FUTURE SEAS

A Physics-to-Fisheries Management Strategy Evaluation for the California Current System

Project Team

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Objective

To develop an end-to-end framework to identify climate-resilient management strategies for the CCLME and evaluate the impacts of climate change on US-managed marine species and fishing communities in the CCLME.

Key elements of the proposed work plan

1. **Produce regional climate projections for the CCLME**, using output from global climate models to force a high resolution regional ocean model (ROMS) coupled with a biogeochemical model;

2. Use these projections in conjunction with ecological and socio-economic models to **predict productivity and distribution changes for managed species in the CCLME, and the socio-economic impacts of these changes on fishing communities**;

3. **Evaluate current catch advice and spatial management strategies** for the Pacific sardine, albacore, and swordfish fisheries given the potential future impacts of climate variability and change;

4. Use management scenarios to **explore possible policy and management responses to climate change and resultant socioeconomic impacts on fishery participants and fishing communities**;

Project Motivation and Guidance

SWORDFISH

1. Management Objectives / Stakeholder Priorities

Minimize bycatch (Highly Migratory Species Fishery Management Plan)
Maintain sustainable harvest levels (HMS FMP)
Minimize adverse impacts on fishing communities (HMS FMP)
Consideration of economic and ecological impacts of dynamic closures

2. Performance Metrics

Bycatch rates (leatherback turtles)
Swordfish catch and landings
Socioeconomic metrics (fisher profit, harvester and processor engagement)

3. Management Strategies / Scenarios

No closures
Static closures
Dynamic closures with EcoCast

Project Motivation and Guidance SARDINE

1. Management Objectives / Stakeholder Priorities

Promote efficiency and profitability (Coastal Pelagic Species FMP)
Prevent overfishing, provide adequate forage for predators (CPS FMP)
Stability of catch (boom/bust cycles, temperature sensitivity)
Switching between coastal pelagic species (e.g., sardine ➔ market squid)

2. Performance Metrics

Biomass and catch mean, variability, and frequency above/below thresholds
Ecosystem metrics (e.g., availability to upper trophic levels)
Socio-economic metrics (revenue, harvester and processor engagement)

3. Management Strategies / Scenarios

Status quo harvest guideline (HG)
Alternative options for environmentally informed HG
Not environmentally informed

Project Motivation and Guidance ALBACORE

1. Management Objectives / Stakeholder Priorities

HMS FMP objectives (as for swordfish)

Albacore as “insurance” fleet (not limited entry)

Understanding migration dynamics and impact of prey availability

Understanding changes in distribution (offshore/inshore and north/south)

2. Performance Metrics

International albacore Management Strategy Evaluation

Landings by port

Socio-economic metrics (revenue, harvester and processor engagement)

