

Socio-economic Analyses

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Organizing Principles

- Consider potential for climate-driven disruptions to fisheries operations, e.g. due to shifts in target-species or protected species distributions
- Capture economic impacts through models of the potential loss of landings, revenue, profits
- Capture community impacts through indices of community harvesting and processing engagement

Swordfish Fishery

- Interactions with charismatic megafauna is a key regulatory concern in the west coast swordfish fisheries
- Hard caps have been proposed for use in the CA DGN fishery to mitigate rare event protected species interactions
- A bootstrap analysis is under development to model the impact of climate-driven regulatory closures on fishery landings, revenues and profits
- Revenue impacts are measured by Community Engagement Indexes
- A swordfish MSE models the impacts of different closures on fishery landings, revenues and profits

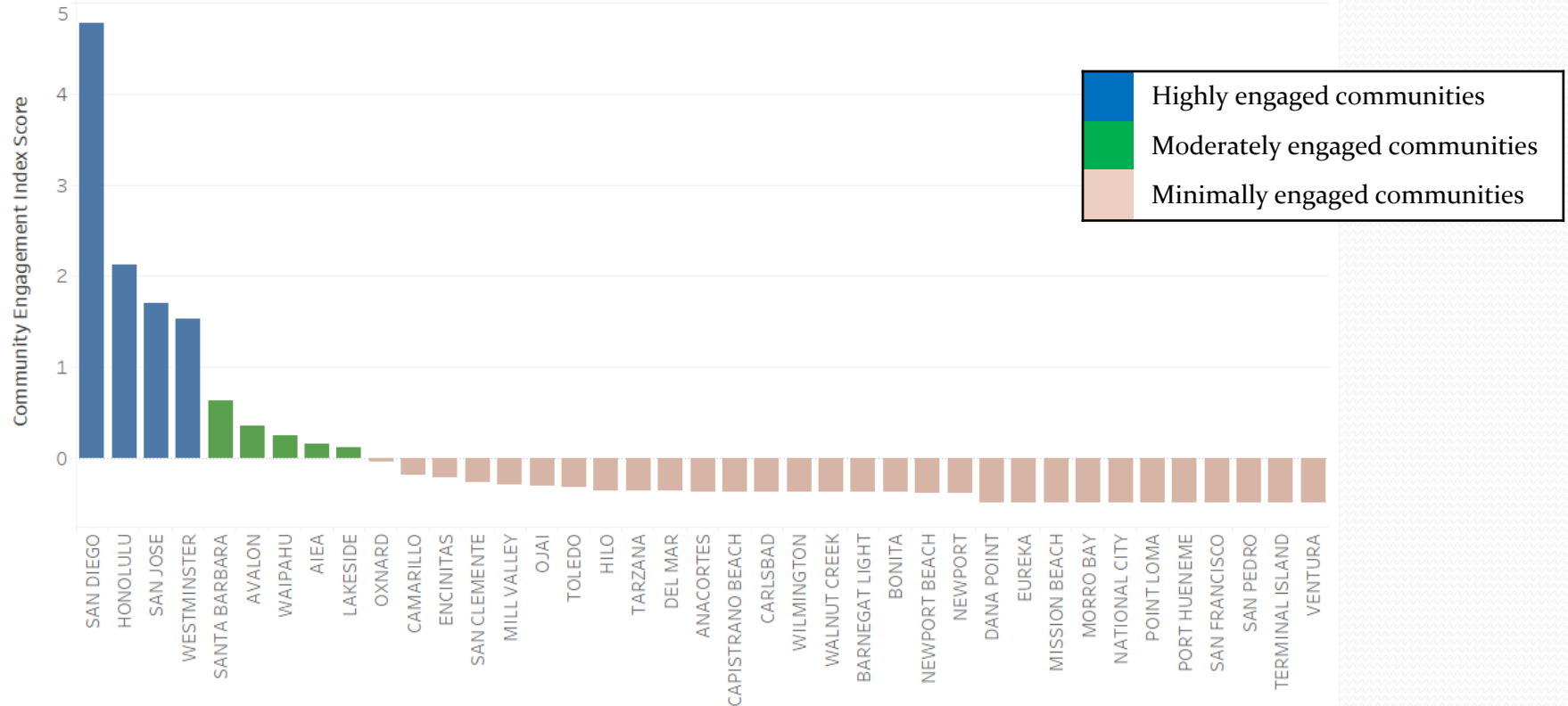
Community fishing participation indices: Methods

