The Dynamics of Adaptation to Climate-Driven Variability in California Current Fisheries And Fishing Communities

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Funding and Organization

- NSF CNH Award 1616821 $1.5 million 2016-2020 with Josh Abbott Arizona State University as lead PI
  - Josh Abbott (ASU)
  - Andre Punt (UW SAFS)
  - Melissa Poe (UW Sea Grant)
  - Malin Pinsky (Rutgers)
- NOAA in-kind support
  - Dan Holland (NFWFC)
  - Karma Norman (NWFSC)
  - Nate Mantua (SWFSC)

National Science Foundation WHERE DISCOVERIES BEGIN

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Sea Grant Washington

Project Objectives

- To understand how environmental variability travels through, and is dampened or amplified by, linked social and ecological processes in fisheries systems on the U.S. West Coast.
- To explore how more integrated management of fisheries can be used to increase resilience and human benefits derived from West Coast commercial fisheries.
- To engage disparate parts of the fishery management community in development and application of the research and modeling tools needed to implement ecosystem-based fishery management.

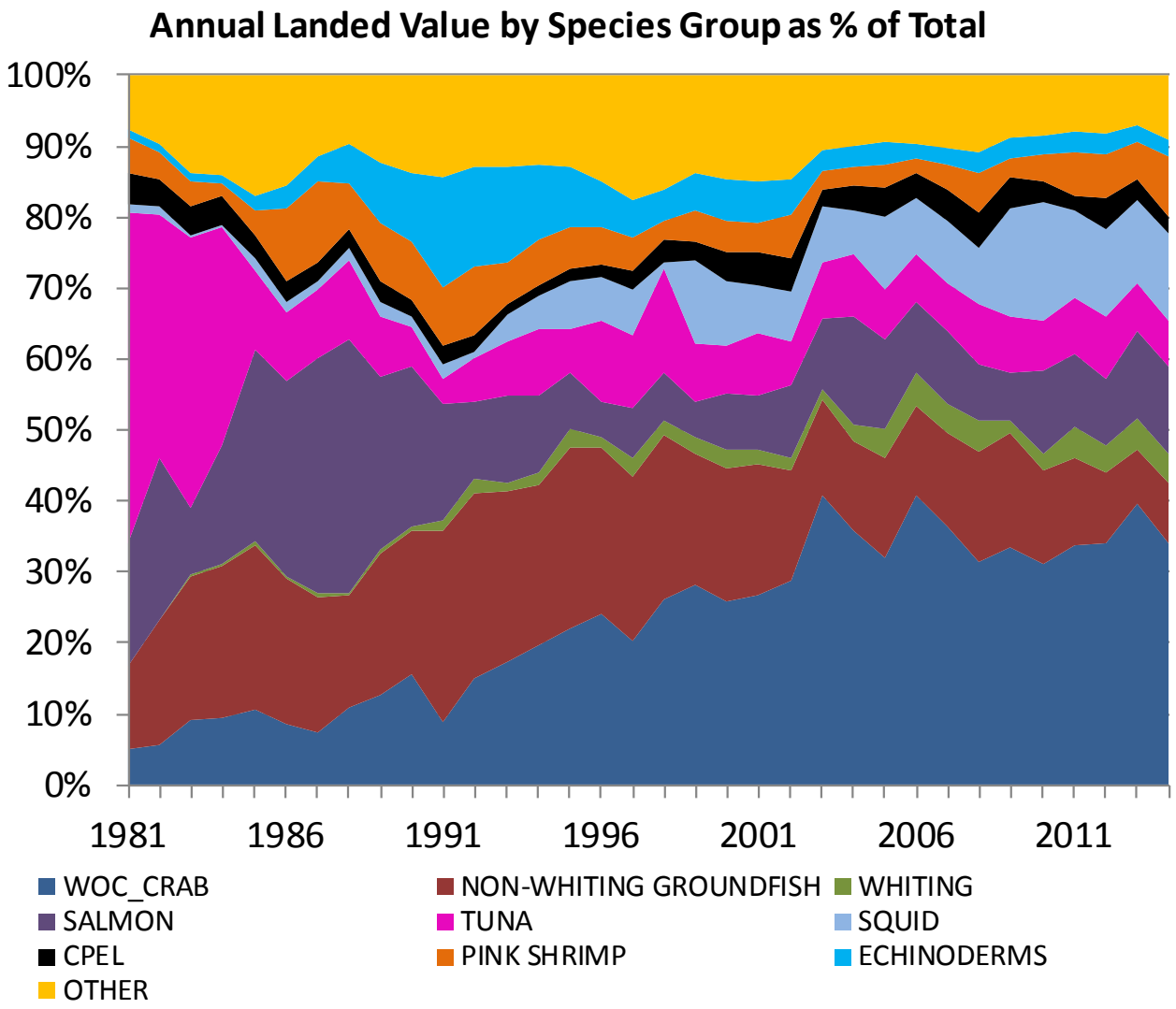


Figure 1: Ex-vessel revenues by species group as a percentage of total West Coast ex-vessel revenues from 1981 to 2014

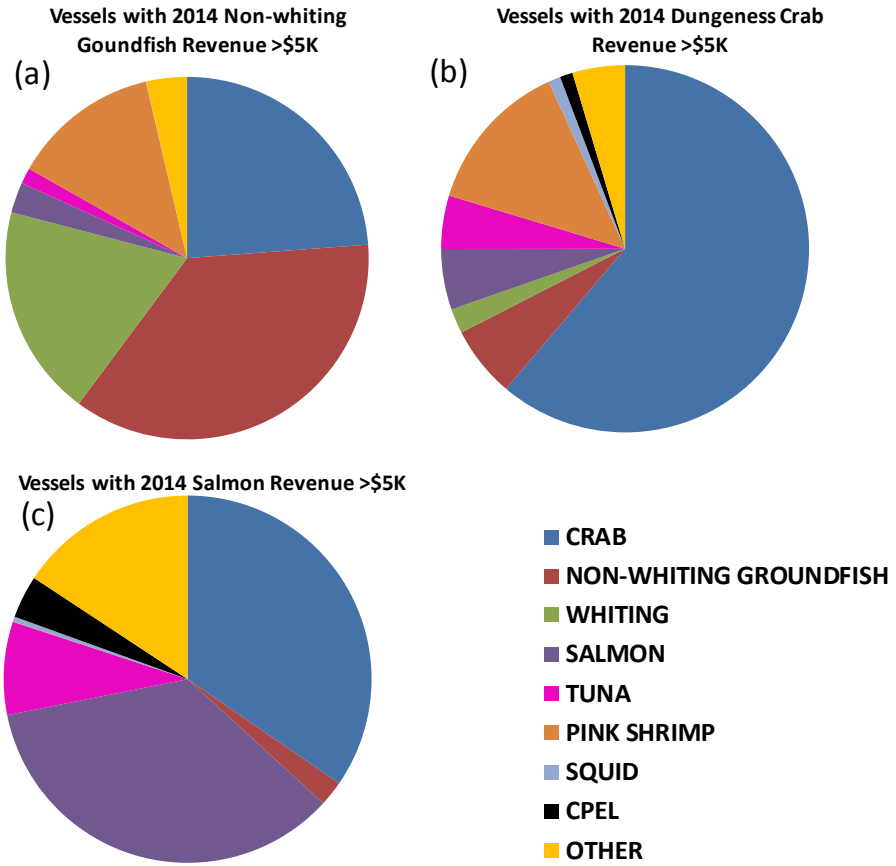
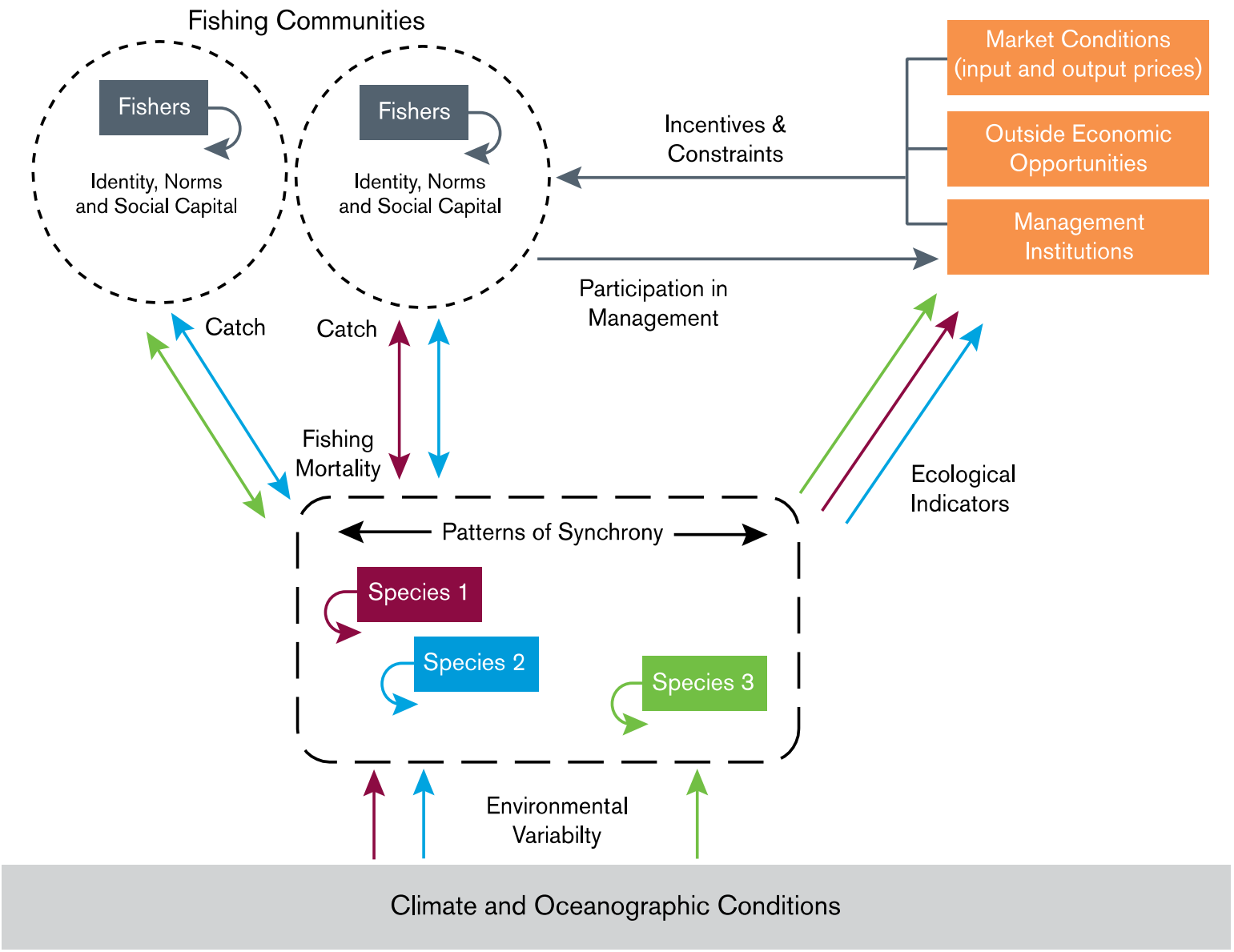


