Gene Banking Florida's *Porites astreoides* and additional weedy coral species

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Final Report

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Management Summary

Florida's coral reefs have experienced extensive losses of living coral cover over recent decades due to repeated thermal bleaching, disease outbreaks, water-quality stressors, and ocean acidification (Fisher 2023). Coral biorepositories, or coral gene banks, help ensure that important genetic diversity is not lost from Florida's Coral Reef (Hagedorn et al. 2025; Hagedorn et al. 2021). As restoration efforts expand, weedy coral species, which are stress-tolerant and increasingly dominant on present-day reefs, remain underrepresented in Florida's coral biorepositories relative to their ecological importance (Toth et al. 2019; Darling et al. 2012).

This project addressed that gap by acquiring living fragments and tissue samples from seven target weedy coral species: *Porites astreoides, Agaricia agaricites, Siderastrea siderea, Siderastrea radians, Solenastrea bournoni, Solenastrea hyades,* and *Stephanocoenia intersepta*. Collections spanned four reef zones across six Florida Department of Environmental Protection (DEP)-prioritized regions of the Florida Coral Reef. Corals were acquired through direct collections of corals of opportunity (COOs), transfers from Florida restoration organizations, and rescue corals obtained by the Office of National Marine Sanctuaries (ONMS) from nearshore construction projects.

In total, 287 colonies were collected from 71 unique reef sites across 17 logged field expedition days. These included 244 genotypes from targeted weedy species and 43 genotypes from other species in demand by the Gene Bank. Each colony received a unique coral ID linking underwater photographs, scale-bar photographs, GPS coordinates, depth, reef zone, environmental parameters, and tissue samples preserved in DNA/RNA Shield and ethanol. Collections were conducted under Florida Keys National Marine Sanctuary permit #FKNMS-2026-048 and Special Activity License #SAL-24-2116-SRCP. Live colonies and tissue samples were transferred to Mote's International Coral Gene Bank in Sarasota, Florida, resulting in a fivefold increase in their gene-banked weedy coral genotypes.

Executive Summary
Land-based biorepositories, commonly called gene banks, preserve coral species and intra-species genotypic diversity outside the cumulative threats facing in-water nurseries and natural reef populations. Mote Marine Laboratory's International Coral Gene Bank in Sarasota, Florida, currently holds thousands of stony coral colonies, with a per-species target of 72 distinct genotypes held in triplicate. Florida's acroporid and orbicellid species have received the largest share of past biorepository attention because of their historical reef-building dominance and Endangered Species Act listing. Weedy coral species, which are stress-tolerant and now represent a dominant assemblage of Florida's modern coral reef communities, remain underrepresented in Florida's gene bank inventory despite their growing ecological prominence and value to resilience-focused restoration.

This project (DEP C6667A; FY25-26) was designed to expand Mote Marine Laboratory's International Coral Gene Bank's representation of seven target weedy coral species across Florida's Coral Reef. The four objectives were to: (1) collect 2–3 colonies of *Porites astreoides* per reef zone (marginal, nearshore, midchannel, offshore) in each of six DEP-prioritized regions; (2) opportunistically collect 2–3 colonies per zone of *Agaricia agaricites, Siderastrea siderea*, *Siderastrea radians*, *Solenastrea bournoni*, *Solenastrea hyades*, and *Stephanocoenia intersept*a when present; (3) record standardized metadata (GPS coordinates, depth, approximate size, coral ID, photos) and collect tissue samples preserved in DNA/RNA Shield for every colony; and (4) transfer collected colonies and tissue samples to Mote's International Coral Gene Bank for long-term care and preservation.

Across the reporting period, CIMAS and Mote scientists completed 17 logged field expedition days, yielding 287 colonies from 71 unique reef sites spanning Martin/Palm Beach, Miami/Broward, the Upper Keys, Middle Keys, Lower Keys, and Marquesas Keys. The two leading target species gene banked were *Porites astreoides* (52 colonies) and *Siderastrea siderea* (50 colonies). *Solenastrea hyades* (10 colonies) and *Agaricia agaricites* (21 colonies) had the lowest gene banked totals due to strong habitat zonation, with *S. hyades* found more often in marginal/nearshore zones and *A. agaricites* in offshore/midchannel zones. Collections were strongest in Miami/Broward (56 colonies) due to ease of access, familiarity with local reef sites, favorable weather, and need, as Mote's Gene Bank already held several representative genotypes of weedy coral species from the Lower and Upper Keys. Every colony in the project registry is linked to underwater photographs, ID-tagged scale-bar photographs, environmental observations, and tissue subsamples preserved in ethanol (for genetics) and DNA/RNA Shield (for microbiome). Collected colonies and tissue samples have been transferred to Mote's International Coral Gene Bank in Sarasota, where they have been or will soon be fragmented in triplicate onto ~3 cm plugs with RF-ID chips for tracking. After a one-month quarantine period, corals are integrated into the Gene Bank's long-term holding systems. Corals acquired through this project support Mote's Gene Bank goal of maintaining genetic representatives of threatened coral species for restoration, assisted sexual reproduction, and future research to help ensure genetic diversity in restored and wild populations is not lost.

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1. BACKGROUND

Florida's Coral Reef is the only barrier reef system in the continental United States and the third-largest barrier reef system in the world. It contributes billions of dollars annually to the regional economy, acts as a primary coastal defense, and supports an abundance of marine life (Lane et al., 2013; Micheli et al., 2014; Storlazzi et al., 2021). Over the past four decades, Florida's reef has experienced precipitous losses of living coral cover driven by repeated thermal bleaching, disease outbreaks, declining water quality, coastal development, and ocean acidification (Lane et al., 2013; Micheli et al., 2014; Storlazzi et al., 2021). The cumulative impact of stressors has restructured the species composition of Florida's reefs so that historically dominant reef-building species, acroporids and orbicellids, are now greatly reduced, while smaller, stress-tolerant, collectively referred to as *weedy* species, represent the dominant coral species on Florida's Coral Reefs (Fisher et al. 2023, Toth et al. 2019).

