Future Seas Econ Report

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1 Introduction

This is a weekly report for the Economic group of the Future Seas Project. I downloaded landings data publicity available from PacFIN. The data has a panel data structure, where we observe commercial **west coast** species over *years*.

Changes from previous report:

- Exclude Bonito from the analysis.
- Include Pacific Herring as main species.
- Order ports geographically.
- Include comments from Smith et al. [2021].
- **Organize research ideas and add suggestion about how we can address them.**
- Exclude data for Pacific Sardine in 2018 at SDA.

2 Descriptive statistics

Table 1 shows descriptive statistics for each variable in the dataset:

Table 1: Descriptive statistics.

	Mean	Std.Dev	Min	Max
Landing_year	2001.89	11.65	1981.00	2021.00
Landings	293.31	2172.46	0.00	66890.30
N_dealers	20.38	13.01	0.75	68.00
N_vessels	42.10	31.42	0.75	182.00
Price	1.37	1.79	0.00	28.53
Revenue	347993.43	1835052.50	0.00	49987499.00

3 Graphical analysis

3.1 Revenue and landings: Historical averages.

Mean revenues by species are shown in Figure 1, while mean landings by species are shown in Figure 2.

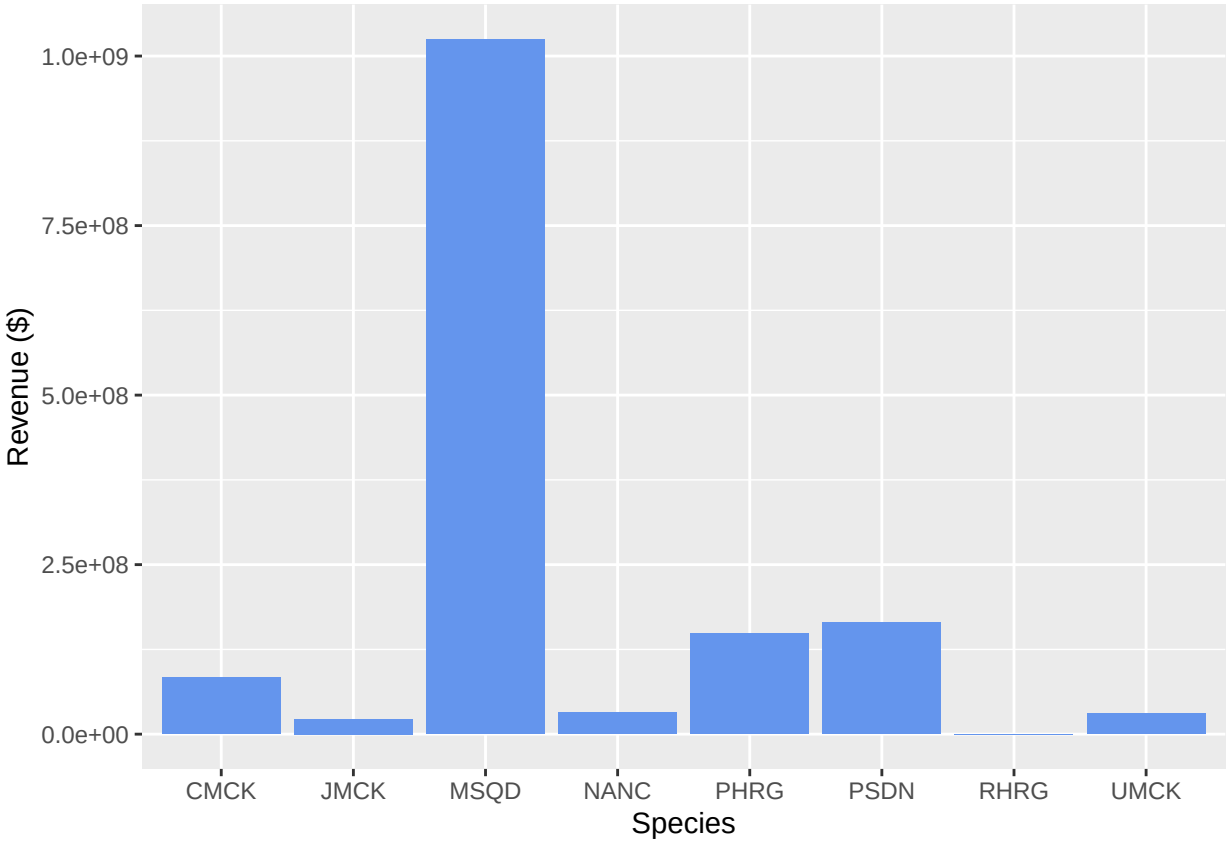

Figure 1: Annual mean revenue by CPS species. 1981-2021.

