Assessing the Impact of Untreated Sewage on the Coral Reef System off the Coast of Caye Caulker, Belize: Applying the Foram Index

by

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Dedication

I would like to dedicate this research to all of those people who ever thought about giving up. Please don’t give up, you actually do find out that it is worth all the hard work in the end.

I would also like to dedicate this research to my husband and my family for putting up with me throughout the entire process. The long nights and aggravation you put up with while I was finishing this research is what made it possible for me to finish. Without you it wouldn’t have happened, not just because of what you have done, but also because of what you knew that I could do and never let me forget it.

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Abstract

Human raw sewage pollution is one of several environmental concerns in coastal waters of Belize. This study utilizes foraminiferal assemblage distribution in combination with fecal sterols to determine the presence of human sewage and its effects on a coral reef system off the coast of Caye Caulker-Belize. A total of 125 sediment samples were collected off the coast of Caye Caulker. Fecal sterol concentrations (coprostanol), grain analysis (mud percent), foraminiferal ecological indices (species richness, density, and diversity), foraminiferal assemblages, and the FORAM Index (FI) were assessed.

Coprostanol analysis showed higher concentrations nearest the eastern shore of Caye Caulker, with lower concentrations found in proximity to the reef; 20 samples had a concentration of greater than 100 ng/g. Cluster analysis and assemblage show that the east and west side are dominated by *Quinqueloculina* and *Asterigerina* and these clusters are characterized by relative medium species richness and diversity (28 and 2.66 respectively). The FI indicates that the water quality of the area is conducive to reef growth and recovery. However, 37 samples (out of 125) indicate that the area may be experiencing environmental change (per the FI), and points to the need for further evaluation. Pearson correlation analyses of all variables and samples on the east coast of Caye Caulker show a strong positive correlation between coprostanol-mud percent; and a strong negative correlation between coprostanol-FI, and mud percent-FI. This strongly suggests that raw human sewage does have an effect on foraminifers and on coral reefs. When data is assessed longitudinally (i.e. parallel to the coast rather than

from the coast moving offshore) using the same correlation matrix, however, the results showed no correlation among coprostanol, FI and mud percent except for samples 3 and 4 groups. This suggests that further evaluation of local conditions (e.g. groundwater movement, ocean surface conditions, etc.) may be needed to explain the latter results.

Abbreviations

Cu- copper

Sb- antimony

Ppm- parts per million= µg/g= ng/mg

SCUBA- Self Contained Underwater Breathing Apparatus

DCM- Dichloromethane; Methylene chloride

HCl- Hydrochloric acid

Rpms- revolutions per minute

GC/MS- Gas chromatograph/ Mass Spectrometer

IDL- Instrument Detection Limit

SIM- Selective Ion Monitoring

R1- Coprostanol/ Cholesterol

R2- Coprostanol/ (Coprostanol + Cholestanol)

$CaCO_3$- Calcium Carbonate

DO- Dissolved Oxygen

FI- FORAM Index

P_S= Proportion of symbiont-bearing foraminifera; Number of symbiont-bearing/ total individuals

P_O=Proportion of opportunistic foraminifera; number of opportunistic/total individuals

P_h=Proportion of heterotrophic foraminifera; number of heterotrophic/ total individuals

Chapter 1: Introduction and Background

Coral Reefs

Coral reefs play a vital role in marine ecosystems. Not only do they provide habitat for numerous organisms, they also offer nursery and feeding grounds for various developmental levels of pelagic and coastal marine species (e.g. Humann and DeLoach, 2002). Due to their proximity to coastlines, coral reefs are exposed to a myriad of anthropogenic impacts (e.g. pollution, tourism) and are one of the most reduced and endangered ecosystems in the world (Buddemeier *et al.*, 2011; Hughes, 1994; Padolfi *et al.*, 2003). Numerous studies have shown an extreme susceptibility of corals to minor changes in temperature, pH, organic matter, and agricultural runoff and other environmental changes (Sheppard *et al.*, 2009; Humann and DeLoach, 2002; Bayona and Albaiges, 2006). In addition, many of the problems associated with a decrease in reef health and cover are tied to increased coastal development. Recent models estimate that somewhere between 43% and 82% of current coral reef habitat could be lost by the year 2100 due to anthropogenic impacts of land-based activities (Freeman *et al.*, 2013).

Determining the anthropogenic influence on coastal ecosystems is a very complex endeavor. Multiple pollutants (e.g. sediments, nutrient, pesticides) can have a synergistic effect on an ecosystem or a given pollutant can affect multiple ecosystems. For example, Haynes *et al.* (2007) modeled the fate and transport of pollutants from a particular catchment into the Great Barrier Reef in Australia. This model attempts to identify anthropogenic land activities which may result in increased contamination and pollution through agriculture, fertilizer and pesticide use, sedimentation, and other stressors that result in the degradation of coral reef systems. This model demonstrates the importance of incorporating all factors that could possibly contribute to the fate and transport of pollutants to a coral reef system. In order to understand the overall impact of land-based sources of pollutants on coastal ecosystems it is often necessary to determine the impact of each pollutant or a suite from a spatial and/or temporal perspective.

There have been many studies conducted to assess pollution effects on coral reef systems. Eutrophication (e.g., Costa Jr. *et al.*, 2000), turbidity (e.g., Fabricius *et al.*, 2012), sewage (e.g., Lapointe *et al.*, 1990), sedimentation (e.g., Melbourne-Thomas *et al.*, 2011), and ocean acidification (e.g., Sheppard *et al.*, 2009; Comeau *et al.*, 2013) are some of the major concerns that impact survivorship and health of coral reefs worldwide. Sewage is of special interest because it provides excess nutrients, toxins (e.g., heavy metals), and pathogens that seep through groundwater or moves as runoff into the coastal waters. Excess nutrients can result in algal blooms that will decrease light penetration and increase turbidity, and can cause major changes in the taxonomic richness and composition of coral reefs as well as their health (e.g., Pastorek and Bilyard, 1985; Futch *et al.*, 2011). In areas where sewage contamination is of concern, such as Southeast Florida (Florida Keys), studies have shown that untreated sewage can bring excess nutrients in combination with other viruses and bacteria that can cause damage to coastal reefs (Futch *et al.*, 2011). Costa *et al.* (2000) also found similar results in Bahia-Brazil. Their study concluded that the variation in the algal cover was primarily attributed to the increase in pollution (pathogens, organic material, and nutrients) coming from increased septic tank usage.

There is a critical need to quantify coral reef health in anthropogenically-impacted coastal sites with biomonitors in order to better understand the magnitude and effect of pollution. When the overall coral reef structure degrades, the habitats within this ecosystem can be expected to degrade as well due to the intricate relationship between the organisms and the surrounding physicochemical parameters (e.g., temperature, pH, nutrients).

Some examples of biomonitors that have been used include the corals themselves (e.g., Eca *et al.*, 2012), various species of fish and invertebrates (e.g, seabass, gobies; polychaetes, shrimp) for heavy metals (Cacador *et al.*, 2012), pesticides in fish tissues (Waltham *et al.*, 2011), and benthic foraminifera (Hallock *et al.*, 2003; Uthicke and Nobes, 2008). Using biomonitors, scientists are able to interpret the changes in specific individuals of a species, population, or community structure in order to evaluate the effects of contaminants on the ecosystem (e.g., Hallock *et al.*, 2003; Martinez-Colón *et al.*, 2009).

Reefs in Belize

Anthropogenic impacts on the coral reefs of Belize are not well studied. Several studies on Belizean reefs adjacent to Caye Caulker have focused on algal biomass (McClanahan *et al.,* 2002), nutrient (LaPointe, 2004; McCLanahan *et al.,* 2005; Littler *et al.,* 2010) and bioerosion (e.g., Carreiro-Silva *et al.,* 2012.) experimental work, and fish population modeling (Babcock *et al.,* 2013), among others. Of all the studies conducted, only two have addressed direct anthropogenic impact. Castillo *et al.* (2011) studied the effects of increasing human population on the coral species *Siderastrea siderea.* This study found that forereef colonies of *S. siderea* were more susceptible to environmental stress than backreef and nearshore colonies which may have historically been exposed to higher baseline stressors (*i*e.g., temperature, weather). These results also suggest that sediment and nutrient plumes originating from Guatemala and Honduras may disproportionately impact the Mesoamerican barrier reef system. Prouty *et al.* (2008) used the incorporation of trace metals in long-lived coral skeletons as a temporal indicator of environmental conditions. This study found increased levels of Cu (copper) and Sb (antimony) over the course or five years that are most likely attributed to freshwater runoff linked to industrial shipping activities off Honduras, thus demonstrating the negative impacts that terrestrial runoff and anthropogenic activities have on coastal water quality. Neither of these studies addressed a specific impact nor did they address the location of our study. However, the study conducted by Prouty *et al.* (2008) did have one sampling site in close relation to Caye Caulker. Both studies concluded that the increase in human population, and therefore coastal development, has had a negative impact on the coral reef ecosystem and structure.

In recent years there has been a significant increase in the development along the Belizean coastlines due to an influx of tourism traffic (Young 2008), resulting in the Belize Tourism Board enacting the Belize Cruise Tourism Policy that limits the number of tourists to 8000 per day (Diedrich, 2010). The number of overnight tourists increased from approximately 131,000 in 1995 to nearly 290,000 in 2013 while the number of cruise tourists increased from none in 1995 (when cruise ship tourism was nonexistent) to over 700,000 during the same time period (Aaron Lewis, Statistical Institute of Belize, pers. comm.). Much of the increase in coastal populations in Belize can be attributed to tourism, including ecotourism (Lindberg *et al.,* 1996). When tourism traffic is generated through the attraction of endangered ecosystems, it is referred to as ecotourism. Often the income generated from visitation to this ecosystem is used for the ecosystem's management and continued monitoring, which is intended to protect the ecosystem. Corals reefs are one of the main attractions of ecotourists in Belize (Lindberg *et al.*, 1996). An increase in tourism traffic is naturally followed by an increase in the development of hotels and other infrastructure to service the needs of tourists. In the period from 2000 to 2005 alone, employment in the hotel sector of the economy grew by 46% in Belize (Fabro and Rancharan, 2011).

Understanding and documenting the effects of sewage on coral reefs systems of Belize has never been attempted. The significant increase in the development along the Belizean coastlines due to the increase in tourism traffic (Fabro and Rancharan, 2011) and urban growth (Young, 2008) directly translates to an increase in sewage production. Currently, only four population centers in Belize have sewage-treatment facilities: Belize City, Belmopan, San Pedro, and most recently, Mahogany Heights (Fabro and Rancharan, 2011). A high number of urban residents and facilities rely on septic systems and on latrines in rural areas (Young, 2008).

A good location to study sewage pollution is Caye Caulker (Figure 1).

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 1: Caye Caulker-Belize.

Caye Caulker is a low lying coralline island and is the second most populated in Belize with 1,500 permanent residents (Fabro and Rancharan, 2011) in an area of approximately 3.35 mi^2, many of whom are fairly recent immigrants to the island as a result of the increasing tourism activities. Due to its proximity to coral reefs, Caye Caulker receives a significant influx of tourists (Lindberg *et al.*, 1996) adding to the population density of the island. In spite of its growing population, Caye Caulker has no central waste-treatment facilities, leading to concerns that untreated sewage may be harming the environment. A pilot project conducted by Fabro and Rancharan (2011) examined groundwater in Caye Caulker and found high nutrient loads of nitrates (0.9-15.5 ppm), phosphates (0.1-1.5ppm) and high fecal coliform (1 colony/100mL to 160 colonies/100mL) concentrations. Since groundwater migrates offshore towards the reefs (Fabro and Rancharan, 2011), there is potential for environmental degradation of the coral reefs in the area. Water currents in the Caribbean and along the Belizean coastline also make the reefs off the coast of Belize more susceptible to pollutants (Figure 2). Due to the Yucatan Peninsula's coastal configuration, a western bound limb of the Caribbean current travels southward along the Belizean coastline and forms a gyre that falls just east of the mainland (Figure 2). These currents could reduce the flushing that occurs along the reef and the entire coastline of Belize, resulting in concentration of pollutants possibly along the shorelines of many Belizean cayes.

Reefs east of Caye Caulker (Figure 2) are thought to be impacted by sewage pollution (Fabro and Rancharan, 2011) due to their proximity to the coast (< 1 mile), and the bottom condition in the area makes sediment-based environmental assessments appropriate. The sediments surrounding the cayes in Belize are rich in well preserved microorganisms (Foraminifera) (Richardson, 2006 and 2009; Gupta and Machain-

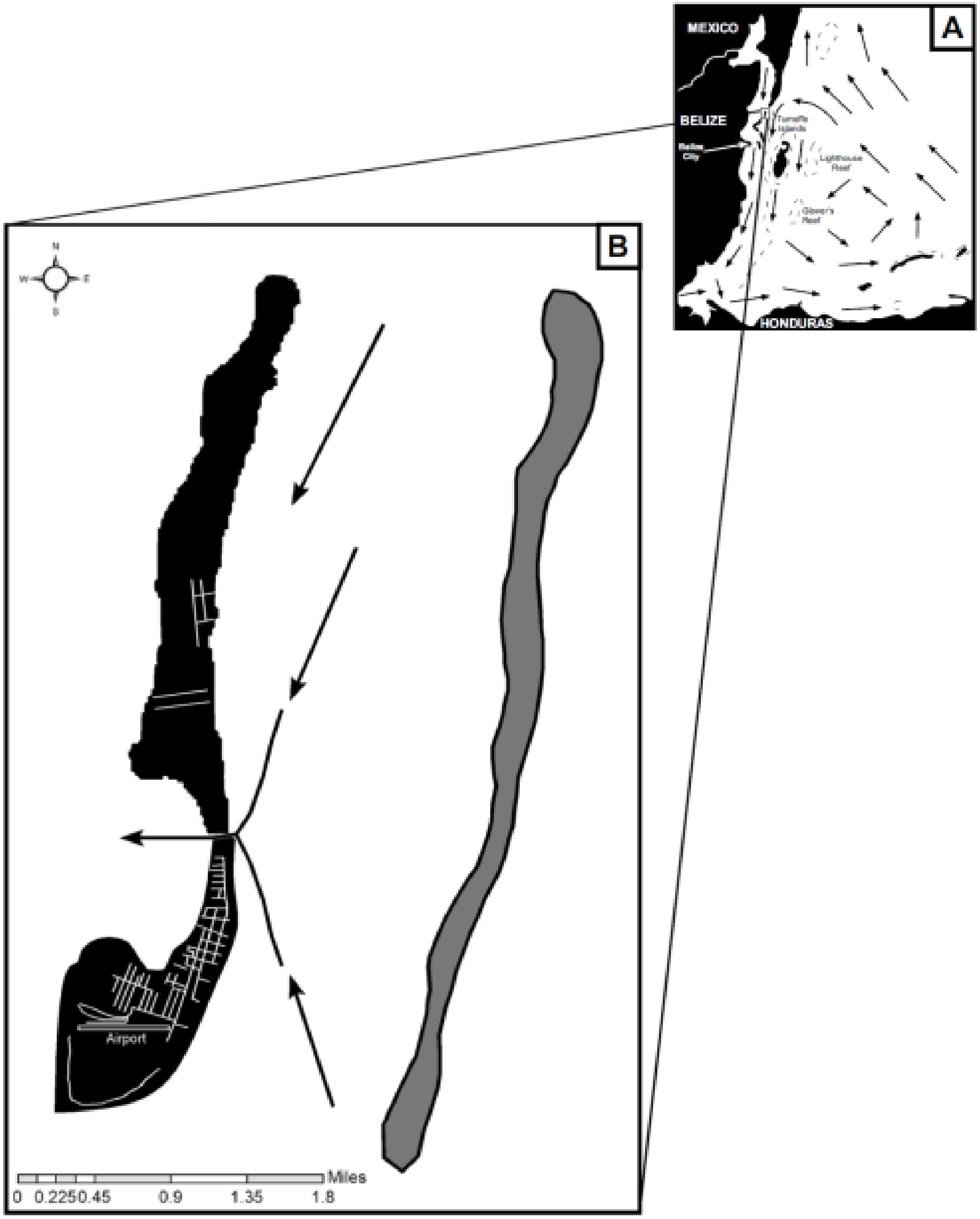

Figure 2: Belizean Surface-water Currents. Inset A: General surface ocean circulation around the Belizean coastline. Notice the gyre just off the coast (source: www.web.mit.edu). Inset B: Inferred surface currents between Caye Caulker (black) and the coral reef (gray). White lines in insert B represent anthropogenic development.

Castillo, 1993) that provide the opportunity (for the first time) to apply them as biomonitors (FORAM Index of Hallock *et al.*, 2003) of sewage pollution and coral reef health. Gischler *et al.* (2003) found that the majority of sediments fell between 63µm and 2mm (phi values 0 and 3 respectively), indicating that sediments were between coarse and fine-grained sand. The narrow range of sediment type allows for an easier application of foraminifera as a bioindicator of impacts caused by sewage input and removes another variable that could cause variation in the FI.

The reef off Caye Caulker is very important to the economy to local residents and to the country's economy as a whole. Historically, local fishing industries have been the primary source of income for many locals who have lived on the island of Caye Caulker (Gibson *et al.*, 1998). Now that tourism has shifted the economic focus of the island and the country, it is vital to assess and address the impacts created by an increase in the urban development. Because the country and the local population rely so heavily on the reefs for their continued economic stability, it is imperative to address issues now before the detrimental impacts are beyond repair.

Research Question and Objectives

The question that this research addresses is: Are the coral reefs off the coast of Caye Caulker-Belize experiencing degradation due to the influx of excess nutrients that originate from the seepage of sewage from septic systems into the groundwater of the caye? To answer this question, this project has three objectives: (1) determine the presence of raw sewage in coastal waters off Caye Caulker; (2) implement the FORAM Index as the biomonitor for water quality and, by proxy, coral reef health; and, (3) determine any correlation between the presence of untreated sewage and coral reef health in order to recommend suitable management practices to the Department of Environment in Belize.

Chapter 2: Assessing the Presence of Untreated Sewage in the Coastal Environment of Caye Caulker

Background

The use of fecal coliform bacteria is the most widely used method to assess raw sewage. However, since coliform bacteria can come from different sources, it is challenging to use it as an anthropogenic indicator (Dutka, 1974; Goodfellow *et al.*, 1977) and even their presence is not absolute proof of raw sewage. On the other hand, the absence of fecal coliform bacteria does not conclusively prove the absence of raw sewage since environmental stress may result in rapid population decline before fecal coliform bacteria can be measured (Rhodes, 1988). An enhanced diagnostic technique is to analyze for the presence of coprostanol (Hatcher and McGillivary, 1979; Brown and Wade, 1984; Pastorek and Bilyard, 1985; Writer *et al.*, 1995; Chan *et al,*. 1998; Peng *et al.*, 2002; Readman *et al.*, 2005; Pratt *et al.*, 2007).

Coprostanol (5β-cholestan-3β-ol) is metabolized in the intestinal tract of humans, other upper mammals, or created naturally by the breakdown of cholesterol (Rosenfel and Hellman, 1971; Chan *et al.*, 1998) (Figure 3). Thus, raw sewage containing

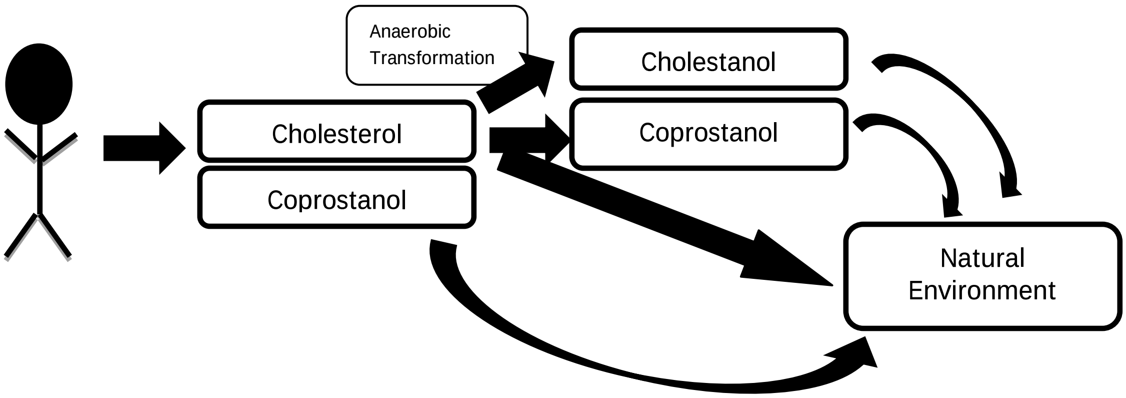

Figure 3: Sources of Sterols Entering Natural Habitats

significant amounts of this chemical can be measured and recorded (Brown and Wade, 1984). Due to its hydrophobicity, coprostanol strongly adsorbs to anoxic sediments and therefore is persistent in the environment (Brown and Wade, 1984; Kelly, 1995; Chan *et al.*, 1998). As a result, sediments can be analyzed for coprostanol to prove that raw sewage must have been present in surrounding waters. Coprostanol alone is not typically used to indicate sewage pollution in coastal areas, due to the sources other than humans from which it can originate, such as in the breakdown of cholesterol (Chan *et al.* 1998) (Figure 3). However, researchers have shown that raw sewage (whose presence in the environment is indicated by elevated levels of coprostanol) can be conclusively proven to be of human origin by measuring the ratios of either coprostanol to total steroids, coprostanol to (coprostanol + cholestanol) or coprostanol to (cholestanol + cholesterol) (Readman *et al.*, 2005). Due to the lack of standardization among research as to which thresholds indicate sewage contamination, we examined all studies and will be using thresholds that overlap most often among studies. For coprostanol, sediment concentrations exceeding 400ng/g were classified as contaminated; coprostanol to cholesterol ratios exceeding 0.20 and coprostanol to total sterol ratios exceeding 0.30 were classified as contaminated by human sewage.

Studies conducted in the Black Sea (Readman *et al.*, 2005), Chesapeake Bay (Brown and Wade, 1984), Hong Kong (Chan *et al.*, 1998), Brazil (Gutterres-Vilela *et al.*, 2011), and in the Macao estuary (Peng *et al.*, 2002), have used sterols/stanols (e.g., coprostanol) to prove the presence of anthropogenic sewage in coastal areas. In Caye Caulker only one study suggested the possible contamination of the coral reef system from untreated human sewage (Fabro and Rancharan, 2011). This study found nutrients and fecal coliform bacteria in groundwater samples from several wells dug on the island. The authors point out that the groundwater is connected to the surrounding ocean, so there is concern that the nutrients and fecal coliform are being transported to the surrounding ocean and into the nearby reefs.

In order to test this hypothesis, this study was designed to assess levels of three test compounds that indicate the presence of untreated human sewage – coprostanol, cholestanol, and cholesterol. Total levels of coprostanol and ratios as indicated previously were used to determine if untreated human sewage originating from Caye Caulker is being flushed offshore all the way to the coral reefs.

Methodology

Study Site and Sample Collection

Caye Caulker is a low-lying coralline island that sits off the west coast of Belize, accessible by boat and air. The coral reef assessed in this study lies approximately 1 mile west of the island and is frequently visited by both tourists and local residents. To accurately determine the movement of sterols from the island to the reef, 10 transects each with 10 samples were run on the east side of the island spanning from shoreline to reef and 5 transects with 5 samples each were run on the west side of the island spanning approximately 1 mile from the shoreline eastward, for a total of 125 sediment samples (Figure 4).

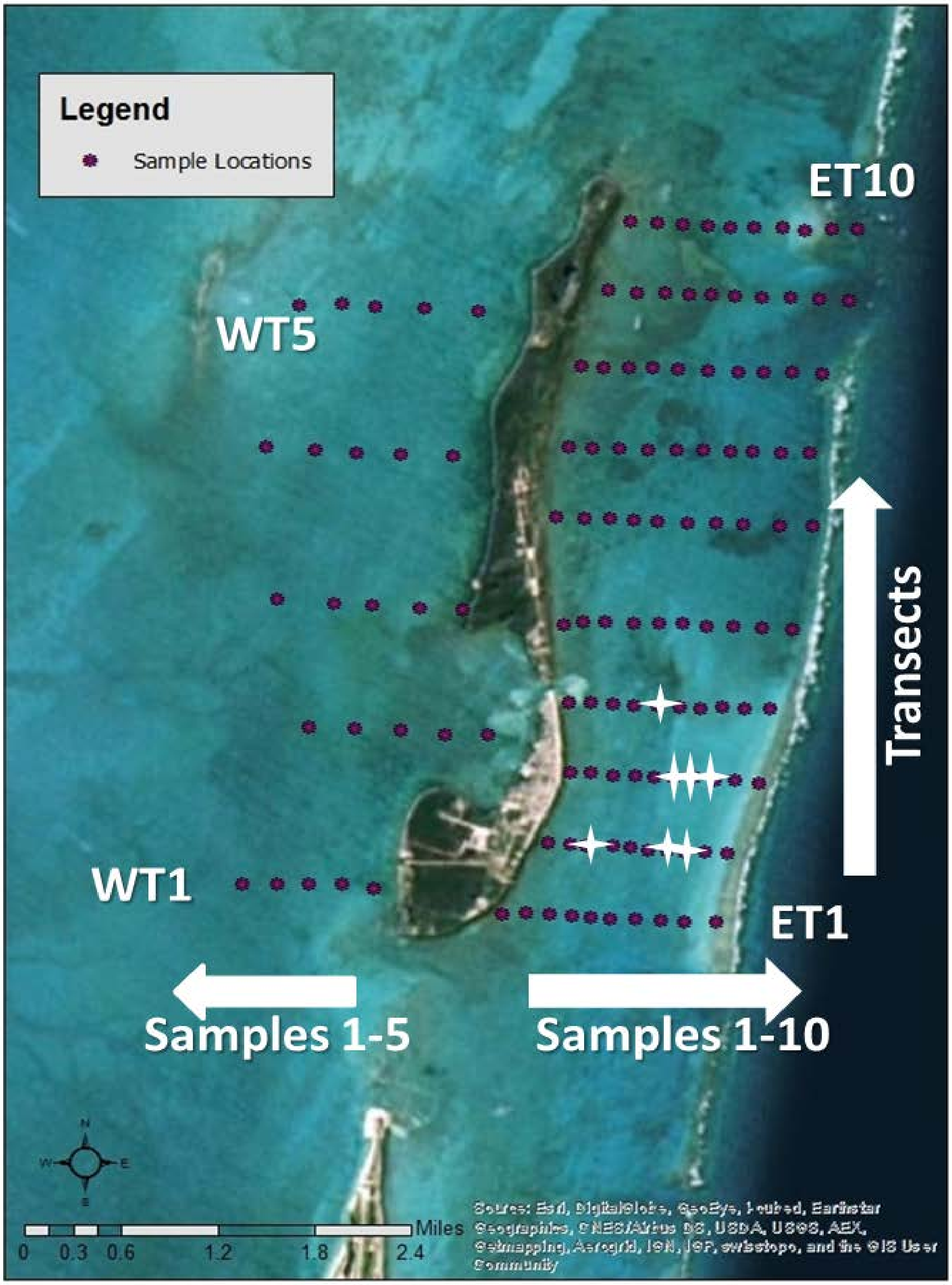

Figure 4: Sampling Sites. Sites marked by an asterisk indicate sites that were sampled either by SCUBA or free-diving not petite ponar.

Most samples were collected using a petit ponar sampler. However, due to sediment grain size in certain locations, 7 samples were obtained via free-diving or SCUBA diving (See Figure 4 for stars indicating those samples that were taken via SCUBA or free-diving). After collection, samples were placed in acid-washed Nalgene containers and frozen until further evaluation could be performed.

Sterol Analysis

Sterol Extraction

Analysis for sterols followed the methodology established by Isobe et al. (2002). In the laboratory all 125 samples were oven-dried in glass beakers covered with aluminum foil at 50.0^0 C for 24 hours and returned to the freezer upon completion of drying. From each sample, 10.0 grams of sediment was weighed out and placed in a beaker and a few small pieces of DrieRite were used to remove any residual water from samples being stored in the freezer. All samples were then extracted using a three step process: (1) ultrasonicated with 30 mL of methanol for 60 minutes; (2) ultrasonicated with 30 mL of 1:1 methanol and dichloromethane (DCM) for 60 minutes; and (3) ultrasonicated with 30 mL of DCM for 60 minutes. All three extractions were combined, ultracentrifuged and reduced to approximately 1.0 mL using a rotary evaporator and then reduced further to near dryness using a nitrogen evaporator, before being redissolved in 0.5 mL of 3:1 DCM/hexane to make column chromatography more effective.

Column Chromatography

After extraction and redissolution, all samples were processed through a 1 cm i.d. glass chromatographic column to remove the majority of unwanted organics from the samples. The column consisted of 3.0 grams of baked silica topped with ~0.5 grams of anhydrous sodium sulfate. The column was pre-eluted first with 20 mL of DCM followed by 20 mL of hexane after which the concentrated sample was added to the column. Each sample was eluted with three different solvents: (F1) 20 mL a 3:1 mixture of hexane and DCM, (F2) 40 mL of DCM, and (F3) 30 mL of a 3:7 mixture of acetone and DCM. The first elution (F1), 3:1 hexane/ DCM, was collected and stored in the freezer. The second and third elutions (F2 and F3) contained the sterols and were therefore collected and concentrated using a rotary evaporator to ~0.5 mL and stored in the freezer until further analysis was completed.

Derivitization

Due to the fact the three sterols in question, coprostanol, cholestanol, and cholesterol, are polar, it was necessary to perform a derivitization on each sample to reduce their polarities and make them amenable to analysis by gas chromatography. To do this, each sample was first reduced to dryness using a nitrogen evaporator, then to each sample 50µL pyridine and 50µL acetic anhydride were added and allowed to sit at room temperature overnight for the reaction (conversion of the alcohol moiety to an acetate ester) to complete. The following day 200µL of 4M HCl and 500µL of hexane were added to each sample, mixed well and ultracentrifuged (Fisher Scientific Model 225; max rpms of 5100). The upper organic layer (hexane) was removed from the test tube and passed through a miniature column created by using a pipette packed with glass wool and approximately 0.5 grams of anhydrous sodium sulfate to remove any aqueous solution. Two more additions and removals of 500µl of hexane were performed and all three hexane extractions were placed into a chromatography vial. After all three hexane extractions were completed the samples underwent a solvent-exchange using iso-octane resulting in a final volume of 0.5ml. All samples were stored in the freezer until gas chromatography/ mass spectroscopy could be completed.

Gas Chromatography/ Mass Spectroscopy (GC/MS)

The GC/MS used for this study was an Agilent 7890A/ 5975C instrument. Samples were analyzed using a DB-5 column (30m- 250µm- 0.25µm column) using the temperature program: initial temperature of 60°C, hold for 5 minutes, then increase by 6°C per minute until 290°C, and a final temperature of 300°C and hold for 5 minutes. For each target compound, identification involved testing for four ions, their ratios and their retention times using the GC/MS operated in selective ion monitoring (SIM) mode. Coprostanol had a retention time of 41.832 and was identified and quantified using the target ion 370.300, and qualifier ions of 355.3, 215.1, and 276.1. Cholestanol had a retention time of 43.02 and was identified and quantified using the target ion 215.1 and qualifier ions of 370.3, 355.3, and 276.1. Cholesterol had a retention time of 42.866 and was identified and quantified using the target ion 368.3, and qualifier ions 353.3, 247.2, and 215.1.

Quality Assurance/Quality Control

To ensure quality of the concentrations determined several steps were taken. First, the instrument detection limit (IDL) was determined for the compounds. Standards were sequentially diluted by a factor of 10 beginning with 100 ppm and analyzed on the

GC/MS until a concentration was reached that could not be reliably reproduced or did not have the required 3:1 signal to noise ratio. Using this method, the limit of detection determined for the three compounds (coprostanol, cholestanol, and cholesterol) was 0.1 ppm. Standards of known concentrations were processed at the beginning and end of all analytical runs, with a solvent blank of hexane and coprostanol standard after every 10 runs to ensure accuracy of data collected. Separate calibration curves were made for each of the three target compounds. For coprostanol, the calibration curve was created from standard solutions with concentrations of 5ppm, 10ppm, 25ppm, 50ppm, and 75ppm. The cholestanol and cholesterol calibration curves were made from standard solutions of 25ppm, 50ppm, 100ppm, 250ppm, and 500ppm. Concentrations were calculated using the instrument's software, which compares the response factors of samples with those in the calibration plots. Calibration curves had r^2 values of 0.970, 0.998, and 0.971 respectively to coprostanol, cholestanol, and cholesterol.

Results

All 125 sediment samples collected off the coast of Caye Caulker were analyzed for three compounds: coprostanol, cholestanol, and cholesterol (Table 1). Results were assessed to determine mean, minimum, and maximum for each individual sample, as well as calculations for east and west and north and south of Caye Caulker. East and west samples can be differentiated by the "W" or "E" at the beginning of the sample identifier, while north and south are separated by transect number. Transects ET1 through ET4 and WT1 and WT2 were grouped as the southern end of the island, while transects ET5 through ET10 and WT3 through WT5 were grouped as the northern end of the island. The southern end of the island is far more heavily populated and contains almost all hotels.

Table 1: Arithmetic Calculations for Each of the Three Compounds and Ratios

	Minimum	Maximum	Mean	East Mean	West Mean	North Mean	South Mean
Coprostanol (ng/g)	0.42	721.92	57.12	50.65	82.98	63.41	47.68
Cholesterol (ng/g)	0.17	2773.17	300.66	289.19	346.55	349.39	227.56
Cholestanol (ng/g)	0.46	1450.96	142.47	125.63	209.84	171.09	99.55
Coprostanol/Total Sterol	0.06	4.67	0.31	0.32	0.24	0.31	0.31
Coprostanol/ Cholesterol	0.01	18.47	0.38	0.42	0.23	0.47	0.24

Table 1: The arithmetic, minimum, maximum, and mean values for all three compounds (coprostanol, cholestanol, and cholesterol). Table includes values found across all samples for minimum and maximum, while means were found for all samples, and each division observed (east, west, north, and south).

Coprostanol levels found ranged from 0.42 ng/g to 721.92 ng/g across all transects (Table 1 and Figure 4), indicating that there is some form of sewage entering the coastal area in Caye Caulker. Three samples out of 125 were determined to exceed the 400 ng/g concentration indicating severe contamination (Figure 4). The remaining 122 samples had coprostanol concentrations of <400ng/g suggesting less severe sewage contamination; 17 had concentrations between 100ng/g and 400 ng/g; 15 samples had concentrations between 50 ng/g and 100 ng/g; and 13 samples had concentrations below the detection limit of the GC/MS (see Figure 5). Of those samples which showed coprostanol concentrations exceeding 400ng/g, 2 in particular stand out: ET4S1 and WT3S1. These 2 samples were taken closest to the shoreline and are the closest to the expected travel path of the compounds (see Figure 2). There is a strong current that flows between the northern and southern sections of the island, suggesting that there may be a draw of contamination to these areas as water enters and exits the channel (see Figure 3 for locations of these samples). There is an overall trend that shows higher levels of coprostanol near the shore of the island, but tapers off quickly as you move away indicating that contamination has not yet reached the reefs (Figure 5). All raw data can be found in Appendix B.

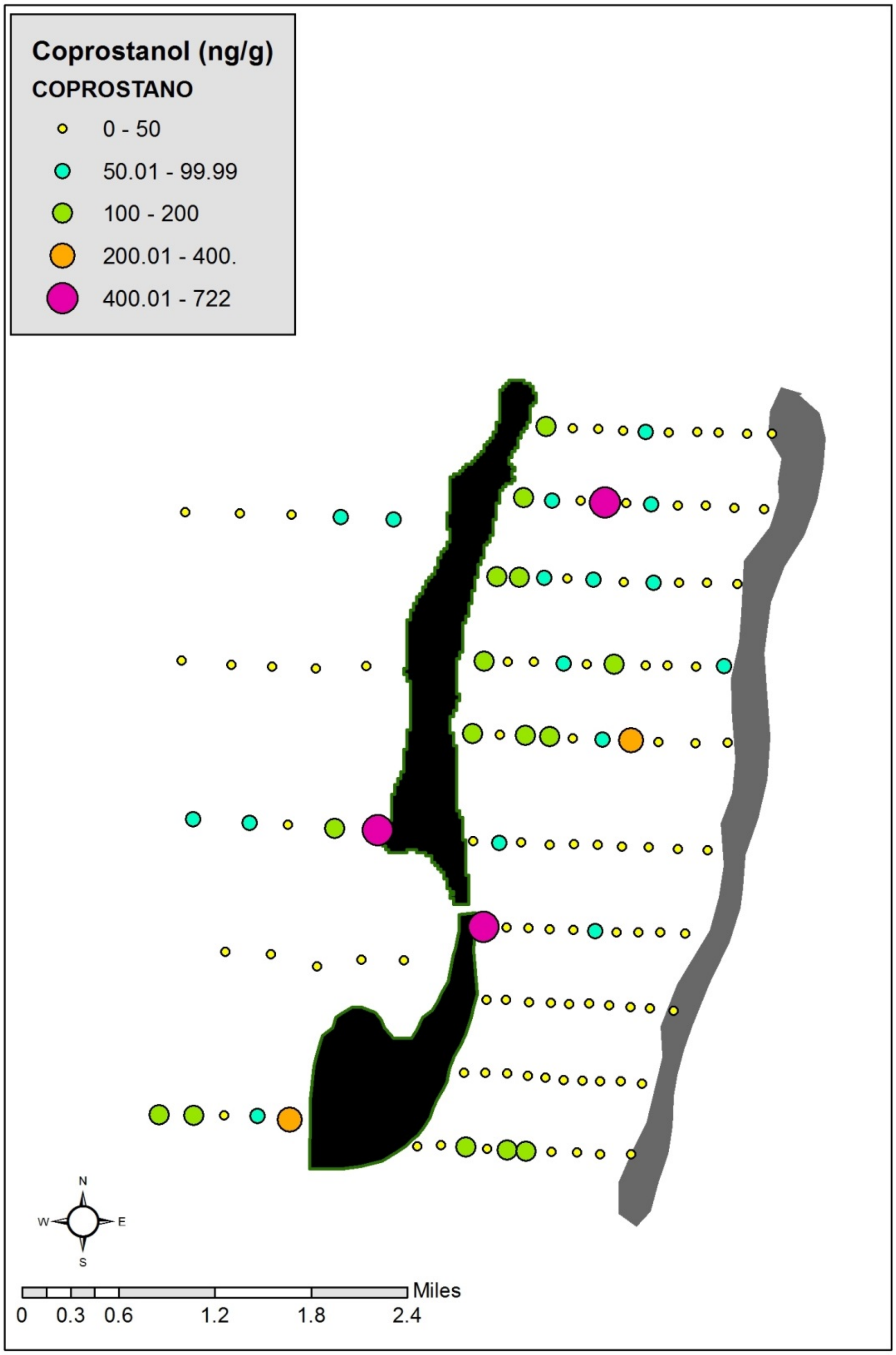

Figure 5: Coprostanol Concentration Distribution

The final step in confirming sewage pollution using coprostanol is the use of sterol/stanol ratios. These ratios indicate whether or not the coprostanol can be attributed to human sewage contamination or to the natural breakdown of cholesterol. The first of two ratios that used was the coprostanol to cholesterol ratio (R1), and the second was the coprostanol to (coprostanol + cholestanol) ratio (R2) (Readman *et al.*, 2005; Brown and Wade, 1984). Using available literature and previous research, it has been determined that if R1 exceeds 0.2 and R2 exceeds 0.3, then concentrations are indicative of raw human sewage. Using these values and the concentrations found, we can state that 43 samples exceeded the R1 ratio and 24 samples exceeded the R2 ratio, confirming that human sewage contamination was present in these samples. If we cross-reference these two ratios 16 samples were found to have values that exceed both ratio limits for contamination. Only a handful of the locations that showed high ratios were found beyond ~ 0.5 miles from the shoreline. This suggests that contamination is originating from the shoreline but is being diluted by the time it gets to the reef area (see figures 6 and 7 for locations and ratios.)

