

Site Summaries

RATIONALE

The purpose of this section is to provide a more comprehensive survey of TCRMP site characteristics than can be achieved in the overall data compilations. Each TCRMP monitoring site is each unique and has experienced unique responses to local and global stressors. Given the increase in sites included under this program and the inclusion of more information at each site, such as physical data, this section is designed to provide a summary that highlights the each site's characteristics and serves as a quick reference guide for managers, policy makers, and academics. The duration of surveys at most sites also now provides sufficient data from which to draw conclusions about longer term site dynamics and the processes that might be contributing to recent trajectories of health, development, and degradation.

SITE SUMMMARY ELEMENTS

TCRMP site information is presented in six pages that provide a brief description of the setting and the potential susceptibility to local and global stressors and disturbances. Subsections include a description of (1) the physical environment, (2) the benthic community and (3) the fish community. The benthic data and coral health are updated in each annual report, whereas the fish summaries and physical data are updated periodically.

Benthic community structure is presented as the mean ($\pm$ SE) cover of coral, macroalgae, cyanobacteria, and epilithic algae. Epilithic algal communities are diminutive turf and filamentous algae that cover hardbottom surfaces, whilst macroalgae have identifiable thallus differentiation and structure. Any open hardbottom space is assumed to host an epilithic algal community even if algae cannot be resolved in video images. The loss of coral cover due to the 2005 bleaching event was calculated as the relative change in coral cover from 2005 to 2007, unless otherwise noted for sites not sampled in these years. In addition, the percent recovery from the 2005 bleaching event was calculated as the amount of coral cover regained by 2011 $(\text{Cover}_{2011} - \text{Cover}_{2007})/(\text{Cover}_{2005} - \text{Cover}_{2007})$. Change calculations must be treated with caution for sites where transects were not made

SITE SUMMARIES

permanent until after the 2005 bleaching event or where percent cover is low, since the conditions introduce an unknown amount of error.

Benthic community pie charts were constructed from all years of data. The sessile epibenthic animal community includes *Agaricia* spp., *Colpophyllia natans*, *Diploria strigosa*, *Orbicella*¹ spp. (*O. faveolata*, *O. franksi*, + unidentified *Orbicella* spp.), *Orbicella annularis*, *Montastraea cavernosa*, *Porites astreoides*, branching *Porites* species, *Siderastrea siderea*, other corals, sponges, gorgonians. The algae/non-living substrata category includes cyanobacteria, epilithic algae (“DCA”), *Lobophora variegata*, *Dictyota* spp., *Halimeda* spp. crustose coralline algae, and sand/sediment.

Coral Health is presented as the mean ($\pm$ SE) of coral bleaching prevalence (proportion of population affected) and extent (proportion of colony affected), disease prevalence, and partial mortality prevalence.

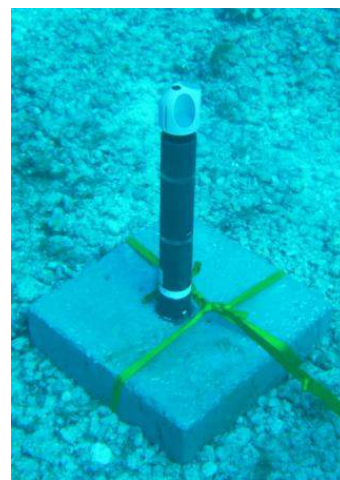
PHYSICAL CHARACTERISTICS.

Temperature. Benthic

temperatures were recorded at each site with a HoboTemp™ thermistor data logger (Onset



Computer Corporation, Bourne, Massachusetts). Thermistors were affixed within transects and set to record at intervals of 15 minutes. Records are presented as daily averages across months, February 29th excluded. Each temperature figure includes the climatological monthly maximum mean temperature (28.5°C), and the bleaching threshold temperature (29.5°C) established for the region (NOAA 2006). Data for 2005 was taken from current profilers or federal data sources.



Currents. Water currents were recorded at a subset of sites and

¹ The genus *Orbicella* was formerly named *Montastraea*, but changed in 2012 reflecting an earlier precedence and dissimilarity with *Montastraea cavernosa* (Budd et al. 2012). Some figures in this report may still abbreviate the genus name as “M.”

SITE SUMMARY

times with Nortek Aquadopp™ Acoustic Doppler Current Profilers (ADCPs). Profilers were set in bases on the seafloor and set to record current speed and direction within predefined depth bins above the substrate. The bin closest to the substrate and closest to the coral reef was selected for display. Compass rose figures were developed that show the frequency of current in magnetic directions 0, 22.5, 45, 67.5, 90, 112.5, 135, 157.5, 180, 202.5, 225, 247.5, 270, 292.5, 315, 337.5, 360°. Within each direction the frequency of current speed within bins of 0.1 m s⁻¹ were plotted. For Flat Cay, current data was retrieved with an Aandaraa 2-D current meter that measured current speed and direction directly over the sensor head.

Chlorophyll and Turbidity. Continuous fluorometric measurements of chlorophyll and turbidity were conducted at some sites for short periods (Black Point, Grammanik, Magens Bay). Wetlabs ECOFLNT fluorometers with antifouling bio-wipers were deployed and set to record for one minute at hourly intervals. Water column chlorophyll measurements detect phytoplankton abundance. Fluorometric measurements of chlorophyll are proxies for true chlorophyll concentrations. Direct chlorophyll measurements to calibrate fluorometric measurements have not been conducted at the monitoring sites.

St. Thomas

SITE SUMMARIES

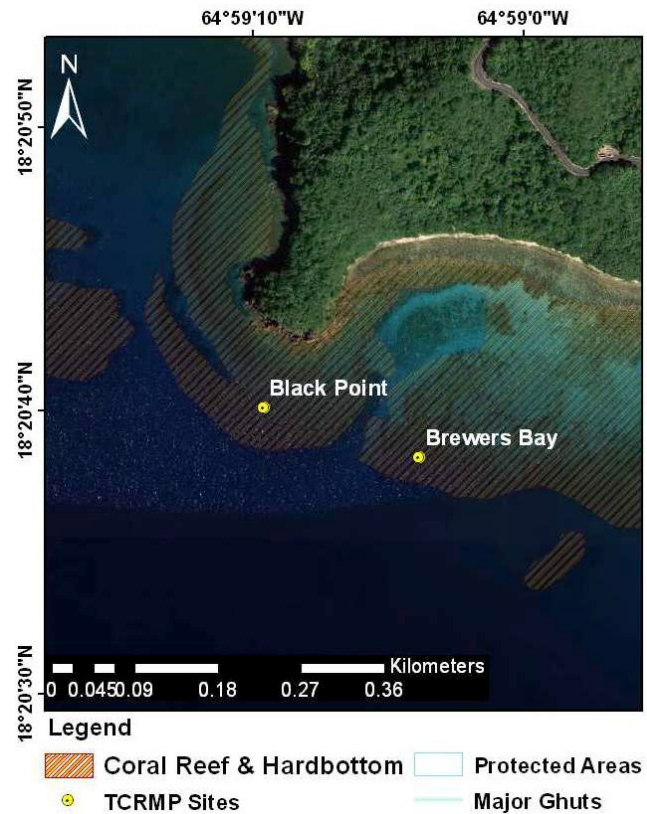
BLACK POINT

Description. Black Point is a nearshore fringing reef located at the mouth of Brewers Bay along the southwest coast of St. Thomas in water depths of 7 – 17 m. The reef has a sharp break in slope leading to a steep escarpment that terminates in a sediment plain at the reef base. Black Point appears to be a true reef with a well-developed carbonate framework over bedrock. Black Point has been monitored since 2003, with permanent benthic transects installed in 2007. A ciguatera fish poisoning study with monthly sampling has been ongoing since 2009.

Outstanding Feature. Black Point supports a fish spawning aggregation of striped parrotfish (*Scarus iserti*) with afternoon mating at the edge of the upper reef break.

Threats. Brewers Bay subjected to land-based sources of pollution and tends to have turbid water and overgrowth by heterotrophic organisms, such as sponges. Recreational/artisanal fishers with handline and spear frequently fish this site.

Figure 97. Black Point. (top) Location. (right) A representative photo of the reef.



BLACK POINT

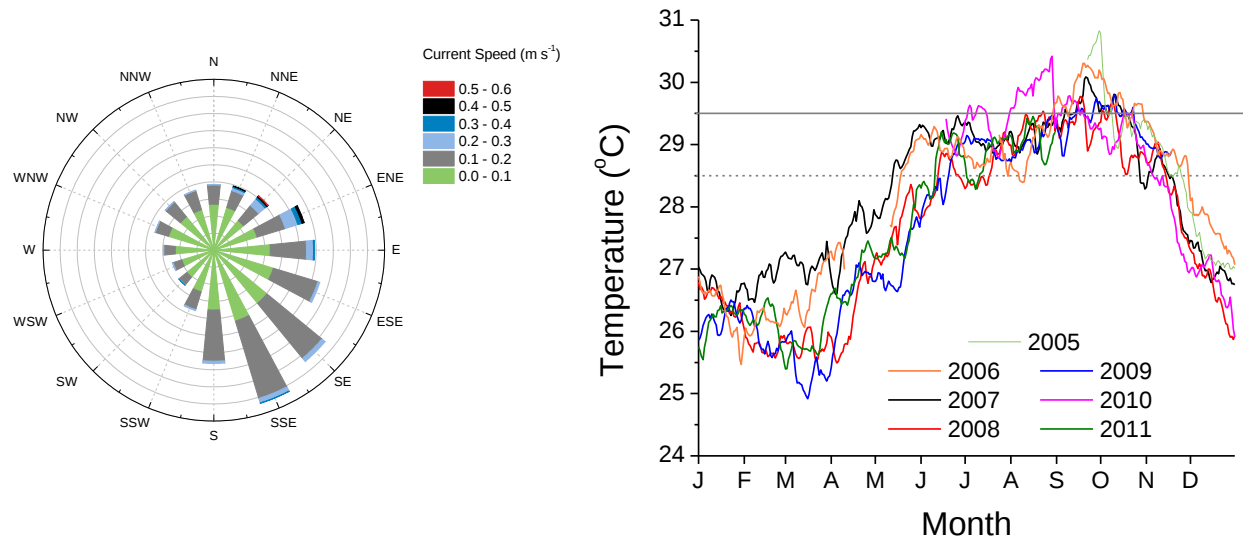


Figure 98. Black point current speed and benthic temperature record (8 m depth).

Physical Characteristics. Current. Black Point has restricted water flow dominated by weak currents running counter or orthogonally to the left of the dominant wind direction. This may indicate that there is a counter flowing eddy from Perseverance Bay to the west that impinges on the headland. Current data are based on average data taken every 30 min. (11/29/06 to 3/1/2007) and hourly (4/19/07 to 9/5/07). **Temperature.** Black Point has low circulation and relatively high mean temperatures with very low day-to-day variability. **Chlorophyll & Turbidity.** Chlorophyll tends to be high at Black Point, likely due to inputs of land-based nutrients that fuel pelagic productivity. There are also exists a very prominent tidal signature that reflects switching source currents at the reef.

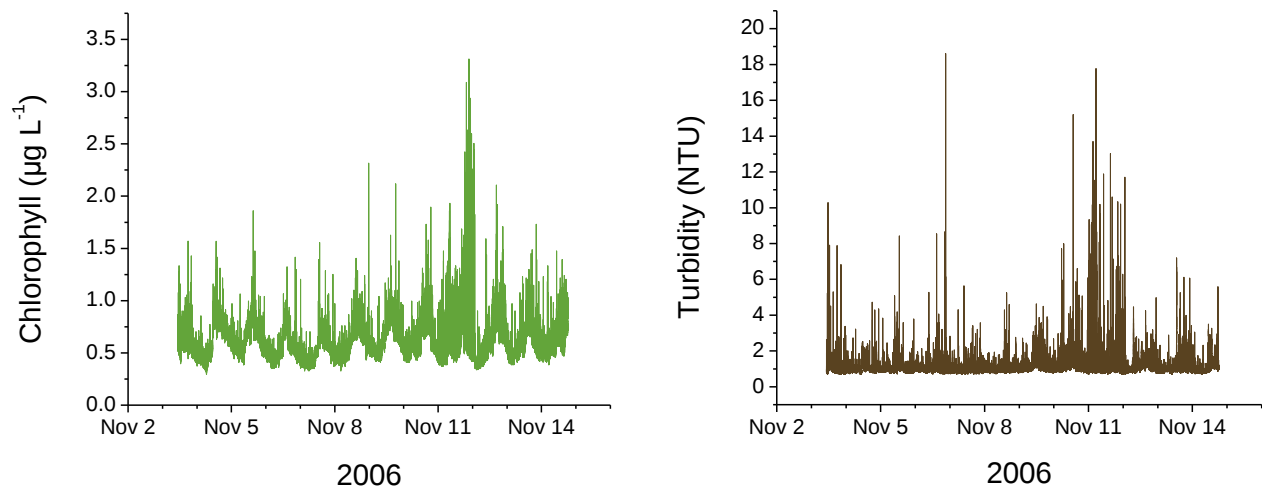


Figure 99. Black Point chlorophyll (left) and turbidity (right) record (16 m depth)

SITE SUMMARIES

Benthic Community. Black Point supports a very diverse coral community with very equal representation by many coral species. However, large colonies (> 100 cm diameter) of *Orbicella annularis* and *Orbicella faveolata* occur on the eastern edge of the site, with a few occurring within transects. This coral community lost 40.5% of its coral cover in the 2005 bleaching event; however, by 2011 it had regained 103.5% of its coral cover. The algal community at Black Point is co-dominated by epilithic algae and the macroalga *Dictyota* spp..

Coral Health. Black point corals were severely affected during the 2005 bleaching event with nearly all colonies bleached over 100% of the colony surface. The prevalence of coral diseases was moderate with dark spots disease predominating. However, white disease outbreaks occurred at least twice over the sampling period. Old partial mortality became very prevalent after the 2005 coral bleaching event and subsided in the following two years.

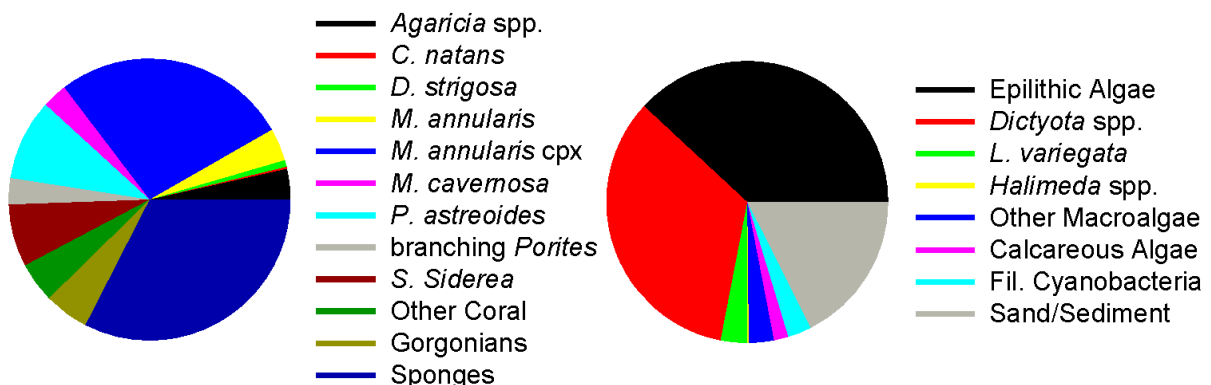


Figure 100. Black Point. (left) Relative composition of the sessile epibenthic animal community. (right) Relative composition of the algal community and unconsolidated sediment.

