

Conservation of the herpetofauna on the Dutch Windward Islands: St. Eustatius, Saba, and St. Maarten

Robert Powell

Department of Biology, Avila University, Kansas City, MO 64145, USA
e-mail: robert.powell@avila.edu

Abstract. The Dutch Windward Islands (St. Eustatius, Saba, St. Maarten) support a collective herpetofauna consisting of two frogs (both introduced), six turtles (one introduced, one of uncertain origin, and four sea turtles, of which three are known to nest in the islands), 15 or 16 lizards (depending on whether the iguanas of Saba are a species distinct from *Iguana iguana*), and three snakes (one introduced). Although politically united, the islands are distinct biogeographic entities and binary similarity indices for the herpetofauna are 0.38 for St. Eustatius/Saba, 0.35 for St. Eustatius/St. Maarten, and 0.20 for Saba/St. Maarten (with values varying only little when the introduced species are included). Only three species, *Eleutherodactylus johnstonei*, *Hemidactylus mabouia*, and *Thecadactylus rapicauda*, are found on all three islands. Species given formal recognition as being in need of protection include the sea turtles (listed in CITES appendices and the IUCN Redlist), *Geochelone carbonaria* (CITES), *Iguana delicatissima* (CITES and IUCN), *Iguana iguana* (CITES), and two species of *Alsophis* (IUCN). Other species of conservation concern include two species of *Ameiva*, both of which are restricted to areas of considerable human activity on islands where mongooses (*Herpestes javanicus*) are established, and *Mabuya* sp., which may be extirpated on St. Maarten. Three factors largely responsible for the status of these species are: (1) large size and economic value (turtles and iguanas), (2) persecution by people who fear them (snakes), and (3) diurnally active, terrestrial, and vulnerable to predation by mongooses (snakes, *Ameiva*, *Mabuya*). Non-governmental organizations on each island are largely responsible for conservation and related educational efforts. Specific recommendations for each island are listed.

Key words: Amphibians; conservation; Dutch Windward Islands; reptiles.

Introduction

Although part of a political entity (the Netherlands Antilles, which also includes Bonaire and Curaçao, two of the three “Leeward Islands”) and geographically proximate, each of the Dutch Windwards is a distinct biogeographic element (Powell et al., 2005; fig. 1). St. Eustatius (Statia) is part of the St. Christopher (St. Kitts) Bank, which also includes St. Christopher and Nevis. Saba is an isolated

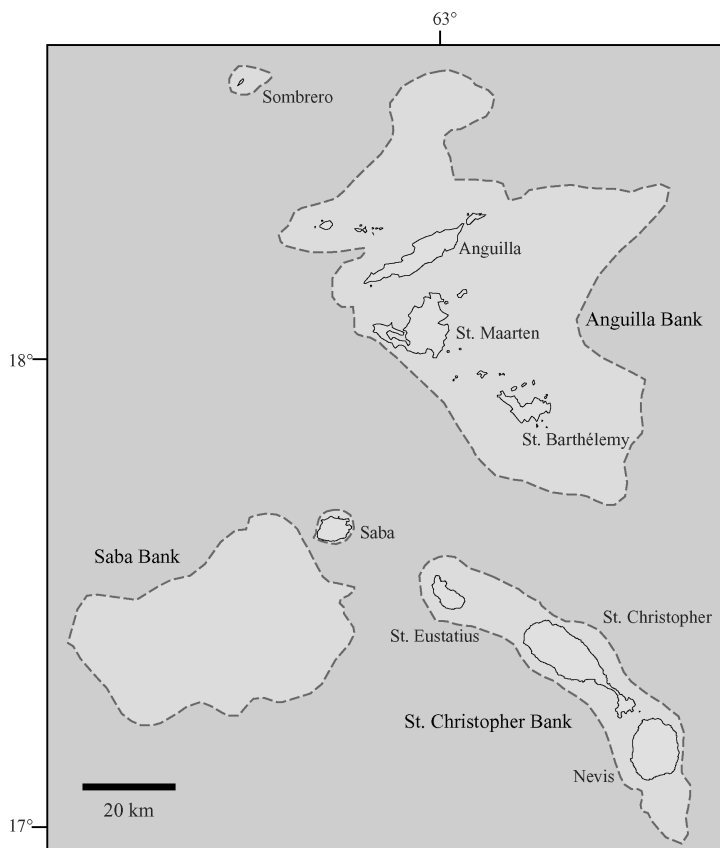


Figure 1. An overview of the island banks in the northern Lesser Antilles (from Powell et al., 2005).

