Seabird Nesting and Conservation in the Northern Bahamas

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Abstract.—Seabirds and other colonial waterbirds nesting in the northern Bahamas are nearly undocumented. This study is the first complete inventory of seabirds and other colonial waterbirds nesting in the northern Bahamas (including the islands of the Abacos, Grand Bahamas, Biminis, and Berries). The survey found 20,267 nests of 19 species of seabirds and other colonial waterbirds at 113 colony sites. The over 40,000 seabirds and other colonial waterbirds found nesting in the northern Bahamas doubles population estimates previously published for The Bahamas as a whole, which included few of these sites. Sooty Tern (*Sterna fuscata*) was the most abundant species, having a nesting population of over 10,000 pairs. Next most abundant were the Bridled Tern (*Sterna anaethetus*), Laughing Gull (*Larus atricilla*), and Brown Noddy (*Sterna stolidus*). This paper documents the first nesting record in the Commonwealth of The Bahamas of the White Ibis (*Eudocimus albus*), the first recent nesting in northern Bahamas of the Magnificent Frigatebird (*Fregatta magnificens*), and the first recent nesting in Grand Bahama of the Brown Pelican (*Pelecanus occidentalis*). Based on the results, 27 sites may be recognized as of special importance to seabird conservation in the northern Bahamas. Opportunities for conservation, including community-based colony site stewardship and protection of the most important sites within twelve protected areas are discussed. *Received 18 October 2006, accepted 25 March 2007.*

Key words.—Abaco, Audubon's Shearwater, The Bahamas, Berry Islands, Bimini, Brown Pelican, colonial waterbirds, colonies, conservation, cormorant, distribution, egging, egret, Grand Bahama, heron, important bird areas, Magnificent Frigatebird, national parks, populations, seabirds, terns, wading birds, White Ibis.

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Within the West Indies, The Commonwealth of The Bahamas has a particularly diverse assemblage of seabirds (White and Lee 2000). The status of non-nesting seabirds has recently been well reviewed (White 2004), but the status of nesting seabirds remains poorly documented. The status of other colonial waterbirds in the northern Bahamas is even more poorly documented. Most contemporary knowledge of waterbirds nesting in The Bahamas is, in fact, decades old, inexact, and confined to a few islands. The best knowledge being from the Exumas, San Salvador, and New Providence, with only scattered reports from other islands (Lee and Clark 1994; White 1998; White and Lee 2000; Bracy 2004). Recently a survey has been completed of the Turks and Caicos, to the immediate south of The Bahamas (Pienkowski *et al.* 2005). For the northern Bahamas, information on breeding seabirds is nearly nonexistent, somewhat surprising given the region's high visitation. Due to lack of information, White and Lee (2000) found themselves unable to identify and defend their choice of any location in the northern Bahamas as important to seabird conservation. Conservation of nesting sites of waterbirds in the Bahamas is of critical importance not only nationally but within the West Indian region as a whole. The purpose of the current study was to investigate the size, distribution, and locations of colonies of seabirds and other colonial waterbirds in the northern Bahamas and to assess conservation opportunities.

STUDY AREA

The Islands of The Commonwealth of The Bahamas lie in the North Atlantic Ocean, east of Florida and Cuba. This study was conducted in the northern Bahamas, encompassing Grand Bahama Island and its associated smaller islands, the Abacos island chain, the Bimini island chain, and the Berry Islands (Fig. 1). The study area covered about 60,000 km^2, from Jump Off Rocks (nr Walker Cay in the Abacos) (27°16.463', 78°25.371') (northwestern-most point), to Elbow Cay (nr Great Abaco Island) (26°31.754', 76°57.389') (eastern-most point), and to Sandy Cay (nr West End, Grand Bahama Island) (26°48.088', 79°00.906') (western-most point). The southern boundary ran northeastward from South Riding Rocks in the Biminis (25°13.784', 70°09.347'), through the tip of Bird Cay in the Berrys (25°23.423', 77°50.079'), through Southwest Point on Great Abaco (25°50.816', 77°13.119').

