Blue crab use of turtlegrass across the northern Gulf of Mexico: the influence of plant complexity on abundance, growth, and mortality

Zachary Darnell

The University of Southern Mississippi

Habitat Complexity

- “The absolute abundance of habitat structural components within a given habitat” (McCoy and Bell 1991)

- Essential functions
  - Increased habitat surface area
  - Food source
  - Refuge structure

Nursery Hypothesis

- Structurally complex habitats provide:
  - Enhanced food supply
  - Greater protection from predation
  - Greater contribution of recruits to adult populations

- Changes in habitat complexity may alter nursery functionality and ecosystem health

Sandy Franz, NWF

Turtle grass (*Thalassia testudinum*) in the northern GOM

- Seagrass with high morphological plasticity across GOM (McDonald et al. 2016)
- Regional declines of seagrasses linked to nutrient and sediment inputs
- Few studies compare seagrass nursery function over large areas

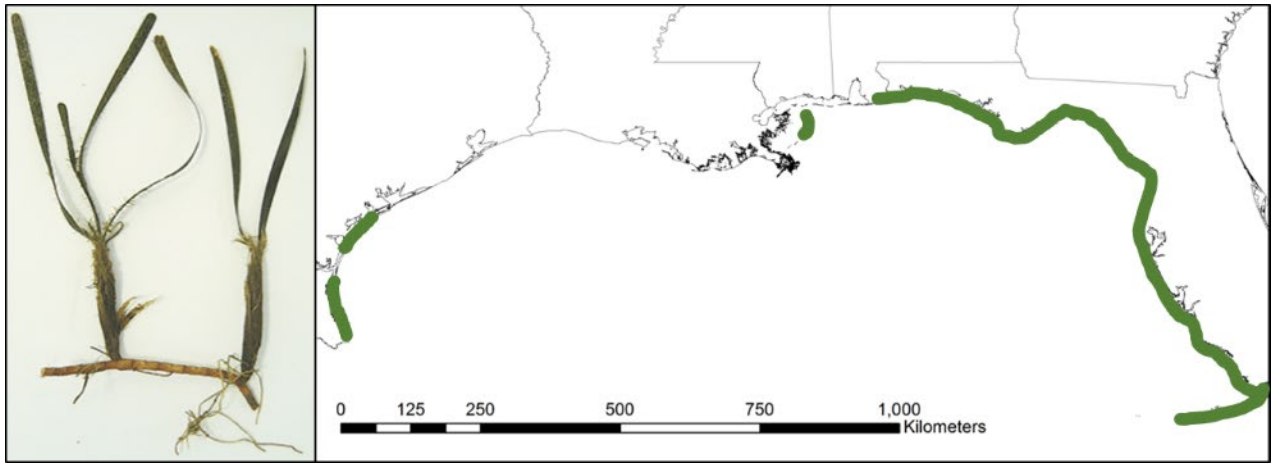

Photo (left) from K. Dunton

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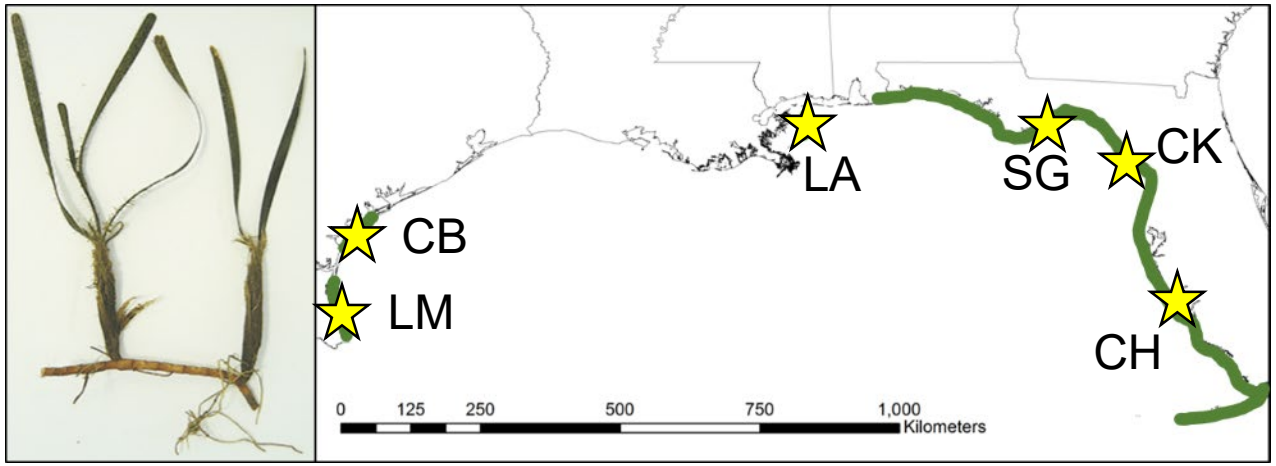