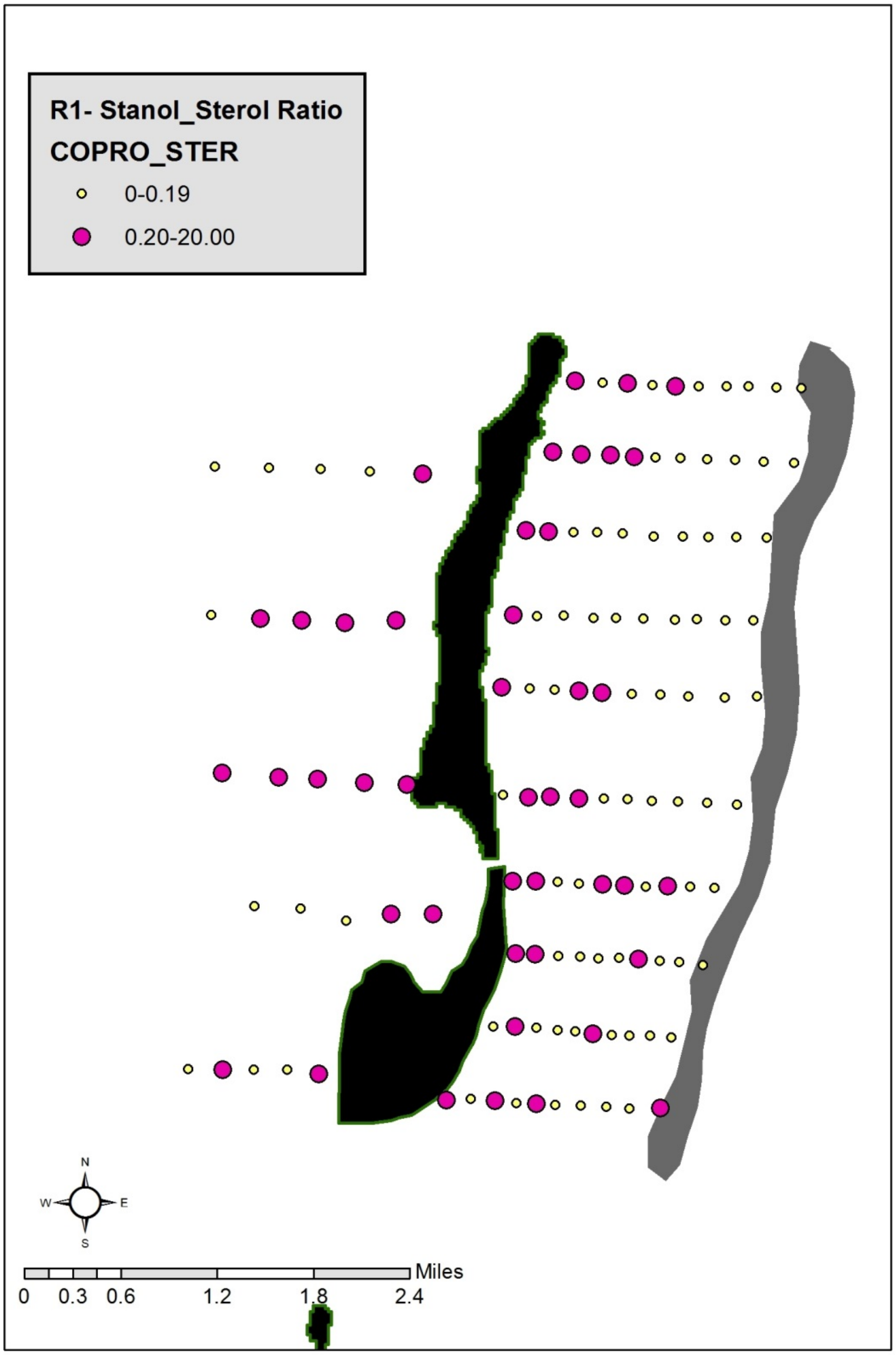

Figure 6: Coprostanol to Cholesterol Ratio Distribution (R1)

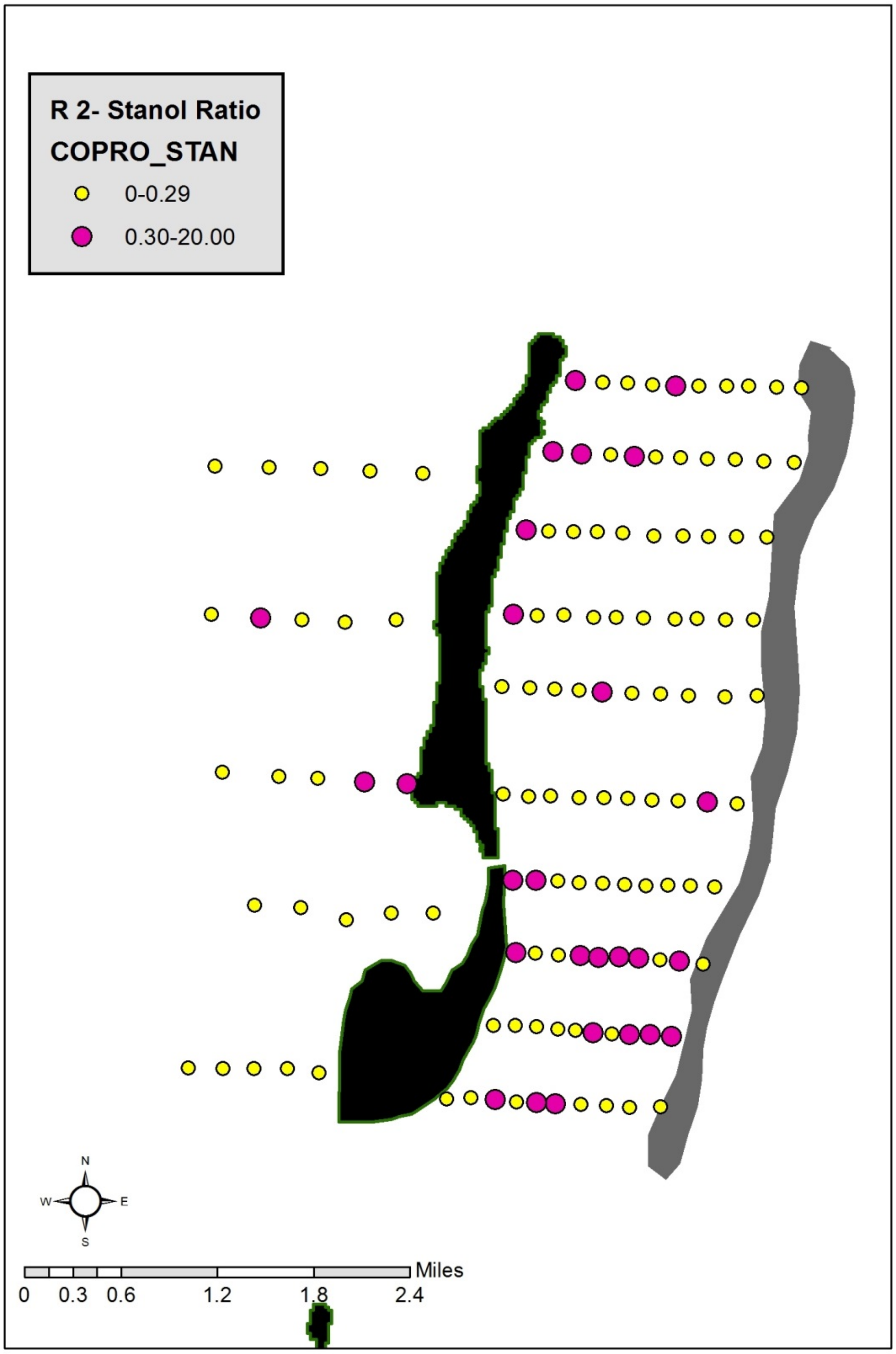

Figure 7: Coprostanol to Total Sterol Ratio Distribution (R2)

Discussion

The coprostanol concentrations and ratios found all suggest that there may be concern for the near-shore reef off the coast of Caye Caulker. Several studies that have been conducted to assess the concentration of coprostanol at sewage discharge have all confirmed that coprostanol levels are highest at the point of discharge (Brown and Wade, 1984; Chan *et al.*, 1998; Peng *et al.*, 2002; Readman *et al.*., 2005) Figures 4, 5, and 6 show that the highest coprostanol concentrations and ratios indicative of sewage are currently found closest to shore where discharge is thought to be occurring, following the expected trend.

Scientists have yet to determine definitive coprostanol concentrations that would indicate “low,” “medium,” or “high” levels of contamination. Therefore, we used a value between the highest cutoff and the lowest for the severely contaminated and adjusted the thresholds beneath to create relative classifications. Readman *et al.* (2005) used 500ng/g as the threshold for severe contamination while others reported average concentrations ranging from 142ng/g to 390ng/g in severely contaminated areas (Brown and Wade, 1984; Chan *et al.*, 1998; Peng *et al.*, 2002). Writer *et al.* (1995) used a coprostanol concentration of 10ng/g or above as the threshold for areas adversely affected by sewage discharge, but did not set a threshold for severely contaminated areas. Therefore we used the level of 400ng/g or greater as the threshold to indicate severely contaminated areas.

For the concentrations less than 400ng/g we used the separations of 0-50ng/g, 50.01- 99.99ng/g, 100-200ng/g, 200.01-400ng/g, and >400ng/g. These separations were chosen to efficiently show the variation in coprostanol concentrations and to effectively determine relative contamination in the coastal area of Caye Caulker. Using the aforementioned separations, we can conclude that in most cases higher concentrations of coprostanol are found nearer to shore, while lower concentrations are dominant closest to the reef. Coprostanol's hydrophobicity may be the primary cause as to why no contamination is being detected at farther distances from the shoreline – that is, it adsorbs to particulates efficiently and settles as sediments closer to the shoreline. However, if continued input overloads the sediment closest to shore, excess nutrients resulting from sewage discharge could put extra stress on the reef possibly causing degradation and loss of reef cover. It is also important to note that coprostanol, as observed by other studies, has a positive correlation with smaller sediment particles (Hatcher and McGillivary, 1979; Brown and Wade, 1984; Writer *et al.*, 1995). However, upon further evaluation, the grain size in the study area does not greatly vary, suggesting that sediment particle size is not considered to be a major factor in determining local coprostanol concentrations.

Both ratios used in this study have been used by several other researchers, but yet again, there is no consensus regarding which steroids or what ratio thresholds definitively indicate sewage contamination. Therefore, it was again necessary to assess the literature to determine which thresholds would be used. Readman *et al*. (2005) uses ketone ratios (coprostanol / (coprostanol +cholestanone)) of 0.3 to classify a sample as contaminated by human sewage. Therefore, this study used the same threshold for the coprostanol to cholestanol ratio. The coprostanol to cholesterol ratio threshold used was 0.2, based on Brown and Wade (1984) who stated that marine environments only contribute 9.5% of the cholesterol, while constituting 50-80% of fecal sterols. Any variation in cholesterol and coprostanol can then be attributed to their variation in sources. However, the similarity in their sources, namely sewage, makes them comparable in this ratio. Thirteen out of the 15 samples taken closest to the shoreline indicate sewage contamination by both ratios, suggesting that there is sewage contamination at the closest sampling stations. There were also a higher number of samples that exceeded the ratio thresholds found at the southern end of the island where the population density is higher. Since the area with higher population and development would have a higher number of septic tanks, an increase in coprostanol input to the coastal area was expected and also confirmed.

Chapter 3: Foraminifera as a Bioindicator

Background

Foraminifera are single celled protists that secrete a shell made out of $CaCO_3$. Foraminifers are divided into two main groups based on their life mode: benthic (living in or on substratum) and planktic (living in the water column). These shelled protists can be found in all marine environments from shallow water (i.e., coastal, estuarine) to deep marine (i.e., continental slope) (e.g., Goldstein, 1999), but most importantly, some species are found to be very resilient to natural- and/or anthropogenic-induced environmental stresses.

A series of environmental factors affect the location in which foraminifers in general can thrive. These factors include pH, salinity, dissolved oxygen (DO), sediment type, food supply, taphonomic processes, etc. (Martinez-Colon et al., 2009). Numerous studies have shown that food supply is a limiting factor controlling benthic foraminiferal populations and assemblages (Alve, 1995; Jorissen, 1999; Schönfeld et al., 2012). The amount of food supply (i.e., organic matter) controls several chemical parameters such as DO, alkalinity, pH, among others within the sediments and pore waters (Martinez-Colon *et al.*, 2009). Food supply or organic matter is an important parameter to consider when studying marine environments impacted by sewage as this pollutant potentially serves as a direct or indirect food source to foraminifers. Modeling work conducted by Jorissen (1999) found that excess food supply will reduce the DO in eutrophic settings resulting in anoxic conditions and in oligotrophic environments (e.g., reefs) will impact the abundance and depth foraminiferal distribution. These conditions are reflected in the dominance and distribution of benthic foraminifers in which epifaunas are replaced by oxygen depleted infaunas and subsequently by dysoxic tolerant infaunas when environments change from oligotrophic to eutrophic conditions.

Benthic foraminifers have been used in pollution studies in coastal environments for the past 50 years as proxies for heavy metal contamination (Samir and El Din, 2001; Frontalini and Coccioni, 2008; Gutterres- Vilela*et al.*, 2011), eutrophication (Seiglie, 1968; Richardson, 2006), water quality, coral reef health (Hallock *et al.*, 2003; Fabricus *et al.*, 2012); sewage (Bandy *et al.*, 1964), and agricultural runoff (Samir and El- Din, 2001; Carnahan *et al.*, 2009), among others. Benthic foraminifers have proven useful in assessment and monitoring of coastal and shelf environments due to their taxonomic diversity, wide distribution, abundance, relatively small size, short reproductive cycles, and because their shells are often well preserved in sediments (Yanko *et al.*, 1999; Martinez-Colon *et al.*, 2009). In addition, the spatial distributions of benthic foraminifers respond very quickly to existing environmental conditions (e.g., Hallock *et al.*, 2003). Foraminiferal faunal composition can be statistically correlated to specific contaminants providing researchers an upper-hand in identifying polluted sites. Benthic foraminifers have been found to respond to pollution gradients (e.g., Schafer, 2000; Tsujimoto et al., 2006; Schönfeld et al., 2012) and their responses translate to drastic faunal successions, stepwise faunal changes, species abundance, and malformations (e.g., Elberling et al., 2003; Martinez-Colon et al., 2009).

However, caution needs to be exercised when using benthic foraminifers as bioindicators. Numerous authors agree that foraminifers react to numerous and simultaneous confounding environmental factors (Martinez-Colon *et al.*, 2009). In some environments like estuaries, environmental conditions vary so drastically that the foraminiferal assemblage can be affected in the absence of pollutants (Debenay *et al.*, 2000; Murray, 2001) leading to possible misinterpretations. Just because a foraminiferal assemblage has a natural spatial/temporal variability, does not invalidate its response as an indicator of stress (Martinez-Colon *et al.*, 2009). In this situation, it is imperative to understand the natural variability and distribution of assemblages in order to properly assess pollution-induced variations in foraminiferal communities.

Limited studies involving benthic foraminifers have been done in Belizean coastal areas. These studies mainly concentrated their efforts on taxonomy and spatial distribution of assemblages (Richardson, 2000 and 2009; Purdey and Gishler, 2003). Other studies have addressed bleaching episodes on symbiont-bearing larger foraminifera associated with elevated temperatures (Richardson, 2009) or on the distribution effects of epiphytic foraminifera associated with natural eutrophication events (Richardson 2006). Caye Caulker contains a wide array of extant benthic foraminiferal faunas that have not been exploited for their use in environmental studies.

By analyzing the distribution and abundance of benthic foraminifera, we can quantify coral reef health. The FORAM Index (FI), developed by Hallock *et al.* (2003), has been used in many studies worldwide as a very effective bioindicator of coral reef system health. Not only does it indicate water quality, thus act as a proxy for the suitability of a site for coral growth, but it also indicates the suitability of the area to support reef recovery from a detrimental event (Hallock *et al.*, 2003 and 2012). The FI consists of three morphogroups of benthic foraminifera (Hallock *et al.*, 2003). These groups are: (1) symbiont-bearing, (2) stress-tolerant, and (3) other small heterotrophic taxa. Each of these three groups has differing water quality parameters under which they can persist (Hallock *et al.*, 2012). The study performed by Uthicke and Nobes (2008) indicated that the larger symbiont-bearing foraminifers were indicative of clear water and low nutrient areas, while smaller heterotrophic taxa were indicative of low light, high nutrient conditions. By using these parameters and the proportions in which these foraminiferal morphogroups are present, the FI will determine the suitability of an area for reef growth and health status (Hallock *et al.*, 2003). Studies conducted in Kirimati Island (Carilli and Walsh, 2012), Australia (Fabricius *et al.*, 2012; Uthicke and Nobes, 2008), Indonesia (Natsir and Muchlisin, 2012), Florida (Carnahan *et al.*, 2009), Brazil (Teodoro *et al.*, 2010; Gutterres-Vilela *et al.*, 2011), Puerto Rico (Oliver *et al.*, 2014) and areas throughout the Caribbean (Velasquez *et al.*, 2011), have applied and validated the FI as a biomonitoring tool.

The FI is represented by the following formula (Hallock *et al.*, 2003):

$$FI = (10 \text{ X } P_s) + (P_o) + (2 \text{ X } P_h)$$

where P_s = proportion of symbiont- bearing foraminifera, P_o = proportion of stress-tolerant foraminifera, and P_h = proportion of other small, heterotrophic foraminifera. FORAM Index values <2 is indicative of unsuitable conditions for reef growth; values between 2 and 4 indicates marginal conditions for reef growth but unsuitable for reef recovery; and values >4 is indicative of environments conducive for reef growth and recovery. A FI value between 3 and 5 indicates that the area is undergoing environmental change.

It is not uncommon to use more than one bioindicator or biomonitor to evaluate and address environmental concerns. Using the resulting FI in combination with the presence and source of the fecal sterols addressed in the previous chapter, this study aims to determine the existing conditions of the reef off the coast of Caye Caulker-Belize. In doing so, this study seek to clarify the environmental concerns for an economically and environmentally important ecosystem. In addition to applying the FI, other statistical assessments were conducted on the samples to determine density, diversity, and species richness. The application of these additional evaluations will further enhance the environmental interpretation which the FI provides.

Methodology and Results

Grain Size Analysis

From the original oven-dried samples (see Chapter 2 methods), 5.0 gram sub samples were used for grain size data analysis. All sub samples were wet-sieved using a >63µm sieve to remove all sediment <63µm. This sediment was subsequently re-dried (50°C) and accounted for in the weight percent calculations, by subtracting the mass after wet-sieving from the mass before and recorded as the percent mud. After drying (overnight), the samples were removed and each was passed through a series of dry sieves which separated the sub-sample by the following grain sizes: 2000µm, 1000µm, 500µm, 250µm, 125µm and <62µm, with phi values of-1, 0, 1, 2, 3, and 4, respectively. Each subsequent sieve was weighed to determine the weight percent of each size fraction and recorded for use in later analysis (Appendix C). All fractions were recombined to be used for assemblage analysis.

Grain size analysis was evaluated across all samples and between east and west, and north and south comparisons. The minimum mud percent obtained was 0 and the maximum was 28 (WT5S2), both of which were the only appearance of these values

(Table 2). The average mud percent across all samples was 5.3; comparison values between east and west and north and south were, 3.63, 11.95, 4.55, and 6.43, respectively (Figure 8). In no samples was mud the dominant sediment, only 18 samples had a mud percent greater than 10 with the dominant sediment size being medium sand (phi = 2) (Table 3). Raw grain size analysis data, including weight percent, and mud percent can be found in Appendix C.

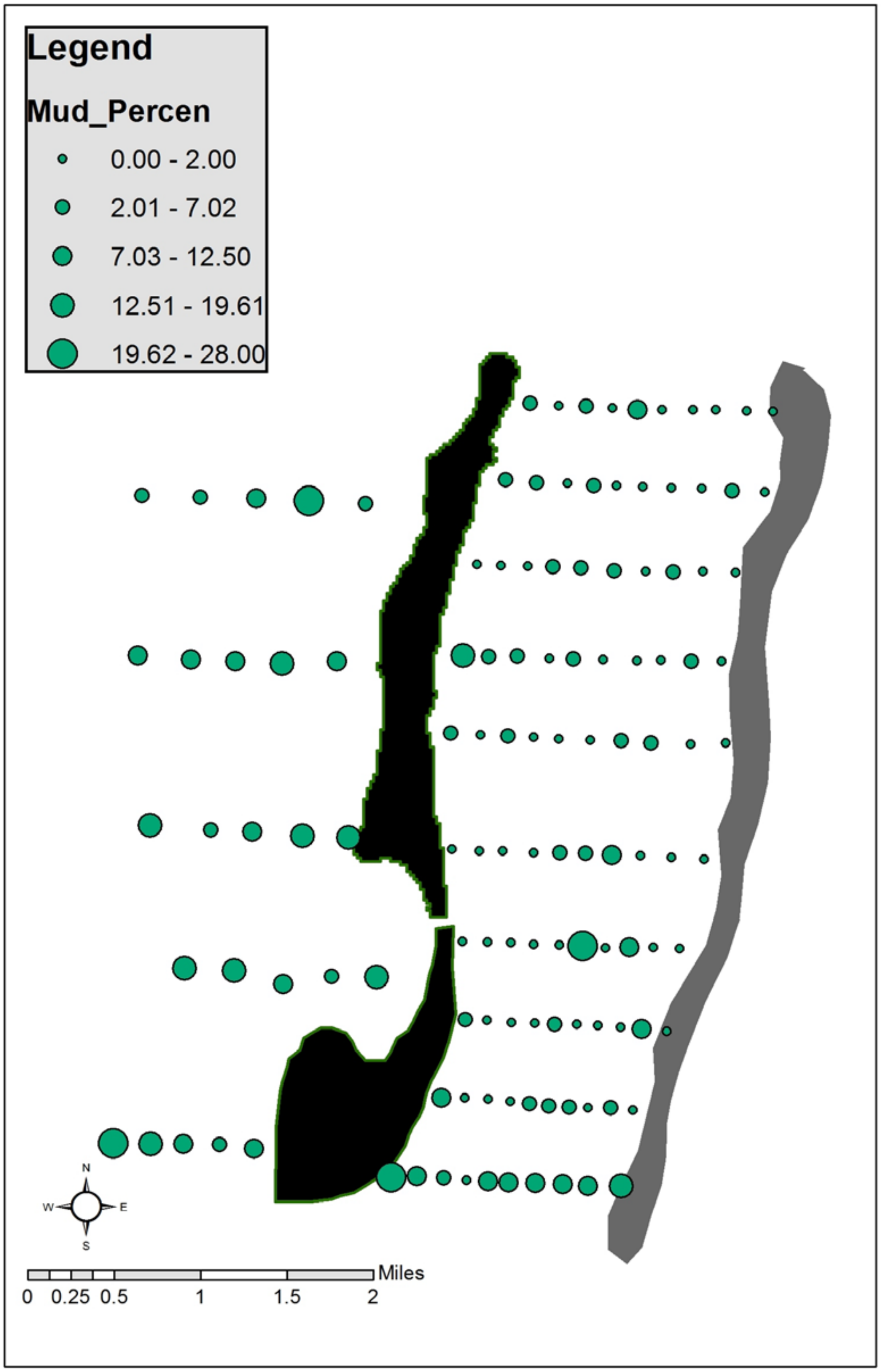

Figure 8: Mud Percent Distribution

Foraminiferal Analysis

Foraminiferal assemblages were evaluated by assessing the species present in the collected sediment samples. From the 5.0 gram sub sample, either 1.0 gram was picked for foraminiferal shells or until 200 individuals were reached following Hallock *et al.* (2003) protocols. All foraminiferal shells were placed on sectioned slides for later identification to species, or genus when species identification was not possible.

Several statistical analyses were performed on the foraminiferal data. This data consists of: (1) species richness (number of species per sample); (2) foraminiferal density (number of individuals per gram); (3) FI; and, (4) diversity index {H(S) =$-\sum p_i \ln(p_i)$}. Cluster analysis was performed on all data after adjustments for distribution and transformations were conducted. The first adjustment was the removal of any species of foraminifers that was not present in at least 5% of samples (minimum 7 samples) (Appendix A). Then data was standardized by calculating the relative abundance of each taxon (Genus) in each of the 125 samples. All taxa data was fourth root transformed (Parker and Arnold, 2003) using Primer 6 software, thus creating a resemblance matrix that generates a cluster dendrogram based on Bray-Curtis similarity (Figure 8). Five cluster analyses were performed: (1) all taxa across all samples; (2) all taxa in transects at the northern end of the island (W3-W5 and ET5-ET10); (3) all taxa in transects at the southern end of the island (WT1 and WT2 and ET1-ET4); (4) all taxa in transects on the east side of the island; and, (5) all taxa in transects on the west side of the island. Each of these clusters was analyzed for foraminiferal assemblages. Finally, a Pearson correlation was performed to determine if any significant trends were found in the data using log transformed data (Parker and Arnold, 2003). Pearson correlation included the diversity index, foraminiferal density, FI, taxa, species richness, and coprostanol concentrations. Diversity index, species richness, foraminiferal density, and FI were calculated using raw, non-standardized data, while clusters and Pearson correlation analyses were conducted on 5% adjusted data. Mud percent was also used in the correlation matrix analysis. Data on the sterols, sediment size, and foraminiferal relations will be discussed in Chapter 4.

From 125 samples, 20,069 foraminifers were picked, identified and divided into 47 genera and 97 species (Appendix A). Of the 97 species, *Archaias angulata, Asterigina carinata, Discorbis rosea, and Quinqueloculina agglutinans* were the most abundant, each having more than 1000 total individuals across all samples; 2898, 2475, 2094, and 1903, respectively. *Cymballoporetta sp., Laevinopeneraoplis bradyii, Quinqueloculina bicostata,* and *Quinqueloculina lamarkiana* all had greater than 500 individuals but less than 1000; 545, 545, 803, and 576, respectively. Raw data on all foraminiferal counts can be found in Appendix A. Statistical evaluations were conducted on all data including FI and foraminiferal density, the diversity index, grain size analysis, and species richness. Each analysis was performed on each sample with all results available in Appendix D. Comparisons between east and west sides of the island were made as well as north and south. East and west samples can be differentiated by the “W” or “E” at the front of the sample identifier, while north and south are separated by transect number. Transects ET1 through ET4 and WT1 and WT2 were grouped as the southern end of the island, while Transects ET5 through ET10 and WT3 through WT5 were grouped as the northern end of the island.

Throughout all samples the FI value had a minimum value of 2.55 (sample WT3S1), maximum value of 8.28 (sample ET3S5), and an average across all samples of

5.07 (Table 2; Figure 9). East and west side comparison was made as well as north and south, 5.22 versus 4.47 and 4.96 versus 5.24, respectively. There were only 20 samples out of 125 that had an FI value of less than 4, while the remaining 105 samples had FI values of greater than 4, and no samples having an FI of less than 2. In addition, there were 37 samples which had an FI between 3 and 5.

Table 2: Arithmetic Calculations for Five Parameters Assessed Using Foraminifera

	FI	Foram Density	H(S)	Species Richness	Mud Percent
Minimum	2.55 (WT3S1)	2 (ET6S10)	0.6365 (ET6S10)	2 (ET6S10)	0
Maximum	8.28 (ET3S5)	1396 (WT2S1)	3.33 (WT2S1)	48 (ET5S4)	28
Mean					
Overall	5.07	331	2.6641	28	5.3
Northern	4.96	252	2.61	29	4.55
Southern	5.24	449	2.69	28	6.43
East	5.22	331	2.64	28	3.63
West	4.47	363	2.64	28	11.95

Table 2: Arithmetic mean, minimum, and maximum values for the 5 parameters analyzed in regards to the foraminiferal assemblages. Table includes minimums and maximums for all parameters across all samples, mean values across all samples as well as mean values among the four divisions assessed (north, south, east, and west).

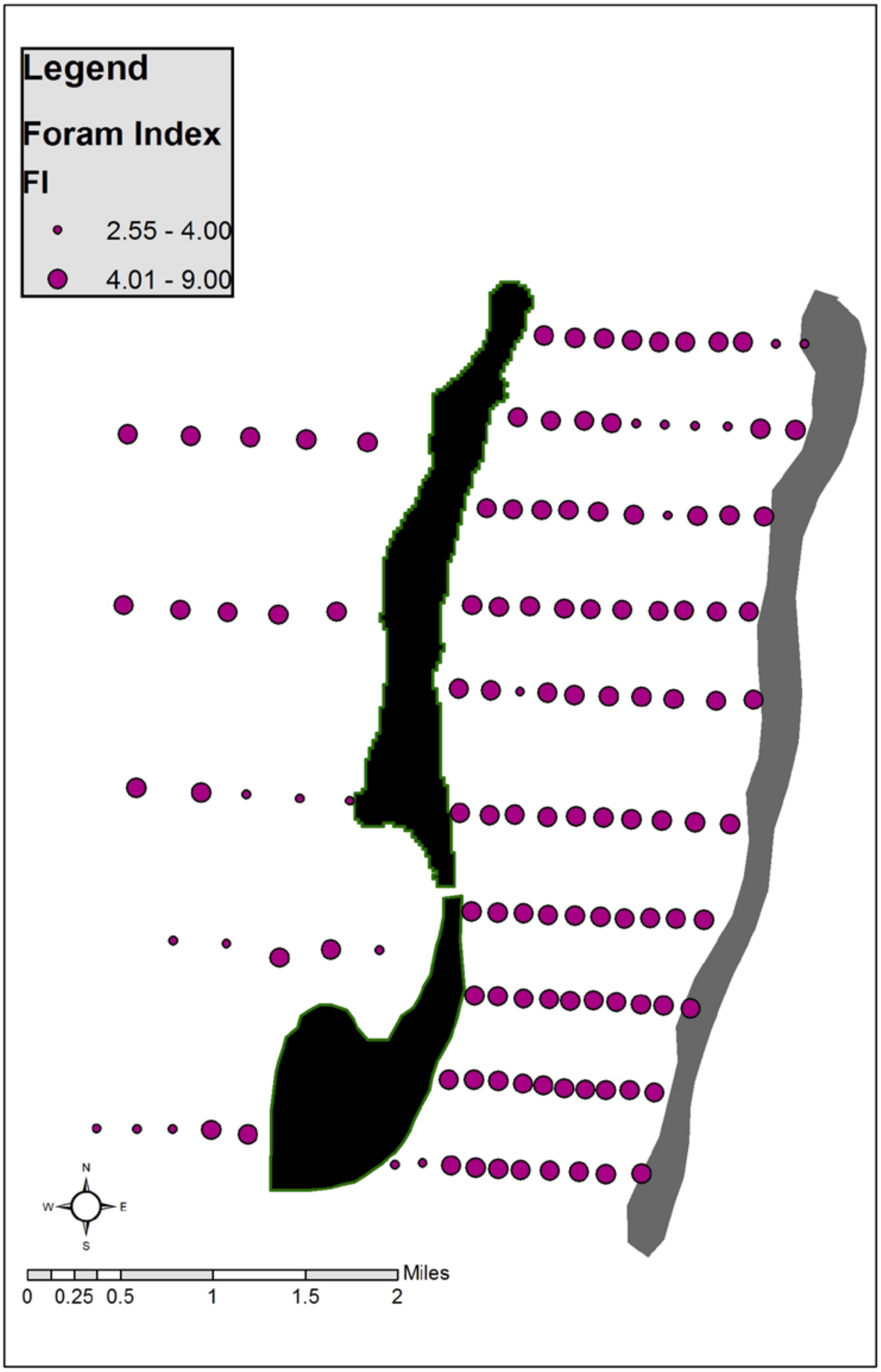

Figure 9: Foram Index Distributrion

The FI is also found to vary greatly based on the environmental conditions of the area being evaluated. When conditions are conducive to reef growth the FI is much higher than in areas where the habitat is not conducive to reef growth. This is often linked to areas affected by anthropogenic impacts. Caye Caulker FI values do not vary significantly among transects or samples. All samples have a FI of greater than 4.00 with the exception of 18 samples. Though these samples had FI values of less than 4.00 (conducive to reef growth), none of them had values below 2.00 which would indicate an area unsuitable for reef growth and recovery. These areas where the FI is less than 4.00 but greater than 2.00 suggest that an environmental change may be occurring (Hallock *et al.*, 2003). Stephenson *et al.* (2015) found an average FI of 5.6 in a pristine reef environment, while this study found an FI of 5.07 (Table 2) suggesting that the Caye Caulker is not heavily impacted. Narayan and Pandolfi (2010) found a mean FI of 3.38 in an anthropogenically impacted estuary of Australia with a range from 1.1 to 7.6. The lowest FI value found was closest to the output of the river which was being assessed indicating lower FI values can be expected in areas that are experiencing anthropogenic influences. This finding supports the lack of negative impact is reflected in the FI in Caye Caulker samples.

Foraminiferal density (Figure 10) was determined to be wide-ranging with a minimum of 2 ind/g (sample ET6S10) and a maximum of 1396 ind/g (sample WT2S1) with the average foraminiferal density across all samples being 331 ind/g (Table 2). In the east vs. west and north vs. south comparisons values were 331 ind/g, 363 ind/g, 252 ind/g, and 449 ind/g, respectively (Table 2). In the southern end of the island transect 1 (ET1) had samples with the highest densities compared to all other transects.

Therefore, it may be important to note that the southern end average, excluding transect 1, is 365 ind/g (Transect values can be seen in Table 3).

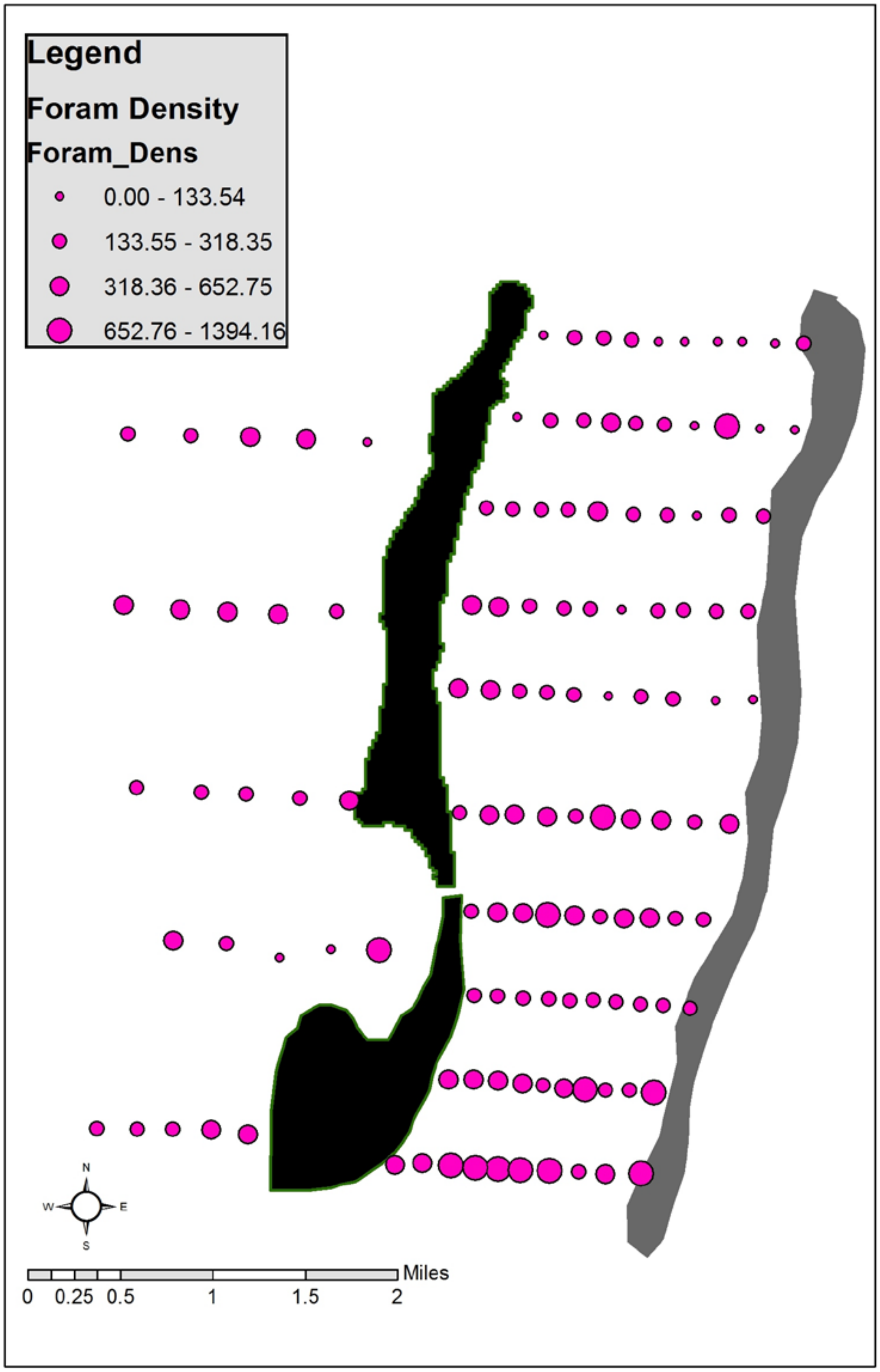

Figure 10: Foraminiferal Density Distribution

Table 3: Averages by Transect for Eight Parameters Using Foraminifera

Sample	Foram Index	Environmental Change	Reef Condition	Shannon Index	Grain Size - Phi Value	Species Richness	Foram Density	Mud Percent
ET1	4.55	Y	Conducive	3.06	1.80	32	780	9.852
ET2	6.11	N	Conducive	2.57	2.00	25	438	2.943
ET3	6.03	N	Conducive	2.38	1.90	21	217	2.732
ET4	5.32	N	Conducive	2.83	2.10	35	444	4.4
ET5	5.32	N	Conducive	2.96	1.70	40	438	2
ET6	5.15	N	Conducive	2.63	1.50	27	195	2.542
ET7	4.91	5Y;5N	Conducive	2.96	2.10	32	210	3.834
ET8	5.42	N	Conducive	2.57	1.70	27	205	1.882
ET9	4.77	5Y;5N	Conducive	2.15	1.70	23	248	3.422
ET10	4.63	Y	Conducive	2.30	1.60	23	140	2.787
WT1	3.77	Y	Marginal	2.78	2.60	32	311	12.536
WT2	4.61	Y	Marginal	2.45	1.80	24	418	11.912
WT3	3.83	Y	Marginal	2.78	2.40	30	271	13.566
WT4	4.99	Y	Conducive	2.71	2.20	30	380	11.904
WT5	5.17	N	Conducive	2.46	2.40	24	255	9.876

Table 3: Average values for each parameter along each transect. It can be seen in the foram density that Transect 1 had a very high average compared to all other transects, however species richness was not largely variable as was foram density. Also, the FI of 6 out of 15 transects indicate that the area is undergoing environmental change and all but 3 transect FI averages indicate that the reef is conducive to reef growth and recovery.

The remaining analyses were used to evaluate diversity, evenness, and species richness. The Shannon Diversity Index was used to evaluate diversity, while species richness was determined separately. Shannon Index values ranged from a minimum of 0.6365 (ET6S10) and a maximum of 3.337 (WT2S1) with an average across all samples of 2.641 (See table 2; Figure 11). Due to the relativity of these values indices between 0.64 and 1.76 were classified as “low” diversity, values from 1.77 to 2.88 were classified as “medium” diversity, and value from 2.89-3.34 were classified as “high” diversity. Only 7 samples were classified as having low diversity, while 79 were classified as medium, and 39 were classified as high. Again, comparisons between the east and west sides of the islands and northern and southern ends were made; the results were 2.64, 2.64, 2.61, and 2.69, respectively, showing little to no difference between the divisions (Table

4). It is important to note that transects 1 and 7 on the east side had a higher occurrence of samples classified as “high” diversity, 9/10 and 8/10, respectively.

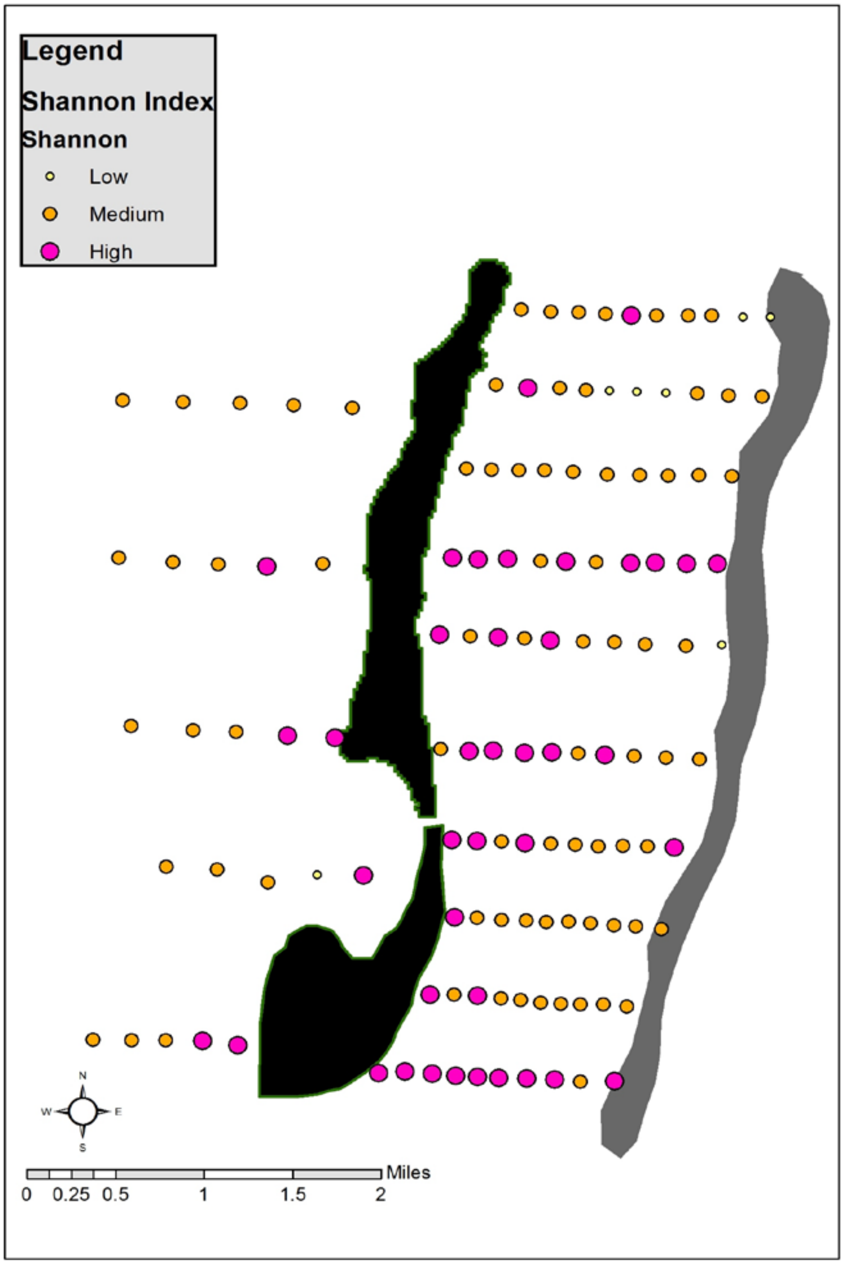

Figure 11: Shannon Diversity Distribution

Table 4: Relative Divisions of Diversity and Species Richness

Relative Divisions	H(S)	Number of Samples classified as each level in H(s)	Species Richness	Number of Samples classified as each level fo Species Richness
Low	0.64- 1.76	7	2.00-15.00	10
Medium	1.77-2.88	79	15.01-37.00	68
High	2.89-3.34	39	37.01-48.00	47

Table 4: Relative diversities of Shannon Index, H(S), and species richness. The majority of samples fall in the range of "medium" diversity, indicating that there is a normal distribution of diversities among the samples.

