The marine mammals of the Dutch Caribbean: a comparison between EEZ sectors, contrasts and concerns

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ABSTRACT

We here provide a synoptic overview and preliminary update of the marine mammals of the Dutch Caribbean EEZ based on 279 cetacean sighting and stranding records. The Dutch Caribbean EEZ is composed of two distinct sectors. One is centered around the leeward Dutch islands of Aruba, Bonaire and Curaçao (71,000 km^2) while the other is centered around the windward Dutch islands of Saba, St. Eustatius and St. Maarten (22,000 km^2). The previous principal review (of cetaceans) dating from 1998, was based on only 70 records from the leeward sector and confirmed the occurrence of some 13 species for Dutch Kingdom waters. Now, with a 4-fold increase in number of records, 19 species can be documented for the Dutch Kingdom waters (18 species in the leeward sector and 8 species in the windward sector).

The windward sector stands out for its large number of humpback whale sightings (45% of records) and may form part of its former (or current) calving grounds. This species remains relatively rare in the leeward sector (5% of records) and continues to be targeted by aboriginal fishing in its destination wintering grounds to the east, where the relict breeding population is having difficulty to rebound. The species is of growing interest to tourism in the region and urgently needs full protection from all fishing in the southern Caribbean. The leeward EEZ sector further lies down-stream from seasonal upwelling areas off Venezuela that support the largest fishery of the Caribbean. This sector stands out for its high occurrence of beaked whales and the Bryde's whale. Marine mammal strandings are much more common here (26% of records) than in the northern sector (3% of records). Human induced mortalities (first suggested in 1974) and disturbance due to coastal tourism and recreation are key and growing concerns in the southern Dutch EEZ sector.

The marine mammal fauna of the Dutch Caribbean is evidently rich and varied but continues to suffer man-induced mortality and disturbance. Several nations, including the USA, the Dominican Republic and France, have recently established marine mammal sanctuaries in Caribbean waters. The Netherlands should consider doing the same.

KEYWORDS: CARIBBEAN, STRANDINGS, WHALE RECORDS, WHALE WATCHING, SHIP STRIKE, BYCATCH

INTRODUCTION

With the new constitutional changes that took place on 10 October, 2010, in the Dutch Kingdom, Saba, St. Eustatius and Bonaire have integrated into the Netherlands proper as special overseas municipalities, while Curaçao and St. Maarten have become new autonomous overseas entities within the Kingdom. The ultimate responsibility for the sustainable management and conservation of the marine biodiversity in the EEZ of Saba, St. Eustatius and Bonaire, as well as the territorial waters of these islands will come to lie with the Ministry Economic Affairs, Agriculture & Innovation of the Netherlands (EL&I). In preparation for this expanded responsibility, this ministry has been developing a management plan for the EEZ (Meesters *et al.* 2010).

The Dutch Caribbean Exclusive Economic Zone (EEZ) as established on June 10, 2010, falls principally in the pelagic zone of the Venezuela Basin, and concerns two discontinuous areas, separated by a minimum of some 550 km. One is based around the southern Caribbean island group of Aruba, Bonaire and Curaçao, and amounts to some 71,000 km^2 of sea surface (13°11'N 69°10'W). The other is based around the northeastern Caribbean islands of Saba, St. Eustatius and St. Maarten, and amounts to a total sea surface of some 22,000 km^2 (17°22'N 63°30'W) (Figure 1).

At least 33 native species of marine mammals have been documented from the Wider Caribbean Region (WCR): namely six species of baleen whales, 24 species of toothed whales, one sirenian (the West Indian manatee), and two pinnipeds (the extinct Caribbean monk seal, and the vagrant hooded seal) (Mignucci-Giannoni 1998, Ward and Moroscop 1999, Ward *et al.* 2001). Although some species have been studied extensively elsewhere, data

concerning the biology, life history, distribution and behaviour of most marine mammal populations in the Caribbean Sea remain sparse.

Since 1998 a few new studies have become available which provide additional information on the marine mammal fauna of the leeward Dutch waters (e.g. Debrot 2000, Debrot *et al.* 2006, Maldani 2008, Luksenburg 2011). However, most records remained uncompiled and unassessed. To answer to this need, in current studies commissioned by the Ministry of EL&I (Debrot *et al.* in review and Witte *et al.* in prep.) we have assembled and assessed both published and previously unpublished records of marine mammals for both sectors of the Dutch Caribbean waters. Here we present a synoptic overview of those findings.

