

# Biodiversity of the Saba Bank supports status of Particularly Sensitive Sea Area (PSSA)

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# Summary

This report contains a study regarding the biodiversity of the Saba Bank, one of the three largest atolls in the world. All scientific and anecdotic evidence suggests that the area is a hot spot of biodiversity and one of the few areas in the Caribbean that is still in a relatively pristine condition. The atoll is likely also important as a source of larvae for other areas in the region because of its enormous dimensions and diverse habitats. Major damage however may already be inflicted by the anchoring of large oil tankers. More scientific research is necessary with regards to the damage inflicted by anchoring and to the sustainability of current fishing practices, but to date there is already sufficient data to call for strong protection of the Saba Bank as soon as possible.

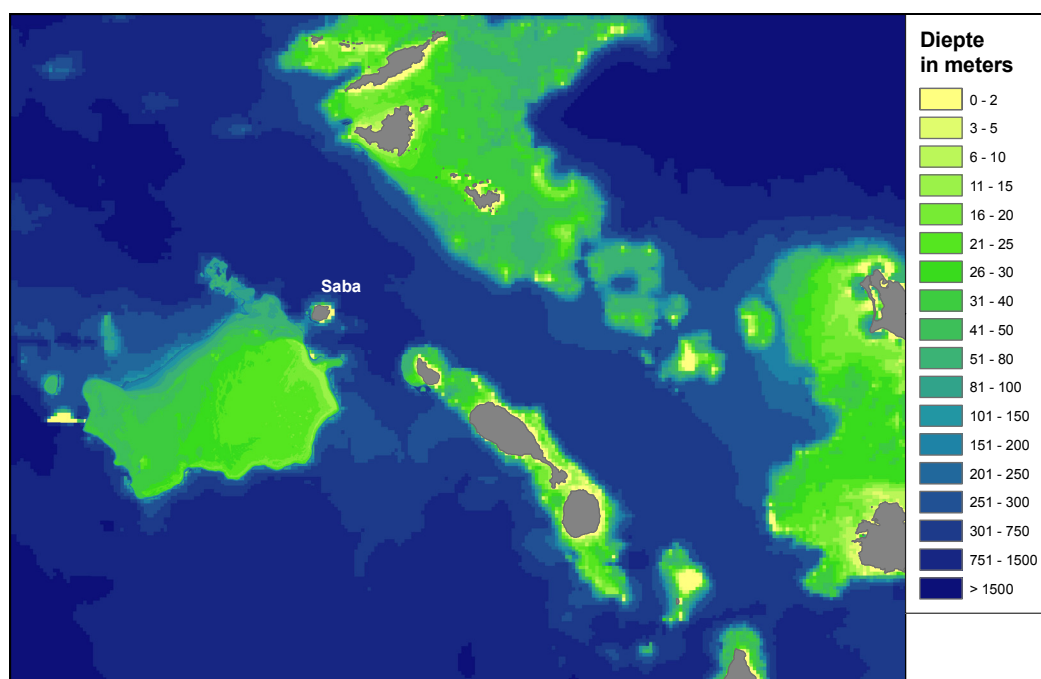
Therefore, an application to the International Maritime Organization (IMO) to designate the Saba Bank as a Particularly Sensitive Sea Area (PSSA) in order to prevent possibly irreversible damage to the ecosystem and to enable sustainable protection of it's vulnerable resources seems crucial and urgent.

This research is performed within 'Beleidsondersteunend Onderzoek' (BO-11), cluster NLP of LNV-programs.