Finally, species richness was evaluated across all samples and again, comparisons between east and west and north and south were made. Species richness values ranged from a minimum of 2 (ET6S10) and a maximum of 48 (ET5S4) with an average across all samples of 28 (Table 2; Figure 12). A species richness relative classification was made for this parameter as well. The first classification being "low" species richness included values ranging from 2.00 to 15.00. The second classification ranged from 15.01 to 37.00 and was labeled "medium" species richness. The third and final classification had values that ranged from 37.01 to 48.00 and was labeled as "high" species richness. Ten samples were classified as low species richness, 68 samples were classified as medium species richness, and the remaining 47 were classified as high species richness (Table 4). When comparing the east and west and northern and southern divisions, averages were 28, 28, 29, and 28, respectively (Table 2). In relation to this parameter it is important to note that transects 4 and 5 had the highest occurrences of samples with "high" species richness, 8/10 and 10/10, respectively.

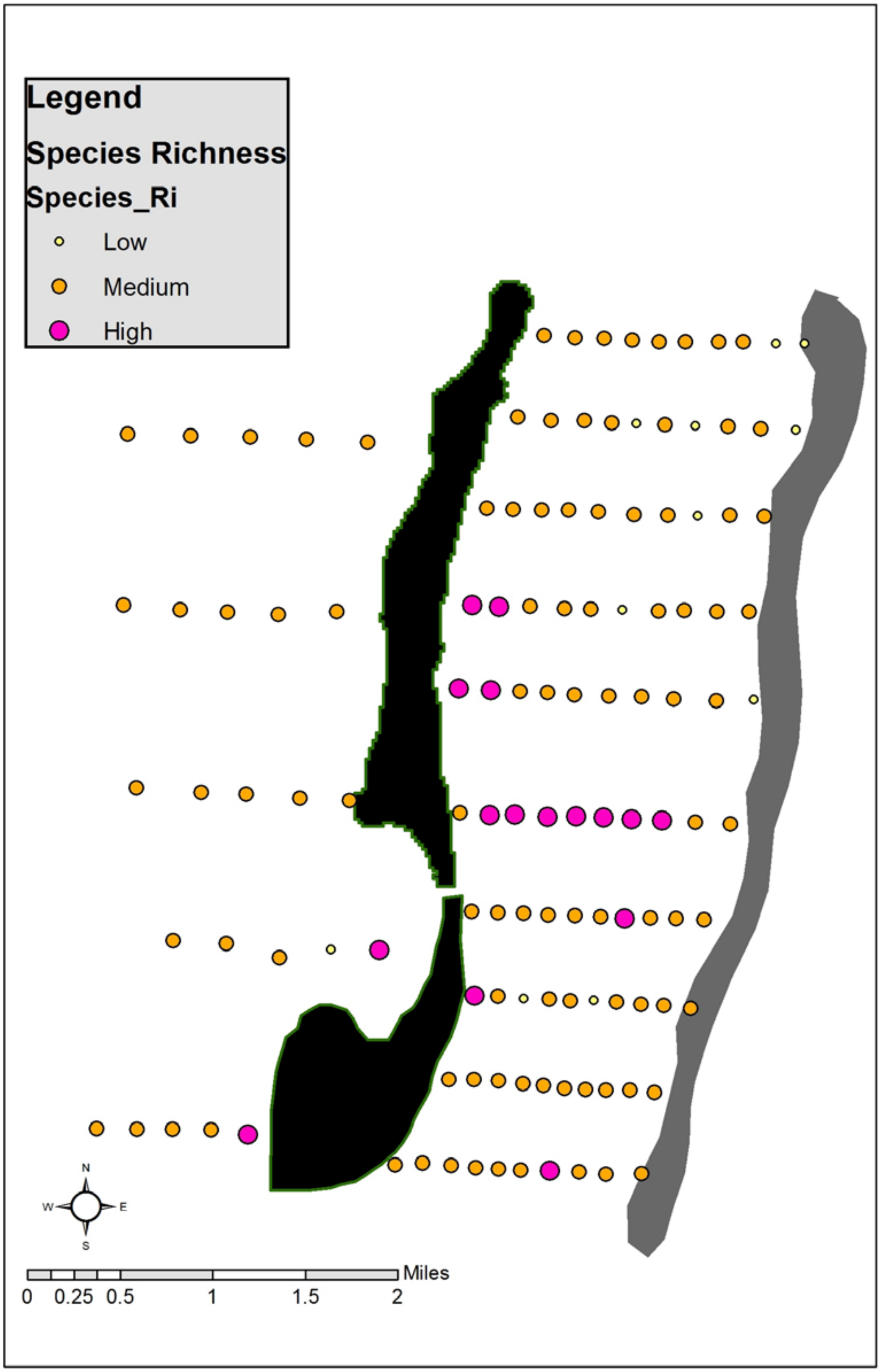

Figure 12: Species Richness Distribution

Discussion

Not all natural marine environments have a unique species distribution by which they can be characterized. Diversity index (Shannon-Index) can vary drastically between natural and anthropogenic impacted sites. Under normal conditions reef are characterized as high diversity environments in relationship to macrofaunas and microfaunas. Caye Caulker diversity values have been classified into three relative divisions (Table 4). There are no clear trends between and within transects (Figure 11) (Table 2) except that in the west side all samples except 7 have a medium diversity, while on the east all samples except 1 have a high diversity along transect 1. Total average values per transect vary between 2.15 to 3.06 (Table 3). This range of “medium” to “high” has been found in other reef environments. In relative pristine settings like Conch Reef in the Florida Keys foraminiferal diversity have mean values of 2.9 (n = 177) (Stephenson *et al.*, 2015); the diversity values of Brazilian reefs range from 2.1 to 3.1 (n = 40) (Fernandes-Barbosa *et al.,* 2009), and from 1.13 to 3.41 (non-calculated) (n = 54) (Oliveira-Silva et al., 2012); and, in areas adjacent to sewage outflow in the Mediterranen’s Aegean Sea, the diversity was calculated to have a mean value of 1.76 (n = 40 samples) (Koukousioura *et al.,* 2012). In a transitional environment (i.e. estuaries) in Brazil that is heavily impacted by raw sewage, the foraminiferal diversity is 0.46 (n= 24) (Eichler *et al.,* 2012).

Numerous factors (i.e., sediment size, food, pH, etc.) affect the distribution, diversity and abundance of foraminifers. The west coast of Caye Caulker has overall lower diversity values than the east coast (Figure 11). This corresponds to the ecological adaptation of foraminifers to different substrates. The west coast has four times the amount of mud-sized sediments than the east coast (Table 2; Figure 8) although the median grain size is sand. Surface currents along Caye Caulker's east coast transport mud size sediments (silt + clay) produced by the reefs towards the west coast through the navigational channel that separates the north and south sides of the Caye (Figure 2). In addition, Caye Caulker serves as a wave barrier in which wave energy is greatly reduced on the west coast allowing for greater deposition and preservation of carbonate mud sediments which allows foraminiferal communities to differ due to different substrates. Another important factor of concern is the presence of sewage in the area as a food source (i.e., excess nutrients and organic matter). Previous studies have found that an increase in foraminiferal abundance and diversity are directly related to food supply (e.g., Alve, 1995; Jorissen*, et al.,* 1999; Martinez-Colon and Hallock, 2010) but an overabundance of food will decrease diversity (Eichler *et al.,* 2012). Other studies have reported a decrease in foraminiferal diversity as distance increases from sewage outfalls (e.g., Seiglie 1971; Mohtaid *et al.,* 2008). Alve (1995) suggested that an increase in food availability and variability in DO will allow populations of opportunistic/stress-tolerant foraminifers (i.e., *Ammonia sp.*) to dominate the assemblage. The fact that stress tolerant species are in very low numbers and that there is relative constant foraminiferal diversity along the east and west coast transects (Fig 11) suggests that the conditions presently at Caye Caulker reflect those of Conch Reef.

All foraminiferal data and analyses indicate that the near-shore reef off the coast of Caye Caulker-Belize is not currently experiencing enough harmful impacts to cause reef degradation, reduction in growth, or the inability to recover. This conclusion is supported by the lack of FI values below 2 and an overwhelming number of samples showing FI values exceeding 4. It is important to note, however, that lower values were found closer to the shoreline, especially near the break in the sections of the island, which, by the same study, indicates that there could be an issue beginning at the shoreline. Following the trends in decreasing FI values may be important in determining where reef degradation and reduction in corals' ability to grow will occur in the future.

Foraminiferal assemblages varied among the 5 analyzed areas: overall, northern end of the island, southern end of the island, east side and west side. Cluster diagrams were created using PRIMER 6 statistical analysis software. Across all taxa and all samples it appears that 4 clusters are present (Figure 13): (a) dominated by taxa with less than 49 individuals present (*Rosalina* and *Nonion* were the most abundant); (b) *Sigmolina*, *Cibicidoides, Pyrgo,* and *Crieoelphidium*; (c) *Peneroplis* and *Miliolinella*; (d) all species in high abundance (*Quinqueloculina*-3269, *Discorbis*- 1716, and *Asterigerina*-1459) and also appeared to be driving the assemblages overall; (e) *Valvulina, Textularia, Clauvulina, Planorbulina, Borelis,* and *Broeckina*; (f) *Vertebralina, Articulina, Haurina,* and *Ammonia*; and (g) *Spiroculina* and *Pseudohaurina*. On the east side of the island, 7 clusters were evident (Figure 14): (a) *Rosalina, Borelis,* and *Pyrgo;* (b) this appeared to be the driving cluster on the east side of the island containing taxa that were present in highest abundance such as *Quinqueloculina, Asterigerina,* and on the east side *Elphidium*; (c) *Peneroplis, Discorbis, Amphistegina, Cymballoperetta, Broeckina,* and *Ammonia* were grouped in this cluster; (d) *Haurina, Articulina, Vertebralina, Valvulina,* and *Miliolinella*; (e) *Planorbulina* and *Clauvulina*; (f) *Spiroculina, Wisnerella, Spiroloculina,* and *Nonion*; and, (g) *Cibicidoides, Cyclorbiculina, Pseudohaurina, Sigmoilina,* and *Textularia.* The west side of the island also had 6 clusters (Figure 15), but varied highly from the east side: (a) *Haurina, Ammonia,* and *Cibicidoides;* (b) *Pyrgo, Cribeoelphidium, Borelis,* and *Amphistegina*; (c) *Valvulina, Elphiudium, Sorites,* and

Planorbulina; (d) this cluster appeared to be the driving cluster on the west side of the island containing such taxa as *Quiqueloculina, Asterigerina,* and *Discorbis*; (e) this cluster had most of the remaining taxa that had very low similarity and were all heterotrophic; and, (f) *Nonion, Cyclorbiculina,* and *Wisnerella*. The northern end of the island showed 8 clusters (Figure 16): (a) *Spiroculina,* and *Ammonia*; (b) *Valvulina, Planorbulina, Clauvulina,* and *Textularia* (2 out of 4 being agglutinated); (c) this cluster is one of two that appears to be driving the northern assemblages and includes the taxa *Laevipeneroplis, Elphidium, Triloculina, Sorites,* and *Cymballoperetta*; (d) this cluster is dominated by high abundance taxa such as *Quinqueloculina* and *Asterigerina* and is the second cluster that appears to be driving the assemblages at the northern end; (e) *Peneroplis, Borelis, Broekina,* and *Miliolinella*; (f) this cluster is dominated by heterotrophic taxa and contains one opportunistic taxa, *Cribeoelphidium*; (g) this cluster is also dominated by heterotrophic taxa and contains one opportunistic taxa, *Nonion*; and, (h) *Wisnerella* and *Cyclorbiculina*. The southern end of the island showed 8 clusters as can be seen in Figure 17. The clusters are: (a) *Sorites, Discorbis, Miliolinella,* and *Cymballoperetta*; (b) this cluster contained high abundance taxa including *Quinqueloculina, Asterigerina,* and *Laevipeneroplis*, and one opportunistic species, *Elphidium* and appeared to be driving the southern assemblages; (c)*Articulina, Peneroplis,* and *Amphistegina*; (d) *Textularia, Planobulina, Borelis, Broeckina,* and *Clauvulina*; (e) *Vertebralina, Valvulina, Cibicidoides, Pyrgo,* and *Cribeoelphidium*; (f) *Rosalina, Nonion,* and *Cyclorbiculina*; (g) *Haurina* and *Ammonia*; and, (h) *Sigmoilina, Wisnerella, Spiroculina, Pseudohaurina,* and *Spiroloculina*.

Many similarities were evident among the clusters for the five different divisions However, there are some notable differences. In 4 out of 5 divisions, *Elphidium* was found in the driving assemblage. *Elphidum* was not found in the driving assemblages of east side cluster, therefore, this cluster lacks an opportunistic species. *Quinqueloculina,* being of high abundance (3269 individuals in all samples) was represented in every division's cluster as driving the assemblages.

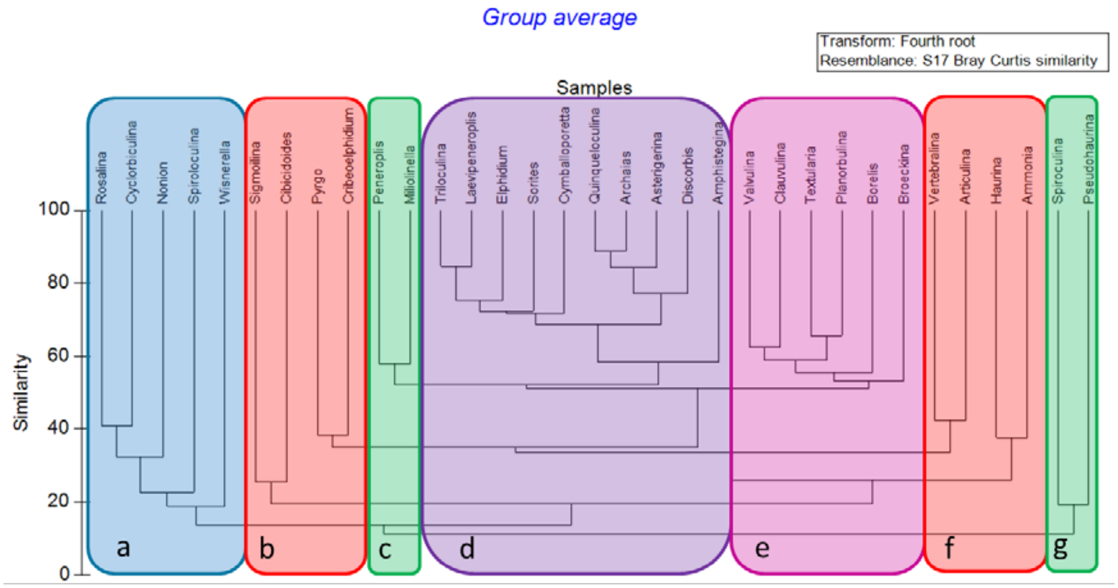

Figure 13: Overall Cluster Analysis by Taxa

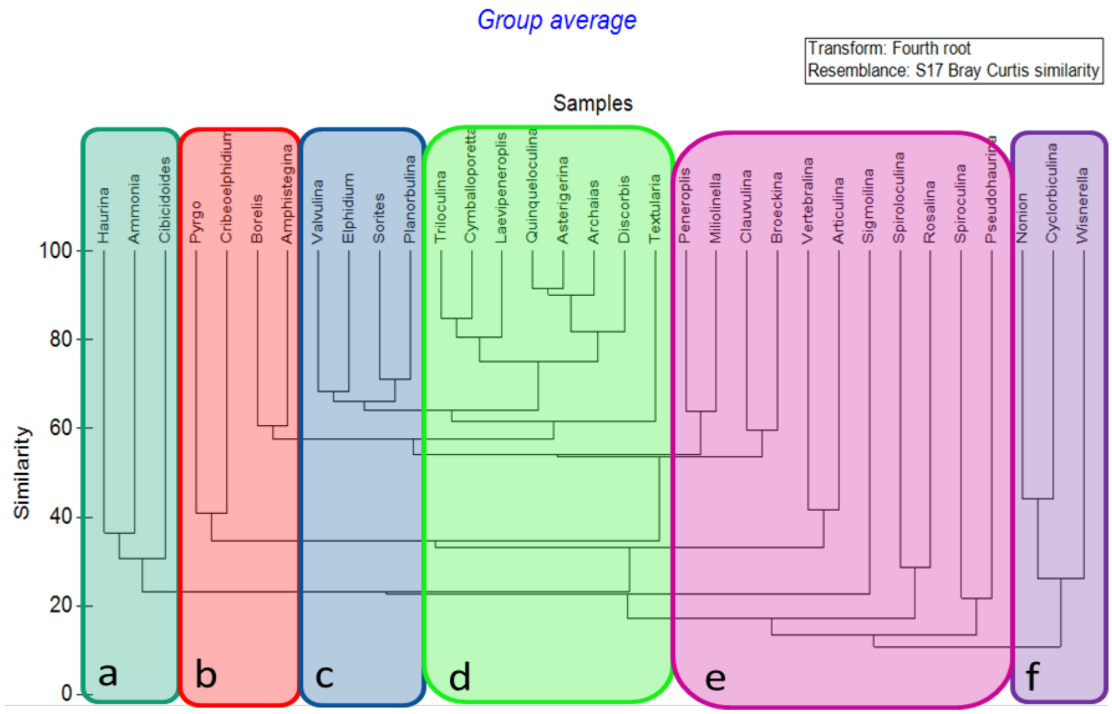

Figure 14: East Side Cluster Analysis by Taxa

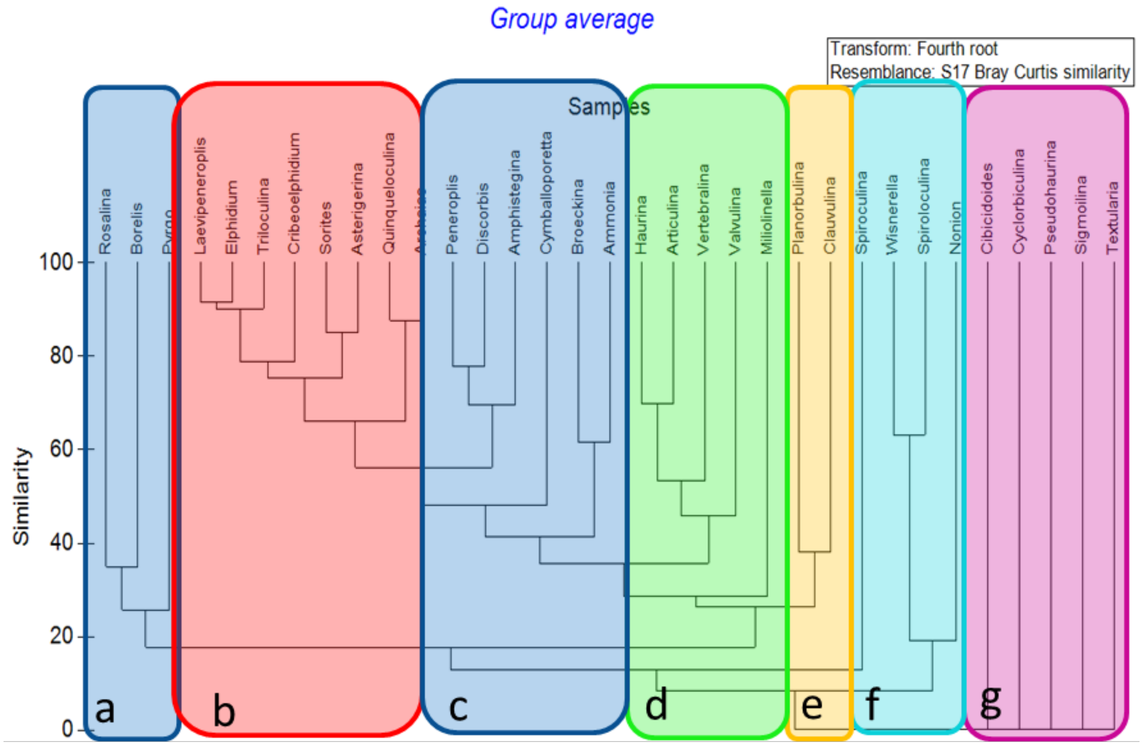

Figure 15: West Side Cluster Analysis by Taxa

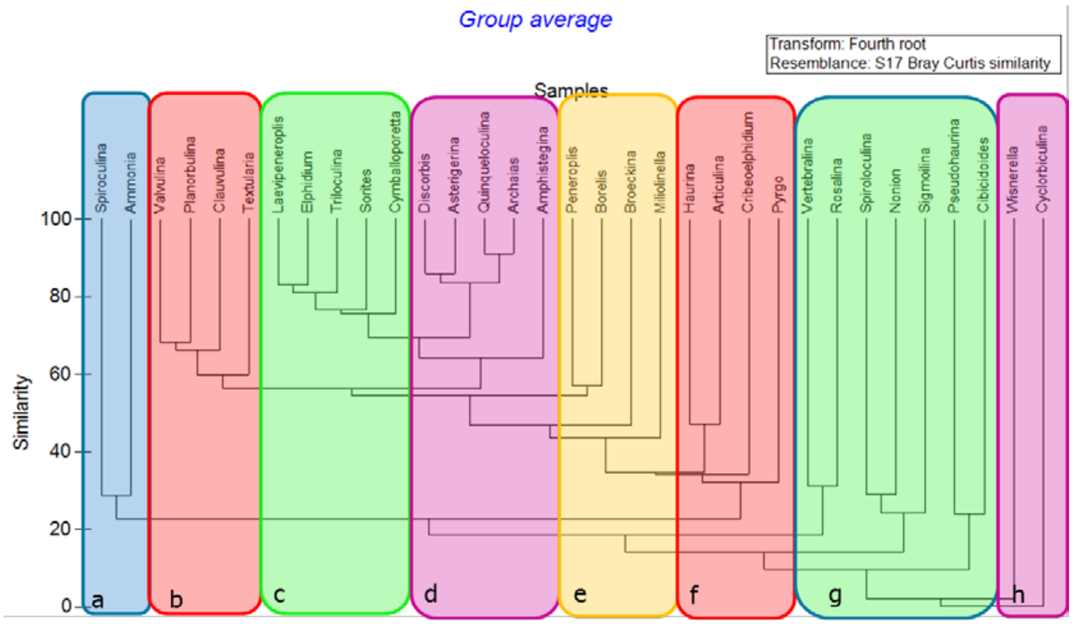

Figure 16: Northern End Cluster Analysis by Taxa

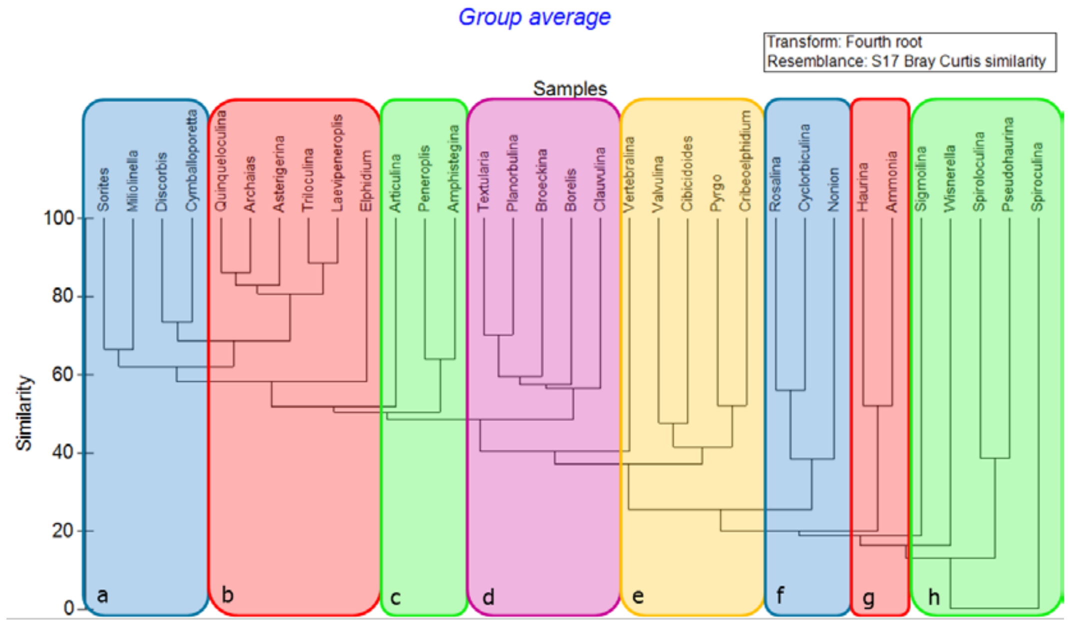

Figure 17: Southern End Cluster Analysis by Taxa

Cluster analysis allows researchers to assess assemblages and how they are associated to one another. In many cases in our study these assemblages are not very different except for when east and west sides of the island are compared. This could be due to several factors including, but not limited to, grain size and pollution. The average phi value for the east and west were 2 and 2, respectively. This means that grain size did not vary overall but could have been much more varied among samples resulting in a change in assemblage. Another factor that could affect the assemblages is the presence of raw sewage. If raw sewage is present in these locations, then assemblages could be greatly affected. Our data show that although assemblages varied, the FI does not indicating that severe degradation has occurred.

Chapter 4: Determining Potential Correlation Between Sewage Contamination and Coral Reef Health

Correlations

One of the main purposes of this study was to compare two different bio-assessments in order to gain a more complete understanding of the current condition and state of the Belizean coral reef off the coast of Caye Caulker-Belize. We began by separately applying the FI, a bioindicator, and to determine the presence of raw sewage using a biomarker, coprostanol. The FI provides an effective, simple assessment to determine the current water quality conditions, which serves as a proxy for the state of coral reefs in relation to the reef's ability to grow and recover from external stressors, while coprostanol concentrations can identify whether or not raw sewage (and the pollutants associated with it) is contaminating surface waters. By conducting both of these assessments on the same area we attempted to determine if there was a correlation between the FI and coprostanol concentrations as well as if there were any important correlations among the other diversity indices used in the foraminiferal evaluations (*i.e.* number of individuals per genera, Shannon diversity, species richness) and grain size.

To determine correlations using Pearson correlation, there were several steps that needed to be completed. First, we removed any species that were not present in at least 5% (Parker and Arnold, 2003) of the samples, after which we adjusted foraminiferal counts to be represented by genera to simplify correlations. Genus level divisions were sufficient at this level of correlation since variations in habitat do not typically vary to species level. Other data that was compiled included: coprostanol concentrations, mud percent, FI, Shannon Index, species richness, and foraminiferal density. All data were compiled into a single spreadsheet and imported into PRIMER 6 for correlation. After importation all data were log transformed, and a resemblance analysis was generated followed by a Pearson correlation analysis. For those values that were determined to be below the detection limit per Parker and Arnold (2003), half the detection limit was used to conduct the Pearson correlation.

Table 5: Pearson Correlation Coefficients

Pearson Correlation n=125 r= 0.166	**Coprostanol_ Amount**	**Mud Percent**	**Foram Index**	**Shannon Index**	**Species Richness**	**Foram Density**
Coprostanol_Amount	~					
Mud Percent	0.269698	~				
Foram Index	-0.245005077	-0.30670819	~			
Shannon Index	0.287863308	0.231971767	-0.18756	~		
Species Richness	0.307728093	0.188420819	-0.26173	0.86661	~	
Foram Density	0.088857228	0.178092867	-0.15841	0.575604	0.727045	~

Results from the Pearson correlation were evaluated based on n=125 with a correlation coefficient (r-value) of 0.166. All values that were greater than 0.166 were regarded as statistically significant (positively and negatively). As expected, FI had a negative correlation with mud percent (Table 5) since reefs are dominated by sand-sized sediments. This is supported by Hallock *et al.* (2003) who reported that an increase in mud percent is indicative of declining reef environment due to a decrease in water motion. In addition, it is well known that sediment grain size is an important factor in controlling foraminiferal distributions (e.g., Martinez-Colon et al., 2009). In the case of

Caye Caulker, the foraminiferal assemblages are dominated by symbiont-bearing foraminifers (e.g., *Amphistegina*) which thrive in sandy environments.

Coprostanol had significant positive correlation with mud percent and a statistically significant negative correlation with the FI (Table 5). The fate and transport of coprostanol is controlled by its hydrophobicity (inability to dissolve in water) and sequestration by smaller grain size. It is well known that mud (clay + silt combined) is a major transport pathway for numerous pollutants like heavy metals, pesticides, organic pollutants (e.g., Schnoor, J.L., 1996; Martinez-Colon et al., 2009) and coprostanol (Brown and Wade, 1984). Of the 125 samples, none were dominated by mud-sized sediments. This correlation suggests that most of the coprostanol (hence raw sewage) being discharged in Caye Caulker is transported away by surface currents causing limited damage to the reefs. This is supported by the negative correlation between coprostanol and FI. As explained in Chapter 3, the FI is a tool to assess coral reef health and in Caye Caulker the dominant trend of reef condition is that of “conducive for reef growth,” (Table 3) although three transects indicate “poor environmental conditions for reef growth and recovery.” However, numerous corals showing brown band and black band diseases were observed during the field sampling in Summer 2013 and this could be indicative of initial stages of reef degradation. These diseases are caused by viruses, bacteria, fungi, and increased temperatures. Table 5 shows the positive correlation between coprostanol and Shannon Index, species richness, and foraminiferal density. This correlation could be attributed to the environmental change that the FI values indicate is occurring in the study area. Bandy et al. (1964) found in the periphery of sewage outfalls in California, an increase in foraminiferal abundance (50-500 greater than at point source) related to more sewage-derived nutrients. This could explain why in Caye Caulker foraminiferal density is high aside from oligotrophic conditions. In comparison, areas heavily impacted by sewage pollution show comparable species richness but lower densities (Teodoro *et al.*, 2010) to those of Caye Caulker. It is expected that to some extent coprostanol (hence raw sewage) is benefiting the foraminiferal community. Since coprostanol concentrations are very low (see Appendix B) suggesting minor sewage pollution, it could serve as a food source. However, Ward et al. (2003) fed the foraminifer *Haynesina germanica* with sewage derived material in control experiments to reduce the selective feeding nature of benthic foraminifers in the natural environment. They found no presence of coprostanol in *H. germanica* suggesting that for this particular species coprostanol has no nutritional value. They did find that this species indeed fed indirectly from sewage by ingesting sewage derived bacteria.

Pearson correlations were also performed on individual genera to determine their correlation to coprostanol, mud percent, foram index, Shannon index, species richness, and foraminiferal density and are displayed by morphogroup (i.e. opportunistic, heterotrophic, and symbiont-bearing). *Ammonia, Elphidium,* and *Cribeoelphidium* were all found to have a statistically significant positive correlation to mud percent and negative correlation to the FI (Appendix G). Since, high mud percent in (i.e. sedimentation) is linked to poorer water quality, and therefore reef conditions, the positive correlation found between the opportunistic taxa and mud percent follows expected trends. Fabricus *et al*. (2012) determined that increased turbidity, which can be caused by finer sediment sizes being suspended in the water column, was the best predictor of diversity in a particular catchment of the Great Barrier Reef in Australia. They found that the higher the turbidity the lower the species diversity in that area. Only *Elphidium* showed a significant positive correlation with coprostanol, however it is important to note that *Ammonia* was fairly close to the cutoff for statistical significance and further research may be able to tease out a definitive answer on its correlation.

Heterotrophic genera that produced significant correlations included: *Haurina, Quinqueloculina, Triloculina, Textularia,* and *Valvulina* (Appendix G)*. Haurina, Triloculina, and Valvulina* all demonstrated significant positive correlation with coprostanol, which could be a function of two factors, food availability and decrease in the number of symbiont-bearing taxa. When nutrients and organic matter increase, which is found to occur with sewage discharge, the population of bacteria and other plankton on which foraminifera feed could increase (Ward *et al.*, 2003). This may however not be accurate for all foraminifers since they have been shown to be selective feeders (Sen-Gupta, 2003; Ward *et al.*, 2003). Ward *et al.* (2003) investigated two species *H. germanica* and *Phaeodaytylum tricornutum* and found that only *P. tricornutum* consumed the diatoms that were provided as food. *Haurina, Triloculina,* and *Valvulina* all show positive correlation with coprostanol, which could be due to increased food availability or because the number of larger, symbiont-bearing individuals is decreasing. Having a large proportion of heterotrophic foraminifera could be representative of decreased water quality resulting in the reduction of symbiont-bearing individuals residing in the sediment. Therefore as water quality conditions worsen so does the population of symbiont-bearing individuals and the number of heterotrophic increase representing degraded but not poor water quality conditions, and by proxy coral reef health. *Textularia* show a negative correlation with both mud percent and coprostanol. The negative correlation with coprostanol could be due to *Textularia* being a selective feeder and not feeding on the bacteria and plankton that proliferate in the presence of excess nutrients from sewage discharge, while the negative correlation with mud percent could be again related to how much coprostanol is present in the sediment. As mentioned before coprostanol sequesters in finer-grained sediment (i.e. mud) and therefore if mud percent increases so does coprostanol as can be seen in the overall Pearson correlation between these two parameters (Table 5). If *Textularia* does not proliferate is the presence of coprostanol than it would be logical to see a negative correlation with mud percent since as mud percent increases so does coprostanol.

In contrast, *Triloculina* has a negative correlation with the FI, while *Textularia* has a positive correlation. Again, knowing the relationship between coprostanol and the FI is inverse, we can conclude that since *Triloculina* has a positive correlation with coprostanol it should have a negative correlation with the FI; and since *Textularia* has a negative correlation with coprostanol it should have a positive correlation with the FI.

The symbiont-bearing foraminifera Pearson correlations also demonstrate expected relationships with the exception of one species (Appendix G). *Asterigerina* and *Laevipeneroplis* have a negative correlation with coprostanol as expected, since as sewage increases so does coprostanol thus causing water quality to decrease. As water quality decreases so does the suitability of the area for symbiont-bearing foraminifera, and by proxy corals. *Amphistegina* and *Asterigerina* also showed negative correlations with mud percent as would be expected since again higher mud percent in associated with poorer water quality and thus reef conditions. Also *Amphistegina, Archaias, Asterigerina,* and *Laevipeneroplis* all showed positive correlations with the FI which per Hallock *et al.* (2003) is what would be expected since symbiont-bearing foraminifera have a large influence on increasing the FI. The one symbiont-bearing taxon that did not follow the expected results was *Sorites*. Though at first this seems contradictory, the availability of food may serve as an explanation. Nowhere in the study area did the FI indicate poor conditions, meaning that the sewage discharge has not severely impacted the area but is still causing nutrient influx into the system. *Sorites* may be a foraminifer that feeds on the bacteria and other plankton benefitting from this input. Knowing that the conditions are not poor enough to cause major degradation and symbiont-bearing taxa are present, we can hypothesize that the positive correlation seen between *Sorites* and coprostanol could be explained by the increased availability of food which *Sorites* consumes.

Longitudinal Statistical Analysis

A longitudinal statistical analysis of the data was also carried out in an attempt to elucidate any patterns. This involved grouping all samples parallel to the coast rather than was done previously from the coast moving offshore (e.g. all #1 samples were grouped together, all #2 samples were grouped together, etc.). The results are shown in Appendix G. Treated in this manner, the correlations seen between coprostanol and mud percentage (positive) and coprostanol and F1 (negative) when the overall data set is statistically treated and (more significantly) when the East data (on the side where the reefs are located) is statistically treated disappear, and in fact often is contradictory. It is difficult to interpret these results since they would seem to contradict known science (e.g. positive correlation between coprostanol and mud percentage) and since it is not customary to analyze the data for a project of this type in this manner. The results may simply indicate that to treat the data in this manner, it may be necessary to carry out further studies on local ocean currents, groundwater movement and local ocean bottom conditions. We are confident of the previous results when the data was treated in a more conventional manner.

Conclusions and Future Work

The purpose of this research was to provide synergistic information on anthropogenic pollution, specifically sewage pollution, using foraminiferal biomonitors as proxies for coral reef health in order answer the question of whether sewage pollution is affecting coral reef health in the reef system off the coast of Caye Caulker, Belize. The results of this research show: (1) across all samples, transects, and divisions, the FORAM Index indicates that the coastal area off of Caye Caulker is conducive to reef growth and recovery; (2) foraminiferal assemblage variation between the east and west sides of Caye Caulker may be attributed to mud percent; (3) limited variation in grain size (*i.e.* mud percent) suggests little influence on the eastern side (reef side) of the island; (4) higher coprostanol levels were found nearest the shoreline suggesting that the contamination is originating at the shoreline; and (5) both ratios confirmed that the sources of the sewage present (represented by coprostanol) is from untreated human sewage.

We did find a significant negative correlation between coprostanol and the FI. Figures 18 and 19 indicate that where coprostanol concentrations were high, lower FI values are found and conversely, lower coprostanol concentrations are found where high FI values were determined.

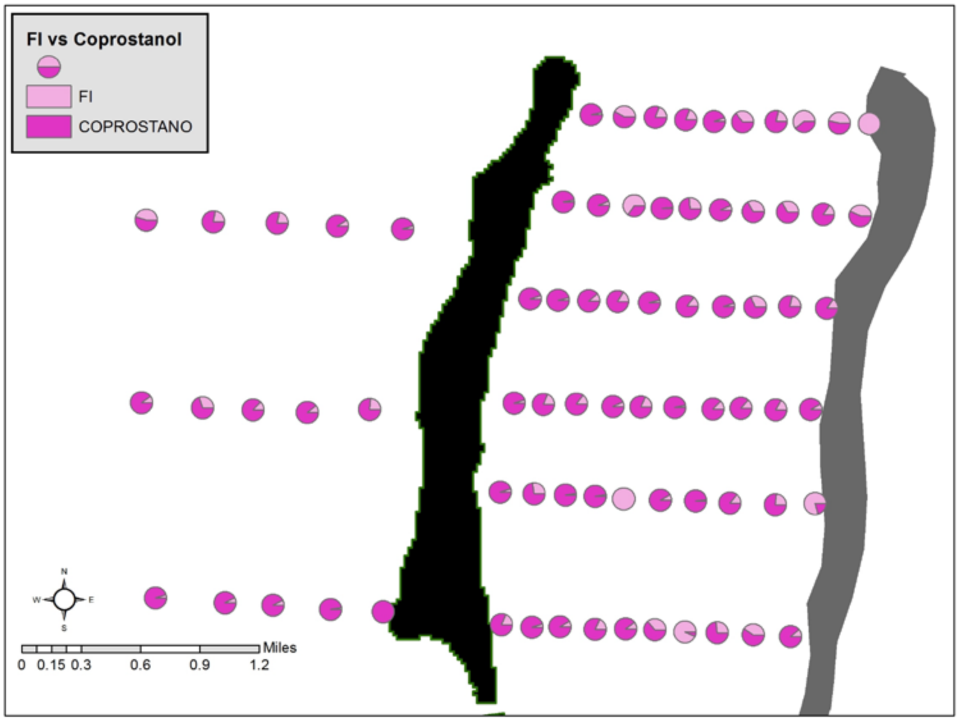

Figure 18: Coprostanol to FI Comparison at Northern End of Caye Caulker

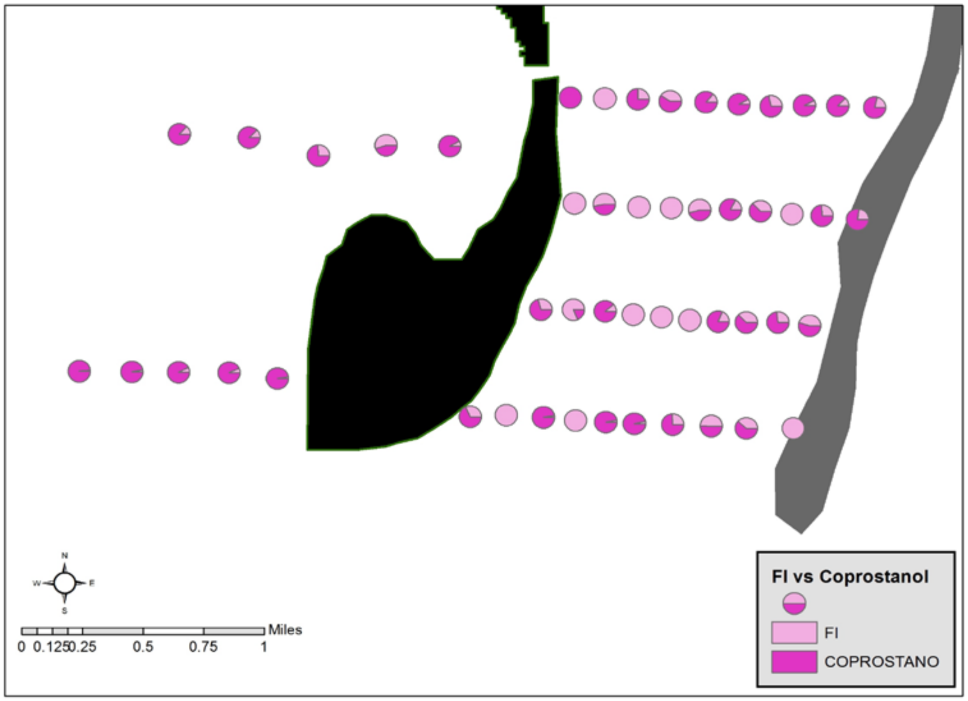

Figure 19: Coprostanol to FI Comparison at Southern End of Caye Caulker

The FI values determined show that the area is conducive to reef growth and recovery and trends followed expected results. In no samples was the FI below 2, but there were variations between assemblages which could be attributed to other factors. For example, there was a negative correlation between mud percent and the FI, following Hallock *et al.* (2003) which suggests poor habitat for reefs and was reflected in the foraminiferal assemblages found in these areas. The separation of mud percent values between the east and west sides of the island were reflected in the FI values that were determined and thus, confirm the correlation between higher mud percent and lower FI values. Limited variation in mud percent on the east side (reef side) of the island suggests little influence on the foraminiferal assemblages found; therefore, variation in foraminiferal assemblages can be attributed to other variables.

