

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 unique and has had distinct 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 each site's individual 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 SUMMARY ELEMENTS

TCRMP site information is presented in a few 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

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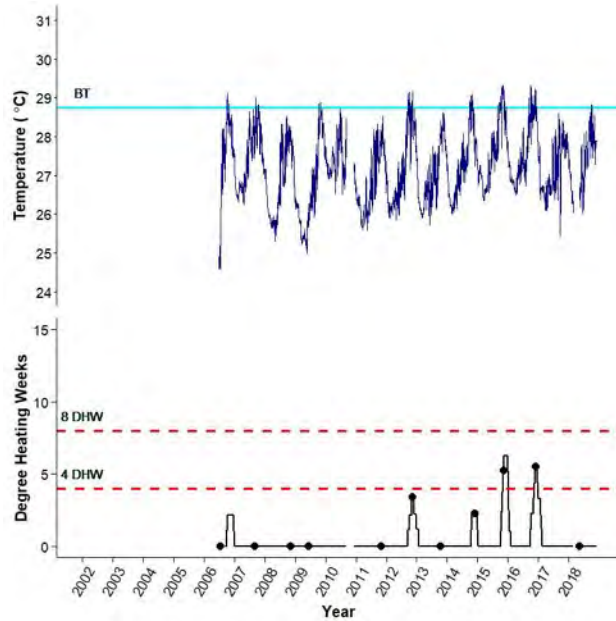
permanent until after the 2005 bleaching event or where percent cover is low, since the conditions introduce an unknown amount of error. Trends are shown for all available years of monitoring. The sessile epibenthic animal community are also presented in benthic community structure summaries and include *Agaricia* spp., *Colpophyllia natans*, *Pseudodiploria strigosa*, *Orbicella annularis*, *Orbicella* spp. (*O. faveolata*, *O. franksi*, + unidentified *Orbicella* spp.), *Montastraea cavernosa*, *Porites astreoides*, branching *Porites* species, *Siderastrea siderea*, other corals, sponges, and gorgonians. The algae/non-living substrata category presented include cyanobacteria, epilithic algae (“EAC”), *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 calibration checked HoboTemp™ thermistor data logger (Onset Computer Corporation, Bourne, Massachusetts). After 2011 sensors were only deployed if recorded temperatures did not deviate more than 0.2°C from actual, recorded in an ice bath for at least 2 hours. 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. Data for 2005 was taken from current profilers or federal data sources when available. See Temperature Figure Guide (following page) for interpretation of temperature data. Degree heating weeks was calculated based on the NOAA methodology (NOAA 2006) and using site-specific bleaching thresholds. As a rough estimate, 4 DHW is associated with the onset of widespread bleaching, and 8 DHW is associate with the onset of mass bleaching and the start of coral mortality.

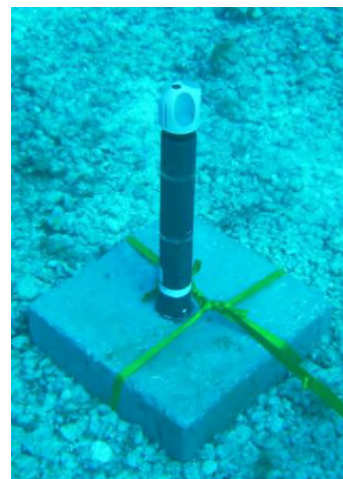
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Temperature Figure Guide. Temperatures in degrees Celsius and degree heating weeks. BT = Bleaching Threshold, calculated empirically or taken from linear relationship shown in Smith et al. (2016a). MMM = BT – 1°C, EMMM = Empirical MMM derived from non-bleaching years over period of observation. DHW = Degree Heating Week (NOAA 2006). Black dot on DHW line indicates the date of annual sampling to put the bleaching observations in context. Example taken from the Hind Bank Monitoring site.

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



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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. Croix

SITE SUMMARIES

BUCK ISLAND, ST. CROIX

Description. The Buck Island, St. Croix site is a seaward extension of the southeast Buck Island barrier reef complex in water depth of 15 m. The reef is a low framework surrounded by a sand plain to the west and a rolling reef/hardbottom to the east. The Buck Island, St. Croix site is largely composed of large living and dead *O. annularis* heads surrounded by sand. The site has been monitored since 2001, with three permanent benthic transects installed in 2001, and three additional transects installed in 2003.

Outstanding Feature. The Buck Island, St. Croix site is within the expanded (2001) Buck Island Reef National Monument. The reef fish populations may show recovery due to the restriction of fishing.

Threats. Due to its protected area status and remoteness from land-based pollution Buck Island, St. Croix is primarily threatened by changing climate as its populations of *O. annularis* were shown to be susceptible during the 2005 bleaching event.

Figure 20. (top) The Buck Island, St. Croix position in the Buck Island Reef National Monument. (right) A representative photo (photo credit: V. W. Brandtneris).



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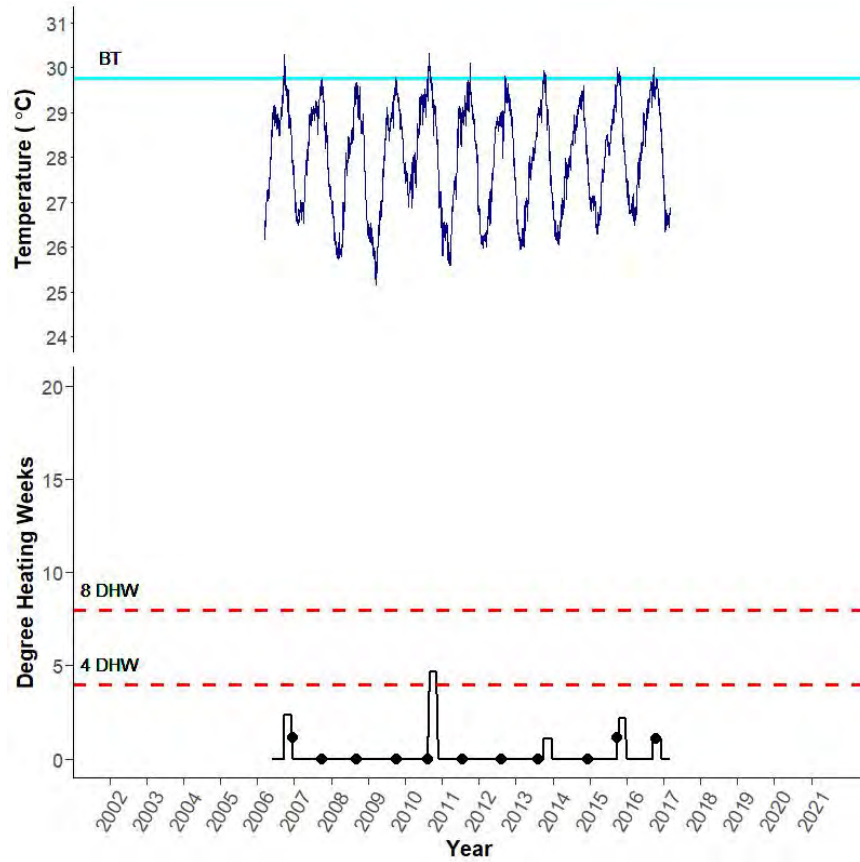


Figure 21. Buck Island, St. Croix benthic temperatures (14 m depth). Data provided by the National Park Service (site BUIS_SFR).

Physical Characteristics

Current. Currents have not been recorded at the Buck Island, St. Croix monitoring site. Unidirectional currents have always been light during monitoring. Oscillatory currents occasionally impact the site when swell is from the east.

Temperature. Temperatures at the Buck Island, St. Croix monitoring sites can get very warm and surpassed the bleaching threshold at or above 4 Degree Heating Weeks in 2005 (data from NOAA Coral Reef Watch, not shown) and 2010.

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Benthic Community. The Buck Island, St. Croix hard coral community is dominated by the boulder star coral *Orbicella annularis*; however, the most abundant sessile epibenthic animals are gorgonians. Epilithic algae dominate the algal community, with a low cover of macroalgae relative to other sites. There is a high proportion of sand.

This coral community lost 65.5% of its coral cover in the 2005 bleaching event and had only regained 6% of coral cover by 2011. Filamentous cyanobacteria showed very large increases in cover after the 2005 bleaching event.

Coral Health. Buck Island, St. Croix corals were likely severely affected during the 2005 bleaching event; however, bleaching health surveys were not completed until Jan. 13, 2006 when recovery had already commenced. Bleaching showed its second highest prevalence/extent in 2019 during surveys on Oct. 15 and Dec. 3. The prevalence of coral diseases was high on *O. annularis*, with frequent incidence of yellow band disease and white disease following the 2005 bleaching event. Old partial mortality was very prevalent after the 2005 coral bleaching event and then decreased, becoming stable over time in 2011. However, since 2015 coral cover has declined again for unknown reasons, but possibly related to diseases on *Orbicella* spp. Prevalence of disease increased in 2021 (November) with the arrival of Stony Coral Tissue Loss Disease at the Buck Island STX location.

SITE SUMMARIES

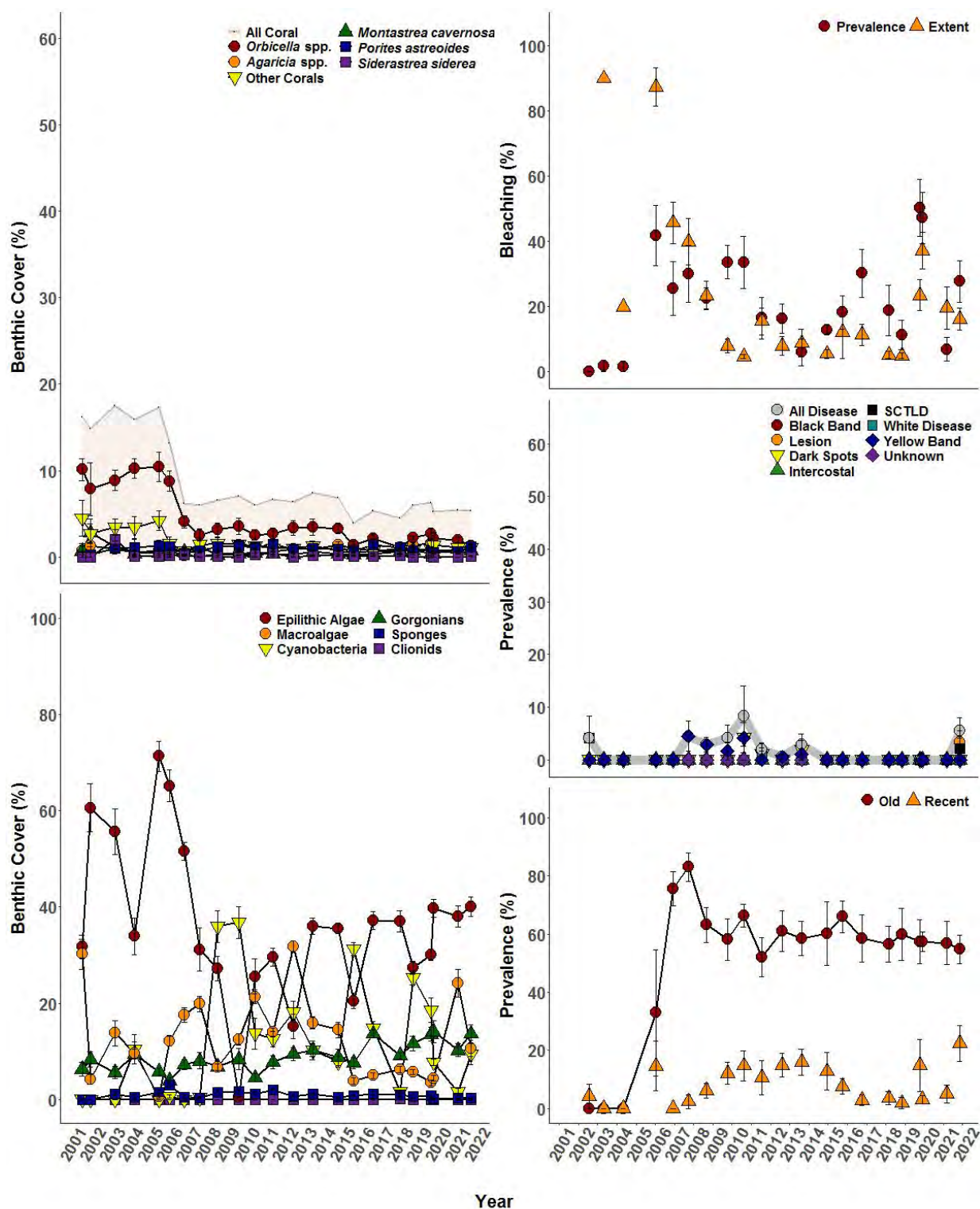


Figure 22. Buck Island, St. Croix benthic cover and coral health through time (mean $\pm$ SE).

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Fish Community. Buck Island is a low patchy reef community surrounded by and interspersed with sand. The fish community is highly dominated in biomass by herbivores, with large grazing schools of blue tang and an abundance of adult stoplight parrotfish. Close to the monitoring site are “the Haystacks”, large *Acropora palmata* skeletal remains that provide ample grazing area for large parrotfish. The Buck Island site is within the Buck Island Coral Reef National Monument and the fish inhabitants are theoretically protected from all fishing. Invertivore fishes at Buck Island also contribute a relatively high biomass to the community composition. Grunts (tomtate, French, Spanish, white, and bluestripe) and yellowhead wrasses dominate the guild, although the group is very diverse, utilizing the variety of resources available at the site. Conversely, piscivores are uncommon; the only serranids observed during TCRMP monitoring include small red hind, graysby, small basslets and hamlets. Snapper are limited to rare schoolmaster and mahogany snapper, although a subadult dog snapper was recorded at Buck Island in 2018. Other than this fish, no recovery has been noted for the fish populations on the site.

SITE SUMMARIES

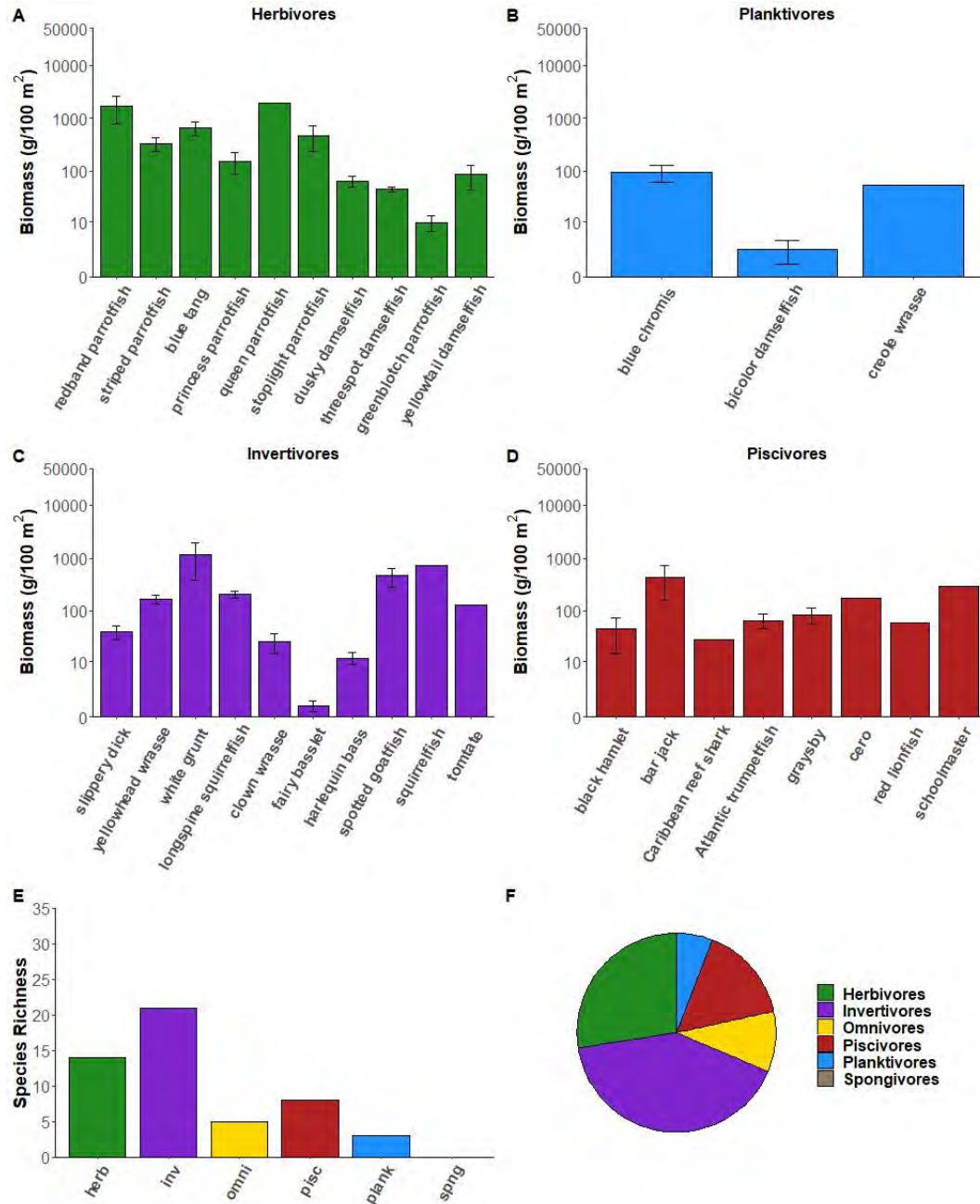
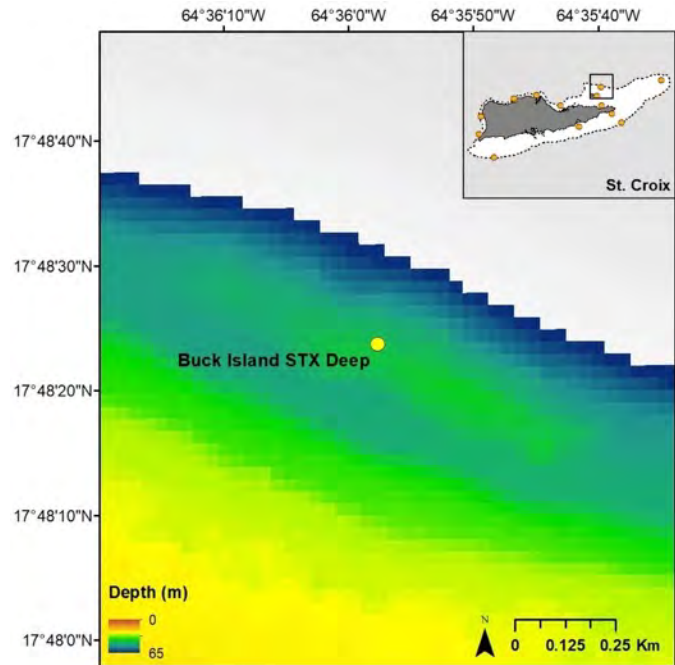


Figure 23. The Buck Island, St. Croix fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

BUCK ISLAND DEEP, ST. CROIX

Description. The Buck Island Deep, St. Croix site is an upper mesophotic bank reef northeast of Buck Island in water depth of 33 m. The reef is a low slope bank system similar in form to the mesophotic reefs systems south of St. Thomas. The Buck Island Deep reef site is dominated by plating growth forms of the *O. annularis* species complex. The site was first described in an exploratory mission following the 2016 TCRMP sampling. Six benthic transects were installed in collaboration with NPS in April 2017 and have been monitored since.



Outstanding Feature. The Buck Island Deep, St. Croix site is an exceptionally healthy mesophotic orbicellid bank system on the island of St. Croix. The coral cover is double that of the next highest cover site in the TCRMP St. Croix monitoring program and large corals are largely intact with, high levels of coral-coral competition.

Threats. Due to its protected area status and remoteness from land-based pollution Buck Island Deep is largely threatened by climate change and disease.

Figure 24. (top) The Buck Island Deep, St. Croix position in the Buck Island Reef National Monument. (right) A representative photo (photo credit: J. Quetel).



SITE SUMMARIES

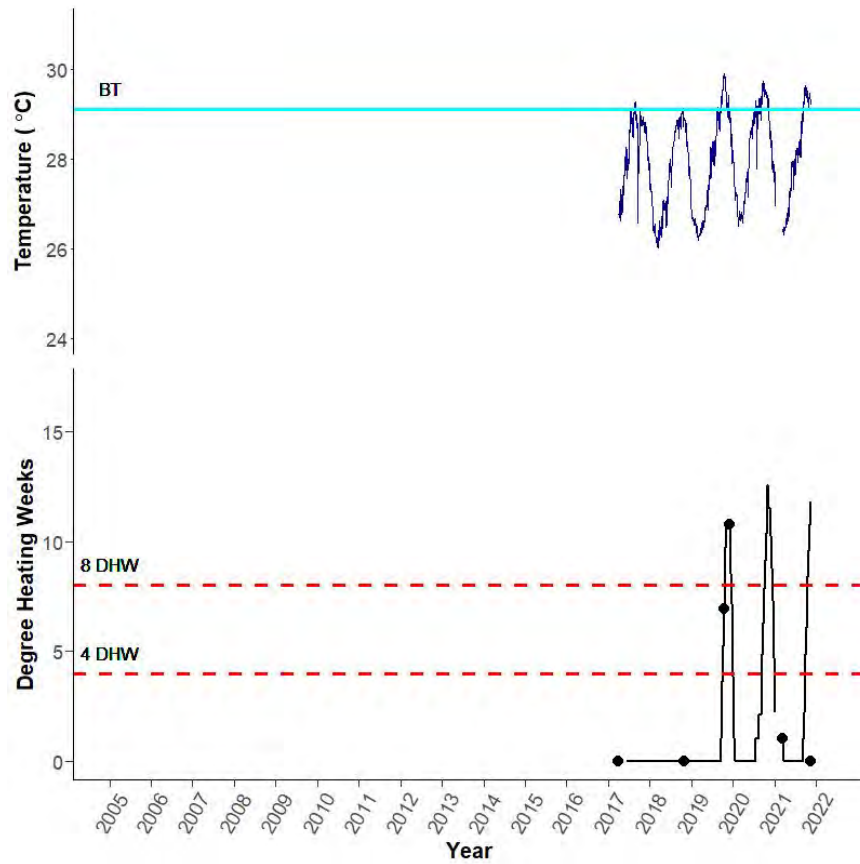


Figure 25. Buck Island Deep, St. Croix benthic temperatures (33 m depth).

Physical Characteristics

Current. Currents have not been recorded at the Buck Island Deep monitoring site. Unidirectional currents have always been light during monitoring. Oscillatory currents are not expected at this depth except during very strong storms.

Temperature. Temperatures at the Buck Island Deep, St. Croix surpassed the bleaching threshold in 2019 and were still high when the probe was retrieved on Oct. 15. This led to at least 7 degree heating weeks. The bleaching threshold is based on the hypothetical formula of bleaching threshold with depth for the USVI from Smith et al. 2016a and not on empirical observations.

SITE SUMMARIES

Benthic Community. Coral cover at the Buck Island Deep, St. Croix location was 33% in 2017, which is exceptionally high for St. Croix. However, the site lost about 27% of its relative cover in between the 2017 and 2018 monitoring, possibly due to an outbreak of white disease. The coral community is dominated by the boulder star coral *Orbicella franksi*. Stony Coral Tissue Loss Disease was first observed at the Buck Island STX Deep location in early 2021 and has resulted in substantial losses in coral cover since (about 40% relative cover). Epilithic algae and other macroalgae have shown an inverse relationship in monitoring data, and collectively account for the majority of living benthic cover. Sponge cover is high relative to other mesophotic bank locations, but below average for other types of mesophotic locations in St. Croix. Gorgonian cover is the highest of any other mesophotic monitoring site in the TCRMP.



Figure 26. Stony Coral Tissue Loss Disease at Buck Island STX Deep, November 2021 (Photo credit. K. Cobleigh).

SITE SUMMARIES

Coral Health. The Buck Island Deep, St. Croix location had the highest disease prevalence of any mesophotic location in the TCRMP during the first two years of monitoring. Disease prevalence was driven by both dark spot disease and white disease (possibly a type of white plague) before 2021. Disease prevalence peaked around 20% prevalence in November 2021 due largely to the arrival of Stony Coral Tissue Loss Disease. However, old and recent mortality and bleaching prevalence was average at this site compared to other mesophotic locations. In 2019 a high prevalence of bleaching with a modest extent on corals was recorded on Oct. 15 and Dec. 3. This suggests the hypothetical bleaching threshold for the site is a reasonable approximation. Diseases declined in 2019, particularly white disease, which is perhaps a common feature during bleaching (Smith et al. 2013).

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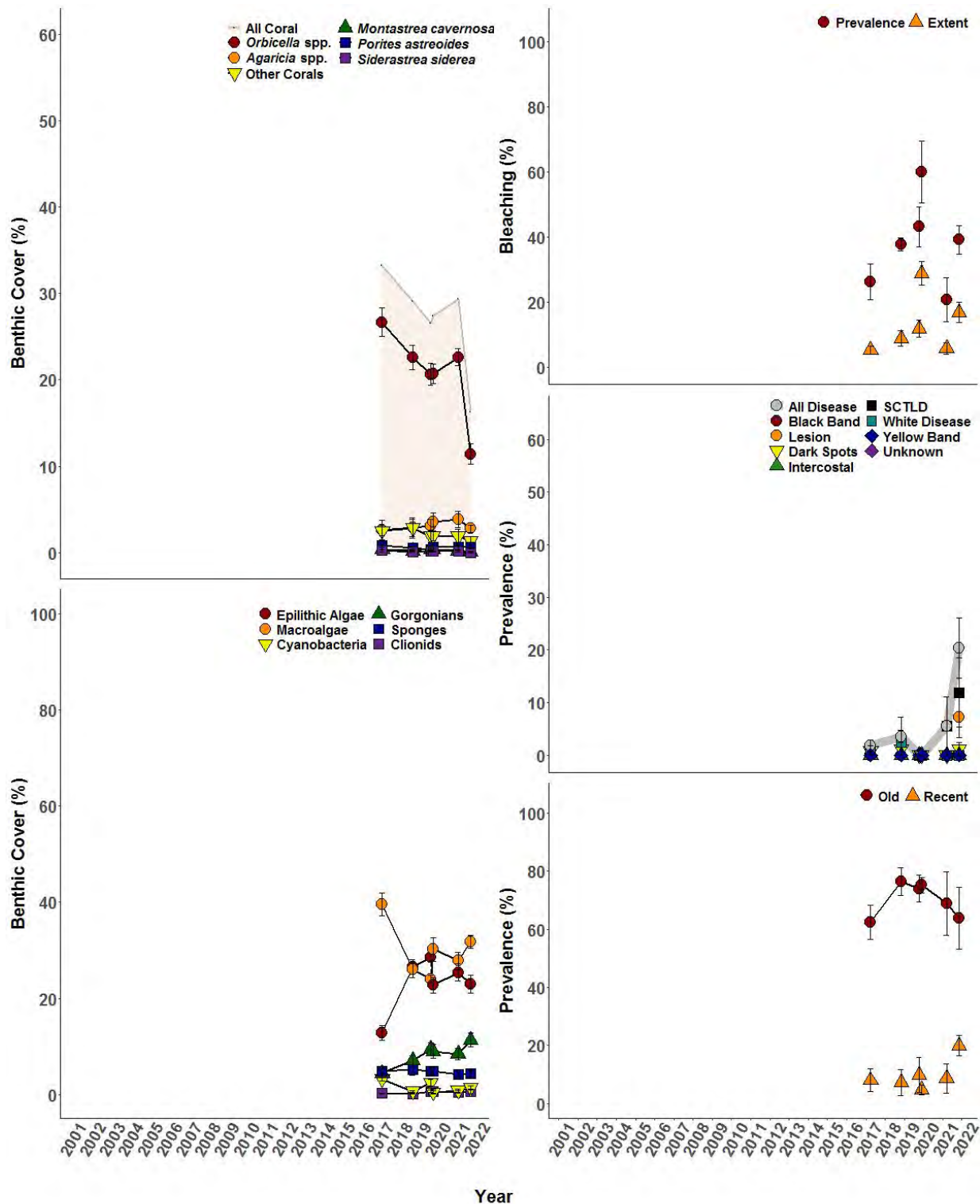


Figure 27. Buck Island Deep, St. Croix benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Buck Island Deep has a rich upper mesophotic reef community that is largely dominated in biomass by herbivores, primarily princess and stoplight parrotfishes. The planktivore guild is relatively high in biomass, but limited to a few species: creole wrasse, blue chromis and black durgon. Benthic invertivore feeders are diverse and include significant numbers of adult red hind. Adult schoolmaster were also recorded at large sizes on the Buck Island Deep site, and in the first year of sampling, 2018, dog snapper, a rare fish on the St. Croix shelf, were observed in transects. Large serranids were not observed, however, since the site is now protected from all fishing, it is hoped that larger groupers will return to the deep water community.

SITE SUMMARIES

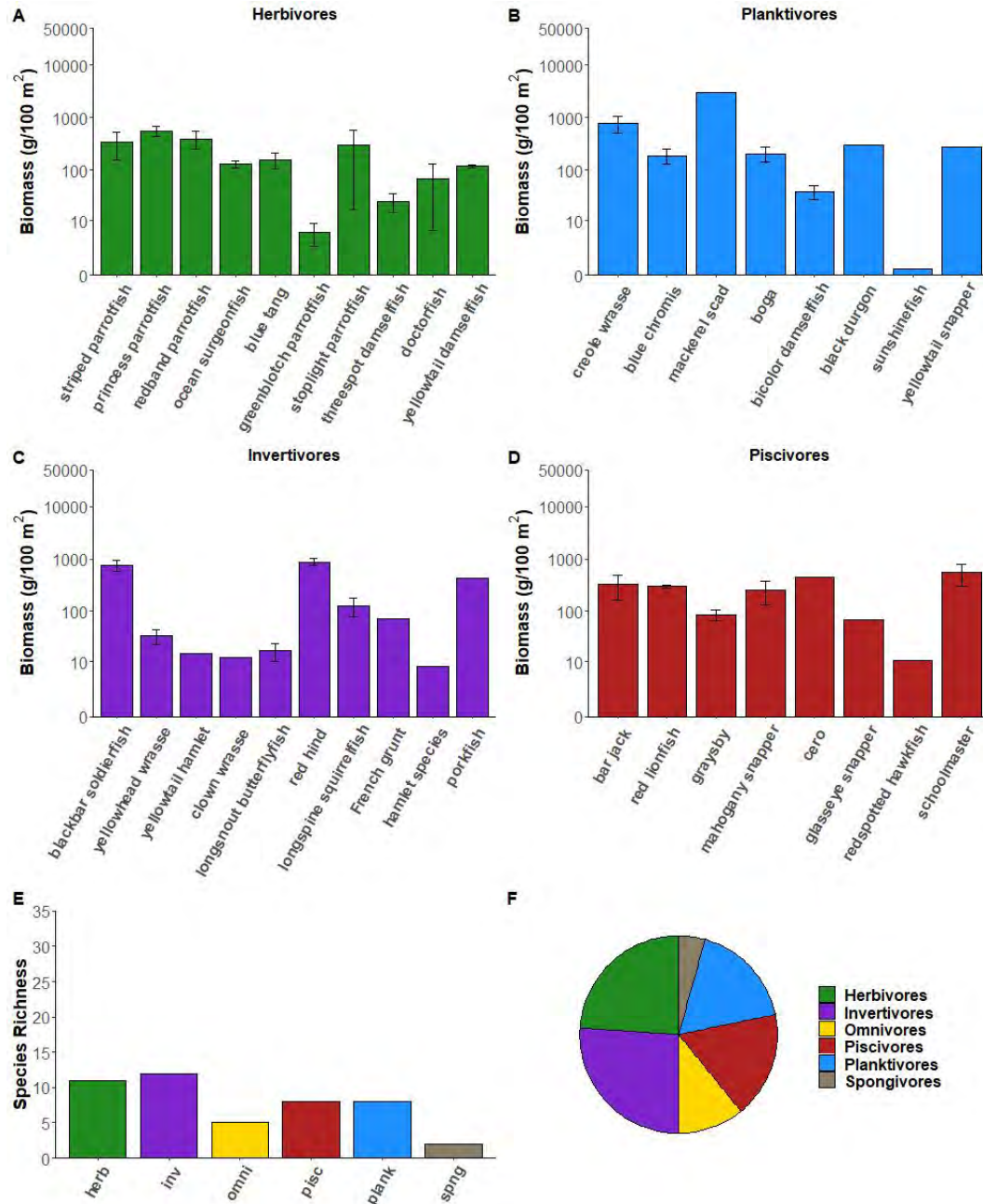


Figure 28. The Buck Island Deep, St. Croix fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

CANE BAY

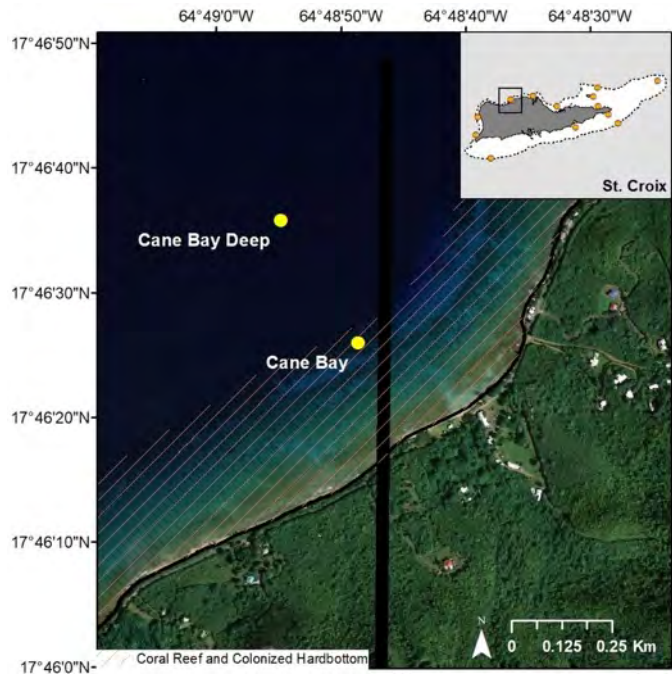
Description. The Cane Bay monitoring site is a nearshore/shelf edge fringing reef on the northwest coast of St. Croix. Transects follow the trend of the leeward spur and groove formations. Cane Bay has been monitored since 2001.

Outstanding Feature. Cane Bay is one of the most well-developed nearshore reefs on St. Croix. It is also one of the most heavily visited dive sites by both tourists and residents in the Virgin Islands due to its proximity to the wall, considered by some to be the most precipitous submarine drop off in the world. The reef has been under scientific investigation since the 1970's.

Threats. Although the Cane Bay reef is a singular treasure for the Virgin Islands, it is threatened by pollution, fishing, climate change, and recreational overuse. The watershed above Cane Bay has been planned for residential development with potential for the influx of terrestrial sediment. The reef is also fished commercially, and teams of spearfishers on SCUBA have been observed.

This reef also lost half its coral cover in the 2005 bleaching event, suggesting it is vulnerable to warming ocean temperatures.

Figure 29. (top) Cane Bay location. (right) A representative photo of the reef (photo credit: L. M. Henderson).



SITE SUMMARIES

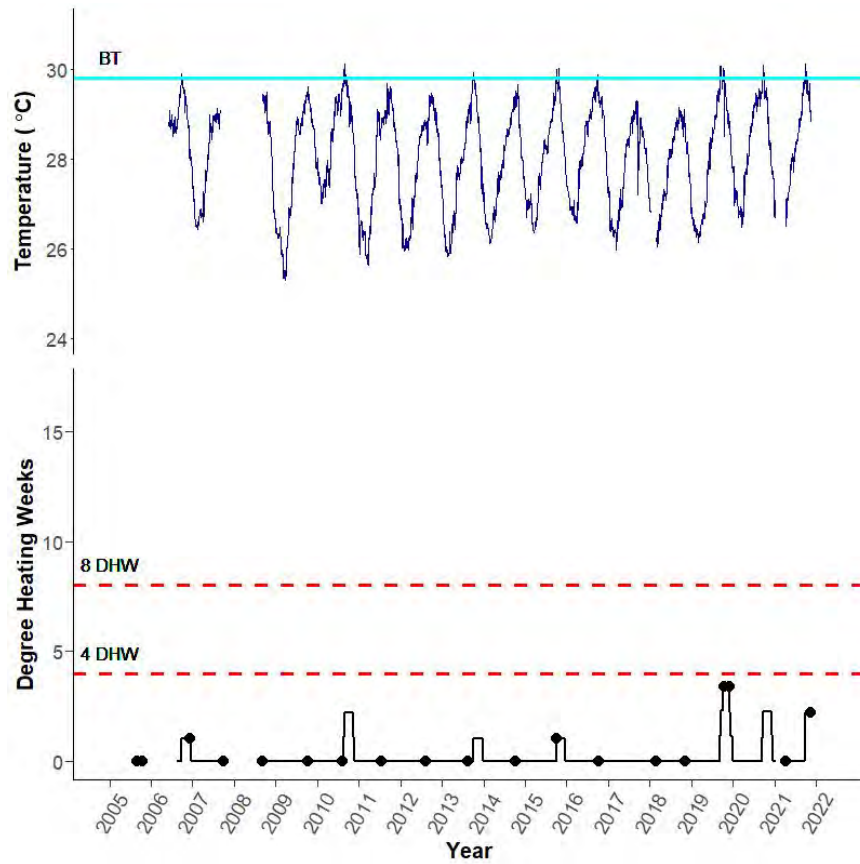


Figure 30. Cane Bay benthic temperatures (8 m depth)

Physical Characteristics

Current. Cane Bay currents have not been directly measured by the TCRMP. However, this site typically has moderate unidirectional currents with the occasional exposure to strong north swell. The current at the site may be part of an eddy formed by the dominant westward flowing current wrapping around the eastern point. Its downstream location from the entire north coast of St. Croix may also make this site a recruitment sink for larvae, potentially adding to the diversity.

Temperature. Cane Bay is a relatively open and clear environment, and the temperatures tend to stay cooler, but the propensity for bleaching may be increased by the high light transmission. Temperatures surpassed the bleaching threshold in 2010 and 2019.

SITE SUMMARIES

Benthic Community. Cane Bay supports a very diverse coral community, with dominance by *Orbicella* spp. Open substrates were mostly epilithic algal community; however, epilithic algae cover has declined since the 2005 bleaching event with increases in the cover of macroalgae and filamentous cyanobacteria. This indicates that the resident herbivore community was not able to effectively graze substrates opened by coral mortality. This coral community lost 46.8% of coral cover in the 2005 bleaching event and lost 6% more as of 2011. However, more recently coral cover has shown an increasing trend, led by recovery of the orbicellid community. Unfortunately, there were losses in coral cover (about 15% relative cover) largely driven by *Orbicella* sp. cover from 2019 to 2021 likely due to Stony Coral Tissue Loss Disease.

Coral Health. Cane Bay corals were severely affected during the 2005 bleaching event with nearly all colonies bleached over 80% of the colony surface. The prevalence of bleaching was also high in 2010, yet at a low extent. In 2019, there was a high prevalence of bleaching at a moderate extent in surveys on Oct. 15 and Dec. 3. The prevalence of coral diseases was low before 2005, but outbreaks of white, yellow band, and dark spots disease have occurred more recently, another indication of declining health at this reef. Old and recent partial mortality became very prevalent after the 2005 coral bleaching event and have remained nearly steady or increased since. Stony coral tissue loss disease was recorded in transects in the 2020 year sampling (April 2021).

SITE SUMMARIES

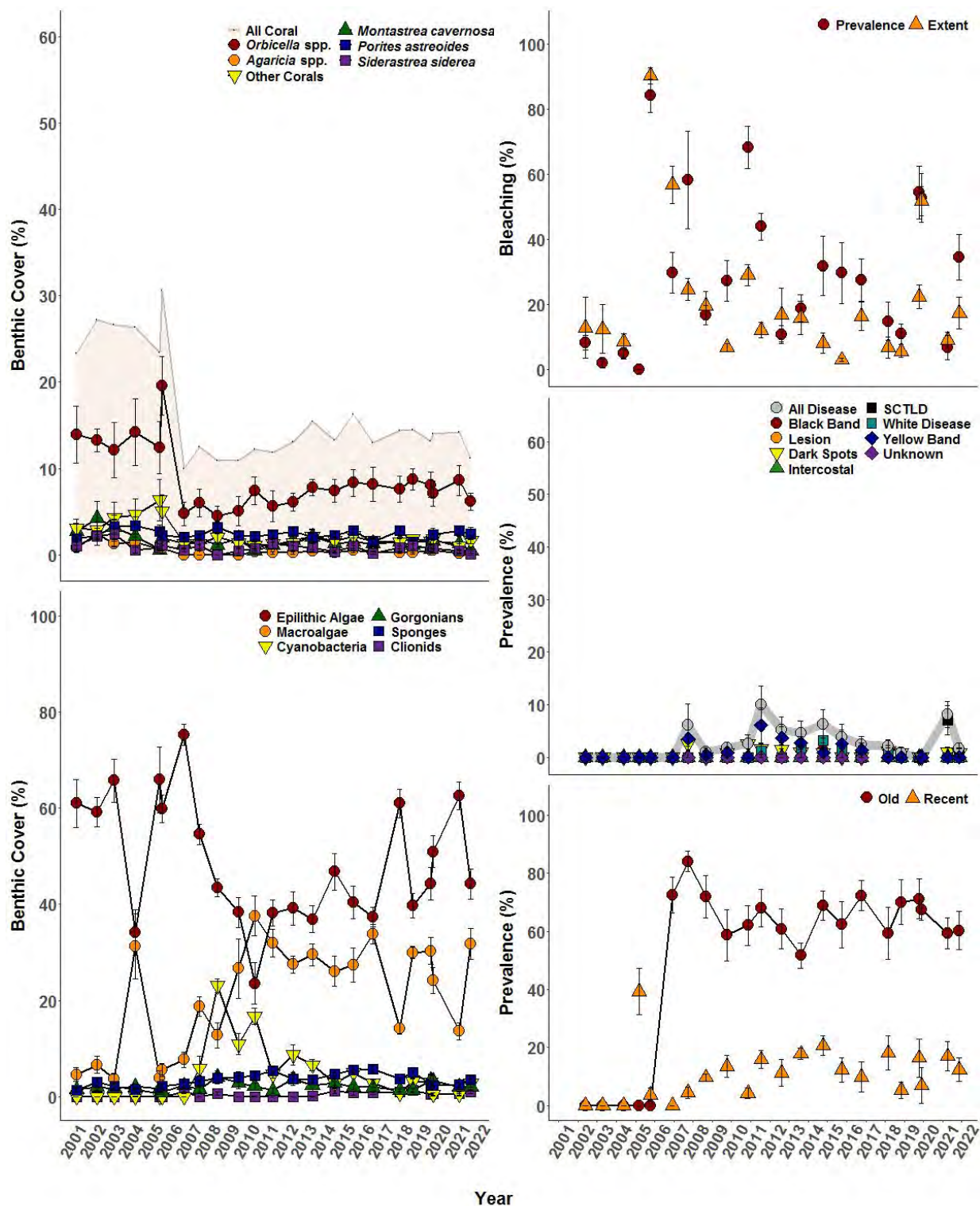


Figure 31. Cane Bay benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Cane Bay has a high diversity, abundance, and biomass of fish, reflecting the benthic diversity and high structural complexity of the reef. The trophic guilds are evenly split, illustrating the resources available. Herbivores are dominated both in abundance and biomass by the common Caribbean parrotfishes, which occur at the site as both juveniles and adults. Planktivores include both huge numbers of small chromis, and adult black surgeon, yellowtail snapper and black jacks, indicative of a shelf edge site. The piscivore guild is dominated both in abundance and biomass by schoolmaster and mahogany snapper, followed by coney and graysby. Large grouper and snapper are rare at the Cane Bay reef; however, a tiger grouper and Nassau grouper (~30 cm total length each) were sited at the shelf break in 2018. The site is not protected from fishing, and spearfishing is popular along this northern wall of St. Croix. Nonetheless the site has a high diversity of fish, and holds some of the deeper water species (sunshinefish, longsnout butterflyfish, and cherubfish) due to the site's close proximity to the northern wall drop.

SITE SUMMARIES

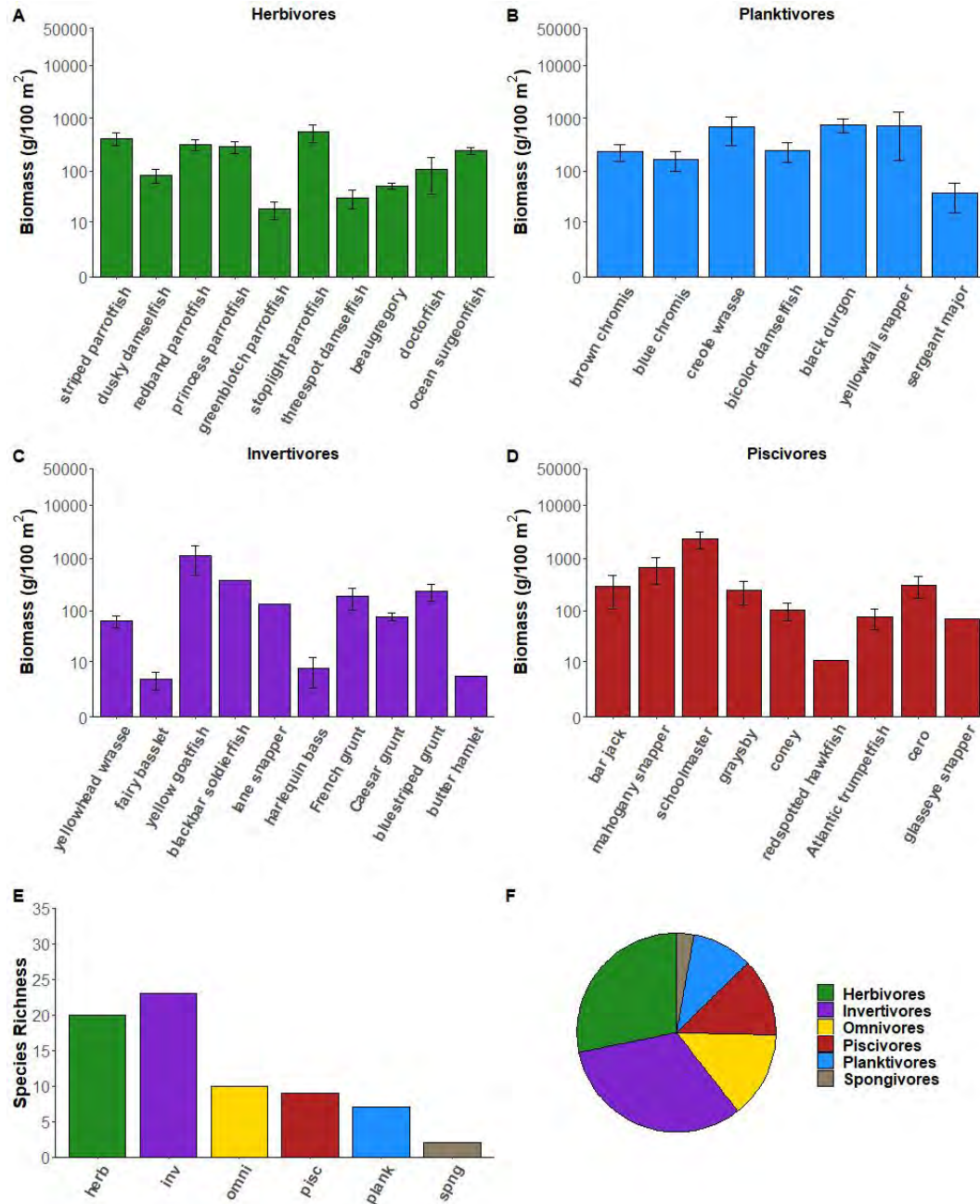


Figure 32. The Cane Bay fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

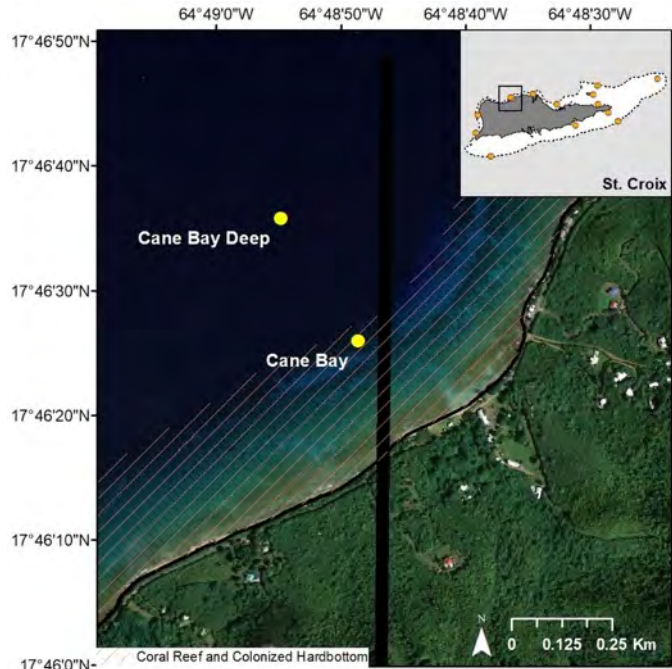
CANE BAY DEEP

Description. The Cane Bay Deep monitoring site is a mesophotic wall coral reef environment just downslope from the Cane Bay site. The reef is composed of deep spurs of coral interspersed with sediment. Cane Bay Deep was first surveyed during the 2005 coral bleaching event, but a permanent monitoring site was not established until 2009. Temperature monitoring was expanded to 67 and 100 m depths in 2018.

Outstanding Feature. Cane Bay Deep is one of the most impressive wall environments in the Caribbean and is the crown jewel for St. Croix dive tourism and biodiversity.

Threats. Although Cane Bay is economically important via dive tourism, it is under no special protection. Cane Bay Deep is threatened by sediment, fishing, climate change, and recreational overuse. Sediment cascades down from the shallow reef. Fishing occurs even at the deep reef evidenced by the presence of lost gear (monofilament and trap lines).

Figure 33. (top) Cane Bay Deep location. (right) A representative photo of the reef at the monitoring site (photo credit: J. Quetel).



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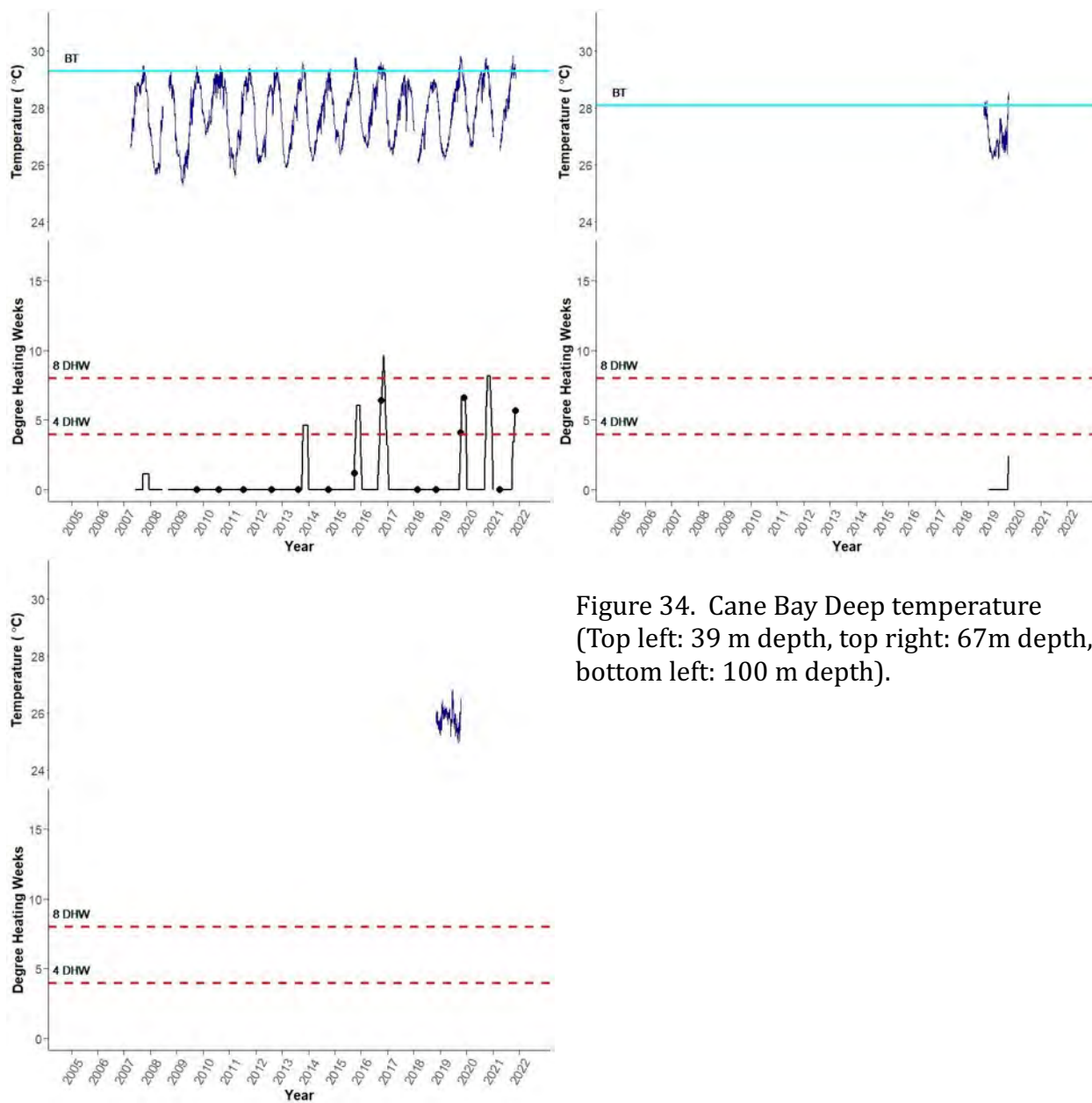


Figure 34. Cane Bay Deep temperature (Top left: 39 m depth, top right: 67m depth, bottom left: 100 m depth).

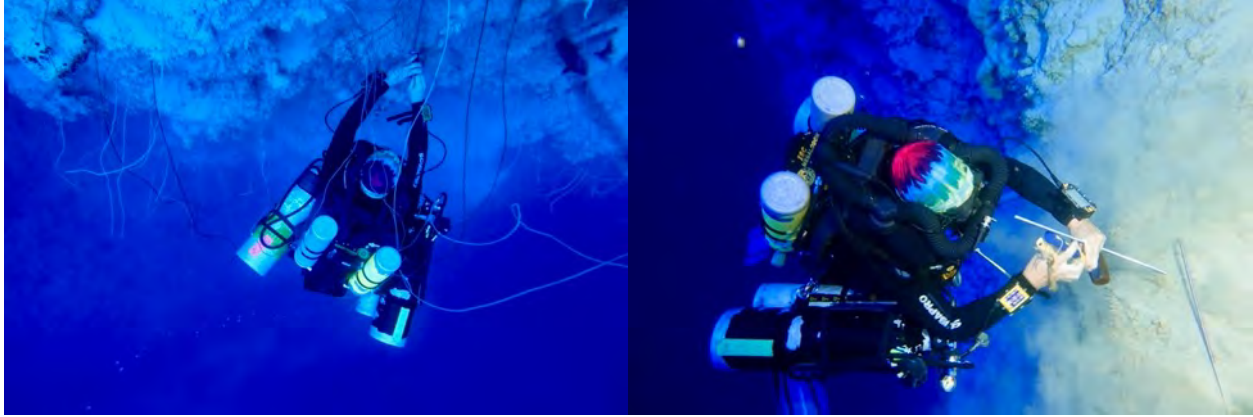


Figure 35. Installation of temperature monitoring stations at Cane Bay at 67 m (left) and 100 m (right) on the wall (credit: Viktor Brandtneris).

Physical Characteristics

Current. Cane Bay Deep is a calm wall environment that is buffered from water motion. However, it does receive sediment cascades from particles resuspended from the upper reef terrace. These flows are directed in the depressions between spurs.

Temperature. Cane Bay Deep temperatures are buffered in the warmest months by the presence of the thermocline. However, internal tide activity at this site is not as strong as in deep (~40 m) sites on the south shelf of St. Thomas, leading to less diurnal variability in temperatures. This may make the mesophotic wall environments more susceptible to bleaching than other mesophotic sites on the southern Puerto Rican shelf. The bleaching threshold is currently based on the Smith et al. (2016a) model; however, observations of elevated bleaching in 2016 and 2019 concomitantly with elevated hypothetical degree heating weeks suggest the bleaching threshold is reasonable. Temperatures at 67 and 100 m depths were much cooler than at 40 m.

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Benthic Community. Cane Bay Deep is a mesophotic plating coral community dominated by lettuce corals (*Agaricia* spp.), sponges, gorgonians, and black coral. Coral cover declined after 2017, a possible effect of Hurricane Maria. Relative coral cover decreased by nearly 40% from 2020 to 2021 likely due to the arrival of Stony Coral Tissue Loss Disease. The algal community is mostly epilithic algae, but there are also quantities of *Dictyota* spp. and *Lobophora variegata*. A high proportion of the substrate is soft sediment that flows from the upper shelf to deposit in grooves.

Coral Health. Surprisingly for a dim and cooler mesophotic reef, Cane Bay Deep corals bleached heavily in the 2005 coral bleaching event based on limited observations prior to establishment of the TCRMP site (Smith et al. 2016a). This site bleached heavily again in 2019, with nearly 80% of corals bleached at a level of about 50% of the colony surface. Low-extent coral bleaching is very prevalent even in years without thermal stress, a likely result of sediment deposition. Unknown diseases and dark spots diseases are prevalent in some years. Old partial mortality increased after 2005 and has remained high since. It is unclear if SCTLD was recorded in transects in the 2020 year sampling (April 2021), but a high abundance of lesions were present and SCTLD was present at the shallow site, so lesions may reflect SCTLD impacts.

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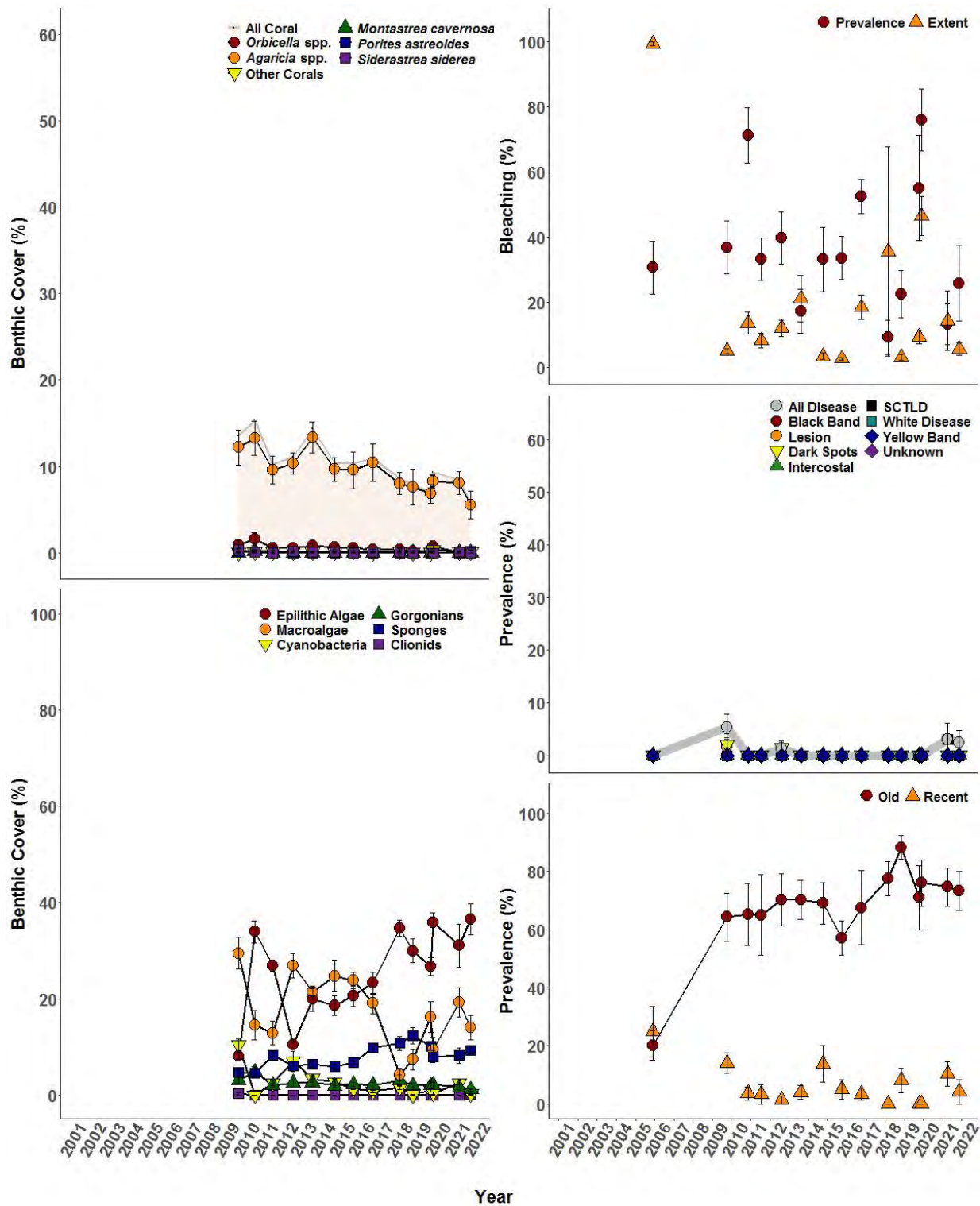


Figure 36. Cane Bay Deep benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Cane Bay Deep is characterized by a very low fish biomass compared to both other mesophotic sites across the TCRMP, and shallow and midshelf sites of St. Croix. The site is dominated by planktivores: creole wrasse, blue chromis black durgelon and yellowtail snapper. This planktivorous community is depauperate compared to that of Salt River Deep however. The herbivore guild contributes little to the community composition, and is composed primarily of striped, princess, and redband parrotfish. Large stoplight parrotfish are recorded very occasionally. There is also very low biomass in the invertivore guild, which is made up primarily French and bluestriped grunts, goatfish and wrasse. Caribbean reef sharks cruise the wall, looking for a free lionfish handout that has become common from local divers. They have become quite bold as a consequence of this generosity however lionfish are now absent from the site. The Caribbean reef shark contributes highly to the piscivore trophic guild and is joined by other pelagics: the almaco jack, horse eye jack, barracuda and bar jack. Benthic piscivores are limited to graysby and small mahogany and schoolmaster snapper. The St. Croix northern wall is heavily fished by both commercial and sport spearfishermen, so large snappers and groupers are rare. Small deep water reef species such as the bantum bass, fairly basslet, cherubfish, and sunshine fish are recorded at the site. Peppermint bass are commonly observed in the 67-100 m depth range near the temperature recorders.

