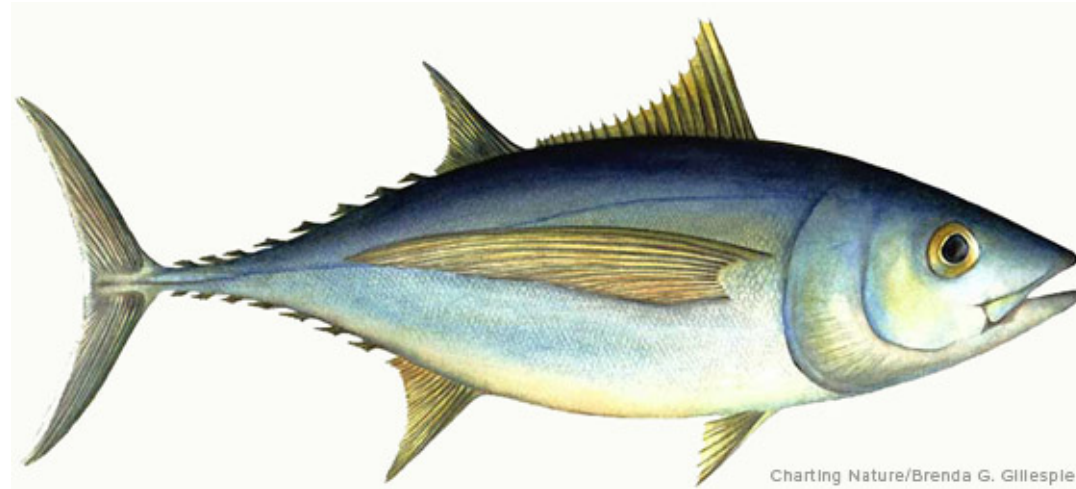


Spatio-temporal changes in albacore landings in West Coast ports

Desiree Tommasi, Barbara Muhling, and Future Seas Team



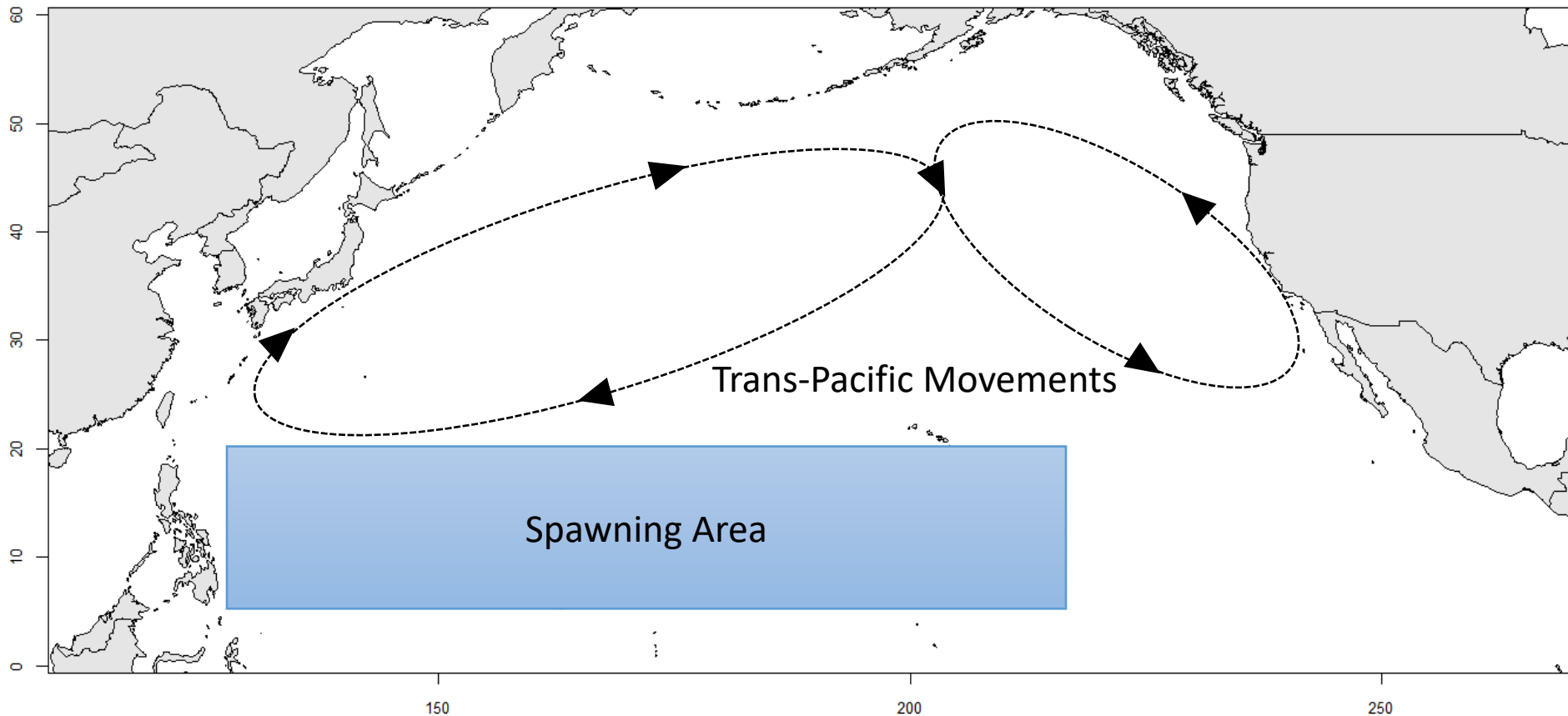
North Pacific Albacore MSE

- GOAL: Examine performance of alternative harvest strategies and associated reference points relative to a set of management objectives for North Pacific albacore given uncertainty
- Requested by management bodies, extensive stakeholder engagement, international

North Pacific Albacore Future Seas

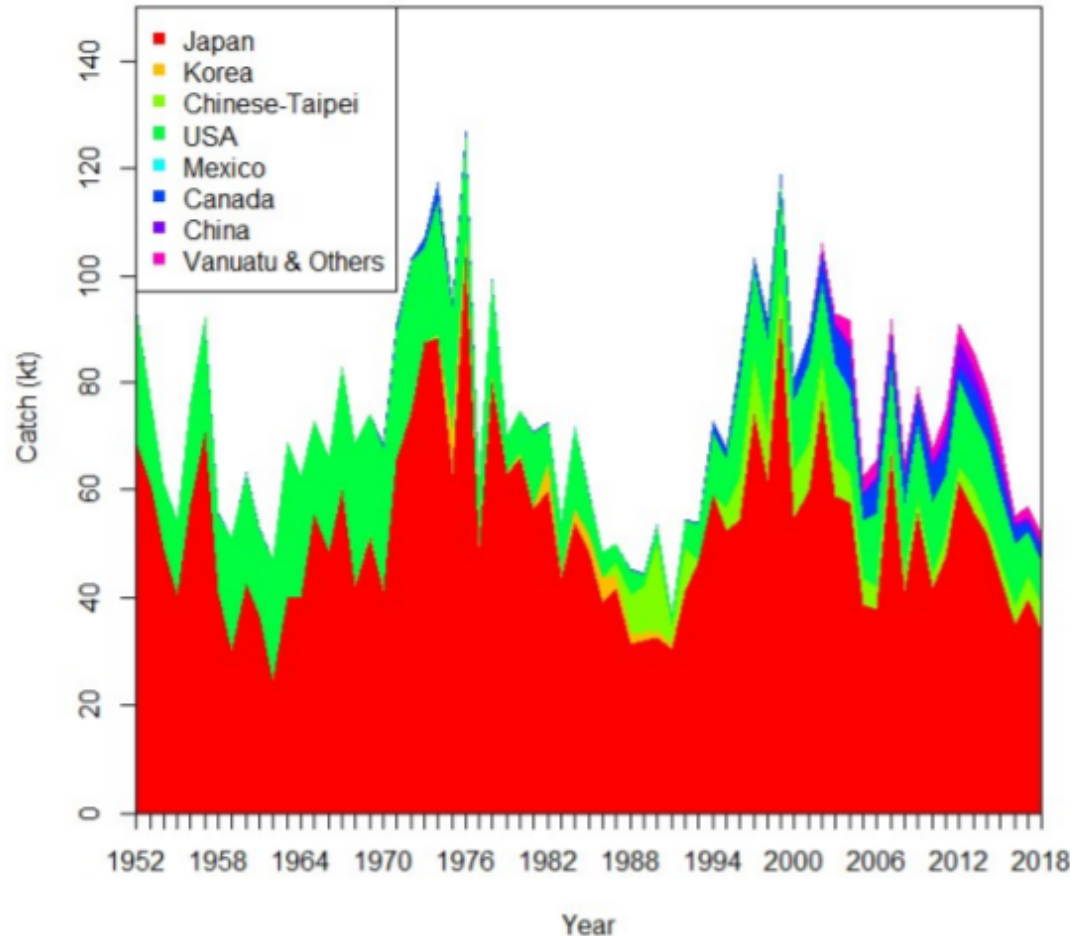
- GOAL: Evaluate impacts of climate change on albacore, dependent fishing communities, and transboundary (Canada/US) stock management issues
 - Research focus, some engagement with US stakeholders

North Pacific Albacore is a highly migratory species whose habitat spans the entire North Pacific Ocean

