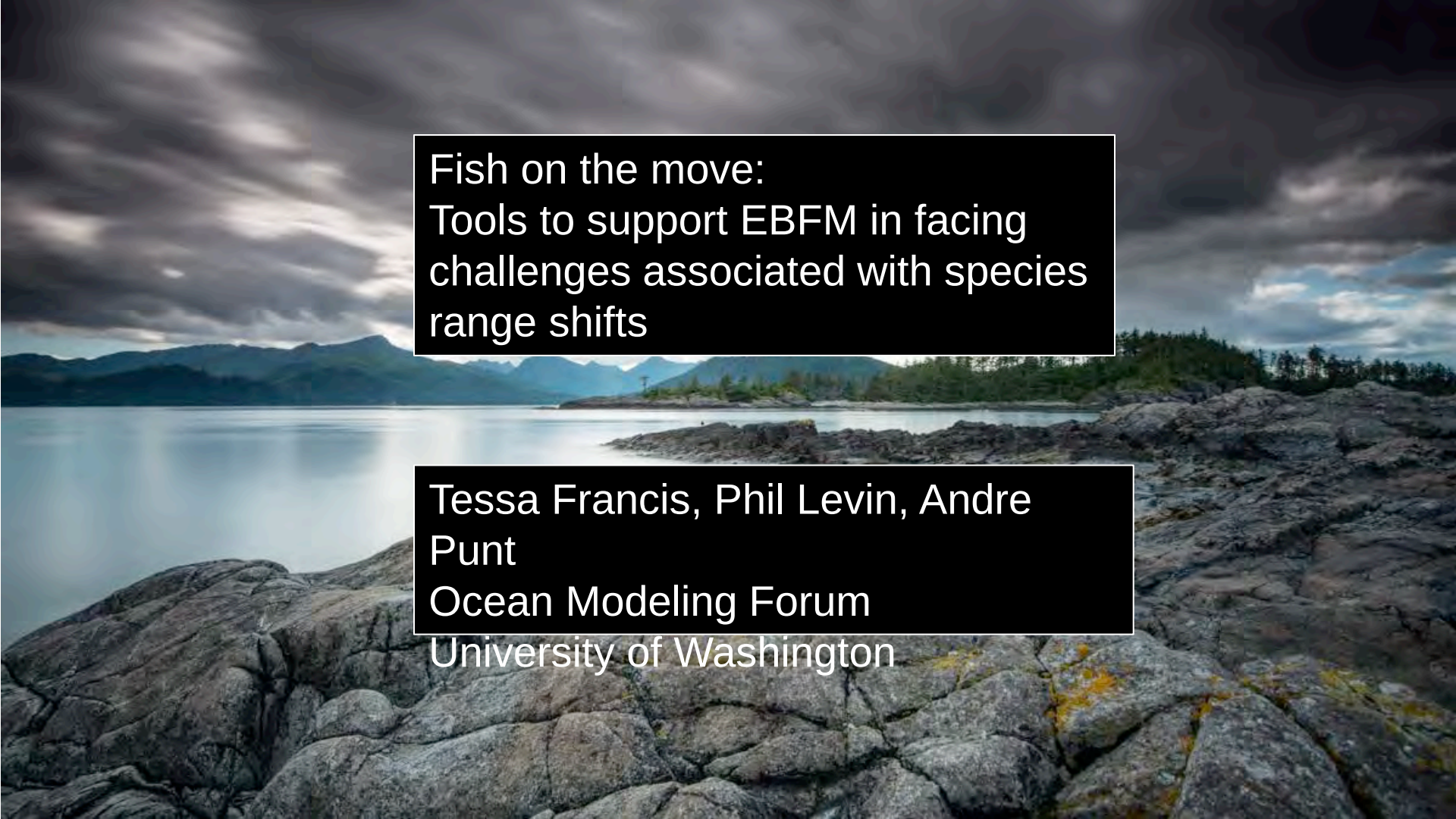
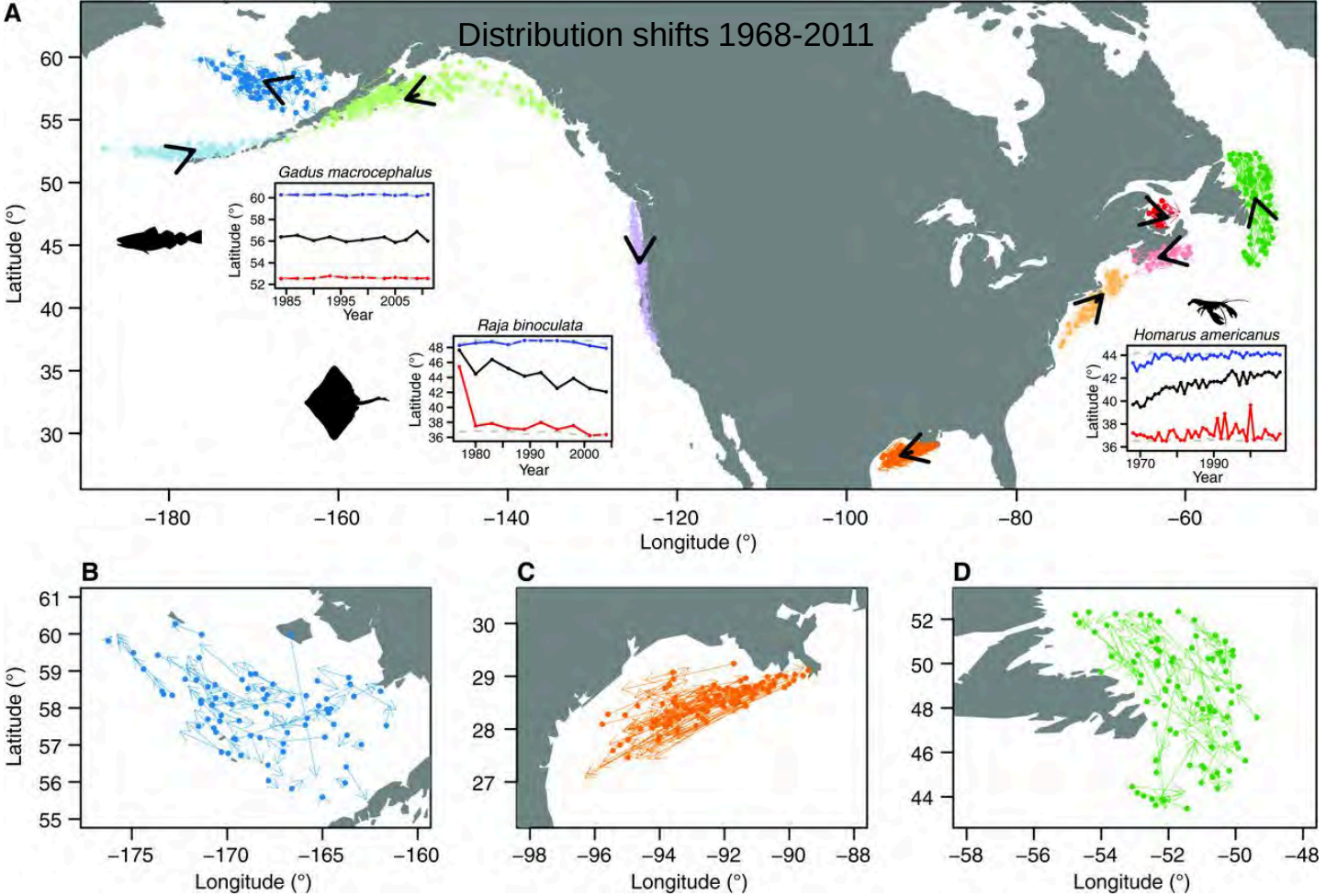


