The Effects of Sea Level Rise on the Population Distribution of the Fiddler Crab (*Uca pugnax*) in Southern Delaware Salt Marshes

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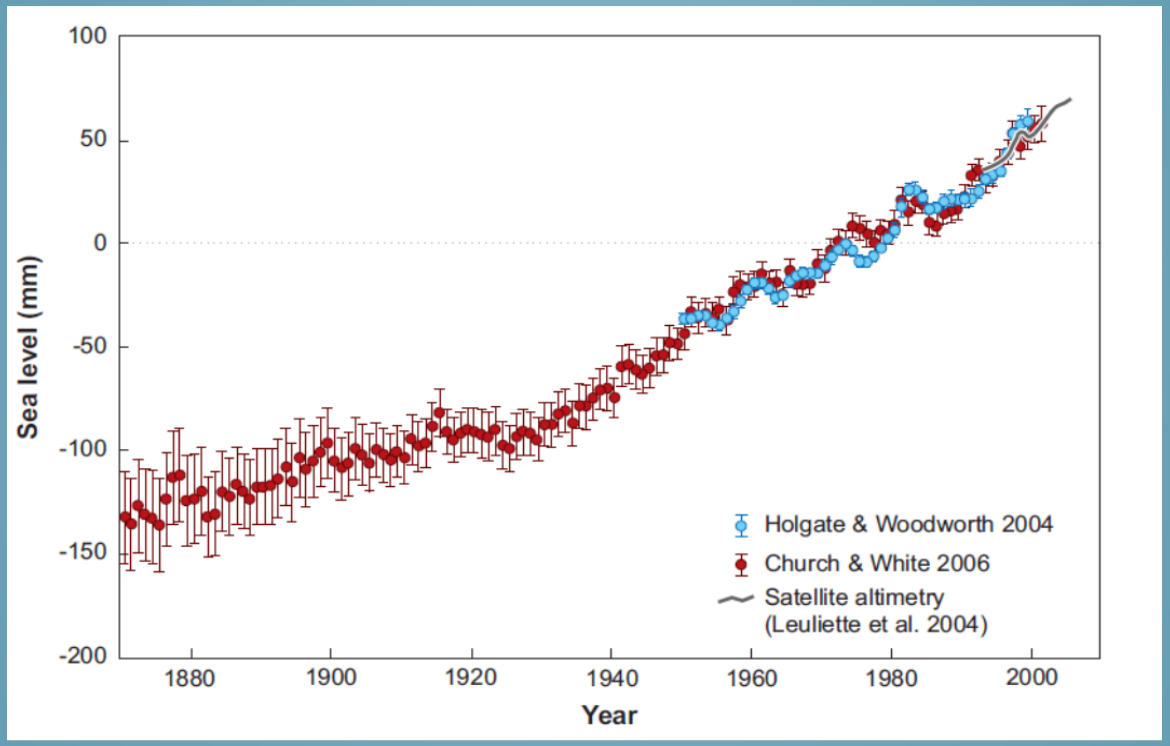
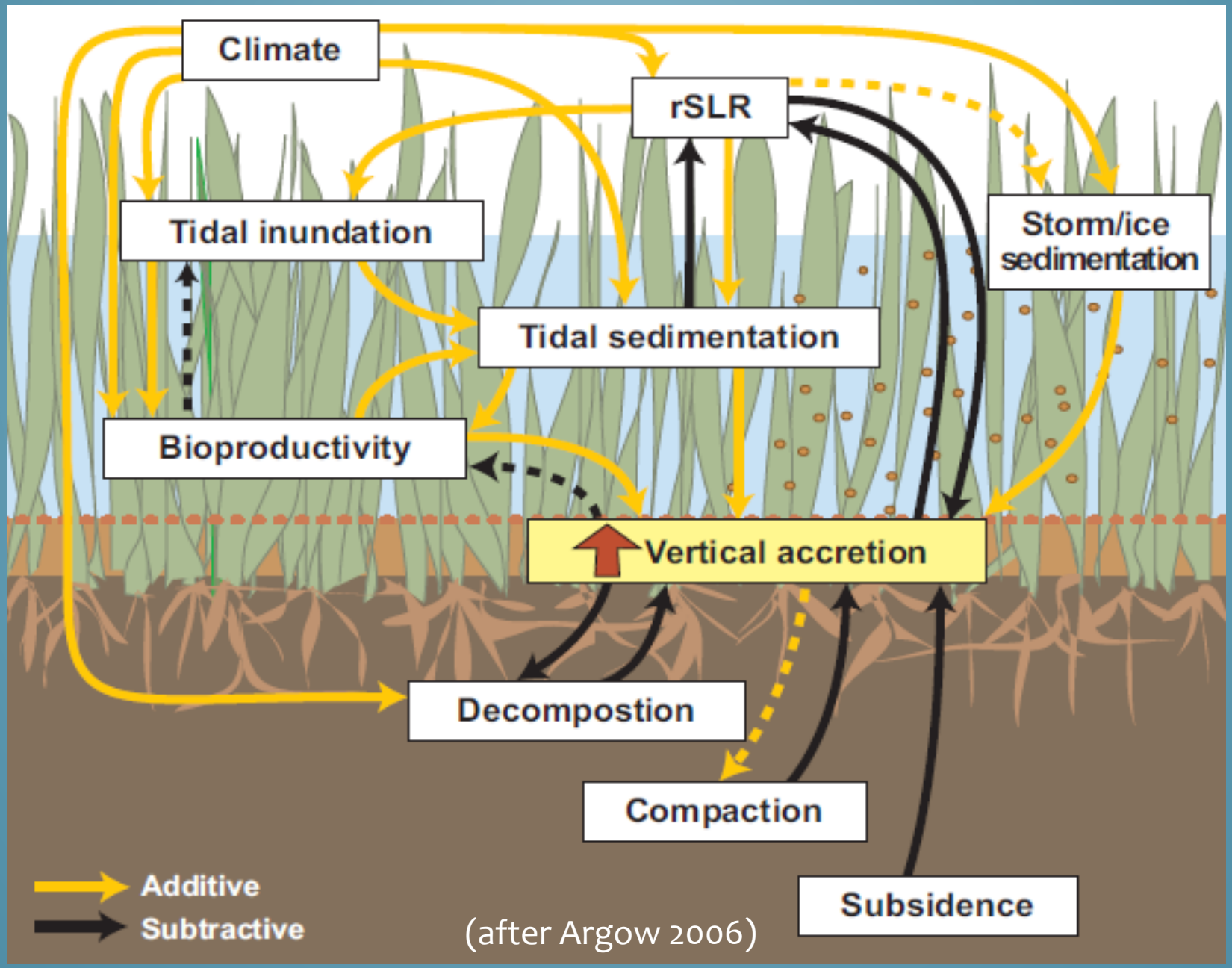
The Threat of Sea Level Rise (SLR)