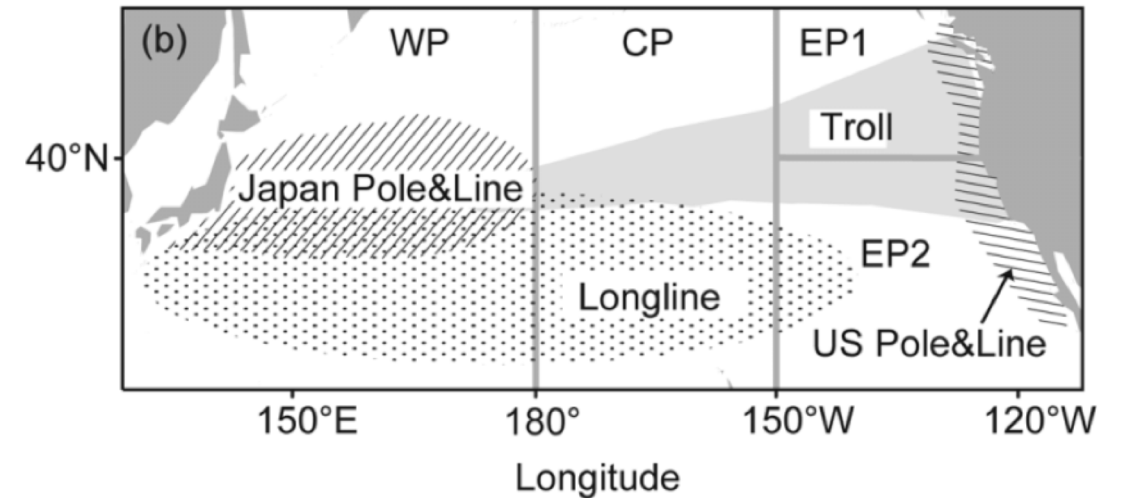


- #1 HMS fishery on West Coast
- >80% of landings July-Sept
- Juvenile fishery (ages 2-4)

Majority of the catch occurs in the Western Pacific

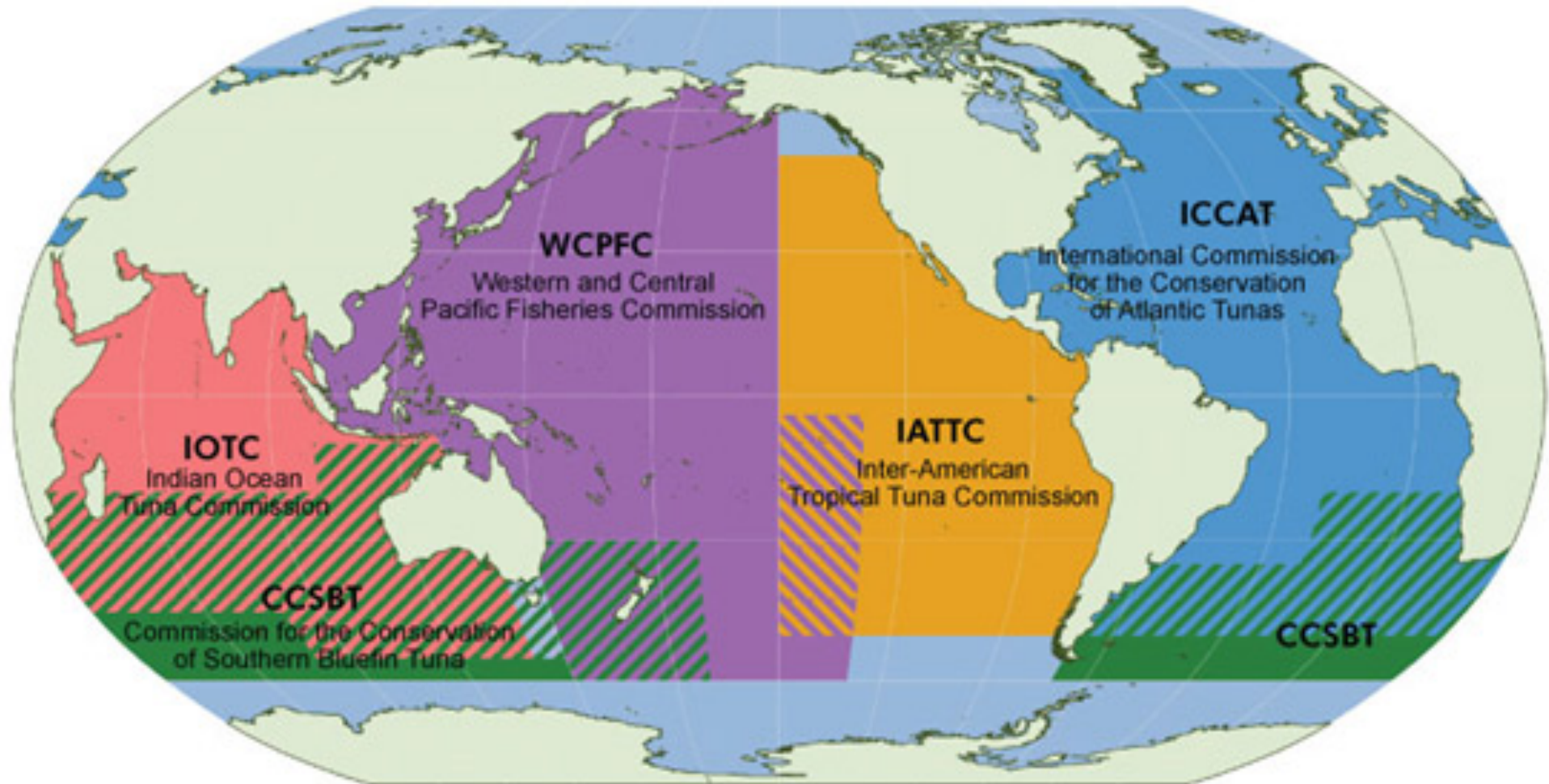


ISC ALBWG,
http://isc.fra.go.jp/working_groups/albacore.html

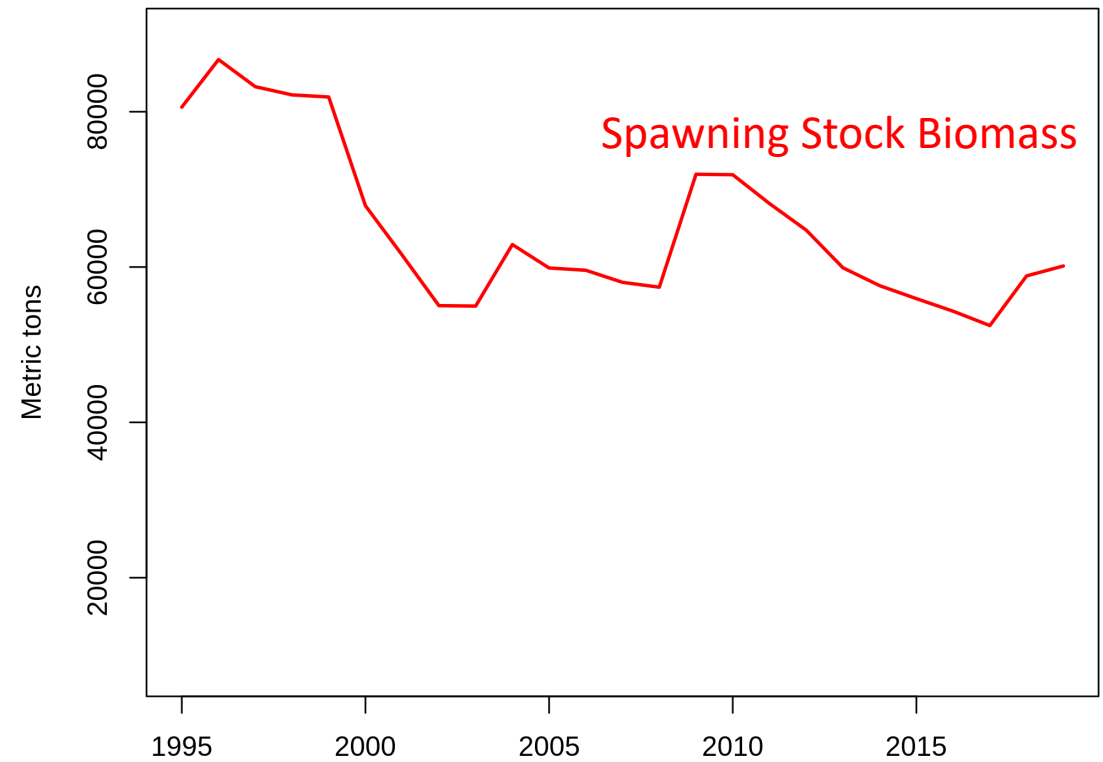
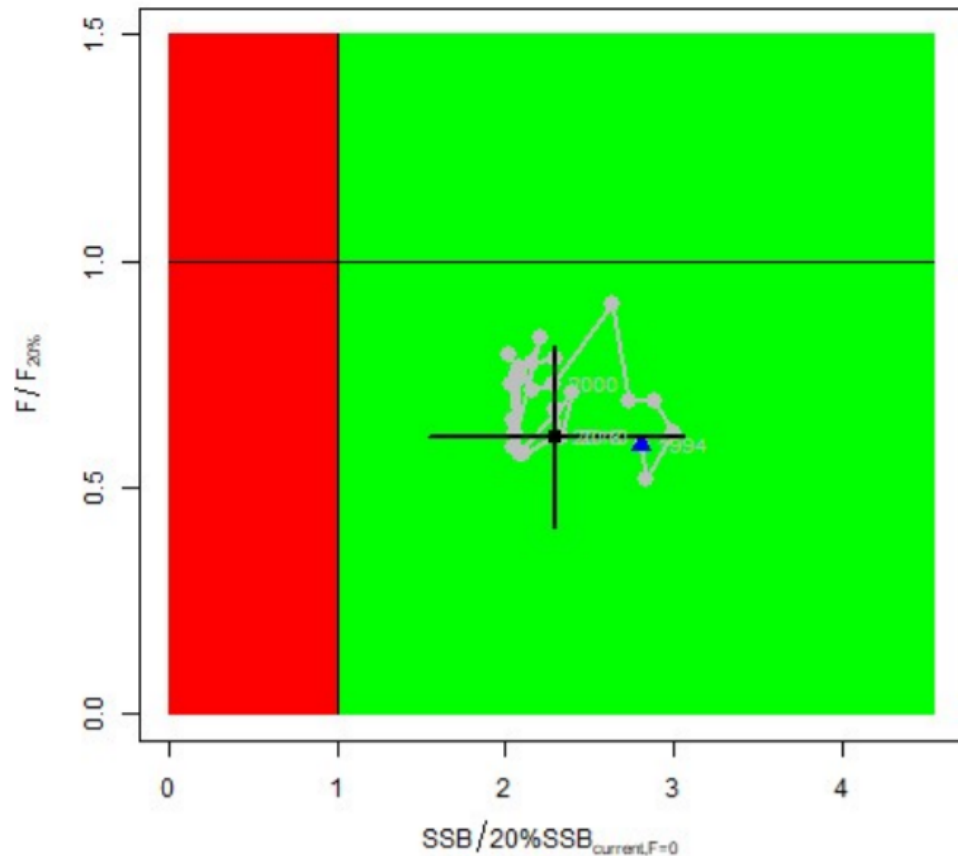


