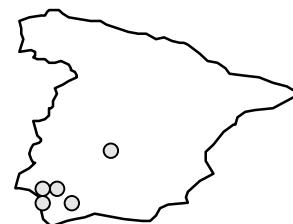
Lead poisoning in opportunistic scavengers



21 lead poisoned



Spanish imperial eagle
Aquila adalberti



Golden eagle
Aquila chrysaetos



5 birds possibly poisoned

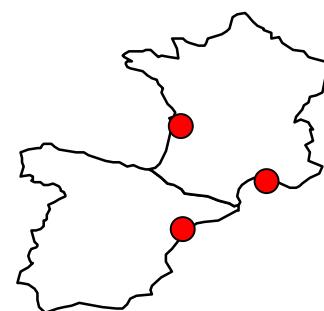
14.7% of regurgitated pellets in winter
with lead shot

12% ($n=34$) with bone $>50 \mu\text{g/g dw}$

Borg 1975, Cerradello et al. 1992, Bezzel and Fünfstück 1995, Zechner et al. 2005, Kenntner et al. 2007, Hernández 1995, Mateo et al. 2001, Pain et al. 2005



Lead poisoning in opportunistic scavengers



26-40% of birds with >300 ng/ml
10.7-14.8% of pellets with Pb shot

Marsh harrier
Circus aeruginosus

Pain et al. 1993, 1997; Mateo et al. 1999



Red kite
Milvus milvus
(Endangered)

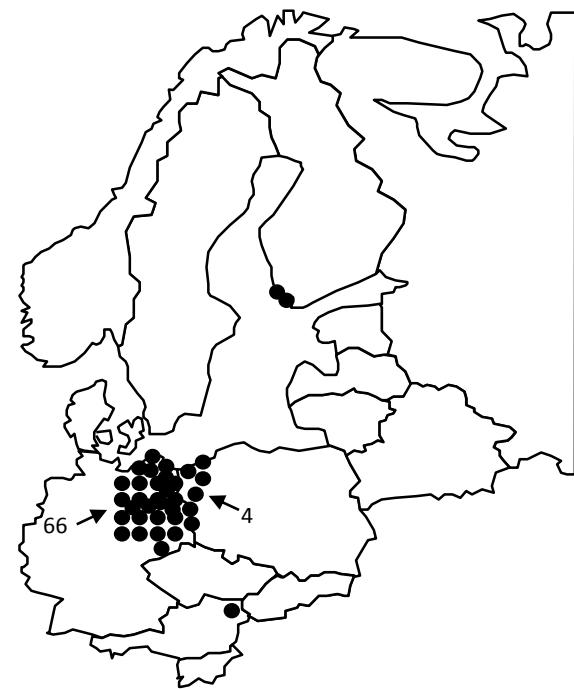
Reintroduction in England:
1.5-2.3% of pellets with Pb shot
13% (n=44) >15 µg/g dw liver Pb

Spain:
5.5% of pellets with shot in Doñana
8.3% (n=12) >20 µg/g dw bone Pb

Mateo et al. 2001, 2003; Pain et al. 2007



Lead poisoning in opportunistic scavengers



Germany: 18-28% of mortality

>74 cases of lead poisoning

Falandysz et al. 1988, 2001; Muller et al. 2001;
Kenntner et al. 2001, 2004, 2005; Krone et al. 2004,
2006, 2009; Kalisińska et al. 2006.

Lead poisoning in vultures



Egyptian vulture *Neophron percnopterus*

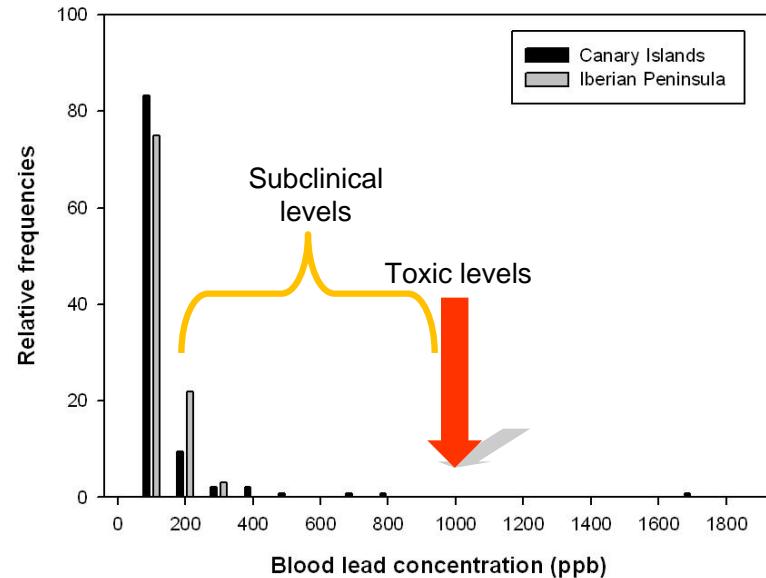


Lead shot in pellets:

Canary Islands: 5.3% (January) – 1.3% (November), n=327

Iberian Peninsula: 0%, n=424

1 Egyptian vulture with 3.1 µg/ml and clinical signs



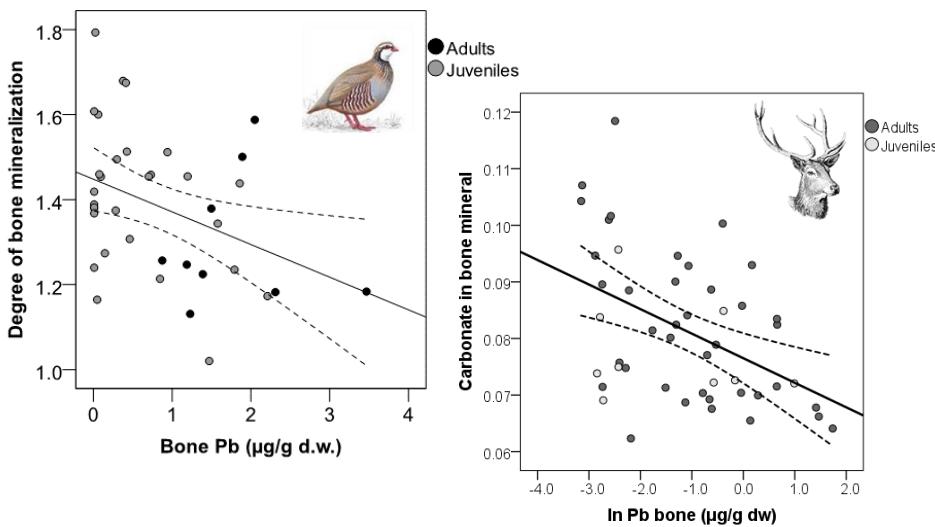
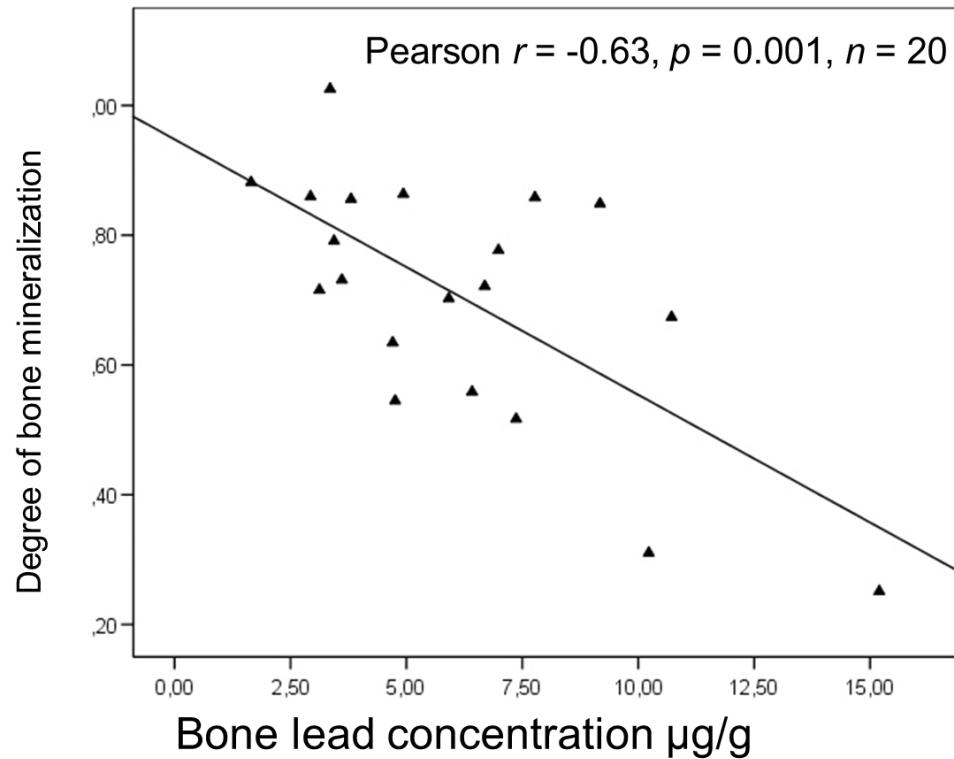
>200 ng/ml in blood:

