

April 20, 2018

Hi Rachel,

We have attended to all your recent questions, in order, below.

1) I see an explanation of why you did not use channel-side site data in your analysis, but why did you decide not to include outer reef control sites in your manuscript?

RESPONSE: Estimates of species-specific WPD susceptibility were initially assessed at 10 sites throughout Miami-Dade County in 2014-2015 and published in Precht et al. (2016). This region-wide data is an independent source of disease prevalence and disease-related mortality estimates that occurred throughout southeast Florida reefs during Port Miami construction monitoring. **Precht et al. (2016) only assessed coral condition on the inner reef tract (2nd Reef), and used these sites as a proxy for coral condition region-wide.** Because all timed-swim survey sites and were performed at 2nd Reef locations it was appropriate to only use the corresponding 2nd Reef controls in our analysis.

As stated in Precht et al. (2016) in the Methods Section under *Timed Swim Surveys* (p. 9): “We used timed swims at ten sites **along the inner-reef tract** that were geographically widespread throughout the waters of Miami-Dade County.”

We also noted the following under *Study Sites* (p. 8): “**The coral assemblages documented in this study are all from the inner (second) reef terrace.**”

2) Did you also use this same method of determining disease mortality without direct disease observation in the compliance reports that you provided to FDEP? If so, how did you determine disease mortality for the channel-side sites? Did you use the same assumptions about the cause of the mortality for channel-side sites?

RESPONSE: The white-plague disease category was not reported in all FDEP compliance reports. In general, the total numbers of corals with visible white-plague were detailed in the report discussion after epidemic levels were first noted. For compliance reports 68 and 69/70 reported counts of white-plague disease were enumerated as follows: “The white-plague disease category includes colonies photographed with definitive signs of white-plague disease and those consistent with white-plague due to the resulting mortality patterns, timing, location, and species involved.” Because of the weekly nature of these compliance reports, they were analyzed rapidly to understand the difference in coral stress between the channel-side corals and their paired controls, however, data used in the Scientific Reports paper underwent greater scrutiny and rates may have varied slightly based on the higher level of QA/QC. In the one-year post-impact assessment permanent site report we also note that mortality that is “unidentified” is likely related to the white-plague disease epidemic. As we noted in our previous response to you, corals that died between monitoring visits were assigned to WPD-related mortality only if they were WPD susceptible species.

Other researchers throughout the region are presently using the same terminology. For instance, recently Ruzicka (2018) noted the following “In June and July 2016, additional disease outbreaks were reported from the Coral Reef Evaluation and Monitoring Project (CREMP) at historical sites in the upper Florida Keys. The CREMP team, part of FWC FWRI, conducted a directed sampling effort at Grecian Rocks targeting both apparently healthy and disease colonies for comparison and collected paired molecular and histology tissue samples for analysis. **Prevalence surveys conducted at the time of sampling revealed** that 100% of *Meandrina meandrites* colonies, 66.7% of *Diploria labyrinthiformis* colonies, 53.3% of *Montastraea cavernosa* colonies, 50% of *Dichocoenia stokesii* colonies, 50% of *Pseudodiploria strigosa* colonies, 42.3% of *Siderastrea siderea* colonies, 33.3% of *Colpophyllia natans* colonies, and 33.3% of *Eusmilia fastigiata* colonies were actively diseased or recently dead.”

3) The paper states, "The first sign of a white-plague disease outbreak (prevalence > 5%) was noticed at the southern monitoring sites, near Virginia Key, on September 26, 2014." However, at this site on this date only find one coral, a *D. stokesii*, with the WP condition code on that date (a 4% prevalence). Can you help us understand how you determined that this was the start of the outbreak?

RESPONSE: This was a typo and was not caught in the galley stage. The original statement should have read “< 5%” not “> 5%.”

