

# Assessment of the Breeding Success of Red-billed Tropicbirds on St. Eustatius

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## Abstract

We assessed the breeding success of Red-billed Tropicbirds *Phaethon aethereus* on St. Eustatius, particularly in relation to predation at the nest. We conducted weekly surveys at five sites during 2012-2013 and measured chick and adult morphometrics. Apparent nest success ranged from 55-100% across five breeding areas, while apparent fledge success ranged from 63-100% at those same locations. We used cameras and baited rat traps to document the presence of predators at nest sites. Predation rates captured on cameras were low (ca. 20 images of predators from ca. 263,000 images over 11 weeks). Cameras documented cats and rats at accessible nests. Although we could not confirm the cause of egg loss or the death of some chicks, the presence of cats and rats suggests that additional effort be expended to accurately measure their impact.

## 1. Introduction

The island of St Eustatius, affectionately called Statia, lies in the Northern Leeward Islands at 17°30'N 62°58'W (Figure 1) and is a special municipality of the Netherlands, formerly the Netherlands Antilles. It has a population of 3,791 (Central Bureau of Statistics, 2012). The island is 21 km<sup>2</sup> in area with a dormant volcano, the Quill, to the south standing at 600 m above sea level, and hills to the north, the Boven Hills, which stand at 200-300 m above sea level.



Figure 1: SSS Island Map (© 2009 Hanhill)

The average yearly temperature is 25.7° C (1959-1980; De Palm, 1985). The change in temperature throughout the year is minimal. January is on an average the coldest month with 25.2° C and August is on an average the hottest month with 28.0° C. Rainfall on low-lying area the Boven is limited to around 1100 mm per year, classifying this area's climate as savannah with a dry season. Above elevations of 400 m on the Quill, rainfall reaches 1,500-2,000 mm per year, which classifies this area as monsoon forest dry climate. Average humidity on the island is 85%.

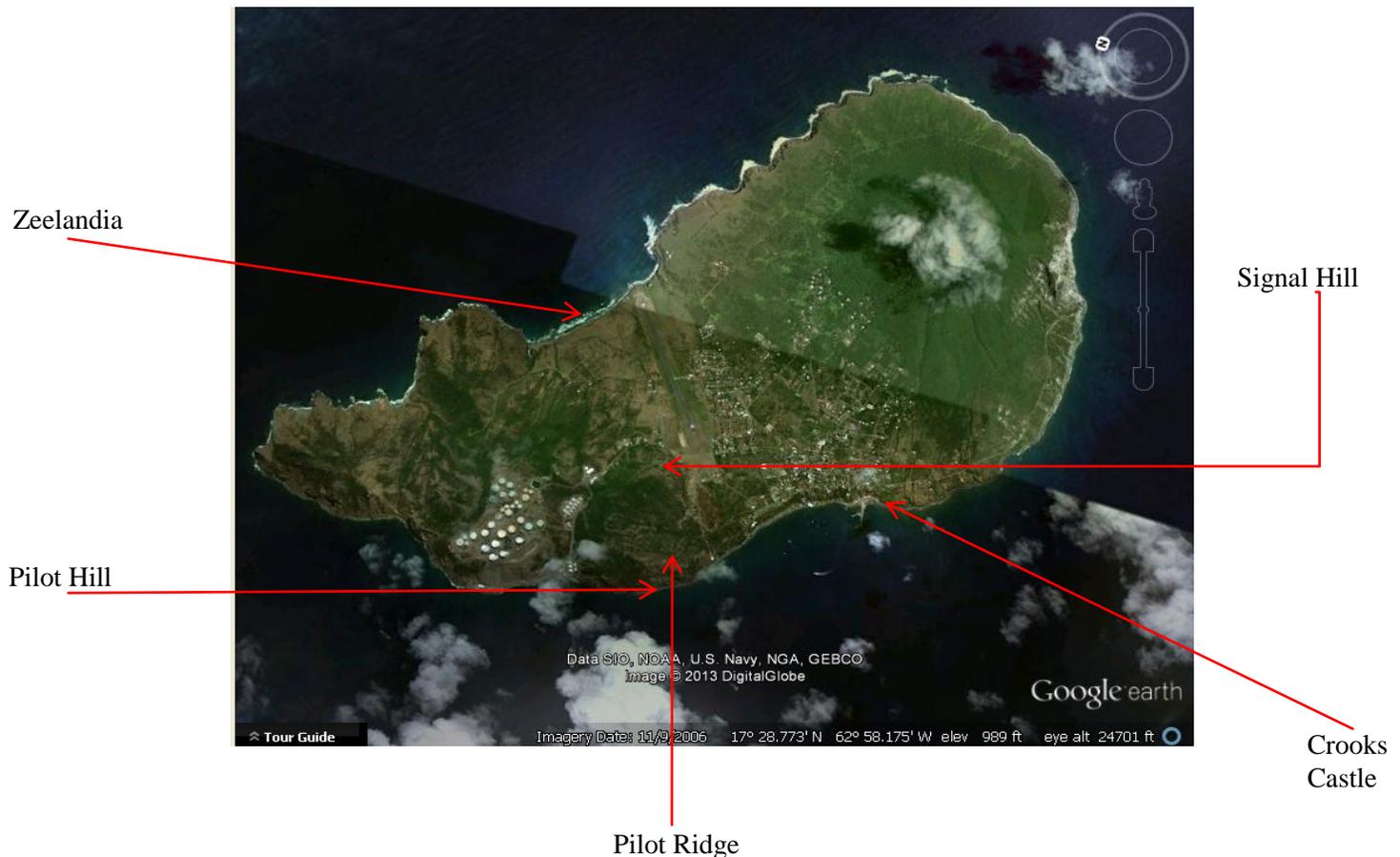
Statia was 'discovered' in 1493 by Christopher Columbus. Throughout a turbulent colonial era that followed, the island changed hands 22 times. It is difficult for present day visitors to imagine that this tiny island was once one of the busiest ports in the region.

