

Can San Salvador's Iguanas and Seabirds Be Saved?

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San Salvador Island's remoteness and isolation have created a haven for many animals that have declined or vanished elsewhere in the Bahamas. Even so, the impacts by humans have been severe. Today, the island looks very different from what Christopher Columbus saw in 1492 when he first stepped onto its fine white beaches. The huge trees, dragon-like iguanas, and vast flocks of parrots and seabirds, all of which the Lucayan Indians relied on for sustenance, greatly impressed Columbus. However, the parrots and Lucayans disappeared soon afterward. Following the American Revolution, loyalist plantation-owners felled the majestic trees to raise cotton, an endeavor that eventually was abandoned. Fossil remains indicate that tortoises and crocodiles once roamed the landscape as well (Olson et al., 1990), though their disappearance may have predated Columbus and perhaps even the arrival of Indians roughly 2,000 years ago. Sadly, only the iguanas and seabirds now remain—and these, too, could easily suffer the same fate.

I have been privileged to study San Salvador's iguanas and seabirds for more than a decade. My collaborators and I have grown increasingly worried about what the future holds for them. Called by some "The Forgotten Island," San Salvador remains relatively pristine and undeveloped. However, whether we like it or not, the island's fragile ecosystems will come under increasing pressure as development inevitably brings more residents, tourists, construction, pollution, and exotic species to the island. If the iguanas and seabirds are to persist, we must learn more about them and seek ways to protect the habitats and resources critical for their survival.

San Salvador Rock Iguana (*Cyclura rileyi rileyi*)

We know from the fossil record that the main island of San Salvador formerly teemed with iguanas. As the largest terrestrial vertebrates in the Bahamas, iguanas contribute to the uniqueness and health of Bahamian ecosystems. As vegetarians, they distribute the seeds of plants in their feces, and the

fecal material actually increases the viability of seeds and seedlings.

Iguanas are found elsewhere in the Bahamas (Figure 1), but those on San Salvador are unique. They have no other home in the world. Sadly, their decline has been staggering. At present, fewer than 600 iguanas likely remain, and these are now restricted to a mere fraction (0.2%) of their former range (Hayes et al., 1995, 2004). They are essentially confined to the most remote and inaccessible places available: four tiny offshore cays and two small islets within the hypersaline lakes (31.5 ha total; Figure 2). A few individuals are still encountered rarely on the main island (163 km²), but no viable population remains. Three populations have become extirpated in recent decades (Barn Cay in the 1970's, and High Cay and Gaulin Cay in the 1990's). Since 1993, when we first began to study these populations, we have documented declines on other cays as well.

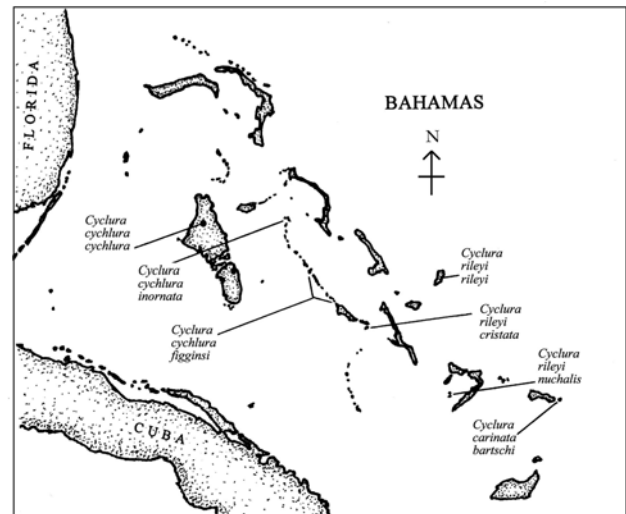


Figure 1. Distribution of *Cyclura* in the Bahamas, including the three subspecies of *C. cychlura* (Andros, northern Exumas, southern Exumas) and the three subspecies of *C. rileyi* (southern Exumas, San Salvador Island, Acklins Bight). *Cyclura carinata bartschi* exists only on Booby Cay off of Mayaguana Island, Bahamas; the second subspecies of *C. carinata* occurs in the Turks and Caicos Islands to the south.