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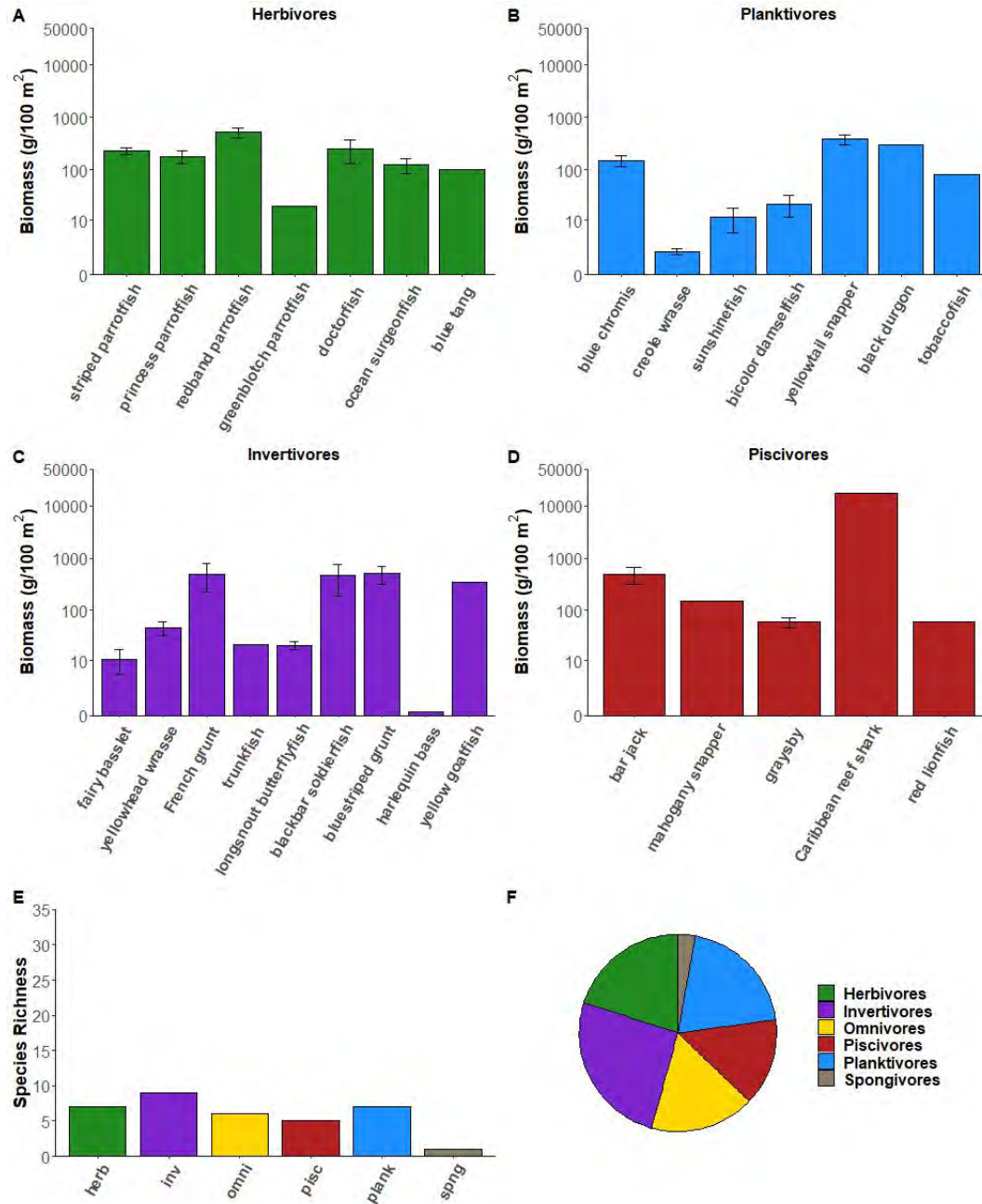
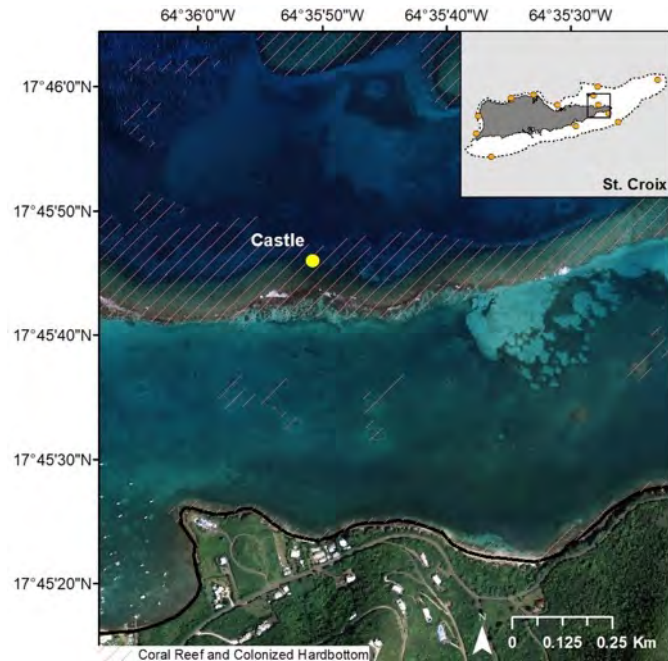


Figure 37. The Cane Bay Deep fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

CASTLE

Description. Castle (aka. West Indies Lab) is part of the seaward northeastern St. Croix barrier reef complex outside Teague Bay. The reef starts at sea level as a relict elkhorn coral reef and is dominated by boulder star corals along the seaward edge. The area around the Castle site was monitored initially in 2003, but permanent transect were not installed until 2008.



Outstanding Feature. Castle is part of the once luxurious living elkhorn coral barrier reef that protects the northeastern St. Croix shoreline. It was a research area of the former West Indies Laboratory of Farleigh Dickenson University, which was a seminal area for global coral reef research from the 1970's and 1980's.

Threats. The barrier reef outside Teague Bay is inside the St. Croix East End Marine Park, but is in the open fishing zone. There is relatively low potential for land-based sources of pollution due to the sites midshelf location in front of a lightly populated area. Clear water and warm temperatures make this an area of potential concern during bleaching events.



Figure 38. (top) Castle location. (right) A representative photo of the reef (photo credit: L. M. Henderson).

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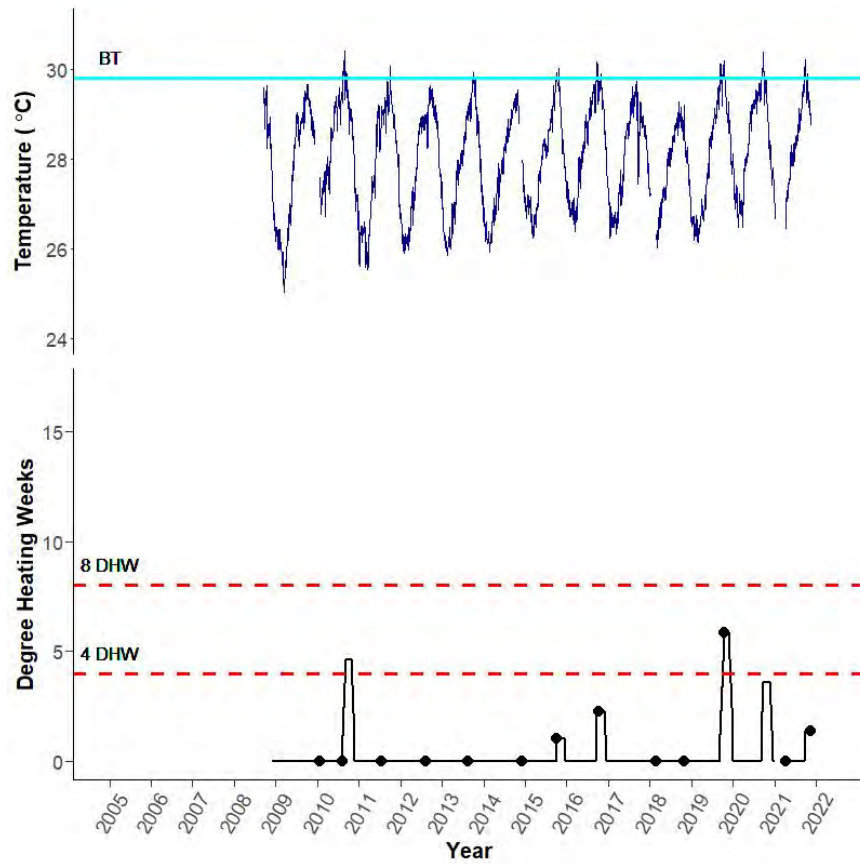


Figure 39. Castle benthic temperatures (9 m depth).

Physical Characteristics

Current. Little is known about the current at the Castle site. It is under the influence of wave-driven oscillatory flow in the shallows, but strong directional currents have not been experienced during monitoring activities.

Temperature. Castle has the potential to develop very warm temperatures and spent nearly a month above the bleaching threshold in 2010 (4.5 DHW) and reached at least 6 DHW in 2019 when the sensor was retrieved.

SITE SUMMARIES

Benthic Community. The Castle site is unusual for its dominance of branching *Porites* corals along the slope and concentrations of *Orbicella* spp. corals at the outer fringe adjacent to sand. The algal community is dominated by epilithic algae, with lesser abundance of *Dictyota* spp.. Macroalgae and filamentous cyanobacteria are also common. The impacts of the 2005 bleaching event are not known since monitoring in 2003 was not necessarily in exactly the same spot as the location of permanent transects established in 2008. The arrival of Stony Coral Tissue Loss Disease in 2021 has resulted in a relative coral cover loss of 15.6%.

Coral Health. Bleaching is mild at the site. Corals were assessed prior to but not during the 2010 coral bleaching event. During the 2019 beaching event corals were sampled near what might have been the peak of the shallow water heat stress based on the regional DHW. However, the beaching response at that time was not that different from non-bleaching years, illustrating resistance at this site. Old partial mortality is high in prevalence and steady. Recent partial mortality is particularly high at the site, and this may be a consequence of numerous damselfish (*Stegastes* spp.) and predatory snails (*Coralliophila* spp.) on large *Orbicella* spp. colonies. Stony coral tissue loss disease was not recorded in transects in the 2020 year sampling (April 2021), but was present at the location during the 2021 annual sampling (November 2021).

SITE SUMMARIES

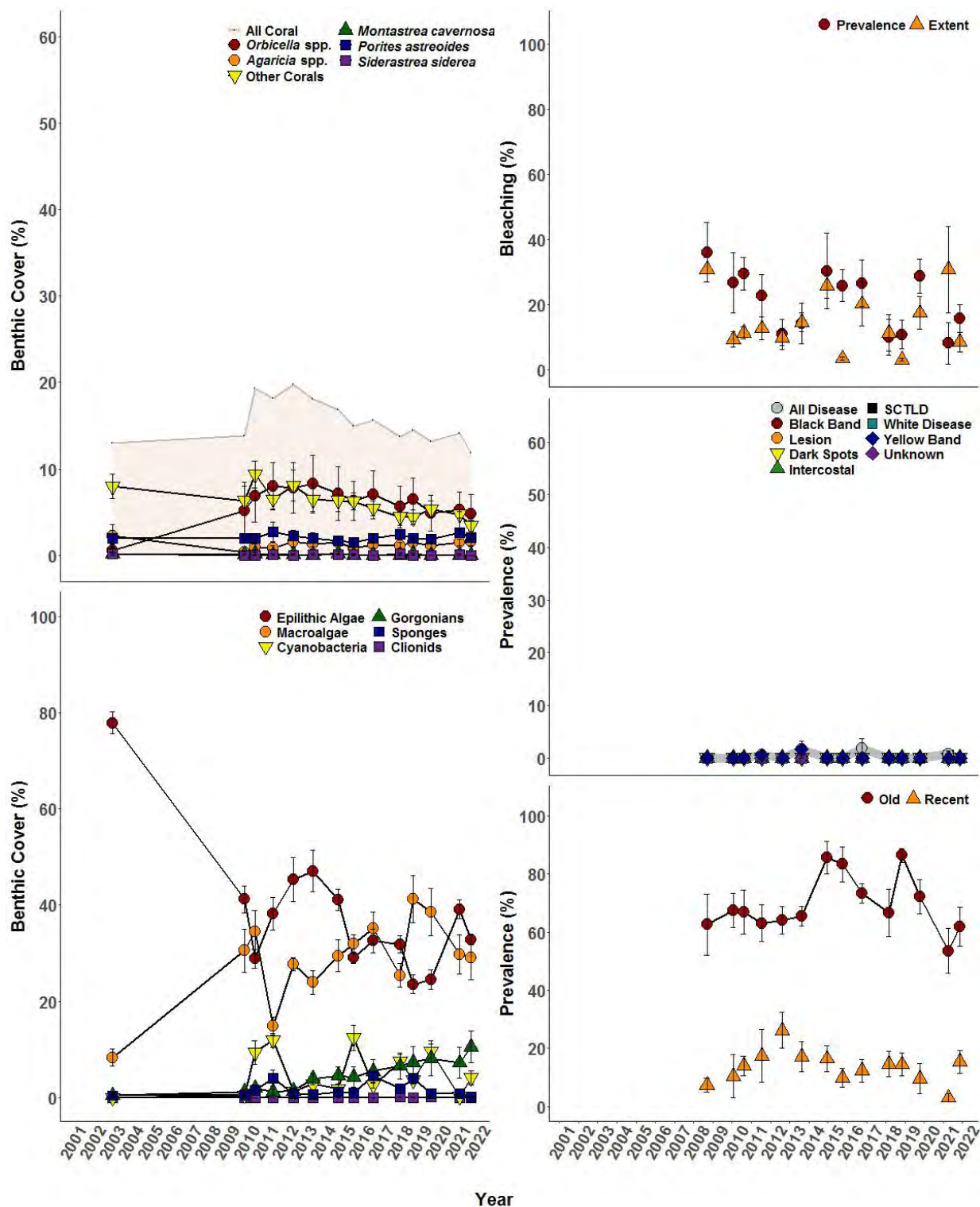


Figure 40. Castle benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The Castle fish community is typically lower in overall abundance and biomass than most of the St. Croix offshore sites. It is dominated by herbivores in biomass, driven by schools of subadult striped parrotfish and mixed acanthurids. Invertivores are diverse and fairly high in biomass; the group is dominated by wrasses, French grunts and spotted goatfishes. Piscivores and planktivores contribute less to community structure and are limited to a few species. Juvenile yellowtail snapper and blue chromis contribute most to the invertivore biomass and bar jacks and yellow jacks contribute most to the piscivore guild. No serranids other than graysby, hamlets and tiny basslets have been recorded at Castle. Lionfish have been observed there commonly over the past five years.

SITE SUMMARIES

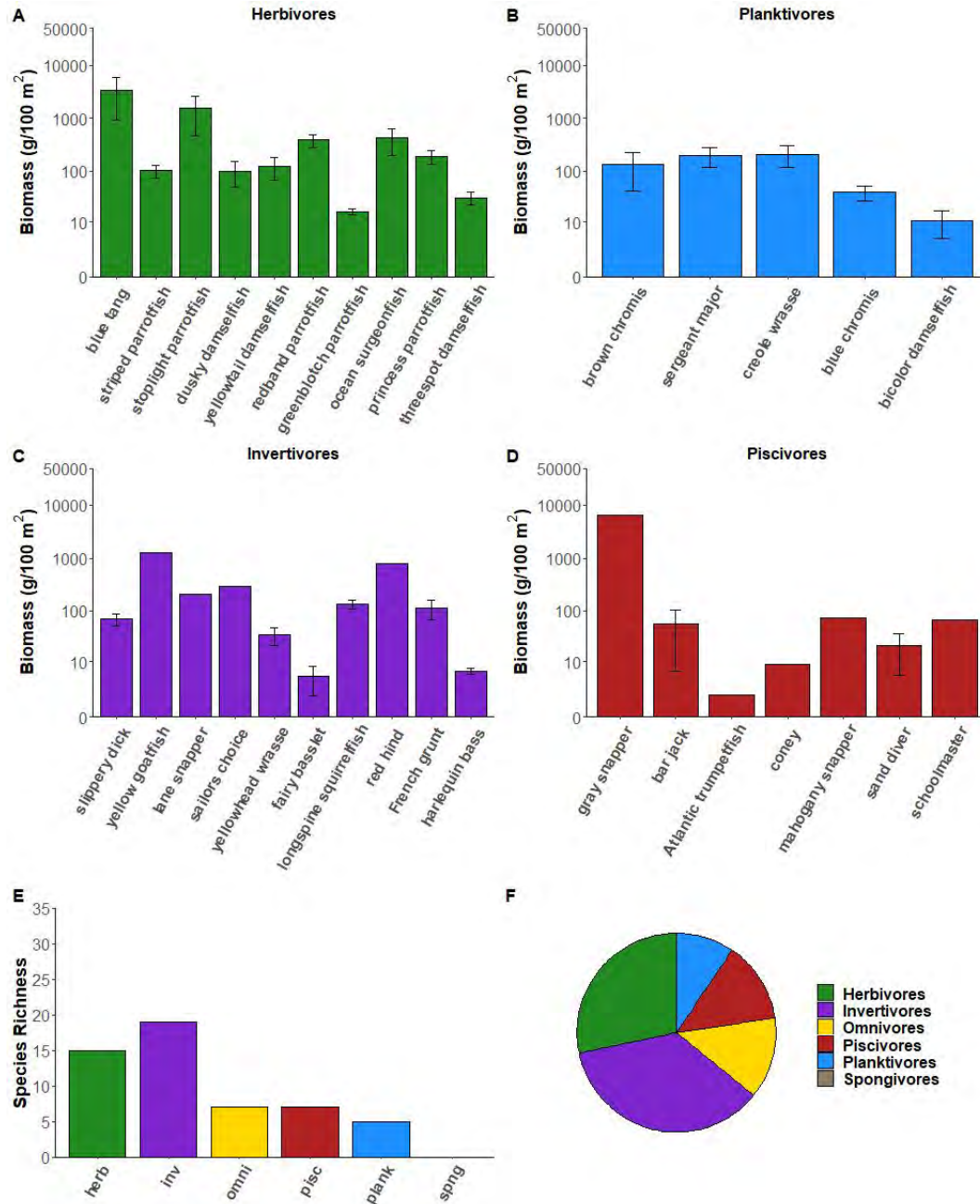


Figure 41. The Castle fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

EAGLE RAY

Description. The Eagle Ray site is a shallow seaward barrier reef located at west dive buoy 1 outside the main Christiansted access channel. The monitoring site is colonized hardbottom to coral reef, with more extensive development of reef at the seaward edge. Eagle Ray has been monitored since 2001.

Outstanding Feature. Eagle Ray is one of the most visited dive sites due to its proximity to Christiansted.

Threats. Proximity to Christiansted increases the potential for land-based sources of pollution, such as sewage, run-off, and marine debris. The site is frequented by small fishing craft that venture just out of port, likely increasing the fishing pressure.

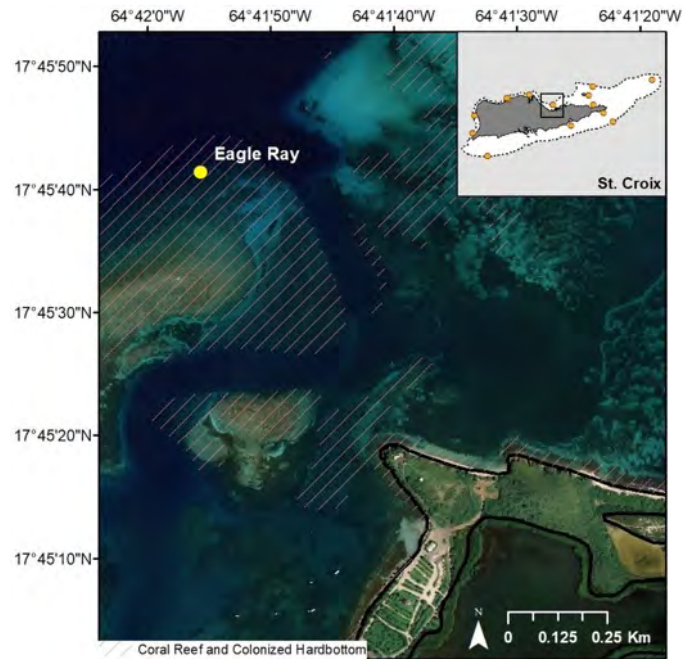


Figure 42. (top) Eagle Ray location. (right) A representative photo of the reef (photo credit: L. N. Henderson).



SITE SUMMARIES

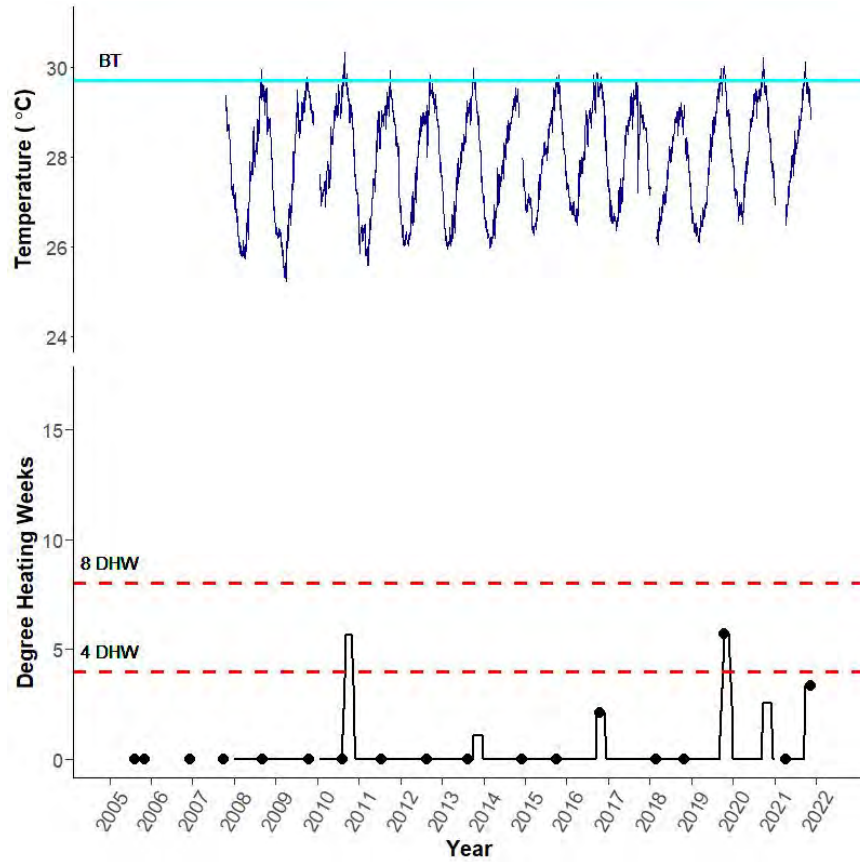


Figure 43. Eagle Ray benthic temperature at 9 m depth

Physical Characteristics

Current. Currents have not been measured at Eagle Ray; however, strong unidirectional currents seem rare. There are increased oscillatory currents near the shallow portion of the site.

Temperature. Eagle Ray is shallow but near deep water on two sides, which may potentially help to reduce the temperature relative to sites in more enclosed environments. Based on the bleaching response in 2019 an adjusted bleaching threshold of 29.70 °C was established for the site.

SITE SUMMARIES

Benthic Community. Eagle Ray supports a diverse community of small coral colonies, but sponges and gorgonians compose half the sessile epibenthic animal community. Coral cover has been low (less than 10%) throughout the monitoring period. Coral cover decreased only slightly with the 2005 coral bleaching event, 11.7%, but cover has come back and actually increased above pre-bleaching values. The limited response may be partly due to the high relative abundance of more thermally resistant coral species. However, coral cover has decreased by about 52% from 2019 to 2021 likely due to Stony Coral Tissue Loss Disease. The site was dominated with epilithic algae; however, this has declined after the 2005 bleaching event with a concomitant increase in macroalgae and filamentous cyanobacteria.

Coral Health. Eagle Ray corals were severely affected during the 2005 bleaching event with nearly all colonies bleached over about 80% of the colony surface. Low-level bleaching is also common in years without thermal stress. The site was monitored in 2010 prior to the thermal stress event and bleaching is underestimated for that year. In 2019 the site showed moderate prevalence and extent of bleaching.

Diseases are a common feature of the site, with black band, yellow band, and dark spots disease having outbreaks in certain years. Lesions were also common during the 2005 coral bleaching event. Old partial mortality became very prevalent after the 2005 coral bleaching event and subsided in the following years. Stony coral tissue loss disease was recorded in transects in the 2020 year sampling (April 2021).

SITE SUMMARIES

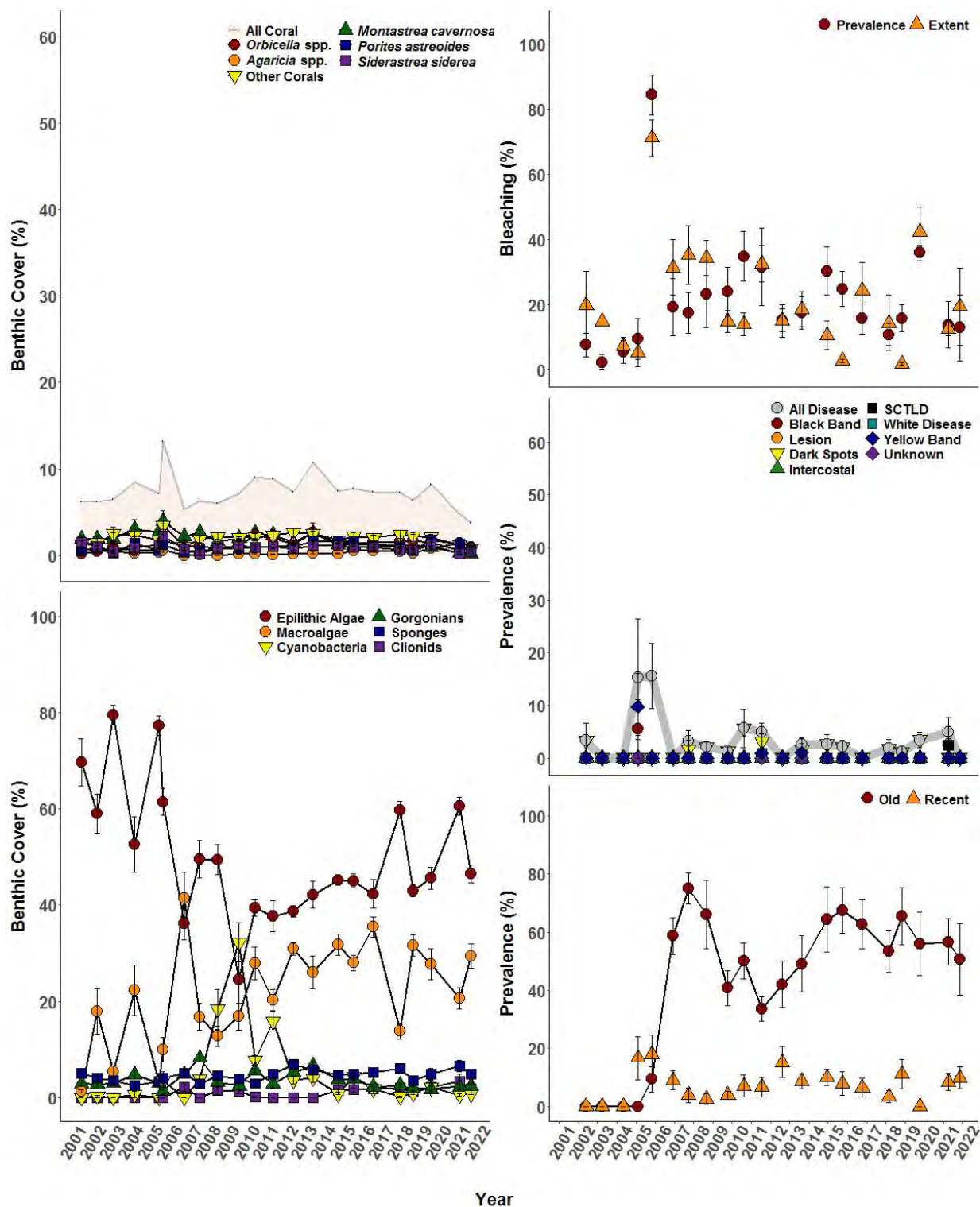


Figure 44. Eagle Ray benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Eagle Ray is a diverse and rich site; surprising considering the fishing and diving pressure it receives as well as the land source pollution due to the site's proximity to Christiansted Harbor. It is dominated by herbivores and invertivores, with a strong component of parrotfish, acanthurids and herbaceous damselfishes. Invertivores are led in both abundance and biomass by the nocturnal benthic feeder, the blackbar soldierfish. Proximity to open deep water is evidenced by the occurrence of high numbers of planktivorous creole wrasse, and black durgon and piscivorous large jacks and great barracuda. Yellowtail snapper are large and plentiful, probably due to the divers that frequent the site with fish food. Graysby, coney, schoolmaster and mahogany snapper comprise the benthic piscivore guild. No large serranids or lutjanids are ever observed on Eagle Ray. However Caribbean reef sharks are recorded at the site and overall the fish community remains high in overall biomass and species richness.

SITE SUMMARIES

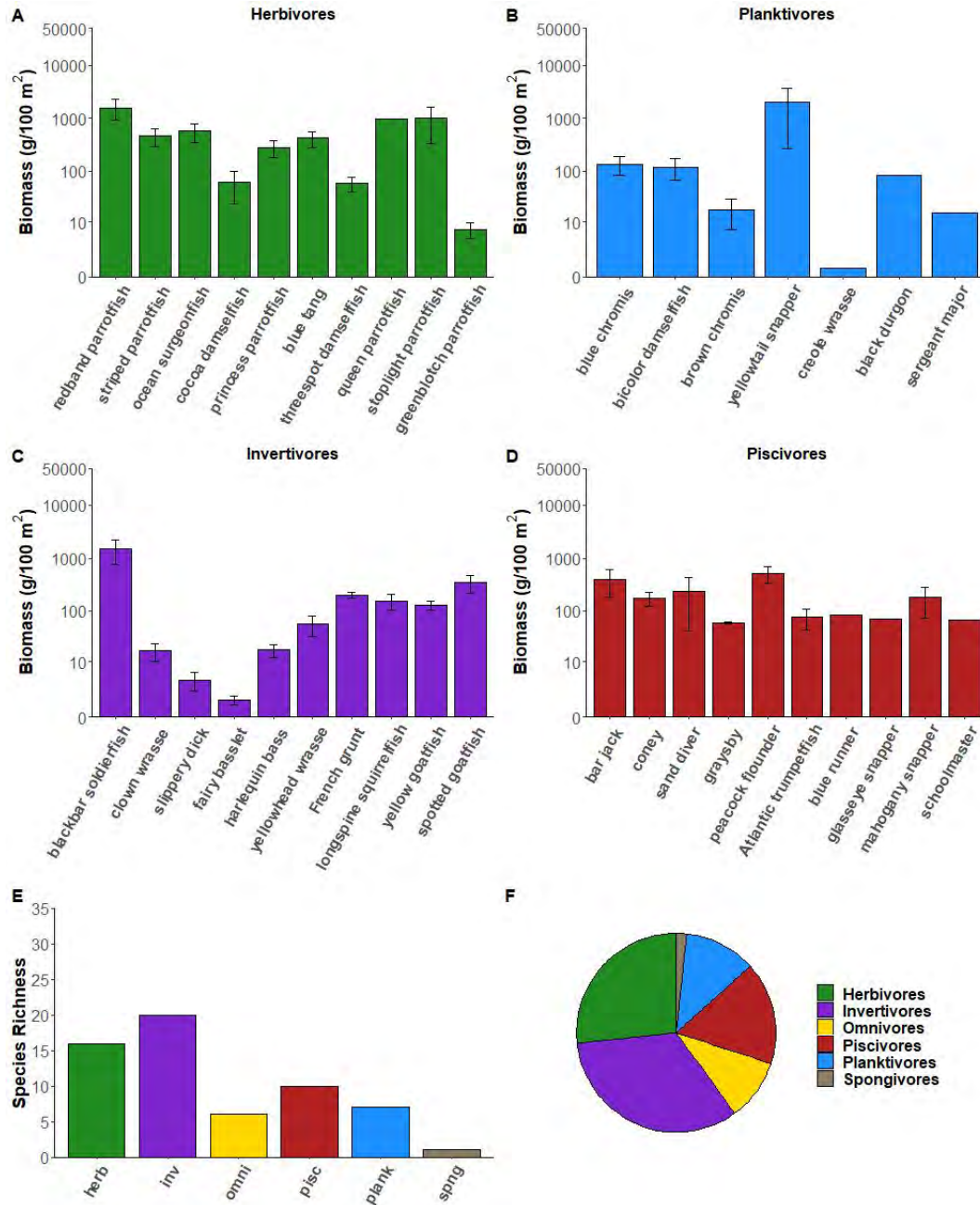


Figure 45. The Eagle Ray fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

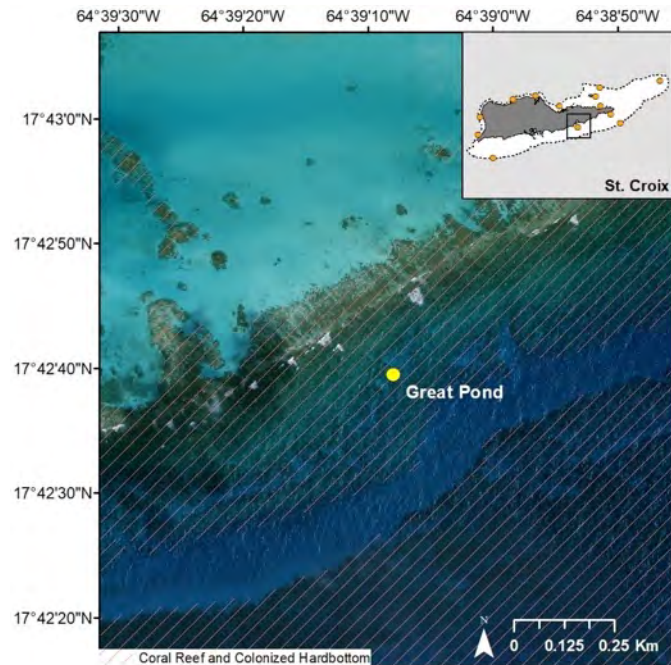
GREAT POND

Description. The Great Pond monitoring site is a wave-washed shallow barrier reef that was formerly an elkhorn coral reef in depths of 5-7 m. The reef is part of the barrier reef front surrounded by patch reefs and sand. Great Pond has been monitored since 2003.

Outstanding Feature. Great Pond hosts the largest population of the black spiny urchin *Diadema antillarum* of any TCRMP monitoring site, likely because of its shallow depth. It also hosts an abundance of large-bodied stoplight (*Sparisoma virde*) and yellowfin parrotfish (*Sparisoma rubripinne*) that likely spawn near the site.

Threats. The Great Pond monitoring site is located in the St. Croix East End Marine Park but outside the no-take fishery zone. If park rules are enforced, this site could see a return of fisheries species by spillover from adjacent protected areas. Because of high turbulence and low watershed development, sediment is not considered a problem; however, large industrial sites operate within 3-10 km westward and could contribute to pollution.

Figure 46. (top) Great Pond location. (right) A representative photo of the reef (photo credit: L. M. Henderson).



SITE SUMMARIES

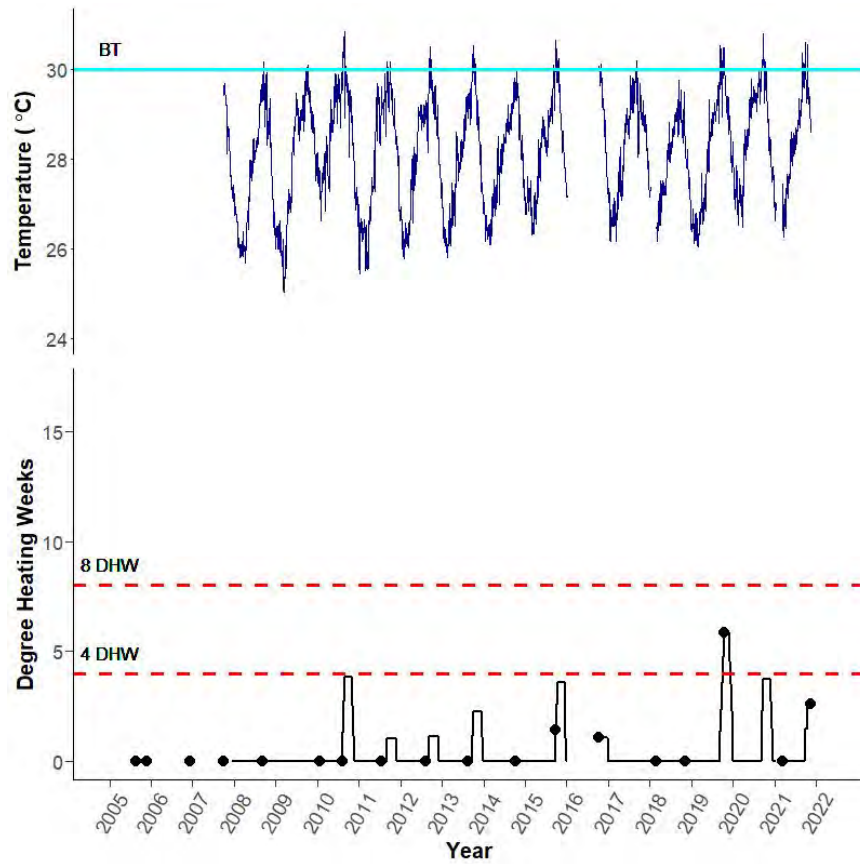


Figure 47. Great Pond benthic temperature (5 m depth).

Physical Characteristics

Current. Great Pond currents have not been measured directly. Wave-generated oscillatory currents dominate and this is the most regularly swell-influenced site in the TCRMP making work conditions difficult on all but the calmest day. Strong unidirectional currents have not been experienced.

Temperature. Great Pond typically experiences very high temperatures in August to October, with temperatures peaking at nearly 31°C in 2010. Temperatures surpassed the bleaching threshold in 2019 causing a minimum of 6 DHW when the sensor was pulled.

SITE SUMMARIES

Benthic Community. The Great Pond site is unusually dominated with the mustard hill coral (*Porites astreoides*) and *Pseudodiploria strigosa*. It is also the only site with a relatively high abundance of *Pseudodiploria clivosa*. The site lost 55.9% of its coral cover in the 2005 bleaching event, but had regained about half as of 2011. Hurricanes Irma and Maria caused damage to this location in 2017, resulting in a 65% drop in relative coral cover during the 2017 annual monitoring (March 2018). Macroalgal blooms occur occasionally (2007 and 2011), but the site is dominated by epilithic algae.

Coral Health. Great Pond corals were moderately affected during the 2005 coral bleaching event, which may be a reflection of the high composition of resistant coral species and the regular exposure to high temperatures. The site was not monitored during the height of the 2010 coral bleaching event. In 2019 there were very few bleached colonies, but those that were affected had a high extent of bleaching on colony surfaces. Patchy, low-level bleaching is common in some years. Diseases have been almost non-existent at the monitoring site. Partial mortality is variable and has not shown consistent trends over years. Stony coral tissue loss disease was not recorded in transects in the 2020 year sampling (April 2021), but was present during the 2021 sampling (November 2021).

SITE SUMMARIES

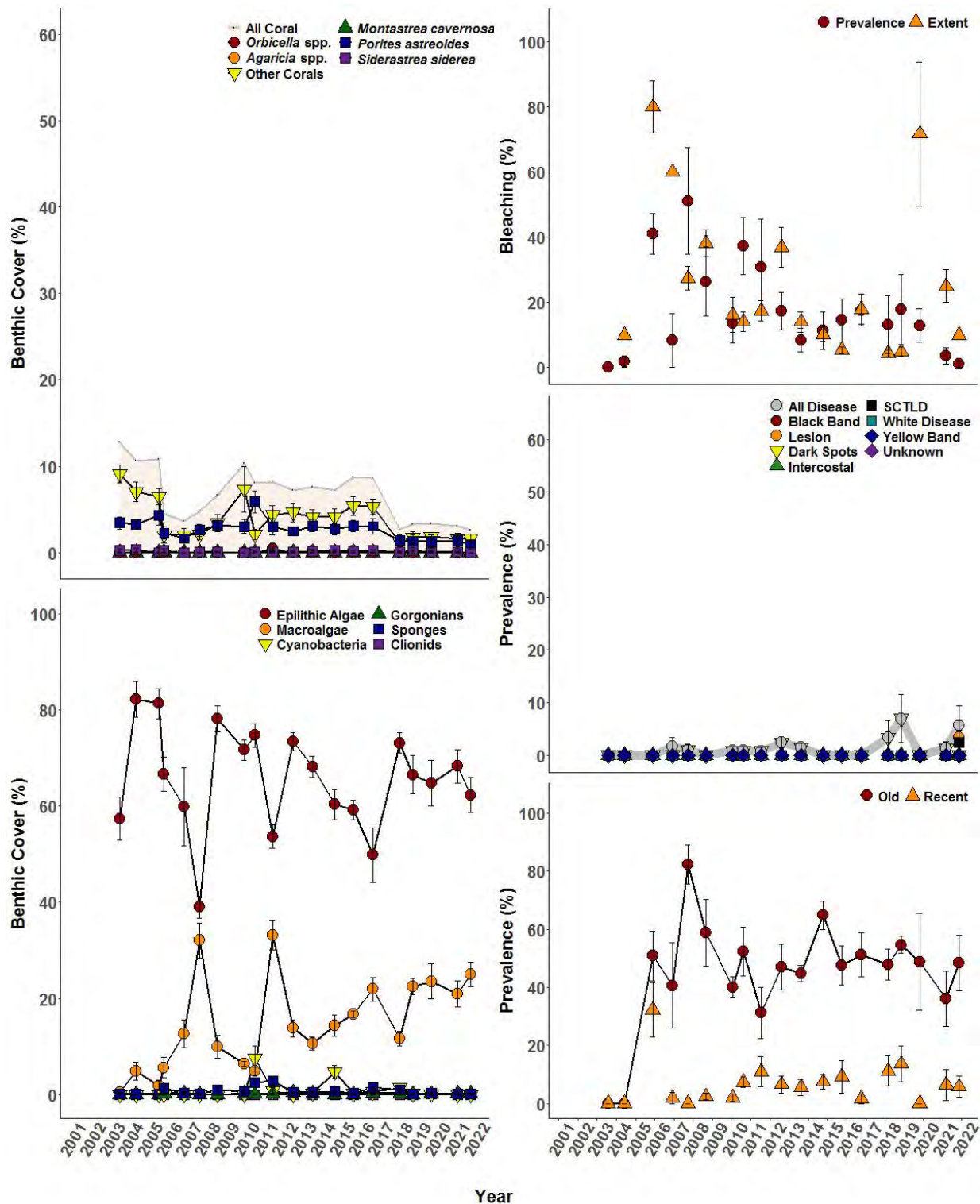


Figure 48. Great Pond benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The Great Pond fish community is highly dominated by herbivores. The primary herbivores at the site are the ocean surgeonfish and blue tang, which swim in foraging schools feeding on algae covering the relict elkhorn coral. Also present are the stoplight, yellowtail and queen parrotfish, which can also be seen foraging in large groups on old elkhorn skeletal remains. Quite possibly these fish are spawning in the late afternoon and evening hours at or near the site. Between the old relic *Acropora* stands the fish biomass is low and is primarily made up of yellow goatfish, wrasses, and schools of juvenile parrotfish. Piscivores at Great Pond are limited almost entirely to mahogany snapper and bar jacks, with the occasional mackerel or schoolmaster snapper. Benthic invertivores are dominated in biomass and abundance by wrasses. Wrasse diversity is high and includes the slippery dick, clown wrasse, yellowhead and bluehead wrasse, rainbow wrasse, puddingwife, and Spanish hogfish.

SITE SUMMARIES

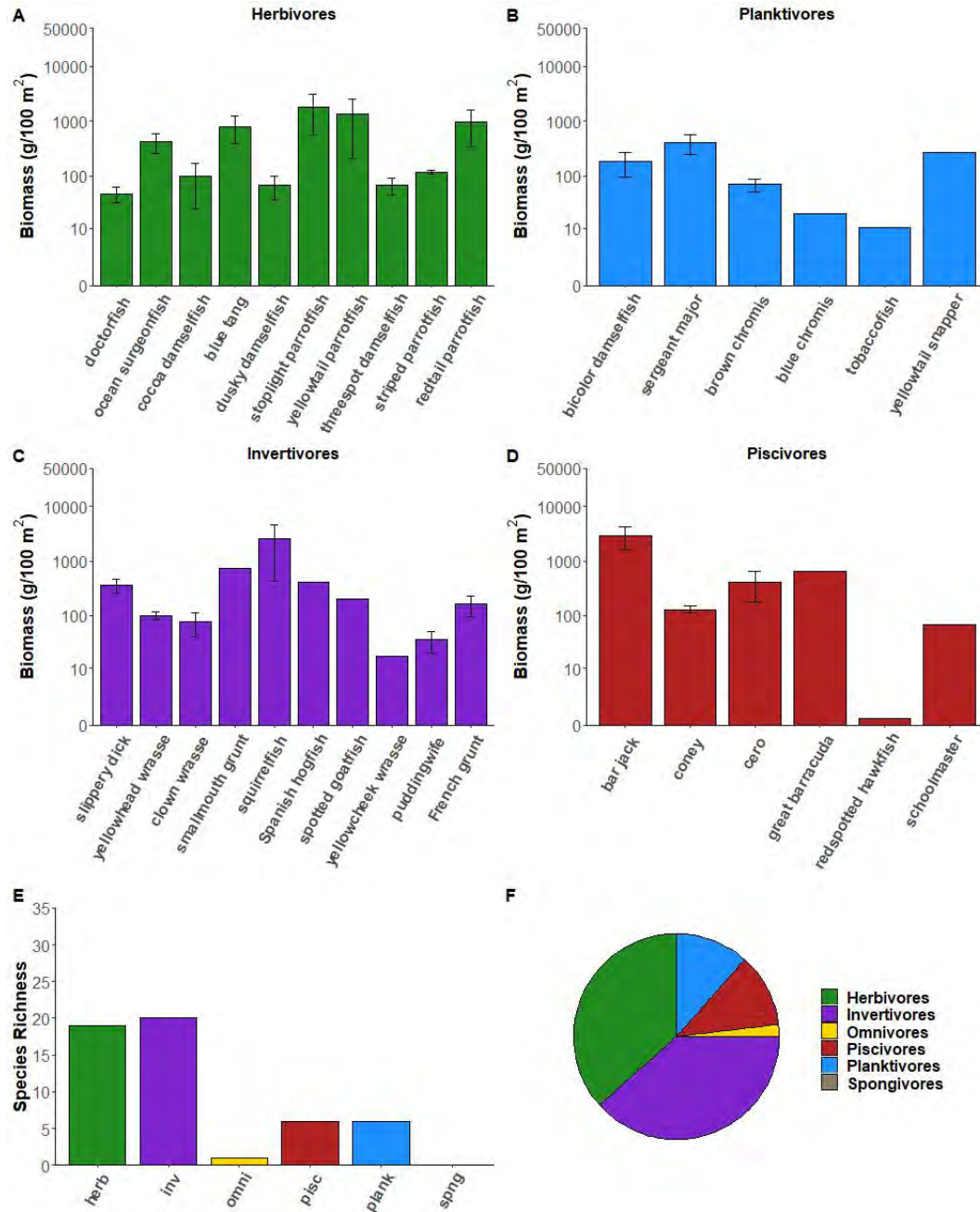


Figure 49. The Great Pond fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

JACKS BAY

Description. The Jacks Bay monitoring site (aka Jacks/Isaacs Bay) is part of fringing reef, colonized hardbottom on the southeast point of St. Croix in water depths of 13-16 m. The monitoring site is just inward from the shelf break and seaward reef slope, which terminates in a sand plain at about 20 m depth. Jacks Bay is largely a carbonate hardbottom with scattered hard coral, although there are some large coral heads

seaward of the transects. Permanent transects were installed at Jacks Bay in 2001.

Outstanding Feature. Jacks Bay hosts a unique fish community with high abundance of small wrasses and the occasional occurrence of red hind (*Epinephelus guttatus*).

Threats. Jacks Bay is within the St. Croix East End Marine Park but lies just outside the restricted fisheries area and is open to fishing. High turbulence and no watershed development mean there is low threat of land-based sources of pollution at this nearshore site.

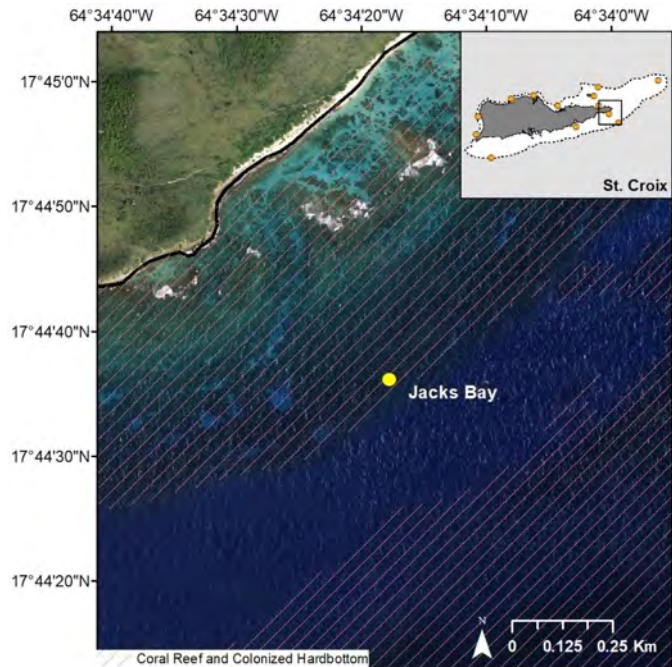


Figure 50. (top) Jacks Bay location. (right) A representative photo of the reef (photo credit: L. M. Henderson).



SITE SUMMARIES

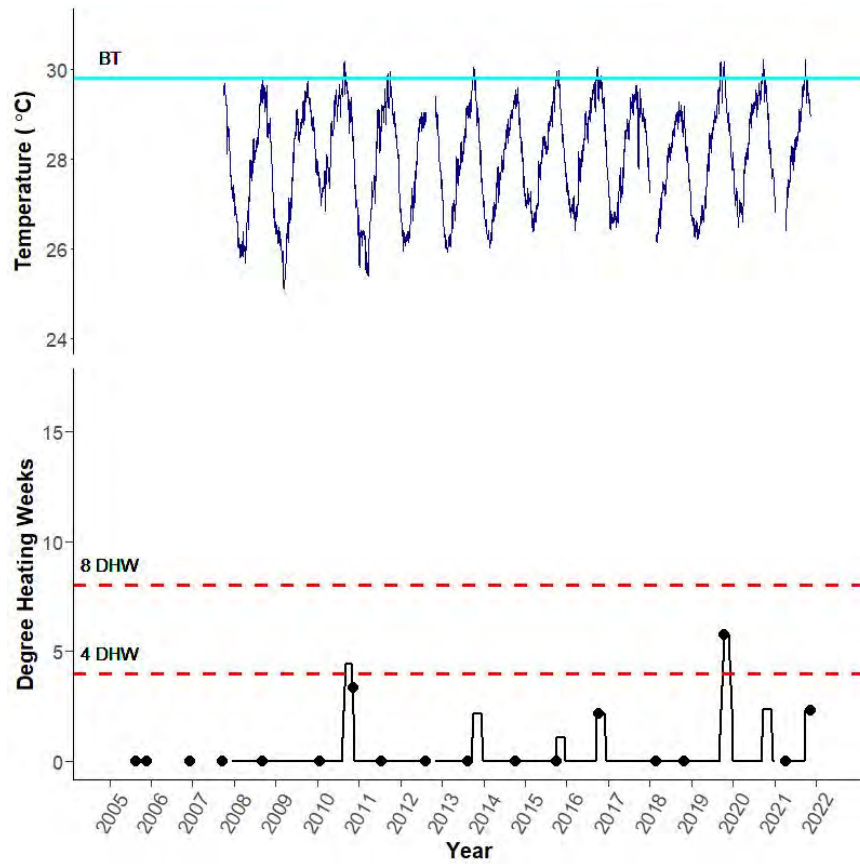


Figure 51. Jacks Bay benthic temperature at 12 m depth

Physical Characteristics

Current. Jacks Bay currents have not been measured directly. There are weak unidirectional currents, but there is a propensity for strong wave-generated oscillatory currents due the open coast southeast exposure.

Temperature. Jacks Bay can experience high temperatures during August to October. 2010 and 2019 showed sufficient accumulation of heat stress to cause coral bleaching.

SITE SUMMARIES

Benthic Community. The Jacks Bay site has low coral cover (<10%) and is the only TCRMP site dominated by the great star coral *Montastraea cavernosa*. Jacks Bay lost 44.7% of its coral cover in the 2005 coral bleaching event, but had regained about 32% of the loss by 2011. Over half of the sessile epibenthic community is composed of gorgonians and sponges and the site might be considered more a colonized hardbottom than true coral reef. The algal community is composed of high proportions each of epilithic algae, macroalgae, and filamentous cyanobacteria. The site also shows a high degree of sand intermixed with filamentous algae, an important deterrent for coral larval settlement (Bellwood and Fulton 2008). This site is often colonized by fleshy upright brown algae, such as *Turbinaria turbinata* and *Sargassum hystrix* (species unconfirmed). Very large beach wrack of these brown algae can often accumulate on the windward beaches behind the site.

Coral Health. The Jacks Bay site was strongly affected during the 2005 bleaching event and was moderately affected during the 2010 and 2019 bleaching event. Disease prevalence was low and only dark spots disease was present. Recent partial mortality was high during the 2005 bleaching event, likely reflecting the fact that surveys were conducted in November 2005 when mortality had begun. Old partial mortality increased greatly after the 2005 bleaching and then declined to stable levels in 2009-2011, with an increase in 2018 for unknown reasons. Stony coral tissue loss disease was not recorded in transects in the 2020 year sampling (April 2021), but was present during the 2021 annual sampling (November 2021).

SITE SUMMARIES

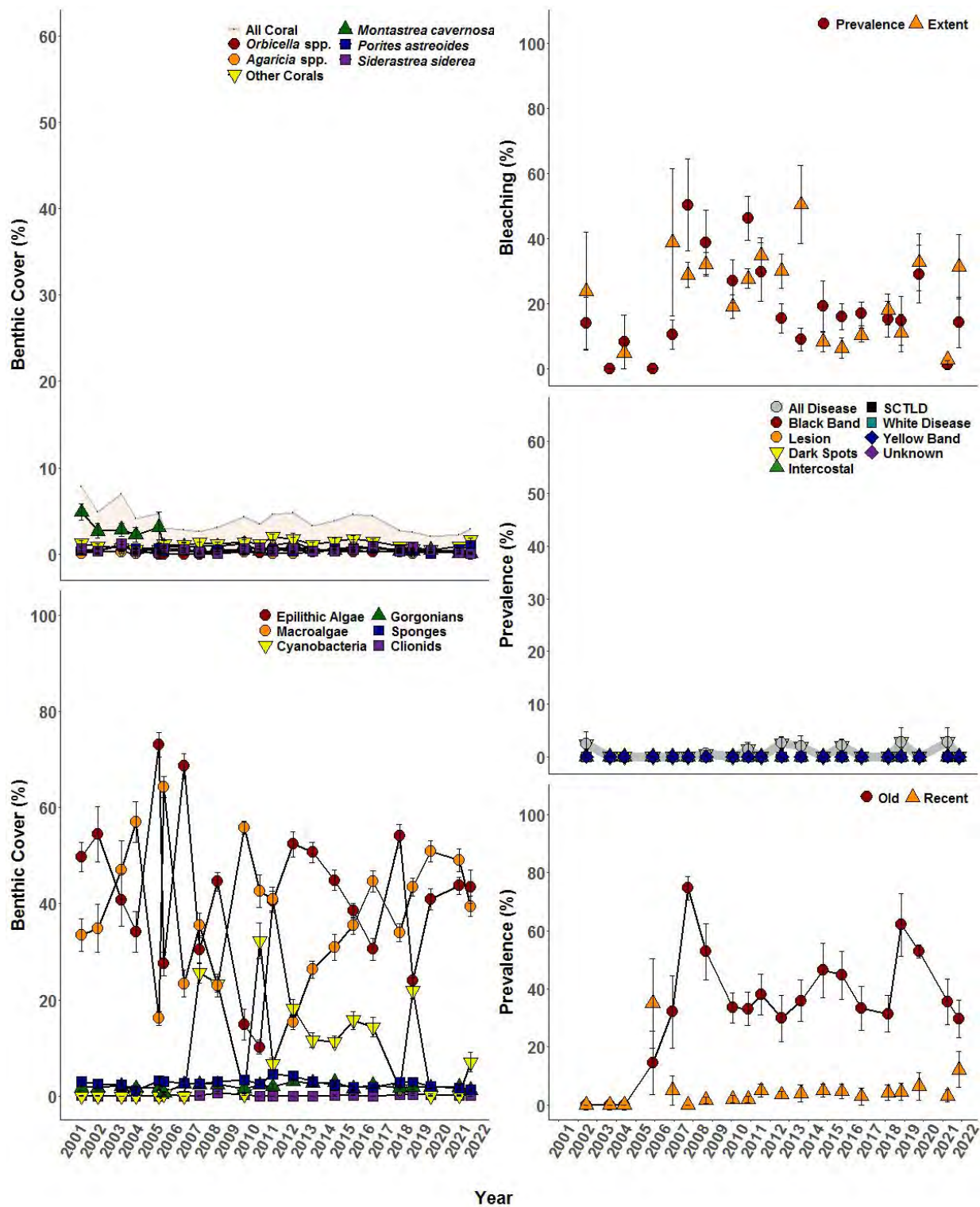


Figure 52. Jacks Bay benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The Jacks Bay fish community is characterized by very low fish biomass and abundance but relatively high diversity. Total fish biomass is disproportionately made up of small herbivores. The site is primarily hard bottom, adjacent to more developed coral reef on the seaward edge, over which some larger fishes are observed. The hardbottom community is highly dominated numerically by blue chromis, yellowhead wrasse, and bicolor damselfish. Juvenile wrasse and parrotfish swim and hover in mixed schools among the rubble and gorgonians. Slippery dicks, clown wrasse, rainbow wrasse, and blackear wrasse are common. Piscivores are always rare and are usually limited to small coney, graysby, schoolmaster, mahogany snapper and a few jacks. Medium to larger sized benthic species are very rare overall, and when observed at Jacks Bay they are generally seen in the juvenile life history stage.

SITE SUMMARIES

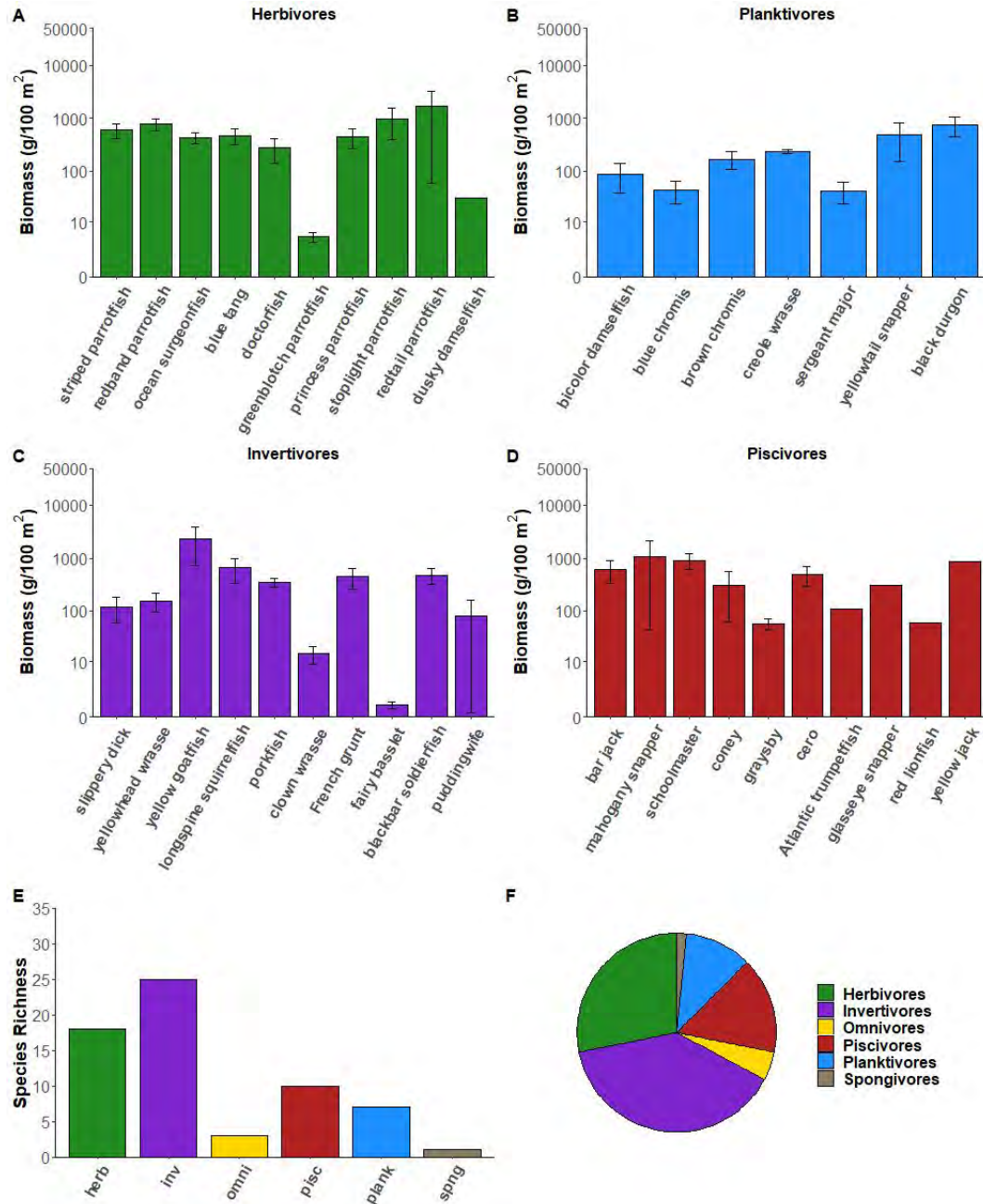


Figure 53. The Jacks Bay fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

KINGS CORNER

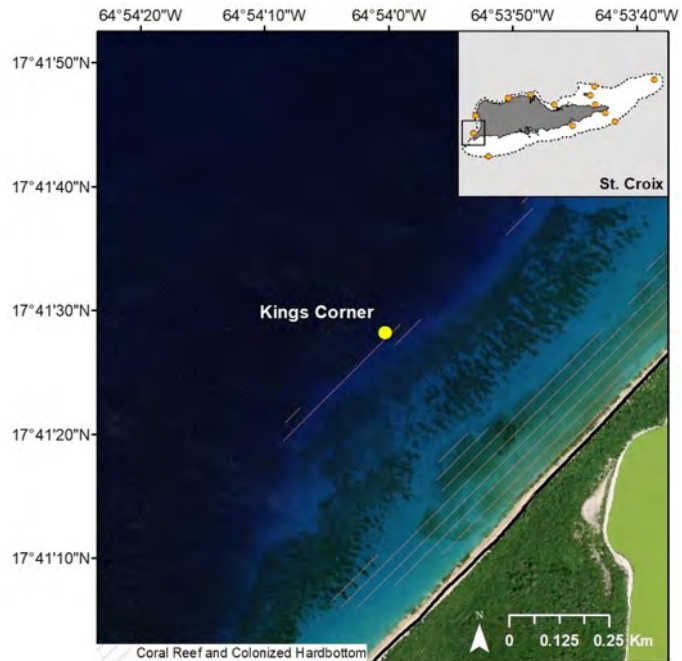
Description. The Kings Corner monitoring site is a part of a patchy reef complex along the steeply sloping west coast of St. Croix in depths of 15-25 m. The reef contains a high diversity of corals and sponges on mounds surrounded by sand. Kings Corner has been monitored since 2006, with permanent transects installed in 2007.

Outstanding Feature. Kings Corner is a commercially important recreational dive site. The site supports a high diversity and density of fishes. It is also a very aesthetically pleasing site with high topographic relief.

Threats. Kings Corner is open to fishing and is easily accessible as part of the calm lee of western St. Croix near Frederiksted. Derelict fishing lines, fish traps, fish weights, and other marine debris are in evidence in and around the site. Large plumes of sediment that wrap around Sandy Point from the south coast of St. Croix also periodically affect the site.

Plumes can drop visibility to near zero and lead to high incidence of sediment on coral and spotty bleaching.

Figure 54. Kings Corner. (top) Location. (right) A representative photo of the reef (photo credit: L. M. Henderson).



SITE SUMMARIES

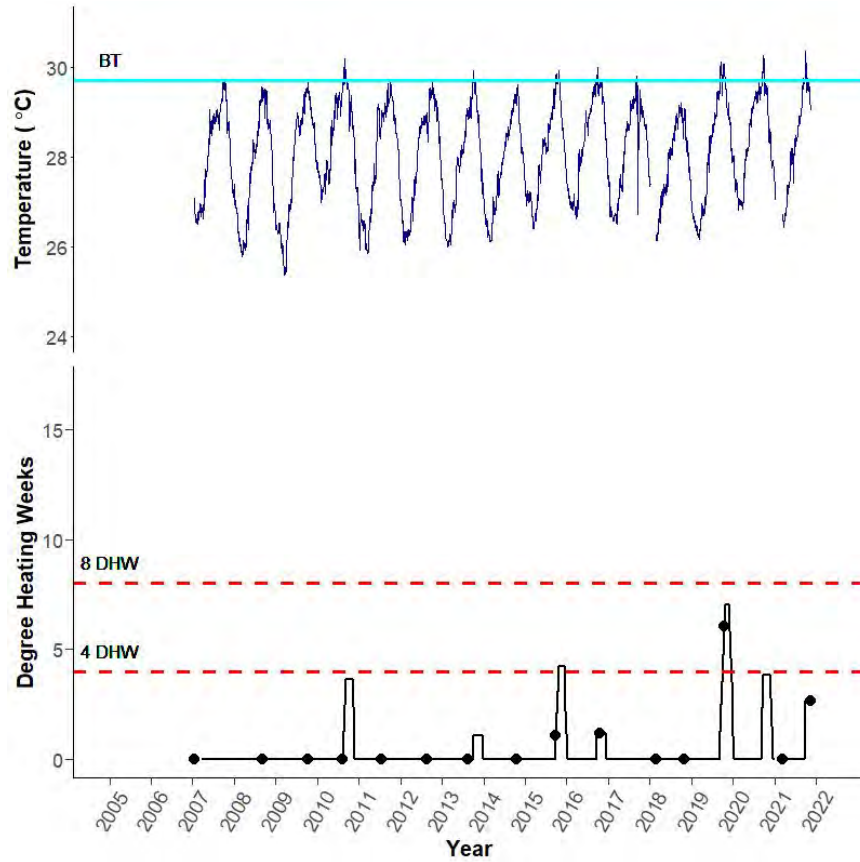


Figure 55. Kings Corner benthic temperature (17 m depth)

Physical Characteristics

Current. Kings Corner currents have not been measured directly. The site is protected from wave action, but can experience strong unidirectional currents at times, particularly at shallower depths.

Temperature. Kings Corner has moderately high temperatures. An adjusted bleaching threshold of 29.70 °C was established based on historical bleaching responses and 2019.

SITE SUMMARIES

Benthic Community. The Kings Corner site supports a diverse community of hard corals dominated by *Orbicella* spp. The site also has a very abundant population of sponges. This site was not monitored until after the 2005 bleaching event, so the impacts on coral cover are not known. Indications of increasing coral cover after 2005 suggest bleaching related mortality, but then resilience after the disturbance. An outbreak of white disease in 2012 temporarily reduced coral cover. Relative coral cover dropped precipitously by 2021 (70.0%), likely due to the arrival of Stony Coral Tissue Loss Disease. Epilithic algae dominate the algal community at Kings Corner, with very low abundance of macroalgae and filamentous cyanobacteria. Sand is prominently interspersed among the coral banks.