# 1 Introduction

The Saba Bank (17°25' N, 63°30' W) is an undersea elevation with a flattened top, a bank, 3 - 5 km Southwest of the island of Saba and 25 km west of St. Eustatius (Figure 1). It is raised about 1000m above the general depths of the surrounding sea floor and its shape is approximately square or slightly elliptical, the long axis trending ENE-WSW. With a length of 60 to 65 km and a width of 30 to 40 km, the total surface area is approximately 2200 km<sup>2</sup> (measured to the 200 m isobath). The platform is somewhat tilted with the north-western part of the surface being deeper than the south-eastern part. The largest part of the bank is between 20 and 50 m depth, but a substantial eastern part (app. 225 km<sup>2</sup>) is between 10 and 20 m depth. On its western rim depths are around 50 m, while on the eastern and south-eastern edges, where a prominent coral ridge system (55 km long) runs along the platform, depths vary between 7 and 15 m (Van der Land 1974, MacIntyre et al. 1975). Saba Bank is a classic subsurface atoll consisting of a submerged mountain with a margin or ring of actively growing coral reefs. As such it constitutes the largest atoll in the Atlantic Ocean Basin and one of the three largest atolls on earth.



**Figure 1. Bathymetric chart of the Saba Bank.**

The Saba Bank has been studied a number of times for different reasons. In 1977 and 1982 the Bank was explored for oil but no commercially interesting amounts were found. Attention was drawn to the biodiversity of the Bank in relation to other areas in the Caribbean by Van der Land (1977) and Meesters et al. (1996). The

Netherlands Antilles clearly saw the need for more research concerning the nature values of the Saba Bank. Meesters et al. (1996) already mentioned the damage that anchoring of large oil tankers was inflicting on the reefs and since then anchoring, sometimes for weeks, has continued. Since 1996 the Saba Bank has been studied a number of times through projects that focused on the biodiversity of the Bank. This culminated into the drafting of a proposal to designate the Saba Bank the status of a Particularly Sensitive Sea Area (PSSA). This is a status that can be assigned to an marine area by the International Maritime Organization (IMO) which allows countries strict regulations concerning shipping lanes and anchoring.

The Ministry of LNV asked IMARES to evaluate this proposal with special attention to the biodiversity of the area. For this purpose all existing reports, scientific articles, and recently submitted manuscripts dealing with the biodiversity of the Bank have been used.



## 2 Evaluation

Much of the available data on the Saba Bank has not appeared in peer-reviewed journals. However, this does not mean that the reports that are available do not support the unique position of the Saba Bank in terms of geomorphology and biodiversity. The Bank is relatively isolated from land-based influences and intensive fisheries. Therefore, disruption of the ecosystem by common sources of reef degradation such as eutrophication, sediment runoff and overfishing may be small or even absent. Damage caused by other agents such as temperature increases as a consequence of climate change, diseases, the sea urchin (*Diadema antillarum*) die-off in 1983, hurricanes, and the introduction of invasive species such as the lion fish (*Pterois volitans/miles*) most probably occurred as well on the Saba Bank. There is growing scientific support that resilience of coral reef ecosystems to these region-wide disturbances may be better in areas that are relatively free from anthropogenic pressures (Mumby et al. 2007, Smith et al. 2008, Carilli et al. 2009). The biggest direct threat to the Saba Bank ecosystem today is probably the anchoring of large tankers and cargo vessels. Their anchors and heavy chains may flatten large extensions of reef area that may require decades or longer to regenerate. When considering that some ships may be anchoring for weeks (anchor lines destroy everything when lying on and scouring the bottom), the accumulated damage to all living bottom components could be enormous, potentially disrupting the ecosystem.

At present the Saba Bank is increasingly being investigated by the scientific community and Hoetjes and Carpenter (2010) present an overview of biodiversity research that has taken place on the Bank. Below a summary is given with respect to the different taxa that are present on the Saba Bank (Table 1). Research to date has been mainly focused on species diversity and little is known about the functioning of the Bank. In the future ecological processes should also be studied in order to better understand and protect the Bank effectively. Below in Table 1 the different species groups (in alphabetic order) are shortly discussed. The total number of species that were found in the references in Table 1 represent a sample of what is present and is limited by sampling effort. Generally, the higher the effort the more species will be found, although this increase will gradually level off.

