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Photo: Richard Brown

Seabird surveys on Dog Island, Anguilla, following eradication of black rats find a globally important population of Red-billed Tropicbirds (*Phaethon aethereus*)

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Abstract Dog Island is one of the most important islands for seabirds in the eastern Caribbean, despite being only 207 ha in size. It is part of Anguilla's Important Bird Area (IBA) network, and has globally important populations of Brown Boobies (*Sula leucogaster*) and regionally important populations of Magnificent Frigatebirds (*Fregata magnificens*), Masked Boobies (*Sula dactylatra*), Laughing Gulls (*Leucophaeus atricilla*), and Sooty Terns (*Onychoprion fuscatus*). These populations have been threatened by the presence of introduced black rats (*Rattus rattus*), which prey on eggs and nestlings. We carried out baseline seabird surveys between 25 March and 4 April 2012 following eradication of black rats during the previous two months, and recorded the following numbers of Apparently Occupied Nests (AONs): 100 Red-billed Tropicbird (*Phaethon aethereus*), 418 Magnificent Frigatebird, 31 Masked Booby, and 1,231 Brown Booby. Numbers of Red-billed Tropicbirds were much higher than previously recorded and exceed 1% of the global population, meaning Dog Island is now a globally important site for this species. In addition, two Audubon's Shearwater (*Puffinus lherminieri*) nests were found, providing the first confirmed breeding record of this species on Dog Island. Laughing Gulls, Brown Noddies (*Anous stolidus*), Sooty Terns, and Bridled Terns (*Onychoprion anaethetus*) had not arrived on the island by the end of the visit and require later surveys in mid to late May. Dog Island's importance for breeding seabirds should increase following the eradication of rats. The seabird colony on Dog Island is one of Anguilla's great natural assets and deserves a high level of protection; any development on Dog Island would be likely to have a detrimental effect on nesting seabirds and could lead to the re-introduction of rats.

Keywords Audubon's Shearwater, Brown Booby, *Fregata magnificens*, Magnificent Frigatebird, Masked Booby, *Phaethon aethereus*, *Puffinus lherminieri*, Red-billed Tropicbird, seabird conservation, *Sula dactylatra*, *Sula leucogaster*

Resumen Muestreos de aves marinas en la isla Dog, Anguila, localizan una población de rabijuncos de pico rojo (*Phaethon aethereus*) con importancia global tras la erradicación de las ratas negras—La isla Dog es una de las islas más importantes para las aves marinas en las Antillas Menores a pesar de tener sólo 207 ha de tamaño. Forma parte de la red de Áreas de Importancia para las Aves de Anguila y tiene poblaciones importantes a nivel global de *Sula leucogaster*, y poblaciones importantes a escala regional de *Fregata magnificens*, *Sula dactylatra*, *Leucophaeus atricilla*, y *Onychoprion fuscatus*. Estas poblaciones han estado amenazadas por la presencia de ratas negras (*Rattus rattus*) introducidas, que se alimentan de huevos y pichones. Llevamos a cabo muestreos de referencia entre el 25 de marzo y el 4 de abril de 2012, tras la erradicación de las ratas durante los dos meses previos, y registramos los siguientes valores de nidos aparentemente ocupados (NAOs): 418 *Fregata magnificens*, 31 *Sula dactylatra*, 1.231 *Sula leucogaster*, y 100 *Phaethon aethereus*. Los números de esta última especie fueron mucho mayores que los previamente registrados y exceden el 1% de la población global, lo que significa que la isla Dog es ahora un sitio con importancia global para esta especie. Además, se encontraron dos nidos de *Puffinus lherminieri* brindando el primer registro de cría confirmado de esta especie en la isla. *Leucophaeus atricilla*, *Anous stolidus*, *Onychoprion fuscatus*, y *Onychoprion anaethetus* aún no habían llegado a la isla al final de la visita y se necesitan muestreos posteriores a mediados o finales de Mayo. La importancia de la isla Dog para la reproducción de aves marinas debe aumentar tras la erradicación de las ratas. La colonia de aves marinas de la isla Dog es uno de los mayores bienes naturales y merece un alto nivel de protección; cualquier urbanización o desarrollo posiblemente tenga un efecto perjudicial en la cría de estas especies y puede conllevar la reintroducción de ratas.

