

A threefold increase in documented cetacean diversity in the Windward Dutch Caribbean

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Abstract

Cetacean diversity in the Windward Dutch Caribbean remains poorly known, with only six species previously reported in its waters. By contrast, cetacean diversity is well documented in neighbouring islands, including Puerto Rico and the Virgin Islands, as well as in parts of the Lesser Antilles, where 23 species are known to occur. Based on 40 days of systematic boat-based surveys conducted over five years, supplemented by opportunistic sightings, we update the information of cetacean diversity within the Exclusive Economic Zones of Saba, St. Maarten, and St. Eustatius. Each record was individually reviewed, and first-time species reports were validated through photographic evidence or confirmation by researchers with recognized expertise. A total of 124 cetacean sightings were recorded, documenting 17 species in the Windward Dutch Caribbean. These findings demonstrate that this previously understudied area harbors a cetacean diversity comparable to that of neighboring Antillean islands and provide new insights into coastal cetacean distribution in the region. This

Keywords:

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work establishes a baseline for future research and conservation planning around these islands and across the broader Northern Lesser Antilles.

Introduction

In the Wider Caribbean region, a maximum of 34 cetacean species have been recorded to date (SPAW-RAC, 2021), representing approximately one-third of the world's cetacean diversity. In the Lesser Antilles, the presence of 23 cetacean species has been confirmed, mainly around Martinique, Dominica, and Guadeloupe (Laran et al., 2019). In this area, long-term monitoring programs have advanced our understanding of local populations. For example, research has provided insights into species diversity around Guadeloupe (Rinaldi & Rinaldi, 2011), population size estimates of sperm whales (*Physeter macrocephalus*) (Vachon et al., 2024), and residency patterns of pantropical spotted dolphins (*Stenella attenuata*) in Martinique and Guadeloupe (Courtin et al., 2023). Additionally, sighting reports from large-scale surveys have provided broader insights into cetacean diversity in the Lesser Antilles (Boisseau et al., 2006; Yoshida et al., 2010; Vachon et al., 2022). Despite this remarkable species richness, significant disparities remain in cetacean research across the region. These disparities are particularly evident in the northern Lesser Antilles, including the islands of St. Maarten, Saba, and St. Eustatius. These areas have either been unsurveyed during past large-scale surveys (Yoshida et al., 2010; Vachon et al., 2022) or lacked species-specific identifications (Boisseau et al., 2006). The most recent peer-reviewed study on cetacean diversity in the waters around Saba, St. Eustatius, and St. Maarten confirmed the presence of six cetacean species, within at least one of their respective Exclusive Economic Zones (EEZs) (Debrot et al., 2013). This includes the humpback whale (*Megaptera novaeangliae*), the short-finned pilot whale (*Globicephala macrorhynchus*), the sperm whale, the goose-beaked whale (*Ziphius cavirostris*), the spinner dolphin (*Stenella longirostris*) and the bottlenose dolphin (*Tursiops truncatus*) (Debrot et al., 2013). Since then, a few studies have attempted to assess cetacean diversity around these islands, relying on opportunistic reports from fishers

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(Scheidat et al., 2015) and surveys conducted during transits between Saba and the Saba Bank diving sites (Geelhoed & Verdaat, 2012). However, these efforts have not yielded significant new records to enhance our understanding of cetacean diversity in the Windward Dutch Caribbean. This reported cetacean diversity remains relatively low compared with neighboring regions such as Guadeloupe, Dominica, and Martinique, where 23 species have been documented (Laran et al., 2019), and with Puerto Rico and the Virgin Islands, which have records of 26 species (Mignucci-Giannoni et al., 1999). This difference, attributed to more extensive and long-term survey efforts in the latter regions, suggests that actual cetacean diversity in the Dutch Windward Islands is likely underestimated. Given that cetaceans can disperse over large distances, and considering the geographical proximity to these better-studied regions and the connectivity of marine habitats, the occurrence of additional species is expected (Debrot et al., 2013). Moreover, limited data availability constrains current knowledge of cetacean diversity in the region, and the low number of documented species likely reflects insufficient survey efforts rather than the true absence of species.