BLACK POINT

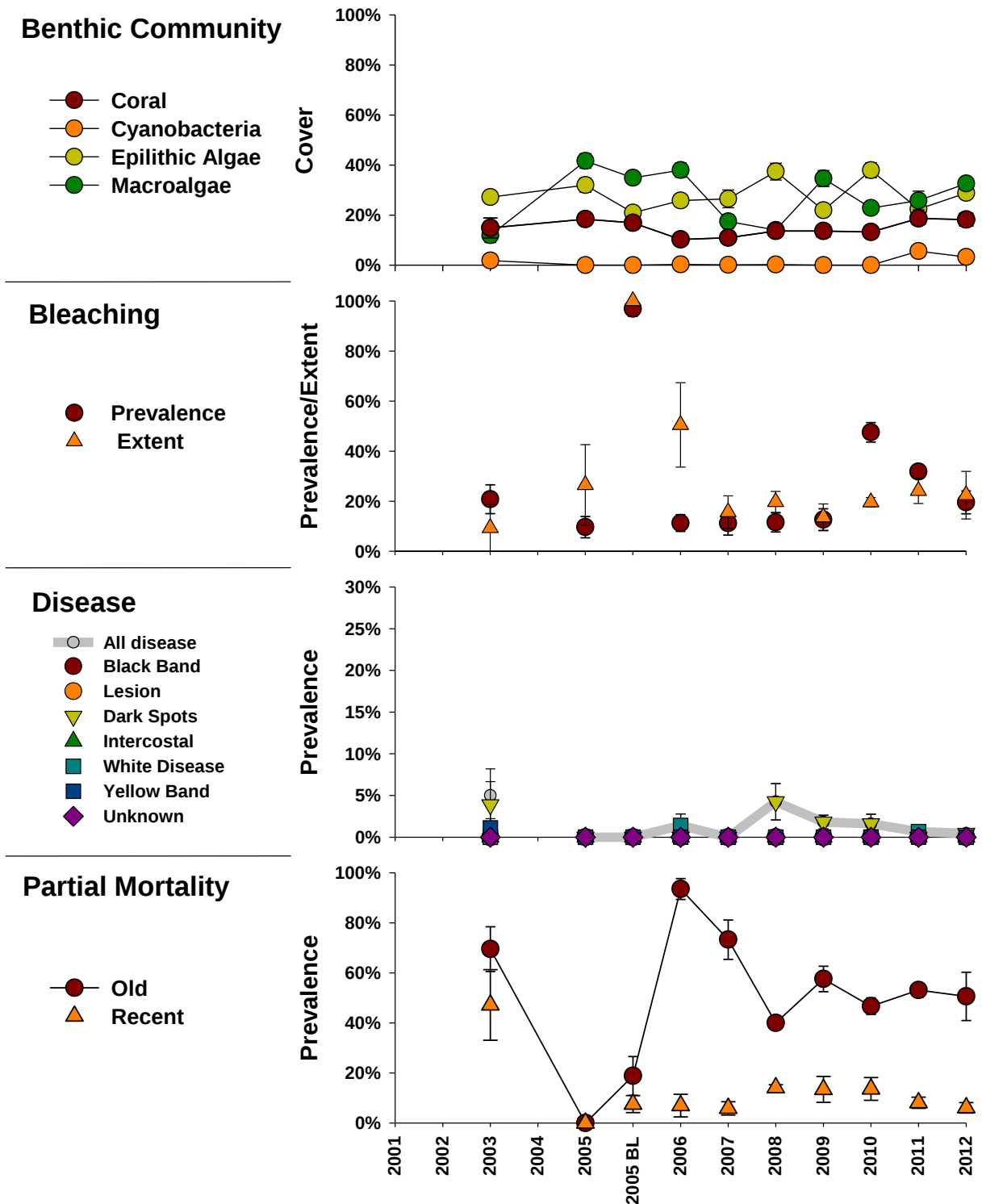


Figure 101. Black Point benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Black Point is highly dominated by herbivores. Juvenile parrotfish and damselfish are numerous. Brown chromis are equally abundant. The site is turbid and holds very few large fish, although the occasional cubera snapper, Nassau grouper, and yellowfin grouper are spotted, a rarity for nearshore areas of the USVI. A resident mutton snapper is regularly observed cruising the sand line at the bottom of the reef. Hamlets are diverse and common. The black hamlet is especially abundant among the hamlets. In the mid to late afternoon striped parrotfish (*Scarus iserti*) spawn at Black Point. They can be seen swimming along the reef edge in large groups beginning in the early afternoon. Spawning goes in to the late afternoon and involves tens of fish. Black Point is close to shore and is not trapped often; however, divers can swim to the reef from the beach to spearfish. It is notably absent of resident large edible fish.

BLACK POINT

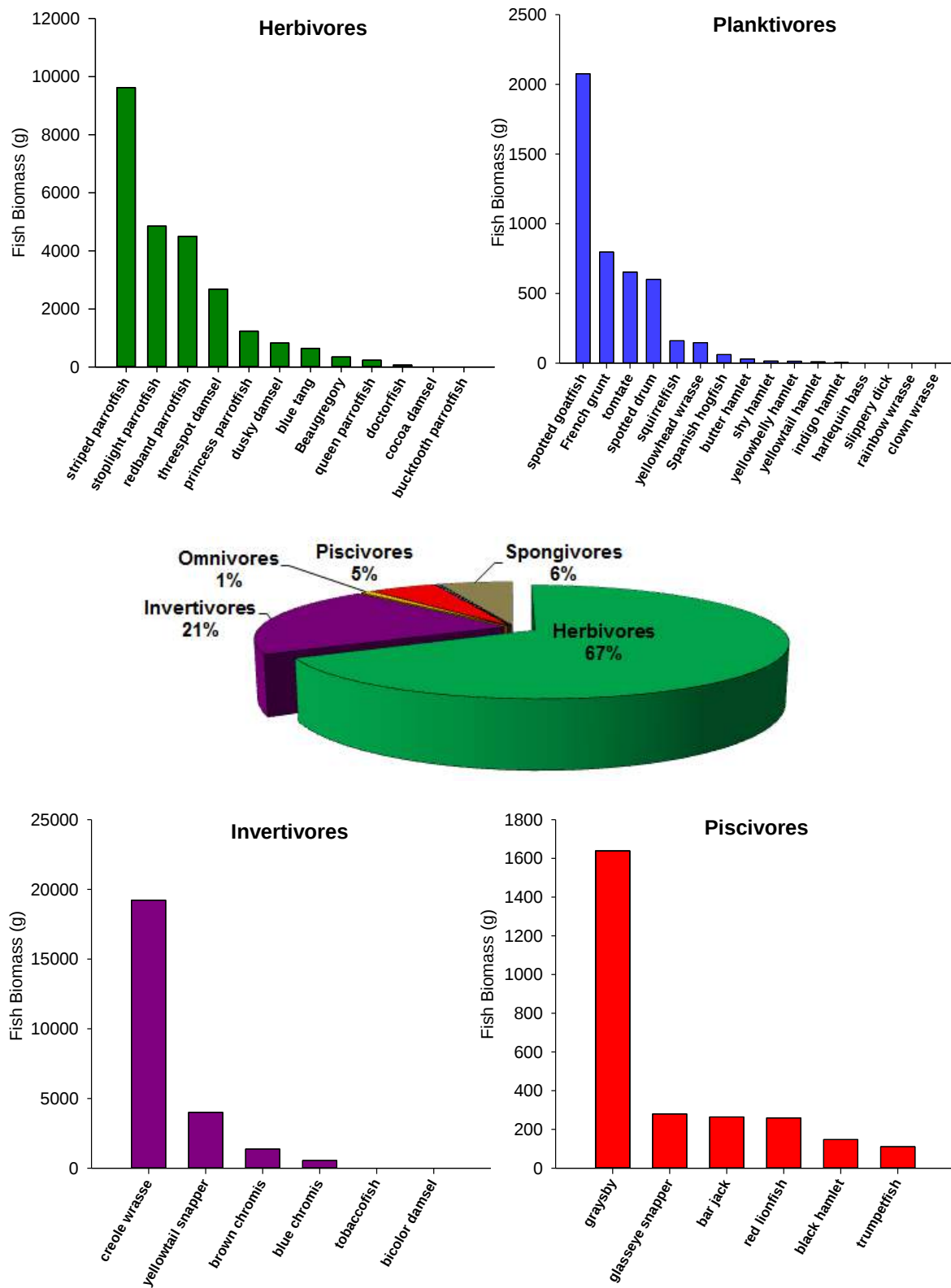


Figure 102. The Black Point fish community by absolute and relative biomass.

SITE SUMMARIES

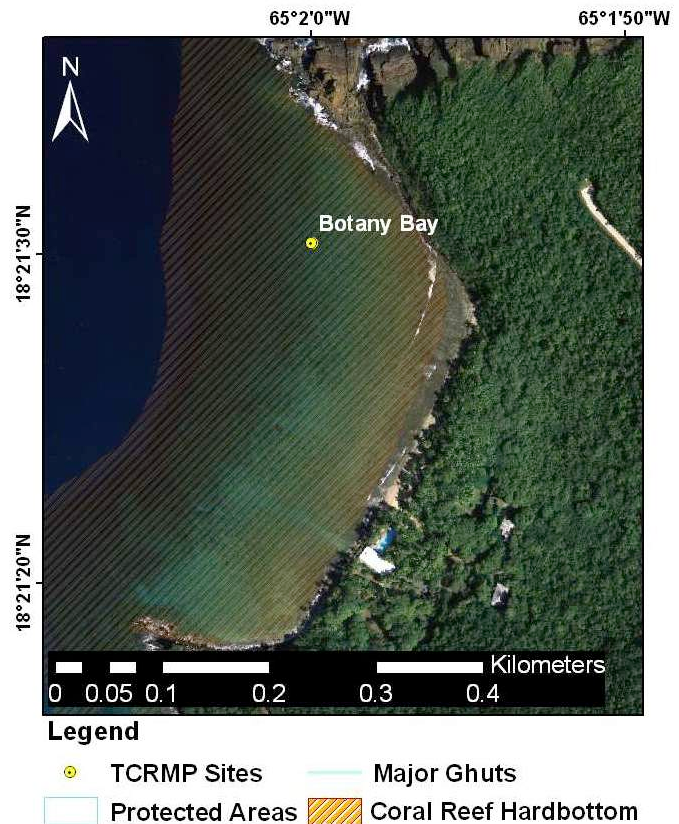
BOTANY BAY

Description. The Botany Bay site is located on the fore slope of a nearshore fringing reef in water depths of 5 – 17 m. The reef crest is a distinct spur-and-groove, with a sharp break in slope leading to an escarpment that terminates in a sand/sediment plain at the reef base. Botany Bay has been monitored since 2002.

Outstanding Feature. Botany Bay supports a diverse and productive reef that is one of the prettiest nearshore reefs in the Virgin Islands and is surrounded by one of the most aesthetically pleasing locales on St. Thomas.

Threats. Botany Bay is threatened by development of the previously fully vegetated watershed and increased land-based sources of pollution. The area is open to fishing. Increased residential development in the watershed may lead to increased recreational use of the reef, including fishing and collecting. The area is also occasionally impacted by large Atlantic swells, causing breakage of corals.

Figure 103. Botany Bay. (top) Location. (right) A representative photo of the reef.



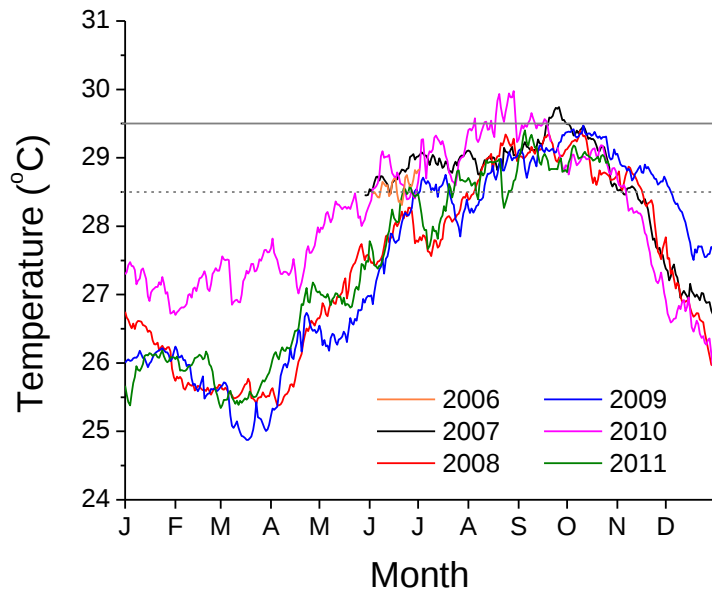


Figure 104. Botany Bay benthic temperature record (11 m depth).

Physical Characteristics. Current. Currents have not been measured at directly at Botany Bay. Unidirectional currents do not tend to be strong. Wave-driven oscillatory currents can impact the reef crest and fore reef. The site is vulnerable to impacts from large Atlantic swells. Many corals were broken and toppled during the 2009 March swell event when offshore swells reached heights to 4 m. **Temperature.** Botany Bay tends to have slightly cooler temperatures than other nearshore sites, likely owing to its open position facing the Atlantic.

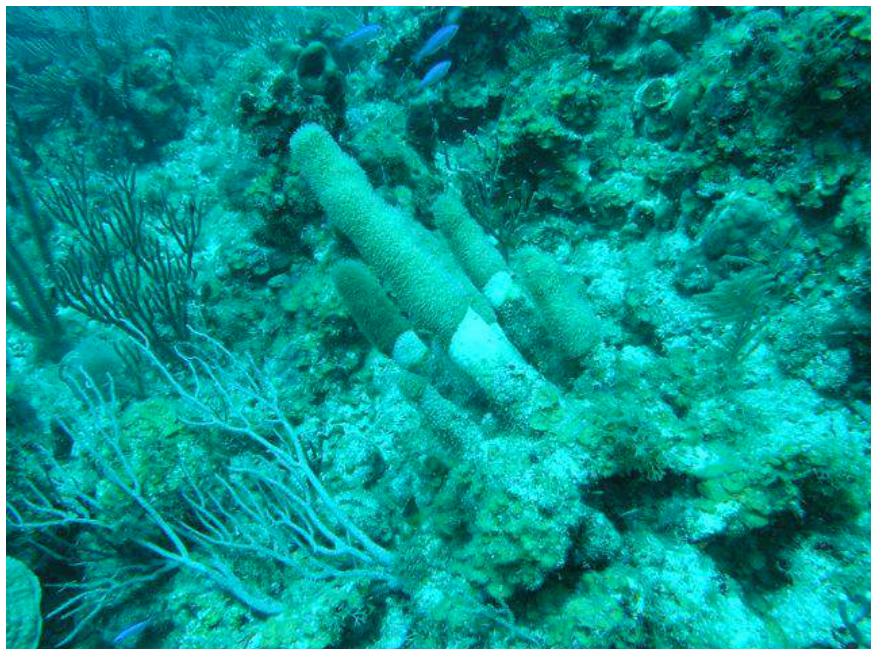


Figure 105. A large colony of pillar coral (*Dendrogyra cylindrica*) dislodge, toppled, and diseased after the 2009 swell event (Botany Bay, June 25, 2009).

SITE SUMMARIES

Benthic Community. The Botany Bay site coral community is unique for the dominance of branching *Porites* spp., particularly *Porites porites*. The site lost 38.9% of its coral cover in the 2005 bleaching event and had regained 10.6% by 2011. There is a high abundance of gorgonians on the seaward slope exposed to wave swell. The Botany Bay algal community is co-dominated by epilithic algae and the macroalga *Dictyota* spp., which tend to negatively covary.

Coral Health. Bleaching was extremely severe during 2005, with nearly 100% of corals bleached or pale over 100% of their surface. There was also a high prevalence of bleaching in 2002 at an unknown extent and in 2010 at a low extent. Non-thermal stress years have seen variable bleaching. Coral diseases can be high at Botany Bay, with a preponderance of white and dark spots diseases, and lesions that are likely related to white disease. Old partial mortality shows a pattern that is difficult to explain before 2005. During bleaching and afterwards consistent observers have done partial mortality assessments and this data is valid. There was a large increase in old partial mortality after the 2005 bleaching event, then some subsidence and leveling off after 2008. Recent partial mortality was high through most years of monitoring, largely due to biting by territorial damselfish (*Stegastes* spp.; data not shown).

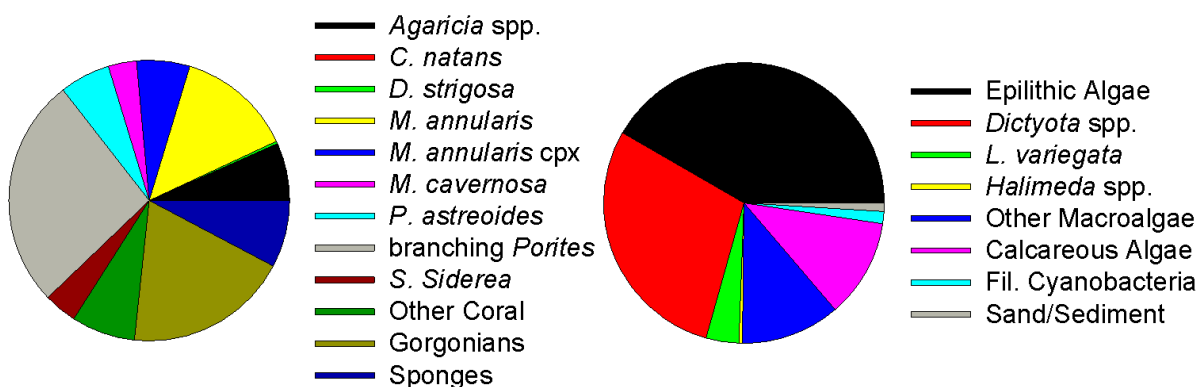


Figure 106. Botany Bay. (left) Relative composition of the sessile epibenthic animal community. (right) Relative composition of the algal community and unconsolidated sediment.

