The Lesser Antillean Iguana on St. Eustatius: 2012 status update and review of limiting factors

Adolphe O. Debrot and Erik Boman

Report number C166/12

IMARES Wageningen UR

Institute for Marine Resources & Ecosystem Studies

Client: The Ministry of Economic Affairs, Agriculture and Innovation
Paul C. Hoetjes, Policy Coordinator Nature
P.O. Box 20401, 2500 EK The Hague,
The Netherlands

BO-11-011.05-004

Publication date: January, 2013

ST. EUSTATIUS
CARIBISCH NEDERLAND

IMARES is:

- an independent, objective and authoritative institute that provides knowledge necessary for an integrated sustainable protection, exploitation and spatial use of the sea and coastal zones;
- a key, proactive player in national and international marine networks (including ICES and EFARO).

This report is part of the Wageningen University BO research program (BO-11-011.05-004) and has been financed by the Ministry of Economic Affairs, Agriculture and Innovation (EL&I) under project number 4308701004.

P.O. Box 68
1970 AB IJmuiden
Phone: +31 (0)317 48 09 00
Fax: +31 (0)317 48 73 26
E-Mail: imares@wur.nl
www.imares.wur.nl

P.O. Box 77
4400 AB Yerseke
Phone: +31 (0)317 48 09 00
Fax: +31 (0)317 48 73 59
E-Mail: imares@wur.nl
www.imares.wur.nl

P.O. Box 57
1780 AB Den Helder
Phone: +31 (0)317 48 09 00
Fax: +31 (0)223 63 06 87
E-Mail: imares@wur.nl
www.imares.wur.nl

P.O. Box 167
1790 AD Den Burg Texel
Phone: +31 (0)317 48 09 00
Fax: +31 (0)317 48 73 62
E-Mail: imares@wur.nl
www.imares.wur.nl

A_4_3_2-V12.3

Summary

The endangered Lesser Antillean Iguana*, Iguana delicatissima*, is an emblematic species for the island of St. Eustatius and in Caribbean Netherlands it is only found on St. Eustatius. In this study we conducted an extensive population survey for the iguana and compared densities in different areas to densities documented most recently in 2004. We conducted 39 field surveys and spent a total of 80 hours and 21 minutes searching for iguanas. We covered 63,672 m of trails and tracks and found only 22 iguanas. An overall average of 3.70 hours were searched for each iguana found. Due to the low encounter rates, detailed estimation and comparison of population densities remain problematic. Overall population density was 0.35 iguanas per hectare which represents 0.5-1% of densities documented elsewhere in healthy populations. Current population densities have declined across all habitats since the 2004 survey. Iguana encounter rates and densities in natural habitat were highest for the region where the northern hills abut onto the central plain. Island-wide, those areas provide the best combination of sun, shelter, food and potential for nesting sites. The population of the Lower Town sector, indicated in 2004 as the most dense and promising subpopulation, has all but disappeared. Island-wide, the residential estate subdivision remains the second-most important area for the iguana.

We conclude that even though several valuable conservation measures are in place (e.g. establishment of legally protected parks, designation as a legally protected species and a successfully-run awareness campaign), the status of the iguana has not improved significantly in the last 8 years. Our results show that compared to 2004 when the population was estimated to number 425 (275-650) animals, current population size certainly lies on the low side of this range. This is far below the required minimum viable population size of 5000 animals and means that the iguana is critically endangered on St. Eustatius. It is readily vulnerable to extirpation on the island. Human hunting is likely a minor problem, shelter and food availability on the island are abundant, and invasive predator densities in the wild are relatively low. Of the 28 documented instances of death or endangerment of iguanas during the study period, most were attributable to anthropogenic causes. Suitable nesting sites for the iguana appear very limited, especially due to a combination of geology and vegetation. Therefore, lack of nesting sites and high iguana mortalities due to anthropogenic causes are suggested as the two core factors limiting recovery of the iguana on St. Eustatius.

We propose management interventions along three main themes, namely, 1) implement simple measures for better protection of the wild population, 2) conduct studies for a better knowledge of the critical biological parameters and 3) increase public awareness for the plight of the species. The four principal protective measures recommended are to a) train and equip border officials to prevent potential entry of the mongoose and the Green Iguana from neighbouring islands, b) implement enforcement and upgrade protective legislation, c) develop and maintain new additional nesting habitat, a measure that is both easy and inexpensive, and finally d) establish a program to promote “iguana-friendly” gardens, as the main means of reducing cumulative mortality.

In addition, we suggest that develop *in situ* husbandry and breeding could serve a pivotal role in bolstering the other core program themes and especially offers a relaxed setting in which islanders can experience the iguana as the gentle and beautiful animal that it is.

This report is part of the Wageningen University BO research program (BO-11-011.05-004) and was financed by the Ministry of Economic Affairs, Agriculture and Innovation (EL&I) under project number 4308701004.

Contents

Terms of reference

The Lesser Antillean Iguana, *Iguana delicatissima* (Laurenti, 1768), has a very limited distribution in the Lesser Antilles and is gradually being extirpated throughout its range due to three principal causes namely, invasive predators, habitat loss and hybridization with the invasive Green Iguana, *I. iguana*. Of the three islands that now comprise the Caribbean Netherlands (Bonaire, Saba, and St. Eustatius) the species is only found on St. Eustatius, where it is the largest native terrestrial animal and a prime emblem of the island's biodiversity. St. Eustatius is among the few north-eastern Caribbean, Lesser Antillean islands blessed in not having the destructive mongoose and not having any invasive Green Iguanas. Notwithstanding several favourable preconditions and the implementation of several legal protective measures in the last decade, the anticipated recovery of this CITES and IUCN Red list species had been questionable. This, combined with the fact that the latest population assessment for the species was done in 2004, called for a reassessment of the status of the species.

Since the new Kingdom constitutional changes of 10 October 2010, the principal mandate for terrestrial nature management resides with the island government. However, the Netherlands Ministry of Economic Affairs, Agriculture and Innovation, carries final responsibility for nature management. In light of the international significance of the species, the Netherlands' longstanding commitment to biodiversity conservation and shortage of local means and capacity to conduct such a survey entirely on their own, the Ministry commissioned IMARES to help coordinate and execute such an initiative on behalf of the island partners.

This research is a joint project between Stenapa (St. Eustatius National Parks Foundation), the St. Eustatius Agriculture Service and IMARES. IMARES's participation was made possible as part of the Wageningen University BO research program (BO-11-011.05-004) and was financed by the Ministry of Economic Affairs, Agriculture and Innovation (EL&I) under project number 4308701004. Stenapa's participation and research support was made possible through its structural subsidy as received from the island government of St. Eustatius. Participation by the Agricultural Service was made possible both by means of structural funding from the Island government as well as from the Netherlands Ministry of EL&I.

The authors would like to thank several people for their generous assistance, information and cooperation: Paul Hoetjes (RCN) and Hayo Haanstra (EL&I) for their instrumental role in making this study possible. The Department of Agriculture Animal Husbandry and Fisheries (LVV) of St Eustatius for logistical support and work space. Roberto Hensen and Inge Jaspers for all-around island support and for being the best hosts on the island. Steve Pointek, Hannah Madden, Jessica Berkel, Jackie Berkel, Nicole Esteban and Kate Walker, as well as Stenapa staff and volunteers who shared freely of their expert information and provided useful pointers. If it hadn't been for the tip by Steve, the shared nesting site on the lower south-eastern Quill slope would not have been found. Hannah Madden and Nicole Esteban pointed us to two large joint nesting sites at Courtar Mountain, while Jackie Berkel told us of the rescue of her iguana from fencing. Elze Dijkman plotted our map and Liesbeth van der Vlies did the layout for this report. We further thank Pat Wesley, the owners of Kings Well, Win and Laura, Sjouke Bakker, Paul and Olga Schatz and many other island estate owners and part-time farmers of the friendly island of Statia for taking time to share their information with the authors. We are grateful to Ruud Stelten and Joost Morsink of SECAR for providing living space during the principal author's November visit to the island. Mike McDonald, director of the Statia NUSTAR terminal is thanked for arranging access to the NUSTAR facilities. James Johnson, Martin Ruijter and Hylke van der Velde provided information on the Saba Green Iguana. Valuable reviews of earlier drafts of this report were provided by Drs. Chuck Knapp, Martin Baptist, Paul Hoetjes and Warren Spencer, while Dr. Robert Powell provided us with critical literature.

1 Introduction

1.1 Iguanas of the Dutch Caribbean

There are two species of iguana found in the Dutch Caribbean. These are the Green Iguana, *Iguana iguana*, and the Lesser Antillean Iguana*, Iguana delicatissima*. The Green Iguana is found on the three Dutch leeward islands of Bonaire, Aruba and Curaçao, and also on Saba and St. Maarten. In the ABC-islands the species was deemed vulnerable to local extirpation due to hunting until the mid-1990s, but has since gained much favour with the inhabitants of these islands (Fig. 1) . As a consequence, today the species is seen less as a simple food species and more and more as beautiful, gentle and rightful inhabitant of gardens and woodlands.

In Curaçao, some 15 years of elementary-, grade- and secondary-school petting-encounters by the Carmabi Foundation education program (reaching over 10 thousand school children annually) as well as a captive breeding program open for public viewing, probably greatly contributed to the rising tolerance and appreciation felt for this animal in the leeward ABC islands. As a consequence, the species is today widely distributed on the island, both in suburban areas and in the wild. The species has been successfully bred in captivity in Curaçao and its ecology has been well studied. Scientific studies have examined size and sexual differentiation (Bakhuis 1982) , digestion (Van Marken Lichtenbelt 1992), optimal foraging (Van Marken Lichtenbelt 1993), energy budgets and seasonality in the wild (Van Marken Lichtenbelt et al. 1993), reproduction (Van Marken Lichtenbelt and Albers 1993) and energetics (Van Marken Lichtenbelt et al. 1997). The populations of the Leeward Dutch islands appear to be uniquely adapted to survive in the arid climate in being notably smaller than the same species from the mainland (Bakhuis 1982).

On St. Maarten on the other hand, the species was only introduced relatively recently (mid-1990s) but has since expanded greatly to the detriment and demise of the island's formerly native Lesser Antillean Iguana. At present the latter species is considered extirpated on St. Martin (Powell 2006), whereas the Green Iguana, initially rare (Powell 2006), is today found all across the island.

Figure 1. A pet male Curaçao "garden" iguana showing off to the Debrot family. Note the species-specific large circular subtympanic scale on the lower jowls and characteristic of this species (photo: A. Debrot).

The Saba population of the Green Iguana, is a unique melanistic population of the species (Fig. 2) and is certainly native to the island (Powell 2006). During fieldwork on Saba in November 2012, the species was fairly abundant and easy to find sunning itself on rocks amid the dry scrub and woodlands at altitudes generally lower than 300 m. Therefore, the situation appears to have improved compared to 2006 when Powell listed the Saba iguana as rare (Powell 2006). However evidence of recent hunting at Fort Bay was observed (A. Debrot, pers. obs.). Genetic studies are needed to evaluate the possibility that this population may even be considered a new and distinct species. Recent work on the genetics of the Green Iguana elsewhere have found large genetic differentiation within this widely distributed species and it is likely that the species actually consists of a number of sibling cryptic species (Stephen et al, in press). This means that a unique species status for the Saba iguana would not at all be surprising and genetic studies should certainly be pursued. On Saba, an apparent lack of suitable nesting habitat makes the species dependent on shared nest sites to where females will migrate when it comes time to lay. One such site is located on the barren ridge named Fairplay, directly on the trail to Spring Bay.

Figure 2. A virtually black female Saba Island Green Iguana, Iguana iguana, at the foot of Bunker Hill, Saba (photo: A. Debrot).

The second species of iguana found in the Dutch Caribbean, The Lesser Antillean Iguana, *Iguana delicatissima* (Laurenti, 1768), was found both on St. Eustatius and St. Martin until the recent introduction of the Green Iguana to St. Martin, but today only survives on St. Eustatius (Powell et al. 2005, Powell 2006). The species looks quite different from the Green Iguana and can be most easily distinguished from it in the field by the absence of the large subtympanic scale that lies under the jaw on the jowls of the Green Iguana. The adult male of the Lesser Antillean Iguana instead has a pronounced series of wide and elongated scales lining the lower jaw, a feature not seen in the Green Iguana. Another distinguishing difference is that banding of the tail is species-specific to the Green Iguana (Powell et al. 2005).

