

The Precipitous Decline of Black-crowned Night-Herons in Massachusetts and the Northeast

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Left: Black-crowned Night-Heron. Photograph by John Wiese. Right: Checking heron nest contents with extensible pole and mirror. Photograph by Dave Twichell.

Introduction: Colonies of Birds have Disappeared

One hundred years ago, Alfred O. Gross published a detailed account of a Black-crowned Night-Heron (*Nycticorax nycticorax*) colony on Sandy Neck, Barnstable County, Massachusetts (Gross 1923). Bent (1926) reported that the Sandy Neck colony, which extended a half mile in length and one-eighth mile wide, had existed since at least the early 1800s and was—at 2,536 nests—the largest in North America. Griscom and Snyder (1955) reported “vast colonies at Plum Island, Ipswich, Barnstable Neck (Sandy Neck), and Hyannis” in the early decades of the twentieth century. This extraordinary abundance of birds evokes the legendary richness of wildlife in North America prior to exponential growth of the human population that took place in the nineteenth century (United States Census Bureau).

Over the past century, Black-crowned Night-Herons in Massachusetts have gone from populating the largest colony in North America to a much-diminished

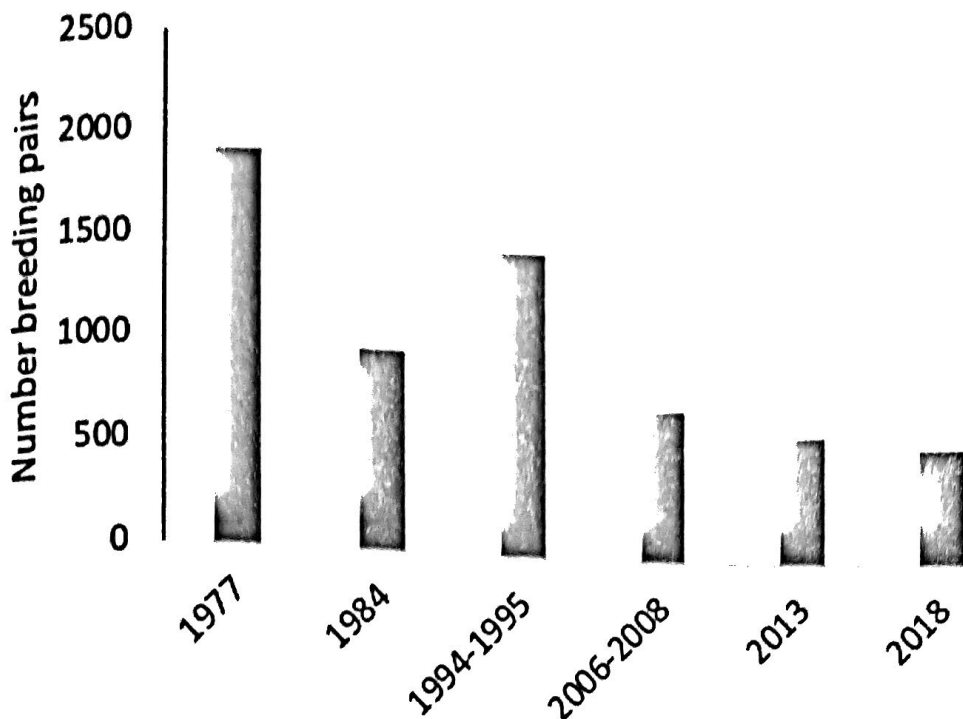


Figure 1. Abundance of Black-crowned Night-Herons in Massachusetts, 1977–2018 (Kushlan et al. 2002; Melvin 2010; MassWildlife unpublished data).

presence in the state. Despite the many threats night-herons faced in the first 75 years of the twentieth century—including widespread use of chlorinated pesticides and lack of wetlands protection—they emerged in the 1970s, when large-scale surveys were initiated, with a state population of nearly 4,000 breeding adults. Approximately 1,100 continue to nest in the state today. Figure 1 shows that, with updated information through 2018, only 25% of the Black-crowned Night-Heron population surveyed in 1977 still exists in Massachusetts (MassWildlife unpublished data; Figure 1).

