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EDITED AND REVIEWED BY
Scott Robinson,
University of Florida, United States

*CORRESPONDENCE
Çağan H. Şekercioğlu
c.s@utah.edu

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Editorial: Avian biodiversity collapse in the Anthropocene: drivers and consequences

Çağan H. Şekercioğlu[1,2,3]*, William J. Sutherland[4], Evan R. Buechley[5], Binbin V. Li[6,7], Natalia Ocampo-Peñuela[8] and Bruktawit Abdu Mahamued[9]

[1]School of Biological Sciences, University of Utah, Salt Lake City, UT, United States, [2]Department of Molecular Biology and Genetics, Koç University, Istanbul, Türkiye, [3]KuzeyDoğa Society, Kars, Türkiye, [4]Department of Zoology, University of Cambridge, Cambridge, United Kingdom, [5]The Peregrine Fund, Albuquerque, NM, United States, [6]Environmental Research Center, Duke Kunshan University, Kunshan, China, [7]Nicholas School of the Environment, Duke University, Durham, NC, United States, [8]Environmental Studies Department, University of California, Santa Cruz, Santa Cruz, CA, United States, [9]Department of Biology, Kotebe University of Education, Addis Ababa, Ethiopia

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Editorial on the Research Topic
Avian biodiversity collapse in the Anthropocene: drivers and consequences

Birds are increasingly becoming more threatened with extinction (Figure 1). Conservation is primarily the process of identifying threats and then delivering effective solutions. The papers in our Research Topic cover a diversity of subjects related to the essential issue of identifying threats. The approaches vary from describing the distribution of threatened species (Develey and Phalan, Kittelberger et al., Lees et al., McClure and Rolek), describing change (Kim et al., Neate-Clegg et al.), identifying the nature of threats (Bell, Develey and Phalan, Lees et al.), identifying multiple drivers of change (Kittelberger et al., Lindenmayer et al., Sherry), elucidating the mechanisms for threats (Blount et al., Manning and Sullivan), describing the distribution of threats (Fusco et al., O'Bryan et al., Yong et al.), and examining options (Lei et al., Voskamp et al.).

These papers focus on some of the most threatened groups of birds, including tropical forest specialists, long-distance migrants, raptors, and birds living in human-dominated landscapes, while providing a comprehensive overview of the drivers and consequences of avian population declines in the Anthropocene.

Tropical forests

Most of the world's bird species live in the tropics, mainly forests (Figure 1), and many tropical species are highly sensitive to habitat disturbance and fragmentation (Şekercioğlu and Sodhi, 2007; Sodhi et al., 2011).

Kittelberger et al. investigated the biological correlates of extinction risk among resident birds in the Philippines, a hotspot of biodiversity and endemism, based on ecological, biogeographical, and life history traits. Endemism, narrower elevational ranges, high forest dependency, and larger body size were most associated with extinction risk. The authors identify 14 species within the Philippines that are not currently recognized as threatened and warrant heightened conservation attention. Their findings also provide a useful framework for using biological correlates to identify extinction vulnerability in tropical birds elsewhere.

Analyzing bird species extinctions in Brazil's Atlantic Forest, Develey and Phalan conclude that 5–7 bird species have likely been driven to extinction in the wild in recent decades, plus two species elsewhere in Brazil, mainly because of habitat loss. Priority conservation efforts include multi-stakeholder planning, advocacy, habitat protection and restoration, focused research, and intensive population management. The reduction in Atlantic Forest deforestation rates, increases in forest restoration and recovery, and increases in public interest in birds and participating in citizen science give some optimism for many of the Critically Endangered species.

