Comparison of synchronous ecological regime shifts in Humboldt and Kuroshio Currents

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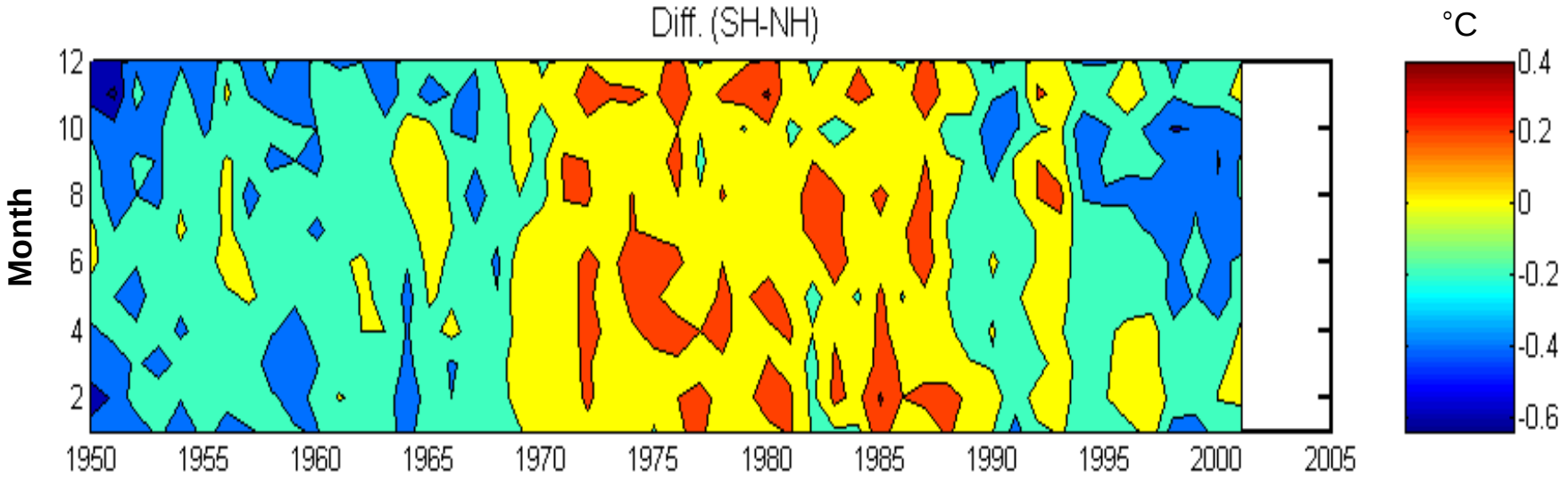
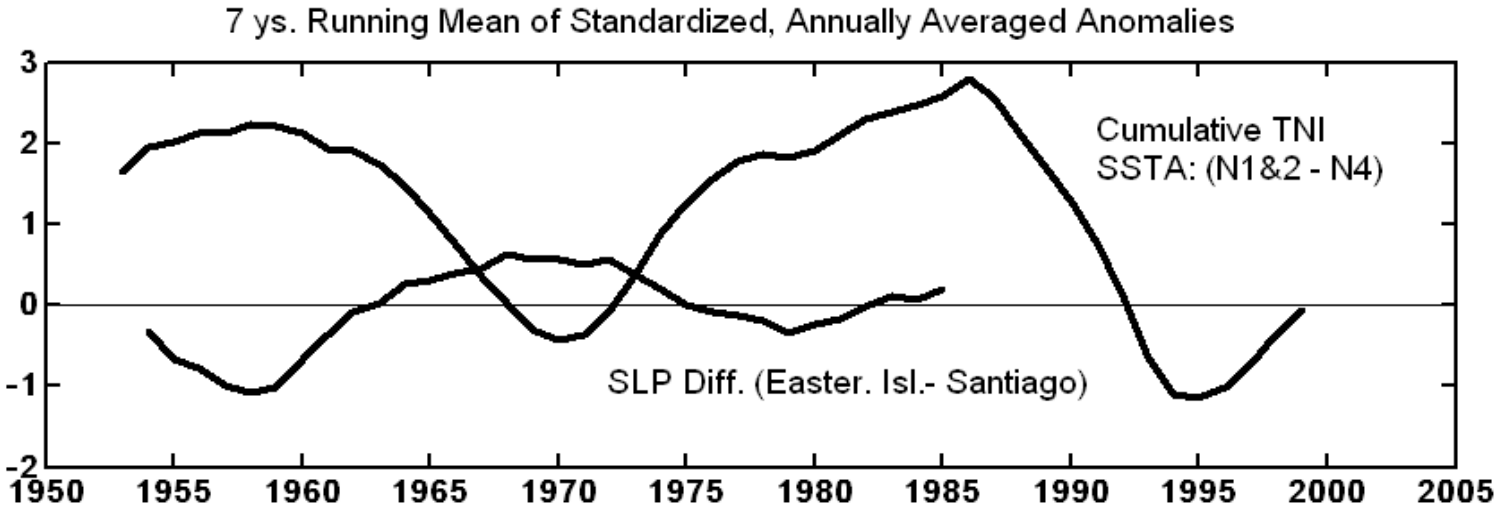
Regime Shift:

