

# A Brief History of Raptor Conservation in North America

*Keith L. Bildstein*<sup>1</sup>

ABSTRACT.—The conservation of North American raptors has changed considerably since European settlement. Historically, raptors were treated with indifference or outright hostility by most people of European descent, including ornithologists and conservationists. Shooting-era declines of many populations of birds of prey in the early 20th century energized segments of the scientific and conservation communities and led to special protection efforts on behalf of Bald Eagles (*Haliaeetus leucocephalus*) via the U.S. Bald Eagle Protection Act of 1940, and, eventually, to protection efforts for all species of raptors once they had been included within the jurisdiction of the Migratory Bird Treaty Act with Mexico in 1972. Catastrophic declines in regional populations of many birds of prey, including high-profile species such as Bald Eagles and Peregrine Falcons (*Falco peregrinus*) during the DDT-era of mid-20th-century North America, refocused protection efforts on the new threat of environmental contaminants. Today, the most significant human threats to raptors appear to be (1) a growing number of environmental contaminants, many of whose potential effects remain unknown and unexplored, (2) land-use change, including the loss of natural landscapes and the erection of harmful structures, and (3) potential conflicts between humans and birds of prey as raptor populations rebounding from reduced persecution and pesticide-era lows reassert themselves as significant predators in both natural and human landscapes. I first review the largely historic threats of direct persecution and pesticide contamination, and then discuss new and old environmental contaminants, the current and likely potential threats of land-use change, and the growing potential for raptor-human conflict as populations of both increase. The bulk of the paper focuses on direct persecution for two reasons: (1) the history of human persecution of raptors in North America is largely unknown among today's conservationists, and (2) this history played a major role in the creation of raptor-migration watchsites and the sport of hawkwatching.

<sup>1</sup>*Acopian Center for Conservation Learning, Hawk Mountain Sanctuary, 410 Summer Valley Road, Orwigsburg, Pennsylvania 17961, USA.*

## THE HISTORY OF HUMAN PERSECUTION

Although the history of raptor–human interactions in North America clearly predates that of European settlement (Tyler 1979, Broughton 2004), regionally significant impacts date largely from the mid-1800s. Improvements in shotguns and the development of breech-loading rifles increased the popularity of game hunting in North America and elsewhere (Newton 1990), and this, together with increasing human populations, conspired to reduce raptor numbers in many parts of the continent, particularly in the eastern United States (Hornaday 1914, Bildstein 2001). Perhaps not surprisingly, the same factors and attitudes also reduced raptor populations in Western Europe, where the threat was such that several species were extirpated from large portions of the continent. (Those interested in the history of raptor persecution in the Old World should consult Bijleveld’s [1974] meticulously detailed and, at times, mind-numbing account of the situation there.)

The “problem” of raptor persecution did not become part of mainstream nature conservation in North America until well into the 20th century, when a small but dedicated and initially ostracized group of raptor conservationists began to speak up for the birds (Broun 1949, Bildstein 2001). Although mainstream raptor conservation happened early enough to protect all but one of the continent’s distinct populations of diurnal birds of prey—the Guadalupe Caracara (*Caracara lutosus*) became extinct in the early part of the 20th century as a result of an all-too-lethal combination of local goatherds and overzealous skin collectors (Greenway 1958, Bildstein 2006)—the fight to protect “common” raptors offers a quintessential example of single-species management gone awry.

Given the often incessant and indiscriminate nature of human persecution (Broun 1949; Newton 1990; Bildstein et al. 1993, 2006), it is small wonder that by the middle of the 20th century most raptor strongholds in North America were in relatively remote and unpopulated areas of the continent. The phenomenon of “wilderness raptor strongholds” convinced many conservationists that birds of prey selected such habitats because of superior prey- or nest-site availability, rather than because many of these places served as essential (human) predator-free zones. That the latter was the principal driving force in shaping raptor distributions is evidenced by recent expansions of many of the same species into human-dominated landscapes (e.g., Rosenfield et al. 1996, Cade and Burnham 2003) following reduced persecution there.

The twin histories of raptor persecution and protection in North America are best told through the writings of those involved, and below I quote heavily from the historical record. Specifically, I detail: (1) the role that ornithologists and, more recently, conservationists played in shaping

North Americans' attitudes toward birds of prey, (2) how persecution-era effects were quickly overshadowed by pesticide-era concerns, and (3) the extent to which widespread human persecution reshaped habitat use in many populations of North America's birds of prey.

*Attitudes toward Bald Eagles.*—In addition to being the national emblem of the United States, as well as its most recognizable raptor, the Bald Eagle (*Haliaeetus leucocephalus*) has been one of the nation's most heavily persecuted birds of prey (Beans 1996). The love-hate relationship with Bald Eagles dates from colonial times, and the writings of colonial and postcolonial ornithologists shed significant light on how the relationship came to be.

Writing in the early 1700s, Mark Catesby described the species not only as having "...great strength and spirit..." and as "*formidable to all birds, yet suffer[ing] them to breed near his royal nest without molestation,*" but also as regularly "...prey[ing] on pigs, lambs, and fawns..." (Catesby 1731–1743). These discordant themes would shadow the Bald Eagle for the next 200 years. For example, Alexander Wilson, writing in *American Ornithology* (Wilson 1808–1814), not only characterized the species as "[A] *distinguished bird, the most beautiful of its tribe,*" that was both "*contemplative*" and "*daring,*" but also as frequently retiring "*inland in search of young pigs...*" And John James Audubon in *The Birds of America* not only portrayed the Bald Eagle as "*a noble bird... well known throughout the civilized world...*" that possessed "*great strength, daring, and cool courage,*" but also as a species that was hated by many and that had been "*forced to seek refuge from the persecution of man*" because it was considered vermin (Audubon 1840).

That Bald Eagles regularly preyed upon both farm and game animals, however, was not the only reason people disliked them. At a time when human traits were routinely ascribed to birds and other animals, Bald Eagles were judged by many to be dishonorable bullies. Both Wilson and Audubon described the species as "*tyrannical,*" with Audubon suggesting that it also "*exhibited a great degree of cowardice.*" The most damning condemnation of the species, however, can be found in a letter from Benjamin Franklin to his daughter Sarah in 1784. Writing from Paris, while contemplating a recently arrived medal honoring Revolutionary War heroes that included an image of the Bald Eagle, Franklin stated,

*"For my own part, I wish the Bald Eagle had not been chosen as the representative of our country: he is a bird of bad moral character; he does not get his living honestly... too lazy to fish for himself, he watches the labor of the Fishing Hawk [Osprey]; and, when that diligent bird at length has taken a fish, and is bearing it to his nest for the support of his mate and young ones, the Bald Eagle*

*pursues him and takes it from him. With all this injustice he is never in good case; but, like those among men who live by sharpening and robbing, he is generally poor, and often very lousy. Besides, he is a rank coward; the little [Eastern] Kingbird [Tyrannus tyrannus], not bigger than a sparrow, attacks him boldly and drives him out of the district. He is therefore by no means a proper emblem for the brave and honest [war heroes] who have driven all the kingbirds [i.e., British] from our country...."* (Franklin 1987)

Franklin's oft-quoted negative depiction of the species, albeit somewhat correct ornithologically, established an unfortunate moral condemnation of the bird that was to remain in place for more than a century.

An early birdwatcher and founder of the Connecticut Audubon Society, Mabel Osgood Wright, in *Birdcraft*, called the Bald Eagle "*an inveterate bully; [that obtained] a great part of its food by robbing the [Osprey], while perfectly able to fish for itself,*" and went on to characterize adults as "*cowardly parents*" that although "*known to carry off lambs and young pigs, [have] been vanquished in a fair fight by a rooster*" (Wright 1895). Neltje Blanchan, in the highly regarded and widely read *Birds that Hunt and are Hunted* (1898), called the Bald Eagle "*...neither the most intelligent nor enterprising of birds, nor the bravest,*" as well as an "*unsportsmanlike hunter.*" A quarter of a century later, National Association of Audubon Societies President, T. Gilbert Pearson, described the bird as being "*very shrewd*" and "*having no inconvenient scruples, whatsoever...*" and noted that that "*in regions where these birds become a serious loss to sheep-raisers, we cannot well blame men for occasionally killing these raiders of the sheep-fold.*" Pearson also described in detail an encounter near the mouth of the Suwannee River in Gulf Coast Florida in which he intervened to protect the "*new-born progeny of an old hog*" that was being set upon by three eagles; all of this in an Audubon educational leaflet meant to discourage "*wanton*" shooting (Pearson 1921).

Later still, William T. Hornaday, the Director of the New York Zoo and President of the Wildlife Conservation Society, remarked in *Thirty Years War for Wildlife* (1931) that "*The [Bald] Eagle [was], in a few places in Alaska, too numerous; and [that] there it should be thinned out.*" And in 1937, noted ornithologist Witmer Stone, writing in *Bird Studies at Old Cape May*, characterized the species as both "*a coward and a parasite*" and a "*degenerate member of the eagle tribe*" that had achieved recognition as our national emblem only "*through the machinations of ignorant politicians.*" Although Pearson, Hornaday, and Stone did argue for saving the species from outright extinction, rants such as these from leading ornithologists and conservationists did little to protect healthy populations of the species in early-20th-century North America, especially when others were accusing it of baby snatching.