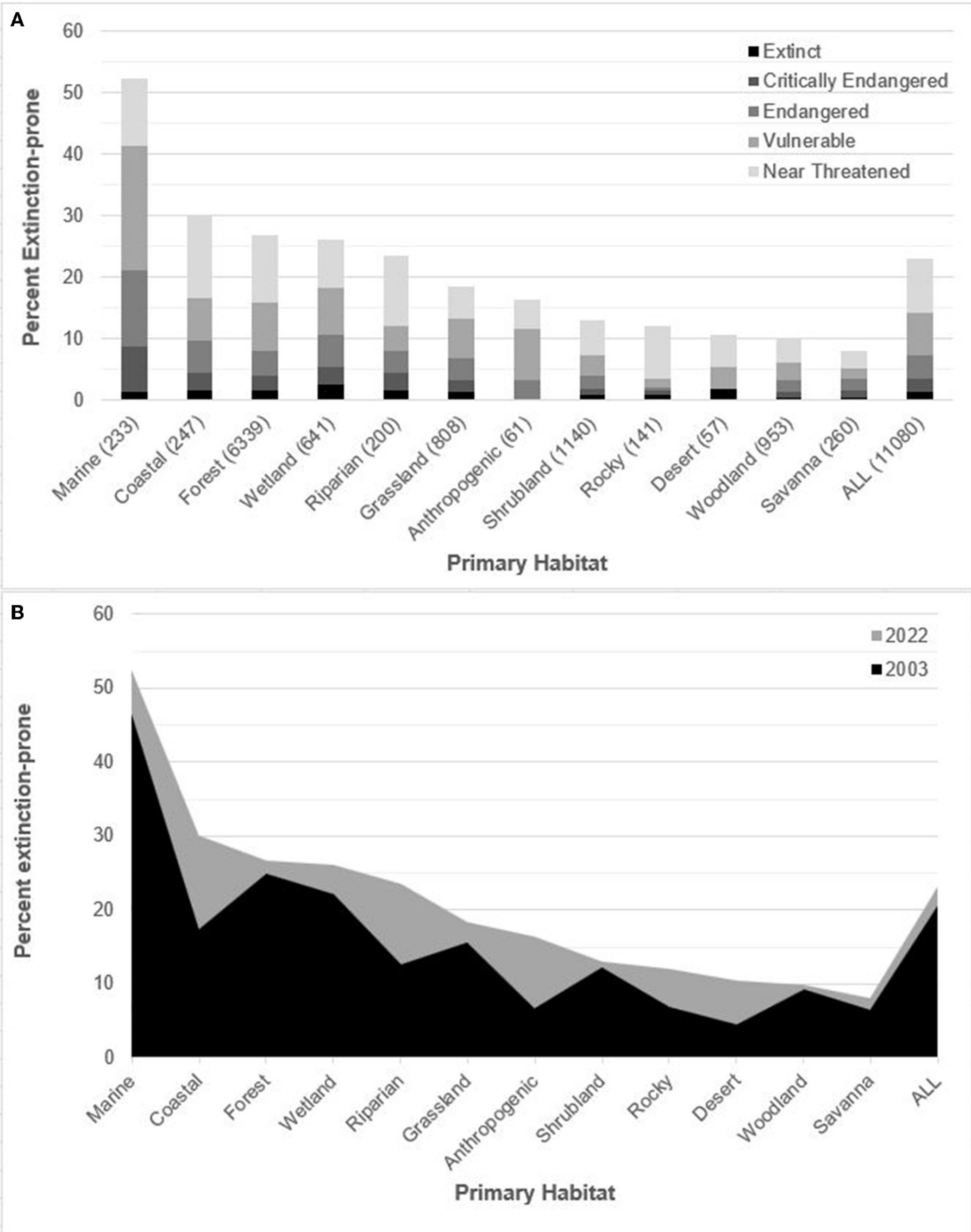

FIGURE 1
(A) Distribution of extinction-prone bird species based on primary habitat preference. Conservation status is from Birdlife International (2022). In parentheses, is the number of bird species which prefer that habitat most. Extinct includes species extinct in the wild. **(B)** Changes between 2003 and 2022 in the percentages of extinction-prone species.

Unfortunately, one exception is Purple-winged Ground Dove (*Paraclaravis geoffroyi*). Lees et al. used literature, specimen records, media sources and citizen science data to assess its status and compare its occurrence with a congener, Violaceous Quail-Dove (*Geotrygon violacea*). Despite similar historical distributions, there was no documented evidence of Purple-winged Ground Doves after the 1980s. Captive breeding might have helped the species survive, but private captive breeding efforts were prohibited by conservation laws.