(FitzGerald et al. 2008)

- Increased rate of SLR due to climate change
- Mid-Atlantic region at higher risk (Lewes, DE: ~3.2 mm/yr)
- Threat of land and habitat loss

Marsh accretion is falling behind



(after Argow 2006)

Importance of *Uca pugnax*

- Burrowing behavior promotes nutrient mixing and aeration of substrates
  - In turn promotes accretion
- Detritivores: Marsh garbage men
- Maintains healthy marsh

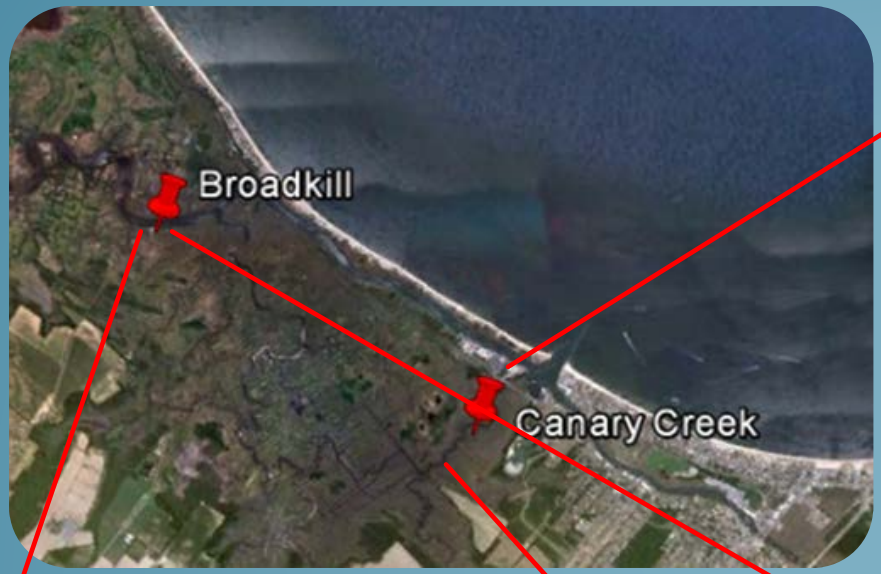
Research Questions

- How will habitat loss due to SLR affect *Uca pugnax* populations?
- What Impact will this have on the marsh as a whole?

Hypothesis and Objectives

Increased SLR due to climate change will negatively impact available habitat for *Uca pugnax*, limiting overall abundance and distribution of the population.

- Characterize fiddler crab populations through distribution and abundance surveys
- Model SLR predictions for marsh habitats
- Compare species distribution model and SLR model to determine future impacts on the crabs and the marsh


Broadkill
Canary Creek

Canary Creek
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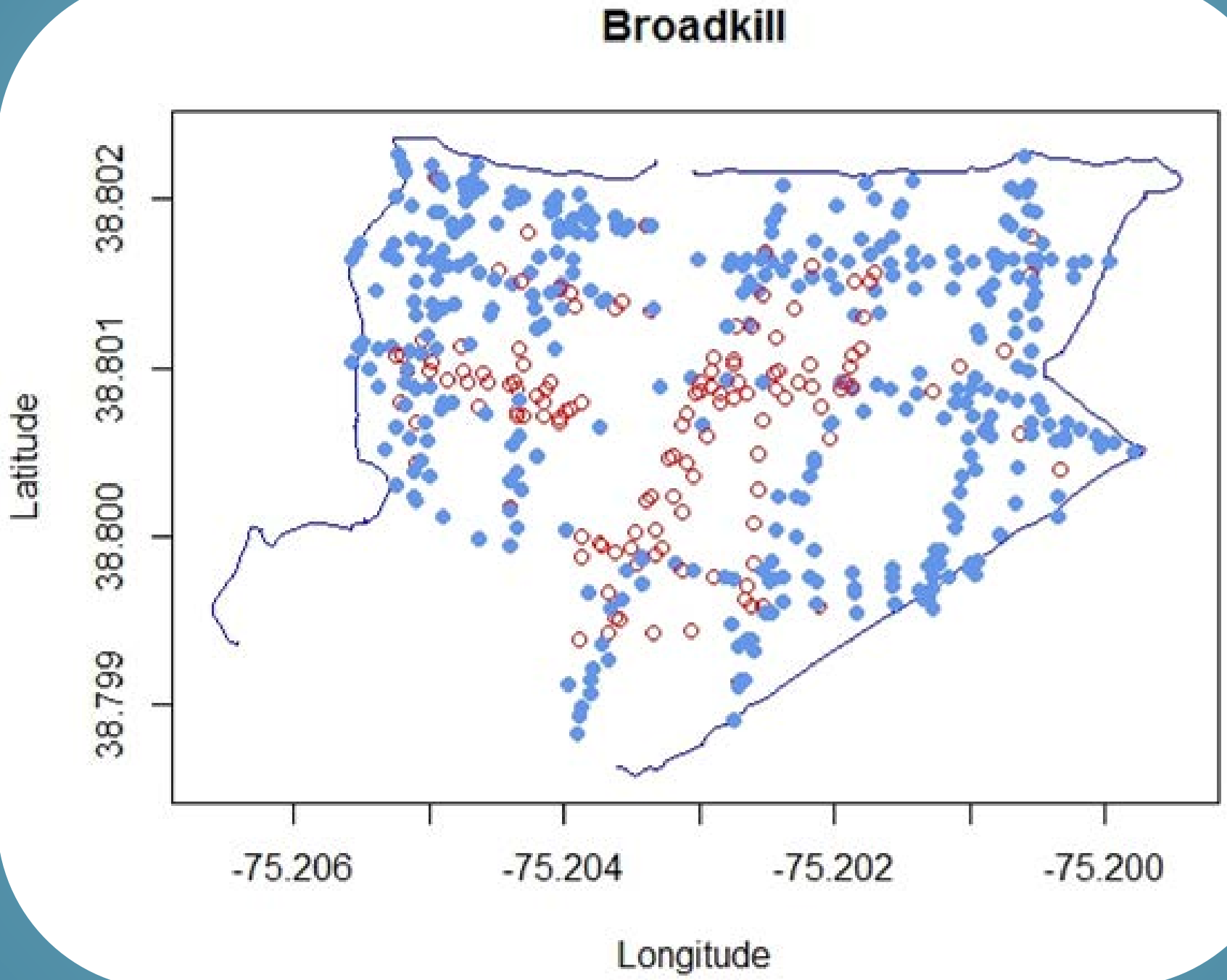
Oyster Rocks Rd
Broadkill