This study demonstrates that there was untreated sewage entering the coastal waters of Caye Caulker-Belize. However, further studies must be performed to confirm the movement of the groundwater in Caye Caulker and where it may actually be entering the coastal areas. High concentrations of coprostanol (and high ratios) were found in some places that were not associated with a greater human population, indicating that the movement of groundwater may be affecting the movement of sewage and therefore where is appears on the coastline. Also, the surface currents in the area may be moving pollutants farther south than where our samples were taken, providing opportunity for research to determine where pollutants may be traveling if not found directly offshore of Caye Caulker.

There were a few limitations to this research that, if not absent, may have possibly improved the resolution of the results. First, there was no replicate analysis conducted on any of the samples due to a concern of solvent availability. However, replicate extractions and analyses would have enhance the competence of the results obtained and provide verification of coprostanol concentrations. Second, we did not assess the movement of groundwater or the surface currents of Caye Caulker. A search for this data none yielded no results, providing an opportunity for further research. Finally, extension of transects further south (*i.e.* south of the actual island land mass) could possibly illuminate the cause of variation in transect 1 on the east side of the island since there were conspicuous differences in the statistical values.

The current state of corals on the reef suggests that there are stressors causing concern for reef health. Visual observations of corals during field sampling revealed various diseased specimens which is cause for concern. The presence of disease, in combination with the 37 samples that indicate environmental change, suggests that further evaluation and monitoring may be needed. Further, work to determine the cause of these diseases may disclose other anthropogenic stressors affecting the coral reef system, and may therefore provide a better picture of the impacts affecting the reefs off of Caye Caulker.

References

Alve, E., 1995, Benthic foraminiferal responses to estuarine pollution: a review. Journal of Foraminiferal Research, 25, p. 190–203.

Babcock, E. A., Coleman, R., Karnauskas, M., and Gibson, J., 2013. Length-based indicators of fishery and ecosystem status: Glover's Reef Marine Reserve, Belize, Fisheries Research, 147, p. 434-445.

Bahgat, M., 2011. Factors governing the removal of faecal indicator bacteria in the ecosystem of Lake, Timsah, Egypt, African Journal of Aquatic Science, 36-1, p. 11-18.

Bandy, O.L., Ingle, J.C., and Resig, J.M., 1964. Foraminifera, Los Angeles county outfall area-California, Limnology and Oceanography, 9-1, p.124-137.

Bayona, J.M., and Albaiges, J., 2006. Sources and fate of organic contaminants in the marine environment. Hdb Env Chem, 2, p. 323- 370.

Brown, R.C. and Wade, T.L., 1984. Sedimentary Coprostanol and Hydrocarbon Distribution Adjacent to a Sewage Outfall. Water research 18-5, p. 621-32.

Buckingham, S., Tipping, E., and Hamilton-Taylor, J., 2008. Dissolved organic carbon in soil solutions: a comparison of collection methods. Soil Use and Management, 24, p. 29-36.

Buddemeier, R.W., Lane, D.R., and Martinich, J.A., 2011. Modeling Coral Reef Responses and changes in ocean chemistry: Caribbean case study. Climactic Change, 109, p. 375- 397.

Cacador, I., Costa, J.L., and Duarte, B., 2012. Macroinvertebrates and biomonitors of heavy metal concentration in the Seixal Bay (Tagus estuary): Which species performs better? Ecological Indicators, 19, p. 184-190.

Carreiro-Silva, M., Kiene, W. E., Golubic, S., and McClanahan,T. R., 2012. Phosphorous and nitrogen effects on microbial euendolithic communities and their bioerosion rates, Marine Pollution Bulletin, 64, p. 602-613.

Caribbean Tourism Organization (CTO). Annual Tourism Overview. http://www.onecaribbean.org/statistics/annualoverview/{accessed 10-19-14}

Carilli, J. and Walsh, S., 2012. Benthic Foraminiferal assemblages from Kiritimati (Christmas) Island indicate human-mediated nutrification has occurred over the scale of decades. Marine Ecology-Progress Series, 456, p. 87.

Carnahan, E.A., Hoare, A.M., Hallock, P., Lidz, B.H., and Reich, C.D., 2009. Foraminiferal assemblages in Biscayne Bay, Florida, USA: Responses to urban and agricultural influence in a subtropical estuary. Marine Pollution Bulletin, 59, p. 221-233.

Castillo, K. D., Ries, J.B., Weiss, J.M., 2011. Declining coral skeletal extension for forereef coloies of *Siderastrea sidereal* on the Mesoamerican Barrier Reef system, Southern Belize. PLoS ONE, 6-2, p. e14615.

Chan, K.H., Lam, M.H, Poon, K., and Yeung, H., and Chiu, T.K., 1998. Application of sedimentary fecal stanols and sterols in tracing sewage pollution in coastal waters. Water research 32-1, p. 225-35.

Comeau, S., Carpenter, R.C., and Edmunds, P.J., 2013. Coral reef calcifiers buffer their response to ocean acidification using both bicarbonate and carbonate. Proceedings of the Royal Society B- Biological Sciences. 280: 753 art. Num. 20122374.

Costa Jr., O.S., Leao, Z.M.A.N, Nimmo, M., and Attrill, M.J., 2000. Nitrification Impacts on Coral Reefs from Northern Bahia, Brazil. Hydrobiologia 440,1-3, p. 307-15.

Debanay, J.-P., Guillou, J.J., Redois, F., and Geslin, E., 2000. Distribution trends of foraminiferal assemblages in paralic environments: a base for using foraminifera as bioindicators, *in* Martin, R. E. (ed.), Environmental Micropaleontology: Kluwer Academic/Plenum Publishers, Boston, p. 39–67.

Diedrich, A., 2010. Cruise ship tourism in Belize: The implications of developing cruise ship tourism in an ecotourism destination, Ocean & Coastal Management, 53, p. 234-244.

Dutka, B.J., 1974. Coliforms are an inadequate index of water quality. J. Envir Health, 36, p. 39-46.

Eca, G.F., Mendonca Filho, C.V.S., and Hatje, V., 2012. Corals as biomonitors: application, pre- treatment, and determination of major and trace elements. Quimica Nova, 35-3, p. 581-592.

Fabricius, K.E., Cooper, T.F., Humphrey, C., Uthicke, S., De'ath, G., Davidson, J., LeGrand, H., Thompson, A., and Schaffelke, B., 2012. A bioindicator system for water quality on inshore coral reefs of the Great Barrier Reef. Marine pollution bulletin, 65-9, p. 320-32.

Fabro, I.E. and Rancharan, J., 2011. Sewage needs assessment pilot project for Caye Caulker. Belize Environmental Technologies.

Freeman, L. A., 2013. Coral Reef Habitat Response to Climate Change Scenarios. PLoS ONE, 8-12, p. e82404

Frontalini, F. and Coccioni, R., 2008. Benthic foraminifera for heavy metal pollution monitoring: A case study from the central Adriatic Sea coast of italy. Estuarine, Coastal, and Shelf Science, 76, p. 404-417.

Futch, J.C., Griffin, D.W., Banks, K., and Lipp, E.K., 2011. Evaluation of sewage source and fate on southeast Florida coastal reefs. Marine Pollution Bulletin, 62, p. 2308-2316.

Gibson, J., McField, M., and Wells, S., 1998. Coral reef management in Belize: An approach through integrated coastal zone management. Ocean andCoastal Management, 39.3, p. 229-44. Print.

Gischler, E., Hauser, I., Heinrich, K., and Scheitel, U., 2003. Characterization of depositional environments in isolated carbonate platforms based on benthic foraminifera, Belize, Central America. Palaios, 18, p. 236-255.

Goodfellow, R.M., Cardosa, J., Eglinton, G., Dawson, J.P., and Best, G.A., 1977. A faecal sterol survey in the Clyde Estuary, Marine Pollution Bulletin, 8-12, p. 272-276.

Gupta, B.K.S. and Machain- Castillo, M.L., 1993. Benthic foraminifera in oxygen-poor habitats. Marine Micropaleontology, 20, p. 183-201.

Gutterres-Vilela, C., Batista, D., Neto, J.A., and Giselli, R.O. . 2011. Benthic foraminifera distribution in a tourist lagoon in Rio de Janiero, Brazil: A response to anthropogenic impacts. Marine Pollution Bulletin, 62, p. 2055-2074.

Hallock, P., Lidz, B.H., Cockey-Burkhard, E.M., and Donnelly, K.B., 2003. Foraminifera as bioindicators in coral reef assessment and monitoring: The Foram Index. Environmental Monitoring and Assessment, 81, p. 221-238.

Hatcher, P. and McGillivary, P., 1979. Sewage contamination in the New York Bight: Coprostanol as an indicator. Environmental Science and Techonology, 13.10, p. 1225- 1229.

Haynes, D., Brodie, JWaterhouse, J., Bainbridge, Z., Bass, D., and Hart, B. 2007. Assessment of the water quality and ecosystem health of the Great Barrier Reef (Australia): Conceptual Models. Environmental Management, 40.6, p. 993-1003.

Hughes, T.P., 1994. Catastrophes, phase shifts and large-scale degradation of a Caribbean coral reef. Science 265, p. 1547–1551.

Humann, P. and N. DeLoach. Reef Coral Identification: Florida, Caribbean, Bahamas; 2nd Edition. New World Publications. Jacksonville, Fl. 2002.

Jorissen, F.J., 1999. Benthic foraminiferal microhabitats below the sediment-water interface, in Sen Gupta, B. K. (ed.), Modern Foraminifera: Kluwer Academic Publishers, Boston, p. 191–179.

Kelly, A.G., 1995. Accumulation and persistence of chlorobiphenyls, organochlorine pesticides and fecal sterols at the Garroch-Head sewage-sludge disposal Site, Firth of Clyde. Environmental Pollution, 88-2, p. 207-17.

Lapointe, B.E., O'Connell, L.D., and Garrett, G.S., 1990. Nutrient couplings between on-site sewage disposal systems, groundwaters, and nearshore surface waters of the Florida Keys. Biogeochemistry 10.3, Groundwater Inputs to Coastal Waters, p. 289-307.

LaPointe, B. E., 2004. Correspondence: Phosphorous-rich waters in Glovers Reef, Belize? Marine Pollution Bulletin, 48, p. 193-195.

Lindberg, K., Enriquez, J., and Sproule, K., 1996. Ecotourism Questioned: Case studies from Belize. Annals of Tourism Research, 23, p. 543-562.

Littler, M. M., Littler, D. S., and Brooks, B. L., 2010. The effects of nitrogen and phosphorous enrichments on algal community development: Artificial mini-reefs on the Belize Barrier Reef sedimentary lagoon, Harmful Algae, 9, p. 255-263.

Martinez-Colon, M., Hallock, P., and Green-Ruiz, C., 2009. Strategies for using shallow-water foraminifers as bioindicators of potentially toxic elements: A review. Journal of Foraminiferal Research, 39-4, p. 278-299.

McClanahan, T. R., Cokos, B. A., and Sala, E., 2002. Algal growth an species composition under experimental control of herbivory, phosphorous and coral abundance in Glovers Reef, Belize, Marine Pollution Bulletin, 44, p. 441-451.

McClanahan, T. R., Steneck, R. S., Pietri, D., Cokos, B. and Jones, S., 2005. Interaction between inorganic nutrients and organic matter in controlling coral reef communities in Glovers Reef, Belize, Marine Pollution Bulletin, 50, p. 566-575.

Melbourne-Thomas, J., Johnson, C. R., and Fulton, E.A., 2011. Regional-scale scenario analysis for the Meso-American reef system: Modelling coral reef futures under multiple stressors. Ecological Modelling, 222-10, p. 1756-70.

Murray, J.W., 2001. The niche of benthic foraminifera, critical thresholds and proxies. Marine Micropaleontology, 41, p. 1–7.

Natsir, S. M., and Muchlisin, Z. A. 2012. Benthic foraminiferal assemblages in Tambelan Archipelago, Indonesia. Aquaculture, Aquarium, Conservation andLegislation - International Journal of the Bioflux Society (AACL Bioflux) 5.4, p. 259-64.

Oliver, L.M., Fisher, W.S., Dittmar, J., Hallock, P., Campbell, J., Quarles, R.L., Harris, P., LoBue, C. 2014. Contrasting responses of coral reef fauna and foraminiferal assemblages to human influence in La Parguera, Puerto Rico. Marine Environmental Research, 99, p. 95-105

Pandolfi, J.M., Bradbury, R.H., Sala, E., Hughes, T.P., Bjorndal, K.A., Cooke, R.G., Macardle, D., McClenahan, L., Newman, M.J.H., Paredes, G., Warner, R.R., and Jackson, J.B.C., 2003. Global trajectories of the long-term decline of coral reef ecosystems. Science, 301, p. 955–958.

Parker, W.C. and Arnold, A.J. 2003. Quantitative methods of data analysis in foraminiferal ecology *in* Sen Gupta, B.K. (ed.), Modern Foraminifera: Kluwer Academic Publishers, Boston, p. 71-92

Pastorok, R.A. and Bilyard, G.R., 1985. Effects of sewage pollution on coral-reef communities." Marine Ecology Progress Series, 21.1-2, p. 175-89.

Peng, X., Zhang, G., Mai, B., Min, Y., and Wang, Z. 2002, Spatial and temporal trend of sewage pollution indicated by coprostanol in Macao Estuary, Southern China. Marine Pollution Bulletin, 45.1-12, p. 295-9.

Pratt, C., Warnken, J., Leeming, R., Arthur, J.M., and Grice, D.I., 2007. Detection of intermittent sewage pollution in a subtropical, oligotrophic, semi-enclosed embayment system using sterol signatures in sediments. Environmental Science andTechnology, 41-3, p. 792-802.

Prouty, N. G., Hughen, K.A., and Carilli, J., 2008. Geochemical signature of land-based activities in Caribbean coral surface samples. Coral Reefs, 27-4, p. 727-724.

Purdey, E.G. and Gischler, E., 2003. The Belize margin revisited. 1. Holocene marine facies. International Journal of Earth Science, 92, p. 532-551.

Readman, J.W., *et al.* 2005. The use of Steroid markers to assess sewage contamination of the Black Sea." Marine pollution bulletin, 50.3, p. 310-8. Print.

Rhodes, M.W. and Kator, H., 1988. Survival of *Escherichia coli* in estuarine environments. Appl Environ Microbiology, 54, p. 2902-2907.

Richardson, S., 2000. Epiphytic foraminifera of the Pelican Cays, Belize: Diversity and distribution. The Natural History of the Pelican Cays. Attol Research Bulletin, 475, p. 208-228.

Richardson, S., 2006. Response of epiphytic foraminiferal communities to natural eutrophication in seagrass habitats off Man O'War Cay, Belize. Marine Ecology. 27, p. 404-416.

Richardson, S.L., 2009. An overview of symbiont-bleaching in the epiphytic foraminiferan *Sorites dominicensis*. Smithsonian Contribution to the marine Sciences, 38:429–436

Rosenfel, R.S. and Hellman, L., 1971. Reduction and esterification of cholesterol and sitosterol by homogenates of feces. Journal of Lipid Research, 12-2, p. 192.

Samir, A.M. and El-Din, A.B., 2001. Benthic foraminiferal assemblages and morphological abnormalities as pollution proxies in two Egyptian bays. Marine Micropaleontology 41.3-4, p. 193-227.

Schafer, C.T., 2000. Monitoring nearshore marine environments using benthic foraminifera: some protocols and pitfalls. Micropaleontology, 46, p. 161–169.

Schnoor, J.L. 1996. Environmental modeling: fate and transport of pollutants in water, air, and soil: Wiley and Sons, New York, 676p.

Schönfeld, J., Alve, E., Geslin, E., Jorissen, F., Korsun, S., Spezzaferri, S., Members of Fobimo Group, 2012. The FOBIMO (FOraminifeal Bio-Monitoring) initiative- Towards a standardized protocol for soft-bottom benthic foraminiferal monitoring studies. Marine Microapleontology, 94-95, p. 1-13.

Seigle, G.A., 1975. Foraminifers of Guayanilla Bay and their use as environmental indicators. Revisita Espanola de Micropaleontologia, 7, p. 453-487.

Sheppard, C.R.C., Davy, S.K., and Pilling, G.M., 2009. The Biology of Coral Reefs. New York: Oxford University Press.

Teodoro, A.C., Duleba, W., Gubitoso, S., Prada, S.M., Lamparelli, C.C., and Bevilacqua, J.E., 2010. Analysis of foraminifera assemblages and sediment geochemical properties to characterise the environment near Araçá and Saco da Capela domestic sewage submarine outfalls of São Sebastião Channel, São Paulo State, Brazil. Marine Pollution Bulletin, 60, p. 536- 553.

Tsujimoto, A., Nomura, R., Yasuhara, M., Yamazai, H., and Yoshikawa, S., 2006. Impact of eutrophication on shallow marine benthic foraminifers over the last 150 years in Osaka Bay, Japan. Marine Micropaleontology, 60, p. 258–268.

Uthicke, S. and Nobes, K., 2008. Benthic foraminifera as ecological indicators for water quality on the Great Barrier Reef. Estuarine, Coastal and Shelf Science, 78.4, p. 763-73.

Velasquez, J., Lopez-Angarita, J., and Sanchez, J.A., 2011. Evaluation of the FORAM Index in a case of conservation benthic foraminifera as indicators of ecosystem resilience in protected and non-protected coral reefs of the southern Caribbean. Biodiversity and Conservation, 20.14, p. 3591-603.

Waltham, N.J., Teasdale, P.R., and Connolly, R.M., 2011. Contaminants in water, sediment, and fish biomonitor species from natural and artificial estuarine habitats along the urbanized Gold Coast, Queensland. Journal of Environmental Monitoring, 13, p. 3409-3419.

Ward, J.N., Pond, D.W., and Murray, J.W., 2003. Feeding of benthic foraminifera on diatoms and sewage-derived organic matter: an experimental application of lipid biomarker techniques. Marine Environmental Research, 56, p. 515–530.

Writer, J.H., Leenheer, J., Barber, L.B, Amy, G.L., and Chapra, S.C., 1995. Sewage contamination in the upper Mississippi River as measured by the fecal sterol, coprostanol. Water Research, 29.6, p. 1427-36.

Yanko, V., Arnold, A. J., and Parker, W.C., 1999. Effects of marine pollution on benthic foraminifera. Pages 217-235 in B.K. Sen Gupta, ed. Modern Foraminifera. KluweAcademic Publishers-Netherlands.

Young, C., 2005. Belize Ecosystems: Threats and challenges to conservation in Belize. Tropical Conservation Science, 1, p. 18-33.

Appendix A: Raw Foraminiferal Data

** Indicates that the species was found in at least 5% of samples.

Opportunistic Species	**Ammonia sp.****	**Astrononion stelligerum**	**Cribeoelphidium poeyanum****	**Elphidium advenum****	**E. cf. discordae f.**	**E. poeyanum**	**E. sagrum****	**E. excavatum****	**Elphidium spp.****	**Nonion cf. gratelopui****	**Nonion depressulum****	**Nonion spp.**
ET1S1	0	0	0	0	1	0	1	0	0	0	0	0
ET1S2	0	0	0	0	2	0	0	0	0	0	0	0
ET1S3	0	1	0	0	0	0	0	0	0	0	3	0
ET1S4	0	3	0	0	0	0	0	0	0	0	0	0
ET1S5	0	1	0	0	0	0	0	0	0	0	2	0
ET1S6	0	0	0	2	0	0	0	0	0	0	6	0
ET1S7	0	0	0	0	0	0	0	0	0	0	0	0
ET1S8	0	0	0	0	0	0	1	0	0	1	0	0
ET1S9	0	0	0	0	0	0	0	0	0	1	0	0
ET1S10	0	0	0	0	0	0	0	0	0	1	1	0
ET2S1	0	0	0	0	2	0	0	0	1	0	7	0
ET2S2	0	0	0	0	0	0	0	0	0	0	1	0
ET2S3	0	0	0	0	3	0	0	0	0	0	0	0
ET2S4	0	0	1	0	2	0	0	0	2	0	0	0
ET2S5	0	0	0	0	0	0	0	0	0	0	0	0
ET2S6	0	0	2	0	0	0	0	0	1	0	0	0
ET2S7	0	0	0	0	4	0	0	0	0	0	0	0
ET2S8	0	0	0	0	2	0	0	0	0	0	0	0
ET2S9	0	0	1	0	0	0	0	0	0	0	0	0
ET2S10	1	0	0	0	0	1	0	0	0	2	0	0
ET3S1	0	1	0	1	0	0	0	0	0	0	0	0
ET3S2	0	0	2	0	0	0	0	0	0	0	0	1
ET3S3	0	0	2	0	0	0	0	0	0	0	0	2
ET3S4	0	0	2	0	0	0	0	0	7	0	0	0
ET3S5	0	0	0	0	0	0	0	0	2	0	0	0
ET3S6	0	0	1	0	0	0	0	0	0	0	0	0
ET3S7	0	0	0	0	0	0	0	0	0	0	0	0
ET3S8	0	0	2	0	0	2	0	0	0	0	0	0
ET3S9	0	0	2	0	0	0	0	0	0	1	0	0
ET3S10	0	0	1	1	0	1	0	0	0	0	0	0
ET4S1	0	0	3	1	1	0	0	2	0	0	0	0
ET4S2	0	0	1	0	0	0	0	1	0	0	0	0
ET4S3	0	0	1	1	0	0	0	5	0	0	0	0
ET4S4	0	0	2	4	0	0	0	4	8	0	0	0
ET4S5	0	0	2	1	0	0	0	0	3	0	0	0
ET4S6	0	0	0	2	0	0	0	3	0	0	0	0
ET4S7	0	0	1	0	0	0	0	3	1	0	0	0
ET4S8	1	0	0	0	0	0	1	0	0	0	0	0
ET4S9	2	0	0	0	0	0	0	3	1	1	0	0
ET4S10	1	0	1	1	0	0	0	0	0	0	0	0

Appendix A (Continued)

Opportunistic Species (Continued)	Ammonia sp.**	Astrononion stelligerum	Cribeoelphidium poeyanum**	Elphidium advenum**	E. cf. discordae f. translucens**	E. poeyanum	E. sagrum**	E. excavatum**	Elphidium spp.**	Nonion cf. gratelopui**	Nonion depressulum**	Nonion spp.
ET5S1	1	0	0	1	0	0	0	4	0	0	0	0
ET5S2	0	0	0	0	0	0	1	2	0	0	0	0
ET5S3	0	0	2	5	1	0	0	2	0	0	0	0
ET5S4	1	0	0	2	0	0	3	4	0	0	0	0
ET5S5	0	0	1	0	0	0	0	0	3	0	0	0
ET5S6	1	0	0	5	0	0	0	7	4	0	0	0
ET5S7	1	0	0	2	0	0	0	0	1	0	0	0
ET5S8	0	0	1	0	0	0	0	2	3	0	0	0
ET5S9	0	0	0	0	0	0	0	1	0	0	0	0
ET5S10	0	0	0	0	0	0	0	1	0	0	0	0
ET6S1	0	0	0	3	1	0	0	0	2	0	0	0
ET6S2	1	0	0	0	1	0	0	0	5	0	0	0
ET6S3	2	0	0	0	2	0	0	0	4	0	0	0
ET6S4	0	0	0	0	0	0	0	0	0	0	0	0
ET6S5	0	0	1	0	0	0	0	0	3	0	0	0
ET6S6	0	0	0	0	0	0	0	0	0	0	0	0
ET6S7	0	0	0	0	0	0	0	0	0	0	0	0
ET6S8	0	0	0	0	0	0	1	0	0	0	0	0
ET6S9	0	0	0	0	0	0	0	0	1	0	0	0
ET6S10	0	0	0	0	0	0	0	0	0	0	0	0
ET7S1	0	0	1	1	0	0	1	0	3	0	0	0
ET7S2	0	0	0	2	2	0	2	1	0	0	0	0
ET7S3	0	0	1	7	0	0	1	1	1	0	0	0
ET7S4	0	0	0	0	0	0	0	2	0	0	0	0
ET7S5	0	0	1	0	0	0	0	3	1	0	0	0
ET7S6	0	0	0	0	0	0	0	0	0	0	0	0
ET7S7	0	0	1	3	0	0	0	3	7	0	0	0
ET7S8	0	0	0	0	1	0	0	1	5	0	0	0
ET7S9	0	0	0	0	0	0	0	0	2	0	0	0
ET7S10	0	0	0	0	0	0	0	0	1	0	0	0
ET8S1	0	0	0	1	0	0	0	0	0	0	0	0
ET8S2	0	0	0	0	0	0	0	0	0	0	0	0
ET8S3	0	0	1	2	1	0	1	0	0	0	0	0
ET8S4	0	0	0	0	0	0	1	1	0	0	0	0
ET8S5	0	0	0	1	1	0	0	1	0	0	0	0
ET8S6	0	0	0	0	0	0	0	0	0	0	0	0
ET8S7	0	0	0	0	0	0	1	0	0	0	0	0
ET8S8	0	0	0	0	0	0	0	0	0	0	0	0
ET8S9	0	0	0	0	0	0	1	0	0	0	0	0
ET8S10	0	0	0	0	0	0	0	0	0	0	0	0
ET9S1	0	0	0	1	0	0	1	0	0	0	0	0
ET9S2	1	0	1	1	0	0	0	0	0	0	0	0
ET9S3	0	0	1	1	0	0	0	0	0	0	0	0
ET9S4	0	0	1	0	0	0	0	0	0	0	1	0
ET9S5	0	0	0	0	0	0	0	0	0	0	0	0
ET9S6	0	0	0	0	0	0	0	0	0	0	0	0
ET9S7	0	0	0	0	0	0	0	0	0	0	0	0
ET9S8	0	0	0	1	0	0	0	0	0	0	0	0
ET9S9	1	0	0	0	0	0	0	0	1	0	0	0
ET9S10	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A (Continued)

Opportunistic Species (Continued)	Ammonia sp.**	Astrononion stelligerum	Cribeoelphidium poeyanum**	Elphidium advenum**	E. cf. discordae f. translucens**	E. poeyanum	E. sagrum**	E. excavatum**	Elphidium spp.**	Nonion cf. gratelopui**	Nonion depressulum**	Nonion spp.
ET10S1	0	0	0	2	0	0	0	0	0	0	0	0
ET10S2	0	0	0	3	0	0	0	1	0	0	0	0
ET10S3	0	0	1	1	0	0	0	0	0	0	0	0
ET10S4	0	0	0	0	0	0	0	2	0	0	0	0
ET10S5	0	0	0	1	0	0	0	1	0	0	0	0
ET10S6	0	0	0	0	0	0	0	2	0	1	0	0
ET10S7	0	0	0	0	0	0	0	0	0	0	0	0
ET10S8	0	0	0	1	0	0	0	1	0	0	0	0
ET10S9	0	0	0	0	0	0	0	0	0	0	0	0
ET10S10	0	0	0	0	0	0	0	0	0	0	0	0
WT1S1	0	0	0	5	4	0	2	9	0	0	0	0
WT1S2	0	0	4	5	1	0	3	4	0	0	0	0
WT1S3	0	0	2	5	0	0	1	3	0	0	0	0
WT1S4	1	0	2	4	0	0	1	6	0	0	1	0
WT1S5	1	0	0	11	5	0	2	13	0	0	0	0
WT2S1	5	0	3	0	5	0	4	3	0	0	0	0
WT2S2	0	0	0	0	0	0	0	0	0	0	0	0
WT2S3	0	0	1	0	0	0	0	2	0	0	0	0
WT2S4	0	0	3	2	0	0	0	5	0	0	0	0
WT2S5	0	0	5	3	0	0	0	3	0	0	0	0
WT3S1	4	0	3	0	0	0	0	1	0	0	0	0
WT3S2	0	0	9	0	0	0	2	3	0	0	0	0
WT3S3	0	0	5	7	0	0	0	0	0	0	0	0
WT3S4	0	0	2	2	0	0	0	2	0	1	0	0
WT3S5	0	0	3	2	2	1	0	4	0	0	0	0
WT4S1	0	0	1	3	0	0	1	4	0	1	0	0
WT4S2	1	0	6	9	0	0	1	3	0	0	0	0
WT4S3	1	0	4	3	0	0	0	6	0	0	0	0
WT4S4	2	0	4	2	0	0	0	5	0	0	0	0
WT4S5	0	0	2	3	0	0	0	3	0	0	0	0
WT5S1	0	0	1	3	0	0	0	0	0	0	0	0
WT5S2	1	0	3	11	0	0	0	0	0	0	0	0
WT5S3	1	0	2	5	0	0	0	0	0	0	0	0
WT5S4	0	0	1	7	0	1	0	0	0	0	0	0
WT5S5	0	0	0	7	0	1	0	0	0	0	0	0
Total	31	6	107	160	44	7	34	143	73	10	22	3

Appendix A (Continued)

Symboint Bearing	A. lessonii**	A. gibbosa**	Archaias angulata**	Asterigina **	Borelis Pulchra**	Borelis sp	Broeckina orbitolitoides**	Cyclorbiculina compressi**	Laevipeneroplis bradyi**	Laevipeneroplis proteus**	Peneroplis pertusus**	Sorites marginalis**
ET1S1	0	0	2	0	0	0	0	1	1	0	2	2
ET1S2	0	0	12	9	0	0	0	6	5	0	0	1
ET1S3	0	3	8	11	1	0	0	3	9	0	4	8
ET1S4	0	0	10	17	0	0	0	2	15	0	3	1
ET1S5	0	0	6	29	1	0	0	2	11	0	2	4
ET1S6	0	0	5	24	0	0	0	2	15	0	0	6
ET1S7	0	12	5	23	2	0	5	0	16	15	1	2
ET1S8	0	16	0	20	2	1	9	0	11	0	4	2
ET1S9	0	7	8	25	3	0	9	0	21	0	2	0
ET1S10	0	5	8	17	2	0	6	0	5	0	4	4
ET2S1	0	0	29	23	3	0	3	2	9	6	1	1
ET2S2	0	0	24	37	3	0	4	0	15	6	0	1
ET2S3	0	0	29	23	3	0	3	2	9	6	0	1
ET2S4	0	1	28	25	0	0	1	0	0	24	0	3
ET2S5	0	0	35	36	1	0	4	0	3	10	0	2
ET2S6	0	0	30	25	0	0	1	0	3	7	1	0
ET2S7	1	1	37	50	0	0	0	0	0	8	1	1
ET2S8	0	0	17	38	0	0	2	0	2	16	0	3
ET2S9	1	5	23	50	0	0	1	0	2	7	2	0
ET2S10	1	1	0	27	0	0	0	1	3	10	3	5
ET3S1	0	0	12	11	4	0	0	2	12	1	0	3
ET3S2	0	1	22	8	0	0	0	0	32	10	1	2
ET3S3	0	0	30	26	2	0	0	0	1	10	0	0
ET3S4	0	0	29	30	2	0	0	0	0	15	0	1
ET3S5	0	12	48	22	2	0	8	0	75	20	3	1
ET3S6	0	5	29	50	0	0	1	0	0	71	0	2
ET3S7	0	2	34	31	2	0	0	0	4	22	1	1
ET3S8	0	4	19	31	1	0	0	0	8	2	0	0
ET3S9	0	0	12	28	0	0	0	0	0	16	2	1
ET3S10	0	7	43	26	1	0	0	0	3	4	2	3
ET4S1	0	0	31	15	0	0	0	0	2	1	3	4
ET4S2	0	0	25	27	1	0	2	0	6	0	1	0
ET4S3	0	1	25	40	0	0	4	0	4	4	1	0
ET4S4	0	0	22	43	2	0	1	0	9	0	0	0
ET4S5	0	0	33	75	0	0	3	0	7	1	0	1
ET4S6	0	0	28	36	0	0	1	0	6	0	0	1
ET4S7	2	0	38	54	1	0	1	0	4	2	0	4
ET4S8	0	4	28	41	1	0	1	0	3	0	3	1
ET4S9	3	1	42	42	2	0	0	0	4	3	1	2
ET4S10	2	4	18	32	1	0	2	0	7	3	1	0
ET5S1	2	4	43	17	3	0	1	0	1	1	0	0
ET5S2	0	4	30	14	3	0	1	0	4	2	3	8
ET5S3	0	3	19	24	5	0	4	0	3	0	3	4
ET5S4	0	1	18	43	5	0	0	0	4	3	3	9
ET5S5	0	2	15	46	3	0	0	0	1	5	1	12
ET5S6	0	0	29	83	1	0	1	0	4	1	0	7
ET5S7	0	0	41	48	3	0	2	0	1	4	3	3
ET5S8	2	2	25	44	0	0	0	0	1	1	1	0
ET5S9	0	1	17	47	1	0	0	0	0	1	0	6
ET5S10	1	0	16	51	0	0	0	0	0	1	1	13

Appendix A (Continued)

Symboint Bearing (Continued)	A. lessonii**	A. gibbosa**	Archaias angulata**	Asterigina **	Borelis Pulchra**	Borelis sp	Broeckina orbitolitoides**	Cyclorbiculina compressi**	Laevipeneroplis bradyi**	Laevipeneroplis proteus**	Peneroplis pertusus**	Sorites marginalis**
ET6S1	0	4	33	38	5	0	1	0	4	1	4	7
ET6S2	0	0	18	58	0		0	0	1	1	1	0
ET6S3	0	0	11	21	0	0	0	0	0	1	1	0
ET6S4	0	0	25	12	1	0	2	0	1	1	1	5
ET6S5	2	3	20	15	1	0	0	0	1	1	1	6
ET6S6	0	3	15	14	2	0	2	0	1	0	2	5
ET6S7	0	3	13	18	0	0	2	0	1	0	2	18
ET6S8	0	11	16	8	1	0	2	0	0	0	0	2
ET6S9	0	5	12	4	0	0	1	0	1	0	0	2
ET6S10	0	2	0	0	0	0	0	0	0	0	0	0
ET7S1	0	12	47	19	2	0	1	0	1	0	2	0
ET7S2	0	0	49	17	1	0	3	0	5	0	2	6
ET7S3	0	2	31	22	2	0	2	0	8	1	5	8
ET7S4	0	2	32	13	1	0	1	0	0	2	1	5
ET7S5	0	0	19	23	0	0	0	0	1	2	0	12
ET7S6	0	0	1	3	0	0	1	0	0	0	1	0
ET7S7	0	0	12	29	0	0	0	0	0	1	3	4
ET7S8	0	0	23	16	0	0	0	0	0	0	0	3
ET7S9	0	0	13	20	1	0	0	0	2	2	3	8
ET7S10	0	9	17	13	1	0	1	0	1	1	0	8
ET8S1	0	3	50	2	2	0	0	0	4	1	0	3
ET8S2	0	26	39	6	3	0	0	0	2	2	1	3
ET8S3	2	6	37	15	1	0	0	0	1	2	1	7
ET8S4	0	1	27	0	0	0	0	0	1	2	1	2
ET8S5	2	17	9	28	1	0	2	0	0	1	2	7
ET8S6	0	2	13	23	2	0	1	0	1	1	2	2
ET8S7	2	7	17	4	0	0	8	0	1	0	0	4
ET8S8	0	4	16	5	1	0	0	0	0	0	0	3
ET8S9	2	6	22	36	4	0	2	0	4	1	0	11
ET8S10	0	42	8	7	1	0	0	0	0	0	4	0
ET9S1	1	0	28	13	0	0	0	0	1	0	0	2
ET9S2	0	21	37	9	3	0	0	0	3	3	0	10
ET9S3	0	4	22	39	0	0	1	0	0	0	2	1
ET9S4	1	4	22	43	0	0	1	0	3	1	4	1
ET9S5	10	2	6	12	2	0	0	0	0	0	0	0
ET9S6	4	2	3	34	4	0	1	0	2	0	2	2
ET9S7	0	4	5	3	1	0	0	0	0	0	0	0
ET9S8	0	3	3	26	6	0	0	0	1	0	2	3
ET9S9	2	3	5	4	1	0	1	0	1	0	0	2
ET9S10	2	0	3	1	0	0	0	0	0	0	0	1
ET10S1	0	0	22	10	0	0	0	0	2	0	0	0
ET10S2	2	5	37	25	2	0	0	0	1	1	2	8
ET10S3	4	1	25	20	0	1	0	0	0	1	0	4
ET10S4	2	1	36	23	0	0	0	0	1	0	0	1
ET10S5	4	4	6	7	1	0	0	0	0	0	0	6
ET10S6	0	0	8	15	0	0	0	0	3	1	1	1
ET10S7	1	1	15	13	1	0	0	0	1	1	2	0
ET10S8	0	0	21	8	1	0	0	0	1	1	3	0
ET10S9	5	0	3	2	1	0	0	0	0	0	0	0
ET10S10	20	5	6	11	4	0	1	0	1	1	1	0

Appendix A (Continued)

Symboint Bearing (Continued)	A. lessonii**	A. gibbosa**	Archaias angulata**	Asterigina **	Borelis Pulchra**	Borelis sp	Broeckina orbitolitoides**	Cyclorbiculina compressi**	Laevipeneroplis bradyi**	Laevipeneroplis proteus**	Peneroplis pertusus**	Sorites marginalis**
WT1S1	0	1	47	3	0	0	0	0	6	2	1	8
WT1S2	0	0	38	9	0	1	0	0	3	5	0	5
WT1S3	1	0	36	0	0	0	0	0	3	5	0	0
WT1S4	0	0	29	2	0	0	1	0	1	1	0	1
WT1S5	0	1	18	1	0	0	1	0	0	1	0	1
WT2S1	0	6	5	2	0	0	0	0	3	6	6	3
WT2S2	0	0	10	0	0	0	0	0	0	0	0	0
WT2S3	0	0	28	0	0	0	0	0	1	0	0	0
WT2S4	0	0	28	1	0	0	0	0	2	5	1	0
WT2S5	0	0	22	0	0	0	0	0	5	3	2	6
WT3S1	0	0	4	1	0	0	0	0	4	1	0	5
WT3S2	0	0	28	0	0	0	0	0	5	5	0	0
WT3S3	0	0	24	1	0	0	0	0	2	0	1	2
WT3S4	0	0	45	1	0	0	0	0	3	2	2	1
WT3S5	0	0	49	1	0	0	0	0	3	3	0	0
WT4S1	1	0	27	7	0	0	0	0	6	5	1	1
WT4S2	2	7	35	3	0	0	1	0	10	3	2	4
WT4S3	0	5	60	7	4	0	1	0	16	8	1	7
WT4S4	0	0	34	9	0	0	1	0	6	2	1	2
WT4S5	0	0	59	8	0	0	4	0	5	4	0	7
WT5S1	0	1	17	1	0	0	0	0	1	2	0	1
WT5S2	0	2	47	9	0	0	0	0	12	5	4	7
WT5S3	0	5	43	11	0	0	1	0	7	13	5	11
WT5S4	0	4	32	11	0	0	1	0	7	6	1	2
WT5S5	0	2	38	6	0	0	1	0	10	6	1	1
Total	87	373	2898	###	131	3	130	23	545	446	152	394

Appendix A (Continued)