seamount volcano separated from the nearby Saba Bank. St. Maarten not only shares an island with St.-Martin, an overseas department of France, but is part of the Anguilla Bank, which includes Anguilla, St.-Barthélemy, and satellites. In addition, islands of the Anguilla Bank are part of the “Limestone Caribees,” also called the outer-arc islands of the Lesser Antilles. These very old islands, originally of volcanic origin, have weathered considerably and have been submerged during periods of high ocean levels. Consequently, limestone deposits of marine origin cover the volcanic core. The Limestone Caribees, due to erosion by wind and water, also lack substantial elevations. The highest peak on St. Maarten/St. Martin is Pic Paradis, with an elevation of about 400 m asl (above sea level). In stark contrast, Saba and the islands of the St. Kitts Bank (which includes St. Eustatius) belong to the “Volcanic Caribees,” also called the inner-arc islands. These much more recently formed islands are characterized by active or dormant volcanoes, substrates of volcanic origin, and substantial elevations. The highest peak on Saba is Mount Scenery (870 m a.s.l.) and the Quill on St. Eustatius is slightly over 600 m a.s.l. The greater elevations function to “snag” clouds, which results in mesic conditions,

especially near the tops of peaks and on the higher slopes, and a much greater differential in precipitation with drier lowlands than on the lower outer-arc islands that are more uniformly xeric.

The Herpetofauna of the Islands

The herpetofauna of the three islands consists of two amphibians (both frogs and both presumably introduced, at least one by human agency), 15 or 16 lizards (depending on whether or not the green iguana of Saba is a species distinct from *Iguana iguana*; see discussion in Powell et al., 2005), three snakes (one introduced), and two turtles (at least one introduced), plus three species of sea turtles known to nest in the islands and a fourth that is sometimes seen in surrounding waters (table 1). In addition, strays (populations of species not known to have established breeding populations), all on St. Maarten (Powell et al., 1992, 2005), include two species (*Anolis bimaculatus* and *Alsophis rufiventris*) native to other Dutch islands and at least five exotic species of snakes (only two of which are listed in the table because the others represent isolated incidents and are very unlikely to establish self-perpetuating populations). St. Maarten is plagued by introduced exotics to a much greater extent than either Statia or Saba, a situation reflecting that island's larger size, larger and more transient human population, and the island's status as a regional shipping center serving the pet trade.

Binary indices of similarity (Krebs, 1989) comparing the herpetofaunas of the three islands (Powell et al., 2005; table 2) emphasize the differences that exist despite the islands' geographic proximity to one another. The greater similarity between St. Eustatius and Saba compared to that for either island and St. Maarten undoubtedly reflects the fact that prevailing currents in the region would facilitate movement of species via overwater dispersal from the St. Kitts Bank to Saba. Notable is the fact that only three species (possibly four, if *Geochelone carbonaria* was historically present on Statia), other than sea turtles, are common to all three islands. *Hemidactylus mabouia* commonly functions as a human commensal (Vitt and Zani, 1997; Powell et al., 1998, 2005; Henderson and Powell, 2001; Howard et al., 2001; Hodge et al., 2003) and is likely to appear eventually on any inhabited island in the area. *Thecadactylus rapicauda* is less frequently and closely allied with humans (Vitt and Zani, 1997; Powell et al., 1998, 2005; Howard et al., 2001; Russell and Bauer, 2002; Hodge et al., 2003), but the occasional associations may facilitate dispersal. Both species, however, also have characteristics (hardiness, ecological versatility, and both adults and eggs that are resistant to exposure; Powell and Henderson, 2006) that render them good candidates for natural dispersal. The third species, *Eleutherodactylus johnstonei*, is all but ubiquitous in the Lesser Antilles (Kaiser and Hardy, 1994; Henderson and Powell, 2001), testament to its dispersal abilities despite the generalization that amphibians are less capable of overwater movement and colonization than reptiles (Henderson and Powell, 1999; Lever, 2003; Powell and Henderson, 2006).

