STATE OF THE WORLD'S RAPTORS
CHAPTER 5

Raptor conservation in North America

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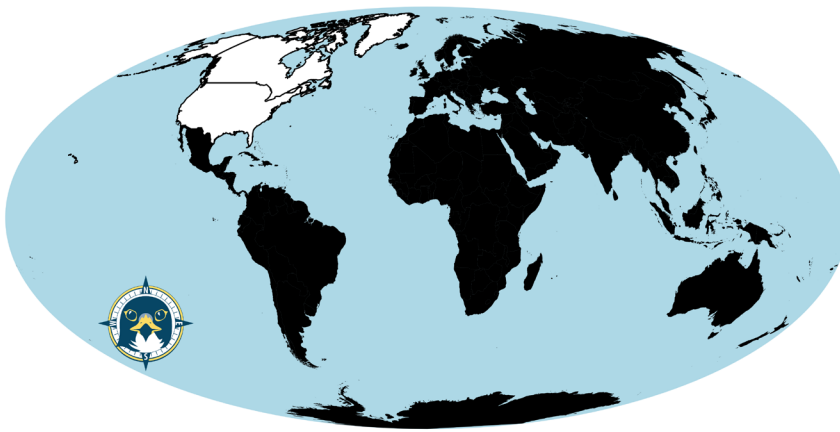

Figure 5.1. Map of the world highlighting national-level jurisdictions in North America (white).

Table 5.1. National-level jurisdictions within North America.

National-level jurisdictions in North America
Bermuda
Canada
Greenland
Saint Pierre and Miquelon
United States

Introduction

North America (Figure 5.1; Table 5.1) is the site of the most raptor research on Earth (McClure et al. 2022b), and some of the best bird monitoring infrastructure in the world. The region also devotes substantial resources to conservation and wildlife management. North America therefore has great capacity to identify and remedy raptor conservation issues.

Such capacity is evidenced by raptor populations in North America being robust relative to other groups of birds. Rosenberg et al. (2019) estimated that the North American avifauna has declined by roughly 3 billion birds since 1970. However, although some raptor species are still rebounding from the population lows of the DDT era (Rosenberg et al. 2019), 50-70% of species show increasing or stable trends (Oleyar et al. 2021). Despite these positive signs and the great capacity for conservation, nearly a third of North American raptors show decreasing trends within migration count data (Oleyar et al. 2021).

Some raptor populations are especially robust within North America. The most abundant raptors in the United States and Canada are the Black (*Coragyps atratus*) and Turkey (*Cathartes aura*) Vultures. Populations of these vultures are several times larger than the raptor with the third largest population, the Great Horned Owl (*Bubo virginianus*; McClure et al. 2022a). The health of most vulture populations in North America is in stark contrast to the many threatened species of Old World vultures (Santangeli et al. 2022).

Despite the overall robustness of raptor populations in the region, several priorities are recognized by governments and past authors. There are 8 raptor taxa listed on the United States' Endangered Species Act and 9 raptor taxa listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as either Threatened or Endangered (McClure et al. 2022a). NatureServe assesses the conservation status of species within the United States and Canada. Eighteen raptor taxa are listed by NatureServe as insecure (i.e. Vulnerable, Imperiled, or Critically Imperiled). The Red List considers two raptor species, the California Condor (*Gymnogyps*

californianus) and Snowy Owl (*Bubo scandiacus*) as threatened with extinction (i.e. in one of the 'threatened' Red List categories, Vulnerable, Endangered, Critically Endangered). There are also knowledge gaps despite the relative abundance of raptor research in North America. For example, populations of American Kestrels are declining across much of the continent, yet the cause of decline remains unknown (McClure et al. 2017). There are therefore many opportunities to leverage existing research and conservation infrastructure for North American raptors.

Raptor subspecies are heavily featured on lists of conservation priorities in North America. Seven of the 8 taxa listed by the United States' Endangered Species Act are subspecies. Sixteen of the 18 taxa listed as insecure by NatureServe are subspecies (McClure et al. 2022a). Half of the species listed as either Threatened or Endangered in Canada are subspecies and there are 2 listed populations—the eastern and western populations of the Common-barn Owl (*Tyto alba*).

A previous analysis of raptor conservation priorities in the United States and Canada (McClure et al. 2022a) highlighted several sub-national units as important for raptor conservation. Texas and Arizona contain the most raptor species because the northern extent of several species ranges terminates in those states. McClure et al. (2022a) also highlighted Haida Gwaii (formerly the Queen Charlotte Islands) as important for raptor conservation because of endemic subspecies of the Northern Saw-whet Owl (*Aegolius acadicus brooksi*) and Northern Goshawk (*Accipiter gentilis laingi*). Recent work suggests that the goshawks occurring in North America could be considered separate taxa from their Old World counterparts (Chesser et al. 2023). However, this book follows the taxonomy of BirdLife International (HBW and BirdLife International 2024) and thus considers these two potential species as conspecific.

