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JP246

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Jonah Crab Write-Up

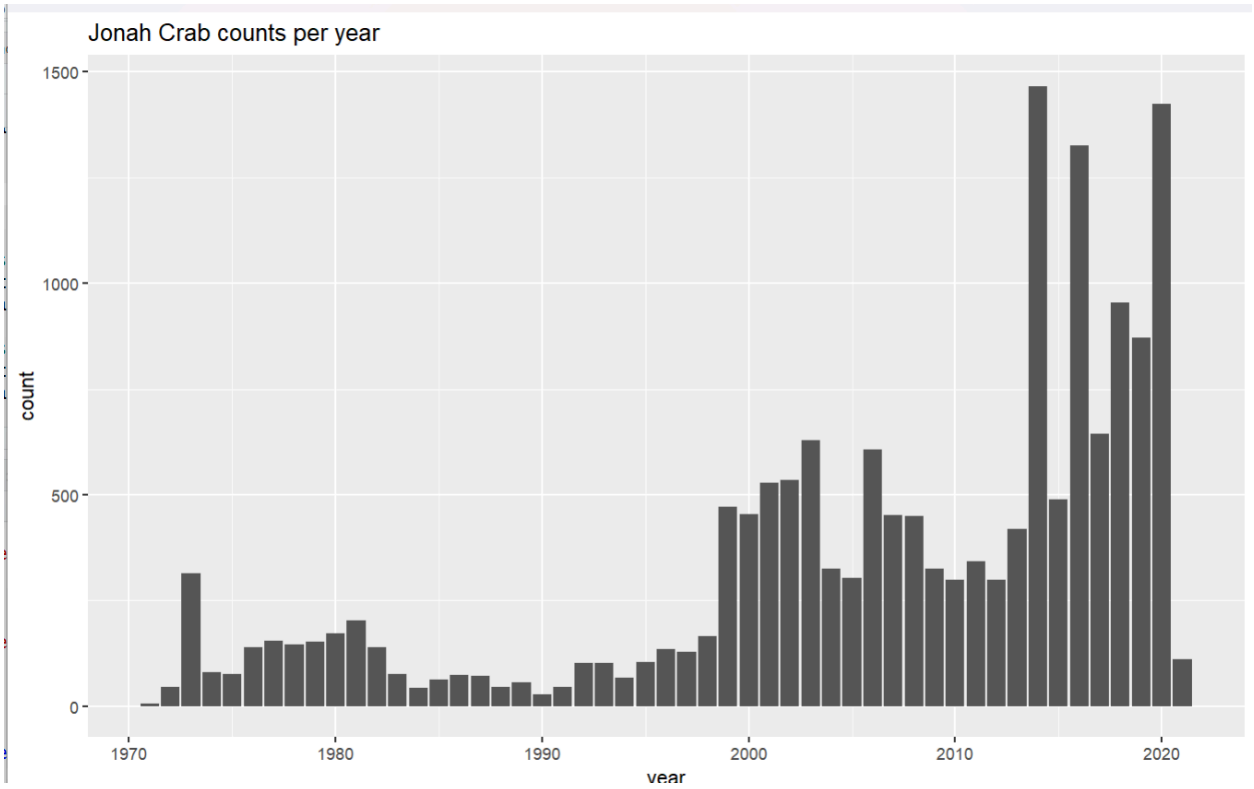
The species that I decided to forecast for the Gulf of Maine over the past month was the Jonah Crab. Jonah Crabs are a type of crustaceans that have a habitat in the waters of the Northwest Atlantic ocean, ranging from Canada to Florida. They can grow up to 8.75 inches wide, with a height of 2-3 inches. They also weigh around 1 pound and the lifespan expectancy ranges from 1-5 years. NOAA regulations state that Jonah Crab cannot be caught if they are not at least 4.75 inches across the carapace, and that egg-bearing females cannot be captured. According to NOAA, “There is limited information regarding Jonah crab life cycle and behavior because not many research studies have been conducted. Female crab are believed to move nearshore during the late spring and summer and then return offshore in the fall and winter”. This behavior is theorized to happen so that the crabs can breed and lay eggs near the shore. It is also widely seen that Jonah Crab are an accidental catch due to them being fished up in lobster traps, with landings increasing in recent years due to a decrease in lobsters.

