

Predation Impacts of Invasive Blue Catfish on Blue Crabs in Estuarine Environments

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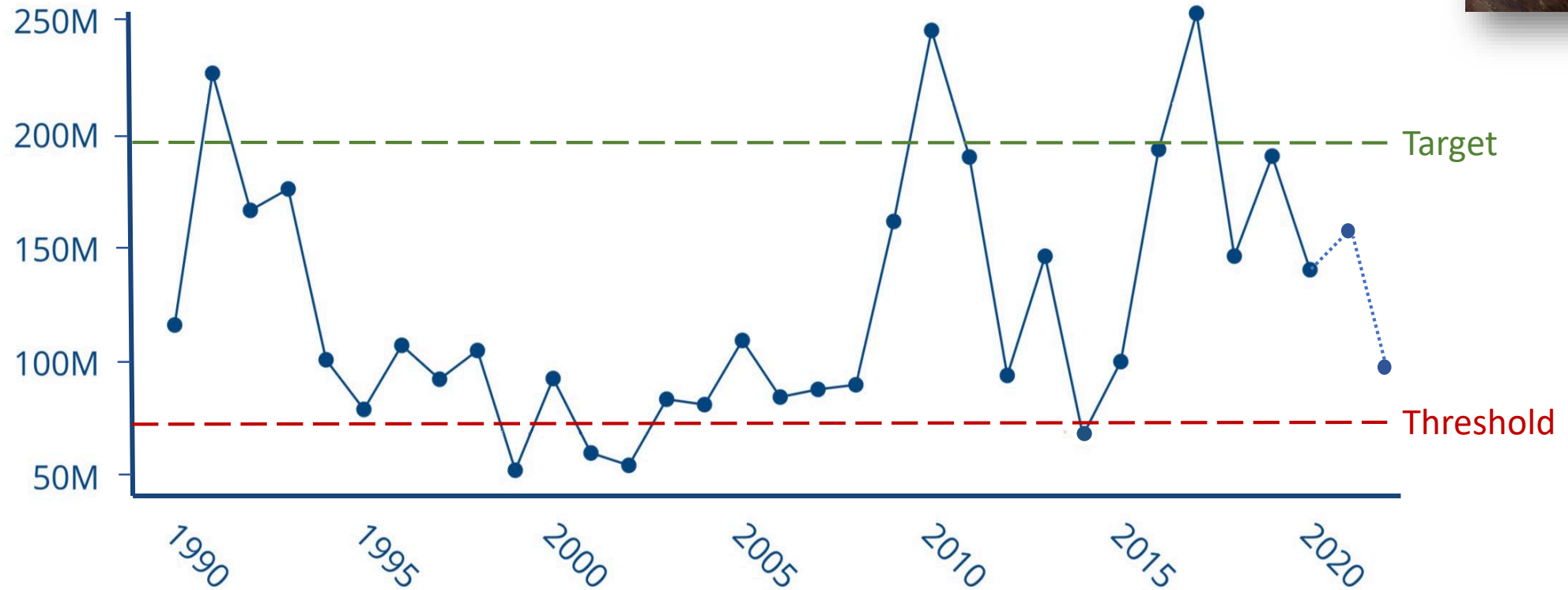


Blue Crab Populations In Chesapeake Bay



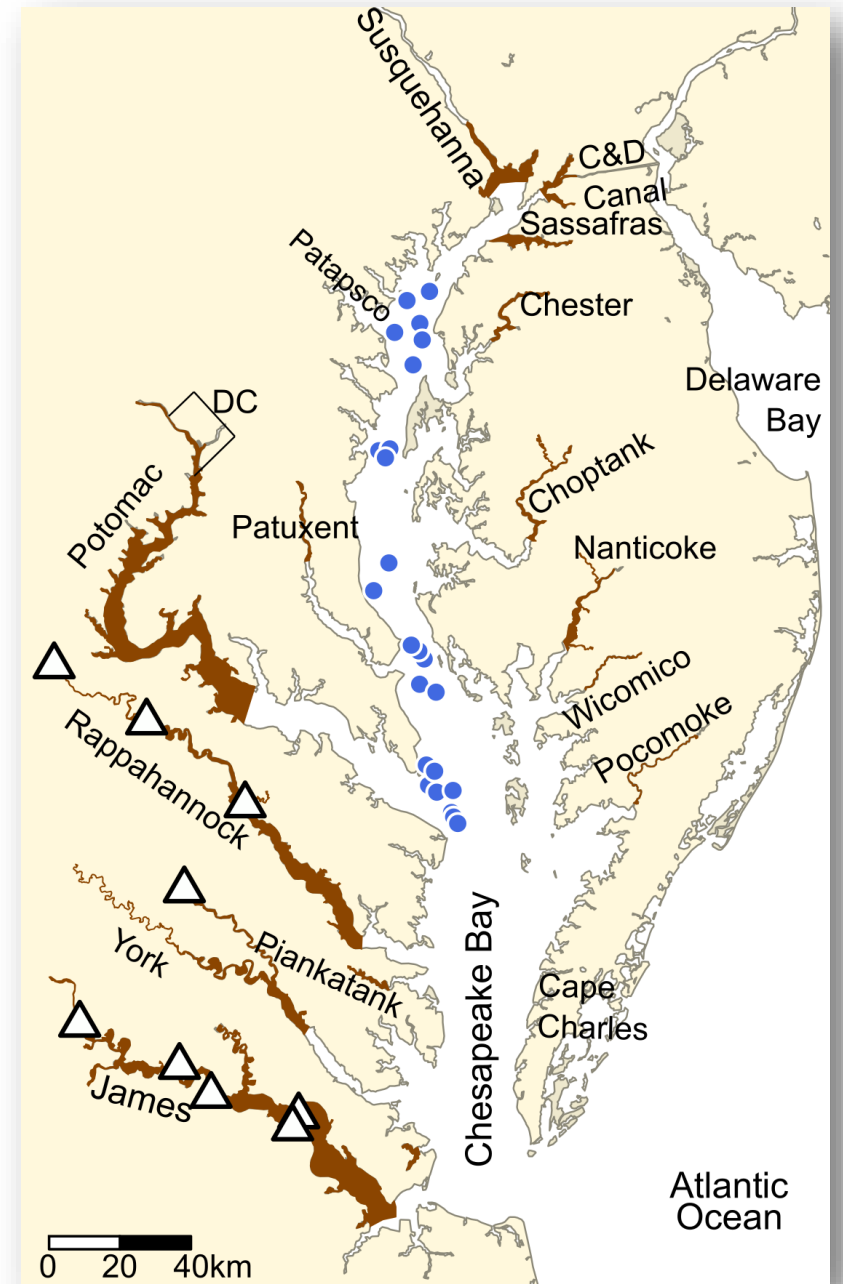
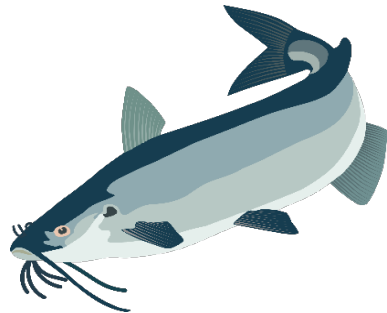
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Abundance of female spawners