These three territories, collectively referred to as the Windward Dutch Caribbean islands, are all part of the Kingdom of the Netherlands. Notably, the EEZs of Saba and St. Eustatius are included in the Yarari marine mammal and shark sanctuary (Debrot et al., 2017). Based on new records and systematic cetacean surveys, this study aims to update and review cetacean diversity around the islands of the Windward Dutch Caribbean. This information is essential to support ongoing conservation and research efforts in the region and to better understand the distribution of cetacean species.

Methods

Study area

The study area is defined by the respective EEZs of Saba, St. Eustatius, and St. Maarten (Fig. 1), covering 9,487 km², 2,176 km², and 466 km², respectively. Their sizes are unequal, and given their proximity to one another, we report species presence at both the individual EEZ and combined EEZ scales for all three islands. Saba's EEZ exhibits the most diverse environmental conditions, characterized by a wider range of depths and slopes. It includes the shallow waters of the Saba Bank, a 2,000 km² underwater plateau with an average depth of 25 meters (Hoetjes & Carpenter, 2010). This area is represented here in QGIS using a 100 m isobath around the bank (Fig. 1). The topography of Saba's EEZ is both steeper and deeper than that of the other two islands, with depths increasing rapidly and exceeding 1,500 m around the Saba Bank (Fig. 1). St. Maarten and St. Eustatius, on the other hand, are characterized by shallow waters (< 100 m) close to the coast, with depths increasing slowly and progressively offshore to 500-1,000 m due to the lower bathymetric slopes compared with those of the Saba EEZ. Only a small portion of their EEZ extends beyond 1,000 m near the outer boundary.

Cetacean diversity

The baseline used to assess cetacean diversity in the Windward Dutch Caribbean is derived from the most recent peer-reviewed study on the topic by Debrot et al. (2013). Two additional, non-peer-reviewed reports by the same lead author (Debrot et al., 2011; 2017) were also considered. The 2011 report represents a preliminary, non-peer-reviewed version of the assessment that was later formalised and published in peer-reviewed form in 2013, while the 2017 report builds upon this published assessment. Although minor differences in species status were noted among

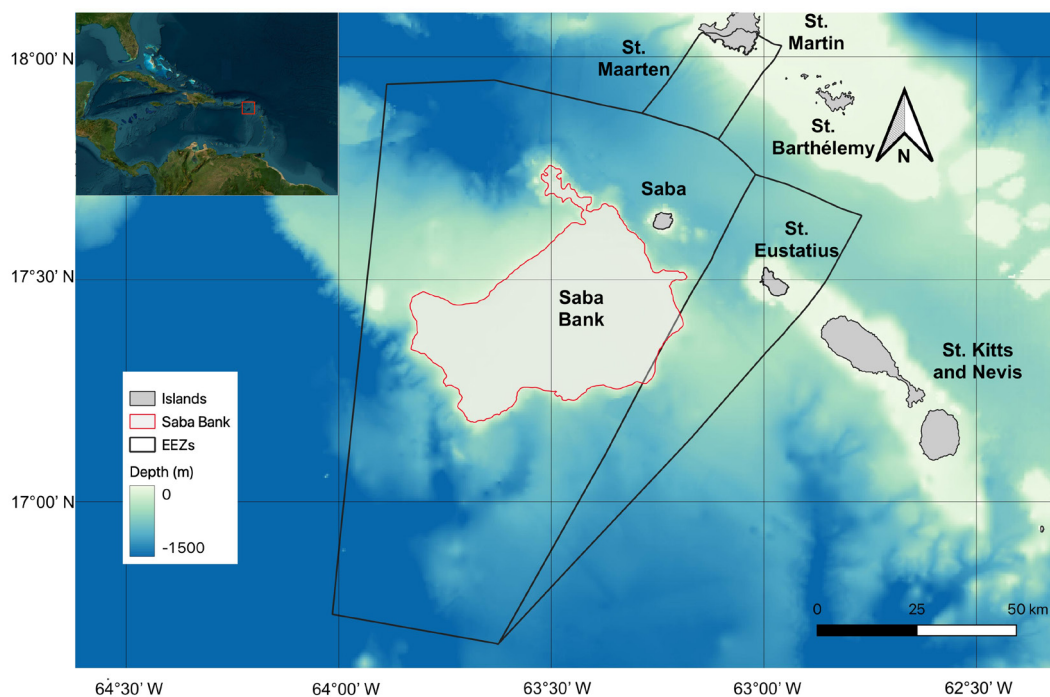


Figure 1. Study area within the Wider Caribbean region (red box) represented by the EEZs of Saba, St. Eustatius, and St. Maarten. The Saba Bank is delineated by the 100 m isobath line.

