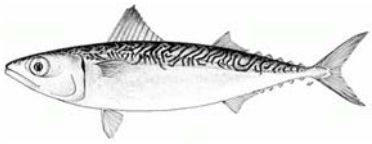
Effect of Water-Mass Properties on the Distribution of Pacific Mackerel *Scomber japonicus* Larvae in the California Current



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Introduction

- Pacific mackerel are highly managed and fished throughout the world
- The stock that occurs from Alaska to southern Baja California in the northeastern Pacific supported a large fishery in the 1930s-1940s and 1980s, now very low
- Like other coastal pelagic species, abundance fluctuates greatly

Photo: darrp.noaa.gov

Introduction

• Only one current source of fishery-independent data:

• California Cooperative Oceanic Fisheries Investigations (CalCOFI) program has collected environmental data, eggs, and larvae since 1951

• Daily larval production similar to daily-egg-production method but not in the most recent stock assessment (identification of eggs recently possible)

Photo: darrp.noaa.gov

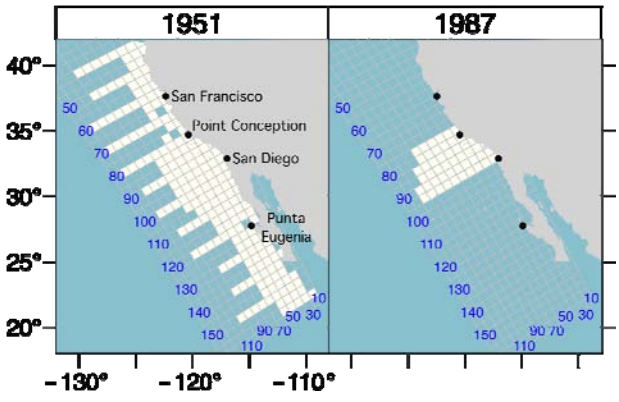
Introduction

CalCOFI

• U.S. and Mexican waters until 1984, core area in the Southern California Bight since

• Fish from ring nets or bongo nets

• Environmental data from bottle samples and CTD



Objectives

Model probability of capturing Pacific mackerel larvae as a function of environmental variables to:

- Improve future surveys
- "Smooth" patchy catch data for easier Interpretation of habitat occupied
- Quantify trends in the core CalCOFI area and Mexican waters where possible – is the core area representative?

Photo: Sherri Charter

Methods

- Logistic generalized linear models with natural splines (i.e. GAMs) but constrain number of knots to achieve biologically realistic responses
- Shrinkage to adjust parameter estimates, possibly to zero (model selection)

- Response variable was presence of Pacific mackerel larvae in May through September

Methods

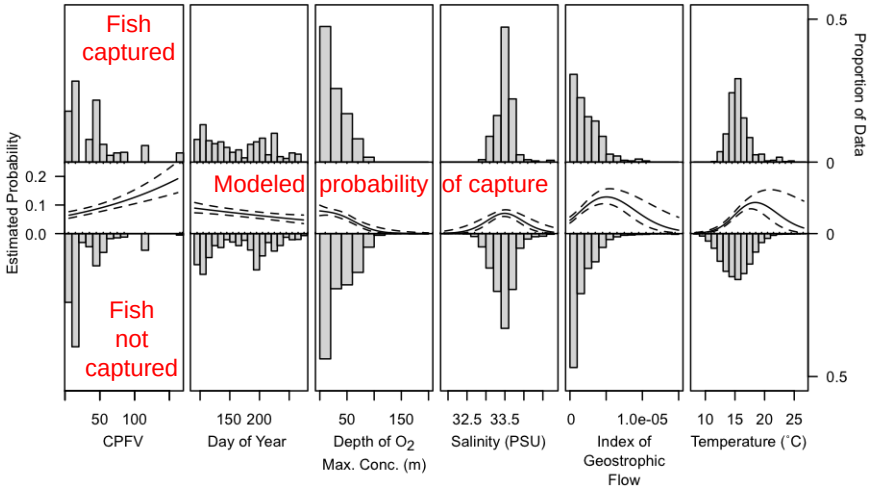
Predictors were temperature, salinity, and oxygen concentration in upper 50 m,
depth at which maximum oxygen concentration occurred,
mixed-layer depth,
an index of geostrophic flow,
day of year that samples were collected and
commercial-passenger-fishing-vessel index (stock size) as blocking vars

