The Impact Of Decreased Temperatures On The Nonindigenous Carcinus maenas at Reid State Park, Ft. Popham, and Todd's Landing.

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Abstract

I am investigating the impact of temperature differations on the nonindigenous *Carcinus maenas*(green crabs). Research on *Carcinus maenas* is important to help stop the spread of 1 of the 100 worst invasive species. We set varying traps at varying day and recorded the size, sex, aggressiveness, colors, and number of claws. I got monthly temperature data via neracoos buoy E01, Central Maine Shelf. I discovered a correlation between decreased temperature and green crab population, as well as a correlation between green crab aggressiveness and decreased temperatures. There is a correlation between decreased temperatures and green crab abundance.

Introduction

I am investigating temporal impacts on the nonindigenous *Carcinus maenas*(green crabs) at Reid State Park. Research on *Carcinus maenas* is important to help stop the spread of 1 of the 100 worst invasive species.[1]*Carcinus maenas* can live in temperatures from 32-72 degrees fahrenheit, a wide range of salinities, can survive 10 days out of water, and according to Casco Bay Estuary.org, *Carcinus maenas* can, "spawn up to 185,000 eggs at a time", and "A single female can produce one or two clutches of eggs each year" [2,3], making them extremely prolific invaders. They got here by boat on poorly cleaned ships in the 1800's. They are bad not just because of that, but also because they eat 36 clams a day, and deter lobsters away from traps.

Studies on *Carcinus maenas* are important to fishermen because it will help Lobster fishermen know when to set traps without *Carcinus maenus* intruding and stealing the bait. It will also help clam fishermen to

know the ideal time to dig for clams without the interference. A third reason is because of global warming. Will global warming help us remove the invasive *Carcinus maenus*? It is most important to scientists as it will help identify when is the best time to look for more crabs. Scientists already know that *Carcinus maenas* are pushing native species *Cancer Irroratus* and *Cancer Borealis* into deeper waters, as well as eating juvenile *Homarus americanus*. My investigation will add more information to what scientists know because it will see if abundance, size, sex, and aggresiveness are affected by lower temperatures still in the acceptable temperature, as I haven't found a credible study on this exact topic.

My question is if the temperature has an effect on *Carcinus maenus*'s aggressiveness, abundance, sex, and size. I predict colder weather will result in less crabs as they go into a state of overwintering- the crabs go dormant for the winter and slow their metabolism. I predict this will also result in less aggressive crabs, as they try to hunker down. I predict that size and sex will not change with the temperature

Methods

In 2013 and 2015 through 2021, BMS 7th grade students set a varying amount of traps at Fort Popham, Phippsburg, ME. Todd's Landing, and Reid State Park on a variable number of days near the late October and November, keeping track of the date. We obtained our data by using sardines in oil as our bait, thinking the oil would not mix with water and attract more green crabs. We placed 3 traps at Reid and Popham, and 1 trap at Todd's Landing. The traps were all underwater the entire time they had bait, as to maximize the green crabs caught. We recorded the size, sex, aggresiveness, color beneath the eyes, how many claws they had, and how hard their shell was. We also put fingernail polish on them to get an idea of how many crabs there are in general. We did this exact same thing every year we were there.

I will calculate the abundance by the following formula: $nCrabs/(TrapsPerDay \times nDaysWentPerMonth)$. We went for a different amount of days per year, as well as setting a different amount of traps per year. For size, I found the Median Per Month. We will calculate aggressiveness and sex by taking the majority of the crabs aggressiveness and sex and counting it as the monthly crabs sex/aggresiveness.

It will be difficult to answer my research question without temperature data, which we will obtain via Neracoos buoy E01, which we chose because we believe it is the closest that gives us monthly data. We took the monthly data from the buoy at 1m water depth every month we were there.

There are a few flaws with this assessment, As it was designed for *Carcinus maenas* only, so we could not take a lot of data on the native crustaceans. This study was also designed to inflate the total number of green crabs via using special bait, putting it away from other crabs, and putting it out of the way of human foot traffic, so the total count might not be comparable to other scientific studies. I can not get specific temperatures for each individual location, as the most accurate buoy is in the Central Maine Shelf, so we will not have any specific site data.