these documents, this progression supports the use of the 2013 publication as the primary baseline for the present study. In addition, it is important to note that although common minke whale (*Balaenoptera acutorostrata*) vocalizations were detected by a passive acoustic recorder deployed at the edge of the Saba Bank between February and April 2012 (Risch et al., 2014; Risch & de Haan, 2016), these calls can propagate over distances exceeding 30 km (Risch et al., 2014). Given the absence of visual sightings in the area, the species was excluded from this study. To update and expand upon this baseline, new records were compiled from publicly available sources (including online databases, peer-reviewed publications, and technical reports), from systematic cetacean monitoring surveys conducted by the Caribbean Cetacean Society (CCS) and Pelagis (Pelagis, 2021), and cetaceans report databases held by the Nature Foundation St. Maarten (NFSXM) and St. Eustatius National Park Foundation (STENAPA). Only visual records were considered in this study.

Survey records

Between 2021 and 2025 (March-August), we conducted ten research expeditions in the northern Lesser Antilles, spanning from Montserrat to Anguilla. During each expedition, one to three days of standardized cetacean surveys were carried out around each island in the Windward Dutch Caribbean. Surveys followed a consistent visual protocol across all expeditions. Two trained observers were positioned at the front of a 40-46 ft sailing catamaran, maintaining a cruise speed of approximately 5 knots, with eye levels between 3 and 5 meters above sea level, and continuously scanned for cetaceans, each covering a 0°-90° observation sector on their respective forward sides. Observers were rotated every two consecutive hours to maintain constant visual effort. Survey effort was maintained during daylight hours (06:00h-18h00h) and suspended during rain or when wind exceeded Beaufort 4 to avoid reduced detectability. Survey routes were planned each morning to ensure coverage of environmental gradients (depth, bathymetric slope, and distance from the coast), while maintaining favourable sighting conditions by navigating in areas sheltered from the wind when necessary, and considering constraints to reach a mooring each evening.

Once cetaceans were detected, all six rotating observers, together with the expedition leader, recorded information on species identification and its certainty level, visually estimated minimum and maximum group size, predominant behaviour, presence of juveniles, visually estimated radial detection distance (without the use of binoculars), and GPS coordinates. Photographs for species confirmation and individual photo-identification were taken whenever possible using two cameras equipped with lenses of 70–300 mm and 100–400 mm, respectively. Additionally, a 100-m towed hydrophone array was deployed continuously during on-effort periods to detect vocalizations, supporting both real-time detection of sperm whales and post-survey species identification of visual or missed encounters through acoustic analysis.

To update species diversity, all visual records with confirmed species identifications from these surveys were compiled. Additionally, acoustic recordings were analyzed using PAMguard (Gillespie, 2008) when beaked whales were sighted but species-level identification was not possible via visual means. Detectors were configured to target frequency ranges of 15–30 kHz and

30–50 kHz and detected beaked whale clicks were compared with descriptions available in the literature to aid in species identification (Johnson et al., 2006; Cholewiak et al., 2017).

Citizen science and opportunistic records

Between January and May 2011, the NFSXM launched a citizen science program to monitor cetaceans within the territorial waters of St. Maarten. Observation forms targeting actors at sea (both professionals and recreational users) were developed and distributed to dive centers, yacht charter companies, and marinas. Participants were asked to record the location, species observed, time of day, name of the observer, sea state, weather conditions, vessel characteristics and available pictures or videos for each cetacean encounter. Those records were considered along with cetacean opportunistic record databases held by STENAPA in St. Eustatius from 2013 to 2025 and CCS in the Lesser Antilles from 2021 to 2025. To ensure the reliability of any newly reported species in those waters, available photographs or videos were examined to allow for species-level identification by an expert and to validate the record. Potential information on species presence in the study area derived from social media was not examined in this study.