- Two main indices of vulnerability
 - Community harvesting engagement index
 - Community processing engagement index
- Obtained data representing each index category
- Conducted general principal component analysis to evaluate overall relationship between variables
 - Varimax Rotation of factor loadings
 - Kaiser Normalization
 - Using the Kaiser Criterion (keep only Eigenvalues >1)
- Create index scores from the rotated factor loadings using the regression method

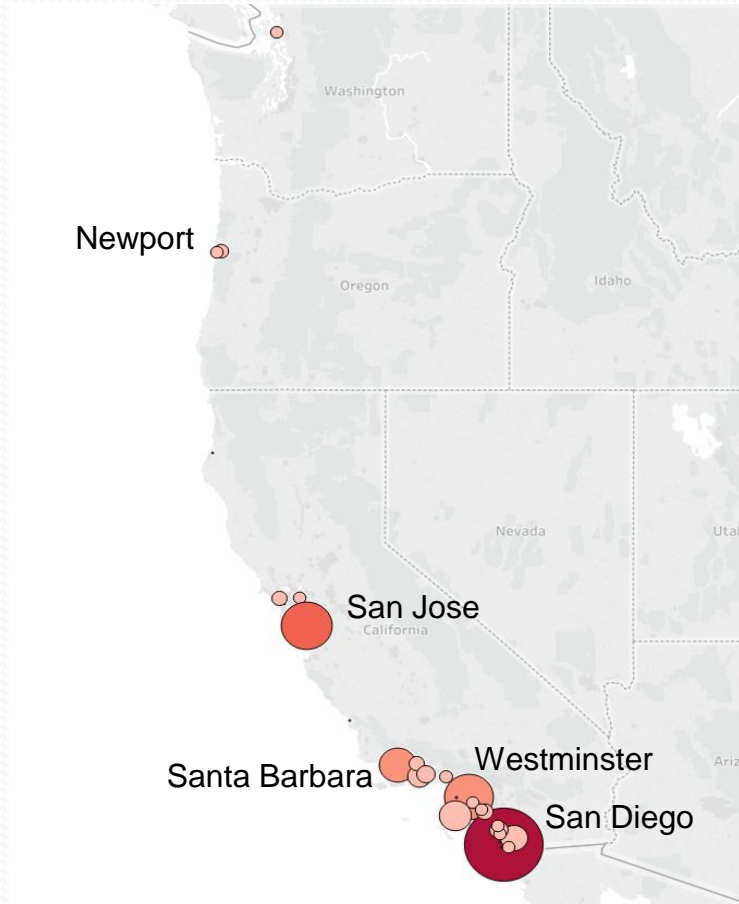
Data

- **Harvesting**
 - Ex-vessel value of swordfish landed by vessels owned by community members
 - Pounds of swordfish landed by vessels from community
 - Number of vessels from community that landed swordfish
- **Processing**
 - Ex-vessel value of swordfish landed in community
 - Pounds of swordfish landed in community
 - Number of dealers present in community