Coral restoration is now a central component of Florida's coral reef management strategy. As outplant programs scale, the long term resilience of restored populations depends on maintaining the genetic and species diversity present in source stocks. Land-based coral biorepositories, or gene banks, fulfill this role by preserving species and intra-species genotypic diversity outside the threats facing in-water nurseries and natural reef populations (Hagedorn et al., 2025). Mote Marine Laboratory's Coral Gene Bank in Sarasota, Florida, currently holds thousands of stony coral colonies. The Gene Bank's per-species target is 72 distinct genotypes, held in triplicate, for each Florida coral species. This is based on a hierarchical spatial plan that includes the nine disturbance response regions, and then four distinct reef zones, with a goal to collect 2-3 unique genotypes per reef zone per region (Figure 1). To date, the Gene Bank's inventory is mainly acroporids and orbicellids due to their listing under the Endangered Species Act and their historical role as Florida's primary reef-builders, while the weedy species remain relatively underrepresented.

Weedy corals are increasingly central to Florida's contemporary reef ecology. *Porites astreoides* is the focal species of this project and a brooding species with natural thermal tolerance, a substrate stabilizing role on reef habitats, and recognized for its value in resilience-focused restoration strategies. The additional target species *Agaricia agaricites, Siderastrea siderea, Siderastrea radians, Solenastrea bournoni, Solenastrea hyades,* and *Stephanocoenia intersepta* comprise much of the visible living coral cover that persists across Florida's reef zones today. Expanding biorepository representation of these species is therefore both a hedge against further losses and a direct investment in the breadth of stock available to Florida's coral restoration community and research interests.

This project (DEP C6667A) was scoped to address the weedy-coral inventory gap in Florida's gene bank inventory by completing standardized, well-documented field

collections of corals of opportunity across the six DEP-prioritized regions of the Florida Coral Reef and transferring all collected colonies and associated tissue samples to Mote's International Coral Gene Bank. The project objectives are summarized below and form the structural backbone of the methods and results sections that follow:

Objective 1 - Collect *Porites astreoides*. Collect 2–3 *Porites astreoides* colonies per reef zone (marginal, nearshore, midchannel, offshore) within each of the six DEP-prioritized regions: Martin/Palm Beach, Miami/Broward, Upper Keys, Lower Keys, Middle Keys, and Marquesas.

Objective 2 - Opportunistically collect additional weedy species. Collect 2–3 colonies per reef zone of up to four additional underrepresented weedy coral species (*Agaricia agaricites, Siderastrea siderea, S. radians, Solenastrea bournoni, S. hyades,* and *Stephanocoenia intersepta*) when present.

Objective 3 - Capture Standardized metadata. Record standardized metadata (GPS coordinates, depth, approximate size, coral ID, photos) and collect tissue samples preserved in DNA/RNA shield for every colony collected.

Objective 4 - Transfer to Mote's International Coral Gene Bank. Transfer collected colonies and tissue samples to Mote's International Coral Gene Bank for long-term care & preservation.

2. METHODS

Corals were acquired in three ways: direct field collections by project members, transfers from other restoration practitioners, and transfers of rescue corals. All field collections were performed by AAUS-certified divers from the University of Miami CIMAS and Mote Marine Laboratory. Coral of Opportunity (COO) collections were permitted under the Florida Keys National Marine Sanctuary (FKNMS) permit (#FKNMS-2026-048) or SAL permit (SAL-24-2116-SRCP). The methodology below describes the per-site protocol and the post-dive chain of custody transfer of colonies and tissue samples to Mote's International Coral Gene Bank. Figure 2 summarizes the workflow.

2.1. Site selection & refining reef zones across regions of Florida's Coral Reef

Six DEP-prioritized regions of the Florida Coral Reef were targeted: Martin/Palm, Miami/Broward, the Upper Keys, the Middle Keys, the Lower Keys, and the Marquesas (Figure 1). These six regions span more than 400km of contiguous Florida reef tract and capture the principal gradients in coral community composition along its length. Within each region, predefined dive sites were selected to span four reef zones, which varied by regions, but generally followed a marginal/nearshore to offshore gradient. Site selection along the marginal to offshore gradient was designed to capture environmental

heterogeneity in source habitats for each target species, which in turn maximizes the breadth of genotypic diversity captured for downstream gene-banking.

All regions contain a marginal reef zone which extends 50 m from land. While the Upper, Middle, and Lower Keys reef zones follow the typical marginal/nearshore to offshore gradient, reef zones of the Marquesas Region (Region 8) were distinct because of the influence of the Gulf, as well as the lack of populated land-areas (Figure 3). The Gulf zone in the Marquesas Region contains reefs north of the nearshore region, above the Gulf/Atlantic line (Figure 3A&B). The nearshore zone in the Marquesas consists of patch reefs, pavement, & mixed seagrass areas subject to higher temperature swings. A midchannel zone extends south from the nearshore zone up to the outer reef line (Figure 3B), where the offshore zone then begins. In the rest of the Keys, the nearshore zone consists of shallow, inshore patch reefs subject to greater environmental variation; hawk channel divides the nearshore from the midchannel zone which is typically murkier with intermediate depths; and the offshore zone contains the outer reef tract with the most typical reef conditions (Figure 3C). The northern regions of Florida's Coral Reef have three reef "lines" from nearshore to offshore that are commonly referred to as "Reef 1, Reef 2, and Reef 3." Thus, we use these delineations for the reef zones in Miami/Broward (Region 2) and Martin/Palm (Region 1a & 1b), in addition to the marginal zone (Figure 4). Potential sites were selected such that 2-3 sites per zone per region were visited.