Fish on the move:
Tools to support EBFM in facing challenges associated with species range shifts

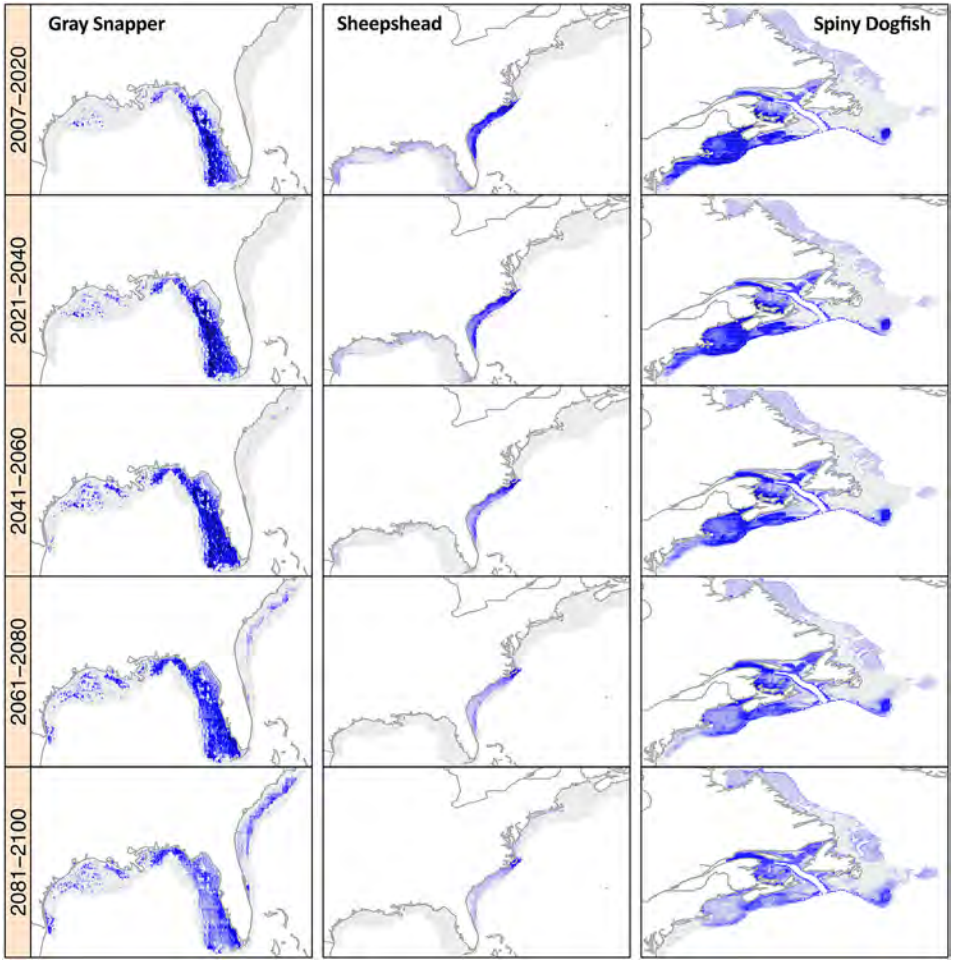
Tessa Francis, Phil Levin, Andre Punt
Ocean Modeling Forum
University of Washington



