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2 **Conservation Plan for the Peregrine**
3 **Falcon**
4 **(*Falco peregrinus*)**
5 **in North Carolina**



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NC WILDLIFE RESOURCES COMMISSION

**Conservation Plan for the Peregrine Falcon (*Falco peregrinus*)
in North Carolina
DRAFT**

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EXECUTIVE SUMMARY

In North Carolina, the Peregrine Falcon is a state-listed endangered species and is identified as a Species of Greatest Conservation Need in the N.C. Wildlife Action Plan. Peregrine Falcons nest on tall cliffs in the mountain region and occasionally at disjunct cliff sites in the Piedmont and on tall buildings in urban areas. The Peregrine Falcon is considered one of North Carolina's conservation success stories. The species was extirpated from North Carolina and much of the eastern U.S. by 1958 and federally listed as Endangered by the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Conservation Act of 1969 (USFWS 2003). The North Carolina Wildlife Resources Commission (NCWRC) co-led reintroduction efforts in North Carolina in the 1980s and 1990s with the USFWS. Reintroductions were slow but ultimately successful, and the USFWS delisted the Peregrine Falcon in 1999 (USFWS 1999). NCWRC has led population monitoring efforts and provided technical guidance to land managers to limit disturbance at nest sites since the reintroduction. NCWRC's analysis of monitoring data from the post-delisting period (2003 to 2015) revealed low nest success and productivity, despite steady territory occupancy. Since 2014, mated pairs attempted breeding at 19 cliff sites in western North Carolina and 2 urban sites in the Piedmont. All these sites are not occupied by a pair annually (on average, 13.1 sites were occupied by pairs from 2014 to 2024, and 15.8 sites were occupied by pairs from 2020 to 2024).

Availability of suitable cliffs for nesting and having an inexperienced subadult in a pair are factors naturally limiting nest performance and size of the breeding population. Anthropogenic threats to Peregrine Falcons include human disturbance, environmental contamination, loss or degradation of foraging and nesting habitats, climate change, and direct persecution. Human disturbance is one of the greatest threats to peregrines nesting in North Carolina and may exacerbate several natural limiting factors. Conservation success of the species will depend on managing disturbance at nest sites during the breeding season. Continued collaboration with local rock-climbing organizations is essential for monitoring and managing disturbance.

The objective of this plan – to protect and increase the abundance and distribution of the breeding Peregrine Falcon population in North Carolina – will be achieved using a combination of population monitoring, protection from disturbance, management of habitat, and education and outreach targeted at recreationists. Economic incentives to protect nesting habitat may be realized by private property owners with nest sites on their lands.

BIOLOGICAL INFORMATION

Listing Status

State

- Endangered¹
- Species of Greatest Conservation Need²
- S1 Breeding, Critically Imperiled / S2 Nonbreeding, Imperiled³

Federal / Global

- Federal Status: not listed⁴
- IUCN Least Concern⁵
- Global Rank: G4T4, Apparently Secure³

Description and Taxonomic Classification

The Peregrine Falcon is a medium-sized (40 cm, 610-950 g [16 inches, 22-34 ounces]) raptor with long, pointed wings and a long tail. The adult has a slate gray back and wings and a white colored belly with light horizontal streaking or spotting across the breast. The head is dark gray to black with a dark stripe or sideburn in the malar region. The skin of the cere, orbital ring, and legs is bright yellow. The female is approximately one-third larger than the male.

Peregrine falcons belong to the order Falconiformes, family Falconiformidae, and genus *Falco*. The three recognized subspecies of *Falco peregrinus* in North America are the American Peregrine Falcon (*F. p. anatum* – Bonaparte 1838), Arctic Peregrine Falcon (*F. p. tundrius* – White 1968), and Peale's Peregrine Falcon (*F. p. pealei* – Ridgeway 1873). The original population in North Carolina, the American Peregrine Falcon, was extirpated from North Carolina and much of its range by 1958. Recovery involved reintroducing falcons from available lineages. Thus, the founder population for the recovery effort was comprised of *F. p. anatum*, *F. p. pealei*, *F. p. peregrinus* (Tunstall 1771, Europe, Northern Asia [excluding China], and Southern Asia geographic range), and in some areas, *F. p. brookei* (Sharpe 1873, Europe and Northern Asia [excluding China] geographic range).

Life History and Habitat

Peregrine Falcons in North Carolina nest primarily on tall cliffs in the mountains. High-quality cliffs for nesting have sheer vertical faces, making them inaccessible to terrestrial predators while affording an extensive view of the territory, and have ledges with overhanging roofs that shelter the nest from the elements. The highest quality cliffs have multiple ledges, allowing the resident pair to rotate annually between fresh ledges. A high-quality nest site is usually free of disturbance, particularly

¹ 15A NCAC 10I .0103(b)(2)(A). October 1, 2024.

² North Carolina Wildlife Action Plan 2025, [State Wildlife Action Plan | NC Wildlife](#)

³ North Carolina Natural Heritage Program, List of Rare Animal Species of North Carolina, 2024. [SAP Crystal Reports -](#)

⁴ Federal Register 64(164):46542-46558. <https://www.govinfo.gov/content/pkg/FR-1999-08-25/pdf/99-21959.pdf>

⁵ IUCN Red List, [IUCN Red List of Threatened Species](#) (accessed May 18, 2026)

disturbance within line of sight. Only certain cliffs meet the species' requirements, thereby limiting the size and success of the cliff-nesting population.

In North Carolina, peregrines have been found nesting on lower quality cliffs that are shorter, have low angle rock, an open ledge unprotected by a roof, or extensive vegetation screening over the lower portion of the rock face that inhibits defense and hunting. Occupancy at lower quality cliffs in North Carolina is inconsistent (Boynton and Currie 1993). Rarely, buildings in urban areas have been used by peregrines in North Carolina. One pair nested on a skyscraper in downtown Charlotte between 2013 and 2015, and another pair may have attempted to nest in downtown Raleigh in 2022 and 2024.

Foraging habitat and size of breeding territories in North Carolina have not been well documented. Most nest sites are in heavily forested areas where falcons may hunt for passing birds. Direct observations and prey composition suggest that the falcons also hunt in nearby open areas (river valleys, reservoirs, farmlands, cities, etc.). Predominant prey in the mountain region includes Blue Jays, blackbirds, Northern Flickers, Mourning Doves, pigeons, and even bats. During spring migration, shorebirds are taken. Waterfowl and mammals appear to be infrequent prey items. In North Carolina, peregrines habitually perch on the most prominent features (rock face or tree) high on a cliff to observe their surroundings for passing prey or threats. The typical hunting strategy is to stoop (dive) on a bird in flight, striking the bird with its feet to stun or kill it.

