

# Seabird nesting on Curaçao and Bonaire, 2002

Adolphe O. Debrot, Coen Boogerd and Dieter van den Broeck  
Carmabi Foundation, Piscaderabaai z/n  
P.O.Box 2090, Curaçao, Netherlands Antilles  
adebrot@cura.net

## Introduction

The islands of the Leeward Dutch Antilles (Aruba, Curaçao and Bonaire) lie next to each other off the north coast of Venezuela in the southern Caribbean Sea, just downstream of one of the most productive upwelling areas of the Caribbean (Sturm, 1991). These islands have long been recognized as regionally important breeding sites for several tern species (Voous, 1983; Halewijn and Norton, 1984). While Aruba has had a sovereign status within the Kingdom of the Netherlands since 1986, Curaçao and Bonaire form part of the Netherlands Antilles together with Saba, St. Eustatius and St. Maarten, three islands which are separated from the leeward group by about 900 km of open sea. In contrast to the large tern nesting colonies of Aruba, numbering in the thousands, and which have been fairly well studied in recent years (Halewijn, 1985, 1986, 1988, in press; Gochfeld et al. 1994; del Nevo, in prep.) only little recent information is available for Bonaire (del Nevo, in prep.; Wells and Childs Wells, in prep.) and none is available for Curaçao. The objective of this study was to attempt comprehensive tern nesting surveys for both Curaçao and Bonaire so as to 1) update tern species nesting status for these islands, 2) identify key breeding areas for conservation and 3) make conservation recommendations.

Curaçao lies about 70 km from the Venezuelan mainland, has a surface area of approximately 444 km<sup>2</sup> and has approximately 130 000 inhabitants. The highest point is 375 m high. The island consists of a volcanic core rimmed by coastal limestone formations. Rainfall averages 550 mm y<sup>-1</sup> and the vegetation is generally xerophytic, with landscapes dominated by cactus and thorn scrub. Approximately 10 km to the east lies a small, flat, 1.7 km<sup>2</sup> offshore reef island named Klein Curaçao which is under Curaçao jurisdiction. Terns nest in coastal areas of both islands as well as on small islets in the inland lagoons of the main island of Curaçao.

Bonaire lies about 40 km to the northeast of Curaçao and is approximately 288 km<sup>2</sup>. Its highest point is 241 m high and total inhabitants number about 14 000. As in Curaçao, the island consists of a volcanic core, rimmed by limestone formations. Rainfall averages 450 mm y<sup>-1</sup> and the vegetation similar to that of Curaçao. Like Curaçao, Bonaire also has an offshore island which is named Klein Bonaire. Klein Bonaire is a flat completely calcareous island of about 6 km<sup>2</sup> and is located about 1.5 km off the west coast of the main island. It falls under Bonaire jurisdiction. Terns nest in coastal areas of both islands as well as on small islets in the inland lagoons of the main island of Bonaire.

Table 1 provides a summary of results in terms of seabird nesting for Curaçao and Bonaire jurisdictions in the year 2002.

Table 1. Summary of seabird nesting (number of pairs) for Curaçao and Bonaire, 2002.

	Antillean	Cayenne	Common	Royal	Laughing
Curaçao	619 +	-	133 +	3	-
Bonaire	792 +	180	39	85	60

### Curaçao

#### General

In 2002, two species of terns and one species of gull nested inside Curaçao jurisdiction at a total of 18 locations, two of which had been missed in 2002 but which were “rediscovered” in 2004. Fig. 1 provides a map of locations while numbers of pairs at each location are given in Table 2. Species which have nested in Curaçao in the 20<sup>th</sup> century but not in recent decades are the Royal Tern, *Sterna maxima* the Cayenne Tern, *S. sanvicensis eurygnatha*, and the Roseate Tern, *S. dougalli* (Voous, 1983).

#### Laughing Gull

On Curaçao, three pairs of Laughing Gulls nested on the tern island in the lagoon of Janthiel, in association with nesting Common Terns and nesting Black-winged Stilts, *Himantopus himantopus*. In 2003, the species was present again (two pairs and one chick, June 23). The birds harrassed and probably fed upon the Common Tern chicks and eggs.