Ichinokawa et al. 2008, Canadian Journal of Fisheries and Aquatic Sciences

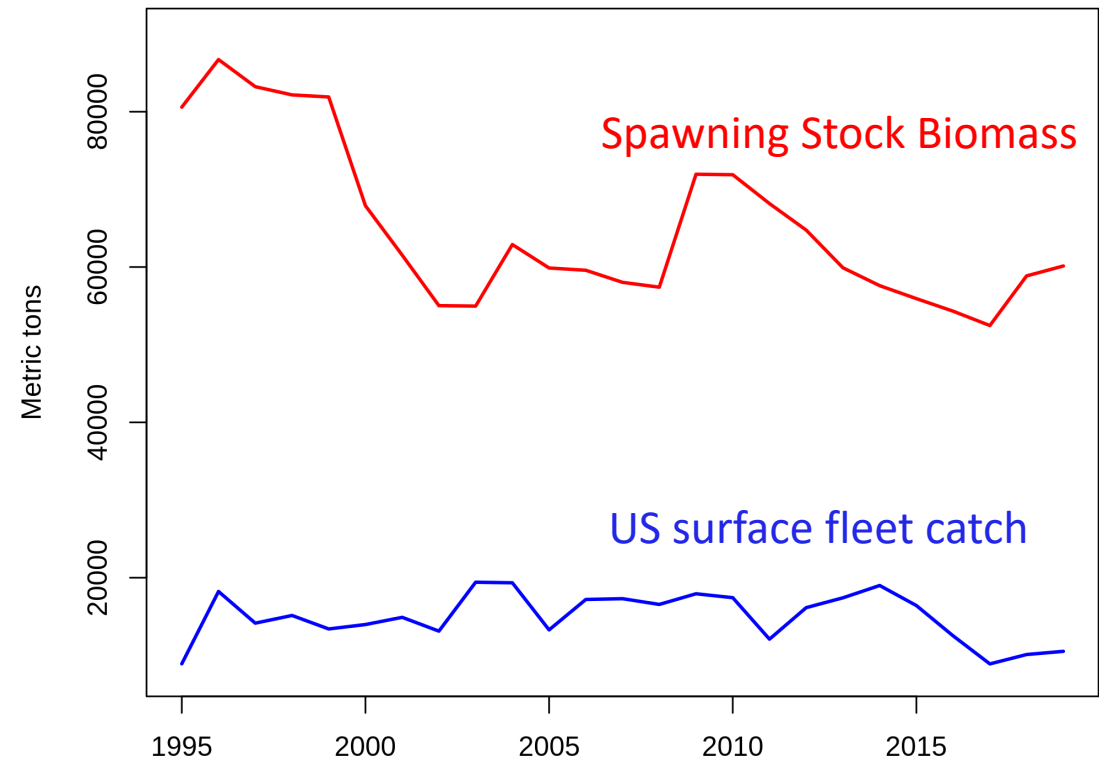
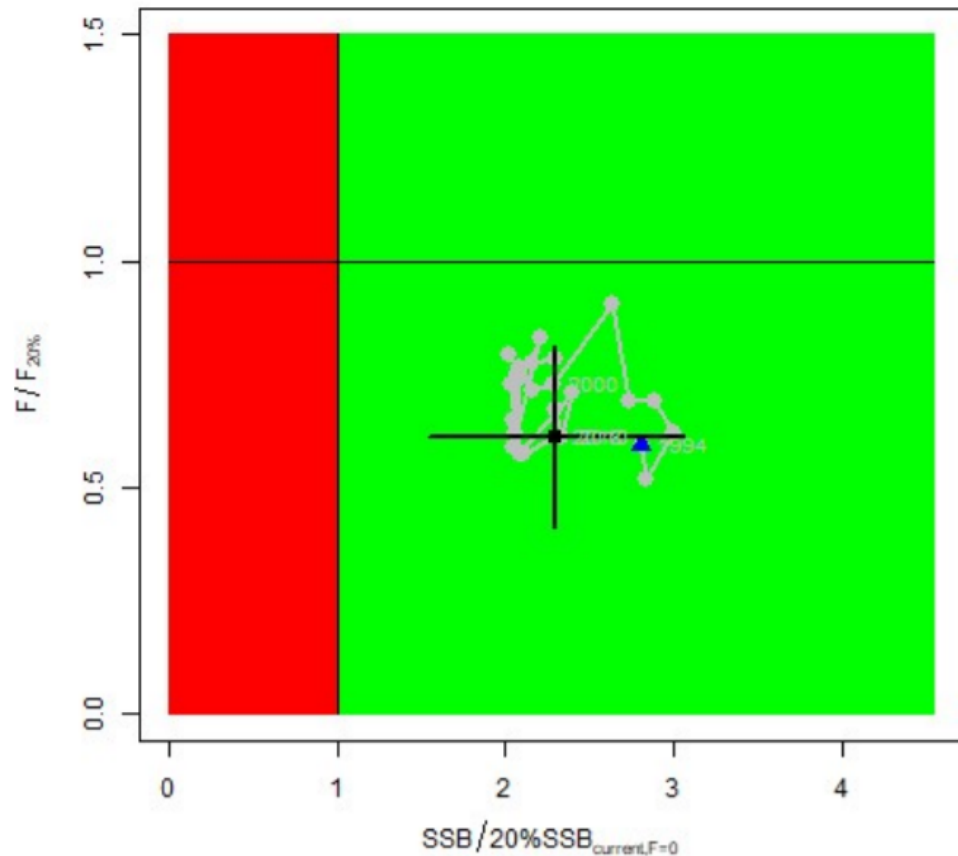
Managed internationally via RFMOs



North Pacific Albacore stock status is determined on North Pacific wide basis based on spawning stock biomass from stock assessment model

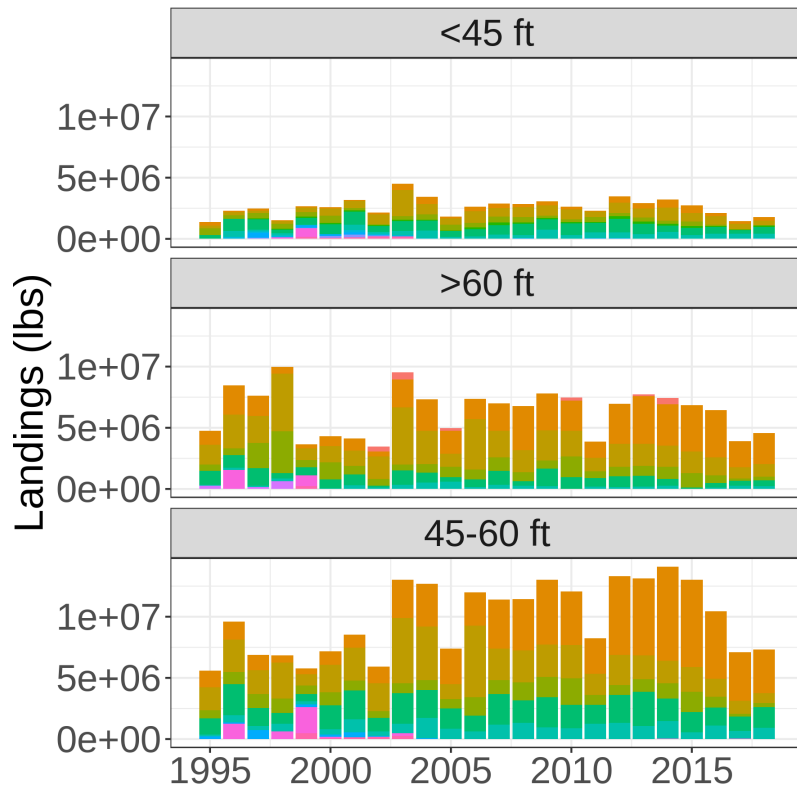


At times reality on the water does not match main stock assessment output => disenfranchised stakeholders

