Science, Service, Stewardship

NMFS

Developing ocean ecosystem indicators for marine turtle juvenile recruitment

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Director's Office
Pacific Islands Fisheries Science Center
NOAA Fisheries

Conservation Biology

Special Section

Incorporating Climate Science in Applications of the U.S. Endangered Species Act for Aquatic Species

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Abstract: *Aquatic species are threatened by climate change but have received comparatively less attention than terrestrial species. We gleaned key strategies for scientists and managers seeking to address climate change in aquatic conservation planning from the literature and existing knowledge. We address 3 categories of conservation effort that rely on scientific analysis and have particular application under the U.S. Endangered Species Act (ESA): assessment of overall risk to a species; long-term recovery planning; and evaluation of effects of specific actions or perturbations. Fewer data are available for aquatic species to support these analyses, and climate effects on aquatic systems are poorly characterized. Thus, we recommend scientists conducting analyses supporting ESA decisions develop a conceptual model that links climate, habitat, ecosystem, and species response to changing conditions and use this model to organize analyses and future research. We recommend that current climate conditions are not appropriate for projections used in ESA analyses and that long-term projections of climate-change effects provide temporal context as a species-wide assessment provides spatial context. In these projections, climate change should not be discounted solely because the magnitude of projected change at a particular time is uncertain when directionality of climate change is clear. Identifying likely future habitat at the species scale will indicate key refuges and potential range shifts. However, the risks and benefits associated with errors in modeling future habitat are not equivalent. The ESA offers mechanisms for increasing the overall resilience and resistance of species to climate changes, including establishing recovery goals requiring increased genetic and phenotypic diversity, specifying critical habitat in areas not currently occupied but likely to become important, and using adaptive management.*

Keywords: climate change, conservation planning, effects analysis, population models, recovery planning, risk assessment, vulnerability

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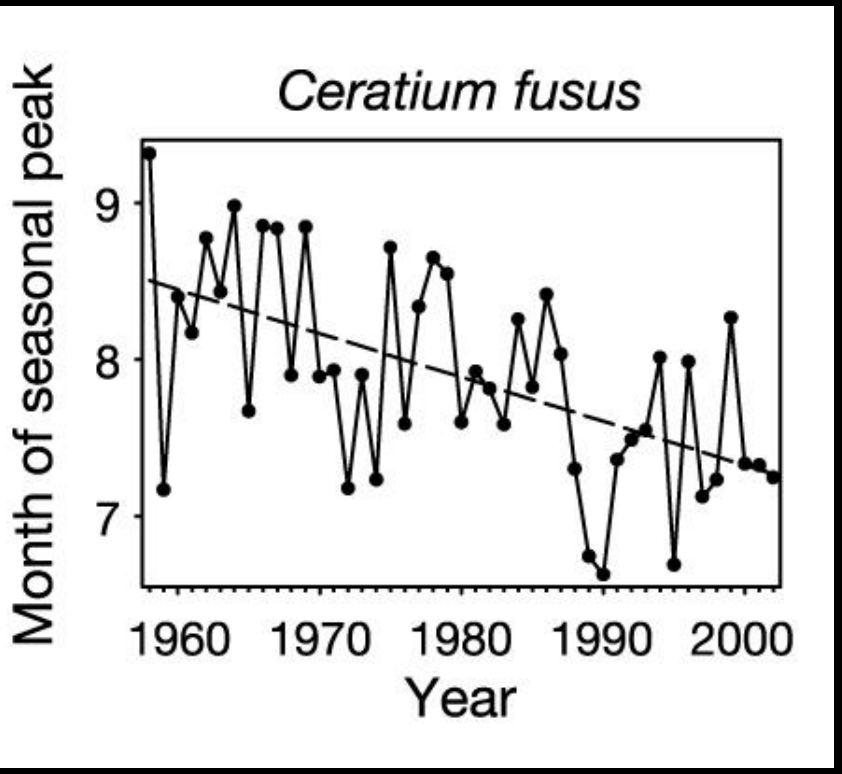
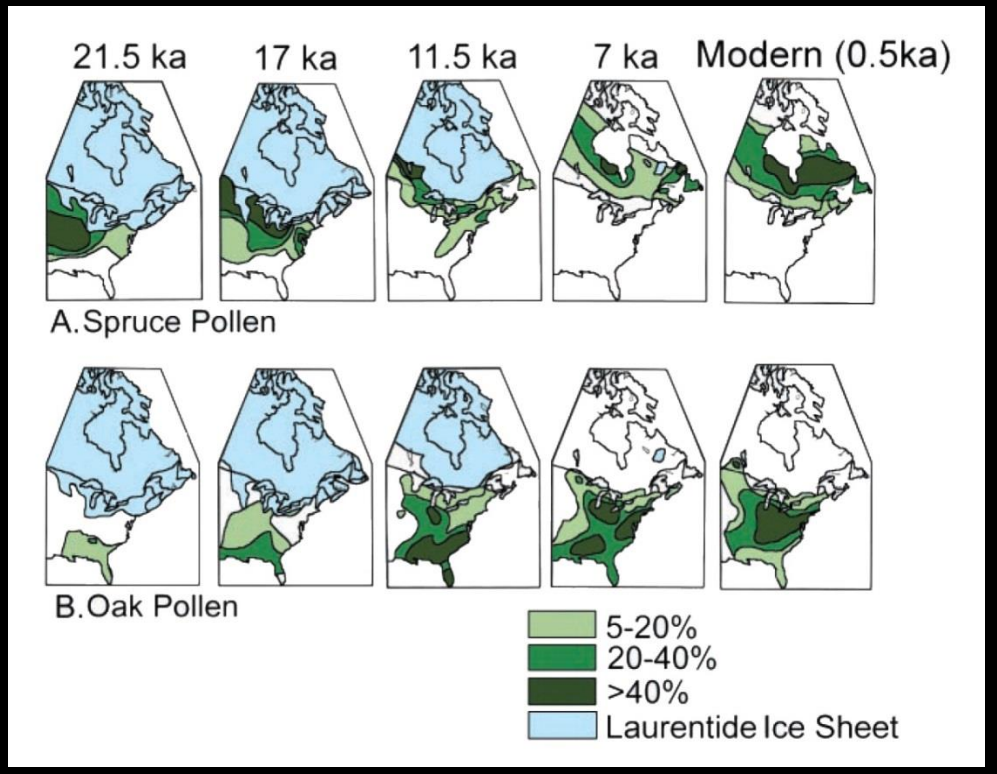
Being Climate Ready

McClure *et al.* (2013)

Climate envelopes



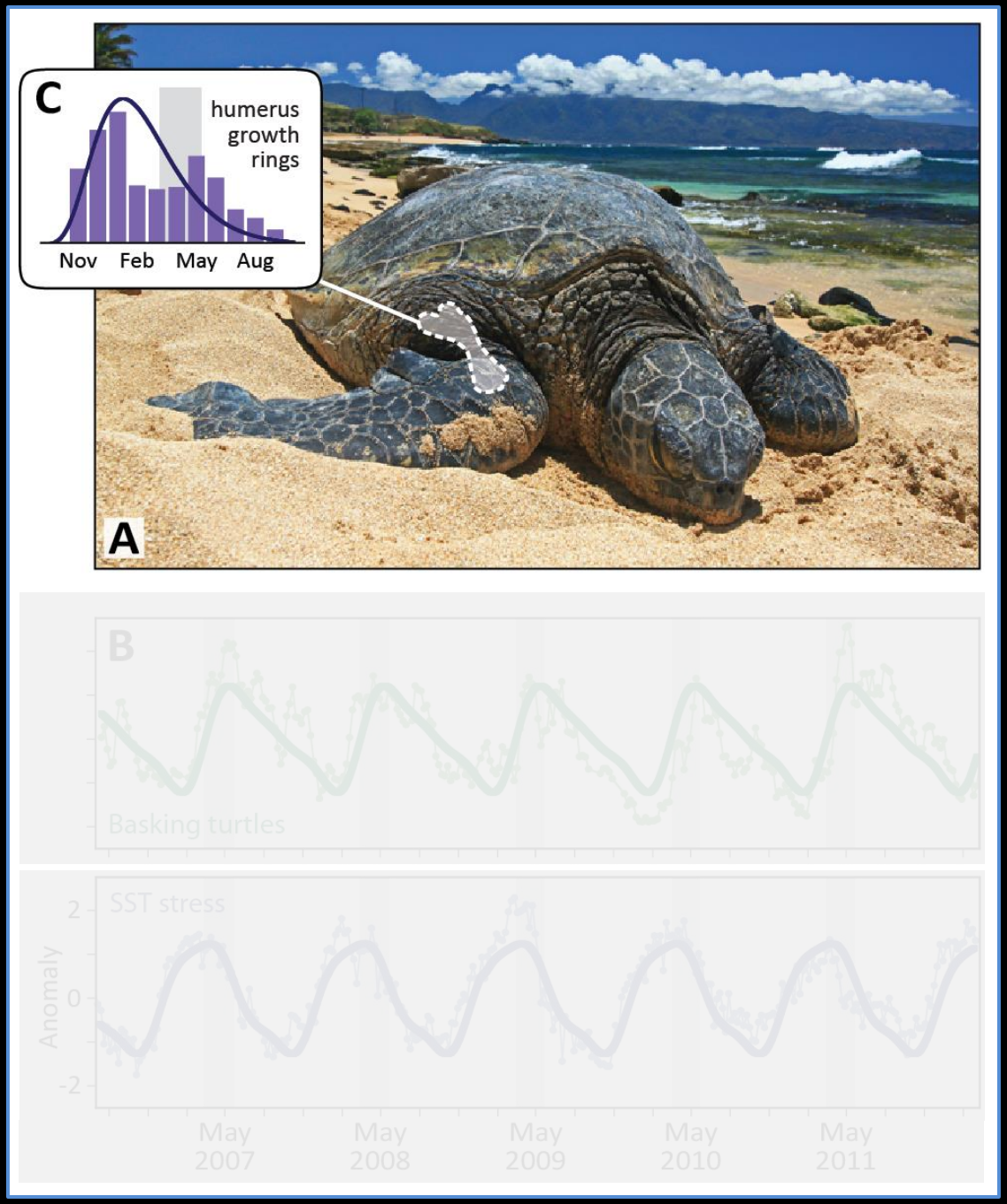
Edwards & Richardson (2004)



