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LEAD IN HUNTING AMMUNITION: WHAT ARE WE WAITING FOR?

For about fifteen years, the Italian Institute for Environmental Protection and Research (ISPRA) has been warning the Italian national and regional authorities of the need to phase out the use of lead ammunition for hunting in wetlands and terrestrial ecosystems to prevent damages to wildlife, the environment, and human health (Andreotti & Borghesi 2012). This recommendation raised protests from hunting associations and ammunition manufacturers, who started pushing

to prevent the introduction of bans on the use of lead-based ammunition. To date, ISPRA's advice has been largely ignored, and the issue is still far from being solved.

But why did ISPRA decide to solicit initiatives to ban lead in hunting ammunition?

Evidence of the adverse effects of lead ammunition on waterbird populations dates back to the 19th century. The Italian ornithologist Paolo Savi was the first to describe and hypothesize lead poisoning in birds based on acute observations and analysis of the behaviour of mallards *Anas platyrhynchos*, carried out from 1786 to

1829 and published posthumously (Savi 1876). Actually, ducks, geese, swans and other waterbirds die in large numbers following the ingestion of lead gunshot lying on the wetland bottom (Andreotti *et al.* 2021). Birds swallow gunshot because they normally collect grit to grind off food in their muscular gizzard. Gunshot and grit are similar in size and hardness; therefore, birds do not distinguish them. Since gunshots are retained in the gizzard until they are completely eroded, lead has the time to be fully absorbed by the body (Bellrose 1959). Birds ingesting lead experience anaemia, diarrhoea, weight loss, severe behavioural disorders, damages to the reproductive system, reduced ability to fly, or total inability to fly and feed. A single lead gunshot is enough to cause lead poisoning in a medium-sized bird, whereas 4-5 shots can provoke death (Pain *et al.* 2019).

On the other hand, the awareness on the impact of lead ammunition in terrestrial habitats is relatively more recent. The first proof of the adverse consequences on landbirds emerged in the mid-1970s, during the campaigns to save the California Condor *Gymnogyps californianus* from extinction (Finkelstein *et al.* 2012). Since then, the pathways through which birds ingest lead from ammunition and the effects of this metal on individuals and populations have been deeply investigated (Delahay & Spray 2015, Krone 2018, Green *et al.* 2022). Furthermore, evidence of the impact on birds has prompted researchers to assess whether lead ammunition could also have nega-

tive consequences on the health of humans (Green & Pain 2019) and wild mammals (Hydeskov *et al.* 2024). Scientists have long since reached a consensus on the severity of the problems (Bellinger *et al.* 2013, Group of Scientists, 2014).

Terrestrial birds get contaminated with lead from spent ammunition through two pathways. Granivorous birds ingest lead gunshots lying on the soil surface, as waterbirds do. In the EU, about 1.3 million birds are estimated to die each year from lead poisoning due to the ingestion of lead pellets (ECHA 2022).

Predatory and scavenging mammals and birds are exposed to lead when feeding on living animals or carcasses of game species previously shot with lead ammunition (Pain *et al.* 2019). The number of prey hit by hunters and not retrieved may be high (Tavecchia *et al.* 2001); this means that the probability that a carnivorous species feeds on meat contaminated by lead from ammunition is not negligible. Furthermore, in mountainous areas, hunters often leave the viscera of killed ungulates on the hunting ground to preserve the organoleptic qualities of the meat and facilitate the transport of the prey. A study carried out in the Italian Alps (Bassi *et al.* 2014) revealed that 62% of the discarded viscera are contaminated by many tiny lead fragments resulting from the impact of the bullet against the body of the prey. This helps explain why a high percentage of scavenging raptors in Italy are contaminated with lead, given the high number of wild ungulates harvested by hunters each year (Carnevali *et*

al. 2009, Ramanzin *et al.* 2010).

Eagles and vultures are particularly at risk because they are long-lived species with delayed sexual maturity and a low reproductive rate. In some areas with intense hunting, virtually every bird is lead-poisoned before it has produced enough offspring to guarantee the recruitment into the population (Bassi *et al.* 2021, Green *et al.* 2022). Currently, lead poisoning likely represents the main limiting factor for recolonisation of the Alps by the Bearded Vulture *Gypaetus barbatus*, an endangered raptor that has returned to Italy as a result of an international long-lasting reintroduction programme (Ganz *et al.* 2018).

As mentioned above, in Italy, the picture is particularly alarming. Of 205 large scavenging birds found dead or weakened, 98 (47,8%) had lead levels exceeding background values in at least one of the tissues (blood, liver, kidney and bone) for which threshold for lead exposure are defined (Franson & Pain 2011) (Tab. 1). Considering that some individuals with

background values had high lead levels in the brain or the blood clot, tissues for which reference values are not available, the prevalence of lead exposure is likely even higher (66.9% according to Bassi 2025, based on 281 large birds of prey).

The seriousness of the situation became evident to the public in 2025 when three lead poisoned Golden Eagles *Aquila chrysaetos* were found in the waters of pre-alpine lakes over the course of eight months.