Since reintroduction, peregrines have been observed at the eyries in western North Carolina throughout the year, not just the breeding season. Stupka (1963) considered the Peregrine Falcon to be a resident species in Great Smoky Mountains National Park, occurring throughout the year. But it is unclear if these individuals are the resident breeders holding a high-quality territory year-round or if they are winter visitors from the northern U.S. and Canada. Throughout its range, the Peregrine Falcon exhibits strong, life-long site fidelity to a territory. The male begins vigorously defending the territory from other males in late winter and awaits the return of his mate. Site fidelity and dispersal patterns of the North Carolina breeding population have not been examined through recent banding or tagging efforts. However, some individuals can be identified by unique markings in their plumage, providing evidence of individuals returning or remaining on territory across years.

Although individuals venture into North Carolina during migration and winter, the Arctic breeding population of peregrines (*P. f. tundrius*) is not the focus of this plan. Hatch-year "passage migrants" of breeding stock from northern populations (*tundrius* subspecies) are managed for "take" by licensed falconers in the United States via a system developed by the USFWS (2024. 50 CFR § 21.82) and state wildlife agencies through the Atlantic Flyway Council. Measures are incorporated into falconry regulations⁶ to minimize the risk of taking hatch-year peregrines from North Carolina's breeding population. For example, falconers with a special hunt permit may only attempt to trap a passage migrant during a specific range of dates in the autumn migration season and from areas east of U.S. Highway 17, which is well east of North Carolina's breeding population. Further, passage migrants of the *tundrius* subspecies have notable plumage differences from North Carolina's breeding peregrines, which hail from a mix of subspecies used in captive breeding for the peregrine's reintroduction; thus, can be distinguished easily.

Distribution and Population Status

Historical information on the breeding distribution of Peregrine Falcons is limited to 10 records in western North Carolina (Boynton and Currie 1993). These records are all anecdotal and not based

⁶ 15A NCAC 10H .0810(d)(5)

on a systematic survey. Some high-quality cliffs (e.g., Panthertail Mountain, Cedar Rock, Dunn's Rock) were not mentioned in these historical records, and it is not known if they were ever checked for falcons; thus, it is reasonable to expect that the historic population was larger than 10 pairs. By 1958, the Peregrine Falcon was extirpated from North Carolina and from much of its range due to impacts of organochlorine pesticides such as DDT. DDE, a metabolite of this chemical, accumulated in the food chain of falcons and other birds, resulting in thin eggshells that cracked when the parents attempted to brood their eggs (Cade 1988). In 1964, search efforts at 5 sites were unsuccessful (Boynton and Currie 1993) and a breeding population was absent from the state for 2.5 decades until the species was reintroduced. The Peregrine Falcon was listed as Endangered by the federal government in June 1970 and by the State of North Carolina in 1977.

During the early reintroduction period from 1987 to 1992 (see Historic and Ongoing Conservation Efforts), peregrines established territories at 9 cliff sites in the mountains, 4 of which were known to be occupied historically (Fig. 1). In 1987, a pair of peregrines in Linville Gorge made the first documented nesting attempt since 1957. The first successful nesting attempt was at Whiteside Mountain in 1988. In this 6-year period, 5 of the 9 territories produced 19 fledglings. Productivity during this time averaged 0.59 young fledged per pair per year (healthy populations often range from 1.2 to 1.5 young fledged/pair [White et al. 2024]). Biologists attributed low productivity to infertile eggs, predation of eggs and young, disease, insufficient food resources, human disturbance, and death by exposure to the elements (Boynton and Currie 1993). In August 1999, the USFWS determined that the Peregrine Falcon had recovered and removed it from the List of Threatened and Endangered Species (USFWS 1999). At the time, North Carolina's breeding population numbered 9 pairs and remained listed as Endangered by the state.

During the 13-year post-delisting period (2003–2015), Peregrine Falcons nested at 18 sites in North Carolina (17 cliffs, 1 building), 6 of which were newly discovered sites. All the cliff nests were in the mountain region (Fig. 2) except 1 cliff nest in the northern Piedmont (Moore's Wall). Eight to 13 territories were occupied annually. Biologists documented 139 nesting attempts and production of 171 young. Mean nest success (55%) during this period fell below the 1999–2002 national average but was more than double the mean nest success of earlier (1987–1992) efforts in western North Carolina (Fig. 1). Likewise, mean productivity (1.23 fledged young/pair/year) was more than double earlier efforts in North Carolina but reflects the disproportionately high contribution of 5 sites. The breeding pairs at these 5 successful sites produced 63% of all offspring during the post-delisting monitoring period (2003–2015), and 3 of these sites produced 82% of all offspring since the 1980s (Kelly et al. 2018).

Following the post-delisting period (2016 until present day), the annual breeding population has varied from 10 to 18 pairs with unpaired falcons defending territories at 2 additional cliffs. Staff discovered new nesting pairs by surveying cliffs that the reintroduction team had ranked medium to high quality. Despite the increase in number of breeding pairs, nest success is still primarily associated with just 6 higher-performing sites, while the remaining sites experience variable nest success or chronic nest failure. In addition, some nest sites are more secure from threats, such as development or disturbance, than others.

The Peregrine Falcon is now found across North Carolina with most nesting pairs in the mountains where they can be found year-round (Fig. 2). The number of nest sites occupied by a pair annually grew from 9 at the time of delisting (1999) to a recent high of 14–18 from 2020–2024. Along the coast and in the Piedmont, peregrines are seen mainly in the fall and winter during migration. The focus of this conservation plan is on the North Carolina breeding population. The Peregrine Falcon is designated as Least Concern by IUCN, G4 Apparently Secure by NatureServe, and Delisted due to

Recovery by the USFWS. But recovery was not uniform across its geographic range. Thus, the North Carolina listing status remains Endangered.