The Lesser Antillean Iguana was originally found in the Lesser Antilles from Anguilla to Martinique, but is rapidly being lost from both large and small islands due to a range of factors, which include invasive alien predators, hybridization with *Iguana iguana*, and habitat loss. Populations have been extirpated on Antigua, Barbuda, St. Kitts and Nevis, Les Îles des Saintes, Marie Galante, as well as St.-Martin/St. Maarten as recently as since 1996, when the species was last reliably documented from the Colombier valley area (Breuil 2002). Of the 13 remaining island populations, only 2 (Dominica and Guadeloupe) exceed the long-term minimum viable population (MVP) size of 5000 individuals, and six are critically endangered. Two of the populations listed by Breuil as critically endangered in 2002 have since been extirpated (i.e. Antigua and St. Martin/St. Maarten) while the population on Anguilla, the closest neighbour-island of St. Martin, are also critically endangered (Pasachnik et al. 2002). While its precarious status would stress the need for scientific study, life history information on *Iguana delicatissima* remains very limited (Pasachnik et al. 2006, Knapp 2007). Past population size estimates for St. Eustatius amount to about 300 animals in 1992, less than 300 animals in 2000, and about 425 (275-650) animals in 2004 (Fogarty et al. 2004). As a consequence, this CITES Appendix II species is listed by IUCN as “vulnerable”. Powell (2006) reviewed the conservation status of the herpetofauna of the Windward Dutch Caribbean which comprises six turtles (most of which are marine, two frogs (both

introduced), three snakes and 15 lizards of which *Iguana delicatissima*, two snakes and the sea turtles are all IUCN Red listed. In light of a slew of declines and threats, Powell and Henderson (2006) argue that the Red List status of the species should be reassessed and almost certainly upgraded to "endangered." According to Powell and Henderson (2006) if it weren't for scattered surviving populations on multiple islands, the status listing of "critically endangered" would necessarily apply. As a key range state, the fact that The Netherlands has one of the last surviving, potentially viable and genetically pure remaining populations of this species, stresses the strong international responsibility that The Netherlands carries with respect to this critically endangered species.

Figure 3. Adult male Lesser Antillean Iguana, Iguana delicatissima, sunning itself in a tree at the foot of Signal Hill, St. Eustatius (photo: A. Debrot).

1.2 Species profile

The Lesser Antillean Iguana (Fig. 3) can attain snout to vent lengths (SLV) of up to 42 cm but smaller-sized populations are also known. Measurements by Reichling (1999) indicated SVL of up to 43 cm, total lengths of up to 86 cm and corresponding body weights of up to 3430 g for a limited sample of animals measured in St. Eustatius. Pasachnik et al. (2006) provide an extensive overview of literature pertaining to the species. The species is fully herbivorous, unlike various West Indian cyclurid iguanas, which may also take insects. It feeds on leaves, fruits and flowers of a wide variety of plants and is versatile in its habitat choice. It can thrive in habitats ranging from mangroves, to dry or humid forest and dry rocky shrub lands (Pasachnik et al. 2002) or manicured gardens (Legouez 2007). On Isle de Chancel (Martinique), and based on our observations in St. Eustatius, the species is considerably more arboreal and less terrestrial than its relative the Green Iguana. While Green Iguanas in Curaçao and on Saba can often be seen sunning on rocks, only two of the 22 iguanas detected during this study were found on the ground. However, on Anguilla the species was found to spend about 86% of time basking on rocks as opposed to 6.5% in trees (Pasachnik et al. 2002). Studies on the Green Iguana in Curaçao show that digestion in the long intestinal tracts of herbivorous iguanas is done by symbiotic intestinal flora and

requires animals to warm-up in the sun to achieve healthy digestion (van Marken Lichtenbelt 1992). Therefore, adequate sunning locations probably are also important to the Lesser Antillean Iguana.

The species shows strong sexual dimorphism, with males being larger and heavier than females, and displaying territorial behaviour, which is communicated principally through head-bobbing displays (Turk et al. 2010). Males can especially be distinguished from females by their stouter and more triangular-shaped profile, whereas females have a more elongate head shape. Males also turn more greyish as they mature, while females retain the green colour well into adulthood. Animals may live longer than 15 years. Like the Green Iguana, the species is polygynous with males defending territories and harems of up to twelve females. The Antillean iguana may lay anywhere from 8-30 eggs depending on the age of the animal. Eggs are deposited in a 90-cm deep dug nest. In contrast to the Green Iguana in which laying is tightly cued to seasonality (van Marken Lichtenbelt and Albers 1993), the laying season of the Lesser Antillean Iguana may be more protracted and on some islands lasts from February to August (Lemm et al. 2006). Nesting sites need to be sun-lit, barren sandy and well-drained. Incubation is believed to last about three months. Females have been documented to traverse kilometres in search of a nesting habitat, which on several islands is practically limited to the island beaches (Legouez 2007). The species is closely related to the Green Iguana and can hybridize with this species. This forms a major threat to preserving the integrity of the species (Legouez 2007) The species is also quite vulnerable to hurricanes and can experience major mortalities and possible population bottlenecks soon after a hurricane strikes (Legouez 2007).

2 Methods

This work is the result of two field visits by the senior author Adolphe O. Debrot (AOD) to the island of St. Eustatius, as well as directed data collection by the junior author Erik Boman (EB) spanning the period of May-December 2012. The first visit by AOD was in March 2012 during which a few days were spent collecting initial field observations and planning the study together with the main participants. From 29 March till 16 November field data were collected by EB, following a standard protocol for both transect surveys and interviews with inhabitants. Finally, the field work for the study was completed during the field visit by AD, during the period of 16-27 of November 2012.

Dedicated iguana surveys: Iguana surveying methods remain problematic even in high density populations, leading to only rough estimates of population size and density (e.g. Lorvelc et al. 2007). Nevertheless, for high density populations a line transect method for population density assessment appears to have been successfully applied (Lorvelec et al. 2007). In our survey, the island was divided into "habitat" sectors following to Fogarty et al. (2004). Iguana surveys were conducted between 10 am and 2 pm to coincide with the likely period of peak iguana activity (Pasachnik et al. 2002). We felt that in most habitats we could reliably find iguanas up to 5 m away on each side of the transect walked. In this, counts were conducted using 10-m wide transects of 50 m length. Replicate transects were separated by a minimum of 50 m. All positions were marked by GPS beginning and endpoints. During the counts, the vegetation was carefully searched for iguanas and all iguanas detected were recorded. Special attention was devoted to the detection of iguana scats and possible nesting sites. All iguanas detected during the time spent moving from one transect to the next were also recorded.

Field data were collected during a total of 39 excursions during which 2 to more than 10 transects were surveyed. Preliminary analysis indicated very low sighting frequencies, such that meaningful density estimates and statistical analysis were not possible using the small (50-m) transect method chosen. We therefore estimated density and calculated density indices by including the distances linking the different (short) transects (i.e. all distance and time spent in the field searching). Densities were expressed both in terms of iguanas per unit time spent searching, following Fogarty et al. (2004) and Reichling (2000) before them, and in terms of iguanas per hectare.

Questionnaire and opportunistic sightings: Aside from directed iguana surveys, opportunistic sightings were solicited from many inhabitants of the island. All such sightings, as well as our sightings made outside field sampling sessions, were mapped to provide additional indications of the distribution and abundance of iguanas on the island. Inhabitants and particularly estate owners, were further queried about their recent iguana sightings using a basic questionnaire (Appendix 1).

3 Results and Discussion

3.1 Distribution and densities

Documented distribution: Figure 4 maps the locations of iguanas sighted during dedicated searches as well as all opportunistic sightings recorded. Our field surveys were conducted during 39 different survey sessions, during which a total 63,672 m of trails and transects were walked and 80 hours and 21 minutes were spent searching for iguanas in the field. Based on iguanas seen during our transect counts and reliable sightings reported by the public, the iguana can be seen to be relatively widely distributed on the island (Fig. 4). From this it is clear that iguanas are not a shy or unadaptable species relegated to faraway places but that they very well occur in the central inhabited part of the island. So while this would also suggest that the iguana should (in principle) be able to thrive in the suburban environment, living there may also expose it to certain dangers inherent to living close to man.

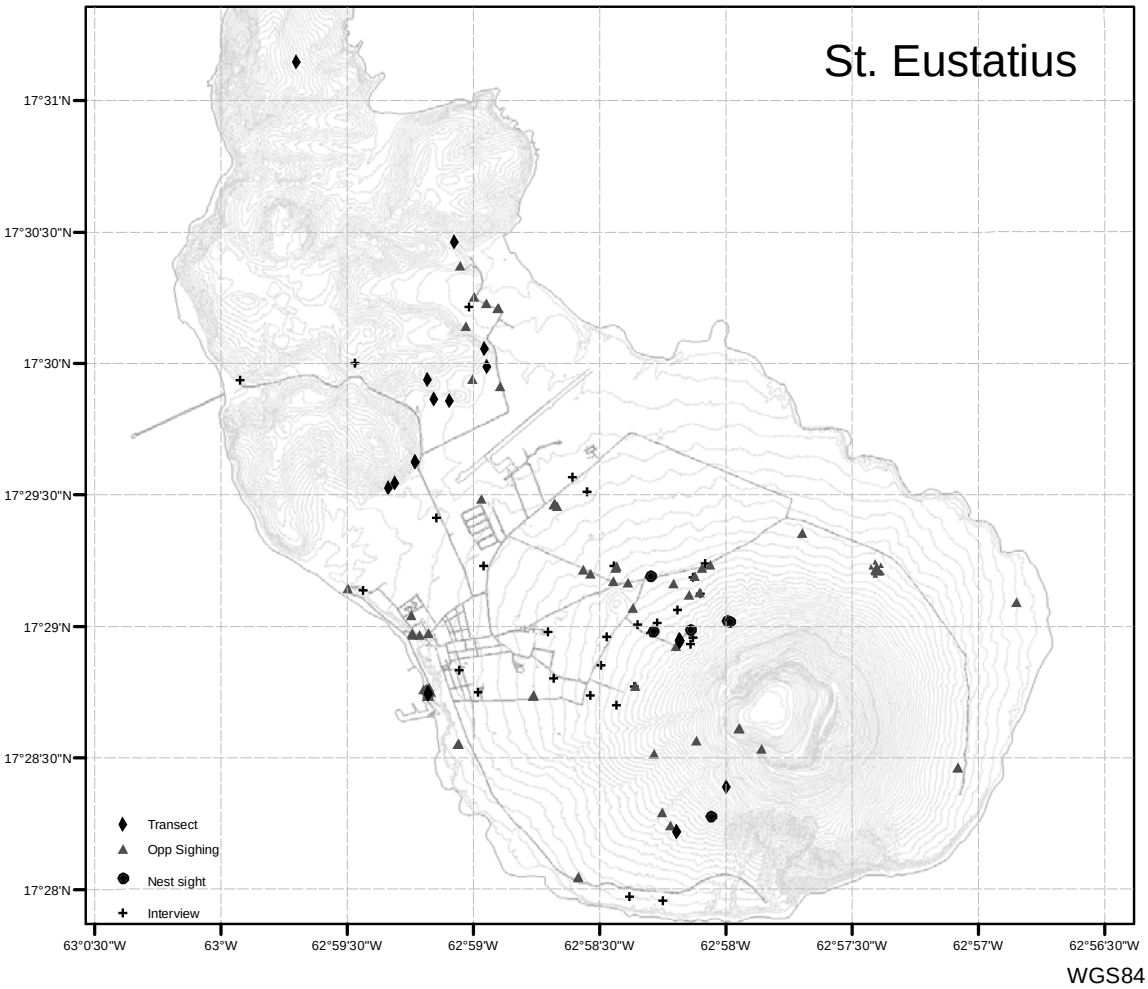


Figure 4. Map of St. Eustatius showing locations of observed iguanas during dedicated transect surveys (◇) as opportunistic sightings (Δ), as reported during interviews (+) and documented nesting locations (●).

Dedicated iguana sightings and relative density: During the 80 hours and 21 minutes of effort we detected only 22 iguanas with an average effort of 3.70 hrs spent for each iguana detected (Table 1). Fogarty et al. 2004 spent no time sampling directly in either a) the lower Quill foothills, b) the borders region between the northern hills and the central plain, or c) the central plains (Cultuurvlakte). We did conduct directed sampling in all three of these habitat zones. We further sampled the escarpments of Lower Town (Oranje Bay) as a distinct habitat whereas Fogarty et al. (2004) labelled this area as part of the "central plains".