**Table 1. An overview of the results of a literature survey with respect to the diversity of the Saba Bank including reports and peer-reviewed articles.**

<b>Taxonomic group</b>	<b>Author</b>	<b>Number of different species found</b>	<b>Remark</b>
Fish	(McKenna 2006)	200	Possibly 2 new species
Fish	(Toller et al. 2010)	97	High abundance of predatory fish indicate healthy system in contrast to other areas in the Caribbean
Fish	(Williams et al. 2010)	270	Expected number of species between 320 and 411.
Hard corals	(Meesters et al. 1996)	28	
Hard corals	(McKenna 2006)	40	
Mammals	(McKenna 2006)	One female humpback whale, <i>Megaptera novaeangliae</i> with a calf	
Mammals	(Lundvall 2008)	Humpback Whales ( <i>Megaptera novaeangliae</i> ), Sperm Whales ( <i>Physeter macrocephalus</i> ), Spinner Dolphins ( <i>Stenella longirostris</i> ), Bottlenose Dolphins ( <i>Tursiops truncatus</i> ).	
Marine macro algae	(McKenna 2006, Littler et al. 2010)	Around 200 species found.	Diversity is extremely high. Possibly 12 new species. All species can be viewed at <a href="http://sweetgum.nybg.org/saba/algae.html">http://sweetgum.nybg.org/saba/algae.html</a>
Sea birds	(Lundvall 2008)	Frigate Birds ( <i>Fregata magnificens</i> ), Red Billed Tropicbirds ( <i>Phaethon aethereus</i> ), Brown Pelicans ( <i>Pelecanus occidentalis</i> ), Audubon's Shearwater ( <i>Puffinus lherminieri</i> )	
Sea turtles	(Lundvall 2008)	Green Turtles ( <i>Chelonia mydas</i> ) Leatherbacks ( <i>Dermochelys coriacea</i> ), and Loggerheads ( <i>Caretta caretta</i> ) have been observed	
Sharks	(McKenna 2006)	1 nurse shark	
Soft corals	(McKenna 2006)	20	
Soft corals	(Etnoyer 2007, Etnoyer et al. 2010)	47	Exceptionally high diversity. Two new species
Sponges	(McKenna 2006, Thacker et al. 2010)	45-50 new and 39 from previous expeditions, totaling 84 species.	Probably only 45-82% of all species.
Sponges	(Thacker et al. 2010)	84	Underestimation and new species are expected

**Sea birds.** Postma and Nijkamp (1996) found that seabird densities on the Saba Bank averaged two times higher than off the Bank. On the Saba Bank most seabirds appear to be concentrated around the 200 m isobath. The most common species recorded (April-May) were Red-billed Tropicbird, *Phaeton aethereus*, Magnificent Frigatebird, *Fregata magnificens*, Sooty Tern, *Sterna fuscata*, and Bridled Tern, *S. anaethetus*. Other species were Pomerine Skua, *Stercorarius pomarinus*, and Wilson's Storm Petrel, *Oceanites oceanites*. In the pelagic areas adjacent to the bank, the Brown Noddy, *Anous stolidus*, and Audubon's Shearwater, *Puffinus lherminieri*, were most common.

**Hard corals.** Coral reefs are present along the east and southeast edges of the Bank and are rich in terms of cover and diversity of reef-building corals. The stony corals form the habitats (fore reef, back reef, lagoon) that other species groups use. Individual coral colonies can be found over the whole Bank. The coral reef area is quite broad, up to a kilometer in width, which means that the total reef area of the Bank is very large and may well constitute the largest coral reef area within the Dutch Caribbean.

**Fish.** Some habitat types such as mangroves and sea grass bed are not present on the Saba Bank. Therefore fish species that occur solely in these habitats are absent from the Bank. Despite this, the Bank still is high in diversity of fish and ranks as the 8<sup>th</sup> highest diversity in the Greater Caribbean (Williams et al 2010).

**Mammals.** Mammals have been sighted already many times (Hoetjes and Carpenter 2010), but little effort has been made to carry out bias-free surveys from which population densities can be calculated. It is likely that a shallow area as large as the Saba Bank plays an important role in a mostly much deeper region.