Public records

To complement the dataset used to establish the updated baseline, available reports, peer-reviewed publications, aerial systematic surveys led by Pelagis in 2017 (Pelagis, 2021), and the GBIF observation database (GBIF, 2025) were consulted, and publicly available cetacean records for the Windward Dutch Caribbean were extracted. Each record was carefully reviewed, and entries lacking species-level identification, as well as those already reported by Debrot et al. (2013), were excluded. Particular attention was given to identifying and removing duplicate records to avoid overcounting. After filtering, the datasets from each source were merged, eliminating repeated observations across sources. For any species newly recorded from the GBIF dataset, at the scale of the overall study area or within an individual EEZ, photographic evidence was requested to confirm species identification.

Results

A total of 124 additional cetacean sightings were compiled in the study area from multiple sources, including STENAPA opportunistic sightings database ($n = 59$), the NFSXM citizen science program ($n = 25$), GBIF records ($n = 18$), CCS surveys ($n = 16$), Pelagis aerial surveys ($n = 5$), and the CCS Lesser Antilles opportunistic sightings database, restricted to the study area ($n = 1$). Overall, 17 species were represented across the dataset and the most represented species were the humpback whale ($n = 73$), followed by the bottlenose dolphin ($n = 15$), and the spinner dolphin ($n = 12$). The remaining species were represented by one to five records.

Our survey cumulative effort in the EEZs of St. Maarten, Saba, and St. Eustatius totals 2,153 km navigated over 40 survey days across five years. A total of 290 hours of survey effort were conducted in the area, including seven hours during which

Table 1. Summary of cetacean species recorded within the Exclusive Economic Zones (EEZs) of St. Eustatius, Saba, and St. Maarten. Previously established baseline records are indicated with an x (Debrot et al., 2013), while newly documented records from this study are marked with an o. Species presence only confirmed through stranding events are denoted with a dagger (†). A dash (-) indicates that the species has not yet been recorded in the respective EEZ. An asterisk (*) indicates beaked whale sightings for which the species could only be determined through acoustic analysis following a visual detection. When available, the institution that contributed the observation to GBIF is cited as the source. The Caribbean Cetacean Society (CCS) and the Nature Foundation St. Maarten (NFSXM) are represented by their respective abbreviations.

Species	Latin name	St. Eustatius	Saba	St. Maarten	Source
Humpback whale	<i>Megaptera novaeangliae</i>	x	x	x	Debrot et al., 2013
Sperm whale	<i>Physeter macrocephalus</i>	-	x	x	Debrot et al., 2013
Bottlenose dolphin	<i>Tursiops truncatus</i>	x	x	x	Debrot et al., 2013
Spinner dolphin	<i>Stenella longirostris</i>	x	-	o	Debrot et al., 2013; NFSXM
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	o	x	x†	Debrot et al., 2013; Pelagis, 2021; CCS
Goose-beaked whale	<i>Ziphius cavirostris</i>	-	o	x†	Debrot et al., 2013; Pelagis, 2021
Gervais's beaked whale	<i>Mesoplodon europaeus</i>	-	o*	-	CCS
Atlantic spotted dolphin	<i>Stenella frontalis</i>	o	o	-	CCS
Pantropical spotted dolphin	<i>Stenella attenuata</i>	o	o	-	CCS; Saba Conservation Foundation (GBIF, 2025)
Striped dolphin	<i>Stenella coeruleoalba</i>	-	o	-	CCS
Fraser's dolphin	<i>Lagenodelphis hosei</i>	-	o	-	Bernier et al., 2025; CCS
Rough-toothed dolphin	<i>Steno bredanensis</i>	o	-	-	CCS
False killer whale	<i>Pseudorca crassidens</i>	-	o	-	Saba Conservation Foundation (GBIF, 2025)
Pygmy killer whale	<i>Feresa attenuata</i>	o	o	-	CCS
Killer whale	<i>Orcinus orca</i>	-	o	o	Bolaños-Jiménez et al., 2023; CCS; GBIF 2025
Risso's dolphin	<i>Grampus griseus</i>	-	o	-	Pelagis, 2021