Table 1. The distribution of non-marine reptiles and amphibians on the Dutch Windward Islands (from Powell et al., 2005): Saba (13 km²), St. Eustatius (Statia) (20 km²), and St. Maarten (includes the French portion of the island known as St.-Martin) (85 km²). In addition to taxa listed, three species of sea turtles (green turtle, *Chelonia mydas*; hawksbill, *Eretmochelys imbricata*; leatherback, *Dermochelys coriacea*) are known to nest on all three islands at least occasionally, and another (*Caretta caretta*) is a vagrant in these waters. Note that green iguanas (*Iguana iguana*) from Saba may be distinct at the species level from populations of green iguanas found elsewhere. The asterisk (*) denotes populations that probably are native, but some individuals and possibly even entire populations might be introduced (see text); other symbols: X = extirpated; E = critically endangered; A = abundant (at least at some locations), likely to be encountered within a few minutes of searching in appropriate habitat; R = rare, encountered at most sporadically, even in appropriate habitat; I = introduced; S = stray (one or few individuals introduced, but no population established). The question mark (?) used in combination with the “X” for the slipperyback (*Mabouya* sp.) indicates uncertainty about the possible extirpation of the population on St. Maarten. The question mark in combination with the “S” for the red-footed tortoise (*Geochelone carbonaria*) on Statia denotes a situation where we cannot rule out the possibility that the species was once present.

Species	Saba	Statia	St. Maarten
Lizards			
Green iguana (<i>Iguana iguana</i>)	R		RI
Lesser Antillean iguana (<i>Iguana delicatissima</i>)		E	X
Red-faced ground lizard (<i>Ameiva erythrocephala</i>)		A	
Anguilla Bank ground lizard (<i>Ameiva plei</i>)			A
Green tree lizard (<i>Anolis bimaculatus</i>)		A	IX
Common tree lizard (<i>Anolis gingivinus</i>)			A
Anguilla Bank bush anole (<i>Anolis pogus</i>)			A
Saba anole (<i>Anolis sabanus</i>)	A		
Statia bush anole (<i>Anolis schwartzi</i>)		A	
Woodslave (<i>Hemidactylus mabouia</i>)	A*	A*	A*
Turnip-tailed gecko (<i>Thecadactylus rapicauda</i>)	R	R	R
Little dwarf gecko (<i>Sphaerodactylus parvus</i>)			A
Saba dwarf gecko (<i>Sphaerodactylus sabanus</i>)	A	A	
Island dwarf gecko (<i>Sphaerodactylus sputator</i>)		A	A
Slipperyback (<i>Mabouya</i> sp.)			X?
Snakes			
Boa constrictor (<i>Boa constrictor</i>)			S
Anguilla Bank racer (<i>Alsophis rijgersmaei</i>)			E
Red-bellied racer (<i>Alsophis rufiventris</i>)	A	A	S
Corn snake (<i>Elaphe guttata</i>)			S
Worm snake (<i>Ramphotyphlops braminus</i>)			RI
Turtles			
Red-footed tortoise (<i>Geochelone carbonaria</i>)	E*	S?	E*
Red-eared slider (<i>Trachemys scripta</i>)			AI
Frogs			
Johnstone’s whistling frog (<i>Eleutherodactylus johnstonei</i>)	AI	AI	AI
Cuban treefrog (<i>Osteopilus septentrionalis</i>)			AI

Table 2. Binary indices of similarity for pairwise comparisons of the herpetofaunal communities on St. Eustatius (Statia), Saba, and St. Maarten. Similarity indices (S) compare the faunas of two entities using the following formula (Krebs, 1989): $S = a/(a + b + c)$, where a = number of species common to both entities, b = number of species found only on one, and c = number of species found only on the other. The native population of iguanas on Saba and the introduced population on St. Maarten are considered conspecific (*Iguana iguana*) for purposes of these comparisons (but see text) and the extirpated population of Lesser Antillean iguanas (*I. delicatissima*) is included only for comparisons of endemic and native species. “Introduced” populations are limited to those designated with an “I” (and which are not extirpated) in Table 1. Values differ from those in Powell et al. (2005) because some taxa were assigned to different categories.