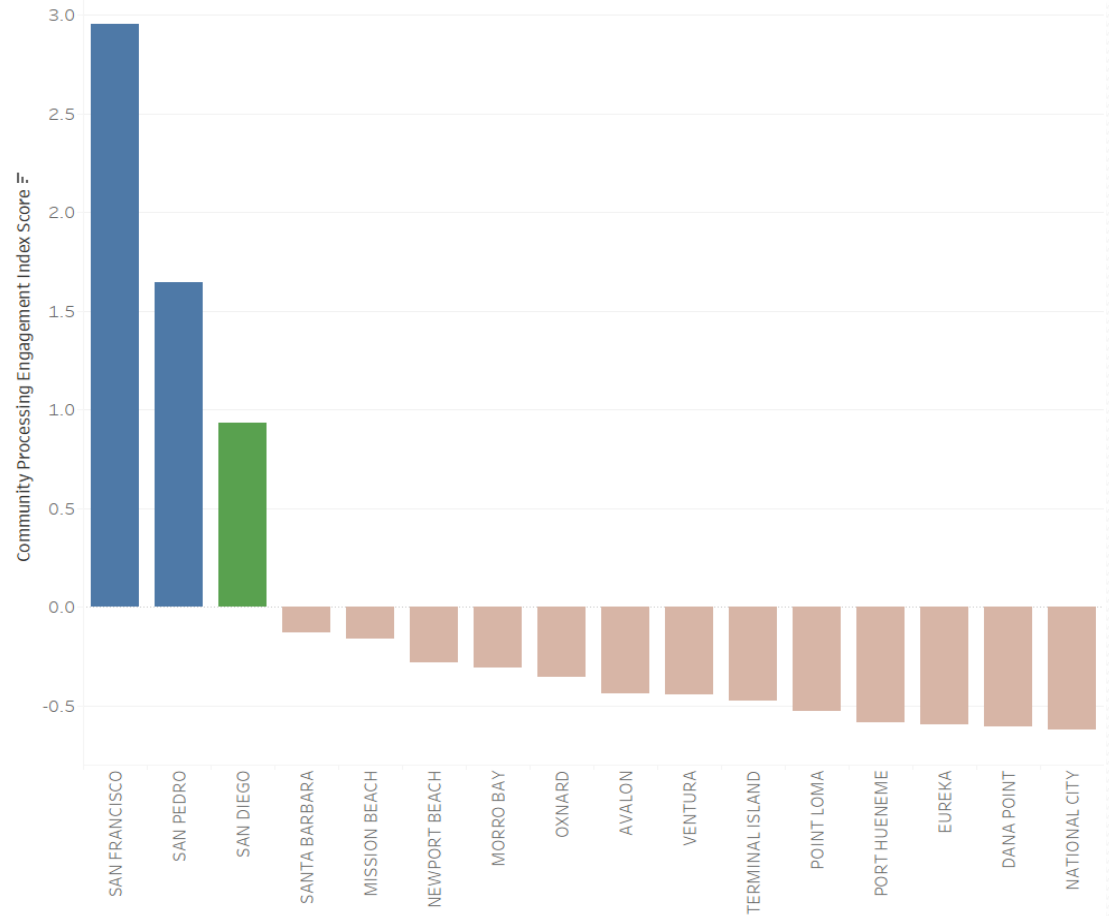
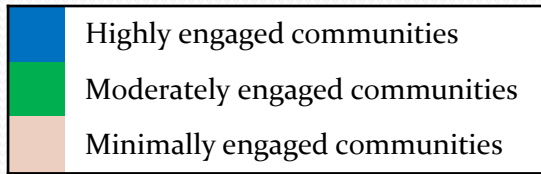
Community Harvesting Engagement Index