Davis & Shaw (2001)

Climate envelopes

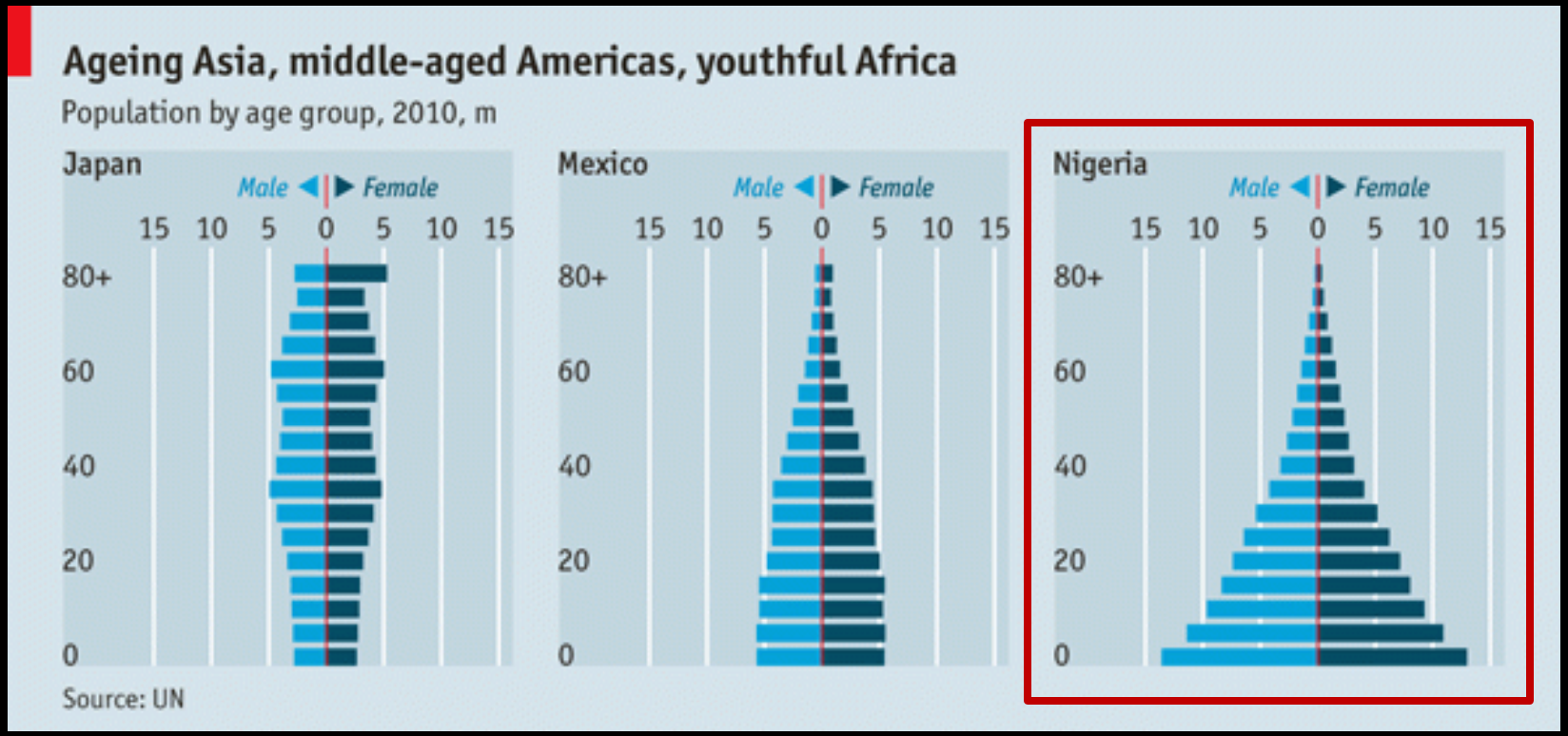
NOAA/Papahanaumokuakea MNM



Climate envelopes

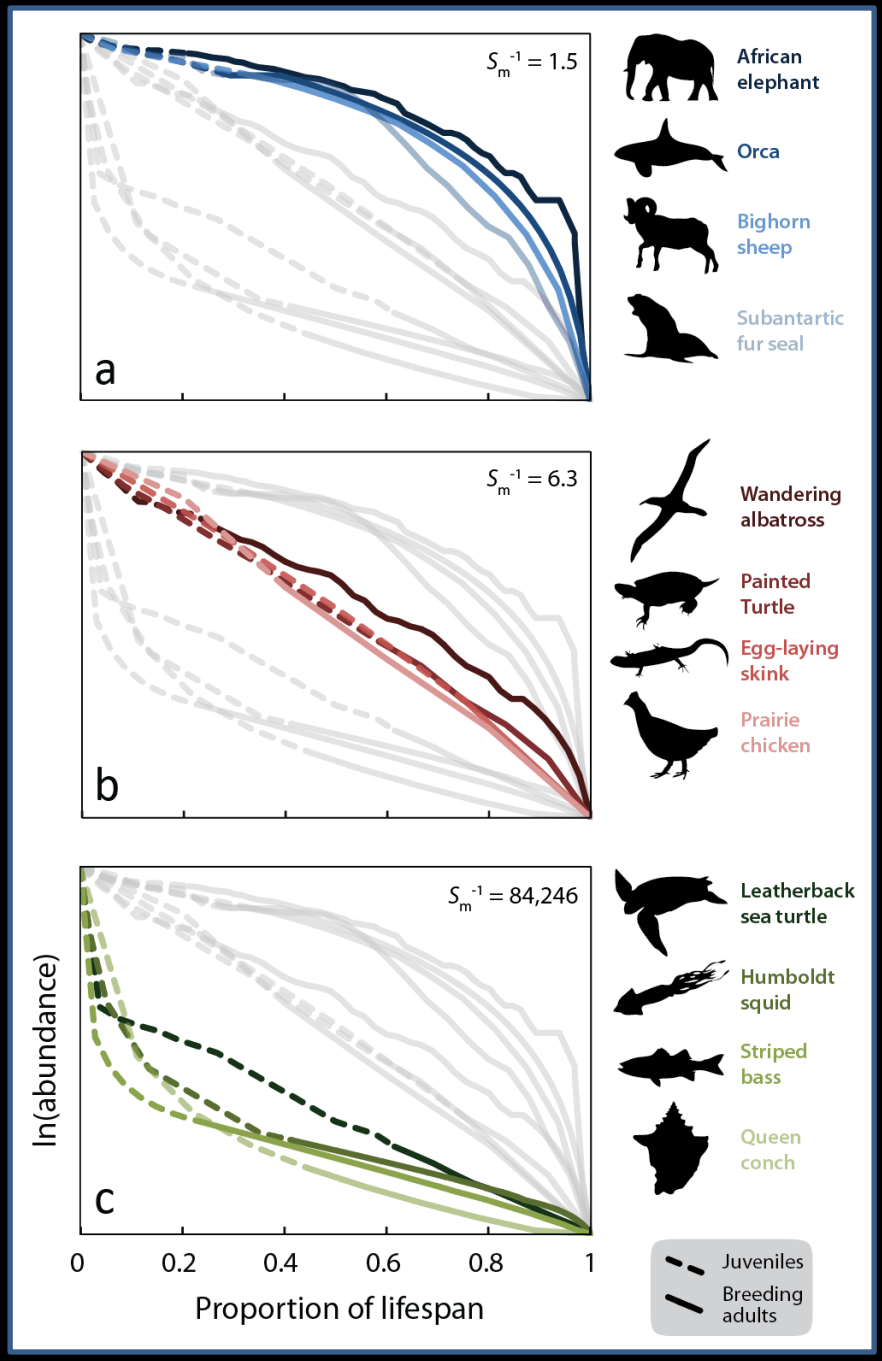
Van Houtan, Halley, & Marks (2015)

If turtles were a country...