Other Small Heterotrophic - Section 1	Articulina mexicana**	Articulina sulcrata**	Articulina sp	Articularia sagra	Bulimina spicata	Cibicidoides sp. **	Clauvulina sp.**	Cornuspira planulorbis	Coruspira sp.	Cymballoporetta* *	Dendritina striata	Discorbis mira**	D. rosea**	Discorbis spp**
ET1S1	2	0	0	0	0	0	0	0	0	0	1	0	1	1
ET1S2	2	0	0	0	0	0	0	0	0	1	0	0	1	1
ET1S3	1	0	0	0	0	0	1	0	0	1	0	5	5	0
ET1S4	0	0	0	0	0	0	3	0	0	0	0	0	0	9
ET1S5	0	0	0	0	0	0	0	0	0	5	0	0	0	1
ET1S6	1	0	0	0	0	0	1	0	0	1	0	0	0	3
ET1S7	1	0	0	0	0	0	1	1	0	0	0	0	1	0
ET1S8	0	0	0	0	0	0	2	0	0	0	0	0	9	0
ET1S9	2	0	0	0	0	0	1	0	0	5	0	0	19	5
ET1S10	1	2	0	0	0	0	1	5	0	4	0	0	22	1
ET2S1	4	0	0	0	0	0	3	0	0	3	0	0	1	0
ET2S2	0	0	0	0	0	0	1	0	0	4	1	0	4	0
ET2S3	4	0	0	0	0	0	3	0	0	3	0	0	1	0
ET2S4	0	0	0	0	0	0	1	0	0	0	0	0	1	0
ET2S5	0	0	0	0	0	0	1	0	0	2	0	0	0	0
ET2S6	0	0	0	0	0	2	1	0	0	5	0	0	0	0
ET2S7	0	0	0	0	0	4	1	0	0	9	0	0	2	0
ET2S8	0	0	0	0	0	7	0	0	0	10	0	0	8	0
ET2S9	0	0	0	0	0	0	0	0	0	11	0	0	7	0
ET2S10	0	0	0	0	2	5	0	0	0	17	0	0	14	0
ET3S1	0	0	0	0	0	0	5	0	0	2	3	0	7	4
ET3S2	0	0	0	0	0	0	0	0	0	3	0	0	1	0
ET3S3	0	0	0	0	0	0	1	0	0	2	0	0	1	0
ET3S4	0	0	0	0	0	0	0	0	0	5	0	0	0	0
ET3S5	0	1	0	0	0	0	0	0	0	0	0	0	0	0
ET3S6	35	0	0	0	0	0	0	0	0	0	0	0	0	0
ET3S7	40	0	0	0	0	0	0	0	0	2	0	0	4	0
ET3S8	30	0	0	0	0	0	0	0	0	5	0	0	5	0
ET3S9	19	0	0	0	0	0	0	0	0	6	0	0	7	0
ET3S10	35	1	0	0	0	0	0	0	0	11	0	0	22	0
ET4S1	1	0	0	0	0	1	4	0	0	8	0	5	11	3
ET4S2	0	0	0	0	0	7	2	0	0	12	0	2	1	2
ET4S3	0	1	0	0	0	8	2	0	0	0	0	3	4	0
ET4S4	0	0	0	0	0	3	3	0	0	4	0	0	7	2
ET4S5	1	0	0	0	0	0	3	0	0	15	0	1	0	3
ET4S6	2	1	0	0	0	0	0	0	0	7	0	0	5	4
ET4S7	1	2	0	0	0	3	0	0	0	14	0	0	4	1
ET4S8	1	0	0	0	0	4	0	0	0	14	0	1	136	1
ET4S9	0	0	0	0	0	4	0	0	0	9	0	0	11	3
ET4S10	1	0	0	0	0	1	0	0	1	6	0	1	11	2
ET5S1	0	0	0	0	0	0	1	0	0	7	0	3	6	4
ET5S2	0	0	0	0	0	0	4	0	0	10	0	3	7	3
ET5S3	2	0	0	0	0	1	0	0	0	5	0	4	9	11
ET5S4	1	0	0	0	0	0	6	0	0	7	0	11	2	2
ET5S5	2	0	0	0	0	1	4	0	0	4	0	8	4	1
ET5S6	4	0	0	0	0	3	2	0	0	9	0	4	1	0
ET5S7	3	0	0	0	0	0	2	0	0	5	0	5	4	7
ET5S8	1	1	0	0	0	0	0	0	0	12	0	3	20	14
ET5S9	1	0	0	0	0	0	0	0	0	13	0	0	13	2
ET5S10	0	1	0	0	0	0	1	0	0	8	0	3	10	2

Appendix A (Continued)

Other Small Heterotrophic-Section 1 (Continued)	Articulina mexicana**	Articulina sulcrata**	Articulina sp	Articularia sagra	Bulimina spicata	Cibicidoides sp. **	Clauvulina sp.**	Cornuspira planulorbis	Coruspira sp.	Cymballoporetta**	Dendritina striata	Discorbis mira**	D. rosea**	Discorbis spp**
ET6S1	2	0	0	0	0	0	0	0	0	9	0	9	24	3
ET6S2	2	0	0	0	0	0	5	0	0	13	0	3	10	8
ET6S3	0	0	0	0	0	0	3	0	0	9	0	13	10	8
ET6S4	0	0	0	0	0	0	1	0	0	5	0	3	9	3
ET6S5	0	0	0	0	0	0	3	0	0	4	0	5	22	7
ET6S6	0	0	0	0	0	0	3	0	0	4	0	3	27	0
ET6S7	0	0	0	0	0	0	2	0	0	3	0	2	22	5
ET6S8	0	0	0	0	0	0	5	0	0	7	0	6	42	30
ET6S9	0	0	0	0	0	0	1	0	0	2	0	3	9	0
ET6S10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET7S1	1	0	0	0	0	0	1	0	0	6	0	9	7	7
ET7S2	0	0	0	0	0	0	2	0	0	9	0	13	7	5
ET7S3	0	0	0	0	0	0	0	0	0	6	0	7	16	9
ET7S4	0	0	0	0	0	0	0	0	0	6	0	4	18	2
ET7S5	0	0	0	0	0	0	1	0	0	10	0	11	14	0
ET7S6	1	0	0	0	0	0	2	0	0	0	0	0	1	1
ET7S7	0	0	0	0	0	0	2	0	0	7	0	3	19	3
ET7S8	2	0	0	0	0	0	3	0	0	5	0	5	18	1
ET7S9	0	0	0	0	0	0	1	0	0	5	0	12	18	0
ET7S10	0	0	0	0	0	0	6	0	0	2	0	6	15	0
ET8S1	0	0	0	0	0	0	1	0	0	2	0	1	7	0
ET8S2	0	0	0	0	0	0	3	0	0	1	0	8	10	0
ET8S3	0	0	0	0	0	0	0	0	0	2	0	7	11	0
ET8S4	0	0	0	0	0	0	0	0	0	9	0	4	12	4
ET8S5	0	0	0	0	0	0	2	0	1	8	0	28	49	0
ET8S6	0	0	0	0	0	0	3	0	0	3	0	6	28	0
ET8S7	0	0	0	0	0	0	12	0	0	1	0	3	16	1
ET8S8	0	0	0	0	0	0	0	0	0	0	0	1	33	0
ET8S9	0	0	0	0	0	0	2	0	0	10	0	10	74	1
ET8S10	0	0	0	0	0	0	0	0	0	1	0	0	20	1
ET9S1	0	0	0	0	0	0	1	0	0	3	0	2	12	1
ET9S2	0	0	0	0	0	0	7	0	0	4	0	8	28	16
ET9S3	0	0	0	0	0	0	1	0	0	9	0	5	25	3
ET9S4	0	0	0	0	0	0	1	0	0	13	0	5	72	7
ET9S5	0	0	0	0	0	0	0	0	0	6	0	0	130	0
ET9S6	0	0	0	0	0	0	3	0	0	3	0	3	127	6
ET9S7	0	0	0	0	0	0	0	0	0	1	0	0	41	1
ET9S8	0	0	0	0	0	0	0	0	0	15	0	5	110	2
ET9S9	0	0	0	0	0	0	0	0	0	0	0	0	22	3
ET9S10	0	0	0	0	0	0	0	0	0	0	0	0	3	1

Appendix A (Continued)

Other Small Heterotrophic-Section 1 (Continued)	Articulina mexicana**	Articulina sulcrata**	Articulina sp	Articularia sagra	Bulimina spicata	Cibicidoides sp. **	Clauvulina sp.**	Cornuspira planulorbis	Coruspira sp.	Cymballoporetta**	Dendritina striata	Discorbis mira**	D. rosea**	Discorbis spp**
ET10S1	0	0	0	0	0	0	0	0	0	5	0	1	24	0
ET10S2	0	0	0	0	0	0	0	0	0	3	0	3	63	3
ET10S3	0	0	0	0	0	0	0	0	0	4	0	0	63	3
ET10S4	0	0	0	0	0	0	1	0	0	7	0	0	93	0
ET10S5	1	0	0	0	0	0	3	0	0	2	0	13	27	0
ET10S6	0	0	2	0	0	0	0	0	0	3	0	0	22	0
ET10S7	0	1	0	0	0	0	1	0	0	1	0	0	6	0
ET10S8	0	0	0	0	0	0	1	0	0	0	0	0	13	0
ET10S9	0	0	0	0	0	0	1	0	0	0	0	0	36	0
ET10S10	0	0	0	0	0	0	0	0	0	0	0	0	161	0
WT1S1	5	0	0	0	0	0	1	0	0	0	0	0	1	0
WT1S2	1	0	0	0	0	0	0	0	0	6	0	0	1	0
WT1S3	0	0	0	0	0	0	0	0	0	5	0	0	0	0
WT1S4	2	0	0	0	0	0	0	0	0	0	0	0	0	0
WT1S5	0	0	0	0	0	0	0	0	0	1	0	0	1	0
WT2S1	9	0	0	0	0	0	0	0	0	0	0	7	0	2
WT2S2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WT2S3	0	0	0	0	0	0	0	0	0	2	0	0	0	0
WT2S4	1	0	0	0	0	0	1	0	0	0	0	0	0	0
WT2S5	0	0	0	0	0	0	1	0	0	0	0	0	0	1
WT3S1	12	0	0	1	0	0	1	0	0	0	0	0	0	0
WT3S2	3	0	0	0	0	0	0	0	0	0	0	0	0	0
WT3S3	3	0	0	0	0	0	0	0	0	0	0	0	0	1
WT3S4	0	0	0	0	0	0	0	0	0	0	0	0	3	1
WT3S5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WT4S1	0	0	0	0	0	0	1	0	0	5	0	0	6	0
WT4S2	0	0	0	0	0	0	0	0	0	1	0	0	0	2
WT4S3	0	0	0	0	0	0	0	0	0	0	0	2	0	0
WT4S4	0	0	0	0	0	0	0	0	0	0	0	0	0	1
WT4S5	0	0	0	0	0	0	0	0	0	3	0	0	0	0
WT5S1	0	0	0	0	0	0	0	0	0	2	0	0	7	1
WT5S2	0	0	0	0	0	0	2	0	0	3	0	0	1	0
WT5S3	2	0	0	0	0	0	1	0	0	1	0	0	3	0
WT5S4	0	0	0	0	0	0	0	0	0	2	0	0	14	0
WT5S5	1	0	0	0	0	0	0	0	0	0	0	0	2	0
Total	246	11	2	1	2	54	153	6	2	545	5	301	2094	246

Appendix A (Continued)

Other Small Heterotrophic- Section 2	Eponides antillarum	E. repanus	Haurina bradyii**	Haurina sp	Massilina protea	Miliolinella circularis**	Miliolinella fichteliana	Miliolinella sp 1**	Miliolinella sp 2**	Monalysidium politum	Neoepinoides	Planorbulina acervalis**	Pseudohaurina**	Pseudotriloculina sp
ET1S1	0	0	0	0	0	14	0	6	2	0	0	2	0	1
ET1S2	0	0	0	0	0	14	0	10	0	0	0	0	0	0
ET1S3	0	0	0	0	0	3	0	0	6	0	0	0	0	0
ET1S4	0	0	0	0	0	6	0	1	0	0	0	2	0	0
ET1S5	0	0	0	0	0	3	0	1	4	0	0	3	0	0
ET1S6	0	0	0	0	0	0	0	1	4	1	4	5	0	0
ET1S7	6	0	0	0	0	0	0	7	3	0	1	2	1	0
ET1S8	0	0	0	0	0	2	0	1	0	0	5	0	0	0
ET1S9	0	0	0	1	0	1	0	10	1	0	0	0	1	0
ET1S10	0	0	0	0	0	9	0	6	1	0	2	1	1	0
ET2S1	0	0	0	0	0	1	0	0	0	0	0	5	0	0
ET2S2	0	0	0	0	0	3	0	0	0	0	0	1	0	0
ET2S3	0	0	0	0	0	1	0	0	0	0	0	5	0	0
ET2S4	0	0	0	0	0	0	0	0	0	0	0	9	0	0
ET2S5	0	0	0	0	0	4	0	0	0	0	0	6	0	0
ET2S6	0	0	0	0	0	3	0	0	0	0	0	0	0	0
ET2S7	0	0	0	0	0	0	0	1	0	0	0	0	0	0
ET2S8	0	0	0	0	0	1	0	0	0	0	0	1	0	0
ET2S9	0	0	0	0	0	0	0	3	0	0	0	2	0	0
ET2S10	0	0	0	0	0	9	1	2	0	0	0	0	0	0
ET3S1	0	0	0	0	0	8	0	2	1	0	0	1	0	0
ET3S2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET3S3	0	0	0	0	0	0	0	0	0	0	0	7	0	0
ET3S4	0	0	0	0	0	0	0	0	0	0	0	4	0	0
ET3S5	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ET3S6	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ET3S7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET3S8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET3S9	0	0	0	0	0	0	0	3	0	0	0	1	0	0
ET3S10	0	0	0	0	0	1	0	2	0	0	0	2	0	0
ET4S1	0	0	0	0	0	0	0	0	1	0	0	4	0	0
ET4S2	0	0	0	0	0	0	0	2	0	0	0	4	0	0
ET4S3	0	0	0	0	0	0	0	0	0	0	0	4	0	0
ET4S4	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ET4S5	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ET4S6	0	0	1	0	0	0	0	0	0	0	0	0	0	0
ET4S7	0	0	3	0	0	2	0	0	0	0	0	6	0	0
ET4S8	0	0	0	0	0	1	0	2	0	0	0	0	0	0
ET4S9	0	0	4	0	0	0	0	7	0	0	0	0	0	0
ET4S10	0	0	2	0	0	5	0	0	0	0	0	0	0	0
ET5S1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
ET5S2	0	0	2	0	0	0	0	0	0	0	0	0	0	0
ET5S3	0	0	4	0	0	0	0	0	0	0	0	1	0	0
ET5S4	0	0	1	0	0	0	0	1	0	0	0	4	0	0
ET5S5	0	0	3	0	0	1	0	2	0	0	0	7	1	0
ET5S6	0	0	3	0	0	1	1	0	0	0	0	9	0	0
ET5S7	0	0	3	0	0	1	0	0	2	0	0	4	0	0
ET5S8	0	0	0	0	0	5	0	0	0	0	0	14	0	0
ET5S9	0	0	0	0	0	5	0	0	0	0	0	1	0	0
ET5S10	0	0	1	0	0	2	0	0	0	0	0	12	1	0

Appendix A (Continued)

Other Small Heterotrophic-Section 2	Eponides antillarum	E. repanus	Haurina bradyii**	Haurina sp	Massilina protea	Miliolinella circularis**	Miliolinella fichteliana	Miliolinella sp 1**	Miliolinella sp 2**	Monalysidium politum	Neoepinoides	Planorbulina acervalis**	Pseudohaurina**	Pseudotriloculina sp
ET6S1	0	0	0	0	0	3	2	2	0	0	0	2	0	0
ET6S2	0	0	0	0	0	4	0	0	0	0	0	14	1	0
ET6S3	0	0	1	0	0	3	0	0	1	0	0	14	0	0
ET6S4	0	0	0	0	0	0	0	0	0	0	0	9	0	0
ET6S5	0	0	0	0	0	2	0	0	0	0	0	10	0	0
ET6S6	0	0	0	0	0	0	0	0	0	0	0	8	0	0
ET6S7	0	0	0	0	0	2	0	2	0	0	0	24	0	0
ET6S8	0	0	0	0	0	0	0	0	0	0	0	6	0	0
ET6S9	0	0	0	0	0	0	0	0	0	0	0	6	0	0
ET6S10	0	0	0	0		0	0	0	0	0	0	0	0	0
ET7S1	0	0	5	0	0	0	0	0	2	0	0	0	0	0
ET7S2	0	0	4	0	0	2	0	0	0	0	0	2	0	0
ET7S3	0	0	0	0	0	3	1	0	0	0	0	2	0	0
ET7S4	0	0	0	0	0	0	0	0	0	0	0	2	0	0
ET7S5	0	0	0	0	0	1	0	0	0	0	0	11	0	0
ET7S6	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ET7S7	6	0	0	0	0	4	0	0	0	0	0	8	1	0
ET7S8	0	0	0	0	0	0	0	0	0	0	0	3	0	0
ET7S9	2	0	0	0	0	0	0	0	0	0	0	12	0	0
ET7S10	0	0	0	0	0	0	0	0	0	0	0	12	0	0
ET8S1	0	0	2	0	0	3	0	0	0	0	0	1	0	0
ET8S2	0	0	2	0	0	0	0	0	0	0	0	0	0	0
ET8S3	0	0	0	0	0	1	0	0	0	0	0	0	0	0
ET8S4	0	0	2	0	0	0	0	0	0	0	0	0	0	0
ET8S5	0	0	3	0	0	0	0	0	0	0	0	7	0	0
ET8S6	0	0	0	0	0	0	0	0	0	0	0	2	0	0
ET8S7	0	0	0	0	0	0	0	0	0	0	0	12	0	0
ET8S8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET8S9	0	0	1	0	0	0	0	0	0	0	0	9	0	0
ET8S10	0	0	0	0	0	1	0	0	0	0	0	0	0	0
ET9S1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ET9S2	0	0	0	0	0	1	0	0	0	0	0	0	0	0
ET9S3	0	0	0	0	0	1	0	0	0	0	0	3	0	0
ET9S4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET9S5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET9S6	0	0	0	0	0	0	0	0	2	0	0	0	0	0
ET9S7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET9S8	0	0	2	0	0	1	0	0	2	0	0	1	0	0
ET9S9	0	0	0	0	0	0	0	0	0	0	0	7	0	0
ET9S10	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A (Continued)

Other Small Heterotrophic-Section 2	Eponides antillarum	E. repanus	Haurina bradyii**	Haurina sp	Massilina protea	Miliolinella circularis**	Miliolinella fichteliana	Miliolinella sp 1**	Miliolinella sp 2**	Monalysidium politum	Neoepinoides	Planorbulina acervalis**	Pseudohaurina**	Pseudotriloculina sp
ET10S1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
ET10S2	0	0	0	0	0	0	0	1	0	0	0	0	0	0
ET10S3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET10S4	0	0	0	0	0	1	0	0	0	0	0	0	0	0
ET10S5	3	0	1	0	0	0	0	0	0	0	0	2	1	0
ET10S6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET10S7	5	1	0	0	0	0	0	0	0	0	0	0	0	0
ET10S8	0	1	0	0	0	0	0	1	0	0	0	0	0	0
ET10S9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET10S10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WT1S1	1	0	1	0	0	1	0	2	1	0	0	0	0	0
WT1S2	2	1	2	0	0	0	0	0	0	0	0	0	0	0
WT1S3	0	0	0	0	0	2	0	0	0	0	0	0	0	0
WT1S4	0	1	1	0	0	0	0	0	0	0	0	0	0	0
WT1S5	2	0	0	0	0	1	0	0	0	0	0	0	0	0
WT2S1	0	0	5	0	1	0	0	6	8	0	0	0	0	0
WT2S2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WT2S3	1	1	0	0	0	0	0	1	0	0	0	0	0	0
WT2S4	0	0	1	0	0	0	0	0	0	0	0	0	0	0
WT2S5	0	0	0	0	1	0	0	0	0	0	0	0	0	0
WT3S1	1	10	7	0	0	0	0	0	4	0	0	0	0	0
WT3S2	0	1	3	0	1	0	0	0	0	0	0	0	0	0
WT3S3	0	2	0	0	0	0	0	0	0	0	0	0	0	0
WT3S4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WT3S5	0	0	1	0	0	0	0	0	0	0	0	0	0	0
WT4S1	0	1	0	0	0	0	0	0	0	0	0	1	0	0
WT4S2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WT4S3	0	0	5	0	0	0	0	0	0	0	0	0	0	0
WT4S4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WT4S5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WT5S1	0	0	2	0	2	0	0	0	0	0	0	0	0	0
WT5S2	0	0	0	0	0	0	0	0	0	0	0	3	0	0
WT5S3	0	1	0	0	0	0	0	0	0	0	0	0	0	0
WT5S4	0	0	0	0	0	0	0	0	0	0	0	1	0	0
WT5S5	0	0	3	0	0	0	0	0	0	0	0	1	0	0
Total	31	20		1		143	5	85	45	1	12	330	8	1

Appendix A (Continued)

Other Small Heterotrophic-Section 3	Pyrgo denticulata	Pyrgo spp**	Quinqueloculina agglutinans**	Q. bicostata**	Q. bicarinata**	Q. bosciana**	Q. candeiana**	Q. crassa f. subcuneata**	Q. laevigata**	Q. lamarckiana**	Q. occidentalis	Q. parkeri	Q. poeyana**	Q. polygna**
ET1S1	0	0	5	4	0	5	0	0	0	3	0	0	2	2
ET1S2	0	0	7	1	0	18	0	2	5	5	0	0	1	2
ET1S3	0	0	10	12	0	14	0	0	6	5	0	0	8	6
ET1S4	0	0	13	16	7	1	0	0	1	5	12	0	10	9
ET1S5	0	0	10	10	0	4	0	3	5	4	0	0	0	9
ET1S6	0	0	13	19	0	7	6	0	0	0	0	0	1	3
ET1S7	0	0	25	15	0	2	21	0	4	0	0	0	0	8
ET1S8	0	0	2	13	0	1	1	0	0	0	0	0	1	5
ET1S9	0	0	10	0	0	2	0	0	1	0	0	0	0	0
ET1S10	0	0	6	13	0	7	8	0	0	0	0	0	0	0
ET2S1	0	0	9	9	0	0	0	0	0	0	0	0	2	9
ET2S2	0	0	8	12	0	0	0	0	0	2	0	0	3	6
ET2S3	0	0	3	7	0	0	0	0	1	13	0	0	3	7
ET2S4	0	0	0	5	0	0	0	2	0	0	0	0	0	0
ET2S5	0	0	24	0	0	1	0	5	0	0	0	0	0	0
ET2S6	0	1	18	14	0	0	0	3	0	0	0	0	0	0
ET2S7	0	1	36	10	0	2	0	4	0	0	0	0	0	0
ET2S8	0	0	19	0	0	0	1	3	0	0	0	0	0	0
ET2S9	0	2	15	0	0	3	0	2	0	0	0	0	0	0
ET2S10	0	0	6	12	0	3	0	6	0	0	0	0	0	0
ET3S1	0	0	7	10	1	0	0	0	2	10	0	0	0	5
ET3S2	0	2	27	2	0	2	28	2	0	0	0	0	0	0
ET3S3	0	0	28	10	0	0	0	1	0	0	0	0	0	0
ET3S4	0	0	19	14	0	0	0	0	0	0	0	0	0	0
ET3S5	0	0	21	9	0	2	0	6	0	0	0	0	0	0
ET3S6	0	1	19	6	0	0	0	10	0	0	0	0	0	0
ET3S7	0	1	16	11	0	0	0	4	0	0	0	0	0	0
ET3S8	0	0	25	9	0	0	0	1	0	0	0	0	0	0
ET3S9	0	0	19	14	0	1	0	1	0	0	0	0	0	0
ET3S10	0	1	17	4	0	1	0	0	0	0	0	0	0	0
ET4S1	0	4	34	7	0	0	4	4	0	13	0	0	0	2
ET4S2	0	2	24	15	3	1	5	3	0	8	0	0	1	2
ET4S3	0	2	11	13	0	0	1	1	0	9	0	0	0	3
ET4S4	0	0	29	19	0	0	6	2	0	0	0	0	0	1
ET4S5	0	3	22	25	0	2	0	0	0	3	0	0	1	1
ET4S6	0	1	17	18	0	0	1	0	2	2	0	0	0	0
ET4S7	0	1	18	16	0	0	0	0	0	2	0	0	0	3
ET4S8	0	0	20	9	0	0	0	0	0	0	0	0	1	3
ET4S9	0	1	16	11	0	2	1	0	0	0	0	0	0	3
ET4S10	0	0	8	6	1	0	0	0	0	0	0	0	1	2

Appendix A (Continued)

Other Small Heterotrophic- Section 3	Pyrgo dentriculata	Pyrgo spp**	Quinqueloculina agglutinans**	Q. bicostata**	Q. bicarinata**	Q. bosciana**	Q. candeiana**	Q. crassa f. subcuneata**	Q. laevigata**	Q. lamarckiana**	Q. occidentalis	Q. parkeri	Q. poeyana**	Q. polygna**
ET5S1	0	0	14	3	0	0	2	2	0	14	0	0	0	0
ET5S2	0	0	18	12	1	0	4	1	0	24	0	0	2	2
ET5S3	0	0	23	9	2	0	2	3	0	11	0	0	1	1
ET5S4	1	0	20	9	3	1	2	1	0	15	0	0	1	2
ET5S5	0	1	16	6	0	2	1	0	1	8	0	0	1	5
ET5S6	0	0	25	23	2	0	2	0	0	12	0	0	0	7
ET5S7	0	0	15	8	1	2	2	0	0	9	0	0	3	2
ET5S8	0	0	3	3	1	2	1	0	0	5	0	0	0	0
ET5S9	0	1	18	10	2	0	1	0	0	8	0	0	0	0
ET5S10	1	1	13	4	0	0	1	0	0	3	0	0	3	0
ET6S1	0	1	13	3	3	0	1	1	0	5	0	0	0	2
ET6S2	0	2	3	3	1	2	1	0	0	5	0	0	0	0
ET6S3	0	0	3	3	1	2	1	0	0	5	0	0	0	0
ET6S4	0	1	12	2	1	0	0	0	0	1	0	0	0	1
ET6S5	0	0	11	2	0	1	1	0	0	4	0	0	0	2
ET6S6	0	0	6	2	0	0	0	0	0	1	0	0	0	1
ET6S7	0	0	2	0	3	0	0	0	0	0	0	0	1	0
ET6S8	0	0	2	2	1	0	0	0	0	0	0	0	0	0
ET6S9	0	0	2	2	0	0	0	0	0	0	0	0	0	0
ET6S10	0	0	1	0	0	0	0	0	0	0	0	0	0	0
ET7S1	0	4	5	1	0	3	0	5	0	15	0	0	2	2
ET7S2	0	0	11	2	3	2	0	1	0	2	0	0	0	2
ET7S3	0	0	8	4	0	0	0	4	0	5	0	0	0	2
ET7S4	0	1	9	1	0	0	1	0	2	7	0	0	0	1
ET7S5	0	0	8	2	1	0	0	0	0	4	0	0	1	1
ET7S6	0	0	4	1	1	0	0	0	0	0	0	0	0	0
ET7S7	0	0	19	8	2	0	2	2	0	6	0	0	2	0
ET7S8	0	1	13	3	1	0	0	0	0	5	0	0	1	0
ET7S9	0	1	6	5	0	0	0	0	0	1	0	0	0	0
ET7S10	0	0	9	1	1	0	0	0	0	1	0	0	0	3
ET8S1	0	1	8	0	0	1	2	0	0	8	0	0	0	4
ET8S2	0	0	6	0	0	0	0	2	0	2	0	0	0	1
ET8S3	0	2	6	2	0	0	2	2	0	3	0	0	0	0
ET8S4	0	1	6	2	0	0	2	2	0	3	0	0	0	0
ET8S5	0	0	6	3	1	1	1	1	0	3	0	0	1	0
ET8S6	0	2	6	1	0	1	1	0	0	7	0	0	0	0
ET8S7	0	0	8	1	0	0	0	0	0	2	0	1	0	0
ET8S8	0	0	4	0	0	0	1	0	0	0	0	0	0	0
ET8S9	0	0	3	1	0	0	1	0	0	0	0	1	0	0
ET8S10	0	0	2	0	0	0	0	0	0	1	0	0	0	0

Appendix A (Continued)

Other Small Heterotrophic-Section 3	Pyrgo dentriculata	Pyrgo spp**	Quinqueloculina agglutinans**	Q. bicostata**	Q. bicarinata**	Q. bosciana**	Q. candeiana**	Q. crassa f. subcuneata**	Q. laevigata**	Q. lamarckiana**	Q. occidentalis	Q. parkeri	Q. poeyana**	Q. polygna**
ET9S1	0	0	7	2	0	0	0	2	0	6	0	0	0	0
ET9S2	0	0	5	2	0	1	2	3	1	4	0	0	3	2
ET9S3	0	0	7	2	0	0	0	0	0	7	0	0	2	2
ET9S4	0	0	0	2	0	0	0	1	0	4	0	0	0	0
ET9S5	0	0	0	0	1	0	0	1	0	1	0	0	0	0
ET9S6	0	0	6	0	0	0	2	0	0	0	0	0	0	3
ET9S7	0	0	2	0	0	0	0	0	0	0	0	0	0	0
ET9S8	0	3	2	0	0	0	1	0	0	0	0	0	0	3
ET9S9	0	0	2	0	0	0	0	0	0	0	0	0	0	3
ET9S10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET10S1	0	1	1	0	0	0	0	1	1	3	0	0	0	2
ET10S2	0	1	10	2	1	0	0	1	1	5	0	0	0	3
ET10S3	0	0	5	1	0	1	1	0	0	3	0	0	0	2
ET10S4	0	0	8	3	0	0	0	0	0	2	0	0	1	1
ET10S5	0	0	4	3	1	1	1	0	0	2	0	0	1	3
ET10S6	0	0	6	4	0	0	0	0	0	7	0	0	0	0
ET10S7	0	0	12	1	0	0	4	0	0	0	0	0	0	1
ET10S8	0	0	16	0	0	0	2	0	1	0	0	0	0	0
ET10S9	0	0	7	0	0	0	0	0	0	1	0	0	0	0
ET10S10	0	0	1	1	0	0	1	0	0	2	0	0	0	0
WT1S1	0	0	23	15	1	0	5	4	1	10	0	0	2	0
WT1S2	0	0	35	9	7	1	0	6	0	15	0	0	4	2
WT1S3	0	0	49	14	1	0	0	6	0	0	0	0	3	2
WT1S4	0	0	39	16	0	1	0	1	0	8	0	0	3	3
WT1S5	0	0	38	13	0	1	0	0	0	11	0	0	5	3
WT2S1	0	0	7	8	1	3	0	1	2	11	0	0	5	1
WT2S2	0	0	3	0	0	0	0	0	0	0	0	0	0	0
WT2S3	0	0	18	6	0	0	0	2	0	5	0	0	0	2
WT2S4	0	0	33	12	0	0	0	4	0	16	0	0	1	2
WT2S5	0	1	25	17	0	0	2	3	1	16	0	0	4	0
WT3S1	0	0	21	7	0	3	2	4	2	3	0	0	12	0
WT3S2	3	0	30	9	3	0	2	2	0	13	0	0	1	5
WT3S3	0	0	34	11	0	0	0	1	2	12	0	0	1	14
WT3S4	0	0	36	6	0	0	6	3	0	18	0	0	1	11
WT3S5	0	2	22	2	0	1	1	1	1	8	0	0	0	6
WT4S1	0	3	38	8	2	1	0	2	2	13	0	0	1	0
WT4S2	0	0	46	3	0	1	0	0	0	12	0	0	1	9
WT4S3	0	2	43	9	0	0	0	0	0	10	0	1	3	4
WT4S4	0	2	46	15	5	0	1	0	0	14	0	0	2	3
WT4S5	0	0	33	5	0	0	3	1	0	20	0	0	0	3
WT5S1	0	0	6	20	0	0	0	0	0	2	0	0	0	0
WT5S2	0	0	41	4	0	1	0	0	1	6	0	0	3	8
WT5S3	0	0	44	10	0	0	1	0	1	0	0	0	2	8
WT5S4	0	0	57	5	1	0	2	0	0	9	0	0	0	0
WT5S5	0	0	32	12	0	0	2	0	0	8	0	0	3	1
Total	5	58	1903	803	68	117	159	142	47	576	12	3	118	244

Appendix A (Continued)

Other Small Heterotrophic- Section 4	Q. sabulosa**	Q. seminula**	Q. subpoeyana**	Q. tenagos**	Q. tricarinata**	Quinqueloculina spp**	Rosalina floridana**	Rosalina spp**	Sigmoilina schlumbergeri**	Siphonina pulchra	Spirilina obconica	Spiroculina angulata**	Spiroloculina antillarum**	Spiroloculina rotunda
ET1S1	0	4	6	0	0	0	0	1	0	0	0	0	0	0
ET1S2	3	10	2	3	0	0	0	3	0	0	0	0	2	1
ET1S3	2	1	1	5	0	1	0	3	2	0	0	0	0	0
ET1S4	2	5	4	0	0	3	0	4	0	0	0	0	0	0
ET1S5	12	5	5	4	0	0	0	3	0	0	0	0	1	0
ET1S6	2	1	9	1	0	0	0	0	0	0	0	0	0	0
ET1S7	1	1	0	0	0	1	6	0	0	0	2	0	1	0
ET1S8	0	1	0	1	4	7	4	0	0	0	0	0	0	0
ET1S9	0	0	0	3	0	5	0	0	0	0	0	0	1	0
ET1S10	0	1	0	0	2	3	0	0	0	3	0	0	0	0
ET2S1	0	6	0	1	0	9	0	0	0	0	0	0	0	0
ET2S2	0	0	1	2	0	26	0	0	0	0	0	0	0	0
ET2S3	1	0	0	3	0	21	0	0	0	0	0	0	0	0
ET2S4	0	0	0	0	0	5	0	0	0	0	0	0	2	0
ET2S5	0	0	0	0	0	6	0	0	0	0	0	0	0	0
ET2S6	0	0	0	0	0	10	0	0	0	0	0	0	0	0
ET2S7	0	0	0	0	0	1	0	0	0	0	0	0	0	0
ET2S8	0	0	0	0	0	5	0	0	0	0	0	0	0	0
ET2S9	0	0	0	0	0	5	0	0	0	0	0	0	0	0
ET2S10	0	0	0	0	0	8	0	0	0	0	0	0	0	0
ET3S1	4	3	1	1	1	0	0	4	0	0	0	0	0	0
ET3S2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET3S3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET3S4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET3S5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET3S6	0	0	0	0	0	0	0	0	0	0	0	0	1	0
ET3S7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET3S8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET3S9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET3S10	0	0	0	0	0	0	0	2	0	0	0	0	1	0
ET4S1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
ET4S2	0	0	5	0	0	0	0	0	2	0	0	0	0	0
ET4S3	0	0	1	0	2	7	0	0	0	0	0	0	0	0
ET4S4	0	0	3	0	0	3	0	0	1	0	0	0	0	0
ET4S5	0	0	7	0	0	0	0	0	1	0	0	0	0	0
ET4S6	0	0	7	0	1	5	0	0	0	0	0	0	0	0
ET4S7	0	1	3	0	0	3	0	0	0	0	0	0	0	0
ET4S8	0	0	13	0	0	3	0	0	2	0	0	0	0	0
ET4S9	0	3	3	0	0	0	3	0	1	0	0	0	0	0
ET4S10	0	5	4	0	0	4	0	0	0	0	0	0	0	0

Appendix A (Continued)

Other Small Heterotrophic- Section 4	Q. sabulosa**	Q. seminula**	Q. subpoeyana**	Q. tenagos**	Q. tricarinata**	Quinqueloculina spp**	Rosalina floridana**	Rosalina spp**	Sigmoilina schlumbergeri**	Siphonina pulchra	Spirilina obconica	Spiroculina angulata**	Spiroloculina antillarum**	Spiroloculina rotunda
ET5S1	0	1	0	0	0	5	0	0	0	0	0	0	0	0
ET5S2	4	0	2	0	0	7	3	0	0	0	0	1	0	0
ET5S3	0	1	1	0	0	4	0	0	1	0	0	0	0	0
ET5S4	1	3	2	0	0	3	0	0	0	0	0	1	1	0
ET5S5	0	0	4	0	2	0	0	0	0	0	0	0	0	0
ET5S6	7	3	2	1	0	2	1	0	0	0	0	0	0	0
ET5S7	0	0	7	1	0	0	0	0	0	0	0	0	0	0
ET5S8	0	0	5	1	0	1	0	0	0	0	0	1	0	0
ET5S9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET5S10	0	0	0	2	0	1	0	0	0	0	0	0	0	0
ET6S1	0	0	0	0	0	0	0	0	3	0	0	0	0	0
ET6S2	0	0	5	1	0	1	0	0	0	0	0	1	0	0
ET6S3	0	0	5	1	0	1	0	0	0	0	0	0	0	0
ET6S4	0	0	0	0	0	4	0	0	0	0	0	0	0	0
ET6S5	0	0	1	2	0	0	0	0	1	0	0	0	0	0
ET6S6	0	0	0	0	0	1	0	0	0	0	0	0	0	0
ET6S7	0	0	0	0	0	0	0	0	1	0	0	0	0	0
ET6S8	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ET6S9	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ET6S10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET7S1	8	3	0	0	0	2	0	0	0	0	0	0	0	0
ET7S2	1	0	4	0	0	2	2	2	2	2	0	0	1	0
ET7S3	0	1	0	2	1	2	0	0	0	0	0	0	0	0
ET7S4	1	2	0	3	0	3	0	0	0	0	0	0	0	0
ET7S5	0	2	0	0	0	0	0	0	0	0	0	0	2	0
ET7S6	0	0	0	0	0	2	0	0	0	0	0	0	0	0
ET7S7	0	4	0	0	0	0	0	0	0	0	0	0	0	0
ET7S8	0	0	0	0	0	7	0	0	0	0	0	0	0	0
ET7S9	0	0	0	2	0	0	0	0	0	0	0	0	0	0
ET7S10	0	0	0	5	0	0	0	0	0	0	0	0	0	0
ET8S1	5	1	0	0	0	5	0	0	0	0	0	0	0	0
ET8S2	0	0	0	3	0	3	0	0	0	0	0	0	0	0
ET8S3	0	2	0	0	0	2	0	0	0	0	0	0	0	0
ET8S4	0	2	0	0	0	2	0	0	0	0	0	0	0	0
ET8S5	0	0	0	3	10	7	0	0	0	0	0	2	0	0
ET8S6	0	1	1	0	4	0	0	0	0	0	0	0	0	0
ET8S7	0	0	0	1	22	2	0	0	0	0	0	1	0	0
ET8S8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET8S9	0	0	0	2	3	0	0	0	4	0	0	0	0	0
ET8S10	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A (Continued)

Other Small Heterotrophic-Section 4	Q. sabulosa**	Q. seminula**	Q. subpoeyana**	Q. tenagos**	Q. tricarinata**	Quinqueloculina spp**	Rosalina floridana**	Rosalina spp**	Sigmoilina schlumbergeri**	Siphonina pulchra	Spirilina obconica	Spiroculina angulata**	Spiroloculina antillarum**	Spiroloculina rotunda
ET9S1	7	1	0	0	0	0	0	0	0	0	0	0	0	0
ET9S2	1	0	0	0	2	0	0	0	0	0	0	0	2	0
ET9S3	0	5	0	2	0	2	0	0	0	0	0	0	0	0
ET9S4	1	3	1	0	0	1	0	0	1	0	0	0	1	0
ET9S5	1	0	0	0	1	1	0	0	0	0	0	0	0	0
ET9S6	0	0	0	0	0	0	0	0	2	0	0	1	0	0
ET9S7	0	0	0	1	0	0	0	0	0	0	0	0	0	0
ET9S8	0	0	0	0	1	0	0	0	0	0	0	1	1	0
ET9S9	0	0	0	0	1	0	0	0	0	0	0	0	0	0
ET9S10	0	0	0	0	1	0	0	0	0	0	0	0	0	0
ET10S1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
ET10S2	5	0	2	0	0	1	0	0	3	0	0	0	1	1
ET10S3	2	0	0	0	0	2	1	0	1	0	0	0	0	0
ET10S4	0	1	1	1	1	2	0	0	0	0	0	0	0	0
ET10S5	0	0	0	0	3	0	0	0	2	0	0	1	0	0
ET10S6	4	0	0	0	0	0	0	0	3	0	0	0	0	0
ET10S7	0	4	0	3	1	0	1	0	0	0	0	0	0	0
ET10S8	0	3	0	1	3	3	0	0	0	0	0	0	0	0
ET10S9	0	0	0	0	1	2	0	0	0	0	0	0	0	0
ET10S10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WT1S1	23	0	7	2	0	0	0	0	0	0	0	0	0	0
WT1S2	28	1	0	3	0	4	0	0	0	0	0	0	0	0
WT1S3	30	0	0	0	0	2	0	0	0	0	0	0	0	0
WT1S4	25	2	0	2	0	3	0	0	0	0	0	0	0	0
WT1S5	44	0	0	0	0	0	0	0	0	0	0	0	0	0
WT2S1	29	2	11	0	0	3	0	1	0	0	0	0	0	0
WT2S2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
WT2S3	5	2	0	0	0	0	0	0	0	0	0	0	0	0
WT2S4	30	1	0	4	0	3	0	0	0	0	0	0	0	0
WT2S5	36	0	0	3	0	1	0	0	0	0	0	0	0	0
WT3S1	24	0	0	6	0	0	0	0	0	0	0	2	0	0
WT3S2	22	1	0	2	0	1	0	0	0	0	0	0	2	0
WT3S3	11	0	0	0	0	1	1	0	0	0	0	0	0	0
WT3S4	21	1	1	0	0	1	1	0	0	0	0	0	1	0
WT3S5	11	0	0	3	0	0	0	0	0	0	0	0	0	0
WT4S1	0	0	0	5	0	0	0	0	0	0	0	0	0	0
WT4S2	14	3	0	0	0	0	1	0	0	0	0	1	0	0
WT4S3	9	1	0	0	0	2	2	0	0	0	0	0	0	0
WT4S4	0	1	0	2	0	0	0	0	0	0	0	0	0	0
WT4S5	7	0	3	0	0	1	0	0	0	0	0	0	0	0
WT5S1	0	0	1	0	1	0	0	0	0	0	0	0	0	0
WT5S2	21	4	1	1	0	0	0	0	0	0	0	0	0	0
WT5S3	0	3	0	0	0	0	0	0	0	0	0	0	0	0
WT5S4	3	0	0	0	0	3	0	0	0	0	0	0	0	0
WT5S5	2	0	0	0	0	1	0	0	0	0	0	0	0	0
Total	473	112	144	95	68	250	26	23	33	5	2	15	21	2