#### Common Tern

On Curaçao, the Common Tern was the second most abundant breeding species in 2002. It was found at three sites, Janthiel (75 pairs), St. Michiel (15 pairs) and Isla Makuaku (3 pairs). In 2004 a traditional breeding site of importance was rediscovered and included in Fig. 1 and Table 2. The site had simply been missed in the 2002 survey and amounts to more than 40 pairs on an island in Buskabaai, in the contaminated harbor of Willemstad. According to Refineria Isla, breeding occurred here every year for at least the past 5 years (R. Rhuggenaath, pers. comm.). Last documented breeding at a traditional site in Spaanse Water was 1 pair on the island of Willemsberg with chicks on June 3, 1992 (A. Debrot, pers. observ.). Almost all feeding by the Common Tern colonies of Janthiel and Buskabaai throughout the breeding season takes place inside the highly contaminated Schottegat harbor (observ. A. Debrot, 2002, 2003 and 2004). As a consequence many of the breeding Common Terns are soiled by oil.

Table 2. Numbers of breeding pairs at sea bird breeding sites for Curaçao, summer 2002. Evidence for breeding: d = defense, e = eggs, c = chicks. Sites 17 and 18 were missed in 2002, data is from 25 May and 2 June, 2004.

Site #	Location	Antillean	Common	Laughing	Comments
1	Boka Bartol	50, c			
2	Playa Grandi, N side	25, c			
3	Playa Grandi, S side	100+, c			
4	Saliña Rif-St. Marie	4, d			
5	Shingot, 1 km W	75+, e			
6	Saliña St. Michiel		15, c		
7	7th wind mill	6, d			
8	3d wind mill	1, d			
9	Ser'i Kueba, coast	5, d			
10	St. Jorisbaai, W side	50+, e			- dogs
11	Isla di Makuaku		3, c		
12	Saliña Janthiel	9, d	75, c	3, c	- high recr.
13	Ser'i Boka, E side	4, d			disturbance, dogs
14	West of Pos # 2	100, e			
15	Punt Kanon	12, d			
16	Klein Curaçao	143+, e			- high recr. disturbance, cats
17	islands in Buskabaai	20+, c	40+, c, e		
18	W shore Buskabaai	15+, e			- dog, egg collection
Curaçao totals		619+	133+	3	

### Antillean Tern

Antillean Terns were the most numerous species, amounting to some 619 pairs and nesting at 16 of the 18 tern breeding sites located. Most Antillean Tern nesting took place along the barren wind-exposed coast of the island. Largest breeding aggregations were at the plantations of Wacao (sites 1-3), at Hato (site 5), Koraal Tabak (site 10), Eastpoint (site 14) and Klein Curaçao (site 16). For the most part, these are regular breeding sites. Wacao is visited annually (R. Finies, pers. comm.), Koraal Tabak had 100+ breeding pairs with chicks and eggs on June 3, 1996 (A. Debrot, pers. observ.), the Eastpoint site is a traditional breeding site (confidential source), and Klein Curaçao is also visited annually (A. Debrot, pers. observ.). Other sites in Curaçao with recent larger breeding aggregations of Antillean Terns, but not intensively used in 2002 were a coastal site just east of Boka Tabla in the Shete Boka Park (30+ pairs, W. Sambo, pers. comm.) and a site on the shore of Janthielbaai (many birds, 1989, Debrot and de Freitas, 1991; 100+ pairs,

A. Debrot and B. de Boer, May 1996; 6 pairs, A. Debrot and T. Ryan, May 2004). The earliest eggs we documented were 16 May 2002 at Wacao. Feeding by adults took place in the rough waters of the exposed northeast coast, just off the breeding sites.

## Bonaire

### General

In 2002, four species of terns and one species of gull were found nesting at a total of 49 locations inside Bonaire jurisdiction. Fig. 2 provides a map of locations, while other information is given in Table 3. The only species documented in the past but not found nesting in recent years on Bonaire is the Roseate Tern. Possible nesting by small numbers of Audubon's Shearwater, *Puffinus lherminieri*, and the Magnificent Frigatebird, *Fregata magnificens*, in Bonaire has never been confirmed (Voous, 1983; Halewijn and Norton, 1984).

### Laughing Gull

Laughing Gulls nested at two locations (Fig. 2). They nested together with Cayenne Terns and Common Terns on an island in Goto Lake (several chicks on July 1, 2002) and they nested on the dams of condenser C-3 in the Cargill saltworks area (flying chicks, July 12, 2002). Total numbers for the saltworks area is about 50 pairs (R. St. Jago, pers. comm.).

### Royal Tern

About 200 adult birds were first noticed on 31 May in the Cargill saltworks area. The birds were again seen on July 1, 2002 (A. Debrot and A. del Nevo, pers. observ.), but no nesting could be confirmed. However, on July, 12, 2002, a herd of 50+ well-fledged chicks were observed at the same location, confirming that nesting had occurred. Our estimate stands at 85 pairs in concordance with the count by del Nevo in 1999.