Canary Islands: 7.3%, n=137

Iberian Peninsula: 1%, n=32

Lead poisoning in vultures

High rate of bone fractures



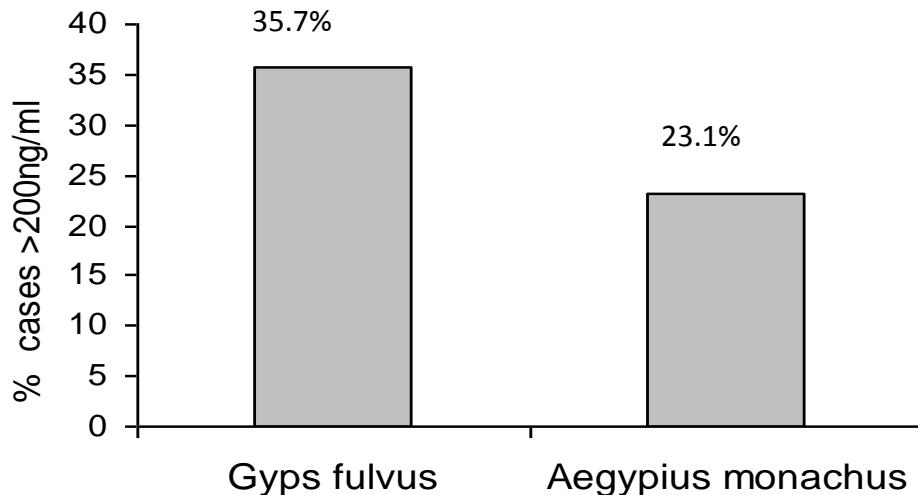
Lower bone mineralization and lower carbonate levels

Gangoso et al. 2009, Rodríguez-Estival et al. 2011,
Álvarez-Lloret et al. 2014

Lead poisoning in vultures



Cinereous vulture *Aegypius monachus*



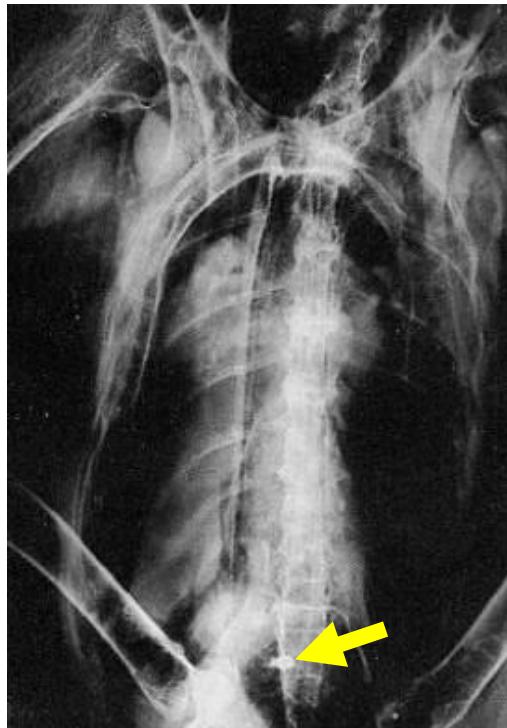
Pb in blood: >200 ng/ml
Castilla-La Mancha (Spain):
23.1% n=13



