Climate effects on species-location choices

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1 Introduction

High variability on forage fisheries could encourage fisher to have complex fishers portfolio, using diversification as a tool for reducing risk [Kasperski and Holland, 2013]. This diversification can allow for species-specific environmental shocks affect other non-related fisheries through "harvest" arbitrage [Richerson and Holland, 2017]. Hetoregeneity must be considerate as fleet that differ by specific characteristics may have different responses to changes in policy and environmental conditions [Zhang and Smith, 2011]. We capture vessel heterogeneity estimating a Mixed Logit model.

Because we have access to vessel characteristics, we can estimate a sorting model with observable heterogeneity following Zhang and Smith [2011].

Previous studies on fishers behavior focus moslty on a single-species framework. TO our knowledge, only [Richerson and Holland, 2017] address the complexity of fleet dynamics on multispecies fishery in the U.S. West Coast, where the desicion which species to harvest is interdependent between species. They study how a closure of the salmon fishery on fisher behavior. Our study expand on their work studying the interrelation and the effect of closures and weather events on the desion to participate in fishery for the Coastal Pelagic Species fishery in the California current.

Moreover, fisher decision to participate in a particular fishery could vary depending on the season. Some vessels change within a year their target species to follow species distribution over the year. Regulations (e.g. whether or not the fishery have limited entry, and the vessel holds a permit) and profitability can also condition the decision to participate in a fishery during a year [Richerson and Holland, 2017]. Complementary v/s substitute fisheries [Richerson and Holland, 2017]

Additional, we study fishers response to weather events (e.g. storms) and to a fishery closure, such as the Pacific sardine closure in 2015.

- Research question:
  - **Big question:** What is the effect of climate change on fishers dexision.
  - **Narrow question:** How does changes in the presence of CPS affect species and location choices by vessels registered in the US west coast?
  - Check if state limits affect the behavior of fish decisions.
- Contribution:
  - SDM projections to forecast fisher behavior
  - Better understanding of fishers species portfolio
  - Policy analysis
- Method
  - Mixed logir model:
    * Mixed logit? (A mixed logit (or random-coefficient logit) avoids assuming IIA allowing for marginal utility varies between individuals)
    * Relax the independence of irrelevant alternative assumption: Coeficient vary randomnly across vessels, and "Variance in the unobserved vessel-specific parameters induces correlation over alternatives in the stochastic portion of utility." Revelt and Train [1998]
    * Account for correlation in unobserved utility between repeated choices Revelt and Train [1998]. The estimations is efficient.
- Characterize the fishery
  - Heterogeneity in location, do a map and calculate variation on latitude and longitude.
  - How far from ports
  - How far from the coast.
  - Average distance traveled.
  - Fishing effort

2 Species/location choice model for the CPS fishery

- Choices:
  - Set of location/specie
  - Number of choices can vary between vessels, as well as the number of periods or choice situtations Revelt and Train [1998].
  - What is the outside option, non-CPS fishery or non-fishing? [Zhang and Smith, 2011]
  - Use Hicks et al. [2020] methodology to select the choice set:

    * Crucial for the model the selection of the choice set. If is erroneous, our estimates would be biased.
    * We don't observe fishers complete set of alternatives. "A limitation of all of the models discussed thus far is the assumption that the choice set is finite and tractable. In the caseof spatial choice models in a number of environmental settings, including fisheries, the choice set is virtually infinite as spacecan be continually divided to form different "alternatives.""
    * They propose a method to construct alternative choices when alternative are effectively infinite *we just observe a point where vessel fish over a very large open ocean area).
    * What is wrong with aggregating fishing areas? -> "areas may encompass highly heterogeneous fishing locations in terms of species composition and density or feasibility of fishing (e.g.unfishable rocky areas)". THIS COULD BIAS OUR RESULTS.
    * How this work: "Sample points from a fine scale grid of specific locations." It is a point-based approach for choosing the choice set.
    * Should improve modeling in setting with fine-scale spatial heteogeneity.
    * The method is called: **Grid point-based sampling models.**
        · The region study is restricted, but within the region there are infinite points.
        · The choice set considerate **depth on water**. Does this is an important variable for CPS fisheries?