Palabras clave conservación de aves marinas, *Fregata magnificens*, *Phaethon aethereus*, *Puffinus lherminieri*, *Sula dactylatra*, *Sula leucogaster*

Résumé Le suivi des oiseaux marins sur le Dog Island, Anguilla, après l'éradication des rats noirs met en évidence une population de Phaétons à bec rouge (*Phaethon aethereus*) d'importance internationale—Dog Island est une des îles les plus importantes pour les oiseaux marins dans l'est de la Caraïbe, malgré sa surface réduite de 207 ha. Elle fait partie

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du réseau de Zones importantes pour la conservation des oiseaux (ZICO) à Anguilla, et accueille des populations de Fous bruns (*Sula leucogaster*) d'importance internationale et des populations d'importance régionale de Frégates superbes (*Fregata magnificens*), de Fous masqués (*Sula dactylatra*), de Mouettes atricilles (*Leucophaeus atricilla*), et de Sternes fuligineuses (*Onychoprion fuscatus*). Ces populations ont été menacées par la présence de rats noirs (*Rattus rattus*) qui avaient été introduits et se nourrissaient d'œufs et d'oisillons. Les premiers relevés d'oiseaux marins ont été effectués entre le 25 mars et le 4 avril 2012, après l'éradication des rats noirs au cours des deux mois précédents. Le nombre de nids apparemment occupés a été noté pour chaque espèce: 100 Phaéton à bec rouge (*Phaethon aethereus*), 418 Frégates superbes, 31 Fous masqués, et 1.231 Fous bruns. L'effectif de Phaétons à bec rouge était bien supérieur à celui précédemment enregistré et dépassait 1 % de la population mondiale, ce qui signifie que Dog Island est maintenant un site d'importance internationale pour cette espèce. De plus, deux nids de Puffins d'Audubon (*Puffinus lherminieri*) ont été trouvés, confirmant la première nidification de cette espèce sur l'île. Les Mouettes atricilles, les Noddis bruns (*Anous stolidus*), les Sternes fuligineuses, et les Sternes bridées (*Onychoprion anaethetus*) n'étaient pas encore arrivés sur Dog Island à la fin de la visite, ce qui a entraîné un relevé plus tardif mi-mai à fin mai. L'importance de Dog Island pour les oiseaux marins nicheurs devrait augmenter suite à l'éradication des rats. La colonie d'oiseaux marins de Dog Island est l'un des grands atouts naturels d'Anguilla et mérite un niveau de protection élevé. Tout développement sur Dog Island serait susceptible d'avoir un effet néfaste sur les oiseaux nicheurs et pourrait conduire à la réintroduction des rats.

Mots-clés conservation des oiseaux marins, *Fregata magnificens*, Frégate superbe, Fou brun, Fou masqué, Phaéton à bec rouge, *Phaethon aethereus*, Puffin d'Audubon, *Puffinus lherminieri*, *Sula leucogaster*, *Sula dactylatra*

Anguilla is a United Kingdom Overseas Territory (UKOT) at the northernmost edge of the Lesser Antilles, and Dog Island is an uninhabited island 207 ha in size, 13 km off its northwest coast (Pollard and Wilkinson 2007, BirdLife International 2008). The UKOTs were recently classified by BirdLife International as among the most important sites in the world for seabirds and Dog Island is considered the second most important individual island in the eastern Caribbean for globally-significant seabird colonies (Lowrie et al. 2012). Dog Island holds many globally and regionally important seabird populations, and is the only breeding site for Magnificent Frigatebirds (*Fregata magnificens*) in Anguilla, and one of just four in the Lesser Antilles (Lowrie et al. 2012). It also has one of the two breeding sites for Masked Boobies (*Sula dactylatra*) in Anguilla, and of just four in the Lesser Antilles (Lowrie et al. 2012). Dog Island is one of Anguilla's seven Important Bird Areas (IBAs; BirdLife International 2008).

Black rats (*Rattus rattus*) were eradicated on Dog Island between February and March 2012 by Anguilla National Trust (ANT), in partnership with the Government of Anguilla, Fauna and Flora International (FFI), and the Royal Society for the Protection of Birds (RSPB), with technical support from Wildlife Management International Ltd. The eradication was a ground-based operation, with bait containing the anticoagulant brodifacoum deployed at 1,714 stations on a grid network across the island, and on all accessible offshore inlets, between 16 February and 30 March 2012 (Bell 2012). The aim of the eradication was to reduce depredation of seabird eggs, and increase seabird abundance and diversity (Phillips 2010).