Table 3. Numbers of breeding pairs at sea bird breeding sites for Bonaire, summer 2002. Evidence for breeding: d = defense, e = eggs, c = chicks.

Site #	Location	Antillean	Cayenne	Common	Royal	Laughing	Comments
1	Island Goto Lake		180, c	5, c		10, c	- at viewpoint park
2	Island Saliña Slagbaai	87, c		4, c			- at viewpoint park
3	Boka Bartol	3, d					
4	Malmok	10, e					
5	Seru Meimei	8, d					
6	Playa Macoshi	10, d					
7	Boka Chikitu, W side	30+, e					
8	Boka Chikitu E side	8, d					
9	E of Boka Chikitu	50+, d					
10	Morotin	8, d					
11	Pos di Punta	5, d					

12	Boka Onima, W side	3, d				
13	Boka Onima, E side	15, d				
14	W of Boka Onima	6, d				
15	W of Fontein	1, d				
16	W of Pos Roshikiri	1, d				
17	E of Kueba Roshikiri	15, d				
18	W of Suplado	1, d				
19	W of Boka Kanoa	10, d				
20	W side Punta Spelonk	10, d				
21	S side Punta Spelonk	10, d				
22	S of Lighthouse	3, c				
23	S of location # 22	10, d				
24	N side Boka Chikitu	40, d				
25	S side Boka Chikitu	10, d				
26	S of Boka Chikitu	15, d				
27	N of Pos Kurá	10, c				
28	Lagun, N side	15, d				
29	road to Lagun	3, e				
30	Lagun S side	30, c				
31	S of Boka Washikemba	5, c				
32	Roi Lamunchi	10				
33	road to Cai	2				
34	bahia Cai	4				
35	Cai	2				
36	Marcultura-Intake* <sup>1</sup>	111+, c, e				
37	Intake-Lacre Punt	10, d				
38	Witte Pan	5, c				
39	Condenser* <sup>2</sup> C-5	30	5			
40	island Condenser C-8	50+				
41	islands Condenser C-9	5				- site later floods
42	Condenser C-2a	50+				
43	S of Condenser C1-d			85, c		
44	island N side Cond. C-5		20, c			
45	S dike Cond. C-4		5			
46	Cristallizer* <sup>3</sup> F-3	30, d				
47	dams Condenser C-3				50, c	- + 20 (pers. comm. St. Jago)
48	S side Klein Bonaire	1, d				
49	W salina Klein Bonaire	50+, e				- cat seen
Bonaire totals		792+	180	39	85	60

\*1) Intake = seawater intake canal for solar saltworks.

\*2) Condenser = expansive shallow pond for solar evaporation to form concentrated brine.

\*3) Crystallizer = shallow pond for salt precipitation and harvest.

### Cayenne Tern

A colony estimated at about 150 pairs was found on an island on the west side of the Goto Salt Lake on June 8, 2002. By the 1<sup>st</sup> of July 170-190 large chicks were counted and the estimate was increased to 180 pairs (A. Debrot and A. del Nevo, pers. observ.). The adult birds all flew off and on with food from a westerly direction and were evidently feeding off the western side of the island. Del Nevo (2003) speaks of a colony of 170 birds nesting at a confidential site (in the Cargill saltworks area) on Bonaire in 1999. No birds were observed nesting in Goto Lake by del Nevo in 1999 (in prep.) and it may be that the same flock had simply moved breeding locations.

### Common Tern

Del Nevo found Common Terns at two sites on Bonaire in 1999. In this survey we document them from three locations inside the Cargill saltworks area, from Goto and from Slagbaai. In June 1998, 3-4 active nests were seen at Slagbaai (J. Ligon, pers. comm.).

### Antillean Tern

On Bonaire, Antillean Terns were also the most numerous nesting species, amounting to some 792 pairs, nesting at 44 of the 49 breeding sites located. Most nesting took place along the barren wind-exposed coast of the island. Nesting was much more widely spread and colonies were much more open and dispersed than on Curaçao. Areas with the largest breeding aggregations on Bonaire were the north coast of the Washington-Slagbaai park (sites 4-9), the coast between Spelonk and Lagoen (sites 21-28), the southeastern tip of the island (site 36) and the solar saltworks area (sites 39-42, 46). One site not visited in the present study due to inaccessibility but known to have served as a breeding site in the past is Isla di Rancho at Lac. Between 1994-1996 upwards of 20 pairs of Antillean Terns were observed nesting there one year but were not seen the subsequent two years (E. Newton, pers. comm.)