Coral Health. Non-thermal bleaching with moderate prevalence but low extent on colonies is a common feature at this site, likely as the result of chronic sedimentation. The prevalence of coral diseases has been low with dark spots disease predominating. Old partial mortality has been very high at this site and may be an indication of impacts from the 2005 coral bleaching event. The site bleached moderately in 2019. Old partial mortality has increased lately. Stony coral tissue loss disease was recorded at a high prevalence in transects in the 2020 year sampling (March 2021).

SITE SUMMARIES

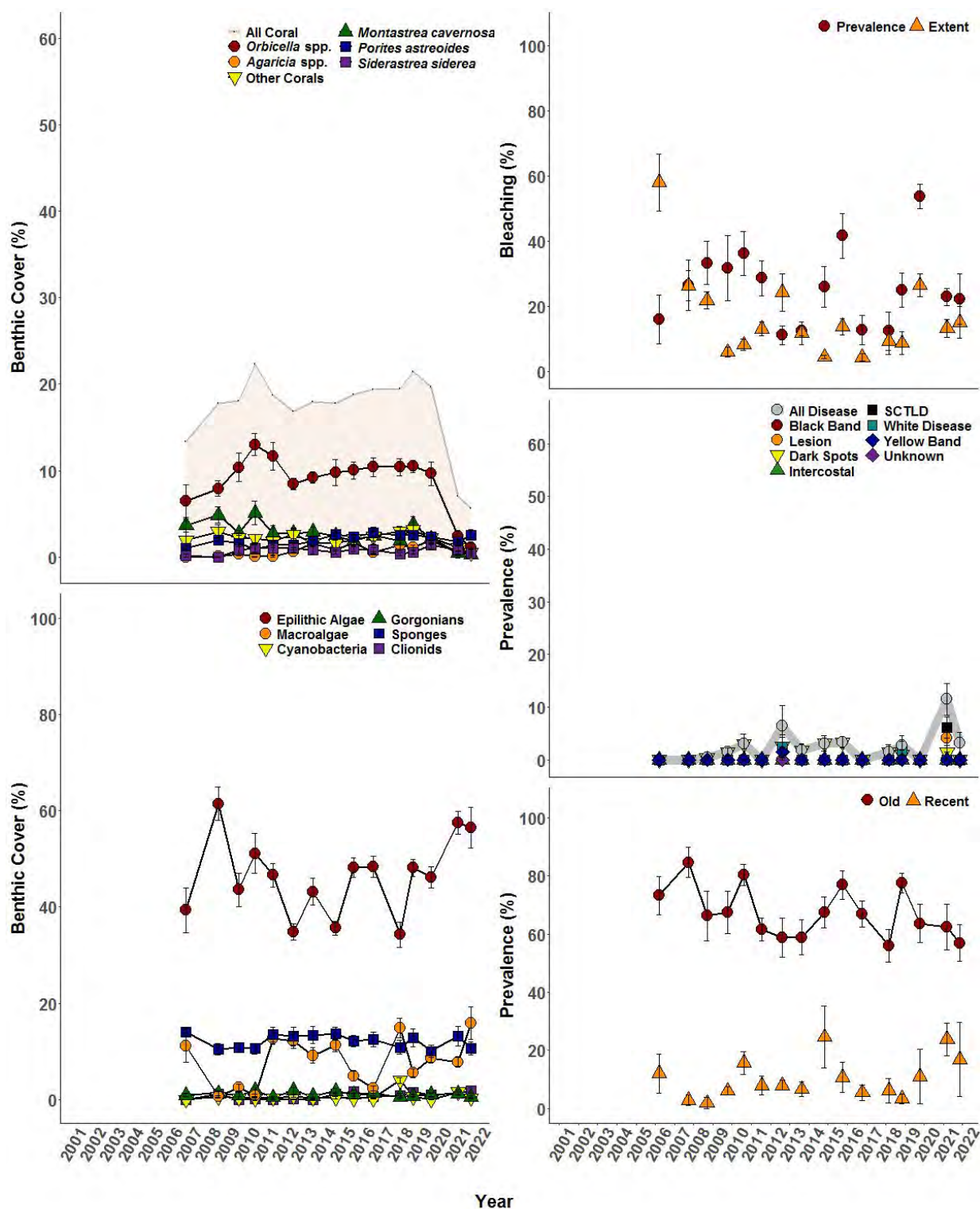


Figure 56. Kings Corner benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Kings Corner represents the most diverse fish community with the highest fish biomass in the TCRMP monitoring program on St. Croix, with a huge variety of resources available for foraging and habitat. The site is dominated by invertivores, where overall biomass is influenced highly by the large numbers of the nocturnal feeding blackbar soldierfish, a zooplanktivore, and the tomtate, a more opportunistic benthic feeder of invertebrates, zooplankton and benthic algae. Other common planktonic feeders at Kings Corner include the boga, black surgeon, and creole wrasse. Common benthic herbivores include the blue tang and ocean surgeonfish as well as the common Caribbean parrotfishes (stoplight, princess, redband, redfin, queen, and striped). A variety of grunts are common on the site as well as angelfishes and huge moray eels. Mutton snapper are occasional. Piscivores as a group are relatively low in biomass, and are represented by jacks (pelagic), glass-eye snapper and bigeye (nocturnal feeders), and graysby, coney, lionfish, and small snappers (diurnal bottom feeders). No large snappers or groupers have been observed on the site. It is not protected from any fishing pressure.

SITE SUMMARIES

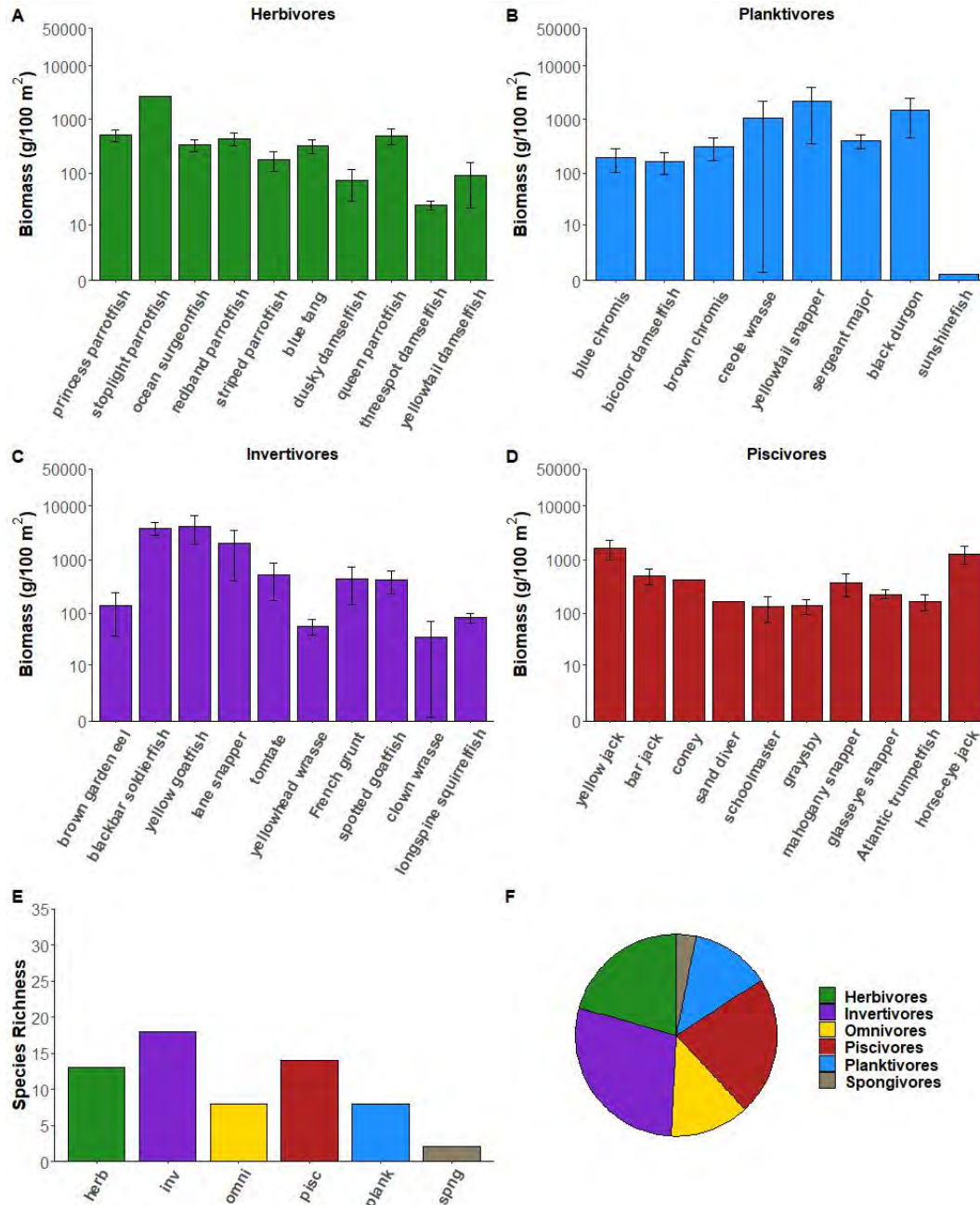


Figure 57. The Kings Corner fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

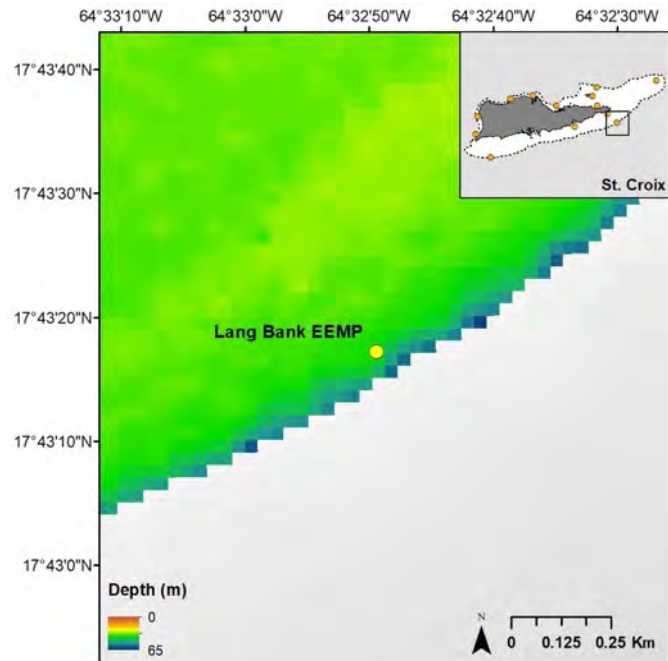
LANG BANK EAST END MARINE PARK

Description. The Lang Bank EEMP site is a shelf edge mesophotic coral reef located at a depth of 27 – 30 m. The monitoring site sits just above a steep shelf break and is composed of rolling coral knolls dominated by boulder star corals (*Orbicella* spp.). This site was established in 2009.

Outstanding Feature. The Lang Bank EEMP site appears to be a well-developed mesophotic boulder star coral reef on St. Croix, which may be relatively rare compared to St. Thomas. Large populations of fishes and spiny lobsters are often encountered.

Threats. The Lang Bank EEMP is in the outer park area and is open to fishing year-round. Its offshore location protects it from land-based sources of pollution.

Figure 58. Lang Bank EEMP. (top) Location. (right) A representative photo of the reef.



SITE SUMMARIES

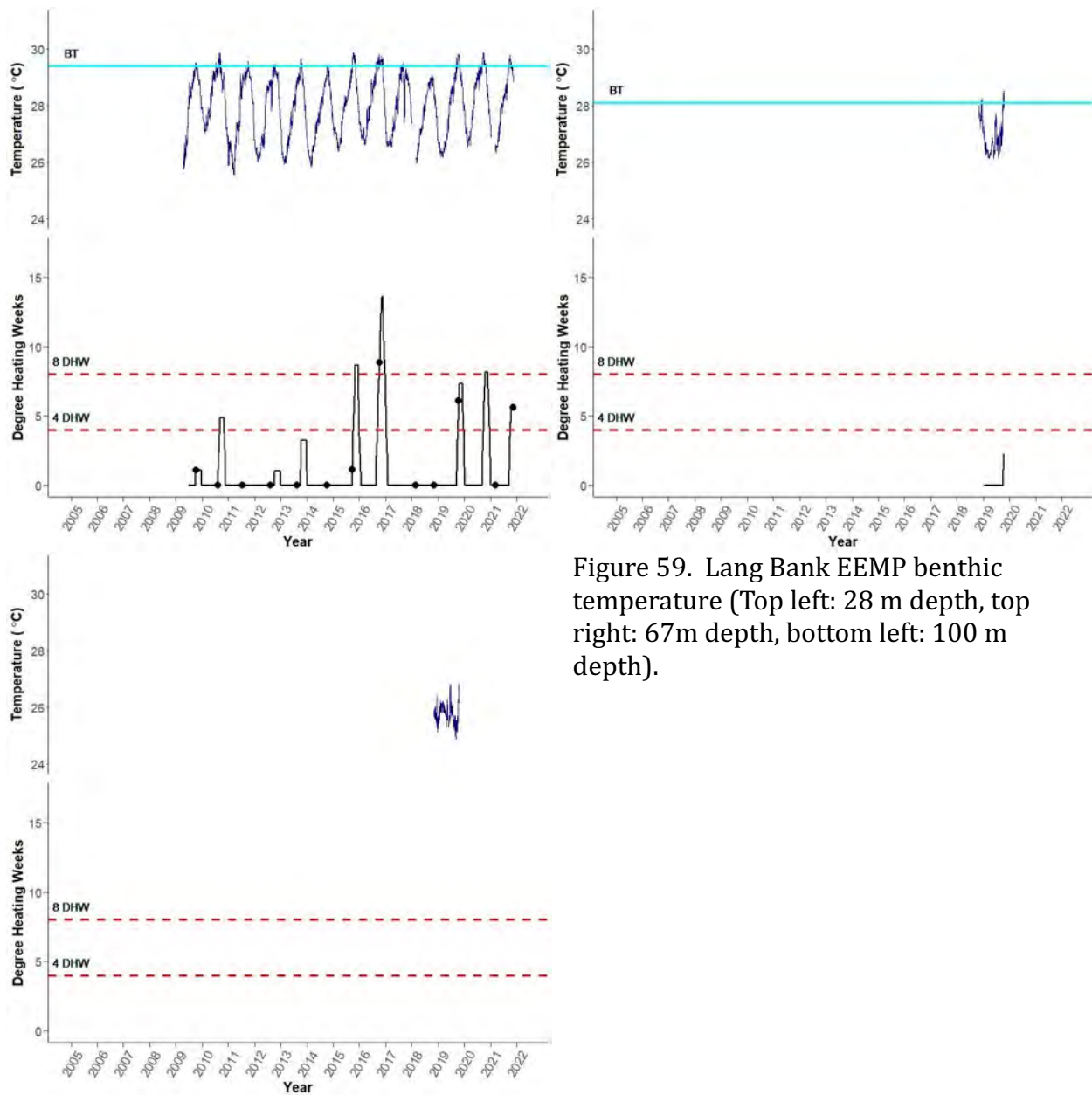


Figure 59. Lang Bank EEMP benthic temperature (Top left: 28 m depth, top right: 67m depth, bottom left: 100 m depth).

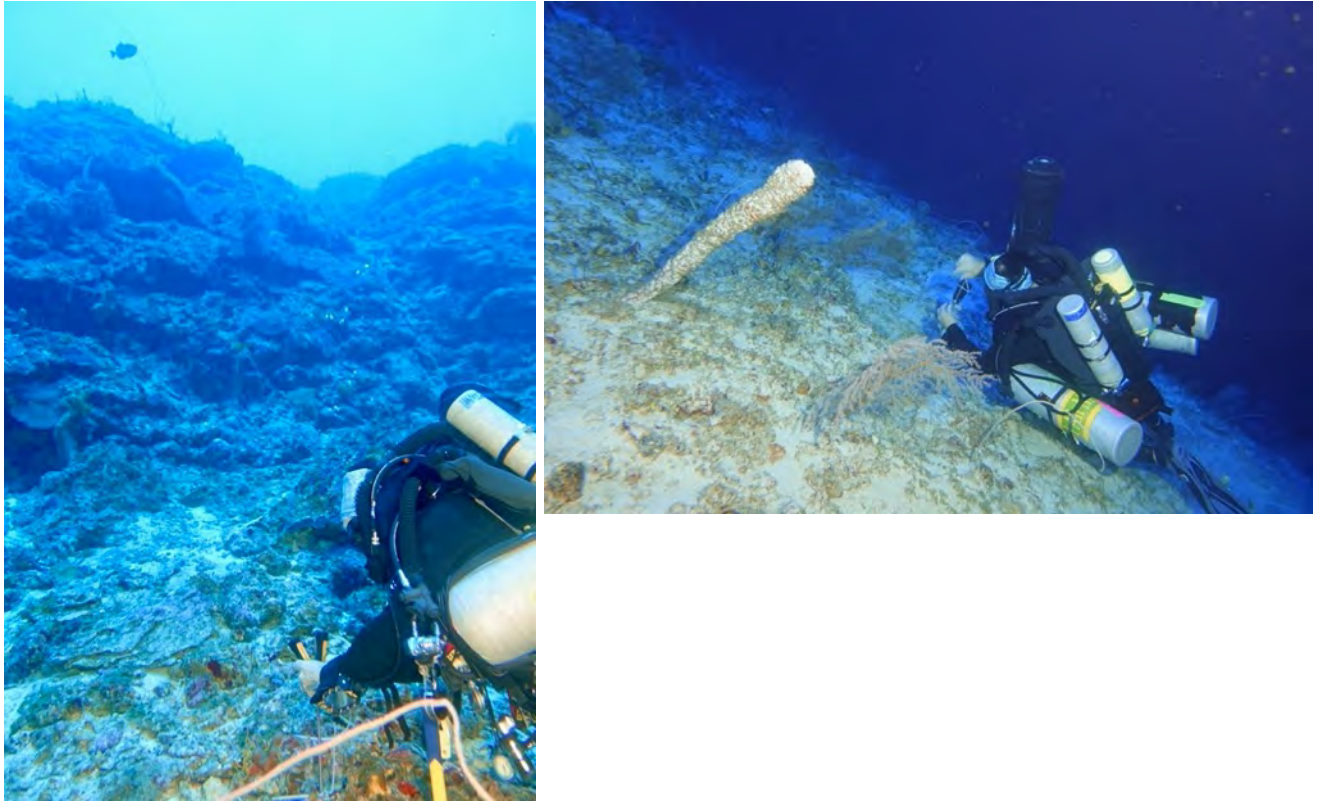


Figure 60. Installation of temperature monitoring stations at Lang Bank EEMP at 67 m (left) and 100 m (right) (credit: Viktor Brandtneris). There is a nice *Agaricia* spp. reef on the escarpment at 67 m.

Physical Characteristics

Current. Direct current measurements have not been taken at Lang Bank EEMP. The depth buffers the site from wave-driven oscillatory currents. Only weak unidirectional benthic currents have been experienced at the site during monitoring; however, midwater and surface currents can be moderate to strong ($>10\text{cm s}^{-1}$).

Temperature. Lang Bank EEMP has temperature that is reduced relative to shallow water sites. However, the bleaching threshold has not been established and here is based on a relationship between depth (Smith et al. 2016a). Based on the response of corals to thermal stress in 2019 an adjusted bleaching threshold of $29.63\text{ }^{\circ}\text{C}$ was established.

SITE SUMMARIES

Benthic Community. Lang Bank EEMP supports many coral species but is dominated by *Orbicella* spp.. Sponges are also quite prominent and make up a quarter of the sessile epibenthic animal community. Epilithic algae, *Lobophora variegata*, and filamentous cyanobacteria near equally represent the algal community. The prominence of filamentous cyanobacteria is quite striking and has reached almost 40% of the substrate in some years. There has been a relative decrease of nearly 30% coral cover from 2019 – 2021 likely due to Stony Coral Tissue Loss Disease.

Coral Health. Background, non-thermal bleaching prevalence is quite high at Lang Bank EEMP. White disease showed an outbreak in 2011. Lang Bank EEMP was not initially monitored until well after the 2005 coral bleaching event; however, a high prevalence of old partial mortality suggests that corals were impacted. Many of the large faviids show lesion patterns that are consistent with the large lunate dead areas caused by white diseases following bleaching in 2005. Stony coral tissue loss disease was likely recorded in transects in the 2020 year sampling (March 2021), but were recorded as lesions.

SITE SUMMARIES

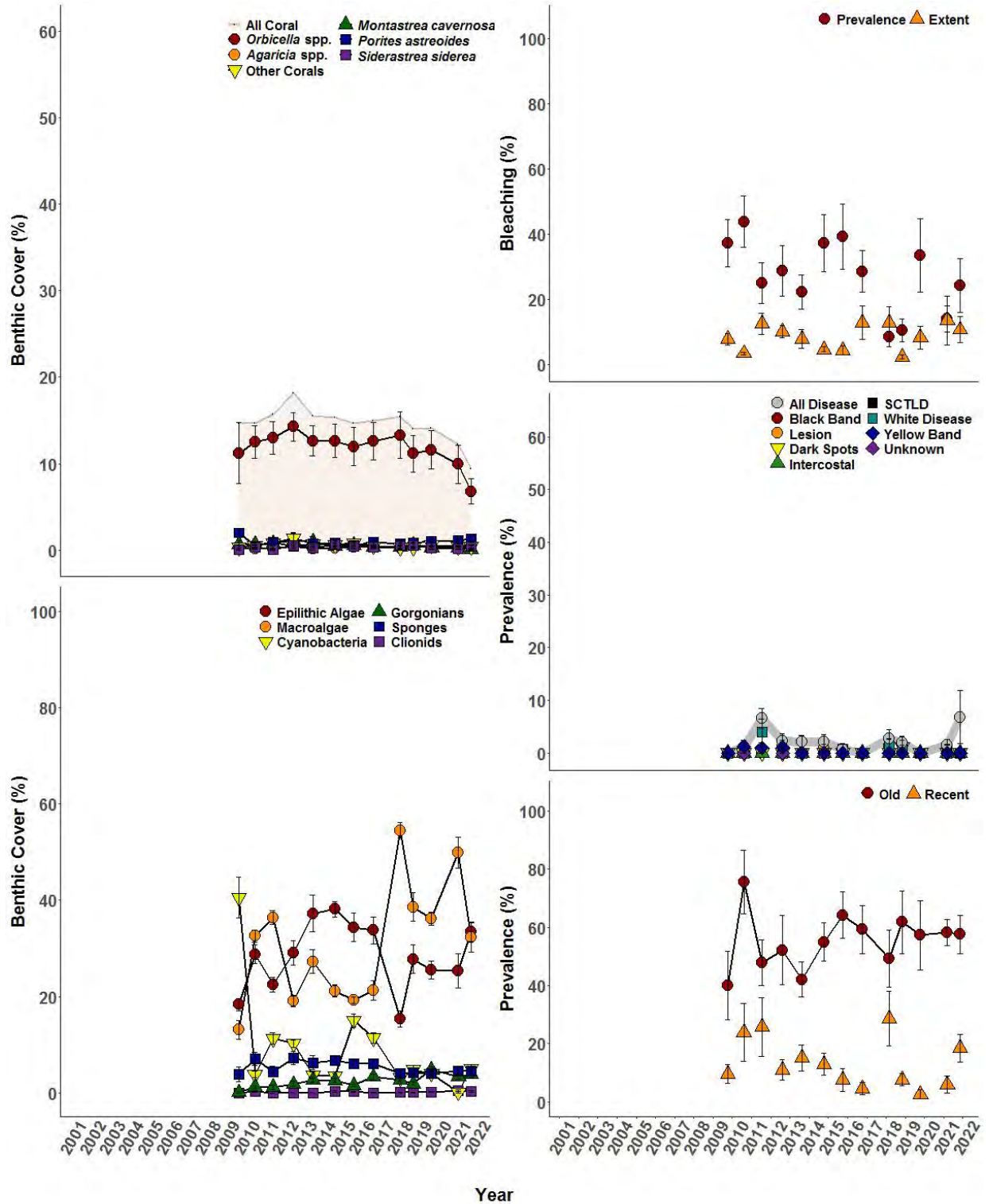


Figure 61. Lang Bank EEMP benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The Lang Bank East End Marine Park site represents a mesophotic reef community that is characterized by a high biomass of planktonic feeders and a low biomass of herbivores. The high overall biomass of planktivores is influenced by the ocean triggerfish and black durgon, while numerically blue chromis and creole wrasse are dominant. Benthic herbivores are dominated both numerically and in biomass by the ocean surgeonfish, redband parrotfish, and stoplight parrotfish. Benthic invertivores at the site are diverse and include nocturnally feeding blackbar soldierfish and squirrelfish, as well as several species of grunt (French, tomtate, white, bluestriped, Caesar, and smallmouth), red hind and several wrasse species. Piscivores are generally dominated in biomass by jacks, barracuda and Caribbean reef sharks, however, coney, graysby, schoolmaster and mahogany snapper contribute as benthic piscivores. There have been no large snappers or groupers recorded there. The Lang Bank East End Marine Park is now protected from fishing, so there is hope that large snappers and groupers will return to this rich mesophotic community.

SITE SUMMARIES

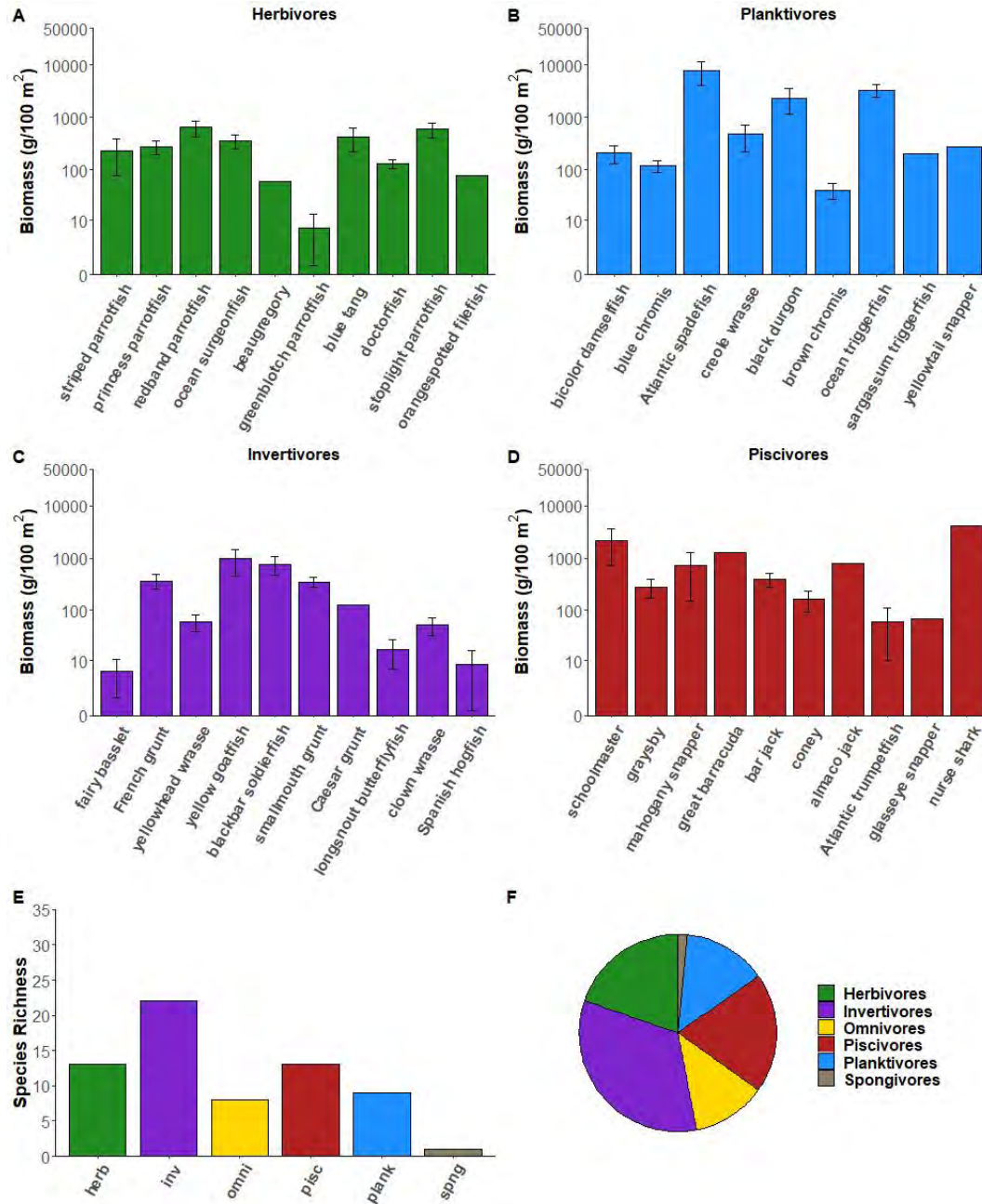


Figure 62. The Lang Bank EEMP fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

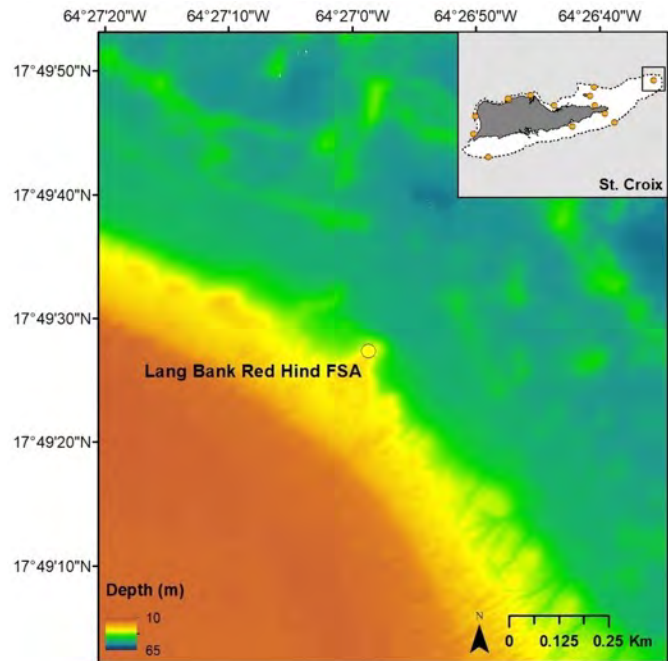
LANG BANK RED HIND FISH SPAWNING AGGREGATION

Description. The Lang Bank Red Hind Fish Spawning Aggregation (Lang Hind) monitoring site is a mesophotic reef of antecedent spur and groove structure at a depth of 30 – 35 m. The site is perched on the southeast side of the spur, which is a large finger that rises to 24 m to the west and drops on all other sides to a rhodolith/sand plain at about 50 m. Lang Hind was initially monitored in 2001 at a site on the shallower (24 m) portion of the bank to the west. Monitoring in 2004-2007 occurred along random transects in a deeper portion of the reef (~33 m depth) and benthic transects were made permanent in this area in 2009

Outstanding Feature. Lang Hind supports an annual fish spawning aggregation of the red hind (*Epinephelus guttatus*). This site also possesses high water clarity.

Threats. The Lang Hind site is removed from land-based stressors. Fishing of the red hind aggregation was common prior to closure of the area to fishing in 1993. However, the aggregation is near the closure boundary.

Figure 63. Lang Bank Red Hind FSA. (top) Location. (right) A representative photo of the reef



SITE SUMMARIES

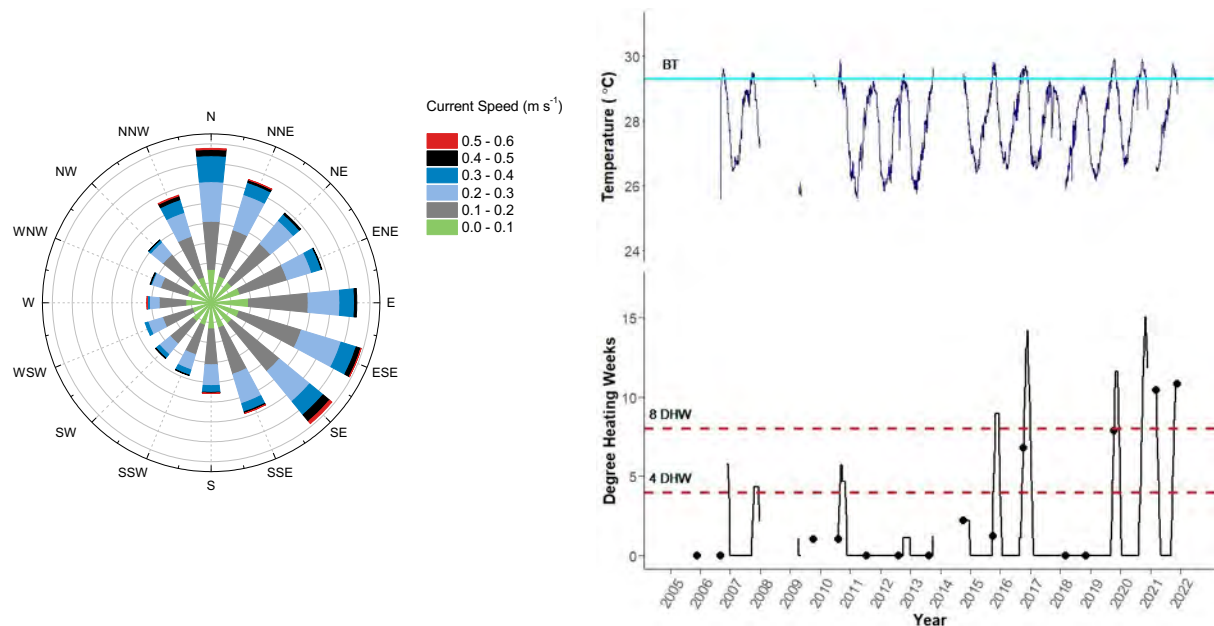


Figure 64. Lang Bank Hind current speed (left) and benthic temperature (right; 33 m depth).

Physical Characteristics

Current. Lang Hind had benthic currents recorded with ADCP every 30 minutes from 11/20/05 to 8/20/06, and 12/11/06 to 3/10/07. Bottom currents most typically alternate between north and southeast and can attain strong speeds periodically exceeding 0.4 m s^{-1} .

Temperature. Lang Hind has temperatures that are reduced due to the depth and proximity of the warm season thermocline. However, temperatures are not as cool or variable as sites on the southern Puerto Rican shelf, indicating that this site may be more susceptible to warming ocean temperatures. There is no empirically established bleaching threshold and the one displayed is based on a depth – bleaching threshold model (Smith et al. 2016a). The site-specific bleaching threshold is likely higher than the model because there was low-level bleaching when the site was monitored in 2016 and 2019, yet the model predicted ~8 DHW, which should have led to a mass bleaching response.

SITE SUMMARIES

Benthic Community. Lang Hind has a diverse sessile epibenthic community dominated by hard corals, predominantly *Orbicella* spp., gorgonians, and sponges. Coral cover actually increased by 110% between the coral bleaching event and re-monitoring in 2006, but this may reflect the fact that transects were laid in random, rather than permanent, locations prior to 2009. There has been about a 47% relative drop in coral cover (2019 – 2021) since Stony Coral Tissue Loss Disease was first observed. The algal community is largely open epilithic algal communities, but also contains large proportions of *Lobophora variegata* and filamentous cyanobacteria. The algal community shows high inter-annual variability.

Coral Health. Lang Hind FSA was heavily affected during the 2005 coral bleaching event, with a very high prevalence of corals that were 100% bleached over the colony surface. Non-thermal bleaching with moderate prevalence and low extent on colonies also occurred in later years. In particular, 2019 saw moderate prevalence of bleaching at a low extent. The site was heavily affected with white diseases after the coral bleaching event and has had high disease prevalence in all years of monitoring. Old partial mortality jumped after the 2005 bleaching event and was variable in later years. Recent partial mortality is unusually high at Lang Hind, largely as the result of fish bites and predation by the corallivorous snail *Coralliophila* spp. Stony coral tissue loss disease was recorded in transects in the 2020 year sampling (March 2021).

SITE SUMMARIES

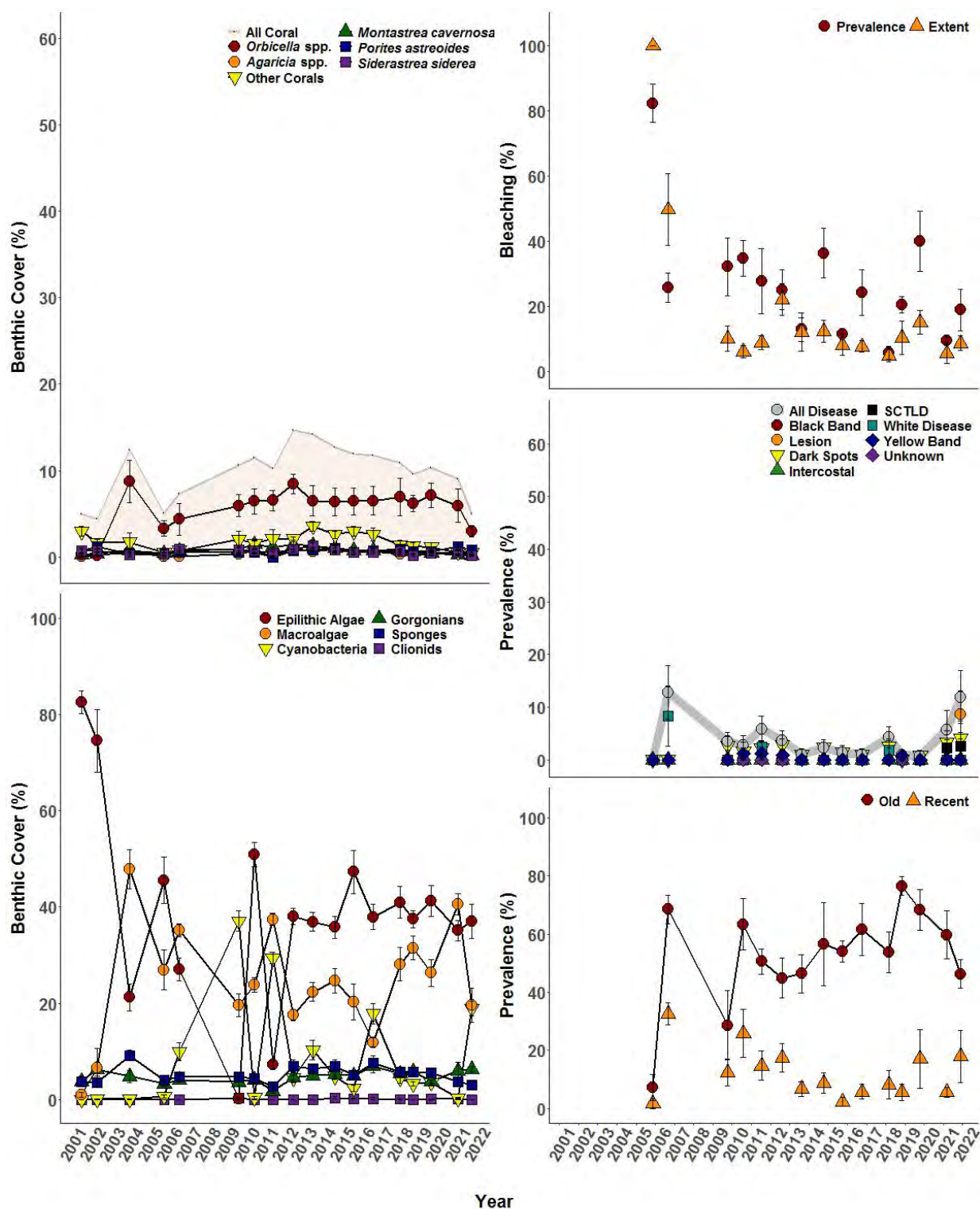


Figure 65. Lang Bank Red Hind FSA benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The fish community at Lang Bank FSA is representative of a St. Croix mesophotic reef system. High water column planktonic feeders are abundant and include the black durgelon, creole wrasse, black jack, and creolefish. Bicolor damselfish are numerous while herbivorous damselfishes are uncommon. Benthic herbivores are relatively low in diversity, abundance and biomass compared to nearshore sites. Invertivores are diverse and include many planktivores as well as benthic feeders, utilizing the varied resources of the bank. Four species of angelfish were observed on transects reflecting the high sponge cover. Lang Bank FSA supports a red hind spawning site, active during December through February each year, and red hind are occasionally seen on both roving dives and transects. One Nassau grouper was observed on the bank in 2011, a first observation across all St. Croix monitoring sites. There is reportedly a historic Nassau grouper spawning site near the Lang Hind monitoring site, and with the bank now closed to trap fishing there is hope of some re-establishment of the species on St. Croix. In 2018 a yellowfin grouper was reported on Lang Bank FSA. This is also a new TCRMP St. Croix record. The mahogany snapper dominates in abundance the piscivorous fish community on Lang Bank FSA. Other important piscivores include the great barracuda, coney, graysby and Caribbean reef shark.

SITE SUMMARIES

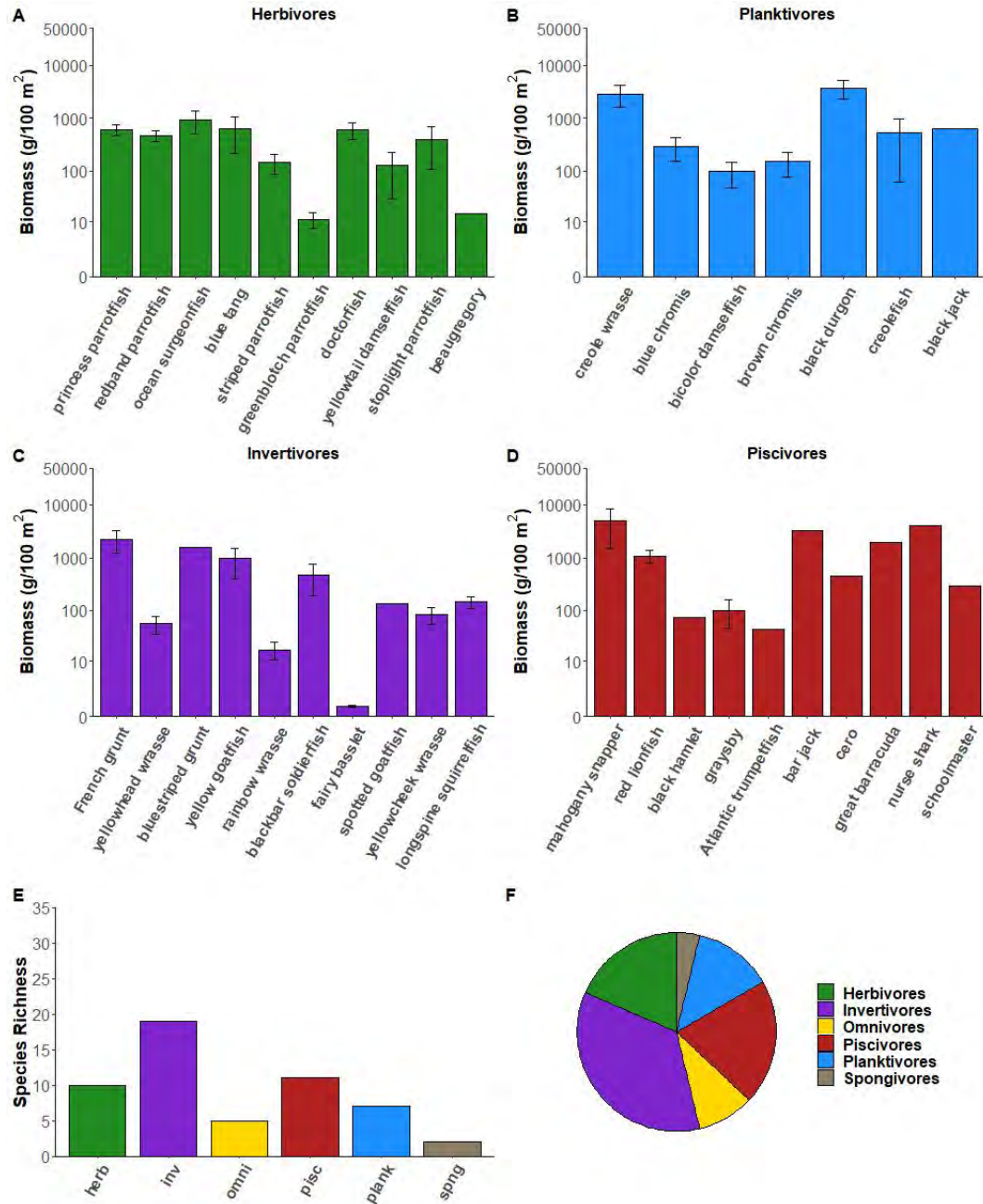
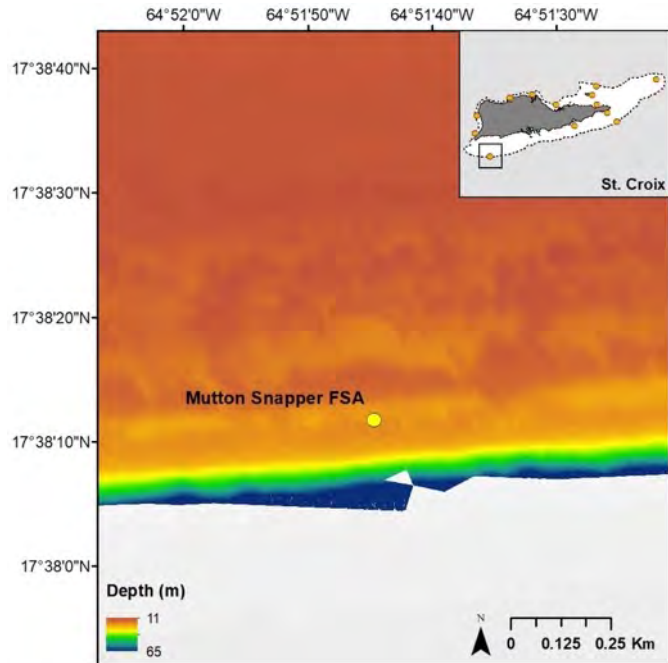


Figure 66. The Lang Bank Red Hind FSA fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

MUTTON SNAPPER

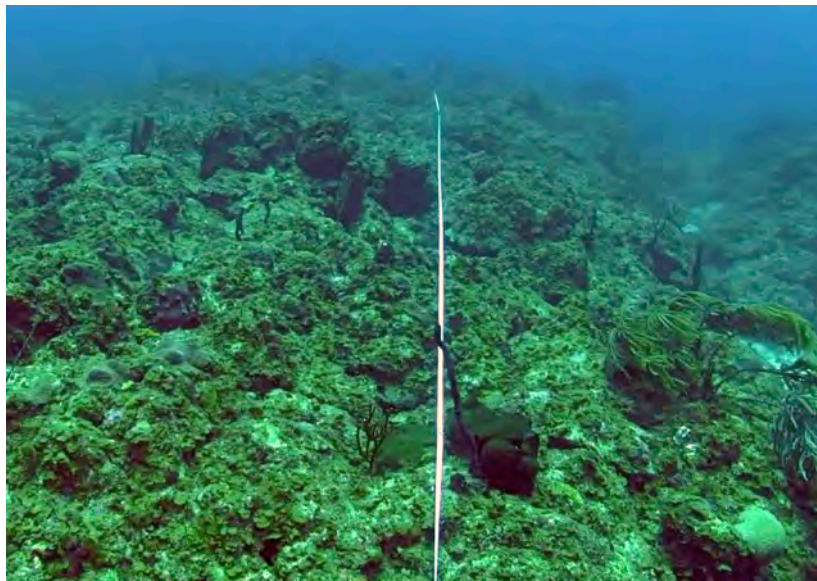
Description. The Mutton Snapper site is located on the landward side of a shelf edge spur and groove reef on the southwest shelf of St Croix in depths of 22-24 m. The reef was dominated by boulder star coral (primarily *Orbicella franksi*) until a mass coral die-off following the 2005 bleaching event. Mutton Snapper has been monitored since 2003.



Outstanding Feature. The Mutton Snapper site was located in conjunction with the possible proximity of a mutton snapper (*Lutjanus analis*) spawning aggregation. It is seasonally closed to fishing. The site was devastated by the 2005 coral bleaching event, with an 87% drop in coral cover and a concomitant increase in algae.

Threats. The Mutton Snapper site is threatened by fishing pressure as evidenced by the abundance of fishing line and fishing trap debris. This site is offshore and less likely threatened by land-based stressors. The clear waters and warm temperatures make this site vulnerable to long-term seawater warming.

Figure 67. Mutton Snapper. (top) Location. (right) A representative photo of the reef taken in 2014.



SITE SUMMARIES

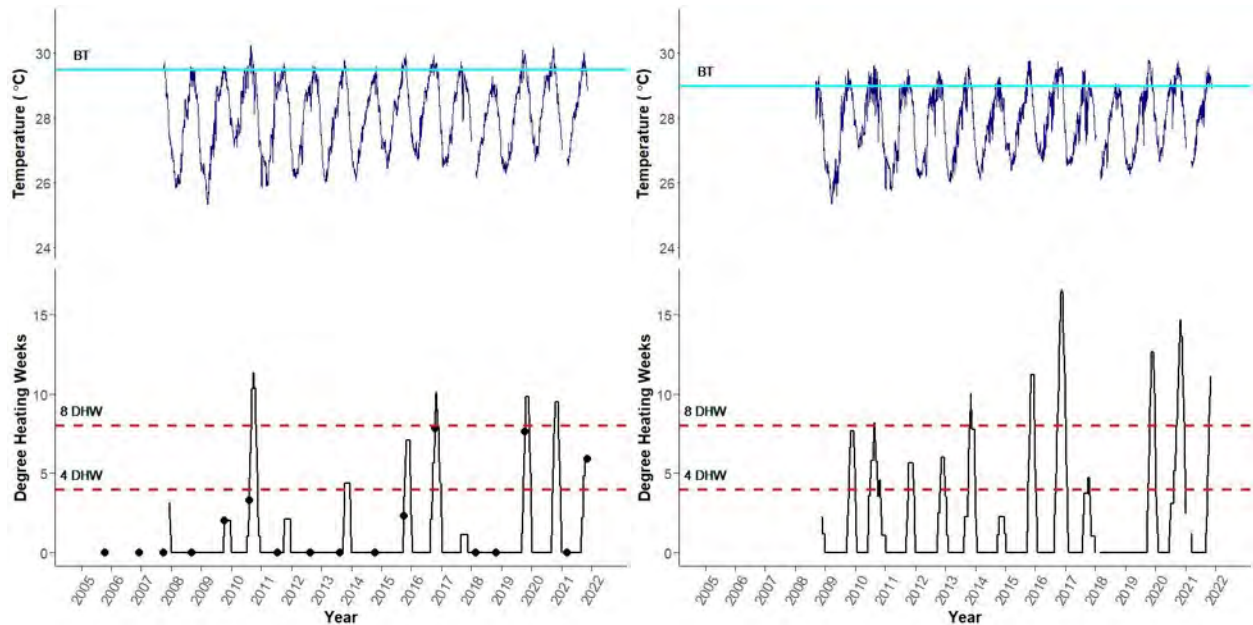


Figure 68. Mutton Snapper benthic temperature record at 24 m (left) and 40 m depth (right).

Physical Characteristics.

Current. Current records have not been taken at Mutton Snapper. There seems to be little wave-driven oscillatory flow. There are often strong unidirectional currents in a westward direction that penetrate to the bottom.

Temperature. Benthic temperatures at the Mutton Snapper site (23 m) showed warming above the regional bleaching threshold during 2010 and 2016. However, this may be an overestimation of the heat stress (bleaching threshold set to low) since an empirical bleaching threshold has not yet been established for this site.

SITE SUMMARIES

Benthic Community. The Mutton Snapper site's sessile epibenthic animal community is dominated the boulder star coral (*Orbicella* spp.), with sub-dominance of sponges. This site lost an extreme amount of coral cover (87.0%) in the 2005 coral bleaching event and has not regained any cover (-2.3%) as of 2011. Since the first observation of Stony Coral Tissue Loss Disease, there has been a 33% decrease in relative coral cover at this location (2019 – 2021). *Lobophora variegata*, epilithic algae, and filamentous cyanobacteria dominate the algal community. Apparent is the rise in the abundance of macroalgae and filamentous cyanobacteria after 2005. Filamentous cyanobacteria reached extreme cover values (57.7%) in 2009. Current levels of herbivory no longer appear to be able to control algal abundance.

Coral Health. Mutton Snapper bleached heavily in the 2005, with 100% of corals bleaching over 90% of the colony surface. Bleaching prevalence has remained high for most years since 2005, but at low colony extent, indicating continued impairment of corals. There was an uptick in the percentage of corals experiencing bleaching in 2019 at a predicted 6 DWH. White disease has been at consistently high values through many years of monitoring. Old partial mortality increased after 2005, and then subsided as whole colonies were lost from the system. Impairment of this site is puzzling as stressors besides fishing appear to be low. Clear water and low genetic diversity of corals may increase susceptibility to environmental stress and white disease. Stony coral tissue loss disease was likely recorded in transects in the 2020 year sampling (March 2021), but were marked as lesions.

SITE SUMMARIES

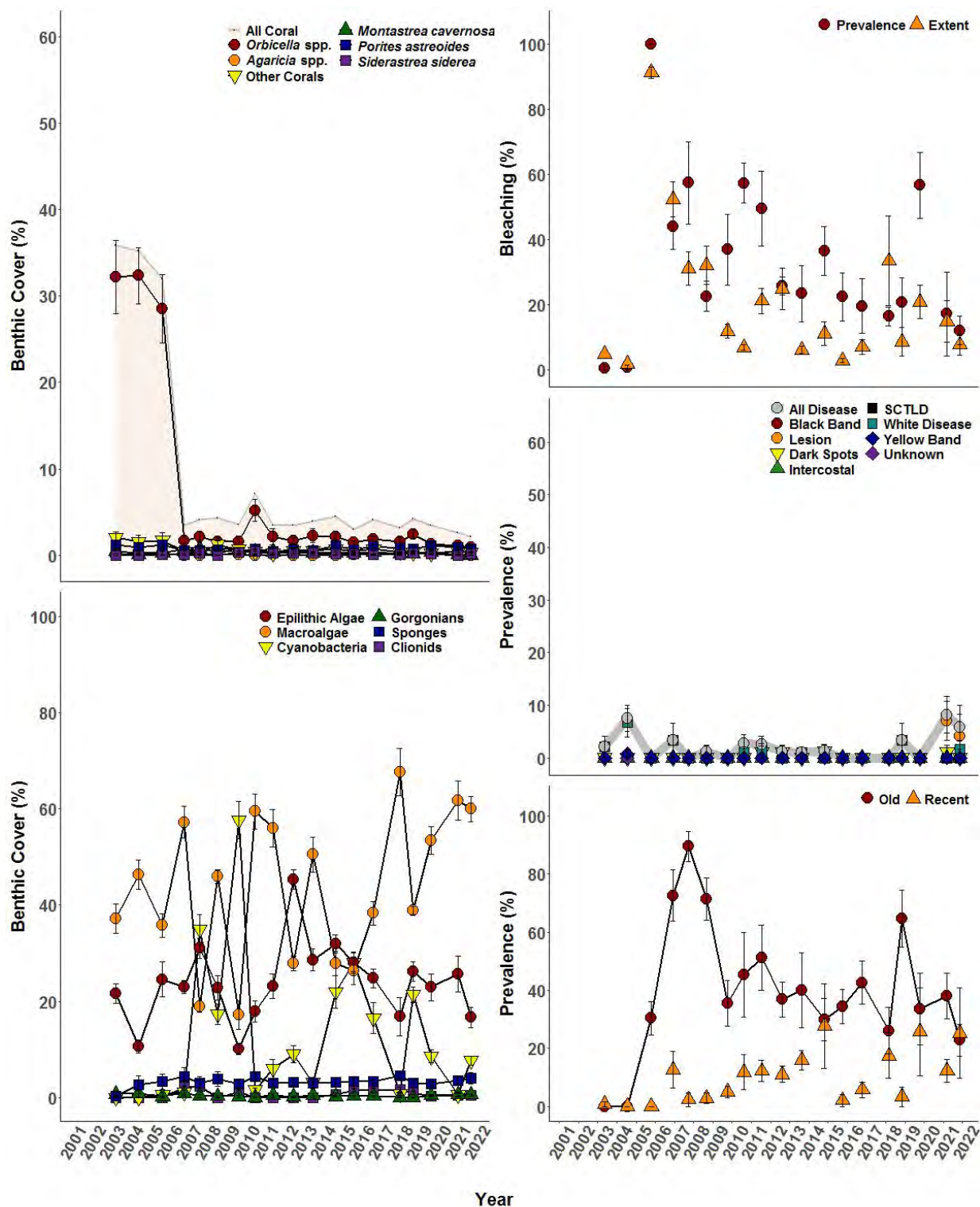


Figure 69. Mutton Snapper benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The Mutton Snapper site is an offshore, shelf edge site with a diverse and rich fish community. Mutton Snapper is reportedly in an area that mutton snapper spawn, however this species has been rare in surveys conducted at the site over the past 8 years. The Mutton Snapper site has an equally divided community composition between herbivores, invertivores and piscivores. Planktivores are relatively low in biomass but are dominated by black durgon and yellowtail snapper. The herbivore trophic guild is numerically led by the very prolific threespot damselfish, but the biomass is primarily contributed by redband, striped and princess parrotfish. The majority of these fish encountered are in the juvenile and sub-adult phase. The invertivore group is diverse, and indicative of the variety of resources available on the reef. Blackbar soldierfish contribute most highly to invertivore abundance and biomass. Piscivores are not common on Mutton Snapper and in general the biomass of this group is made up of jacks, barracuda and mackerel. Piscivorous serranids and lutjanids are usually limited to the graysby and mahogany snapper, however in 2018 a cubera snapper was recorded. Red lionfish are observed regularly on Mutton Snapper, probably because the reef is offshore and does not receive the recreational diving and hunting pressure of nearshore sites.

SITE SUMMARIES

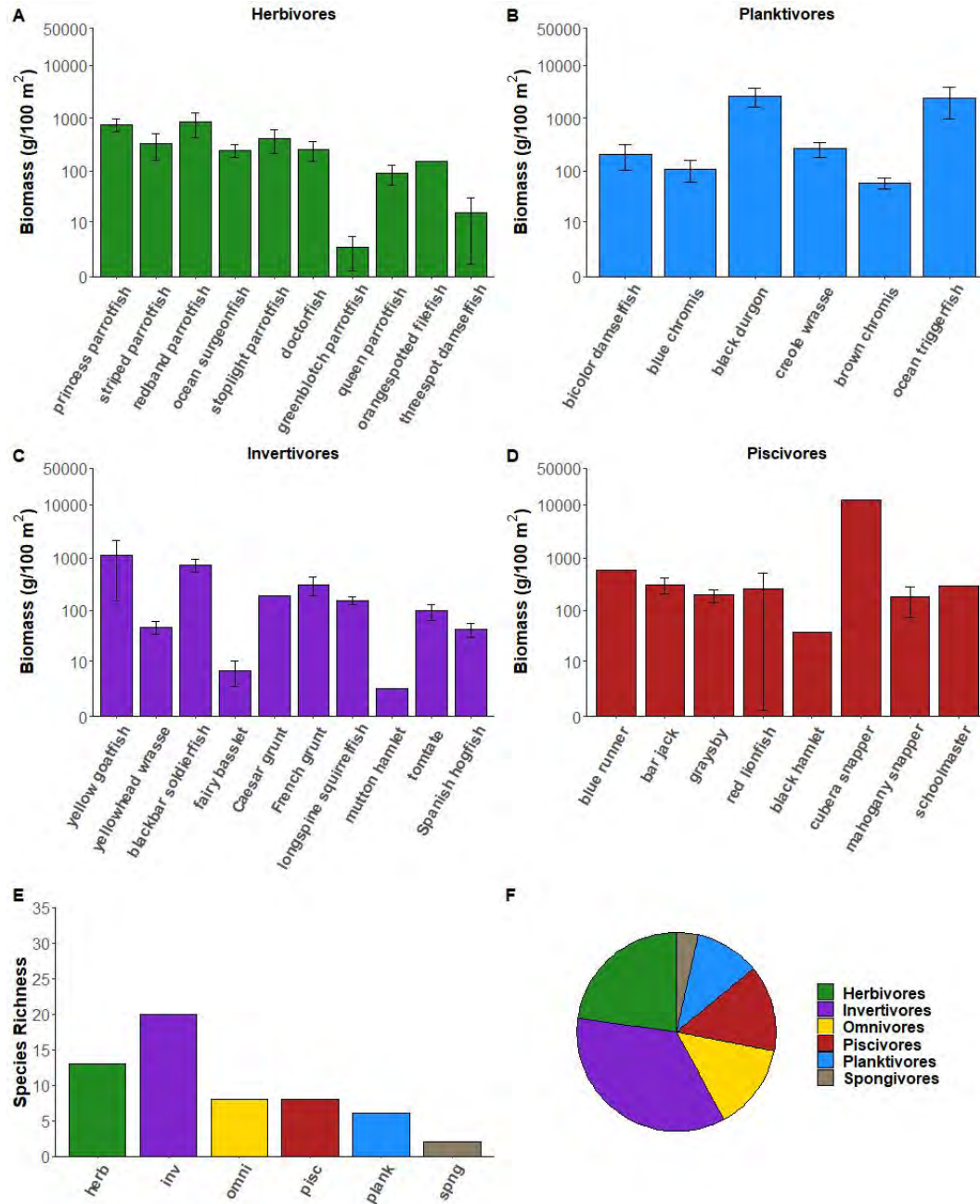


Figure 70. The Mutton Snapper fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

SALT RIVER WEST

Description. Salt River West lies just atop the Salt River Canyon west wall in a depth of 9 m. The reef is a flat colonized hardbottom/coral community atop ancient carbonates. Salt River West has been monitored since 2001.

Outstanding Feature. Salt River West is a popular tourist dive site with a unique sharp drop to the wall environment. This area has been under scientific investigation since the 1970s, beginning with the installation of the Hydrolab undersea habitat run by NOAA.

Threats. Salt River West is exposed to the outflow from the Salt River Canyon and resuspension of sediment from the Salt River eastern flats. The site is now adjacent the Salt River National Historic Park and Ecological Preserve with marine waters protected in a territorial park. This protection will hopefully increase the fish populations within the reserve in the coming decades.

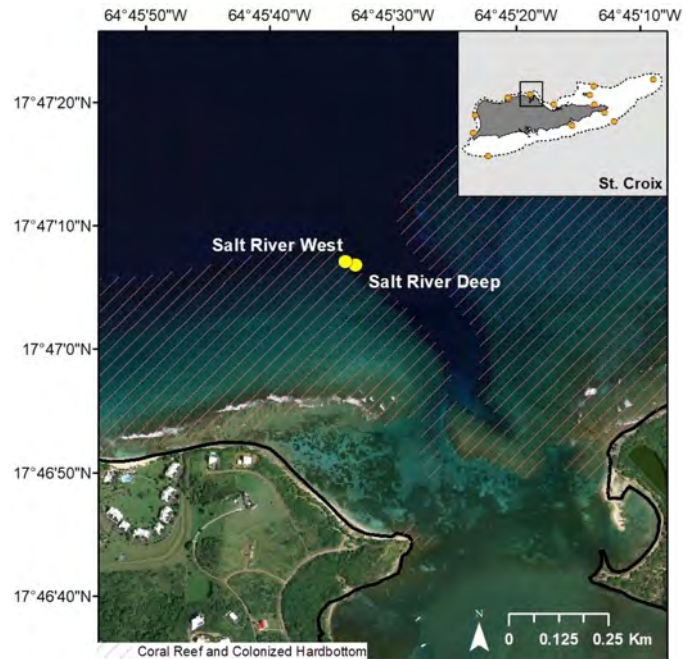


Figure 71. Salt River.
(top) Location.
(right) A
representative photo
of the reef (photo
credit: L. M.
Henderson).



SITE SUMMARIES

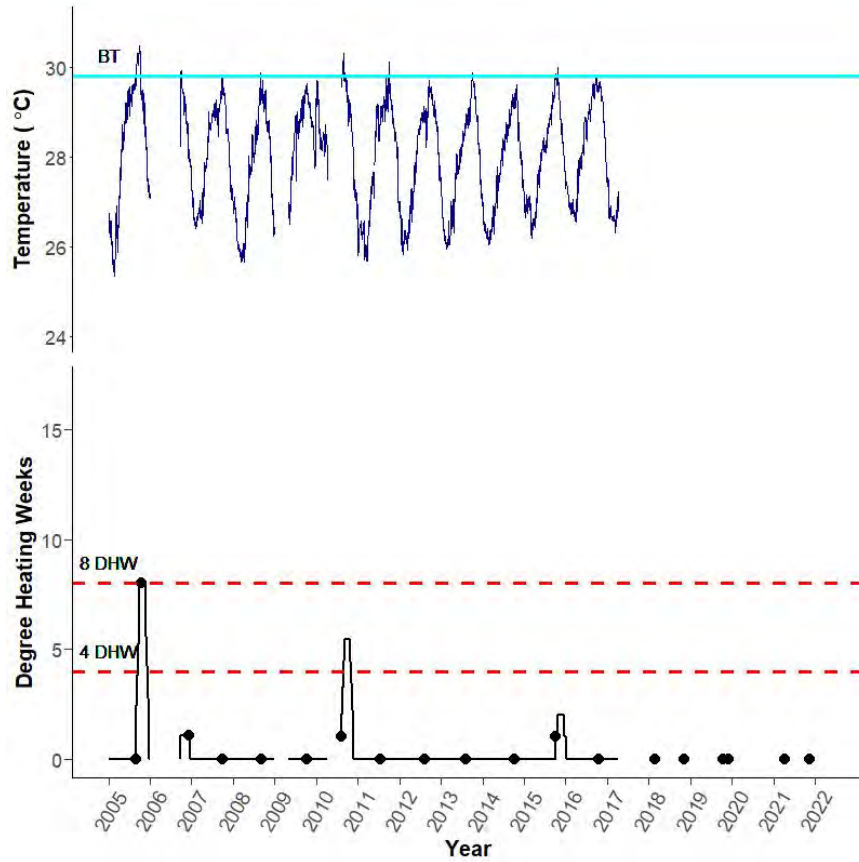


Figure 72. Salt River West surface-benthic temperature record 5m depths. Data provided by the NOAA ICON monitoring network.