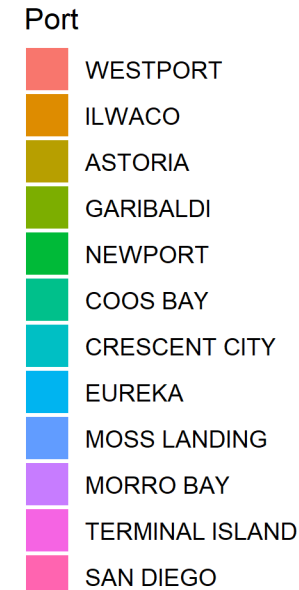
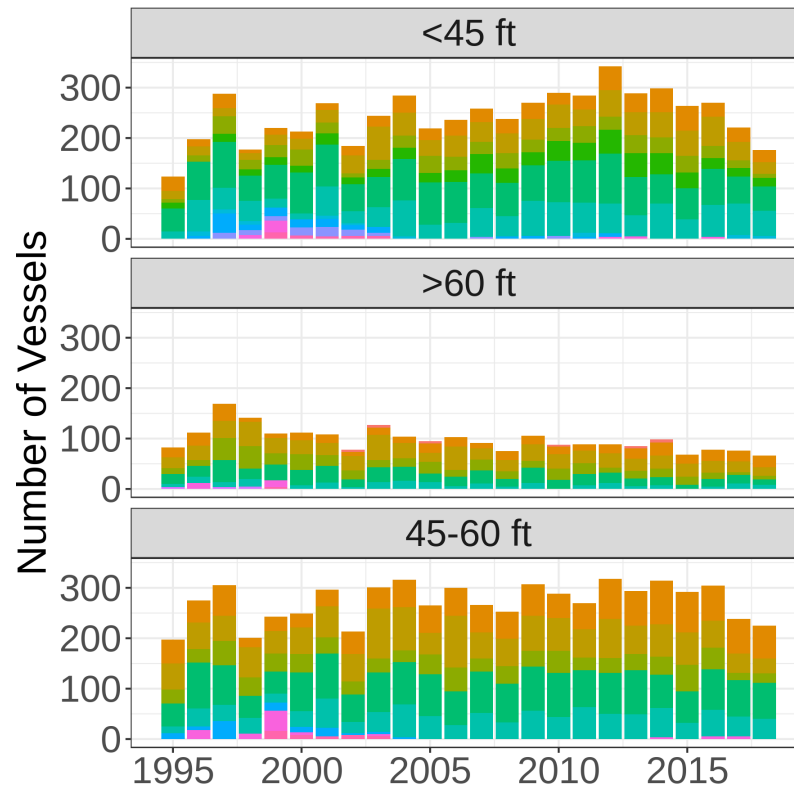


Develop indicators more relevant to US stakeholders. Is overall biomass a good indicator of availability in US waters? What drives spatio-temporal changes to US landings by port?

Landings of US Albacore Fleet by Port from 1995-2018

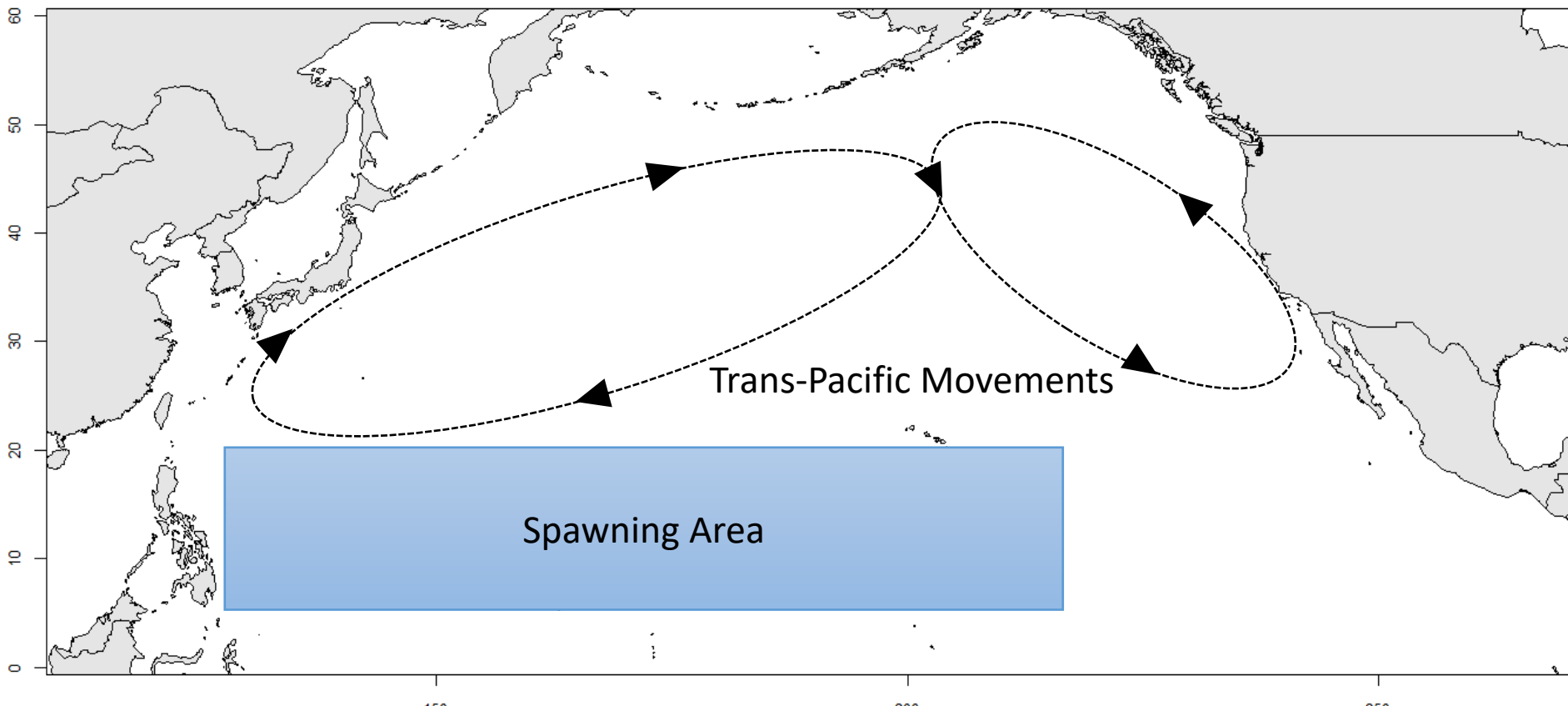


Fleet Capacity of US Albacore Fleet by Port from 1995-2018



Diminished importance of Southern California Ports

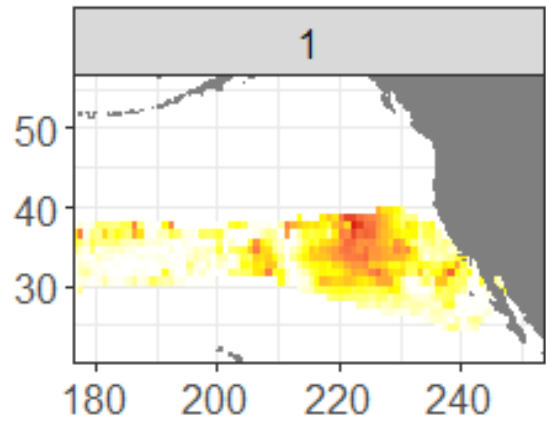
What drives spatio-temporal changes to US landings by port?