BOTANY BAY

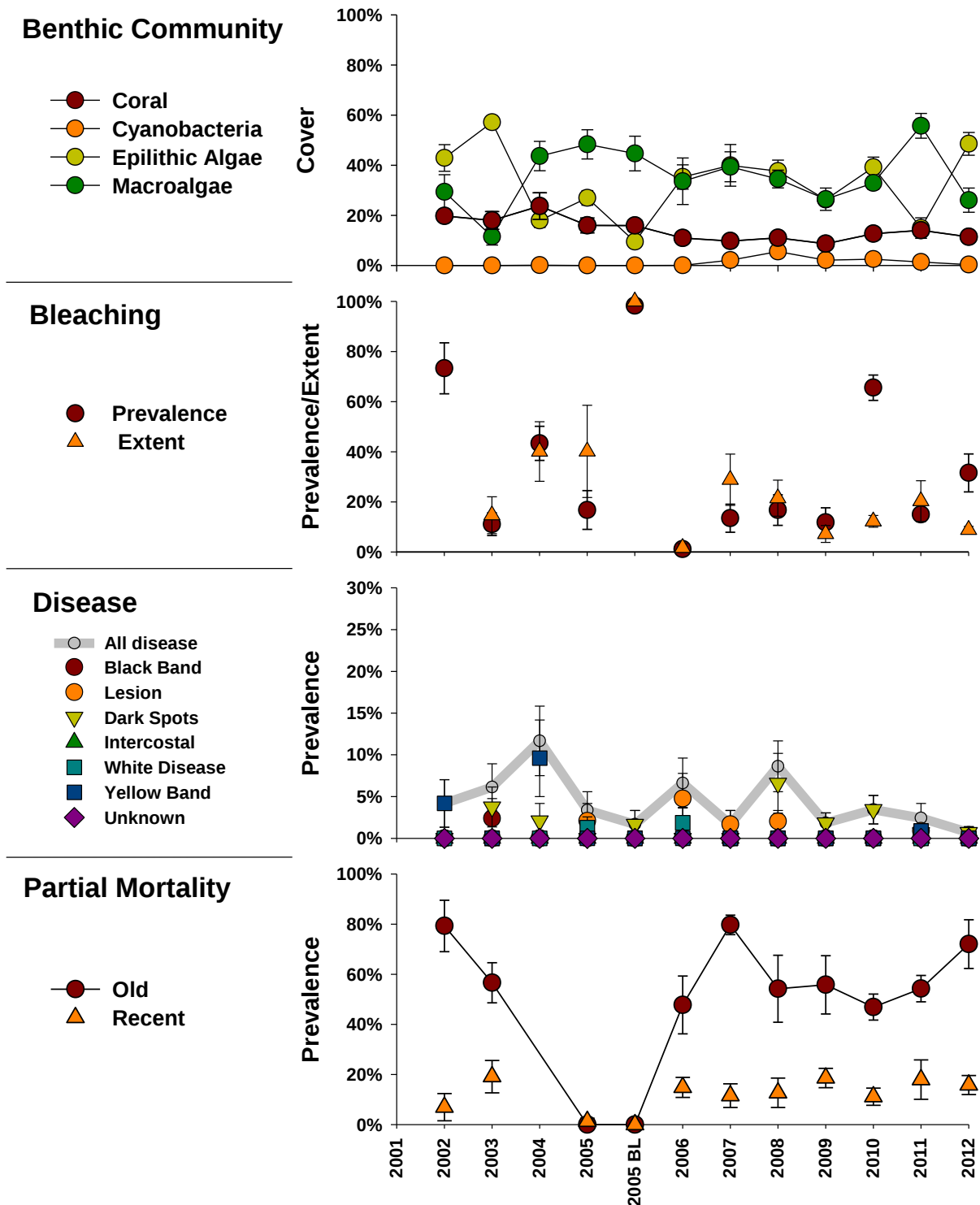
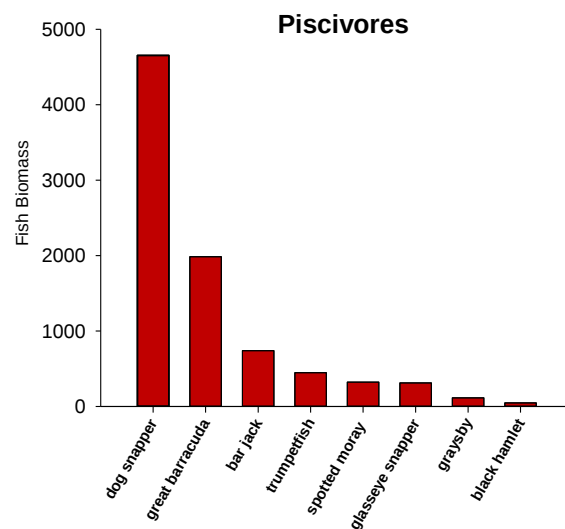
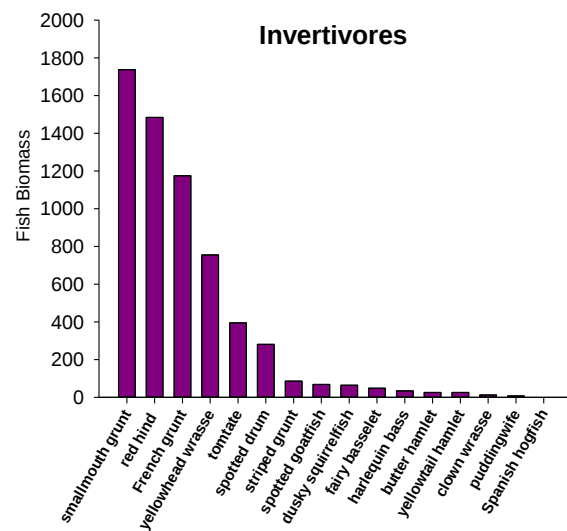
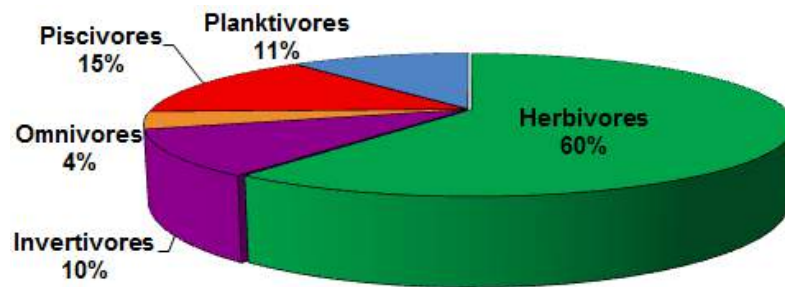
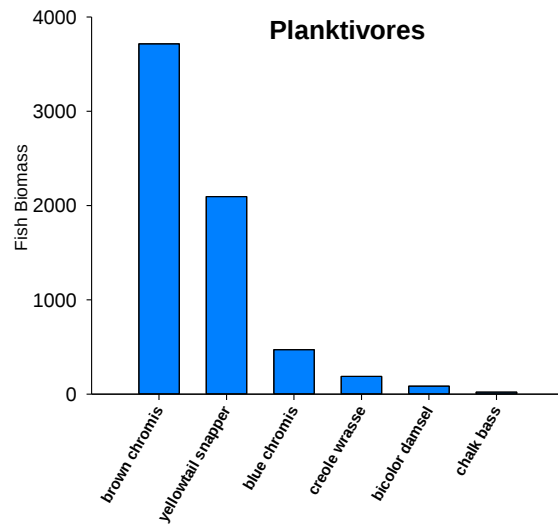
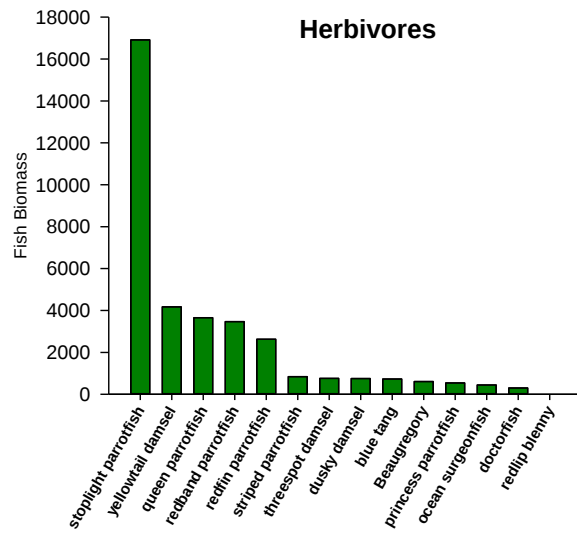


Figure 107. Botany Bay benthic cover and coral health through time (mean $\pm$ SE).

Fish Community. The fish community at Botany Bay is typical of a well developed nearshore reef around St. Thomas. The site is dominated by herbivores, primarily large stoplight parrotfish. Large habitat diversity at the site supports fish species richness; and all trophic groups are well represented. Botany had a highly diverse fish community, similarly to Cane Bay, St. Croix. These sites may each be recruitment sinks owing to their position on the northwest sides of the islands where eddies tend to recirculate. Red hind, dog snapper and several yellowtail snapper were recorded in fish transects in 2012. On roving dives, spiny lobsters are nearly always encountered. Grunts and wrasses are especially numerous and diverse on the site. Like most nearshore reefs, large jacks and balistids are nearly absent, and the planktivore community is comprised mainly of blue and brown chromis.

BOTANY BAY



SITE SUMMARIES

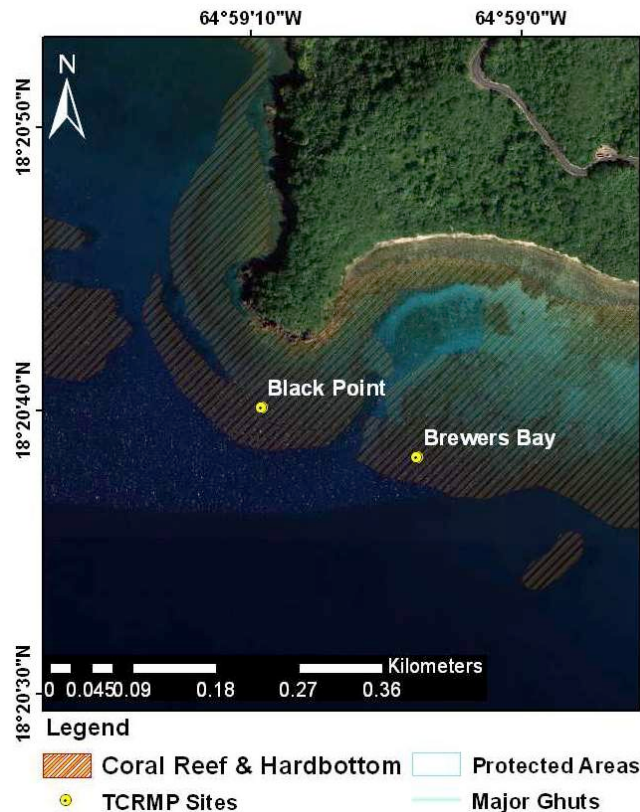
BREWERS BAY

Description. Brewers Bay is a nearshore fringing reef located at the mouth of Brewers Bay along the southwest coast of St. Thomas in water depths of 7 – 17 m. Brewers Bay is a very well develop boulder star coral (*Orbicella annularis*) dominated reef. Brewers Bay was initially monitored in 2002/2003, but was abandoned due to its proximity to the Black Point site. It was picked-up again in 2008 due the excellent coral development and resistance to bleaching impacts.

Outstanding Feature. Brewers Bay is very good example of a nearshore boulder star coral fringing reef and has fared better than other reefs of this type over the 2005 mass coral bleaching event.

Threats. Brewers Bay is subjected to land-based sources of pollution, is located directly below a trash dumpster collection area, and tends to have turbid water and overgrowth by heterotrophic organisms, such as sponges. Recreational/artisanal fishers frequently fish Brewers Bay with hand line and spear. The site has a great deal of marine debris, including boat hulls, rope, and metal pieces.

Figure 108. Brewers Bay. (top) Location. (right) A representative photo of the reef.



BREWERS BAY

Physical Characteristics.

Current. Brewers Bay currents have not been measured directly, but both unidirectional and oscillatory currents are usually very low in magnitude. See also the Black Point physical data, which was taken within 500m distance.

Temperature. Brewers Bay temperatures have not been recorded directly, but see the Black Point temperature data. The site has restricted flow and should develop high warm season temperatures.

SITE SUMMARIES

Benthic Community. The Brewers Bay site is highly dominated by the boulder coral *Orbicella annularis* and exhibits the highest coral cover of any nearshore site in the TCRMP, with a coral cover of 32% in 2011. Coral cover was not monitored between 2003 and 2008; however there was a 28.4% decline in cover that could largely be attributed to the 2005 coral bleaching event. The algal community at Brewers Bay is dominated by epilithic algae, with lesser amounts of the macroalga *Dictyota* spp..

Coral Health. Corals at the Brewers Bay site were not monitored for health over the 2005 bleaching event. However, corals exhibited some of the highest prevalence of bleaching during the 2010 coral bleaching event, albeit at a low extent. In other years bleaching prevalence remained high, with a low extent. Yellow band disease outbreaks were severe and affected the *O. annularis* community in 2002 and 2003. Old partial mortality is a prominent and persistent feature of the large *O. annularis* colonies. Recent mortality is very high and largely attributable to the biting of large populations of the territorial three-spot damselfish (*Stegastes planifrons*; data not shown).

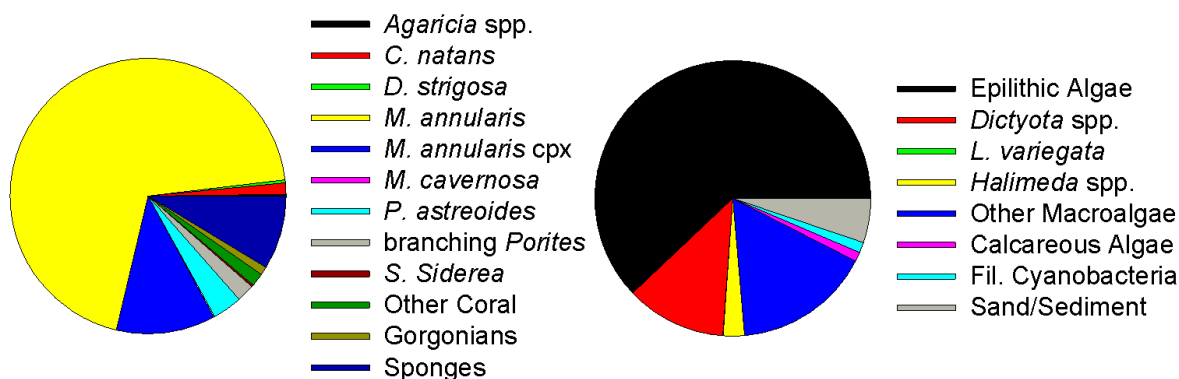


Figure 109. Brewers Bay. (left) Relative composition of the sessile epibenthic animal community. (right) Relative composition of the algal community and unconsolidated sediment.