Physical Characteristics.

Current. Currents have not been directly measured by the TCRMP. Due to the northern exposure and shallow depth, Salt River West experiences wave-driven oscillatory flow, which can be strong. Unidirectional benthic currents are typically weak to moderate ($<15\text{cm s}^{-1}$).

Temperature. The temperature at Salt River West can be very warm and in 2005 surpassed the bleaching threshold (29.5°C) for approximately 2.5 months between August and October. This site is not monitored for temperature by TCRMP since it is a site of the physical monitoring for the National Coral Reef Monitoring Program.

SITE SUMMARIES

Benthic Community. The Salt River West epibenthic sessile animal community has a diverse hard coral community of small massive head corals and large proportions of sponges and gorgonians. The site lost an imperceptible amount of coral cover in the 2005 coral bleaching event (-13.6%) and had regained nearly half of that cover by 2011 (37.1%). However, there has been a 40.9% decrease in relative coral cover over 2019 – 2021, likely due to Stony Coral Tissue Loss Disease at this location. The algal community shows extreme dominance by epilithic algae and low abundance of macroalgae and filamentous cyanobacteria. However, the abundance of macroalgae has been increasing at this site between 2009 and 2018, suggesting a change in herbivory.

Coral Health. Corals were severely bleached during the 2005 coral bleaching event, with over 90% of corals bleached over 80% of the colony surface. Corals were assessed just prior to the 2010 bleaching event in August, but were showing increased prevalence of low colony extent bleaching by then. In 2019 there was moderate bleaching in October and early December, which likely captured the peak bleaching response. Diseases are typically low, with the outstanding case of dark spots disease, which attains some of the highest values seen in TCRMP sites. Of note, is the fact that dark spots disease actually decreased following severe bleaching and recovery in 2005 and 2006. Old partial mortality increased rapidly after the 2005 bleaching and then subsided somewhat by 2011. Recent partial mortality can be high and is primarily caused by fish biting, such as from parrotfish. However, extent is quite low (data not shown). Stony coral tissue loss disease was recorded in transects in the 2020 year sampling (April 2021).

SITE SUMMARIES

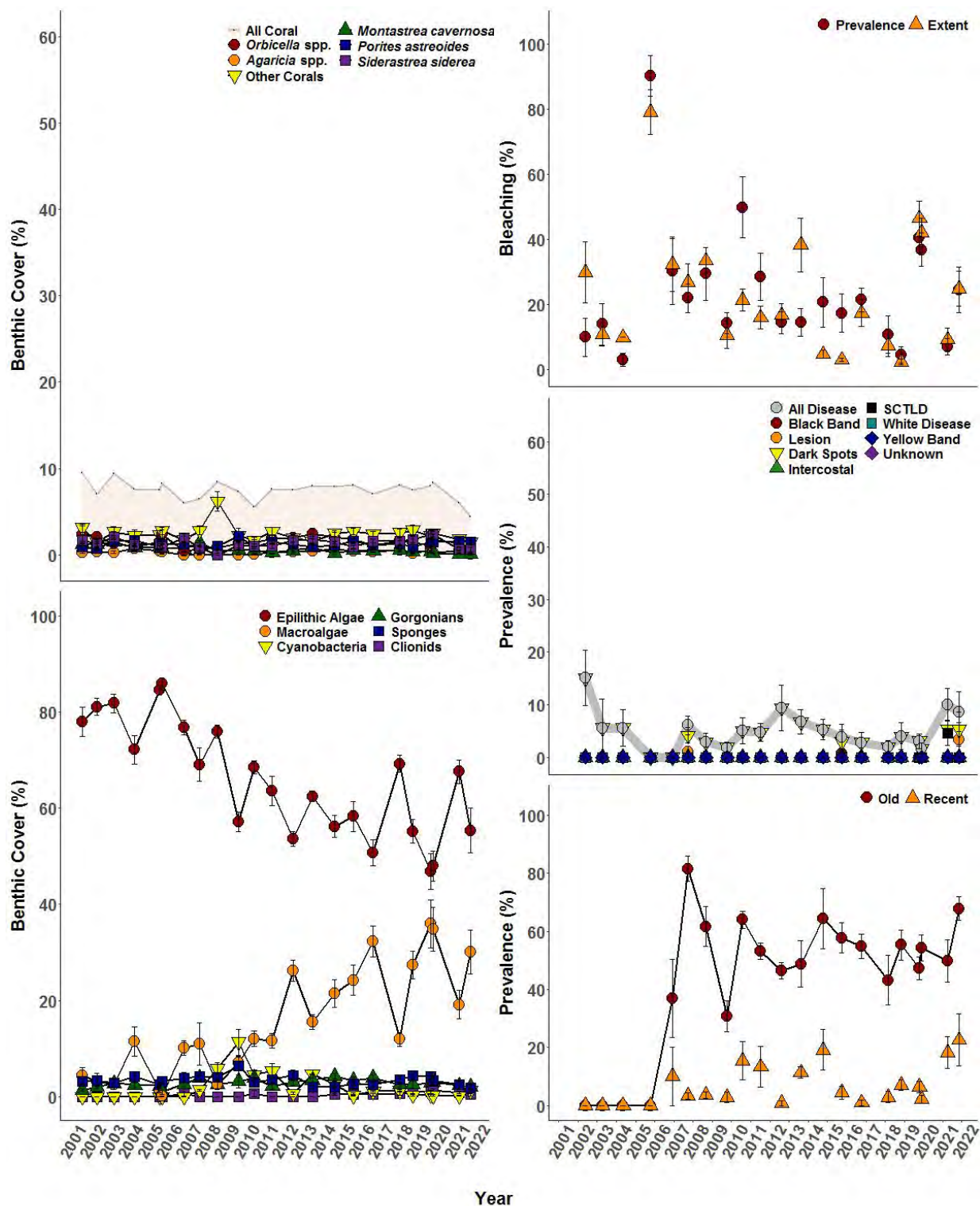


Figure 73. Salt River West benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Fish biomass is relatively low on the Salt River West site. More diversity and some larger fishes can be seen close to the edge of the site, near the Salt River wall; however, the top of the reef has little structure for larger fishes, with low lying coral heads, gorgonians, and sponges. Wrasses and damselfishes are both numerous and diverse; the most dominant species on the site is the bluehead wrasse followed closely by the bicolor damselfish. Black surgeon, an opportunistic planktivore that feeds on zooplankton, phytoplankton and algae, dominates the Salt River West site in biomass, followed by the stoplight parrotfish, ocean surgeonfish, and very numerous creole wrasse. Piscivores are nearly non-existent; they include graysby, coney, barracuda and schoolmaster snapper. Occasional red lionfish are seen on a Salt River West.

SITE SUMMARIES

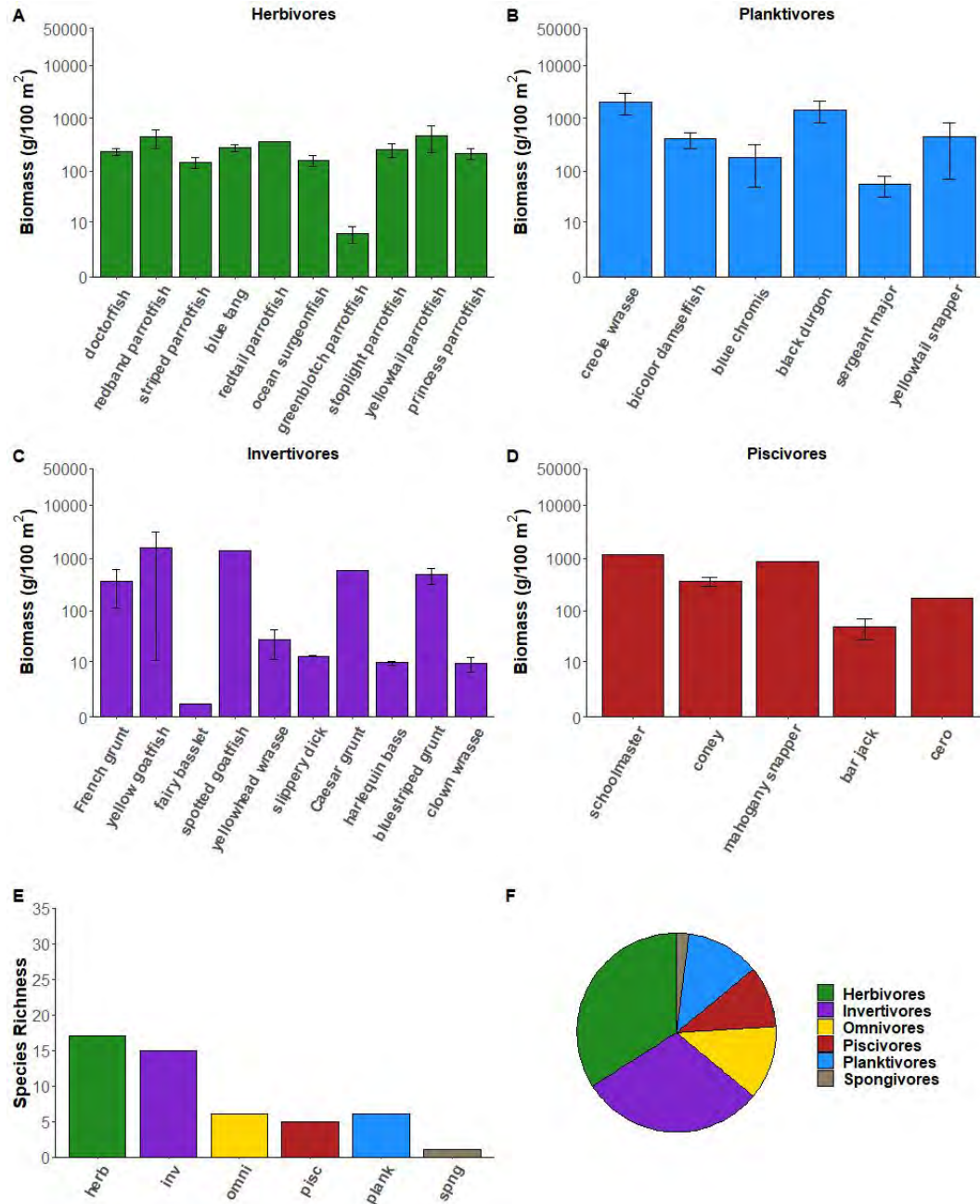
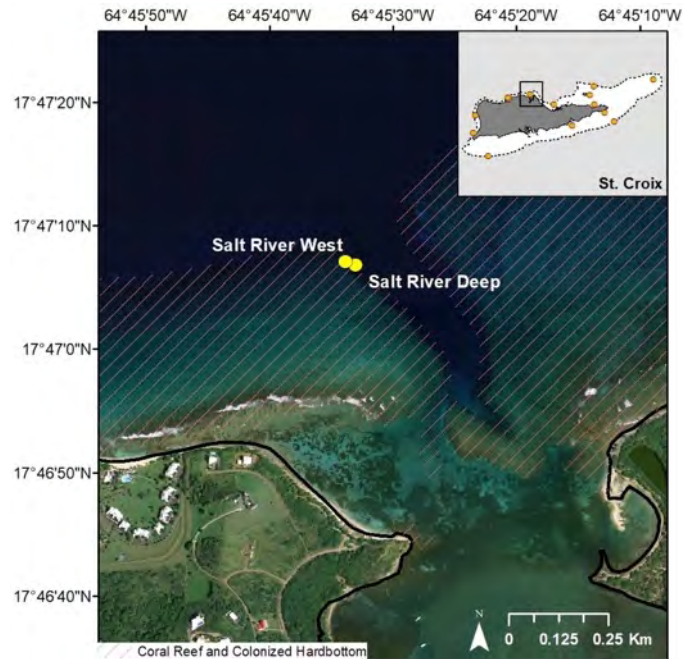


Figure 74. The Salt River West fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

SALT RIVER DEEP

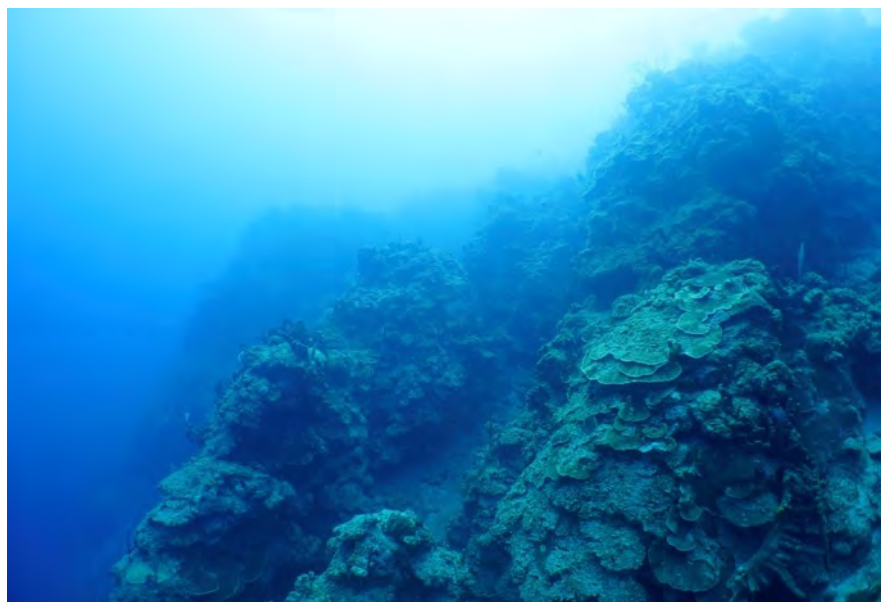
Description. The Salt River Deep site is located on the steep canyon wall just below the Salt River West monitoring site. The reef consists of vertical buttresses surrounded by extensive sand deposits. The reef is largely formed of plating coral at these deep, mesophotic depths. The initial site was deployed in 2009 with two transects at 30 m depth and 4 transects at 40 m. Due to low coral cover at 40 m transects were moved to 30m in 2010.



Outstanding Feature. Salt River Deep is a heavily visited recreational dive site. The site has been under scientific investigation since the 1970's. The underwater HYDROLAB habitat was maintained near the site from 1977 to 1985 and the Aquarius habitat from 1986 to 1989.

Threats. Salt River Deep is threatened by land-based sources of pollution due to its proximity to the Salt River Canyon outflow. The site may also be susceptible to warming temperatures.

Figure 75. Salt River Deep. (top) Location. (right) A representative photo of the reef (photo credit: L. M. Henderson).



SITE SUMMARIES

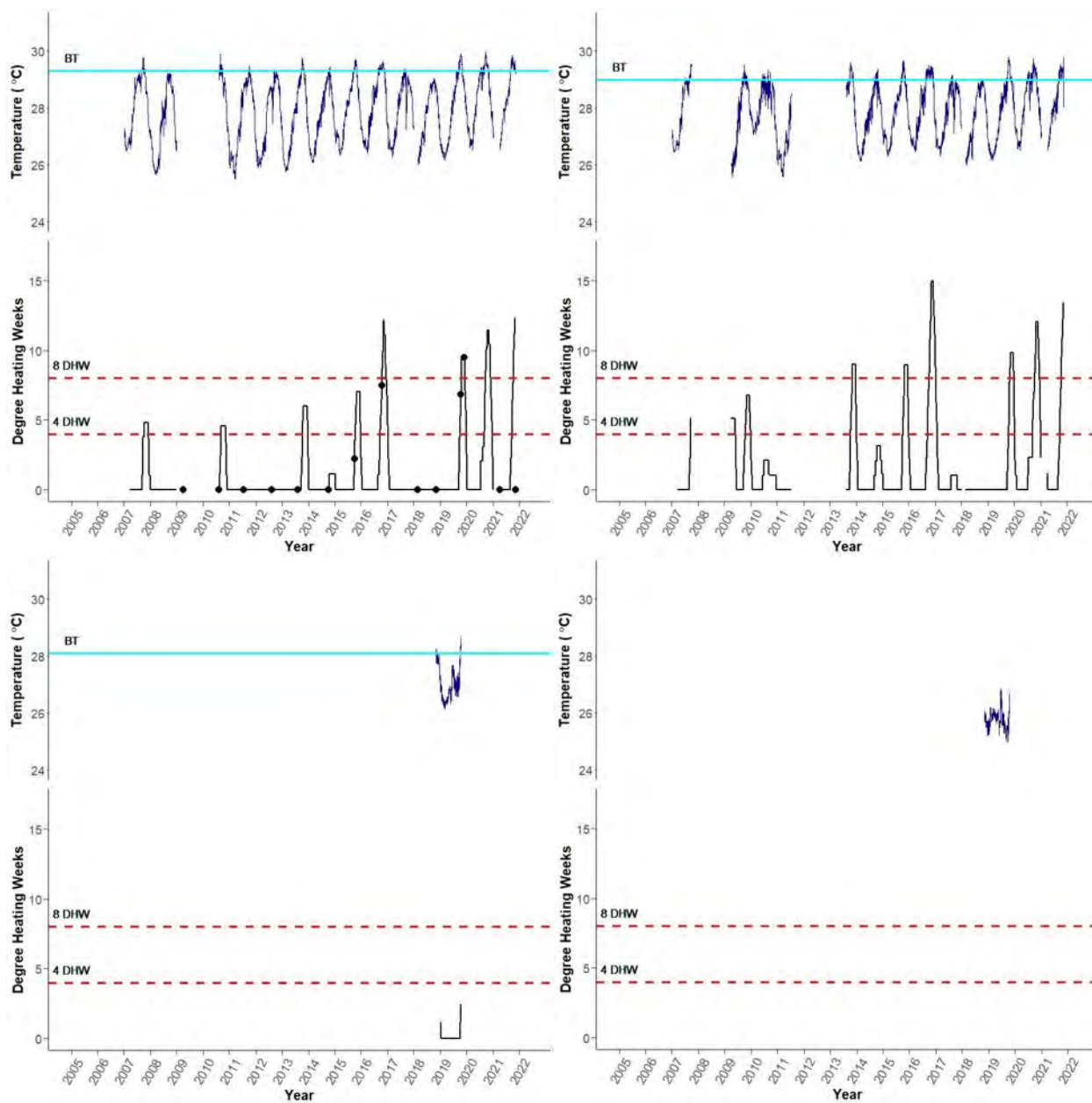


Figure 76. Salt River Deep benthic temperature (Top left: 30 m depth, top right: 41 m depth, bottom left: 67 m depth, bottom right: 100 m depth).

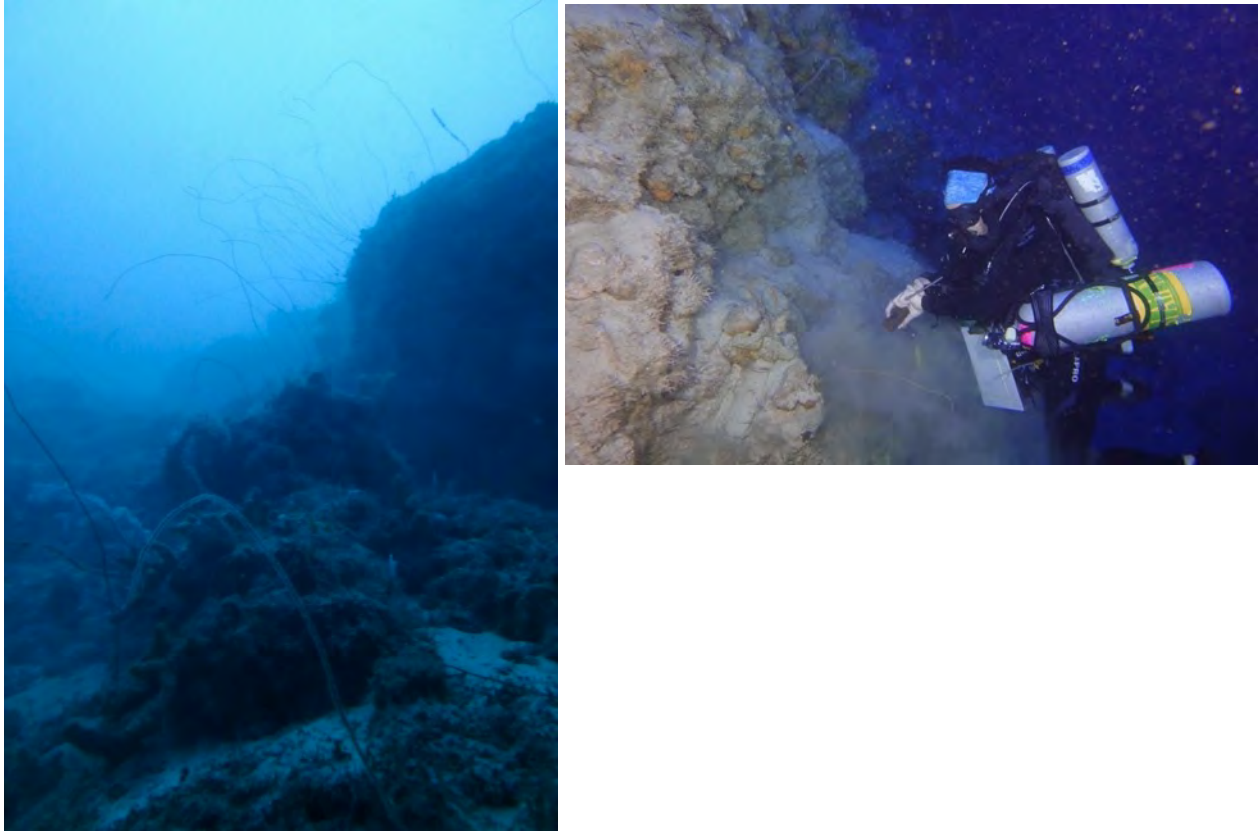


Figure 77. Installation of temperature monitoring stations at Salt River Deep at 67 m (left) and 100 m (right) in the canyon (credit: Viktor Brandtneris).

Physical Characteristics.

Current. Salt River deep currents have not been measured directly by the TCRMP. Only very weak oscillatory and unidirectional currents have been experienced at the site.

Temperature. Temperatures on the wall have been measured at 30 and 41 m depths since 2017, with probes placed at 67 and 100 m in 2018. Both sites have temperatures that are much cooler than the shallow site. The 41 m site experiences even greater cooling and experiences more diel variability (not shown) and day-to-day variability due to the influence of internal waves. Despite some interaction with the thermocline, cooling is not as great as at the mesophotic reefs at similar depths on the southern Puerto Rican Shelf. The empirical bleaching threshold has not been established at this site and the modeled bleaching threshold used here (Smith et al. 2016a).

SITE SUMMARIES

Benthic Community. Hard coral community of the Salt River Deep monitoring site is dominated by plating lettuce corals (*Agaricia* spp.); however, sponges, gorgonians, and black corals dominate the overall sessile epibenthic animal community. The site was not monitored during the 2005 bleaching event, but as with the Cane Bay Deep site, severe bleaching was observed down to depths of 40m. The algal community is dominated by epilithic algae and unidentified diminutive macroalgae. The site is notable for the high composition of sediment, which cascades from the upper reef between spurs and buttresses.

Coral Health. Low extent coral bleaching is typically in moderate to high prevalence at the Salt River Deep site. This may reflect bleaching sensitive taxa (e.g., *Agaricia* spp.) and the influence of down-canyon sedimentation impacts. There was a high prevalence of bleaching by December 2019 at a moderate extent. Interaction data (not shown) indicates that sediment and *Lobophora variegata* overgrowth are responsible for much of the bleaching. Diseases have not been observed. Old partial mortality is high on corals, which may be a reflection of the 2005 bleaching event and cumulative impacts from interaction with sediment and algae. Stony coral tissue loss disease was not recorded in transects in the 2020 year sampling (April 2021), but there was an increase in the prevalence of lesions and rapid tissue loss during the 2021 sampling period (November 2021).

SITE SUMMARIES

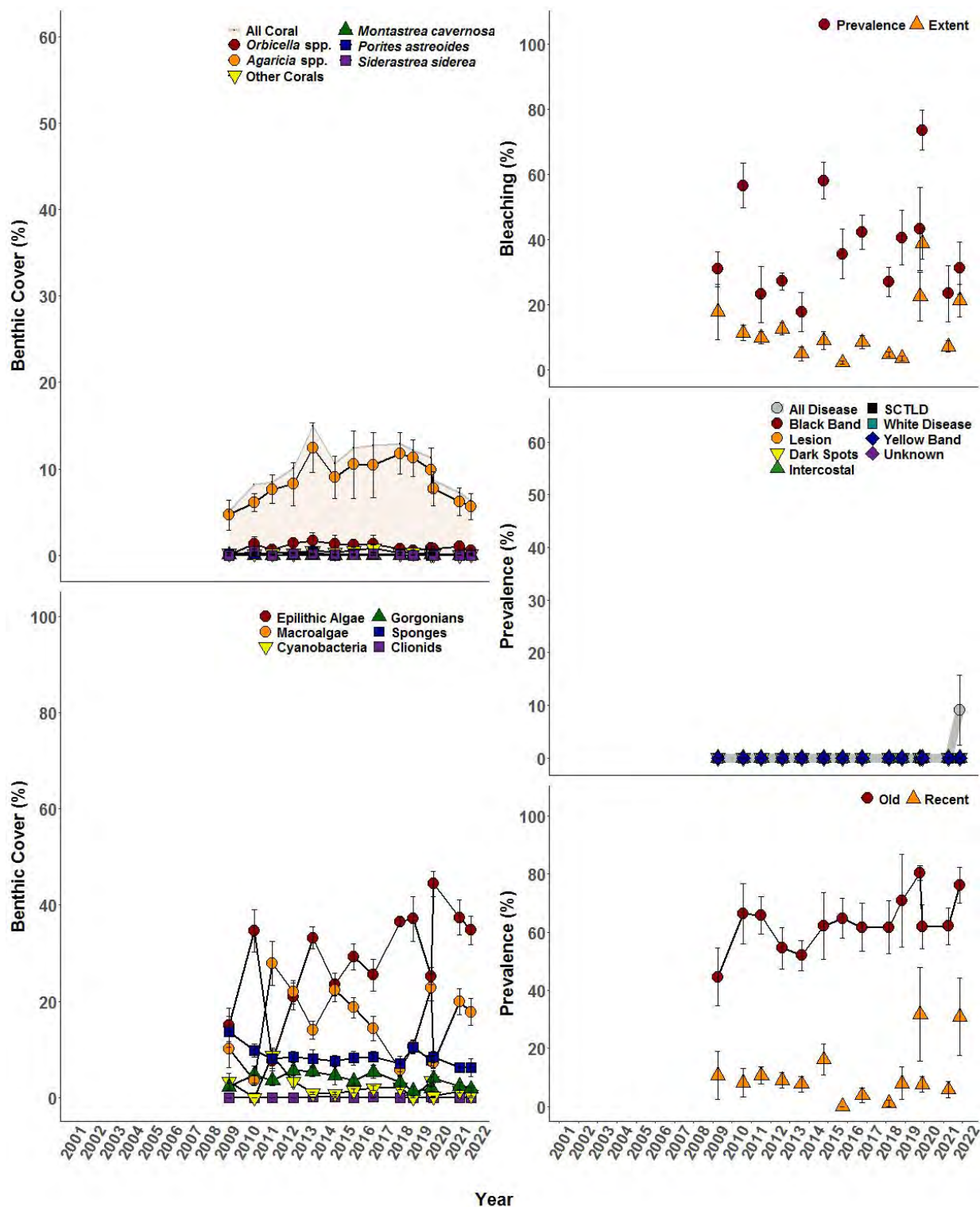


Figure 78. Salt River Deep benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The relatively high turbidity and high composition of sand and silt bottom, as a consequence of river discharge, influences the fish community of Salt River Deep. The mesophotic reef wall site is characterized by a fish community of very low abundance and biomass in all trophic guilds. Planktivores are dominated numerically and in biomass by the creole wrasse. Yellowtail snapper are also present. The invertivore guild is led in biomass by the yellow and spotted goatfish, bottom feeders that capitalize on the silt and sediment. These fish swim in small schools along the steep wall. Schoolmaster snapper and graysby are common piscivores; however, piscivore biomass is generally very low. Characteristic deep water fishes observed commonly on Salt Water Deep include the sunshinefish, bantum bass, fairy basslet, and longsnout butterflyfish. As on the Cane Bay Deep site, occasional cubera snapper (*Lutjanus cyanopterus*), mutton snapper (*L. analis*), or southern stingrays (*Dasyatis americana*) are observed during roving dives on the wall, and commonly one or two small, curious Caribbean reef sharks (*Carcharhinus perezí*) are present. Deeper in the canyon in the 50 – 70 m depth range, resting schools of black margate have been observed on every dive.

SITE SUMMARIES

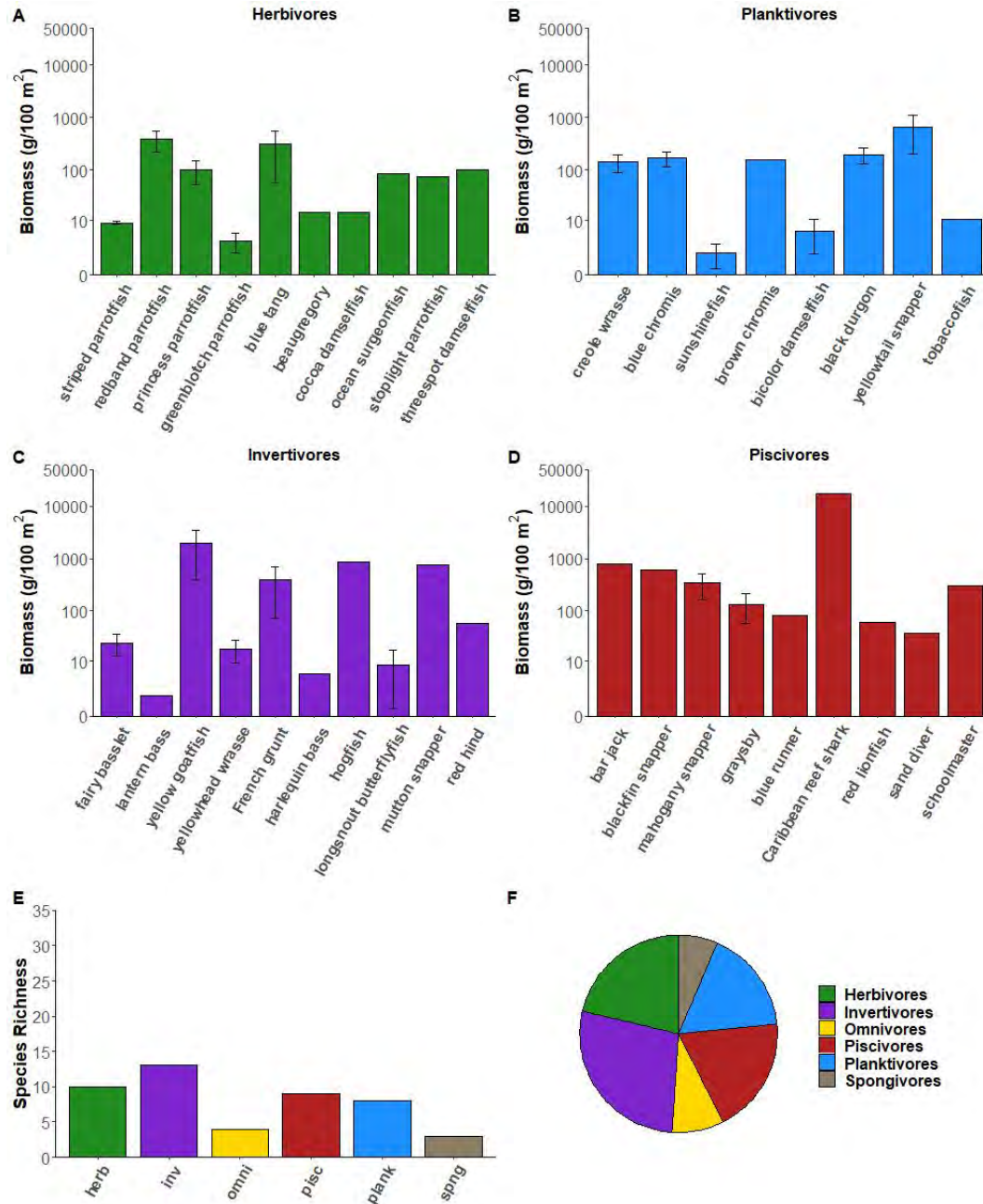


Figure 79. The Salt River Deep fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

SPRAT HOLE

Description. The Sprat Hole site is a nearshore/shelf-edge fringing reef in depths of 7 – 10 m. The site is a rolling boulder star coral (*Orbicella annularis*) reef. The slope to the west drops off to an attractive mixed coral community with abundant fish where it meets sand at about 25 m. Sprat Hole has been monitored since 2001.

Outstanding Feature. Sprat Hole is a heavily visited reef for snorkel and dive tours. It supports a very diverse fish community.

Threats. The Sprat Hole reef is vulnerable to land based sources of pollution if there is increased development of the watershed. Low wave action and light currents favor settling of small particles of terrestrial sediment that injure corals. The site is also frequently fished and there is derelict fishing gear in abundance. Recreational overuse may also be a threat.



Figure 80. Sprat Hole. (top) Location. (right) A representative photo of the reef (photo credit: L. M. Henderson).



SITE SUMMARIES

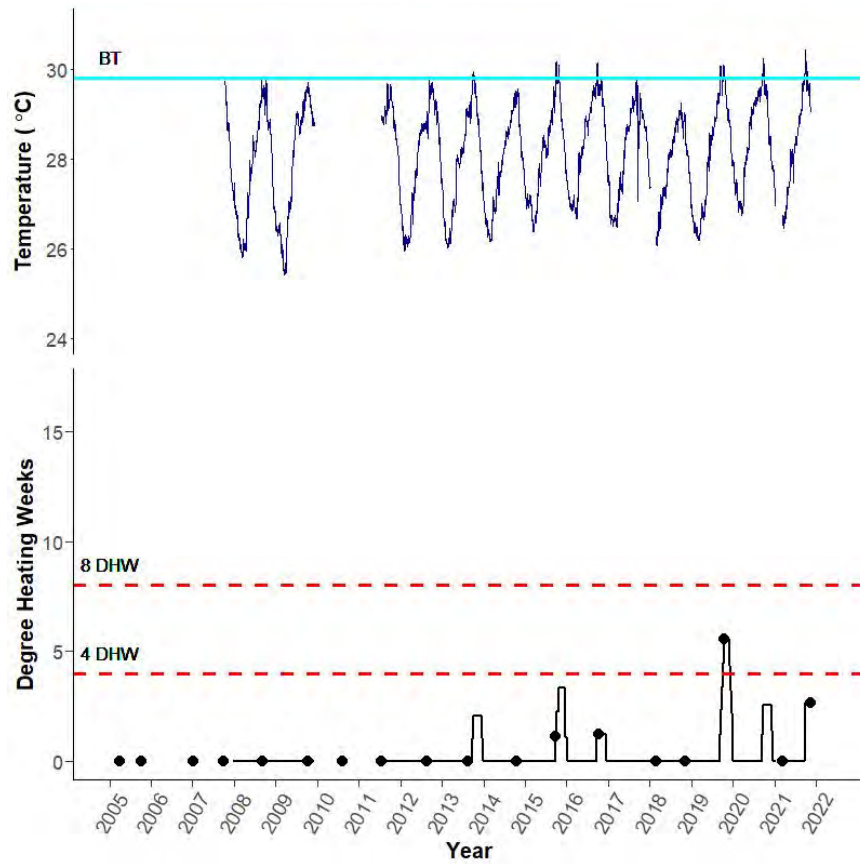


Figure 81. Sprat Hole benthic temperature (7 m depth).

Physical Characteristics.

Current. Currents have not been measured at Sprat Hole. Oscillatory currents are typically weak on the western lee of St. Croix. Unidirectional currents during monitoring have always been weak ($<10\text{cm s}^{-1}$).

Temperature. Sprat Hole temperature has not been monitored over many years due to loss of probes. This is likely due to the high exposure to recreational and commercial fishing divers. Since 2013 temperature probes of the National Coral Reef Monitoring Program have been co-located at this site. In general Sprat Hole appears to be a warm site. It does not have an empirically derived bleaching threshold temperature, but observations of moderate bleaching in 2019 suggest that the current threshold of 29.8°C is reasonable.

SITE SUMMARIES

Benthic Community. Sprat Hole is a fringing *Orbicella annularis* dominated reef, with a good diversity of other coral species. There was a 62.3% decline in coral cover due to the 2005 coral bleaching event, with a regain of 11.9% of cover by 2011. Although not reflected in coral cover and partial mortality, the site did suffer damage due to Hurricane Maria on September 20, 2017, as evidenced by broken and toppled lobes of *O. annularis*. Epilithic algae dominate the algal community, with smaller amounts of a diverse group of macroalgae, including *Dictyota* spp. and *Halimeda* spp. There has been variable, but increasing cover of filamentous cyanobacteria since 2005.

Coral Health. The coral community at Sprat Hole was heavily affected during the 2005 coral bleaching event, with a high prevalence of bleaching at a very high extent. Bleaching prevalence has tended to be higher since the event. There was high prevalence of low extent bleaching in 2019 at a predicted 6 DHW. Disease prevalence can be quite high, particularly for white disease. Dark spots disease has also been in high prevalence in certain years. Old partial mortality was high on colonies from 2005 to 2011, and low when recorded in 2002. In this case, old partial mortality is a very common feature of *O. annularis* and it is likely that low values are due to observer bias and a different method for estimating partial mortality. Recent partial mortality is consistently very high at Sprat Hole, due in part to the high abundance of territorial damselfish (*Stegastes* spp.) forming algal lawns on *O. annularis*. Stony coral tissue loss disease was recorded in transects in the 2020 year sampling (March 2021).

SITE SUMMARIES

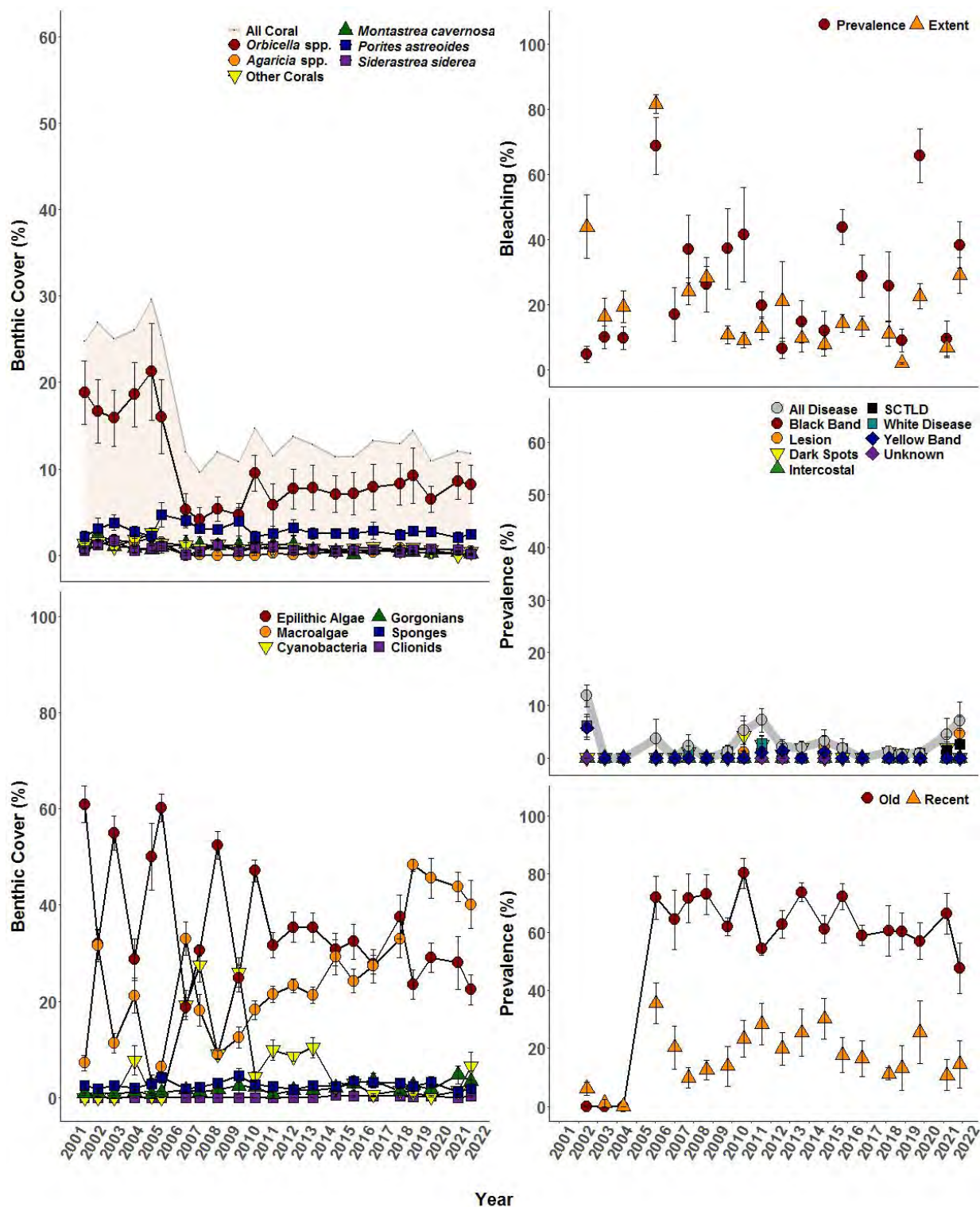


Figure 82. Sprat Hole benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Sprat Hole exhibits typical fish community structure for a nearshore developed coral reef ecosystem receiving some amount of terrestrial runoff from the watershed. Fish biomass is moderate, and the site is dominated numerically by the creole wrasse and blue chromis, planktivorous invertivores. Benthic herbivores are common and include all common Caribbean species of parrotfish and all three acanthurid species. Most of these fish are in a juvenile or subadult phase. Invertivores are diverse and include both planktivores and benthic feeders; mostly small fish in small numbers. Grunts, goatfish and a variety of wrasse are common. Mutton snapper have been recorded on the sight sporadically. Numerically and by biomass the graysby and schoolmaster snapper contribute most to the benthic piscivore group. A juvenile tiger grouper was recorded in 2013, and a yellowfin grouper was seen in 2014. Lionfish have been observed on the Sprat Hole site every year since 2012. Bar jacks and cero mackerel, nearshore pelagic piscivores, round out the piscivore trophic guild.

SITE SUMMARIES

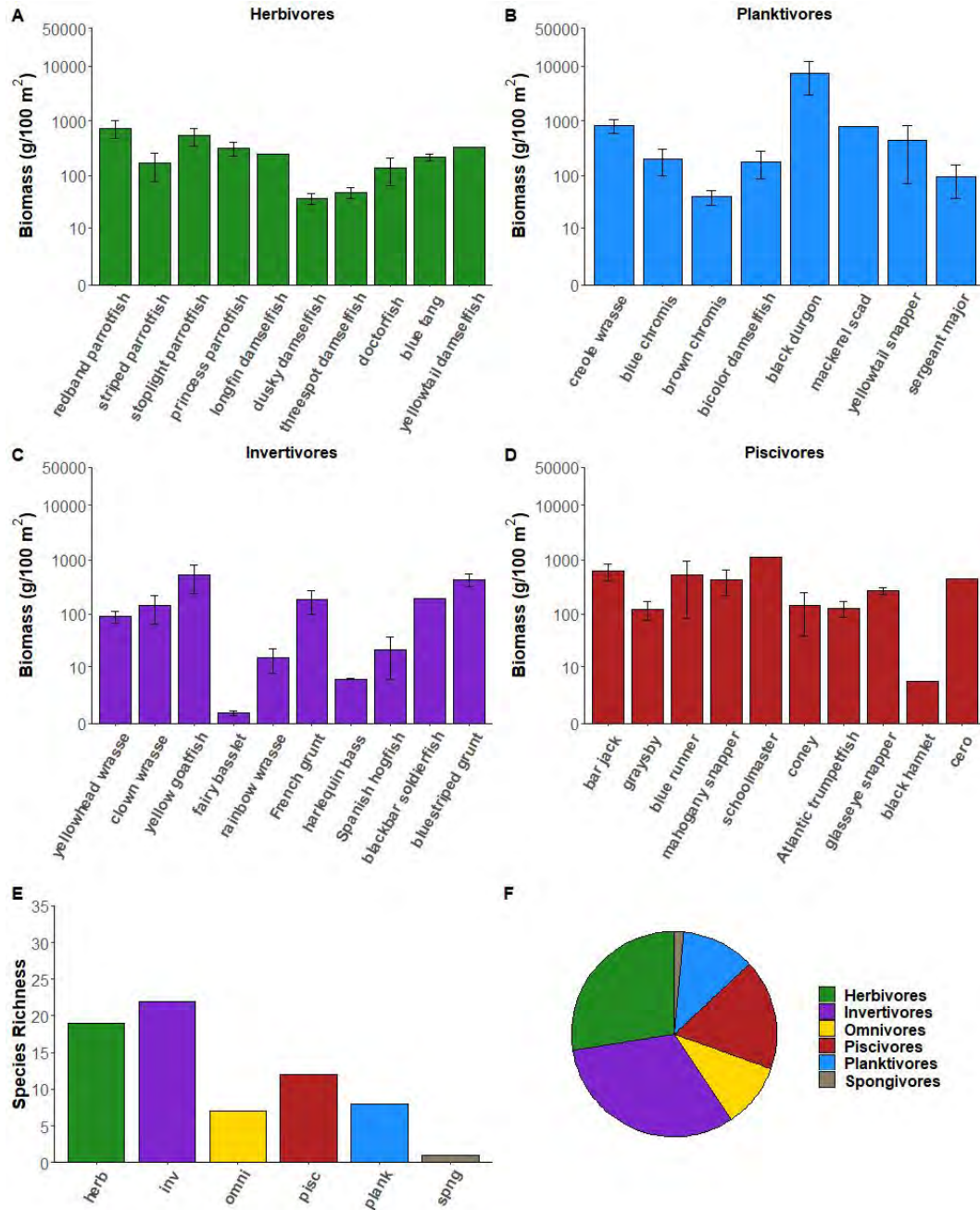


Figure 83. The Sprat Hole fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

St. John

SITE SUMMARIES

CORAL BAY

Description. The Coral Bay site is atop a patch reef complex at the southeast mouth of Coral Harbor. The reef is a low carbonate build up with high coral diversity. Coral Bay appears to be a true reef with a well-developed carbonate framework over bedrock. Coral Bay monitoring was initiated in 2011.

Outstanding Feature. Coral Bay supports a high diversity of coral and an apparent high rate of coral recruitment.

Threats. Coral Bay is subject to land-based sources of pollution, primarily as sediment influx from the large and steep Coral Bay watershed. Coral Bay may also be threatened by maritime activities within Coral Harbor. Turbidity at the site is usually very high, with underwater visibility usually <4 m. Proximity to land makes this site in territorial waters potentially vulnerable to fishing.

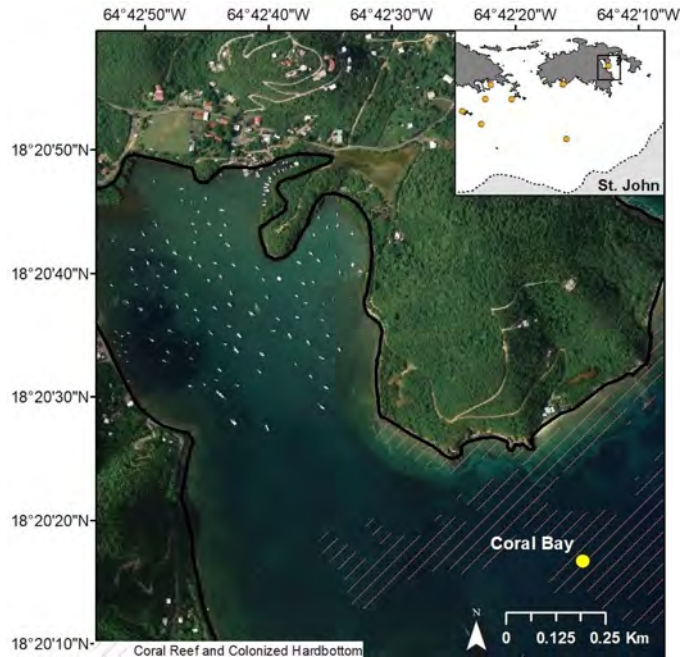


Figure 84. Coral Bay.
(top) Location.
(right) A
representative photo
of the reef.



SITE SUMMARIES

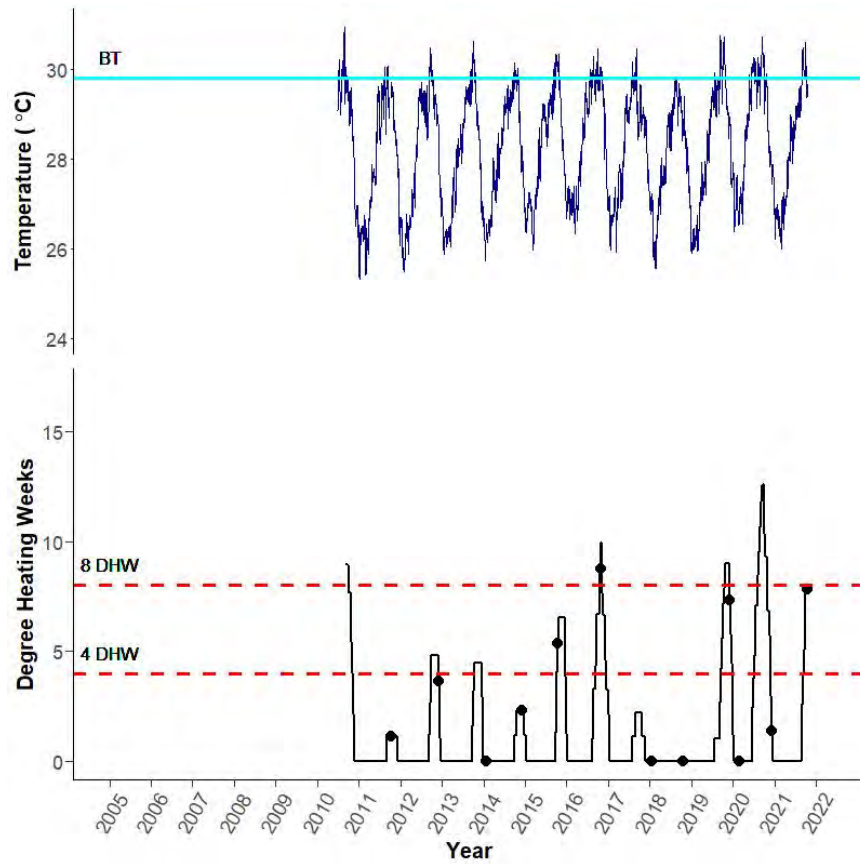


Figure 85. Coral Bay benthic temperature (9 m depth)

Physical Characteristics.

Current. Currents have not been measured by the TCRMP, however, Dr. Sarah Gray (University of San Diego) has measured 2-D near bottom measurements for some years between 2009-2011. Oscillatory currents are expected to be light and only weak unidirectional currents have been experienced.

Temperature. Coral Bay may have restricted water circulation and had very high temperatures during the 2010 bleaching event. There is no empirically established bleaching threshold and the modeled bleaching threshold (Smith et al. 2016a) is likely too low, given high DHW values with limited observed bleaching, especially in 2019.

Other. This site and the wider Coral Bay area have been under investigation for land-based sources of pollution impacts since 2009 (Smith et al. 2013a).

SITE SUMMARIES

Benthic Community. Coral Bay has a very diverse coral community, with no clear dominance of cover. In contrast to most sites, the mustard hill coral *Porites astreoides* has the greatest cover among coral species. Coral cover has been declining since 2015, with a precipitous decline in the year 2018. Increasing impacts of land-based sources of pollution may be contributing to the degradation. Sponges and gorgonians are also very common at this site. In particular, gorgonians have been increasing in cover at this site, following a possible island-wide trend for St. John (Tsounis and Edmunds 2017). Epilithic algae and a high abundance of crustose coralline algae dominate the algal community, with very low abundance of macroalgae. This is surprising at this turbid reef site that likely receives high inputs of particulate and dissolved nutrient sources and indicates that grazing is quite high. There is not a high abundance of herbivorous fish and only the occasional occurrence of *Diadema antillarum*. However, there is a great abundance of the rock boring urchin *Echinometra* spp. that appears to be the dominant grazer. This genus is not monitored in TCRMP protocols, but perhaps should be included in future years.

Coral Health. It is not known how corals were affected by bleaching in 2005. There was a low prevalence of low extent bleaching in 2019. In 2019 there was an increase in bleaching prevalence and extent, but to a low level. This bleaching was not evident in February 2020, when the site was resurveyed. Stony coral tissue loss disease was not recorded in transects in the 2020 year sampling (September and December 2021). The arrival of SCTLD seemed to be delayed relative to other sites around St. John, but was present during the 2021 sampling period.

SITE SUMMARIES

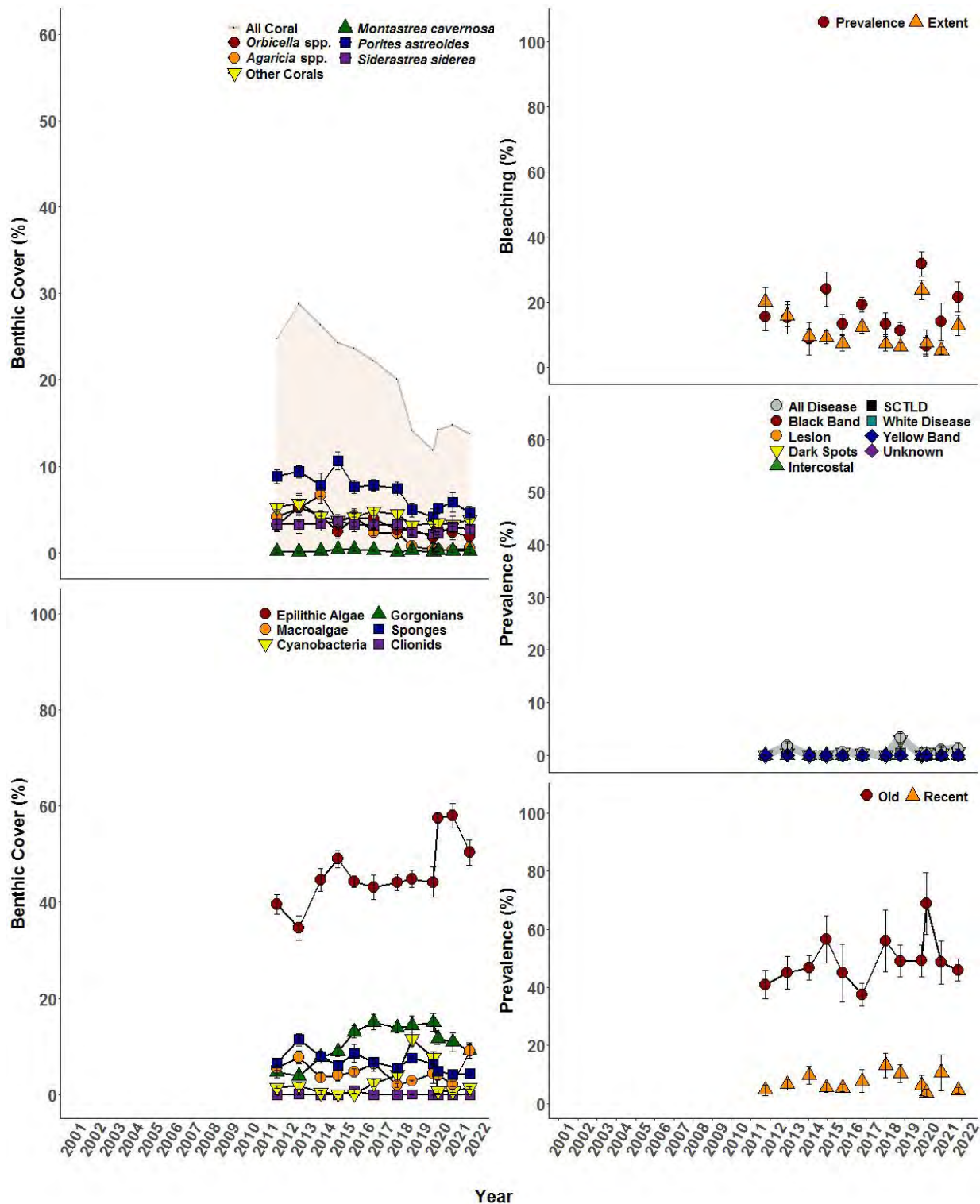


Figure 86. Coral Bay benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The Coral Bay site is low in fish diversity, biomass and abundance. Although epilithic algae are prolific, large grazers are nearly absent. Three spot damselfish dominate the group in abundance and juvenile striped and redbad parrotfish in biomass. Acanthurids are present but only in the juvenile phase. Planktivores in the high turbidity habitat are limited to a few juvenile yellowtail snapper and bicolor damselfish. Although benthic invertivores are more prolific and diverse, only a few individuals comprise each species group and most fish are juveniles. Likewise, piscivores have a very low biomass and are limited to a very few individuals that appear to be moving across the reef rather than residing there.

SITE SUMMARIES

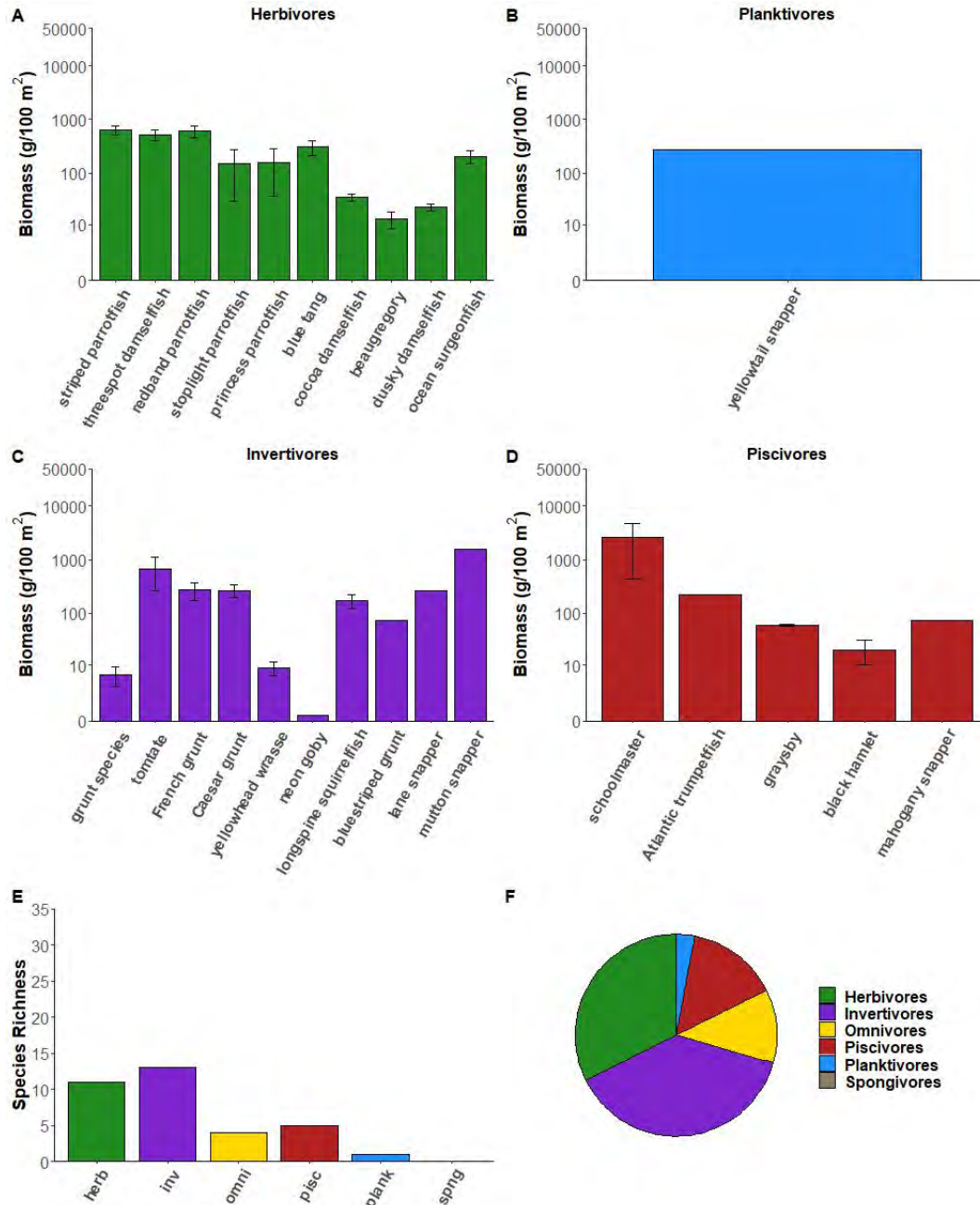


Figure 87. The Coral Bay fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

FISH BAY

Description. Fish Bay is a nearshore Fringing Reef in territorial waters. The monitoring site is a sharp edge of a shallow water coral community dropping to sand at 7 m depth. The site has been monitored since 2001.

Outstanding Feature. Fish Bay inner transects (1 – 3) are heavily sediment impacted, while outer transects (4-6) support large boulder star corals (*Orbicella faveolata*). The site lies just outside the southwestern boundary of the Virgin Islands National Park.

Threats. Fish Bay is subjected to land-based sources of pollution.

Inner bay transects tend to have turbid water and overgrowth by macroalgae. This site may also be vulnerable to fishing impacts.

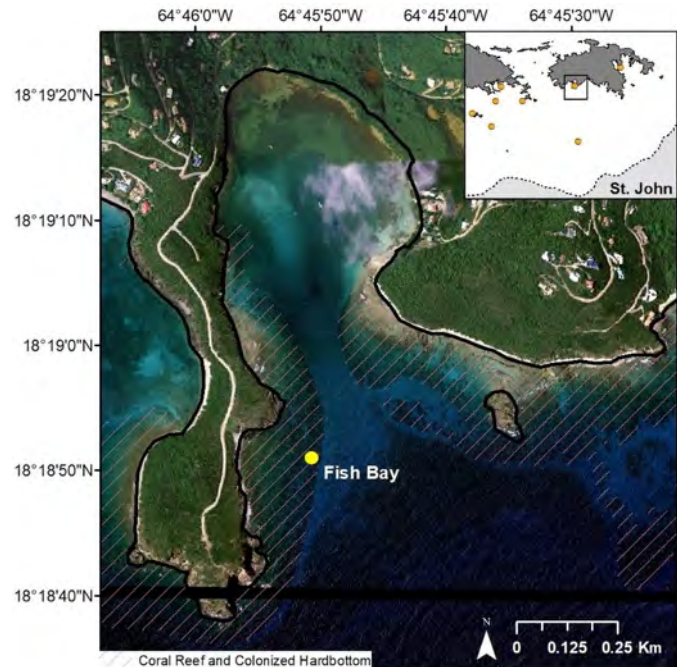


Figure 88. Fish Bay. (top) Location. (right) A representative photo of the reef (photo credit: S. Kadison).



SITE SUMMARIES

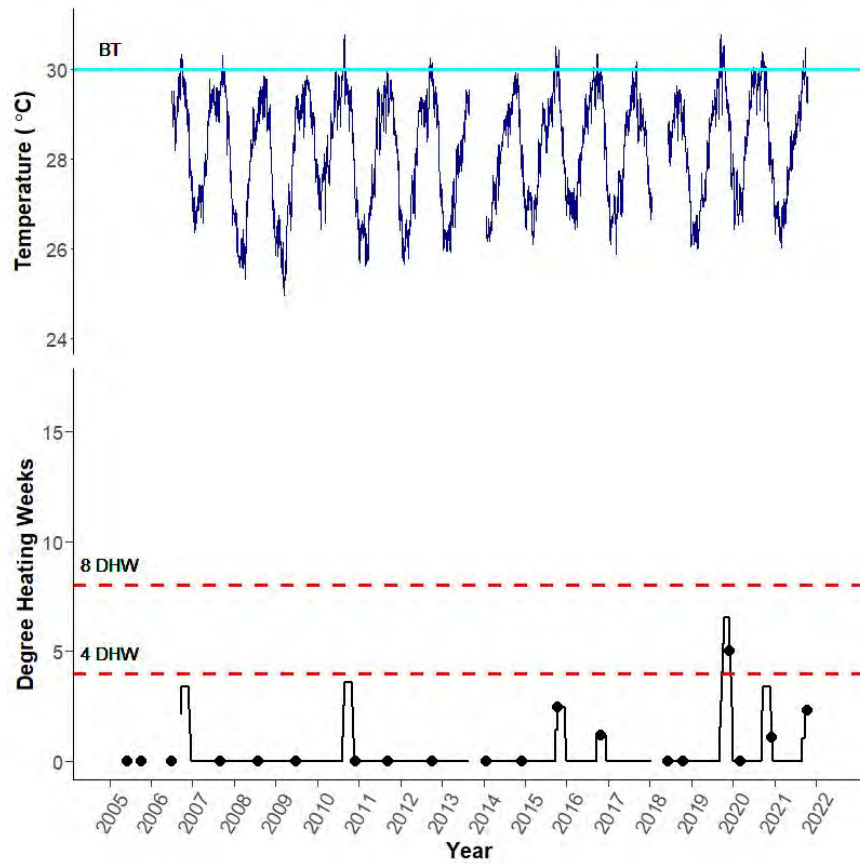


Figure 89. Fish Bay benthic temperature record (6 m depth).