A persistent radical shift in typical levels of abundance or productivity of multiple important components of the marine biological community structure, occurring at multiple trophic levels and on a geographical scale that is at least regional in extent.

Bakun, 2004. Regime Shifts. The Sea, vol. 13, (in press)

Anomalies of Hemispheric Air Temperature





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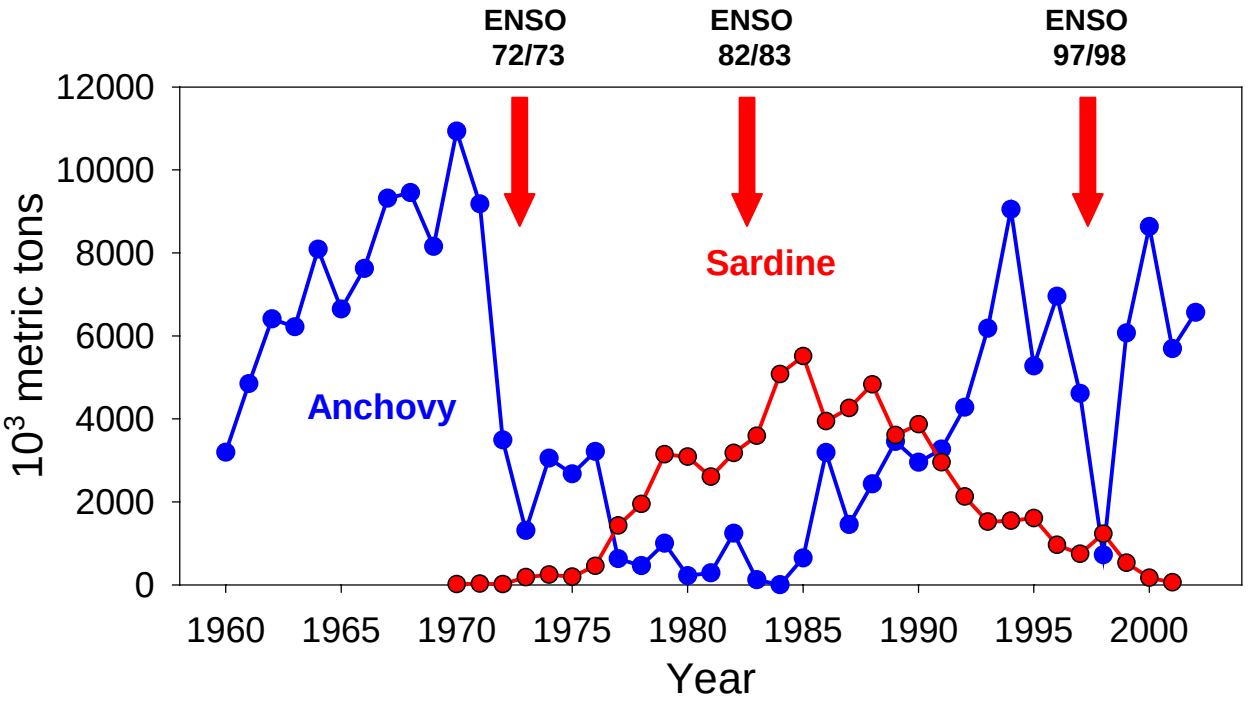
Anchovy and Sardine Catches in Humboldt Current