Since the 1970s, state and federal wildlife agencies have conducted systematic surveys of colonially nesting waterbirds at state and regional scales (Custer and Osborn 1977; Erwin and Korschgen 1977; Spendelow and Patton 1988; Melvin 2010). The abundance of breeding Black-crowned Night-Herons along the coast from Delaware to Maine fell 62%—from more than 60,000 birds to fewer than 23,000—from the 1970s through the early 2000s (Figure 2). Similarly, 63% of Snowy Egrets (*Egretta thula*) disappeared during this time (Kushlan et al. 2002). Notably, most Snowy Egret nesting occurs where Black-crowned Night-Herons also nest; this was the case in 96% of colonies in New England where snowies nested from 1977 to 1995.

These documented losses contribute to the shocking disappearance of nearly 30% of the entire avifauna of North America since the 1970s (Rosenberg et al. 2019). Whereas the scale of loss is stunning, it is unsurprising that the authors attributed the cause to “habitat loss and other factors yet to be pinned down.” Habitat loss as a major and catchall determinant of avian biodiversity loss has been long reported (e.g., Palmer 1962; Hothem et al. 2020); that additional factors are unknown reflects the incomplete state of our knowledge and ability to address threats to populations.

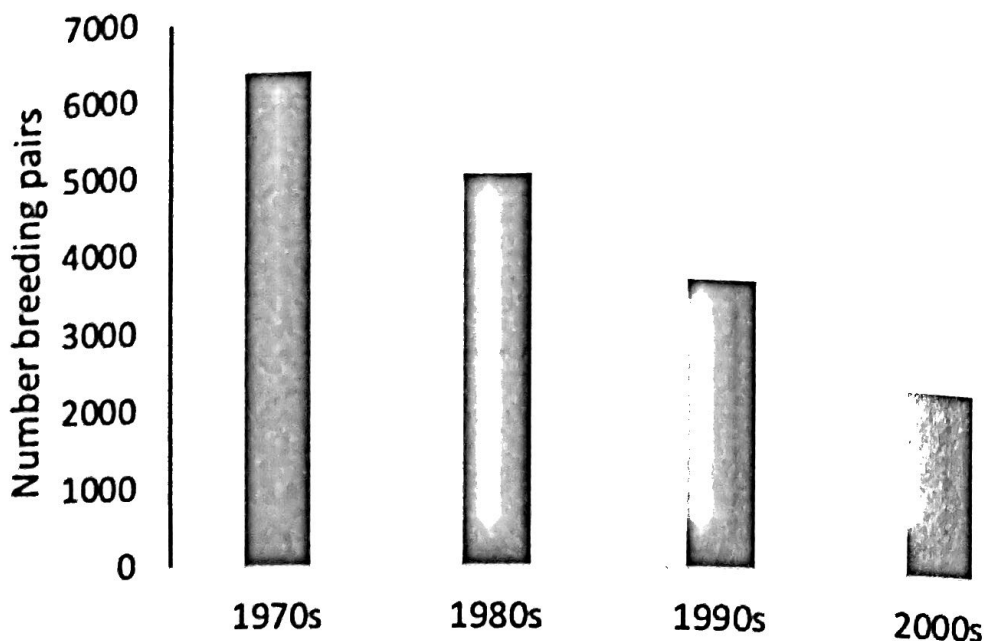


Figure 2. Abundance of Black-crowned Night-Herons in the northeast United States (coastal Delaware-Maine), 1970s–2000s (Kushlan et al. 2002; unpublished data).