One of the earliest and perhaps most effective narratives in what would become a genre of tall tales describing this supposed phenomenon appeared in a grammar-school reader published in 1857. McGuffey's *New Sixth Eclectic Reader* (Anonymous 1857) included among its many stories the tale of "The Eagle's Nest," a spell-binding thriller for young readers set in the mountains of far-off Scotland (Fig. 1). One can only imagine the impact that a story in which a young girl is carried off by an eagle, and thereafter laid in a bloody and bone-strewn nest in front of an eaglet, only to be rescued by her mother at the last minute, must have had on decades of American school children. Although the species in question was a Golden Eagle (*Aquila chrysaetos*) rather than a Bald Eagle, the conservation status of both suffered for decades, as year after year, hundreds of thousands of children "learned" just how cruel eagles really were. An early film by Thomas Edison, whose special effects graphically portrayed a variation on this theme, certainly helped fan the flames of such fears (Fig. 2).

Unfortunately, many turn-of-the-century conservationists did little to assuage these concerns. The popular natural-history writer Neltje Blanchan, for example, suggested that whereas "*scientists raise their eyebrows at tales of children being borne away by eagles... it would seem that some rare instances* [of baby snatching by eagles] *are well authenticated*" (Blanchan 1898). In 1921, the best that then National Association of Audubon Societies President T. Gilbert Pearson could offer was to suggest that such instances were improbable, if only because "*babies* [that were] *small enough to be carried by an eagle* [were] *not usually left unguarded in* [such] *situations*" (Pearson 1921). As a result of these and other stories, Pennsylvania's State Ornithologist, George Miksch Sutton, writing in *The Auk* in 1929, felt it necessary to remind "*bird-lovers*" that "*even today the eagle which carries off babies has not been forgotten...*" (Sutton 1929). As late as 1933, the Associated Press reported as fact an incident in which two Bald Eagles tried to carry off a three-year-old Maryland toddler, and that the event was forestalled only because one of the birds had been shot by a passerby and the other driven off. The reported "fact" that the dead bird weighed in at 50 pounds, or about four times the actual mass of a Bald Eagle (Buehler 2000), clearly demolishes the veracity of the report. That a leading news service was willing to carry this story, however, hints at its lasting impact.

Given such sentiments, it is not surprising that despite reported declines throughout much of its range in early-20th-century North America, the Bald Eagle remained unprotected in 24 of the United States as late as 1935 (May 1935). It was in the then territory of Alaska that the species was most heavily persecuted, at least in absolute terms. Between 1917 and 1952, Alaska paid 50-cent to two-dollar bounties on more than 128,000 Bald Eagles—an average daily take of 10 birds, each and every day, for 35 years. The birds were shot for many reasons, probably most often because



Fig. 1. Illustration from *McGuffey's New Sixth Eclectic Reader*, a grammar-school reading text published in 1857 (Anonymous 1857) depicting a young girl being carried by a Golden Eagle (*Aquila chrysaetos*) to its nest. The impact of this image on young readers was probably significant. (Photo: Hawk Mountain Sanctuary Archives.)



Fig. 2. Still photograph from an early film by Thomas Edison whose “special effects” included an eagle carrying off a baby. (Photo: Hawk Mountain Sanctuary Archives.)

they were considered threats to the salmon (*Salmonidae*) industry (Beans 1996). Alaska, however, was not the only place where eagles were shot in large numbers at the time. Charles Broley, a retired bank manager from Winnipeg, Manitoba, began banding Bald Eagles in central Florida in the late 1930s and continued to do so into the late 1940s. Forty-eight of the more than 800 nestling eagles that Broley banded were later recovered. More than half had been shot or otherwise killed by humans (Broley 1952). Shooting—some of it from airplanes—was just one way that Bald Eagles were dispatched by humans. In the 1920s and 1930s, poultry farmers in southern New Jersey regularly cut potential nest trees for eagles whenever they happened upon them (Stone 1937).

As Bald Eagle numbers continued to decline in the early 1900s, public sentiment for the species began to grow. The Bald Eagle Protection Act first introduced in Congress in 1930 was enacted 10 years later. With several specific and notable exceptions, the new law made it a crime—with penalties including both fines and imprisonment—to take Bald Eagles or their eggs or nests (Bean 1983). The Act, which at first excluded the territory of Alaska from its provisions, was amended in 1959—the year Alaska

gained statehood—to include that jurisdiction. The Act was again amended in 1962 to extend protection to the Golden Eagle because of the latter's resemblance to juvenile Bald Eagles. One exception in the Act that remains in force even today permits eagles to be taken for “*the protection of wildlife or of agricultural or other interests at a particular locality*” (Bean 1983). The Act also allows the Secretary of the Department of the Interior to issue permits for take for several other reasons, most notably for religious and cultural purposes by native Americans. Regulations authorizing some forms of take allowed by the Act have not been promulgated, but that may change upon de-listing from the Endangered Species Act.

The Bald Eagle Protection Act, together with bans on the widespread use of DDT in 1972, enabled the species to undergo a remarkable comeback beginning in the late 1970s that continues today. Although the Bald Eagle remained listed as federally “threatened” in the contiguous 48 states (the species does not occur in Hawaii) in early 2007, most populations were stable or increasing.

“*Good*” versus “*bad*” hawks.—Most hawks were totally unprotected in the United States and Canada throughout the 18th and 19th centuries. By the mid-1930s a hodgepodge of state laws protected some species, particularly vultures and Ospreys (*Pandion haliaetus*), in some states, whereas no protections were afforded in others. In states that protected some but not all species, Sharp-shinned Hawks (*Accipiter striatus*), Cooper's Hawks (*A. cooperii*), Northern Goshawks (*A. gentilis*), and, to a lesser extent, Merlins (*Falco columbarius*) and Peregrine Falcons (*F. peregrinus*), typically were singled out as unprotected (May 1935), as were Great Horned Owls (*Bubo virginianus*) among nocturnal raptors. At the federal level, except for the two eagles mentioned above and the Peregrine Falcon in 1970 (Cade 2003), raptors remained unprotected in the United States until March 1972, when the Migratory Bird Treaty Act with Mexico at last was amended and ratified to include them (Senner 1984).

Raptor persecution, which had been largely episodic and unorganized throughout most of the 18th and early 19th centuries, increased substantially in the decades following the American Civil War as the availability of breech-loading guns increased small-game hunting, and as human populations continued their spread across much of North America. As animosity for raptors grew, organized persecution reached a fever pitch in Pennsylvania, with local newspapers reporting that the overwhelming majority of rural residents considered raptors highly injurious. In response to such feelings, the Pennsylvania state General Assembly enacted the so-called “Scalp Act of 1885,” which placed a 50-cent bounty on the “head” of all birds of prey except for Northern Saw-whet Owls (*Aegolius acadicus*), Eastern Screech Owls (*Megascops asio*), and Barn Owls (*Tyto alba*). Pennsylvania's general public, 90% of which supported the Act, overwhelmingly embraced



it. Within two years, the Commonwealth had paid bounties on 180,000 birds of prey. Fraudulent claims were common, and funding for the program was quickly exhausted. One estimate suggested that chicken farmers saved about one dollar for each \$1,205 paid in bounties (Hornaday 1913). Increased populations of rodents and insects also sapped public support for the program, and the legislature repealed what by then was being characterized by many, including the state veterinarian and author of *Diseases and Enemies of Poultry*, as unjust, uneconomic, foolish, and simply wrong-headed (Pearson 1897, Hornaday 1914).

When, at the behest of so-called “sportsmen,” bounties on predators were reinstated in Pennsylvania in 1913, only the three species of accipiters were included. Although fraudulent claims continued to inflate the numbers of raptors killed for bounty—one individual, for example, swore to have killed 102 Northern Goshawks in just four days of summertime culling—Pennsylvania Game Commission employees alone were said to have killed more than 600 hawks in 1921, and to have destroyed dozens of nests (Kosak 1995). Presumably, state workers focused their efforts entirely on bountied species.

Predator control, and raptor conservation in turn, took something of a small step forward in 1893 with the publication of A. K. Fisher’s *The Hawks and Owls of the United States in Their Relation to Agriculture* (Fisher 1893). Having evaluated food habits of 73 species by examining the contents of their digestive tracts, Fisher concluded that only six species of hawks and owls were, in fact, “injurious” to agriculture. Unfortunately Fisher’s work did little to protect species such as Sharp-shinned Hawks and Cooper’s Hawks and may have served to confirm the worst fears of proponents of predator control by demonstrating the problem “scientifically.”

The notion that some raptors were beneficial, and as such were “good” hawks, whereas others were destructive, and as such were “bad” hawks, and that the “goodness” of a species could disappear with an increase in its abundance, reflects the pervasive “single-species” management mindset of the late 1800s and early 1900s, when the majority of mainstream bird conservationists and wildlife managers converged on largely indiscriminant predator control in which “bad” species were targeted for destruction in an attempt to control nature (Hornaday 1914, 1931; Worster 1977; but see Leopold 1933, Errington 1946). As expected, bird conservationists focused principally on protecting “*valuable wild* [song] *birds*,” whereas farmers and hunters focused on protecting poultry and game birds. Only a handful of so-called “sentimentalists” (Holt 1926) rallied in support of all raptors, regardless of the prey taken. One was Warren F. Eaton, founder of the Hawk and Owl Society (Anonymous 1933a); another was Rosalie Barrow Edge, creator of Hawk Mountain Sanctuary (Edge 1936, Broun 1949).