We complied, documented and reviewed a large number of published and unpublished strandings, sightings by reliable observers identifying distinctive species, as well as sightings and strandings reported to us but not identified with certainty. In our assessment we also included voluminous documentation freely available in the public media of the islands, such as newspapers, websites and sightings published on Youtube. Most of this material was collected by amateurs and had to be thoroughly reassessed. We are aware of on-going directed studies in progress for Aruba and St. Maarten, but did not include them. Also, one large directed study documenting 135 records of bottlenose dolphin for Bonaire (Maldani 2008) was not included in this analysis of records.

RESULTS

Two-hundred-and-seventy-nine cetacean sighting and stranding records were compiled and assessed in this review. One hundred and eighty-seven (197) marine mammal records were compiled for the leeward Dutch Caribbean waters, comprising 96 previously published records and 101 new records (Witte *et al.* in prep.). Of these, 175 records could be confirmed to species level, while 22 remained unidentified. A total of 18 distinct extant species could be confirmed (Table 1). The most commonly recorded large whale belonged to the order *Balaenoptera* (mainly *B. edeni*) (21 records = 10%). Humpbacks were the second most common large whale and accounted for 9 records (5%). The most common dolphins were spinner and bottlenose dolphins (both at 19% of records).

Fifty-two of the 197 records (26%) concerned strandings. The principal species stranded were the deep-diving Gervais' beaked whale (9x), sperm whale (7x), and Cuvier's beaked whale (6x) and *Balaenoptera* spp. (6x) (incl. *B. edeni*). Since the year 2000 there have been 20 strandings, three of which concerned sperm whales entangled in fishing gear (total 4 animals) and one of which involved a lethal collision of a cruise ship with a Bryde's whale.

For the windward Dutch maritime sector, 82 marine mammal records were reviewed, comprising 8 previously published records and 74 new records (Debrot *et al.* in review). While 58 records could be confirmed to species level, 26 remain unidentified. Thirty-eight records (45%) concerned the humpback whale which was the most commonly identified species. A total of 8 distinct extant species were confirmed, one of which only to the family level (Table 1). Only three records (4%) involved strandings.

A combined total of 19 different marine mammals can now be documented for the Dutch Caribbean EEZ (including recent records of the manatee and an unidentified pinniped species). This represents an increase by 6 species over the 1998 review. While some 33 species of marine mammals are known from the Western Central Atlantic, 25 are known from the expansive neighbouring maritime areas of Venezuela (Romero *et al.* 2001). Three of the latter are principally limited to the freshwater and estuarine Amazon river basin and are unlikely to be encountered in the Dutch Caribbean.

DISCUSSION AND CONCLUSIONS

Faunal differences between the leeward and windward EEZ sectors

Based on our review, some basic faunal differences between the windward and leeward Dutch EEZ sectors appear eminent. Briefly, the most important contrasts appear to be a remarkably higher abundance of beaked whales and Bryde's whale around the leeward Dutch islands than around the windward Dutch islands, and a much higher abundance of humpback whales around the windward Dutch islands than around the leeward Dutch islands.

Confirmed sightings of beaked whales are very rare and most of our insight is derived from strandings. For the leeward Dutch EEZ, strandings by beaked whales (15x) account for almost a third of all strandings. Strandings by beaked whales in this area are high in both absolute and relative terms which may reflect a high abundance of beaked whales in the southern Caribbean. These deep diving species feed mostly on squids which could be an abundant food source, based on the seasonal wind driven upwelling of the southern Caribbean (Sturm 1991).

Others have already suggested that the Bryde's whale is principally a southern Caribbean species (e.g. Watkins *et al.* 1979; Notarbartolo di Sciara 1983; Romero *et al.* 2001), and our results corroborate that view. While the Bryde's whale is well known from the Leeward Dutch EEZ (Debrot *et al.* 1998, Witte *et al.* in prep.) and the southeastern Caribbean in general (e.g. Mignucci-Giannoni 1998, Romero *et al.* 2001), it appears much less common in the northeastern Caribbean. The rarity of the Bryde's whale in the northeastern Caribbean (Mignucci-Giannoni 1996) as opposed to several reliable sightings of the minke whale, *B. acutorostrata*, give cause to suspect that the most common rorqual whale for the windward Dutch Caribbean will be the minke whale. However, as yet no records of this species can be confirmed for the windward Dutch EEZ.