Lead poisoning is the greatest threat to scavenging raptors across North America (McClure et al. 2022a). Fragments of spent lead ammunition are often ingested by scavenging raptors that subsequently die from the toxin. Lead poisoning is the principle reason that populations of the California Condor are not self-sustaining (Finkelstein et al. 2012) and it limits the population growth of Bald (*Haliaeetus leucocephalus*) and Golden (*Aquila chrysaetos*) Eagles (Slabe et al. 2022).

Although the conservation status of raptors in the United States and Canada was recently reviewed by McClure et al. (2022a), this chapter is unique in that it views raptor conservation through the lens of the wEDGE score. We therefore build on previous work by incorporating evolutionary history into our assessment of raptor conservation priorities in North America. For methodology see Chapter 4 (McClure et al. 2025).

Results

Species

According to BirdLife International's range maps (BirdLife International and Handbook of the Birds of the World 2023), 55 raptor species occur within North America. The Red List indicates that there are 16 raptor species that have decreasing global populations, and 2 of which are threatened (Table S5.1). The Northern Goshawk has an unknown global population trend. The Hawaiian Hawk (*Buteo solitarius*) is the only raptor species endemic to the region and 17 species have most of their range within North America. The top 10 threatened, Near Threatened, or decreasing Least Concern species within the region are listed in Table 5.2.

California Condor ranks first on the wEDGE list for the region, followed by the Snowy Owl, and the Northern Saw-whet Owl (*Aegolius acadicus*; Tables 5.2; S5.1). The California Condor and Northern Saw-whet Owl are nearly endemic with > 97% of their ranges within the region.

There are several high-ranking species of Least Concern within North America (Table 5.2). This generally indicates species that are either highly evolutionarily distinct such as the Elf Owl (*Micrathene whitneyi*) or have relatively high proportions of their ranges within the region, such as the Northern Saw-whet Owl. There are 14 Least Concern raptor species in the region that have decreasing global populations.

Table 5.2. The 10 highest priority raptor species for conservation within the region. EDGE scores (EDGE) combine evolutionary distinctiveness with extinction risk. Weight is the proportion of the species' range within the region, which is multiplied by the EDGE score to create the wEDGE score (i.e. weighted EDGE score). Red List classifications include Least Concern (LC), Near Threatened (NT), Vulnerable (VU), Endangered (EN), and Critically Endangered (CR). Only species listed as threatened (VU, EN, CR), NT, or LC with decreasing populations are shown. See Table S5.1 for the full list.

Species	EDGE	Weight	wEDGE	Red List	Trend
California Condor *Gymnogyps californianus*	21.84	0.99	21.68	CR	Increasing
Snowy Owl *Bubo scandiacus*	1.64	0.42	0.68	VU	Decreasing
Northern Saw-whet Owl *Aegolius acadicus*	0.48	0.98	0.47	LC	Decreasing
Elf Owl *Micrathene whitneyi*	2.23	0.20	0.44	LC	Decreasing
Spotted Owl *Strix occidentalis*	0.66	0.60	0.40	NT	Decreasing
Burrowing Owl *Athene cunicularia*	1.09	0.29	0.32	LC	Decreasing
Eastern Screech-owl *Megascops asio*	0.29	0.96	0.28	LC	Decreasing
Flammulated Owl *Psiloscops flammeolus*	0.66	0.41	0.27	LC	Decreasing
Hawaiian Hawk *Buteo solitarius*	0.26	1.00	0.26	NT	Stable
Western Screech-owl *Megascops kennicottii*	0.34	0.75	0.26	LC	Decreasing

National-level Jurisdictions

All 55 raptor species within the region occur within the United States. This country contains by far the most weighted threatened evolutionary history in the region, followed by Canada. Seventy-nine percent of the weighted threatened evolutionary history within the United States is due to the California Condor.