STENAPA is a grassroots NGO that was established in 1996. It is responsible for the management of marine and terrestrial protected areas, including two Important Bird Areas. The only species of seabird known to nest on St. Eustatius is the Red-billed Tropicbird, and the island supports the second-largest breeding colony of tropicbirds in the Caribbean (Delnevo, pers. comm.).

## 2. Project Overview

Red-billed Tropicbirds *Phaethon aethereus* are classified as a species of least concern by the IUCN at the global scale (Birdlife International, 2012). Within the Caribbean, however, the species status appears to vary among islands. For example, Red-billed Tropicbirds nesting on the nearby island of Saba suffered 100% chick mortality during the 2011/12 breeding season at two of their three main nesting sites (Boeken, pers. comm.). Given that St. Eustatius and Saba support approximately 33-40% of the global population of Red-billed Tropicbirds (Delnevo, pers. comm.), reproductive failure at the level reported on Saba could have a detrimental effect even at the global scale. For this reason we sought to investigate reproductive success of Red-billed Tropicbirds at St Eustatius and to determine if chick mortality levels were similar to those recorded on Saba.

Few data are available regarding the size, distribution, or breeding success of the St Eustatius population of Red-billed Tropicbirds. Therefore our goal was to assess these breeding attributes and develop baseline data for use in long-term monitoring. Due to the topography of the island and the nature of the sites used for nesting it was not possible to visit all nests or nesting sites. Based on accessibility and anecdotal evidence of tropicbird activity, five areas were searched for primary nests and these were regularly visited to measure chick growth and investigate nesting and fledging success.



### 3. Methods

We visited each nesting site and each primary nest on average once per week. Visitation rates are given below (Table 1):

Signal Hill (SH)	Zeelandia (ZE)	Crooks Castle (CR)	Pilot Hill (PH)	Pilot Ridge (PR)
5-14	3-14	9-11	4-17	3-17

**Table 1: Visitation rates showing the minimum and maximum number of visits to each nesting colony.**

At each nest visited we noted the number of adults and whether each nest contained an egg or chick. We measured standard morphometrics for each bird (adult and chick). Culmen length ( $\pm 1$  mm) was measured with as the distance from the end of the upper mandible to the point where the feathering begins on the head. The length of the head plus bill ( $\pm 1$  mm) was measured as the distance from the end of upper mandible to the back of the skull. Bill depth ( $\pm 1$  mm) was measured at the gonydeal expansion. Each bird was also weighed using a spring scale and previously weighed bag ( $\pm 5$  or  $\pm 10$  g depending upon whether the mass was  $> 600$ g).

Birds were banded using numbered aluminium bands, which were manufactured specifically for St Eustatius, funded by the Dutch Caribbean Nature Alliance (DCNA). These purple bands have the prefix EUX followed by four digits. (Similar bands were donated to Saba with the prefix SAB and a different colour.) Adults were only measured when first encountered to minimise disruption to their natural behaviour (Le Maho et al, 1992). Chicks were removed from the nest and measured on each visit, although occasionally the size or shape of the nest and the chick's location within it prohibited capture of the chick. Measurements were taken using the smallest amount of handling and shortest time out of the nest that was possible to minimize stress. Where possible we estimated the age of the chicks based on known or estimated hatch dates so that we could monitor and compare growth.