A number of threats make continued survival of the iguanas tenuous (Hayes et al., 1995, 2004). They are especially vulnerable to feral animals, including cats, dogs, and rats. For this reason, the iguanas may never be able to re-colonize the main island. Some of the remaining populations coexist with rats, and others have suffered vegetation damage from recent catastrophic storms and the larvae of an introduced, cactus-eating moth (*Cactoblastis cactorum*). Rising sea levels threaten to inundate the lower-elevation cays. Disease could be catastrophic because of the small populations and limited genetic diversity. In spite of strict protection by CITES (Convention on the International Trade in Endangered Species) and Bahamian law, humans still remove some of the iguanas. Two smugglers are presently in a United States jail for having done so!

These unique and majestic lizards (Figures 3-4) still have a chance to survive. Based on more than a decade of research, we have a much clearer picture of their ecological requirements (Carter and Hayes, 2004; Hayes et al., 1995, 2004). Though our time and funds are severely constrained, we are working to safeguard and improve remaining

habitats. We hope to eventually create new populations. Through an outreach program (Carter et al., 2003), we have brought their fragile existence to the attention of San Salvadorans, who are eager to see the iguanas thrive and hopefully increase in numbers. However, we are greatly concerned by the threat of further development. Increased visitation by humans, their pets, or unintended stowaways (e.g., rats, fire ants, non-native plants) will spell certain doom.

The most critical populations to protect include Green Cay (Graham's Harbor) and Goulding Cay (Green's Bay); collectively, these islands harbor nearly two-thirds of the remaining iguanas. Because the iguanas on Low Cay attain the largest size and produce the largest clutches of eggs, they warrant protection as well. Unfortunately, only two populations (Green Cay and Pigeon Cay) appear to be on Crown Land; these would be the easiest to protect from future development.

San Salvador's Seabirds

Because of the island's relatively pristine state, the seabirds of San Salvador are absolutely spectacular. The offshore cays, main island bluffs, and interior lakes support some of the largest breeding colonies of seabirds to be found in the Bahamas (Table 2). Remarkably, San Salvador hosts 14 (82%) of the 17 seabird species that breed in the Bahamas (some are pictured in Figures 5-11). This number does not include a pair of masked boobies that I observed courting but could not confirm nesting in 1998. The number of seabird species breeding here exceeds that of any other locality in the Bahamas (White and Lee, 2001). Eight of these species are of special concern because of declining numbers in the West Indies region and their vulnerability to extinction (White and Lee, 2001). For some species, such as Audubon's shearwater and double-crested cormorant, a substantial fraction of the entire West Indies population breeds on San Salvador Island.

The fragility of San Salvador's seabird populations can be better appreciated from a broader perspective. Globally, seabirds are declining at an alarming rate (Schreiber and Lee, 2000). Approximately 20% of the world's seabird species are threatened by extinction. The loss of seabirds on tropical islands due to human disturbance has been estimated at a staggering 90 to 99%. Several life history attributes render seabirds especially vulnerable. These include nesting in high density at few sites, small clutch sizes, prolonged nest occupancy because of slow chick growth, and slow maturation. As a consequence, seabirds are slow to

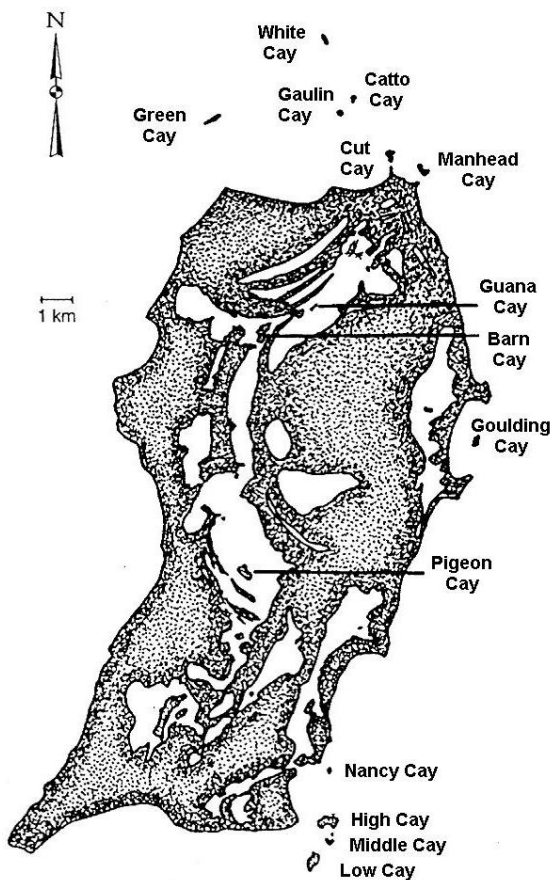


Figure 2. San Salvador Island and its associated cays.

