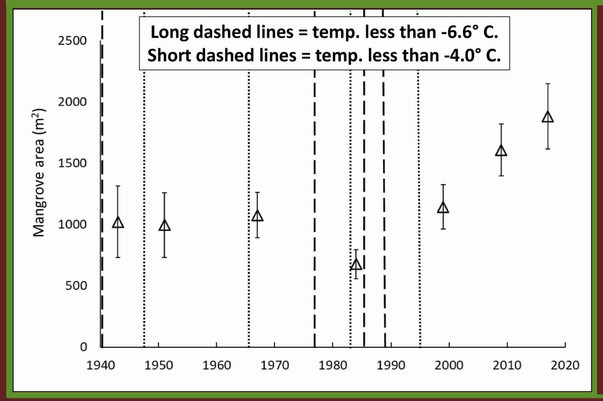
Replacement of oyster reefs by mangroves: unexpected climate-driven ecosystem shifts

Linda Walters (Biology, Univ. of Central FL, linda.walters@ucf.edu), Giovanna McClenachan (Biology, Nicholls State Univ.), Megan Witt (Biology, Univ. of Central FL) & Paul Sacks (Biology, Univ. of Central FL)

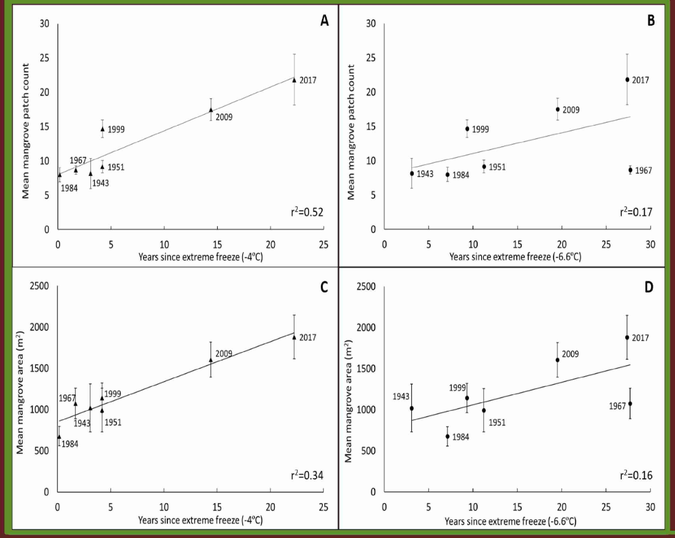
Abstract: Increases in minimum air temperatures have facilitated poleward expansion of mangroves. Using aerial photographs and satellite imagery, we determined percent cover and number of mangrove patches on oyster reefs in Mosquito Lagoon over 74 years (1943-2017). There was an overall 103% increase in mangrove cover on live oyster reefs from 1943 (6.6%) to 2017 (13.4%), with a range of 0-76% cover on reefs. Between 1943 and 1984, the cover remained consistent (~7%), while between 1984 and 2017, mangrove colonization and growth increased rapidly with a 6%/yr increase in mangrove area on oyster reefs (198% increase). Site visits found at least one mature black mangrove (*Avicennia germinans)* on each tracked mangrove reef, with large numbers of smaller red mangroves (*Rhizophora mangle)*, suggesting the post-1984 mangrove increases were the result of increased *R. mangle* recruitment and survival. The lack of freezes could lead to an ecosystem shift of intertidal oyster reefs to mangrove islands.

Mangrove Area on Oyster Reefs from 1943-2017 Showing Freeze Events Since 1940



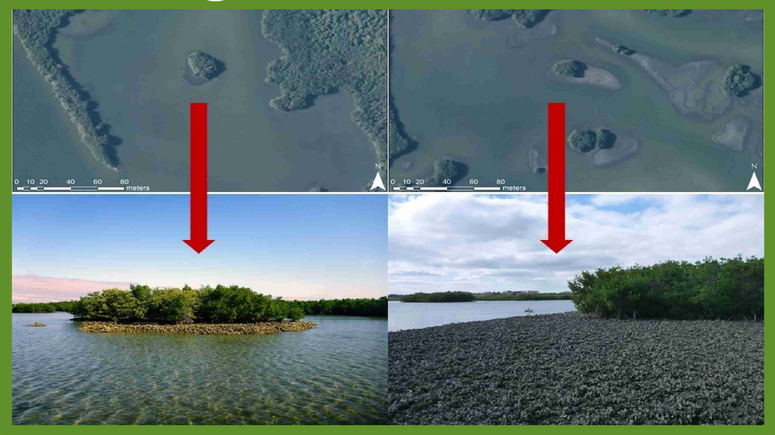
Mean (± S.E.) mangrove area on oyster reefs. Temperatures less than -6.6° C are lethal to black mangroves, while < -4.0° C is lethal to red mangroves. Since 1984, mangrove cover has increased by 198% on intertidal oyster reefs in Mosquito Lagoon.

Mangrove Patch Count vs Days Since Freezes



Relationship of mean (± S.E.) mangrove patch count to days (A, B) and mean mangrove area (C, D). Temperature data from the Fl Climate Center, Titusville. All relationships were significant ($p < 0.01$). The tightest relationship was with patches & -4° C, suggesting that red mangroves are driving this recent ecosystem shift.

Reefs from 2017 imagery and on the ground view in 2019



What's Next?

In August 2020, we began monthly tracking of recruitment of all mangrove propagules on 15 reefs in Mosquito Lagoon. Over 1000 propagules (90% *R. mangle*, 10% *A. germinans*) were/are being followed to understand which propagules are retained on reefs long enough to establish and reproduce. For each propagule, we recorded: time of arrival/departure, propagule length, distance to closest adult mangrove, distance to reef edge, burial in sediment, orientation of propagule , and leaf count.

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