Although Eaton and Edge championed the plight of birds of prey, the general conservation stature and treatment of common bird-eating hawks and falcons in the first three decades of the 20th century is best reflected in the words of those closer to the “center” of natural-resource conservation at the time.

The following is from John Muir’s autobiography, published in 1913:

*“When I went to the stable to feed the horses, I noticed a big white-breasted hawk [most likely a Northern Goshawk or Red-tailed Hawk (*Buteo jamaicensis*)] on a tall oak tree in front of our chicken house, evidently waiting for a chicken breakfast... I ran to the house for a gun, and when I fired, he fell... then managed to stand erect. I fired again to put him out of pain. He flew off... but then died suddenly in the air, and dropped like a stone.”*

Although the episode that Muir refers to took place in the 1850s when he was still a young Wisconsin farm boy, the founder of the Sierra Club expressed absolutely no remorse (other than finishing off the culprit in short order) when recalling the event more than 50 years later (Muir 1913).

And John Muir was not alone in his thoughts concerning “*chicken hawks*.” William T. Hornaday, the eventual founder of the Permanent Wild Life Protection Fund, had this to say on the subject in the widely read *Our Vanishing Wild Life*:

*“... ‘chicken hawk or hen hawk’ are usually applied to the [Red-shouldered (*Buteo lineatus*)] or the [Red-tailed Hawk] species. Neither of these is really very destructive to poultry, but both are very destructive to mice, rats and other pestiferous creatures.... Neither of them should be destroyed—not even though they do once in a great while, take a chicken or wild bird, however [t]here are several species of birds that may at once be put under the sentence of death for their destructiveness of useful birds, without any extenuating circumstances worth mentioning. Four of these are Cooper’s Hawk, the Sharp-shinned Hawk, Pigeon Hawk [i.e., Merlin] and Duck Hawk [i.e., Peregrine Falcon].” (Hornaday 1913)*

The Peregrine Falcon, in particular, drew Hornaday’s ire. “*Each bird of this species deserves treatment with a choke-bore gun. First shoot the male and female, then collect the nest, the young or the eggs, whichever may be present. They all look best in collections*” (Hornaday 1914).

Like many at the time, Hornaday drew his distinctions in both moral and utilitarian tones: “*The ethics of men and animals are thoroughly comparative.... Guilty animals, therefore, must be brought to justice*”

(Hornaday 1922). The National Association of Audubon Societies spoke similarly, and it was not until wildlife biologist Aldo Leopold joined the Association's board in 1935 that things began to change within that organization. "*When we attempt to say an animal is 'useful,' 'ugly,' or 'cruel,'*" Leopold wrote, "*we are failing to see it as part of the land. We do not make the same error of calling a carburetor 'greedy:' We see it as part of a functioning motor*" (Leopold 1949).

By 1931, William T. Hornaday had dropped the Merlin from his list of "bad" hawks, presumably because of its increased rarity. He did, however, retain the others, together with the Great Horned Owl, Barred Owl (*Strix varia*), and, amazingly enough, the diminutive Eastern Screech-Owl. Moreover, although Hornaday was quick to caution against killing other species by mistake, the lack of decent field guides at the time meant that most shooters, including the majority of "experienced" birdwatchers, were ill equipped to make the necessary distinctions.

Leading conservationists were not the only group that thought this way about birds of prey. The scientific and birdwatching communities of the era also carefully selected the raptors they were concerned about. Widely respected ornithologist and renowned bird artist Louis Agassiz Fuertes had this to say in the ever-popular *National Geographic Magazine* in 1920: "*The whole genus Accipiter, consisting of [Northern] Goshawk, Cooper's Hawk, and Sharp-shinned Hawk, are savage, bloodthirsty, and cold-hearted slaughterers, and are responsible in large measure for the anathema that is portion to all hawks*" (Fuertes 1920). Pennsylvania's official State Ornithologist, George Miksch Sutton, remarked in his *Introduction to the Birds of Pennsylvania* (1928a) that "[t]he sharpshin is the enemy of all small birds...[and it] and [the] Cooper's Hawk, both bird killers, are fairly common and are rated as our most objectionable birds of prey.... They are not protected in Pennsylvania." Similar condemnations appeared in numerous state accounts of the era, including these from *The Raptorial Birds of Iowa* (Bailey 1918):

*"These destructive little hawks [sharpshins] are common to all parts of the state...; Cooper's Hawk is without doubt the most destructive of our residential birds of prey.... Its dash and daring in securing poultry and game are well known...."*

and

*"The evidence in hand shows that [the Northern Goshawk] is the most destructive of Iowa hawks, and that it would be a matter of serious concern if these birds should become as common every winter as they have been during the past season [1916]."*

The shooting and trapping that resulted from this line of reasoning were especially prominent along traditional migration corridors and at well-established migration bottlenecks. Premiere shooting galleries in the late 1920s and early 1930s included Cape May Point, in coastal southern New Jersey, where recent prohibitions on shooting Northern Flickers (*Colaptes auratus*) refocused shooting efforts on migrating accipiters. At Hawk Mountain, in the central Appalachians of eastern Pennsylvania, a \$5 bounty on Northern Goshawks fostered a “shoot-first-and-ask-questions-later” mentality (Bildstein 2001). In places where migratory movements failed to concentrate birds, other measures were taken. Alabama’s Conservation Commission, for example, promulgated a special “hawk-killing week” as well as broader anti-vermin campaigns, in which it attempted to enlist the support of sporting-goods houses and conservation clubs who, in press releases, were asked to “*put up prizes or awards to be given to individuals and clubs for work accomplished in the destruction of vermin*” (Holt 1926). The State of Virginia had similar campaigns (McAtee 1926).

Poultry-, game-, and bird-eating hawks, in particular, were heavily persecuted in early-20th-century North America. Compounding the problem was the fact that many shooters were often unable or unwilling to distinguish the “bad” or destructive hawks from the “good” or “beneficial hawks,” putting all birds of prey at risk (Broun 1949, Kosak 1995). The impact of the shooting, which occurred outside the gaze of mainstream conservation, was relatively little studied at the time, save at raptor conservation hotspots such as Hawk Mountain and Cape May Point, where thousands of hawks, eagles, and falcons were being shot annually (Sutton 1928b, Allen and Peterson 1936). The overall impact of the onslaught appears to have been significant. Banding recoveries of Cooper’s Hawks, for example, indicate that first-year mortality from shooting ranged from 28% to 47% in 1929–1940, and from 12% to 21% in 1946–1957 (Henny and Wight 1972).

The tide against “bad” hawks began to turn, albeit incrementally, in the late 1920s, as indiscriminant shooting began to reduce the distributions and abundances of both targeted and non-targeted raptors. Writing in *The Auk* in 1926, Henry R. Carey pointed to the “*marked absence*” of hawk records in a recent issue of *Bird Lore* (the predecessor to *North American Birds*) as evidence of successful extermination campaigns and suggested that all states pass laws prohibiting hawk shooting except when an individual bird was “*caught in the act of attacking domestic fowl or game birds on private reservations*” (Carey 1926). The U.S. Biological Survey’s Waldo Lee McAtee amplified Carey’s comments in a second General Note in *The Auk* later in 1926 (McAtee 1926). Carey and McAtee’s comments, although lauded by many, sparked much debate in the ornithological community, including this response from Ernest G. Holt, who feared for his collecting rights:

*“Some conservationists are so blinded by sentimentalism that they become as extreme as the [shooters], and would absolutely prohibit all bird shooting, even for the purposes of scientific investigation... [consequently] between sentimentalists and [shooters] we seem to be placed as ‘between the devil and the deep blue sea,’ for one would stop our collecting by process of law, while the other would leave us with nothing to collect.” (Holt 1926)*

Witmer Stone’s editorial in *The Auk* in 1930 summarized the so-called “hawk question” from the standpoint of the American Ornithologists’ Union:

*“Unless drastic measures are taken at once our hawk and eagle population will be a thing of the past: exterminated because some hawks interfere with the raising of game birds for sportsmen to kill; and because some eagles may occasionally kill lambs. While some hawks must be controlled—i.e., shot if actually engaged in killing young chickens or game birds; it is of the utmost of importance that they not be exterminated.” (Stone 1930)*

The 10-page editorial, which went on to urge passage of a Bald Eagle Protection Act, as well as the protection of all species of hawks excepting those “*in the act of destroying game or poultry*,” closed with “*Do not write to The Auk about [the hawk question] but make your appeal where it will reach those who do not know about the facts,*” effectively shutting the door to additional comments on the subject at least in that journal.

Despite the position of the American Ornithologists’ Union, many in the conservation community continued to heap coals on the burning debate well into the 1930s. Writing in the National Association of Audubon Societies’ *The Hawks of North America: Their Field Identification and Feeding Habitats*, John Richard May characterized the Northern Goshawk as “*at times... persistent and destructive about poultry farms and game rearing establishments, [and at such times] control measures may be necessary,*” the Sharp-shinned Hawk as “*one of the most persecuted of our hawks, due to its habit of feeding upon small birds,*” and the Cooper’s Hawk as “*when common... extremely destructive to small birds, young poultry, and game birds*” (May 1935). Although the same volume expressed the National Association of Audubon Societies’ official policy as opposing the “*extermination of any species of bird,*” advocating “*under all conditions*” the protection “*of rare hawks... and of all beneficial hawks and owls*” and condemning bounties and pole traps, it also specifically limited its advocated “*protection, under all circumstances*” “[to] *rare hawks, such as the Duck Hawk [Peregrine Falcon], and... beneficial hawks and owls, such as the Broad-winged Hawk [Buteo platypterus] and the Barn Owl,*” and

indicated that it did not oppose the killing of “*individual* [hawks and owls] *known to be damaging property*” (May 1935).

