**2022 Benthic Ecology Meeting presentations**

**associated with Wells National Estuarine Research Reserve**

**Suggested Citations**

Burke EA, Goldstein JS, Gutzler BC, Furey NB. 2022. Tracking and connecting green crab movements with acoustic telemetry in a Gulf of Maine estuary. Talk presented at the 50th Benthic Ecology Meeting, March 29-April 2, 2022, Portsmouth NH

Craft HE, Crane LC, Gutzler BC, Bradt GM, Jury SH, Goldstein JS. 2022. To molt or not to molt? Indicators of premolt status in the invasive European green crab (*Carcinus maenas*). Talk presented at the 50th Benthic Ecology Meeting, March 29-April 2, 2022, Portsmouth NH

Crane LC, Miller JW, Gutzler BC, Burke EA, Goldstein JS. 2022. Paddling up the coast: monitoring the northward range expansion of the blue crab (*Callinectes sapidus*) into the Gulf of Maine. Talk presented at the 50th Benthic Ecology Meeting, March 29-April 2, 2022, Portsmouth NH

Dorrance AN, Goldstein JS, Carloni JT, Gutzler BC, Watson WH. 2022. Sublethal behavioral and physiological effects of claw removal on Jonah crabs (*Cancer borealis*). Talk presented at the 50th Benthic Ecology Meeting, March 29-April 2, 2022, Portsmouth NH

Goldstein JS, Zarella-Smith KA, Pugh TL. 2022. Egg-bearing American lobsters in a sea of trouble: reduced fecundity in southern New England – drivers and implications. Talk presented at the 50th Benthic Ecology Meeting, March 29-April 2, 2022, Portsmouth NH

Gutzler BC, Goldstein JS, Watson WH. 2022. Chew on this: monitoring American lobster feeding in the wild. Talk presented at the 50th Benthic Ecology Meeting, March 29-April 2, 2022, Portsmouth NH

Jury SH, Gutzler BC, Goldstein JS, Watson WH, Carloni JT. 2022. Behavioral thermoregulation of ovigerous American lobsters (*Homarus americanus*). Talk presented at the 50th Benthic Ecology Meeting, March 29-April 2, 2022, Portsmouth NH

Miller JW, Crane LC. The Marine Invader Monitoring and Information Collaborative (MIMIC): citizen scientists track the spread of invasive species in the Gulf of Maine. Talk presented at the 50th Benthic Ecology Meeting, March 29-April 2, 2022, Portsmouth NH *(talk canceled)*

Oehmig PC, Gutzler BC, Carloni JT, Goldstein JS. 2022. Effect of warming sea temperatures on postlarval lobster (*Homarus americanus*) swimming performance and energy reserves. Talk presented at the 50th Benthic Ecology Meeting, March 29-April 2, 2022, Portsmouth NH

**Abstracts**

**Tracking and connecting green crab movements with acoustic telemetry in a Gulf of Maine estuary**

Emily A. Burke1, Jason S. Goldstein2, Benjamin C. Gutzler2, Nathan B. Furey1

1 University of New Hampshire, School of Marine Science and Ocean Engineering, Durham, NH 03924

2 Wells National Estuarine Research Reserve, Maine Coastal Ecology Center, Wells, ME 04090

The invasive green crab (*Carcinus maenas*) negatively impacts estuarine habitats and shellfish fisheries in New England. Knowing when and where to target specific subpopulations of green crabs, including pre-molt and ovigerous animals, may facilitate harvest or removal efforts in the future. We hypothesized that green crabs move widely throughout estuarine systems but may show stage- or sex-specific patterns of habitat use. We deployed an array of 23 acoustic telemetry receivers in a Gulf of Maine estuary from May–December 2021, and externally affixed acoustic tags to 43 crabs, including males and both non-ovigerous and ovigerous females. Tagged crabs were detected most frequently in middle and upper estuary sites, while the fewest detections occurred at the ocean inlet and up-estuary sites. Ovigerous females were detected in every region of the estuary, and most consistently in the middle estuary region. Interestingly, ovigerous females were also detected moving from the estuary into the ocean, then back into the estuary. These data suggest connectivity between ocean and estuarine habitats for individual crabs, which may be linked with reproductive processes. Findings from this study may help to guide a novel soft shell crab fishery and inform targeted removals of ovigerous green crabs.