Like birds, humans are exposed to lead when consuming meals containing meat from game killed with lead ammunition. The prey bagged by hunters are contaminated by many small lead fragments, even in parts of the body far from the tissues penetrated by the bullet or the gunshot, and therefore it is not feasible to remove them during food preparation (Hunt *et al.* 2006, Andreotti *et al.* 2016). In a study on dietary exposure to lead in the European population, EFSA (2025) found the highest mean lead occurrence in the food category 'Meat and meat products',

Table 1. Prevalence of lead exposure in large obligate or facultative scavenging birds caught or found dead or injured in Italy. Threshold values for subclinical and clinical exposure from Franson & Pain (2011). (Bassi *et al.*, 2021; Bassi 2025 and unpublished data).

Species	n. individuals	n. background values (%)	n. subclinical values (%)	n. clinical values (%)
Golden Eagle <i>Aquila chrysaetos</i>	114	41 (36.0)	36 (31.6)	37 (32.5)
Griffon Vulture <i>Gyps fulvus</i>	77	54 (70.1)	16 (20.8)	7 (9.1)
Bearded Vulture <i>Gypaetus barbatus</i>	11	10 (90.9)	0 (0.0)	1 (9.1)
Cinereous Vulture <i>Aegypius monachus</i>	3	2 (66.7)	0 (0.0)	1 (33.3)
Total	205	107 (52.2)	52 (25.4)	46 (22.4)

because of the extreme lead concentrations found in game mammals' meat. This situation poses a concrete risk for high consumers of game meat, including hunters and their families. As the meat cooks, high temperatures and acidic ingredients such as vinegar and tomato facilitate the transformation of these metallic lead particles into an ionic form, which is easily absorbed by the intestinal tract (Hunt *et al.* 2009, Mateo *et al.* 2011). Indeed, it has been proven that even the consumption of a few servings of lead-shot game meat per month is sufficient to increase the blood lead levels (Iqbal *et al.* 2009).

To counteract this situation, several initiatives have been adopted at the international level in the framework of multilateral environmental agreements, first of all the Convention on Migratory species (UNEP-CMS), which approved a resolution in 2014 to phase-out the use of lead ammunition in all habitats (wetland and terrestrial) with non-toxic alternatives.

In the meantime, the European Union (EU) has become aware of this serious problem. In January 2021, after a long technical investigation, the EU Parliament and the Council approved a restriction on carrying and using lead gunshots in or within 100 metres of wetlands (EU 2021). The restriction came into force in February 2023, becoming valid immediately throughout the territory of the Union. Furthermore, the European Commission (EC) requested the European Chemicals Agency (ECHA) to prepare a technical dossier to support a restriction proposal on the use of lead ammunition in terrestrial

habitats. ECHA's investigation confirmed the adverse effects of lead ammunition on wildlife, the environment and human health and proved that hunting with lead-free ammunition is possible (ECHA 2022). Consequently, the EC proposed to the EU Parliament a restriction whose approval is still pending (Pain *et al.* 2025).

Italy has not fully implemented the EU restriction on carrying and using lead gunshot in wetlands. Indeed, in 2024, the Italian Parliament approved Law 166/2024 to limit the geographical scope of the restriction to a few categories of wetlands (Ramsar sites and wetlands in protected areas or in Natura 2000 sites). Following this, the EC raised objections to Italy under EU Pilot 10542 (2023) concerning the incomplete compliance with the European directives for some hunting issues. The dispute between Italy and the EC is still ongoing.

To make the situation worse, very limited restrictions have been approved by regional Administrations to prohibit the use of lead ammunition in terrestrial ecosystems following ISPRA's recommendation. In Italy, the "lead affair" seems destined to become a never-ending story.

Italy's position is in stark contrast to the initiatives adopted by other EU member States, such as Denmark and the Netherlands, which have long chosen to ban the use of lead in any kind of hunting ammunition.

On this highly controversial issue, clarity is needed to prevent polarization between supporters and opponents of hunting. The scientific community, includ-

ing ornithologists, has a responsibility to disseminate correct information and find adequate solutions.

As highlighted by ECHA, hunting can continue to be carried out safely and satisfactorily using alternative lead-free ammunition, now available on the market at affordable prices (Kanstrup & Thomas 2019). Therefore, mandating the use of alternative ammunition is a win-win solution, that prevents millions of birds from dying of lead poisoning, safeguards the health of game meat consumers, prevents environmental pollution, and ensures a future for hunting.

To introduce this change, however, it is crucial to involve hunters, informing them about the risks related to the use of lead to themselves and their families, the environment in general, and the species they hunt (Kanstrup & Thomas 2020). It is necessary to clearly communicate that a ban on lead ammunition is not intended to hinder hunting: on the contrary, phasing out lead in cartridges and bullets is the only way to make hunting sustainable in the long run (Kanstrup *et al.* 2018).

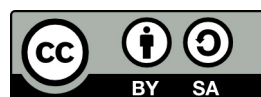
Nevertheless, the need to spread awareness should not be used as an excuse to delay the introduction of a ban. The time has come to establish an accelerated transition to lead-free ammunition, respecting the tight timeline defined by the EC in its restriction proposal and supported by 102 scientists from 15 European countries and seven countries beyond Europe (Group of Scientists 2025).

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