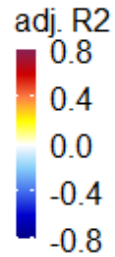
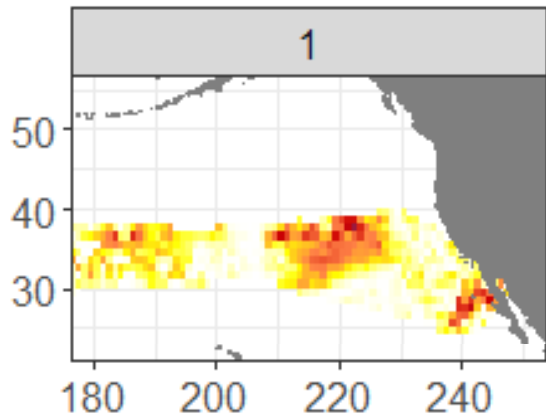
Migration route associated with transition zone chlorophyll front (TZCF), which coincides with optimal thermal habitat of 14-20°C

Location of center of US fishing activity in summer (Center of gravity of CPUE from albacore logbooks) depends on SST and Chl conditions in TZCF in winter

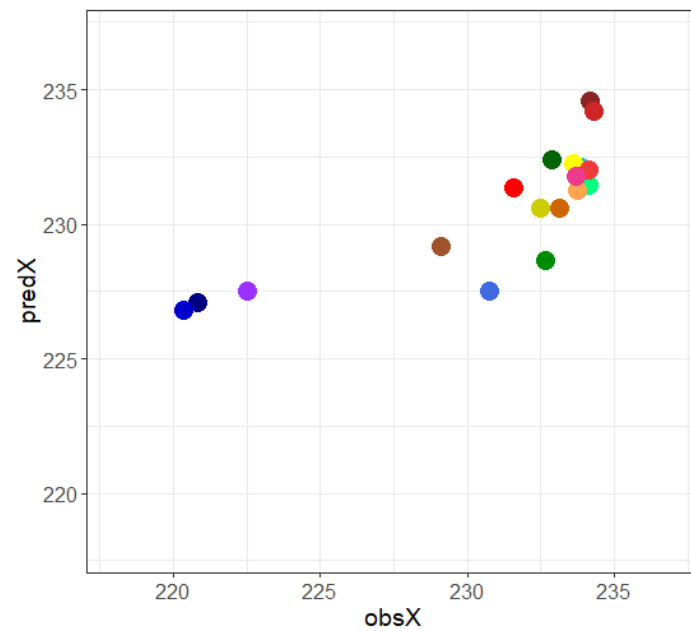
SST/CHL: COG latitude



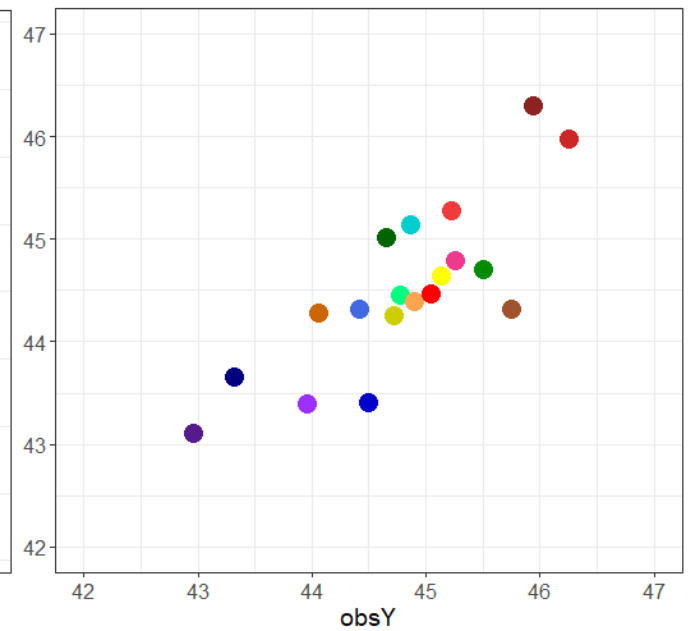
SST/CHL: COG longitude



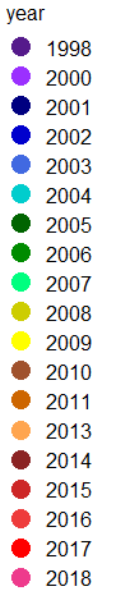
- Best models determined on R^2 on out of sample data



Observed COG longitude



Observed COG latitude



What determines if a port is active or not?

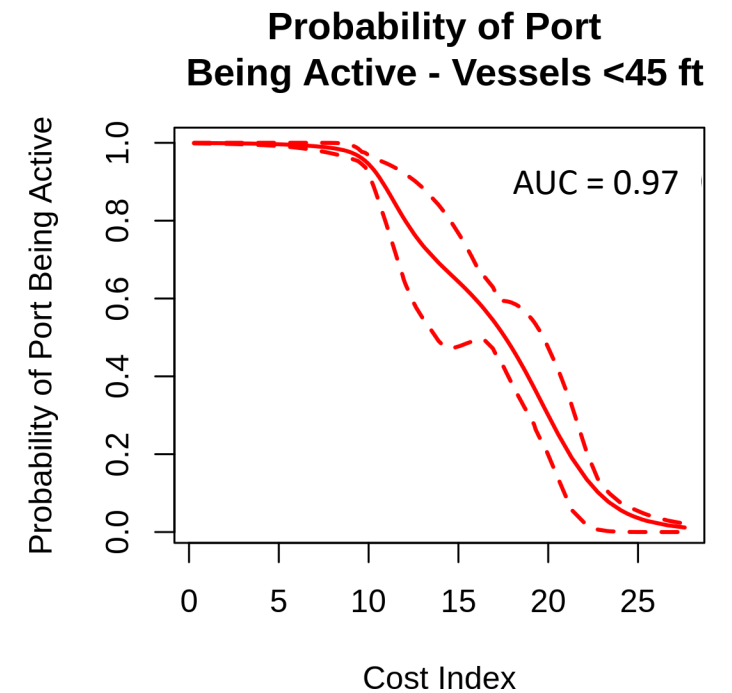
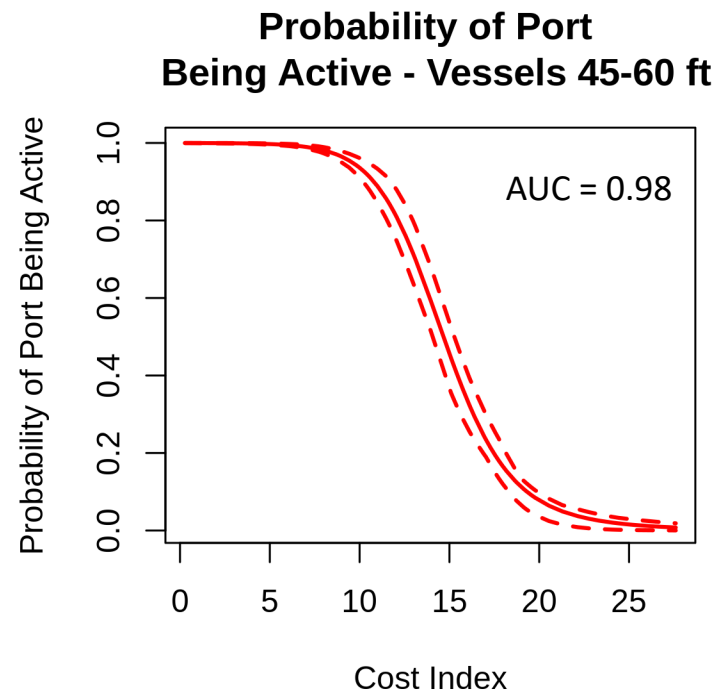
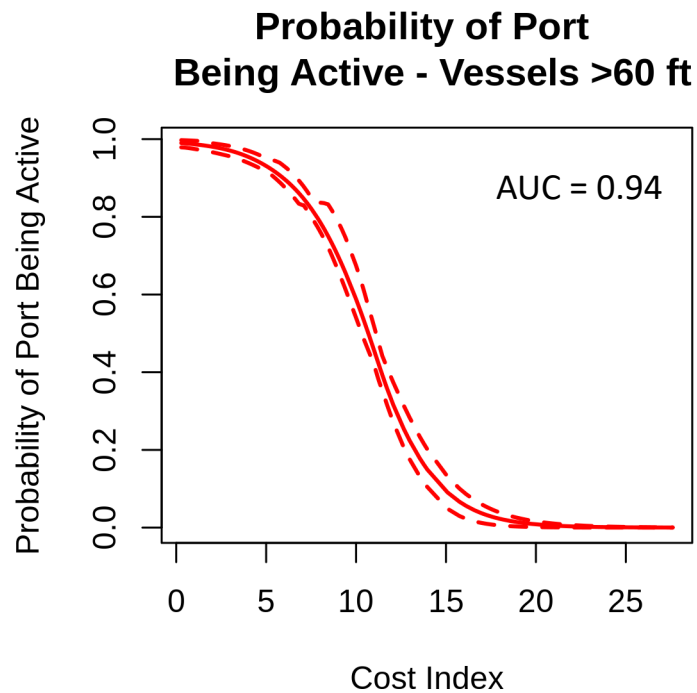
Fit binomial generalized additive model (GAM) to model probability of port being active (i.e. with landings or not) by vessel type for season 3 (July-September)

Prob \sim Cost Index

Cost Index = distance from center of fishing grounds weighted by fuel price (corrected for inflation)

Center of fishing grounds = COG of logbook CPUE data

Small vessels showed more varied response and took longer to respond to changes in costs
May be more vulnerable to future changes in distribution



AUC is mean AUC on testing set. Model trained on 75% of data points, randomly selected, repeated 20 times

For active ports, what drives spatio-temporal changes to landings?

$$\text{Catch} \sim \text{Effort} * \text{Biomass} * \text{Catchability}$$

Chinook landings
Dungeness landings
Groundfish
Port infrastructure
(fixed port effect)

Stock wide biomass at
age * fleet selectivity
disaggregated over
California Current with
SDMs and averaged
over fishing grounds