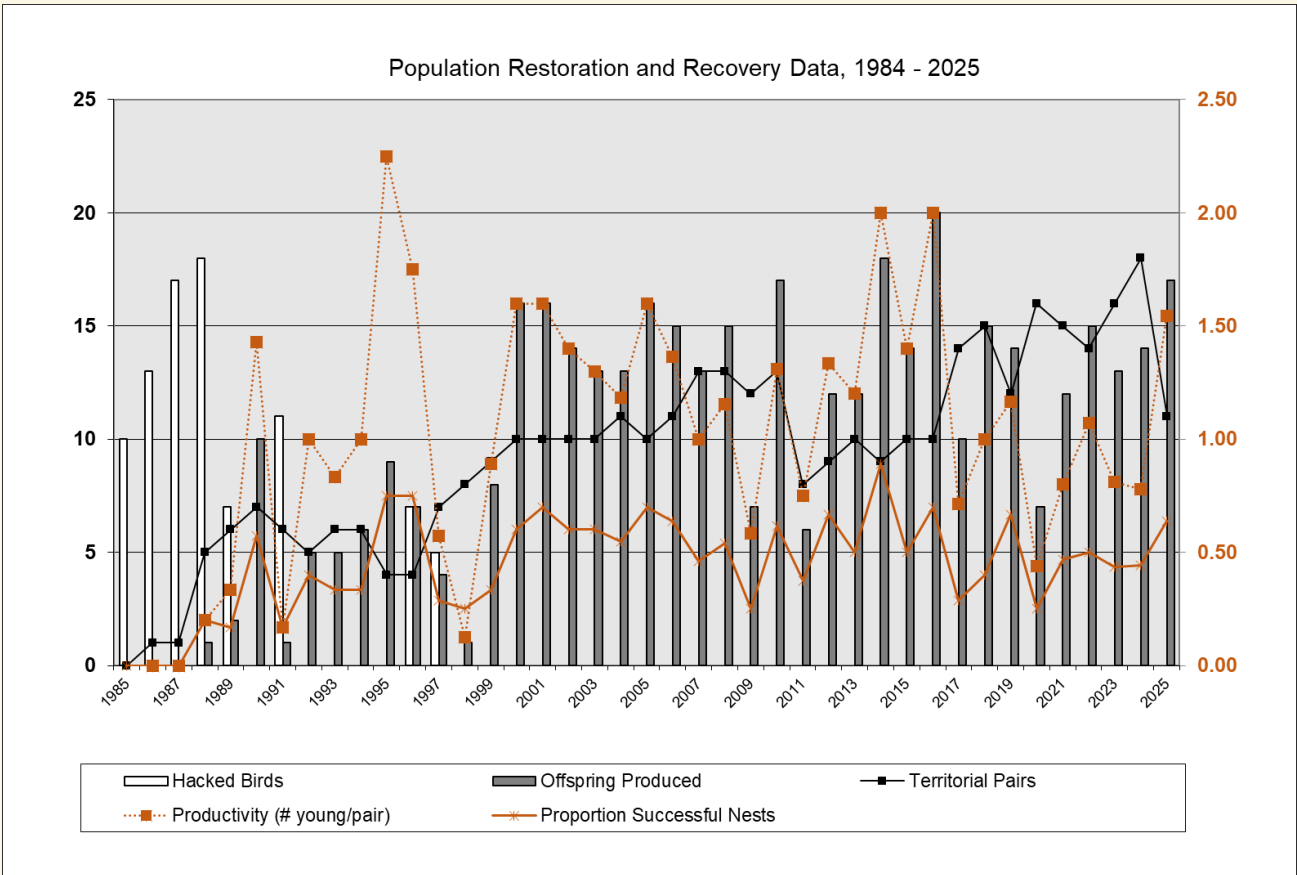


FIGURE 1. Peregrine Falcon nest performance in North Carolina from 1999-2024. The left y-axis is number of birds, offspring produced, or territorial pairs, and the right y-axis is number of young per pair (productivity) and nest success. Years of data collection, 1985 to 2025, are on the x-axis.

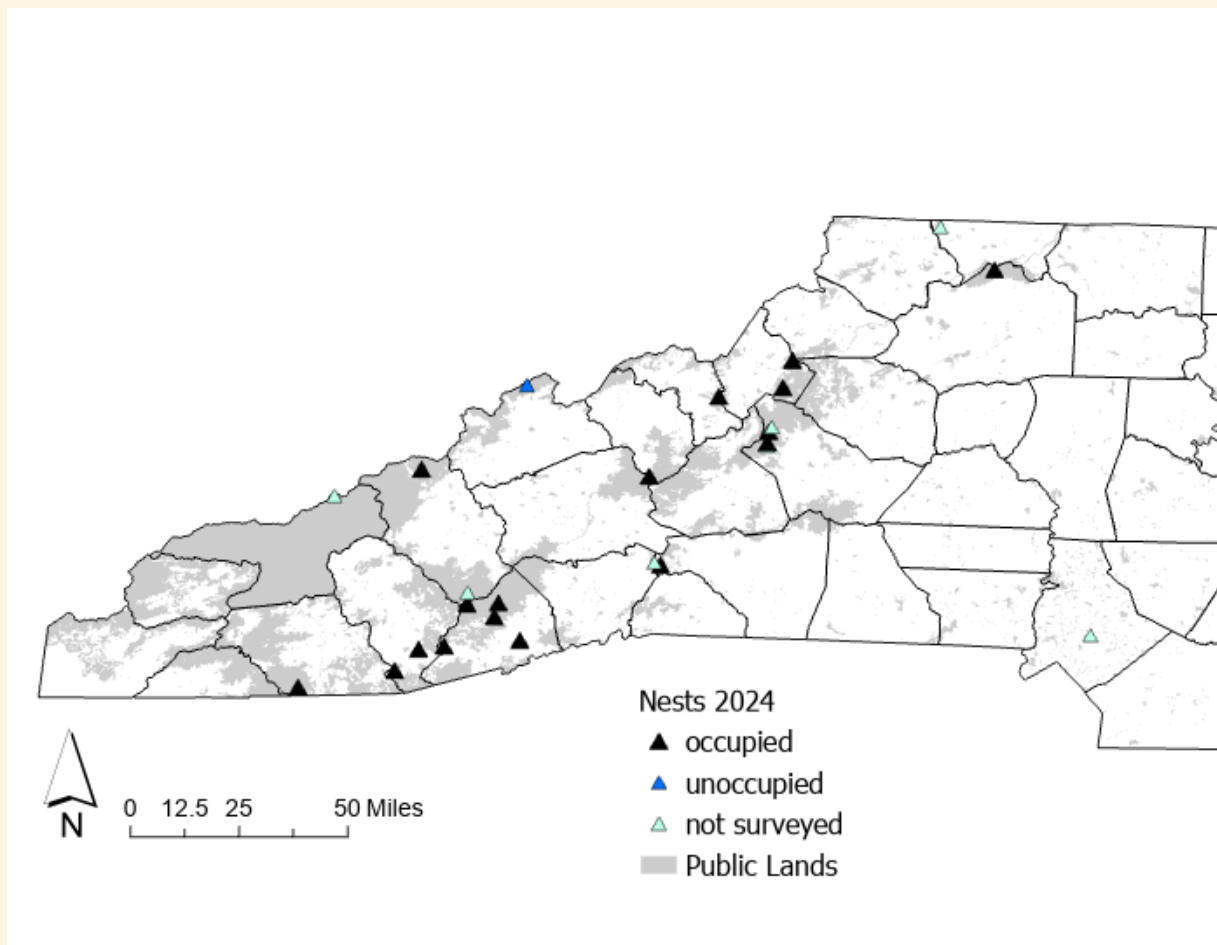


FIGURE 2. Distribution of Peregrine Falcon nesting territories in western North Carolina.

THREAT ASSESSMENT

Reason for Listing

The Peregrine Falcon was listed as a North Carolina endangered species in 1977, when the species was extirpated (15A NCAC 10I.0103). State listing followed federal listing as Endangered in 1970; however, when the Peregrine Falcon was federally delisted (USFWS 1999), the NCWRC approved its state status as Endangered due to its small breeding population and low annual productivity rates.