Figure 2: Shares of total 2014 West Coast fishery revenue by species group for fleets of vessels with (a) non-whiting groundfish; (b) dungeness crab; and (c) salmon revenues over $5000

Some “Big Picture” Questions

- Do differential recruitment/growth/distribution responses to environmental conditions make it possible for fishers to form robust portfolios of fisheries?
- How do biological fluctuations interact with management, economic and social/psychological factors to influence the adaptive flow of effort across fisheries in these portfolios?
- How do these adaptations feed back to the variability and robustness of the system?
  - Do fisher’s adaptations moderate or exacerbate exogenous fluctuations?
  - How does/could management alter this relationship?
- Can an understanding of the dynamics of this system of fisheries enable managers to anticipate and mitigate shocks to the system?

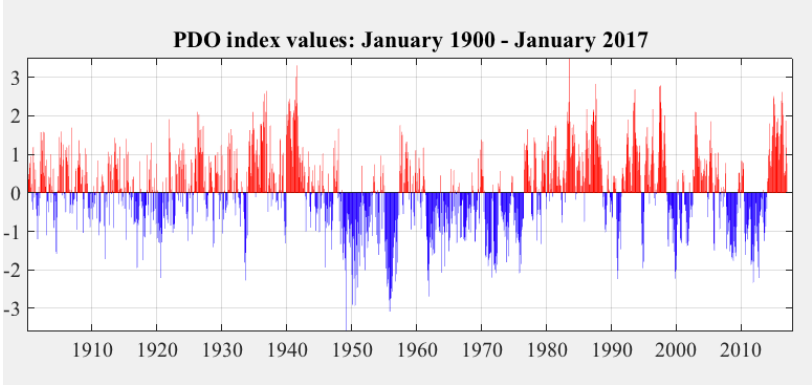

Fishing Communities
Fishers
Identity, Norms and Social Capital
Fishers
Identity, Norms and Social Capital
Incentives & Constraints
Market Conditions (input and output prices)
Outside Economic Opportunities
Management Institutions
Participation in Management
Catch
Catch
Fishing Mortality
Ecological Indicators
Patterns of Synchrony
Species 1
Species 2
Species 3
Environmental Variabilty
Climate and Oceanographic Conditions

Research Themes

- Theme 1: Linking Environmental Variability to Marine Species' Recruitment and Distribution
- Theme 2: Psychological and Social Benefits and Drivers of Fishery Participation
- Theme 3: Linking Stock Status, Regulation and Social Motivations to Fisher Behavior
- Theme 4: Model Integration

Theme 1: Linking Environmental Variability to Marine Species' Recruitment and Distribution

- How does climate variability affect recruitment, growth, and distribution of key target species
- To what extent are California Current species' population dynamics synchronized?
- Is synchrony driven by climate variability?
- Do populations within synchronous groups share similar characteristics?



Theme 2: Psychological and Social Benefits and Drivers of Fishery Participation

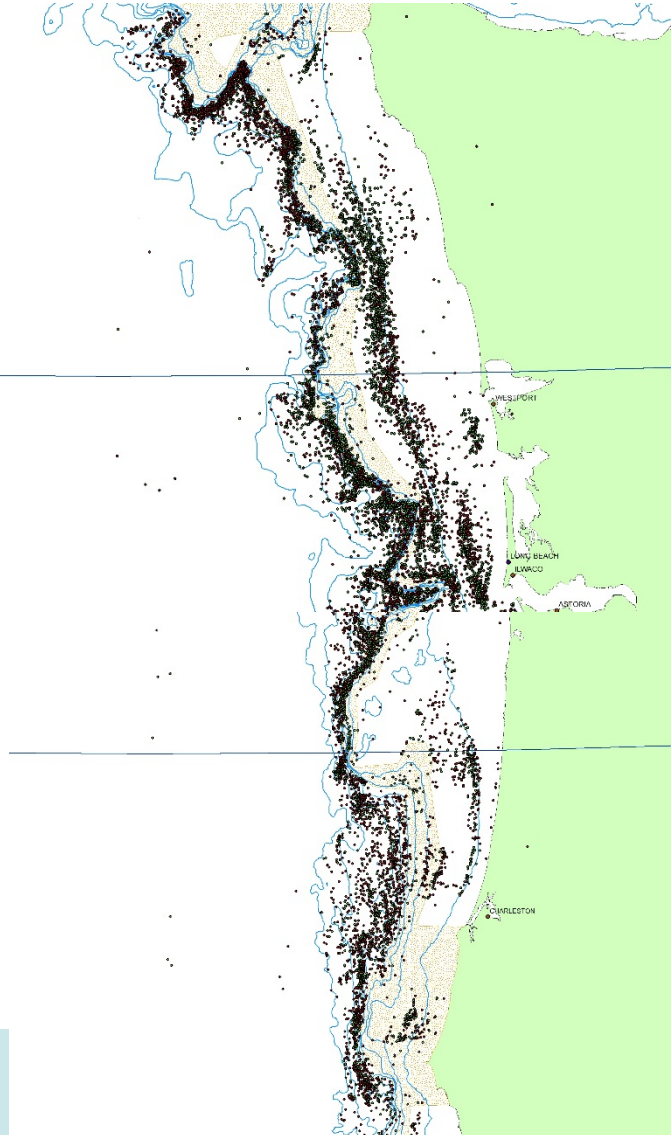
- How do personal tastes for fishing vs. socially influenced identity serve as a motivation for participation in fisheries?
- What role does seafood retained for personal use play in fishing households and communities and how does it affect participation in particular fisheries?
- What role do non-fishery sources of income play in fishing households?
- Mail survey of 2800 current participants in West Coast commercial fisheries (50% response rate)
- Key Focus: non-pecuniary and indirect motivations for fishery participation