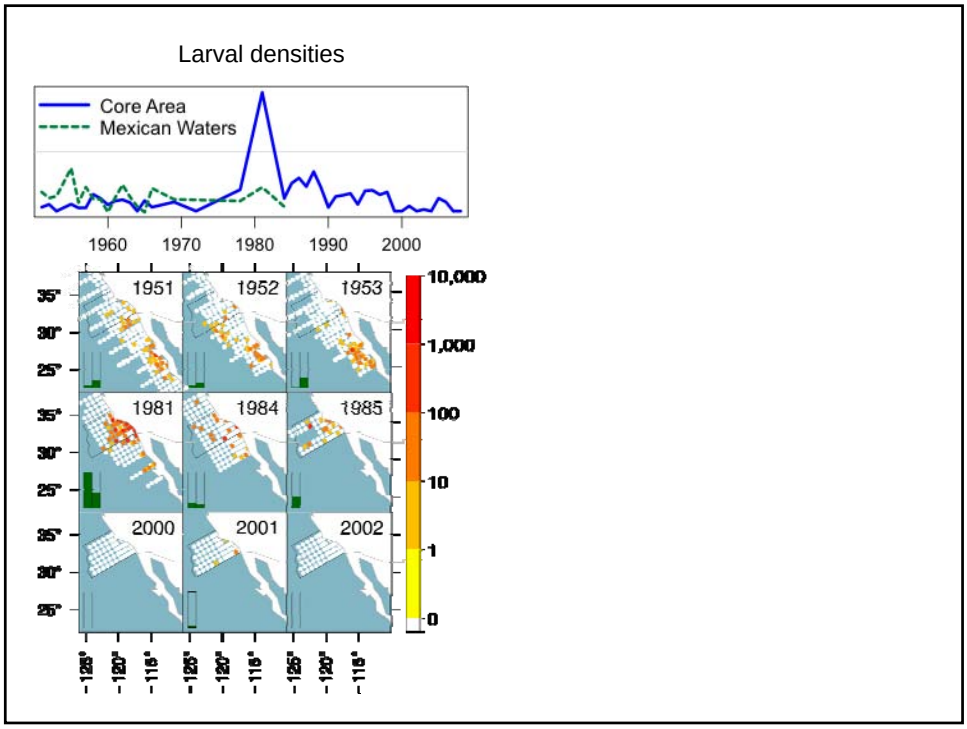
Photo: Andrew Thompson

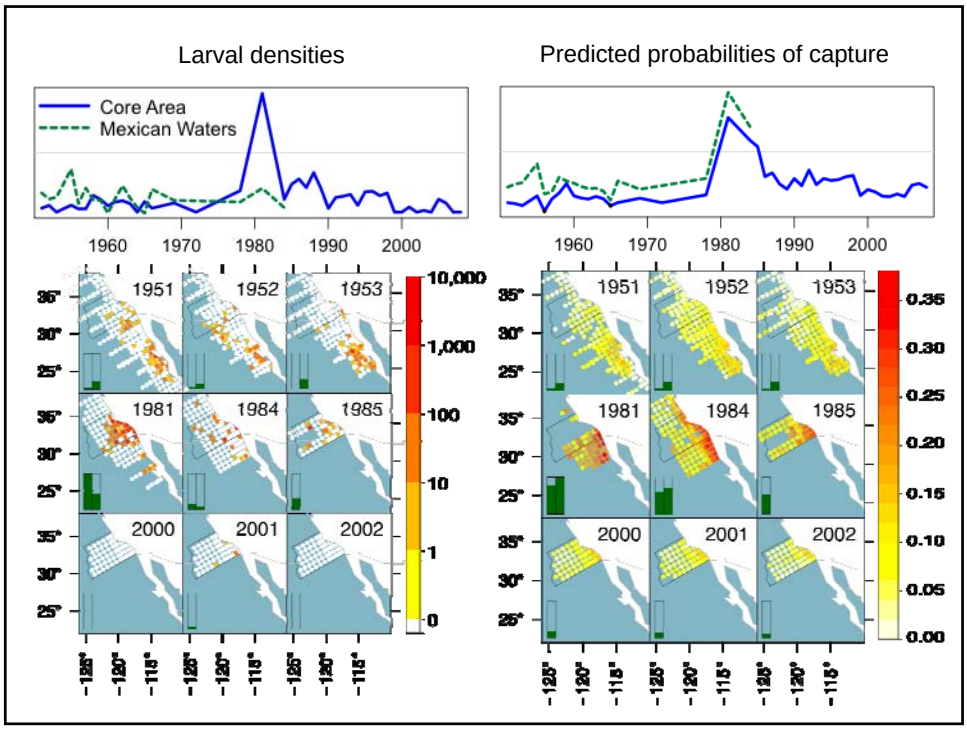
Results

Partial effects:

