

# Preliminary inventory of key terrestrial nature values of Bonaire

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Report number C003/12



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BO-11-011.05-000

Publication date: March 2012

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This research is part of the BO program Helpdesk BES (BO-11-011.05-000) and has been co-financed by the Ministry of Economic Affairs, Agriculture and Innovation (EL&I) under project number HD3360.

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## Summary

Based on a helpdesk question from the Dutch Ministry of Economic Affairs, Agriculture and Innovation (EL&I) a preliminary inventory is given of key terrestrial nature values of Bonaire in order to determine their occurrence in relation to areas designated as “nature” and “open landscape”, according to the Spatial development plan of Bonaire. This was based on a literature study and supplemented by expert advice.

In 2010 a spatial development plan was written in order to determine the spatial policy and regulation for the future development of Bonaire. The island was partitioned into areas for different uses such as agriculture and recreation. Two specific designations are “nature” and “open landscape”. The occurrence of nature values within these areas remained unclear. This makes implementation of protective measures based on international treaties and island legislation problematic. An inventory of the occurrence of these values should help facilitate more effective implementation of these protective measures. In the present study key nature values are determined, both in terms of protected species and essential habitat (e.g. caves). Figure 1 shows the location of the different “nature” and “open landscape” within the different regions of Bonaire.

From the literature study it became apparent that data on the occurrence of most of the priority species of flora and fauna, is limited and scattered, especially with respect to “open landscape” and “nature” outside parks. Therefore, only a preliminary inventory is provided showing the general distribution of nature values across the entire island, as linked to various habitat types. An exact distribution of the different nature values was not possible at this time, but extrapolation from areas of known occurrence into other areas of similar habitat type was used to show the occurrence of overlapping distributions of nature values within the designated areas of “nature” and “open landscape”. The number of overlapping distributions of nature values may contribute to setting conservation priorities.

From the results it can be concluded that the areas of “open landscape” and “nature” (outside the national parks) seem to harbour unique and critical nature values. These areas are not actively managed or protected as national parks. The “open landscape” of Bolivia possibly harbours a few rare plant species (unique), an important population of critical key columnar cacti and at least two columnar cactus-pollinating bat species. The “open landscape” of Washikemba/Bakuna harbours key mangrove species that only have another main location at Lac Bay (national park). The “nature” area of Terrace Landscape Middle Bonaire seems to harbour a concentration of unique (e.g. *Tillandsia balbisiana*) and rare plant species (e.g. *Krugiodendron ferreum* etc.) and four bat species. The same is the case for Lima (e.g. Sabal palm, *Maytenus versluysii* and three bat species) while in Southern Bonaire key mangrove species also still occur.

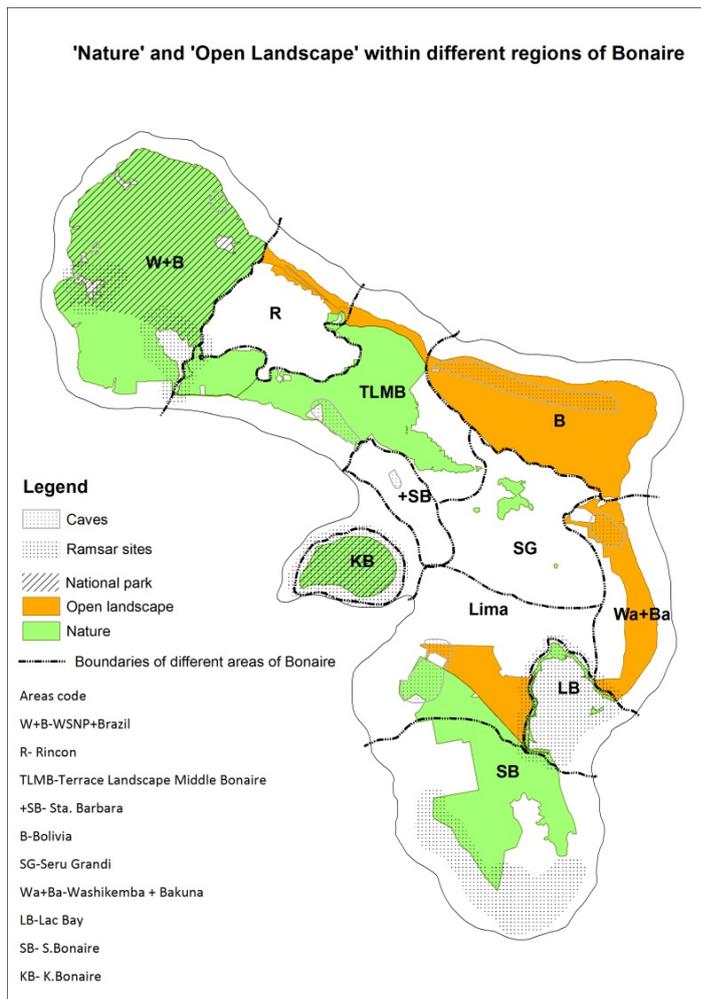
Table 1 shows which nature values are found or expected to occur within each “open landscape” and “nature” (outside national parks) area.

It can be concluded that outside the current parks, the main regions that harbour a concentration of key nature values are Terrace Landscape Middle Bonaire/Sta. Barbara, Bolivia, Washikemba/Bakuna and Lima. Terrace Landscape Middle Bonaire is designated as “nature” area, while Washikemba/Bakuna and Bolivia are in part designated as “open landscape”. Lima has both “nature” and “open landscape” designations. Sta. Barbara is designated for other uses, but the present review shows that the occurrence of several significant nature values is likely within this area.

Additionally, based on the preliminary inventory, the combination of apparent concentrations of rare plants, occurrence of critical bat species and the high probability of corridor values show that the areas of

Terrace Landscape Middle Bonaire/Sta. Barbara and Lima are important areas concerning conservation and further research. The areas of Bolivia and Washikemba/Bakuna follow closely.

To be able to implement the necessary protective measures within these areas, it is recommended that more extensive research through fieldwork is done, in order to obtain a complete inventory of the different nature values found on Bonaire, not only in the areas of "nature" and "open landscape" but also in areas with other designations. Additionally, it is recommended to assess the list of vulnerable and endangered species ('Informatieblad beschermde dier- en plantensoorten Bonaire') as certain species that may be of importance to Bonaire are not included.



When executing a complete and extensive inventory of Bonaire it would be of value to also determine the ecological conditions needed for the different species to survive. Based on the ecological conditions necessary for their life functions, it may be possible to pinpoint those areas of main ecological importance per species. A complete inventory of the nature values on the island can contribute to better management of nature values (e.g. determining the distribution of caves and the distribution, health status and diversity of keystone cacti species for better management of bat populations). It is also recommended to determine areas with high potential for the occurrence of rare or relict species and which areas harbour high corridor values.

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Figure 1 – A sketch map of the location of "nature" and "open landscape" within the regions of Bonaire.

Table 1. The nature values observed and expected within the different areas of a) "open landscape" and b) "nature" (outside of parks). Abbreviations: R – Rincon, TLMB – Terrace Landscape Middle Bonaire, B – Bolivia, Wa+Ba – Washikemba/Bakuna, StB – Sta. Barbara, SG – Seru Grandi, SB – Southern Bonaire.

a)

R - Open	TLMB - Open	B - Open	Wa+Ba Open	Lima Open	StB
<i>Caretta caretta</i> *	<i>Caves</i> * (6)	<i>Conocarpus erecta</i> *	<i>Rhizophora mangle</i> (2)	<i>Mormoops megalophylla</i> (2)	<i>Machaonia ottonis</i> (1)
<i>Chelonia mydas</i> *	<i>Subpilocereus repandus</i> *	<i>Crateva tapia</i> * (1)	<i>Laguncularia racemosa</i> (2)	<i>Leptonycteris curasoae</i> (3)	<i>Guaiacum sanctum</i> (2)
<i>Eretmochelys imbricata</i> *	<i>Stenocereus griseus</i> *	<i>Bromelia humilis</i> (2)	<i>Avicennia germinans</i> (2)	<i>Glossophaga longirostris</i> (4)	<i>Manihot carthaginensis</i> (2)
<i>Dermochelys coriacea</i> *	<i>Pilosocereus lanuginosus</i> *	<i>Leptonycteris curasoae</i> (3)	<i>Conocarpus erecta</i> *	<i>Subpilocereus repandus</i> *	<i>Zanthoxylum flavum</i> (3)
<i>Caves</i> * (6)	<i>Melocactus macracanthus</i> *	<i>Glossophaga longirostris</i> (4)	<i>Caretta caretta</i> *	<i>Stenocereus griseus</i> *	<i>Subpilocereus repandus</i> *
<i>Subpilocereus repandus</i> *	<i>Opuntia wentiana</i> *	<i>Caves</i> (6)	<i>Chelonia mydas</i> *	<i>Pilosocereus lanuginosus</i> *	<i>Stenocereus griseus</i> *
<i>Stenocereus griseus</i> *	<i>Tyto alba spp.</i> (3)	<i>Subpilocereus repandus</i> *	<i>Eretmochelys imbricata</i> *	<i>Melocactus macracanthus</i> *	<i>Pilosocereus lanuginosus</i> *
<i>Pilosocereus lanuginosus</i> *	<i>Buteo albicaudatus</i> (3)	<i>Stenocereus griseus</i> *	<i>Dermochelys coriacea</i> *	<i>Buteo albicaudatus</i> * (3)	<i>Melocactus macracanthus</i> *
<i>Melocactus macracanthus</i> *	<i>Sterna antillarum</i> (7)	<i>Pilosocereus lanuginosus</i> *	<i>Caves</i> (6)	<i>Polyborus plancus</i> (8)	<i>Buteo albicaudatus</i> (3)
<i>Opuntia wentiana</i> *	<i>Polyborus plancus</i> (8)	<i>Melocactus macracanthus</i> *	<i>Subpilocereus repandus</i> *	<i>Amazona barbadensis</i> (9)	<i>Polyborus plancus</i> (8)
<i>Tyto alba spp.</i> * (3)	<i>Amazona barbadensis</i> (9)	<i>Opuntia wentiana</i> *	<i>Stenocereus griseus</i> *	<i>Margarops fuscatus</i> (9)	<i>Amazona barbadensis</i> (9)
<i>Buteo albicaudatus</i> (3)	<i>Margarops fuscatus</i> (9)	<i>Tyto alba spp.</i> (3)	<i>Pilosocereus lanuginosus</i> *	<i>Aratinga pertinax xanthogenius</i> (9)	<i>Margarops fuscatus</i> (9)
<i>Falco peregrinus</i> (7)	<i>Aratinga pertinax xanthogenius</i> (9)	<i>Buteo albicaudatus</i> * (3)	<i>Melocactus macracanthus</i> *	<i>Chrysolampis mosquitus</i> (9)	<i>Aratinga pertinax xanthogenius</i> (9)
<i>Sterna antillarum</i> (7)	<i>Chrysolampis mosquitus</i> (9)	<i>Falco peregrinus</i> (7)	<i>Opuntia wentiana</i> *	<i>Coereba flaveola bonairensis</i> (10)	<i>Chrysolampis mosquitus</i> (9)
<i>Polyborus plancus</i> (8)	<i>Coereba flaveola bonairensis</i> (10)	<i>Sterna antillarum</i> (7)	<i>Fulica caribaea</i> (2)	<i>Water caves</i> *	<i>Coereba flaveola bonairensis</i> (10)
<i>Amazona barbadensis</i> (9)	<i>Water caves</i> *	<i>Polyborus plancus</i> (8)	<i>Tyto alba spp.</i> * (3)	<i>Iguana iguana</i> *	<i>Water caves</i> *
<i>Margarops fuscatus</i> (9)	<i>Iguana iguana</i> *	<i>Amazona barbadensis</i> (9)	<i>Buteo albicaudatus</i> * (3)	<i>Fresh water sources</i> *	<i>Iguana iguana</i> *
<i>Aratinga pertinax xanthogenius</i> (9)	<i>Fresh water sources</i> *	<i>Margarops fuscatus</i> (9)	<i>Tryngites subruficollis</i> (5)	<i>Fresh water species</i> *	<i>Fresh water sources</i> *
<i>Chrysolampis mosquitus</i> (9)	<i>Fresh water species</i> *	<i>Aratinga pertinax xanthogenius</i> (9)	<i>Phoenicopterus ruber</i> * (5)	<i>Other endemic species</i> *	<i>Fresh water species</i> *
<i>Coereba flaveola bonairensis</i> (10)	<i>Other endemic species</i> *	<i>Chrysolampis mosquitus</i> (9)	<i>Falco peregrinus</i> (7)		<i>Other endemic species</i> *
<i>Water caves</i> *		<i>Coereba flaveola bonairensis</i> (10)	<i>Pandion haliaetus</i> (7)		
<i>Iguana iguana</i> *		<i>Water caves</i> *	<i>Sterna antillarum</i> (7)		
<i>Fresh water species</i> *		<i>Iguana iguana</i> *	<i>Polyborus plancus</i> (8)		
<i>Other endemic species</i> *		<i>Fresh water sources</i> *	<i>Amazona barbadensis</i> (9)		
		<i>Fresh water species</i> *	<i>Margarops fuscatus</i> (9)		
		<i>Other endemic species</i> *	<i>Aratinga pertinax xanthogenius</i> (9)		
			<i>Chrysolampis mosquitus</i> (9)		
			<i>Coereba flaveola bonairensis</i> (10)		
			<i>Water caves</i> *		
			<i>Iguana iguana</i> *		
			<i>Fresh water sources</i> *		
			<i>Fresh water species</i> *		
			<i>Other endemic species</i> *		

*	Expected within this regions due to the occurrence of a specific landscape (e.g. Roois, landscapesubtype or water)
	Seaturtles
	Trees
	Mangroves
	Plants
	Bats
	Caves
	Cacti
	Birds
	Water caves
	Reptiles
	Fresh water sources
	Fresh water species
	Other endemic species
(..)	The numbers in brackets shows in how many regions this species has been observed (actual and documented observations).

b)

Brasil - Nature	R - Nature	TLMB - Nature	SG- Nature	Lima Nature	SB - Nature
<i>Conocarpus erecta</i> *	<i>Fulica caribaea</i> (2)	<i>Krugiodendron ferreum</i> (1)	<i>Subpilocereus repandus</i> *	<i>Sabal palm</i> (1)	<i>Salicornia perennis</i> (3)
<b>Caves</b>	<i>Buteo albicaudatus</i> (3)	<i>Guaiacum sanctum</i> (2)	<i>Stenocereus griseus</i> *	<i>Maytenus versluisii</i> (2)	<i>Rhizophora mangle</i> *
<i>Subpilocereus repandus</i> *	<i>Tyto alba spp.</i> * (3)	<i>Schoepfia shreberi</i> (2)	<i>Pilosocereus lanuginosus</i> *	<i>Mormoops megalophylla</i> (2)	<i>Laguncularia racemosa</i> *
<i>Stenocereus griseus</i> *	<i>Phoenicopterus ruber</i> (5)	<i>Croton niveus</i> (2)	<i>Melocactus macracanthus</i> *	<i>Leptonycteris curasoae</i> (3)	<i>Avicennia germinans</i> *
<i>Pilosocereus lanuginosus</i> *	<i>Tryngites subruficollis</i> (5)	<i>Zanthoxylum flavum</i> (3)	<i>Buteo albicaudatus</i> * (3)	<i>Glossophaga longirostris</i> (4)	<i>Conocarpus erecta</i> *
<i>Melocactus macracanthus</i> *	<i>Polyborus plancus</i> (8)	<i>Crateva tapia</i> *	<i>Polyborus plancus</i> (8)	<b>Caves</b> (6)	<i>Caretta caretta</i> *
<i>Opuntia wentiana</i> *	<i>Amazona barbadensis</i> (9)	<i>Conocarpus erecta</i> *	<i>Amazona barbadensis</i> (9)	<i>Subpilocereus repandus</i> *	<i>Chelonia mydas</i> *
<i>Sterna hirundo</i> (2)	<i>Margarops fuscatus</i> (9)	<i>Tillandsia balbisiana</i> (1)	<i>Margarops fuscatus</i> (9)	<i>Stenocereus griseus</i> *	<i>Eretmochelys imbricata</i> *
<i>Sterna maxima</i> (2)	<i>Aratinga pertinax xanthogenius</i> (9)	<i>Bromelia humilis</i> (2)	<i>Aratinga pertinax xanthogenius</i> (9)	<i>Buteo albicaudatus</i> * (3)	<i>Dermochelys coriacea</i> *
<i>Thalasseus eurygnathus</i> (2)	<i>Chrysolampis mosquitus</i> (9)	<i>Tillandsia flexuosa</i> (2)	<i>Chrysolampis mosquitus</i> (9)	<i>Polyborus plancus</i> (8)	<i>Subpilocereus repandus</i> *
<i>Tyto alba spp.</i> (3)	<i>Coereba flaveola bonairensis</i> (10)	<i>Myrmecophila humboldtii</i> (2)	<i>Coereba flaveola bonairensis</i> (10)	<i>Amazona barbadensis</i> (9)	<i>Stenocereus griseus</i> *
<i>Phoenicopterus ruber</i> (5)	<i>Iguana iguana</i> *	<i>Caretta caretta</i> *	<i>Water caves</i> *	<i>Margarops fuscatus</i> (9)	<i>Pilosocereus lanuginosus</i> *
<i>Pelecanus occidentalis</i>	<i>Fresh water sources</i>	<i>Chelonia mydas</i> *	<i>Iguana iguana</i> *	<i>Aratinga pertinax xanthogenius</i> (9)	<i>Opuntia wentiana</i> *
<i>Tryngites subruficollis</i> * (5)	<i>Fresh water species</i> *	<i>Eretmochelys imbricata</i> *	<i>Fresh water sources</i> *	<i>Chrysolampis mosquitus</i> (9)	<i>Sterna hirundo</i> (2)
<i>Falco peregrinus</i> (7)	<i>Other endemic species</i> *	<i>Dermochelys coriacea</i> *	<i>Fresh water species</i> *	<i>Coereba flaveola bonairensis</i> (10)	<i>Sterna maxima</i> (2)
<i>Pandion haliaetus</i> (7)		<i>Mormoops megalophylla</i> (2)	<i>Other endemic species</i> *	<i>Water caves</i> *	<i>Thalasseus eurygnathus</i> (2)
<i>Amazona barbadensis</i> (9)		<i>Natalus tumidirostris</i> (2)		<i>Iguana iguana</i> *	<i>Phoenicopterus ruber</i> * (5)
<i>Margarops fuscatus</i> (9)		<i>Leptonycteris curasoae</i> (3)		<i>Fresh water sources</i> *	<i>Tryngites subruficollis</i> (5)
<i>Aratinga pertinax xanthogenius</i> (9)		<i>Glossophaga longirostris</i> (4)		<i>Fresh water species</i> *	<i>Pelecanus occidentalis</i> (6)
<i>Chrysolampis mosquitus</i> (9)		<b>Caves</b> (6)		<i>Other endemic species</i> *	<i>Falco peregrinus</i> (7)
<i>Coereba flaveola bonairensis</i> (10)		<i>Subpilocereus repandus</i> *			<i>Pandion haliaetus</i> (7)
<i>Caretta caretta</i> *		<i>Stenocereus griseus</i> *			<i>Sterna antillarum</i> (7)
<i>Chelonia mydas</i> *		<i>Pilosocereus lanuginosus</i> *			<i>Coereba flaveola bonairensis</i> (10)
<i>Eretmochelys imbricata</i> *		<i>Melocactus macracanthus</i> *			<i>Water caves</i> *
<i>Dermochelys coriacea</i> *		<i>Opuntia wentiana</i> *			<i>Iguana iguana</i> *
<i>Water caves</i> *		<i>Tyto alba spp.</i> (3)			<i>Fresh water sources</i> *
<i>Fresh water sources</i> *		<i>Buteo albicaudatus</i> (3)			<i>Fresh water species</i> *
<i>Iguana iguana</i> *		<i>Pelecanus occidentalis</i> (6)			<i>Other endemic species</i> *
<i>Fresh water species</i> *		<i>Pandion haliaetus</i> (7)			
<i>Other endemic species</i> *		<i>Polyborus plancus</i> (8)			
		<i>Amazona barbadensis</i> (9)			
		<i>Margarops fuscatus</i> (9)			
		<i>Aratinga pertinax xanthogenius</i> (9)			
		<i>Chrysolampis mosquitus</i> (9)			
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		<i>Water caves</i> *			
		<i>Fresh water sources</i> *			
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		<i>Fresh water species</i> *			
		<i>Other endemic species</i> *			

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	Seaturtles
	Trees
	Mangroves
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	Bats
	Caves
	Cacti
	Birds
	Water caves
	Reptiles
	Fresh water sources
	Fresh water species
	Other endemic species
(..)	The numbers in brackets shows in how many regions this species has been observed (actual and documented observations).

# 1. Introduction

## 1.1 Background

On July the 8<sup>th</sup> 2010, a spatial development plan for Bonaire was ratified by the Public Entity of Bonaire (OLB) in order to set the spatial policy and regulation for the future. The spatial development plan partitioned and designated the land surface of Bonaire to various important purposes such as agrarian, residential, recreation, conservation and industrial purposes (ROB, 2010).

Bonaire has a wealth of aquatic nature, a characteristic landscape and a unique biodiversity. The purpose of the spatial development plan was to recognise the qualities and identity of Bonaire and to ensure that these are not compromised due to spatial developments. The different areas of Bonaire were assigned specific designations which range from agriculture to recreation, based on the present use of the area.

Since 10 October 2010 the Caribbean islands Bonaire, St. Eustatius and Saba have become Public Entities. The Dutch government has therefore become responsible for the implementation and adherence to the international conventions concerned. The following international conventions apply to Bonaire:

- The Ramsar convention
- The Biodiversity convention
- The CITES convention
- The SPAW-Protocol
- The Sea Turtle convention
- Bonn-convention
- IUCN

The Island Ordinance Nature Management Bonaire states that all species of flora and fauna that are listed in the Appendix I of the CITES convention, Appendix 1 of the Bonn convention, Appendices I and II of the SPAW Protocol and Appendix I of the Sea Turtle convention are designated as protected species. Additionally other native species of flora and fauna can also be designated as protected species. Based on the Island Ordinance Nature Management Bonaire, a list of protected flora and fauna of Bonaire was made. This is presented by the 'Dienst Ruimtelijke Ontwikkeling en Beleid' (DROB) as the 'Information supplement on protected flora and fauna of Bonaire' (2010). In addition to the species that are listed in the different international conventions, the Executive Council of Bonaire may choose to add other species to the list, based on additional criteria such as endemism or rarity, listing on the IUCN Red list, key-stone species etc. However, the full implementation of all applicable international conventions and local nature legislation is still difficult, due to lack of information on the distribution of protected and endangered species of Bonaire.

Several areas of Bonaire have been designated as "nature" and others have been designated as "open landscape". The sketch map (figure 10) shows the location of these areas within the different regions of Bonaire (Washington Slagbaai National Park, Rincon, Lima etc.). Note: the boundaries of the different regions of Bonaire are sketched. There is concern of the Ministry of EL&I, the Netherlands, and the Public Entity of Bonaire that the nature values found on Bonaire, in particular those found within the areas of "nature" (outside parks) and "open landscape" may be insufficiently protected due to lack of knowledge on their distribution throughout Bonaire. Key questions are whether or not the "open-land" and "nature" outside park areas possess or are likely to possess nature values, and whether or not these may also concern critical or unique conservation values. Based on that concern, the Ministry of EL&I, the Netherlands, asked IMARES to execute a preliminary inventory (Helpdesk question HD3360 Nature values of Bonaire for protection of nature and open landscape) of the key nature values of Bonaire. With

such an inventory, better implementation of the international treaties and protection of the rare species will be easier. As Helpdesk questions only regard very limited studies, this preliminary inventory is only based on a desk study, and supplemented by expert knowledge.

Here a preliminary inventory is provided of the species that are legally protected on Bonaire and their distribution throughout the island. This inventory is then used to analyse the occurrence of nature values within the two specific designations of “nature” and “open landscape”. From the outset it was expected that these areas harbour a combination of nature values. In order to be able to implement the necessary protective measures correctly it is important to obtain detailed information on the distribution of protected species within the “nature” (outside parks) and “open landscape” areas.

The collection of information and analysis of the data in this report would not be possible without valuable contributions from different persons and organisations. In this respect we would like to thank the following people: Frank van Slobbe from Department of Environment and Natural Resources (DROB-MNB). Fernando Simal of the Washington Slagbaai National Park. Marlene Robinson from Sea Turtle Conservation Bonaire (STCB). Personal comments from Andre van Proosdij, Sam Williams, Jerry Ligon, Peter Montanus and Eric Newton. Personal comments from Paul C. Hoetjes from Ministry of Economic Affairs, Agriculture & Innovation (EL&I). Jur van der Velde and Fokke Plantinga from Buro Vijn. Materials from Gerard van Buurt, Erik Meesters and Diana Slijkerman. Special thanks to Liesbeth van der Vlies.

## 1.2 Bonaire

Bonaire is one of the islands of the Leeward Antilles that lie in the Southern Caribbean Sea (between 68°11' and 68°25' W and 12°02' and 12°19' N) in front of the Venezuelan coast (De Freitas, 2005). The length of the island is 40 km, its width varies between 5 and 12 km and the total surface area is 288 km<sup>2</sup> (De Palm (1985) as mentioned in De Freitas *et al.*, 2005). Bonaire lies in a slanted position, the north western part of the island lies higher above sea level than the south eastern part of the island. The Brandaris, situated in the Washington Slagbaai National Park, is the highest elevation on Bonaire and lies 238 m above sea level. However, the southern part of Bonaire lies less than 2 m above sea level (STINAPA). In front of the leeward coast of Bonaire, approximately 6 km<sup>2</sup> and opposite of the main town Kralendijk, lies the small island of Klein Bonaire (De Freitas, 2005).

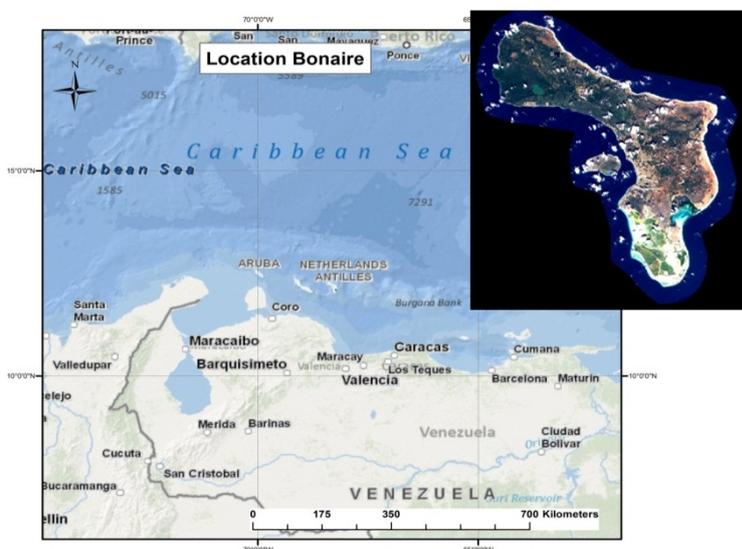


Figure 2 - Location of Bonaire island, Credits: IMARES, RapidEye satellite image of Bonaire , date of acquisition 09-Mar-2011

## 1.3 The international conventions

### *The CITES Convention*

CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival (CITES). On Bonaire, this law applies to a total of nine native species including *Amazona barbadensis*, *Caracara plancus* and the five sea turtles found in the waters and on the beaches surrounding Bonaire.

### *The Bonn Convention*

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention) aims to conserve terrestrial, aquatic and avian migratory species throughout their range. It is an intergovernmental treaty, concerned with the conservation of wildlife and habitats on a global scale (CMS). The sea turtles of Bonaire, the Osprey and the Buff breasted sandpiper are examples of a few of Bonaire's species that are listed in the appendices of the Bonn convention.

### *The SPAW-Protocol*

The Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (the Cartagena Convention) is a legally binding environmental treaty for the Wider Caribbean Region. The Convention and its Protocols (SPAW-Protocol) constitute a legal commitment by the participating governments to protect, develop and manage their coastal and marine resources individually or jointly (UNEP). The sea turtles of Bonaire, the Yellow shouldered Amazon and the Brown Pelican are examples of a few of Bonaire's species that are listed in the annexes of the SPAW-Protocol.

### *The Sea Turtle Convention*

The Inter-American Convention for the Protection and Conservation of Sea Turtles ("IAC") is an intergovernmental treaty which provides the legal framework for countries in the American Continent to take actions in benefit of these species (IAC). This law applies to all five species of sea turtle known from Bonaire.

### *IUCN*

In addition to the above treaties it needs to be said that Bonaire is also home to a several species that are internationally recognized as threatened species. These are listed on the IUCN Red List of Threatened Species™ which provides taxonomic, conservation status and distribution information on plants and animals that have been globally evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction (IUCN). Examples are: *Guaiacum sanctum*, *Typhlatya monae* and *Fulica caribaea*.

The present study focuses on flora and fauna species that are vulnerable or endangered based on the international treaties that apply to Bonaire and/or because the Executive council of Bonaire has appointed these species as protected based on other reasons. The latter may include criteria such as being endemic to the island or of special importance to the ecology of the island. The official Information supplement on Protected flora and fauna species of Bonaire presents a list of those species protected. The supplement is based on the Islands regulation of natural resources on Bonaire ('Informatieblad beschermde dier- en plantensoorten Bonaire').

## 2. Assignment

The assignment has two main objectives:

- To identify which protected nature values are found within the areas designated as "open landscape" and "nature" (outside of national parks) as mentioned in the spatial development plan of Bonaire and whether they may also concern critical or unique conservation values.
- To provide of short description on each nature value, their distribution throughout the island, their conservation status and when applicable also their feeding and breeding habits.

In order to identify which nature values are found within these areas a preliminary inventory was made of the distribution of the different nature values throughout Bonaire, based on literature study. The final analysis specifically focused on two areas of "nature" and "open landscape".

The relevant scientific literature was collected for these nature values in order to determine their distribution on the island. For the fauna species, when possible, information was collected on two life functions, breeding and feeding habits in order to determine the species primary requirements.

### 3. Materials and methods

The spatial environmental assessment (RBOI, 2010) mentions the following nature values of Bonaire:

- Areas with well-developed (climax) vegetation types
- Areas with occurrence of rare plant species
- Legally designated RAMSAR sites
- Important birds area (IUCN)
- Caves with threatened bat species
- Areas with endemic invertebrate species
- Breeding and feeding areas for the international sea turtles.

In the present study, our focus is given to the same nature values. However, a few boundaries are added. In the present study, the focus is given to the species of flora and fauna that are vulnerable or endangered according to the Island Ordinance Nature Management Bonaire (2008). The Information Supplement on protected flora and fauna of Bonaire (2010) presents a list of those species. In the present study, these species are defined as the nature values of interest. Additionally, habitats that are of importance to the survival of these species are included (e.g. caves, fresh water sources). A few species that were not on the list, but which were thought of to be of importance as nature values, were included, based on expert opinion. As the present study focusses on the occurrence of nature values within "nature" and "open landscape" areas, only terrestrial species are included or marine species that make use of the beaches of Bonaire (e.g. sea turtles).

To obtain a clear picture of the distribution of the different nature values on Bonaire a preliminary inventory was made, based on a desk study. Literature information was collected on the distribution of these nature values throughout Bonaire. For fauna, where possible, information was collected on the two life functions; breeding and feeding, in order to determine the species primary requirements with regards to habitat needs. For the fauna a table was constructed showing which species occur in the different landscape types as defined based on their vegetation (Appendix II- Potential occurrence of different nature values). This means that the vegetation map of Bonaire (Freitas *et al.*, 2005) was used as the main source for habitat characterization.