	Saba/Statia	Saba/St. Maarten	Statia/St. Maarten
Endemic and native species only	0.33	0.20	0.25
With introduced species	0.42	0.28	0.24

Conservation Status

Animal populations often suffer as a consequence of alterations to their habitats by humans. Insular populations, particularly habitat specialists and endemic species that have evolved in the absence of efficient mainland predators and competitors, are most vulnerable (e.g., Powell and Henderson, 2005; Powell et al., 2005). Declines in amphibian populations throughout the world have been documented in recent years (e.g., IUCN et al., 2004), but comparable surveys of reptilian species have yet to be implemented (but see Gibbons et al., 2000). A few species and even some genera (e.g., West Indian rock iguanas in the genus *Cyclura*; e.g., Alberts, 2000; Alberts et al., 2004) have been the focus of intensive conservation efforts. Populations of many more species, a large proportion of which are found only on small islands, are in various stages of decline, some in imminent danger of extinction, often with little recognition by the public or even professional conservation biologists.

Lesser Antillean reptiles are frequently the most abundant and obvious naturally occurring vertebrates (Henderson and Powell, 1999), but overviews of conservation needs have been rare. Whereas many Lesser Antillean species are ecological generalists (Henderson and Powell, 1999; Powell and Henderson, 2005, 2006) and some thrive in altered habitats, populations of many others are declining at alarming rates. Recent extirpations and even some extinctions have been documented, with a majority of both attributable to human agency. Powell and Henderson (2005) contended that at least 37 of 81 (45.7%) native terrestrial reptiles inhabiting the Lesser Antilles have been affected negatively in some substantive way by human activities. These include species that have become extinct since European arrival and species with at least some populations that have been extirpated or drastically reduced in numbers.

Addressing these concerns (table 3) for the native reptiles of the Dutch Windward islands (both amphibians on these islands are introduced and not of concern), all sea turtles are listed in CITES Appendix I. Green (*Chelonia mydas*) and loggerhead (*Caretta caretta*) turtles are red-listed as endangered, whereas the

Table 3. Formally recognized conservation status of reptilian species in the Dutch Windward Islands: St. Eustatius (Statia), Saba, and St. Maarten. CITES appendices are indicated by “I” or “II,” and IUCN Red List status by CR (critically endangered), EN (endangered), or VU (vulnerable).

Species	Status
Loggerhead turtle (<i>Caretta caretta</i>)	I, EN
Green turtle (<i>Chelonia mydas</i>)	I, EN
Hawksbill turtle (<i>Eretmochelys imbricata</i>)	I, CR
Leatherback turtle (<i>Dermochelys coriacea</i>)	I, CR
Red-footed tortoises (<i>Geochelone carbonaria</i>) ^a	II
Lesser Antillean iguana (<i>Iguana delicatissima</i>)	II, VU ^b
Common or green iguana (<i>Iguana iguana</i>) ^{a,c}	II
Anguilla Bank racer (<i>Alsophis rijgersmaei</i>)	EN ^d
Red-bellied racer (<i>Alsophis rufiventris</i>)	EN ^e

^a No distinction is made between island and continental populations.

^b Status almost certainly needs to be upgraded to EN in light of continuing declines in population sizes and ongoing threats to habitat and gene pools on nearly all islands where the species occurs.

^c No distinction is made between native and introduced island populations.

^d While the population on St. Maarten is functionally extirpated, those elsewhere on the Anguilla Bank are relatively healthy. This situation is very similar to that for *Ameiva plei*, which remains abundant only locally on St. Maarten, and for *Mabuya* sp., which may be extirpated on St. Maarten but is apparently widespread but rarely encountered on other Anguilla Bank islands.