Figure 1 (below) are photographs of the original MMEA colony (R2SC2 – T2 – C1) that had signs of WPD on 9/26/2014. This was the first coral noted with signs of the disease (not a DSTO colony as you state above). On September 26, 2014 this coral was still bleached from high summer temperatures but recent tissue loss was evident and a faint “white line” surrounding the recent mortality was visible. Divers in the field noted this coral initially with an “UC” code for “unknown condition.” Follow-up in situ surveys and field photographs taken over the next few weeks in early October confirmed this UC as WPD. However, in addition to this tagged coral (R2SC2-T2-C1 – MMEA) our divers also noted two adjacent corals with likely signs of WPD on R2SC2-T2 that day. All three corals (C1 – MMEA, C2 - DSTO, and C3 - MMEA) were initially given a field code of UC (unknown condition) on 9/26/2014. All three of these corals became infected with WPD (as confirmed in photographs) and all three suffered complete or near complete mortality in the month of October 2014. It was the observation of numerous corals with active disease that led to epidemic levels of infection (prevalence >5%), the rate of complete mortality, and the rapid spread to nearby corals (both on and off transect) that led us to identify the area near this site as the likely start of the disease epidemic.

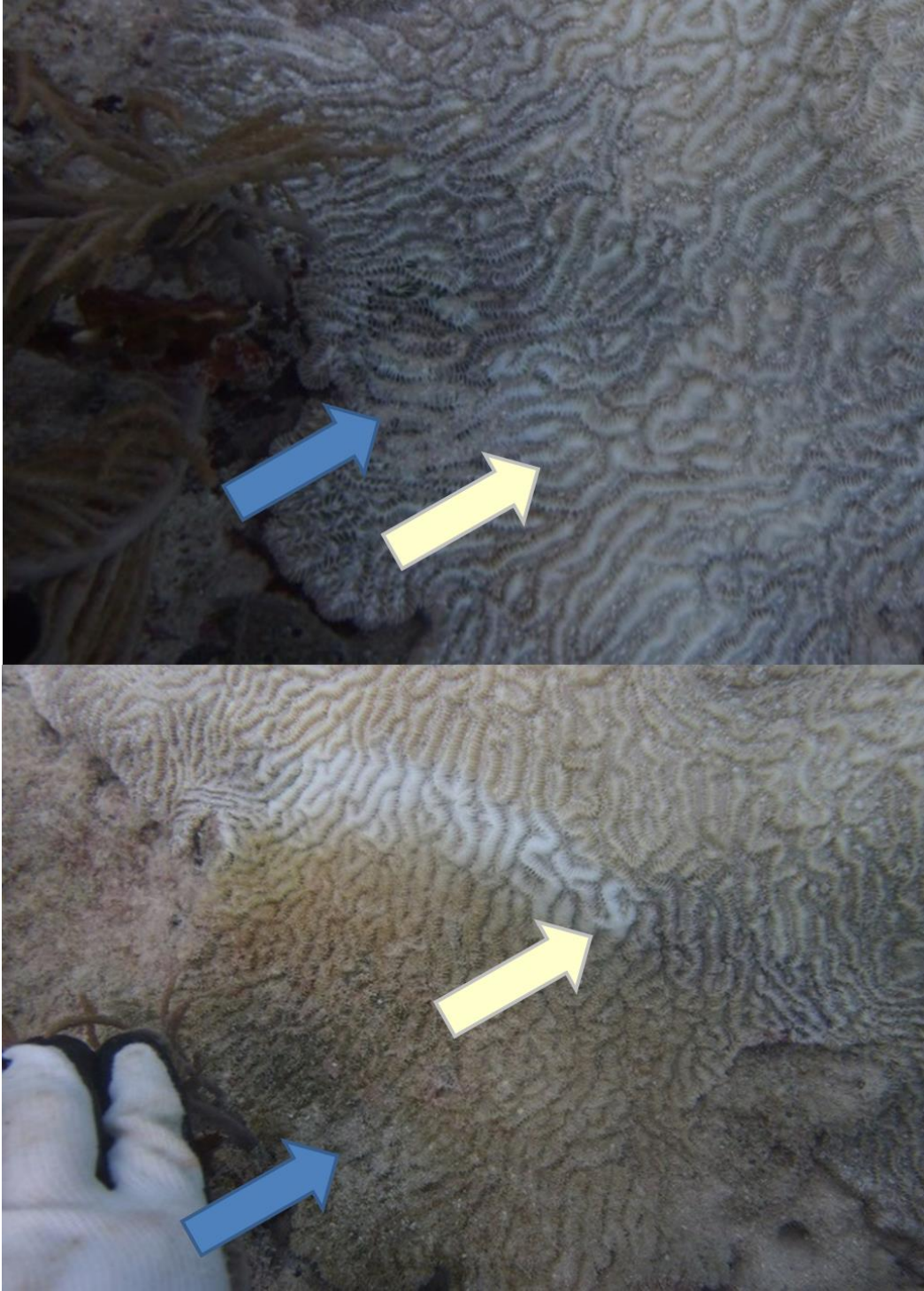


Figure 1. Initial observation of partial mortality (blue arrow) and first appearance of the white disease line (light yellow arrow) from tagged MMEA coral located at R2SC2-LR-T2-C1) September 26, 2014 (top) and again with well-defined white-plague disease line (light yellow arrow) and continued partial mortality from initial location of mortality (blue arrow) on October 8, 2014 (bottom). This was the first coral documented with active white-plague disease at any of the 26 permanent monitoring stations.