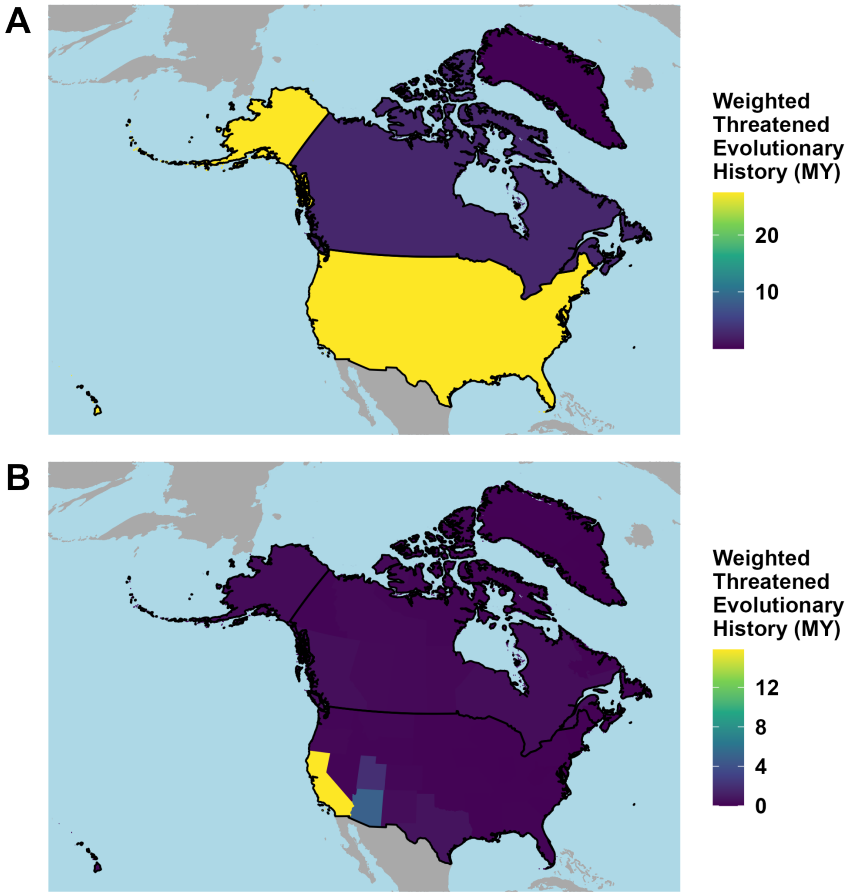

Figure 5.2. Maps of the weighted threatened evolutionary history per national-level jurisdiction (A) and sub-national unit (B). Weighted threatened evolutionary history is the sum of the wEDGE scores for all raptor species within a given area.

Sub-national Units

California is the top sub-national unit for weighted threatened evolutionary history, followed by Arizona, and Utah (Figure 5.2; Table S5.3). These top three are all within the United States and contain substantial proportions of the California Condor's range.

Habitats, Threats, and Actions

Forests harbor by far the most threatened evolutionary history in the region (Figure 5.3A; Table S5.4). This habitat is listed as of major importance for 16 raptor species in North America including the California Condor.

Habitat shifting due to climate change threatens the most evolutionary history among raptor species occurring in the region, followed by logging and displacement by the Barred Owl (*Strix varia*; Figure 5.3C; Table S5.5). The Snowy Owl is threatened by habitat shifting, and the Spotted Owl (*Strix occidentalis*) is threatened by logging and displacement by the Barred Owl. There are no medium or high-level threats listed for the California Condor.

Changes to law and policy, land management, species management, and education are the recommended actions across each species' total range that would protect the most threatened raptor evolutionary history in this region (Figure 5.3C; Table S5.6). These four actions are all listed for the California Condor and Spotted Owl. Changes to law and policy are listed for the Snowy Owl.