^e Populations on St. Christopher (St. Kitts) and Nevis are extirpated, but snakes remain abundant on St. Eustatius and Saba. Somewhat similarly, populations of *Ameiva erythrocephala* are greatly restricted on St. Kitts and Nevis, but the species is widespread and abundant on Statia.

hawksbill (*Eretmochelys imbricata*) and leatherback (*Dermochelys coriacea*) turtles are critically endangered. Red-footed tortoises (*Geochelone carbonaria*) are listed in CITES Appendix II. In addition, sea turtles are protected by national and local legislation. Although all turtles are affected by habitat alteration, the sea turtles especially by the development of nesting beaches, the principal threats are due to exploitation by humans for food or, in the case of tortoises, as pets.

The original range of the Lesser Antillean iguana (*I. delicatissima*) extended from Martinique in the south to Anguilla in the north (Powell, 2004; Pasachnik et al., 2006), but several populations, including that on St. Maarten, are extirpated. Along with all iguanas, the species is listed in CITES Appendix II and as “vulnerable” in the IUCN Red List. Like sea turtles, the principal threat is exploitation, although habitat destruction and competition with invasive mammalian herbivores also are major factors. Also like sea turtles, populations are protected by local regulations, although enforcement ranges from non-existent to sporadic.

Some Lesser Antillean populations of green iguanas (*Iguana iguana*) are undoubtedly descendants of ancestors that arrived in the islands by natural (non-human-mediated) overwater dispersal. Others may have been introduced by Amerindians (probably for food), established recently as a consequence of escaped pets, or combinations thereof (Powell, 2004). The population on Saba is presumably native (Malone and Davis, 2004; Powell, 2004), whereas that on St. Maarten is known

to be introduced (Powell et al., 2005). Because of the species' broad continental range, which extends from México through Central America and across much of northern South America, and a general lack of recognition of genetic variability among populations, protective measures are considerably less stringent than for *I. delicatissima*. *Iguana iguana* is listed in CITES Appendix II, but export quotas exist for many countries, primarily for live animals (pet trade) or products (leather goods and meat). No distinction is made for native versus introduced or for continental versus insular populations. Hunting is usually prohibited, but enforcement of laws is often lax.

Neither of the two species of *Ameiva* that occur in the Dutch Windwards is listed. Although some populations have declined dramatically, they remain common in at least some portion of their historic ranges. *Ameiva plei* is common on Anguilla, some of its satellites, and St.-Barthélemy, but populations on mongoose-infested St. Maarten are localized, and the species is absent from many areas that apparently provide suitable habitat and adequate resources. Similarly, *A. erythrocephala* is doing quite well on mongoose-free St. Eustatius (Rojer, 1997a; Kerr et al., 2005a,b), but is essentially restricted to heavily trafficked "urban" areas on St. Christopher and Nevis (Barbour, 1930; Westerman, 1953; Malhotra and Thorpe, 1999), where its apparent dependence on humans to deter mongoose activity renders it a human commensal in such situations. Skinks in the genus *Mabuya* are widely distributed throughout the Lesser Antilles (Schwartz and Henderson, 1991), but they are nowhere abundant. The population on St. Maarten may have been extirpated (Breuil, 2002). Predation by mongooses, cats, and other exotic predators appears to be primarily responsible.

The ranks of the common snakes (Family Colubridae), like the ground-dwelling *Ameiva* lizards, have suffered the greatest number of extirpations, extinctions, or dramatic reductions in geographic ranges in the Lesser Antilles (Henderson, 1992, 2004; Powell and Henderson, 2005). West Indian racers (*Alsophis*) are, essentially, snake counterparts of *Ameiva*. They are ground-dwelling, diurnal, fast-moving, oviparous, and apparently susceptible to predation by ground-dwelling, diurnal, fast-moving mongooses. Although some islands harbor healthy racer populations (e.g., *Alsophis rijgersmaei* on Anguilla and St.-Barthélemy and *A. rufiventris* on Saba and Statia; Rojer, 1997a, b; Malhotra and Thorpe, 1999; Breuil, 2002; Hodge et al., 2003; Heinz et al., 2004; Henderson, 2004; Maley et al., 2005; Powell and Henderson, 2005; Powell et al., 2005; Savit et al., 2005), populations of the same species are restricted to small, isolated enclaves on St. Maarten (*A. rijgersmaei*; Powell et al., 1992, 2005; Rojer, 1997c; Breuil, 2002; Powell and Henderson, 2005) and extirpated on St. Christopher and Nevis (*A. rufiventris*; Barbour, 1930; Sajdak and Henderson, 1991; Henderson, 1992, 2004; Sajdak, 2004; Maley et al., 2005). In each instance, the mongoose appears to be primarily responsible (Henderson, 1992, 2004; Powell and Henderson, 2005; Powell et al., 2005). Both *A. rijgersmaei* and *A. rufiventris* are included on the IUCN Red List as endangered.