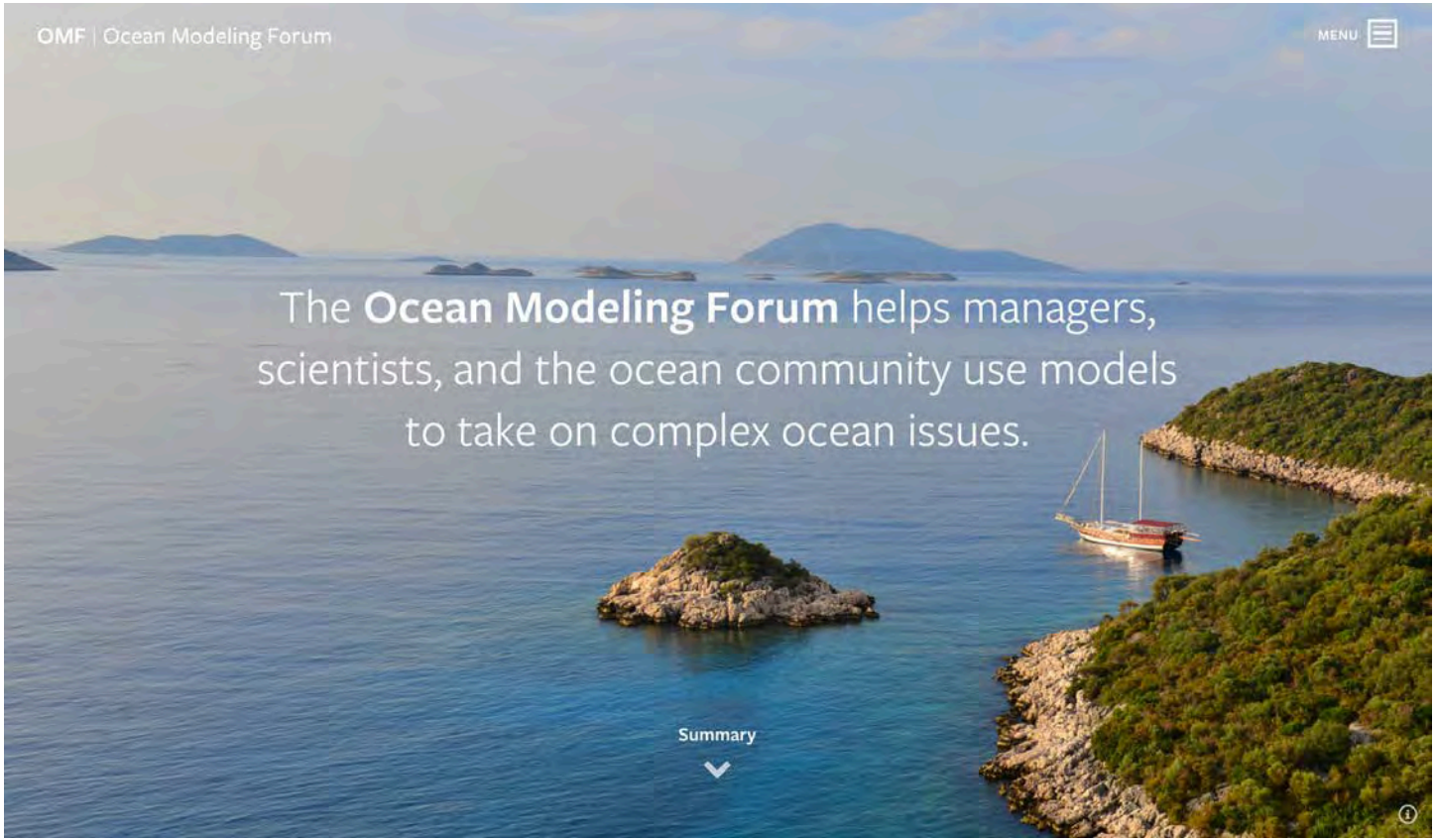
Pinsky et al. 2013

Challenges

- Multiple governance structures
- Multiple harvest rules
- Multiple fleets
- Access & equity (mobile vs non-mobile fleets)

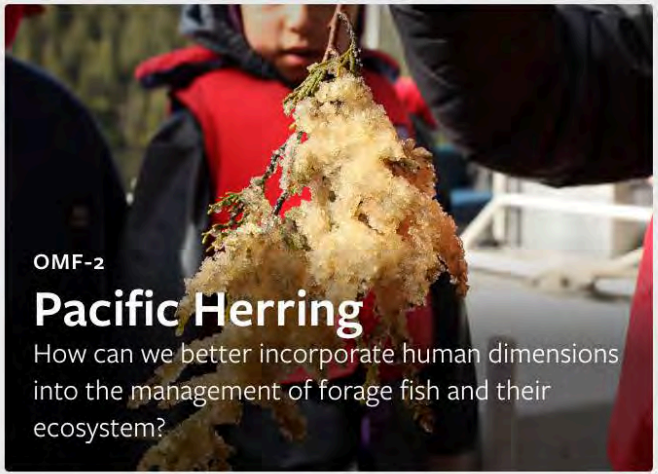


Morley et al. 2018


OMF | Ocean Modeling Forum
MENU
The **Ocean Modeling Forum** helps managers, scientists, and the ocean community use models to take on complex ocean issues.
Summary

WORKING GROUPS

OMF working groups address pressing ocean management topics using diverse modeling methods. Working group members are scholars from a range of natural and social scientific disciplines who work in an integrated and collaborative manner. Scientists work alongside stakeholders and managers to co-develop goals, approaches, and outputs.