- Explanatory variables:
  - Species value? This assumes fisher that has rational preferences and maximizes utility. It might be that they harvest a species as they have been doing it for a long time. Landings;
  - Vessel characteristics (Note: Not all vessels go to the exact location, so that decisions might depend on their characteristics).
  - Expected catch / species abundance?
  - Catch per unit of effort" (use monthly data to calculate this, maybe correlated with SDM outputs [Zhang and Smith, 2011])
  - DIstance? Maybe is endogenus (comment from Dale Squires)
- Data
  - CDWF logbooks and landings (Caitlin)
  - PacFIN landings by vessel & logbooks (try to connect to Global Fishing Watch).
  - SDM's from Barb
- Consideration:
  - Choice set important (locations and species).
  - Outside option?

3 Method

- Dale comments
  - Results are sensible when your have high resolution data (stochastic within day)
  - We have to find the optimal degree of disagregation (multicollinearity between explanatory variables)
  - Check for endogeneity, heterokedasticity and serial correlation (in panel data).
    - Distance might be endogeneous (location or distance is chosen? do a Hausman test)
  - Try including splines in the regressors

It is of high relevance to define rigorously the choice set. For instance, Stafford [2018] show that aggregating relevant alternative in the generic outside option lead to biased results and distorted substitution patterns. Thus, we should carefully assess the set of alternative in this case. In our case, this require to carefully select the set of species a fisher has as alternatives, as well as the location included in the choice set.

We develop to different discrete choice model: + Multispecies participation model + Location and species decision model

For the multispecies participation model, we follow a similar methodology than **?**. We estimate a discrete choice model for probability that a vessel participate in a particular fishery. First, we identify vessels that participate in at least two fishery. Then, we...

Variables that can explain fishery participation on a particular fishery are **HHI and LI?** (Think about this) (Peña et al have some ideas how to use expected catch and cost. It could be the month average...)

Our second model is a location and species decision model. We can estimate a conditional logit for species-location choice set using charactristics of the choice and incorporating heterogeneity through interaction variables.