Present and Anticipated Anthropological Threats

Human disturbance – Human disturbance at Peregrine Falcon nest sites in North Carolina takes many forms including hiking, rock climbing, bouldering, slacklining, flying unoccupied aerial vehicles, hang gliding, construction activities, aircraft flights near cliffs (tourist planes and helicopters, military aircraft conducting practice flights, helicopters delivering construction materials), wildlife photography, and ridgeline development. In North Carolina, most disturbance is caused by human recreational activity at the tops, base, or in front of nesting cliffs particularly within line-of-sight of the nest. Raptors, including Peregrine Falcons, tend to be more sensitive to humans

on foot and to other raptors near their nests than they are to ground machinery near nests (Nordmeyer 1999). Peregrines are especially disturbed by activity above the nest and within line-of-sight of the nest or perches (Ruddock and Whitfield 2007). Human disturbance on or near a cliff interrupts breeding activities and results in nest failure and, during certain phases of the nest cycle (e.g., courtship), it may prompt abandonment by one or both members of the pair (Herbert and Herbert 1965; Kelly et al. 2018). In some cases, a pair may become reconciled to some level of disturbance and not abandon a site (Ruddock and Whitfield 2007). However, disturbance draws the attention of the adults away from the nest and leaves the unattended eggs or young vulnerable to predation and the elements. The young may not be provisioned sufficiently by the distracted adults to thrive. Thus, anthropogenic disturbances are often additive, increasing impacts of natural limiting factors such as exposure, predation, and starvation. Further, upon leaving the nest, fledglings need safe, undisturbed, familiar places to land and rest while the adults continue to feed and care for them for several weeks. Ultimately, human disturbance has the potential to reduce territory occupancy and productivity and thereby limit population growth.

Environmental contaminants – The organochlorine pesticide DDT was causative to the reproductive failure and historic extirpation of Peregrine Falcons (Augspurger and Boynton 1998, Chen et al. 2010). DDE, a metabolite of DDT, caused eggshell thinning associated with population decline. Although DDT was banned for sale in the United States, Canada, and Mexico, it is still used in parts of Central and South America. Thus, peregrines preying on Neotropical-Nearctic migratory songbirds may accumulate these chemicals from contaminated avian prey, resulting in lethal and sublethal effects on peregrines.

Other environmentally persistent chemicals and heavy metals such as mercury and lead are a concern for raptors. For example, polybrominated flame retardants (PBDEs) used in numerous textiles, thermoplastics, polyurethane foams, and electrical products are chemically similar to organochlorine chemicals. Deemed persistent organic pollutants (POPs), production was ceased for some formulations of PBDEs (Chen et al. 2008). The production (including importation), processing, and distribution of Deca-BDE was banned in the United States in 2021 (Decabromodiphenyl Ether (DecaBDE); Regulation of Persistent, Bioaccumulative, and Toxic Chemicals 2021). Despite this ban, goods containing this chemical are widely consumed and discarded in North America, providing a pathway to exposure. Levels of the more concentrated DecaBDEs were higher in Peregrine Falcons living nearer urban areas than those in more rural areas of the Northeastern United States (Chen et al. 2008). Perfluoroalkyl Acids (PFAAs) used in various industrial, commercial, and consumer products are additional POPs that have been found in eggs and nestlings of peregrines in Canada (Sun et al. 2020).

Use of second generation anti-coagulant rodenticides (SGARs) and current avicides poses another concern for raptors in North Carolina (Niedringhaus 2021). The mountain peregrine's diet of pigeons and Mourning Doves exposes peregrines to these chemicals if their avian prey has eaten contaminated seed.

Augspurger and Boynton (1998) examined 5 eggs collected from eyries in western North Carolina in the early 1990s and concluded that environmental contaminants were likely not limiting productivity. At that time, the North Carolina population consisted of young individuals that would not yet have accumulated high levels of contaminants. They reported DDE concentration levels well below those associated with population decline, eggshell thickness approximately 7% thinner than pre-DDT era eggshells, and acceptable levels of chlordane, dieldrin, lindane, and mercury. NCWRC has not sampled the population since then. Levels of organochlorine pesticides are expected to be lower now. However, the emerging threats posed by newer classes of agricultural chemicals,

chemicals used in textiles, rodenticides, and avicides may warrant testing (Augspurger, USFWS retired, pers. comm). Given the small size of North Carolina's peregrine population, inference would be greater if North Carolina data were part of a sampling effort across a broader geography.

Loss or degradation of nesting and foraging habitats – Forestry operations for natural resources management are distinguished here from logging or land clearing for development (e.g., residential, commercial). The latter often eliminates habitat for the peregrine's avian prey and can increase disturbance if development occurs near a nest ledge. The impacts of forestry operations for the management of natural resources depend on whether the logged area is allowed to regenerate as forest or is managed as a permanent field or "wildlife opening". A regenerating young forest can temporarily increase avian prey abundance to the benefit of Peregrine Falcons, while permanent openings in the forest canopy attract Great Horned Owls and Red-tailed Hawks which pose a threat to nesting peregrines.

Collisions – Data on peregrine mortality or injury due to collisions are not available for North Carolina. In New England, collisions with stationary objects, aircraft, vehicles, and trains accounted for more than 25% of mortalities (Faccio et al. 2013). Collision risks may be comparatively lower for the North Carolina peregrine population because most pairs nest in remote or rural settings. However, the falcons will fly from cliff nest sites into nearby towns to hunt pigeons and birds in agricultural areas. Citizens in Brevard, North Carolina have reported close brushes with falcons swooping over traffic.

Climate change – It is unknown how changes in precipitation and temperature are affecting nesting Peregrine Falcons in North Carolina. These changes may create new challenges for peregrines as they affect food availability and habitat. Further, warming temperatures are favorable to many ectoparasites and disease pathogens. For example, in the Arctic, black fly outbreaks reduced nestling survival by 30% and impacted adult nesting behavior (LaMarre et al. 2018). Declines in nestling survival rates in a peregrine population in the Canadian Arctic were linked to an increase in the frequency of heavy rain over the last three decades (Ancil et al. 2014).

Direct persecution – Gunshot injuries are a minor but possibly increasing threat. A Peregrine Falcon banded and hacked in Macon County, North Carolina during reintroduction efforts in 1989 was found dead 4 months later after being shot in Mexico. Since 2018, the [Carolina Raptor Center](#) has received 1 peregrine with a gunshot wound. The Center reported a rise in cases of all raptor species with gunshot injuries, including 50 cases in 2021.

Summary of Threats

Threats to Peregrine Falcons include **human disturbance, environmental contaminants, loss or degradation of foraging and nesting habitat, collisions, climate change, and direct persecution**. Of these, human disturbance is the most significant threat to peregrines nesting in North Carolina. Furthermore, human disturbance has the potential to exacerbate several natural limiting factors.

Natural Limiting Factors

Limited suitable nest sites – The availability of suitable cliffs for nesting is a factor limiting nest performance and the size of the North Carolina breeding population. The smooth, granitic domes (plutons) found in North Carolina's mountains, though often large, typically offer few protected ledges. Territories with poor quality nest sites, especially those with unprotected ledges that leave young exposed to the elements, may influence the productivity of peregrines in western North Carolina. Peregrines still attempt to nest at such sites but frequently fail; hence, territory occupancy

remains stable or increases while nest success and productivity decline. Thus, the cliff nesting population is not expected to increase substantially. Given the limited availability of high-quality nest ledges, competition is fierce, and peregrines are known to fight to the death over territory ownership in North Carolina. Unpaired individuals (“floaters”) occasionally usurp the territory from the resident male or female.

