

Grand Bahama's Brown-headed Nuthatch: A Distinct and Endangered Species

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Abstract

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The purpose of this paper is to rapidly disseminate recent findings concerning the taxonomic and conservation status of the Brown-headed Nuthatch population on Grand Bahama. Heretofore, this population has been regarded as conspecific with continental populations of the Brown-headed Nuthatch (*Sitta pusilla*) in the southeastern United States. However, on the basis of morphometric differentiation and very distinctive vocalizations, we propose recognition of the Bahama Nuthatch (*S. insularis*) as an endemic, full species. Population surveys conducted on Grand Bahama in 2004 suggest this species is endangered, with hundreds to possibly a few thousand individuals remaining. These birds require mature, fire-maintained stands of Caribbean Pine (*Pinus caribaea*) and face serious threats associated with accelerated development, potential logging, invasive species (including snakes, cats, raccoons, and competing cavity-nesting birds), and catastrophic storm damage. Thus, the species may become extinct unless Bahamians are willing to take action to save it. We offer several suggestions to begin formulating a management plan. As the rarest bird in the Bahamas, and one of the rarest birds in the world, the nuthatch will become a high-profile symbol of conservation efforts (or their failure) in the Bahamas.

Introduction

During an era of shifting views and rapidly-changing methods in taxonomy, ornithologists have largely ignored questions of taxonomic relationships in the Bahamas. Because of limited funds for protecting the environment, conservation biologists frequently establish priorities based on taxonomic considerations. They seek to identify the most distinct species (often called evolutionarily significant units, ESU's) and prioritize saving these rather than local races (sometimes called management units, MU's).

Historically, ornithologists have recognized three bird species and a multitude of subspecies as being endemic to the Bahamas. The endemic species include the Bahama Woodstar (*Calliphlox evelynae*), Bahama Swallow (*Tachycineta cyaneoviridis*), and

Bahama Yellowthroat (*Geothlypis rostrata*). More research using refined techniques may reveal that some currently-recognized subspecies are, in fact, distinct species. Tragically, some candidate species may have already vanished (e.g., Grand Bahama race of the West Indian Woodpecker, *Melanerpes superciliaris bahamensis*; New Providence race of the Bahama Yellowthroat, *Geothlypis rostrata rostrata*), and others may soon disappear unless we can identify their proper taxonomic status and commit to saving them before it is too late.

In an effort to address this urgent need for conservation taxonomy, we focused on the Grand Bahama race of the Brown-headed Nuthatch. We chose this taxon because the population may be taxonomically distinct and because it appears to be endangered.



Figure 1. Brown-headed Nuthatch (*Sitta pusilla*). Photo: Frederick K. Truslow/©VIREO.

At present, three subspecies of the Brown-headed Nuthatch (*Sitta pusilla*) are recognized (see photo in Figure 1). These include two continental forms in the southeastern United States (*S. p. pusilla* occupying most of the range and *S. p. caniceps* confined to the Florida peninsula and extreme southern Georgia) and an insular form on Grand Bahama Island (*S. p. insularis*). James Bond (1931), the noted ornithologist (not to be confused with a certain British spy, whose name was actually derived from the ornithologist), described the Grand Bahama subspecies on the basis of two specimens collected in 1891. Norris (1958) examined a third specimen and concurred with Bond, noting the longer bill, shorter wings, and darker loreal and auricular regions compared to continental forms. Smith and Smith (1994), based on two birds seen and heard on Grand Bahama, described the call of *S. p. insularis* as being more rapid and higher-pitched, suggesting further differentiation from the continental forms. However, after examining the 17 specimens from Grand Bahama collected by Donald Buden in 1968, Smith and Smith (1994) concluded that *S. p. insularis* was less distinct morphologically than Bond and Norris believed.