Iguanas were not detected in the Quill crater or on the central plains, and these results correspond closely to the findings/observations of Fogarty et al (2004). The Quill crater ridge lies at a minimum altitude of 378 m while the crater floor lies at about 278 m above sea level. These areas are often covered in clouds and fog and according to Veenenbos (1955) the amount of rainfall on the Quill (above 400 m) averages 1500-2000 mm per year. The moisture, and lower temperature probably makes this habitat less ideal for iguanas. The central plains area of the island consists of outstretched areas with low shrubs and grassland and provides the iguana little shelter possibilities either in the form of high vegetation or in the form of boulder fields with crevices. While the habitat would otherwise be suitable, iguanas appear not to choose these areas.

The lower foothills of the Quill were not sampled by Fogarty et al. (2004). We spent 9 hours and 3 minutes searching in these areas and found only one iguana. Thus iguanas do occur here but at exceedingly low densities (Table 1). As Fogarty et al. (2004) had indicated the northern hills as important iguana habitat with some of the higher densities observed, we spent more than 28 hours during 10 different excursions into the area and included both hills sampled by them (Boven and Gilboa, in addition to Signal Hill and natural habitat within the NUSTAR industrial complex). However, again, we found very few animals.

The most important natural iguana habitat at present is the zone with vegetated and boulder-strewn slopes of where the northern hills abut onto the central plains (Fig 5). These areas essentially constitute a band of not much more than 100 m width running along the base of the hills from Signal Hill in the west to Gilboa in the east. Iguanas often exploit and seek out discontinuities in habitats, and this area apparently offers the features of both the plains (sun, and more potential nesting sites) and the hills (escarpments and crevices for escape and shelter). These areas further had plenty of casha trees (*Acacia/Valchellia*) which iguanas cherish as food (particularly the flowers) as well as dense calabash trees (*Crescentia cujete*) in which they liked to hide and were often seen. These areas had the third-highest estimated iguana densities (1.38 iguana/ha) and second-highest encounter rates (1.09 hr/iguana) of all habitat studied.

The highest iguana densities and sighting rates were found in the estate subdivisions concentrated along the north-western lower flanks of the Quill and along the escarpment and cliffs between the Oranjestad harbour and the town located above the cliffs. In the latter area the relatively high density (2.00 iguana/ha) and sighting frequency (1.56 iguana/hr) was largely due to a small concentration (possibly up to 7 different iguanas) living between the STENAPA office in the harbour and the Roman Catholic church directly above on the cliff. In the rest of the area, iguanas are virtually absent.

Table 1. Iguana sampling effort in the different areas of the island and the number of iguanas detected, expressed as iguanas per hour searched. Results by Fogarty et al. 2004 are included for comparison.

Sector	Number of visits	Time (h:min)	Distance (m)	Area (m^2)	Iguanas seen	Iguanas. ha^{-1}	Iguanas. h^{-1}	h. $iguana^{-1}$	2004 h. $iguana^{-1}$
Quill crater	2	3:15	1400	14000	0	0.00	0.00	Indef	-
Quill out. slopes	5	17:38	11700	117000	1	0.09	0.06	17.63	8.30
Quill foothills	6	9:03	5250	52500	1	0.19	0.11	9.05	-
Island estates	2	4:10	3600	36000	6	1.67	1.44	0.69	0.20
Central plains	4	3:35	6500	65000	0	0.00	0.00	indef	-
Border N. H.	6	9:49	6500	65000	9	1.38	0.92	1.09	-
Northern Hills	10	28:07	27222	272220	2	0.07	0.07	14.06	1.80
Oranje Bay	4	4:40	1500	15000	3	2.00	0.64	1.56	0.40
Total:	39	80:21	63672	636720	22	0.35	0.27	3.70	

Figure 5. The favourite natural iguana habitat on St. Eustatius, where the northern hills abut onto the central plains (photo: A. Debrot).

Comparison to the 2004 survey: The results obtained by Fogarty et al (2004) have been listed in table 1 along with our results. In 2004, Fogarty et al. saw more iguanas with much less time spent in dedicated surveys. Across the board, our indices of density were much lower than those by Fogarty et al. (2004) suggesting lower densities of iguanas across the island. Whereas Fogarty et al. (2004) indicated that their lack of experience in spotting iguanas possibly meant that their relative density estimates might have been on the low side, in our case, both researchers are good iguana-spotters, the lead author having more than 40 years of iguana spotting experience, starting out as a hunter and later turning conservationist. While it is certainly possible that we actually could have missed animals (particularly juveniles) in the narrow transects we surveyed, we tended to sample in the best habitat available to

iguanas in the chosen areas, and likely included iguanas that, strictly-seen, fell just outside the 10-m transect width when they were observed. Therefore, we feel that our density estimates are most likely to err on the high side. Based on our results we feel confident to conclude that the situation with the iguana on Statia has certainly taken a turn for the worse since the survey by Fogarty et al. (2004).

The Smoke Alley population described by Fogarty et al. (2004) as flourishing, and then numbering between 10 and 50 animals is no longer present. This population used to be centred around the Kings Well Hotel which started a breeding population that was subsequently released around the year 2000. While at least one animal is present at the Old Gin House and was observed opportunistically during this study, and about seven individuals still inhabit the cliffs behind the STENAPA headquarters, this once promising population has all but disappeared. The habitat quality of this erosion-prone disturbed escarpment area has all but been destroyed by extensive mats of the invasive Mexican creeper vine*,* *Antigonon leptopus*, locally known as “corallita”. These areas, formerly without corallita, would have been among the best nesting habitat available to iguanas in the central section of the island. The available habitat is also very narrow, being pinned in between the busy harbour road at the waterfront and the town directly above and along the cliff edge. The area is a prime waterfront area and in the long-term will be used for waterfront development. Its long-term prospects as iguana habitat are limited.

In contrast, the estates development area of the island continues to harbour significant numbers of iguana. This area showed the overall highest encounter rate (0.69 h/iguana) and second-highest estimate of density (1.67 iguana/ha). The area is characterized by spacious villas situated on large lots. Many vacant lots remain undeveloped and have high semi-natural dry-evergreen vegetation. At least 50% of the villas have no permanent occupation but are only inhabited 3-6 months of the year by foreign owners. Iguanas appear largely absent from lots with dogs. About 50% of estate owners (10 out of 19) interviewed, kept dogs. At least one lot was observed to have iguanas despite a dog being present. The iguana stayed near the fence-line and could escape from the dog by climbing up or going through the fence. The importance of the estates area as a refuge for the iguana is hence largely dependent on the happy circumstance of undeveloped lots, which serve as the main habitat refuge, and a number of villa owners that do not keep dogs and/or are iguana-aware. The main risk to the iguanas of this area of St. Eustatius is if more owners start keeping dogs or if more lots get developed, in which case the value of this area as iguana habitat will decrease. Also, in few instances was there any suitable nesting habitat found in the estates area.

The habitat-value of the estates area can be improved by creating suitable nesting habitat for the resident iguanas (fenced-off to keep dogs out) and by promoting owners to plant suitable bushes near the fence-line (so the iguanas can more easily escape from pet predators). Bushes of great habitat value along fence-lines would be dense thorny ornamental plants like *Pandanus* which in several gardens was used as night-time shelter sites by iguanas. People can be encouraged by maintaining a registry and issuing awards for people willing to make their yards “iguana-friendly”.

Population densities and size: Under favourable circumstances, iguana populations can attain high densities. Healthy populations of the Lesser Antillean Iguana in the French islands have been estimated at some 60 adults per hectare (Breuil 2002). Such densities are also seen in the Green Iguana in the Dutch Caribbean. For instance in 1979, the senior author snared 150 iguanas from an area of less than 5 ha at Girouette on Curaçao (i.e densities of >30/ha) for a restoration-translocation project (STINAPA 1980). More recently Knapp and Perez-Hydrich (2012) documented densities of 36-43 iguanas/ ha for several Lesser Antillean Iguana populations in Dominica. The density estimates in our study on the other hand are extremely low. Our density estimates for on St. Eustatius varied between zero and maximally 2.00 for an overall average of 0.35 iguanas/ha. These densities are clearly very low (0.5-1.0%) compared to potential densities under good circumstances. Iguanas are generally gregarious animals and probably thrive best under higher densities than observed in St. Eustatius. Aside from being a major

threat to the species, these low densities, make density estimation and analysis problematic (many zero's), and constitute a major impediment to general studies into critical aspects of the biology and ecology of the species.

Our results show that compared to 2004 when the population was estimated to number 425 (275-650) animals (Fogarty et al. 2004), current population size certainly lies on the low side of this range. This is far below the required minimum viable population size (MVP) of 5000 animals and means that the iguana is critically endangered on St. Eustatius.

Figure 6. Alarmed by our presence, two adult female iguanas blend into the grass and face towards the back-yard fence and an escape into the scrub of the adjacent lot (photo: A. Debrot).

While by account of our surveys and counts, iguana densities on St. Eustatius are very low (in concurrence with the expert opinion of STENAPA, and the results from previous surveys: Day and Leysner 1992, Reichling 2000, Fogarty et al. 2004), islanders still do report seeing iguanas relatively regularly. Of the 53 islanders interviewed, 30 persons (56%) had reported seeing iguanas recently, at or near their residence within the last three months and 14 (26%) within the last week (Figure 7). For comparison, if such a survey had been conducted with inhabitants from Bonaire, the answers to both questions would have been close to 100%. Nevertheless, despite low densities, iguanas are seen regularly enough. This may very well be based on a small number of mobile animals being seen by many people and resulting in a false sense of abundance which undermines any sense of the real urgency required for conservation and recovery of this species.

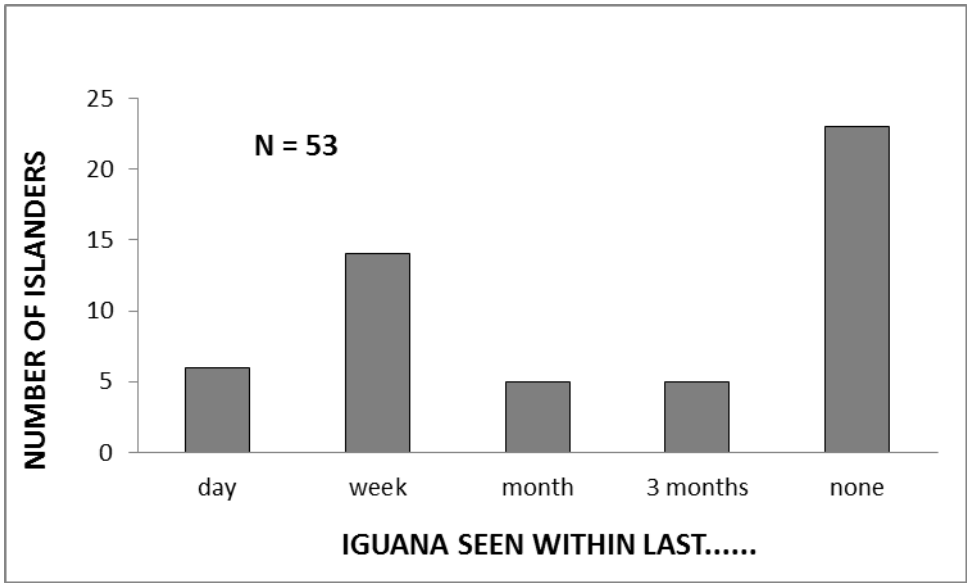


Figure 7. Iguana sighting frequency by island residents.

3.2 Documented mortalities and rescues

We documented a total of 28 iguanas reported dead or rescued from life-threatening situations during the course of our study and based on interviews with 53 resident islanders (Table 2). From this overview it is clear that dogs kept in gardens in areas used by iguanas are a major danger. Other sources of iguana mortalities were starvation (or drowning) in abandoned cisterns, traffic casualties, entanglement in fencing, hunting and "unknown"… possibly the only one representing natural mortality. Twenty-seven (i.e. 96%) of the 28 endangerment or mortality events were man-related. In these, documented killing of iguanas for consumption was quite limited and both incidents involved the same people.

Table 2. Overview of documented death or endangerment of iguanas in Statia, April-December 2012.