Physical Characteristics.

Current. Fish Bay currents have not been measured directly by the TCRMP. Unidirectional currents are mild to slack. Because of the southeast exposure, wave driven oscillatory currents can be quite intense, particularly on the outer transects.

Temperature. Fish Bay has relatively high mean temperatures and a high bleaching threshold.

SITE SUMMARIES

Benthic Community. The coral community of Fish Bay is dominated by the boulder star coral *Orbicella* spp.. Large (>2m wide) colonies of *O. faveolata* are common on the seaward transects (4-6). The inner transects (1-3) are mostly depauperate of coral (< 4% cover as of 2011). The site lost 37.1% of its cover due to the 2005 coral bleaching event, but had regained 136.1% of cover by 2011. Gorgonians are also very common on the wave-washed outer transects. Gorgonians have been increasing in cover at this site, following a possible island-wide trend for St. John (Tsounis and Edmunds 2017). Equal parts epilithic algae and the macroalgae *Dictyota* spp. dominate the algal community. The site also has a high abundance of *Halimeda opuntia*, which can smother coral on inner bay transects closest to land-based sources of pollution.

Coral Health. Fish Bay corals were very severely affected in the 2005 with 100% of corals showing almost 100% bleaching. In 2019 bleaching prevalence stayed consistent, but thermal stress evidently increased bleaching extent. Bleaching is also normally high at this site even in years without thermal stress, a likely consequence of sediment and macroalgal interactions. Diseases, particularly dark spots disease and white disease, can have very high prevalence at Fish Bay. SCTLD affected corals in 2020, particularly on the outer transects with a more abundant and diverse coral community. This site has been the focus of SCTLD treatment with antibiotic pastes, which has likely rescued many of the large *O. faveolata* colonies in the near term. Old partial mortality did increase after the 2005 coral bleaching event, with a decline in 2010 and resurgence in 2011. Recent partial mortality can also be relatively high compared with other sites, largely as the results of bites from site-attached damselfish (*Stegastes* spp.).

SITE SUMMARIES

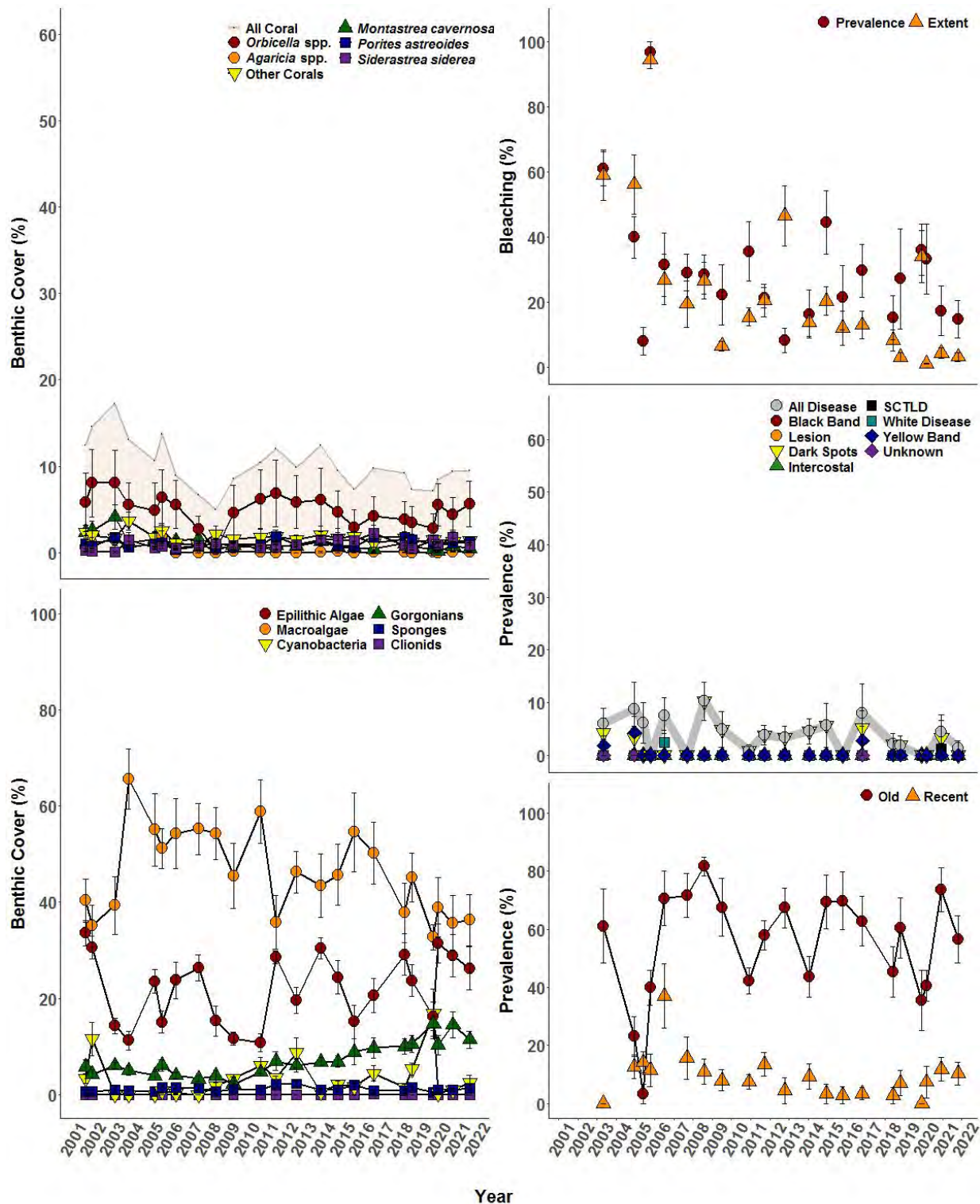


Figure 90. Fish Bay benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The Fish Bay fish community is typical of a nearshore reef habitat that receives moderate to heavy sedimentation. The site is dominated by herbivores that include all the common Caribbean parrotfishes, large schools of mixed acanthurids, and herbivorous pomacentrids. The common planktivores in the turbid water are limited to juvenile yellowtail snapper and a few small pomacentrids. Benthic invertivores and piscivores are more diverse and have a higher biomass, but generally fish are juveniles or subadults; large fish are rare in the bay. Invertivores are comprised primarily of grunts, goatfish and wrasses, and piscivore biomass is dominated annually by jacks. Large serranids and lutjanids are generally absent from Fish Bay although in 2018 a dog snapper was recorded. Both Caribbean reef sharks and lemon sharks are known to pup in Fish Bay, and juvenile lemon sharks are sometimes seen in the murky water.

SITE SUMMARIES

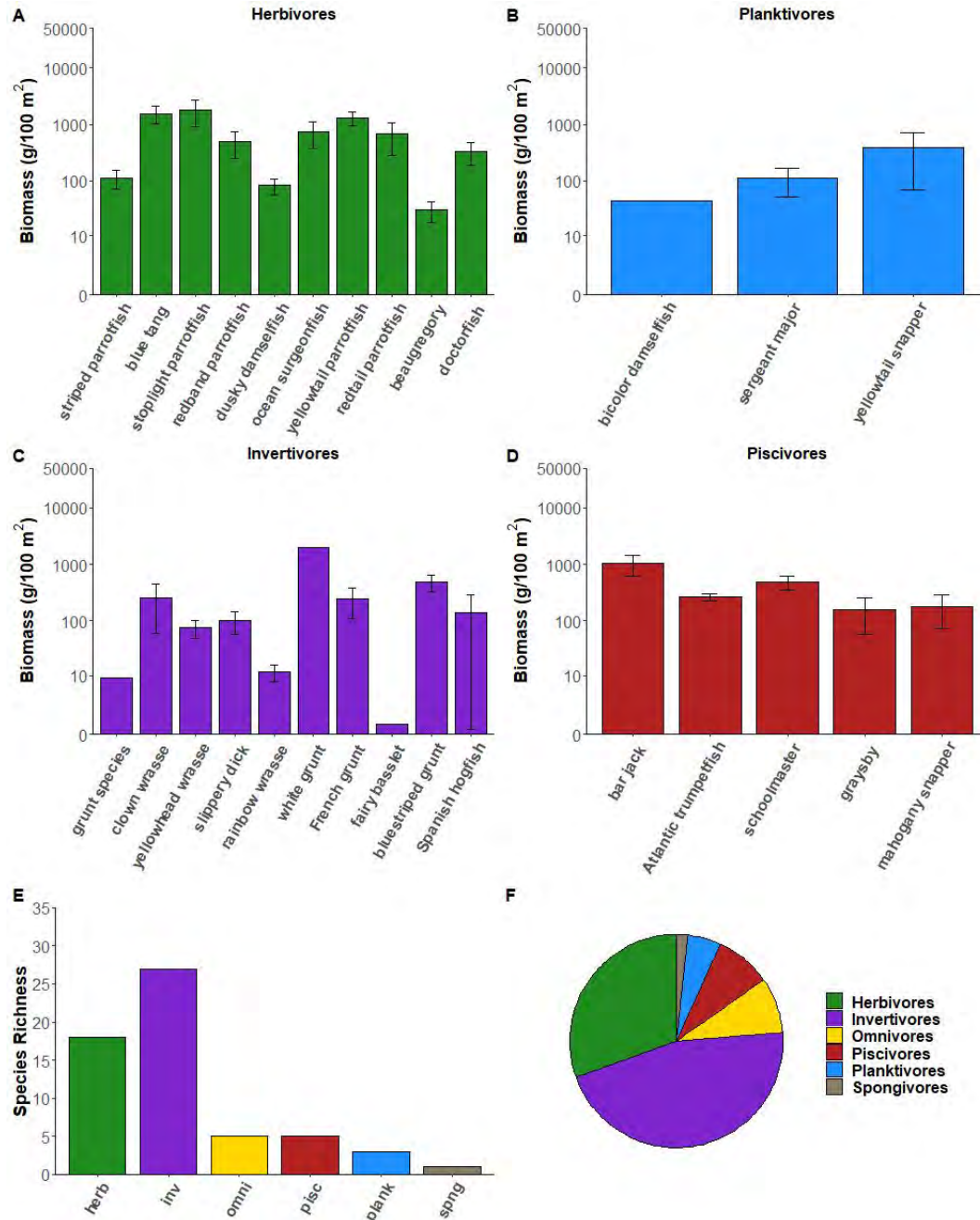
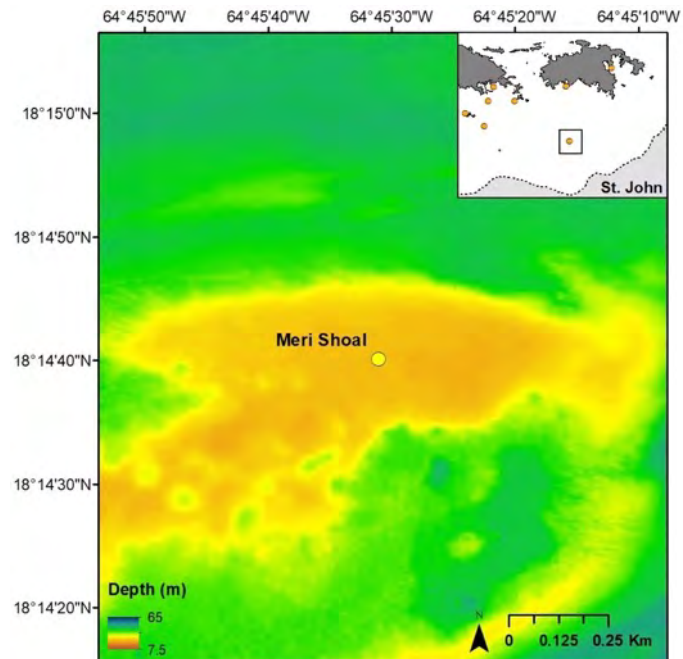


Figure 91. The Fish Bay fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

MERI SHOAL

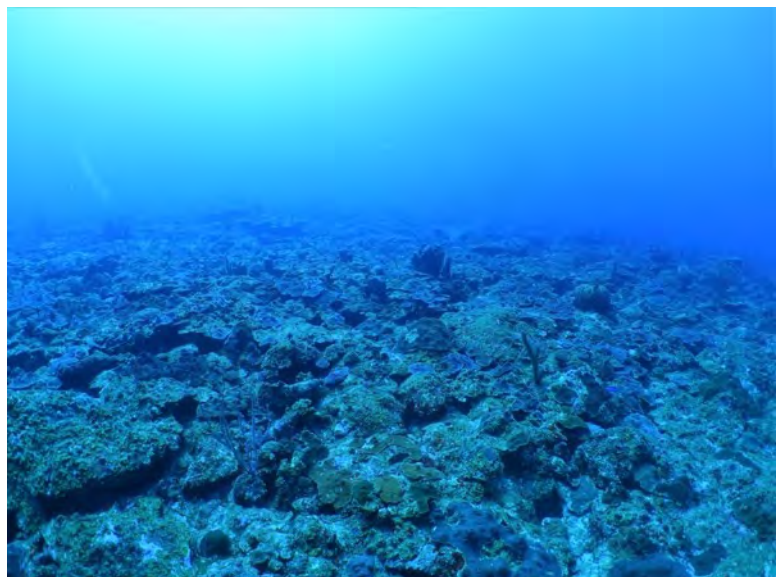
Description. Meri Shoal is an offshore mesophotic coral bank 30 m depth. The reef is located four miles south of St. John and is on the southernmost of two impressive midshelf coral banks. The reef is dominated by interlocking colonies of boulder star corals (*Orbicella* spp.). The reef top is very flat coral plain. The site is named for Dr. Meri Whitaker, former director of the VI EPSCoR Program who passed away in 2009. Meri Shoal has been monitored since 2005.



Outstanding Feature. Meri Shoal has the highest star coral abundance of any site in the TCRMP and is bathed in clear, clean water.

Threats. Meri Shoal is vulnerable to fishing impacts, as it is outside any marine protected area. The high density of corals may also make this site vulnerable to disease impacts.

Figure 92. Meri Shoal. (top) Location. (right) A representative photo of the reef (photo credit: S. L. Heidmann).



SITE SUMMARIES

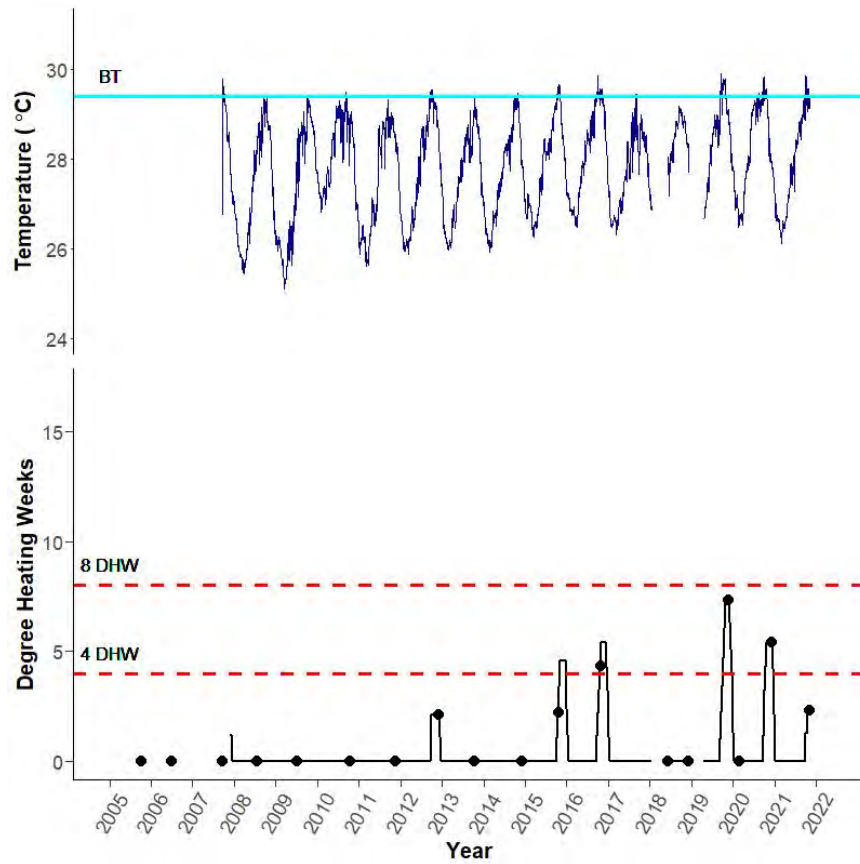


Figure 93. Meri Shoal benthic temperature record (30 m depth).

Physical Characteristics.

Current. Currents have not been measured directly at the Meri Shoal site, although the Caribbean Regional Association buoy VI 1 is located within 700 m and its downward focused ADCP has been recording data since April 2011.

Temperature. Meri Shoal has relatively low temperatures that are more similar to other mesophotic sites.

SITE SUMMARIES

Benthic Community. The Meri Shoal site is exceptional for its dominance by boulder star corals (*Orbicella* spp.). Cover of this and other coral species was exceptionally high when the site was first monitored during the 2005 coral bleaching event, but declined by 36.0% after bleaching and had not recovered any cover as of 2011 (-9.6%). Losses of coral cover between 2019 and 2020 were the result of SCTLTD impacts on *O. franksi*. Surprisingly, given the high coral cover, *Lobophora variegata*, and not epilithic algae, dominate the algal community and there has been a trend of increasing macroalgal cover since 2008.

Coral Health. Coral bleaching was relatively high for a mesophotic site during the coral bleaching event in 2005. Bleaching was again at high prevalence, but low extent in the thermal stress of 2010 and 2019. Disease, particularly white disease and lesions that are likely the remnants of white disease, are highly prevalent, particularly in years following high thermal anomalies, such as 2006 and 2011. SCTLTD was recorded in transect in 2020 and had reached nearly 10% prevalence. Old partial mortality climbed steeply from the 2005 coral bleaching event onwards and reached very high levels by 2006. Recent partial mortality has also been consistently high as the result of white disease and disease lesions.

SITE SUMMARIES

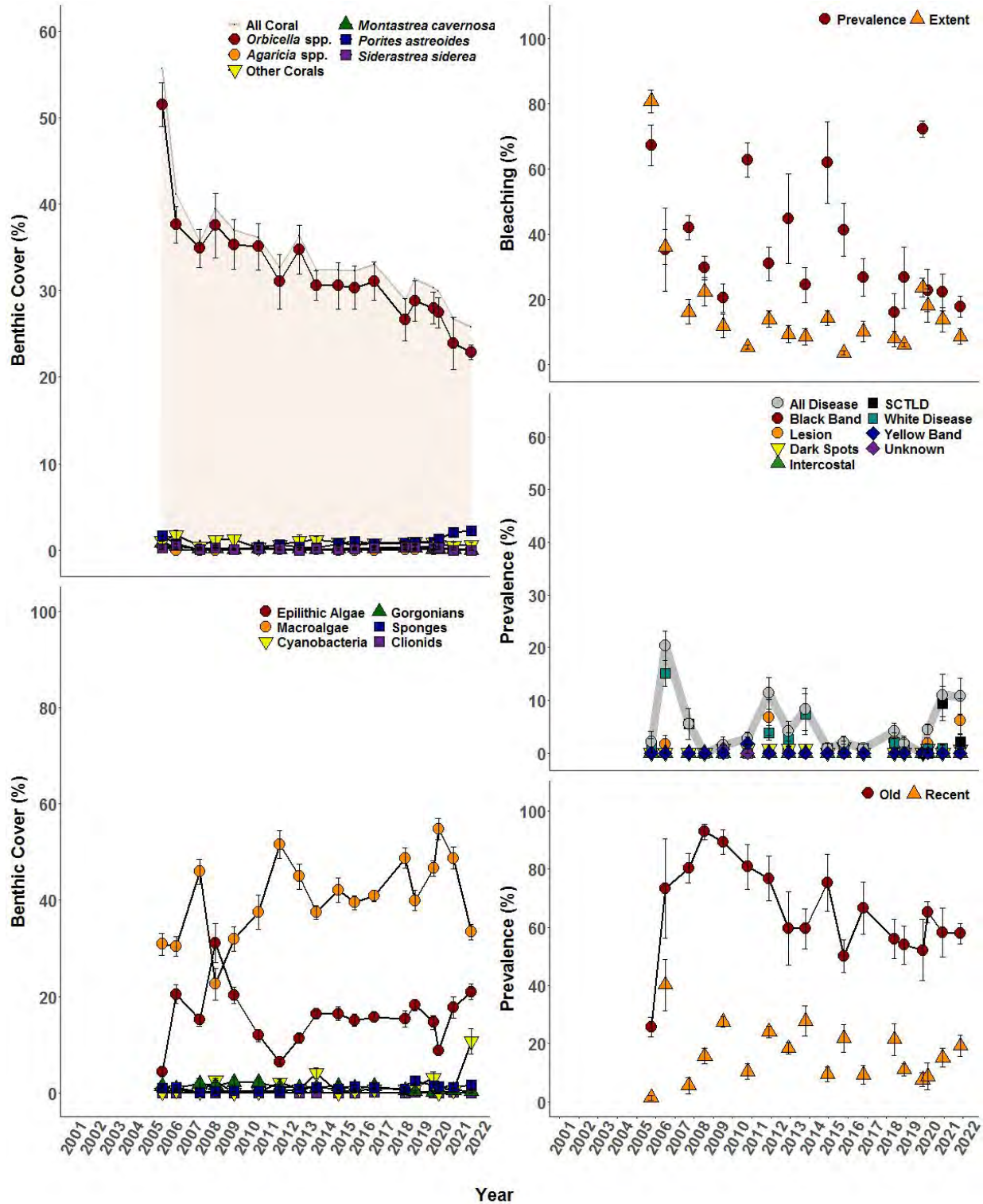


Figure 94. Meri Shoal benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Meri Shoal is a beautiful site in relatively deep water and holds a dynamic fish community of high biomass. Important planktivores include the very prolific creole wrasse, feeding on tiny jellyfish, invertivore larvae and phytoplankton, and the black surgeon, primarily a zooplankton feeder. Herbivores observed on the site include large stoplight parrotfish, as well as the three common smaller Caribbean parrotfish (redband, striped and princess), and all three acanthurids. Ocean surgeonfish are especially in high abundance. Queen triggerfish and red hind are both common at Meri Shoal. In 2012 a tiger grouper was observed on a belt transect and another on a roving dive. A Nassau grouper was also observed on a roving dive in 2013. These are rare but exciting encounters as the site is not protected from traps or any bottom fishing. Large jacks, mackerels, and barracuda are also regularly observed in the water column at Meri Shoal.

SITE SUMMARIES

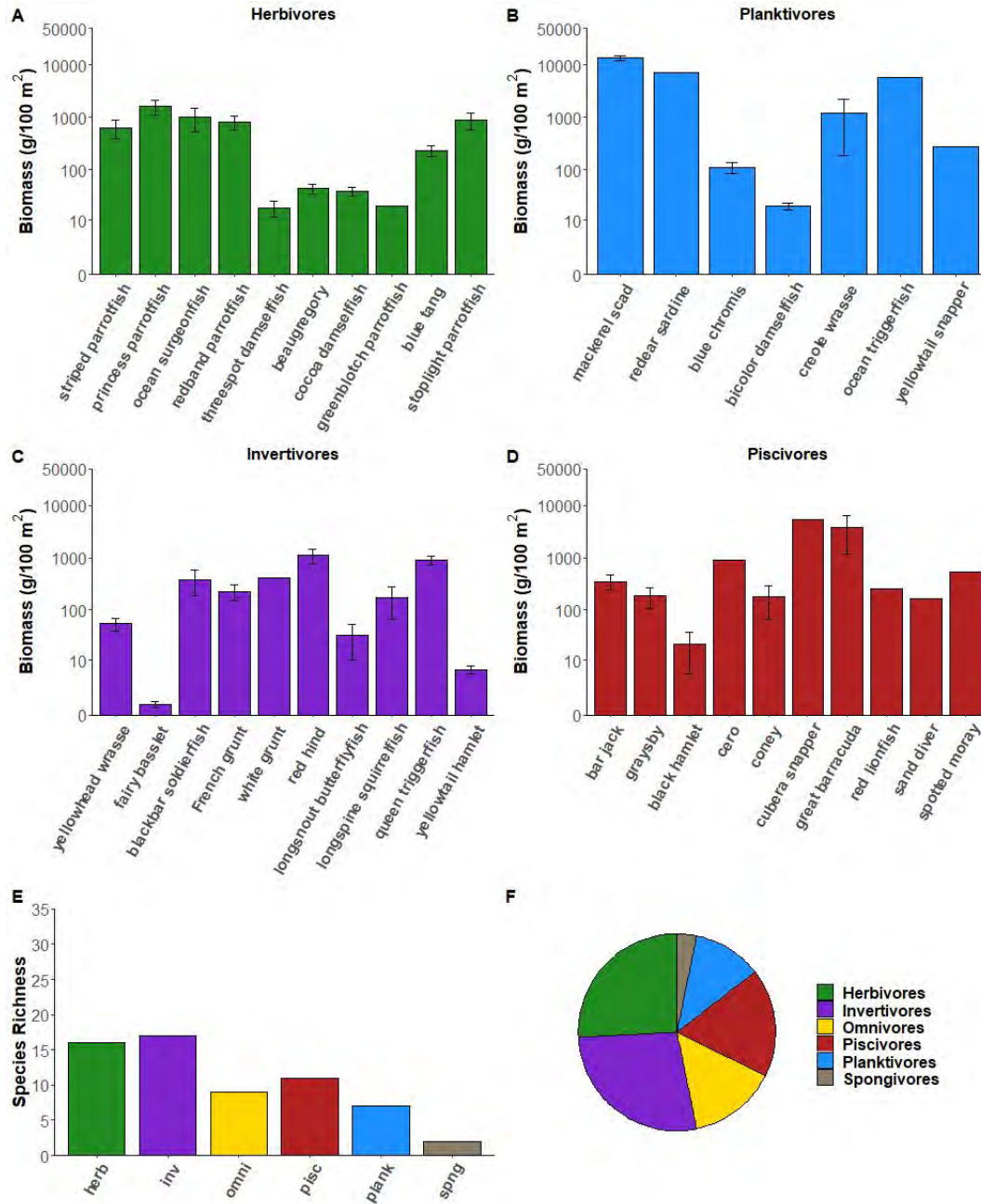


Figure 95. The Meri Shoal fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

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.

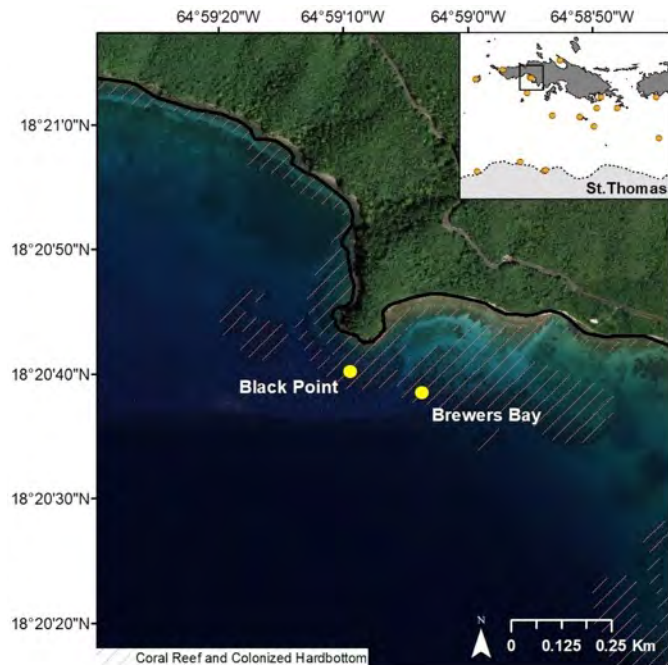
Black Point has been monitored since 2003, with permanent benthic transects installed in 2007. A ciguatera fish poisoning study with monthly sampling has been ongoing since 2009.

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

Threats. Black Point is 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 96. Black Point. (top) Location. (right) A representative photo of the reef.



SITE SUMMARIES

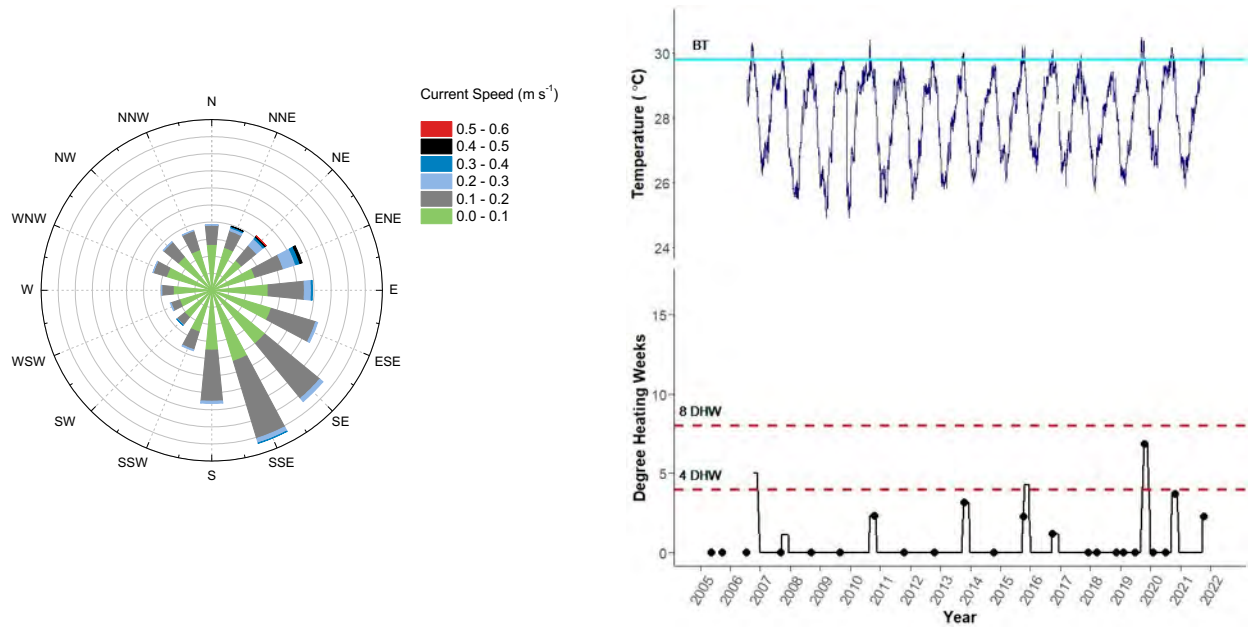


Figure 97. Black point current speed and benthic temperature record (8 m depth).

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.

SITE SUMMARIES

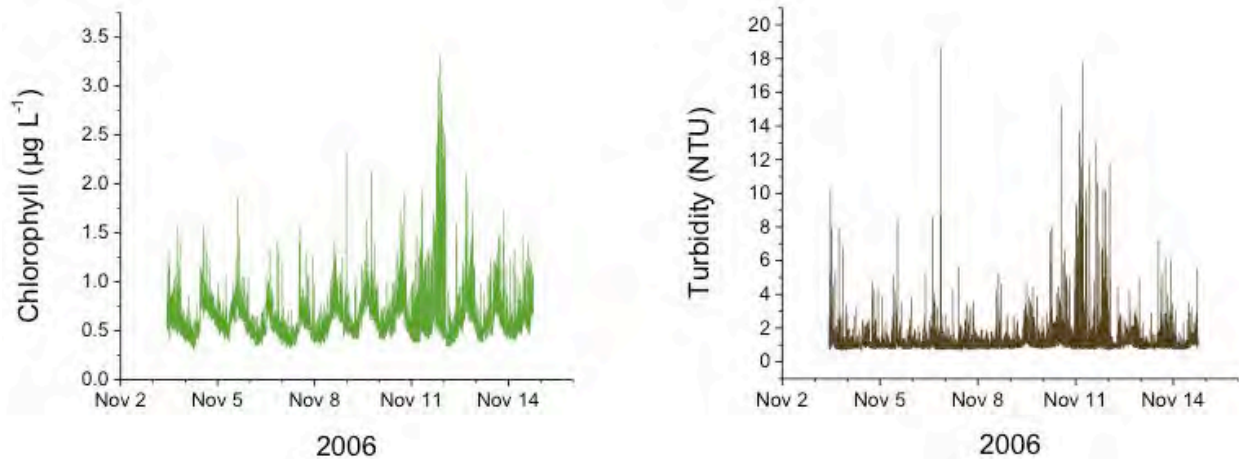


Figure 98. Black Point chlorophyll (left) and turbidity (right) record (16 m depth).

Chlorophyll & Turbidity. Chlorophyll tends to be high at Black Point, likely due to inputs of land-based nutrients that fuel pelagic productivity. There also exists a very prominent tidal signature that reflects switching source currents at the reef.

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 appearance of SCTLD in 2019 and a thermal stress event caused about a 30% decline in coral cover. The sponge community was damaged and cover lost in the major hurricanes of 2017 (Gochfeld et al. 2020), with slow recovery thereafter. 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. In 2019 bleaching prevalence and extent was elevated. Prior to the appearance of stony coral tissue loss disease, 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.

SITE SUMMARIES

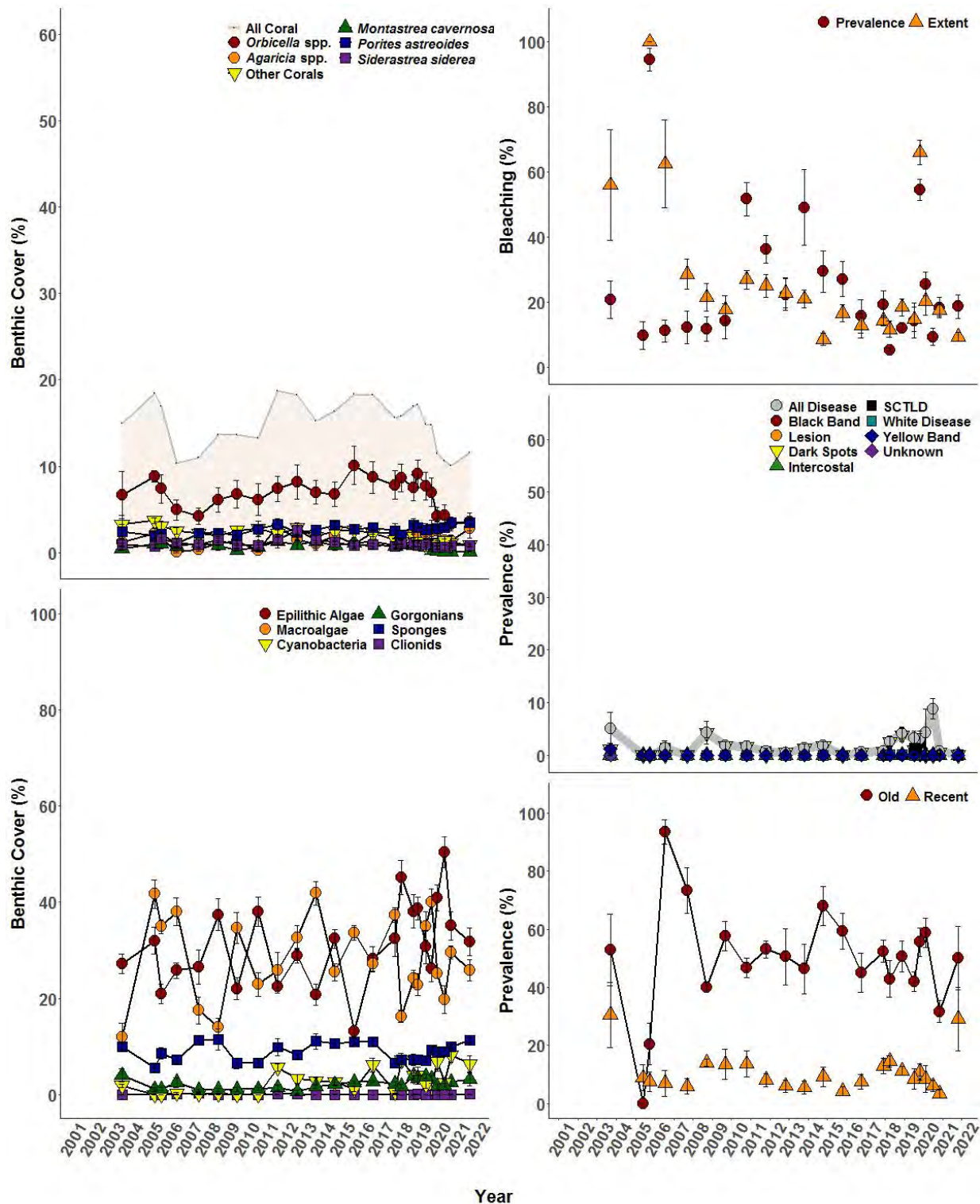


Figure 99. Black Point benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Black Point fish abundance is highly dominated by herbivores. Juvenile parrotfish, wrasse and damselfish are numerous. Brown chromis and schools of creole wrasse are equally abundant in the turbid, plankton filled water. In 2018 a very large school of southern sennets shared the water column with these planktivores. The site holds very few large fish, although cubera snapper, Nassau grouper, and yellowfin grouper have been recorded in TCRMP surveys over the years. These rare fish are normally observed near the eastern edge of the site where the reef is undercut and caves have formed. Mutton snapper are seen regularly on roving dives, cruising the bottom of the reef where it meets the sand/hardbottom plain. Hamlets are especially diverse and numerous on Black Point. In the mid to late afternoon, striped parrotfish (*Scarus iserti*) spawn at the western end of the site. They can be seen swimming along the reef edge in large groups beginning in the early afternoon. Spawning goes into the late afternoon and involves tens of fish. Black Point is close to shore and is not fished by commercial traps often; however, like Brewers Bay reef, divers can swim to the site from the public beach to spearfish. It is notably lacking resident large fish.

SITE SUMMARIES

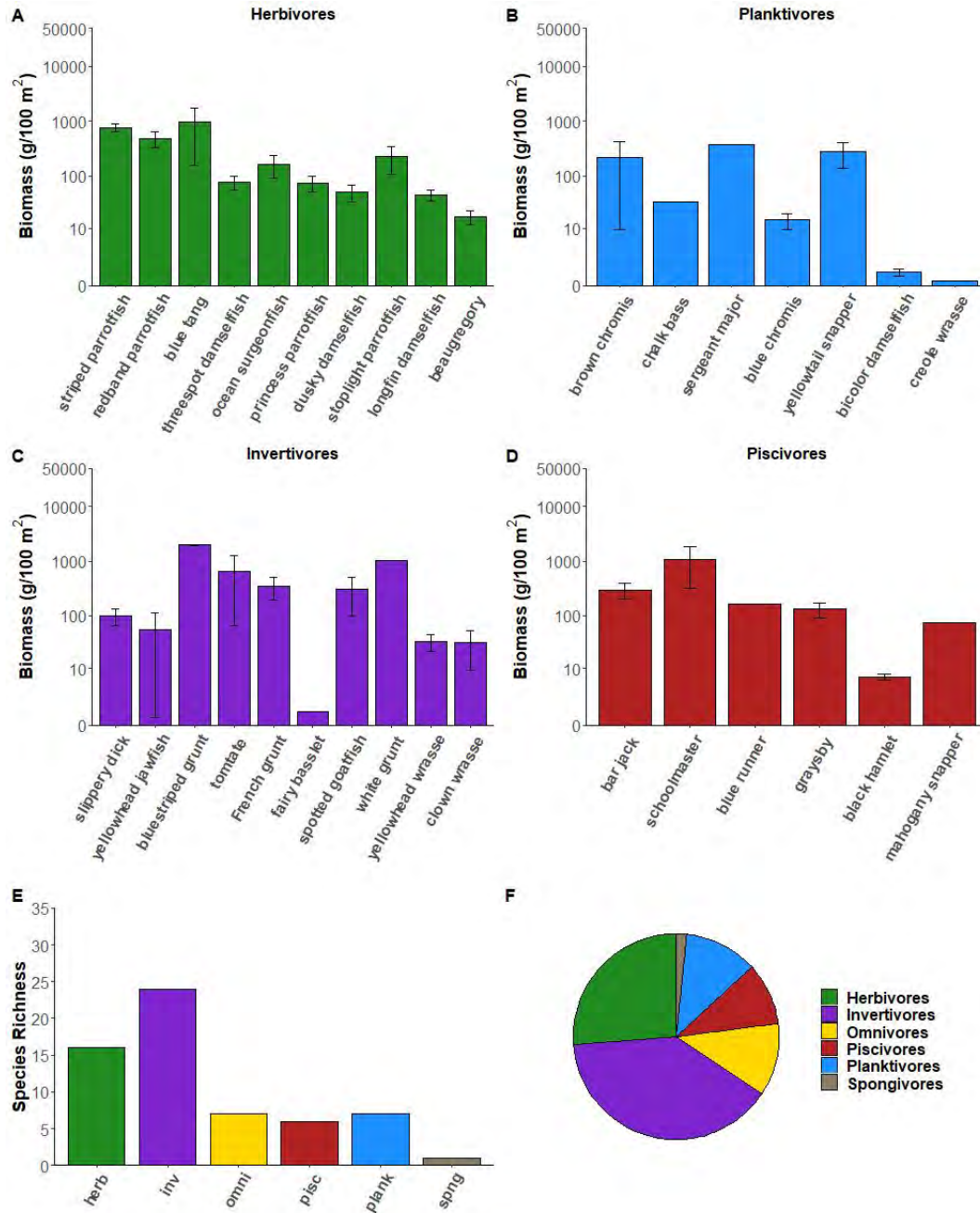


Figure 100. The Black Point fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

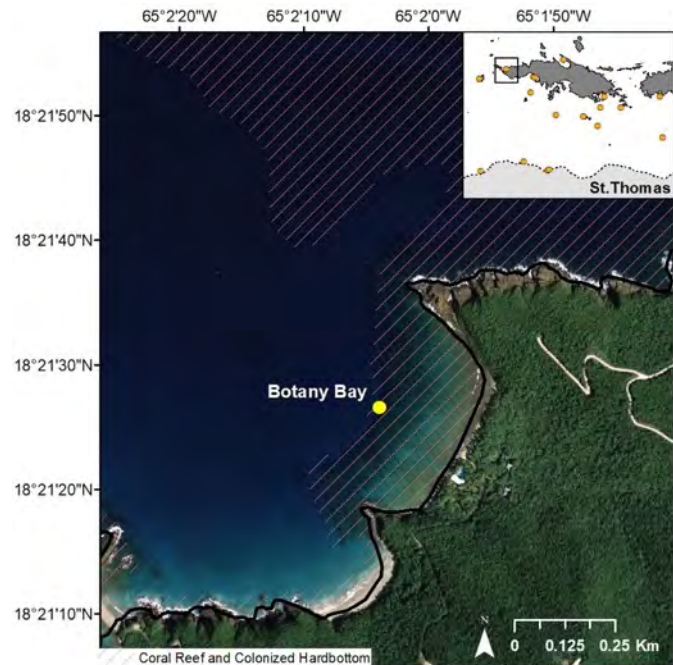
BOTANY BAY

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.

Threats. Botany Bay is threatened by development of the previously fully vegetated watershed and increased land-based sources of pollution. Cuts in the hillsides for construction of roads for luxury homes has left large areas without vegetation. 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 101. Botany Bay. (top) Location. (right) A representative photo of the reef.



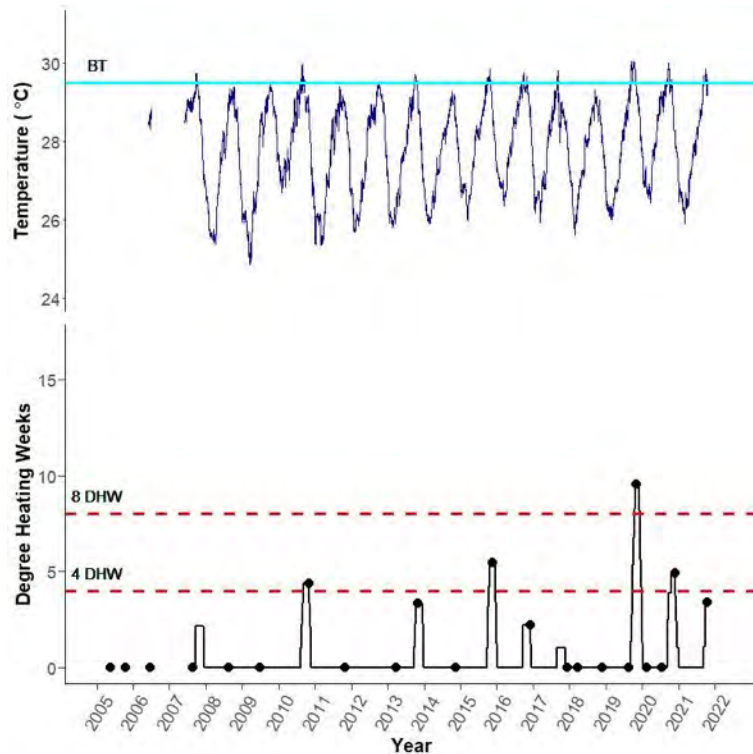


Figure 102. Botany Bay benthic temperature record (11 m depth).

Physical Characteristics.

Current. Currents have not been measured 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 (Bright et al. 2016).

Temperature. Botany Bay tends to have slightly cooler temperatures than other nearshore sites, likely owing to its open position facing the Atlantic.

Figure 103. A large colony of pillar coral (*Dendrogyra cylindrus*) 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 porites*. The site lost 38.9% of its coral cover in the 2005 bleaching event and had regained 10.6% by 2011. However, beginning in 2015 coral cover began to decline at this site for unknown reasons, but potentially related to sediment impacts from development. Botany Bay was heavily impacted by the passage of Hurricane Irma just to the north of St. Thomas on September 6th, 2017. The *P. porites* fields were stripped and *Orbicella* spp. colonies were dislodged or removed. SCTLD was first encountered here in 2019 and has continued to impact coral cover. 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. Even though not indicated by records of thermal stress, the site showed elevated prevalence and extent of bleaching in 2019. 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. SCTLD and lesions likely associated with SCTLD reached over 10% prevalence in 2019 and 2020. 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 planifrons* and *S. adustus*; data not shown).

SITE SUMMARIES

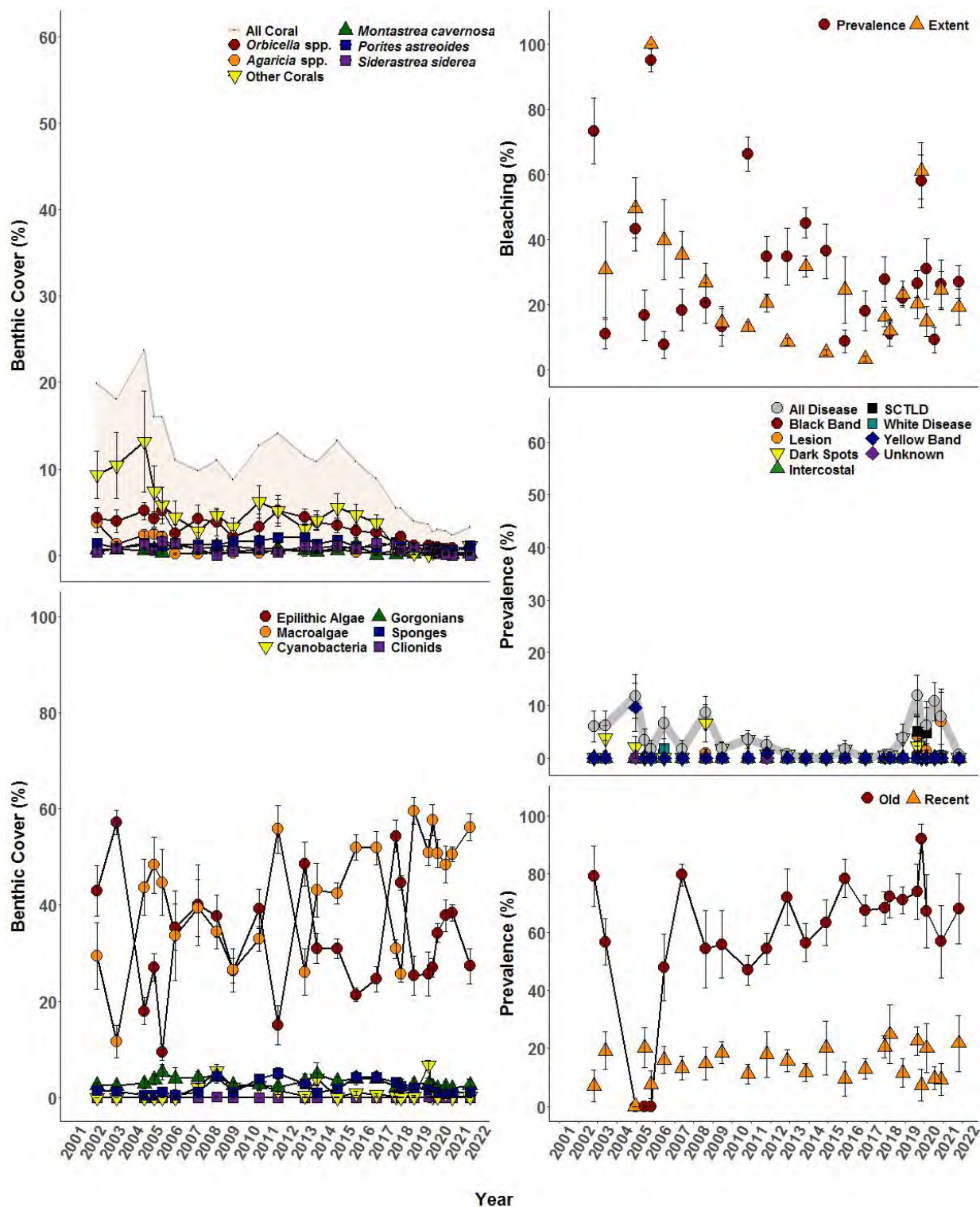


Figure 104. Botany Bay benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The fish community at Botany Bay is fairly typical of well-developed nearshore reefs around St. Thomas. The site is dominated by herbivores, equally split between the four common nearshore parrotfish species (stoplight, queen, redband and striped). In recent years, fish diversity and biomass has declined in Botany Bay, probably due to the continued degradation of the reef. In 2017, however, Nassau grouper were recorded at the site. Historically red hind and dog snapper contributed to the piscivore trophic guild; however, in recent years the major piscivores have been limited to graysby, coney and bar jacks. Coney are especially numerous in Botany Bay. The abundance of yellowtail snapper has also declined, and planktivores are now limited primarily to small chromis and damselfishes. Grunts and wrasses are numerous and diverse at the site, utilizing the variety of resources available for invertivores. Like most of the nearshore reefs in the northern USVI's, large jacks and mackerels are nearly absent from the site.

SITE SUMMARIES

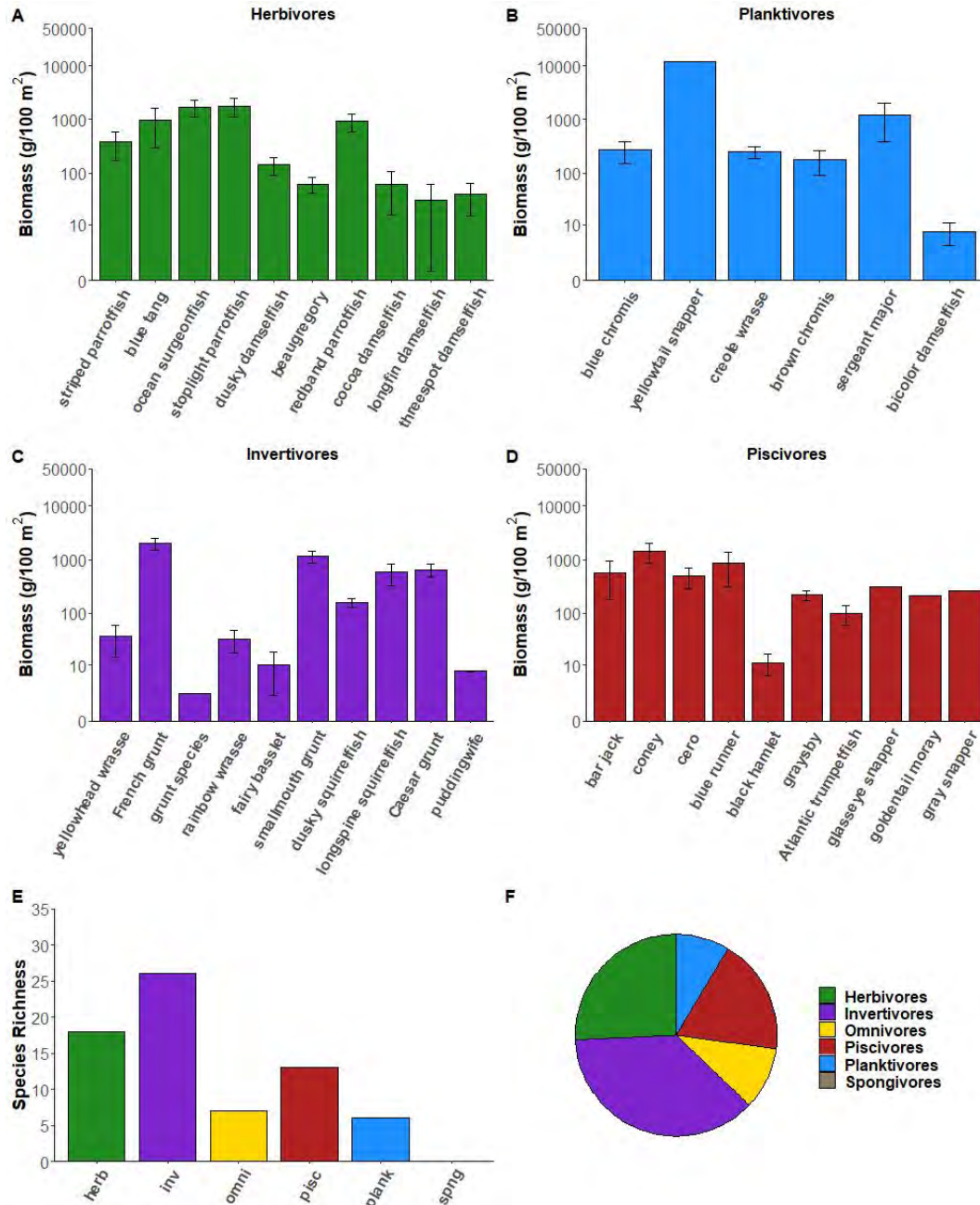
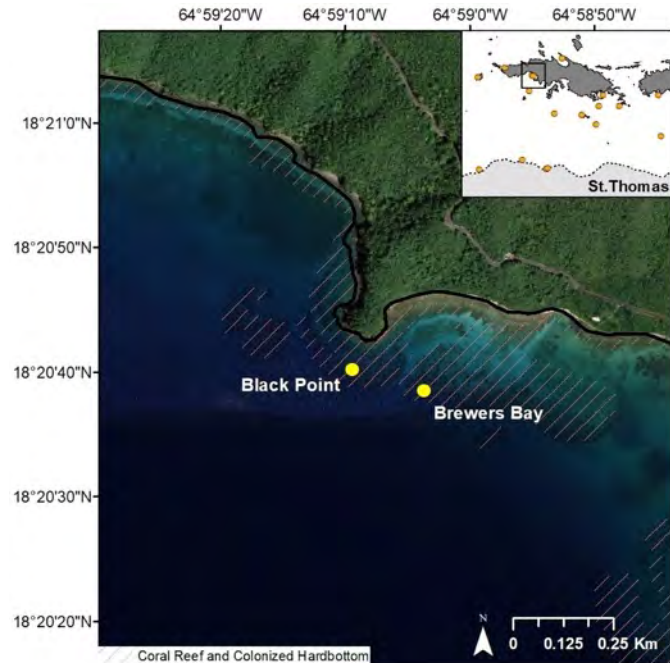


Figure 105. The Botany Bay fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

BREWERS BAY

Description. Brewers Bay is a nearshore fringing reef located along the southwest coast of St. Thomas in water depths of 7 – 17 m. Brewers Bay is a very well-developed 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 restarted in 2008 because it was resistant to the 2005 bleaching is one of the best preserved *O. annularis* reefs around St. Thomas.



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



SITE SUMMARIES

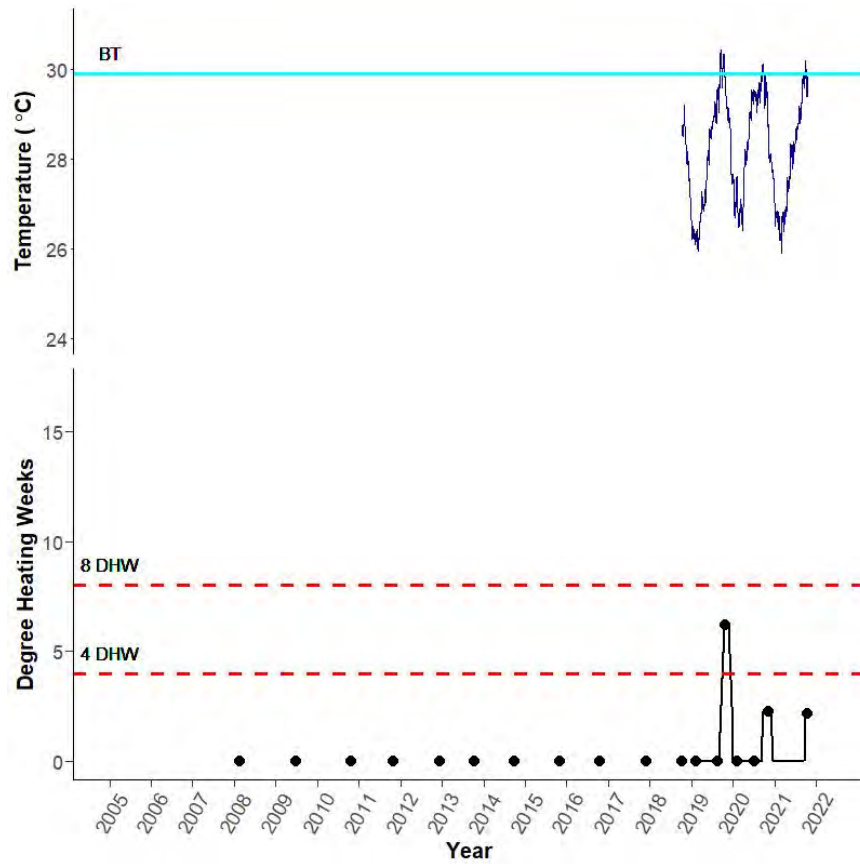


Figure 107. Brewers Bay benthic temperature record (8 m depth).

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 500 m distance.

Temperature. Brewers Bay temperatures began to be recorded in 2018, but previous records from Black Point are a decent proxy for historical temperatures. The site is also co-located with a physical oceanography monitoring station of the National Coral Reef Monitoring Program.

SITE SUMMARIES

Benthic Community. The Brewers Bay site is highly dominated by the boulder coral *Orbicella annularis* and exhibited the highest coral cover of any nearshore site in the TCRMP, with a coral cover of 32% in 2013. 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. Recently coral cover has declined dramatically with the arrival of SCTLD and bleaching in 2019. This disease has already caused a catastrophic decline in coral cover from 30% in 2018 to 9.8% by February 2020. 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 2019 there was high prevalence of high extent bleaching. 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. The 2019 monitoring period saw the emergence of SCTLD at the Brewers Bay reef and impacts at the monitoring site were extremely severe. The prevalence of lesions likely associated with SCTLD and recovery from heat stress surpassed 35%. 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).

SITE SUMMARIES

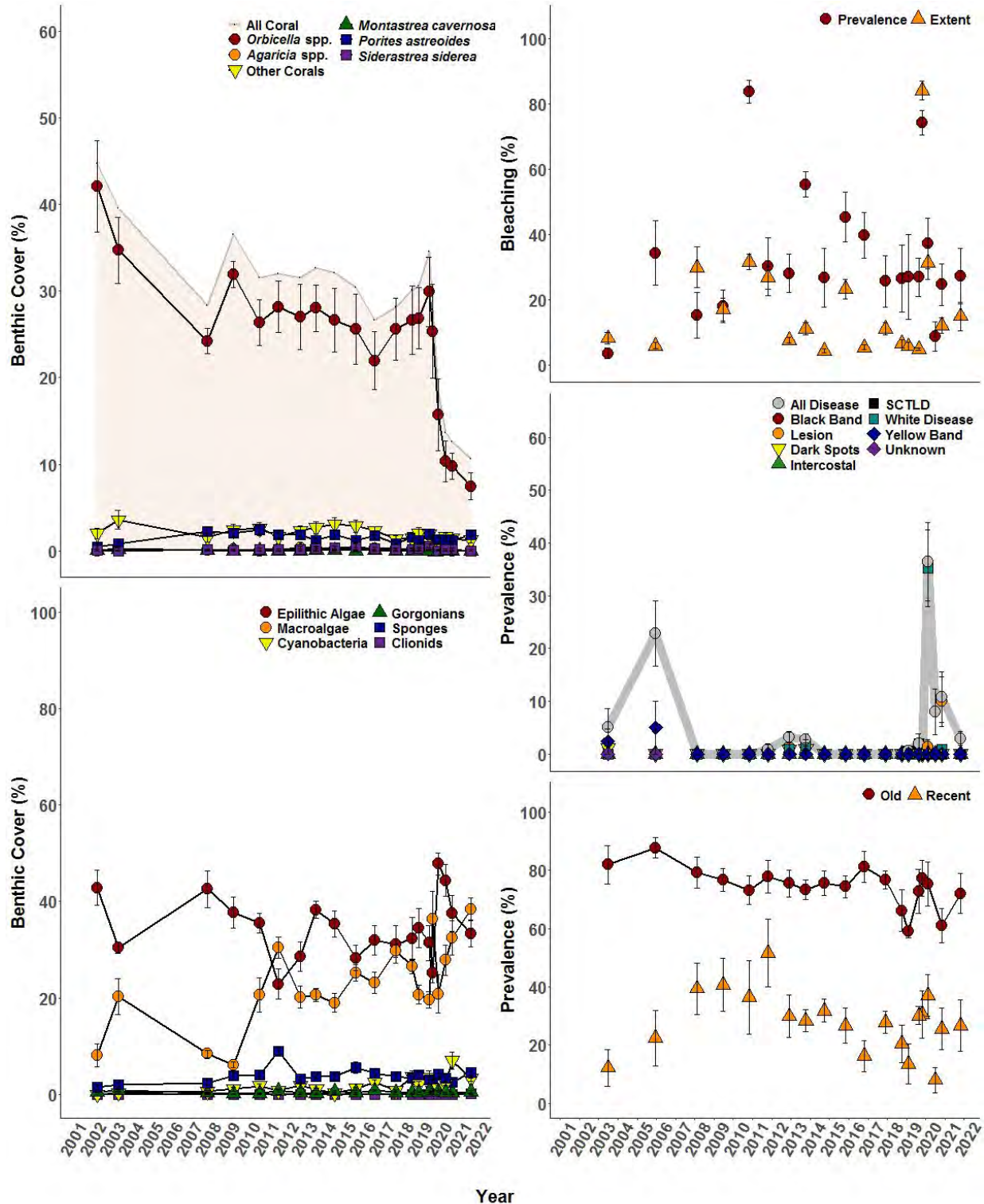


Figure 108. Brewers Bay benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Brewers Bay is characterized by a high fish abundance dominated by herbivores. The site holds large numbers of parrotfish. Numerically, the herbivores are dominated by juvenile striped parrotfish that swim over the reef in groups of mixed parrotfish, acanthurids and wrasse. Both yellowhead and bluehead wrasse are prolific and school with the juvenile parrotfish. There are also larger stoplights and queen parrotfish grazing the reef. 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, mutton, and cubera) are sighted on the reef periphery or around large coral heads. The reef is spearfished regularly, so these sightings are becoming more and more rare. Nassau, black, and yellowfin grouper and the now rare blue and rainbow parrotfish were present in Brewers Bay forty years ago (Rogers 1982). Nassau and yellowfin grouper are rarely seen at the reefs today; the other species are no longer observed.