**Marine macro algae.** Littler et al. (2010) remark "Prior to this survey, the two most diverse areas for algae reported in the Caribbean had been Diamond Rock, Martinique and Pelican Cays, Belize, a mangrove, sea grass, and coral complex. Habitats on Saba Bank have far exceeded both of these places for species diversity. A major reason for this uniqueness and richness is the sheer size and habitat range of the seamount/atoll.". Thus, the Saba Bank appears exceptionally rich in diversity of marine macro algae.

**Sea turtles.** The enormous diversity and abundance of marine algae and sponges means that there is ample food for these animals. Therefore it is assumed that the area is important as a feeding area for turtles. There have been several confirmed sightings of Hawksbills (*Eretmochelys imbricata*) during a survey in 2007. Leatherbacks (*Dermochelys coriacea*), and Loggerheads (*Caretta caretta*) have also been seen on the Bank (Lundvall 2008)

**Sharks.** Sharks appear to be reasonably common on the bank (Lundvall 2008). Species that have been found during a dedicated survey in 2010 (Williams et al. 2010) are nurse shark (*Ginglymostoma cirratum*), cuban dogfish (*Squalus cubensis*), reef shark (*Carcharhinus perezi*), tiger shark (*Galeocerdo cuvier*), and lined lantern shark (*Etmopterus bullisi*).

**Soft corals.** The species diversity of soft corals appears to be exceptionally high (Etnoyer 2007, Etnoyer et al. 2010) and already two new species have been found. Soft corals may benefit from the high energy environment of the Bank, which makes it an excellent environment to develop local endemisms.

**Sponges.** A high number of sponge species were found with a comparably small sampling effort (Thacker et al. 2010). The large area and wide variety of Saba Bank's reef habitats suggest that they provide an important reservoir of sponge biodiversity for the Caribbean. Sponge community health appeared to be very good compared to other localities in the Caribbean. Unique and potentially endemic sponge species were collected from each site, thus further exploration of Saba Bank might also reveal additional species that are new to science. Some sponge species grow to an age of hundreds of years and are especially vulnerable to anchor damage.

The proposal that was given for evaluation to IMARES addresses all criteria for the designation of a Particularly Sensitive Sea Area (IMO A 24/Res.982), which includes information on its biological resources. The ministry of LNV has requested to review this proposal with regards to the biodiversity. This chapter has given an overview of available literature for the major species groups that can be found on the Bank.

### 3 Conclusions

Scientific evidence that the Saba Bank constitutes a major hot spot in marine biodiversity in the Caribbean region has strongly increased over the last couple of years and is now overwhelming. Designating the Saba Bank as a Particularly Sensitive Sea Area appears highly advisable. All studies to date express surprise and wonder about the number of different habitats and species. With limited sampling effort new species have already been found and more are to be expected. Furthermore, the Bank may also quite likely be one of the very few places in the Caribbean that as yet has largely escaped human related pressures and may still be considered as being in a relatively pristine condition. The diversity of marine life on the Bank and the vulnerability of its species requires policy measures as soon as possible to protect this unique area as much as possible. At present anchoring outside the 12 miles zone is not regulated and anchor damage could be devastating to the whole ecosystem (see Appendix 2). PSSA status of the Bank provides the opportunity for extended shipping regulations such as designating “no-anchoring zones” preventing the continuous impact from anchoring.

The effects of fishing, however, should also be studied, so that it will remain at a sustainable level. A management plan should be drafted and implemented as soon as possible. It appears that the bank constitutes a major source of larvae that maintain marine ecosystems down current of the Saba Bank. Although a good impression of the diversity of the Bank is now available, little is known about the ecological processes that sustain this unique ecosystem. Further research should also try to address this in order to be able to protect the Bank in the most effective way.