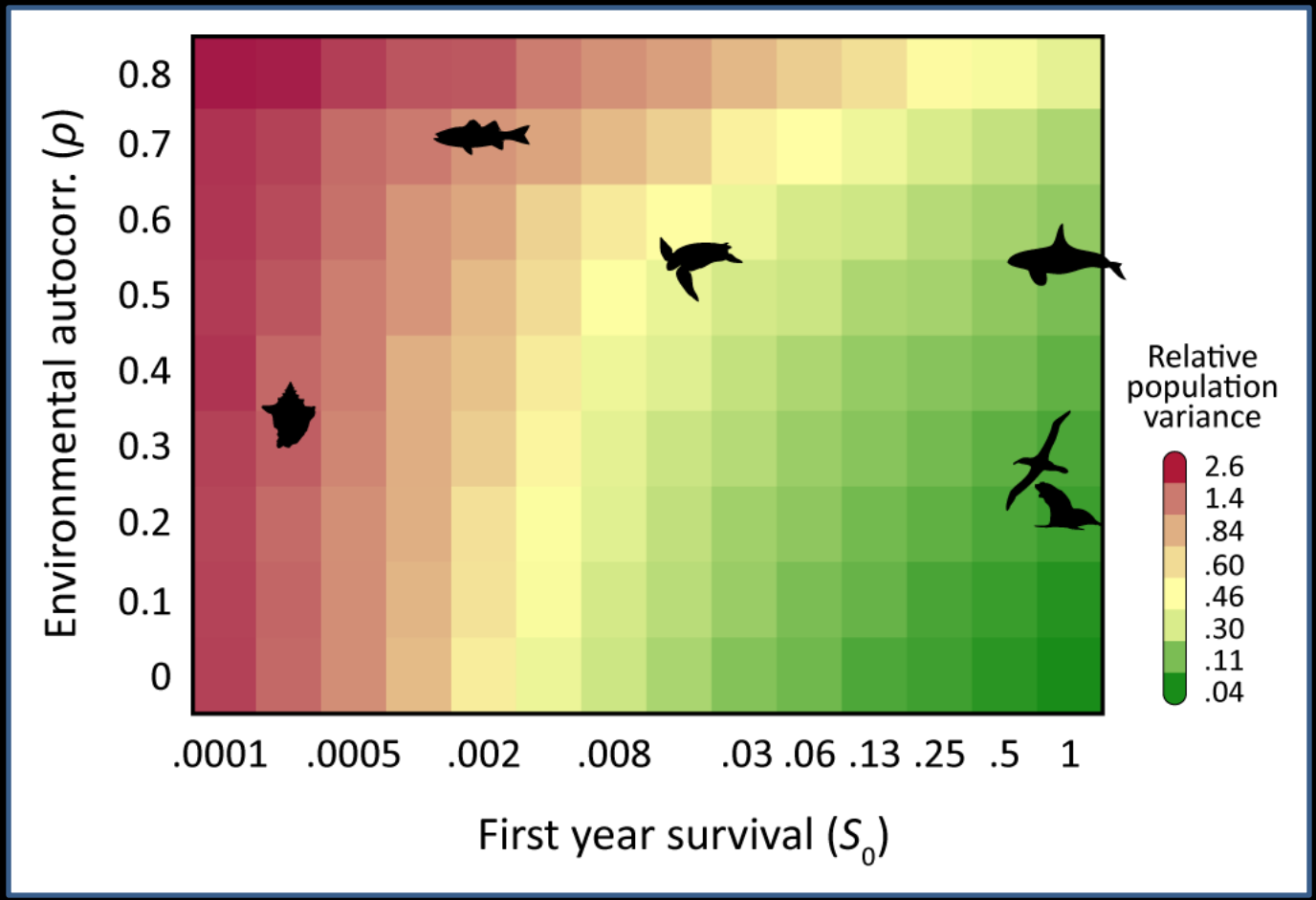
The Economist (Dec 2011)

Climate Sensitivity



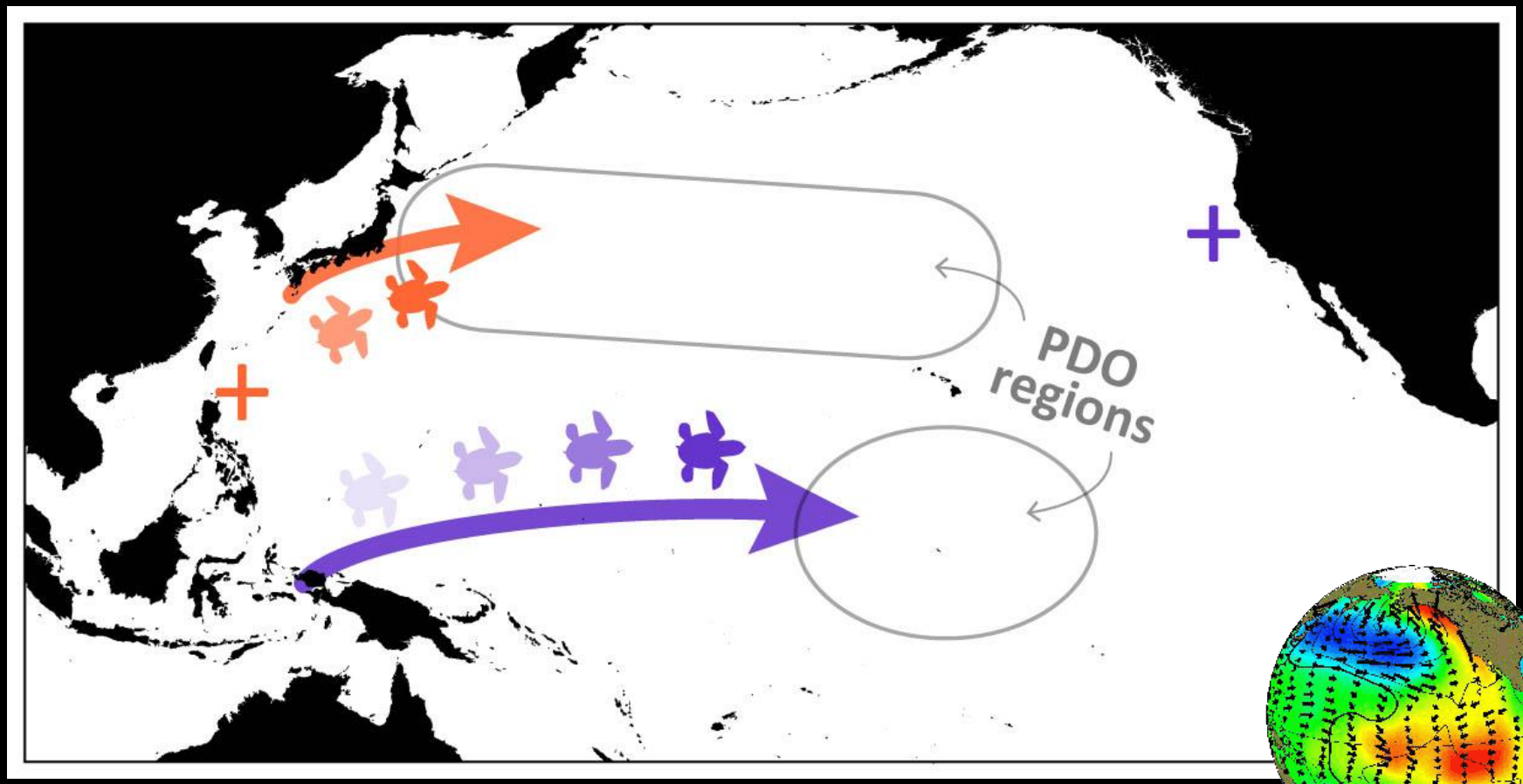
Halley, Van Houtan, Mantua (*in review*)

Climate sensitivity



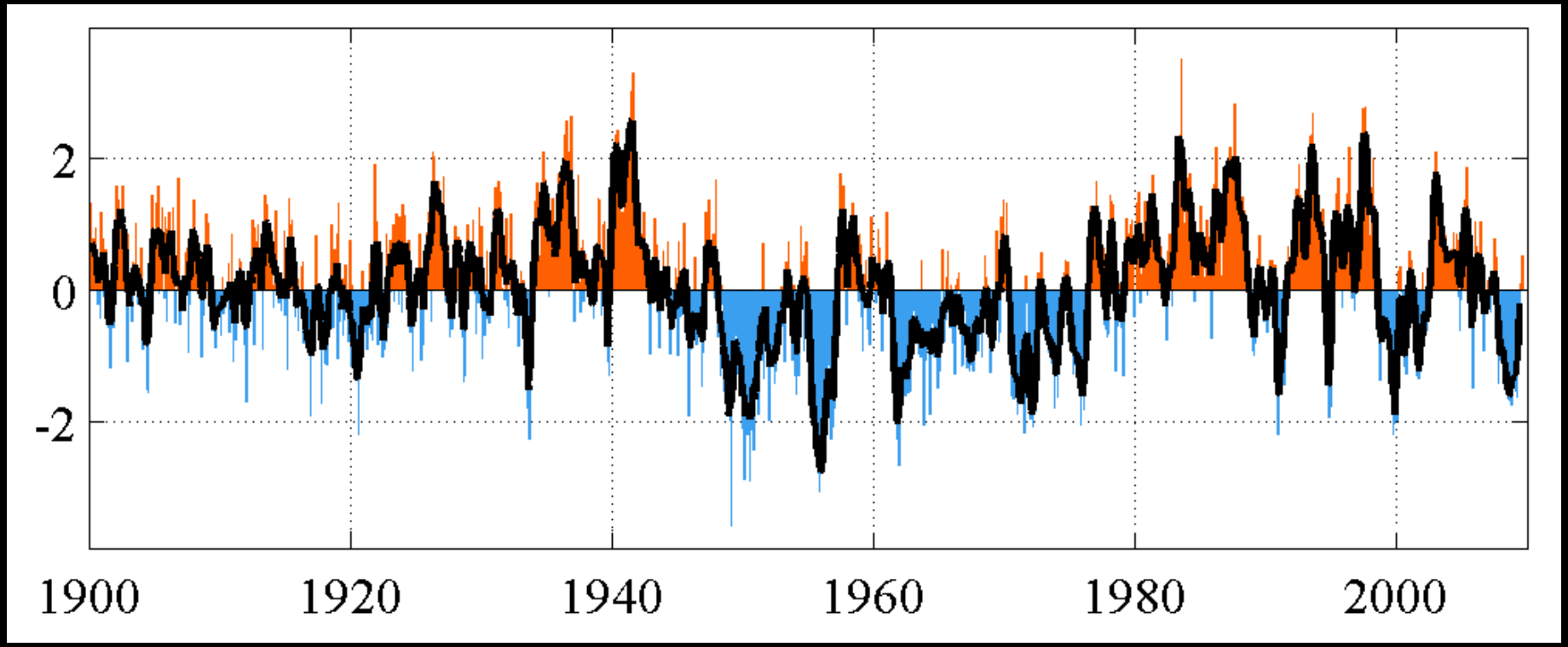
Halley, Van Houtan, Mantua (*in review*)