Brown-headed Nuthatches require mature, fire-maintained pine forests to survive (reviewed by Withgott and Smith, 1998). On Grand Bahama, they inhabit Caribbean Pine (*Pinus caribaea*), one of the most critically threatened habitats in the West Indies. In the 1950s, nearly all of the forest on Grand Bahama was logged, with more than 70% removed in just three years (Allen, 1996). Somehow, the nuthatch survived. A few decades later, John Emlen conducted extensive field work on Grand Bahama's avian communities and found nuthatches to be fairly common in the older pine forests. He reported densities of 8.48 birds/km² in 1969 (Emlen, 1977) and 13 birds/km² in 1979 (Emlen, 1981). However, Smith and Smith (1994) conducted extensive surveys in 1993, encountering only two individuals. They concluded that the nuthatch had suffered more than a

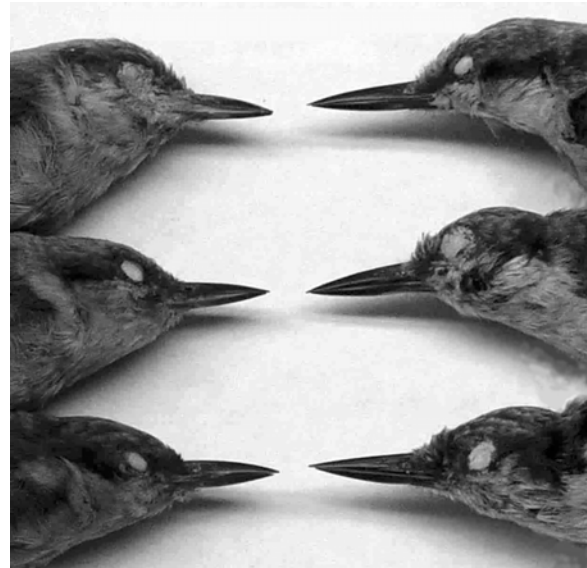


Figure 2. Representative adults of the Florida (*Sitta pusilla caniceps*; left) and Grand Bahama (*S. p. insularis*, right) forms of the Brown-headed Nuthatch. Note the longer bills of the Grand Bahama race.

90% decline since 1969. Clearly, there was reason to be concerned about the future of this taxon.

The purposes of this paper are: 1) to summarize new morphometric and vocalization data suggesting the Grand Bahama race of the Brown-headed Nuthatch is a distinct, endemic species; 2) to summarize recent field surveys confirming endangered status of this taxon; 3) to ascertain breeding phenology based on museum specimens and field observations; and 4) to offer preliminary suggestions for an *in situ* management plan.

Because this bird warrants both elevation to full species and recognition as an endangered species, we wish to bring its current taxonomic and conservation status to the immediate attention of those in the best position to safeguard it from extinction—Bahamians. Here, we only summarize the key findings and conclusions of our studies. Detailed methods and data analyses will be published elsewhere.

Taxonomic Distinctiveness

Morphometric analyses. We began our studies with museum specimens, comparing Brown-headed Nuthatches from the Grand Bahama (n = 11 adults and 7 juveniles) and continental U.S. populations (N = 23 adults and 0 juveniles of *S. p. pusilla* and 83 adults and 8 juveniles of *S. p. caniceps*). Using calipers, one of us (WKH) took standard morphometric measurements, including bill length (nares to tip), bill width, bill depth, wing length, tail length, tarsus length, and middle toe length. We chose not to quantify plumage coloration because of substantial character overlap between the three taxa and poor plumage quality of most study skins from

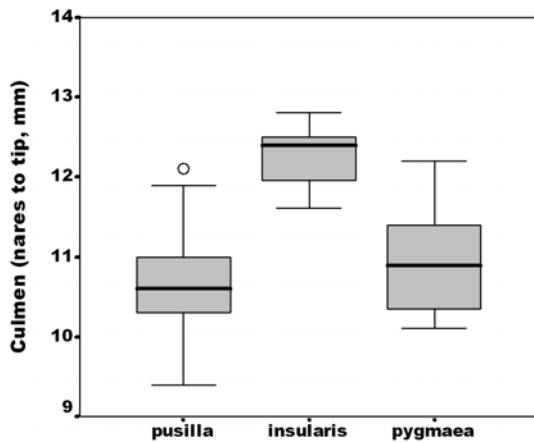


Figure 3. Boxplot of adult bill lengths measured in continental Brown-headed Nuthatch (*Sitta pusilla pusilla* + *caniceps*, n = 99), Bahama Nuthatch (*S. p. insularis*, n = 11), and Pygmy Nuthatch (*S. pygmaea*, n = 11). The box (interquartile range) contains 50% of the values, the horizontal line represents the median, the vertical whiskers show the highest and lowest values excluding outliers, and the circles represent outliers.