Multiple Factors Cause the Decline in Night-Heron Populations

Through long-term studies first at Clark’s Island in Plymouth Harbor, Plymouth County, Massachusetts, and then at colonies on Cape Cod and Nantucket and in Boston Harbor, Delaware Bay, and New York Harbor, colleagues and I documented nesting abundance and productivity of Black-crowned Night-Herons as well as species nesting with them, including Snowy Egret, Great Egret (*Ardea alba*), Little Blue Heron (*Egretta caerulea*), Cattle Egret (*Bubulcus ibis*), and Glossy Ibis (*Plegadis falcinellus*). We assessed status and investigated factors limiting reproductive success including predation, starvation, and adverse weather (Parsons et al. 2001). In addition, we developed site-specific conservation plans (Kushlan et al. 2002).

Our long-term studies of Black-crowned Night-Heron reproductive success show that in most years and locations, productivity is not sufficient to sustain the population (Parsons et al. 2001; Hothem et al. 2020). There is little evidence that herons are disappearing due to factors occurring in the birds’ wintering grounds. In addition to factors expected to be regulating the population—such as predation and poor weather—there are exacerbating effects from pesticides, human-facilitated predator populations, climate change, and human disturbance.

Parasites and Pesticides

Sampson’s Island in Cotuit Bay, Barnstable County, Massachusetts, provided nesting habitat for more than 500 breeding herons and egrets in 1977, and presumably in prior years, because it has been protected and managed for bird conservation since the 1940s. The low-lying island with shimmering marsh-fringed shoreline in the bay and small dunes fronting Vineyard Sound hosted four wading bird species in 1977:

Black-crowned Night-Heron, Snowy Egret, Great Egret, and Little Blue Heron. By the mid-1990s, approximately 300 wading birds nested in a small grove of cedars and pines.

During a three-year study (1991–1993), I and colleagues from Manomet were surprised to find symptoms of disease in many of the Black-crowned Night-Herons on the island. Alarming, in 88% of study nests, nestlings showed abdominal lesions ranging in size from small pinpricks to large, bleeding wounds—some perforating the abdominal wall.

The lesions were caused by nest parasites—scavenging skin beetles (*Dermestes nidum*)—that were found to be in all study nests (Parsons et al. 2009). However, not all nests with nestlings showed lesions. In working with the Wildlife Clinic at Tufts University Veterinary School, we learned that birds with lesions had significantly lower cholinesterase blood levels than birds without lesions (Parsons et al. 2000; Parsons unpublished data).

Cholinesterase is an enzyme critical to neurological function in all animals and is the biochemical target of anti-cholinesterase pesticides (organophosphates, carbamates) used in insect control. In working with environmental scientists at Southern Illinois University, we detected the pesticides dimethoate, parathion, malathion, methamidophos, and chlorpyrifos in food delivered to heron nestlings at colonies on Monomoy National Wildlife Refuge, Barnstable County, Massachusetts, and Pea Patch Island in Delaware Bay, New Castle County, Delaware, where lesions on Cattle Egrets were also prevalent (Table 1).

Table 1. Mean lesion scores of wading-bird nestlings in northeast estuaries, 1991–1998. Lesion scores combined the number and severity of lesions documented on nestlings. Lesions were never observed on Glossy Ibis and rarely seen on nestlings in urban estuaries. The species most impacted by lesions were Black-crowned Night-Heron on Cape Cod and Cattle Egret in Delaware Bay. Not all species nested at each location.

	Black-crowned Night-Heron	Snowy Egret	Little Blue Heron	Cattle Egret	Glossy Ibis
Boston Harbor	0	0			
Cape Cod	0.8	0.2			
New York Harbor	0	0		0	0
Delaware Bay	0.1	0.1	0	0.4	0

Sublethal symptoms of low cholinesterase in birds include lethargy and loss of anti-predator behaviors (Parsons et al. 2006; Scholz and Hopkins 2006). Beetles opportunistically fed on the abdomens of lethargic nestlings, although this rarely