A few other observations of WPD were made around this time, in particular, a tagged coral at R2NC1 was noted with WPD on 8/13/2014 but the colony remained alive through active construction monitoring. An additional coral at R3NC1 (9/16/2014) was noted by divers as having WPD and died on 10/3/2014 but it was the only tagged colony at the site noted with WP that died during active construction and thus WP did not reach epidemic levels at this location in the fall of 2015. One additional SBOU colony was noted at R3SC3 on 9/25/2014 but like the coral at R2NC1 this one did not die during active construction monitoring. WPD was later noted on additional colonies at R3SC3 but not until December of 2014. Unlike isolated observations of WPD noted at other locations, WPD at R2SC2 was observed with active disease on multiple corals, caused rapid complete mortality of infected corals, and quickly spread to nearby corals.

On November 12, 2014 I dove the R2SC sites with the DCA team. Because it appeared that there were more many more corals off our transect lines with WPD-like signs, I performed a 60 min timed-swim survey due south of the R2SC2 site and sent out the following email to colleagues:

From: William Precht <william.precht@gmail.com>

Date: Thu, Nov 20, 2014 at 11:02 PM

Subject: White Plague Outbreak in Miami-Dade County

To: "Craig J. Kruempel" <Craig.Kruempel@tetrattech.com>, Terri Sellers <Terri.Jordan-Sellers@usace.army.mil>, "Hope, Becky (Seaport)" <bhope@miamidade.gov>, Steve Blair <BlairS@miamidade.gov>, "Bohnsack, Karen" <Karen.Bohnsack@dep.state.fl.us>, Margaret W Miller <Margaret.W.Miller@noaa.gov>, Diego Lirman <dliman@rsmas.miami.edu>, "Hague, Erin" <erin.hague@tetrattech.com>, Jayne.Bergstrom@tetrattech.com, Tyler Shelley <tylerashelley@gmail.com>, Ryan Fura <rfura73@gmail.com>, Christina Marmet <christina.marmet@gmail.com>, Alexis Schroeder <as1850@nova.edu>, Martha Robbart <mrobbart@dialcordy.com>, brooke gintert <brookegintert@gmail.com>, Richard Aronson <raronson@fit.edu>, S Miller Gmail <smiller52@gmail.com>, Bill Goodwin <Bill.Goodwin@noaa.gov>, Mark Chiappone <mc191@nova.edu>, Les Kaufman <lesk@bu.edu>, ...