Furthermore, for the different bird species, where possible, data was obtained on the different habitat types potential, actual and documented distribution.

"Potential" distribution is defined as those areas a certain species may use for different life functions if there was no disturbance present. In other words, those areas that provide a suitable habitat for this certain species. This is based on the historical known distribution of the species or based on the species known occurrence in comparable habitat elsewhere (e.g. Curaçao).

"Actual" distribution is defined as those areas where the specific species is currently observed, based on expert knowledge. "Actual" distribution is the result of such factors as habitat distribution ("potential" distribution) and competition. The "potential" distribution area is typically larger than the area of actual distribution due to competition and other limiting factors (e.g. other species or disturbance by humans).

"Documented" distribution are those areas a certain species occurs based on documented observations (scientific articles). Figure 3 shows a conceptual diagram of the logical relationship between these three different habitat classifications. The information regarding the different bird species was individually mapped (Appendix V- Bird's habitat maps).

### DIAGRAM OF HABITAT TYPES

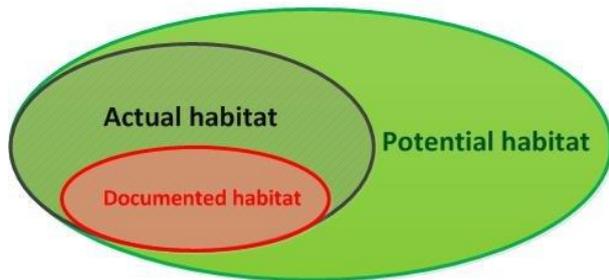


Figure 3 Conceptual diagram showing the logical relationships between potential, actual and documented habitat/distribution.

The occurrence of the different nature values within certain regions of Bonaire were linked to the landscape types found within these regions, in order to get an idea of the nature values found within the different landscape types of Bonaire (for this the landscape types (based on vegetation, De Freitas *et al.*, 2005) were used. Freitas *et al.*, (2005) divided Bonaire into seven main landscape types with a number of subtypes: Beaches (B, with 3 subtypes), the Salinas (S, 2 subtypes), the Lower Terraces (TL, 9 subtypes), the Middle Terraces (TM, 9 subtypes), the Higher Terraces (TH, 2 subtypes), the Escarpments (E, 2 subtypes) and the Undulating Landscapes (D, 5 subtypes) (Appendix I).

For an overview of the nature values that occur within certain regions of Bonaire tables (Tables 2, 4 to 12) were constructed which show the occurrence of the different nature values within the different regions. The regions of focus are Washington Slagbaai National Park (WSNP) + Brasil, Rincon, Terrace Landscape of Middle Bonaire + Sta. Barbara, Bolivia, Seru Grandi, Washikemba + Bakuna, Lima, Lac Bay, Southern Bonaire and Klein Bonaire. The inventory that results from the present study may contribute to eventually identifying priority areas for conservation by the government of Bonaire. An often used method in assigning priority areas to specific species is based on the range-wide priority-setting method by Sanderson *et al.*, (2002) (Thorbjarnarson *et al.*, 2006; Wolf *et al.*, 2006; Ferrier *et al.*, 2010; Bryan *et al.*, 2011; Capotorti *et al.*, 2011). This approach consists of a sequence of logical steps to determine conservation priority areas for a certain species: (1) systematic consideration of the entire historic range of the species; (2) identification of key regional habitat associations that represent important variations in species ecology; (3) identification of areas where the species status is known (known areas) and where the species is presently found (current range); and (4) delineation of the area's most important for the species' conservation (Thorbjarnarson *et al.*, 2006). The landscape classification was used as baseline information on the distribution of species. According to Capotorti *et al.*, (2012) and Ferrier & Drielsma, (2010) the landscape classification should form the basis for nature evaluation and setting the conservation priorities, as it can significantly affect where and what conservation or other investments are made.

The goal of the present study is not to assign priority areas but to make an inventory. However, the inventory is made to eventually be useful in assigning biodiversity priority areas. Therefore, this framework was used in the present study. The present study follows step 3 of this framework. An overview of the distribution of the nature values throughout the entire island was necessary in order to get a clearer picture of the overall distribution of the nature values on the island and to eventually be able to useful in determining key biodiversity areas.

The final analysis concerns two specific destinations: "nature" and "open landscape". The designated "nature" areas are those areas that were defined as areas of which the nature, ecological and landscape

values should be protected. The present study focusses on the distribution of the natural values within the areas designated as “open landscape” and “nature”, but specifically nature that is found outside of parks and are not yet protected under National park or Ramsar regulations. Figure 10 shows that Washington Slagbaai National park, Klein Bonaire and Lac bay are protected by these regulations. The “nature” areas not actively protected are found in Brasil Labra, Terrace Landscape Middle Bonaire, Lima, Southern Bonaire and a small portion in the region of Seru Grandi and in Rincon.

The Strategic Environmental Assessment of Bonaire (RBOI, 2010) stated that within these areas a multitude of values are found (e.g. important ecological habitats of important species (caves, salina’s) and landscape values (Rooi systems, limestone terraces). The “open landscape” areas are those areas that were defined as undeveloped areas without a specific function (Appendix III). (Note: the designation of the different areas was based on limited data during the ROB assessment). The designation of “open landscape” was intended to prevent the uncontrolled development of these areas and deterioration of Bonaire’s values (ROB, 2010). “Open landscape” areas are found in the regions Rincon, Terrace Landscape Middle Bonaire, Bolivia, Washikemba/Bakuna and Lima (Figure 10).

Our analysis identified the protected nature values within the “nature” and “open landscape” and specifically mentions the protected species within each of the ten focus regions Washington Slagbaai, Brasil Labra, Rincon, Terrace Landscape Middle Bonaire, Klein Bonaire, Bolivia, Seru Grandi, Washikemba/Bakuna, Lima, Lac Bay and Southern Bonaire.



*Figure 4 - Dry evergreen woodland Terrace Landscape Middle Bonaire (left) and terrace landscape Sta. Barbara (right). Credits: A.O. Debrot, 2011.*

## 4. Results

### 4.1 Trees

In addition to the species mentioned on the Islands regulation of natural resources on Bonaire ('Informatieblad beschermde dier- en plantensoorten Bonaire'), the shrubby tree *Croton niveus* was incorporated as it is a rare species for Bonaire.

De Freitas *et al.*, (2005) present a semi-detailed landscape-based vegetation map for Bonaire. Within that study they identified 18 vegetation types and 32 (sub) landscape types. The occurrence of different vegetation is mapped and the vegetation types are described. The present study will focus on a few plant species that are regarded as conservation priorities. A short description of the different nature values is given below.

#### 4.1.1. Trees

##### 1. Sabal palm.

The Sabal palm (*Sabal cf causerium*) is a rare species on Bonaire. At present the only known natural location of the Sabal palm is on the Middle Terraces (subtypes TM3 and TM4) in Lima, all along the road from Punt Vierkant to Lac Bay (pers.ob. A.O. Debrot and John De Freitas). The palm is protected by Island Legislation (Eilandsbesluit natuurbeheer Bonaire). Young plants originating from Curaçao were planted in protected enclosures in the WSNP. Early historical account speak of palms on Klein Bonaire, where today none are found. These accounts may regard Sabal, a species harvested intensively in the past for basket weaving.

##### 2. *Zanthoxylum flavum*.

The West Indian Satin wood (*Zanthoxylum flavum*) is a medium-sized tree predominately found on Klein Bonaire. Recent observations have shown that this species may occur on the Middle Terraces of Karpata (subtype TM6) and Sta. Barbara (subtypes TM4, TM5, TM6 and TM8) (pers.ob. John de Freitas). In Sta. Barbara it may also occur on the Lower Terraces (subtypes TL6, TL7 and TL8). De Freitas *et al.*, (2008) located it in the Washington Slagbaai National Park. This species is vulnerable according to IUCN's Red list. It was extensively cut in the past for its valuable wood and is also locally known as "geelhout".

Table 2- Distribution of different tree species in the different regions of Bonaire.

Trees	W+B	R	TLMB+SB	B	SG	Wa+Ba	Lima	LB	SB	KB
Sabal palm										
<i>Zanthoxylum flavum</i>										
<i>Maytenus versluisii</i>										
<i>Krugiodendron ferreum</i>										
<i>Guaiaacum sanctum</i>										
<i>Euphorbia</i>										
<i>Salicornia perennis</i>										
<i>Strumpfia maritima</i>										
<i>Schoepfia shreberi</i>										
<i>Croton niveus</i>										
<i>Manihot carthaginensis</i>										
<i>Rhizophora mangle</i>									E	
<i>Laguncularia racemosa</i>									E	
<i>Avicennia germinans</i>									E	
<i>Conocarpus erecta</i>	E	E	E	E		E	E	E	E	E
<i>Crateva tapia</i>			E	E		E				

Abbreviations:

	uncertain
	Present based on observations.
E	Expected due to the occurrence of a specific Landscape (e.g. Roois, landscape subtype or water)
P	Potential habitat

W+B- WSNP + Brasil; R- Rincon; TLMB+SB- Terrace Landscape Middle Bonaire + Sta. Barbara; B- Bolivia; SG- Seru Grandi; Wa+Ba- Washikemba + Bakuna; LB- Lac Bay; SB- S. Bonaire; KB- K. Bonaire.

3. *Maytenus versluysii*.

*Maytenus versluysii* is endemic to Bonaire and Curaçao (De Freitas et al, 2005, Debrot, 2006). This species has been observed on the Middle Terraces (subtypes TM3 and TM4) of Lima (Pers.ob., A.O. Debrot). De Freitas *et al.*, (2008) located it in the Washington Slagbaai National Park on Seru Hobao, Seru Yuwana, Brandaris and Matado di Packu (approx. subtypes D1 and D3; pers.ob. John de Freitas). This species is protected by Island Legislation.

4. *Krugiodendron ferreum*.

*Kaubati*, *Krugiodendron ferreum* will be expected to be found on the Higher Terraces (subtype TH1) along the road from Subi Rincon to Barkadera (pers.ob. A.O. Debrot) and is protected according to Island Legislation.

5. *Guaicum sanctum*.

Wayaka shimaron, Holywood Lignumvitae (*Guaicum sanctum*) is expected to be found on the Higher Terraces (subtype TH1) Subi Rincon terraces to Barkadera and the Middle Terraces (approx. subtypes TM4, TM5, TM6 and TM8) of Sta. Barbara (pers.ob. A.O. Debrot and John de Freitas). It is listed in Appendix II of CITES and is Endangered according to the IUCN Red list. It was also located in the Washington Slagbaai National Park by De Freitas *et al.*, (2008).

6. *Salicornia perennis*.

Glasswort (*Salicornia perennis*), an aquatic plant found in salt marshes, is abundantly found along the muddy shores of Lac Bay. It is expected to be in areas in or near the Washington Slagbaai National Park and Lagun (pers.ob. John de Freitas). This species is protected by the decision of Island Legislation.

7. *Strumpfia maritima*

Bai no bolbe (*Strumpfia maritima*) is a low, cushion-like shrub and is predominately found on rocky shores. The specific distribution of this species on Bonaire is unclear. This species is protected by Island Legislation.

8. *Schoepfia schreberi*.

Gulf Graytwig (*Schoepfia schreberi*) is found on WSNP hills and on the Highest Terraces of Sta. Barbara (pers.ob. John de Freitas). This rare hardwood tree species is protected by Island Legislation.

9. *Croton niveus*.

Kiviti (*Croton niveus*) has been observed at several location between Barkadera and Karpata on the Middle Terrace (subtype TM6; pers.ob. A.O. Debrot). It has also been seen at several locations in the Washington Slagbaai National Park at Juwa (approx. subtypes D2 and D3). It has a strong preference for limestone areas (pers.ob. John de Freitas). This rare species is protected by Island Legislation.

#### 10. *Manihot carthaginensis*.

Kasabi di mondi, (*Manihot carthaginensis*) has been observed on the Middle Terraces of Sta. Barbara (approx. subtypes TM4, TM5, TM6 and TM8; pers.ob. John de Freitas) and in the Washington Slagbaai National Park. This rare species is protected by Island Legislation.

#### 11. *Crateva tapia*.

Surun di mondi, (*Crateva tapia*) has been observed in Roois in various locations of the Washington Slagbaai National Park. It is expected that this species will be found in Roois with high amount of water. Examples of where this species has been observed are entrada Slagbaai (above Goto Lake and Bronswinkel (subtype D3). It has also been observed on Seru Yuwana (subtype D1) and Matado di Pasku (subtype D3) (pers.ob. John de Freitas). This rare species is protected by Island Legislation.

### 4.1.2. Mangrove species

On Bonaire four mangrove species occur, the Red mangrove (*Rhizophora mangle*), the White mangrove (*Laguncularia racemosa*), the Black mangrove (*Avicennia germinans*) and the Buttonwood (*Conocarpus erecta*). They are listed as protected because of their limited distribution and their keystone role in ecology (particularly nursery function for reef fishes). The first three mangrove species are found within a certain vegetation type that is only found in the one of the subtypes of the landscape Salina (S1) (see Appendix I for the location of S1) such as Lac Bay and Lagun. Strictly speaking, *Conocarpus erecta* is not a mangrove but is associated with brackish to hyper saline waters and mangrove vegetation. It is especially found within different vegetation types that may occur in Salinas (subtypes S1 and S2), Beaches (subtypes B1, B2 and B3), Lower Terraces (subtypes TL1, TL2, TL3, TL5) and Middle Terraces (subtype TM8). Areas where this species is found are Lima and the rest of southern Bonaire. All four mangrove species are protected species according to Island Legislation.

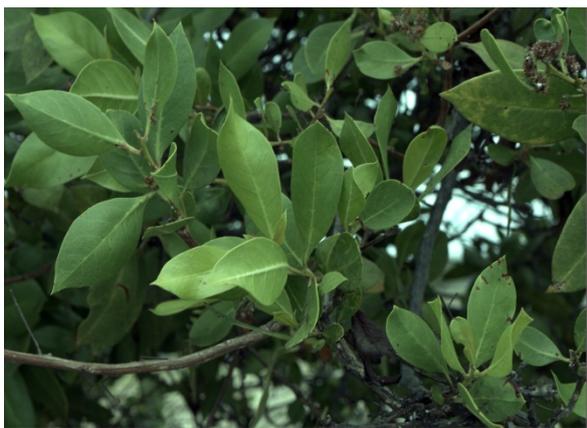


Figure 5 - Red (left) and Black (right) mangroves, Credits: Erik Meesters, 2011

### 4.1.3. Rare tree species

There are several tree species on Bonaire for which only limited data (on distribution) is available, and that are rare or very rare. De Freitas *et al.*, (2008) did a survey of rare vegetation species found in the Washington Slagbaai National Park on the west side of Bonaire. The Washington Slagbaai National Park is dominated by landscape types D3 and D2. But subtypes D1, D4, D5 and the limestone (coastal) areas TL1 and TL7 are also found (Appendix I). The rare tree species that were found in this study are listed in Table 3. Complementary to Table 3, *Guaiacum sanctum* is very rare, as is *Guapira fragrans* (pers. ob.

A.O. Debrot). The distribution of these rare species outside the Washington Slagbaai National Park needs further investigation.

Insufficient information was found regarding the three tree species *Amyris ignea*, *Euphorbia cotinifolia* and *Phorandendron trinervium* and they are not discussed in this study. All three however, are found on Bonaire (*E. cotinifolia* is also found on Curacao) as rare species. On Bonaire *Amyris ignea* has been found on the higher terraces of Colombia (per. ob. A. van Proosdij).

Table 3- Distribution of rare tree species in WSNP

TREES	Rare in WSNP	Bonaire	CITES	IUCN	Bonn	SPAW
<i>Capparis linearis</i>	Very rare	-	-	-	n.a.	-
<i>Capparis tenuisiliqua</i>	Very rare	x	-	-	n.a.	-
<i>Celtis iguanaea</i>	Rare	x	-	-	n.a.	-
<i>Clusia sp.</i>	Very rare	x	-	*	n.a.	-
<i>Crateva tapia</i>	Rare	x	-	-	n.a.	-
<i>Croton niveus</i>	Rare	-	-	-	n.a.	-
<i>Eugenia procera</i>	Rare	-	-	-	n.a.	-
<i>Ficus brittonii</i>	Very rare	x	-	-	n.a.	-
<i>Geoffroea spinosa</i>	Rare	x	-	-	n.a.	-
<i>Guaiacum officinale</i>	-	x	II	E	n.a.	-
<i>Guaiacum sanctum</i>	Rare?	x	II	E	n.a.	-
<i>Guapira fragrans</i>	-	x	-	-	n.a.	-
<i>Guapira pacurero</i>	-	x	-	-	n.a.	-
<i>Jacquinia armillaris</i>	Very rare	-	-	-	n.a.	-
<i>Manihot carthaginensis</i>	(Very?) rare	x	-	-	n.a.	-
<i>Maytenus tetragona</i>	Rare	x	-	-	n.a.	-
<i>Maytenus versluisii</i>	Rare	x	-	-	n.a.	-
<i>Melicocca bijuga</i>	Rare	-	-	-	n.a.	-
<i>Myrcia curassavica</i>	Rare	-	-	-	n.a.	-
<i>Psidium sartorianum</i>	Rare	-	-	-	n.a.	-
<i>Schoepfia schreberi</i>	Rare	x	-	-	n.a.	-
<i>Spondias mombin</i>	Rare	x	-	-	n.a.	-
<i>Ximenia americana</i>	Rare	x	-	-	n.a.	-
<i>Zanthoxylum monophyllum</i>	(Very) rare	x	-	-	n.a.	-

\* Some *Clusia spp.* are Vulnerable according to the IUCN Redlist.

Those tree species that are listed as protected species by the Executive council of Bonaire and the rare tree species that were found in the Washington Slagbaai National Park located by De Freitas et al., 2008.

Legend: x - This species is protected by the decision of the Executive council of Bonaire; II - Appendix II of CITES;

E - Endangered according to IUCN Red List; n.a. - not applicable.

## 4.2 Plants

In the present study a short description is given of the plant species that are seen as key nature values of Bonaire, their distribution on the island and their conservation status.

Plant species added to the inventory were the plant *Tillandsia balbisiana* because it was not known to occur on Bonaire and is a rare and new plant record for the Leeward Dutch islands. It has recently been collected by Marlene Robinson and determined by Andre van Proosdij. The plant *Machaonia ottonis* (palu di heru) was also included because of its uncommon occurrence on Bonaire.

#### 4.2.1 Orchids

According to Trejo-Torres & Ackerman (2001) only two orchid species have been reported to occur on Bonaire, none of which are endemic. These are the Lady of the night (*Brassavola nodosa*) and *Myrmecophila humboldtii* (*Schomburgkia humboldtii*). De Freitas et al, (2008) located the same orchid species within the Washington Slagbaai National Park and concluded that these were rare species found within the National Park. Just recently the orchid *Myrmecophila humboldtii* was found on the Higher Terraces (subtype TH1) at Sta. Barbara (Personal observation Marlene Robinson). It has also been observed on the Middle Terrace (approx. subtypes TM4, TM5 and TM8) of the western part of Sta. Barbara. ( pers.ob. John de Freitas). Both orchid species are protected on Bonaire and are listed in Appendix II of CITES.

#### 4.2.2. Ferns

The Executive Council of Bonaire lists fern species as protected ('Informatieblad Beschermde dier- en plantensoorten Bonaire'). De Freitas et al, (2008) located several rare fern species within the Washington Slagbaai National Park of Bonaire.

The ferns located by De Freitas et al, (2008) are listed below:

- *Adiantum capillus-veneris*
- *Cheilanthes concolor*
- *Cheilanthes microphylla*
- *Lygodium venustum*
- *Nephrolepis biserrata*
- *Pityrogramma calomelanos*
- *Thelypteris sp.*

However, little data is available of their occurrence outside Washington Slagbaai National Park. Native ferns are protected by Island Legislation.

#### 4.2.3. Other plants

##### 1. *Bromelia humilis*

Based on comparison with Curaçao, the Middle Terraces of Bolivia and the Higher Terraces of Colombia are high potential areas for the occurrence of natural patches of *Bromelia humilis*. Normally, the species could also be expected in the WSNP but it has not been found there after relatively extensive botanical research. This species is protected by Island Legislation. The species has been seen in captivity on the main road through Bolivia (A. O. Debrot) but it is not known whether the plants originate from the wild or have been imported as an ornamental.

Table 4- Distribution of different plant species in the different regions of Bonaire.

Plants	W+B	R	TLMB+SB	B	SG	Wa+Ba	Lima	LB	SB	KB
<i>Bromelia humilis</i>										
<i>Tillandsia flexuosa</i>										
<i>Tillandsia balbisiana</i>										
<i>Brassavola nodosa</i>										
<i>Myrmecophila humboldtii</i>										
<i>Machaonia ottonis</i>										
Varnes										

Abbreviations:

	uncertain
	Present based on observations.
E	Expected due to the occurrence of a specific Landscape (e.g. Roois, landscape subtype or water)
P	Potential habitat

W+B- WSNP + Brasil; R- Rincon; TLMB+SB- Terrace Landscape Middle Bonaire + Sta. Barbara; B- Bolivia; SG- Seru Grandi; Wa+Ba- Washikemba + Bakuna; LB- Lac Bay; SB- S. Bonaire; KB- K. Bonaire; Varnes – ferns (throughout the report).

#### 2. *Tillandsia flexuosa*

Recently *Tillandsia flexuosa* was observed on the Higher Terraces (subtype TH1) near Sta. Barbara (pers.ob. Marlene Robinson). De Freitas *et al.*, (2008) found the *Tillandsia flexuosa* within the Washington Slagbaai National park. This rare epiphytic species is protected by Island Legislation.

#### 3. *Tillandsia balbisiana*

Recently a small population of *Tillandsia balbisiana* was found on the Higher Terraces (subtype TH1) near Sta. Barbara (pers.ob. Marlene Robinson). This species does not have a protected status on Bonaire. The species ranges from Florida and Mexico, throughout the West Indies to Venezuela. It was not known to occur in the leeward islands of the Dutch Caribbean and represents a new and unique addition to the flora of the ABC islands.

#### 4. *Machaonia ottonis*

*Machaonia ottonis* has been observed as a high shrub on the Middle Terraces of Sta. Barbara (subtypes TM4, TM5, TM6 and TM8) (pers.ob. John de Freitas) and on the Higher Terraces near Subi Rincon (A. O. Debrot pers. comm.). This species does not have a protected status on Bonaire.

#### 5. *Scaevola plumieri*

This species is a rare native evergreen beach shrub only found at Lac Bay (Debrot *et al.*, 2010). This species is not protected.

### 4.3 Sea turtles

Five sea turtle species are found in the waters surrounding Bonaire: the Loggerhead Turtle (*Caretta caretta*), the Green Turtle (*Chelonia mydas*), the Hawksbill Turtle (*Eretmochelys imbricata*) and the Leatherback Turtle (*Dermochelys coriacea*). However, the Leatherback turtle is only seen infrequently on the island (Dow *et al.*, 2007). The Olive ridley *L. olivacea*, is known by local fishermen as turtuga bastardo and has been documented for Curaçao, but (is not formally listed for Bonaire). It is extremely rare species in the Leeward Dutch Caribbean. The sea turtles nests on mainland beaches of South America.



Figure 6 - Sea turtle of Bonaire, Credits: by we-sea.it, Diana Slijkerman, 2011.

The Green Turtle and the Hawksbill Turtle visit Bonaire to nest on the beaches and to forage, while the Loggerhead Turtle merely visits Bonaire's beaches to nest (Dow *et al.*, 2007). Sea turtles forage at sea. All five species are protected by CITES (Appendix I), the Cartagena convention (Appendix I), The SPAW protocol (Annex II) and the Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC).

The Loggerhead Turtle and the Green Turtle are listed by IUCN as Endangered while the Leatherback and the Hawksbill turtle are listed as Critically endangered species (IUCN). In the present study focus is given to the occurrence of different nature value on land and therefore only potential nesting sites are included here. Eijck & Eckert (1994) made a survey of the occurrence of sea turtles on Bonaire. The potential nesting areas of the different sea turtle species are the beaches. One may assume that all beaches on Bonaire may function as nesting areas. However, undisturbed, quiet and unlighted beaches are preferred by sea turtles.

Table 5- Distribution of sea turtles in the different regions of Bonaire.

Sea turtles	W+B	R	TLMB+SB	B	SG	Wa+Ba	Lima	LB	SB	KB
<i>Caretta caretta</i>	E	E	E			E	E	E	E	E
<i>Chelonia mydas</i>	E	E	E			E	E	E	E	E
<i>Eretmochelys imbricata</i>	E	E	E			E	E	E	E	E
<i>Dermochelys coriacea</i>	E	E	E			E	E	E	E	E

**Abbreviations:**

	uncertain
	Present based on observations.
E	Expected due to the occurrence of a specific Landscape (e.g. Roois, landscape subtype or water)
P	Potential habitat

W+B- WSNP + Brasil; R- Rincon; TLMB+SB- Terrace Landscape Middle Bonaire + Sta. Barbara; B- Bolivia; SG- Seru Grandi; Wa+Ba- Washikemba + Bakuna; LB- Lac Bay; SB- S. Bonaire; KB- K. Bonaire.

## 4.4 Mammals

### 4.4.1. Bats

Eight bat species have been observed on Bonaire (STINAPA, Rojer, 2008): the velvety free tailed bat (*Molossus molossus*), the Peter's Ghost-faced bat (*Mormoops megalophylla*), the Funnel eared bat (*Natalus tumidirostris*), the Little brown bat (*Myotis nesopolus*), the Small leaf-nosed bat (*Ametrida centurio*), the Greater bulldog bat (*Noctilio leporinus*), the Lesser-long nose bat (*Leptonycteris curasoae*)

and the Common long-tongued bat (*Glossophaga longirostris*). However, only four of them have been seen in de last ten years (Rojer, 2008 as mentioned in RBOI, 2010).

Table 6- Distribution of bats in the different regions of Bonaire.

Bats	W+B	R	TLMB+SB	B	SG	Wa+Ba	Lima	LB	SB	KB
<i>Mormoops megalophylla</i>										
<i>Natalus tumidirostris</i>										
<i>Leptonycteris curasoae</i>										
<i>Glossophaga longirostris</i>										

Abbreviations:

	uncertain
	Present based on observations.
E	Expected due to the occurrence of a specific Landscape (e.g. Roois, landscape subtype or water)
P	Potential habitat

W+B- WSNP + Brasil; R- Rincon; TLMB+SB- Terrace Landscape Middle Bonaire + Sta. Barbara; B- Bolivia; SG- Seru Grandi; Wa+Ba- Washikemba + Bakuna; LB- Lac Bay; SB- S. Bonaire; KB- K. Bonaire.

In 2000 Rojer (unpublished) held a census of the bat population of Bonaire. During this census Rojer (unpub.) did not observe *Ametrida sp.*, *Molossus molossus*, *Myotis nesopolus* or *Noctilio leporinus*. Personal observations of Fernando Simal from STINAPA also only included *L. Curasoae*, *G. longirostris* and *M. megalophylla*. (Appendix II).

A distinction can be made between insect-feeding and nectar-feeding bats and one fish-eating bat. The first four species are insect-feeding bats. The diet of the small leaf-nosed bat is unknown but may be fruits. *Noctilio leporinus* feeds on fish and is also known as the Fisherman bat. *Glossophaga longirostris* and *Leptonycteris curasoae* are the nectar-feeding bats and are the only pollinators of the cacti and key species *Subpilocereus repandus*, *Stenocereus griseus* and probably *Pilosocereus lanuginosus* (Petit, 2001) and are therefore of great importance to Bonaire.

#### 4.4.2. Caves

Bats use caves and crevices to roost and as nursery habitat for their young. The occurrence of caves and crevices is therefore an ecological condition for the presence of bats within an area. As caves are directly related with habitat of bats the distribution of caves throughout Bonaire was included in the present study. The bats predominately occur in caves and crevices found within the limestone terraces of the Middle and Higher Terraces.

Cave formation is predominately found within the limestone terraces as limestone rock is susceptible to dissolution. The Lower, Middle and Higher Terraces are therefore high potential areas for caves. The entrances to the caves are often found in or near escarpments.

Table 7- Location of caves in the different regions of Bonaire

	W+B	R	TLMB+SB	B	SG	Wa+Ba	Lima	LB	SB	KB
Caves (dry)										E
Water caves (wet)	E	E	E	E	E	E	E	E	E	E

Abbreviations:

	uncertain
	Present based on observations.
E	Expected due to the occurrence of a specific Landscape (e.g. Roois, landscape subtype or water)
P	Potential habitat

W+B- WSNP + Brasil; R- Rincon; TLMB+SB- Terrace Landscape Middle Bonaire + Sta. Barbara; B- Bolivia; SG- Seru Grandi; Wa+Ba- Washikemba + Bakuna; LB- Lac Bay; SB- S. Bonaire; KB- K. Bonaire.

The caves that are found within the Lower Terraces lie closer to sea level and therefore have a higher possibility to contain groundwater. Drier caves will be found in the Middle and Higher Terraces of Bonaire.

#### 4.4.3. Cacti

The three species of columnar cacti *Subpilocereus repandus*, *Stenocereus griseus* and *Pilosocereus lanuginosus* are elements of arid vegetation on Bonaire. *Subpilocereus repandus* and *Stenocereus griseus* provide food for several species of animals during the dry season, when many other plant species are non-productive. They constitute a critically important group of plants to the island ecosystem (Petit, 2001). Therefore, the cacti species *Subpilocereus repandus* and *Stenocereus griseus* are an example of keystone species. These different cacti species are found throughout the entire island of Bonaire.

##### 1. *Subpilocereus repandus*

According to De Freitas (2005) *Subpilocereus repandus* may occur practically everywhere, such as on the Beaches (subtype B3), the Lower Terraces (subtypes TL3, TL5, TL6, TL7, TL8 and TL9), the Middle Terraces (subtypes TM2, TM3, TM4, TM6, TM7, TM8 and TM9), the Higher Terraces (subtype TH1), the Escarpments (subtypes E1 and E2) and the Undulating Landscapes (subtypes D1, D2, D3, D4 and D5). This species is listed in Appendix II of CITES.

##### 2. *Stenocereus griseus*

*Stenocereus griseus* may occur throughout the landscape types Beaches (subtype B3), Lower Terrace (TL3, TL5 to 9), Middle Terraces (subtype TM2, TM3, Tm4 and TM6 to 9), Higher Terraces (both subtypes), all Escarpment and Undulating landscape types. This species is listed in Appendix II of CITES.



Figure 7 - Candelabra cactus of Bonaire (left), Iguana hiding in cactus (right). Credits: A.O. Debrot.

Table 8- Location of cacti in the different regions of Bonaire.

Cacti	W+B	R	TLMB+SB	B	SG	Wa+Ba	Lima	LB	SB	KB
<i>Subpilocereus repandus</i>	E	E	E	E	E	E	E		E	E
<i>Stenocereus griseus</i>	E	E	E	E	E	E	E		E	E
<i>Pilosocereus lanuginosus</i>	E	E	E	E	E	E	E		E	E
<i>Melocactus macracanthus</i>	E	E	E	E	E	E	E			E
<i>Opuntia wentiana</i>	E	E	E	E		E	E		E	E

Abbreviations:

	uncertain
	Present based on observations.
E	Expected due to the occurrence of a specific Landscape (e.g. Roois, landscape subtype or water)
P	Potential habitat

W+B- WSNP + Brasil; R- Rincon; TLMB+SB- Terrace Landscape Middle Bonaire + Sta. Barbara; B- Bolivia; SG- Seru Grandi; Wa+Ba- Washikemba + Bakuna; LB- Lac Bay; SB- S. Bonaire; KB- K. Bonaire.