Forecasting Jonah crabs can lead to many benefits for multiple different groups. Starting off with a conservational impact, a Jonah crab forecast can help get some much needed research done on the species, as there is not much known about them. It can also allow for appropriate catch limits to be put into place as NOAA specifically notes that they are not sure if Jonah crabs are being overfished or if overfishing is occurring as a whole, and forecasting can help prevent overfishing from happening in the first place. Jonah crabs can also be used to predict the locations of other species, such as lobsters, due to the fact that Maine lobsters and Jonah crabs share a habitat. It may be possible to mitigate the fact that Jonah crabs are caught as a byproduct

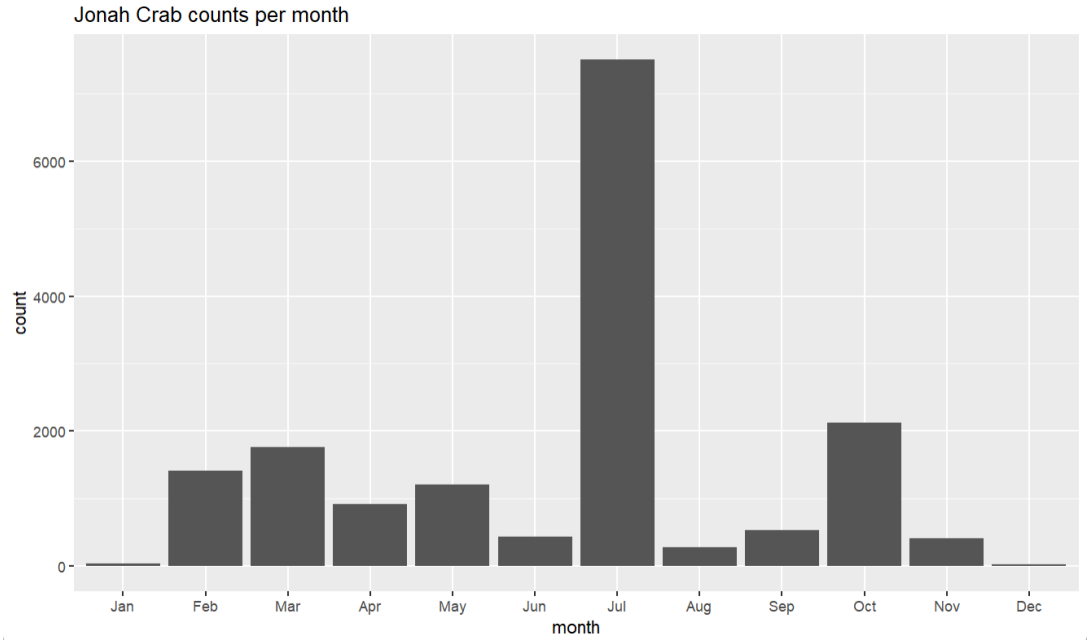
of lobster traps by predicting their movements and adjusting traps accordingly with more research. Research can also lead to a greater understanding of the Gulf of Maine and the habitat suitability it provides. On the industry and economical side, forecasting Jonah crab can lead to a greater economic stability for fishermen, considering the fact that numbers have been on the rise in recent years. They can target high-likelihood areas and add a new catch to their roster to mitigate the fallout from decreasing lobster numbers. This could lead to special traps being created for Jonah crabs as well.

The data that I had procured was fetched from OBIS, the Ocean Biodiversity Information System. For Jonah crab specifically, there were around 17000 entries. These entries had come from many different sources, with many being human observations, but some were preserved specimens, as well as sightings from Canadian vessels getting counts on various species. The data ranges from 1903 to 2021, with most counts before 1970 being less than 10. For my