**To molt or not to molt? Indicators of premolt status in the invasive European green crab (*Carcinus maenas*)**

Hannah E. Craft1,2, Laura C. Crane2, Benjamin C. Gutzler2, Emily A. Burke3, Gabriela M. Bradt4, Steven H. Jury5, Jason S. Goldstein2

1 Monmouth University, West Long Branch, NJ 07764

2 Wells National Estuarine Research Reserve, Maine Coastal Ecology Center, Wells, ME 04090

3 University of New Hampshire, School of Marine Science and Ocean Engineering, Durham, NH 03924

4 New Hampshire Sea Grant, University of New Hampshire, Durham NH 03824

5 Saint Joseph’s College of Maine, Standish, ME 04084

The European green crab (*Carcinus maenas*) is a prolific invasive species that has dominated coastal habitats throughout much of the Northeastern U.S., negatively impacting salt marsh integrity and the sustainability of many native species. The development of a targeted soft-shell crab fishery for this species may provide an economic opportunity to utilize this abundant resource, while potentially mitigating ecosystem impacts in some areas. The goal of this research was to identify indicators of pre-molt status in green crabs that could aid in developing a rapid assessment tool for harvesters wishing to produce soft-shell product. Green crabs were collected from the Webhannet estuary, Wells, ME, held for up to six weeks, and assessed 2x/week for molt status and total hemolymph (blood) proteins. Preliminary data suggests a correlation in hemolymph protein that may be predictive of molting. The average initial hemolymph protein level of green crabs that molted during holding was higher than that of crabs that did not molt. These results, along with complementary trapping and acoustic telemetry studies, will further aid in developing an artisanal soft-shelled green crab fishery by providing necessary biological information that can be applied by end-users, including local harvesters and coastal resource managers.

**Paddling up the coast: Monitoring the northward range expansion of the blue crab (*Callinectes sapidus*) into the Gulf of Maine**

Laura C. Crane1**,** Jeremy W. Miller1, Benjamin C. Gutzler1, Emily A. Burke2, and Jason S. Goldstein1

1 Wells National Estuarine Research Reserve, Maine Coastal Ecology Center, Wells, ME 04090

2 University of New Hampshire, School of Marine Science and Ocean Engineering, Durham, NH 03924

The rapidly warming Gulf of Maine has attracted a diversity of species expanding their ranges northward including the blue crab, *Callinectes sapidus*. While the geographic range of *C. sapidus* has historically occurred south of Cape Cod, recent observations suggest the establishment of more permanent year-round populations in southern Maine. We initiated a trapping survey to investigate the occurrence, persistence, and spatio-temporal distribution of *C. sapidus* in salt marsh pools in two estuaries. Traps were deployed and fished weekly, Sep-Dec 2020 (n = 30 crabs) and Apr-Nov 2021 (n = 115 crabs). Environmental data were also regularly measured. In 2021, peak crab catches occurred May-July with no crabs caught after September. There was no clear correlation between catch and salinity or temperature over time, though a sudden drop in dissolved oxygen preceded declines in catch on two occasions. The majority of crabs (79%) were male, with females primarily caught in Spring and Fall. A complementary acoustic telemetry study will further reveal trends in *C. sapidus* movements throughout the estuary. This ongoing study provides evidence for the establishment of year-round *C. sapidus* populations in southern Maine estuaries and expands our insight into the environmental conditions under which this species may persist.