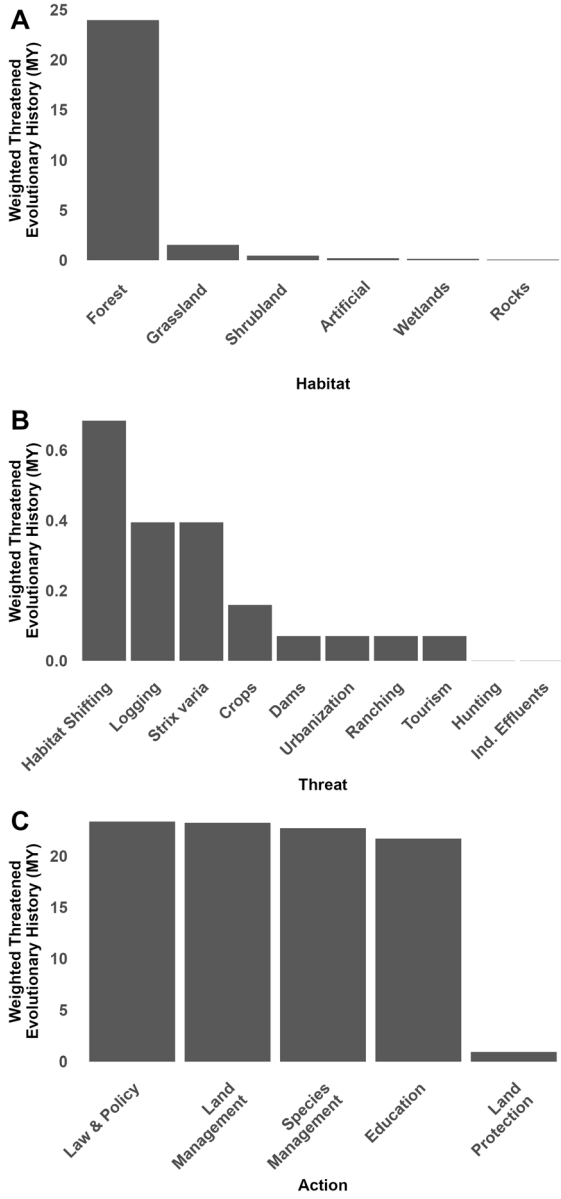

Figure 5.3. Weighted threatened evolutionary history per habitat (A), threat (B), and recommended conservation action (C). If there are more than 10 categories, only the top 10 are depicted. Weighted threatened evolutionary history is the sum of the wEDGE scores for all raptor species within the region. See Tables S4.1-S4.3 for full names and Salafsky et al. 2008 for definitions of threats and actions.

Discussion

Species

It is no surprise that the California Condor and the Snowy Owl are the top 2 priority species because they are the only species in the region with conservation status above Near Threatened. Recent work demonstrates that the continued decline in population levels of the Snowy Owl justifies its Vulnerable status (McCabe et al. 2024). The California Condor is especially important because it is Critically Endangered, highly evolutionarily distinct, and most of its range is within the region. Indeed, the California Condor ranks 3rd globally for raptor EDGE scores, and 10th among all birds (McClure et al. 2023). This species is thus the main raptor conservation priority for the entire region.

There are two Near Threatened species in the region. One of them, the Hawaiian Hawk (or, ʻIo), is the only raptor species endemic to the region. It is somewhat awkward to consider this species endemic to North America when it only occurs in Hawaii. However, the Hawaiian Hawk's conservation is the sole responsibility of the United States.

The Spotted Owl is Near Threatened and ranks 5th in priority based on this analysis (Table 5.2). There are three subspecies of Spotted Owl. The Northern subspecies (*S. o. caurina*) is listed as Threatened in the United States and Endangered in Canada. The Mexican subspecies (*S. o. lucida*) is listed as Threatened in the United States, and the California subspecies (*S. o. occidentalis*) is considered a bird of conservation concern within the United States (McClure et al. 2022a). Given the conservation and research attention afforded to subspecies of the Spotted Owl (Gutiérrez 2008), it might surprise some readers that this species is ranked below several Least Concern species. However, this analysis does not consider individual subspecies.

The current analysis excludes subspecies because they are not assessed by BirdLife International for the Red List. Instead, this analysis considers taxa at the species level and uses the proportion of range within a region as a proxy for the responsibility of that region for the conservation of the species. Species are inherently at lower risk of extinction than their individual subspecies. So, although some subspecies of Spotted Owl are threatened with extinction, the entire species is only considered as Near Threatened. Further, the Mexican subspecies has a substantial proportion of its range in Mexico and thus only 59.8% of the Spotted Owl's range is within North America. This species is thus ranked as 5th in priority despite some endemic subspecies being threatened with extinction.

The Northern Goshawk further highlights the importance of subspecies designations and taxonomy for conservation (see McClure et al. 2020). As mentioned above, BirdLife International considers the Northern Goshawk

as a single circumpolar species (HBW and BirdLife International 2024) of Least Concern. Our results therefore suggest that this species is of low priority within North America. However, researchers that consider the American Goshawk (*Astur atricapillus*) a species (Chesser et al. 2023) might conclude that it is of conservation concern given declines observed in migration counts across the region (Oleyar et al. 2021).

The American Kestrel (*Falco sparverius*) is not within the top 10 most important species in the region because it is listed as having a stable global population. If this species was listed by BirdLife International as having a declining population, the American Kestrel would be listed as a priority in Table 5.2 because of its relatively high wEDGE score. This species thus highlights the importance of considering outside data and of continually updating the Red List. Indeed, populations of the American Kestrel have been in decline across North America probably since the mid-20th century (McClure and Schulwitz 2022). The Red List account for the American Kestrel cites the North American Breeding Bird Survey (Sauer et al. 2017) and Christmas Bird Count (Butcher 1990) as showing stable populations. Yet, these and other datasets clearly show declines in American Kestrels (Smallwood et al. 2009, McClure et al. 2017, Oleyar et al. 2023). This species should therefore be considered declining in North America and, from a conservation perspective, is one of the most important species in the region.