Appendix A (Continued)

Other Small Heterotrophic-Section 5	Spirulina arietus	Textularia candeiana**	Triloculina bermudezi	T. carinata**	T. circularis	T. cf. fitteri var meningoi	T. linneiana**	T. linneianna f. comis	T. cf sidebottomi**	T. tricarinata**	T. trigonula**	T. variolata**	Triloculina spp	Valvulina Oviedoiana	Vertebralina mucro**	Wisnerella auriculata**
ET1S1	0	0	4	1	0	0	2	0	0	5	0	0	0	0	0	0
ET1S2	0	0	0	0	0	0	0	0	0	3	1	0	1	0	0	0
ET1S3	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
ET1S4	0	1	0	0	0	0	1	0	0	0	12	0	0	0	0	2
ET1S5	0	1	0	0	0	0	7	0	0	0	16	0	0	0	1	0
ET1S6	0	0	0	4	0	0	3	0	0	0	3	0	0	0	0	1
ET1S7	2	2	0	0	0	0	5	0	2	0	2	3	0	0	2	1
ET1S8	0	1	5	16	0	0	0	0	4	0	7	0	0	1	3	0
ET1S9	0	4	0	0	0	0	0	0	0	0	3	0	1	2	0	0
ET1S10	0	4	0	0	0	0	2	0	0	0	1	0	0	0	2	0
ET2S1	0	4	0	4	0	0	0	0	0	7	3	0	0	0	3	0
ET2S2	0	0	0	1	0	0	1	0	0	7	5	0	0	2	0	0
ET2S3	0	4	0	5	0	0	0	0	0	0	3	0	0	3	0	0
ET2S4	0	8	0	0	0	0	0	0	0	0	1	7	4	0	2	0
ET2S5	0	6	0	0	0	0	0	0	0	0	0	2	4	0	2	0
ET2S6	0	4	0	0	0	0	0	0	0	0	2	2	6	0	0	0
ET2S7	0	2	0	0	0	0	0	0	0	0	1	2	3	0	0	0
ET2S8	0	8	0	0	0	0	0	0	0	0	0	0	4	0	0	0
ET2S9	0	4	0	0	0	0	0	0	0	0	0	3	6	0	0	0
ET2S10	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	1
ET3S1	0	1	0	6	0	2	0	0	0	12	11	0	3	1	0	0
ET3S2	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1
ET3S3	0	4	0	0	0	0	0	0	0	0	2	4	6	0	0	2
ET3S4	0	3	0	0	0	0	0	0	0	0	0	1	2	0	0	0
ET3S5	0	1	0	0	0	0	0	0	0	0	0	5	2	0	2	0
ET3S6	0	3	0	0	0	0	0	0	0	0	0	10	0	0	0	0
ET3S7	0	8	0	0	0	0	0	0	0	0	0	4	0	0	3	0
ET3S8	0	3	0	0	0	2	0	0	0	0	0	0	1	0	0	0
ET3S9	0	3	0	0	0	0	0	2	0	0	0	2	10	0	0	0
ET3S10	0	0	0	0	0	1	0	2	10	0	0	1	1	0	2	0

Appendix A (Continued)

Other Small Heterotrophic-Section 5	Spirulina arietus	Textularia candeiana**	Triloculina bermudezi	T. carinata**	T. circularis	T. cf. fitteri var meningoi	T. linneiana**	T. linneianna f. comis	T. cf sidebottomi**	T. tricarinata**	T. trigonula**	T. variolata**	Triloculina spp	Valvulina Oviedoinana	Vertebralina mucro**	Wisnerella auriculata**
ET4S1	0	4	0	4	0	2	0	0	0	1	0	0	0	4	0	0
ET4S2	0	1	0	3	0	0	0	0	3	3	0	0	0	1	0	0
ET4S3	0	2	0	1	0	0	0	0	0	1	0	0	0	5	0	0
ET4S4	0	3	0	4	0	0	2	0	2	0	4	0	0	3	0	0
ET4S5	0	5	0	3	0	1	4	0	1	4	0	0	0	2	1	0
ET4S6	0	2	0	5	0	0	4	0	0	0	0	0	0	3	0	0
ET4S7	0	8	0	4	0	8	5	0	2	0	0	0	0	8	1	0
ET4S8	0	6	0	4	0	2	4	0	0	7	0	0	0	2	0	1
ET4S9	0	1	0	2	0	1	0	0	0	1	0	0	0	3	0	0
ET4S10	0	0	0	2	0	2	1	0	0	0	1	0	0	1	1	0
ET5S1	0	1	0	5	0	0	3	0	0	1	1	0	0	4	0	0
ET5S2	0	3	0	5	0	1	2	0	0	3	3	0	0	2	0	0
ET5S3	0	1	0	6	0	1	4	0	0	6	1	0	0	5	0	0
ET5S4	0	3	0	2	0	0	1	1	0	6	1	0	0	8	0	0
ET5S5	0	0	0	5	0	0	4	0	0	4	2	0	0	2	1	0
ET5S6	0	3	0	0	0	0	4	0	0	4	1	0	0	10	4	0
ET5S7	0	4	0	4	0	0	4	0	0	0	0	0	0	14	0	0
ET5S8	0	4	0	2	0	0	3	0	4	3	1	0	0	7	0	0
ET5S9	0	5	0	1	0	0	5	0	1	6	0	0	0	4	1	0
ET5S10	0	3	0	2	0	0	4	0	2	0	0	0	0	4	0	0
ET6S1	0	1	0	3	0	0	3	0	0	4	0	0	0	7	1	0
ET6S2	0	4	0	2	0	0	3	0	4	9	1	0	0	7	0	0
ET6S3	0	4	0	2	0	0	3	0	4	3	1	0	0	1	0	0
ET6S4	0	1	0	1	0	0	12	0	1	1	0	0	0	16	0	0
ET6S5	0	1	0	2	0	0	3	0	0	2	0	0	0	2	0	0
ET6S6	0	1	0	1	0	0	10	0	0	0	0	0	0	2	0	0
ET6S7	0	0	0	0	0	0	10	0	0	0	0	0	0	8	1	0
ET6S8	0	0	0	0	0	0	1	0	0	1	0	0	0	5	0	0
ET6S9	0	0	0	0	0	0	1	0	0	1	0	0	0	5	0	0
ET6S10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A (Continued)

Other Small Heterotrophic- Section 5	Spirulina arietus	Textularia candeiana**	Triloculina bermudezi	T. carinata**	T. circularis	T. cf. fitteri var meningoi	T. linneiana**	T. linneianna f. comis	T. cf sidebottomi**	T. tricarinata**	T. trigonula**	T. variolata**	Triloculina spp	Valvulina Oviedoinana	Vertebralina mucro**	Wisnerella auriculata**
ET7S1	0	1	0	4	0	0	4	0	1	0	0	0	0	2	0	0
ET7S2	0	0	0	8	0	0	2	1	4	3	1	0	0	16	1	0
ET7S3	0	3	0	0	0	0	2	0	0	3	0	0	0	5	0	0
ET7S4	0	3	0	2	0	0	1	0	0	0	1	0	0	11	0	0
ET7S5	0	3	0	2	0	0	5	0	1	0	6	0	0	7	0	0
ET7S6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET7S7	0	2	0	1	0	0	4	0	2	3	0	0	0	4	0	0
ET7S8	0	3	0	4	0	0	2	0	0	2	1	0	0	4	0	0
ET7S9	0	4	0	1	0	0	2	0	2	0	1	0	0	9	0	0
ET7S10	0	2	0	2	0	0	6	0	1	1	0	0	0	17	0	0
ET8S1	0	0	0	0	0	4	0	0	0	0	0	0	0	7	0	0
ET8S2	0	0	0	2	0	0	2	0	0	2	0	0	0	13	0	0
ET8S3	0	0	0	2	0	0	1	0	1	2	0	0	0	8	0	0
ET8S4	0	0	0	0	0	0	1	0	0	1	0	0	0	4	0	0
ET8S5	0	1	0	0	0	0	4	0	0	2	0	0	0	20	0	0
ET8S6	0	1	0	0	0	0	2	0	1	0	0	0	0	4	0	0
ET8S7	0	2	0	0	0	0	4	0	0	0	0	0	0	86	0	0
ET8S8	0	0	0	0	0	0	2	0	0	0	0	0	0	14	0	0
ET8S9	0	2	0	0	0	0	1	0	0	1	0	0	0	8	0	0
ET8S10	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
ET9S1	0	0	0	1	0	0	2	0	2	4	0	0	0	1	1	0
ET9S2	0	0	0	1	0	0	4	2	0	1	0	0	0	2	0	0
ET9S3	0	1	0	2	0	0	3	0	0	0	0	0	0	3	0	0
ET9S4	0	2	0	2	0	0	0	0	2	1	0	0	0	1	0	0
ET9S5	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
ET9S6	0	1	0	2	0	0	1	0	0	1	1	0	0	1	0	0
ET9S7	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0
ET9S8	0	4	0	0	0	0	4	0	0	0	1	0	0	0	0	0
ET9S9	0	0	0	0	0	0	0	0	2	0	0	0	0	3	0	0
ET9S10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A (Continued)

Other Small Heterotrophic- Section 5	Spirulina arietus	Textularia candeiana**	Triloculina bermudezi	T. carinata**	T. circularis	T. cf. fitteri var meningoi	T. linneiana**	T. linneianna f. comis	T. cf sidebottomi**	T. tricarinata**	T. trigonula**	T. variolata**	Triloculina spp	Valvulina Oviedoinana	Vertebralina mucro**	Wisnerella auriculata**
ET10S1	0	0	0	3	0	0	0	0	0	2	0	0	0	0	0	0
ET10S2	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0
ET10S3	0	1	0	0	0	0	2	0	2	1	0	0	0	0	0	0
ET10S4	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0
ET10S5	0	0	0	0	0	0	1	0	0	3	0	0	0	1	0	0
ET10S6	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	
ET10S7	0	0	0	0	0	0	4	0	1	3	1	0	0	3	0	0
ET10S8	0	0	0	0	0	0	4	1	0	0	0	0	0	1	0	0
ET10S9	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
ET10S10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WT1S1	0	0	0	4	0	0	6	0	2	3	6	0	0	2	1	0
WT1S2	0	0	0	5	0	0	0	0	0	2	1	0	0	2	2	0
WT1S3	0	0	0	5	0	0	0	0	0	4	2	0	0	0	0	0
WT1S4	0	0	0	6	0	0	4	0	1	8	0	0	0	2	1	0
WT1S5	0	0	0	6	0	0	0	0	1	3	0	0	0	0	0	0
WT2S1	0	0	0	10	0	0	2	0	0	7	2	0	0	0	0	0
WT2S2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WT2S3	0	0	0	5	0	0	1	0	0	1	0	0	0	0	1	0
WT2S4	0	0	0	5	0	0	1	0	0	1	0	0	0	0	1	0
WT2S5	0	0	0	6	0	0	0	0	0	4	1	0	0	2	2	0
WT3S1	0	0	0	7	6	0	3	0	21	0	20	0	0	0	20	0
WT3S2	0	0	0	5	0	0	3	0	4	2	0	0	0	0	1	1
WT3S3	0	0	0	4	0	0	2	0	2	5	0	0	0	3	0	0
WT3S4	0	0	0	8	0	0	0	0	0	2	0	0	0	0	1	0
WT3S5	0	0	0	4	0	0	4	0	3	0	0	0	0	1	2	0
WT4S1	0	0	0	7	0	0	0	0	1	4	1	0	0	0	0	0
WT4S2	0	0	0	10	0	0	2	0	0	5	5	0	0	0	1	0
WT4S3	0	0	2	2	0	0	3	0	0	1	1	0	0	0	0	0
WT4S4	0	0	0	4	0	0	1	0	0	0	0	0	0	0	0	0
WT4S5	0	0	0	4	0	0	6	0	5	4	0	0	0	0	0	0
WT5S1	0	0	0	1	0	0	1	0	1	1	0	0	0	0	0	0
WT5S2	0	0	0	0	0	0	0	0	1	1	2	0	0	0	1	0
WT5S3	0	0	0	4	0	0	6	0	0	0	0	0	0	0	0	0
WT5S4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
WT5S5	0	0	0	4	0	0	3	0	1	5	1	0	0	0	0	0
Total	2	187	11	276	6	27	241	9	107	206	157	48	54	431	69	10

Appendix B: Raw Sterol Concentration Data

*Note: All samples that have BDL indicate that the concentration was below the detection limit of 0.1 ppm.

Sample	ET1S1	ET1S2	ET1S3	ET1S4	ET1S5	ET1S6	ET1S7	ET1S8	ET1S9	ET1S10
Coprostanol	5.92	BDL	148.42	BDL	148.42	133.92	14.92	5.42	9.42	BDL
Cholesterol	23.17	0.17	600.17	1.17	60.17	1203.17	182.67	49.67	99.67	BDL
Cholestanol	44.46	0.96	337.96	2.46	51.46	44.46	241.46	33.96	51.46	0.96
Coprostanol/ Total Sterol	0.12	0.00	0.31	0.00	0.74	0.75	0.06	0.14	0.15	0.00
Coprostanol/ Cholesterol	0.26	0.00	0.25	0.00	2.47	0.11	0.08	0.11	0.09	1.75

Sample	ET2S1	ET2S2	ET2S3	ET2S4	ET2S5	ET2S6	ET2S7	ET2S8	ET2S9	ET2S10
Coprostanol	13.92	1.42	46.42	BDL	BDL	BDL	26.92	10.42	17.92	5.92
Cholesterol	100.67	4.67	281.17	0.67	4.67	BDL	208.67	59.17	255.67	274.67
Cholestanol	112.46	8.96	154.46	3.46	0.96	BDL	85.46	2.46	8.96	9.96
Coprostanol/ Total Sterol	0.11	0.14	0.23	0.00	0.00	0.52	0.24	0.81	0.67	0.37
Coprostanol/ Cholesterol	0.14	0.30	0.17	0.00	0.00	0.70	0.13	0.18	0.07	0.02

Sample	ET3S1	ET3S2	ET3S3	ET3S4	ET3S5	ET3S6	ET3S7	ET3S8	ET3S9	ET3S10
Coprostanol	BDL	5.42	BDL	BDL	6.92	33.92	10.42	BDL	14.92	18.92
Cholesterol	BDL	10.17	14.67	8.17	53.67	197.67	45.17	0.67	116.17	152.17
Cholestanol	BDL	25.96	0.46	0.46	1.96	7.46	1.46	1.46	3.96	71.96
Coprostanol/ Total Sterol	0.67	0.17	0.00	4.67	0.78	0.82	0.88	0.00	0.79	0.21
Coprostanol/ Cholesterol	1.30	0.53	0.00	0.00	0.13	0.17	0.23	0.00	0.13	0.12

Sample	ET4S1	ET4S2	ET4S3	ET4S4	ET4S5	ET4S6	ET4S7	ET4S8	ET4S9	ET4S10
Coprostanol	721.92	BDL	16.92	7.42	37.92	68.42	13.92	48.92	39.92	21.92
Cholesterol	1334.67	BDL	113.67	75.67	156.17	315.67	77.17	165.17	347.67	205.67
Cholestanol	430.96	BDL	62.96	23.46	99.96	303.46	53.96	158.96	139.46	80.46
Coprostanol/ Total Sterol	0.63	0.67	0.21	0.24	0.28	0.18	0.21	0.24	0.22	0.21
Coprostanol/ Cholesterol	0.54	0.81	0.15	0.10	0.24	0.22	0.18	0.30	0.11	0.11

Appendix B (Continued)

Sample	ET5S1	ET5S2	ET5S3	ET5S4	ET5S5	ET5S6	ET5S7	ET5S8	ET5S9	ET5S10
Coprostanol	24.92	92.92	48.42	22.92	48.92	9.42	0.42	13.42	7.92	48.42
Cholesterol	255.17	430.17	182.67	93.17	598.17	56.67	3.67	110.67	154.17	341.67
Cholestanol	102.96	273.46	132.96	75.96	158.96	26.46	1.46	54.96	16.96	192.96
Coprostanol/ Total Sterol	0.19	0.25	0.27	0.23	0.24	0.26	0.22	0.20	0.32	0.20
Coprostanol/ Cholesterol	0.10	0.22	0.27	0.25	0.08	0.17	0.11	0.12	0.05	0.14

Sample	ET6S1	ET6S2	ET6S3	ET6S4	ET6S5	ET6S6	ET6S7	ET6S8	ET6S9	ET6S10
Coprostanol	106.42	13.42	153.42	173.42	BDL	55.92	285.92	25.42	17.92	1.92
Cholesterol	224.67	123.67	1308.17	778.67	BDL	540.17	2773.17	187.67	197.67	166.67
Cholestanol	262.96	65.46	460.46	1450.96	0.46	254.46	904.96	73.96	67.46	25.46
Coprostanol/ Total Sterol	0.29	0.17	0.25	0.11	4.67	0.18	0.24	0.26	0.21	0.07
Coprostanol/ Cholesterol	0.47	0.11	0.12	0.22	1.75	0.10	0.10	0.14	0.09	0.01

Sample	ET7S1	ET7S2	ET7S3	ET7S4	ET7S5	ET7S6	ET7S7	ET7S8	ET7S9	ET7S10
Coprostanol	111.92	21.92	32.92	72.92	22.42	126.42	28.92	28.42	23.92	53.92
Cholesterol	204.17	214.17	317.67	584.17	283.67	769.67	284.17	254.17	263.67	874.17
Cholestanol	262.96	78.96	116.96	268.46	127.46	447.46	90.96	102.46	80.96	172.46
Coprostanol/ Total Sterol	0.30	0.22	0.22	0.21	0.15	0.22	0.24	0.22	0.23	0.24
Coprostanol/ Cholesterol	0.55	0.10	0.10	0.12	0.08	0.16	0.10	0.11	0.09	0.06

Sample	ET8S1	ET8S2	ET8S3	ET8S4	ET8S5	ET8S6	ET8S7	ET8S8	ET8S9	ET8S10
Coprostanol	113.92	156.42	53.42	25.92	99.42	29.92	66.92	10.42	18.92	41.42
Cholesterol	6.17	641.67	305.17	236.17	840.67	186.67	1841.17	234.67	548.67	398.67
Cholestanol	5.96	688.96	221.46	63.46	360.46	87.46	270.46	45.46	84.46	177.96
Coprostanol/ Total Sterol	0.95	0.19	0.19	0.29	0.22	0.25	0.20	0.19	0.18	0.19
Coprostanol/ Cholesterol	18.47	0.24	0.18	0.11	0.12	0.16	0.04	0.04	0.03	0.10

Sample	ET9S1	ET9S2	ET9S3	ET9S4	ET9S5	ET9S6	ET9S7	ET9S8	ET9S9	ET9S10
Coprostanol	180.42	80.42	2.92	406.92	9.92	52.92	7.42	7.42	24.92	8.92
Cholesterol	174.17	290.67	12.67	273.67	113.67	457.17	265.67	385.67	419.67	301.17
Cholestanol	85.46	144.46	10.46	267.96	41.46	194.46	30.96	38.96	120.46	35.46
Coprostanol/ Total Sterol	0.68	0.36	0.22	0.60	0.19	0.21	0.19	0.16	0.17	0.20
Coprostanol/ Cholesterol	1.04	0.28	0.23	1.49	0.09	0.12	0.03	0.02	0.06	0.03

Appendix B (Continued)

Sample	**ET10S1**	**ET10S2**	**ET10S3**	**ET10S4**	**ET10S5**	**ET10S6**	**ET10S7**	**ET10S8**	**ET10S9**	**ET10S10**
Coprostanol	184.42	7.42	19.92	19.42	74.92	8.42	18.92	3.42	3.92	BDL
Cholesterol	105.17	77.17	89.67	111.17	325.67	68.17	264.17	380.67	139.67	50.67
Cholestanol	56.96	50.96	59.96	64.96	166.46	34.96	65.46	37.96	21.46	11.46
Coprostanol/ Total Sterol	0.76	0.13	0.25	0.23	0.31	0.19	0.22	0.08	0.15	0.00
Coprostanol/ Cholesterol	1.75	0.10	0.22	0.17	0.23	0.12	0.07	0.01	0.03	0.00

Sample	**WT1S1**	**WT1S2**	**WT1S3**	**WT1S4**	**WT1S5**	**WT2S1**	**WT2S2**	**WT2S3**	**WT2S4**	**WT2S5**
Coprostanol	216.92	57.92	49.92	116.92	182.42	37.42	6.42	13.42	27.92	22.92
Cholesterol	847.17	332.67	266.17	555.17	1894.17	186.67	25.67	94.67	222.67	156.17
Cholestanol	577.96	243.96	204.96	299.96	563.96	139.46	16.96	59.96	106.46	99.96
Coprostanol/ Total Sterol	0.27	0.19	0.20	0.28	0.24	0.21	0.27	0.18	0.21	0.19
Coprostanol/ Cholesterol	0.26	0.17	0.19	0.21	0.10	0.20	0.25	0.14	0.13	0.15

Sample	**WT3S1**	**WT3S2**	**WT3S3**	**WT3S4**	**WT3S5**	**WT4S1**	**WT4S2**	**WT4S3**	**WT4S4**	**WT4S5**
Coprostanol	660.42	156.92	45.92	50.92	97.92	13.92	37.92	37.42	10.92	49.42
Cholesterol	1050.67	572.17	234.17	186.17	474.67	56.17	190.17	190.17	33.67	309.67
Cholestanol	878.96	332.46	143.46	189.96	316.96	47.96	118.96	132.46	23.96	184.96
Coprostanol/ Total Sterol	0.43	0.32	0.24	0.21	0.24	0.22	0.24	0.22	0.31	0.21
Coprostanol/ Cholesterol	0.63	0.27	0.20	0.27	0.21	0.25	0.20	0.20	0.32	0.16

Sample	**WT5S1**	**WT5S2D**	**WT5S3**	**WT5S4**	**WT5S5**
Coprostanol	81.42	54.42	21.42	16.92	6.42
Cholesterol	163.67	333.17	141.17	108.17	38.67
Cholestanol	207.96	186.96	85.46	58.46	23.46
Coprostanol/ Total Sterol	0.28	0.23	0.20	0.22	0.21
Coprostanol/ Cholesterol	0.50	0.16	0.15	0.16	0.17