BREWERS BAY

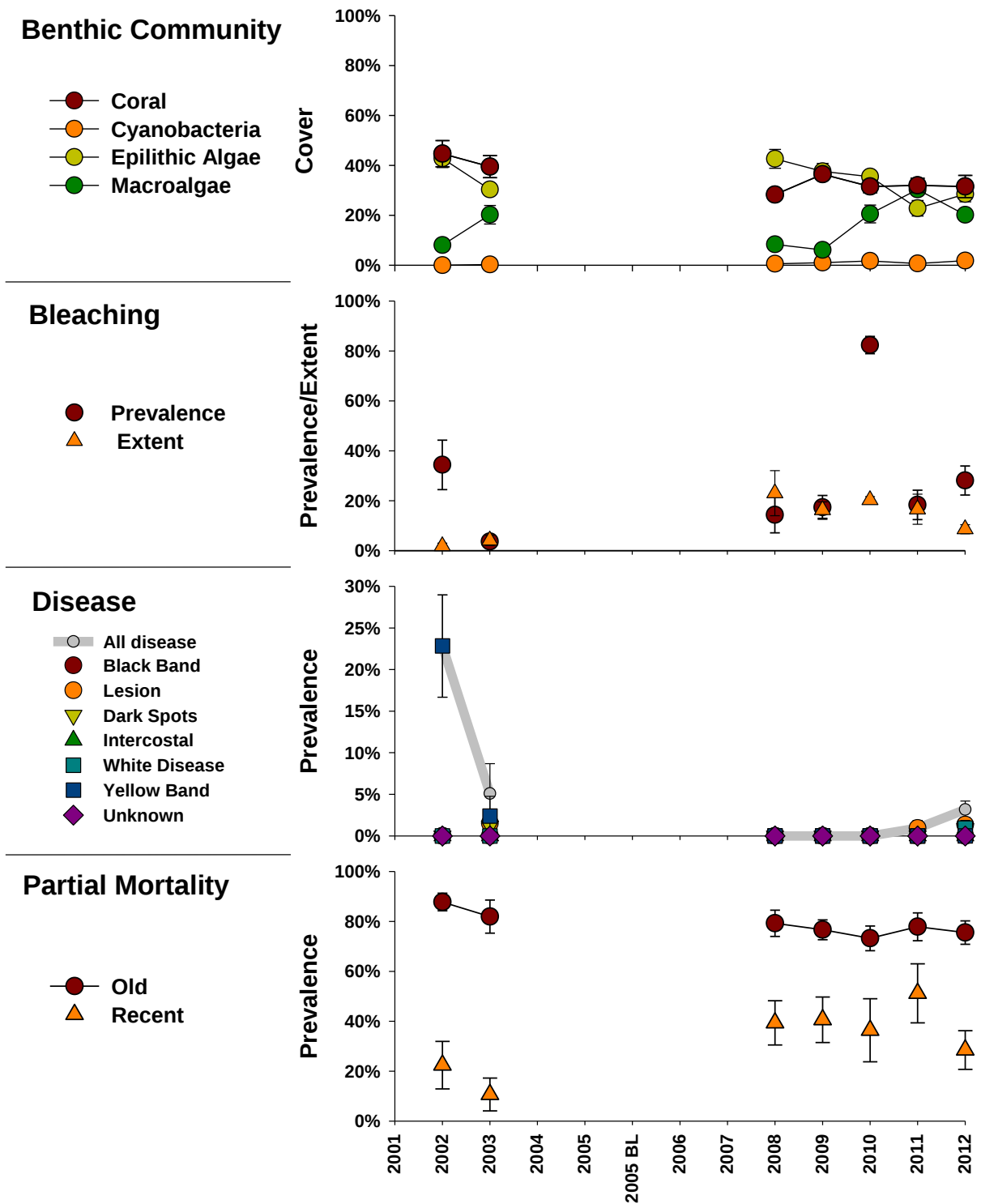


Figure 110. Brewers Bay benthic cover and coral health through time (mean $\pm$ SE)

Fish Community. Brewers Bay is characterized by high fish abundance, dominated by herbivores. The site holds large numbers of parrotfish. Numerically the herbivores are dominated by juveniles that swim over the reef in groups of mixed parrotfish and wrasse. Both yellowhead and bluehead wrasse are prolific, schooling with the juvenile parrotfish. Piscivores are limited in biomass but are fairly diverse and generally include inshore pelagics such as cero mackerel and bar jacks or yellow jacks. Hamlets (*Hypoplectrus*) are very common and diverse, represented by 6 to 7 species in each annual survey. The occasional large snapper (schoolmaster, dog, and cubera) are sighted on the reef periphery or around large coral heads. This nearshore reef is spearfished regularly, so these species do not generally last long.

BREWERS BAY

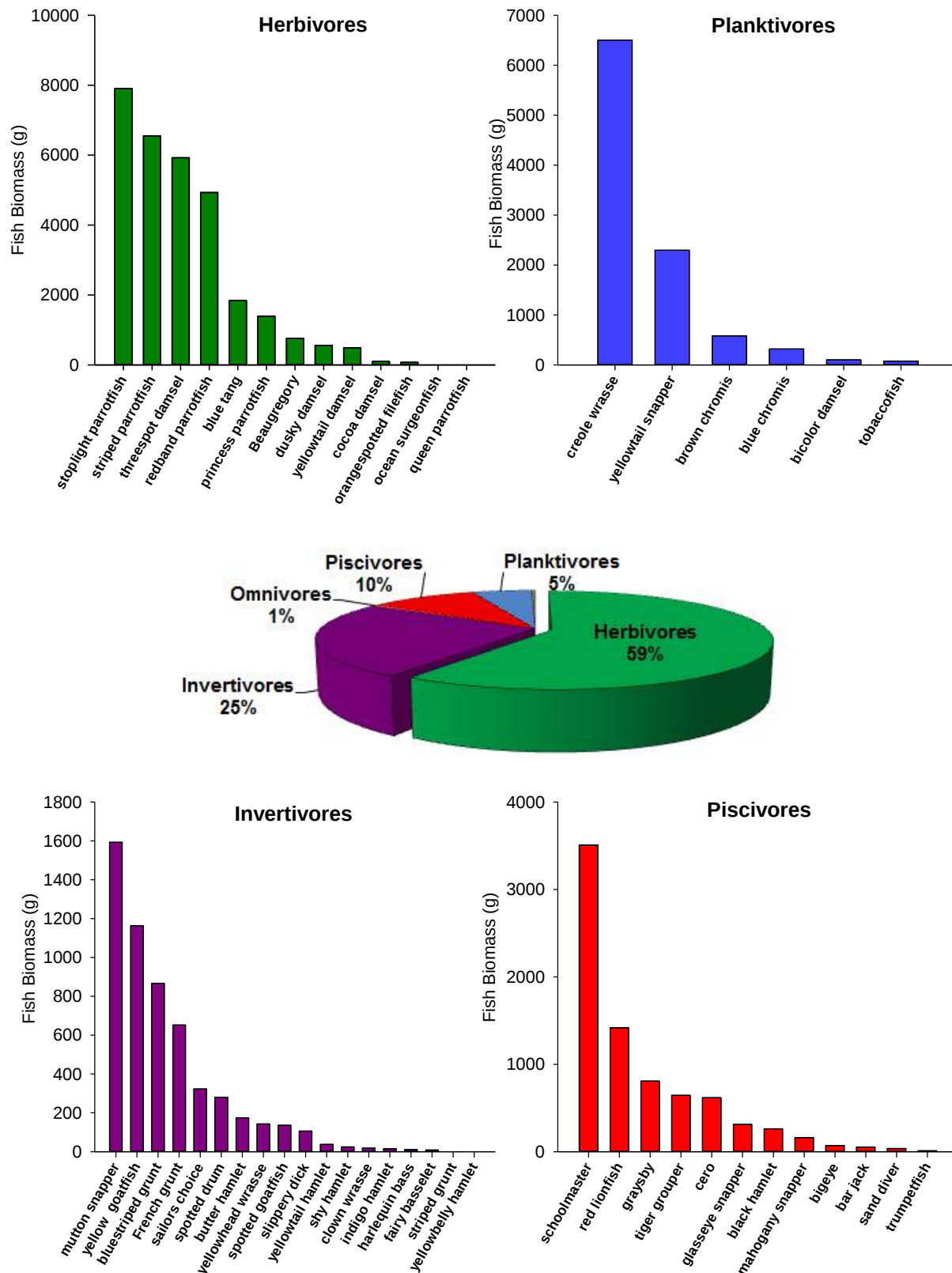


Figure 111. The Brewers Bay fish community by absolute and relative biomass.

SITE SUMMARIES

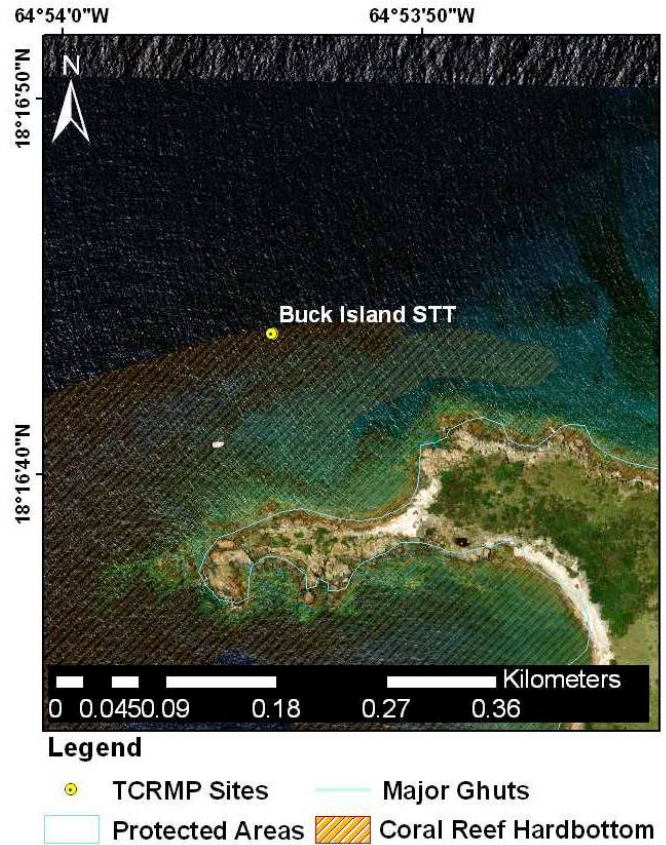
BUCK ISLAND, ST. THOMAS

Description. Buck Island, St. Thomas is a midshelf reef fringing the northwest coast of an uninhabited offshore island in water depths of 7 – 20 m. The reef has a sharp break in slope leading to a steep escarpment that terminates in a sand/sediment plain at the reef base. The monitoring site is located on that slope. Buck Island, St. Thomas has been monitored since 2005, with permanent benthic transects installed in 2007.

Outstanding Feature. Buck Island, St. Thomas is one of the most important tourist sites in the Virgin Islands, with frequent visitation by cruise ship passengers on day boats.

Threats. Buck Island, St. Thomas is very heavily used as a recreational dive site with the potential for cumulative impacts. The water surrounding Buck Island, St. Thomas is open to fishing. Commercial trap fishermen frequently target this site, and trap strings have been laid over the monitoring transects. Federally protected Nassau Grouper (*Epinephelus striatus*) have been observed within traps at the monitoring site. In addition, derelict traps are common around the site.

Figure 112. Buck Island, St. Thomas. (top) Location. (right) A representative photo of the reef.



BUCK ISLAND

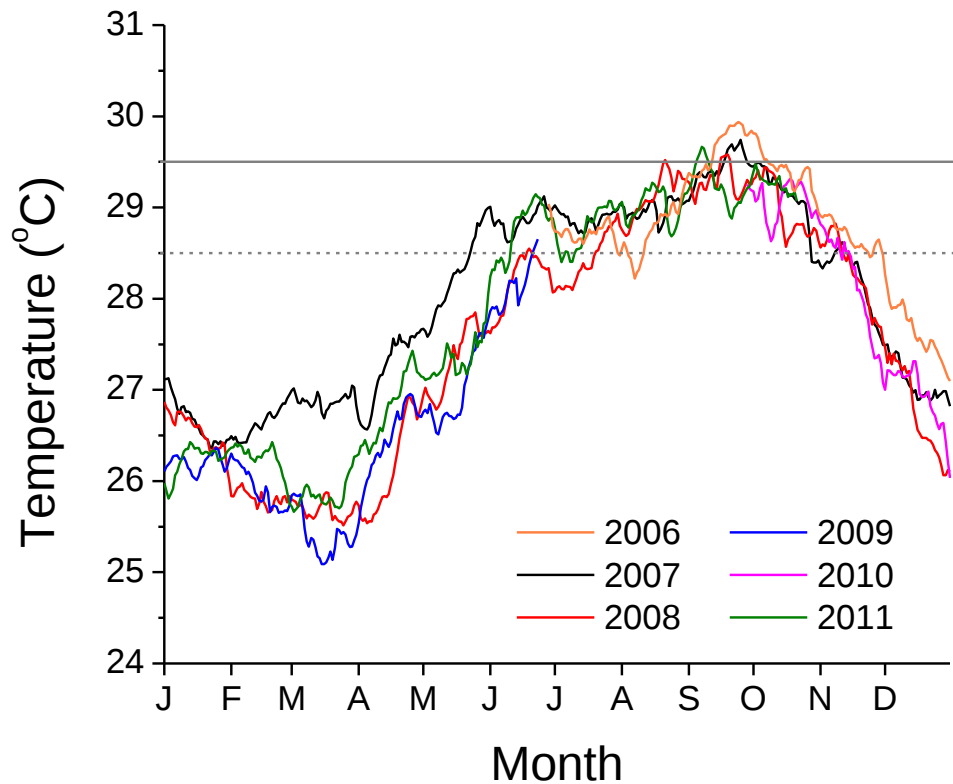


Figure 113. Buck Island, St. Thomas benthic temperature record (12 m depth).

Physical Characteristics.

Current. Buck Island, St. Thomas currents have not been measured directly. Moderately strong unidirectional currents occasionally influence the site, however, in general currents are very weak.

Temperature. Buck Island, St. Thomas may develop high temperatures. Unfortunately the temperature probe placed during the 2010 coral bleaching event was lost.

SITE SUMMARIES

Benthic Community. The Buck Island, St. Thomas site coral community is dominated by the boulder star coral (*Orbicella spp.*), but shows high and even representation of other species. Coral cover declined by 23.4% due to the 2005 coral bleaching event and the site had regained 13.4% of this cover by 2011. Among sessile epibenthic animals a high proportion of the community is composed of sponges. The algal community is co-dominated by epilithic algae and the macroalgae *Dictyota spp.* and *Lobophora variegata*. Filamentous cyanobacteria were also abundant in 2008.

Coral Health. The Buck Island, St. Thomas site was severely bleached in the 2005 coral bleaching event, with over 80% of colonies bleached over 100% of the colony surface. Bleaching was also high during the 2010 bleaching event, but at a low extent on colonies. Low prevalence of low-extent bleaching was common in other years of study. Coral diseases were usually low, in prevalence with the striking exception of 2006, when white diseases and lesions consistent with recent white disease reached extremely high prevalence. Old partial mortality increased rapidly after the 2005 bleaching event and then declined steadily in following years.

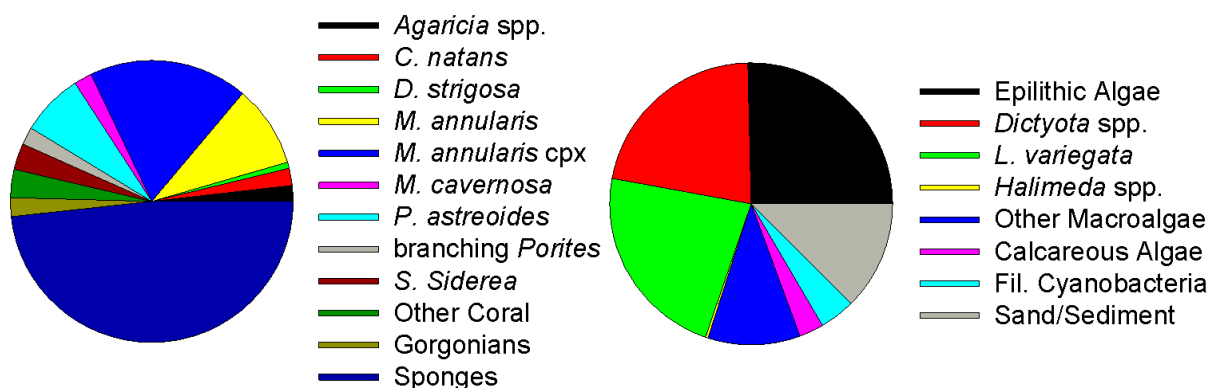


Figure 114. Buck Island, St. Thomas. (left) Relative composition of the sessile epibenthic animal community. (right) Relative composition of the algal community and unconsolidated sediment.