3. Management Strategies / Scenarios

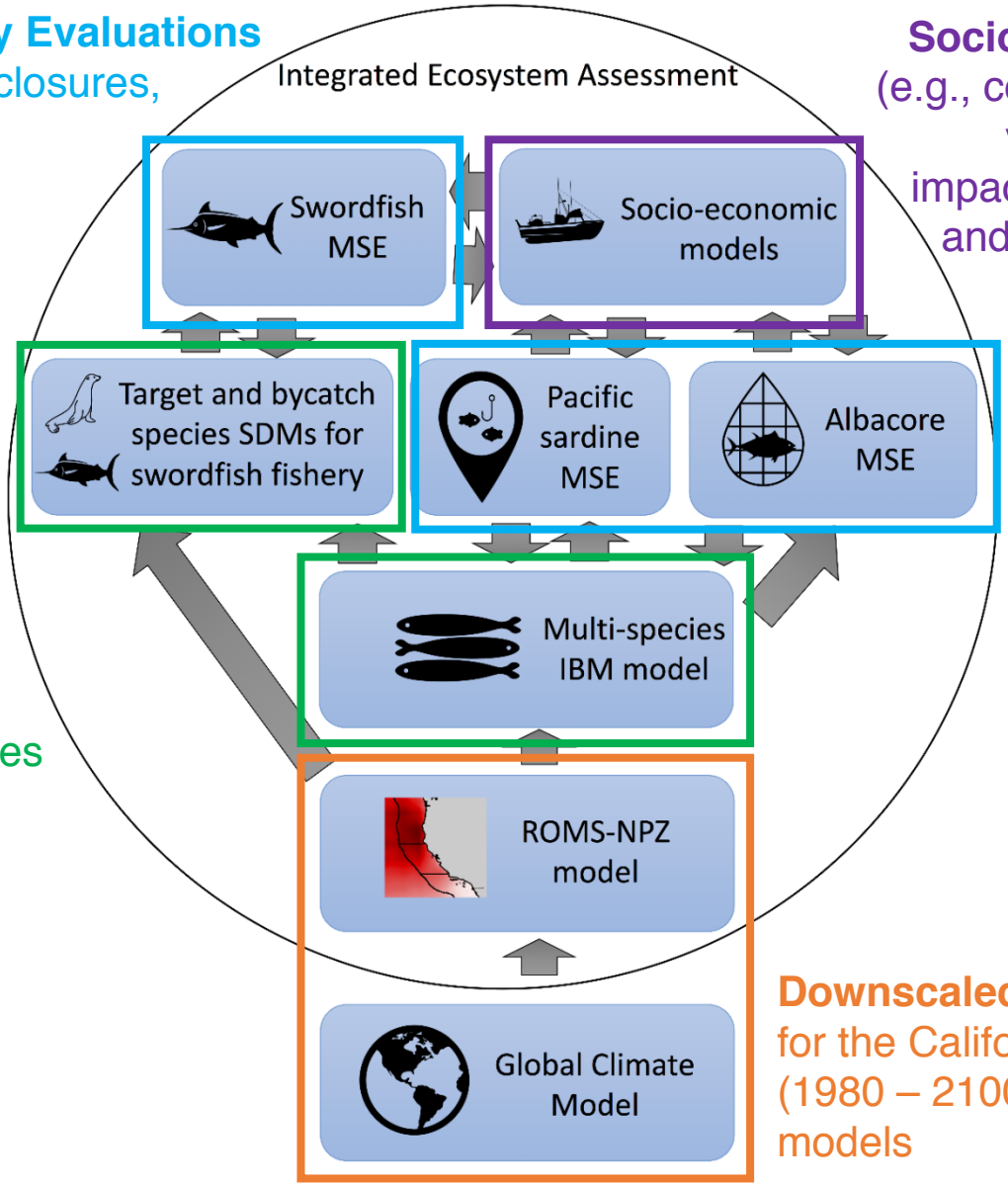
No limited entry

Total allowable catch/effort at international level

West coast implementation of international TAC/TAE

Management Strategy Evaluations
(e.g., spatial/temporal closures, harvest guidelines)

Socio-economic Analyses
(e.g., community reliance and vulnerability, economic impacts of distribution shifts and changing abundance)



Biological Models
for sardine, albacore, swordfish, and multiple prey and bycatch species

Downscaled Ocean Projections
for the California Current System (1980 – 2100) from multiple climate models

Management Strategy Evaluations
(e.g., spatial/temporal closures, harvest guidelines)

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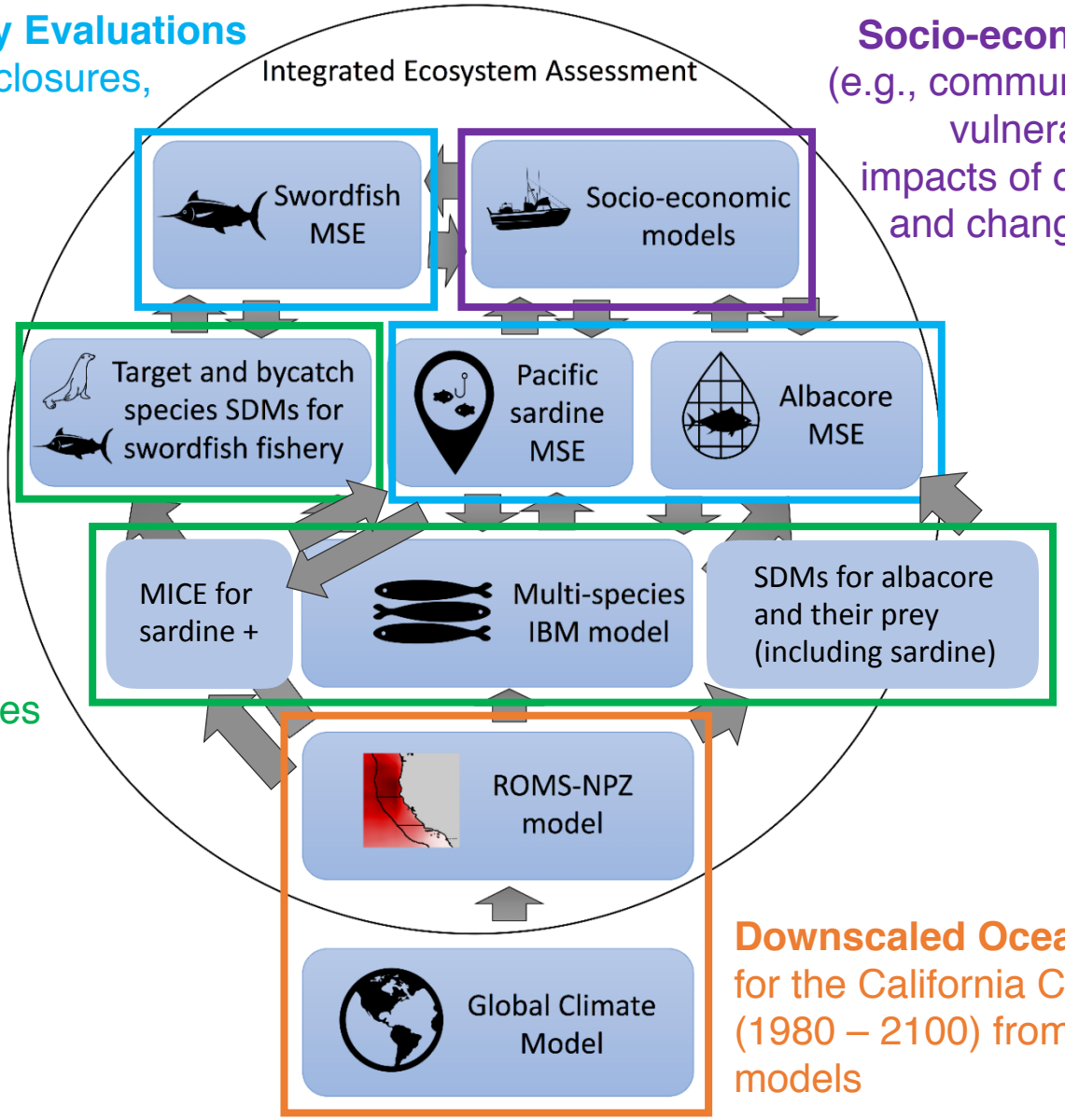
(e.g., community reliance and vulnerability, economic impacts of distribution shifts and changing abundance)