Finally the higher sighting frequency of humpback whales in the windward as opposed to the leeward Dutch EEZ is striking. In the windward Dutch EEZ 45% of all records concerned the humpback whale, as opposed to only 5% in the leeward sector. The humpback whale uses the Caribbean principally as a wintering and calving area and the populations of the northeastern Caribbean are evidently in much better shape than those of the southeastern Caribbean which formerly supported large populations of baleen whales (incl. humpback) (Romero *et al.* 2000, Romero and Hayford 2000) but have not recovered.

Based on several crossings from the leeward to the windward Dutch islands, Poppe (1974) further suggests that the southern part of the Venezuela Basin has higher densities of cetaceans than the northern half. This would correlate with the higher density and species richness of seabirds observed in the southern half of the Venezuela Basin (north of the ABC islands) (Poppe 1974) and might be expected based either on the higher productivity caused by the seasonal upwelling phenomenon of the southern Caribbean (Sturm 1991). This idea would need further corroboration based on committed quantitative survey effort before being confirmed.

Strandings and man-related cetacean mortalities and disturbance

The southern Caribbean Dutch EEZ sector also stands out for its much higher stranding incidence and higher frequency of man-caused mortalities. Whereas only three records in the windward Dutch EEZ have so far concerned strandings, in the leeward sector strandings accounted for 26% of all analysed records. There are many potential causes which may underlie or contribute to this large difference between the two sectors. For instance, even the contrasting difference in island size and general accessibility of the coastline between the windward and leeward Dutch islands could play a role. However the potentially more serious possibility may be a regional difference cetacean mortality rates, either due to natural or anthropogenic causes, such as the intensive and possibly still questionable fishery practices taking place in the southern Caribbean (Sturm 1991, Romero *et al.* 1997).

Debrot *et al.* (1998) pointed out an apparent increase in stranding incidences in the leeward Dutch EEZ after 1989, the causes whereof remained unknown. Since then, strandings (category includes all incidences of dead cetaceans) have continued to remain high (20 documented strandings since 2000). Van Bree and Kristensen (1974) were the first authors to suggest possible mortalities caused by man (Dutch naval operations) for the stranding of beaked whales in Bonaire. Debrot and Barros (1994) documented a head of *Stenella attenuata* obviously severed by man, but also point out that marine mammals are not taken or used as bait by fishermen in the Dutch Caribbean. This was in contrast to the situation at that time upstream in bordering Venezuela (Romero *et al.* 1997). Debrot (1998) documented ingestion of man-made materials by a beaked whale stranded in Curaçao. Evidence compiled indicate that in any case until recently, fishing-related mortality of marine mammals in Venezuela has been frequent and persistent, as well as an obviously sensitive matter leading to human rights violations and persecution of environmentalists (Agudo 1991, Romero *et al.* 1997, IAC 2000). Our documentation of numerous recent cases of man-related mortality (two cases involving sperm whales entangled in fishing gear adrift in Aruban waters) and a lethal ship strike to a juvenile Bryde's whale (near Bonaire), show that this issue remains a serious point of concern.

The last decade has further seen an explosive increase in touristic and recreational use of coastal zones of the leeward Dutch islands of Aruba, Bonaire and Curaçao. The concomitant massive growth in the number of fast pleasure and recreational vessels along the coast today, means that when cetaceans approach the coasts of these islands during daylight hours they are more easily detected and followed than ever before by the curious and interested public. Increasingly often, this generally well-intentioned and genuine interest in these unique animals takes place in an irresponsible way (Debrot, pers. observ.). Marine mammals are often followed closely and persistently for long distances whereby enthusiasts will swim with these animals and interact at close quarters. No guidelines have been established for human conduct around marine mammals. As public and touristic interest in these animals continues to grow, as well as both their detectability and vulnerability to disturbance (fast vessels), the need for protective measures and guidelines is urgent.

Economic significance

Marine mammals are spectacular species that are of growing significance to recreation and tourism throughout the region as well as in the Dutch Caribbean. Their economic value is no longer as a fisheries resource but in terms of recreational and touristic value as they provide visitors of the coastal zone with memories that last a life long. They even open possibilities for whale watching as a distinct product once a minimum dependable density of cetaceans is reached. Live cetaceans bring economic and ecosystem advantages to many island nations year after year. Therefore, they are certainly worth more to man alive than dead, but many in the eastern Caribbean apparently still do not appreciate this.