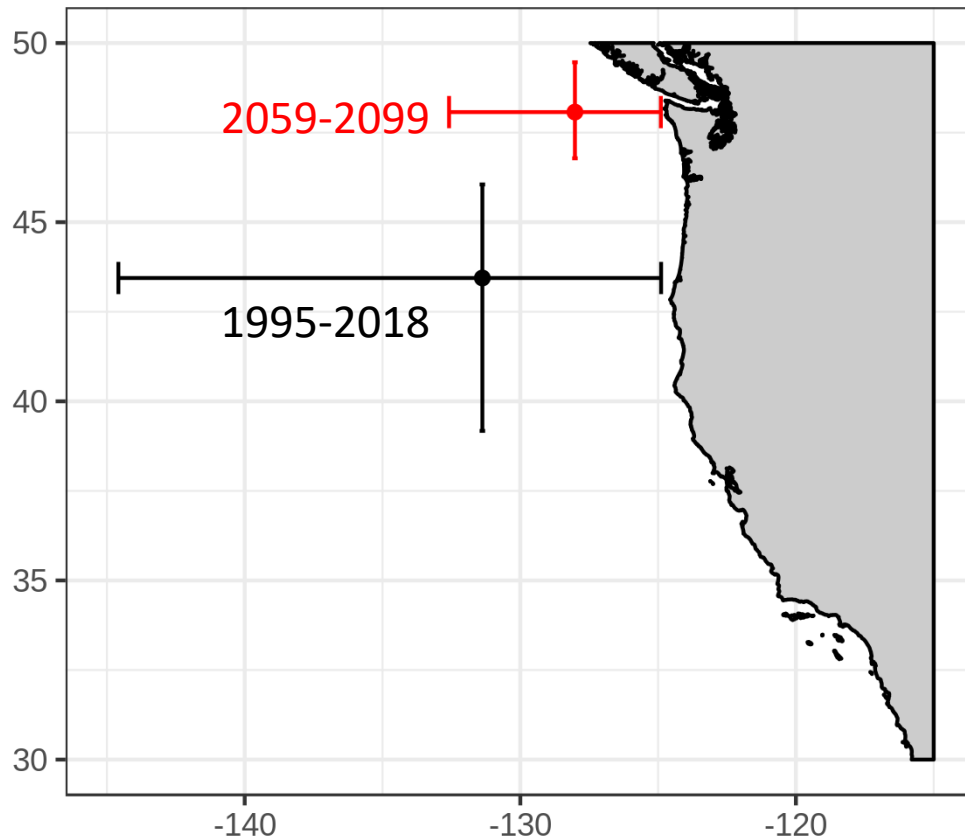
Transition zone position
Environmentally driven
spatio-temporal patterns
of albacore habitat
distribution over
California Current

Fit generalized additive model (GAM) on log-transformed landings by port for season 3 (July-September) by vessel type. Variables selected by backward selection.

Projections

Projected future COGs for 2059-2099 are strongly inshore and further north

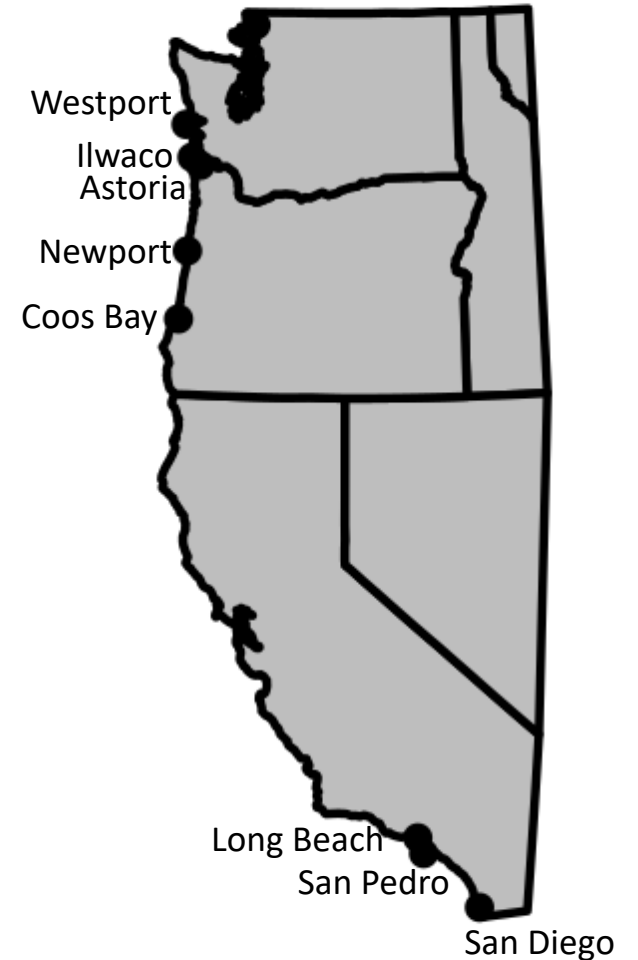
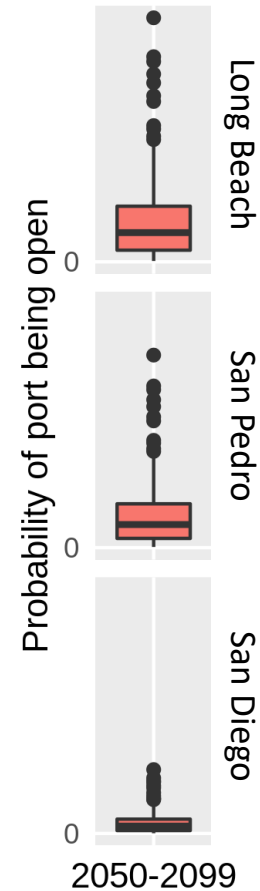
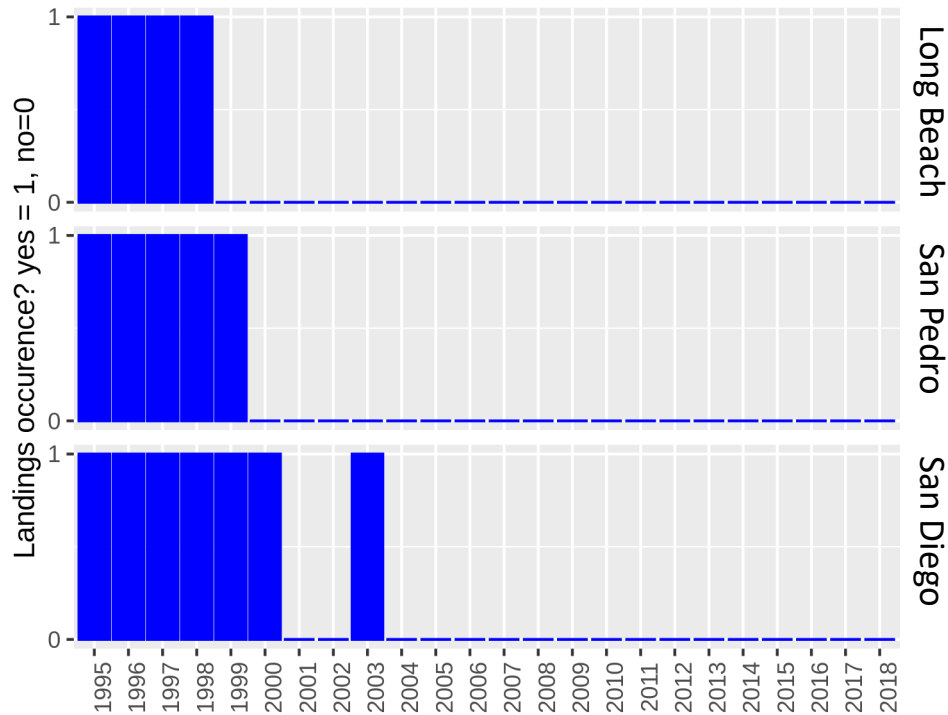
Mean and 5th and 95th quantiles



What would be the impact on US fishers of an exclusive Canadian territory fishing right?

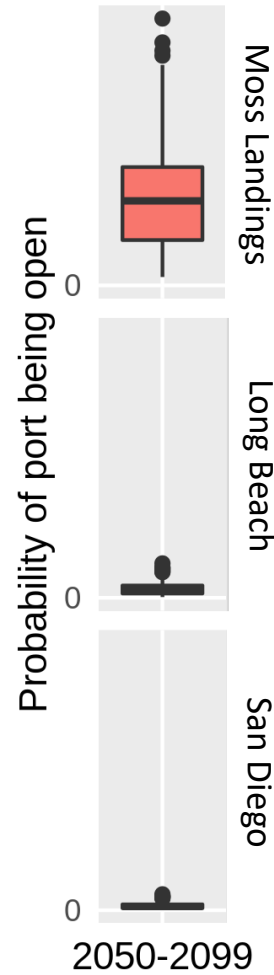
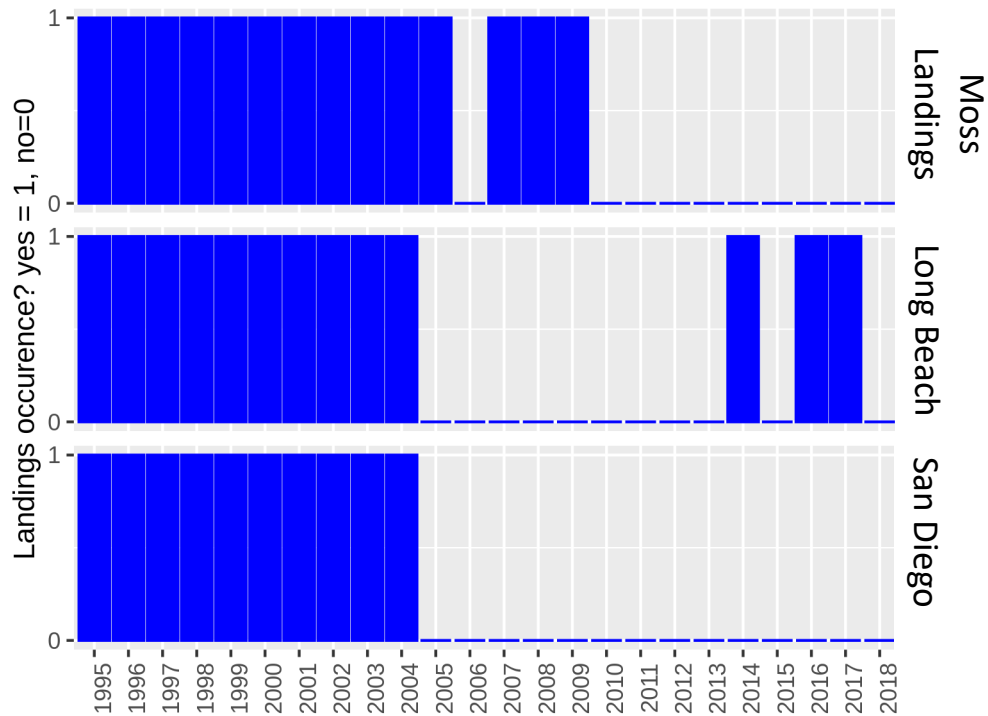
Projections – Large Vessels