Exposure to the elements – During North Carolina’s peregrine reintroduction efforts, death of small young during inclement weather was suspected to be a significant cause of nest failure. During the post-delisting monitoring period, years with exceptionally low nest success in North Carolina coincided with years of heavier than average rainfall in the mountains (Kelly et al. 2018). Peregrine Falcon young are most vulnerable to cold and wet conditions during the first 3 weeks of life. Nestlings with shelter from the elements have higher survival rates than nestlings lacking overhead shelter and juveniles that wander out of the shelter of the nest site (Ancil et al. 2014). Ultimately, exposure to the elements can reduce productivity and thereby limit the North Carolina population.

Subadult member of the pair – The presence of a subadult bird as a member of a resident pair is an important factor contributing to nest failure in the North Carolina breeding population (Kelly et al. 2018). Biologists observed mixed subadult–adult pairs throughout the study, and regular turnover of individuals. Most mixed-age pairs were comprised of a subadult female and an adult male. Yearling females are more frequently a member of a pair than yearling males, possibly a result of yearling males lacking the hunting skills required to feed a mate and young (Wendt and Septon 1991). However, the success of yearling females in a pair is only marginally better than males, and these nesting attempts are characterized by failure to produce eggs or by smaller clutches (Wendt and Septon 1991).

Predation – Other birds, including the Red-tailed Hawk, Bald Eagle, Turkey Vulture, and Black Vulture, may prey on eggs or chicks. The Great Horned Owl is considered a significant predator of Peregrine Falcons, particularly just after young owls hatch in late winter. Owls in the eastern United States typically kill, but do not eat peregrines and it is hypothesized that the owls see peregrines as competitors or threats (Cade et al. 1988). A pair of Great Horned Owls nested below a historic peregrine eyrie in Linville Gorge in 2013, prompting the peregrines to relocate 0.8-mile up the gorge. Nests on low angle rock are vulnerable to predation by terrestrial mammals. Southern Flying Squirrels, Gray Squirrels, woodrats, and Gray Foxes have been observed or documented on nest cameras in or on nest ledges in North Carolina. Predation of eggs and chicks was suspected as a possible cause of nest failure during the reintroduction period. If one of the adults is killed, the surviving adult may be unable to protect and provision the young sufficiently. Ultimately, predation may reduce nest success and productivity and thereby limit population growth.

Competition – In the North Carolina mountains, Common Ravens may coexist with Peregrine Falcons or may compete for nest ledges, with variable success. Even at the same cliff site, peregrines may outcompete ravens one year, only to lose the next. In addition to being a predator of peregrines, Great Horned Owls will also compete for cliff ledges for nesting. Intraspecific competition with other peregrines occurs in the North Carolina mountains. On numerous occasions, observers have documented one of the resident pair being replaced mid-nesting season by a different individual. Nest cameras have captured further evidence of intraspecific competition that was not documented by observers monitoring for a few hours once every few weeks through spotting scopes from the ground. Thus, turnover rates from intraspecific battles for a prize territory may be higher than documented by passive observation.

Disease – Peregrine Falcons are highly susceptible to avian influenza which they can contract from infected prey, particularly waterfowl. Fortunately, waterfowl appear to be an infrequent prey item taken by peregrines in western North Carolina. As of March 2023, in the United States there were 35 known wild mortalities and 15 captive mortalities of Peregrine Falcons from the HPAI 5 strain of Highly Pathogenic Avian Influenza, and none of these mortalities were in North Carolina. Pigeons and Mourning Doves in the mountain peregrine's diet can expose them to trichomonas, aspergillosis, salmonella, and coccidia.

Parasites – Heavy infestations of feather mites can leave nestlings anemic and weak. The Asian long-horned tick is found on birds, including raptors, and is becoming more widespread in the North Carolina mountains.

Starvation - Starvation has been implicated in peregrine nestling mortality elsewhere, but it is not known if this is a problem in North Carolina. Prey availability is expected to be lower in the North Carolina mountains compared to nest territories in urban or coastal settings. Hunting success of adults may be lower during wet weather or unusually wet nesting seasons when avian prey is less active and available to catch on the wing.

Historic and Ongoing Conservation Efforts

The Peregrine Falcon received considerable conservation attention to restore the species to North Carolina and throughout North America. Recovery entailed listing the Peregrine Falcon as Endangered under the Endangered Species Conservation Act of 1969, the subsequent banning of DDT, and reintroduction efforts by states (USFWS 2003). Before reintroducing falcons to North Carolina, NCWRC staff and partners completed an extensive inventory of cliffs in western North Carolina and provided details about each cliff's potential suitability for nesting falcons. In North Carolina, 92 captive-bred nestling peregrines were released via hacking or fostering at cliff sites beginning in 1984. Of these nestlings, 80 were released from 1984 to 1991, and another 12 were released in 1996 and 1997 in response to a drop in the number of territorial pairs in the mid-1990s. In 1987, NCWRC began annual monitoring of the growing breeding population while reintroductions continued. NCWRC also began issuing guidance to land managers for seasonal or year-round cliff closures to protect nesting peregrines from human disturbance.

Federal delisting in 1999 triggered a post-delisting monitoring effort of no less than 5 years, as required under Section 4(g)(1) of the Endangered Species Act and implemented by states (USFWS 2003). In response to concerns about the long-term future of Peregrine Falcons, the post-delisting monitoring effort was spread out to monitor the species 5 times at 3-year intervals beginning in 2003 and ending in 2015 (USFWS 2003). However, due to concerns about North Carolina's small population, NCWRC elected to monitor nests annually.

Since federal delisting, the Peregrine Falcon has received fairly consistent monitoring in North Carolina. **The primary purpose of nest monitoring** is to measure annual breeding performance of the population. NCWRC follows the *Post-delisting Monitoring Plan for American Peregrine Falcons* (USFWS 2003) by tracking 3 metrics: territory occupancy (the number of territories occupied by a pair), nest success (percent of pairs that raise young), and productivity (the number of fledglings per pair). **The secondary purpose of nest monitoring** is to provide timely technical guidance to land managers responsible for protecting wildlife resources on their lands. Seasonal or year-round cliff closures are used to manage human disturbance at nests. NCWRC staff provide technical guidance on the spatial extent and timeline of each closure which land managers can adapt to meet their legal standards. Staff and volunteers also assist with posting closure signs and notices.

Monitoring has included passive observation, nest cameras, aerial surveys, and nest site visits. Nest sites are visited to band chicks, collect prey remains, and collect unhatched eggs for analyses. Most monitoring uses passive observation by NCWRC staff with some assistance from partners and citizen volunteers. Skilled rock climbers assist monitoring activities that entail accessing the nest ledge (e.g., to deploy cameras, collect samples, etc.).