cetaceans were present. The survey effort was not spatially homogeneous and did not extend to the southern edge of the study area (Fig. 2). This effort yielded 16 confirmed cetaceans' sightings, representing 11 different species (Fig. 2, Table 1). Eight of these species were documented in the area for the first time: pantropical spotted dolphin, Atlantic spotted dolphin (*Stenella frontalis*), striped dolphin (*Stenella coeruleoalba*), pygmy killer whale (*Feresa attenuata*), rough-toothed dolphin (*Steno bredanensis*), Fraser's dolphin (*Lagenodelphis hosei*), dwarf sperm whale (*Kogia sima*), and Gervais' beaked whale (*Mesoplodon europaeus*). The arguable presence of Gervais' beaked whale was initially sighted visually, but species identification remained uncertain until it was confirmed through the acoustic analysis described above. On the other hand, 12 of the 16 sightings represented the first recorded occurrence of a species around the specific island where they were detected (Table 1). The overall cetacean group encounter rate for the region was 7.4 encounters per 1,000 km surveyed. On the other hand the Pelagis aerial surveys resulted in the first report of Risso's dolphin (*Grampus griseus*) and the first live sighting of a goose-beaked whale in the area (Fig. 2). Overall, systematic surveys (CCS and Pelagis) were the most important source of additional information regarding species diversity in this study while only representing 17% of cetacean sightings gathered during this study. This pattern is likely a consequence of the standardized protocols employed and the wide range of habitats surveyed.

The STENAPA, NFSXM citizen science, GBIF and CCS opportunistic sightings and datasets provided 103 additional cetacean records within the study area. Unlike the systematic surveys, the compiled opportunistic records over-represent previously known coastal and shallow-water species, particularly humpback whales ($n = 73$), bottlenose dolphins ($n = 12$), and spinner dolphins ($n = 13$). Nevertheless, these records provided the first evidence of false killer whales (*Pseudorca crassidens*) in the region and the first records of spinner dolphins around St. Maarten. Killer whale (*Orcinus orca*) presence was also confirmed in the waters of Saba and St. Maarten. These two public records were also considered by Bolaños-Jiménez et al. (2023). However, the exact island locations were not provided, so the authors were contacted to confirm that the records used in our study corresponded to the same public observations.

By combining survey data with publicly available records, 14 species were for the first time reported in at least one of the three EEZs and a total of 11 cetacean species were newly reported in the region (Table 1). When added to the six species previously documented, the confirmed cetacean diversity for the EEZs of St. Maarten, Saba, and St. Eustatius now stands at 17 species. The presence status of each documented species is summarized in Table 1.