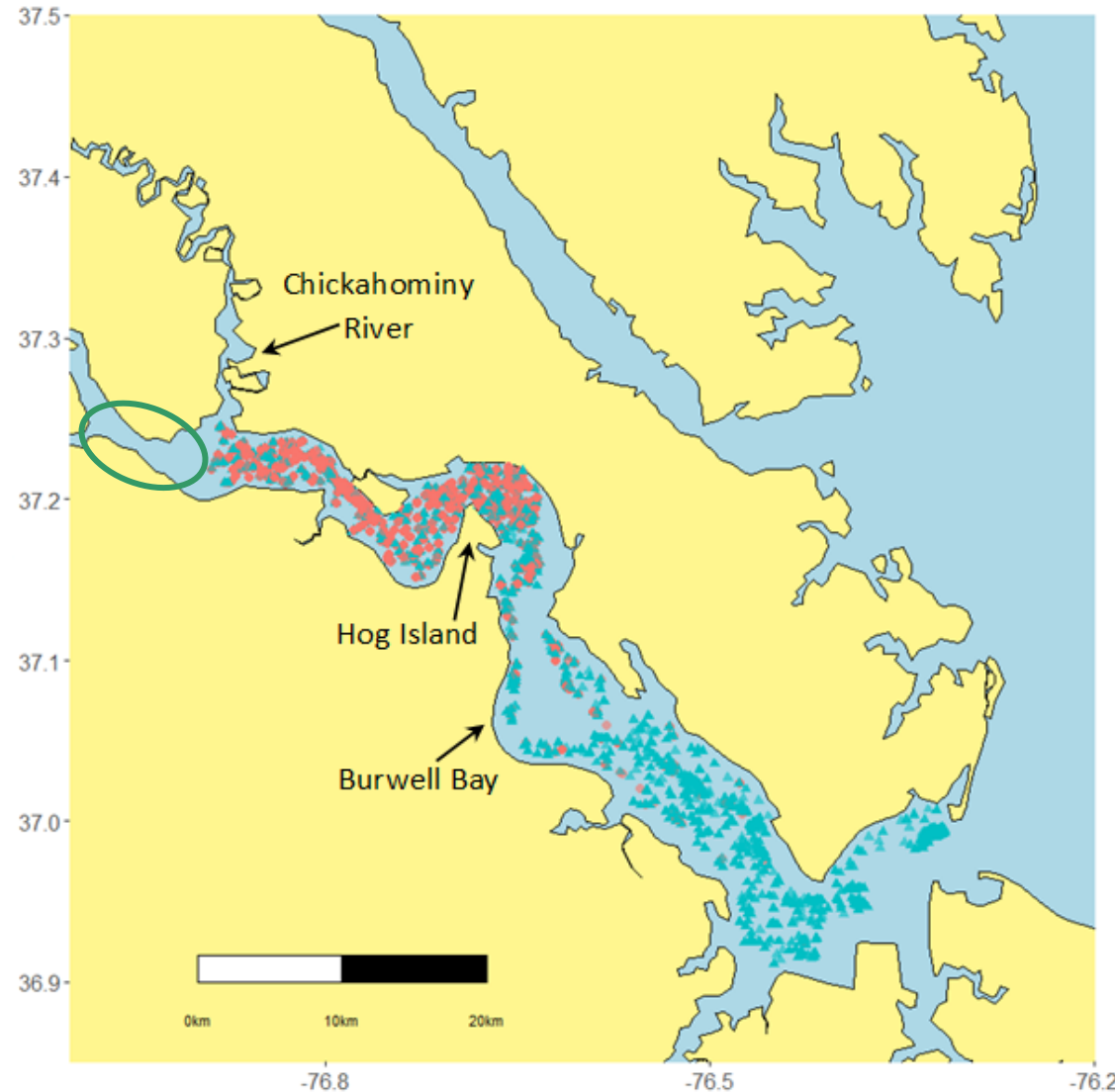
Blue Catfish as a Predator of Blue Crabs

- Omnivorous
- Up to 143 lbs, 29+ years
- Schmitt et al. 2019 – documented consumption of blue crabs in tidal freshwater/oligohaline regions
 - Percent occurrence: 15% to 32%
- What about mesohaline environments?
 - 5 – 18 psu



