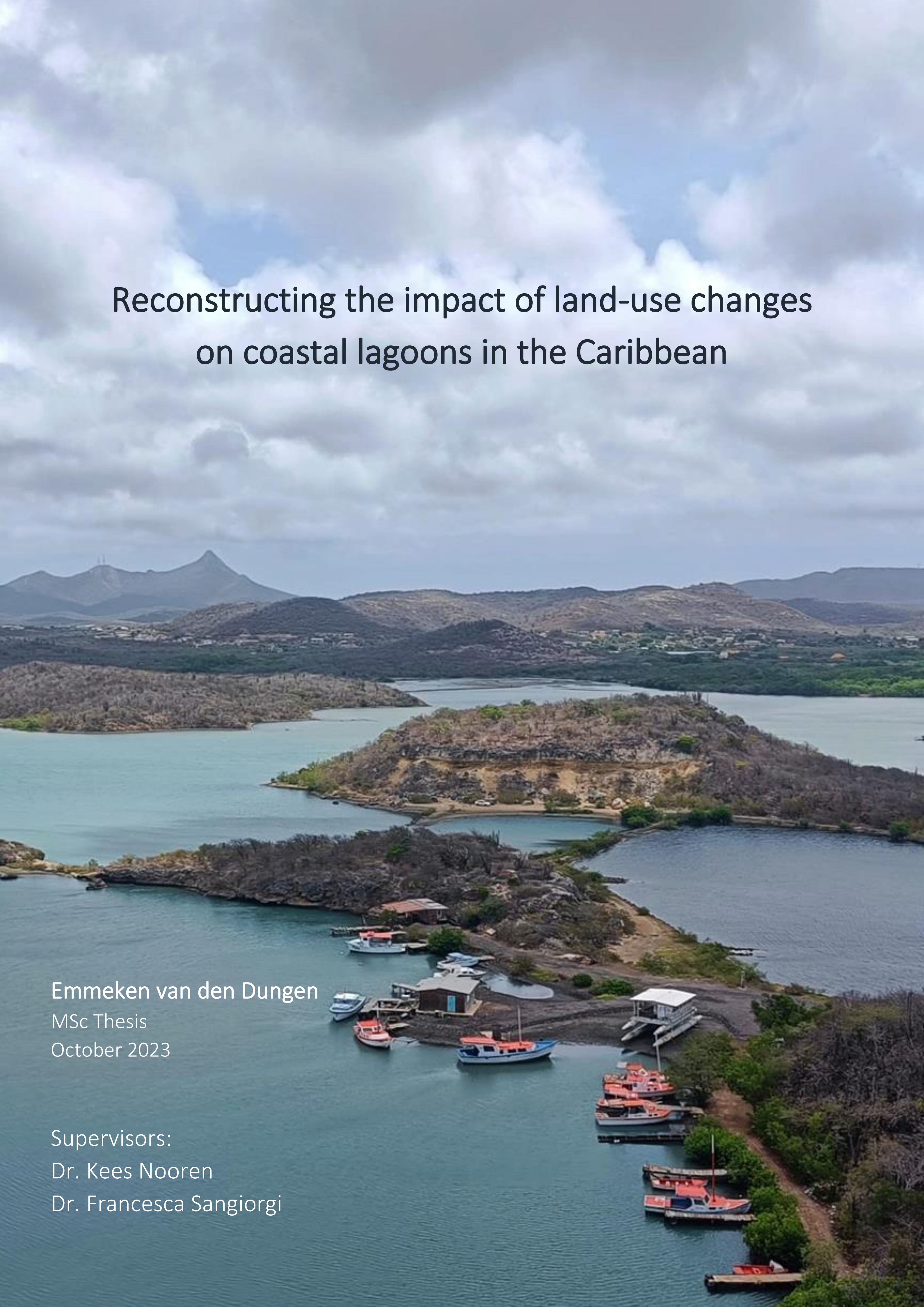

Reconstructing the impact of land-use changes on coastal lagoons in the Caribbean

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Acknowledgements

Over the past six months I have researched the current state of coastal lagoons in the Caribbean, and their development over the past decades. Diving into this topic has not only offered me academic knowledge of anthropogenic threats to coastal lagoons, chemical elements and diatoms, but also gave me the great opportunity to further develop research skills within marine sciences. I am very grateful that I got this opportunity to contribute to collecting such valuable data that is necessary for the protection of these beautiful biodiverse ecosystems.

When I started this research project, I worked on the sediment cores that had already been collected. Of course, I had some experience in research before I started this project. However, almost everything I did was completely new to me. I would like to thank dr. Kees Nooren for his guidance and supervision throughout the whole process, from the first days in the lab where I had never been before, to analyzing diatoms and throughout the writing process. Furthermore, I would like to thank Dr. Francesca Sangiorgi for her enthusiasm during the project whenever we had new results, new ideas and new conclusions. Over two years ago, Dr. Francesca Sangiorgi convinced me to enroll in this master's program because of my passion for the underwater world. She was convinced that I would make up for my completely different background. I am happy that I did, and grateful that she supervised me in this last phase of my master's.

After a couple of months of working on the sediment cores, I went to one of the islands that this study concerns, Curacao, and collected more samples to allow for an additional analysis. This fieldwork would not have been possible without the support of FONA Conservation and Treub Maatschappij. Fieldwork on Curacao has not only increased the insightful results of this study, but made me – once again – more aware of my passion to contribute to a sustainable future for nature and people. Thank you very much for your support.

Abstract

Coastal lagoons are rich in biodiversity and offer various *ecosystem services*. The close relation to the terrestrial ecosystems causes coastal lagoons to be vulnerable to impacts that are caused by human activities on land.

The state of the coastal lagoons and the impact of human activities, is unknown for the Wider Caribbean Region. This study analyzes nitrate (N), phosphate (P), heavy metals, sedimentation rate and diatoms to reconstruct the recent development of four coastal lagoons in the Caribbean. Diatoms are used as proxy as they quickly respond to changes in water quality. Using short sediment cores, for four lagoons human impact is assessed. The lagoons have varying degrees of impact, from high (Fresh Pond, Sint Maarten), to medium (Spanish Lagoon, Aruba; Santa Martha, Curacao) to low impact (Saliña Bartol, Bonaire). Surface sediment samples were collected from eleven additional sites to provide a spatial context.

Expected was that 1) levels of N, P, and heavy metals increase with increased human impact, that 2) biodiversity increases with decreasing human impact, and that 3) diatoms are a valuable and useful proxy for reconstructing water quality and environmental conditions.

Results of heavy metals and N and P impact show that indeed human impact is most strongly pronounced in the site that was selected as high impact site (Fresh Pond, Sint Maarten). The medium and low impact sites do not show clear signs of human impact. Furthermore, results show that there is no correlation between diatom diversity and P, Chromium (Cr), Copper (Cu), and Nickel (Ni) concentrations. Although the Zinc (Zn) concentrations seem negatively correlated with diatom diversity, this is mainly caused by the low diversity of diatoms in the ponds on Sint Maarten.

Observed diatom diversity is influenced by dissolution of diatom valves. Poor diatom preservation can bias results. As alkalinity, salinity and morphology of diatoms can strongly influence preservation, these factors are analyzed. Data suggests that species that are morphologically robust are less susceptible to dissolution in hyper saline conditions. A comparison of diatom assemblage between modern and sediment surface samples show that differences in observed diatom assemblage are substantial.

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1. Introduction

1.1 Background

Coastal lagoons occur along 13% of the world's coastlines (Barnes, 1980; Newton et al., 2018), are among the most productive systems (Alongi, 2020) and are rich in biodiversity (Newton et al., 2018). They offer various functions, varying from providing a nursery area and feeding ground for marine estuarine fish (Franco et al., 2006; Pérez-Rufuza, 2012), to more direct human benefits captured under the concept of *ecosystem services* (Millennium Assessment, 2005). *Ecosystem services* of coastal lagoons refer to services as storm protection, flood control (Pérez-Rufuza et al., 2012), nutrient cycling (Barbier et al., 2011), and food provisioning. In fact, together with estuaries, coastal lagoons are the major supplier of ecosystem services of all aquatic systems (Chapman, 2012).

Globally, human impacts such as water pollution and overfishing have led to a degradation of coastal lagoons (Millennium Ecosystem Assessment, 2005; UNEP, 2006). Actually, along with coral reefs, coastal lagoons are identified as one of the most threatened systems. The close relation to the terrestrial ecosystems causes coastal lagoons to be vulnerable to impacts that are caused by human activities on land as well (Pérez-Rufuza et al., 2012).

Human impact on land affect coastal lagoons in various ways. Firstly, human activities cause erosion on land, which lead to sediment accumulation and ultimately filling of lagoons (Zedlet & Kercher, 2005). Sedimentation and filling are among the main causes of degradation, because it reduces the ability to store water (Luo et al., 1997). Secondly, coastal lagoons are subject to excessive nutrient loading, which is the primary driver of eutrophication (Foekema et al., 2021). Nutrient enrichment causes an increase of biomass of phytoplankton, which consequently reduces water column transparency and can ultimately lead to anoxic conditions. This can also strongly reduce the growth of benthic species due to the lack of light and oxygen (Ouaissa et al., 2023). Eutrophication may lead to harmful algal blooms and biodiversity loss (Anthony et al., 2009; Lapointe et al., 2015). Thirdly, anthropogenic activities have drastically increased concentrations of heavy metals. Heavy metals, despite its natural occurrence, can become toxic in high concentrations. The accumulation of heavy metals in marine ecosystems is among the major environmental problems, because of its long-term effects on coastal lagoons (Mensi et al., 2008). Heavy metal pollution is closely linked to industrialization and agriculture (Briffa et al., 2020). Particularly mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), nickel (Ni), copper (Cu), and lead (Pb) frequently cause environmental pollution (Hazrat et al., 2019 in Mitra et al., 2022). Urbanization and domestic wastewater are furthermore associated with elevated concentrations of zinc (Zn) (Mitra et al., 2022; Fujita et al, 2014; Jaishankar et al., 2014).

Many of the ecosystems in the marine environment of the Wider Caribbean Region (WCR) are hotspots in marine biodiversity (Brooks & Smith, 2001). The Caribbean is described as an under-industrialized region where income is mostly generated through tourism (Kalantzi et al., 2013). The increase in tourism since the 1960s resulted in rapid development and urbanization on the islands. As a result, improper land-use, run-off, and sewage treatment have become the major causes of increased sedimentation rates, the enrichment of nitrate (N) and phosphate (P) (Burke & Maidens, 2004; Foekema et al., 2021), and high influx of heavy metals.

The impacts of anthropogenic activity are visible and well-known (Ruiz-Fernández et al., 2020). However, quantitative data concerning heavy metal contamination (Fernandez-Maestre et al., 2018), nutrient enrichment and the development and current state of coastal lagoons is lacking for the Wider Caribbean Region (Govers et al., 2014).

Diatoms are frequently used to reconstruct past and present environmental conditions of water bodies. Diatoms are single celled algae with a skeleton built of silica. After the diatom dies, the silica skeleton sinks to the bottom where it is incorporated into the sediments. Therefore, the sediments provide an assemblage of diatom fossils that indicate present and past environmental conditions at the site. Diatoms quickly respond to water quality changes and therefore are sensitive indicators of human impact (Stoermer & Smol, 1999).

Preservation of diatoms in the sediment is variable across time and space (Warnock et al., 2007). Preservation and dissolution of diatoms is influenced by multiple factors. Firstly, alkaline and saline conditions can reduce the preservation of diatoms in sediments (e.g. Reed, 1998). In fact, dissolution of diatoms is a problem that particularly applies to marine and saline sites (Mackay et al., 1993; Ryves, 1995). Secondly, preservation is influenced by the morphology of the species (Flower & Ryves, 2009), i.e. more robust and larger diatoms are frequently shown to be better preserved. It is therefore variable between taxa (Shemesh et al., 1989). Taking into account varying levels of diatom preservation is crucial, since dissolution can cause a bias in diatom counts.

This study investigates the possibility to use diatoms as a proxy to understand past environmental changes at coastal lagoons in the Caribbean. As far as we known this is the first diatom research carried out on these islands, and therefore this research should be regarded as a pilot study.

1.2 Approach

Using an integrated approach, this study investigates the human impact on coastal lagoons in the Caribbean. This study focuses on human impact on sediment accumulation rates, nutrient enrichment, and heavy metal loading. Sediment cores, surface sediment samples and modern diatom samples are used. The research question that was formulated is as follows: *"To what extent are coastal lagoons in the Caribbean impacted by recent (±50 years) land-use changes?".*

1.3 Hypotheses

Three hypotheses were formulated:

1. Concentrations of heavy metals and N and P are expected to increase with increasing human impact. A relative increase of, or even dominance of planktonic species is expected as a result of eutrophication;
2. Diatom diversity is expected to decrease with increasing human impact;
3. Diatoms are a valuable and useful proxy to reconstruct past changes in water quality and environmental conditions at coastal lagoons in the Caribbean.

2. Materials and methods

2.1 Site description

A total of twelve coastal lagoons at four Caribbean islands (Table 1, Fig. 1) were selected for this study. Short sediment cores and surface sediment samples were collected at these sites in 2022. Short sediment cores were used to study four of out of the twelve lagoons in more detail: 1) Fresh Pond (Sint Maarten), 2) Spanish Lagoon (Aruba), 3) Santa Martha (Curacao), 4) Saliña Bartol (Bonaire). These four sites have different levels of human impact.

2.1.1 Fresh Pond (Sint Maarten)

Fresh Pond is an enclosed fresh water pond that is occasionally connected to the sea. The catchment area is 6.0 km^2. The catchment of Fresh Pond has become increasingly constructed and populated over the past decades. As a result of the erosion in the catchment, Fresh Pond received a high sediment load. This led to the need for dredging (EcoVision, 1995), which happened in 1999.

Although monitoring of Fresh Pond is largely lacking, water and sediment samples were collected in 1995 to asses the state of the lagoon. The data shows that Fresh Pond was polluted with nutrients, garbage, and oil (EcoVision, 1995). In fact, the concentration of P and N in water samples analyzed in 1995 were already extremely high reaching respectively 60 and 9 times the limit value for general ecological functioning of surface waters (EcoVision, 1995). Finally, also a high concentration of Cu in sediment samples was reported, as well as the occurrence of anoxic conditions in both shallow and deeper water (EcoVision, 1995). Because of the highly urbanized catchment, and the already high concentrations of heavy metals, N and P in water and sediment samples collected in 1995, Fresh Pond is considered a high impact site.

2.1.2 Santa Martha (Curacao)

Santa Martha (Curacao) is a currently an open bay with saline water. The bay has been occasionally closed in the past. The catchment area is 16.2 km^2. The catchment of Santa Martha has been urbanized, however to a lesser extent compared to the catchment of Fresh Pond. Part of the catchment is in use for agriculture. The Santa Martha bay is considered an important area for fishing activities, however no activity has been noticed in July and August 2023. Tourism is developed to a very small extent. In fact, the only hotel that was close to Santa Martha Bay was closed in 2007. The recent *EOP* (Eilandelijk Ontwikkelingsplan, Development Plan for the Island) identifies Santa Martha Bay as an area destinated for tourism. Recently, the government and investors signed an agreement for the development of Santa Martha for the coming ten years. This will include the construction of two new hotels within the coming ten years, as well as the construction of a marina with water sport activities.[1] Santa Martha is considered a medium impact site because the urbanization of the catchment is relatively limited, and the site it is not officially protected.

2.1.3 Spanish Lagoon (Aruba)

Spanish Lagoon (Aruba) is the only coastal lagoon on Aruba. It is an open bay with impeded in and outflow of seawater since the construction of a low bridge in 1929. Spanish Lagoon has saline water, and a catchment area of 13.1 km^2. The area is characterized by a high abundance of *Rhizophora* mangroves. This is in contrast to the three other sites selected for this study where *Rhizophora*

[1] https://www.avilabeachhotel.com/curacao-tips/news-facts/groot-santa-martha-awaits-unique-development/ Retrieved on October 5th, 2023

mangroves are almost lacking (Santa Martha) or completely absent (Fresh Pond, Saliña Bartol). In 1980, Spanish Lagoon obtained the status of RAMSAR site. However, policies, monitoring and research is largely lacking. In 2017, the site was adopted as part of Arikok National Park, meaning that the catchment exists for the majority of protected area within the national park. Still, a MSc thesis by Emiel Kuppen (2017) shows that sediment coming in from the catchment is perceived as a threat to the lagoon. Although Spanish Lagoon is an officially protected site, because of its close location to touristic and populated areas, it is considered as a medium impact site.

2.1.4 Saliña Bartol

Saliña Bartol is a hypersaline enclosed bay, with a catchment area of 4.4 km^2. It is one of the many saliñas, or salt lakes, on Bonaire. These saliñas are saltwater bodies that experience salinity shifts from nearly fresh to hypersaline conditions throughout the year (Jongman et al., 2009). Five of them, among which Saliña Bartol, have been identified as a RAMSAR sites. Many of the saliñas on Bonaire are threatened by eutrophication and relatively rapid silting and land accretion (Van Beukering et al., 2022). Saliña Bartol is a low impact site because of its isolated location, its location within Washington-Slagbaai National Park, and the lack of human constructions (besides some dirt roads) in the catchment.

Fig. 1: The four sites that are the focus of this research. The catchments of the lagoons (white outlined) have different degrees of human impact, and range from highly impacted (Fresh Pond, Sint Maarten) to a low impact site (Saliña Bartol, Bonaire). Spanish Lagoon (Aruba) and Santa Martha (Curacao) are medium impact sites. Red dots indicate sites where surface samples are collected. The scale is the same for the four islands.

2.1 Data collection

In 2022, an UWITEC gravity corer was used to collect surface sediment samples at twelve lagoons on four islands (Fig. 1, Tab. 1). At Fresh Pond (Sint Maarten), at the same location also two short piston cores were collected. The surface samples are used as a modern reference dataset, and to allow comparison between sites.

For a reconstruction back in time four sites have been selected with different levels of human impact. The sediment cores collected at these sites likely represent accumulated sediments deposited over the last decades: The sediment cores from Fresh Pond (103 cm), Spanish Lagoon (54 cm), Santa Martha (47 cm) and Saliña Bartol (top 23 cm) were subsampled in the field or in the laboratory. For Fresh Pond, Spanish Lagoon and Santa Martha, the entire core was sliced into 1 cm increments. For Saliña Bartol, the top 23 cm was sliced into 2-4 mm thick subsamples. The rest of the Saliña Bartol core was sealed and stored in the 7°C laboratory storage. Subsamples were frozen and freeze-dried.

Site	Country	Type	Catchment area	Water
*Fresh Pond**	Sint Maarten	Enclosed pond, occasionally connected to sea	6.0 km^2	Fresh
*Santa Martha** (two sites)	Curacao	Open bay, formerly occasionally closed	16.2 km^2	Saline
*Saliña Bartol**	Bonaire	Enclosed bay	4.4 km^2	Hypersaline
*Spanish Lagoon**	Aruba	Open bay with impeded in- and outflow of seawater since the construction of a low bridge in 1929	13.1 km^2	Saline
Sint Joris Bay	Curacao	Open bay		Saline
Piscadera Bay (two sites)	Curacao	Open bay		Saline
Simpson Bay Lagoon	Sint Maarten	Enclosed		Saline
Mullet Bay Pond (two sites)	Sint Maarten	Enclosed, open connection to Simpson Bay Lagoon		Saline
Étang aux Poissoins	Sint Maarten	Narrow inlet		Saline
Oyster Pond	Sint Maarten	Open bay		Saline
Salt Pond	Sint Maarten	Enclosed		Brackish
Little Bay Pond	Sint Maarten	Enclosed		Brackish

*Table 1: Sites on Aruba, Bonaire, Curacao and Sint Maarten analyzed in this study. * indicates which sites were selected for a reconstruction.*

For Santa Martha, additionally, seven modern diatom samples were collected in July 2023 (Fig. 2). At the inlet of Santa Martha bay, one epiphytic (SM-d1) and one epilithic (SM-d2) sample from the tide line was collected. Further inwards of the bay, where a small fishers harbor is located, and a small stand of *Rhizophora* mangrove trees is present, an epiphytic (SM-d3) and an epipelon (SM-d4) sample were collected. Near the site where the sediment core was collected in 2022 an epiphyte (SM-d5), an epipelon (SM-d6), and a planktonic (SM-d7) were collected. For the planktonic sample 10L of surface water was collected with a bucket and was filtered using a filter with a 8µm mesh width.

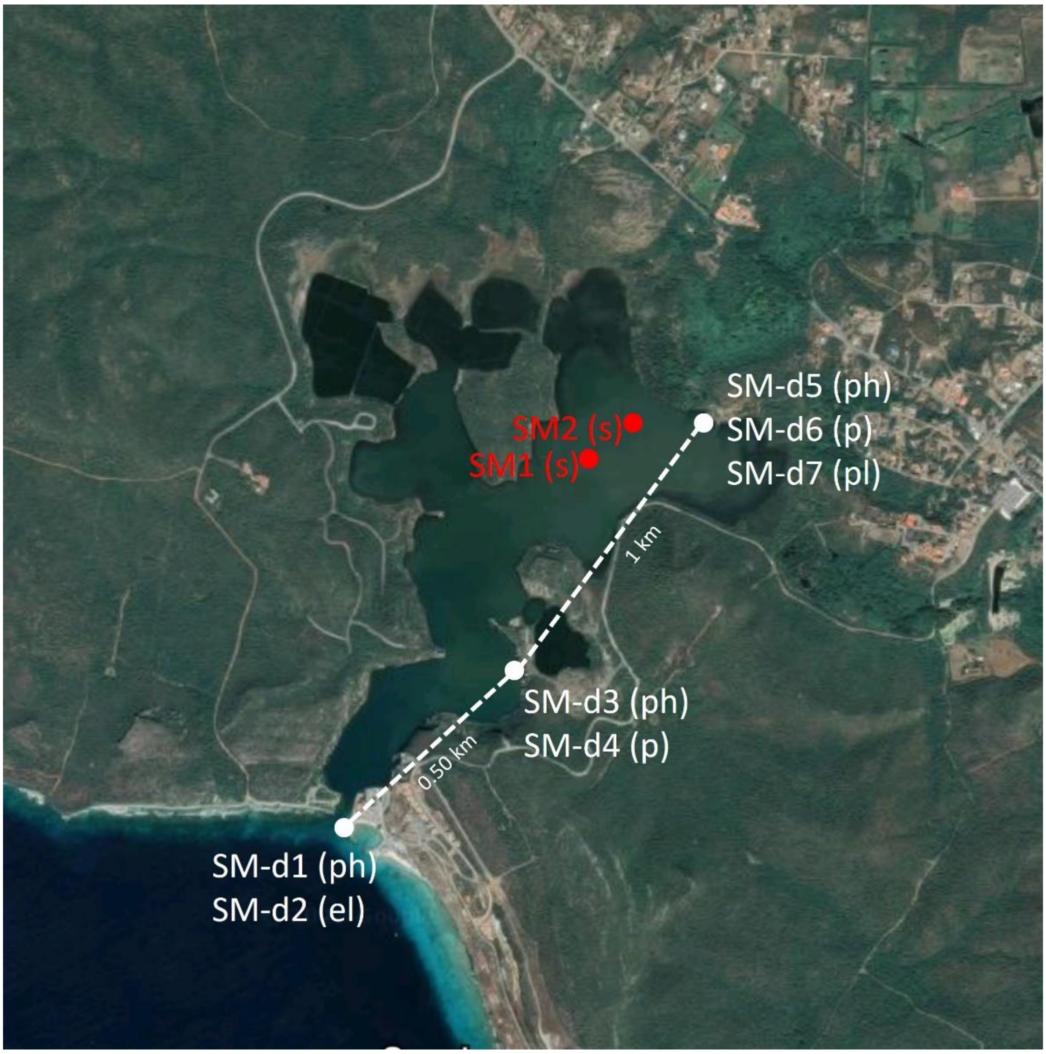


Fig. 2: Map of Santa Martha Bay and sites where samples were collected. Red dots indicate sites where sediment cores were collected in 2022. White dots indicate sites were modern diatom samples where collected. ph = epiphytic, el = epilithic, p = epipelon, pl = planktonic sample.

2.2 Methods

Freeze-dried samples were used for multiple analyses to assess sediment chronology, chemical elements (C, P, N, heavy metals), and diatom assemblages.

2.2.1 Sedimentation chronology

Sedimentation chronology of the four sediment cores was determined by ^{210}Pb dating using mass spectronomic techniques. At Fresh Pond (Sint Maarten), a composite core was constructed by matching similar lithological layers found in the gravity core (Fg), and the two piston cores (F1, F2), along with comparison of the ^{210}Pb activity of the various samples from the three cores.

2.2.2 Sediment analyses: organic and inorganic chemistry

Subsamples of the four selected lagoons (Aruba: 12; Bonaire: 32; Curacao: 15; Sint Maarten: 16) and surface samples (12 total) were assessed for chemical elements.

2.2.2.1 ICP-OES

Phosphorous and the heavy metals selected for this study (Cd Cu, Cr, Ni, Pb, Zn) were determined using Inductively Coupled Plasma Optical Emission spectroscopy (ICP-OES). Subsamples were grinded and 0.125 gram was used for total destruction, with hydrofluoric acid (48%), perchloric acid (72%) and nitric acid (65%). The destruction vessels were placed on a 90°C hotplate for one night, after which temperature was increased to 140°C until they were dried and a gel was formed. Afterwards, 25 ml 0.7M HNO_3 was added, and the vessels were placed on a hotplate at 90°C. The dilution was determined by weighing the vessels. 5 ml was poured in a 15 ml Greiner tube, the remaining material was poured into a 50 ml Greiner tube and stored. The 5 ml Greiner tubes were used for ICP-OES, together with 2 standards and 6 duplos.

2.2.2.2 Flash IRMS elemental analyzer

Total C and N were determined by the Flash IRMS elemental analyzer (Thermo Scientific EA Isolink IRMS system). Here, 0.3 gram of grinded samples were decalcified with 15 ml HCl, cleaned with 20 ml demi-water and dried in the oven at 40°C for four days. The subsamples were grinded again. 15 mg was put into a tinen cup. These were, together with three standards and an empty cup at the start, after every ten samples, and at the end, analyzed in the Flash IRMS elemental analyzer. Standards were used in different amounts to construct a calibration line based on which C and N were calculated for the subsamples.

2.2.3 Diatoms extraction

Subsamples taken from the sediment cores of Fresh Pond, Saliña Bartol, Spanish Lagoon, Santa Martha and surface sediment samples were analyzed for diatoms. For Saliña Bartol, 0.3 gram of the freeze-dried subsample was used. For Fresh Pond, Spanish Lagoon, Santa Martha, and the surface samples, 1 gram was used for microfossil analysis. The modern epiphytic, epipelon, epilithic and planktonic diatom samples collected at Santa Martha were not pre-treated.

Samples were subsequently treated with 15 ml 10% HCl and 30% H_2O_2 to remove organic matter and $CaCO_3$. The samples were cleaned with demi-water until a neutral pH was reached. Demiwater was added to the beakers until a total of 100 ml. 10 ml was added to settling trays (Battarbee, 1973). The coverslips (diameter 20mm) were mounted on slides with Naphrax. The diatom slides from Fresh Pond were scanned at 100x magnification with a Leica DM 6000 B microscope equipped with a Leica DFC 310 FX camera. The slides from Saliña Bartol were scanned at 40x magnification with a Leica DM6 B microscope equipped with a Leica K-5C camera. Diatom valves were counted until a total of 300 was reached. Additionally, the slides from Fresh Pond slides were scanned on 10x magnification to specifically search for *Pleurosira laevis*. This indicator species occurs in relatively low abundance and is easily missed when slides are counted up to 300 valves. Slides from Curacao were counted on an Olympus CX21 microscope at 40x and 100x magnification.

Diatom identification was largely based on the diatom atlas for the Bahamas (Hein et al., 2008), and online databases (https://diatoms.org/; https://fce-lter.fiu.edu/data/database/diatom/). The results are presented as relative abundance of diatom species, and total diatom concentrations. Diatoms were divided into two ecological groups: benthic and planktonic species. The Shannon Diversity Index (SDI) was calculated for each of the subsamples as indicator for diatom diversity.

3. Results and interpretation

In this section, it is presented to what extent coastal lagoons are influenced by human impact through sediment accumulation, nutrient enrichment and elevated heavy metals concentrations. Firstly, the results are presented for each of the four focus sites separately. Secondly, sites are compared with each other.

3.1 Fresh Pond (Sint Maarten)

Fresh Pond is considered a high impact site (see 2.1.1.). In this section, data is used to understand the current state and the development of Fresh Pond. After this site specific analysis, the results are compared to other sites on Sint Maarten.

From the three sediment cores collected at the site two distinct lithological zones can be distinguished. Zone 1 (45 – 95 cm depth) is composed of cm-thick laminated sediments, while zone 2 (0 – 45 cm depth), is composed of more homogeneous sediments. The boundary at 45 cm is sharp, and most likely indicate the depth of dredging in 1999. The mean sedimentation rate for the top 45 cm is therefore 2.0 cm yr^{-1}. The ^{210P}b dating suggest a slight decrease in sedimentation rate for the upper 15 cm of the core (Appendix A.1). It is difficult to estimate the age of the sediments below 45 cm depth because the excess ^{210}Pb activity is almost constant, and no ^{137}Cs peak was found.

Results the elemental analysis (Fig. 3 and Fig. 4) and diatom analysis (Fig. 5) are presented below. Values for Cd and Pb were below the detection limit.