Study Sites

Distribution Surveys

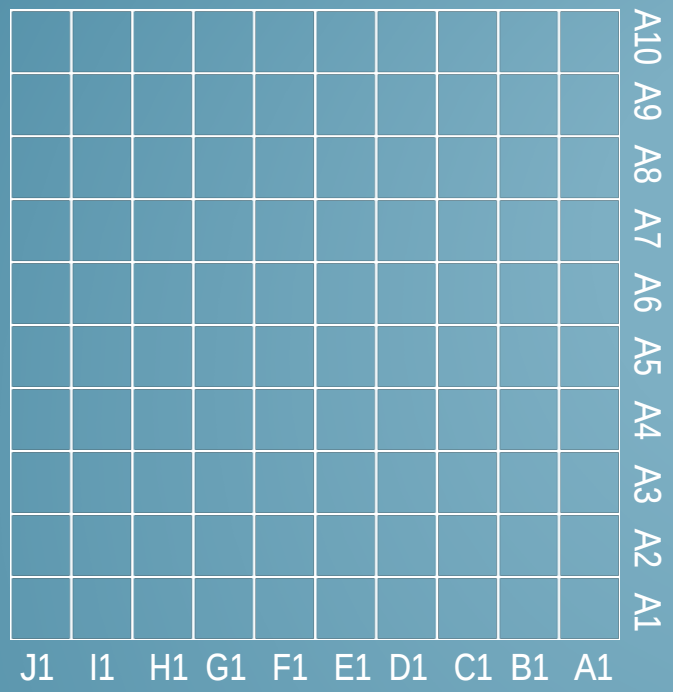
- *U. pugnax* presence/absence and variable sampling
- Sampled ~1 m radius every 20 m along transect lines

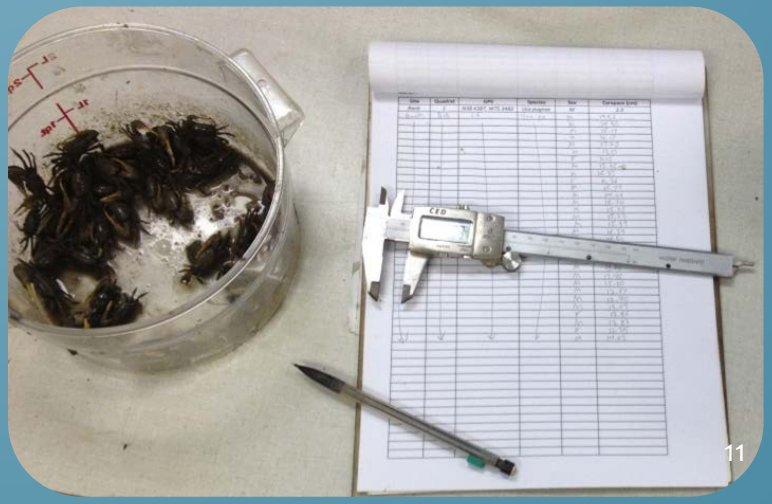

Broadkill
Latitude
38.802
38.801
38.800
38.799
-75.206
-75.204
-75.202
-75.200
Longitude

Presence Predictor Variables

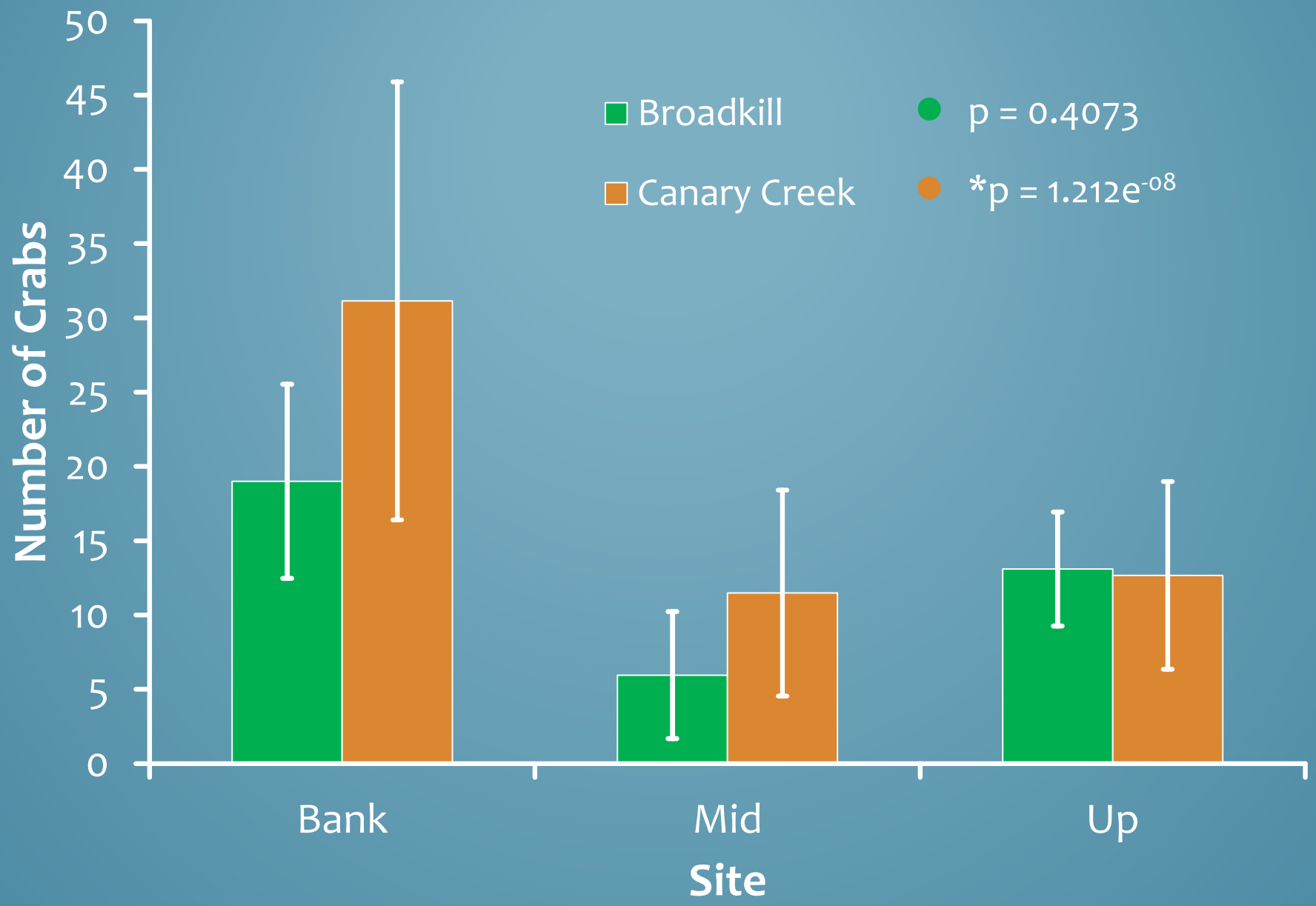
Variable	Correlation	Significance (p)
Elevation	-	0.01120
Percent Vegetation	+	< 2e-16
S. alterniflora	+	1.45e-05
Soil Shear	-	0.00744
Soil Compression	+	7.97e-05
Substrate Saturation	-	5.17e-08