While whale watching in the Caribbean has grown in recent years to an important new 10+ million dollar a year industry, it continues to have additional potential. To achieve this, first adequate protection and recovery are needed. Such has been the case in Curaçao with sea turtles. Until the 1990's sea turtles were so rare that they were only sporadically seen. However, since their legal protection by the island government in 1996, numbers have rebounded to the extent that sea turtle sighting can today be offered as a major attraction in various areas of the island (e.g. Debrot *et al.* 2005). The same is the case in Bonaire and Aruba. Likewise, for the leeward Dutch islands to truly benefit from the potential of marine mammals, protection must come first.

The most spectacular species without question for sighting purposes is the humpback whale. The results of our study show that marine mammals, particularly the endangered and targeted humpback whale make notably regular and consistent use of the windward Dutch EEZ, but remain rare in the leeward sector. However, this species, along with others, continue to be hunted on artisanal scale in the eastern Caribbean. This activity is based in St. Vincent and the Grenadines which have a IWC regulated quota for 20 humpback whales for the period 2002-2007. While as of 2010, Dominica has decided to abandon its formerly pro-whaling stance, and choose to instead use marine mammals to bolster their tourism industry, five other eastern Caribbean nations continue to vote pro-whaling in the IWC. These are Antigua and Barbuda, Grenada, St. Kitts and Nevis, St. Lucia and St. Vincent and the Grenadines. As a consequence, the future of whaling remains contended and the protection of the severely depleted humpback stocks of the eastern Caribbean (Stevick *et al.* 1999, Swartz *et al.* 2003) remains critical. Therefore, the possibility for these islands to benefit economically from humpback whale watching also remains seriously curtailed. The islands that still have aboriginal whaling should consider whale watching as an economic alternative to hunting.

Marine Mammal Sanctuaries

To effectively protect whales, protection of their habitat is also essential. To this end, several nearby nations have already established marine mammal sanctuaries in Caribbean waters. These include the USA (adjoining waters of Puerto Rico and the U.S. Virgin Islands to the west of the windward Dutch EEZ) and the Dominican Republic, even further west. In September 2010, the French followed suit and declared the AGOA Marine Mammal Sanctuary for their Caribbean overseas waters. These sanctuaries are all clustered in the eastern Caribbean. The concepts of habitat size and connectivity are critical to conservation ecology and signify that purely on these criteria alone, the designation of the Dutch EEZ as a marine mammal sanctuary can help bolster these other related conservation initiatives and form a sound basis for cooperation. The present and potential future increased importance of the Dutch EEZ for cetaceans as well as their growing significance to recreation and the tourist industry, argues for the Netherlands to follow suit and declare the Dutch EEZ too as a marine mammal sanctuary.

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Figure 1. Map of the Caribbean showing the location of the two sectors of the Dutch Caribbean EEZ.