Bird population monitoring is essential to assessing how successful such interventions have been in increasing bird abundances or diversity. Seabird surveys were conducted between 25 March and 4 April 2012, with the aim of providing a baseline to compare future survey data with. Full surveys of Red-billed Tropicbirds (*Phaethon aethereus*), Magnificent Frigatebirds, Masked Boobies, and Brown Boobies (*Sula leucogaster*) were conducted. March and April are optimum months to survey these species, but Laughing Gulls (*Leucophaeus atricilla*), Brown Noddies

(*Anous stolidus*), Sooty Terns (*Onychoprion fuscatus*), and Bridled Terns (*O. anaethetus*) require a later survey in mid-late May.

Here, we present results from surveys of Dog Island as a baseline for post rat-eradication monitoring, compare them with results of past surveys, and discuss future priorities for seabird monitoring.

Methods

Dog Island is a low, rocky island with three smaller cays off the west and north coasts. Low coastal cliffs are interspersed with five sandy beaches and weathered limestone rocks which reach sea level on parts of the west and north east coast (BirdLife International 2008). There are two large ponds behind the beaches at Spring Bay and Stoney Bay. The center of the island is dominated by impenetrable, low, thorny scrub and prickly pear cacti (*Opuntia dillenii*); this inland scrub is home to the large Sooty Tern colony. Between the edge of the scrub and cliffs there is a zone of bare earth, stunted bushes, and grass, favored by Masked and Brown Boobies, with Masked Boobies appearing to prefer more grass-dominated areas (Pollard and Wilkinson 2007). A herd of several hundred feral goats (*Capra aegagrus hircus*) are a remnant of former more extensive grazing by livestock (Pollard and Wilkinson 2007, BirdLife International 2008).

We conducted seabird surveys on Dog Island between 25 March and 4 April 2012. The rat eradication was carried out during February and March 2012, and the last evidence of rats on the island was found on 14 March, although the island will not be declared rat-free until two further years of monitoring is completed. Thus, although rats were not present during the surveys themselves they had been just two weeks previously, meaning the surveys can be considered a baseline to allow for comparisons with post-eradication monitoring in future years.

We generally conducted surveys between the hours of 0600–1200, and 1500–1830 to avoid the mid-day heat. Where possible, we followed methodology used by Pollard and Wilkinson (2007), and the *Seabird Breeding Atlas of the Lesser Antilles* (Lowrie et al. 2012).

Seabird Surveys

The fundamental survey parameter during seabird monitoring is Apparently Occupied Nests (AONs), which we calculated by recording and summing birds on nests, with chicks, or on eggs, unattended nests with chicks or eggs, and nest-building adults (Bibby *et al.* 1992). For Red-billed Tropicbird we also recorded and included previously occupied nests. Counts of adults provide much more limited information, as it is difficult to distinguish which, if any, of the adults counted are part of a breeding population.

A key consideration during all surveys was minimising disturbance to the seabirds. We moved through the seabird colonies as quickly as possible to limit the duration of disturbance and exposure of eggs and chicks to the hot tropical sun, which can cause fatal damage to them within 15–20 min (Burger and Lawrence 2000). Disturbance was a particular consideration for sensitive species such as Magnificent Frigatebirds, which readily leave the nest in alarm, potentially damaging chicks and eggs (Lowrie *et al.* 2012).

Brown and Masked Boobies.—Surveys were conducted by two observers walking slowly through the colony, recording all AONs. We recorded the numbers of adults and juveniles within the colony, but did not include individuals loafing on cliffs or other nearby habitat (which are likely to represent immature or non-breeding adults).

Magnificent Frigatebird.—We surveyed the frigatebird colony at the eastern end of Dog Island by dividing the colony into sections which could be seen from six vantage points, and counting all adults sitting on nests, nests with eggs or chicks, and juveniles (all birds with white heads). Where possible, we chose vantage points outside of the colony to minimise disturbance, although it was necessary to stand within the colony to see one of the sections. Any males with inflated red gular pouches were noted. We surveyed the frigatebird colony on two different days to assess the repeatability of counts.

Red-billed Tropicbird.—We conducted a systematic search for Red-billed Tropicbird nests in all suitable habitats (generally under and between crevices in boulders and cavities in the cliff-face). Nests were highly concealed, and only a minority of birds alarm-called on approach, making it necessary to crouch right down or get on hands and knees to locate all birds; searching from a standing or walking position would miss a large proportion of nests. We often located nests by smell, sometimes from up to 1 m away; regularly sniffing while searching suitable nesting habitat helped with nest finding. We also recorded evidence of previously occupied nests, identified by smell and droppings. We recorded two nests based on adult behavioral cues near a site, although we were not able to physically locate these nests.

