Assessment of horseshoe crab (*Limulus polyphemus*) nesting beaches in the ACE Basin, South Carolina

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Introduction

- The Atlantic horseshoe crab, *Limulus polyphemus*, plays important ecological and economic roles in South Carolina.
- Each spring, horseshoe crabs arrive on beaches to spawn during the new and full moons at high tide. During these iconic mass spawning events, females lay eggs on the beaches.
- Horseshoe crabs are harvested in South Carolina by the biomedical industry for the production of *Limulus amoeocyte lysate* (LAL). LAL is produced via the bleeding of crabs, and provides verification of bacterial sterility for pharmaceutical drugs and medical instruments.
- Migratory shorebirds such as the federally threatened red knot (*Calidris canutus*) depend on nutritionally rich horseshoe crab eggs almost exclusively at their staging sites in South Carolina.
- Little is known about the spatial or temporal extent of their spawning events in South Carolina. More information is needed with respect to preferential spawning habitat for horseshoe crabs. This study focused on beaches in the ACE Basin NERR.

Methods

**Shoreline Characterization**- Shorelines within the ACE Basin were chosen based on orientation (6 north-facing and 6 south-facing) and shoreline migration pattern (6 erosional and 6 accretional). This selection method yielded four different types of shorelines; these shorelines of each type were chosen as spawning survey sites.

**Spawning Survey**- Surveys for spawning crabs were conducted from April 2017 through June 2017 for three consecutive nights around both the new and full moons starting on the night of the new/full moon. Transect surveys began 30 minutes prior to the evening high tide. Crabs were enumerated and recorded as single males, single females, mating pairs, or satellite males. Densities were calculated based on length and width of each transect.

**Statistical Analysis**- Outliers with disproportionate leverage on the data were identified and removed by calculating a Cook's Distance cutoff. Statistical analyses were calculated in terms of the density of mating pairs per transect (mating pairs/m²) in order to better assess the reproductive value of a shoreline. Wilcoxon Rank-Sum and Wilcoxon Signed-Rank tests were used to assess the data.

Results

**Determination of Preferential Spawning Habitat**
- • 3,065 horseshoe crabs were counted during the 2017 spawning season (1,056 single males, 7 single females, 758 mating pairs, 482 satellite males).
- Spatial and temporal patterns of spawning were assessed in terms of total abundance and density (crabs/m²).

**Future Work**

Assessment of Egg Availability to Shorebirds
- Assess egg availability across different shorelines in terms of density and retention rates;
- Egg availability will vary with different shorelines; characteristics such as sediment grain size, shoreline migration, and average tidal height will affect spawning densities.
- Horseshoe crab density will increase during peak spawning season.

**Significance**

Identifying preferential spawning habitat of horseshoe crabs can facilitate direct conservation of high priority habitat and preservation of both species as well as ensure continued supply of breeding adults for commercial harvest of horseshoe crabs and ecological stability.

Objectives and hypotheses

**Determination of Preferential Spawning Habitat**
1. Investigate the role that shoreline characteristics play in spawning densities of horseshoe crabs;
   - H₁a: Densities of spawning horseshoe crabs will be higher on new moons than full moons.
   - H₁b: Densities of spawning horseshoe crabs will be higher on accretional shorelines than on erosional shorelines.
   - H₁c: Densities of spawning horseshoe crabs will be higher on north-facing shorelines compared to shoreline characteristics such as orientation and migration.

**Assessment of Egg Availability to Shorebirds**
- Compare successful spawning habitat to successful egg habitat to identify hotspots that are crucial to the management and conservation of both horseshoe crabs and migratory shorebirds.
- H₂: Shorelines that are a largely successful spawning habitat will have both a higher density and retention rate of eggs.

**Results**

**Abundances of horseshoe crabs varied spatially within the ACE Basin.**

**Density of horseshoe crabs per transect (mating pairs/m²).**

**Spatial variation of spawning crabs within the ACE Basin is highlighted by the variances in both total abundances and densities shown in the 12 study shorelines.**

**Density of mating pairs per transect (mating pairs/m²) during opposite lunar phases as well as compared to shoreline characteristics such as orientation and migration.**

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**Literature cited**