Comprising more than 60% of all tropical birds, tropical insectivorous birds are particularly sensitive to human disturbance (Şekercioğlu, 2002), but the mechanisms are incompletely understood. Sherry reviewed the mechanisms and conservation implications of the sensitivity of tropical insectivorous birds. He argues that the unique evolutionary history of these birds, synthesized by the Biotic Challenge Hypothesis (BCH), explains their vulnerabilities to many threats due to these birds' evolutionary feeding specializations and poor dispersal capacity. More proximate, ecological threats include bottom-up forces like declining insect populations, top-down forces like meso-predator increases, and especially habitat loss and fragmentation, agricultural intensification, and climate change. These conditions peak in the lowland, mainland Neotropics, but tropical regions vary with respect to these birds' ecological sensitivity. Sherry argues that conservation strategies need stronger incorporation of species' evolutionary histories, these birds have greater value than generally recognized, and protecting these birds will require more and larger reserves.

Global warming is further exacerbating the threats to tropical forest birds by pushing montane species to higher elevations, but climate change effects on tropical birds are greatly understudied (Harris et al., 2011; Neate-Clegg et al.). Understanding the traits that drive their responses to climate change is critical for conservation planning. In a meta-analysis of 421 species across eight tropical study sites, Neate-Clegg et al. found a signal of upslope shifts, but variation in both shift direction and speed was considerable. Despite the prevalence of upslope shifts, shift rates varied among species, including many species that shifted downslope. Upslope shifts were greatest for smaller, less territorial species while larger-bodied species were more likely to shift downslope.

Voskamp et al. highlight the importance of taking a network-scale perspective when making management decisions under climate change. They examined changes in the ranges and abundance of 3,798 Neotropical bird species under future climate change scenarios and explored the future suitability of the network of Important Bird and Biodiversity Areas (IBAs). Despite some projected range shifts, they show that the continental network of sites will be effective even under future climate change scenarios.

Human-dominated landscapes

Temperate regions host a minority of bird species, but often have a longer and more intensive history of human land use. As landscape context is of critical importance for biodiversity conservation in human-dominated landscapes (Kati and Şekercioğlu, 2006), even modest improvements of landscape context for native biodiversity (Şekercioğlu, 2009) are critical for the conservation of avian populations and their ecosystem services.

Fusco et al. examined 211 bird assemblages to understand how taxonomic and functional diversity in the Mediterranean basin is correlated with land use change to identify priority areas for more systematic bird surveys. They found that high bird functional diversity overlapped with desertification, shrub encroachment, and agricultural land abandonment, while high species richness areas were associated with agricultural intensification. These results spatially delineated the threatened areas, especially those with few survey efforts to document or assess the effects of land use change.

Manning and Sullivan used water quality, aquatic invertebrate, and bird survey data to study how impaired water quality in United States streams and lakes can reverberate through communities. Emergent aquatic insects were sensitive to water quality impairment, but relationships between bird populations and emergent insects were generally weak. For streams, the strongest positive relationships were observed for a mixture of upland and riparian aerial insectivorous birds such as Western Wood-Pewees (*Contopus sordidulus*), Olive-sided Flycatchers (*Contopus cooperi*), and Acadian Flycatchers (*Empidonax virescens*), with Purple Martins (*Progne subis*) showing the strongest negative association. Emergent insects were negatively correlated with pollution, suggesting a large-scale loss of this nutritional subsidy to terrestrial environments. The authors emphasize the need for developing conservation and biomonitoring strategies for the cross-ecosystem effects of water quality declines for threatened insectivorous avifauna and other terrestrial wildlife.

Lindenmayer et al. analyzed 18-year datasets on the impacts of fire and logging on the bird communities of Mountain Ash and Alpine Ash eucalypt forests of south-eastern Australia. Wildfire reduced old-growth forest extent and led to increased bird abundance in unburned areas. Fire can trigger salvage logging, resulting in elevated fire frequency. Because many bird species have strict associations with old-growth forests, the authors propose a series of inter-related management actions designed to enhance their conservation. They propose conserving all existing stands of old growth forest, significantly expanding the extent of old growth, protecting old trees, banning salvage logging, and retaining intact source patches within logged areas.

