Distribution of microplastics on remote, isolated islands of the Chagos Archipelago; globally and regionally significant nesting sites of green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtle populations.

Katherine Whitehead BSc

Submitted to Swansea University in fulfilment of the requirements for the Degree of MRes Biosciences

Swansea University

2022

Swansea University
Prifysgol Abertawe

Abstract

Microplastic concentration, composition, spatial distribution, and sediment characteristics are reported from green (*Chelonia mydas)* and hawksbill (*Eretmochelys imbricata)* turtle rookeries in the Chagos Archipelago, Western Indian Ocean. Between March and July 2019, 25 sediment cores (60 cm depth by 10 cm diameter) were extracted from the turtle nesting line on five beaches. This study reports the highest beach microplastic concentration recorded in the literature to date (0 – 2 cm depth; mean 371,000 particles/m^3 ± 114,000 s.e.). Furthermore, with microplastic concentrations, orders of magnitude higher in both the surface layers and at turtle nesting depth than global reports; Chagos may have the highest microplastic concentrations in beach sand yet recorded. Boddam and Egmont beaches accounted for 91% of the total concentration recorded and very few microplastics were found on Nelson and Parasol Islands (5 particles). High variability was observed between stations with concentrations differing by an order of magnitude on Diego Garcia Island. Smaller microplastics were discovered in higher proportions (68%; 0.15 – 0.49 mm) than larger size classes (32%; 1 – 4.99 mm). Fragments were most prevalent accounting for 86.6% of the shapes recorded and polyethylene and polypropylene were the most frequently recorded polymers (46.3% and 20.6%). Beach sediment particle size varied from medium grained coarse skewed (Parasol, mean 0.47 mm; Nelson, stations 30 – 90, 0.46 mm; Diego Garcia, 0.40 mm) to symmetrical and fine skewed sediment (Egmont, mean 0.37 mm; Boddam, 0.31 mm). With the exception of Nelson Island (station 10) which is highly heterogenous, Chagos sediment is moderate to well sorted and the sediment particle size distribution is homogenous across the shoreline. This provides favourable conditions for high turtle nesting densities. The high microplastic concentrations discovered at turtle nesting depth however may be deleterious for this highly successful nesting site.

Key Words: Plastic pollution, marine pollution, marine turtle, endangered species, beach sediment composition

Lay Summary

Decades of poor waste management and disposal have led to a global plastic pollution crisis. Large amounts of small plastics (<5 mm), otherwise known as microplastics are found in every environment i.e., rivers, deserts, forests, the ocean, the air. They have spread widely throughout the world and are found in remote, 'pristine' regions such as the Arctic, Antarctica and on remote, isolated coral islands such as the Chagos Archipelago. The Chagos Archipelago situated in the centre of the Indian Ocean is a turtle nesting site for endangered green and critically endangered hawksbill turtles. This study reports microplastic concentration, composition, spatial distribution, and sediment characteristics across five atolls to understand the potential effects of microplastics on turtle rookeries in this region. Between March and July 2019, 25 sand samples were taken from five nesting beaches across the Chagos Archipelago. Here we discovered the highest beach microplastic concentration recorded in the literature to date. Furthermore, with microplastic concentrations orders of magnitude higher in both the surface layers and at turtle nesting depth than global reports; Chagos may have the highest microplastic concentrations in beach sand yet recorded. Boddam and Egmont beaches accounted for 91% of the total concentration recorded and very few microplastics were found on Nelson and Parasol Islands (5 particles). High variability was observed between stations with concentrations differing by an order of magnitude on Diego Garcia Island. Smaller microplastics were discovered in higher proportions (68%; 0.15 – 0.49 mm) than larger size classes (32%; 1 – 4.99 mm). Fragments were most prevalent accounting for 86.6% of the shapes recorded and polyethylene and polypropylene were the most frequently recorded polymers (46.3% and 20.6%). Beach sand particle size varied from medium – coarse grained sand to medium – fine grained sand. With the exception of Nelson Island (station 10) which is highly heterogenous, Chagos sediment is moderate to well sorted and the sediment particle size distribution is homogenous across the shoreline. This provides favourable conditions for high levels of turtle nesting. The high microplastic concentrations discovered at nesting depth may however be deleterious for this highly successful nesting site.

Statement of Contribution

Contributor Role	Contributor
Conceptualisation	NE
Data Curation	NE, RJ, PC, JM
Formal Analysis	KW
Funding Acquisition	NE
Investigation	KW
Methodology	KW, NE, KS
Laboratory Work	KW, KS, AW
Project Administration	NE
Resources	NE
Supervision	NE, KS, PE
Validation	NE, KS
Visualisation	KW
Writing – Original Draft Preparation	KW
Writing – Review & Editing	NE, KS, PE, KW

NE – Dr Nicole Esteban (Supervisor & Data collection)

KS – Dr Kimberley Stoakes (Supervisor)

PE – Dr Peter Esteban (Supervisor)

KW – Kathy Whitehead (MRes Student)

JM – Dr Jeanne Mortimer (Data collection and provision)

RJ – Rachel Jones (Data collection)

PC – Dr Pete Carr (Data collection)

Acknowledgements

I would like to firstly thank the Darwin Plus programme for funding this research project. Thank you James Good for encouraging me to fulfil my dream of becoming a researcher and for your incredible patience and support throughout. A huge thank you to my 'cheerleaders', Mom and Dad, Amy Nicholas and Sandy Good for your encouragement, guidance, and support. Thank you to my supervisors Nicole, Kim and Peter for your expertise, guidance, and patience, without which this thesis would not have been possible. I'd also like to thank Alice Wheeler, for your hard work and the time you generously gave in the lab, Ian Mabbett for your expertise and guidance with FT-IR and Dr Jeanne Mortimer for allowing me to use your sediment data from the Seychelles. Finally, thank you to Dr Rachel Jones, Dr Pete Carr, the Bertarelli Foundation, and my supervisor Nicole for your back breaking work, extracting and transporting sediment samples from such a remote location.

Declarations

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

Signed [redacted]

Date 14/03/22

This thesis is the result of my own investigations, except where otherwise stated. Other sources are acknowledged by footnotes giving explicit references. A bibliography is appended.

Signed [redacted]

Date 14/03/22

I hereby give consent for my thesis, if accepted, to be available for photocopying and for inter-library loan, and for the title and summary to be made available to outside organisations.

Signed [redacted]

Date 14/03/22

The University's ethical procedures have been followed and, where appropriate, that ethical approval has been granted.

Signed [redacted]

Date 14/03/22

Contents

List of Figures and Tables

Introduction

Marine plastics

Plastic pollution is a global crisis and one of the largest environmental problems facing the world today. Due to their persistence and longevity plastics are ubiquitous throughout the earth's environments (Trainic et al., 2020; Brahney et al., 2021). It has been estimated that 19 – 23 million tonnes of plastics entered the oceans in 2016, 90% originating from rivers and waste discharge (Borrelle et al., 2020). Moreover, if global plastic production and waste management continues along the current trajectory, by 2030, 90 million tonnes/year may be discharged into the world's oceans. Plastic waste may be divided into size categories: macro <1m, meso 25 – 5mm, micro 5mm - 1µm and nano-plastics ≤1 µm (Lambert et al., 2018; Zhang et al., 2020). Derived from a variety of polymers, and subject to mechanical degradation, ocean plastics are diverse in shape, size, and density. Influenced differently by ocean processes, they are pervasive throughout the water column from the sea surface to the depths of abyssal plains (Zhao et al., 2021). Plastics floating on the ocean's surface travel considerable distances, often reaching isolated mid ocean islands and regions as remote as the Southern and Arctic Oceans (Lechthaler et al., 2020). Further transported onto beaches, they split and abrade further, accumulating according to coastal ocean dynamics, plastic, and beach morphology (Khalid et al*.,* 2021).

The effects of plastic on marine organisms

Plastic ingestion and entanglement have been recorded across 693 marine species, from microscopic plankton to birds, large marine mammals, and reptiles (Anderson et al., 2015). Between 1990 and 2008, an estimated 85,000 sea turtles were caught in fishing nets during use or in lost or abandoned 'ghost nets' (Parga et al., 2020). Furthermore, turtle deaths have been linked directly to stomach and intestine perforations and blockages associated with substantial quantities of ingested microplastics (Nelms et al., 2015; Ryan et al., 2016). In addition to their wide range of chemical additives, marine plastics often become vectors of persistent organic pollutants (POPs) such as heavy metals and PCB's, (polychlorinated biphenyls), (Clukey et al., 2018). Once ingested these chemicals have the potential to leach into surrounding tissues (Mazurais et al., 2015; Gallo et al., 2018; Delgado-Gallardo et al., 2021). It is therefore not surprising that plastic associated chemicals have been discovered in the tissues of lugworms (*Arenicola marina*), Maldivian corals, whale sharks (*Rhincodon typus*), marine fishes (Saliu et al*.,* 2018) and (by maternal transfer) within the shell, yolk, and albumen of loggerhead sea turtle eggs (Savoca et al., 2021). These chemicals can cause reduced immune responses, neurotoxicity, oxidative stress and changes in gene expression and energy related enzyme activities (Mazurais et al., 2015). All seven sea turtle species are impacted by marine plastic pollution at every life stage (Ryan et al., 2016; Duncan et al., 2018). Records show hatchlings becoming entangled in fishing nets and trapped in plastic containers during their journey from the nest to the sea (Triessnig et al., 2012). A study removing anthropogenic marine debris on Cape San Blas beach (northwest Florida) led to an increase in turtle nesting activity (Fujisaki and Lamont, 2016). Investigating the effects of microplastics on beach sediment has revealed plastics alter sediment permeability and temperature (Carson et al., 2011; Jones, 2019; Lavers et al., 2021; Wheeler, 2021). Depending on local conditions and anthropogenic stressors this may negatively influence hatchling sex ratios and incubation success which are influenced by these factors (Fuentes et al., 2010; Laloë et al 2017; Lolovar et al., 2020; Maurer et al., 2021).

Indian ocean plastics

Studies have recorded large quantities of plastics discharged into the northern Indian Ocean from countries enveloping it from the North, East and West (Pattiaratchi et al., 2022). During the intermonsoon season plastics are transported from the north into the southern Indian basin. Winds and currents then drive marine debris west and southwest towards Africa and east and southeast towards the southern Australian coastline where they are intercepted and collected by Islands, atolls, and mainland shores (Van der Mheen et al., 2018; 2020). Studies measuring plastic debris on beaches in the Indian Ocean have focussed predominantly on highly populated regions in Asia: India, Thailand, Malaysia (Lusher, 2015; Balasubramaniam, 2016) and on remote, tourist focussed islands in the West: the Seychelles and the Maldives (Duhec et al., 2015; Imhof et al., 2017; Saliu et al., 2018; Patti et al., 2020). There has been little focus on remote, mainly uninhabited islands such as those in the Chagos Archipelago which could serve as a baseline reference as islands that do not export plastics.

The Chagos Archipelago

Located in the centre of the Indian Ocean (Longitude 71–73°E and Latitude 4.5–7.5°S), 2100 km south of India, 2000 km east of the Seychelles and 500 km south of the Maldives (Mortimer and Broderick, 1999; Craig, 2008) the Chagos Archipelago, (hereafter termed Chagos) is one of the most isolated archipelagos in the world (Hamylton and East, 2012). Chagos comprises 67 coral islands (Figure 1) distributed across five atolls: Diego Garcia, Peros Banhos, Salomon, Great Chagos Bank and Egmont (Hamylton and East 2012; Purkis, 2016; Mortimer et al., 2020). Surrounded by unique reef systems and seamounts, the region supports endemic fish and coral species and some of the highest levels of marine biodiversity in the world (Koldewey et al., 2010; Sheppard et al., 2012). Chagos has the highest reef fish biomass in the Indo-Pacific supporting highly migratory species such as tuna, sharks, and manta rays in an area (Indian Ocean) where fisheries are highly exploited and unregulated (Koldewey et al., 2021; Sheppard et al., 2012; Samoilys et al., 2019). Furthermore, the islands provide genetic links between corals of the Western Indian Ocean and Indo-Pacific and breeding and nesting sites for globally and regionally significant green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtle populations (Sheppard et al., 2012; Mortimer et al., 2020). This important region was designated a no take marine reserve in 2010, preserving an area of 550,000 km² from exploitation.

Chagos atolls consist of raised ocean facing rims and significantly lower inner lagoon shores (Woodroffe, 2007; Hamylton and East, 2012). The atolls are low lying, on average 2 - 3 m in elevation, with shorelines >2 m above mean sea level (Sheppard et al., 2017). Coastlines (235 km) are made of unconsolidated biogenic sands (Sheppard et al., 2012; Mortimer et al., 2020) and island vegetation consists of a mixture of native flora and deserted coconut plantations (Bárrios and Wilkinson, 2018). The region experiences high year-round rainfall with highest rainfall over northern Chagos islands and peak rainfall between December and February (Stoddart, 1971). Due to Chagos' small tidal range (1 – 2 m), changes to shoreline morphology are predominantly determined by wave action, with winds working the top 10 cm of sediment (Fadini et al., 2011). Light to moderate winds blow from the northwest during October to April and strong southwest trade winds blow from May to September, altering wave mechanics, beach morphology and accumulated debris (Sheppard et al., 1999; Woodroffe, 2007).

With the exception of a military base on the atoll of Diego Garcia, the Chagos islands have not been inhabited for more than 50 years and therefore experience little anthropogenic disturbance (Sheppard et al., 2012; Mortimer et al., 2020). Despite the region's remote location, protection afforded by the marine reserve and low anthropogenic impacts, Chagos beaches are sinks for high levels of macroplastic waste (Hoare et al., 2022). Anthropogenic marine debris surveys have revealed plastics as the dominant waste material across islands, and fragments and bottles are the most abundant items (Hoare et al., 2022).

Sea turtle nesting ecology

Sea turtle incubation

Female sea turtles exhibit natal philopatry, returning to the same beach within and between nesting seasons, and therefore intra-beach nest site selection appears to be an important factor for successful incubation (Lee et al., 2007; Salleh et al., 2018). Once deposited into the nest, sea turtle eggs are entirely reliant on the nest environment for survival (Ralph Ackerman, 1997). The environment is highly dynamic, with interrelating abiotic factors: temperature, hydric content, oxygen, and carbon dioxide determining embryo survival, sexual differentiation, hatchling size and fitness (Ackerman et al., 1985; Wallace et al., 2004; Chen et al., 2010; Cheng et al., 2015). Factors may vary considerably between species, populations, clutches, seasons, and between and within beaches (Tilley et al., 2019; Lolovar et al., 2020; Porter et al., 2021). For example, green and hawksbill embryos experience different incubation environments in part due to their different nesting depths which range between 60 and 85 cm and 30 – 45 cm respectively (Fuentes et al., 2010).

Nest hydric content tightly coupled with temperature and gas exchange is highly dependent upon beach sediment grain size and sorting (Ozdilek et al., 2007; Fadini et al., 2007; Salleh et al., 2018). Beach sediment particle size is defined by a variety of factors: mineral content, beach morphology, season, tidal range, and weather patterns (Ozdilek et al., 2007; Salleh et al., 2018). Optimal grain size for successful incubation may therefore not exist, rather an optimal size range per beach and species with critical upper and lower size limits. For example, global green turtle nesting grain sizes range between 250 - 2000 µm (Mortimer, 1990; Salleh et al., 2018). Sediments that are too fine and moist impede gas exchange and nest excavation (Ralph Ackerman, 1997). While larger grain sizes reduce moisture which may lead to egg desiccation and nest collapse (Ozdilek et al., 2007).

Study Species

Southwest Indian Ocean green and hawksbill sea turtle populations lay 39 – 51% and 14 – 20% of their clutches in Chagos and therefore this region is a significant nesting site (Mortimer et al., 2020). The unique island morphology and geography of dense vegetation, narrow shore platforms and heavy rainfall, provide favourable incubation conditions for reasonably balanced hatchling sex ratios (Esteban et al., 2016). Rising incubation temperatures linked with climate change have resulted in highly female skewed sex ratios and an increase in embryo mortality worldwide (Fuentes et al., 2010, Porter et al., 2021). Chagos is therefore a globally important nesting site where the effects of feminisation and decreasing hatch rates on population viability are of concern (Esteban et al., 2016, Tilley et al., 2019). Green and hawksbill sea turtle populations nest on all five Chagos atolls with highest nest concentrations (70.4% green and 90.4% hawksbill) on Diego Garcia and Peros Banhos and lowest concentrations (13.8% green and 7.5% hawksbill) on Salomon and Egmont shorelines (Mortimer et al., 2002; Mortimer et al., 2020). Both species nest above the high tide line, predominantly beneath vegetation, with nest depths ranging from 30 – 70 cm for both species (Mortimer et al., 2020). Green sea turtles nest year-round, increasing nesting frequency between June and October and hawksbill nesting takes place between October and February (Mortimer et al., 2020).

Aims and objectives

This study contains two parts which aim to: 1) quantify the concentration, distribution, spatial variation, and composition (size, shape, colour, and polymer type) of microplastics on turtle nesting beaches across the Chagos Archipelago and 2) characterise the beach sand particle size.

Previous studies have focussed solely on the presence of macroplastics on Chagos beaches and so this study aims to determine the presence of microplastics. Specifically, we focus on inter-island, intra-beach, and intra-depth microplastic concentration, distribution, and composition to understand the potential effects of microplastics on sea turtle incubation in this region. Furthermore, reporting microplastic composition (shape, colour, polymer type) may help to facilitate conservation and management strategies within the Chagos Archipelago and wider West Indian Ocean whilst measuring the effectiveness of those actions.

Sediment samples collected for microplastic analysis will be used further to characterise the beach sediment. Inter-island, intra-beach, and intra-depth patterns and differences will be compared with other rookeries in the Western Indian Ocean to further advance our understanding of turtle nesting ecology in this region.

Methods

Sediment sampling

Sediment samples were collected from the recorded nesting beaches on five islands: Diego Garcia, Nelson, Parasol, Egmont and Boddam, each situated on one of the five Chagos atolls (Figure 1). Refer to (appendix 1, table 1) for sampling dates and site coordinates. Islands were selected based on (a) abundance of turtle nesting activities recorded during surveys in 2016 (Mortimer et al., 2020), (b) length of suitable nesting beach and (c) accessibility for transport of sand cores (each weighing approximately 10 kg). Length of suitable nesting beach (b) on each island was determined as follows: on Diego Garcia: the 2.8 km Index beach was selected for the highest density of turtle nesting activity (Mortimer et al., 2020). On other atolls: Boddam, Nelson, Parasol and Egmont, sites were chosen based on available nesting beach and longest stretch of nesting beach, avoiding pocket beaches between rocky headlands.

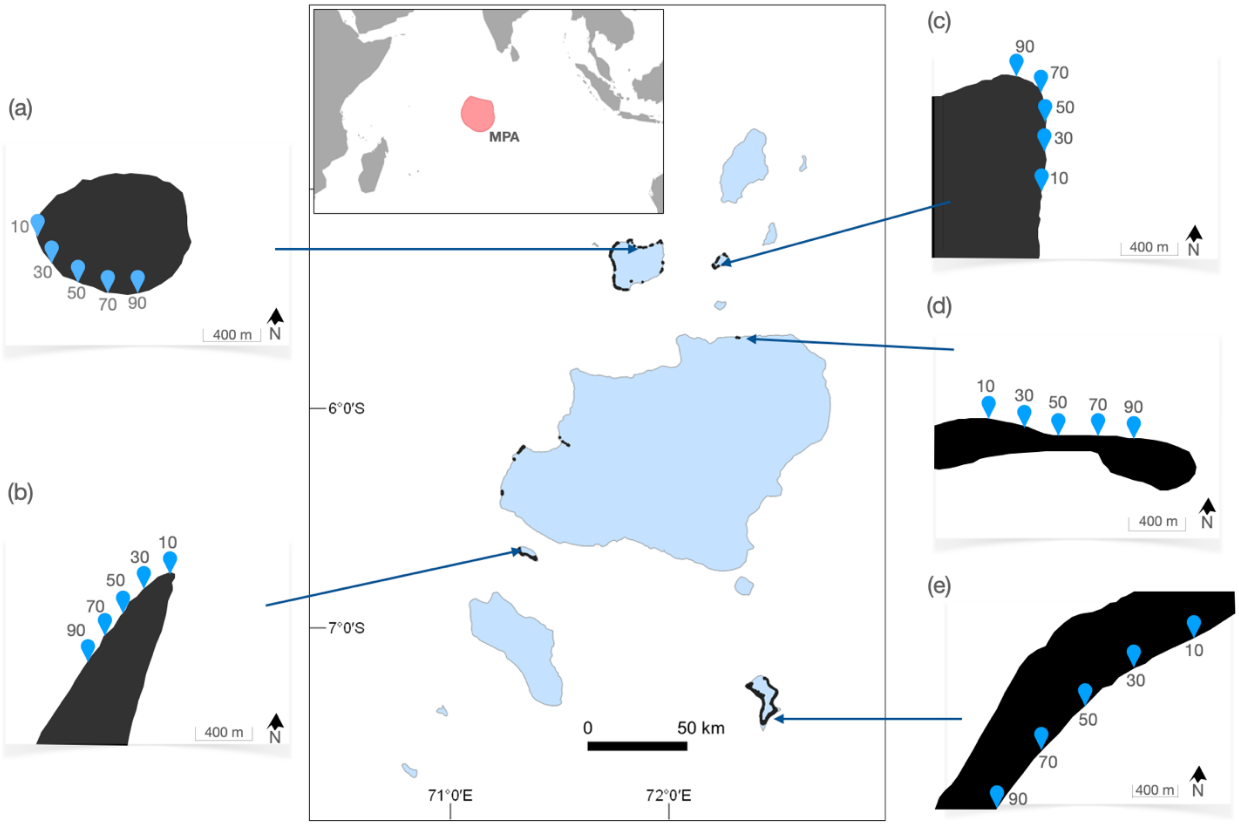

Figure 1. The Chagos Archipelago with inset map showing Chagos' location within the Indian Ocean (Chagos Marine Protected Area highlighted in red). Adapted from: Hays et al., 2020. (b) Egmont Island (Egmont atoll) and (e) Diego Garcia Island (Diego Garcia atoll) lie to the south. (d) Nelsons Island (Great Chagos Bank), (a) Parasol Island (Peros Banhos) and (c) Boddam Island (Salomon) are situated to the north. Blue markers in figures (1a - e) indicate stations. Stations 10 - 90 represent the percentage distance along the beach section from which a core was extracted.

Between March and July 2019, selected nesting beaches were divided into five equal intervals 10%, 30%, 50%, 70% and 90% across the shoreline and sediment cores were extracted at each interval (station). Parasol, Boddam, Egmont and Nelson sampling beaches were 1 km in length and therefore intervals were 200 m apart with samples covering 0.02% of the total beach area. Diego Garcia Index beach measured 2.8 km in length and therefore intervals were 550 m apart, covering 0.007% of the total beach area. This small sample size may increase sampling error however this was unavoidable due to the large size of the sampling area. The cores were extracted from turtle nesting sites above the high-water mark (or strandline) along the turtle nesting line (TNL). The TNL is defined as a transect, parallel to the shore that is approximately the medial distance between the strandline and the landward limit of the beach within which turtles nest. This is evidenced by body pits from nesting attempts and or marked nests recorded during surveys (Broderick and Godley, 1996). To ensure the turtle nesting sites were sampled, every core was taken from between two existing body pits. Sampling between body pits also prevented accidental sampling of nest sites.

Samples were collected using 10 cm internal diameter and 60 cm height PVC pipe cores. The core height is representative of the range of mean turtle nesting depths in Chagos (Esteban et al., 2018). PVC pipes and lids were used to minimise the sand core weight. This was particularly important where it was necessary to swim the cores to the research vessel when beach access by boat was not possible. PVC is however a potential source of contamination and therefore microplastics identified as PVC through FT-IR analysis were cross referenced by colour with the pipes and lids used for sampling. Using a wooden mallet, cores were hammered into the sediment until sand was level with the top of the core. Surface sand was then brushed away before securing the PVC lid to avoid contamination from the surrounding sand. Sand surrounding the base of the core was dug away to reveal the bottom of the core so it could be capped and removed successfully. Cores were labelled with the date and nesting line reference, and the top of the core lid was marked with a duct tape cross to indicate which end was top and bottom.

Sand core processing & analysis

369 sub samples from 25 sand cores were analysed for microplastic size, abundance, distribution, and sediment particle size (June – August 2019; table 1) and, of those, 279 sub samples from 19 cores were additionally analysed (June – September 2021) for organic content and plastic shape, colour, and polymer. The majority of cores were transported directly and kept intact where they were separated in the laboratory at Swansea University. Two cores (Diego Garcia, station 10 and Parasol, station 50) were separated and bagged into 4 cm depth sub samples, posted, and inspected by Customs & Excise who removed six sub samples (Diego Garcia depth intervals 0 – 4 cm, 4 – 8 cm, 8 – 12 cm, 20 – 24 cm, 40 – 44 cm; Parasol, depth interval 56 – 60 cm).

Table 1. Date of analysis of sub samples from Chagos Islands: Egmont, Boddam, Diego Garcia, Nelson, and Parasol.

Atoll	Island	Stations	Sub samples (n)	Date
Egmont	Egmont	10, 30, 50	45	June-August 2019
Egmont	Egmont	70, 90	30	June-September 2021
Salamon	Boddam	10, 30, 50	45	June-August 2019
Salamon	Boddam	70, 90	30	June-September 2021
Diego Garcia	Diego Garcia	10, 30, 50, 70, 90	70	June-September 2021
Great Chagos Bank	Nelson	10, 30, 50, 70, 90	75	June-September 2021
Peros Banhos	Parasol	10, 30, 50, 70, 90	74	June-September 2021

Laboratory contamination control

The following measures were taken to minimise plastic contamination (Monteiro et al., 2020; Patti et al., 2020). In the field a wooden mallet was used to hammer cores into the sediment. Once fully immersed, sediment surrounding the core was carefully brushed away before securing the lid to prevent contamination from the surrounding sand. During sample processing, clothing, shoes, and hair ties worn in the lab were plastic free and lab coats and covid masks were 100% cotton. Latex gloves were worn while handling hazardous chemicals. Non plastic equipment was used wherever possible, e.g., glass stirring rods, glass magnetic fleas and metal or glass storage containers. Equipment and utensils were rinsed three times with ultrapure water before use and dried with plastic free towels. Devices such as weighing scales and microscopes were wiped down with ethanol and ovens were cleaned before use. Three control samples (damp filter papers; Whatman GF/B: 1.0 µm) were placed on open petri dishes and exposed to laboratory air during sample processing and analysis to capture airborne contamination. The extraction solution (K_2CO_3) was prefiltered twice before use. Materials and equipment such as decanted solutions, filters with extracted material, empty beakers and flasks were covered with foil lids during processing.

Sub sampling

Each core was split into fifteen sub samples (volume 314 cm^3) and microplastic particles and organic matter weight were converted to concentration (particles/m^3, kg/m^3) by dividing the number of particles/weight by the sub sample volume. This is standard practice for efficient quantification of microplastics and allowed for literature wide comparisons (Fok et al., 2017; Duncan et al., 2018). Cores were marked in 4 cm increments from the sediment surface to the core base. Sand from the surface was scooped into a metal container until it was level with the mark indicating the successive 4 cm sub sample. This was repeated until the core was empty. Each sub sample container was sealed with metal foil and the top labelled with the relevant island, sampling station and depth.

Following Besley et al. (2017), Boddam (n = 3) and Egmont (n = 3) sub samples (processed in 2019) were separated further according to sieve fractions (5, 1, 0.5, 0.25 and 0.125 mm). The process of separating microplastics according to sieve size involved dry sieving sediment. See 'sediment grain size analysis' for further detail. Studies published after the processing of these samples indicate dry sieving can further abrade microplastics thus increasing procedural error (Cashman et al., 2020; Thomas et al., 2020). Sub samples processed in 2021 were therefore not dry sieved (separated into size classes) prior to microplastic extraction.

Sub samples (processed in 2021) from Diego Garcia, Nelson, and Parasol (n = 15) and Boddam and Egmont (n = 4) were further divided into a one quarter subcomponent so that plastics could be extracted using a centrifuge (Patti et al., 2020). Centrifugal separation improved the efficiency of microplastic extraction where sediment in test extractions required > 24 hours to settle. To split a sub sample, it was emptied into a glass beaker, covered tightly with foil, and mixed gently and randomly for two minutes. The sediment was then poured into a riffle box container and further poured evenly through a riffle box (mechanical sample splitter) splitting the sediment in two (Petersen et al., 2004). This robust method of mass reduction was used to ensure precision and accuracy for representative sampling. A catcher container was randomly selected and sediment from this container poured through the riffle box to split the sediment further. The randomly selected catcher container from this split became the one quarter subcomponent for microplastic extraction.

Subcomponent weight was recorded on Precison XB 3200C scales before storing in a metal container sealed with foil. The remaining 75% sediment was stored in a metal container sealed with foil for sediment characterisation.

Microplastic extraction

Boddam (n = 3) and Egmont (n = 3) samples (processed in 2019) were extracted following Besley et al. (2017). Sub samples from each sieve fraction (1, 0.5, 0.25 and 0.125 mm) were divided equally into separate beakers and each beaker was filled to the top with a salt solution. High density zinc chloride ($ZnCl_2$, 1.5 g/cm^3) was used to extract plastics from sieve fractions 1 and 0.5 mm and sodium chloride (NaCl, 1.17 g/cm^3) was used to extract fractions 0.25 and 0.125 mm. Low density NaCl was used to extract microplastics from sediment consisting of smaller grain sizes, where test extractions took > 24 hours to settle. Microplastic centrifugal separation methods had not been reported in literature at this time and therefore it was necessary to use a low-density salt solution to reduce sediment settling time. Using a magnetic stirring bar, the supernatant was agitated for two minutes, and then left to settle for two minutes (Beckwith and Fuentes, 2018). After the sediment had settled the supernatant was poured through a 63 µm mesh sieve. The sides of the beaker were rinsed with ultrapure water into the sieve and the material in the sieve was then rinsed into a petridish for analysis.

Following sample processing of Boddam (n = 3) and Egmont (n = 3) cores (2019) a study investigating anthropogenic marine debris in Chagos (Hoare et al., 2022) revealed high density (1.35 g/cm^3) PET plastic bottles as the predominant macroplastic. To capture PET microplastics it was necessary to use a high-density salt solution for all extractions (1.5 g/cm^3). Centrifugal separation was therefore used during 2021 sample processing to reduce sediment settling time in a high-density salt solution (Patti et al., 2020). Microplastics were extracted from Diego Garcia, Nelson, and Parasol (n = 15) and Boddam and Egmont (n = 4) samples following Patti et al. (2020). Before every extraction the density of the salt solution was calculated and if necessary, adjusted to ensure the correct density (1.5 g/ cm^3) was used. The solution was evenly mixed, stirring for 24 hours on a magnetic stirring plate at 800rpm (Quinn et al., 2016) and prefiltered twice prior to extraction. Each sediment subcomponent sample weight was divided so that approximately 25g of sediment was poured into separate centrifuge tubes (50ml). 35 ml of potassium carbonate solution (1.5 g/ cm^3, K_2CO_3) was added to each centrifuge tube before shaking the tubes for twenty seconds. The tubes were then placed into a Biofuge primo centrifuge and run for five minutes at 2500 rpm. After five minutes, the top 15 ml of supernatant was poured into a prelabelled glass container. The centrifuge tubes were refilled with K_2CO_3 to the 50 ml line, shaken for twenty seconds and run again for five minutes at 2500 rpm. The top 15 ml of supernatant was poured into the appropriately labelled container and the process repeated once more so that the sediment underwent three extractions.

Prior to filtering the supernatant, the filter funnel was rinsed with potassium carbonate and preweighed filter papers (Whatman microfiber filter paper, grade GF/B, thickness 675 µm, diameter 90 mm, pore size 1.0 µm) were soaked in potassium carbonate. This prevented the supernatant from precipitating onto the filter paper during the initial stage of filtration. Supernatant was then poured from its storage container onto filter paper, inside a Buchner funnel which was secured to a conical flask. The sides of the storage container and container lid were rinsed three times onto the filter with a squeeze bottle of K_2CO_3 to prevent microplastic loss. Two litres of ultrapure water were then vacuum pumped through the filter paper containing extracted material to remove all the salt solution. Once rinsed with ultrapure water, filters with extracted material were placed into prelabelled petri dishes and oven dried (uncovered) for four hours at 60 °C. Prior to the process of drying samples the oven was cleaned to prevent microplastic contamination. Furthermore, three control samples (damp filter papers; Whatman GF/B: 1.0 µm) were placed on open petri dishes within the oven to capture airborne contamination. Once removed from the oven, petri dishes were covered with lids and the filter papers left to cool for 24 hours. Once cool, filter papers were weighed on precision scales (readability 0.0001 g) and the weight of organic matter, plastics and filter paper recorded.

Organic material removal

Organic material floated with microplastics during density separation was removed from Diego Garcia, Nelson, and Parasol (n = 15) and Boddam and Egmont (n = 4) sub samples. Hydrogen peroxide (H_2O_2, 30%) was chosen to remove organic matter due to its efficiency whilst not altering microplastic size and shape (Al-Azzawi et al., 2020). Before discarding, large pieces of organic matter (twigs and sticks) were rinsed with hydrogen peroxide into 50 ml beakers to capture trapped microplastics. The contents of the filter papers were then rinsed with H_2O_2 into labelled beakers. Filters were rinsed thoroughly before covering the beakers with foil lids and labelling. Following the transfer of material from filter paper to beakers, filter papers were inspected with a dissecting microscope (Olympus SZX61, 0.7-11.5x with an SDF PLAPO 1XPF objective lens) to ensure microplastics were not lost during this procedure. Beakers were placed on a metal tray and placed in an oven at 60 °C for 24 hours. After 24 hours, 10 ml of Tween 20 solution (0.1%) was added to each beaker. After stirring the solution, the glass rod was rinsed back into the beaker with Tween 20 to prevent microplastic loss. The supernatant was then poured into a funnel lined with preweighed filter paper. The sides of the beaker were rinsed onto the filter paper three times with ultrapure water to prevent microplastic loss. Two litres of ultrapure water were then vacuum pumped through the filter paper to remove all H_2O_2 and Tween solution. Once rinsed with ultrapure water, filter papers were placed into prelabelled petri dishes and placed in an oven (uncovered) for four hours at 60 °C. Once removed from the oven, petri dishes were covered with lids and the filter papers left to cool for 24 hours. After cooling, the filter papers were weighed on precision scales (readability 0.0001 g) and the weight of plastics and filter paper recorded. The weight of plastics was calculated by subtracting the initial dry weight of each filter paper from the final dry weight of the filter paper with plastics.

Sorting microplastics into size classes, colour, and shape

Prior to microplastic extraction, Boddam (n = 3) and Egmont (n = 3) microplastics (processed in 2019) were sorted into size classes by dry sieving the sediment samples. Post extraction, microplastics retained in petri dishes were placed under a dissecting microscope (Olympus SZX61, 0.7-11.5x) with (SDF PLAPO 1XPF) to identify and quantify them. Where microplastics could not be differentiated from organic matter the hot needle test was used (De Witte et al., 2014). Microplastics will melt or curl when a hot needle is placed near them, whereas non plastic materials remain unchanged. Microplastic colours, shapes, and polymers were not recorded for Boddam (n = 3) and Egmont (n = 3).

Colour, shape, and size of microplastics (processed in 2021) from Diego Garcia (n = 5 cores), Nelson (n = 1 core), Parasol (n = 1 core) and Egmont (n = 1 core) were recorded. The remaining cores from Egmont (n = 1), Boddam (n = 2), Parasol (n = 4) and Nelson (n = 4) did not contain microplastics. These samples were not dry sieved prior to microplastic extraction and therefore microplastics were separated into size classes via sieving post extraction. This is an efficient method of size categorisation when quantifying large quantities of microplastics. To prevent microplastic loss filter papers were held within the walls of the top sieve, in the centre and close to the sieve mesh. Holding each filter paper with tweezers, the contents were brushed carefully into the top of a 100 mm diameter sieve stack made up of six fractions: 5, 2, 1, 0.5, 0.25, 0.15 mm. Microplastics were then counted, weighed and their colour, shape, and size recorded. Shapes were divided into the following categories: fibre, foam, fragment, sheet, film, and virgin pellet (Figure 2). Once counted, plastics from the largest sieve fractions (5 and 2 mm) were picked out with tweezers, placed into preweighed petri dishes and their weight was recorded on precision scales (readability 0.0001 g, SNR = 2.5). The smaller fraction, 0.5 mm was brushed gently from the inside and tapped from the underside of the sieve into a preweighed petri dish and its weight recorded. After weighing, larger particles were placed back into prelabelled petri dishes. The total weight of microplastics was then calculated and cross referenced with the total microplastic weight recorded after organic matter removal. Matching these weights verified no microplastics were lost during this procedure. Smaller microplastics, too light to register on the scales may however have been lost during this process. Microplastic particles from fractions <0.5 mm were too light to register on the weighing scales and so were counted and then brushed gently from the inside and tapped from the underside of sieves into prelabelled petri dishes. Finally, the collecting dish was brushed along the base and sides and tapped from the underside to ensure all plastics were emptied back into a labelled petri dish. The sieve walls of each sieve and sieve mesh were then brushed a further three times into prelabelled petri dishes to ensure all microplastics had been removed. A measuring-eyepiece 10x magnifier was used to inspect each sieve to ensure all microplastics had been removed. Smaller microplastics that may not have been visible with the 10x magnifier may have been lost during this procedure.

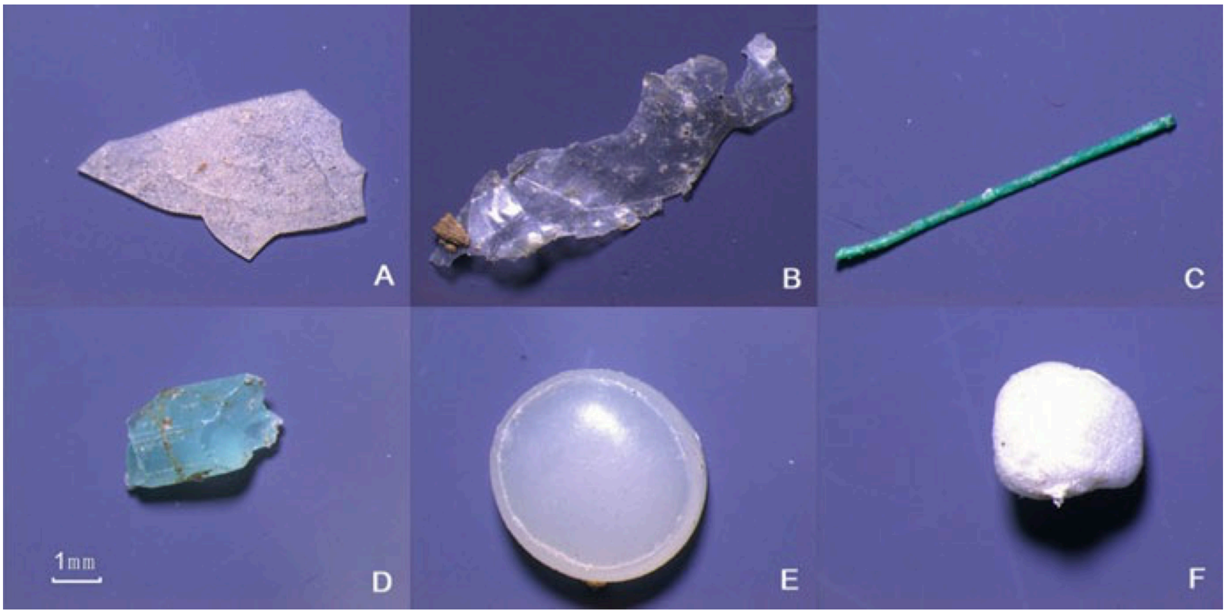

Figure 2. Microplastic shapes: A (sheet), B (film), C (fibre), D (fragment), E (virgin pellet), F (foam). Adapted from: Wu et al., 2018.

FT-IR Analysis

All microplastics (n = 253) in the size class 1 – 4.99 mm from Diego Garcia (n = 5 cores), Nelson (n = 1 core), Parasol (n = 1 core) and Egmont (n = 1 core) underwent Fourier-transform infrared spectroscopy (FT-IR) analysis to identify their composite materials. Particles in the size class 1 – 4.99 mm were chosen for FT-IR analysis as particles <1 mm were too small to provide good sample contact. Specifically, a Perkin Elmer Spectrum Two (10.5.3) with single reflection ATR accessory was used. Samples were pressed on to the diamond crystal and 32 sample scans recorded in the range 4000 - 400 cm^{-1}, resolution 4

cm^{-1} (Pimpke et al., 2018). IR spectrum results were cross referenced with the FT-IR inbuilt spectral library and validated with a >70% match, Turner et al. (2021). Known pure polymer samples were then run through the FT-IR to further cross reference and identify individual sample polymers.

Sediment grain size analysis

The sediment from core samples was further processed and analysed for grain size and sorting to advance our understanding of Chagos sea turtle nest site characteristics. Following Besley et al. (2017) the remaining 75% sediment sub samples were oven dried at 60 °C, weighing every 24 hours until a weight <0.1% less than the previous drying weight was achieved. Once this has been achieved the sediment is considered dry. Using an Endecott sieve shaker sediment sub samples (processed in 2021) from Diego Garcia, Nelson, and Parasol (n = 15) and Boddam and Egmont (n = 4) were sieved for two minutes (Jones. 2019) with Endecott sieves (diameter 200 mm), fractions: 32 mm, 16 mm, 8 mm, 4 mm, 2 mm, 1 mm 0.5 mm, 0.25 mm, 0.125 mm, and 0.063 mm (Ozdilek et al., 2007; Carson et al., 2011; Franklin Rey, 2021; Salleh et al., 2021). Sediment pieces larger than 32 mm were measured with a ruler. Following the sieving process sand was poured from each sieve fraction into separate metal containers. Using a sieve brush, sediment remaining in the sieves was brushed from the inside and tapped from the underside into the appropriate container and the sub sample weighed. The sediment was then classified according to size fraction using the Wentworth scale (Carson et al., 2011; Franklin Rey, 2021; Salleh et al., 2021). Grain size analysis programme GRADISTAT v 8.0 was used to analyse sediment sorting and skew. Boddam (n = 3) and Egmont (n = 3) sub samples (processed in 2019) were processed following the protocols described above, except for the use of a narrower range of sieve sizes (5, 1, 0.5, 0.25 and 0.125 mm) and sieves were shaken by hand. A literature review was conducted to compare beach sediment characteristics in Chagos with sediment from other rookeries in the WIO.

Statistical Analysis

All statistical tests were completed using RStudio 4.1.2. One-way ANOVA and non-parametric Kruskal-Wallis tests were used to compare intra-island and inter-beach microplastic, sediment and organic matter data. A Wilcoxon signed-rank (*post-hoc*) test was used to make further pair-wise comparisons and to compare organic matter data from Boddam and Egmont stations 70 and 90. Two-way ANOVA and nonparametric Scheirer-Ray-Hare tests were used to compare inter-island microplastic size, colour, shape, and polymer type. Tukey (HSD) and Dunn's (*post-hoc*) tests were used to make further pair-wise comparisons. Linear regression models (lm) were used to investigate relationships between depth, microplastic abundance, sediment grain size and organic matter content. All tests were performed at a significant level with a p value ≤ 0.05 considered to be statistically significant.

Results

Microplastics

Concentration

Microplastics on Chagos Islands are ubiquitous throughout the depth profile from the sediment surface to 60 cm depth (Figure 3). The top 20 cm of sediment contains 50% of the plastic particles, with the highest microplastic concentrations (mean 742,000 particles/m^3, ± 228,000) in the top 4 cm of sediment (refer to appendix 2 table 1). Concentrations decrease rapidly in the surface layers and remain consistent, around 250,000 particles/m^3 throughout turtle nesting depth (30 – 60 cm). Microplastic size and sediment depth showed no correlation. Investigating the relationship between sediment organic matter content and microplastic concentration (refer to appendix 2, figure 1) revealed a weak negative linear relationship (R^2 0.04, F 11.13, df 278, P<0.001). Microplastic weight has been excluded from the results for the following reason. Microplastics from Boddam (n = 3 cores) and Egmont (n = 3 cores) were not weighed during sample processing in 2019. Unequal sampling effort combined with the small or no microplastic count from the remaining cores and the skew towards smaller size classes, too light to be weighed (Microplastics weighed: Diego Garcia

33%, Egmont 15%) meant that meaningful comparisons could not be made. Control filter papers visually inspected for airborne contamination revealed no microplastics.

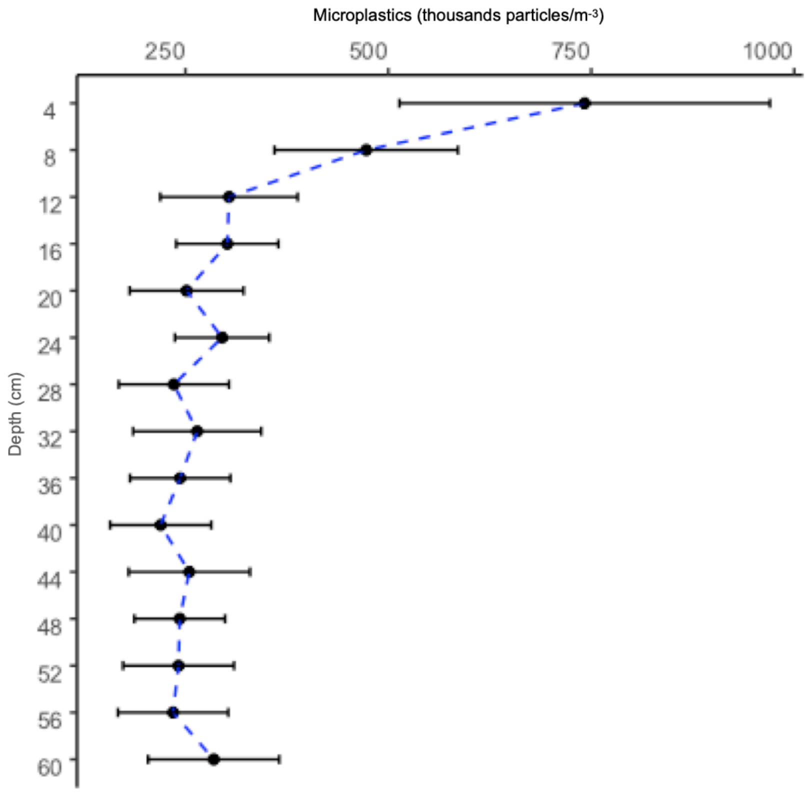

Figure 3. Microplastic depth distribution. Microplastics at core depth categories (4 cm intervals) from the sediment surface to turtle nesting depth (30 - 60 cm). Sediment cores taken from the shorelines of five Chagos Islands: Diego Garcia, Parasol, Nelson, Egmont and Boddam. Dots indicate the mean and bars indicate standard error of the mean.

Spatial variation

Microplastics were recorded on all five Chagos atolls (Figure 4) and at 15 of 25 stations (Diego Garcia all stations, Boddam stations, 10, 30, 50, Egmont 10, 30, 50, 70, Parasol 70 and Nelson 90). High variability was observed between islands with high concentrations discovered on Egmont (mean 360,824 particles/m^3, ± 28787 s.e.) and Boddam (mean 280,476 particles/m^3, ± 17376), moderate concentrations on Diego Garcia (mean 49,184 particles/m^3, ± 5023) and low concentrations on Nelson, (mean 2623 particles/m^3, ± 524) and Parasol (mean 848 particles/m^3, ± 170).