In summary, many Lesser Antillean reptiles and some of those found on the Dutch Windwards are habitat generalists, descendants of effective colonizers, and often adapt well to human-mediated alterations of their environments (Henderson and Powell, 1999; Powell and Henderson, 2005; Powell et al., 2005). The most obvious examples are the many anoles that probably were arboreal historically, but adapt readily to almost any vertical structure. Also apparently doing well are some of the nocturnally active species (e.g., wall geckos, *Hemidactylus* and *Thecadactylus*), and those that are small and inconspicuous (e.g., dwarf geckos, *Sphaerodactylus*; e.g., Hensley et al., 2004). In sharp contrast, many other reptiles have seen populations decline precipitously and even disappear altogether. Particularly vulnerable are species that are associated primarily or solely with pristine habitats that no longer exist on most islands, those that are large and can serve as economic commodities (e.g., sea turtles, tortoises, iguanas), species that inspire fear and are actively persecuted by residents who consider them dangerous (e.g., snakes), or forms that are diurnally active and terrestrial (e.g., *Ameiva*, *Mabuya*, *Alsophis*) – but, in the absence of mongoose introductions, extirpations and dramatic reductions in populations sizes would be far less common (Sajdak and Henderson, 1991; Henderson, 1992, 2004; Henderson and Powell, 1999; Sajdak, 2004; Powell and Henderson, 2005; Powell et al., 2005).

Conservation Action

Despite a collective population of fewer than 220,000 people and a total land area of just 800 km², and division into two distinct island groups separated by more than 900 km of open water, and linguistic and cultural differences, the conservation efforts of the Netherlands Antilles over the past decades are exemplary for the region. Each island has one or more legally established protected area of significance. All are managed by non-governmental, not-for-profit foundations, which are struggling to protect and make wise use of the natural heritage of their islands. Common threats to these protected areas include limited and at times unreliable governmental support and escalating pressure to develop particularly tourism-related construction. Other problems include entrenched local issues, such as disputes over land tenure, persistent overharvesting of resources, and overgrazing by free-roaming goats, sheep, cattle, and donkeys.

The Dutch Caribbean Nature Alliance (DCNA) was established with goals of safeguarding the biodiversity and promoting sustainable management of the islands' natural resources. The DCNA supports the local conservation organizations on each of the islands, seeks to develop a collective trust fund for nature conservation, and aims to make the rich and varied nature of the islands wider known in the Netherlands and elsewhere. Within the Kingdom of the Netherlands, the islands are the most important “hotspot” of biodiversity.

The St. Eustatius National Parks Foundation (STENAPA) is the only environmental organization on St. Eustatius. It was established in 1988 with the primary

objective of protecting terrestrial and marine areas of ecological, scientific, and cultural significance. In 1996, the island government delegated STENAPA to protect and manage the newly declared Marine Park and, in 1998, the Quill and Boven National Park. Since 2002, staff, interns, and volunteers have been active with day and night patrols during nesting seasons to document, measure, and tag all nesting sea turtles, to protect nests, and ensure that hatchlings reach the sea.

The Saba Conservation Foundation (SCF), operational since 1987, has a stated mission of contributing to the sustainable development of Saba through the preservation and sensible use of the island's natural and cultural resources. The island government has delegated the responsibility of nature management, including management of the Saba National Marine Park to the SCF. The SCF also conducts programs on species protection (particularly for *Anolis sabanus*, *Alsophis rufiventris*, and *Iguana iguana*), has implemented an ongoing and to date somewhat successful effort to reduce the island's domestic and feral cat population through a tagging, registration, spay-and-neuter program, was instrumental in promoting efforts to reduce populations of free-ranging goats, and conducts occasional animal management and protected species public relations and awareness campaigns.