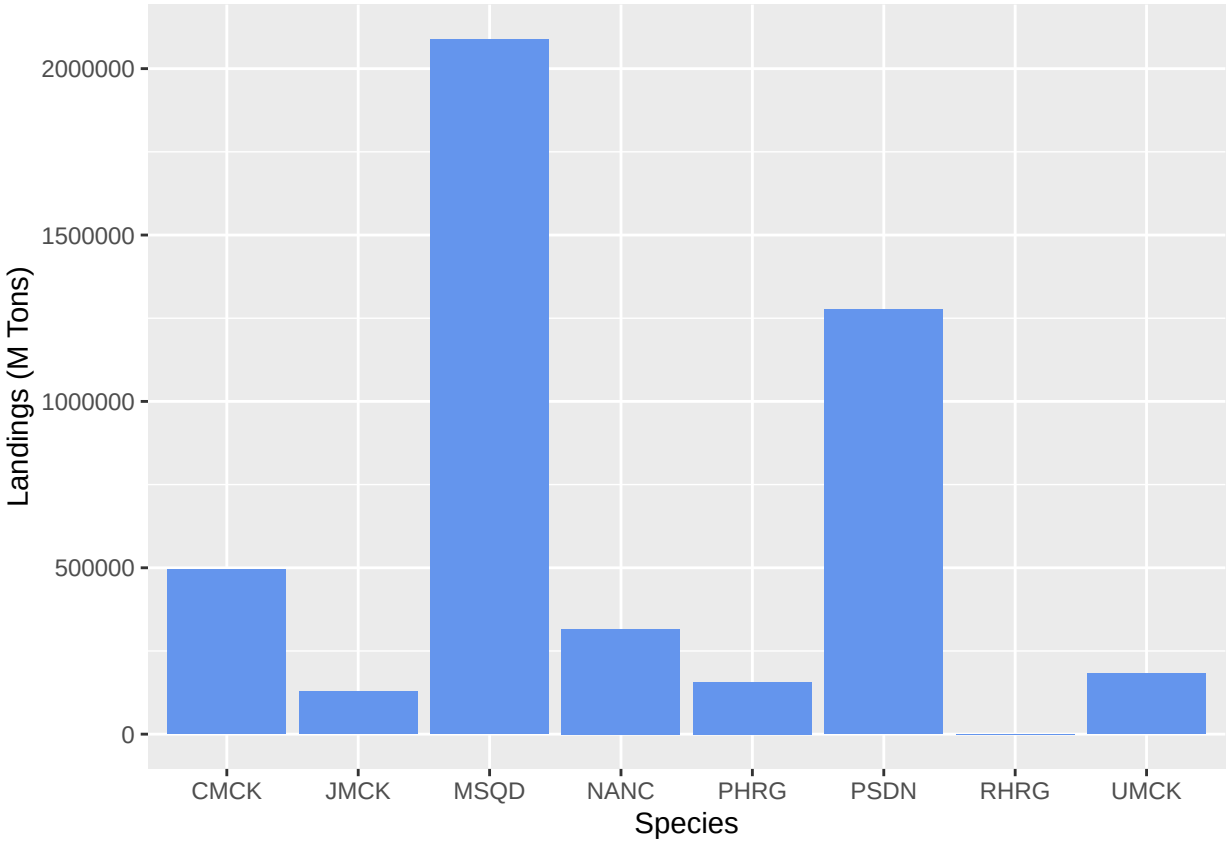

Figure 2: Annual mean landing by CPS species. 1981-2021.

3.2 Price and landings: Time series

Figure 3 shows landing over time by species, while Figure 4 shows landing and prices over time for selected CPS species.

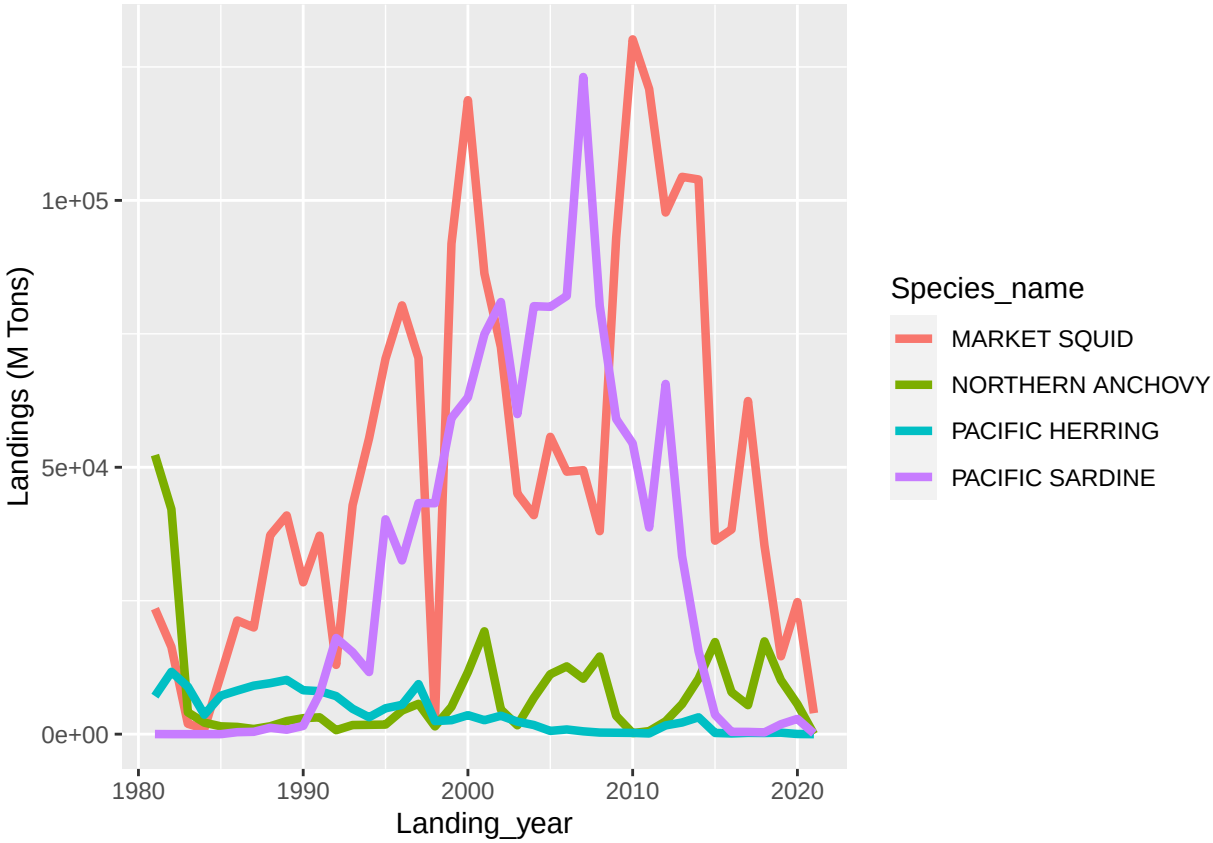

Figure 3: Total annual landing by CPS species.

