FastTrack publication

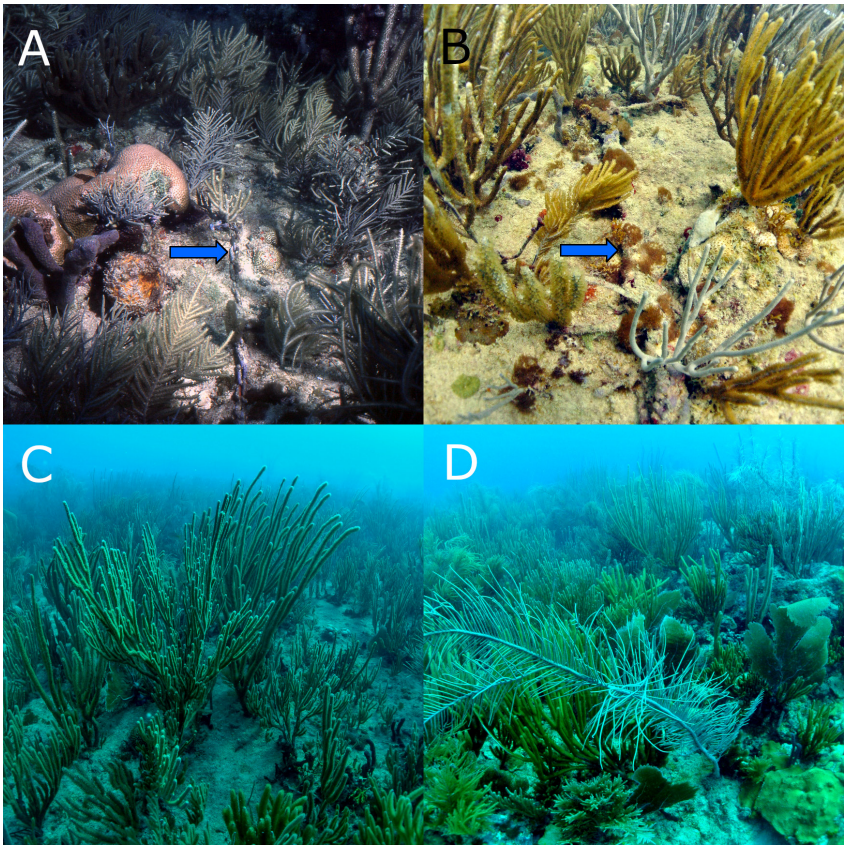
Bull Mar Sci. 98(4):000–000. 2022
https://doi.org/10.5343/bms.2022.0023

Information legacies of early ecological studies †

Christopher D Wells [1*], *J David Muñoz-Maravilla* [2], *Howard R Lasker* [1,3], *Peter J Edmunds* [2]

[1] *Department of Geology, State University of New York at Buffalo, 126 Cooke Hall, Buffalo, New York 14260.* [2] *Department of Biology, California State University, 18111 Nordhoff Street, Northridge, California 91330.* [3] *Department of Environment and Sustainability, State University of New York at Buffalo, 602 Clemens Hall, Buffalo, New York 14260.* * *Corresponding author email: <christopher.wells.23@gmail.com>*

† This Portrait of Marine Science is dedicated to Paul M Yoshioka, whose foresight and careful work has provided the basis for future research



The study of changes in ecological patterns and processes are deeply ingrained in modern ecology and the need to record these effects over decadal scales has become particularly great in the Anthropocene as the climate has changed (Crutzen 2006). Ecological responses to climate change have appeared in every major biome (Walther et al. 2002) and there is an acute need to ensure descriptions of the responses are rooted in fact and not recollection. As baselines shift, comparisons with historical data are becoming increasingly valuable. Legacy datasets predate the development of modern data archiving and precise details of many such studies are being lost through oversight and the retirement of the researchers involved in those studies. Here we highlight the recovery of two legacy research sites in Caribbean octocoral forests and call for the preservation of other sites and their associated data before these scientifically important locations become irrevocably lost.

Caribbean reefs have profoundly changed since their ecology became widely known in the 1950s (Goreau 1959). Against a backdrop of declining abundances of scleractinians (Jackson et al. 2014), rising incidences of coral diseases (Weil and Rogers 2011), a decline in population density of *Diadema antillarum* (Lessios 2016),

and increased abundances of macroalgae (Contreras-Silva et al. 2020), octocorals have increased in abundance at some sites (Ruzicka et al. 2013, Lenz et al. 2015, Sánchez et al. 2019), and may reflect a "new normal" for these communities (Edmunds and Lasker 2016). However, an accurate interpretation of the "rise of the octocorals" requires us to place recent data (i.e., about 2000–present) in a longer temporal context.

While there are several single timepoint surveys of octocorals in the tropical western Atlantic from the 1970s and later from a variety of Caribbean sites (e.g. Goldberg 1973, Kinzie 1973, Lasker and Coffroth 1983), the studies of Paul Yoshioka off Puerto Rico provide data for 20 yrs, which captured the trends and variance of community composition in the late 20th century. Beginning in 1983, Yoshioka quantified octocoral communities with species resolution at Media Luna (6.7 m depth) and San Cristobal (10.7 m depth). Paul Yoshioka died on 1 June, 2021, before we jointly could visit his sites in Puerto Rico and, therefore, finding his sites rested with Global Positioning System (GPS) coordinates in his papers and insights from Beverly Yoshioka as well as his former students and collaborators.