**Sublethal behavioral and physiological effects of claw removal on Jonah crabs (*Cancer borealis*)**

Anna N. Dorrance1, Jason S. Goldstein2,1, Joshua T. Carloni3, Benjamin C. Gutzler2, and Winsor H. Watson III1

1 University of New Hampshire, School of Marine Science and Ocean Engineering, Durham, NH 03924

2 Wells National Estuarine Research Reserve, Maine Coastal Ecology Center, Wells, ME 04090

3 New Hampshire Fish and Game Department, Durham, NH 03824

Jonah crabs have become a targeted fishery in recent years, prompting the need for improved data to better help manage this expanding fishery. In some areas, male claws are harvested at sea; however, little is known about the impacts of claw removal on the crabs that survive this practice. We tested the impacts of claw removal on Jonah crab locomotion, feeding, activity, and mating. In the lab, declawed crabs were significantly less active than intact crabs while in the field, crabs with both claws removed moved about 50% less per day than control crabs, although this difference was not significant. Crabs might have been less active because their hemocyanin levels dropped significantly after the removal of both claws and remained depressed for up to two weeks. Crabs with no claws were able to feed, which might help them replenish hemocyanin levels in the wild, but they had difficulty opening mussel shells, which may influence their diet. Finally, in mating trials, both control and declawed males managed to successfully mate when paired with females. These data suggest that, while those crabs that do survive declawing might be impaired, they should be able to both forage and mate.

**Egg-bearing American lobsters in a sea of trouble: Reduced fecundity in southern New England – drivers and implications**

Jason S. Goldstein1, Katrina A. Zarrella-Smith1, and Tracy L. Pugh2

1 Wells National Estuarine Research Reserve, Maine Coastal Ecology Center, Wells, ME 04090

2 Massachusetts Division of Marine Fisheries, New Bedford, MA 02744

Lobsters in Southern New England (SNE) have experienced decades of environmental stressors and disease. We hypothesized that the sub-lethal effects of physiological stress resulting from increased temperature have contributed to a decline in reproductive investment in SNE lobsters. Using the presence of epizootic shell disease (ESD) as a proxy for stress, we examined potential fecundity through the number of early-stage eggs and their nutritional quality, realized fecundity based on counts of late-stage eggs, and compared realized fecundity to historical data (1980s) from the region. Generalized linear modeling showed that female size was a significant predictor of both potential and realized fecundity as expected, but that ESD status did not result in differences in fecundity. Realized fecundity of recent-day females was significantly reduced compared to the fecundity of historical females. We found few differences in egg nutritional content from non-diseased and diseased females, though diseased individuals with larger clutches produced eggs with lower protein content and dry weight. Stressful environmental conditions, particularly temperature, may have contributed to decreased fecundity over a 30-year period in SNE. Defining how stress has contributed to the depleted condition of the SNE lobster stock will be valuable in assessing climate-related risk to other vulnerable stocks.

**Chew on this: monitoring American lobster feeding behavior in the wild**

Benjamin C. Gutzler1,2, Jason S. Goldstein2, and Winsor H. Watson III1

1 Department of Biological Sciences, University of New Hampshire, Durham, NH 03824

2 Wells National Estuarine Research Reserve, Maine Coastal Ecology Center, Wells, ME 04090

Given the value of the American lobster (*Homarus americanus*) fishery, and its dependence on bait to attract lobsters to traps, surprisingly few observations have been made of lobster foraging behavior in the wild. To fill in this knowledge gap we designed and built datalogger “backpacks” that were capable of measuring and recording lobster movements, heart rate, and feeding activity. Five lobsters equipped with these backpacks were released off the coast of New Hampshire, USA, inside an acoustic positioning array. After 24-48 hrs at large the lobsters were recaptured and the data were downloaded. Bouts of feeding included one or more sequences of mandible movements lasting 1–5 minutes each, as well as elevated heart rates. While both feeding and locomotion occurred at all hours, most activity was nocturnal or crepuscular. Feeding occurred during most hours, but relatively few hours included extended periods of feeding, indicative of larger meals. Lobsters also moved less in the hours with the most feeding activity, potentially indicative of periods of searching followed by pauses to consume prey. This study illustrates how dataloggers, such as the one used in this study, can provide a window into the behavior and physiology of lobsters in their natural habitat.