Several case of lead poisoning
in Central Spain and Mallorca

Lead poisoning in vultures

Griffon vulture *Gyps fulvus*



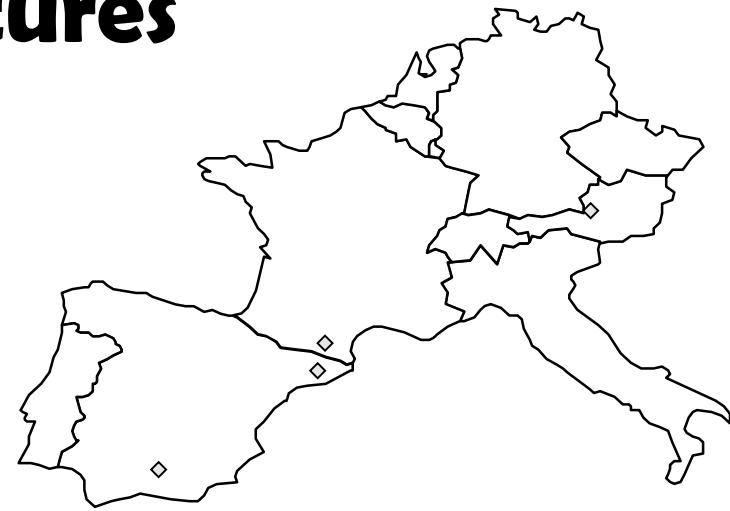
Pb in blood: >200 ng/ml
Spain:
Castilla-La Mancha: 35,7% n=56
Sierra de Cazorla: 91%, n=23

Mateo et al. 1997, García-Fernández et al. 2005, Rodríguez-Ramos et al. 2009,

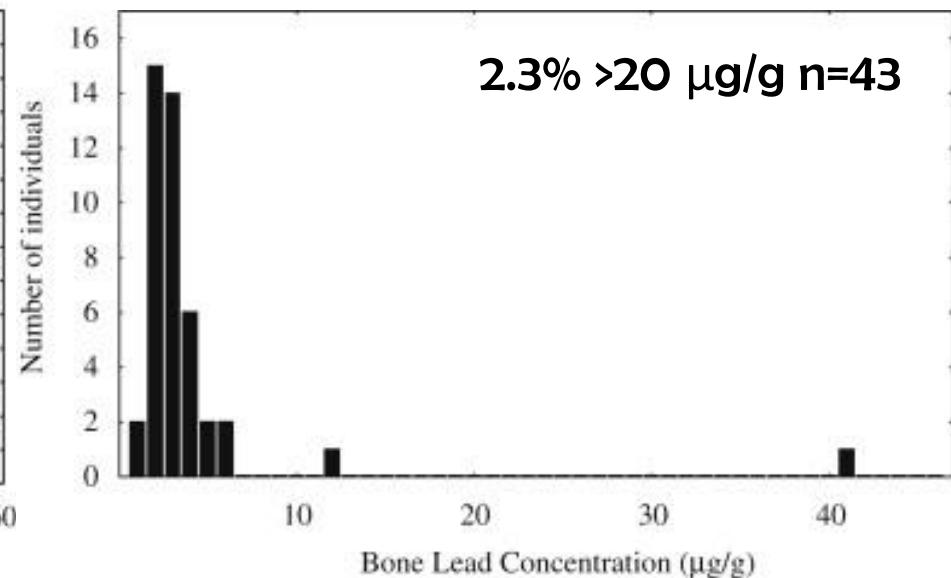
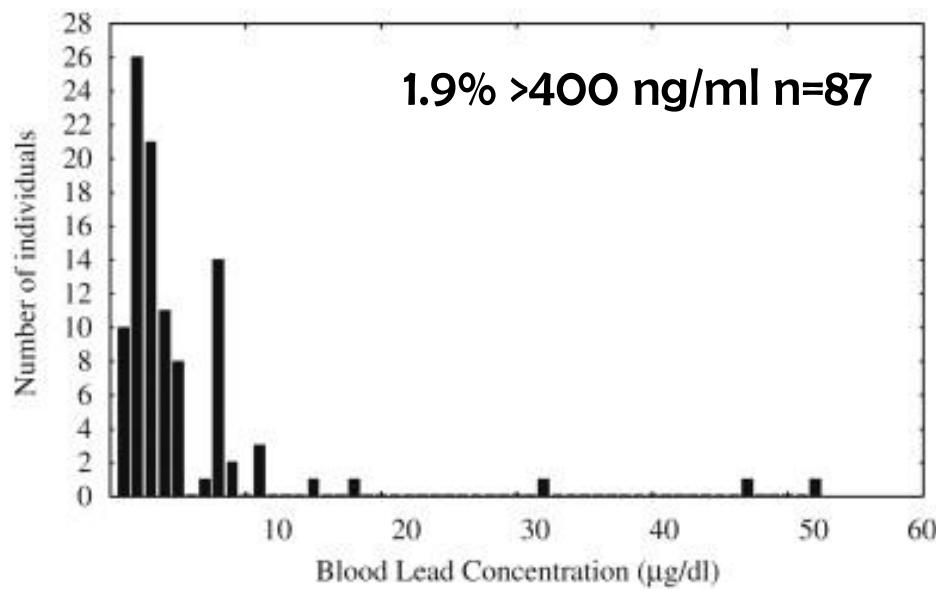
Lead poisoning in vultures