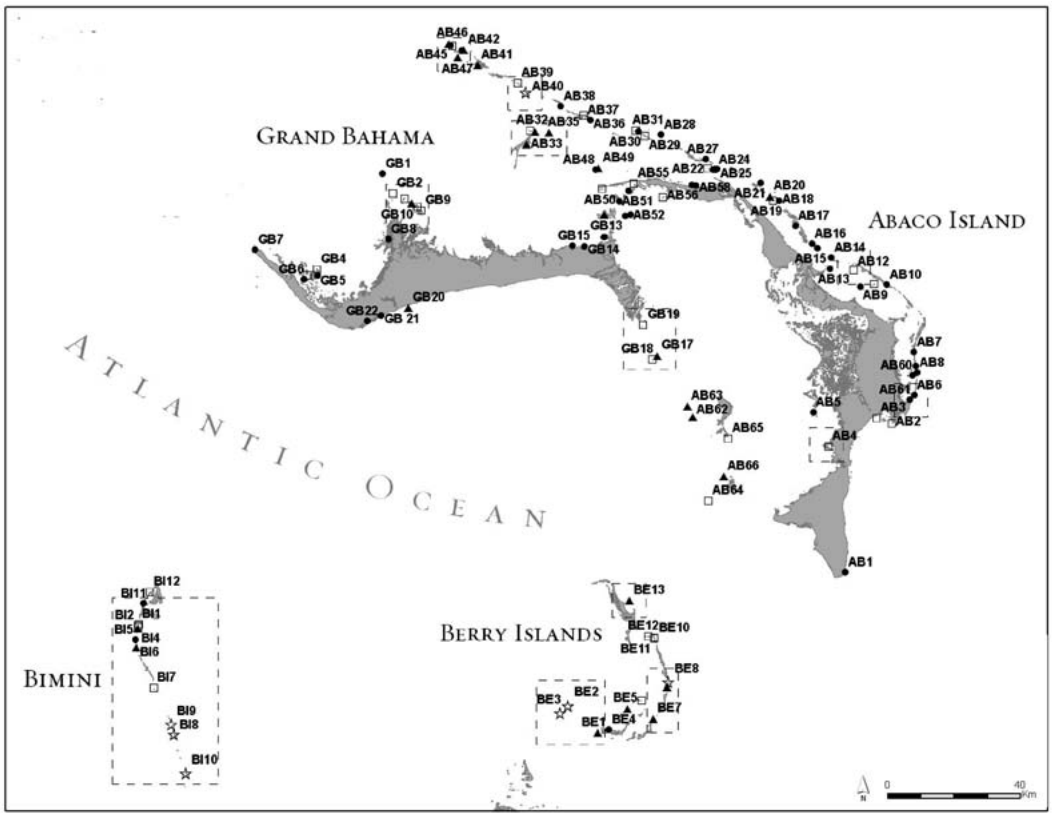

Figure 1. Map of the northern Bahamas, showing colony sites of seabirds and other colonial waterbirds. Colony size categories in number of nests of all species are: dot, <20; square, 20-99; triangle, 100-999; star, >999. Location of potential reserve areas encompassing important sites encompassed by dashed lines.

The geography of the northern Bahamas goes a long way toward explicating seabird nesting dispersion. The islands of The Bahamas emerge from shallow banks surrounded by abyssal ocean depths. The largest islands in the study area, Grand Bahama and Little/Great Abaco, form an arc on the Little Bahama Bank with their outer shores facing the open ocean and inner shores facing the Bank. Smaller islands (cays) occur off-shore of the larger islands. The Berrys and Biminis are island chains on Great Bahama Bank, occurring along the edge of the deep waters of the Northwest Providence Channel and Gulf Stream, respectively. The smaller cays provided most of the nesting sites. Shores exposed to intermittent high waves and strong currents are rocky and sparsely vegetated. Shores with more protection, depending on ambient conditions, are beach, mud, or mangrove-covered. On the Bank sides (north of Grand Bahama and southwest of Abaco), islands tend to be mangrove-covered. All these sites provide opportunities for nesting.

Within a few kilometers of the sea-facing nesting sites are deep oceanic waters, falling off to 300-500 m within a few kilometers of nesting islands. Along this zone sport fishermen habitually use foraging birds to find predatory sport fish. This phenomenon occurs close to shore in the northern Bahamas so typically coastally-bound terns, tropicbirds, and gulls join the off-shore seabirds forming diverse feeding aggregations. The bank-facing cays are surrounded by shallow tidal flats that provide foraging opportunities for wading and coastal species.

The larger islands (Grand Bahama and Great/Little Abaco) are well populated by towns, settlements, and individual holdings. Settlements also occur on smaller islands, including North and South Bimini, Cat Cay, Mores Island, Sweeting's Cay, Water Cay, Great Harbour, Grand Cay, Green Turtle Cay, Great Guana Cay, Man of War Cay and Elbow Cay. Several islands are well known as deep-sea sport fishing ports (North Bimini, Walker Cay, Frazier's Hog Cay = Chubb Cay. Others have been developed by cruise lines as holiday stopover locations (Little Stirrup Cay = Coco Cay, Gorda Cay = Castaway Island). Private homes have been built on smaller cays. The Abacos, Biminis, and Berrys are destinations for private cruising and sport fishing boats. Two marine parks have been set aside in the northern Bahamas, Peterson Cay near Grand Bahama and Abaco Land and Sea Park near Great Abaco.