BUCK ISLAND

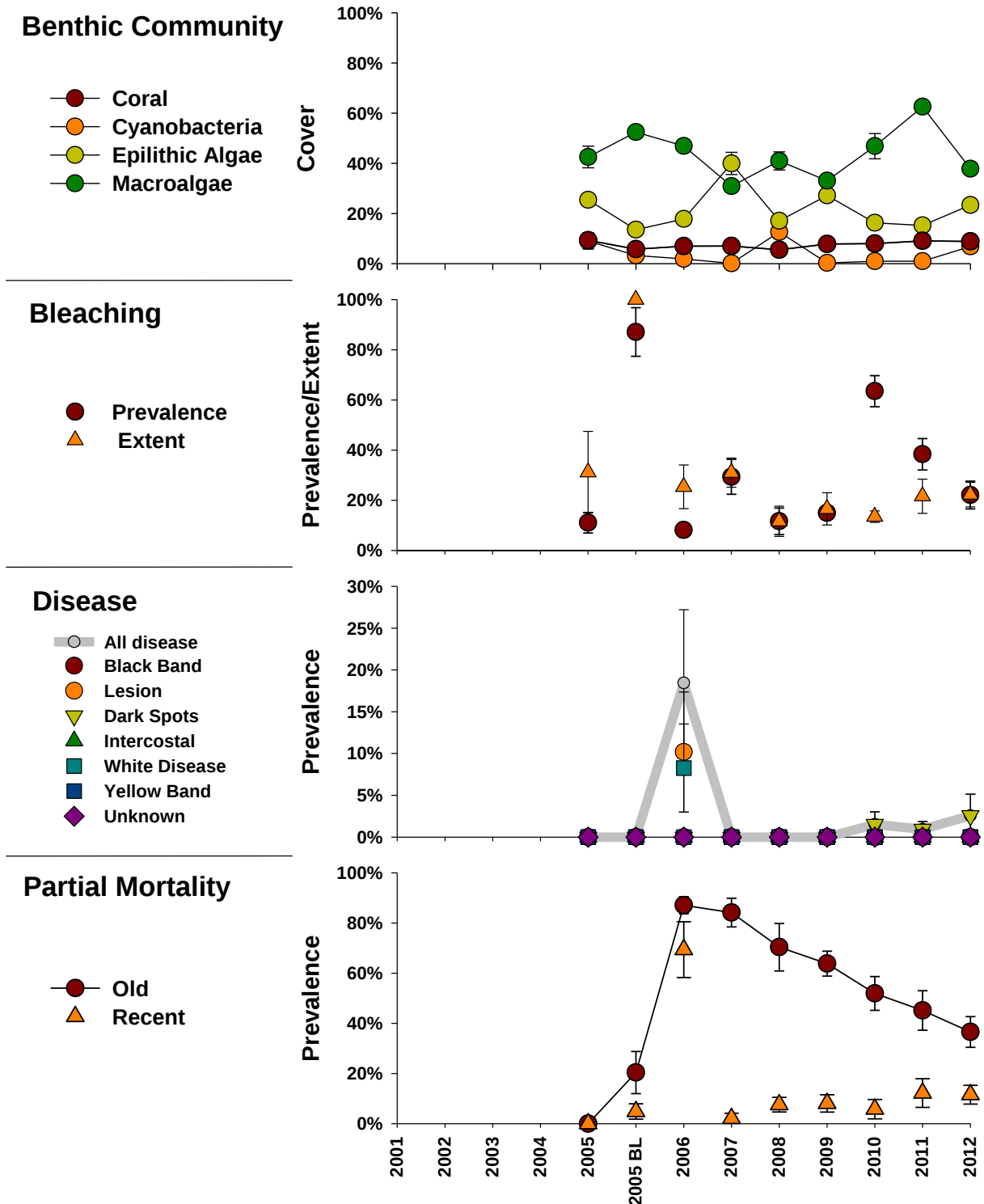
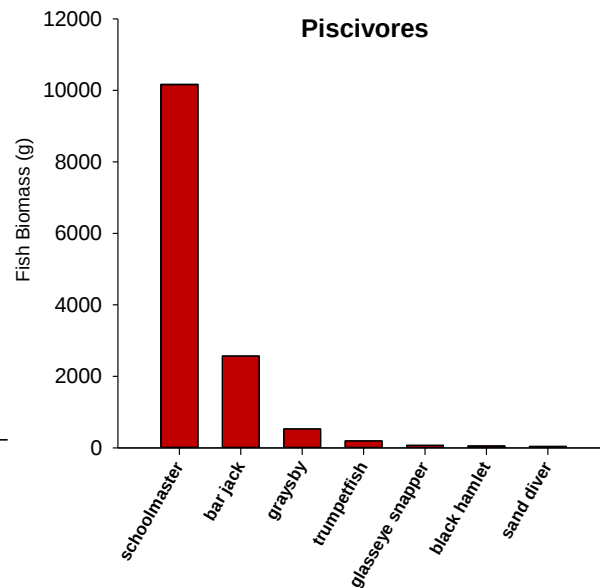
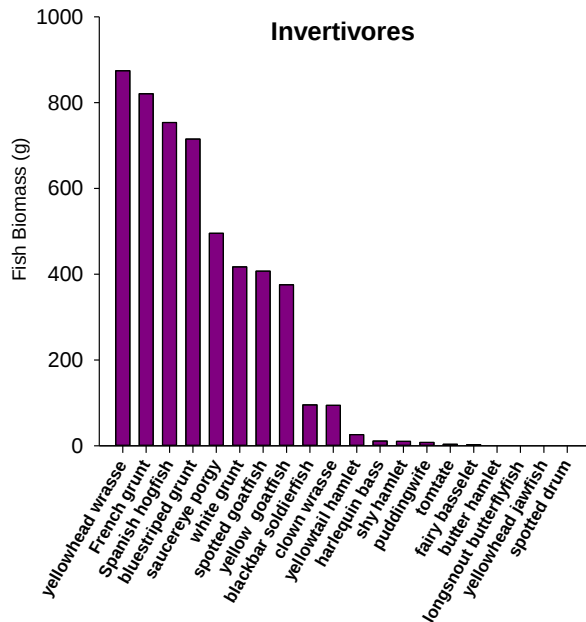
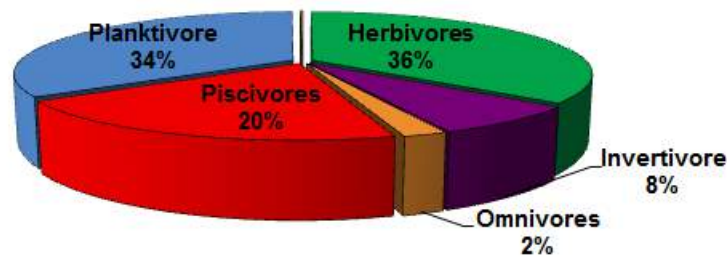
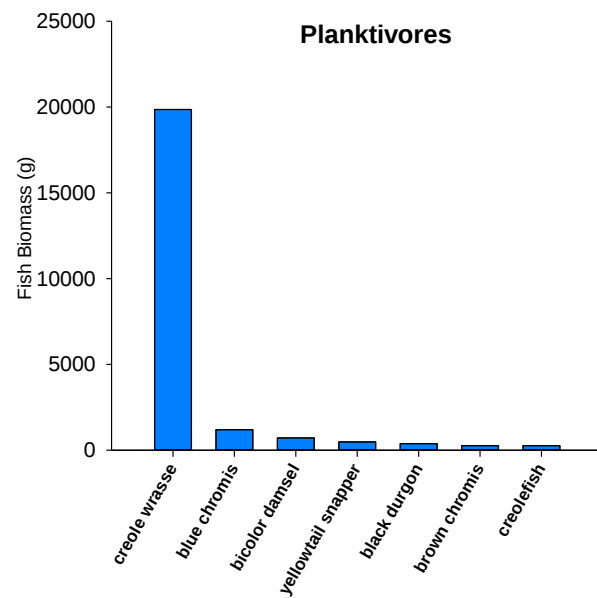
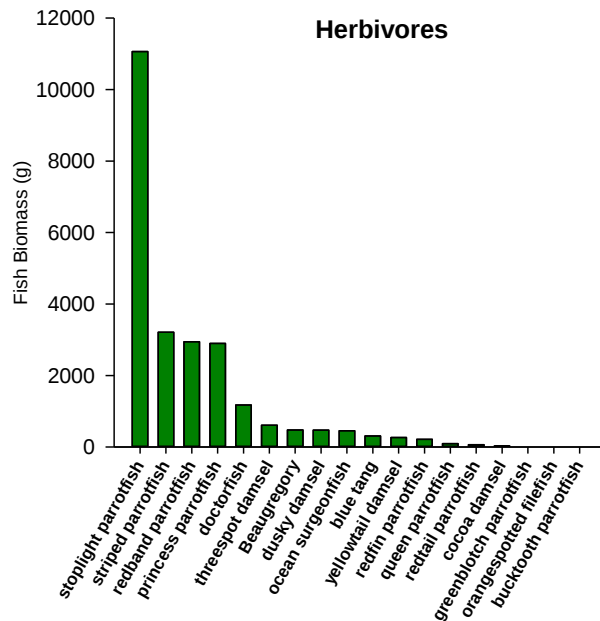


Figure 115. Buck Island, St. Thomas benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The fish community at Buck Island, St. Thomas is diverse and represents the utilization of many habitats and resources. Herbivores, especially parrotfishes, dominate the site. However, in 2012 the creole wrasse was the most prolific fish on belt transects. Invertivores are also very diverse and common, and include goatfishes, several wrasses and a variety of grunts. Piscivores in 2012 were dominated by schoolmaster snapper. No large grouper or snapper have been observed in belt transects or roving dives. Although a Territorial Park on land, the area is fished with hook and line, traps and speargun. It is also a very heavily dove SCUBA and snorkel site. Tourists and commercial dive operators are known to feed fish at Buck Island and gregarious yellowtail snapper are large and numerous. Small reef sharks are also commonly observed.

BUCK ISLAND



SITE SUMMARIES

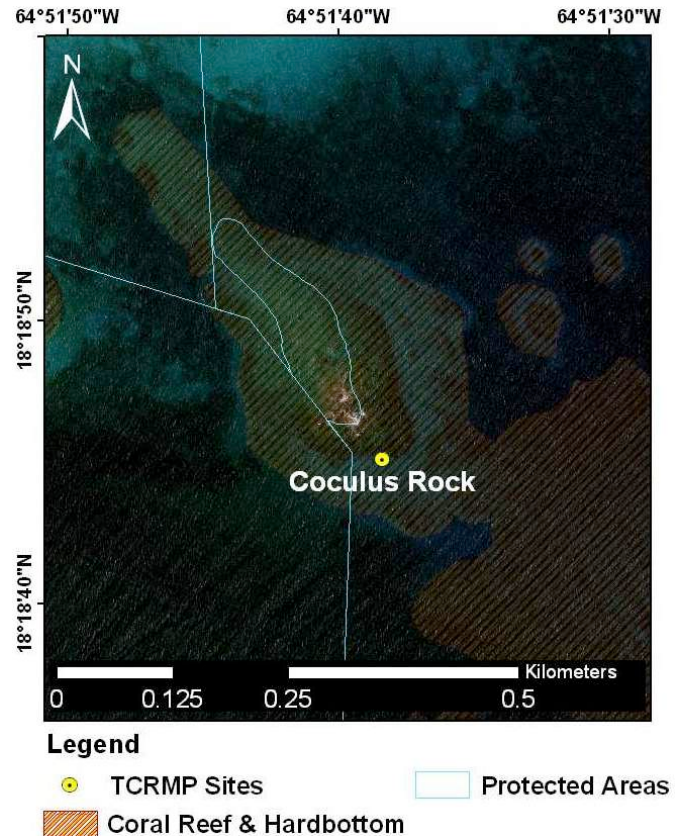
COCULUS ROCK

Description. The Coculus Rock site is a coral community on bedrock and pavement in depths of 4 – 7 m. The reef is formed between emergent rocks and a sand plain at 7m. Coculus Rock has been monitored since 2001, with fish community assessment starting in 2009. A ciguatera fish poisoning study with monthly sampling has been ongoing since 2009.

Outstanding Feature. Coculus Rock is located in the St. Thomas East End Reserve and is closed to taking of reef fishes. The site supports a fish spawning aggregation of redfin parrotfish (*Sparisoma rubripinne*). These 100+ fish engage in daily afternoon mating at southeast reef corner. A ciguatera study with monthly sampling has been ongoing since 2009.

Threats. Coculus Rock is subject to land-based sources of pollution from the Turpentine Gut drainage of the Tutu watershed and the numerous industrial maritime activities in Benner Bay.

Figure 116. Coculus Rock. (top) Location. (right) A representative photo of the reef showing the aggregation of redfin parrotfish.



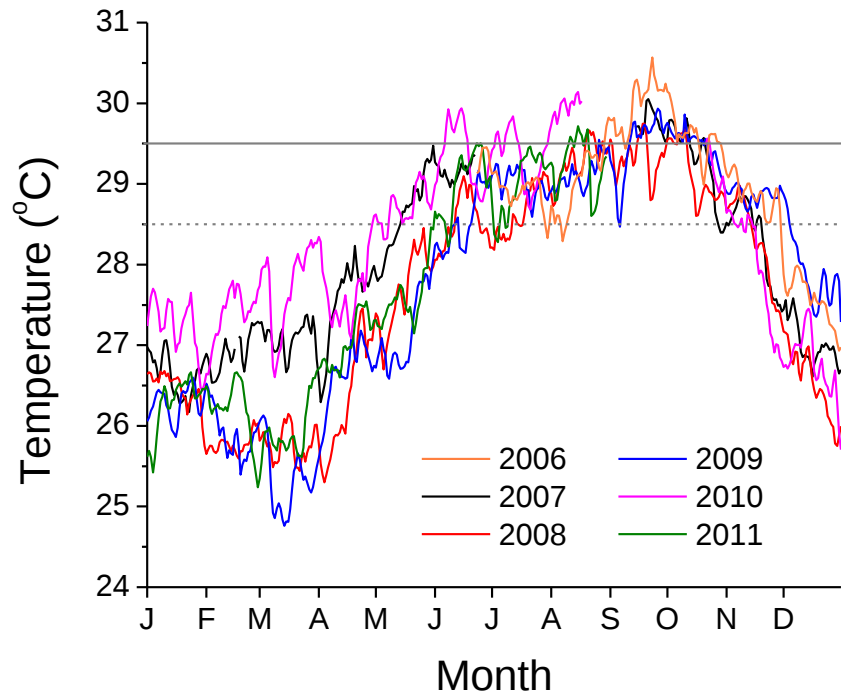


Figure 117. Cocus Rock benthic temperature record (7m depth).

Physical Characteristics.

Current. Cocus Rock currents have not been measured directly. Only weak unidirectional currents have been experienced. Wave-driven oscillatory currents can be intense from swells coming from the southeast.

Temperature. Cocus Rock can experience very high temperatures during the peak warm season.

SITE SUMMARIES

Benthic Community. The Cocus Rock site is a coral community on bedrock and thin carbonate pavement that supports a very diverse coral community with no dominance by any species. The site lost 10.7% of its coral cover in the 2005 bleaching event, but had regained 76.0% of this lost cover by 2011. Sponges are a very prominent component of the sessile epibenthic animal community. The algal community is co-dominated by epilithic algae and the macroalga *Dictyota* spp., which tend to covary.

Coral Health. Corals at Cocus Rock were relatively moderately impacted by the 2005 coral bleaching event in both prevalence and extent on colonies. This may be due to a coral species assemblage composed of small massive species that tend to be less susceptible to bleaching (Smith et al., unpublished manuscript). A modest prevalence of low extent bleaching was also evident in the 2010 coral bleaching event. In years without high thermal stress there tends to be a relatively high prevalence of bleaching relative to other sites, and prior to 2004 this was at high extent over colonies. Coral diseases, represented almost exclusively by dark spots disease, can be quite high in some years. Old partial mortality has been fairly high and consistent over time, with a slight increase after the 2005 and 2010 bleaching events. Recent partial mortality tends to be quite low in prevalence.

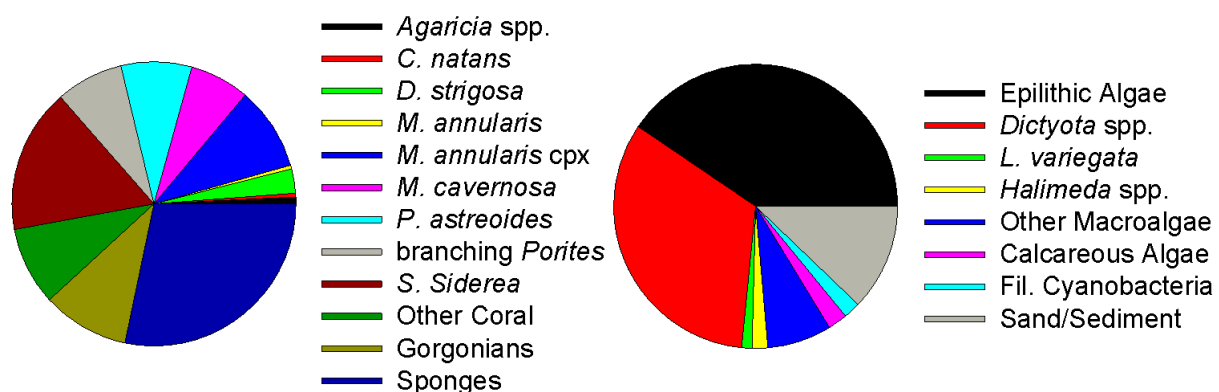


Figure 118. Cocus Rock. (left) Relative composition of the sessile epibenthic animal community. (right) Relative composition of the algal community and unconsolidated sediment.