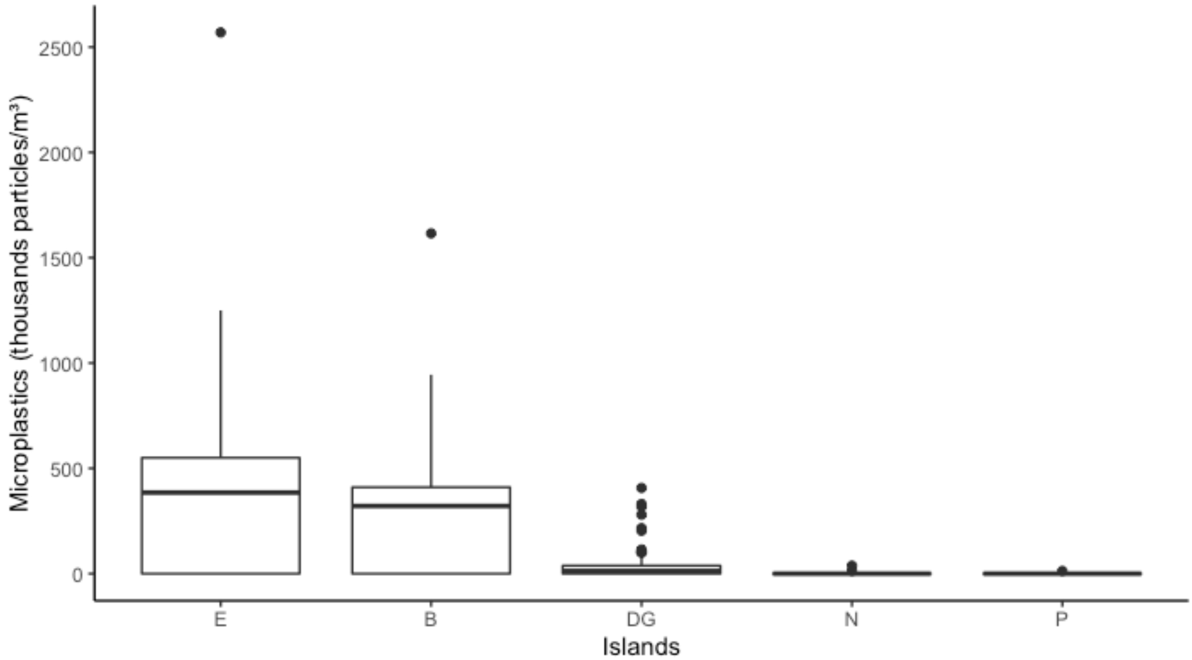

Figure 4. Inter-island microplastic distribution. Mean number of microplastics (thousands particles/m^3) collected from Chagos Islands: Egmont (E), Boddam (B), Diego Garcia (DG), Nelson (N) and Parasol (P). Horizontal lines on the box-plots indicate the mean microplastic concentration. Boxes indicate the interquartile range. Whiskers indicate the upper extreme and dots indicate outliers.

High small scale spatial variability was observed between stations on Egmont, Boddam and Diego Garcia. On Egmont Island microplastics were discovered in high concentrations (Table 2) at stations 10 and 30 (593,812 particles/m^3 ± 37,120 s.e; 599,112 particles/m^3 ± 56,367), moderate concentrations at station 50 (393,260 ± 45,777), low concentrations were detected at station 70 (217,936 particles/m^3 ± 170,705) and no microplastics were found at station 90 (refer to appendix 2, figure 2). High microplastic concentrations were discovered at stations 10, 30 and 50 (mean range 435,448 particles/m^3 – 527,224 particles/m^3) on Boddam and no plastics were found at stations 70 and 90. On Diego Garcia the highest microplastic concentration was discovered at station 50 (102,608 particles/m^3, ± 28,991) comparatively moderate concentrations were detected at station 10 (66,144 particles/m^3 ± 30,386) and comparatively low concentrations at stations 70, 90 and 30 (mean range 8,480 – 34,768 particles/m^3).

Table 2. Intra-beach microplastic distribution. Mean number of microplastics (thousands particles/m-3) collected from stations 10 – 90 of Chagos islands: Egmont, Boddam, Diego Garcia, Nelson, and Parasol.

Island	Station	Mean	S.e.
Egmont	10	593,812	± 37,120
Egmont	30	599,112	± 56,367
Egmont	50	393,260	± 45,777
Egmont	70	217,936	± 170,705
Egmont	90	0	0
Island average		360,824	± 28,787
Boddam	10	435,448	± 35,344
Boddam	30	439,688	± 29,152
Boddam	50	527,244	± 95,022
Boddam	70	0	0
Boddam	90	0	0
Island average		280,476	± 17,376
Diego Garcia	10	66,144	± 30,386
Diego Garcia	30	8,480	± 3,205
Diego Garcia	50	102,608	± 28,991
Diego Garcia	70	33,920	± 22,228
Diego Garcia	90	34,768	± 14,607
Island average		49,184	± 5,023
Nelson	10	0	0
Nelson	30	0	0
Nelson	50	0	0
Nelson	70	0	0
Nelson	90	3,392	± 678
Island average		678	± 135
Parasol	10	0	0
Parasol	30	0	0
Parasol	50	0	0
Parasol	70	848	± 170
Parasol	90	0	0
Island average		170	± 34

Microplastic Composition

All four size classes of microplastic particles showed high concentration where microplastics were abundant in the sand column (Table 3). Egmont and Boddam shared a similar size class distribution (31.4%, 31.6%; 1 – 4.99 mm and 67.9%, 68.4%; 0.15 – 0.49 mm) with microplastic sizes positively skewed towards the smaller size classes (Figure 5). Diego Garcia showed a different size class distribution (63.6%; 1 – 4.99 mm and 36.4%; 0.15 – 0.49 mm), negatively skewed towards smaller size classes. The four plastics discovered on Nelson's Island and the single plastic piece found on Parasol were in the size class 1 – 4.99 mm. Egmont, Boddam and Diego Garcia show a bimodal distribution.

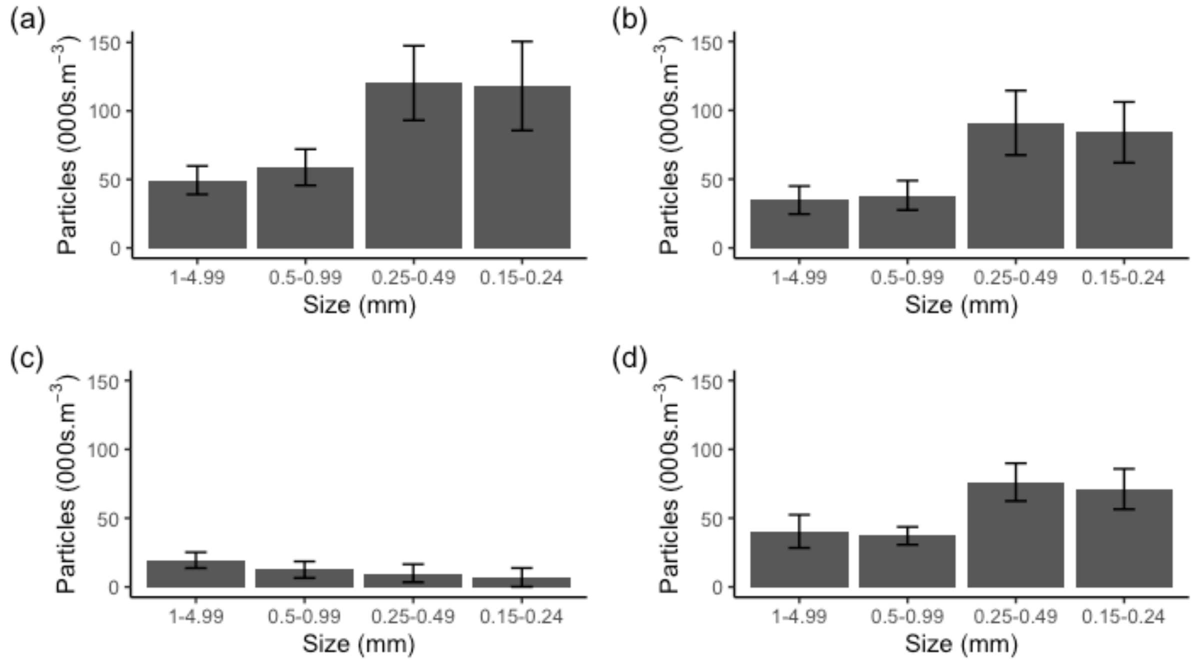

Figure 5. Microplastic size distribution on beaches: Egmont (a), Boddam (b), Diego Garcia (c) and between islands (d). Bars represent the mean number of microplastics (thousands particles/m^3) and error bars indicate the standard error of the mean.

Table 3. Categorisation of microplastic particles by size from islands: Egmont, Boddam, Diego Garcia, Nelson, and Parasol.

			Size (mm)			
Island	Stations	Sum	1 - 4.99	0.5 - 0.99	0.25 - 0.49	0.15 - 0.24
Egmont	10,30,50,70,90	Total	1152	1280	2830	2476
		%	14.9	16.5	36.5	31.9
Boddam	10,30,50,70,90	Total	995	1095	2544	1981
		%	15.0	16.6	38.5	29.9
Diego Garcia	10,30,50,70,90	Total	74	69	49	33
		%	32.9	30.7	21.7	14.7
Nelson	90	Total	4	0	0	0
		%	100	0	0	0
Parasol	70	Total	1	0	0	0
		%	100	0	0	0
All islands		Total	2226	2444	5423	4490
		%	15.3	16.8	37.2	30.8

Across all islands microplastic fragments were the predominant shape recorded (Figure 6) making up 100% of the plastics found on Egmont, Nelson, and Parasol islands and 71.1% (n = 160) on Diego Garcia (Table 4). Microplastics varied in shape on Diego Garcia Island with foam making up 21.7 % (n = 49), fibres 3.5% (n = 8) and film and pellets 1.7% (n = 8) of the shapes discovered.

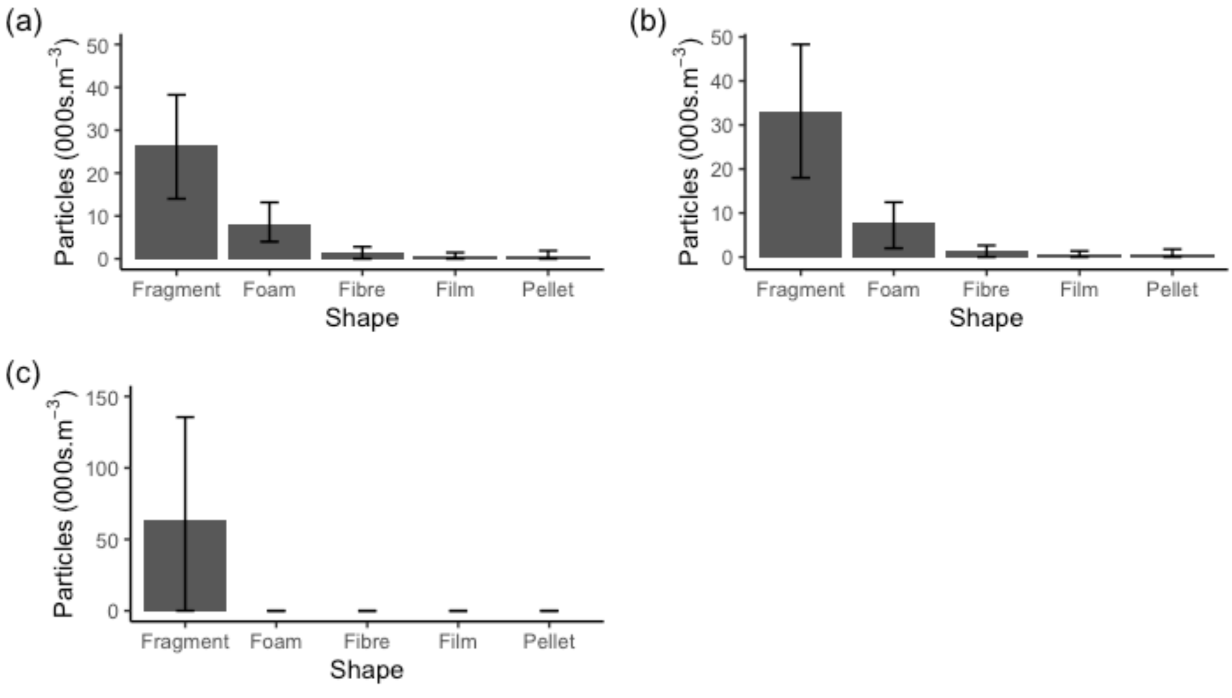

Figure 6. Microplastic shape distribution on beaches: Diego Garcia (a), Between islands (b) and Egmont (c). Bars represent the mean number of microplastics (thousands particles/m^3) and error bars indicate the standard error of the mean.

Table 4. Categorisation of microplastic particles by shape from islands: Egmont, Diego Garcia, Nelson, and Parasol.

Island	Stations	Sum	Fragment	Foam	Fibre	Film	Pellet
Egmont	70	Total	257	0	0	0	0
		%	100	0	0	0	0
Diego Garcia	10,30,50,70,90	Total	160	49	8	4	4
		%	71.1	21.7	3.5	1.7	1.7
Nelson	90	Total	4	0	0	0	0
		%	100	0	0	0	0
Parasol	70	Total	1	0	0	0	0
		%	100	0	0	0	0
All islands		Total	422	49	8	4	4
		%	86.6	1.0	16.3	0.8	0.8

A large range of colours were recorded on Diego Garcia Island with the colour white making up the highest proportion (n = 70, 31.1%) followed by blue (n = 51, 22.6%), green (n = 50, 22.2%) and grey (n = 32, 14.2%) (Figure 7). Black, yellow, translucent, red, pink, and brown were discovered in considerably lower (≤ 4.8%) proportions (Table 5). In comparison, a small range of colours were recorded on Egmont Island with the colour orange making up the highest proportion of microplastics (n = 183, 71.2%). Yellow made up 20.2% (n = 52), followed by blue (n = 19, 7.4%), translucent (n = 2, 0.8%) and white (n = 1, 0.4%). Nelson's Island microplastics were blue (3) and translucent (1) and the single plastic piece discovered on Parasol was blue.

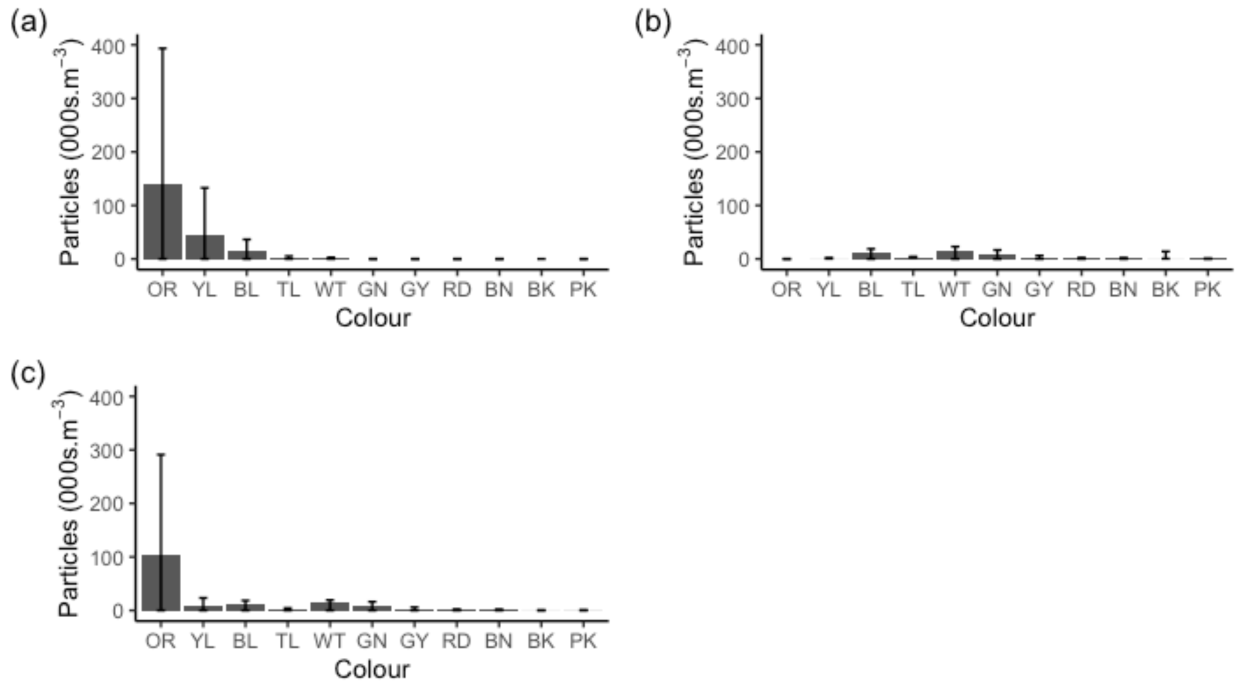

Figure 7. Microplastic colour distribution on beaches: Egmont (a), Diego Garcia (b) and between islands (c). Bars represent the mean number of microplastics (thousands particles/m^3) and error bars indicate standard error of the mean. Colour abbreviations: OR = orange, YL = yellow, BL = black, TL = translucent, WT = white, GN = green, GY = grey, RD = red, BN = brown, BK = black and PK = pink.

Table 5. Categorisation of microplastic particles by colour from islands: Egmont, Diego Garcia, Nelson, and Parasol. Colour abbreviations: OR = orange, YL = yellow, BL = black, TL = translucent, WT = white, GN = green, GY = grey, RD = red, BN = brown, BK = black and PK = pink.

Island	Stations	Sum	BK	BL	TL	YL	WT	RD	PK	GY	GN	BN	OR
Egmont	70	Total	0	19	2	52	1	0	0	0	0	0	183
		%	0	7.4	0.8	20.2	0.4	0	0	0	0	0	71.2
Diego Garcia	10,30,50,70,90	Total	1	51	11	1	70	4	2	32	50	3	0
		%	0.4	22.6	4.8	0.4	31.1	1.8	0.9	14.2	22.2	1.3	0
Nelson	90	Total	0	1	3	0	0	0	0	0	0	0	0
		%	0	25	75	0	0	0	0	0	0	0	0
Parasol	70	Total	0	1	0	0	0	0	0	0	0	0	0
		%	0	100	0	0	0	0	0	0	0	0	0
All islands		Total	1	71	17	53	71	3	2	32	50	4	183
		%	0.2	14.6	3.5	10.9	14.6	0.6	0.4	6.6	10.3	0.8	37.6

Low density polyethylene made up the highest proportion of polymers recorded on Egmont (n = 11, 47.8%) and Diego Garcia (n = 76, 33.6%) and 100% of the microplastics discovered on Nelson's Island (Table 6). On Diego Garcia polypropylene made up the second highest proportion (n = 58, 25.3%) followed by polystyrene (n = 48, 21.4%) high density polyethylene (n = 23, 10.5%) and PVC (n = 20, 9.2%). PET was not recorded on Diego Garcia

(Figure 8). On Egmont Island polypropylene, high density polyethylene, PET and PVC were recorded in the same proportions (n = 3, 13%) and no polystyrene was found. The single plastic piece discovered on Parasol Island was made from polypropylene. Microplastics identified as PVC were colour matched with the PVC lids and pipes used for sediment sampling. PVC microplastics from samples did not match the PVC from the cores.

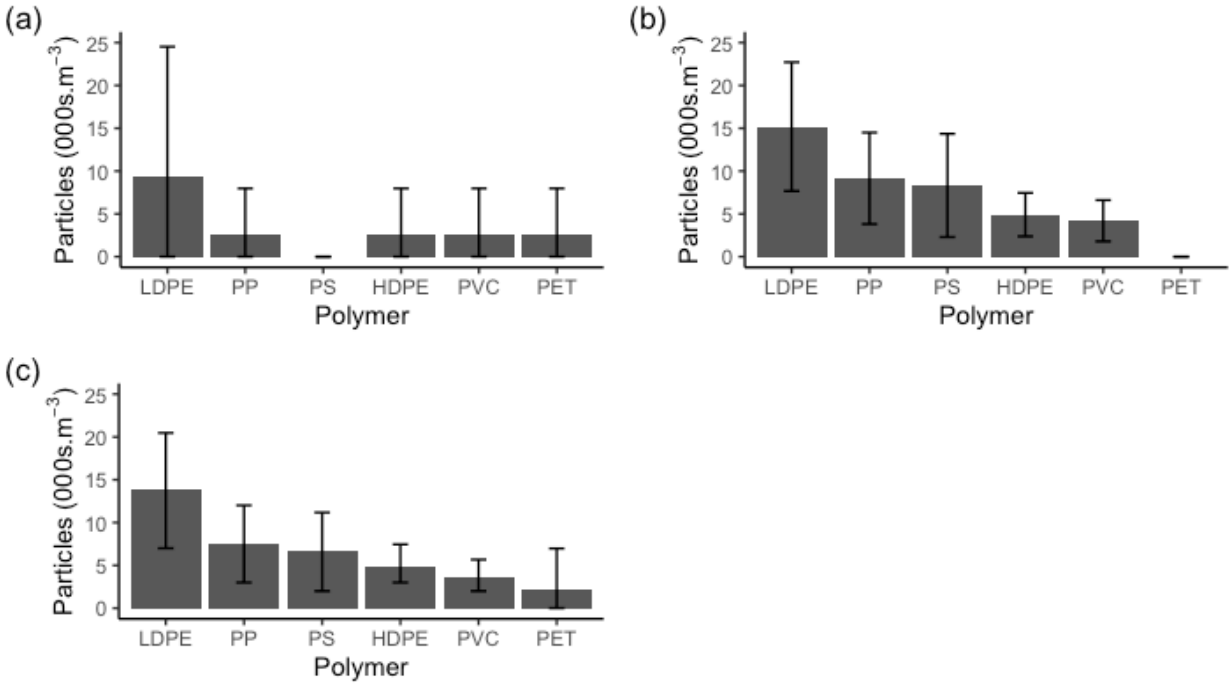

Figure 8. Microplastic polymer distribution on beaches: Egmont (a), Diego Garcia (b) and between islands (c). Bars represent the mean number of microplastics (thousands particles/m^3) and error bars indicate the standard error of the mean. Polymer abbreviations: HDPE and LDPE = high-density and low-density polyethylene (mostly used to manufacture toys and food and drink containers), PET = polyethylene terephthalate (mostly used to manufacture drink/water bottles), PP = polypropylene (mostly used to manufacture food containers and bottle caps), PS = polystyrene (most used to manufacture buoys/floats for the fishing industry and for the manufacture of food packaging), PVC = polyvinyl chloride (most used to manufacture plastics used in building and construction).

Table 6. Categorisation of microplastic particles by polymer from islands: Egmont, Diego Garcia, Nelson, and Parasol. Polymer abbreviations: HDPE and LDPE = high-density and low-density polyethylene, PET = polyethylene terephthalate, PP = polypropylene, PS = polystyrene, PVC = polyvinyl chloride.

Island	Stations	Sum	PP	LDPE	HDPE	PS	PET	PVC
Egmont	70	Total	3	11	3	0	3	3
		%	13.0	47.8	13.0	0	13.0	13.0
Diego Garcia	10,30,50,70,90	Total	58	76	23	48	0	20
		%	25.3	33.6	10.5	21.4	0	9.2
Nelson	90	Total	0	4	0	0	0	0
		%	0	100	0	0	0	0
Parasol	70	Total	1	0	0	0	0	0
		%	100	0	0	0	0	0
All islands		Total	52	91	26	58	3	23
		%	20.6	36.0	10.3	22.9	1.2	9.1

Sand Characterisation

With the exception of Nelson Island (station 10) which had a highly heterogenous grain size distribution, Diego Garcia, Nelson, and Parasol beaches shared similar sediment properties (Table 7) of medium grained (0.25 – 0.5 mm), coarse skewed sand (0.5 – 1 mm). In contrast Boddam and Egmont islands were characterised by medium grained symmetrical and fine skewed (0.125 – 0.25 mm) sand.

Table 7. Intra-beach sediment characteristics of Chagos Islands: Diego Garcia, Nelson, Parasol, Egmont, and Boddam and sediment characteristics of Seychelle Islands: Aldabra and Cousin. Mean sediment grain size measured in mm.

Island	Station	Mean	Sorting	Skew
Diego Garcia	10	0.40	Moderate	Coarse
Diego Garcia	30	0.42	Moderate	Coarse
Diego Garcia	50	0.34	Moderate well	Symetrical
Diego Garcia	70	0.44	Moderate well	Coarse
Diego Garcia	90	0.40	Moderate well	Coarse
Island Average		0.40	Moderate	Coarse
Nelson	10	1.54	Very poor	Very coarse
Nelson	30	0.41	Moderate well	Coarse
Nelson	50	0.50	Moderate well	Symetrical
Nelson	70	0.43	Moderate well	Coarse
Nelson	90	0.48	Moderate well	Coarse
Island Average		0.67	Moderate	Very coarse
Parasol	10	0.47	Moderate well	Coarse
Parasol	30	0.36	Moderate well	Symetrical
Parasol	50	0.39	Moderate well	Coarse
Parasol	70	0.56	Moderate well	Fine
Parasol	90	0.57	Moderate	Very coarse
Island Average		0.47	Moderate well	Coarse
Boddam	10	0.32	Well	Symetrical
Boddam	30	0.29	Moderate well	Symetrical
Boddam	50	0.27	Moderate well	Symetrical
Boddam	70	0.39	Moderate well	Symetrical
Boddam	90	0.30	Moderate well	Symetrical
Island Average		0.31	Moderate well	Symetrical
Egmont	10	0.32	Well	Fine
Egmont	30	0.38	Moderate well	Fine
Egmont	50	0.35	Moderate well	Fine
Egmont	70	0.44	Moderate well	Fine
Egmont	90	0.35	Moderate well	Fine
Island Average		0.37	Moderate well	Fine
Sechelles				
Aldabra	NA	0.42	Moderate	NA
Cousin	NA	0.56	Poor	NA

A literature review comparing Chagos sediment characteristics with those of other rookeries in the WIO revealed two studies in the Seychelles (Mortimer., 1988; 1990). Comparisons between Seychelle Islands (Aldabra and Cousin); turtle nesting islands, 1.8 km west of Chagos revealed Diego Garcia (mean 0.40 mm), Parasol (0.47 mm), Nelson (stations 30 – 90;

mean 0.46 mm) and Aldabra (0.42 mm) share similar sediment particle sizes (Figure 9). High proportions of gravel (large coral pieces) were discovered on Nelson's beach (station 10) which highly skewed the island mean (0.67 mm; Figure 10). Cousin Island's granitic sediment is composed of coarser sediments (mean 0.56 mm) and Egmont and Boddam islands are characterised by finer sediments (mean 0.37 and 0.30 mm).

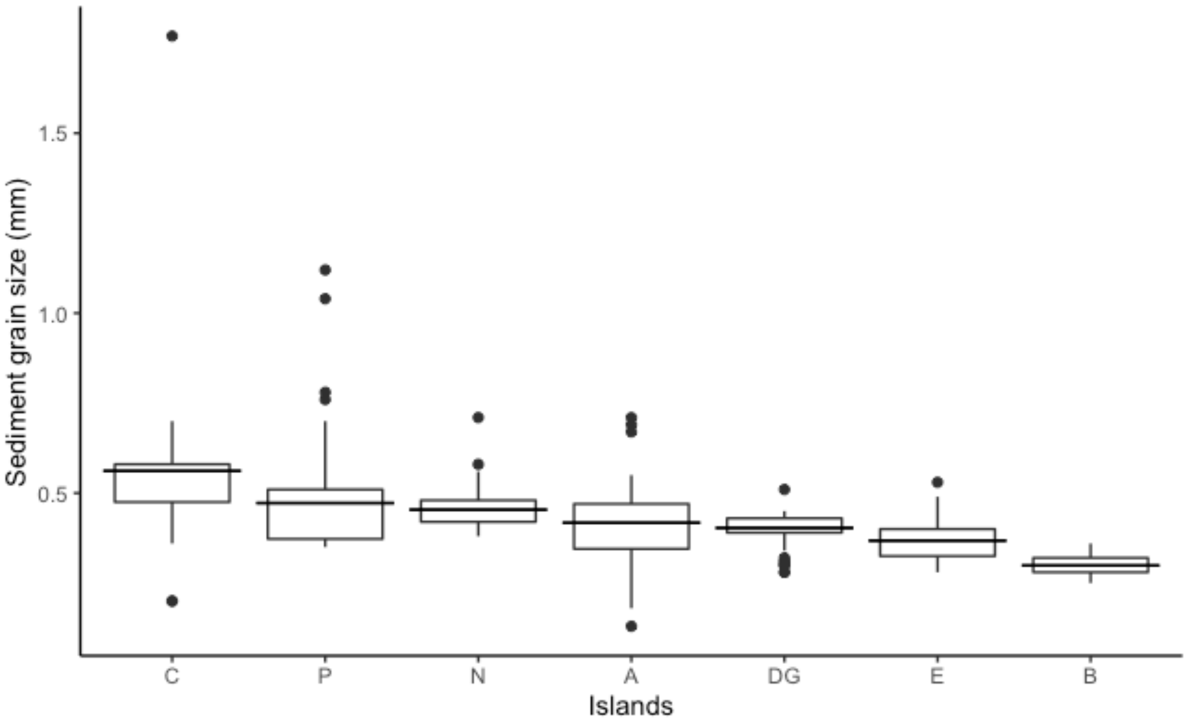

Figure 9. Inter-island grain size distribution. This plot excludes data from station 10 (Nelsons Island). Mean grain size of islands: (C) Cousin and (A) Aldabra (Seychelles), (DG) Diego Garcia, (P) Parasol, (N) Nelson (stations 30 – 90), (E) Egmont and (B) Boddam (Chagos Archipelago). The horizontal lines on the box-plots indicate the mean grain size. Boxes indicate the interquartile range. Whiskers indicate the upper and lower extremes and dots indicate outliers.

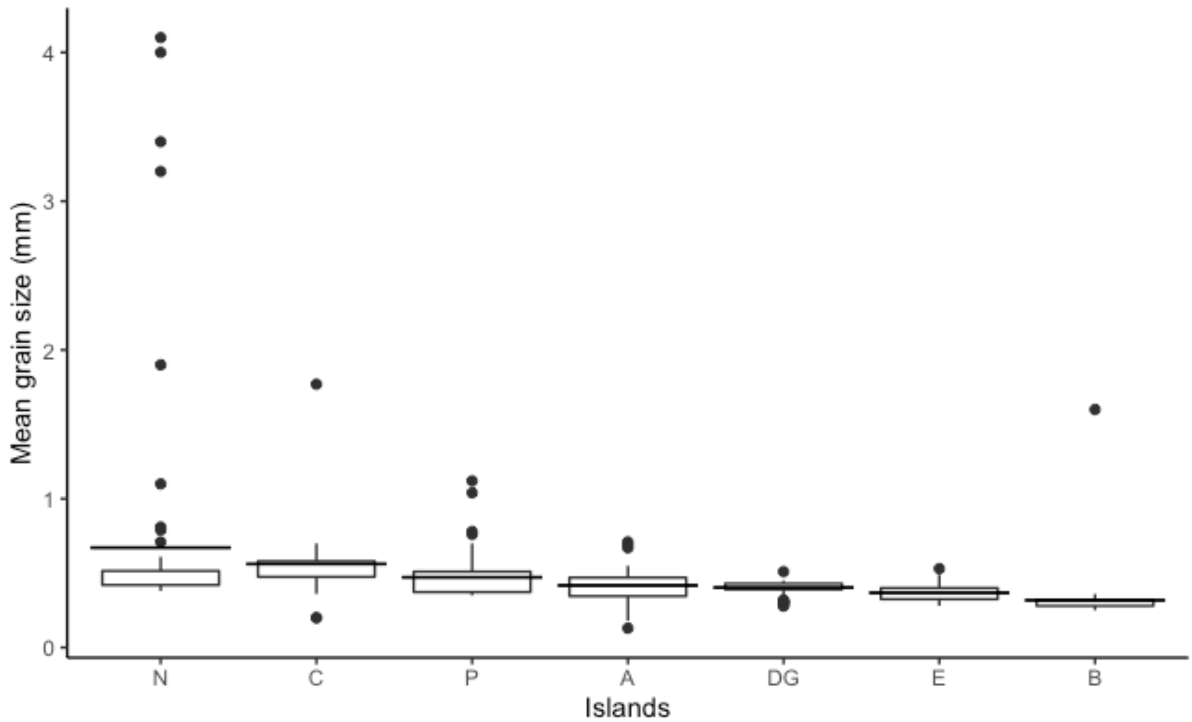

Figure 10. Inter-island grain size distribution. This plot includes data from all stations (10 – 90) across all islands. Mean grain size of islands: (C) Cousin and (A) Aldabra (Seychelles), (DG) Diego Garcia, (P) Parasol, (N) Nelson, (E) Egmont and (B) Boddam (Chagos Archipelago). The horizontal lines on the box-plots indicate the mean grain size. Boxes indicate the interquartile range. Whiskers indicate the upper and lower extremes and dots indicate outliers.

Depth distribution

With the exception of Boddam (station 70) and Nelson (station 10) the sediment depth distribution throughout Chagos Islands is well-mixed, homogenous with mean particle sizes consistent throughout the depth profile from the sediment surface to 60 cm (Figure 12). Boddam (depth 8 – 16 cm) and Nelson (depth 36 – 60 cm) consist of high proportions (2.99% and 6.20%) of gravel (large coral pieces) skewing the grand mean towards larger grain sizes (Figure 11).

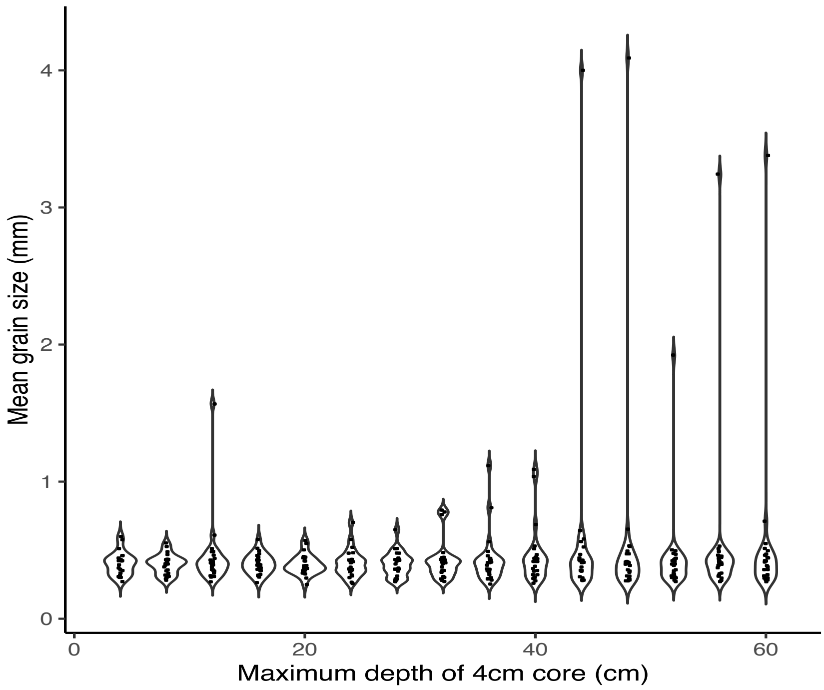

Figure 11. Sediment depth distribution. Relationship between mean sediment grain size and core depth categories (4 cm intervals) from the sediment surface to 60 cm. Cores taken from nesting lines 10,30,50,70 and 90 across the shorelines of five Chagos Islands: Diego Garcia, Nelson, Parasol, Egmont and Boddam. Violin plots show the distribution of data with wider regions indicating values that occur more frequently and the tall extensions indicating single outliers.

Spatial variation

Nelsons Island

Nelson's Island beach sediment consists of mostly medium grained (0.25 – 0.5 mm), moderately sorted, very coarse skewed sand (Figure 13b) with higher proportions of coarse to very coarse sand (35.60%; 0.5 – 2 mm) and gravel (6.20%; 2 - 64 mm). Gravel content is considerably higher on Nelson's Island than other Chagos islands which have an average gravel content of 1.20%. Station 10 stands out (Figure 12e) as highly heterogenous, poorly sorted sediment composed of very fine sand (32.3%; 0.063 – 0.25 mm), coarse sand (42.33%; 0.5 – 1 mm), very coarse sand (15%; 1 – 2 mm) and gravel (25.33%; 2 – 64 mm).

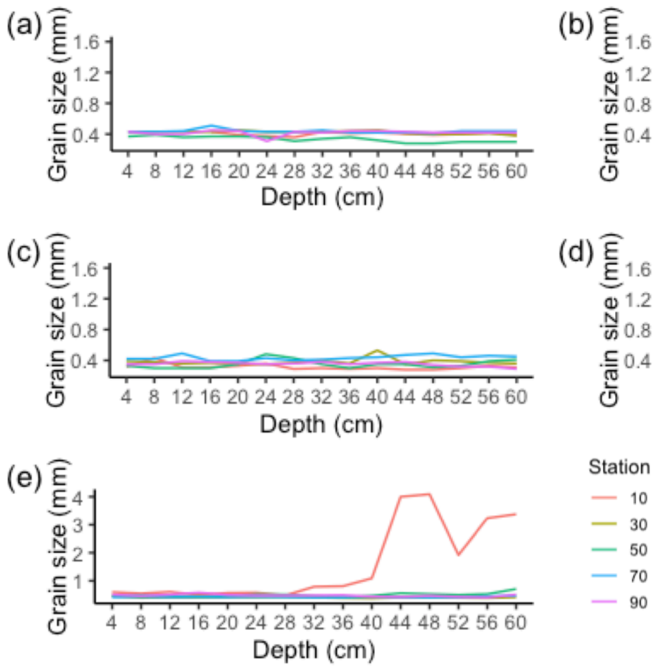

Figure 12. Intra-beach sediment depth distribution. Mean grain size distribution at 4 cm depth intervals from the sediment surface to 60 cm. Cores taken from nesting lines 10,30,50,70 and 90 across shorelines of five Chagos Islands: Diego Garcia (a), Parasol (b), Egmont (c), Boddam (d) and Nelson (e). Stations represented by coloured bars indicate the percentage distance along the beach section from which a core was extracted.

Parasol Island

Parasol Island beach sediment (Figure 13c) is made up of mostly medium grained sand (0.25 – 0.5 mm), moderately well sorted, coarse skewed (0.5 – 1 mm). Station 90 stands out as being very coarse skewed with 11.98% sand grains between 1 and 2 mm (Figure 12b).

Egmont Island

Egmont Island stations consist of mostly medium grained sands (0.25 – 0.5 mm) following a symmetrical distribution (Figure 13d) with similar proportions of grain sizes (21.46%; 0.063 – 0.125 mm) and (20.45%; 0.25 – 0.5 mm). All stations have moderately sorted sand with some larger pieces of gravel (1.3%; 8 – 32 mm).

Boddam Island

Boddam Island beach is made up of mostly medium grained (0.25 – 0.5 mm), fine skewed sediment with higher proportions of fine sand (26.78%; 0.125 – 0.25 mm) and low proportions of coarse sand (1.99%; 0.5 – 1mm). Stations are moderately well sorted with some very coarse gravel (2.99%; 32 – 64 mm) at station 70 (Figure 12d).

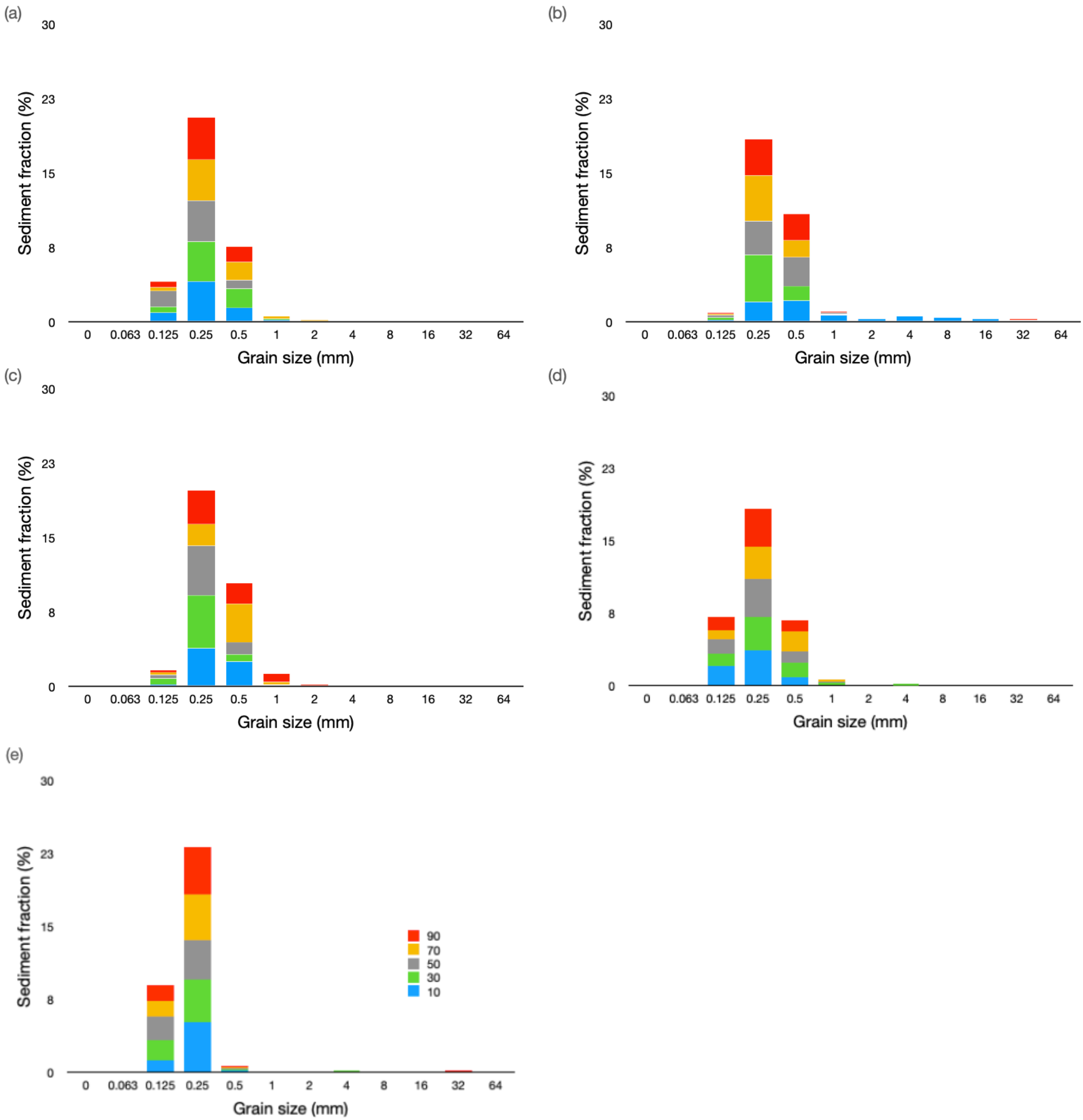

Figure 13. Percentage distribution of sediment according to grain size from Chagos shorelines: (a) Diego Garcia, (b) Nelson, (c) Parasol, (d) Egmont and (e) Boddam. Stations represented by coloured bars (10 – 90) indicate the percentage distance along the beach section from which a core was extracted. Sediment fraction (%) per sub sample, multiply by 3 for station %.

Organic matter

Nelson, Egmont, and Diego Garcia beach sediment contain high densities (Figure 13) of organic matter (mean range 2.85 – 2.59 kg/m^3). In contrast Boddam and Parasol beaches contain low organic matter content (0.53 kg/m^3 and 0.44 kg/m^3). The relationship between organic matter content and sediment grain size (refer to appendix 3, figure 1) was non-significant.

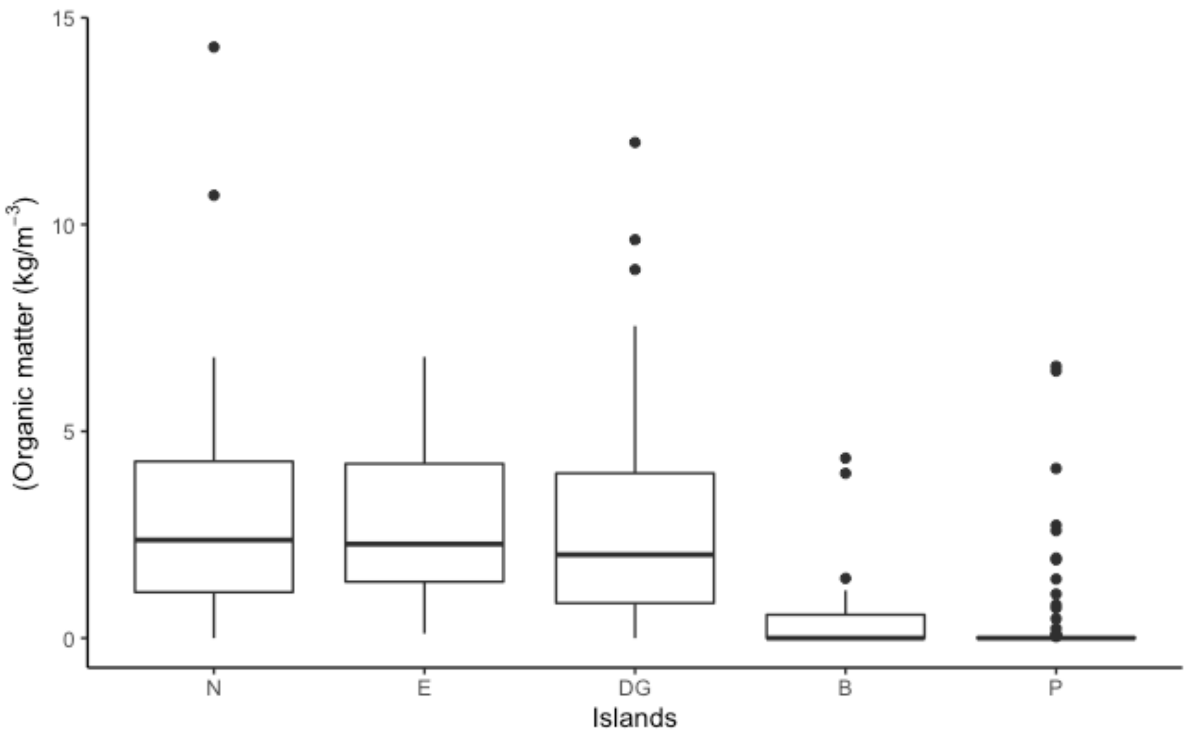

Figure 14. Inter-island organic matter distribution. Mean sediment organic matter content between Chagos Islands: Diego Garcia (DG), Parasol (P), Nelson (N), Egmont (E) and Boddam (B). Horizontal lines on the box-plots indicate the mean and the boxes indicate the interquartile range. Whiskers indicate the upper and lower extremes and dots indicate outliers.

Small scale spatial variability was observed between stations on all islands except Boddam. High organic matter content was discovered at station 30 (4.71 kg/m^3) on Nelson Island (Table 8) moderate concentrations were detected at stations 10, 70 and 90 (mean range 3.40 – 2.16 kg/m^3) and low organic matter content was discovered at station 50 (0.92 kg/m^3). Egmont Island station 70 consisted of high organic matter (4.08 kg/m^3) and station 90 (1.48 kg/m^3) consisted of low organic matter. Organic matter content was high at stations 10 and 90 on Diego Garcia Island (4.84 kg/m^3 and 4.39 kg/m^3), moderate at station 30 (2.08 kg/m^3) and low at stations 50 and 70 (1.41 kg/m^3 and 0.26 kg/m^3). Boddam stations 70 and 90 consisted of low organic matter (0.77 kg/m^3 and 0.30 kg/m^3). Low organic matter content was discovered at station 50 on Parasol Island (1.97 kg/m^3). Organic matter at stations 10, 30 and 90 (mean range 0.01 – 0.21 kg/m^3) was considerably lower and organic matter was not detected at station 70.

Table 8. Intra-beach organic matter distribution. Mean organic matter content from Chagos islands: Diego Garcia, Nelson, and Parasol (stations 10 – 90) and Egmont and, Boddam (stations 70 and 90). Mean organic matter density is measured in kg/m^3.