In June 2022, we searched for Yoshioka's sites using GPS coordinates in Yoshioka (2005). Yoshioka's transects were each marked with 32+ m of galvanized chain that was nailed to the reef and last seen by scientists in 2005 (Panel A shows chain at Media Luna photographed in September 1987). After searching for 13-person hrs, we found the chains, which were heavily fouled, integrated with the reef, and missing in places. The chain at San Cristobal started at 17.92787°N, 67.06961°W and ended at 17.92792°N, 67.06991°W and the chain at Media Luna started at 17.93471°N, 67.05532°W and ended at 17.93445°N, 67.05519°W. The detectable parts of the chains were revealed by lines of *Erythropodium caribaeorum* and other encrusting taxa (Panel B). The chains contained no visible iron and crumbled when we tried to clean them. Our search proved timely in detecting nearly vanished markers of important sites for octocoral ecology (Panels C and D show legacy communities at Media Luna and San Cristobal, respectively). We can now resurvey the same areas studied from 1983 to 2003 and bring the results into a holistic analysis of octocoral forests spanning four decades and extending over 250 km (including St. John, US Virgin Islands; Lasker et al. 2020).

Our experience in reactivating these sites emphasizes the challenges of revisiting ecological legacy sites. Similar sites with comparable risks of loss should incorporate procedures to preserve, maintain, and archive the data, collect high-precision GPS coordinates, and install enduring site markers (e.g., stainless steel) with the potential to persist for decades.

Acknowledgments

This research was funded by the US National Science Foundation (OCE 17-56678 to PJE and 17-56381 to HRL). We thank B Yoshioka, O Espinosa, C Prada, E McLean, and E Weil for assistance in finding the transects and two anonymous reviewers for comments which helped improve the manuscript.

Literature Cited

Contreras-Silva AI, Tilstra A, Migani V, Thiel A, Pérez-Cervantes E, Estrada-Saldívar N, Elias-Ilosvay X, Mott C, Alvarez-Filip L, Wild C. 2020. A meta-analysis to assess long-term spatiotemporal changes of benthic coral and macroalgae cover in the Mexican Caribbean. Sci Rep. 10(1):8897. https://doi.org/10.1038/s41598-020-65801-8

Crutzen PJ. 2006. The "Anthropocene". *In:* Ehlers E, Krafft T, editors. Earth system science in the Anthropocene. Berlin, DE: Springer Berlin Heidelberg. p. 13–18. https://doi.org/10.1007/3-540-26590-2_3

Edmunds PJ, Lasker HR. 2016. Cryptic regime shift in benthic community structure on shallow reefs in St. John, US Virgin Islands. Mar Ecol Prog Ser. 559:1–12. https://doi.org/10.3354/meps11900

Goldberg WM. 1973. The ecology of the coral-octocoral communities off the Southeast Florida coast: geomorphology, species composition, and zonation. Bull Mar Sci. 23(3):465–488.

Goreau TF. 1959. The ecology of Jamaican coral reefs I. Species composition and zonation. Ecology. 40(1):67–90. https://doi.org/10.2307/1929924

Jackson JBC, Donovan MK, Cramer KL, Lam V. 2014. Status and trends of Caribbean coral reefs: 1970–2012. Gland, Switzerland: Global Coral Reef Monitoring Network, IUCN.

Kinzie RA 3rd. 1973. The zonation of West Indian gorgonians. Bull Mar Sci. 23(1):93–155.

Lasker HR, Coffroth MA. 1983. Octocoral distributions at Carrie Bow Cay, Belize. Mar Ecol Prog Ser. 13(1):21–28. https://doi.org/10.3354/meps013021

Lasker HR, Martínez-Quintana Á, Bramanti L, Edmunds PJ. 2020. Resilience of octocoral forests to catastrophic storms. Sci Rep. 10(1):4286. https://doi.org/10.1038/s41598-020-61238-1

Lenz EA, Bramanti L, Lasker HR, Edmunds PJ. 2015. Long-term variation of octocoral populations in St. John, US Virgin Islands. Coral Reefs. 34(4):1099–1109. https://doi.org/10.1007/s00338-015-1315-x

Lessios HA. 2016. The great *Diadema antillarum* die-off: 30 years later. Annu Rev Mar Sci. 8(1):267–283. https://doi.org/10.1146/annurev-marine-122414-033857

Ruzicka RR, Colella MA, Porter JW, Morrison JM, Kidney JA, Brinkhuis VIP, Lunz KS, Macaulay KA, Bartlett LA, Meyers MK, et al. 2013. Temporal changes in benthic assemblages on Florida Keys reefs 11 years after the 1997/1998 El Niño. Mar Ecol Prog Ser. 489:125–141. https://doi.org/10.3354/meps10427

Sánchez JA, Gómez-Corrales M, Gutierrez-Cala L, Vergara DC, Roa P, González-Zapata FL, Gnecco M, Puerto N, Neira L, Sarmiento A. 2019. Steady decline of corals and other benthic organisms in the SeaFlower Biosphere Reserve (Southwestern Caribbean). Front Mar Sci. 6:73. https://doi.org/10.3389/fmars.2019.00073

Walther G-R, Post E, Convey P, Menzel A, Parmesan C, Beebee TJC, Fromentin J-M, Hoegh-Guldberg O, Bairlein F. 2002. Ecological responses to recent climate change. Nature. 416(6879):389–395. https://doi.org/10.1038/416389a

Weil E, Rogers CS. 2011. Coral reef diseases in the Atlantic-Caribbean. *In:* Dubinsky Z, Stambler N, editors. Coral reefs: an ecosystem in transition. Dordrecht, Netherlands: Springer Netherlands. p. 465–491.

Yoshioka PM. 2005. Biotic neighborhoods of shallow-water gorgonians of Puerto Rico. Bull Mar Sci. 76(3):625–636.

Date Submitted: 23 July, 2022.
Date Accepted: 29 August, 2022.
Available Online: 30 August, 2022.