4 # Graphs

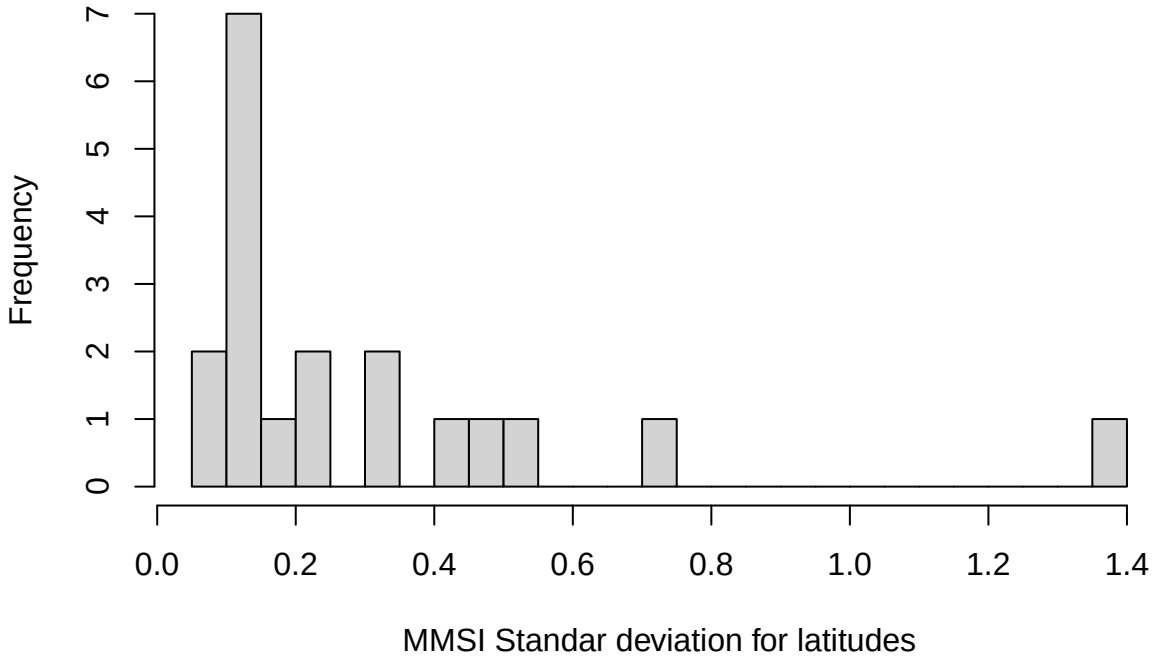

Figure 1: Histogram for standard deviation of latitude

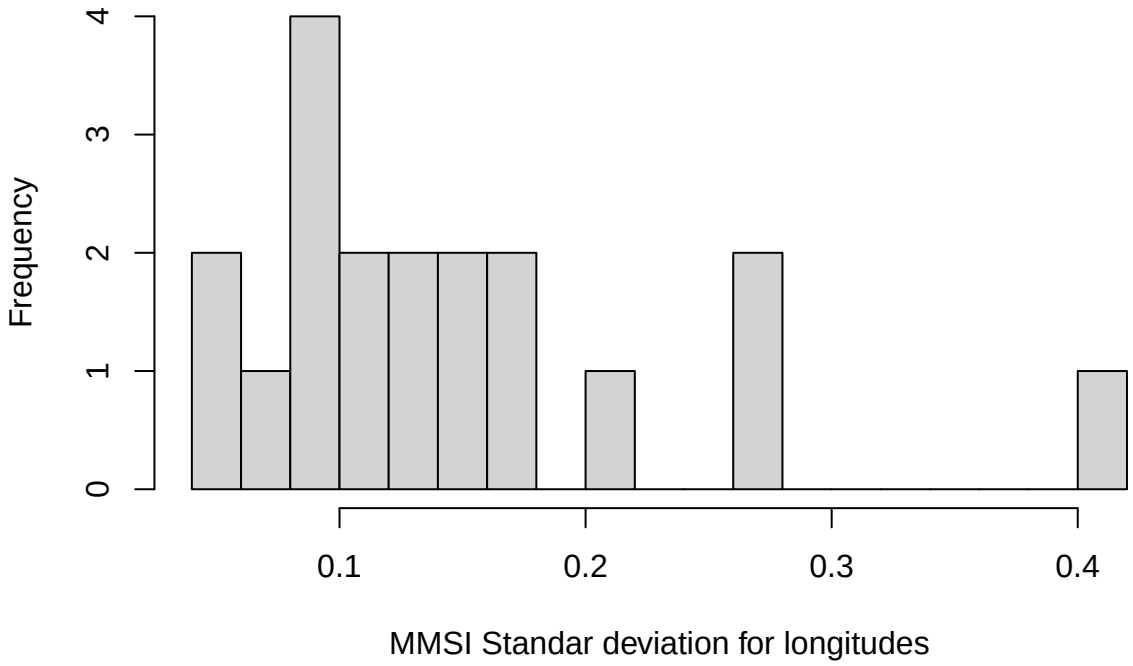

Figure 2: Histogram for standard deviation of longitudes