2.2. In-field collection protocol

Collection sites were selected prior to each field day to ensure an efficient use of time to collect coral along the marginal to offshore zones. Team familiarity with the reefs, and their coral composition was also leveraged to improve efficiency of dive site selection. At each dive site (Figure 2A), GPS coordinates were recorded, AAUS-certified divers entered the water and searched for the seven target weedy coral species that qualified as corals of opportunity (COO), colonies that were completely detached from the reef framework. Collected COOs were photographed with their IDs and a ruler, then tissue samples were taken in-situ and stored in Whirl-Paks with corresponding coral IDs. Only one species was collected per dive site as a geographic safeguard to ensure collected colonies were genetically distinct. Once available COOs were collected and in-situ data collection was completed, the coral and divers returned to the boat. The corals were immediately placed in large coolers with seawater that was changed at each dive site. Within the coolers, corals were placed in baskets to redundantly separate by dive site, and the coral IDs were glued to the non-living part of the coral colony, often the bottom. While the coral were being situated, the coral tissue samples were processed by different team members which involved transferring the tissue samples into a 2ml tube of ethanol and separately into a 2ml tube of DNA/RNA shield, both labeled with the corresponding coral ID and stored on ice (Figure 2B). While omics sequencing and analysis is beyond the scope of this project, this in-situ tissue sample preservation provides a measurable baseline of genetic activity for potential future omics work. Finally, water temperature, pH,

dissolved oxygen, and salinity was measured with a YSI with a 30 foot line to reach approximate reef depth before leaving the dive site. Then the team would be boated to the next dive site and the process would repeat for approximately 4-7 collection sites per field day. Repeating the in-field (2A) and post-dive (2B) steps at each site allows the project to capture the necessary data systematically across all collected coral.

2.3. Coral Collections from Institutions

While most of the coral collections derived from in-situ COO collections, 6 corals came from collaborative institutions and another 6 were received as rescue corals from coastal construction projects via FKNMS personnel. Transfer agreement forms were used to track chain of custody.

2.4. Permitting and FKNMS Authorization

Collections of COOs in the FKNMS, which included the Marquesas, Lower Keys, Middle Keys, and Upper Keys regions, were performed under FKNMS permit (#FKNMS-2026-048) authorization. For each FKNMS region collection event, photographs and transfer-authorization documentation were submitted to the FKNMS permitting office through the Sanctuary's Google coral collection form and via email notification. The submission included scale-bar photographs, species, ID, GPS coordinates, region, site name, depth, and size. Collections in Martin/Palm and Miami/Broward were performed under permit (SAL-24-2116-SRCP) authorization.

2.5. Transfer to Mote's International Coral Gene Bank for long-term holding

Following transfer approval, colonies were transferred to Mote's International Coral Gene Bank in Sarasota, Florida for permanent long-term care. Corals were transported following best practices outlined in the 2026 FWC *Protocols for the Management of Coral Transportation*. At the Gene Bank, each colony was initially held in a quarantine system for a 30-day period of observation. During this time, each genotype/colony had the field ID's replaced with a Mote Universal ID, fragmented into triplicate replicates onto plugs with RF-ID chips, and accessioned into the long-term inventory system, Tracks. If no adverse health signs were observed after the quarantine period, corals were moved into the general Gene Bank holding systems such that one fragment per genotype was placed into three different systems. All corals are cared for following coral husbandry best practices. Preserved tissue samples (ethanol and DNA/RNA shield) accompany every transferred colony and remain associated with the colony record so that any downstream molecular work can be linked back to the source colony and its full collection metadata.

2.6. Metadata and data archival

The itemized metadata for every colony in this project can be found in the Q4 Exhibit A

Progress Report Task 2D submitted alongside this Final report.

3. RESULTS

3.1. Overall collection summary

During the project period, 287 coral colonies were collected from 71 unique reef sites, distributed across the DEP-prioritized regions of the Florida Coral Reef (Table 1 & Figure 5). Of those 287 colonies, 244 were the target weedy species and the remaining 19 were additional species that were in demand by the Gene Bank and collected opportunistically while searching for the target weedy species. This resulted in a 5x increase of gene banked weedy species genotypes in Mote's International Coral Gene Bank (Table 1 & Figure 5).

3.2. Collections by species

Collections by species are summarized in Figure 6. The two leading species by colony count were Porites astreoides (52 colonies) and Siderastrea siderea (50 colonies); together these two species account for 41.8% of the project's collected coral.
Solenastrea hyades (36 colonies) and Agaricia agaricites (21 colonies) had the least number of colonies collected. S. hyades was absent from the two northernmost regions (Martin/Palm and Miami/Broward), consistent with its more southerly Florida distribution, and nearly exclusively preferred marginal and nearshore (shallow) zones which are not common in the northern regions. Agaricia agaricites was found more commonly in offshore and midchannel (deeper) zones. Coral collection was dependent on their natural presence, and these patterns of species distribution have demonstrated strong zonation and region preferences for these two species.

3.3. Collections by region and reef zones

Collections by regions and reef zone are summarized in Figure 6. The region with the strongest collection count was Miami/Broward (56). Collectively, the cross-shelf gradient was represented in the collections (Figure 6). In the northern regions (Figure 7), marginal zone collections, which included urban corals collected from a seawall in Miami, accounted for 17% of the 92 colonies collected. While, the collections among the three Reefs were more equal: Reef 1 30%, Reef 2 32%, and Reef 3 21%. Of the 107 colonies collected from the Upper, Middle, and Lower Keys regions (Figure 8), 11% were from the marginal zone, 29% from nearshore, 24% from midchannel, and 36% from offshore. In the Marquesas region (Figure 9), we collected 45 colonies, 18% of which were from the gulf zone, 31% from nearshore, 16% from midchannel, and 36% from offshore.