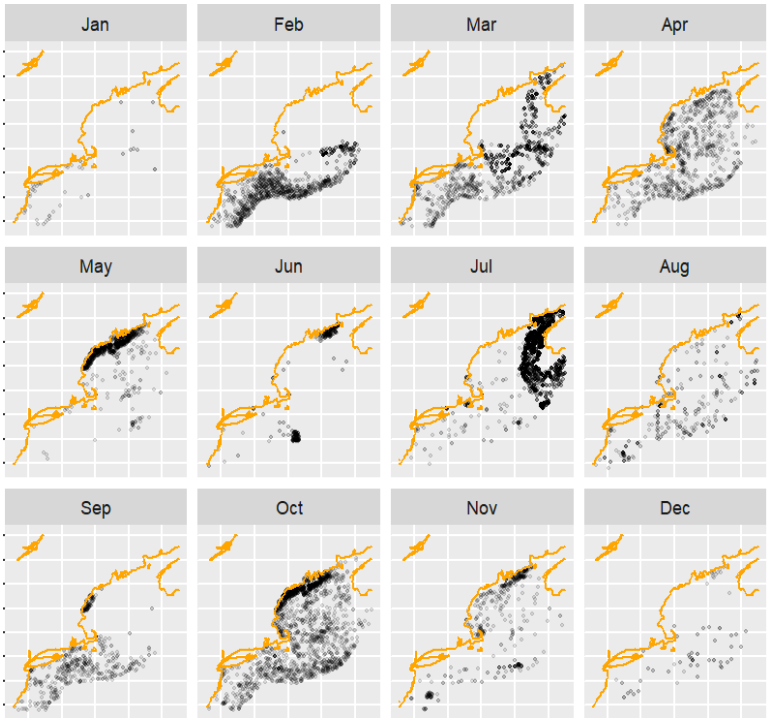
purposes, I decided to use data from beyond 1970, and after filtering, there were 16648 counts.



Most observations are of only 1 crab at a time, with a few exceptions, such as observations from recording vessels. Jonah crab counts spiked up at around 1972, with counts around 300, then steadying around 100 until about 1995, where counts began on a steady rise and spiked in 2000, with counts reaching 500. Counts fluctuated around the 500 mark until 2014, where counts jumped in massive numbers to almost 1500. Counts fluctuated for a bit while staying close to 1000 before jumping close to 1500 again in 2020.

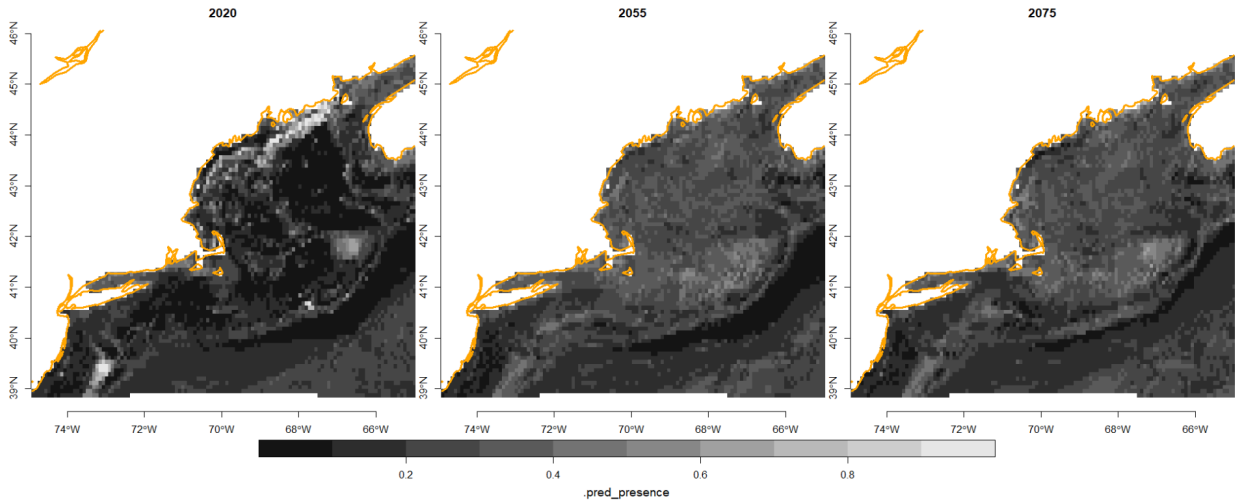


For Jonah crabs counts per month, the graph is heavily skewed. Starting in January, there are little to no observations, with even less in December. For February through May, the counts stay around the same amount, between 1000-1800. In June, the counts dip down to around 300-400, and then a heavy spike occurs in July, with counts spiking up to around 6800. The reason for this is unknown, but I speculate that there may have been a survey recording in July that added their observations to OBIS. The counts shoot down in August and September, being around 500, with another heavy spike in October, with around 2000 counts, before dipping back down in November for around 500 counts.