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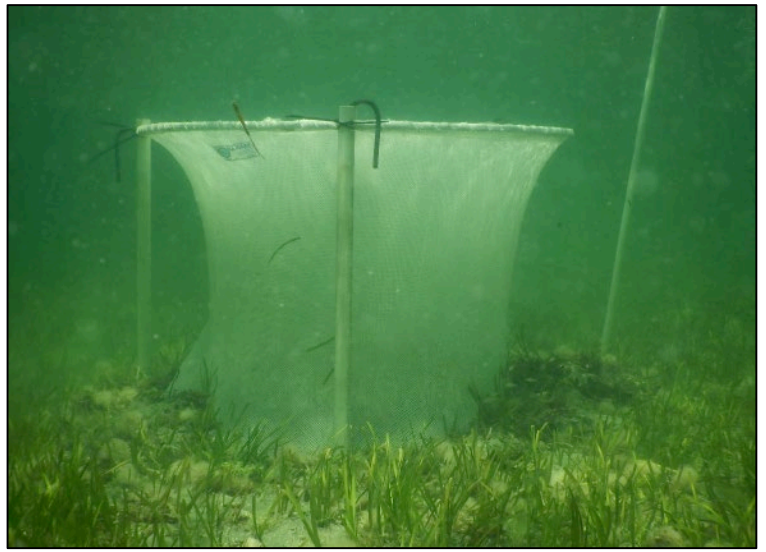
Objectives

- Evaluate role of seagrass complexity on blue crab growth
  - H_1: Juvenile blue crab growth rate varies as a function of seagrass shoot density, canopy height, leaf area index, and location across the GOM
- Evaluate role of seagrass complexity on blue crab mortality
  - H_2: Juvenile blue crab mortality varies as a function of seagrass shoot density, canopy height, leaf area index, and location across the GOM

Growth experiments

- Timing: June–July, 2018 with each experiment running 1 month
- 8–13 cages per site and 8 crabs/cage
- Crabs injected with VIE
- HOBO loggers in 5 cages at each site
- Quantify seagrass complexity using single quadrat and core for each cage



Shakeri 2018

Mortality experiments

- 24-hr crab mortality experiment at each site
  - June 2–July 20, 79-120 crabs per site at ten stations at each site

- Attach crabs to PVC stakes using monofilament line and see how many are alive the next day.
  - Studies have indicated that crabs cannot easily escape tether (Hovel and Lipcius 2001).