3.4. Transfer & Long-term Care at Mote's International Coral Gene Bank

In a series of 7 transfer events, 247 total coral (7 weedy species and 19 additional species) have been received at Mote's Gene Bank in Sarasota, FL. From those transfer events, three groups have cleared the 30-day quarantine period and have been moved into general holding. Four groups are still in quarantine systems. So far, 543 replicate fragments on plugs with RFID chips have been created. The remaining coral to be fragmented will be fragged before the end of their quarantine periods.

Due to FKNMS permit protocols and transfer approval process, 38 corals are currently still in temporary holding at Mote's Summerland Key Facility and one is in temporary holding at Mote's Islamorada Facility These corals will be transferred to the Gene Bank on June 30th, 2026. Additionally, as of this report deadline, we are still working with The Reef Institute to obtain corals from Peanut Island (marginal zone in Martin/Palm). This transfer will occur on June 17th, 2026, and is anticipated to consist of 6 more corals.

Only two weedy species' genotypes were lost due to health issues: SR737, a *S. radians* collected from a marginal site in Miami/Broward, and SSID-150, a *S. siderea* collected from Reef 2 in Miami/Broward. We observed that the *Siderastrea spp.* and *Stephanocoenia intersepta* did not recover well when fragmented to smaller sizes, thus we adjusted our fragmenting protocol to cut larger fragments of these species, which often resulted in only two replicate fragments per these genotypes.

This project also supported the training and mentorship of four interns at Mote's Gene Bank. They developed coral husbandry and species identification skills and gained data management and GIS data visualization experience.

4. DISCUSSION

4.1. Gene Banking Florida's Weedy coral species

The 287 colonies and tissue samples collected under this project with per colony provenance and collection site coordinates provide a gene banked population for Florida's contemporary weedy coral populations. Corals gene banked here represent the end to end length of the Florida Coral Reef across a gradient of reef habitat zones, which experienced unique temperature patterns, water-quality conditions, light, and disease exposure. This spectrum of within-species variation provides a future opportunity to distinguish stress tolerant lineages from susceptible ones, while currently ensuring that this important genetic diversity is not lost due to future extreme stress events or disease outbreaks.

4.2. Management Recommendations

4.2.1. *Sustain coral gene bank collection and holding efforts*

Continued, multi-year collection efforts, in addition to coordinated transfers from other coral

restoration organizations, will be required to approach Mote's Gene Bank's per species target of 72 distinct genotypes held in triplicate. The four reef zone per region sampling structure used here aligns with the current Coral Restoration Consortium Genetics Working Group guidance on genotypes-per-reef sampling recommendations along environmental gradients which should be retained for continued efforts. Future collection cycles should also extend collections to include the Dry Tortugas and Biscayne so that the full Florida Reef Tract is represented in gene banking inventory. Additionally, sustaining coral gene bank holding efforts, e.g. coral husbandry and continued system maintenance, is essential to ensuring that the collected corals have continuous care and preservation.

4.2.2. *Establish a sustained rescue coral pipeline for the marginal reef zone*

The marginal zone is distinct from the other reef zones because it is largely structured and impacted by anthropogenic shoreline features such as seawalls, bridges, port infrastructure, and construction projects. Coordinated acquisition of rescue corals from active construction and maintenance projects is an opportunity to fill the marginal-zone inventory gap in Florida's coral gene banks.

4.2.3. *Leveraging surplus biomass for research and restoration*

Once Mote's Gene Bank biomass requirements are met, any additional biomass beyond what is retained as backup becomes available to research and restoration communities. This provides a well documented chain of custody of coral material available for research. Those research insights can then be tracked to the gene banked inventory, which can then be leveraged for optimizing restoration decisions.

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6. TABLES

Table 1. Project-wide summary as of June 13, 2026.

Metric	Value	Notes
Total coral genotypes acquired	287	Target + opportunistic across all regions
Genotypes of target species collected by project members	244	Across the seven priority weedy species
Genotypes of target species acquired through transfers from other organizations	6	
Genotypes of target species acquired from rescue corals	6	
Gene Bank in-demand species	19	Additional species encountered
Transfers of additional, non-weedy species' genotypes supported through coordination with project-related transfers	43	Coordination of additional priority coral transfers was supported through project activities associated with target species transfers
Unique reef sites visited	71	Across the six DEP-prioritized regions
Distinct coral species recorded	26	Includes opportunistic additional species
Logged field expedition days	17	Per the project fieldwork tracker (see note above)
DEP regions covered	6 / 6	Martin/Palm Beach, Miami/Broward, Upper Keys, Middle Keys, Lower Keys, Marquesas

7. FIGURES

Figure 1. Map of Mote Marine Laboratory's International Coral Gene Bank's collection plan for Florida's Coral Reef. Image shows the delineations of the nine regions: 1a & 1 b - Martin & Palm Beach, 2 - Miami/Broward, 3 - Biscayne, 4 - Upper Keys, 5 - Middle Keys, 6 - Lower Keys, 7 - Marquesas, & 8 - Dry Tortugas.