Source	Mortality	Rescue	Total
Dogs	10	1	11
Traffic	3	-	3
Cistern	1	4	5
Fencing	-	6	6
Hunting	2	-	2
Unknown	1	-	1
Total incidents:			28

3.3 Observations on nesting sites

During our surveys we kept a keen lookout for potential nesting sites. However, potential nesting sites appear to be very rare in most areas, even including northern hills. We documented nests at one fully natural location, three semi-natural and 2 domestic locations (Table 3). We also were told of one 2010 failed attempt to nest in a pile of garden refuse at the Botanical Garden (R. Hensen, K. Walker, pers. comm.). The largest nest site found was a barren patch of about 5 x 12 metres on a ridge between two

densely forested gullies on the lower southern flank of the Quill (Fig. 8). The area was bare, well-drained, with mull gravel and sand and had nine holes in all. A dry shell of a successfully hatched egg was found at the site. This was the only fully natural site that had no human intervention. Two natural nest sites documented for the period Jan-Aug 2008 by Nicole Esteban (with egg shells seen) on the wind-swept ridges of Gilboa Hill (Appendix 2), were visited on Nov 26, 2012. Two hours of intensive searching the area by two persons yielded no signs of any iguana nesting or even potential nesting activity.

Figure 8. Shared nesting site on the lower south west foot-slopes of the Quill, with nine recently dug holes. Fortuitously discovered by Steve Piontek, Erik Boman taking notes (photo: A. Debrot).

The natural nesting sites mapped by Esteban for the Quill trail routes were found to still be actual and are listed by us as sites 3 and 4 (N. Esteban, pers. comm.). These were relatively large nest sites located very close to each other along the partly shaded trail around the Quill (Fig. 9). There the nests were dug into the eroded trail cut and even into the trail itself. Empty hatched egg shells have been photographed at these locations in the past (H. Madden, photos on file). Nesting burrows of iguanas had typical elliptical, arched openings. Measurements (in cm) of four entrances of iguana nesting cavities were as follows (heights/width in cm): site 3: 13/18, 14/15; site 4: 10/14, 14/18.

Figure 9. Nest site 3, with nests dug into the eroded trail cut of the round the mountain trail on the northwest flank of the Quill. (photo: E. Boman).

We found a single active iguana nest nearby at the Quill trail head starting at Courtar Mountain (site 2, Table 3). The nest was at a disturbed site in a pile of discarded fill, about a foot from the actual trail. Most of the suitable nesting areas at this site had already been overgrown by the invasive corallita. The location certainly has potential but then the corallita and other weeds will need to be kept at bay and the nests will need to be protected from trampling (by hikers and feral livestock) and digging (by pet dogs taken along hiking by their owners).

Table 3. Data on documented iguana nesting locations.

Site	Location	Altitude (m)	Site type	Site origin	Shading	Orientation of clearing	Available area (m2)	Number of holes	Date of last digging	Principal threat
1	S Quill slopes	206	gully ridge	natural	low	E-W	60	9	U*	Trampling**
2	W Quill slopes	124	trail head	semi-natural	medium	E-W	100	1	Nov/22/2012	overgrowth
3	W Quill slopes	243	trail cut	semi-natural	medium	E-W	18	6	U	overgrowth
4	W Quill slopes	243	trail clearing	semi-natural	medium	E-W	30	3	Jan/1/2013	overgrowth
5	Estates	171	fenced garden	man-made	low	NA***	4	1	Nov/20/2012	dog
6	Estates	200	fenced garden	man-made	high	NA	3	1	Nov/10/2012	cat

*(U) = unknown, **due to goats, *** (NA) = not applicable.

We also document two individual nests from two different estate gardens. In all, five of the six documented nest sites were in part thanks to ground and vegetation disturbance by man. Overgrowth with shading, higher humidity and soil compaction was the main threat to the semi-natural sites, whereas domestic predators were the main threat to nests deposited in gardens (Table 3). All open areas in the vegetation and along trails also attract goats which could trample nests. The orientation of the natural and semi-natural clearings was such to allow direct sun exposure for several hours daily. For four nests we were able to establish the dates of actual digging: November 10, 20 and 22, 2012, and January 1, 2013.

In the shady forested areas of the Quill, burrows nestled at the foot of tree trunks or under boulders are common, but should not be confused as iguana nesting cavities (Fig 10). Iguana nesting holes are invariably found in forest clearings, open barren areas, and along eroded cuts with loose soil. Burrows found under other circumstances or lacking the distinctive shape and dimensions are dug by other forest denizens such as lizards (*Ameiva erythrocephala*), and land crabs (*Gecarcinus ruricola*).

Figure 10. Burrows of lizards and crabs should not be mistaken for iguana nests (photo: E. Boman).

In the absence of more precise data on population structure and composition of the St. Eustatius iguana (because of low densities and counts) we plot the size/sex-structure of iguanas as reported by islanders who indicated to have recently seen iguanas on the island, whether it be in their yard or in the wild (Fig. 11). Of the 73 iguanas reported seen by islanders, most could not be successfully sexed by the inexperienced observers (which is not surprizing). Interesting is that 15 (20%) juveniles were recorded (i.e. total length less than 30 cm), which would provide evidence of continued reproductive success. We can conclude that notwithstanding the shortage of suitable nesting sites, some level of successful nesting and hatching continues to take place on the island. The size structure further is as can be expected from a long-lived species that reaches adult sizes relatively rapidly and then slows in growth. Such populations are typified by population structures dominated by adult-sized animals.

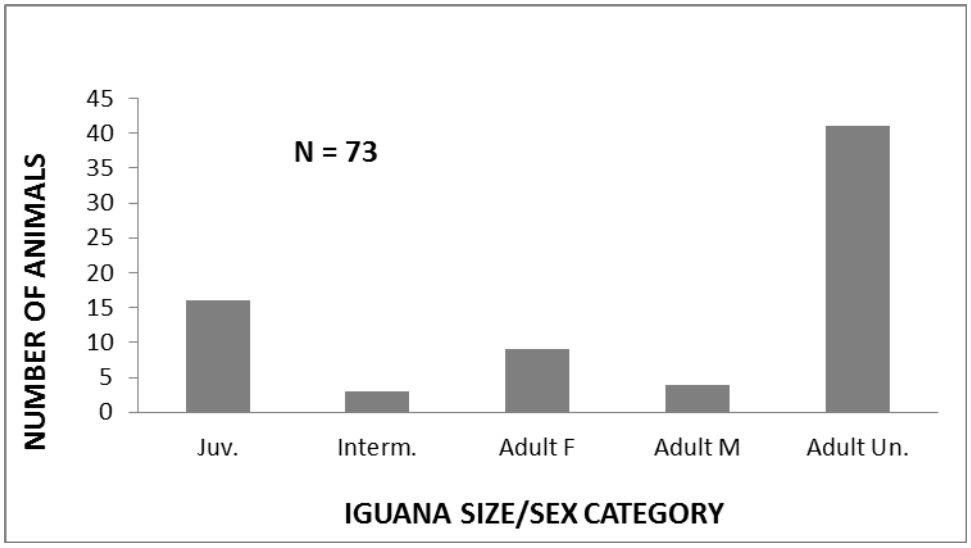


Figure 11. Size/sex structure of iguanas recently sighted by island residents.

4 Analysis of limiting factors

The numbers of iguana on St. Eustatius remain disappointingly low. After an apparent upturn between 1999 and 2004 (Fogarty et al. 2004), one important population has all but disappeared and the island-wide status of the species has not improved further but quite convincingly taken a turn for the worse. The questions to ask are what are the key factors that define iguana population health and which of the multitude of possible factors might be really limiting iguana recovery on St. Eustatius?

From what is known about iguana ecology in general, the following factors can or might especially limit the distribution of iguanas: a) temperature and/or humidity, b) availability and/or competition for food, c) sites for sunning, d) suitable shelter sites, e) human and/or other predation or mortality, f) availability of suitable nesting sites, g) diseases, h) genetic bottlenecks.

4.1 Temperature and/or humidity

This factor appears to play a notable role in limiting the distribution of the iguana on St. Eustatius as is also the case with the iguana of Saba. Notwithstanding other favourable conditions such as rocks for sunning and copious food abundance on St. Eustatius, iguanas were (almost) never seen (even outside of this study) above 300 m altitude. They definitely prefer the warmer lower parts of the island and this preference likely has to do with temperature needs for digestion (van Marken Lichtenbelt 1992, van Marken Lichtenbelt et al. 1997). But at lower altitudes there is no shortage of suitable habitat on St. Eustatius, so this factor certainly does not seriously impede population growth.

4.2 Availability of and/or competition for food

From observations on St. Eustatius, and elsewhere, as well as on the Green Iguanas of the Dutch Caribbean, it is evident that the iguana can survive on very sparse vegetation and in a variety of habitats ranging from sparse rocky ridges, mangroves, to shady forests where food availability may differ greatly in terms of diversity, abundance and seasonality. Food availability is certainly not limiting on St. Eustatius, even in those areas most heavily grazed or those areas overgrown by the invasive corallita vine. The area with highest iguana concentrations on Statia is also heavily populated with goats (A. Debrot, pers. obs.). Other authors (eg. Powell and Henderson 2005; Powell 2006) cite corallita as a possible major threat to the iguana of Statia, especially with regard to its effect on food availability. Once established in an area, this unpalatable vine indeed overgrows and eventually kills most native vegetation (Ernst and Ketner 2007). Therefore, it certainly degrades habitat quality for the iguana in terms of food availability. However, an update on the status of the vine in St. Eustatius, fortunately shows that the plant is almost fully limited to areas that have suffered intensive recent ground disturbance by man (Burg et al. 2012), and large sectors of the island remain free or virtually free of this invader. We believe its most deleterious effect is on nesting habitat as it thrives and rapidly invades the bare, erosion-prone, and unconsolidated patches of soil that iguanas require as nesting.

4.3 Sites for sunning

Sites for sunning, and the period of day time with enough sun exposure is certainly affected by topography considering that adjacent hills and cliffs can cover large parts of potentially suitable habitat in shade for large parts of the day. This may in part help explain the apparent preference of iguanas for high ground and escarpment edges especially with afternoon sun. This may in part explain the apparent current preference of the iguanas for the ridges of the northern hills which abut the central plain (Cultuurvlakte) and run along an east to west axis. This area has practically unobstructed sun-exposure

the whole day, combined with other favourable factors such as good shelter availability and the best potential for nesting sites.

4.4 Shelter sites

From our experience, the Lesser Antillean Iguana certainly appears to have a stronger arboreal tendency than the Green Iguana but almost all animals seen in the wild fled to hide in crevices among rock outcrops or boulder fields. Rocky outcrops are certainly in no short supply on St. Eustatius which should mean that the availability of adequate hiding places cannot be a major limiting factor island-wide. The situation may be different in the central plains area (Cultuurvlakte) which has been tilled and worked for agriculture since prehistoric times and where the soils are relatively boulder-free and the vegetation is principally composed of low bushes. Another area where adequate shelter may be limiting are the estates sections of the island. In such areas adequate shelter can be increased by planting the non-indigenous ornamental *Pandanus* plants, which form dense green thickets and provide iguanas with ideal hiding places (R. Hensen, pers. comm.) (Fig. 12). Fogarty et al. (2004) and Powell et al. (2005) picture an iguana in a *Pandanus*, or so-called “razor plant”. Another suitable ornamental is the non-indigenous “kaktus Surnam”, *Euphorbia lactea*, a slow-growing green thorny cactus-like plant, in which the iguana of the front cover of this report was sitting. Fogarty et al. (2004) and Powell et al. (2005) also picture an iguana hiding among the branches of this hardy ornamental. The only disadvantage of this plant species is that it grows very slowly and can take years to reach a size at which it will be useful to the iguana. Neither of these two ornamentals forms a serious invasive threat (Burg et al. 2012).

4.5 Mortality sources

During the study period we became aware of 17 iguana deaths and 11 additional instances in which iguanas were fortunately successfully rescued from life-threatening situations. This likely was only a portion of the total mortalities and life-threatening situations that actually occurred. Because of the small population size present on the island (Fogarty et al 2004) we may conclude that mortality sources and associated mortality rates due to multiple sources are likely high and probably limiting to population recovery.

4.5.1 Hunting

Human hunting of the iguana must only occur sporadically as it is hardly profitable to go out for directed iguana hunts. Population densities and sighting frequencies are simply too low. Locals are also afraid to enter the bush because aggressive feral bee-colonies are common (F. Gibbs, pers. comm.). In the case of property-owners who have carefully observed the iguanas on their land, estate or farm and know their habits thoroughly, hunting of iguanas may be more feasible. Even so, human consumption of iguanas is probably limited and not a main source of iguana deaths. During the whole period of study we only learned of 2 substantiated cases of iguanas taken for consumption and further also heard no credible rumours. Both instances involved single iguanas and the same group of persons. Along with 16 other species, *Iguana delicatissima* has been listed as a protected species since the “Statia Flora and Fauna Ordinance” was passed into law in 1997 (A.B. 1997, No. 6 &7) (McRae and Esteban 2009) (Appendix B). Present legislation stipulates maximum penalties of up to 1 month of incarceration and fines of up to 5000 (guilders) per infraction. The legal requirements for enforcement are present, and enforcement is called for and appropriate but has, nevertheless, remained lacking. Therefore, minimally the perpetrators of recent iguana hunting should be spoken to and made aware of the fact that the species is highly endangered on St. Eustatius.