The diatom record of Fresh Pond (Sint Maarten) shows two distinct zones, that corresponds to the two zones identified in the lithology of the core. Zone 1 is characterized by a lower concentration of diatoms, and a lower relative abundance of planktonic species. Levels of P, N and heavy metals were lower. Throughout zone 1, planktonic species *Stephanocyclus meneghiniana* was observed in a high relative abundance. In zone 1a (90 – 95 cm), besides *Stephanocyclus meneghiniana, Nitzschia angustata* has a high relative abundance. In zone 1b (45 – 90 cm), the relative abundance of Nitzs*chia angustata* decreases, whereas the relative abundance of *Nitzschia palea* rapidly increases. Interestingly, all three of these species are associated with eutrophic conditions. Firstly, *Stephanocyclus meneghiana* is associated with shifts to hypereutrophic conditions (Costa-Böddeker et al., 2012). Secondly, *Nitzschia palea* is referred to as an indicator species for hypereutrophic environments that occurs in hypoxic water (Van Dam et al., 1994). This species is furthermore described as a pollution tolerant taxa that is among the most resistant to heavy metal pollution (Sabater, 2000). Finally, *Nitzschia* a*ngustata* is well known to be tolerant for organic pollution and eutrophication (Malinowska-Gniewosz et al., 2008). *Nitzschia angustata* is not associated with hypereutrophic conditions, whereas *Nitzschia palea* and *Stephanocyclus meneghiniana* are. The rapid decrease of the abundance of *Nitzschia angustata*, that seems to be replaced by *Nitzschia palea*, therefore might indicate stronger eutrophic conditions. However the concentrations of N and P hardly changes from zone 1a to 1b. Similarly, the heavy metal concentrations remain almost the same. Other conditions, like an increase in water depth, may have favored *Nitzschia palea* over *Nitzschia angustata* in Zone 1b.

In Zone 2 (0 – 45 cm) concentrations of P, N, Cu and Zn increase. Simultaneously, a transition towards a system in which the planktonic marine species *Actinocyclus normanii* dominates is found. *Actinocyclus normanii* dominates in Zone 2a. This species is associated with aquatic degradation, eutrophication and contamination (Garcia-Rodriguez et al., 2011). Zone 2b show a strong increase in the concentration of diatoms. Furthermore, the relative abundance of *Pleurosira laevis,* an indicator species for eutrophication, strongly increases in zone 2b. *Pleurosira laevis* is also found to be highly tolerant to heavy metals (Kim et al., 2008) and elevated N concentrations (Kipp et al., 2023). The increasing relative abundance of *Pleurosira laevis* strongly corresponds to the increase of Cu and N in the data.

Dredging implies that part of the sediment was removed and therefore this core deals with a data hiatus. This potentially explains the extreme, rather than gradual changes in concentration of P, N and the diatom assemblage, from zone 1b to zone 2a (at 45 cm).

In short, Fresh Pond shows to be a site that is highly impacted by humans. Sedimentation rate appears to be high, diatom assemblage shows multiple signs of contamination and nutrient enrichment, and data of nutrients and heavy metals confirm this. The SDI remains low throughout the core, and varies between 1 and 2.

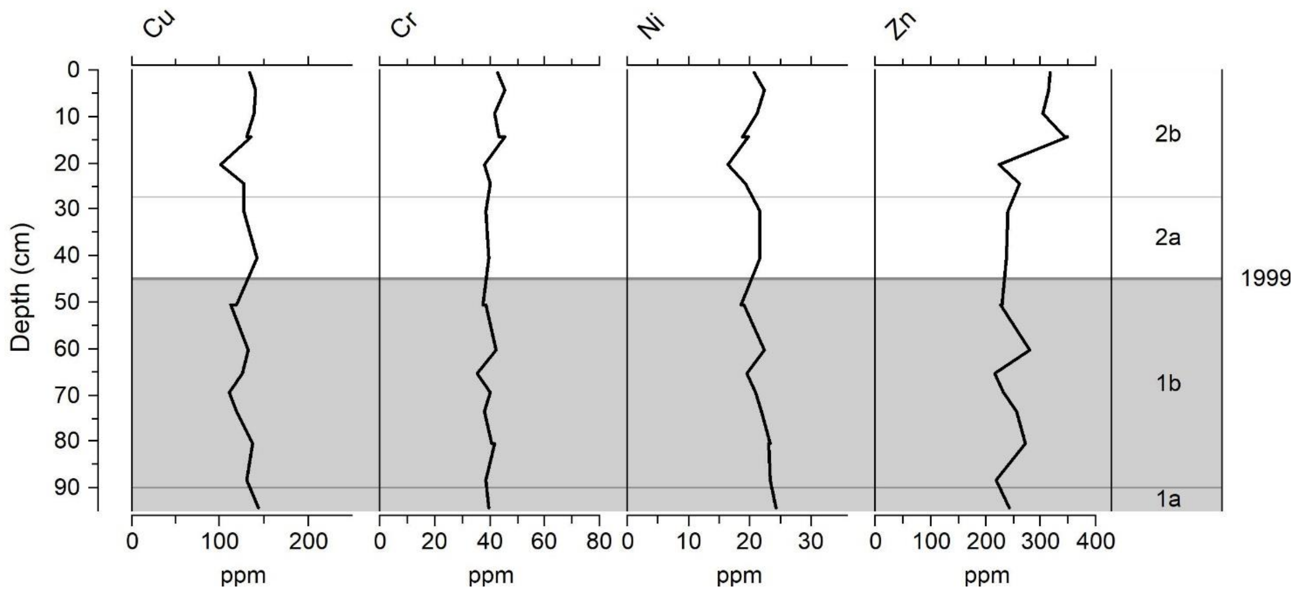


Fig. 3: Concentrations of Cu, Cr, Ni and Zn measured in subsamples from the sediment core collected at Fresh Pond (Sint Maarten).

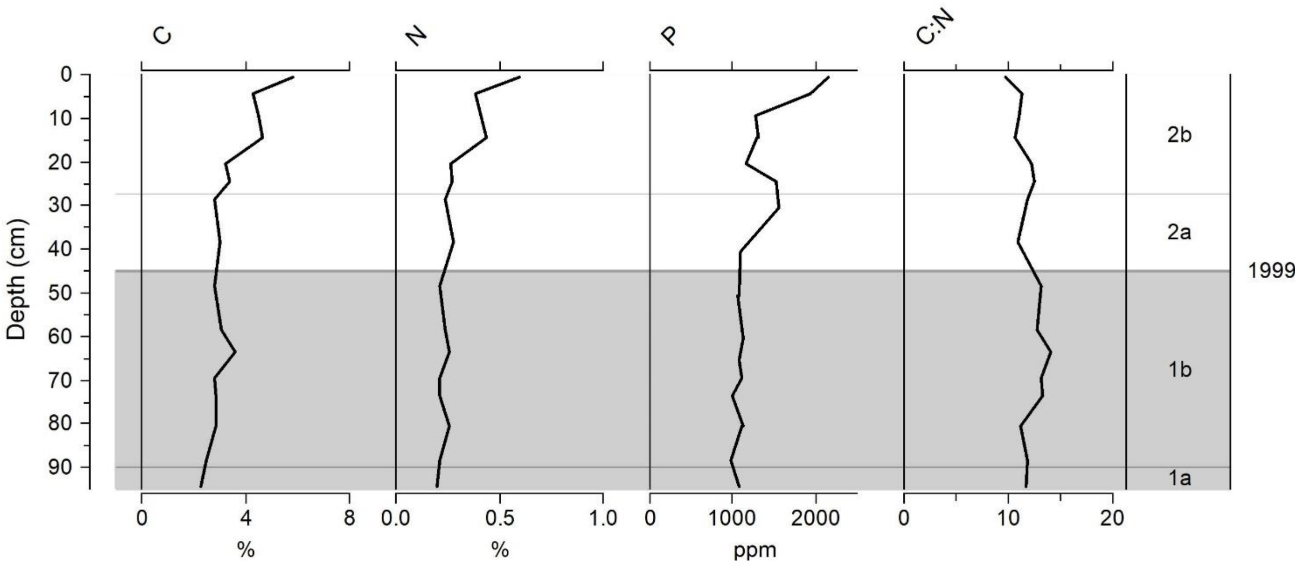


Fig. 4: Concentration of %C, %N, P and C:N measured in subsamples from the sediment core collected at Fresh Pond (Sint Maarten).

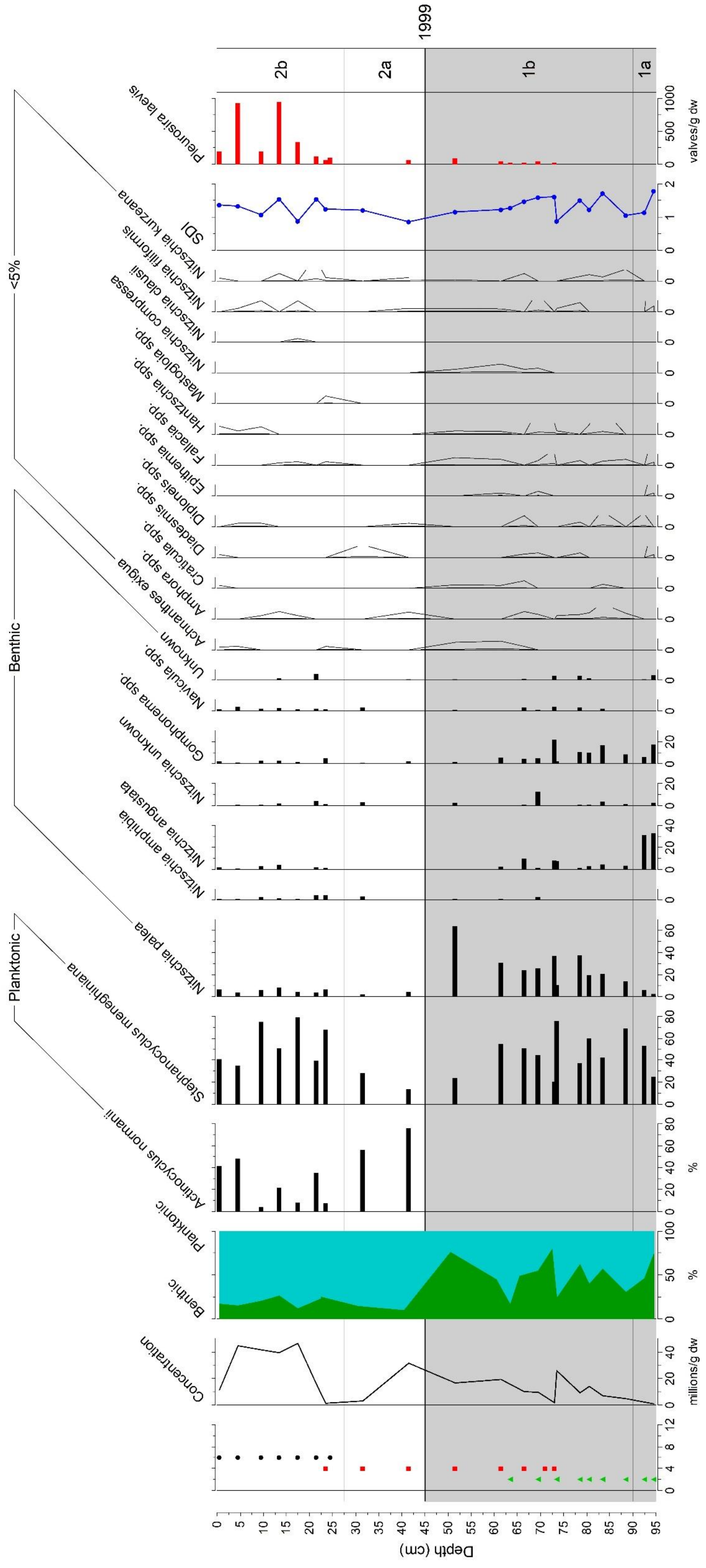
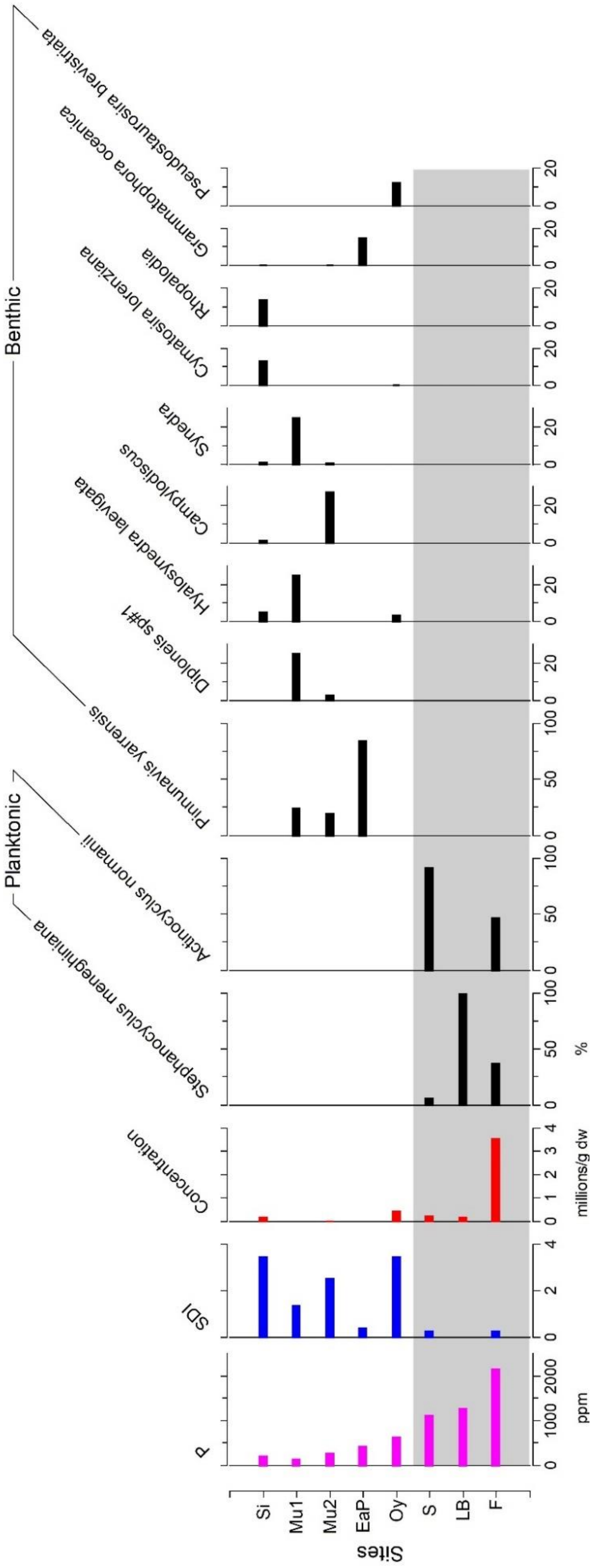


Fig. 5: SDI, concentration of diatoms, diatom assemblage, and occurrence of indicator species *Pleurosira laevis* in subsamples from sediment core from Fresh Pond (Sint Maarten). Division between benthic and planktonic species is indicated in green and blue respectively.



3.1.1 Spatial context

Data from Fresh Pond confirms that it is a site that is highly impacted by human activity in the catchment. To investigate to what extent conditions in Fresh Pond are different compared with other waterbodies on the island of Sint Maarten, here data of diatom assemblage, P and heavy metal concentration of seven surface sediment samples from six sites on Sint Maarten is presented. As such, it provides an indication of the current environmental conditions at the sites, rather than a reconstruction over time.

Based on the diatom assemblages (Fig. 6), sites on Sint Maarten can be grouped into two. The first group consists of the saline lagoons Simpson Bay, Mullet Bay (1 and 2), Étang aux Poissons and Oyster Pond. These sites are characterized by a low diatom concentration that are dominated by benthic species. In three out of the five sites, *Pinnunavis yarrensis* is one of the most abundant species. Interestingly this species was not found in the Bahamas (Hein et al., 2008), and is absent in the diatom records of coastal lagoons in Florida (Wachnicka et al., 2010; Wachnicka et al., 2013; Soelen et al., 2010).

The second group are the brackish to freshwater ponds Salt Pond, Little Bay Pond and Fresh Pond. These sites are characterized by a low SDI, and are dominated by the planktonic species *Actinocyclus normanii,* and *Stephanocyclus meneghiniana*, that indicate eutrophic conditions.

Fig. 6: P concentration, SDI, concentration of diatoms and relative abundance of diatom species in surface sediment samples taken in Simpson Bay (Si), Mullet Bay (two sites: Mu1, Mu2), Étang aux Poisson (EaP), Oyster Pond (Oy), Salt Pond (S), Little Bay Pond (LB) and Fresh Pond (F).

The surface sediments at all three sites also have a high concentration of heavy minerals (Fig. 7). Fresh Pond shows to strongest signs of eutrophication, and has the highest P concentration of 2158 ppm. Also, the highest concentrations of diatoms were found at Fresh Pond.

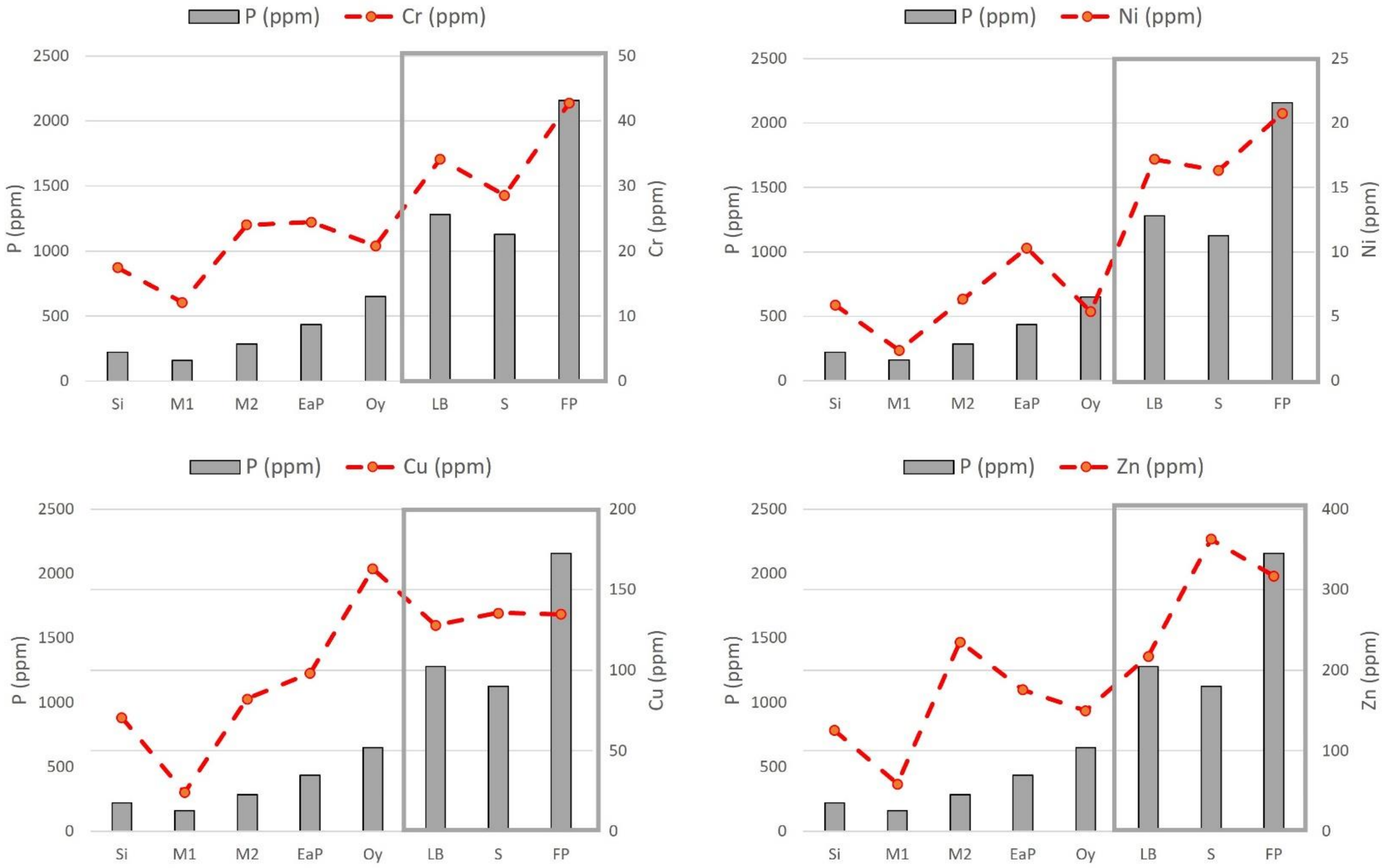


Fig. 7: Concentrations of P, Cr, Cu, Ni and Zn in Simpson Bay (Si), Mullet Bay (two sites: Mu1, Mu2), Étang aux Poisson (EaP), Oyster Pond (Oy), Salt Pond (S), Little Bay Pond (LB) and Fresh Pond (F). In grey outlined are sites that are categorized into group 2.

3.2 Santa Martha

Santa Martha is considered a medium impact site (see 2.1.2).

Sediment dating was unsuccessful for the sediment core due to a weak signal of ^{210}Pb and the absence of a ^{137}Cs peak (Appendix A.2). Therefore, sedimentation rate could not be calculated. However, the strong decrease in ^{210}Pb activity below 27 cm depth suggests the presence of a hiatus at 27 cm depth. Also a lithological shift can be observed, from cm-thick laminated sediments in the lower section (27 – 47cm) towards more homogeneous sediments in the upper section (0 – 27 cm) of the core. The lower section also show a relatively high C content (Fig. 8), yet P concentration does not show much variation over depth.

Concentrations of Cd and Pb were below the detection limit. Cu, Cr, Ni and Zn (Fig. 9) show hardly any variation over time. Diatoms are poorly preserved at the site, and were absent below 11 cm depth. The diatom assemblage for the five samples from the top of the core are very similar (Fig. 10). The SDI also does not show much variation. It has a mean value of 2.5. The diatom assemblage is dominated by benthic species, including *Pinnunavis yarrensis*, *Tryblionella granulata* and *Diploneis cf. smithii.*

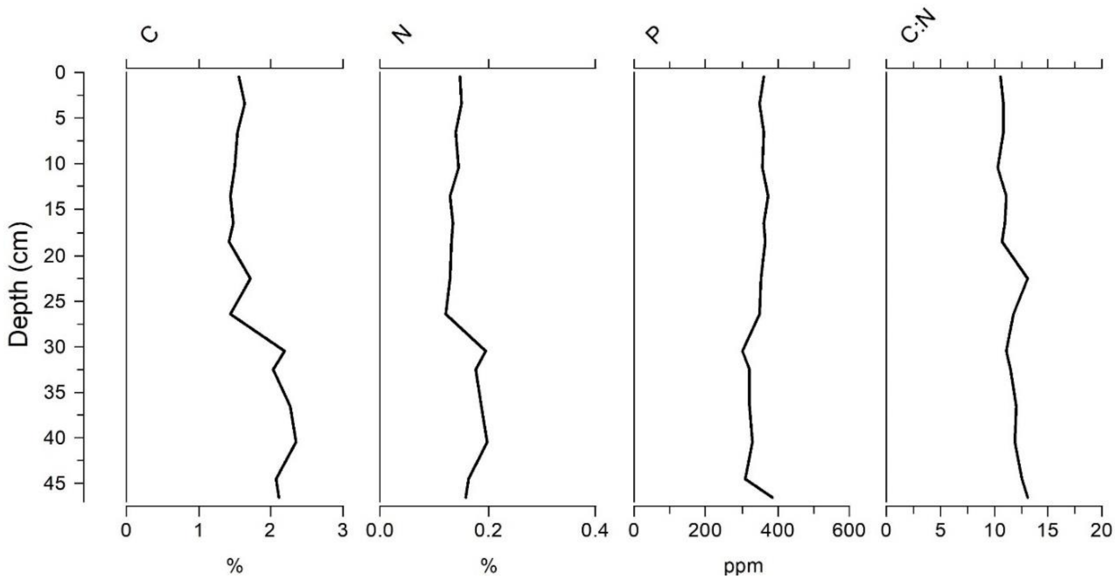


Fig. 8: Concentration of %C, %N, P and C:N measured in subsamples from the sediment core collected at Santa Martha (Curacao).

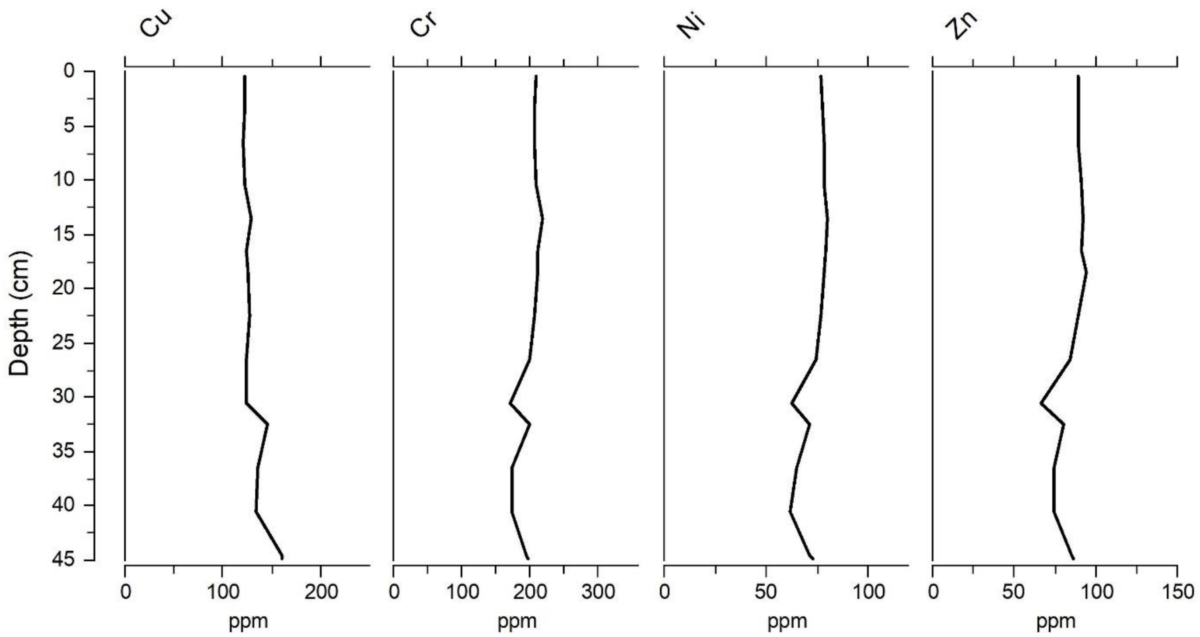


Fig. 9: Concentrations of Cu, Cr, Ni and Zn measured in subsamples from the sediment core collected at Santa Martha (Curacao).

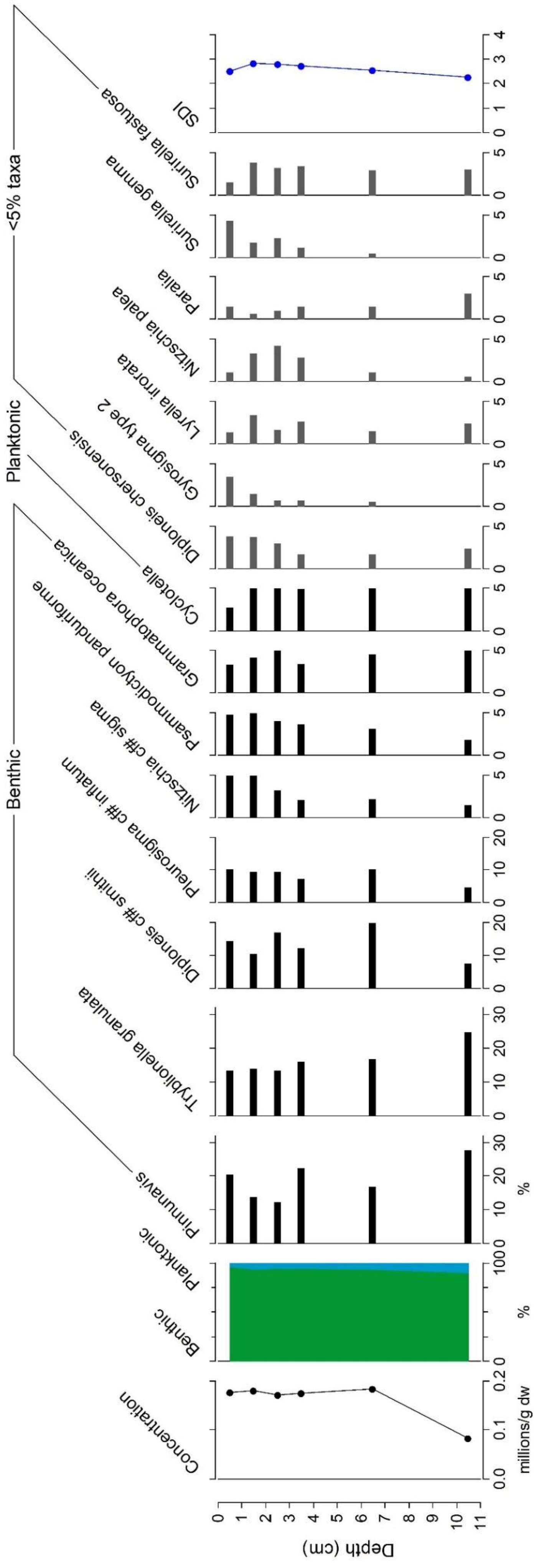


Fig. 10: SDI, concentration of diatom and diatom in subsamples from sediment core from Santa Martha (Curacao). Division between benthic and planktonic species is indicated in green and blue respectively.