Kim et al. modeled changes in the occupancy of 52 common breeding landbird species in South Korea between 1997–2005 and 2013–2019. Thirty-eight percent of the species showed declines, with seven declining severely (46–95%). Long-distance migrants (9/20) and common species (14/20) showed more rapid declines than the other groups. Declines of five species were associated with climate change, and two species appeared to be affected by land-cover change but causes of change for most species (46/52) were not clear. They suggest an immediate re-evaluation of conservation status and legal protection levels for seven severely declining species, continued monitoring of landbird populations to understand the mechanisms for these declines, and international collaborations to better quantify population trends across the full annual cycle.

Migrants

Long-distance migratory birds are increasingly threatened by global change (Zurell et al., 2018) and their collective conservation status is declining (Horns and Şekercioğlu, 2018).

Yong et al. reviewed the distribution, threats and conservation needs of migratory landbirds in the East Asian Flyway, the world's most diverse flyway with nearly 400 migratory landbird species, many of them threatened. Unsustainable hunting, habitat loss and increased agrochemical use are the key threats. Recent tracking studies of raptors, cuckoos, kingfishers and passerines greatly improved our knowledge of their distribution and migration ecology, but to identify efficient conservation strategies, key future research directions include identifying migration bottlenecks and evaluation of habitat use during the non-breeding season.

Blount et al. combined a literature review of crop management practices and a model of ecological correlates of avian population change to understand how land use change drives migratory bird declines at stopover sites. Migratory birds spend up to one-third of their life migrating and up to 85% of that time at stopover locations. However, the importance of these sites and how land use change affects different species have been little studied. This paper synthesizes how different land types and land management practices affect avian biodiversity at stopover sites and identifies the bird families most affected.

Lei et al. investigated how artificial wetlands serve as breeding grounds for Pied Avocets (*Recurvirostra avosetta*) in China's Nanpu saltpans on the East Asia–Australasia flyway. Nest success in artificial wetlands was comparable to this species' average and significantly higher than that in natural wetlands or sites with both natural and artificial wetlands. They conclude that artificial wetlands have conservation value for the breeding of some migratory birds.

Raptors

Raptors comprise one of the most threatened groups of birds, with 52% facing declining populations due to human threats (McClure et al., 2018).

Bell investigated the role of predatory species like raptors and corvids in limiting songbird populations in the UK. Despite lack of past evidence, new methods covering a range of prey species and site-level modeling to estimate predator abundance showed a significant aggregate predator effect in 33 out of 40 prey species and significant individual predator effects, with 41 significantly negative and 84 significantly positive. Bell concludes that analyses using census data have limitations and more field experiments are needed on the population limitations of songbirds by predatory species.

McClure and Rolek compared the population declines and conservation status of bird orders, using simulations based on Red List assessments. Eight orders had proportionally more threatened and declining species than average, including raptors (Accipitriformes), even when Old World vultures were excluded.

O'Bryan et al. mapped 15 leading threats to raptors across the ranges of 172 threatened or near threatened species. Human threats impact raptors across 78% of Earth's terrestrial area, particularly in Sahelian and eastern Africa, northern India, and south-eastern South America. Seventy-three percent of raptor species are impacted by deforestation, followed by agricultural conversion (71%). Sixty-six percent of raptor species' ranges is impacted by anthropogenic threats, with one-third of species having >90% of their ranges impacted, and 16 species have >99% of their ranges impacted, especially migratory raptors, longer-lived and larger raptors.

Conclusion

What then is the way forward with anthropogenic threats putting birds and other biodiversity at risk? Whilst we continue to identify problems, we need to be more strategic in addressing them. With the development of evidence-based conservation, the collation of evidence on the effectiveness of actions has become routine so that it can be searched quickly, and selected actions embedded into the conservation decision-making processes (Sutherland, 2022).

We suggest an urgent need for strategic collation of the threat literature such that a user can gain easy access to the literature relevant to an area, habitat, species, or threat, and determine the importance of the threat, which species or habitats are most sensitive, the spatial distribution and the mechanisms. Without such strategic and evidence-based conservation assessments, our chances of preventing biodiversity collapse in the Anthropocene will be greatly diminished.

Author contributions

ÇŞ developed the idea for the paper and led the writing of the manuscript. All authors contributed to the writing of the article, provided intellectual insights, reviewed the manuscript and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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