### 3. *Pilosocereus lanuginosus*

*Pilosocereus lanuginosus* may occur on the Lower Terraces (subtype TL6, TL7 and TL8), the Middle Terraces (subtype TM6, TM8 and TM9), the Higher Terraces (subtype TH1), the Escarpments (subtype E1) and the Undulating Landscapes (subtypes D1, D2 and D3) on Bonaire. This species is listed in Appendix II of CITES.

Other cacti are the *Melocactus macracanthus* and *Opuntia wentiana*.

### 4. Milon di seru, *Melocactus macracanthus*

The *Melocactus macracanthus* is often found on surfaces with a high percentage of surface stoniness (De Freitas *et al.*, 2005). Such surfaces can be found on the Lower, Middle and Higher Terraces of Bonaire. De Freitas *et al.*, (2005) found this species on the Lower Terraces in subtypes TL6 and TL8. On the Middle Terraces this species was found on the subtypes TM2, TM4, TM6, TM7 and TM9. On the Higher Terraces *Melocactus macracanthus* was located on the subtype TH1. This species is listed in Appendix II of CITES

and is protected according to Island Legislation.

### 5. Tuna, *Opuntia wentiana*

The Prickly pear (*Opuntia wentiana*) is also a cactus that is found throughout the entire islands according to De Freitas *et al.* (2005), with exception to the subtypes B1, B2 of the Beaches, the Salinas, TL1 and TL2 of the Lower Terraces and TM1 of the Middle Terraces. This species is listed in Appendix II of CITES. However, this species is considered a nuisance species.

In order to identify the main populations of the different cacti species and the status of these critical plants in terms of species composition, size frequency distributions, and plant health, an accurate inventory of the island will have to be done by extensive mapping of their location through fieldwork. All *Cactaceae spp.* are listed as CITES Appendix II species.

## 4.5 Birds

A certain amount of research has been done on the occurrence of different bird species on Bonaire (Flikweert *et al.*, 2007; Harms & Eberhard, 2003; Nijman *et al.*, 2009, Nijman *et al.*, 2008; Prins *et al.*, 2009, Wells & Debrot, 2008). To visualize the distribution of the different key bird species on Bonaire that are protected, maps were made. The maps and the description of the different birds are found in

Appendix V. As mentioned, when possible those areas are shown that are potential, actual or documented habitat areas of the specific bird species.

In addition to the bird species mentioned on the Islands regulation of natural resources on Bonaire ('Informatieblad beschermde dier- en plantensoorten Bonaire'), the Caribbean coot (*Fulica caribbea*) and the Bananaquit (*Coereba flaveola bonairensis*) were included in the present study. The Caribbean coot is a rare to uncommon species (Prins *et al.*, 2005) and a priority species for conservation in the Caribbean as it is listed as Near Threatened by IUCN. The Bananaquit is endemic to Bonaire. Additionally the different terns (*Sterna antillarum*, *Sterna hirundo*, *Sterna maxima* and *Thalasseus eurgnathus*) are added because they are priority species for conservation in the Caribbean where Bonaire is critical breeding island for the region (Debrot *et al.* 2009).

Table 9- Distribution of birds in different regions of Bonaire.

Birds	W+B	R	TLMB+SB	B	SG	Wa+Ba	Lima	LB	SB	KB
<i>Phoenicopus ruber</i>						E		E		
<i>Fulica caribbea</i>										
<i>Pelecanus occidentalis</i>										
<i>Tryngites subruficollis</i>						E				E
<i>Amazona barbadensis</i>										
<i>Margarops fuscatus</i>										
<i>Aratinga pertinax xanthogenius</i>										
<i>Chrysolampis mosquitus</i>										
<i>Coereba flaveola bonairensis</i>										
<i>Tyto alba spp.</i>		E				E				
<i>Polyborus plancus</i>										
<i>Buteo albicaudatus</i>				E	E	E	E	E		E
<i>Falco peregrinus</i>										
<i>Pandion haliaetus</i>										
<i>Sterna antillarum</i>										
<i>Sterna hirundo</i>										
<i>Sterna maxima</i>										
<i>Thalasseus eurynathus</i>										

Abbreviations:

	uncertain
	Present based on observations.
E	Expected due to the occurrence of a specific Landscape (e.g. Roois, landscape subtype or water)
P	Potential habitat

W+B- WSNP + Brasil; R- Rincon; TLMB+SB- Terrace Landscape Middle Bonaire + Sta. Barbara; B- Bolivia; SG- Seru Grandi; Wa+Ba- Washikemba + Bakuna; LB- Lac Bay; SB- S. Bonaire; KB- K. Bonaire.

## 4.6 Reptiles

Van Buurt (2005) suggests that the tree lizard *Iguana iguana* is probably native to some of the Lesser Antilles, but has been introduced on many other West Indian islands. On Bonaire the *Iguana iguana* has developed the habits of a ground lizard. They are found throughout the entire island and Klein Bonaire.



Figure 8 - *Iguana iguana*, Credits: Erik Meesters, 2011

This species are listed in Appendix II of CITES and are protected according to Island Legislation. It is prohibited to export this species.

Table 10- Distribution of reptiles in different regions of Bonaire.

Reptiles	W+B	R	TLMB+SB	B	SG	Wa+Ba	Lima	LB	SB	KB
<i>Iguana iguana</i>	E	E	E	E	E	E	E	E	E	E

Abbreviations:

	uncertain
	Present based on observations.
E	Expected due to the occurrence of a specific Landscape (e.g. Roois, landscape subtype or water)
P	Potential habitat

W+B- WSNP + Brasil; R- Rincon; TLMB+SB- Terrace Landscape Middle Bonaire + Sta. Barbara; B- Bolivia; SG- Seru Grandi; Wa+Ba- Washikemba + Bakuna; LB- Lac Bay; SB- S. Bonaire; KB- K. Bonaire.

## 4.7 Fresh water species

### 1. *Typhlatya monae*

The Mona cave shrimp (*Typhlatya monae*) are limited to karst waters (Debrot, 2003) found throughout the island of Bonaire. *T. monae* is rapidly consumed in the presence of *Macrobrachium lucifugum*. One can assume that these two species may occur in the different cavern waters on the island. *T. monae* is most abundant below the halocline and in oxygen-depleted waters (Florijn and Visser, unpub. as mentioned by Debrot, 2003). *Typhlatya monae* is Vulnerable according to the IUCN Red list.

### 2. *Poecilia vandepolli*

The fish *Poecilia vandepolli* is endemic to the ABC islands and on Bonaire it occurs in the fresh and brackish water streams and ponds (Hulsman *et al*, 2008). This species and the also native killifish *Cyprinodon dearborni* appear to competitively exclude each other depending on chance or unknown ecological factors. This species is not protected.



Figure 9 - Karst well on Klein Bonaire. Credits: A.O. Debrot.

Table 11- Distribution of fresh water species in different regions of Bonaire.

Fresh water species	W+B	R	TLMB+SB	B	SG	Wa+Ba	Lima	LB	SB	KB
<i>Macrobrachium lucifugum</i>	E	E	E	E	E	E	E	E	E	E
<i>Typhlatya monae</i>	E	E	E	E	E	E	E	E	E	E
<i>Poecilia vandepolli</i>	E	E	E	E	E	E	E	E	E	E

Abbreviations:

	uncertain
	Present based on observations.
E	Expected due to the occurrence of a specific Landscape (e.g. Roois, landscape subtype or water)
P	Potential habitat

W+B- WSNP + Brasil; R- Rincon; TLMB+SB- Terrace Landscape Middle Bonaire + Sta. Barbara; B- Bolivia; SG- Seru Grandi; Wa+Ba- Washikemba + Bakuna; LB- Lac Bay; SB- S. Bonaire; KB- K. Bonaire.

#### 4.7.1 Fresh water sources

As fresh water sources are habitats for fresh water species they are included in the present study. Natural and semi-natural fresh water sources can be seen as a restricted habitat, as they supply drinking water for multiple species and serve as refuge localities for indigenous fish and crustacean fauna during phases of drought (Hulsman *et al*, 2008, Debrot 2003b). On Bonaire the number of available natural fresh water sources depends on the season. Further research is needed in order to map the availability and locations of the different fresh water resources of the island during the different seasons.

#### 4.7.2 Cavern waters

Cavern waters can contain fresh water, making them possible habitats for fresh water species. They are therefore included in the present study. As already mentioned, cave formation mostly occur within the limestone terraces, where the sediments are susceptible to erosion. Caves with water are predominately found within the Lower and Middle Terraces of Bonaire as these areas lie low enough for the groundwater to accumulate in the cavities. However, the northern and eastern part of Bonaire lie higher than the southern part of the island, compared to sea level. Therefore, on the south and west side of the island cavern waters can be found in both Middle- and Lower Terraces, whereas on the north and east of the island there is a high probability that water caves more often occur in the Lower terraces as the Middle Terraces lie too high to contain groundwater. The map will show that water caves to the north of Lima are most often found within the Lower terraces or in deep caves of the Middle terrace.

## 4.8 Other endemic species of Bonaire

Several invertebrates of Bonaire were included in the inventory because of their strictly endemic status. These are: *Diachaeta bonairensis* (worm), *Cryptostemma cobbeni* (bug), *Cicindela. s. sobrina f. bonaireana* (beetle), *Garypus bonairiensis* (pseudo-scorpion), the snails *Stoastomps walkeri*, *Tudora aurantia*, *Tudora maculata* and two reptiles *Anolis bonairensis* and *Cnemidophorus murinus ruthveni*.

Debrot (2006) published a preliminary checklist of extant and fossil endemic taxa of the ABC-islands. As the present study focuses on Bonaire and the endemic species handled here are strictly endemic to Bonaire. Appendix IV shows a list of endemic species belonging to at least Bonaire but may also be found in neighbouring areas, such as Curacao, Aruba, northern Venezuela or the Venezuelan islands etc.

Table 12- Distribution of endemic species in different regions of Bonaire.

Endemic worm	W+B	R	TLMB+SB	B	SG	Wa+Ba	Lima	LB	SB	KB
<i>Diachaeta bonairensis</i>	E	E	E	E	E	E	E	E	E	E
<b>Endemic bug</b>										
<i>Cryptostemma cobbeni</i>	E	E	E	E	E	E	E	E	E	E
<b>Endemic beetle</b>										
<i>Cicindela. s. sobrina f. bonaireana</i>	E	E	E	E	E	E	E	E	E	E
<b>Endemic pseudoscorpion</b>										
<i>Garypus bonairiensis</i>	E	E	E	E	E	E	E	E	E	E
<b>Endemic snails</b>										
<i>Stoastomps walkeri</i>	E	E	E	E	E	E	E	E	E	E
<i>Tudora aurantia</i>	E	E	E	E	E	E	E	E	E	E
<i>Tudora maculata</i>	E	E	E	E	E	E	E	E	E	E
<b>Endemic reptiles</b>										
<i>Anolis bonairensis</i>	E	E	E	E	E	E	E	E	E	E
<i>Cnemidophorus murinus ruthveni</i>	E	E	E	E	E	E	E	E	E	E

### Abbreviations:

	uncertain
	Present based on observations.
E	Expected due to the occurrence of a specific Landscape (e.g. Roois, landscape subtype or water)
P	Potential habitat

W+B- WSNP + Brasil; R- Rincon; TLMB+SB- Terrace Landscape Middle Bonaire + Sta. Barbara; B- Bolivia; SG- Seru Grandi; Wa+Ba- Washikemba + Bakuna; LB- Lac Bay; SB- S. Bonaire; KB- K. Bonaire.

There are a number of species, belonging to different phyla, that are strictly endemic to Bonaire. However, not for all of these species sufficient data is available to pinpoint their distribution on the island. For few, such as an endemic worm (*Diachaeta bonairensis*), an endemic bug (*Cryptostemma cobbeni*), an endemic beetle (*Cicindela. s. sobrina f. bonaireana*), an endemic pseudoscorpian (*Garypus bonairiensis*) and three endemic snails (*Stoastomps walkeri*, *Tudora aurantia* and *Tudora maculata*) it is safe to assume for now that they can be found throughout the entire island and Klein Bonaire as they are ground dwellers. Bonaire also has a few endemic subterranean/freshwater isopods (Appendix II). Again it is safe to assume for now that these species can likely be found throughout the entire island and on Klein Bonaire. Likewise, Buurt (2005) reports that the two endemic reptiles (*Anolis bonairensis* and *Cnemidophorus murinus ruthveni*) are found throughout the entire island and Klein Bonaire. Bonaire has three endemic bird species (*Amazona barbadensis rothschildi*, *Aratinga pertinax xanthogenius* and *Coereba flaveola bonairensis*) (Debrot, 2006), which will be discussed in Appendix V with other bird species found on Bonaire.

## 5. Connectivity

De Freitas et al, (2005) recommend the designation of corridors and buffer zones on Bonaire. Corridors are necessary to allow fauna species to disperse throughout the whole island, preventing them to be isolated in a certain area of the island. Bennett & Mulongoy (2006) define corridors and buffer zones as follows: corridors serve to maintain vital ecological connectivity by maintaining a physical linkage between areas of biodiversity conservation and buffer zones protect the ecological network from potentially damaging external influences and are essentially transitional areas characterized by compatible land uses. In the Strategic environmental Assessment of Bonaire (RBOI, 2010) a start has been made in identifying the most important corridors on Bonaire. The proposal is to achieve a corridor that runs from Southern Bonaire, along the Salinas Lac Bay and Lagoon, along the northern coast to Salina Mathijs. An additional four corridors are mentioned; one from Brasil, along Karpata, through Rincon to the northern coast; one from Salina Mathijs to Tolo; one from the western tip of Sta. Barbara to Bolivia and the last from Punt Vierkant to Bakuna. RBOI (2010) state that further research is necessary to identify the required dimension and locations of such corridors, which depends on the species that will be needing them. The distances on an island such as Bonaire are relatively small compared to distances found on continental areas. Further research will be needed to determine if and what kind of wildlife corridors are necessary. This also depends on the life-history characteristics, size and mobility of species that use them, and will likely differ greatly, for instance between birds that fly, seasonally migrating land crabs and hermit crabs, or semi-sedentary endemic land snails.

## 6. Discussion

Bonaire has a multitude of nature values, ranging from rare vegetation species, endemic species, key and endangered species to migratory bird areas. Here, we provide a preliminary inventory of the different nature values found on Bonaire based on available information and scientific studies. The present study had two main objectives. The first objective was to identify which protected nature values are found within the areas designated as "open landscape" and "nature" (outside of national parks) as mentioned in the spatial development plan of Bonaire. The second objective was to provide a short description on each nature value, their distribution throughout the island, their conservation status and when applicable also their feeding and breeding habits. The description of each nature value is given throughout this report.

The objective to identify which protected nature values are found within the areas designated as "open landscape" and "nature" needs further discussion. The areas designated as "nature" on Bonaire are found in Washington Slagbaai Park, Brasil Labra, Terrace landscape Middle Bonaire, Lac Bay, Lima, Southern Bonaire, Klein Bonaire, a small area near Seru Grandi and small area in Rincon (figure 10). From all these regions only Washington Slagbaai, Lac Bay and Klein Bonaire are assigned as National parks. Leaving the nature in Brasil Labra, Terrace Landscape Middle Bonaire, Southern Bonaire, Seru Grandi, Rincon and Lima as "nature" areas outside national parks. The areas designated as "open landscape" on Bonaire are found in Bolivia, Lima, Washikemba & Bakuna and the north coast of Rincon and Terrace landscape Middle Bonaire (Appendix III).

Given the lack of detailed data for most specific areas, a course-grained total assessment of the distribution of the nature values throughout the entire island (using extrapolation based on habitat type) was necessary in order to get a clearer picture of the overall distribution (and potential areas of concentration) of the nature values on the island. In doing so a clearer picture can be attained of the association of certain nature values with certain landscape types and possible patterns may be distinguished. In other words, the occurrence of certain nature values within certain landscape types in one region of Bonaire can lead to the consideration of these nature values within the same landscape types elsewhere on the island. As the present study focusses on the preliminary inventory of the nature values of Bonaire to ensure their protection, the areas of "nature" also within parks were included as a basis for distinguishing such patterns. This is something that needs further research and is not further handled in present study. A complete inventory of the nature values on the island can add valuable information and can contribute to their protection status designation and better management.

During the study it became apparent that the data available to obtain a complete inventory was limited. The inventory given within the present study is therefore preliminary.

A description can be given on the presence of different nature values within the different regions, based on the available data. The sketch map (figure 10) shows the location of the "nature" and "open landscape" areas within the different regions of Bonaire (Washington Slagbaai National Park, Rincon, Lima etc.).

## 'Nature' and 'Open Landscape' within different regions of Bonaire

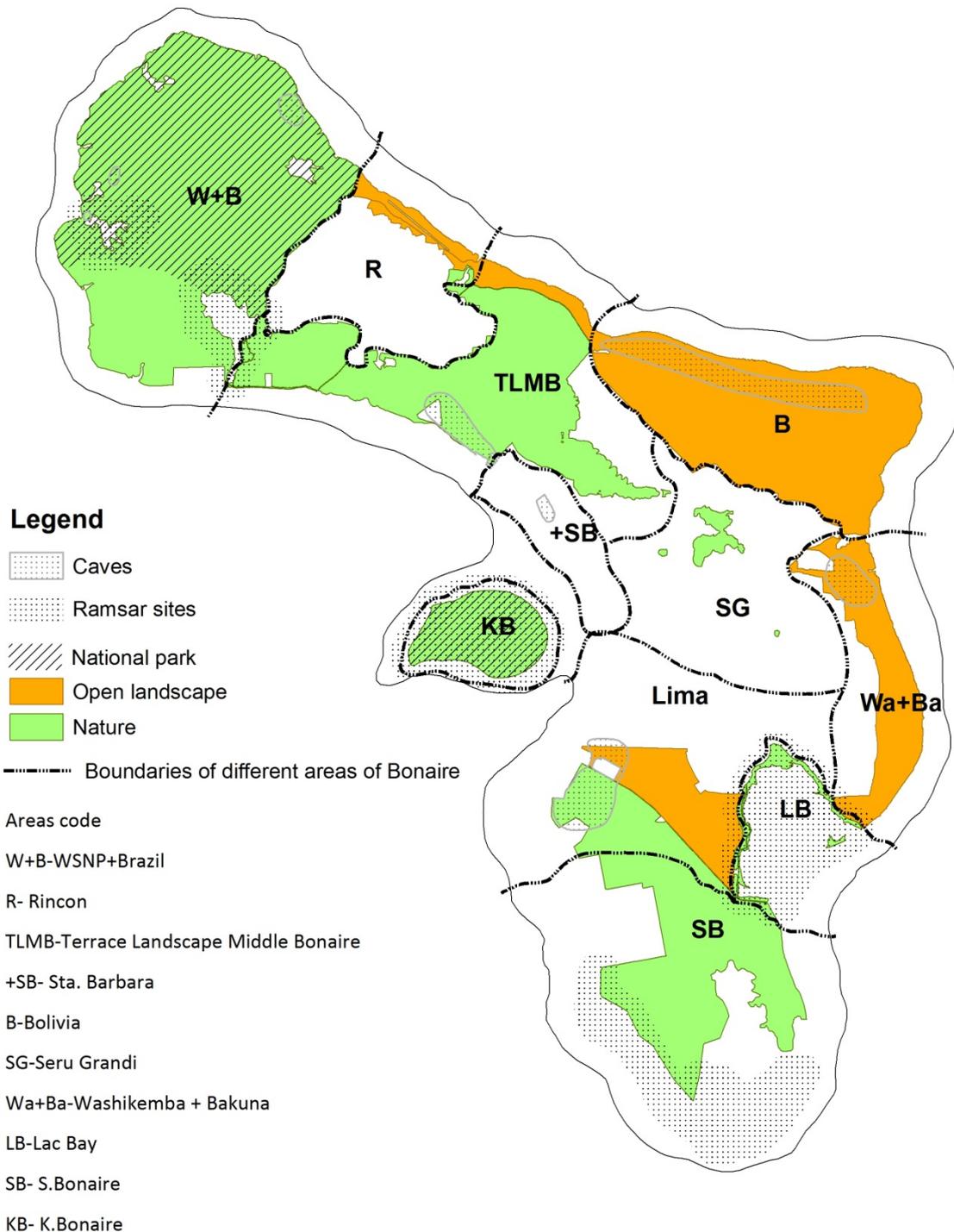


Figure 10 – A sketch map of the location of “nature” and “open landscape” within the regions of Bonaire.

#### WASHINGTON SLAGBAAI AND BRASIL LABRA (W+B)

Washington Slagbaai Park (WSNP) and Brasil are found in the western part of Bonaire and are designated as "nature" areas. WSNP is assigned as National park and Brasil Labra is a partial Ramsar site. De Freitas *et al.* (2008) executed an extensive survey on the occurrence of rare vegetation species, showing that the park harbours a large number of rare vegetation species (Table 3) e.g. *G. sanctum*, *C. niveus* etc. The beaches are potential nesting areas for the sea turtles found on Bonaire. Caves (dry and with water) are present with two of the four bat species. The vegetation types harbouring the different cacti species, including the keystone species *Subpilocereus repandus* and *Stenocereus griseus*, are found here. The area is an Important Bird Area (Wells & Debrot, 2008) with habitat of Caribbean flamingo, the Brown pelican, the Brown throated parakeet, the Yellow shouldered Amazon and the Bananaquit. The presence of the Barn owl and the White tailed hawk have also been documented. The Osprey, the Peregrine falcon, the Crested caracara and several terns e.g. *Sterna albifrons*, *Sterna hirundo*, *Sterna maxima* and the *Thalasseus eurygnathus* habitats have been observed in this area. The presence of the different endemic invertebrates is also expected.

#### RINCON (R)

The area of Rincon is assigned as protected landscape (De Freitas *et al.*, 2005). Only the northern part of Rincon along the coast is designated as "open landscape". At the coast beaches are found (e.g. Playa Grandi) which potentially serve as nesting areas for the different sea turtles found on Bonaire.

The area possesses a few Middle Terrace areas where the presence of caves (dry or with water) is possible. Onima reservoir is found within this area, where the Caribbean coot and the Caribbean flamingo may occur. Here a few rocky escarpments are found along the Middle Terrace landscape types that may serve as habitat for the Barn owl. The area also serves as potential habitat for the White tailed hawk and the Crested caracara. On the Lower Terraces nesting Least terns are found. The Pearly eyed thrasher, the Yellow shouldered Amazon, the Brown throated parakeet and the Bananaquit also occur in this area. As in other areas, the presence of the different endemic invertebrates is also expected.

#### TERRACE LANDSCAPE MIDDLE BONAIRE (TLMB + SB)

The Terrace landscape Middle Bonaire includes the Higher Terraces found in the Middle part of Bonaire, the area of St. Barbara and the Middle Terrace of Karpata. Most of the region is designated as "nature" area, only the northern part of TLMB along the coast is designated as "open landscape". Sta. Barbara is designated for other uses, but present study shows that the overlapping occurrence of several important nature values is likely within this area. Several protected vegetation species are found on the Higher Terraces e.g. *K. ferreum*, the rare *G. sanctum*, *S. schreberi* etc. and the Middle Terraces such *M. carthaginensis*. Just recently *T. flexuosa*, *T. balbisiana* and the orchid *M. humboldtii* were discovered on the Higher Terraces near Sta. Barbara. The Middle Terraces of Karpata are potential areas for caves (dry and with water). This area has a concentration of the least disturbed and most diverse evergreen vegetation of the island. Several rare species have recently been documented here based on fortuitous finds. These vegetation offer high potential for surviving patches of rare plant species.

Caves are present here and presence of all four bat species have been observed. The different vegetation type with several cacti species, including the keystone species *Subpilocereus repandus* and *Stenocereus griseus* are found here. Within the area the Yellow shouldered Amazon, the Brown pelican, the Pearly eyed thrasher, the Brown throated parakeet, the Bananaquit, the Barn owl has been documented to occur within the Higher Terraces, in particular in Rooi Sangu. The area is potential habitat for the White tailed hawk and presence of these birds were documented. The area harbours hunting ground of the White-tailed hawk, Osprey, the Crested caracara and the Peregrine falcon, with expected presence of the different endemic invertebrates.

#### *KLEIN BONAIRE (KB)*

Klein Bonaire is the small island that lies approximately 800 m (nearest point) off the west coast of Bonaire. Like Lac Bay, it is a Ramsar site and is assigned as a National park. The entire island is designated as "nature" area. On the island those vegetation types occur that have the highest concentration of West Indian Satin wood (*Z. flavum*), buttonwood (*C. erecta*), and the cacti species of Bonaire. The beaches of Klein Bonaire are potential nesting areas for the four different sea turtles of Bonaire. The island harbours low Middle (limestone) Terraces with a high potential of water caverns. The vegetation types in which the different cacti species may occur are present on the island (Debrot 1996). Several bird species have been observed on the island; the Caribbean flamingo, the Brown pelican, the Osprey, the Pearly eyed Thrasher, the Antillean tern and the Peregrine falcon. The area is potential habitat for the White tailed hawk, the Crested caracara and the Yellow shouldered Amazon. The presence of the different endemic invertebrates is also expected.

#### *BOLIVIA (B)*

This region is designated as "open landscape". The inventory shows that several nature values are found within this area. Within the Middle terraces of Bolivia caves are found, where several bat species occur (Royer, 2000). The Barn owl (*Tyto alba sp.*) nests on the rocky escarpment within this area. The Crested caracara and the White tailed hawk have been documented to occur in the Middle terraces of this area. On the Lower Terraces of Bolivia are popular nesting areas for the Least tern (*Sterna albifrons*). The Lower Terraces are also the preferred hunting grounds of the Peregrine Falcon. Other birds such as the Bananaquit, the Brown throated parakeet, the Pearly eyed thrasher and the Yellow shouldered Amazon are found within the area of Bolivia as well. As of yet it is unsure if the area of Bolivia supports any rare vegetation types. The vegetation types in which the different cacti species occur, including the keystone species *Subpilocereus repandus* and *Stenocereus griseus* are found in Bolivia as well. The occurrence of endemic invertebrates within this area is probable. As already mentioned it is safe to assume that the latter occur throughout the entire island. Additionally Bolivia is thought to be essential as a corridor along the northern coast to provide in ecological connectivity between Lima and Lac Bay with the rest of Bonaire.

#### *SERU GRANDI (SG)*

A small area of "nature" is found within the area of Seru Grandi which harbours the landscape subtypes D2 and D3. Limited data is available on the occurrence of rare vegetation types in this area. For this further research is needed. The two landscape subtypes can however harbour vegetation types where four cacti species of Bonaire may occur, including the keystone species *Subpilocereus repandus* and *Stenocereus griseus*. The following bird species have been observed within this area: the Yellow shouldered Amazon (pers. ob. E.C. Newton), the Brown throated parakeet (pers. ob. A.O. Debrot), the Bananaquit (pers. o. A.O. Debrot) and the Pearly eyed Thrasher (pers. ob. A.O. Debrot). The area is potential habitat for the White tailed hawk and the Crested caracara. The presence of the different endemic invertebrates is also expected.

#### *WASHIKEMBA & BAKUNA (W+B)*

Washikemba and Bakuna lie on the east coast of Bonaire, above Lac Bay and below Bolivia. This region is partially "open landscape". The inventory shows that within this area the four keystone mangrove species *Rhizophora mangle*, *Laguncularia racemosa*, *Avicennia germinans* and *Conocarpus erecta* can be found at Lagun. The area of Washikemba Bakuna harbours a few Middle Terrace areas where the occurrence of caves (with and without water) may be expected. The Spatial Environment Assessment of RBOI (2010) showed the location of caves near Lagoon. It is unclear if these caves harbour any bat species. If karstwaters are present it is possible to assume the presence of karstwater species.

The vegetation types in which the different cacti species, including the keystone species *Subpilocereus repandus* and *Stenocereus griseus* occur, are also found in this area. Bananaquit, Brown throated

parakeet, Yellow shouldered Amazon, Pearly eyed thrasher and the Near Threatened Caribbean coot have been observed within this area.

Inland fresh water sites found in Washikemba & Bakuna are potential areas for the Caribbean flamingo. The Caribbean coot is found at Washikemba reservoir. Rock escarpment are found along the east coast along the Middle Terraces, which potentially serve as habitat for the Barn owl and the White tailed hawk. This area may also serve as hunting habitat of the Peregrine falcon due to the occurrence of small migratory bird species such as the Least tern (*Sterna albifrons*). The Osprey is a fish eater and hunts is found within the Lower Terraces along the coast. In the area in Washikemba & Bakuna it occurs at Lagoon. The Crested Caracara is found on the Middle Terraces within this area. The presence of the different endemic invertebrates is also expected.

#### *LIMA (Lima)*

Lima harbours both "nature" as "open landscape" areas. The inventory shows that Lima harbours a high number of nature values. Just as in Bolivia, this area harbours a large area of Middle (limestone) Terraces, so it has a high potential for the occurrence of caves and freshwater sources. Due to the high potential occurrence of karst waters, the probability in finding the different fresh water species is high. Within the caves three of the four bat species are found. Here the only natural location of the rare Sabal palm is known and the protected *Maytenus versluisii* is abundant here. The area has a concentration of climax evergreen vegetation (Freitas *et al.*, 2005). The beaches of Lima e.g. Punt Vierkant, Bachelors beach and Windsock are potential nesting beaches for sea turtles (STCB, RBOI, 2010). The vegetation types in which the different cacti species, including the keystone species *Subpilocereus repandus* and *Stenocereus griseus* occur, are also found in Lima.

A large number of protected bird species are found in Lima. The fish eating Osprey and Brown Pelican can be found on the west coast of "Lima", the Crested caracara has been documented on the Middle Terraces of Lima. Other birds such as the Bananaquit, the Brown throated parakeet, the Pearly eyed thrasher and the Yellow shouldered Amazon are found within the area of Lima as well. Inner fresh waters and inland bays found in Lima are potential areas for the Caribbean flamingo. The presence of the different endemic invertebrates is expected, as they are in any other area of the island.

#### *LAC BAY (LB)*

Lac Bay lies on the east coast of Bonaire and is assigned as a Ramsar site. The region is designated as "nature" area. Here, the four keystone mangrove species are concentrated as are the rare plant species *S. perennis* and *Scaevola plumieri*. The beaches of Lac Bay are potential nesting areas for the four different sea turtles of Bonaire (while current use of the beaches of Sorobon and Cai by sea turtles are practically nil, recent attempts to nest at Sorobon show that if human disturbance would be reduced, these areas could indeed probably once again be of use to sea turtles). Multiple bird species occur here e.g. the Caribbean flamingo, the Brown pelican, the Osprey and the Crested caracara. The area around Lac Bay is thought to be potential habitat for the White tailed hawk, however its present actual habitat is found on the northwest of the island.

#### *SOUTHERN BONAIRE (SB)*

The area of Southern Bonaire encompasses the area south of Lima and Lac Bay, which includes Pekelmeer (Ramsar site). Southern Bonaire is designated as "nature" area. Beaches are present that may serve as nesting grounds for the sea turtles of Bonaire. Pekelmeer and inner saline lagoons found here harbour the Caribbean flamingo and the Buff breasted sandpiper. Along the coast the Brown pelican and the Osprey have been observed. This area is also a concentrated breeding area for the four different terns. Due to the presence of the terns, the Peregrine falcon is also present. The presence of the different endemic invertebrates is also expected. The Lower (limestone) Terraces within these areas have a high potential of harbouring cavern waters.