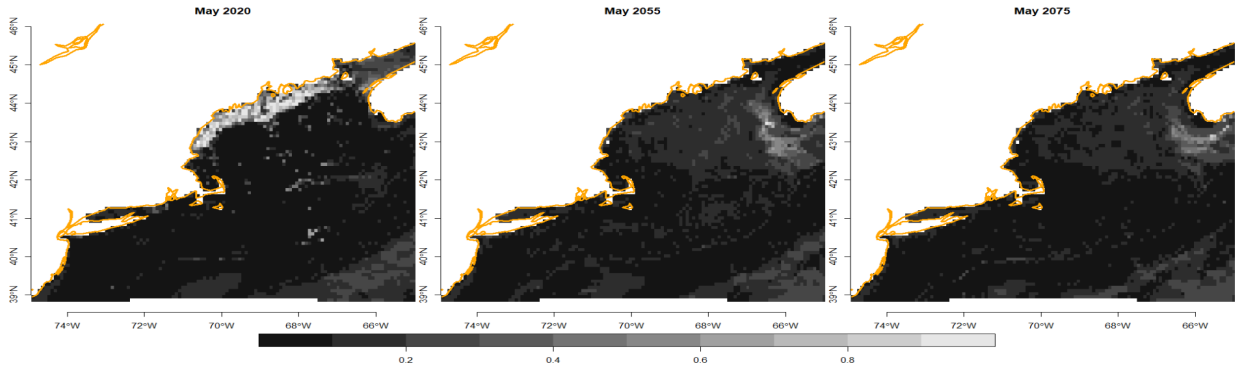


I also plotted the counts per month with spatial data onto the Gulf of Maine. The small amount of points in January and December are clear, with almost the entirety of the plots being empty for those two months. For February, the behavioral pattern of Jonah crabs sticking offshore during the fall and winter months is evident, with the bulk of the observations in the offshore south and middle of the Gulf. There is a similar pattern for March, with a bit more evidence of the crabs moving onshore during the spring and summer months, which is also present in April. For May and June, the pattern of nearshore activity is extremely prevalent, with the bulk of the observations being very close to or even directly on the coastline. For July, the monthly skew that was present in the monthly counts graph is once again visible. There is a heavy amount of observations next to the coastline, specifically on the east side, close to Nova Scotia, which makes me think a Canadian vessel could have taken these observations. August and September do not have much of note except for a potential shift back down towards the offshore south side of the Gulf, while October and November have a decent spread of points all throughout the Gulf.

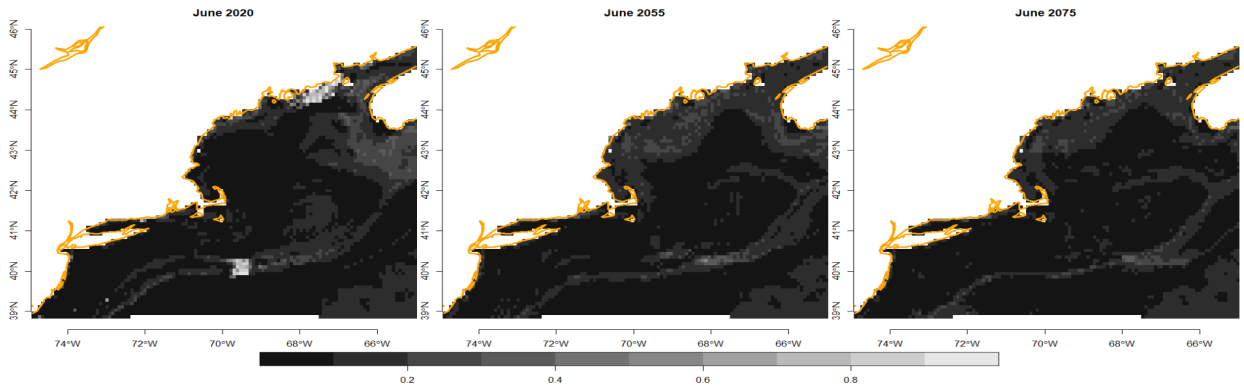
For my modeling, I chose to tackle it in two different ways. I first did a yearly approach using RCP4.5, showing the overall habitat suitability for Jonah crabs in the Gulf of Maine for the present, 2055, and 2075. I also used a somewhat seasonal approach, trying to mitigate the skew of July, by mapping out some spring/summer and fall/winter months, to try and see the behavioral patterns of Jonah crabs in the different seasons as reported by NOAA.



Starting off with the yearly approach, the nowcast echoes the same things that the monthly spatial data has, with heavy presence near the coastline, with some heavy presence in the middle of the Gulf, offshore. For the forecasts into 2055 and 2075, the data seems heavily skewed by the high amount of observations present in July, with a massive amount of spread all over the Gulf. There is a large amount of presence both nearshore and offshore, reflecting different seasons, with a pattern that exists along the continental shelf. The same is reflected in the 2075 forecast, with a bit less overall presence in certain concentrated areas.