Multiple jurisdictions

Equity and access
Mobile and nonmobile fishers

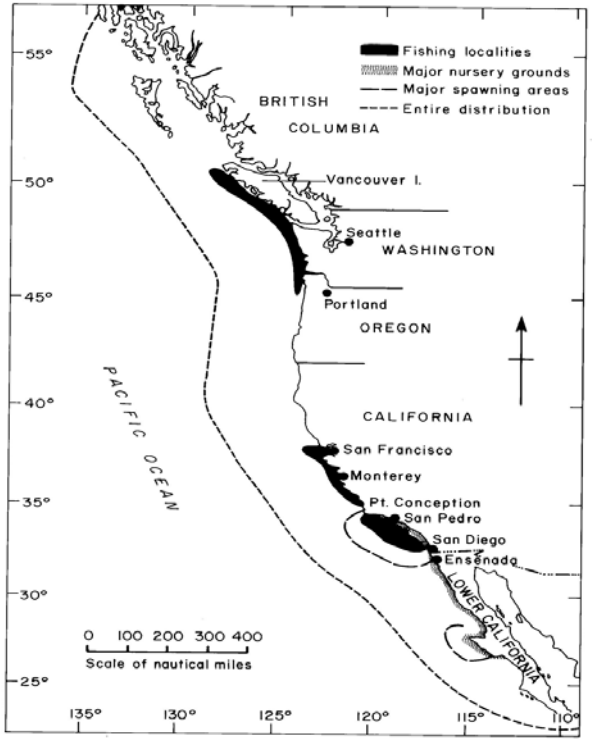
Case study 1: Pacific sardine

How can we evaluate ecosystem impacts of fisheries,

under three nations' harvest rules,

for species with international distribution that varies with environmental conditions?

Case study 1: Pacific sardine



Schweigert 2002

Hill,Crone and Zwolinski 2017 stock assessment

Case study 1: Pacific sardine

Working group members

Fisheries Modelers
André Punt
Felipe Hurtado
Kelli Johnson
Alec MacCall

Ecosystem Modelers
Isaac Kaplan
Laura Koehn
Tim Essington
Kirstin Holsman

Management Agency
Kerry Griffin (PFMC)
Nathan Taylor (DFO)