We also conducted maximum counts of flying birds at most of the main colonies during 20 min vantage point watches between 1500 and 1630 (the period of peak flying activity; Lowrie *et al.* 2012). Counts of Red-billed Tropicbirds at this time of day was the measure used by the *Seabird Breeding Atlas of the Lesser Antilles* (Lowrie *et al.* 2012), as it was not feasible to conduct nest searches in most cases. We used both methods to investigate how maximum counts of flying adults over colonies related to number of nests found during nest searches, and whether a suitable correction factor could be devised to convert flying adult counts to AONs.

Audubon's Shearwater (*Puffinus lherminieri*).—Nests of Audubon's Shearwater were discovered by members of the rat eradication team (R. Brown and L. Banse pers. comm.). We were not able to conduct a full survey using playback of Audubon's Shearwater calls.

Other Species.—A full list of species observed on Dog Island was compiled by Richard Brown (Appendix 1). We took care to look for White-tailed Tropicbirds (*Phaethon lepturus*), which currently are only recorded breeding at Little Bay on mainland Anguilla, and Least Terns (*Sternula antillarum*), which have previously bred on Dog Island (Holliday and Hodge 2009).

Table 1. Numbers of Apparently Occupied Nests (AONs) recorded for species surveyed on Dog Island in 2012, with results from previous surveys presented for comparison. Survey units are AONs unless otherwise specified. This table does not include birds on the three small cays off Dog Island, which were not visited.

Species	Survey Date						
	April/May 2000 ^a	February 2003 ^b	May/June 2004 ^c	May/June 2007 ^d	March 2010 ^e	May 2011 ^f	March/April 2012 ^g
Red-billed Tropicbird ⁱ	7 adults, 2 AON	25 adults	2 adults	15	14	1	100
Magnificent Frigatebird	~ 200 adults and 142 chicks	> 100	112 (210 during winter boat survey)	310	243	317	418
Masked Booby ⁱ	10 pairs with chicks	15 (> 12 on East Cay)	1 (+6 adults)	42	16	4	31 ^j
Brown Booby	1,267 pairs	> 1,077 ^h	381 (1,035 during winter boat survey)	600	1,137	467	1,231

^aBryer *et al.* 2000; ^bCollier and Brown 2003; ^cCollier and Brown 2004; ^dPollard and Wilkinson 2007; ^eDaltry 2010; ^fT. Ross unpubl. data (collected for Fauna and Flora International); ^gThis study

^hIncomplete survey

ⁱHolliday and Hodge (2009) also note a population of 30 Masked Boobies on Dog Island and Mid Cay, and five pairs of Red-billed Tropicbirds on Dog Island between 1998 and 2004 (precise year not specified).

^jA minimum of 10 pairs nesting on Mid Cay and two on East Cay were noted prior to our visit (R. Brown pers. comm.).

Table 2. Status of nests recorded on Dog Island during March/April 2012.

Species	Nest-building	Adult Sitting ^a	Eggs	Chicks	Unknown ^b	Previously Occupied Nest	Total
Red-billed Tropicbird		38	2	36	14	10	100
Magnificent Frigatebird		96	4	318			418
Masked Booby		2	3	26			31
Brown Booby	20	61	298	852			1,231

^aNest contents could not be determined for this category

^bNest stage unknown due to inaccessibility

Results

Numbers of AONs for all species surveyed on Dog Island are presented in Table 1. We recorded 100 Red-billed Tropicbird nests, most of which were located between or under boulders, with just five located in cavities on cliff-faces. Red-billed Tropicbirds were found at all stages of breeding (Table 2). The maximum count of adults flying over the colonies varied between 24 % and 69 % of the total number of nests in each area (Table 3). The 1,231 Brown Booby AONs recorded were at all different stages of breeding (Table 2), from nest-building to fledged chicks. The 31 Masked Booby AONs were late in their stage of breeding (Table 2), with 20 of them containing chicks that were fledged or near to fledging. We were not able to survey Dog Island's three small cays, but a minimum of 10 pairs of Masked Boobies nesting on Mid Cay and two on East Cay were noted prior to our visit (R. Brown pers. comm.). We recorded 418 Magnificent Frigatebird AONs during both counts of the colony. Most birds were past the egg stage (319 chicks or juveniles, four nests with eggs, and 96 adults sitting on either eggs or chicks; Table 2). A breakdown of different stages of breeding is only given for the first count, as the two counts were conducted just a few days apart. No males with inflated gular pouches were noted during surveys, although one was seen on arrival on the island on 25 March.