Blue Catfish and Blue Crabs in the James River

- 544 fish/ha in 12-km section
- 240-460 mm FL
- 1.6 M fish



Blue catfish
Blue crab (<75 mm CW)
2005-2015

Blue Crab Predation Avoidance

- Grow to a large size –
 - Exceed the gape size of predators
 - Evade capture
 - Fight back
- Avoid detection –
 - Hide in vegetated habitats
 - Burrow in the sediment (Bromilow & Lipcius 2017)

May not be effective refuge from predators that use tactile or chemical cues to locate prey



A. Schneider



D. Malmquist

Objectives

- Characterize blue catfish predation on blue crabs in estuarine environments
- Quantify predatory impacts of blue catfish on blue crabs

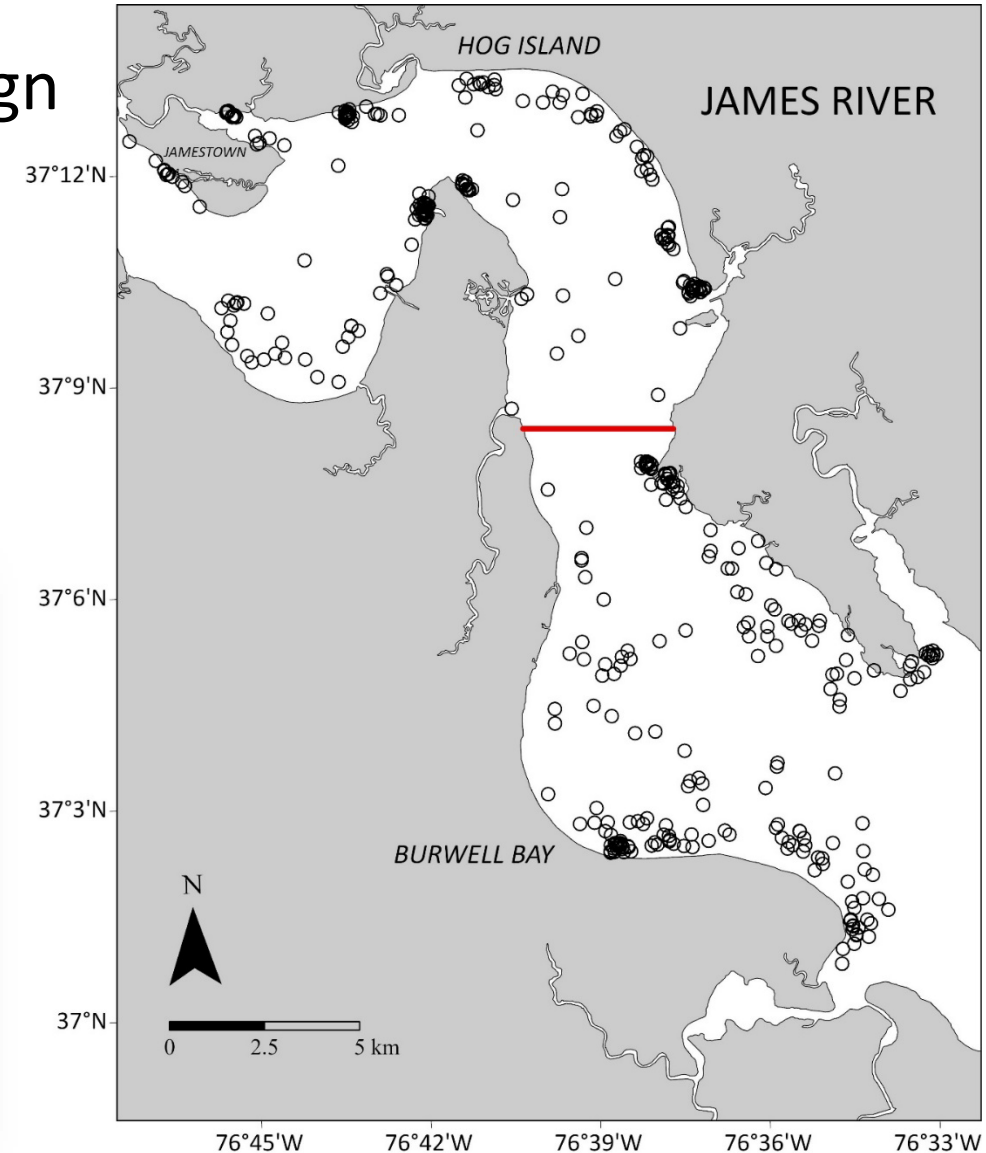
Approach

- Examine blue catfish stomach contents
- Estimate consumption rates



Sampling Design

- Multi-panel gillnets, stratified random design
 - Burwell Bay and Hog Island
 - Aug 2018 – Jun 2020
 - 6 nets set every 2 weeks, 21-hr soak time
 - 416 gillnet sets → 6,388 blue catfish (200 – 1102 mm FL)



Approach: Diet Metrics

- Characterize seasonal diets of blue catfish from the lower James River
 - % occurrence, % weight, prey-specific index of relative importance
 - Size classes of blue catfish
 - 200 – 300 mm FL
 - 301 – 500 mm FL
 - ≥ 501 mm FL

Diet metrics provided rough characterizations of diets, and confirmed the role of predator size in consumption of specific prey types