the Bahamas. For additional perspective, we also examined specimens of Pygmy Nuthatch from Western North America (*Sitta pygmaea*, n = 11 adults and 1 juvenile of three subspecies). Adult males and females were pooled in the analyses, as they differ by 2% or less (males larger) in most measurements. Juveniles were excluded because their bill lengths were significantly smaller than adults. Because we were unable to reliably distinguish the two continental subspecies of Brown-headed Nuthatch (*S. p. pusilla* and *S. p. caniceps*), we pooled these two groups in the analyses that follow.

The results suggest, but do not confirm, species status of the Grand Bahama form. As Bond and Norris concluded, the Grand Bahama form is indeed longer-billed and shorter-winged than the continental form (see Figures 2-4). Thus, the Grand Bahama form has a greater bill-wing ratio (mean = 0.20 ± 0.02 SE) than the continental form (0.17 ± 0.001), with only one Grand Bahama specimen overlapping the range of measurements from continental specimens. The Grand Bahama form also has longer tarsus measurements (16.1 ± 0.2 mm) than the continental form (15.1 ± 0.1 mm), but overlap is considerable.

Stepwise discriminant function analyses were used to determine whether each specimen of the continental and Grand Bahama forms could be correctly assigned to the right group. Using two characters (bill-wing ratio, tarsus length), 100% of the continental specimens were correctly assigned to the continental form, but only 91% of the Grand Bahama specimens were correctly identified. One

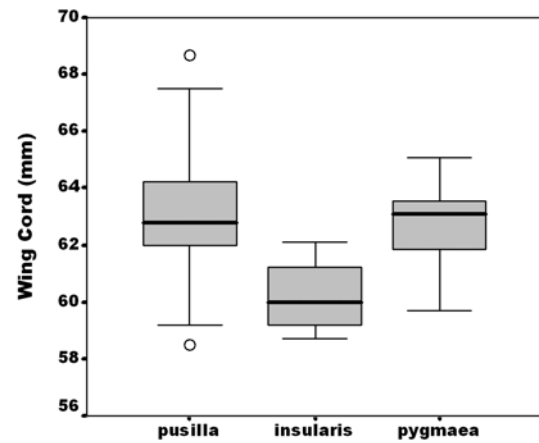


Figure 4. Boxplot of adult wing lengths measured in continental Brown-headed Nuthatch (*Sitta pusilla pusilla* + *caniceps*, n = 99), Bahama Nuthatch (*S. p. insularis*, n = 11), and Pygmy Nuthatch (*S. pygmaea*, n = 11). See Figure 1 for explanation of boxplots

Grand Bahama specimen was misidentified as a continental form. Most taxonomists require 100% discrimination between full species (e.g., Helbig et al., 2002) and at least 75% discrimination between subspecies (e.g., Patten and Unitt, 2002).

Curiously, the continental form of the Brown-headed Nuthatch shows greater morphometric similarity to the Pygmy Nuthatch than to the Grand Bahama form of the Brown-headed Nuthatch (Figures 3-4). This contrasts with plumage, in which case the continental and Grand Bahama forms of the Brown-headed Nuthatch are virtually indistinguishable (Grand Bahama forms exhibit more white and less gray on the throat and belly), whereas the Pygmy Nuthatch has a darker brown cap and white spots in the tail.