There are several high ranking Least Concern species. Monitoring and conservation efforts for these species should be a priority so that declines can be remedied before those species become Near Threatened. Efforts to monitor raptors globally should therefore be supported (McClure et al. 2022b).

Notably, 8 of the top 10 wEDGE species listed in Table 5.2 and 12 of the top 20 overall species in Table S5.1 are owls. Despite including some of the most studied species (e.g. Barn and Spotted), owls overall are among the least studied and poorly monitored groups of raptors globally, particularly those associated with forest habitats (Buechley et al. 2019). North America has some of the best bird-monitoring infrastructure in the world, yet lacks robust population and trend estimates for owls. Designing replicable and scalable survey methods for owls to complement those that exist for diurnal species would fill a large information gap and help conserve raptor evolutionary diversity.

National-level Jurisdictions and Sub-national units

The United States is a large jurisdiction with the highest species richness in the region and contains 99.3% of the California Condor's range. Other jurisdictions in the region are either small (Bermuda or Saint Pierre and

Miquelon) or relatively large but with low raptor species richness and no endemics (Canada and Greenland). Indeed, the species with the greatest proportion of its range in Canada is the Barred Owl with 38.3%. The United States therefore has the greatest responsibility for raptor conservation within North America.

The top 3 subnational units for weighted threatened evolutionary history all harbor substantial proportions of the California Condor's range, with California being the highest ranked. This is in contrast to McClure et al. (2022a) highlighting Texas and Arizona because they contain the most total species and taxa considered insecure by NatureServe. The current analysis considers evolutionary distinctiveness and the amount of range in a given political unit. Therefore, California, Arizona, and Utah are identified as the most important sub-national units in the region largely because of their responsibility for the California Condor.

Habitats, Threats, and Actions

The habitat with by far the most weighted threatened evolutionary history is forest because this habitat is the only one listed as of major importance to the California Condor. Savanna and shrubland are listed as only suitable (i.e. not of major importance) for the California Condor, even though in our opinion they are just as important as forest for this species. Forest remains the most important habitat for weighted threatened evolutionary history when California Condor is excluded from analysis. Therefore, forest is the most important habitat for raptors in North America, but Figure 5.3A underrepresents the importance of grassland and shrubland.

The results suggest that habitat shifting due to climate change is the most important threat to raptors in the region because it is listed as of medium importance to the Snowy Owl. However, no threats are listed as of medium or high importance to the California Condor. Biological resource use, the threat category which includes lead poisoning, is listed as low impact. We think this is wrong. Lead poisoning is clearly a major threat to the California Condor (Finkelstein et al. 2012) and other scavenging raptors (Slabe et al. 2022). Therefore, lead poisoning should be considered the greatest threat to raptor evolutionary history in North America.

Law and policy, land management, species management, and education are mostly logical actions needed for the California Condor and the Spotted Owl. It is unclear how land management applies to the California Condor. Law and policy and education would address lead poisoning. The North American Non-lead Partnership (www.nonleadpartnership.org) has formed to educate hunters about the benefits of switching to non-lead ammunition. Such voluntary initiatives to assuage lead poisoning should be supported.

The California Condor, Snowy Owl, and Spotted Owl are subjects of several large-scale conservation and research programs. Species management is important for the California Condor because the wild population is currently sustained by captive breeding and release (Finkelstein et al. 2012). The Snowy Owl is the subject of the International Snowy Owl Working Group and Project SNOWstorm, which are initiatives to study and conserve the species. Intensive research and conservation efforts have been conducted on the Spotted Owl (Gutiérrez 2008), including culling of invasive Barred Owls (Wiens et al. 2021), which, according to the current analysis, are one of the main threats to raptor evolutionary history in North America. Many resources have been expended to study or recover the California Condor, Snowy Owl, and Spotted Owl. The current analysis highlights the importance of these efforts and suggests that they should be bolstered.

Conclusions

The highest priority for raptor conservation in North America is addressing lead poisoning because it is the principal threat to the species of greatest priority, the California Condor. California, Arizona, and Utah are the most important places for raptor conservation because of their importance to this species.

Other priority species for research and conservation action include the Snowy Owl, Spotted Owl, and Hawaiian Hawk. There are several high-priority species classified as Least Concern that have declining global populations, including six species of owls. These priority Least Concern species also require conservation action and warrant monitoring and research.

For supplementary material and other chapters see the book website: https://science.peregrinefund.org/state-of-worlds-raptors

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