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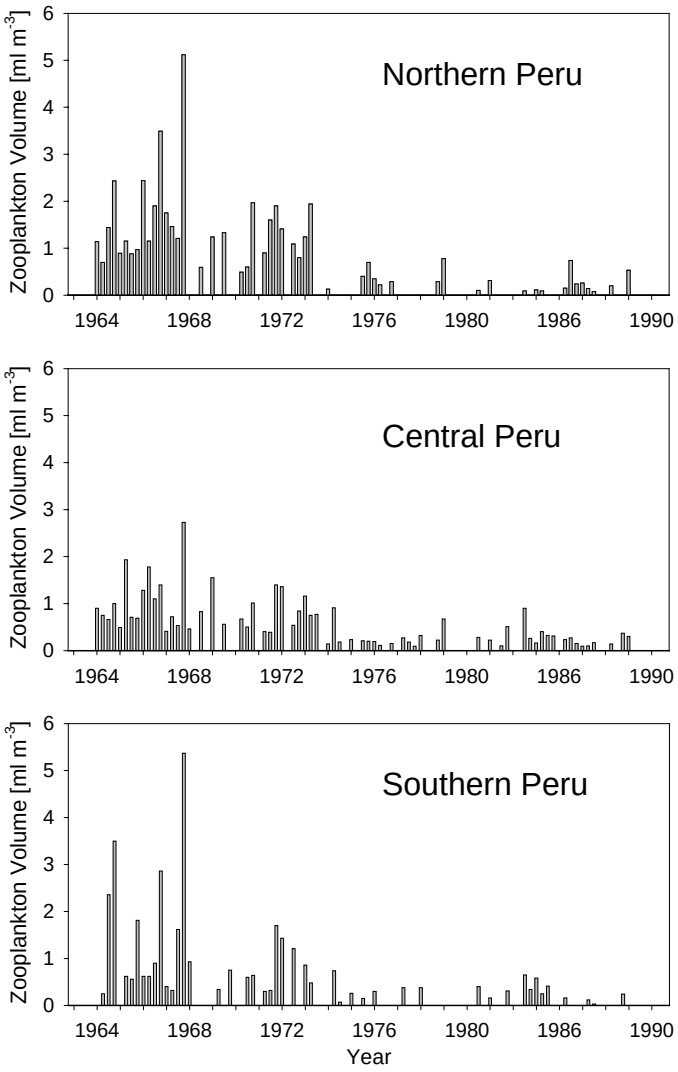
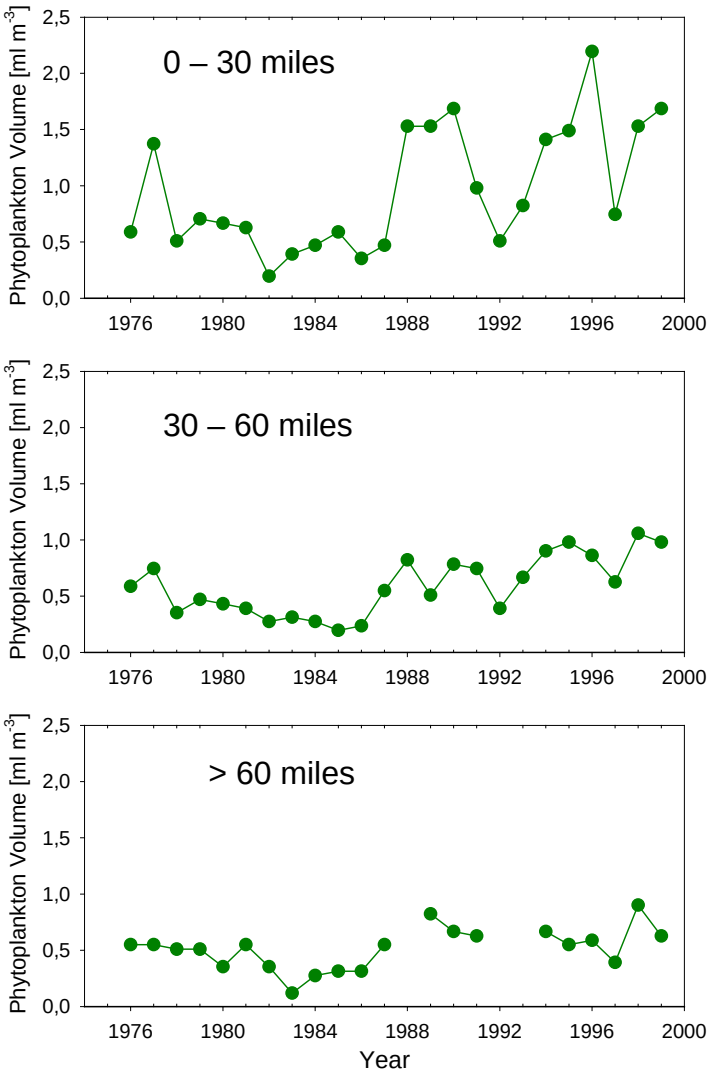