3.2.1 Modern samples

The results of the diatom analysis indicate that that diatom preservation at Santa Martha Bay is limited. In order to understand to what extent diatoms are preserved in sediment samples taken from Santa Martha, modern samples were collected. These modern samples include three epiphytic, one epilithic, two epipelic and one planktonic sample collected at three sites (Fig. 2). These samples give an indication of the species that currently live in Santa Martha Bay. Comparing the data of modern samples to data of fossils from sediment cores gives an understanding of which species are sensitive to dissolution. Also, it indicates to what extent sediment surface samples are representative for the living diatom population at a particular site. The results are presented in Fig. 11.

Few things stand out. Firstly, the three species that have the highest relative abundance in fossil samples (*Pinnunavis yarrensis*, *Tryblionella granulata* and *Diploneis cf. smithii)*, occur in a much lower relative abundance in modern samples. These species are overrepresented in the sediment surface samples. In contrast, some diatom species that are observed in modern samples are not observed, or in a lower relative abundance, in fossil samples. This is most obvious for the planktonic species *Chaetoceros*, that is completely absent in the sediment surface samples. Interestingly the dominant diatom species of the epiphytic samples are much less abundant in the sediment surface samples. The diatom assemblage of the sediment surface samples are more comparable with the epipelon samples.

It is important to consider that diatoms can be transported with the currents, and that a difference between sediment and modern samples partly can be explained by the transportation and redistribution of diatom valves. Even though multiple factors play a role in the preservation of diatoms, the discrepancy between diatoms observed in fossil samples and modern samples is striking.

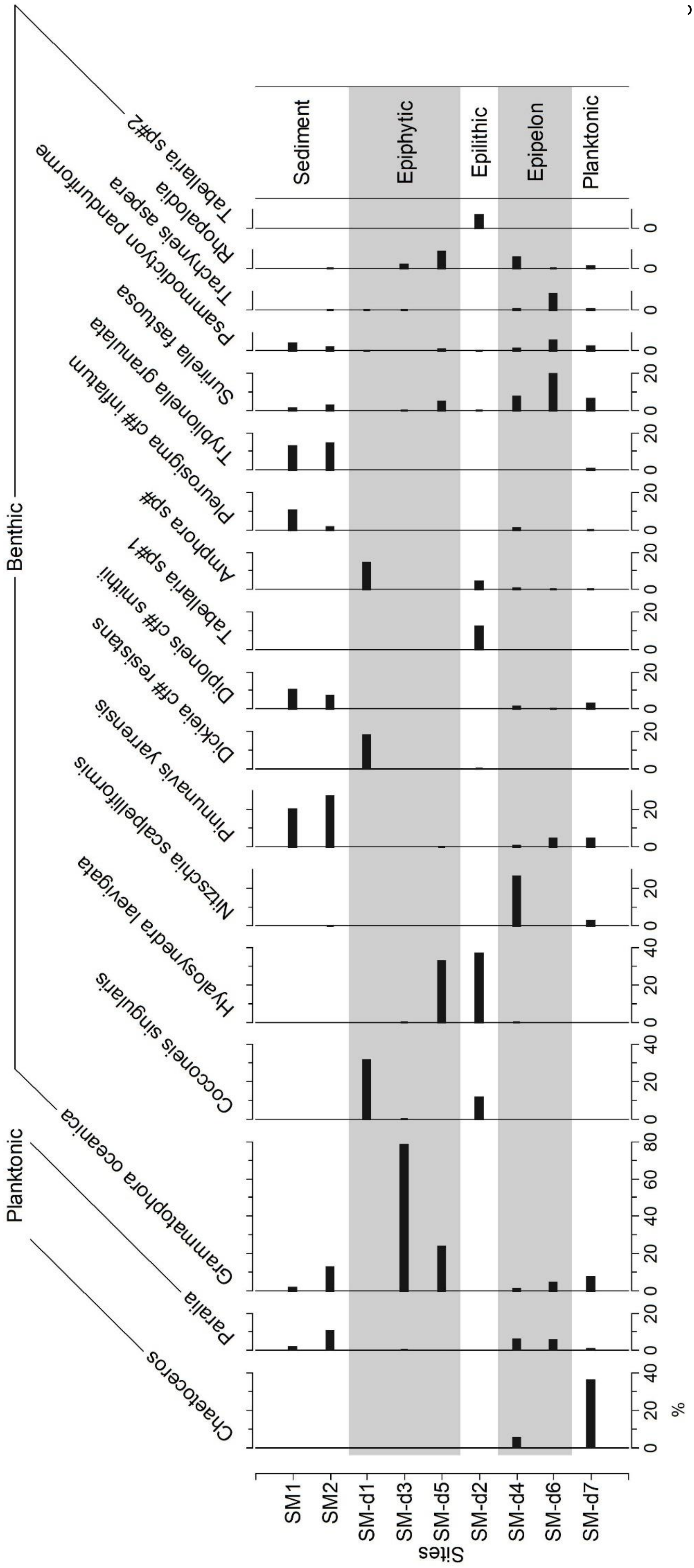


Fig. 11: Concentration of diatoms, diatom assemblage, and SDI in subsamples from sediment core from Santa Martha (Curacao). Division between benthic and planktonic species is indicated in green and blue respectively.

3.2.2 Spatial context

The Santa Martha Bay seems to have a very limited human impact, with relatively low heavy metals and nutrient concentrations in the sediments. In order to study to what extent this limited human impact corresponds to other sites on the island, surface sediment subsamples for other sites on the island were analyzed. Subsamples were collected from two other lagoons: Sint Joris Bay (1 sample) and Piscadera Bay (2 samples). Results of heavy metals and P concentration, and diatom assemblage are presented in Fig. 12 and Fig. 13 respectively.

There are a few things that stand out. Firstly, Sint Joris Bay shows to have the lowest concentrations of Cr, Cu, Ni and Zn. P concentration for Sint Joris is also low compared to other sites. Secondly, Piscadera site 2 shows to have the highest concentrations of P, and among the highest concentrations of heavy metals. The site also has the lowest SDI (1.3). A clear difference can be observed in P concentration and Zn concentration with Piscadera site 1. This indicates local variability in sedimentation within the lagoon. This is also evident from the difference between the diatom assemblages at Piscadera site 1 and Piscadera site 2. The site with the highest P concentration (Piscadera site 2) is dominated by the diatom species *Pinnunavis yarrensis*, which may indicate that this species is not a key indicator species for nutrient poor conditions as found for coastal sites in Louisiana, USA (Parsons et al., 2006).

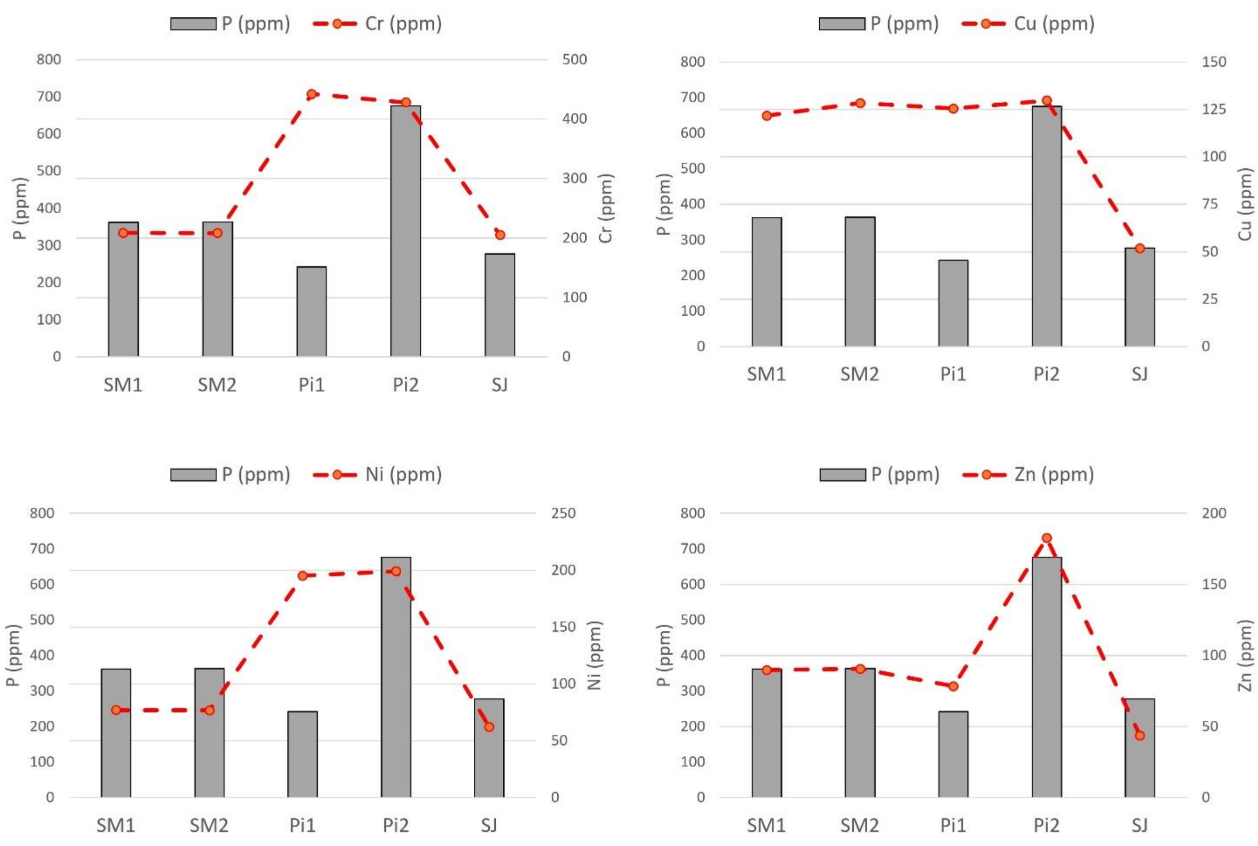


Fig. 12: Concentrations of P, Cr, Cu, Ni and Zn in surface sediment samples taken on Curacao: two sites in Santa Martha (SM1, SM2), two sites in Piscadera Bay (Pi1, Pi2) and Sint Joris Bay.

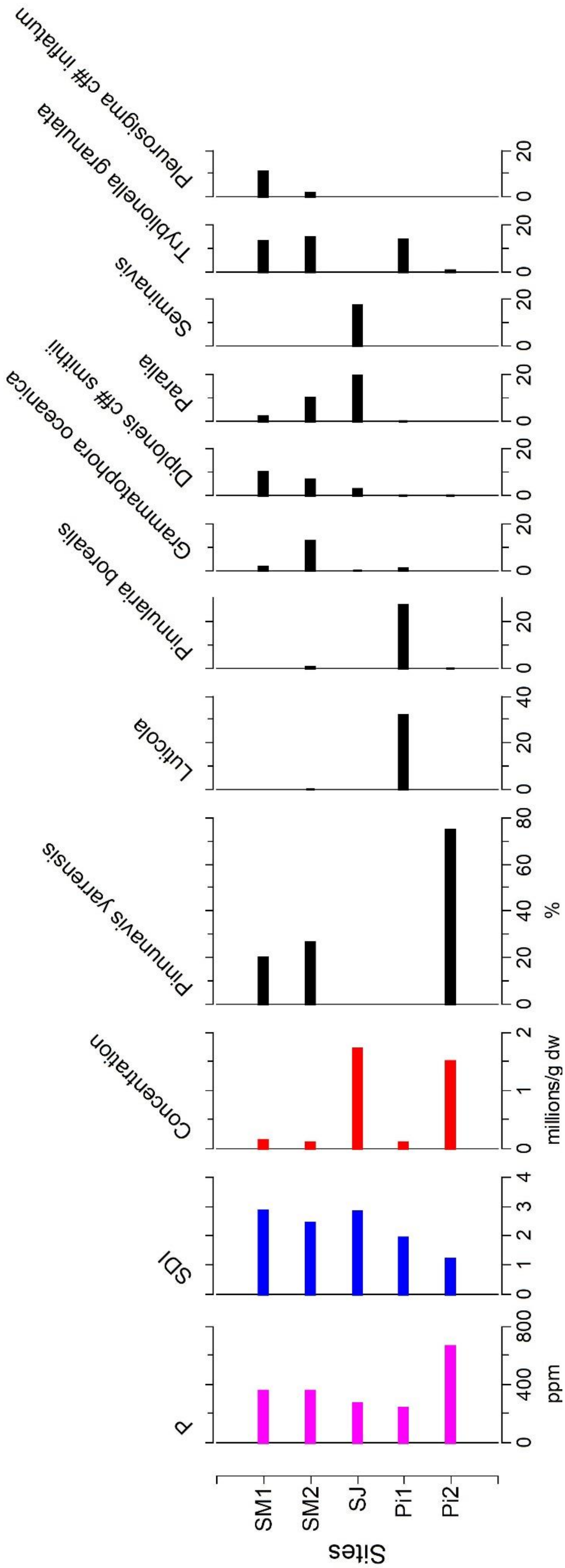


Fig. 13: P concentration, SDI, concentration of diatoms and relative abundance of diatom species in surface sediment samples taken on Curacao: two sites in Santa Martha (SM1, SM2), two sites in Piscadera Bay (Pi1, Pi2) and Sint Joris Bay.

3.3 Saliña Bartol (Bonaire)

Saliña Bartol is considered a low impact site because of its isolated location and low human impact in its catchment. However, the lamination of the core (Fig. 14) allows for sediment dating, assuming that each year consists of two layers: one deposited during the dry seasons, and one during the rainy season. This indicate that the average sedimentation rate was approximately 1.25mmyr^{-1}.

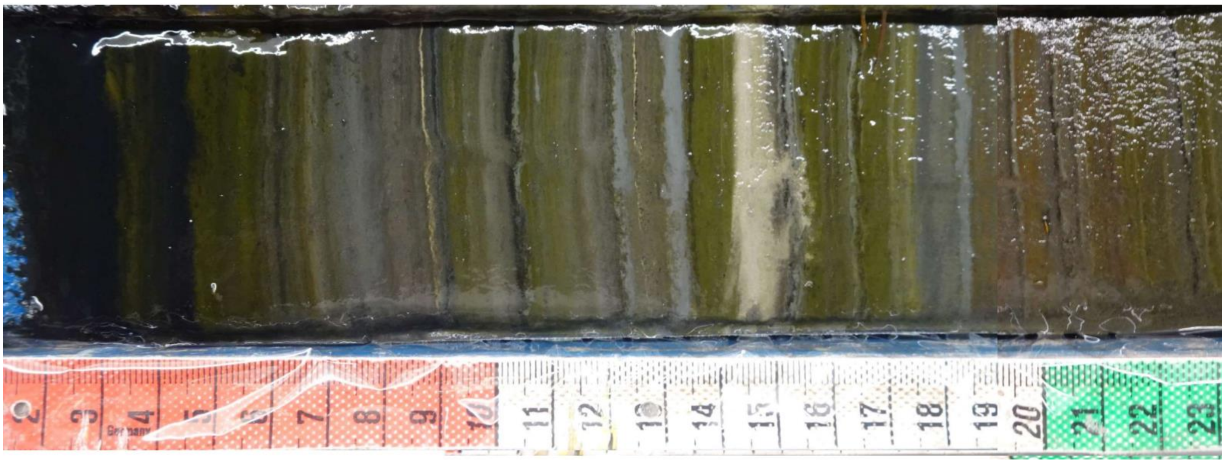


Fig. 14: Photo of part of the core of Saliña Bartol Bonaire that was used for this study. Based on the lamination in the core, age of the sediment was estimated.

The results of the diatom analysis, heavy metal and nutrient concentrations are presented in Fig. 15 – Fig. 17. Generally, results shows that the concentration of P is relatively low and stable, except for one high peak at 14.3 cm depth, likely related to the deposition of apatite. The concentrations of N and C are highly variable and reflect variations in organic matter content. The heavy mineral concentrations are relatively low, and concentrations of Cd, Pb and Ni were below the detection limit.

Before interpreting the diatom record, it is important to note that diatoms were poorly preserved. In subsamples from 1 cm – 6 cm diatom valves were absent, and the majority of diatoms in the other samples were broken or partially dissolved.

Since dissolution appears to be an important issue in this hypersaline lagoon, factors that influence preservation are presented together with the diatom record. Firstly, concentrations of Ca, as indicator of alkalinity, were added to the diatom diagram. Secondly, Na concentrations are used as indicator for salinity. Thirdly, species are classified in three different categories of robustness. Robustness of diatoms has not yet been assessed in relation to preservation before. In dissolution studies, the state of dissolution is intuitively determined using light microscopy (e.g. Ryves et al., 2006). Similarly, this study uses microscopy to assess the robustness of diatoms. As dissolution could have influenced the morphology of the valves, other sources (e.g. https://diatoms.org/) were consulted for determining in which robustness categories species were classified. Consequently, diatoms were categorized into categories of high, medium and low robustness. High robustness is characterized by a sharp and clearly outlined raphe and striae. Medium robustness is characterized by either a vague raphe and sharp striae, or a sharp raphe and vague striae. Low robustness is characterized by both a vague raphe, as well as vague striae. Appendix B.1 – B.3 contains the categorization of diatoms into categories of robustness.

Three zones are identified in the diatom record, mainly based on the presence or absence of *Stephanocyclus meneghеniana.* This planktonic species is usually found in fresh and brackish water. The diatom concentration in zone 1 (15.5 – 23 cm) is low, and mainly composed of high to medium robust benthic species. *Stephanocyclus meneghеniana* is absent in this zone.

The diatom concentration increases in zone 2 (9 – 15 cm). The relative abundance of *Stephanocyclus meneghiana* reaches 51% at 10 cm depth. Sediment transport (Wachnicka et al., 2013) or water inflow from land (Sylvestre et al., 2001) are explanations for the occurrence of brackish and freshwater species in a hypersaline lagoon. It is most likely that the lagoon was less saline during this period, because the catchment lacks any fresh water bodies that could have been the source of this diatom species. Also the Na concentration in this zone is slightly lower, which indicate less saline conditions during zone 2.

The peak in Ca at 14.3 cm depth, related to the deposition of apatite, may indicate a brief period with a decrease in water level, and more alkaline conditions. As a high concentration of Ca could lead to poor preservation, it is interesting to see that in particular one robust species, *Rhopalodia guetingeri,* is observed in a high relative abundance. This is in contrast to for instance *Nitzschia compressa,* categorized as medium robust, of which the relative abundance strongly drops at the Ca peak. Interestingly, also the percentage of valves that could not be identified is highest at 14.3 cm. Valves in this sample were to a large extent dissolved. *Rhopalodia guettingeri* showed only limited signs of dissolution.

Zone 3 shows increasing Na concentrations, whilst Ca concentrations strongly drop until 0.5 cm. Zone 3 furthermore is characterized by the poor preservation of diatoms, as no diatoms were found between 1 – 6 cm. An increase in salinity, reflected by elevated concentrations of Na, may explain the poor preservation of diatoms in this zone.

In short, the preservation of diatoms in the sediments at Saliña Bartol is strongly variable with depth. Robust species seems to be better preserved with alkaline conditions, but dissolve under highly saline conditions.

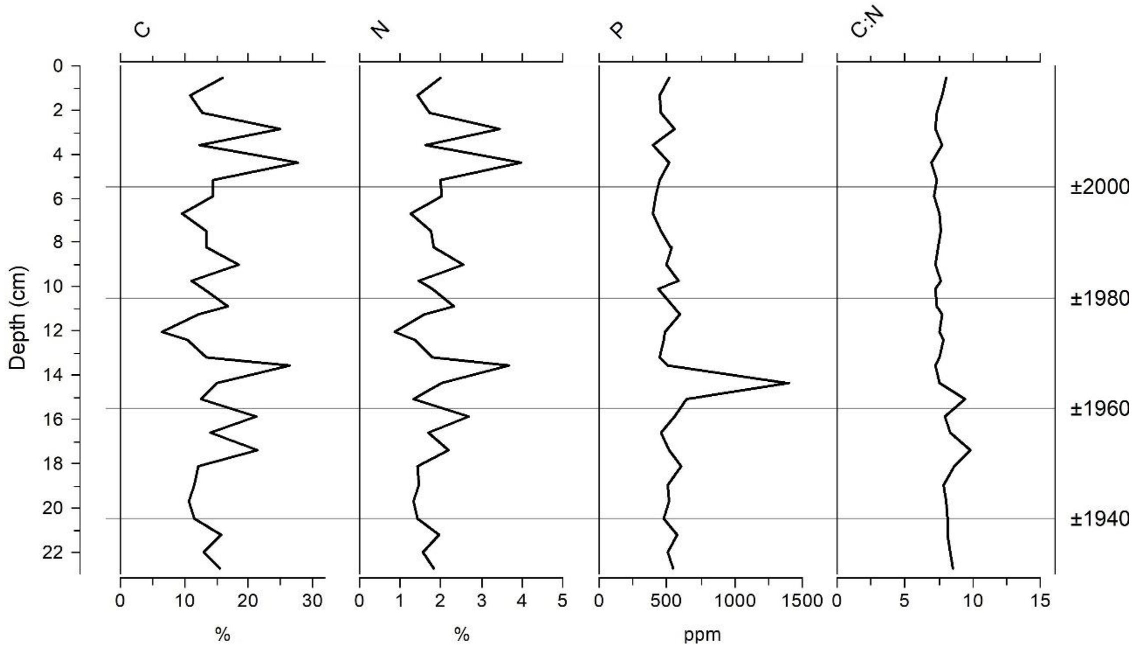


Fig. 15: Concentration of %C, %N, P and C:N measured in subsamples from the sediment core collected at Saliña Bartol (Bonaire).

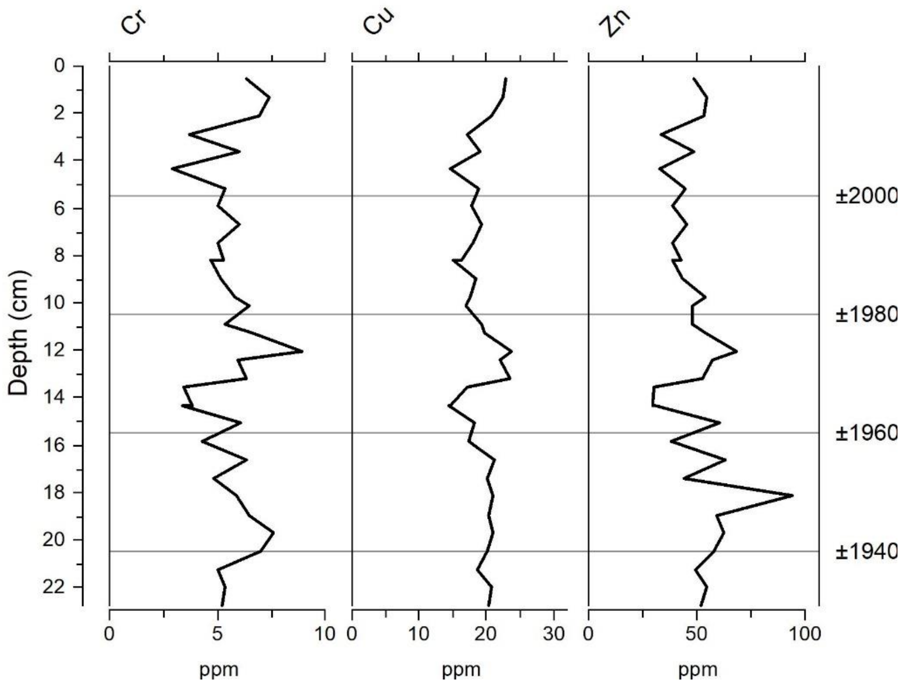


Fig. 16: Concentrations of Cr, Cu and Zn measured in subsamples from the sediment core collected at Saliña Bartol (Bonaire).

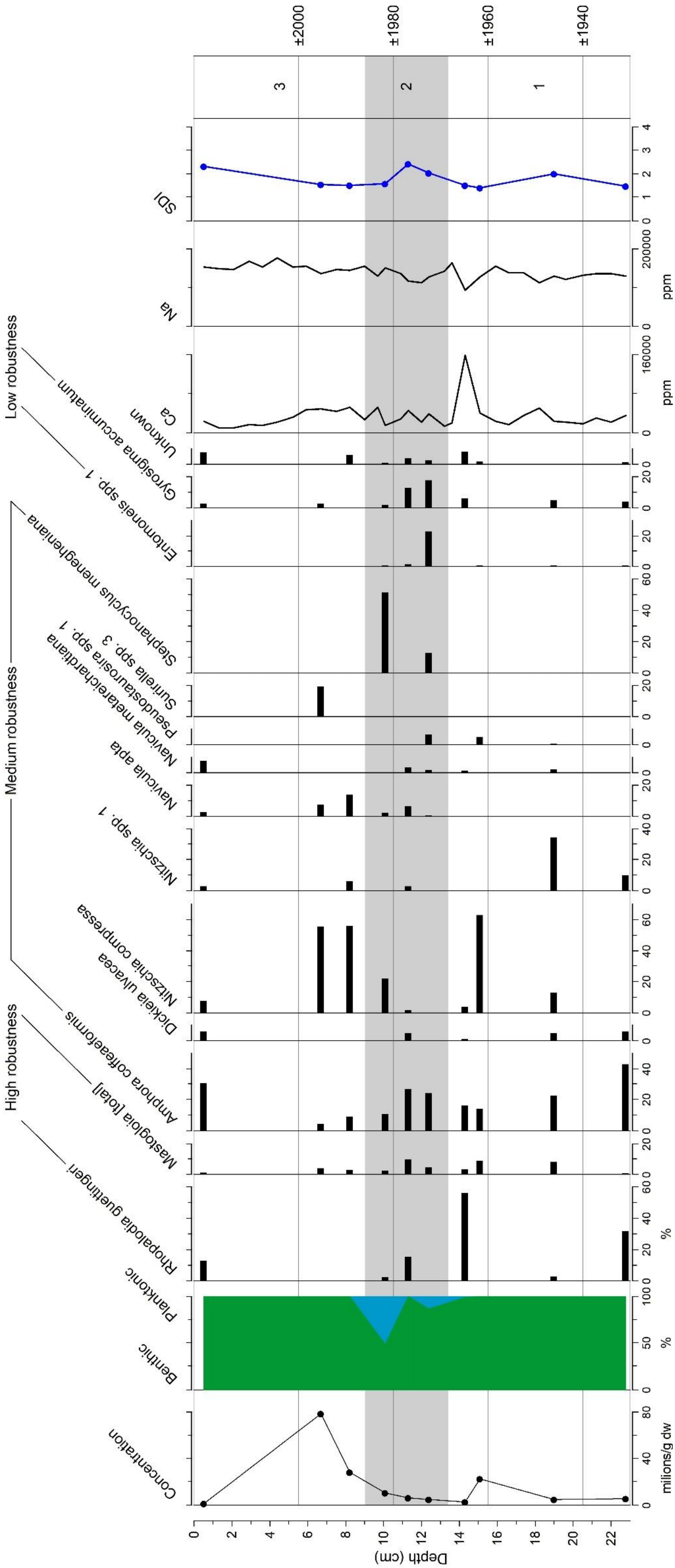


Fig. 17: Concentration of diatoms, diatom assemblage, SDI, Ca concentration, and Na concentration in subsamples from sediment core from Saliña Bartol (Bonaire). Division between benthic and planktonic species is indicated in green and blue respectively.

3.4 Spanish Lagoon (Aruba)

Spanish Lagoon is considered a medium impact site. No lithological boundaries have been observed in the core. The ^{210}Pb activity rapidly decreases in the top centimeters of the core (Appendix A.3), to very low values. A ^{137}Cs peak at 7.5 cm depth, is related to the peak in nuclear fallout in 1963. This implies an average sedimentation rate for the top 7.5 cm of the core of 1.3mm y^{-1}. The ^{210}Pb activity of deeper samples was insufficient for dating the sediment samples below 7.5 cm, and therefore the sedimentation rate of 1.3mm y^{-1} only applies for the top 7.5cm.

Diatoms were only observed in the subsample taken from the top of the core (0 – 1cm). Based on the sedimentation rate of 1.3mm yr^{-1}, this subsample represents 7 – 8 years. In this sample, 19 benthic species were found, of which only 7 species have a relative abundance of >2%. These include *Pinnunavis yarrensis* (47.5%), *Gyrosigma hummii* (19.1%), *Tryblionella acuminata* (12.2%), *Plagiotropis lepidoptera* (5.9%), *Nitzschia scabra* (5.0%) and *Stauroneis Africana* (2.2%).

Data of nutrients and heavy metals are presented in Fig. 18 and Fig. 19. Cd and Pb concentrations were below the detection limit. Heavy metal concentrations show to increase between 12 cm (Cr, Cu, Ni) and 15 cm (Zn). From ±1987 (4.5 cm) onwards, heavy metal concentrations start to decrease. The top 12 cm furthermore shows an increase in the concentration of N. Because the concentration of C also increases, this increase is likely due to an increase of the organic mater content in the upper centimeters. A peak in the concentration of P is measured in the bottom of the core. Towards the top of the core, a slight increase is measured.

Concentrations of N and P, and of diatom assemblage of the surface sediment sample do not indicate eutrophication of the lagoon. Higher concentrations of heavy metals between 3 and 12 cm may be related to agricultural activity in the catchment, that happened before the rapid development of tourism on the island.