Island	Station	Mean	S.e.
Nelson	10	2.16	0.39
Nelson	30	4.71	0.55
Nelson	50	0.92	0.16
Nelson	70	3.40	0.51
Nelson	90	3.04	0.88
Island average		2.85	0.63
Egmont	70	4.08	0.42
Egmont	90	1.48	0.27
Island average		2.78	1.30
Diego Garcia	10	4.84	0.47
Diego Garcia	30	2.08	0.23
Diego Garcia	50	1.41	0.23
Diego Garcia	70	0.26	0.26
Diego Garcia	90	4.39	0.5
Island average		2.59	0.88
Boddam	70	0.77	0.37
Boddam	90	0.30	0.09
Island average		0.53	0.23
Parasol	10	0.02	0.02
Parasol	30	0.21	0.13
Parasol	50	1.97	0.62
Parasol	70	0	0
Parasol	90	0.01	0.01
Island average		0.44	0.38

Discussion

Microplastic concentration

This study reports the highest beach microplastic concentration recorded in the literature to date. The grand mean of microplastics in the surface layer (0 – 2 cm) of Chagos beach samples (371,000 particles/m^3 ± 114,000) was twice as high as microplastic concentrations on Guangdong, South China (167,000 particles/m^3 ± 176,000), which held the highest recorded microplastic concentrations (Fok et al., 2017). Furthermore, mean surface concentrations were approaching an order of magnitude higher than those recorded on heavily contaminated turtle nesting beaches in Cyprus, Mediterranean (45,497 particles/m^3 ± 11,456) and several orders of magnitude higher than those reported on Vavvaru Island, Maldives, WIO (Imhof et al., 2017) and turtle nesting beaches in Florida, USA (Beckwith and Fuentes, 2018). Imhof and Duncan (2017, WIO; 2018, Mediterranean) recorded microplastic sizes ≥ 1 mm which may explain some of this disparity as smaller microplastics are more prevalent than larger size classes in the marine environment (Saliu et al., 2018; Bridson et al., 2020).

In contrast with the beaches in Guangdong (South China) which receive high levels of local plastic waste, Chagos is unpopulated, isolated, and remote. However due to its location in the centre of the Indian ocean, Chagos is surrounded by 34 countries (Pattiaratchi et al., 2022). Furthermore, Asia to the north produces 51% of the worlds plastics and generates 65% of global mismanaged plastic waste, Chagos is therefore likely to receive high levels of plastics from the northern Indian ocean. Moreover, located across two degrees of latitude, plastics may be transported towards Chagos by both northeast and southwest monsoon currents and therefore Chagos may receive plastics travelling from both the eastern and the western Indian ocean (Van der Mheen et al., 2020).

Microplastic concentration in the sand column showed a similar depth distribution profile to global studies (Duncan et al., 2018; Chai et al., 2022; Pervez et al., 2022), but with concentrations in the Chagos Archipelago orders of magnitude higher both in surface layers and at turtle nesting depth. Average concentrations decay rapidly with depth but remain high throughout, with 742,000 particles/ m^3 in the top 4cm, decreasing to 473,000 particles/

m^3 at depths of 4 - 8 cm, and settling around 250,000 particles/m^3 from 20 to 60 cm depth. The high concentrations (relative to those in surface layers) recorded at deeper depths (20 – 60 cm) mirror depth distributions of studies in other oceanic environments and may reflect the consistent mixing of sediment in these regions (Turra et al., 2014; Brazil; Fisner et al., 2017; Brazil). This remote, largely unpopulated, and protected location may have the highest microplastic concentrations in beach sand yet recorded. Furthermore, with global plastic production increasing exponentially, plastic levels on Chagos beaches will continue to rise.

Spatial variation

Microplastics were distributed unevenly across atolls, with two of the five atolls sampled accounting for 91% of the total concentration recorded (Boddam and Egmont Islands). Very few microplastics were found on a further two atolls (Nelson and Parasol Islands, total microplastic count: 5 particles). This inter-island disparity and the inter-island nesting distribution (80.4%, Peros Banhos and Diego Garcia; 10.6%, Salomon and Egmont) provides the Chagos nesting population with some protection from the highest microplastic concentrations. The low accumulation of microplastics on Parasol is surprising given some of the highest levels of macroplastics were recorded here (Hoare et al., 2022). The differences between islands are however consistent with studies reporting high spatial variation across sites (Kim et al., 2015; Bridson et al., 2020; Schröder et al., 2021). For example, microplastic abundance between coral islands in the South China Sea ranged from 40 to 610 items/kg (Zhang et al., 2020) and on Faafu atoll (Maldives) inter-island abundance ranged from 4.2 to 38.5 particles/m^2. Parameters such as ocean currents, local bathymetry, island geomorphology, wind conditions and wave heights contribute to the heterogeneity of concentrations recorded (Godoy et al., 2020; Harris et al., 2020). Sheltered, low energy beaches such as those on Boddam and Egmont islands are particularly efficient at trapping high levels of microplastic waste, with low energy constructive waves depositing material onto the shore (Harris et al., 2020; Schröder et al., 2021). Facing the prevailing winds, the southeast-facing site on Diego Garcia is subject to high wave energy and erosion with destructive waves removing particles from the coastline (Wu et al., 2021; Harris et al., 2020).

High small-scale spatial variability in microplastic concentration was observed within Chagos beaches. The highest mean microplastic concentration recorded on Diego Garcia, station 50 (102,608 particles/m^3, ± 28,991) was an order of magnitude higher than the lowest mean concentration at station 30 (8,480 particles/m^3, ± 3,205). Stations 10 and 30 (Egmont Island) had mean concentrations (593,812 particles/m^3, ± 37,120 and 599,112 particles/m^3, ± 56,367) twice as high as those discovered at station 70 (217,936 particles/m^3, ± 170,705) and no microplastics were detected at station 90 and stations 70-90 (Egmont and Boddam Islands). These findings are consistent with global microplastic studies where high spatial heterogeneity was observed between stations/replicates (Moreira et al., 2016; Fisner et al., 2017; Imhof et al., 2017; Bridson et al., 2020; Godoy et al., 2020., Patti et al., 2020). For example, particle distribution between stations from two beaches on an isolated island in Korea ranged from 5667 to 137,860 particles/m^2 and 27,749 to 285,221 particles/m^2 (Kim et al., 2015). On the Fernando de Noronha Archipelago (Brazil) a difference of up to 55-fold was reported between replicates with a decreasing trend from west to east along the coast (Carvalho et al., 2021). Studies indicate this small-scale spatial variation may be influenced by small-scale changes in wind speed and direction, shore height, beach slope, the tidal cycle, bathymetry e.g. reef structure and complex hydro- and morphodynamic processes across the shoreline (Turra et al., 2014; Bridson et al., 2020; Godoy et al., 2020; Kerpen et al., 2020). Dry sieving sediment samples from Egmont and Boddam (stations 10, 30 and 50) may also account for some of this variation, where dry sieving can further fracture and abrade microplastics. Microplastic concentrations on Egmont followed a decreasing trend from the supralittoral zone towards the waterline. Vegetation is an efficient trap for microplastics deposited by both aeolian and wave-induced transport and therefore high concentrations accumulate within the supralittoral region, a predominant nesting area for Chagos sea turtles (Moreira et al., 2016; Imhof et al., 2017). A weak correlation however was detected between organic matter content and microplastic concentrations across Chagos. Boddam Island microplastic concentrations were high on the lagoon side (stations 10 - 50) and no microplastics were discovered on the northeast tip (oceanside). This is consistent with Hoare's (2022) findings with macroplastic abundance significantly higher on the lagoon side of Chagos islands. Chagos' lagoon facing shorelines are mostly low energy environments subject to net accretion (Wu et al., 2021).

Composition

Size

Smaller microplastics were discovered in considerably higher proportions (68%; 0.15 – 0.49 mm) than larger size classes (32%; 0.50 – 4.99 mm) on Boddam and Egmont islands. This is consistent with global studies reporting particle size distribution strongly skewed towards smaller sizes due to the continuous biomechanical fracturing of larger particles within the ocean environment (Kim et al., 2015; Saliu et al., 2018; Bridson et al., 2020; Harris et al., 2020; Patti et al., 2020). The deposition of smaller, less dense particles is higher in low energy environments such as those in Boddam and Egmont, furthermore dissipative waves continuously fracture particles within the swash zone which may explain the lower accumulation rates of smaller microplastics in a high energy site such as Diego Garcia. Evidence suggests the bimodal distribution observed between size classes (0.15 – 0.49 and 0.50 – 4.99 mm) may be associated with bedload transport where particles < 2 mm (depending on density) are transported in suspension preventing further mechanical fracturing until microplastics reach the shoreline (Harris et al., 2020).

Shapes

Fragments were the most frequently recorded shape (Egmont, Nelson, Parasol, 100%; Diego Garcia, 71.1%) corresponding with Hoare's macroplastic study (2022; Chagos) where fragments were the second most abundant plastic reported after plastic bottles. This is consistent with global studies and is indicative of plastics durability and the continuous biomechanical fracturing of particles which leads to its prevalence within the environment (Karthik et al., 2018; Monteiro et al., 2020; Saliu et al., 2018; Jones et al., 2021). Consistent with several Indian ocean studies (Imhof et al., 2017; Karthik et al., 2018; Saliu et al., 2018) foams were the second highest recorded shape (21.7%) on Diego Garcia followed by low proportions of fibres, films, and pellets (≤ 3.5%). Foams composed of low-density polystyrene float in seawater. Commonly used in the Indian Ocean to create buoys and floats for fisheries and aquaculture, these microplastics are ubiquitous within this region (Imhof et al., 2017). Preproduction pellets (microbeads) are primary microplastics used in the manufacture of plastic products. These microplastics enter the ocean via accidental spills and therefore their presence on Diego Garcia (1.7%) indicates these microplastics have been transported over considerable distances before reaching the shore (Saliu et al., 2018). Fibres, mostly composed of high-density polyamide sink in seawater and are therefore locally distributed. Their low proportions (3.5%) and the low abundance of fishing nets detected in this region (Hoare et al., 2022) indicate the success of the Chagos marine park and the protection it provides from the fishing industry.

Polymers

Diego Garcia and Egmont follow similar polymer distributions to global studies (Imhof et al., 2017; Saliu et al., 2018; Patti et al., 2020). Corresponding with global plastic demand and in order of increasing density, polyethylene was the most prevalent polymer (Diego Garcia, 44.1%; Egmont, 60.8%) followed by polypropylene (Diego Garcia, 25.3%; Egmont, 13%). Polystyrene accounted for 21.4% of the polymers on Diego Garcia but were not detected on Egmont. Low proportions of PET (13%) were discovered on Egmont, however, were absent from Diego Garcia. The low proportion of PET discovered is surprising as plastic bottles (PET) were the highest recorded macroplastic in Chagos (Hoare et al., 2022). Furthermore, PET is a high-density polymer that sinks in seawater and so PET microplastics are likely to come from a local source. PET drink bottles are designed to be durable and resistant to fracturing (Saxena et al., 2013) which may explain the low levels of PET microplastics discovered in Chagos. PVC accounted for 13% of the polymers on Egmont and 9.1% on Diego Garcia. This is also a high-density polymer likely to have come from a local source. The low concentrations of PET and PVC and the disparity between macro and microplastics reported on Parasol suggest the majority of Chagos microplastics may not derive from macroplastics fragmenting in situ and instead plastics are being transported to Chagos in both macro and microplastic form.

Colours

Egmont and Diego Garcia islands followed a different colour distribution with Diego Garcia exhibiting greater variation. The most prevalent colours on Diego Garcia were white (31%) black (22.6%), green (22.2%) and grey (14.2%). On Egmont orange was the predominant colour accounting for 71.2% of microplastics followed by yellow (20.2%). The heterogenity between islands, with twice as many different colours reported on Diego Garcia indicates this island is receiving microplastics from different sources and a greater number of sources than Egmont. Comparisons with other Indian ocean microplastic studies (Saliu et al., 2018; Patti et al., 2020) revealed no patterns between colour distributions and therefore no connections could be made with regards to the source.

Sand characterisation

Chagos beaches consist of moderate to moderate - well sorted biogenic sediment, ranging from medium grained coarse skewed (Parasol, mean 0.47 mm; Nelson stations 30 - 90, 0.46 mm; Diego Garcia, 0.40 mm) to symmetrical and fine skewed sediment (Egmont, mean 0.37 mm; Boddam, 0.31 mm). These sediment characteristics support high levels of turtle nesting success with an estimated 6,300 hawksbills and 104,000 – 143,500 green turtle clutches laid in the Chagos Archipelago (Mortimer et al., 2020). Global hawksbill and green turtle nesting populations lay clutches in a wide range (125 – 2000 µm) of sediment particle sizes (Mortimer, 1990; Ozdilek et al., 2007; Salleh et al., 2018) with optimal grain sizes (indicated by higher beach nesting densities and embryo survival) being site specific (Scott, 2020). Nest abiotic factors (gas and water exchange, temperature, moisture) which determine sexual differentiation, embryo survival and hatchling fitness (Ackerman et al., 1985; Wallace et al., 2004; Cheng et al., 2015) are highly dependent upon the local mineral content, grain size, sorting, beach morphology, tidal range, and climate (Lolovar et al., 2020). Turtle nesting distribution may therefore exhibit high inter-island and intra-beach spatial and temporal variation. For example, on Sharma beach (Yemen), green sea turtles nest predominantly in medium - coarse grained (250 - 500 µm) sediment (Sönmez et al., 2013). Conversely, green turtles on Penang Island (Malaysia) predominantly nest in very coarse sediment (1000 µm) aborting nests with finer (425 µm) grain sizes (Salleh et al., 2018). Hawksbill turtles (Persian Gulf) nest predominantly in sites with coarse – very coarse (500 – 1000 µm) sediment (Hesni et al., 2019). Whilst nesting populations on Long Island (Antigua) favour very fine (>2000 µm) gravel (Ditmer et al., 2012). For all studies the predominant factor determining nesting and incubation success was a lower nest hydric content.

Comparing West Indian Ocean turtle rookeries, Chagos and Seychelle Islands revealed similar sediment properties between coral islands Diego Garcia, Parasol, Nelson (stations 30 – 90) and Aldabra (Mortimer., 1988; 1990). These nesting sites share biogenic, moderately –

moderately well sorted sands with mean grain sizes (Diego Garcia, 0.40 mm; Nelson, stations 30 - 90, 0.46 mm; Parasol, 0.47 mm; Aldabra, 0.42 mm). In contrast, Cousin Island (Seychelles), composed of volcanic granitic sediment, consists of coarser (0.56 mm), poorly sorted sediments and Egmont and Boddam Islands (Chagos) consist of finer (0.37 and 0.31 mm) moderately - well sorted sediments. Moisture availability within the nest is highly dependent upon sediment characteristics and their ability to absorb and hold moisture (Ozdilek et al., 2007; Sallleh et al., 2018). Nests with coarser grain sizes and lower hydric content are optimal for gas exchange and nest excavation, whereas very coarse grain sizes facilitate a dry incubation environment which may lead to egg desiccation and nest collapse. Conversely, fine sediments with high nest hydric content may impede gas exchange and nest excavation (Ackerman, 1997). The sediment characteristics of the Seychelle Islands strongly correlate with nesting success, embryo survival and the spatial and temporal variation in nesting distribution (Mortimer, 1990). For example, turtles nesting in a region of coarser, dry sediments (Aldabra) made multiple nesting attempts. Furthermore, a strong negative correlation between embryo mortality and substrate water potential was reported. Turtles nesting on coarse, poorly sorted, dry granitic sands (Cousin Island), susceptible to desiccation and nest cave-ins nest only during months of heaviest rainfall. Similarly, hawksbills in Chagos nest only during peak rainfall, October – February (Stoddart, 1971; Mortimer et al., 2020). The nesting distribution of green and hawksbill turtles in Chagos is positively skewed towards islands with coarser grain sizes with the highest nesting densities on Diego Garcia and Peros Bhanos (green, 70.4%; hawksbill, 90.4%) and lowest nesting densities on Egmont (green; 10.2%; hawksbill; 5%) and Boddam (green; 3.4%; hawksbill; 2.5%). These observations indicate temporal and spatial variation in nest site selection may be linked to sediment composition in Chagos. Further investigations into inter-island nesting success and embryo survival throughout green and hawksbill nesting seasons are needed to determine if correlations exist.

Chagos sediment is largely well mixed throughout the depth profile from the sediment surface to turtle nesting depth. Sediment sorting is of particular importance for successful incubation with well sorted sediments reducing nest hydric content (Fadini et al., 2011). Nest site selection indicates turtles prefer to build nests in well sorted sediments with turtles aborting nests in poorly sorted sediment (Karavas et al., 2005; Ozdilek et al., 2007;

Scott, 2020). The moderate to moderate – well sorted sediments in Chagos therefore provide optimal conditions for successful nesting and incubation. However, the highly heterogenous sediment recorded on Nelson Island, station 10 (very coarse, very poorly sorted) may lead to multiple nesting attempts in this region.

The sediment particle size distribution across Chagos shorelines is largely homogenous with the exception of the very coarse skewed sediment detected at station 90 (Parasol Island; 11.98%; 1 – 2 mm), coarse gravel at station 70 (Boddam Island; 2.99%; 32 – 64 mm) and the highly heterogenous, poorly sorted sediment at station 10 (Nelson Island) which consisted of very fine sand (32.3%; 0.063 – 0.25 mm), coarse sand (42.33%; 0.5 – 1 mm), very coarse sand (15%; 1 – 2 mm) and gravel (25.33%; 2 – 64 mm). Sites globally exhibit a range of spatial variation across the shore with high cross shore dispersion leading to reduced nesting density (Karavas et al., 2005; Fadini et al., 2011; Salleh et al., 2021). For example, turtle nesting density on Sekania beach (Zakynthos Island; Greece) decreased across the shore in proportion with an increase in finer sediment (Karavas et al., 2005). Nesting and hatching success on Samandağ beach (Turkey) negatively correlated with increasing distance from the sea (Ozdilek et al., 2007). The homogenous nature of Chagos beach sediment may therefore facilitate high densities of turtle nesting in this region.

Both green and hawksbill turtles nest predominantly within vegetation on Chagos which is reflected in the high concentrations of organic matter recorded in samples. Organic matter distribution varied between atolls with high organic matter content detected on Nelson, Egmont and Diego Garcia and low organic matter on Boddam and Parasol beaches. Small scale spatial variation was also observed between stations on all islands except Boddam, however no trend was detected between organic matter concentrations and station position.

Conclusion

Chagos receives high levels of microplastic waste despite its remote location and isolation. Moreover, this study reports the highest beach microplastic concentration recorded in the literature to date (0 – 2 cm depth; mean 371,000 particles/m^3 ± 114,000 s.e). Microplastic concentrations were highest in the top 4 cm of sediment, decreasing with depth. Concentrations were however orders of magnitude higher in both the surface layers and at turtle nesting depth than global reports. Chagos may therefore have the highest microplastic concentrations in beach sand yet recorded.

Microplastics were distributed unevenly between atolls with Boddam and Egmont beaches accounting for 91% of the total concentration recorded. Very few microplastics were found on Nelson and Parasol Islands (5 particles). This spatial heterogeneity and the inter-island nesting distribution affords the Chagos nesting population some protection from the highest microplastic concentrations. High small scale spatial variation was observed between stations with station 50 (Diego Garcia) for example containing concentrations an order of magnitude higher (102,608 particles/m^3 ± 28,991) than station 30 (8,480 particles/m^3 ± 3,205). Fragments were the most frequently recorded shape accounting for 86.6% of the shapes recorded and polyethylene and polypropylene were the most prevalent polymers (46.3% and 20.6%). Smaller microplastics were discovered in considerably higher proportions (68%; 0.15 – 0.49 mm) than larger size classes (32%; 1 – 4.99 mm).

Chagos beaches consist of moderate to moderate – well sorted biogenic sediment ranging from medium grained coarse skewed sediment (Parasol, mean 0.47 mm; Nelson, stations 30 – 90, 0.46 mm; Diego Garcia, 0.40 mm) to symmetrical and fine skewed sediment (Egmont, mean 0.37 mm; Boddam; 0.31 mm). The sediment sorting provides optimal conditions for successful nesting and incubation. Furthermore, the sediment particle size distribution across Chagos shorelines is largely homogenous which favours high beach nesting densities.

The accumulation of high concentrations of microplastics throughout turtle nesting depths in Chagos is of concern. Plastics change the physical properties of their environment and may alter incubation conditions (temperature and permeability) essential for turtle nesting success and embryo survival. The leaching of chemical additives from microplastics may also expose eggs and embryos to chemical toxicity (Savoca et al., 2021). Furthermore, the discovery of high levels of microplastics in a region as isolated and remote as the Chagos Archipelago provides further evidence that microplastics are ubiquitous throughout the environment. Despite growing research and global education plastics remain a huge threat to our natural environment and public health.

References

Ackerman, R.A., Razi, D., Amos, A. (1985) 'Water and Heat Exchange between Parchment-Shelled Reptile Eggs and Their Surroundings'. *Copeia,* 3, pp. 703-711.

Ackerman, R.A. (1997) 'The respiratory gas exchange of sea turtle nests (Chelonia, Caretta)'. *Respiration Physiology,* 31(1), pp**.** 19-38.

Al-Azzawi, S.M.M., Kefer, S., Weiber, J., Reichel, J., Schwaller, C., Glas, K., Knoop, O. & Drewes, J.E. (2020) 'Validation of Sample Preparation Methods for Microplastic Analysis in Wastewater Matrices- Reproducibility and Standardization'. *Water*, 12(9), pp. 2445.

Anderson, A.A., Arthur, C., Baker, J., Bouwman, H., Gall, S., Hidalgo-Ruz, V., Law, K.L., Leslie, H., Kershaw, P., Pahl, S., Potemra, J., Ryan, P., Shim, W.J., Thompson, R., Takada, H., Turra, A., Vethaak, D & Kayleigh Wyles. (2015) 'Sources, fate and effects of microplastics in the marine environment: a global assessment'. 10.13140/RG.2.1.3803.7925.

Balasubramaniam, M., Phillott, A. (2016) 'Preliminary observations of microplastics from beaches in the Indian ocean.' *Indian Ocean Turtle Newsletter,* 23, pp. 13-16.

Beckwith, V.K. & Fuentes, M. (2018) Microplastic at nesting grounds used by the northern Gulf of Mexico loggerhead recovery unit. *Marine Pollution Bulletin,* 131, pp. 32-37.

Bárrios, S & Wilkinson T. (2018) 'Mapping the vegetation of Diego Garcia Island, British Indian Ocean Territory'. Fieldwork report. Overseas Fieldwork Committee registration number 893. Richmond, Surrey, U.K.: Royal Botanic Gardens, Kew.

Benoit, C.M.S. (2019) 'Examining the density and distribution of micro and macroplastics as a possible contributor to sea turtle nesting sand habitat quality'. *Thesis, Georgia State University, https://scholarworks.gsu.edu/geosciences_theses/136.*

Besley, A., Vijver, M.G., Behrens, P. & Bosker, T. (2017) 'A standardized method for sampling and extraction methods for quantifying microplastics in beach sand'. *Marine Pollution Bulletin*, 114(1), pp. 77-83.

Borrelle, S.B., Ringma, J., Law, K.L., Monnahan, C.C., Lebreton, L., McGivern, A., Murphy, E., Jambeck, J., Leonard, G.H., Hilleary, M.A., Eriksen, M., Possingham, H.P., De Frond, H., Gerber, L.R., Polidoro, B., Tahir, A., Bernard, M., Mallos, N., Bairnes, M & Rochman, C.M. (2020) 'Predicted growth in plastic waste exceeds efforst to mitigate plastic pollution'. *Science,* 369, pp. 1515-1518.

Brahney, J., Mahowald, N., Prank, M., Cornwell, G., Kilmont, Z., Matsui & Prather, K.A. (2021) ‘Constraining the atmospheric limb of the plastic cycle’. *PNAS,* 118(16).

Carson, H.S., Colbert, S.L., Kaylor, M.J., McDermid, K.J. (2011) ‘Small plastic debris changes water movement and heat transfer through beach sediments’. *Marine Pollution Bulletin,* 62(8), pp. 1708-1713.

Bridson, J., Patel, M., Lewis, A., Gaw, S., Parker, K. (2020) ‘Microplastic contamination in Auckland (New Zealand) beach sediments’. *Marine Pollution Bulletin,* 151, pp. 110867.

Broderick, A.C, Godley, B.J. (1996) ‘Population and nesting ecology of the green turtle, *Chelonia mydas,* and the loggerhead turtle, *Caretta caretta,* in northern Cyprus’. *Zool Middle East*, 13, pp.27-46.

Carvalho, J.P.S., Silva, T.S., Costa, M.F. (2021) ‘Distribution characteristics and short-term variability of microplastics in beach sediment of Fernando de Noronha Archipelago, Brazil’. *Marine Pollution Bulletin,* 166, pp. 112-212.

Cashman, M.A., Ho, K.T., Boving, T.B., Russo, S., Robinson, S. & Burgess, R.M. (2020) ‘Comparison of microplastic isolation and extraction procedures from marine sediments’. *Marine Pollution Bulletin,* 159, pp. 111-507.

Chai, B., Yanping, L., Wang, L., Xiao-Tan, Z., Yi-Ping, W., Fengyuan, C., Jie, M, Wenlu, L., Ke, P. (2022) ‘Microplastic contamination on the beaches of South China’. *Frontiers in Marine Science,* 9.

Chen, C.L., Wang, C.C., Cheng, I.J. (2010) ‘Effects of biotic and abiotic factors on the oxygen content of green sea turtle nests during embryogenesis’. *Journal Comparative Physiology B,* 180, pp. 1045-1055.

Cheng, I-J., Lin, C.H., Tseng, C.T. (2015) ‘Factors influencing variations of oxygen content in nests of green sea turtles during egg incubation with a comparison of two nesting environments’. *Journal of Experimental Marine Biology and Ecology,* 471, pp. 104-111.

Cheng, I-J., Cheng, W., Chan, Y-T. (2018) ‘Geographically closed, yet so different: contrasting long-term trends at two adjacent sea turtle nesting populations in Taiwan due to different anthropogenic effect’. *Plos ONE.* 13, 7.

Clukey, K.E., Lepczyk, C.A., Balazs, G.H., Work, T.M., Li, Q.X., Bachman, M.J. & Lynch, J.M. (2018) 'Persistent organic pollutants in fat of three species of Pacific pelagic longline caught sea turtles: Accumulation in relation to ingested plastic marine debris'. *Science Total Enviroment,* 610-611, pp. 402-411.

Craig, M.T. (2008) 'The goldrim surgeonfish (*Acanthurus nigricans;* Acanthuridae) from Diego Garcia, Chagos Archipelago: first record for the central Indian Ocean'. *Zootaxa,* 1850, pp.65-68.

Detmer, D.M. (1995) 'Permeability, porosity, and grain-size distribution of selected Pliocene and 0uaternary sediments in the Albuquerque Basin'. *New Mexico Geology,* **79-87.**

De Witte, B., Devriese, L., Bekaert, K., Hoffman, S., Vandermeersch, G., Cooreman, K. & Robbens, J., (2014) 'Quality assessment of the blue mussel (Mytilus edulis): comparison between commercial and wild types'. *Marine pollution bulletin*, 85(1), pp.146-155.

Delgado-Gallardo, J., Sullivan, G.L., Esteban, P., Wang, Z., Arar, O., Li, A., Watson, T.M. & Sarp, S. (2021) 'From Sampling to Analysis: A Critical Review of Techniques Used in the Detection of Micro- and Nanoplastics in Aquatic Environments'. *ACS EST Water*, 1(4), pp. 748-764.

Ditmer, M.A., Stapleton, S.P. (2012) 'Factors affecting hatch success of hawksbill sea turtles on Long Island, Antigua, West Indies'. *PlosOne,* 7(7).

Duhec, A.V., Jeanne, R.F., Maximenko, N., Hafner, j. (2015) 'Composition and potential origin of marine debris stranded in the Western Indian Ocean on remote Alphonse Island, Seychelles'. *Marine Pollution Bulletin,* 96(1-2), pp. 76-86.

Duncan, E.M., Arrowsmith, J., Bain, C., Broderick, A.C., Lee, J., Metcalfe, K., Pikesley, S.K., Snape,R.T.E., Sebille, E.V., Godley, B.J. (2018) 'The true depth of the Mediterranean plastic problem: extreme microplastic pollution on marine turtle nesting beaches in Cyprus'. *Marine Pollution Bulletin*, 136, pp. 334-340.

Enders, K., Lenz, R., Stedmon, C.A., Nielsen, T.G. (2015) 'Abundance, size and polymer composition of marine microplastics ≥ 10 µm in the Atlantic Ocean and their modelled vertical distribution'. *Marine Pollution Bulletin,* 100, pp. 70-81.

Escudero, M., Reguero, B.G., Mendoza, E., Secaira, F., Silva, R. (2021) 'Coarl reef geometry and hydrodynamics in beach erosion control in North Quintana Roo, Mexico'. *Marine Science,* 8, pp. 684-732.

Esteban, N., Laloë, J.O., Mortimer, J.A., Guzman, A.N., Hays, G.C. (2016) 'Male hatchling production in sea turtles from one of the world's largest marine protected areas, the Chagos Archipelago'. *Scientific Reports,* 6, pp. 20339.

Esteban, N., Mortimer, J.A., Hays, G.C. (2017) 'How numbers of nesting sea turtles can be overestimated by nearly a factor of two. *Biological Sciences*, 284, pp. 2016-2581.

Esteban, N., Mortimer, J.A., Hays, G. (2018) 'Sea turtle conservation research Diego Garcia, British Indian Ocean Territory'. *Expedition Report,* 25 June – 18 July 2018.

Fadini, L.S., Silva, A.G. & Ferreira-Júnior, P.D. (2011) 'Sedimentary characteristics and their effects on hatching success and incubation duration of Caretta caretta (Testudines: Cheloniidae) in Espirito Santo, Brazil'. *Zoologia (Curitiba, Impresso),* 28, pp. 312-320.

Fisner, M., Majer, A.P., Balthazar-Silva, D., Gorman, D., Turra., A. (2017) ' Quantifying microplastic pollution in sandy beaches: the conundrum of large sample variability and spatial heterogeneity'. *Environ Sci Pollut Res,* 24, pp. 13732-13740.

Fok, L., Cheung, P.K., Tang, G., Chin Li, W. (2017) 'Size distribution of stranded small plastic debris on the coast of Guangdong, South China'. *Environmental Pollution,* 220, pp. 407-412.

Franklin Rey, S., Franklin, J., Rey, S.J. (2021) 'Microplastic pollution on island beaches, Oahu, Hawai'I'. *PLoS ONE, 16(2).*

Fuentes, B.P.M.M., Hamann, M., Limpus, C.J. (2010) 'Past, current and future thermal profiles of green turtle nesting grounds: Implications from climate change. *Journal of Experimental Marine Biology and Ecology,* 383(1), pp. 56-64.

Fujisaki, I., Lamont, M.M. (2016) 'The effects of large beach debris on nesting sea turtles'. *Journal of Experimental Marine Biology and Ecology.* 482, pp. 33-37.

Gallo, F., Fossi, C., Weber, R., Santillo, D., Sousa, J., Ingram, I., Nadal & Romano, D. (2018) 'Marine litter plastics and microplastics and their toxic chemicals components: the need for urgent preventive measures'. *Environmental Sciences Europe*, 30(13).

Gangiredla, S., Remya, P.G., Pravenn, K., Anuradha, M., Balakrishnan Nair, T.M. (2020) 'The imparct of Indian Ocean Dipole on tropical Indian Ocean surface wave heights in ERA5 and CMIP5 models'. *International Journal of Climatology,* 41(1).

Gjerdseth, E. (2017) 'Quantitative analysis of debris and plastic pollution on beaches in Northern Madagascar'. *Oregon Undergraduate Research Journal,* 10(1), pp. 33-46.

Gleason, F.H., Allerstorfer, M., Lilje, O. (2020) 'Newly emerging diseases of marine turtles, especially sea turtle egg fusariosis (SEFT), caused by species in the *Fusarium solani* complex (FSSC)'. *Mycology,* 11:3, pp. 184-194.

Godley, B.J. & Broderick, A.C. (1996) 'Population and nesting ecology of the Green Turtle, *Chelonia mydas*, and the Loggerhead Turtle, *Caretta caretta*, in northern Cyprus'. *Zoology in the Middle East,* 13:1, pp. 27-46.

Godoy, V., Prata, J.C., Blázquez, G., Almendros, A.I., Duarte, A.C., Rocha-Santos, T. Calero, M., Martín-Lara, M.A. (2020) 'Effects of distance to the sea and geomorphological characteristics on the quantity and distribution of microplastics in beach sediments of Granada (Spain)'. *Science of the Total Environment*, 746.

Gohla, J., Bracun, S., Gretschel, G., Koblmuller, S., Wagner, M. & Pacher, C. (2021) 'Potassium carbonate (K_2CO_3) – A cheap, non-toxic and high-density floating solution for microplastic isolation from beach sediments'. *Marine Pollution Bulletin,* 170, pp. 112618.

Harris, P.T. (2020) 'The fate of microplastic in marine sedimentary environments: A review and synthesis'. *Marine Pollution Bulletin,* 158*.*

Hays, G. C., Koldewey, H. J., Andrzejaczek, S., Attrill, M. J., Barley, S., Bayley, D. T. I., Benkwitt, C. E., Block, B., Schallert, R. J., Carlisle, A. B., Carr, P., Chapple, T. K., Collins, C., Diaz, C., Dunn, N., Dunbar, R. B., Eager, D. S., Engel, J., Embling, C. B., Esteban, N., Ferretti, F., Foster, N. L., Freeman, R., Gollock, M., Graham, N. A. J., Harris, J. L., Head, C. E. I., Hosegood, P., Howell, K. L., Hussey, N. E., Jacoby, D. M. P., Jones, R., Sannassy Pilly, S., Lange, I. D., Letessier, T. B., Levy, E., Lindhart, M., McDevitt-Irwin, J. M., Meekan, M., Meeuwig, J. J., Micheli, F., Mogg, A. O. M., Mortimer, J. A., Mucciarone, D. A., Nicoll, M. A., Nuno, A., Perry, C. T., Preston, S. G., Rattray, A. J., Robinson, E., Roche, R. C., Schiele, M., Sheehan, E. V., Sheppard, A., Sheppard, C., Smith, A. L., Soule, B., Spalding, M., Stevens, G. M. W., Steyaert, M., Stiffel, S., Taylor, B. M., Tickler, D., Trevail, A. M., Trueba, P., Turner, J., Votier, S., Wilson, B., Williams, G. J., Williamson, B. J., Williamson, M. J., Wood, H. and Curnick, D. J. (2020) 'A review of a decade of lessons from one of the world's largest MPAs: conservation gains and key challenges'. *Marine Biology*, 167(159).

Hamylton, S. & East, H. (2012) 'A geospatial appraisal of ecological and geomorphic change on Diego Garcia Atoll, Chagos Islands (British Indian Ocean Territory)'. *Remote Sensing*, 4, pp. 3444-3461.

Hesni, M.A., Rezaie-Atagholipour, M., Zangiabadi, S., Tollab, M.A., Moazeni, M., Jafari, H., Matin, M.T., Zafarani, G.G., Shojaei, M., Motlaghnejad, A. (2019) 'Montiroing hawksbill turtle nesting sites in some protected areas from the Persian Gulf'. *Acta Oceanologica Sinica*, 38, pp.43-51.

Hoare, V., Balmond, N.A., Hays, G.C., Jones, R. Koldewey, H., Laloë, J.O, Levy, E., Llewellyn, F., Morrall, H., Esteban, N. (2022) ‘Spatial variation of plastic debris on important turtle nesting beaches of the remote Chagos Archipelago, Indian Ocean’. *Marine Pollution Bulletin,* 113868*.*

Imhof, H.K., Sigl, R., Brauer, E., Feyl, S., Giesemann, P., Klink, S., Leupolz, K., Loder, M.G., Loschel, L.A., Missun, J., Muszynski, S., Ramsperger, A.F., Schrank, I., Speck, S., Steibl, S., Trotter, B., Winter, I. & Laforsch, C. (2017) ‘Spatial and temporal variation of macro-, meso- and microplastic abundance on a remote coral island of the Maldives, Indian Ocean’. *Maine Pollution Bulletin,* 116, pp. 340-347.

Jillavenkatesa, A., Dapkunas, J.S., Lum, L.H. (2001) ‘Particle size characterisation’. *NIST Recommended Practice Guide: special publication (NIST SP), National Institute of Standards and Technology,* [online] https://doi.org/10.6028/NBS.SP.960-1 (Accessed May 02, 2021).

Jones, K (2019) ‘Microplastic effects on the sand permeability of the turtle nesting environment in the West Indian Ocean’. *Masters dissertation, Swansea University*.

Jones, J.S., Porter., A., Muñoz-Pérez, J.P., Alarcón-Ruales, D., Galloway., T.S., Godley, B.J., Santillo, D., Vagg, J., Lewis, C. (2021) ‘Plastic contamination of a Galapagos Island (Ecuador) in the relative risks to native marine species’. *Science of the total environment*, 789.

Karavas, N., Georghiou, K., Arianoutsou, M., Dimopoulos, D. (2005) ‘Vegetation and sand characteristics influencing nesting activity of *Caretta caretta* on Sekania beach’. *Biological Conservation,* 121(2), pp. 177-188.

Karthik, R., Robin, R.S., Ganguly, D., Anandavelu, I., Raghuraman, R., Hariharan, G., Ramakrishna, A., Ramesh, R. (2018) ‘Microplastics along the beaches of southeast coast of India’. *Science of the total environment,* 645, pp. 1388-1399.

Kerpen, N.B., Schlurmann, T., Schendel, A., Gundlach, J., Marquard, D., Hüpgen, M. (2020) ‘Wave-induced distribution of microplastic in the surf zone’. *Frontiers in marine science,* 7.

Khalid, N., Aqeel, M., Noman, A., Hashem, M., Mostafa, Y.S., Alhaithloul, H.A.S. & Alghanem, S.M. (2021) ‘Linking effects of microplastics to ecological impacts in marine environments’. *Chemosphere,* 264, pp. 128541.

Kim, I., Chae, D., Kim, S., Choi, S., Woo, S. (2015) ‘Factors influencing the spatial variation of microplastics on high tidal coastal beaches in Korea’. *Arch Environ Contam Toxicol*, 69, pp.299-309.

Koldewey, H.J., Curnick, D., Harding, S., Harrison, L.R., Gollock, M. (2010) 'Potential benefits to fisheries and biodiversity of the Chagos Archipelago/British Indian Ocean Territory as a no-take marine reserve'. *Marine Pollution Bulletin,* 60(11), pp. 1906-1915.

Koldewey, H.J., Atchison-Balmond, N., Graham, N., Jones, R., Perry, C., Sheppard, C., Spalding, M., Turner, J., Williams, G. (2021) 'Key climate change effects on the coastal and marine environment around the Indian Ocean UK Overseas Territories. *MCCIP Science,* 31.

Lacerda, A.L.D.F., Proietti, M.C., Secchi, E.R., Taylor, J.D. (2020) 'Diverse group of fungi are associated with plastics in the surface waters of the Western South Atlantic and the Antarctic Peninsula'. *Molecular Ecology.* 29(10), pp. 1903-1918.

Laloë, J.O., Cozens, J., Renom, B., Taxonera, A., Hays, G.C. (2017) 'Climate change and temperature-linked hatchling mortality at a globally important sea turtle nesting site'. *Global Change Biology.* 23 (11), pp. 4922-4931.

Lambert, Scott & Wagner, Martin. (2018) 'Microplastics are contaminants of emerging concern in freshwater environments: An overview'. *Freshwater Microplastics.* 1:23.

Lavers, J.L., Rivers-Auty, J., Bond, A.L. (2021) ' Plastic debris increases circadian temperature extremes in beach sediments'. *Journal of Hazardous Materials.* 416, pp. 126-140.

Lechthaler, S., Waldschläger, K., Stauch, G. & Schüttrumpf, H. (2020) 'The Way of Macroplastic through the Environment'. *Environments,* 7.

Lee, P.L.M., Luschi, P., Hays, G.C. (2007) 'Detecting female precise natal philopatry in green turtles using assignment methods'. *Molecular Ecology,* 16, pp. 61-74.

Lolovar A, Wyneken J. (2020) 'The impact of sand moisture on the temperature-sex ratio responses of developing loggerhead (Caretta caretta) sea turtles'. *Zoology,* 138, pp. 125739.

Lusher, A. (2015) 'Microplastics in the Marine Environment: Distribution, Interactions and Effects'. *Marine Anthropogenic Litter,* pp. 245-307.

Maurer, A.S., Seminoff, J.A., Layman, C.A., Stapleton, S.P., Godfrey, M.H., Burford Reiskind, M.O. (2021) 'Population viability of sea turtles in the context of global warming'. *BioScience,* 71(8), pp. 790-804.

Mazurais, D., Ernande, B., Quazuguel, P., Severe, A., Huelvan, C., Madec, L., Mouchel, O., Soudant, P., Robbens, J, Huvet, A., Zambonino-Infante, Z. (2015) 'Evaluation of the impact of polyethylene microbeads ingestion in European sea bass (Dicentrarchus labrax) larvae'. *Marine Environmental Research*, 112(A), pp. 78-85.

Mohanan, N., Montazer, Z., Sharma, P.K., Levin, D.B. (2020) 'Microbial and Enzymatic Degradation of Synthetic Plastics'. *Frontiers in Microbiology,* 11.

Monteiro, R.C.P., Ivar do Sul, J.A., Ferreira Costa, M. (2020) 'Small microplastics on beaches of Fernando de Noronha Island, Tropical Atlantic Ocean'. *Ocean and Coastal Research,* 68, pp. 10-19.

Moreira, F.T., Prantoni, A.L., Martini, B., Alves de Abreu, M., Stoiev, S.B., Turra, A. (2016) ' Small-scale temporal and spatial variability in the abundance of plastic pellets on sandy beaches: Methodological considerations for estimating the inputs of microplastics'. *Marine pollution bulletin,* 102, pp.114-121.

Mortimer, J.A. (1988) 'Green turtle nesting at Aldabra atoll – population estimates and trends'*. Biol Soc Wash,* 8, pp. 116-128.

Mortimer, J.A. (1990) 'The influence of beach sand characteristics on the nesting behaviour and clutch survival of green turtles (*Chelonia mydas*)'. *Copeia,* 3, pp. 802-817.

Mortimer, J.A., Broderick, D. (1999) 'Population genetic structure and developmental migrations of sea turtles in the Chagos Archipelago and adjacent regions inferred from mtDNA sequence variation.' *Ecology of the Chagos Archipelago*, pp. 185-194.

Mortimer, J.A., Mark, D., Broderick, D. (2002) 'Sea Turtle Populations of the Chagos Archipelago, British Indian Ocean Territory'. *20th Annual Sea Turtle Symposium, 2000.*

Mortimer, J.A., Esteban, N., Guzman, A.N. and Hays, G.C. (2020) 'Estimates of marine turtle nesting populations in the south-west Indian Ocean indicate the importance of the Chagos Archipelago'. *Oryx*, 54(3), pp. 332-343.

Nelms, S.E., Duncan, E.M., Broderick, A.C., Galloway, T.S., Godfrey, M.H., Hamann, M., Lindeque, P.K., Godley, B.J. (2015) 'Plastic and marine turtles: a review and call for research'. *ICES Journal of Marine Science*, 73(2), pp. 165-181.

Ozdilek, Y.S., Ozdilek, H.G., Ozaner, F.S. (2007) 'Possible Influence of Beach Sand Characteristics on Green Turtle Nesting Activity on Samandag Beach, Turkey'. *Journal of Coastal Research,* 23:6, pp. 1379-1390.

Parga, M.L., Crespo-Picazo, J.L., Monteiro, García-Párraga, D., Hernandez, J.A., Swimmer, Y., Paz, S. & Stacy, N.I. (2020) 'On-board study of gas embolism in marine turtles caught in bottom trawl fisheries in the Atlantic Ocean'. *Scientific Reports*, 10, pp. 5561.

Patti, T.B., Fobert, E.K., Reeves, S.E. & Burke da Silva, K. (2020) Spatial distribution of microplastics around an inhabited coral island in the Maldives, Indian Ocean. *Science Total Environment,* 748, pp. 141-263.

Pattiaratchi, C., van der Mheen, M., Schlundt, C., Bhavani, E., Appalanaidu Sura, N., Hajbane, S., White, R., Kumar, N., Fernandes, M., Wijeratne, S. (2022) 'Plastic in the Indian Ocean – sources, fate, distribution and impacts'. *Ocean Science,* 18, pp. 1-28.

Perry, C.T., Murphy, G.N., Graham, N.A.J., Wilson, S.K., Januchowski-Hartley, F.A., East, H.K. (2015) 'Remote coral reefs can sustain high growth potential and may match future sea-level trends'. *Scientific Reports*, 5, pp. 18289.

Pervez R., Wang, Y. (2022) 'Microplastic distribution within core sediments of beach and its responses to anthropogenic activities'. *Marine Pollution Bulletin,* 174.

Petersen, L., Dahl, C.K. & Esbensen, K.H. (2004) 'Representative mass reduction in sampling – a critical survey of techniques and hardware'. *Chemometrics and Intelligent Laboratory Systems,* 74, pp. 95-114.

Pimpke, S., Wirth, M., Lorenz, C. & Gerdts, G. (2018) 'Reference database design for the automated analysis of microplastic samples based on Fourier transform infrared (FTIR) spectroscopy'. *Analytical and Bioanalytical Chemistry*, 410, pp. 5131-5141.

Porter, E., Booth, D.T., Limpus, C.J., Staines, M.N., Smith, C.E. (2021) ' Influence of short-term temperature drops on sex-determination in sea turtles'. *Ecological and Integrative Physiology.* 335:8, pp. 649-658.

Purkis, S.J., Gardiner, R., Johnston, M.W. & Sheppard, C.R.C. (2016) 'A half-century of coastline change in Diego Garcia – The largest atoll island in the Chagos'. *Geomorphology*, 261, pp. 282-298.

Quinn, B., Murphy. & Ewins, C. (2016) 'Validation of density separation for the rapid recovery of microplastics from sediment'. *The Royal Society of Chemistry,* 9, pp. 1491-1498.

Rocamora, G., Skerrett, A. (2001) 'Seychelles'. *IBAs in Africa and associated islands,* pp. 751-768.

Ryan, P.G., Cole, G., Spilby, K., Ronel, N., Osborne & Vonica, P. (2016) 'Impacts of plastic ingestion on post-hatchling loggerhead turtles off South Africa'. *Marine Pollution Bulletin.* 107(10).

Salleh, S.M, Nishizawa, H., Ishihara, T., Mohd Sah, S.A., Chowdhury, A.J.K. (2018) 'Importance of Sand Particle Size and Temperature for Nesting success of Green Turtles in Pengang Island, Malaysia'. *Chelonian Conservation and Biology*, 17(1), pp. 116-122.

Salleh, S.M., Nishizawa, H., Anuar Mohd Sah, S., Khan Chowdhury, A.J., Rusli, M.U. (2021) 'Sand particle size influences nest site selection of green turtles (*Chelonia mydas*) differently in East and West Peninsular Malaysia'. *Herpetological Conservation and Biology,* 16(3), pp 671-680.

Saliu, F., Montano, S., Garavaglia, M.G., Lasagni, M., Seveso, D. & Galli, P. (2018) 'Microplastic and charred microplastic in the Faafu Atoll, Maldives.' *Marine Pollution Bulletin,* 136, pp. 464-471.

Samoilys, M.A., Halford, H., Osuka, K. (2019) 'Disentangling drivers of the abundance of coral reef fishes in the Western Indian Ocean'. *Ecology and Evolution*, 9(7), pp. 4149-4167.

Savoca, D., Arculeo, M, Vecchioni, L., Cambera, I., Vicsonti, G., Melfi, R., Arizza, V., Piccionello, A.P., Buscemi, S., Pace, A. (2021) 'Can phthalates move into the eggs of loggerhead sea turtle *Caretta caretta*? The case of the nests on the Linosa Island in the Meditteranean Sea'. *Marine Pollution Bulletin,* 168, pp.

Saxena., S., Singh., M. (2013) 'Eco-Architecture: Pet Bottle Houses'. *International journal of scientific engineering and technology,* 2, pp. 1243-1246.

Schröder, K., Kossel, E., Lenz, M. (2021) 'Microplastic abundance in beach sediments of Kiel Fjord, Western Baltic Sea'. *Environmental Science and Pollution Research,* 28, pp. 26515-26528.

Schumann, E.H., MacKay, F.C, Strydom, N.A. (2019) ' Nurdle drifters around South Africa as indicators of ocean structures and dispersion'. *South African Journal of Science,* 115, pp. 5-6.

Scott, K. (2020) ' Nesting site preference of marine turtles in the Central Red Sea'. *MS thesis, Kaust research repository.*

Sheppard, C.R.C. (1999) 'Changes in coral cover on reefs of Chagos over eighteen years. In: Sheppard, C.R.C, Seaward MRD (eds) Ecology of the Chagos archipelago. Linnean Society/Westbury, London, pp. 91.