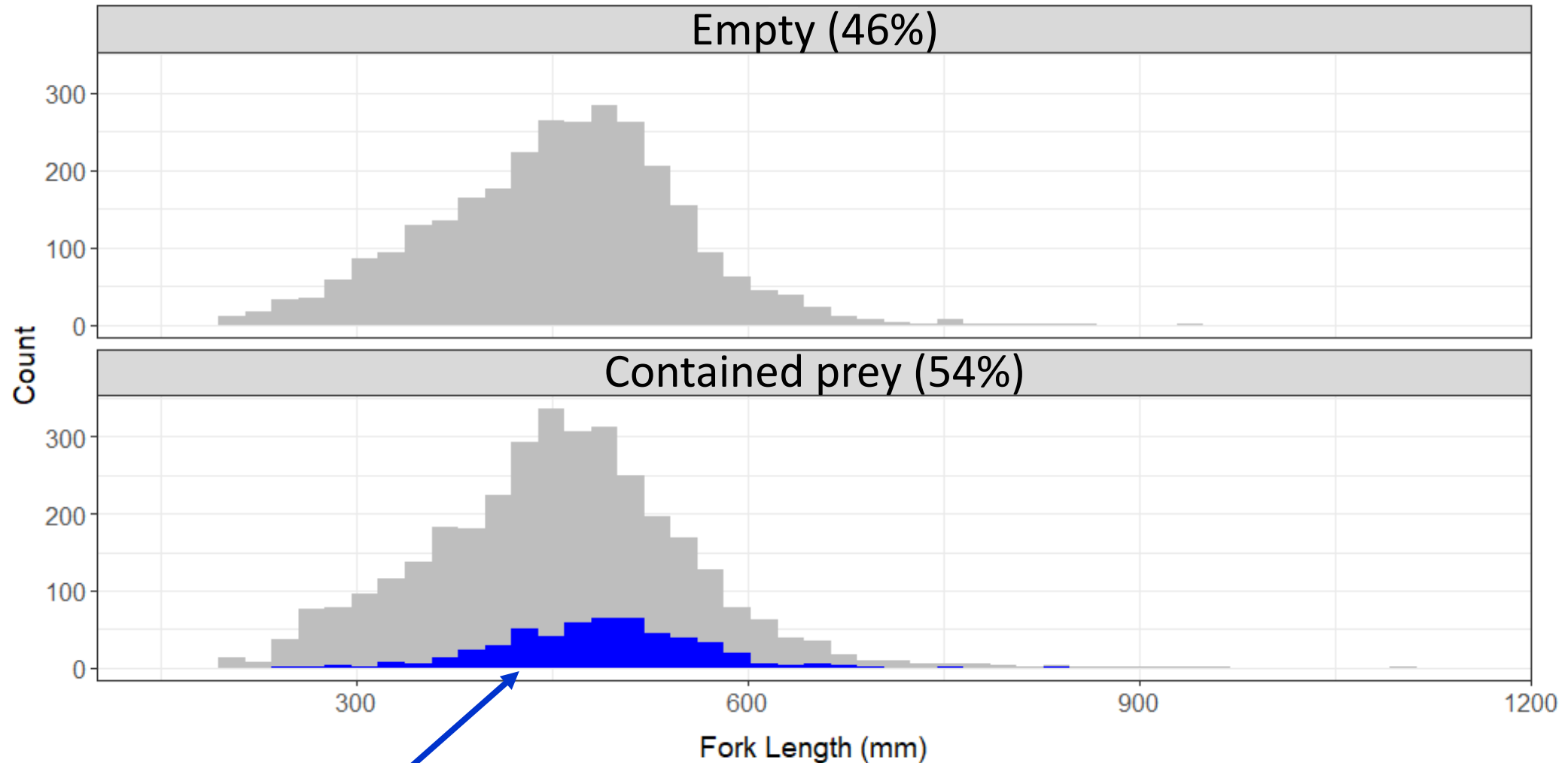


Approach: Crab Consumption



- Identify factors associated with blue crab consumption
 - Probability of consuming any prey
 - Probability of consuming blue crabs } by fish size, salinity, temperature, stratum, month
- Modeled with hierarchical logistic mixed models that accounted for clustered observations
- Estimate numbers and weight of blue crabs consumed by blue catfish
 - Average number of blue crabs consumed by size class, season, stratum
 - Modeled with Poisson hierarchical model that accounted for clustered observations
- Quantify predation impact using estimates of daily consumption, evacuation rates, and abundance of blue catfish in the study region (Link et al. 2002)