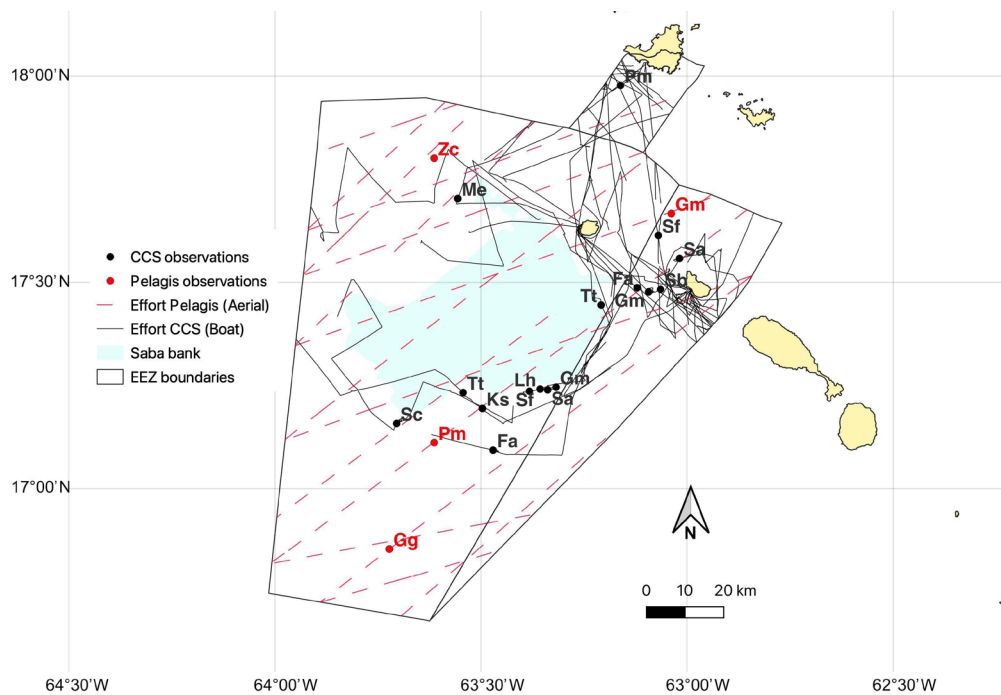


Figure 2. Cetacean visual observations and survey effort recorded during this study (2021-2025; black) and Pelagis (2017; red) systematic surveys conducted within the EEZs of Saba, St. Eustatius, and St. Maarten. The observed species were *Feresa attenuata* (Fa), *Globicephala macrorhynchus* (Gm), *Grampus griseus* (Gg), *Kogia sima* (Ks), *Lagenodelphis hosei* (Lh), *Mesoplodon europaeus* (Me), *Physeter macrocephalus* (Pm), *Stenella attenuata* (Sa), *Steno bredanensis* (Sb), *Stenella coeruleoalba* (Sc), *Stenella frontalis* (Sf), *Tursiops truncatus* (Tt) and *Ziphius cavirostris* (Zc).

Discussion

Diversity overview

Originally estimated at up to six species (Debrot et al., 2013), the baseline for cetacean diversity in the Windward Dutch Caribbean now stands at 17 species. All species documented in our study area have also been recorded in neighbouring regions of the Lesser Antilles, as well as in Puerto Rico and the Virgin Islands, further supporting a similar structuring of local cetacean assemblages (Mignucci-Giannoni et al., 1999; Gero & Whitehead, 2006; Rinaldi et al., 2006; Laran et al., 2019). In comparison, the reported richness in the Windward Dutch Caribbean appears lower than in other parts of the Wider Caribbean Region, where 31 oceanic species have been described (SPAW-RAC, 2021), including 26 confirmed by live sightings in the Gulf of Mexico (Würsig, 2017), 21 in the south-eastern Caribbean (Boer, 2015), 23 in the Lesser Antilles (Gero & Whitehead, 2006; Rinaldi et al., 2006; Laran et al., 2019), and 26 in Puerto Rico and the Virgin Islands, of which at least nine species are known only from stranding events (Mignucci-Giannoni et al., 1999). These differences may reflect a combination of factors, including the relatively small spatial extent of the study area, limited survey effort, and contrasting oceanographic features, particularly when compared with the southern Caribbean, where wind-driven upwelling strongly enhances productivity (Rueda-Roa & Muller-Karger, 2013). However, such comparisons must be interpreted cautiously, particularly when species records are based exclusively on strandings or extralimital sightings of wide-ranging species, which may not reflect true local presence. In our study, each documented species is supported by at least one confirmed live visual observation. Considering this confirmed diversity and the parameters described above, the cetacean

assemblage in the Windward Dutch Caribbean appears broadly comparable in richness and composition to those reported in other regions of the Wider Caribbean (Mignucci-Giannoni et al., 1999; Boer, 2015; Würsig, 2017; Laran et al., 2019). Interestingly, no single species emerged as clearly predominant in the area based on the systematic survey results (Fig. 2). This is likely due to the limited number of sightings, which were insufficient to reveal definitive patterns. Importantly, most of the newly documented species were detected through these dedicated at-sea surveys, underscoring the critical role of systematic survey efforts in improving our understanding of cetacean composition in the region.

Recorded cetaceans' species

Commonly reported species

Humpback whales, sperm whales, bottlenose dolphins, and short-finned pilot whales have all been previously reported in the region (Debrot et al., 2013) and are commonly observed around neighboring islands (Mignucci-Giannoni, 1998; Rinaldi et al., 2006). Those four species were reported around Saba during a monitoring program based on fishers' reports (Scheidat et al., 2015). They were the only species successfully identified, suggesting that these species may be easier to recognize or more accessible than others. Consequently, cetacean reports in the Dutch islands may have been historically biased toward these more easily identifiable species. This pattern is also reflected in records originating from citizen-science and other opportunistic reports from this study, which similarly show an over-representation of humpback whales. Although humpback whales were not visually observed during the surveys, likely because the expeditions took place at the end or after the