### 4. Reproductive Success

Red-billed Tropicbirds lay just one egg per nest. We report apparent hatching success (AHS), apparent fledging success (AFS) and apparent breeding success (ABS) for each nesting area.

- AHS was measured as the percentage of eggs that hatched per eggs that were found

$$\frac{n_h}{n_l} \times 100 = AHS$$

- AFS was measured as the percentage of apparently fledged chicks per number of hatched eggs

$$\frac{n_f}{n_h} \times 100 = AFS$$

- ABS is the percentage of fledged chicks per number of laid eggs

$$\frac{n_f}{n_l} \times 100 = ABS$$

( $n_h$  = number hatched;  $n_l$  = number laid;  $n_f$  = number fledged)

Each of these measurements was done for each of the five areas we visited based on our observations from January to June 2013.

We deployed ten Reconyx HC500 cameras to monitor activity at the entrance/exit of nests. Where possible, cameras were deployed at nests with eggs or young chicks in order to collect as much data as possible. However, the majority of cameras were not delivered until towards the end of the nesting season, therefore it was not possible to study all nests with an egg or young chick. The cameras were set up to take one photo every 5 minutes 24 hours a day and also to take three photos, one second apart, every time a variance in temperature was detected. The main focus of the cameras for this project was to capture photos of introduced predators, namely cats (*Felis catus*) and rats (*Rattus norvegicus*).

## 5. Results

Apparent hatching success (AHS) ranged between 54.5% and 100% across nesting sites, with an average of 59.6% across all areas. Apparent fledging success (AFS) ranged between 62.5% and 100% across nesting sites, with an average of 78% across all areas. Apparent breeding success (ABS) ranged between 33.3% and 75% across nesting sites, with an average of 48.4% across all areas (Table 2).

Status	Eggs laid	Eggs hatched (still incubating)	AHS (%)	Chicks apparently fledged	AFS (%)	ABS (%)
Signal Hill (n=10)	11	6	54.5%	6	100.0%	54.5%
Crooks Castle (n=4)	4	4	100.0%	3	75.0%	75.0%
Zeelandia (n=10)	14	8	57.1%	5	62.5%	35.7%
Pilot Hill (n=38)	45	22 (4)	48.9%	15	68.2%	33.3%
Pilot Ridge (n=23)	25	19	76.0%	17	89.5%	68.0%
<b>Total</b>	<b>99</b>	<b>59</b>	<b>59.6%</b>	<b>46</b>	<b>78.0%</b>	<b>48.4%</b>

**Table 2: Reproductive Success of Red Billed Tropicbirds at five study sites in St. Eustatius, November 2012 – June 2013.**

**Definitions:**

Eggs laid: All nests in which an egg is laid (or chick observed)

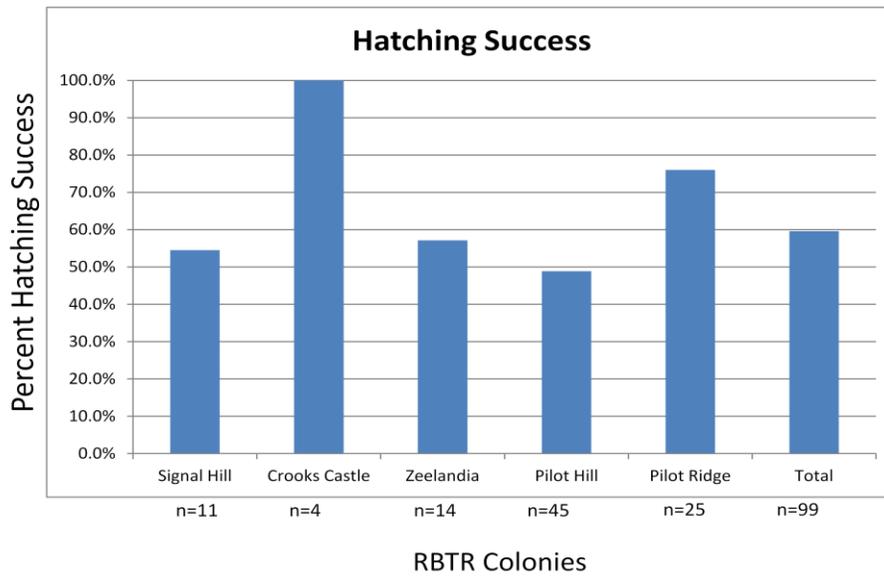
Eggs hatched: All (probably) hatched eggs + nests with chicks