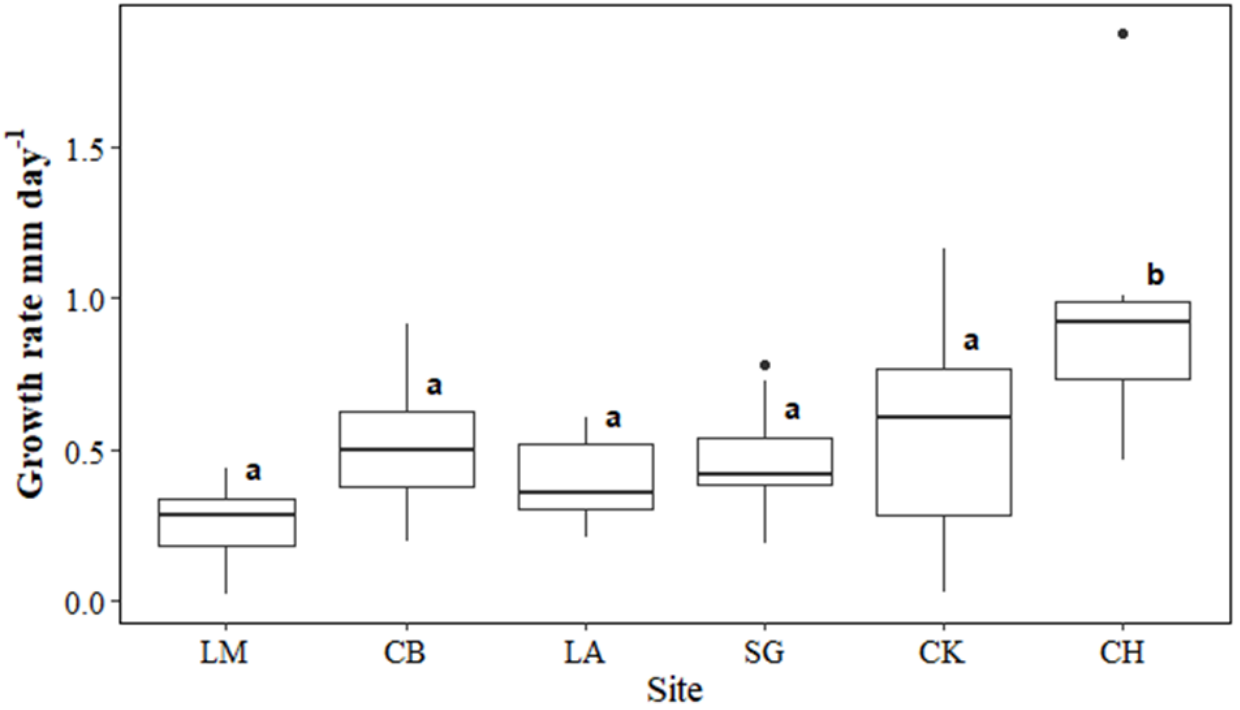
- Measure seagrass complexity metrics with single quadrat and core for each tethered crab

Shakeri 2018

Results: Growth experiments

- Crab growth rate was independent of shoot density, canopy height, and LAI ($P > 0.05$)
- CH had highest growth rate

Site	Total crabs	Growth rate (mm day^{-1})	Change cw (mm)	Exp time (days)
LM	23	0.27 ± 0.13	6.68 ± 3.26	25.23 ± 0.35
CB	27	0.52 ± 0.2	13.42 ± 5.25	25.65 ± 0.53
LA	16	0.39 ± 0.13	11.04 ± 3.55	28.14 ± 1
AP	19	0.47 ± 0.2	11.55 ± 4.94	24.76 ± 0.41
CK	19	0.56 ± 0.36	14.77 ± 9.86	25.95 ± 1.08
CH	21	0.92 ± 0.39	28.79 ± 11.85	31.41 ± 0.4