Community Harvesting Engagement Index

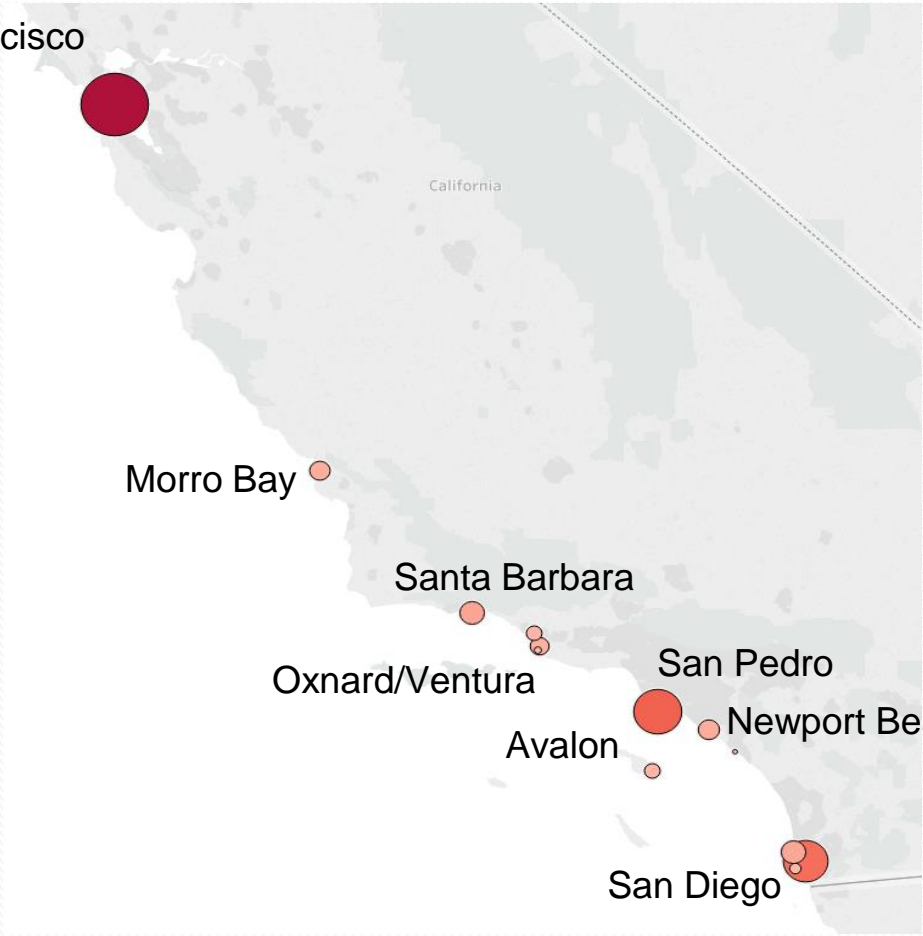


Community Processing Engagement Index



Community Processing Engagement Index

San Francisco



Morro Bay

Santa Barbara

Oxnard/Ventura

Avalon

San Pedro

Newport Beach

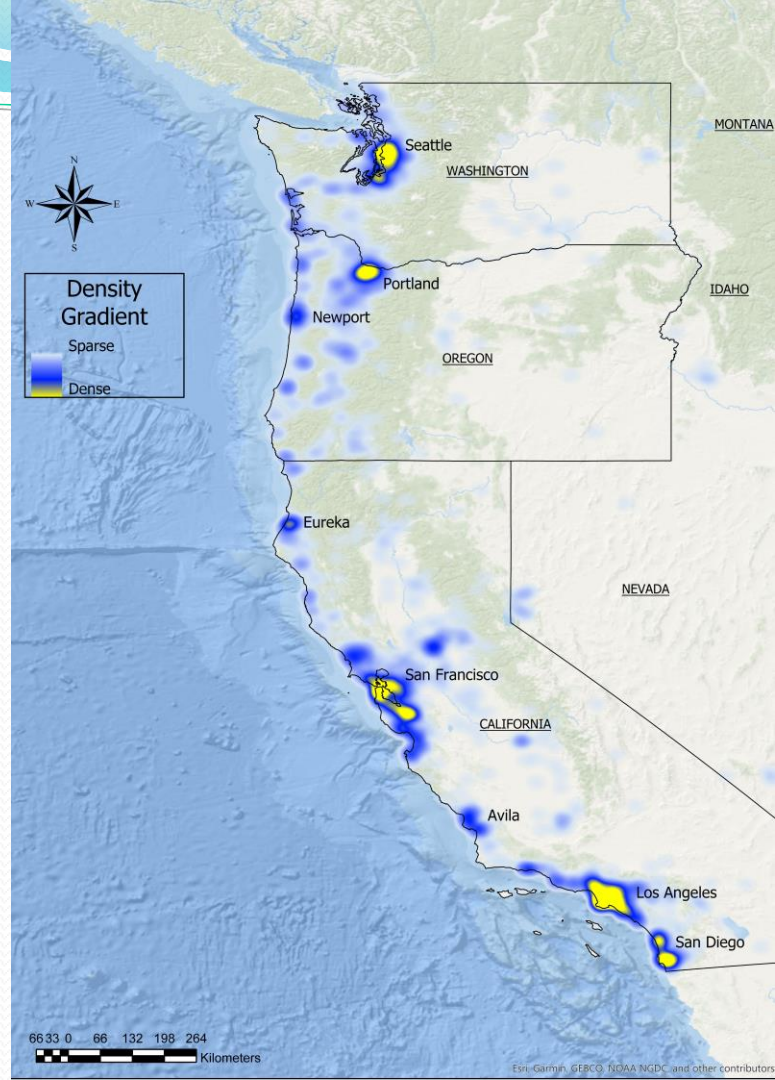
San Diego

Albacore Fishery

- Albacore distribution off the west coast drives the location of fishing activity
- Since 2000 the albacore distribution has shifted north, concentrating off Oregon and Washington
- The U.S.-Canada albacore treaty could constrain U.S. fishing opportunity in case of a distribution shift into Canada EEZ
- Modeling strategy: Consider the effect of shifts in albacore distribution on the level and distribution of U.S. fishery production (landings, revenues and profits)

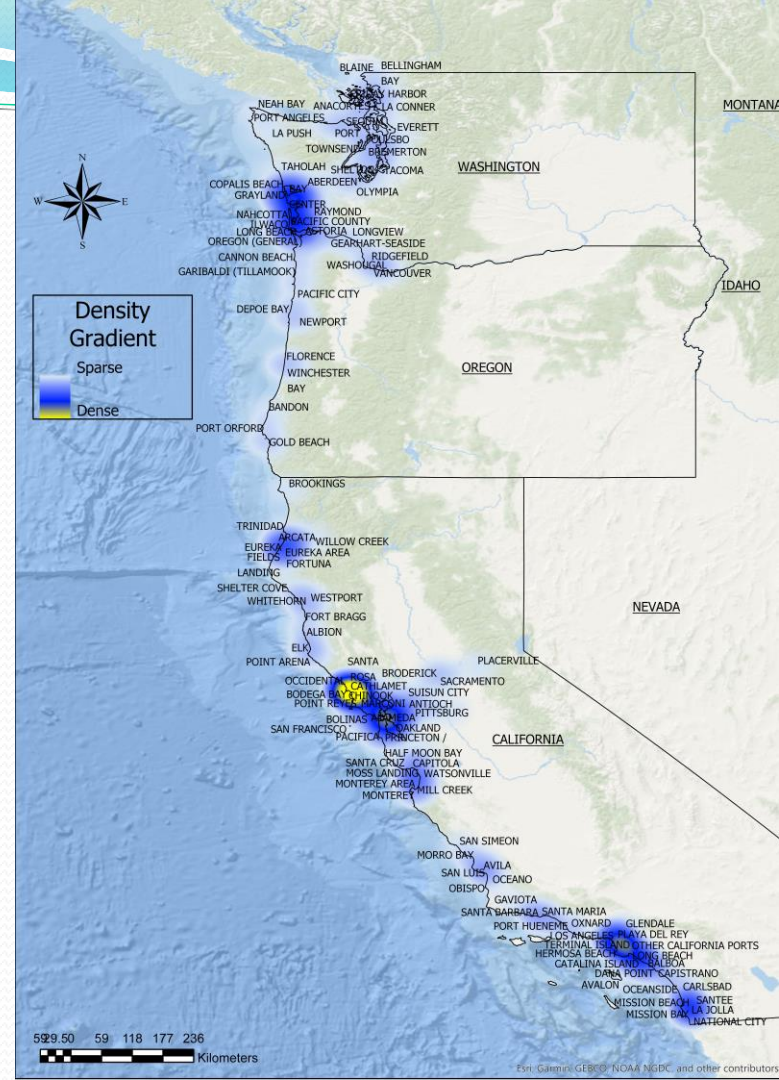
Vessel Owner Addresses

- The Community Harvesting Engagement Index associates engagement with vessel owner addresses
- Vessel owner address locations for the albacore fishery from 1981-2016 are identified in the heat map



Albacore Ports

- The Community Processing Engagement Index associates engagement with ports where albacore was landed
- Albacore landing port cities from 1981-2016 are identified in the figure



Sardine Fishery

- Consider ecosystem service tradeoffs between directed commercial harvest, bait supply to recreational fishery, and leaving fish in situ to provide forage for higher trophic level species, including HMS market species and protected species
- To what extent are sardine population concerns driven by environmental factors versus fishing pressure?
- What levers are available for managing the sardine fishery?
- How does a U.S.-specific harvest guideline affect management?