Blue Catfish of all Sizes Consumed Blue Crabs



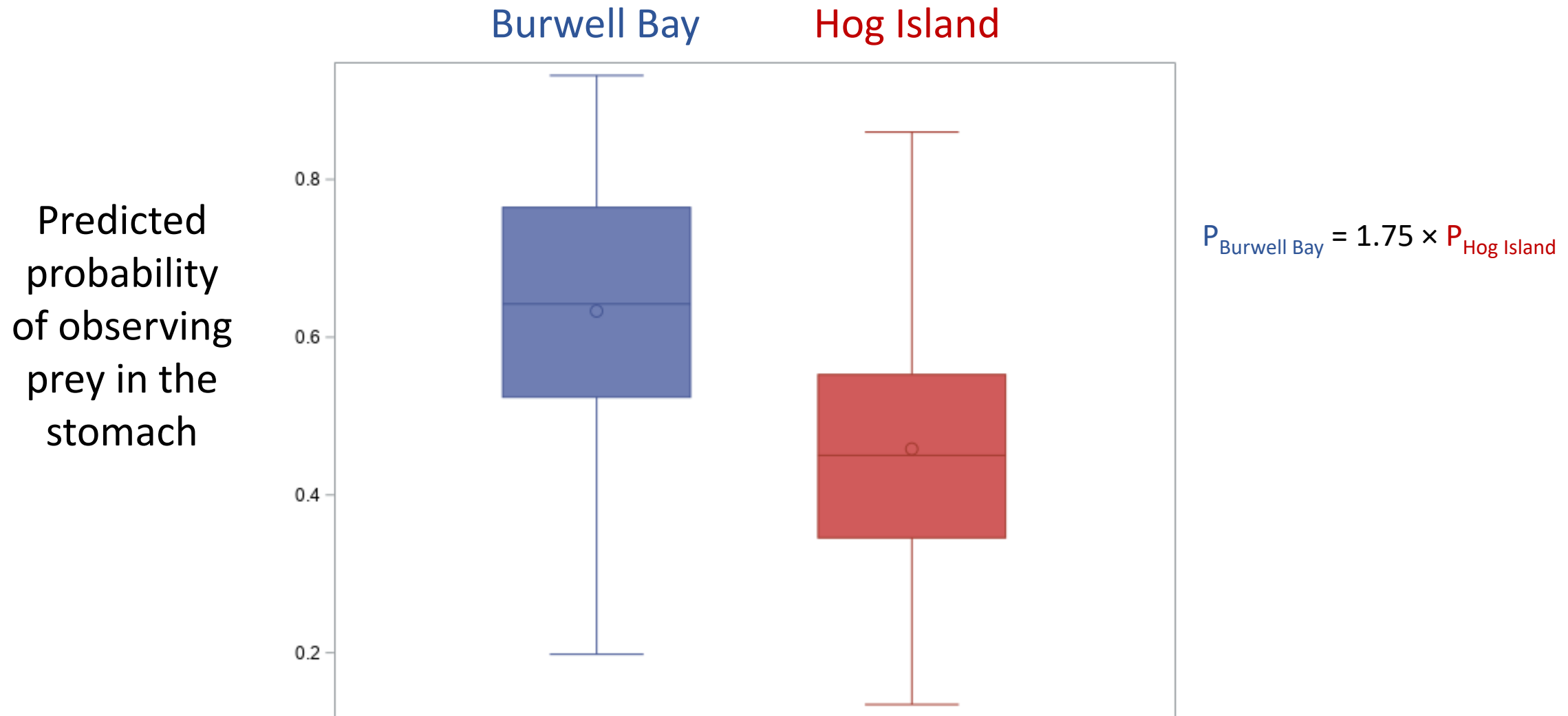
Blue catfish that contained blue crabs in their stomachs

Predation likelihoods varied spatially, temporally, and with blue catfish size (200 – 1102 mm FL)



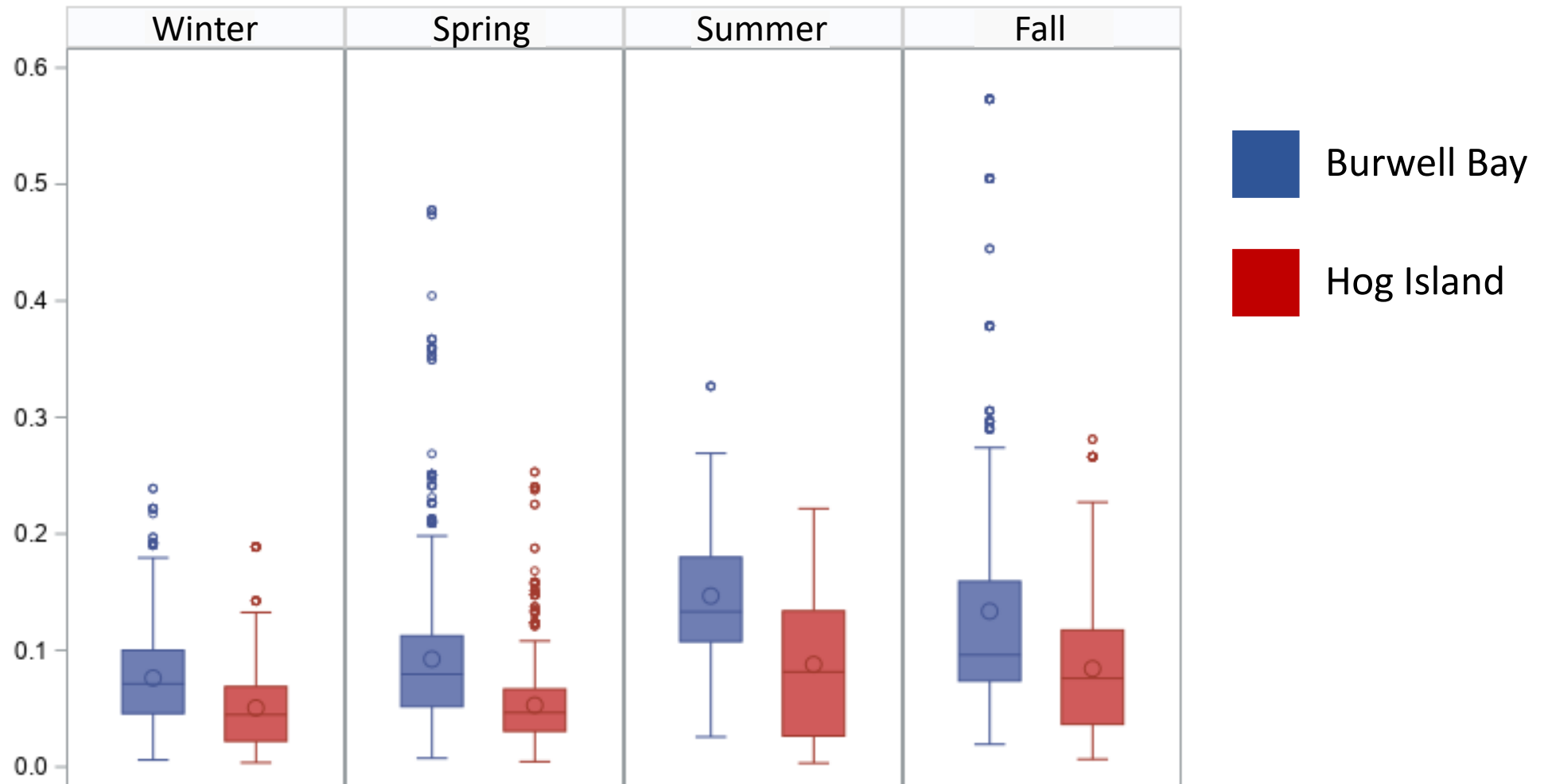
G. Mears

Blue Catfish at Downriver, Higher Salinity Sites Were More Likely to Have Consumed Prey