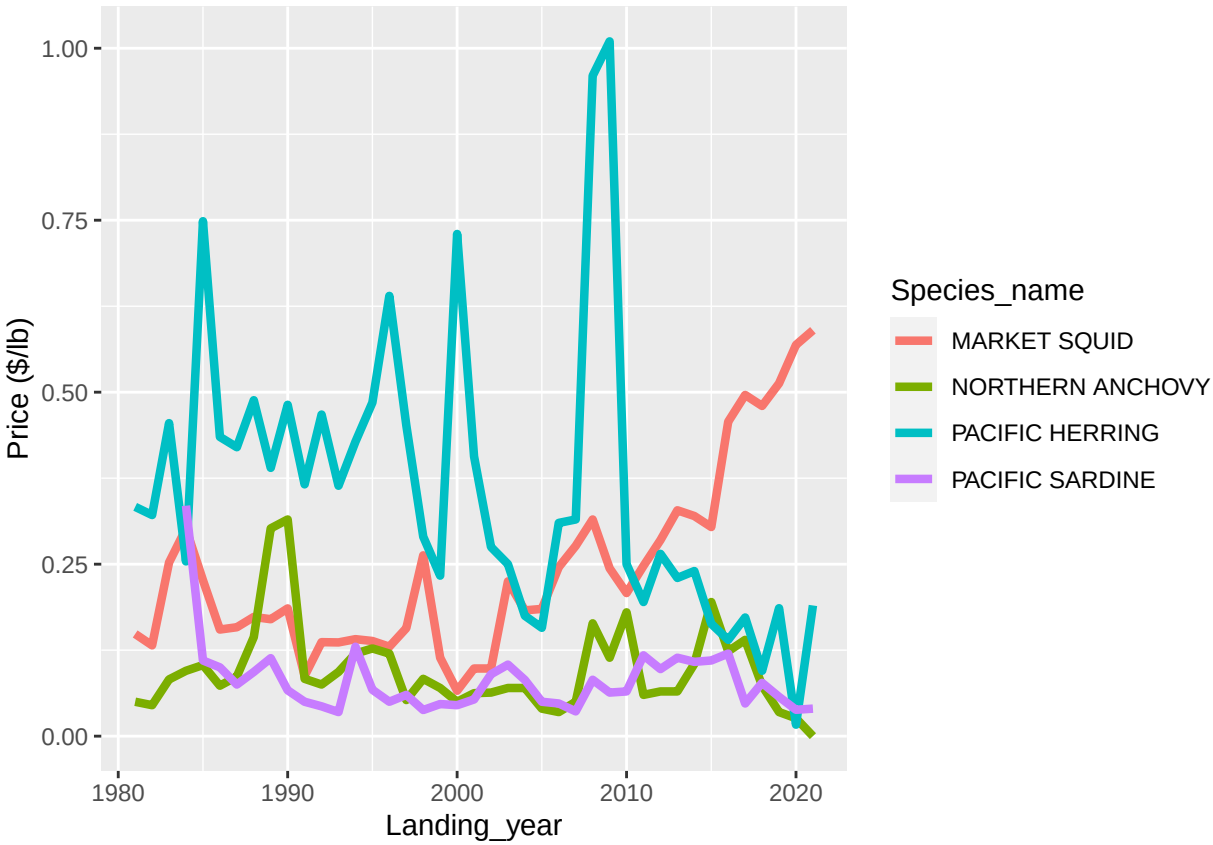

Figure 4: Annual averages of prices by CPS species.

3.2.1 Sardine

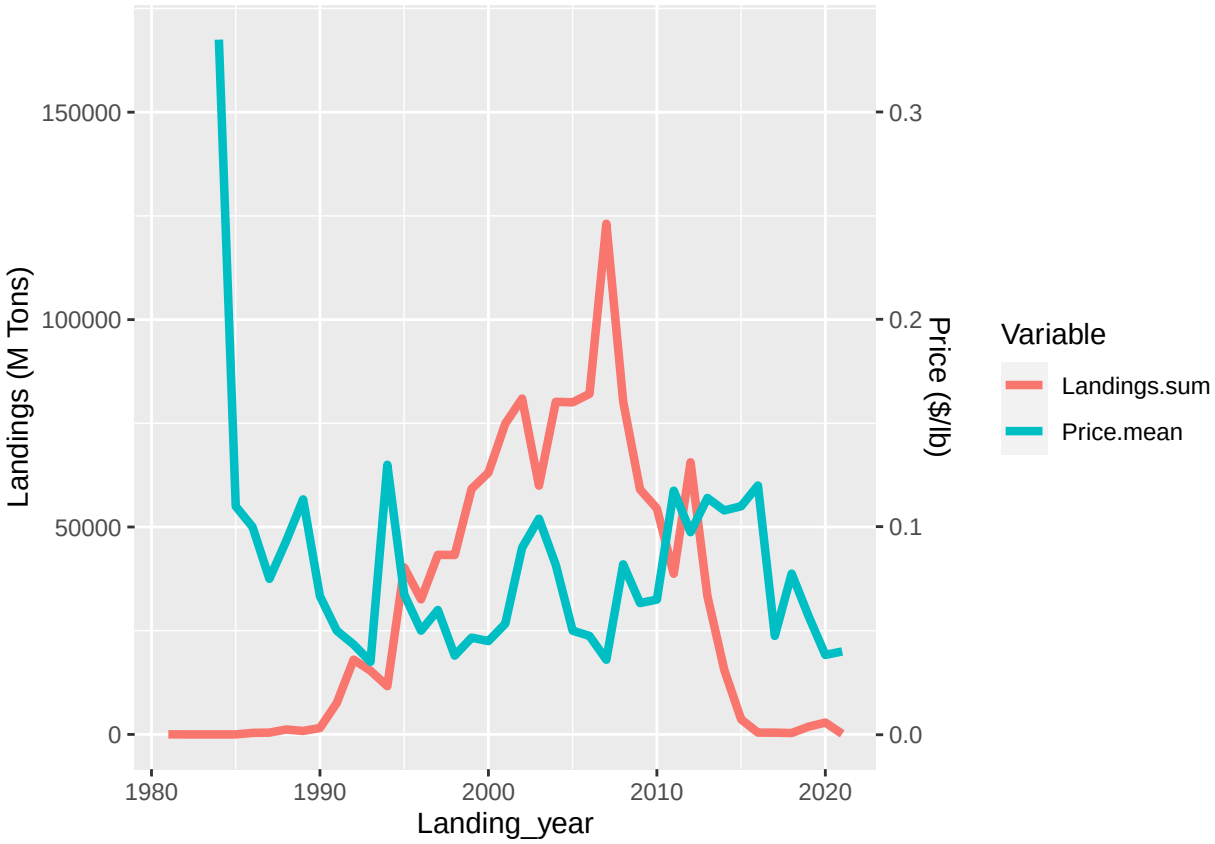

Figure 5: Landing v/s Prices. Pacific Sardine.