Sheppard, C.R.C. (2002) 'Coral decline and weather patterns over 20 years in the Chagos Archipelago, central Indian Ocean'. *Ambio,* 28, pp. 472-478.

Sheppard, C.R.C., Ateweberhan, M., Bowen, B.W., Carr, P., Chen, C.A., Clubbe, C., Ebinghaus, C.R., Eble, J., Fitzsimmons, N., Gaither, R., Gan, C.H., Gollock, M., Guzman, N., Graham, A., Harris, R.J., Keshavmurthy, S., Koldewey, H., Lundin, C.G., Mortimer, J.A., Obura, D., Pfeiffer, M., Price, A.R.G., Purkis, S., Raines, P., Readman, W., Riegl, B., Rogers, A., Schleyer, M., Seaward, A.L.S., Sheppard, J., Tamelander, J.R., Turner, R., Visram, S., Vogler, C., Vogt, H, Wolschke, J.M.C., Yang, S.Y., Yesson, C.Y. (2012) 'Reefs and islands of the Chagos Archipelago, Indian Ocean: why it is the world's largest no-take marine protected area'. *Aquatic Conservation,* 22:2, pp. 232-261.

Sheppard, C.R.C., Bowen, B.W., Chen, C.A., Craig, M.T Eble, J.A., Fitzsimmons, N., Gan, C., Gaither, M.R., Gollock, M., Keshavmurthy, S., Koldewey, H., Mortimer, A.J., Obura, D., Pfeiffer, M., Rogers, A.D., Sheppard, A.L.S.,Vogler, K., Wörheide, G., Yang, M & Yesson, C. (2013) 'British Indian Ocean Territory (the Chagos Archipelago): Setting, Connections and the Marine Protected Area'. *Coral Reefs of the United Kingdom Overseas Territories, Coral Reefs of the World.* 4(17), pp. 223-240.

Sheppard, C.R.C., Sheppard, A. Mogg, A., Bayley, D., Dempsey, A.C., Alexandra, R.C. (2017) 'Coral Bleaching and Mortality in the Chagos Archipelago'. *Atoll Research Bulletin,* 613, pp. 1-26.

Sönmez, B., Turan, C., Özdilek, S.Y. (2013) 'Comparison of the physical properties of two Green Turtle (*Chelonia mydas)* nesting beaches (Akyatan and Samandağ) in the eastern Mediterraneean (Reptilia: Cheloniidae)' *Zoology in the Middle East,* 59, pp. 30-38.

Stoddart, D.R. (1971) 'Rainfall on Indian Ocean coral islands'. *Atoll Research Bulletin,* 147.

Thomas, D., Schütze, B., Heinze, W.M. & Steinmetz, Z. (2020) 'Sample Preparation Techniques for the Analysis of Microplastics in Soil-A Review'. *Sustainability.* 12, pp. 9074.

Tilley, D., Ball, S., Ellick, J., Godley, B., Weber, N., Weber, S.B. & Broderick, A.C. (2019) 'No evidence of fine scale thermal adaptation in green turtles'. *Journal of experimental Marine Biology and Ecology,* 514-515, pp. 110-117.

Trainic, M., Flores, J.M., Pinkas, I., Pedrotti, M.L., Lombard, F., Bourdin, G., Gorsky, G., Boss, E., Rudich, Y., Vardi, A & Koren, I. (2020) 'Airborne microplastic particles detected in the remote marine atmosphere'. *Communications Earth & Environment,* 1(64).

Triessnig, P., Roetzer, A. & Stachowitsch, M. (2012) 'Beach Condition and Marine Debris: New Hurdles for Sea Turtle Hatchling Survival.' *Chelonian Conservation and Biology,* 11, pp. 68-77.

Turra, A., Manzano, A.B., Dias, R.J., Mahiques, M.M., Barbosa, L., Balthazar-Silva, D., Moreira, F.T. (2014) 'Three dimensional distribution of plastic pellets in sandy beaches: shifting paradigms'. *Scientific Reports,* 4.

Turner, A., Ostle, C. & Wootton, M. (2021) 'Occurrence and chemical characteristics of microplastic pain flakes in the North Atlantic Ocean'. *Science of The Total Environment*, 886, Part1.

Van Cauwenberghe, L., Devriese, L., Galgani, F., Robbens, J., Janssen, C.R. (2015) 'Microplastics in sediments: a review of techniques, occurrence and effects'. *Marine Environment,* 111, pp. 5-17.

Van de Merwe, J., Ibrahim, K., Whittier, J. (2006) 'Effects of Nest Depth, Shading, and Metabolic Heating on Nest Temperatures in Sea Turtle Hatcheries'. *Chelonian Conservation and Biology,* 5, pp. 210-215, 216.

Van der Mheen, M., Pattiaratchi, C., van Sebille, E. (2018) 'Role of Indian Ocean Dynamics on Accumulation of Bouyant Debris'. *Research Oceans,* 124, pp. 2571-2590.

Van der Mheen, M., van Sebille, E., Pattiaratchi, C. (2020) ' Beaching patterns of plastic debris along the Indian Ocean rim'. *Ocean Sciences,* 16, pp. 1317-1336.

Veerasingam, S., Vethamony, P., Aboobacker, V.M., Giraldes, A.E., Dib, S., Al-Khayat, J.A. (2021) 'Factors influencing the vertical distribution of microplastics in the beach sediments around the Ras Rakan Island, Qatar'. *Environ Sci Pollut Res Int*, 26, pp. 34259-34268.

Viehman, S., Vander Pluym, J.L., Schellinger, J. (2011) 'Characterization of marine debris in North Carolina salt marshes'. *Marine Pollution Bulletin,* 62(12), pp. 2771-2779.

Wallace, B.P., Sotherland, P.R., Spotila, J.R., Reina, R.D., Franks, B.F., Paladino, F.V. (2004) 'Biotic and abiotic factors affect the nest environment of embryonic leatherback turtles Dermochelys coriacea.' *Physiological and Biochemical Zoology,* 77(3), pp. 423-432.

Weber, S.B., Broderick, A.C., Groothuis, T.G.G., Ellick, J., Godley, J.B & Blount, J.D. (2011) 'Fine-scale thermal adaptation in a green turtle nesting population'. *Proceedings of the Royal Society B,* 279, pp. 1077-1084.

Wheeler, A. (2021) 'The effect of microplastics on sea turtle nesting temperatures in the Western Indian Ocean'. *Masters dissertation, Swansea University.*

Woodroffe, C.D. (2007) 'Reef-island topography and the vulnerability of atolls to sea-level rise'. *Global and Planetary Change,* 62(1-2), pp. 77-96.

Wu, C., Zhang, K., Xiong, X. (2018) 'Microplastic pollution in inland waters focusing on Asia'. *Freshwater Microplastics, 58,* pp. 85-99.

Wu, M., Duvat, V.K.E., Purkis, S.J. (2021) 'Multi-decadal atoll-island dynamics in the Indian Ocean Chagos Archipelago'. *Global and planetary change,* 202.

Sombatsompop, N., Wood, A.K. (1997) 'Measurement of Thermal Conductivity of Polymers using an Improved Lee's Disc Apparatus'. *Polymer Testing.* 16(3), pp. 203-223.

Zare, R., Vaghefi, M.E., Kamel, S.J. (2012) 'Nest location and clutch success of the hawksbill sea turtles (*Eretmochelys imbricata)* at Shidvar Island, Iran'. *BioOne*, 11, pp. 229-234.

Zhang, Y., Kang, S., Allen, S., Allen, D., Gao, T & Sillanpää, M. (2020) 'Atmospheric microplastics: A review on current status and perspectives'. *Earth-Science Reviews,* 203.

Zhao, S., Zettler, E.R., Bos, R.P., Lin, P., Amaral-Zettler, L.A., Mincer, T.J. (2021) 'Large quantities of small microplastics permeate the surface ocean to abyssal depths in the South Atlantic Gyre'. *Global Change Biology,* 00(1), pp. 1-16.

Zimmermann, L.G.S., Oehlmann, J., Wagner, M., Volker, C. (2020) 'What are the drivers of microplastic toxicity? Comparing the toxicity of plastic chemicals and particles to Daphnia magna'. *Environ Pollut,* 267, pp. 115-392.

Appendix

Appendix 1: Methods

Table 1. Station coordinates indicating the locations core samples were extracted from Diego Garcia, Parasol, Nelson, Egmont and Boddam Islands across five Chagos atolls.

Island	Date	Beach Length (km)	Station	Latitude	Longitude
Diego Garcia	25/06/2019	2.8	10	-7.4012	72.4675
Diego Garcia	25/06/2019	2.8	30	-7.4038	72.4634
Diego Garcia	25/06/2019	2.8	50	-7.4072	72.45994
Diego Garcia	25/06/2019	2.8	70	-7.4098	72.45727
Diego Garcia	25/06/2019	2.8	90	-7.4131	72.45441
Parasol	15/03/2019	0.95	10	-5.2635	71.84237
Parasol	15/03/2019	0.95	30	-5.2644	71.84251
Parasol	15/03/2019	0.95	50	-5.2649	71.84315
Parasol	16/03/2019	0.95	70	-5.2652	71.84403
Parasol	16/03/2019	0.95	90	-5.265	71.84486
Nelson	07/07/2019	1.6	10	-5.6806	72.30932
Nelson	07/07/2019	1.6	30	-5.6804	72.31206
Nelson	07/07/2019	1.6	50	-5.6809	72.3145
Nelson	07/07/2019	1.6	70	-5.6812	72.31792
Nelson	07/07/2019	1.6	90	-5.6817	72.32128
Egmont	18/03/2019	1	10	-6.6408	71.31855
Egmont	18/03/2019	1	30	-6.6411	71.31805
Egmont	18/03/2019	1	50	-6.6416	71.31756
Egmont	18/03/2019	1	70	-6.6421	71.31713
Egmont	18/03/2019	1	90	-6.6425	71.31682
Boddam	24/03/2019	0.75	10	-5.3543	72.20695
Boddam	24/03/2019	0.75	30	-5.3534	72.20703
Boddam	24/03/2019	0.75	50	-5.3518	72.20718
Boddam	24/03/2019	0.75	70	-5.3511	72.20689
Boddam	24/03/2019	0.75	90	-5.3509	72.20631

Validation of methodology

The 2019 study on Boddam (n = 3) and Egmont (n = 3) samples, a literature review of the latest research methodologies and trials with $ZnCl_2$ and K_2CO_3 informed the protocols for Diego Garcia, Nelson, and Parasol (n = 15) and Boddam and Egmont (n = 4) samples.

Microplastic extraction

Diego Garcia, Nelson, and Parasol (n = 15) and Boddam and Egmont (n = 4) sub samples were not sieved prior to microplastic extraction as dry sieving can further abrade microplastics thus increasing procedural error (Cashman et al., 2020; Lusher et al., 2015; Thomas et al., 2020). The density of the salt solution chosen for microplastic extraction was particularly important due to the high concentrations of high-density (1.35 g/cm^3) PET macroplastics discovered on Diego Garcia index beach (Hoare et al., 2022; Price et al., 2009). As zinc chloride ($ZnCl_2$, 1.5g/cm^3) has high rates of recovery for the most common plastics with mean density range 0.9 - 1.5 g/cm^3 it was trialled for efficacy. $ZnCl_2$ produced a vigorous reaction with Chagos test sediment and so potassium carbonate (K_2CO_3, 1.5g/cm^3) was selected as a lower cost and non-toxic alternative. Six trial extractions were carried out on 50, 100 and 200g of fine and coarse test sediment. All required >24 hours for the sediment to completely settle. For this reason, further trial extractions with coarse and fine sediment were carried out using a high-density salt solution and centrifugal separation (Patti et al.,2020). This was a highly efficient microplastic extraction method, moreover, it provided the time to carry out three extractions increasing extraction efficiency (Besley et al., 2017; Patti et al., 2020).

Organic material removal

It was necessary to remove organic matter so that microplastic weight and organic matter weight could be determined. Furthermore, removing organic matter significantly improves accuracy of microplastics recovered for analysis and the accuracy of polymer identification with mass spectrophotometry (Al-Azzawi et al., 2020; Delgado-Gallardo et al 2021). Hydrogen peroxide (H_2O_2, 30%) was chosen to remove organic matter from Diego Garcia, Nelson, and Parasol (n = 15) and Boddam and Egmont (n = 4) sub samples due to its efficiency whilst not altering microplastic size (Al-Azzawi et al., 2020).

Microplastic size classification

Boddam (n = 3) and Egmont (n = 3) sediment samples were dry sieved prior to microplastic extraction which allowed the categorisation of microplastic sizes according to sieve fractions (5, 1, 0.5, 0.25 and 0.125 mm). This efficient method of size categorisation was used for Diego Garcia, Nelson, and Parasol (n = 15) and Boddam and Egmont (n = 4) after microplastics had been extracted from the sediment. Eight sieve fractions were chosen (5, 2, 1, 0.5, 0.25, 0.15, 0.05, 0.02 mm) so that microplastic size distribution was representative of the population. Furthermore, as microplastic size distribution is skewed towards smaller sizes (Benoit., 2019; Bridson et al., 2020; Patti et al., 2020; Zimmerman et al., 2020) with fibres making up a high proportion of plastics between 0.01 to 0.03 mm (Imhof et al., 2017; Veerasingam et al., 2021) it was important to include smaller sieve fractions. Following Saliu and Patti et al (2018; 2020; Maldives), sieve fractions 0.15, 0.05, 0.02 mm were chosen to represent smaller sizes. During size separation trials smaller microplastics 0.05 and 0.02 mm could not be seen without a microscope and as time constraints did not allow for microscopic analysis, sieve fractions (5, 2, 1, 0.5, 0.25, 0.15 mm) were used to separate plastics from Diego Garcia, Nelson, and Parasol (n = 15) and Boddam and Egmont (n = 4).

Sediment grain size analysis

Boddam (n = 3) and Egmont (n = 3) sediment samples were separated by sieve fractions (5, 1, 0.5, 0.25 and 0.125 mm) according to the microplastic definition (Besley et al., 2017). Diego Garcia, Nelson, and Parasol (n = 15) and Boddam and Egmont (n = 4) sediment samples were separated by sieve fractions (32, 16, 8, 4, 2, 1 0.5, 0.25, 0.125, and 0.063 mm) following the Wentworth scale for classifying sediments by grain size (Mortimer., 1990: Ozdilek et al., 2007; Carson et al., 2011; Franklin Rey., 2021; Salleh et al., 2021). The range of sieve sizes covered particle sizes from large coral pieces down to the finest sand particles 0.063 mm. A sieve shaker was used as agitation using mechanical shakers gives consistent amplitude and periodicity, improving precision (Jillavenkatesa et al 2001).

Appendix 2: Microplastic results

Validation of results

To accurately compare microplastic sizes between Boddam (n = 3) and Egmont (n = 3) and Diego Garcia, Nelson, and Parasol (n = 15) plastics were placed into size classes 1 – 4.99, 0.5 – 0.99, 0.25 – 0.49 and 0.15 – 0.24 mm.

Spatial Variation

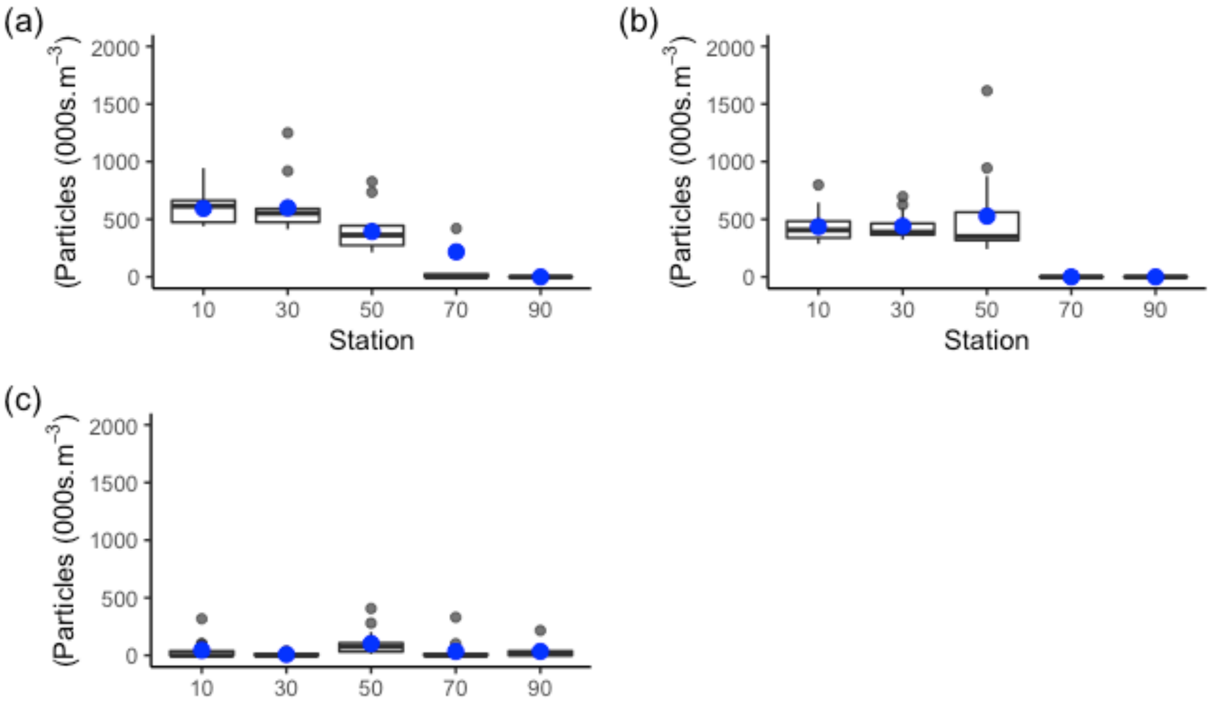

Figure 1. Variation in microplastic concentration (thousands particles/m^{-3}) across the shoreline (stations 10 – 90) of islands (a) Egmont, (b) Boddam and (c) Diego Garcia. Horizontal lines on the box-plots indicate the median. Boxes indicate the interquartile range and the blue circles indicate the mean.

Table 1. Mean microplastic concentration at 4 cm intervals from the sediment surface to turtle nesting depth (30 – 60 cm). Sediment cores taken from the shorelines of five Chagos Islands: Diego Garcia, Parasol, Nelson, Egmont and Boddam.

Depth (cm)	Mean (thousands particles/m^{-3})	S.e.
0-4	742,000	228,000
4-8	473,000	113,000
8-12	304,000	85,000
12-16	302,000	63,000
16-20	251,000	70,000
20-24	295,000	58,000
24-28	236,000	68,000
28-32	265,000	79,000
32-36	243,000	62,000
36-40	219,000	62,000
40-44	255,000	70,000
44-48	243,000	56,000
48-52	241,000	68,000
52-56	235,000	68,000
56-60	285,000	81,000

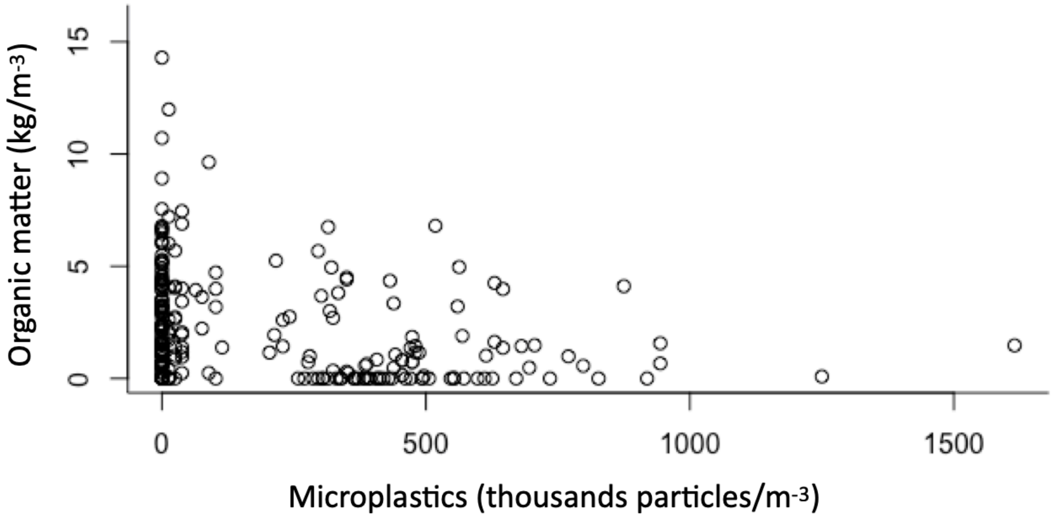

Figure 2. Relationship between sediment organic matter content and microplastic concentration. Sediment samples from Chagos islands: Diego Garcia, Nelson, Parasol, and Egmont.

Appendix 3: Sediment characterisation and organic matter results

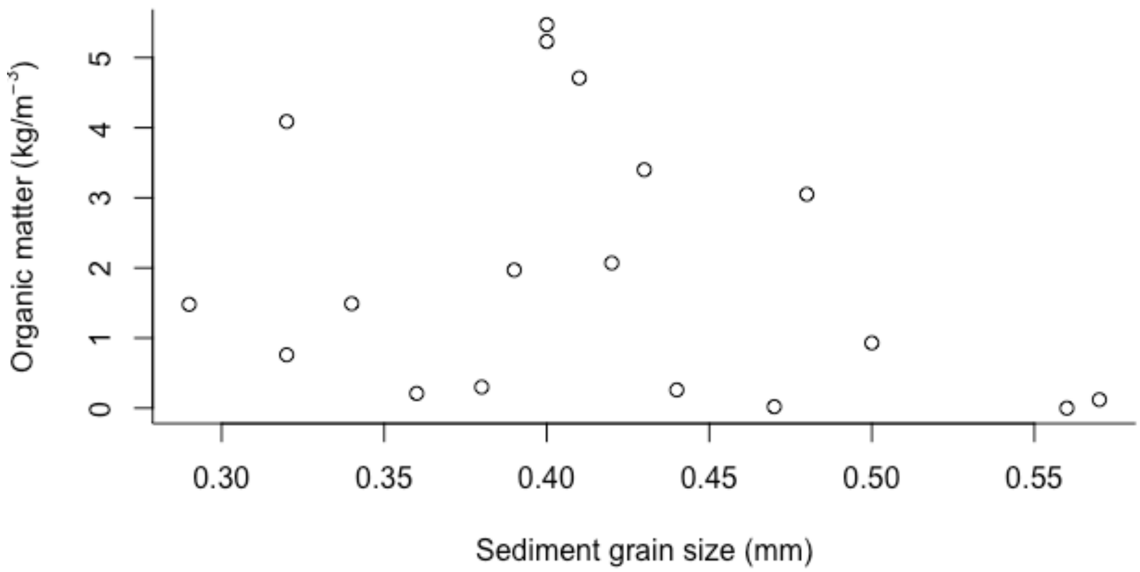

Figure 1. Relationship between sediment organic matter content and sediment grain size. Sediment samples from Chagos islands: Diego Garcia, Nelson, Parasol, Egmont and Boddam.

Appendix 4: Microplastic particles and weight data sheets

Table 1. Microplastic particles (n) collected across Egmont beach, stations 10, 30, 50, 70 and 90.

Station	10	30	50	70	90
Sub sample Size	Full	Full	Full	1/4	1/4
Depth			Particles		
4	297	393	260	202	0
8	242	289	231	33	0
12	222	192	148	2	0
16	214	172	135	18	0
20	193	159	145	2	0
24	203	137	117	0	0
28	198	155	93	0	0
32	198	211	81	0	0
36	151	180	85	0	0
40	149	138	87	0	0
44	148	179	67	0	0
48	138	143	72	0	0
52	143	174	99	0	0
56	156	174	121	0	0
60	149	130	114	0	0
Mean	187	188	124	17	0
S.e.	11.6731139	17.7256338	14.3953255	13.4202642	0

Station	10	30	50	70	90
	Full	Full	Full	Full	Full
Depth			Particles/m3		
4	944460	1249740	826800	2569440	0
8	769560	919020	734580	419760	0
12	705960	610560	470640	25440	0
16	680520	546960	429300	228960	0
20	613740	505620	461100	25440	0
24	645540	435660	372060	0	0
28	629640	492900	295740	0	0
32	629640	670980	257580	0	0
36	480180	572400	270300	0	0
40	473820	438840	276660	0	0
44	470640	569220	213060	0	0
48	438840	454740	228960	0	0
52	454740	553320	314820	0	0
56	496080	553320	384780	0	0
60	473820	413400	362520	0	0
Mean	593812	599112	393260	217936	0
S.e.	37120.5021	56367.5156	45777.1352	170705.761	0

Table 2. Microplastic weight (g) across Egmont beach, stations 10, 30, 50, 70 and 90.

Station	10	30	50	70	90
Sub sample Size	Full	Full	Full	1/4	1/4
Depth			Plastic weight (g)		
4	NA	NA	NA	0.0491	0
8	NA	NA	NA	0.0015	0
12	NA	NA	NA	0	0
16	NA	NA	NA	0.0038	0
20	NA	NA	NA	0	0
24	NA	NA	NA	0	0
28	NA	NA	NA	0	0
32	NA	NA	NA	0	0
36	NA	NA	NA	0	0
40	NA	NA	NA	0	0
44	NA	NA	NA	0	0
48	NA	NA	NA	0	0
52	NA	NA	NA	0	0
56	NA	NA	NA	0	0
60	NA	NA	NA	0	0
Mean	NA	NA	NA	0.0036	0
S.e.	NA	NA	NA	0.00325884	0

Station	10	30	50	70	90
	Full	Full	Full	Full	Full
Depth		Plastic weight (g/m3)			
4	NA	NA	NA	624.552	0
8	NA	NA	NA	19.08	0
12	NA	NA	NA	0	0
16	NA	NA	NA	48.336	0
20	NA	NA	NA	0	0
24	NA	NA	NA	0	0
28	NA	NA	NA	0	0
32	NA	NA	NA	0	0
36	NA	NA	NA	0	0
40	NA	NA	NA	0	0
44	NA	NA	NA	0	0
48	NA	NA	NA	0	0
52	NA	NA	NA	0	0
56	NA	NA	NA	0	0
60	NA	NA	NA	0	0
Mean	NA	NA	NA	46.1312	0
S.e.	NA	NA	NA	41.4524571	0

Table 3. Microplastic particles (n) collected across Boddam beach, stations 10, 30, 50, 70 and 90.

Station	10	30	50	70	90
Sub sample size	Full	Full	Full	1/4	1/4
Depth			Particles		
4	251	219	508	0	0
8	203	197	297	0	0
12	153	122	177	0	0
16	151	139	95	0	0
20	155	143	102	0	0
24	136	111	101	0	0
28	130	110	93	0	0
32	128	102	163	0	0
36	128	115	99	0	0
40	106	149	110	0	0
44	96	123	176	0	0
48	96	121	110	0	0
52	107	188	76	0	0
56	124	120	105	0	0
60	90	115	275	0	0
Mean	137	138	166	0	0
S.e.	11.1143265	9.16747183	29.8813846	0	0

Station	10	30	50	70	90
	Full	Full	Full	Full	Full
Depth			Particles/m3		
4	798180	696420	1615440	0	0
8	645540	626460	944460	0	0
12	486540	387960	562860	0	0
16	480180	442020	302100	0	0
20	492900	454740	324360	0	0
24	432480	352980	321180	0	0
28	413400	349800	295740	0	0
32	407040	324360	518340	0	0
36	407040	365700	314820	0	0
40	337080	473820	349800	0	0
44	305280	391140	559680	0	0
48	305280	384780	349800	0	0
52	340260	597840	241680	0	0
56	394320	381600	333900	0	0
60	286200	365700	874500	0	0
Mean	435448	439688	527244	0	0
S.e.	35344	29152.5604	95022.8029	0	0

Table 4. Microplastic particles (n) collected across Diego Garcia Index beach, stations 10, 30, 50, 70 and 90.

Station	10	30	50	70	90
Sub sample Size	1/4	1/4	1/4	1/4	1/4
Depth			Particles		
4	NA	0	7	1	5
8	NA	3	6	1	1
12	NA	1	3	2	1
16	3	0	22	8	7
20	2	0	6	0	3
24	NA	1	9	26	17
28	0	0	8	0	1
32	0	2	3	1	2
36	3	1	16	0	1
40	3	0	2	0	0
44	NA	0	2	1	0
48	8	0	32	0	0
52	8	0	1	0	3
56	0	0	3	0	0
60	25	2	1	0	0
Mean	5	1	8	3	3
S.e.	2.38886305	0.25197632	2.27923685	1.74756066	1.14835977

Station	10	30	50	70	90
	Full	Full	Full	Full	Full
Depth			Particles/m3		
4	NA	0	89040	12720	63600
8	NA	38160	76320	12720	12720
12	NA	12720	38160	25440	12720
16	38160	0	279840	101760	89040
20	25440	0	76320	0	38160
24	NA	12720	114480	330720	216240
28	0	0	101760	0	12720
32	0	25440	38160	12720	25440
36	38160	12720	203520	0	12720
40	38160	0	25440	0	0
44	NA	0	25440	12720	0
48	101760	0	407040	0	0
52	101760	0	12720	0	38160
56	0	0	38160	0	0
60	318000	25440	12720	0	0
Mean	66144	8480	102608	33920	34768
S.e.	30386.338	3205.13873	28991.8928	22228.9716	14607.1363

Table 5. Microplastic weight (g) across Diego Garcia Index beach, stations 10, 30, 50, 70 and 90.

Station	10	30	50	70	90
Sub sample Size	1/4	1/4	1/4	1/4	1/4
Depth			Plastic weight (g)		
4	NA	0	0.0869	0.0041	0.1266
8	NA	0.0031	0.0166	0.011	0.0065
12	NA	0.104	0.0236	0.0079	0.0079
16	0.0007	0	0.0151	0.0033	0.0084
20	0.0131	0	0.011	0.0011	0.002
24	NA	0	0.0152	0.1601	0.0261
28	0.0487	0.0077	0.0304	0.0037	0.0339
32	0	0.0216	0.0307	0.0222	0.0029
36	0.0342	0.003	0.0128	0.0042	0.0023
40	0	0.0249	0.0067	0.0035	0.0024
44	NA	0	0.0132	0.0012	0.0015
48	0.0018	0	0.0585	0.0015	0.0038
52	0.0037	0	0.0012	0	0.0104
56	0	0	0	0.005	0.0006
60	0.0766	0.088	0.001	0.002	0.0043
Mean	0.02	0.02	0.02	0.02	0.02
S.e.	0.00916345	0.00858592	0.0060504	0.01043396	0.00827306

Station	10	30	50	70	90
	Full	Full	Full	Full	Full
Depth		Plastic weight (g/m3)			
4	NA	0	1105.368	52.152	402.588
8	NA	39.432	211.152	139.92	82.68
12	NA	1322.88	300.192	100.488	100.488
16	8.904	0	192.072	41.976	106.848
20	166.632	0	139.92	13.992	25.44
24	NA	0	193.344	2036.472	331.992
28	619.464	97.944	386.688	47.064	431.208
32	0	274.752	390.504	282.384	36.888
36	435.024	38.16	162.816	53.424	29.256
40	0	316.728	85.224	44.52	30.528
44	NA	0	167.904	15.264	19.08
48	22.896	0	744.12	19.08	48.336
52	47.064	0	15.264	0	132.288
56	0	0	0	63.6	7.632
60	974.352	1119.36	12.72	25.44	54.696
Mean	227.4336	213.9504	273.8192	195.7184	122.6632
S.e.	116.559135	109.2129	76.9610274	132.720023	37.0288659

Table 6. Microplastic particles (n) collected across Nelson's beach, stations 10, 30, 50, 70 and 90.

Station	10	30	50	70	90
Sub sample Size	1/4	1/4	1/4	1/4	1/4
Depth			Particles		
4	0	0	0	0	3
8	0	0	0	0	0
12	0	0	0	0	0
16	0	0	0	0	0
20	0	0	0	0	1
24	0	0	0	0	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	0	0	0
Mean	0	0	0	0	0.27
S.e.	0	0	0	0	0.2062515

Station	10	30	50	70	90
	Full	Full	Full	Full	Full
Depth			Particles/m3		
4	0	0	0	0	38160
8	0	0	0	0	0
12	0	0	0	0	0
16	0	0	0	0	0
20	0	0	0	0	12720
24	0	0	0	0	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	0	0	0
Mean	0	0	0	0	3392
	0	0	0	0	2623.51912

Table 7. Microplastic weight (g) across Nelson's beach, stations 10, 30, 50, 70 and 90.

Station	10	30	50	70	90
Sub sample Size	1/4	1/4	1/4	1/4	1/4
Depth			Plastic weight (g)		
4	0	0	0	0	0.0039
8	0	0	0	0	0
12	0	0	0	0	0
16	0	0	0	0	0
20	0	0	0	0	0
24	0	0	0	0	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	0	0	0
Mean	0	0	0	0	0.00026
S.e.	0	0	0	0	0.00026

Station	10	30	50	70	90
	Full	Full	Full	Full	Full
Depth		Plastic weight (g/m3)			
4	0	0	0	0	49.608
8	0	0	0	0	0
12	0	0	0	0	0
16	0	0	0	0	0
20	0	0	0	0	0
24	0	0	0	0	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	0	0	0
Mean	0	0	0	0	3.3072
S.e.	0	0	0	0	3.3072

Table 8. Microplastic particles (n) collected across Parasol beach, stations 10, 30, 50, 70 and 90.

Station	10	30	50	70	90
Sub sample Size	1/4	1/4	1/4	1/4	1/4
Depth			Particles		
4	0	0	0	0	0
8	0	0	0	0	0
12	0	0	0	0	0
16	0	0	0	0	0
20	0	0	0	0	0
24	0	0	0	1	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	0	0	0
Mean	0	0	0	0.07	0
S.e.	0	0	0	0.06666667	0

Station	10	30	50	70	90
	Full	Full	Full	Full	Full
Depth			Particles/m3		
4	0	0	0	0	0
8	0	0	0	0	0
12	0	0	0	0	0
16	0	0	0	0	0
20	0	0	0	0	0
24	0	0	0	12720	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	0	0	0
Mean	0	0	0	848	0
S.e.	0	0	0	848	0

Table 9. Microplastic weight (g) across Parasol beach, stations 10, 30, 50, 70 and 90.

Station	10	30	50	70	90
Sub sample Size	1/4	1/4	1/4	1/4	1/4
Depth			Plastic weight (g)		
4	0	0	0	0	0
8	0	0	0	0	0
12	0	0	0	0	0
16	0	0	0	0	0
20	0	0	0	0	0
24	0	0	0	0.0011	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	NA	0	0
Mean	0	0	0	0.0001	0
S.e.	0	0	0	0.00007	0

Station	10	30	50	70	90
	Full	Full	Full	Full	Full
Depth		Plastic weight (g/m3)			
4	0	0	0	0	0
8	0	0	0	0	0
12	0	0	0	0	0
16	0	0	0	0	0
20	0	0	0	0	0
24	0	0	0	13.992	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	NA	0	0
Mean	0	0	0	0.9328	0
S.e.	0	0	0	0.93280	0

Appendix 5: Microplastic size data sheets

Table 1. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 10, Egmont beach.

Station			Station 10	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	44	41	126	86
8	32	35	85	90
12	33	23	81	85
16	34	20	91	69
20	10	18	89	76
24	19	18	84	82
28	16	15	81	86
32	38	35	73	52
36	21	22	65	43
40	28	19	52	50
44	22	32	49	45
48	17	31	43	47
52	15	30	46	52
56	18	48	44	46
60	23	32	47	47

Station			Station 10	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	139920	130380	400680	273480
8	101760	111300	270300	286200
12	104940	73140	257580	270300
16	108120	63600	289380	219420
20	31800	57240	283020	241680
24	60420	57240	267120	260760
28	50880	47700	257580	273480
32	120840	111300	232140	165360
36	66780	69960	206700	136740
40	89040	60420	165360	159000
44	69960	101760	155820	143100
48	54060	98580	136740	149460
52	47700	95400	146280	165360
56	57240	152640	139920	146280
60	73140	101760	149460	149460

Table 2. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 30, Egmont beach.

Station			Station 30	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	24	70	142	157
8	32	43	125	89
12	28	32	76	56
16	39	37	55	41
20	27	36	54	42
24	33	31	41	32
28	33	31	48	43
32	42	47	66	56
36	14	37	68	61
40	19	18	59	42
44	28	27	68	56
48	25	22	49	47
52	43	37	53	41
56	31	41	56	46
60	34	30	42	24

Station			Station 30	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	76320	222600	451560	499260
8	101760	136740	397500	283020
12	89040	101760	241680	178080
16	124020	117660	174900	130380
20	85860	114480	171720	133560
24	104940	98580	130380	101760
28	104940	98580	152640	136740
32	133560	149460	209880	178080
36	44520	117660	216240	193980
40	60420	57240	187620	133560
44	89040	85860	216240	178080
48	79500	69960	155820	149460
52	136740	117660	168540	130380
56	98580	130380	178080	146280
60	108120	95400	133560	76320

Table 3. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 50, Egmont beach.

Station			Station 50	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	35	28	130	67
8	36	26	111	58
12	22	19	57	50
16	29	19	42	45
20	26	19	42	58
24	24	18	44	31
28	16	16	25	36
32	21	13	20	27
36	13	19	26	27
40	12	13	32	30
44	4	12	28	23
48	8	15	22	27
52	17	23	33	26
56	30	32	28	31
60	15	14	38	47

Station			Station 50	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	111300	89040	413400	213060
8	114480	82680	352980	184440
12	69960	60420	181260	159000
16	92220	60420	133560	143100
20	82680	60420	133560	184440
24	76320	57240	139920	98580
28	50880	50880	79500	114480
32	66780	41340	63600	85860
36	41340	60420	82680	85860
40	38160	41340	101760	95400
44	12720	38160	89040	73140
48	25440	47700	69960	85860
52	54060	73140	104940	82680
56	95400	101760	89040	98580
60	47700	44520	120840	149460

Table 4. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 70, Egmont beach.

Station			Station 70	
Sub sample Size	1/4	1/4	1/4	1/4
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	16	23	86	76
8	4	5	0	16
12	1	1	8	8
16	2	6	0	4
20	0	1	0	0
24	0	0	0	0
28	0	0	0	0
32	0	0	0	0
36	0	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	0
56	0	0	0	0
60	0	0	0	0

Station			Station 70	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	203000	292560	1093920	966720
8	50880	63600	111000	203520
12	12720	12720	101760	101760
16	25440	76320	0	50880
20	0	12720	0	0
24	0	0	0	0
28	0	0	0	0
32	0	0	0	0
36	0	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	0
56	0	0	0	0
60	0	0	0	0

Table 5. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 90, Egmont.

Station			Station 90	
Sub sample Size	1/4	1/4	1/4	1/4
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	0	0	0	0
8	0	0	0	0
12	0	0	0	0
16	0	0	0	0
20	0	0	0	0
24	0	0	0	0
28	0	0	0	0
32	0	0	0	0
36	0	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	0
56	0	0	0	0
60	0	0	0	0

Table 6. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 10, Boddam.

Station			Station 10	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	31	53	95	72
8	36	43	89	35
12	41	23	52	37
16	18	19	67	47
20	14	12	76	53
24	16	29	50	41
28	30	28	38	34
32	22	33	49	24
36	20	18	56	34
40	11	17	52	26
44	0	15	47	34
48	10	9	31	46
52	20	18	43	26
56	5	29	48	42
60	14	13	42	21

Station			Station 10	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	98580	168540	302100	228960
8	114480	136740	283020	111300
12	130380	73140	165360	117660
16	57240	60420	213060	149460
20	44520	38160	241680	168540
24	50880	92220	159000	130380
28	95400	89040	120840	108120
32	69960	104940	155820	76320
36	63600	57240	178080	108120
40	34980	54060	165360	82680
44	0	47700	149460	108120
48	31800	28620	98580	146280
52	63600	57240	136740	82680
56	15900	92220	152640	133560
60	44520	41340	133560	66780

Table 7. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 30, Boddam.

Station			Station 30	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	35	27	83	74
8	38	17	76	66
12	17	16	57	32
16	36	39	41	23
20	31	35	30	47
24	17	18	52	24
28	24	7	55	36
32	0	12	54	48
36	15	12	40	42
40	16	13	78	40
44	11	13	59	47
48	8	12	54	63
52	17	24	84	37
56	21	15	47	32
60	12	14	57	24

Station			Station 30	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	111300	85860	263940	235320
8	120840	54060	241680	209880
12	54060	50880	181260	101760
16	114480	124020	130380	73140
20	98580	111300	95400	149460
24	54060	57240	165360	76320
28	76320	22260	174900	114480
32	0	38160	171720	152640
36	47700	38160	127200	133560
40	50880	41340	248040	127200
44	34980	41340	187620	149460
48	25440	38160	171720	200340
52	54060	76320	267120	117660
56	66780	47700	149460	101760
60	38160	44520	181260	76320

Table 8. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 50, Boddam.

Station			Station 50	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	89	78	186	155
8	58	49	109	81
12	42	38	53	44
16	16	10	31	38
20	18	21	34	29
24	25	13	29	34
28	16	17	27	33
32	26	64	38	35
36	18	17	33	31
40	19	34	25	32
44	20	32	93	31
48	16	18	33	43
52	17	16	26	17
56	17	22	41	25
60	12	33	84	146

Station			Station 50	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	283020	248040	591480	492900
8	184440	155820	346620	257580
12	133560	120840	168540	139920
16	50880	31800	98580	120840
20	57240	66780	108120	92220
24	79500	41340	92220	108120
28	50880	54060	85860	104940
32	82680	203520	120840	111300
36	57240	54060	104940	98580
40	60420	108120	79500	101760
44	63600	101760	295740	98580
48	50880	57240	104940	136740
52	54060	50880	82680	54060
56	54060	69960	130380	79500
60	38160	104940	267120	464280

Table 9. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 70, Boddam.

Station			Station 70	
Sub sample Size	1/4	1/4	1/4	1/4
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	0	0	0	0
8	0	0	0	0
12	0	0	0	0
16	0	0	0	0
20	0	0	0	0
24	0	0	0	0
28	0	0	0	0
32	0	0	0	0
36	0	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	0
56	0	0	0	0
60	0	0	0	0

Table 10. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 90, Boddam.

Station			Station 90	
Sub sample Size	1/4	1/4	1/4	1/4
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	0	0	0	0
8	0	0	0	0
12	0	0	0	0
16	0	0	0	0
20	0	0	0	0
24	0	0	0	0
28	0	0	0	0
32	0	0	0	0
36	0	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	0
56	0	0	0	0
60	0	0	0	0

Table 11. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 10, Diego Garcia Index beach.

Station			Station 10	
Sub sample Size	1/4	1/4	1/4	1/4
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	NA	NA	NA	NA
8	NA	NA	NA	NA
12	NA	NA	NA	NA
16	0	0	2	1
20	1	0	0	1
24	NA	NA	NA	NA
28	0	0	0	0
32	0	0	3	0
36	1	0	1	1
40	1	0	0	2
44	NA	NA	NA	NA
48	1	0	5	1
52	4	0	0	0
56	0	0	0	0
60	4	3	3	18

Station			Station 10	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	NA	NA	NA	NA
8	NA	NA	NA	NA
12	NA	NA	NA	NA
16	0	0	25440	13000
20	13000	0	0	13000
24	NA	NA	NA	NA
28	0	0	0	0
32	0	0	38000	0
36	13000	0	13000	13000
40	13000	0	0	25440
44	NA	NA	NA	NA
48	13000	0	63600	13000
52	50880	0	0	0
56	0	0	0	0
60	50880	38160	38160	228960

Table 12. Microplastic particles (n), size range 0.15 - 4.99 *mm, collected from station 30, Diego Garcia Index beach.*

Station			Station 30	
Sub sample Size	1/4	1/4	1/4	1/4
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	0	0	0	0
8	1	0	0	0
12	2	0	0	0
16	2	0	0	0
20	2	1	0	0
24	0	0	0	0
28	0	0	0	0
32	0	0	0	0
36	2	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	0
56	0	0	0	0
60	2	0	2	0

Station			Station 30	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	0	0	0	0
8	13000	0	0	0
12	25440	0	0	0
16	25440	0	0	0
20	25440	13000	0	0
24	0	0	0	0
28	0	0	0	0
32	0	0	0	0
36	25440	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	0
56	0	0	0	0
60	25440	0	25440	0

Table 13. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 50, Diego Garcia Index beach.

Station			Station 50	
Sub sample Size	1/4	1/4	1/4	1/4
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	7	4	9	0
8	2	8	1	0
12	4	2	5	3
16	6	3	1	1
20	5	2	2	0
24	6	9	3	2
28	5	1	0	0
32	4	4	0	0
36	3	0	0	0
40	2	3	0	0
44	4	3	0	0
48	2	0	0	0
52	0	0	0	1
56	3	0	0	0
60	0	1	0	0

Station			Station 50	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	89000	51000	114000	0
8	25000	102000	13000	0
12	50880	25000	64000	38160
16	76320	38160	13000	13000
20	63600	25440	25000	0
24	76000	114000	38160	25440
28	64000	13000	0	0
32	50880	50880	0	0
36	38160	0	0	0
40	25440	38160	0	0
44	50880	38160	0	0
48	25440	0	0	0
52	0	0	0	13000
56	38160	0	0	0
60	0	13000	0	0

Table 14. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 70, Diego Garcia Index beach.

Station			Station 70	
Sub sample Size	1/4	1/4	1/4	1/4
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	1	0	0	0
8	1	3	5	0
12	1	6	0	0
16	1	1	0	0
20	7	0	13	0
24	1	0	0	0
28	0	0	0	0
32	0	0	0	0
36	0	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	0
56	0	0	0	0
60	0	0	0	0

Station			Station 70	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	13000	0	0	0
8	13000	38000	63600	0
12	13000	76000	0	0
16	13000	13000	0	0
20	89000	0	165000	0
24	13000	0	0	0
28	0	0	0	0
32	0	0	0	0
36	0	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	0
56	0	0	0	0
60	0	0	0	0

Table 15. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 90, Diego Garcia Index beach.

Station			Station 90	
Sub sample Size	1/4	1/4	1/4	1/4
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	4	1	0	0
8	1	3	0	0
12	1	0	0	4
16	4	7	0	0
20	3	1	0	0
24	1	0	0	0
28	1	0	0	0
32	1	3	0	0
36	3	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	3
56	0	0	0	0
60	0	0	0	0

Station			Station 90	
Sub sample Size	Full	Full	Full	Full
Microplastic Size (mm)	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	51000	13000	0	0
8	13000	38000	0	0
12	13000	0	0	50880
16	51000	89000	0	0
20	38000	13000	0	0
24	13000	0	0	0
28	13000	0	0	0
32	13000	38000	0	0
36	38000	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	38000
56	0	0	0	0
60	0	0	0	0

Table 16. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 90, Nelson's beach.

Station			Station 90	
Sub sample S	1/4	1/4	1/4	1/4
Microplastic	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	3	0	0	0
8	0	0	0	0
12	0	0	0	0
16	0	0	0	0
20	1	0	0	0
24	0	0	0	0
28	0	0	0	0
32	0	0	0	0
36	0	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	0
56	0	0	0	0
60	0	0	0	0

Station			Station 90	
Sub sample S	Full	Full	Full	Full
Microplastic	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	38000	0	0	0
8	0	0	0	0
12	0	0	0	0
16	0	0	0	0
20	13000	0	0	0
24	0	0	0	0
28	0	0	0	0
32	0	0	0	0
36	0	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	0
56	0	0	0	0
60	0	0	0	0

Table 17. Microplastic particles (n), size range 0.15 - 4.99 mm, collected from station 70, Parasol beach.

Station			Station 70	
Sub sample :	1/4	1/4	1/4	1/4
Microplastic	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	0	0	0	0
8	0	0	0	0
12	0	0	0	0
16	0	0	0	0
20	0	0	0	0
24	1	0	0	0
28	0	0	0	0
32	0	0	0	0
36	0	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	0
56	0	0	0	0
60	0	0	0	0

Station			Station 70	
Sub sample :	Full	Full	Full	Full
Microplastic	1-4.99	0.5-0.99	0.25-0.49	0.15-0.24
Depth				
4	0	0	0	0
8	0	0	0	0
12	0	0	0	0
16	0	0	0	0
20	0	0	0	0
24	13000	0	0	0
28	0	0	0	0
32	0	0	0	0
36	0	0	0	0
40	0	0	0	0
44	0	0	0	0
48	0	0	0	0
52	0	0	0	0
56	0	0	0	0
60	0	0	0	0

Appendix 6: Microplastic colour data sheets

Table 1. Microplastic colours collected from station 70, Egmont beach.