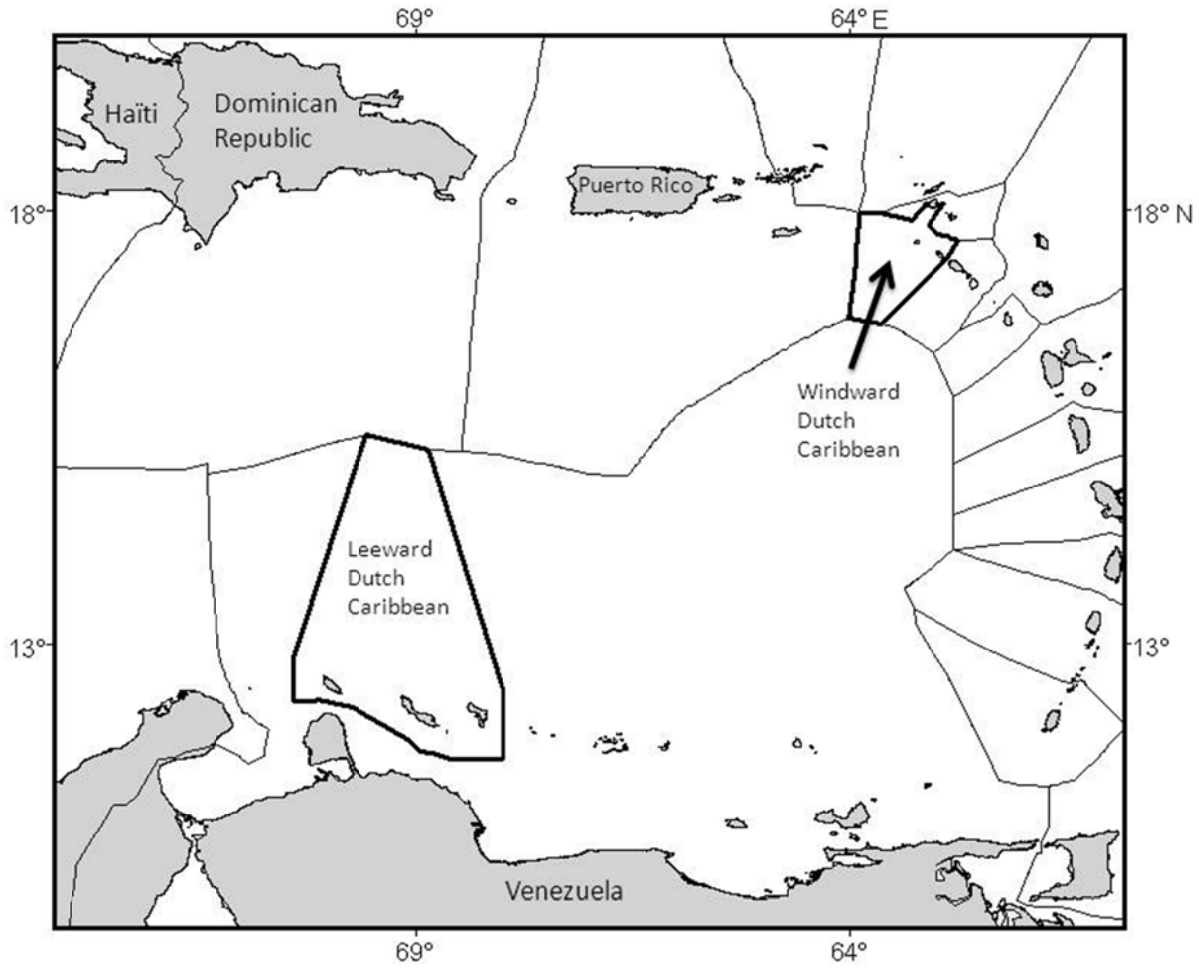


Table 1. Overview of extant marine mammal occurrences in the Dutch Caribbean as based on 279 incidental sighting records and strandings (from: Witte *et al.* in prep. and Debrot *et al.* in review).