Spatial structure



Van Houtan 2011

Temporal structure

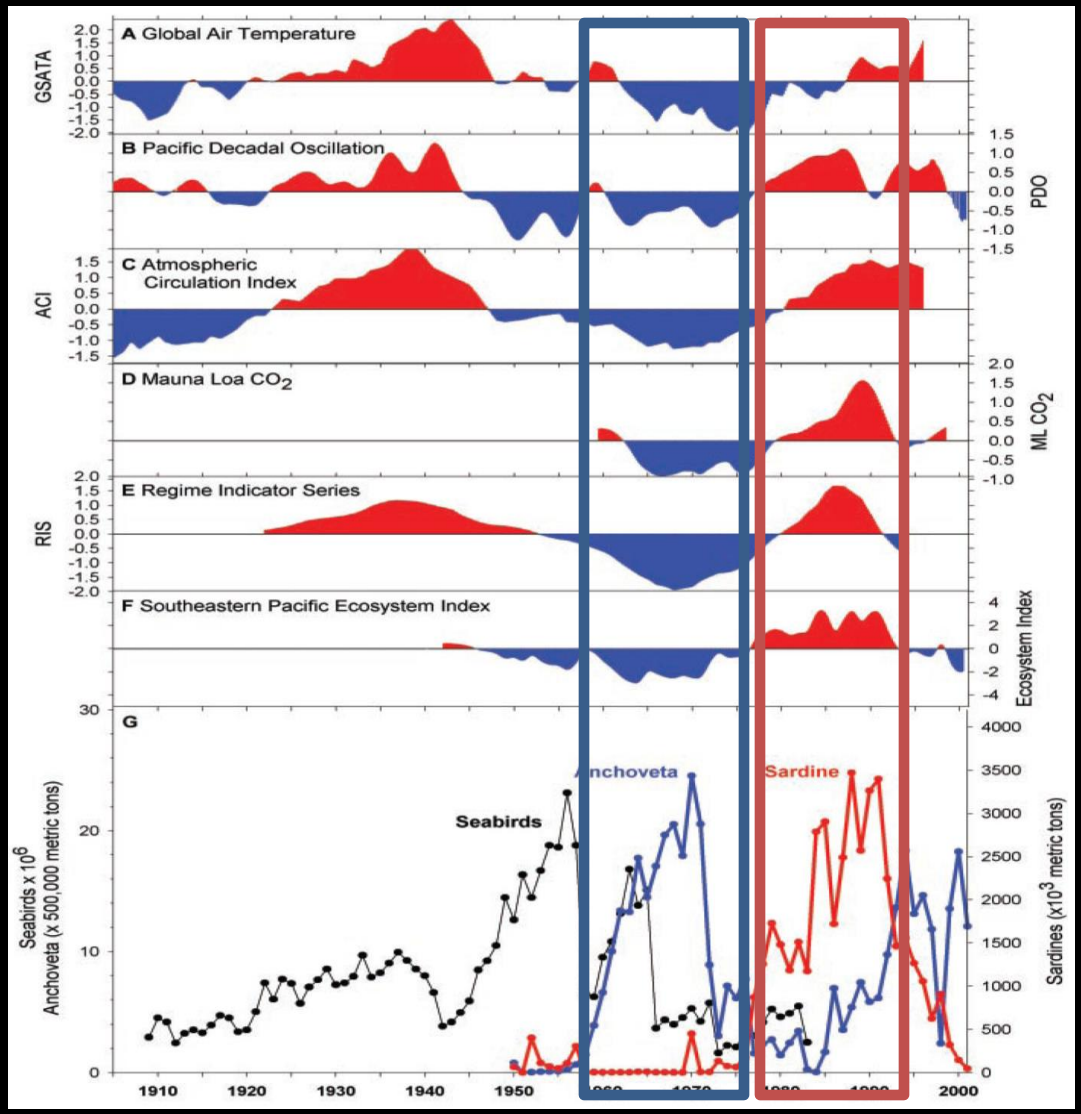


Mantua (1997)