AHS(%): Percentage of hatched eggs per number of eggs

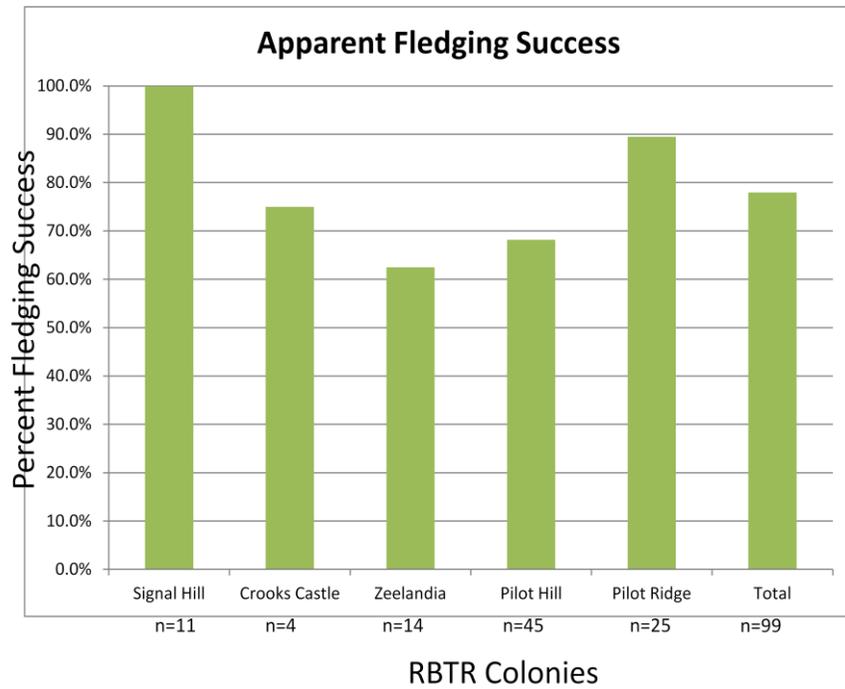
Chicks apparently fledged: Percentage of fledged chicks per number of hatched eggs

AFS(%): All chicks probably fledged

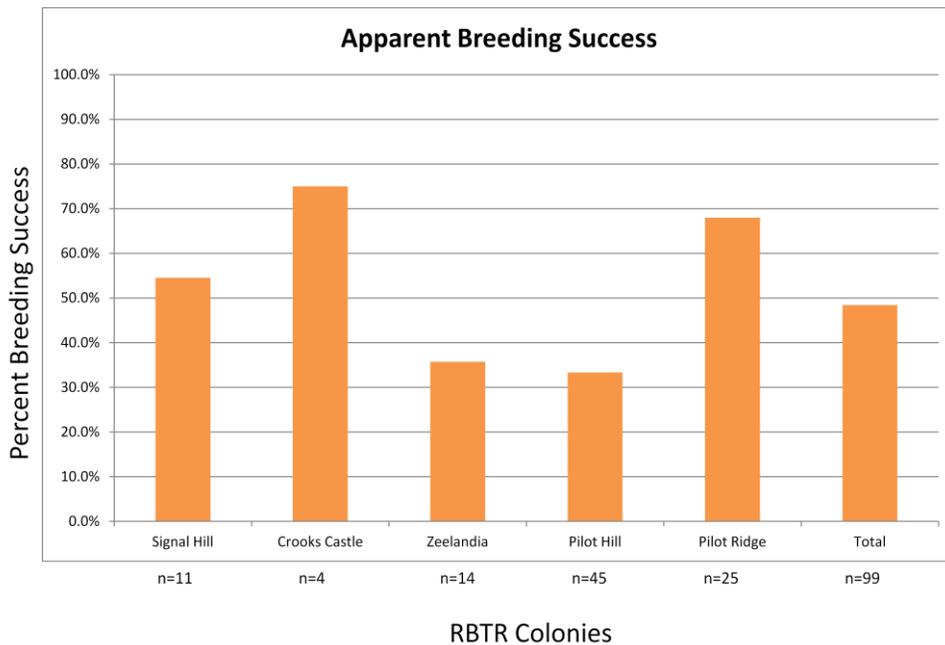
AP(%): Percentage of fledged chicks per number of laid eggs



