



The Food and Environment
Research Agency

Review of evidence concerning the contamination of wildlife and the environment arising from the use of lead ammunition

Roger Quay

Wildlife Management Programme

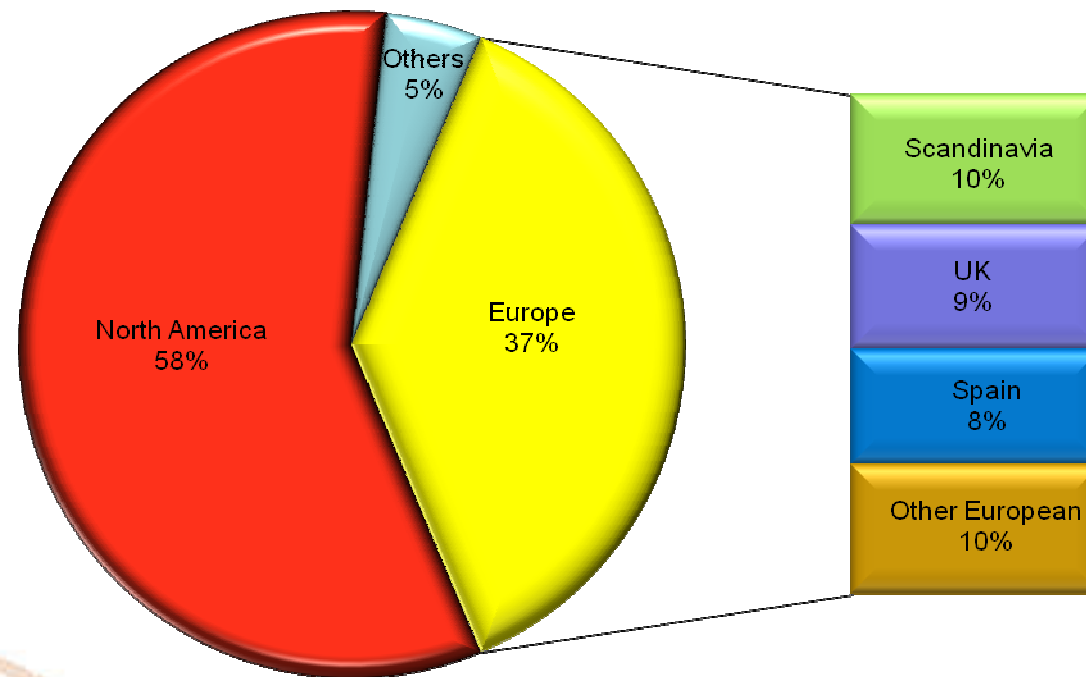
Sand Hutton, York



Scope of the review

- Lead ammunition
 - Shotgun pellets
 - Bullets
 - Airgun pellets
- Environmental fate of spent ammunition
 - Soils, water, plants
 - Wildlife - birds, mammals
 - Humans – contaminated game
- Remedial measures
 - Immobilisation
 - Recovery and recycling
 - Non-toxic ammunition

Where the studies were carried out



- 300 peer-reviewed articles, Government Agency reports.

Concern about lead ammunition

- Worldwide
 - USA, Canada, Europe, Australia/NZ, Japan, Korea, Argentina (first report 2009)
- First recorded over 100 yrs ago
 - Calvert, 1876
 - Grinnell, 1894



Fate of lead

- Universal contaminant, occurs naturally
- No known biological function
- In soils, complete transformation of metallic lead into lead compounds in 100-300 years, 50% in 40-70 years.
- Lead much more soluble under acidic conditions (pH<6.0). (pH in gizzard of Bald eagle 1.3, Snowy owl 2.5, duck 2.1)
- High CaCO_3 , Fe, Al, P reduce lead mobility

Shooting activities

- Wildfowling
 - Ducks, geese
- Game shooting
 - Pheasants, partridges, grouse
 - Deer, wild boar
- Pest control
 - Rabbits, rodents, pigeons
- Target shooting

Wetlands - seasonal

Farmland, forests,
moorland – seasonal,
all year (pests, wild
boar)

Designated shooting
ranges – all year

Source of contamination

- Spent pellets

Primary poisoning of birds – pellets ingested as grit or mistaken for seeds. Plants absorb dissolved lead through roots.

- Embedded shot/bullet fragments
- Biol-incorp lead

Secondary poisoning of raptors, humans (mammalian predators & scavengers?)

- Spent bullets

Abrasion and weathering leads to contamination of soils and groundwater. Lead dust adheres to leaf surface.

Level of contamination – pellet densities

- Wetlands
 - 300,000/ha
 - >2,000,000/ha
- Game-shooting
 - 107,639/ha
 - 560,000/ha
- Trap & skeet
 - 3.7×10^9 /ha

Densities vary due to:

Core depth

Time of year

Size of sieve

Size of shot-fall zone

Lead shot ban for wildfowling

- Came into force in England in 1999. Effect unknown, compliance 'low'.
- Nationwide ban in the USA in 1991, by 1997 estimated that 1.4 million of 90 million ducks spared from fatal lead poisoning. Compliance considered 'high'.
- Similar bans in Canada, most of Europe, Australia, New Zealand.
- Most Governments still allow lead ammunition for other forms of hunting.

Exposure of non-waterfowl birds to spent ammunition

- Ingestion rates tend to be lower compared with wildfowl.
- Low rates may be deceptive – higher rates found when non-toxic shot used.
- More rapid voiding of pellets.
- Raptors can expel shot/bullet fragments via regurgitated pellets.
- Kestrels expelled shot after 1 day, but bald eagles retained shot for up to 48 days.
- Dust-sized shot/bullet fragments in gut piles and unretrieved bodies can be rapidly dissolved and absorbed.

Risk to humans from spent ammunition

- Greatest risk for communities that depend heavily on game for subsistence.
- Risk associated more with embedded lead rather than biologically-incorporated lead.
- Traditional recipes may help dissolve lead fragments (e.g. use of vinegar).
- Difficult to detect and remove all shot/bullet fragments.
- No 'safe' level of lead.

Reducing exposure to spent ammunition

- Reducing availability
 - Cultivation to bury pellets
 - Adding phosphorus to reduce lead solubility
 - Liming to raise pH
 - Phytostabilisation to bind lead.
- Recovery and recycling
 - Rubber granule traps, shot curtains
 - Vacuuming
 - Hydrodynamic, density or gravity separation

Reducing exposure

- Encourage or compel use of ‘non-toxic’ ammunition.
 - Steel
 - Bismuth
 - Tungsten composites
 - Copper/tungsten/tin bullets



Conclusions

- Problem has been present for decades
- Mass die-offs rare, perception is 'no problem'
- Lack of bodies hides the scale of the problem
- Site-specific factors determine degree of risk
- Population effects of lead poisoning unknown
- Raptor pops. naturally small, slow breeding & susceptible to increases in adult mortality
- Lead poisoning one of many mortality factors
- Risks to humans from contaminated game?