Based on the preliminary inventory the number of different nature values expected to be found within the different areas can be determined. According to the inventory the largest number of nature values (80% of the included nature values) is expected to be found within WSNP/Brasil. It must be noted that this number is increased because the rare vegetation species are included. As already mentioned the occurrence of most of the rare vegetation species has not yet been investigated for the other areas of Bonaire. WSNP/Brasil is followed by Terrace Landscape Middle Bonaire/Sta. Barbara (62%), Washikemba/Bakuna (51%), Lima (49%), Klein Bonaire (46%), Southern Bonaire (45%), Rincon (44%), Bolivia and Lac Bay (42%) and Seru Grandi (30%). A large number of nature values are found within the different regions of Bonaire, the inventory shows that not all nature values occur in each part of Bonaire, but may differ per species (nature value). As mentioned, only the areas Washington Slagbaai National Park (without Brasil Labra), Lac Bay and Klein Bonaire are National parks and therefore protected. This leaves the "nature" areas in Brasil Labra, Rincon, Terrace Landscape Middle Bonaire, Seru Grandi, Lima and Southern Bonaire as nature areas outside national parks with an unprotected status. However, these regions ("open landscape" and "nature" outside parks) seem to harbour not only multiple nature values, but also nature values that are unique to this region and crucial for the islands ecosystem. A few examples are Terrace Landscape Middle Bonaire (TLMB), Lima and Bolivia. In Lima three of the four bat species (crucial for Bonaire) and the only known occurrence of the Sabal palm are found (unique). While in TLMB a concentration of rare vegetation (*Krugiodendron ferreum*, *Zanthoxylum flavum* etc.) has been located. The large "open landscape" areas of Bolivia may harbour a few rare plant species and an important population large area of cacti, which are crucial for species such as birds and bats. Hence the "nature" and "open land" areas outside national parks do possess unique and critical nature values. Table 13 shows the nature values that occur within the different regions, whereas Table 14 shows the occurrence of nature values within the specific "open landscape" and "nature" areas.

The preliminary inventory of Bonaire provides the general overview of the occurrence of the different nature values throughout the entire island, based on previous studies and on expert knowledge. From the results of the study it becomes evident that data required to document the distribution of the different nature value remains incomplete and patchy. Due to this it is not possible to predict the occurrence of these species throughout the entire island. Few studies were available that focus on the distribution of a specific value on Bonaire and the studies that do look at the distribution of a certain species often only concerned a specific area on Bonaire and not the island as a whole. This makes it difficult to identify the most important areas for the species.

For example, De Freitas *et al.*, (2008) did an extensive survey on the occurrence of rare vegetation species in the area of the Washington Slagbaai National Park. Other areas of Bonaire were not included. The occurrence of the discovered rare plant species in other areas of Bonaire at present is unknown. They are, however, occasionally observed which may mean that areas outside the park may be more important for them than inside the park. This is already known to be the case for many species and vegetation types. The recent discovery of the rare *Tillandsia flexuosa* on the Higher Terraces of Sta. Barbara supports the expectation that (some of) these rare vegetation species occur throughout other areas on Bonaire.

It was observed that the nature values are not uniformly distributed throughout the entire island. A few nature values overlap but only partially. This observation can partly be the result of the incompleteness of the inventory. However, it is more likely that it is a result of the heterogeneous distribution of habitats on Bonaire. Different nature values are tied to specific topographical or geological aspects. Caves, for instance, are predominantly found in calcium carbonate areas, while caves with water are also associated with limestone terraces but rather with Lower limestone terraces in order for ground water to enter the caves.

The distribution of nature values is greatly influenced by topographic and geologic heterogeneity. The heterogeneous distribution of habitats may explain much of the difference in distribution of a single species across the island and between the different species. Different species prefer different habitats. However, the bird maps show that several species do not use all the habitat areas available to them. The reason for this can be a result of too much disturbance within these areas but may also occur due to species preference or the historical effect on their population. The rare species that are protected can potentially use larger areas of Bonaire, but may not because of their depleted (low population) numbers.

It is important to consider the possibility of areas with a concentration of nature values. The recent discovery of a cluster of surviving rare orchids and bromeliads in Sta. Barbara illustrate the patchy distribution of rare species and the value that detailed surveys can have in uncovering species deemed lost. In order to secure the survival of these species and to be able to implement the necessary protective measurements, it is of great importance to determine those areas with high probability of harbouring such rare species. It is important to understand which areas on Bonaire could harbour a high concentration of rare species. Based on experience, recent discoveries and patterns in vegetation diversity, it is expected that the limestone areas of central and southern Bonaire and the Roois have high potential for the concentration of these rare species. To identify these areas further research is needed. The further identification of nature value hotspots on Bonaire is also essential when considering the implementation of ecological corridors and buffer zones.

When considering the most important corridors on Bonaire as identified in the Strategic environmental Assessment of Bonaire (RBOI, 2010) it becomes clear that parts of the "open landscape" of Lima, Washikemba/Bakuna and mostly the entire 'open landscapes' of Bolivia and the north coast of Rincon occur within the proposed corridors. For the "nature" areas parts of Washington Slagbaai/Brasil, Southern Bonaire and Terrace landscape Middle Bonaire occur within the proposed corridors. Further investigation is necessary to determine the location of these corridor values (RBOI, 2010).

## 7. Conclusion

From the present study it becomes clear that the information on the distribution of the different nature values on Bonaire is patchy and limited. Due to the lack of data it can be concluded that the present inventory has a high probability of being incomplete, this should be kept in mind when considering the present study. In order to reach a complete inventory further extensive research is necessary.

From the preliminary inventory it is apparent that a large number of nature values do occur within the areas of "nature" and "open landscape". Not only do these areas harbour nature values, but they also harbour nature values that are unique or crucial for Bonaire. The descriptions of the different regions show that the areas designated as "nature" harbour protected bird species (e.g. Yellow shouldered Amazon, endemic species (e.g. *Aratinga pertinax xanthogenius*), keystone species (cacti and mangrove species), but also aspects that are of important to specific life functions (e.g. caves) of certain species are found within these areas. The same conclusion can be made for the "open landscape" areas.

For the bird species, maps were made and when possible a distinction was made between their potential, actual and documented distribution. Certain maps show that the potential habitat area is larger than the actual area (e.g. Yellow shouldered Amazon, the Barn owl and the White tailed hawk). Apparently, the species do not always use the habitats available to them.

The present inventory shows that WSNP/Brasil harbours 80% of the nature values looked at in the present study. Terrace Landscape Middle Bonaire/Sta. Barbara 62%, Washikemba/Bakuna 51%, Lima 49%, Klein Bonaire 46%, Southern Bonaire 45%, Rincon 44%, Bolivia and Lac Bay 42% and Seru Grandi 30%. It can be concluded that, based on present results, the key areas that harbour a concentration of key nature values are WSNP/Brasil, Terrace Landscape Middle Bonaire/Sta. Barbara, Washikemba/Bakuna and Lima. Sta.Barbara has been designated for other uses than "nature" and "open landscape". Present study shows that nature values also occur not only in areas designated as "nature" or "open landscape", but also in areas that are not designated as such. Key nature values may therefore occur in areas designated for other purposes.

Tables 2 and 4 to 12 show the occurrence of each nature value within a specific region of Bonaire (WSNP/Brasil, Rincon, Terrace Landscape Middle Bonaire/Sta. Barbara, Bolivia, Seru Grandi, Washikemba/Bakuna and Southern Bonaire). From the inventory and the bird maps it becomes clear that several species are expected to occur in multiple if not all regions of Bonaire (e.g. the Ruby Topaz hummingbird, the Peregrine falcon, the Least tern, the endemic invertebrates). However, certain nature values are at present only known (not expected) to be found in specific regions of Bonaire (e.g. the occurrence of the Sabal palm in Lima).

Table 13 shows the nature values that are known to occur only within specific regions of Bonaire based on the present preliminary inventory. Those species that occur throughout the most of Bonaire are not included, as are those species that are expected within this region but have not yet been confirmed.

Table 13 shows the actual and documented occurrence of nature values within all the different regions of Bonaire. In which the whole region has been included. A further specification is made in listing the nature values found within the "nature" and "open landscape" areas found within each region. From Table 13 it can be concluded that there are three areas with apparent concentration of rare plants Washington Slagbaai National Park/Brasil, Terrace Landscape Middle Bonaire and Lima. Two are based on undisturbed Terrace Landscapes that where unsuitable for agriculture in the past and the later represents the highest concentration of microhabitats on the island due to the combination of topographic and geological diversity. The areas of Washington Slagbaai/Brasil, Terrace Landscape Middle Bonaire/Sta. Barbara, Lima

and Bolivia seem to be the principal areas for the occurrence of Bonaire's bat species. Washington Slagbaai National Park is a National park, however the critical "nature" areas where bats occur in Terrace Landscape Middle Bonaire and in Lima lie outside the national parks and are not protected. The "open landscape" where bats are found in Bolivia are likewise not protected.

Figure 10 shows the areas designated as "open landscape" and "nature". The assignment of the present study focusses on the areas of "open landscape" and "nature" outside parks. A large part of the "nature" areas of Bonaire are found within National parks or Ramsar sites. The "nature" areas that are not found in parks are Brasil Labra, Terrace Landscape Middle Bonaire, Lima, Southern Bonaire and a small area in Seru Grandi and in Rincon. Next to the "open landscape" areas, these areas of "nature" are included in Table 14. Table 14 makes a distinction between the nature values found within the area of "open landscape" or "nature" (outside parks) within each region. Here the actual, documented and potential occurrence are included. Sta. Barbara has not been designated as "open landscape" and "nature" area but has been included due to the number of nature values found within this region.

It can be concluded that the areas of "open landscape" and "nature" (outside the national parks) seem to harbour unique and critical nature values. These areas are not actively managed as national parks. The "open landscape" of Bolivia possibly harbours a few rare plant species (unique), an important population of critical key columnar cacti and at least two columnar cactus-pollinating bat species. The "open landscape" of Washikemba/Bakuna harbours key mangrove species that only have another main location at Lac Bay (national park). The "nature" of Terrace Landscape Middle Bonaire seems to harbour a concentration of unique (e.g. *Tillandsia balbisiana*) and rare plant species (e.g. *Krugiodendron ferreum* etc.) and four bat species. The same is the case for Lima (e.g. Sabal palm, *Maytenus versluisii* and three bat species) while in Southern Bonaire key mangrove species also still occur.

Table 14 shows which nature values are found or expected to occur within each "open landscape" and "nature" (outside national parks) area.

Additionally, the "open landscape" and "nature" of Lima, "open landscape" Washikemba/Bakuna, the entire 'open landscapes' of Bolivia, the north coast of Rincon, the north coast of Terrace Landscape Middle Bonaire and parts of the "nature" areas Washington Slagbaai/Brasil, Southern Bonaire and Terrace landscape Middle Bonaire occur within the proposed corridors and may therefore likely possess critical corridor values as well.

Table 13 Occurrence of nature values within different regions of Bonaire.

W+B	R	TLMB+SB	B	SG	Wa+Ba	Lima	LB	SB	KB
<i>Crateva tapia</i>	<i>Fulca caribaea</i>	<i>Krugiodendron ferreum</i>	<i>Bromella humilis</i>	<i>Polyborus plancus</i>	<i>Rhizophora mangle</i>	<i>Sabal palm</i>	<i>Rhizophora mangle</i>	<i>Sterna hirundo</i>	<i>Zanthoxylum flavum</i>
<i>Capparis tenuisiliqua</i>	<i>Buteo albicaudatus</i>	<i>Tillandsia balbisiana</i>	<i>Leptonycteris curasoae</i>	<i>Amazona barbadensis</i>	<i>Laguncularia racemosa</i>	<i>Maytenus versluisii</i>	<i>Laguncularia racemosa</i>	<i>Sterna maxima</i>	<i>Phoenicopterus ruber</i>
<i>Celtis iguanaea</i>	<i>Phoenicopterus ruber</i>	<i>Machaonia ottonis</i>	<i>Tyto alba spp.</i>	<i>Margarops fuscatus</i>	<i>Avicennia germinans</i>	<i>Mormoops megalophylla</i>	<i>Avicennia germinans</i>	<i>Thalasseus eurygnathus</i>	<i>Tryngites subruficollis</i>
<i>Clusia sp.</i>	<i>Tryngites subruficollis</i>	<i>Guaiacum sanctum</i>	<i>Glossophaga longirostris</i>	<i>Aratinga pertinax xanthogenius</i>	<i>Fulca caribaea</i>	<i>Leptonycteris curasoae</i>	<i>Salicornia perennis</i>	<i>Salicornia perennis</i>	<i>Pelecanus occidentalis</i>
<i>Ficus brittonii</i>	CAVES	<i>Schoepfia shreberi</i>	CAVES	<i>Chrysolampis mosquitus</i>	CAVES	<i>Glossophaga longirostris</i>	<i>Phoenicopterus ruber</i>	<i>Phoenicopterus ruber</i>	<i>Falco peregrinus</i>
<i>Geoffroea spinosa</i>	<i>Sterna antillarum</i>	<i>Croton niveus</i>	<i>Falco peregrinus</i>	<i>Coereba flaveola bonairensis</i>	<i>Falco peregrinus</i>	CAVES	<i>Tryngites subruficollis</i>	<i>Tryngites subruficollis</i>	<i>Pandion haliaetus</i>
<i>Guaiacum officinale</i>	<i>Falco peregrinus</i>	<i>Manihot carthaginensis</i>	<i>Sterna antillarum</i>		<i>Pandion haliaetus</i>	<i>Pelecanus occidentalis</i>	<i>Pelecanus occidentalis</i>	<i>Pelecanus occidentalis</i>	<i>Sterna antillarum</i>
<i>Guaiacum fragrans</i>	<i>Polyborus plancus</i>	<i>Bromella humilis</i>	<i>Polyborus plancus</i>		<i>Sterna antillarum</i>	<i>Pandion haliaetus</i>	<i>Falco peregrinus</i>	<i>Falco peregrinus</i>	<i>Amazona barbadensis</i>
<i>Guapira pacurero</i>	<i>Amazona barbadensis</i>	<i>Tillandsia flexuosa</i>	<i>Amazona barbadensis</i>		<i>Polyborus plancus</i>	<i>Polyborus plancus</i>	<i>Pandion haliaetus</i>	<i>Pandion haliaetus</i>	<i>Margarops fuscatus</i>
<i>Maytenus tetragona</i>	<i>Margarops fuscatus</i>	<i>Myrmecophila humboldtii.</i>	<i>Margarops fuscatus</i>		<i>Amazona barbadensis</i>	<i>Amazona barbadensis</i>	<i>Polyborus plancus</i>	<i>Sterna antillarum</i>	<i>Aratinga pertinax xanthogenius</i>
<i>Spondias mombin</i>	<i>Aratinga pertinax xanthogenius</i>	<i>Mormoops megalophylla</i>	<i>Aratinga pertinax xanthogenius</i>		<i>Margarops fuscatus</i>	<i>Margarops fuscatus</i>	<i>Amazona barbadensis</i>	<i>Coereba flaveola bonairensis</i>	<i>Chrysolampis mosquitus</i>
<i>Ximelia americana</i>	<i>Chrysolampis mosquitus</i>	<i>Natalus tumidirotris</i>	<i>Chrysolampis mosquitus</i>		<i>Aratinga pertinax xanthogenius</i>	<i>Aratinga pertinax xanthogenius</i>	<i>Margarops fuscatus</i>		<i>Coereba flaveola bonairensis</i>
<i>Zanthoxylum monophyllum</i>	<i>Coereba flaveola bonairensis</i>	<i>Zanthoxylum flavum</i>	<i>Coereba flaveola bonairensis</i>		<i>Chrysolampis mosquitus</i>	<i>Chrysolampis mosquitus</i>	<i>Aratinga pertinax xanthogenius</i>		
<i>Brassavola nodosa</i>		<i>Leptonycteris curasoae</i>			<i>Coereba flaveola bonairensis</i>	<i>Coereba flaveola bonairensis</i>	<i>Chrysolampis mosquitus</i>		
<i>Varnes</i>		<i>Tyto alba spp.</i>					<i>Coereba flaveola bonairensis</i>		
<i>Maytenus versluisii</i>		<i>Buteo albicaudatus</i>							
<i>Guaiacum sanctum</i>		<i>Glossophaga longirostris</i>							
<i>Schoepfia shreberi</i>		CAVES							
<i>Croton niveus</i>		<i>Pelecanus occidentalis</i>							
<i>Manihot carthaginensis</i>		<i>Pandion haliaetus</i>							
<i>Tillandsia flexuosa</i>		<i>Sterna antillarum</i>							
<i>Myrmecophila humboldtii.</i>		<i>Polyborus plancus</i>							
<i>Natalus tumidirotris</i>		<i>Amazona barbadensis</i>							
<i>Sterna hirundo</i>		<i>Margarops fuscatus</i>							
<i>Sterna maxima</i>		<i>Aratinga pertinax xanthogenius</i>							
<i>Thalasseus eurygnathus</i>		<i>Chrysolampis mosquitus</i>							
<i>Zanthoxylum flavum</i>		<i>Coereba flaveola bonairensis</i>							
<i>Salicornia perennis</i>									
<i>Tyto alba spp.</i>									
<i>Buteo albicaudatus</i>									
<i>Glossophaga longirostris</i>									
<i>Phoenicopterus ruber</i>									
<i>Tryngites subruficollis</i>									
CAVES									
<i>Pelecanus occidentalis</i>									
<i>Pandion haliaetus</i>									
<i>Sterna antillarum</i>									
<i>Falco peregrinus</i>									
<i>Polyborus plancus</i>									
<i>Amazona barbadensis</i>									
<i>Margarops fuscatus</i>									
<i>Aratinga pertinax xanthogenius</i>									
<i>Chrysolampis mosquitus</i>									
<i>Coereba flaveola bonairensis</i>									

Abbreviations:

	These species at present are only known to occur within this specific region of Bonaire.
	These species at present are only known to occur within two regions of Bonaire.
	These species at present are only known to occur within three regions of Bonaire.
	These species at present are only known to occur within four regions of Bonaire.
	These species at present are only known to occur within five regions of Bonaire.
	These species at present are only known to occur within six regions of Bonaire.
	These species at present are only known to occur within seven regions of Bonaire.
	These species at present are only known to occur within eight regions of Bonaire.
	These species at present are only known to occur within nine regions of Bonaire.
	These species at present are known to occur within all ten regions of Bonaire.

W+B: Washington Slagbaai + Brasil; R: Rincon; TLMB+SB: Terrace Landscape Middle Bonaire + Sta. Barbara; B: Bolivia; SG: Seru Grandi; Wa+Ba: Washikemba + Bakuna; LB: Lac Bay; SB: Southern Bonaire; KB: Klein Bonaire.

Table 14 The nature values observed and expected within the different areas of a) "open landscape" and b) "nature" (outside of parks).

a)

R - Open	TLMB - Open	B - Open	Wa+Ba Open	Lima Open	StB
<i>Caretta caretta</i> *	Caves* (6)	<i>Conocarpus erecta</i> *	<i>Rhizophora mangle</i> (2)	<i>Mormoops megalophylla</i> (2)	<i>Machaonia ottonis</i> (1)
<i>Chelonia mydas</i> *	<i>Subpilocereus repandus</i> *	<i>Crateva tapia</i> * (1)	<i>Laguncularia racemosa</i> (2)	<i>Leptonycteris curasoae</i> (3)	<i>Guaiacum sanctum</i> (2)
<i>Eretmochelys imbricata</i> *	<i>Stenocereus griseus</i> *	<i>Bromelia humilis</i> (2)	<i>Avicennia germinans</i> (2)	<i>Glossophaga longirostris</i> (4)	<i>Manihot carthaginensis</i> (2)
<i>Dermochelys coriacea</i> *	<i>Pilosocereus lanuginosus</i> *	<i>Leptonycteris curasoae</i> (3)	<i>Conocarpus erecta</i> *	<i>Subpilocereus repandus</i> *	<i>Zanthoxylum flavum</i> (3)
Caves* (6)	<i>Melocactus macracanthus</i> *	<i>Glossophaga longirostris</i> (4)	<i>Caretta caretta</i> *	<i>Stenocereus griseus</i> *	<i>Subpilocereus repandus</i> *
<i>Subpilocereus repandus</i> *	<i>Opuntia wentiana</i> *	Caves (6)	<i>Chelonia mydas</i> *	<i>Pilosocereus lanuginosus</i> *	<i>Stenocereus griseus</i> *
<i>Stenocereus griseus</i> *	<i>Tyto alba</i> spp. (3)	<i>Subpilocereus repandus</i> *	<i>Eretmochelys imbricata</i> *	<i>Melocactus macracanthus</i> *	<i>Pilosocereus lanuginosus</i> *
<i>Pilosocereus lanuginosus</i> *	<i>Buteo albicaudatus</i> (3)	<i>Stenocereus griseus</i> *	<i>Dermochelys coriacea</i> *	<i>Buteo albicaudatus</i> * (3)	<i>Melocactus macracanthus</i> *
<i>Melocactus macracanthus</i> *	<i>Sterna antillarum</i> (7)	<i>Pilosocereus lanuginosus</i> *	Caves (6)	<i>Polyborus plancus</i> (8)	<i>Buteo albicaudatus</i> (3)
<i>Opuntia wentiana</i> *	<i>Polyborus plancus</i> (8)	<i>Melocactus macracanthus</i> *	<i>Subpilocereus repandus</i> *	<i>Amazona barbadensis</i> (9)	<i>Polyborus plancus</i> (8)
<i>Tyto alba</i> spp.* (3)	<i>Amazona barbadensis</i> (9)	<i>Opuntia wentiana</i> *	<i>Stenocereus griseus</i> *	<i>Margarops fuscatus</i> (9)	<i>Amazona barbadensis</i> (9)
<i>Buteo albicaudatus</i> (3)	<i>Margarops fuscatus</i> (9)	<i>Tyto alba</i> spp. (3)	<i>Pilosocereus lanuginosus</i> *	<i>Aratinga pertinax xanthogenius</i> (9)	<i>Margarops fuscatus</i> (9)
<i>Falco peregrinus</i> (7)	<i>Aratinga pertinax xanthogenius</i> (9)	<i>Buteo albicaudatus</i> * (3)	<i>Melocactus macracanthus</i> *	<i>Chrysolampis mosquitos</i> (9)	<i>Aratinga pertinax xanthogenius</i> (9)
<i>Sterna antillarum</i> (7)	<i>Chrysolampis mosquitos</i> (9)	<i>Falco peregrinus</i> (7)	<i>Opuntia wentiana</i> *	<i>Coereba flaveola bonairensis</i> (10)	<i>Chrysolampis mosquitos</i> (9)
<i>Polyborus plancus</i> (8)	<i>Coereba flaveola bonairensis</i> (10)	<i>Sterna antillarum</i> (7)	<i>Fulica caribaea</i> (2)	Water caves*	<i>Coereba flaveola bonairensis</i> (10)
<i>Amazona barbadensis</i> (9)	Water caves*	<i>Polyborus plancus</i> (8)	<i>Tyto alba</i> spp.* (3)	<i>Iguana iguana</i> *	Water caves*
<i>Margarops fuscatus</i> (9)	<i>Iguana iguana</i> *	<i>Amazona barbadensis</i> (9)	<i>Buteo albicaudatus</i> * (3)	Fresh water sources*	<i>Iguana iguana</i> *
<i>Aratinga pertinax xanthogenius</i> (9)	Fresh water sources*	<i>Margarops fuscatus</i> (9)	<i>Tryngites subruficollis</i> (5)	Fresh water species*	Fresh water sources*
<i>Chrysolampis mosquitos</i> (9)	Fresh water species*	<i>Aratinga pertinax xanthogenius</i> (9)	<i>Phoenicopterus ruber</i> * (5)	Other endemic species*	Fresh water species*
<i>Coereba flaveola bonairensis</i> (10)	Other endemic species*	<i>Chrysolampis mosquitos</i> (9)	<i>Falco peregrinus</i> (7)		Other endemic species*
Water caves*		<i>Coereba flaveola bonairensis</i> (10)	<i>Pandion haliaetus</i> (7)		
<i>Iguana iguana</i> *		Water caves*	<i>Sterna antillarum</i> (7)		
Fresh water species*		<i>Iguana iguana</i> *	<i>Polyborus plancus</i> (8)		
Other endemic species*		Fresh water sources*	<i>Amazona barbadensis</i> (9)		
		Fresh water species*	<i>Margarops fuscatus</i> (9)		
		Other endemic species*	<i>Aratinga pertinax xanthogenius</i> (9)		
			<i>Chrysolampis mosquitos</i> (9)		
			<i>Coereba flaveola bonairensis</i> (10)		
			Water caves*		
			<i>Iguana iguana</i> *		
			Fresh water sources*		
			Fresh water species*		
			Other endemic species*		

*	Expected within this regions due to the occurrence of a specific landscape (e.g. Roois, landscapesubtype or water)
	Seaturtles
	Trees
	Mangroves
	Plants
	Bats
	Caves
	Cacti
	Birds
	Water caves
	Reptiles
	Fresh water sources
	Fresh water species
	Other endemic species
(..)	The numbers in brackets shows in how many regions this species has been observed (actual and documented observations).

b)

Brasil - Nature	R - Nature	TLMB - Nature	SG- Nature	Lima Nature	SB - Nature
<i>Conocarpus erecta</i> *	<i>Fulica caribaea</i> (2)	<i>Krugiodendron ferreum</i> (1)	<i>Subpilocereus repandus</i> *	<i>Sabal palm</i> (1)	<i>Salicornia perennis</i> (3)
<b>Caves</b>	<i>Buteo albicaudatus</i> (3)	<i>Guaiacum sanctum</i> (2)	<i>Stenocereus griseus</i> *	<i>Maytenus versluisii</i> (2)	<i>Rhizophora mangle</i> *
<i>Subpilocereus repandus</i> *	<i>Tyto alba</i> spp.* (3)	<i>Schoepfia shreberi</i> (2)	<i>Pilosocereus lanuginosus</i> *	<i>Mormoops megalophylla</i> (2)	<i>Laguncularia racemosa</i> *
<i>Stenocereus griseus</i> *	<i>Phoenicopterus ruber</i> (5)	<i>Croton niveus</i> (2)	<i>Melocactus macracanthus</i> *	<i>Leptonycteris curasoae</i> (3)	<i>Avicennia germinans</i> *
<i>Pilosocereus lanuginosus</i> *	<i>Tryngites subruficollis</i> (5)	<i>Zanthoxylum flavum</i> (3)	<i>Buteo albicaudatus</i> * (3)	<i>Glossophaga longirostris</i> (4)	<i>Conocarpus erecta</i> *
<i>Melocactus macracanthus</i> *	<i>Polyborus plancus</i> (8)	<i>Crateva tapia</i> *	<i>Polyborus plancus</i> (8)	<b>Caves</b> (6)	<i>Caretta caretta</i> *
<i>Opuntia wentiana</i> *	<i>Amazona barbadensis</i> (9)	<i>Conocarpus erecta</i> *	<i>Amazona barbadensis</i> (9)	<i>Subpilocereus repandus</i> *	<i>Chelonia mydas</i> *
<i>Sterna hirundo</i> (2)	<i>Margarops fuscatus</i> (9)	<i>Tillandsia balbisiana</i> (1)	<i>Margarops fuscatus</i> (9)	<i>Stenocereus griseus</i> *	<i>Eretmochelys imbricata</i> *
<i>Sterna maxima</i> (2)	<i>Aratinga pertinax xanthogenius</i> (9)	<i>Bromelia humilis</i> (2)	<i>Aratinga pertinax xanthogenius</i> (9)	<i>Buteo albicaudatus</i> * (3)	<i>Dermochelys coriacea</i> *
<i>Thalasseus eurygnathus</i> (2)	<i>Chrysolampis mosquitus</i> (9)	<i>Tillandsia flexuosa</i> (2)	<i>Chrysolampis mosquitus</i> (9)	<i>Polyborus plancus</i> (8)	<i>Subpilocereus repandus</i> *
<i>Tyto alba</i> spp. (3)	<i>Coereba flaveola bonairensis</i> (10)	<i>Myrmecophila humboldtii</i> (2)	<i>Coereba flaveola bonairensis</i> (10)	<i>Amazona barbadensis</i> (9)	<i>Stenocereus griseus</i> *
<i>Phoenicopterus ruber</i> (5)	<i>Iguana iguana</i> *	<i>Caretta caretta</i> *	<i>Water caves</i> *	<i>Margarops fuscatus</i> (9)	<i>Pilosocereus lanuginosus</i> *
<i>Pelecanus occidentalis</i>	<i>Fresh water sources</i>	<i>Chelonia mydas</i> *	<i>Iguana iguana</i> *	<i>Aratinga pertinax xanthogenius</i> (9)	<i>Opuntia wentiana</i> *
<i>Tryngites subruficollis</i> * (5)	<i>Fresh water species</i> *	<i>Eretmochelys imbricata</i> *	<i>Fresh water sources</i> *	<i>Chrysolampis mosquitus</i> (9)	<i>Sterna hirundo</i> (2)
<i>Falco peregrinus</i> (7)	<i>Other endemic species</i> *	<i>Dermochelys coriacea</i> *	<i>Fresh water species</i> *	<i>Coereba flaveola bonairensis</i> (10)	<i>Sterna maxima</i> (2)
<i>Pandion haliaetus</i> (7)		<i>Mormoops megalophylla</i> (2)	<i>Other endemic species</i> *	<i>Water caves</i> *	<i>Thalasseus eurygnathus</i> (2)
<i>Amazona barbadensis</i> (9)		<i>Natalus tumidirotris</i> (2)		<i>Iguana iguana</i> *	<i>Phoenicopterus ruber</i> * (5)
<i>Margarops fuscatus</i> (9)		<i>Leptonycteris curasoae</i> (3)		<i>Fresh water sources</i> *	<i>Tryngites subruficollis</i> (5)
<i>Aratinga pertinax xanthogenius</i> (9)		<i>Glossophaga longirostris</i> (4)		<i>Fresh water species</i> *	<i>Pelecanus occidentalis</i> (6)
<i>Chrysolampis mosquitus</i> (9)		<b>Caves</b> (6)		<i>Other endemic species</i> *	<i>Falco peregrinus</i> (7)
<i>Coereba flaveola bonairensis</i> (10)		<i>Subpilocereus repandus</i> *			<i>Pandion haliaetus</i> (7)
<i>Caretta caretta</i> *		<i>Stenocereus griseus</i> *			<i>Sterna antillarum</i> (7)
<i>Chelonia mydas</i> *		<i>Pilosocereus lanuginosus</i> *			<i>Coereba flaveola bonairensis</i> (10)
<i>Eretmochelys imbricata</i> *		<i>Melocactus macracanthus</i> *			<i>Water caves</i> *
<i>Dermochelys coriacea</i> *		<i>Opuntia wentiana</i> *			<i>Iguana iguana</i> *
<i>Water caves</i> *		<i>Tyto alba</i> spp. (3)			<i>Fresh water sources</i> *
<i>Fresh water sources</i> *		<i>Buteo albicaudatus</i> (3)			<i>Fresh water species</i> *
<i>Iguana iguana</i> *		<i>Pelecanus occidentalis</i> (6)			<i>Other endemic species</i> *
<i>Fresh water species</i> *		<i>Pandion haliaetus</i> (7)			
<i>Other endemic species</i> *		<i>Polyborus plancus</i> (8)			
		<i>Amazona barbadensis</i> (9)			
		<i>Margarops fuscatus</i> (9)			
		<i>Aratinga pertinax xanthogenius</i> (9)			
		<i>Chrysolampis mosquitus</i> (9)			
		<i>Coereba flaveola bonairensis</i> (10)			
		<i>Water caves</i> *			
		<i>Fresh water sources</i> *			
		<i>Iguana iguana</i> *			
		<i>Fresh water species</i> *			
		<i>Other endemic species</i> *			

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	Fresh water sources
	Fresh water species
	Other endemic species
(..)	The numbers in brackets shows in how many regions this species has been observed (actual and documented observations).