METHODS

The study was conducted during 2002-2006. Due to the extensive area to be covered during a several-week peak of the annual nesting cycle, field work in each year

focused on different areas—the Berry Islands (2002), the Abacos (2003, 2004, 2005, 2006), Grand Bahama and the Biminis (2005).

Based on available information, terns were expected to arrive at their colony sites in late April, and lay eggs in late May and June. Seabird nesting was expected to be completed by late August. Frigatebirds, with their prolonged nesting cycle, were expected to be present at colonies throughout most of the year. Shearwaters were expected to begin nesting in February and March ending in June. Tropicbirds were expected to begin nesting in April and fledge young in July. Herons and ibises were expected to nest in summer, being completed by August. Based on this information, censuses were conducted during the peak of nesting period for most species, June. Additional observations were made in April for shearwaters and January for frigatebirds.

Colony sites were coded by number within island chain (AB1 = Abaco #1) and are identified by island name and coordinates. Names for the smaller islands in The Bahamas are somewhat unstable and where possible those used were taken from Lewis and Lewis (2004). Island locations do not always show accurately on charts. Coordinates given are based on GPS readings taken at the site. Every potential island site was observed as closely as possible from a boat or from land. In 2002, ground observations in the Berry Islands were supplemented by an aerial survey, but this proved of little added value.

Counts were made of nests and of birds. Data are given as number of nests. Because sites were visited during incubation and early chick-rearing when there was one adult bird in attendance per nest, counting the birds emerging from nest sites provided a nest estimate (Burger and Lawrence 2000). For sites visited more than once, the largest number of nests counted is reported. Tropicbird nests were counted as the number of birds observed attending holes (Wingate personal communication, Lee and Mackin 2006). Shearwater colonies were identified by the presence of dead young at the site, and nests were estimated by the number of apparently recently-used burrows (Burger and Lawrence 2000). The survey constituted a rapid assessment of the locations and approximate size of nesting colonies. The accuracy of the estimates was not determined. Data on number of nests estimated for each species at each colony site and the coordinates of each site are available from the Bahamas National Trust (P.O. Box N4105, The Retreat Gardens, Village Road, Nassau, Bahamas; bnt@bahamasnationaltrust.org). These are summarized in the present paper.

A principal goal of this study was to identify sites of importance to waterbirds in the northern Bahamas. Although such analysis is best done using the standard criteria for Important Bird Areas, the lack of data presently published on national or regional population sizes made this impossible. The data from the current study, for many species, is in excess of the previously published totals for the nation or, in some cases, the region. So for present purposes, it is sufficient to bring to attention sites that have some level of importance within the context of the northern Bahamas. Two criteria were used to identify sites of particular regional importance: those supporting 10% of the northern Bahamas population of the species (Criterion 1) and those supporting over 1,000 nests of all species present (Criterion 2).

RESULTS

Fauna

Nineteen species of seabirds and other waterbirds were confirmed to nest in the northern Bahamas (Table 1). Nine may be considered true seabirds including Audubon's Shearwaters (*Puffinus ilherminieri*), White-tailed Tropicbirds (*Phaethon lepturus*), Magnificent Frigatebirds (*Fregatta magnifi-*

Table 1. Number of nests and number of sites (in parentheses) of colonial waterbirds in the northern Bahamas.

Species	Berry Islands	Abaco Islands	Grand Bahama	Bimini Islands	Totals
Audubon's Shearwater	105 (4)				105 (4)
White-tailed Tropicbird	86 (5)				86 (5)
Brown Pelican	14 (1)				14 (1)
Double-crested Cormorant		341 (6)	231 (9)		572 (15)
Magnificent Frigatebird		48 (1)			48 (1)
White Ibis				12 (1)	12 (1)
Great Egret		1 (1)			1 (1)
Tricolored Heron			31 (4)	3 (1)	34 (5)
Reddish Egret			19 (5)	2 (1)	21 (6)
Green Heron			10 (3)		10 (3)
Black-crowned Night Heron			4 (2)		4 (2)
Laughing Gull	737 (6)	644 (28)	801 (7)	456 (8)	2638 (49)
Sandwich Tern				410 (30)	410 (30)
Royal Tern				109 (2)	109 (2)
Roseate Tern	390 (4)	330 (9)		155 (2)	875 (15)
Least Tern	18 (2)	218 (16)	44 (3)	22 (1)	302 (22)
Bridled Tern	1068 (9)	1575 (30)	161 (2)	1086 (10)	3890 (51)
Sooty Tern	3685 (5)	3555 (11)		3480 (3)	10720 (19)
Brown Noddy	700 (6)	429 (8)		182 (2)	1309 (16)