3.2.2 Anchovy

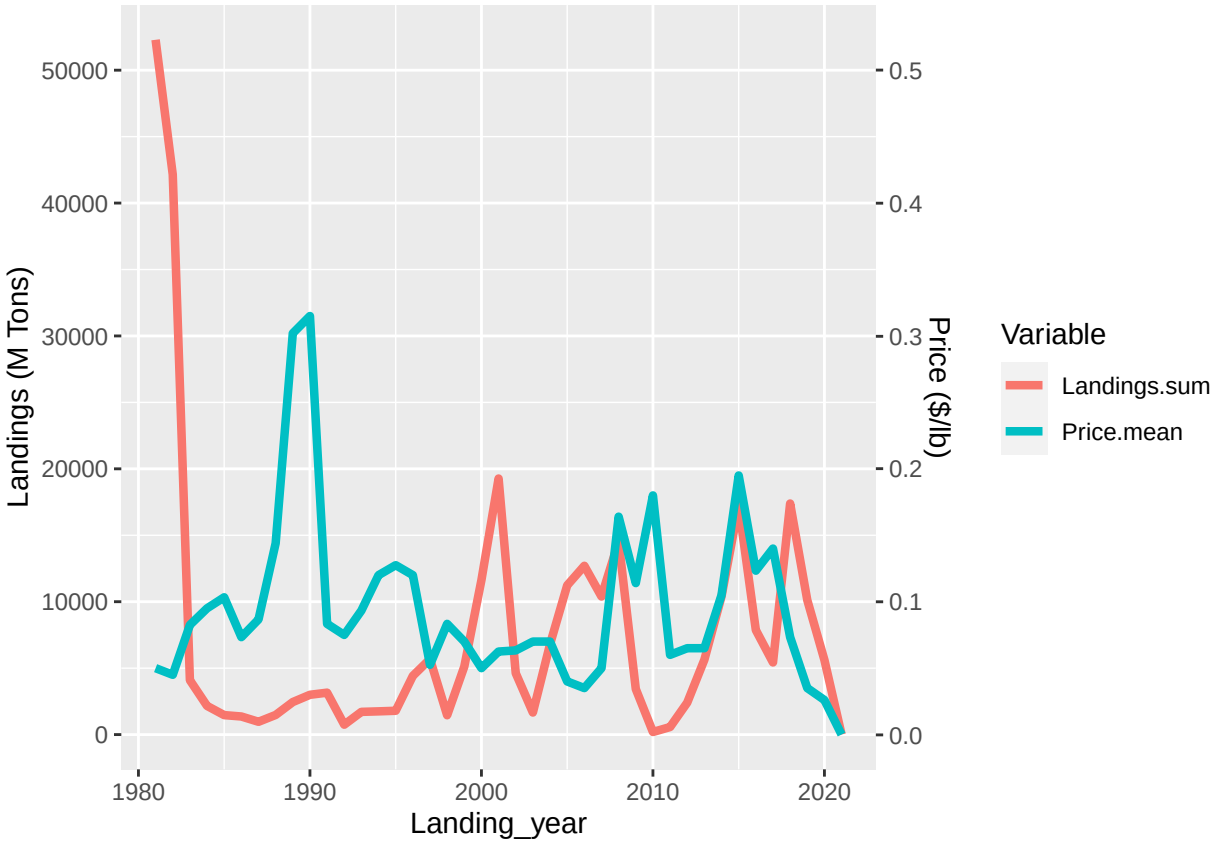

Figure 6: Landing v/s Prices. Northern Anchovy.

3.2.3 Market squid

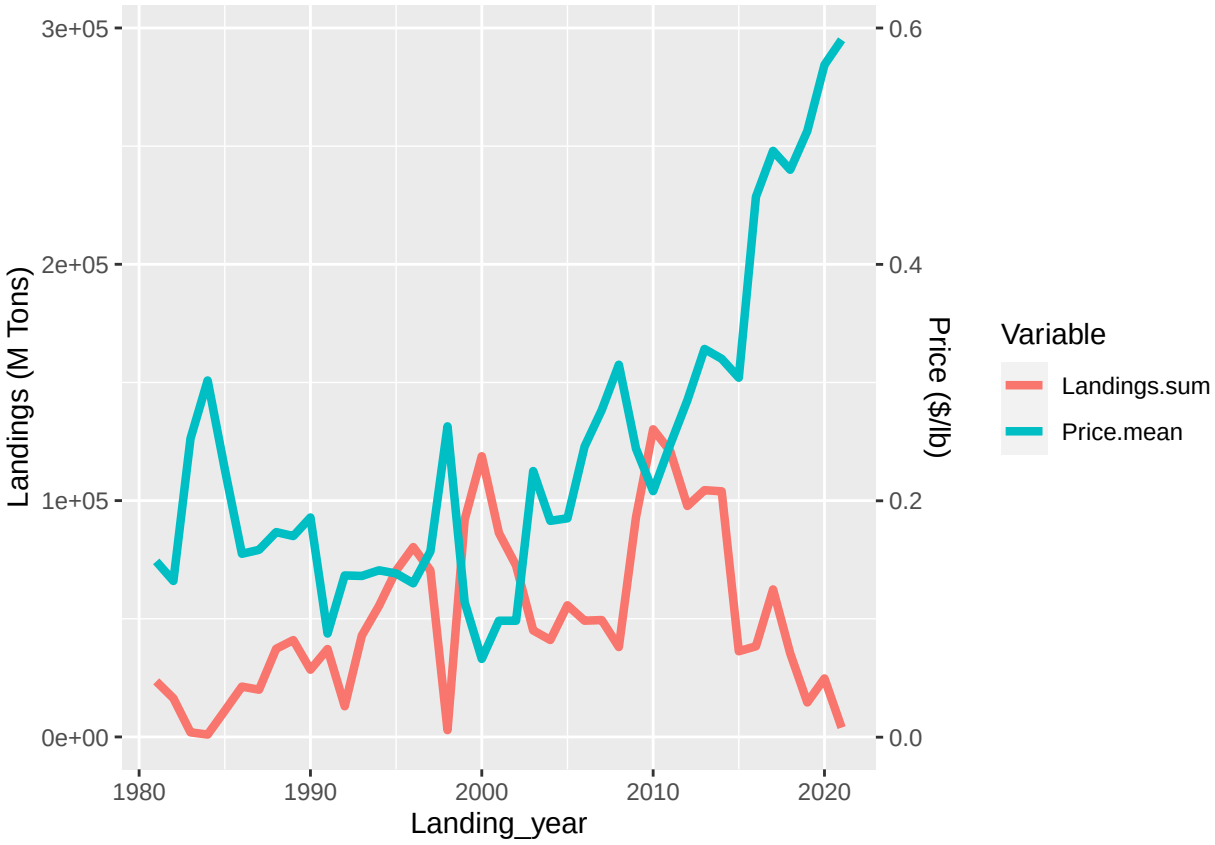

Figure 7: Landing v/s Prices. Market Squid.