Abundance Surveys





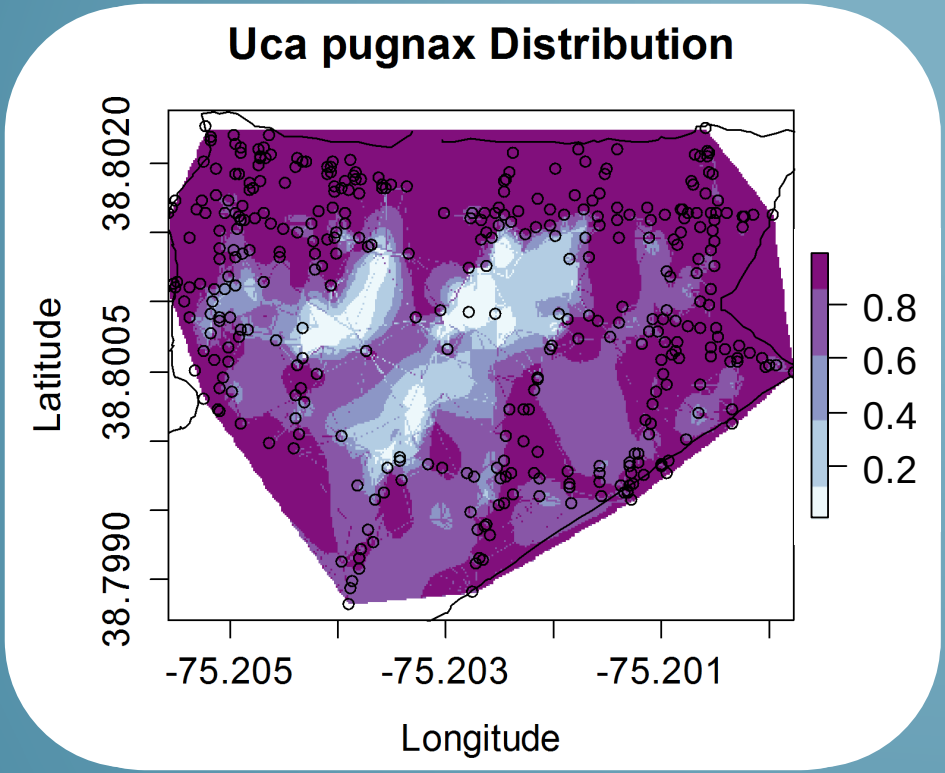
Most abundant near bank sites

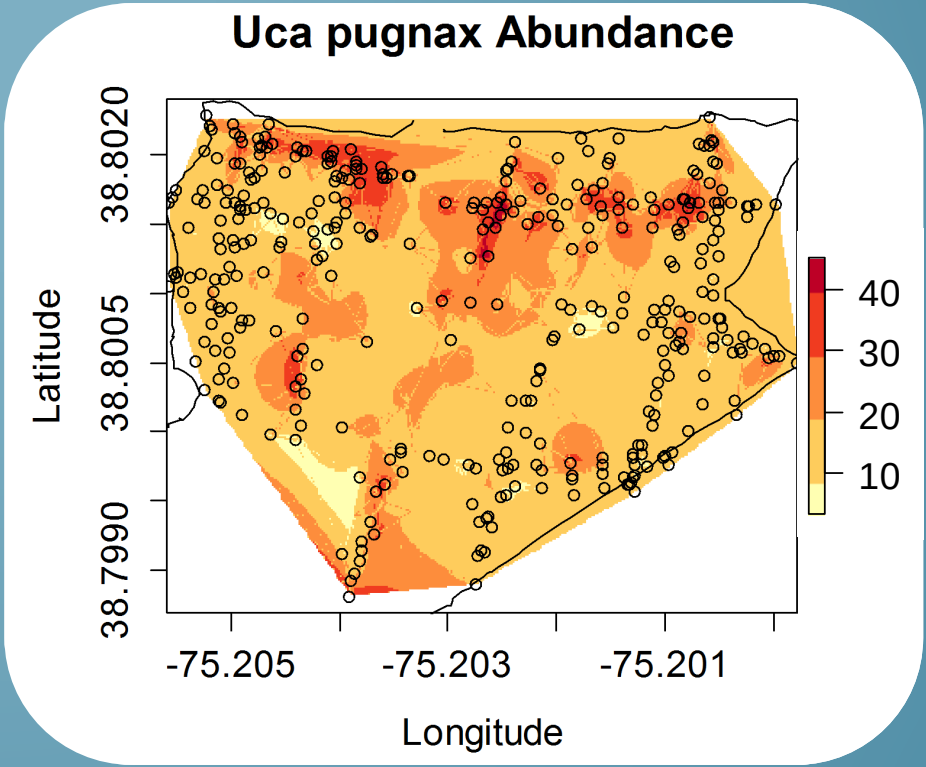


Abundance Predictor Variables

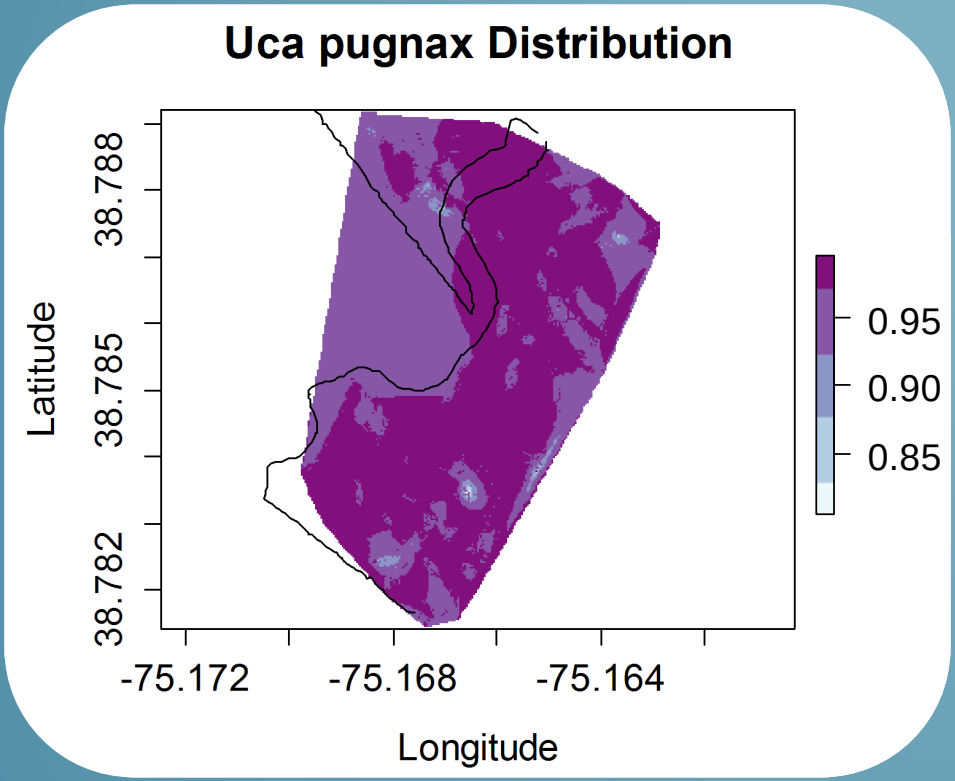
Variable	Correlation	Significance (p)
S. alterniflora	-	1.17e-04