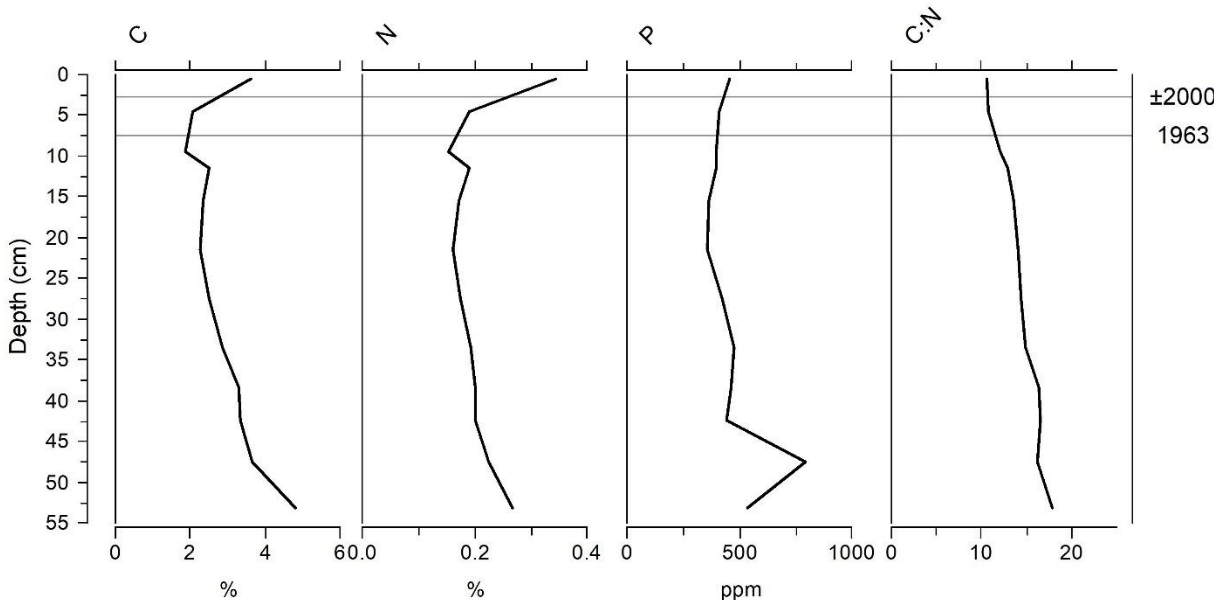


Fig. 18: Concentration of %C, %N, P and C:N measured in subsamples from the sediment core collected at Spanish Lagoon (Aruba).

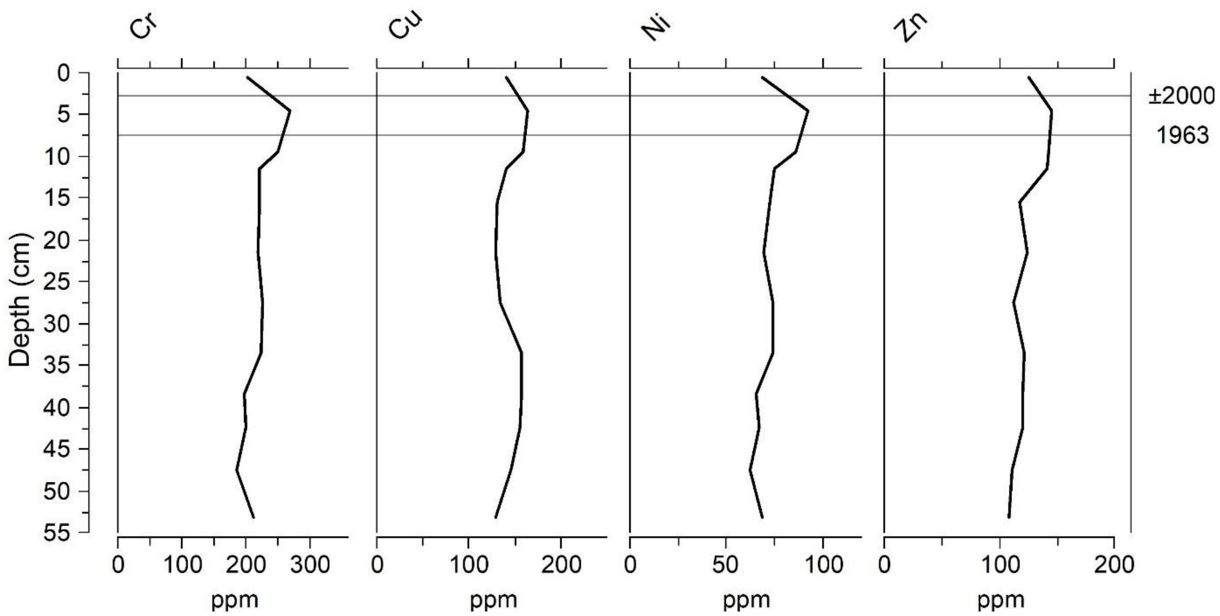


Fig. 19: Concentrations of Cr, Cu, Ni and Zn measured in subsamples from the sediment core collected at Spanish Lagoon (Aruba).

3.5 Comparing sites

The P and heavy mineral concentrations of all sediment surface samples from the different coastal lagoons are presented in Fig. 20.

The three brackish to freshwater ponds on Sint Maarten have high P concentrations. Heavy metal concentrations are also high in the sediments of this pond compared to the other sites. This is except for Cr and Ni, that seem to have naturally low concentrations compared with sites on Aruba and Curacao. The sediment sample from Saliña Bartol (Bonaire) shows in general the lowest concentration of heavy minerals.

For heavy metals, many countries, including the Netherlands, have institutionalized reference values. Quality reference values refer to values of heavy metals in water and soil in a natural state, i.e. with little or minimal human interference. For the Caribbean islands considered in this study, such values do not exist. For Cuba, quality reference values for sediment were recently calculated (in ppm) Cr (153), Cu (83), Ni (170), Zn (86) (Alfaro et al., 2015). Also Brazil has studied and published these values (in ppm): Cu (20.82), Cr (48.35), Ni (14.44), Zn (33.65) (Almeida et al., 2016). Quality reference values for sediment in the Netherlands are Cr (55), Cu (40), Ni (35) and Zn (140) (in ppm) (Spijker et al., 2012). These extreme differences in quality reference values already indicate that heavy metal concentrations are very context specific.

Even though reference values are unknown for the selected sites, the relatively long record found in the sediment cores of Spanish Lagoon (Aruba) and Saliña Bartol (Bonaire) provides an understanding of concentrations of heavy metals before recent human impact (Fig 16 and Fig. 19). Using these values as quality reference values seems fair for the site itself. However, it is inaccurate to apply these values to other sites. This is because of the discrepancy between Spanish Lagoon and Saliña Bartol (Fig. 9 and Fig 18). For instance, concentrations for Cr, before the rapid development of the islands, are up to 40 times higher for Spanish Lagoon compared to Saliña Bartol. The fact that these original values already severely differ, confirms that heavy metal concentrations are very site specific. Using quality reference values from other sites would not allow for an accurate interpretation of the data. Therefore, for the sites where only a surface sample was collected, it remains difficult to distinguish naturally occurring elevated concentrations from elevated concentrations caused by human impact.

The diatom assemblage data for the surface samples show that indicator species for eutrophication are only found in the three fresh to brackish ponds on Sint Maarten (group 2). These sites are characterized by a relatively high P concentration. In the saline lagoons, where P concentrations are lower, *Pinnunavis yarrensis* is frequently found in a rather high relative abundance. This robust species is likely overrepresented in the surface samples, because it occurred in low relative abundances in the modern diatom samples. Interestingly, in the sites with the highest SDI (Simpson Bay and Oyster Pond), diatom concentration is low, and species that are observed in a high relative abundance in other sites are absent here.

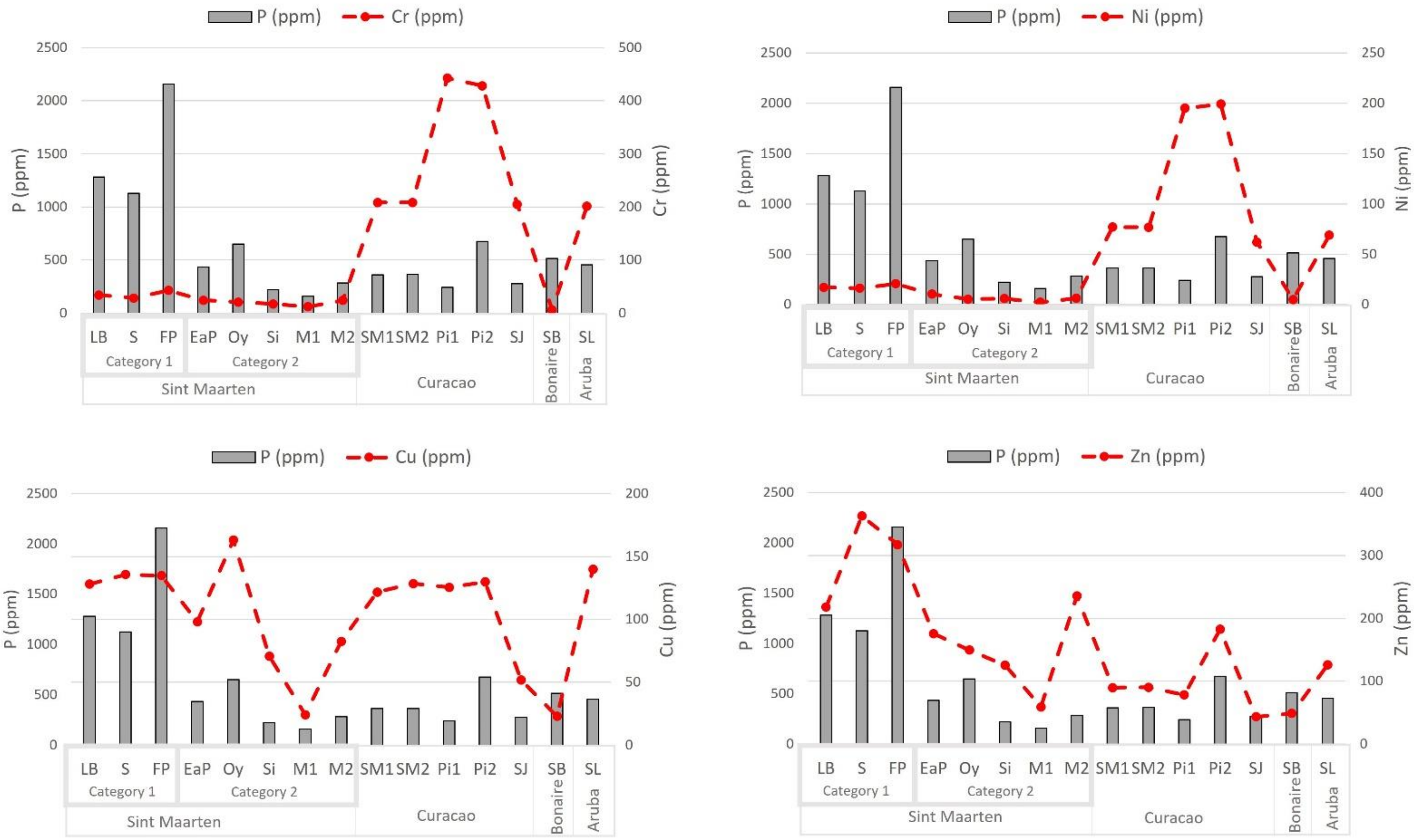


Fig. 20: Concentration of P and the heavy minerals Cu, Zn, Ni and Cr in sediment surface samples collected in 2022. Samples with heavy minerals exceeding the intervention levels are regarded as highly polluted with this element. SB: Saliña Bartol (Bonaire); SL: Spanish Lagoon (Aruba); SM: Santa Martha Bay (Curacao); SJ: Sint Joris Bay (Curacao); Pi1 and Pi2: Piscadera Bay (Curacao); Si: Simpson Bay (Sint Maarten); M1 and M2: Mullet Bay (Sint Maarten); EaP: Étang aux Poissons (Sint Maarten); Oy: Oyster Pond (Sint Maarten); S: Salt Pond (Sint Maarten); LB: Little Bay Pond (Sint Maarten); F: Fresh Pond (Sint Maarten).

3.5 Rethinking medium impact sites

Spanish Lagoon and Santa Martha Bay were considered medium impact sites. Spanish Lagoon shows a very low sedimentation rate over the past 60 years, and shows a decrease in heavy metal concentrations during this period. At Santa Martha, heavy metal and P concentrations hardly show any variations over depth. Furthermore, the diatom assemblages at both sites do not indicate strong eutrophication or heavy metal pollution. Therefore, Spanish Lagoon and Santa Martha can be regarded as low impact sites, rather than medium impact sites.

3.6 Human impacts on biodiversity

Human impact affect coastal lagoons in various ways. This study specifically investigated three types of human impact: sediment accumulation and filling of lagoons, nutrient enrichment and the increase in heavy metals. It was expected that human impact would decrease diatom diversity.

Diatom diversity is indicated by the SDI. It was expected that Saliña Bartol (Bonaire) would have the highest SDI values, as human impact was considered to be lowest. However, low SDI values were encountered in the Saliña Bartol samples. This can be explained by the dissolution of diatom valves, and by the fact that relatively fewer diatom species can survive in hypersaline waters.

Lowest SDI was expected to be found at Fresh Pond. When comparing Fresh Pond, Santa Martha, Spanish Lagoon and Saliña Bartol, indeed Fresh Pond shows the lowest SDI. This can be explained by the dominance of planktonic species as a result of eutrophication. Salinity is found to be an important factor for diatom diversity (Wachnicka et al., 2010). The highest SDI is expected in the saline lagoons with a strong gradient in salinity. This study shows that SDI is between 0.4 and 3.5 in saline lagoons. These values are comparable with SDI values found in coastal lagoons in Florida: between 1.3 and 3.9 (Wachnicka et al., 2010), at Homa lagoon in Turkey, between 1.0 and 3.4 (Sabanci, 2011), and in New Jersey, where SDI values are between 2.0 and 4.3 (Desianti et al., 2017).

Excessive nutrient loading is the primary driver of eutrophication that may lead to biodiversity loss. Elevated concentrations of heavy metals can lead to toxicity for organisms, which consequently might lead to a decreased biodiversity. To study this, the relationship between P and SDI, and between heavy metals and SDI was studied for the fifteen sediment surface samples. No correlation was found between the P concentration and the SDI (Fig. 20). Similarly, Cu, Cr and Ni do not show a correlation with SDI (Fig. 21). Although the Zn concentrations seem negatively correlated with the SDI (Fig. 21), this is mainly caused by the low diversity of diatoms in the ponds on Sint Maarten.

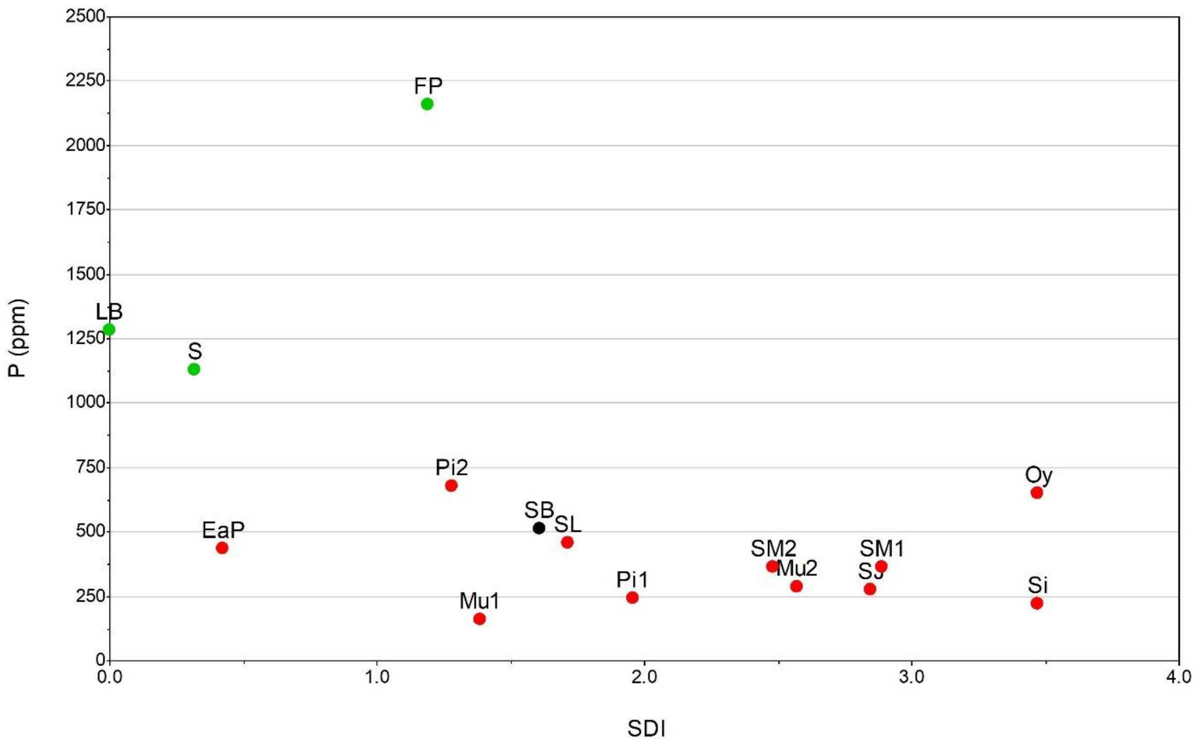


Fig. 21: Correlation between P (ppm) and SDI for surface samples. LB: Little Bay Pond (Sint Maarten); S: Salt Pond (Sint Maarten); FP: Fresh Pond (Sint Maarten); EaP: Étang aux Poissons (Sint Maarten); Mu1: Mullet Bay site 1 (Sint Maarten); Mu2: Mullet Bay site 2 (Sint Maarten); Si: Simpson Bay (Sint Maarten); Oy: Oyster Pond (Sint Maarten); Pi1: Piscadera Bay site 1 (Curacao); Pi2: Piscadera Bay site 2 (Curacao); SJ: Sint Joris Bay (Curacao); SM1: Santa Martha site 1 (Curacao); SM2: Santa Martha site 2 (Curacao); SB: Saliña Bartol (Bonaire); SL: Spanish Lagoon (Aruba). Color indicates the salinity: green indicates brackish water, red indicates marine sites, black indicates high salinity.

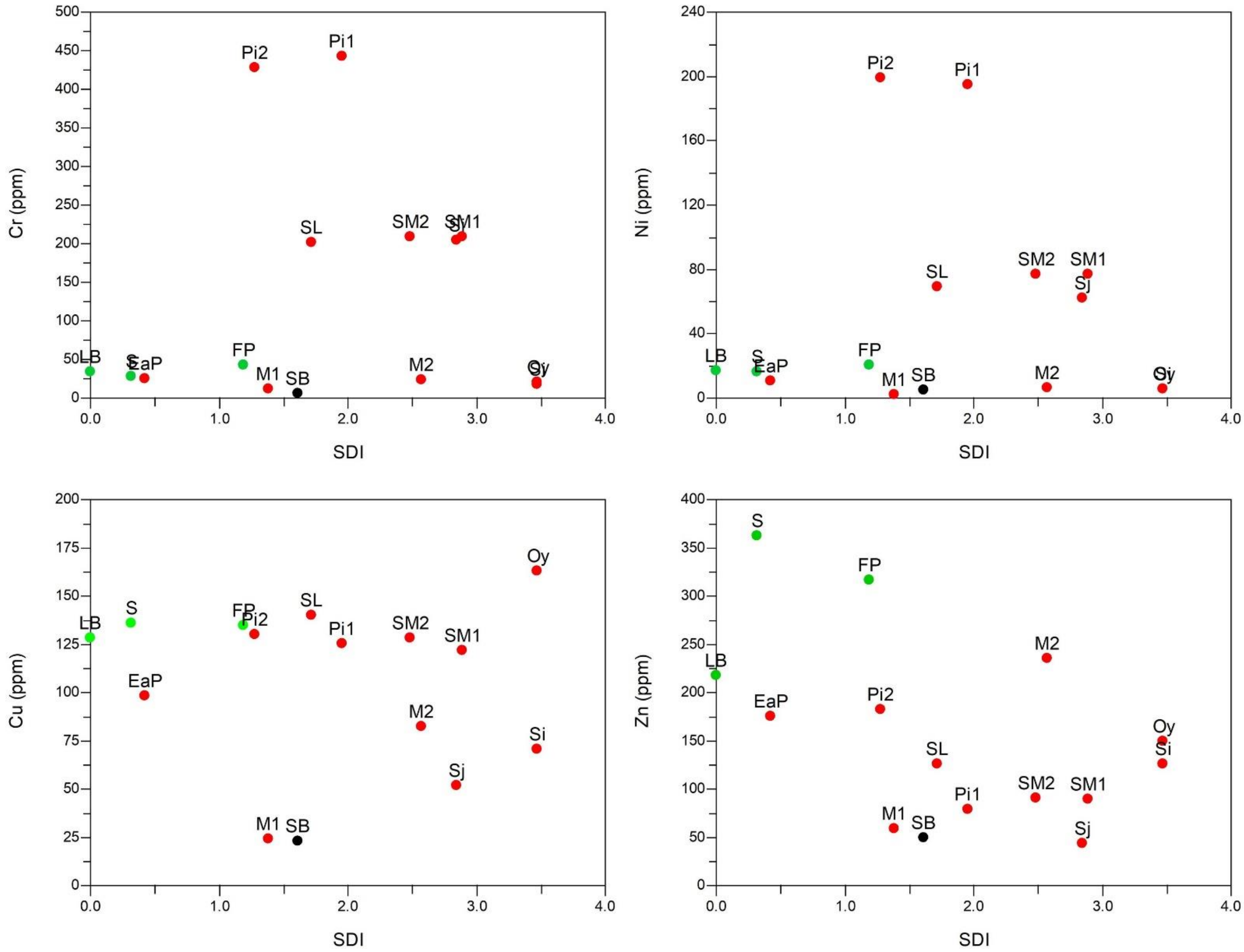


Fig. 22: Correlation between Cr (top left), Cu (top right), Ni (bottom left), Zn (bottom right) and SDI for surface samples. LB: Little Bay Pond (Sint Maarten); S: Salt Pond (Sint Maarten); FP: Fresh Pond (Sint Maarten); EaP: Étang aux Poissons (Sint Maarten); Mu1: Mullet Bay site 1 (Sint Maarten); Mu2: Mullet Bay site 2 (Sint Maarten); Si: Simpson Bay (Sint Maarten); Oy: Oyster Pond (Sint Maarten); Pi1: Piscadera Bay site 1 (Curacao); Pi2: Piscadera Bay site 2 (Curacao); SJ: Sint Joris Bay (Curacao); SM1: Santa Martha site 1 (Curacao); SM2: Santa Martha site 2 (Curacao); SB: Saliña Bartol (Bonaire); SL: Spanish Lagoon (Aruba). Color indicates the salinity: green indicates brackish water, red indicates marine sites, black indicates high salinity.

3.7 Limitations

Reconstructions of environmental conditions and water quality at freshwater sites are frequently done using diatoms, because diatom assemblages quickly respond to changes and variations in nutrient levels. However, this study showed that this can be complicated at coastal lagoons were preservation of diatoms can be poor.

The preservation of diatoms in the four sediment cores of Fresh Pond, Santa Martha, Spanish Lagoon and Saliña Bartol varied considerably. Marine sites are, because of salinity, more prone to dissolution of diatoms (Ryves & Flowers, 2009). Taking into account preservation issues is crucial because results based on diatom counts can be biased. This is because, firstly, poor preservation might cause an overestimation of species that are better preserved. Secondly, because of dissolution, the concentration of diatoms might be underestimated. It was therefore considered crucial to include dissolution data, as well as determination of absolute concentrations in order to accurately interpret diatom assemblage data. Reliability and validity was impacted by poor preservation of diatoms. In order to overcome this limitation, preservation was assessed for two coastal lagoons, and results concerning human impacts were based on multiple proxies rather than using diatoms only.

Another limitation that applies to this study is that it exclusively focused on the elements P, N, C, Ca, Na, Cr, Cu and Zn. It is acknowledged that other elements and contaminants might influence diatom assemblage as well. Since this study focuses on the state of coastal lagoons linked to human activities and impact, it was considered suitable to focus on the nutrients that are linked most strongly to human activity: P and N, as well as heavy metals. Ca and Na were included in this research, since literature suggests that is an important factor for diatom preservation. It was beyond the scope of this research to include other elements.

4. Conclusion and outlook

Coastal lagoons in the Caribbean are degrading. They are, in particular, vulnerable to impacts from human activities on land. However, the state of coastal lagoons, and the impact of human activities is largely unknown. The aim of this study was to assess the extent to which coastal lagoons in the Caribbean are impacted by land-use changes. This was done by studying diatom assemblages in sediment samples, by estimating the sedimentation rate, and by analyzing nutrients (P and N) and heavy metals. Four sites varying from high impact (Fresh Pond, Sint Maarten), to medium impact (Spanish Lagoon, Aruba; Santa Martha, Curacao) to low impact sites (Saliña Bartol, Bonaire) were selected for this study. Expected was that 1) levels of P, N and heavy metals are higher in high impact sites than in medium and low impact sites, and that 2) diatom diversity is higher in low impact sites, than in medium and high impact sites. Results confirm that the high impact site Fresh Pond (Sint Maarten) is most strongly influenced by human impacts. High sedimentation rates, elevated levels of heavy metals, P and N, a low SDI, and the dominance of planktonic species are indicators of a degraded waterbody with eutrophic conditions.

Spanish Lagoon (Aruba) and Santa Martha (Curacao) do not show clear signs of eutrophication. Saliña Bartol (Bonaire) shows a lower than expected SDI. However, results of the diatoms assemblage at Saliña Bartol are most likely influenced by a poor preservation of valves and the limited number of species that can survive under hypersaline conditions.

This research is the first of its kind to explore the state of coastal lagoons in the Caribbean by using diatoms. Based on this study, a couple of recommendations are made. Firstly, an integrated approach with multiple proxies is recommended when aiming at reconstructing past and present environmental conditions at coastal lagoons. Secondly, for monitoring purposes, it is recommended to include modern sediment surface samples.