3.2.4 Pacific Herring

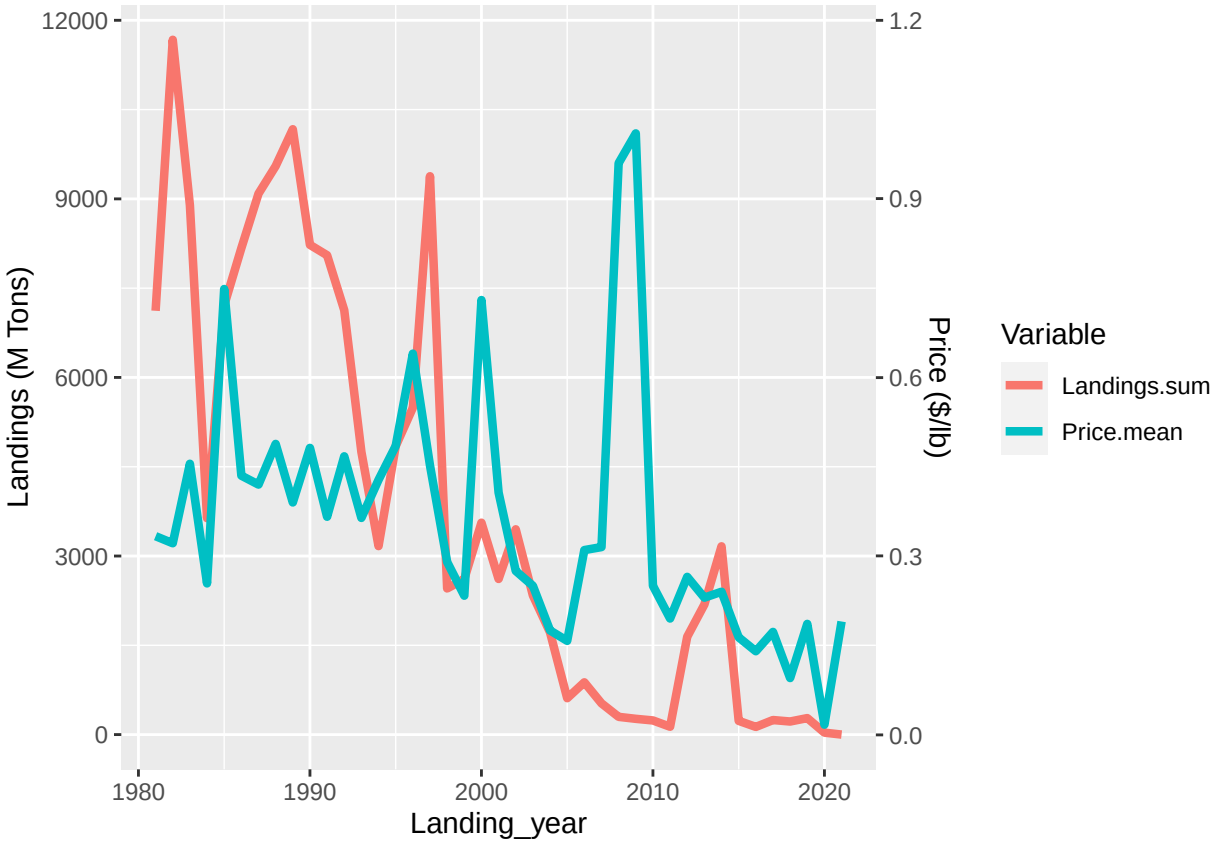

Figure 8: Landing v/s Prices. Market Squid.

3.3 Historical averages by state and port

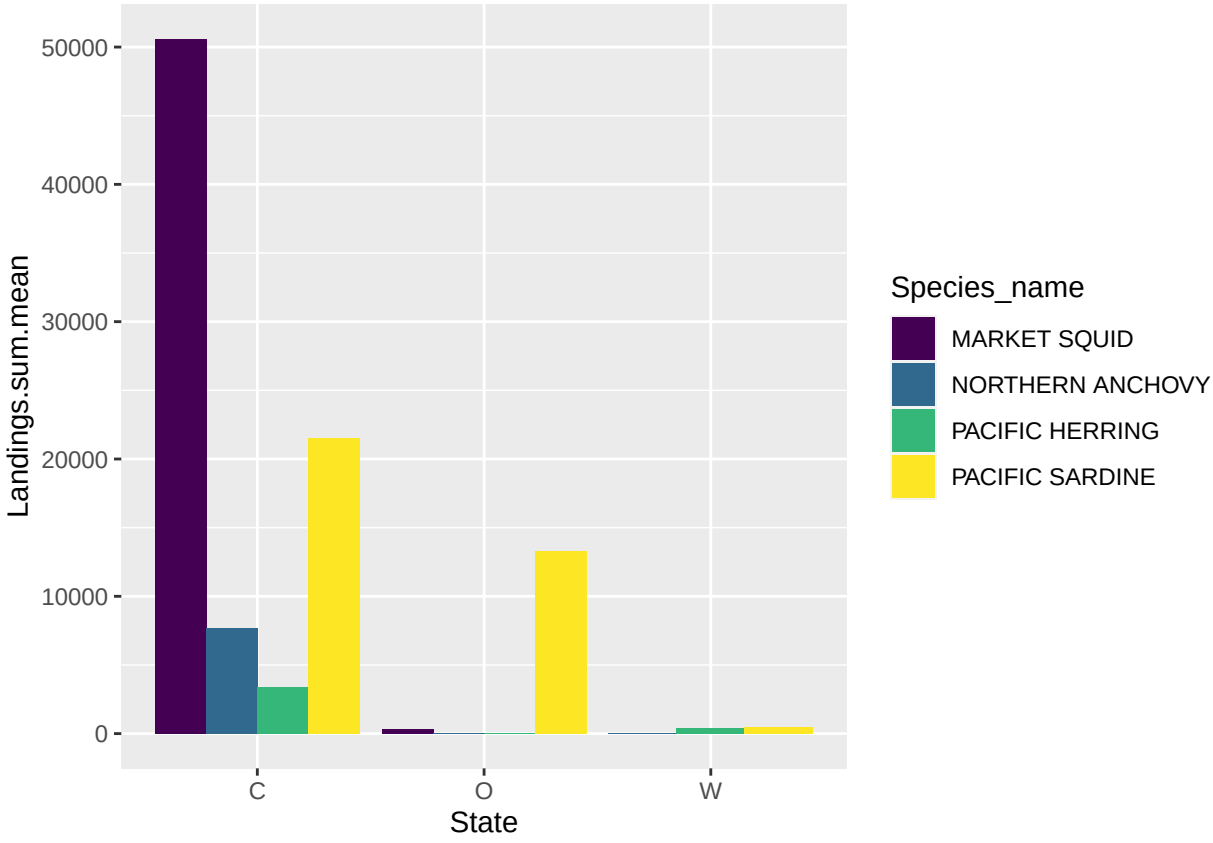

Figure 9: Landing by state.