cens), Sandwich Terns (*Sterna sandvicensus*), Sooty Terns (*Sterna fuscata*), Roseate Terns (*Sterna dougalli*), Bridled Terns (*Sterna anaethetus*)), Brown Noddy (*Anous stolidus*), and Royal Terns (*Sterna maxima*). Inshore species included Brown Pelicans (*Pelecanus occidentalis*), Double-crested Cormorants (*Phalacrocorax auratus*), Laughing Gulls (*Larus atricilla*), and Least Terns (*Sterna antillarum*). Wading birds were White Ibis (*Eudocimus alba*), Great Egrets (*Ardea alba*), Tricolored Herons (*Egretta tricolor*), Reddish Egrets (*Egretta rufescens*), Green Herons (*Butorides virescens*), and Black-crowned Night Herons (*Nycticorax nycticorax*).

Sites

Seabirds and other colonially nesting waterbirds were found nesting at 113 sites (Fig. 1, Table 1). Bridled Terns and Laughing Gulls nested at the most sites, about 50 each. In contrast, Magnificent Frigatebirds, White Ibis, Brown Pelicans, and Great Egrets were found nesting at only one site each. Among the islands, the Abacos chain of islands by far supported the most nesting sites, 66. Grand Bahama (22), Berrys (13), and the Biminis (twelve) had fewer.

In the northern Bahamas, terns and shearwaters tended to nest on small islands adjacent to the ocean and on the Little Bahama Banks. Frigatebirds, cormorants, herons and ibises tended to nest on mangrove-covered islands on the bank side of the main island chains. Three species appeared to tolerate humans better than the rest. Least Terns nested in numerous small colonies on newly cleared sites on the main islands. Black-crowned Night Herons nested in bushes in backyards bordering canals. White-tailed Tropicbirds nested on cliffs, which while inaccessible, were sometimes quite near habitations. These three species excepted, nesting sites found in the present study were on small islands, offshore from the larger, inhabited islands. Many colony sites were situated on quite inaccessible sites either some distance across open water from a town, surrounded by exceptional shallow water, or high in or above cliffs. Birds often nested in or under cactus, agave, or other protective vegetation.

Populations

The census found 20,267 nests, thereby accounting for over 40,000 seabirds and other colonial waterbirds nesting in the northern Bahamas. The Sooty Tern was most abundant, with an estimated nesting population of over 10,000 pairs. The next most abundant were the Bridled Tern, over 3,800 pairs, Laughing Gull, over 2,600, and Brown Noddy, over 1,300. The Abacos had the highest combined nesting populations, with over 7,200 nests, principally Sooty and Bridled terns. The Berry Islands had over 6,500 nests and the Bimini Islands nearly 6,000 nests, most of which also were Sooty and Bridled terns. Nesting populations of Brown Pelicans, Magnificent Frigatebirds, White Ibis, and Royal Terns were small and localized.

Species

Audubon's Shearwaters nested at four sites in the western Abacos, three on islands near Walkers Cay (AB42, AB46, AB47) and another near Sale Cay (AB34).

White-tailed Tropicbirds were found nesting at five sites near the Abacos, totaling 86 nest sites (AB1, AB10, AB32, AB60, AB61). Little Sale Cay (AB32) was by far the most important site in the region.

Brown Pelicans nested at one site, on a tiny island locally known as Bush Cay, near the east end of Grand Bahama (GB19).

Double-crested Cormorants nested at 15 sites with total 562 nests. The largest colony of 250 nests was in mangroves on a point of Great Sale Cay (AB33). Other colonies ranged from two to 77 nests. Many more cormorants were observed around the area than were nesting.

Magnificent Frigatebirds were found at one site, on a small mangrove-covered island behind Cornwall Point in the Marls west of Great Abaco (AB4). This colony was visited three times, in June and January. The numbers of nests were the same each visit. Twenty-seven frigatebirds were also found roosting in mangroves in the center of Middle Cross Cay, north of Grand Bahama (GB13).

White Ibises were found to nest at one site, on a small island (called variously Sandy

Cay and Pigeon Cay) in the lagoon adjacent to the town harbor of North Bimini Island (BI11). Young of the year ibis were also observed in the southern Berry islands in 2002 and 2004, so nesting may be likely in this area.

A single Great Egret nest was found in the Abacos (AB54). Tricolored Herons were found at five sites. Reddish Egrets were found at six sites, with 19 nests of Reddish Egrets on the bank side of Grand Bahama Island. Green Herons were found at three sites. Black-crowned Night Herons were nesting at two sites.