## 8. Recommendations

1. For future research it is recommended to execute a complete and extensive inventory of Bonaire, through fieldwork, in order to implement the necessary protective measures to ensure the conservation of these nature values. The present study shows that the areas of WNSP/Brasil, Terrace Landscape Middle Bonaire, Lima and Bolivia may be of priority as these areas seem to harbour a concentration of unique and critical plants.
2. Present studies shows that key nature values may occur in areas with a different designation than "nature" or "open landscape". For future research it is recommended not to limit inventory research to the areas of "nature" and "open landscape", but to include other areas with different designations.
3. In the present study the nature values chosen were based on the list of vulnerable and endangered species (Informatieblad beschermde dier- en plantensoorten Bonaire). During the study several species were added based on expert knowledge. The list used therefore seems to be limited. For future research it is recommended to assess if there are other nature values that are important to Bonaire that should be included on the list (e.g. *Clusia sp.*, *Ammodramus savannarum*).
4. A complete inventory of the nature values on the island can contribute to the better management of nature values. A good example is the management of Bonaire's bat population. In order to define the priority areas to maintain for the management of the different bats on Bonaire it is essential to obtain a detailed inventory of the different caves that these species use as habitat.
5. Additionally for the nectar-feeding bats it is crucial to map the occurrence of the different candle cacti on which they feed. The nectar-feeding bats are the critical pollinators of the three candle cacti (Petit, 2001). As already mentioned these cacti are key species on the island as they provide food for several species of animals during the dry season, when many other plant species are non-productive (Petit, 2001). Research on the distribution, health status and diversity of candle cacti on Bonaire is recommended in order to pinpoint priority areas for nectar-feeding bats. The cactus populations are threatened severely by feral livestock (goats, donkeys) which remove the bark of the mature trees, thereby threatening the food supply for frugivores and nectarivores. From our analysis open land areas of Bolivia would seem to possess large cactus populations of vital interest to conservation of endangered bird species on an island-wide scale.
6. When executing a complete and extensive inventory of Bonaire it would be of value to determine the ecological conditions and various habitats needed for the different species to survive. Based on the ecological conditions necessary for their life functions it may be possible to pinpoint those areas of principal ecological importance per species.
7. It is necessary to identify those areas with a high potential for the concentration of nature values rare species or relict vegetation species in order to secure the survival of these species and to be able to implement the necessary protective measurements. Such areas for instance are the open land and nature sections of Lima, Terrace Landscape Middle Bonaire (nature) and Bolivia (open).
8. For future research it is recommended to determine those areas with high corridor values for the implementation of ecological corridors and buffer zones on Bonaire.

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References for birds pictures:

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## Quality Assurance

IMARES utilises an ISO 9001:2008 certified quality management system (certificate number: 57846-2009-AQ-NLD-RvA). This certificate is valid until 15 December 2012. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Environmental Division has NEN-AND-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 27 March 2013 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

## Justification

Report C003/12  
Project Number: 430.82010.80

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

Approved: Dr. H.W.G. Meesters  
Researcher

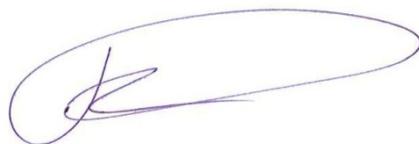
Signature:



Date: 15<sup>th</sup> March 2012

Approved: F.C. Groenendijk, MSc.  
Head of Department

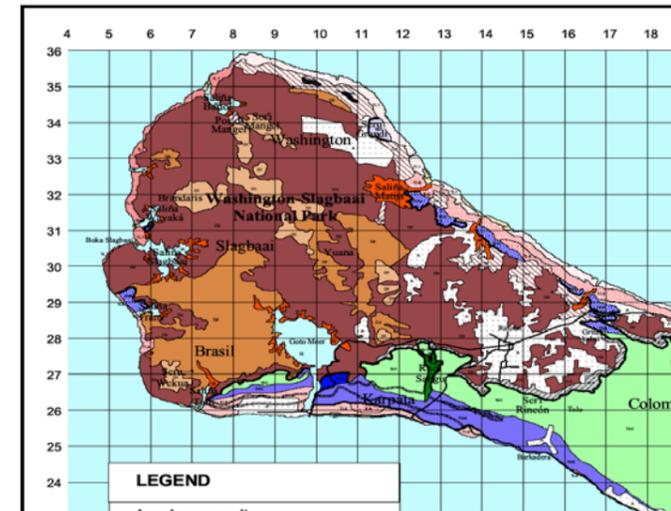
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APPENDIX I- Landscape Ecological Vegetation map of Bonaire



A map of the distribution of the different Landscape types on Bonaire according to De Freitas *et al.*, (2005)

## APPENDIX II- Potential occurrence of different nature values

### Legend

Bonaire	●	Protected species according to Executive council Bonaire, based on Island regulation on management of natural resources of Bonaire.
	○	Protected species according to Executive council Bonaire, based on CITES II status.
	◇	Protected species, based on international treaties.
CITES	I	Appendix I
	II	Appendix II
IUCN Red List	LC	Least Concern
	VU	Vulnerable
	EN	Endangered
	CR	Critically endangered
Bonn	I	CMS Appendix I
	II	CMS Appendix II
SPA W	I	Annex I
	II	Annex II
Endemic	Y	Yes
	N	No

Note: The numbers found under the column 'Sources' coincide with the numbers of the references.

Potential occurrence of different nature values within the Lower Terrace Landscape

Nature values	Associated species	Status					Endemic	Importance	Location	Sources
		Bonaire	CITES	IUCN	Bonn	SPAW				
<b>Lower Terraces (TL)</b>	Lower Terraces are found along the entire coast of Bonaire and Klein Bonaire and locally borders the Landscape of Beaches (B). The width of TL is very variable along the coasts. Salt (spray) and wind strongly influence the vegetation (De Freitas <i>et al</i> , 2005).									
TL1	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Pelecanus occidentalis</i>	-	-	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation J. C. Ligon, A.O. Debrot
	<i>Pandion haliaetus</i>	●○	-	LC	II	-	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Sterna albifrons</i>	-	-	LC	-	II	N	Protected	At the north and east coast of Bonaire, from Salina Bartol until Boka Chikitu to Suplado. South of Bonaire at Manparia Kutu.	8, 29
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	Cavern waters	-	-	-	-	-	-	Fresh water cave species	(see map Appendix V)	personal observation A.O. Debrot
TL2	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Sterna albifrons</i>	-	-	LC	-	II	N	Protected	North and east coast of Bonaire, from Salina Bartol untill Boka Chikitu to Suplado. Also in the south of Bonaire at Manparia Kutu.	2, 29
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	Cavern waters	-	-	-	-	-	-	Fresh water cave species	(see map Appendix V)	personal observation A.O. Debrot
TL3	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Pandion haliaetus</i>	●○	-	LC	II	-	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	Cavern waters	-	-	-	-	-	-	Fresh water cave species	(see map Appendix V)	personal observation A.O. Debrot

Potential occurrence of different nature values within the Lower Terrace Landscape

Nature values	Associated species	Status					Endemic	Importance	Location	Sources
		Bonaire	CITES	IUCN	Bonn	SPAW				
<b>Lower Terraces (TL)</b>	Lower Terraces are found along the entire coast of Bonaire and Klein Bonaire and locally borders the Landscape of Beaches (B). The width of TL is very variable along the coasts. Salt (spray) and wind strongly influence the vegetation (De Freitas <i>et al</i> , 2005).									
TL4	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N		(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Marqarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	Cavern waters	-	-	-	-	-	-	Fresh water cave species	(see map Appendix V)	personal observation A.O. Debrot
TL 5	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	Cavern waters	-	-	-	-	-	-	Fresh water cave species	(see map Appendix V)	personal observation A.O. Debrot
TL6	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Marqarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba, Fontein, Onima	29, 38
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	Cavern waters	-	-	-	-	-	-	Fresh water cave species	(see map Appendix V)	personal observation A.O. Debrot
TL7	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Pelecanus occidentalis</i>	-	-	LC	-	II	N	Protected	WSNP, Sta. Barbara	29, personal observation A.O. Debrot
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Pandion haliaetus</i>	●○	-	LC	II	-	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot

Potential occurrence of different nature values within the Lower Terrace Landscape

Nature values	Associated species	Status					Endemic	Importance	Location	Sources
		Bonaire	CITES	IUCN	Bonn	SPAW				
<b>Landscape</b>	Lower Terraces are found along the entire coast of Bonaire and Klein Bonaire and locally borders the Landscape of Beaches (B). The width of TL is very variable along the coasts. Salt (spray) and wind strongly influence the vegetation (De Freitas <i>et al</i> , 2005).									
<b>Lower Terraces (TL)</b>	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
<b>TL7</b>	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	Cavern waters	-	-	-	-	-	-	Fresh water cave species	(see map Appendix V)	personal observation A.O. Debrot
<b>TL8</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Pelecanus occidentalis</i>	-	-	LC	-	II	N	Protected	Karpata	29, personal observation A.O. Debrot
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Pandion haliaetus</i>	●○	-	LC	II	-	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	Cavern waters	-	-	-	-	-	-	Fresh water cavespecies	(see map Appendix V)	personal observation A.O. Debrot
<b>TL9</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	Cavern waters	-	-	-	-	-	-	Fresh water cave species	(see map Appendix V)	personal observation A.O. Debrot

Potential occurrence of different nature values within the Middle Terrace Landscape

Nature values	Associated species	Status					Endemic	Importance	Location	Sources
		Bonaire	CITES	IUCN	Bonn	SPAW				
<b>Middle Terraces (TM)</b>	TM is present in most of Bonaire and consists of both depositional and erosional terraces. It is less continuous than the Lower Terrace. The transition between the Middle Terrace and the other terraces and the undulating landscape is not always clear. The most extensive areas of the Middle Terrace landscape are found at Bolivia. (De Freitas <i>et al</i> , 2005)									
<b>TM1</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Tyto alba spp.</i>	●○	-	LC	-	-	Y	Endemic	Bolivia	17, 29
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	Caves	-	-	-	-	-	-	Important as habitat for bats, owls etc.	Seru Grandi	32, 33
	<i>Glossophaga longirostris</i>	●	-	DD	-	-	N	Nectarfeeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Seru Grandi, WSNP	32
	<i>Natalus tumidirostris</i>	●	-	LC	-	-	N	Protected	Seru Grandi, WSNP	32
	Cavern waters	-	-	-	-	-	-	Fresh water cavespecies	(see map Appendix V)	personal observation A.O. Debrot
<b>TM2</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	manchineel grove on west side of Lac Bay	19
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Tyto alba spp.</i>	●○	-	LC	-	-	Y	Endemic	Bolivia	17, 29
	Cavern waters	-	-	-	-	-	-	Fresh water cavespecies	(see map Appendix V)	personal observation A.O. Debrot
	Caves	-	-	-	-	-	-	Important as habitat for bats, owls etc.	Spelonk, Washikemba	32, 33
	<i>Leptonycteris curasoae</i>	●	-	VU	-	-	N	Nectarfeeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Lima, Spelonk in Bolivia.	32, personal observations Fernando Simal.
<i>Glossophaga longirostris</i>	●	-	DD	-	-	N	Nectarfeeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Lima, Spelonk in Bolivia.	32, personal observations Fernando Simal.	

Potential occurrence of different nature values within the Middle Terrace Landscape

Nature values	Associated species	Status					Endemic	Importance	Location	Sources
		Bonaire	CITES	IUCN	Bonn	SPAW				
<b>Middle Terraces (TM)</b>	TM is present in most of Bonaire and consists of both depositional and erosional terraces. It is less continuous than the Lower Terrace. The transition between the Middle Terrace and the other terraces and the undulating landscape is not always clear. The most extensive areas of the Middle Terrace landscape are found at Bolivia. (De Freitas <i>et al</i> , 2005)									
<b>TM2</b>	<i>Mormoops megalophylla</i>	•	-	LC	-	-	N	Protected	Lima	32, personal observations Fernando Simal.
<b>TM3</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	•	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Buteo albicaudatus</i>	•○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	•○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	Caves	-	-	-	-	-	-	Important as habitat for bats, owls etc.	Lima	32, 33
	<i>Leptonycteris curasoae</i>	•	-	VU	-	-	N	Nectar feeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Lima	32, personal observations Fernando Simal.
	<i>Glossophaga longirostris</i>	•	-	DD	-	-	N	Nectar feeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Lima	32, personal observations Fernando Simal.
	<i>Mormoops megalophylla</i>	•	-	LC	-	-	N	Protected	Lima	Personal observations Fernando Simal.
	Cavern waters	-	-	-	-	-	-	Fresh water cave species	(see map Appendix V)	personal observation A.O. Debrot
<b>TM4</b>	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Buteo albicaudatus</i>	•○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	•	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	•○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	Caves	-	-	-	-	-	-	Important as habitat for bats, owls etc.	Lima	32, 33
	<i>Leptonycteris curasoae</i>	•	-	VU	-	-	N	Nectar feeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Lima	32, personal observations Fernando Simal.

Potential occurrence of different nature values within the Middle Terrace Landscape

Nature values	Associated species	Status					Endemic	Importance	Location	Sources
		Bonaire	CITES	IUCN	Bonn	SPAW				
<b>Middle Terraces (TM)</b>	TM is present in most of Bonaire and consists of both depositional and erosional terraces. It is less continuous than the Lower Terrace. The transition between the Middle Terrace and the other terraces and the undulating landscape is not always clear. The most extensive areas of the Middle Terrace landscape are found at Bolivia. (De Freitas <i>et al</i> , 2005)									
	<i>Glossophaga longirostris</i>	•	-	DD	-	-	N	Nectar feeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Lima	32, personal observations Fernando Simal.
TM5 p.t.o	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Amazona barbadensis</i>	◊	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
TM5	<i>Margarops fuscatus</i>	•	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Buteo albicaudatus</i>	•◊	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Falco peregrinus</i>	◊	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	•◊	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	Caves	-	-	-	-	-	-	Important as habitat for bats, owls etc.	Spelonk	32, 33
	<i>Leptonycteris curasoae</i>	•	-	VU	-	-	N	Nectarfeeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Spelonk	32, personal observations Fernando Simal.
	<i>Glossophaga longirostris</i>	•	-	DD	-	-	N	Nectarfeeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Spelonk	32, personal observations Fernando Simal.
Cavern waters	-	-	-	-	-	-	Fresh water cavespecies	(see map Appendix V)	personal observation A.O. Debrot	
TM6	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Amazona barbadensis</i>	◊	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	•	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Buteo albicaudatus</i>	•◊	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Falco peregrinus</i>	◊	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	•◊	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	Cavern waters	-	-	-	-	-	-	Fresh water cave species	(see map Appendix V)	personal observation A.O. Debrot
Caves		-	-	-	-	-	maternity caves used by L. Curasoae and G. longirostris, Urzujan Blanku is also used by <i>M. megalophylla</i> .	Barkadera, Spelonk	32, 33, personal observations Fernando Simal.	

Potential occurrence of different nature values within the Middle Terrace Landscape

Nature values	Associated species	Status					Endemic	Importance	Location	Sources
		Bonaire	CITES	IUCN	Bonn	SPAW				
<b>Middle Terraces (TM)</b>	TM is present in most of Bonaire and consists of both depositional and erosional terraces. It is less continuous than the Lower Terrace. The transition between the Middle Terrace and the other terraces and the undulating landscape is not always clear. The most extensive areas of the Middle Terrace landscape are found at Bolivia. (De Freitas <i>et al</i> , 2005)									
	<i>Leptonycteris curasoae</i>	•	-	VU	-	-	N	Nectarfeeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Barkadera, Spelonk	32, personal observations Fernando Simal.
<b>TM6</b>	<i>Glossophaga longirostris</i>	•	-	DD	-	-	N	Nectarfeeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Barkadera, Spelonk	32, personal observations Fernando Simal.
	<i>Mormoops megalophylla</i>	•	-	LC	-	-	N	Protected	Barkadera	32, personal observations Fernando Simal.
	<i>Natalus tumidirostris</i>	•	-	LC	-	-	N	Protected	Barkadera	32
<b>TM7</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	•	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Aratinga pertinax xanthogenius</i>	•○	-	LC	-	-	Y	Endemic	manchineel grove on west side of Lac Bay	19
	<i>Tyto alba spp.</i>	•○	-	LC	-	-	Y	Endemic	Bolivia	17
	<i>Buteo albicaudatus</i>	•○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Chrysolampis mosquitos</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	Cavern waters	-	-	-	-	-	-	Fresh water cavespecies	(see map Appendix V)	personal observation A.O. Debrot
	Caves	-	-	-	-	-	-	Important as habitat for bats, owls etc.	Spelonk	32, 33
	<i>Leptonycteris curasoae</i>	•	-	VU	-	-	N	Nectarfeeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Spelonk	32, personal observations Fernando Simal.
	<i>Glossophaga longirostris</i>	•	-	DD	-	-	N	Nectarfeeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Spelonk	32, personal observations Fernando Simal.
<b>TM8</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	•	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Tyto alba spp.</i>	•○	-	LC	-	-	Y	Endemic	Bolivia	17
	<i>Buteo albicaudatus</i>	•○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Chrysolampis mosquitos</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot

Potential occurrence of different nature values within the Middle Terrace Landscape

Nature values	Associated species	Status	Status type				Endemic	Importance	Location	Sources
		Bonaire	CITES	IUCN	Bonn	SPAW				
<b>Middle Terraces (TM)</b>	TM is present in most of Bonaire and consists of both depositional and erosional terraces. It is less continuous than the Lower Terrace. The transition between the Middle Terrace and the other terraces and the undulating landscape is not always clear. The most extensive areas of the Middle Terrace landscape are found at Bolivia. (De Freitas <i>et al</i> , 2005)									
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	Caves	-	-	-	-	-	-	Important as habitat for bats, owls etc.	Spelonk	32, 33
	<i>Leptonycteris curasoae</i>	●	-	VU	-	-	N	Nectar feeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Spelonk	32, personal observations Fernando Simal.
	<i>Glossophaga longirostris</i>	●	-	DD	-	-	N	Nectar feeding and the only pollinators of the 3 species candle cacti, key species on Bonaire.	Spelonk	32, personal observations Fernando Simal.
	Cavern waters	-	-	-	-	-	-	Fresh water cave species	(see map Appendix V)	personal observation A.O. Debrot
<b>TM9</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	manchineel grove on west side of Lac Bay	19
	<i>Tyto alba spp.</i>	●○	-	LC	-	-	Y	Endemic	Bolivia	17
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Falco peregrinus</i>	◇	II	LC	-	II	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	Cavern waters	-	-	-	-	-	-	Fresh water cave species	(see map Appendix V)	personal observation A.O. Debrot
	Caves	-	-	-	-	-	-	Important as habitat for bats, owls etc.	Lima, Bolivia	32, 33

Potential occurrence of different nature values within the Higher Terrace Landscape

Nature values	Associated species	Status	Status type				Endemic	Importance	Location	Sources
		Bonaire	CITES	IUCN	Bonn	SPAW				
<b>Higher Terrace and Plateau land (TH)</b>	This landscape is only found in the central part of Bonaire, and includes some of the less disturbed vegetation types of the island (De Freitas et al, 2005).									
<b>TH1</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	North of Seru Largu	19
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Chrysolampis mosquitos</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
<b>TH2</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Schomburgkia humboldtii</i>		II	-	-	-	N	Protected	Sta. Barbara	personal observation Marlene Robinson
	<i>Tillandsia flexuosa</i>	●	-	-	-	-	N	Protected	Sta. Barbara	personal observation Marlene Robinson
	<i>Tillandsia balbisiana</i>		-	-	-	-	N		Sta. Barbara	personal observation Marlene Robinson
	<i>Tyto alba spp.</i>	●○	-	LC	-	-	Y	Endemic	Bolivia	17
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Chrysolampis mosquitos</i>	-	-	LC	-	-	N	-	(see map Appendix V)	26, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	Caves	-	-	-	-	-	-	Important as habitat for bats, owls etc.	Rooi Sangu	personal observation Fernando Simal
	Cavern waters	-	-	-	-	-	-	Fresh water cavespecies	(see map Appendix V)	personal observation A.O. Debrot

Potential occurrence of different nature values within the Escarpment Landscape

Nature values	Associated species	Status	Status type					Endemic	Importance	Location	Sources
		Bonaire	CITES	IUCN	Bonn	SPAW					
<b>Landscape</b>											
<b>Escarpments (E)</b>	This landscape is limited to the escarpments of the 'Plateau land' surrounding the village of Rincón and the limestone hill Seru Largu (also a 'Plateau land'). Escarpments are the result of the exposure of the volcanic material underlying the harder limestone caps as a result of the weathering of these caps. The presence of limestone rocks and boulders on the slopes gives evidence of this process (De Freitas <i>et al</i> , 2005).										
<b>E1</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams	
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38	
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot	
	<i>Tyto alba spp.</i>	●○	-	LC	-	-	Y	Endemic	Bolivia	17	
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29	
	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot	
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot	
<b>E2</b>	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29	
	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams	
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38	
	<i>Chrysolampis mosquitus</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot	
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	26, personal observation A.O. Debrot	
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot	

Potential occurrence of different nature values within the Undulating Landscape

Nature values	Associated species	Status	Status type				Endemic	Importance	Location	Sources
		Bonaire	CITES	IUCN	Bonn	SPAW				
<b>Undulating landscape (D)</b>	This landscape consists of the Washikemba Formation areas in the western and central sections of the island. Five sub-landscapes can be distinguished. (De Freitas <i>et al</i> , 2005)									
<b>D1</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	hillside south of Seru Juwa	19
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Chrysolampis mosquitos</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	manchineel grove on west side of Lac Bay	19
<b>D2</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Chrysolampis mosquitos</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
<b>D3</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Pelecanus occidentalis</i>	-	-	LC	-	II	N	Protected	WSNP	29, personal observation A.O. Debrot
	<i>Pandion haliaetus</i>	●○	-	LC	II	-	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	hillside south of Seru Juwa	19
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Chrysolampis mosquitos</i>	-	-	LC	-	-	N	-	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
<b>D4</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Chrysolampis mosquitos</i>	-	-	LC	-	-	N	-	(see map Appendix V)	personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	25, 29, personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot
<b>D5</b>	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	Lac Bay	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected & Endemic	Washikemba - Fontein - Onima	29, 38
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	Washington Slagbaai National Park	25, 31
	<i>Chrysolampis mosquitos</i>	-	-	LC	-	-	N	-	(see map Appendix V)	personal observation A.O. Debrot
	<i>Caracara plancus</i>	-	II	LC	-	II	N	Protected	(see map Appendix V)	personal observation A.O. Debrot
	<i>Aratinga pertinax xanthogenius</i>	●○	-	LC	-	-	Y	Endemic	(see map Appendix V)	personal observation A.O. Debrot

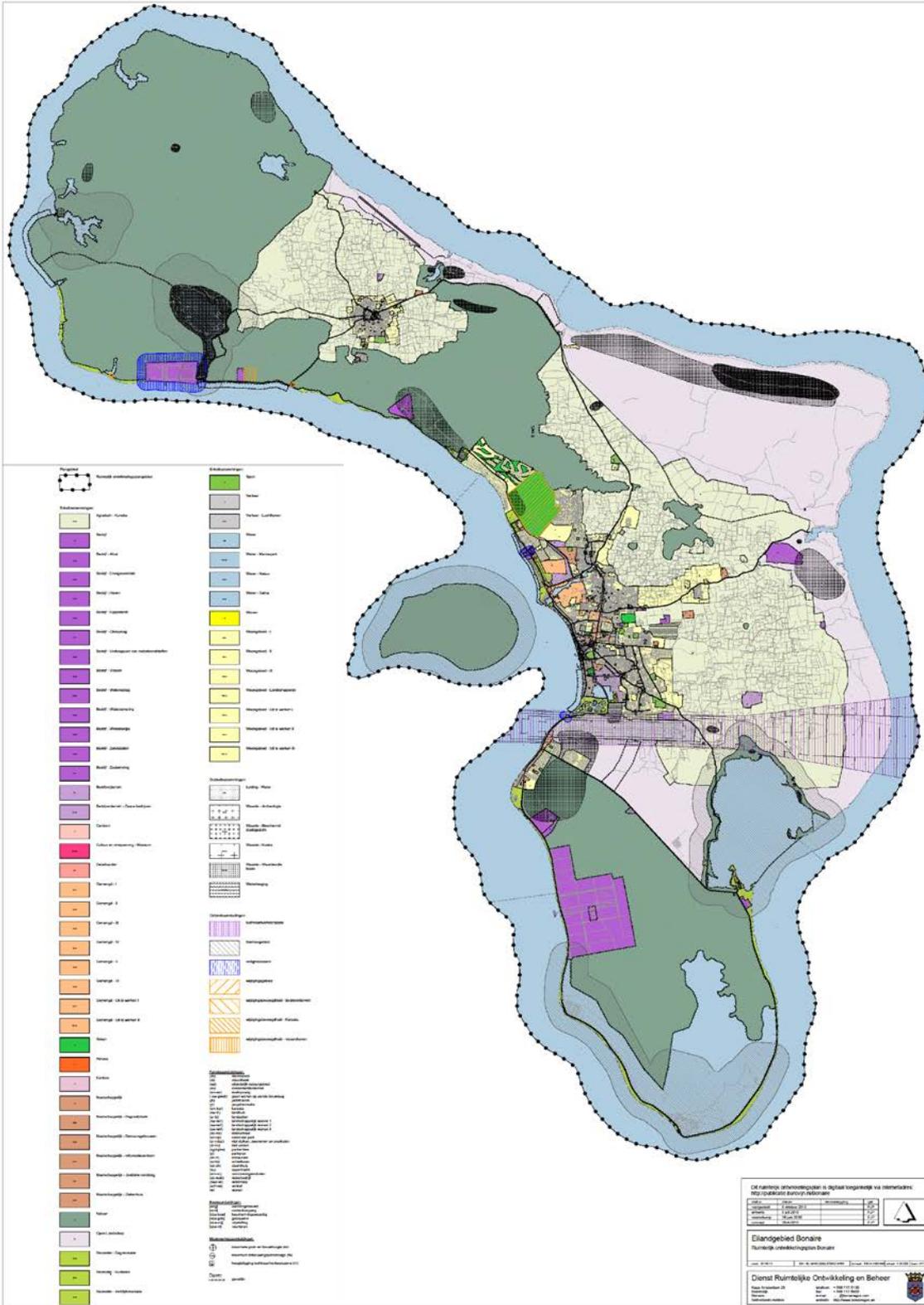
Potential occurrence of different nature values within areas of water

Nature values	Associated species	Status					Endemic	Importance	Location	Sources
		Bonaire	CITES	IUCN	Bonn	SPAW				
Water	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	WSNP	9, personal observation E. Newton, S. Williams
	<i>Phoenicopus ruber</i>	●○	II	LC	-	-	N	Protected	Pekelmeer, Washington Slagbaai.	29, 41
	<i>Tryngites subruficollis</i>	-	-	NT	I	-	N	Protected	Inland bays	29, personal observation A.O. Debrot
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29
	<i>Pandion haliaetus</i>	●○	-	LC	II	-	N	Protected	(see map Appendix V)	29, personal observation A.O. Debrot
	<i>Sterna albofrons</i>	-	-	LC	-	II	N	Protected	Klein Bonaire	2, 8
	<i>Sterna maxima</i>	-	-	LC	II	-	N	Protected	Klein & Southern Bonaire	8, 29
	<i>Sterna hirundo</i>	-	-	LC	II	-	N	Protected	Bonaire	8
	<i>Thalasseus eurygnathus</i>	-	-	-	-	-	N	Conservation priority	Bonaire	8
	<i>Fulica caribea</i>	-	-	NT	-	-	N	Protected	Dos Pos, Onima Reservoir, Playa Grandi Reservoir and Washikemba Reservoir	22, 27, 38
	Cavern waters	-	-	-	-	-	-	Fresh water cavespecies	(see map Appendix V)	personal observation A.O. Debrot

Potential occurrence of different nature values within Areas of anthropogenic use

Nature values	Associated species	Status					Endemic	Importance	Location	Sources
		Bonaire	CITES	IUCN	Bonn	SPAW				
Areas of anthropogenic use	<i>Amazona barbadensis</i>	◇	I	VU	-	II	Y	Threatened & endemic	WSNP	9, personal observation E. Newton, S. Williams
	<i>Margarops fuscatus</i>	●	-	LC	-	-	Y	Protected	Washikemba - Fontein - Onima	29, 38
	<i>Buteo albicaudatus</i>	●○	-	LC	-	-	N	Protected	WSNP	23, 25, 29

# Appendix III - Land use map



## APPENDIX IV- List endemic taxa of Bonaire

Based on the Preliminary checklist of extant and fossil endemic taxa of the ABC islands, Leeward Antilles. By Adolphe O. Debrot, 2006. (C = Curacao, B = Bonaire, A = Aruba, eCar = eastern Caribbean, sCar = southern Caribbean, St. M = St. Maarten, Col = Colombia, Ven = Venezuela, nVen = northern Venezuela and Visl = Venezuelan islands.) The species strictly endemic to Bonaire are highlighted.

Scientific name	Occurrence	Source Reference
<b>Plants</b>		
<i>Agave boldinghiana</i>	C, B	Proosdij 2001
<i>Agave cocui</i>	C, B, nVen	Proosdij 2001
<i>Agave vivipara</i>	A, B, C	Proosdij 2001
<i>Aristida arubensis</i>	A, B, C	Proosdij, 2001, Stoffers 1981
<i>Chloris suringari</i>	C, B	Proosdij 2001, Stoffers, 1981
<i>Cynanchum boldinghii</i>	C, A, B	Proosdij 2001
<i>Maytenus versluisii</i>	C, B	Proosdij 2001, Freitas and Rojer 2000
<i>Myrcia curassavica</i>	C, B	Proosdij 2001, Freitas and Rojer 2000
<i>M. macracanthos</i>	C, A, B	Proosdij 2001, Thomson 2005, Antesberger, 1990, 1995
<i>Cereus repandus</i>	C, A, B, nVen	Proosdij 2001, Hoyos 1985
<i>Stenocereus griseus</i>	C, A, B, nVen	Proosdij 2001, Hoyos 1985
<i>Pilocereus lanuginosus</i>	C, A, B, nVen	Proosdij 2001, Hoyos 1985
<i>Pereskia guamacho</i>	C, A, B, nVen	Proosdij 2001, Hoyos 1985
<i>Opuntia wentiana</i>	C, A, B, nVen	Proosdij 2001, Hoyos 1985
<i>Paspalum curassavicus</i>	C, A, B	Proosdij 2001
<i>Paspalum bonairensis</i>	C, B	Proosdij 2001
<b>Annelida</b>		
<i>Diachaeta bonairensis</i>	B	Righi 1995
<b>Thysanura and Machilida</b>		
<i>Ctenolepisma dubitalis</i>	C, B	Wygodzinsky 1959
<b>Water-striders</b>		
<i>Hebrus elimatus</i>	C, A, B	Drake & Cobben 1960, Kort-Gommers and Nieser 1969
<b>Heteroptera</b>		
<i>Dictyla alia</i>	C, A, B	Drake and Cobben 1960
<i>Cryptostemma cobbeni</i>	B	Wygodzinsky 1960
<i>Micracanthia drakei</i>	C, A, B	Cobben 1960
<b>Beetles</b>		
<i>Cicindela. s. sobrina f. bonaireana</i>	B	Wagenaar-Hummelinck 1983
<i>Methia trium</i>	C, A, B	Gilmour 1968
<i>Eburia bonairensis</i>	C, B	Gilmour 1968
<i>Anthicus laterotuberculatus</i>	C, A, B	Buck 1960
<i>Ecnomosternum vermiculatum</i>	C, B	Marcuzzi 1959

<i>Tapinocomus subnudus</i>	C, A, B	Marcuzzi 1959
<i>Stictoderia subseriata</i>	C, A, B, Visl	Marcuzzi 1959
<i>Rhypasma maria-gratiae</i>	C, B	Marcuzzi 1954, 1959
<i>Diastolinus curtatus curtatus</i>	C, A, B, nVen	Marcuzzi 1959
<i>Blapstinus curassavicus</i>	C, B	Marcuzzi 1954, 1959
<i>Blapstinus orchilensis occidentalis</i>	C, A, B, nVen, Col	Marcuzzi 1954, 1959
<i>Zophobas batavarum</i>	C, A, B, St.M	Marcuzzi 1959, 1977
<i>Rhypasma venezuelense</i>	B, Visl, nVen	Marcuzzi 1977
<i>Blapstinus hummelinki</i>	C, B	Marcuzzi 1954, 1977

### Butterflies

<i>Brephidium exilis</i> ssp.	C, A, B, nVen	Debrot <i>et al.</i> 1999, Miller <i>et al.</i> 2003
<i>Ministymon ligia</i>	C, A, B, nVen	Debrot <i>et al.</i> 1999, Miller <i>et al.</i> 2003.