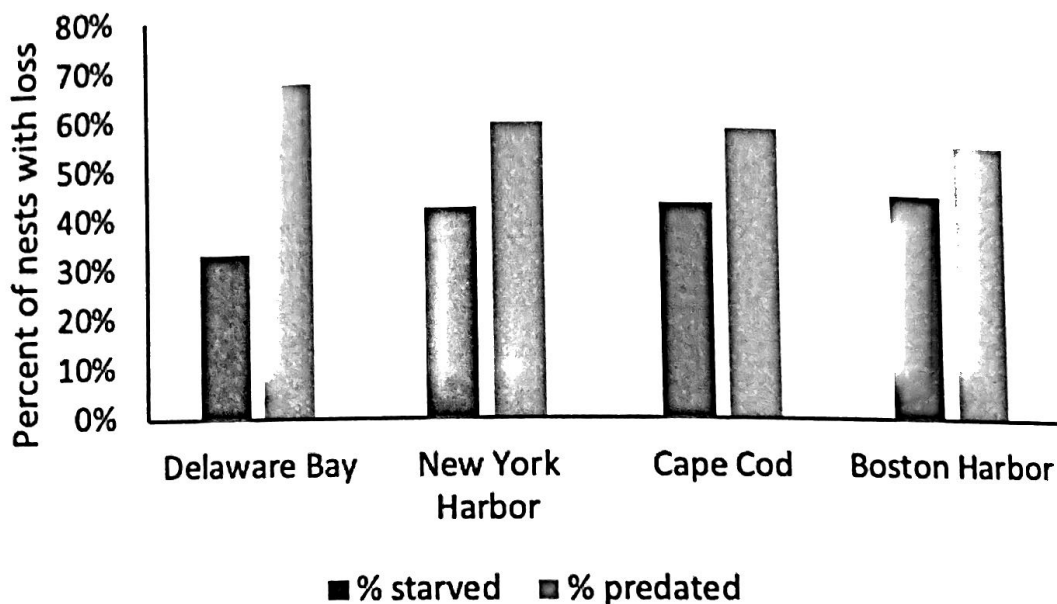
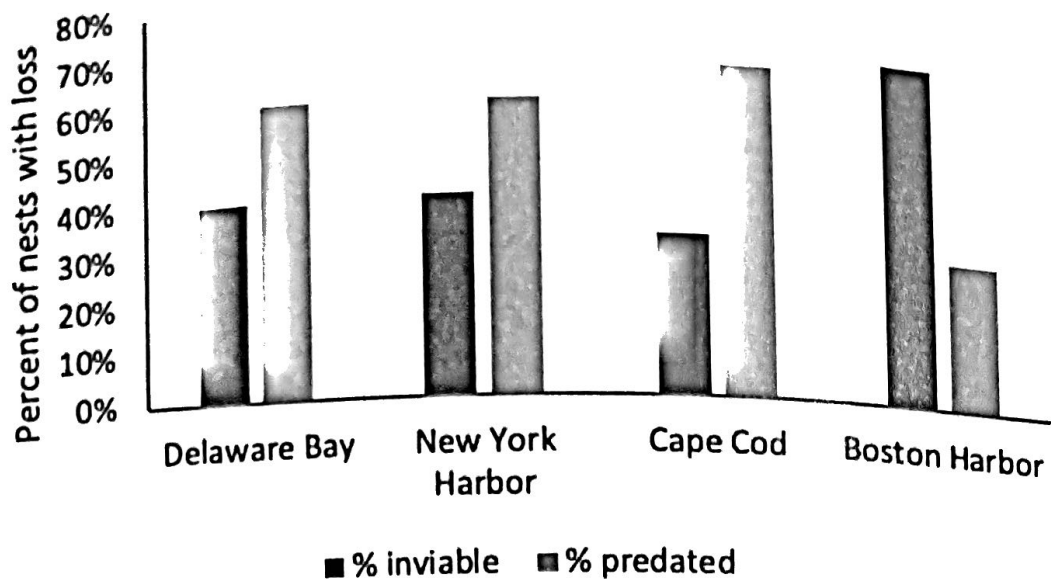