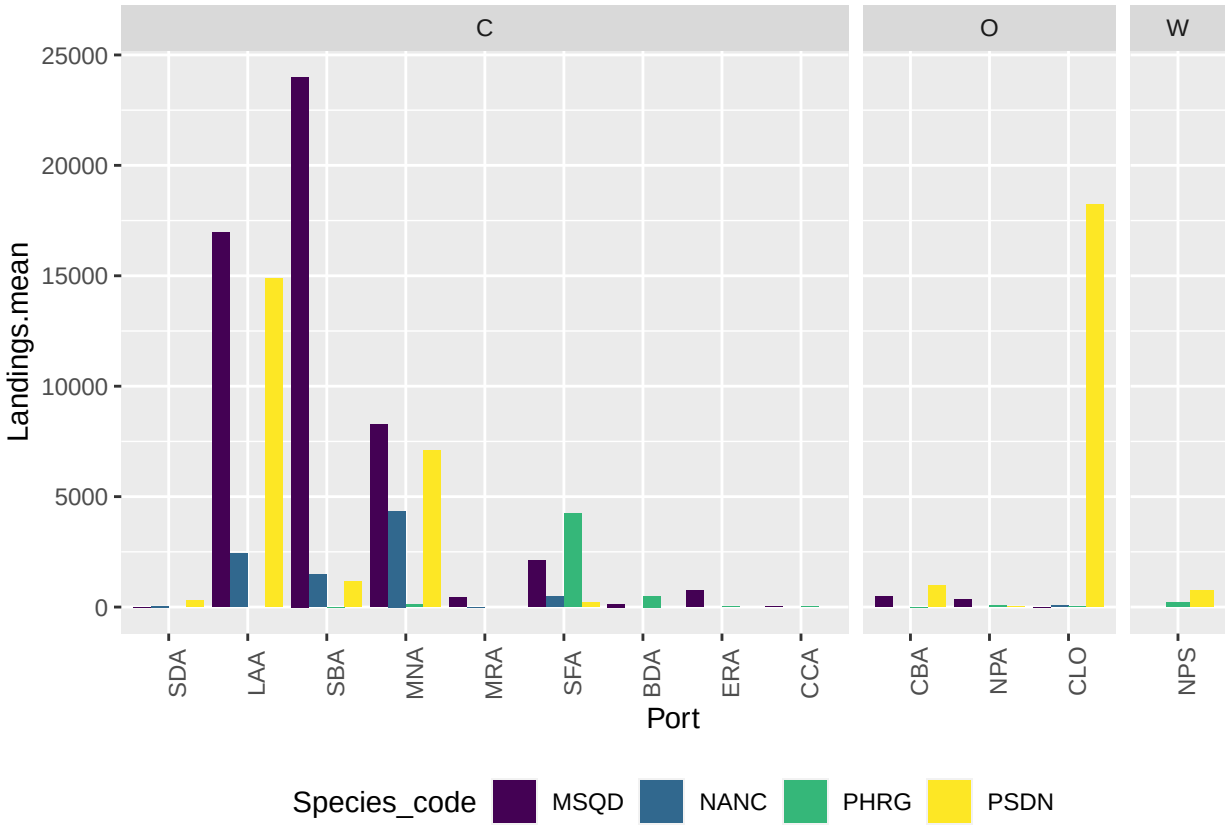

Figure 10: Landing by Port.

3.4 Time series by state and area ports

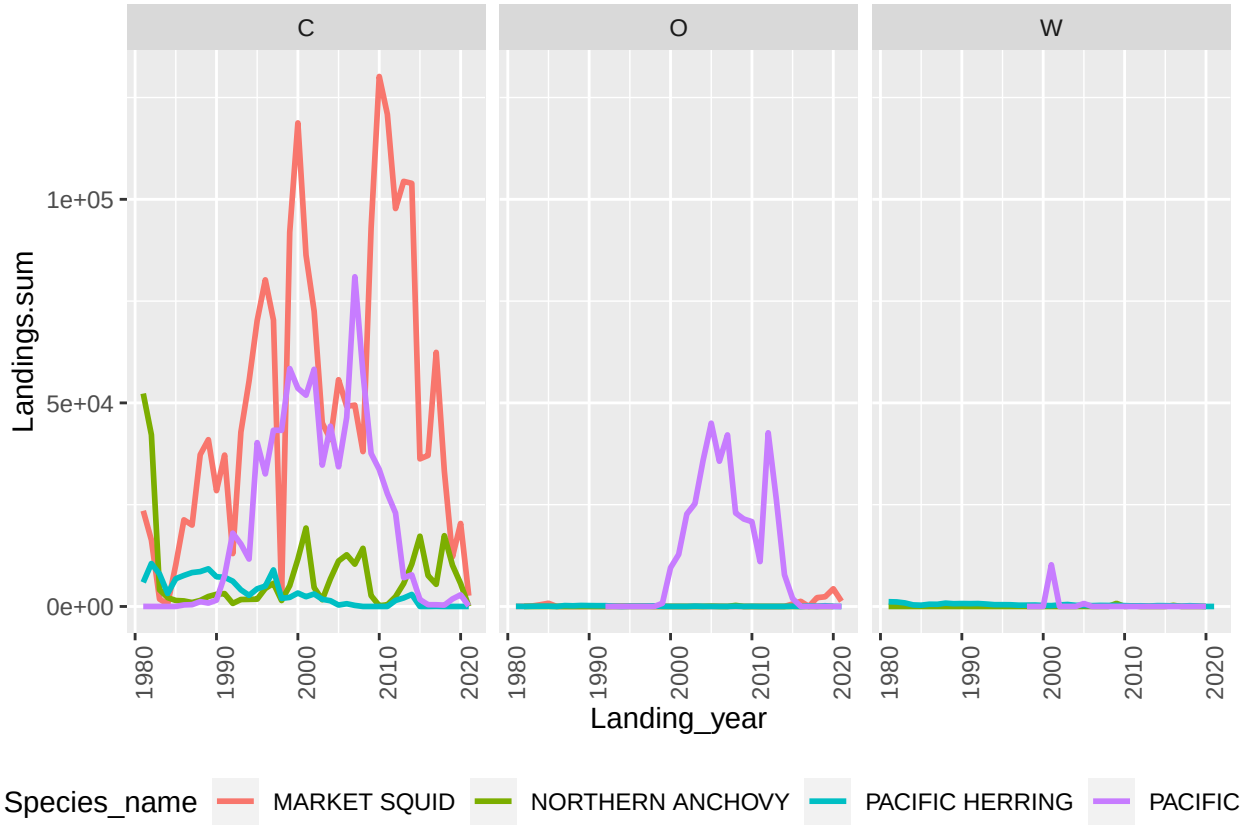

Figure 11: Annual average landing by state.