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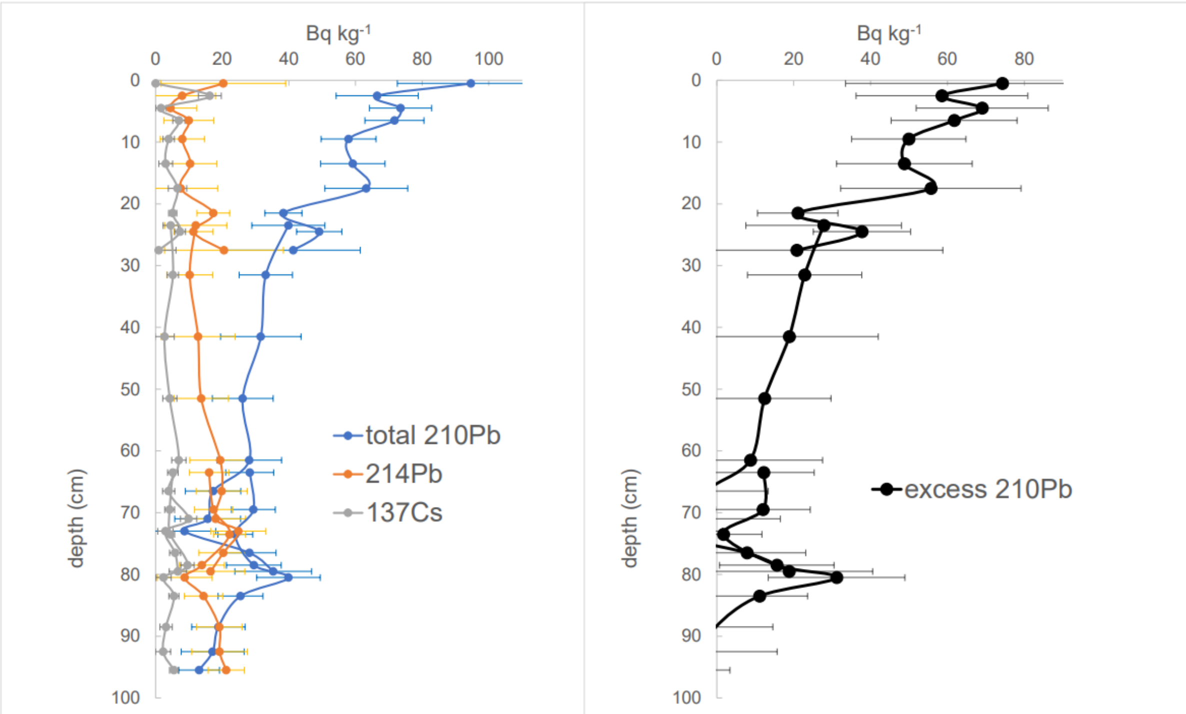
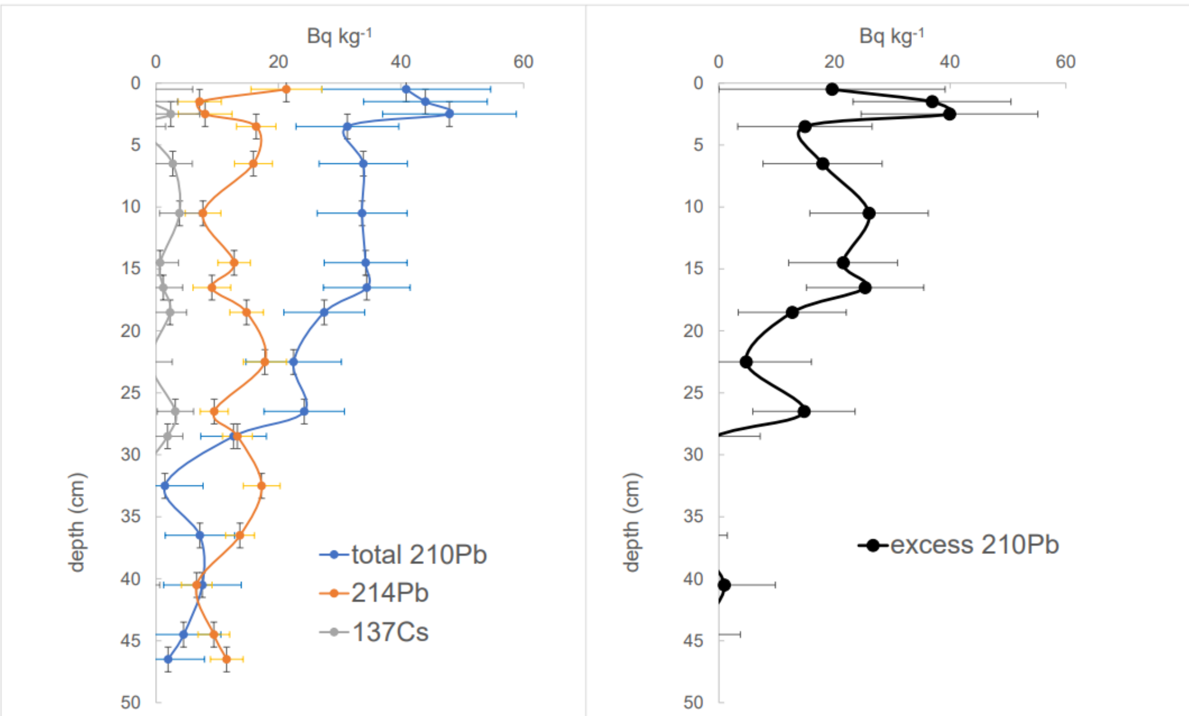
Appendix

A. ^{210}Pb and ^{137}Cs values for sediment cores

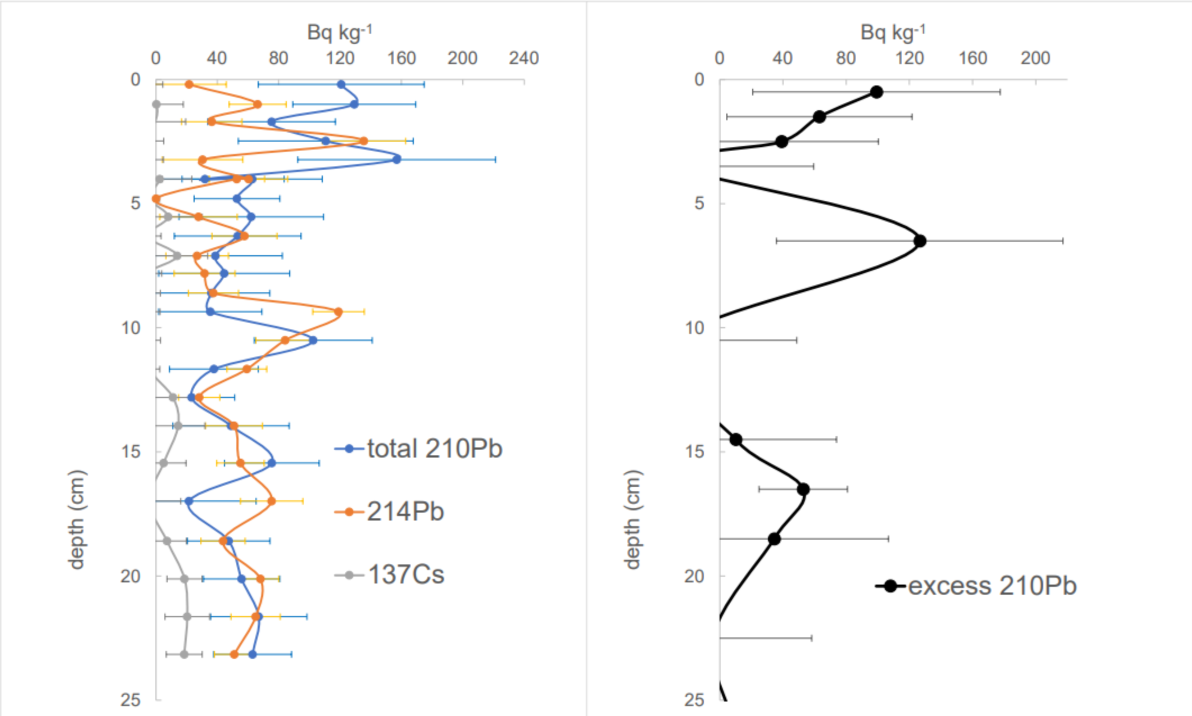
A.1 ^{210}Pb and ^{137}Cs values for Fresh Pond (Sint Maarten)



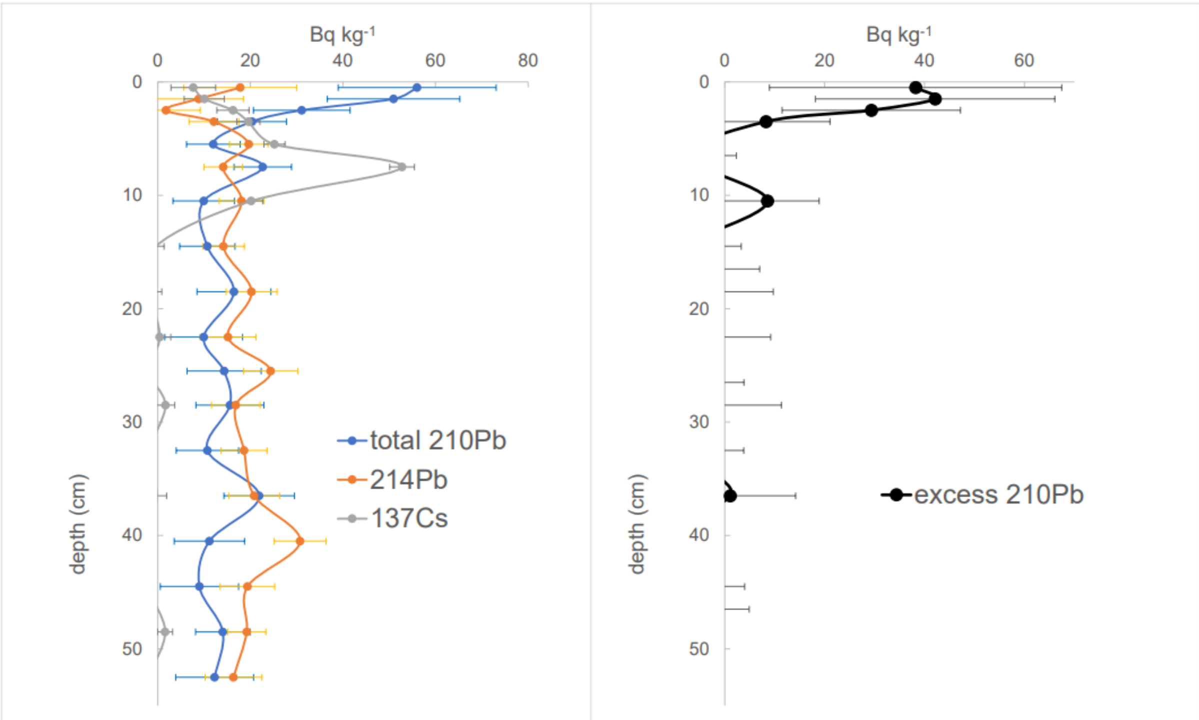
A.2 ^{210}Pb and ^{137}Cs values for Santa Martha (Curacao)



A.3 ^{210}Pb and ^{137}Cs values for Saliña Bartol (Bonaire)

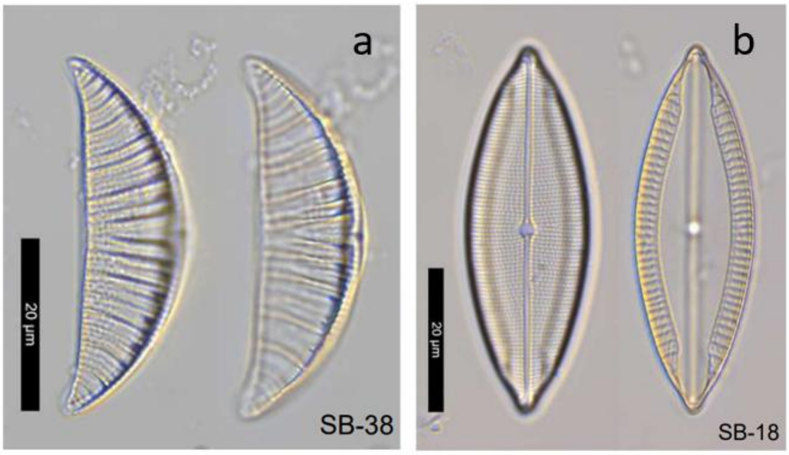


A.4 ^{210}Pb and ^{137}Cs values for Spanish Lagoon (Aruba)



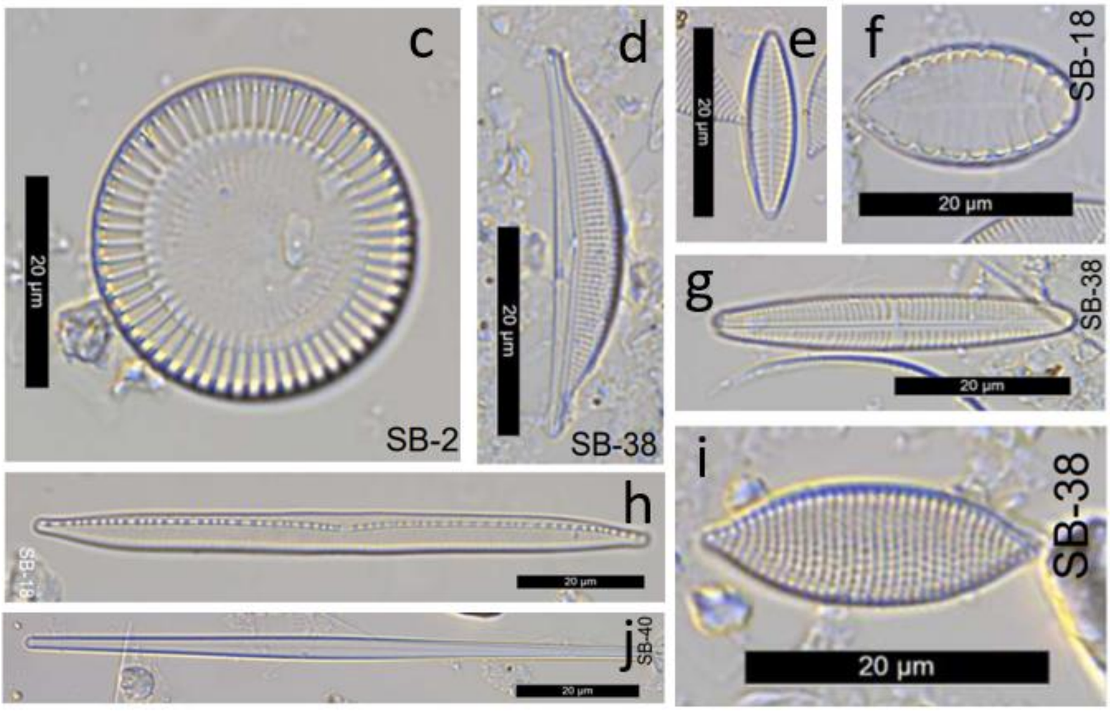
B. Robustness of diatoms

B.1 Species classified under the category high robustness



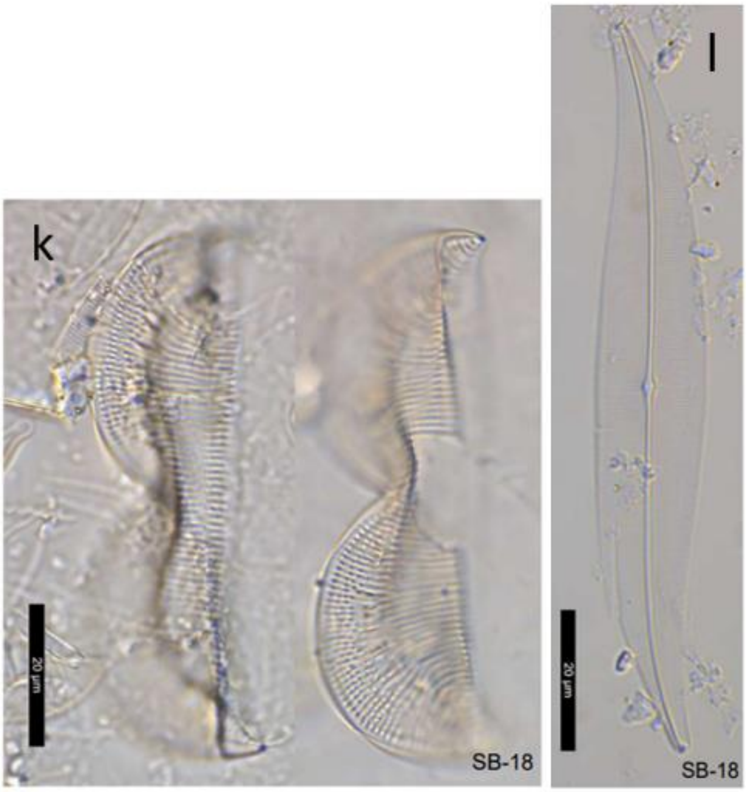
a: Rhopalodia guettengeri; b: Mastogloia spp. 1.

B.2 Diatom species classified under the category medium robustness



C: Stephanocyclus meneghiniana; d: Amphora coffeaeformis; e: Nitzschia apta; f: Surirella spp. 3; g: Dickieia ulvacea; h: Nitzschia filiformis; i: Nitzschia compressa; j: Pseudostaurosira spp. 1.

B.3 Diatom species classified under the category low robustness



k: Entomeis spp. 1; l: Pleurosigma formosum;

C. ICP-EOS data

	Al 396.153 (ppm)	Ba 455.403 (ppm)	Be 313.107 (ppm)	Ca 317.933 (ppm)	Cd 228.802 (ppm)	Ce 418.660 (ppm)	Co 230.786 (ppm)
LOQ	0.1119	0.0005	0.0051	0.1128	0.0088	0.0452	0.0175
Detection Limt	0.1216	0.0005	0.0052	0.1274	0.0099	0.0522	0.0219
BEC	0.0078	0.0037	0.0001	0.0007	0.0018	0.0342	0.0113
2x STD high	1244.650	64.342	64.320	1216.322	64.490	64.388	63.978
Recovery QC1 (%)		102	98		100	104	97
Recovery QC2 (%)	97			104		101	
Recovery QC3 (%)		101	99		100	101	98
Recovery QC4 (%)	98			104			

Location	Depth (cm)	Sample Id	R	Al 396.153 (ppm)	Ba 455.403 (ppm)	Be 313.107 (ppm)	Ca 317.933 (ppm)	Cd 228.802 (ppm)	Ce 418.660 (ppm)	Co 230.786 (ppm)
Blank		EvdD-001	1.0	0.079	0.000	0.000	0.264	0.004	-0.007	-0.011
Standard		EvdD-002	220.6	54053.108	574.795	2.189	43977.935	3.274	43.290	11.789
Saliña Bartol, Bonaire	0.5	EvdD-003	258.0	22066.090	186.813	0.256	23590.857	1.256	0.521	2.269
Saliña Bartol, Bonaire	1.3	EvdD-004	241.3	28387.531	172.270	0.330	10757.483	0.918	0.346	3.222
Saliña Bartol, Bonaire	2.1	EvdD-005	213.3	29568.700	193.147	0.330	10171.833	1.164	-2.378	1.140
Saliña Bartol, Bonaire	2.9	EvdD-006	258.4	12471.013	123.684	0.155	17459.282	1.055	-1.978	0.968
Saliña Bartol, Bonaire	3.6	EvdD-007	251.8	25322.057	199.556	0.270	15546.121	1.147	-1.913	1.344
Saliña Bartol, Bonaire	4.4	EvdD-008	238.0	9799.541	107.483	0.113	21086.101	0.714	-2.028	-1.187
Saliña Bartol, Bonaire	5.2	EvdD-009	225.3	20058.552	167.649	0.212	32810.455	0.693	-0.662	0.464
Saliña Bartol, Bonaire	5.9	EvdD-010	240.1	17064.639	158.736	0.193	47341.858	1.128	-2.959	-1.236
Saliña Bartol, Bonaire	6.7	EvdD-011	239.1	24130.219	217.141	0.252	48740.292	0.864	-0.674	1.580
Saliña Bartol, Bonaire	7.5	EvdD-012	267.6	19578.651	188.255	0.205	44566.810	1.105	-0.040	0.958
Saliña Bartol, Bonaire	8.2	EvdD-013	262.8	18604.235	203.903	0.207	51624.710	0.585	-2.444	-0.550
Saliña Bartol, Bonaire	8.2	EvdD-014	238.7	18760.693	203.001	0.243	51813.869	0.591	-0.463	1.018
Saliña Bartol, Bonaire	9.0	EvdD-015	260.3	19422.771	172.049	0.227	27666.534	0.994	-2.833	0.488
Saliña Bartol, Bonaire	9.7	EvdD-016	248.5	25676.530	253.935	0.291	51422.171	1.182	-2.119	0.352
Saliña Bartol, Bonaire	10.1	EvdD-017	239.3	24744.385	167.519	0.282	14659.021	0.970	-2.357	0.461
Saliña Bartol, Bonaire	10.9	EvdD-018	254.1	22788.743	206.502	0.267	28297.514	0.914	-2.712	1.404
Saliña Bartol, Bonaire	11.3	EvdD-019	244.4	27369.542	254.357	0.284	46260.631	1.022	-0.754	2.655
Saliña Bartol, Bonaire	12.0	EvdD-020	248.6	40637.186	257.457	0.403	21249.684	0.927	-2.758	4.183
Saliña Bartol, Bonaire	12.4	EvdD-021	239.2	27271.023	209.640	0.363	38107.947	1.101	3.209	4.902
Saliña Bartol, Bonaire	13.2	EvdD-022	260.2	28058.731	185.074	0.398	12938.774	0.989	-3.057	1.101
Saliña Bartol, Bonaire	13.6	EvdD-023	248.3	12679.138	120.034	0.167	19801.565	1.300	-1.607	-0.629
Saliña Bartol, Bonaire	14.3	EvdD-024	255.6	13887.627	169.942	0.188	158303.670	0.921	-1.817	-1.717
Saliña Bartol, Bonaire	14.3	EvdD-025	254.1	13822.184	168.701	0.189	154584.390	0.852	-1.978	-0.629
Saliña Bartol, Bonaire	15.1	EvdD-026	260.5	25819.727	185.975	0.310	40141.095	1.112	0.916	1.874
Saliña Bartol, Bonaire	15.9	EvdD-027	261.1	18598.669	165.093	0.230	23324.890	0.818	-1.496	0.216
Saliña Bartol, Bonaire	16.6	EvdD-028	256.3	29187.247	221.455	0.346	16201.436	1.182	-1.081	3.441
Saliña Bartol, Bonaire	17.4	EvdD-029	251.0	19109.204	179.356	0.251	36045.592	1.710	-1.660	1.051
Saliña Bartol, Bonaire	18.2	EvdD-030	250.6	28310.640	252.291	0.350	49689.884	1.365	-0.203	2.526
Saliña Bartol, Bonaire	19.0	EvdD-031	246.7	28757.628	230.378	0.344	23531.233	1.213	-1.370	2.280
Saliña Bartol, Bonaire	19.7	EvdD-032	254.1	31832.158	268.487	0.353	22168.531	1.022	-2.078	2.698
Saliña Bartol, Bonaire	20.5	EvdD-033	254.2	29749.664	249.902	0.379	18735.208	1.383	-2.576	2.208
Saliña Bartol, Bonaire	21.2	EvdD-034	257.7	24221.725	233.150	0.288	30216.713	1.498	-4.053	1.677
Saliña Bartol, Bonaire	22.0	EvdD-035	245.1	28391.869	243.193	0.335	22725.060	1.255	-2.986	2.333
Saliña Bartol, Bonaire	22.8	EvdD-036	262.6	25091.671	237.037	0.290	35677.728	1.557	-0.572	1.985
Saliña Bartol, Bonaire	22.8	EvdD-037	264.1	25255.939	240.697	0.271	32583.665	1.221	-3.090	1.616
Étang aux Poissons, Saint Martin	0.5	EvdD-038	253.4	57165.911	150.741	0.485	105634.377	0.941	-7.928	7.858
Oyster Pond, Sint Maarten	0.5	EvdD-039	261.9	37483.362	123.431	0.302	169435.229	0.378	-3.854	0.701

Simpson Bay Lagoon, Sint Maarten	1	EvdD-040	256.2	16372.052	64.718	0.192	232718.673	1.639	-4.780	-0.976
Mullet Bay lagoon, Sint Maarten	0.5	EvdD-041	256.4	5608.301	19.303	0.152	323955.995	1.522	-1.732	-2.078
Mullet Bay lagoon, Sint Maarten	1	EvdD-042	249.5	17156.866	69.743	0.330	234812.829	4.425	-2.058	0.869
Little Bay Pond, Sint Maarten	0.5	EvdD-043	250.2	64819.115	206.618	0.611	64976.461	0.651	-12.035	14.240
Salt Pond, Sint Maarten	0.5	EvdD-044	253.7	45870.872	206.990	0.465	93024.306	1.309	-4.608	12.581
Piscadera Bay, Curaçao	0.5	EvdD-045	252.9	68314.588	21.532	0.353	27001.892	-0.155	-27.480	37.989
Piscadera Bay, Curaçao	0.5	EvdD-046	260.1	65024.289	38.343	0.293	28829.690	0.692	-23.563	43.190
Sint Joris Bay, Curaçao	0.5	EvdD-047	265.7	35574.052	12.217	0.195	196246.152	0.543	-10.668	15.942
Santa Martha Bay, Curaçao	0.5	EvdD-048	263.1	62702.945	102.508	0.474	46537.277	-0.131	-25.325	32.688
Fresh Pond, Sint Maarten	0.5	EvdD-049	262.6	72778.765	218.992	0.634	46736.703	0.800	-14.191	14.630
Fresh Pond, Sint Maarten	4.5	EvdD-050	250.6	75887.202	213.454	0.677	44995.954	0.586	-13.834	15.687
Fresh Pond, Sint Maarten	9.5	EvdD-051	258.7	75118.805	216.806	0.648	49727.164	1.300	-11.858	15.288
Fresh Pond, Sint Maarten	14.5	EvdD-052	240.6	73609.623	218.795	0.605	55415.449	1.211	-12.532	14.892
Fresh Pond, Sint Maarten	14.5	EvdD-053	260.5	74315.140	221.699	0.631	55919.020	0.646	-11.058	14.820
Fresh Pond, Sint Maarten	20.5	EvdD-054	256.9	70748.202	222.789	0.905	68579.457	0.483	-12.889	14.767
Fresh Pond, Sint Maarten	24.5	EvdD-055	253.0	74301.436	215.557	0.625	56074.388	0.815	-15.724	16.147
Fresh Pond, Sint Maarten	29.5	EvdD-056	258.6	76789.888	212.887	0.635	58587.503	1.424	-16.314	17.185
Fresh Pond, Sint Maarten	39.5	EvdD-057	262.0	79601.408	216.457	0.626	43579.588	0.789	-15.890	17.371
Fresh Pond, Sint Maarten	49.5	EvdD-058	261.5	79527.260	253.689	0.655	54926.204	1.096	-15.410	17.091
Fresh Pond, Sint Maarten	49.5	EvdD-059	249.2	79372.531	252.385	0.663	54523.655	0.894	-13.403	17.077
Fresh Pond, Sint Maarten	59.5	EvdD-060	264.3	85432.313	273.098	0.692	52139.123	1.072	-14.747	19.227
Fresh Pond, Sint Maarten	64.5	EvdD-061	253.7	79390.347	244.209	0.741	45501.234	1.485	-12.858	19.833
Fresh Pond, Sint Maarten	76.5	EvdD-062	260.5	77919.855	256.771	0.692	58974.059	0.851	-12.813	18.056
Fresh Pond, Sint Maarten	80.5	EvdD-063	259.6	80388.959	254.958	0.690	46111.622	0.501	-14.597	18.280
Fresh Pond, Sint Maarten	87.5	EvdD-064	247.8	82367.881	250.766	0.665	36458.040	0.902	-15.493	20.720
Fresh Pond, Sint Maarten	87.5	EvdD-065	247.8	82025.279	250.016	0.667	36287.112	0.702	-14.675	19.262
Fresh Pond, Sint Maarten	95.5	EvdD-066	255.9	83239.905	245.776	0.671	37673.735	0.748	-17.892	20.336
Fresh Pond, Sint Maarten	101.5	EvdD-067	241.9	84421.067	244.811	0.678	39013.417	1.364	-16.069	23.213
Santa Martha Bay, Curaçao	0.5	EvdD-068	251.5	62549.085	103.607	0.440	44914.674	-0.229	-24.604	30.553
Santa Martha Bay, Curaçao	3.5	EvdD-069	256.2	62386.049	107.076	0.425	44550.056	0.121	-24.672	31.268
Santa Martha Bay, Curaçao	6.5	EvdD-070	237.4	63060.072	108.585	0.450	45870.033	0.318	-24.351	31.620
Santa Martha Bay, Curaçao	10.5	EvdD-071	258.1	63678.621	110.408	0.436	46183.901	0.561	-24.508	31.935
Santa Martha Bay, Curaçao	13.5	EvdD-072	257.3	65815.435	108.575	0.432	48634.345	-0.025	-27.551	32.250
Santa Martha Bay, Curaçao	16.5	EvdD-073	254.5	63926.771	113.326	0.450	47057.342	0.260	-26.076	30.792
Santa Martha Bay, Curaçao	18.5	EvdD-074	260.1	63130.733	106.754	0.434	49167.706	0.078	-25.160	31.864
Santa Martha Bay, Curaçao	22.5	EvdD-075	256.5	62691.975	105.068	0.395	54799.766	-0.123	-24.803	32.225
Santa Martha Bay, Curaçao	26.5	EvdD-076	245.7	60823.913	108.842	0.429	55092.144	0.241	-23.304	30.945
Santa Martha Bay, Curaçao	30.5	EvdD-077	250.2	51499.179	83.949	0.356	89016.019	0.313	-21.727	27.670
Santa Martha Bay, Curaçao	32.5	EvdD-078	252.3	59104.344	85.081	0.371	58347.164	-0.571	-26.788	31.024
Santa Martha Bay, Curaçao	36.5	EvdD-079	242.0	56043.609	94.969	0.330	69252.886	-0.050	-24.271	28.071
Santa Martha Bay, Curaçao	40.5	EvdD-080	241.7	55855.117	102.752	0.354	77537.637	0.417	-22.199	27.729
Santa Martha Bay, Curaçao	44.5	EvdD-081	246.6	62742.252	83.171	0.507	45803.944	0.043	-25.202	29.824
Santa Martha Bay, Curaçao	46.5	EvdD-082	257.9	66573.571	99.561	0.433	34376.624	0.206	-27.429	33.502
Spanish Lagoon, Aruba	0.5	EvdD-083	262.8	73727.121	261.677	0.723	26699.915	0.660	-24.055	28.226
Spanish Lagoon, Aruba	4.5	EvdD-084	259.8	83701.906	265.383	0.732	23843.329	-0.098	-27.517	32.505
Spanish Lagoon, Aruba	9.5	EvdD-085	262.0	83892.931	269.549	0.669	22216.215	0.147	-25.831	32.120
Spanish Lagoon, Aruba	11.5	EvdD-086	254.1	79504.404	273.785	0.673	26578.827	-0.117	-26.690	28.087
Spanish Lagoon, Aruba	15.5	EvdD-087	251.8	78545.414	263.678	0.738	28273.906	0.449	-24.363	27.945
Spanish Lagoon, Aruba	21.5	EvdD-088	259.5	77197.059	261.059	0.651	34800.812	0.033	-24.690	26.812
Spanish Lagoon, Aruba	27.5	EvdD-089	243.1	76362.957	255.304	0.634	39385.185	-0.315	-23.465	25.881
Spanish Lagoon, Aruba	33.5	EvdD-090	256.4	77202.172	263.158	0.681	34250.491	0.409	-24.627	25.611
Spanish Lagoon, Aruba	38.5	EvdD-091	239.5	75878.465	265.604	0.684	32053.620	0.197	-23.054	24.679
Spanish Lagoon, Aruba	42.5	EvdD-092	254.4	75639.351	261.708	0.660	35715.373	-0.130	-21.489	23.689
Spanish Lagoon, Aruba	47.5	EvdD-093	242.2	70821.044	237.452	0.612	57888.995	0.452	-21.928	22.123
Spanish Lagoon, Aruba	53.3	EvdD-094	260.6	73445.745	234.987	0.665	37668.766	-0.073	-23.350	22.771
Standard		EvdD-095	233.6	54260.905	579.928	2.120	43146.032	2.613	42.583	11.856
Blank		EvdD-096	1.0	0.083	0.000	0.000	0.285	0.002	-0.009	-0.013