Vocal analyses. To compare vocalizations, we recorded the calls of Brown-headed Nuthatches from central Florida (Three Lakes Wildlife Management Area, Osceola County, n = 8+ individuals in 2 groups) and south Florida (Everglades National Park, Miami-Dade County, a population established by translocation from Big Cypress National Preserve, Collier County, n = 2 adults of one pair) in February, 2004, and from Grand Bahama in July and August, 2004 (n = 12+ from 4 groups). We used a WM-D6C Sony Professional Walkman cassette recorder and Sennheiser ME-62 omni-directional microphone with K6 pre-amp powered module attached to a generic 61 cm parabolic dish via an AT-8415 Audio Technica microphone shock mount. Recordings were rendered on type II cassette tapes. Calls were digitized and analyzed spectrographically using Spectrogram version 10.2 (Visualization Software LLC; sample rate = 48,000 kHz, time resolution = 2.8 msec, frequency resolution = 31.2 Hz). For further

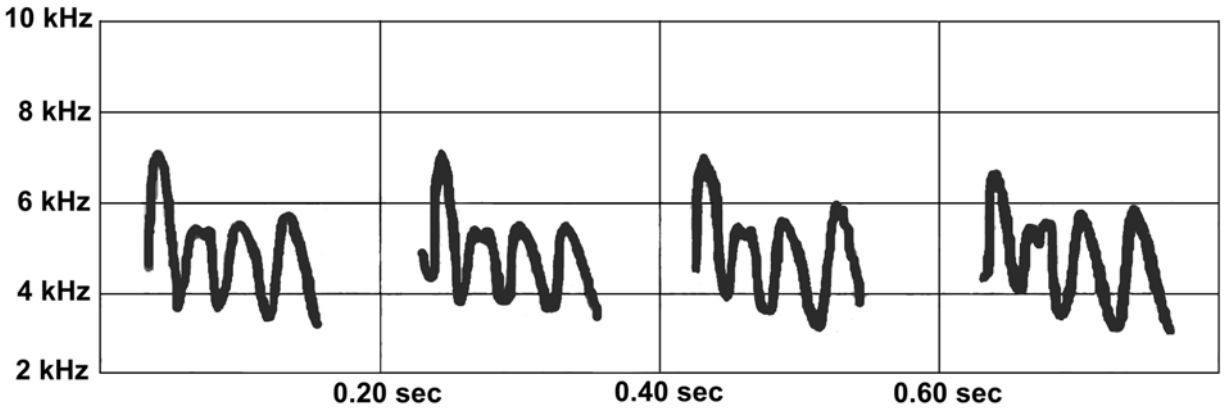


Figure 5. Spectrogram of the “warble” call of the Bahama Nuthatch.

comparison, we also purchased recordings of continental Brown-headed Nuthatches and Pygmy Nuthatches from the Borror Laboratory of Bioacoustics at University of Ohio. Withgott and Smith (1998) describe and provide spectrograms of the four primary calls of continental Brown-headed Nuthatches.

We identified at least three calls in the Grand Bahama birds. The most distinctive vocalization in the Grand Bahama birds was a rapid, high-pitched “warble” call bearing no resemblance whatsoever to any call recorded by us or previously described in continental Brown-headed Nuthatches. Figure 5 shows a spectrogram of this unique call and a digital file of the call is available for download at the senior author’s website (www.llu.edu/llu/grad/natsci/hayes/). The call consisted of 3-7 (usually 4-5) oscillating elements (the first element usually higher or lower in frequency than the others) of roughly 0.10-0.18 sec duration in the 3-7 kHz range (sometimes higher-pitched, at 4-10 kHz), and these were usually repeated continuously at 0.2-0.3 sec intervals. This call was frequently heard and seemed to be associated with rapid movement (flight) of groups through the forest. “Pic” notes similar to the “single-note” vocalization of continental Brown-headed Nuthatches were also frequently heard. These appeared to be contact calls. Only occasionally did we hear the “rubber ducky” call in Grand Bahama birds that is given more frequently by continental birds. Although adults used all of these vocalizations, we were unable to determine the vocalizations used by juveniles. Nuthatch groups responded most vigorously to taped playback of the warble call and virtually ignored playback of the continental rubber ducky call.

Conclusions. Morphometric differences suggest considerable divergence of the Grand Bahama population from continental populations of the

Brown-headed Nuthatch. The distinctive vocalizations, however, provide greater justification for elevating the Grand Bahama population to full species status. Thus, we propose recognition of the Bahama Nuthatch (*S. insularis*) as a full species. It joins the Bahama Woodstar, Bahama Swallow, and Bahama Yellowthroat as a fourth bird species endemic to the Bahamas.