WA, OR ports remain active, but CA ports retain low probability of being open



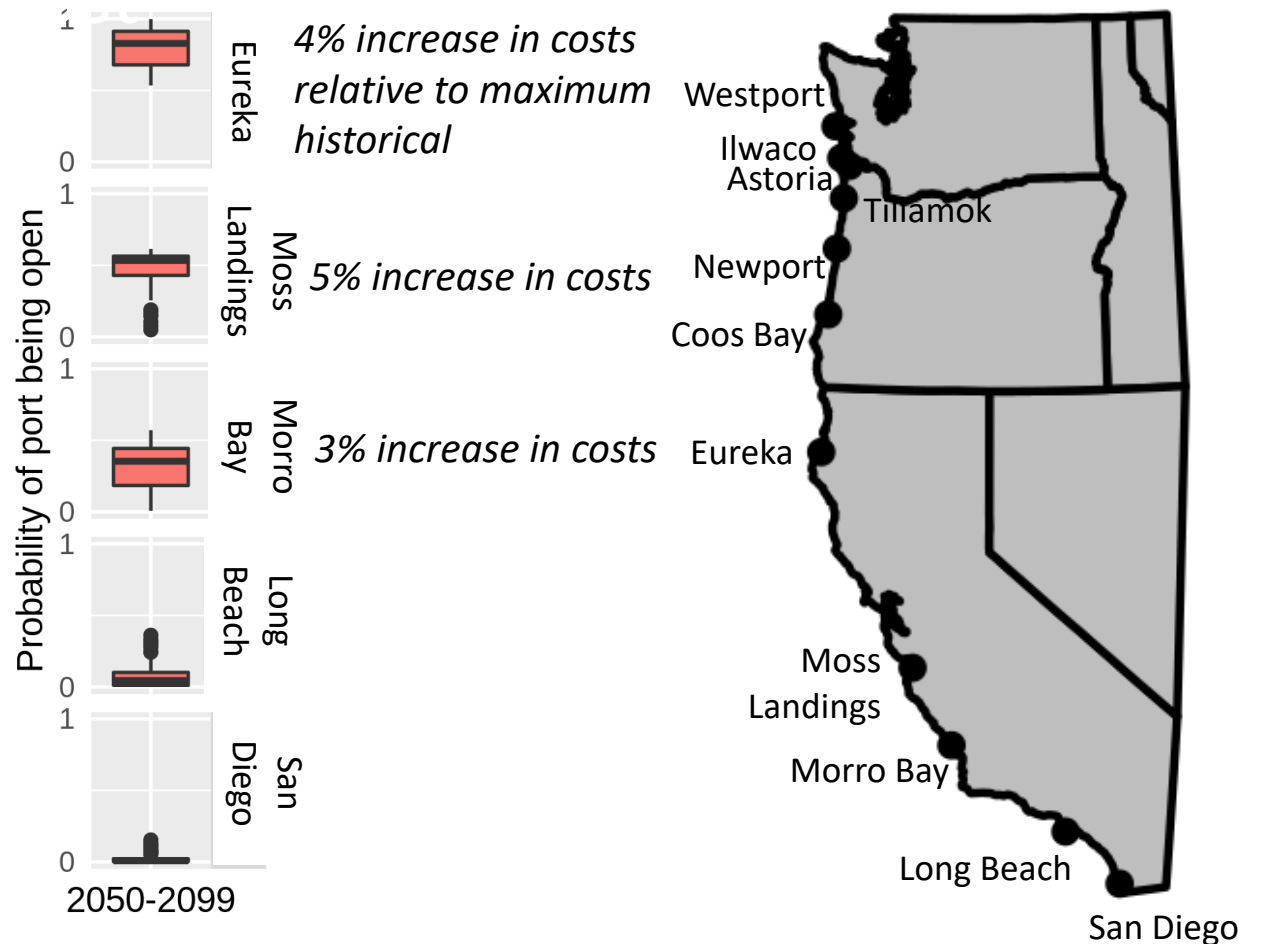
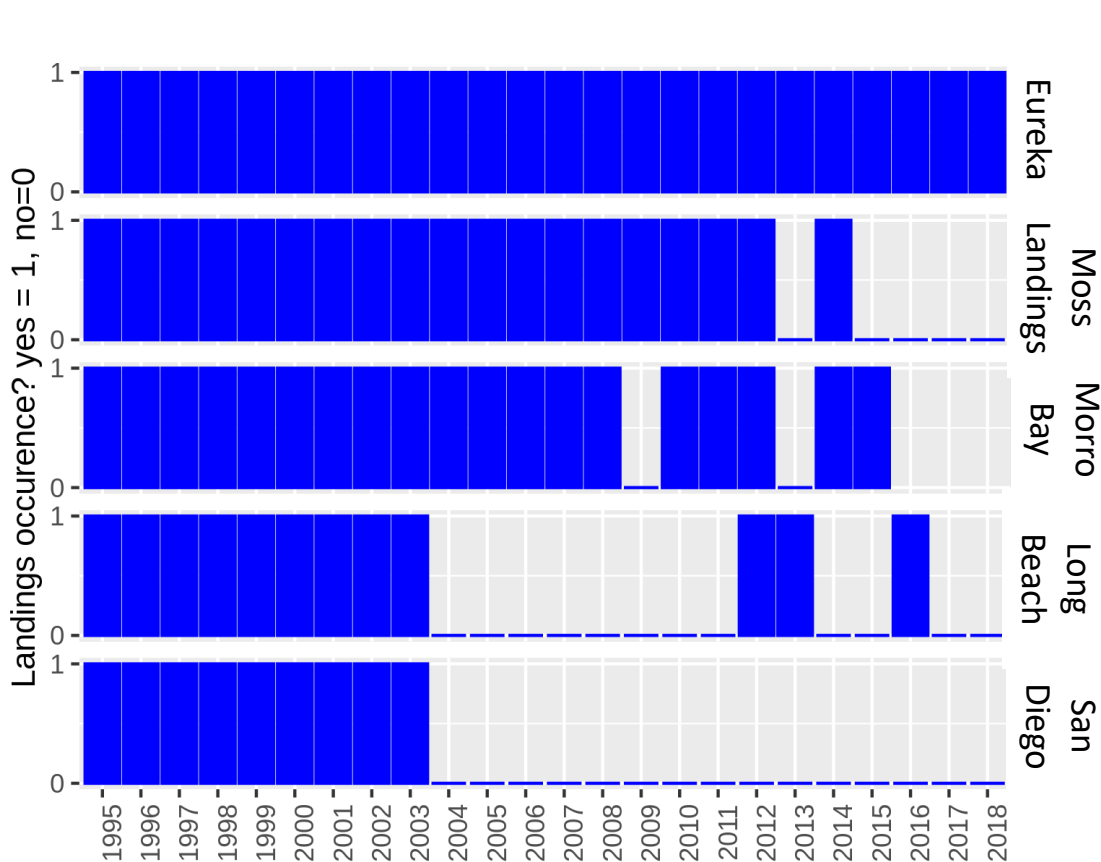
Projections – Medium Vessels

WA, OR ports remain active, but southern CA ports retain low probability of being open