D. spicata	+	0.00364
S. reticulatum	+	0.03353
Soil Compression	-	0.03455
Percent Water Content	-	6.84e-04

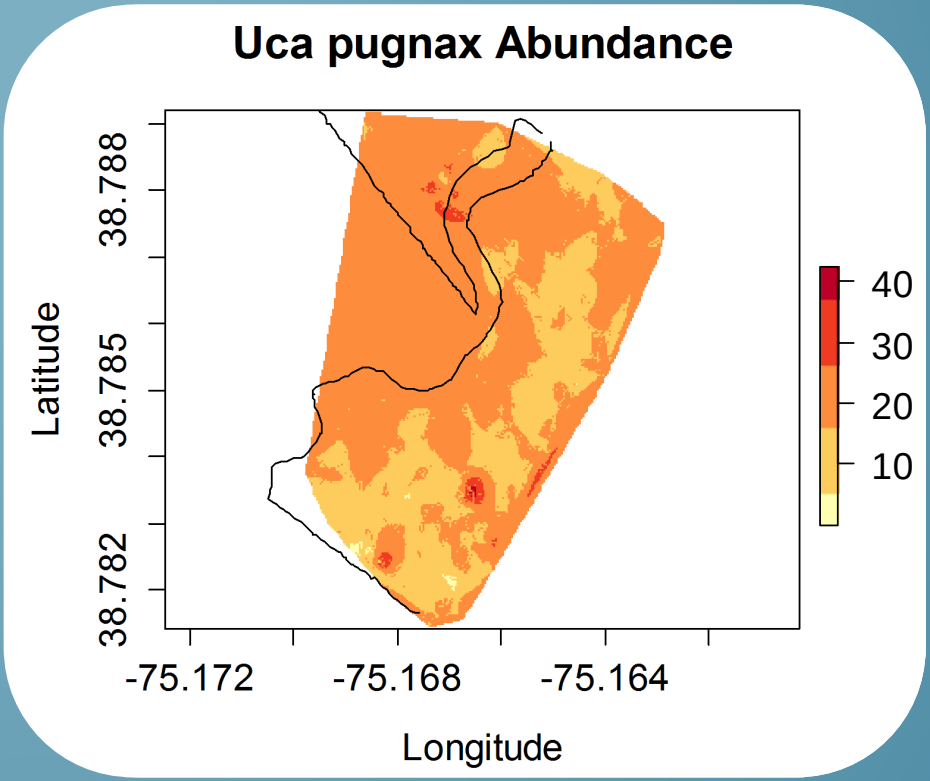
Species Distribution Models (Broadkill)





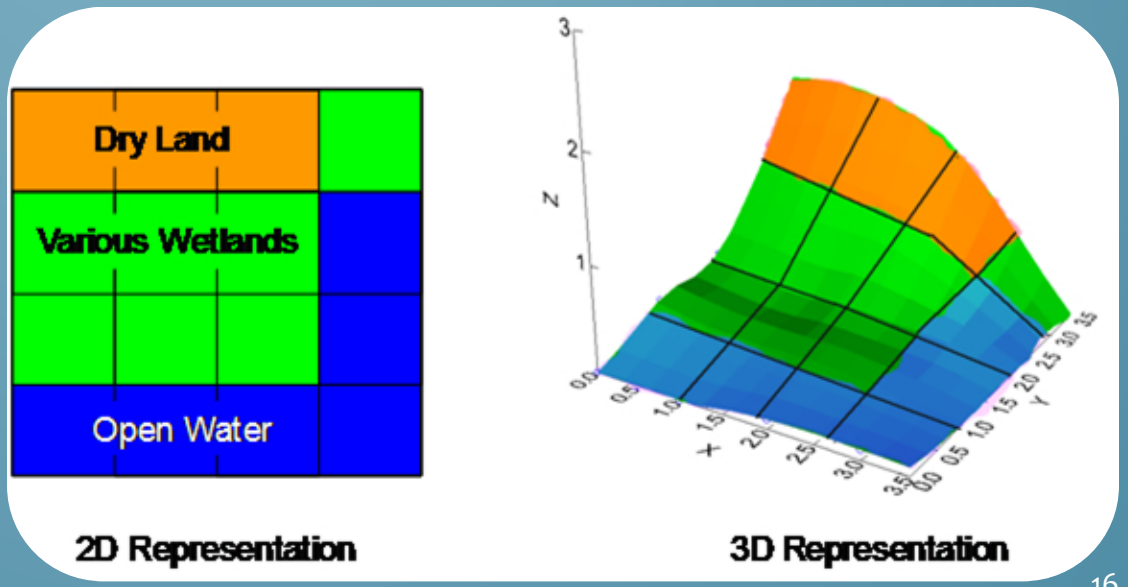
Species Distribution Models (Canary Creek)