Passive observation – Beginning in 1987, monitoring entailed a 4-stage process: searching suitable cliffs for peregrines during the courtship phase, following up at positive sites to verify territories and determine nest outcomes, surveying areas of difficult terrain by helicopter, and climbing onto ledges to verify nesting and collect unhatched eggs and prey remains. With assistance from volunteers, the reintroduction team checked an average of 13 sites per year between 1987 and 1992, spent an average of 156 hours searching for occupied territories each year, and detected peregrines on territory within an average of 7.5 hours of starting observations (Boynton and Currie 1993).

Since delisting, nests have been monitored passively from afar by staff or trained volunteers. Observers watch eyries through spotting scopes or binoculars from a vantage point that looks back at the cliff face. NCWRC follows USFWS protocols (USFWS 2003), completing at least 2 4-hour observation sessions at each site to determine if a pair is present, followed by additional monitoring sessions to assess nest stage and progress from courtship in February to egg laying, incubation, brooding, and fledging in May, June, July, or August. Monitoring the nesting cycle from start to finish is also needed to help land managers effectively manage seasonal cliff closures and strike a balance between the birds and recreationists.

As acknowledged in other states' Peregrine Falcon management plans, annual monitoring by passive observation is intensive. To prevent disturbance, observing cliff nests must be done from afar and this requires long hours of waiting, uninterrupted watching, and quick recognition of fleeting behaviors, such as a rapid incubation exchange between the adult male and female. NCWRC relies on 2 seasonal technicians who focus on falcon survey duties for >30 hours per week, including traveling to and observing nests during critical phases of the nesting cycle. Volunteer recruitment, training, and retention have proven challenging. Volunteers have cited the time commitment, including the extreme hours, cost of optics, commute time and travel costs, strenuous hikes, long observation sessions, and the steep learning curve to interpret peregrine behaviors as barriers to participation. Another challenge to recruiting and retaining volunteers is working alone at remote sites, which is a safety concern for many volunteers. The mountain bird program was most successful at enlisting the help of volunteers early in the post-delisting period, when much more attention was focused on this species, but it lacks such capacity now, given competing conservation needs of other listed species.

Nest cameras – Since 2020, trail cameras have been placed, with the help of rock climbers, at select nest sites to monitor activity, timing, and threats. The nest photos and videos generate content for outreach materials. Cameras are also used to gauge the frequency of illegal entry into closed areas, such as above or below the eyrie. Cameras are not currently used for enforcement.

Aerial surveys – Aerial surveys were conducted in the 1980s and 1990s from small airplanes and helicopters. Two flights were completed in the early 2000s in a small airplane. Unoccupied aerial vehicles such as drones have not yet been used for surveys in North Carolina.

Banding – Nestling Peregrine Falcons were banded early in the reintroduction phase, but this effort was discontinued due to risks to the young and to staff. Nestling Peregrine Falcons must be banded

at a very precise age when their legs are fully grown but before the young are capable of running or flying. Accurately estimating nestling age is difficult from a long distance and accessing a ledge based on an incorrect age estimate puts mobile young falcons at risk of bolting off the cliff before they can fly. To ensure accurate age estimates for banding, more intensive monitoring (weekly) of nests would be required, and far exceeds current staff capacity. Furthermore, some sites lack close vantage points for better evaluating plumage development as a proxy for age from afar.

Prey and egg collection – Prey remains and unhatched eggs and eggshell fragments are collected periodically but not routinely, with the help of rock climbers. Identification of prey from remains has been useful for assessing diet, possible hunting areas, and potential exposure to pathogens.

CONSERVATION GOAL and OBJECTIVES

Overarching Goal

The overarching conservation goal for North Carolina's Peregrine Falcons is to ensure long-term viability of the population by protecting them from anthropogenic threats and maintaining and/or enhancing the functionality of their habitats.

Objectives

Conservation objectives for the Peregrine Falcon:

1. Maintain current **population level** of 14 breeding pairs (on average over 10 years) on cliffs in western North Carolina.
2. Identify and limit **threats**, especially sources of **disturbance** at nests.
3. **Improve nest outcome** at territories with variable nest success or chronic nest failure.

Because threats and needed conservation actions vary from site to site in North Carolina – as is evident in widely varying nest success – Commission biologists operate under an informal, site-specific framework. Biologists continuously update an “Eyrie Management Overview” that lists known and suspected threats, limiting factors, proposed management solutions, and monitoring needs and strategies (including nest monitoring methods and frequency, and disturbance monitoring) for each nest site. Each nest site record also provides a summary of general nesting performance and identifies additional management needs. The Eyrie Management Overview – a living document – should be developed and adopted to complement and support implementation of the overarching Peregrine Falcon Conservation Plan. With this approach, conservation actions at sites having a relatively high average nest success rate over a 5-year period will focus on providing continued protection (see Action B). The 6 top performing sites are critical to maintaining the breeding population. In contrast, at sites with sporadic nest success or chronic nest failure, conservation actions will focus on increasing protection measures and determining causes of nest failure so they can be addressed. Example actions that could improve nest outcomes (Objective 3) might include installing nest aids, reconfiguring a closure boundary, or launching an education and awareness campaign for a site. Human disturbance, which is one of the primary factors contributing to nest failure and one of the few that can be controlled, should be mitigated at *all* sites. Identifying and managing disturbance will require education, outreach, collaboration with local climbing organizations, regulation, and enforcement, informed by monitoring and research. Taken altogether, the protection and long-term viability of North Carolina's Peregrine Falcon population require a

combination of monitoring, protection from disturbance (such as closures), habitat management, research, education, and outreach.

CONSERVATION ACTIONS

Action A: Monitoring

Monitor peregrine nests using appropriate survey methodologies by following an approach that reflects site-specific needs as well as personnel and funding capacity.

- Continue to update the Eyrie Management Overview with new site-specific information about known and suspected threats, limiting factors, proposed management solutions, monitoring needs and strategies, and overall nesting performance.
- Develop a long-term nest monitoring plan for the breeding population that establishes a survey schedule (inter- and intra-annual), identifies standardized and novel survey methodologies, and indicates personnel (staff, volunteers, contractor) requirements to implement. The schedule will consider site-specific information in the Eyrie Management Overview and will indicate if all or a subset of sites will be monitored annually. For example, the relative breeding performance at a site or the use of a seasonal closure may influence whether a site is monitored annually or less frequently. Furthermore, the program would consider tradeoffs between monitoring known sites versus exploring new locations to document population expansion.
- Install additional nest cameras. Advances in trail camera technology hold promise for monitoring activity and threats at nests and are excellent tools for outreach. However, to avoid disturbing the falcons, nest cameras must be placed before the breeding season and retrieved after the breeding season. Thus, nest cameras are a suitable option for only a few territories where the resident pair reliably uses the same nest scrape each year, allowing for correct camera placement in advance of the breeding season. Nonetheless, these efforts strengthen NCWRC's collaboration with local rock climbers. Nest cameras may be pursued wherever the opportunity arises to improve monitoring efficiency and outreach.
- Consider bioacoustics surveys. Small devices programmed to record audio could be deployed in eyries before nesting and retrieved at the end of the nesting season. Biologists would review audio files for vocalizations indicating presence of an adult pair and offspring. Bioacoustics would not allow biologists to determine age of adults or exact number of offspring but could supplement passive observation sessions. Audio recordings might also provide insights into instances of predation or disturbance.
- Consider aerial surveys. Aerial surveys from an airplane, helicopter, or drone could be conducted to quickly gather information on territory occupancy and number of young produced.
- Consider contaminant sampling opportunistically to determine impacts. Egg shell fragments or feathers could be collected opportunistically in eyries after the breeding season.