Survival follows climate

Pacific

salmon
sablefish
flatfish
gadids
anchoveta
sardine
capelin
shrimp
seabirds

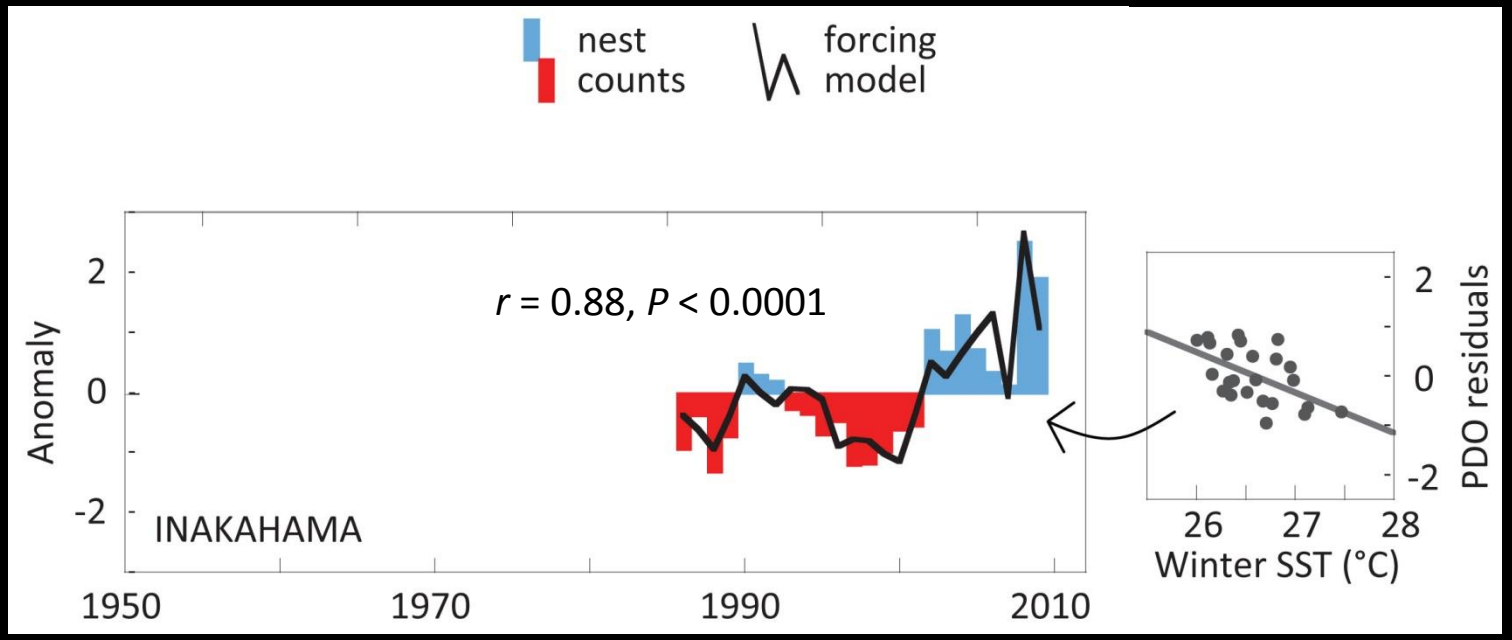


Atlantic

salmon
gadoids
herring
plankton
cod
Lobster
shrimp
snow crab
striped bass

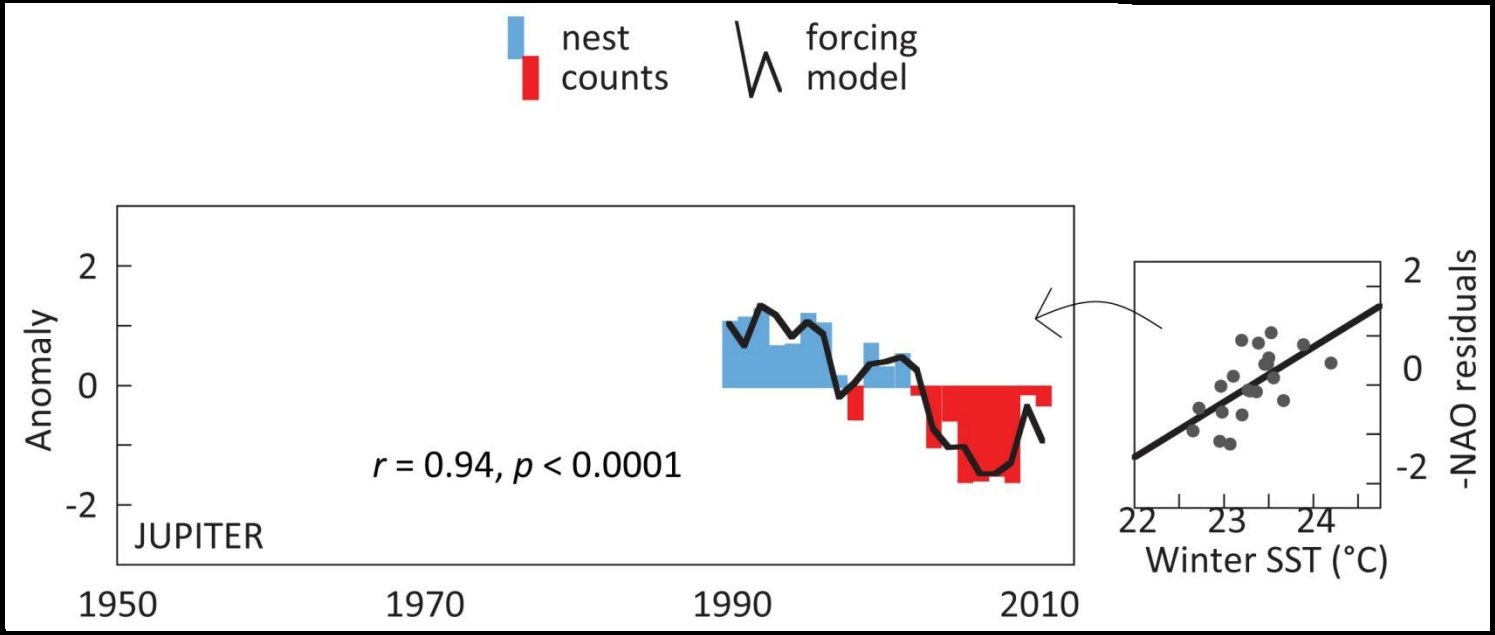
Chavez *et al* 2003

Japan loggerheads



Van Houtan & Halley 2011

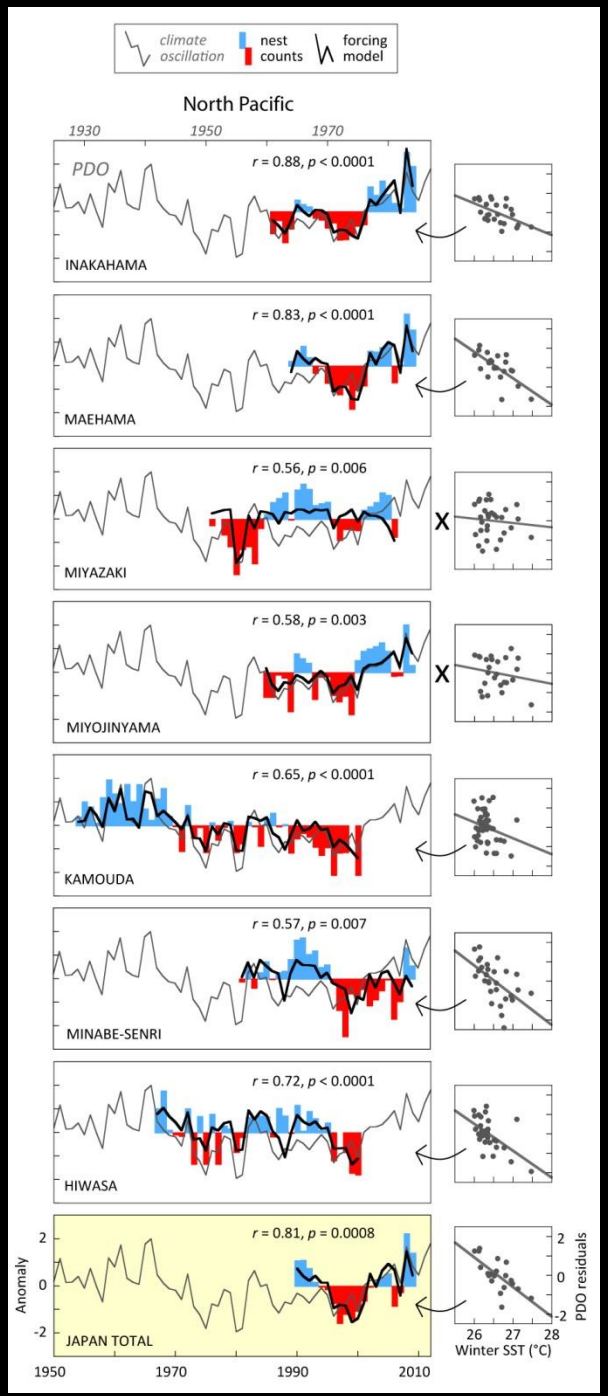