By mid May most birds were not yet nesting but assembling on the breeding sites and starting courtship behavior. Bird numbers peaked by late May and early June. The latest eggs observed were on 12 July, 2002, on Klein Bonaire and the road to Lagoen, Bonaire, and 13 July at Malmok, Bonaire. Large, almost fully feathered fledglings were seen on June 8 on the south side of Lagoen. Feeding by adults took place in the rough waters of the exposed northeast coast, just off the breeding sites.

## Discussion

### Laughing Gull

Voous (1983) listed this species as only incidentally nesting on Bonaire and possibly nesting on Klein Curaçao and Aruba. In the meantime, the species has been found nesting annually and in steadily increasing numbers on Aruba (Gochfeld et al., 1994). In this study we further document its repeated nesting on Curaçao and a significantly increased nesting aggregation on Bonaire. This species was often seen maurauding tern colonies in Curaçao and Bonaire (Cayenne, Royal and Common Terns) and is a potential threat to

these endangered tern species. Its recent population expansion in the ABC islands should be a matter of concern.

#### Royal Tern

Voous (1983) indicated only small numbers of nesting birds from Bonaire and Curaçao. However, del Nevo reported a nesting colony of some 87 birds from a confidential nesting site (saltworks area) in 1999. Our results for 2002, and those by del Nevo for 1999 indicate repeated nesting by larger numbers of Royal Terns in the saltworks area as hinted at by Voous (1983) but only now confirmed.

#### Cayenne Tern

No Cayenne Terns nested in Curaçao in 2002, nor have they in recent years. The species has disappeared since the early 1960s when they nested at several sites in Curaçao, numbering upwards of a thousand pairs (Ansingh et al. 1960; Voous, 1983). Most birds fed at sea off the north coast of the island, although the lagoon of Eastpoint is also specifically mentioned (Ansingh et al., 1958). All three former breeding sites of the Cayenne Tern experience heavy recreational disturbance today. Their former main site, Janthiel, is frequented daily for recreation, jogging and horseback riding. Only Least and Common Terns hang on at this site. In the last two decades their other lesser site in the Spanish Water has been crowded by sprawling marinas nearby, with intense disturbance by sailing, motor boating, jet ski's and campers trespassing onto the former nesting islands (Willemsberg, Penso, Chikitu and Meeuwte) where they (and Common Terns up till 1992) formerly nested. The species has further also not nested in recent years on Klein Curaçao. However, on Bonaire they continue to breed, albeit in much reduced numbers compared to as recently as 1982 when 600 pairs nested at Goto, or 1969, when 3-4000 nested in the saltworks area (Voous, 1983).

#### Roseate Tern

No Roseate Tern nesting was documented in the present study for either Curaçao or Bonaire, whereas the species formerly nested at several sites on both islands (Ansingh et al., 1960; Voous, 1963, 1983). Voous (1963) points out that the species never formed breeding colonies of its own but always joined other species. This would suggest that when large colonies of other species are disrupted (as they have been), the Roseate Tern will be one of the first species to stop nesting. Hence, it could be that this species may be particularly vulnerable to local extirpation due to declines in other species.

#### Common Tern

Voous (1965, 1983) mentions the presence of four nesting sites for the Common Tern in Curaçao: Isla di Makuaku in the St. Jorisbaai, "islets in Schottegat harbor", specifically in Buskabaai, and Spaanse Water. At present we also document four nesting sites in Curaçao, the most important of which are at Buskabaai and Janthiel. Voous (1965) indicated only 14 nesting pairs from Buskabaai, but the current numbers (40+) are considerably higher. Ansingh et al. (1960) found no nesting of Common Terns at Janthiel, which in this study is documented as an important breeding site for this species. For Isla di Makuaku, Voous (1965) estimated 5 pairs, which is similar to our findings.

For Spaanse Water, Voous (1965) indicated 10-15 pairs. However, this site has had no breeding since 1992.

Both in Curaçao and Bonaire, this species showed a great preference for nesting on islets and in aggregations of 20 or more pairs. Current totals for Curaçao (123 pairs), Bonaire (39 pairs) and Aruba (143 pairs, del Nevo, in prep.) mean that, as previously indicated by Halewijn and Norton (1984) the Leeward Dutch Antilles continue to be a critical breeding area for this species in the Caribbean.