Action B: Protection from Disturbance

Minimize or prevent disturbance by working with partners and land managers to adopt the following recommendations for closures and buffers:

- Pursue legal or voluntary closures or other protections that restrict recreational activities that take place on, above, or below the cliff if the activity causes aggressive or avoidant response

from peregrines during the nesting season (January 15 to August 15). Examples of specific prohibited recreational activities include rock climbing, rappelling, ice climbing, bouldering, slacklining, hang gliding, via ferrata, and drone use on the rock face. Overnight camping within posted areas is typically not allowed. Through-hiking may be allowed by certain land managers. Additional sources of recreational disturbance may be identified and prohibited.

- Collaborate with local climbing organizations whose members can provide valuable information about the cliffs, how climbing routes are accessed, which climbing routes are popular, peak climbing seasons, known compliance issues, and peregrine behavior they have witnessed while climbing.
- Delineate the spatial extent of a closed area. This should be customized to each site, as no standardized, “one size fits all” formula exists for distance buffers around peregrine nests. At a minimum, closure boundaries should reflect potential disturbance within line-of-sight of the nest ledge(s). This can be evaluated via a viewshed analysis in GIS or site visit. Where falcon nests are already established near humans, these recommendations may be relaxed, unless the birds show evidence of disturbance from human activity.
- Delineate the seasonal closure period. January 15 to August 15 is the standard closure period in North Carolina. Adjustments to start or end dates may be considered under an adaptive management framework when supported by site-specific monitoring data *and* approved by the land manager. Closures will not begin later than February 15 to ensure protection of early territorial activity. Maintain closures until 5 weeks after the last bird has fledged (ranges from late June to mid-August). Land managers should consider lifting closures early (before mid-August) at nests that finish earlier in the season and do not require protection through mid-August. Closure plans are evaluated annually, and are typically revised between August and January, where applicable. This “partial lift” can strengthen relations with the climbing community.
- Aircraft should not approach closer than 450 m (1500 ft) above a nest (Fyfe and Olendorf 1976). Closer approaches may cause peregrines to attack aircraft or may cause a frantic departure from the nest. Peregrines startled from the eyrie have been known to damage eggs or injure nestlings because they place their feet under or between their offspring when brooding. Adult response to overflights, measured as nest attendance and time-activity budgets, is influenced by the bird’s sex and the stage of the nest cycle (Palmer et al. 2003).
- Avoid operating heavy equipment such as logging or construction equipment near an active eyrie during the nesting season. Note that recommendations for specific distance of spatial buffers for peregrines vary greatly. A general guideline is to avoid these activities within 0.5 mile of the eyrie during sensitive phases of the nest cycle (Cade et al. 1996).
- Develop a communication plan for reporting issues, such as human disturbance, to authorities and for announcing the start and end of the closure period and partial lifts to stakeholders. Consider developing additional communications that increase the public’s awareness of Peregrine Falcon conservation and inspire compliance with closures. Examples include sharing nesting season summaries with the public or reporting on partner activities such as placing nest cameras with local rock climbers.
- Work with land-managers and owners and stakeholders to establish site-specific goals and management plans to limit disturbance. Details associated with closed areas should be in

writing and in illustrations, and a plan should be in place for posting seasonal and year-round regulatory and educational signs.

Action C: Habitat Management

Maximize favorable habitat conditions for successful Peregrine Falcon nesting and hunting by adopting the following recommendations for land managers and landowners:

- Before land development near (0.5 to 1 mile) Peregrine Falcon eyries, consult with a biologist from NCWRC to assist with planning.
- Evaluate the need for buffers around nests for proposed construction projects, road projects, utility installations, recreation development, logging, etc. Route trails away from areas within line-of-sight of the nest, using vegetation or topographic features as visual buffers. Consider frequency and predictability of use of trails.
- Route powerlines and other wires away from eyries to avoid collisions and electrocution hazards.
- Protect wetlands, which are key feeding areas used regularly by Peregrine Falcons, from filling, development, or other disturbances that could alter prey abundance and habitat quality.
- Maintain large trees and snags around the nest site. These perches are important for roosting and hunting.
- Avoid applying pesticides around occupied eyries during the breeding season.
- Pursue land conservation practices and land acquisition in areas where Peregrine Falcons nest.
- Address site-specific habitat management needs by working with NCWRC biologists to detail improvements needed at nest sites. For example, consider installing nest aids (nest boxes or trays) where nest success is low and add pea gravel where water pools on ledges.

Action D: Research

- Consider research that provides insight on causes of nest failure. Although it is often difficult to confirm causes of nest failure, criteria established by researchers in Canada have identified causes of nestling mortality by classifying mortality events as parasite attack, starvation, rain, predation, or “other” (Lamarre et al. 2018).
- Consider research that evaluates bird response and the level and impact of disturbance on breeding performance.
- Consider banding and tagging individuals to learn about dispersal and migratory patterns.
- Consider research to evaluate effectiveness of nest aids as a way to boost breeding performance at poorly performing sites.

Action E: Education and Outreach

People are a critical element to the successful conservation of North Carolina’s Peregrine Falcon population. Education and outreach efforts would support the proposed conservation actions by protecting peregrines from disturbance, managing their habitat, and increasing the public’s understanding and appreciation through direct (volunteering) or indirect (consuming outreach

materials) involvement. Enlist the Commission’s Science Support Team and Communications, Media, and Digital Engagement Office to assist with education and outreach efforts.

- Evaluate strengthening the monitoring network.
 - Gain support from private citizens, landowners and land managers to monitor and report breeding peregrines across urban and cliff areas.
 - Recruit a core group of observers consisting of volunteers and professional biologists to monitor nests. Train and retain the core group of nest monitoring personnel.
 - Continue to work with the local climbing community to strengthen the monitoring network by incorporating their unique knowledge and skillsets. Collaboration may include assisting with placement of electronics or nest aids, designing and posting signs, reporting raptor activity or disturbance, and promoting stewardship messages among climbers.
- Improve the public’s enjoyment and appreciation of peregrines.
 - Educate the public about identification and natural history of Peregrine Falcons through electronic and digital media.
 - Create educational materials to complement remote cameras at nest sites.
 - Expand awareness of potential nest sites such as cliffs, quarries, and tall buildings.
 - Host field trips for members of the Eastern Band of Cherokee Indians to view Peregrine Falcons at cliffs, some of which are sacred to the Cherokee people.
- Educate recreationists, landowners and land managers about protecting nesting peregrines.
 - Develop a quick reference guide to educate landowners and land managers on how to minimize nest disturbance and protect habitat.
 - Develop educational materials and signage tailored to different groups of recreationists that detail nesting, disturbance, and recreation. For example, educational materials targeting out-of-town hikers or drone operators will differ from educational materials targeting local groups such as the rock-climbing community. Effective tools for communicating with drone operators are particularly needed.
 - Provide clear signage to identify closed areas. Signs may include clearly labeled maps of closed areas, legal closure notifications (where applicable), and interpretive or informational messaging.
 - Consider naturalist rover programs for managing disturbance at sites with chronic disturbance from transient visitors such as out-of-town hikers.