NGO
Steve Marx

Fishing Industry
Richard Parrish

Ecologists
Bill Sydeman
Salvador Lluch Cota
Phil Levin
Tessa Francis

Oceanographers
Francisco Chavez
Enrique Curchitser

Case study 1: Pacific sardine

MICE: model of intermediate complexity

Restricted to management questions
Parameterized using data
With process error

PREY MODEL
Sardine
Anchovy
Other forage
Other prey

HARVEST CONTROL RULE

3 countries

PREDATOR MODEL
Pelicans
Sea lions

PERFORMANCE

Punt et al. 2016

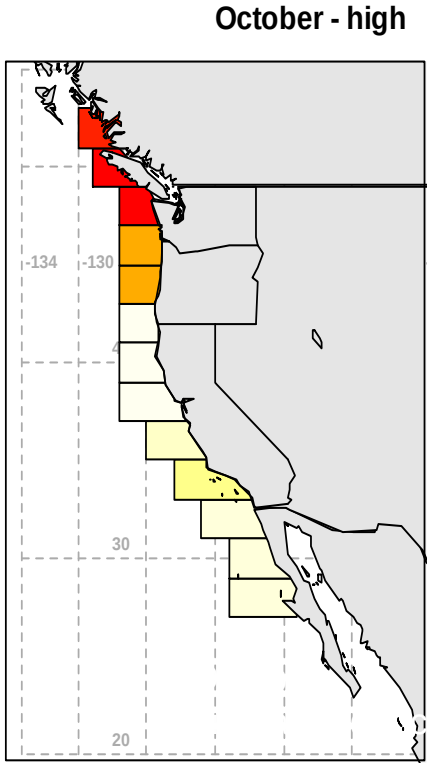
Case study 1: Pacific sardine

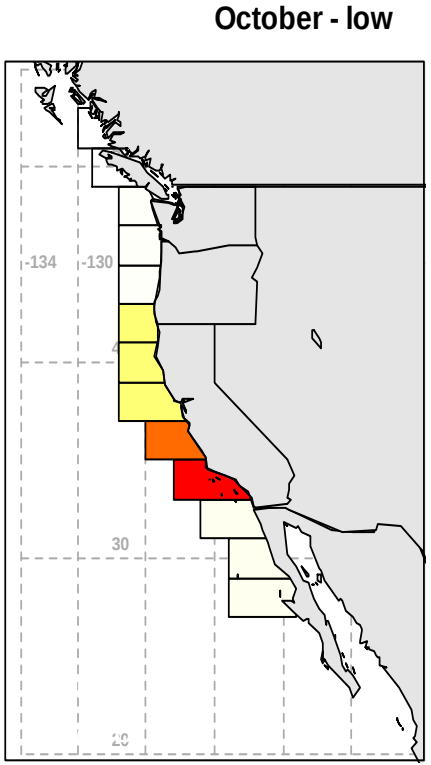
MICE: model of intermediate complexity

Spatially- weekly-, and age-structured

recruitment driven by SST

movement driven by biomass

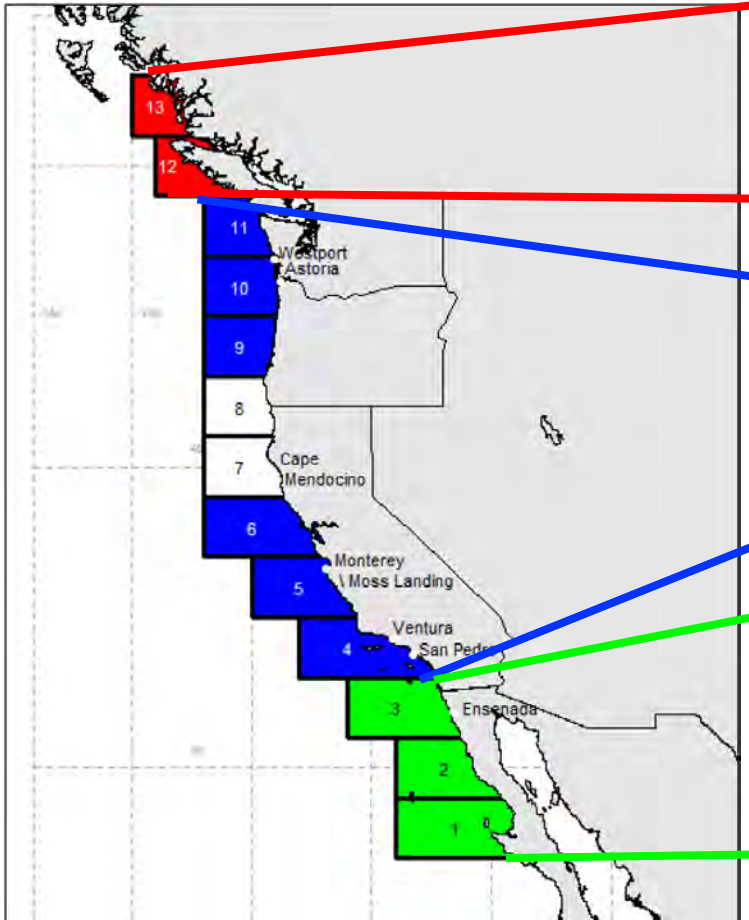




Punt et al. 2016

Case study 1: Pacific sardine

MICE: three harvest rules



Catch = 5% of the biomass above 150,000mt

Constrained to be <22,000 mt

HG = MAX(0.87*FRACTION*($B1^{+}$ -CUTOFF),MAXCATCH)

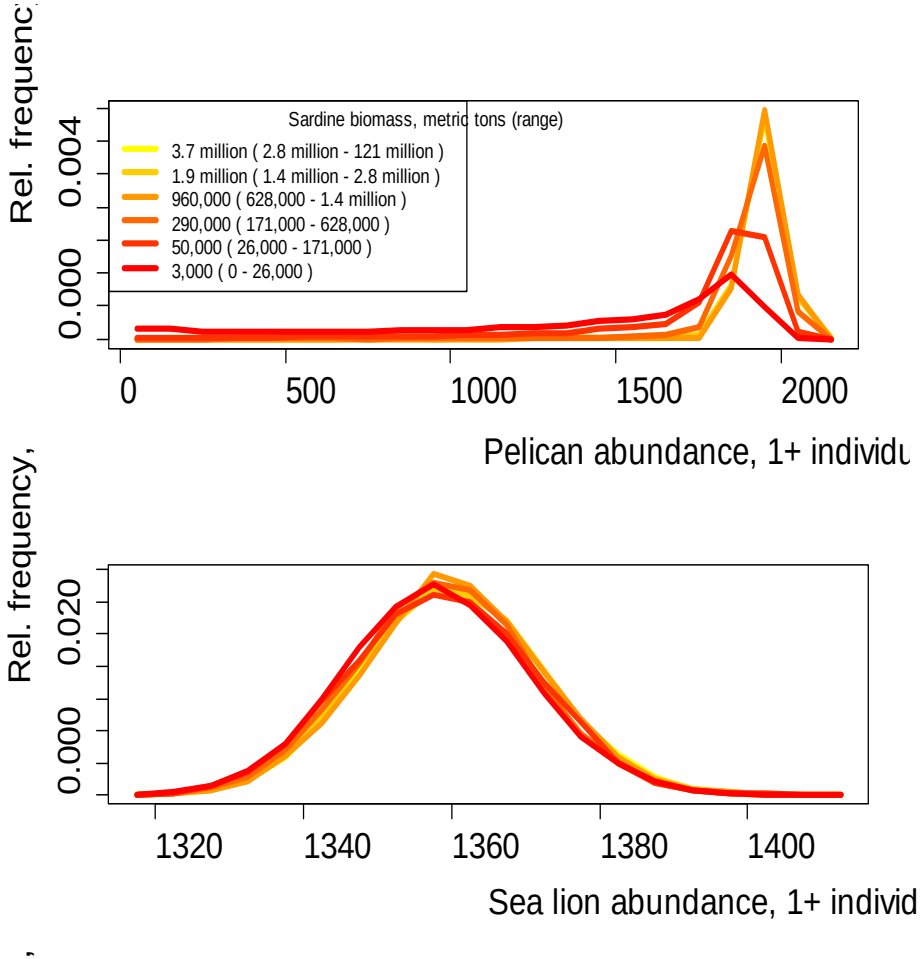
FRACTION depends on temp

Constant fishing mortality

Set to achieve the average catch from 1981-2009

Punt et al. 2016

Brown pelicans are more sensitive to sardine fluctuations



Kaplan et al. 2018 *MEPS*

Case study 1: Pacific sardine

Conclusions

- Forming a working group with representatives from the jurisdictional areas (Canada, USA, Mexico) led to realistic modeling of multiple unique harvest rules
- EBFM motivation – understanding influence of fishing on predators with different foraging strategies, given environmental drivers of recruitment, multiple prey species, food web dynamics – required expansion into multiple jurisdictions
- Development of simple-ish model afforded opportunity to complexify spatial structure, incorporate multiple harvest rules
- Sea lions fare better than pelicans