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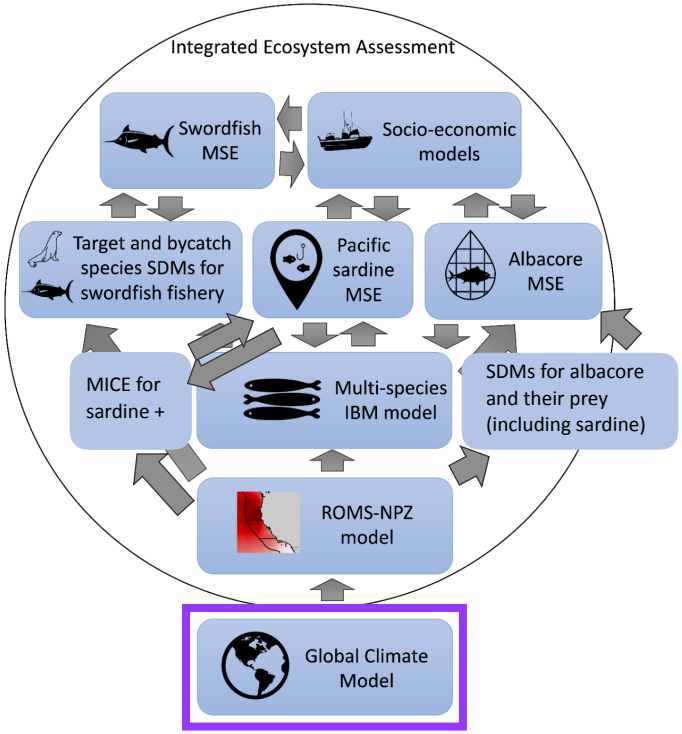