Appendix C: Weight Percent Data (Grain Size)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
13-Jul-13	T1S1	50.400	55.600	5.200	54.500	4.100	1.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.100	0.200		3.85%	3.85%	96.15%
18	91.100	91.700	0.600		11.54%	15.38%	84.62%
35	93.400	94.300	0.900		17.31%	32.69%	67.31%
60	87.200	88.100	0.900		17.31%	50.00%	50.00%
120	86.200	87.000	0.800		15.38%	65.38%	34.62%
230	85.700	86.200	0.500		9.62%	75.00%	25.00%
PAN	63.300	63.300	1.100		21.15%	96.15%	3.85%
		T. Mass (Mt)=	**5.00**	**Total %=**	**96.15%**		
		%Error =	**-3.85%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
13-Jul-13	T1S2	29.800	33.800	4.000	33.400	3.600	0.400
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		2.50%	2.50%	97.50%
18	91.100	91.500	0.400		10.00%	12.50%	87.50%
35	93.400	94.200	0.800		20.00%	32.50%	67.50%
60	87.200	88.000	0.800		20.00%	52.50%	47.50%
120	86.200	87.000	0.800		20.00%	72.50%	27.50%
230	85.700	86.300	0.600		15.00%	87.50%	12.50%
PAN	63.300	63.400	0.500		12.50%	100.00%	0.00%
		T. Mass (Mt)=	**4.00**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
13-Jul-13	T1S3	29.700	33.000	3.300	32.900	3.200	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		3.03%	3.03%	96.97%
18	91.100	91.500	0.400		12.12%	15.15%	84.85%
35	93.400	94.500	1.100		33.33%	48.48%	51.52%
60	87.200	88.100	0.900		27.27%	75.76%	24.24%
120	86.200	86.500	0.300		9.09%	84.85%	15.15%
230	85.700	86.000	0.300		9.09%	93.94%	6.06%
PAN	63.300	63.300	0.100		3.03%	96.97%	3.03%
		T. Mass (Mt)=	**3.20**	**Total %=**	**96.97%**		
		%Error =	**-3.03%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T1S4	28.900	34.100	5.200	34.100	5.200	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.100	91.300	0.200		3.85%	3.85%	96.15%
35	93.400	94.500	1.100		21.15%	25.00%	75.00%
60	87.200	88.700	1.500		28.85%	53.85%	46.15%
120	86.200	87.700	1.500		28.85%	82.69%	17.31%
230	85.700	86.200	0.500		9.62%	92.31%	7.69%
PAN	63.300	63.300	0.000		0.00%	92.31%	7.69%
		T. Mass (Mt)=	**4.80**	**Total %=**	**92.31%**		
		%Error =	**-7.69%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T1S5	49.800	54.800	5.000	54.400	4.600	0.400
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.100	91.200	0.100		2.00%	2.00%	98.00%
35	93.400	94.300	0.900		18.00%	20.00%	80.00%
60	87.200	88.600	1.400		28.00%	48.00%	52.00%
120	86.200	87.600	1.400		28.00%	76.00%	24.00%
230	85.700	86.400	0.700		14.00%	90.00%	10.00%
PAN	63.300	63.300	0.400		8.00%	98.00%	2.00%
		T. Mass (Mt)=	**4.90**	**Total %=**	**98.00%**		
		%Error =	**-2.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T1S6	50.700	55.700	5.000	55.200	4.500	0.500
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.200	0.300		6.00%	6.00%	94.00%
18	91.100	91.400	0.300		6.00%	12.00%	88.00%
35	93.400	94.300	0.900		18.00%	30.00%	70.00%
60	87.200	88.500	1.300		26.00%	56.00%	44.00%
120	86.200	87.300	1.100		22.00%	78.00%	22.00%
230	85.700	86.200	0.500		10.00%	88.00%	12.00%
PAN	63.300	63.300	0.500		10.00%	98.00%	2.00%
		T. Mass (Mt)=	**4.90**	**Total %=**	**98.00%**		
		%Error =	**-2.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T1S7	49.400	54.400	5.000	53.900	4.500	0.500
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.100	91.300	0.200		4.00%	4.00%	96.00%
35	93.400	94.100	0.700		14.00%	18.00%	82.00%
60	87.200	88.700	1.500		30.00%	48.00%	52.00%
120	86.200	87.500	1.300		26.00%	74.00%	26.00%
230	85.700	86.400	0.700		14.00%	88.00%	12.00%
PAN	63.300	63.300	0.500		10.00%	98.00%	2.00%
		T. Mass (Mt)=	**4.90**	**Total %=**	**98.00%**		
		%Error =	**-2.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T1S8	56.000	61.100	5.100	60.700	4.700	0.400
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.400	0.500		9.80%	9.80%	90.20%
18	91.100	91.700	0.600		11.76%	21.57%	78.43%
35	93.400	94.500	1.100		21.57%	43.14%	56.86%
60	87.200	88.300	1.100		21.57%	64.71%	35.29%
120	86.200	86.900	0.700		13.73%	78.43%	21.57%
230	85.700	86.200	0.500		9.80%	88.24%	11.76%
PAN	63.300	63.300	0.400		7.84%	96.08%	3.92%
		T. Mass (Mt)=	**4.90**	**Total %=**	**96.08%**		
		%Error =	**-3.92%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T1S9	50.700	55.700	5.000	55.200	4.500	0.500
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.100	91.200	0.100		2.00%	2.00%	98.00%
35	93.400	94.100	0.700		14.00%	16.00%	84.00%
60	87.200	88.800	1.600		32.00%	48.00%	52.00%
120	86.200	87.600	1.400		28.00%	76.00%	24.00%
230	85.700	86.300	0.600		12.00%	88.00%	12.00%
PAN	63.300	63.300	0.500		10.00%	98.00%	2.00%
		T. Mass (Mt)=	**4.90**	**Total %=**	**98.00%**		
		%Error =	**-2.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T1S10	29.700	34.700	5.000	33.900	4.200	0.800
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		4.00%	4.00%	96.00%
18	91.100	91.300	0.200		4.00%	8.00%	92.00%
35	93.400	94.100	0.700		14.00%	22.00%	78.00%
60	87.200	88.500	1.300		26.00%	48.00%	52.00%
120	86.300	86.900	0.600		12.00%	60.00%	40.00%
230	85.700	86.800	1.100		22.00%	82.00%	18.00%
PAN	63.300	63.300	0.800		16.00%	98.00%	2.00%
		T. Mass (Mt)=	**4.90**	**Total %=**	**98.00%**		
		%Error =	**-2.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
13-Jul-13	T2S1	50.500	55.500	5.000	55.100	4.600	0.400
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		1.92%	1.92%	98.08%
18	91.000	91.300	0.300		5.77%	7.69%	92.31%
35	93.300	94.400	1.100		21.15%	28.85%	71.15%
60	87.200	88.800	1.600		30.77%	59.62%	40.38%
120	86.200	87.600	1.400		26.92%	86.54%	13.46%
230	85.700	85.900	0.200		3.85%	90.38%	9.62%
PAN	63.300	63.300	0.400		7.69%	98.08%	1.92%
		T. Mass (Mt)=	**5.10**	**Total %=**	**98.08%**		
		%Error =	**2.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
13-Jul-13	T2S2	49.600	54.600	5.000	54.600	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.000	91.200	0.200		5.00%	5.00%	95.00%
35	93.300	94.500	1.200		30.00%	35.00%	65.00%
60	87.200	89.300	2.100		52.50%	87.50%	12.50%
120	86.200	87.600	1.400		35.00%	122.50%	-22.50%
230	85.700	85.800	0.100		2.50%	125.00%	-25.00%
PAN	63.300	63.300	0.000		0.00%	125.00%	-25.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**125.00%**		
		%Error =	**0.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
13-Jul-13	T2S3	50.400	55.400	5.000	55.300	4.900	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.000	91.300	0.300		9.09%	9.09%	90.91%
35	93.300	94.700	1.400		42.42%	51.52%	48.48%
60	87.200	89.400	2.200		66.67%	118.18%	-18.18%
120	86.200	86.900	0.700		21.21%	139.39%	-39.39%
230	85.700	86.000	0.300		9.09%	148.48%	-48.48%
PAN	63.300	63.300	0.100		3.03%	151.52%	-51.52%
		T. Mass (Mt)=	**5.00**	**Total %=**	**151.52%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
13-Jul-13	T2S4	50.700	55.700	5.000	55.700	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		1.92%	1.92%	98.08%
18	91.000	91.400	0.400		7.69%	9.62%	90.38%
35	93.300	95.200	1.900		36.54%	46.15%	53.85%
60	87.200	89.000	1.800		34.62%	80.77%	19.23%
120	86.200	86.900	0.700		13.46%	94.23%	5.77%
230	85.700	85.800	0.100		1.92%	96.15%	3.85%
PAN	63.300	63.300	0.000		0.00%	96.15%	3.85%
		T. Mass (Mt)=	**5.00**	**Total %=**	**96.15%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
13-Jul-13	T2S5	50.200	55.400	5.200	55.200	5.000	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		2.00%	2.00%	98.00%
18	91.000	91.700	0.700		14.00%	16.00%	84.00%
35	93.300	94.900	1.600		32.00%	48.00%	52.00%
60	87.200	88.400	1.200		24.00%	72.00%	28.00%
120	86.200	87.100	0.900		18.00%	90.00%	10.00%
230	85.700	86.100	0.400		8.00%	98.00%	2.00%
PAN	63.300	63.300	0.200		4.00%	102.00%	-2.00%
		T. Mass (Mt)=	**5.10**	**Total %=**	**102.00%**		
		%Error =	**-1.92%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
13-Jul-13	T2S6	50.200	55.400	5.200	55.200	5.000	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.200	0.400		8.00%	8.00%	92.00%
18	91.000	91.500	0.500		10.00%	18.00%	82.00%
35	93.300	94.400	1.100		22.00%	40.00%	60.00%
60	87.200	88.700	1.500		30.00%	70.00%	30.00%
120	86.200	87.000	0.800		16.00%	86.00%	14.00%
230	85.700	86.200	0.500		10.00%	96.00%	4.00%
PAN	63.300	63.300	0.200		4.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**-3.85%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T2S7	50.100	55.300	5.200	55.100	5.000	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		2.00%	2.00%	98.00%
18	91.000	91.200	0.200		4.00%	6.00%	94.00%
35	93.300	94.000	0.700		14.00%	20.00%	80.00%
60	87.200	89.000	1.800		36.00%	56.00%	44.00%
120	86.200	88.300	2.100		42.00%	98.00%	2.00%
230	85.700	86.000	0.300		6.00%	104.00%	-4.00%
PAN	63.300	63.300	0.200		4.00%	108.00%	-8.00%
		T. Mass (Mt)=	**5.40**	**Total %=**	**108.00%**		
		%Error =	**3.85%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T2S8	50.700	55.700	5.000	55.600	4.900	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		1.96%	1.96%	98.04%
18	91.000	91.300	0.300		5.88%	7.84%	92.16%
35	93.300	94.600	1.300		25.49%	33.33%	66.67%
60	87.200	89.300	2.100		41.18%	74.51%	25.49%
120	86.200	87.100	0.900		17.65%	92.16%	7.84%
230	85.700	85.900	0.200		3.92%	96.08%	3.92%
PAN	63.300	63.300	0.100		1.96%	98.04%	1.96%
		T. Mass (Mt)=	**5.00**	**Total %=**	**98.04%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
15-Jul-13	T2S9	49.400	54.500	5.100	54.200	4.800	0.300
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		2.00%	2.00%	98.00%
18	91.000	91.400	0.400		8.00%	10.00%	90.00%
35	93.300	94.200	0.900		18.00%	28.00%	72.00%
60	87.200	89.000	1.800		36.00%	64.00%	36.00%
120	86.200	87.200	1.000		20.00%	84.00%	16.00%
230	85.700	86.100	0.400		8.00%	92.00%	8.00%
PAN	63.300	63.300	0.300		6.00%	98.00%	2.00%
		T. Mass (Mt)=	**4.90**	**Total %=**	**98.00%**		
		%Error =	**-3.92%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
15-Jul-13	T2S10	50.400	55.400	5.000	55.400	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.000	91.100	0.100		2.00%	2.00%	98.00%
35	93.300	93.600	0.300		6.00%	8.00%	92.00%
60	87.200	88.100	0.900		18.00%	26.00%	74.00%
120	86.200	88.300	2.100		42.00%	68.00%	32.00%
230	85.700	87.200	1.500		30.00%	98.00%	2.00%
PAN	63.300	63.300	0.000		0.00%	98.00%	2.00%
		T. Mass (Mt)=	**4.90**	**Total %=**	**98.00%**		
		%Error =	**-2.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T3S1	50.400	55.600	5.200	55.400	5.000	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		1.92%	1.92%	98.08%
18	91.000	91.500	0.500		9.62%	11.54%	88.46%
35	93.400	94.800	1.400		26.92%	38.46%	61.54%
60	87.100	88.800	1.700		32.69%	71.15%	28.85%
120	86.200	87.000	0.800		15.38%	86.54%	13.46%
230	85.700	86.100	0.400		7.69%	94.23%	5.77%
PAN	63.300	63.300	0.200		3.85%	98.08%	1.92%
		T. Mass (Mt)=	**5.10**	**Total %=**	**98.08%**		
		%Error =	**-1.92%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T3S2	49.600	54.600	5.000	54.500	4.900	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.100	91.300	0.200		5.00%	5.00%	95.00%
35	93.400	94.500	1.100		27.50%	32.50%	67.50%
60	87.100	89.000	1.900		47.50%	80.00%	20.00%
120	86.200	87.300	1.100		27.50%	107.50%	-7.50%
230	85.700	86.200	0.500		12.50%	120.00%	-20.00%
PAN	63.300	63.300	0.100		2.50%	122.50%	-22.50%
		T. Mass (Mt)=	**4.90**	**Total %=**	**122.50%**		
		%Error =	**-2.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T3S3	50.700	55.700	5.000	55.700	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		3.03%	3.03%	96.97%
18	91.100	91.500	0.400		12.12%	15.15%	84.85%
35	93.400	94.900	1.500		45.45%	60.61%	39.39%
60	87.100	88.800	1.700		51.52%	112.12%	-12.12%
120	86.200	87.300	1.100		33.33%	145.45%	-45.45%
230	85.700	85.900	0.200		6.06%	151.52%	-51.52%
PAN	63.300	63.300	0.000		0.00%	151.52%	-51.52%
		T. Mass (Mt)=	**5.00**	**Total %=**	**151.52%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T3S4	50.500	55.800	5.300	55.800	5.300	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		1.92%	1.92%	98.08%
18	91.100	91.400	0.300		5.77%	7.69%	92.31%
35	93.400	94.800	1.400		26.92%	34.62%	65.38%
60	87.100	89.500	2.400		46.15%	80.77%	19.23%
120	86.200	86.900	0.700		13.46%	94.23%	5.77%
230	85.700	86.000	0.300		5.77%	100.00%	0.00%
PAN	63.300	63.300	0.000		0.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.20**	**Total %=**	**100.00%**		
		%Error =	**-1.89%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T3S5	50.200	55.300	5.100	55.000	4.800	0.300
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		2.00%	2.00%	98.00%
18	91.100	91.700	0.600		12.00%	14.00%	86.00%
35	93.400	95.500	2.100		42.00%	56.00%	44.00%
60	87.100	88.600	1.500		30.00%	86.00%	14.00%
120	86.200	86.500	0.300		6.00%	92.00%	8.00%
230	85.700	85.900	0.200		4.00%	96.00%	4.00%
PAN	63.300	63.300	0.300		6.00%	102.00%	-2.00%
		T. Mass (Mt)=	**5.10**	**Total %=**	**102.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T3S6	50.200	55.600	5.400	55.500	5.300	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		2.00%	2.00%	98.00%
18	91.100	91.300	0.200		4.00%	6.00%	94.00%
35	93.400	94.700	1.300		26.00%	32.00%	68.00%
60	87.100	89.600	2.500		50.00%	82.00%	18.00%
120	86.200	87.300	1.100		22.00%	104.00%	-4.00%
230	85.700	85.900	0.200		4.00%	108.00%	-8.00%
PAN	63.300	63.300	0.100		2.00%	110.00%	-10.00%
		T. Mass (Mt)=	**5.50**	**Total %=**	**110.00%**		
		%Error =	**1.85%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T3S7	50.400	55.500	5.100	55.400	5.000	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.100	91.200	0.100		2.00%	2.00%	98.00%
35	93.400	94.700	1.300		26.00%	28.00%	72.00%
60	87.100	89.500	2.400		48.00%	76.00%	24.00%
120	86.200	87.300	1.100		22.00%	98.00%	2.00%
230	85.700	85.800	0.100		2.00%	100.00%	0.00%
PAN	63.300	63.300	0.100		2.00%	102.00%	-2.00%
		T. Mass (Mt)=	**5.10**	**Total %=**	**102.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T3S8	50.400	55.700	5.300	55.600	5.200	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.100	91.300	0.200		3.92%	3.92%	96.08%
35	93.400	94.600	1.200		23.53%	27.45%	72.55%
60	87.100	89.700	2.600		50.98%	78.43%	21.57%
120	86.200	87.100	0.900		17.65%	96.08%	3.92%
230	85.600	85.800	0.200		3.92%	100.00%	0.00%
PAN	63.300	63.300	0.100		1.96%	101.96%	-1.96%
		T. Mass (Mt)=	**5.20**	**Total %=**	**101.96%**		
		%Error =	**-1.89%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T3S9	50.000	55.000	5.000	54.600	4.600	0.400
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		4.00%	4.00%	96.00%
18	91.100	91.500	0.400		8.00%	12.00%	88.00%
35	93.400	94.900	1.500		30.00%	42.00%	58.00%
60	87.100	88.500	1.400		28.00%	70.00%	30.00%
120	86.200	86.700	0.500		10.00%	80.00%	20.00%
230	85.700	86.300	0.600		12.00%	92.00%	8.00%
PAN	63.300	63.300	0.400		8.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
	T3S10	25.200	30.500	5.300	30.400	5.200	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.100	91.400	0.300		6.00%	6.00%	94.00%
35	93.400	94.600	1.200		24.00%	30.00%	70.00%
60	87.100	88.700	1.600		32.00%	62.00%	38.00%
120	86.200	87.600	1.400		28.00%	90.00%	10.00%
230	85.700	86.400	0.700		14.00%	104.00%	-4.00%
PAN	63.300	63.300	0.100		2.00%	106.00%	-6.00%
			5.30	**Total %=**	**106.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T4S1	28.500	33.500	5.000	33.500	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		3.85%	3.85%	96.15%
18	91.000	91.600	0.600		11.54%	15.38%	84.62%
35	93.400	94.500	1.100		21.15%	36.54%	63.46%
60	87.200	88.700	1.500		28.85%	65.38%	34.62%
120	85.600	87.200	1.600		30.77%	96.15%	3.85%
230	86.200	86.200	0.000		0.00%	96.15%	3.85%
PAN	63.200	63.200	0.000		0.00%	96.15%	3.85%
		T. Mass (Mt)=	**5.00**	**Total %=**	**96.15%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T4S2	30.000	35.500	5.500	35.500	5.500	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.000	91.500	0.500		12.50%	12.50%	87.50%
35	93.400	94.500	1.100		27.50%	40.00%	60.00%
60	87.200	88.800	1.600		40.00%	80.00%	20.00%
120	85.600	87.900	2.300		57.50%	137.50%	-37.50%
230	86.200	86.200	0.000		0.00%	137.50%	-37.50%
PAN	63.300	63.300	0.000		0.00%	137.50%	-37.50%
		T. Mass (Mt)=	**5.50**	**Total %=**	**137.50%**		
		%Error =	**0.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T4S3	29.600	34.600	5.000	34.600	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.000	91.400	0.400		12.12%	12.12%	87.88%
35	93.400	94.800	1.400		42.42%	54.55%	45.45%
60	87.200	88.800	1.600		48.48%	103.03%	-3.03%
120	85.600	87.000	1.400		42.42%	145.45%	-45.45%
230	86.200	86.300	0.100		3.03%	148.48%	-48.48%
PAN	63.300	63.300	0.000		0.00%	148.48%	-48.48%
		T. Mass (Mt)=	**4.90**	**Total %=**	**148.48%**		
		%Error =	**-2.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T4S4	28.200	33.200	5.000	33.200	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.000	91.200	0.200		3.85%	3.85%	96.15%
35	93.400	94.100	0.700		13.46%	17.31%	82.69%
60	87.200	89.200	2.000		38.46%	55.77%	44.23%
120	85.600	87.700	2.100		40.38%	96.15%	3.85%
230	86.200	86.200	0.000		0.00%	96.15%	3.85%
PAN	63.300	63.300	0.000		0.00%	96.15%	3.85%
		T. Mass (Mt)=	**5.00**	**Total %=**	**96.15%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T4S5	28.400	33.400	5.000	33.300	4.900	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.000	91.200	0.200		4.00%	4.00%	96.00%
35	93.400	94.400	1.000		20.00%	24.00%	76.00%
60	87.200	89.200	2.000		40.00%	64.00%	36.00%
120	85.600	87.300	1.700		34.00%	98.00%	2.00%
230	86.200	86.200	0.000		0.00%	98.00%	2.00%
PAN	63.300	63.300	0.100		2.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T4S6	29.600	34.600	5.000	33.200	3.600	1.400
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.000	91.200	0.200		4.00%	4.00%	96.00%
35	93.400	94.500	1.100		22.00%	26.00%	74.00%
60	87.200	88.700	1.500		30.00%	56.00%	44.00%
120	85.600	86.400	0.800		16.00%	72.00%	28.00%
230	86.200	86.200	0.000		0.00%	72.00%	28.00%
PAN	63.300	63.300	1.400		28.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T4S7	28.600	33.600	5.000	33.500	4.900	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		2.00%	2.00%	98.00%
18	91.000	91.200	0.200		4.00%	6.00%	94.00%
35	93.400	94.600	1.200		24.00%	30.00%	70.00%
60	87.200	89.200	2.000		40.00%	70.00%	30.00%
120	85.600	87.000	1.400		28.00%	98.00%	2.00%
230	86.200	86.200	0.000		0.00%	98.00%	2.00%
PAN	63.300	63.300	0.100		2.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T4S8	28.300	33.300	5.000	32.800	4.500	0.500
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.000	91.300	0.300		5.88%	5.88%	94.12%
35	93.400	94.700	1.300		25.49%	31.37%	68.63%
60	87.200	89.300	2.100		41.18%	72.55%	27.45%
120	85.600	86.400	0.800		15.69%	88.24%	11.76%
230	86.200	86.200	0.000		0.00%	88.24%	11.76%
PAN	63.300	63.300	0.500		9.80%	98.04%	1.96%
		T. Mass (Mt)=	**5.00**	**Total %=**	**98.04%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T4S9	30.000	35.000	5.000	35.000	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		4.00%	4.00%	96.00%
18	91.000	91.600	0.600		12.00%	16.00%	84.00%
35	93.400	95.200	1.800		36.00%	52.00%	48.00%
60	87.200	88.900	1.700		34.00%	86.00%	14.00%
120	85.600	86.300	0.700		14.00%	100.00%	0.00%
230	86.200	86.200	0.000		0.00%	100.00%	0.00%
PAN	63.300	63.300	0.000		0.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T4S10	28.600	33.600	5.000	33.500	4.900	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		4.00%	4.00%	96.00%
18	91.000	91.600	0.600		12.00%	16.00%	84.00%
35	93.400	95.100	1.700		34.00%	50.00%	50.00%
60	87.200	88.500	1.300		26.00%	76.00%	24.00%
120	85.600	86.700	1.100		22.00%	98.00%	2.00%
230	86.200	86.200	0.000		0.00%	98.00%	2.00%
PAN	63.300	63.300	0.100		2.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T5S1	29.600	34.600	5.000	34.600	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.100	0.300		5.77%	5.77%	94.23%
18	91.000	91.600	0.600		11.54%	17.31%	82.69%
35	93.400	94.800	1.400		26.92%	44.23%	55.77%
60	87.100	89.100	2.000		38.46%	82.69%	17.31%
120	85.700	86.400	0.700		13.46%	96.15%	3.85%
230	86.200	86.200	0.000		0.00%	96.15%	3.85%
PAN	63.300	63.300	0.000		0.00%	96.15%	3.85%
		T. Mass (Mt)=	**5.00**	**Total %=**	**96.15%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T5S2	29.400	34.400	5.000	34.300	4.900	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.000	91.400	0.400		10.00%	10.00%	90.00%
35	93.400	94.700	1.300		32.50%	42.50%	57.50%
60	87.100	88.900	1.800		45.00%	87.50%	12.50%
120	85.700	87.100	1.400		35.00%	122.50%	-22.50%
230	86.200	86.200	0.000		0.00%	122.50%	-22.50%
PAN	63.300	63.300	0.100		2.50%	125.00%	-25.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**125.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T5S3	28.300	33.300	5.000	33.300	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.000	91.300	0.300		9.09%	9.09%	90.91%
35	93.400	94.600	1.200		36.36%	45.45%	54.55%
60	87.100	89.100	2.000		60.61%	106.06%	-6.06%
120	85.700	87.100	1.400		42.42%	148.48%	-48.48%
230	86.200	86.200	0.000		0.00%	148.48%	-48.48%
PAN	63.300	63.300	0.000		0.00%	148.48%	-48.48%
		T. Mass (Mt)=	**4.90**	**Total %=**	**148.48%**		
		%Error =	**-2.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T5S4	28.600	33.600	5.000	33.600	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		1.92%	1.92%	98.08%
18	91.000	91.500	0.500		9.62%	11.54%	88.46%
35	93.400	94.200	0.800		15.38%	26.92%	73.08%
60	87.100	88.500	1.400		26.92%	53.85%	46.15%
120	85.700	87.800	2.100		40.38%	94.23%	5.77%
230	86.200	86.300	0.100		1.92%	96.15%	3.85%
PAN	63.300	63.300	0.000		0.00%	96.15%	3.85%
		T. Mass (Mt)=	**5.00**	**Total %=**	**96.15%**		
		%Error =	**0.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T5S5	28.700	33.700	5.000	33.500	4.800	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	104.100	1.300		26.00%	26.00%	74.00%
18	91.000	91.700	0.700		14.00%	40.00%	60.00%
35	93.400	94.200	0.800		16.00%	56.00%	44.00%
60	87.100	87.900	0.800		16.00%	72.00%	28.00%
120	85.700	86.900	1.200		24.00%	96.00%	4.00%
230	86.200	86.200	0.000		0.00%	96.00%	4.00%
PAN	63.300	63.300	0.200		4.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T5S6	29.700	34.700	5.000	34.500	4.800	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.000	91.200	0.200		4.00%	4.00%	96.00%
35	93.400	94.400	1.000		20.00%	24.00%	76.00%
60	87.100	88.900	1.800		36.00%	60.00%	40.00%
120	85.700	87.500	1.800		36.00%	96.00%	4.00%
230	86.200	86.200	0.000		0.00%	96.00%	4.00%
PAN	63.300	63.300	0.200		4.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T5S7	29.600	34.600	5.000	34.400	4.800	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.800	1.000		20.00%	20.00%	80.00%
18	91.000	91.900	0.900		18.00%	38.00%	62.00%
35	93.400	94.600	1.200		24.00%	62.00%	38.00%
60	87.200	88.000	0.800		16.00%	78.00%	22.00%
120	85.700	86.500	0.800		16.00%	94.00%	6.00%
230	86.200	86.200	0.000		0.00%	94.00%	6.00%
PAN	63.300	63.300	0.200		4.00%	98.00%	2.00%
		T. Mass (Mt)=	**4.90**	**Total %=**	**98.00%**		
		%Error =	**-2.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T5S8	25.200	30.200	5.000	29.800	4.600	0.400
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		1.96%	1.96%	98.04%
18	91.000	91.200	0.200		3.92%	5.88%	94.12%
35	93.400	94.200	0.800		15.69%	21.57%	78.43%
60	87.100	88.900	1.800		35.29%	56.86%	43.14%
120	85.700	87.300	1.600		31.37%	88.24%	11.76%
230	86.200	86.200	0.000		0.00%	88.24%	11.76%
PAN	63.300	63.300	0.400		7.84%	96.08%	3.92%
		T. Mass (Mt)=	**4.90**	**Total %=**	**96.08%**		
		%Error =	**-2.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T5S9	29.400	34.400	5.000	34.400	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.000	91.400	0.400		8.00%	8.00%	92.00%
35	93.400	94.700	1.300		26.00%	34.00%	66.00%
60	87.100	89.000	1.900		38.00%	72.00%	28.00%
120	85.700	87.100	1.400		28.00%	100.00%	0.00%
230	86.200	86.200	0.000		0.00%	100.00%	0.00%
PAN	63.300	63.300	0.000		0.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
26-Dec-13	T5S10	28.600	33.600	5.000	33.600	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		4.00%	4.00%	96.00%
18	91.000	91.500	0.500		10.00%	14.00%	86.00%
35	93.400	94.700	1.300		26.00%	40.00%	60.00%
60	87.100	89.300	2.200		44.00%	84.00%	16.00%
120	85.700	86.500	0.800		16.00%	100.00%	0.00%
230	86.200	86.200	0.000		0.00%	100.00%	0.00%
PAN	63.300	63.300	0.000		0.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T6S1	28.500	33.600	5.100	33.300	4.800	0.300
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		3.85%	3.85%	96.15%
18	91.000	91.600	0.600		11.54%	15.38%	84.62%
35	93.400	94.400	1.000		19.23%	34.62%	65.38%
60	87.200	88.500	1.300		25.00%	59.62%	40.38%
120	85.600	87.000	1.400		26.92%	86.54%	13.46%
230	86.200	86.300	0.100		1.92%	88.46%	11.54%
PAN	63.300	63.300	0.300		5.77%	94.23%	5.77%
		T. Mass (Mt)=	**4.90**	**Total %=**	**94.23%**		
		%Error =	**-3.92%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T6S2	29.200	34.300	5.100	34.300	5.100	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.800	0.000		0.00%	0.00%	100.00%
18	91.000	91.200	0.200		5.00%	5.00%	95.00%
35	93.400	94.300	0.900		22.50%	27.50%	72.50%
60	87.200	88.900	1.700		42.50%	70.00%	30.00%
120	85.600	87.800	2.200		55.00%	125.00%	-25.00%
230	86.200	86.200	0.000		0.00%	125.00%	-25.00%
PAN	63.300	63.300	0.000		0.00%	125.00%	-25.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**125.00%**		
		%Error =	**-1.96%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T6S3	29.500	34.600	5.100	34.400	4.900	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.500	0.700		21.21%	21.21%	78.79%
18	91.000	91.900	0.900		27.27%	48.48%	51.52%
35	93.400	94.400	1.000		30.30%	78.79%	21.21%
60	87.200	88.300	1.100		33.33%	112.12%	-12.12%
120	85.600	86.700	1.100		33.33%	145.45%	-45.45%
230	86.200	86.200	0.000		0.00%	145.45%	-45.45%
PAN	63.300	63.300	0.200		6.06%	151.52%	-51.52%
		T. Mass (Mt)=	**5.00**	**Total %=**	**151.52%**		
		%Error =	**-1.96%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T6S4	28.200	33.200	5.000	33.200	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.100	0.300		5.77%	5.77%	94.23%
18	91.000	91.700	0.700		13.46%	19.23%	80.77%
35	93.400	95.100	1.700		32.69%	51.92%	48.08%
60	87.200	88.600	1.400		26.92%	78.85%	21.15%
120	85.600	86.400	0.800		15.38%	94.23%	5.77%
230	86.200	86.200	0.000		0.00%	94.23%	5.77%
PAN	63.300	63.300	0.000		0.00%	94.23%	5.77%
		T. Mass (Mt)=	**4.90**	**Total %=**	**94.23%**		
		%Error =	**-2.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T6S5	28.200	33.600	5.400	33.500	5.300	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.100	0.300		6.00%	6.00%	94.00%
18	91.000	91.300	0.300		6.00%	12.00%	88.00%
35	93.400	94.900	1.500		30.00%	42.00%	58.00%
60	87.200	89.200	2.000		40.00%	82.00%	18.00%
120	85.600	86.800	1.200		24.00%	106.00%	-6.00%
230	86.200	86.200	0.000		0.00%	106.00%	-6.00%
PAN	63.300	63.300	0.100		2.00%	108.00%	-8.00%
		T. Mass (Mt)=	**5.40**	**Total %=**	**108.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T6S6	29.600	34.600	5.000	34.500	4.900	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.500	0.700		14.00%	14.00%	86.00%
18	91.000	91.700	0.700		14.00%	28.00%	72.00%
35	93.400	94.900	1.500		30.00%	58.00%	42.00%
60	87.200	88.500	1.300		26.00%	84.00%	16.00%
120	85.600	86.300	0.700		14.00%	98.00%	2.00%
230	86.200	86.200	0.000		0.00%	98.00%	2.00%
PAN	63.300	63.300	0.100		2.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T6S7	29.400	34.600	5.200	34.300	4.900	0.300
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	104.000	1.200		24.00%	24.00%	76.00%
18	91.000	91.700	0.700		14.00%	38.00%	62.00%
35	93.400	94.500	1.100		22.00%	60.00%	40.00%
60	87.200	88.500	1.300		26.00%	86.00%	14.00%
120	85.600	86.200	0.600		12.00%	98.00%	2.00%
230	86.200	86.200	0.000		0.00%	98.00%	2.00%
PAN	63.300	63.300	0.300		6.00%	104.00%	-4.00%
		T. Mass (Mt)=	**5.20**	**Total %=**	**104.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T6S8	28.500	33.500	5.000	33.300	4.800	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.100	0.300		5.88%	5.88%	94.12%
18	91.000	91.300	0.300		5.88%	11.76%	88.24%
35	93.400	95.300	1.900		37.25%	49.02%	50.98%
60	87.200	88.900	1.700		33.33%	82.35%	17.65%
120	85.600	86.100	0.500		9.80%	92.16%	7.84%
230	86.200	86.300	0.100		1.96%	94.12%	5.88%
PAN	63.300	63.300	0.200		3.92%	98.04%	1.96%
		T. Mass (Mt)=	**5.00**	**Total %=**	**98.04%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T6S9	28.500	33.500	5.000	33.400	4.900	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.300	0.500		10.00%	10.00%	90.00%
18	91.000	92.000	1.000		20.00%	30.00%	70.00%
35	93.400	95.100	1.700		34.00%	64.00%	36.00%
60	87.200	88.200	1.000		20.00%	84.00%	16.00%
120	85.600	86.100	0.500		10.00%	94.00%	6.00%
230	86.200	86.300	0.100		2.00%	96.00%	4.00%
PAN	63.300	63.300	0.100		2.00%	98.00%	2.00%
		T. Mass (Mt)=	**4.90**	**Total %=**	**98.00%**		
		%Error =	**-2.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T6S10	29.800	34.900	5.100	34.900	5.100	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.100	0.300		6.00%	6.00%	94.00%
18	91.000	93.600	2.600		52.00%	58.00%	42.00%
35	93.400	95.200	1.800		36.00%	94.00%	6.00%
60	87.200	87.300	0.100		2.00%	96.00%	4.00%
120	85.600	85.700	0.100		2.00%	98.00%	2.00%
230	86.200	86.300	0.100		2.00%	100.00%	0.00%
PAN	63.300	63.300	0.000		0.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**-1.96%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T7S1	28.600	33.700	5.100	32.900	4.300	0.800
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		3.85%	3.85%	96.15%
18	91.000	91.400	0.400		7.69%	11.54%	88.46%
35	93.400	94.100	0.700		13.46%	25.00%	75.00%
60	87.200	88.500	1.300		25.00%	50.00%	50.00%
120	85.700	87.200	1.500		28.85%	78.85%	21.15%
230	86.200	86.200	0.000		0.00%	78.85%	21.15%
PAN	63.300	63.300	0.800		15.38%	94.23%	5.77%
		T. Mass (Mt)=	**4.90**	**Total %=**	**94.23%**		
		%Error =	**-3.92%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T7S2	30.000	35.200	5.200	35.000	5.000	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.100	0.300		7.50%	7.50%	92.50%
18	91.000	91.600	0.600		15.00%	22.50%	77.50%
35	93.400	94.800	1.400		35.00%	57.50%	42.50%
60	87.200	88.500	1.300		32.50%	90.00%	10.00%
120	85.700	86.800	1.100		27.50%	117.50%	-17.50%
230	86.200	86.300	0.100		2.50%	120.00%	-20.00%
PAN	63.300	63.300	0.200		5.00%	125.00%	-25.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**125.00%**		
		%Error =	**-3.85%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T7S3	29.500	34.700	5.200	34.500	5.000	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		6.06%	6.06%	93.94%
18	91.000	91.500	0.500		15.15%	21.21%	78.79%
35	93.400	94.400	1.000		30.30%	51.52%	48.48%
60	87.200	88.800	1.600		48.48%	100.00%	0.00%
120	85.700	87.400	1.700		51.52%	151.52%	-51.52%
230	86.200	86.200	0.000		0.00%	151.52%	-51.52%
PAN	63.300	63.300	0.200		6.06%	157.58%	-57.58%
		T. Mass (Mt)=	**5.20**	**Total %=**	**157.58%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T7S4	28.000	33.100	5.100	33.000	5.000	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.300	0.500		9.62%	9.62%	90.38%
18	91.000	91.800	0.800		15.38%	25.00%	75.00%
35	93.400	94.900	1.500		28.85%	53.85%	46.15%
60	87.200	88.400	1.200		23.08%	76.92%	23.08%
120	85.700	86.700	1.000		19.23%	96.15%	3.85%
230	86.200	86.200	0.000		0.00%	96.15%	3.85%
PAN	63.300	63.300	0.100		1.92%	98.08%	1.92%
		T. Mass (Mt)=	**5.10**	**Total %=**	**98.08%**		
		%Error =	**0.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T7S5	29.400	34.600	5.200	34.400	5.000	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		4.00%	4.00%	96.00%
18	91.000	91.500	0.500		10.00%	14.00%	86.00%
35	93.400	94.500	1.100		22.00%	36.00%	64.00%
60	87.200	88.500	1.300		26.00%	62.00%	38.00%
120	85.700	87.500	1.800		36.00%	98.00%	2.00%
230	86.200	86.200	0.000		0.00%	98.00%	2.00%
PAN	63.300	63.300	0.200		4.00%	102.00%	-2.00%
		T. Mass (Mt)=	**5.10**	**Total %=**	**102.00%**		
		%Error =	**-1.92%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T7S6	28.000	34.000	6.000	33.900	5.900	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	104.100	1.300		26.00%	26.00%	74.00%
18	91.000	92.000	1.000		20.00%	46.00%	54.00%
35	93.400	94.900	1.500		30.00%	76.00%	24.00%
60	87.200	88.400	1.200		24.00%	100.00%	0.00%
120	85.700	86.400	0.700		14.00%	114.00%	-14.00%
230	86.200	86.200	0.000		0.00%	114.00%	-14.00%
PAN	63.300	63.300	0.100		2.00%	116.00%	-16.00%
		T. Mass (Mt)=	**5.80**	**Total %=**	**116.00%**		
		%Error =	**-3.33%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T6S7	28.300	33.500	5.200	33.300	5.000	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		4.00%	4.00%	96.00%
18	91.000	91.300	0.300		6.00%	10.00%	90.00%
35	93.400	94.000	0.600		12.00%	22.00%	78.00%
60	87.200	88.700	1.500		30.00%	52.00%	48.00%
120	85.700	88.000	2.300		46.00%	98.00%	2.00%
230	86.200	86.200	0.000		0.00%	98.00%	2.00%
PAN	63.300	63.300	0.200		4.00%	102.00%	-2.00%
		T. Mass (Mt)=	**5.10**	**Total %=**	**102.00%**		
		%Error =	**-1.92%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T6S8	28.100	33.200	5.100	33.200	5.100	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		3.92%	3.92%	96.08%
18	91.000	91.500	0.500		9.80%	13.73%	86.27%
35	93.400	94.800	1.400		27.45%	41.18%	58.82%
60	87.200	89.000	1.800		35.29%	76.47%	23.53%
120	85.700	86.900	1.200		23.53%	100.00%	0.00%
230	86.200	86.200	0.000		0.00%	100.00%	0.00%
PAN	63.300	63.300	0.000		0.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.10**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T6S9	28.200	33.600	5.400	33.400	5.200	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.100	0.300		6.00%	6.00%	94.00%
18	91.000	91.700	0.700		14.00%	20.00%	80.00%
35	93.400	94.400	1.000		20.00%	40.00%	60.00%
60	87.200	88.300	1.100		22.00%	62.00%	38.00%
120	85.700	87.500	1.800		36.00%	98.00%	2.00%
230	86.200	86.300	0.100		2.00%	100.00%	0.00%
PAN	63.300	63.300	0.200		4.00%	104.00%	-4.00%
		T. Mass (Mt)=	**5.20**	**Total %=**	**104.00%**		
		%Error =	**-3.70%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T6S10	28.400	34.500	6.100	34.400	6.000	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.200	0.400		8.00%	8.00%	92.00%
18	91.000	91.700	0.700		14.00%	22.00%	78.00%
35	93.400	95.000	1.600		32.00%	54.00%	46.00%
60	87.200	88.600	1.400		28.00%	82.00%	18.00%
120	85.700	86.500	0.800		16.00%	98.00%	2.00%
230	86.200	87.400	1.200		24.00%	122.00%	-22.00%
PAN	63.300	63.300	0.100		2.00%	124.00%	-24.00%
		T. Mass (Mt)=	**6.20**	**Total %=**	**124.00%**		
		%Error =	**1.64%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T8S1	29.200	34.600	5.400	34.500	5.300	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		1.92%	1.92%	98.08%
18	91.000	91.700	0.700		13.46%	15.38%	84.62%
35	93.400	94.700	1.300		25.00%	40.38%	59.62%
60	87.100	88.500	1.400		26.92%	67.31%	32.69%
120	85.700	87.300	1.600		30.77%	98.08%	1.92%
230	86.200	86.200	0.000		0.00%	98.08%	1.92%
PAN	63.200	63.200	0.100		1.92%	100.00%	0.00%
		T. Mass (Mt)=	**5.20**	**Total %=**	**100.00%**		
		%Error =	**-3.70%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T8S2	30.100	35.100	5.000	35.100	5.000	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		5.00%	5.00%	95.00%
18	91.000	91.700	0.700		17.50%	22.50%	77.50%
35	93.400	95.100	1.700		42.50%	65.00%	35.00%
60	87.100	88.700	1.600		40.00%	105.00%	-5.00%
120	85.700	86.400	0.700		17.50%	122.50%	-22.50%
230	86.200	86.200	0.000		0.00%	122.50%	-22.50%
PAN	63.200	63.200	0.000		0.00%	122.50%	-22.50%
		T. Mass (Mt)=	**4.90**	**Total %=**	**122.50%**		
		%Error =	**-2.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T8S3	29.600	34.700	5.100	34.600	5.000	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		6.06%	6.06%	93.94%
18	91.000	91.700	0.700		21.21%	27.27%	72.73%
35	93.400	95.000	1.600		48.48%	75.76%	24.24%
60	87.100	88.500	1.400		42.42%	118.18%	-18.18%
120	85.700	86.800	1.100		33.33%	151.52%	-51.52%
230	86.200	86.300	0.100		3.03%	154.55%	-54.55%
PAN	63.200	63.200	0.100		3.03%	157.58%	-57.58%
		T. Mass (Mt)=	**5.20**	**Total %=**	**157.58%**		
		%Error =	**1.96%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T8S4	29.400	34.700	5.300	34.500	5.100	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	102.900	0.100		1.92%	1.92%	98.08%
18	91.000	91.500	0.500		9.62%	11.54%	88.46%
35	93.400	95.000	1.600		30.77%	42.31%	57.69%
60	87.100	88.900	1.800		34.62%	76.92%	23.08%
120	85.700	86.800	1.100		21.15%	98.08%	1.92%
230	86.200	86.200	0.000		0.00%	98.08%	1.92%
PAN	63.200	63.200	0.200		3.85%	101.92%	-1.92%
		T. Mass (Mt)=	**5.30**	**Total %=**	**101.92%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T8S5	29.500	34.800	5.300	34.600	5.100	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.100	0.300		6.00%	6.00%	94.00%
18	91.000	91.400	0.400		8.00%	14.00%	86.00%
35	93.400	94.600	1.200		24.00%	38.00%	62.00%
60	87.100	88.600	1.500		30.00%	68.00%	32.00%
120	85.700	87.100	1.400		28.00%	96.00%	4.00%
230	86.200	86.200	0.000		0.00%	96.00%	4.00%
PAN	63.200	63.200	0.200		4.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**-5.66%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T8S6	28.600	34.000	5.400	33.800	5.200	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		4.00%	4.00%	96.00%
18	91.000	91.600	0.600		12.00%	16.00%	84.00%
35	93.400	94.900	1.500		30.00%	46.00%	54.00%
60	87.100	88.900	1.800		36.00%	82.00%	18.00%
120	85.700	86.700	1.000		20.00%	102.00%	-2.00%
230	86.200	86.300	0.100		2.00%	104.00%	-4.00%
PAN	63.200	63.200	0.200		4.00%	108.00%	-8.00%
		T. Mass (Mt)=	**5.40**	**Total %=**	**108.00%**		
		%Error =	**0.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T8S7	28.000	33.200	5.200	33.200	5.200	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.100	0.300		6.00%	6.00%	94.00%
18	91.000	91.600	0.600		12.00%	18.00%	82.00%
35	93.400	95.300	1.900		38.00%	56.00%	44.00%
60	87.100	88.600	1.500		30.00%	86.00%	14.00%
120	85.700	86.500	0.800		16.00%	102.00%	-2.00%
230	86.200	86.300	0.100		2.00%	104.00%	-4.00%
PAN	63.200	63.200	0.000		0.00%	104.00%	-4.00%
		T. Mass (Mt)=	**5.20**	**Total %=**	**104.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T8S8	29.500	34.800	5.300	34.600	5.100	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.000	0.200		3.92%	3.92%	96.08%
18	91.000	91.500	0.500		9.80%	13.73%	86.27%
35	93.400	95.700	2.300		45.10%	58.82%	41.18%
60	87.100	88.800	1.700		33.33%	92.16%	7.84%
120	85.700	85.900	0.200		3.92%	96.08%	3.92%
230	86.200	86.400	0.200		3.92%	100.00%	0.00%
PAN	63.200	63.200	0.200		3.92%	103.92%	-3.92%
		T. Mass (Mt)=	**5.30**	**Total %=**	**103.92%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T8S9	28.300	33.500	5.200	33.500	5.200	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.200	0.400		8.00%	8.00%	92.00%
18	91.000	91.700	0.700		14.00%	22.00%	78.00%
35	93.400	94.600	1.200		24.00%	46.00%	54.00%
60	87.100	89.100	2.000		40.00%	86.00%	14.00%
120	85.700	86.500	0.800		16.00%	102.00%	-2.00%
230	86.200	86.200	0.000		0.00%	102.00%	-2.00%
PAN	63.200	63.200	0.000		0.00%	102.00%	-2.00%
		T. Mass (Mt)=	**5.10**	**Total %=**	**102.00%**		
		%Error =	**-1.92%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T8S10	29.300	34.500	5.200	34.500	5.200	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.800	103.100	0.300		6.00%	6.00%	94.00%
18	91.000	91.300	0.300		6.00%	12.00%	88.00%
35	93.400	95.200	1.800		36.00%	48.00%	52.00%
60	87.100	89.500	2.400		48.00%	96.00%	4.00%
120	85.700	86.000	0.300		6.00%	102.00%	-2.00%
230	86.200	86.300	0.100		2.00%	104.00%	-4.00%
PAN	63.200	63.200	0.000		0.00%	104.00%	-4.00%
		T. Mass (Mt)=	**5.20**	**Total %=**	**104.00%**		
		%Error =	**0.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T9S1	29.500	34.600	5.100	34.300	4.800	0.300
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		1.92%	1.92%	98.08%
18	91.000	91.700	0.700		13.46%	15.38%	84.62%
35	93.400	94.600	1.200		23.08%	38.46%	61.54%
60	87.200	88.700	1.500		28.85%	67.31%	32.69%
120	85.700	86.800	1.100		21.15%	88.46%	11.54%
230	86.200	86.300	0.100		1.92%	90.38%	9.62%
PAN	63.300	63.300	0.300		5.77%	96.15%	3.85%
		T. Mass (Mt)=	**5.00**	**Total %=**	**96.15%**		
		%Error =	**-1.96%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T9S2	28.200	33.900	5.700	33.500	5.300	0.400
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		2.50%	2.50%	97.50%
18	91.000	91.800	0.800		20.00%	22.50%	77.50%
35	93.400	94.800	1.400		35.00%	57.50%	42.50%
60	87.200	88.700	1.500		37.50%	95.00%	5.00%
120	85.700	87.100	1.400		35.00%	130.00%	-30.00%
230	86.200	86.200	0.000		0.00%	130.00%	-30.00%
PAN	63.300	63.300	0.400		10.00%	140.00%	-40.00%
		T. Mass (Mt)=	**5.60**	**Total %=**	**140.00%**		
		%Error =	**-1.75%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T9S3	29.400	34.500	5.100	34.400	5.000	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.100	0.200		6.06%	6.06%	93.94%
18	91.000	91.500	0.500		15.15%	21.21%	78.79%
35	93.400	94.600	1.200		36.36%	57.58%	42.42%
60	87.200	88.900	1.700		51.52%	109.09%	-9.09%
120	85.700	87.000	1.300		39.39%	148.48%	-48.48%
230	86.200	86.300	0.100		3.03%	151.52%	-51.52%
PAN	63.300	63.300	0.100		3.03%	154.55%	-54.55%
		T. Mass (Mt)=	**5.10**	**Total %=**	**154.55%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T9S4	28.600	33.600	5.000	33.300	4.700	0.300
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		1.92%	1.92%	98.08%
18	91.000	91.300	0.300		5.77%	7.69%	92.31%
35	93.400	93.800	0.400		7.69%	15.38%	84.62%
60	87.200	89.200	2.000		38.46%	53.85%	46.15%
120	85.700	87.400	1.700		32.69%	86.54%	13.46%
230	86.200	86.200	0.000		0.00%	86.54%	13.46%
PAN	63.300	63.300	0.300		5.77%	92.31%	7.69%
		T. Mass (Mt)=	**4.80**	**Total %=**	**92.31%**		
		%Error =	**-4.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T9S5	28.500	33.600	5.100	33.500	5.000	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.100	0.100		2.00%	2.00%	98.00%
35	93.400	94.800	1.400		28.00%	30.00%	70.00%
60	87.200	89.600	2.400		48.00%	78.00%	22.00%
120	85.700	86.700	1.000		20.00%	98.00%	2.00%
230	86.200	86.200	0.000		0.00%	98.00%	2.00%
PAN	63.300	63.300	0.100		2.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**-1.96%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T9S6	29.300	34.600	5.300	34.500	5.200	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		2.00%	2.00%	98.00%
18	91.000	91.300	0.300		6.00%	8.00%	92.00%
35	93.400	94.400	1.000		20.00%	28.00%	72.00%
60	87.200	89.200	2.000		40.00%	68.00%	32.00%
120	85.700	87.200	1.500		30.00%	98.00%	2.00%
230	86.200	86.400	0.200		4.00%	102.00%	-2.00%
PAN	63.300	63.300	0.100		2.00%	104.00%	-4.00%
		T. Mass (Mt)=	**5.20**	**Total %=**	**104.00%**		
		%Error =	**-1.89%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T9S7	29.400	34.500	5.100	34.400	5.000	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.700	0.800		16.00%	16.00%	84.00%
18	91.000	91.900	0.900		18.00%	34.00%	66.00%
35	93.400	95.500	2.100		42.00%	76.00%	24.00%
60	87.200	88.000	0.800		16.00%	92.00%	8.00%
120	85.700	85.900	0.200		4.00%	96.00%	4.00%
230	86.200	86.400	0.200		4.00%	100.00%	0.00%
PAN	63.300	63.300	0.100		2.00%	102.00%	-2.00%
		T. Mass (Mt)=	**5.10**	**Total %=**	**102.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T9S8	28.300	33.600	5.300	33.500	5.200	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.100	0.100		1.96%	1.96%	98.04%
35	93.400	93.600	0.200		3.92%	5.88%	94.12%
60	87.200	90.000	2.800		54.90%	60.78%	39.22%
120	85.700	87.700	2.000		39.22%	100.00%	0.00%
230	86.200	86.300	0.100		1.96%	101.96%	-1.96%
PAN	63.300	63.300	0.100		1.96%	103.92%	-3.92%
		T. Mass (Mt)=	**5.30**	**Total %=**	**103.92%**		
		%Error =	**0.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T9S9	28.200	33.500	5.300	33.300	5.100	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.700	0.800		16.00%	16.00%	84.00%
18	91.000	92.100	1.100		22.00%	38.00%	62.00%
35	93.400	94.500	1.100		22.00%	60.00%	40.00%
60	87.200	88.400	1.200		24.00%	84.00%	16.00%
120	85.700	86.400	0.700		14.00%	98.00%	2.00%
230	86.200	86.400	0.200		4.00%	102.00%	-2.00%
PAN	63.300	63.300	0.200		4.00%	106.00%	-6.00%
		T. Mass (Mt)=	**5.30**	**Total %=**	**106.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T9S10	29.700	34.900	5.200	34.800	5.100	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	104.500	1.600		32.00%	32.00%	68.00%
18	91.000	92.800	1.800		36.00%	68.00%	32.00%
35	93.400	94.500	1.100		22.00%	90.00%	10.00%
60	87.200	87.400	0.200		4.00%	94.00%	6.00%
120	85.700	85.900	0.200		4.00%	98.00%	2.00%
230	86.200	86.400	0.200		4.00%	102.00%	-2.00%
PAN	63.300	63.300	0.100		2.00%	104.00%	-4.00%
		T. Mass (Mt)=	**5.20**	**Total %=**	**104.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T10S1	28.100	33.400	5.300	33.200	5.100	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.200	0.300		5.77%	5.77%	94.23%
18	91.000	91.500	0.500		9.62%	15.38%	84.62%
35	93.400	94.300	0.900		17.31%	32.69%	67.31%
60	87.200	89.400	2.200		42.31%	75.00%	25.00%
120	85.700	86.900	1.200		23.08%	98.08%	1.92%
230	86.200	86.200	0.000		0.00%	98.08%	1.92%
PAN	63.300	63.300	0.200		3.85%	101.92%	-1.92%
		T. Mass (Mt)=	**5.30**	**Total %=**	**101.92%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T10S2	29.800	35.200	5.400	35.100	5.300	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		2.50%	2.50%	97.50%
18	91.000	91.200	0.200		5.00%	7.50%	92.50%
35	93.400	94.200	0.800		20.00%	27.50%	72.50%
60	87.200	90.200	3.000		75.00%	102.50%	-2.50%
120	85.700	86.800	1.100		27.50%	130.00%	-30.00%
230	86.200	86.200	0.000		0.00%	130.00%	-30.00%
PAN	63.300	63.300	0.100		2.50%	132.50%	-32.50%
		T. Mass (Mt)=	**5.30**	**Total %=**	**132.50%**		
		%Error =	**-1.85%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T10S3	28.500	33.800	5.300	33.600	5.100	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.100	0.100		3.03%	3.03%	96.97%
35	93.400	94.300	0.900		27.27%	30.30%	69.70%
60	87.200	90.200	3.000		90.91%	121.21%	-21.21%
120	85.700	86.600	0.900		27.27%	148.48%	-48.48%
230	86.200	86.400	0.200		6.06%	154.55%	-54.55%
PAN	63.300	63.300	0.200		6.06%	160.61%	-60.61%
		T. Mass (Mt)=	**5.30**	**Total %=**	**160.61%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T10S4	29.600	34.700	5.100	34.600	5.000	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		1.92%	1.92%	98.08%
18	91.000	91.100	0.100		1.92%	3.85%	96.15%
35	93.400	94.000	0.600		11.54%	15.38%	84.62%
60	87.200	90.200	3.000		57.69%	73.08%	26.92%
120	85.700	86.800	1.100		21.15%	94.23%	5.77%
230	86.200	86.300	0.100		1.92%	96.15%	3.85%
PAN	63.300	63.300	0.100		1.92%	98.08%	1.92%
		T. Mass (Mt)=	**5.10**	**Total %=**	**98.08%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T10S5	28.300	33.900	5.600	33.300	5.000	0.600
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	104.000	1.100		22.00%	22.00%	78.00%
18	91.000	91.600	0.600		12.00%	34.00%	66.00%
35	93.400	94.400	1.000		20.00%	54.00%	46.00%
60	87.200	88.200	1.000		20.00%	74.00%	26.00%
120	85.700	86.800	1.100		22.00%	96.00%	4.00%
230	86.200	86.400	0.200		4.00%	100.00%	0.00%
PAN	63.300	63.300	0.600		12.00%	112.00%	-12.00%
		T. Mass (Mt)=	**5.60**	**Total %=**	**112.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T10S6	29.300	34.300	5.000	34.200	4.900	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.100	0.200		4.00%	4.00%	96.00%
18	91.000	91.100	0.100		2.00%	6.00%	94.00%
35	93.400	94.000	0.600		12.00%	18.00%	82.00%
60	87.200	89.700	2.500		50.00%	68.00%	32.00%
120	85.700	87.100	1.400		28.00%	96.00%	4.00%
230	86.200	86.300	0.100		2.00%	98.00%	2.00%
PAN	63.300	63.300	0.100		2.00%	100.00%	0.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T10S7	30.000	35.400	5.400	35.300	5.300	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.500	0.500		10.00%	10.00%	90.00%
35	93.400	95.600	2.200		44.00%	54.00%	46.00%
60	87.200	89.000	1.800		36.00%	90.00%	10.00%
120	85.700	86.200	0.500		10.00%	100.00%	0.00%
230	86.200	86.400	0.200		4.00%	104.00%	-4.00%
PAN	63.300	63.300	0.100		2.00%	106.00%	-6.00%
		T. Mass (Mt)=	**5.30**	**Total %=**	**106.00%**		
		%Error =	**-1.85%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T10S8	28.100	33.200	5.100	33.100	5.000	0.100
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		1.96%	1.96%	98.04%
18	91.000	91.400	0.400		7.84%	9.80%	90.20%
35	93.400	95.400	2.000		39.22%	49.02%	50.98%
60	87.200	89.200	2.000		39.22%	88.24%	11.76%
120	85.700	86.000	0.300		5.88%	94.12%	5.88%
230	86.200	86.300	0.100		1.96%	96.08%	3.92%
PAN	63.300	63.300	0.100		1.96%	98.04%	1.96%
		T. Mass (Mt)=	**5.00**	**Total %=**	**98.04%**		
		%Error =	**-1.96%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T10S9	29.400	34.700	5.300	34.700	5.300	0.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		2.00%	2.00%	98.00%
18	91.000	91.200	0.200		4.00%	6.00%	94.00%
35	93.400	96.400	3.000		60.00%	66.00%	34.00%
60	87.200	89.000	1.800		36.00%	102.00%	-2.00%
120	85.700	85.800	0.100		2.00%	104.00%	-4.00%
230	86.200	86.300	0.100		2.00%	106.00%	-6.00%
PAN	63.300	63.300	0.000		0.00%	106.00%	-6.00%
		T. Mass (Mt)=	**5.30**	**Total %=**	**106.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	T10S10	28.400	33.500	5.100	33.500	5.100	0.000
Sieve #	**Sieve (g)**	**ed+Sieve (g**	**ass Sediment (**		**Weight %**	**Cum % Ret**	**um % Pas**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.100	0.100		2.00%	2.00%	98.00%
35	93.400	94.000	0.600		12.00%	14.00%	86.00%
60	87.200	91.500	4.300		86.00%	100.00%	0.00%
120	85.700	85.800	0.100		2.00%	102.00%	-2.00%
230	86.200	86.300	0.100		2.00%	104.00%	-4.00%
PAN	63.300	63.300	0.000		0.00%	104.00%	-4.00%
		T. Mass (Mt)=	**5.20**	**Total %=**	**104.00%**		
		%Error =	**1.96%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT1S1	29.500	34.700	5.200	34.100	4.600	0.600
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.300	0.300		5.77%	5.77%	94.23%
35	93.400	94.000	0.600		11.54%	17.31%	82.69%
60	87.200	88.400	1.200		23.08%	40.38%	59.62%
120	85.700	87.600	1.900		36.54%	76.92%	23.08%
230	86.200	86.700	0.500		9.62%	86.54%	13.46%
PAN	63.300	63.300	0.600		11.54%	98.08%	1.92%
		T. Mass (Mt)=	**5.10**	**Total %=**	**98.08%**		
		%Error =	**-1.92%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT1S2	28.300	33.300	5.000	33.000	4.700	0.300
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.300	0.300		7.50%	7.50%	92.50%
35	93.400	94.300	0.900		22.50%	30.00%	70.00%
60	87.200	88.700	1.500		37.50%	67.50%	32.50%
120	85.700	86.800	1.100		27.50%	95.00%	5.00%
230	86.200	87.100	0.900		22.50%	117.50%	-17.50%
PAN	63.300	63.300	0.300		7.50%	125.00%	-25.00%
		T. Mass (Mt)=	**5.00**	**Total %=**	**125.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT1S3	29.800	35.200	5.400	34.800	5.000	0.400
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		3.03%	3.03%	96.97%
18	91.000	91.600	0.600		18.18%	21.21%	78.79%
35	93.400	94.600	1.200		36.36%	57.58%	42.42%
60	87.200	88.700	1.500		45.45%	103.03%	-3.03%
120	85.700	86.700	1.000		30.30%	133.33%	-33.33%
230	86.200	86.800	0.600		18.18%	151.52%	-51.52%
PAN	63.300	63.300	0.400		12.12%	163.64%	-63.64%
		T. Mass (Mt)=	**5.40**	**Total %=**	**163.64%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT1S4	49.600	54.900	5.300	54.100	4.500	0.800
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		1.92%	1.92%	98.08%
18	91.000	91.600	0.600		11.54%	13.46%	86.54%
35	93.400	94.300	0.900		17.31%	30.77%	69.23%
60	87.200	88.400	1.200		23.08%	53.85%	46.15%
120	85.700	87.200	1.500		28.85%	82.69%	17.31%
230	86.200	86.400	0.200		3.85%	86.54%	13.46%
PAN	63.300	63.300	0.800		15.38%	101.92%	-1.92%
		T. Mass (Mt)=	**5.30**	**Total %=**	**101.92%**		
		%Error =	**0.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT1S5	50.400	55.700	5.300	54.500	4.100	1.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.300	0.300		6.00%	6.00%	94.00%
35	93.400	94.100	0.700		14.00%	20.00%	80.00%
60	87.200	88.200	1.000		20.00%	40.00%	60.00%
120	85.700	86.800	1.100		22.00%	62.00%	38.00%
230	86.200	87.200	1.000		20.00%	82.00%	18.00%
PAN	63.300	63.300	1.200		24.00%	106.00%	-6.00%
		T. Mass (Mt)=	**5.30**	**Total %=**	**106.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT2S1	50.400	55.500	5.100	54.600	4.200	0.900
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.200	0.200		3.85%	3.85%	96.15%
35	93.400	93.800	0.400		7.69%	11.54%	88.46%
60	87.200	88.000	0.800		15.38%	26.92%	73.08%
120	86.200	87.900	1.700		32.69%	59.62%	40.38%
230	85.700	86.800	1.100		21.15%	80.77%	19.23%
PAN	63.300	63.300	0.900		17.31%	98.08%	1.92%
		T. Mass (Mt)=	**5.10**	**Total %=**	**98.08%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT2S2	52.600	57.600	5.000	57.400	4.800	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	104.000	1.100		27.50%	27.50%	72.50%
18	91.000	92.500	1.500		37.50%	65.00%	35.00%
35	93.400	94.300	0.900		22.50%	87.50%	12.50%
60	87.200	87.700	0.500		12.50%	100.00%	0.00%
120	86.200	86.600	0.400		10.00%	110.00%	-10.00%
230	85.700	86.000	0.300		7.50%	117.50%	-17.50%
PAN	63.300	63.300	0.200		5.00%	122.50%	-22.50%
		T. Mass (Mt)=	**4.90**	**Total %=**	**122.50%**		
		%Error =	**-2.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT2S3	50.400	56.000	5.600	55.600	5.200	0.400
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.100	0.200		6.06%	6.06%	93.94%
18	91.000	92.000	1.000		30.30%	36.36%	63.64%
35	93.400	95.100	1.700		51.52%	87.88%	12.12%
60	87.200	88.200	1.000		30.30%	118.18%	-18.18%
120	86.200	86.900	0.700		21.21%	139.39%	-39.39%
230	85.700	86.200	0.500		15.15%	154.55%	-54.55%
PAN	63.300	63.300	0.400		12.12%	166.67%	-66.67%
		T. Mass (Mt)=	**5.50**	**Total %=**	**166.67%**		
		%Error =	**-1.79%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT2S4	50.700	55.900	5.200	55.200	4.500	0.700
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		1.92%	1.92%	98.08%
18	91.000	91.400	0.400		7.69%	9.62%	90.38%
35	93.400	94.300	0.900		17.31%	26.92%	73.08%
60	87.200	88.300	1.100		21.15%	48.08%	51.92%
120	86.200	87.300	1.100		21.15%	69.23%	30.77%
230	85.700	86.600	0.900		17.31%	86.54%	13.46%
PAN	63.300	63.300	0.700		13.46%	100.00%	0.00%
		T. Mass (Mt)=	**5.20**	**Total %=**	**100.00%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT2S5	49.400	54.600	5.200	53.700	4.300	0.900
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.400	0.400		8.00%	8.00%	92.00%
35	93.400	94.200	0.800		16.00%	24.00%	76.00%
60	87.200	88.100	0.900		18.00%	42.00%	58.00%
120	86.200	87.300	1.100		22.00%	64.00%	36.00%
230	85.700	86.700	1.000		20.00%	84.00%	16.00%
PAN	63.300	63.300	0.900		18.00%	102.00%	-2.00%
		T. Mass (Mt)=	**5.10**	**Total %=**	**102.00%**		
		%Error =	**-1.92%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT3S1	29.300	34.400	5.100	33.400	4.100	1.000
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.300	0.300		5.77%	5.77%	94.23%
35	93.400	94.000	0.600		11.54%	17.31%	82.69%
60	87.200	88.500	1.300		25.00%	42.31%	57.69%
120	86.200	87.300	1.100		21.15%	63.46%	36.54%
230	85.700	86.400	0.700		13.46%	76.92%	23.08%
PAN	63.300	63.300	1.000		19.23%	96.15%	3.85%
		T. Mass (Mt)=	**5.00**	**Total %=**	**96.15%**		
		%Error =	**-1.96%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT3S2	29.500	34.700	5.200	33.800	4.300	0.900
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.500	0.500		12.50%	12.50%	87.50%
35	93.400	94.100	0.700		17.50%	30.00%	70.00%
60	87.200	88.100	0.900		22.50%	52.50%	47.50%
120	86.200	87.200	1.000		25.00%	77.50%	22.50%
230	85.700	86.800	1.100		27.50%	105.00%	-5.00%
PAN	63.300	63.300	0.900		22.50%	127.50%	-27.50%
		T. Mass (Mt)=	**5.10**	**Total %=**	**127.50%**		
		%Error =	**-1.92%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT3S3	28.200	33.800	5.600	33.200	5.000	0.600
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.200	0.300		9.09%	9.09%	90.91%
18	91.000	91.600	0.600		18.18%	27.27%	72.73%
35	93.400	94.400	1.000		30.30%	57.58%	42.42%
60	87.200	88.300	1.100		33.33%	90.91%	9.09%
120	86.200	87.300	1.100		33.33%	124.24%	-24.24%
230	85.700	86.600	0.900		27.27%	151.52%	-51.52%
PAN	63.300	63.300	0.600		18.18%	169.70%	-69.70%
		T. Mass (Mt)=	**5.60**	**Total %=**	**169.70%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT3S4	28.200	33.400	5.200	33.200	5.000	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.300	0.300		5.77%	5.77%	94.23%
35	93.400	94.700	1.300		25.00%	30.77%	69.23%
60	87.200	88.700	1.500		28.85%	59.62%	40.38%
120	86.200	87.000	0.800		15.38%	75.00%	25.00%
230	85.700	86.700	1.000		19.23%	94.23%	5.77%
PAN	63.300	63.300	0.200		3.85%	98.08%	1.92%
		T. Mass (Mt)=	**5.10**	**Total %=**	**98.08%**		
		%Error =	**-1.92%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT3S5	29.300	34.800	5.500	33.900	4.600	0.900
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.600	0.600		12.00%	12.00%	88.00%
35	93.400	94.400	1.000		20.00%	32.00%	68.00%
60	87.200	88.200	1.000		20.00%	52.00%	48.00%
120	86.200	87.200	1.000		20.00%	72.00%	28.00%
230	85.700	86.600	0.900		18.00%	90.00%	10.00%
PAN	63.300	63.300	0.900		18.00%	108.00%	-8.00%
		T. Mass (Mt)=	**5.40**	**Total %=**	**108.00%**		
		%Error =	**-1.82%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT4S1	28.300	33.400	5.100	32.900	4.600	0.500
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.200	0.300		5.77%	5.77%	94.23%
18	91.000	91.500	0.500		9.62%	15.38%	84.62%
35	93.400	94.300	0.900		17.31%	32.69%	67.31%
60	87.200	88.500	1.300		25.00%	57.69%	42.31%
120	86.200	87.200	1.000		19.23%	76.92%	23.08%
230	85.700	86.300	0.600		11.54%	88.46%	11.54%
PAN	63.300	63.300	0.500		9.62%	98.08%	1.92%
		T. Mass (Mt)=	**5.10**	**Total %=**	**98.08%**		
		%Error =	**0.00%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT4S2	28.100	33.600	5.500	32.800	4.700	0.800
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.500	0.500		12.50%	12.50%	87.50%
35	93.400	94.400	1.000		25.00%	37.50%	62.50%
60	87.200	88.400	1.200		30.00%	67.50%	32.50%
120	86.200	87.200	1.000		25.00%	92.50%	7.50%
230	85.700	86.600	0.900		22.50%	115.00%	-15.00%
PAN	63.300	63.300	0.800		20.00%	135.00%	-35.00%
		T. Mass (Mt)=	**5.40**	**Total %=**	**135.00%**		
		%Error =	**-1.82%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT4S3	29.800	35.400	5.600	34.700	4.900	0.700
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.300	0.300		9.09%	9.09%	90.91%
35	93.400	94.100	0.700		21.21%	30.30%	69.70%
60	87.200	88.500	1.300		39.39%	69.70%	30.30%
120	86.200	87.600	1.400		42.42%	112.12%	-12.12%
230	85.700	86.800	1.100		33.33%	145.45%	-45.45%
PAN	63.300	63.300	0.700		21.21%	166.67%	-66.67%
		T. Mass (Mt)=	**5.50**	**Total %=**	**166.67%**		
		%Error =	**-1.79%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT4S4	28.600	33.700	5.100	33.100	4.500	0.600
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.300	0.300		5.77%	5.77%	94.23%
35	93.400	94.200	0.800		15.38%	21.15%	78.85%
60	87.200	88.300	1.100		21.15%	42.31%	57.69%
120	86.200	87.300	1.100		21.15%	63.46%	36.54%
230	85.700	86.700	1.000		19.23%	82.69%	17.31%
PAN	63.300	63.300	0.600		11.54%	94.23%	5.77%
		T. Mass (Mt)=	**4.90**	**Total %=**	**94.23%**		
		%Error =	**-3.92%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT4S5	29.800	35.300	5.500	34.700	4.900	0.600
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.500	0.500		10.00%	10.00%	90.00%
35	93.400	94.700	1.300		26.00%	36.00%	64.00%
60	87.200	88.600	1.400		28.00%	64.00%	36.00%
120	86.200	87.300	1.100		22.00%	86.00%	14.00%
230	85.700	86.200	0.500		10.00%	96.00%	4.00%
PAN	63.300	63.300	0.600		12.00%	108.00%	-8.00%
		T. Mass (Mt)=	**5.40**	**Total %=**	**108.00%**		
		%Error =	**-1.82%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT5S1	28.500	33.800	5.300	33.600	5.100	0.200
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.300	0.400		7.69%	7.69%	92.31%
18	91.000	91.900	0.900		17.31%	25.00%	75.00%
35	93.400	95.200	1.800		34.62%	59.62%	40.38%
60	87.200	88.500	1.300		25.00%	84.62%	15.38%
120	86.200	86.500	0.300		5.77%	90.38%	9.62%
230	85.700	86.100	0.400		7.69%	98.08%	1.92%
PAN	63.300	63.300	0.200		3.85%	101.92%	-1.92%
		T. Mass (Mt)=	**5.30**	**Total %=**	**101.92%**		
		%Error =	**0.00%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT5S2	28.100	33.600	5.500	32.200	4.100	1.400
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.200	0.200		5.00%	5.00%	95.00%
35	93.400	93.900	0.500		12.50%	17.50%	82.50%
60	87.200	88.100	0.900		22.50%	40.00%	60.00%
120	86.200	87.300	1.100		27.50%	67.50%	32.50%
230	85.700	87.000	1.300		32.50%	100.00%	0.00%
PAN	63.300	63.300	1.400		35.00%	135.00%	-35.00%
		T. Mass (Mt)=	**5.40**	**Total %=**	**135.00%**		
		%Error =	**-1.82%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT5S3	28.400	34.400	6.000	33.800	5.400	0.600
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		3.03%	3.03%	96.97%
18	91.000	91.400	0.400		12.12%	15.15%	84.85%
35	93.400	94.400	1.000		30.30%	45.45%	54.55%
60	87.200	88.900	1.700		51.52%	96.97%	3.03%
120	86.200	87.700	1.500		45.45%	142.42%	-42.42%
230	85.700	86.300	0.600		18.18%	160.61%	-60.61%
PAN	63.300	63.300	0.600		18.18%	178.79%	-78.79%
		T. Mass (Mt)=	**5.90**	**Total %=**	**178.79%**		
		%Error =	**-1.67%**				