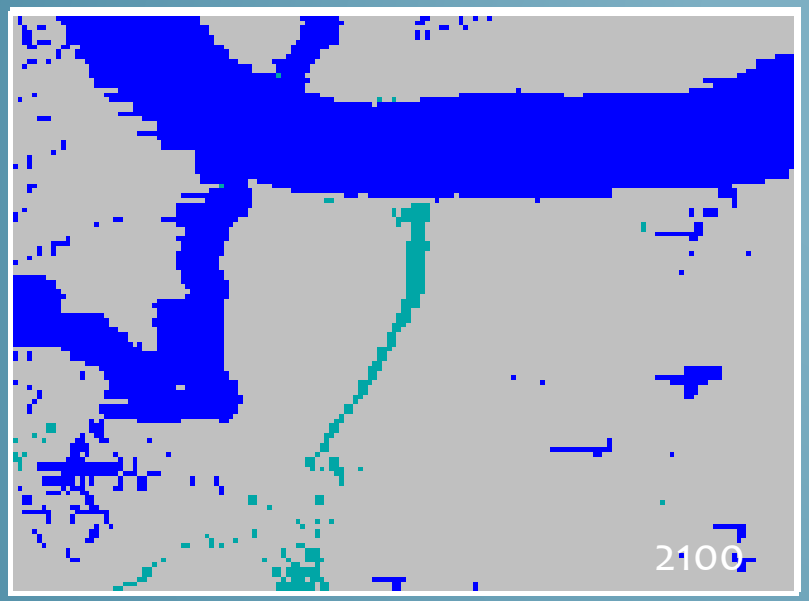
Sea Level Affecting Marshes Model (SLAMM)

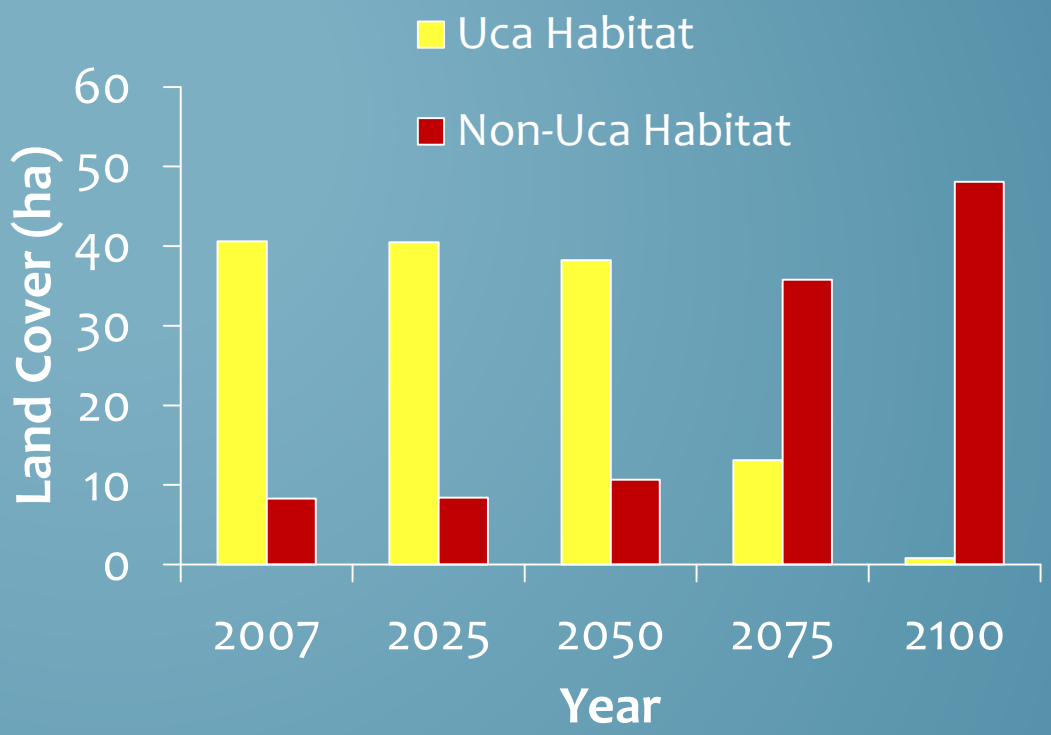
- Developed in 1986 by Richard A. Park with EPA funding
- Simulates the dominant processes involved in wetland conversions and shoreline modifications during long-term SLR
- Uses 5 primary processes to determine wetland fate in each SLR scenario
  - Inundation
  - Erosion
  - Accretion
  - Overwash
  - Saturation



(Clough et al. 2010)

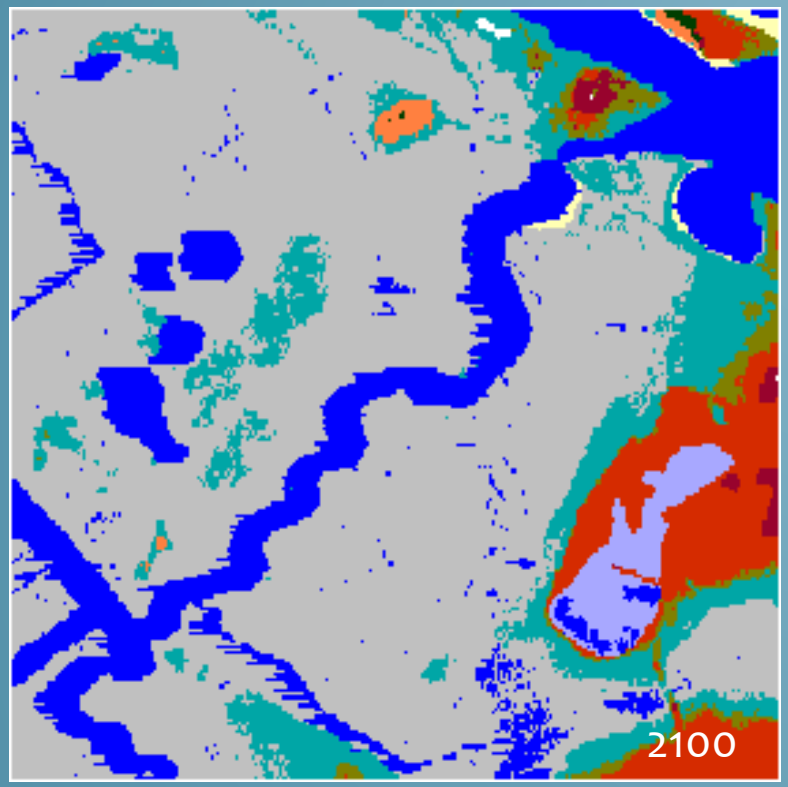
SLR Impacts (1.0 m Broadkill)