Table 1. Population estimates (N) for San Salvador Island iguanas (*Cyclura rileyi rileyi*), with their present status and identified threats (data from 1993-2003).

<u>Cay</u>	<u>N</u>	<u>Status & Identified Threats</u>
Goulding	116-174	Stable; no known threats
Green	130-195	Declining; hurricane damage, cactus die-off, smuggling by humans
Guana	30-45	Increasing; recovery from mortality event in 1994, rats present
Low	42-63	Declining; low survival of juveniles to adults, cactus die-off, rats present
Manhead	38-57	Stable or declining; cactus die-off
Pigeon	70-105	Stable or declining; hurricane damage, rising water levels, rats present
Total:	426-639	Decline continues

recover from population declines. Increased development of coastal sites exacerbates the primary threats, which include habitat destruction, colony disturbance, exotic predators, pollution, and egg collecting. The diversity and sheer number of seabirds nesting in the Bahamas exceed that of any other nation in the West Indies region. Nevertheless, while San Salvador’s populations appear to be healthy, dramatic declines have been documented in other regions of the Bahamas (White and Lee, 2001).

By virtue of their high vagility, the Bahamas’ wealth of seabirds is truly an international resource. Outside their breeding season, a number of species disperse great distances, some as far as Africa. Conversely, many seabirds that breed elsewhere migrate through or forage seasonally in Bahamian waters. Clearly, healthy foraging and nesting sites within the Bahamas are critical for the survival of many seabird species.

Seabird conservation may not be as simple as one might think. The most obvious resource to protect would be existing nesting sites.



Figure 3. With its often exquisite coloration, the San Salvador rock iguana, *Cyclura rileyi rileyi*, is among the smallest (usually under 1 m) and most photogenic of the eight species of rock iguana in the West Indies.

Unfortunately, seabirds frequently colonize coastal habitats that are prized by humans for their real estate or recreational value. Though much less well understood, productive foraging sites are also critical for survival. Some species forage far out to sea, whereas others rely on coastal wetlands. Coastal development and pollution disrupt natural processes and damage important marine nurseries that may be critical for early development of both near-shore and pelagic prey species. Impacts may extend far beyond coastal wetlands, and threaten not only the seabirds but also marine-related economies. Numerous examples, often involving massive population losses, illustrate the consequences of failure to provide adequate protection for seabirds and their habitats (e.g., Steadman, 1997; Schreiber and Lee, 2000; White and Lee, 2001).

A number of critical areas must be protected if San Salvador’s seabirds are to persist. Most important, Graham’s Harbor and its offshore cays (Catto, Gaulin, Green, and White Cays) presently support the largest colonies (Table 3, Figure 2). More than a thousand pairs of ten species nest each year on these cays and on the main island bluffs. The eelgrass beds and coral reefs provide a rich nursery for sustaining their prey. Also important are Pigeon Cay in Great Lake and the adjacent islets to the immediate southeast (Table 3, Figure 2). These support large colonies of double-crested cormorants, laughing gulls, and three or more heron species that thrive on the small fish inhabiting Great Lake. High, Middle, and Low Cays, at the mouth of Pigeon Creek, also support seabird colonies (Table 3, Figure 2), though the largest colonies (sooty terns and brown noddies) have disappeared from here in recent years. Pigeon Creek itself provides a vital nursery for prey species. Finally, bluffs on the main island shoreline provide nesting burrows for Audubon’s shearwaters and white-tailed tropicbirds. Ideally, further development should be prohibited on any rocky shoreline.

Table 2. Estimated populations of seabirds inhabiting San Salvador Island (data from 1993-2003). Asterisks indicate priority species that warrant protection because of threatened status in the West Indies. See Raffaele et al. (1998) for scientific names.