BUCK ISLAND

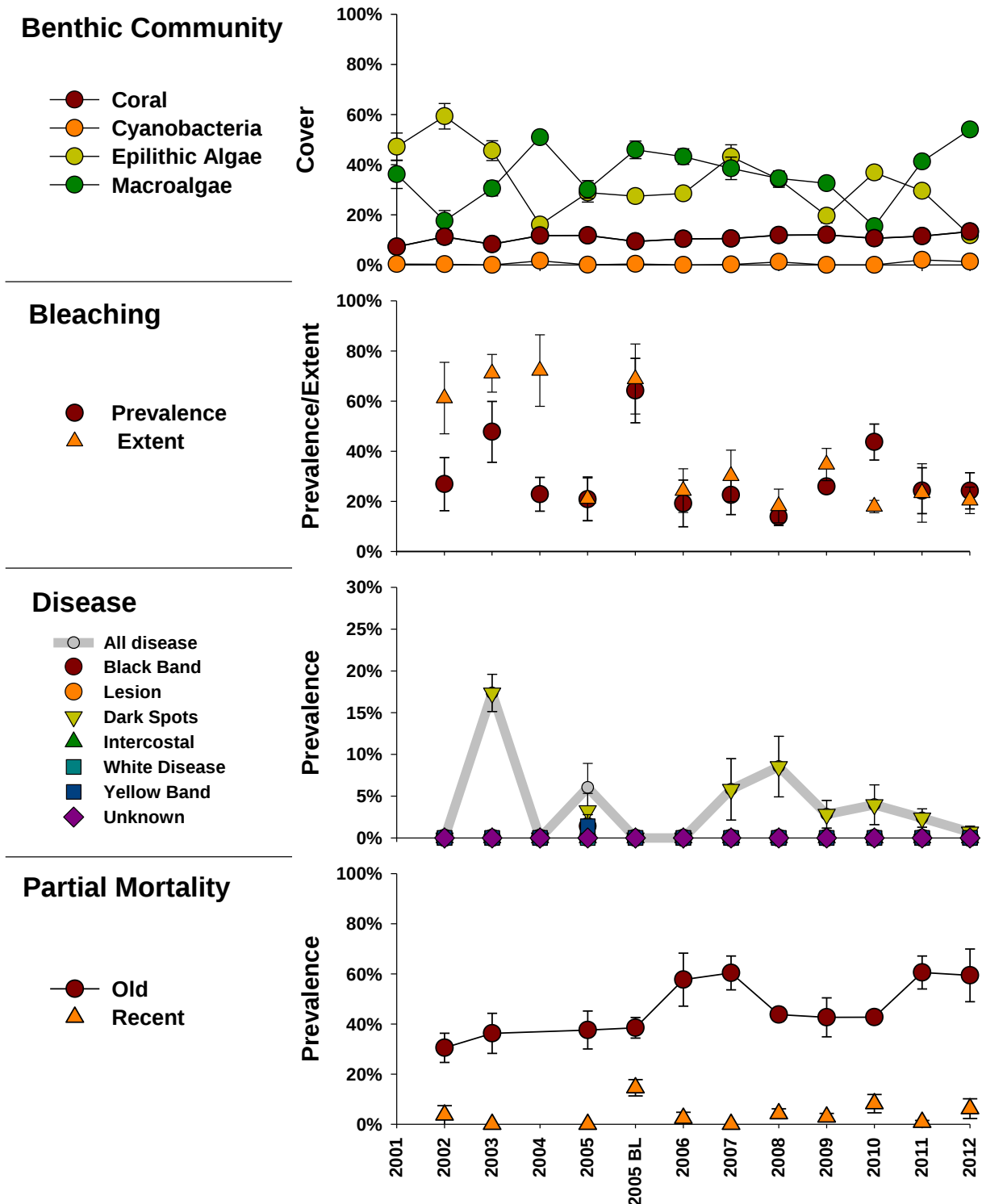
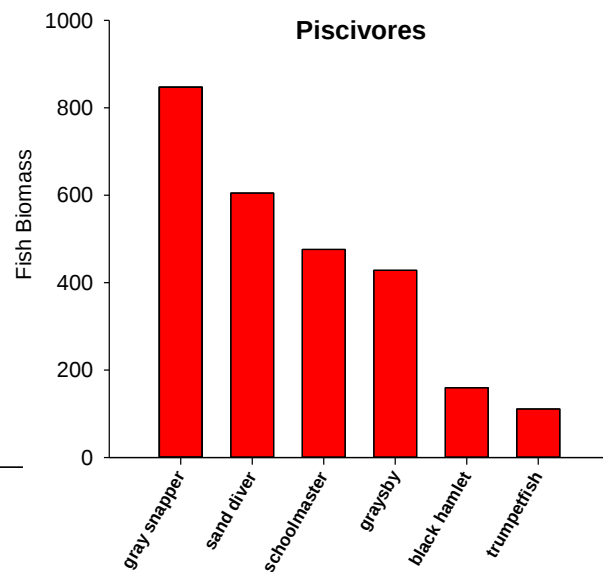
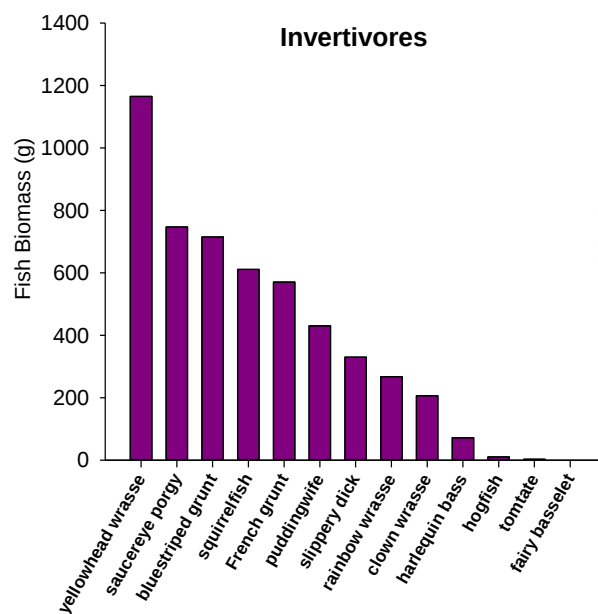
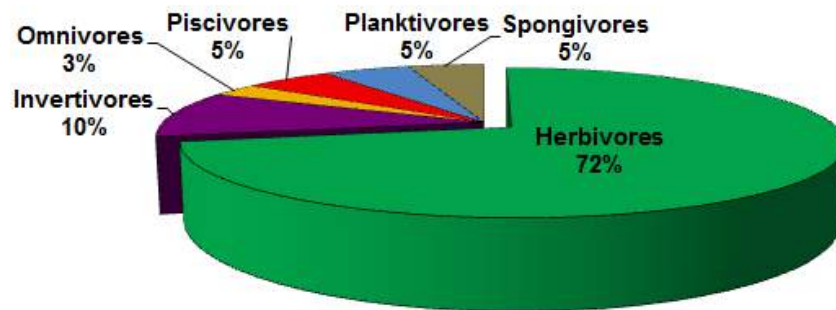
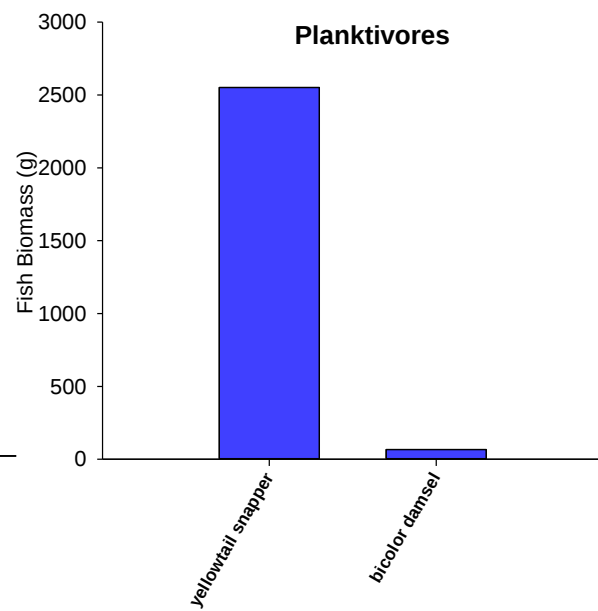
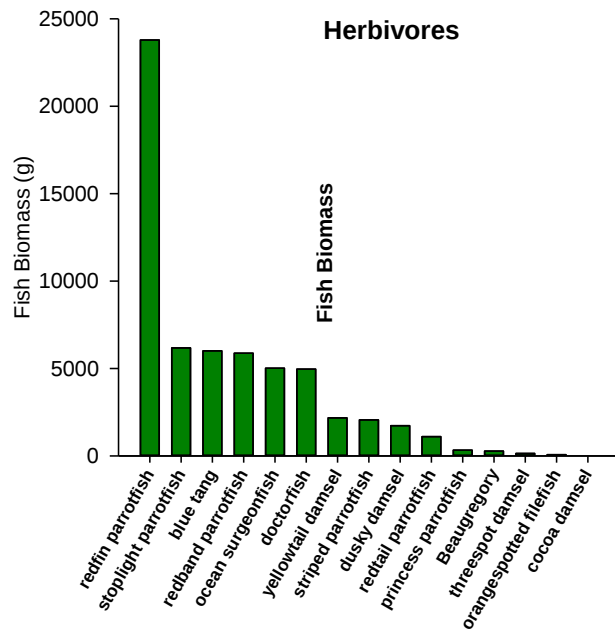


Figure 119. Cocus Rock benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The Cocus Rock fish community is interesting in several ways and it represents an inshore promontory that aggregates redfin parrotfish (*Sparisoma rubripinne*) to spawn every afternoon. For that reason redfin highly dominate the site in biomass. The top of the reef, emergent at points, is turbid and rough with breaking waves, but large parrotfish, jacks, snappers, doctorfish and damselfishes swim in this area. At the bottom of the reef, where coral and rock meet the sand, a small ledge runs along the southeast edge. Red hind and an occasional Nassau grouper have been observed hiding in the ledge here. There are generally a dozen or more juvenile lobster using the ledge as well. Juvenile grunts can be particularly common at Cocus Rock, schooling on large limestone rocks on the western side of the site. Otherwise the fish community inhabiting the steep walled rock and algae covered limestone site is primarily wrasses, small parrotfishes and acanthurids. Cocus Rock is part of the Territorial East End Reserve (STEER) and fishes are protected from all harvest year-round.

BUCK ISLAND



SITE SUMMARIES

COLLEGE SHOAL

Description. College Shoal is part of a mesophotic bank located in the Red Hind Marine Conservation District (est. 1999) in depths of 28 – 33 m. The densely populated coral reef is surrounded by continuous reef structure dominated by boulder star corals (*Orbicella annularis* spp.). College Shoal has been monitored since 2003, with permanent benthic transects installed in 2007.

Outstanding Feature. College Shoal is notable for possessing high water clarity, relatively strong currents, a high density of corals (>30% coral cover), and a great abundance of fishes, including commercially important groupers and snappers. College Shoal is one of the most aesthetically pleasing reefs for diving due to its relatively pristine condition, high coral abundance, and high fish abundance.

Threats. College Shoal has experienced coral white diseases at chronically high levels (> 1% prevalence). This reef also supports a high abundance of the invasive Indo-Pacific Lionfish (*Pterois volitans*).

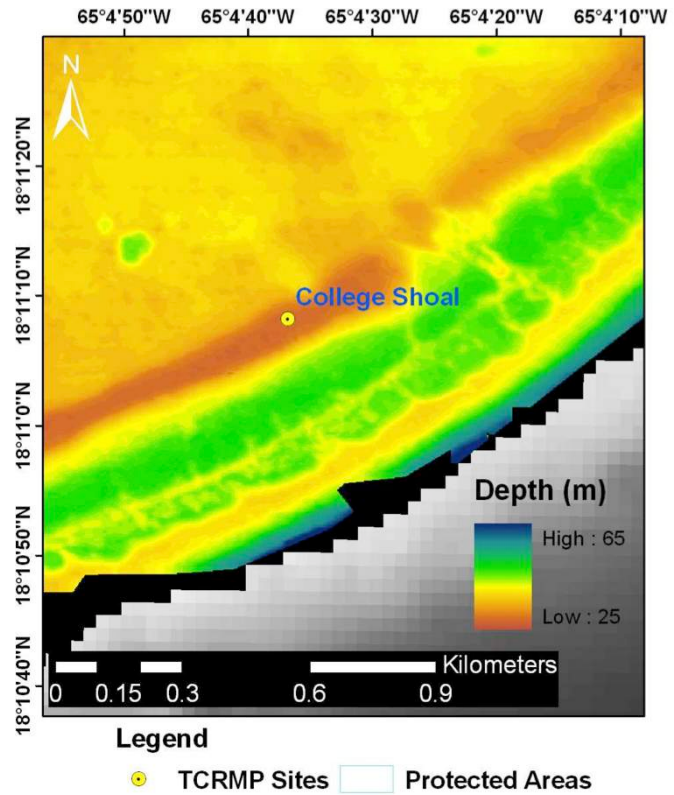


Figure 120. College Shoal. (top) Location. (right) A representative photo of the reef.



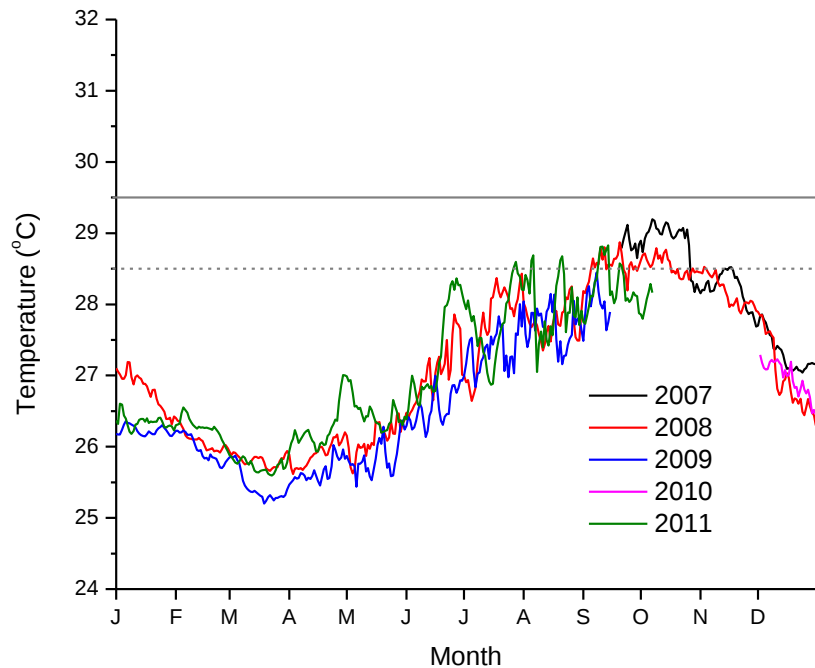


Figure 121. College Shoal benthic temperature record (29m depth).

Physical Characteristics.

Currents. Although not measured directly, College Shoal has strong unidirectional driven currents that seem to be tidally driven and follow a pattern of increasing strength during spring tides.

Temperature. Benthic temperatures are ameliorated in the warm season by the proximity of the thermocline. The presence of the thermocline causes temperatures that are cool and diurnally variable from May to October. Unfortunately the thermistor re-initialized improperly in 2009 and the 2010 coral bleaching event temperatures were missed at this site.

SITE SUMMARIES

Benthic Community. College Shoal is among the TCRMP sites with the highest coral cover (38.2% in 2011) and, similar to other bank mesophotic sites south of the St. Thomas, is dominated by the boulder star coral (*Orbicella* spp.). This site lost only 10.1% of its coral cover in the 2005 bleaching event, but had not regained cover since then (-1.3%); however, these estimates have some additional error since transects were not made permanent until 2007. Sponges and gorgonians are in very low relative abundance. The algal community is dominated by the macroalga *Lobophora variegata* and lesser representation by epilithic algae. There is also a relatively high proportion of crustose coralline algae.

Coral Health. College Shoal bleached at a relatively low prevalence during the 2005 mass coral bleaching event, although corals that were bleached tended to lose color over their entire surface. The 2010 coral bleaching event had no apparent effect above background bleaching levels. Bleaching in years without thermal stress tends to be moderate. Diseases were dominated by white disease, which reached very high prevalence after the 2005 bleaching event, with an outbreak that lasted for two years in 2006 and 2007. This disease was again very prevalent in 2011 after the 2010 bleaching event, even without apparent thermal bleaching. Old partial mortality was elevated on corals after the mortality from the 2005 bleaching event, and this level has remained stable through 2011. Recent partial mortality is always relatively high, much of it attributable to fish bites.