3.4.1 California ports

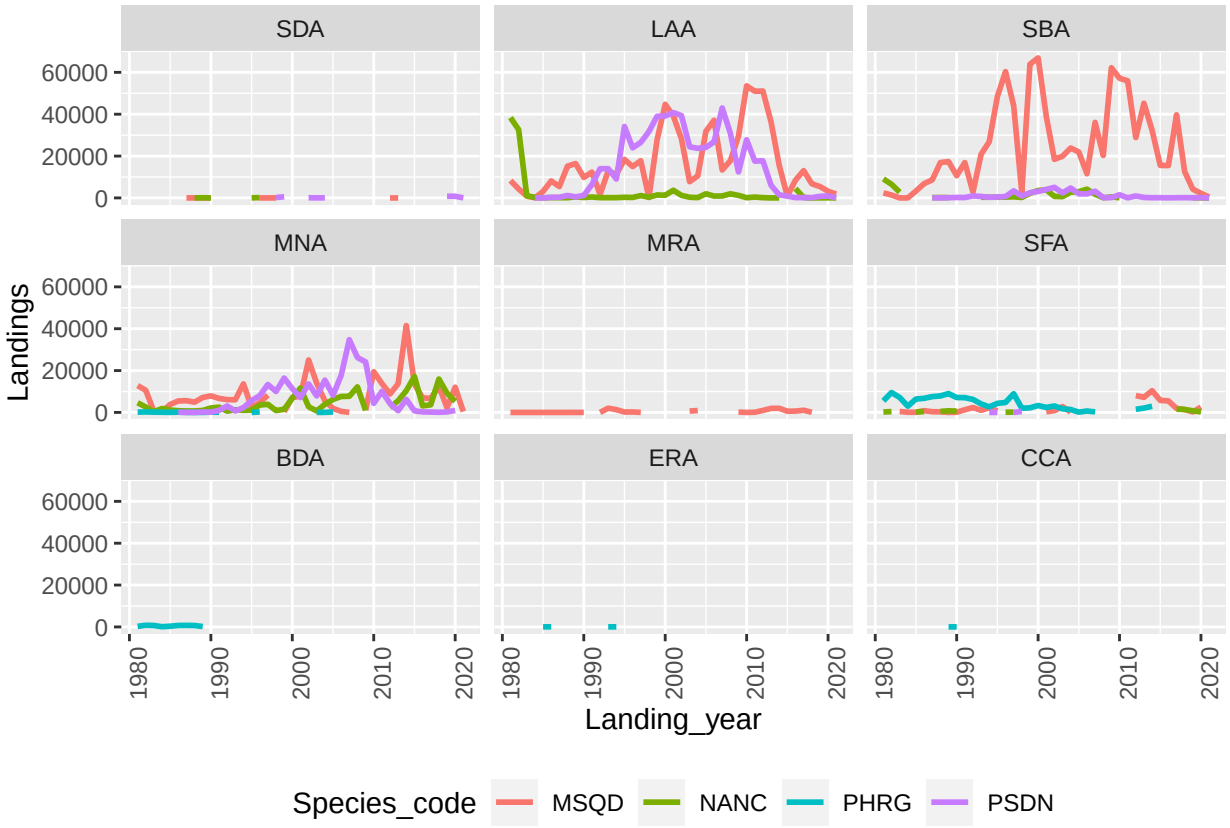

Figure 12: Annual average landing by area ports in California. *Notes:* BDA = Bodega Bay; CCA = Crescent City; ERA = Eureka; LAA = Los Angeles; MNA = Monterey; MRA = Morro Bay; SBA = Santa Barbara; SDA = San Diego; SFA = San Francisco.

3.4.2 Oregon ports

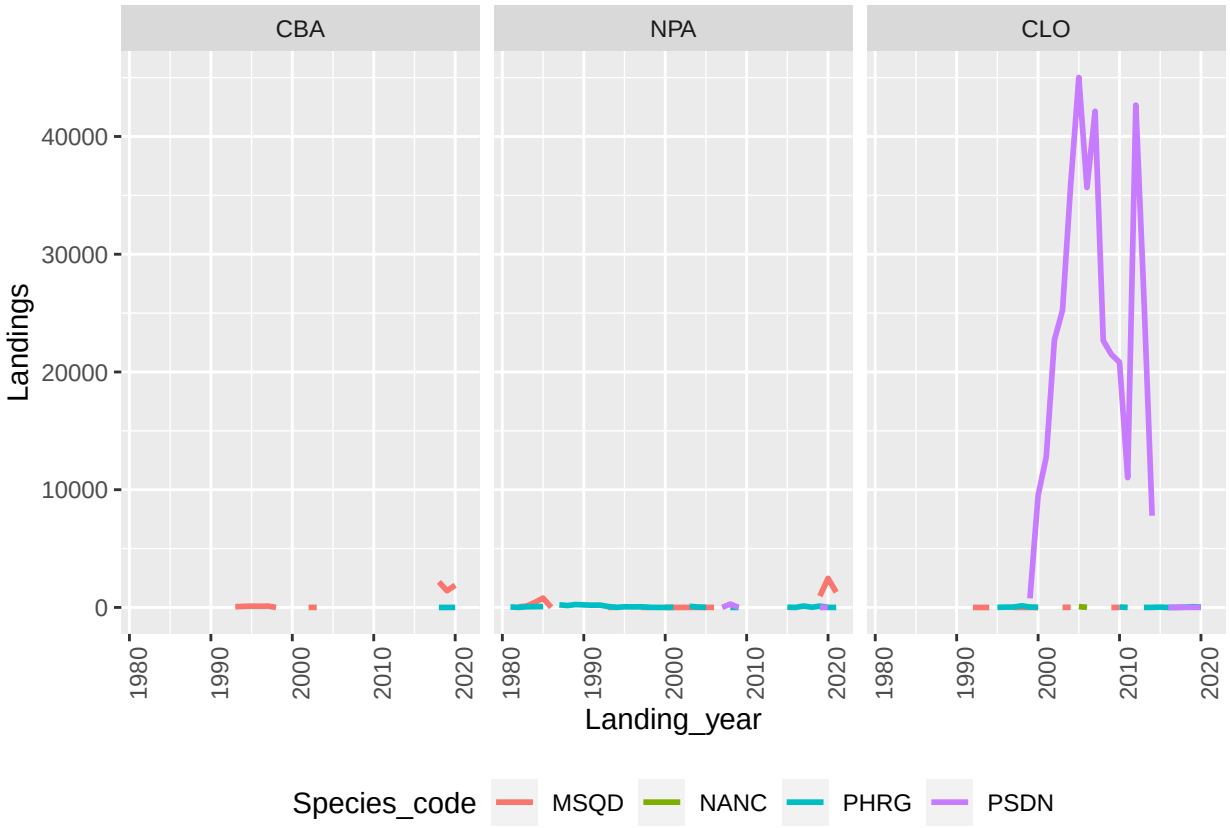

Figure 13: Annual average landing by area ports in Oregon. *Notes:* BRA = Brookings; CBA = Coos Bay; CLO = Columbia River (OR); NPA = Newport.