Figure 12. The Pandanus, a hardy garden ornamental with sharp serration of the leaves and cherished by iguanas as a shelter site (photo: A. Debrot).

4.5.2 Native predators

Natural predators for the adult iguana are very limited on St. Eustatius. The only native predator capable of taking a mid-sized iguana would be the Red-tailed hawk, *Buteo jamaicensis*, a species that is extremely rare on the island. Young iguanas may fall prey to a number of predatory birds which include the Killy-killy, *Falco sparverius*, the Pearly-eyed Thrasher, *Margarops fuscatus*, which are relatively low in abundance, as well as to the Red-bellied racer snake, *Alsophis rufiventris,* or even large *Ameiva erythrocephala*.

4.5.3 Introduced predators

St. Eustatius is fortunate in not having any introduced mongoose, *Herpestes auropuntatus*, a species responsible for countless extirpations and extinctions of birds and reptiles in the Caribbean (Powell and Henderson 2005; Powell 2006). However, iguanas are commonly killed in gardens by dogs (R. Hensen, pers. comm). There is no dramatic stray dog or cat problem on Statia (like e.g. on Saba). Predation by dogs and cats is therefore principally a problem in the estates development sections of the island where you have the combination of high iguana density and high (predatory) pet density. Reported deaths due to dogs lead the list of documented mortalities. Of the 19 estate owners spoken to during our surveyed 10 (52%) kept dogs. The practice of keeping dogs as pets, for early-warning and/or guard purposes will likely not decline in the foreseeable future. Nevertheless, pet-related iguana mortalities could be limited by reducing the number of dogs and cats kept, by restricting their movement to smaller sections of the estates gardens, or by placing suitable shelter bushes in the yard so that the iguanas have an effective place to flee to. Feral chickens, *Gallus gallus*, are avid predators of small critters of all sorts and are particularly abundant on and around the Quill, where they might also affect young iguanas.

Hogs may prey on the nests of iguanas, as may hermit crabs and land crabs. Feral hogs are particularly present in the English Quarter sector of the island and the road out to the Botanical Garden. Hogs are a species adept at detecting food under the ground, such as invertebrates (crabs, arthropods) and tubers, and probably are a major threat to any iguana nest in their territory. Burrowing crabs, might interfere or prey on iguana nests. Particularly the large *Gecarcinus ruricola*, the red mountain crab, which are still abundant and a forestry resource of export-significance on Saba, have declined dramatically on St. Eustatius in recent years due to unknown reasons. In contrast, hermit crabs, *Coenobita clypeatus*, remain very abundant and could certainly affect iguana nests.

4.5.4 Traffic

Traffic is an important source of documented mortality (and probably under-represented in our data). Iguanas move about during daytime and are on or near roads when traffic is heaviest. This source of mortality is particularly lethal to large animals and females that need to traverse large distances in search of suitable nesting sites. It is possible that traffic mortality is seasonal, associated with the nesting season. Elsewhere, in Dominica, road-kill is an important source of mortality when iguanas migrate to coastal beaches for laying (Knapp 2007).

4.5.5 Hurricanes

Hurricanes are known to be particularly deadly for iguanas, occasionally resulting in mortalities of 60% or more (Lorvelec et al. 2007). Knapp and Valeri (2008) Describe hurricane mortalities for both hatchlings and adult iguana in Dominica. Any major hurricane, which on average affect St. Eustatius once every 5 years, can drastically reduce population numbers. This makes small, localized populations very vulnerable to extirpation. The effect on iguanas is most severe when hurricanes come with little rain towards the end and in which large salt loads are deposited on land and on plant foliage. In the aftermath of hurricanes, a shelter to rehabilitate iguanas before release back into the wild could be very beneficial and help prevent precipitous mortalities. Major iguana mortalities were seen on Saba after hurricanes George and Lenny during which the vegetation of the island was defoliated and “burnt” by the combination of wind and salt spray (James Johnson, pers. comm). Between 2004 and 2012 the only major hurricane to affect the island was hurricane Omar on October 16, 2008. The centre of the hurricane remained well away from the islands, so that mainly tropical storm conditions were experienced. While some damage to infrastructure occurred, the event was accompanied by heavy rainfall which probably kept the impact to iguanas somewhat limited. Debrot and Bugter (2010) have reviewed the potential effects that climate change can be expected to have on the nature of the Dutch Caribbean. Of these, the likely increase in extreme weather events (hurricanes and storms) is the item that probably represents the greatest direct threat to the iguana.

4.5.6 Entanglement and entrapment

Entanglement and entrapment of iguanas in human materials and structures is documented, particularly where it concerns gravid females that get stuck in the harmonica wire fencing that is the main fencing material used on the island (Fig. 13). This fencing has a maximum mesh diameter of 7.6 cm and Stenapa regularly rescues iguanas from such fences. During our study period STENAPA staff rescued seven iguanas from such fencing but in the 2-3 years before, Hannah Madden reported rescuing two additional animals from fencing at Wilhelmina park and Upper Round Hill (H. Madden, pers. comm.). This fencing is durable but actually unnecessarily fine-meshed for most fencing needs (keeping dogs in and goats out). Such fencing is widespread on the island and likely is responsible for several mortalities of gravid females every year. People should be encouraged to use different fencing wire more often (standard “goat wire” or “geitengaas”) but changing established practices is likely hard. However, in response to our findings, the Department of Agriculture Animal Husbandry and Fisheries (LVV) of St Eustatius has since decided to

start phasing-out its use of harmonica wire fencing (Director, R. Hensen, pers. comm.). Hopefully private citizens will also follow the example!

Figure 13. The most common form of fencing used on St. Eustatius and quite dangerous to iguanas, whereas less expensive wide-meshed "goat wire" would be equally suitable (photo: A. Debrot)

We have also documented cases of iguanas seeking water in a cistern and subsequently being unable to exit and either drowning or starving to death. Abandoned cisterns should be mapped and equipped with an iron re-barb woven into wire mesh and hung into the cavity such that any animals that fall in have a way to escape.

4.5.7 Nest-site availability

On several islands, the females of this species are known to migrate long distances to the coast for laying eggs (Dominica, Chancel island in Martinique and îles de la Petite Terre) (Breuil 2002). On such islands, suitable habitat for laying appear to be limited by both vegetation and geology, and coastal beaches are the prime areas having suitable nesting habitat. Bock and McCracken (1988) describe nest site limitation for an island population of the Green Iguanas. Stories that "formerly the people swam with iguanas at Venus Bay" may attest to Venus Bay at one time having provided important nesting habitat for the iguana populations of the northern section of the island. However, a field visit to Venus Bay on November 24 yielded no finds of nesting sites.

All in all, nesting habitat for the iguana appear to be in short supply, and is likely an important factor accounting for low recovery potential of this species. Nesting spots should ideally be bare, sandy, well-drained and sunny. In this study we document one larger, shared nesting site and two small single nests. Especially in the Quill area such habitat is very rare. A lack of good nesting spots likely forces female iguanas to roam widely in search of places to lay eggs. This exposes the iguanas to risk of being struck in traffic, to being killed by dogs or even to getting stuck in the harmonica wire fencing that is

found all over on the island. The identification, protection and construction of supplemental nesting sites should be a key part of the recovery plan for this species.

Ideal sites to look for iguana nests are in piles of gravel along road cuts, excavations or other areas with human disturbance of the ground and man-made clearings. The construction of suitable nest sites is easy, amounting to no more than dumping a few tons of gravel in a sunny spot, and can be achieved with a loader or back-hoe and truck (Figure 14). The trail heads would be ideal places to establish and maintain nesting spots for iguanas. On the NUSTAR grounds, many roadside clearings were seen along the way down to the pumping station at the pier where it would be easy to establish a suitable sunny nesting spot. Estate owners should be able to be found that will cooperate by creating and maintaining a gravel mound for iguana nesting.

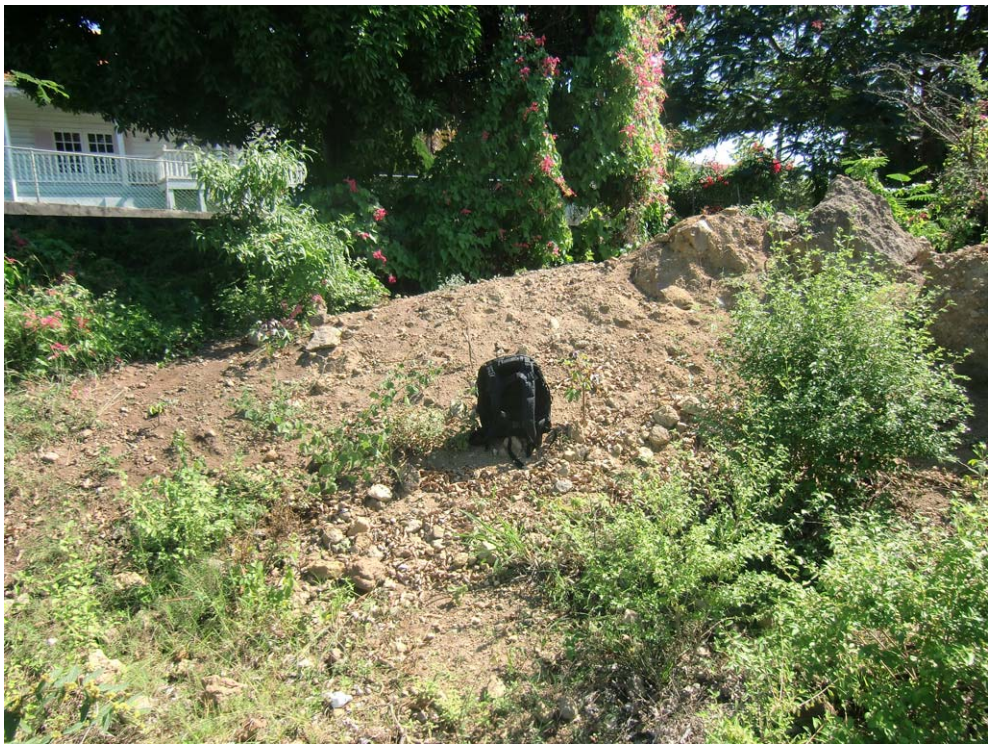


Figure 14. A bare pile of fill in the centre of Oranjestad. A great nesting possibility for iguanas, only at the wrong location (photo: A. Debrot).

4.5.8 Diseases

Wild iguana populations are known to harbour diseases such as coccidian and oxyurid intestinal parasites, piroplasmid and microsporidian blood parasites (Alberts et al. 1998, Lemm et al. 2006) as well as ticks and scale mites (Knapp et al. 2012). The natural levels of disease and parasite loads in the St. Eustatius iguana have never been studied and are certainly worth investigating. However, these factors alone are unlikely to be a major problem limiting the re-expansion of the species on St. Eustatius. Health screening of the wild population but especially also captive animals for breeding or release will be important to reduce the biosecurity risk for transfer/introduction of diseases and pathogens. The possibility of introduced feral animals serving as a reservoir of disease should also not be excluded. The abundant feral chickens may also carry intestinal parasitic diseases which could spread to wild animal populations, including the iguana.

4.5.9 Genetic limitations

Small island populations may be subject to a limited gene pool and reduced vitality. This is particularly the case in populations that have experienced one or more major population bottlenecks in the past. In the historical past, the island was intensively farmed and supported human population sizes of up to 20-thousand inhabitants. At such times the iguanas were probably greatly reduced in numbers and may have suffered major declines in population genetic diversity that can lastingly affect population vitality. Hurricanes may also have had such effects. This question makes studies into the genetics of the species an important research priority (IUCN/SSC Iguana Specialist Group, in prep.).

4.6 Summary of limiting-factor review

Table 4 captures the main conclusions of our review of limiting factors as regards the re-establishment of a minimum viable population of the Statia iguana. From our assessment, many issues are unlikely to be problematic on the island but both limited nesting sites and high man-mediated mortality rates appear to be the core matters that are currently problematic for successful recovery of the iguana population. Knapp and Perez-Hydrich (2012) reached similar conclusions for the Lesser Antillean Iguana in Dominica, where degradation of nest sites and killing by non-native mammalian predators appeared to be the greatest problem. For both problems, several potential solutions are available in Statia and should be able to be implemented effectively even with modest effort and resources.