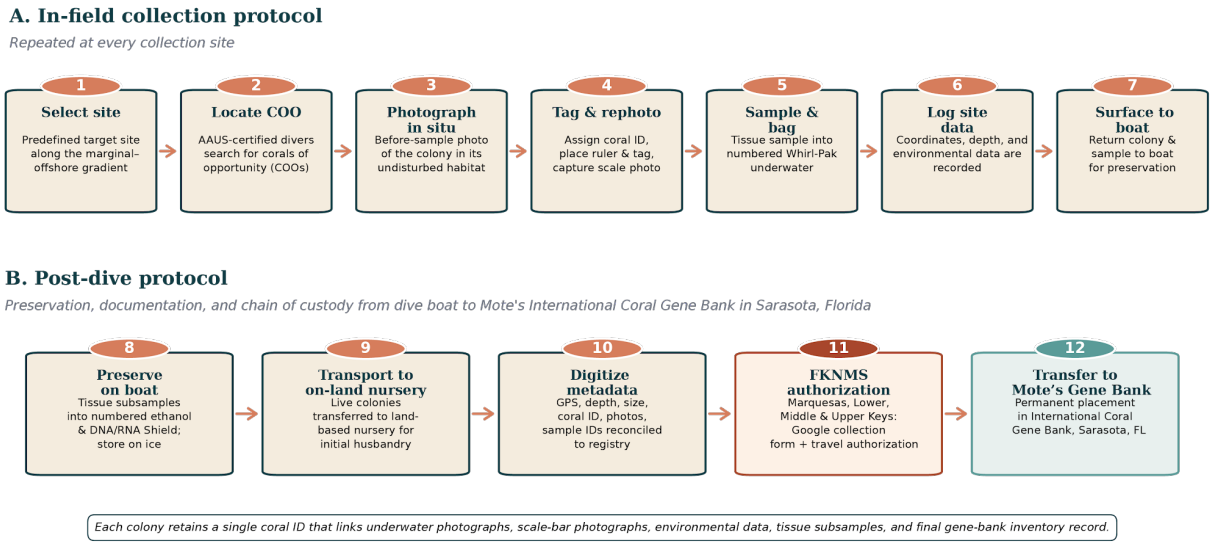


Figure 2. Protocol overview for coral collections.

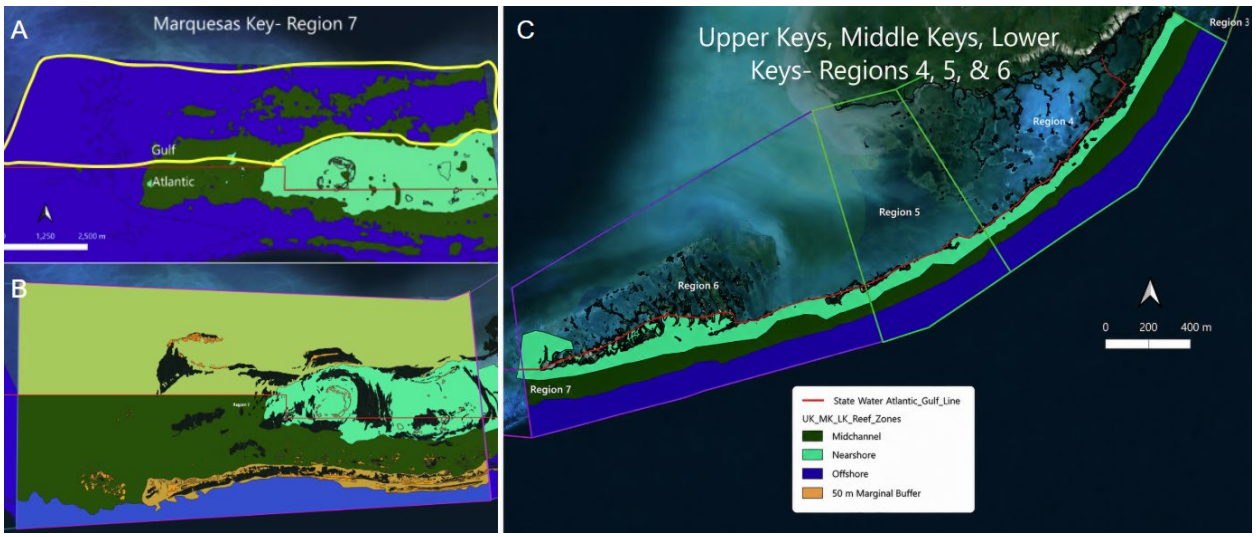


Figure 3. Qualifying reef zones in Marquesas (A&B), Lower, Middle, and Upper Keys (C) in consideration of region-specific bathymetry and environmental gradients.

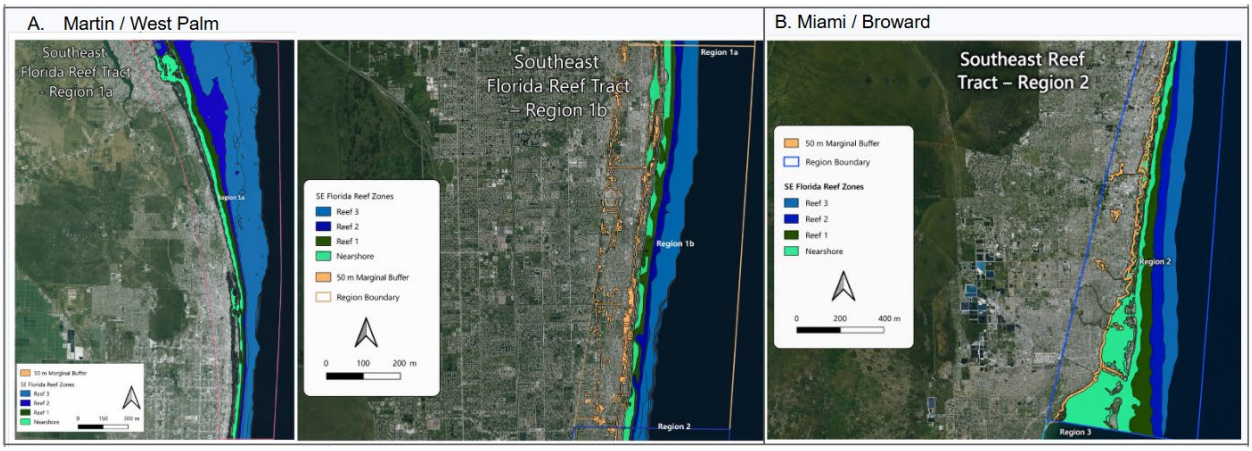


Figure 4. Qualifying reef zones in Martin/Palm (A) and Miami/Broward (B) regions in consideration of region-specific bathymetry, history, and environmental gradients.