Median crab size to Temperature

The data for this graph was calculated by finding the median size of the Green Crabs and made into 1 crab with said size for each month and the average temperature for the same month. This graph shows there is a miniscule difference in median Size as the temperature goes down. There is no visible correlation between temperature and median size.

M.Size (mm)

Temp (C)

Size:Temp
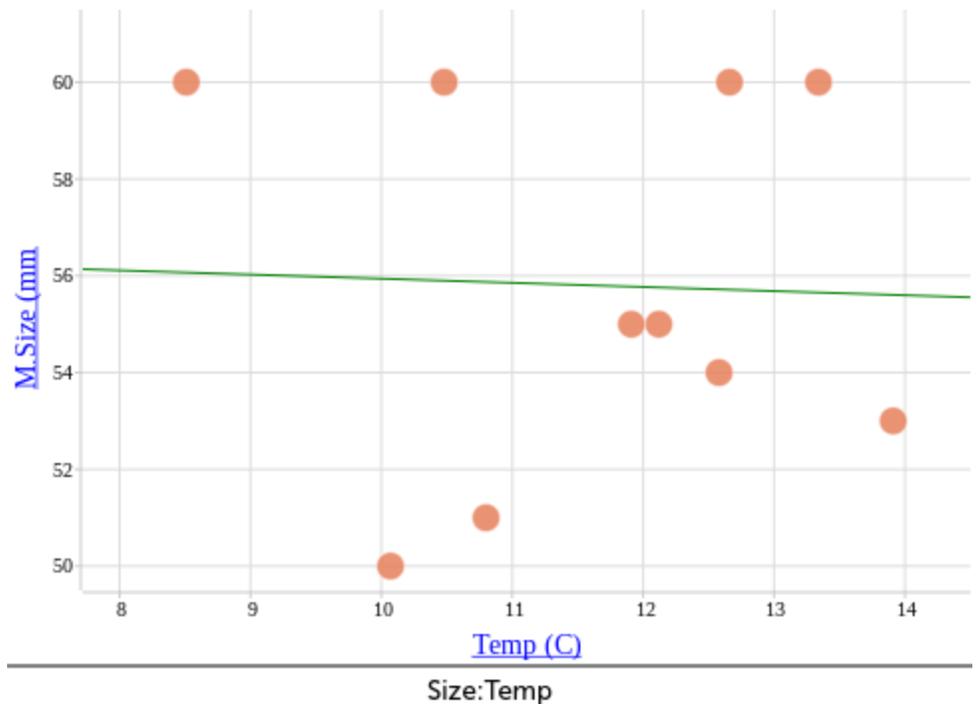
Aggressiveness to Temperature

This data was calculated by taking the majority of crabs aggressiveness each month and made into 1 crab with said aggressiveness. I also took the same temperature data for each graph. This shows a correlation between lower temperatures and higher aggressiveness. This graph may be misleading, as we only took data on aggressiveness since 2019, potentially inflating results.
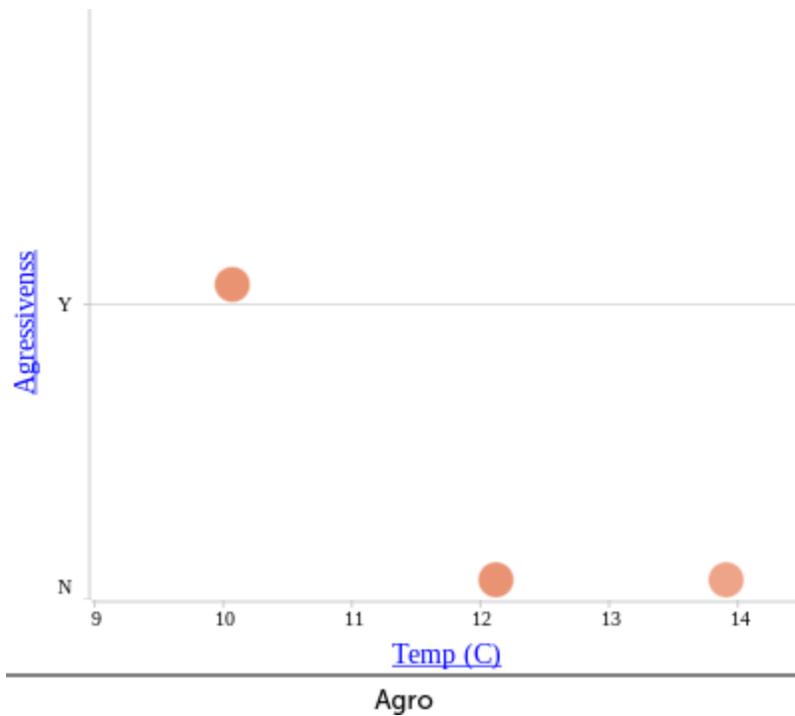
Sex to Temperature