	Cr 205.560 (ppm)	Cu 324.752 (ppm)	Fe 259.939 (ppm)	K 766.490 (ppm)	Li 670.784 (ppm)	Mg 280.271 (ppm)
LOQ	0.0149	0.0084	0.1031	0.1375	0.0049	0.0982
Detection Limt	0.0164	0.0128	0.4033	0.1411	0.0051	1.1428
BEC	0.0027	0.0004	0.0014	0.2442	0.0053	0.0006
2x STD high	63.570	62.666	1009.158	500.512	64.248	1018.040
Recovery QC1 (%)	**99**	**99**		**98**	**103**	
Recovery QC2 (%)			**99**	**96**		**101**
Recovery QC3 (%)	**99**	**100**			**103**	
Recovery QC4 (%)			**99**	**98**		**101**

Location	Depth (cm)	Sample Id	R	Cr 205.560 (ppm)	Cu 324.752 (ppm)	Fe 259.939 (ppm)	K 766.490 (ppm)	Li 670.784 (ppm)	Mg 280.271 (ppm)
Blank		EvdD-001	1.0	0.002	0.058	-0.253	0.347	0.098	-1.001
Standard		EvdD-002	220.6	119.652	107.577	30476.354	17995.496	69.891	10853.632
Saliña Bartol, Bonaire	0.5	EvdD-003	258.0	6.334	22.826	15039.920	11165.677	37.825	24994.106
Saliña Bartol, Bonaire	1.3	EvdD-004	241.3	7.448	22.514	19199.647	12437.966	30.981	25887.470
Saliña Bartol, Bonaire	2.1	EvdD-005	213.3	6.954	20.673	18992.235	12925.115	33.282	25021.531
Saliña Bartol, Bonaire	2.9	EvdD-006	258.4	3.682	17.215	8685.782	9484.876	22.198	25410.689
Saliña Bartol, Bonaire	3.6	EvdD-007	251.8	6.049	19.027	15575.394	12126.960	28.174	25736.737
Saliña Bartol, Bonaire	4.4	EvdD-008	238.0	2.929	14.636	6492.482	9195.961	19.752	25585.652
Saliña Bartol, Bonaire	5.2	EvdD-009	225.3	5.353	18.920	12498.875	10687.669	22.383	24985.930
Saliña Bartol, Bonaire	5.9	EvdD-010	240.1	5.014	17.808	11156.035	9993.397	27.167	25220.649
Saliña Bartol, Bonaire	6.7	EvdD-011	239.1	6.033	19.195	15555.481	11098.294	31.313	24662.833
Saliña Bartol, Bonaire	7.5	EvdD-012	267.6	5.058	18.082	12846.067	10335.279	32.809	25440.339
Saliña Bartol, Bonaire	8.2	EvdD-013	262.8	5.294	16.313	12020.080	9965.327	32.691	24113.020
Saliña Bartol, Bonaire	8.2	EvdD-014	238.7	4.728	15.072	11835.419	9955.411	28.800	24348.706
Saliña Bartol, Bonaire	9.0	EvdD-015	260.3	5.159	18.538	12173.112	10659.588	29.926	24684.285
Saliña Bartol, Bonaire	9.7	EvdD-016	248.5	5.849	17.529	16287.772	11119.826	25.273	22928.093
Saliña Bartol, Bonaire	10.1	EvdD-017	239.3	6.521	17.024	16266.169	11300.055	26.428	24857.827
Saliña Bartol, Bonaire	10.9	EvdD-018	254.1	5.379	19.205	15025.321	10799.276	21.783	22995.689
Saliña Bartol, Bonaire	11.3	EvdD-019	244.4	6.598	19.807	17902.357	10983.680	22.831	20944.389
Saliña Bartol, Bonaire	12.0	EvdD-020	248.6	8.914	23.839	26639.433	13692.795	33.365	22267.771
Saliña Bartol, Bonaire	12.4	EvdD-021	239.2	5.976	22.024	17691.227	11386.495	26.585	21576.004
Saliña Bartol, Bonaire	13.2	EvdD-022	260.2	6.333	23.490	17928.078	12456.421	32.704	24697.115
Saliña Bartol, Bonaire	13.6	EvdD-023	248.3	3.423	17.234	8445.706	9460.592	22.301	24640.281
Saliña Bartol, Bonaire	14.3	EvdD-024	255.6	3.840	14.652	9810.935	7012.592	24.469	14977.318
Saliña Bartol, Bonaire	14.3	EvdD-025	254.1	3.400	14.413	9815.484	6948.420	25.569	14829.942
Saliña Bartol, Bonaire	15.1	EvdD-026	260.5	6.098	18.173	17396.405	11020.771	31.950	22600.718
Saliña Bartol, Bonaire	15.9	EvdD-027	261.1	4.309	17.359	11919.279	10362.934	25.717	24602.690
Saliña Bartol, Bonaire	16.6	EvdD-028	256.3	6.390	21.189	19141.078	12413.667	30.964	24472.006
Saliña Bartol, Bonaire	17.4	EvdD-029	251.0	4.852	20.200	12999.732	10068.329	22.151	22572.139
Saliña Bartol, Bonaire	18.2	EvdD-030	250.6	5.877	21.030	19245.509	11243.152	25.281	20668.619
Saliña Bartol, Bonaire	19.0	EvdD-031	246.7	6.498	20.415	19013.572	12091.108	26.994	24179.561
Saliña Bartol, Bonaire	19.7	EvdD-032	254.1	7.636	20.914	20827.979	12320.063	27.730	23583.840
Saliña Bartol, Bonaire	20.5	EvdD-033	254.2	6.990	20.041	19333.894	12608.103	29.177	25044.619
Saliña Bartol, Bonaire	21.2	EvdD-034	257.7	5.065	18.665	15375.849	11317.545	24.830	23658.551
Saliña Bartol, Bonaire	22.0	EvdD-035	245.1	5.383	20.737	18520.476	12211.110	29.926	24318.791
Saliña Bartol, Bonaire	22.8	EvdD-036	262.6	5.231	20.320	16129.022	11195.047	28.256	22744.393
Saliña Bartol, Bonaire	22.8	EvdD-037	264.1	4.903	21.170	16236.228	11288.977	31.338	23056.275
Étang aux Poissons, Saint Martin	0.5	EvdD-038	253.4	24.429	98.116	35785.410	9441.754	43.854	18390.442
Oyster Pond, Sint Maarten	0.5	EvdD-039	261.9	20.805	163.094	20763.094	6948.835	23.223	11334.943

Simpson Bay Lagoon, Sint Maarten	1	EvdD-040	256.2	17.444	70.662	10319.730	3950.714	17.177	12565.860
Mullet Bay lagoon, Sint Maarten	0.5	EvdD-041	256.4	12.096	24.125	3458.616	1386.124	11.828	9038.786
Mullet Bay lagoon, Sint Maarten	1	EvdD-042	249.5	23.999	82.419	9981.975	3713.814	17.660	13079.859
Little Bay Pond, Sint Maarten	0.5	EvdD-043	250.2	34.137	127.981	45222.862	6867.063	30.552	24181.398
Salt Pond, Sint Maarten	0.5	EvdD-044	253.7	28.559	135.665	33142.306	8519.199	36.172	22499.768
Piscadera Bay, Curaçao	0.5	EvdD-045	252.9	442.294	125.463	72635.576	7505.973	41.555	32440.789
Piscadera Bay, Curaçao	0.5	EvdD-046	260.1	428.007	129.757	69364.808	6092.918	51.395	41588.876
Sint Joris Bay, Curaçao	0.5	EvdD-047	265.7	204.978	51.862	32480.945	3117.649	25.376	25210.734
Santa Martha Bay, Curaçao	0.5	EvdD-048	263.1	208.312	128.419	69886.145	8382.827	59.979	32195.531
Fresh Pond, Sint Maarten	0.5	EvdD-049	262.6	42.706	134.739	49358.161	8149.424	34.585	23132.009
Fresh Pond, Sint Maarten	4.5	EvdD-050	250.6	45.583	140.527	51393.356	8386.868	33.943	23154.288
Fresh Pond, Sint Maarten	9.5	EvdD-051	258.7	42.102	139.854	50861.217	8272.191	30.270	23185.123
Fresh Pond, Sint Maarten	14.5	EvdD-052	240.6	43.363	131.231	50225.942	8171.428	27.456	22959.180
Fresh Pond, Sint Maarten	14.5	EvdD-053	260.5	45.372	135.521	50620.972	8306.384	28.792	23018.922
Fresh Pond, Sint Maarten	20.5	EvdD-054	256.9	37.895	101.416	45186.614	7997.677	21.715	20046.978
Fresh Pond, Sint Maarten	24.5	EvdD-055	253.0	40.235	127.761	49844.747	8394.733	26.664	24019.336
Fresh Pond, Sint Maarten	29.5	EvdD-056	258.6	38.812	126.819	51311.271	8640.104	29.130	24958.208
Fresh Pond, Sint Maarten	39.5	EvdD-057	262.0	39.574	142.186	55213.879	9027.202	33.343	26976.879
Fresh Pond, Sint Maarten	49.5	EvdD-058	261.5	37.808	119.115	50553.644	9045.095	26.442	22962.668
Fresh Pond, Sint Maarten	49.5	EvdD-059	249.2	38.429	111.868	50170.300	9080.953	25.508	22783.892
Fresh Pond, Sint Maarten	59.5	EvdD-060	264.3	42.508	132.736	56013.958	9594.793	30.927	26075.834
Fresh Pond, Sint Maarten	64.5	EvdD-061	253.7	35.519	125.618	51447.176	9058.530	33.351	23435.340
Fresh Pond, Sint Maarten	76.5	EvdD-062	260.5	40.009	110.763	50589.699	8769.098	28.206	23739.257
Fresh Pond, Sint Maarten	80.5	EvdD-063	259.6	38.111	119.284	54021.910	9335.602	29.653	24202.319
Fresh Pond, Sint Maarten	87.5	EvdD-064	247.8	40.538	137.521	57913.006	9512.943	28.849	27883.862
Fresh Pond, Sint Maarten	87.5	EvdD-065	247.8	41.973	136.818	57771.062	9605.772	29.142	27274.461
Fresh Pond, Sint Maarten	95.5	EvdD-066	255.9	38.925	130.210	56451.556	9674.779	27.963	28545.198
Fresh Pond, Sint Maarten	101.5	EvdD-067	241.9	39.901	143.640	57683.702	9976.510	34.858	31714.080
Santa Martha Bay, Curaçao	0.5	EvdD-068	251.5	208.621	121.732	70976.665	7947.466	52.704	32851.308
Santa Martha Bay, Curaçao	3.5	EvdD-069	256.2	208.511	121.774	70589.112	8030.400	53.070	32645.787
Santa Martha Bay, Curaçao	6.5	EvdD-070	237.4	206.955	121.627	71237.237	8356.692	56.673	33006.650
Santa Martha Bay, Curaçao	10.5	EvdD-071	258.1	209.696	123.247	72226.341	8299.098	56.971	33519.581
Santa Martha Bay, Curaçao	13.5	EvdD-072	257.3	218.753	128.520	74734.338	8466.277	59.073	33901.045
Santa Martha Bay, Curaçao	16.5	EvdD-073	254.5	211.083	124.891	72872.465	8308.098	61.049	33083.563
Santa Martha Bay, Curaçao	18.5	EvdD-074	260.1	211.433	125.614	71945.946	8442.532	59.149	33134.177
Santa Martha Bay, Curaçao	22.5	EvdD-075	256.5	208.326	127.048	70401.568	8544.112	59.508	32604.444
Santa Martha Bay, Curaçao	26.5	EvdD-076	245.7	201.383	123.916	67423.161	8638.151	56.250	31338.348
Santa Martha Bay, Curaçao	30.5	EvdD-077	250.2	171.863	124.254	65461.072	7676.776	51.300	24233.216
Santa Martha Bay, Curaçao	32.5	EvdD-078	252.3	200.104	145.844	71322.894	8847.673	61.158	28005.366
Santa Martha Bay, Curaçao	36.5	EvdD-079	242.0	174.182	136.459	65400.344	8103.991	55.712	24882.079
Santa Martha Bay, Curaçao	40.5	EvdD-080	241.7	174.042	134.416	64427.942	8071.312	56.953	23689.334
Santa Martha Bay, Curaçao	44.5	EvdD-081	246.6	194.405	159.855	73788.736	9137.758	59.365	22670.784
Santa Martha Bay, Curaçao	46.5	EvdD-082	257.9	208.012	159.279	76602.689	9460.993	66.423	26509.669
Spanish Lagoon, Aruba	0.5	EvdD-083	262.8	201.623	139.921	67266.195	9932.243	36.277	26945.921
Spanish Lagoon, Aruba	4.5	EvdD-084	259.8	269.656	164.130	78190.557	11941.616	47.098	30970.166
Spanish Lagoon, Aruba	9.5	EvdD-085	262.0	250.057	158.517	75212.736	11995.223	51.832	30433.738
Spanish Lagoon, Aruba	11.5	EvdD-086	254.1	220.978	140.478	70240.059	10494.516	43.292	28836.426
Spanish Lagoon, Aruba	15.5	EvdD-087	251.8	222.801	130.537	69334.743	10076.872	40.524	28197.660
Spanish Lagoon, Aruba	21.5	EvdD-088	259.5	218.294	128.812	69998.628	9684.896	38.311	28145.395
Spanish Lagoon, Aruba	27.5	EvdD-089	243.1	225.914	134.609	66536.550	10544.661	39.195	28638.423
Spanish Lagoon, Aruba	33.5	EvdD-090	256.4	224.856	157.512	65570.635	10997.197	42.948	29862.892
Spanish Lagoon, Aruba	38.5	EvdD-091	239.5	196.940	157.773	63769.572	11282.087	40.978	27906.830
Spanish Lagoon, Aruba	42.5	EvdD-092	254.4	201.082	156.337	64070.471	10865.295	41.495	27828.122
Spanish Lagoon, Aruba	47.5	EvdD-093	242.2	186.107	146.149	58747.831	10304.498	39.881	28003.270
Spanish Lagoon, Aruba	53.3	EvdD-094	260.6	212.691	129.289	63234.293	10180.438	43.003	28311.458
Standard		EvdD-095	233.6	122.378	103.779	30130.000	18293.210	62.103	10706.816
Blank		EvdD-096	1.0	0.003	0.017	-0.256	0.156	0.023	-1.026

	Mn 257.610 (ppm)	Mo 203.845 (ppm)	Na 589.592 (ppm)	Ni 231.604 (ppm)	P 213.617 (ppm)	Pb 220.353 (ppm)	S 181.975 (ppm)
LOQ	0.0031	0.0696	0.0895	0.0227	0.1044	0.1624	0.2407
Detection Limt	0.0039	0.0738	0.0933	0.0253	0.1148	0.1685	0.4733
BEC	0.0066	0.0080	0.0899	0.0088	0.0011	0.0336	0.0829
2x STD high	200.316	64.280	509.676	63.922	122.418	39.136	1014.648
Recovery QC1 (%)	**102**	**98**	**101**	**97**	**96**	**96**	
Recovery QC2 (%)	**109**		**96**	**106**	**103**		**99**
Recovery QC3 (%)	**102**	**99**		**98**		**100**	
Recovery QC4 (%)			**97**		**101**		**99**

Location	Depth (cm)	Sample Id	R	Mn 257.610 (ppm)	Mo 203.845 (ppm)	Na 589.592 (ppm)	Ni 231.604 (ppm)	P 213.617 (ppm)	Pb 220.353 (ppm)	S 181.975 (ppm)
Blank		EvdD-001	1.0	-0.004	-0.009	0.535	0.009	-0.024	0.005	0.294
Standard		EvdD-002	220.6	1264.679	1.639	5437.374	44.531	1353.161	165.255	714.891
Saliña Bartol, Bonaire	0.5	EvdD-003	258.0	722.436	18.413	152565.220	5.035	513.278	-3.067	18672.741
Saliña Bartol, Bonaire	1.3	EvdD-004	241.3	329.663	12.557	148013.372	3.860	449.106	-7.565	17016.070
Saliña Bartol, Bonaire	2.1	EvdD-005	213.3	208.300	16.475	145884.623	5.207	457.608	1.730	18817.814
Saliña Bartol, Bonaire	2.9	EvdD-006	258.4	284.486	14.235	168186.207	3.725	552.566	-5.146	20072.673
Saliña Bartol, Bonaire	3.6	EvdD-007	251.8	268.912	10.041	153708.188	4.527	395.006	-2.169	18158.585
Saliña Bartol, Bonaire	4.4	EvdD-008	238.0	271.572	7.235	176053.524	3.708	521.267	-1.157	21176.892
Saliña Bartol, Bonaire	5.2	EvdD-009	225.3	446.892	4.609	152378.992	3.936	447.748	-2.306	19599.288
Saliña Bartol, Bonaire	5.9	EvdD-010	240.1	589.248	7.905	155367.759	3.780	416.531	-0.687	19406.510
Saliña Bartol, Bonaire	6.7	EvdD-011	239.1	882.536	6.274	137072.600	4.672	401.865	-5.467	20329.381
Saliña Bartol, Bonaire	7.5	EvdD-012	267.6	878.728	5.603	146312.263	4.653	452.169	-2.551	20145.282
Saliña Bartol, Bonaire	8.2	EvdD-013	262.8	730.757	4.549	145511.754	3.347	522.970	-1.176	19313.669
Saliña Bartol, Bonaire	8.2	EvdD-014	238.7	718.783	2.922	146866.211	3.347	534.681	-0.961	19773.018
Saliña Bartol, Bonaire	9.0	EvdD-015	260.3	523.903	4.926	155580.183	4.489	496.826	-2.069	21888.337
Saliña Bartol, Bonaire	9.7	EvdD-016	248.5	1102.630	4.932	130632.070	4.694	583.201	-0.445	20225.776
Saliña Bartol, Bonaire	10.1	EvdD-017	239.3	537.051	7.168	150694.196	4.145	441.930	-2.964	21817.930
Saliña Bartol, Bonaire	10.9	EvdD-018	254.1	888.991	8.605	136084.097	4.096	544.064	-4.825	22556.811
Saliña Bartol, Bonaire	11.3	EvdD-019	244.4	1372.502	4.619	116515.290	4.876	595.300	2.121	22196.473
Saliña Bartol, Bonaire	12.0	EvdD-020	248.6	984.024	8.192	112552.284	5.588	488.783	-2.272	23289.159
Saliña Bartol, Bonaire	12.4	EvdD-021	239.2	1508.193	7.396	126896.048	5.568	474.378	-1.541	22249.512
Saliña Bartol, Bonaire	13.2	EvdD-022	260.2	354.803	9.220	143196.646	4.667	450.964	-0.739	22874.915
Saliña Bartol, Bonaire	13.6	EvdD-023	248.3	365.066	10.090	164447.898	3.796	503.020	-1.280	23269.580
Saliña Bartol, Bonaire	14.3	EvdD-024	255.6	696.506	9.211	94447.032	0.600	1384.296	4.102	15926.433
Saliña Bartol, Bonaire	14.3	EvdD-025	254.1	702.091	5.964	93522.163	1.753	1396.270	6.647	16062.487
Saliña Bartol, Bonaire	15.1	EvdD-026	260.5	774.601	10.913	128011.247	4.380	641.872	3.425	20900.857
Saliña Bartol, Bonaire	15.9	EvdD-027	261.1	548.664	7.709	155541.945	2.579	552.409	-4.947	24035.269
Saliña Bartol, Bonaire	16.6	EvdD-028	256.3	775.948	15.229	138978.435	4.148	457.192	-4.874	25822.332
Saliña Bartol, Bonaire	17.4	EvdD-029	251.0	756.258	14.367	138775.128	3.618	520.793	-1.684	23539.557
Saliña Bartol, Bonaire	18.2	EvdD-030	250.6	1404.634	14.465	111805.848	6.345	607.279	2.466	24269.560
Saliña Bartol, Bonaire	19.0	EvdD-031	246.7	893.577	11.384	128802.963	4.659	509.207	-0.072	23376.315
Saliña Bartol, Bonaire	19.7	EvdD-032	254.1	730.133	14.886	121905.832	5.800	517.799	-1.265	22971.103
Saliña Bartol, Bonaire	20.5	EvdD-033	254.2	525.520	18.260	132243.697	5.550	473.779	-0.347	23820.722
Saliña Bartol, Bonaire	21.2	EvdD-034	257.7	657.154	18.849	135911.894	2.890	574.433	-3.194	22956.165
Saliña Bartol, Bonaire	22.0	EvdD-035	245.1	728.189	19.826	136621.826	4.757	507.330	2.911	23979.393
Saliña Bartol, Bonaire	22.8	EvdD-036	262.6	853.732	14.700	129015.665	4.862	548.100	-2.739	23789.998
Saliña Bartol, Bonaire	22.8	EvdD-037	264.1	825.285	14.510	129442.661	3.343	527.112	-5.345	24208.395
Étang aux Poissons, Saint Martin	0.5	EvdD-038	253.4	581.468	5.388	29061.770	10.292	434.776	28.830	15484.836
Oyster Pond, Sint Maarten	0.5	EvdD-039	261.9	355.965	-0.166	28272.110	5.366	649.401	21.797	6764.734
Simpson Bay Lagoon, Sint Maarten	1	EvdD-040	256.2	299.417	9.564	34740.965	5.871	222.524	10.456	11016.479
Mullet Bay lagoon, Sint Maarten	0.5	EvdD-041	256.4	101.439	9.000	14415.763	2.363	160.117	15.954	4621.230

Mullet Bay lagoon, Sint Maarten	1	EvdD-042	249.5	210.675	5.552	32084.120	6.337	284.320	29.080	11554.102
Little Bay Pond, Sint Maarten	0.5	EvdD-043	250.2	1343.911	1.732	11470.619	17.182	1281.261	8.646	16983.911
Salt Pond, Sint Maarten	0.5	EvdD-044	253.7	1023.502	7.873	18207.103	16.315	1127.200	70.375	19844.345
Piscadera Bay, Curaçao	0.5	EvdD-045	252.9	644.483	-1.256	22667.464	195.108	242.577	-0.676	5314.331
Piscadera Bay, Curaçao	0.5	EvdD-046	260.1	677.556	2.687	26163.514	199.151	675.586	6.318	12269.831
Sint Joris Bay, Curaçao	0.5	EvdD-047	265.7	454.668	0.459	18084.311	61.967	277.121	7.726	2835.536
Santa Martha Bay, Curaçao	0.5	EvdD-048	263.1	1217.675	1.148	30642.903	76.833	363.511	6.027	3640.922
Fresh Pond, Sint Maarten	0.5	EvdD-049	262.6	1021.775	-1.330	13020.820	20.756	2157.781	21.639	5209.625
Fresh Pond, Sint Maarten	4.5	EvdD-050	250.6	1165.393	1.225	11854.424	22.427	1934.385	26.429	4153.031
Fresh Pond, Sint Maarten	9.5	EvdD-051	258.7	969.423	1.918	11891.350	21.144	1268.227	28.281	5730.203
Fresh Pond, Sint Maarten	14.5	EvdD-052	240.6	1109.643	-3.873	12676.565	18.916	1303.059	33.708	10487.448
Fresh Pond, Sint Maarten	14.5	EvdD-053	260.5	1121.099	-1.552	12975.600	19.814	1297.829	35.848	10579.047
Fresh Pond, Sint Maarten	20.5	EvdD-054	256.9	955.890	-0.403	14331.376	16.449	1160.156	26.443	4955.337
Fresh Pond, Sint Maarten	24.5	EvdD-055	253.0	1059.552	-1.546	12306.880	19.367	1515.010	26.417	3742.867
Fresh Pond, Sint Maarten	29.5	EvdD-056	258.6	1065.666	0.577	12378.802	21.691	1549.190	19.651	4401.909
Fresh Pond, Sint Maarten	39.5	EvdD-057	262.0	1100.673	1.052	11839.256	21.807	1084.713	29.185	7461.454
Fresh Pond, Sint Maarten	49.5	EvdD-058	261.5	1108.182	-0.421	15967.144	18.608	1075.094	28.186	3411.051
Fresh Pond, Sint Maarten	49.5	EvdD-059	249.2	1091.626	-0.877	16029.800	19.175	1064.324	30.442	3387.965
Fresh Pond, Sint Maarten	59.5	EvdD-060	264.3	1228.918	-0.450	16621.805	22.522	1126.415	31.178	7295.980
Fresh Pond, Sint Maarten	64.5	EvdD-061	253.7	1089.775	0.005	14051.922	19.434	1079.489	34.322	4074.445
Fresh Pond, Sint Maarten	76.5	EvdD-062	260.5	1131.993	2.510	16315.449	21.017	1106.559	27.545	4395.846
Fresh Pond, Sint Maarten	80.5	EvdD-063	259.6	1128.311	-1.258	15325.860	22.006	990.607	28.485	7707.180
Fresh Pond, Sint Maarten	87.5	EvdD-064	247.8	1162.024	-0.381	13991.839	23.323	1118.886	32.178	7010.069
Fresh Pond, Sint Maarten	87.5	EvdD-065	247.8	1178.662	-1.645	13897.216	23.053	1107.519	33.005	7022.375
Fresh Pond, Sint Maarten	95.5	EvdD-066	255.9	1203.402	-1.176	14406.590	23.251	981.383	25.534	5365.982
Fresh Pond, Sint Maarten	101.5	EvdD-067	241.9	1175.387	0.162	13141.956	24.426	1077.330	31.729	4993.445
Santa Martha Bay, Curaçao	0.5	EvdD-068	251.5	1443.398	0.809	28879.093	76.973	362.406	5.388	2336.239
Santa Martha Bay, Curaçao	3.5	EvdD-069	256.2	1339.288	0.230	29384.225	78.187	348.967	6.638	2418.555
Santa Martha Bay, Curaçao	6.5	EvdD-070	237.4	1292.961	-0.814	27689.789	78.376	362.615	7.311	2239.615
Santa Martha Bay, Curaçao	10.5	EvdD-071	258.1	1348.957	-1.933	29201.980	78.641	357.834	1.748	2330.789
Santa Martha Bay, Curaçao	13.5	EvdD-072	257.3	1275.460	-0.434	27629.797	80.244	371.617	2.930	2200.699
Santa Martha Bay, Curaçao	16.5	EvdD-073	254.5	1229.261	-1.124	27460.221	79.653	360.325	0.994	2139.024
Santa Martha Bay, Curaçao	18.5	EvdD-074	260.1	1198.146	-1.243	26858.122	79.007	364.828	0.643	2126.118
Santa Martha Bay, Curaçao	22.5	EvdD-075	256.5	1153.359	2.158	27901.272	77.406	352.270	6.411	2752.811
Santa Martha Bay, Curaçao	26.5	EvdD-076	245.7	1105.463	-0.600	26509.979	74.792	350.866	-1.059	2970.633
Santa Martha Bay, Curaçao	30.5	EvdD-077	250.2	2570.239	5.495	23928.503	62.555	300.004	5.024	23884.155
Santa Martha Bay, Curaçao	32.5	EvdD-078	252.3	1215.277	6.530	26389.512	71.341	322.808	7.478	22326.702
Santa Martha Bay, Curaçao	36.5	EvdD-079	242.0	1021.408	4.649	25054.102	65.271	320.428	-1.041	22993.856
Santa Martha Bay, Curaçao	40.5	EvdD-080	241.7	1092.897	1.503	26686.167	62.306	328.743	2.273	21257.560
Santa Martha Bay, Curaçao	44.5	EvdD-081	246.6	778.081	-0.031	25302.732	71.228	308.006	2.536	24186.568
Santa Martha Bay, Curaçao	46.5	EvdD-082	257.9	1283.823	-0.192	27933.936	77.322	384.985	-2.177	23109.830
Spanish Lagoon, Aruba	0.5	EvdD-083	262.8	858.717	5.745	31095.557	68.836	457.089	9.060	22047.825
Spanish Lagoon, Aruba	4.5	EvdD-084	259.8	960.258	2.149	23927.276	92.713	412.881	-3.901	23800.055
Spanish Lagoon, Aruba	9.5	EvdD-085	262.0	892.338	-0.801	24347.388	86.324	397.381	4.081	22364.124
Spanish Lagoon, Aruba	11.5	EvdD-086	254.1	904.154	2.936	27563.319	75.069	396.931	8.668	23553.197
Spanish Lagoon, Aruba	15.5	EvdD-087	251.8	802.576	0.281	27355.055	72.458	362.465	3.939	23653.283
Spanish Lagoon, Aruba	21.5	EvdD-088	259.5	775.514	3.085	28064.830	69.696	357.790	5.445	27700.154
Spanish Lagoon, Aruba	27.5	EvdD-089	243.1	716.033	-0.004	25688.085	74.156	421.121	2.536	23026.100
Spanish Lagoon, Aruba	33.5	EvdD-090	256.4	707.948	-3.211	25085.017	74.137	478.361	3.030	21866.139
Spanish Lagoon, Aruba	38.5	EvdD-091	239.5	655.616	-0.591	24965.585	65.753	461.632	2.287	21771.717
Spanish Lagoon, Aruba	42.5	EvdD-092	254.4	677.847	0.750	24319.366	67.474	445.478	3.343	23192.955
Spanish Lagoon, Aruba	47.5	EvdD-093	242.2	615.569	1.289	25472.701	62.038	793.322	6.189	21021.117
Spanish Lagoon, Aruba	53.3	EvdD-094	260.6	686.778	-0.743	28241.940	68.447	534.500	-3.379	21802.764
Standard		EvdD-095	233.6	1239.435	-1.967	5430.384	44.506	1350.908	174.650	698.909
Blank		EvdD-096	1.0	-0.005	-0.002	0.429	0.008	0.007	-0.017	0.215