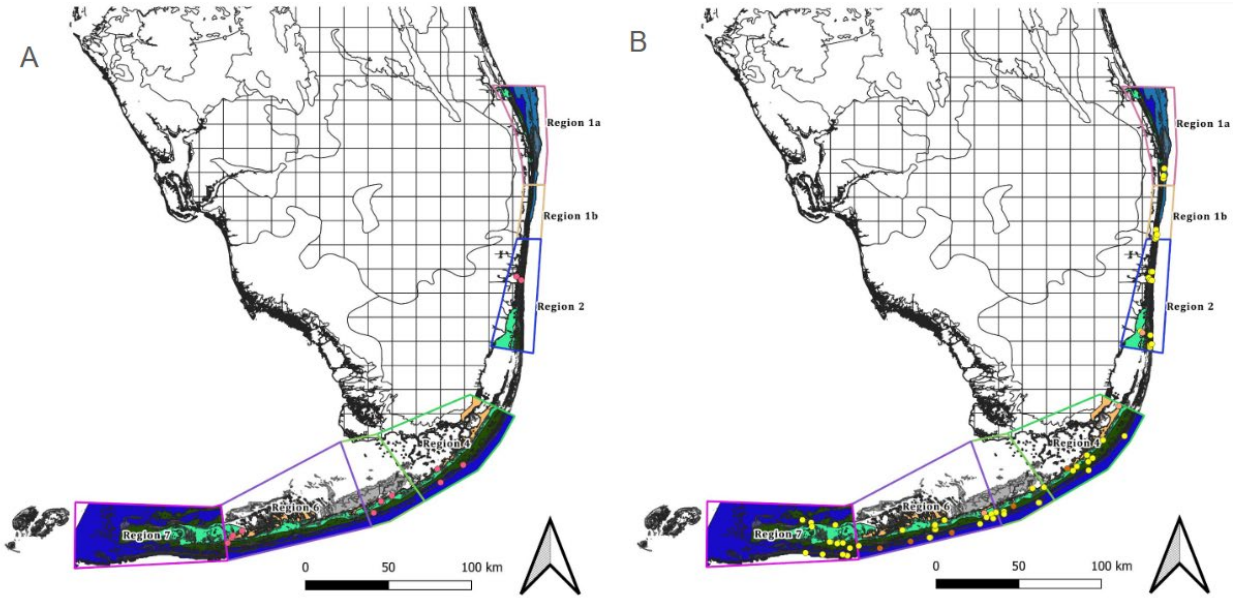
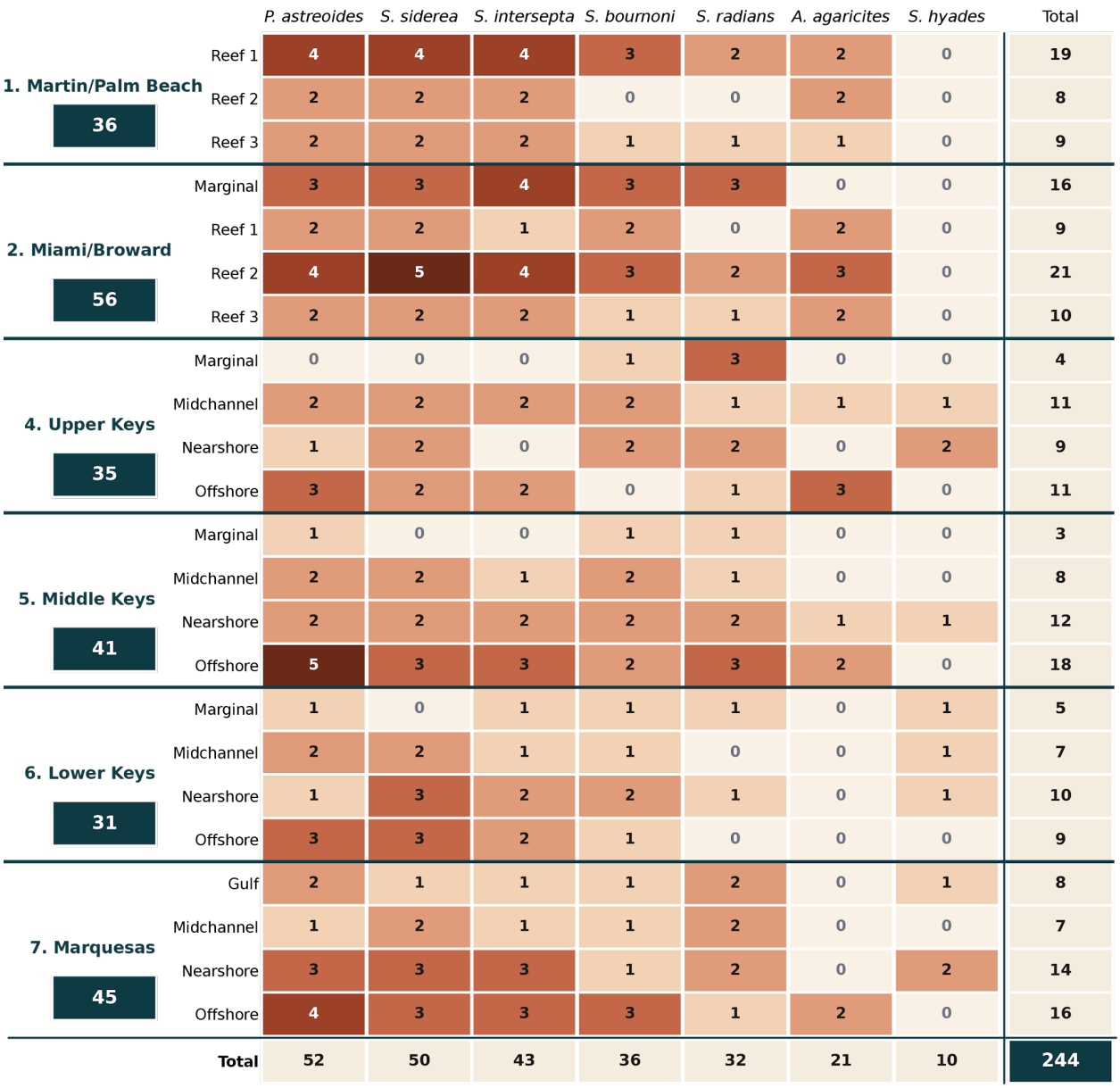


Figure 5. Map of weedy coral species in Mote's Gene Bank. A) Gene-banked weedy coral species prior to the start of collections for this project (pink points) and B) locations of all new collections (yellow points) and rescue/transfers (orange dots).