### Scorpions

<i>Diplocentrus hasethi</i>	C, B	Wagenaar-Hummelinck, 1940b
<i>Rhopalurus hasethi</i>	C, A, B	Wagenaar-Hummelinck, 1940b

### Pseudoscorpions

<i>Garypus bonairiensis</i>	B	Beier 1936, Tooren 1995
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### Spiders

<i>Selenops curacaoe</i>	C, A, B	Ayalón García 2001.
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### Subterranean/freshwater isopods, etc.

<i>Curassanthura halma</i>	C, B	Kensley 1981, Wagele 1982, Wagele & Brandt 1985
<i>Ingolfiella putealis</i>	B	Stock 1976b,c
<i>Ingolfiella fontinalis</i>	B	Stock 1977c
<i>Microcharon herrerae</i>	B	Stock 1977a
<i>Angeliella dubitans</i>	B	Stock 1977a
<i>Mesocyclops intermedius</i>	B	Pesce 1985
<i>Metacyclops botosaneanui</i>	B	Pesce 1985
<i>Neocyclops stocki</i>	B	Pesce 1985
<i>sammogammarus caesicolus</i>	C, B	Stock 1980, Vonk & Stock 1987
<i>Psammogammarus longidactylus</i>	B	Vonk & Stock 1987
<i>Saliweckelia emarginata</i>	C, B	Stock 1977b, Vonk & Stock 1987
<i>Saliweckelia holsingeri</i>	B	Stock 1977b
<i>Thermocyclops tenuis longifurcatus</i>	B	Pesce 1985

### Fresh- and brackishwater fishes

<i>Poecilia vandepolli</i>	C, A, B, St.M	Poeser 1992
<i>Rivulus marmoratus bonairensis</i>	C, A, B	Hoedeman 1958
<i>Cyprinodon dearborni</i>	C, A, B, Ven, Col	Eschmeyer 1999

### Terrestrial Molluscs

<i>Stoastomps walkeri</i>	B	de Jong & Kristensen 1968
<i>Cistulops raveni</i>	C, A, B	de Jong & Kristensen 1968
<i>Tudora aurantia</i>	B	de Jong & Kristensen 1968
<i>Tudora maculata</i>	B	de Jong & Kristensen 1968

<i>Succinea gyrata</i>	C, B	de Jong & Kristensen 1968
<i>Gastrocopta curacoana</i>	C, A, B, Ven	de Jong & Kristensen 1968
<i>Gastrocopta octonaria</i>	C, A, B, Ven	de Jong & Kristensen 1968
<i>Leptinaria gloynii</i>	C, A, B, St.M	de Jong & Kristensen 1968
<i>Cerion u. uva</i>	C, A, B	de Jong & Kristensen 1968
<i>Cerion u. knipensis</i>	C, A, B	de Jong & Kristensen 1968
<i>Brachypodella raveni</i>	C, A, B	de Jong & Kristensen 1968
<i>Microceramus bonairensis</i>	C, A, B, Ven	de Jong & Kristensen 1968

### Reptiles

<i>Anolis bonairensis</i>	B	Wagenaar-Hummelinck 1940a
<i>C. m. ruthveni</i>	B	Wagenaar-Hummelinck 1940a
<i>Gonatodes antillensis</i>	C, B, Visl	Wagenaar- Hummelinck 1940a
<i>Phyllodactylus martini</i>	C, B	Wagenaar-Hummelinck 1940a

### Birds

<i>Amazona barbadensis rothschildi</i>	B, Visl	Voous, 1957, 1983
<i>Ammodramus savannarum caribaeus</i>	C, B	Voous 1957, 1983
<i>A. p. xanthogenius</i>	B	Voous 1957, 1983
<i>Butorides striatus curacensis</i>	C, A, B	Voous 1957, 1983
<i>Caprimulgus cayenensis insularis</i>	C, A, B, Visl	Voous, 1957, 1983
<i>C. f. bonairensis</i>	B	Voous 1957, 1983
<i>Dendroica petechia rufopileata</i>	C, A, B	Voous 1957, 1983
<i>Margarops fuscatus bonairensis</i>	B, Visl	Voous 1957, 1983
<i>Myiarchus tyrannulus brevipennis</i>	C, A, B, Visl	Voous 1957, 1983
<i>Sublegatus modestus pallens</i>	C, A, B, Visl	Voous 1957, 1983
<i>Tiaris bicolor sharpei</i>	C, A, B	Voous 1957, 1983
<i>Tyto alba spp.</i>	B	Prins <i>et al.</i> 2003.
<i>Vireo altiloquus bonairensis</i>	C, B, A, Visl	Voous 1957, 1983
<i>Zenaida auriculata vinaceorufa</i>	C, A, B	Voous 1957, 1983

### Marine Gastropods

<i>Chicoreus spectrum</i>	C, A, B	Diaz 1995, Jong & Coomans 1988
<i>Risomurex withrowi</i>	C, A, B, sCar	Diaz 1995, Jong & Coomans 1988
<i>Conus aurantius</i>	C, A, B	Jong & Coomans 1988
<i>Crassispira candace</i>	B, eCar	Jong & Coomans 1988

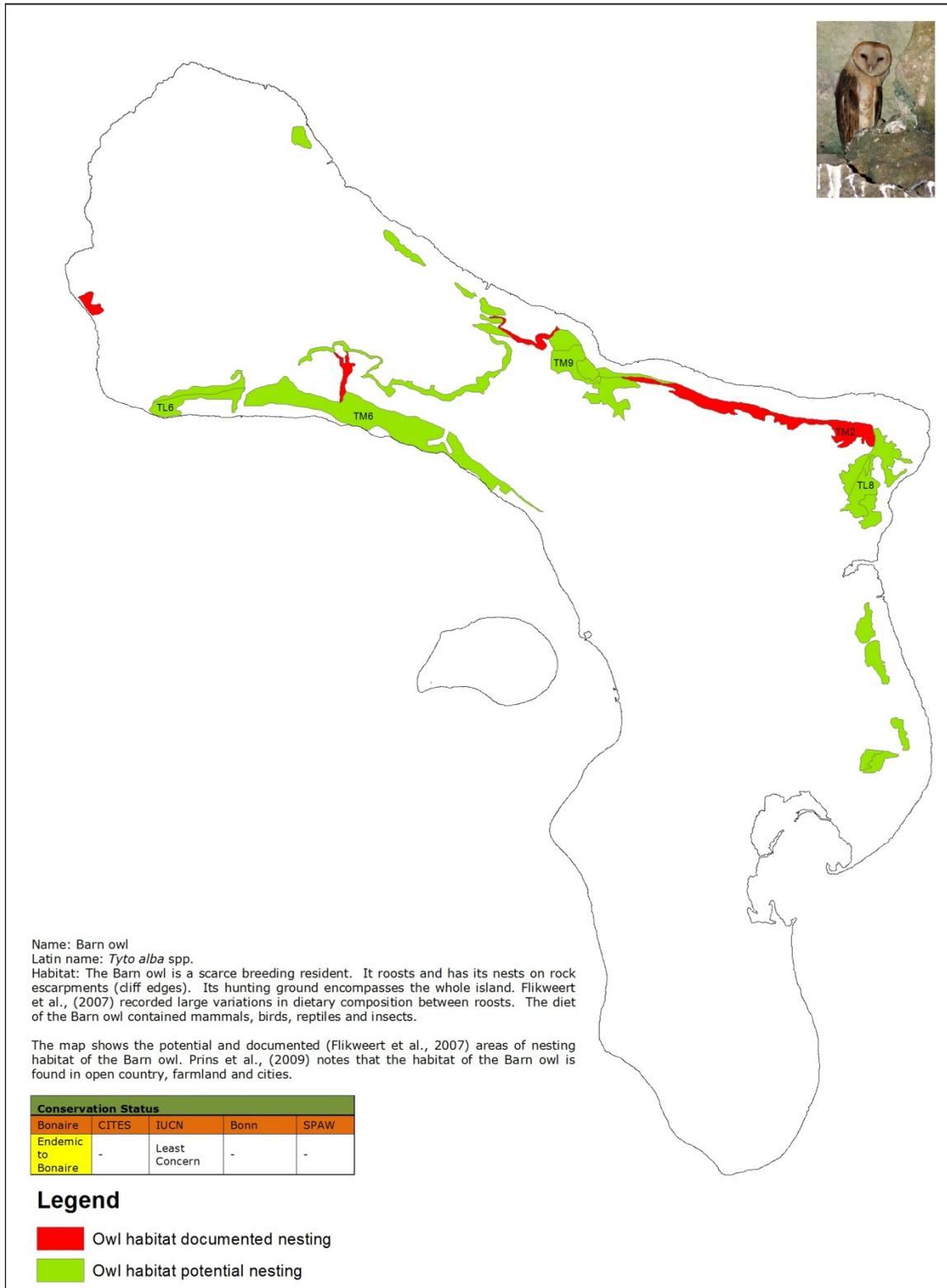
### Marine crinoids (Echinodermata)

<i>Davidaster n. sp.</i>	C, B	Meyer and Cornett, in prep.
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# APPENDIX V- Bird's habitat maps

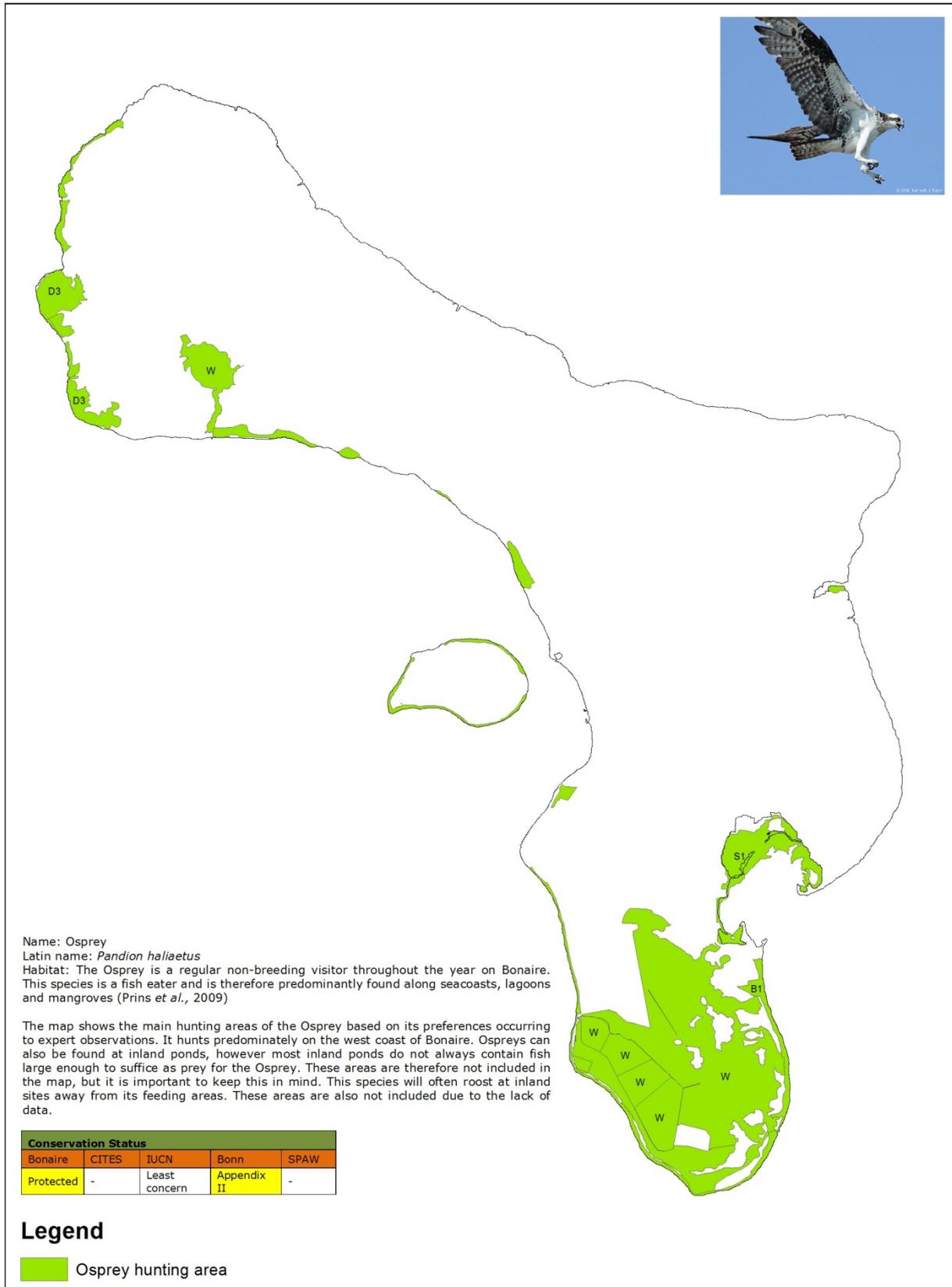


## BARN OWL POTENTIAL AND DOCUMENTED NESTING HABITAT



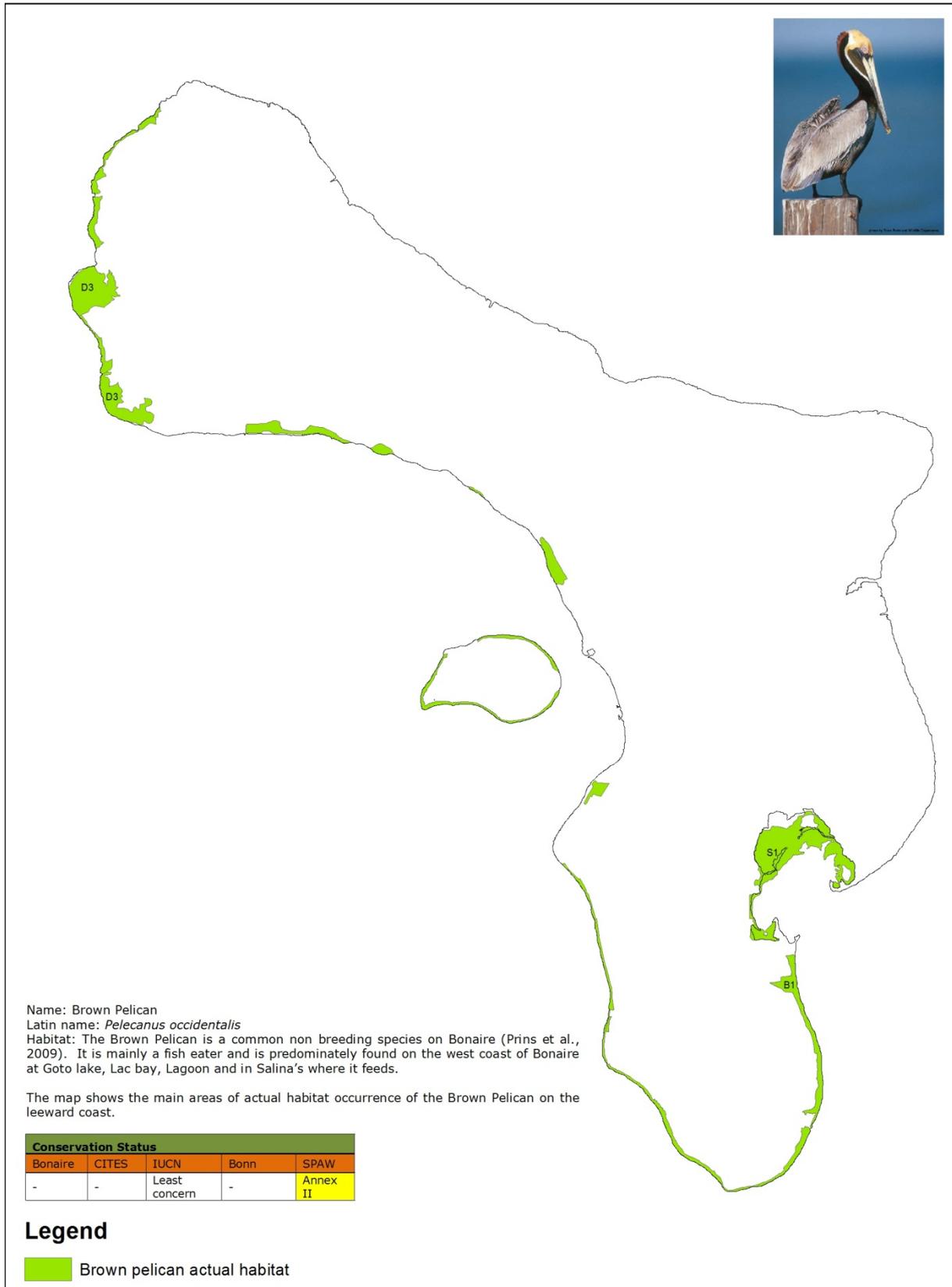


## OSPREY HUNTING AREA





## BROWN PELICAN ACTUAL HABITAT



Name: Brown Pelican  
 Latin name: *Pelecanus occidentalis*  
 Habitat: The Brown Pelican is a common non breeding species on Bonaire (Prins et al., 2009). It is mainly a fish eater and is predominately found on the west coast of Bonaire at Goto lake, Lac bay, Lagoon and in Salina's where it feeds.

The map shows the main areas of actual habitat occurrence of the Brown Pelican on the leeward coast.

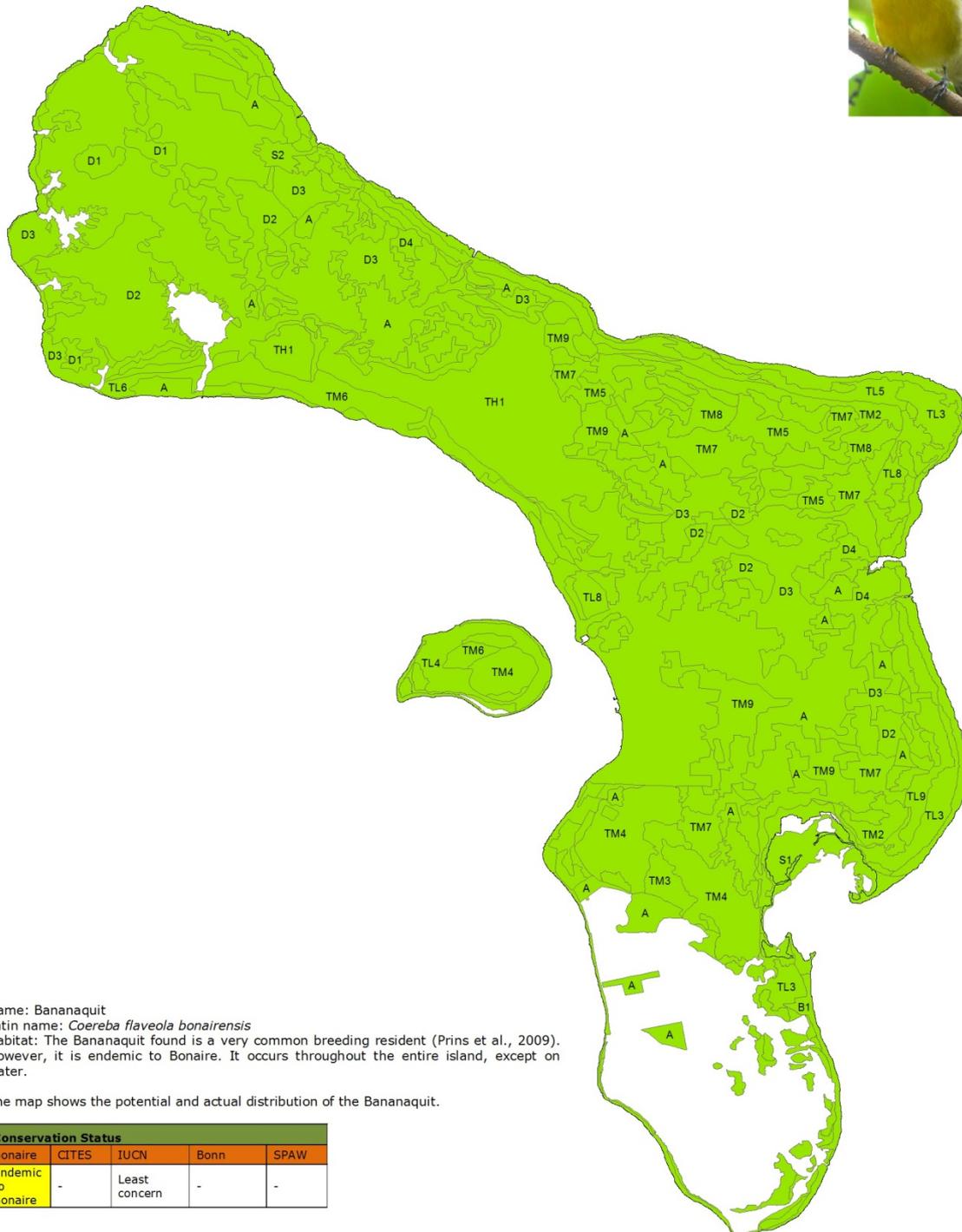
Conservation Status				
Bonaire	CITES	IUCN	Bonn	SPAW
-	-	Least concern	-	Annex II

### Legend

 Brown pelican actual habitat



## BANANAQUIT POTENTIAL ACTUAL HABITAT



Name: Bananaquit  
 Latin name: *Coereba flaveola bonairensis*  
 Habitat: The Bananaquit found is a very common breeding resident (Prins et al., 2009). However, it is endemic to Bonaire. It occurs throughout the entire island, except on water.

The map shows the potential and actual distribution of the Bananaquit.

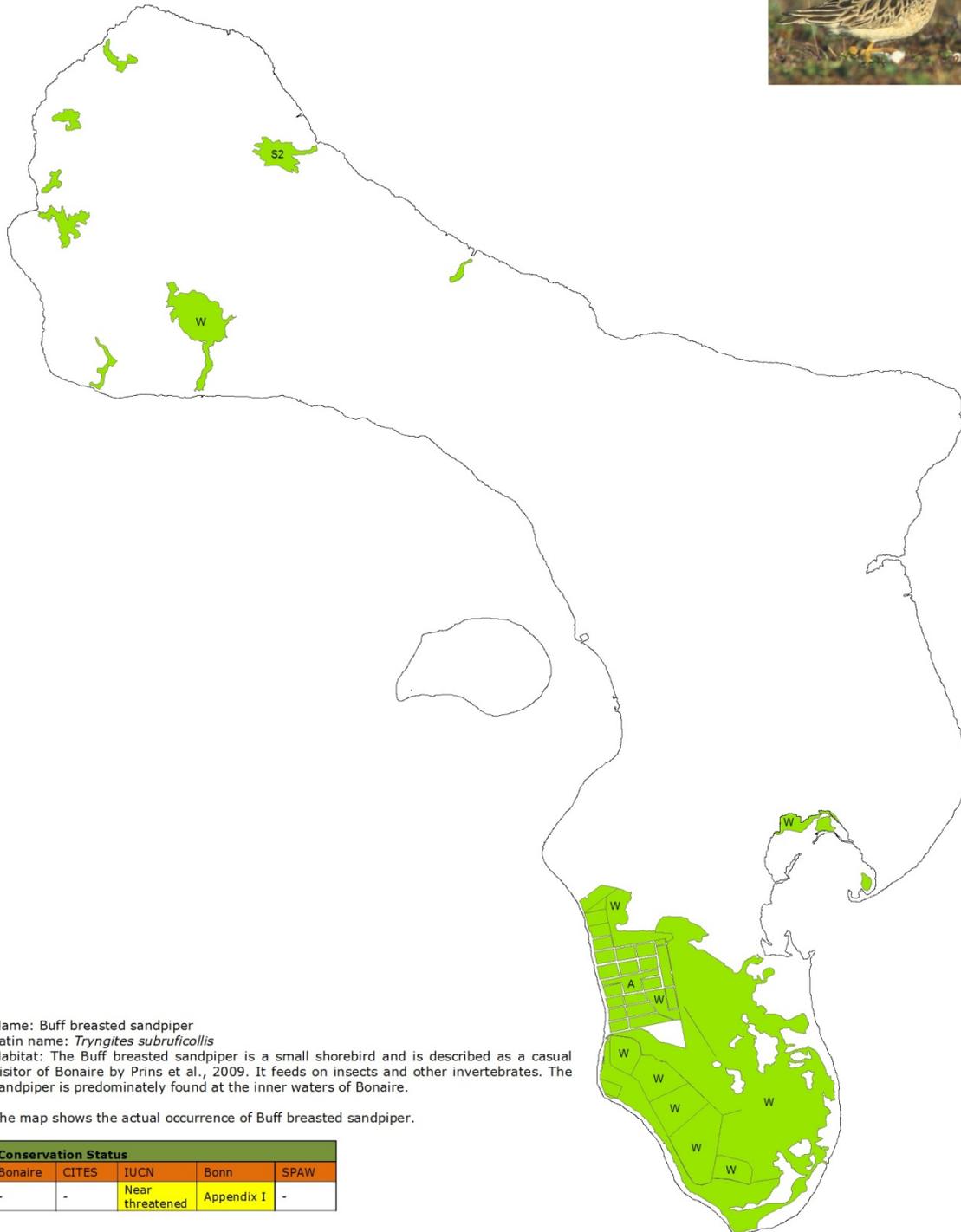
Conservation Status				
Bonaire	CITES	IUCN	Bonn	SPA
Endemic to Bonaire	-	Least concern	-	-

### Legend

 Bananaquit potential actual habitat



## BUFF BREASTED SANDPIPER ACTUAL HABITAT



Name: Buff breasted sandpiper  
 Latin name: *Tryngites subruficollis*  
 Habitat: The Buff breasted sandpiper is a small shorebird and is described as a casual visitor of Bonaire by Prins et al., 2009. It feeds on insects and other invertebrates. The sandpiper is predominately found at the inner waters of Bonaire.

The map shows the actual occurrence of Buff breasted sandpiper.

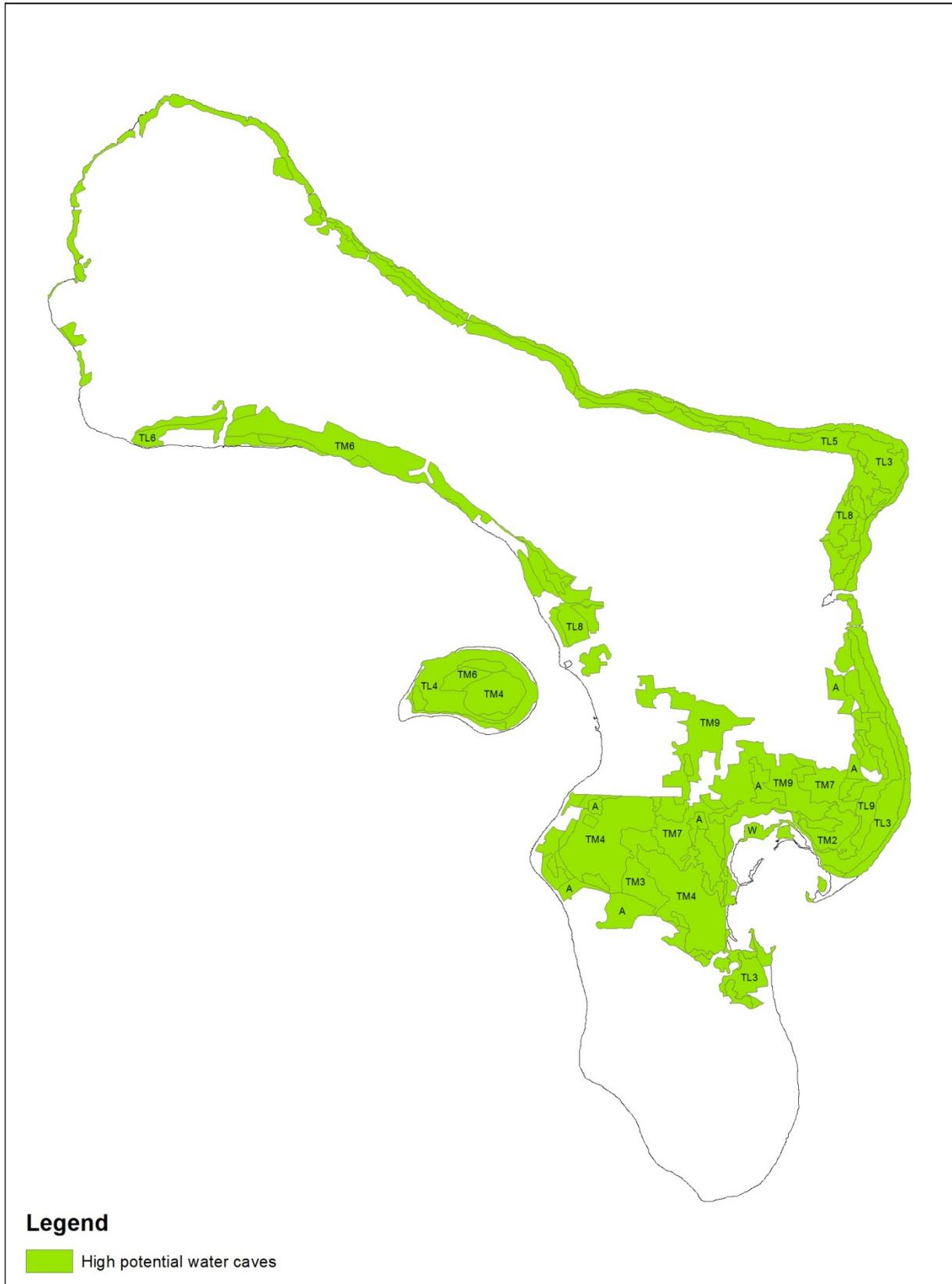
Conservation Status				
Bonaire	CITES	IUCN	Bonn	SPAW
-	-	Near threatened	Appendix I	-

### Legend

Buff breasted sandpiper actual habitat

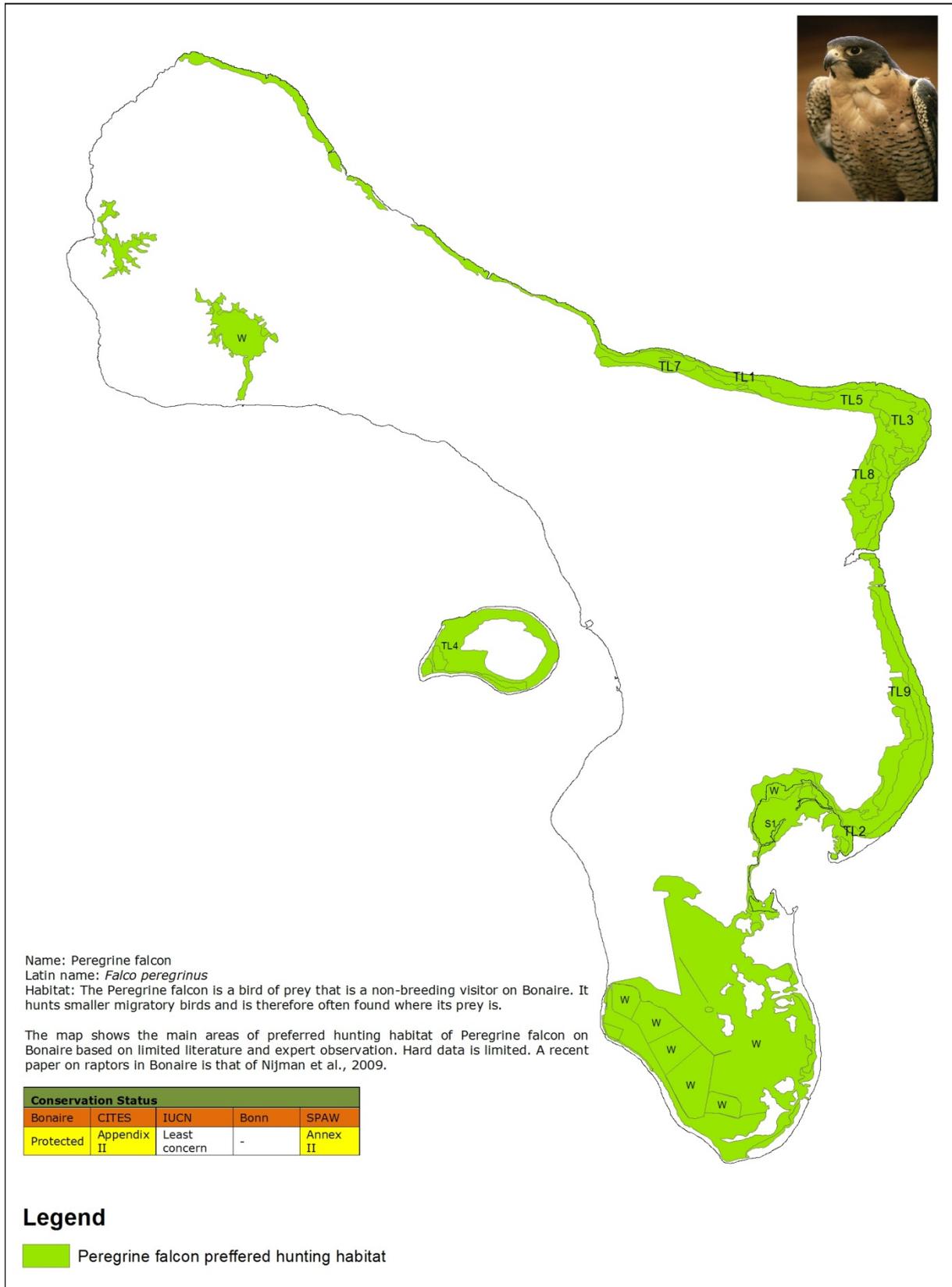


## HIGH POTENTIAL WATER CAVES





## PEREGRINE FALCON PREFERRED HUNTING HABITAT



Name: Peregrine falcon  
 Latin name: *Falco peregrinus*  
 Habitat: The Peregrine falcon is a bird of prey that is a non-breeding visitor on Bonaire. It hunts smaller migratory birds and is therefore often found where its prey is.