Figure 3. Egg and nestling mortality of Black-crowned Night-Heron in United States northeast estuaries, 1987–1998 (from Parsons et al. 2001). Given is percent of study nests that lost > 1 egg attributed to either predation or inviability (top) or > 1 nestling to either predation or starvation (bottom).

resulted in death. Figure 3 shows that herons nesting in agricultural and suburban landscapes, such as Delaware Bay and Cape Cod, had lower cholinesterase and higher predation rates than herons in urban estuaries such as Boston Harbor and New York Harbor (Parsons et al. 2000; Parsons et al. 2001).

Contamination and Oil Spills

Although anti-cholinesterase pesticides and their effects were not detected in urban

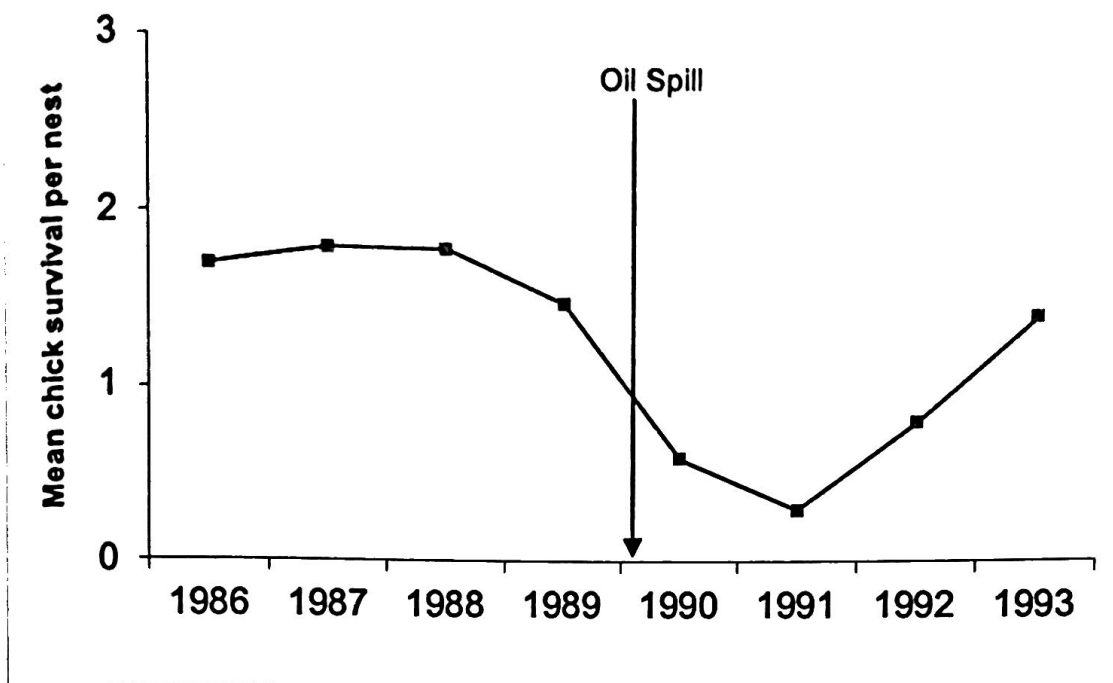


Figure 4. Snowy Egret chick survival to 15 days post-hatch in New York Harbor before and following a major oil spill, 1986–1993 (from Parsons 1994).

estuaries, the presence of contaminated foraging habitats in commercial ports is not unexpected. Piscivorous bird species such as Black-crowned Night-Heron are known to be adversely affected through exposure to persistent industrial contaminants such as polychlorinated biphenyls (Rattner et al. 2000; Matz and Parsons 2004; Hothem et al. 2020), and as a result of catastrophic events such as oil spills (Fry et al. 1986).