Laughing Gulls were the third most abundant species, overall, with 2,638 nests at 52 sites. They were relatively evenly divided among areas. Gulls tended to nest in small numbers among terns or on beach ridges, although the largest colony was in the center of a rather extensive island. The largest colony was 400 nests, on Petit Cays in the Berrys (BE13). Other sites with more than 10% of the regional total were Turtle Rocks in the Biminis (BI4), Water Cay off the east end of Grand Bahama (GB17), and three Barracuda Swash Cays together on the banks north of Grand Bahama (GB10, GB11, GB12). Most colonies were smaller, median size being only 29 nests, and 17 sites had fewer than ten nests.

Sandwich Terns were found nesting at three sites in the Biminis, Holm and Beach Cays (B16, B18) being most important. There were 410 nests in total.

Royal Tern nests were at two sites, Holm and North Riding Rock (B16, B10) in the Biminis, totaling 109 nests.

Roseate Terns nested at 14 sites. A total of 875 nests were counted, the largest being 200 nests on Alder Cay in the Berrys (BE9). Other important sites were Little Whale Cay Rock in the Berrys (BE7) and Beach Cay in the Biminis (B18).

Least Tern nests were dispersed among 21 sites, totaling 308 nests. They were generally in colonies of ten to 20 nests. Only two sites had 30 nests (Spoil Bank and Old Yankee Cay in the Abacos (AB12, AB37). These terns typically nested on newly disturbed sites, either due to human activity or due to exposure on rocky-sandy shores.

The Bridled Tern was the second most abundant species and was much more dispersed in its nesting than was the Sooty Tern. Colony sizes varied, from a single nest to 630, with a median of only 20 nests per colony. Bridled Terns nested under rock ledges, in holes, or under dense vegetation. The only nest on one island was placed under a Styrofoam cooler lid. The Bridled Tern population was relatively evenly divided among areas, about 1,000-1,500 each in the Berrys, Biminis, and Abacos, with fewer around Grand Bahama. The most important sites were Bushes in the Berries (BE2), Rhoda Rocks in the Abacos (AB40), and North Riding Rock in the Biminis (BI10).

The Sooty Tern was the most abundant species, with 10,720 nests, at 22 sites. It also had the largest colonies, with one site exceeding 1,800 nests and four sites had more than 1,000 nests each. The median colony size was 400 nests. Sooty Terns in The Bahamas nested most commonly under the cover of dense dune vegetation, rather than in the open. Sooty Terns were rather evenly divided among areas. The most important sites were Bushes and Rum cays in the Berrys (BE2, BE3) and Brown's Cay and North Riding Rock in the Biminis (BI9, BI10).

Brown Noddy was the forth most common species, with 1,309 nests at 21 sites, mostly in the Berrys and Biminis. Noddies nested in or under trees or on the edges of cliffs. Important sites were Moma Rhoda Rock and Frozen Cay in the Berrys (BE1, BE8), Sale Cay Rocks and Rhoda Rocks in the Abacos (AB35, AB40), and Brown's Cay in the Biminis (BI9).

DISCUSSION

Fauna

Thirteen of the 16 seabirds known to nest in The Bahamas (White 1998, White and Lee 2000) were found nesting in the northern Bahamas. Documentation of nesting of three species was unexpected. This study found the first nesting of White Ibis in the Commonwealth of The Bahamas. It also found the first nesting of the Brown Pelican

for Grand Bahama and the first recent nesting for Magnificent Frigatebirds in the northern Bahamas.

Sites

Prior to this study, only about ten nesting sites had been reported from the northern Bahamas (based on maps in Schreiber and Lee 2000). The 113 breeding colonies documented in this study clearly far extends the number of sites previously published for the region, and, even for the nation as a whole.

Other than Least Terns, Black-crowned Night Herons, and White-tailed Tropicbirds, that colonies tended to be situated on small cays rather than on main islands suggested the importance of isolation from disturbance. Every indication is that present colonies of most species persist on the most isolated and least disturbed of the sites available to the birds. This observation is of some importance to conservation, as discussed beyond. An exception is the colony located on Peterson Cay, a national park, which receives visitors without apparent harm.

Three sites had been proposed by Carey *et al.* (2001) as potential nationally important bird areas for seabirds in the northern Bahamas. These are Peterson Cay off Grand Bahama for Bridled Terns, Hole-in-the-wall on Abaco for White-tailed Tropicbirds, and "cays north of Abaco" for White-tailed Tropicbirds. A reanalysis of important sites based on the results of the present study would result in a much larger list of sites. Interestingly, by most criteria, the three sites previously suggested no longer appear to be regionally critical to seabirds, although they may be important for other reasons. Table 2 lists 27 sites of special importance to colonial waterbirds and seabirds in the northern Bahamas. Their locations are shown in Figure 1. As discussed below, the locations of these sites can be used to suggest new protected areas.