Bearded vulture *Gypaetus barbatus*



Some cases in the Alps, Pyrenees,
Cazorla

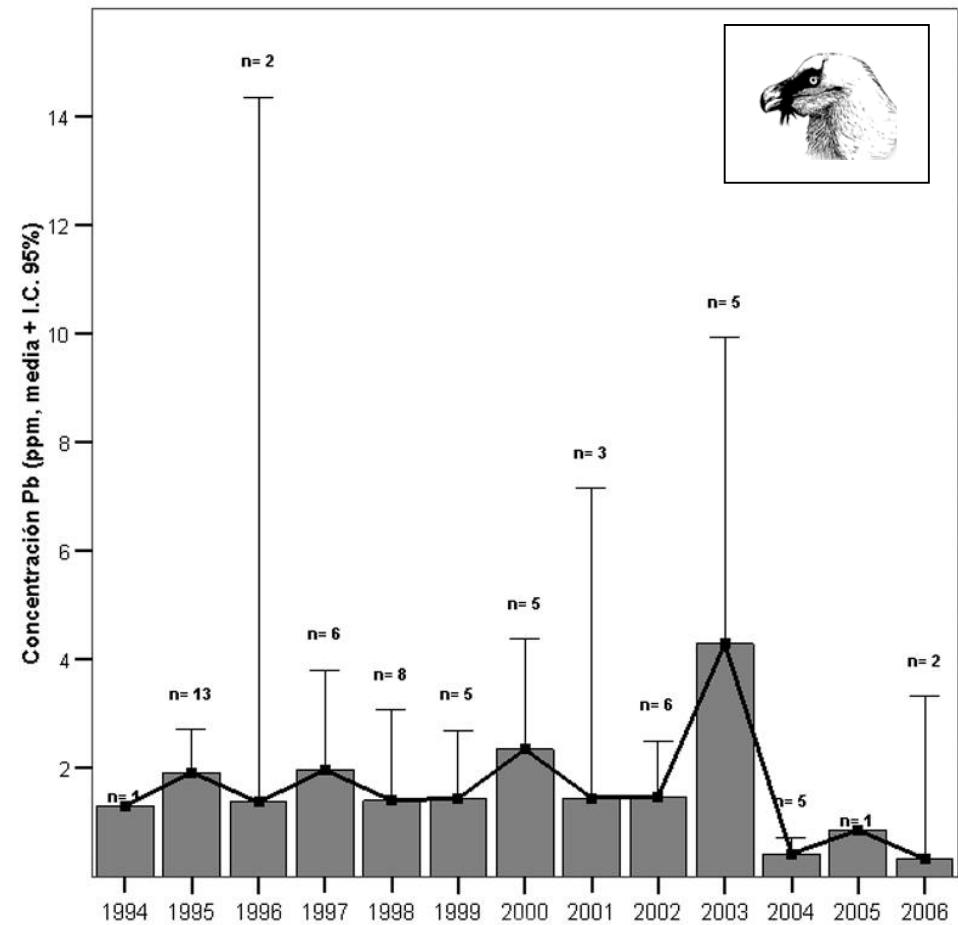


Lead poisoning in vultures



Bearded vulture
Gypaetus barbatus

Concentration in feathers Pyrenees (1994-2006)