#### Antillean Tern

While Voous (1983) and Halewijn and Norton (1984) indicated that total numbers of nesting Antillean Tern may approach 1000 pairs for the three islands together, few attempts have been made to provide comprehensive estimates. The Antillean Tern nests in many types of coastal areas, scattered along the coasts of the islands and is known for dispersed colonies and asynchronous breeding. This makes counts tedious and the chance of missing small colonies is high. In contrast to the other larger species, individual counts of Antillean Terns were generally not possible. Estimates were obtained by flushing the birds and counting them in the air. The number of birds was then divided in half to provide a rough estimate of the number of breeding pairs. The estimates provided are judged to err on the low side and hence to be indicative of minimum population estimates.

In July 2001 Wells and Childs Wells (in prep.) surveyed tern nesting on Bonaire (and Klein Bonaire) and documented some 360 adult birds or 180 pairs at some 13 sites. However, their survey was very late in the season and did not include the extensive grounds of the Cargill saltworks. In late June 1999, del Nevo did a more extensive survey and documented at least 450 pairs nesting at 37 locations on the island. However his survey was also relatively late in the season and did not include the island of Klein Bonaire. As a consequence he considered his estimates to be minimum estimates (del Nevo, in prep.). In contrast his Antillean Tern estimate of 85 pairs for Aruba was from early in the season and is likely accurate. Results by Halewijn (1985, 1986) were significantly higher (1984: 155+ pairs; 1985: 140 pairs).

In the present study we made three surveys of Curaçao and Bonaire and included all coastal areas of the island, and yet the estimates obtained most likely err on the low side (smaller aggregations could easily have been missed (in fact were missed!) and the number of birds in large aggregations were estimated conservatively). For Curaçao the total breeding population is estimated at 619 pairs while for Bonaire the total is estimated at 792 pairs. Our survey yields a total breeding population of some 1,400 pairs for Curaçao and Bonaire combined, which amounts to more than 20% of the total Caribbean breeding population estimate by Halewijn and Norton (1984).

Voous (1983) and Halewijn and Norton (1984) believed the majority of Antillean Tern breeding to be taking place on Bonaire. Our results confirm this. We (as does del Nevo, in prep.) suggest that the paucity of birds on Aruba may be due to the extreme human disturbance. All breeding habitat along the north coast of Aruba lies close to a particularly intensively used tourist route (A. Debrot, pers. observ.). In contrast, on Curaçao and Bonaire several of the large traditional breeding sites are in relatively inaccessible areas or on private property where disturbance is limited. A notable contrast between Curaçao and Bonaire is that on Curaçao nesting further appears to be much more



concentrated into larger aggregations than on Bonaire (Tables 1 & 2). The abundance of Sparrow Hawks, *Falco sparverius*, on Curaçao and the absence thereof on Bonaire may contribute to this evident difference in nest site dispersion (del Nevo, in prep.). It may be that breeding site selection for this species is partly dictated by nearby food availability.

### Conservation assessment and recommendations

#### General

Bij means of national ordinance of July 20, 1926 (PB 1926, No. 60) and September 28, 1931 (PB 1931, No 59) all species in question are legally protected in the Netherlands Antilles. The Cayenne Tern was added to the list of protected species in 1955 (PB 1955, No. 86) while all other terns breeding on these islands were added in 1960 (PB 1960, No. 102) (Timmers, 1979). The birds may not be taken, their eggs may not be taken and their nests may not be disturbed (Timmers, 1979). To our knowledge, the definition of “disturbance” to tern nests has never been legally defined nor tested in the court of law. However, research evidence from tern colonies in the United States would appear to recommend a minimum distance of about 150 m around the nesting site (T. Ryan, pers. comm.). On both Curacao and Bonaire, most seabird nesting sites further lie in legally designated conservation areas (see below). Hence there exists a wide scope for exercising conservation measures. While collection of eggs is practically a thing of the past in both Curaçao and Bonaire, unfortunately, the existing legal instruments have yet translated into little actual protection of nesting sites.

In the 1930's and 40's, boiled tern eggs (especially from the Aves Islands; Boeke, 1907) were regularly sold from large baskets by street vendors in Willemstad. Collection of tern eggs was done by first removing and destroying all eggs from the nesting site and then returning at 2-day intervals to reap the fresh eggs (A. Debrot Sr., pers. comm.; e.g. Eeuwens, 1926). In 2004, a single instance of egg-collection was documented. In mid May the management of the Isla Refinery was asked by an employee for permission to collect tern eggs for “potency”. Permission was granted and 31 eggs were collected from sites 17 and 18 (R. Rhuggenaath, pers. comm.). Since the refinery has been informed of the protected status of these birds it has promised full cooperation for their protection, including information to employees, closure of the areas during the breeding season, and placement of poisoned bait against stray dogs (R. Rhuggenaath, pers. comm.).