Species	**Scientific name**	**WCR**	**CAR**	**SCAR**	**Ven.**	**Saba / Saba bank**	**St. Eustatius**	**St. Maarten**	**Aruba**	**Bonaire**	**Curac.**
North Atlantic Right	*Eubalaena glacialis*	**E**	**-**	**-**	**-**	-	-	-	-	-	-
Unidentified rorgual	*Balaenoptera species*	[-]	**[-]**	**[-]**	**[-]**	**[-]**	**[-]**	**[-]**	[s]	[-]	[-]
Blue Whale	*B. musculus*	**X**	**-**	**-**	**-**	-	-	-	-	-	-
Fin Whale	*B. physalus*	**X**	**X**	**X**	X	?	?	?	?	?	?
Sei Whale	*B. borealis*	**X**	**X**	**X**	X	?	?	?	?	?	?
Bryde's Whale	*B. edeni*	**X**	**X**	**X**	X	?	?	?	**?**	**S**	**V**
Common Minke whale	*B. acutorostrata*	**P**	**P**	**P**	-	-	-	-	-	-	-
Humpback Whale	*Megaptera novaeangliae*	**P**	**P**	**X**	X	**V**	**V**	V	?	V	V
Sperm Whale	*Physeter macrocephalus*	**P**	**P**	**P**	X	V	?	V	S	?	V
Pygmy Sperm Whale	*Kogia breviceps*	**P**	**P**	**P**	?	?	?	?	?	?	?
Dwarf Sperm Whale	*Kogia simus*	**P**	**P**	**P**	X	?	?	?	S	?	S
Cuvier's Beaked whale	*Ziphius cavirostris*	**P**	**P**	**P**	X	-	-	S	S	S	S
Blainville's Beaked	*Mesoplodon densirostris*	**P**	**P**	**P**	?	?	?	?	?	?	?
Sowerby's Beaked whale	*Mesoplodon bidens*	**E**	-	-	-	-	-	-	-	-	-
Gervais' Beaked whale	*Mesoplodon europaeus*	**P**	**P**	**P**	**?**	?	?	?	S	S	S
True's Beaked Whale	*Mesoplodon mirus*	?	-	-	-	-	-	-	-	-	-
Killer Whale	*Orcinus orca*	**P**	**P**	**X**	X	?	?	?	V	V	V
Long-finned Pilot	*Globicephala melas*	?	-	-	-	-	-	-	-	-	-
Short-finned Pilot whale	*G. macrorhynchus*	**P**	**P**	**P**	X	V	?	S	S	?	V
False Killer Whale	*Pseudorca crassidens*	**P**	**P**	**P**	X	?	?	?	V	?	-
Pygmy Killer Whale	*Feresa attenuata*	**P**	**P**	**P**	X	?	?	?	**?**	**?**	**?**
Melon Headed Whale	*Peponocephala electra*	**P**	**P**	**P**	X	?	?	?	?	S	S
Unidentified dolphin		**V**	**V**	**V**	V	V	V	V	V	V	V
Tucuxi	*Sotalia fluviatilis*	X	X	X	**P**	-	-	-	-	-	-
Guiana Dolphin	*Sotalia guianensis*	X	X	**P**	**P**	-	-	-	-	-	-
Rough Toothed dolphin	*Steno bredanensis*	**P**	**P**	**P**	X	?	?	?	**V**	**?**	**V**
Risso's Dolphin	*Grampus griseus*	**P**	**P**	**P**	X	?	?	?	S	?	?

Species	**Scientific name**	**WCR**	**CAR**	**SCAR**	**Ven.**	**Saba / Saba bank**	**St. Eustatius**	**St. Maarten**	**Aruba**	**Bonaire**	**Curac.**
Bottlenose Dolphin	*Tursiops truncatus*	**P**	**P**	**P**	X	V	V	V	**V**	**V**	**V**
Pantropical Spotted	*Stenella attenuata*	**P**	**P**	**P**	X	?	?	?	**V**	**V**	**S**
Atlantic Spotted Dolphin	*Stenella frontalis*	**P**	**P**	**P**	X	?	?	?	**V**	**?**	**?**
Spinner Dolphin	*Stenella longirostris*	**P**	**P**	**P**	X	?	V	V	**V**	**V**	**V**
Clymene Dolphin	*Stenella clymene*	**P**	**P**	**P**	X	?	?	?	**?**	**?**	**?**
Striped Dolphin	*Stenella coeruleoalba*	**P**	**P**	**P**	X	?	?	?	V	?	S
Short Beaked common	*Delphinus delphis*	?	-	-	-	-	-	-	-	-	-
Long Beaked common	*Delphinus capensis*	X	X	X	X	?	?	?	**?**	**?**	**?**
Fraser Dolphin	*Lagenodelphis hosei*	**P**	**P**	**P**	**?**	?	?	?	**?**	**?**	**?**
Boto	*Inia geoffrensis*	**-**	**-**	**-**	**P**	-	-	-	-	-	-
Antillean Manatee	*Trichechus manatus*	**P**	**P**	**P**	**P**	-	-	V	†	†	V
Hooded seal	*Cystophora cristata*	**E**	**E**	**-**	**-**	-	-	-	-	-	-
Unidentified Pinniped	*Pinnipedia sp.*	**X**	**X**	**X**	**-**	-	-	V	-	-	-
Californian Sea Lion	*Zalophus californianus*	**Int**	**Int**	**-**	**-**	-	-	?	-	-	-
Total native, extant:		33	30	29	25	4	3	8	14	9	15

WCR = Wider Caribbean Range, CAR = Caribbean, SCAR = southeaster Caribbean, Ven. = Venezuela, P= primary range; X = Secondary range; - = absent; ? = possibly present; † = extinct; S = stranded or found dead; V = (visual) sighted alive; bold = resident; Int. = Introduced/Escaped;. E = extralimital