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**Quality Assurance**

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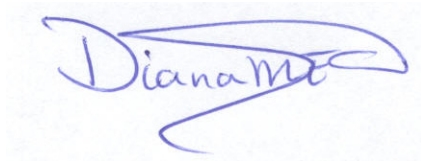
# Justification

Rapport C014/10

Project Number: 4308201011

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

Approved: Dr. D. Slijkerman  
Researcher



Signature:

Date: 25 March 2010

Approved: F. Groenendijk  
Department head Ecology



Signature:

Date: 25 March 2010



# Appendices.

## 4.1 Appendix 1. Internet movies about the Saba Bank

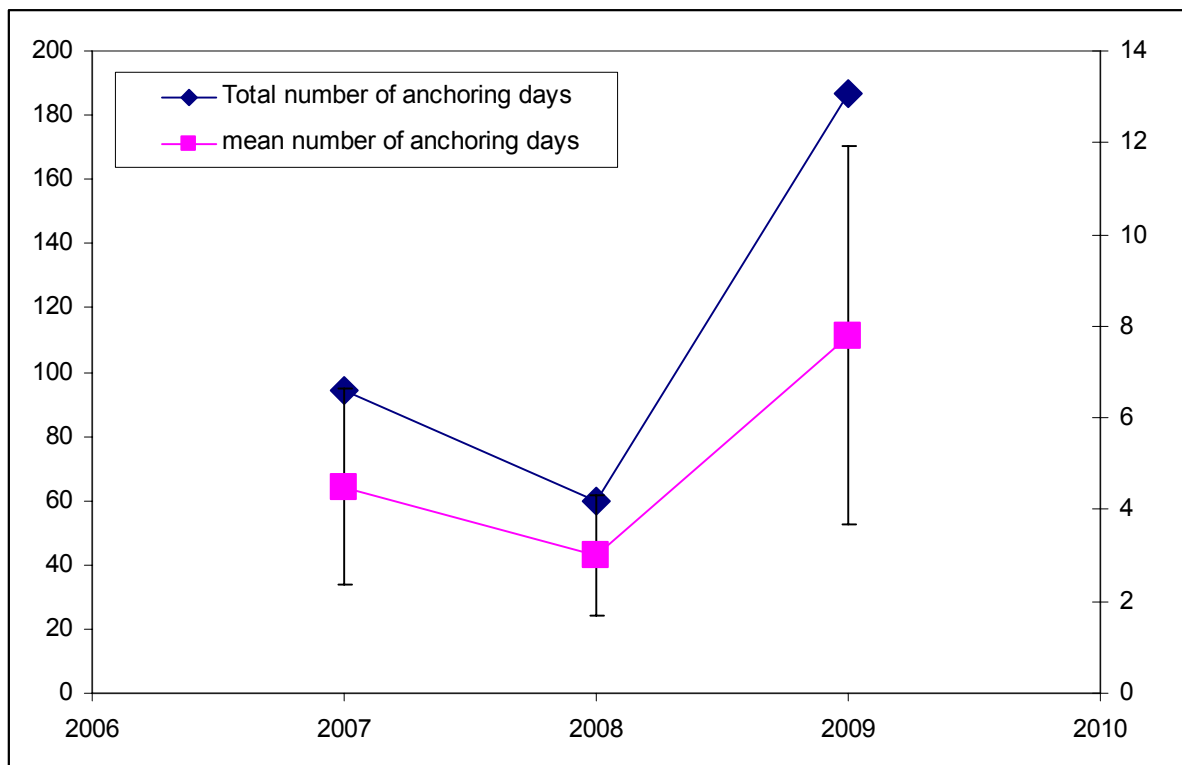
You Tube movies:

<http://www.youtube.com/watch?v=sbjpaLyxoM>

<http://www.youtube.com/watch?v=KehCZoF5uaU>

## 4.2 Appendix 2. Anchoring on the Saba Bank

An overview of anchoring and passing ships on the Saba Bank. Data are from an AIS antenna positioned on Saba, which covers a large part of the Bank.



**Figure 2. Total number of anchoring days (left axis) and the mean number of days per ship with 95% confidence limits (right axis). In 2007 observations are a minimum as the Bank was not monitored the whole year round. The total number of ships anchoring was 20 and 24, and crossing the Bank 54 and 29 in respectively 2008 and 2009. Data from P. Hoetjes, VOMIL, Curaçao.**