Recreational disturbance remains the single most serious and pervasive threat to the future of seabird nesting in Curaçao and Bonaire (Debrot and de Freitas, 1991; Debrot and Sybesma, 2000), and requires concerted action.

#### Curaçao

Inside Curaçao jurisdiction, most of the breeding sites fall within the boundaries of conservation areas as designated by the Island Development Plan (Eilandelijke Ontwikkelingsplan; A.B. 1995, No.36) as ratified in 1997. Notwithstanding a high level of private land ownership on Curaçao, many important sites further lie on public land. These are Hato (# 5), St. Michiel (# 6), Isla di Makuaku (# 11, DROV, 1985), Eastpoint (# 13; DROV, 1985), Klein Curaçao (# 16), and Buskabaai (# 17, #18).

Only three important nesting sites do not fall inside legally designated conservation areas. One of these is the Antillean Tern site of Klein Curaçao (site 16; 100+ pairs) where Cayenne Terns and probably Laughing Gulls have also nested in the recent past (Voous, 1983), and where two species of endangered sea turtle (Green turtle, *Chelonia mydas*, and Hawksbill, *Eretmochelys imbricata*) also currently nest (deceased specimens found well inland from the beach, October 22, 2000, collected by A. Debrot, identified by L. Pors, K. Eckert and P. Borkent). The other sites not legally designated as conservation area are the small island on the west side of Buskabaai and the western shore of Buskabaai, in the oil-polluted Schottegat harbor of Willemstad.

These and all other sites are variously susceptible to disturbance, which is presently the most serious threat to seabirds in Curaçao. The Janthiel and Spaanse Water sites have been previously mentioned and serve as examples of the damage that uncontrolled recreational access can have. Another site is the Common Tern breeding site of the islet Isla di Makuaku in the St. Jorisbaai. This was the first site in Curaçao designated as a seabird sanctuary area (DROV, 1985). All that presently remains are the concrete footposts of the sign (announcing the reserve) that stood there years ago. This remote island is named after the Frigatebirds that traditionally roosted there. However, since 2001 the birds have been chased off by recreational wind and kite surfers and police helicopters which practice(d) nearby (C. Schmitz and M. Martina, pers. comm.). For now the age-old late-afternoon sight of circling Frigatebirds is a distant memory, preserved for posterity only in the poem "Isla di Makwakoe" by the well-known Dutch writer "Boeli" van Leeuwen (1947).

With the growing popularity of out-door and nature related recreation, even the most remote areas of the island are being seriously disturbed and measures are urgently needed to keep seabird sites off limits to the public. Until the recent past, the small 1.7 km<sup>2</sup> island of Klein Curaçao (known as an important seabird nesting site since the early 17<sup>th</sup> century; Eeuwens, 1926) was only visited by small numbers of boaters and fishermen. However, in the last ten years recreational visitors have swelled to several hundred people a week and this is causing heavy disturbance to the Antillean Tern breeding colony. The birds were also being preyed on by feral cats (A. Debrot, pers. observ.). However, on October 6, 2001, five of the six cats present on the island (4 females, 1 male) were exterminated using the pesticide Temik-10 mixed in canned catfood. A lone male cat in poor condition escaped extermination and is reported still alive (May, 2004, G. van Buurt, pers. comm.).

Another concern in Curaçao is that the two main endangered Common Tern colonies feed almost exclusively in the contaminated Schottegat harbor. This fact should stress the need to continue with efforts to clean up this harbor which, notwithstanding the contamination, is an important feeding area visited by large numbers of sea and shore birds. Studies to assess and monitor the levels and effects of contamination in these birds are recommended.

## Bonaire

Inside Bonaire jurisdiction, the majority of the nesting sites fall inside protected zones as defined in the Bonaire nature policy plan (Natuurbeleidsplan 1999-2004) as ratified by the Island Council in June 1999. Private land ownership is much less common in Bonaire and only affects the coastal Antillean Tern sites between Lagoen and Lac (#

30-35). Even most of the industrial saltworks area is government land granted in lease (E. Newton, pers. comm.).