Two Audubon's Shearwater nests with adults sitting were found on 26 March, one contained an egg, and the other a small chick. In addition, a pair of dismembered wings and legs discovered on the southeast coast on 9 March was considered to belong to an Audubon's Shearwater, based on tarsus and wing chord measurements (B.D. Bell pers. comm.). Ragged tears to the sternum suggested a Peregrine Falcon (*Falco peregrinus*) kill.

Sooty Terns were often heard offshore in what sounded like large numbers from the start of the rat eradication on 10 February 2012, but only a few were recorded on the island during the eradication or our surveys (see Appendix 1).

All monitoring data has been submitted to the World Bird DataBase managed by BirdLife International.

Discussion

Survey Results

The 100 Red-billed Tropicbird nests recorded during our surveys represents by far the highest number recorded for Dog Island to date (Table 1), meaning that the population now exceeds the IBA threshold of 1 % of the global population (BirdLife International 2008). This increased population estimate could be the

result of a genuine increase, but is more likely the result of time being available for a systematic search of all suitable breeding habitat. As data on breeding seabird populations for Dog Island only go back as far as 1999, it is not possible to make conclusions about long-term population trends. In addition, single counts at seabird colonies are likely to produce under-estimates, as many species have protracted breeding seasons (Ratcliffe *et al.* 2008); ideally several counts per year would be made at important colonies, but resources mean this is often not possible. We also conducted maximum counts of Red-billed Tropicbird adults flying around the colonies at peak activity time, 1500 to 1630, to investigate how flying adult counts, the measure used by the *Seabird Breeding Atlas of the Lesser Antilles* (Lowrie *et al.* 2012), related to number of nests found. Only a few comparisons were made, but adult counts varied between 24 % and 69 % of the total nest count. This relationship merits further investigation as breeding populations are often estimated from flying adult counts for this species. Birds were found at different stages of nesting, and this lack of nesting synchrony is similar to that reported by Pollard and Wilkinson (2007) and Lowrie *et al.* (2012), who recorded nesting birds throughout the study period of January to July, and reported anecdotal evidence that the species may breed year round in the Lesser Antilles.

Our count of 1,231 Brown Booby nests is similar to numbers recorded in 2000, 2003, and 2010 (Table 1), and means this species remains at globally important levels as recorded previously. Lower counts from 2004, 2007, and 2011 may be due to the later timing of these surveys, which were conducted in May or June; Pollard and Wilkinson (2007) reported that 95 % of young had fledged during their survey, whereas we found birds at all stages of breeding. Lowrie *et al.* (2012) found birds at all stages of breeding between January and July, but with more records of eggs early in the year, and of large chicks in the middle of the year, and again suggested the species may breed year-round in the Lesser Antilles.

We recorded 31 Masked Booby nests, this is at the upper end of previous estimates of AONs (Table 1). Twenty out of the 31 nests recorded had chicks that were fledged or close to fledging, indicating that the count may well have been higher had the survey been conducted at an earlier stage of breeding. The Dog Island Masked Booby colony is one of only four in the Lesser Antilles, and is a regionally significant population, containing over 1 % of the Caribbean population (BirdLife International 2008). Surveys of Dog Island's three small offshore cays were not conducted, but members of the rat eradication team noted a mini-

Table 3. Comparison of Red-billed Tropicbird numbers recorded during counts of flying adults between 1500 and 1650 and full searches of sections of nesting habitat (adults as a percentage of nest count in parentheses). Counts were conducted between 30 March and 1 April 2012.

Section	Nest Count	Maximum Adult Count 1	Maximum Adult Count 2
1	16	8 (50 %)	8 (50 %)
2	45	19 (42 %)	11 (24 %)
3	16	11 (69 %)	

mum 10 additional pairs nesting on Mid Cay and two on East Cay (R. Brown pers. comm.).

We recorded 418 Magnificent Frigatebird AONs at various stages of breeding, this is at the higher end of numbers recorded previously (Table 1). In May 2007, the majority of young found were either fledged or close to it, with no nests with eggs or very young chicks (Pollard and Wilkinson 2007).