Progress to Date

- A prototype of the bootstrap model has been developed and applied to analyzing historic DGN fishery data
- Plans have been developed to link community indices to swordfish MSE scenarios
- Work to develop community indices for the albacore fishery is nearing completion
- Unstructured interviews of swordfish fishery participants have been conducted and are underway for the albacore and sardine fisheries

Fishery participant interviews

- Conducted telephone and in-person semi-structured interviews with 15 swordfish and 12 albacore fishermen; more upcoming, including sardine fishermen
- Interview topics
 - Environmental factors and swordfish/albacore catches
 - Interactions with protected species
 - Management and policy pertaining to fishing opportunities, catches and protected species interactions
 - Industry-led actions to reduce interactions and future perspectives
 - Stock distribution and availability, landing ports, places of residence
 - Community aspects (mobility, dependence on fishery, evolution..)

Swordfish Fishermen's views...

"I've been geographically challenged because of the size of my boat, I mean there's been warm water events where I think I would have had a better opportunity to catch fish way further north than I normally fish; however, you know the logistics of my operation just doesn't allow it."

"Some years we have colder water and we have albacore, and there's less yellowfin tuna or skipjack or things like that, and then, you know, in the last few years there's been just an unbelievable amount of bluefin tuna around here, I mean more than I've ever seen in my 20 years of fishing."

"It turns out that if the sword-fishermen stay in water that's warmer than 67 Fahrenheit, they interact with loggerheads much, much, much less frequently and yet the presence of swordfish is, you know, almost assured. So, rather than fishing in 61 to 70 degree water, most of the sword-fishermen I'm familiar with are now fishing in 67 to 70 degree water and doing very well."

"Leaving the door open for experimental fishery permits is a great way to start because it gives guys the opportunity to try things that they may not have tried in the past."

"It doesn't take a genius to know that coastal waters appear to be warming up substantially over the last 50 years with episodic La Nina cooling from tropics and episodic off the West Coast of North America, episodic intrusions of colder water coming down from the Bering Sea and into the California Current. The general trend has been increasing temperature."

Albacore Fishermen's views...

“There is a strong contingent of the fleet that does that every year from San Diego [fishes in Washington], that leaves San Diego and comes up and goes albacore fishing and comes back down.”

“A lot of people can make a pretty good living salmon fishing all summer long and now that the salmon seasons are so restricted and whatnot due to the problems with salmon populations, and it's a lot of smaller boats, would now fish albacore full time than would in the past. Not that they wouldn't go albacore fishing in the past but that wouldn't have been their primary focus.”

“10 years ago was the peak of biomass and population right here on our coast and I think it's fallen off dramatically in the last 4 or 5 years.”

“The last 5 to 10 years, most of the fish has been on the beach. There has been a mixed year where we have been offshore, 500 to 1,000 miles, maybe 1 or 2 out of the last 10, but most of it has been on the beach here, off of Oregon, and maybe Washington.”

“What rolls through a fisherman's head when you go to unload, the minute you start getting on the phone and calling these guys, you find out that they're all buying for the same guy, and he's probably up in Canada somewhere. You got maybe a dozen buyers in Canada buying through maybe 4 different plants in the Columbia River.”

Future Goals

- Finalize bootstrap model for DGN fishery
- Develop economic model of albacore fishery response to distribution changes
- Complete community index analyses for albacore and sardine fisheries
- Identify appropriate weights for predicting economic impacts of climate change on CCLME fisheries
- Integrate socio-economic project elements with MSEs
- Publish socio-economic analysis of swordfish and albacore fisheries

Challenges

- Integrating economic models and metrics into MSEs
- Capturing the effect of distributional changes in landings and fishing revenues on fishing communities
- Developing suitable assumptions for protected species interaction rates in hard caps analysis and for climate-driven population shifts in albacore fishery analysis