Assessing resistance to recovery in oyster populations – inferences from inadequate monitoring programs

Cognitive dissonance

*Introduction* - Eastern oyster populations in the northern Gulf of Mexico are depressed from historic levels for reasons that are poorly understood. Since 2010, the states of Florida, Alabama, Mississippi, Louisiana, and Texas have all declared state or federal level oyster fishery disasters due to prolonged drought, intense rain events, or freshwater releases from water management structures (refs) and Florida has engaged in litigation at the US Supreme Court level over oyster population collapse in Apalachicola Bay (ref). Several of these states have also implemented fishery closures in response to depressed status of oyster stocks (i.e., Mobile Bay in Alabama, Apalachicola in Florida) but only one of these stocks (Mobile Bay) has reopened to harvest with Apalachicola scheduled to re-open in 2025. Oyster populations in the Gulf of Mexico were also damaged by the sinking of the *Deepwater Horizon* and subsequent oil spill which created substantial funding opportunities (more than $199M US) for oyster restoration in the Gulf of Mexico exceeding the annual value of oyster landings (Pine et al. 2022).

Many proposed, ongoing, recent, and historical oyster restoration efforts focus on the addition of various materials for oyster spat (larvae) to settle and grow. Adding this material to substrate is an effort to promote a positive oyster shell budget (harvest removes shell stock, Pine et al. 2015) by providing outside material to replace degraded (natural), displaced (from culling during harvest) or removed (from harvest) cultch to mimic natural oyster cultch; a complex matrix of living and dead material where oyster larvae settle and grow. These restoration efforts are an attempt to shift oyster reefs from an observed low but resilient state to a more desired productive state Pine et al. 2022) through restoration actions.

We used opportunistic sampling from ongoing and recently completed efforts to shift oyster populations from undesired to desired states through restoration and fishery closure projects in estuaries in the northern Gulf of Mexico. Many of the large restoration programs that are currently funding these efforts are long-term (10-year) projects but information from these projects is needed over shorter time scales to inform other proposed restoration and management projects in similar systems. This is an issue of both temporal and spatial scale (Pine et al. 2022). To facilitate learning under an adaptive management framework as programmatically adopted by these funders, these restoration efforts should be assessed in-progress and if necessary, corrective changes made to improve the likelihood of the restoration objective of shifting the oyster population from an undesired low-level, to a more desired level. This desired state can vary by location, and type of oyster bar (intertidal vs. subtidal), and management goals, but in general the desired expectation motivating these restoration efforts are to provide and promote both ecosystem services (ref) and create opportunities for oyster harvest.

*Site description* – We assessed trends in oyster populations in three estuaries in the Florida panhandle that currently have ongoing or recently completed oyster restoration projects. Pensacola Bay (F1) in northwest Florida (Santa Rosa and Escambia counties) is the fourth largest estuary in Florida with a surface area of approximately 126,000 total acres. Reported oyster landings and trips for Pensacola Bay in recent decades have suggested XYZ (F2) since the current mandatory TRIP ticket program was implemented in 1986. The East Bay (F1) arm of St. Andrew Bay, near Panama City (? Counties) is one region of St. Andrew Bay with a total surface area of approximately XYZ acres. Reported oyster landings and trips for Easy Bay are not available, but for the counties comprising St. Andrew Bay oyster trips and landings in recent decades have ??? (F2). Apalachicola Bay is a large estuary in Franklin County which historically supported the largest oyster fishery in Florida.

*Management actions* – Cultch material was deployed

to assess oyster population responses to the addition of cultch material and persistence of this cultch material over time.

of oyster reefs in three estuaries in the Florida panhandle, northern Gulf of Mexico, to assess trends in oyster populations and persistence of substrate material following restoration.