The breeding records for Audubon's Shearwater may constitute the first for the island. Only two confirmed breeding records were recorded in the Lesser Antilles on islands where cavity searches were possible throughout the 200 sites surveyed for the *Seabird Breeding Atlas of the Lesser Antilles* (Catholic Island, Tobago Cays Marine Park, and St. Vincent and White Island, Grenada), most surveys having been conducted using call-playback from a boat (Lowrie *et al.* 2012). Although Audubon's Shearwater is recorded as a former or possible breeding species in Anguilla by the IBA report (BirdLife International 2008), the only other recent record from Anguilla is of a nest discovered on Little Scrub in 2010 by the Department of the Environment. This is a species that is likely to benefit from the rat eradication, and a full survey should be a priority.

Conservation Priorities

Ongoing monitoring for rats will continue for two more years before the island is declared rat-free, but evidence to date suggests that the eradication has been a success. Invasive rats are some of the largest contributors to seabird extinction and endangerment worldwide, preying on seabird eggs, chicks, and adults, and are thought to be responsible for numerous seabird extirpations and population declines (Atkinson 1985, Jones *et al.* 2010). Evidence from other islands suggest that rats can substantially reduce the breeding success of Audubon's Shearwaters, Red-billed Tropicbirds, Brown Noddies, Sooty Terns, and Bridled Terns (Townes *et al.* 2006), so all of these species may stand to benefit from the eradication. Audubon's Shearwater may be particularly likely to benefit, as smaller birds that nest in crevices and burrows are the most vulnerable to rat predation (Atkinson 1985, Jones *et al.* 2010), and they are described as particularly vulnerable to predation by Lowrie *et al.* (2012), along with Red-billed Tropicbirds.

Further surveys of Red-billed Tropicbirds, Magnificent Frigatebirds, Masked Boobies, and Brown Boobies should be conducted in late March or early April to allow comparison with

results here, although Masked Boobies may benefit from earlier survey; higher numbers were observed in February than late March 2012 (J. C. Daltry pers. comm.). Surveys of Sooty Tern, Laughing Gulls, Bridled Terns and Brown Noddies should be conducted during mid-late May to enable future comparisons to be made, following previous methodology (Pollard and Wilkinson 2007). Surveys would ideally be conducted annually, but it is more important to obtain full estimates of populations at regular (even if less than annual) intervals, than to get underestimates due to insufficient time available annually to comprehensively survey all species. A repeat study of Sooty Tern productivity to compare with pre-eradication data from 2007 (Pollard and Wilkinson 2007) may be more likely to show any positive response to eradication in a shorter time scale than breeding numbers. A full Audubon's Shearwater survey using playback should be conducted between January and March (no birds were heard from May to July during playback surveys by Lowrie *et al.* [2012]).

The main remaining threats to seabird populations on Dog Island are development, and possibly the goat population. Anguilla has a human population of about 15,000, but is visited by approximately 100,000 tourists a year (F. Mukhida pers. comm.), making tourism the most important source of income on the island (Lowrie *et al.* 2012, BirdLife International 2008). Although Anguilla has designated National Parks and Marine Parks and some fairly comprehensive environmental legislation is currently under consultation (F. Mukhida pers. comm.), decisions relating to land-use remain challenging, particularly as the local government only owns about 3 % of land (BirdLife International 2008). Dog Island is privately owned, although at least two development proposals for tourism, and one for a coastguard station have been rejected since the 1990s by the island's owners (BirdLife International 2008). Disturbance of the seabirds by humans on Dog Island appears to be relatively low; although one or more yachts visited the island on most days, most visitors stayed on the main beach. Any development on Dog Island, or changes in the boats landing there if a jetty was built, would be likely to have a detrimental effect on the island and would have the potential to re-introduce rats unless strict quarantine measures were put in place.

The population of goats may be another potential threat to the seabirds; Pollard and Wilkinson (2007) found traces of them throughout the Sooty Tern colony, and it is possible they trample eggs. They will also affect the vegetation, although it may be that they maintain some open habitat in the vegetation and make it more suitable for the terns. An enclosure study to investigate the likely effects of removing the goats is planned.

Anguilla is one of the smallest island groups in the West Indies, but is a key site for seabird populations (Lowrie *et al.* 2012). Dog Island was identified as the second most important single island in the Lesser Antilles for seabirds by Lowrie *et al.* (2012), an impressive feat for an island just 207 ha in size. This is based on the number of globally and regionally important species, as well as the overall number of species present, to which Red-billed Tropicbird can now be added as a globally important species, and Audubon's Shearwater as a confirmed breeding species. Globally, seabirds are the most threatened of bird groups (Crocoll *et al.* 2012), with 80 % of species in decline (Lowrie *et al.* 2012). Dog

Island deserves a high level of protection, the seabird colony being one of Anguilla's great natural assets, and also having potential as an ecotourism site if carefully managed.