Station			Station 70		
Sub sample Size	1/4	1/4	1/4	1/4	1/4
Microplastic colour	Blue	Translucent	Yellow	White	Orange
Depth					
4	7	2	49	1	140
8	11	0	2	0	20
12	1	0	0	0	3
16	0	0	1	0	19
20	0	0	0	0	1
24	0	0	0	0	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	0	0	0

Station			Station 70		
Sub sample Size	Full	Full	Full	Full	Full
Microplastic colour	Blue	Translucent	Yellow	White	Orange
Depth					
4	89040	25440	623280	13000	1780800
8	139920	0	25440	0	254400
12	13000	0	0	0	38000
16	0	0	13000	0	241680
20	0	0	0	0	13000
24	0	0	0	0	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	0	0	0

Table 2. Microplastic colours collected from station 10, Diego Garcia Index beach.

Station				Station 10						
Sub sample Size	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Microplastic colour	Black	Blue	Translucent	Yellow	White	Red	Pink	Grey	Green	Brown
Depth										
4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
16	0	1	0	0	1	1	0	0	0	0
20	0	2	0	0	0	1	0	0	0	0
24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
28	0	2	0	0	1	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0
36	0	2	0	0	0	0	0	0	1	0
40	0	3	0	0	0	0	0	0	0	0
44	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
48	0	8	0	0	0	0	0	0	0	0
52	0	8	0	0	0	0	0	0	0	0
56	0	0	0	0	4	0	0	0	0	0
60	0	17	0	0	6	0	0	1	1	0

Station				Station 10						
Sub sample Size	Full		Full	Full	Full	Full	Full	Full	Full	Full
Microplastic colour	Black	Blue	Translucent	Yellow	White	Red	Pink	Grey	Green	Brown
Depth										
4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
16	0	13000	0	0	13000	13000	0	0	0	0
20	0	25440	0	0	0	13000	0	0	0	0
24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
28	0	25440	0	0	13000	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0
36	0	25440	0	0	0	0	0	0	13000	0
40	0	38160	0	0	0	0	0	0	0	0
44	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
48	0	101760	0	0	0	0	0	0	0	0
52	0	101760	0	0	0	0	0	0	0	0
56	0	0	0	0	50880	0	0	0	0	0
60	0	216240	0	0	76320	0	0	13000	13000	0

Table 3. Microplastic colours collected from station 30, Diego Garcia Index beach.

Station				Station 30						
Sub sample Size	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Microplastic colour	Black	Blue	Translucent	Yellow	White	Red	Pink	Grey	Green	Brown
Depth										
4	0	0	0	0	0	0	0	0	0	0
8	0	0	1	0	1	1	0	0	0	0
12	0	1	0	0	1	0	0	0	0	0
16	0	0	0	0	1	0	0	0	0	0
20	0	0	0	0	1	0	0	0	0	0
24	0	0	0	0	1	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	1	0	0	1	0	0
36	0	0	0	0	1	0	0	0	0	0
40	0	1	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	4

Station				Station 30						
Sub sample Size	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Microplastic colour	Black	Blue	Translucent	Yellow	White	Red	Pink	Grey	Green	Brown
Depth										
4	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
12	0	13000	13000	0	13000	13000	0	0	0	0
16	0	0	0	0	13000	0	0	0	0	0
20	0	0	0	0	13000	0	0	0	0	0
24	0	0	0	0	13000	0	0	0	0	0
28	0	0	0	0	13000	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	13000	0	0	13000	0	0
40	0	13000	0	0	13000	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	50880

Table 4. Microplastic colours collected from station 50, Diego Garcia Index beach.

Station				Station 50						
Sub sample Size	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Microplastic colour	Black	Blue	Translucent	Yellow	White	Red	Pink	Grey	Green	Brown
Depth										
4	0	0	0	0	3	0	0	0	4	0
8	0	0	4	0	0	0	0	0	2	0
12	0	0	0	1	1	0	0	0	1	0
16	0	3	0	0	5	0	0	1	13	0
20	0	0	2	0	3	0	0	0	1	0
24	0	0	0	0	9	0	0	0	0	0
28	0	0	0	0	5	0	0	0	4	0
32	0	1	1	0	1	0	0	0	0	0
36	0	0	0	0	6	0	0	0	10	0
40	0	1	0	0	1	0	0	0	0	0
44	0	0	0	0	1	0	0	1	0	0
48	0	1	0	0	1	0	0	0	1	0
52	0	0	0	0	1	0	0	0	0	0
56	0	0	1	0	0	0	0	0	2	0
60	0	0	0	0	1	0	0	0	0	0

Station				Station 50						
Sub sample Size	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Microplastic colour	Black	Blue	Translucent	Yellow	White	Red	Pink	Grey	Green	Brown
Depth										
4	0	0	0	0	38160	0	0	0	50880	0
8	0	0	50880	0	0	0	0	0	25440	0
12	0	0	0	13000	13000	0	0	0	13000	0
16	0	38000	0	0	63600	0	0	13000	165360	0
20	0	0	25440	0	38000	0	0	0	13000	0
24	0	0	0	0	114480	0	0	0	0	0
28	0	0	0	0	63600	0	0	0	50880	0
32	0	13000	13000	0	13000	0	0	0	0	0
36	0	0	0	0	76320	0	0	0	127200	0
40	0	13000	0	0	13000	0	0	0	0	0
44	0	0	0	0	13000	0	0	13000	0	0
48	0	13000	0	0	13000	0	0	0	13000	0
52	0	0	0	0	13000	0	0	0	0	0
56	0	0	13000	0	0	0	0	0	25440	0
60	0	0	0	0	13000	0	0	0	0	0

.

Table 5. Microplastic colours collected from station 70, Diego Garcia Index beach.

Station				Station 70							
Sub sample Size	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	
Microplastic colour	Black	Blue	Translucent	Yellow	White	Red	Pink	Grey	Green	Brown	
Depth											
4	0	0	0	0	0	0	1	0	0	0	
8	0	0	0	0	0	0	1	0	0	0	
12	0	2	0	0	0	0	0	0	0	0	
16	0	0	0	0	0	0	0	8	0	0	
20	0	0	0	0	0	0	0	0	0	0	
24	0	0	0	0	6	0	0	21	0	0	
28	0	0	0	0	0	0	0	0	0	0	
32	0	0	0	0	0	0	0	0	1	0	
36	0	0	0	0	0	0	0	0	0	0	
40	0	0	0	0	0	0	0	0	0	0	
44	0	0	0	0	0	0	0	0	1	0	
48	0	0	0	0	0	0	0	0	0	0	
52	0	0	0	0	0	0	0	0	0	0	
56	0	0	0	0	1	0	0	0	0	0	
60	0	0	0	0	0	0	0	0	0	0	

Station				Station 70						
Sub sample Size	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Microplastic colour	Black	Blue	Translucent	Yellow	White	Red	Pink	Grey	Green	Brown
Depth										
4	0	0	0	0	0	0	13000	0	0	0
8	0	0	0	0	0	0	13000	0	0	0
12	0	25440	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	76320	0	0
20	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	76320	0	0	76320	0	0
28	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	13000	0
36	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	13000	0
48	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0
56	0	0	0	0	13000	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0

Table 6. Microplastic colours collected from station 90, Diego Garcia Index beach.

Station				Station 90							
Sub sample Size	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	
Microplastic colour	Black	Blue	Translucent	Yellow	White	Red	Pink	Grey	Green	Brown	
Depth											
4	0	0	0	0	7	0	0	0	0	0	
8	0	0	1	0	0	0	0	0	0	0	
12	0	0	0	0	1	0	0	0	0	0	
16	1	0	1	0	0	0	0	0	6	0	
20	0	0	1	0	0	0	0	0	2	0	
24	0	0	0	0	10	3	0	0	4	0	
28	0	0	0	0	1	0	0	0	0	0	
32	0	0	0	0	2	0	0	0	0	0	
36	0	0	0	0	1	0	0	0	0	0	
40	0	0	0	0	0	0	0	0	0	0	
44	0	0	0	0	0	0	0	0	0	0	
48	0	0	0	0	0	0	0	0	0	0	
52	0	0	0	0	3	0	0	0	0	0	
56	0	0	0	0	0	0	0	0	0	0	
60	0	0	0	0	0	0	0	0	0	0	

Station				Station 90						
Sub sample Size	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Microplastic colour	Black	Blue	Translucent	Yellow	White	Red	Pink	Grey	Green	Brown
Depth										
4	0	0	0	0	89040	0	0	0	0	0
8	0	0	13000	0	0	0	0	0	0	0
12	0	0	0	0	13000	0	0	0	0	0
16	13000	0	13000	0	0	0	0	0	76320	0
20	0	0	13000	0	0	0	0	0	25440	0
24	0	0	0	0	127200	38160	0	0	50880	0
28	0	0	0	0	13000	0	0	0	0	0
32	0	0	0	0	25440	0	0	0	0	0
36	0	0	0	0	13000	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	3	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0

Table 7. Microplastic colours collected from station 90, Nelson's beach.

Station			Station 90				Station			Station 90		
Sub sample Size	1/4	1/4	1/4	1/4	1/4		Sub sample Size	Full	Full	Full	Full	Full
Microplastic colo	Blue	Translucent	Yellow	White	Orange		Microplastic colour	Blue	Translucent	Yellow	White	Orange
Depth							Depth					
4	0	3	0	0	0		4	0	38000	0	0	0
8	0	0	0	0	0		8	0	0	0	0	0
12	0	0	0	0	0		12	0	0	0	0	0
16	0	0	0	0	0		16	0	0	0	0	0
20	1	0	0	0	0		20	13000	0	0	0	0
24	0	0	0	0	0		24	0	0	0	0	0
28	0	0	0	0	0		28	0	0	0	0	0
32	0	0	0	0	0		32	0	0	0	0	0
36	0	0	0	0	0		36	0	0	0	0	0
40	0	0	0	0	0		40	0	0	0	0	0
44	0	0	0	0	0		44	0	0	0	0	0
48	0	0	0	0	0		48	0	0	0	0	0
52	0	0	0	0	0		52	0	0	0	0	0
56	0	0	0	0	0		56	0	0	0	0	0
60	0	0	0	0	0		60	0	0	0	0	0

Table 8. Microplastic colours collected from station 70, Parasol beach.

Station			Station 70				Station			Station 70		
Sub sample Size	1/4	1/4	1/4	1/4	1/4		Sub sample Size	Full	Full	Full	Full	Full
Microplastic colo	Blue	Translucent	Yellow	White	Orange		Microplastic colour	Blue	Translucent	Yellow	White	Orange
Depth							Depth					
4	0	0	0	0	0		4	0	0	0	0	0
8	0	0	0	0	0		8	0	0	0	0	0
12	0	0	0	0	0		12	0	0	0	0	0
16	0	0	0	0	0		16	0	0	0	0	0
20	0	0	0	0	0		20	0	0	0	0	0
24	1	0	0	0	0		24	13000	0	0	0	0
28	0	0	0	0	0		28	0	0	0	0	0
32	0	0	0	0	0		32	0	0	0	0	0
36	0	0	0	0	0		36	0	0	0	0	0
40	0	0	0	0	0		40	0	0	0	0	0
44	0	0	0	0	0		44	0	0	0	0	0
48	0	0	0	0	0		48	0	0	0	0	0
52	0	0	0	0	0		52	0	0	0	0	0
56	0	0	0	0	0		56	0	0	0	0	0
60	0	0	0	0	0		60	0	0	0	0	0

Appendix 7: Microplastic shape data sheets

Table 1. Microplastic shapes collected from station 70, Egmont beach.

Station			Station 70		
Sub sample Size	1/4	1/4	1/4	1/4	1/4
Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet
Depth					
4	202	0	0	0	0
8	33	0	0	0	0
12	2	0	0	0	0
16	18	0	0	0	0
20	2	0	0	0	0
24	0	0	0	0	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	0	0	0

Station			Station 70		
Sub sample Size	Full	Full	Full	Full	Full
Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet
Depth					
4	2569440	0	0	0	0
8	419760	0	0	0	0
12	25440	0	0	0	0
16	228960	0	0	0	0
20	25440	0	0	0	0
24	0	0	0	0	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	0	0	0

Table 2. Microplastic shapes collected from station 10, Diego Garcia Index beach.

Station			Station 10		
Sub sample Size	1/4	1/4	1/4	1/4	1/4
Microplastic shape	Fragment	Foam	Fibre	Fiilm	Virgin pellet
Depth					
4	NA	NA	NA	NA	NA
8	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA
16	3	0	0	0	0
20	3	0	0	0	0
24	NA	NA	NA	NA	NA
28	2	1	0	0	
32	0	0	0	0	0
36	3	0	0	0	0
40	3	0	0	0	0
44	NA	NA	NA	NA	NA
48	8	0	0	0	0
52	8	1	0	0	0
56	3	0	1	0	0
60	28	0	0	0	0

Station			Station 10		
Sub sample Size	Full	Full	Full	Full	Full
Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet
Depth					
4	NA	NA	NA	NA	NA
8	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA
16	38160	0	0	0	0
20	38160	0	0	0	0
24	NA	NA	NA	NA	NA
28	25440	13000	0	0	
32	0	0	0	0	0
36	38160	0	0	0	0
40	38160	0	0	0	0
44	NA	NA	NA	NA	NA
48	101760	0	0	0	0
52	101760	13000	0	0	0
56	38160	0	13000	0	0
60	356160	0	0	0	0

Table 3. Microplastic shapes collected from station 30, Diego Garcia Index beach.

Station			Station 30		
Sub sample Size	1/4	1/4	1/4	1/4	1/4
Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet
Depth					
4	0	0	0	0	0
8	2	0	0	1	0
12	2	0	0	1	0
16	0	0	0	0	0
20	0	0	0	0	0
24	1	0	0	0	0
28	0	0	0	0	0
32	2	0	0	0	0
36	1	0	0	0	0
40	0	1	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	4	0	0	0	0

Station			Station 30		
Sub sample Size	Full	Full	Full	Full	Full
Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet
Depth					
4	0	0	0	0	0
8	25440	0	0	13000	0
12	25440	0	0	13000	0
16	0	0	0	0	0
20	0	0	0	0	0
24	13000	0	0	0	0
28	0	0	0	0	0
32	25440	0	0	0	0
36	13000	0	0	0	0
40	0	13000	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	4	0	0	0	0

Table 4. *Microplastic shapes collected from station 50, Diego Garcia Index beach.*

Station			Station 50				Station			Station 50		
Sub sample Size	1/4	1/4	1/4	1/4	1/4		Sub sample Size	Full	Full	Full	Full	Full
Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet		Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet
Depth							Depth					
4	4	3	0	0	0		4	50880	38160	0	0	0
8	3	0	3	0	0		8	38160	0	38160	0	0
12	3	0	0	0	0		12	38160	0	0	0	0
16	16	5	1	0	0		16	203520	63600	13000	0	0
20	2	3	1	0	0		20	25440	38160	13000	0	0
24	1	8	0	0	0		24	13000	101760	0	0	0
28	8	0	0	0	0		28	101760	0	0	0	0
32	2	0	0	0	1		32	25440	0	0	0	13000
36	16	0	0	0	0		36	203520	0	0	0	0
40	2	0	0	0	0		40	25440	0	0	0	0
44	1	1	0	0	0		44	13000	13000	0	0	0
48	3	0	0	0	0		48	38160	0	0	0	0
52	1	0	0	0	0		52	13000	0	0	0	0
56	2	0	0	1	0		56	25440	0	0	13000	0
60	1	0	0	0	0		60	13000	0	0	0	0

Table 5. *Microplastic shapes collected from station 70, Diego Garcia Index beach.*

Station			Station 70				Station			Station 70		
Sub sample Size	1/4	1/4	1/4	1/4	1/4		Sub sample Size	Full	Full	Full	Full	Full
Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet		Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet
Depth							Depth					
4	0	1	0	0	0		4	0	13000	0	0	0
8	1	0	0	0	0		8	13000	0	0	0	0
12	2	0	0	0	0		12	25440	0	0	0	0
16	8	0	0	0	0		16	101760	0	0	0	0
20	0	0	0	0	0		20	0	0	0	0	0
24	21	0	0	0	0		24	267120	0	0	0	0
28	0	0	0	0	0		28	0	0	0	0	0
32	0	1	0	0	0		32	0	13000	0	0	0
36	0	0	0	0	0		36	0	0	0	0	0
40	0	0	0	0	0		40	0	0	0	0	0
44	1	0	0	0	0		44	13000	0	0	0	0
48	0	0	0	0	0		48	0	0	0	0	0
52	0	0	0	0	0		52	0	0	0	0	0
56	0	0	1	0	0		56	0	0	13000	0	0
60	0	0	0	0	0		60	0	0	0	0	0

Table 6. *Microplastic shapes collected from station 90, Diego Garcia Index beach.*

Station			Station 90				Station			Station 90		
Sub sample Size	1/4	1/4	1/4	1/4	1/4		Sub sample Size	Full	Full	Full	Full	Full
Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet		Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet
Depth							Depth					
4	0	7	0	0	0		4	0	89040	0	0	0
8	1	0	0	0	0		8	13000	0	0	0	0
12	1	0	0	0	0		12	13000	0	0	0	0
16	0	6	0	1	0		16	0	6	0	13000	0
20	0	2	1	0	0		20	0	25440	13000	0	0
24	0	7	0	0	0		24	0	89040	0	0	0
28	1	0	0	0	0		28	13000	0	0	0	0
32	0	2	0	0	0		32	0	25440	0	0	0
36	0	1	0	0	0		36	0	13000	0	0	0
40	0	0	0	0	0		40	0	0	0	0	0
44	0	0	0	0	0		44	0	0	0	0	0
48	0	0	0	0	0		48	0	0	0	0	0
52	0	0	0	0	3		52	0	0	0	0	38160
56	0	0	0	0	0		56	0	0	0	0	0
60	0	0	0	0	0		60	0	0	0	0	0

Table 7. Microplastic shapes collected from station 90, Nelson's beach.

Station			Station 90		
Sub sample Size	1/4	1/4	1/4	1/4	1/4
Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet
Depth					
4	3	0	0	0	0
8	0	0	0	0	0
12	0	0	0	0	0
16	0	0	0	0	0
20	1	0	0	0	0
24	0	0	0	0	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	0	0	0

Station			Station 90		
Sub sample Size	Full	Full	Full	Full	Full
Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet
Depth					
4	38160	0	0	0	0
8	0	0	0	0	0
12	0	0	0	0	0
16	0	0	0	0	0
20	13000	0	0	0	0
24	0	0	0	0	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	0	0	0

Table 8. Microplastic shapes collected from station 70, Parasol beach.

Station			Station 70		
Sub sample Size	1/4	1/4	1/4	1/4	1/4
Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet
Depth					
4	0	0	0	0	0
8	0	0	0	0	0
12	0	0	0	0	0
16	0	0	0	0	0
20	0	0	0	0	0
24	1	0	0	0	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	0	0	0

Station			Station 70		
Sub sample Size	Full	Full	Full	Full	Full
Microplastic shape	Fragment	Foam	Fibre	Film	Virgin pellet
Depth					
4	0	0	0	0	0
8	0	0	0	0	0
12	0	0	0	0	0
16	0	0	0	0	0
20	0	0	0	0	0
24	13000	0	0	0	0
28	0	0	0	0	0
32	0	0	0	0	0
36	0	0	0	0	0
40	0	0	0	0	0
44	0	0	0	0	0
48	0	0	0	0	0
52	0	0	0	0	0
56	0	0	0	0	0
60	0	0	0	0	0

Appendix 8: Microplastic polymer data sheets

Table 1. *Microplastic polymers collected from station 70, Egmont beach.*

Station			Station 70					Station			Station 70			
Sub sample Size	1/4	1/4	1/4	1/4	1/4	1/4		Sub sample Size	Full	Full	Full	Full	Full	Full
Microplastic polymer	PP	LDPE	PS	PET	HDPE	PVC		Microplastic polymer	PP	LDPE	PS	PET	HDPE	PVC
Depth								Depth						
4	3	0	0	3	0	0		4	38000	0	0	38160	0	0
8	0	8	0	0	3	0		8	0	101760	0	0	38000	0
12	0	0	0	0	0	3		12	0	0	0	0	0	38000
16	0	3	0	0	0	0		16	0	38000	0	0	0	0
20	0	0	0	0	0	0		20	0	0	0	0	0	0
24	0	0	0	0	0	0		24	0	0	0	0	0	0
28	0	0	0	0	0	0		28	0	0	0	0	0	0
32	0	0	0	0	0	0		32	0	0	0	0	0	0
36	0	0	0	0	0	0		36	0	0	0	0	0	0
40	0	0	0	0	0	0		40	0	0	0	0	0	0
44	0	0	0	0	0	0		44	0	0	0	0	0	0
48	0	0	0	0	0	0		48	0	0	0	0	0	0
52	0	0	0	0	0	0		52	0	0	0	0	0	0
56	0	0	0	0	0	0		56	0	0	0	0	0	0
60	0	0	0	0	0	0		60	0	0	0	0	0	0

Table 2. *Microplastic polymers collected from station 10, Diego Garcia Index beach.*

Station			Station 10					Station			Station 10			
Sub sample Size	1/4	1/4	1/4	1/4	1/4	1/4		Sub sample Size	Full	Full	Full	Full	Full	Full
Microplastic polymer	PP	LDPE	PS	PET	HDPE	PVC		Microplastic polymer	PP	LDPE	PS	PET	HDPE	PVC
Depth								Depth						
4	NA	NA	NA	NA	NA	NA		4	NA	NA	NA	NA	NA	NA
8	NA	NA	NA	NA	NA	NA		8	NA	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA	NA		12	NA	NA	NA	NA	NA	NA
16	1	2	0	0	0	0		16	12720	25440	0	0	0	0
20	1	1	1	0	0	0		20	12720	12720	12720	0	0	0
24	NA	NA	NA	NA	NA	NA		24	NA	NA	NA	NA	NA	NA
28	0	0	1	0	1	1		28	0	0	12720	0	12720	12720
32	0	0	0	0	0			32	0	0	0	0	0	0
36	1	2	0	0	0	0		36	12720	25440	0	0	0	0
40	0	0	0	0	2	1		40	0	0	0	0	25440	12720
44	NA	NA	NA	NA	NA	NA		44	NA	NA	NA	NA	NA	NA
48	2	3	0	0	2	1		48	25440	38160	0	0	25440	12720
52	3	3	1	0	1	1		52	38160	38160	12720	0	12720	12720
56	1	2	0	0	1	0		56	12720	25440	0	0	12720	0
60	8	10	0	0	5	5		60	101760	127200	0	0	63600	63600

Table 3. *Microplastic polymers collected from station 30, Diego Garcia Index beach.*

Station			Station 30					Station			Station 30			
Sub sample Size	1/4	1/4	1/4	1/4	1/4	1/4		Sub sample Size	Full	Full	Full	Full	Full	Full
Microplastic polymer	PP	LDPE	PS	PET	HDPE	PVC		Microplastic polymer	PP	LDPE	PS	PET	HDPE	PVC
Depth								Depth						
4	0	0	0	0	0	0		4	0	0	0	0	0	0
8	1	2	0	0	0	0		8	13000	25440	0	0	0	0
12	0	2	0	0	1	0		12	0	25440	0	0	13000	0
16	0	0	0	0	0	0		16	0	0	0	0	0	0
20	0	0	0	0	0	0		20	0	0	0	0	0	0
24	0	0	0	0	0	1		24	0	0	0	0	0	13000
28	0	0	0	0	0	0		28	0	0	0	0	0	0
32	1	1	0	0	0	0		32	13000	13000	0	0	0	0
36	0	1	0	0	0	0		36	0	13000	0	0	0	0
40	1	0	0	0	0	0		40	13000	0	0	0	0	0
44	0	0	0	0	0	0		44	0	0	0	0	0	0
48	0	0	0	0	0	0		48	0	0	0	0	0	0
52	0	0	0	0	0	0		52	0	0	0	0	0	0
56	0	0	0	0	0	0		56	0	0	0	0	0	0
60	1	2	1	0	1	0		60	13000	25440	13000	0	13000	0

Table 4. Microplastic polymers collected from station 50, Diego Garcia Index beach.

Station			Station 50			
Sub sample Size	1/4	1/4	1/4	1/4	1/4	1/4
Microplastic polymer	PP	LDPE	PS	PET	HDPE	PVC
Depth						
4	2	2	3	0	0	0
8	1	3	0	0	1	1
12	1	1	0	0	1	1
16	5	8	5	0	2	2
20	1	1	3	0	1	0
24	1	0	8	0	0	0
28	3	3	0	0	1	1
32	2	1	0	0	0	0
36	5	7	0	0	2	2
40	2	0	0	0	0	0
44	0	1	1	0	0	0
48	1	1	0	0	0	1
52	0	1	0	0	0	0
56	1	1	0	0	1	0
60	0	1	0	0	0	0

Station			Station 50			
Sub sample Size	Full	Full	Full	Full	Full	Full
Microplastic polymer	PP	LDPE	PS	PET	HDPE	PVC
Depth						
4	25440	25440	38160	0	0	0
8	13000	38160	0	0	13000	13000
12	13000	13000	0	0	13000	13000
16	63600	101760	63600	0	25440	25440
20	13000	13000	38160	0	13000	0
24	13000	0	101760	0	0	0
28	38160	38160	0	0	13000	13000
32	25440	13000	0	0	0	0
36	63600	89040	0	0	25440	25440
40	25440	0	0	0	0	0
44	0	13000	13000	0	0	0
48	13000	13000	0	0	0	13000
52	0	13000	0	0	0	0
56	13000	13000	0	0	13000	0
60	0	13000	0	0	0	0

Table 5. Microplastic polymers collected from station 70, Diego Garcia Index beach.

Station			Station 70			
Sub sample Size	1/4	1/4	1/4	1/4	1/4	1/4
Microplastic polymer	PP	LDPE	PS	PET	HDPE	PVC
Depth						
4	0	0	1	0	0	0
8	0	1	0	0	0	0
12	1	1	0	0	0	0
16	3	3	0	0	2	2
20	0	0	0	0	0	0
24	8	9	0	0	2	2
28	0	0	0	0	0	0
32	0	0	1	0	0	0
36	0	0	0	0	0	0
40	0	0	0	0	0	0
44	1	0	0	0	0	0
48	0	0	0	0	0	0
52	0	0	0	0	0	0
56	0	1	0	0	0	0
60	0	0	0	0	0	0

Station			Station 70			
Sub sample Size	Full	Full	Full	Full	Full	Full
Microplastic polymer	PP	LDPE	PS	PET	HDPE	PVC
Depth						
4	0	0	13000	0	0	0
8	0	13000	0	0	0	0
12	13000	13000	0	0	0	0
16	38160	38160	0	0	25440	25440
20	0	0	0	0	0	0
24	101760	114480	0	0	25440	25440
28	0	0	0	0	0	0
32	0	0	13000	0	0	0
36	0	0	0	0	0	0
40	0	0	0	0	0	0
44	13000	0	0	0	0	0
48	0	0	0	0	0	0
52	0	0	0	0	0	0
56	0	13000	0	0	0	0
60	0	0	0	0	0	0

Table 6. Microplastic polymers collected from station 90, Diego Garcia Index beach.

Station			Station 90			
Sub sample Size	1/4	1/4	1/4	1/4	1/4	1/4
Microplastic polymer	PP	LDPE	PS	PET	HDPE	PVC
Depth						
4	0	0	7	0	0	0
8	1	0	0	0	0	0
12	0	1	0	0	0	0
16	0	0	6	0	0	0
20	0	1	2	0	0	1
24	0	0	7	0	0	0
28	1	0	0	0	0	0
32	0	0	2	0	0	0
36	0	0	1	0	0	0
40	0	0	0	0	0	0
44	0	0	0	0	0	0
48	0	0	0	0	0	0
52	0	3	0	0	0	0
56	0	0	0	0	0	0
60	0	0	0	0	0	0

Station			Station 90			
Sub sample Size	Full	Full	Full	Full	Full	Full
Microplastic polymer	PP	LDPE	PS	PET	HDPE	PVC
Depth						
4	0	0	89040	0	0	0
8	13000	0	0	0	0	0
12	0	13000	0	0	0	0
16	0	0	76320	0	0	0
20	0	13000	25440	0	0	13000
24	0	0	89040	0	0	0
28	13000	0	0	0	0	0
32	0	0	25440	0	0	0
36	0	0	13000	0	0	0
40	0	0	0	0	0	0
44	0	0	0	0	0	0
48	0	0	0	0	0	0
52	0	38160	0	0	0	0
56	0	0	0	0	0	0
60	0	0	0	0	0	0

Table 7. Microplastic polymers collected from station 90, Nelson's beach

Station			Station 90			
Sub sample Size	1/4	1/4	1/4	1/4	1/4	1/4
Microplastic polymer	PP	LDPE	PS	PET	HDPVC	LDPVC
Depth						
4	0	3	0	0	0	0
8	0	0	0	0	0	0
12	0	0	0	0	0	0
16	0	0	0	0	0	0
20	0	1	0	0	0	0
24	0	0	0	0	0	0
28	0	0	0	0	0	0
32	0	0	0	0	0	0
36	0	0	0	0	0	0
40	0	0	0	0	0	0
44	0	0	0	0	0	0
48	0	0	0	0	0	0
52	0	0	0	0	0	0
56	0	0	0	0	0	0
60	0	0	0	0	0	0

Station			Station 90			
Sub sample Size	Full	Full	Full	Full	Full	Full
Microplastic polymer	PP	LDPE	PS	PET	HDPVC	LDPVC
Depth						
4	0	38160	0	0	0	0
8	0	0	0	0	0	0
12	0	0	0	0	0	0
16	0	0	0	0	0	0
20	0	13000	0	0	0	0
24	0	0	0	0	0	0
28	0	0	0	0	0	0
32	0	0	0	0	0	0
36	0	0	0	0	0	0
40	0	0	0	0	0	0
44	0	0	0	0	0	0
48	0	0	0	0	0	0
52	0	0	0	0	0	0
56	0	0	0	0	0	0
60	0	0	0	0	0	0

Table 8. Microplastic polymers collected from station 70, Parasol beach

Station			Station 70			
Sub sample Size	1/4	1/4	1/4	1/4	1/4	1/4
Microplastic polymer	PP	LDPE	PS	PET	HDPVC	LDPVC
Depth						
4	0	0	0	0	0	0
8	0	0	0	0	0	0
12	0	0	0	0	0	0
16	0	0	0	0	0	0
20	0	0	0	0	0	0
24	1	0	0	0	0	0
28	0	0	0	0	0	0
32	0	0	0	0	0	0
36	0	0	0	0	0	0
40	0	0	0	0	0	0
44	0	0	0	0	0	0
48	0	0	0	0	0	0
52	0	0	0	0	0	0
56	0	0	0	0	0	0
60	0	0	0	0	0	0

Station			Station 70			
Sub sample Size	Full	Full	Full	Full	Full	Full
Microplastic polymer	PP	LDPE	PS	PET	HDPVC	LDPVC
Depth						
4	0	0	0	0	0	0
8	0	0	0	0	0	0
12	0	0	0	0	0	0
16	0	0	0	0	0	0
20	0	0	0	0	0	0
24	13000	0	0	0	0	0
28	0	0	0	0	0	0
32	0	0	0	0	0	0
36	0	0	0	0	0	0
40	0	0	0	0	0	0
44	0	0	0	0	0	0
48	0	0	0	0	0	0
52	0	0	0	0	0	0
56	0	0	0	0	0	0
60	0	0	0	0	0	0

Appendix 9: Sediment characterisation data sheets

Table 1. Sediment particle size (mm) across Diego Garcia Index beach, station 10.

							Station 10										
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size																	Total
<0.63 (mm)	Weight (g)	NA	NA	NA	0.05	0.05	NA	0.08	0.04	0.08	0.04	NA	0.03	0.05	0.03	0.04	0.49
	Proportion (%)	NA	NA	NA	0.01%	0.02%	NA	0.02%	0.01%	0.02%	0.01%	NA	0.01%	0.01%	0.01%	0.01%	0.01%
0.63	Weight (g)	NA	NA	NA	0.09	0.06	NA	0.08	0.12	0.1	0.06	NA	0.07	0.1	0.11	0.1	0.89
	Proportion (%)	NA	NA	NA	0.02%	0.02%	NA	0.02%	0.04%	0.03%	0.02%	NA	0.02%	0.03%	0.03%	0.03%	0.03%
0.125	Weight (g)	NA	NA	NA	36.55	37.42	NA	57.88	37.2	48.45	34.34	NA	47.79	53.72	45.23	51.02	449.6
	Proportion (%)	NA	NA	NA	9.13%	13.71%	NA	16.93%	11.57%	14.60%	12.30%	NA	16.39%	15.88%	12.48%	13.20%	13.51%
0.25	Weight (g)	**NA**	**NA**	**NA**	242.23	173.47	NA	221.75	181.43	193.23	163.77	NA	177.06	199.22	218.34	248.66	2019.16
	Proportion (%)	**NA**	**NA**	**NA**	60.52%	63.55%	NA	64.87%	56.41%	58.22%	58.64%	NA	60.71%	58.89%	60.22%	64.34%	60.69%
0.5	Weight (g)	NA	NA	NA	111.66	56.65	NA	56.72	89.07	79.8	68.3	NA	52.98	65.32	75.25	71.5	727.25
	Proportion (%)	**NA**	**NA**	**NA**	27.90%	20.75%	NA	16.59%	27.69%	24.04%	24.46%	NA	18.17%	19.31%	20.76%	18.50%	21.86%
1	Weight (g)	NA	NA	NA	6.13	3.42	NA	3.51	8.77	7.04	8.54	NA	8.52	11.4	15.26	9.52	82.11
	Proportion (%)	**NA**	**NA**	**NA**	1.53%	1.25%	NA	1.03%	2.73%	2.12%	3.06%	NA	2.92%	3.37%	4.21%	2.46%	2.47%
2	Weight (g)	NA	NA	NA	2.19	1.54	NA	1.28	3.06	2.44	2.37	NA	3.63	4.49	5.17	3.66	29.83
	Proportion (%)	**NA**	**NA**	**NA**	0.55%	0.56%	NA	0.37%	0.95%	0.74%	0.85%	NA	1.24%	1.33%	1.43%	0.95%	0.90%
4	Weight (g)	NA	NA	NA	0.74	0.35	NA	0.53	1.93	0.74	1.86	NA	0.79	2.51	1.88	1.09	12.42
	Proportion (%)	**NA**	**NA**	**NA**	0.18%	0.13%	NA	0.16%	0.60%	0.22%	0.67%	NA	0.27%	0.74%	0.52%	0.28%	0.37%
8	Weight (g)	NA	NA	NA	0.64	0	NA	0	0	0	0	NA	0.76	1.51	1.29	0.9	5.10
	Proportion (%)	**NA**	**NA**	**NA**	0.16%	0.00%	NA	0.00%	0.00%	0.00%	0.00%	NA	0.26%	0.45%	0.36%	0.23%	0.15%
16	Weight (g)	NA	NA	NA	0	0	NA	0	0	0	0	NA	0	0	0	0	0.00
	Proportion (%)	**NA**	**NA**	**NA**	0.00%	0.00%	NA	0.00%	0.00%	0.00%	0.00%	NA	0.00%	0.00%	0.00%	0.00%	0.00%
32	Weight (g)	NA	NA	NA	0	0	NA	0	0	0	0	NA	0	0	0	0	0.00
	Proportion (%)	**NA**	**NA**	**NA**	0.00%	0.00%	NA	0.00%	0.00%	0.00%	0.00%	NA	0.00%	0.00%	0.00%	0.00%	0.00%
64	Weight (g)	NA	NA	NA	0	0	NA	0	0	0	0	NA	0	0	0	0	0.00
	Proportion (%)	**NA**	**NA**	**NA**	0.00%	0.00%	**NA**	0.00%	0.00%	0.00%	0.00%	NA	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	NA	NA	NA	400.28	272.96	NA	341.83	321.62	331.88	279.28	NA	291.63	338.32	362.56	386.49	3326.85
	Total Proportion (%)	NA	NA	**NA**	100.00%	100.00%	**NA**	100.00%	100.00%	100.00%	100.00%	**NA**	100.00%	100.00%	100.00%	100.00%	100.00%

Table 2. Sediment particle size (mm) across Diego Garcia Index beach, station 30.

							Station 30										
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size (mm)																	Total
<0.63	Weight (g)	0.12	0.12	0.09	0.2	0.22	0.18	0.17	0.12	0.08	0.09	0.03	0.08	0.16	0.18	0.09	1.93
	Proportion (%)	0.04%	0.04%	0.03%	0.06%	0.07%	0.07%	0.05%	0.04%	0.03%	0.03%	0.01%	0.02%	0.05%	0.06%	0.06%	0.04%
0.63	Weight (g)	0.15	0.19	0.12	0.19	0.24	0.23	0.19	0.15	0.16	0.09	0.06	0.08	0.11	0.12	0.05	2.13
	Proportion (%)	0.05%	0.06%	0.04%	0.06%	0.08%	0.09%	0.06%	0.05%	0.05%	0.03%	0.02%	0.02%	0.04%	0.04%	0.03%	0.05%
0.125	Weight (g)	26.02	25.35	22.99	25.98	24	23.06	32.23	32.01	27.82	29.21	41.12	40.52	37.35	33.34	21.09	442.09
	Proportion (%)	8.84%	8.22%	7.99%	8.39%	7.54%	9.39%	9.96%	9.69%	9.21%	8.74%	13.88%	11.03%	12.24%	11.02%	13.27%	9.86%
0.25	Weight (g)	177.96	183.86	176.45	185.42	182.93	145.13	188.1	190.12	173.96	178.8	174.75	233.92	194.43	185.65	105.36	2676.84
	Proportion (%)	60.45%	59.64%	61.34%	59.91%	57.51%	59.12%	58.13%	57.58%	57.56%	53.47%	59.01%	63.66%	63.72%	61.34%	66.30%	59.70%
0.5	Weight (g)	83.34	91.77	81.75	88.88	97.4	70.74	91.16	96.33	89.99	115.6	73.13	86.77	67.78	76.69	29.32	1240.65
	Proportion (%)	28.31%	29.77%	28.42%	28.72%	30.62%	28.81%	28.17%	29.17%	29.78%	34.57%	24.69%	23.61%	22.21%	25.34%	18.45%	27.67%
1	Weight (g)	4.61	4.49	4.07	6.15	8.17	4.41	6.37	7.12	5.7	7.26	4.9	4.65	3.79	4.28	2.41	78.38
	Proportion (%)	1.57%	1.46%	1.41%	1.99%	2.57%	1.80%	1.97%	2.16%	1.89%	2.17%	1.65%	1.27%	1.24%	1.41%	1.52%	1.75%
2	Weight (g)	1.65	1.86	1.26	1.49	1.57	1.05	1.32	1.46	1.89	1.52	1.29	0.82	0.89	1.29	0.54	19.9
	Proportion (%)	0.56%	0.60%	0.44%	0.48%	0.49%	0.43%	0.41%	0.44%	0.63%	0.45%	0.44%	0.22%	0.29%	0.43%	0.34%	0.44%
4	Weight (g)	0.56	0.66	0.95	1.18	0.8	0.37	1.47	0.85	0.48	1.82	0.88	0.63	0.61	1.1	0.05	12.41
	Proportion (%)	0.19%	0.21%	0.33%	0.38%	0.25%	0.15%	0.45%	0.26%	0.16%	0.54%	0.30%	0.17%	0.20%	0.36%	0.03%	0.28%
8	Weight (g)	0	0	0	0	2.77	0.33	2.56	2.02	2.13	0	0	0	0	0	0	9.81
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.87%	0.13%	0.79%	0.61%	0.70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.22%
16	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
32	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	294.41	308.3	287.68	309.49	318.1	245.5	323.57	330.18	302.21	334.39	296.16	367.47	305.12	302.65	158.91	4484.14
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 3. Sediment particle size (mm) across Diego Garcia Index beach, station 50.

							Station 70									
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										
<0.63 (mm)	Weight (g)	0.07	0.06	0.03	0.04	0.09	0.16	0.66	0.08	0.05	0.23	0.19	0.29	0.14	0.17	0.28	2.54
	Proportion (%)	0.03%	0.02%	0.01%	0.01%	0.03%	0.05%	0.24%	0.03%	0.02%	0.09%	0.06%	0.11%	0.05%	0.05%	0.08%	0.06%
0.63	Weight (g)	0.15	0.16	0.13	0.11	0.08	0.13	0.35	0.16	0.12	0.13	0.14	0.17	0.11	0.11	0.21	2.26
	Proportion (%)	0.05%	0.05%	0.04%	0.04%	0.02%	0.04%	0.13%	0.05%	0.04%	0.05%	0.05%	0.06%	0.04%	0.03%	0.06%	0.05%
0.125	Weight (g)	19.21	23.08	16.49	15.05	17.94	19.43	19.69	18	22.42	22.18	22.37	19.63	19.04	19.82	19.67	294.02
	Proportion (%)	6.98%	7.89%	5.56%	4.83%	5.34%	6.57%	7.27%	5.98%	8.02%	8.52%	7.52%	7.23%	6.62%	6.29%	5.78%	6.64%
0.25	Weight (g)	176.76	184.59	184.83	153.5	208.64	190.3	166.7	173.93	177.46	164.53	192.48	184.45	171.6	197.07	211.97	2738.81
	Proportion (%)	64.21%	63.12%	62.37%	49.24%	62.09%	64.39%	61.53%	57.74%	63.47%	63.23%	64.72%	67.92%	59.69%	62.54%	62.25%	61.81%
0.5	Weight (g)	67.63	73.45	81.13	102.59	93.91	76.61	73.66	98.12	73.13	64.04	71.43	59.53	87.54	86.77	93.16	1202.7
	Proportion (%)	24.57%	25.12%	27.38%	32.91%	27.95%	25.92%	27.19%	32.58%	26.16%	24.61%	24.02%	21.92%	30.45%	27.54%	27.36%	27.14%
1	Weight (g)	4.68	4.68	6.97	22.04	9.4	4.71	5.41	6.93	3.92	4.95	7.21	5.13	5.7	6.03	7.66	105.42
	Proportion (%)	1.70%	1.60%	2.35%	7.07%	2.80%	1.59%	2.00%	2.30%	1.40%	1.90%	2.42%	1.89%	1.98%	1.91%	2.25%	2.38%
2	Weight (g)	2.11	2.39	3.46	11.43	3.21	2.06	1.87	2.8	1.28	1.46	2.42	1.23	1.88	2.15	2.76	42.51
	Proportion (%)	0.77%	0.82%	1.17%	3.67%	0.96%	0.70%	0.69%	0.93%	0.46%	0.56%	0.81%	0.45%	0.65%	0.68%	0.81%	0.96%
4	Weight (g)	2.25	2.81	2.3	5.65	1.96	2.13	1.49	1.19	0.66	1.29	1.18	1.14	1.47	1.01	1.71	28.24
	Proportion (%)	0.82%	0.96%	0.78%	1.81%	0.58%	0.72%	0.55%	0.40%	0.24%	0.50%	0.40%	0.42%	0.51%	0.32%	0.50%	0.64%
8	Weight (g)	2.44	1.2	0.99	1.36	0.79	0	1.08	0	0.55	1.39	0	0	0	1.96	3.07	14.83
	Proportion (%)	0.89%	0.41%	0.33%	0.44%	0.24%	0.00%	0.40%	0.00%	0.20%	0.53%	0.00%	0.00%	0.00%	0.62%	0.90%	0.33%
16	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
32	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	275.3	292.42	296.33	311.77	336.02	295.53	270.91	301.21	279.59	260.2	297.42	271.57	287.48	315.09	340.49	4431.33
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 4. Sediment particle size (mm) across Diego Garcia Index beach, station 70.

							Station 50									
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size																Total
<0.63 (mm)	Weight (g)	0.06	0.09	0.04	0.04	0.05	0.2	0.11	0.02	0.03	0.04	0.02	0.02	0.03	0.03	0.04	0.82
	Proportion (%)	0.02%	0.03%	0.01%	0.01%	0.01%	0.06%	0.03%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.02%
0.63	Weight (g)	0.22	0.37	0.24	0.26	0.22	0.19	0.74	0.41	0.32	0.37	0.72	1.15	0.69	0.64	0.27	6.81
	Proportion (%)	0.07%	0.10%	0.09%	0.08%	0.06%	0.05%	0.21%	0.11%	0.10%	0.12%	0.25%	0.37%	0.26%	0.21%	0.15%	0.15%
0.125	Weight (g)	49.09	52.27	44.66	52.94	48.6	49.96	89.29	65.69	54.39	70.29	104.2	116.05	83.69	88.91	53.11	1023.14
	Proportion (%)	15.39%	14.67%	16.20%	15.47%	13.81%	14.45%	25.91%	17.72%	17.03%	23.44%	36.10%	37.23%	31.86%	29.46%	29.13%	21.90%
0.25	Weight (g)	211.38	222.41	184.16	227.14	240.3	240.88	224.81	246.47	209.09	185.2	162.42	170.3	149.48	173.97	106.32	2954.33
	Proportion (%)	66.27%	62.41%	66.78%	66.37%	68.26%	69.67%	65.23%	66.49%	65.46%	61.77%	56.27%	54.64%	56.91%	57.65%	58.32%	63.22%
0.5	Weight (g)	52.48	74.3	41.55	56.43	56.93	49.76	25.73	53.69	52.01	40.33	18.8	20.1	25.85	33.73	19.66	621.35
	Proportion (%)	16.45%	20.85%	15.07%	16.49%	16.17%	14.39%	7.47%	14.48%	16.28%	13.45%	6.51%	6.45%	9.84%	11.18%	10.78%	13.30%
1	Weight (g)	3.58	3.45	2.96	3.13	3.6	2.93	2.2	2.9	2.89	3.04	1.51	2.51	1.86	2.45	1.54	40.55
	Proportion (%)	1.12%	0.97%	1.07%	0.91%	1.02%	0.85%	0.64%	0.78%	0.90%	1.01%	0.52%	0.81%	0.71%	0.81%	0.84%	0.87%
2	Weight (g)	1.08	1.86	1.37	1.45	0.93	1.03	0.87	0.94	0.44	0.28	0.83	0.78	0.87	1.21	0.33	14.27
	Proportion (%)	0.34%	0.52%	0.50%	0.42%	0.26%	0.30%	0.25%	0.25%	0.14%	0.09%	0.29%	0.25%	0.33%	0.40%	0.18%	0.31%
4	Weight (g)	0.59	1.64	0.78	0.86	1.39	0.81	0.9	0.55	0.27	0.29	0.15	0.28	0.2	0.82	0.14	9.67
	Proportion (%)	0.18%	0.46%	0.28%	0.25%	0.39%	0.23%	0.26%	0.15%	0.08%	0.10%	0.05%	0.09%	0.08%	0.27%	0.08%	0.21%
8	Weight (g)	0.49	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0.91	1.9
	Proportion (%)	0.15%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.16%	0.00%	0.00%	0.50%	0.04%
16	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
32	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	318.97	356.39	275.76	342.25	352.02	345.76	344.65	370.67	319.44	299.84	288.65	311.69	262.67	301.76	182.32	4672.84
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 5. Sediment particle size (mm) across Diego Garcia Index beach, station 90.