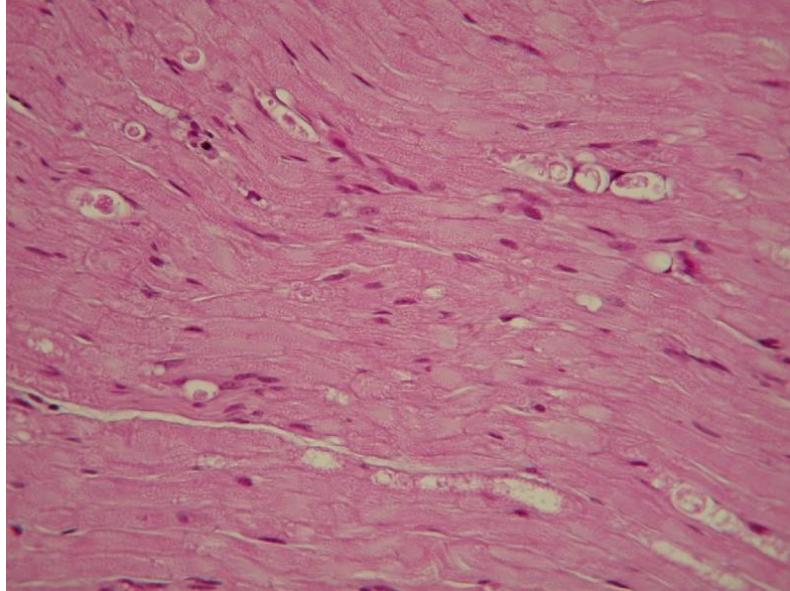


Roscales et al. 2009

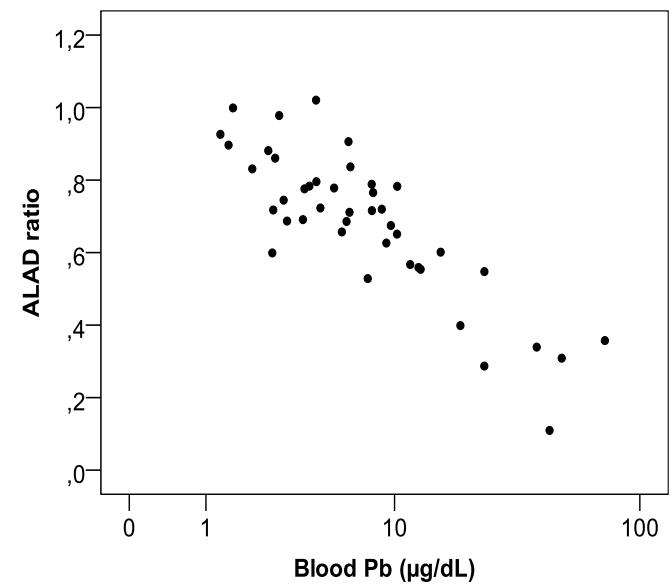
Adverse effects of lead



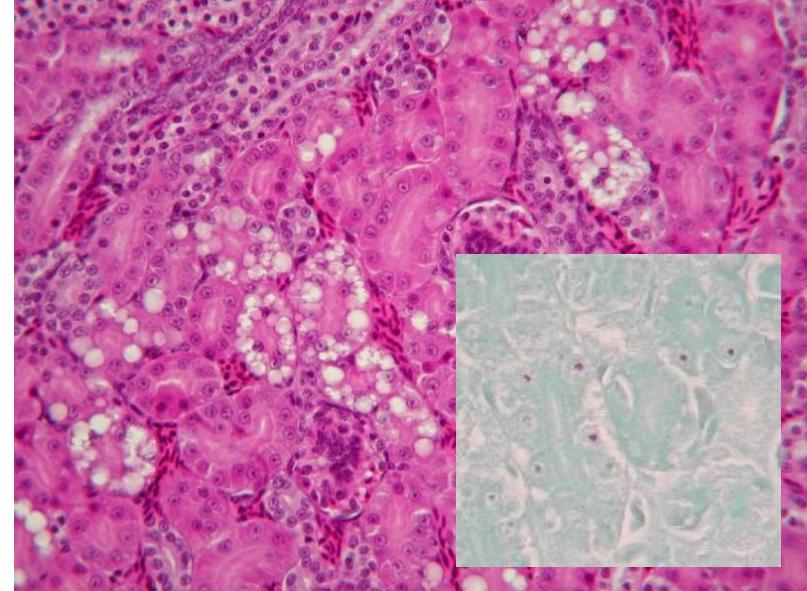
Weakness



Neurotoxicity



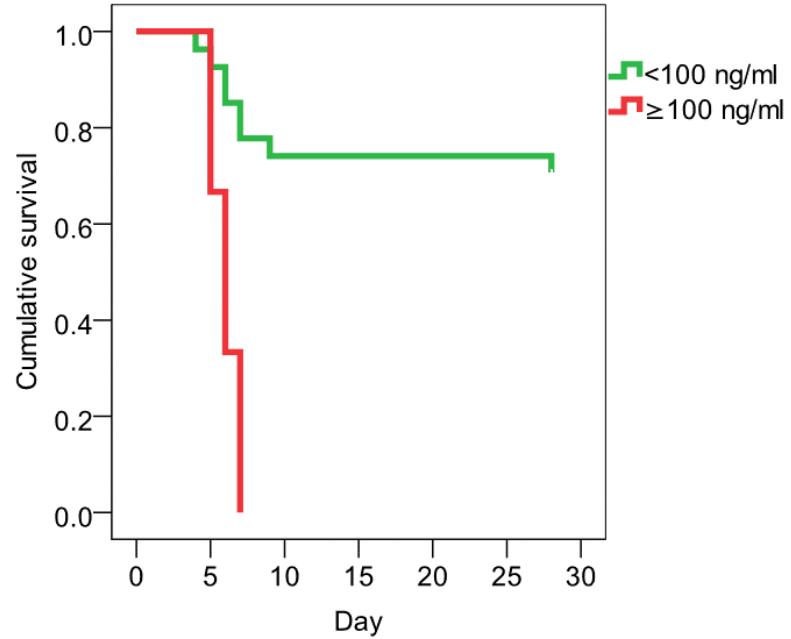