Table 4. Overview of key determinants of iguana population health and recovery potential on St. Eustatius.

Factor	Sub-factor	Non-limiting	Part limiting	Limiting	Action Possible? (Y/N)
Temperature			X		N
Food		X			N
Sunning sites			X		N
Shelter			X		Y
Combined mortality factors				**X**	Y
	- Hunting	X			Y
	- Native predators	X			N
	- Predacious pets		X		Y
	- Traffic		X		Y
	- Hurricanes		X		Y
	- Entrapment		X		Y
Nest sites				**X**	Y
Disease		?	?	?	?
Genetics		?	?	?	Y

5 Action points

The key components of an action plan for the St. Eustatius population of the Lesser Antillean Iguana, are the same as that implemented for the French West Indies (Legouez 2010). We recommend the same three-fold focus on 1) protection of the current populations 2) improving the knowledge about the iguana, and 3) public awareness. However, we also propose the establishment of an on-island husbandry program, in association with key international partners, as the pivotal project with which to bolster guarantee successful integration of the three main themes. Captive husbandry and/or breeding, and the facilities it entails provides not only a venue for critical scientific studies but also forms the ideal setting from which to promote awareness with school children and the general public via direct contact with tame animals.

5.1 Protect current populations

5.1.1 Prevent introduction of invasive species

Two massive threats to the iguana elsewhere, and the most important causes for its extirpation on islands throughout its current and former range, are predation by the mongoose, *Herpestes auropunctatus,* and hybridization with the Green Iguana, *Iguana iguana*. These threats fortunately are not (yet) an issue for this species on St. Eustatius and all effort at the borders should be mobilized to prevent entry of these two species onto Statia soil. This can only be achieved with better legislation, awareness, training and control by border control and customs personnel. Currently there is no legislation to prevent the importation of green iguana or mongoose as pets. Although importation of the green iguana requires an (CITES) export permit from the country of origin, this is not hard to get since it is an Appendix II species. If such a permit can be produced, at present there is no way that importation can be prohibited (P. Hoetjes, pers. comm.). Therefore, it is critical to amend legislation to prohibit importation of both the green iguana and the mongoose.

5.1.2 Enforce and upgrade legal protection

The iguana has been listed as a protected species since the “Statia Flora and Fauna Ordinance” was passed into law in 1997 (MacRae and Esteban 2009). Present legislation stipulates maximum penalties of up to 1 month of incarceration and fines of up to 5000 guilders per infraction. While hunting is only one of several factors responsible for iguana deaths, the number of animals on the island is so small that no hunting can be warranted. While enforcement is clearly possible and important it has, nevertheless, remained lacking. With compliance already high (hunting is very limited), renewed implementation of the legislation first should be preceded by an information-campaign to give due warning. At present the island nature legislation does not meet all the requirements of the framework law “Wet grondslagen natuurbeheer BES” and is being upgraded (P. Hoetjes, pers. comm.). In this, amendment of the articles pertaining to the iguana are called for. It may further be most opportune to initiate stricter enforcement at the same time when the new, upgrade legislation is introduced, probably later in 2013.

5.1.3 Develop and protect additional nesting sites

In our survey we fairly established that in most areas of the island there is a virtual lack of suitable nesting sites. Those sites that are present are additionally vulnerable to the large numbers of trampling livestock or potential nest predators. Good nesting sites are relatively easy to establish, maintain and protect. They can also form pivotal sites for research and as a source of young animals for head-starting, breeding and other studies. STENAPA is currently using recommendations of this study to advise estate developers on the need to provide safe nesting sites for the iguana.

5.1.4 Introduce a “Iguana-friendly yard” program

One of the important habitat areas for the iguana at present is the estates development area of the island. The owners of these estates are largely retired, many of whom, with the right information might be willing to devote a little attention to the most critical matters for the survival of the largest and most spectacular native vertebrate land species of Statia. An “Iguana-friendly yard” program could stimulate and encourage estate owners to adapt their practices towards better iguana stewardship. In response to our findings, the Department of Agriculture Animal Husbandry and Fisheries (LVV) of St. Eustatius has since decided to start phasing-out its use of harmonica wire fencing (Director, R. Hensen, pers. comm.). Hopefully private citizens will follow the example!

5.2 Increase the biological knowledge about the iguana

Whereas the biology of the Green Iguana has been well (if not massively) studied in the Caribbean, the biology of the Lesser Antillean Iguana remains poorly known (Knapp 2007). Aside from one recent thorough population dynamic study (Knapp and Perez-Hydrich 2012), generally only summary population studies have been done, most of which on the French Caribbean islands and from the largest and healthiest populations of the species (e.g. Legouez 2007). The current population size of iguanas on St. Eustatius is very low such that there are no good concentrations of animals available in the wild for effective field studies. This means that field studies will have to use techniques such as radio-telemetry to study the habitat use and home-range of wild/semi-wild iguanas. Knowledge of active communal nesting sites can help study nesting success and yield young animals with which to establish a captive breeding program. Field studies may initially focus on animals living semi-wild in the estates development section of the island and on the breeding sites to assess reproductive seasonality, nesting success and vulnerability to invasive predatory species. The species action plan by IUCN stresses the need for a regional genetic analysis of both the Lesser Antillean Iguana and the Green Iguana (IUCN/SSC Iguana Specialist Group, in prep.). This research can help determine the degree of genetic isolation of the different iguana populations and their genetic purity. Participation in such an initiative by providing blood and serum samples for such work would be very valuable.

5.3 Create public awareness

In casual conversation with many native Statians, there appears to be little real appreciation for the uniqueness of the Statian iguana. Most inhabitants are not even aware that the Green Iguana so common elsewhere is a separate species that is not threatened. Several people spoken to believe that there are different “kinds” of iguanas on the island. This overall lack of understanding detracts from the resident public’s sense of urgency for protection. People experience iguanas as being relatively “abundant” (also elsewhere) and conservation concerns as exaggerated by “over-zealous” environmentalists .

A second aspect of awareness is that in general, the iguana is an animal that invokes fear and disgust with most native inhabitants. Very few have experienced iguanas as a gentle and beautiful animal that deserves a safe spot in every yard. Awareness can best be stimulated by taking tame pet iguanas to school for children to experience first-hand. In Curaçao, the Green Iguana was so persecuted and rare in the early 1970s and 1980s that a research and captive breeding program was established on the island. This created the opportunity for generations of school children to experience the iguana in a relaxed setting. In part due to the success of this program, by the time the project was terminated in the early 2000s, the iguana was no longer threatened on the island and is today found in most gardens in Curaçao where the species is now seen as an admired garden pet and no longer as an object of fear or something to eat. Education and awareness have been identified as key priorities at the regional level, and tying

into the regional IUCN species action plan could therefore be beneficial. Current educational efforts by Stenapa include the species and should be funded and preferably formalized as part of the educational curriculum.

5.4 Establish a small, local husbandry project

This theme is seen as having a pivotal support-role in an iguana action plan (Figure 15). Local husbandry, first for head-starting and gradually to be up-scaled to captive breeding, is the most direct means of propagating animals and increasing population size for a critically endangered animal. It secondly creates a situation that makes it easy to develop vital knowledge about the species, especially considering the low number and low population density of wild and/or semi-wild living iguanas. The presence of such facilities also opens the possibility to house any animals that are in need of rehabilitation whether it be due to normal injury or acute situations arising after certain types of hurricane scenarios. Finally, by making tame animals available for observation and experience by the public in a relaxed setting, captive breeding creates a setting allowing the public a new appreciation for the animal. The San Diego and Fort Worth zoos have developed an extensive manual on the captive breeding of West Indian iguanas among which also the Lesser Antillean Iguana (Lemm et al. 2006). The manual can provide the basis for establishing a local husbandry and captive breeding program.

A small-scale husbandry program on-island can probably be begun relatively easily. Such a program existed previously on-island but the great value and potential of such a program to yield critical new information was recognized too late and the whole initiative was never professionally documented before it terminated due to lack of interest. At this point the most critical need towards re-establishing a captive breeding program is to find an organization or individual willing to start such an initiative in the protected confines of his/her property, but to be run with professional oversight. The office headquarters of the Department of Agriculture Animal Husbandry and Fisheries (LVV) of St Eustatius would be a fine location and can be made available for such a project (Director, R. Hensen, pers. comm.). Egg collection and subsequent release practices (in the case of head-starting) and breeding managed by kinship, should be designed to ensure as little possible loss of genetic biodiversity (W. Spencer, pers. comm.). While both head-starting and breeding require animals to be kept in captivity, and thus require "husbandry" the two certainly represent different extremes on a sliding scale of complexity and requirements in terms of facilities and expertise. Animals raised through head-starting or captive breeding could not only be used to bolster population numbers on St. Eustatius but could also be used to support re-introduction elsewhere or the establishment of new populations for long-term conservation. For instance, the small offshore St. Martin satellite islands of Pinel (but only after eradication of *I. iguana*) and Tintamarre present potential locations for establishing new populations of this species in a protected island settings (IUCN/SS SSC Iguana Specialist Group, in prep.), much as has been done already in the French islands (Legouez et al. 2009). Such projects could be made possible (in whole or in part) on animals bred or head-started in St. Eustatius.

For optimum results, on-island efforts could be coupled with an overseas zoo breeding program. The species is currently being kept in captivity at the Durrell Wildlife Conservation Trust (UK), Chester Zoo (UK), and Chaffee Zoo (USA) but these are almost fully based on animals from Dominica (IUCN/SS SSC Iguana Specialist Group, in prep.). Nevertheless, breeding in the highly artificial and cramped zoo settings with small numbers of animals has proven problematic and plagued with many difficulties (IUCN/SSC Iguana Specialist Group, in prep.). Therefore*, in situ* husbandry and breeding may be preferable (as recommended by the IUCN/SSC Iguana Specialist Group, in prep.) and more easily achieve success because these projects occur under less-controlled and more-natural circumstances. Both of the past iguana husbandry projects for the Dutch Caribbean took place under natural lighting and climate, with local and native fresh foods and in spacious, outdoor enclosures. Local husbandry can best

be eased into with head-starting and later to develop captive breeding trials as the level of experience and expertise grows. Nevertheless, an overseas zoo breeding program potentially yields new important information on health, dietary requirements, reproduction and husbandry techniques with which to develop, up-scale and professionalize the on-island husbandry efforts. An additional value of *ex situ* breeding is that it would represent a last option for species restoration in the worst-case event of total extirpation on the island. Considering the recent extirpation of the species on other small islands, the very real risks of unpredictable unintentional introductions (of either *H. auropunctatus* or *I. iguana*) which could wipe-out the population within a few short years, as well as the present down-turn in the St. Eustatius population, developing this option as a potential last resort is certainly not an extravagant measure. Any of several Dutch zoos (eg. Artis and/or Blijdorp) might be able to cooperate and be willing accept a small number of animals for breeding in the Netherlands, which could serve as a valuable complement to small-scale local breeding efforts. Specifically such programs could help develop captive breeding techniques and science, assist in keeper and veterinary training, help develop and maintain studbook data to manage genetics and demography of captive populations (European Endangered species Programme/European StudBook), and assist in awareness and interpretation activities (W. Spencer, pers. comm.). Zoo breeding of this flagship species in the European Netherlands could also be an important means to promote awareness of and build support for Caribbean biodiversity in The Netherlands (P. Hoetjes, pers. comm.).