Projections – Small Vessels

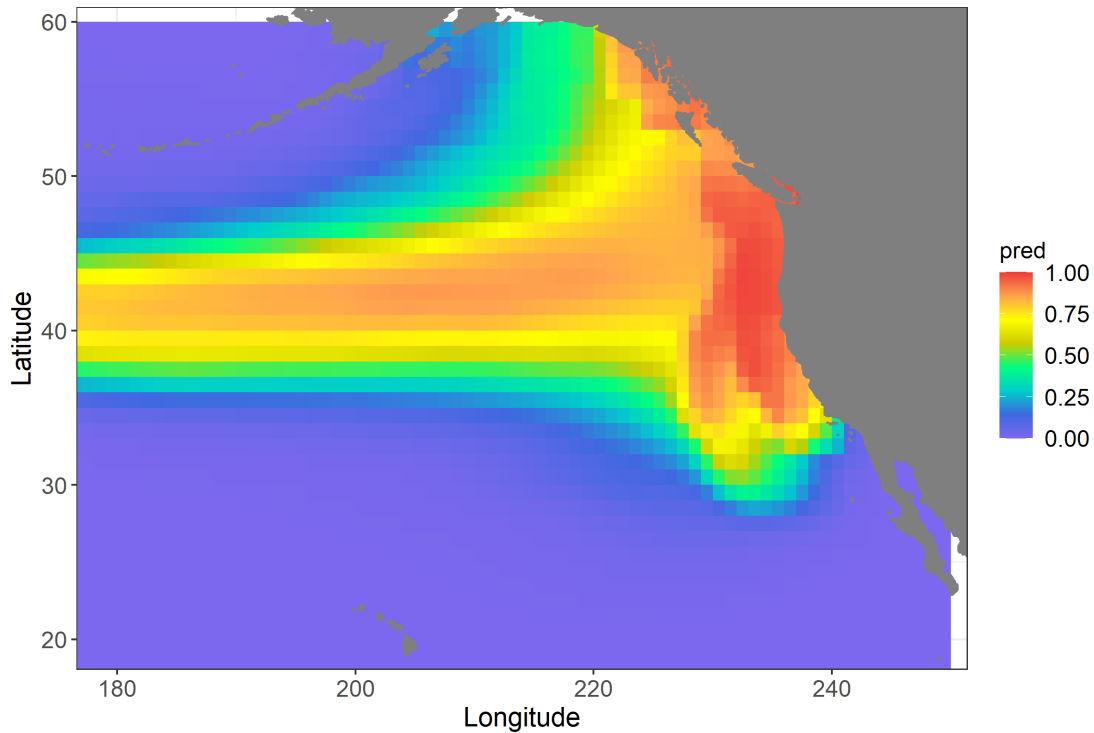
WA, OR ports remain active, southern CA ports low probability of being open, northern CA port remain active but higher operating costs



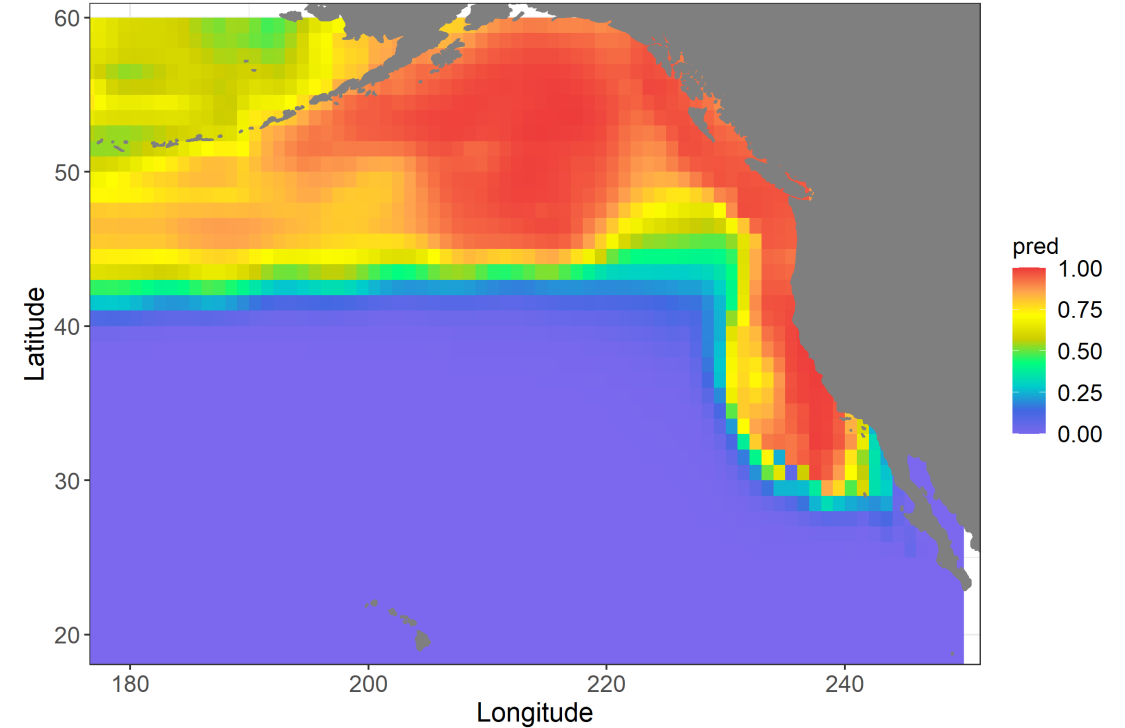
Projections – Other COG scenarios?

North Pacific wide SDM (GAM with chl, sst, and their gradients as covariates) forced by global ESMs

Historical



Future



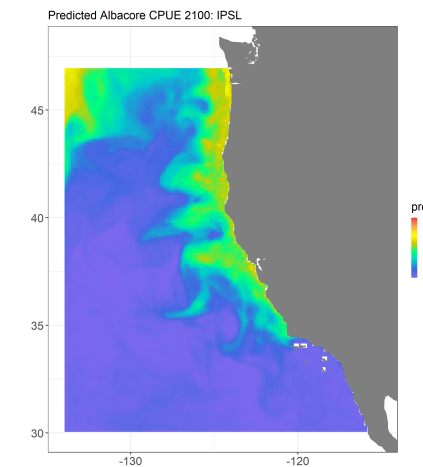
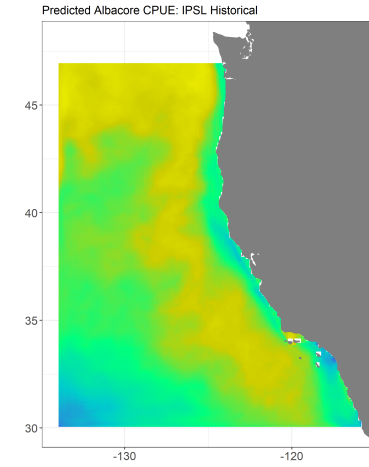
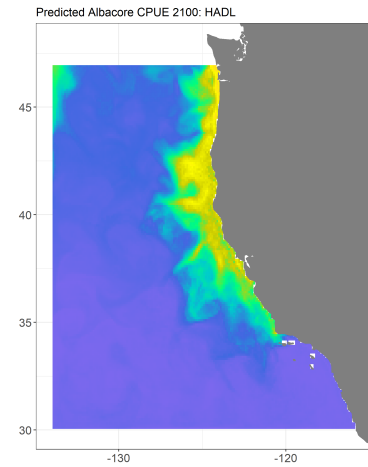
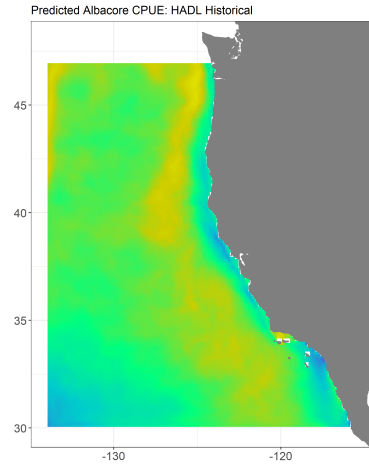
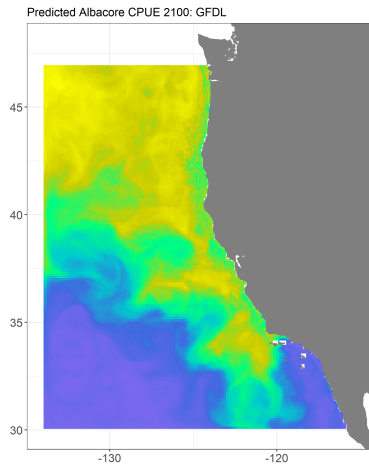
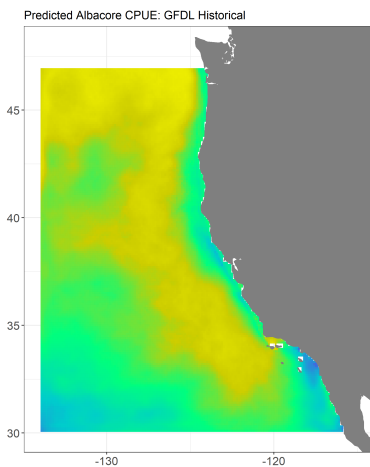
Projections –Landings

Will be dependent on California Current SDM output forced by downscaled climate projections from three ESMs. Example output for year 2100 shows suitable habitat contracting shoreward and northward

GFDL

Hadley

IPSL



Historical

2100

Historical

2100

Historical

2100

pred
3
2
1
0

Conclusions

- Albacore fishing grounds move northward and shoreward
- Important to maintain accessibility to Canadian waters
- Different adaptive capacity of fishers, largest among large vessels
- Small vessels less flexible, more tied to a specific community
- Interplay between adaptability and community resilience?

Acknowledgements

Future Seas Team – <https://future-seas.com/team/>

PacFIN for providing data, in particular Bob Ryznar, Jenny Suter and Brad Stenberg

US albacore stakeholders who participated in Future Seas MSE workshop



NOAA Climate Program Office



QUESTIONS? desiree.tommasi@noaa.gov