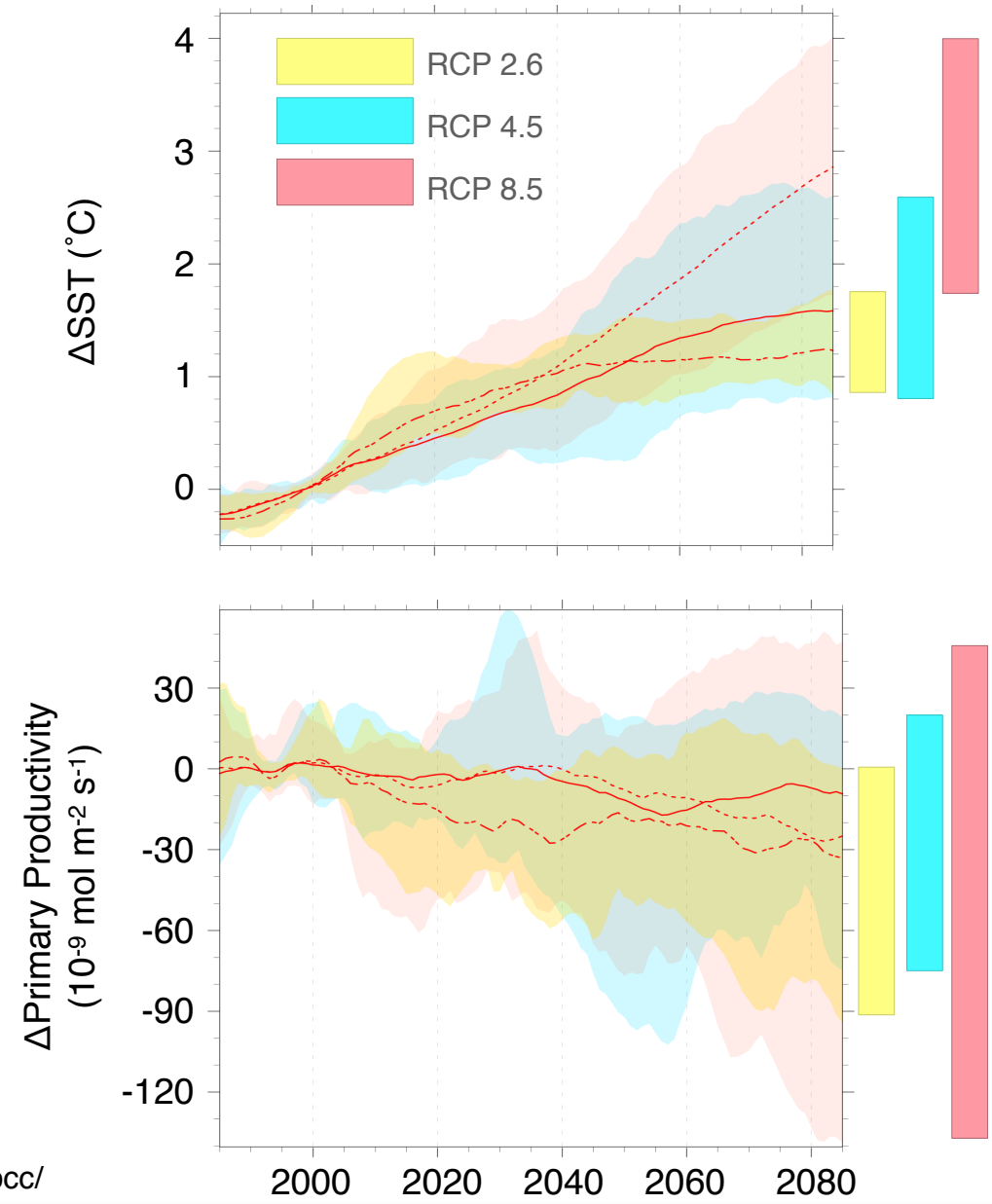

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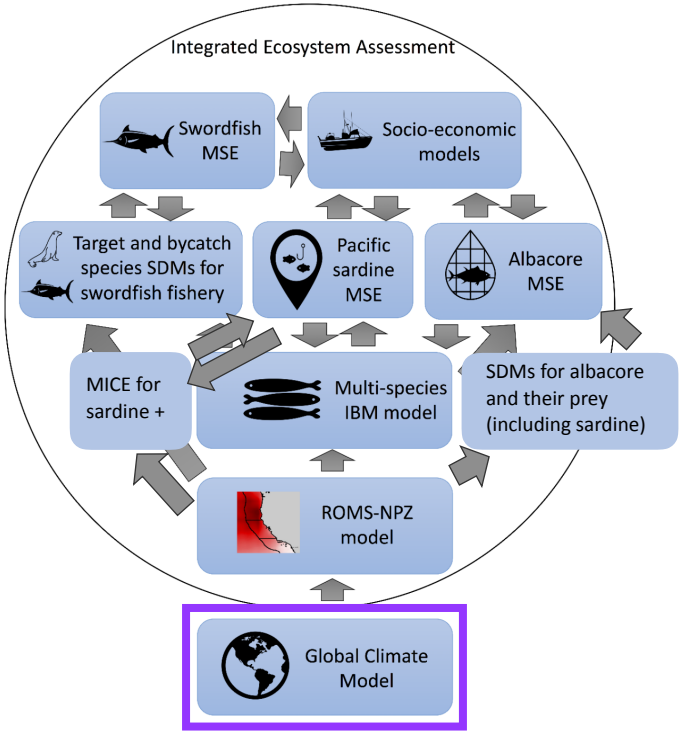