North Atlantic breeding season, the presence of singing males was acoustically detected, confirming their continued seasonal use of the area. Passive acoustic monitoring on the Saba Bank recorded extensive singing activity from December to late April 2012 (Risch & de Haan, 2016), which likely reflects the species' presence in the area throughout the breeding season. Bottlenose dolphins were reported as the most frequently observed dolphin species in the Windward Dutch Caribbean (Debrot et al., 2013). However, in the absence of systematic surveys, this pattern may reflect a detection bias, since this species typically inhabits coastal waters and is therefore more likely to be observed near shore (Wells & Scott, 1999). Both coastal and offshore ecotypes are likely to occur in the study area as documented in several regions globally including Guadeloupe (Haderlé et al., 2025). Sperm whales, on the other hand, favor deeper offshore waters and have been the focus of long-term studies in the neighboring waters of Dominica (Gero et al., 2014; 2016). These studies have identified up to three vocal clans using the Lesser Antilles, each with distinct habitat use and social behaviors (Vachon et al., 2022). While the presence of sperm whales in the Windward Dutch Caribbean is regularly reported, no information on vocal clan composition has yet been published. Acoustic monitoring would help identify which vocal clans are present, offering insights that go beyond species-level identification. In contrast, little is known about the ecology of short-finned pilot whales in the region, aside from a recent photo-identification study in Martinique and Guadeloupe, which revealed a range of residency patterns, from transient groups to individuals exhibiting site fidelity (Riou et al., 2024), reflecting the range of possibilities for the species use of the windward Dutch islands.

***Stenella* genus**

Spinner dolphins have been recorded on several occasions around St. Eustatius (Debrot et al., 2013) and were previously reported as commonly observed from Puerto Rico to the Virgin Islands (Mignucci-Giannoni, 1998). Additionally, they were sighted three times during NFSXM surveys between March and April 2011 near St. Maarten, marking the first documented presence of the species within that EEZ. Surprisingly, no sightings were recorded during our recent surveys in the Windward Dutch Caribbean, suggesting that the species may be less common than previously thought or that its presence in the area is temporally variable or seasonal. Reports of spinner dolphins are similarly inconsistent across the other islands of the Lesser Antilles. They are uncommon around Guadeloupe and Dominica (Gero & Whitehead, 2006; Rinaldi et al., 2006) whereas in Saint Vincent, they have been commonly reported as harvested alongside short-finned pilot whales, pantropical spotted dolphins, and Fraser's dolphins (Fielding & Kiszka, 2021). However, data from GBIF and STENAPA confirm multiple occurrences near St. Eustatius between 2011 and 2022. Three other species of the genus *Stenella* were documented for the first time in the study area. Both Atlantic and pantropical spotted dolphins are common in neighboring islands (Mignucci-Giannoni, 1998; Rinaldi et al., 2006) and were therefore expected in the study area. However, the Dutch windward islands may represent a biogeographical boundary for these two species. Atlantic spotted dolphins are rarely observed south of this zone, where pantropical spotted dolphins become

more frequent (Boisseau et al., 2006; Gero & Whitehead, 2006; Rinaldi et al., 2006; Yoshida et al., 2010). Conversely, from Puerto Rico to Anguilla, Atlantic spotted dolphins are more commonly reported (Mignucci-Giannoni, 1998; Roden & Mullin, 2000). The Windward Dutch Caribbean may thus represent an overlap zone in the distribution of these species, potentially marking a transition in their regional relative predominance. In contrast, the presence of the striped dolphin was more unexpected and is now confirmed from a single sighting. Occasional records from Guadeloupe and Dominica (Rinaldi et al., 2006; Gero & Whitehead, 2006), as well as a historical skull from St. Croix (Mignucci-Giannoni, 1998), indicate that the species is rare in the region, though its sporadic occurrence in the Windward Dutch Caribbean is now confirmed.

Fraser's dolphin and killer whales

Fraser's dolphin presence in the area was previously undocumented until an observation made during our surveys as reported by Bernier et al. (2025). This recent study, focused on the species, suggested the existence of a population spatially restricted to the Lesser Antilles, where individuals move between islands. Given their frequent sightings throughout the Lesser Antilles (Gero & Whitehead, 2006; Rinaldi et al., 2006; Bernier et al., 2025), their presence in the Dutch islands was anticipated. The lack of records from the Virgin Islands and Puerto Rico (Mignucci-Giannoni, 1998), aside from a single stranding in Puerto Rico (Mignucci-Giannoni et al., 1999), suggests that the Windward Dutch Caribbean may represent the northern limit of their core distribution in the Lesser Antilles (Bernier et al., 2025). The distribution of Caribbean killer whales was also recently reviewed (Bolaños-Jiménez et al., 2023). Their presence around Saba and St. Maarten aligns with the species' widespread but low-density distribution throughout the Caribbean (Bolaños-Jiménez et al., 2023). Recent findings suggest that, in this region, killer whales primarily prey on other cetaceans (Kiszka et al., 2021), underscoring their role as apex predators within the local marine ecosystem.