Results: Growth experiments

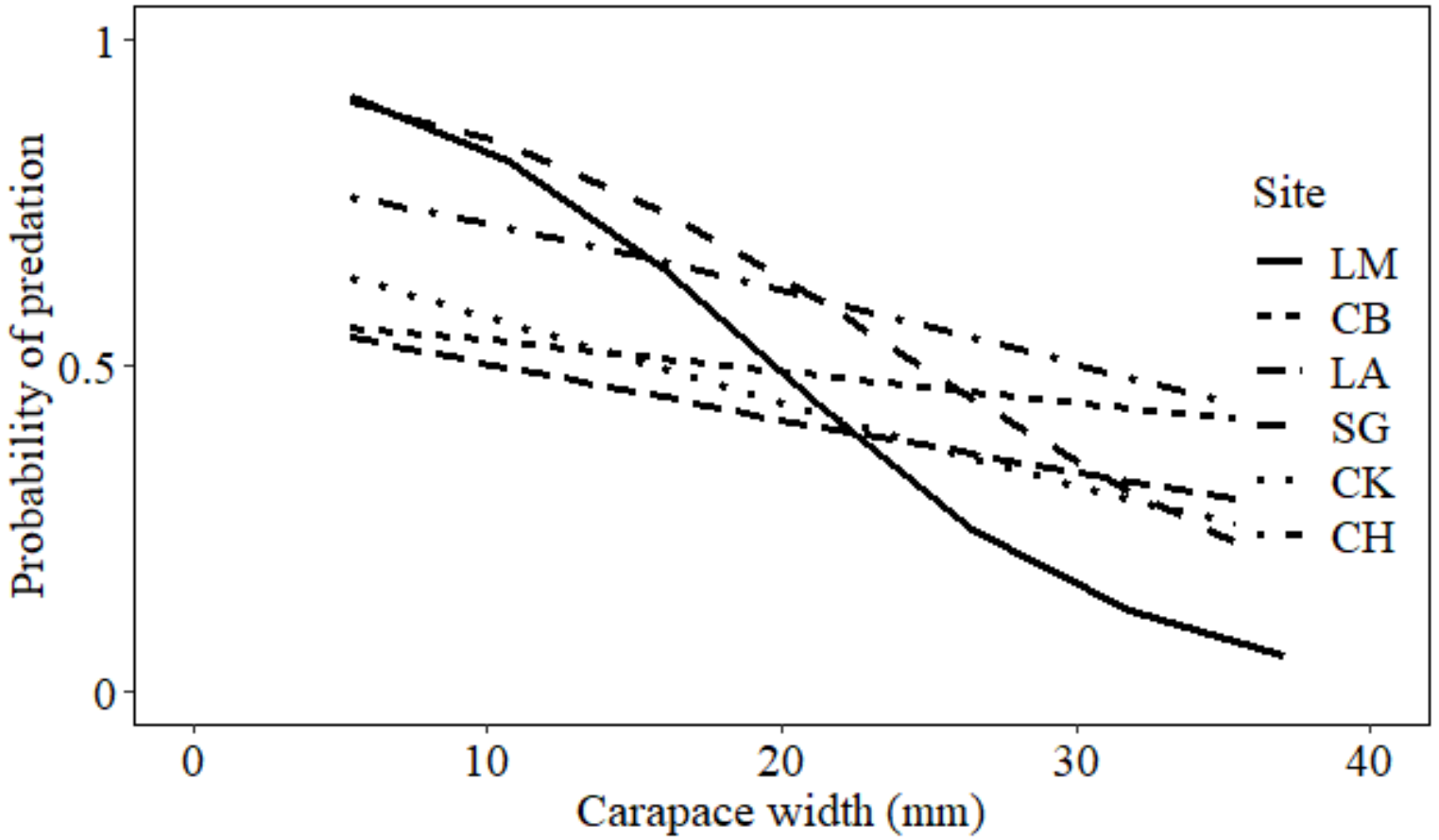
Site	No. Cages	Depth (cm) Mean ± SD	Temp (°C) Mean ± SD	Salinity Mean ± SD	DO (mg L^{-1}) Mean ± SD
LM	13	108.67 ± 27.34	29.88 ± 1.52	36.88 ± 0.44	7.06 ± 1.14
CB	13	88.87 ± 20.39	29.76 ± 1.60	34.52 ± 1.35	9.74 ± 1.65
LA	9	97.56 ± 9.04	30.59 ± 1.76	25.92 ± 0.38	8.71 ± 1.44
SG	8	117 ± 13.61	30.19 ± 1.46	29.73 ± 2.39	5.92 ± 0.78
CK	11	116.55 ± 6.64	30.08 ± 1.64	24.42 ± 2.6	6.45 ± 1.16
CH	10	90.85 ± 13.74	30.76 ± 1.26	20.18 ± 5.5	6.26 ± 1.01

Sites: (LM) Laguna Madre, Texas; (CB) Coastal Bend, Texas; (LA), Chandeleur Islands, Louisiana; (SG) St. George Sound, Florida; (CK) Cedar Key, Florida; and (CH) Charlotte Harbor, Florida.

Results: Mortality experiments

- Predation decreases with cw
- Predation decreases with leaf area index (LAI)
- No effect of shoot density or canopy height on mortality

Source	Df	Chisq	P
Site	4	10.14	0.07
Carapace width	8	17.24	< 0.001
LAI	8	12.31	< 0.001
Site*CW	9	7.88	0.16



Results: Mortality experiments

- Predation decreases with increasing CW
- Predation decreases with leaf area index (LAI)
- No effect of shoot density or canopy height on mortality