5 Graphs

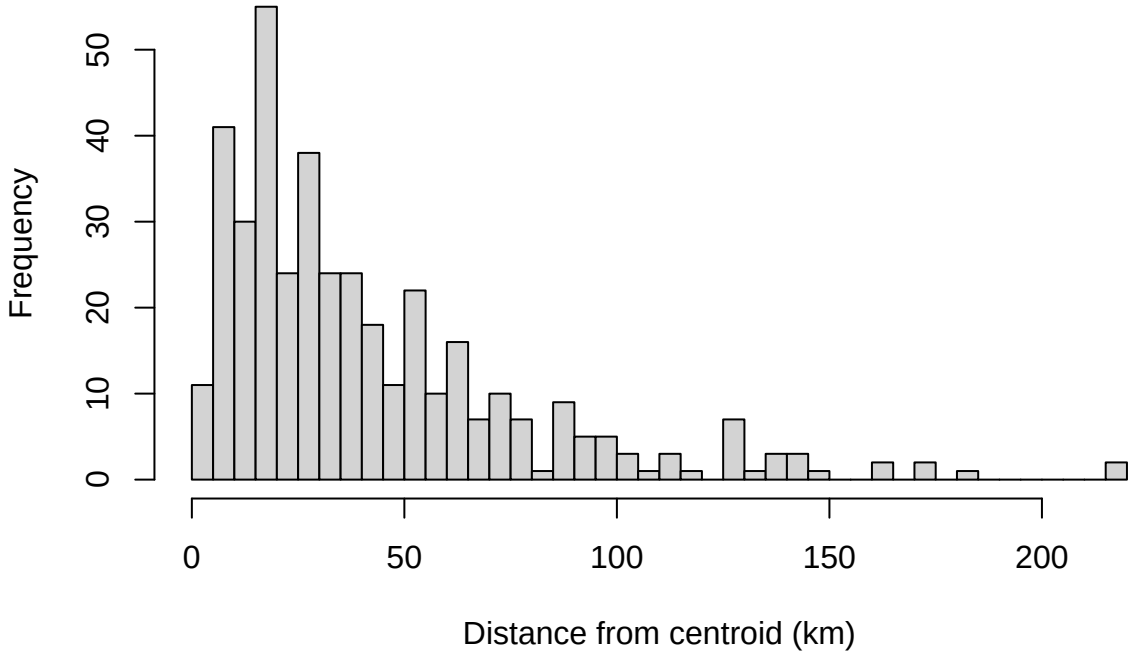

Figure 3: Histogram for distance from centroid

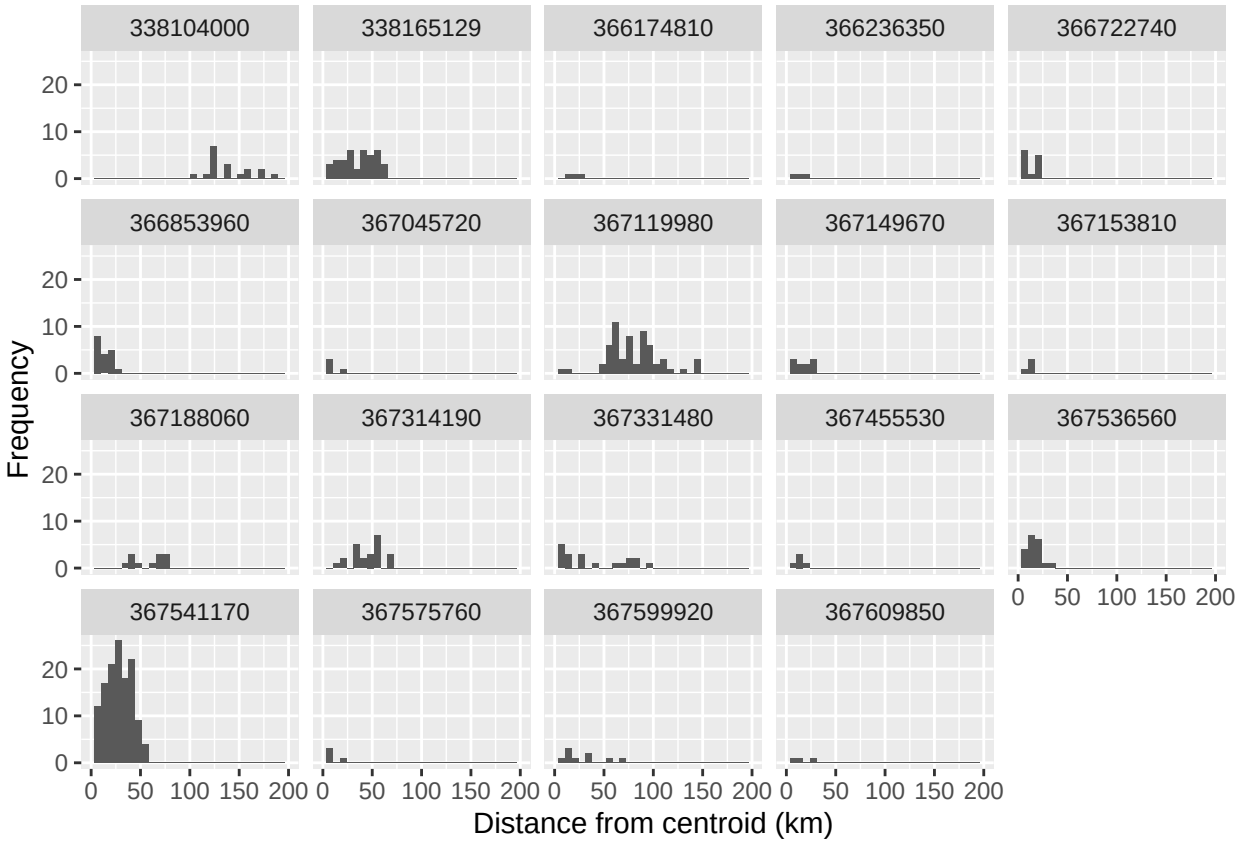