Florida loggerheads

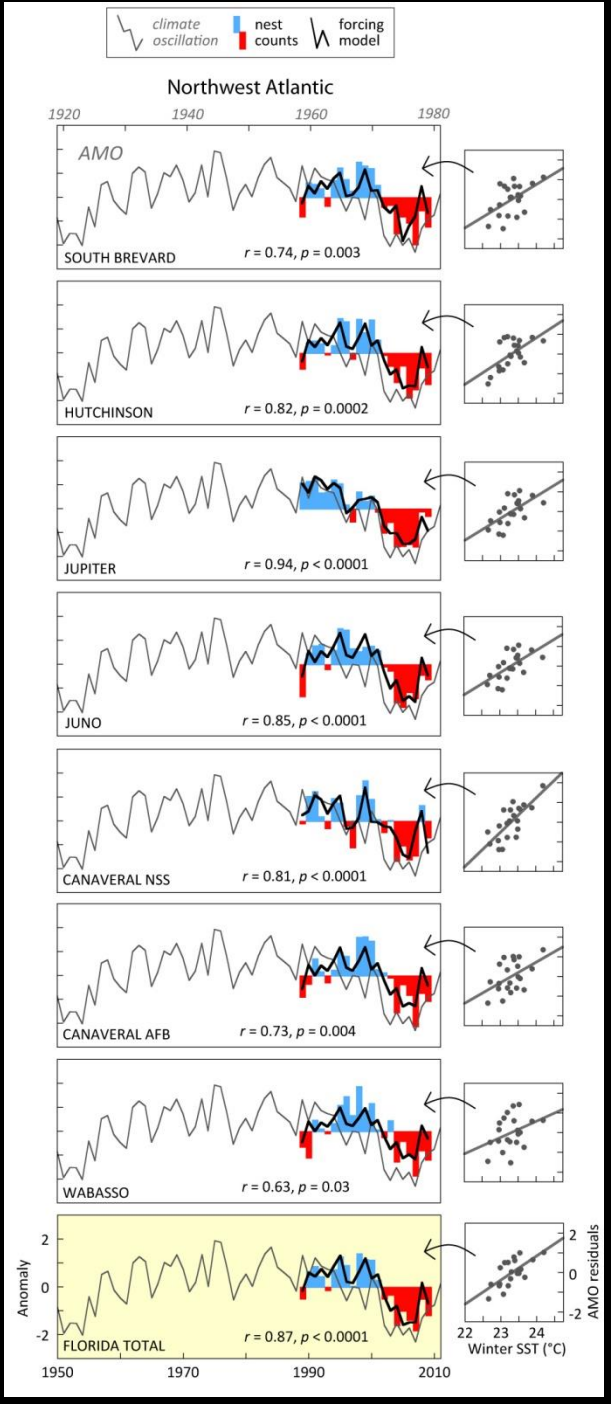


Van Houtan & Halley 2011

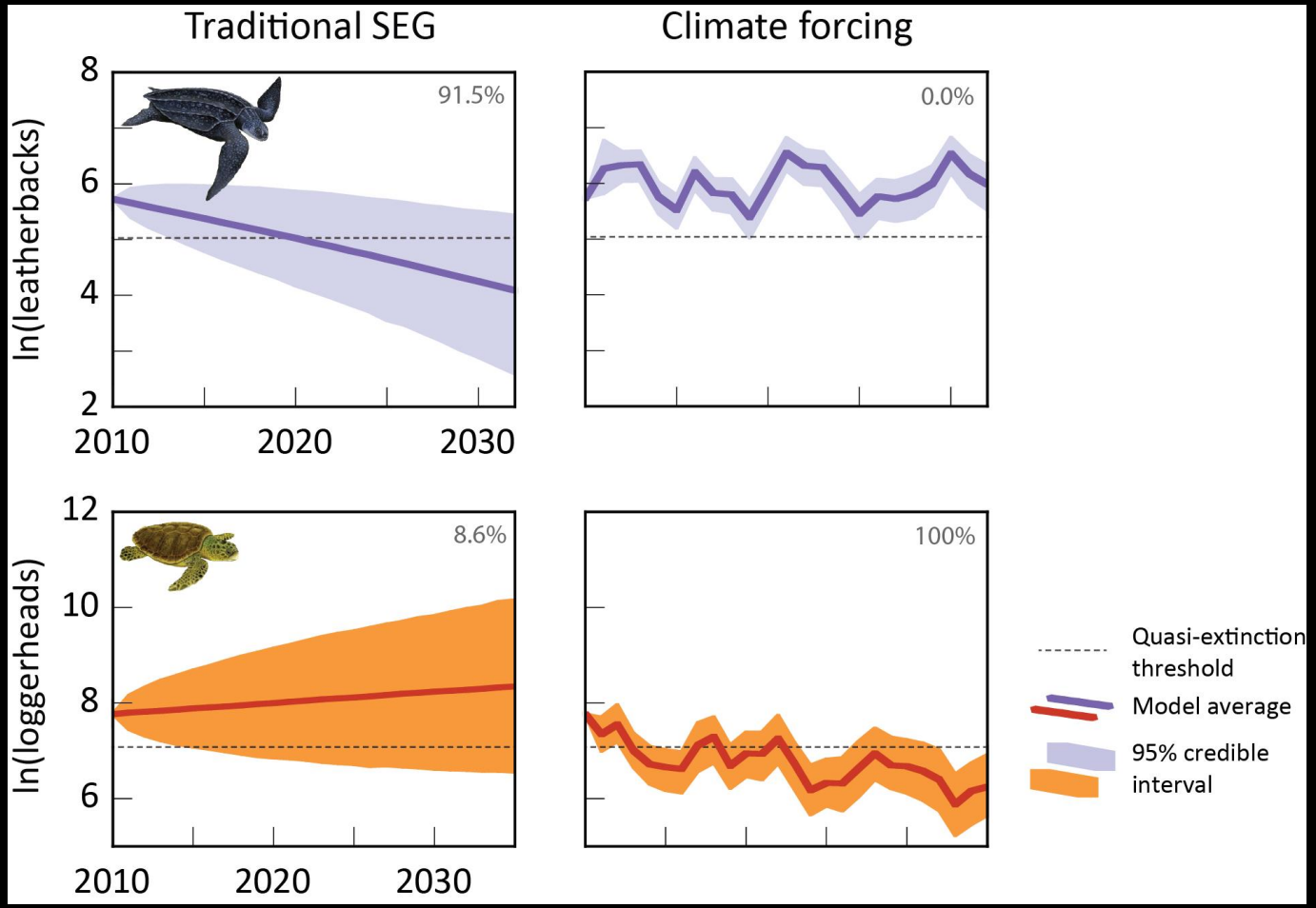
← Pacific

Atlantic →



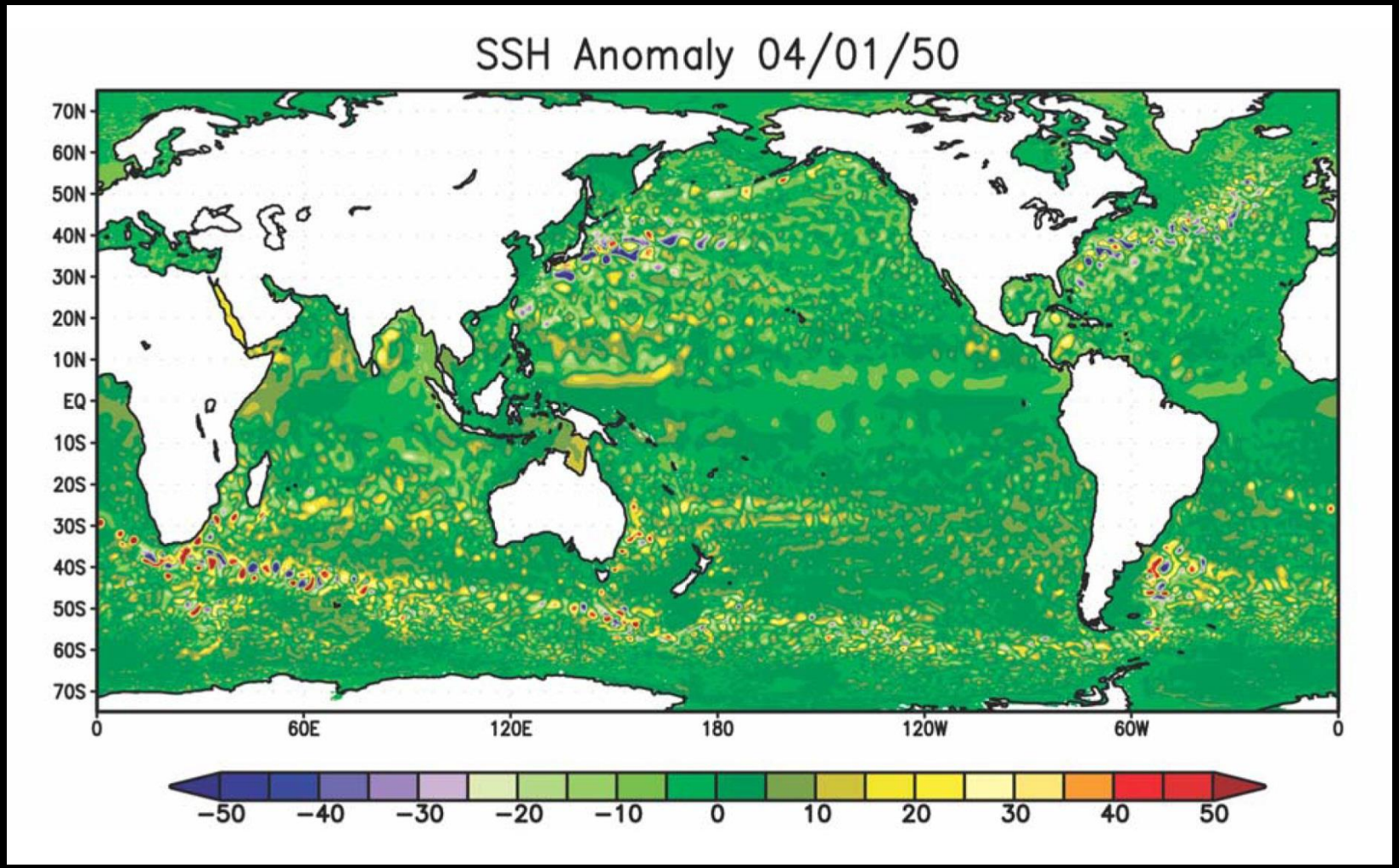


Climate-based PVA



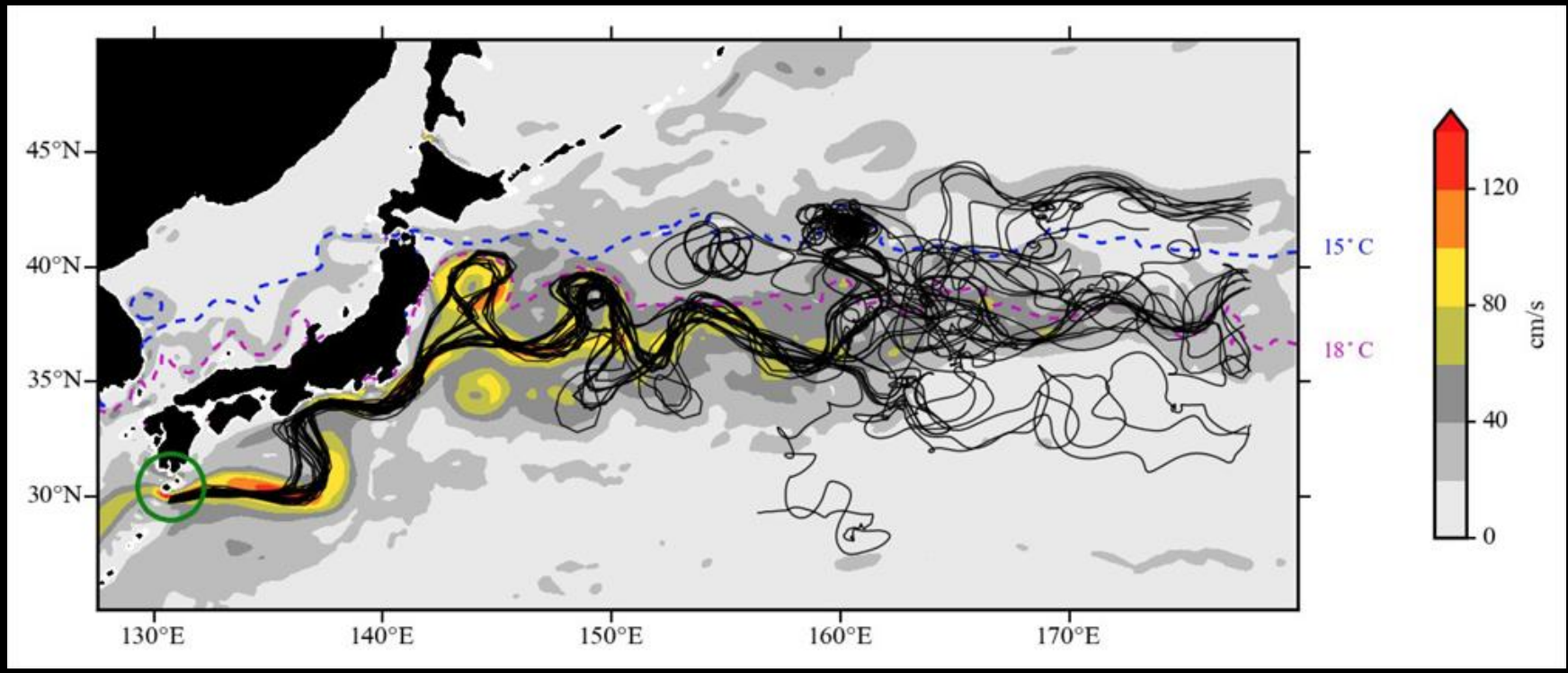
Van Houtan 2011

OFES models



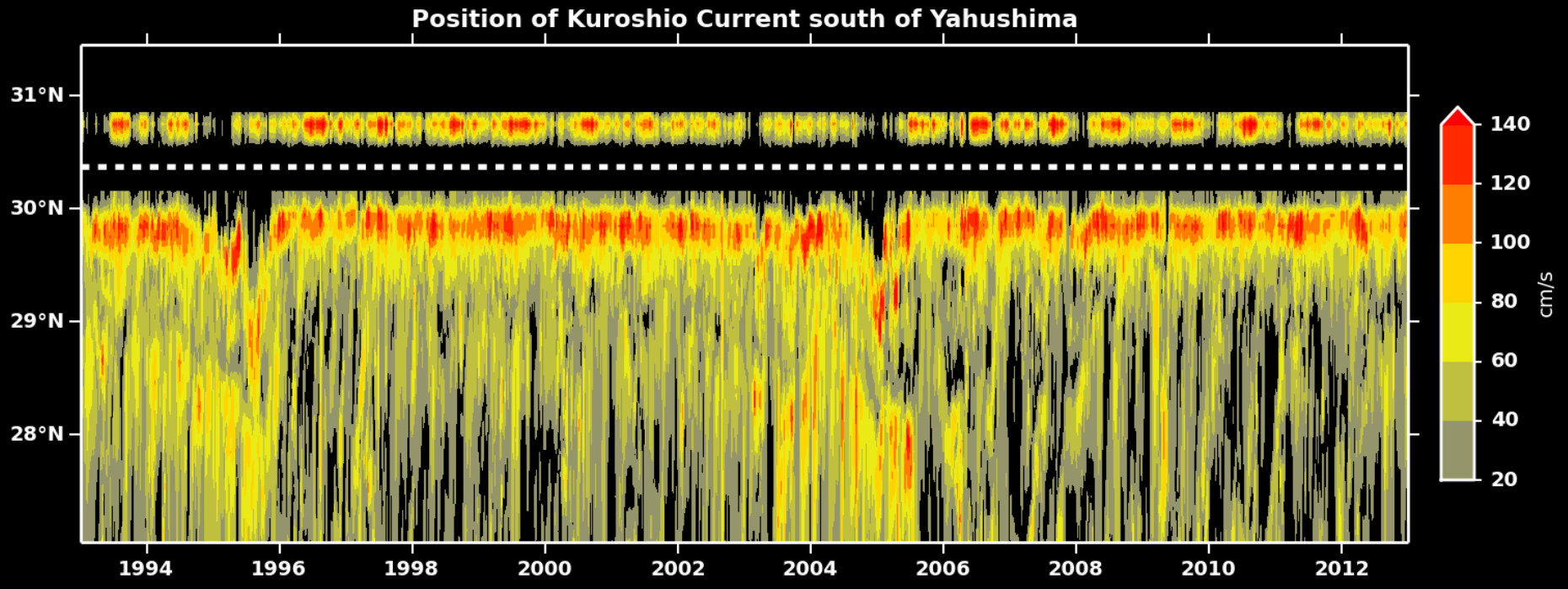
Masumoto et al (2004)