Conservation Status

Population surveys. In July and August, 2004, we conducted population surveys throughout much of the Caribbean Pine forest on Grand Bahama. The transects were widely distributed along the many secondary roads and logging tracks between Freeport (in the center of the island) and McClean’s Town (at the east end of the island). Less than 5% of the pine forest occurs west of Freeport, and we did not survey this area. Surveys were conducted primarily in the morning, from 0645–1200 hrs, but occasionally continuing to 1400 hrs if bird activity persisted under overcast skies. Surveys were briefly interrupted on occasion by rain showers. Although transects ideally should not follow roads, we saw little hesitation on the part of most birds, nuthatches included, to forage close to and move readily across the narrow gaps in the forest. Given what we wished to accomplish within a limited time frame, we relied on the roads to increase survey efficiency.

Initially (18-23 July), we walked (individually or as a twosome at approximately 2 km/hr) 23 transects totaling 62.5 km, with 3.5 km (6%) between West Beach Drive and Churchill Rd (south of the highway), 40.3 km (64%) in the Lucayan Estates area east of Grand Lucayan Waterway and west of Lucayan National Park (both north and south of the highway), 14.1 km (23%) between Free Town and Mt. Pleasant (mostly north of the highway), and 4.6 km (7%) near McLean’s Town (north of the highway). For most transects, we recorded all species

of birds (in addition to nuthatches) either seen or heard, and on all transects we regularly used taped playback through a small, battery-boosted computer speaker (Sony SRS-A27) of a “rubber ducky” call recorded in Florida (a 9 sec wav file from *Bird Songs of Florida*, downloaded from the Cornell Laboratory of Ornithology website).

Later (31 July – 12 August), one of us (ZM) repeated the surveys by automobile while stopping every 0.2 km and using taped playback of the “warble” call. Vocal responses were then verified by a search on foot. The 19 transects covered 80.3 km, with 8.6 km (11%) between West Beach Drive and Churchill Rd (both north and south of the highway), 57.4 km (71%) in the Lucayan Estates area (mostly north of the highway), 9.7 km (12%) in the High Rock area (north of the highway), and 4.6 km (6%) in the McClean’s Town area (north of the highway). Because of difficulty counting the number of birds within groups of more than two individuals, we assumed that four birds were present on five encounters with such groups. This number was the average size of four groups of 3-5 individuals that were tracked more carefully, allowing an accurate count.

To estimate population size of the nuthatch (and other bird species), we relied on Emlen’s (1977) coefficient of detectability method. Emlen computed density (birds/km²) based on transect counts (N, number of birds detected), a coefficient of detectability (C, probability of detecting any individual actually present within 125 m of a transect line), and transect length (L). Thus, density for any given species = (N/C)/(L/4). The coefficient of detectability (C) was 0.25 for the nuthatch, but differed from species to species. Of course, C may vary with many factors, including habitat, season, time of day, weather, speed of transect, and observer ability. We chose to duplicate Emlen’s method, recognizing the inherent shortcomings. In our surveys, obvious departures from Emlen included our initial unfamiliarity with the distinctive calls of the Bahama Nuthatch (decreasing C) and the use of taped playback (increasing C).

In the initial surveys, using taped playback of the continental “rubber ducky” call, we failed to detect nuthatches until a single individual was heard (but not seen) responding to the playback on the sixth day. At this point, we had completed 62.5 km of transects, giving a deplorable density of 0.26 birds/km². This estimate supports the conclusion of Smith and Smith (1994) that the nuthatch is approaching extinction. Returning later to the site where we had heard the single bird, we encountered a group of nuthatches and recorded their distinctive vocalizations. In retrospect, we recalled hearing similar calls on earlier transects, but assumed they might be from unseen swallows or food-begging juvenile warblers.

In the later surveys, using taped playback of the distinctive “warble” call, we encountered substantially more nuthatches: at least 43 individuals in 21 locations. We found nuthatches only within the Lucayan Estates area north of the highway. For all transects, the density estimate was 8.56 birds/ km². For transects within the Lucayan Estates area, the density estimate was 12.0 birds/ km². These estimates are close to those reported several decades earlier by Emlen (1977, 1981), but taped playback no doubt increased detectability in our surveys.