		P. astreoides	*S. siderea*	*S. intersepta*	*S. bournoni*	*S. radians*	*A. agaricites*	*S. hyades*	Total
1. Martin/Palm Beach	Reef 1	4	4	4	3	2	2	0	19
	Reef 2	2	2	2	0	0	2	0	8
36	Reef 3	2	2	2	1	1	1	0	9
2. Miami/Broward	Marginal	3	3	4	3	3	0	0	16
	Reef 1	2	2	1	2	0	2	0	9
	Reef 2	4	5	4	3	2	3	0	21
56	Reef 3	2	2	2	1	1	2	0	10
4. Upper Keys	Marginal	0	0	0	1	3	0	0	4
	Midchannel	2	2	2	2	1	1	1	11
	Nearshore	1	2	0	2	2	0	2	9
35	Offshore	3	2	2	0	1	3	0	11
5. Middle Keys	Marginal	1	0	0	1	1	0	0	3
	Midchannel	2	2	1	2	1	0	0	8
	Nearshore	2	2	2	2	2	1	1	12
41	Offshore	5	3	3	2	3	2	0	18
6. Lower Keys	Marginal	1	0	1	1	1	0	1	5
	Midchannel	2	2	1	1	0	0	1	7
	Nearshore	1	3	2	2	1	0	1	10
31	Offshore	3	3	2	1	0	0	0	9
7. Marquesas	Gulf	2	1	1	1	2	0	1	8
	Midchannel	1	2	1	1	2	0	0	7
	Nearshore	3	3	3	1	2	0	2	14
45	Offshore	4	3	3	3	1	2	0	16
	Total	52	50	43	36	32	21	10	244

Figure 6. Collections by species, region, and reef zone. Dark red cells indicate higher collection counts.

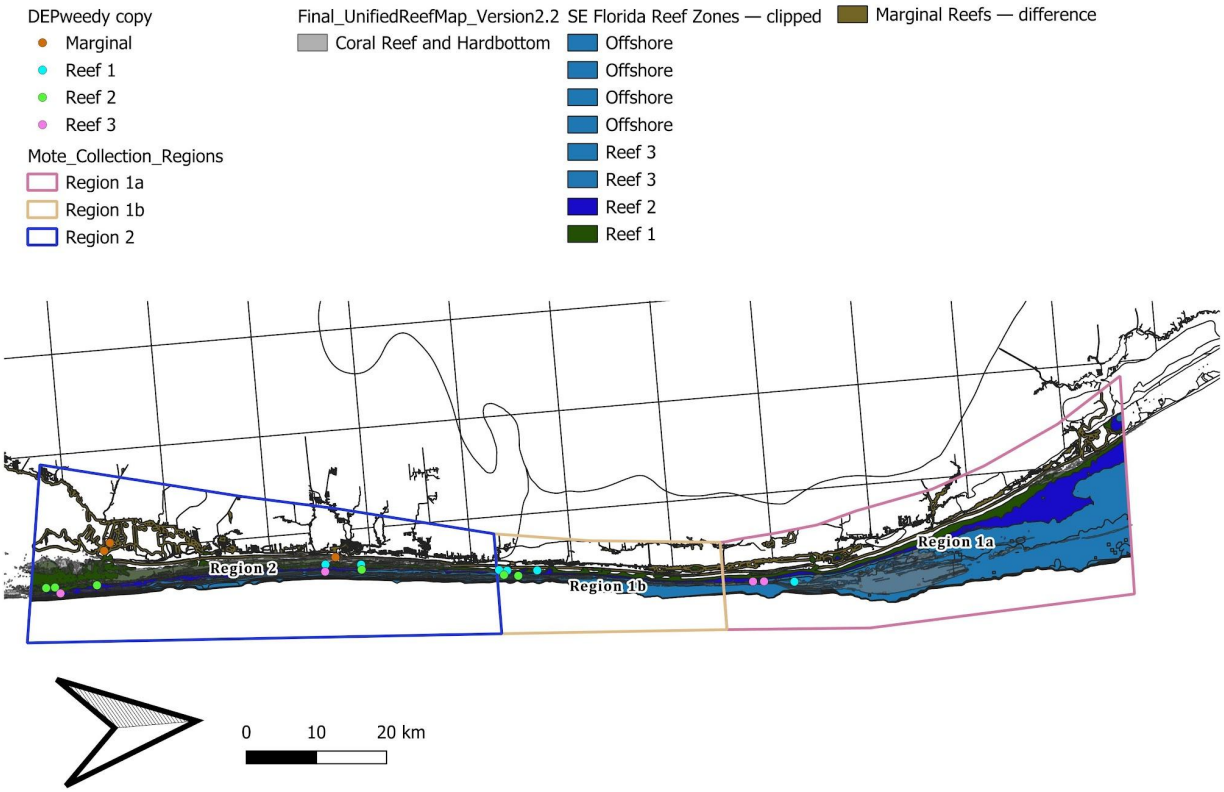


Figure 7. Miami/Broward (region 2) and Martin/Palm (region 1a & 1b) reef zones distinguished by colored polygons with overlaid collection sites (points) and their reef zone categorization (point color)