	Sc 361.383 (ppm)	Sr 407.771 (ppm)	Ti 334.940 (ppm)	V 292.402 (ppm)	Y 324.227 (ppm)	Zn 206.200 (ppm)
LOQ	0.0054	0.0046	0.0069	0.0057	0.0042	0.0114
Detection Limt	0.0056	0.0062	0.0089	0.0069	0.0043	0.0120
BEC	0.0019	0.0690	0.0011	0.0000	0.0018	0.0034
2x STD high	64.264	40.532	121.708	64.390	64.344	64.268
Recovery QC1 (%)		**102**	**92**	**100**		**97**
Recovery QC2 (%)	**105**	**104**	**103**		**107**	
Recovery QC3 (%)	**100**	**98**		**100**	**101**	**97**
Recovery QC4 (%)			**103**			

Location	Depth (cm)	Sample Id	R	Sc 361.383 (ppm)	Sr 407.771 (ppm)	Ti 334.940 (ppm)	V 292.402 (ppm)	Y 324.227 (ppm)	Zn 206.200 (ppm)
Blank		EvdD-001	1.0	0.003	-0.066	0.011	-0.001	0.001	0.020
Standard		EvdD-002	220.6	10.006	161.883	3282.919	92.691	23.768	543.173
Saliña Bartol, Bonaire	0.5	EvdD-003	258.0	7.983	466.197	1236.548	30.296	13.533	48.917
Saliña Bartol, Bonaire	1.3	EvdD-004	241.3	11.007	162.831	1473.944	34.958	16.904	54.551
Saliña Bartol, Bonaire	2.1	EvdD-005	213.3	10.668	182.970	1618.716	35.317	15.510	53.195
Saliña Bartol, Bonaire	2.9	EvdD-006	258.4	4.573	352.055	712.386	20.742	8.430	33.744
Saliña Bartol, Bonaire	3.6	EvdD-007	251.8	9.005	297.640	1394.008	32.013	13.582	48.445
Saliña Bartol, Bonaire	4.4	EvdD-008	238.0	3.505	420.465	581.196	18.550	6.298	33.037
Saliña Bartol, Bonaire	5.2	EvdD-009	225.3	6.878	663.779	1114.349	30.219	9.920	44.634
Saliña Bartol, Bonaire	5.9	EvdD-010	240.1	6.055	997.218	970.821	28.408	9.571	38.687
Saliña Bartol, Bonaire	6.7	EvdD-011	239.1	8.362	950.535	1352.303	37.312	13.303	45.345
Saliña Bartol, Bonaire	7.5	EvdD-012	267.6	6.843	832.619	1115.345	34.158	10.682	38.552
Saliña Bartol, Bonaire	8.2	EvdD-013	262.8	6.670	1038.967	1054.205	26.370	11.525	42.594
Saliña Bartol, Bonaire	8.2	EvdD-014	238.7	6.590	1034.168	1027.574	26.255	11.366	38.996
Saliña Bartol, Bonaire	9.0	EvdD-015	260.3	6.598	573.009	1112.124	27.146	10.182	43.229
Saliña Bartol, Bonaire	9.7	EvdD-016	248.5	9.026	1113.790	1448.836	32.054	15.990	53.718
Saliña Bartol, Bonaire	10.1	EvdD-017	239.3	8.847	237.806	1280.628	29.602	12.501	48.244
Saliña Bartol, Bonaire	10.9	EvdD-018	254.1	7.952	555.254	1305.114	29.918	13.174	48.349
Saliña Bartol, Bonaire	11.3	EvdD-019	244.4	9.571	946.883	1553.606	34.263	17.892	53.860
Saliña Bartol, Bonaire	12.0	EvdD-020	248.6	14.562	402.193	2206.983	45.483	22.494	68.639
Saliña Bartol, Bonaire	12.4	EvdD-021	239.2	9.891	777.675	1527.831	32.896	20.088	57.352
Saliña Bartol, Bonaire	13.2	EvdD-022	260.2	10.167	229.085	1613.806	33.949	14.397	52.697
Saliña Bartol, Bonaire	13.6	EvdD-023	248.3	4.605	412.972	737.948	19.299	7.456	30.054
Saliña Bartol, Bonaire	14.3	EvdD-024	255.6	4.874	4084.711	777.704	20.074	10.280	29.431
Saliña Bartol, Bonaire	14.3	EvdD-025	254.1	4.862	3940.633	779.975	19.668	10.349	31.205
Saliña Bartol, Bonaire	15.1	EvdD-026	260.5	9.176	862.196	1368.375	33.359	15.513	60.689
Saliña Bartol, Bonaire	15.9	EvdD-027	261.1	6.432	509.244	1078.835	26.582	10.788	38.321
Saliña Bartol, Bonaire	16.6	EvdD-028	256.3	10.224	306.076	1634.753	38.662	16.455	63.248
Saliña Bartol, Bonaire	17.4	EvdD-029	251.0	6.740	804.834	1103.968	29.098	11.598	44.130
Saliña Bartol, Bonaire	18.2	EvdD-030	250.6	10.024	1104.682	1609.024	40.403	18.266	93.930
Saliña Bartol, Bonaire	19.0	EvdD-031	246.7	10.237	422.189	1661.554	39.371	17.388	59.261
Saliña Bartol, Bonaire	19.7	EvdD-032	254.1	10.844	408.572	1817.940	42.003	17.046	62.646
Saliña Bartol, Bonaire	20.5	EvdD-033	254.2	10.107	352.852	1764.602	42.366	15.864	57.723
Saliña Bartol, Bonaire	21.2	EvdD-034	257.7	8.000	613.392	1416.291	35.750	13.698	49.185
Saliña Bartol, Bonaire	22.0	EvdD-035	245.1	9.789	427.149	1600.460	40.945	15.115	54.828
Saliña Bartol, Bonaire	22.8	EvdD-036	262.6	8.584	759.468	1482.264	34.319	15.104	51.964
Saliña Bartol, Bonaire	22.8	EvdD-037	264.1	8.570	680.496	1492.547	34.858	14.754	60.896
Étang aux Poissons, Saint Martin	0.5	EvdD-038	253.4	14.639	843.505	2493.814	80.732	15.538	175.621
Oyster Pond, Sint Maarten	0.5	EvdD-039	261.9	9.439	1545.235	1584.493	59.714	10.822	149.599

Simpson Bay Lagoon, Sint Maarten	1	EvdD-040	256.2	3.880	3855.761	762.662	40.765	6.698	125.308
Mullet Bay lagoon, Sint Maarten	0.5	EvdD-041	256.4	1.109	4533.277	268.716	13.912	3.812	59.095
Mullet Bay lagoon, Sint Maarten	1	EvdD-042	249.5	3.806	3530.192	732.799	44.189	8.424	235.579
Little Bay Pond, Sint Maarten	0.5	EvdD-043	250.2	18.602	379.540	2902.828	133.020	14.930	217.880
Salt Pond, Sint Maarten	0.5	EvdD-044	253.7	13.898	1150.100	2137.727	103.291	13.970	362.849
Piscadera Bay, Curaçao	0.5	EvdD-045	252.9	44.168	126.878	4677.707	195.368	23.332	78.364
Piscadera Bay, Curaçao	0.5	EvdD-046	260.1	33.701	89.740	4104.886	218.181	19.243	182.571
Sint Joris Bay, Curaçao	0.5	EvdD-047	265.7	22.306	2285.010	2166.332	89.777	12.694	43.492
Santa Martha Bay, Curaçao	0.5	EvdD-048	263.1	45.083	544.921	4694.254	212.068	24.490	90.507
Fresh Pond, Sint Maarten	0.5	EvdD-049	262.6	20.965	348.417	3400.865	146.213	17.245	316.974
Fresh Pond, Sint Maarten	4.5	EvdD-050	250.6	21.994	334.086	3517.928	162.528	18.115	315.620
Fresh Pond, Sint Maarten	9.5	EvdD-051	258.7	21.660	349.792	3453.150	163.698	17.878	305.104
Fresh Pond, Sint Maarten	14.5	EvdD-052	240.6	20.886	436.317	3416.064	151.112	17.880	345.128
Fresh Pond, Sint Maarten	14.5	EvdD-053	260.5	21.165	441.185	3456.949	154.301	18.243	349.777
Fresh Pond, Sint Maarten	20.5	EvdD-054	256.9	19.032	686.619	3302.107	154.067	18.075	226.222
Fresh Pond, Sint Maarten	24.5	EvdD-055	253.0	21.660	417.735	3471.794	159.899	17.927	261.111
Fresh Pond, Sint Maarten	29.5	EvdD-056	258.6	22.153	430.219	3422.390	160.096	17.811	240.670
Fresh Pond, Sint Maarten	39.5	EvdD-057	262.0	23.379	404.400	3448.409	176.461	17.659	238.774
Fresh Pond, Sint Maarten	49.5	EvdD-058	261.5	21.707	487.362	3607.441	180.963	19.587	229.499
Fresh Pond, Sint Maarten	49.5	EvdD-059	249.2	21.504	487.073	3588.125	179.265	19.089	227.820
Fresh Pond, Sint Maarten	59.5	EvdD-060	264.3	24.081	405.998	3879.132	200.326	20.142	279.727
Fresh Pond, Sint Maarten	64.5	EvdD-061	253.7	22.088	385.628	3462.849	183.788	18.408	217.001
Fresh Pond, Sint Maarten	76.5	EvdD-062	260.5	21.916	507.237	3645.858	176.282	19.512	234.153
Fresh Pond, Sint Maarten	80.5	EvdD-063	259.6	22.508	365.863	3640.767	183.816	19.130	256.752
Fresh Pond, Sint Maarten	87.5	EvdD-064	247.8	24.570	303.638	3726.504	192.387	19.423	272.707
Fresh Pond, Sint Maarten	87.5	EvdD-065	247.8	24.442	301.446	3693.661	191.423	19.410	271.679
Fresh Pond, Sint Maarten	95.5	EvdD-066	255.9	24.666	329.731	3734.867	191.295	19.358	219.064
Fresh Pond, Sint Maarten	101.5	EvdD-067	241.9	25.436	382.324	3666.741	210.769	18.857	242.868
Santa Martha Bay, Curaçao	0.5	EvdD-068	251.5	44.449	486.845	4644.245	204.160	23.891	89.747
Santa Martha Bay, Curaçao	3.5	EvdD-069	256.2	44.489	478.436	4620.316	204.788	24.055	89.170
Santa Martha Bay, Curaçao	6.5	EvdD-070	237.4	45.176	496.987	4673.628	204.725	24.699	89.414
Santa Martha Bay, Curaçao	10.5	EvdD-071	258.1	45.465	498.324	4727.783	206.584	24.419	90.921
Santa Martha Bay, Curaçao	13.5	EvdD-072	257.3	46.756	525.480	4885.593	214.989	25.518	92.322
Santa Martha Bay, Curaçao	16.5	EvdD-073	254.5	45.969	512.075	4763.178	209.831	24.721	91.780
Santa Martha Bay, Curaçao	18.5	EvdD-074	260.1	45.651	537.791	4696.600	209.802	24.701	94.795
Santa Martha Bay, Curaçao	22.5	EvdD-075	256.5	44.716	659.288	4648.169	210.577	24.681	89.041
Santa Martha Bay, Curaçao	26.5	EvdD-076	245.7	43.557	719.175	4457.618	206.156	23.731	84.352
Santa Martha Bay, Curaçao	30.5	EvdD-077	250.2	38.355	1736.730	3865.738	202.748	21.073	66.373
Santa Martha Bay, Curaçao	32.5	EvdD-078	252.3	45.642	1023.319	4504.765	224.317	21.673	80.730
Santa Martha Bay, Curaçao	36.5	EvdD-079	242.0	41.247	1310.993	4183.647	218.781	21.420	74.836
Santa Martha Bay, Curaçao	40.5	EvdD-080	241.7	42.511	1524.362	4190.216	217.618	22.623	74.861
Santa Martha Bay, Curaçao	44.5	EvdD-081	246.6	48.531	793.144	4807.666	250.598	27.505	85.172
Santa Martha Bay, Curaçao	46.5	EvdD-082	257.9	51.370	240.569	4995.462	252.263	29.586	89.218
Spanish Lagoon, Aruba	0.5	EvdD-083	262.8	32.827	168.193	4943.978	211.084	21.531	126.229
Spanish Lagoon, Aruba	4.5	EvdD-084	259.8	36.728	141.880	5466.523	266.365	23.498	145.629
Spanish Lagoon, Aruba	9.5	EvdD-085	262.0	34.812	136.159	5511.441	260.101	22.640	142.700
Spanish Lagoon, Aruba	11.5	EvdD-086	254.1	32.151	172.830	5050.133	242.003	22.523	142.001
Spanish Lagoon, Aruba	15.5	EvdD-087	251.8	32.318	185.143	4890.066	226.912	22.184	117.745
Spanish Lagoon, Aruba	21.5	EvdD-088	259.5	31.787	217.561	4744.583	228.682	21.396	124.421
Spanish Lagoon, Aruba	27.5	EvdD-089	243.1	30.407	236.279	4695.768	219.596	20.886	112.711
Spanish Lagoon, Aruba	33.5	EvdD-090	256.4	30.708	225.590	4703.606	216.685	20.567	122.056
Spanish Lagoon, Aruba	38.5	EvdD-091	239.5	28.642	225.745	4589.470	208.591	20.187	120.458
Spanish Lagoon, Aruba	42.5	EvdD-092	254.4	29.257	237.188	4611.514	215.246	20.224	120.837
Spanish Lagoon, Aruba	47.5	EvdD-093	242.2	27.333	314.210	4347.957	198.846	19.100	111.270
Spanish Lagoon, Aruba	53.3	EvdD-094	260.6	29.994	289.649	4604.614	202.938	20.772	108.510
Standard		EvdD-095	233.6	10.043	159.115	3350.432	92.944	24.954	537.396
Blank		EvdD-096	1.0	0.002	-0.067	0.018	-0.002	0.000	0.004

D. C and N data

Site	Depth (cm)	Sample code	%N	%C	Notes
Saliña Bartol, Bonaire	0.5	ED1	1.98	15.92	
Saliña Bartol, Bonaire	1.3	ED2	1.42	10.90	
Saliña Bartol, Bonaire	2.1	ED3	1.74	12.83	
Saliña Bartol, Bonaire	2.9	ED4	3.45	25.08	Too much C and N
Saliña Bartol, Bonaire	3.6	ED5	1.61	12.51	
Saliña Bartol, Bonaire	4.4	ED6	3.99	27.87	Too much C and N
Saliña Bartol, Bonaire	5.2	ED7	2.00	14.57	
Saliña Bartol, Bonaire	5.9	ED8	2.02	14.47	
Saliña Bartol, Bonaire	6.7	ED9	1.27	9.66	
Saliña Bartol, Bonaire	7.5	ED10	1.77	13.49	
Saliña Bartol, Bonaire	8.2	ED11	1.81	13.48	
Saliña Bartol, Bonaire	9.0	ED12	2.55	18.54	Too much C
Saliña Bartol, Bonaire	9.7	ED13	1.45	11.06	
Saliña Bartol, Bonaire	10.1	ED14	1.80	13.04	
Saliña Bartol, Bonaire	10.9	ED15	2.30	16.85	
Saliña Bartol, Bonaire	11.3	ED16	1.58	12.17	
Saliña Bartol, Bonaire	12.0	ED17	0.87	6.55	
Saliña Bartol, Bonaire	12.4	ED18	1.35	10.56	
Saliña Bartol, Bonaire	13.2	ED19	1.78	13.40	
Saliña Bartol, Bonaire	13.6	ED20	3.66	26.54	Too much C and N
Saliña Bartol, Bonaire	14.3	ED21	2.01	15.20	
Saliña Bartol, Bonaire	15.1	ED22	1.34	12.63	
Saliña Bartol, Bonaire	15.9	ED23	2.67	21.31	Too much C
Saliña Bartol, Bonaire	16.6	ED24	1.70	14.18	
Saliña Bartol, Bonaire	17.4	ED25	2.18	21.41	Too much C
Saliña Bartol, Bonaire	18.2	ED26	1.43	12.28	
Saliña Bartol, Bonaire	19.0	ED27	1.47	11.55	
Saliña Bartol, Bonaire	19.7	ED28	1.33	10.67	
Saliña Bartol, Bonaire	20.5	ED29	1.43	11.68	
Saliña Bartol, Bonaire	21.2	ED30	1.95	15.87	
Saliña Bartol, Bonaire	22.0	ED31	1.56	12.95	
Saliña Bartol, Bonaire	22.8	ED32	1.81	15.48	
Étang aux Poissons, Saint Martin	0.5	ED33	0.37	3.54	
Oyster Pond, Sint Maarten	0.5	ED34	0.75	5.56	
Simpson Bay Lagoon, Sint Maarten	1	ED35	1.67	16.39	
Mullet Bay lagoon, Sint Maarten	0.5	ED36	2.02	20.19	
Mullet Bay lagoon, Sint Maarten	1	ED37	1.80	16.93	
Little Bay Pond, Sint Maarten	0.5	ED38	0.86	7.82	
Salt Pond, Sint Maarten	0.5	ED39	1.28	9.93	
Piscadera Bay, Curaçao	0.5	ED40	0.12	2.07	
Piscadera Bay, Curaçao	0.5	ED41	0.24	3.85	

Sint Joris Bay, Curaçao	0.5	ED42	0.27	2.44
Santa Martha Bay, Curaçao	0.5	ED43	0.13	1.55
Fresh Pond, Sint Maarten	0.5	ED44	0.60	5.85
Fresh Pond, Sint Maarten	4.5	ED45	0.38	4.32
Fresh Pond, Sint Maarten	9.5	ED46	0.41	4.53
Fresh Pond, Sint Maarten	14.5	ED47	0.44	4.66
Fresh Pond, Sint Maarten	20.5	ED48	0.26	3.23
Fresh Pond, Sint Maarten	24.5	ED49	0.27	3.41
Fresh Pond, Sint Maarten	29.5	ED50	0.24	2.81
Fresh Pond, Sint Maarten	39.5	ED51	0.28	3.02
Fresh Pond, Sint Maarten	49.5	ED52	0.21	2.80
Fresh Pond, Sint Maarten	59.5	ED53	0.24	3.07
Fresh Pond, Sint Maarten	64.5	ED54	0.26	3.59
Fresh Pond, Sint Maarten	76.5	ED55	0.21	2.80
Fresh Pond, Sint Maarten	80.5	ED56	0.21	2.84
Fresh Pond, Sint Maarten	87.5	ED57	0.26	2.87
Fresh Pond, Sint Maarten	95.5	ED58	0.21	2.50
Fresh Pond, Sint Maarten	101.5	ED59	0.20	2.30
Santa Martha Bay, Curaçao	0.5	ED60	0.15	1.56
Santa Martha Bay, Curaçao	3.5	ED61	0.15	1.64
Santa Martha Bay, Curaçao	6.5	ED62	0.14	1.53
Santa Martha Bay, Curaçao	10.5	ED63	0.15	1.51
Santa Martha Bay, Curaçao	13.5	ED64	0.13	1.45
Santa Martha Bay, Curaçao	16.5	ED65	0.13	1.48
Santa Martha Bay, Curaçao	18.5	ED66	0.13	1.43
Santa Martha Bay, Curaçao	22.5	ED67	0.13	1.71
Santa Martha Bay, Curaçao	26.5	ED68	0.12	1.43
Santa Martha Bay, Curaçao	30.5	ED69	0.20	2.19
Santa Martha Bay, Curaçao	32.5	ED70	0.18	2.04
Santa Martha Bay, Curaçao	36.5	ED71	0.19	2.27
Santa Martha Bay, Curaçao	40.5	ED72	0.20	2.35
Santa Martha Bay, Curaçao	44.5	ED73	0.17	2.08
Santa Martha Bay, Curaçao	46.5	ED74	0.16	2.10
Spanish Lagoon, Aruba	0.5	ED75	0.35	3.63
Spanish Lagoon, Aruba	4.5	ED76	0.19	2.06
Spanish Lagoon, Aruba	9.5	ED77	0.15	1.87
Spanish Lagoon, Aruba	11.5	ED78	0.19	2.49
Spanish Lagoon, Aruba	15.5	ED79	0.17	2.36
Spanish Lagoon, Aruba	21.5	ED80	0.16	2.27
Spanish Lagoon, Aruba	27.5	ED81	0.18	2.52
Spanish Lagoon, Aruba	33.5	ED82	0.19	2.88
Spanish Lagoon, Aruba	38.5	ED83	0.20	3.32
Spanish Lagoon, Aruba	42.5	ED84	0.20	3.34
Spanish Lagoon, Aruba	47.5	ED85	0.23	3.67
Spanish Lagoon, Aruba	53.3	ED86	0.27	4.80

E. Diatom counts

E.1 Fresh Pond Sint Maarten

Sample depth	**0.5**	**4.5**	**9.5**	**13.5**	**17.5**	**21.5**	**21.5**	**29.5**	**39.5**	**49.5**	**59.5**
Tray	1	2	3	4	5	6	8	9	10	11	12
Composite depth	0.5	4.5	9.5	13.5	17.5	21.5	23.5	31.5	41.5	51.5	61.5
Sample code	Fg 0-1	Fg 4-5	Fg 9-10	Fg 13-14	Fg 17-18	Fg F21-22	F 21-22	F 29-30	F 39-40	F 49-50	F 59-60
Gomphonema spp	11	4	9	14	6	0	16	1	8	7	21
Nitzschia palea	27	12	19	36	14	2	20	2	15	192	116
Navicula spp.	6	13	6	11	4	1	5	3	0	3	1
Achnanthes exigua	1	1	0	0	0	0	1	0	0	2	3
Actinocyclus normanii	169	146	13	94	26	17	23	50	248	0	0
Amphora spp.	0	0	1	3	1	0	0	0	2	0	0
Aulacosira spp.	0	0	0	0	0	0	0	0	0	0	1
Nitzschia compressa	0	0	0	0	0	0	0	0	0	1	3
Craticula spp.	1	0	0	0	0	0	0	0	0	1	1
Cyclotella	0	1	0	0	0	0	1	0	0	0	0
Diadesmis spp.	1	0	0	0	0	0	0	1	0	0	0
Diploneis spp.	0	1	1	0	0	0	0	0	1	0	0
Epithemia spp.	0	0	0	0	0	0	0	0	0	0	1
Fallacia spp.	0	0	0	1	1	0	1	0	0	2	2
Gomphonema t1	9	3	3	9	4	0	9	0	5	6	18
t2	2	1	3	5	2	0	6	1	3	1	3
t3	0	0	3	0	0	0	0	0	0	0	0
t4	0	0	0	0	0	0	1	0	0	0	0
Mastogloia spp.	0	0	0	0	0	0	2	0	0	0	0
Navicula	0	0	0	0	0	0	0	0	0	0	0
Nitzschia amphibia	5	3	8	7	3	2	14	3	0	3	5
Nitzchia angustata	**8**	**3**	**9**	**18**	**2**	**1**	**4**	**0**	**0**	**1**	**9**
Nitzschia clausii	0	0	0	0	1	0	0	0	0	0	0
Nitzschia filiformis	0	1	3	0	3	0	0	0	1	1	1
Hantzschia	3	1	2	0	0	0	0	0	0	1	1
Nitzschia kurzeana	1	0	0	3	0	1	1	0	1	3	0
Nitzschia palea 2	**14**	**1**	**2**	**22**	**1**	**2**	**0**	**0**	**1**	**29**	**12**
Nitzschia Palea 1	**13**	**11**	**17**	**14**	**13**	**0**	**20**	**2**	**14**	**163**	**104**
Navicula 1	6	13	6	11	4	1	5	3	0	3	1
Nitzschia unknown	3	3	3	8	1	2	5	3	1	8	2
Pleurosigma decorum	1	0	0	0	0	0	0	0	0	0	0
Pleurosira spp.	0	1	0	0	0	0	0	0	0	0	0
Stephanocyclus meneghiniana	167	106	226	218	238	19	204	25	44	71	204
Stephanocyclus unk	0	0	0	0	0	0	1	0	0	0	0
Unknown	2	2	0	10	0	3	0	0	3	3	0

Sample depth	**70.5**	**64.5**	**76.5**	**71**	**80.5**	**85.5**	**87.5**	**90.5**	**95.5**	**99.5**	**101.5**
Tray	16	13	17	15	18	19	20	21	22	23	24
Composite depth	63.5	66.5	69.5	73	73.5	78.5	80.5	83.5	88.5	92.5	94.5
Sample code	F2 70-71	F 64-65	F2 76-77	F 70.5-71.5	F2 80-81	F2 85-86	F2 87-88	F 90-91 cm	F2 95-96	F2 99-100	F2 101-102
Gomphonema spp	12	14	12	16	8	27	36	48	17	5	7
Nitzschia palea	21	74	61	27	35	90	68	59	27	5	1
Navicula spp.	3	9	2	3	1	8	1	7	1	0	0
Achnanthes exigua	0	1	0	0	0	0	0	0	0	0	0
Actinocyclus normanii	82	0	0	0	0	0	0	0	0	0	0
Amphora spp.	1	2	1	0	1	1	2	4	1	0	0
Aulacosira spp.	0	0	0	0	0	0	0	0	0	0	0
Nitzschia compressa	1	1	1	0	0	0	0	0	0	0	0
Craticula spp.	0	2	0	0	0	0	0	1	0	0	0
Cyclotella	0	0	0	0	0	0	0	0	0	0	0
Diadesmis spp.	0	1	1	0	0	1	0	0	0	0	1
Diploneis spp.	0	3	0	0	0	1	0	4	0	1	0
Epithemia spp.	0	0	1	0	0	0	0	0	0	0	1
Fallacia spp.	1	0	1	1	0	1	0	1	1	0	1
Gomphonema t1	11	9	10	12	5	16	36	36	17	4	7
t2	1	5	2	4	3	11	0	11	0	1	0
t3	0	0	0	0	0	0	0	1	0	0	0
t4	0	0	0	0	0	0	0	0	0	0	0
Mastogloia spp.	0	0	0	0	0	0	0	0	0	0	0
Navicula	3	0	0	0	0	0	0	1	1	0	0
Nitzschia amphibia	2	0	7	0	0	0	0	2	0	0	0
Nitzchia angustata	**2**	**31**	**4**	**6**	**26**	**4**	**11**	**14**	**7**	**26**	**13**
Nitzschia clausii	0	0	0	0	0	0	0	0	0	0	0
Nitzschia filiformis	1	0	4	0	1	2	0	0	0	0	2
Hantzschia	0	0	5	1	1	0	3	7	0	0	0
Nitzschia kurzeana	0	2	0	0	0	1	2	1	2	0	0
Nitzschia palea 2	**5**	**19**	**7**	**9**	**14**	**19**	**6**	**20**	**12**	**5**	**1**
Nitzschia Palea 1	**16**	**55**	**54**	**18**	**21**	**71**	**62**	**39**	**15**	**0**	**0**
Navicula 1	0	9	2	3	1	8	1	6	0	0	0
Nitzschia unknown	2	3	30	0	2	2	3	11	3	0	1
Pleurosigma decorum	0	0	0	0	0	0	0	0	0	0	0
Pleurosira spp.	0	0	0	0	0	0	0	0	0	0	0
Stephanocyclus meneghiniana	170	156	107	15	247	90	205	121	133	44	10
Stephanocyclus unk	0	0	0	0	0	0	0	0	0	0	0
Unknown	3	5	0	3	2	11	8	2	0	1	2

E.2 Spanish Lagoon (Aruba)

Depth	0.5cm
Pinnularia sp.	152
Gyrosigma cf. hummii	61
Tryblionella acuminata	39
Plagiotropis cf. lepidoptera	19
Nitzschia cf. scabra	16
Stauroneis africana	7
Fallacia	5
Amphora sp.	3
Nitzschia compressa	3
Pinnularia borealis	3
Amphora coffeaformis	2
Navicula pseudocrassirostris	2
Seminavis	2
Buddulphia cf. tridens	1
Entomoneis	1
Luticola	1
Nitzschia sp.	1
Oestrupia t4	1
Toxarium	1