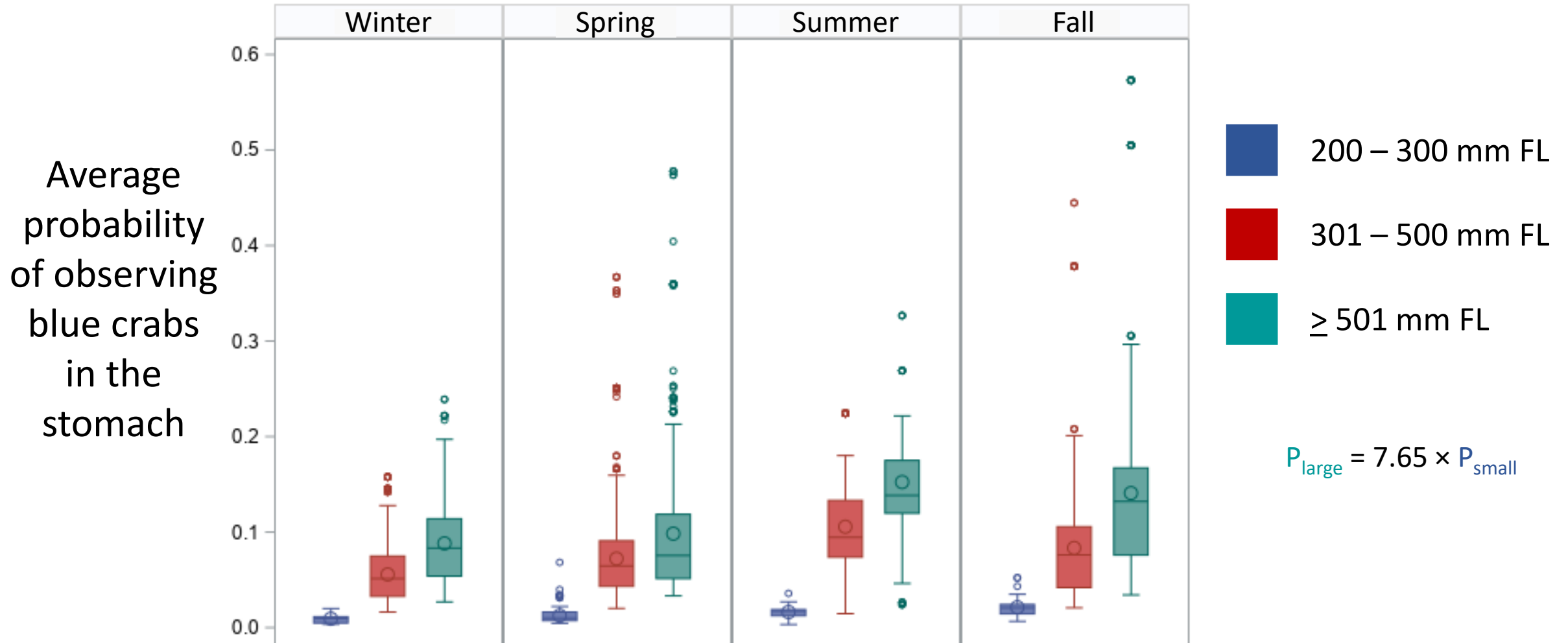
Blue Catfish at Downriver, Higher Salinity Sites Were More Likely to Have Consumed Blue Crabs