Peruvian Zooplankton Volumes
1964 - 1988

Peruvian Phytoplankton Volumes
1976 - 1999



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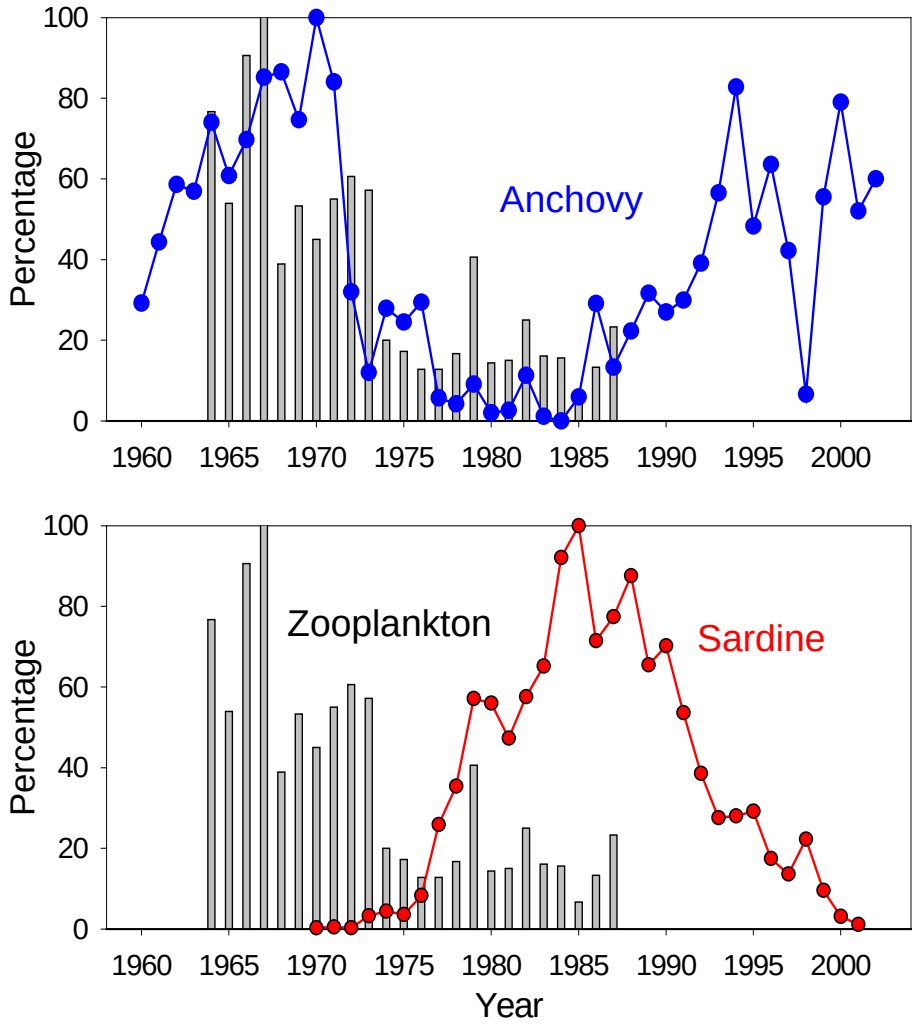
Dynamics of Anchovies, Sardines, and Zooplankton