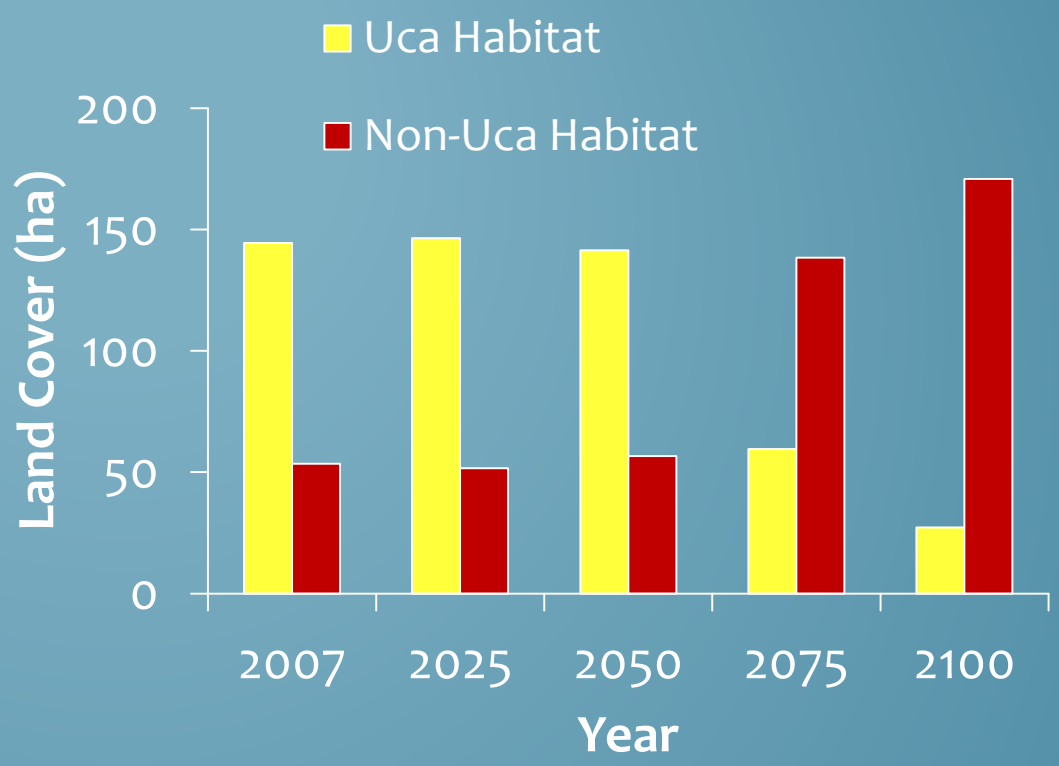




- Loss of 39.822 ha of *U. pugnax* habitat by 2100
  - 81 % of total region
  - 98 % of current *U. pugnax* habitat

SLR Impacts (1.0 m Canary Creek)





- Loss of 117.2615 ha of *U. pugnax* habitat by 2100
  - 59 % of total region
  - 81 % of current *U. pugnax* habitat

Preliminary Habitat Loss Predictions

	Broadkill		Canary Creek	
Scenario	**Habitat Lost (ha)**	**Habitat Lost (%)**	**Habitat Lost (ha)**	**Habitat Lost (%)**
A1B Max	24.5798	60.5	78.9032	53
0.5 m	4.4	11	10.7415	6
1.0 m	39.822	98	118.6242	81
1.5 m	40.6268	100	131.4504	91

Conclusions

- *Uca pugnax* prevalent throughout marsh except in areas of dieback and pooling
- Most abundant in near banks and areas conducive to burrowing
- SLR-induced loss to suitable habitat is predicted to range from ~50-100%

Looking Forward

- Apply findings to other Mid-Atlantic marshes
- Provide insight for marsh conservation and coastal management
- Work toward <0.5 m of SLR!

Acknowledgements

Thank you to:

- Delaware Sea Grant
- The University of Delaware
- Dr. Doug Miller
- Drs. Jonathan Cohen and Charles Epifanio
- Ian Combs, Meghan Owings, and Samantha Goodwin

Questions?