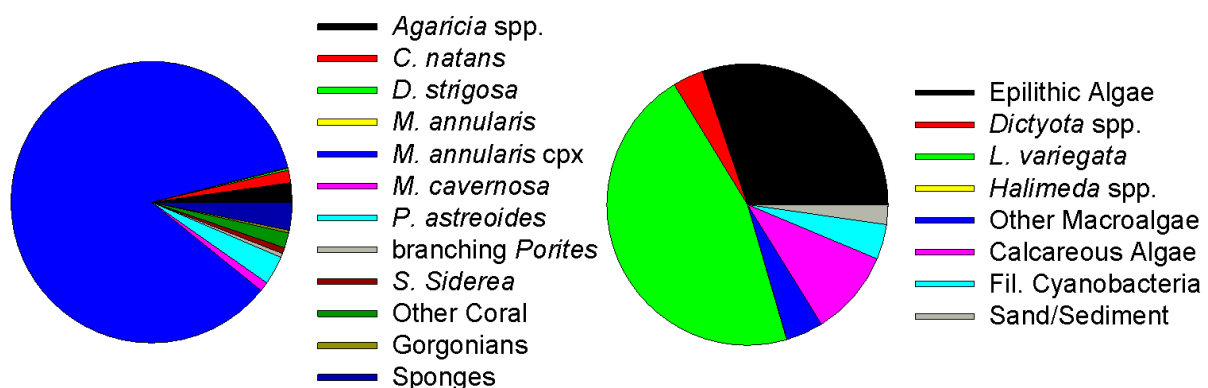


Figure 122. College Shoal (left) Relative composition of the sessile epibenthic animal community. (right) Relative composition of the algal community and unconsolidated sediment.

COLLEGE SHOAL

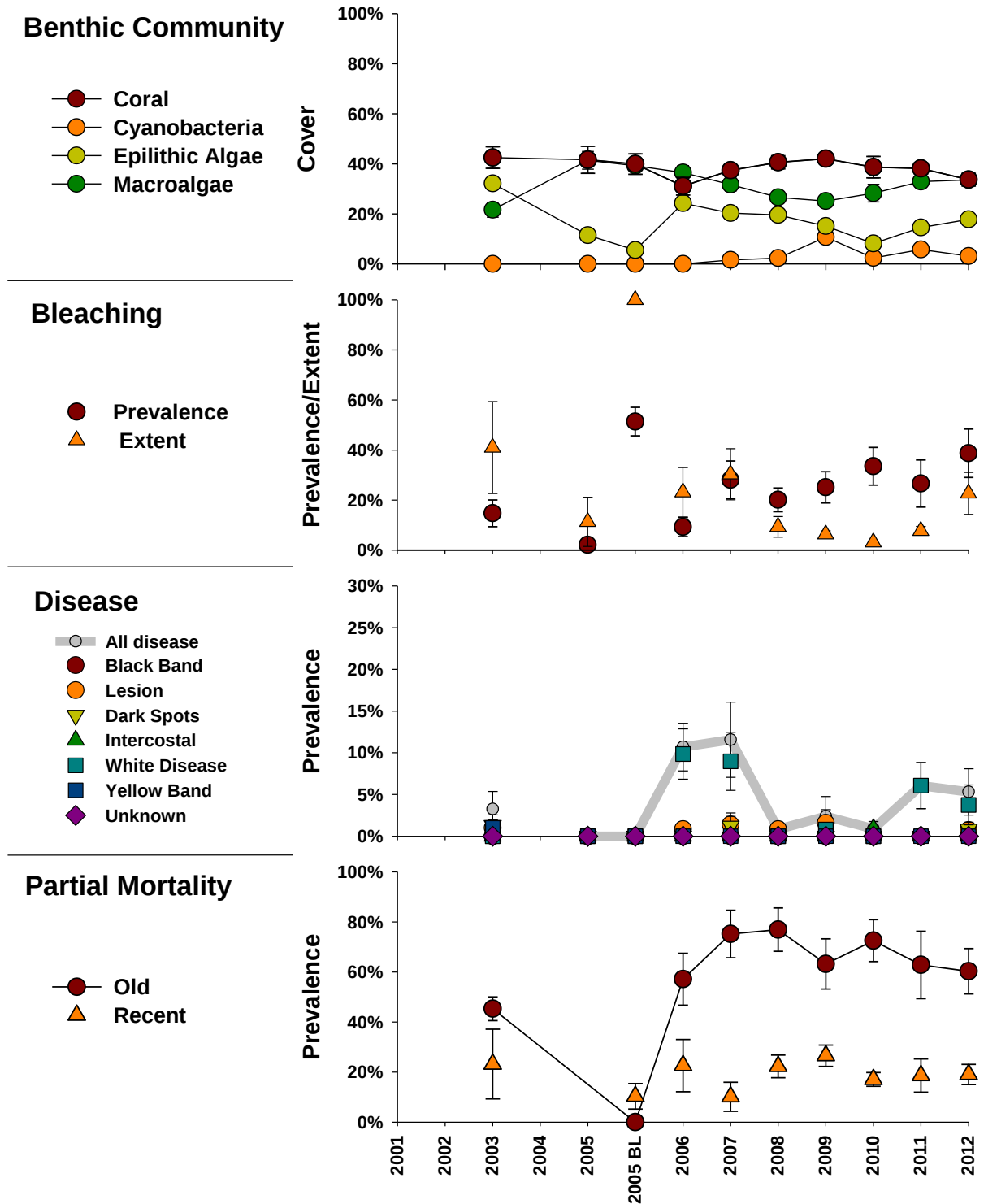


Figure 123. College Shoal benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. College Shoal is characterized by a high fish biomass and high species diversity. Large planktivores are also characteristic of College Shoal, including ocean triggerfish, Atlantic spadefish, black jacks and yellowtail snapper. Numerically, the site is dominated by creole wrasse; however large jacks, snappers, ocean triggerfish and black durgelon are common. College Shoal lies within the Marine Conservation District (MCD) and is protected year round from all fishing. Nassau, yellowfin, yellowmouth and tiger grouper are occasionally observed on the site. The mesophotic, high coral cover reef supports less herbivores than the more shallow nearshore and offshore sites; however, more herbivores (ocean surgeonfish) are present than on the significantly deeper Hind Bank and Grammanik Bank. Diversity is high in all trophic guilds indicating a high variety of micro-niches available for fishes.

COLLEGE SHOAL

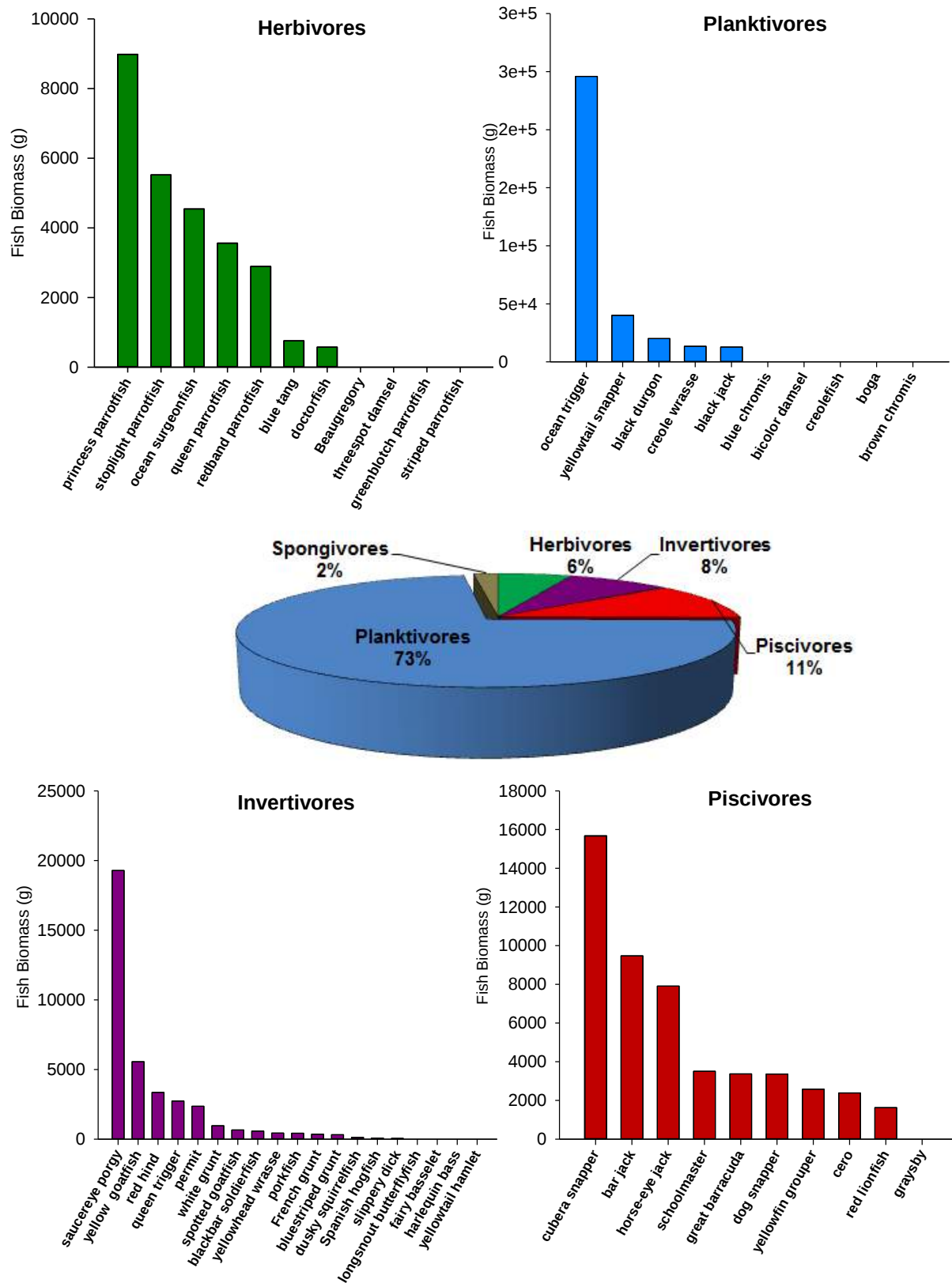


Figure 124. The College Shoal fish community by absolute and relative biomass.

SITE SUMMARIES

FLAT CAY

Description. This monitoring site wraps around the northwest corner depths of Flat Cay in depths of 10 – 17 m. Black Point has been monitored since 2003, with permanent benthic transects installed in 2007. A ciguatera fish poisoning study with monthly sampling has been ongoing since 2009.

Outstanding Feature. Flat Cay supports a lush coral community, including dense populations of the endangered elkhorn and staghorn corals (*Acropora* spp.) outside the TCRMP monitoring site. The site is a popular tourist dive site and is an important site for research by local and international investigators.

Threats. Flat Cay is down current of industrial port activities and a major sewage outfall. Mollusks, including the commercially important queen conch (*Strombus gigas*) show sterility (imposex) as a likely result of exposure to hormone mimics released from boat hulls coated with marine antifouling paint containing Tributyltin (Strand et al. 2009). The area experiences heavy fishing and damage from anchoring within the reef.

Figure 125. Flat Cay. (top) Location. (right) A representative photo of the reef.



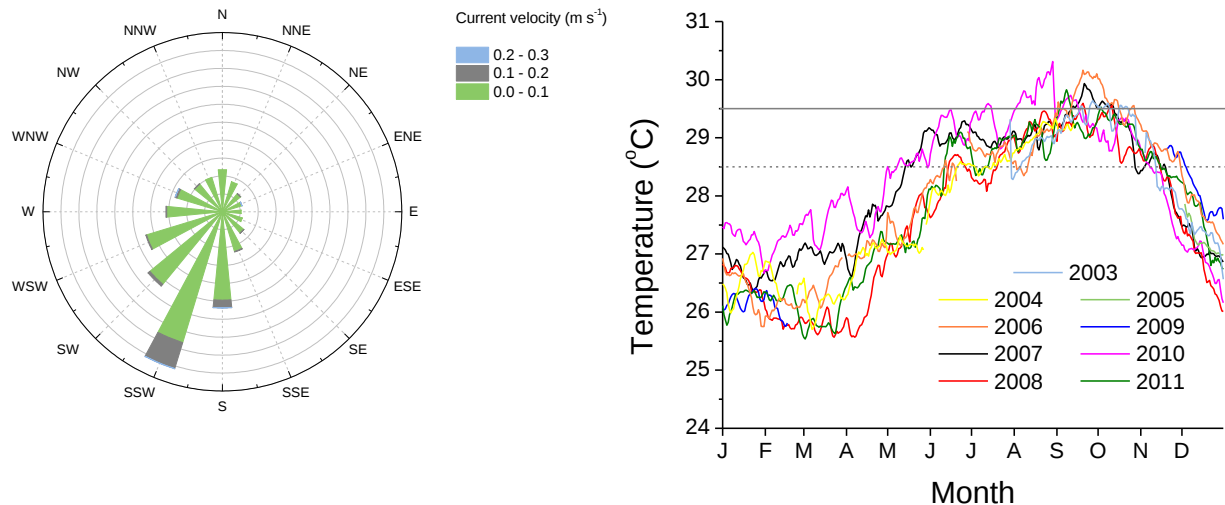


Figure 126. Flat Cay benthic current speed (left) and temperature record (right) (14m depth).

Physical Characteristics.

Current. The benthic current at the Flat Cay site is weak and dominated by a south-southwesterly flow. This may be an effect of the wrapping of the generally westward and occasionally strong surface current. Currents were measured with an Aandaraa 2-D current meter measuring 1m above the seafloor.

Temperature. Flat Cay experiences moderate warming for a shallow water site and rapid cooling with the passage of tropical storms.

SITE SUMMARIES

Benthic Community. Flat Cay supports a diverse coral community with dominance of boulder star corals (*Orbicella spp.*). The sessile epibenthic animal community also shows a high abundance of sponges. The site lost a moderate 21.9% of cover in the 2005 bleaching event and had regained 159.3% of this cover by 2011. A caveat is that transects were not made permanent until 2007. Epilithic algae and the macroalga *Dictyota spp.*, with lesser amounts of *Lobophora variegata*, dominate the algal community. Sand in pockets between coral also makes up a fair amount of the non-living substrate.

Coral Health. Corals were severely affected during the 2005 coral bleaching event, with over 90% of corals bleached at 100% extent of the colony surface. Bleaching was also moderately prevalent in the 2010 bleaching event, but at low extent. Coral diseases, particularly dark spots disease can be very prevalent at Flat Cay. There was an unusual outbreak of black band disease in 2004. This disease is rare at the depths of Flat Cay. White disease was somewhat prevalent after the 2005 bleaching. Old partial mortality increased rapidly after the 2005 bleaching event and has not decreased in the intervening years. Recent mortality can be moderate and is due to a variety of causes.

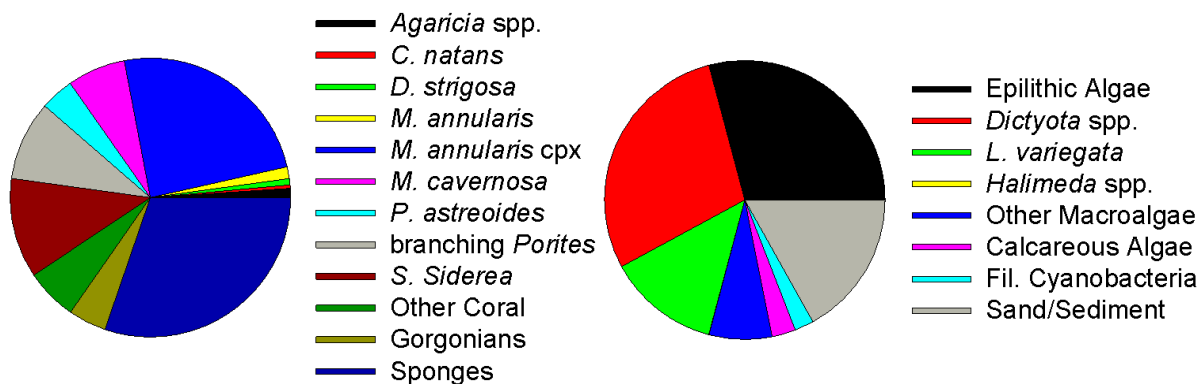
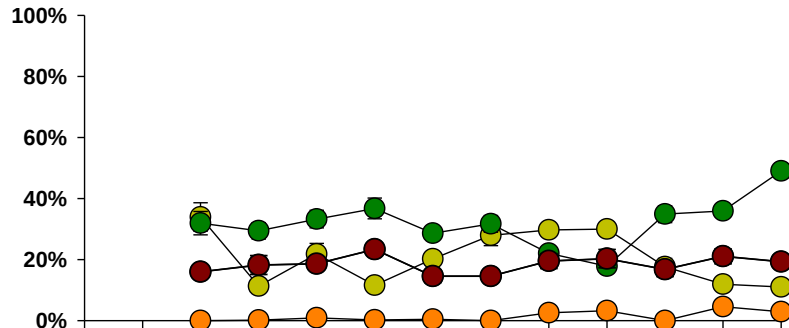


Figure 127. Flat Cay (left) Relative composition of the sessile epibenthic animal community. (right) Relative composition of the algal community and unconsolidated sediment.