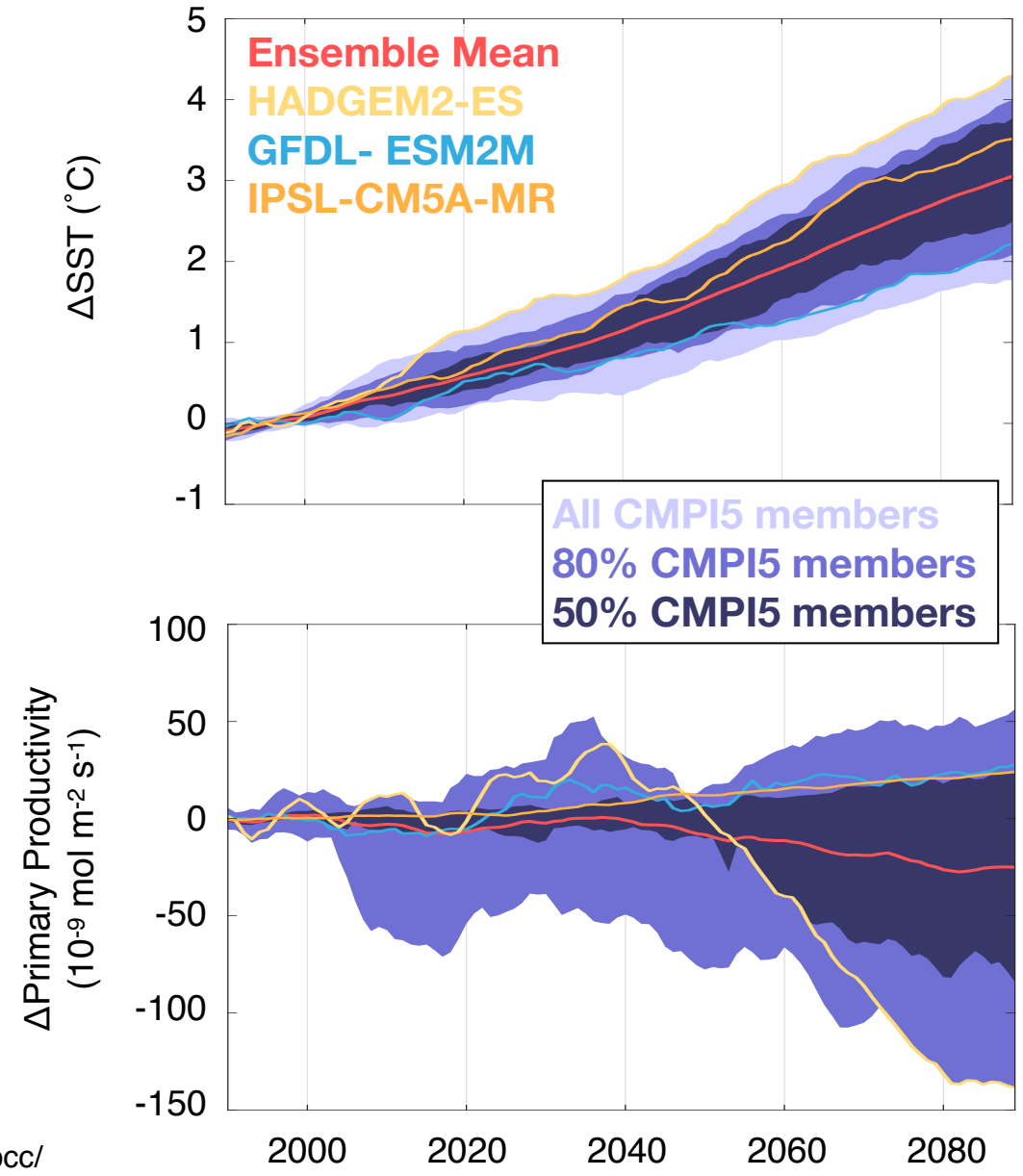

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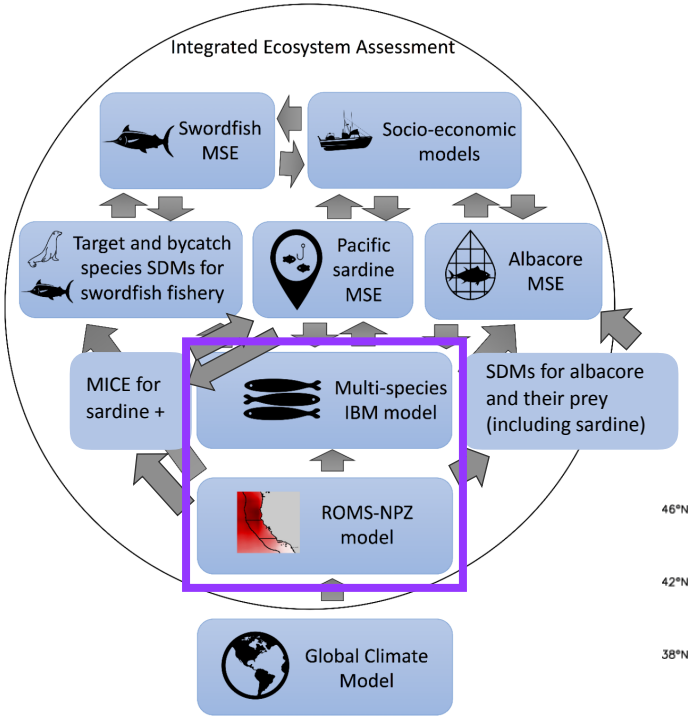