The Nature Foundation of St. Maarten (NAFSXM), established in January 1997, with the objective of enhancing the environment through proper management, education, awareness, and protection of natural resources. St. Maarten recently established a marine park and legislation calling for the protection of beaches, coral reefs, turtles, mangroves, sea grasses, and other protected species are planned. The Nature Foundation also has proposed development of a "hillside park" that will protect the island's indigenous terrestrial flora and fauna and educational programs to stimulate environmental awareness in the schools are ongoing.

The Future

Paralleling the geological and geographic differences between the islands, the probable fates of natural biotic communities on Statia and Saba versus those on St. Maarten differ substantially, as do priorities for conservation. The latter differences are largely attributable to dramatically different states of development, largely related to tourism and attributable to size and ready access via air or cruise ships. I have somewhat presumptuously decided to present my views as lists of priorities for each island. Readers must keep in mind that these are solely opinions that reflect my experiences and herpetological biases and may not accurately represent the policies or priorities of the islands' governments or conservation organizations. Also important is an awareness that the following recommendations apply solely to terrestrial communities, may not be equally practical or easily implemented, and that my lists of priorities are not meant to be all-inclusive. In addition, I have not separated those priorities currently being addressed with varying degrees of success from those that are not being addressed at all. Finally, readers will note

similarities between priorities I have proposed for Saba and Statia, whereas those for St. Maarten differ considerably, with only a few common threads.

Saba, due to its stark topography and lack of tourist-friendly beaches, remains the most “natural” of the three Windward Islands. However, an economy increasingly dependent on tourism will inevitably increase pressure to expand related development and accompanying infrastructure to portions of the island less and less suited to accommodate them. Furthermore, proposed expansion of an offshore medical school will increase the human population, number of motor vehicles, and pressure to support them adequately. Priorities for conservation should include: (1) restrictions on development to areas already altered by human presence; (2) fostering and possibly subsidizing eco-friendly development (most tourists to Saba are attracted by the excellent diving or hiking trails and should be open to these sorts of facilities); (3) defending vigorously existing protected areas and supporting initiatives to expand them; (4) continuing efforts to educate residents and visitors regarding the island’s unique and fragile biota (the island’s Sea & Learn program is an outstanding example of an educational partnership between businesses, schools, and the international scientific community; for more information see: www.seaandlearn.org); (5) implementation of stringent regulations restricting introduction of alien species (of particular importance are efforts to preclude importation of exotic plants that might displace the native flora, green iguanas that might interbreed with native iguanas and dilute the population’s gene pool, and non-native predators such as mongooses and exotic snakes with the potential to wreak havoc with native avian and reptilian populations); and (6) ongoing restrictions and efforts to reduce the number of feral cats and free-ranging goats.

St. Eustatius, once an international commercial center, is now off the beaten track. Consequently, pressures to develop the island’s remaining relatively natural areas have been minimal in recent years. However, easier access by tourists via air service directly from Puerto Rico, the presence of a medical school with plans for expansion, domination of the local economy by a major petroleum transshipment operation, and inconsistent governmental support of current conservation efforts speak to rapidly changing realities. Priorities for conservation should include: (1) very stringent control of development that might affect existing natural areas (especially important and vulnerable are Zeelandia Beach, where sea turtles nest, and the slopes of the Quill); (2) resolving land-ownership issues in those parts of the Boven Sector not incorporated in the grounds of the refueling station in order that historical and biotic resources in that area might be preserved; (3) fostering and possibly subsidizing eco-friendly development (most tourists to Statia, like those to Saba, are attracted by the excellent diving or hiking trails and should be open to these sorts of facilities); (4) continuing efforts to educate residents and visitors regarding the island’s unique and fragile biota (effective educational collaborations between the island’s schools and the National Parks Foundation are a solid beginning); (5) implementation of stringent regulations restricting introduction of alien species (of particular importance are efforts to preclude importation of