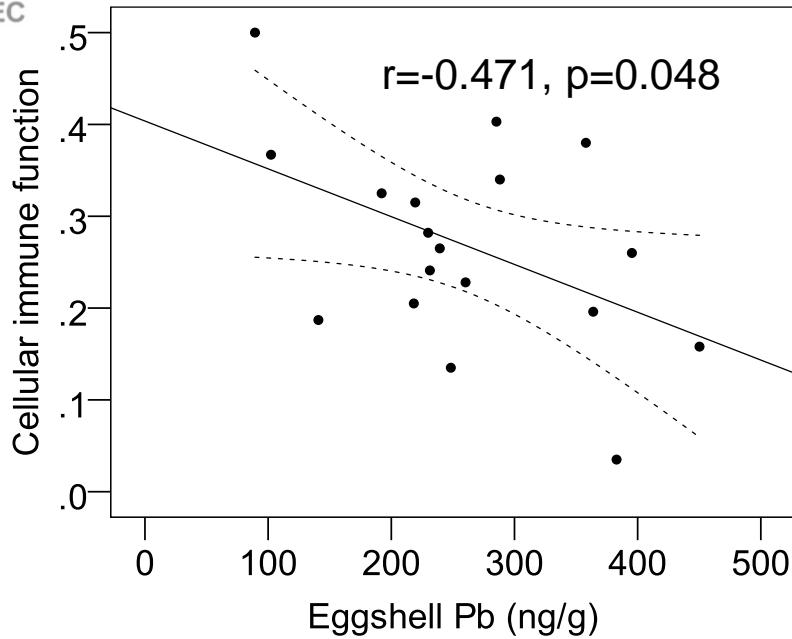
Heme synthesis



Nefrotoxicity

Mateo et al. 2003

Effects in the immune response



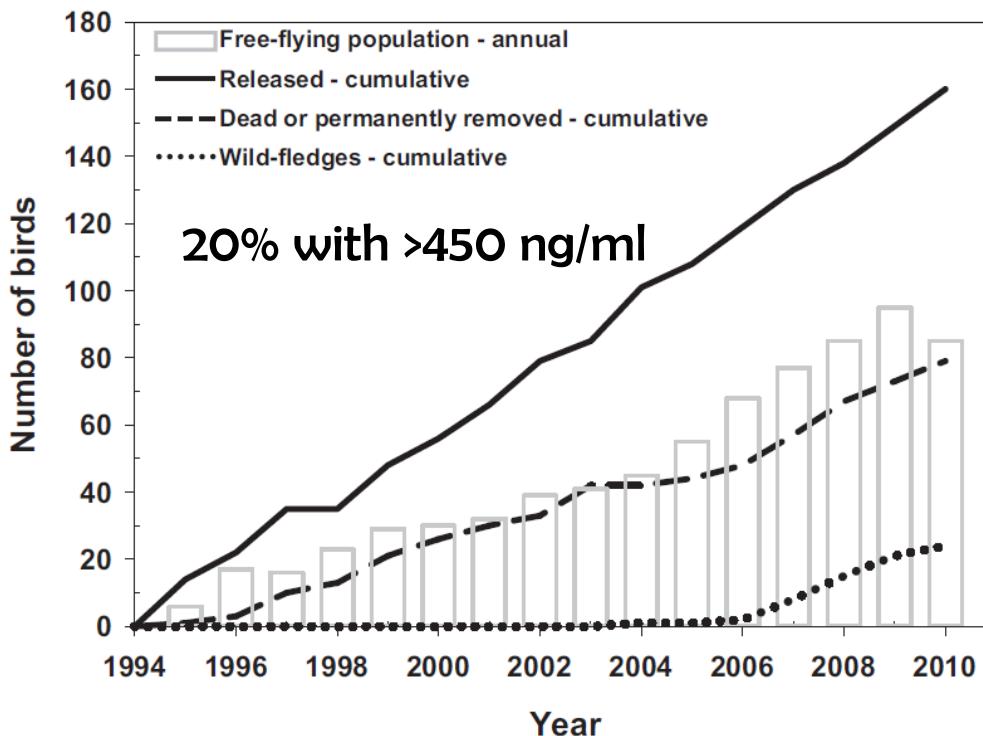
Eggshell and blood Pb correlates with PHA response in ducklings