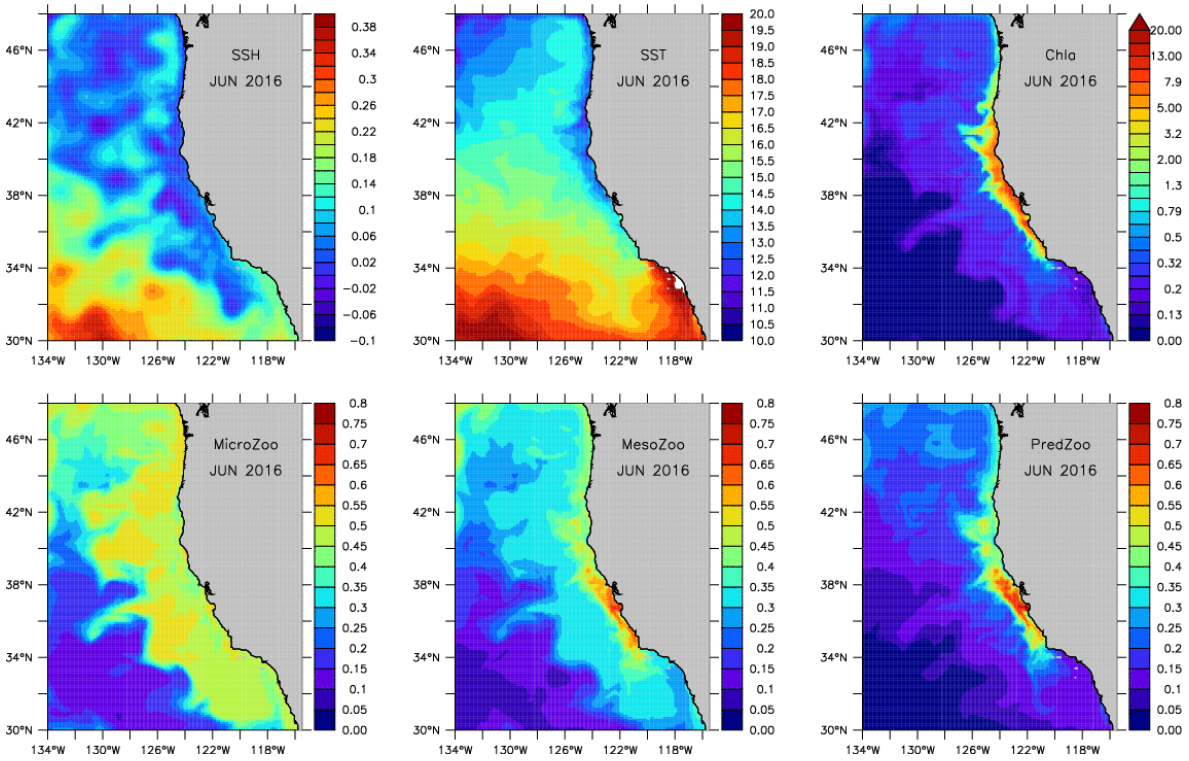
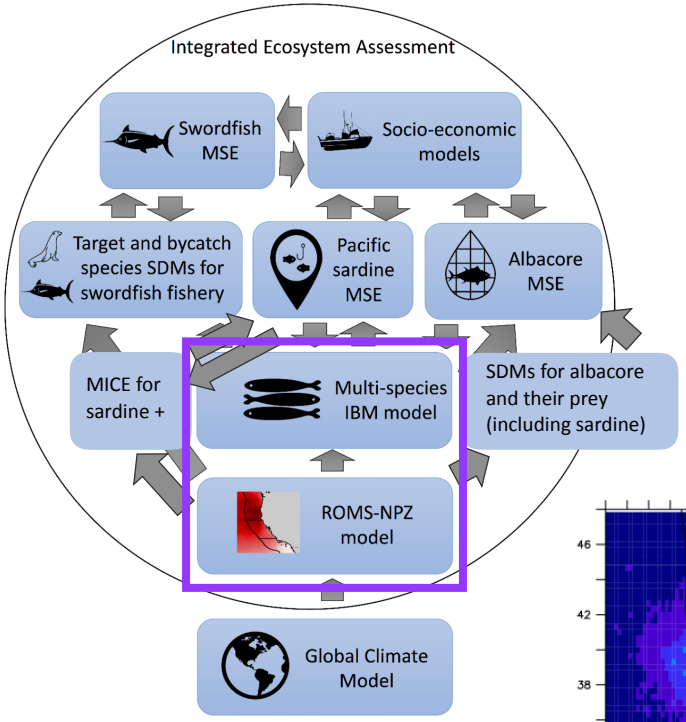
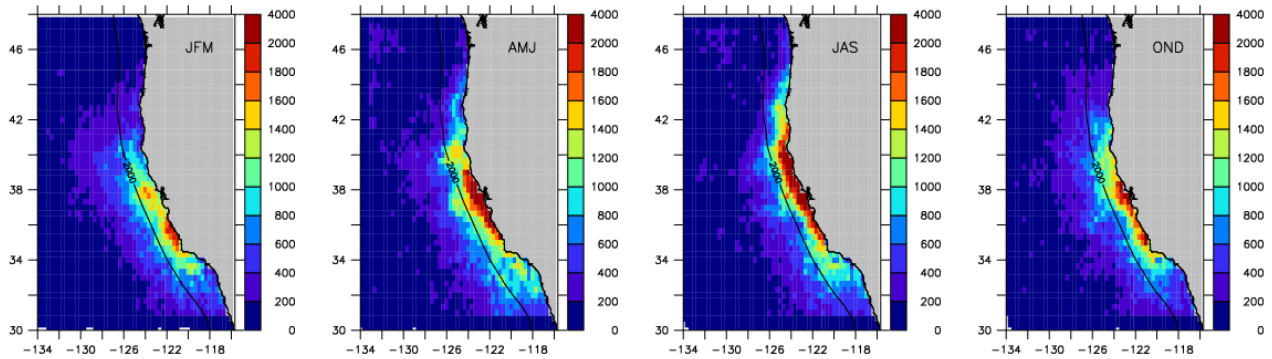
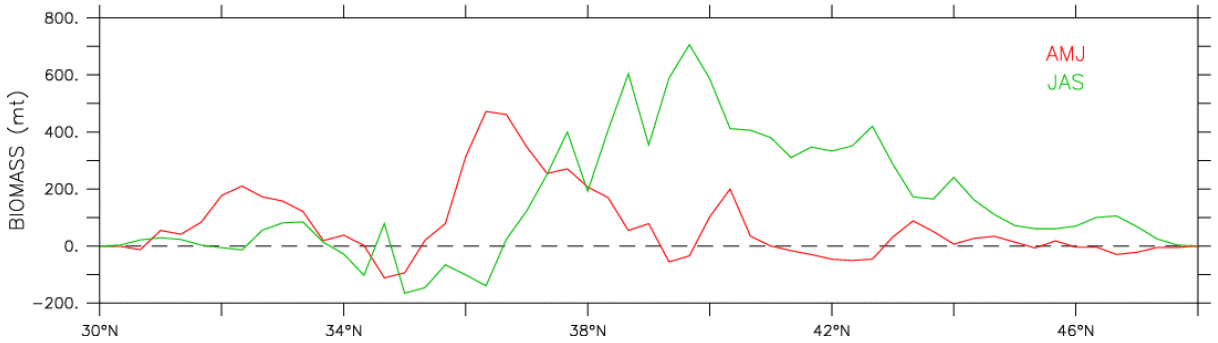