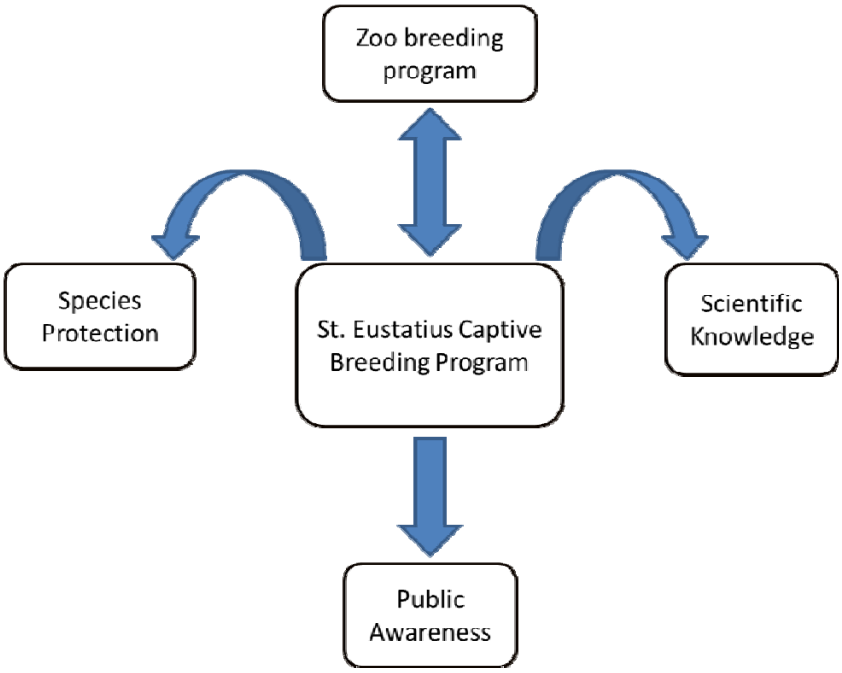


Figure 15. Captive husbandry of the Statia iguana, with breeding as the ultimate goal, can provide pivotal support towards core conservation objectives.

Literature cited

Alberts, M. L. Oliva, M. B. Worley, S. R. Telford, P. J. Morris and D. L. Janssen. 1998. The need for pre-release health screening in animal translocations: a case study of the Cuban iguana (*Cyclura nubila*). Animal Conservation 1, 165–172.

Bakhuis, W.L. 1982. Size and sexual differentiation in the lizard *Iguana iguana* on a semi-arid island. Journal of Herpetology 16(3): 322-325.

Bock, B.C. and G. F. McCracken. 1988. Genetic Structure and Variability in the Green Iguana (*Iguana iguana*). Journal of Herpetology 22(3): 316-322.

Breuil, M. 2002. Histoire naturelle des amphibiens et reptiles terrestres de l'Archipel Guadeloupéen. Guadaloupe, Saint-Martin, Saint-Barthélemy. Patrimoines Naturels 54:1–339.

Burg, W. J. van der, J. de Freitas, A. O. Debrot and L. A. P. Lotz. 2012. Naturalised and invasive alien plant species in the Caribbean Netherlands: status, distribution, threats, priorities and recommendations. PRI report 437. Imares report C185/11. 82 pp.

Debrot, A. O. and R. Bugter. 2010. Climate change effects on the biodiversity of the BES islands: Assessment of the possible consequences for the marine and terrestrial ecosystems of the Dutch Antilles and the options for adaptation measures. Alterra report 2081-IMARES-report C118/10, Alterra Wageningen UR Wageningen, 34 pp.

Ernst, J. & P. Ketner. 2007. Corallita Pilot Project St. Eustatius: Study on the ecology and possible control methods of the invasive plant species *Antigonon leptopus* (Corallita or Mexican Creeper). Report.

Fogarty, S. P., V. H. Zero and R. Powell. 2004. Revisiting St. Eustatius: Estimating the Population Size of Lesser Antillean Iguanas, *Iguana delicatissima.* Iguana 11(3): 139-146.

IUCN/SSC Iguana Specialist Group. (in prep.) Lesser Antillean Iguana *Iguana delicatissima* Conservation Action Plan 2013 – 2015. 37 pp.

Knapp, C. R. 2007. Ecology and Conservation of the Lesser Antillean Iguana (*Iguana delicatissima*). Iguana 14(4): 223-225.

Knapp, C. R., L. A. Durden and H. Klompen. 2012. *Iguana delicatissima* (Lesser Antillean Iguana). Ectoparasitism. Herpetological Review 43(1): 134.

Knapp, C. R. and C. Perez-Heydrich. 2012. Using non-conspicuous metrics to examine selected impacts of disturbance on a long-lived reptile. Endangered Species Research 17: 193–200.

Knapp, C. R. and S. Valeri. 2008. *Iguana delicatissima* (Lesser Antillean Iguana) mortality. Herpetological Review 39(2): 227-228.

Legouez, C. 2007. Les iguanes des Petites Antilles : étude de la population de l'îlet Chancel (Martinique) et elaboration du plan de restauration. Rapport destage. 70 p.

Legouez, C. 2010. The lesser Antillean iguana national actions plan. Office National de la Chasse et de la Faune Sauvage (ONCFS), French West Indies. 6 pp.

Legouez, C., J-F. Maillard, V. Arenales Del Campo and M. Breuil. 2009. L'iguane des Petites Antilles: une espèce menacée en Martinique: premières mesures de conservation. Faune Sauvage 284: 60-65.

Lemm, J. M., N. Lung, and A. M. Ward. 2006. Husbandry Manual for West Indian Iguanas. 100 pp.

Lorvelec, O., M. Pascal, C. Pavis and P. Feldmann. 2007. Amphibians and reptiles of the French West Indies: Inventory, threats and conservation. Applied Herpetology 4: 131-161.

MacRae D.R., and N. Esteban. 2009. The Quill/Boven National Park and Botanical Garden Management Plan 2009. Coastal Zone Management (UK), STENAPA (St. Eustatius). 134 pp.

Pasachnik, S.A., Breuil, M.and R. Powell. 2006: *Iguana delicatissima*. Cat. Amer. Amphib. Rept. 811:1-14.

Pasachnik, S.A., J.J. Shew, J.H. Townsend and R. Powell. 2002. *Iguana delicatissima* (Lesser Antillean Iguana) activity. Herpetological Review 33(1):51-52.

Powell, R. 2006. Conservation of the herpetofauna on the Dutch Windward Islands: St. Eustatius, Saba, and St. Maarten. Applied Herpetology 3: 293-306.

Powell, R. and R.W. Henderson. 2005. Conservation status of Lesser Antillean reptiles. Iguana 12: 62-77.

Powell, R., R. W. Henderson and J. S. Parmerlee. 2005. The reptiles and amphibians of the Dutch Caribbean. STENAPA, St. Eustatius. 192 pp.

Reichling, S. 2000. The status of the Lesser Antillean Iguana on Sint Eustatius. *Iguana Times* (*J. Intl. Iguana Soc.*) 8(1):3–6.

Turk, P. A., N. N. Wyzynski and R. Powell. 2010. *Iguana delicatissima* (Lesser Antillean Iguana) display behaviour. Herpetological Review 41: 79–80.

Stephen, C.L., V.H. Reynoso, W.S., Collett, C.R., Hasbun, and J.W. Breinholt. 2012 (in press) Geographical structure and cryptic lineages within common green iguanas, *Iguana iguana*. J. Biogeography.

STINAPA 1980. Jaarverslagen CARMABI-STINAPA 1979. Stinapa No. 20: 55.

Van Marken Lichtenbelt, W. D. 1992. Digestion in an ectothermic herbivore, the green iguana *(Iguana iguana)*: effect of food composition and body temperature. Physiological Zoology 65: 649–673.

Van Marken Lichtenbelt, W. D. 1993. Optimal foraging of a herbivorous lizard, the green iguana, in a seasonal environment. Oecologia 95: 246–256.

Van Marken Lichtenbelt, W. D. and K. B. Albers. 1993. Reproductive adaptations of the green iguana on a semiarid island. Copeia 1993: 790–798.

Van Marken Lichtenbelt, W. D., J. T. Vogel and R. A. Wesselingh. 1997. Energetic consequences of field body temperatures in the green iguana. Ecology 78(1): 297–307.

Van Marken Lichtenbelt, W. D., R. A. Wesselingh, J. T. Vogel and K. B. M. Albers. 1993. Energy budgets in free-living green iguanas in a seasonal environment. Ecology 74: 1157–1172.

Veenenbos, J.S. 1955. A soil and land capability survey of St. Maarten, St. Eustatius, and Saba. Publ. Found. Sci. Res. Sur. Neth. Ant., Utrecht, The Netherlands. 11, 94 pp.

Quality Assurance

IMARES utilises an ISO 9001:2008 certified quality management system (certificate number: 124296-2012-AQ-NLD-RvA). This certificate is valid until 15 December 2015. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Fish Division has NEN-EN-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 27 March 2013 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

Justification

Report C166/12
Project Number: 430.87010.04

The scientific quality of this report has been peer reviewed by a colleague scientist and the head of the department of IMARES.

Approved:	Dr. ir. M.J. Baptist researcher
Signature:	
Date:	January 11, 2013

Approved:	F.C. Groenendijk, MSc. Head of Department
Signature:	
Date:	January, 2013

Appendix A. Question list used to structure interviews

Interview Questions Iguana Survey 2012

Date:

Name of the interviewed:

Address of Estate:

GPS N GPS W

In and around your garden:

1. Have you seen any Iguanas in or around your garden (If answer if NO then move on to question 6)?

2. When was the last time you saw one?

3. How often do you see Iguanas and how many do you see?

4. What size was it/were they?

5. Are you aware of any nesting around here?

6. Do you have any dogs?

Elsewhere:

7. Have you seen any live Iguanas lately elsewhere and if so when and where?

8. Any dead iguanas? If so when and where?

Appendix B. Present legislation

"Verordening bescherming fauna en flora"

A.B. 1997, no. 6

HOOFDSTUK I Algemene bepalingen

Artikel 1

In deze verordening en de daarop berustende bepalingen wordt verstaan onder:

- a. bestuurscollege: het bestuurscollege van het eilandgebied Sint Eustatius;
- b. eilandgebied: het eilandgebied Sint Eustatius;
- c. fauna en flora: de fauna en flora op het land en in de territoriale wateren rond het eilandgebied Sint Eustatius.

Artikel 2

Bij eilandsbesluit, houdende algemene maatregelen, worden aangewezen:

- a. planten, struiken, heesters, struikgewas, bomen of klimplanten;
- b. dieren die vallen onder speciale bescherming van deze verordening.

HOOFDSTUK II Beschermende maatregelen

Artikel 3

Het is verboden om de krachtens artikel 2 aangewezen fauna en flora species:

- a. te plukken, af te snijden, te transplanteren, te verstekken, te verzamelen, te vernietigen, te verstoren, te beschadigen of het direct of indirect nalaten van handelingen die het vernietigen of verstoren van de flora tot gevolg hebben;
- b. te vangen, in bezit hebben, te rapen, te doden, te verwonden of het direct of indirect verstoren van de leefomgeving met als resultaat een fysieke bedreiging en/of beschadiging van de fauna.

Artikel 4

Personen die dieren houden zijn verantwoordelijk voor iedere schade die de dieren aanbrengen aan de krachtens artikel 2 aangewezen fauna en flora.

Artikel 5

De gebieden die worden aangemerkt als gezichtsbepalend of uniek natuurlandschap worden bij eilandsbesluit, houdende algemene maatregel, vastgesteld.

Artikel 6

Het is niet toegestaan om gezichtsbepalende of unieke natuurlandschappen te beschadigen, vernietigen of te veranderen.

HOOFDSTUK III Ontheffingen

Artikel 7

- 1. Het Bestuurscollege kan ontheffing verlenen van de in de artikelen 3 en 5 opgenomen verboden.
- 2. Bij eilandsbesluit, houdende algemene maatregelen, kunnen nadere regels worden gegeven voor de voorwaarden waaraan moet worden voldaan om voor ontheffing in aanmerking te komen.

Artikel 8

Een verzoek om ontheffing wordt schriftelijk door de aanvrager bij het Bestuurscollege ingediend onder:

- 1. opgaaf van reden(en);
- 2. overlegging van bescheiden waaruit de noodzaak van ontheffing blijkt.

Artikel 9

Het Bestuurscollege kan aan een ontheffing voorwaarden en andere beperkende regelingen te verbinden waarbij, voorafgaande aan het inwerking treden van de ontheffing, moet worden voldaan.

Artikel 10

Het Bestuurscollege zal de aanvrager schriftelijk informeren over de ontheffing en de datum van inwerkingtreding.

Artikel 11

Het Bestuurscollege zal een geheel of gedeeltelijke afwijzing schriftelijk motiveren.

Artikel 12

1. De aanvrager kan bezwaar indienen tegen een geheel of gedeeltelijke afwijzing van de ontheffing.
2. Het bezwaarschrift moet binnen een (1) maand na dagtekening schriftelijk bij het Bestuurscollege worden ingediend. De datum van binnenkomst (tijdig) is bepalend of het bezwaarschrift in behandeling wordt genomen.
3. Het Bestuurscollege hoort de aanvrager alvorens een definitief standpunt in te nemen.
4. Het Bestuurscollege beslist schriftelijk op een bezwaarschrift.