On Bonaire, human disturbance is much less acute than on Curaçao. Nevertheless, several important breeding sites inside or bordering the Washington-Slagbaai Park lie particularly close to routes open to vehicles and prone to the public (e.g., Antillean Tern nesting sites at Boka Chikitu and the tern islands of Slagbaai and Goto Lake). The National Park Foundation (STINAPA Bonaire) could implement measures to keep such sites closed to the public during the breeding season from April-August.

Feral cats are abundant on Bonaire and were observed on the Antillean Tern nesting colony of Klein Bonaire. Feral cats take large numbers of prey and are a recognized exotic pest in the island ecosystem (Churcher and Lawton, 1989; Garcia et al. 2001). Therefore, we (just as Wells and Childs Wells, in prep.) strongly recommend measures to control and/or exterminate cats from park and tern breeding areas to the maximum extent possible.

One of the key waterbird and tern breeding areas of Bonaire is the expansive saltworks area, which covers approximately 27 km<sup>2</sup> on the southern part of the island. The Flamingo sanctuary lies inside the saltworks area and is actively managed for optimal Flamingo, *Phoenicopterus ruber*, breeding. However, aside from keeping the public out, no specific measures are being taken to protect or stimulate tern breeding.

Most of the dikes in the saltworks area are subject to low yet disruptive levels of industrial traffic. In addition, dikes are only second-rate breeding sites as most of the large tern species prefer to nest on small islands (e.g., also in Aruba, see Halewijn 1986; del Nevo, in prep.). However, islands are exceedingly scarce in the constructed saltworks. The saltworks area has grown significantly in recent years but very few areas have been added that are of any real nesting value to most tern species. Therefore, we recommend the construction of a number of low artificial islands inside the expansive condensers to improve nesting habitat availability and help restore and increase tern nesting to its historic levels in this key seabird area. In the U.S. many management techniques have been developed to help increase or restore tern populations (Wells and Child Wells, in prep.; Kress 1998), and include the use of decoys to attract birds to new or prior breeding sites.

A final matter of concern, especially on Bonaire, is the large increase of nesting by Laughing Gulls. The adult birds will harass the tern colonies, taking tern eggs and young especially when the gulls are raising their own young (del Nevo, in prep.). Various field measures which have been used in the past are to “prick” or shake eggs to prevent hatching of the gull chicks (del Nevo, in prep.), or the use of poisoned bait to kill adult nesting birds (R. van Halewijn, pers. comm.). However, in some cases it appears that non-breeding “loafing” sub-adults can in fact cause more disturbance and predation than breeding gulls, and certain measures could even aggravate the situation (R. van Halewijn, pers. comm.).

### Acknowledgments

This study would not have been possible without the generous assistance by several individuals and organizations. Our colleague, Leon Pors, prepared the figures, while

George Saragoza, July-Ann Frans, Edwin Domacassé and Fernando Simal of STINAPA Bonaire provided logistical assistance on Bonaire, both on land and at sea. Thanks are further due to Jack Chalck of Habitat Bonaire for providing a luxurious apartment during our visits to the “Flamingo island”. We further thank Jan Gielen and Rudi St. Jago of the Cargill saltworks of Bonaire, and N. Chaclin and R. Rhuggenaath of Refineria Isla (Curacao) S A for their cooperation with this study. Reviews by R. van Halewijn and E. Newton provided numerous important improvements to the manuscript. Principal funding for this study was by the Carmabi Foundation based on annual general subsidies by the Central Government of the Netherlands Antilles and the Island Government of Curaçao. Additional funding was provided as student grants to the junior authors by the Hogeschool INHOLLAND Delft, The Netherlands.

#### Literature Cited

Ansingh, F. H., H. J. Koelers, P. A. van der Werf and K. H. Voous. 1960. The breeding of the Cayenne of Yellow-billed Sandwich Tern in Curaçao in 1958. *Ardea* 48: 51-65.

Boeke, J. 1907. Iets over de visserij op Bonaire. *Neerlandia* 11 (12): 206-207.

Buckley, P. A. and F. G. Buckley. 2000. Breeding Common Terns in Greater West Indies: status and conservation priorities. Pp. 96-102 in (Schreiber E. A. and D. S. Lee, editors), *Status and conservation of West Indian seabirds*. Society of Caribbean Ornithology, Special Publication Number 1.

Churcher, P. B. and J. H. Lawton. 1989. Beware of well-fed felines. *Nat. Hist.* 7/1989:40-47.

Debrot, A. O. and J. A. de Freitas. 1991. Wilderness areas of exceptional conservation value in Curaçao, Netherlands Antilles. *Netherlands Commission for International Nature Protection, Proc.* 26. 25 pp.