Populations

There is no previous information for the northern Bahamas on wading bird populations or those of inshore species. For seabirds, chapter authors in Schreiber and Lee (2000) provided information for nesting numbers in The Bahamas as a whole. Few data were available from the northern Bahamas. The range of national population estimates of 13 of the species found in the present study was 8,670-13,526 pairs. The present study found 19,078 nests of these species, and so exceeded that previously known for the nation as a whole (which included few data from the study area). In fact for every species in this study, the data represent substantial increases in previously published national population totals.

Species

This study found four Audubon Shearwater colonies, a full understanding of the status, nesting timing, and annual cycle in the northern Bahamas requires additional documentation. Colonies were visited in April and June in different years. In both months it appeared that nesting was no longer underway and no currently active nest burrows were found. The rapid count of 105 apparently recently-used burrows likely underestimated the total nesting population. There may also be conservation implications of these observations, as further discussed below.

The five locations of White-tailed Tropicbird nesting increases the number of known sites in the northern Bahamas. They previously were known to nest at three sites on or near Great Abaco Island (White 1998, Lee and Walsh-McGehee 2000). Because of recent declines in the most important colony in the nation, conservation of this species is considered a priority (Lee and Mackin 2005).

Although occurring in the northern Bahamas year round, the nesting status of Brown Pelicans had been unclear. The nearest persistent colonies are in Florida and on Inagua Island in the southern Bahamas. Incidental breeding had been reported in the Berrys and Mayaguana (A. White, pers. comm.). The colony found in this study is the first definitive recent nesting record for the Grand Bahama area. Information from local fishermen indicate that the colony site has been active for a number of years.

Table 2. Potential protected areas in the northern Bahamas for nesting waterbirds, Colony location (island group, colony name and identification as in Fig. 1), and criteria.[a]

Area	Island Group	Colony	Criteria, Species
Chub Cay Area	Berrys	Moma Rhoda Rocks BE1 Rum Cay BE3 Bushes BE2	1 Brown Noddy 1 Sooty Tern, 2 1 Sooty Tern, Bridled Tern, 2
Frozen Cay Area	Berrys	Frozen Cay BE8 Alder Cay BE9 Little Whale Cay Rock BE7	1 Brown Noddy, 2 1 Roseate Tern 1 Roseate Tern
Petit Cay Area	Berrys	Petit Cay BE13	1 Laughing Gull
Cornwall Point	Abacos	Cornwall Point AB4	1 Magnificent Frigatebird
Spoil Bank Area	Abacos	Spoil Bank Cay AB12	1 Least Tern
Sale Cay Area	Abacos	Little Sale CayAB32 Great Sale Cay AB33 Channel Rocks AB34 Sale Cay Rocks AB35	1 White-tailed Tropicbirds 1 Double-crested Cormorant 1 Audubon's Shearwater 1 Brown Noddy
Rhoda Rocks Area	Abacos	Rhoda Rocks AB40	1 Brown Noddy, Bridled Tern, 2
Walker Cay Area	Abacos	Tea Table Cay AB46 Sit Down Cay Rocks AB47 Tom Brown Cay AB42	1 Audubon's Shearwater 1 Audubon's Shearwater 1 Audubon's Shearwater
Little Harbour	Abacos	Little Harbour AB61	1 White-tailed Tropicbird
Barracuda Cays Area	Grand Bahama	Barracuda Swash Cays GB10, GB11, GB12	1 Laughing Gull
East End Cays Area	Grand Bahama	Brush Cay GB19 Water Cay GB 17	1 Brown Pelican 1 Laughing Gull
Bimini Cays Area	Biminis	Sandy Cay BI11 South Turtle Rock BI4 Holm Cay BI6 Brown's Cay BI9 Beach Cay BI8 North Riding Rock BI10	1 White Ibis 1 Laughing Gull 1 Sandwich Tern 1 Sooty Tern, Brown Noddy, 2 1 Sandwich Tern, Roseate Tern, 2 1 Royal Tern, Bridled Tern, Sooty Tern, 2

[a]Criteria 1 = 10% or more of northern Bahamas population of a species; Criteria 2 = 1,000 or more nests of all species.

There is surprisingly limited information on nesting of Double-crested Cormorants in the northern Bahamas. Nesting was, in fact, thought to be relatively rare in the region (White 1989). This turns out not the case, given the study found nesting at 15 sites. The total numbers of cormorants in the area was much greater than those found nesting. The colonies were found and censused in the summer following a severe hurricane, which de-leafed and likely killed many thousand hectares of mangrove forest. Most sites had few birds and many failed nests and these were barely secured in the dead and broken branches of storm-killed mangrove trees. It seems likely that in other years, the nesting population may be larger than found in this study.