This data was calculated by finding the majority of the crabs sex and making it 1 crab with said sex. The temperature data is still collected from the same buoy at the same time. This graph shows that females are more common than males and male appear more often at colder temperatures.
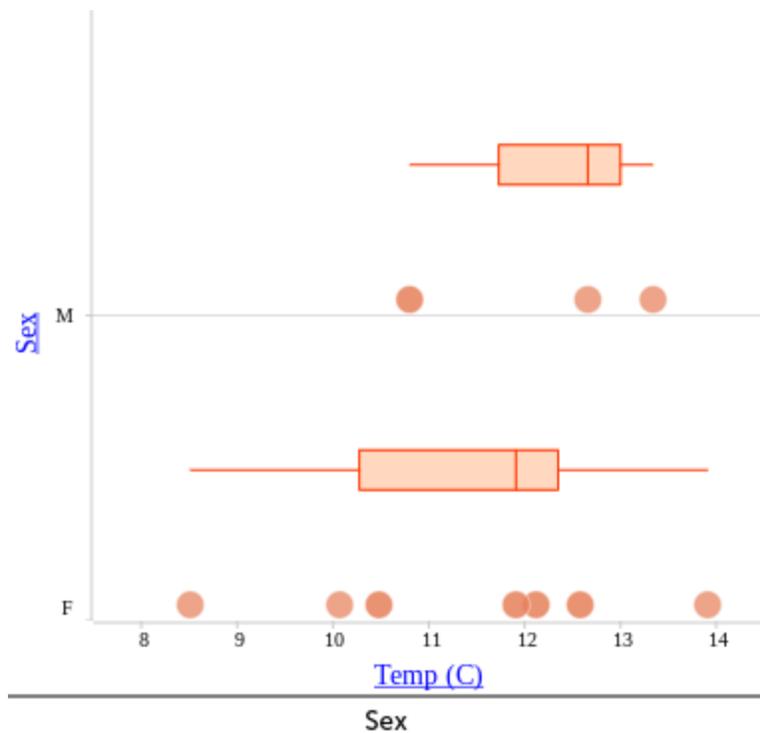
Crabs per trap to Temperature