Kuroshio Current



Ascani et al (*in revision*)

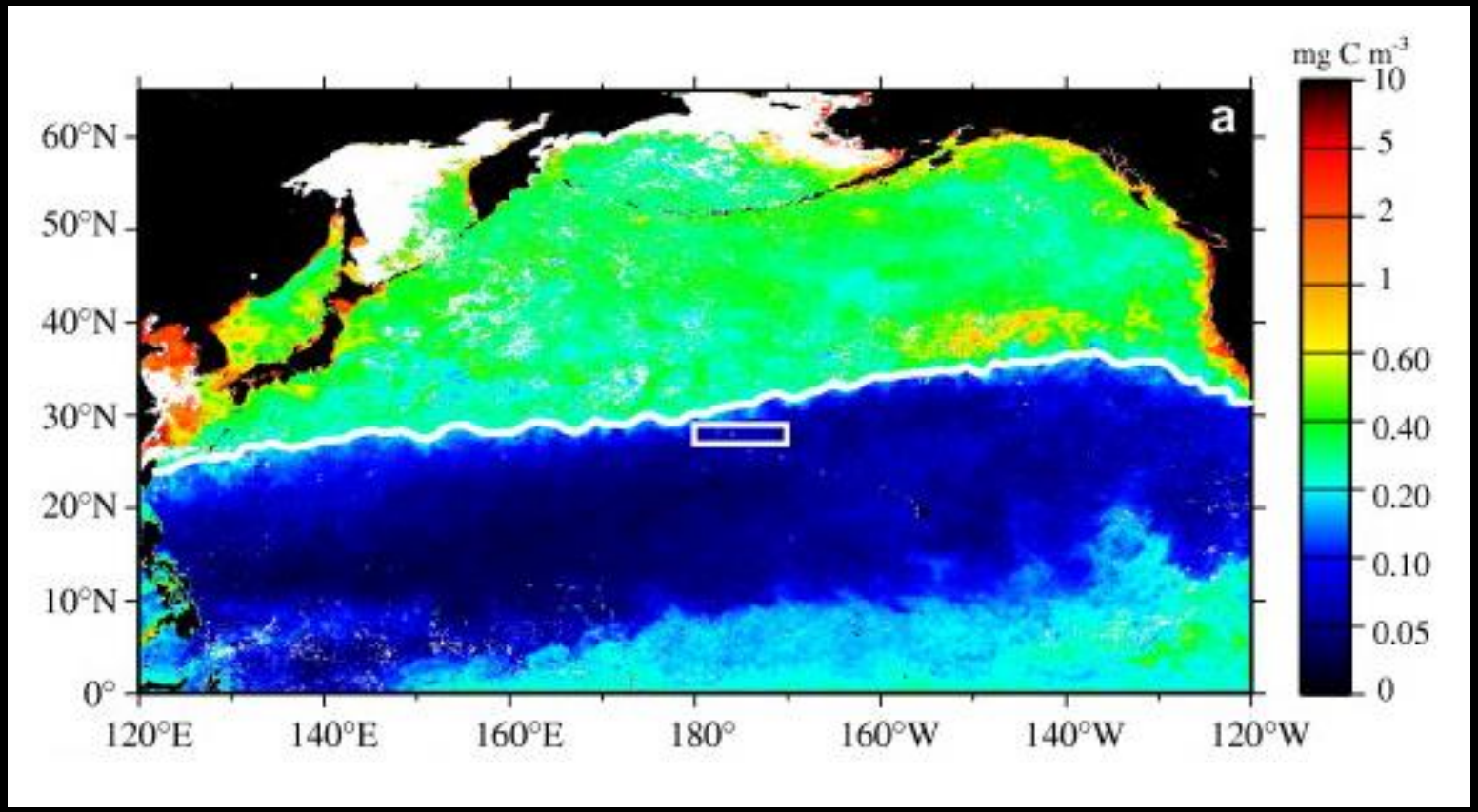
Proximity of KC



Ascani et al (*in revision*)