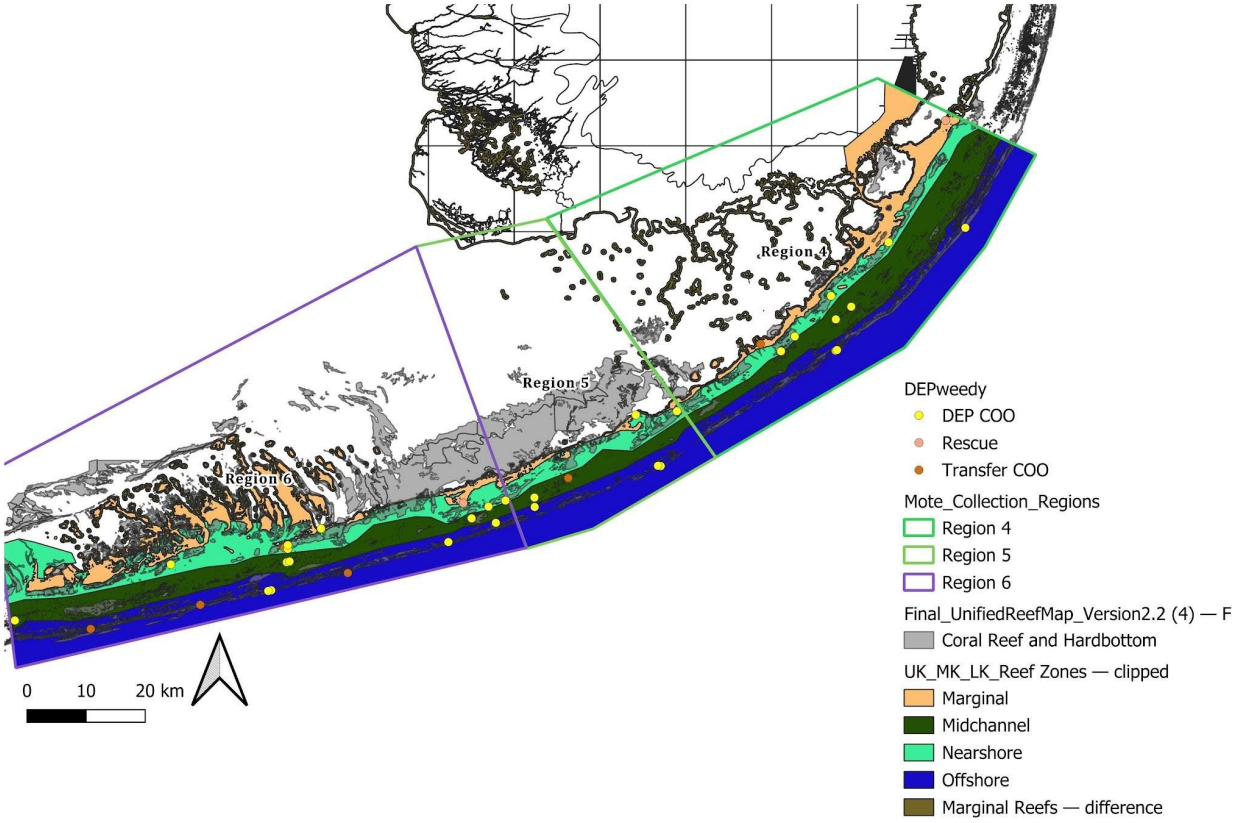


Figure 8. Upper (region 4), Middle (region 5), and Lower Keys (region 6) reef zones distinguished by colored polygons with overlaid collection sites (points) and their type of collection, i.e., DEP COO = direct COO collection during project, Rescue = rescue coral, and Transfer COO = COO transferred from other organizations (point color).

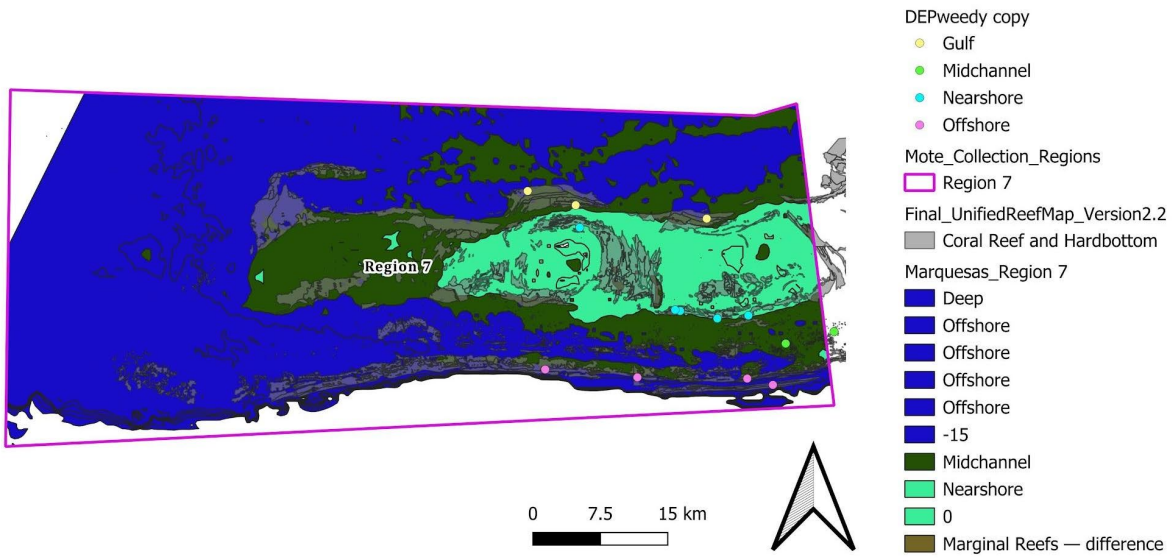


Figure 9. Marquesas (region 7) reef zones are distinguished by colored polygons with overlaid collection sites (points) and their reef zone categorization (point color).