

The Status of *Acropora palmata* founders in South Florida after the 2023 marine heatwave.

June 2024

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Objectives:

1. Identify the location of all remaining South Florida *Acropora palmata* founder genets that are remaining at their native sites.
2. Estimate the number of founder genets that were lost during the 2023 bleaching event.

Background

This report describes the status of *Acropora palmata* founder genets in South Florida (Broward County to the Dry Tortugas) after the 2023 heatwave. Founder genets are defined as genets that are expected to be unrelated to each other and is a term used to describe genets originally found naturally occurring on the reef. While these founder genets exist as naturally occurring colonies at their native sites, they may also exist as outplanted colonies at non-native reefs due to live genebanking and nursery propagation. Through most of this report, unless otherwise stated, the status of a founder applies to the founder genet at its native reef site and is unrelated to its status in a live genebank, coral nursery, or as an outplant on any reef other than its native reef. As of June 2024, there are over 180 founder genotypes alive in human care. In addition to founder genets, there are unique lab-cultured genets in holding that are the offspring of founders produced through human-facilitated sexual reproduction. These cultured genets are not included in the counts presented in this report. Additionally, after the data for this report was compiled, two newly identified founder genotypes were found to have survived the 2023 bleaching event at their native reefs (Molasses and Looe Key). They are not included in these tallies but suggest there may be others found. While these discoveries are encouraging it does not diminish the conclusion that the 2023 bleaching event resulted in a dramatic loss to the *Acropora palmata* population and a significant reduction in the spatial distribution of this once ubiquitous and iconic reef coral.

All known founder genotypes

Samples contributed to the STAGdb (Standardized Tools for *Acropora* Genotyping) were used to compile a list of all known *Acropora palmata* (APAL) founder genotypes. This list is based on 1306 tissue samples collected from Florida APAL by multiple agencies (Appendix 1) for genotyping. While the list

includes samples that were collected as early as 2002, it is not a complete listing of founder genotypes that were alive at any one time. This list of samples was evaluated using methods described in Williams et al. (2024) to identify founder genotypes that originated from Florida's Coral Reef (from the Dry Tortugas to Broward County). In addition to the samples in the STAG database, there are additional samples from founders that have not yet been analyzed but are assumed to be unique/novel genotypes (n=17 genotypes) based on their locations. These additional 17 genotypes were added to this list to arrive at a list of all known founders that have been sampled. There are a total of 247 genotyped and sampled founder genotypes.

The list of 247 founders includes archived samples from genotypes that perished more than 10 years ago. Therefore, a more meaningful tally can be made by including only those genotypes known to be alive after 2018, either on their native reef or in a nursery. This timeframe was selected because the APAL population experienced major losses in fall of 2017 when Hurricane Irma passed over south Florida. In 2018, both the genotyping of wild colonies and the collection of additional genotypes for nursery propagation accelerated. Thus, the list of 210 founders (Table 1, Figure 1) alive in 2018 is closer to a complete list of all existing Florida APAL that remained after Hurricane Irma.