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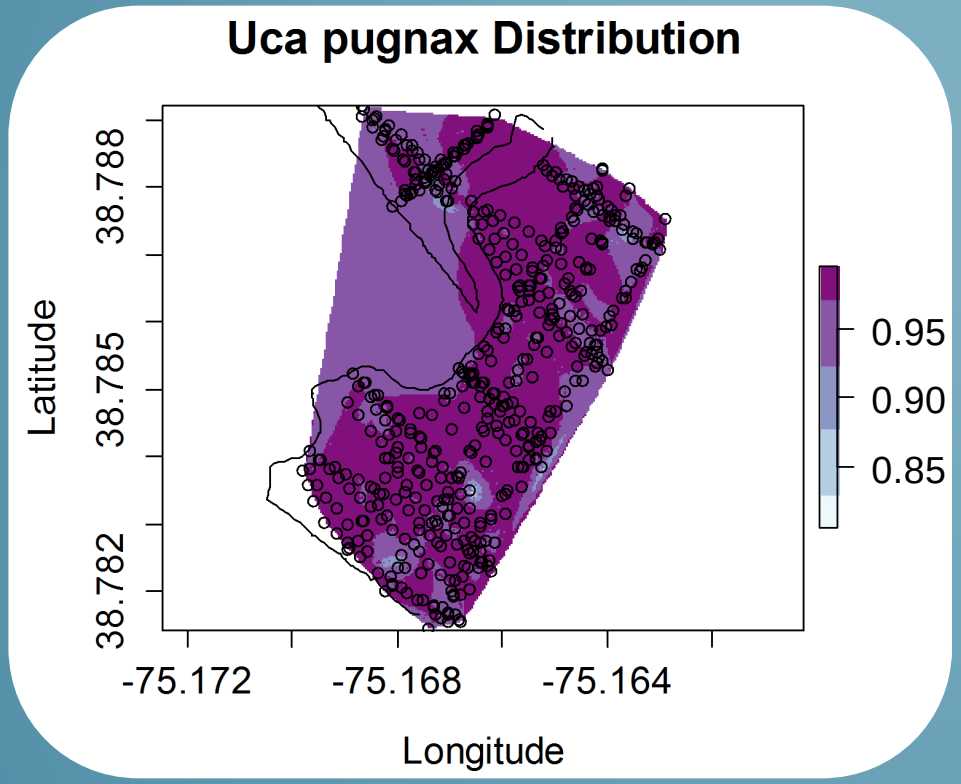
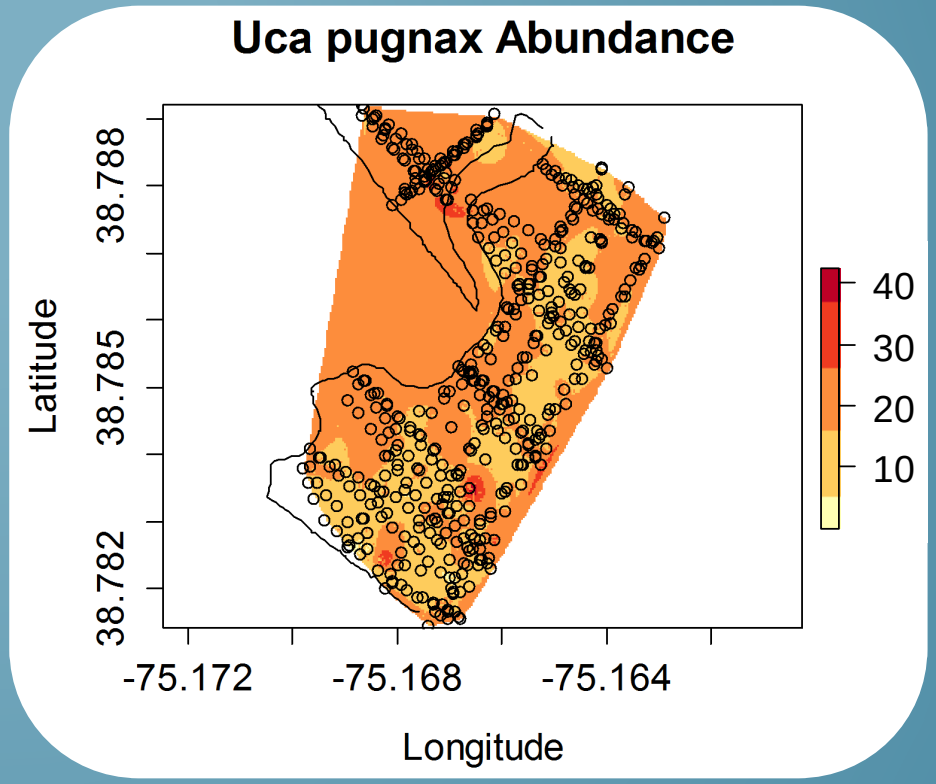
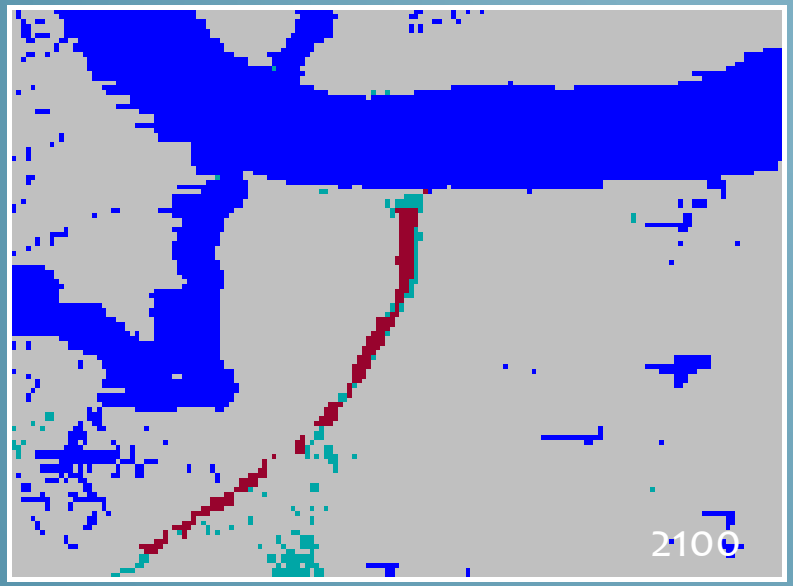

Uca pugnax Distribution
Latitude
38.788
38.785
38.782
-75.172
-75.168
-75.164
Longitude
0.95
0.90
0.85


Uca pugnax Abundance
Latitude
38.788
38.785
38.782
-75.172
-75.168
-75.164
Longitude
40
30
20
10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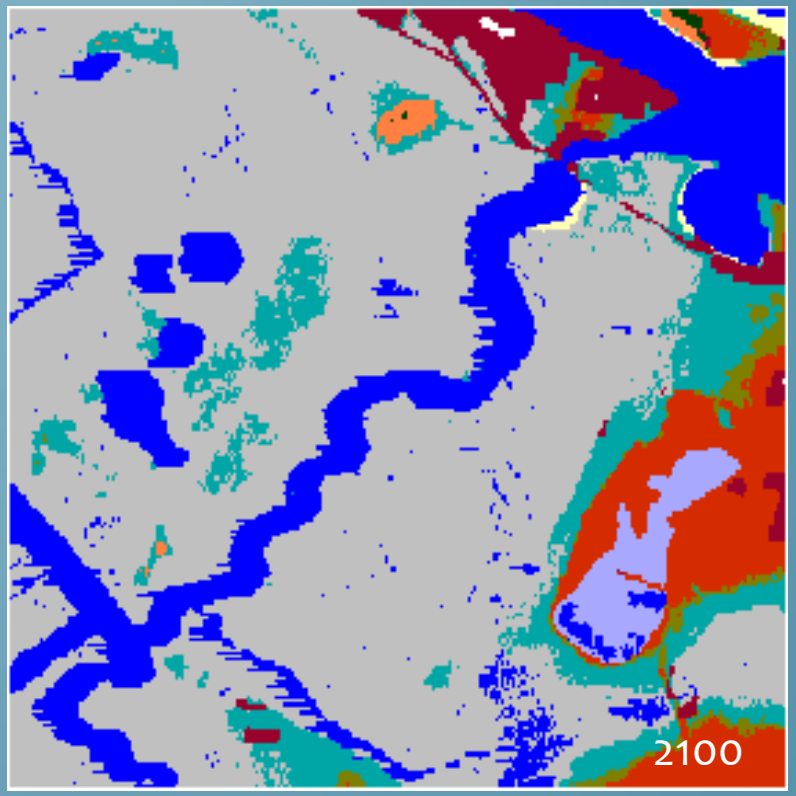
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