SITE SUMMARIES

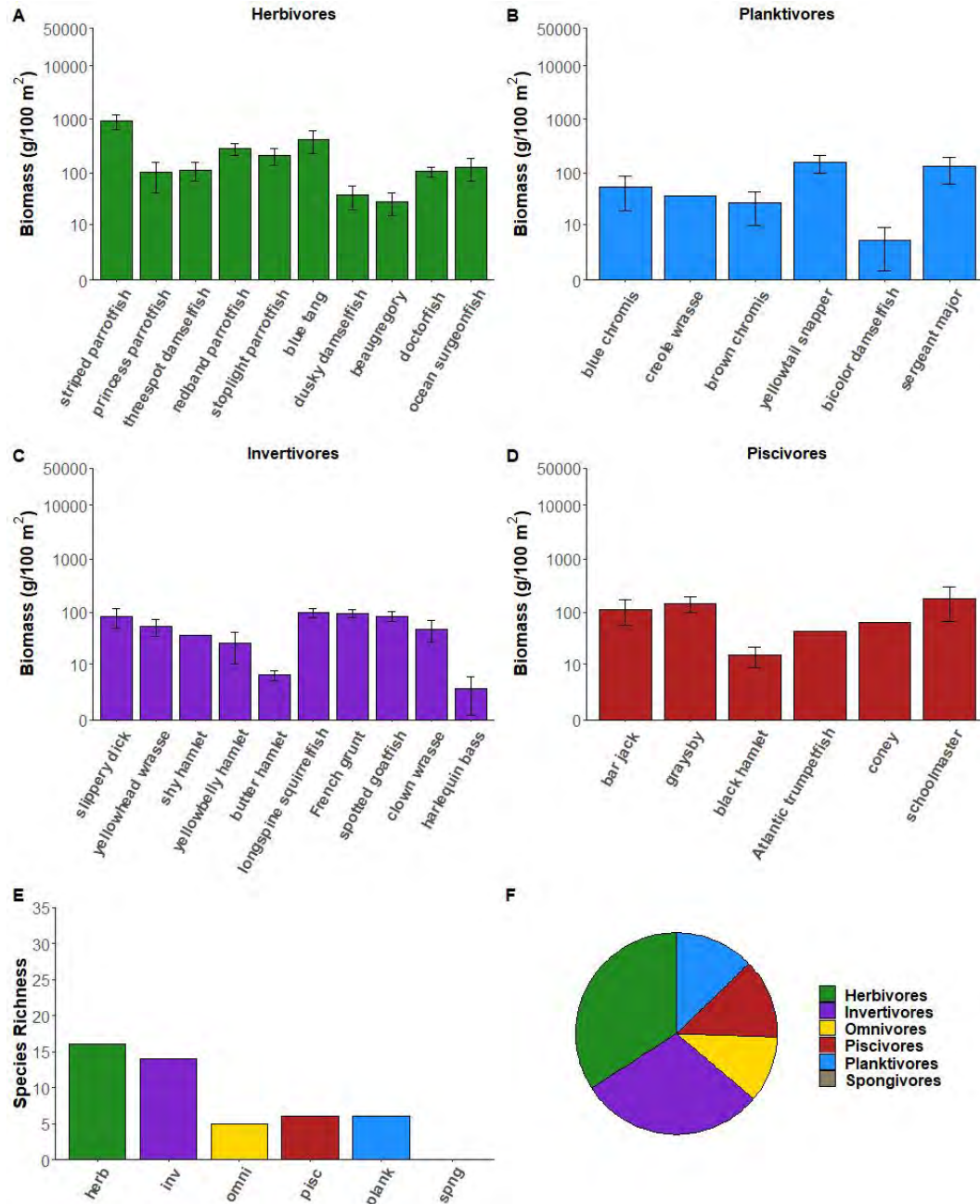
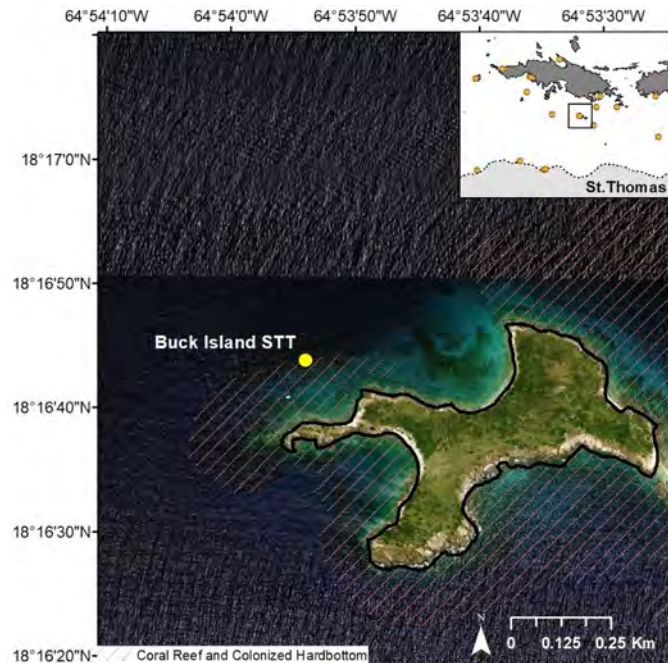


Figure 109. The Brewers Bay fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

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



SITE SUMMARIES

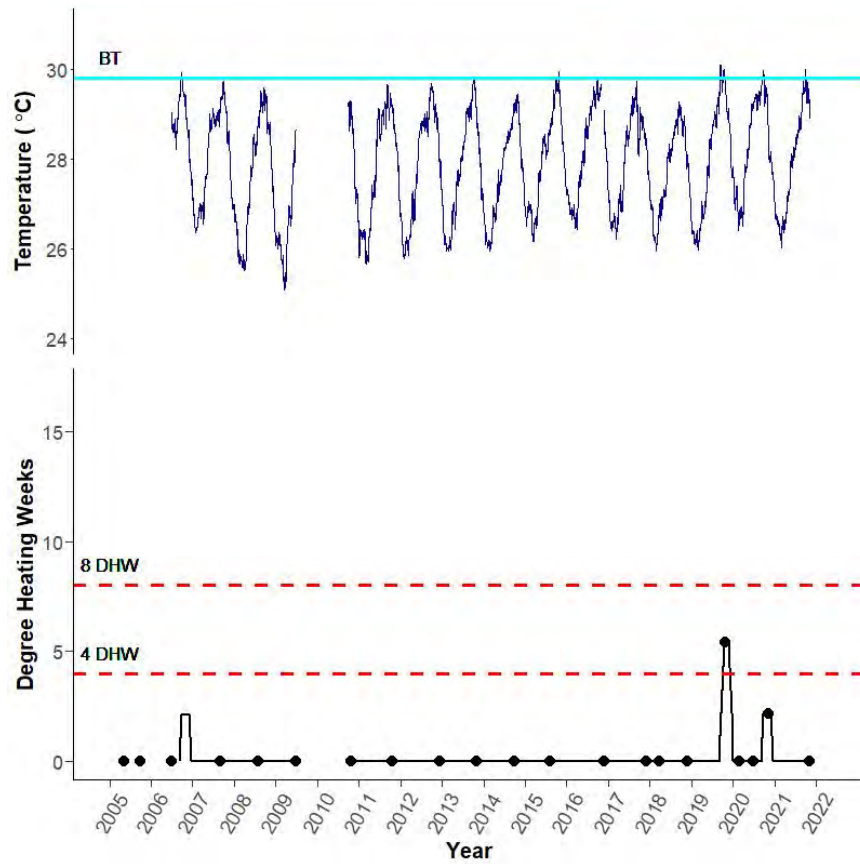


Figure 111. Buck Island, St. Thomas benthic temperature record (12 m depth).

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, causing a gap in data.

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. Coral cover again dipped with the arrival of SCTL in 2019, but not as severely as at other sites. Among sessile epibenthic animals a high proportion of the community is composed of sponges. The algal community is dominated by epilithic the macroalgae *Dictyota* spp. and *Lobophora variegata*, which are in very high abundance. Typical macroalgal cover is about 50%, but it reached 70% after Hurricane Irma on September 6, 2017 and largely the result of increases in *Dictyota*. *Ramificrasta* spp. is also a very significant space occupier on the upper slope just south of the site, and may be becoming more common in the TCRMP transects. Filamentous cyanobacteria can also be abundant at times.

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. A similar prevalence of bleaching was evident in 2019, but at a higher 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. In 2019 SCTL reached the monitoring site. Old partial mortality increased rapidly after the 2005 bleaching event and then declined steadily in following years.

SITE SUMMARIES

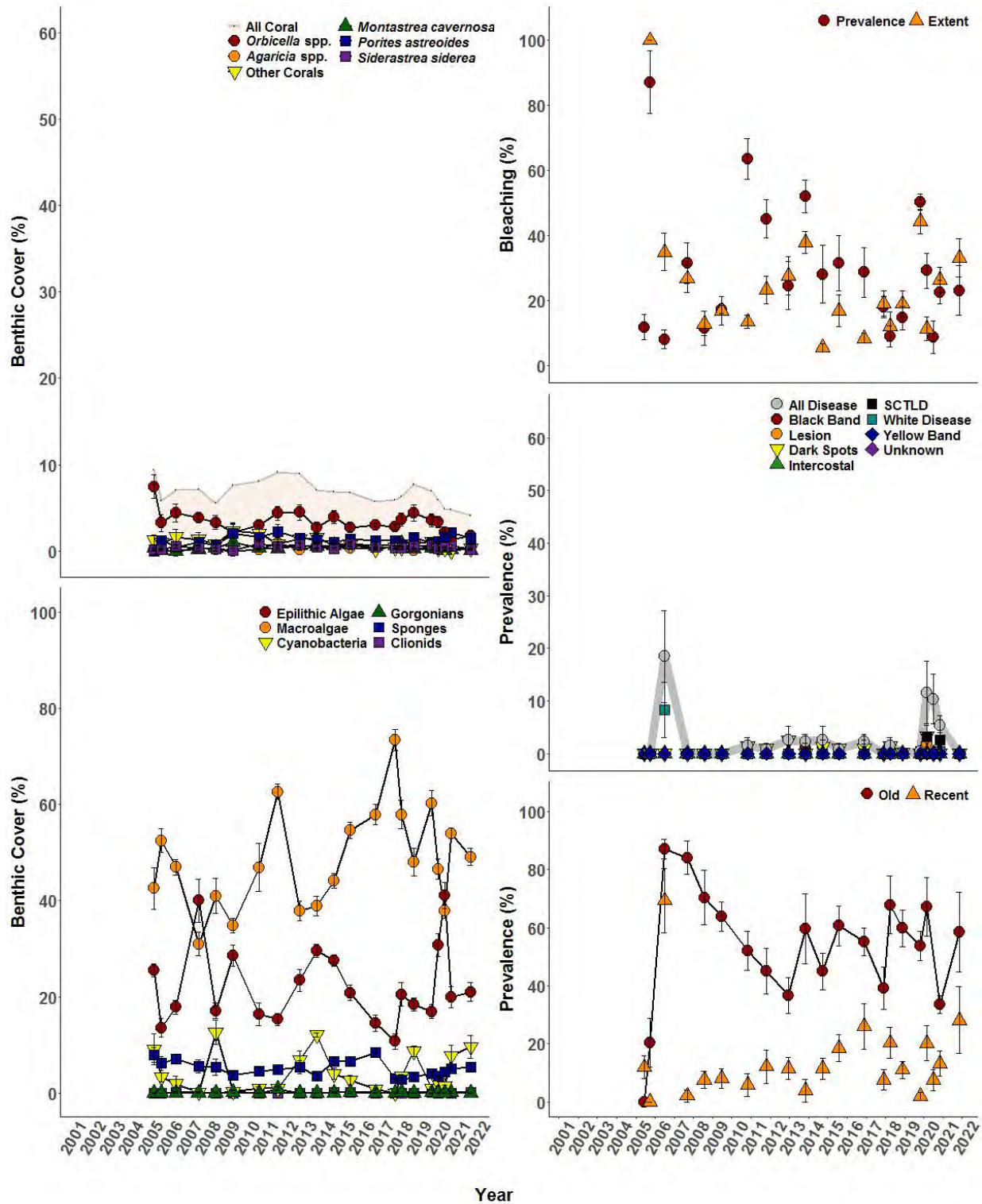


Figure 112. Buck Island, St. Thomas benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The fish community at Buck Island, St. Thomas is very diverse and represents the utilization of many habitats and resources. The site is dominated in biomass by planktivores, primarily yellowtail snapper and creole wrasse. Tourists and commercial dive operators feed fish at Buck Island and gregarious yellowtail snapper are large and numerous. Herbivores are represented by large stoplight parrotfish as well as the other common parrotfish species, blue tang and ocean surgeonfish. Invertivores are diverse and very common. Both spotted and yellow goatfish roam the top of the reef and large wrasses, including the Spanish hogfish and puddingwife, are prolific. In addition to goatfish and wrasses, a variety of grunts inhabit the Buck Island Reef, including French, white, bluestriped, Ceasar, tomtate, and cottonwick. Schoolmaster, grey and mahogany snapper dominate the piscivores community on the site. Occasional pelagic jacks (yellow, almaco and bar) swim in the water column above. Seaward of Buck Island the reef has a steep 10m drop to a sand plain below and numerous species of fish can be seen swimming this deep reef edge including jolthead and saucereye porgies, mutton snapper, white and black margates and Caribbean reef sharks. Two Nassau grouper were observed in belt transects in 2018. No other large groupers have been observed at Buck Island. 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.

SITE SUMMARIES

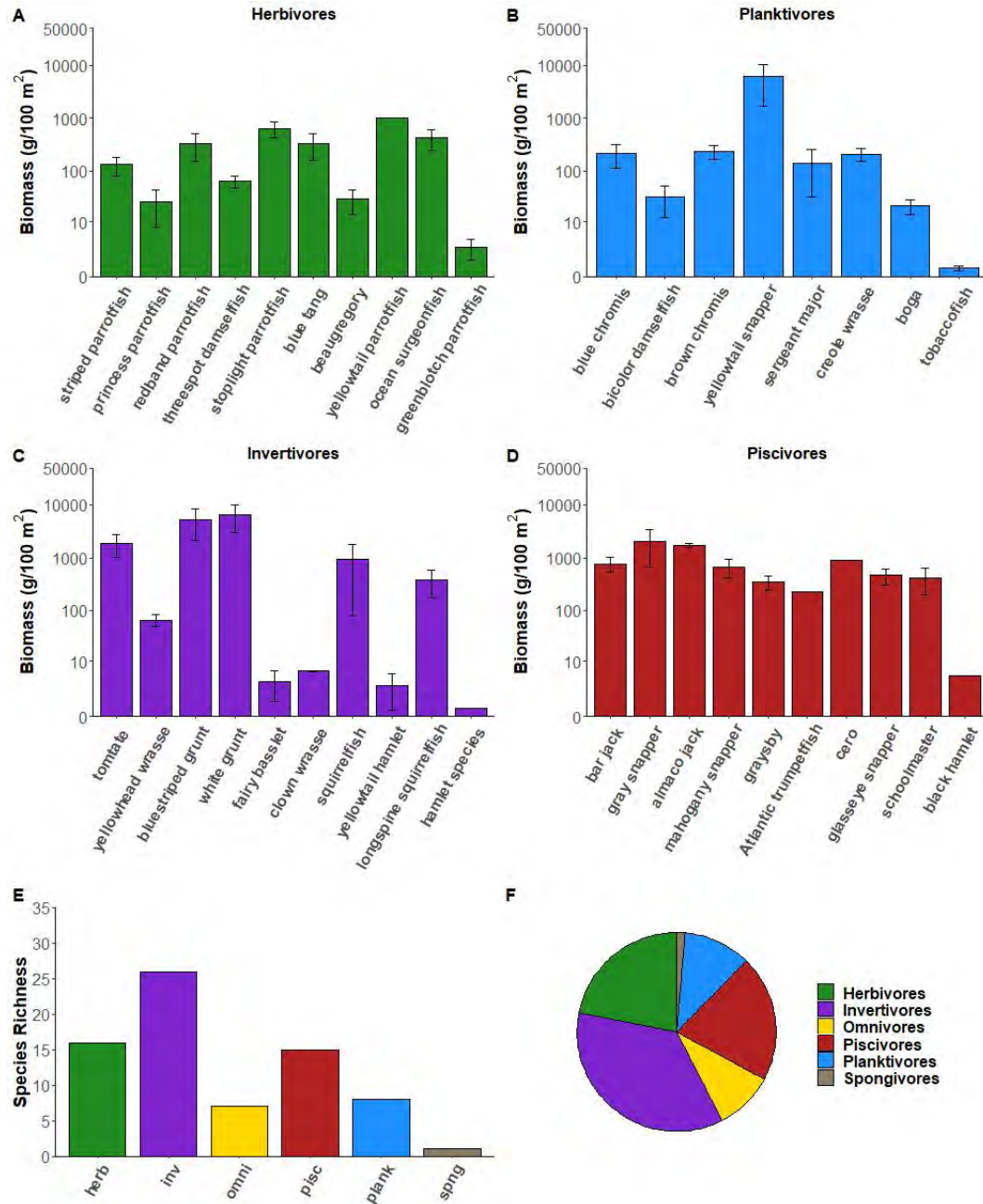
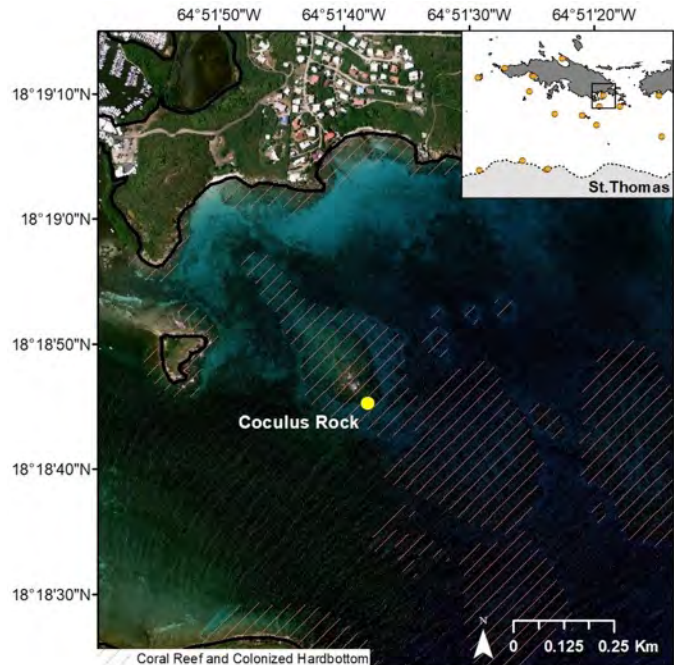


Figure 113. The Buck Island, St. Thomas fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

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 yellowfin parrotfish (*Sparisoma rubripinne*). These 100+ fish engage in daily afternoon mating at southeast reef corner. A ciguatera study with monthly sampling was conducted from 2009 - 2017.

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

Figure 114. Coculus Rock. (top) Location. (right) A representative photo of the reef showing the aggregation of yellowfin parrotfish.



SITE SUMMARIES

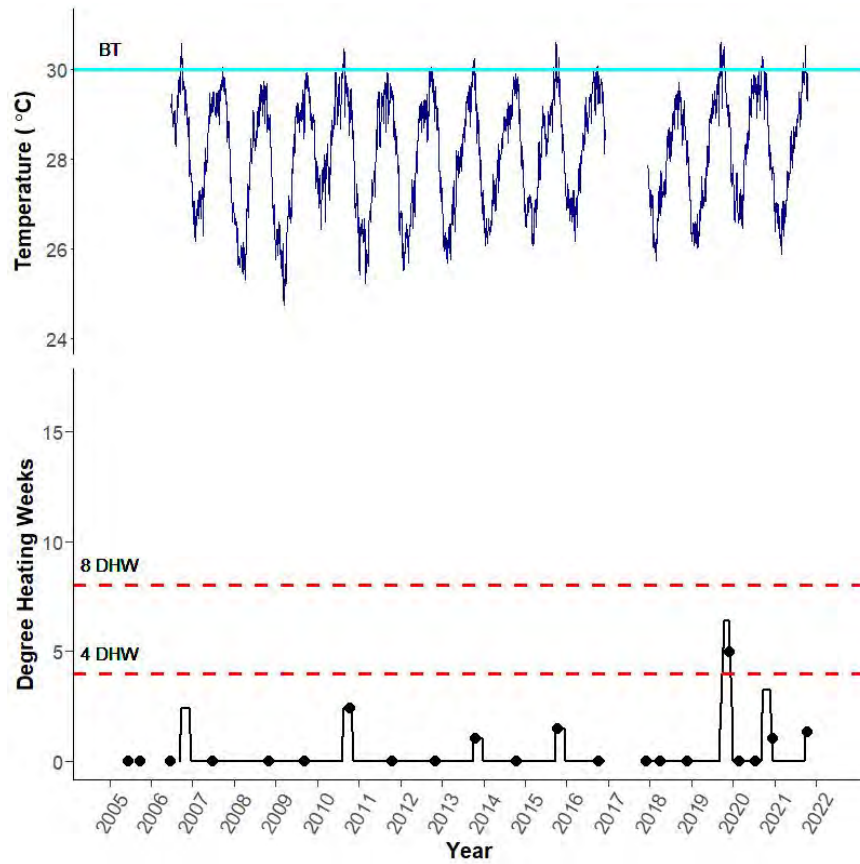


Figure 115. Cocus Rock benthic temperature record (7 m depth).

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. The site sensor was lost in September 2017 hurricanes causing a gap in the record.

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. This location has lost about 44% relative coral cover (2019 – 2021) since the arrival of Stony Coral Tissue Loss Disease. 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-morphology species that tend to be less susceptible to bleaching (Smith et al. 2013b). A modest prevalence of low extent bleaching was also evident in the 2010 coral bleaching event, whereas in 2019 the bleaching response was indistinguishable from years without heat stress. 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. SCTLD had reached the site in 2020 but the impacts are ongoing. 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.

SITE SUMMARIES

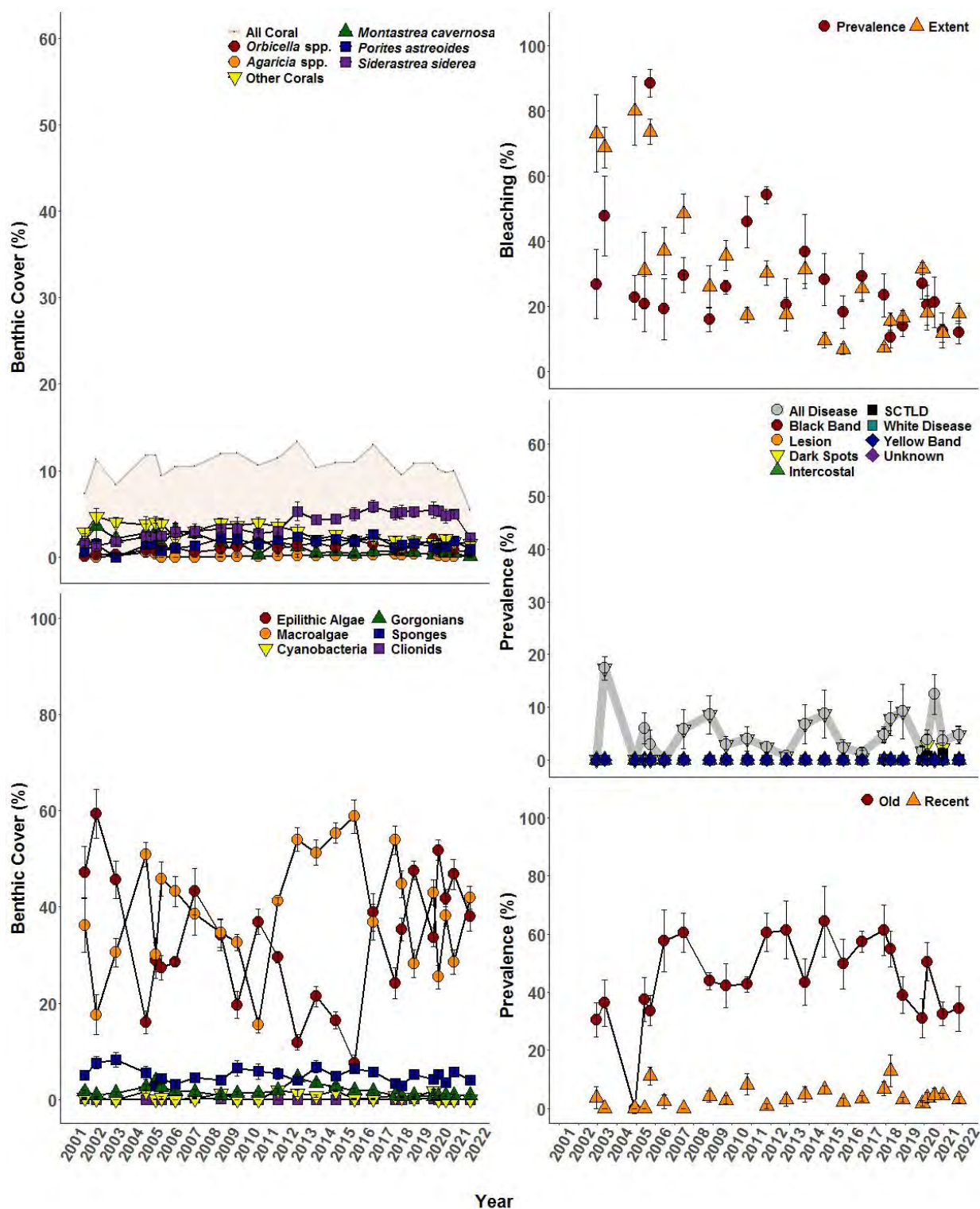


Figure 116. Cocus Rock benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The Cocus Rock fish community is interesting in several ways. It represents an inshore promontory that serves as an aggregation and spawning site for yellowtail parrotfish (*Sparisoma rubripinne*) in the afternoon, apparently year-round. The top of the bedrock reef, emergent at points, is turbid and rough with breaking waves, but large parrotfish, jacks, doctorfish, and damselfishes swim in the milky, turbulent water. At the bottom of the rock promontory, where coral and bedrock meet the sand, small ledges run along the southeast edge of the reef. Red hind and an occasional Nassau grouper have been observed hiding in the dark of the undercut. There are generally a dozen or more juvenile lobster using the ledges as well. Juvenile grunts can be particularly common at Cocus Rock, “hanging” in large schools on and under limestone rocks and ledges on the western side of the site. Otherwise the fish community inhabiting the steep walled rock and algae covered limestone site is primarily wrasses, juvenile parrotfishes, and acanthurids. Except for the occasional red hind or Nassau grouper, piscivores are limited to juvenile schoolmaster, mahogany and gray snappers. The planktivore guild is dominated in biomass by juvenile yellowtail snapper and the invertivore guild is made up of juvenile grunts and a variety of small wrasses. Cocus Rock is part of the territorial Saint Thomas East End Reserve (STEER) and fishes are protected from all harvest year-round.

SITE SUMMARIES

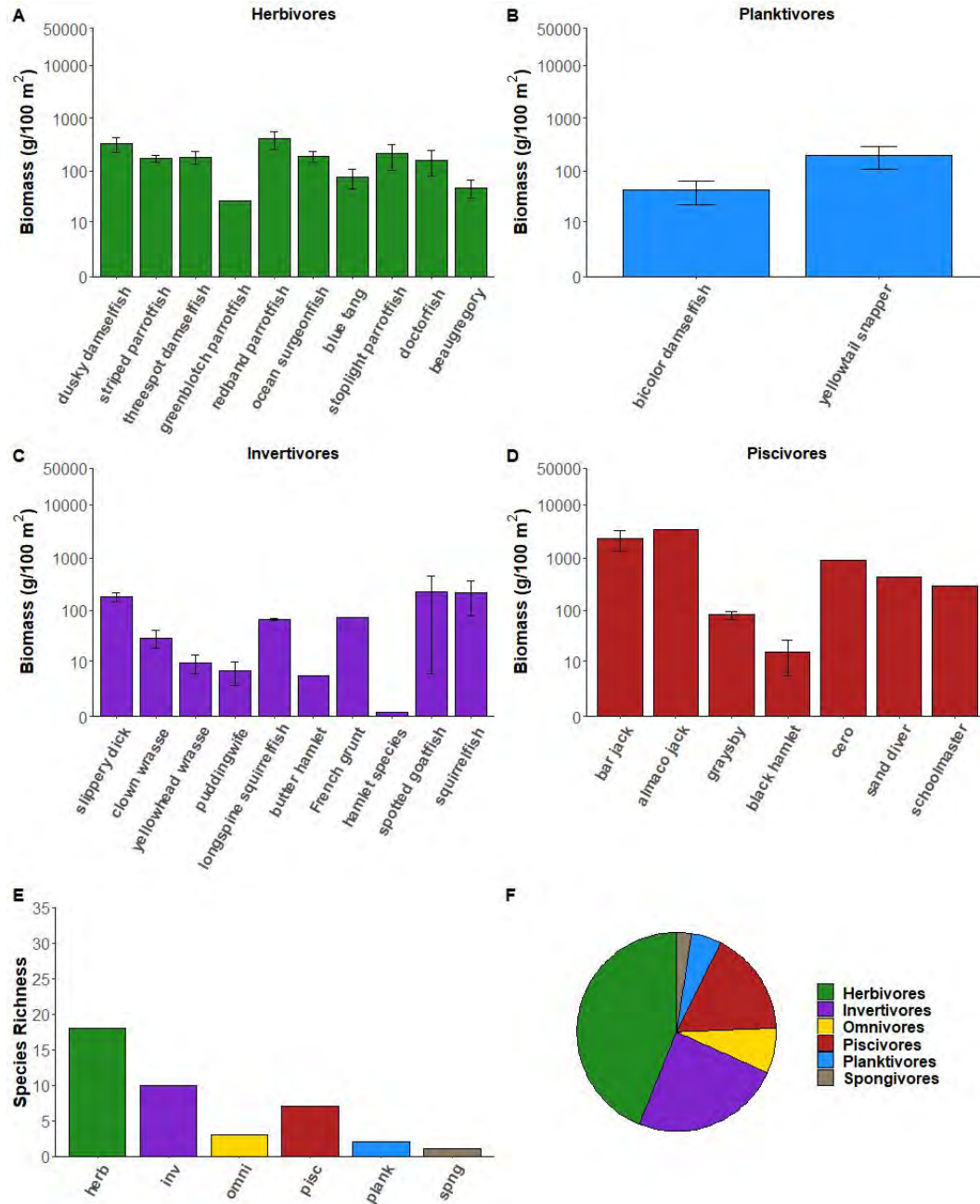


Figure 117. The Cocus Rock fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

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 star corals (*Orbicella* 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*).

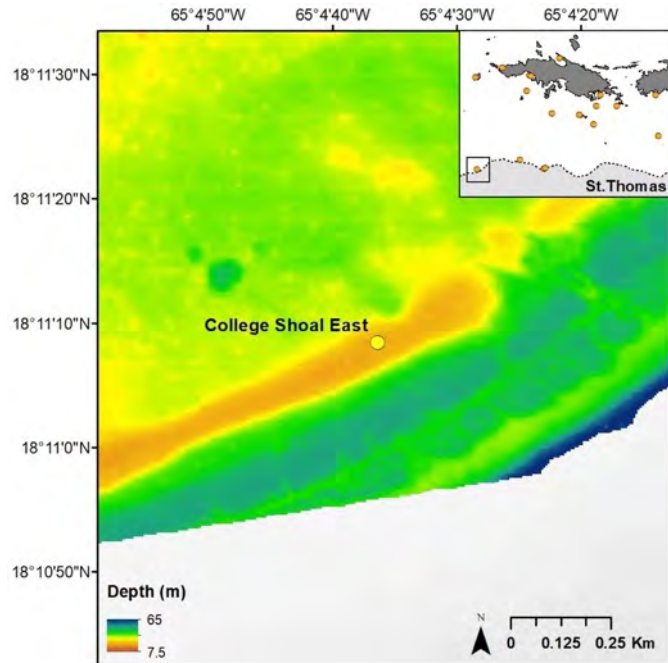


Figure 118. College Shoal. (top) Location. (right) A representative photo of the reef (photo credit: V. W. Brandtneris).



SITE SUMMARIES

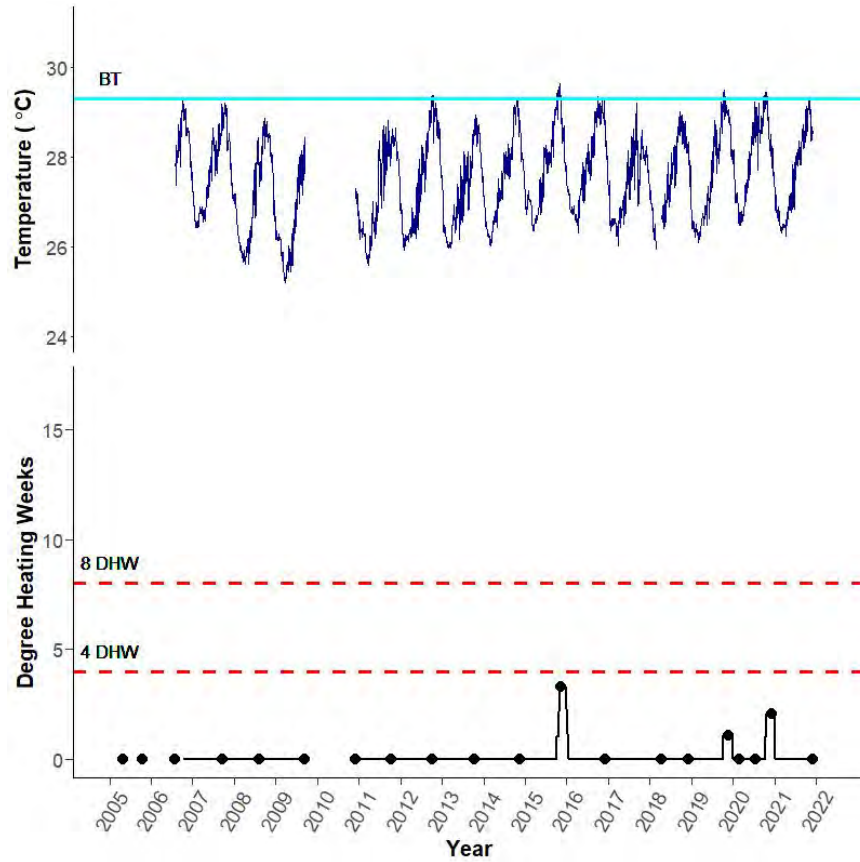


Figure 119. College Shoal benthic temperature record (29 m depth).

Physical Characteristics.

Currents. College Shoal has strong unidirectional driven currents that seem to be tidally driven and follow a pattern of increasing strength during spring tides. Current data has been collected and will be presented in a future report.

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, like 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; however, these estimates have some additional error since transects were not made permanent until 2007. SCTLTD arrived at this site in 2019 and has already contributed to a decline in coral cover from 33% to below 20%. 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. The impacts of SCTLTD were very severe in 2019, with about 25% of colonies displaying disease signs. 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.

SITE SUMMARIES

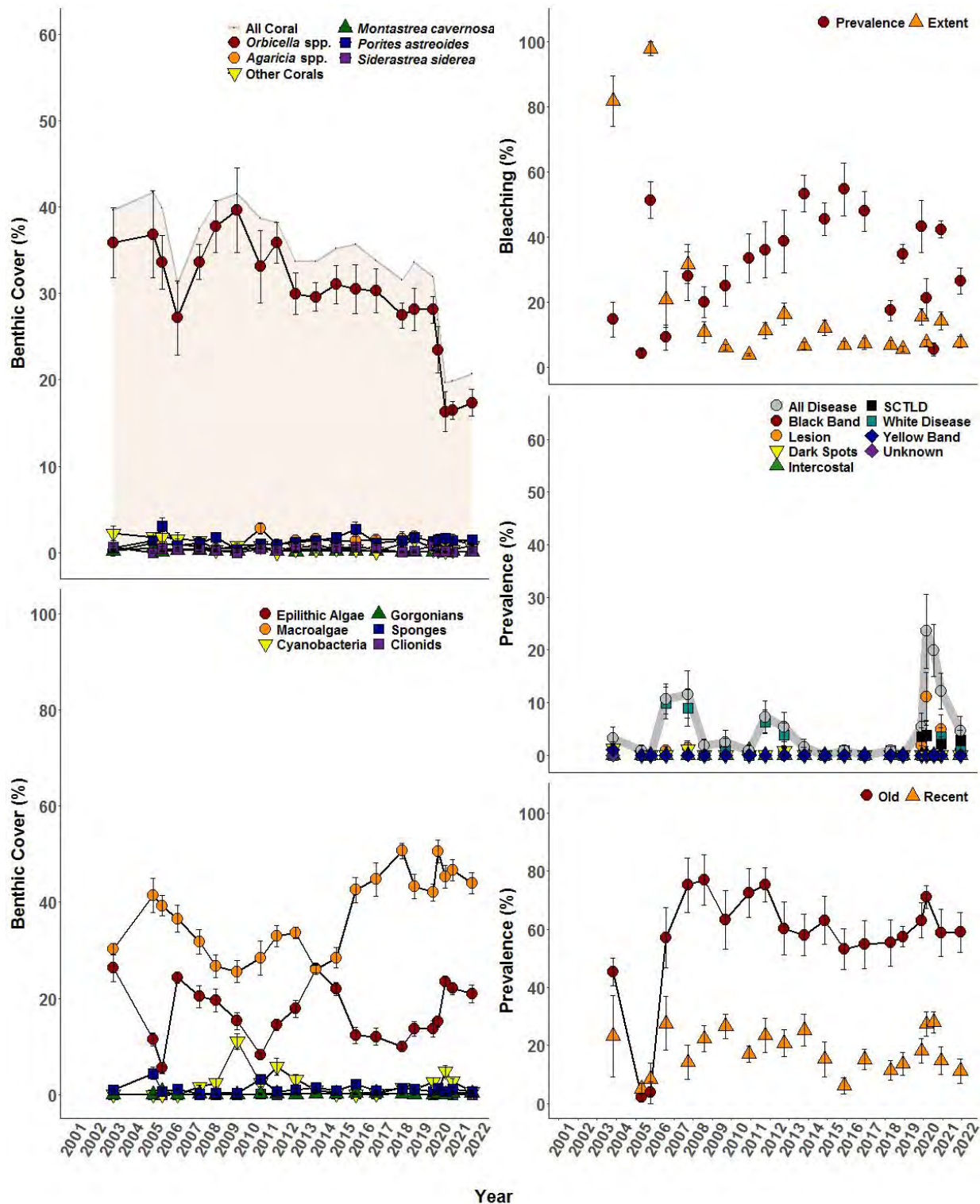


Figure 120. College Shoal benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. College Shoal is characterized by a high overall fish abundance and diversity, and an especially high planktivore biomass. Large planktivorous species including ocean triggerfish, Atlantic spadefish, black jacks, and yellowtail snapper contribute to this biomass, as well as large schools of the smaller creole wrasse and boga. The mesophotic, high coral cover reef supports more herbivores than the deeper Hind Bank FSA and Grammanik Bank FSA sites. This guild is split equally between the common parrotfish species (princess, striped, redband, stoplight and queen) and the blue tang and ocean surgeonfish. Piscivores have a relatively high relative biomass as well, made up primarily of jacks, mackerels, barracuda and large snappers. Invertivores are diverse but contribute much less biomass to the community composition, College Shoal lies within the Marine Conservation District (MCD) and is protected year round from all fishing. Nassau, yellowfin, and yellowmouth grouper are occasionally observed on the site and tiger grouper are seen there regularly.

SITE SUMMARIES

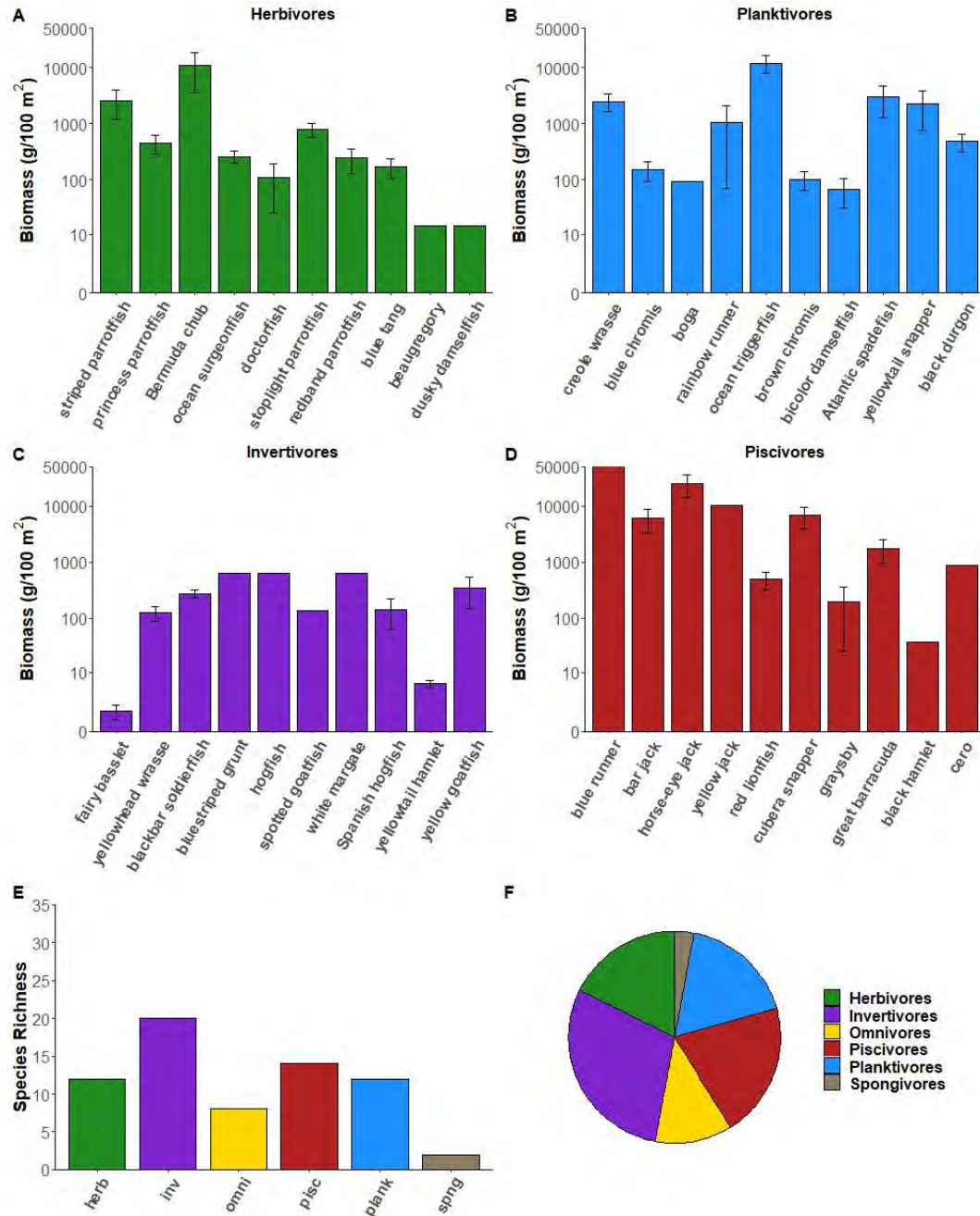


Figure 121. The College Shoal fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

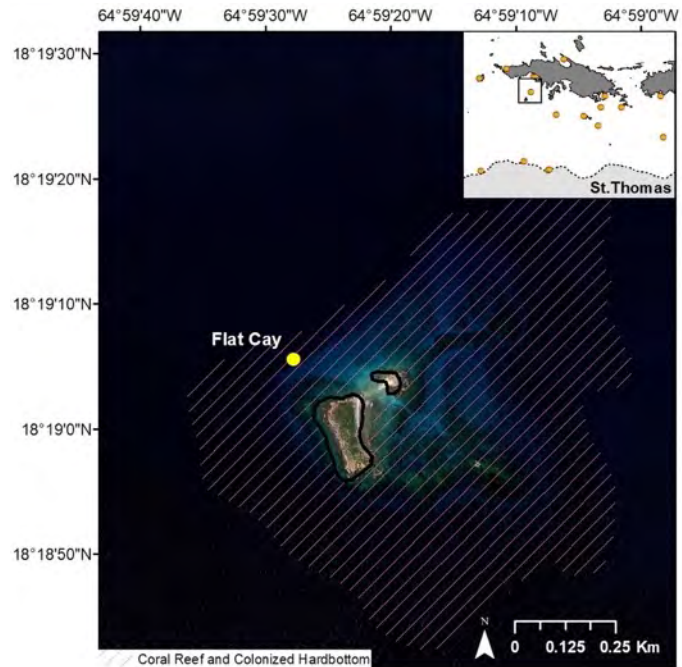
FLAT CAY

Description. This monitoring site wraps around the northwest corner of Flat Cay in depths of 10 – 17 m. Flat Cay has been monitored since 2003, with permanent benthic transects installed in 2007. A ciguatera fish poisoning study with monthly to quarterly 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. This site was the first location where SCTL D was discovered in the USVI (December 2018).

Figure 122. Flat Cay. (top) Location. (right) A representative photo of the reef.



SITE SUMMARIES

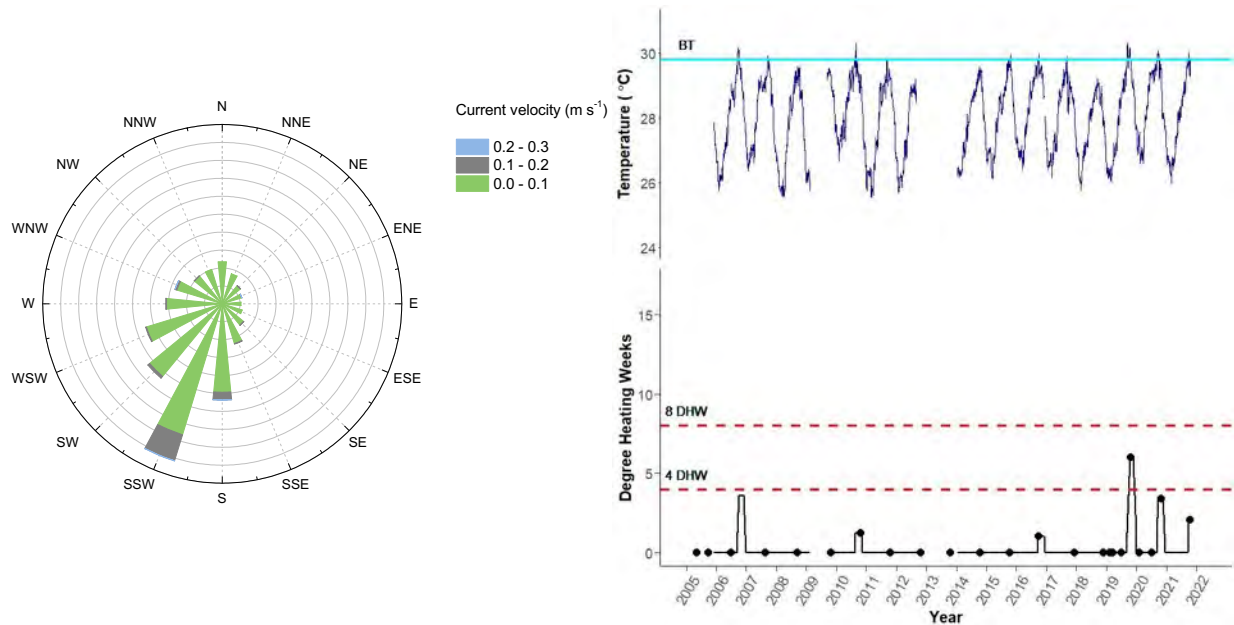


Figure 123. Flat Cay benthic current speed (left) and temperature record (right) (14 m depth).

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. Impact of 2018-2019 SCTL D were catastrophic, with a decline in coral cover from 23% in 2018 to 7% in February 2020. Effects were particularly severe for *Orbicella* spp. 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. Bleaching was relatively severe in 2019, and this may relate to thermal stress combined with SCTL D stress. 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 the Flat Cay site. White disease was somewhat prevalent after the 2005 bleaching. SCTL D and related lesions had a relatively high prevalence in 2019. 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.

SITE SUMMARIES

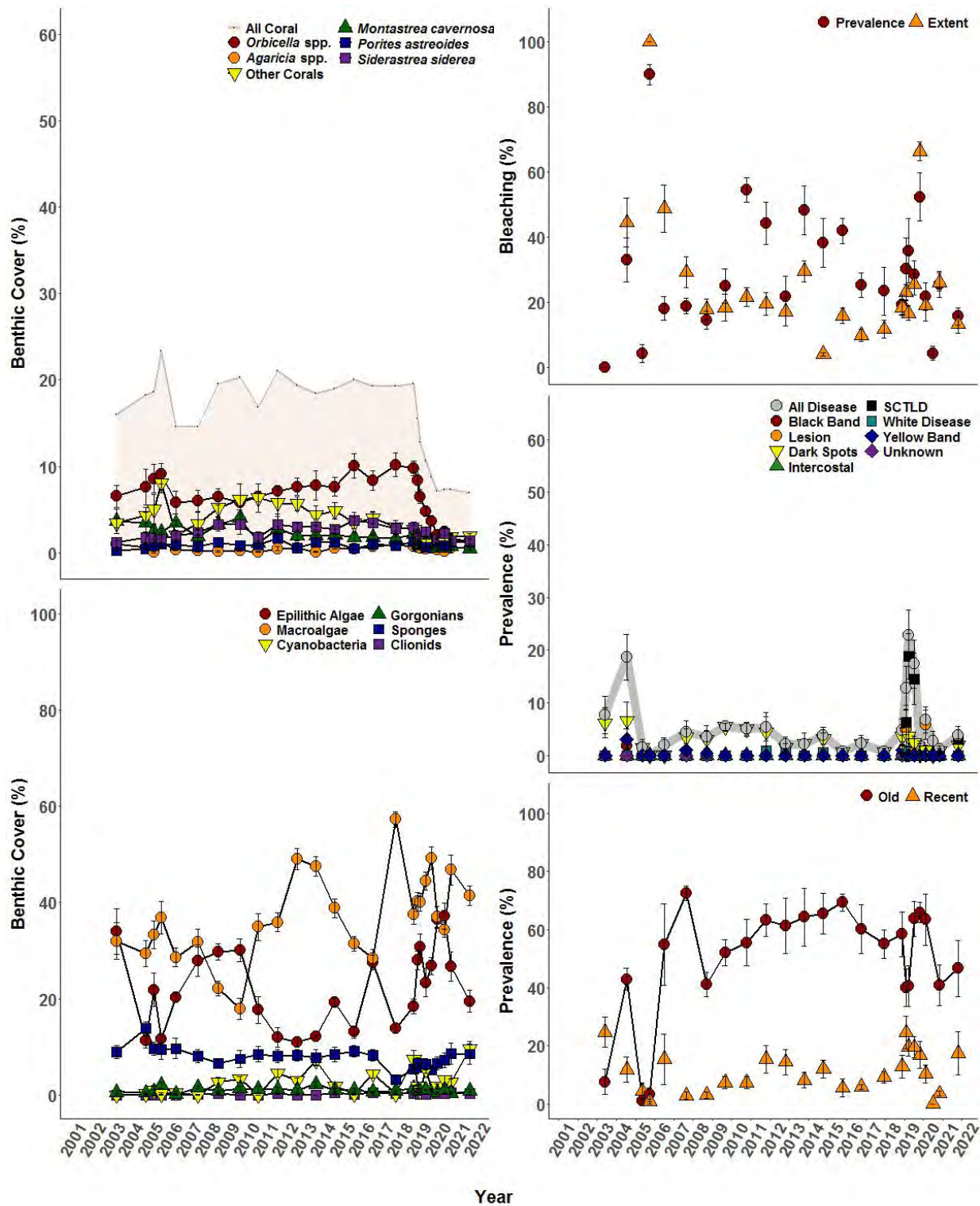


Figure 124. Flat Cay benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Flat Cay is characterized by a large diversity of fish evenly distributed across trophic guilds. There is generally a high biomass of planktivores due to relatively high densities of yellowtail snapper and large schools of chromis and creole wrasse. Invertivores are very diverse and common, reflecting the huge variety of resources available in the sand and hard bottom bordered reef community. Herbivores make a relatively moderate contribution to community composition and are equally represented by the common parrotfishes and acanthurid species. Schools of tiny juvenile parrotfish are prevalent mixed with yellowhead wrasse and juvenile acanthurids across the reef. A variety of jacks frequent the site and dominate the piscivore trophic guild. Very occasional large groupers (Nassau, yellowfin, black) have been observed on Flat Cay over the past eight years. The occurrence of black grouper in 2017 is notable; this species is extremely rare throughout the territory. In 2018 three subadult Nassau grouper were found on the site. Where the reef meets the seaward sand plain, large schools of white, French and blue-striped grunts, as well as gray snapper, squirrelfish, and goatfish swim. Small reef sharks are seen out over the sand regularly and in 2018 a hammerhead was observed cruising the edge of the reef. The Flat Cay reef is heavily used as a recreational dive site and spearfishing occurs there regularly.

SITE SUMMARIES

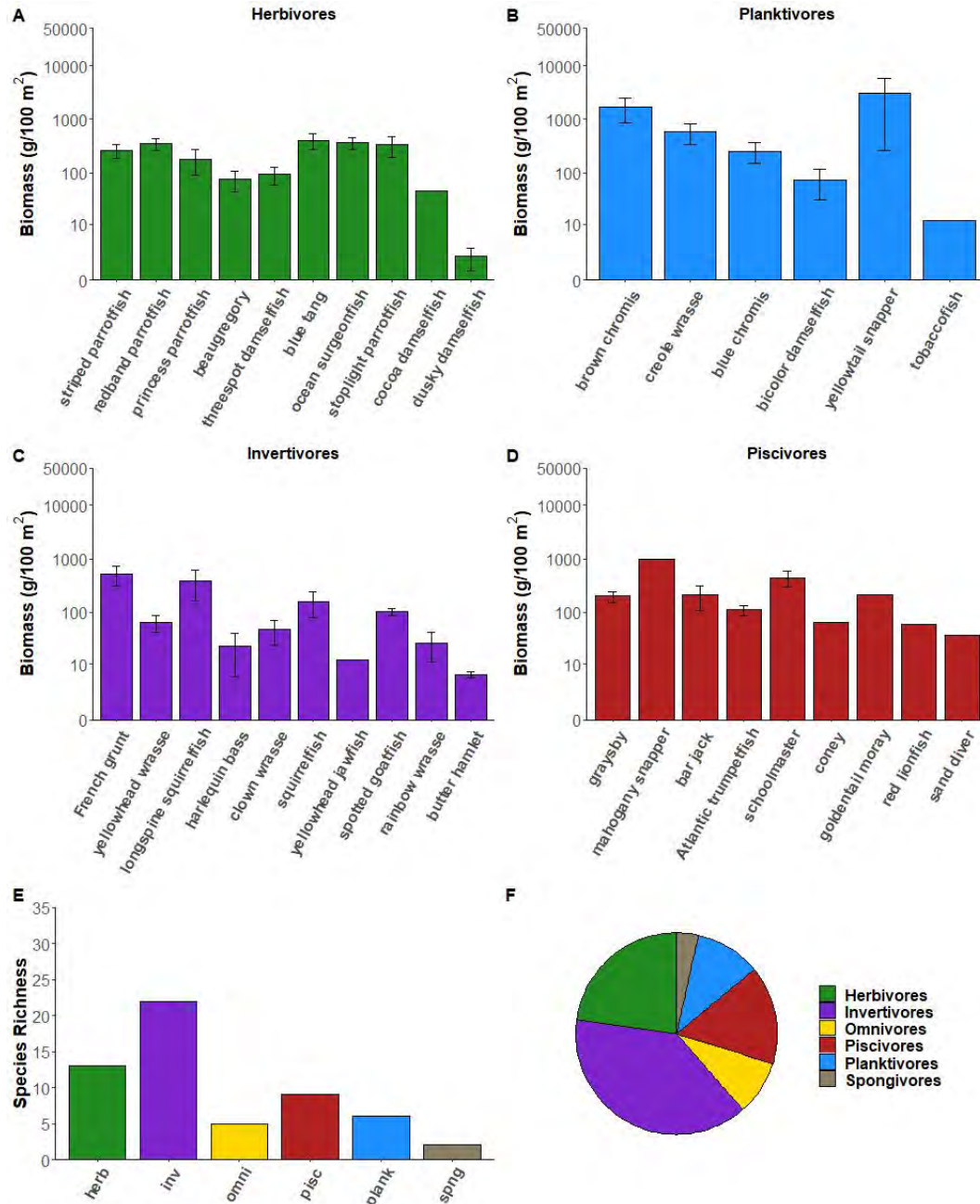


Figure 125. The Flat Cay fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

GINSBURGS FRINGE

Description. Ginsburgs Fringe is a lower mesophotic lettuce coral (*Agaricia undata*.) reef at depths of 60-75 m (established in 2011). The reef is on a steep escarpment dropping into the abyssal Virgin Islands trough.

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, Lettuce corals at these depths are potato chip thin at edges and fragile. Reef claw-type anchors appear to be responsible for a 50% drop in coral cover in the last few years. The site is being heavily invaded by red lionfish (*Pterois volitans*).

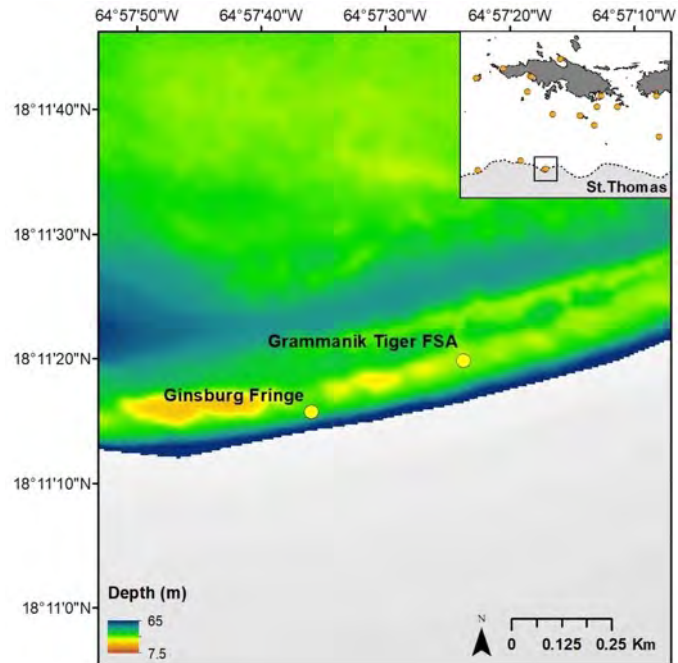


Figure 126. Ginsburgs Fringe. (top) Location. (right) A representative photo of the reef showing whorled lettuce coral colonies up to 7m in width and research diver filming permanent transect in background (Nov. 13, 2015).



SITE SUMMARIES

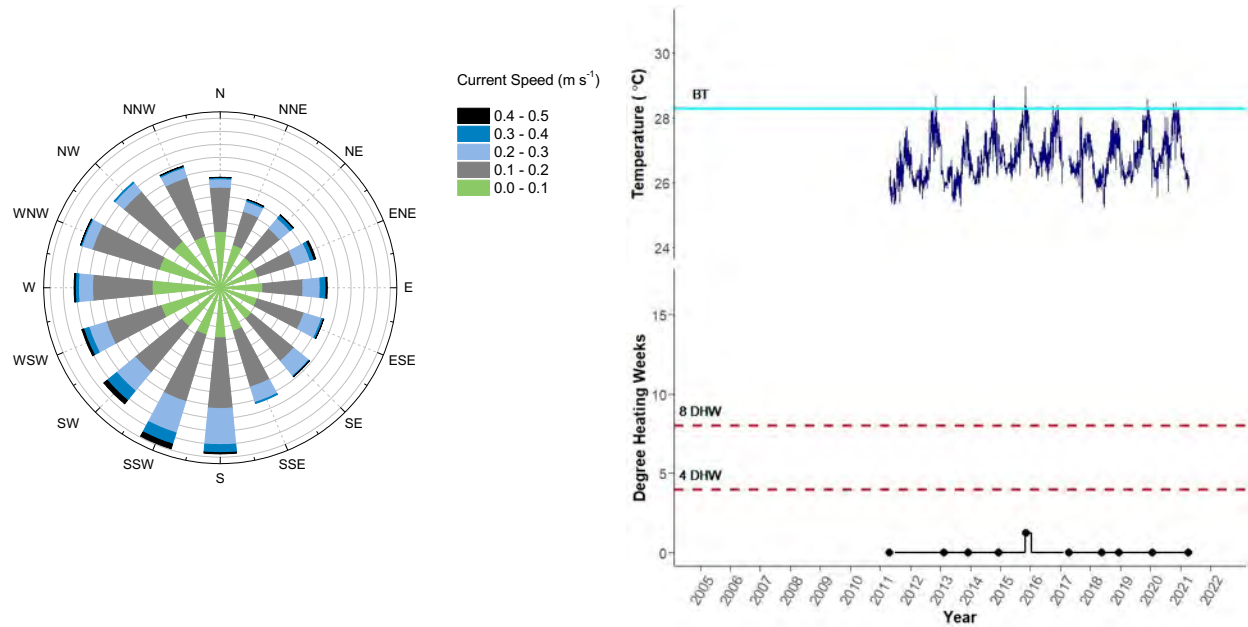


Figure 127. Ginsburgs Fringe current speed (50 m depth) and benthic temperature (63 m depth). BT = bleaching threshold ; DHW = degree heating weeks.

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. Temperatures are much cooler at Ginsburgs Fringe than any other TCRMP site, but still quite suitable for healthy Caribbean stony corals. There is no established empirical bleaching threshold for Ginsburgs Fringe. The site showed bleaching in 2012 (Smith et al. 2016a), suggesting it was above at least 4 DHW. Since this is not reflected in the modeled DHW, it suggests that the bleaching threshold is lower than predicted.

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. These species identifications are tentative as voucher specimens have not been collected. Although not well represented in cover, individual colonies of *Montastraea cavernosa* and *Siderastrea siderea* also occur at the site. The site has experienced extreme loss of coral cover (65%), likely due to anchoring (Smith et al. 2019b). 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, including what appears to be *Peyssonnelia iradescens* (Ballantine and Ruiz 2010).

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 has been observed (Smith et al. 2016a; Smith et al. 2019b). 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.

SITE SUMMARIES

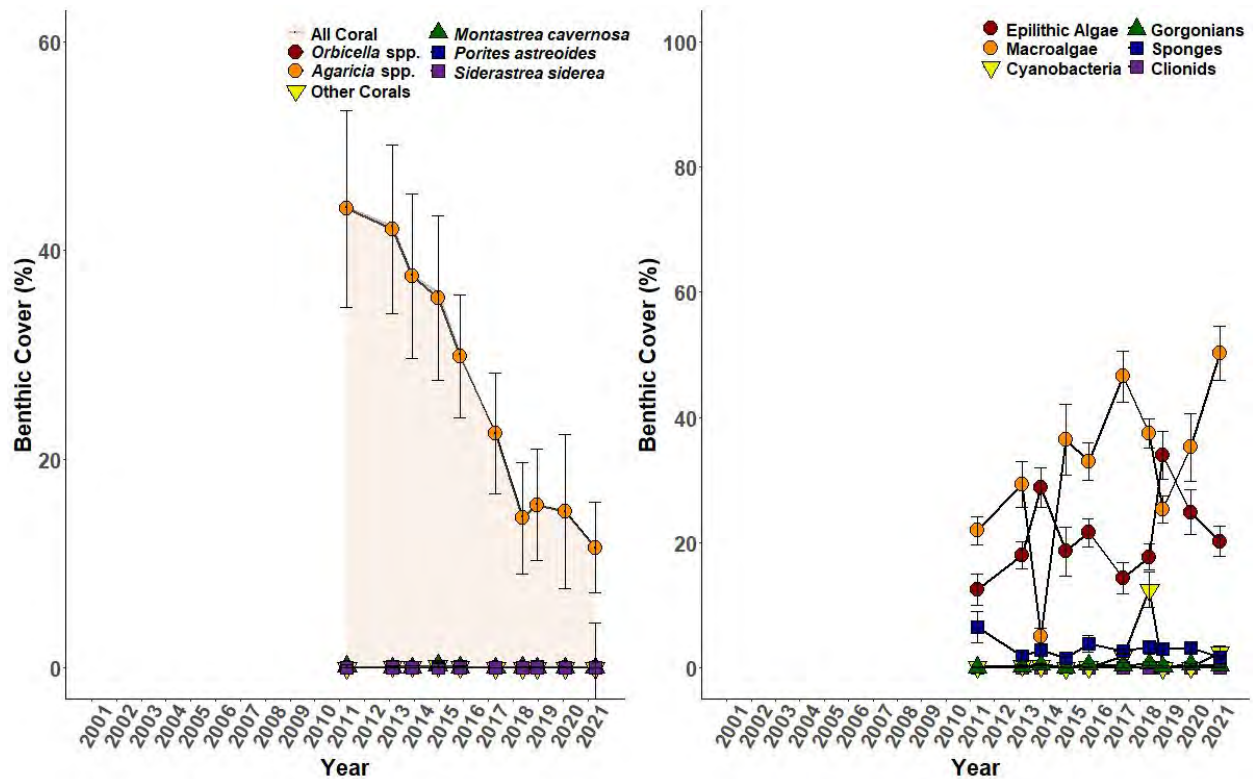


Figure 128. Ginsburgs Fringe benthic cover through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Fish abundance, biomass and diversity are low on Ginsburgs fringe, the deep mesophotic lettuce coral reef. Herbivores are in notably low abundance and piscivores make up the bulk of fish biomass encountered. Blackfin snapper, a deeper water species, are the most common piscivore. Dog snapper are occasionally observed, and in 2018 a yellowmouth grouper was seen on a transect. In 2016 lionfish were abundant on the deep water shelf edge site. They were not observed in the following two years, however only four transects were completed each year. Deep-water fishes, including cherubfish and sunshinefish are found on Ginsburgs Fringe in addition to the blackfin snapper. During the grouper spawning aggregation period in the winter and spring months, large groups of Nassau and yellowfin grouper have been observed spawning over the reef at depths between 46-65 m. Historically, black grouper were caught off this reef in the spawning season, but they have not been observed spawning here in the last 25 years (Edmond Bryan, commercial fishermen).