Lower survival of ducklings with $>100 \text{ ng/ml}$

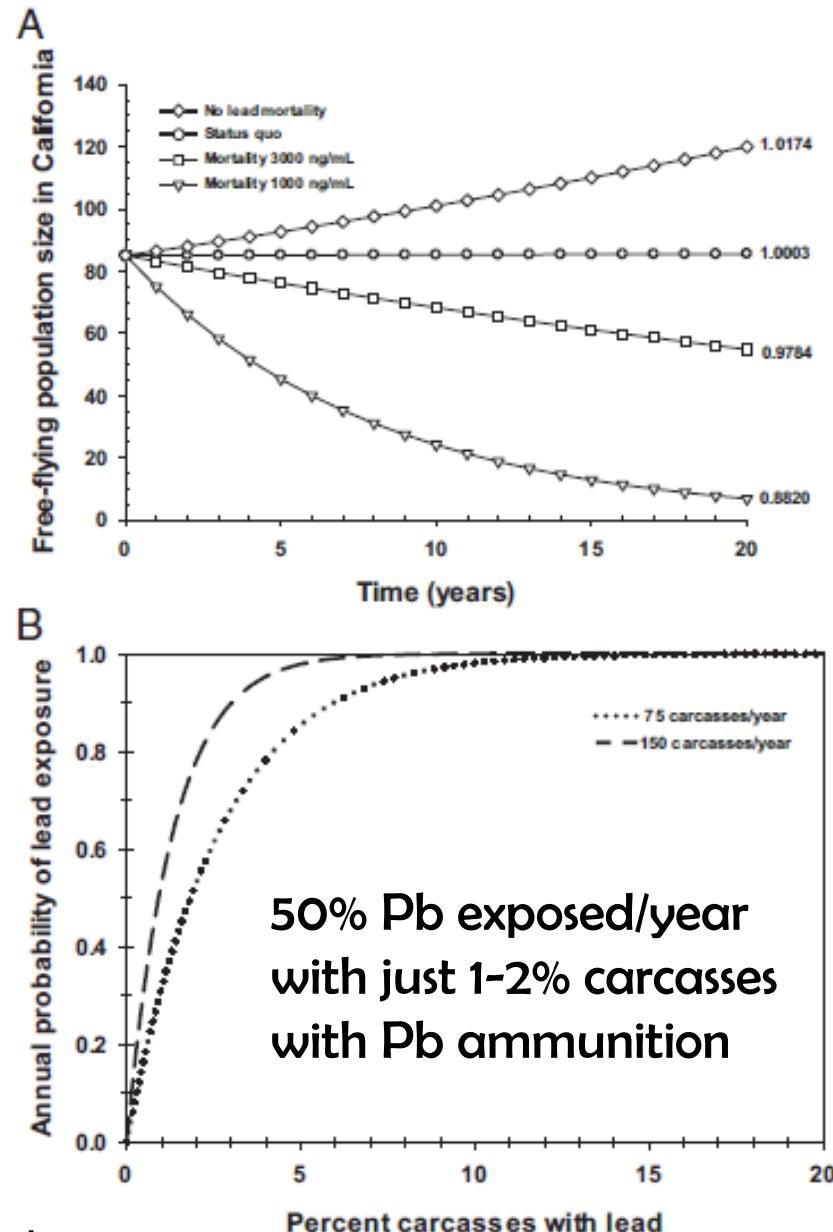
Effects on populations: California condor



Continuous monitoring for chelation therapy



Finkelstein et al. 2012



Thank you for your attention