							Station 90										
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										Total
<0.63 (mm)	Weight (g)	0.07	0.06	0.03	0.04	0.09	0.16	0.66	0.08	0.05	0.23	0.19	0.29	0.14	0.17	0.28	2.54
	Proportion (%)	0.03%	0.02%	0.02%	0.01%	0.03%	0.05%	0.21%	0.02%	0.02%	0.07%	0.06%	0.09%	0.04%	0.05%	0.09%	0.05%
0.63	Weight (g)	0.03	0.19	0.18	0.18	0.13	0.14	0.18	0.18	0.13	0.19	0.11	0.15	0.25	0.22	0.2	2.46
	Proportion (%)	0.01%	0.08%	0.09%	0.05%	0.04%	0.04%	0.06%	0.05%	0.04%	0.05%	0.03%	0.05%	0.07%	0.07%	0.06%	0.05%
0.125	Weight (g)	0.08	0.32	0.24	0.2	0.14	0.15	0.15	0.14	0.12	0.19	0.12	0.17	0.26	0.21	0.21	2.7
	Proportion (%)	0.03%	0.13%	0.12%	0.05%	0.05%	0.05%	0.05%	0.04%	0.04%	0.05%	0.04%	0.05%	0.07%	0.07%	0.07%	0.06%
0.25	Weight (g)	15	26.32	16.29	14.72	15.44	16.76	17.94	18.92	17.34	17.13	16.99	17.35	19.6	18.82	17.73	266.35
	Proportion (%)	5.41%	10.56%	8.16%	3.97%	5.02%	5.34%	5.66%	5.07%	5.62%	4.88%	5.30%	5.42%	5.44%	6.06%	5.67%	5.68%
0.5	Weight (g)	180.78	164.71	138.79	227.94	194.21	203.53	209.28	245.71	193.28	219.19	210.33	218.98	242.72	212.28	213.22	3074.95
	Proportion (%)	65.21%	66.07%	69.49%	61.50%	63.14%	64.89%	65.99%	65.85%	62.66%	62.41%	65.67%	68.35%	67.40%	68.31%	68.23%	65.53%
1	Weight (g)	73.95	53.06	38.93	117.7	87.44	84.05	80	99.45	90.17	106.75	84.63	72.87	87.46	66.04	68.95	1211.45
	Proportion (%)	26.67%	21.28%	19.49%	31.76%	28.43%	26.80%	25.23%	26.65%	29.23%	30.39%	26.42%	22.74%	24.29%	21.25%	22.06%	25.82%
2	Weight (g)	5	2.96	2.79	6.6	5.44	5.02	4.7	4.78	4.29	4.06	5.62	4.6	4.94	5.01	5.02	70.83
	Proportion (%)	1.80%	1.19%	1.40%	1.78%	1.77%	1.60%	1.48%	1.28%	1.39%	1.16%	1.75%	1.44%	1.37%	1.61%	1.61%	1.51%
4	Weight (g)	1.03	1.37	1.26	1.9	2.03	1.74	1.51	1.86	1.82	1.9	1.49	1.54	2.01	1.82	2.06	25.34
	Proportion (%)	0.37%	0.55%	0.63%	0.51%	0.66%	0.55%	0.48%	0.50%	0.59%	0.54%	0.47%	0.48%	0.56%	0.59%	0.66%	0.54%
8	Weight (g)	1.3	0.32	1.21	1.33	2.68	2.1	1.55	1.32	1.25	1.1	0.82	2.39	2.54	0.94	2.42	23.27
	Proportion (%)	0.47%	0.13%	0.61%	0.36%	0.87%	0.67%	0.49%	0.35%	0.41%	0.31%	0.26%	0.75%	0.71%	0.30%	0.77%	0.50%
16	Weight (g)	0	0	0	0	0	0	1.16	0.68	0	0.47	0	2.04	0.22	2.04	2.43	9.04
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.37%	0.18%	0.00%	0.13%	0.00%	0.64%	0.06%	0.66%	0.78%	0.19%
32	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	3.2	0	3.2
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.03%	0.00%	0.07%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	277.24	249.31	199.72	370.61	307.6	313.65	317.13	373.12	308.45	351.21	320.3	320.38	360.14	310.75	312.52	4692.13
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 6. Sediment particle size (mm) across Nelson beach, station 10.

							Station 10										
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										Total
<0.63 (mm)	Weight (g)	0.05	0.01	0.01	0.01	0.01	0.04	0.05	0.01	0.1	0.11	0.08	0.07	0.08	0.02	0.07	0.72
	Proportion (%)	0.02%	0.00%	0.00%	0.00%	0.00%	0.01%	0.02%	0.00%	0.05%	0.02%	0.02%	0.02%	0.02%	0.01%	0.01%	0.01%
0.63	Weight (g)	0.06	0.05	0.05	0.06	0.07	0.08	0.1	0.14	0.12	0.17	0.14	0.13	0.15	0.1	0.21	1.63
	Proportion (%)	0.02%	0.02%	0.01%	0.02%	0.02%	0.03%	0.03%	0.04%	0.05%	0.04%	0.03%	0.04%	0.04%	0.04%	0.04%	0.03%
0.125	Weight (g)	9.76	7.78	7.47	11.12	8.96	9.83	17.24	16.74	8.99	8.17	7.87	5.75	7.69	3.52	6.24	137.13
	Proportion (%)	3.56%	3.78%	2.01%	4.40%	3.01%	3.33%	5.21%	4.41%	4.06%	1.72%	1.60%	1.61%	1.87%	1.47%	1.23%	2.68%
0.25	Weight (g)	105.07	88.35	95.99	114.64	97.06	96.24	175.44	150.97	82.82	118.34	67.95	45.82	78.16	27.25	58	1402.10
	Proportion (%)	38.31%	42.89%	25.87%	45.34%	32.66%	32.56%	52.98%	39.78%	37.43%	24.96%	13.85%	12.80%	19.00%	11.41%	11.41%	27.44%
0.5	Weight (g)	109.44	76.56	224.14	115	155.05	143.34	109.62	123.27	75.12	190.93	59.6	40.68	64.34	23.59	51.14	1561.82
	Proportion (%)	39.90%	37.17%	60.41%	45.48%	52.17%	48.49%	33.10%	32.48%	33.95%	40.27%	12.14%	11.37%	15.64%	9.88%	10.06%	30.56%
1	Weight (g)	22.2	19.75	24.48	7.08	27.13	22.81	11.5	23.34	15.64	46.98	69.96	58.32	77.91	40.89	77.26	545.25
	Proportion (%)	8.09%	9.59%	6.60%	2.80%	9.13%	7.72%	3.47%	6.15%	7.07%	9.91%	14.26%	16.30%	18.94%	17.12%	15.20%	10.67%
2	Weight (g)	6.75	3.81	5.68	1.68	5.46	4.27	2.52	8.75	6.2	25.9	49.81	32.76	42.1	26.36	55.14	277.19
	Proportion (%)	2.46%	1.85%	1.53%	0.66%	1.84%	1.44%	0.76%	2.31%	2.80%	5.46%	10.15%	9.16%	10.23%	11.04%	10.85%	5.42%
4	Weight (g)	13.99	6.32	8.52	1.11	3.47	6.24	2.97	21.05	12.82	32.46	58.66	31.47	56.07	51.34	125.51	432.00
	Proportion (%)	5.10%	3.07%	2.30%	0.44%	1.17%	2.11%	0.90%	5.55%	5.79%	6.85%	11.95%	8.79%	13.63%	21.50%	24.69%	8.45%
8	Weight (g)	6.94	3.35	4.72	2.16	0	3.92	1.66	28.24	9.36	35.39	35.46	48.56	51.11	31.75	59.72	322.34
	Proportion (%)	2.53%	1.63%	1.27%	0.85%	0.00%	1.33%	0.50%	7.44%	4.23%	7.46%	7.23%	13.57%	12.42%	13.30%	11.75%	6.31%
16	Weight (g)	0	0	0	0	0	8.83	10.07	6.98	10.11	15.7	54.49	31.88	33.78	30.59	54.09	256.52
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	2.99%	3.04%	1.84%	4.57%	3.31%	11.10%	8.91%	8.21%	12.81%	10.64%	5.02%
32	Weight (g)	0	0	0	0	0	0	0	0	0	0	45.83	41.35	0	3.39	20.9	111.47
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	9.34%	11.56%	0.00%	1.42%	4.11%	2.18%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	40.91	21.04	0	0	0	61.95
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	8.34%	5.88%	0.00%	0.00%	0.00%	1.21%
	Total Dry Weight (g)	274.26	205.98	371.06	252.86	297.21	295.6	331.17	379.49	221.28	474.15	490.76	357.83	411.39	238.8	508.28	5110.12
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table7. Sediment particle size (mm) across Nelson beach, station 30.

							Station 30									
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										Total
<0.63 (mm)	Weight (g)	1.24	0.75	0.45	0.51	0.5	0.34	0.2	0.13	0.11	0.08	0.06	0.05	0.05	0.02	0.01	4.5
	Proportion (%)	0.21%	0.25%	0.15%	0.17%	0.15%	0.09%	0.05%	0.04%	0.04%	0.03%	0.02%	0.02%	0.02%	0.01%	0.00%	0.09%
0.63	Weight (g)	1.45	0.87	0.54	0.61	0.43	0.31	0.13	0.11	0.12	0.09	0.07	0.05	0.1	0.02	0.07	4.97
	Proportion (%)	0.25%	0.29%	0.18%	0.20%	0.13%	0.08%	0.03%	0.04%	0.05%	0.04%	0.03%	0.02%	0.04%	0.01%	0.02%	0.10%
0.125	Weight (g)	14.3	17.71	13.83	14.68	13.12	12.61	15.13	13.04	14.37	13.3	9.74	10.7	11.74	12.58	9.56	196.41
	Proportion (%)	2.43%	5.92%	4.60%	4.76%	4.02%	3.31%	3.97%	4.22%	5.40%	5.60%	3.50%	3.56%	4.68%	5.27%	2.71%	4.07%
0.25	Weight (g)	349.47	213.15	218.3	218.95	232.34	271.99	265.75	227.63	201.22	180.86	206.54	217.35	184.64	179.69	249.35	3417.23
	Proportion (%)	59.31%	71.24%	72.56%	71.05%	71.13%	71.29%	69.65%	73.60%	75.60%	76.18%	74.16%	72.33%	73.60%	75.33%	70.67%	70.88%
0.5	Weight (g)	211.21	61.54	61.31	61.39	65.63	89.51	82.24	61.29	45.7	39.14	57.66	68.47	49.44	44.15	86.46	1085.14
	Proportion (%)	35.84%	20.57%	20.38%	19.92%	20.09%	23.46%	21.56%	19.82%	17.17%	16.49%	20.70%	22.79%	19.71%	18.51%	24.50%	22.51%
1	Weight (g)	5.75	2.54	3.62	3.73	3.03	3.69	2.96	2.28	2.37	1.8	2.09	2.49	1.72	1.59	3.76	43.42
	Proportion (%)	0.98%	0.85%	1.20%	1.21%	0.93%	0.97%	0.78%	0.74%	0.89%	0.76%	0.75%	0.83%	0.69%	0.67%	1.07%	0.90%
2	Weight (g)	2.42	1.33	1.61	1.9	1.43	1.14	1.05	0.65	1.26	1.36	1.28	0.85	0.53	0.42	1.36	18.59
	Proportion (%)	0.41%	0.44%	0.54%	0.62%	0.44%	0.30%	0.28%	0.21%	0.47%	0.57%	0.46%	0.28%	0.21%	0.18%	0.39%	0.39%
4	Weight (g)	2.67	1.31	1.19	2.31	1.53	0.95	0.88	1.53	1.01	0.77	1.07	0.53	0.84	0.06	1.14	17.79
	Proportion (%)	0.45%	0.44%	0.40%	0.75%	0.47%	0.25%	0.23%	0.49%	0.38%	0.32%	0.38%	0.18%	0.33%	0.03%	0.32%	0.37%
8	Weight (g)	0.76	0	0	0.9	0	1	0	2.62	0	0	0	0	1.82	0	1.13	8.23
	Proportion (%)	0.13%	0.00%	0.00%	0.29%	0.00%	0.26%	0.00%	0.85%	0.00%	0.00%	0.00%	0.00%	0.73%	0.00%	0.32%	0.17%
16	Weight (g)	0	0	0	3.18	8.63	0	0	0	0	0	0	0	0	0	0	11.81
	Proportion (%)	0.00%	0.00%	0.00%	1.03%	2.64%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.24%
32	Weight (g)	0	0	0	0	0	0	13.19	0	0	0	0	0	0	0	0	13.19
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.46%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.27%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	589.27	299.2	300.85	308.16	326.64	381.54	381.53	309.28	266.16	237.4	278.51	300.49	250.88	238.53	352.84	4821.28
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 8. Sediment particle size (mm) across Nelson beach, station 50.

							Station 50									
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										Total
<0.63 (mm)	Weight (g)	0.04	0	0	0	0	0	0.02	0	0	0.02	0	0	0	0	0.03	0.11
	Proportion (%)	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0.63	Weight (g)	0.06	0.05	0	0.02	0.02	0.02	0.11	0.04	0.03	0.06	0.03	0.05	0.08	0.03	0.16	0.76
	Proportion (%)	0.02%	0.02%	0.00%	0.01%	0.01%	0.01%	0.03%	0.01%	0.01%	0.02%	0.01%	0.02%	0.02%	0.01%	0.02%	0.01%
0.125	Weight (g)	6.29	5.55	5.76	8.01	9.04	6.26	7.26	13.13	17.19	14.41	5.06	8.25	7.84	6.32	16.8	137.17
	Proportion (%)	2.25%	1.80%	2.13%	2.34%	2.88%	1.70%	1.96%	3.77%	4.72%	3.99%	2.05%	2.59%	2.35%	2.31%	2.31%	2.62%
0.25	Weight (g)	163.6	155.92	158.59	217.84	194.71	158.79	161.69	213.85	255.44	200.75	84.09	123.82	162.23	110.84	187.15	2549.31
	Proportion (%)	58.58%	50.66%	58.53%	63.58%	62.12%	43.14%	43.70%	61.36%	70.14%	55.56%	34.08%	38.87%	48.56%	40.49%	25.75%	48.78%
0.5	Weight (g)	107.91	140.88	104.68	114.46	105.85	186.39	195.27	119.29	88.94	121.62	142.41	174.74	152.67	146.89	398.25	2300.25
	Proportion (%)	38.64%	45.78%	38.63%	33.40%	33.77%	50.64%	52.78%	34.23%	24.42%	33.66%	57.72%	54.86%	45.70%	53.66%	54.79%	44.01%
1	Weight (g)	1.09	4.52	1.74	2.22	3.1	15.01	5.05	1.97	1.55	10.69	10.22	7.93	9.49	7.22	14.46	96.26
	Proportion (%)	0.39%	1.47%	0.64%	0.65%	0.99%	4.08%	1.36%	0.57%	0.43%	2.96%	4.14%	2.49%	2.84%	2.64%	1.99%	1.84%
2	Weight (g)	0.29	0.77	0.2	0.07	0.45	1.59	0.46	0.24	0.27	4.04	1.42	0.81	1.54	0.6	3.14	15.89
	Proportion (%)	0.10%	0.25%	0.07%	0.02%	0.14%	0.43%	0.12%	0.07%	0.07%	1.12%	0.58%	0.25%	0.46%	0.22%	0.43%	0.30%
4	Weight (g)	0	0.07	0	0.03	0.28	0.04	0.14	0	0	2.89	2.69	0.47	0.2	0.6	7.41	14.82
	Proportion (%)	0.00%	0.02%	0.00%	0.01%	0.09%	0.01%	0.04%	0.00%	0.00%	0.80%	1.09%	0.15%	0.06%	0.22%	1.02%	0.28%
8	Weight (g)	0	0	0	0	0	0	0	0	0.77	6.82	0.82	2.47	0	1.26	15.07	27.21
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.21%	1.89%	0.33%	0.78%	0.00%	0.46%	2.07%	0.52%
16	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11.38	11.38
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.57%	0.22%
32	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72.96	72.96
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	10.04%	1.40%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	279.28	307.76	270.97	342.65	313.45	368.1	370	348.52	364.19	361.3	246.74	318.54	334.05	273.76	726.81	5226.12
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 9. Sediment particle size (mm) across Nelson beach, station 70.

							Station 70										
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										Total
<0.63 (mm)	Weight (g)	0.25	0.15	0.15	0.17	0.13	0.16	0.14	0.15	0.17	0.14	0.09	0.05	0.03	0.02	0	1.8
	Proportion (%)	0.07%	0.05%	0.04%	0.06%	0.05%	0.05%	0.04%	0.05%	0.05%	0.04%	0.03%	0.02%	0.01%	0.01%	0.00%	0.04%
0.63	Weight (g)	0.29	0.18	0.18	0.16	0.15	0.15	0.16	0.15	0.2	0.14	0.12	0.07	0.01	0.03	0.04	2.03
	Proportion (%)	0.08%	0.06%	0.05%	0.05%	0.05%	0.04%	0.04%	0.05%	0.06%	0.04%	0.04%	0.02%	0.00%	0.01%	0.01%	0.04%
0.125	Weight (g)	8.73	8.16	8.99	8.27	8.53	8.36	9.83	8.74	9.14	7.37	9.29	8.3	8.72	6.66	9.74	128.83
	Proportion (%)	2.32%	2.67%	2.57%	2.75%	3.08%	2.40%	2.76%	3.03%	2.90%	2.06%	3.28%	2.63%	2.24%	2.43%	1.80%	2.54%
0.25	Weight (g)	273.47	218.61	253.21	208.52	193.24	241.93	256.73	210.61	223.09	244.52	199.87	229.93	282.54	166.12	312.64	3515.03
	Proportion (%)	72.76%	71.50%	72.29%	69.28%	69.72%	69.55%	72.12%	73.05%	70.69%	68.46%	70.67%	72.83%	72.53%	60.55%	57.63%	69.20%
0.5	Weight (g)	85.64	62.95	83.04	79.44	72.08	93.91	84.85	65.11	76.64	95.34	67.27	75.3	94.12	99.23	217.9	1352.82
	Proportion (%)	22.79%	20.59%	23.71%	26.40%	26.00%	27.00%	23.83%	22.58%	24.28%	26.69%	23.79%	23.85%	24.16%	36.17%	40.17%	26.63%
1	Weight (g)	2.32	2.16	2.56	2.05	1.74	2.03	2.16	1.81	1.98	1.84	2.18	1.24	1.8	1.94	1.8	29.61
	Proportion (%)	0.62%	0.71%	0.73%	0.68%	0.63%	0.58%	0.61%	0.63%	0.63%	0.52%	0.77%	0.39%	0.46%	0.71%	0.33%	0.58%
2	Weight (g)	0.72	0.99	1	0.85	0.82	0.72	0.68	0.82	1.04	0.66	0.37	0.42	0.53	0.2	0.36	10.18
	Proportion (%)	0.19%	0.32%	0.29%	0.28%	0.30%	0.21%	0.19%	0.28%	0.33%	0.18%	0.13%	0.13%	0.14%	0.07%	0.07%	0.20%
4	Weight (g)	2.45	1.27	1.15	0.88	0.49	0.58	1.44	0.9	0	1.09	0.1	0.38	1.78	0.16	0	12.67
	Proportion (%)	0.65%	0.42%	0.33%	0.29%	0.18%	0.17%	0.40%	0.31%	0.00%	0.31%	0.04%	0.12%	0.46%	0.06%	0.00%	0.25%
8	Weight (g)	1.96	0	0	0.62	0	0	0	0	1.71	0	0	0	0	0	0	4.29
	Proportion (%)	0.52%	0.00%	0.00%	0.21%	0.00%	0.00%	0.00%	0.00%	0.54%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.08%
16	Weight (g)	0	0	0	0	0	0	0	0	1.62	6.06	3.53	0	0	0	0	11.21
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.51%	1.70%	1.25%	0.00%	0.00%	0.00%	0.00%	0.22%
32	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
64	Weight (g)	0	11.29	0	0	0	0	0	0	0	0	0	0	0	0	0	11.29
	Proportion (%)	0.00%	3.69%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.22%
	Total Dry Weight (g)	375.83	305.76	350.28	300.96	277.18	347.84	355.99	288.29	315.59	357.16	282.82	315.69	389.53	274.36	542.48	5079.76
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 10. Sediment particle size (mm) across Nelson beach, station 90.

							Station 90										
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										Total
<0.63 (mm)	Weight (g)	0	0	0	0	0.15	0.06	0.05	0.09	0.08	0.03	0.01	0	0	0.02	0	0.49
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.05%	0.02%	0.02%	0.03%	0.03%	0.01%	0.00%	0.00%	0.00%	0.01%	0.00%	0.01%
0.63	Weight (g)	0.08	0	0	0.08	0.29	0.13	0.07	0.13	0.15	0.09	0.01	0.08	0.07	0.06	0.01	1.25
	Proportion (%)	0.02%	0.00%	0.00%	0.02%	0.10%	0.04%	0.02%	0.04%	0.05%	0.02%	0.00%	0.02%	0.02%	0.02%	0.00%	0.02%
0.125	Weight (g)	5.23	4.21	3.82	2.7	5.68	5.25	6.75	6.04	7.79	8.3	7.1	8.44	9.11	11.63	9.02	101.07
	Proportion (%)	1.38%	1.60%	1.13%	0.75%	1.87%	1.63%	2.23%	1.76%	2.50%	2.27%	2.40%	2.40%	2.93%	4.42%	1.81%	2.02%
0.25	Weight (g)	176.83	149.42	158.61	114.43	151.97	172.92	167.44	188.66	168.46	236.75	199.88	212.34	213.41	187.35	221.89	2720.36
	Proportion (%)	46.82%	56.95%	46.88%	31.87%	49.97%	53.71%	55.21%	54.93%	54.01%	64.78%	67.63%	60.50%	68.66%	71.17%	44.58%	54.34%
0.5	Weight (g)	191.47	106.62	173.93	208.71	133.51	131.35	109.57	144.39	107.8	117.94	86.52	102.01	84.88	62.89	262.49	2024.08
	Proportion (%)	50.69%	40.64%	51.41%	58.13%	43.90%	40.80%	36.13%	42.04%	34.56%	32.27%	29.28%	29.06%	27.31%	23.89%	52.74%	40.43%
1	Weight (g)	3.92	1.84	1.86	28.15	10.21	8.53	2.93	2.58	3.14	1.79	0.99	1.49	1.25	0.41	2.95	72.04
	Proportion (%)	1.04%	0.70%	0.55%	7.84%	3.36%	2.65%	0.97%	0.75%	1.01%	0.49%	0.33%	0.42%	0.40%	0.16%	0.59%	1.44%
2	Weight (g)	0.17	0.03	0.1	2.66	1.89	2.19	0.64	0.76	0.67	0.44	0.23	0	0.23	0.55	0.26	10.82
	Proportion (%)	0.05%	0.01%	0.03%	0.74%	0.62%	0.68%	0.21%	0.22%	0.21%	0.12%	0.08%	0.00%	0.07%	0.21%	0.05%	0.22%
4	Weight (g)	0	0.25	0	1.14	0.43	1.54	0.27	0.82	1.15	0.12	0.79	0.53	0.17	0	1.13	8.34
	Proportion (%)	0.00%	0.10%	0.00%	0.32%	0.14%	0.48%	0.09%	0.24%	0.37%	0.03%	0.27%	0.15%	0.05%	0.00%	0.23%	0.17%
8	Weight (g)	0	0	0	1.18	0	0	0	0	0.65	0	0	0	1.71	0.35	0	3.89
	Proportion (%)	0.00%	0.00%	0.00%	0.33%	0.00%	0.00%	0.00%	0.00%	0.21%	0.00%	0.00%	0.00%	0.55%	0.13%	0.00%	0.08%
16	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
32	Weight (g)	0	0	0	0	0	0	15.54	0	22.02	0	0	26.09	0	0	0	63.65
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.12%	0.00%	7.06%	0.00%	0.00%	7.43%	0.00%	0.00%	0.00%	1.27%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	377.7	262.37	338.32	359.05	304.13	321.97	303.26	343.47	311.91	365.46	295.53	350.98	310.83	263.26	497.75	5005.99
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 11. Sediment particle size (mm) across Parasol beach, station 10.

							Station 10										
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										Total
<0.63 (mm)	Weight (g)	0	0	0	0.02	0	0	0	0	0	0	0	0	0.01	0	0	0.03
	Proportion (%)	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0.63	Weight (g)	0.04	0	0.03	0.02	0	0	0.02	0.03	0.02	0.03	0.02	0.01	0.03	0.02	0.01	0.28
	Proportion (%)	0.01%	0.00%	0.01%	0.01%	0.00%	0.00%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%	0.01%	0.00%	0.00%	0.01%
0.125	Weight (g)	19.2	19.39	11.67	10.77	11.76	10.98	10.62	12.06	6.66	5.65	5.68	8.66	10.89	8.53	6.98	159.50
	Proportion (%)	5.42%	5.56%	3.70%	3.01%	3.48%	3.17%	2.99%	3.42%	1.98%	1.61%	1.62%	2.21%	2.99%	2.11%	1.50%	2.94%
0.25	Weight (g)	224.97	219.1	151.82	209.27	259.43	248.88	224.52	232.52	201.22	168.86	151.45	220.4	196.04	187.32	166.07	3061.87
	Proportion (%)	63.53%	62.78%	48.16%	58.56%	76.82%	71.89%	63.18%	65.88%	59.69%	48.11%	43.16%	56.31%	53.77%	46.35%	35.66%	56.36%
0.5	Weight (g)	95.42	106.59	142.99	131.15	64.05	84.57	117.06	106.36	119.8	158.8	179.64	153.59	146.2	199.63	281.55	2087.40
	Proportion (%)	26.95%	30.54%	45.36%	36.70%	18.96%	24.43%	32.94%	30.14%	35.54%	45.24%	51.19%	39.24%	40.10%	49.40%	60.45%	38.42%
1	Weight (g)	3.59	3.7	6.4	5.57	2.25	1.59	2.97	1.85	7.12	15.85	13.35	7.98	4.97	6.89	10.44	94.52
	Proportion (%)	1.01%	1.06%	2.03%	1.56%	0.67%	0.46%	0.84%	0.52%	2.11%	4.52%	3.80%	2.04%	1.36%	1.70%	2.24%	1.74%
2	Weight (g)	0.58	0.23	0.63	0.22	0.24	0.18	0.16	0.1	0.98	1.63	0.79	0.76	0.14	0.29	0.48	7.41
	Proportion (%)	0.16%	0.07%	0.20%	0.06%	0.07%	0.05%	0.05%	0.03%	0.29%	0.46%	0.23%	0.19%	0.04%	0.07%	0.10%	0.14%
4	Weight (g)	0.09	0	0.54	0.36	0	0	0	0	0.15	0.17	0	0	0	1.45	0.19	2.95
	Proportion (%)	0.03%	0.00%	0.17%	0.10%	0.00%	0.00%	0.00%	0.00%	0.04%	0.05%	0.00%	0.00%	0.00%	0.36%	0.04%	0.05%
8	Weight (g)	0	0	1.16	0	0	0	0	0	1.17	0	0	0	6.33	0	0	8.66
	Proportion (%)	0.00%	0.00%	0.37%	0.00%	0.00%	0.00%	0.00%	0.00%	0.35%	0.00%	0.00%	0.00%	1.74%	0.00%	0.00%	0.16%
16	Weight (g)	10.23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.23
	Proportion (%)	2.89%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.19%
32	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	354.12	349.01	315.24	357.38	337.73	346.2	355.35	352.92	337.12	350.99	350.93	391.4	364.61	404.13	465.72	5432.85
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 12. Sediment particle size (mm) across Parasol beach, station 30.

							Station 30										
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										Total
<0.63 (mm)	Weight (g)	0.03	0.02	0.01	0	0	0	0	0.01	0	0	0.01	0.02	0	0	0	0.1
	Proportion (%)	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
0.63	Weight (g)	0.08	0.12	0.08	0.03	0.06	0.13	0.07	0.04	0.06	0.06	0.05	0.07	0.02	0.02	0.02	0.91
	Proportion (%)	0.02%	0.04%	0.02%	0.01%	0.02%	0.04%	0.02%	0.01%	0.02%	0.02%	0.01%	0.02%	0.01%	0.01%	0.01%	0.02%
0.125	Weight (g)	27.47	29.2	26.89	25.22	28.48	18.21	29.76	27.41	34.45	29.6	31.48	38.81	32.49	27.79	27.5	434.76
	Proportion (%)	7.87%	9.24%	7.53%	6.97%	7.67%	5.08%	7.72%	7.53%	9.00%	7.73%	8.35%	10.33%	9.29%	7.95%	13.21%	8.22%
0.25	Weight (g)	278.08	249.91	310.29	301.87	294.74	276.68	327.85	318.64	328.74	323.34	328.56	315.93	275.38	238.38	148.08	4316.47
	Proportion (%)	79.64%	79.11%	86.93%	83.47%	79.38%	77.21%	85.04%	87.49%	85.88%	84.46%	87.14%	84.07%	78.73%	68.18%	71.11%	81.61%
0.5	Weight (g)	39.74	34.17	18.76	33.56	46.79	62.24	27.39	17.77	19.29	29.37	16.72	19.77	41.22	81.85	31.81	520.45
	Proportion (%)	11.38%	10.82%	5.26%	9.28%	12.60%	17.37%	7.10%	4.88%	5.04%	7.67%	4.43%	5.26%	11.79%	23.41%	15.28%	9.84%
1	Weight (g)	2.54	1.88	0.89	0.97	1.11	0.91	0.42	0.25	0.24	0.41	0.22	0.48	0.64	1.47	0.77	13.2
	Proportion (%)	0.73%	0.60%	0.25%	0.27%	0.30%	0.25%	0.11%	0.07%	0.06%	0.11%	0.06%	0.13%	0.18%	0.42%	0.37%	0.25%
2	Weight (g)	0.65	0.26	0.03	0.01	0.14	0.2	0.03	0.09	0	0.03	0.02	0.17	0.01	0.11	0.06	1.81
	Proportion (%)	0.19%	0.08%	0.01%	0.00%	0.04%	0.06%	0.01%	0.02%	0.00%	0.01%	0.01%	0.05%	0.00%	0.03%	0.03%	0.03%
4	Weight (g)	0.6	0.01	0	0	0	0	0	0	0	0	0	0.56	0	0	0	1.17
	Proportion (%)	0.17%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.15%	0.00%	0.00%	0.00%	0.02%
8	Weight (g)	0	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33
	Proportion (%)	0.00%	0.10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
16	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
32	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	349.19	315.9	356.95	361.66	371.32	358.37	385.52	364.21	382.78	382.81	377.06	375.81	349.76	349.62	208.24	5289.2
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 13. Sediment particle size (mm) across Parasol beach, station 50.

							Station 50										
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										Total
<0.63 (mm)	Weight (g)	0.01	0	0	0	0	0	0	0.03	0	0.03	0.02	0.01	0.04	0	NA	0.14
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.01%	0.01%	0.00%	0.01%	0.00%	NA	0.00%
0.63	Weight (g)	0.07	0.08	0.08	0.06	0.09	0.1	0.12	0.19	0.16	0.16	0.15	0.12	0.11	0.11	NA	1.6
	Proportion (%)	0.02%	0.02%	0.02%	0.02%	0.02%	0.03%	0.03%	0.05%	0.05%	0.04%	0.04%	0.04%	0.04%	0.03%	NA	0.03%
0.125	Weight (g)	20.49	21.03	22.24	23.65	26.72	26.32	26.44	28.78	27.11	28.67	20.22	22.16	22.2	21.6	NA	337.63
	Proportion (%)	5.86%	6.17%	5.75%	6.18%	6.32%	7.42%	6.25%	8.01%	7.65%	7.99%	5.09%	7.68%	8.12%	5.64%	NA	6.65%
0.25	Weight (g)	232.44	234.97	298.92	277.05	322.5	281.2	354.91	307.87	239.16	224.44	246.93	240	231.68	225.17	NA	3717.24
	Proportion (%)	66.45%	68.91%	77.34%	72.41%	76.30%	79.32%	83.90%	85.72%	67.50%	62.57%	62.13%	83.18%	84.72%	58.77%	NA	73.25%
0.5	Weight (g)	94.02	82.89	64.29	78.29	65.8	41.23	41.14	22.08	87.09	102.06	125.4	23.51	16.08	101.02	NA	944.9
	Proportion (%)	26.88%	24.31%	16.63%	20.46%	15.57%	11.63%	9.73%	6.15%	24.58%	28.45%	31.55%	8.15%	5.88%	26.37%	NA	18.62%
1	Weight (g)	2.2	1.45	0.79	2.58	4.05	2.61	0.38	0.19	0.76	2.86	3.91	1.82	0.95	22.76	NA	47.31
	Proportion (%)	0.63%	0.43%	0.20%	0.67%	0.96%	0.74%	0.09%	0.05%	0.21%	0.80%	0.98%	0.63%	0.35%	5.94%	NA	0.93%
2	Weight (g)	0.48	0.38	0.16	0.63	2.07	1.34	0.03	0	0.01	0.47	0.37	0.81	0.28	2.37	NA	9.4
	Proportion (%)	0.14%	0.11%	0.04%	0.16%	0.49%	0.38%	0.01%	0.00%	0.00%	0.13%	0.09%	0.28%	0.10%	0.62%	NA	0.19%
4	Weight (g)	0.1	0.16	0	0.33	1.42	1.7	0	0	0	0	0.41	0.09	0	0.58	NA	4.79
	Proportion (%)	0.03%	0.05%	0.00%	0.09%	0.34%	0.48%	0.00%	0.00%	0.00%	0.00%	0.10%	0.03%	0.00%	0.15%	NA	0.09%
8	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	2.12	3.72	NA	5.84
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.78%	0.97%	NA	0.12%
16	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	5.78	NA	5.78
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.51%	NA	0.11%
32	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NA	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	NA	0.00%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NA	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	NA	0.00%
	Total Dry Weight (g)	349.81	340.96	386.48	382.59	422.65	354.5	423.02	359.14	354.29	358.69	397.41	288.52	273.46	383.11	NA	5074.63
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	NA	100.00%

Table 14. Sediment particle size (mm) across Parasol beach, station 70.

							Station 70										
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										Total
<0.63 (mm)	Weight (g)	0	0	0	0	0	0	0	0	0	0	0.12	0.03	0.01	0.04	0.04	0.24
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04%	0.01%	0.00%	0.01%	0.01%	0.00%
0.63	Weight (g)	0.06	0.07	0.08	0.05	0.06	0.03	0.04	0.06	0.04	0.05	0.14	0.12	0.06	0.07	0.12	1.05
	Proportion (%)	0.02%	0.02%	0.03%	0.01%	0.02%	0.01%	0.01%	0.02%	0.01%	0.02%	0.05%	0.04%	0.02%	0.02%	0.02%	0.02%
0.125	Weight (g)	9.62	14.48	16.79	16.33	8.37	5.12	2.35	1.5	2.92	1.69	8.26	3.69	13.63	15.88	26.72	147.35
	Proportion (%)	3.61%	4.17%	5.83%	4.54%	2.54%	1.74%	0.72%	0.48%	0.93%	0.59%	2.71%	1.13%	4.60%	4.44%	4.35%	2.93%
0.25	Weight (g)	81.84	127.3	202.51	182.33	114.67	41.47	56	44.23	102.87	43.11	75.75	56.84	126.11	161.67	269.52	1686.22
	Proportion (%)	30.68%	36.68%	70.31%	50.74%	34.85%	14.13%	17.07%	14.23%	32.59%	14.93%	24.83%	17.34%	42.58%	45.24%	43.86%	33.54%
0.5	Weight (g)	137.51	192.17	67.29	158.51	188.33	208.64	261.17	210.27	203.75	215.45	212.05	254.76	153.73	178.34	311.67	2953.64
	Proportion (%)	51.54%	55.37%	23.36%	44.11%	57.23%	71.09%	79.62%	67.65%	64.55%	74.59%	69.50%	77.73%	51.91%	49.90%	50.71%	58.74%
1	Weight (g)	12.1	10.87	1.06	2.08	8.56	36.48	8.23	19.93	5.72	27.22	7.37	12.08	2.44	1.24	5.44	160.82
	Proportion (%)	4.54%	3.13%	0.37%	0.58%	2.60%	12.43%	2.51%	6.41%	1.81%	9.42%	2.42%	3.69%	0.82%	0.35%	0.89%	3.20%
2	Weight (g)	1.07	0.92	0.3	0.07	1.05	1.23	0.17	0.63	0.06	0.35	0.48	0.21	0.19	0.13	0.93	7.79
	Proportion (%)	0.40%	0.27%	0.10%	0.02%	0.32%	0.42%	0.05%	0.20%	0.02%	0.12%	0.16%	0.06%	0.06%	0.04%	0.15%	0.15%
4	Weight (g)	0.1	0.76	0	0	1.32	0.5	0.07	1.29	0.31	0.96	0.94	0	0	0	0.13	6.38
	Proportion (%)	0.04%	0.22%	0.00%	0.00%	0.40%	0.17%	0.02%	0.42%	0.10%	0.33%	0.31%	0.00%	0.00%	0.00%	0.02%	0.13%
8	Weight (g)	0	0.51	0	0	6.69	0	0	5.92	0	0	0	0	0	0	0	13.12
	Proportion (%)	0.00%	0.15%	0.00%	0.00%	2.03%	0.00%	0.00%	1.90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.26%
16	Weight (g)	0	0	0	0	0	0	0	26.98	0	0	0	0	0	0	0	26.98
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	8.68%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.54%
32	Weight (g)	24.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24.49
	Proportion (%)	9.18%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.49%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	266.79	347.08	288.03	359.37	329.05	293.47	328.03	310.81	315.67	288.83	305.11	327.73	296.17	357.37	614.57	5028.08
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 15. Sediment particle size (mm) across Parasol beach, station 90.

						Station 90										
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										Total
<0.63 (mm)	Weight (g)	0	0	0	0	0	0	0	0.01	0	0	0	0	0.03	0	0	0.04
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%
0.63	Weight (g)	0.04	0.04	0.01	0.02	0.03	0.01	0.03	0.03	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.31
	Proportion (%)	0.01%	0.01%	0.00%	0.01%	0.01%	0.00%	0.01%	0.01%	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%	0.01%	0.01%
0.125	Weight (g)	19.14	17.73	14.81	21.78	19.39	15.49	10.59	9.75	1.67	2.68	4.92	4.82	6.68	8.69	6.33	164.47
	Proportion (%)	5.81%	5.34%	4.00%	6.23%	5.19%	4.40%	3.01%	2.10%	0.44%	0.60%	1.67%	1.23%	2.01%	2.59%	2.81%	3.09%
0.25	Weight (g)	229.41	227.68	254.11	256.67	306.73	254.09	149.59	100.27	20.88	58.47	113.57	171.74	199.29	202.28	136.79	2681.57
	Proportion (%)	69.67%	68.57%	68.66%	73.36%	82.06%	72.20%	42.46%	21.63%	5.49%	13.12%	38.56%	43.80%	59.96%	60.33%	60.83%	50.33%
0.5	Weight (g)	65.31	69.02	93.99	68.92	47.27	80.73	188.69	180.79	111.35	127.48	105.86	188.74	111.63	111.58	74.89	1626.25
	Proportion (%)	19.83%	20.79%	25.40%	19.70%	12.65%	22.94%	53.56%	39.00%	29.29%	28.61%	35.94%	48.13%	33.59%	33.28%	33.30%	30.52%
1	Weight (g)	11.76	13	6.38	2.08	0.32	1.28	3.31	162.7	210.32	200.34	52.39	22.45	12.22	9.98	6.63	715.16
	Proportion (%)	3.57%	3.92%	1.72%	0.59%	0.09%	0.36%	0.94%	35.09%	55.33%	44.97%	17.79%	5.72%	3.68%	2.98%	2.95%	13.42%
2	Weight (g)	2.18	2.25	0.58	0.29	0.06	0.17	0.11	9.18	26.38	35.24	11.79	3.5	1.29	1.07	0.059	94.149
	Proportion (%)	0.66%	0.68%	0.16%	0.08%	0.02%	0.05%	0.03%	1.98%	6.94%	7.91%	4.00%	0.89%	0.39%	0.32%	0.03%	1.77%
4	Weight (g)	1.44	0.71	0.23	0.1	0	0.16	0	0.87	8.86	15.03	4.45	0.87	0.15	0.48	0.15	33.5
	Proportion (%)	0.44%	0.21%	0.06%	0.03%	0.00%	0.05%	0.00%	0.19%	2.33%	3.37%	1.51%	0.22%	0.05%	0.14%	0.07%	0.63%
8	Weight (g)	0	1.62	0	0	0	0	0	0	0.65	6.26	1.55	0	1.05	1.19	0	12.32
	Proportion (%)	0.00%	0.49%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.17%	1.41%	0.53%	0.00%	0.32%	0.35%	0.00%	0.23%
16	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
32	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	329.28	332.05	370.11	349.86	373.8	351.93	352.32	463.6	380.13	445.51	294.54	392.14	332.35	335.28	224.869	5327.769
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 16. Sediment particle size (mm) across Egmont beach, station 10.

Sub-sample		dry weight (g)				
	>5mm	1mm	500um	250um	125um	Total dry weight (g)
0-3.99	0.65	5.9	42.24	170.36	80.57	299.72
	0.22%	1.97%	14.09%	56.84%	26.88%	
4-7.99	5.04	15.15	83.01	160.63	49.18	313.01
	1.61%	4.84%	26.52%	51.32%	15.71%	
8-11.99	0	3.65	50.37	204.55	98.14	356.71
	0.00%	1.02%	14.12%	57.34%	27.51%	
12-15.99	0	2.3	36.35	187.22	87.87	313.74
	0.00%	0.73%	11.59%	59.67%	28.01%	
16-19.99	0	1.51	39.61	186.5	58.29	285.91
	0.00%	0.53%	13.85%	65.23%	20.39%	
20-23.99	0	5.99	56.61	179.14	62.94	304.68
	0.00%	1.97%	18.58%	58.80%	20.66%	
24-27.99	0	0.9	24.75	163.63	102.2	291.48
	0.00%	0.31%	8.49%	56.14%	35.06%	
28-31.99	0	0.69	33.5	196.5	104.59	335.28
	0.00%	0.21%	9.99%	58.61%	31.19%	
32-35.99	0	1.53	29.98	176.28	107.52	315.31
	0.00%	0.49%	9.51%	55.91%	34.10%	
36-39.99	0	3.8	41.34	159.89	94.29	299.32
	0.00%	1.27%	13.81%	53.42%	31.50%	
40-43.99	0	1.17	24.91	148.23	120.82	295.13
	0.00%	0.40%	8.44%	50.23%	40.94%	
44-47.99	0	2.23	32.4	171.94	135.51	342.08
	0.00%	0.65%	9.47%	50.26%	39.61%	
48-51.99	0	4.6	48.78	174.73	112.71	340.82
	0.00%	1.35%	14.31%	51.27%	33.07%	
52-55.99	0	8	69.4	157.89	104.81	340.10
	0.00%	2.35%	20.41%	46.42%	30.82%	
56-60	0	10.81	64.96	203.66	141.83	421.26
	0.00%	2.57%	15.42%	48.35%	33.67%	
Total Mass	**5.69**	68.23	678.21	2641.15	1461.27	4854.55
Total proportion	0.001172	0.014055	0.139706	0.544057	0.30101	4854.55

Table 17. Sediment particle size (mm) across Egmont beach, station 30.

Sub-sample		dry weight (g)				
	>5mm	1mm	500um	250um	125um	Total dry weight (g)
0-3.99	8.35	10.14	68.16	163.13	65.28	315.06
	2.65%	3.22%	21.63%	51.78%	20.72%	
4-7.99	6.32	12.63	78.69	183.45	79.43	360.52
	1.75%	3.50%	21.83%	50.88%	22.03%	
8-11.99	1.04	10.77	71.5	182.48	79.64	345.43
	0.30%	3.12%	20.70%	52.83%	23.06%	
12-15.99	1.21	11.59	76.66	185.66	78.32	353.44
	0.34%	3.28%	21.69%	52.53%	22.16%	
16-19.99	2.72	11.35	61.17	164.83	78.5	318.57
	0.85%	3.56%	19.20%	51.74%	24.64%	
20-23.99	0.83	12.18	67.64	186.18	86.8	353.63
	0.23%	3.44%	19.13%	52.65%	24.55%	
24-27.99	9.09	11.25	62.11	161.03	72.52	316.00
	2.88%	3.56%	19.66%	50.96%	22.95%	
28-31.99	25.93	10.9	59.59	153.1	71.07	320.59
	8.09%	3.40%	18.59%	47.76%	22.17%	
32-35.99	5.33	11.69	64.64	174.34	80.23	336.23
	1.59%	3.48%	19.22%	51.85%	23.86%	
36-39.99	8.5	13.76	175.27	110.35	22.73	330.61
	2.57%	4.16%	53.01%	33.38%	6.88%	
40-43.99	4.29	10.2	51.68	145.79	72.74	284.70
	1.51%	3.58%	18.15%	51.21%	25.55%	
44-47.99	17.96	7.63	66.68	171.4	61.06	324.73
	5.53%	2.35%	20.53%	52.78%	18.80%	
48-51.99	1.23	2.94	58.53	178.09	37.13	277.92
	0.44%	1.06%	21.06%	64.08%	13.36%	
52-55.99	0	2.03	39.55	130.04	36.3	207.92
	0.00%	0.98%	19.02%	62.54%	17.46%	
56-60	0	1.96	32.01	102.34	30.1	166.41
	0.00%	1.18%	19.24%	61.50%	18.09%	
Total Mass	**92.80**	141.02	1033.88	2392.21	951.85	4611.76
Total proportion	0.020122	0.030578	0.224183	0.51872	0.206396	4611.76

Table 18. Sediment particle size (mm) across Egmont beach, station 50.

Sub-sample						
	>5mm	1mm	500um	250um	125um	Total dry weight (g)
0-3.99	1.19	4.96	50.39	144.91	85.17	286.62
	0.42%	1.73%	17.58%	50.56%	29.72%	
4-7.99	0.20	3.73	44.22	176.21	118.92	343.28
	0.06%	1.09%	12.88%	51.33%	34.64%	
8-11.99	0	2.65	35.16	179.33	92.9	310.04
	0.00%	0.85%	11.34%	57.84%	29.96%	
12-15.99	0.26	2.09	38.89	178.25	92.46	311.95
	0.08%	0.67%	12.47%	57.14%	29.64%	
16-19.99	3.17	4.48	38.96	190.03	49.3	285.94
	1.11%	1.57%	13.63%	66.46%	17.24%	
20-23.99	14.66	22.14	97.18	157.43	33.19	324.60
	4.52%	6.82%	29.94%	48.50%	10.22%	
24-27.99	0.64	10.39	110.8	150.89	50.12	322.84
	0.20%	3.22%	34.32%	46.74%	15.52%	
28-31.99	0.44	3.78	65.76	198.84	77.03	345.85
	0.13%	1.09%	19.01%	57.49%	22.27%	
32-35.99	0	2.24	28.73	198.63	99.25	328.85
	0.00%	0.68%	8.74%	60.40%	30.18%	
36-39.99	0	3.77	54.31	173.17	65.81	297.06
	0.00%	1.27%	18.28%	58.29%	22.15%	
40-43.99	1.02	2.67	56.78	225.61	62.77	348.85
	0.29%	0.77%	16.28%	64.67%	17.99%	
44-47.99	0	1.76	27.11	217.94	74.87	321.68
	0.00%	0.55%	8.43%	67.75%	23.27%	
48-51.99	0	2.5	32.43	264.51	70.22	369.66
	0.00%	0.68%	8.77%	71.55%	19.00%	
52-55.99	0.14	12.19	69.88	207.31	56.21	345.73
	0.04%	3.53%	20.21%	59.96%	16.26%	
56-60	0	18.33	96.09	227.47	59.5	401.39
	0.00%	4.57%	23.94%	56.67%	14.82%	
Total Mass	**21.72**	**97.68**	**846.69**	**2890.53**	**1087.72**	4944.34
Total proportion	0.004393	0.019756	0.171244	0.584613922	0.2199930	4944.34

Table 19. Sediment particle size (mm) across Egmont beach, station 70.