The map shows the main areas of preferred hunting habitat of Peregrine falcon on Bonaire based on limited literature and expert observation. Hard data is limited. A recent paper on raptors in Bonaire is that of Nijman et al., 2009.

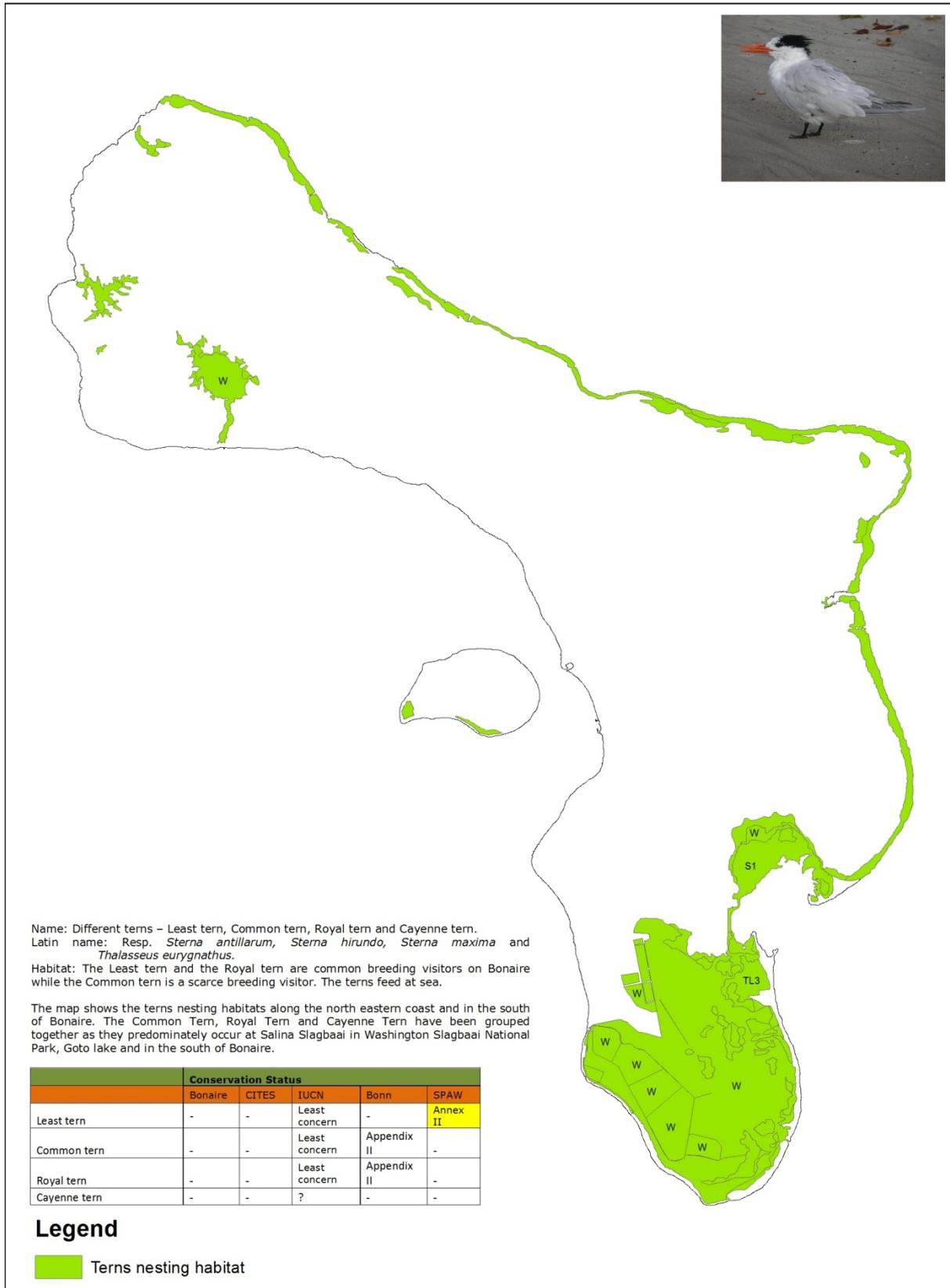
Conservation Status				
Bonaire	CITES	IUCN	Bonn	SPAW
Protected	Appendix II	Least concern	-	Annex II

### Legend

Peregrine falcon preferred hunting habitat



## TERNS NESTING HABITAT



Name: Different terns – Least tern, Common tern, Royal tern and Cayenne tern.  
 Latin name: Resp. *Sterna antillarum*, *Sterna hirundo*, *Sterna maxima* and *Thalasseus eurygnathus*.  
 Habitat: The Least tern and the Royal tern are common breeding visitors on Bonaire while the Common tern is a scarce breeding visitor. The terns feed at sea.

The map shows the terns nesting habitats along the north eastern coast and in the south of Bonaire. The Common Tern, Royal Tern and Cayenne Tern have been grouped together as they predominately occur at Salina Slagbaai in Washington Slagbaai National Park, Goto lake and in the south of Bonaire.

	Conservation Status				
	Bonaire	CITES	IUCN	Bonn	SPAW
Least tern	-	-	Least concern	-	Annex II
Common tern	-	-	Least concern	Appendix II	-
Royal tern	-	-	Least concern	Appendix II	-
Cayenne tern	-	-	?	-	-

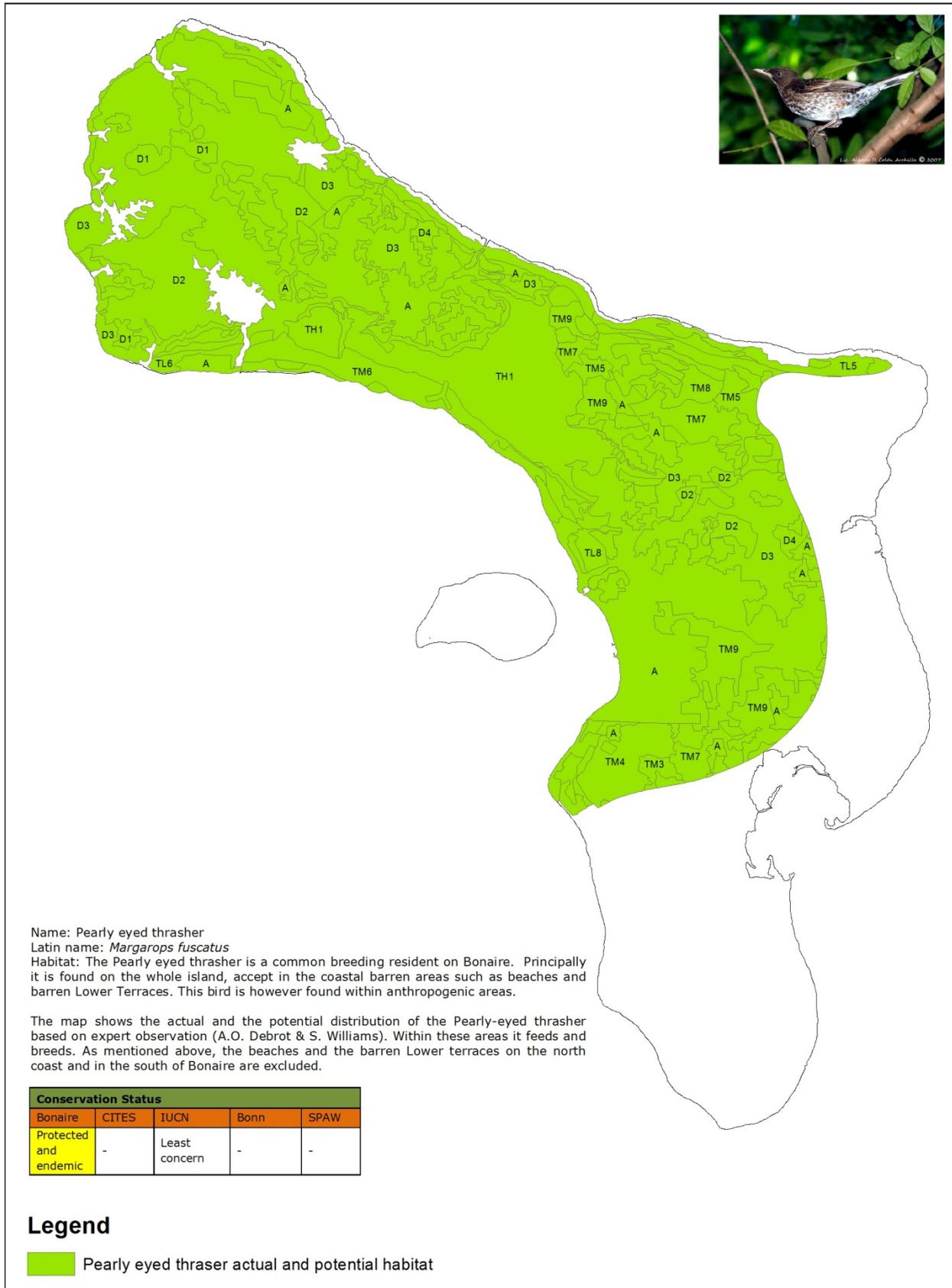
### Legend

Terns nesting habitat





## PEARLY EYED THRASHER POTENTIAL AND ACTUAL HABITAT



Name: Pearly eyed thrasher  
 Latin name: *Margarops fuscatus*  
 Habitat: The Pearly eyed thrasher is a common breeding resident on Bonaire. Principally it is found on the whole island, except in the coastal barren areas such as beaches and barren Lower Terraces. This bird is however found within anthropogenic areas.

The map shows the actual and the potential distribution of the Pearly-eyed thrasher based on expert observation (A.O. Debrot & S. Williams). Within these areas it feeds and breeds. As mentioned above, the beaches and the barren Lower terraces on the north coast and in the south of Bonaire are excluded.

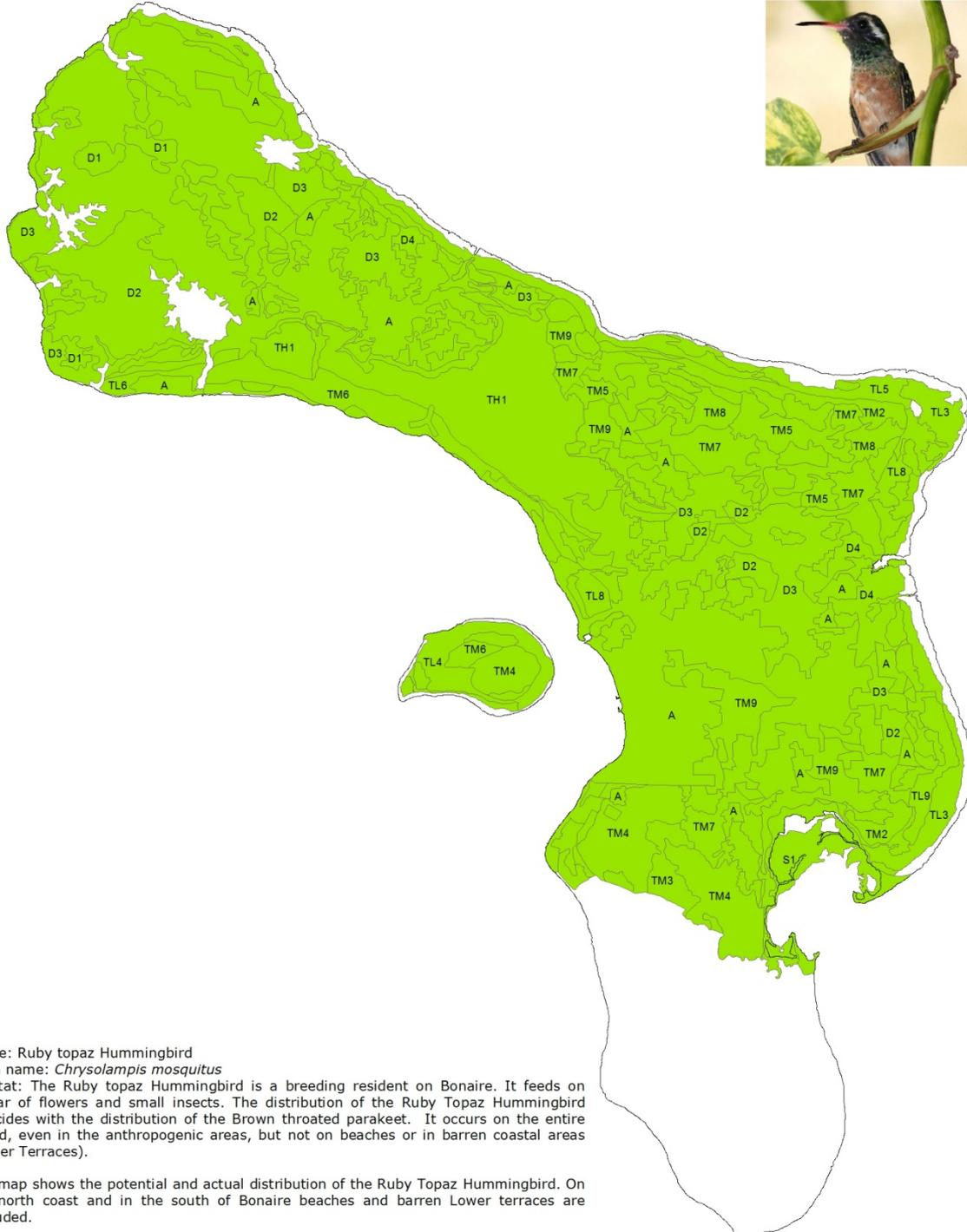
Conservation Status				
Bonaire	CITES	IUCN	Bonn	SPA W
Protected and endemic	-	Least concern	-	-

### Legend

Pearly eyed thrasher actual and potential habitat



# RUBY TOPAZ HUMMINGBIRD POTENTIAL AND ACTUAL HABITAT



Name: Ruby topaz Hummingbird  
 Latin name: *Chrysolampis mosquitus*  
 Habitat: The Ruby topaz Hummingbird is a breeding resident on Bonaire. It feeds on nectar of flowers and small insects. The distribution of the Ruby Topaz Hummingbird coincides with the distribution of the Brown throated parakeet. It occurs on the entire island, even in the anthropogenic areas, but not on beaches or in barren coastal areas (Lower Terraces).

The map shows the potential and actual distribution of the Ruby Topaz Hummingbird. On the north coast and in the south of Bonaire beaches and barren Lower Terraces are excluded.

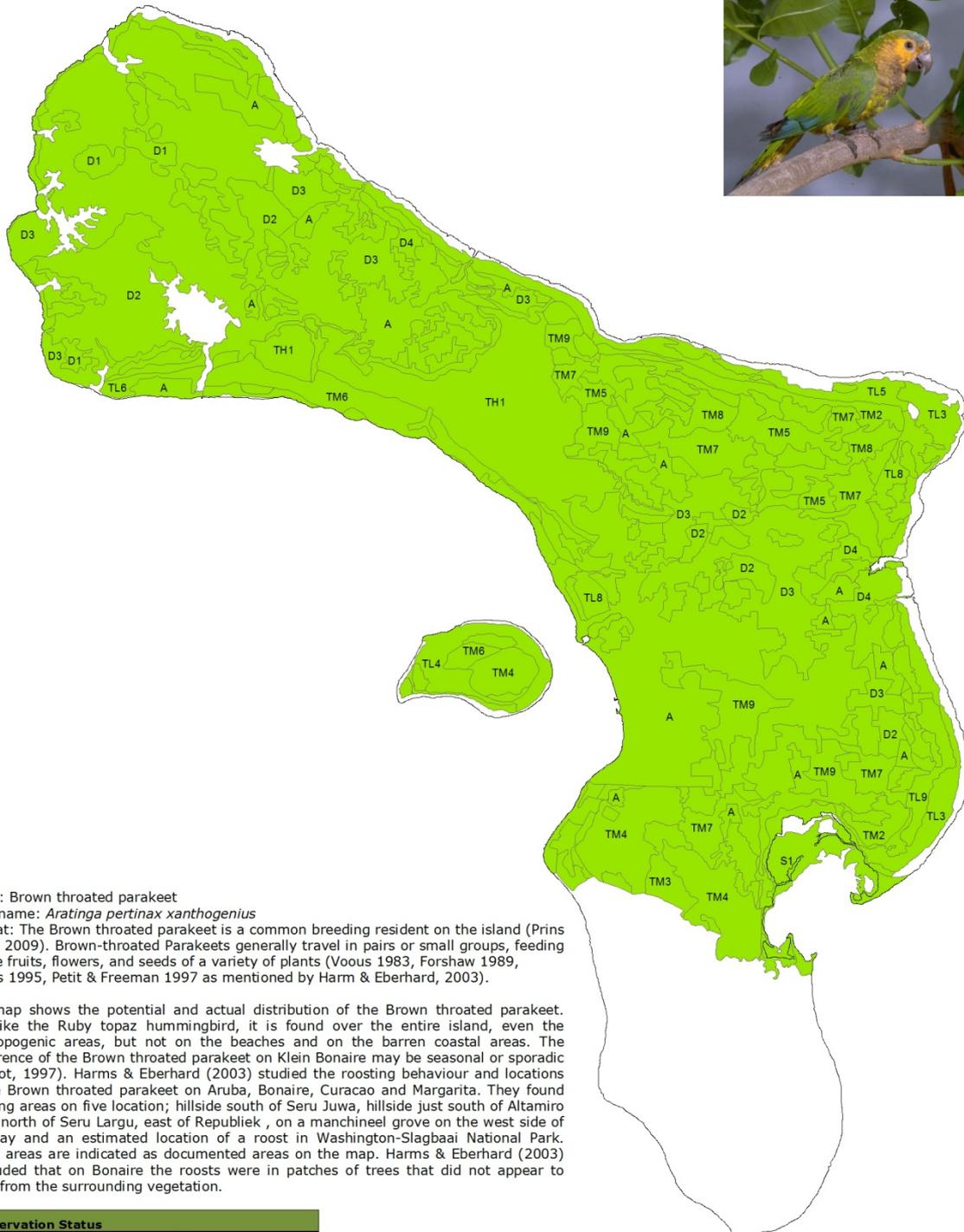
Conservation Status				
Bonaire	CITES	IUCN	Bonn	SPA
-	-	Least concern	-	-

## Legend

Ruby topaz Hummingbird potential actual



# BROWN THROATED PARAKEET POTENTIAL AND ACTUAL HABITAT



Name: Brown throated parakeet  
 Latin name: *Aratinga pertinax xanthogenius*  
 Habitat: The Brown throated parakeet is a common breeding resident on the island (Prins et al., 2009). Brown-throated Parakeets generally travel in pairs or small groups, feeding on the fruits, flowers, and seeds of a variety of plants (Voous 1983, Forshaw 1989, Silvius 1995, Petit & Freeman 1997 as mentioned by Harm & Eberhard, 2003).

The map shows the potential and actual distribution of the Brown throated parakeet. Just like the Ruby topaz hummingbird, it is found over the entire island, even the anthropogenic areas, but not on the beaches and on the barren coastal areas. The occurrence of the Brown throated parakeet on Klein Bonaire may be seasonal or sporadic (Debrot, 1997). Harms & Eberhard (2003) studied the roosting behaviour and locations of the Brown throated parakeet on Aruba, Bonaire, Curacao and Margarita. They found roosting areas on five location; hillside south of Seru Juwa, hillside just south of Altamiro Unjo, north of Seru LARGU, east of Republiek, on a manchineel grove on the west side of Lac Bay and an estimated location of a roost in Washington-Slagbaai National Park. These areas are indicated as documented areas on the map. Harms & Eberhard (2003) concluded that on Bonaire the roosts were in patches of trees that did not appear to differ from the surrounding vegetation.

Conservation Status				
Bonaire	CITES	IUCN	Bonn	SPAW
Protected and endemic*	CITES?	Least concern	-	-

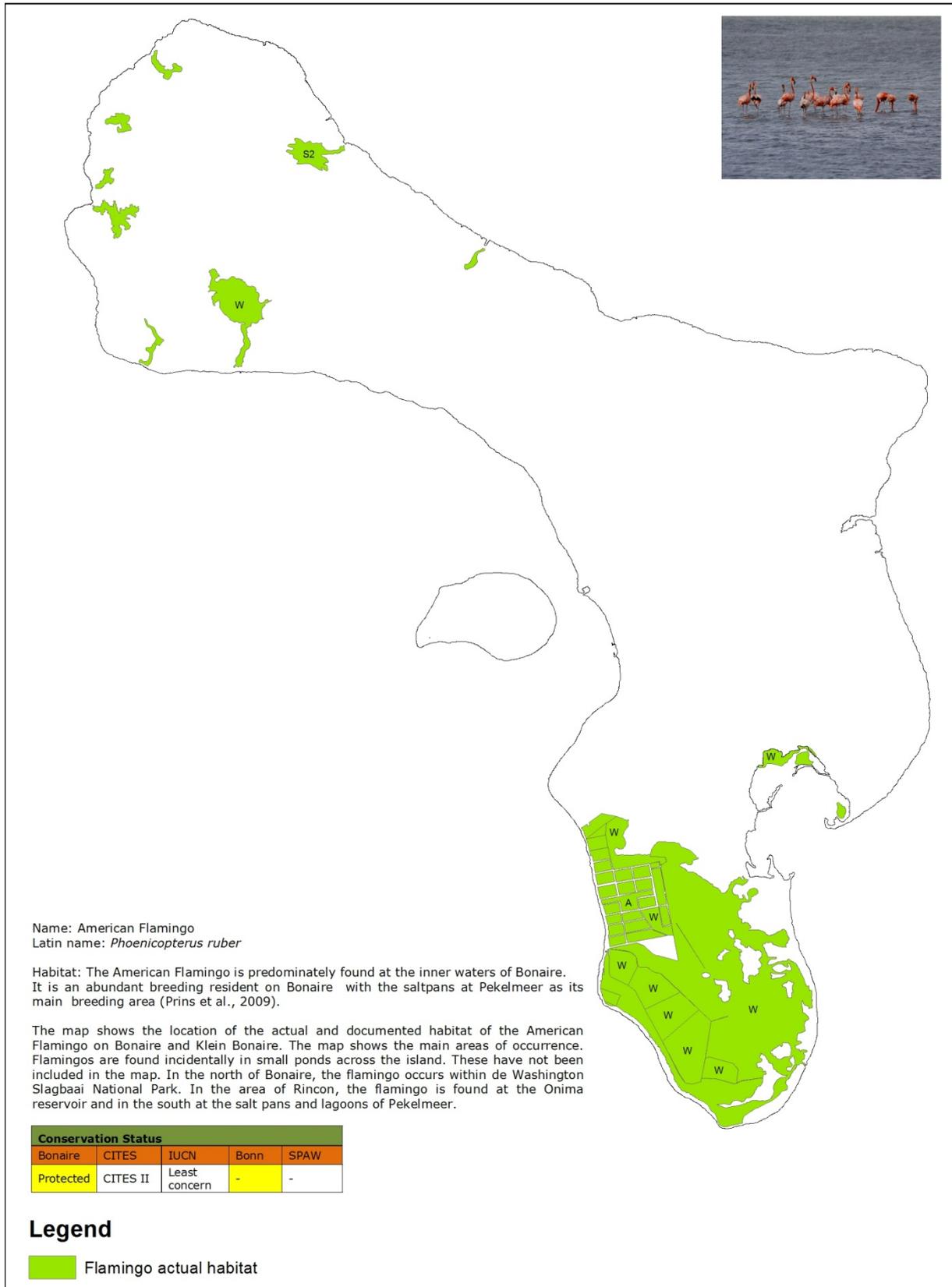
\* This subspecies of Brown-throated parakeet is endemic for Bonaire.

## Legend

Brown throated parakeet potential actual habitat



## AMERICAN FLAMINGO ACTUAL HABITAT



Name: American Flamingo  
 Latin name: *Phoenicopterus ruber*

Habitat: The American Flamingo is predominately found at the inner waters of Bonaire. It is an abundant breeding resident on Bonaire with the salt pans at Pekelmeer as its main breeding area (Prins et al., 2009).

The map shows the location of the actual and documented habitat of the American Flamingo on Bonaire and Klein Bonaire. The map shows the main areas of occurrence. Flamingos are found incidentally in small ponds across the island. These have not been included in the map. In the north of Bonaire, the flamingo occurs within de Washington Slagbaai National Park. In the area of Rincon, the flamingo is found at the Onima reservoir and in the south at the salt pans and lagoons of Pekelmeer.