Figure 4: Histogram for distance from centroid by vessels

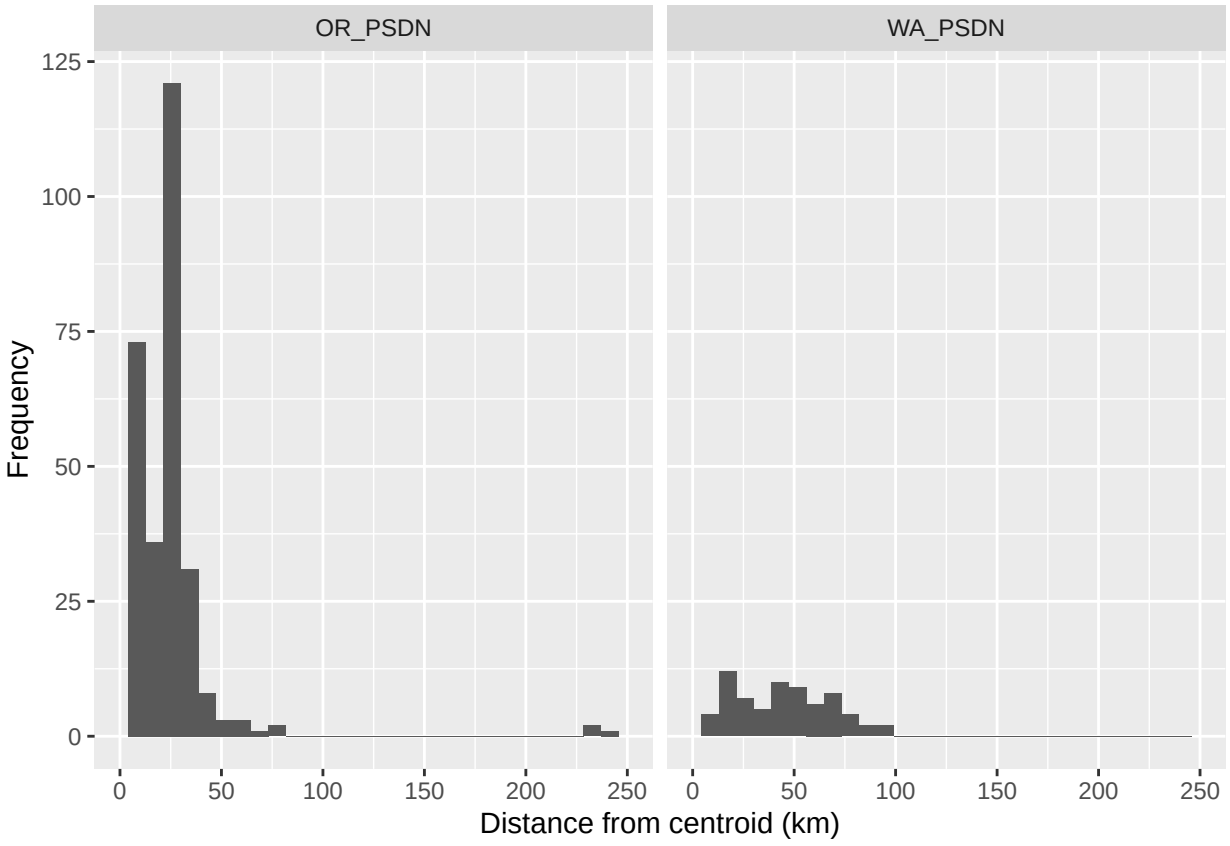

Figure 5: Histogram for distance from centroid by fleet

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