In 1936, the ninth edition of Mabel Osgood Wright’s widely read *Birdcraft* was still referring to the Cooper’s Hawk as a “*Chicken Hawk*” and characterizing it as a “*mischievous harrier of all birds*.” It also continued to suggest that one could help songbirds by “*shooting some of their enemies*,” including “*one of two* [species of] *hawks and owls*” (Wright 1936). In 1933, George E. Hix, a scoutmaster from Brooklyn, New York, writing in *Birds of Prey for Boy Scouts*, noted that “*the beneficial hawks are the larger, slower species, [and] the smaller swifter hawks are the ones which are destructive to wildlife... [and these include] the [Northern] Goshawk, Cooper’s, Sharp-shinned, and Pigeon hawks [Merlin]*” (Hix 1933).

Two events in the early 1930s hastened the rate at which all birds of prey came to be protected. The first was the founding of the Hawk and Owl Society by Warren F. Eaton and others in 1932 (Anonymous 1933a). The second was the creation of Hawk Mountain Sanctuary, the world’s first refuge for birds of prey (Broun 1949, Bildstein and Compton 2000).

The Hawk and Owl Society, in cooperation with the National Association of Audubon Societies, published a series of five newsletter-like “*Bulletins*” and “*Annual Reports*” during its brief existence from 1932 through 1935 (Fig. 3). The Society, which opposed bounties and the use of pole traps and poisons for controlling raptors, believed that “*economically beneficial or harmless hawks should receive legal protection*,” that “*generally harmful* [species] *should be controlled in any particular situation only after thorough and impartial study*,” and that “*no species should be exterminated or extirpated from any part of its habitat*” (Anonymous 1933b). Although the Society had ceased to exist by the late 1930s, its influential newsletters helped move the mainstream conservation community in the direction of a more robust form of raptor protection.

Hawk Mountain Sanctuary was established in the summer of 1934 by Rosalie Barrow Edge, the founder and head of the Emergency Conservation Committee. Edge founded the refuge after hearing photographer Richard Pough speak about the slaughter of raptors there at a joint meeting of the Hawk and Owl, Linnaean, and National Association of Audubon societies at the American Museum of Natural History in New York City the previous October. Unlike the Hawk and Owl Society, Hawk Mountain Sanctuary favored the protection of all birds of prey, “*common*” and “*uncommon*,” “*beneficial*” and “*bad*,” in an adamant and unmitigated fashion, and in doing so treaded into unknown territory.

In August of 1934, Mrs. Edge hired Maurice Broun as “*ornithologist-in-charge*” of the new refuge. Broun, who had acquired his first pair of real binoculars in May of that year, spent most of September posting

*Annual Report*  
OF  
*The Hawk and Owl Society*

BULLETIN No. 4

JUNE 1934



HAWKS KILLED AT DREHERSVILLE, PENNA., ON "HAWK MOUNTAIN". SHOWING  
ARCHIE E. SMITH, PENNSYLVANIA STATE GAME PROTECTOR.  
[It is this sort of wholesale killing the Hawk and Owl Society wants to stop.]

Fig. 3. The cover of the Annual Report of the Hawk and Owl Society, published in 1934. The Society, which existed as a cooperator with the National Association of Audubon Societies for several years in the mid-1930s, helped move raptor conservation closer to "mainstream" bird conservation.

the Sanctuary's boundaries and on 30 September began counting migrating raptors from what he then called Observation Rocks, a job he would continue to enjoy for the next 32 years. Although local opposition to a refuge for birds of prey was intense—after all, Hawk Mountain was the best place in all of Pennsylvania to shoot the then state-bountied Northern Goshawk—news of the new sanctuary spread quickly among the birding community, and an estimated 1,250 enthusiasts flocked to the “Mountain” during its second year of operation. By the late 1940s to early 1950s, tens of thousands were visiting the site (Fig. 4), and in recent years as many as 60,000 people, including thousands of school children, watch the flight each autumn.

By the mid-1930s, the activities of the Hawk and Owl Society and Hawk Mountain Sanctuary helped foster a newfound appreciation for all birds of prey in mainstream conservation, and this, in turn, energized the community to act on behalf of the birds. Consequently, whereas in 1899 only five of the United States protected some raptors, 42 states did so in 1949 and, by 1963, all birds of prey were protected in 19 states and only four states were protecting none (Phillips 1949, Jahn et al. 1963, Clement 1965). Although several states were quick to pass bills protecting beneficial birds of prey and, subsequently, all raptors, other states, including Pennsylvania, were slower to respond. Although the Pennsylvania Game Commission's own biologists were calling into question the usefulness of “vermin” bounties in game management as early as 1937 (Gerstell 1937, Latham 1950), Pennsylvania retained a \$5 bounty on Northern Goshawks until 1951 (Fig. 5), and one on Great Horned Owls until 1965. Indeed, the act that removed the bounty on the goshawk in 1951 specifically left all three “bird-killing” accipiters unprotected. As a result, dozens of shooting blinds remained along the Kittatinny Ridge migration corridor in eastern Pennsylvania well into the mid-1950s, where estimates from the era suggested that as many as 1,500 hawks, many of them “protected” *Buteos*, were killed on single favorable days (Broun 1956). The situation would not be remedied completely until 1970, when state-wide, year-round protection was extended to include these three species (Senner 1984, Kosak 1995). The Great Horned Owl would remain unprotected until covered by federal law in 1972.

Notwithstanding Pennsylvania and a few other states, most widespread raptor shooting faded into history in mid-20th-century North America as bounties were extinguished and protections were extended to most species across much of the United States. Estimates of first-year shooting mortality in Cooper's Hawks are particularly instructive in this regard (see above; Henny and Wight 1972). Although raptor shooting in North America continues even today, it is largely local and episodic and, for the most part, of little ecological consequence (Bildstein 2001).





Fig. 4. Photographs from the 1940s depicting visitors at the trailhead to Hawk Mountain (above) and hawkwatching at the Sanctuary's North Lookout (below). Both as science and as recreation, hawkwatching took off on the heels of Hawk Mountain's founding in 1934. Today, in North America alone, more than 100 watchsites routinely count migrating raptors. And more than 100 additional watchsites do so internationally (Zalles and Bildstein 2000). (Photo: Hawk Mountain Sanctuary Archives.)



Fig. 5. Work Progress Administration posters from the late 1930s produced for the Pennsylvania Game Commission as part of the latter's attempts to help hunters separate "good" hawks (e.g., the Duck Hawk (Peregrine Falcon) [*Falco peregrinus*]) from "bad" hawks (e.g., the Goshawk (Northern Goshawk) [*Accipiter gentilis*]). Note that the "bad" goshawk is specifically labeled "unprotected." (Hawk Mountain Sanctuary Archives.)

#### THE DDT ERA

As the threat of large-scale shooting began to fade in the 1940s, another important human threat to raptors began to take hold: the misuse of second-generation agricultural organochlorine biocides. Inexpensive, broad-spectrum, and long-lasting, these manufactured organic biocides were far less toxic to vertebrates than the inorganic biocides they replaced. The best known of the modern biocides, DDT (dichloro-diphenyl-trichloroethane), was so warmly received that it earned its developer and principal proponent, Paul Muller, a Nobel Prize in Physiology or Medicine in 1948. Heralded as a 20th-century "wonder chemical," the widespread and often indiscriminant use of this new agricultural chemical and other organochlorines began to raise alarms among conservationists as early as the late 1940s (Gabrielson et al. 1950). Nevertheless, these modern weapons in the fight against agricultural pests quickly became the insecticidal agents of choice in the 1950s and 1960s. Their unintended effects on North American raptors are detailed below.

The so-called DDT Era began in earnest in North America at the end the Second World War, when DDT and a few related organochlorine

compounds came into widespread use in agriculture and the control of insect vectors of human disease. It ended in the early 1970s when the governments of Canada and the United States banned most widespread use of DDT. A second main type of organochlorine compounds, the cyclodiene biocides, which included aldrin, dieldrin, and heptachlor, also came into use during this era. Both types of organochlorines are neurotoxins. DDT and closely related compounds act mainly on sodium channels, prolonging action potentials and disrupting nerve impulses; cyclodienes act on so-called GABA, or inhibitory receptors, and lead to convulsions (Walker 2004).

Although warnings about DDT's impacts on bird populations date from the mid-1940s (Hotchkiss and Pough 1946, Gabrielson et al. 1950), it was not until the mid- to late 1950s that organochlorine pesticide impacts on raptors received serious attention (e.g., Broley 1958). Unfortunately, by that time, populations of many North American birds of prey were already in free fall (Hickey 1969). Species that fed in aquatic environments, where pesticide runoff tends to accumulate, and those that fed at higher trophic levels, where biological magnification plays a role in increasing exposure to these environmental contaminants, were particularly affected (Henny and Wight 1972).

Rachel Carson's bestseller, *Silent Spring*, placed the "pesticide problem" in the minds of most Americans in the early 1960s (Carson 1962), and in 1965 a group of concerned scientists and raptorphiles met in Madison, Wisconsin, to discuss the demise of eastern populations of Peregrine Falcons (Hickey 1969). The scientists at the meeting focused on the growing misuse of the modern synthetic biocides in agriculture and the ability of these chemicals to be magnified biologically in organisms along food chains. High levels of biocides in wild Peregrine Falcons suggested a link, and recent evidence of eggshell breakage at peregrine eyries in England (Ratcliffe 1958) suggested a mechanism for the declines.