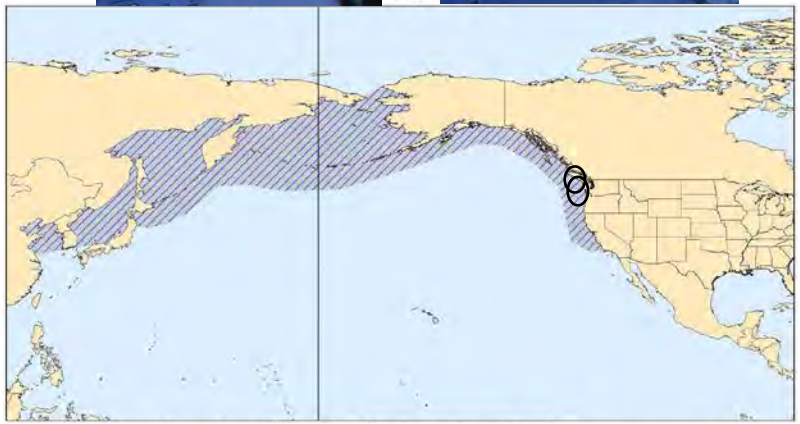
Case study 2: Pacific herring

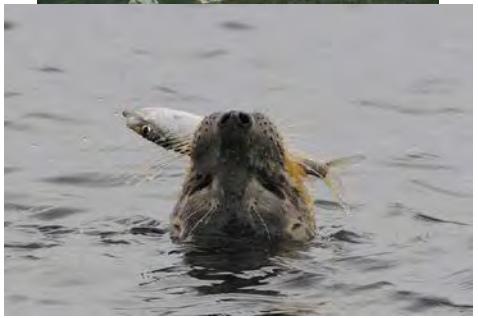
How can we evaluate tradeoffs between mobile and nonmobile fisheries of fisheries management?

