

Quick Look Report: Coral spawning (DSTO, PSTR, PCLI)– September 2020

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Abstract:

Though coral spawning represents the once-a-year opportunity for corals to increase their population and genetic diversity, even basic parameters of the event are poorly known for many species. In September 2020, divers conducted spawning observations at Newfound Harbor, a nearshore site in the Lower Florida Keys containing a high density of *Dichocoenia stokesii*, *Pseudodiploria clivosa*, and *Pseudodiploria strigosa* colonies. Goals were to identify set time, spawn time, gamete buoyancy, and bundle breakup time for these species and also to conduct at-sea assisted fertilization and provide gametes to coral larval/settlement aquaria for growout. Unfortunately, no spawning was recorded during the nights of observation. We nevertheless compiled existing data on these species to provide predicted spawning windows, and built capacity for future spawning efforts.

Background:

Coral spawning and assisted reproduction through gamete collection are well established for a variety of coral species, including the branching Acroporids and the massive *Orbicella* species. Successful propagation efforts (both in the field and in aquaria) require several pieces of basic information: date and time of set and spawn, time of bundle breakup, buoyancy of gametes, and time from fertilization to settlement. However, for many coral species, these basic parameters remain unknown.

Goals for the Neely lab 2020 spawning season were to try to identify the above parameters for three poorly studied coral species: *Dichocoenia stokesii* (DSTO), *Pseudodiploria clivosa* (PCLI), and *Pseudodiploria strigosa* (PSTR). If spawning occurred, gametes would be collected and provided to Joana Figueiredo at Nova Southeastern University for research on development and settlement, and for growout.

Estimating Spawn Time:

We gathered all known existing observations of spawning for the three species of interest (DSTO, PCLI, PSTR) to develop spawning observation windows (Table 1). Spawning windows are identified by the date as “Nights After Full Moon” (NAFM), and by time as “Minutes After Sunset” (MAS).

Pseudodiploria strigosa spawning has been relatively well documented in many regions of the Caribbean. Spawning date peaks 6 – 8 NAFM. Observations, particularly from Curacao, suggest there are two spawning periods; some individuals spawn 30 – 70 MAS while others spawn 220 – 270 MAS.

Pseudodiploria clivosa is very poorly studied, with only a few anecdotal observations recorded. Spawning of this species has been seen 7-8 NAFM and 210-255 MAS.

Dichocoenia stokesii is also poorly studied, with the majority of anecdotal observations coming from Curacao. The spawning date window appears to be large, with spawning observed from 3 – 25 NAFM (the average

observation date is 7 – 8 NAFM) and 100 – 160 MAS. Rescued DSTO colonies held at RSMAS in 2019 were observed spawning 5 – 7 NAFM at 90 – 179 MAS. One anomalous DSTO colony was observed spawning in the Upper Keys in 2009 at 259 MAS, over an hour after other DSTO observations.

Nights After Full Moon	DSTO	PCLI	PSTR
Jordan (2018)			Peak 6-8
K. Marhaver pers comm	Seen 3-25 (avg 7-8)		
CARMABI (2020)	Seen 5-24	Seen 7-8	Peak 6-8
RSMAS rescue coral	Seen 5-7		

Minutes After Sunset	DSTO	PCLI	PSTR
Jordan (2018)			2 groups: a) ~70. b) 150-250
K. Marhaver pers comm	seen 100-159		
CARMABI (2020)	seen 100-160	seen 210-255	2 groups: a) 30-70. b) 220-270
RSMAS rescue corals	seen 90-179		
L. MacLaughlin	259		

Table 1. Sources and observations of previous spawning windows for the three species of interest (*Dichocoenia stokesii*, *Pseudodiploria clivosa*, and *Pseudodiploria strigosa*). Top table indicates date (NAFM); bottom table indicates time (MAS).

The majority of Caribbean stony coral species spawn between August and October. All known past observations of *D. stokesii* spawning have occurred in September (CARMABI 2020), with the exception of some ex situ colonies that spawned August 20-22, 2019 (RSMAS, pers comm). All known past observations of *P. clivosa* spawning have occurred in September (CARMABI 2020). *P. strigosa* has been seen spawning from July through October, and Jordan (2018) identified August as the historical peak spawn window for this species; however, predictions for spawning month depend largely on the timing of the full moon each year. In 2020, the August and September full moons fell very early, with local full moons on August 2 and September 1. As a result, predictions for peak spawning of this species for 2020 fell in September (CARMABI 2020).