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Appendix 1. Dog Island birds: a systematic list. Birds listed below were all recorded on Dog Island, Anguilla, or, where specified, its cays between 10 February and 31 March 2012.

White-cheeked Pintail *Anas bahamensis*.—Three birds on the pond in early April, with one bird being present from 30 March to 3 April 2012.

Helmeted Guineafowl *Numida meleagris*.—A single individual of this large bird was noted on one date in February as it crossed an area of open limestone to the north of the island. The origins of this bird can only be speculated at, but perhaps this is a remnant of farming on the island. That the bird was not seen again may show how it could avoid the attentions of poachers by hiding in dense scrub. The closest known population of this introduced fowl is on Isle Pinel, St. Martin.

Audubon's Shearwater *Puffinus lherminieri*.—A pair of dismembered wings and legs discovered on the Southeast coast on 9 March 2012 were considered to be of this species based on tar-

and wing chord measurements (B.D. Bell pers. comm.). Ragged tears to the sternum were indicative of a Peregrine Falcon (*Falco peregrinus*) kill. Perhaps the avian highlight of the project came in the last week of March (27 March 2012) with the discovery of two adults on nests in crevices on the northeast coast, approximately 300 m to the west of the frigatebird colony. The presence of freshly hatched eggshell in one of the crevices suggested that one of the birds was incubating a small chick. This is the first breeding record for Dog Island.

White-tailed Tropicbird *Phaethon lepturus*.—Noted on one date by two observers on 17 February 2012. The bird was associating with Red-billed Tropicbirds (*P. aethereus*). This species has been recorded at two sites on the mainland since 1999, but this is probably the first record for Dog Island.

Red-billed Tropicbird.—See text.

Magnificent Frigatebird *Fregata magnificens*.—See text.

Masked Booby *Sula dactylatra*.—See text.

Brown Booby *S. leucogaster*.—See text.

Brown Pelican *Pelecanus occidentalis*.—Singles and small groups passed by on most days with a party of eight the most recorded. None of the birds lingered, although one was observed fishing in Stoney Bay. A long dead bird was in prickly pear cactus (*Opuntia dillenii*) near Stoney Bay.

Great Blue Heron *Ardea herodias*.—A single bird was noted drifting west during the third week of March and was later flushed from the ground by a different observer on the same date.

Yellow-crowned Night-heron *Nyctanassa violacea*.—Present throughout the period and frequently flushed during baiting. A minimum of two adults and a juvenile bird were present. A bird was flushed from Mid Cay on the first landing date.

Osprey *Pandion haliaetus*.—Up to two birds occasionally visited the island during both months and successful hunting of fish was noted on three occasions.

American Oystercatcher *Haematopus palliatus*.—Singles and small groups of up to four which frequented the coast during February had paired and taken territories towards the end of March. At least three territorial pairs looked set to breed.

Black-bellied Plover *Pluvialis squatarola*.—The majority of records came from the vicinity of the pond where up to six birds were noted, but with groups of two to four much more regular. Birds also visited Stoney Bay and a single bird was seen at the lake in late March.

Wilson's Plover *Charadrius wilsonia*.—Up to eight birds frequented the rocky slabs to the south of Great Bay for the whole period. Single birds would occasionally join the other shorebirds around the pond.

Semipalmated Plover *C. semipalmatus*.—Common throughout the period with a flock of 22 on the north coast the most observed, however these did not linger. Smaller groups and singles were often encountered along the coast, but these also soon moved on, suggesting that many of the individuals were on passage. The pond area usually supported approximately eight birds but whether it was the same birds lingering or a steady passage was unclear.

Spotted Sandpiper *Actitis macularia*.—Up to three birds were seen around the pond with at least one noted on most days.

Lesser Yellowlegs *Tringa flavipes*.—Up to three were seen

around the pond in February but this species was not noted in March.

Whimbrel *Numenius phaeopus*.—A single bird flushed from the pond in March later circled the camp calling, before heading south.

Ruddy Turnstone *Arenaria interpres*.—Groups of up to 10 birds were seen on most of the rocky areas of coastline and birds occasionally joined the other shorebirds on the pond.

Sanderling *Calidris alba*.—Up to six Sanderlings were recorded during the period with smaller numbers recorded most days. Although the beaches at Great Bay and Stoney Bay were sometimes used, the majority of records came from the pond.