Case study 2: Pacific herring

Sitka, USA

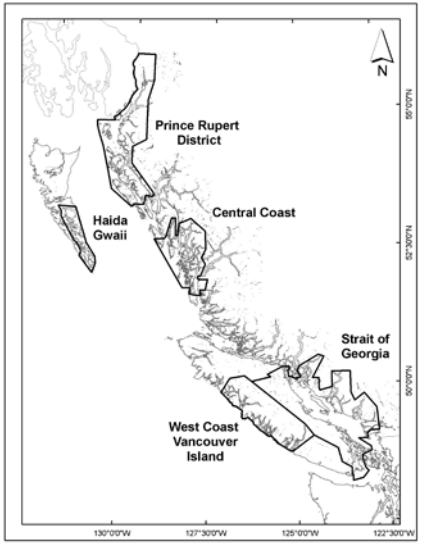
Haida Gwaii, Canada

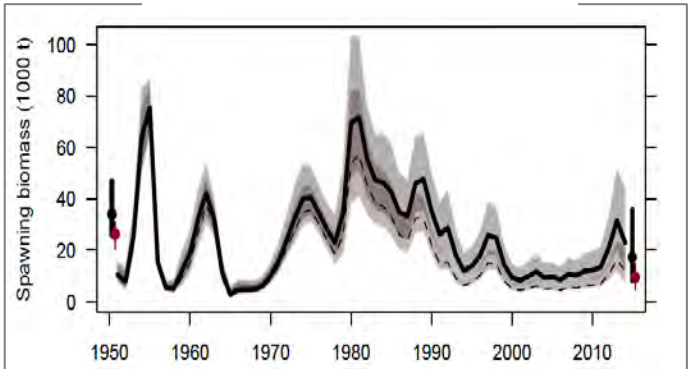


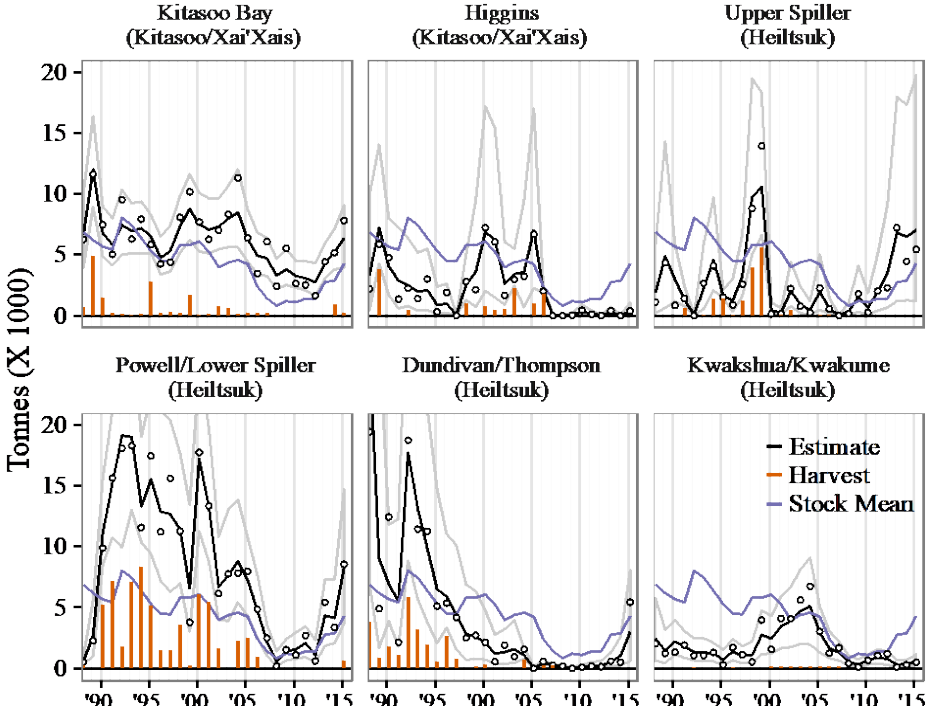


Local scale matters

for non-mobile fishers dependent upon the resource







Courtesy of Dan Okamoto

WORKING GROUP MEMBERS

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Chair
University of Washington / The Nature Conservancy

Tessa Francis
Co-Chair
University of Washington Tacoma

Alec MacCall

André Punt
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University of Washington

Dan Okamoto
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Harvey Kitka
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Jennifer Silver
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Jim McIsaac
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Lynn Lee
Parks Canada

Melissa Poe
Washington Sea Grant, University of Washington

Ole Shelton
NOAA Northwest Fisheries Science Center

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Russ Jones
Haida Oceans Technical Team

Sherri Dressel
Alaska Department of Fish and Game

Thomas Thornton
Oxford University

John Woodruff
Icicle Seafoods

Steve Reifenstuhl
Northern Southeast Regional Aquaculture Association

Case study 2: Pacific herring

Operating Model

Metapopulation:

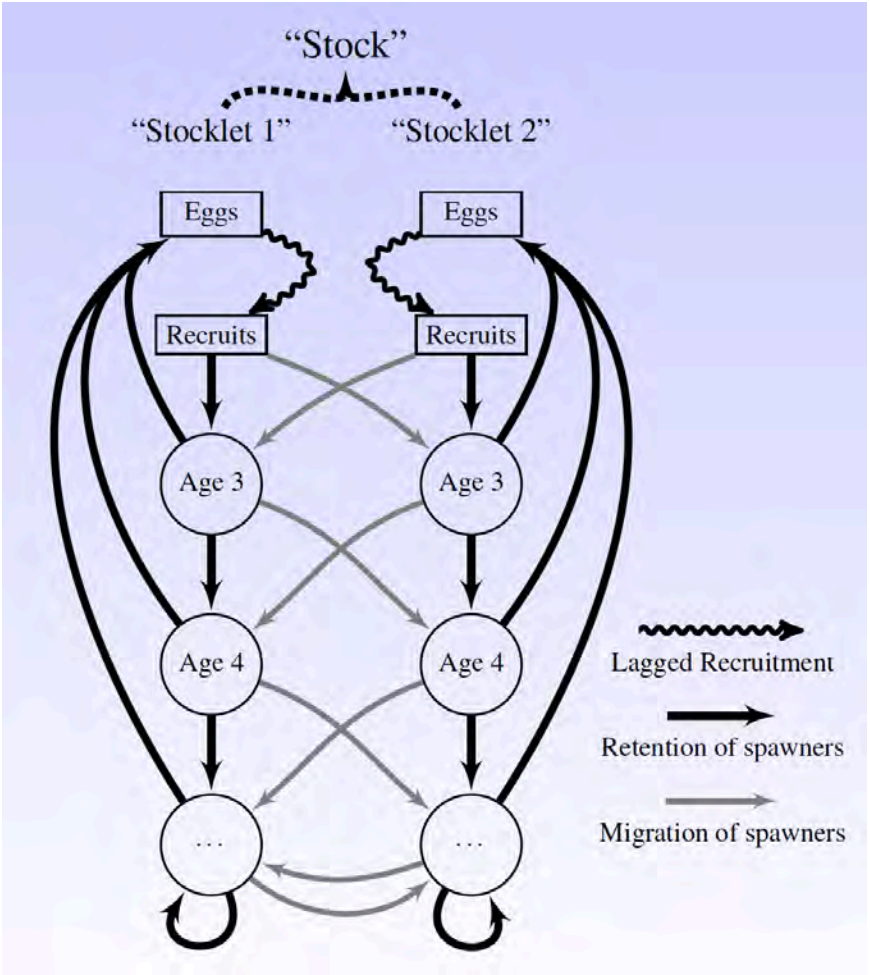
Spatial structure
Migration behavior

Management Scenarios:

Limit threshold
Harvest rate
Spatial closures

Outputs:

Catch
Spawning biomass in space/time



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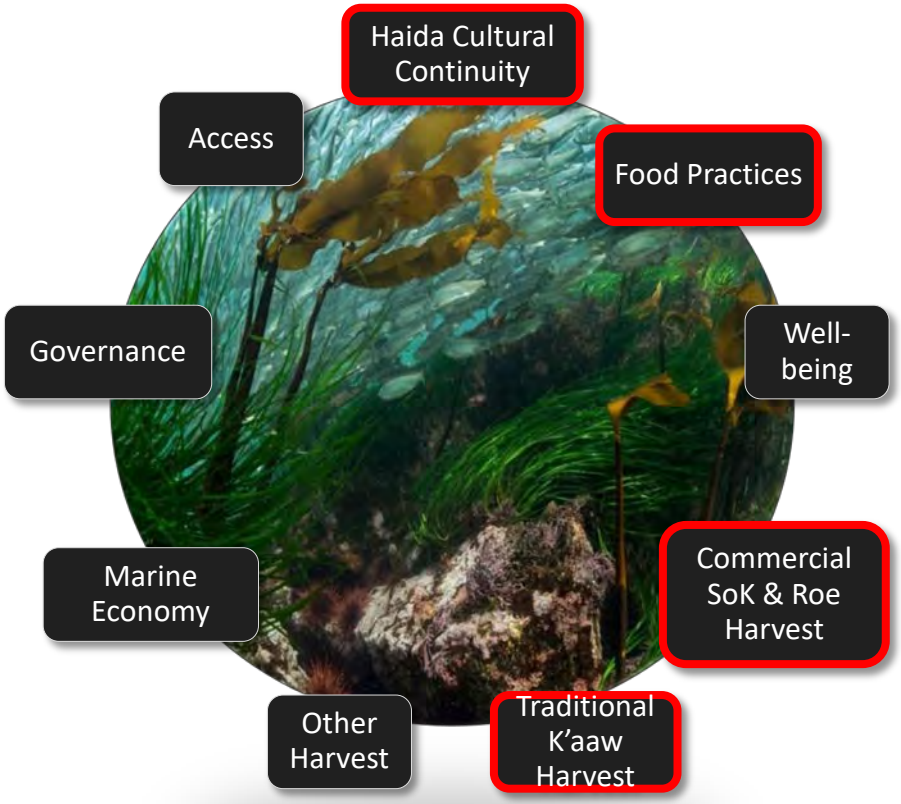
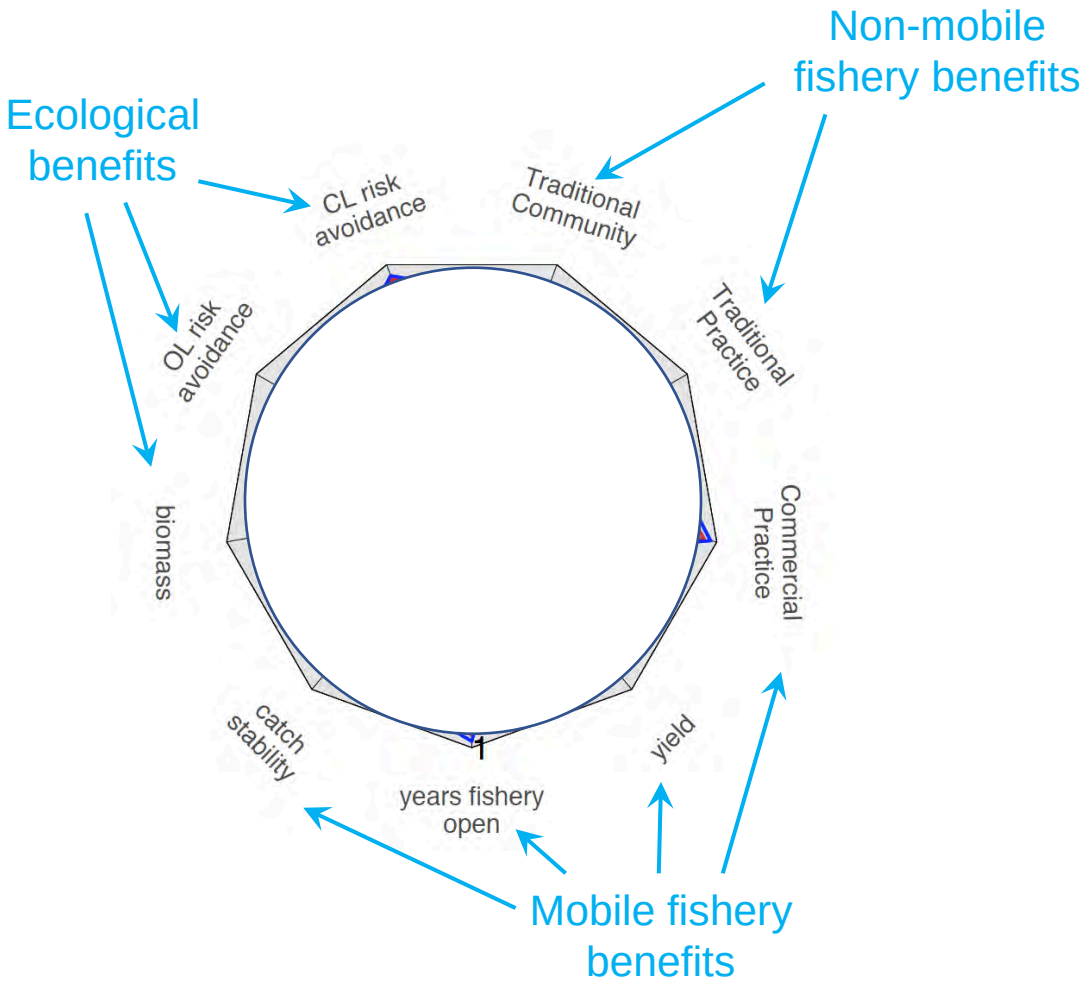
Case study 2: Pacific herring



Social/cultural benefits
for indigenous and non-indigenous users

Ability to practice harvest
Access to food
Community / social relationships
Opportunity to enjoy herring

Case study 2: Pacific herring



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Case study 2: Pacific herring

Conclusions

- Forming a working group with representatives from the different fisheries, the managers, traditional knowledge holders, and social scientists allowed for realistic evaluation of tradeoffs

- Traditional knowledge informed modeling

- In this case, the tradeoffs are strongest with spatial management strategies, not harvest thresholds or limits – protecting local areas for non-mobile access may be important.

Thank you

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