Average
probability
of observing
blue crabs
in the
stomach



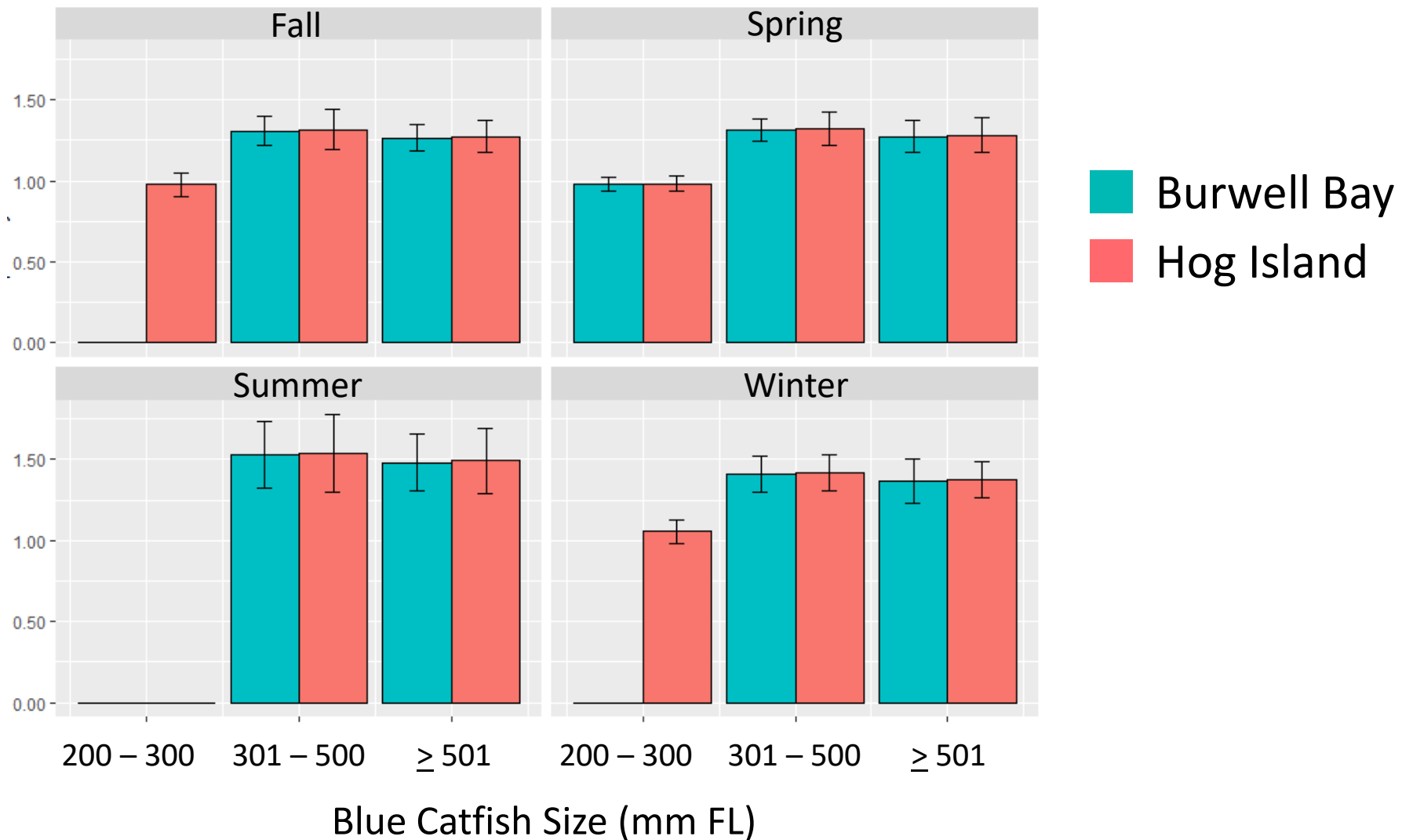
*We did not detect seasonal differences

The Probability of Consuming Blue Crabs Increased with Increasing Size of Blue Catfish

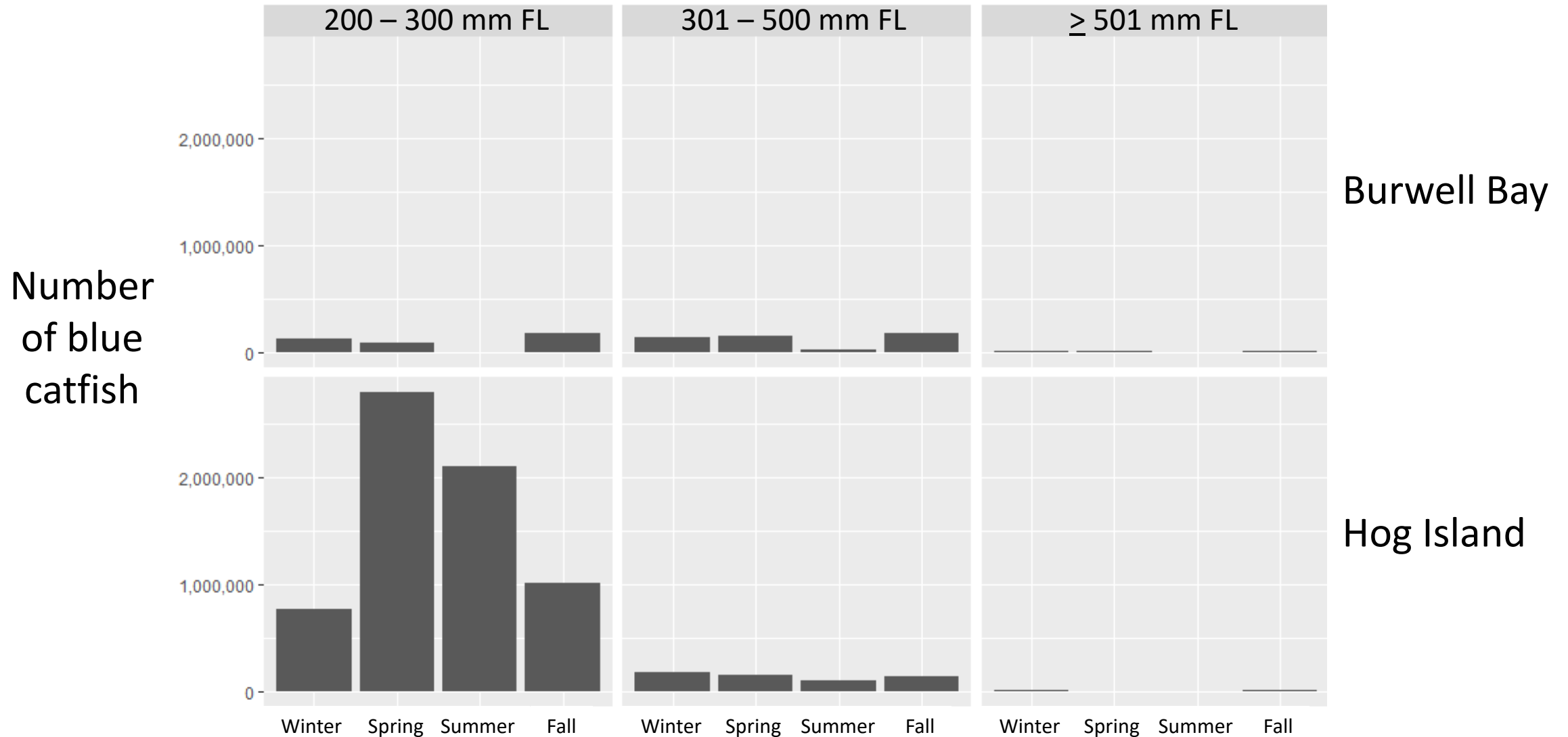


Average Daily Consumption of Blue Crabs: 0.98 to 1.57 crabs/day

Mean
number of
blue crabs
eaten per
day



But the Proportion of the Blue Catfish Population Comprised of Small, Intermediate, and Large Fish Was Not Equal