Source	Df	Chisq	P
Site	4	10.14	0.07
Carapace width	8	17.24	< 0.001
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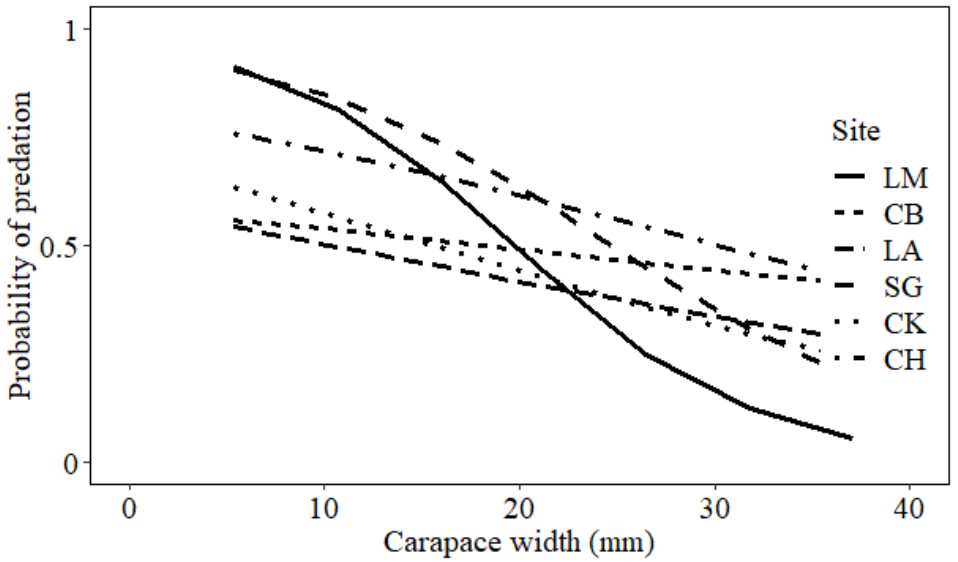

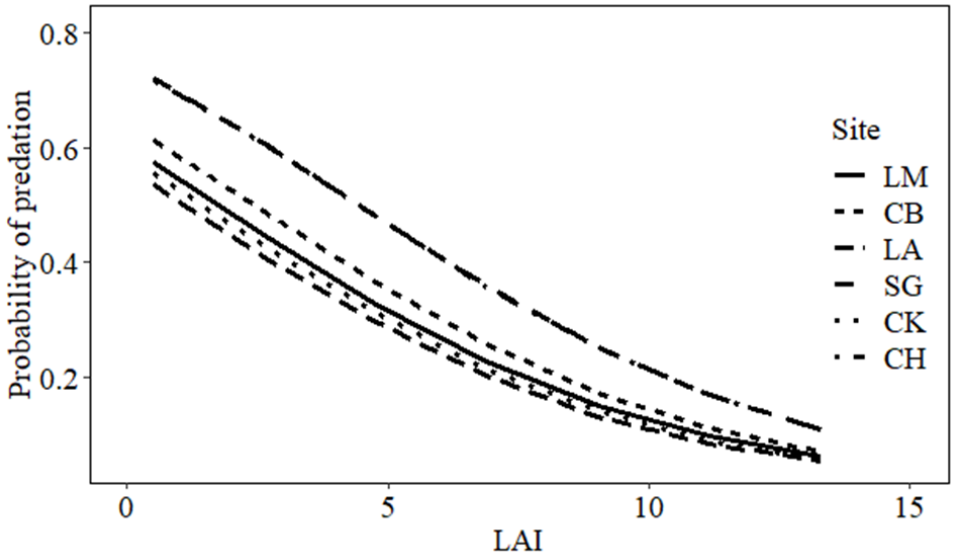

Discussion

- We found that juvenile blue crab mortality varies as a function of seagrass leaf area index and crab size across the northern GOM
  - ➢Seagrass with more leaf area provides more effective cover for juvenile blue crabs across the northern GOM as has been reported for other species (Stoner 1982)
  - ➢Contrasts to previous work showing relationships between mortality and shoot density (Hovel and Lipcius 2001)→ Differences in seasonal variability and study design

Discussion

- Protection of seagrass for crabs is size dependent
  - Larger crabs had lower level of predation→ better able to protect themselves or have outgrown predator gape size
  - Contrasts with results of Shakeri et al. 2020 → differences potentially due to different morphology of SAV
- Simple complexity metrics (e.g. shoot density and canopy height) may fail to adequately measure support of seagrass for crabs
  - Fine resolution metrics incorporating multiple measures of complexity (e.g. LAI) may better explain complexity-predation relationships

Other relevant research

- Distribution, relative abundance, and reproductive output of spawning female blue crabs in offshore waters (published in Fishery Bulletin in 2020)

- Assessment of sperm limitation in LA blue crabs (manuscript currently in press at TAFS).

- April 2021: Began monthly blue crab sampling (traps) at Horn Island and Cat Island, MS.