Using these datasets and predictions, we selected September as the prime spawning month on which to target our observations for all three species. We focused on NAFM 7 and 8 (September 8 and 9), as these aligned with previous PCLI observations, fell within the peak of PSTR observations, and encompassed the average of observations for DSTO (Fig 1). Each night was set up for three spawning observation dives:

1. 8:00-8:45 pm (25 – 70 MAS), focusing on PSTR
2. 9:00-10:35 pm (85 – 180 MAS), focusing on DSTO
3. 11:00-12:00 pm (205 – 265 MAS), focusing on PSTR and PCLI

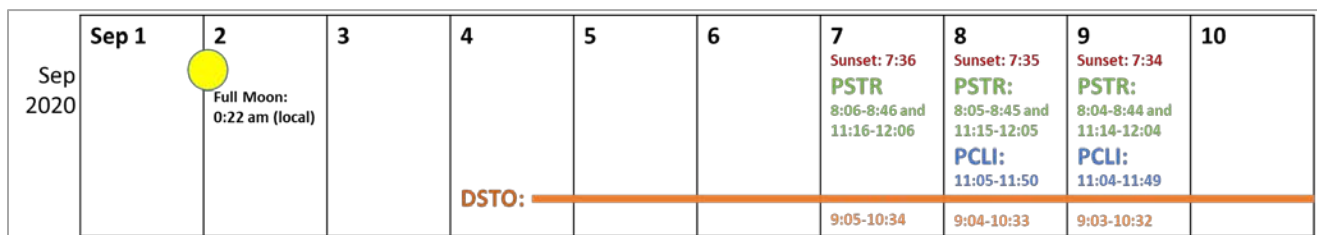


Figure 1. Predictive spawning windows for the three species of interest in September 2020 based on local full moon and local sunset times.

Spawning Site

The three species of interest (PCLI, PSTR, DSTO) were all found in abundance near the southern boundary of the Newfound Harbor SPA. The site is a nearshore patch reef in the Lower Florida Keys, lying at about 6m depth and 800m from shore (Fig 2a). The site has been part of a stony coral tissue loss disease (SCTLD) intervention effort since April 2019. Corals in the area had high prevalence of SCTLD in 2019, and affected corals were treated with an amoxicillin compound to halt disease. Since the initial applications, the site has been monitored every two months, with new infections treated as needed. The site has responded well to treatment, with the majority of treated corals never becoming reinfected. Monitoring has provided a health history of the site, which has documented paling/bleaching during the summers of 2019 and 2020, along with halted SCTLD during these hyperthermal events.

Because each SCTLD-treated coral was tagged and mapped, we were able to use maps of treated colonies to identify target areas containing all three species in abundance (Figure 2). Colony density of all three species was much higher than indicated on the map, as only a subset of colonies in the area had been