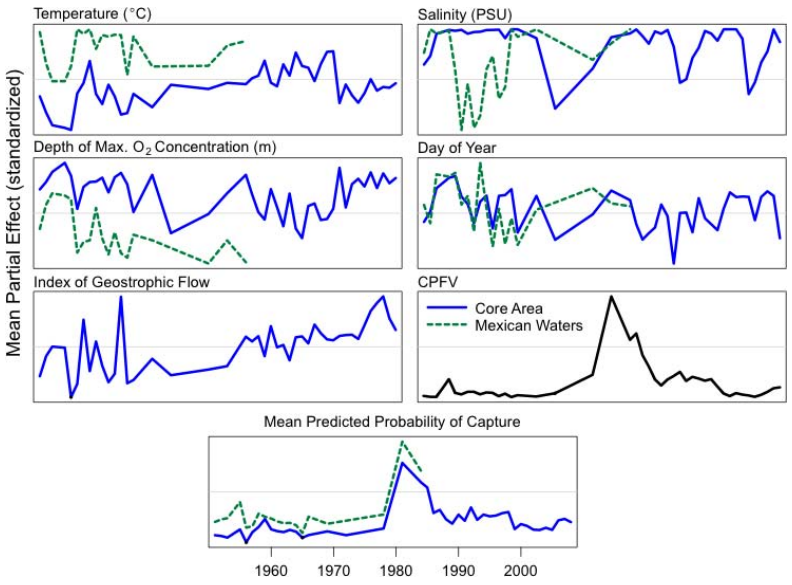
- Each predictor at median value of other predictors in the model
- mixed-layer depth and oxygen concentration dropped from the model



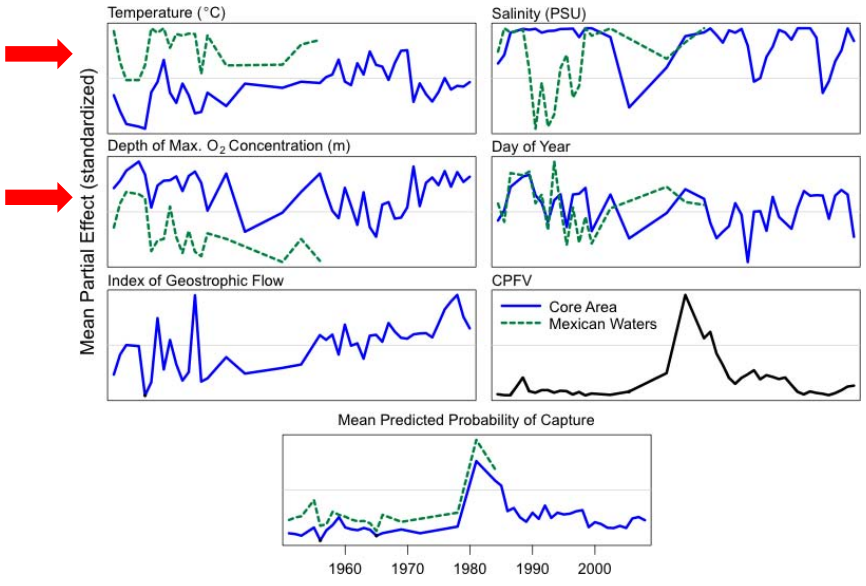

Larval densities
Core Area
Mexican Waters
1960
1970
1980
1990
2000
1951
1952
1953
1981
1984
1985
2000
2001
2002
10,000
1,000
100
10
1
0


Larval densities
Predicted probabilities of capture
Core Area
Mexican Waters
1960
1970
1980
1990
2000
1951
1952
1953
1981
1984
1985
2000
2001
2002
10,000
1,000
100
10
1
0
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00