The Magnificent Frigatebird nested off Great Abaco in the 1950s but had not been known since (Lindsay *et al.* 2000). Thus, the colony found in this census is the first documentation of nesting for the northern Bahamas in fifty years. It would be of value to further study the dispersion of the birds from this colony to determine how far they range, which may include much of the northern Bahamas and perhaps Florida.

The White Ibis nesting found in this study was the first for The Bahamas. However, young ibis were observed elsewhere, particularly on and near Frazer's Hog Cay and Bird Cay in the Berry Islands. It seems probable that the species nests elsewhere in the northern Bahamas as well. This is the most numerous wading bird in nearby Flori-

da and is common within developed areas on the Florida coast. There seems no reason why the species should not be increasing and expanding its range in the Bahamas.

Few nests of herons were found. Great Egret, Tricolored Heron, Reddish Egret, Green Heron, Black-crowned Night Heron were documented as nesting species in the area. There were undoubtedly heron nests that were not found, as small colonies can be readily overlooked. The number of nests of Reddish Egret near Grand Bahama makes this an important area for the species as a whole in that its status within the Caribbean is so little understood. Black-crowned Night Herons were well acclimated to people, nesting along residential canals.

The published Laughing Gull population of The Bahamas as a whole was 50-100 pairs with no sites known in the northern Bahamas (Chardine *et al.* 2000b). This study, substantially increases nesting numbers of these species. Laughing Gulls were well dispersed among the islands, nesting in surprisingly small concentrations. They were most common around populated areas, nesting on smaller protected sites.

The Sandwich Tern population of The Bahamas as a whole was estimated to be 900-1,050 pairs and has been reported nesting on the Great Bahama Bank, a July 1977 survey finding 400 pairs (Norton 2000). This study accounts for a substantial portion of the known country total.

The Royal Tern has been documented to breed in scattered locations in the Bahamas, with a country total of 158-221 pairs (Chardine *et al.* 2000b). This study accounts for nearly the previously known country total.

The status of the Roseate Tern in The Bahamas has been poorly known, with 100-200 estimated pairs for the country (Saliva 2000a). The results of this study found four times as many at 14 sites, revising substantially understanding of the status and distribution of this species in the Bahamas.

Least Terns are known to be a local and common breeder in The Bahamas, but the previous country totals were 302-430 pairs with no records of nesting reported from the northern Bahamas (Jackson 2000). The study found about this number well dispersed throughout the northern Bahamas alone.

The Bridled Tern was known to nest at about 20 sites in The Bahamas, with numbers of pairs thought to be about 1,000 for the country as whole, and the total for the West Indies was thought to be 4,000-6,000 pairs (Chardine *et al.* 2000b). The numbers found in the northern Bahamas are nearly equal the previous West Indies-wide totals. A tendency to nest in many small colonies (or even individually) was borne out in this investigation. Their nests are well hidden in holes and under ledges in the rocks.

Not unexpectedly, the Sooty Tern has the largest population in the study area. The best prior published estimate was 4,000-8,000 pairs at 20+ sites in The Bahamas as a whole (Saliva 2000b). This study found more nests and more sites in northern Bahamas alone. The median colony size was quite small for a species, which nests in huge numbers elsewhere. Sooty Terns in the northern Bahamas appear nest in smaller more scattered colonies than in other regions.

An estimated 600-800 pairs of Brown Noddies are reported to nest in The Bahamas (Chardine *et al.* 2000a). It is clear now that this was an underestimate.

Conservation Opportunities

Many threats to seabirds have been recognized in the West Indies (Schreiber and Lee 2000; White and Lee 2000; Carey *et al.* 2001; Hayes 2003). Some of these region-wide threats are evident in the northern Bahamas. However, many opportunities for conservation also exist.

Hunting appears to be one such threat. Seabirds have been a food source for humans in The Bahamas since prehistory. Colloquially, Sooty and Bridled terns are still called egg-birds. It is illegal in the Bahamas to take eggs and young of seabirds, but observations made during this study suggest that this custom does continue. One site, Sandy Cay (AB41) near Grand Cay in the Abacos, very likely had been egged prior to the census. Shearwater nestlings (locally

called Pimlicos) are also traditionally taken from their burrows to be eaten. In both April and June in two nesting years only dead birds were found at the colony sites, which were readily accessible (including to the settlement on Grand Cay). As it seems unlikely (although possible) that the colonies failed naturally two years in a row, one possible explanation for the observation is that these sites had been hunted, a possibility that deserves further study.