<u>Species</u>	<u>Pairs</u>	<u>Locations</u>
*Audubon's Shearwater	200	Main island bluffs; 9 offshore cays
*White-tailed Tropicbird	100	Main island bluffs
*Magnificent Frigatebird	33	2 offshore cays
*Brown Booby	200	2 offshore cays
*Red-footed Booby	2	2 offshore cays (recent colonization)
*Double-crested Cormorant	110	Pigeon Cay area of inland lake
Laughing Gull	260	Pigeon Cay area of inland lake
Brown Noddy	400	5 offshore cays
Gull-billed Tern	5	Inland lakes (scattered sites)
Royal Tern	10	4 offshore cays (change sites often)
*Roseate Tern	50	5 offshore cays (change sites often)
*Bridled Tern	70	8 offshore cays
Sooty Tern	500	5 offshore cays
Least Tern	100	1 offshore cay; inland lakes
14 species total	2040	

Protection is Urgently Needed

At the moment, there is considerable talk of imminent, large-scale development on San Salvador Island. Among the more alarming elements being proposed would be constructing a marina in Graham's Harbor and opening the hypersaline waters of Storr's Lake (just west of Goulding Cay, Figure 2) to the ocean.

A marina situated in Graham's Harbor would be potentially disastrous to both the iguanas and seabirds. Boat traffic and small watercraft (such as jet-skis and sailboards) would increase substantially. Inevitable fuel and oil spills would kill not only seabirds that come into contact with the pollutants, but also their prey. Eutrophication (nutrient increase) and consequent algal blooms would upset the balance of local marine ecosystems. Rats would proliferate and more likely reach the offshore cays, where they would exterminate the seabird colonies within a few years. The bright lights at night would confuse shearwaters nesting on nearby bluffs, causing mortality. Collectively, these risks will be too much for the iguanas and seabirds to endure. History tells us that they won't survive.

Opening the stagnant, hypersaline waters of Storr's lake to the ocean would potentially jeopardize local marine ecosystems. The tremendous silt load moving into the sea might kill the coral reefs, wrecking havoc not only for local fisheries but also for the seabirds. Developers would want to deepen Storr's lake for boat traffic, creating unacceptable environmental risks similar to those described for Graham's Harbor. San Salvador's reefs have already suffered from the recent debacle of an ill-planned

marina that destroyed a mangrove swamp and broke into an underground aquifer. History has a knack for repeating itself when we fail to learn hard-earned lessons.

In recent years, a number of independent groups have recognized the importance of protecting San Salvador's unique reptiles and birds. Clearly, the best protection possible would result from establishing a National Park. To me, it seems amiss that there is no National Park to protect a critically endangered iguana and the most impressive assemblage of nesting seabirds to be found anywhere in the Bahamas.



Figure 4. *Cyclura rileyi* on Green Cay.

The desire and commitment of the Bahamas National Trust to protect critical habitats on San Salvador Island were expressed as early as 1983 in a document submitted to the Bahamas government (S. Buckner, pers. comm.). More recently, the Iguana Specialist Group (ISG) of the World Conservation Union (IUCN) held an iguana and seabird workshop on San Salvador Island in November 2000. In the document they produced and submitted to the Bahamas government, they ranked Graham's Harbor of San Salvador Island as the highest priority site for conservation of the 31 sites considered (Carey et al., 2001).

Now that large-scale development seems imminent, what can be done to put these recommendations into action? I suggest procuring

four units to establish a new National Park. First and most important, protecting Graham's Harbor within a National Park seems remarkably simple. All of the cays in Graham's Harbor are Crown Land. Presently, the only development on the shoreline of Graham's Harbor is the Gerace Research Center, which utilizes the Harbor and its cays as a natural laboratory for thousands of visiting scientists and students. This unit would protect the largest remaining iguana population (Green Cay), the largest and most diverse seabird colonies (Catto, Gaulin, Green, and White Cays), and the extensive eelgrass beds and coral reefs that serve as important marine nurseries. It would also block construction of a marina in such a sensitive environment. A second unit comprised of Pigeon Cay and the other small islets nearby (all of which are Crown Land) would protect yet another

Table 3. Descriptive details for seabird colonies on San Salvador Island (data from 1993-2003). Because some species shift nesting sites from year to year, some cays do not have all listed species present each year. See Raffaele et al. (1998) for scientific names.