							Station 70										
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										Total
<0.63 (mm)	Weight (g)	0.13	0.11	0.08	0.13	0.12	0.09	0.11	0.16	0.25	0.1	0.17	0.1	0.11	0.22	0.36	2.24
	Proportion (%)	0.05%	0.05%	0.03%	0.06%	0.04%	0.04%	0.05%	0.07%	0.10%	0.04%	0.07%	0.05%	0.05%	0.10%	0.12%	0.06%
0.63	Weight (g)	0.5	0.53	0.44	0.72	0.75	0.41	0.58	0.7	0.79	0.59	0.68	0.7	1	1.15	1.4	10.94
	Proportion (%)	0.20%	0.23%	0.16%	0.31%	0.27%	0.18%	0.27%	0.29%	0.32%	0.26%	0.29%	0.36%	0.47%	0.51%	0.48%	0.31%
0.125	Weight (g)	32.59	34.57	28.59	43.19	43.78	28.97	34.52	39.97	33.34	27.72	28.38	19.69	31.67	27.87	31.63	486.48
	Proportion (%)	12.73%	15.30%	10.72%	18.89%	15.85%	12.49%	16.11%	16.49%	13.48%	12.39%	12.09%	10.06%	14.92%	12.27%	10.84%	13.61%
0.25	Weight (g)	140.11	117.17	117.77	124.28	164.71	122.44	124.05	137.67	121.16	110.33	102.14	75.42	90.91	101.97	152.13	1802.26
	Proportion (%)	54.71%	51.85%	44.15%	54.35%	59.64%	52.77%	57.91%	56.79%	48.98%	49.32%	43.50%	38.53%	42.82%	44.88%	52.13%	50.41%
0.5	Weight (g)	74.31	68.18	87.54	49.04	60.94	70.92	48.6	45.49	87.77	81.18	83.57	90.89	85.48	80.11	88.34	1102.36
	Proportion (%)	29.01%	30.17%	32.82%	21.45%	22.07%	30.57%	22.69%	18.76%	35.48%	36.29%	35.59%	46.44%	40.27%	35.26%	30.27%	30.83%
1	Weight (g)	6.27	4.48	10.96	5.27	4.48	7.39	4.42	4.22	3.02	3.28	15.86	8.45	2.43	11.08	9.84	101.45
	Proportion (%)	2.45%	1.98%	4.11%	2.30%	1.62%	3.19%	2.06%	1.74%	1.22%	1.47%	6.75%	4.32%	1.14%	4.88%	3.37%	2.84%
2	Weight (g)	1.09	0.81	1.9	1.14	0.71	1.36	1.2	0.72	0.52	0.49	2	0.47	0.52	2.9	2.33	18.16
	Proportion (%)	0.43%	0.36%	0.71%	0.50%	0.26%	0.59%	0.56%	0.30%	0.21%	0.22%	0.85%	0.24%	0.24%	1.28%	0.80%	0.51%
4	Weight (g)	0.33	0.15	1.85	1.01	0.22	0.44	0.74	0.22	0.53	0	0.86	0	0.17	0.99	2.28	9.79
	Proportion (%)	0.13%	0.07%	0.69%	0.44%	0.08%	0.19%	0.35%	0.09%	0.21%	0.00%	0.37%	0.00%	0.08%	0.44%	0.78%	0.27%
8	Weight (g)	0.78	0	0	0	0.45	0	0	1.74	0	0	1.15	0	0	0.93	1.08	6.13
	Proportion (%)	0.30%	0.00%	0.00%	0.00%	0.16%	0.00%	0.00%	0.72%	0.00%	0.00%	0.49%	0.00%	0.00%	0.41%	0.37%	0.17%
16	Weight (g)	0	0	0	3.87	0	0	0	0	0	0	0	0	0	0	2.46	6.33
	Proportion (%)	0.00%	0.00%	0.00%	1.69%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.84%	0.18%
32	Weight (g)	0	0	17.62	0	0	0	0	11.55	0	0	0	0	0	0	0	29.17
	Proportion (%)	0.00%	0.00%	6.61%	0.00%	0.00%	0.00%	0.00%	4.76%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.82%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	256.11	226	266.75	228.65	276.16	232.02	214.22	242.44	247.38	223.69	234.81	195.72	212.29	227.22	291.85	3575.31
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 20. Sediment particle size (mm) across Egmont beach, station 90.

							Station 90									
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)									Total
<0.63 (mm)	Weight (g)	0.07	0.06	0.05	0.09	0.08	0.08	0.08	0.1	0.08	0.04	0.07	0.07	0.05	0.09	0.05	1.06
	Proportion (%)	0.03%	0.02%	0.02%	0.03%	0.03%	0.03%	0.03%	0.04%	0.03%	0.02%	0.03%	0.03%	0.02%	0.05%	0.07%	0.03%
0.63	Weight (g)	0.99	0.78	0.76	0.84	0.82	0.95	0.93	0.89	0.91	0.74	0.91	0.68	1.14	1.3	0.69	13.33
	Proportion (%)	0.41%	0.32%	0.29%	0.31%	0.33%	0.40%	0.35%	0.33%	0.38%	0.29%	0.33%	0.26%	0.53%	0.70%	1.01%	0.38%
0.125	Weight (g)	51.98	49.96	48.34	44.49	49.36	51.89	52.13	47.98	49.34	47	40.99	54.31	55.46	48.02	23.1	714.35
	Proportion (%)	21.27%	20.45%	18.61%	16.59%	19.99%	22.09%	19.75%	17.89%	20.79%	18.63%	14.68%	20.81%	25.54%	25.95%	33.83%	20.23%
0.25	Weight (g)	144.12	145.21	138.55	162.8	138.6	133.85	153.02	158.88	140.66	149.47	181.3	159.67	124.35	103.59	36.65	2070.72
	Proportion (%)	58.97%	59.45%	53.34%	60.71%	56.13%	56.99%	57.97%	59.24%	59.26%	59.24%	64.94%	61.19%	57.28%	55.97%	53.68%	58.65%
0.5	Weight (g)	43.25	43.78	63.9	50.33	52.66	40.51	52.43	47.95	41.34	47.1	51.47	43.05	32.35	31.51	7.61	649.24
	Proportion (%)	17.70%	17.92%	24.60%	18.77%	21.33%	17.25%	19.86%	17.88%	17.42%	18.67%	18.44%	16.50%	14.90%	17.03%	11.15%	18.39%
1	Weight (g)	3.35	3.76	3.59	4.21	3.89	3.71	4.19	4.21	3.92	3.97	3.87	1.94	0.69	0.56	0.16	46.02
	Proportion (%)	1.37%	1.54%	1.38%	1.57%	1.58%	1.58%	1.59%	1.57%	1.65%	1.57%	1.39%	0.74%	0.32%	0.30%	0.23%	1.30%
2	Weight (g)	0.6	0.46	0.55	0.55	1.1	0.73	0.66	1.19	0.8	0.66	0.57	0.6	0.07	0.01	0.02	8.57
	Proportion (%)	0.25%	0.19%	0.21%	0.21%	0.45%	0.31%	0.25%	0.44%	0.34%	0.26%	0.20%	0.23%	0.03%	0.01%	0.03%	0.24%
4	Weight (g)	0.05	0.24	0.32	0.46	0.43	0.59	0.51	0.67	0.31	0.33	0	0.64	0	0	0	4.55
	Proportion (%)	0.02%	0.10%	0.12%	0.17%	0.17%	0.25%	0.19%	0.25%	0.13%	0.13%	0.00%	0.25%	0.00%	0.00%	0.00%	0.13%
8	Weight (g)	0	0	0	0	0	0	0	0.66	0	0	0	0	0	0	0	0.66
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.25%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
16	Weight (g)	0	0	3.7	4.38	0	2.56	0	5.67	0	3	0	0	3	0	0	22.31
	Proportion (%)	0.00%	0.00%	1.42%	1.63%	0.00%	1.09%	0.00%	2.11%	0.00%	1.19%	0.00%	0.00%	1.38%	0.00%	0.00%	0.63%
32	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	244.41	244.25	259.76	268.15	246.94	234.87	263.95	268.2	237.36	252.31	279.18	260.96	217.11	185.08	68.28	3530.81
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 21. Sediment particle size (mm) across Boddam beach, station 10.

Sub-sample		**Dry wight (g)**				
	>5mm	**1mm**	**500um**	**250um**	**125um**	**Total dry weight (g)**
0-3.99	7.96	1.27	4.75	288.07	96.49	398.54
	2.00%	0.32%	1.19%	72.28%	24.21%	
4-7.99	6.64	0.75	9	315.76	79.22	411.37
	1.61%	0.18%	2.19%	76.76%	19.26%	
8-11.99	25.36	0.17	8.13	339.43	55.76	428.85
	5.91%	0.04%	1.90%	79.15%	13.00%	
12-15.99	25.55	0.61	14.28	389.78	50.36	480.58
	5.32%	0.13%	2.97%	81.11%	10.48%	
16-19.99	0	0.8	32.43	364.9	39.06	437.19
	0.00%	0.18%	7.42%	83.46%	8.93%	
20-23.99	0	0.24	19.2	341.72	58.79	419.95
	0.00%	0.06%	4.57%	81.37%	14.00%	
24-27.99	0	0.35	41.64	341.63	26.85	410.47
	0.00%	0.09%	10.14%	83.23%	6.54%	
28-31.99	0	1.27	23.4	364.54	43.86	433.07
	0.00%	0.29%	5.40%	84.18%	10.13%	
32-35.99	0	0.13	9.94	340.8	58.41	409.28
	0.00%	0.03%	2.43%	83.27%	14.27%	
36-39.99	0	0.13	10.48	360.77	82.62	454.00
	0.00%	0.03%	2.31%	79.46%	18.20%	
40-43.99	0	0	1.19	275.51	155.2	431.90
	0.00%	0.00%	0.28%	63.79%	35.93%	
44-47.99	0	0.66	3.72	380.75	144.81	529.94
	0.00%	0.12%	0.70%	71.85%	27.33%	
48-51.99	5.06	0.77	11.93	330.23	105.34	453.33
	1.12%	0.17%	2.63%	72.85%	23.24%	
52-55.99	0	0.83	14.09	249.02	71.54	335.48
	0.00%	0.25%	4.20%	74.23%	21.32%	
56-60	1.42	2.85	22.21	310.31	84.85	421.64
	0.34%	0.68%	5.27%	73.60%	20.12%	
Total Mass	**71.99**	10.83	226.39	4993.22	1153.16	6455.59
Total Proportion	0.011152	0.001678	0.035069	0.773472	0.17863	6455.59

Table 22. Sediment particle size (mm) across Boddam beach, station 30.

Sub-sample						Total dry weight (g)
	>5mm	1mm	500um	250um	125um	
0-3.99	2.13	2.1300	2.6700	293.2000	105.3800	405.51
	0.53%	0.53%	0.66%	72.30%	25.99%	
4-7.99	0.92	0.1100	1.8800	287.7400	141.6900	432.34
	0.21%	0.03%	0.43%	66.55%	32.77%	
8-11.99	0.27	0.5200	8.6500	316.3200	89.5300	415.29
	0.07%	0.13%	2.08%	76.17%	21.56%	
12-15.99	0.18	0.4900	4.3200	316.3200	73.4000	394.71
	0.05%	0.12%	1.09%	80.14%	18.60%	
16-19.99	39.43	0.3600	3.4700	294.3800	76.1500	413.79
	9.53%	0.09%	0.84%	71.14%	18.40%	
20-23.99	17.87	1.7300	1.6600	324.4000	85.5100	431.17
	4.14%	0.40%	0.38%	75.24%	19.83%	
24-27.99	3.15	0.0500	0.4400	277.7000	166.6200	447.96
	0.70%	0.01%	0.10%	61.99%	37.20%	
28-31.99	0	0.0000	0.4900	304.4200	127.0000	431.91
	0.00%	0.00%	0.11%	70.48%	29.40%	
32-35.99	0	0.3500	1.3300	244.2400	259.0000	504.92
	0.00%	0.07%	0.26%	48.37%	51.30%	
36-39.99	6.36	0.2400	2.4100	269.9400	211.0700	490.02
	1.30%	0.05%	0.49%	55.09%	43.07%	
40-43.99	2.74	0.6600	12.8700	282.4600	95.0100	393.74
	0.70%	0.17%	3.27%	71.74%	24.13%	
44-47.99	0	0.2200	7.9600	273.9600	110.6400	392.78
	0.00%	0.06%	2.03%	69.75%	28.17%	
48-51.99	44.67	0.7800	3.8100	195.1600	191.6400	436.06
	10.24%	0.18%	0.87%	44.76%	43.95%	
52-55.99	0	2.3900	22.0200	239.0600	158.0600	421.53
	0.00%	0.57%	5.22%	56.71%	37.50%	
56-60	0	3.3200	18.4200	406.5400	207.2000	635.48
	0.00%	0.52%	2.90%	63.97%	32.61%	
Total Mass	**117.72**	13.35	92.4	4325.84	2097.9	6647.21
Total Proportion	0.01771	0.002008361	0.013901	0.650775288	0.315606096	6647.21

Table 23. Sediment particle size (mm) across Boddam beach, station 50.

Sub-sample						**Total dry weight (g)**
	>5mm	**1mm**	**500um**	**250um**	**125um**	
0-3.99	0.17	0.8200	9.3700	240.7900	182.7900	433.94
	0.04%	0.19%	2.16%	55.49%	42.12%	
4-7.99	0.92	0.5600	9.1600	390.5200	159.6200	560.78
	0.16%	0.10%	1.63%	69.64%	28.46%	
8-11.99	0.27	0.4800	3.6600	262.2400	187.4500	454.10
	0.06%	0.11%	0.81%	57.75%	41.28%	
12-15.99	0.11	0.4200	3.0200	250.9300	192.4500	446.93
	0.02%	0.09%	0.68%	56.15%	43.06%	
16-19.99	0.23	0.2600	2.6900	202.3700	225.9600	431.51
	0.05%	0.06%	0.62%	46.90%	52.36%	
20-23.99	0.27	0.4700	9.1000	242.6900	170.5400	423.07
	0.06%	0.11%	2.15%	57.36%	40.31%	
24-27.99	0.52	1.0900	21.0500	267.2000	165.1900	455.05
	0.11%	0.24%	4.63%	58.72%	36.30%	
28-31.99	0.32	0.7500	10.3700	286.0800	185.7500	483.27
	0.07%	0.16%	2.15%	59.20%	38.44%	
32-35.99	0.18	0.6800	9.4800	303.6900	165.0800	479.11
	0.04%	0.14%	1.98%	63.39%	34.46%	
36-39.99	0.29	0.6600	9.8200	312.8900	176.7900	500.45
	0.06%	0.13%	1.96%	62.52%	35.33%	
40-43.99	0.26	0.6100	9.8700	316.3100	154.2200	481.27
	0.05%	0.13%	2.05%	65.72%	32.04%	
44-47.99	0.48	0.6300	4.5600	316.1600	145.2600	467.09
	0.10%	0.13%	0.98%	67.69%	31.10%	
48-51.99	15.21	0.6000	1.5800	249.5800	137.2500	404.22
	3.76%	0.15%	0.39%	61.74%	33.95%	
52-55.99	1.11	0.4200	4.9700	200.8500	123.7800	331.13
	0.34%	0.13%	1.50%	60.66%	37.38%	
56-60	1.03	0.3000	4.2000	159.9100	105.2500	270.69
	0.38%	0.11%	1.55%	59.07%	38.88%	
Total Mass	**21.37**	8.75	112.9	4002.21	2477.38	6622.61
Total Proportion	0.003227	0.001321	0.017048	0.604325183	0.374079102	6622.61

Table 24. Sediment particle size (mm) across Boddam beach, station 70.

						Station 70										
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										Total
<0.63 (mm)	Weight (g)	0.02	0.03	0.01	0.02	0.02	0.04	0.02	0.01	0.02	0.01	0.03	0.01	0.01	0.04	0	0.29
	Proportion (%)	0.01%	0.01%	0.00%	0.01%	0.01%	0.01%	0.01%	0.00%	0.01%	0.00%	0.01%	0.00%	0.00%	0.01%	0.00%	0.01%
0.63	Weight (g)	1.09	0.97	0.62	0.75	0.5	0.68	0.86	0.67	0.62	0.72	0.73	1.16	0.79	0.52	0.27	10.95
	Proportion (%)	0.29%	0.27%	0.15%	0.19%	0.15%	0.21%	0.26%	0.19%	0.18%	0.17%	0.22%	0.35%	0.25%	0.17%	0.21%	0.22%
0.125	Weight (g)	89.16	79.58	65.29	60.84	45.75	77.83	96.44	76.17	96.9	95.03	108.8	119.37	80.53	46.96	33.39	1172.04
	Proportion (%)	23.98%	22.09%	15.77%	15.78%	13.66%	23.74%	28.82%	21.48%	28.14%	23.00%	33.38%	36.13%	25.12%	15.34%	26.40%	23.21%
0.25	Weight (g)	255.76	250.12	271.24	268.07	282.53	246.16	229.55	268.85	237.81	315.73	216	194.58	233.06	250.11	89.21	3608.78
	Proportion (%)	68.78%	69.43%	65.53%	69.53%	84.34%	75.10%	68.60%	75.83%	69.06%	76.40%	66.27%	58.89%	72.71%	81.70%	70.52%	71.45%
0.5	Weight (g)	2.78	2.25	3.52	3.02	6.05	2.86	7.41	8.11	8.13	1.72	0.4	13.26	5.79	8.35	3.57	77.22
	Proportion (%)	0.75%	0.62%	0.85%	0.78%	1.81%	0.87%	2.21%	2.29%	2.36%	0.42%	0.12%	4.01%	1.81%	2.73%	2.82%	1.53%
1	Weight (g)	0.16	0.28	0.19	0.13	0.13	0.16	0.32	0.54	0.71	0.04	0	1.75	0.34	0.15	0.06	4.96
	Proportion (%)	0.04%	0.08%	0.05%	0.03%	0.04%	0.05%	0.10%	0.15%	0.21%	0.01%	0.00%	0.53%	0.11%	0.05%	0.05%	0.10%
2	Weight (g)	0.03	0.12	0.03	0.03	0	0.06	0.01	0.21	0.18	0.01	0	0.28	0.01	0.01	0	0.98
	Proportion (%)	0.01%	0.03%	0.01%	0.01%	0.00%	0.02%	0.00%	0.06%	0.05%	0.00%	0.00%	0.08%	0.00%	0.00%	0.00%	0.02%
4	Weight (g)	0.1	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0.35
	Proportion (%)	0.03%	0.07%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
8	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
16	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
32	Weight (g)	22.74	26.64	0	52.68	0	0	0	0	0	0	0	0	0	0	0	102.06
	Proportion (%)	6.12%	7.40%	0.00%	13.66%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.02%
64	Weight (g)	0	0	73.01	0	0	0	0	0	0	0	0	0	0	0	0	73.01
	Proportion (%)	0.00%	0.00%	17.64%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.45%
	Total Dry Weight (g)	371.84	360.24	413.91	385.54	334.98	327.79	334.61	354.56	344.37	413.26	325.96	330.41	320.53	306.14	126.5	5050.64
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 25. Sediment particle size (mm) across Boddam beach, station 90.

							Station 90									
Depth		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	
Particle size							Weight (g)										Total
<0.63 (mm)	Weight (g)	0.02	0.01	0.01	0.02	0.01	0.03	0	0.05	0.04	0.05	0.04	0.03	0.01	0.06	0.11	0.49
	Proportion (%)	0.01%	0.00%	0.00%	0.01%	0.00%	0.01%	0.00%	0.02%	0.01%	0.02%	0.01%	0.01%	0.00%	0.02%	0.04%	0.01%
0.63	Weight (g)	0.47	0.59	1.11	0.98	0.86	2	1.12	1.9	1.78	2.24	0.96	0.82	1.16	1.16	1.37	18.52
	Proportion (%)	0.14%	0.16%	0.34%	0.31%	0.29%	0.67%	0.39%	0.67%	0.63%	0.84%	0.33%	0.26%	0.42%	0.42%	0.47%	0.41%
0.125	Weight (g)	51.59	56.14	54.46	66.27	67.14	140.52	96.16	96.2	48.73	71.6	59.63	80.51	70.71	61.96	70.15	1091.77
	Proportion (%)	15.66%	15.27%	16.60%	21.00%	22.39%	46.80%	33.81%	34.11%	17.19%	26.75%	20.46%	25.28%	25.89%	22.56%	24.08%	24.22%
0.25	Weight (g)	273.63	307.1	271.47	209.07	231.23	146.37	178.95	183.06	231.82	191.95	225.23	209.2	195.09	200.76	204.73	3259.66
	Proportion (%)	83.07%	83.56%	82.73%	66.24%	77.12%	48.75%	62.92%	64.90%	81.80%	71.70%	77.28%	65.70%	71.43%	73.09%	70.27%	72.32%
0.5	Weight (g)	3.59	3.61	1.09	0.65	0.51	0.49	0.3	0.85	1.02	1.19	5.38	27.27	5.93	10.47	14.54	76.89
	Proportion (%)	1.09%	0.98%	0.33%	0.21%	0.17%	0.16%	0.11%	0.30%	0.36%	0.44%	1.85%	8.56%	2.17%	3.81%	4.99%	1.71%
1	Weight (g)	0.08	0.09	0.01	0.08	0.02	0.09	0.01	0.01	0.02	0.03	0.21	0.59	0.21	0.28	0.45	2.18
	Proportion (%)	0.02%	0.02%	0.00%	0.03%	0.01%	0.03%	0.00%	0.00%	0.01%	0.01%	0.07%	0.19%	0.08%	0.10%	0.15%	0.05%
2	Weight (g)	0	0	0	0.01	0.06	0.07	0.1	0	0	0	0.01	0	0.01	0	0	0.26
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.02%	0.02%	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
4	Weight (g)	0	0	0	0	0	0.08	0.14	0	0	0	0	0	0	0	0	0.22
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
8	Weight (g)	0	0	0	0	0	0.6	0	0	0	0.64	0	0	0	0	0	1.24
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.20%	0.00%	0.00%	0.00%	0.24%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%
16	Weight (g)	0	0	0	11.19	0	1.85	0	0	0	0	0	0	0	0	0	13.04
	Proportion (%)	0.00%	0.00%	0.00%	3.55%	0.00%	0.62%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.29%
32	Weight (g)	0	0	0	27.37	0	8.17	7.64	0	0	0	0	0	0	0	0	43.18
	Proportion (%)	0.00%	0.00%	0.00%	8.67%	0.00%	2.72%	2.69%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.96%
64	Weight (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Proportion (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Total Dry Weight (g)	329.38	367.54	328.15	315.64	299.83	300.27	284.42	282.07	283.41	267.7	291.46	318.42	273.12	274.69	291.35	4507.45
	Total Proportion (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Appendix 10: Organic matter data sheets

Table 1. Organic matter weight (g) across Diego Garcia Index beach, stations 10, 30, 50, 70 and 90.

Station	10	30	50	70	90
Sub sample size	1/4	1/4	1/4	1/4	1/4
Depth			Weight (g)		
4	NA	0.1436	0.019	0	0.3095
8	NA	0.1544	0.2852	0	0.467
12	NA	0.1554	0.0752	0	0.4724
16	0.4862	0.125	0.078	0	0.3573
20	0.4476	0.3254	0.1749	0	0.1616
24	NA	0.2063	0.1085	0	0.4125
28	0.3087	0.253	0.2141	0	0.7421
32	0.3933	0.2087	0.1093	0	0.3176
36	0.4416	0.1642	0.0906	0	0.3184
40	0.2696	0.0962	0.0685	0	0.1708
44	NA	0.0575	0.1104	0	0.3761
48	0.2503	0.1016	0.0659	0	0.4238
52	0.3712	0.2303	0.1347	0	0.3153
56	0.6006	0.1481	0.0927	0	0.1669
60	0.2364	0.0803	0.0319	0.3112	0.1647
Mean	0.38055	0.16333333	0.11059333	0.06567	0.34506667
S.e.	0.037009507	0.0184316	0.01790317	0.02074667	0.03979093

Station	10	30	50	70	90	
Sub sample size	Full	Full	Full	Full	Full	
Depth		Density (g/m-3)				
4	NA	1826.592	241.68	0	3936.84	
8	NA	1963.968	3627.744	0	5940.24	
12	NA	1976.688	956.544	0	6008.928	
16	6184.464	1590	992.16	0	4544.856	
20	5693.472	4139.088	2224.728	0	2055.552	
24	NA	2624.136	1380.12	0	5247	
28	3926.664	3218.16	2723.352	0	9439.512	
32	5002.776	2654.664	1390.296	0	4039.872	
36	5617.152	2088.624	1152.432	0	4050.048	
40	3429.312	1223.664	871.32	0	2172.576	
44	NA	731.4	1404.288	0	4783.992	
48	3183.816	1292.352	838.248	0	5390.736	
52	4721.664	2929.416	1713.384	0	4010.616	
56	7639.632	1883.832	1179.144	0	2122.968	
60	3007.008	1021.416	405.768	3958.464	2094.984	
Mean	4840.596	2077.6	1406.7472	263.8976	4389.248	2595.61776
S.e.	470.76093	234.449983	227.728314	263.8976	506.140668	876.804176

Table 2. Organic matter weight (g) across Nelson's beach, stations 10, 30, 50, 70 and 90.

Station	10	30	50	70	90
Sub sample size	1/4	1/4	1/4	1/4	1/4
Depth			Weight (g)		
4	0.0188	0.8416	0.0874	0.2509	0.025
8	0.1927	0.4028	0.0898	0.3545	0.0413
12	0.0847	0.402	0.0816	0.4103	0.1206
16	0.1001	0.4153	0	0.5269	0.278
20	0.1785	0.3845	0	0.1015	1.1234
24	0.27	0.3235	0	0.4089	0.2147
28	0.0528	0.1867	0.0594	0.345	0.0814
32	0.4724	0.2782	0.0502	0.4831	0.3748
36	0.0405	0.3402	0.115	0.2509	0.3315
40	0.0462	0.3606	0.0871	0.3252	0.0447
44	0.2534	0.4311	0.0518	0.1281	0.2493
48	0.2437	0.1243	0.1864	0.0588	0.2298
52	0.1816	0.5338	0.1025	0.0347	0.1306
56	0.24	0.3436	0.0896	0.2306	0.2574
60	0.173	0.185	0.0904	0.1053	0.0907
Mean	0.169893333	0.37021333	0.07274667	0.26764667	0.23954667
S.e.	0.030885349	0.04352268	0.01271946	0.04047475	0.06924873

Station	10	30	50	70	90	
Sub sample size	Full	Full	Full	Full	Full	
Depth		Density (g/m-3)				
4	239.136	10705.152	1111.728	3191.448	318	
8	2451.144	5123.616	1142.256	4509.24	525.336	
12	1077.384	5113.44	1037.952	5219.016	1534.032	
16	1273.272	5282.616	0	6702.168	3536.16	
20	2270.52	4890.84	0	1291.08	14289.648	
24	3434.4	4114.92	0	5201.208	2730.984	
28	671.616	2374.824	755.568	4388.4	1035.408	
32	6008.928	3538.704	638.544	6145.032	4767.456	
36	515.16	4327.344	1462.8	3191.448	4216.68	
40	587.664	4586.832	1107.912	4136.544	568.584	
44	3223.248	5483.592	658.896	1629.432	3171.096	
48	3099.864	1581.096	2371.008	747.936	2923.056	
52	2309.952	6789.936	1303.8	441.384	1661.232	
56	3052.8	4370.592	1139.712	2933.232	3274.128	
60	2200.56	2353.2	1149.888	1339.416	1153.704	
Mean	2161.0432	4709.1136	925.3376	3404.4656	3047.0336	2849.39872
S.e.	392.861644	553.608466	161.791527	514.838869	880.843806	631.725523

Table 3. Organic matter weight (g) across Parasol beach, stations 10, 30, 50, 70 and 90.

Station	10	30	50	70	90
Sub sample size	1/4	1/4	1/4	1/4	1/4
Depth			Weight (g)		
4	0	0.037	0.057	0	0.0026
8	0	0.1489	0.1523	0	0
12	0.0186	0.0636	0.1123	0	0
16	0	0.0014	0	0	0
20	0	0	0	0	0.0082
24	0.0038	0	0	0	0
28	0.0068	0	0	0	0
32	0	0	0	0	0
36	0	0	0.2146	0	0
40	0	0	0.2043	0	0.0029
44	0	0	0.3225	0	0
48	0	0	0.5166	0	0
52	0	0	0.5076	0	0
56	0	0	0.0837	0	0
60	0	0	NA	0	0
Mean	0.001946667	0.01672667	0.15506429	0	0.00091333
S.e.	0.001290621	0.01055381	0.04836693	0	0.00057693

Station	10	30	50	70	90	
Sub sample size	Full	Full	Full	Full	Full	
Depth		Density (g/m-3)				
4	0	470.64	725.04	0	33.072	
8	0	1894.008	1937.256	0	0	
12	236.592	808.992	1428.456	0	0	
16	0	17.808	0	0	0	
20	0	0	0	0	104.3	
24	48.336	0	0	0	0	
28	86.496	0	0	0	0	
32	0	0	0	0	0	
36	0	0	2729.712	0	0	
40	0	0	2598.696	0	36.888	
44	0	0	4102.2	0	0	
48	0	0	6571.152	0	0	
52	0	0	6456.672	0	0	
56	0	0	1064.664	0	0	
60	0	0	NA	0	0	
Mean	24.7616	212.7632	1972.418	0	11.618	444.312023
S.e.	16.4166943	134.2445	615.2273	0	7.3385	384.017061

Table 4. Organic matter weight (g) across Egmont beach, stations 70 and 90.

Station	70	90		Station	70	90	
Sub sample size	1/4	1/4		Sub sample size	Full	Full	
Depth	Weight (g)			Depth	Density (g/m-3)		
4	0.1157	0.0525		4	1471.704	667.8	
8	0.123	0.0774		8	1564.56	984.528	
12	0.3902	0.1162		12	4963.344	1478.064	
16	0.2891	0.1134		16	3677.352	1442.448	
20	0.2121	0.0798		20	2697.912	1015.056	
24	0.3887	0.1074		24	4944.264	1366.128	
28	0.4462	0.3342		28	5675.664	4251.024	
32	0.5346	0.1279		32	6800.112	1626.888	
36	0.5303	0.0913		36	6745.416	1161.336	
40	0.3465	0.1454		40	4407.48	1849.488	
44	0.2521	0.1069		44	3206.712	1359.768	
48	0.3539	0.2629		48	4501.608	3344.088	
52	0.2159	0.0637		52	2746.248	810.264	
56	0.2995	0.0085		56	3809.64	108.12	
60	0.3232	0.057		60	4111.104	725.04	
Mean	0.3214	0.1163		Mean	4088.208	1479.336	2783.772
S.e.	0.03285596	0.02133344		S.e.	417.927754	271.361401	1304.436

Table 5. Organic matter weight (g) across Boddam beach, stations 70 and 90.

Station	70	90		Station	70	90	
Sub sample size	1/4	1/4		Sub sample size	Full	Full	
Depth	Weight (g)			Depth	Density (g/m-3)		
4	0.0442	0.0377		4	562.224	479.544	
8	0.3132	0		8	3983.904	0	
12	0.0907	0.0505		12	1153.704	642.36	
16	0.1136	0.0834		16	1444.992	1060.848	
20	0	0.0116		20	0	147.552	
24	0.3421	0.0185		24	4351.512	235.32	
28	0	0.0239		28	0	304.008	
32	0	0.027		32	0	343.44	
36	0	0		36	0	0	
40	0	0.0569		40	0	723.768	
44	0	0		44	0	0	
48	0	0.0445		48	0	566.04	
52	0	0		52	0	0	
56	0	0		56	0	0	
60	0	0		60	0	0	
Mean	0.06025333	0.0236		Mean	766.4224	300.192	533.3072
S.e.	0.02958078	0.00674981		S.e.	376.267565	85.8575547	233.1152