Least Sandpiper *C. minutilla*.—The area around the pond was usually frequented by up to 16 birds which roosted on the slabs to the south of Great Bay. This species was also noted around the coast, presumably on passage, with birds briefly alighting in the booby colonies before heading on.

Semipalmated Sandpiper *C. pusilla*.—Up to three birds joined the Least Sandpipers during February, but March saw only a couple of singles noted.

Laughing Gull *Leucophaeus atricilla*.—The freshly predated corpse of a single individual was found on the southeast coast on the morning of 28 March 2012, in the same place as several Sooty Tern (*Onychoprion fuscatus*) carcasses. A Peregrine Falcon (*Falco peregrinus*) was again responsible. No other birds were observed during the period.

Sooty Tern.—Unexpectedly, this species was present throughout the period of the eradication (from 10 February to 31 March 2012), but only during the hours of darkness when large flocks could be heard offshore giving their distinctive 'wide-a-wake' calls. Although the number of birds involved is impossible to estimate, it sounded as if hundreds of birds were present. A few birds would cross the pond area and head inland, with the number doing so gradually increasing as March progressed. This species was frequently predated by Peregrine Falcons, with up to 15 corpses being recorded after a single night. For the majority of the project, diurnal observations were limited to periods of rough weather when up to six birds were noted feeding in high seas, but several evening seawatches, intended to locate the birds as they approached the island, failed to find any birds. Perhaps this suggests that the terns keep their distance until full darkness so as to avoid the attentions of any predators. The first bird noted during the day was flushed from near the frigatebird colony on 26 March 2012 before it drifted west across the island. Two birds were noted chasing each other two days later.

Scaly-naped Pigeon *Columba squamosa*.—One bird seen in the eastern end of the island (along one of the cut tracks) on 3 April 2012. It looked exhausted, and walked along the track and flew a very short distance before sheltering under dense vegetation. A photograph was taken by Farah Mukhida (ANT). This is the second record for Anguilla and a first record for Dog Island.

Zenaida Dove *Zenaida aurita*.—A common species with territorial males recorded across the Island.

Green-throated Carib *Eulampis holosericeus*.—The last week in March saw three records following a period of very calm weather. This species was also recorded on Dog Island during the pre-eradication monitoring in 2011 (J. Cestero pers. comm.)

Belted Kingfisher *Megaceryle alcyon*.—A male was flushed

from Mid Cay during the second visit and what was possibly the same bird was recorded on the west coast of Dog Island on 24 and 25 March 2012.

Peregrine Falcon.—This species was very conspicuous. A male and female were often seen interacting noisily and on one occasion three birds were noted together. The pair was frequently flushed from areas of Manchineel (*Hippomane mancinella*) and Buttonwood (*Conocarpus erectus*) around the lake and on the north coast. The majority of their prey during the period comprised of Sooty Terns, with Audubon's Shearwater and Laughing Gull also taken. Although Peregrine Falcons occasionally disturbed the waders around the pond, no hunting effort was recorded and it is likely that the vast majority of prey taken during the period was killed at night.

Caribbean Elaenia *Elaenia martinica*.—A common species re-corded on most transects but with a concentration around areas of more mature scrub.

Barn Swallow *Hirundo rustica*.—Surprisingly only noted on four dates and all records were of singles.

Yellow Warbler *Setophaga petechia*.—Present throughout the period but with a large arrival in early March from when sing-

ing males were distributed widely across the island.

Bananaquit *Coereba flaveola*.—Very common. Nest-building was noted from the third week of March.

Black-faced Grassquit *Tiaris bicolor*.—Very common. Nest-building was noted from the third week of March.

Lesser Antillean Bullfinch *Loxigilla noctis*.—This very inconspicuous species was probably under recorded. Both sexes were noted in widely dispersed locations.

Blue Grosbeak *Passerina caerulea*.—Although this species was not positively identified, it warrants inclusion as a 'probable' and should be noted as a possible addition to the Anguilla list in the future. A bird with a heavy bill, brown head and body, chestnut median coverts, wing-bar and bluish tail was flushed from one of the transects in the last week of March. The single observer did not have a camera but the description closely fits this North American migrant.

House Sparrow *Passer domesticus*.—Three birds, two males and a female, frequented a small area of the northeast coast for most of the period. An additional two birds, at least one of which was male, arrived in the vicinity of the pond for the last two weeks of March.

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