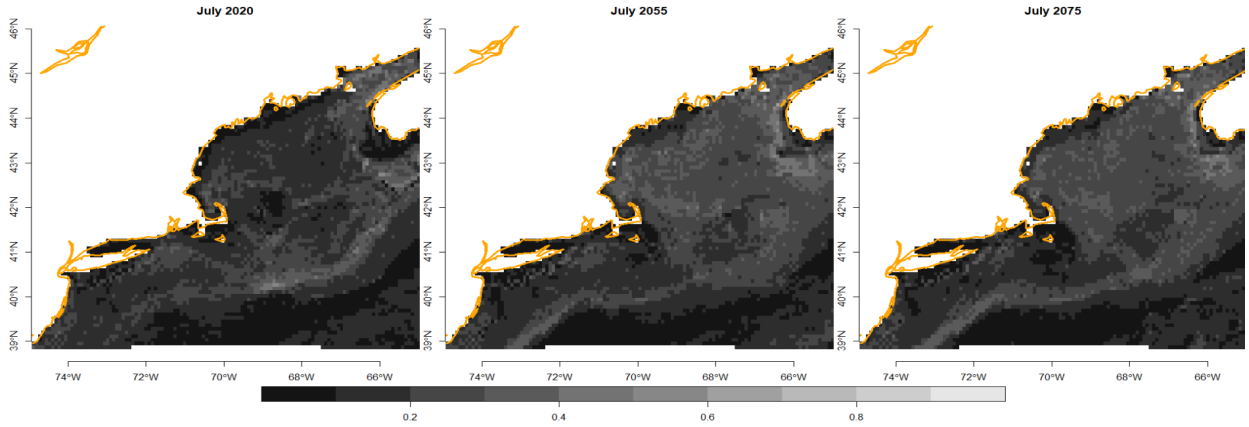


For my spring and summer months, I chose to individually model May, June, and July. Starting with May, for the nowcast, there is a high concentration of likelihood along the west coast of the Gulf, coinciding with typical Jonah crab behavior during spring. The 2055 forecast looks heavily different from the nowcast, while the heavy likelihood near the coastline still exists, the likelihood has shifted completely from the west coast to the east coast, with likelihood on the west coast being almost completely gone. The reason for this is unknown. There is also a small amount of likelihood in the south part of the Gulf. The 2075 forecast is mostly the same, just with a bit less likelihood.

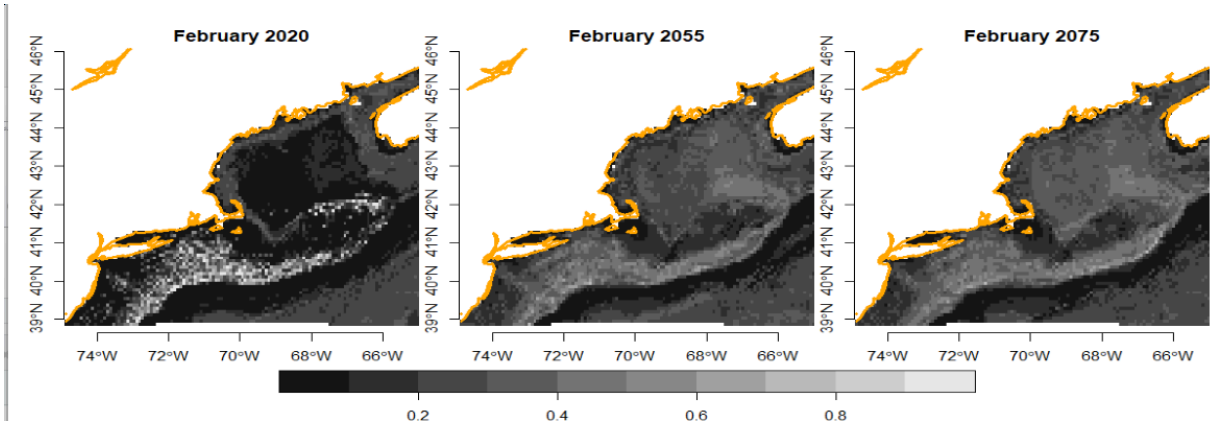


For the June nowcast, it is similar to the May nowcast, with a bit less points due to lack of observations. Interestingly, there are high observations in the south part of the Gulf, as well as the same pattern of observations along the continental shelf, which stretches into the 2055 and 2075 forecasts. For the 2055 forecast, the likelihood lessens a bit on the east coast, but