Clearly, the survey results depended critically on detectability. Our initial surveys, like those of Smith and Smith (1994), suffered because we expected to hear vocalizations similar to those from the continental populations. Once we learned the warble call and used it for playback, we dramatically increased detectability.

The question of how many nuthatches remain on Grand Bahama will be difficult to answer, but our surveys give us some numbers to work with. In terms of habitat availability, we found the Department of Lands and Surveys maps (1:25,000 scale, sheets 1-15), though outdated, to be surprisingly accurate in representing pine habitat. By counting 1 km² quadrants having >50% pine forest, we estimated that up to 591 km² of pine habitat remains on Grand Bahama (see also Allen, 1996). At best, using 8.56 birds/km², the island could presently support 5,059 nuthatches. However, this figure is far too high, as the actual amount of suitable habitat (submature to mature forest in sizeable tracts) is much less, the densest and perhaps only remaining nuthatch population may be confined to the Lucayan Estates area, and playback of the “warble” call dramatically increases detectability. If, for example, the nuthatch presently occupies only 300 km² of forest and taped playback of the warble call increases detectability two-fold (to 0.50, adjusting density estimates to 6.0 birds/km² in the Lucayan Estates, the only habitat we found with nuthatches present), as many as 1,800 individuals might remain. Even so, we find this estimate optimistic. More study, clearly, is needed. Regardless, given its small population size, highly-restricted range, and vulnerability to a number of threats (see below), this bird should be regarded as endangered.

Current threats. The greatest long-term threats to the Bahama Nuthatch are renewed logging and continued development. Without protection of the pine forest, the bird will become extinct. The nuthatch occurs most densely in the Lucayan Estates area, which is subdivided into a patchwork of small tracts owned by both private and corporate interests (Erika Gates, personal communication). Fortunately, the area remains largely undeveloped in spite of earlier plans (some infrastructure, including roads

and electricity, are already in place), but homeowners and small businesses are slowly moving in. Securing this habitat to sustain the species will be a difficult, perhaps impossible, task.

Other risks threaten the pine forest, including catastrophic storm damage and severe fires. In 2004, two level-four hurricanes swept across the island, inundating the northern shore with a substantial storm surge. We don't yet know how much damage occurred. We've received reports that the pine forest remains largely intact along the east-west highway on the south side of the island, but saltwater intrusion from the storm surge has likely caused damage on the northern side. Fortunately, fires are common on the island from both anthropogenic and natural causes. Frequent fires maintain a low vegetation understory, which reduces the risk of mature trees being killed during fires (e.g., Myers et al., 2004).

Identifiable risks to the birds include the arrival of invasive species, such as the Corn Snake (*Elaphe guttata*), House Sparrow (*Passer domesticus*), European Starling (*Sturnus vulgaris*), feral Cat (*Felis domesticus*), and Raccoon (*Procyon lotor*). The snake, a pernicious predator of bird nests, has moved beyond the suburbs of Freeport and Lucaya well into the pine forest habitat. On 16 July, 2004, at 0742 hrs, we encountered a road-killed adult male corn snake on the highway just east of Owl's Hole Road (UTM 2943936 N, 754176 E). Apparently, the native snake species (*Epicrates exsul* and *Alsophis vudii*) are scarce, as we encountered no live or road-killed specimens. The two birds are competing cavity-nesters now established on Grand Bahama. We did not encounter either species during our surveys, but Allen (1996) observed House Sparrows at farms in the midst of otherwise undisturbed forest and both House Sparrows and Starlings were nesting at the abandoned U.S. Air Force missile tracking base, where they appeared to compete with Bahama Swallows for nest sites. Several native species may also compete for nest sites, including the relatively common Hairy Woodpecker (*Picoides villosus*) and the relatively scarce La Sagra's Flycatcher (*Myiarchus sagrae*). Although the Shiny Cowbird (*Molothrus bonariensis*), a nest parasite, has arrived naturally on Grand Bahama (White, 1998), nuthatches seem to be minimally affected by cowbird parasitism (Withgott and Smith, 1998). Cats and Raccoons are also pernicious bird predators. During surveys, we encountered one individual of each in undeveloped forest, the Cat west of Owl's Hole Road (18 July, 2004, 0815 hrs, UTM 2944026 N, 745360 E) and the Raccoon north of South Riding Point (2 August, 2004, UTM 2951236 N, 774310 E). We doubt that substantial predation and competition occur now, but continued development will exacerbate the risks posed by these alien species.

