

# Review of: "Evaluating Hydrologic, Geomorphic, and Vegetation Parameters to Assess Natural, Living, and Hardened Shorelines along the Northern Gulf of Mexico"

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**Potential competing interests:** No potential competing interests to declare.

The authors present the results of a fairly well-designed and replicated field study comparing the features of different types of estuarine shorelines in southern Mississippi and Alabama. The shoreline types compared are natural saltmarsh shorelines, traditional "hardened" shorelines (bulkhead/seawall), and hybrid natural-artificial "living" shorelines. Six locations are studied, with each location having one of each of the three shoreline types in close proximity. The six locations are divided into two groups based on wave exposure: high-energy and low-energy, although it's unclear to what extent wave energy was conceived as an a priori factor in the study design.

The findings generally support the established notion that living shorelines foster vegetation, sediment, and slope characteristics similar to those of natural saltmarsh shorelines, and exhibit rates of erosion lower than those of unprotected shorelines but not as low as those of hardened shorelines. The findings also identify wave exposure as an important factor influencing shoreline and water quality characteristics and having interesting (but confusing) interactions with shoreline slope and protection type.

The paper suffers from being overly long and running into some confounding ambiguities regarding cause and effect relationships, where shoreline characteristics are treated as both independent and dependent variables. A conceptual model attempting to synthesize the results is included in the discussion section, but I found it pretty confusing and not very clearly linked to its stated objective of helping to decide what shoreline sites are best suited to what types of shoreline protection treatments. I thought that a conceptual model would have been more useful in the introduction section. There it could help review our current understanding of the complex interactions of various biological and artificial shoreline features with hydrodynamics and sediment processes in the context of sea level rise. Such a CEM in the introduction could also help illustrate gaps in the knowledge and establish hypotheses and objectives for this project that more clearly addressed important unknowns. I thought the objectives as currently stated were more like a review of what was done than a statement of what questions were being asked or what hypotheses were being tested.

The sampling methods for this study are described and illustrated well, but have some weaknesses that should be disclosed and addressed a little more clearly lest they lead to "apples to oranges" comparisons among sites and shoreline types. My main concern is that elevation/depth relative to tidal datums does not seem to have been recorded and standardized for all types of sampling. The elevation/depth gradient has a huge influence on both physical and biological

features of the intertidal zone. E.g., there are well-characterized patterns of saltmarsh plant productivity and species composition and diversity change from low to high marsh which should be accounted for. Orienting sampling only by horizontal distance from the current shoreline or marsh edge could lead to confounded results. Indeed, this seems to have been the case with the odd plant diversity results recorded at hardened shorelines where plant sampling was in the supralittoral rather than in the intertidal zone. The taking of sediment cores offshore of artificial structures on hardened shorelines but inshore of artificial structures for living shorelines could also have affected results in ways that should be discussed.

In addition to those major points, I have some minor questions and concerns listed below-

\*In the introduction, disclosing some of the context-dependent problems or failures of living shorelines identified in prior literature could help establish the need to learn more about those context dependencies, which this study addresses.

\*In the Data Analysis section of the methods the rationale for and methods of multivariate analysis are not described well. I think some of the multivariate methods description from the results section should be moved back into the methods section. For instance, what variables were included (vegetation, etc.) should be described.

\*Unclear what H values with subscripts mean in the results section for Hydrologic Features.

\*In Table 1 it would be nice to show wave power averages by season as well as by high energy and low energy sites.

\*In Table 2, should relative exposure have units of some kind? A little more description of La Peyre's method of calculating relative exposure would help this be more understandable.

\*The second sentence of the Vegetation Diversity and Cover section in the results belong in the introduction.

\*The first line of the discussion refers to "vegetative processes" which is a little odd. Vegetative characteristics might be a better reflection of what was measured, though processes could be inferred.

\*Turbidity and wave power were certainly well correlated in this study, but I'm not sure that turbidity is always a good proxy for wave power, especially in other systems where it might be more related to freshwater inflow, tidal currents, etc.