This data was calculated by the following formula: nCrabs/ (TrapsPerDay *nDaysWentPerMonth). Temperature data was taken monthly via Neracoos buoy E01[5]. This graph shows a correlation between higher temperatures and lowered green crab population. As the temperature goes down, the green crab population goes up.
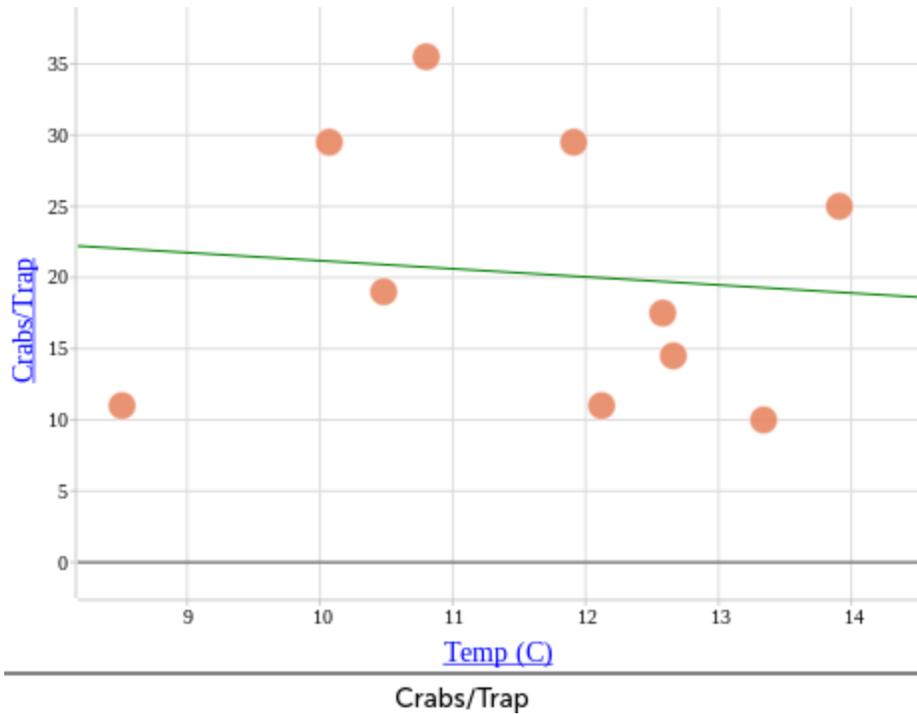
Crabs/Trap

Data Table For Reference

Month/Year	Median Size (mm)	Temp (C)	Crabs/Trap	Sex	Aggressiveness
October 2013	55	11.91	29.5	F	NA
November 2015	60	10.48	19	F	NA
May 2016	60	8.51	11	F	NA
October 2016	60	12.66	14.5	M	NA
October 2017	60	13.34	10	M	NA
November 2017	51	10.8	35.5	M	NA
October 2018	54	12.58	17.5	F	NA
October 2019	55	12.12	11	F	N
November 2020	50	10.07	29.5	F	Y
October 2021	53	13.91	25	F	N

Discussion and Conclusion

The Green crab population dips as the temperatures go up. The green crab aggressiveness goes up when the temperature goes up. There is a correlation between males and higher temperature. There is no correlation between size and temperature. These findings are important, as it helps clam fisherman know when to dig. It is best to dig in warmer temperatures, as there are fewer crabs and less aggressive crabs.

My claim that there is a correlation between lower temperatures and higher population is based on the graph from the results section about crabs/trap ratio. You would expect that you would see the opposite, as the crabs start to go into overwintering, they would go hunting for food less.

I observed that there is not a correlation between temperatures and a difference in size. My hypothesis was that there would not be a difference of size as the temperature rose, and I was correct. There is no correlation between size and temperature.

The data shows a miniscule difference between green crab sex and temperatures. Females appear more often in any temperature, while males appear more often only in warmer temperatures. This does not support my hypothesis. I noticed from the data that there are more aggressive crabs in colder temperatures.

There also is less data on aggressiveness, as we only took data on aggressiveness for 3 years. There is a correlation between lower temperatures and higher aggressiveness. This does not support my hypothesis, as I expected them to just want to go into overwintering.

Some factors may have impacted my data, like the distance of the buoy from the data. I wish we had a buoy at Popham and Reid separately. This would have given us more precise data. I do not have enough evidence to make a concrete conclusion on aggressiveness, as I only have 3 data points.

Acknowledgements

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References Cited

[1] http://www.iucngisd.org/gisd/100_worst.php

[2] http://www.iucngisd.org/gisd/speciesname/Carcinus+maenas

[3}

https://www.cascobayestuary.org/wp-content/uploads/2021/01/2013-CBEP-Factsheet-Green-Crabs-for-web.pdf

[4] http://neracoos.org/datatools/climatologies_display/

[5] http://neracoos.org/realtime_map?platform=E01