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT5S4	28.500	34.400	5.900	34.100	5.600	0.300
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	102.900	0.000		0.00%	0.00%	100.00%
18	91.000	91.400	0.400		7.69%	7.69%	92.31%
35	93.400	94.700	1.300		25.00%	32.69%	67.31%
60	87.200	89.200	2.000		38.46%	71.15%	28.85%
120	86.200	87.300	1.100		21.15%	92.31%	7.69%
230	85.700	86.400	0.700		13.46%	105.77%	-5.77%
PAN	63.300	63.300	0.300		5.77%	111.54%	-11.54%
		T. Mass (Mt)=	**5.80**	**Total %=**	**111.54%**		
		%Error =	**-1.69%**				

Appendix C (Continued)

Date	Sample ID	Beaker (g)	B + Sediment (g)	Sediment (Mi) (g)	B + Dry Sediment (after wet sieved) (g)	Sediment (Mf) (after wet sieving)	Add PAN (Mi-Mf) (g)
27-Jan-14	WT5S5	30.000	35.900	5.900	35.600	5.600	0.300
Sieve #	**Sieve (g)**	**Sed+Sieve (g)**	**Mass Sediment (g)**		**Weight %**	**Cum % Ret**	**Cum % Pass**
10	102.900	103.000	0.100		2.00%	2.00%	98.00%
18	91.000	91.500	0.500		10.00%	12.00%	88.00%
35	93.400	94.700	1.300		26.00%	38.00%	62.00%
60	87.200	89.000	1.800		36.00%	74.00%	26.00%
120	86.200	87.400	1.200		24.00%	98.00%	2.00%
230	85.700	86.400	0.700		14.00%	112.00%	-12.00%
PAN	63.300	63.300	0.300		6.00%	118.00%	-18.00%
		T. Mass (Mt)=	**5.90**	**Total %=**	**118.00%**		
		%Error =	**0.00%**				

Appendix D: Raw Environmental Data

Sample	Foram Index	Environmental Change	Reef Condition	Shannon Index	Grain Size - Phi Value	Species Richness	Foram Density
ET1S1	2.74	Y	Marginal	3.101	2	30	432.16
ET1S2	3.96	Y	Marginal	2.998	2	30	451.18
ET1S3	4.34	Y	Conducive	3.194	1	32	873.63
ET1S4	4.24	Y	Conducive	3.109	2	31	958.33
ET1S5	4.50	Y	Conducive	3.0075	2	32	1286.76
ET1S6	4.68	Y	Conducive	2.967	2	31	798.97
ET1S7	5.14	N	Conducive	3.136	2	40	1097.44
ET1S8	5.29	N	Conducive	3.099	1	34	171.99
ET1S9	5.89	N	Conducive	2.819	2	28	454.28
ET1S10	4.69	Y	Conducive	3.198	2	36	1276.92
ET2S1	5.79	N	Conducive	3.032	2	31	349.61
ET2S2	6.12	N	Conducive	2.741	2	28	412.28
ET2S3	5.78	N	Conducive	2.919	2	29	391.68
ET2S4	6.86	N	Conducive	2.421	1	21	375.35
ET2S5	6.73	N	Conducive	2.319	1	19	185.99
ET2S6	5.78	N	Conducive	2.481	2	21	528.09
ET2S7	6.33	N	Conducive	2.22	3	23	787.88
ET2S8	6.23	N	Conducive	2.399	2	18	182.16
ET2S9	6.69	N	Conducive	2.391	2	29	258.33
ET2S10	4.84	Y	Conducive	2.782	3	27	905.06
ET3S1	4.37	Y	Conducive	3.317	2	38	191.49
ET3S2	6.06	N	Conducive	2.236	2	19	149.00
ET3S3	5.89	N	Conducive	2.325	2	14	190.28
ET3S4	6.53	N	Conducive	2.153	2	17	212.03
ET3S5	8.28	N	Conducive	2.113	2	17	215.87
ET3S6	7.16	N	Conducive	2.031	2	15	289.10
ET3S7	6.08	N	Conducive	2.305	2	18	230.02
ET3S8	5.44	N	Conducive	2.265	2	17	143.82
ET3S9	5.13	N	Conducive	2.505	1	20	247.52
ET3S10	5.39	N	Conducive	2.586	2	30	297.72
ET4S1	4.37	Y	Conducive	3.041	3	35	280.87
ET4S2	4.78	Y	Conducive	3.009	3	36	382.06
ET4S3	5.74	N	Conducive	2.815	2	32	580.40
ET4S4	5.04	N	Conducive	2.967	3	31	922.37
ET4S5	6.04	N	Conducive	2.582	2	35	652.75
ET4S6	5.46	N	Conducive	2.775	2	30	231.08
ET4S7	5.67	N	Conducive	2.865	2	38	480.00
ET4S8	4.05	Y	Conducive	2.519	2	36	394.34
ET4S9	6.09	N	Conducive	2.821	1	36	289.96
ET4S10	5.96	N	Conducive	2.935	1	37	224.12
ET5S1	5.67	N	Conducive	2.861	2	33	238.20
ET5S2	4.73	Y	Conducive	3.235	2	41	405.19
ET5S3	4.62	Y	Conducive	3.262	2	42	473.48
ET5S4	5.12	N	Conducive	3.181	3	48	374.67

Appendix D (Continued)

Sample	Foram Index	Environmental Change	Reef Condition	Shannon Index	Grain Size - Phi Value	Species Richness	Foram Density
ET5S5	5.52	N	Conducive	3.025	-1	42	318.35
ET5S6	5.40	N	Conducive	2.842	2	42	950.59
ET5S7	5.81	N	Conducive	2.995	1	39	325.16
ET5S8	5.03	N	Conducive	2.863	2	38	647.48
ET5S9	5.39	N	Conducive	2.598	2	37	316.84
ET5S10	5.92	N	Conducive	2.753	2	34	330.08
ET6S1	5.67	N	Conducive	3.003	3	39	528.76
ET6S2	5.14	N	Conducive	2.832	3	38	362.20
ET6S3	3.89	Y	Marginal	3.152	1	36	164.64
ET6S4	4.91	Y	Conducive	2.885	1	30	175.31
ET6S5	4.79	Y	Conducive	3.028	2	34	189.58
ET6S6	5.09	N	Conducive	2.75	1	25	128.98
ET6S7	5.14	N	Conducive	2.726	2	25	176.53
ET6S8	4.13	Y	Conducive	2.558	1	23	173.06
ET6S9	5.37	N	Conducive	2.694	1	21	52.63
ET6S10	7.33	N	Conducive	0.6365	0	2	1.72
ET7S1	5.51	N	Conducive	3.026	3	39	358.23
ET7S2	5.14	N	Conducive	3.157	1	45	348.98
ET7S3	5.58	N	Conducive	3.112	3	37	225.49
ET7S4	5.24	N	Conducive	2.872	1	34	158.16
ET7S5	4.91	N	Conducive	2.977	3	31	239.08
ET7S6	4.40	Y	Conducive	2.557	1	15	25.40
ET7S7	4.14	Y	Conducive	3.101	3	35	239.82
ET7S8	4.47	Y	Conducive	2.938	2	29	157.65
ET7S9	4.89	Y	Conducive	2.916	3	28	173.91
ET7S10	4.87	Y	Conducive	2.94	1	29	169.79
ET8S1	6.02	N	Conducive	2.635	3	29	189.02
ET8S2	6.62	N	Conducive	2.615	1	26	213.93
ET8S3	6.29	N	Conducive	2.823	1	32	196.94
ET8S4	4.90	Y	Conducive	2.817	2	28	145.40
ET8S5	4.33	Y	Conducive	2.853	2	37	378.45
ET8S6	5.11	N	Conducive	2.764	2	30	143.63
ET8S7	3.57	Y	Marginal	2.504	1	28	241.21
ET8S8	4.76	Y	Conducive	2.18	1	14	96.89
ET8S9	5.15	N	Conducive	2.574	2	30	289.87
ET8S10	7.45	N	Conducive	1.92	2	16	152.97
ET9S1	5.48	N	Conducive	2.687	2	27	133.54
ET9S2	5.62	N	Conducive	2.957	2	36	264.13
ET9S3	5.53	N	Conducive	2.73	2	29	183.88
ET9S4	5.14	N	Conducive	2.381	2	31	463.47
ET9S5	3.45	Y	Marginal	1.228	2	15	216.15
ET9S6	3.97	Y	Marginal	1.759	2	26	237.53

Appendix D (Continued)

Sample	Foram Index	Environmental Change	Reef Condition	Shannon Index	Grain Size - Phi Value	Species Richness	Foram Density
ET9S7	3.68	Y	Marginal	1.57	1.00	13.00	61.92
ET9S8	3.72	Y	Marginal	1.94	2.00	27.00	847.74
ET9S9	4.41	Y	Conducive	2.31	2.00	17.00	58.82
ET9S10	6.67	N	Conducive	1.96	0.00	8.00	14.84
ET10S1	5.21	N	Conducive	2.37	2.00	19.00	108.27
ET10S2	5.28	N	Conducive	2.61	2.00	33.00	245.36
ET10S3	4.92	Y	Conducive	2.30	2.00	27.00	186.84
ET10S4	4.66	Y	Conducive	2.05	2.00	25.00	227.77
ET10S5	4.02	Y	Conducive	3.01	1.00	34.00	112.28
ET10S6	4.66	Y	Conducive	2.51	2.00	19.00	93.44
ET10S7	5.15	N	Conducive	2.88	1.00	28.00	93.50
ET10S8	5.16	N	Conducive	2.50	1.00	23.00	99.90
ET10S9	3.42	Y	Marginal	1.66	1.00	12.00	49.62
T10S10	3.85	Y	Marginal	1.11	2.00	14.00	185.00
WT1S1	4.40	Y	Conducive	3.01	3.00	38.00	371.15
WT1S2	4.16	Y	Conducive	3.03	2.00	37.00	449.92
WT1S3	3.93	Y	Marginal	2.48	2.00	23.00	217.43
WT1S4	3.50	Y	Marginal	2.80	3.00	34.00	230.26
WT1S5	2.84	Y	Marginal	2.59	3.00	26.00	286.52
WT2S1	3.24	N	Marginal	3.34	3.00	39.00	1394.16
WT2S2	7.71	N	Conducive	1.12	0.00	4.00	20.91
WT2S3	4.69	Y	Conducive	2.36	1.00	21.00	110.89
WT2S4	3.74	Y	Marginal	2.65	2.00	28.00	214.44
WT2S5	3.65	Y	Marginal	2.80	3.00	29.00	347.37
WT3S1	2.55	Y	Marginal	3.09	2.00	33.00	552.24
WT3S2	3.67	Y	Marginal	2.91	4.00	32.00	202.63
WT3S3	3.50	Y	Marginal	2.75	2.00	28.00	167.30
WT3S4	4.32	Y	Conducive	2.60	2.00	30.00	235.29
WT3S5	5.09	Y	Conducive	2.54	2.00	28.00	195.27
WT4S1	4.34	Y	Conducive	2.80	2.00	33.00	212.02
WT4S2	4.55	Y	Conducive	2.94	2.00	34.00	377.14
WT4S3	5.84	N	Conducive	2.82	3.00	34.00	641.03
WT4S4	4.64	Y	Conducive	2.51	2.00	25.00	325.82
WT4S5	5.56	N	Conducive	2.48	2.00	23.00	345.26
WT5S1	4.35	Y	Conducive	2.40	1.00	21.00	69.38
WT5S2	5.29	N	Conducive	2.60	5.00	28.00	483.41
WT5S3	6.01	N	Conducive	2.48	2.00	24.00	336.28
WT5S4	5.77	Y	Marginal	2.69	2.14	32.97	251.81
WT5S5	5.78	Y	Marginal	2.69	2.15	33.14	242.52

Appendix E: Extra Tables

Table E.1: Sterol Concentrations and Ratios by Transect

Transect	Coprostanol	Cholestanol	Cholesterol	Coprostanol/ Total Sterol	Coprostanol/ Cholesterol
ET1	46.57	221.97	80.96	0.06	0.45
ET2	12.17	118.92	38.66	0.15	0.15
ET3	8.82	59.77	11.46	0.81	0.17
ET4	97.62	279.02	135.31	0.31	0.28
ET5	31.77	222.62	103.71	0.24	0.15
ET6	83.32	630.02	356.66	0.64	0.31
ET7	52.37	404.97	174.91	0.22	0.15
ET8	61.67	523.97	200.61	0.28	1.95
ET9	78.22	269.42	97.01	0.30	0.34
ET10	34.02	161.22	57.06	0.23	0.27
WT1	124.82	779.07	378.16	0.24	0.18
WT2	21.62	137.17	84.56	0.21	0.17
WT3	202.42	503.57	372.36	0.29	0.32
WT4	29.92	155.97	101.66	0.24	0.23
WT5	36.12	156.97	112.46	0.23	0.23

Appendix F: Extra Figures

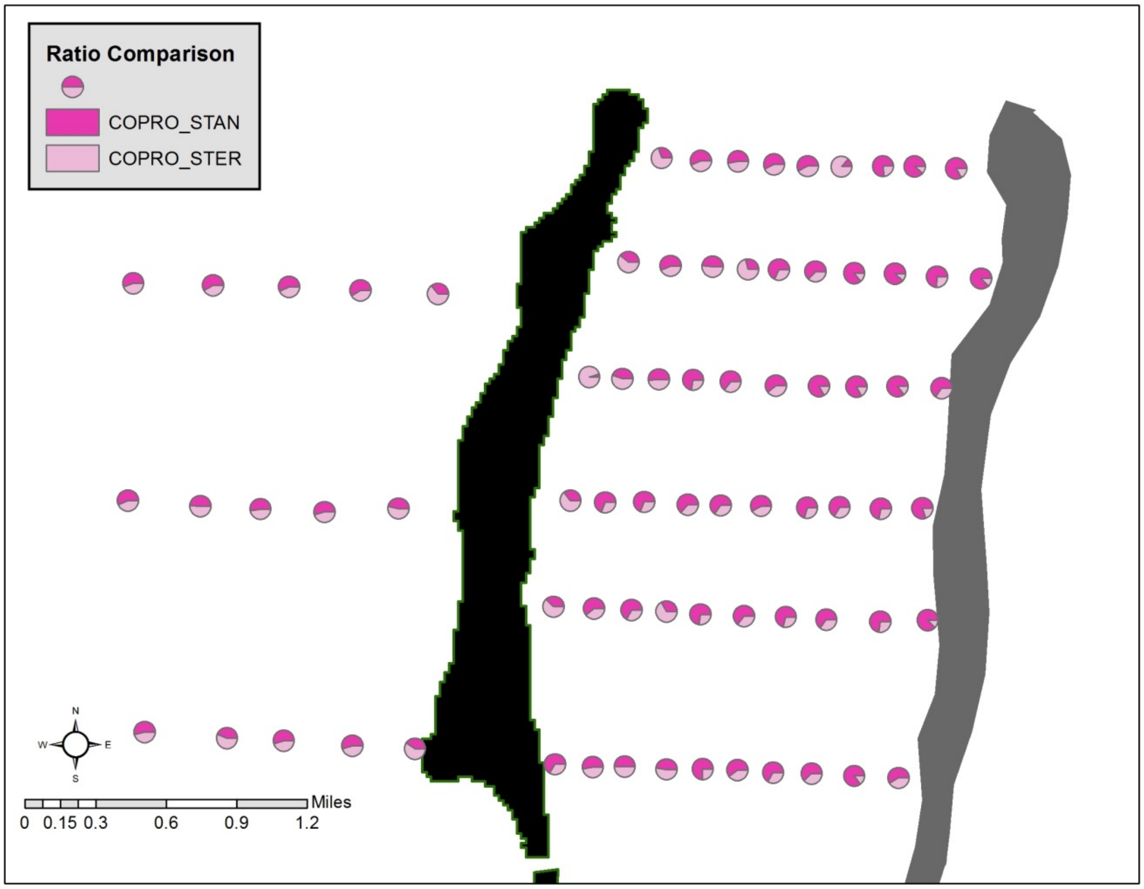

Figure F.1: Northern Ratio Comparison

Appendix F (Continued)

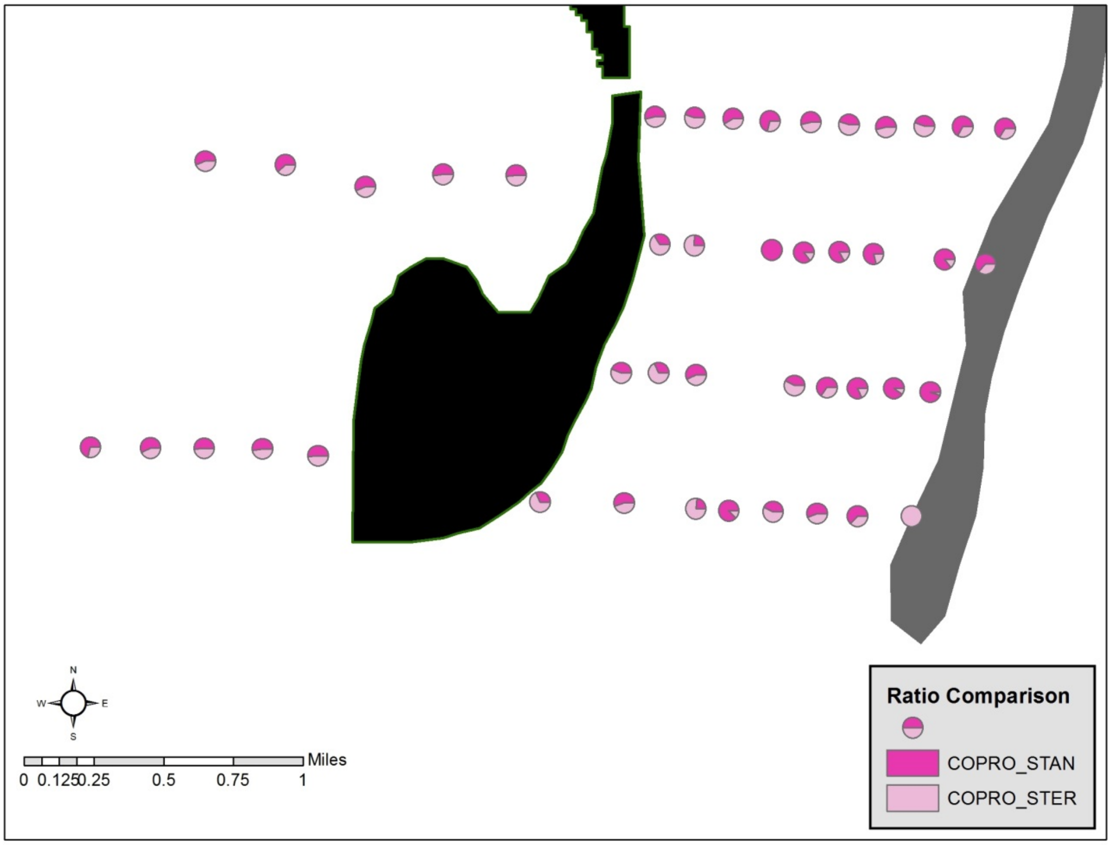

Figure F.2: Southern Ratio Comparison

Appendix G: Additional Pearson Correlations

Table G.1: Pearson Correlation for East Side Only

n=100; r= .195	Coprostanol_ Amount	Mud Percent	Foram Index	Shannon Index	Species Richness	Foram Density
Coprostanol_Amount						
Mud Percent	0.481530173					
Foram Index	-0.621108034	-0.45798				
Shannon Index	0.500433658	0.515761	-0.65487			
Species Richness	0.465118273	0.479385	-0.57919	0.98148		
Foram Density	0.341970063	0.602601	-0.40564	0.828752	0.804981	

Table G.2: Pearson Correlation by Longitudinal Analysis-Sample 1

S1; n=10; r=0.576	Coprostanol	Mud Percent	FORAM Index	Shannon Diversity	Species Richness	Foram Density
Coprostanol						
Mud Percent	-0.35167188					
FORAM Index	0.39589157	-0.31242				
Shannon Diversity	-0.5503473	0.186763	-0.41595			
Species Richness	-0.22884997	0.007527	-0.02389	0.850484		
Foram Density	-0.20328196	0.330169	-0.25092	0.676949	0.70305	

Table G.3: Pearson Correlation by Longitudinal Analysis-Sample 2

S2; n=10; r=0.576	Coprostanol	Mud Percent	FORAM Index	Shannon Diversity	Species Richness	Foram Density
Coprostanol						
Mud Percent	0.04166603					
FORAM Index	0.33942927	-0.50798				
Shannon Diversity	0.17637116	0.259178	-0.63175			
Species Richness	0.24634739	0.118162	-0.49407	0.88396		
Foram Density	-0.28002992	0.05201	-0.66651	0.819661	0.65689	

Appendix G (Continued)

Table G.4: Pearson Correlation by Longitudinal Analysis-Sample 3

S3; n=10; r=0.576	Coprostanol	Mud Percent	FORAM Index	Shannon Diversity	Species Richness	Foram Density
Coprostanol						
Mud Percent	0.46288219					
FORAM Index	-0.5839544	-0.32237				
Shannon Diversity	0.72514848	0.146062	-0.44341			
Species Richness	0.70520102	0.302036	-0.40058	0.799715		
Foram Density	0.37786326	-0.3034	-0.17283	0.477037	0.298853	

Figure G.5: Pearson Correlations by Longitudinal Analysis-Sample 4

S4; n=10; r=0.576	Coprostanol	Mud Percent	FORAM Index	Shannon Diversity	Species Richness	Foram Density
Coprostanol						
Mud Percent	0.62533114					
FORAM Index	-0.33307744	-0.24057				
Shannon Diversity	0.07433811	-0.29735	-0.44576			
Species Richness	0.46829342	0.083589	-0.59509	0.755812		
Foram Density	-0.35655759	-0.34319	-0.21768	0.299942	0.208075	

Table G.6: Pearson Correlations by Longitudinal Analysis-Sample 5

S5; n=10; r=0.576	Coprostanol	Mud Percent	FORAM Index	Shannon Diversity	Species Richness	Foram Density
Coprostanol						
Mud Percent	0.50040007					
FORAM Index	-0.38910118	0.029513				
Shannon Diversity	0.38362217	0.36682	0.07447			
Species Richness	0.57497757	0.117499	-0.2104	0.866327		
Foram Density	0.53860693	-0.01273	0.00583	0.198986	0.308728	

Table G.7: Pearson Correlations by Longitudinal Analysis-Sample 6

S6; n=10; r=0.576	Coprostanol	Mud Percent	FORAM Index	Shannon Diversity	Species Richness	Foram Density
Coprostanol						
Mud Percent	0.19594371					
FORAM Index	-0.3465137	0.114163				
Shannon Diversity	0.05337761	0.503001	0.027621			
Species Richness	-0.02451397	0.523628	-0.17024	0.470434		
Foram Density	-0.33525285	0.400509	0.349323	0.122489	0.622599	

Appendix G (Continued)

Table G.8: Pearson Correlations by Longitudinal Analysis-Sample 7

S7; n=10; r=0.576	Coprostanol	Mud Percent	FORAM Index	Shannon Diversity	Species Richness	Foram Density
Coprostanol						
Mud Percent	-0.25644987					
FORAM Index	-0.2457343	0.556692				
Shannon Diversity	0.04699586	0.324894	0.2739			
Species Richness	-0.0957212	0.317846	0.218431	0.928835		
Foram Density	-0.05288737	0.438726	0.50959	0.46203	0.599246	

Figure G.9: Pearson Correlations by Longitudinal Analysis-Sample 8

S8; n=10; r=0.576	Coprostanol	Mud Percent	FORAM Index	Shannon Diversity	Species Richness	Foram Density
Coprostanol						
Mud Percent	0.13257006					
FORAM Index	-0.52085509	-0.10858				
Shannon Diversity	0.26824439	0.02479	0.248237			
Species Richness	0.4219051	0.185128	-0.34783	0.601738		
Foram Density	0.27951457	0.074253	-0.47613	-0.1326	0.624433	

Table G.10: Pearson Correlations by Longitudinal Analysis-Sample 9

S9; n=10; r=0.576	Coprostanol	Mud Percent	FORAM Index	Shannon Diversity	Species Richness	Foram Density
Coprostanol						
Mud Percent	0.12369558					
FORAM Index	0.49146355	0.303713				
Shannon Diversity	0.62963839	0.268109	0.720703			
Species Richness	0.42713622	-0.1115	0.802898	0.779956		
Foram Density	0.14259405	0.141438	0.695693	0.579553	0.806464	

Table G.11: Pearson Correlations by Longitudinal Analysis-Sample 10

S10; n=10; r=0.576	Coprostanol	Mud Percent	FORAM Index	Shannon Diversity	Species Richness	Foram Density
Coprostanol						
Mud Percent	-0.1792367					
FORAM Index	0.31916517	-0.2457				
Shannon Diversity	0.49859883	0.527196	-0.26541			
Species Richness	0.44172299	0.388694	-0.49404	0.906341		
Foram Density	0.16721015	0.333456	-0.6239	0.776966	0.920052	

Appendix G (Continued)

Table G.12: Pearson Correlations on Opportunistic Species

Pearson Correlation >125 samples: 0.166	**Ammonia**	**Cribro-elphidium**	**Elphidium**
Coprostanol_Amount	0.157067	-	0.216649
Mud Percent	0.191217	0.305961	0.304136
Foram Index	-0.234524	-0.155647	-0.232687
Shannon Index	0.175430	-	0.367910
Species Richness	0.175795	-	0.379410
Foram Density	0.168136	-	0.200988

Table G.13: Pearson Correlations based on Heterotrophic Species

Coprostanol_Amount	**Haurina**	**Quinquelo-culina**	**Triloculina**	**Textularia**	**Valvulina**
Coprostanol_Amount	0.277768	-	0.206516	-0.232316	0.194078
Mud Percent	-	0.365684	0.306869	-0.270788	-0.328947
Foram Index	-	-0.157010	-0.224250	0.304486	-
Shannon Index	0.260789	0.362758	0.634125	-	0.192351
Species Richness	0.327895	0.193315	0.550625	-	0.216495
Foram Density	-	0.185683	0.406087	0.251977	-

Table G.14: Pearson Correlations based on Symbiont-bearing Species

Pearson Correlation >125 samples: 0.166	**Amphistegina**	**Archaias**	**Asterigerina**	**Laevipene-roplis**	**Sorites**
Coprostanol_Amount	-	-	-0.202509	-0.194448	0.256167
Mud Percent	-0.164517	-	-0.420035	0.167341	-
Foram Index	0.193358	0.387389	0.446744	0.343834	-
Shannon Index	-0.387895	-	0.161006	0.233913	0.352253
Species Richness	-0.305688	-	0.220778	-	0.277361
Foram Density	-0.329540	-	0.247851	0.398665	-