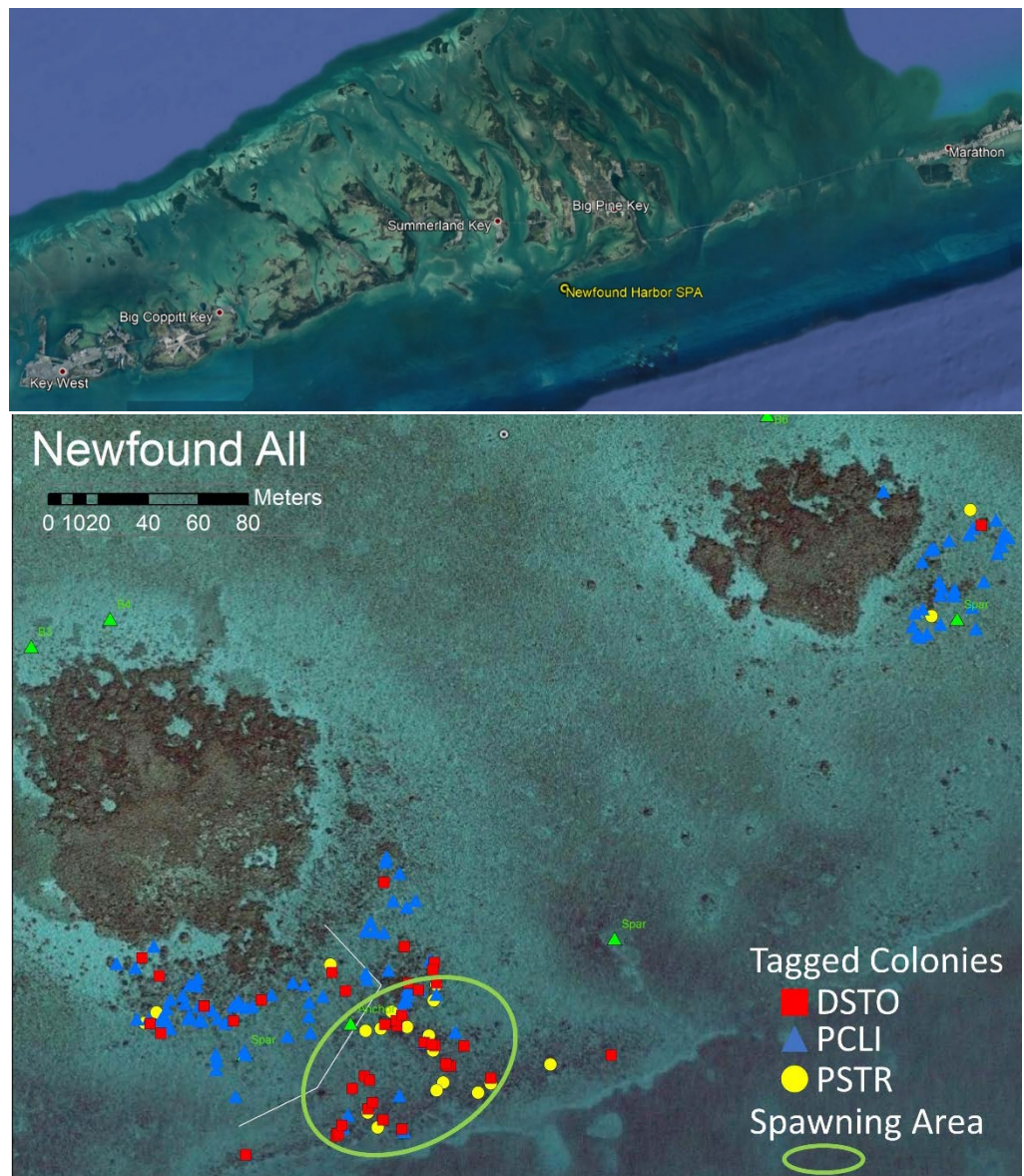


Figure 2. Location of Newfound Harbor SPA (top) in the Lower Florida Keys. Map of Newfound Harbor (bottom) showing locations of known (tagged) colonies of the three target species. The green circle represents the area targeted for spawning observations.

	Diver 1 (KLN)	Diver 2 (EKH)	Diver 3 (MAD)	Diver 4 (KAM)	Total
DSTO	18	13	14	18	63
PCLI	15	18	17	20	70
PSTR	11	5	4	6	26

Table 2. Number of colonies of each target species observed by each diver as well as the total number of corals observed during 2020 spawning dives.

treated and mapped. Within the primary target area, each of four divers laid out dive reels to strategically guide them to as many of the target species as possible within a manageable area. A total of 159 colonies were actively observed: 63 DSTO, 70 PCLI, and 26 PSTR (Table 2). While the species of particular interest changed with each dive due to different spawning windows, a subset of all three species was being observed during every dive.

Net Development

Nets for gamete collection were built using best practices for PSTR and PCLI tents, and experimental methods for DSTO nets. Both PSTR and PCLI are hermaphrodites known to release egg/sperm bundles. The bundles are positively buoyant and float to the surface where they break apart for fertilization. PSTR are known to show “setting” behavior from 3 – 25 minutes before gamete release, which allows observers to prepare for collection. These characteristics made gamete collection tents similar to those used for Acroporids and *Orbicella* species suitable for use with PSTR and PCLI. A total of 36 tents were built and set throughout the spawning plots for immediate deployment when setting was observed (Fig 3a). Average size of PCLI at the site was 70 cm, so nets were built with an 80 cm diameter. Nets were built in two colors to distinguish different species (PCLI and PSTR). All nets are still available for future years’ spawning work.

DSTO is a gonochoric species, with individual colonies releasing either eggs or sperm. Information on the appearance and behavior of DSTO spawn is very limited, but anecdotal observations from Curacao identified that pre-spawning polyps can look swollen or patchy, but other times polyps of normal appearance spawn unexpectedly. Without the “setting” of gametes providing a visual indication of imminent spawning, divers had to be ready for immediate gamete capture. Additionally, anecdotal observations suggest that DSTO gametes are probably neutrally buoyant. These characteristics all necessitated the development of alternative gamete capture devices. For large egg releases, egg collection nets were built using aquarium net frames connected to a funnel and fine-mesh panty hose which could be swept through the plume of eggs for capture (Fig 3b). For small puffs of eggs (as has been seen in Curacao), non-rubber syringes were provided for collections. Syringes were also to be used for sperm collection. All of these supplies remain available for future years’ spawning work.



Figure 3. Collection tents for *Pseudodiploria clivosa* and *P. strigosa* (top). Collection net for *Dichocoenia stokesii* (bottom).

2020 Results and Future Efforts.

Dives were conducted on September 8 (7 NAFM) as planned. On September 9, a large lightning storm kept divers out of the water from 8:45 – 10:35 pm. On that night, dives 1 and 3 occurred as planned, with divers entering the water early for Dive 3.

During no dive was coral spawning observed on any species.

Considerable effort and resources were invested in building the nets needed for gamete collection and for identifying sites and spawning windows for these species. The Newfound Harbor site is rare in being the home for a large number of all three species that can be observed at once. Though SCTLTD continues to ravage Florida's reefs, the regular attention devoted to this site by intervention practitioners should keep these corals alive for future spawning efforts. We strongly recommend that spawning efforts be continued next year. We suggest future efforts also include a histological examination of a subset of colonies to determine whether gametogenesis is occurring within these species at this site. Potentially bringing colonies into land-based facilities or conducting translocation experiments may further elucidate site-specific variables that are influencing spawning.

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Literature Cited

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