In late January 1990, I piloted a 16-foot skiff out of the small marina in Elizabeth, New Jersey, and into the Arthur Kill—a narrow waterway west of Staten Island, New York. An oil spill, unprecedented in volume even for New York Harbor, had released 567,000 gallons into the water on January 1. Over 80 hectares of salt marsh were impacted less than three months before hundreds of herons and egrets would migrate into the estuary to nest. I threw fish traps into salt-marsh creeks—Old Place Creek, Prall’s Creek, Little Fresh Kills (Richmond County, New York)—and other sampling locations where, since 1986, colleagues and I had monitored the presence of forage fish and shrimp, surveyed wading-bird foraging, and, in the nearby colonies, monitored reproductive success.

Heron and egrets did return and nest in New York Harbor in 1990 in numbers comparable to or greater than in previous years. Some species were adversely impacted by the spill and others adapted to utilize comparatively uncontaminated foraging habitat. Over the course of the next three breeding seasons, we documented the devastating effect of reduced mummichog (*Fundulus heteroclitus*) numbers on wading-bird species, such as Snowy Egret, that specialize on tidal fish. Black-crowned Night-Herons shifted their generalist diet to include more freshwater fish and to forage for longer times in the large, nearby landfill. Snowy Egret egg production and hatching

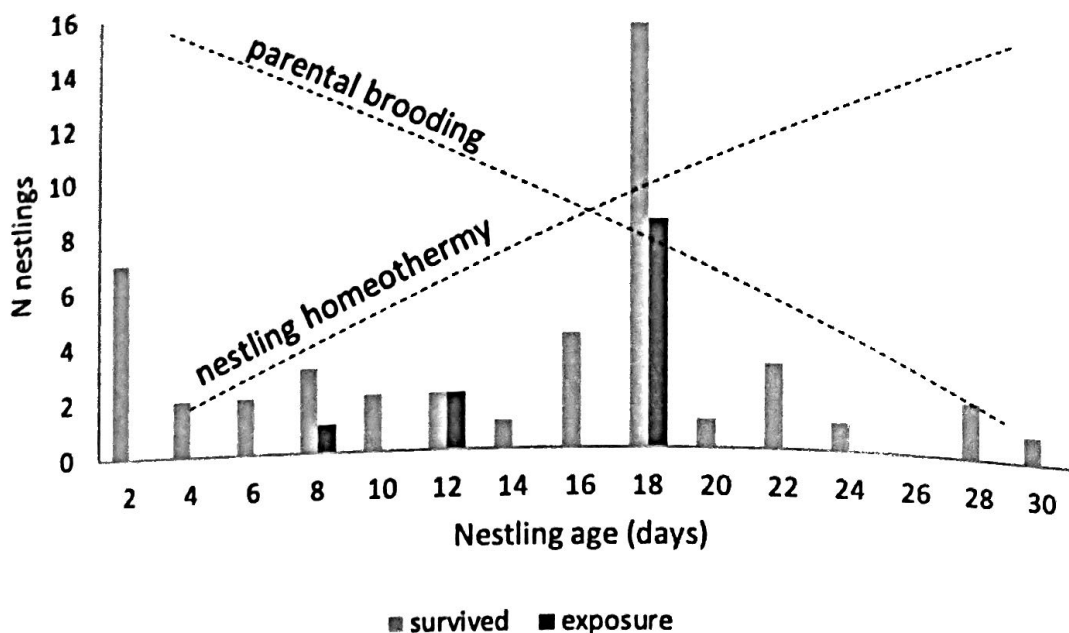


Figure 5. Fate of Great Egret nestlings during a northeast storm, Boston Harbor, 2021. Chicks dying of exposure were more likely to be 8–17 days old compared to chicks that survived. This included all ages (2–30 days). Age of vulnerability to storm events is predicted to be when parental brooding is reduced due to increased foraging needs and when nestling ability to thermoregulate is not fully developed (Parsons 1985).

were unchanged from prior years, but nestling growth rates were significantly lower, and hundreds of nestlings starved in the nest for the three seasons following the oil spill (Parsons 1994; Figure 4).