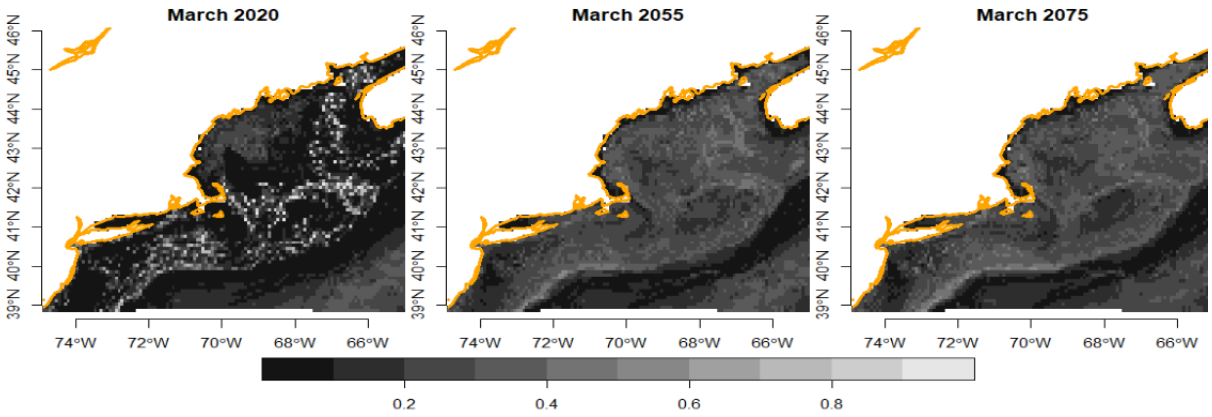
strengthens a bit on the west coast. The same is true for the 2075 forecast, with less likelihood along the continental shelf, but still prevalent enough to make a pattern.



For the July nowcast, the wide spread of points due to the large amount of July observations is clear. There is high likelihood all over the Gulf. The east coast has high likelihood, with some on the west coast as well, and in the south part of the Gulf. For the 2055 forecast, there is even more spread than in the nowcast, with high likelihood all over the graph. There are not many spots with low likelihood, with the middle of the northern section being almost completely full of high likelihood. The pattern of presence along the continental shelf continues as well. The 2075 forecast is not much different, actually having a higher presence than the 2055, opposite of what has been the case for the other months.



For my winter months, I decided to model February and March. The February nowcast has extremely high likelihood offshore, along the continental shelf, which should be typical for Jonah crab behavior during this season. There is also some lesser likelihood closer to the shore on the northside. For the 2055 forecast, the spread booms. There is still an extremely high habitat likelihood along the continental shelf, but there is now also likelihood in the north, where the nowcast was almost completely black. The 2075 forecast is similar, with a bit more likelihood in certain places such as the north.



For the March nowcast, there is a similar high likelihood along the continental shelf, but it stretches even further to the northeast coast of the Gulf. There is also some small likelihood in the northwest part of the Gulf as well. For the 2055 forecast, the graph explodes similarly to the February forecasts, with the high likelihood along the shelf staying, but high likelihood among the coastline appearing as well. This movement towards the coast follows typical behavior for Jonah crab during this season, but to a heavily amplified degree. The 2075 forecast follows similar behavior as the 2055, with a bit less presence.

A large implication seen among the results of my forecasting show that there is a high chance that Jonah crabs spread heavily throughout the Gulf of Maine, and this can mean multiple different things. The overall behavioral pattern of Jonah crabs moving inshore during the spring

and summer months, and offshore during the fall and winter months still continues, but might be less strong due to the fact that crabs are spread throughout the Gulf more as a whole. This higher spread means that there could potentially be a population rise in Jonah crabs. It could also mean that Jonah crabs migrated from elsewhere in the Atlantic and decided to move into the Gulf of Maine, which could mean a lot for some other species. An issue that I have with these results is the fact that behavioral research on Jonah crabs is very limited, more research is needed to make a truly accurate forecast. It raises the question of, “How would this forecast change if there was more data? And if the skew present in July was not there?”. Some next steps would be to get more data on Jonah crabs and run a forecast that is not skewed, which would give much more conclusive results.

Works Cited

Fisheries, NOAA. “Jonah Crab.” *NOAA*, 8 Jan. 2025

www.fisheries.noaa.gov/species/jonah-crab/overview Accessed 31 Jan. 2025.