Conclusions. Our field surveys in 2004 indicate that a viable population of nuthatches remains. We believe the bird should be regarded as endangered, with hundreds to possibly a few thousand individuals remaining. To give a better perspective on the rarity of this bird, we can compare it to other species listed in the IUCN Red List of Threatened Species (http://www.birdlife.net/datazone/search/species_search.html). Within the Bahamas, there is not a single "endangered" or "critically endangered" bird species listed. At present, the high-profile birds receiving a level of conservation support include the West Indian Whistling Duck (*Dendrocygna arborea*, listed as "vulnerable" with >10,000 remaining), the Bahamas race of the Cuban Parrot (*Amazona leucocephala bahamensis*, "near threatened" as a species with >6,000 remaining in the Bahamas; see Wiley et al., 2004), and the Kirtland's Warbler (*Dendroica kirtlandii*, "threatened" with 1,806 remaining). None of these species are endemic to the Bahamas, and none are as rare as the nuthatch.

Breeding Phenology

Based on the collection dates at which juvenal plumage can be discerned from museum specimens (presence of gray rather than brown feathers on cap) and field observations of behavior, we infer approximate dates of breeding on Grand Bahama. If correct, the breeding period differs dramatically from continental populations of the Brown-headed Nuthatch.

For continental nuthatches, Withgott and Smith's (1998) literature review indicates that eggs may be incubated from early March to late May, with birds breeding earlier in the south. Second broods are rarely observed. The authors also summarized the approximate cumulative ages (after egg-laying) for the following events: hatching = 14 days, departure from nest = 31-32 days, food-begging ends = 56-59 days, and molt to adult basic I plumage = 90+ days.

Of nineteen Grand Bahama specimens examined, seven exhibited juvenal plumage. Of these, five were collected 31 January-2 February, 1968 (LSUMZ 144819, 144823, 144826, 144827, 144828), and two were collected 24-29 June, 1891 (FMNH 9603, 9604). We assume that the dates of collection are correct. While in the field, we observed two groups of nuthatches that each included one or more food-begging juveniles on 24-26 July, 2004. These observations suggest that egg-laying in Grand Bahama may occur from early-November (to explain juvenal plumage in late January) to late-May (to explain food-begging in late July).

More study is needed to determine whether the extended period of inferred breeding on Grand Bahama reflects substantial annual variation, multiple broods per season, or both.

Preliminary Management Plan

Here, we offer suggestions on how to begin formulating a management plan for the Bahama Nuthatch. The success of any conservation program will depend on many factors, including some not mentioned here. But ultimately, success will be measured by the degree to which Bahamians become invested in conservation activities, taking ownership of the process of protecting and managing their national treasures. As the rarest bird in the Bahamas, the nuthatch can become a high-profile symbol of conservation efforts in the Bahamas. Its status as one of the rarest birds in the world will likely attract visitors wishing to glimpse this elusive bird, providing some measure of value to the economy of Grand Bahama.

Formal protection of existing habitat. Simply put, the nuthatch will become extinct if and when the pine forest deteriorates to a point where it can no longer support a viable population. At present, the forest remains highly vulnerable to both development and logging interests. Large tracts of mature, fire-maintained forest must be preserved, as significant fragmentation will degrade the ecosystem (Myers et al., 2004). Further study will be needed to determine the amount of pine forest required to sustain the species. The bird's current stronghold is within the Lucayan Estates area, where accelerated development, primarily for housing, seems inevitable. Government agencies will need to work closely with corporate interests to either set aside protected land or devise regulations that minimize deforestation. This will be the biggest challenge. National and international attention on the plight of the nuthatch can add pressure for something to be done. Fortunately, much of the land east of Lucayan National Park may be Crown Land (Erika Gates, personal communication), which will be easier to set aside. Further surveys may show that nuthatches occur there as well.