**Behavioral thermoregulation of ovigerous American lobsters (*Homarus americanus*)**

Steven H. Jury1, Benjamin C. Gutzler2, Jason S. Goldstein2, Winsor H. Watson III3, and Joshua T. Carloni4

1 Saint Joseph’s College of Maine, Standish, ME 04084

2 Wells National Estuarine Research Reserve, Maine Coastal Ecology Center, Wells, ME 04090

3 University of New Hampshire, School of Marine Science and Ocean Engineering, Durham, NH 03924

4 New Hampshire Fish and Game Department, Durham, NH 03824

American lobsters (*Homarus americanus*) can sense small differences in water temperature and their thermal preferences influence their movements and distribution. Thermal preferences of ovigerous (i.e., berried) females at various reproductive stages were determined using a thermal gradient tank (range 8-20°C) to demonstrate that berried females (n=152) often preferred temperatures that differed from control non-berried females (n=127) of similar sizes and acclimation conditions. In the late summer and early fall, when eggs were in early stages of development, berried females preferred warm water temperatures that were similar to controls. During the winter and early spring, all females selected low temperatures and had low levels of activity. In the summer, when berried female eggs were well developed and closer to hatching, they preferred cooler temperatures than controls until their eggs began hatching; at which time they became significantly more active than both controls and females carrying earlier egg stages. This study demonstrates that female reproductive state affects their thermal preferences and activity levels, which in turn lead to predictable changes in their distribution throughout the year. Therefore, as coastal waters warm, the distribution of berried females might change, and this could impact larval transport and recruitment.

**The Marine Invader Monitoring and Information Collaborative (MIMIC): Citizen scientists track the spread of invasive species in the Gulf of Maine**

Jeremy W. Miller and Laura C. Crane

Wells National Estuarine Research Reserve, Maine Coastal Ecology Center, Wells, ME 04090

Recent data suggest that the Gulf of Maine is one of the fastest warming bodies of water on the planet. This warming trend, specifically in the summer and fall, is suspected to increase the chances for invasive species to establish viable populations in the Gulf of Maine and rapidly expand in abundance and spatial coverage. These invasions have implications to fisheries, aquaculture, biodiversity, ecology, and recreation. Since 2008, dedicated groups of well-trained citizen scientists have been monitoring a select set of invasive benthic and fouling organisms in the intertidal zone along the New England Coast. The goal of this Marine Invader Monitoring and Information Collaborative (MIMIC) is to work with community members to help in the early detection and documentation of marine invasive species throughout New England. This presentation will highlight the findings from more than a decade of survey data on marine invasive species occurrences at 21 long-term sampling sites located along ~ 91km of the Maine coast and demonstrate how useful volunteer monitoring data can be for efficiently detecting and tracking marine invasions in coastal systems.

**Effect of warming sea temperatures on postlarval lobster (*Homarus americanus*) swimming performance and energy reserves**

Phoebe C. Oehmig1,2,3, Benjamin C. Gutzler3, Joshua T. Carloni4, and Jason S. Goldstein3

1 Middlebury College, Middlebury, VT 05753

2 Woods Hole Oceanographic Institution, Falmouth, MA 02543

3 Wells National Estuarine Research Reserve, Maine Coastal Ecology Center, Wells, ME 04090

4 New Hampshire Fish & Game, Durham, NH 03824

Recent declines in lobster settlement in the Gulf of Maine (GoM) have raised questions concerning the effects of climate change on shifting lobster recruitment patterns in the GoM. Postlarval (PL) lobsters (Homarus americanus) require sufficient energy reserves to actively swim from locations where they metamorphose from planktonic larvae in offshore waters to inshore nursery grounds where they settle and grow. We used a series of laboratory swimming assays as our basis to test the swimming performance, nutritional condition, and behavior of both laboratory- and field-sourced PLs. We challenged PLs at both physiologically favorable temperatures (15°C), as well as end-of-century projected GoM temperatures (22°C). PLs in the 15°C temperature treatment spent significantly more time actively swimming than PLs in the 22°C temperature treatment; however, no significant differences were observed in PL weights or lipid contents between treatments. Metabolic rates of ectotherms such as lobsters increase in warmer temperatures, so it is possible that decreased swimming at warmer temperatures may be a behavioral strategy for energy conservation. Our results show cause for concern for the future viability of the lobster fishery in the GoM as sea temperatures and other climate-related stressors continue to influence lobsters in the GoM.