3.4.3 All ports

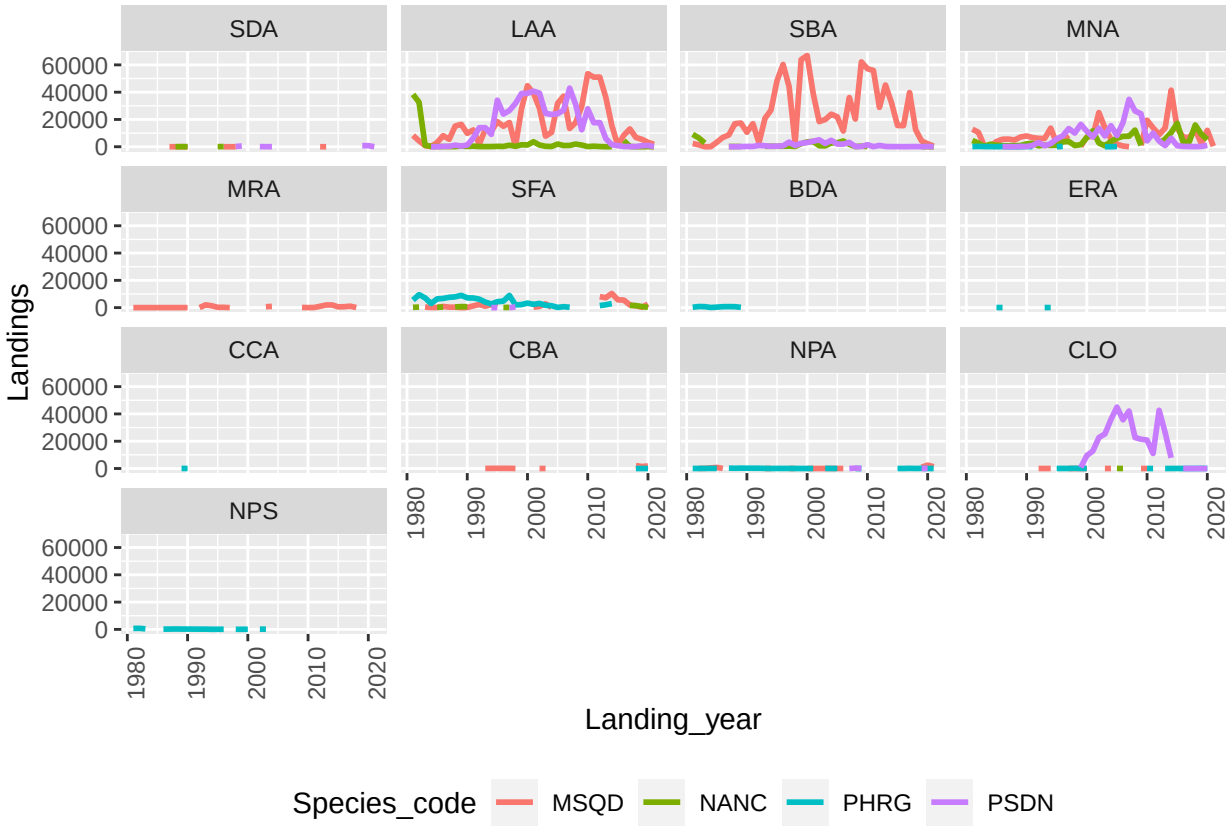

Figure 14: Annual average landing by area port. *Notes:* BDA = Bodega Bay; BRA = Brookings; CBA = Coos Bay; CCA = Crescent City; CLO = Columbia River (OR); ERA = Eureka; LAA = Los Angeles; MNA = Monterey; MRA = Morro Bay; NPA = Newport; NPS = North Puget Sound; SBA = Santa Barbara; SDA = San Diego; SFA = San Francisco.

Figure 15: Annual average revenue by area port. *Notes:* BDA = Bodega Bay; BRA = Brookings; CBA = Coos Bay; CCA = Crescent City; CLO = Columbia River (OR); ERA = Eureka; LAA = Los Angeles; MNA = Monterey; MRA = Morro Bay; NPA = Newport; NPS = North Puget Sound; SBA = Santa Barbara; SDA = San Diego; SFA = San Francisco.

4 Potential research

4.1 The effect of sardine distribution on landings model

Research question: What is the effect of climate change on ports' landings?

- Questions:
  1. Did Smith et al. [2021] have access to vessel data from PacFIN?
  2. Can I use Global Fishing Watch to match vessels with harvest location and landings?

4.1.1 Model fundamentals

In general, landings are conditional to biological stocks (affected by climate change), harvest cost, prices and regulations.

- Outcome variable:
  - Pacific sardine landings by vessel, port and year. In this case we would predict landing by vessel i that land in port j
  - Smith et al. [2021] relate port-level landings to the probaility of presence from a sardine species distribution model (SDM), and then makes projection to quantify future changes in landings.
  - Specifically, Smith et al. [2021] use mean monthly probability of presence of sardine within 60 km of port. **Is this obtained from Atlantis?**
- Treatment variable:
  - Shifts in climate (?)
  - Change spatial distribution of species.
- Explanatory variables
  - Spatial distribution (*important variable in Smith et al. [2021]*)
  - Harvest costs (e.g., distances and fuel cost)
  - Own price
  - Effort (number of vessels as a proxy?)
  - Price of other substitutes?
  - Regulations. Incorporate ACL in the model (Smith et al. [2021] obtained this information from CPS Fisheries Management Plan, and Federal Register), maybe with a function that have a ceiling limit, or as **censored data** (Stan code). Same about port capacity...
  - Port fixed-effects (reflect capacity and effort, assuming fixed over time.)
- Some considerations:
  - Vessels likely to have contract with ports. Less flexibility where they land.
  - Harvest happen near-shore, less probability of longer trips if species move further.

4.1.2 Empircal strategy

- Statistical model:
  - Bayesian heriarchical model?
    - Random effects vessels and time. Each vessel and year may have different coefficients, maybe explained by vessels' characteristics.
    - Uncertainty from modeling the process (as well as from the imperfect observation of the process).

  - Smith et al. [2021] estimate with GAM framework. Any advantage of this approach from a simple linear models (e.g. OLS) or Bayesian modeling?
  - Some details:
    * Solve for endogeneity of prices. IV bayesian model?
    * Spatial autocorrelation between ports through species abundance?
      · Morris et al. [2019] include spatial errors in a bayesian framework.

4.2 Fishers portfolio model

Research question: Understand the determinant of fisher decision on species harvested.

- Data:
  - PacFin data by vessel?
  - We can identify each vessel and which species they land.
- Model:
  - Conditional logit models?
  - Each species is a category, and probability of being selected is affected by their characteristics. Species distribution might be one of the characteristics.
  - We also can include vessel characteristics in a *random-coefficient model* (e.g. size, gear, etc)
- Problems:
  - Endogeneity in prices? (maybe use BLP model?)
  - Include quota in their decision?
  - Simultanous or sequential harvest?
- Consideratins:
  - Easy to change between species (low cost for substitution)

4.3 Estimating trade-off of leaving forage species in the ocean

Research question: Do fishers take into account trade-offs in their harvest decision?

- How to quantify this trade off?
  - Atlantis model could give us insight about the trade-off.
  - Require to quantify non-commercial species.

4.4 Effect of climate change on fishing communities

Research question: How climate change affects fishers communities that depend (directly or indirectly) on forage species?

- Employment?
- Incomes?
- Consumption?

4.5 Price determination model

Research question: Does landing of pacific sardine (or other species) have an effect on prices?

- Some events that can allow us to estimate elasticities.
  - COVID-19 event
    1. From supply as closure / outbreak disrupt production.
    2. Demand affected by market disruptions and restaurant consumption
    3. Market change to other direction (consumption at home).
    4. Processor have been affected (cost of closures and implementing sanitary conditions, and reduced demand coastwide)
  - ENSO event
- Using species prices behavior over years we can also analyze substitution pattern and price leadership.
  - Cointegration methods.
  - *Some questions that we can answer:* Are prices following a common trend? Is there any price which is exogeneous from the system? or the leader? Are prices following fishmeal prices, or world market prices? (e.g. from Peru?)

References

Mitzi Morris, Katherine Wheeler-Martin, Dan Simpson, Stephen J Mooney, Andrew Gelman, and Charles DiMaggio. Bayesian hierarchical spatial models: Implementing the besag york mollié model in stan. *Spatial and spatio-temporal epidemiology*, 31:100301, 2019.

James A Smith, Barbara Muhling, Jonathan Sweeney, Desiree Tommasi, Mercedes Pozo Buil, Jerome Fiechter, and Michael G Jacox. The potential impact of a shifting pacific sardine distribution on us west coast landings. *Fisheries Oceanography*, 2021.