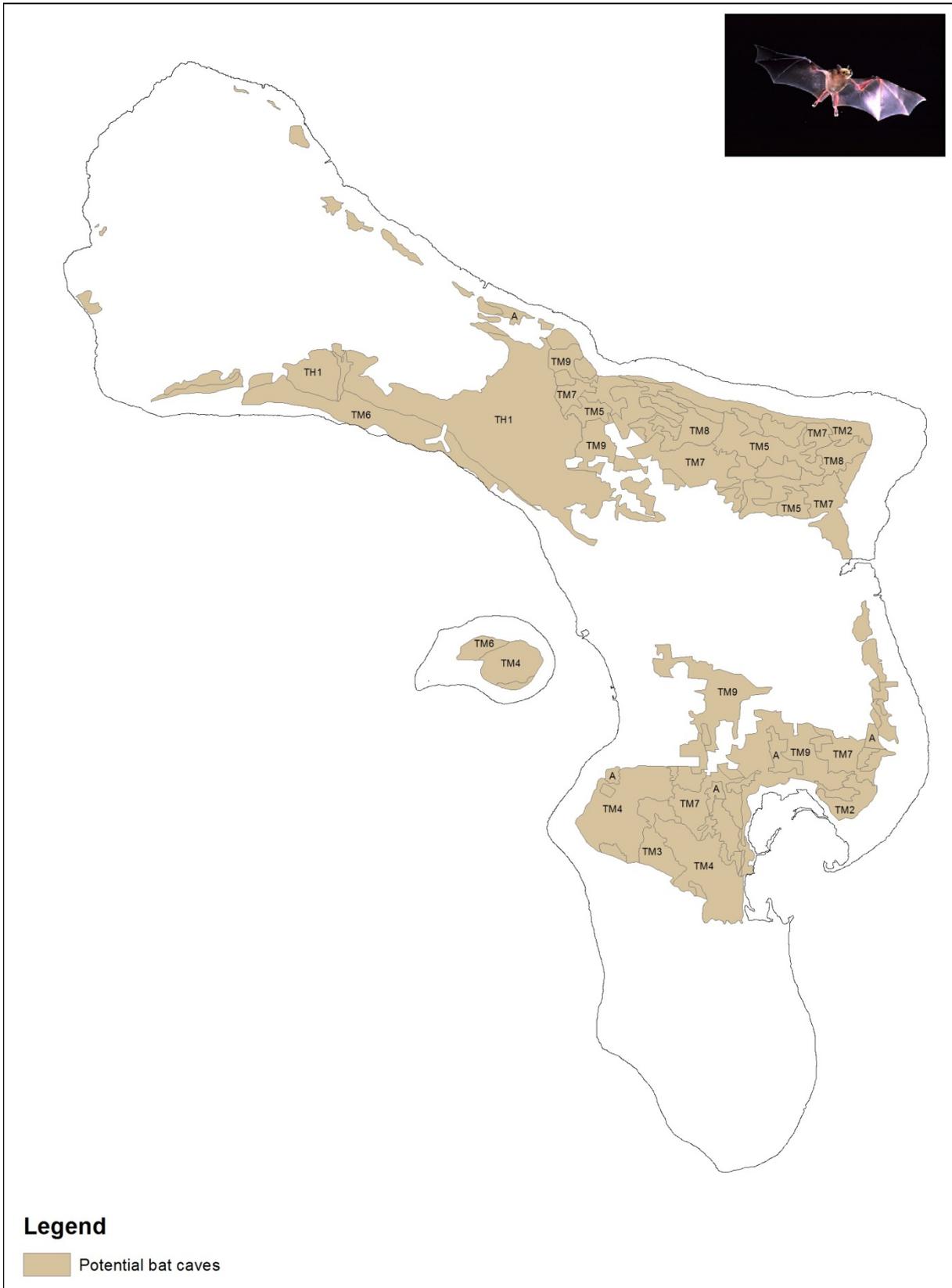
Conservation Status				
Bonaire	CITES	IUCN	Bonn	SPAW
Protected	CITES II	Least concern	-	-

### Legend

Flamingo actual habitat

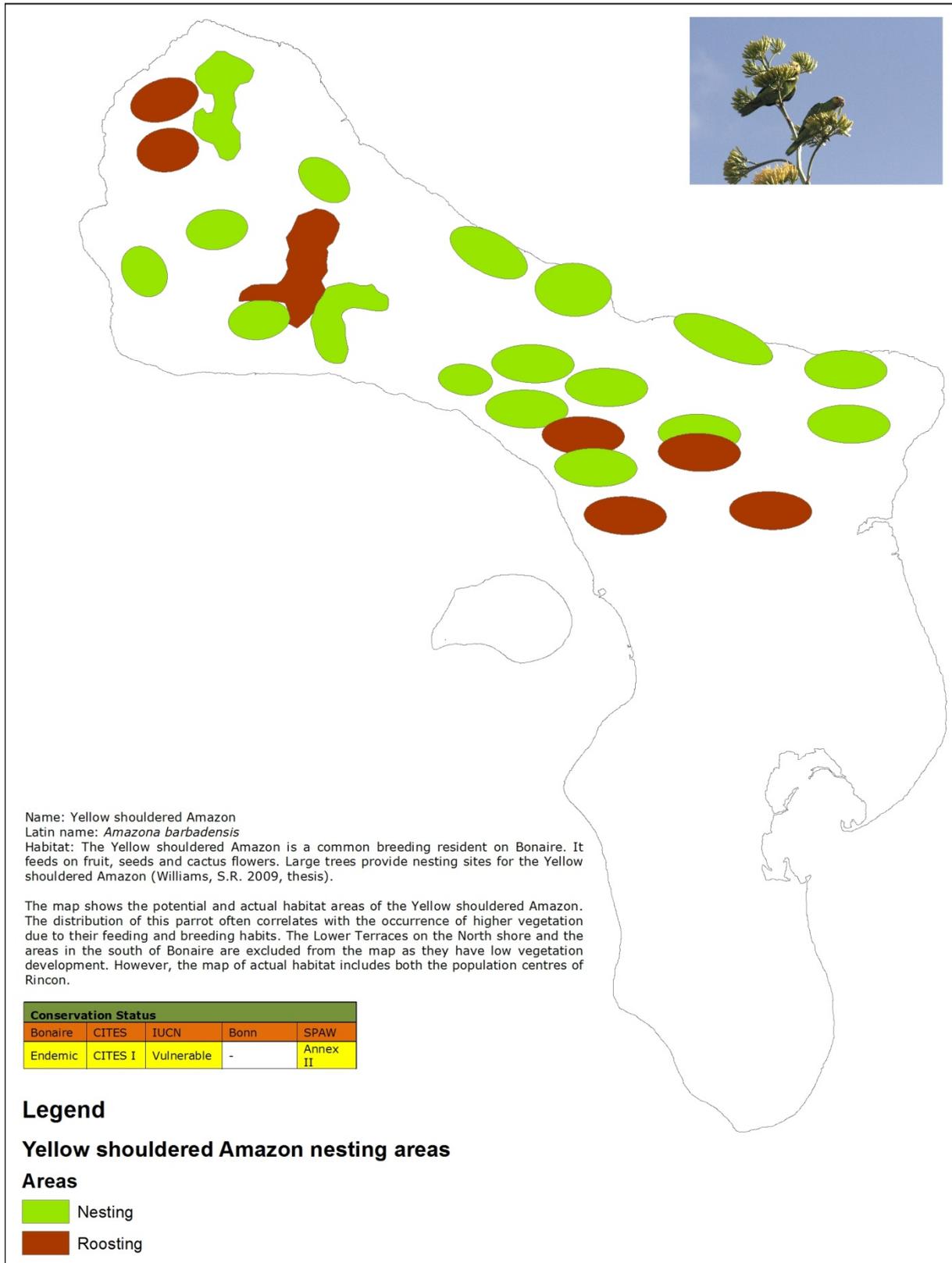


# POTENTIAL BAT CAVES



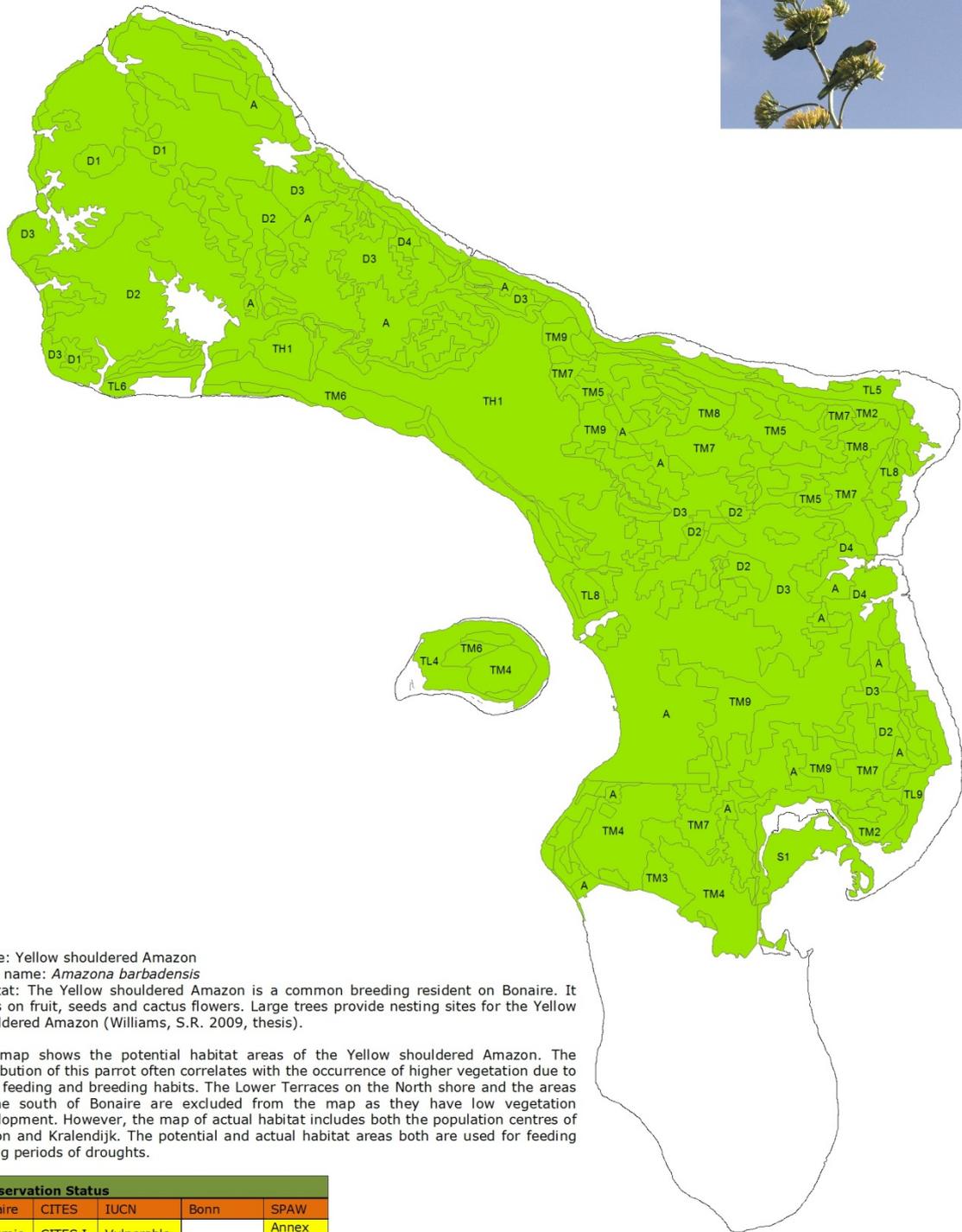


## YELLOW SHOULDERED AMAZON NESTING AREAS





## YELLOW SHOULDERED AMAZON POTENTIAL HABITAT



Name: Yellow shouldered Amazon  
 Latin name: *Amazona barbadensis*

Habitat: The Yellow shouldered Amazon is a common breeding resident on Bonaire. It feeds on fruit, seeds and cactus flowers. Large trees provide nesting sites for the Yellow shouldered Amazon (Williams, S.R. 2009, thesis).

The map shows the potential habitat areas of the Yellow shouldered Amazon. The distribution of this parrot often correlates with the occurrence of higher vegetation due to their feeding and breeding habits. The Lower Terraces on the North shore and the areas in the south of Bonaire are excluded from the map as they have low vegetation development. However, the map of actual habitat includes both the population centres of Rincon and Kralendijk. The potential and actual habitat areas both are used for feeding during periods of droughts.

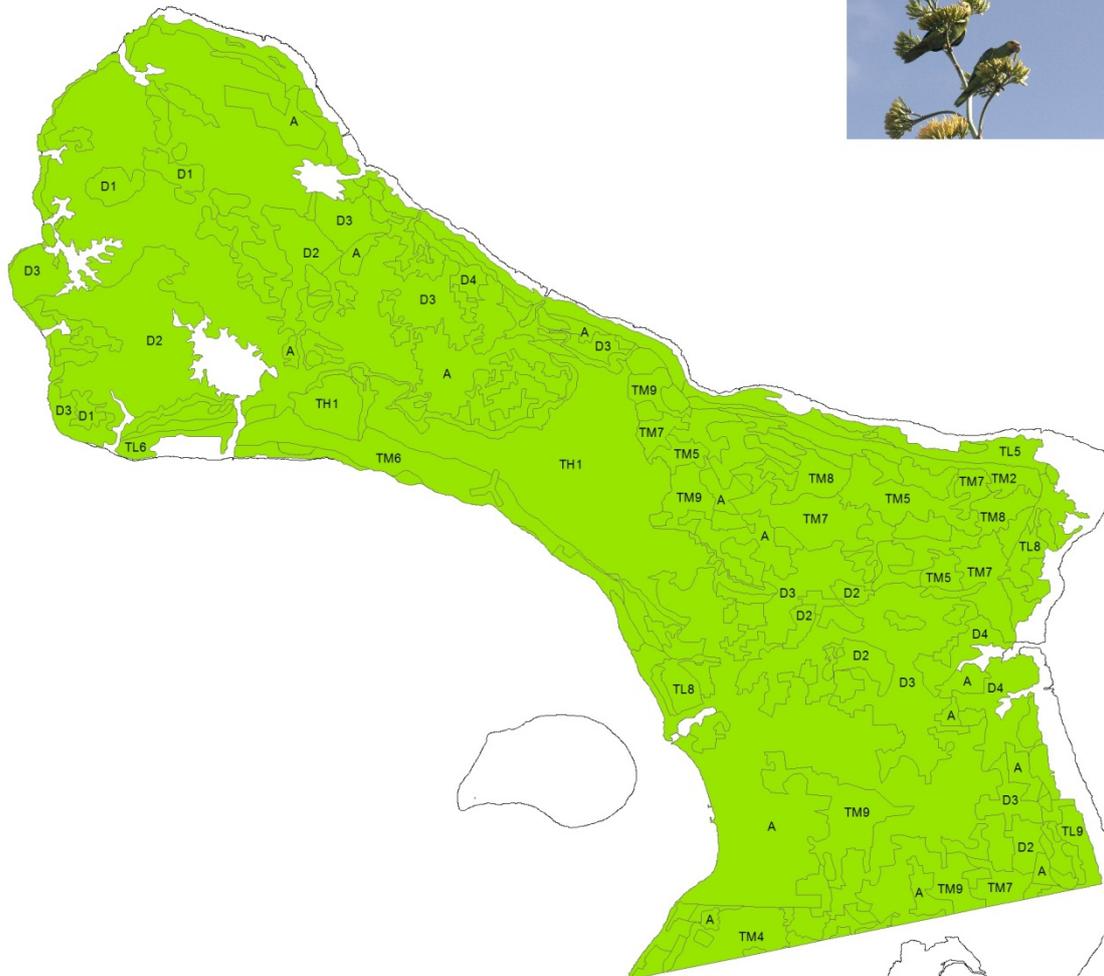
Conservation Status				
Bonaire	CITES	IUCN	Bonn	SPAW
Endemic	CITES I	Vulnerable	-	Annex II

### Legend

Yellow shouldered Amazon potential habitat



## YELLOW SHOULDERED AMAZON ACTUAL HABITAT



### BROWN PELICAN

Name: Yellow shouldered Amazon

Latin name: *Amazona barbadensis*

Habitat: The Yellow shouldered Amazon is a common breeding resident on Bonaire. It feeds on fruit, seeds and cactus flowers. Large trees provide nesting sites for the Yellow shouldered Amazon (Williams, S.R. 2009, thesis).

The map shows the actual habitat areas of the Yellow shouldered Amazon. The distribution of this parrot often correlates with the occurrence of higher vegetation due to their feeding and breeding habits. The Lower Terraces on the North shore and the areas in the south of Bonaire are excluded from the map as they have low vegetation development. However, the map of actual habitat includes both the population centres of Rincon and Kralendijk. The potential and actual habitat areas both are used for feeding during periods of droughts.

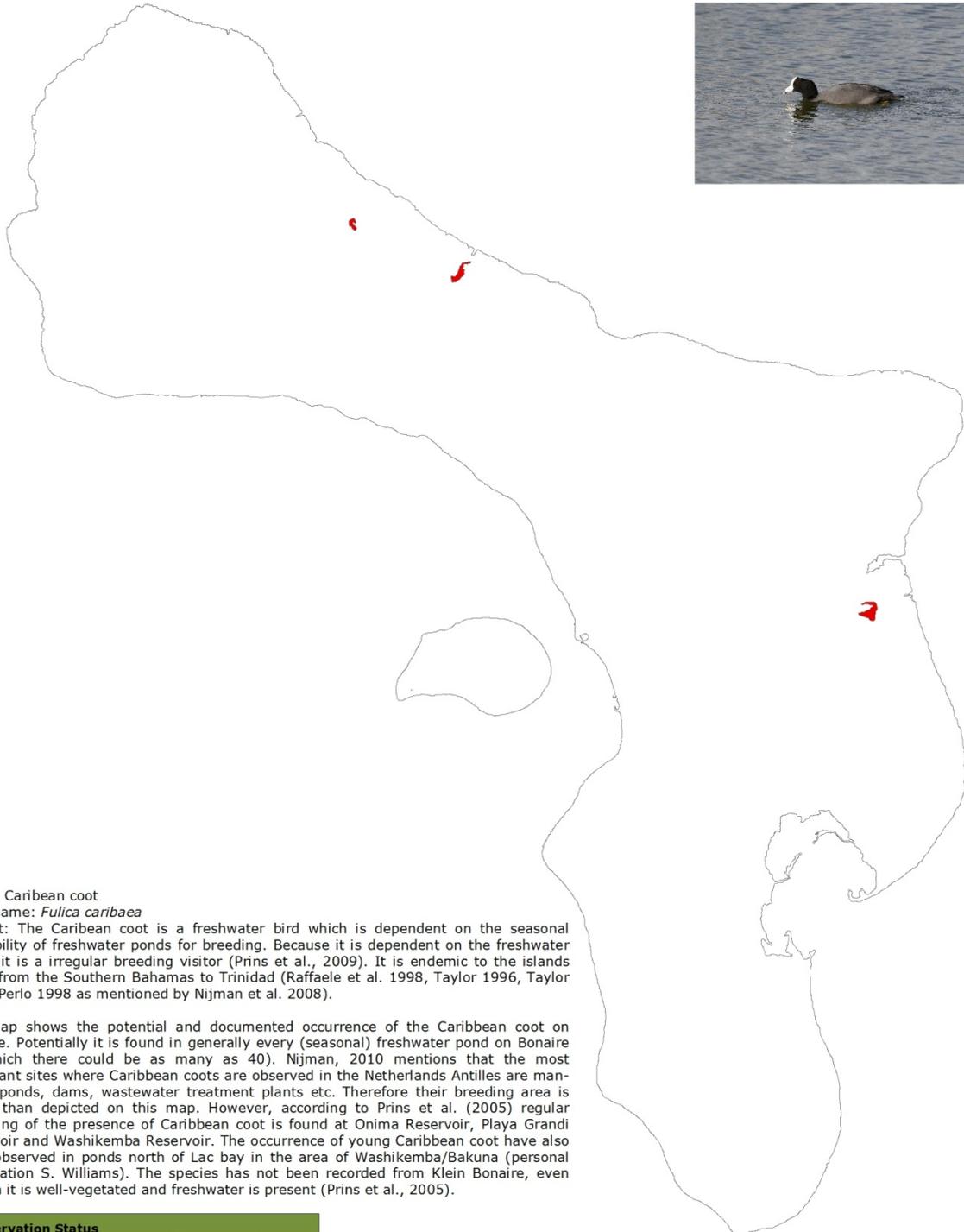
Conservation Status				
Bonaire	CITES	IUCN	Bonn	SPAW
Endemic	CITES I	Vulnerable	-	Annex II

### Legend

Yellow shouldered Amazon actual



## BREEDING HABITAT FOR CARIBBEAN COOT



Name: Caribbean coot

Latin name: *Fulica caribaea*

Habitat: The Caribbean coot is a freshwater bird which is dependent on the seasonal availability of freshwater ponds for breeding. Because it is dependent on the freshwater ponds it is a irregular breeding visitor (Prins et al., 2009). It is endemic to the islands found from the Southern Bahamas to Trinidad (Raffaele et al. 1998, Taylor 1996, Taylor & van Perlo 1998 as mentioned by Nijman et al. 2008).

The map shows the potential and documented occurrence of the Caribbean coot on Bonaire. Potentially it is found in generally every (seasonal) freshwater pond on Bonaire (of which there could be as many as 40). Nijman, 2010 mentions that the most important sites where Caribbean coots are observed in the Netherlands Antilles are man-made ponds, dams, wastewater treatment plants etc. Therefore their breeding area is larger than depicted on this map. However, according to Prins et al. (2005) regular recording of the presence of Caribbean coot is found at Onima Reservoir, Playa Grandi Reservoir and Washikemba Reservoir. The occurrence of young Caribbean coot have also been observed in ponds north of Lac bay in the area of Washikemba/Bakuna (personal observation S. Williams). The species has not been recorded from Klein Bonaire, even though it is well-vegetated and freshwater is present (Prins et al., 2005).

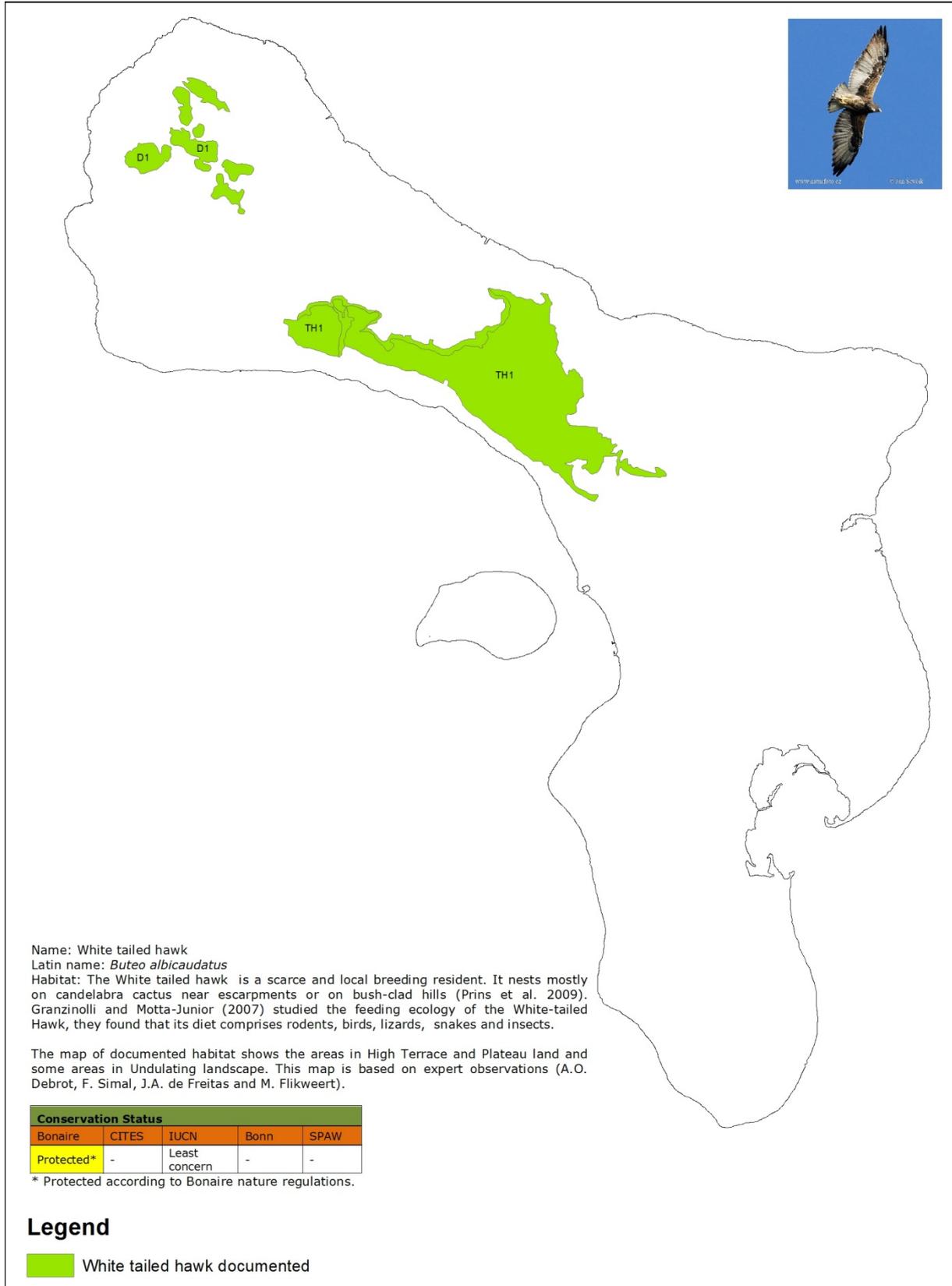
Conservation Status				
Bonaire	CITES	IUCN	Bonn	SPAW
-	-	Near threatened	-	-

### Legend

 Breeding habitat for Caribbean coot



## WHITE TAILED HAWK DOCUMENTED HABITAT



Name: White tailed hawk  
 Latin name: *Buteo albicaudatus*  
 Habitat: The White tailed hawk is a scarce and local breeding resident. It nests mostly on candelabra cactus near escarpments or on bush-clad hills (Prins et al. 2009). Granzinolli and Motta-Junior (2007) studied the feeding ecology of the White-tailed Hawk, they found that its diet comprises rodents, birds, lizards, snakes and insects.

The map of documented habitat shows the areas in High Terrace and Plateau land and some areas in Undulating landscape. This map is based on expert observations (A.O. Debrot, F. Simal, J.A. de Freitas and M. Flikweert).

Conservation Status				
Bonaire	CITES	IUCN	Bonn	SPAW
Protected*	-	Least concern	-	-

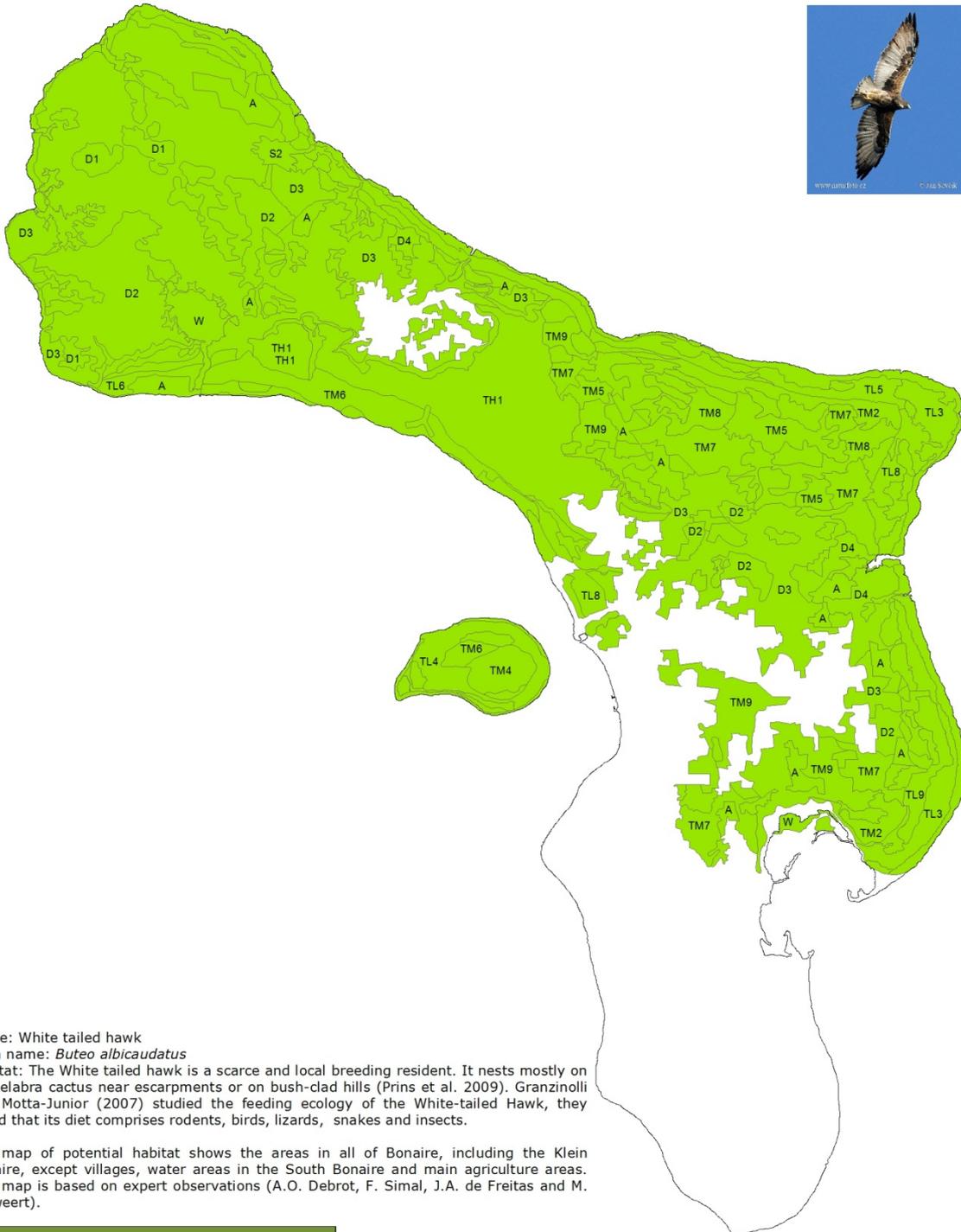
\* Protected according to Bonaire nature regulations.

### Legend

White tailed hawk documented



# WHITE TAILED HAWK POTENTIAL HABITAT



Name: White tailed hawk  
 Latin name: *Buteo albicaudatus*  
 Habitat: The White tailed hawk is a scarce and local breeding resident. It nests mostly on candelabra cactus near escarpments or on bush-clad hills (Prins et al. 2009). Granzinoli and Motta-Junior (2007) studied the feeding ecology of the White-tailed Hawk, they found that its diet comprises rodents, birds, lizards, snakes and insects.

The map of potential habitat shows the areas in all of Bonaire, including the Klein Bonaire, except villages, water areas in the South Bonaire and main agriculture areas. This map is based on expert observations (A.O. Debrot, F. Simal, J.A. de Freitas and M. Flikweert).

Conservation Status				
Bonaire	CITES	IUCN	Bonn	SPAW
Protected*	-	Least concern	-	-

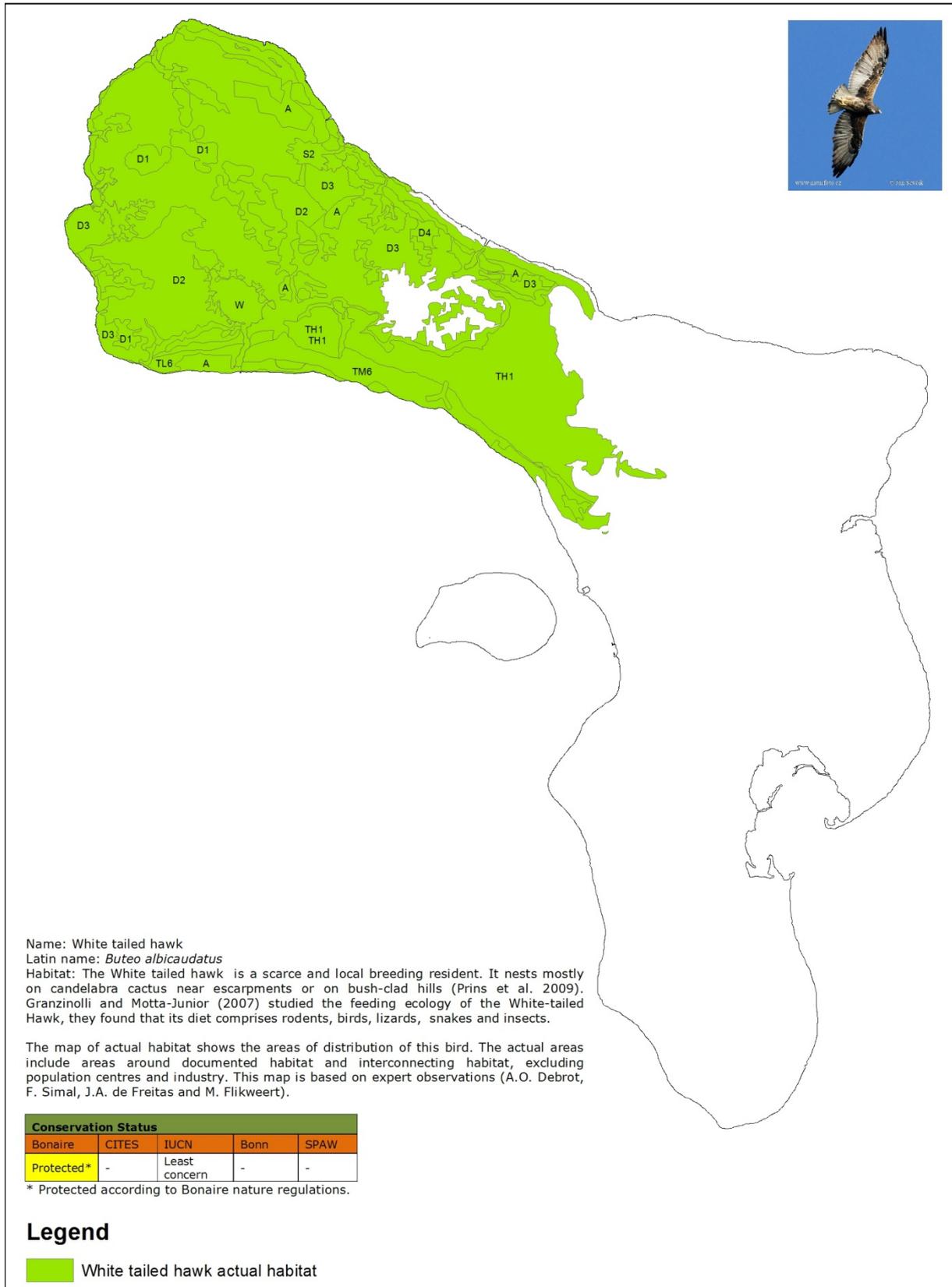
\* Protected according to Bonaire nature regulations.

## Legend

White tailed hawk potential



## WHITE TAILED HAWK ACTUAL HABITAT



Name: White tailed hawk

Latin name: *Buteo albicaudatus*

Habitat: The White tailed hawk is a scarce and local breeding resident. It nests mostly on candelabra cactus near escarpments or on bush-clad hills (Prins et al. 2009). Granzinoli and Motta-Junior (2007) studied the feeding ecology of the White-tailed Hawk, they found that its diet comprises rodents, birds, lizards, snakes and insects.

The map of actual habitat shows the areas of distribution of this bird. The actual areas include areas around documented habitat and interconnecting habitat, excluding population centres and industry. This map is based on expert observations (A.O. Debrot, F. Simal, J.A. de Freitas and M. Flikweert).

Conservation Status				
Bonaire	CITES	IUCN	Bonn	SPAW
Protected*	-	Least concern	-	-

\* Protected according to Bonaire nature regulations.

### Legend

White tailed hawk actual habitat