Kogiidae and Ziphiidae

Dwarf sperm whales and beaked whales are difficult to detect due to their elusive surfacing behavior and the large proportion of time they spend underwater (Schorr et al., 2014; Hodge et al., 2018). During our surveys, a calm sea state (Beaufort 1) allowed the observation of a dwarf sperm whale near the Saba Bank. Known hotspots in the Antilles include Saint Vincent, Guadeloupe (Rinaldi et al., 2006), and the Bahamas (Dunphy-Daly et al., 2008; Kiszka et al., 2024). While distinguishing dwarf from pygmy sperm whales (*Kogia breviceps*) remains challenging, studies suggest both species may overlap in the Antilles (Cardona-Maldonado & Mignucci-Giannoni, 1999; Dunphy-Daly et al., 2008). However, dwarf sperm whales are generally more common in tropical waters (McAlpine, 2018), and appear predominant in places like the Bahamas and Saint Vincent, where pygmy sperm whales are rarely or not reported (Dunphy-Daly et al., 2008; Kiszka et al., 2024). Beaked whale species are notoriously difficult to identify, including Gervais's and goose-beaked whales. Both species are commonly reported throughout the Wider Caribbean Region, and their live presence is now confirmed in the deep waters surrounding the Saba Bank (Mignucci-Giannoni, 1998; Gero & Whitehead, 2006; Boer, 2015; Würsig, 2017).

Globicephalinae

Other species with newly confirmed presence in the study area appear to be relatively rare and poorly documented in the surrounding islands. Risso's dolphins have only been reported twice in the U.S. Virgin Islands (Mignucci-Giannoni, 1998) and once in Guadeloupe (Yoshida et al., 2010), despite seven years of long-term monitoring in Guadeloupe failing to record any sightings of the species (Rinaldi et al., 2006). Notably, the observation reported in the present study occurred offshore at the southern edge of the Saba EEZ, an area with limited prior survey effort. False killer whales and pygmy killer whales are commonly reported around Guadeloupe (Rinaldi et al., 2006), whereas in the U.S. Virgin Islands, only one observation of false killer whales has been documented and pygmy killer whales were only reported stranded once (Mignucci-Giannoni, 1998; Mignucci-Giannoni et al., 1999). Rough-toothed dolphins have been reported sporadically in waters both south and west of the study area (Mignucci-Giannoni, 1998; Rinaldi et al., 2006), suggesting occasional regional occurrence. While the presence of these species in the Windward Dutch Caribbean is now confirmed, their frequency of occurrence remains unknown. Additional effort, particularly through systematic surveys, is needed to better understand their occurrence in the region.

Impact on future research and management

This updated baseline of cetacean diversity in the Windward Dutch Caribbean provides essential groundwork for future research and conservation planning by documenting current species occurrence, improving regional species inventories, and identifying remaining spatial and temporal knowledge gaps. It also addresses a key spatial gap in cetacean diversity and distribution data, bridging previously disconnected knowledge between the Greater Antilles (Mignucci-Giannoni, 1998) and the Lesser Antilles (Gero & Whitehead, 2006; Rinaldi et al., 2006). These findings underscore the importance of continuous and standardized monitoring, and they lay the foundation for further investigations into regional population connectivity, residency patterns, distribution, and exposure to anthropogenic threats. Future research efforts should include standardized monitoring conducted across multiple seasons and along a representative gradient of oceanographic conditions and habitat types. Such research will be critical to advancing the understanding and protection of cetacean communities within the Yarari Marine Mammal and Shark Sanctuary (Debrot et al., 2017), the Windward Dutch Caribbean, and adjacent territories of the Eastern Caribbean. Given the high mobility of cetaceans, and to promote harmonized ocean governance in the region, we recommend extending the Yarari Marine Mammal and Shark Sanctuary to include the waters of St. Maarten, thereby ensuring continuity of protection across territories.

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