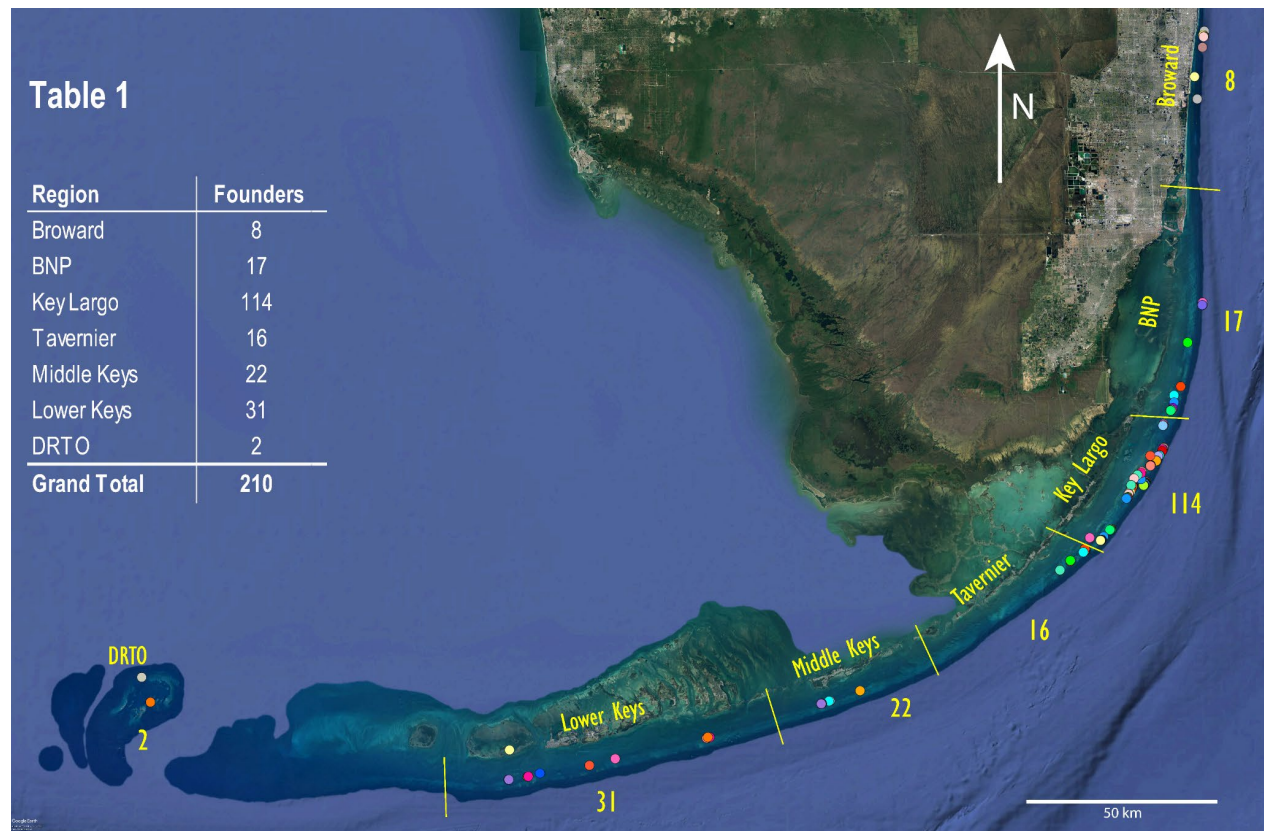


Figure 1. Distribution of the 210 known founder genotypes identified from samples collected after 2018. Each point marks a distinct genotype, the different colors are used to help distinguish overlapping points in some areas. (Table and map show the founders identified prior to June 2024 and do not include at least two newly identified founders that survived the 2023 bleaching event were discovered in July 2024.)

Table 1 Tally of all founder genotypes identified in samples collected after 2018 subdivided into regions (See Fig.1). This total includes founders sampled in nurseries that were no longer alive at their native reef (~14) along with 17 putative genets that have been sampled but are not yet in the STAGdb.

Before 2023 bleaching event

To estimate the number of founder genets lost to the 2023 heat stress event, the list of known founders was further narrowed from 210 down to only those founders believed to have remaining ramets alive on the reef in early 2023 (Table 2). This subset of founders believed to be alive in 2023 was determined via direct observations for the upper keys (Williams et al 2024), Broward County (D. Gilliam, NSU), Biscayne National Park (A. Bourque, NPS), Dry Tortugas National Park (S. Shopmeyer, FWC, I. Kuffner, USGS, and R. Cuning) and select sites in the middle and middle and lower Keys (C. Harrell, FWC). Where direct observations were not available, founder genets known to have live ramets in 2020 or later were assumed to still be alive prior to the bleaching event. Based on these observations and assumptions, it is believed that there were 160 founder genotypes alive at their native reef sites prior to the bleaching event in 2023.

Surviving founder genotypes

Based on reports from multiple research and restoration groups (Appendix 2), all known founders that survived the 2023 bleaching event at their native locations (Table 2, Figure 2) were identified. Following the bleaching event, only 37 founders (Table 2) remained at their native reef sites. These surviving founders were distributed across roughly 16 reefs (defined as either named reefs or contiguous stands of colonies in areas where there are not discrete reefs). At the time of this report, however, the number of founders remaining on the reef at their native sites is lower because many of the 37 founder genotypes survived the heat stress event as small remnant colonies, which are extremely vulnerable to mortality. Some of these vulnerable colonies have since been observed dead and some are being rescued for live gene banking purposes where possible, resulting in a decreasing number of founder genets alive on the reef at their native sites. It is still important to consider the number that survived the heat stress event as it indicates a pool of remaining founders that may be relatively resistant or resilient to heat stress during bleaching conditions.

There are some founder genets that did not survive at their native reefs but survived as outplants at other reefs. There are also lab-cultured genets that survived as outplanted colonies on the reef. Some of these surviving outplants were found at reefs alongside surviving native founder colonies, while others survived at sites with no remaining native founders. Thus, the number of reef sites where live *Acropora palmata* can presently be found is higher than the number of reefs with surviving native founders (n=17).