Weather

When I was an intern at Manomet and as a graduate student, I investigated the effects of adverse weather on Black-crowned Night-Herons and Snowy Egrets nesting on Clark’s Island. Manomet generously made several years of nesting data available to me, and with data I collected in the field, I had a nine-year dataset to examine weather effects. Weather patterns varied annually, with three relatively benevolent seasons, three average, and three with significant northeast storms impacting the heronry in late May (Parsons 1985).

During one of the storms, I climbed a 15-foot pole and watched from a blind as the nesting birds suffered through lashing wind, rain, and low temperatures. Parents were able to shelter nestlings if they were neither too big nor too numerous (Parsons 1985). Nestling age of vulnerability to cold weather—when parents are spending less time brooding and nestling ability to thermoregulate is still developing (Figure 4)—was 14 days for Black-crowned Night-Heron.

In 2021, during an investigation of the status and possible causes of heron declines in Boston Harbor funded by the National Park Service, I and Mass Audubon

Table 2. Percentage of hatching success and chick survival of Black-crowned Night-Heron in United States northeast estuaries, 1986–1998 (from Parsons et al. 2001). Given are mean + SD (N nests hatching >1 egg) of eggs hatched/laid (%) and of nestlings surviving to 15 days post-hatch/eggs hatched (%). Means with unlike superscripts indicate significant differences between estuaries.

	Delaware Bay	New York Harbor	Cape Cod	Boston Harbor
Hatching	84.8 ± 21.6 (112) ^b	85.2 ± 21.2 (233) ^a	82.2 ± 21.7 (195) ^{ab}	87.0 ± 16.8 (96) ^a
Chick survival	38.2 ± 37.0 (109) ^b	78.7 ± 29.3 (231) ^b	57.8 ± 39.3 (193) ^c	87.3 ± 20.8 (96) ^a

colleagues found that this age of weather vulnerability occurred in older Great Egrets. Most egret nestlings survived a six-day nor’easter in 2021, but those that succumbed to exposure—86% of all chick deaths—were in the middle age range for nestlings—16–18 days old (Figure 5). The mean brood size of nests impacted by the storm was four nestlings; brood size averaged three nestlings in nests where chicks survived the storm (Parsons et al. 2023).

Extreme weather events also impact nesting habitat. Hurricane Bob swept over Sampson’s Island in 1991 and inundated the small grove of trees where the herons and egrets nested. Wading birds had migrated away from the island at the time of the storm, but the trees were killed and provided nesting habitat for only two following seasons before falling to the ground. Herons and egrets abandoned Sampson’s Island. As global warming accelerates, rising sea level and increasing storm frequency will put low-lying colony sites and those subject to erosion at risk (Cornell 2022).

Predation

In May 1994, a co-worker and I landed our canoe on the only slip of beach along the rocky shoreline of a small island in Boston Harbor. We climbed through a barrier of shrubs and thickets and reached the canopied island center. The island was enveloped in the sounds and smells of an active heron colony. As part of a state-wide survey, we checked every tree for active nests and recorded nest contents, which we could see with a mirror attached to an extensible pole. The results were: Black-crowned Night-Heron: 547 nests, 843 eggs, 975 chicks; Snowy Egret: 146 nests, 363 eggs, 187 chicks; Great Egret: 1 nest; Double-crested Cormorant (*Nannopterum auritum*): 16 nests.

As part of our recent study in Boston Harbor, the Mass Audubon team in 2022 recorded 121 Black-crowned Night-Heron nests with 78 nestlings and 251 eggs, no Snowy Egret nests, 101 Great Egret nests, and 274 Double-crested Cormorant nests on the same island surveyed in 1994. For sheer presence of wading birds, this is a stunning reduction compared to 1994: 571 heron adults, eggs, and chicks compared to 2,912 in 1994; no Snowy Egrets at all compared to 842 adults and offspring in 1994.