Benthic Community

- Coral
- Cyanobacteria
- Epilithic Algae
- Macroalgae

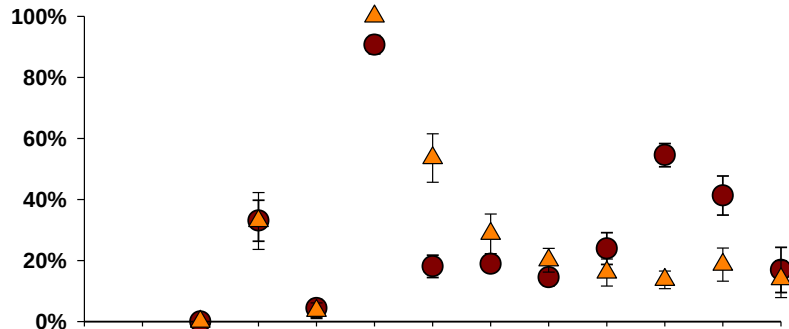
Cover



Bleaching

- Prevalence
- ▲ Extent

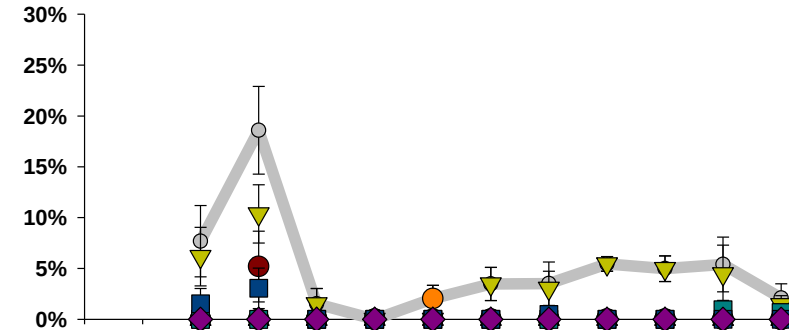
Prevalence/Extent



Disease

- All disease
- Black Band
- Lesion
- ▼ Dark Spots
- ▲ Intercostal
- White Disease
- Yellow Band
- ◆ Unknown

Prevalence



Partial Mortality

- Old
- ▲ Recent

Prevalence

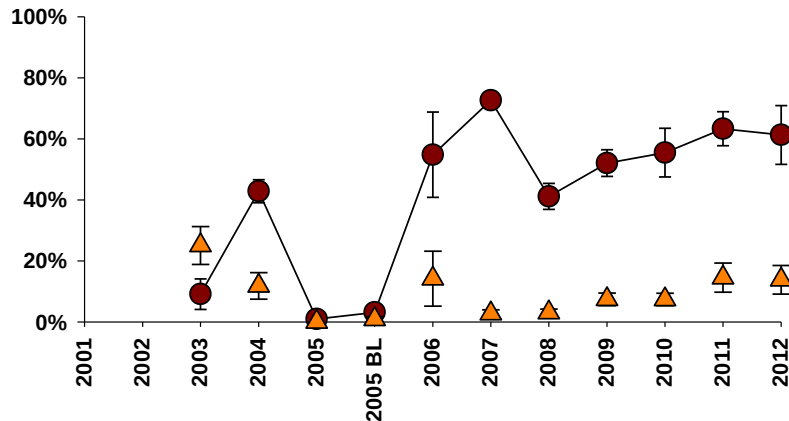


Figure 128. Flat Cay benthic cover and coral health through time (mean $\pm$ SE).

Fish Community. Flat Cay is characterized by a large diversity of fish evenly distributed across trophic guilds. There is a higher biomass of invertivores than other groups due to the regular occurrence of large schools of creole wrasse. Herbivores are dominated by redband and striped parrotfish; however, there is a diversity of parrotfish species. Juvenile parrotfish are prevalent. Carangids frequent the reef and dominate the piscivore trophic group. Occasional large groupers (Nassau, yellowfin, black) have been observed on Flat Cay over the past eight years. The occasional occurrence of black grouper is notable, since this species is absent throughout the majority of monitoring sites. The reef is highly used as a recreational dive site and spearfishing occurs regularly. Where the reef meets the sand offshore, schools of grunts, gray snapper, and goatfish occur. Small reef sharks are seen out over the sand regularly.

FLAT CAY

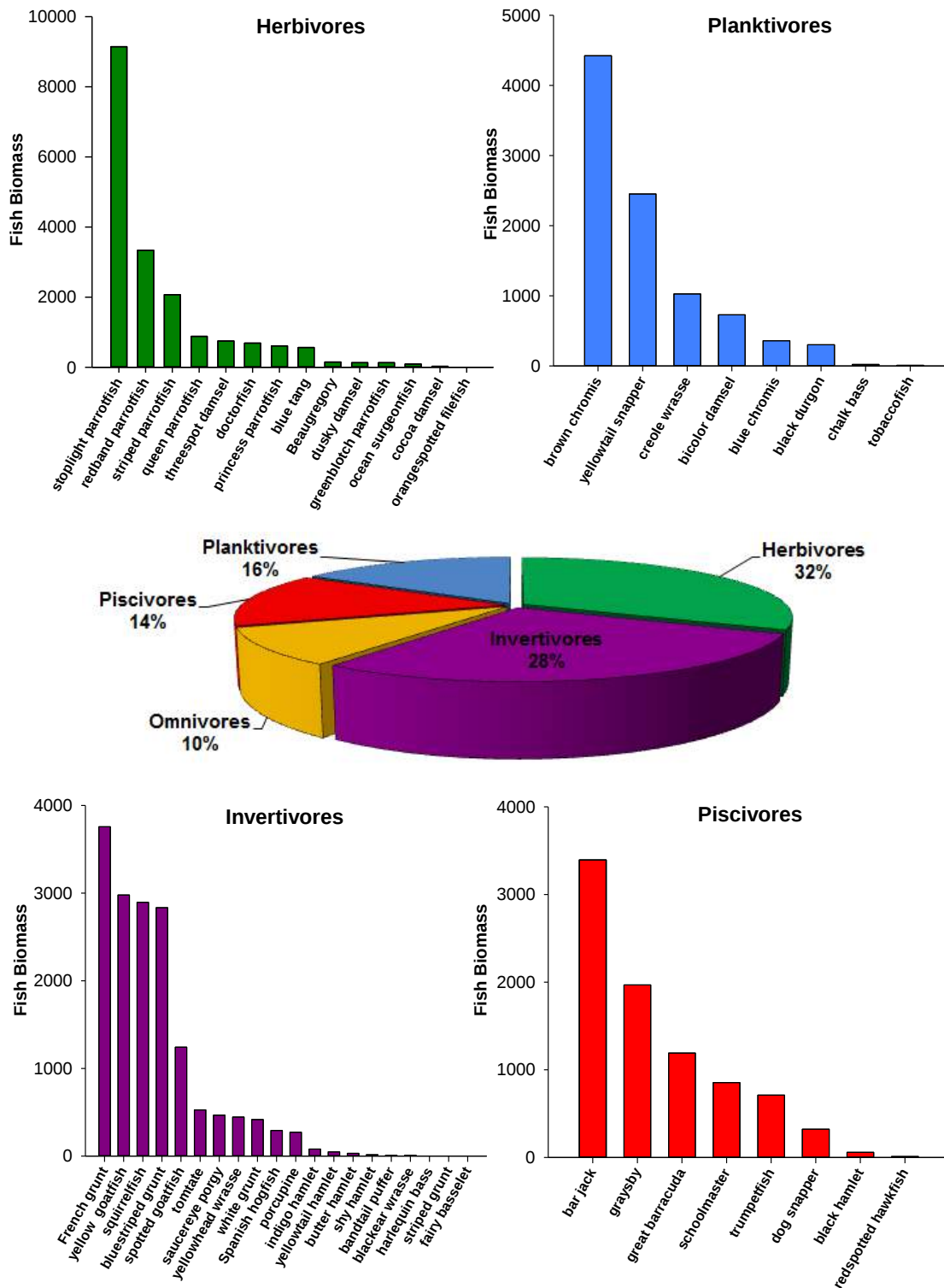


Figure 129. The Flat Cay fish community by absolute and relative biomass.

SITE SUMMARIES

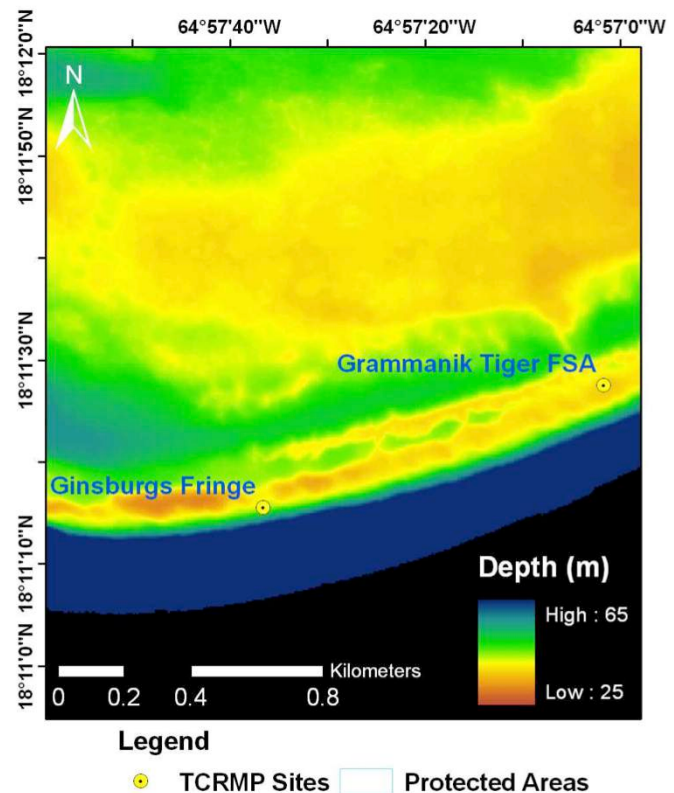
GINSBURGS FRINGE

Description. Ginsburgs Fringe is a mesophotic lettuce coral (*Agaricia* spp.) reef at depths of 60-75m. The reef is on a steep escarpment dropping into the abyssal Virgin Islands trough. Ginsburgs Fringe has been monitored since 2011 and permanent transects have been installed.

Outstanding Feature. Ginsburgs Fringe had the highest 2011 coral cover among all TCRMP monitoring sites (44%), with living colonies of lettuce corals over 6m (20') wide. This site is the epicenter of a multispecies fish spawning aggregation, including the threatened Nassau grouper (*Epinephelus striatus*). The site name honors the father of comparative sedimentology and mesophotic coral studies, Dr. Robert N. Ginsburg.

Threats. Although little is known about conditions in deep mesophotic lettuce coral reefs, Ginsburgs Fringe appears to be almost unscathed by recent mass coral bleaching events. Lettuce corals at these depths are potato chip thin and fragile, making them vulnerable to damage, such as the laying of benthic cables. The site is being heavily invaded by the Indo-Pacific lionfish (*Pterois volitans*).

Figure 130. Ginsburgs Fringe. (top) Location. (right) A representative photo of the reef showing whorled lettuce coral colonies up to 7m in width.



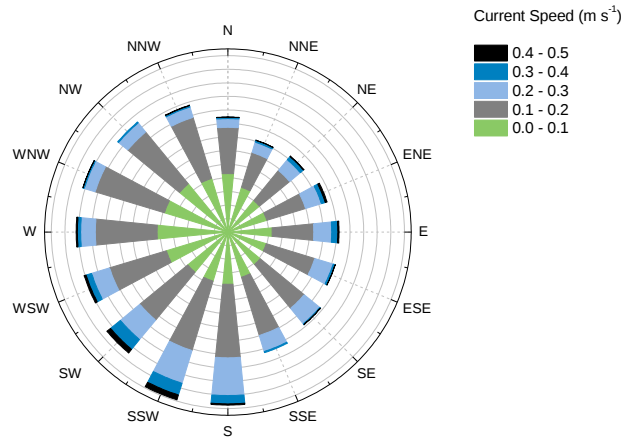


Figure 131. Ginsburgs Fringe current speed (50m depth).

Physical Characteristics.

Current. Currents have been measured above the site in 50 m depth. There is a strong offshelf downwelling (southward) that occurs just above the site, potentially carrying larvae and heterotrophic food supplies to the site.

Temperature. Temperature loggers have not yet been retrieved from the site, but a thermistor string is in place at and above the site, with loggers at 30, 40, 50, and 63 m depth.

SITE SUMMARIES

Benthic Community. The coral community at Ginsburgs Fringe is almost exclusively lettuce corals of the genus *Agaricia*. Among the agariciid genus, the rank abundance of species is *A. undata* (30.8% absolute cover), *A. grahamae* (8.2%), and *A. lamarcki* (2.3%), with no colonies of *A. agaricites* and *A. fragilis* occurring in transects. Although not well represented in cover, individual colonies of *Montastraea cavernosa* and *Siderastrea siderea* also occur at the site. The algal community is dominated by the macroalga *Lobophora variegata*, which is surprising for these depths, and epilithic algae. Crustose coralline algae are also in high abundance, as well as a variety of unidentified algal species.

Coral Health. Coral health is not directly monitored at Ginsburgs Fringe due to the depth and difficulties assessing colonies greater than 3m width. However, some observations have been made. What appears to be warm season bleaching appears to occur. Colonies have a fair degree of partial mortality and recent mortality is very common. In some cases it appears that shaded colony portions die back due to lack of light. The corallivorous snail, *Coralliophila abbreviata*, has been observed feeding on lettuce corals.

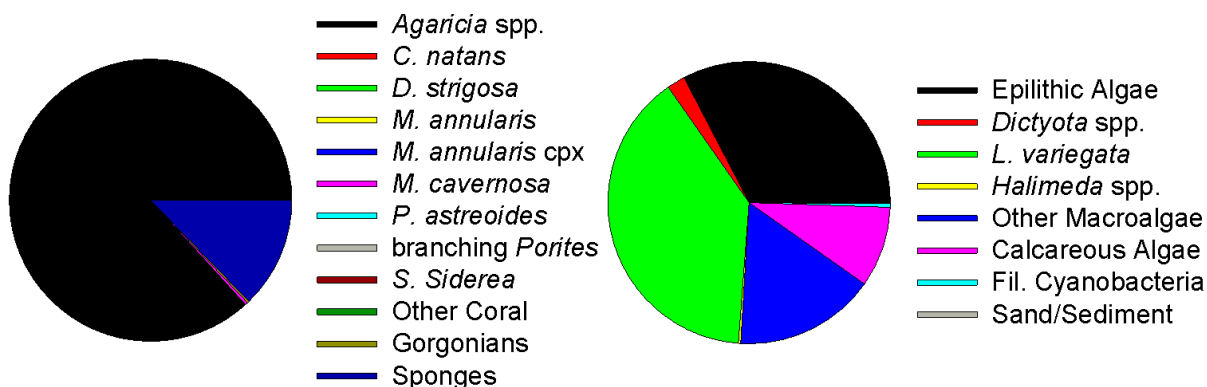


Figure 132. Ginsburgs Fringe. (left) Relative composition of the sessile epibenthic animal community. (right) Relative composition of the algal community and unconsolidated sediment.

GINSBURGS FRINGE

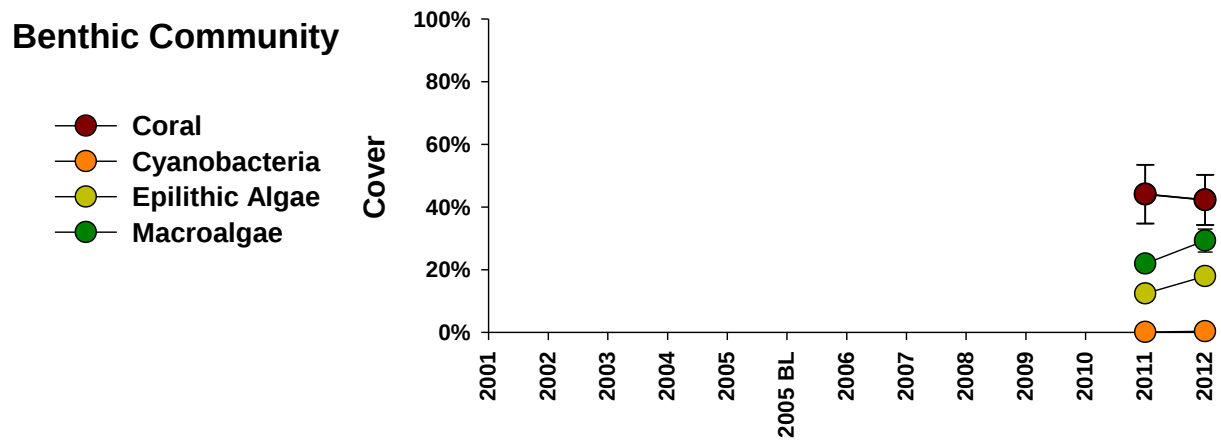


Figure 133. Ginsburgs Fringe benthic cover through time (mean $\pm$ SE).