Other birds also depend on the Caribbean Pine forest. The Bahama Swallow, with as few as 4,800 remaining on Grand Bahama, Abaco, and Andros, may already be extirpated on New Providence (Smith and Smith, 1989). The Cuban Parrot population on Abaco is unique among parrots in that it nests in limestone solution holes in the ground (some would argue this character represents taxonomic distinctiveness). It is threatened on Abaco (with a recent estimate of 1,578 remaining), where it occupies both broadleaf and pine forest (Wiley et al., 2004). The Bahamas race of the Yellow-throated Warbler (*Dendroica dominica flavescens*) is actually another distinct species (David Lee, personal communication), and it is confined to the pine forests of Grand Bahama and Abaco. A host of recognized

subspecies also require the pine forest, including the Grand Bahama race of the West Indian Woodpecker, which has already been extirpated. Myers et al. (2004) provide excellent recommendations for management of the Caribbean Pine forest ecosystem.

Continued research. The basic biology of the organism must be understood if we are to ensure that its needs will be met. We need further study of the bird's current population status, including distribution, population density, and habitat requirements. We need to learn when and where it breeds, how often and how many young are produced, and the factors that most affect reproductive success. We need to understand population genetics, so that we have a better idea of heterozygosity and resistance to inbreeding depression. Fortunately, Emlen (1977, 1981) provides a wealth of data on its foraging ecology and interactions with other bird species. However, we know less about the factors that govern food availability. We need to study social and spatial relationships, as these presumably regulate density, dispersal, and gene flow.

Education and public relations. Public awareness will be a key ingredient to a successful management program. Thus, word of the nuthatch's plight needs to move beyond the black-and-white print of this article and into the minds of Bahamians who can make a difference. Government officials need to be cognizant of how development and logging could impact the pine forest, threatening not just the nuthatch but other unique animals as well. Local corporations, businesses, and especially the general public need to be educated on the uniqueness of their pine forest and endemic birdlife, as the fate of this ecosystem, ultimately, is in their hands. Erika Gates' weekly talk show offers an outstanding means of communicating to the public, but we also need to go into the classroom and influence the children, who can take the message home to their parents.

Education can enhance the heuristic value of an endangered species by changing public perception. Fortunately, the Brown-headed Nuthatch exhibits several highly unusual and endearing behaviors (reviewed by Withgott and Smith, 1998). As a cavity-nesting species, it often excavates its own home, a rare behavior among small birds. It is one of the few North American species that exhibits cooperative breeding, in which mature but non-breeding helpers assist with territory defense, cavity excavation, nest construction, and feeding of the female, nestlings, and fledglings. It is also one of very few birds known to utilize a tool. On occasion, it uses a bark chip to pry off other bark chips during foraging. Like the other North American nuthatches, it frequently forages upside-down. Future research will inform us

whether the Bahama population exhibits behaviors similar to continental birds.

Population expansion via translocation. Much of the habitat east of Lucayan National Park is Crown Land (Erika Gates, personal communication). Although the habitat looks suitable, we were unable to locate nuthatches there. Translocating nuthatches to suitable habitat where they are presently absent could effectively boost population size. Recently, Gary Slater (personal communication) successfully translocated Brown-headed Nuthatches to Everglades National Park in Florida, which demonstrates the feasibility of a translocation program on Grand Bahama.

Corporate sponsorship of a high-visibility program. Our field work on behalf of the nuthatches was made possible through the generosity of the Grand Bahama Power Company. Recognizing the importance of sustainable development, this insightful company has pioneered corporate sponsorship of environmental programs on Grand Bahama. Hopefully, they have set the gold standard for future corporate-sponsored environmental programs on their own island and elsewhere in the Bahamas.

Perhaps because of their agility and grace, birds are particularly well-suited to arouse public interest in environmental issues. High-profile efforts to save endangered birds, whether in the Bahamas or elsewhere, generate considerable publicity. As such, these efforts have deep and long-term positive effects. Such “rescue” attempts provide excellent opportunities to educate the public, fostering good will and sentiment toward the environment. Of course, they also generate favorable publicity for the company, and as such, represent a good investment.

Acknowledgments

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