Things happened quickly after this watershed meeting (Cade et al. 1988, Cade and Burnham 2003). Derek Ratcliffe published a benchmark analysis that clearly established the coincidental timing of widespread DDT misuse and eggshell thinning in English Peregrine Falcons (Ratcliffe 1967). Two years later, controlled experimental studies involving American Kestrels (*Falco sparverius*) demonstrated the cause-and-effect relationship between the two (Porter and Wiemeyer 1969, Wiemeyer and Porter 1969). With this new information in hand, Canada and the United States banned the widespread use of DDT in the early 1970s (Bildstein 2006). In most cases, the bans led to reductions in contaminant levels and a reversal in eggshell thinning. By the mid-1980s, many species of raptors were recovering from pesticide-era lows (Cade et al. 1988, Bednarz et al. 1990, Bildstein 1998, Cade and Burnham 2003). The widespread use of many cyclodienes,

which had been linked to secondary poisoning in raptors in Britain (Walker 2004) was banned soon thereafter.

*New and additional contaminant threats.*—Unfortunately, the biocides that replaced organochlorine pesticides created their own set of problems for birds of prey (Henny and Elliott 2007). Organophosphate pesticides, which include parathion, monocrotophos, famphur, and fen-thion, came into use in the 1960s and 1970s in response to concerns regarding the persistent nature of organochlorine pesticides, as well as to declines in the effectiveness of the latter as insect pests adapted to them. Although far less persistent than the organochlorine pesticides they replaced, organophosphates kill insects by inhibiting cholinesterase, a neurotransmitter common to the nervous system of both insects and vertebrates. Developed as part of nerve-gas research in the 1940s, these so-called safe replacements are 10 to 100 times as toxic to vertebrates, including raptors, as are organochlorines. Carbamates, a second popular class of organochlorine replacements, share many of the same properties, including anticholinesterase action. Because both classes of biocides are absorbed through the skin and lungs, as well as through the digestive tract, contact with them sometimes poses a considerable threat to birds of prey.

Perhaps the best-known example of the extent to which organophosphates have affected populations of North American raptors involves the highly migratory Swainson's Hawk (*Buteo swainsoni*). While on their wintering grounds in 1995–1996, 6,000 to 20,000 Swainson's Hawks were killed by the organophosphates monocrotophos and dimethoate. First-hand accounts indicated that the birds died immediately after being sprayed by the biocides while hunting grasshoppers (Orthopterans) in agricultural fields (England et al. 1997, Goldstein et al. 1999). Although the problem appears to have been solved in parts of Argentina (Goldstein et al. 1999), these pesticides continue to be used elsewhere in Latin America.

In addition to biocides directed at insects, North American populations of raptors also continue to be threatened by environmental contaminants used to control rodent and bird populations in agricultural and urban landscapes (Henny and Elliott 2007). The risk is potentially greatest for species that prey on poisoned rodents and birds, as well as for species that scavenge the carcasses of such "pest" species. The indiscriminant use of rotenone and other "piscicides" poses a potential threat to raptors that prey upon fishes through the loss of local food resources. PCBs, PBDEs (flame retardants), and other persistent organic pollutants, as well as sulfonated perfluorochemicals used in the manufacture of Teflon and Scotchgard, appear in raptor eggs and may be a concern to some populations of North American raptors (Henny and Elliott 2007).

Finally, heavy metals, including lead, continue to threaten many species of birds of prey, particularly those that scavenge some or all of their food (Hunt et al. 2006). Lead poisoning is especially problematic where lead bullets and pellets are used in sport and subsistence hunting. In North America, many raptors, including Bald Eagles, Golden Eagles, and Peregrine Falcons, have been diagnosed with lead poisoning (McBride et al. 2004), and lead has been linked to the initial demise and limited recovery of the California Condor (*Gymnogyps californianus*; Snyder and Schmitt 2002). In addition, researchers have suggested that growing urban populations of Sharp-shinned Hawks and Merlins, too, may be at risk from lead as a result of their selectively feeding on contaminated urban House Sparrows (*Passer domesticus*; Chandler et al. 2004). The historical use of lead in gasoline, its past and current use in sport and subsistence hunting, and the increased urbanization of several species of raptors and their potential exposure to localized urban sources of lead (McBride et al. 2004, Hunt et al. 2006) suggest that lead poisoning is likely to threaten raptors for some time. Bald Eagles figured heavily in the ban on the use of lead shot in waterfowl hunting in 1991 (cf. Feierabend and Myers 1984). Although lead poisoning of Bald Eagles did not decline following this ban (Kramer and Redig 1997), the use of birds of prey in bringing about the change suggests a potentially important role for raptors in eliminating the widespread use of lead for other purposes as well.

Given the rate at which new and inadequately tested chemicals continue to appear in the marketplace, environmental contaminants are likely to continue to threaten at least some populations of North American raptors for some time. Henny and Elliott (2007) provide a useful and well-referenced overview of these threats.

#### LAND-USE CHANGE

Human-induced land-use change has had, and continues to have, an enormous impact on the conservation status of North American birds of prey. Although the full impact of land-use change on the continent's raptors will never be known, as much of it happened prior to conservation interest in raptors, there is ample evidence that human actions, particularly agricultural and forestry practices, limited populations of birds of prey in many parts of North America throughout much of the 19th and 20th centuries. Although many of the impacts were straightforward (e.g., loss of nest sites for obligate tree-nesting species when forests were cut; loss of feeding areas for insectivorous species when grasslands were plowed and planted in row crops), many acted synergistically with other human threats, including environmental contaminants and direct persecution. What follows is

a sample of the many ways in which widespread land-use change has affected North American raptors.

*Deforestation.*—Estimates suggest that 45% of the coterminous United States was originally forested and that 80% of this original forest cover was east of the Great Plains. By 1920, agricultural clearing, lumbering, and other human impacts had reduced the original forest to less than 10% of what it had been at the time of European settlement (Williams 1989). Raptors that depend on forests, either for feeding areas or the nest sites they provide, or for both, most certainly were affected by this extensive forest loss. Widespread cutting of forest coincidentally combined with the increased human persecution of many obligate tree-nesting species—including, most notably, North America's three accipiters—placed many of these birds within a “conservation vice.” The only safe place to nest during the period of intense human persecution was in large forests away from human activity, but this habitat type was shrinking rapidly as forests were being cut for forestry and agriculture. The fact that Sharp-shinned Hawks and Cooper's Hawks are now nesting increasingly in human-dominated, wooded landscapes, including many suburban and urban areas (Rosenfield and Bielefeldt 1993, Boal and Mannan 1999, Coleman et al. 2002), indicates the extent to which the impact of land-use change on raptors depends not only on changes in vegetative cover but also on ongoing human attitudes toward birds of prey. That said, populations of raptors that are associated with so-called “old-growth” forest (e.g., Spotted Owls [*Strix occidentalis*]; Gutiérrez et al. 1995) may remain particularly vulnerable to vegetative change regardless of human attitudes. Bird et al. (1996) provide additional examples of the extent to which North American raptors have taken advantage of human-dominated landscapes when they are no longer heavily persecuted.

*Other land-use changes.*—The construction of numerous impounded reservoirs and the new aquatic habitats they have created throughout non-glaciated North America have provided new breeding and feeding areas for piscivorous raptors, including Ospreys and Bald Eagles. In South Carolina, for example, Bald Eagles colonized major reservoirs completed in the 1940s as ecological succession proceeded at the sites and fish and waterbird communities developed there (Bryan et al. 1996), and the same is true elsewhere. On the other hand, Bald Eagle use of the Flathead catchment region in and around Glacier National Park in northwestern Montana, as a wintering feeding site, which grew from 37 individuals in 1935 to more than 600 in 1981, collapsed precipitously to 25 birds in 1989 when the numbers of land-locked Kokanee salmon (*Oncorhynchus nerka*) at the site crashed in response to competition from introduced opossum shrimp (*Mysis relicta*; Spencer et al. 1991, McClelland et al. 1994). The ephemeral nature of this important winter feeding area for migratory Bald Eagles exemplifies the

potential impact of even apparently innocuous human actions on populations of North American birds of prey.

An additional example of the extent to which seemingly inconsequential human actions affecting “land use” can influence populations of migratory raptors involves the Sharp-shinned Hawk. Having rebounded from pesticide-era lows of the mid-20th century, this species began to show evidence of declines in the northeastern United States in the 1980s. The so-called sharpshin “decline” was deduced from a drop in numbers of migrating Sharp-shinned Hawks at numerous migration watchsites in the Northeast. At first, the drop was explained simply as evidence that the species had reached its natural carrying capacity following a period of explosive post-pesticide-era growth in the 1970s. As the decline in numbers continued into the early 1990s, more nefarious explanations began to take root, including pesticide misuse, acid precipitation, and tropical-deforestation-associated decreases in the species’ Neotropical songbird prey-base. In the end, none of these explanations proved correct. Rather than reflecting a shift in population numbers, the drop in the number of Sharp-shinned Hawks seen at migration watchsites reflected a shift in the species’ migration behavior brought about by increased numbers of backyard bird feeders. By attracting numerous songbirds, the proliferation of feeders was short-stopping migrating Sharp-shinned Hawk north of their traditional wintering grounds, thereby reducing their numbers at the migration watchsites (Duncan 1996, Viverette et al. 1996, Bildstein 2006). That backyard bird feeders could change the migratory behavior and overwinter distribution of one of North America’s most prominent partial migrants indicates the extent to which even small shifts in land-use patterns can affect North American birds of prey.