Participation Survey

- Sent to all recently active West Coast Commercial fishers
- Questions to measure social capital and job satisfaction
- Non pecuniary benefits from and motivations for fishing including catch kept for personal use
- Preference for fishing over alternative employment
- Role of fishing in overall household income
- Over 1400 responses that can be used create ancillary data for modeling fishery participation behavior

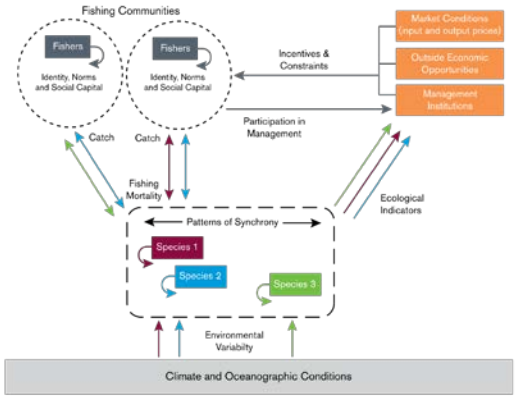
Theme 3: Linking Stock Status, Regulation and Social Motivations to Fisher Behavior

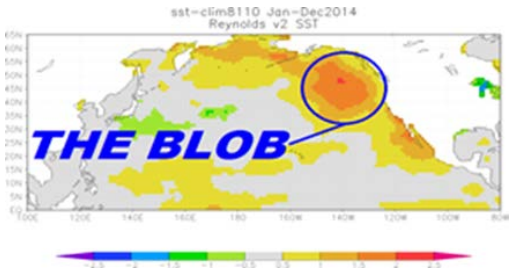
- Discrete choice random utility models of fishery choice, entry/exit
- Improve on standard single-fishery models
- Capture substitutability and complementarity of participation in various fisheries
- Explore how individual-specific characteristics influence choices (e.g., non-pecuniary motivations, alternative income sources, and group or community membership)



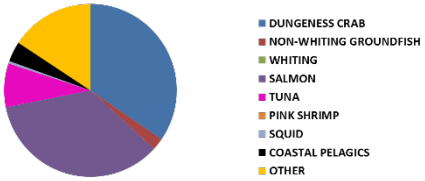
Theme 4: Model Integration

- Build set of bioeconomic models for major fisheries (groundfish, Dungeness crab, salmon, pink shrimp, albacore): linking exogenous drivers of productivity to linked fisheries with multi-fishery participation models
- Use models to explore how exogenous shocks to the fishery system propagate through the system, and how management actions – particularly entry restrictions - affect the dynamics of the system.
- Can management systems and fishing strategies (e.g., diversification with specific portfolios) reduce variability of income for individuals and communities?
- Can these models provide information to help managers anticipate and react to shocks to improve biological and social outcomes?



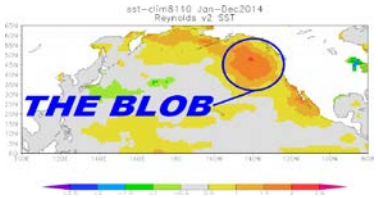


Year 4



Identify fishing portfolios for individuals or communities that reduce variation in income

Hold workshop with fishery managers and industry to consider the results of model simulation scenarios



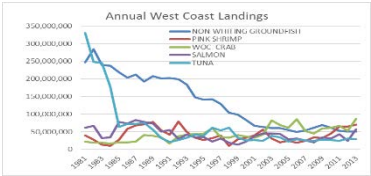
Understand how climate or economic shocks affect fisheries directly and indirectly as a result of fishing participation decisions

Year 2 & 3

Construct models of salmon, Dungeness crab, groundfish, albacore and pink shrimp fisheries linked by participation model

Year 1 &2

Survey fishermen to determine motivations for participation

Hold workshop with fishery managers and industry stakeholders to seek input on research design

Acquire or estimate historical biomass and recruitment for salmon, Dungeness crab, albacore, groundfish, and pink shrimp stocks