Protecting colony sites is the key to waterbird conservation in the northern Bahamas. The large number of colony sites discovered in this study provides both challenges and opportunities. While each colony is of value, the most important colonies number only 27 (Table 2). The Bahamas has a notable system of national parks, Land and Sea Parks, managed by the Bahamas National Trust. Many of the important seabird and waterbird nesting sites found in this study can be collected into twelve areas of manageable size and configuration (Fig. 1). There is limited or no development on most of these nesting islands, and many are remote from settlements. There would seem to be few conflicts with current usage in establishing such reserves. Reserves would increase the protection of the nests and sites and also may provide touristic opportunities for the local communities.

Two such parks now exist in the northern Bahamas, one each on Grand Bahama and Great Abaco, experiences at which can provide guidance for future management of seabird sites within Bahaman parks. Near Grand Bahama, Peterson Cay is no longer one of the largest colony sites but the park still provides an excellent destination for nature tours and opportunity for environmental education. It is well posted with warning and explanatory signage and is visited by wardens from the Bahamas National Trust and local guides and their tourists. Terns continue to nest there in numbers even as visitors use the beach and picnic area. These observations suggest that management approaches are in operation in the northern Bahamas that succeed in allowing both conservation and public usage of nesting islands. The second park, the Abaco Land and Sea Park, has few nesting seabirds although it does protect apparently suitable islands as well as important underwater features. It might be that the lack of nesting birds is due to repeated human disturbance of the islands along with, perhaps, limited enforcement of terrestrial protections. If landings on the islands were discouraged or managed as they are on Peterson Cay, it is possible more birds might nest on islands in the park.

Outreach and education are critical components of conserving colony sites in the northern Bahamas. The use of Peterson Cay for nature tourism is an example of how protected colony sites can provide educational opportunities. All sites can be reached by boat, some readily so, and recreational boating and fishing and various sorts of commercial fishing are extensive in the area making the sites vulnerable to unsupervised landings. Observations of casual visitors disturbing colonies were not uncommon during the study, including anchoring nearby, using beaches, walking through ground nesting sites, allowing dogs into colonies, and even children gathering eggs for play. Such disturbance can only increase as development advances along the coasts. Where possible, the location, importance and expected conservation measures for colonies could be made known to children, and to the adult populace, through present and future education and publicity programs, accessible sites could be posted with educational signage, and volunteer wardens could be recruited to watch over them. It is likely that most residents and tourists would respond well to receiving such information.

Although protecting and publicizing important nesting sites within a matrix of properly managed parks is certainly the most assured way to provide conservation for these nesting populations, the role of private engagement in seabird conservation should not be overlooked. Nongovernmental conservation organizations, support of the fishing community and local settlements, and private ownership can also be important tools. On Grand Bahama and Great Abaco, particularly, opportunity exists for existing

local conservation groups to adopt colony sites, posting important islands with informative markers, controlling landing in the nesting season, and providing periodic monitoring data to a central national data base. Observations and interviews made during study showed that yachtsmen, sailors, and sport fishermen visiting the northern Bahamas have a concern for the natural environment and many already appreciate the seabirds. Information gathered during this study suggests they are willing to provide both direct and logistic support for seabird bird conservation if asked and organized, as could be done by local conservation groups. Local community ownership of water bird conservation action will be increasingly needed in the northern Bahamas, rooted in programs that provide environmental education of children and outreach to citizens, part-time residents, and tourists.

One of the most critical issues for seabird nesting in the northern Bahamas is the potential of their colony sites being converted to commercial and residential use. Islands small and large are being developed for homes and resorts throughout The Bahamas. While most of the islands supporting bird colonies are too small for full-scale development, some can support one or a few houses or marinas and certainly attract day use of the increasing boat-using public. In general, preventing development of colony islands is crucial. However, some important islands, such Frozen/Alder Cays, are privately owned and because of that fact are well protected, except perhaps from domestic pets. This example suggests that successful private management of critical sites may be a possibility, provided appropriate guidances are followed by owners and managers. Enacting agreements between wildlife and parks authorities and owners regarding the management of these sites might offer a degree of protection.

Seabirds are a well appreciated cultural legacy in the Bahamas. Both local residents and many boat-oriented visitors know, appreciate and use them. The use of terns, gulls, and shearwaters to signal the location of sport and commercial fish is a critical tool of the economically and culturally important fishing industry: home fishing by island residents, sport fishing by visitors, and commercial harvest. Seldom is a magazine article on Bahaman deep water sport fishing written that does not describe how to use seabirds to find sport fish. It is not far fetched to suggest that without these birds, the ability to catch sport fish would be severely reduced, to the serious economic detriment of the islands. Conserving such a valuable resource would likely readily gain support among local people, nongovernmental organizations, the government, and visitors.

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