*Land use on southern wintering grounds.*—Each autumn, as many as 10 million of North America’s raptors travel between breeding areas in the United States and Canada and wintering grounds in Mexico and Central and South America. The flight, which in Mesoamerica is made up of 32 species of North and Central American raptors, is dominated by hundreds of thousands to millions of Turkey Vultures (*Cathartes aura*), Mississippi Kites (*Ictinia mississippiensis*), Broad-winged Hawks, and Swainson’s Hawks, and by lesser numbers of Ospreys, Swallow-tailed Kites (*Elanus forficatus*), Northern Harriers (*Circus cyaneus*), Sharp-shinned Hawks, Cooper’s Hawks, American Kestrels, Merlins, and Peregrine Falcons, among others (Bildstein and Zalles 2001). Although few of these birds overwinter in the region’s rapidly disappearing old-growth forest (Bildstein 2004), all of them face different land-use practices and rates of land-use change while wintering in Latin America, and the plight of overwintering Swainson’s Hawks mentioned above is just one of the many threats faced by these birds. Unfortunately, studies of

North American migrants in Latin America, and the monitoring of their conservation status there, appears to have fallen from the “radar screen” of most raptor conservationists, leaving a critical gap in North American raptor-conservation efforts. The recent establishment of several full-season raptor-migration counts in Latin America (Bildstein 2006) offers the potential of narrowing this gap, especially if these sites were to begin monitoring the movements of return migrants in spring as well as those of outbound migrants in autumn.

*Creation and distribution of electrical energy.*—One human activity that has been problematic for raptors in North America and that continues to be so is the generation and distribution of electrical energy. Large raptors, including Ospreys, large hawks, and eagles, are particularly vulnerable to electrocution because their wing spans allow them to contact conducting and ground wires simultaneously (Harness 2007). Although some utility companies have redesigned and retrofitted powerlines to reduce the threat of electrocution (APLIC 2006), many have not. Deregulation of the power industry in the United States, and an increased focus on cost-cutting practices, suggests that this problem will be around for a long time (Bildstein 2006).

The generation of electricity at wind facilities threatens raptors in two ways, first via collisions with the turbines themselves, and second via habitat disturbance brought about by construction and maintenance. Although the peer-reviewed literature concerning this threat remains small, key factors for reducing these interactions include (1) situating turbines away from high-density raptor populations and known migration corridors, (2) avoiding sites that displace existing populations from important resources, and (3) using on–off cycles to reduce or eliminate collisions during periods of peak vulnerability (Bildstein 2006).

#### THE FUTURE

North American raptor populations have increased substantially during the past 25 years (Bednarz et al. 1990, Bildstein 1998, Hoffman and Smith 2003). In some instances, the increases may have returned populations to levels similar to or greater than those of one hundred years ago. As a result, across most of North America birds of prey are no longer the endangered and ecologically dysfunctional “boutique” predators (i.e., predatory species whose populations are so low that they fail to influence the behavior and ecology of their prey) that they were at the end of the DDT Era in the 1960s and 1970s. Rather, they are decidedly more common and again fully functional predators in many natural and, increasingly, human-dominated landscapes. As such, raptor conservationists are facing many of the same management concerns their predecessors faced at the turn of the last



century, when expanding human populations were coming into contact with what were then still-functional populations of birds of prey. Keeping common raptors common in the 21st century may prove as challenging now (see, for example, Garrott et al. 1993) as it was for conservationists in the 1920s and 1930s.

In 1999, for example, the Pennsylvania Game Commission held hearings on a proposal brought forward by its President (Commissioners are appointed by the Governor of Pennsylvania) regarding the need to “experimentally” control Red-tailed Hawks and Great Horned Owls on several state-owned wildlife management areas to increase the survivorship of Ring-necked Pheasants (*Phasianus colchicus*; Riegner 1999). Although a heavily attended public hearing demonstrated widespread opposition to the proposal, which was later withdrawn, letters to several newspapers suggested substantial support for the idea among rural residents (e.g., Riegel 1999).

North American hunters are not the only ones noticing the change in raptor numbers. Birdwatchers, particularly those with backyard birdfeeders, regularly call Hawk Mountain Sanctuary and, I suspect, other nature reserves to express outrage regarding songbird predation by Sharp-shinned Hawks and Cooper’s Hawks, both of which are increasingly willing to hunt in suburban and even urban areas, presumably because of reduced human predation there. Although many callers appear somewhat resigned to the situation, particularly when reminded that removing a single hawk from their backyard is as likely to be as ineffective as removing a single gray squirrel (*Sciurus carolinensis*), others suggest that they are willing to “take things into their own hands” should we fail to act (Bildstein 2001).

Whether or not the increased numbers of accipiters in suburban backyards is affecting regional populations of birds overwintering at bird feeders in North America is unknown. Evidence from England, however, indicates that it is not likely (Newton et al. 1997). Regardless of the ecological situation, accipiters once again are becoming the “enemies of all small birds,” at least in the minds of some people.

Another increasingly common event that has caught the attention of raptor conservationists is aggressive nest-guarding behavior by several species of raptors breeding in human-dominated landscapes. Although the behavior appears to be more common in some species than in others, Mississippi Kites, in particular, are prone to attacking humans (Gennaro 1988); instances involving Northern Goshawks (several instances in Massachusetts), Cooper’s Hawks, Broad-winged Hawks, and Red-shouldered Hawks also have been reported (K. L. Bildstein pers. obs., B. Millsap pers. obs.).

Perhaps the most serious conflict situation, and, to date, the only one that has resulted in a relatively large-scale lethal response, involves Black Vultures (*Coragyps atratus*) and Turkey Vultures in the southeastern

United States. As the numbers of both species have increased in North America (Kiff 2000) in the latter part of the 20th century, so have the numbers of complaints against them (Lowney 1999). Concerns involve livestock and pet depredation, property damage, and threats to human health. In 1994 through 1999, 12 counties in Virginia alone reported Black Vultures killing, injuring, or otherwise harassing pets. Although nonlethal methods, including suspending vulture carcasses and taxidermy effigies, have been used to disperse roosts at communications towers (Avery et al. 2002), in 2002 the U.S. Fish and Wildlife Service issued a permit allowing the take of up to 400 vultures, and a more recent request involved thousands of individuals (Anonymous 2003). Given that these vultures were two of the most heavily persecuted of all raptors in the first half of the 20th century (Parmalee 1954, Snyder and Rea 1998), these more recent federal actions are particularly ominous.

My experience at Hawk Mountain Sanctuary suggests that (1) raptor-focused, science-based conservation education extending from primary schools through the adult general public, and (2) public opportunities to see large numbers of migrating raptors during their seasonal movements, are two of the most effective tools for building local, regional, and national support for birds of prey. Education, in particular, has the potential for reaching large audiences, but it should be emphasized that its effectiveness rests upon the veracity of its science. As populations of North America's birds of prey continue to grow and expand, the use of both of these important tools is likely to become an increasingly essential part of the raptor conservationist's tool kit. Finally, the old palliatives that raptors prey only upon the old and sick and that they do not frequently shape the behavior, distribution, and abundance of their prey must be put aside, and birds of prey must be portrayed as the effective predatory entities they are.

#### FINAL THOUGHTS

Populations of most species of North American raptors are now higher than they have been at any time during the modern raptor-conservation era that began in the 1930s. Although most species are likely to face new and unexpected problems in the future, the inclusion of raptors in the Migratory Bird Treaty Act with Mexico in 1972—the most comprehensive law protecting birds of prey within these jurisdictions—together with the inherent resiliency of the birds themselves, an increased understanding of their biological needs, and a growing cadre of young, willing, and able raptor conservationists and educators, suggest that large numbers of North American birds of prey will be captivating the general public, as well as hawkwatchers and raptor conservationists, for some time.

## ACKNOWLEDGMENTS

My colleagues Chris Farmer, Chuck Henny, Brian Millsap, Ernesto Ruelas, and Jeff Smith, reviewed and commented on earlier drafts of this manuscript. Series in Ornithology editor Dick Veit also helped to improve the manuscript. I thank them all for their help. Much of this conservation history draws upon my earlier writings, and I thank the publishers of those pieces for allowing me to use parts of them here. I dedicate this brief history to my conservation colleague and mentor, Mr. Sarkis Acopian. This is Hawk Mountain Sanctuary contribution to conservation science number 152.