exotic plants that might displace the native flora, green iguanas that might interbreed with naturally occurring Lesser Antillean iguanas, and non-native predators such as mongooses and exotic snakes with the potential to wreak havoc with native avian and reptilian populations); (6) increased emphasis and funding for efforts to control or even eliminate coralita (or Mexican creeper, *Antigonon* sp.), which has overrun Statia to a much greater extent than on the many other West Indian islands on which that invasive plant has become established; and (7) implementation of ever more aggressive efforts to reduce the numbers of free-ranging mammalian herbivores, especially goats that have dramatically altered the biotic communities throughout the island.

Unlike Saba and Statia, much of St. Maarten has already been developed, primarily for tourism. Essentially all lowland habitats have been altered, and construction is climbing higher and higher onto hillsides. In addition, few relatively natural areas remain and exotic species abound; most notably, the mongoose is firmly established. Consequently, my proposals seek to reflect the status quo, acknowledging the damage already done, and stress the need to conserve the few remaining natural resources present on the island. Priorities for conservation should include: (1) establishment of hillside protected areas and constraints on development of hillsides that can only affect negatively the relict relatively natural areas (a failure to do so will inevitably cause further damage to lowlands and watersheds as a consequence of increased erosion); (2) protection of beaches used by nesting sea turtles and not already developed for tourism; (3) ongoing conservation and reestablishment of coastal mangrove stands that protect low lying areas and support a number of native animals; (4) continuing efforts to educate residents and visitors regarding the island's fragile biotic communities (complicated by the island's dual nationality and a relatively large human population that render collaboration with schools much more difficult than on Saba or Statia); and (5) implementation and enforcement of stringent regulations restricting further introductions of alien species.

Summary

Like many other West Indian islands (and islands throughout the world), the three Dutch Windward islands support herpetofaunas with large proportions of insular or bank endemics or species found only on adjacent banks. Those on Saba and Statia are relatively intact; however, the herpetofaunal community on St. Maarten has experienced an extirpation (*Iguana delicatissima*, although the niche has been largely filled by introduced *I. iguana*), a probable extirpation (*Mabuya* sp.), and dramatic reductions in population sizes and distribution (one of which, *Alsophis rijgersmaei*, appears to functionally extirpated). An additional population of one species (*Geochelone carbonaria*) is of unknown origin and status, and invasive species have become established (*Ramphotyphlops braminus* and *Trachemys scripta*) or threaten to do so (*Boa constrictor* and *Elaphe guttata*).

The differences between St. Maarten and the less-developed islands are almost entirely attributable to varying levels of human influence: development, largely for the tourist industry and introductions of exotic species.

Saba and Statia have largely been spared the carnage inflicted on St. Maarten due to smaller island sizes, smaller human populations, and physical characteristics (topography and lack of tourist-friendly beaches) that have retarded development. Consequently, conservation priorities on the two smaller islands deal mainly with preserving relatively natural areas through protection, education, limitations on development, and control of invasive species (those that have been introduced and those that might be). In sharp contrast, extensively developed St. Maarten, already overrun with exotics, has little choice but to minimize the damage already inflicted and prevent further degradation. So, controlling expansion of developed areas onto hillsides, establishing a terrestrial protected area with at least a somewhat natural flora, preventing further invasions by non-native plants and animals, are, along with education, the highest priorities for conservation.

Standing in the way of implementing these (and other, largely tied to marine resources) recommendations on any of the islands are under-funded conservation organizations that rely on the work of too few people, a largely apathetic resident population resistant to educational programs, and governmental entities with firm commitments to development that provide only sporadic or even no support of efforts to conserve natural resources – a litany of hurdles faced by essentially every conservation organization (governmental, not-for-profit, or private) throughout the region.

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Note added in proof. Since the completion of this article, a Cuban Treefrog (*Osteopilus septentrionalis*) was discovered by John Magor in Windwardside on Saba. The species is well established on St. Maarten, the presumed origin of this individual. Its presence on Saba speaks to the need to monitor and prevent introductions of additional non-native species, especially those with the potential to inflict considerable damage on endemic taxa.