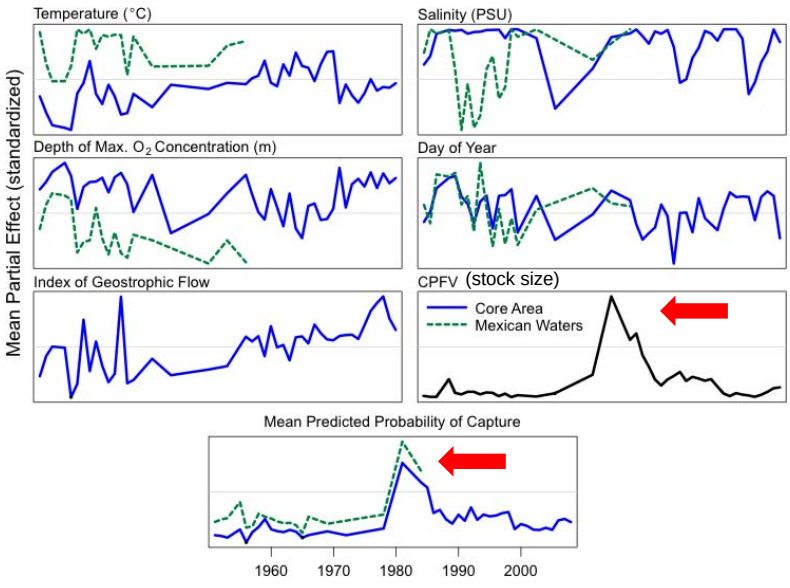
Results



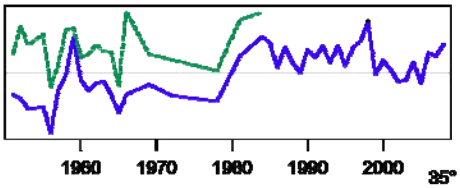
Results

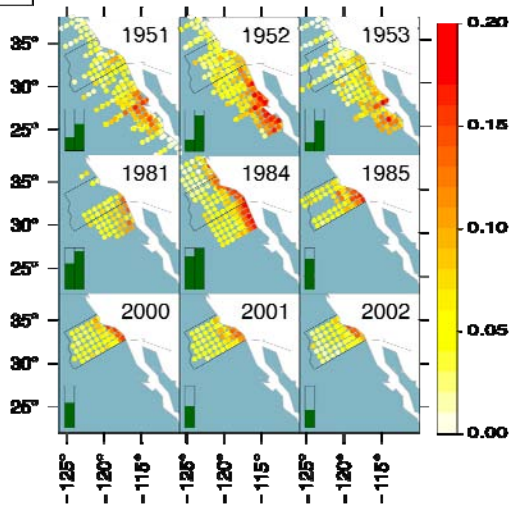


Results



Predicted probabilities at median sampling day and stock size





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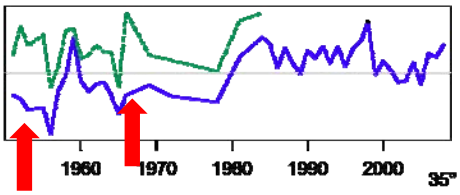

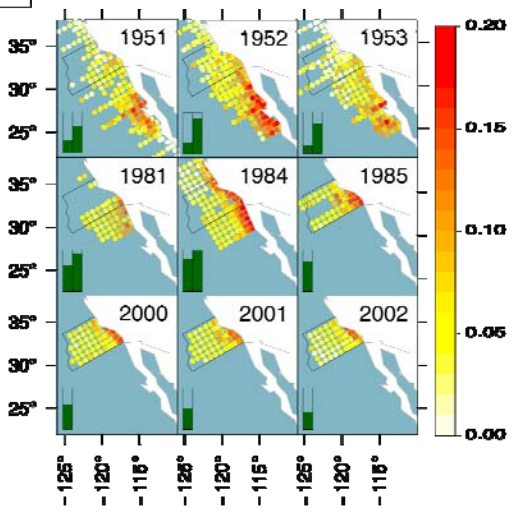

Conclusions

- Mexican waters contain more than half of the habitat during most years. Core area is broadly representative but exhibits some bias – Pairing with IMECOCAL data would be better

- Southern California Bight versus Mexican waters temperature versus productivity near surface?

- Recent low catches are not explained by the model – may be very low population size and/or lack of model fit

- Environmental characteristics will be useful for allocating sampling effort to improve future surveys

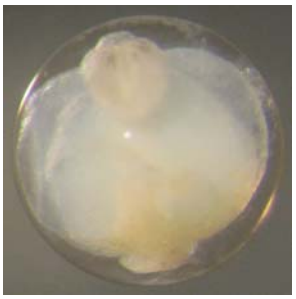

Photo: Andrew Thompson