## LITERATURE CITED

- ALLEN, R. P., AND R. T. PETERSON. 1936. The hawk migrations at Cape May Point, New Jersey. *Auk* 53:393–404.
- ANONYMOUS. 1857. McGuffey's New Sixth Eclectic Reader. Van Antwerp, Bragg & Company, Cincinnati, Ohio.
- ANONYMOUS. 1933a. Notes and news. *Auk* 50:156–157.
- ANONYMOUS. 1933b. The Hawk and Owl Society. Annual report of the Hawk and Owl Society Bulletin 3: unnumbered (inside front cover).
- ANONYMOUS. 2003. Wildlife services step up vulture slaughter. *Bird Calls* 7:13.
- AUDUBON, J. J. 1840. *The Birds of America*, vol. I. J. B. Chevalier, Philadelphia, Pennsylvania.
- APLIC (AVIAN POWER LINE INTERACTION COMMITTEE). 2006. Suggested practices for avian protection on power lines: state of the art in 2006. APLIC, Edison Electric Institute, and the California Energy Commission, Washington, D.C. and Sacramento, California.
- AVERY, M. L., J. S. HUMPHREY, E. A. TILLMAN, K. O. PHARES, AND J. E. HATCHER. 2002. Dispersing vulture roosts on communication towers. *Journal of Raptor Research* 36:45–50.
- BAILEY, B. H., JR. 1918. *The Raptorial Birds of Iowa*. Iowa Geological Survey, Des Moines.
- BEAN, M. J. 1983. *The Evolution of National Wildlife Law*. Praeger, New York.
- BEANS, B. E. 1996. *Eagle's Plume*. University of Nebraska Press, Lincoln.
- BEDNARZ, J. C., D. KLEM, JR., L. J. GOODRICH, AND S. E. SENNER. 1990. Migration counts of raptors at Hawk Mountain, Pennsylvania, as indicators of population trends, 1934–1986. *Auk* 107:96–109.
- BILLEVELD, M. 1974. *Birds of Prey in Europe*. Macmillan Press, London.
- BILDSTEIN, K. L. 1998. Long-term counts of migrating raptors: A role for volunteers in wildlife research. *Journal of Wildlife Management* 62:435–445.
- BILDSTEIN, K. L. 2001. Raptors as vermin: The history of human attitudes towards Pennsylvania's birds of prey. *Endangered Species Update* 18:124–128.
- BILDSTEIN, K. L. 2004. Raptor migration in the Neotropics: Patterns, processes, and evolutionary consequences. *Ornitologia Neotropical* 15 (Supplement):83–99.
- BILDSTEIN, K. L. 2006. *Migrating Raptors of the World: Their Ecology and Conservation*. Cornell University Press, Ithaca, New York.

- BILDSTEIN, K. L., AND R. A. COMPTON. 2000. Mountaintop science: The history of conservation ornithology at Hawk Mountain Sanctuary. Pages 153–181 *in* Contributions to the History of North American Ornithology (W. E. David, Jr. and J. A. Jackson, Eds.). Memoirs of the Nuttall Ornithological Club, Cambridge, Massachusetts.
- BILDSTEIN, K. L., AND J. I. ZALLES. 2001. Raptor migration along the Mesoamerican Land Corridor. Pages 119–141 *in* Hawkwatching in the Americas (K. L. Bildstein and D. Klem, Jr., Eds.). Hawk Migration Association of North America, North Wales, Pennsylvania.
- BILDSTEIN, K. L., J. BRETT, L. GOODRICH, AND C. VIVERETTE. 1993. Shooting galleries. *American Birds* 47:38–43.
- BIRD, D., D. VARLAND, AND J. NEGRO, Eds. 1996. Raptors in Human Landscapes. Academic Press, London.
- BLANCHAN, N. 1898. Birds that Hunt and are Hunted. Grosset & Dunlap, New York.
- BOAL, C. W., AND R. W. MANNAN. 1999. Comparative breeding ecology of Cooper's Hawks in urban and exurban areas of southeastern Arizona. *Journal of Wildlife Management* 63:77–84.
- BROLEY, M. J. 1952. Eagle Man. Pellegrini & Cudahy, New York.
- BROLEY, C. L. 1958. The plight of the American Bald Eagle. *Audubon Magazine* 52: 139, 141.
- BROUGHTON, J. M. 2004. Prehistoric human impacts on California birds: Evidence from the Emeryville Shellmound avifauna. *Ornithological Monographs*, no. 56.
- BROUN, M. 1949. Hawks Aloft: The Story of Hawk Mountain. Cornwall Press, Cornwall, New York.
- BROUN, M. 1956. Pennsylvania's bloody ridges. *Nature Magazine* June–July:14–18.
- BRYAN, A. L., JR., T. M. MURPHY, K. L. BILDSTEIN, I. L. BRISBIN, JR., AND J. J. MAYER. 1996. Use of reservoirs and other artificial impoundments by Bald Eagles in South Carolina. Pages 285–298 *in* Raptors in Human Landscapes (D. Bird, D. Varland, and J. Negro, Eds.). Academic Press, London.
- BUEHLER, D. A. 2000. Bald Eagle (*Haliaeetus leucocephalus*). *In* The Birds of North America, no. 506 (A. Poole and F. Gill, Eds.). Birds of North America, Philadelphia.
- CADE, T. J. 2003. Starting the Peregrine Fund at Cornell University and eastern reintroduction. Pages 73–104 *in* Return of the Peregrine: A North American Saga of Tenacity and Teamwork (T. J. Cade and W. Burnham, Eds.). Peregrine Fund, Boise, Idaho.
- CADE, T. J., AND W. BURNHAM. 2003. Return of the Peregrine: A North American Saga of Tenacity and Teamwork. Peregrine Fund, Boise, Idaho.
- CADE, T. J., J. H. ENDERSON, C. G. THELANDER, AND C. M. WHITE, Eds. 1988. Peregrine Falcon Populations: Their Management and Recovery. Peregrine Fund, Boise, Idaho.
- CAREY, H. R. 1926. Hawk extermination. *Auk* 43:275–276.
- CARSON, R. L. 1962. Silent Spring. Houghton-Mifflin, Boston, Massachusetts.
- CATESBY, M. 1731–1743. The Natural History of Carolina, Florida, and the Bahama Islands. 2 vols. London.

- CHANDLER, R. B., A. M. STRONG, AND C. C. KAUFMAN. 2004. Elevated lead levels in urban House Sparrows: A threat to Sharp-shinned Hawks and Merlins? *Journal of Raptor Research* 38:62–68.
- CLEMENT, R. C. 1965. Last call for the birds of prey. *Audubon Magazine* 67:37.
- COLEMAN, J. L., D. M. BIRD, AND E. A. JACOBS. 2002. Habitat use and productivity of Sharp-shinned Hawks nesting in an urban habitat. *Wilson Bulletin* 114: 467–473.
- DUNCAN, C. D. 1996. Changes in the winter abundance of Sharp-shinned Hawks in New England. *Journal of Field Ornithology* 67:254–262.
- EDGE, R. 1936. The world's first hawk sanctuary. *International Journal of Animal Protection* May:14–16.
- ENGLAND, A. S., M. J. BECHARD, AND C. S. HOUSTON. 1997. Swainson's Hawk (*Buteo swainsoni*). *In* The Birds of North America, no. 265 (A. Poole and F. Gill, Eds.). Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, D.C.
- ERRINGTON, P. L. 1946. Predation and vertebrate populations. *Quarterly Review of Biology* 21:144–177, 221–245.
- FEIERABEND, J. S., AND O. MYERS. 1984. A National Summary of Lead Poisoning in Bald Eagles and Waterfowl. National Wildlife Federation, Washington, D.C.
- FISHER, A. K. 1893. The Hawks and Owls of the United States in their Relation to Agriculture. U.S. Department of Agriculture, Government Printing Office, Washington, D.C.
- FRANKLIN, B. 1987. Writings. The Library of America, New York
- FUERTES, L. A. 1920. American birds of prey—A review of their value. *National Geographic* 38:460–467.
- GABRIELSON, I. N., R. P. ALLEN, I. McTAGGART COWAN, P. A. DUMONT, R. H. POUGH, AND G. A. SWANSON. 1950. Report of the A.O.U. committee on bird protection. *Auk* 67:316–324.
- GARROTT, R. A., P. J. WHITE, AND C. A. V. WHITE. 1993. Overabundance: An issue for conservation biologists? *Conservation Biology* 7:946–949.
- GENNARO, A. L. 1988. Extent and control of aggressive behavior toward humans by Mississippi Kites. Pages 249–252 *in* Proceedings of the Southwest Raptor Management Symposium and Workshop (R. L. Glinski, B. G. Pendleton, M. B. Moss, M. N. LeFranc, Jr., B. A. Millsap, and S. W. Hoffman, Eds.). National Wildlife Federation, Washington, D.C.
- GERSTELL, R. 1937. The Pennsylvania bounty system. *Research Bulletin No. 1. Pennsylvania Game Commission, Harrisburg.*
- GOLDSTEIN, M. I., T. E. LACHER, B. WOODBRIDGE, M. J. BECHARD, S. B. CANAVELLI, M. E. ZACCAGNINI, G. P. COBB, E. J. SCOLLON, R. TRIBOLET, AND M. J. HOOPER. 1999. Monocrotophos-induced mass mortality of Swainson's Hawks in Argentina, 1995–1996. *Ecotoxicology* 8:201–214.
- GREENWAY, J. C. 1958. Extinct and vanishing birds of the world. Special Publication 13. Museum of Comparative Zoology, Cambridge, Massachusetts.
- GUTIÉRREZ, R. J., A. B. FRANKLIN, AND W. S. LAHAYE. 1995. Spotted Owl (*Strix occidentalis*). *In* The Birds of North America, no. 179 (A. Poole and F. Gill, Eds.). Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, D.C.