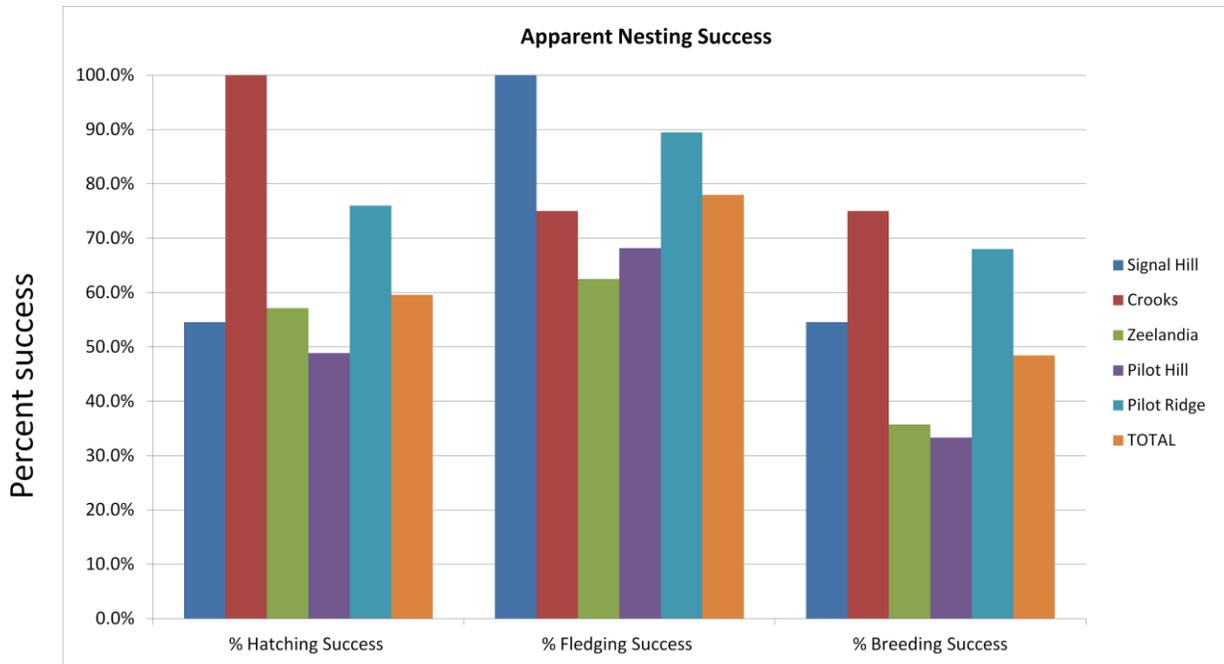
**Figure 2: Hatching success of Red-billed Tropicbirds at five study sites in St. Eustatius, November 2012 – June 2013 (n=number of nests).**



**Figure 3: Apparent fledging success of Red-billed Tropicbirds at five study sites in St. Eustatius, November 2012 – June 2013 (n=number of nests).**



**Figure 4: Apparent breeding success of Red-billed Tropicbirds at five study sites in St. Eustatius, November 2012 – June 2013 (n=number of nests).**



### Biological Measure

**Figure 5: Overall biological measure of Red-billed Tropicbirds at five study sites in St. Eustatius, November 2012 – June 2013.**

Photographs were taken by ten cameras at three nest sites between March and June 2013. Overall, ca. 263,000 photos were taken and there were 3 incidents of cats and rats totalling 21 photos (Table 2). Goats (*Capra aegagrus hircus*) and black land crabs (*Gecarcinus ruricola*) were also seen in the photos, but are not thought to affect tropicbirds due to their plant-based diet (Journal of Crustacean Biology, 2007).

Nest number/site	Photos taken	Photos containing Cat/Rat	Photos containing Cat/Rat %
807	70,573	0	0.0
819	39,633	0	0.0
825	2,447	0	0.0
838	8,035	0	0.0
840	8,802	3	0.034
<b>Total Pilot Ridge</b>	<b>132,778</b>	<b>3</b>	<b>0.0022</b>
818	3,328	0	0.0
854	11,889	0	0.0
874	17,768	4	0.022
<b>Total Pilot Hill</b>	<b>32,985</b>	<b>4</b>	<b>0.012</b>
894	51,766	14	0.027
900	45,580	0	0.0
<b>Total Signal Hill</b>	<b>97,346</b>	<b>14</b>	<b>0.014</b>
<b>Total Overall</b>	<b>263,109</b>	<b>21</b>	<b>0.008%</b>

**Table 2 – Results of Reconyx cameras at three nesting sites, March – June 2013.**

## 6. Conclusion

Our results show that Statia's Red-billed Tropicbird population has a relatively low hatching success at three of the five colonies studied. In contrast, the overall apparent fledging success across all sites is relatively high.