Debrot, A. O. and J. Sybesma. 2000. The Dutch Antilles, Chapter 38. Pp. 595-614 in C.R.C. Sheppard (ed.), *Seas at the Millennium: an Environmental Evaluation, Vol. I Regional Chapters: Europe, The Americas and West Africa*. Elsevier, Amsterdam.

Del Nevo, A. The status and distribution of nesting terns on Aruba and Bonaire, Netherlands Antilles 1999. (in prep.)

DROV (Dienst Ruimtelijke Ontwikkeling en Volkshuisvesting, Curaçao). 1985. *Monumenten inventarisatie. Band IV. Natuur/Cultuurmonumenten*. Pag. var.

Eeuwens, P. A. 1926. Klein-Curaçao. *West Indische Gids* 7 (1926): 401-411.

- Garcia, M. A. C. E. Diez and A. O. Alvarez. 2001. The impact of feral cats on Mona Island wildlife and recommendations for their control. *Car. J. Sci.* 37: 107-108.
- Gochfeld, M., J. Burger, A. Haynes-Sutton, R. van Halewijn and J. E. Saliva. 1994. Successful approaches to seabird protection in the West Indies. Pp. 186-209, in D. N. Nettleship, J. Burger and M. Gochfeld (eds.), *Seabirds on islands: threats, case studies and action plans*. BirdLife Conserv. Ser. No. 1. BirdLife Int. Cambridge, U.K.
- Halewijn, R., van. 1985. Report on 1984 survey of marine birds of Aruba, Netherlands Antilles. Report Stinapa-Aruba and Foundation for Scientific Research in Suriname and the Netherlands Antilles, Netherlands. 135 pp +app.
- Halewijn, R., van. 1986. Marine birds of Aruba. Report on 1985 survey and conservation campaign. Report Stinapa-Aruba and Foundation for Scientific Research in Suriname and the Netherlands Antilles, Netherlands. 144 pp +app.
- Halewijn, R., van. 1988. History of the seabird populations of San Nicolas Bay Keys, Aruba. *Studies in Honour of Dr. Pieter Wagenaar Hummelinck, Uitg. Natuurwetensch. Studiekr. Suriname Ned. Ant.* 123: 33-59.
- Halewijn, R., van. The seabird breeding populations of the Lago Reef, Aruba: a paradox. (in press, this volume)
- Halewijn, R., van and R. L. Norton. 1984. The status and conservation of seabirds. Pp. Conservation of the world's seabirds, Cambridge, U.K.: ICBP, Tech. Publ. 2.
- Jackson, J. 2000. Distribution, population changes and threats to Antillean Terns in the Caribbean and adjacent waters of the Atlantic and Gulf of Mexico. Pp. 109-117 in (Schreiber E. A. and D. S. Lee, editors), *Status and conservation of West Indian seabirds*. Society of Caribbean Ornithology, Special Publication Number 1.
- Kress, S. 1998. Applying research for effective management: case studies in seabird restoration. Pp. 141-154 in J. M. Marzluff and R. Sallabanks (eds.). *Avian Conservation. Island Prep.*, Washinton, D.C.
- Leeuwen, W. C. J., van. 1947. *Tempels in Woestijnen*. Imprenta Bolivar, Curaçao.
- Sturm, M. G. de L. 1991. The living resources of the Caribbean Sea and adjacent regions. *Caribb. Mar. Stud.* 2(1&2): 18-44.
- Timmers, W. W. 1979. Wetgeving natuurbeheer op de Nederlandse Antillen in 1978. *STINAPA Doc. Ser. No. 6*. 304 pp.
- Voous, K. H. 1963. Tern colonies in Aruba, Curaçao, and Bonaire, south Caribbean. *Proc. 13<sup>th</sup> Intern. Ornithol. Congr.* (1961): 1214-1216.

Voous, K. H. 1965. Nesting and nest sites of Common Terns and Dougall's Terns in the Netherlands Antilles. *Ibis* 107: 430-431.

Voous, K. H. 1983. *Birds of the Netherlands Antilles*. De Walburg Pers, Zutphen, The Netherlands. 327 pp.

Wells, J. V. and A. Childs Wells. The significance of Bonaire, Netherlands Antilles, as a breeding site for terns and plovers. (in prep.)

**Fig. 1. Map of Curaçao showing seabird breeding sites, 2002.**

**Fig. 2. Map of Bonaire showing seabird breeding sites, 2002.**