Integrated Ecosystem Assessment
Swordfish MSE
Socio-economic models
Target and bycatch species SDMs for swordfish fishery
Pacific sardine MSE
Albacore MSE
MICE for sardine +
Multi-species IBM model
SDMs for albacore and their prey (including sardine)
ROMS-NPZ model
Global Climate Model

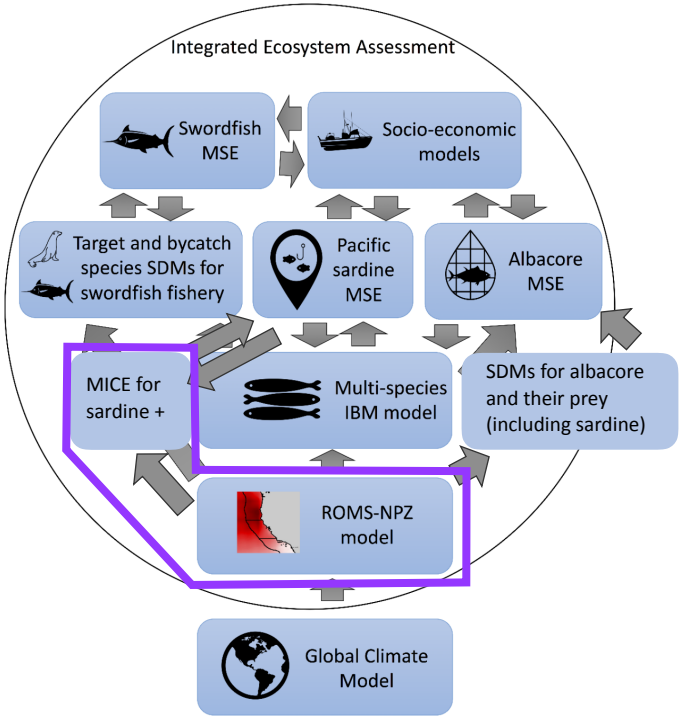

SSH
JUN 2016
SST
JUN 2016
Chla
JUN 2016
MicroZoo
JUN 2016
MesoZoo
JUN 2016
PredZoo
JUN 2016
46°N
42°N
38°N
34°N
30°N
134°W
130°W
126°W
122°W
118°W