SITE SUMMARIES

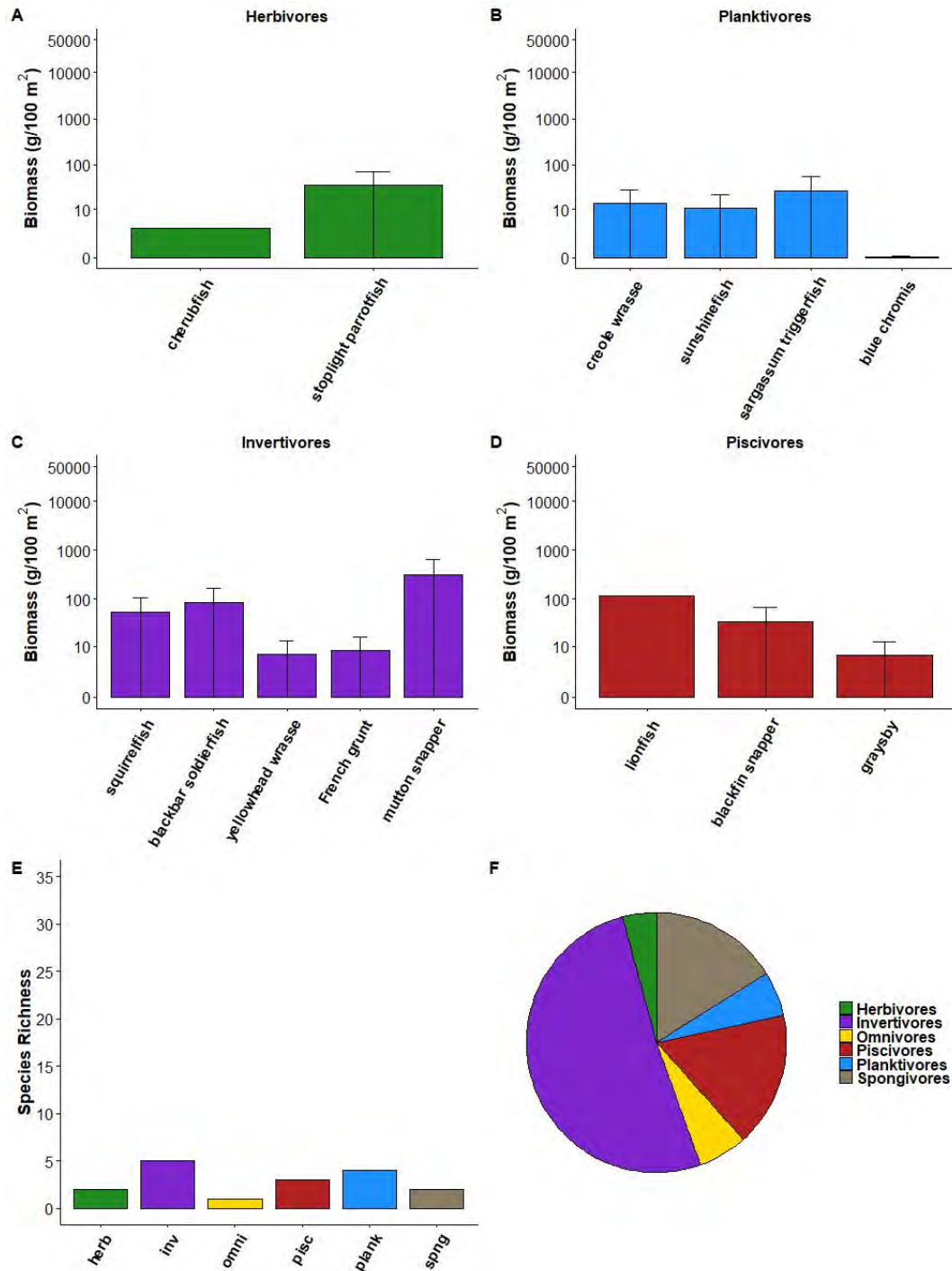


Figure 129. The Ginsburgs Fringe fish community in 2019 as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

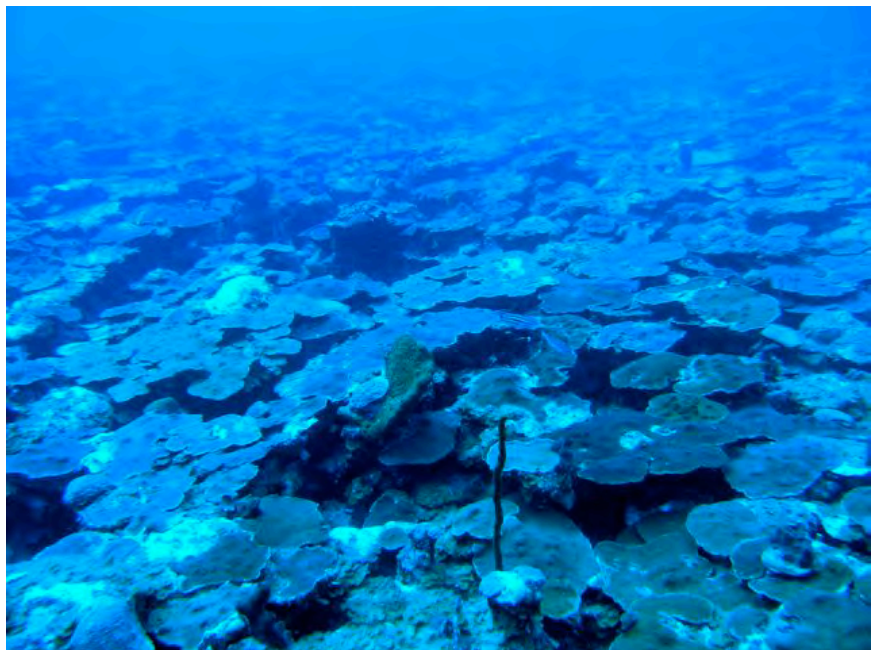
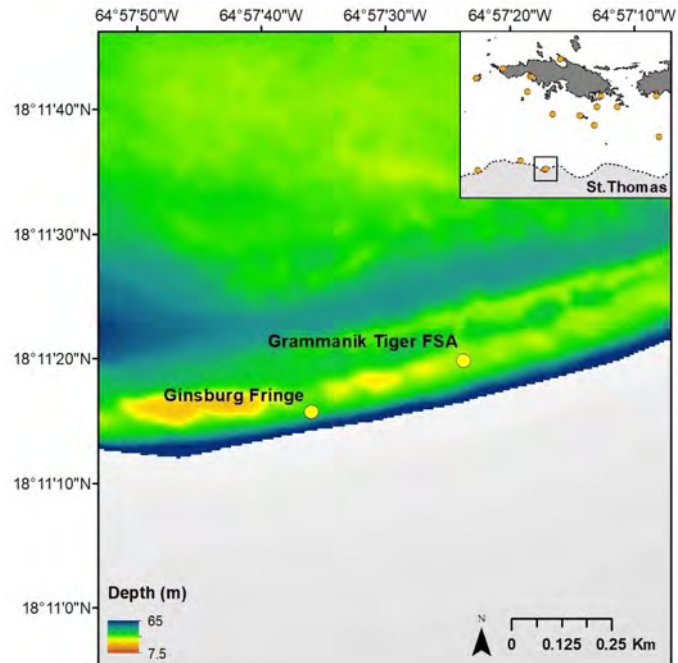
GRAMMANIK TIGER

Description. The Grammanik Tiger monitoring site is a primary bank mesophotic reef in depths of 37 – 41m. Star corals (*Orbicella* spp.) dominate the reef structure. Grammanik Tiger has been monitored since 2003, with permanent transects installed in 2007.

Outstanding Feature. The Grammanik Tiger monitoring site supports a dense coral community that is a staging area for annual multi-species fish spawning events, including the threatened Nassau grouper (*Epinephelus striatus*).

Threats. Although the Grammanik Tiger site and surrounding dense reefs are somewhat buffered from high thermal stress, but they are susceptible to chronic coral white diseases. Periodic disease outbreaks follow coral bleaching events. The Indo-Pacific lionfish (*Pterois volitans*) has formed dense populations within the study area and may be affecting native fish populations.

Figure 130. Grammanik Tiger (top) Location. (right) A representative photo of the reef.



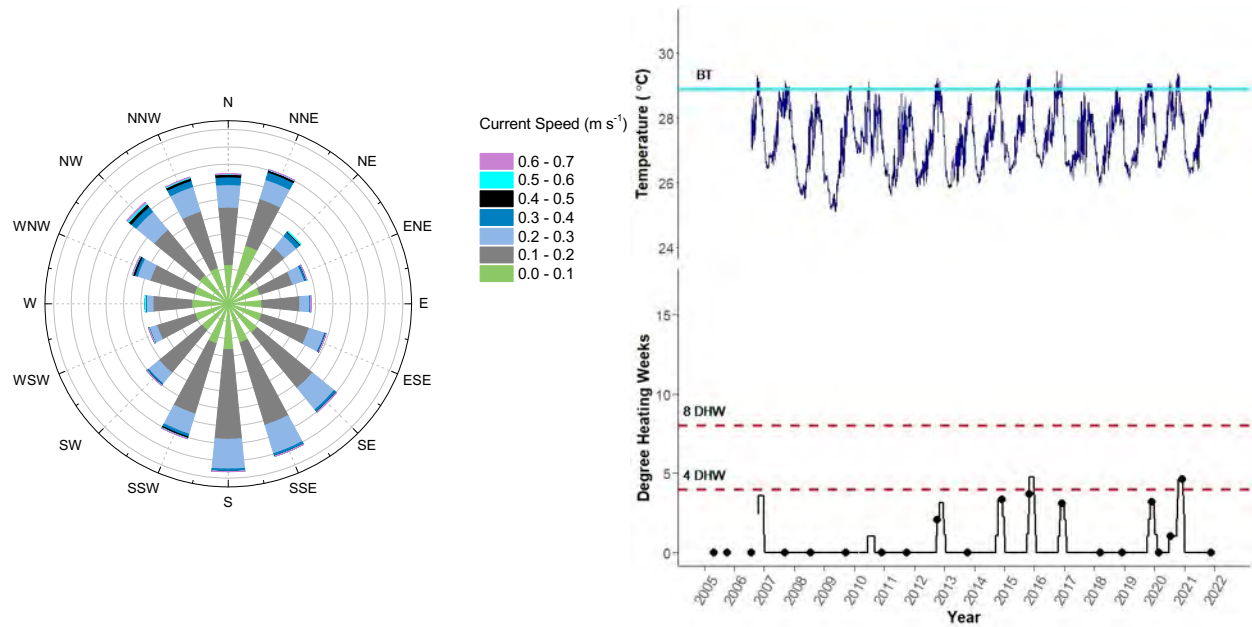


Figure 131. Grammanik Tiger benthic currents speed and temperature record (38 m depth).

Physical Characteristics.

Current. Unidirectional benthic currents at the Grammanik Tiger site are generally north-south, with the strongest current from the north-northeast to the northwest. Currents are typically weak to moderate, but occasionally reach strengths greater than 30 cm s^{-1} . Current speeds are based on near-continuous ADCP deployments from February 2005 to April 2009, with measurements at 30 or 60 minute intervals.

Temperature. Benthic temperatures at Grammanik Tiger are ameliorated by the passage of tidally driven internal tides in the warm season (May-November). Inter-annual variability creates temperatures that can be up to 2°C different for the same Julian Day. The Grammanik Tiger site is a prime example of how cooler temperatures at depth decrease the coral bleaching threshold by acclimation and lead to potential bleaching even in moderate temperatures relative to shallow reefs (Smith et al. 2016a).

SITE SUMMARIES

Benthic Community. Boulder star corals (*Orbicella* spp.) dominate the coral community of the Grammanik Tiger site; however, there is representation by a high number of other species that are also present in shallow water reefs. Grammanik Tiger lost only 5.4% of its coral cover in the 2005 bleaching event but had not regained any cover (-129.6%) by 2011. A caveat is that transects were not made permanent until 2007. SCTLD appeared in by February 2020 but remained at low levels until the October 2020 sampling, and had not yet caused a large decrease in coral cover. Other prominent members of the sessile epibenthic animal community are sponges. The macroalga *Lobophora variegata* and epilithic algae dominate the algal community. There are also a relatively high proportion of crustose coralline algae and various other macroalgae species.

Coral Health. Corals at Grammanik Tiger were very affected by bleaching in 2005, but were underestimated in surveys conducted when thermal stress was only about half (4 degree heating weeks) what it eventually reached (Smith et al. 2016a). The 2010 and 2019 bleaching events did not reveal bleaching detectible above background levels. High prevalence of bleaching in normal years is due largely to granular bleaching of *Orbicella* spp., where pigmented spots are surrounded by bleached areas. Coral diseases are very prevalent with high representation of white disease. Yellow band disease was reported at high prevalence in the first years of monitoring. SCTLD and lesions likely associated with SCTLD appeared at the site by February 2020 and had reached almost 20% prevalence by October 2020. Old partial mortality was low, but increased rapidly after the 2005 coral bleaching event. Recent partial mortality is very high and is caused by disease lesions, predations, and fish bites.

SITE SUMMARIES

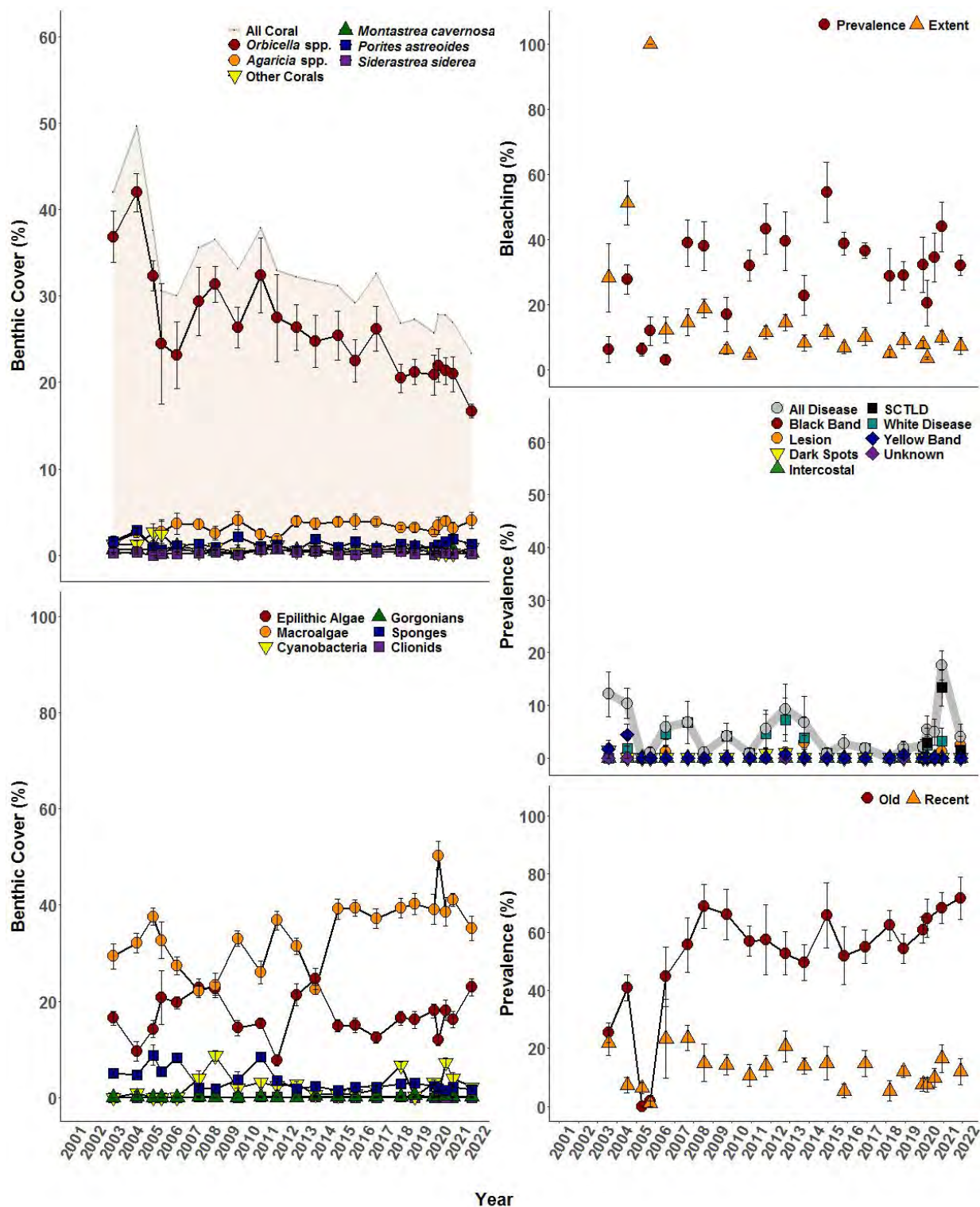


Figure 132. Grammanik Tiger benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The Grammanik Tiger site supports less herbivores and a greater number of piscivores than the shallower sites in the TCRMP. It is a staging area for the spawning site of several species of grouper and snapper and is within 0.5 km of that aggregation area. Given the annual range of spawning across multiple species on the site, surveys often coincide with the occurrence of fish aggregations, particularly those species with protracted spawning seasons (e.g., cubera and schoolmaster snapper). This drives up the relative piscivore biomass, however on the Grammanik Bank there are pelagic jacks as well as resident large grouper and snapper that are rarely found on near or offshore reefs of the USVI. Nassau, yellowfin, yellowmouth, and tiger grouper are present during non-spawning periods at the Grammanik Bank. This reef is protected from traps year round, and from all fishing gear from February through April. Sitting on the Puerto Rican shelf edge, with upwelling and strong tidal flow, planktivores dominate the relative community composition. Huge schools of creole wrasse and boga contribute to the large planktivore biomass. Black jacks, black durgon and yellowtail snapper are also very common on this shelf edge site. The herbivore guild is generally dominated by large adult stoplight parrotfish. During some years the chub is found in small schools on the site, grazing on *Lobophora* and contributing significantly to herbivore biomass. Juvenile parrotfish and doctorfish are relatively uncommon on this and all the northern USVI mesophotic sites. Wrasse are also notably uncommon. In recent years the invasive red lionfish has become very prolific at the Grammanik Bank, with greater than ten individuals commonly observed on any given dive. Although fishing pressure is low, potential lionfish predators are in relatively high abundance at the site, however they do not appear to be controlling the invasive fish. As well as large groupers and snappers, lemon, Caribbean reef and bull sharks are seen frequently on the reef. Nurse sharks and Nassau grouper have been observed killing and eating lionfish that had been collected to be tagged and were caged under clear nets on the bottom. Predators overturned the nets and ate the lionfish, so there is hope that this behavior occurs without the aid of divers.

SITE SUMMARIES

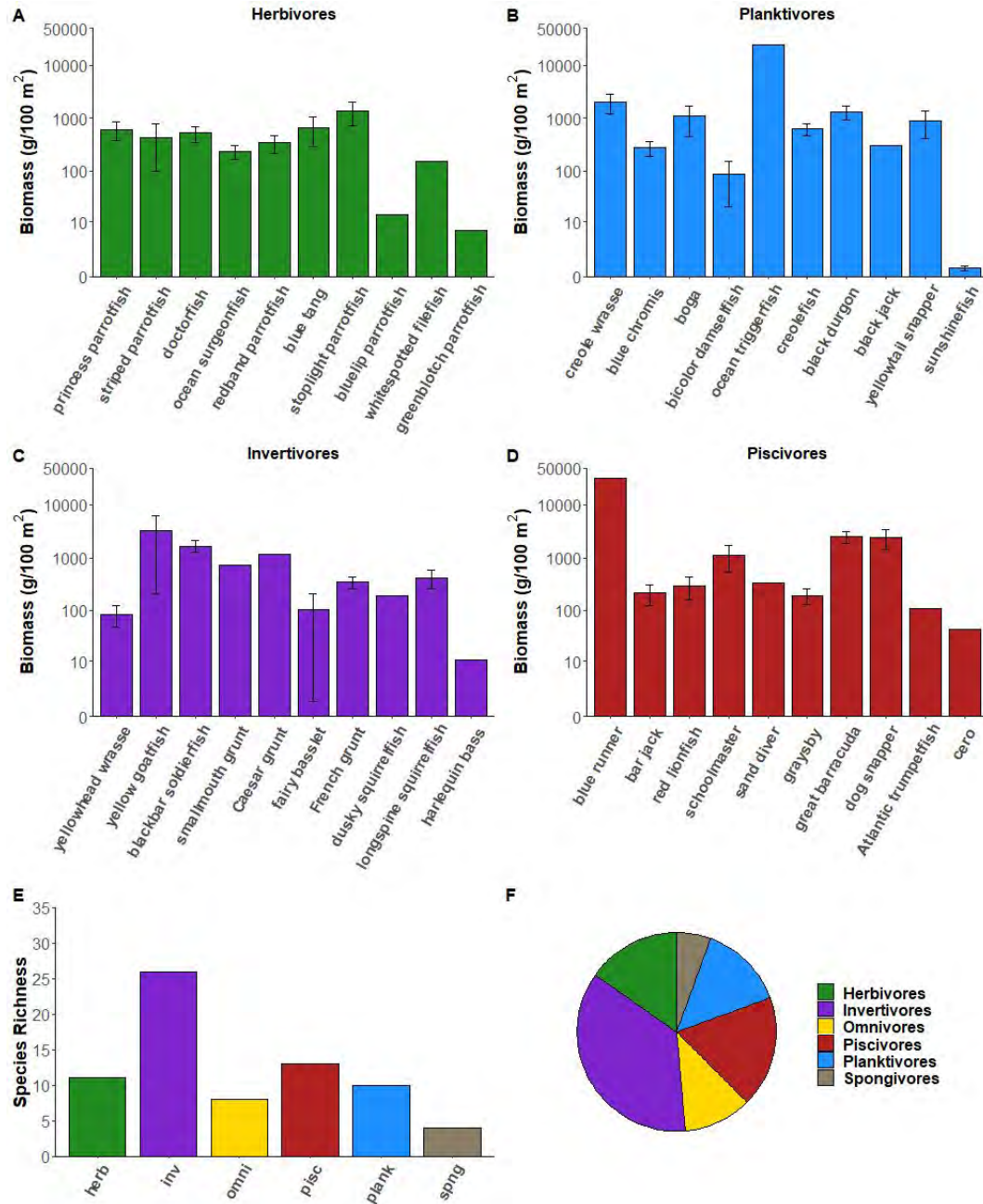


Figure 133. The Grammanik Tiger fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

HIND BANK

Description. The Hind Bank is a mesophotic tertiary bank in depths of 38 – 42 m. The reef is part of a patchy complex of star coral (*Orbicella* spp.) dominated reefs that stretch across the eastern Red Hind Marine Conservation District. The Hind Bank has been monitored since 2003, with permanent benthic transects installed in 2007.

Outstanding Feature. The Hind Bank is within a no-take marine reserve and fish populations are recovering and robust. The Hind Bank monitoring site hosts a multispecies spawning aggregation, including a recovering population of the commercially important red hind grouper (*Epinephelus guttatus*).

Threats. The Hind Bank and surrounding dense reefs are somewhat buffered from high thermal stress, but they are susceptible to chronic coral white diseases. Periodic disease outbreaks follow high thermal stress. The Indo-Pacific lionfish (*Pterois volitans*) has formed dense populations within the study area and may be affecting native fish populations.

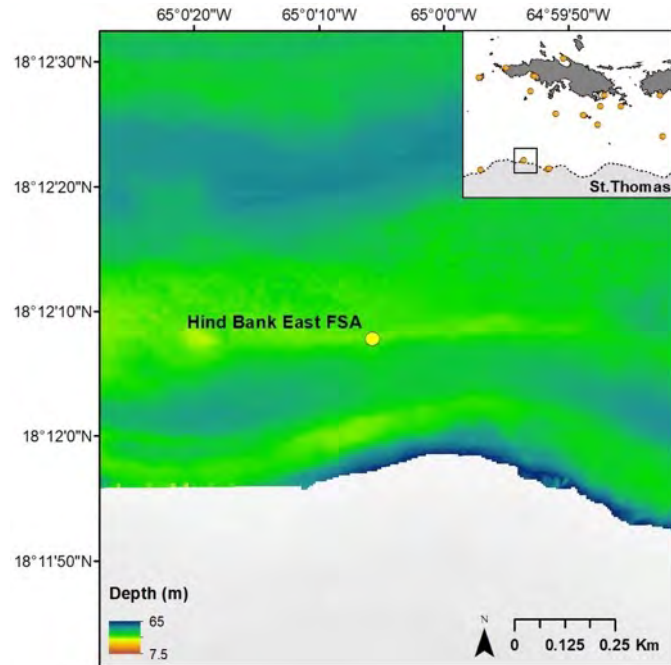


Figure 134. Hind Bank (top) Location. (right) A representative photo of the reef.



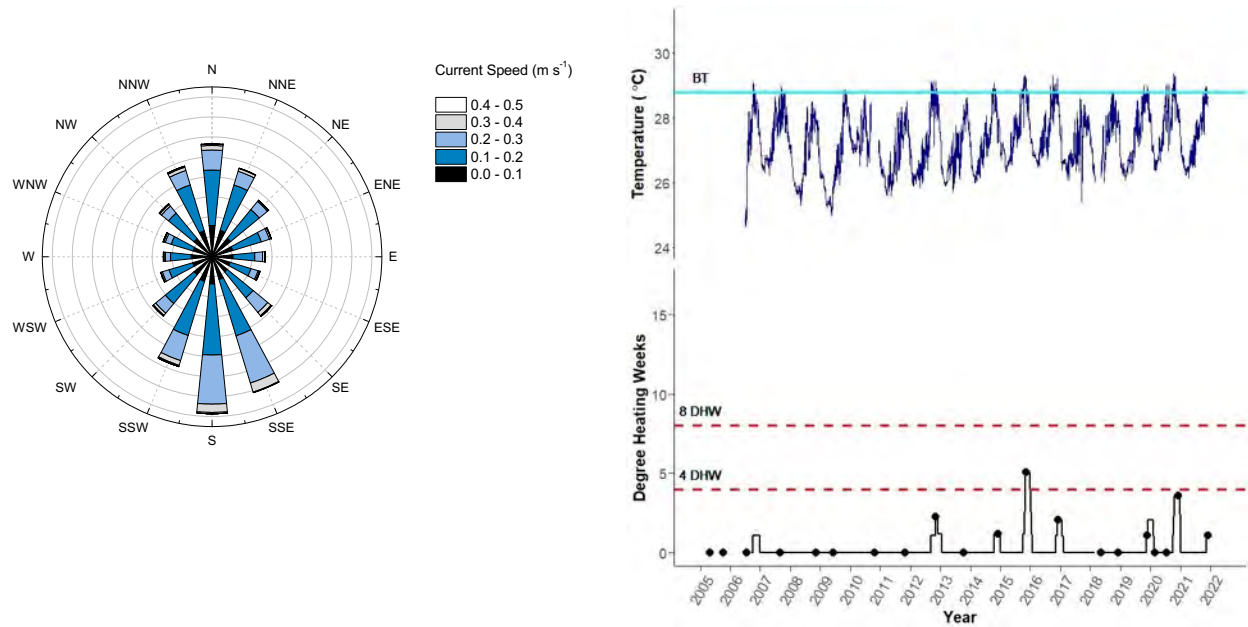


Figure 135. (top) Hind Bank benthic current speed (40m depth). (bottom) Benthic temperature record at 40 m depth.

Physical Characteristics.

Current. Hind Bank has moderately strong unidirectional near-benthic currents that are dominated by a north to south components. Currents can be moderate to strong ($>20\text{ cm s}^{-1}$). Current speeds are based on near-continuous ADCP deployments from February 2005 to May 2012, with measurements at 30 or 60 min. intervals. Oscillatory currents are not known from the Hind Bank.

Temperature. Temperatures show much evidence of internal tides in the warm season and are notably cooler than shallow water sites in the upper mixed layer and nearshore embayments.

SITE SUMMARIES

Benthic Community. The Hind Bank site is dominated by boulder star corals (*Orbicella* spp.), but also has a high abundance of lettuce corals (*Agaricia* spp.). The Hind Bank site lost 21.8% of its coral cover in the 2005 bleaching event, but had regained 71.4% of this cover by 2011. The recent arrival of SCTLTD in 2019 seems to be causing a decline in coral cover. The algal community is co-dominated by epilithic algae and the macroalga *Lobophora variegata*. There is also high representation of crustose coralline algae and other unidentified macroalgal species.

Coral Health. Bleaching during the 2005 event was underestimated because sampling occurred before the peak in heat stress. Neither the 2010 or 2019 events were detected in sampling. In later years, the high prevalence of moderate prevalence, low colony extent bleaching was often associated with granular bleaching. This bleaching pattern shows pigmented spots surrounded by bleached tissue. Coral diseases are common at the Hind Bank and may be increasing. White disease was the dominant disease, and 2011 showed a peak of disease signs. In 2009 there was a high prevalence of intercostal mortality syndrome, which is only known from mesophotic coral reefs (Smith et al. 2010b). SCTLTD had begun to impact the site in 2019. Old partial mortality increased after the 2005 bleaching event and the high prevalence was not reduced until 2011. Recent partial mortality prevalence is often high and reflects the impacts of disease and predation.

SITE SUMMARIES

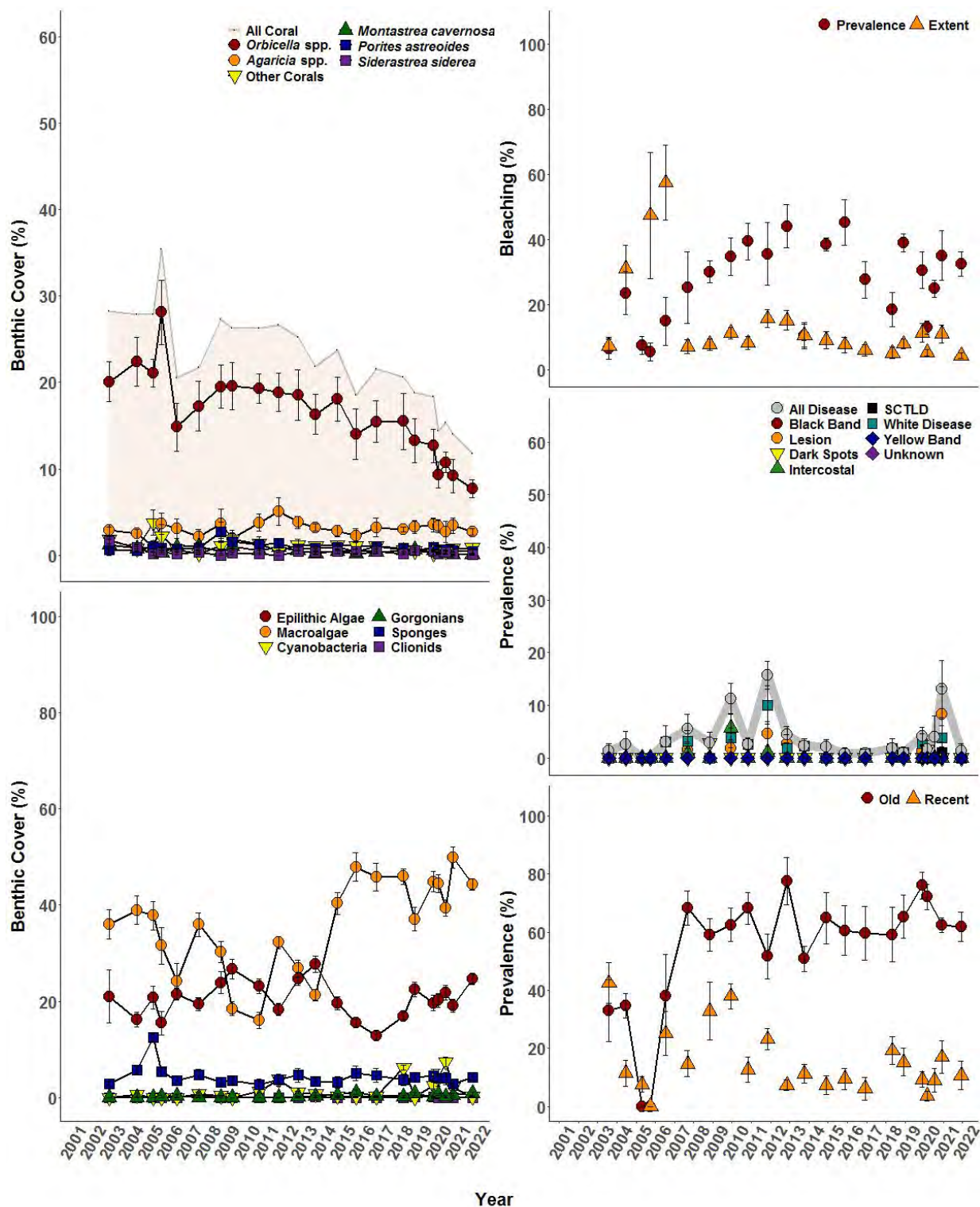


Figure 136. Hind Bank benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Like the Grammanik Bank, the Hind Bank is characterized by a high number and biomass of piscivorous fish. The site is within the Marine Conservation District (MCD) and is protected year-round from all fishing, except surface trolling. It is the spawning site for several species including red hind, mutton snapper, tiger grouper, and schoolmaster snapper. It is also a corridor for large snappers and groupers swimming to and from the Grammanik Bank to spawn. Surveys often coincide with the occurrence of schoolmaster snapper, which has a protracted spawning season. Although this drives up the relative piscivore biomass, there are also jacks, large barracuda, and resident groupers and snappers that contribute. Occasional to common large groupers include the Nassau, yellowfin, tiger and yellowmouth. Herbivore biomass is relatively low on the Hind Bank, as on other mesophotic sites. Herbivores are dominated by adult or semi-adult princess, redband and stoplight parrotfish. Queen parrotfish are also commonly observed. Juvenile parrotfish are absent from the site. Benthic invertivores are dominated by blackbar soldierfish, queen triggerfish and goatfish. The site is surrounded by sand and hardbottom areas, supporting a variety of benthic resources for invertebrates. Planktivores observed at the Hind Bank vary with tide and current. Creole wrasse can be seen in large schools or may be absent. Large yellowtail snapper are generally present. Other planktivores found at the Hind Bank include the black jack, black durgon, boga and creolefish. Mesophotic species such as the fairy basslet, sunshinefish, and longsnout butterflyfish are also common. The red lionfish has become a regular resident of the reef and large sharks are seen occasionally.

SITE SUMMARIES

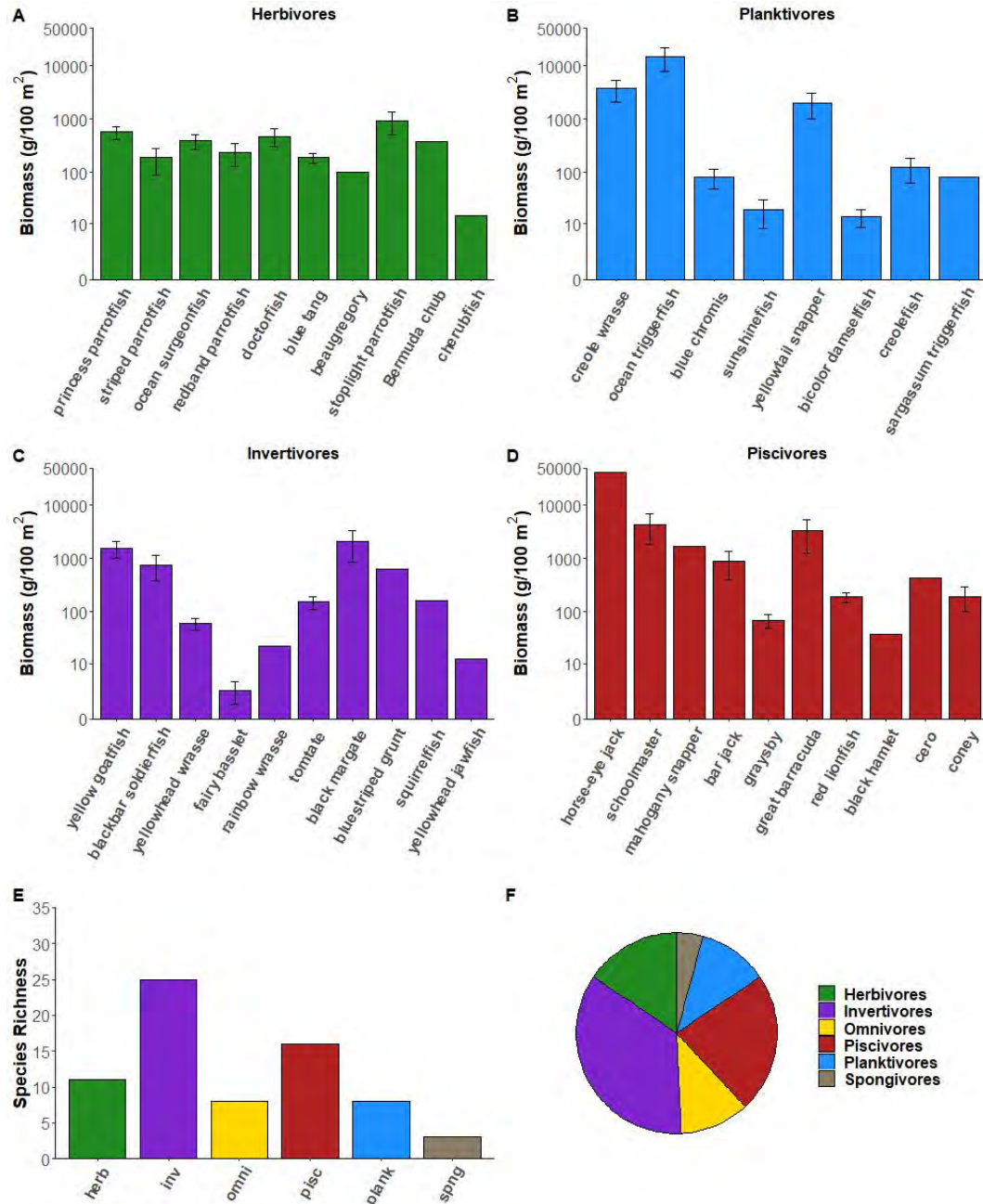


Figure 137. The Hind Bank East fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

LITTLE SAINT JAMES

Description. The Little St. James site is a midshelf hardbottom reef in depths of 16-22 m. The site is a patch reef surrounded by sand/rhodolith plain. Little St. James has been monitored since 2005, with permanent benthic transects installed in 2007.

Outstanding Feature. The Little St. James site is just outside the St. Thomas East End Reserve and supports occasional high densities of snappers, grunts, and queen trigger.

Threats. Commercial fisherman target the Little St. James site and active and derelict fish traps are in high abundance. The site is down-current of development on Little St. James Island and is potentially threatened by land-based source of pollution.

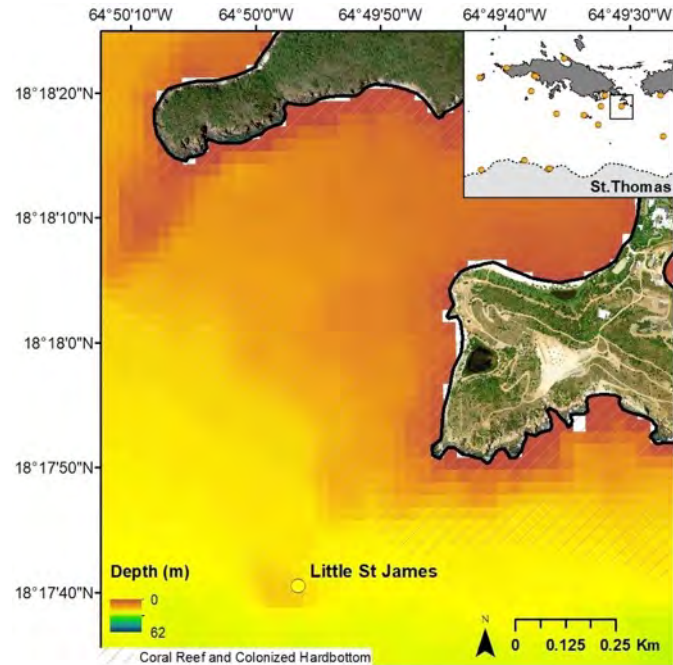


Figure 138. Little St. James. (top) Location. (right) A representative photo of the reef with derelict fish trap



SITE SUMMARIES

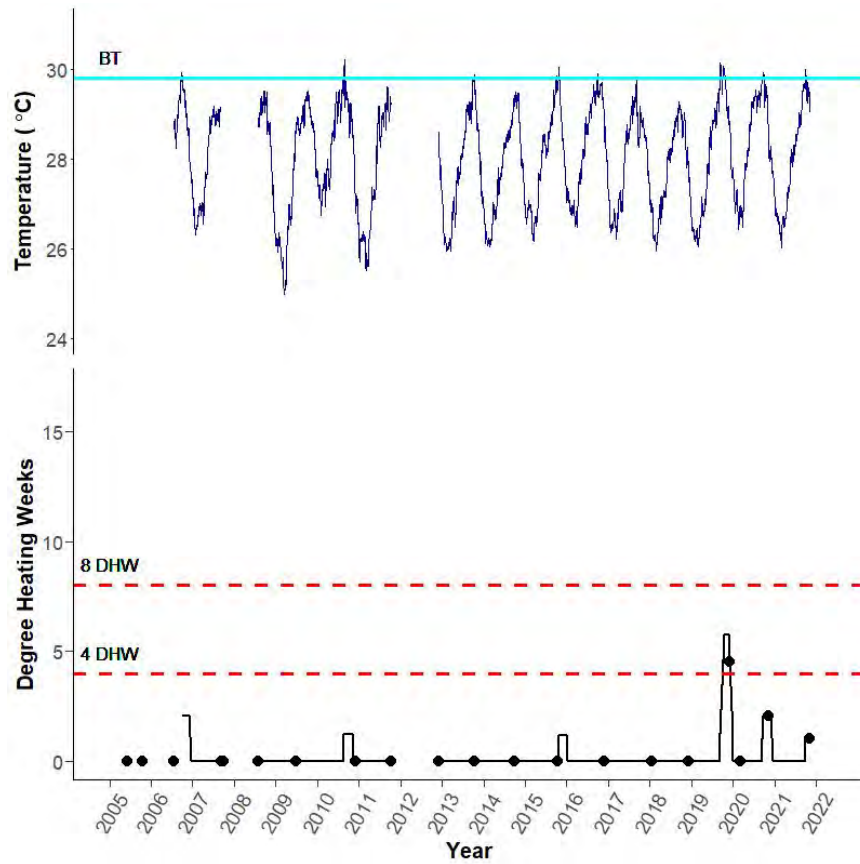


Figure 139. Little St. James benthic temperature record (19 m depth).

Physical Characteristics.

Current. Currents have not been directly measured at St. James. Unidirectional benthic currents have only been weak during monitoring. Strong wave-driven oscillatory currents may take place, as evidenced by the high proportion of gorgonians and *Sargassum* spp. at the site.

Temperature. Benthic temperatures at St. James can be high during warm years, such as 2010 and 2019.

SITE SUMMARIES

Benthic Community. The sparse coral community of the Little St. James site is diverse. There is a high proportion of rare species, such as *Eusmilia fastigiatum*, *Madracis* spp., and *Mycetophyllia* spp.. The site lost 16.5% of coral cover in the 2005 bleaching event but had apparently regained 376.2% of this loss by 2011. This large increase above bleaching losses may be explained by the fact that transects were not made permanent until 2007 and were then sited in areas with the densest coral. SCTLD arrived at Little St. James between October 2019 and February 2020 and may be contributing to the gradual decline in *Orbicella* spp.. The sessile epibenthic community overall is largely composed of sponges and gorgonians. The algal community is dominated by the macroalgae *Dictyota* spp. and the *Sargassum* spp.. *Lobophora variegata* and epilithic algae are also in high proportional abundance.

Coral Health. The coral community at Little St. James was highly affected by the 2005 coral bleaching event, with all corals assessed completely bleached. Half the corals were affected by low extent bleaching in 2010 and about half the corals had moderate prevalence and extent of bleaching in 2019. Low-level bleaching is a common feature of the site. Diseases are less common, with the exception of a white disease outbreak that preceded the coral bleaching event in June 2005. Dark spots disease can also be common. Old partial mortality increased rapidly after the 2005 bleaching event. Recent partial mortality is not very prominent.

SITE SUMMARIES

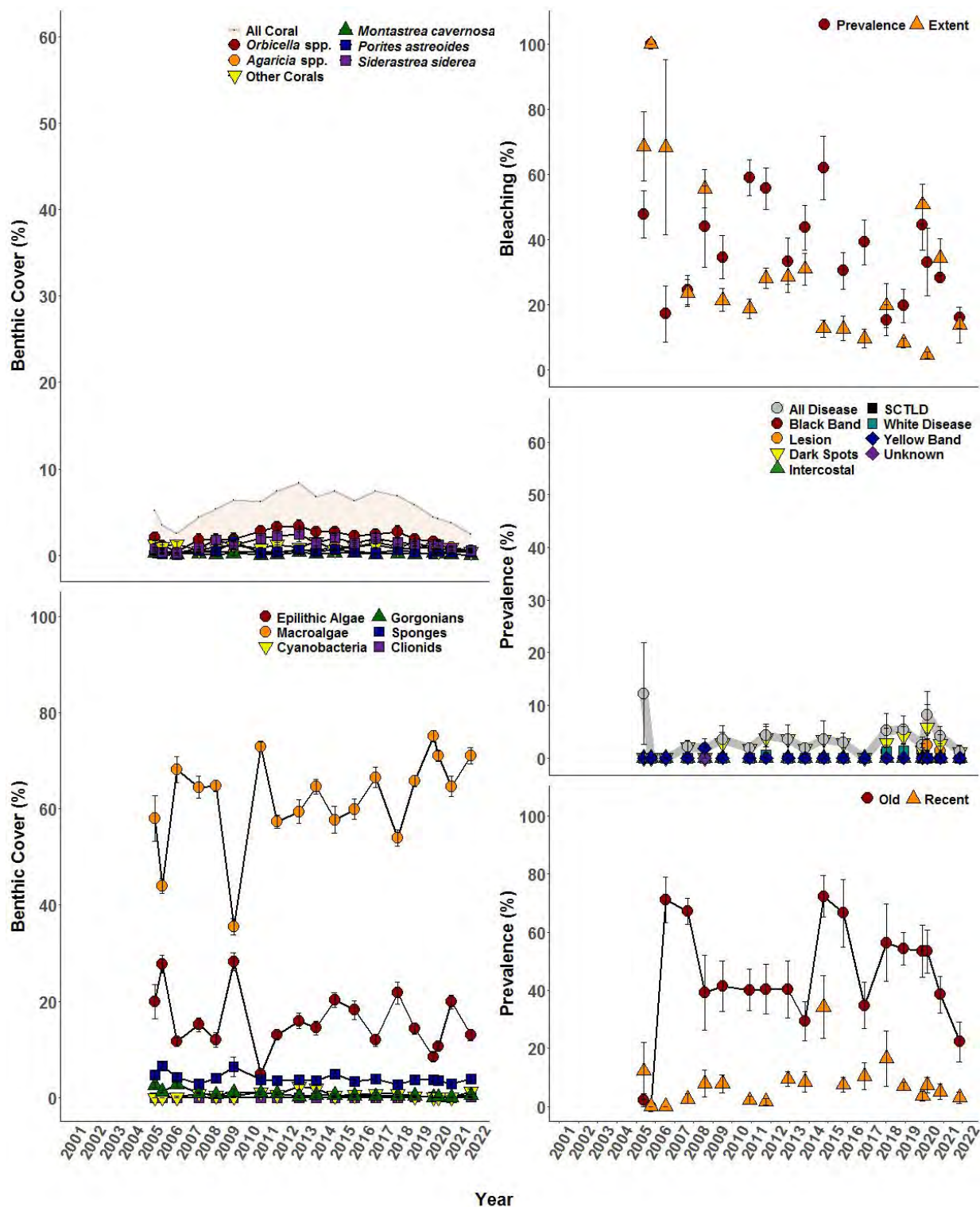


Figure 140. Little St. James benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The fish community of Little St. James differs from those of the more developed reef habitats, representing both a coral reef and hard bottom fish community. Queen triggerfish and mutton snapper are far more common on Little St. James than on other TCRMP sites. Large, adult hind and goatfish are also very common. These benthic invertivores are indicative of hard bottom/sandy sites. During parts of the year, grunts (French and white) have been observed in huge numbers and may use the site for spawning. The spongivores (angelfish) are well represented. Bar jacks, yellow jacks and almaco jacks are very common swimming in the water column at the Little St. James site, contributing to the high overall piscivore biomass. Schoolmaster, gray, and mahogany snapper are also common. All six of these species are considered ciguatoxic in this area and are not targeted by hook and line, trap, or spear fishermen. Herbivores are dominated by the tangs and surgeonfish, which swim and graze the site in large mixed schools. Most notable is the abundant queen triggerfish population that are present across a wide size-spectrum. Lobsters are also relatively dense. The Little St. James reef is outside of the boundaries of the St. Thomas East End Reserve and fish traps are observed regularly on the site and are presumably targeting lobster and queen triggerfish.

SITE SUMMARIES

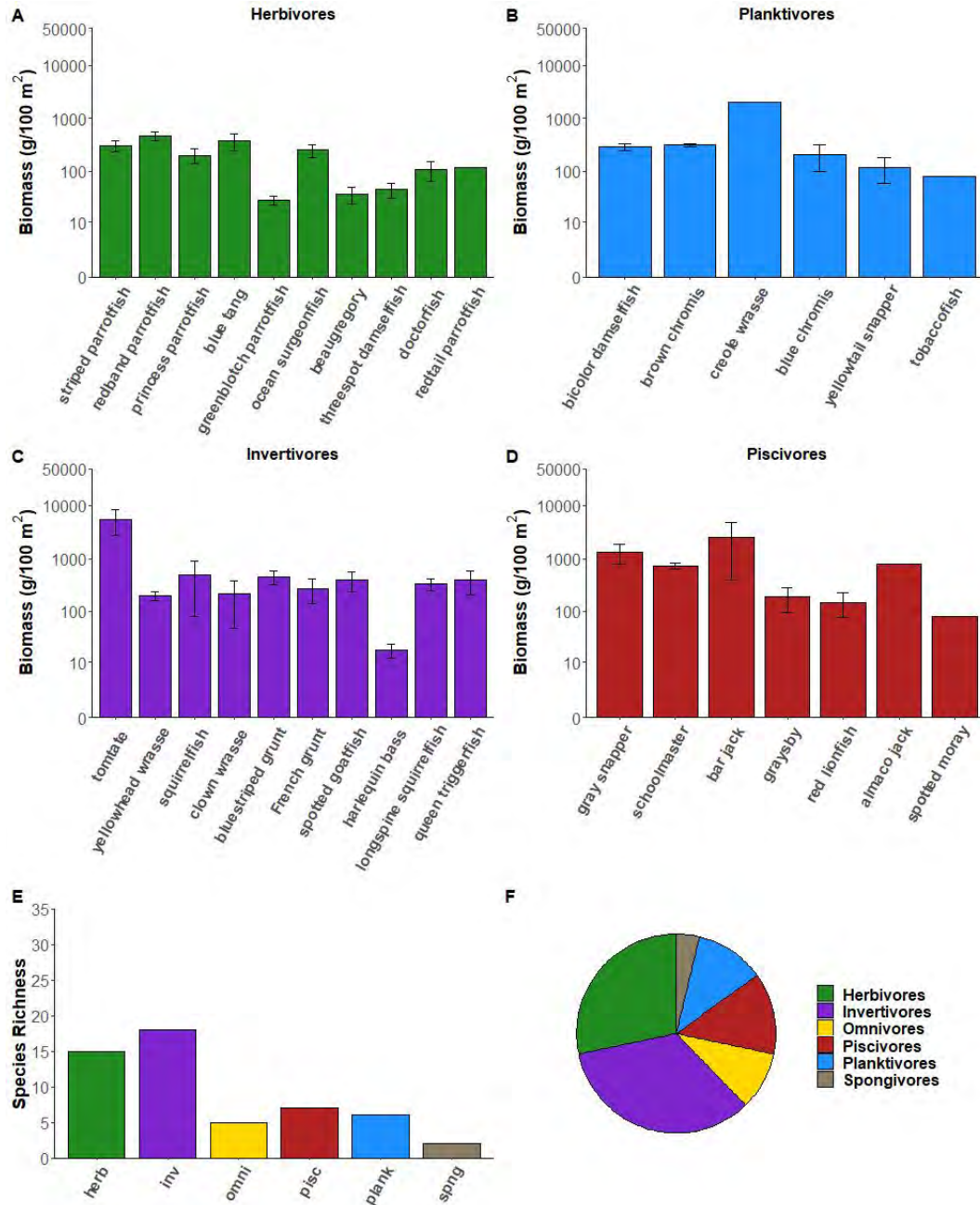


Figure 141. The Little St. James fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

MAGENS BAY

Description. The Magens Bay site is a nearshore fringing reef located along Peterborg Point in depths of 7 – 14 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. Magens Bay has been monitored since 2001.

Outstanding Feature. The Magens Bay site is a well-protected northside St. Thomas reef near one of the most popular tourist beaches in the Caribbean.

Threats. Magens Bay is in a highly enclosed embayment receiving a very large and developed watershed. Sediment run-off is high and deposition on reefs is favored by slow current speeds. The turbidity after rain and swell events can be extreme in the bay and water visibility is often less and 3m. In addition, leaky septic systems may impair bay waters. Recreational/artisanal fishers frequently fish this site with hand line and spear.

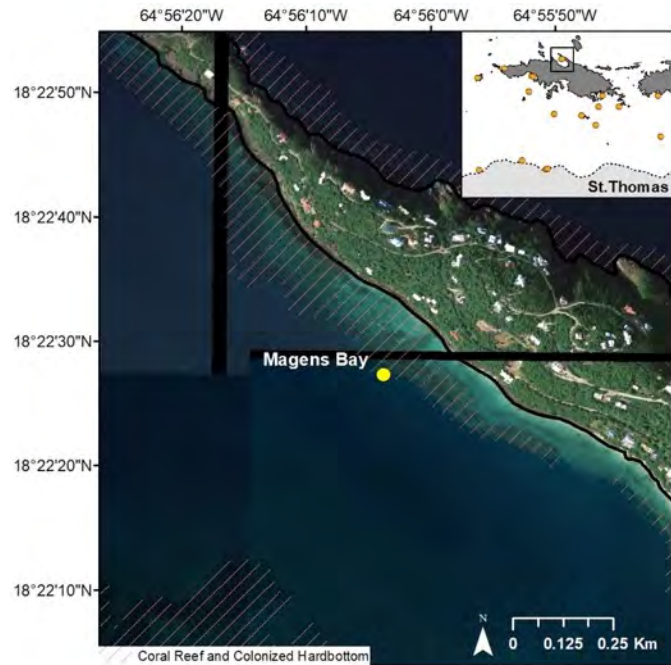


Figure 142. Magens Bay. (top) Location. (right) A representative photo of the reef.



SITE SUMMARIES

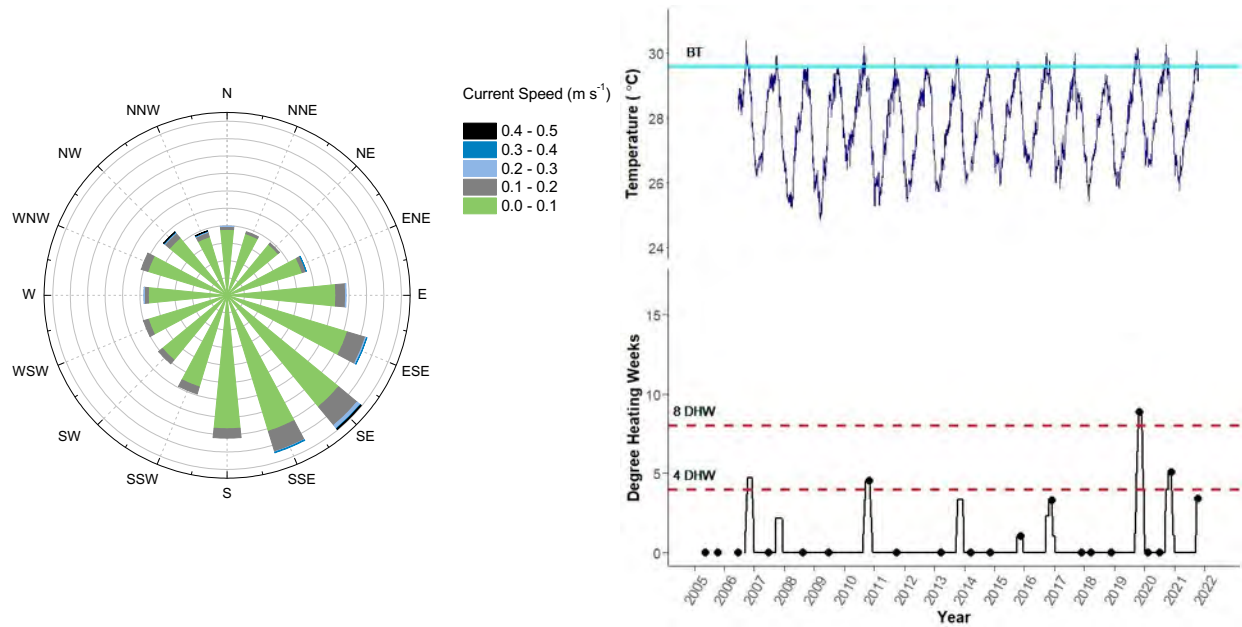


Figure 143. Magens Bay current speed and benthic temperature record (9 m depth).

Physical Characteristics.

Current. Magens Bay 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. Current data are based on average data from Dec. 2006-Oct. 2007 7.5 m above the sensor head.

Temperature. Magens Bay has low circulation, but temperatures are kept cooler by exposure to the Atlantic.

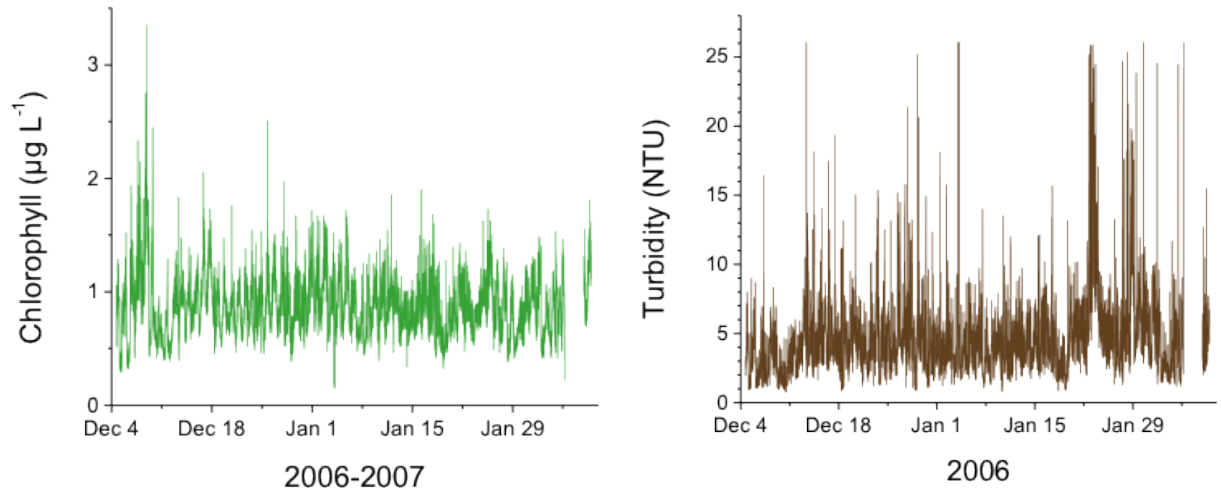


Figure 144. Mogens Bay chlorophyll (left) and turbidity (right) record (16 m depth).

Chlorophyll & Turbidity. Mogens Bay is susceptible to very high chlorophyll and turbidity values indicating very high productivity that is likely fueled by terrestrial run-off. Turbidity reduces light penetration and reduces the depth limits for coral growth and water column productivity favors heterotrophic organisms, such as sponges and gorgonians.

SITE SUMMARIES

Benthic Community. The sparse coral community at Magens Bay is very diverse, with no real dominance by any one species. The site lost 12.4% of its coral cover in the 2005 bleaching and has continued to lose coral, with a cover loss of 33.1% from 2005 pre-bleaching to 2011. Gorgonians and then sponges dominate the sessile epibenthic community. Epilithic algae and the macroalga *Dictyota* spp. dominate the algal community. Filamentous cyanobacteria are also common. There is a high proportion of sand/sediment around corals at the Magens Bay site.

Coral Health. Corals were highly affected by the 2005 bleaching event, with about 80% of all corals about 80% affected across the colony surface. This site also showed a strong response to the 2010 bleaching event with about 60% of corals bleached at a low extent. In 2019 bleaching was moderate to severe in terms of prevalence and extent. Diseases can be high and are dominated by dark spots disease. SCTLD reached the site between October 2019 and February 2020, but has not spiked to high prevalence and has not had a large impact on the coral cover. Old partial mortality increased after the 2005 bleaching event and then declined, with a slight increase from 2009 to 2011. Recent partial mortality is common at the Magens Bay site, largely as the result of biting by territorial damselfish (*Stegastes* spp.; data not shown).

SITE SUMMARIES

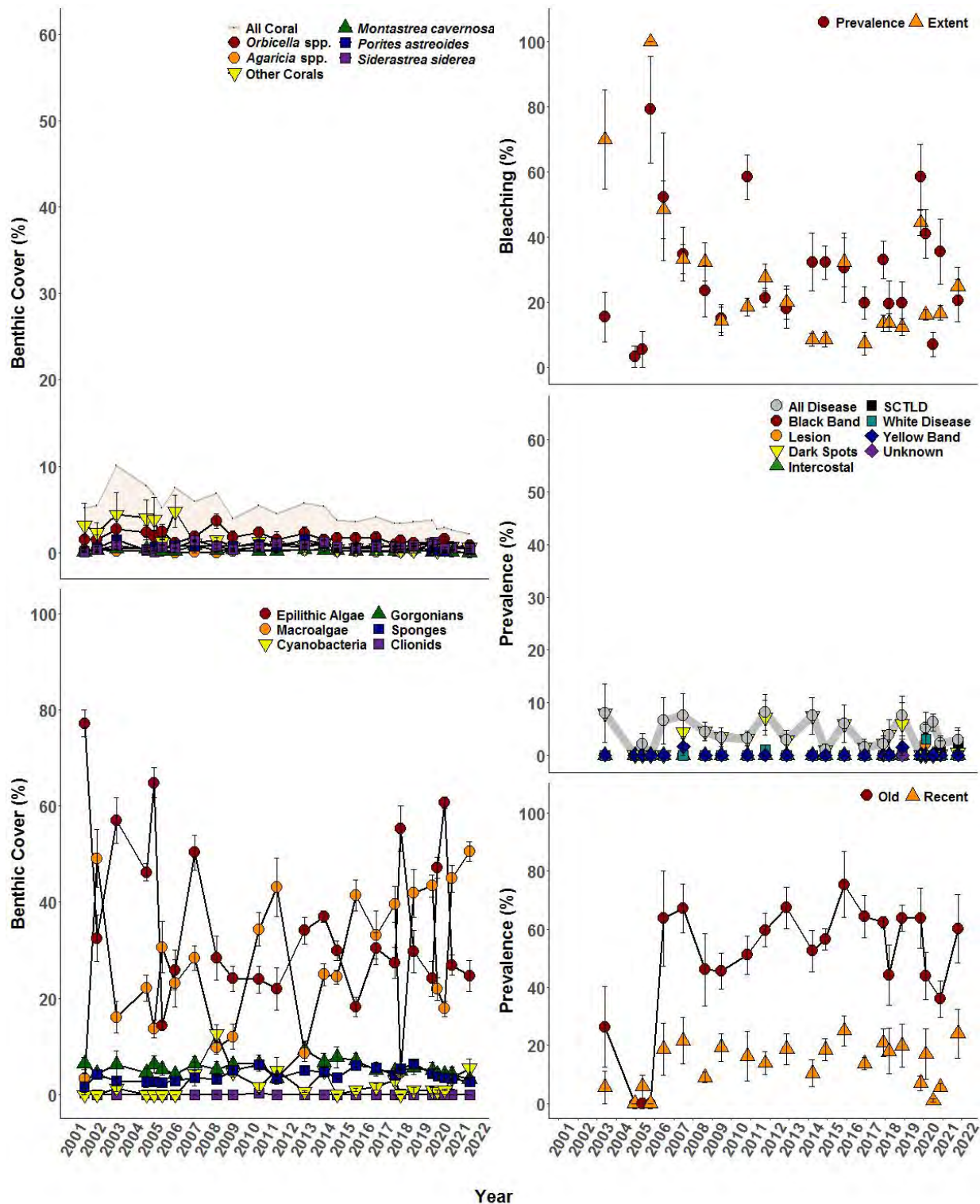


Figure 145. Magens Bay benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Magens Bay once supported its own rich fishery and was the notorious site of the only fatality by shark attack recorded in St. Thomas (Randall 1963a). The days of large, commercially important fish in Magens Bay have been gone since the 1970's; however, the bay is adjacent to the deep Puerto Rican shelf to the north and large sharks are known to frequent the bay. Tiger sharks are still caught commonly off either point defining the bay to the east or west. Anecdotally, hammerheads mate in the middle of Magens Bay during one moon phase of the year, and along the mile long sandy beach it is not uncommon to see young of the year reef sharks swimming in the clear water, suggesting that the deep protected bay is the pupping ground for at least one species of shark. Along the reef on the eastern edge of the bay (the TCRMP monitoring site) large fish are rare, and herbivores make up the bulk of the fish biomass. On the reef edge, mahogany and lane snapper are found, along with grunts, goatfish, and larger parrotfishes. The top of the reef holds schools of wrasse mixed with juvenile parrotfish, along with high densities of damselfish (mainly bicolor) and juvenile yellowtail snapper. In 2017 a juvenile Nassau grouper was seen on a transect in Magens Bay. No other large groupers or snappers have been observed there throughout the survey period, although trap fishing does not occur in the bay anymore.