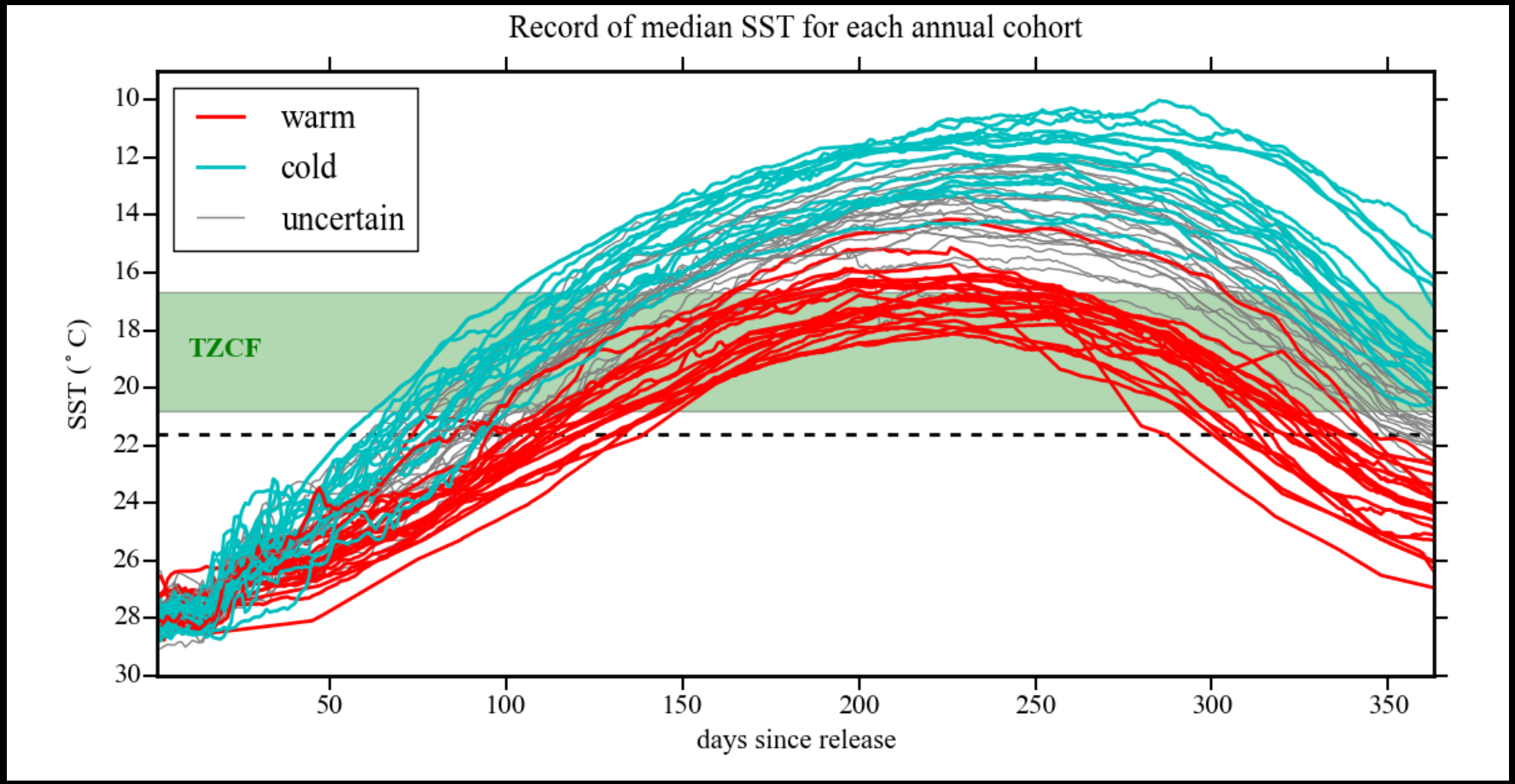
Trajectory releases

T Z C F



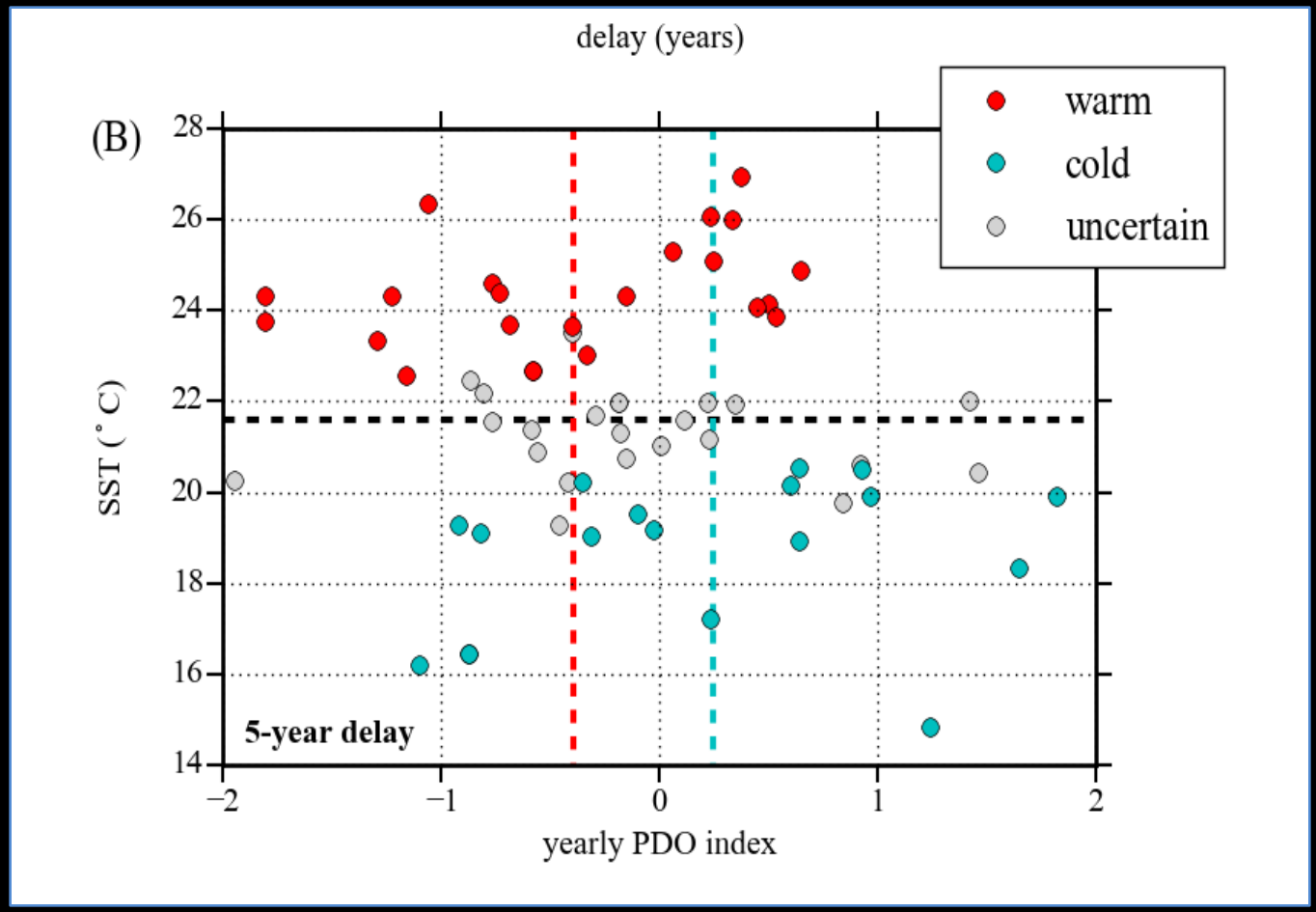
Polovina *et al* (2008)

Trajectory results



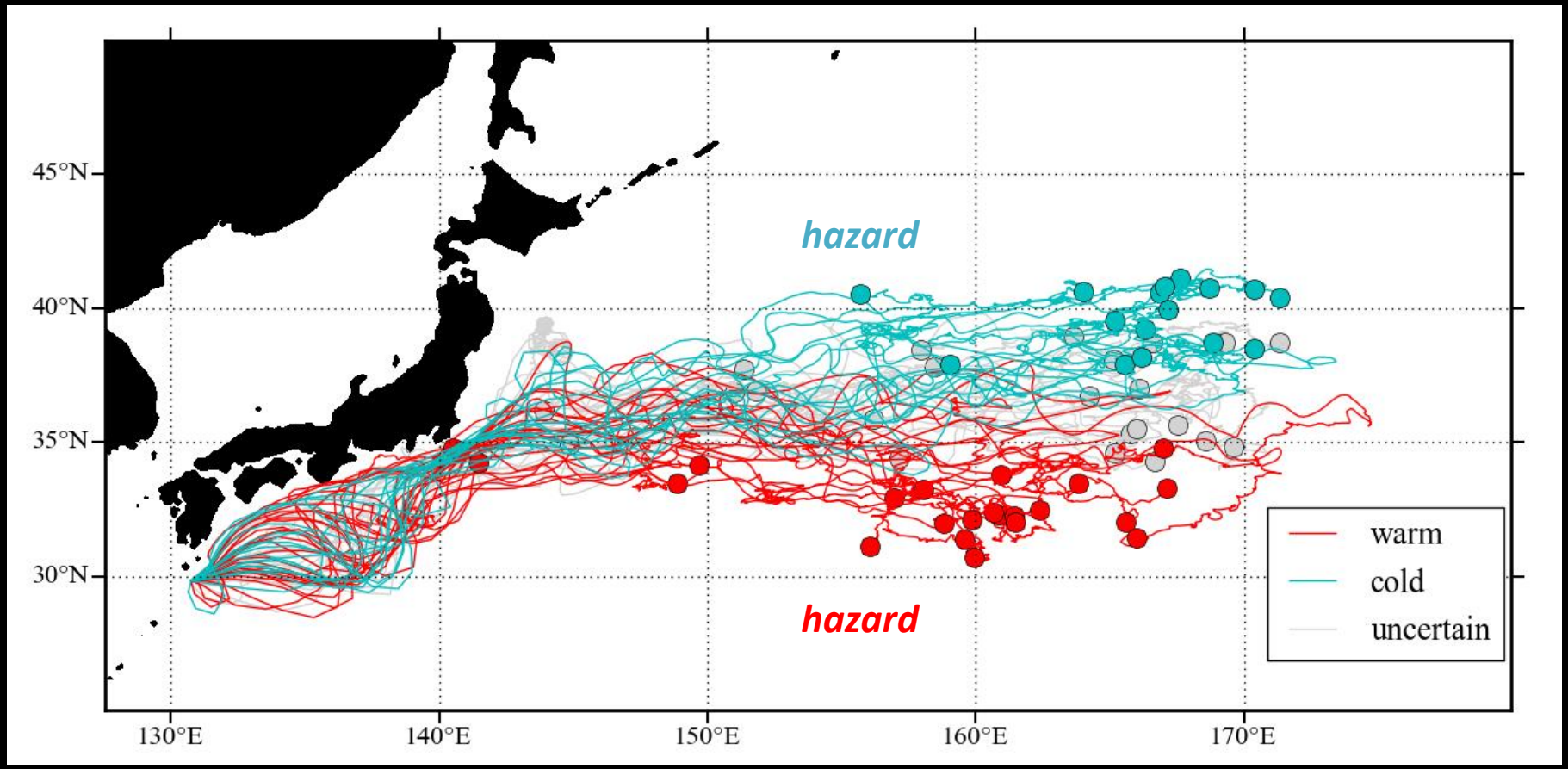
Ascani et al (*in revision*)

Trajectories + PDO



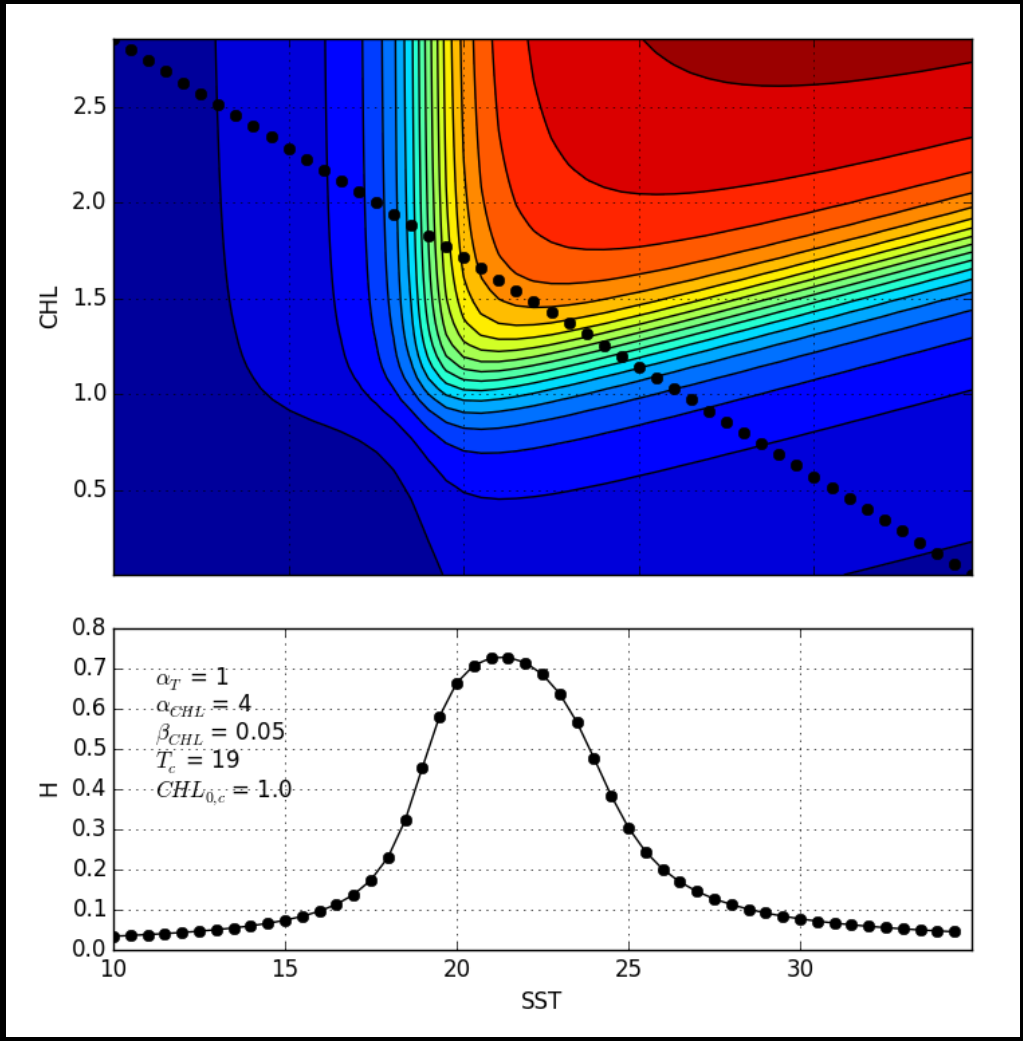
Ascani et al (*in revision*)

Trajectory results



Ascani et al (*in revision*)

MR food = S*


CHL
2.5
2.0
1.5
1.0
0.5
H
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
α_T = 1
α_{CHL} = 4
β_{CHL} = 0.05
T_c = 19
$CHL_{0,c}$ = 1.0
10
15
20
25
30
SST

This PDF was later amended to make the document 508 compliant.