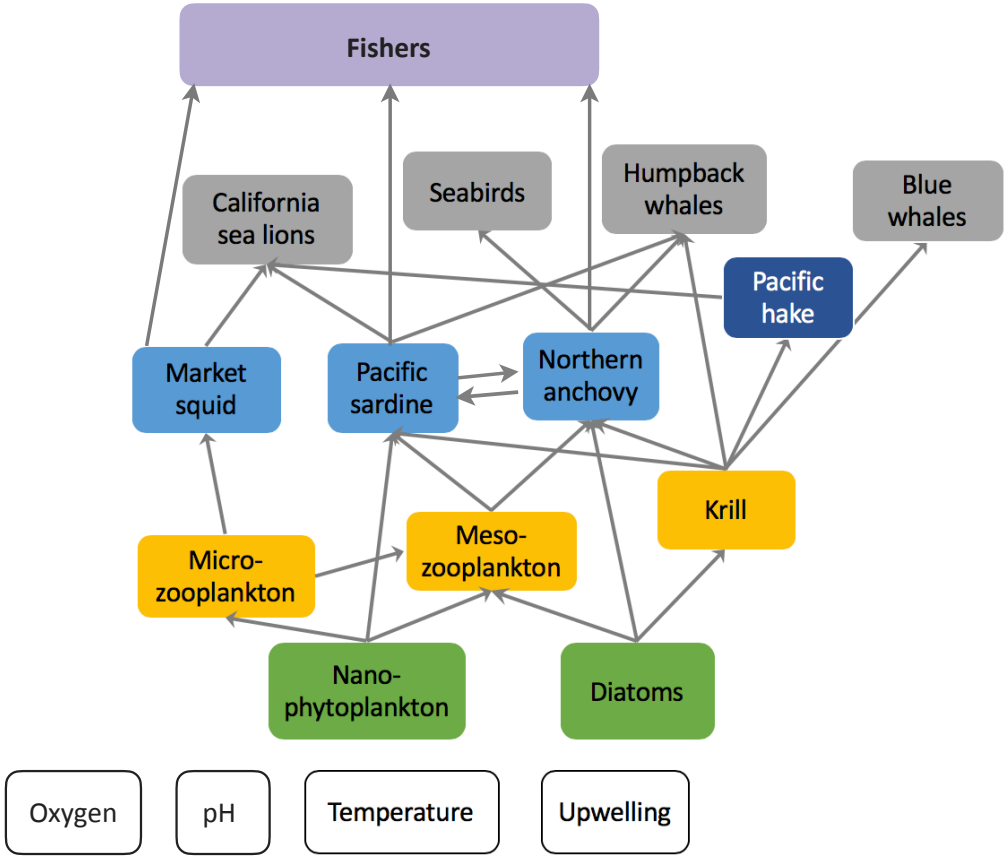
Sardine Biomass and Distribution

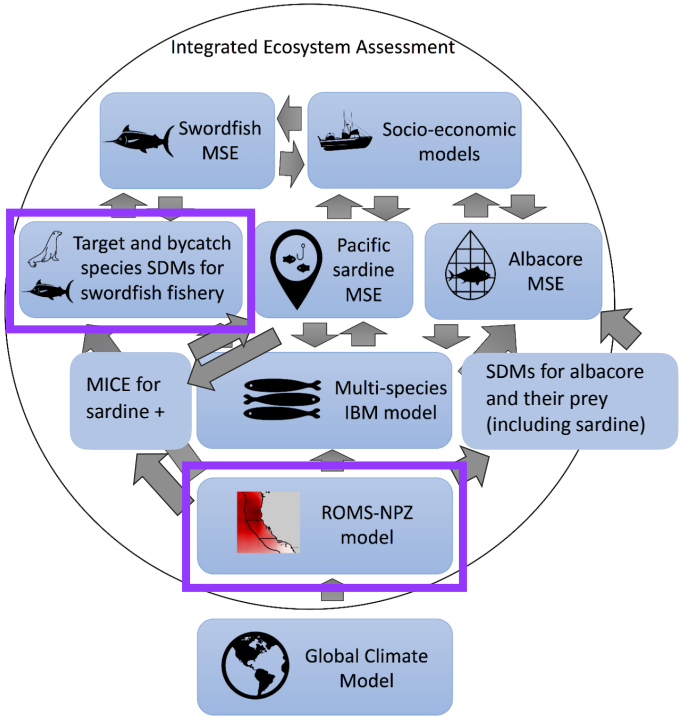




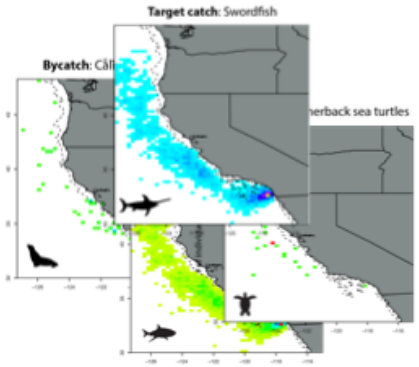


Model of Intermediate Complexity for Ecosystem assessment (MICE)

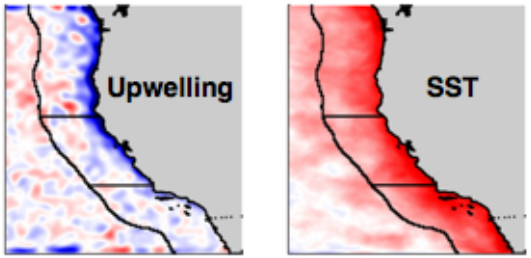




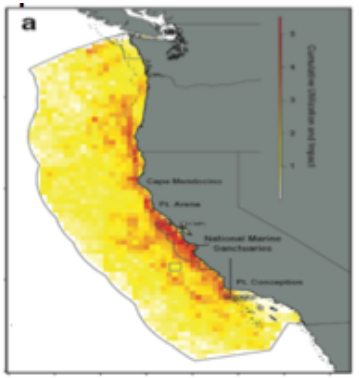
Fishery Observer Data



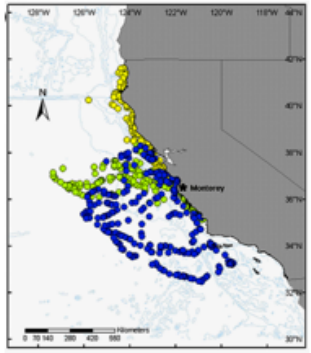
Regional Ocean Model

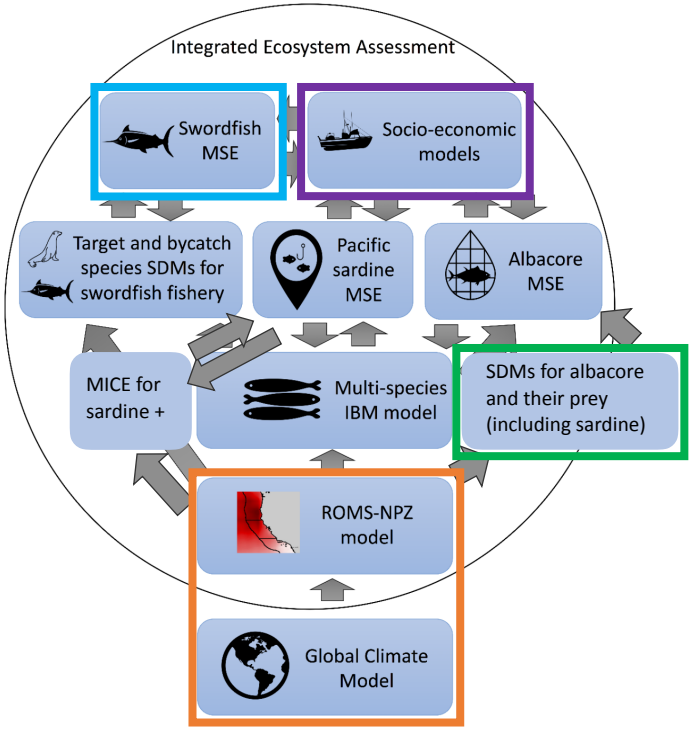


Species Distribution Models



Tracking/Survey Data





Mer Pozo Buil:
Dynamically downscaled climate projections for the California Current System

Barb Muhling:
Albacore and prey species distribution modeling in the California Current

James Smith:
A simulation comparing dynamic and static closures in the drift gill net swordfish fishery

Steve Stohs:
Socio-economic analyses