Table 2

SubRegion	2023 Bleaching Event		Died 2023	% Survival
	Before	After		
Broward	7	7	0	100%
BNP	17	7	10	41%
Key Largo	77	23	54	30%
Tavernier	7	0	7	0%
Middle Keys	20	0	20	0%
Lower Keys	30	0	30	0%
DRT0	2	0	2	0%
Grand Total	160	37	123	

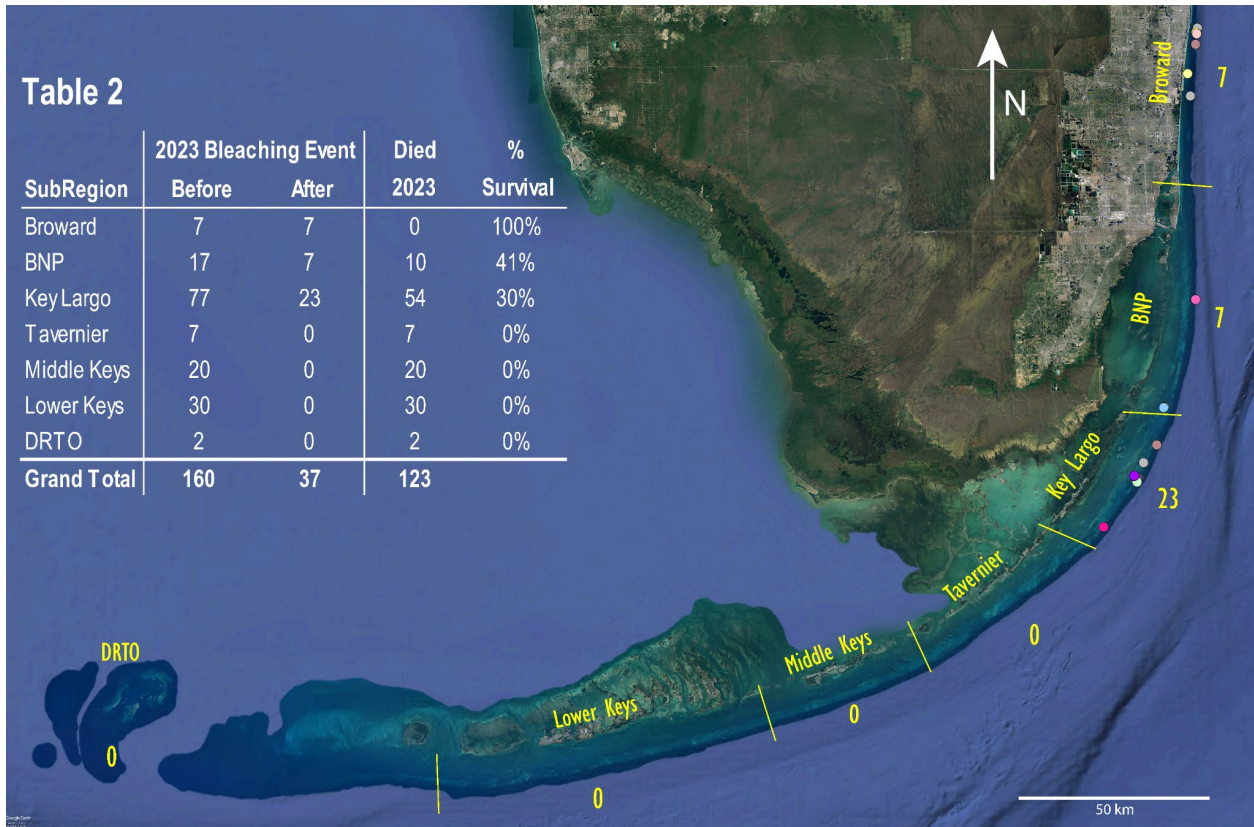


Figure 2. Distribution of the 37 known founder genotypes that survived the 2023 bleaching event. (Table and map show the founders identified prior to June 2024 and do not include at least two newly identified founders that survived the 2023 bleaching event were discovered in July 2024.)

Table 2. Fate of the founder genotypes believed to be alive at their native reef sites prior to the 2023 bleaching event. The observations for the Middle and Lower Keys prior to the bleaching event are less complete than other regions and may overestimate the number alive prior to the event.

Appendix 1 Genotyping sample results contributed to the STAGdb by several organizations were used in this compilation.

Organization Name	STAGdb Sample Contributor
Biscayne National Park*	Bourque, Amanda
Coral Restoration Foundation	Moura, Amelia
Florida Aquarium Center for Conservation	Williams, Emily
Florida Fish and Wildlife	Vollmer, Alicia
Mote Marine Lab	Bartels, Erich
NOAA SEFSC	Miller, Margaret
NOAA SEFSC	Williams, Dana
Nova Southeastern University	Fogarty, Nikki
Nova Southeastern University	Neely, Karen
Nova Southeastern University	Wever, Shane
Penn State University	Baums, Iliana
Penn State University	Kitchen, Sheila
Reef Renewal	Nedimyer, Ken
University of Miami	D'Alessandro, Martine
University of Miami	Williamson, Olivia

*Samples from Biscayne National Park have been collected but at the time this information was compiled (June 2024) the samples were not yet in the database.

Appendix 2. An interactive map showing the locations of the founder genotypes that were believed to be alive prior to the bleaching event and those that died during or survived the heatwave can be downloaded as a .kml file. It can be viewed using Google earth desktop or web viewer.