Appendix 11: R code

```
################Sediment – mean grain size across islands – line graph - multipanel
library (ggplot2)
library (tidyverse)
library (dplyr)
library (hrbrthemes)
library (ggpubr)
library (cowplot)
library (patchwork)
setwd ("~/Desktop")
all <- read.csv ("SedAll.csv",header=TRUE,sep=",")
names (all)<-c("Beach","Depth","Station","Mean")
head(all)
all$Station = as.factor (all$Station)
all$Depth = as.factor (all$Depth)
B<-all[all$Beach=="BP",]
E<-all[all$Beach=="EP",]
DG<-all[all$Beach=="DGP",]
N<-all[all$Beach=="NP",]
P<-all[all$Beach=="PP",]
nrow(B)
nrow(E)
nrow(DG)
nrow(N)
nrow(P)
#############Creating graphs
boxB <- ggplot(data=B,aes(x=Depth,y=Mean,group=Station,colour=Station))
boxE <- ggplot(data=E,aes(x=Depth,y=Mean,group=Station, colour=Station))
boxDG <- ggplot(data=DG,aes(x=Depth,y=Mean,group=Station, colour=Station))
boxN <- ggplot(data=N,aes(x=Depth,y=Mean,group=Station, colour=Station))
boxP <- ggplot(data=P,aes(x=Depth,y=Mean,group=Station, colour=Station))
###############Creating panel
plot1<- boxDG + geom_line() + ylim(0.25,1.6) + theme(panel.background = element_blank())
+ ylab("Grain size (mm)") + xlab ("Depth (cm)") + theme(axis.title.y =
element_text(vjust=0.2)) + theme_classic() + theme(legend.position="none") +
scale_x_discrete(breaks = seq(0, 60, by = 4))  + labs(tag="(a)")
plot1
plot2<- boxP + geom_line()  + ylim(0.25,1.6) + theme(panel.background = element_blank())
+ ylab("Grain size (mm)") + xlab ("Depth (cm)") + theme(axis.title.y =
element_text(vjust=0.2)) + theme_classic() + theme(legend.position="none") +
scale_x_discrete(breaks = seq(0, 60, by = 4))  + labs(tag="(b)")
plot2
plot3<- boxE + geom_line()  + ylim(0.25,1.6) + theme(panel.background = element_blank())
+ ylab("Grain size (mm)") + xlab ("Depth (cm)") + theme(axis.title.y =
element_text(vjust=0.2)) + theme_classic() + theme(legend.position="none") +
scale_x_discrete(breaks = seq(0, 60, by = 4))  + labs(tag="(c)")
```

```
plot3
plot4<- boxB + geom_line() + ylim(0.25,1.6) + theme(panel.background = element_blank()) +
ylab("Grain size (mm)") + xlab ("Depth (cm)") + theme(axis.title.y = element_text(vjust=0.2))
+ theme_classic() + theme(legend.position="none") + scale_x_discrete(breaks = seq(0, 60,
by = 4))  + labs(tag="(d)")
plot4
plot5<- boxN + geom_line() + theme(panel.background = element_blank()) + ylab("Grain size
(mm)") + xlab ("Depth (cm)") + theme_classic() + theme(axis.title.y =
element_text(vjust=0.2)) + theme_classic() + theme(legend.position="none") +
scale_x_discrete(breaks = seq(0, 60, by = 4))  + labs(tag="(e)")
plot5
plot_grid(plot1,plot2,plot3,plot4,plot5,nrow=3)
##################Scatter – mean grain size as a function of depth (all Islands data)
setwd ("~/Desktop")
DGmeangs <- read.csv ("dggsmean.csv",header=TRUE,sep=",")
library (ggplot2)
scatter <- ggplot(DGmeangs,aes(Depth,MeanGrainSize,colour=Station))
scatter +geom_point()
scatter + theme(panel.background = element_blank()) + geom_point()
+geom_smooth(method="lm",aes(fill=Station), alpha = 0.1) + labs(x="Depth",y="Mean grain
size (mm)") + theme_classic()
######## Running lm stats to see if there is correlation between mean grain size & depth
NL50 <- lm(MeanGrainSize~Depth, data =NL50)
summary (NL50)
######## Analysis grain size as a factor of depth - violin plot.
setwd ("~/Desktop")
grain_size <- read.csv ("grain_size.csv",header=TRUE,sep=",")
attach (grain_size)
library (gcookbook)
library (ggplot2)
p <- ggplot(grain_size, aes(x=Depth, y=Grain,group=depth))
p + geom_violin(trim=F) + scale_color_grey(p) + theme_classic() +
geom_jitter(shape=12,size=0.1,position=position_jitter(0.2))
rm (list=ls())
############ Regression analysis - grain size & organic matter.
setwd ("~/Desktop")
gs_om <- read.csv ("GSOMKG.csv",header=TRUE,sep=",")
attach (gs_om)
names (gs_om)
par(yaxs="r",xaxs="r")
par (bty="L")
plot (om~grainsize,xlab=("Mean grain size (mm)"),ylab=("Organic matter kg/m3"))
######## Running lm stats to see if there is correlation between grain size and organic
matter
GSOM <- lm(OM~GS, data =GSOM)
summary (GSOM)
####### Analysis of Diego Garcia's Intra-beach organic matter – boxplot.
```

```
setwd ("~/Desktop/Organic Matter")
getwd ()
DG_OM <- read.csv ("OM_DG_KG.csv",header=TRUE,sep=",")
attach (DG_OM)
par (bty="L")
par(yaxs="r",xaxs="r")
boxplot (DG_OM,na.rm=TRUE,names=c("10","30","50","70","90"))
rm (list=ls()
############ Analysis of Parasol's Intra-beach organic matter – boxplot.
setwd ("~/Desktop/Organic Matter/Parasol")
getwd ()
P_OM <- read.csv ("P_OM.csv",header=TRUE,sep=",")
attach (P_OM)
par (bty="L")
boxplot (P_OM,na.rm=TRUE,las=1,names=c("10","30","50","70","90"))
rm (list=ls()
####### Analysis of Nelson's Intra-beach organic matter – boxplot.
setwd ("~/Desktop/Organic Matter/Nelson")
getwd ()
N_OM <- read.csv ("N_OM.csv",header=TRUE,sep=",")
attach (N_OM)
par (bty="L")
boxplot (N_OM, na.rm=TRUE,names=c("10","30","50","70","90"))
rm (list=ls()
######## Analysis of Boddam's Intra-beach organic matter – boxplot.
setwd ("~/Desktop/Organic Matter/Boddam")
getwd ()
B_OM <- read.csv ("B_OM.csv",header=TRUE,sep=",")
attach (B_OM)
par (bty="L")
boxplot (B_OM,names=c("70","90"))
rm (list=ls()
####### Analysis of Egmont's Intra-beach organic matter – boxplot.
setwd ("~/Desktop/Organic Matter/Egmont")
getwd ()
E_OM <- read.csv ("E_OM.csv",header=TRUE,sep=",")
attach (E_OM)
par (bty="L")
boxplot(E_OM,names=c("70","90"))
rm (list=ls()
###### Analysis of Inter Island organic matter – boxplot.
library (ggplot2)
setwd ("~/Desktop")
all <- read.csv ("IOM.csv",header=TRUE,sep=",")
attach (all)
all$Island= as.factor (all$Island)
all$Island <- factor (all$Island,levels=c("N","E","DG","B","P"))
```

```
head (all)
ggplot(data=all,aes(x=Island,y=OM)) + geom_boxplot(aes(middle=mean(OM))) +
theme_classic() + ylab(expression(paste("(Organic matter (kg/m"^-3,")"))) + xlab("Islands")
rm (list=ls()
#############Scatter graph & lm
setwd ("~/Desktop")
P <- read.csv ("OM_Plastic.csv",header=TRUE,sep=",")
attach (P)
names (P)
par(yaxs="r",xaxs="r")
par (bty="L")
plot (OM~MP,cex=0.8,xlab=(""),ylab=(""),las=1)
######## Running lm stats to see if there is correlation between microplastics and organic
matter
MP <- lm(MP~OM, data =P)
summary (P)
abline (lm(OM~MP))
##########Inter island microplastic concentration
setwd ("~/Desktop")
I<- read.csv ("PI.csv",header=TRUE,sep=",")
attach (I)
names (I)
library (ggplot2)
library (tidyverse)
library (dplyr)
library (hrbrthemes)
I$Island = as.factor (I$Island)
I$Island <- factor (I$Island, levels = c("E","B","DG","N","P"))
ggplot(data=I,aes(x=Island,y=Value)) + geom_boxplot(aes(middle=mean(Value))) +
theme_classic() + ylab("Microplastics (Thousands particles/m³)")+ xlab("Islands") +
scale_y_continuous(breaks=seq(0,3000, by = 500))
##########Microplastic sizes – all islands – multi panel
library (ggplot2)
library (tidyverse)
library (dplyr)
library (hrbrthemes)
library (ggpubr)
library (cowplot)
library (patchwork)
setwd ("~/Desktop")
all <- read.csv ("AllSize.csv",header=TRUE,sep=",")
names (all)<-c("Beach","Size","Value")
head(all)
all$Size = as.factor (all$Size)
all$Size<- factor (all$Size, levels = c("1-4.99","0.5-0.99","0.25-0.49","0.15-0.24"))
B<-all[all$Beach=="BP",]
E<-all[all$Beach=="EP",]
DG<-all[all$Beach=="DGP",]
I<-all[all$Beach=="IP",]
```

```
nrow(B)
nrow(E)
nrow(DG)
nrow(I)
#############Creating graphs
barE <- ggplot(data=E,aes(x=Size,y=Value))
barB <- ggplot(data=B,aes(x=Size,y=Value))
barDG <- ggplot(data=DG,aes(x=Size,y=Value))
barI <- ggplot(data=I,aes(x=Size,y=Value))
###############Creating panel
plot1 <- barE + stat_summary(fun=mean,geom="bar",position="dodge") +
theme(panel.background = element_blank()) + ylab(expression(paste("(Particles (000s.m"^-
3,")"))) + xlab("Size") + theme_classic() + theme(axis.title.y = element_text(vjust=0.1)) +
theme(legend.position="none") + stat_summary(fun.data =
mean_cl_normal,geom="errorbar",position = position_dodge(width=0.90),width=0.2)  +
labs(tag="(a)")
plot1
plot2 <- barB + coord_cartesian(ylim=c(0,150)) +
stat_summary(fun=mean,geom="bar",position="dodge") + theme(panel.background =
element_blank()) + ylab(expression(paste("(Particles (000s.m"^-3,")"))) + xlab("Size") +
theme_classic() + theme(axis.title.y = element_text(vjust=0.1)) +
theme(legend.position="none") + stat_summary(fun.data =
mean_cl_normal,geom="errorbar",position = position_dodge(width=0.90),width=0.2)  +
labs(tag="(b)")
plot2
plot3 <- barDG + coord_cartesian(ylim=c(0,150)) +
stat_summary(fun=mean,geom="bar",position="dodge") + theme(panel.background =
element_blank()) + ylab(expression(paste("(Particles (000s.m"^-3,")"))) + xlab("Size") +
theme_classic() + theme(axis.title.y = element_text(vjust=0.1)) +
theme(legend.position="none") + stat_summary(fun.data =
mean_cl_normal,geom="errorbar",position = position_dodge(width=0.90),width=0.2)  +
labs(tag="(c)")
plot3
plot4 <- barI + coord_cartesian(ylim=c(0,150)) +
stat_summary(fun=mean,geom="bar",position="dodge") + theme(panel.background =
element_blank()) + ylab(expression(paste("(Particles (000s.m"^-3,")"))) + xlab("Size") +
theme_classic() + theme(axis.title.y = element_text(vjust=0.1)) +
theme(legend.position="none") + stat_summary(fun.data =
mean_cl_normal,geom="errorbar",position = position_dodge(width=0.90),width=0.2)  +
labs(tag="(d)")
plot4
plot_grid(plot1,plot2,plot3,plot4)
##########Microplastic colours – all islands – multi panel
library (ggplot2)
library (tidyverse)
library (dplyr)
library (hrbrthemes)
library (ggpubr)
library (cowplot)
library (patchwork)
```

```
library (Hmisc)
setwd ("~/Desktop")
all <- read.csv ("AllColour.csv",header=TRUE,sep=",")
all$Colour <- factor
(all$Colour,levels=c("OR","YL","BL","TL","WT","GN","GY","RD","BN","BK","PK"))
names (all)<-c("Beach","Colour","Value")
head(all)
all$Colour= as.factor (all$Colour)
E<-all[all$Beach=="EP",]
DG<-all[all$Beach=="DGP",]
I<-all[all$Beach=="IP",]
nrow(E)
nrow(DG)
nrow(I)
#####################Creating the graphs
barE <- ggplot(data=E,aes(x=Colour,y=Value))
barDG <- ggplot(data=DG,aes(x=Colour,y=Value))
barI <- ggplot(data=I,aes(x=Colour,y=Value))
#####################Creating panel
plot1 <- barE + coord_cartesian(ylim=c(0,400)) +
stat_summary(fun=mean,geom="bar",position="dodge") + theme(panel.background =
element_blank()) + ylab(expression(paste("(Particles (000s.m"^-3,")"))) + xlab("Colour") +
theme(axis.title.y = element_text(vjust=0.5)) + theme_classic()  +
theme(axis.title.y=element_text(vjust=0.1)) + theme(legend.position="none") +
stat_summary(fun.data = mean_cl_normal,geom="errorbar",ymin=0,position =
position_dodge(width=0.90),width=0.2) + labs(tag="(a)")
plot1
plot2 <- barDG + coord_cartesian(ylim=c(0,400)) +
stat_summary(fun=mean,geom="bar",position="dodge") + theme(panel.background =
element_blank()) + ylab(expression(paste("(Particles (000s.m"^-3,")"))) + xlab("Colour") +
theme(axis.title.y = element_text(vjust=0.5)) + theme_classic()  +
theme(axis.title.y=element_text(vjust=0.1)) + theme(legend.position="none") +
stat_summary(fun.data =
mean_cl_normal,geom="errorbar",ymin=c(0,2,0,3,0,0,0,0,0,14,0),position =
position_dodge(width=0.90),width=0.2) + labs(tag="(b)")
plot2
plot3 <- barI  + coord_cartesian(ylim=c(0,400)) +
stat_summary(fun=mean,geom="bar",position="dodge") + theme(panel.background =
element_blank()) + ylab(expression(paste("(Particles (000s.m"^-3,")"))) + xlab("Colour") +
theme(axis.title.y = element_text(vjust=0.5)) + theme_classic() +
theme(axis.title.y=element_text(vjust=0.1)) + theme(legend.position="none") +
stat_summary(fun.data = mean_cl_normal,geom="errorbar",ymin=0,position =
position_dodge(width=0.90),width=0.2) + labs(tag="(c)")
plot3
plot_grid(plot1,plot2,plot3)
##########Microplastic shape – all islands – multi panel
library (ggplot2)
```

```
library (tidyverse)
library (dplyr)
library (hrbrthemes)
library (ggpubr)
library (cowplot)
library (patchwork)
library (Hmisc)
setwd ("~/Desktop")
all <- read.csv ("AllShape.csv",header=TRUE,sep=",")
names (all)<-c("Beach","Shape","Value")
head(all)
all$Shape= as.factor (all$Shape)
all$Shape <- factor (all$Shape,levels=c("Fragment","Foam","Fibre","Film","Pellet"))
E<-all[all$Beach=="EP",]
DG<-all[all$Beach=="DGP",]
I<-all[all$Beach=="IP",]
nrow(E)
nrow(DG)
nrow(I)
#####################Creating the graphs
barE <- ggplot(data=E,aes(x=Shape,y=Value))
barDG <- ggplot(data=DG,aes(x=Shape,y=Value))
barI <- ggplot(data=I,aes(x=Shape,y=Value))
#####################Creating panel
plot1 <- barDG + coord_cartesian(ylim=c(0,50)) +
stat_summary(fun=mean,geom="bar",position="dodge") + theme(panel.background =
element_blank()) + ylab(expression(paste("(Particles (000s.m"^-3,")"))) + xlab("Shape") +
theme_classic() + theme(axis.title.y=element_text(vjust=0.1)) +
theme(legend.position="none") + stat_summary(fun.data =
mean_cl_normal,geom="errorbar",ymin=c(14,4,0,0,0),position =
position_dodge(width=0.90),width=0.2) + labs(tag="(a)")
plot1
plot2 <- barI + stat_summary(fun=mean,geom="bar",position="dodge") +
theme(panel.background = element_blank()) + ylab(expression(paste("(Particles (000s.m"^-
3,")"))) + xlab("Shape") + theme_classic() + theme(axis.title.y=element_text(vjust=0.1)) +
theme(legend.position="none") + stat_summary(fun.data =
mean_cl_normal,geom="errorbar",ymin=c(18,2,0,0,0),position =
position_dodge(width=0.90),width=0.2) + labs(tag="(b)")
plot2
plot3 <- barE + coord_cartesian(ylim=c(0,150))
+stat_summary(fun=mean,geom="bar",position="dodge") + theme(panel.background =
element_blank()) + ylab(expression(paste("(Particles (000s.m"^-3,")"))) + xlab("Shape") +
theme_classic() + theme(axis.title.y = element_text(vjust=0.1)) +
theme(legend.position="none") + stat_summary(fun.data =
mean_cl_normal,geom="errorbar",ymin=0,position =
position_dodge(width=0.90),width=0.2) + labs(tag="(c)")
plot3
```

```
plot_grid(plot1,plot2,plot3)
##########Microplastic polymer – all islands – multi panel
library (ggplot2)
library (tidyverse)
library (dplyr)
library (hrbrthemes)
library (ggpubr)
library (cowplot)
library (patchwork)
library (Hmisc)
setwd ("~/Desktop")
all <- read.csv ("AllPolymer.csv",header=TRUE,sep=",")
names (all)<-c("Beach","Polymer","Value")
head(all)
all$Polymer= as.factor (all$Polymer)
all$Polymer <- factor (all$Polymer,levels=c("LDPE","PP","PS","HDPE","PVC","PET"))
E<-all[all$Beach=="EP",]
DG<-all[all$Beach=="DGP",]
I<-all[all$Beach=="IP",]
nrow(E)
nrow(DG)
nrow(I)
#####################Creating the graphs
barE <- ggplot(data=E,aes(x=Polymer,y=Value))
barDG <- ggplot(data=DG,aes(x=Polymer,y=Value))
barI <- ggplot(data=I,aes(x=Polymer,y=Value))
#####################Creating panel
plot1 <- barE + coord_cartesian(ylim=c(0,25)) +
stat_summary(fun=mean,geom="bar",position="dodge") + theme(panel.background =
element_blank()) + ylab(expression(paste("(Particles (000s.m"^-3,")"))) + xlab("Polymer") +
theme_classic() + theme(axis.title.y=element_text(vjust=0.1)) +
theme(legend.position="none")  + stat_summary(fun.data =
mean_cl_normal,geom="errorbar",ymin=0,position =
position_dodge(width=0.90),width=0.2) + labs(tag="(a)")
plot1
plot2 <- barDG + coord_cartesian(ylim=c(0,25)) +
stat_summary(fun=mean,geom="bar",position="dodge") + theme(panel.background =
element_blank()) + ylab(expression(paste("(Particles (000s.m"^-3,")"))) + xlab("Polymer") +
theme_classic() + theme(axis.title.y=element_text(vjust=0.1)) +
theme(legend.position="none") + stat_summary(fun.data =
mean_cl_normal,geom="errorbar",position = position_dodge(width=0.90),width=0.2) +
labs(tag="(b)")
plot2
plot3 <- barI + coord_cartesian(ylim=c(0,25)) +
stat_summary(fun=mean,geom="bar",position="dodge") + theme(panel.background =
element_blank()) + ylab(expression(paste("(Particles (000s.m"^-3,")"))) + xlab("Polymer") +
theme_classic() + theme(axis.title.y=element_text(vjust=0.1)) +
```

```
theme(legend.position="none") + stat_summary(fun.data =
mean_cl_normal,geom="errorbar",ymin=c(7,3,2,3,2,0),position =
position_dodge(width=0.90),width=0.2) + labs(tag="(c)")
plot3
plot_grid(plot1,plot2,plot3)
#######################All depths – Frequency particles per depth
setwd ("~/Desktop")
D<- read.csv ("ParticleNumberDepth.csv",header=TRUE,sep=",")
attach (D)
names (D)
library (ggplot2)
D$Depth = as.factor (D$Depth)
line <- ggplot (D,aes(Depth,Microplastics))
line + stat_summary(fun.y = mean, geom = "point") + stat_summary(fun.y = mean, geom =
"line", aes(group=1),colour="Blue",linetype="dashed") + stat_summary(fun.data = mean_se,
geom = "errorbar", width = 0.2) + theme_classic() + theme(axis.title.y = element_blank()) +
theme(axis.title.x = element_blank()) + theme(axis.text.y = element_text(angle = 90)) +
theme(axis.text.x = element_text(angle = 90))
rm (list=ls()
######## Running lm stats to see if there is correlation between microplastic frequency and
sediment depth
D <- lm(Total~Depth, data =D)
summary (D)
############################ Quadratic regression model
Depth2 <- Depth^2
quadratic.model <-lm(Total ~ Depth + Depth2)
summary(quadratic.model)
#####################Fit line to model
Depth2 <- Depth^2
quadratic.model <-lm(Total ~ Depth + Depth2)
summary(quadratic.model)
DepthValues <- seq(0,60,0.1)
predictedTotal <- predict(quadratic.model,list(Depth=DepthValues,
Depth2=DepthValues^2))
plot (Total~Depth,cex=0.8,xlab= (""), ylab=(""))
lines(DepthValues, predictedTotal, col= "blue",lwd = 3)
#####################ANOVA - comparing models, linear model and null model
anova (MP,nullm,test ="F")
###############ANOVA – comparing models, quadratic model & linear model
anova (quadratic.model,MP,test="F")
##################Trying asymptotic model to see if it is a better fit than quadratic model
Depth1 <- exp(-D$Depth)
asymptotic <- lm (D$Total~Depth1)
summary (asymptotic)
###############QQ plots quadratic, asymptotic and lm
plot(MP)
plot(quadratic.model)
plot(asymptotic)
###############Grain size – intra-depth variation
setwd ("~/Desktop")
```

```
D <- read.csv ("GSD.csv",header=TRUE,sep=",")
attach (D)
names (D)
##################### test homogeneity of variance – Bartlett Test
bartlett.test (mean~depth,data=D)
##############Boxplot
boxplotN <- ggplot (D, aes(x=depth,y=mean,group=depth))
boxplotN + geom_boxplot() + theme_classic()
################ log
D$logmean <- log (D$mean)
head (D)
#################Bartlett test of homogenity
bartlett.test (logmean~depth,data=D)
################Kruskal Wallace test
kruskal.test (mean~depth)
####################### Grain Size – Intra-beach variation – Diego Garcia
setwd ("~/Desktop")
DG <- read.csv ("DG.csv",header=TRUE,sep=",")
attach (DG)
names (DG)
##################### test homogeneity of variance – Bartlett Test
bartlett.test (Mean~Station,data=DG)
###############Anova – Diego Garcia Island
anv.model <- aov (Mean~Station)
summary (anv.model)
##################Test the residual distribution with Shapiro Wilks
shapiro.test(anv.model$residuals)
##################Boxplot
boxplotDG <- ggplot (DG, aes(x=Station,y=Mean,group=Station))
boxplotDG + geom_boxplot() + theme_classic()
################ Log (Mean)
DG$logMean <- log (DG$Mean)
############ Anova
anv.model <- aov (DG$logMean~Station)
summary (anv.model)
############Test residual distribution
shapiro.test(anv.model2$residuals)
################Kruskal Wallace test
kruskal.test (Mean~Station)
###############Wilcoxon rank sum test, which pairs of stations are significantly different
from each other?
##############
Library (pgirmess)
kruskalmc (Mean~Station)
####################### Grain Size – Intra-beach variation – Nelson
setwd ("~/Desktop")
N <- read.csv ("N.csv",header=TRUE,sep=",")
attach (N)
names (N)
##################### test homogeneity of variance – Bartlett Test
```

```
bartlett.test (Mean~Station)
#################As data doesn't meet assumption homogeneity of variance must log data
or use Kruskal Wallis test.
###############Boxplot
boxplotN <- ggplot (N, aes(x=Station,y=Mean,group=Station))
boxplotN + geom_boxplot() + theme_classic()
################# Log (Mean)
N$logMean <- log (N$Mean)
############# Anova
anv.model <- aov (N$logMean~Station)
summary (anv.model)
###################### Test assumption with Shapiro Wilks
shapiro.test (anv.model$residuals)
############################
kruskal.test (Mean~Station)
################ Wilcoxon rank sum test to show which pairs of stations are different.
################Wilcoxon rank sum test.
Library (pgirmess)
Kruskalmc (Mean~Station)
######################## Grain Size – Intra-beach variation – Parasol
setwd ("~/Desktop")
P <- read.csv ("P.csv",header=TRUE,sep=",")
attach (P)
names (P)
###################### Test homogeneity of variance – Bartlett Test
bartlett.test (Mean~Station,data=P)
################# Looking at data with boxplots
boxplotP <- ggplot (P, aes(x=Station,y=Mean,group=Station))
boxplotP + geom_boxplot() + theme_classic()
#################As data doesn't meet assumption homogeneity of variance must log data
or use Kruskal Wallis test.
################# Log data
P$logMean <- log (P$Mean)
######################
############# Anova
anv.model <- aov (P$logMean~Station)
summary (anv.model)
###################### Test assumption with Shapiro Wilks
shapiro.test (anv.model$residuals)
############################
kruskal.test (Mean~Station)
#################### Kruskal Wallace multiple comparison test to show which pairs of
stations are different.
#######
kruskalmc (Mean~Station)
######################## Grain Size – Intra-beach variation – Egmont
setwd ("~/Desktop")
E <- read.csv ("E.csv",header=TRUE,sep=",")
attach (E)
names (E)
```

```
###################### test homogeneity of variance – Bartlett Test
bartlett.test (Mean~Station)
######################## look at data with boxplots
boxplot <- ggplot (E, aes(x=Station,y=Mean,group=Station))
boxplot + geom_boxplot() + theme_classic()
################Anova
anv.model <- aov (Mean~Station)
summary (anv.model)
###################### Test assumption with Shapiro Wilks
shapiro.test (anv.model$residuals)
################# Log data
E$logMean <- log (E$Mean)
######################
############ Anova
anv.model2 <- aov (E$logMean~Station)
summary (anv.model2)
###################### Test assumption with Shapiro Wilks
shapiro.test (anv.model2$residuals)
######################Kruskal-wallis test
kruskal.test (Mean~Station)
#################### Multiple comparison test after Kruskal-Wallis which station pairs are
different?
################
Library (pgirmess)
Kruskalmc (MeanRank~Station)
######################## Grain Size – Intra-beach variation – Boddam
setwd ("~/Desktop")
B <- read.csv ("B.csv",header=TRUE,sep=",")
attach (B)
names (B)
###################### test homogeneity of variance – Bartlett Test
bartlett.test (Mean~Station,data=B)
######################## look at data with boxplots
boxplot <- ggplot (B, aes(x=Station,y=Mean,group=Station))
boxplot + geom_boxplot() + theme_classic()
################ As data doesn't meet assumption homogeneity of variance must log or use
Kruskal Wallis test.
################# Log data
B$logMean <- log (B$Mean)
############ Anova
anv.model <- aov (B$logMean~Station)
summary (anv.model)
###################### Test assumption with Shapiro Wilks
shapiro.test (anv.model$residuals)
######################Kruskal-wallis test
kruskal.test (Mean~Station)
###################Kruskal Wallace multiple comparison test, which station pairs are
different?
Library (pgirmess)
Kruskalmc (MeanRank~Station)
```

```
######################## Grain Size – Inter-island variation
setwd ("~/Desktop")
IM <- read.csv ("IM.csv",header=TRUE,sep=",")
attach (IM)
names (IM)
###################### test homogeneity of variance – Bartlett Test
bartlett.test (Mean~Island)
#################As data doesn’t meet assumption homogeneity of variance must log data
or use Kruskal Wallis test.
###############Boxplot
Library (ggplot2)
boxplot <- ggplot (IM, aes(x=Island,y=Mean,group=Island))
boxplot + geom_boxplot() + theme_classic()
################# Log (Mean)
IM$logMean <- log (IM$Mean)
############ Bartlett test
bartlett.test (IM$logMean~Island)
#################As data doesn’t meet assumption homogeneity of variance must use
Kruskal Wallis test.
######################Kruskal-wallis test
kruskal.test (Mean~Island)
#################### Kruskal Wallace multiple comparison test, which station pairs are
different?
###############
library (pgirmess)
kruskalmc (Mean~Island)
######################## Grain Size – Chagos & Seychelles, inter-island variation
setwd ("~/Desktop")
IM <- read.csv ("Sey_Chagos.csv",header=TRUE,sep=",")
attach (IM)
names (IM)
###################### test homogeneity of variance – Bartlett Test
bartlett.test (Mean~Island)
##########Boxplot
library (ggplot2)
ggplot(data=I,aes(x=Island,y=Mean)) +
scale_x_discrete(limits=c("Aldabra","Cousin","Diego
Garcia","Nelson","Parasol","Egmont","Boddam")) + geom_boxplot() + theme_classic() +
ylab("Grain size (mm)") + xlab("Islands") + theme (axis.text.x = element_text(angle =
45,hjust=1))
#################As data doesn’t meet assumption homogeneity of variance must log data
or use Kruskal Wallis test.
################# Log (Mean)
IM$logMean <- log (IM$Mean)
############ Bartlett test
bartlett.test (IM$logMean~Island)
#############Kruskal Wallace test
kruskal.test(Mean~Island)
#################### Kruskal Wallace multiple comparison test, which island pairs are
different?
```

```
##############
library (pgirmess)
kruskalmc (Mean~Island)
######################## Organic matter – Intra-beach variation – Diego Garcia
setwd ("~/Desktop")
DGOM <- read.csv ("DGOM.csv",header=TRUE,sep=",")
attach (DGOM)
names (DGOM)
###################### Test homogeneity of variance – Bartlett Test
bartlett.test (OM~Station)
#################As data doesn't meet assumption homogeneity of variance must log data
or use Kruskal Wallis test.
##############Boxplot
boxplot <- ggplot (DGOM, aes(x=Station,y=OM,group=Station))
boxplot + geom_boxplot() + theme_classic()
################# Kruskal Wallis test
kruskal.test (OM~Station)
################ Kruskal Wallace multiple comparison test to show which pairs of stations
are different.
################ Kruskal Wallace multiple comparison test.
library (pgirmess)
kruskalmc (OM~Station)
######################## Organic matter – Intra-beach variation – Nelson
setwd ("~/Desktop")
NOM <- read.csv ("NOM.csv",header=TRUE,sep=",")
attach (NOM)
names (NOM)
###################### Test homogeneity of variance – Bartlett Test
bartlett.test (OM~Station)
#################As data doesn't meet assumption homogeneity of variance must log data
or use Kruskal Wallis test.
##############Boxplot
boxplot <- ggplot (NOM, aes(x=Station,y=OM,group=Station))
boxplot + geom_boxplot() + theme_classic()
################# Kruskal Wallis test
kruskal.test (OM~Station)
################ Kruskal Wallace multiple comparison test to show which pairs of stations
are different.
################ Kruskal Wallace multiple comparison test.
library (pgirmess)
kruskalmc (OM~Station)
######################## Organic matter – Intra-beach variation – Parasol
setwd ("~/Desktop")
POM <- read.csv ("POM.csv",header=TRUE,sep=",")
attach (POM)
names (POM)
###################### Test homogeneity of variance – Bartlett Test
bartlett.test (OM~Station)
#################As data doesn't meet assumption homogeneity of variance must log data
or use Kruskal Wallis test.
```

```
##############Boxplot
library (ggplot2)
boxplot <- ggplot (POM, aes(x=Station,y=OM,group=Station))
boxplot + geom_boxplot() + theme_classic()
################# Kruskal Wallis test
kruskal.test (OM~Station)
############### Kruskal Wallace multiple comparison test to show which pairs of stations
are different.
############### Kruskal Wallace multiple comparison test.
library (pgirmess)
kruskalmc (OM~Station)
####################### Organic matter – Intra-beach variation – Egmont (Stations 70 &
90) – T test.
setwd ("~/Desktop")
EOM <- read.csv ("EOM.csv",header=TRUE,sep=",")
attach (EOM)
names (EOM)
##################Test the distribution of Station70 with Shapiro Wilks
shapiro.test(Station70)
##################Test the distribution of Station90 with Shapiro Wilks
shapiro.test(Station90)
##############Boxplot
library (ggplot2)
boxplot <- ggplot (EOM, aes(x=Station,y=OM,group=Station))
boxplot + geom_boxplot() + theme_classic()
################# Data at Station90 isn't normally distributed therefore comparison made
with non-parametric Wilcoxon test.
##################
wilcox.test (Station70,Station90, paired=TRUE)
####################### Organic matter – Intra-beach variation – Boddam (Stations 70 &
90) – T test.
setwd ("~/Desktop")
BOM <- read.csv ("BOM.csv",header=TRUE,sep=",")
attach (BOM)
names (BOM)
##################Test the distribution of Station70 with Shapiro Wilks
shapiro.test(Station70)
##################Test the distribution of Station90 with Shapiro Wilks
shapiro.test(Station90)
##############Boxplot
library (ggplot2)
boxplot <- ggplot (BOM, aes(x=Station,y=OM,group=Station))
boxplot + geom_boxplot() + theme_classic()
################# Data isn't normally distributed therefore comparison made with non-
parametric Wilcoxon test.
##################
wilcox.test (Station70,Station90, paired=TRUE)
############ Organic matter – Inter-island variation
setwd ("~/Desktop")
IM <- read.csv ("IM.csv",header=TRUE,sep=",")
```

```
attach (IM)
names (IM)
##################### test homogeneity of variance – Bartlett Test
bartlett.test (OM~Island)
################As data doesn't meet assumption homogeneity of variance must log data
or use Kruskal Wallis test.
#############Boxplot
Library (ggplot2)
boxplot <- ggplot (IM, aes(x=Island,y=Mean,group=Island))
boxplot + geom_boxplot() + theme_classic()
################ Log (OM)
IM$logOM <- log (IM$OM)
Head (IM)
############ Bartlett test
bartlett.test (IM$logOM~Island)
############## Will use Kruskal Wallis
#####################Kruskal-wallis test
kruskal.test (OM~Island)
################### Kruskal Wallace multiple comparison test, which island pairs are
different?
library (pgirmess)
kruskalmc (OM~Island)
#############Scatter graph & lm. Mean microplastic size as a function of mean sediment
#######grain size.
setwd ("~/Desktop")
MP <- read.csv ("MeanMP_MeanGS",header=TRUE,sep=",")
attach (MP)
names (MP)
par(yaxs="r",xaxs="r")
par (bty="L")
plot (MeanMP~MeanGS,cex=0.8,xlab=("Mean grain size (mm)"),ylab=(" Mean microplastic
size (mm)"),las=1)
abline (MP)
#############Scatter graph microplastic size as a function of depth
setwd ("~/Desktop")
MP <- read.csv ("MPDepth.csv",header=TRUE,sep=",")
attach (MP)
names (MP)
par(yaxs="r",xaxs="r")
par (bty="L")
plot (MeanMP~Depth,cex=0.8,xlab=(" Depth kg/m^3"),ylab=(" Mean microplastic size
(mm)"))
abline (MP)
######## Running lm stats to see if there is correlation between microplastic size and
sediment depth
MP <- lm(MeanMP~Depth, data =MP)
summary (MP)
####################### Microplastic Particles – Intra-beach variation – Diego Garcia
setwd ("~/Desktop")
DG <- read.csv ("DG.csv",header=TRUE,sep=",")
```

```
attach (DG)
names (DG)
##################### test homogeneity of variance – Bartlett Test
bartlett.test (Particles~Station,data=DG)
################As data doesn't meet assumption homogeneity of variance must log data
or use Kruskal Wallis test.
##############Boxplot
boxplotDG <- ggplot (DG, aes(x=Station,y=Particles,group=Station))
boxplotDG + geom_boxplot() + theme_classic()
############### log
DG$logmean <- log (DG$mean)
head (DG)
#################Bartlett test of homogenity
bartlett.test (logmean~depth,data=DG)
################Kruskal Wallace test
kruskal.test (Particles~Station)
############### Kruskal Wallace multiple comparison test, which pairs of stations are
significantly different from each other?
##############
Library (pgirmess)
kruskalmc (Mean~Station)
####################### Microplastics – Intra-beach variation – Nelson
setwd ("~/Desktop")
N <- read.csv ("N.csv",header=TRUE,sep=",")
attach (N)
names (N)
##################### test homogeneity of variance – Bartlett Test
bartlett.test (Particles~Station,data=N)
################As data doesn't meet assumption homogeneity of variance must use
Kruskal Wallis test.
##############Boxplot
boxplotN <- ggplot (N, aes(x=Station,y=Particles,group=Station))
boxplotN + geom_boxplot() + theme_classic()
################Kruskal Wallace test
kruskal.test (Particles~Station)
####################### Microplastics – Intra-beach variation – Parasol
setwd ("~/Desktop")
P <- read.csv ("P.csv",header=TRUE,sep=",")
attach (P)
names (P)
##################### test homogeneity of variance – Bartlett Test
bartlett.test (Particles~Station,data=P)
################As data doesn't meet assumption homogeneity of variance must use
Kruskal Wallis test.
##############Boxplot
boxplotP <- ggplot (P, aes(x=Station,y=Particles,group=Station))
boxplotP + geom_boxplot() + theme_classic()
################Kruskal Wallace test
kruskal.test (Particles~Station)
####################### Microplastics – Intra-beach variation – Egmont
```

```
setwd ("~/Desktop")
E <- read.csv ("E.csv",header=TRUE,sep=",")
attach (E)
names (E)
##################### test homogeneity of variance – Bartlett Test
bartlett.test (Particles~Station,data=E)
################As data doesn't meet assumption homogeneity must use Kruskal Wallis
test.
##############Boxplot
boxplotE <- ggplot (E, aes(x=Station,y=Particles,group=Station))
boxplotE + geom_boxplot() + theme_classic()
################Kruskal Wallace test
kruskal.test (Particles~Station)
############### Kruskal Wallace multiple comparison test, which pairs of stations are
significantly different from each other?
##############
Library (pgirmess)
kruskalmc (Mean~Station)
####################### Microplastics – Intra-beach variation – Boddam
setwd ("~/Desktop")
B <- read.csv ("B.csv",header=TRUE,sep=",")
attach (B)
names (B)
##################### test homogeneity of variance – Bartlett Test
bartlett.test (Particles~Station,data=B)
################As data doesn't meet assumption homogeneity of variance must use
Kruskal Wallis test.
##############Boxplot
boxplotB <- ggplot (B, aes(x=Station,y=Particles,group=Station))
boxplotB + geom_boxplot() + theme_classic()
################Kruskal Wallace test
kruskal.test (Particles~Station)
############### Kruskal Wallace multiple comparison test, which pairs of stations are
significantly different from each other?
##############
Library (pgirmess)
kruskalmc (Mean~Station)
####################### Microplastics – Inter Island variation
setwd ("~/Desktop")
I <- read.csv ("I.csv",header=TRUE,sep=",")
attach (I)
names (I)
##################### test homogeneity of variance – Bartlett Test
bartlett.test (Particles~Islands,data=I)
################As data doesn't meet assumption homogeneity of variance must use
Kruskal Wallis test.
##############Boxplot
boxplotI <- ggplot (I, aes(x=Islands,y=Particles,group=Islands))
boxplotI + geom_boxplot() + theme_classic()
################Kruskal Wallace test
```

```
kruskal.test (Particles~Islands)
################ Kruskal Wallace multiple comparison test, which pairs of stations are
significantly different from each other?
###############
Library (pgirmess)
kruskalmc (Mean~Islands)
######################## Intra-beach variation in microplastic sizes – Diego Garcia –
Two way/factorial ANOVA###############
setwd ("~/Desktop")
DG <- read.csv ("DG.csv",header=TRUE,sep=",")
attach (DG)
names (DG)
######################
###############Microplastic size – intra-depth variation
setwd ("~/Desktop")
D <- read.csv ("MPDepth.csv",header=TRUE,sep=",")
attach (D)
names (D)
###################### test homogeneity of variance – Bartlett Test
bartlett.test (Mean~Depth,data=D)
################Anova – Microplastics Depth
anv.model <- aov (Mean~Station)
summary (anv.model)
###############Test the residual distribution with Shapiro Wilks
shapiro.test(anv.model$residuals)
#################
library (ggplot2)
boxplotD <- ggplot (D, aes(x=Depth,y=Mean,group=Depth))
boxplotD + geom_boxplot() + theme_classic()
############Logdata
D$logMean <- log (D$Mean)
head (D)
################Anova – Microplastics Depth
anv.model <- aov (logMean~Depth)
summary (anv.model)
###############Test the residual distribution with Shapiro Wilks
shapiro.test(anv.model$residuals)
######################Kruskal Wallis test
kruskal.test (Mean~Depth)
######################## Microplastic Size – Intra-beach variation – Diego Garcia Nb
logged data so using dataset DGStation_Log
setwd ("~/Desktop")
DG <- read.csv ("DGStation_Log.csv",header=TRUE,sep=",")
attach (DG)
names (DG)
###################### test homogeneity of variance – Bartlett Test
bartlett.test (Total~Station,data=D)
#################As data doesn't meet assumption homogeneity of variance must log data
or use Kruskal Wallis test.
#####################Log
```

```
D$logTotal <- log (D$Total)
head (D)
##################### test homogeneity of variance – Bartlett Test
bartlett.test (Total~Station,data=D)
################Factorial anova – intra beach variation microplastic sizes
two.way <- aov (Total ~ Size + Station, data = D)
summary (two.way)
###################Diego Garcia - Is there a difference in the frequency of different sized microplastics (ANOVA)?
##########
setwd ("~/Desktop")
P <- read.csv ("DiegoGarcia_Station.csv",header=TRUE,sep=",")
attach (P)
names (P)
##############Bartlett test, homogeneity of variance
bartlett.test (Total~ParticleSize,data=P)
################As data doesn't meet assumption homogeneity of variance must log data or use Kruskal Wallis test.
##############Boxplot
boxplot <- ggplot (P, aes(x=Size,y=Total,group=Size))
boxplot + geom_boxplot() + theme_classic()
###################Log
############### log
P$logTotal <- log (P$Total)
head (P)
##############Bartlett test, homogeneity of variance
bartlett.test (P$logTotal~ParticleSize,data=P)
###############ANOVA
anv.model <- aov (P$logTotal ~ ParticleSize)
summary (anv.model)
###################Egmont - Is there a difference in the frequency of microplastics
######between particle sizes (ANOVA)?
##########
setwd ("~/Desktop")
E <- read.csv ("Egmont.csv",header=TRUE,sep=",")
attach (E)
names (E)
##############Bartlett test, homogeneity of variance
bartlett.test (Total~ParticleSize,data=E)
################As data doesn't meet assumption homogeneity of variance must log data or use Kruskal Wallis test.
##############Boxplot
boxplot <- ggplot (E, aes(x=Size,y=Total,group=Size))
boxplot + geom_boxplot() + theme_classic()
###################Log
############### log
E$logTotal <- log (E$Total)
head (E)
##############Bartlett test, homogeneity of variance
bartlett.test (E$logTotal~ParticleSize,data=E)
```

```
###############ANOVA
anv.model <- aov (E$logTotal ~ ParticleSize)
summary (anv.model)
#################Test residuals
shapiro.test (anv.model$residuals)
#####First look at residual distribution on plot
hist(anv.model$residuals)
plot (anv.model)
############Kruskal Wallis
kruskal.test(E$logTotal ~ParticleSize)
################ Kruskal Wallace multiple comparison test, which pairs of microplastic
sizes are significantly different from each other?
###############
Library (pgirmess)
kruskalmc (P$logTotal ~ParticleSize)
###################Boddam - Is there a difference in the frequency of microplastics
######between particle sizes (ANOVA)?
###########
setwd ("~/Desktop")
B <- read.csv ("Boddam.csv",header=TRUE,sep=",")
attach (B)
names (B)
###############Bartlett test, homogeneity of variance
bartlett.test (Total~ParticleSize,data=B)
#################As data doesn't meet assumption homogeneity of variance must log data
or use Kruskal Wallis test.
###############Boxplot
boxplot <- ggplot (B, aes(x=Size,y=Total,group=Size))
boxplot + geom_boxplot() + theme_classic()
###################Log
################ log
B$logTotal <- log (B$Total)
head (B)
###############Bartlett test, homogeneity of variance
bartlett.test (B$logTotal~ParticleSize,data=B)
##########ANOVA
anv.model <- aov (B$logTotal ~ ParticleSize)
summary (anv.model)
#################Test residuals
shapiro.test (anv.model$residuals)
#####First look at residual distribution on plot
hist(anv.model$residuals)
plot (anv.model)
############Kruskal Wallis
kruskal.test(B$logTotal ~ParticleSize)
################ Kruskal Wallace multiple comparison test, which pairs of microplastic
sizes are significantly different from each other?
###############
Library (pgirmess)
kruskalmc (B$logTotal ~ParticleSize)
```

```
########################Is there a difference in the frequency of particle sizes
#########between Islands (two-way ANOVA)?
setwd ("~/Desktop")
I <- read.csv ("Islands_Stats.csv",header=TRUE,sep=",")
attach (I)
names (I)
##############Boxplot
library (ggplot2)
ggplot (I,aes(x=Island,y=Total, fill=Size)) + geom_boxplot() + theme_classic() + theme
(axis.text.x = element_text(angle = 45,hjust=1))
#############Two way ANOVA
two.way <- aov(Total~Size + Island, data = I)
###################Test residuals
shapiro.test (two.way$residuals)
#####First look at residual distribution on plot
hist(two.way$residuals)
plot (two.way)
##########Two-way ANOVA logged total data
P <- read.csv ("Islands_Stats_Log.csv",header=TRUE,sep=",")
two.way <- aov(LogTotal~Size + Island, data = P)
summary (two.way)
###################Test residuals
shapiro.test (two.way$residuals)
#################Scheirer ray hare test
scheirerRayHare(Total~Size+Island, data=I)
########## Post hoc test, Dunn test (Island). First order groups by median.
I$Island =
factor(I$Island,levels=c("DiegoGarcia","Egmont","Boddam","Nelson","Parasol"))
levels(I$Island)
###########Dunn test
library (FSA)
DT = dunnTest(Total~Island, data=I,method="bh")
DT
########## Post hoc test, Dunn test (Size). First order groups by median.
I$Size = factor(I$Size,levels=c("1-4.99","0.5-0.99"," 0.25-0.49","0.15-0.24"))
levels(I$Size)
###########Dunn test
library (FSA)
DT = dunnTest(Total~Size, data=I,method="bh")
DT
###################Diego Garcia - Is there a difference in the frequency of different
coloured microplastics (ANOVA)?
##########
setwd ("~/Desktop")
P <- read.csv ("DiegoGarcia.csv",header=TRUE,sep=",")
attach (P)
names (P)
##############Bartlett test, homogeneity of variance
bartlett.test (Total~ParticleSize,data=P)
```

```
#################As data doesn't meet assumption homogeneity of variance must log data
or use Kruskal Wallis test.
###############Boxplot
boxplot <- ggplot (P, aes(x=Colour,y=Total,group=Colour))
boxplot + geom_boxplot() + theme_classic() + theme (axis.text.x = element_text(angle =
45,hjust=1))
####################Log
################ log
P$logTotal <- log (P$Total)
head (P)
###############Bartlett test, homogeneity of variance
bartlett.test (P$logTotal~Colour,data=P)
################Using Kruskal Wallis test
kruskal.test(P$logTotal ~Colour)
################ Kruskal Wallace multiple comparison test, which pairs of microplastic
colours are significantly different from each other?
###############
Library (pgirmess)
kruskalmc (B$logTotal ~Colour)
####################Egmont - Is there a difference in the frequency of different coloured
microplastics (ANOVA)?
##########
setwd ("~/Desktop")
P <- read.csv ("Egmont_Stats.csv",header=TRUE,sep=",")
attach (P)
names (P)
###############Bartlett test, homogeneity of variance
bartlett.test (Total~ParticleSize,data=P)
#################As data doesn't meet assumption homogeneity of variance must log data
or use Kruskal Wallis test.
###############Boxplot
boxplot <- ggplot (P, aes(x=Colour,y=Total,group=Colour))
boxplot + geom_boxplot() + theme_classic()
####################Log
################ log
P$logTotal <- log (P$Total)
head (P)
###############Bartlett test, homogeneity of variance
bartlett.test (P$logTotal~Colour,data=P)
################Using Kruskal Wallis test
kruskal.test(Total ~Colour)
################ Kruskal Wallace multiple comparison test, which pairs of microplastic
colours are significantly different from each other?
###############
Library (pgirmess)
kruskalmc (B$logTotal ~Colour)
####################Nelson - Is there a difference in the frequency of different coloured
microplastics (small sample size so using non-parametric Mann-Whitney test).
##########
setwd ("~/Desktop")
```

```
P <- read.csv ("Nelson.csv",header=TRUE,sep=",")
attach (P)
names (P)
#######Mann-Whitney test
wilcox.test(Blue,Translucent)
#######################Is there a difference in the frequency of particle colour
#########between Islands (two-way ANOVA)?
setwd ("~/Desktop")
I <- read.csv ("MP_Col.csv",header=TRUE,sep=",")
attach (I)
names (I)
##############Boxplot
library (ggplot2)
ggplot (I,aes(x=Island,y=Total, fill=Colour)) + geom_boxplot() + theme_classic() + theme
(axis.text.x = element_text(angle = 45,hjust=1))
#############Two-way ANOVA
two.way <- aov(Total~Colour + Island, data = I)
summary (two.way)
###################Test residuals
shapiro.test (two.way$residuals)
#####First look at residual distribution on plot
hist(two.way$residuals)
plot (two.way)
##########Two way ANOVA with logged Total
P <- read.csv ("MP_Col_Log.csv",header=TRUE,sep=",")
two.way <- aov(LogTotal~Colour + Island, data = P)
summary (two.way)
###################Test residuals
shapiro.test (two.way$residuals)
##########Results
data:  two.way$residuals
W = 0.91669, p-value = 1.939e-07
################Interpretation
P<0.05, therefore residuals do not follow a normal distribution. Will use a non-parametric
two-way ANOVA, Scheirer ray hare test.
#################Scheirer ray hare test
scheirerRayHare(Total~Colour+Island, data=I)
########## Post hoc test, Dunn test. First order groups by median.
I$Colour =
factor(I$Colour,levels=c("White","Translucent","Green","Black","Red","Yellow","Grey","
Blue","Brown","Pink","Orange"))
levels(I$Colour)
###########Dunn test
library (FSA)
DT = dunnTest(Total~Island, data=I,method="bh")
DT
###################Diego Garcia - Is there a difference in the frequency of different
microplastic shapes (ANOVA)?
##########
setwd ("~/Desktop")
```

```
P <- read.csv ("DiegoGarcia.csv",header=TRUE,sep=",")
attach (P)
names (P)
##############Bartlett test, homogeneity of variance
bartlett.test (Total~Shape,data=P)
################As data doesn’t meet assumption homogeneity of variance must log data
or use Kruskal Wallis test.
##############Boxplot
Library (ggplot2)
boxplot <- ggplot (P, aes(x=Shape,y=Total,group=Shape))
boxplot + geom_boxplot() + theme_classic()
###################Log
############### log
P$logTotal <- log (P$Total)
head (P)
##############Bartlett test, homogeneity of variance
bartlett.test (P$logTotal~Shape,data=P)
################As data doesn’t meet assumption homogeneity of variance must use
Kruskal Wallis test.
############Kruskal Wallis
kruskal.test(P$logTotal ~Shape)
###################Islands - Is there a difference in the frequency of different
microplastic shapes (two way ANOVA)?
setwd ("~/Desktop")
I <- read.csv (“IslandShape.csv",header=TRUE,sep=",")
attach (I)
names (I)
##############Boxplot
library (ggplot2)
ggplot (I,aes(x=Island,y=Total, fill=Shape)) + geom_boxplot() + theme_classic() + theme
(axis.text.x = element_text(angle = 45,hjust=1))
#############Two-way ANOVA
two.way <- aov(Total~Shape + Island, data = I)
summary (two.way)
###################Test residuals
shapiro.test (two.way$residuals)
#####First look at residual distribution on plot
hist(two.way$residuals)
plot (two.way)
##########Two- way ANOVA with logged total data
P <- read.csv (“IslandShapeLog.csv",header=TRUE,sep=",")
attach (P)
names (P)
two.way <- aov(LogTotal~Shape + Island, data = I)
summary (two.way)
###################Test residuals
shapiro.test (two.way$residuals)
################Scheirer ray hare test
scheirerRayHare(Total~Shape+Island, data=I)
########## Post hoc test, Dunn test. First order groups by median.
```

```
I$Island = factor(I$Island,levels=c("DiegoGarcia","Egmont","Nelson","Parasol"))
levels(I$Island)
###########Dunn test
library (FSA)
DT = dunnTest(Total~Island, data=I,method="bh")
DT
##################Diego Garcia - Is there a difference in the frequency of different microplastic polymers (ANOVA).
##########
setwd ("~/Desktop")
P <- read.csv ("DiegoGarcia.csv",header=TRUE,sep=",")
attach (P)
names (P)
##############Bartlett test, homogeneity of variance
bartlett.test (Total~Polymer,data=P)
library (ggplot2)
boxplot <- ggplot (P, aes(x=Polymer,y=Total,group=Polymer))
boxplot + geom_boxplot() + theme_classic()
################ANOVA
anv.model <- aov (Total ~ Polymer)
summary (anv.model)
##################Egmont - Is there a difference in the frequency of different microplastic polymers (ANOVA).
##########
setwd ("~/Desktop")
P <- read.csv ("Egmont.csv",header=TRUE,sep=",")
attach (P)
names (P)
##############Bartlett test, homogeneity of variance
bartlett.test (Total~Polymer,data=P)
library (ggplot2)
boxplot <- ggplot (P, aes(x=Polymer,y=Total,group=Polymer))
boxplot + geom_boxplot() + theme_classic()
################ANOVA
anv.model <- aov (Total ~ Polymer)
summary (anv.model)
###################Islands - Is there a difference in the frequency of different polymers (two way ANOVA)?
setwd ("~/Desktop")
I <- read.csv ("Stats_Island.csv",header=TRUE,sep=",")
attach (I)
names (I)
##############Boxplot
library (ggplot2)
ggplot (I,aes(x=Island,y=Total, fill=Shape)) + geom_boxplot() + theme_classic() + theme (axis.text.x = element_text(angle = 45,hjust=1))
#############Two-way ANOVA
two.way <- aov(Total~Polymer + Island, data = I)
summary (two.way)
##################Test residuals
```

```
shapiro.test (two.way$residuals)
#############TukeyHSD
TukeyHSD (two.way)
```

Appendix 11: Statement of expenditure

Student Name: Kathy Whitehead

Student Number: 520368

Project Title: Distribution of microplastics on remote, isolated islands of the Chagos Archipelago; globally and regionally significant nesting sites of green *(Chelonia mydas)* and hawksbill (*Eretmochelys imbricata*) sea turtle populations.

Category	Item	Description	Cost*
Chemical	Potassium carbonate	Anhydrous/2.5 kg	£73.76
Chemical	Hydrogen peroxide	30% in water/500 ml	£94.86
Chemical	Tween 20 solution	Buffer/500 ml	£69.25
Lab equipment	Sieve stack	100 mm – 0.02 – 5 mm	£678
Lab equipment	Brush	5.8 x 0.5 horse hair	£10.99
Lab equipment	Cleaning cloths	Cellulose sponge	£13.99
Lab equipment	Tea towels	100% cotton	£9.99
Lab equipment	Filter funnel	Polypropylene 90 mm	£25.22
Lab equipment	Filter paper	GF/B 90 mm	£768.20
Lab equipment	Gloves	Latex X 100, size 7.5-8	£34.56
Lab equipment	Lab coats	100% cotton	£40.76
Lab equipment	Foil containers	Foil tins	£11.51
Lab equipment	Centrifuge tubes	Polypropylene 50 ml	£56.62
Lab equipment	Petri dishes	100 ml	£18.98

* Includes VAT and delivery where applicable.

I hereby certify that the above information is true and correct to the best of my knowledge.

Signed,

[redacted] [redacted]

Signature (supervisor) Signature (student)

Appendix 12: Ethics

There were no ethical issues for this study as the removal of beach sediment caused little disturbance to the turtle nesting region and subsequent work was in the laboratory.

Reference Number: STU_BIOL_161676_240521114303_1

Approval Number: SU-Ethics-Student-240521/4244

Appendix 13: Health and Safety Forms

Risk Assessment for Teaching, Administration and Research Activities
Swansea University; College of Science

Name Katherine Whitehead Signature [redacted] date 16/03/21

Supervisor* Nicole Esteban **Signature** [redacted] **date** 18/03/21

Activity title Extracting & quantifying microplastics from sand cores. **Base location (room no. W036)**
(* the supervisor for all HEFCW funded academic and non-academic staff is the HOC)

University Activity Serial # (enter Employee No. or STUREC No.520368
Start date of activity (cannot predate signature dates) 17/03/21
End date of activity (or 'on going') On going

Level of worker MRes student

Approval obtained for Gene Manipulation Safety Assessment by SU not applicable
Licence(s) obtained under "Animals (Scientific Procedures) Act (1986) not applicable
Approval obtained for use of radioisotopes by COS not applicable

Bioscience and Geography Protocol Risk Assessment Form

(Expand or contract fields, or append additional sheets as required; insert NA if not applicable)

Protocol # 1	**Title:** The effect of microplastics on sea turtle nesting conditions in the Western Indian Ocean.
Associated Protocols #..........................	Description: Separating sand core samples. Extracting microplastics. Microplastic and sediment analysis.

Location:

circle which Bioscience and Geography Local Rules apply –

Laboratory

Identify here risks and control measures for work in this environment, additional to Local Rules

Chemicals	**Quantity**	**Hazards**	**Category (A,B,C,D)***	**Exp. Score**
Zinc Chloride		Causes severe skin burns, eye damage and may cause respiratory irritation.	C	3
Fenton's reagent (H_2O_2 & Fe)		Skin burns, inhalation toxicity, eye damage and irritation.	C	3

Hazard Category (known or potential)	**Exposure Potential** Circle the **highest Exposure Score** above. Use this to calculate the exposure potential for the entire protocol (see handbook). Indicate this value below.
A (e.g. carcinogen/teratogen/mutagen) **B** (e.g. v.toxic/toxic/explosive/pyrophoric) **C** (e.g. harmful/irritant/corrosive/high flammable/oxidising) **D** (e.g. non classified)	Low

Primary containment (of product) Sealed flask.
Storage conditions and maximum duration :- Stored in sealed glass containers in locked cupboards in the Benthos lab.

Secondary containment (of protocol) Fume hood.

Disposal
Sediment from outside of the UK, stored in Wallace basement for future research.
Plastics – plastic recycling if possible, otherwise waste bin.
Zinc chloride and Fenton's reagent disposed of according to Swansea Universities' disposal methods.

Identify other control measures (circle or delete) – nitrile gloves, dust mask, ear-defenders, lab coat, eye protection/glasses

Justification and controls for any work outside normal hours NA

Emergency procedures
Communicate spillage to others in the lab. Eliminate all ignition sources. Clean, decontaminate area immediately and thoroughly with spillage kit. Dispose of contaminated cleaning material appropriately.

Supervision/training for worker (circle)
None required Already trained Training required Supervised always

Declaration I declare that I have assessed the hazards and risks associated with my work and will take appropriate measures to decrease these risks, as far as possible eliminating them, and will monitor the effectiveness of these risk control measures.

Name & signature of worker ....Katherine Whitehead.......... [redacted]
....

Name & counter-signature of supervisor....... [redacted] .... *Date*........16/03/21................
Date of first reassessment Frequency of reassessments

Risk Assessment for Teaching, Administration and Research Activities
Swansea University; College of Science

Name Katherine Whitehead Signature [redacted] date 16/03/21

Supervisor* Nicole Esteban **Signatur** [redacted] **date** 18/03/21

Activity title Extracting & quantifying microplastics from sand cores. **Base location (room no. W036)**
(* the supervisor for all HEFCW funded academic and non-academic staff is the HOC)

University Activity Serial # (enter Employee No. or STUREC No.520368
Start date of activity (cannot predate signature dates) 17/03/21
End date of activity (or 'on going') On going

Level of worker MRes student

Bioscience and Geography Protocol Risk Assessment Form

(Expand or contract fields, or append additional sheets as required; insert NA if not applicable)

Protocol # 1	**Title:** The effect of microplastics on sea turtle nesting conditions in the Western Indian Ocean.
Associated Protocols #..........................	Description: Separating sand core samples. Extracting microplastics. Microplastic and sediment analysis.

Location:

circle which Bioscience and Geography Local Rules apply –

Laboratory

Identify here risks and control measures for work in this environment, additional to Local Rules

Chemicals	**Quantity**	**Hazards**	**Category (A,B,C,D)***	**Exp. Score**
Zinc Chloride		Causes severe skin burns, eye damage and may cause respiratory irritation.	C	3
Fenton's reagent (H_2O_2 & Fe)		Skin burns, inhalation toxicity, eye damage and irritation.	C	3

Hazard Category (known or potential) **A** (e.g. carcinogen/teratogen/mutagen) **B** (e.g. v.toxic/toxic/explosive/pyrophoric) **C** (e.g. harmful/irritant/corrosive/high flammable/oxidising) **D** (e.g. non classified)	**Exposure Potential** Circle the **highest Exposure Score** above. Use this to calculate the exposure potential for the entire protocol (see handbook). Indicate this value below. Low

Primary containment (of product) Sealed flask.
Storage conditions and maximum duration :- Stored in sealed glass containers in locked cupboards in the Benthos lab.

Secondary containment (of protocol) Fume hood.

Disposal
Sediment from outside of the UK, stored in Wallace basement for future research.
Plastics – plastic recycling if possible, otherwise waste bin.
Zinc chloride and Fenton's reagent disposed of according to Swansea Universities' disposal methods.

Identify other control measures (circle or delete) – nitrile gloves, dust mask, ear-defenders, lab coat, eye protection/glasses

Justification and controls for any work outside normal hours NA

Emergency procedures

Communicate spillage to others in the lab. Eliminate all ignition sources. Clean, decontaminate area immediately and thoroughly with spillage kit. Dispose of contaminated cleaning material appropriately.
Supervision/training for worker (circle) **None required** Already trained Training required Supervised always
Declaration I declare that I have assessed the hazards and risks associated with my work and will take appropriate measures to decrease these risks, as far as possible eliminating them, and will monitor the effectiveness of these risk control measures. *Name & signature of worker* ....Katherine Whitehead......... [redacted] .... [redacted] *Name & counter-signature of supervisor*......... [redacted] .... *Date*........16/03/21................
Date of first reassessment Frequency of reassessments

Risk Assessment for Teaching, Administration and Research Activities
Swansea University; College of Science

Name Katherine Whitehead Signature [redacted] date 19/05/21

Supervisor* Nicole Esteban **Signature** [redacted] **date** 19/05/21

Activity title Extracting & quantifying microplastics from sand cores. **Base location (room no. W036)**
(* the supervisor for all HEFCW funded academic and non-academic staff is the HOC)

University Activity Serial # (enter Employee No. or STUREC No.520368
Start date of activity (cannot predate signature dates) 17/03/21
End date of activity (or 'on going') On going

Level of worker MRes student

Approval obtained for Gene Manipulation Safety Assessment by SU not applicable
Licence(s) obtained under "Animals (Scientific Procedures) Act (1986) not applicable
Approval obtained for use of radioisotopes by COS not applicable

Bioscience and Geography Protocol Risk Assessment Form

(Expand or contract fields, or append additional sheets as required; insert NA if not applicable)

Protocol # 1	**Title:** The effect of microplastics on sea turtle nesting conditions in the Western Indian Ocean.
Associated Protocols #..........................	Description: Separating sand core samples. Extracting microplastics. Microplastic and sediment analysis.

Location:

circle which Bioscience and Geography Local Rules apply –
Laboratory

Identify here risks and control measures for work in this environment, additional to Local Rules

Chemicals	Quantity	Hazards	Category (A,B,C,D)*	Exp. Score

Potassium Carbonate		Harmful if swallowed. Irritating to eyes, respiratory system and skin.	D	3

Hazard Category (known or potential) **A** (e.g. carcinogen/teratogen/mutagen) **B** (e.g. v.toxic/toxic/explosive/pyrophoric) **C** (e.g. harmful/irritant/corrosive/high flammable/oxidising) **D** (e.g. non classified)	**Exposure Potential** Circle the **highest Exposure Score** above. Use this to calculate the exposure potential for the entire protocol (see handbook). Indicate this value below. Low

Primary containment (of product) Sealed flask.
Storage conditions and maximum duration :- Stored in sealed glass containers in locked cupboards in the Benthos lab.

Secondary containment (of protocol) Fume hood.

Disposal
Disposed of according to Swansea Universities' disposal methods.

Identify other control measures (circle or delete) – nitrile gloves, lab coat, eye protection/glasses

Justification and controls for any work outside normal hours NA

Emergency procedures
Communicate spillage to others in the lab. Eliminate all ignition sources. Clean, decontaminate area immediately and thoroughly with spillage kit. Dispose of contaminated cleaning material appropriately.

Supervision/training for worker (circle)
None required

Declaration I declare that I have assessed the hazards and risks associated with my work and will take appropriate measures to decrease these risks, as far as possible eliminating them, and will monitor the effectiveness of these risk control measures.

Name & signature of worker ....Katherine Whitehead.......... [redacted]
....

Name & counter-signature of supervisor......... ....[redacted]..
Date........19/05/21................

Date of first reassessment Frequency of reassessments