- HARNESS, R. E. 2007. Mitigation. Pages 365–382 *in* Raptor Research and Management Techniques (D. M. Bird and K. L. Bildstein, Eds.). Hancock House Publishers Ltd., Surrey, British Columbia.
- HENNY, C. J., AND J. E. ELLIOTT. 2007. Toxicology. Pages 329–350 *in* Raptor Research and Management Techniques (D. M. Bird and K. L. Bildstein, Eds.). Hancock House Publishers Ltd., Surrey, British Columbia.
- HENNY, C. J., AND H. M. WIGHT. 1972. Population ecology and environmental pollution: Red-tailed and Cooper's hawks. Pages 229–250 *in* Population Ecology of Migratory Birds: A Symposium. U.S. Department of Interior, Wildlife Research Report 2, Washington, D.C.
- HICKEY, J. J., ED. 1969. Peregrine Falcon Populations: Their Biology and Decline. University of Wisconsin Press, Madison.
- HIX, G. E. 1933. The Birds of Prey for Boy Scouts. Privately published. Brooklyn, New York.
- HOFFMAN, S. W., AND J. P. SMITH. 2003. Population trends of migratory raptors in western North America, 1977–2001. *Condor* 105:397–419.
- HOLT, E. G. 1926. Nature-wasters and sentimentalists. *Auk* 43:409–410.
- HORNADAY, W. T. 1913. Our Vanishing Wild Life. New York Zoological Society, New York.
- HORNADAY, W. T. 1914. Wild Life Conservation in Theory and Practice. Yale University Press, New Haven, Connecticut.
- HORNADAY, W. T. 1922. The Minds and Manner of Wild Animals. C. Scribner's Son, New York.
- HORNADAY, W. T. 1931. Thirty Years War for Wild Life. C. Scribner's Son, New York.
- HOTCHKISS, N., AND R. H. POUCH. 1946. Effect on forest birds of DDT used for gypsy moth control in Pennsylvania. *Journal of Wildlife Management* 10: 202–207.
- HUNT, W. G., W. BURNHAM, C. N. PARISH, K. K. BURNHAM, B. MUTCH, AND J. L. OAKS. 2006. Bullet fragments in deer remains: Implications for lead exposure in avian scavengers. *Wildlife Society Bulletin* 34:167–170.
- JAHN, L. R., R. C. CLEMENT, W. W. DYKSTRA, R. A. MCCABE, D. A. POOLE, AND R. L. RUDD. 1963. Annual report of the conservation committee. *Wilson Bulletin* 75: 295–325.
- KIFF, L. F. 2000. The current status of North America vultures. Pages 175–189 *in* Raptors at Risk (R. D. Chancellor and B.-U. Meyburg, Eds.). World Working Group on Birds of Prey and Owls, Berlin, Germany.
- KOSAK, J. 1995. The Pennsylvania Game Commission 1895–1995. Pennsylvania Game Commission, Harrisburg.
- KRAMER, J. L., AND P. T. REDIG. 1997. Sixteen years of lead poisoning in eagles 1980–95: An epizootiologic view. *Journal of Raptor Research* 31:327–332.
- LATHAM, R. M. 1950. The food of predaceous animals in northeastern United States. Pennsylvania Game Commission, Harrisburg.
- LEOPOLD, A. 1933. Game Management. Charles Scribner's Sons, New York.
- LEOPOLD, A. 1949. A Sand County Almanac. Oxford University Press, Oxford, United Kingdom.
- LOWNEY, M. S. 1999. Damage by Black and Turkey Vultures in Virginia, 1990–1996. *Wildlife Society Bulletin* 27:715–719.

- MAY, J. B. 1935. The Hawks of North America: Their Field Identification and Feeding Habits. National Association of Audubon Societies, New York.
- MCATEE, W. L. 1926. Hawk abundance and hawk campaigns. *Auk* 43:542–544.
- MCBRIDE, T. J., J. P. SMITH, H. GROSS, AND M. J. HOOPER. 2004. Blood-lead and ALAD activity levels of Cooper's Hawks (*Accipiter cooperii*) migrating through the southern Rocky Mountains. *Journal of Raptor Research* 38:118–124.
- MCCLELLAND, B. R., L. S. YOUNG, P. T. MCCLELLAND, J. G. GREENSHAW, H. L. ALLEN, AND D. S. SHEA. 1994. Migration ecology of Bald Eagles from autumn concentrations in Glacier National Park. *Wildlife Monographs* 125:1–61.
- MUIR, J. 1913. *The Story of My Boyhood and Youth*. Houghton Mifflin, Boston, Massachusetts.
- NEWTON, I. 1990. Human impacts on raptors. Pages 190–207 *in* *Birds of Prey* (I. Newton and P. Olsen, Eds.). Facts on File, New York.
- NEWTON, I., L. DALE, AND P. ROTHERY. 1997. Apparent lack of impact of Sparrowhawks on breeding densities of some woodland songbirds. *Bird Study* 44:129–135.
- PARMALEE, P. W. 1954. The vultures: Their movements, economic status, and control in Texas. *Auk* 71:443–453.
- PEARSON, L. 1897. *Diseases and Enemies of Poultry*. C. M. Busch, Harrisburg, Pennsylvania.
- PEARSON, T. G. 1921. The Bald Eagle. Educational leaflet, no. 82. National Association of Audubon Societies, New York.
- PHILLIPS, R. S. 1949. A fair deal for our birds of prey. *Audubon Magazine* 51:376–381, 392–397.
- PORTER, R. D., AND S. N. WIEMEYER. 1969. Dieldrin and DDT: Effects on Sparrow Hawk eggshells and reproduction. *Science* 165:199–200.
- RATCLIFFE, D. 1958. Broken eggs in peregrine eyries. *British Birds* 51:23–26.
- RATCLIFFE, D. 1967. Decrease in eggshell weight in certain birds of prey. *Nature* 215:208–210.
- RIEGEL, E. 1999. No sympathy for killer hawks. *Reading Eagle* (newspaper) 11 March.
- RIEGNER, C. 1999. Pheasant problems. *Pennsylvania Game Commission News* 70(11):16–18.
- ROSENFELD, R. N., AND J. BIELEFELDT. 1993. Cooper's Hawk (*Accipiter cooperii*). *In* *The Birds of North America*, no. 75 (A. Poole and F. Gill, Eds.). Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, D.C.
- ROSENFELD, R. N., J. BIELEFELDT, J. L. AFFELDT, AND D. J. BECKMANN. 1996. Urban nesting biology of Cooper's Hawks in Wisconsin. Pages 41–44 *in* *Raptors in Human Landscapes* (D. Bird, D. Varland, and J. Negro, Eds.). Academic Press, London.
- SENNER, S. E. 1984. The model hawk law. *Hawk Mountain News* 62:42–45.
- SNYDER, N. F. R., AND A. M. REA. 1998. California Condor *Gymnogyps californianus*. Pages 32–36 *in* *The Raptors of Arizona* (R. L. Glinski, Ed.). University of Arizona Press, Tucson.
- SNYDER, N. F. R., AND N. J. SCHMITT. 2002. California Condor (*Gymnogyps californianus*). *In* *The Birds of North America*, no. 610 (A. Poole and F. Gill, Eds.). Birds of North America, Philadelphia.

- SPENCER, C. N., B. R. McCLELLAND, AND J. A. STANFORD. 1991. Shrimp stocking, salmon collapse, and eagle displacement. *BioScience* 41:14–21.
- STONE, W. 1930. The hawk question. *Auk* 47:201–217.
- STONE, W. 1937. *Bird Studies at Old Cape May*, vols. I and II. Delaware Valley Ornithological Club, Academy of Natural Sciences, Philadelphia, Pennsylvania.
- SUTTON, G. M. 1928a. *An Introduction to the Birds of Pennsylvania*. J. H. McFarland, Harrisburg, Pennsylvania.
- SUTTON, G. M. 1928b. Notes on a collection of hawks from Schuylkill County, Pennsylvania. *Wilson Bulletin* 40:84–95.
- SUTTON, G. M. 1929. How can the bird-lover help save the hawks and owls? *Auk* 46:190–195.
- TYLER, H. A. 1979. *Pueblo Birds and Myths*. University of Oklahoma Press, Norman.
- VIVERETTE, C. B., S. STRUVE, L. J. GOODRICH, AND K. L. BILDSTEIN. 1996. Decreases in migrating Sharp-shinned Hawks (*Accipiter striatus*) at traditional raptor-migration watch sites in eastern North America. *Auk* 113:32–40.
- WALKER, C. H. 2004. Organochlorine insecticides and raptors in Britain. Pages 133–145 *in* *Insect and Bird Interactions* (H. F. van Emden and M. Rothschild, Eds.). Intercept Ltd., Andover, United Kingdom.
- WIEMEYER, S. N., AND R. D. PORTER. 1969. DDE thins eggshells in captive American Kestrels. *Nature* 227:737–738.
- WILLIAMS, M. 1989. *Americans and Their Forests: A Historical Geography*. Cambridge University Press, Cambridge, United Kingdom.
- WILSON, A. 1808–1814. *American Ornithology*, vols. 1–9. Bradford and Inskeep, Philadelphia, Pennsylvania.
- WORSTER, D. 1977. *Nature's Economy: A History of Ecological Ideas*. Cambridge University Press, Cambridge, United Kingdom.
- WRIGHT, M. O. 1895. *Birdcraft*. Macmillan & Company, New York.
- WRIGHT, M. O. 1936. *Birdcraft*, 9th. ed. Macmillan & Company, New York.
- ZALLES, J. I., AND K. L. BILDSTEIN, Eds. 2000. *Raptor Watch: A Global Directory of Raptor Migration Sites*. BirdLife International, Cambridge, United Kingdom, and Hawk Mountain Sanctuary, Kempton, Pennsylvania.