E.3 Santa Martha Curacao

Depth (cm)	**0.5**	**1.5**	**2.5**	**3.5**	**6.5**	**10.5**
sum	704	723	683	711	799	327
Planktonisch	0.0440341	0.06639	0.0600293	0.0646976	0.0713392	0.1039755
Benthisch	0.9559659	0.93361	0.9399707	0.9353024	0.9286608	0.8960245
Amphora caribaea		3				
Amphora coffeaformis						
Calonies 1?					2	
Cocconeiopsis			8		1	
Coscinodiscus		7		6	6	1
Cyclotella	20	43	34	35	45	24
Diploneis cf. smithii	102	77	116	88	170	25
Diploneis chersonensis	27	27	21	12	14	8
Grammatophora flexuosa		2		7	1	1
Grammatophora oceanica	24	30	46	25	37	25
Gyrosigma cf. hummii	3	3	9	10	4	2
Gyrosigma type 2	25	11	5	5	5	
Lyrella irrorata	10	25	12	19	12	8
Mastogloia decipiens		1	6	4	7	
Navicula cf. distans	145	101	85	160	136	91
Nitzschia 3						
Nitzschia cf. carnicobarica	2	5	4	9	8	2
Nitzschia cf. ligowskii						
Nitzschia cf. sicula		9	3	3		
Nitzschia cf. sigma	49	46	22	15	18	5
Nitzschia grossestriata						
Nitzschia jelineckii						
Nitzschia palea	8	24	29	20	9	2
Nitzschia sp.			1	1	3	
Paralia	11	5	7	11	12	10
Petroneis marina		2	3	1		2
Pleurosigma cf. inflatum	74	69	65	54	83	16
Psammodictyon panduriforme	34	47	28	26	25	6
Rhopalodia			1	2	5	1
Surirella gemma	31	13	16	9	4	
Surirella sp. 2		6	14	12	5	1
Surirella sp. 3	3		4	4	1	
Surirella fastuosa	11	28	22	25	24	10
Trachyneis aspera	2	3	2	2	4	1
Tryblionella granulata	96	102	92	115	135	81
Unknown AC		17	7	9	4	1
Unknown AF and D		5	5	4	5	1
Unknown AU		1	5			

Unknown AW						
Unknown AY						
Unknown BB						
Unknown BD						
Unknown C						
Unknown I					1	
Unknown J	4	5	5	3	2	
Unknown K		2		2		
Unknown R			1	2	2	
Unknown S	19				2	
Unknown V						
Stauroneis	2					
Puntige citroen	2		4	8	3	1
Mastogloia citroen		3				
Pinnularia		1	1	3		1
Mastogloia type 2					1	1
Unk BH					1	
Unk BK					1	
Unk BE					1	

E.4 Bonaire

Depth (cm)	0.5	6.7	8.2	10.1	11.3	12.4	14.3	15.1	19	22.8
Amphora coffeaeformis	19	13	48	48	72	82	34	104	54	95
Nitzschia compressa	5	150	277	98	6	1	9	449	31	0
Climaconeis spp. 1	0	3	0	0	0	0	0	0	0	0
Dickieia ulvacea	4	0	0	2	14	0	3	2	13	14
Entomoneis spp. 1	0	0	3	4	4	77	0	8	2	2
gac	1	0	0	0	0	0	0	0	0	0
Hantzschia spp. 1	0	0	0	1	2	0	0	0	4	0
Licmophora normanniana	0	3	1	0	0	4	0	5	0	1
Mastogloia spp. 1	0	4	1	0	0	0	0	0	0	0
Mastogloia spp. 3	0	2	3	2	9	8	1	14	1	0
Mastogloia spp. 4	1	2	6	5	9	4	2	8	10	0
Mastogloia unknown	0	3	7	4	10	5	5	44	10	2
Navicula phyllepta	1	0	0	0	6	0	0	0	0	0
Navicula metareichardtiana	5	1	2	2	10	7	3	5	6	0
Navicula phyllepta	2	21	70	12	19	3	1	1	0	0
Navicula spp. 1	1	2	3	1	5	1	0	0	0	0
Nitzschia filiformis	3	0	3	1	1	1	1	3	1	0
Nitzschia spp. 1	2	2	32	1	9	1	0	3	82	22
Gyrosigma accuminatum	2	8	2	9	35	60	13	3	12	9
Pseudostaurosira spp. 1	0	0	1	0	0	23	0	39	2	0
Rhopalodia guettingeri	8	1	2	11	42	1	116	5	8	71
saf	0	0	0	2	2	1	0	2	0	0
Stephanocyclus meneghenianа	0	0	0	226	1	44	1	0	0	0
Seminavis delicatula	3	0	0	4	1	0	0	4	1	1
Surirella spp. 3	0	53	0	1	0	0	0	0	1	0
Unknown	5	2	31	5	11	9	17	15	0	3

E.5 Surface samples

	Saliña Bartol	Spanish Lagoon	Santa Martha 1	Santa Martha 2	Sint Joris Lagoon	Piscadera 1	Piscadera 2
	SB	SL	SM1	SM2	SJ	Pi1	Pi2
depth	0.4-0.7 cm	0-1 cm	0-1 cm	0-1 cm	0-1 cm	0-1cm	0-1cm
CaCO3 (% dw)		0	8.8944763	8.8920135	50.121816	0	0.3091498
LOI (% dw)		12.068966	14.561028	12.899106	10.864393	9.7804391	11.520737
P (ppm)	513.27768	457.08891	362.40622	363.51103	277.12114	242.57744	675.58599
surface area counted (cm2)	1.19	0.84	3.1415927	3.1415927	0.2350711	1.5707963	0.242109
surface area batterbee tray (cm2)	66.476101	66.476101	66.476101	66.476101	66.476101	66.476101	66.476101
fraction added to batterbee tray	0.0689655	0.1	0.1	0.1	0.1	0.1	0.1
sample dry weight (g)	0.05	0.517	0.5	0.508	0.516	0.509	0.573
diatom concentration (million valves/g dw)	4.7628171	0.4898303	0.177744	0.1378732	1.7405924	0.1180637	1.5333804
number of species	13	18	43	33	46	19	29
sum	294	320	420	331	317.6	142	320
Achnanthes cf. pseudobliqua							
Actinocyclus ehrenbergii							
Actinocyclus gallicus				1	6		
Actinocyclus nebulosus			1				
Actinocyclus normanii							
Actinocyclus subtilis							
Amphora bigibba							
Amphora caribaea							
Amphora cf. ostrearia					2		
Amphora coffeaformis							
Amphora 8					1		
Amphora sp.	50	5			8	2	3
Ardissonea					1		
Aulacoseira							1
Bacteriastrum			1				
Biddulphia cf. tridens		1					
Biddulphia pulchella							
Caloneis cf. liber		1					
Caloneis egena							
Caloneis excentrica							
Calonies 1			5				
Campylodiscus					1	1	
Campylodiscus intermedius							
Catacombas							
Chaetoceros							
Chaetoceros resting cells	1						
Climaconeis colemaniae							
Climaconeis lorenzii			1	1			
Climaconeis sp.1			1				
Climacosphenia							
Cocconeis cf. scutellum				1	1		
Cocconeis discrepans					1		
Cocconeis guttata							
Cocconeis singularis							
Cocconeis sp.1							
Cocconeis sp.3							
Coscinodiscus							
Cyclotella 1							
Cyclotella litoralis						1	

Cymatosira lorenziana							
Denticula						1	
Diadesmis							
Dickieia cf. resistans							
Dickieia ulvacea	28						
Diploneis cf. smithii / suborbicularis			45	25	10	1	1
Diploneis chersonensis			13	5	2	6	2
Diploneis crabro					2	1	2
Diploneis gruendieri							
Diploneis mini			8		8		2
Diploneis sp.1							
Entomoneis	1	1					
Entomoneis pseudoduplex							
Epithemia							
Eunotia						1	
Eupodiscus radiatus					1		
Fallacia		5					
Glyphodesmis eximia							
Gomphonema							
Gomphonema type 3						1	
Grammatophora oceanica			9	44	2	2	
Gyrosigma acuminatum	15						
Gyrosigma cf. hummii		61	4	3	2		10
Gyrosigma naja							
Gyrosigma type 2			13	3			
Gyrosigma type 3				1			
Hantzschia						8	
Hyalosynedra laevigata							
Hyalosynedra lanceolata							
Licmophora debilis							
Licmophora remulus							
Luticola	6	1		1		46	
Lyrella clavata							
Lyrella irrorata			6	9	2		4
Mastogloia angulata							
Mastogloia bahamensis							
Mastogloia beaufortiana							
Mastogloia binotata			3				
Mastogloia biocellata							
Mastogloia cf. aquilegiae							
Mastogloia cf. elegans							
Mastogloia cf. gracilis							
Mastogloia cf. ovata							
Mastogloia cf. pumila							
Mastogloia citrus							
Mastogloia cocconeiformis							
Mastogloia corsicana							
Mastogloia cribrosa					0.2		
Mastogloia crucicula					3		
Mastogloia crucicula var. alternans							
Mastogloia decipiens			3	4			
Mastogloia elliptica							
Mastogloia erythraea							
Mastogloia fimbriata							
Mastogloia hovarthiana							
Mastogloia lacrimata							
Mastogloia manokwariensis				1			
Mastogloia paradoxa							
Mastogloia pseudolatecostata							
Mastogloia punctatissima					0.2		
Mastogloia SM-d2-R							
Mastogloia sp.							1

Mastogloia sp.4	16						
Mastogloia strigilis							
Mastogloia subaffirmata							
Mastogloia type 2					1		
Melosira							
Navicula apta							
Navicula cf. longa					27		
Navicula cf. viminea							
Navicula flebilis							
Navicula phyllepta	6				5		
Navicula pseudocrassirostris		2					
Navicula sp.3							
Navicula sp.4a							
Navicula sp.5							1
Navicula sp.6							
Navicula sp.7							
Navicula t1							
Navicula t2							
Nitzschia (pipet)							
Nitzschia 3			3				
Nitzschia 4							
Nitzschia 6					1		
Nitzschia 7							
Nitzschia amphibia					1		2
Nitzschia cf. carnicobarica			7	3	13		3
Nitzschia cf. filiformis	3						1
Nitzschia cf. ligowskii			1		1		
Nitzschia cf. microcephala							
Nitzschia cf. scabra		16					1
Nitzschia cf. sicula			2				
Nitzschia cf. sigma			17	6	2		
Nitzschia compressa	4	3				8	
Nitzschia fluminensis							
Nitzschia grossestriata			3				
Nitzschia jelineckii			2		1		
Nitzschia palea			2			1	
Nitzschia punctata			3				8
Nitzschia scalpelliformis				2			
Nitzschia sp.		1	1		2		
Nitzschia sp.1	15			1	3		
Nitzschia sp.2							
Nitzschia spathulata							
Odontella							
Odontella aurita							
Oestrupia t1					2		
Oestrupia t2					1		
Oestrupia t3					0.2		
Opephora							
Paralia			10	35	63	1	
Parlibellus hagelsteinii							2
Petroneis marina			3		3		
Petroneis plagiostoma							
Pinnularia borealis	1	3		3		39	2
Pinnunavis yarrensis		152	86	90			241
Plagiogramma minus			1				
Plagiogramma pulchellum var. pygmaea							
Plagiogramma rhombicum							
Plagiotropis cf. vitrea							
Plagiotropis pusilla		19					
Plagiotropis sp.1							
Plagiotropis sp.2							
Pleurosigma cf. inflatum			47	7			

Pleurosigma cf. latiusculum							
Pleurosigma decorum							
Pleurosigma formosum					8		
Pleurosigma rhombeum				3	6		2
Pleurosira							
Podocystis adriatica							
Podocystis americana							
Podosira stelligera							1
Protokeelia cholnokyi							
Psammodictyon panduriforme			19	8	26		4
Psammodictyon panduriforme var. latum			1		4		
Psammosynedra closterioides							
Psammothidium didymum					5		1
Pseudictyota dubia					1		1
Pseudictyota reticulata							
Pseudostaurosira brevistriata							
Rhizosolenia							
Rhopalodia	148		1	1	1		
Seminavis		2			56		
Shionodiscus oestrupii				2	2		
Stauroneis africana		7					
Stephanodiscus medius							
Stephanocyclus meneghiniana			11	1			
Surirella fastuosa			6	11	24		2
Surirella gemma			4				1
Surirella sp. 3			3	1			
Surirella torquata (sp. 2)			11	3	1		5
Synedra							
Synedra sp.1?							
Tabellaria sp.1							
Tabellaria sp.2							
Tabularia							
Tetramphora intermedia							
Thalassionema						1	10
Thalassionema???					1		
Thalassiosira oestrupii						1	2
Toxarium		1					
Toxarium undulatum							
Trachyneis aspera			1	1	1		
Triceratium favus							
Triceratium pentacrinus							
Trigonium							
Tryblionella acuminata		39					
Tryblionella gracilis				1	2		
Tryblionella granulata			57	50		20	4
Tryblionella lanceola				3			
Unknown 1							
Unknown 2							
Unknown 3							
Unknown 4			2				
Unknown 5							
Unknown 6			1				
Unknown 7			1				
Unknown 8			1				
Unknown 9							

	Simpson Bay Lagoon	Mullet Bay Lagoon 1	Mullet Bay Lagoon 2	Étang aux Poissons	Oyster Pond	Salt Pond	Little Bay
	Si	Mu1	Mu2	EaP	Oy	S	LB
depth	0-1 cm	0-1 cm	0-1 cm	0-1 cm	0-1 cm	0-1 cm	0-1 cm
CaCO3 (% dw)	60.629252	31.645281	60.925356	17.006405	51.696073	24.927288	11.51429
LOI (% dw)	17.962466	8.1145585	19.103774	13.448276	13.461538	22.78481	19.35484
P (ppm)	222.52395	160.11688	284.32026	434.77618	649.40087	1127.2	1281.261
surface area counted (cm2)	2.0507963	3.1415927	6.2831853	3.1415927	1.8129053	1.5707963	3.141593
surface area batterbee tray (cm2)	66.476101	66.476101	66.476101	66.476101	66.476101	66.476101	66.4761
fraction added to batterbee tray	0.1	0.1	0.1	0.1	0.1	0.1	0.1
sample dry weight (g)	0.504	0.501	0.511	0.513	0.502	0.501	0.5
diatom concentration (million valves/g dw)	0.2162271	0.0016894	0.0523824	0.0082495	0.4851948	0.2618603	0.215832
number of species	63	4	31	2	69	4	1
sum	336.2	4	253	20	405.4	310	510
Achnanthes cf. pseudobliqua	3		0		2		
Actinocyclus ehrenbergii	1		0		0		
Actinocyclus gallicus	2		0		4		
Actinocyclus nebulosus			0		0		
Actinocyclus normanii			1		0	285	
Actinocyclus subtilis					1		
Amphora bigibba			0		1		
Amphora caribaea			0		0		
Amphora cf. ostrearia			0		0		
Amphora coffeaformis			0		0		
Amphora 8							
Amphora sp.	13		3		37		
Ardissonea	1		1		2		
Aulacoseira			0		0		
Bacteriastrum							
Biddulphia cf. tridens	4		4		1		
Biddulphia pulchella			2		1		
Caloneis cf. liber			0		1		
Caloneis egena	0.2						
Caloneis excentrica	3		0		0		
Calonies 1			0		0		
Campylodiscus	5		69		1		
Campylodiscus intermedius							
Catacombas			0		1		
Chaetoceros							
Chaetoceros resting cells	1		0		0	2	
Climaconeis colemaniae			0		0		
Climaconeis lorenzii			0		0		
Climaconeis sp.1			0		0		
Climacosphenia			1		0		
Cocconeis cf. scutellum	5		4		38		
Cocconeis discrepans			0		0		
Cocconeis guttata							
Cocconeis singularis	2		0		4		
Cocconeis sp.1	4		0		0		
Cocconeis sp.3							
Coscinodiscus							
Cyclotella 1							

Cyclotella litoralis			0		0
Cymatosira lorenziana	45		0		3
Denticula			0		0
Diadesmis			0		0
Dickieia cf. resistans	1		0		2
Dickieia ulvacea			0		0
Diploneis cf. smithii / suborbicularis	9		0		12
Diploneis chersonensis	7		1		5
Diploneis crabro			0		0
Diploneis gruendieri					
Diploneis mini			0		9
Diploneis sp.1		1	8		0
Entomoneis			0		0
Entomoneis pseudoduplex					
Epithemia					
Eunotia			0		0
Eupodiscus radiatus			0		0
Fallacia			0		0
Glyphodesmis eximia					
Gomphonema			0		0
Gomphonema type 3			0		0
Grammatophora oceanica	2		1	3	0
Gyrosigma acuminatum			0		0
Gyrosigma cf. hummii	7		24		1
Gyrosigma naja					
Gyrosigma type 2			0		0
Gyrosigma type 3			0		0
Hantzschia			0		0
Hyalosynedra laevigata	18	1	0		15
Hyalosynedra lanceolata					
Licmophora debilis					
Licmophora remulus					
Luticola			0		0
Lyrella clavata					
Lyrella irrorata			6		0
Mastogloia angulata					
Mastogloia bahamensis	1		9		0
Mastogloia beaufortiana	1		0		0
Mastogloia binotata			0		3
Mastogloia biocellata	3		0		0.2
Mastogloia cf. aquilegiae					
Mastogloia cf. elegans					
Mastogloia cf. gracilis	20		2		0
Mastogloia cf. ovata	1		3		0
Mastogloia cf. pumila					
Mastogloia citrus	1		0		0
Mastogloia cocconeiformis	7		0		0
Mastogloia corsicana	10		0		0
Mastogloia cribrosa			0		1
Mastogloia crucicula	6		0		1
Mastogloia crucicula var. alternans	1		0		0
Mastogloia decipiens			0		0
Mastogloia elliptica					
Mastogloia erythraea	1		0		0
Mastogloia fimbriata	1		0		0
Mastogloia hovarthiana	1		0		0
Mastogloia lacrimata					
Mastogloia manokwariensis	1		0		0
Mastogloia paradoxa	1		0		0
Mastogloia pseudolatecostata	5		3		0
Mastogloia punctatissima					
Mastogloia SM-d2-R					

Mastogloia sp.			0		0	
Mastogloia sp.4			0		0	
Mastogloia strigilis						
Mastogloia subaffirmata						
Mastogloia type 2			1		1	
Melosira						
Navicula apta			0		3	
Navicula cf. longa	5		0		12	
Navicula cf. viminea			0		1	
Navicula flebilis			1		0	
Navicula phyllepta			0		0	
Navicula pseudocrassirostris			0		0	
Navicula sp.3	3		0		0	
Navicula sp.4a			0		3	
Navicula sp.5			0		0	
Navicula sp.6						
Navicula sp.7						
Navicula t1						
Navicula t2			0		0	
Nitzschia (pipet)						
Nitzschia 3			0		0	
Nitzschia 4						
Nitzschia 6			0		1	
Nitzschia 7	4		0		1	
Nitzschia amphibia			0		1	
Nitzschia cf. carnicobarica			4		6	
Nitzschia cf. filiformis			0		8	
Nitzschia cf. ligowskii			0		2	
Nitzschia cf. microcephala			0		27	
Nitzschia cf. scabra			0		0	
Nitzschia cf. sicula			0		0	
Nitzschia cf. sigma	3		5		1	
Nitzschia compressa			0		1	
Nitzschia fluminensis						
Nitzschia grossestriata			0		0	
Nitzschia jelineckii			0		0	
Nitzschia palea	2		0		6	
Nitzschia punctata			0		0	
Nitzschia scalpelliformis			0		1	
Nitzschia sp.			0		0	
Nitzschia sp.1	2		0		0	
Nitzschia sp.2	1		0		0	
Nitzschia spathulata			0		7	
Odontella			0		1	
Odontella aurita			0		1	
Oestrupia t1			2		0	
Oestrupia t2	3		6		0	
Oestrupia t3						
Opephora						
Paralia	1		7		6	
Parlibellus hagelsteinii			0		0	
Petroneis marina			0		3	
Petroneis plagiostoma	1		1		0	
Pinnularia borealis			0		0	
Pinnunavis yarrensis		1	51	17	1	1
Plagiogramma minus						
Plagiogramma pulchellum var. pygmaea			0		1	
Plagiogramma rhombicum						
Plagiotropis cf. vitrea						
Plagiotropis pusilla						
Plagiotropis sp.1	1		0		0	
Plagiotropis sp.2	2		0		0	

Pleurosigma cf. inflatum			0	0		
Pleurosigma cf. latiusculum			0	10		
Pleurosigma decorum						
Pleurosigma formosum	15		0	1		
Pleurosigma rhombeum			0	1		
Pleurosira						
Podocystis adriatica	2		0	0		
Podocystis americana						
Podosira stelligera			0	0		
Protokeelia cholnokyi						
Psammodictyon panduriforme			0	16		
Psammodictyon panduriforme var. latum			3	0		
Psammosynedra closterioides						
Psammothidium didymum	10		0	6		
Pseudictyota dubia			0	3		
Pseudictyota reticulata			0	1		
Pseudostaurosira brevistriata			0	51		
Rhizosolenia						
Rhopalodia	48		0	0		
Seminavis	8		0	13		
Shionodiscus oestrupii			0	0		
Stauroneis africana	2		0	1		
Stephanodiscus medius						
Stephanocyclus meneghiniana			0	0	22	510
Surirella fastuosa	3		0	13		
Surirella gemma			0	1		
Surirella sp. 3			0	0		
Surirella torquata (sp. 2)			0	0		
Synedra	5	1	3	0		
Synedra sp.1?						
Tabellaria sp.1						
Tabellaria sp.2						
Tabularia			0	10		
Tetramphora intermedia	1		0	1		
Thalassionema			0	10		
Thalassionema???						
Thalassiosira oestrupii				1		
Toxarium	5		5	1		
Toxarium undulatum	1		6	0		
Trachyneis aspera	1		0	2		
Triceratium favus						
Triceratium pentacrinus	7		16	0		
Trigonium						
Tryblionella acuminata			0	1		
Tryblionella gracilis	1		0	8		
Tryblionella granulata			0	0		
Tryblionella lanceola	3		0	10		
Unknown 1						
Unknown 2						
Unknown 3						
Unknown 4			0	2.2		
Unknown 5	2		0	0		
Unknown 6			0	0		
Unknown 7			0	0		
Unknown 8			0	0		
Unknown 9			0	1		

	Fresh Pond	SM-d1	SM-d2	SM-d3	SM-d4	SM-d5	SM-d6	SM-d7
	F	epiphyton	epilithic	epiphyton	epipelon	epiphyton	epipelon	plankton
depth	0-1 cm							
CaCO3 (% dw)								
LOI (% dw)	11.594203					362.40622		
P (ppm)	2157.7813					363.51103		
surface area counted (cm2)	0.132					277.12114		
surface area batterbee tray (cm2)	66.476101					242.57744		
fraction added to batterbee tray	0.05					675.58599		
sample dry weight (g)	1							
diatom concentration (million valves/g dw)	3.5655363							
number of species	11	29	42	23	49	46	44	48
sum	354	338	334	330	338	391	354	312
Achnanthes cf. pseudobliqua						1		2
Actinocyclus ehrenbergii								
Actinocyclus gallicus				2	1	1	1	2
Actinocyclus nebulosus				4			3	1
Actinocyclus normanii	169		1					
Actinocyclus subtilis			1	1				
Amphora bigibba		16	8					
Amphora caribaea								
Amphora cf. ostrearia								
Amphora coffeaformis								
Amphora 8								
Amphora sp.	1	52	16		3	1	1	1
Ardissonea								
Aulacoseira			1					
Bacteriastrum					2			1
Biddulphia cf. tridens			1					
Biddulphia pulchella								
Caloneis cf. liber					1	1		
Caloneis egena								
Caloneis excentrica						1	20	2
Calonies 1								
Campylodiscus						1		
Campylodiscus intermedius			1					
Catacombas								
Chaetoceros					20			113
Chaetoceros resting cells								
Climaconeis colemaniae								
Climaconeis lorenzii					1			
Climaconeis sp.1								
Climacosphenia								
Cocconeis cf. scutellum		18	5			1	5	
Cocconeis discrepans								
Cocconeis guttata		2	1					
Cocconeis singularis		108	40	1		1		
Cocconeis sp.1		9						
Cocconeis sp.3			1					

Coscinodiscus								1
Cyclotella 1					1			
Cyclotella litoralis		2						
Cymatosira lorenziana								
Denticula								
Diadesmis	1							
Dickieia cf. resistans		62	2					
Dickieia ulvacea								
Diploneis cf. smithii / suborbicularis					5	1	2	10
Diploneis chersonensis					5	3	15	9
Diploneis crabro					1	1	13	
Diploneis gruendieri							1	
Diploneis mini								3
Diploneis sp.1								
Entomoneis							3	
Entomoneis pseudoduplex								4
Epithemia								
Eunotia								
Eupodiscus radiatus								
Fallacia								
Glyphodesmis eximia			1					
Gomphonema	12							
Gomphonema type 3								
Grammatophora oceanica				260	6	95	17	24
Gyrosigma acuminatum								
Gyrosigma cf. hummii							4	
Gyrosigma naja							1	2
Gyrosigma type 2							1	
Gyrosigma type 3								
Hantzschia								
Hyalosynedra laevigata			124	2	2	130		
Hyalosynedra lanceolata				1	7	3	2	
Licmophora debilis		2	1					1
Licmophora remulus					1			
Luticola								
Lyrella clavata								4
Lyrella irrorata						1	1	
Mastogloia angulata						1	2	
Mastogloia bahamensis								
Mastogloia beaufortiana								
Mastogloia binotata				6	3	2	1	
Mastogloia biocellata		1	1		1	2		1
Mastogloia cf. aquilegiae					1			
Mastogloia cf. elegans					1			
Mastogloia cf. gracilis					2			
Mastogloia cf. ovata								
Mastogloia cf. pumila						1		
Mastogloia citrus								
Mastogloia cocconeiformis								
Mastogloia corsicana		1				2		
Mastogloia cribrosa								
Mastogloia crucicula		13	2			2		1
Mastogloia crucicula var. alternans								
Mastogloia decipiens					2	1		
Mastogloia elliptica					6	2		
Mastogloia erythraea								
Mastogloia fimbriata				1				1
Mastogloia hovarthiana								
Mastogloia lacrimata					1			2
Mastogloia manokwariensis		1				1		
Mastogloia paradoxa								
Mastogloia pseudolatecostata								

Mastogloia punctatissima								
Mastogloia SM-d2-R			4					
Mastogloia sp.								
Mastogloia sp.4								
Mastogloia strigilis					3			
Mastogloia subaffirmata		1	1					
Mastogloia type 2				4	2	7	1	1
Melosira				13	8	1	28	1
Navicula apta		5	2					
Navicula cf. longa		2	3		1	8	1	
Navicula cf. viminea								
Navicula flebilis		6	3					
Navicula phyllepta								
Navicula pseudocrassirostris								
Navicula sp.3								
Navicula sp.4a		1					1	
Navicula sp.5								
Navicula sp.6						1		
Navicula sp.7							1	
Navicula t1								2
Navicula t2	3							
Nitzschia (pipet)					15			
Nitzschia 3								
Nitzschia 4				2	21	15	5	4
Nitzschia 6						1	1	
Nitzschia 7								
Nitzschia amphibia	7							
Nitzschia cf. carnicobarica					1	1		1
Nitzschia cf. filiformis	2							
Nitzschia cf. ligowskii								
Nitzschia cf. microcephala								
Nitzschia cf. scabra					1		2	
Nitzschia cf. sicula								
Nitzschia cf. sigma				2	7	18		1
Nitzschia compressa								
Nitzschia fluminensis		1						2
Nitzschia grossestriata								
Nitzschia jelineckii							19	
Nitzschia palea	22	5	7			2		
Nitzschia punctata								
Nitzschia scalpelliformis					90	1		10
Nitzschia sp.								
Nitzschia sp.1			1				2	1
Nitzschia sp.2								
Nitzschia spathulata		11	12					
Odontella								
Odontella aurita			1					
Oestrupia t1								
Oestrupia t2								
Oestrupia t3								
Opephora		1	6					
Paralia				2	22	1	21	3
Parlibellus hagelsteinii								
Petroneis marina								
Petroneis plagiostoma							1	
Pinnularia borealis								
Pinnunavis yarrensis					3	3	16	15
Plagiogramma minus								
Plagiogramma pulchellum var. pygmaea								
Plagiogramma rhombicum			1					
Plagiotropis cf. vitrea					2	1	1	1
Plagiotropis pusilla				1	9		9	1

Plagiotropis sp.1								
Plagiotropis sp.2								
Pleurosigma cf. inflatum					5			1
Pleurosigma cf. latiusculum								
Pleurosigma decorum					2			
Pleurosigma formosum			1	2	7	2	5	19
Pleurosigma rhombeum					4		10	8
Pleurosira	1							
Podocystis adriatica								
Podocystis americana			1		1			
Podosira stelligera				1				1
Protokeelia cholnokyi					1			
Psammodictyon panduriforme		2	1		5	5	21	9
Psammodictyon panduriforme var. latum								
Psammosynedra closterioides		1	1					
Psammothidium didymum			1					
Pseudictyota dubia			1	2				
Pseudictyota reticulata				3				
Pseudostaurosira brevistriata		9						
Rhizosolenia								1
Rhopalodia				8	22	38	2	5
Seminavis		2				5	2	
Shionodiscus oestrupii			1					
Stauroneis africana								
Stephanodiscus medius								
Stephanocyclus meneghiniana	135							
Surirella fastuosa			1	2	26	21	70	21
Surirella gemma					1			1
Surirella sp. 3					1		1	
Surirella torquata (sp. 2)								
Synedra								
Synedra sp.1?								1
Tabellaria sp.1			43					
Tabellaria sp.2			25					
Tabularia								
Tetramphora intermedia								
Thalassionema								
Thalassionema???				9				3
Thalassiosira oestrupii	1				1		1	
Toxarium						1	1	
Toxarium undulatum			1					
Trachyneis aspera		1		1	4	1	31	4
Triceratium favus								
Triceratium pentacrinus								
Trigonium		1						
Tryblionella acuminata								
Tryblionella gracilis							8	2
Tryblionella granulata						1		4
Tryblionella lanceola						1		4
Unknown 1		2	1					
Unknown 2			7					
Unknown 3			1					
Unknown 4								
Unknown 5								
Unknown 6								
Unknown 7								
Unknown 8								
Unknown 9								