Crooks Castle had an apparent hatching success of 100% and apparent breeding success of 75%, however it also had the lowest sample size at just 4 nests. Signal Hill had the highest apparent fledging success at 100% with a sample size of 11 nests, however it had a hatching success of only 55%. Zeelandia had an apparent hatching success of 57% and apparent fledging success of 63% out of 14 nests. Pilot Hill had an apparent hatching success of 49% and apparent fledging success of 68% out of 45 nests. Pilot Ridge had apparent hatching success of 76% and apparent fledging success of 90% out of 25 nests. No cameras or rat traps were deployed at Crooks Castle or Zeelandia, therefore we were unable to confirm the presence of predators at these sites. One rat was caught in a trap at Pilot Ridge, however cameras deployed at this site did not capture photos of cats or rats. No photos of cats or rats were captured at Pilot Hill, nor did we catch any rats in the traps. We did capture images of cats and rats at Signal Hill, which is located closer to human habitation than any of the other sites. Our primary nests in this site were located at low elevations and close to the main road that leads to the oil storage terminal, operated by NuStar. Therefore it is unsurprising that cats and rats were documented in the area.

However, we are concerned about the high levels of egg loss at three sites: Signal Hill, Zeelandia and Pilot Hill. In particular, Pilot Hill is a remote area along the north-western coast that is characterized by large boulders on a steep, sandy cliff. It is rarely, if ever, accessed by humans and is further from human habitation than the other sites.

## 7. Discussion and Future Plans

Based on the results above, we plan to investigate the cause of egg loss at one site, namely Pilot Hill, during the 2013-2014 nesting season. This will involve the deployment of our Reconyx field cameras at suitable nests (containing an adult with egg) to document the progress of the nest throughout the breeding season. The data gathered from photographs will give us information about the frequency and timing of egg loss, cause of egg loss, as well as the ecology of the nest; attendance patterns by parents; and other biological information such as incubation period. In addition to cameras, we will also install baited traps in an attempt to catch predators. We envisage the traps will catch rodents (rats and mice), as well as land-crabs, and possibly lizards. We will bait traps weekly and return the following day to check their contents. The results will be recorded in a data sheet.

We are in discussion with Dutch research institution IMARES about undertaking a diet study of tropicbirds. This will involve taking scrapings from the nest, as well as collecting regurgitated fish, and analyzing the contents. In order to be able to do this, we hope to use the lab facilities of the Caribbean Netherlands Science Centre that will open on Statia towards the end of 2013.

We will conduct long-term monitoring of nest fidelity / inter-island movements of tropicbirds between Saba and Statia. It is possible that given the high levels of predation on Saba, adult birds that have suffered a failed nest may fly to Statia in order to make a second (or third) attempt. The coloured and individually numbered leg bands will enable us to easily identify birds that have been banded on either island.

We look forward to welcoming Dr. Pat Jodice back to Statia in order to attempt to retrieve some of the 18 geolocators that were attached in March 2013. The data collected will give us a better understanding of the regional movements of Red-billed Tropicbirds.

We will continue conducting population and productivity monitoring every two to three years on Statia in order to build a better picture of the trends over time. This will enable Stenapa to suggest/implement any conservation measures that may be necessary in the future, such as the removal of roaming animals from nesting sites by their owners.

## 8. Acknowledgements

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- St. Eustatius Gwendoline van Putten high school for weekly field assistance by students Jose-Luis Garcia and Giovanni Balensuela.
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- Stenapa interns Tess Tarling, Steve Leeming and various volunteers that assisted with fieldwork.

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## Appendices

### Appendix 1

The second part of this project involved confirming the presence of Audubon's Shearwater (*Puffinus iherminieri*) on Statia. To do this it was necessary to go out during new moon to areas where Shearwaters are suspected to nest, being rocky limestone cliffs and/or the same sites used by Red-billed Tropicbirds, and listening for their call. To assist with this we obtained a playback device with a taped recording of the Shearwater's call.

Unfortunately at this time we are unable to confirm the presence of Shearwaters, however we will make another attempt during the 2013-2014 nesting season.