We found that Black-crowned Night-Heron fledging success was significantly lower (approximately 57% of hatched chicks fledged) than that documented in the 1990s (87% fledged; Table 2); most loss was attributed to predation (Parsons et al. 2023). Our field cameras caught images of coyote (*Canis latrans* x *C. lycaon*) and Bald Eagle (*Haliaeetus leucocephalus*) in the Boston Harbor colonies—predator species that have greatly increased in abundance in Massachusetts over the past several decades (Grompper 2002; Mass Audubon 2013).

However, juxtaposed against the reductions of Black-crowned Night-Herons and Snowy Egrets are the impressive numbers of Great Egrets and cormorants—species that were just beginning to establish on the island and in Boston Harbor in the mid-1990s. Populations of both species, while increasing steadily from the 1990s through the mid-2010s, appear to have currently stabilized (MassWildlife unpublished data).

Intentional Destruction of Colonies

Over the past 100 years, Black-crowned Night-Heron colonies have been destroyed intentionally (Hill 1965; Veit and Petersen 1993; Prescott 2003), and herons have been culled to reduce predation on eggs and chicks of birds protected under endangered species laws.

Six years after Gross's seminal account of nesting Black-crowned Night-Herons in North America's largest heronry, Bent reported that the colony was repeatedly "shot up" (Bent 1926), and by 1940, it had been abandoned (Veit and Petersen 1993). The colony site of 100 pairs on Spectacle Island in Boston Harbor was destroyed in 1992 to provide a dredge spoil deposition site accommodating the construction of the third harbor tunnel (National Park Service). Similarly, the large colony of 365 pairs on Clark's Island was removed from protective ownership in the late 1980s, and the site was developed for summer homes and a tree farm (Melvin 2010).

In recent years and currently at sites where federal and state wildlife management is focused on recovering the listed Roseate Tern (*Sterna dougallii*), Black-crowned Night-Herons observed in the tern colony are lethally removed (United States Fish and Wildlife Service 2016).

Stabilizing and recovering Black-crowned Night-Heron Populations

In the United States, Black-crowned Night-Heron is ranked vulnerable, imperiled, or critically imperiled in 38 states (NatureServe). In the Northeast, where approximately 26% of the entire United States and Canada population nests (Kushlan et al. 2002), Black-crowned Night-Heron is protected under state endangered-species laws in Maine, Rhode Island, New Jersey, and Delaware. In Connecticut, Snowy Egret—a species that rarely nests without Black-crowned Night-Heron—is listed as Threatened.

What can be done to stabilize and recover heron populations? Colony sites—most of which have been occupied for decades—are well known in Massachusetts and regionally. There has been adequate censusing of nesting birds over reasonable intervals, and therefore abundance is comparatively well known. However, colony sites have not been rigorously protected, and culling of adult herons takes place in the absence of an effective statewide management strategy based on an analysis of population viability.

Listing under the New Jersey state endangered species law has resulted in the mapping of current and historical nesting sites, and the identification of foraging locations. The protection of these habitats is explicitly considered in projects and activities that undergo permit review. Infrequent efforts to restore or attract herons to new colony sites have been long attempted and encouragingly successful (Sumner 1933; Quinn et al. 1996; Crouch et al. 2002). Rodgers and Smith (1995) identified setback distances to prevent human disturbance to nesting birds. States that explicitly protect night-herons with regulatory review of projects and activities in the birds' habitat have developed multi-pronged management and recovery plans (e.g., Maine Department of Inland Fisheries and Wildlife 2015).

Increased conservation efforts are urgently needed. In Massachusetts, greater regulatory protection and a statewide conservation strategy for Black-crowned Night-Heron recovery would benefit many colonially nesting species, including Snowy Egret. Colony-site restoration and management tools are available. The "factors yet to be pinned down" are known well enough to begin action to protect Black-crowned Night-Herons.

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