<u>Site (location, size)</u>	<u>Species</u>	<u>Remarks</u>
Catto Cay (Graham's Harbour, 2 ha)	AUSH, MAFR, BRBO, RFBO, BRNO, ROYT, ROST, BRTE, SOTE	ROYT, ROST colonies irregular; MAFR, RFBO recent nesters
Gaulin Cay (Graham's Harbour, 2 ha)	AUSH, BRNO, ROST, BRTE, SOTE	ROST colonies irregular
Green Cay (Graham's Harbour, 5 ha)	AUSH, BRNO, ROST, BRTE, SOTE	BRNO, ROST, SOTE colonies irregular; tricolored heron colony also present
White Cay (Graham's Harbour, 4 ha)	MAFR, BRBO, RFBO, BRNO, ROYT, BRTE, SOTE	ROYT colony irregular; most species shifting to Catto Cay because of vegetation loss from recent hurricanes
Cut Cay (Snow Bay, 3 ha)	AUSH (BRTE?)	BRTE suspected nesting
Manhead Cay (Snow Bay, 3 ha)	AUSH, BRTE	Green heron and yellow-crowned night heron also nest
Goulding Cay (Green Bay, 3 ha)	AUSH, BRTE	
High Cay (Pigeon Creek, 13 ha)	AUSH, ROST, LETE	ROST, LETE colonies irregular
Low Cay (Pigeon Creek, 11 ha)	AUSH, BRTE	BRTE colony irregular
Low Rock (Pigeon Creek, <1 ha)	ROYT, ROST, BRTE	ROYT, ROST colonies irregular
Middle Cay (Pigeon Creek, 3 ha)	BRNO, SOTE (others?)	Large tern colonies present 1993-1995 now gone
Nancy Cay (Pigeon Creek, 1 ha)	AUSH	
Pigeon Cay area (Great Lake)	DCCO, LAGU	Tricolored herons, green herons, reddish egrets nest; possibly great blue herons and little blue herons
Scattered areas (Great Lake)	GBTE, LETE	Small colonies on scattered sandbars
Main island bluffs	AUSH, WTTR	Large colonies on bluffs along north, east, and south shores

Abbreviations: Audubon's shearwater (AUSH), white-tailed tropicbird (WTTR), magnificent frigatebird (MAFR), brown booby (BRBO), red-footed booby (RFBO), double-crested cormorant (DCCO), laughing gull (LAGU), brown noddy (BRNO), gull-billed tern (GBTE), royal tern (ROYT), roseate tern (ROST), bridled tern (BRTE), sooty tern (SOTE), least tern (LETE).



Figure 5. Audubon's Shearwater.



Figure 6. Bridled Tern perched.



Figure 7. Brown Booby pair.



Figure 8. Brown Noddy on nest.



Figure 9. Double-crested Cormorants.



Figure 10. Roseate Tern.



Figure 11. Sooty Tern on egg

iguana population and the large colonies of cormorants, gulls, and herons that nest in Great Lake. A third unit comprised of Pigeon Creek and the waters surrounding the cays just offshore (Low, Middle, and High Cays) would protect yet another important nursery area. Unfortunately, the cays themselves are privately owned, but the seabirds and iguanas would benefit nevertheless. Finally, a fourth unit comprised of Green's Bay would protect another major iguana population on Goulding Cay (privately owned), the rocky shoreline that supports shearwaters and tropicbirds (at the peninsulas creating the bay), and the reefs that would be damaged by sediment infusion from Storrs Lake if opened to the sea.

Creation of a new National Park on San Salvador Island would benefit far more than just the iguanas and seabirds. Tangible benefits would accrue for humans as well as other flora and fauna. But a National Park will be insufficient to secure the future of the iguanas and seabirds. Additional management policies will need to be put in action, including many of the recommendations already put forth by Carter and Hayes (2004) for iguanas and by White and Lee (2001) for seabirds. Importantly, these authors remind us that San Salvador's iguanas and seabirds *can* be saved if Bahamians are willing to take ownership of these unique treasures and the necessary steps to ensure their survival.

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