

## LETTERS



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## Illegal killing of birds in Europe continues

The European Union has enacted several legislative directives (1–3) in an effort to halt the illegal killing of wildlife. The Environmental Crime Directive (3) requires EU member states to address the killing and trade of protected species and to put an end to the substantial losses of habitats that form the Natura 2000 network of protected areas (4). The European Union has also signed on to international conventions on wildlife crime (5, 6). Despite these global efforts to protect biodiversity, illegal killing and trade of birds in the European Union continues unabated. Policy-makers must prioritize the protection of birds and other wildlife by recognizing that the current legislation is ineffective and developing an improved strategy.

The current EU legislation falls short in several ways. First, the final goal of most environmental regulations is to protect and benefit humans, not to conserve the environment in which both humans and

wildlife live (7). Second, the legislation is not enforced, allowing countries to flagrantly flout the law. For example, the Spanish government authorized the capture of 1.7 million finches between 2013 and 2018, presumably to ensure a stock of captive-bred birds in case the ban on trapping was enforced in the future (8). Third, decentralized systems in countries such as Spain allow a lack of legislative compliance. In the case of illegal poisoning, 10 of the 17 Spanish autonomous regions still lack action plans and invest little in human and economic resources (9) or conservation programs. Spain's lack of commitment shows; in just one of the country's reference laboratories for toxicological analyses, a total of 892 cases of illegal poisoning were diagnosed between 2004 and 2018, including threatened species such as Spanish imperial eagles, cinereous vultures, Egyptian vultures, and red kites (10). Fourth, legal loopholes allow countries to disregard the legislation. Because such loopholes allow hunting of migratory birds in 26 Mediterranean countries, 11 to 36 million birds are killed illegally every year while migrating through the region (11).

To ensure that reintroduction and conservation projects are effective, illegal activities

Threatened birds, such as Egyptian vultures, continue to be illegally poisoned in Spain.

that threaten birds must be halted. The first step should be the enforcement of hunting and environmental laws, accompanied by educational policies. Local, regional, and national governments in EU member states can reduce illegal activities by strengthening penalties, standardizing implementation, and increasing controls in the field. Mobilizing long-term funding to tackle wildlife crime is also imperative.

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## Time for Korean wildlife conservation

Although the populations of many species in the Republic of Korea have declined, fewer species have gone extinct than in other similarly developed countries (1, 2). The relative success of Korea's wildlife provides an opportunity for conservation. However, the country must act quickly; environmental exploitation, absence of protected areas in the regions that need them the most, and ongoing large-scale development projects will soon result in ecological catastrophes and further habitat loss (1, 3). To protect its vulnerable species, Korea must both implement effective policies and raise public awareness about the importance of conservation.

Because Korea's species have declined relatively recently, straightforward conservation actions are likely to be effective. Korea's restoration and conservation programs have already improved conditions for Asian black bears (4). Korea should restore population connectivity for long-tailed gorals to combat the high probability of local extirpation (5)

as well as supplement nesting materials for black-faced spoonbills to increase the number of breeding pairs at colonies (6). To improve prospects of a broad array of taxa, Korea should protect core habitats of species such as the endemic loach *Kichulchoia brevifasciata* (7) and migratory songbirds (8) and designate protected sites that include populations of endangered black rat snakes and Suweon tree frogs (9, 10). The Korean government should prioritize key areas such as wetlands, where biodiversity is as high as the development pressure for economic expansion, and the demilitarized zone (DMZ) between the two Koreas, an important ecological corridor connecting different biotopes. Because laws prevent either nation from developing the DMZ, it has essentially functioned as a protected area since its creation, a trait important to maintain in the future.

Despite Korea's economic and technological advances, the government prioritizes national conservation projects only when they have popular support. For example, Indo-Pacific bottlenose dolphins were kept in captivity until Korean citizens protested, and their release was funded by a tax increase supported by Seoul's population (11, 12). The survival of Korean species should not rest only on the shoulders of those raising awareness and educating the public about conservation. It is time to recognize Korea's neglected biodiversity and expand conservation efforts. Public engagement is important, but political and private-sector involvement should be codified to guarantee protection before it's too late.

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## Invertebrate scavengers matter

Recent assessment reports by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) for Europe and Central Asia (1) and Africa (2) acknowledge that, by removing carcasses, vertebrate scavengers contribute to pest and disease regulation and reduce greenhouse gas emissions (1, 2). Recognizing the value of vertebrate scavengers, in these regions and others, is an important step toward improving policies for management and conservation of biodiversity and ecosystems (3). However, the reports overlook the many and diverse invertebrates that also participate in

carion decomposition in terrestrial and aquatic ecosystems (4–6).

Flies, beetles, and ants are often the first animals to arrive at a carcass and, together with other invertebrates, can remove up to 90% of tissues from small vertebrate carcasses in only a few days (4, 6). Invertebrate scavenger richness, which is an order of magnitude greater than that of vertebrate scavengers, makes a substantial contribution to biodiversity in most ecosystems. For example, 522 invertebrate species of 151 families were recorded at 10 piglet carcasses (4), and about 215 beetle species were found at 18 ungulate carcasses (7). Approximately 400 species of marine invertebrates contribute to the removal of whale carcasses, including their bones (8). The trophic specialization of invertebrate scavengers is widely exploited in forensic entomology and used for criminal prosecutions, including the fight against poaching (9).

The ecological functions of scavengers, including nutrient cycling and biodiversity maintenance (10), are under threat as vertebrate scavengers such as vultures and top predators have plummeted (11). Whereas vertebrate defaunation is pervasive and widely acknowledged, invertebrate populations have been ignored, despite declines in abundance of 45% (compared with a 25% decline in vertebrates) (12). Society—and IPBES, in particular—should recognize invertebrate scavengers' contribution to carcass removal and their role in biodiversity conservation, ecosystem functioning, and human well-being.

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Asian black bears in Korea have benefited from conservation efforts.

# Science

## Illegal killing of birds in Europe continues

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