Action F: Incentives (Tax Break)

Establish contact with landowners to pursue conservation practices such as the NCWRC Wildlife Conservation Lands Program, or land acquisition where nests occur on private land.

SUMMARY OF ACTIONS NEEDED

ACTION	OBJECTIVES	PARTNERS/FUNDING	DESIRED OUTCOMES
Monitor nests and maintain a database	Evaluate trends in occupancy, nest success, and productivity. Gather the necessary information to	USFS, NPS, NC State Parks, SAHC, CCC, The Access Fund, Audubon NC	Monitoring reveals a stable or increasing trend in nest success, productivity, and/or territory occupancy.

	provide timely technical guidance for cliff closures.		Risk of nest failure due to human disturbance is minimized through reasonable and effective cliff closures.
Maintain and update the Eyrie Management Plan	Identify changes in site-specific threats, sources of disturbance, and needs for nest monitoring and habitat management.	USFS, NPS, NC State Parks, SAHC, CCC, The Access Fund, Audubon NC	NCWRC is equipped to adaptively respond to new threats or sources of disturbance and to adjust monitoring and habitat management as needed.
Develop a long-term nest monitoring plan	Ensure adequate population monitoring while balancing effort with agency capacity.	USFS, NPS, NC State Parks, SAHC, CCC, The Access Fund, Audubon NC	A monitoring plan that balances population monitoring needs and approach with practical considerations, funding, and personnel needs.
Incorporate additional survey methodologies (e.g., cameras, bioacoustics, aerial surveys)	Better assess nest status and outcomes, especially at nests with chronic nest failure or limited view of the eyrie.	USFS, NPS, NC State Parks, SAHC, CCC, The Access Fund, Appalachian Mountain Rescue Team, Audubon NC, universities	Reduced time spent on passive observation sessions. Improved understanding of activities at the nest.
Work with land managers on eyrie management and pursue legal or voluntary closures or other protections around nests.	Develop clear site-specific goals and management strategies with land managers. Prevent or minimize disturbance around nests.	USFS, NC State Parks, NPS, SAHC, private landowners	Land managers have a clear understanding of peregrines' needs. Land managers support reasonable, effective closures. Minimal human disturbance at nests.
Post nest sites with regulatory (closure) signs and corresponding illustrations.	Replace some laminated signs with hard signs at select sites. For example, labeled cliff	USFS, NPS, NC State Parks, CCC, The Access Fund	Signs are not easily removed by visitors. Closure boundaries at a site are clearly

	photos/illustrations and “no drone” signs.		marked on a photo or illustration. Clear, consistent messaging, for example, regarding drones.
Collaborate with local climbing organizations and other relevant recreation organizations.	Maintain open communication and partnership with recreationists. Recreation organizations spread awareness of closures to their user community.	CCC, The Access Fund, Appalachian Mountain Rescue Team	NCWRC obtains helpful information from climbers and other recreationists about recreational use near a nest (popular routes, peak seasons, etc.) Reasonable and effective closures. Improved compliance with closures. Minimal human disturbance at nests.
Develop a communication plan	Provide a clear process for reporting issues, announcing seasonal closures, and providing nest updates.	USFS, NPS, NC State Parks, SAHC, CCC, The Access Fund	NCWRC learns about issues, such as disturbance and can act on them and revise the Eyrie Management Plan. Improved compliance with closures. Recreationists and other visitors learn about Peregrine Falcons from nest camera footage and nesting updates.
Manage habitat at and around nest sites.	Support favorable habitat conditions for nesting and hunting	USFS, NPS, NC State Parks, SAHC, private landowners	Habitat is protected and meets the needs of nesting peregrines.
Conduct research	Further our understanding of the breeding population’s full annual cycle, causes of nest failure,	Universities	NCWRC has the necessary information to develop effective conservation actions.

	response to disturbance, etc.		
Provide education and outreach opportunities	Improve public awareness and appreciation of Peregrine Falcons and their conservation.	USFS, NPS, NC State Parks, SAHC, CCC, The Access Fund, Audubon NC	People visiting and recreating at cliffs can identify a Peregrine Falcon. People contribute to peregrine falcon conservation, for example, by volunteering or encouraging their peers to comply with closures. Improved compliance with closures. Improved conditions for nesting at sites prone to human disturbance.

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GLOSSARY

Brood (v): to warm, protect, or cover young with the wings or body

Cere: a waxy, fleshy area at the base of the beak of some birds

Eyrie: a nest of a bird of prey on a cliff ledge

Fledging (v): to leave the nest after acquiring the feathers necessary for flight or independent activity

Fostering: to place a young falcon in an active nest of a mated pair of adult falcons

Granite Dome/Pluton: large mass of intrusive igneous rock (granite) with bare rock exposed over most of the surface

Hacking: the controlled release of a young falcon from an artificial eyrie (typically a hack box)

Intraspecific Competition: competition between individuals of the same species

Malar Region: a feathered area located behind and below the eyes. In Peregrine Falcon, is described as a “side burn”

Nest Aids: nest boxes or platforms placed to encourage nesting by falcons

Nest Success Rate: percentage of nesting pairs per given time period that successfully raise young to at least 1 month of age

Orbital Ring: the circle around the eyes of a bird

Passage Migrant: a bird that stops somewhere for a short period of time during a seasonal migration

Perfluoroalkyl Acids: carbon-based synthetic chemicals that persist in the environment

Persistent Organic Pollutant (POP): chemicals that persist in the environment and accumulate in the tissue of living organisms

Polybrominated Diethyl Ethers (PBDEs): flame retardant additives used in textiles, thermoplastics, polyurethane foams, and electronic products that persist in the environment. DecaBDE is a commercial mixture composed of 97-98% brominated diethyl ether 209 (BDE-209).

Productivity Rate: number of young raised per nesting pair of falcons per given time period

Raptor: a bird of prey, such as a hawk, eagle, falcon, or owl

Resident Pair: a mated male-female pair of falcons defending a breeding territory

Scrape: a simple depression in the ground where a bird lays eggs without constructing a nest. In Peregrine Falcons, the scrape is a shallow depression in the grit or dirt on a cliff ledge and is formed by the adult (typically the female, but sometimes the male) rubbing their abdomen repeatedly over this surface.

757 Territory Occupancy Rate: the percentage of territories surveyed that are occupied by a male-female
758 pair of Peregrine Falcons in a given time period
759

760 LIST OF ACRONYMS

761
762 Carolina Climbers Coalition (CCC)
763 National Park Service (NPS)
764 Southern Appalachian Highlands Conservancy (SAHC)
765 United States Forest Service (USFS)
766
767

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