All,

Recently, while diving on our control monitoring sites south of Government Cut (off Virginia Key) we noticed a devastating outbreak of a disease with White Plague-like symptoms (see attached PDF). It is still on-going, appears to be spreading, and is responsible for rapid mortality of the infected colonies. No work has been done to firmly establish etiology at this point. The outward symptoms strongly resemble previous descriptions of WPD from throughout Florida and the Caribbean. This disease is considered one of the most damaging to coral populations because of its frequent outbreaks, wide host range, and high virulence (Richardson 1998; Richardson et al. 1998a, b; Richardson and Voss, 2005; Weil et al. 2006; Miller et al. 2003, 2006; Croquer and Weil 2009). This outbreak started within the past month or so and followed on the heels of this summer's regional mass coral bleaching event. So far, the

major species affected include MMEA, DSTO, SBOU and MCAV. The disease has not been noted on colonies of SINT, SSID, PAST.

Similar disease outbreaks have been observed following mass coral bleaching events. For instance, Weil et al. (2009) noted for the period following the 2005 mass coral bleaching event in the eastern Caribbean "Colonies were already stressed by a long period (14 degree heating weeks= # of weeks with water temperatures at least 1°C above average) of high water temperatures (and bleaching) which could have increased colony susceptibility and facilitated the WPD-like epizootic to develop. Contrary to the characteristic seasonality of this disease, the 2005 outbreak lasted longer, with many colonies showing disease signs until March-April of 2006 in La Parguera. Similar observations were reported for the Virgin Islands (Miller et al. 2006, 2009; Rogers et al. 2008, Rothenberger et al.2008)."

If anyone else has seen or documented anything similar in their study sites, please share this information with me. Thanks!

Bill

It is worth noting that additional qualitative observations coupled with underwater photographs taken during the timed-swim survey showed that the total numbers of infected corals, the total number of species affected, and the total number of recently dead colonies all increased as I swam south from the R2SC2 site.

4) It seems that some dates are missing from the analyses. For example, it appears that May 18th and May 19, 2015 (for which data were provided to FDEP) are not present in the data accompanying your manuscript. Also, sometimes dates with data recorded do not match the dates when the photographs were taken of colonies -- or alternatively, no data is provided for dates when photographs of colonies were taken. For example, R2SC1 T3 C6 has no data recorded for Dec. 12 and 17, 2014, but it was photographed. Can you help us determine why these observations was not entered into the datasheets?

RESPONSE: The May 19th date that you are referring were part of a separate set of "impact assessment" surveys performed by DCA that employed different field methods. These surveys were not part of our weekly FDEP permit compliance monitoring program. Accordingly, the data associated with these surveys were not included in any other compliance monitoring results and thus was not compiled into our temporal data. These data were not used in the Scientific Reports manuscript

In addition, based upon our records there was data recorded for R2SC1- T3 - C6 on December 12th and this is in the file we provided. However, no data was provided for this same coral on December 17th, 2014. This was due to the fact that the paired channel-side could not be monitored that week due to "poor environmental conditions and the proximity of... all middle reef channel-side sites to active dredge equipment" per our Compliance Report 57.

In several instances in situ coral data from control sites was collected in a given week but due to poor weather conditions or the position of the dredge (too close to the monitoring site), the scientific diving team was unable to safely dive at the paired channel-side locations. As all compliance data was

specifically collected for weekly comparison of channel-side sites with their far-field control, instances where far-field controls were collected with no channel-side comparison these data were excluded from the database. However, the photographs of the control site corals (as you indicated) that were collected were added to the photographic database. In general, these photos were not used except to verify the presence of white-plague disease that was active in periods between paired surveys when preparing the Scientific Reports paper.

5) Can you please confirm which condition codes were used to determine bleaching prevalence and if this was consistent between analyses? We are finding that in some analyses, the P, BL, and P condition codes appear to have been combined to describe "bleaching prevalence", but at other times, only BL and P were combined to describe bleaching prevalence. Can you please let us know which codes were used when to describe bleaching prevalence?

RESPONSE: For the Scientific Reports manuscript we examined the condition of corals that were either P, PB, and/or BL and pooled these into a single bleaching category to determine bleaching prevalence.



We hope the answers provided above help to clarify our use of both tagged coral and timed-swim survey data analyzed in the Scientific Reports manuscript.

With regards,

WFP and BEG