Total numbers are based on observations from the VIMS Juvenile Fish Trawl Survey, 2016 - 2020

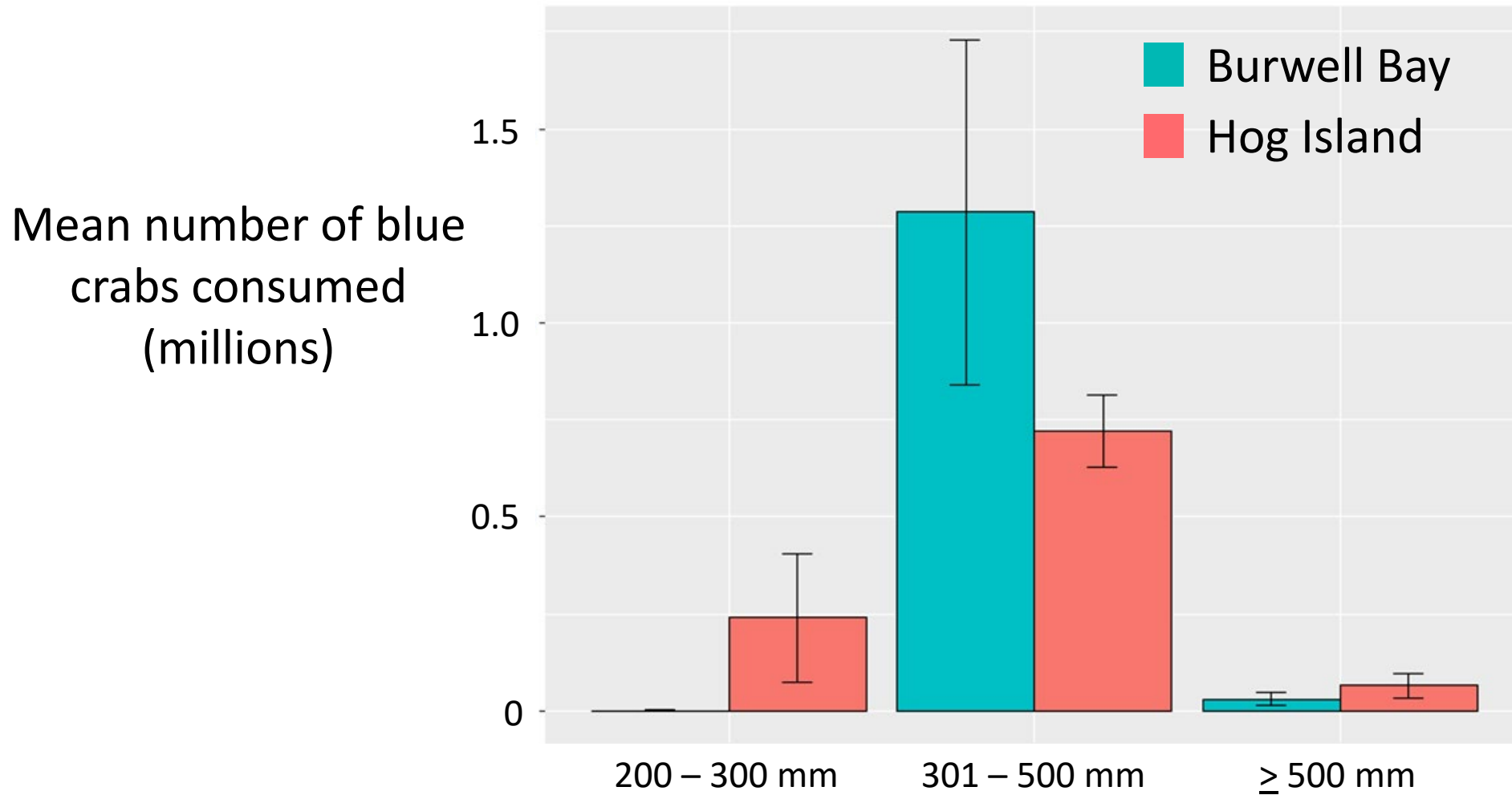
What might this mean for the overall consumption
of blue crabs?



A. Schneider

“A low incidence of prey in the diet [of
invasive fish predators] scales up to a
relatively large number consumed”
when abundance of predators is high
(Hedden et al. 2020)

Intermediate-size Blue Catfish Are Predicted to Consume the Largest Proportion of Blue Crabs



~2.3 million blue crabs were removed annually through predation by blue catfish in the study area (199.2 km²)

Recap

- Predation likelihoods varied spatially, temporally, and with blue catfish size
- Blue catfish in the lower James River consumed blue crabs throughout the year, with no discernible seasonal signal
- Higher salinity reaches were areas of greater predation intensity on blue crabs
- Blue catfish >300 mm FL were more likely to consume blue crabs than were smaller fish
- The average number of blue crabs consumed per day varied between 0.98 and 1.57 depending on fish size, season, and salinity
- ~2.3 million crabs were removed annually through predation by blue catfish in the study area
- Predation impact of blue catfish reflects the relative abundance of size classes of blue catfish in the lower James River such that fish between 301 and 500 mm FL removed a greater number of blue crabs because of the relatively greater number of this size fish in the James River population

Acknowledgments

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- Diet analyses
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Thank you