HOOFDSTUK IV Slotartikelen Strafbepalingen

Artikel 13

Overtreding van de bij of krachtens deze verordening gestelde maatregelen ter bescherming van de fauna en flora wordt gestraft met hechtenis van ten hoogste een maand of een geldboete van ten hoogste vijfduizend gulden.

Artikel 14

De bij deze verordening strafbaar gestelde feiten zijn overtredingen.

Artikel 15

Met het opsporen van de bij deze verordening strafbaar gestelde feiten zijn, behalve de in artikel 8 van het Wetboek van Strafverordening aangewezen ambtenaren belast de bij eilandsbesluit aan te wijzen personen.

Artikel 16

De voorwerpen, door overtreding van een of meer der verbodsbepalingen in deze verordening verkregen, of waarmee de overtreding is gepleegd, kunnen in beslag worden genomen en door de rechter verbeurd worden verklaard.

Artikel 17

Deze eilandsverordening treedt in werking op de dag nadat zij is afgekondigd.

Artikel 18

Zij kan worden aangehaald als de "Verordening bescherming fauna en flora".

EBHAM (Eilandsbesluit, houdende algemene maatregelen), regelende de fauna en flora specimen vallende onder de Verordening bescherming fauna en flora

A.B. 1997, no. 7

HOOFDSTUK I Flora

Artikel 1

Als beschermde flora wordt aangemerkt:

- A. De **Ipomoea sphenophylla** ook bekend onder de naam "Statia Morning Glory".
- B. De navolgende inheemse planten behorende tot de familie der orchidee-achtigen:
    - 01. Epidendrum ciliare
    - 02. Epidendrum diforme
    - 03. Epidendrum Kraenzlinii
    - 04. Epidendrum secundum
    - 05. Oncidium urophyllum
    - 06. Brassavola cucullata
    - 07. Tetramicra canaliculata
    - 08. Spiranthes elata
    - 09. Spiranthes lanceolate
    - 10. Jacquiniella globosa
    - 11. Prescottia stachyodes
    - 12. Erythrodes hirtella
    - 13. Erythrodes plantaginea
    - 14. Polystachya concreta
    - 15. Liparis nervosa

HOOFDSTUK II Fauna

Artikel 2

Als beschermde fauna wordt aangemerkt:

De **Iguana delicatissima**, een inheemse leguaan.

HOOFDSTUK III Natuurlandschappen

Artikel 3

Als gezichtsbepalende natuurlandschappen of unieke bomen/planten worden aangemerkt:

- A. De buitenhelling van de vulkaan "The Quill" vanaf de tweehonderdvijftig (250) meter hoogtelijn alsmede de binnenwanden van de krater en de vegetatie in de krater.
- B. De gebieden welke worden aangeduid als:
  - 1. "Boven"
  - 2. "Venus"
  - 3. "Gilboa Hill”
  - 4. "Signal Hill”
  - 5. "Bergje".
- C. De kapokboom in de lokatie "Lower Town”, nader aangegeven op bijlage I bij dit besluit.
- D. De klifwand in het gebied "Lower Town" over de lengte vanaf het haventerrein tot en met de haarspeldbocht bij "King's Well" zoals nader is aangeduid op bijlage II bij dit besluit.

HOOFDSTUK IV Ontheffingsvoorwaarden

Artikel 4

Op grond van artikel 7 van de verordening kan ontheffing worden verleend in geval van:

- a. het in gedrang komen van de verkeersveiligheid;
- b. bedreiging van privé eigendommen door molest;
- c. wetenschappelijk onderzoek.

Artikel 5

Een verzoek om ontheffing wordt om advies voorgelegd aan:

- de plaatselijke politie autoriteiten;

bij verkeersveiligheid.

- de dienst Openbare Werken van het eilandgebied Sint Eustatius;

bij (bouw)technische beoordelingen,

- bij een of een combinatie van de volgende instanties:

natuur- en milieudeskundigen in dienst bij het eilandgebied, het Departement van Volksgezondheid en Milieu Hygiëne (Vomil), een onafhankelijk (natuurdeskundig) instituut/organisatie, bij het beoordelen van wetenschappelijk onderzoek.

Artikel 6

Voor het in behandeling nemen van het ontheffingsverzoek worden administratieve kosten in rekening gebracht waarvan de hoogte is vastgesteld op Naf 100,- per verzoek.

Artikel 7

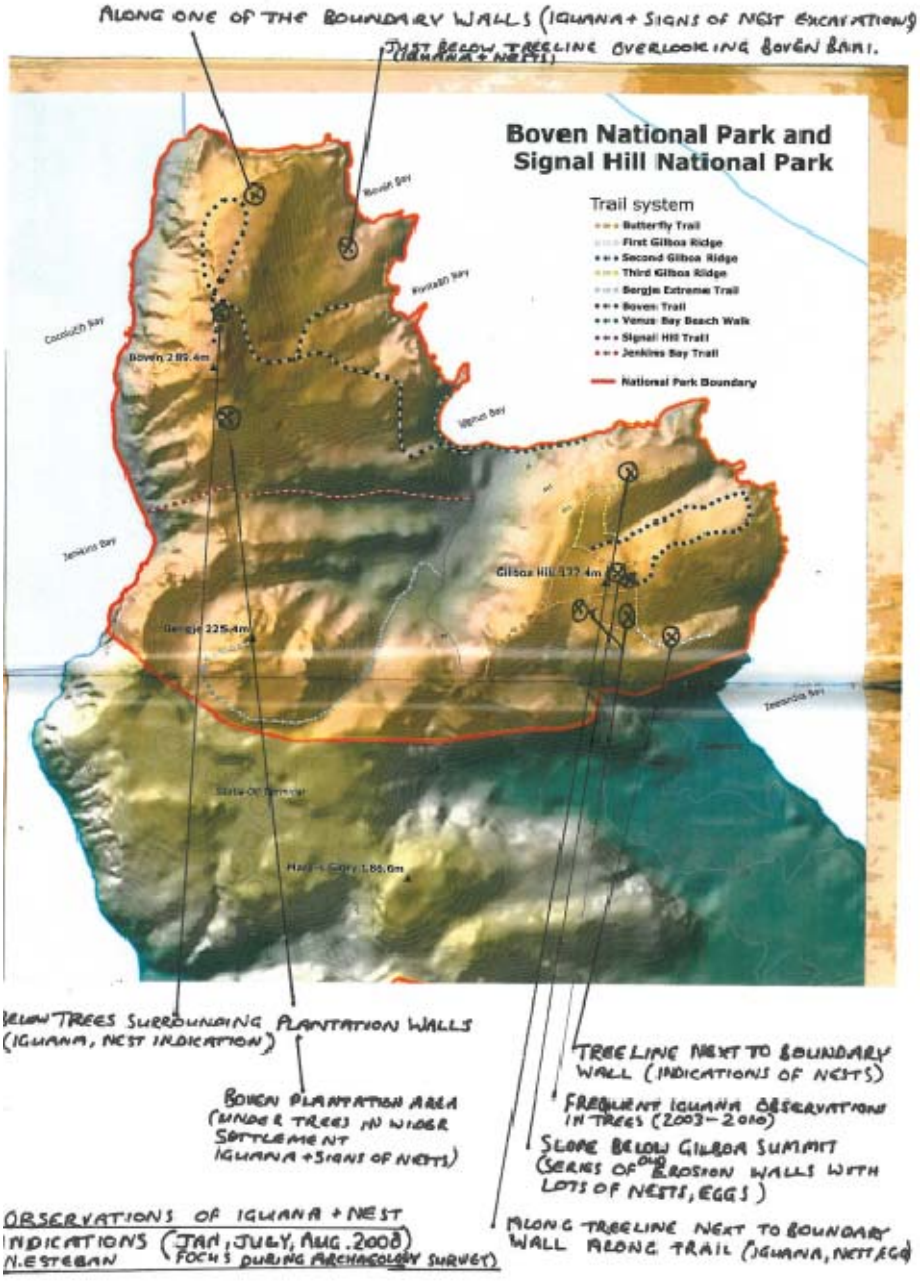
Voor de ontheffingsvergunning worden leges geheven waarvan de hoogte van het bedrag is vastgesteld in de Retributieverordening Sint Eustatius.

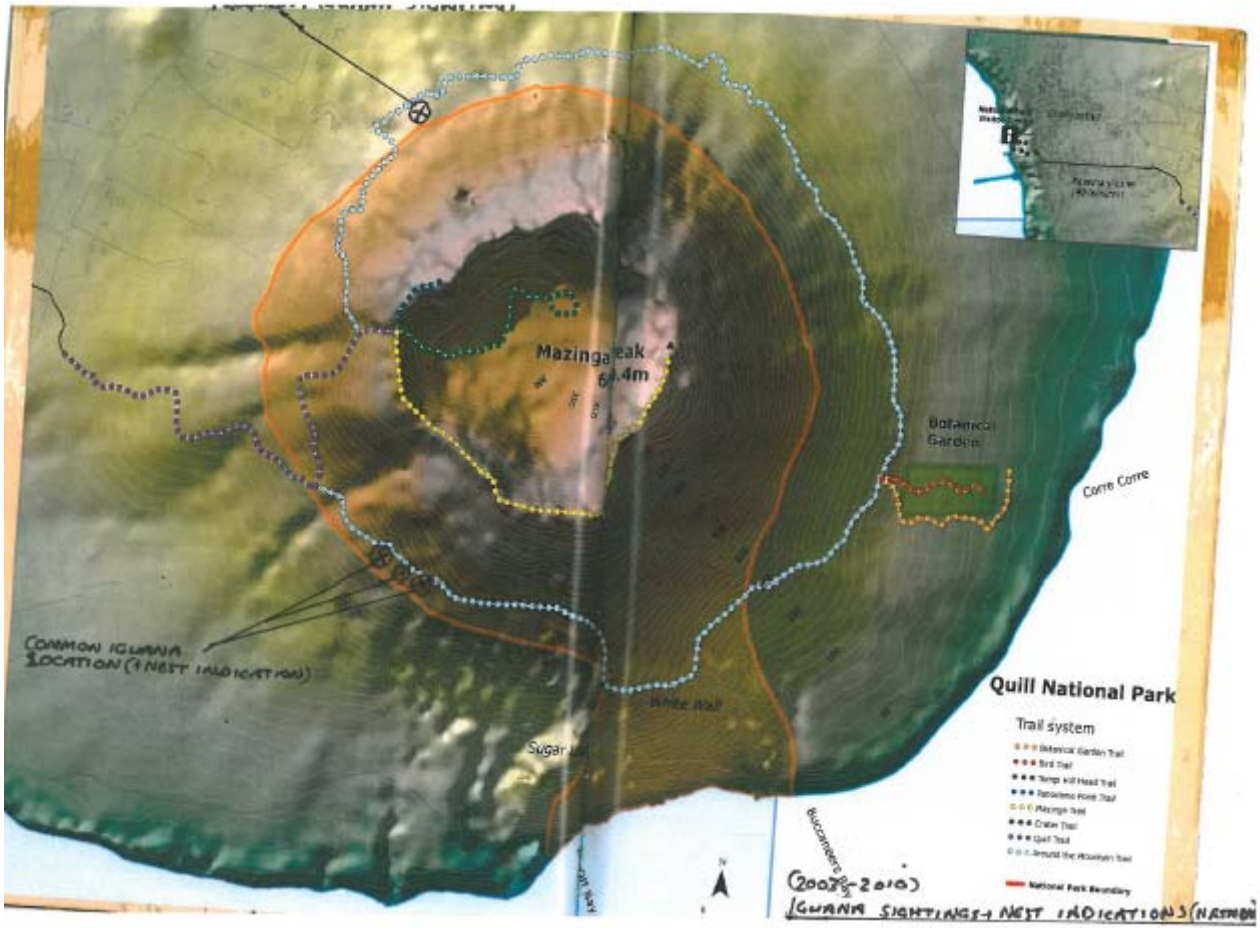
HOOFDSTUK V Slotartikelen

Artikel 8

Dit eilandsbesluit, houdende algemene maatregelen, treedt in werking met ingang van de dag na die zijner afkondiging.

Appendix C. Sites of actual/potential iguana nesting as documented by Nicole Esteban, Jan-Aug 2008.




Mazinga Peak
Botanical Garden
Corre Corre
COMMON IGUANA LOCATION (+NEST INDICATION)
Quill National Park
Trail system
National Park Boundary
(2007-2010)
IGUANA SIGHTINGS+NEST INDICATIONS