SITE SUMMARIES

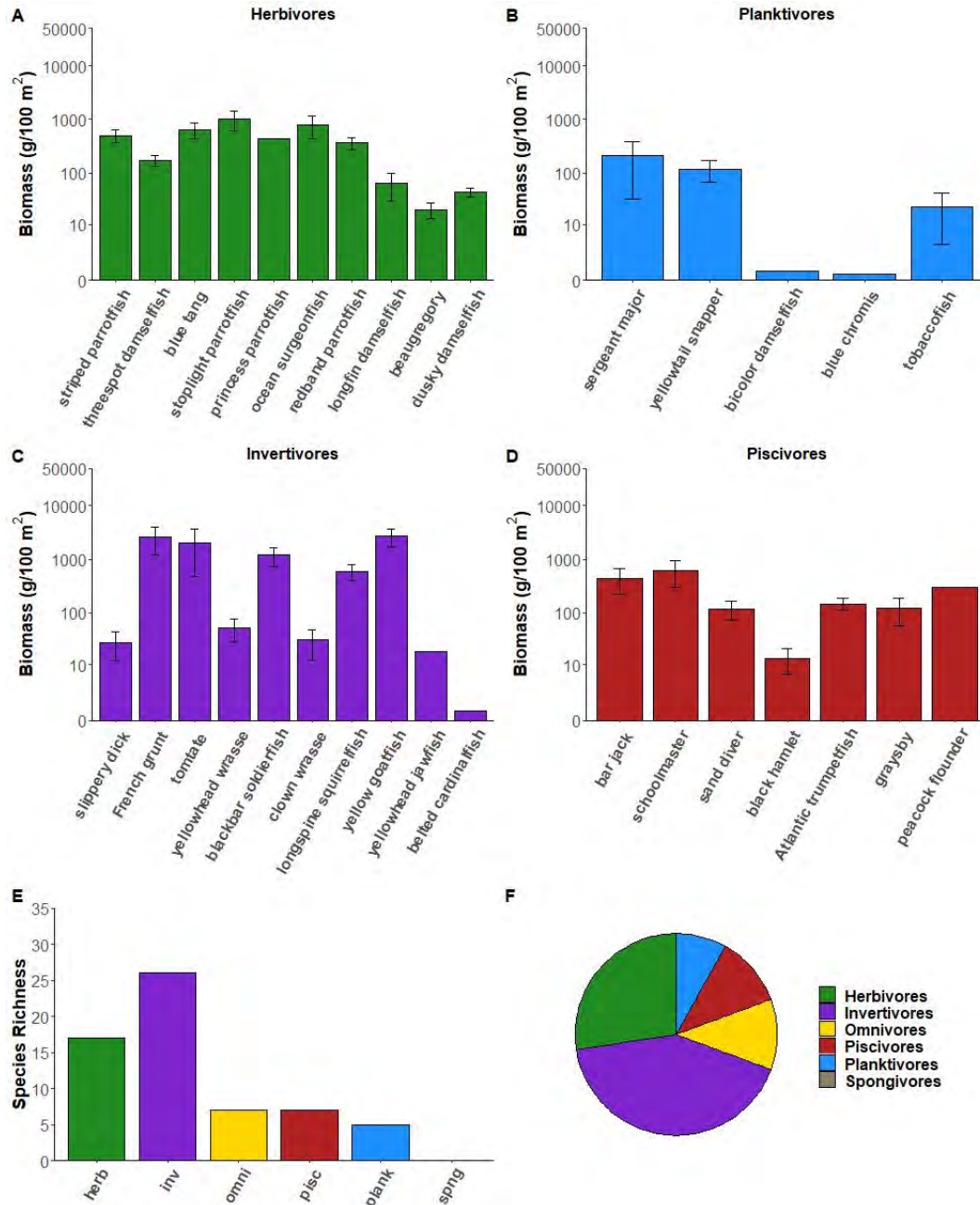


Figure 146. The Magens Bay fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

SAVANA ISLAND

Description. The Savana Island site is a midshelf fringing reef facing the Atlantic Ocean to the northwest in depths of 5 – 17 m. The reef is a well-developed coral community atop bedrock, with some insipient carbonate accumulation. Savana has been monitored since 2003, with permanent benthic transects installed in 2007.

Outstanding Feature. Savana harbors behemoth colonies of boulder star coral (*Orbicella faveolata*) and a diverse and abundant fish community.

Threats. Savana is threatened the invasive algae *Ramircrusta textilis* (Hollister et al. 2021) and by warming ocean temperatures, as *O. faveolata* can be susceptible to bleaching, disease, and partial mortality. The area is also open to fishing and the occasional accumulation of debris can be seen.

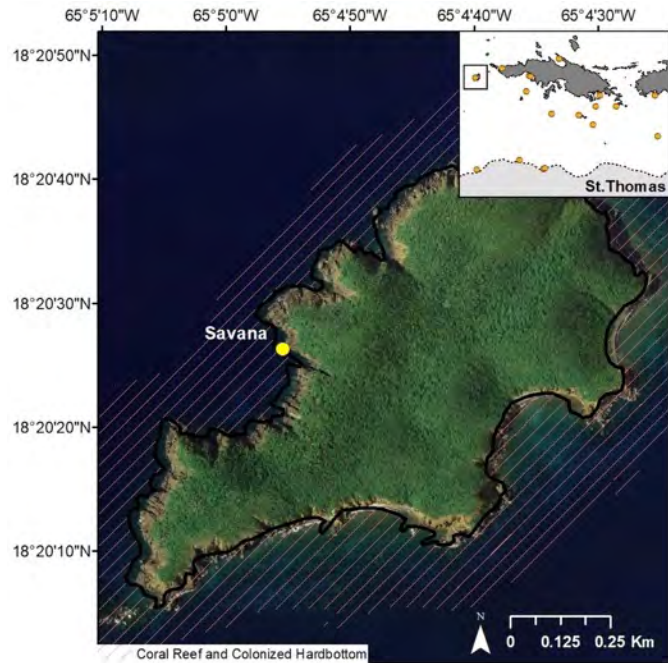


Figure 147. Savana. (top) Location. (right) A representative photo of the reef showing large colonies of *Orbicella faveolata* (Nov. 17, 2015).



SITE SUMMARIES

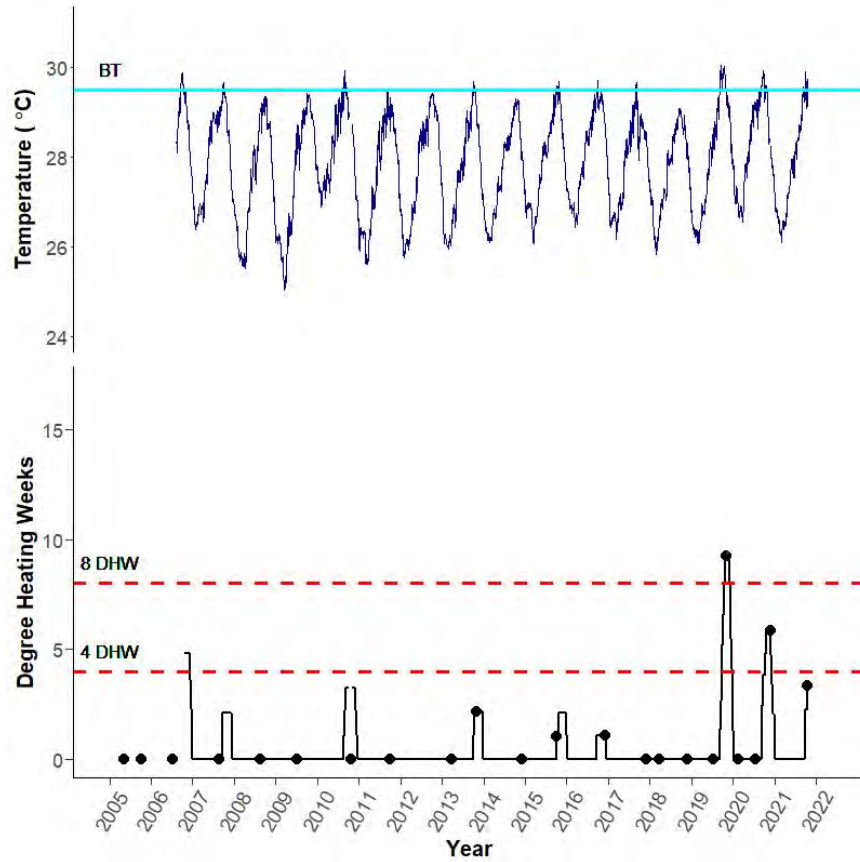


Figure 148. Savana benthic temperature record (10 m depth).

Physical Characteristics.

Current. Currents have not been measured directly at Savana. Strong unidirectional currents can influence the surface near the site. Wave-driven oscillatory currents are common and occasionally strong.

Temperature. Savana has temperatures cooler than other shallow sites, likely due to the proximity of the open Atlantic Ocean.

SITE SUMMARIES

Benthic Community. Boulder star corals, predominately large (>2m wide) colonies of *Orbicella faveolata*, dominate the coral community at the Savana monitoring site. The site lost 45.2% of its coral cover in the 2005 bleaching event. Coral cover has continued to decline, rather than recover, and this is related to a striking increase in the red encrusting algae *Ramicrosta textilis* to over 60% cover (this is responsible for the spike in “macroalgae” in benthic cover after 2005). This alga overtops coral edges leading a slow, creeping mortality. In addition, SCTLD appeared in 2019 and has also contributed to a decline in coral cover. This has especially impacted the remaining *Orbicella* spp., which have declined dramatically. Gorgonians and sponges are also prominent components of the sessile epibenthic animal community.

Coral Health. The coral community at Savana was highly affected in the 2005 bleaching event, with 80% of corals affected on almost 90% of the colony surface. Bleaching was also very prominent in 2006, but at a lower extent. Bleaching was moderate during the 2010 bleaching event, with over 50% of colonies bleached at a low extent. Coral diseases can reach high prevalence and are diversely represented. Particularly noticeable is the dramatic outbreak of white disease in 2006. Dark spots disease has also affected a high proportion of corals from 2008 onwards. Old partial mortality increased markedly after the 2005 coral bleaching event and has declined only slightly. Recent partial mortality after the 2005 coral bleaching event was unprecedented for any site.

SITE SUMMARIES

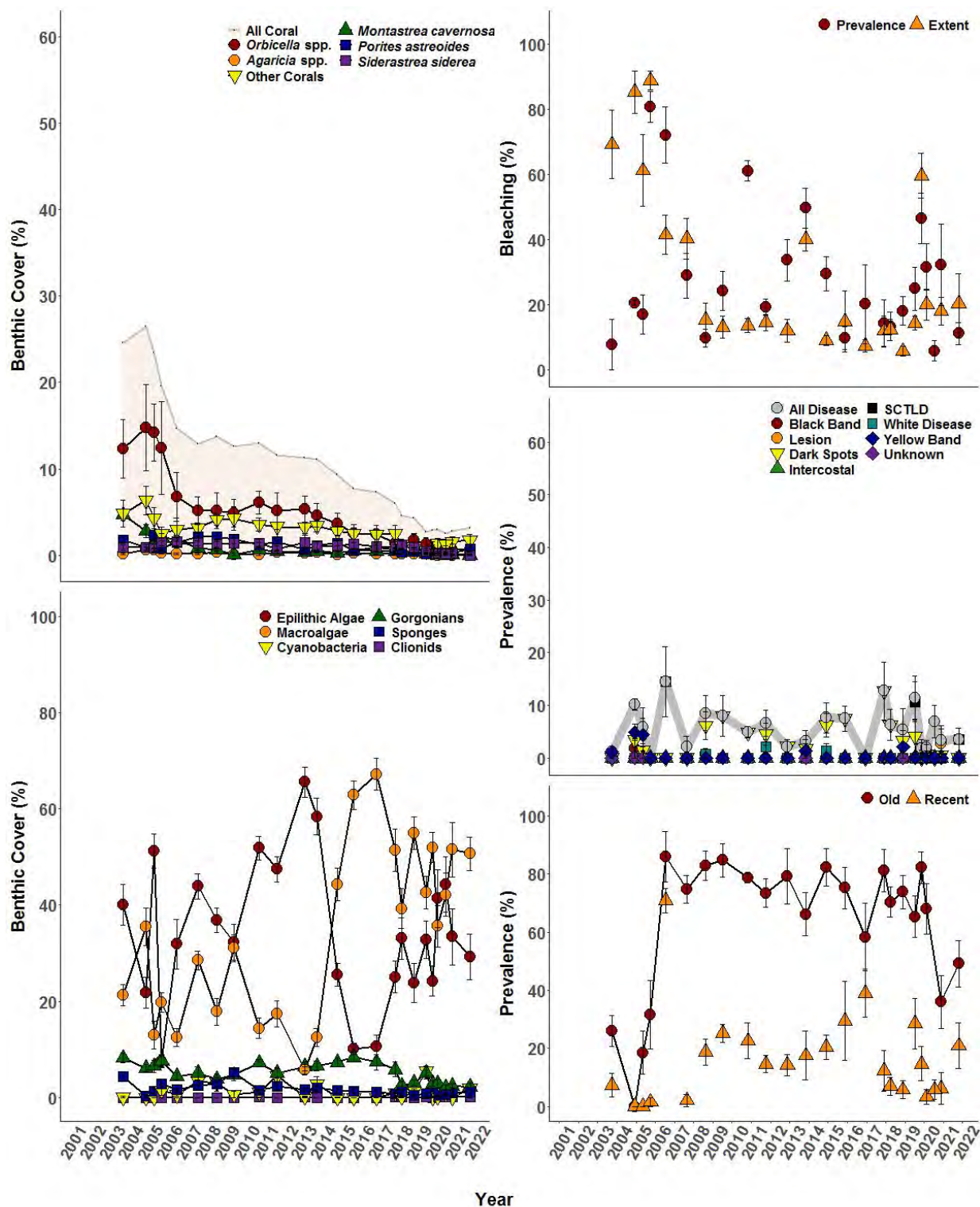


Figure 149. Savana Island benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. The Savana Island fish community is low in biomass, but is quite diverse, and highlights the variety of benthic resources available to fishes in the area. The site is dominated by numerically herbivores, but it also supports a diverse invertivore community and is dominated in biomass by planktivores. The quiet, relatively protected bay receives circulation and resulting plankton loads during parts of the tidal period, supporting large yellowtail snapper and schools of creole wrasse. Jacks and mackerels are commonly seen circling anchovies and other small bait fish. At other times, when the current is less favorable, planktivores are limited to small pomacentrids. Herbivore biomass is evenly split between the common parrotfish species and Acanthurids. Schools of mixed blue tang and surgeonfish are observed grazing the reef commonly. The most numerous piscivore observed at Savana is the coney. These are numerous near the bedrock periphery of the site along the island shoreline. One small yellowmouth grouper (11-20 cm) was observed on a belt transect in 2012, the first seen on a shallow site. Otherwise no large snappers and groupers have been seen in the bay. The area is highly fished with fish traps.

SITE SUMMARIES

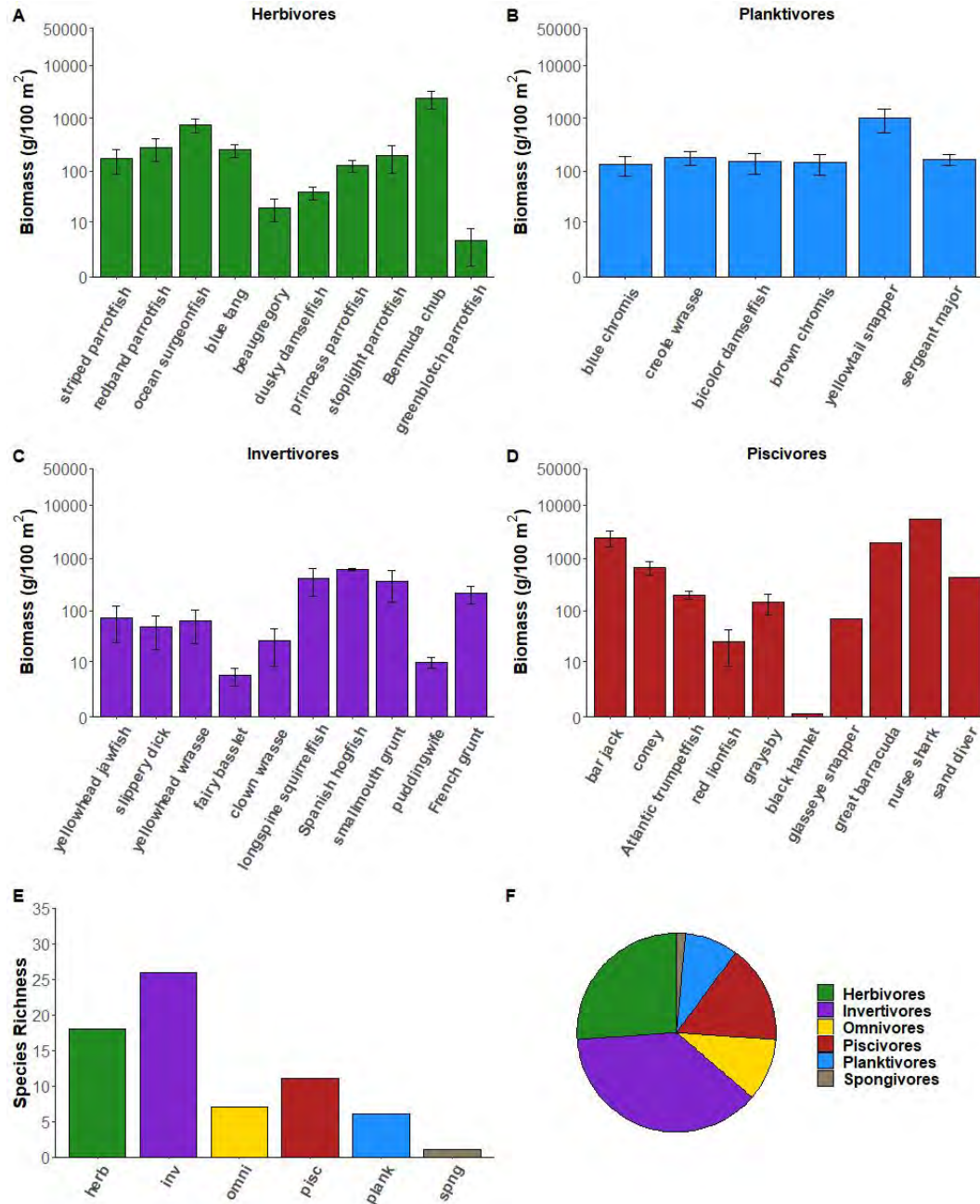
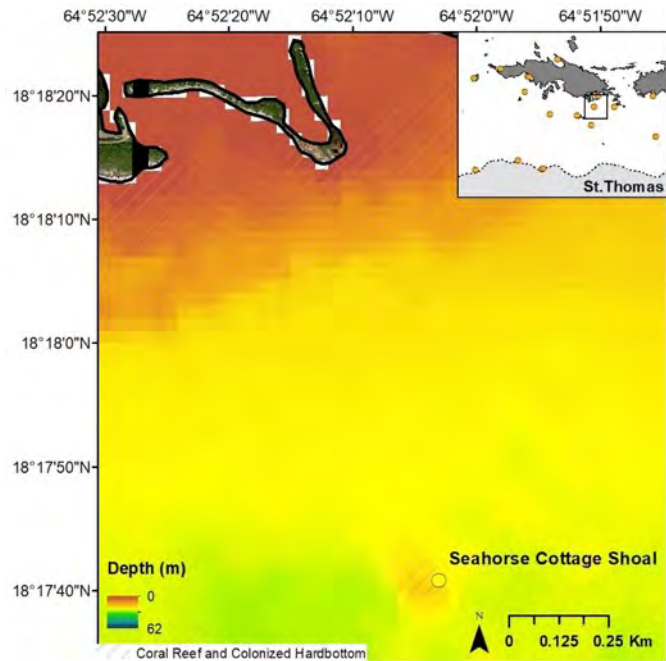


Figure 150. The Savana Island fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

SEAHORSE COTTAGE SHOAL

Description. The Seahorse Cottage Shoal site is a large patch reef surrounded by sand and rhodolith in depths of 17 – 23m. The isolated reef is flat topped and dominated by *Orbicella* spp.. Seahorse has been monitored since 2003, with permanent benthic transects installed in 2007. A ciguatera study with monthly to quarterly sampling has been ongoing since 2009.



Outstanding Feature. Seahorse supports a diverse and abundant coral and fish community adjacent to the St. Thomas East End Reserves.

Threats. Seahorse is buffered from land-based sources of pollution. The site is a targeted site in the St. Thomas trap fishery and trap strings have been observed over and adjacent to the site.

Figure 151. Seahorse Cottage Shoal. (top) Location. (right) A representative photo of the reef.



SITE SUMMARIES

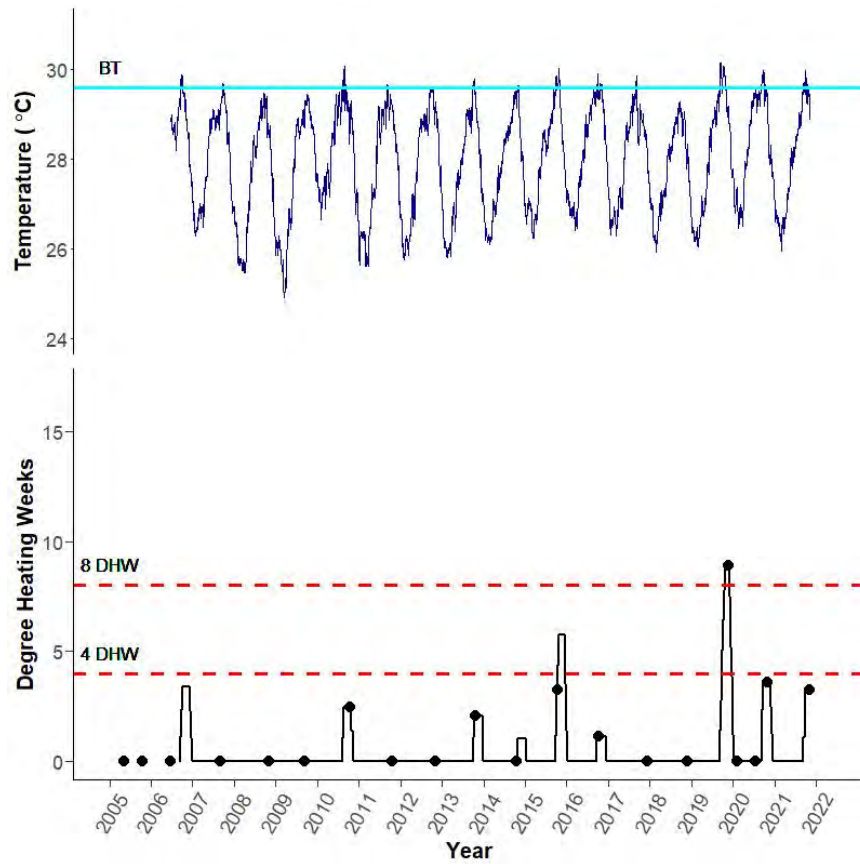


Figure 152. Seahorse benthic temperature record (21 m depth).

Physical Characteristics.

Current. Currents have not been directly measured at Seahorse Cottage Shoal.

Unidirectional benthic currents tend to be slow and wave-driven oscillatory currents only occur during heavy storm activity.

Temperature. Benthic temperatures are moderate to high during warming events.

SITE SUMMARIES

Benthic Community. The coral community of the Seahorse site is dominated by the boulder star coral (*Orbicella* spp.) but hosts a high diversity of other coral species. The site lost 46.6% of its cover in the 2005 bleaching event and had only regained 4.7% of this loss by 2011. SCTL D appeared in 2019 and caused a decline in coral cover from 16% in October 2018 to less than 5% in October 2020. Gorgonians and sponges are also common components of the sessile epibenthic animal community. The algal community is co-dominated by epilithic algae and the macroalgae *Lobophora variegata* and *Dictyota* spp..

Coral Health. The coral community bleached severely in the 2005 bleaching event with nearly 100% of corals bleaching over about 100% of their surface. Bleaching prevalence after 2005 was slow to decline due to delayed recovery in large *Orbicella* spp. colonies. The site also had a high prevalence of bleaching in the 2010 event, but at a low extent on colonies. Bleaching was also moderately prevalent in 2011. In 2019 bleaching was moderate to severe in terms of prevalence and extent. Coral diseases are common and diverse at Seahorse. White disease was also prevalent in 2004, which is rare for a site this shallow. SCTL D appeared in 2019 and reached very high prevalence. Dark spots disease is also ubiquitous. Old partial mortality increased to a very high prevalence after the 2005 bleaching event, but had declined by 2011.

SITE SUMMARIES

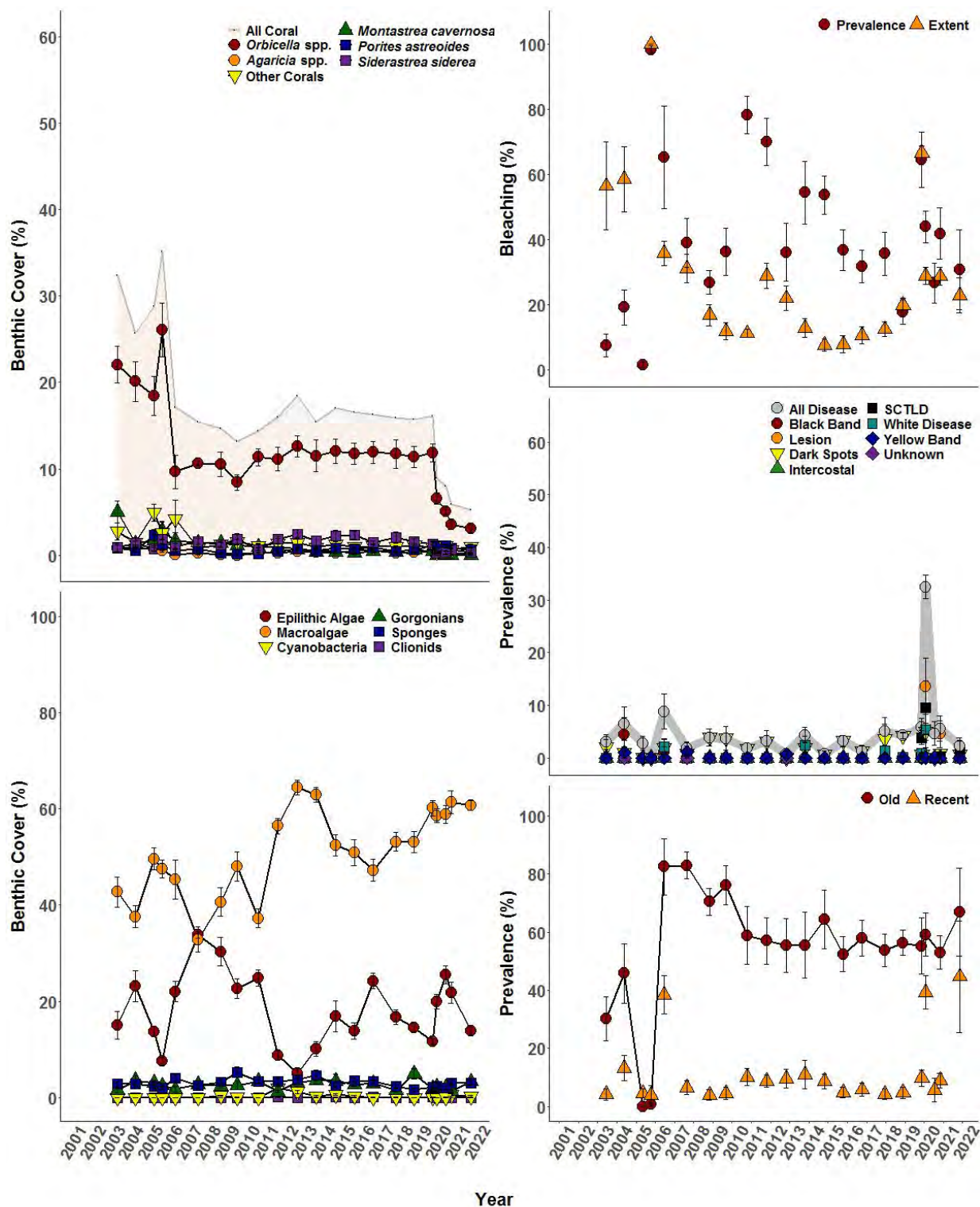


Figure 153. Seahorse Cottage Shoal benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. Seahorse Cottage Shoal supports a large variety of reef fish and hosts aggregations of gray snapper and lane snapper during the summer months. The trophic guilds on the offshore reef are split relatively evenly between herbivores and invertivores, with piscivores nearly as high in biomass during some years. This reflects the heterogeneity of reef substrate and the availability of unconsolidated sand and rhodolith habitat surrounding the reef. The orientation on the circular offshore reef determines the number and species of fish observed. On the western edge of the reef, schools of snapper and porgies can be found. Mutton snapper and queen triggerfish are also relatively common on this edge of the reef. The top of the low spur and groove reef on the other hand holds mainly glasseye snapper, wrasses, and parrotfish. Adult stoplight and redband parrotfish dominate herbivore biomass while glasseye snapper and graysby dominate the benthic piscivore trophic guild. Jacks and mackerels are common on the site. Seahorse Cottage Shoal is well known to fishermen and is heavily fished. Traps on the reef are common during surveys. Except for one sub-adult goliath grouper observed there in 2012, large groupers have never been seen on the reef. However, schoolmaster, lane, gray, and mahogany snapper are all common. This may reflect the proximity to nursery habitats in the St. Thomas East End Reserves and the mangrove habitats therein.

SITE SUMMARIES

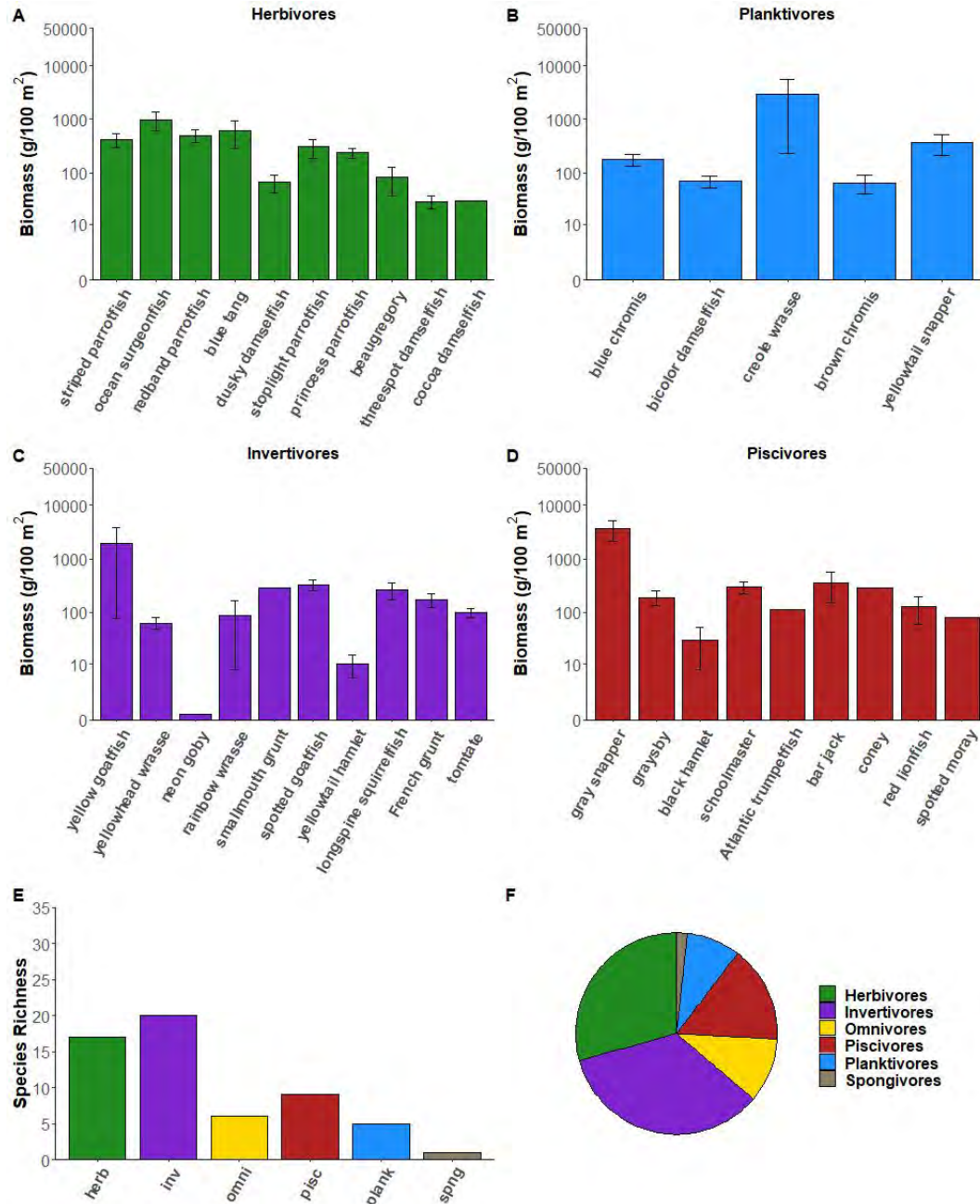


Figure 154. The Seahorse Cottage Shoal fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

SOUTH CAPELLA

Description. The South Capella site is located on a rise of the St. Thomas-St. John midshelf reef complex in depths of 16 - 25 m. The reef is made of rolling ridges of coral and pavement interspersed with sand grooves. South Capella has been monitored since 2003, with permanent benthic transects installed in 2007.

Outstanding Feature. The South Capella site is part of an outstanding shallow water midshelf reef system that is essential fish habitat.

Threats. The St. Thomas trap fishery heavily targets South Capella. Active and derelict trap strings crisscross the site and a derelict trap appeared in permanent transect 1 in 2008 and has been degrading there since. The trap was still fully intact as of 2016 but not actively trapping. The reef was also highly affected by the 2005 coral bleaching event, suggesting a susceptibility to rising sea surface temperatures.

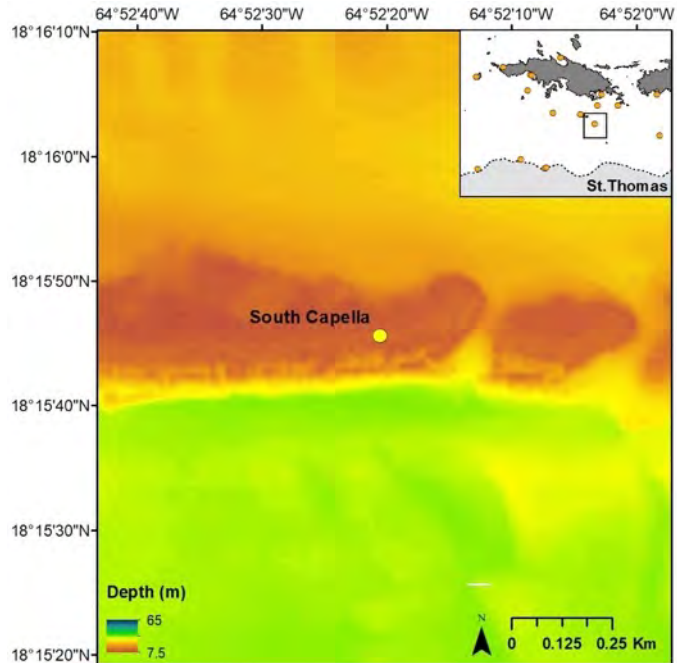
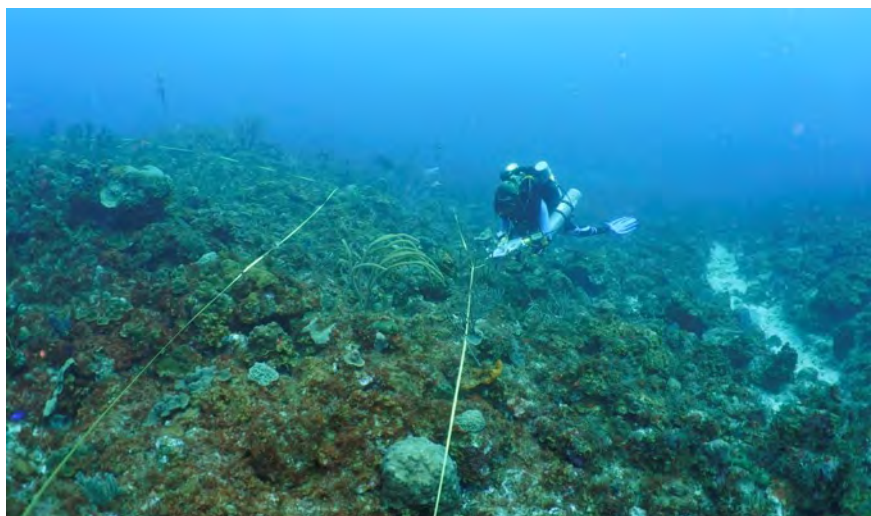


Figure 155. South Capella. (top) Location. (right) Representative photo of the reef (photo credit: V. W. Brandtneris).



SITE SUMMARIES

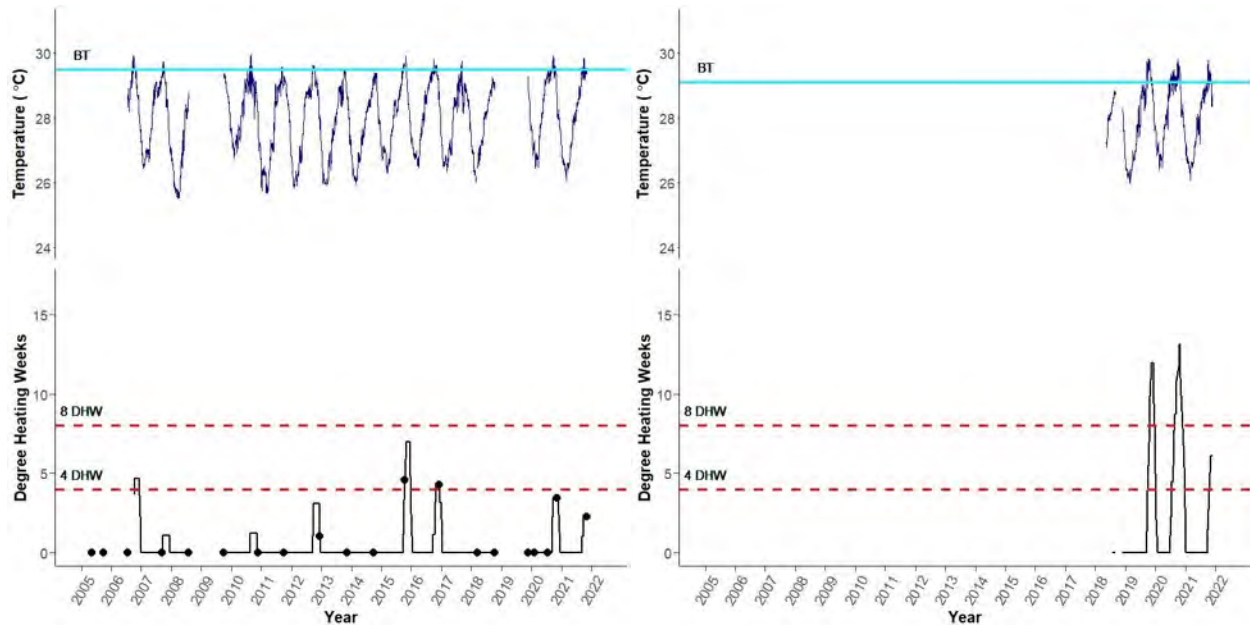


Figure 156. South Capella benthic temperature record (Top right: 24 m depth, top left: 35 m depth).

Physical Characteristics.

Current. Currents were directly measured at South Capella and this data will be included in a future report. Wave-driven oscillatory currents have not been experienced but are likely during swells and storms. Unidirectional benthic currents are usually weak, but strong currents can develop from the surface to midwater.

Temperature. South Capella has relatively cool benthic temperatures for a shallow site during warm years, which may reflect its moderately deep depth and proximity to deep water to the south. The thermistor deployed for 2018-2019 failed to record data.

SITE SUMMARIES

Benthic Community. Boulder star corals (*Orbicella* spp.) dominate the coral community at South Capella. These corals were very heavily affected by mortality due to the 2005 coral bleaching event. The site lost 56.4% of its cover and had not regained any cover by 2011 (-3.7% recovery). SCTLD appeared in 2019 and caused a sharp decline in coral cover. Gorgonians and sponges are also common components of the sessile epibenthic animal community. The macroalga *Lobophora variegata* dominates the algal community, with epilithic algae and *Dictyota* spp. comprising the second largest shares. There was also a high abundance of crustose coralline algae and filamentous cyanobacteria.

Coral Health. Corals were moderately-heavily affected by the 2005 bleaching event, with a prevalence of 80%, but an extent on colonies of only about 50%. Bleaching prevalence also increased during the 2010 bleaching event, but at a low extent. In 2019 bleaching prevalence and extent was relatively severe. Bleaching is moderately prevalent at this site even in years without notable thermal stress. Coral diseases are common and diverse at South Capella. White disease was prevalent after the 2005 bleaching event in 2006, and then again in 2009 and 2011. Black band disease was found in 2002, which is unusual for a site at these depths. Dark spots disease was also typically present in most years. SCTLD appeared at the site in 2019. Old partial mortality increased after the 2005 bleaching event and has declined to 2011. Recent partial mortality was prevalent in most years of monitoring, particularly in 2006. In years not following thermal stress the highest identifiable source of recent partial mortality was biting from territorial damselfish (*Stegastes* spp.).

SITE SUMMARIES

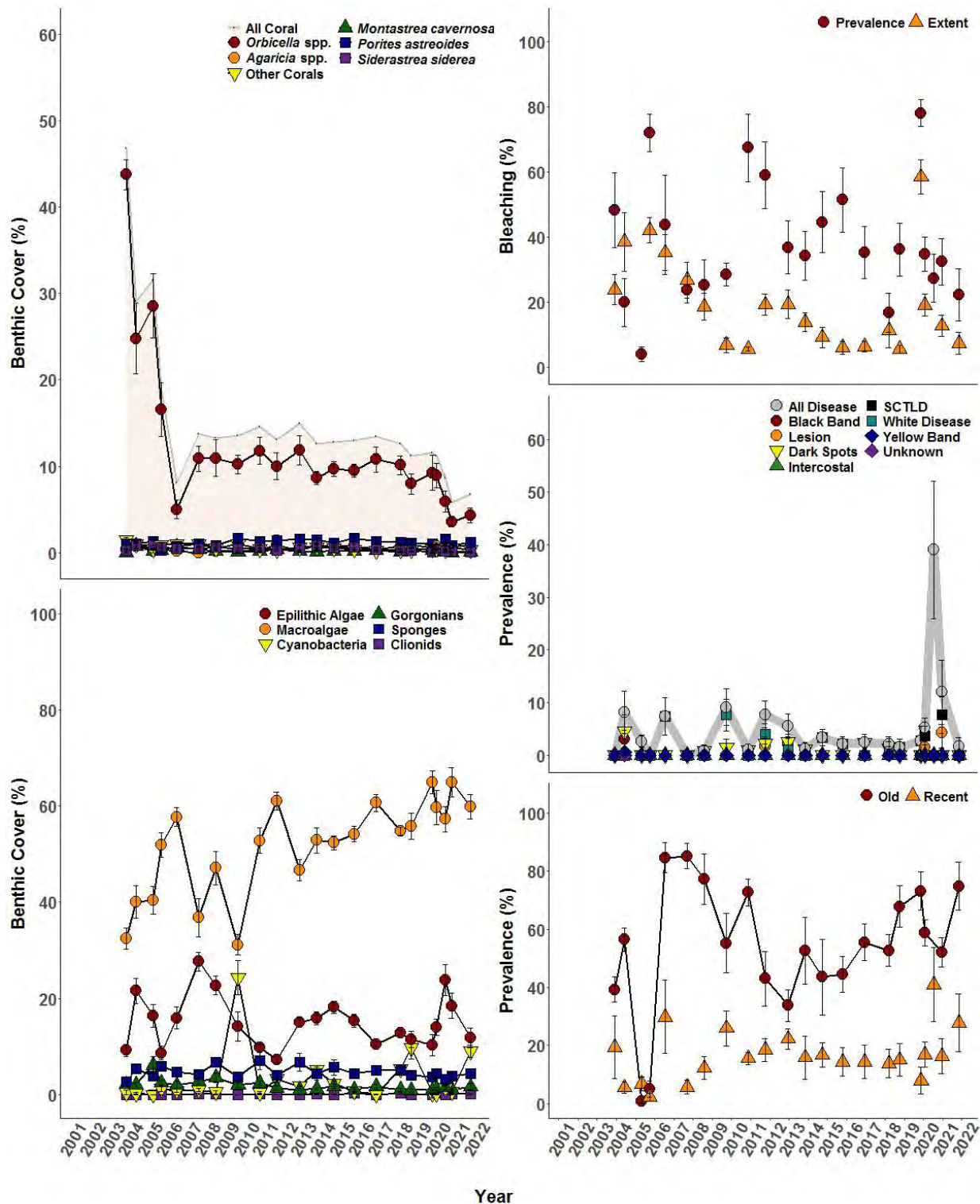


Figure 157. South Capella benthic cover and coral health through time (mean ± SE).

SITE SUMMARIES

Fish Community. South Capella is characterized by a diverse fish community that is well split between trophic levels. Schools of schoolmaster snapper are observed regularly and usually dominate the piscivore biomass, however these schools may be small spawning aggregations and not typical of the daily fish community. The reef is spur and groove with complex reef edges and sand channels that support a large number and variety of invertivores. Grunts and goatfish comprise most of the invertivore biomass. Planktivores include the yellowtail snapper, as well as creole wrasse and black surgeon, generally seen on shelf edge reefs. Benthic herbivores are dominated in biomass by striped parrotfish with redband, stoplight and queen parrotfish also common. The South Capella reef is a highly fished area and traps are commonly seen during our survey events. The rich, complex reef is noticeably bare of large snappers and groupers. The serranid group is represented only by the graysby and small hamlets, with an occasional red hind observed. Nassau grouper have never been observed at this site. Conversely, red lionfish continue to occur more commonly at the South Capella reef than any other mid-depth offshore site.

SITE SUMMARIES

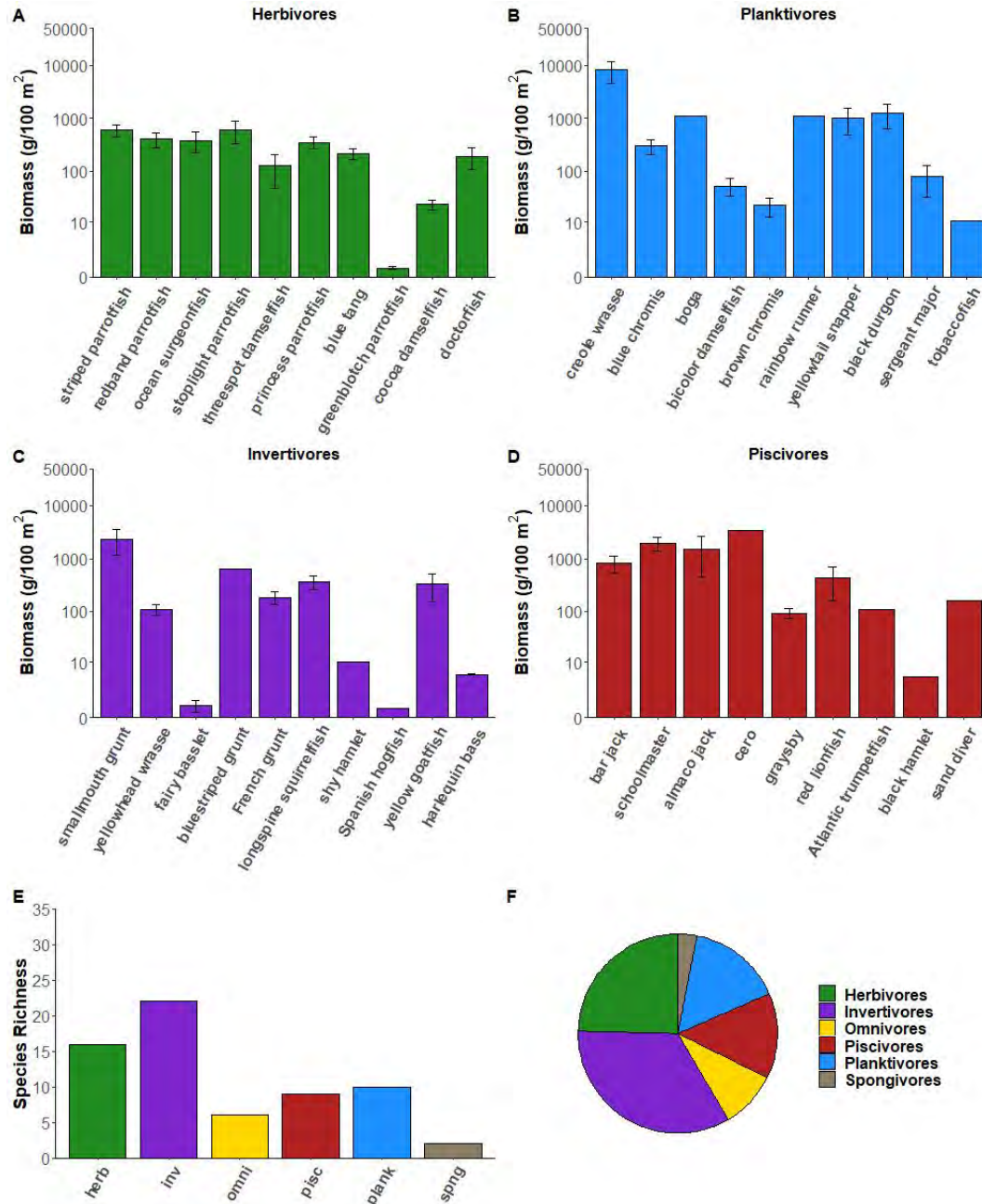
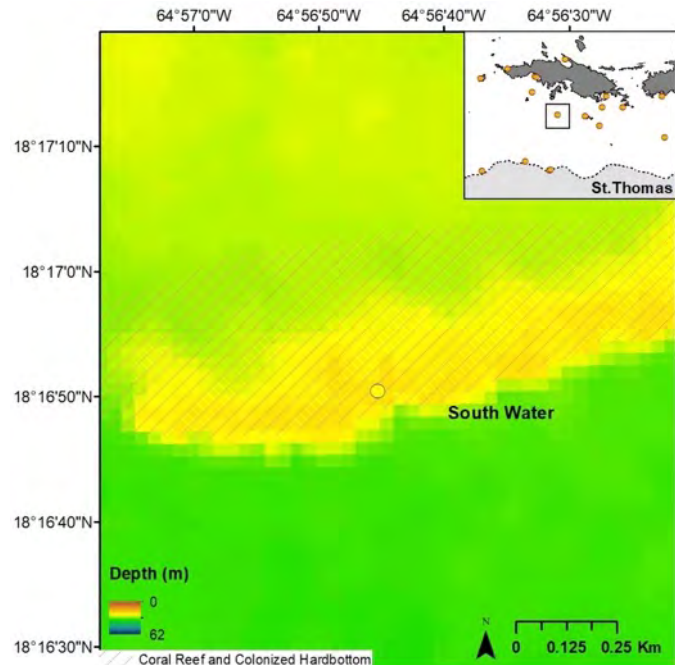


Figure 158. The South Capella fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

SITE SUMMARIES

SOUTH WATER

Description. South Water is a hardbottom coral community along the sharp break of a midshelf hardbottom reef complex in depths of 17 – 28 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. South Water has been monitored since 2005, with permanent benthic transects installed in 2007.



Outstanding Feature. South Water is a commercially important fishing ground for reef fishes and spiny lobster.

Threats. South Water is primarily threatened by fishing and strings of fish and lobster traps are common over the site.

Figure 159. South Water. (top) Location. (right) A representative photo of the reef (Photo credit: J. Quetel).



SITE SUMMARIES

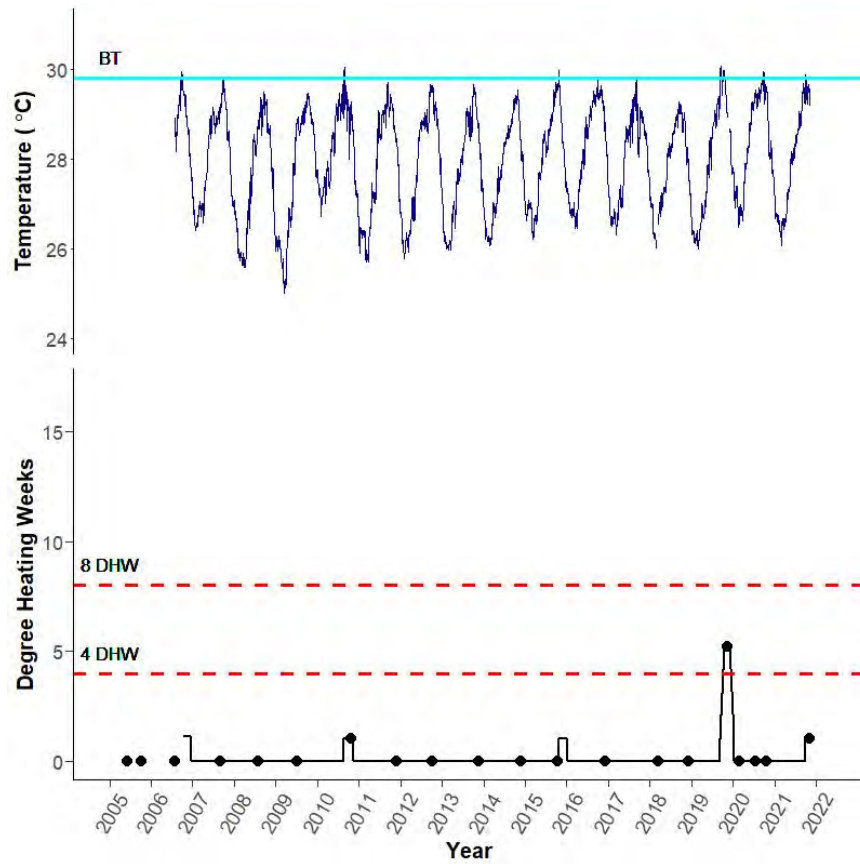


Figure 160. South Water benthic temperature record (24 m depth).

Physical Characteristics.

Current. Current measurements have not been taken at the South Water site.

Unidirectional benthic currents can be moderate on the hardbottom reef top and strong from the surface to midwater. Wave-driven oscillatory currents are likely to be felt on the reef top during swells and storms.

Temperature. South Water has relatively moderate temperatures compared with other shallow water sites during warm years. This may be due to the deeper depths of the site and the proximity of deep water.

SITE SUMMARIES

Benthic Community. The sparse coral community at South Water is very diverse. Coral cover increased by 21.3% over the 2005 bleaching event and had increased by 42.6% between 2005 and 2011. However, permanent transects were not installed until 2007 and the low coral cover means that small variations in detection of corals can lead to large apparent year-to-year differences in cover. Sponges and gorgonians dominate the sessile epibenthic animal community. The algal community is nearly equally divided between *Lobophora variegata*, *Dictyota* spp., and epilithic algae. Crustose coralline algae and filamentous cyanobacteria are also very common.

Coral Health. Corals were severely affected by the 2005 coral bleaching event, with over 80% of corals bleaching over nearly the entire coral surface. Corals were moderately affected in the 2010 bleaching event, with just less than 50% of corals bleaching at a low extent. In 2019 bleaching prevalence and extent was moderate. Bleaching tends to be moderately prevalent even in non-thermal stress years. Coral diseases are not common, although there is a trend of increasing dark spots disease. SCTL D appeared at the site in 2019. Old partial mortality increased in prevalence after the 2005 bleaching event, but at a lower prevalence than most other sites. Recent partial mortality is rare.

SITE SUMMARIES

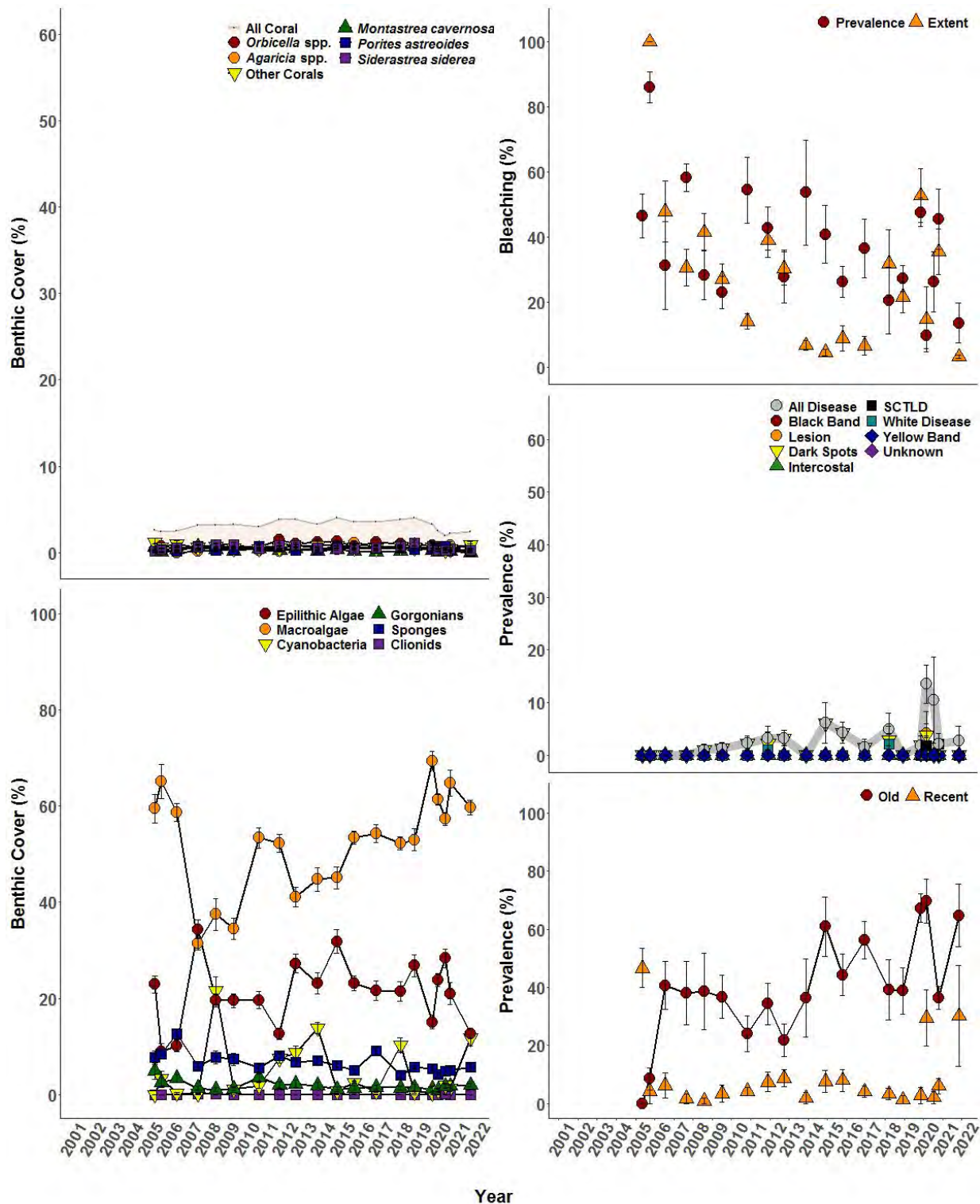


Figure 161. South Water benthic cover and coral health through time (mean $\pm$ SE).

SITE SUMMARIES

Fish Community. South Water Island is a hard bottom reef crossed by sand channels that supports primarily invertivores and herbivores. Fish biomass is lower on this site than most other offshore and mesophotic sites of St. Thomas. The invertivore biomass is dominated by queen triggerfish, long-spine squirrelfish and grunts. Mutton snapper are occasional off the southern edge of the reef. Stoplight and redband parrotfish dominate the herbivore biomass, and many juvenile and sub-adults of these species as well as striped and princess parrotfish occur across the site. Piscivores generally make up a very small percentage of the biomass on the South Water Island site; small mackerels and jacks are commonly observed, driving up average biomass, but the guild is primarily composed of graysby, coney and medium sized snappers that school along the reef edge. The site lies several miles from the shelf edge, and planktivores are in general limited to yellowtail snapper and small chromis. South Water Island is highly fished and traps are commonly seen during our survey events. Lobsters are common on this low-lying reef, hiding in the hard bottom ledges that extend across the site lining the sand channels. Apart from mutton snapper, the reef is devoid of large snappers and groupers.

SITE SUMMARIES

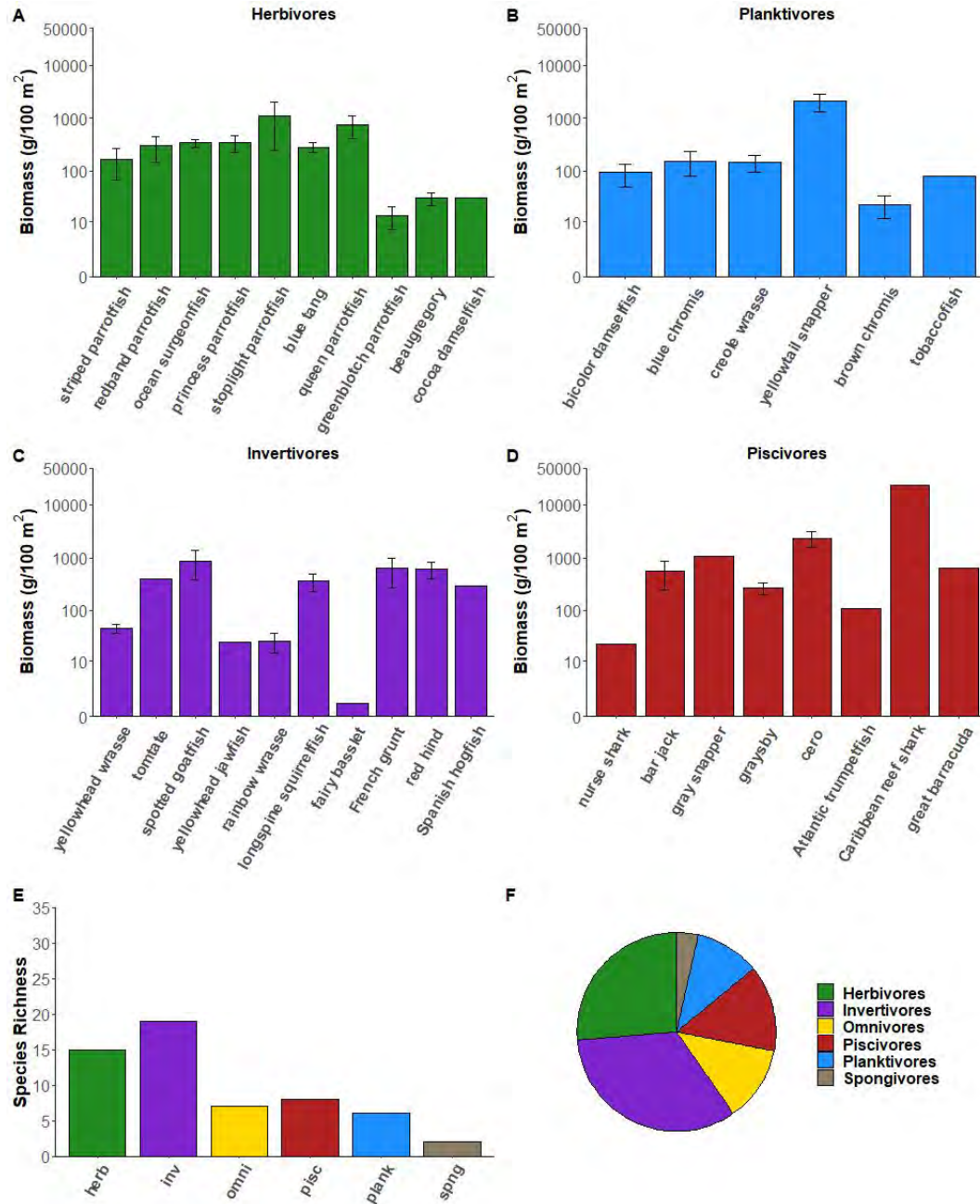


Figure 162. The South Water fish community as (A-D) average biomass per trophic group with the most common species shown in order on the x-axis, (E) species richness, and (F) relative community composition by total biomass. Note that biomass is a log scale.

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