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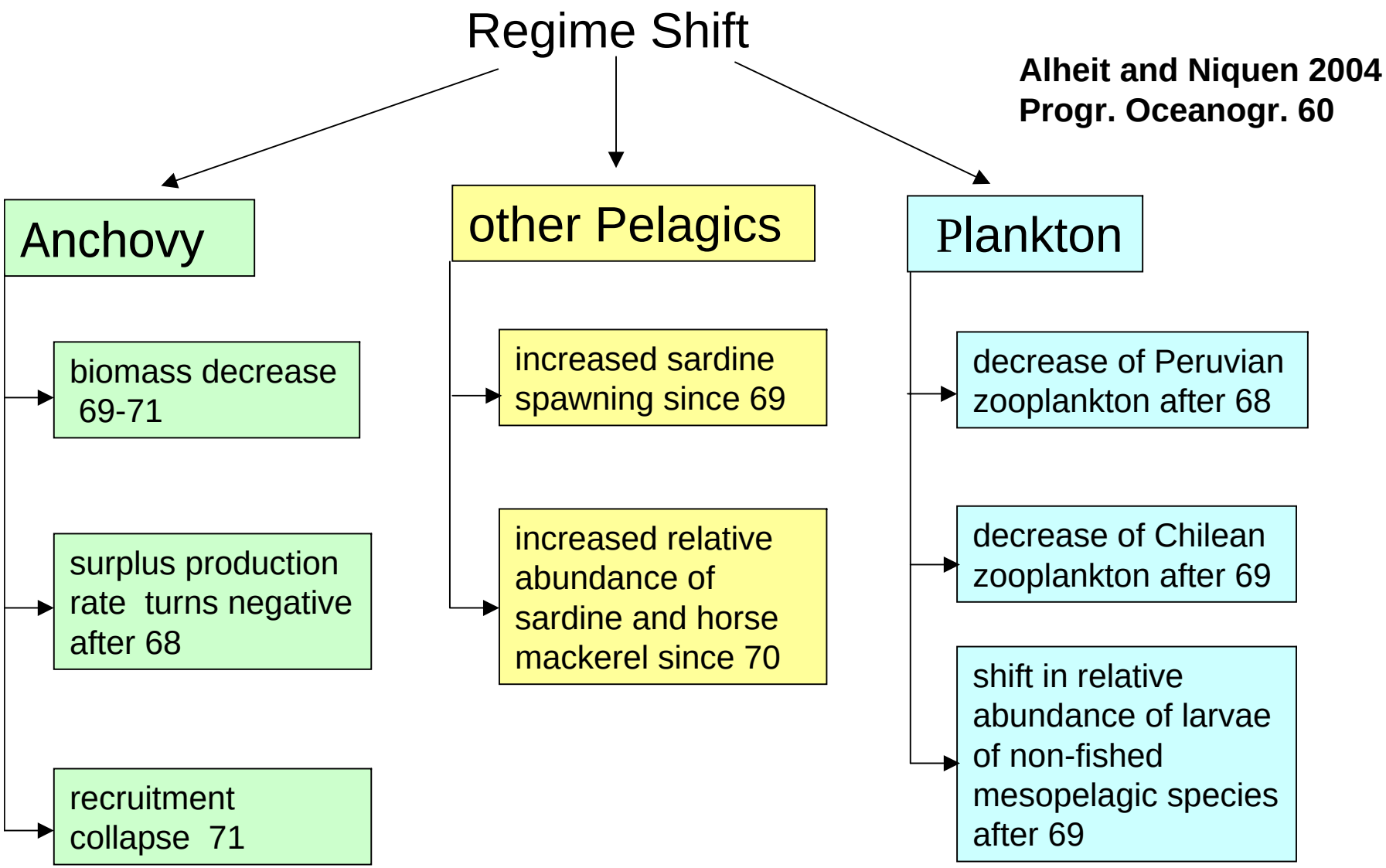
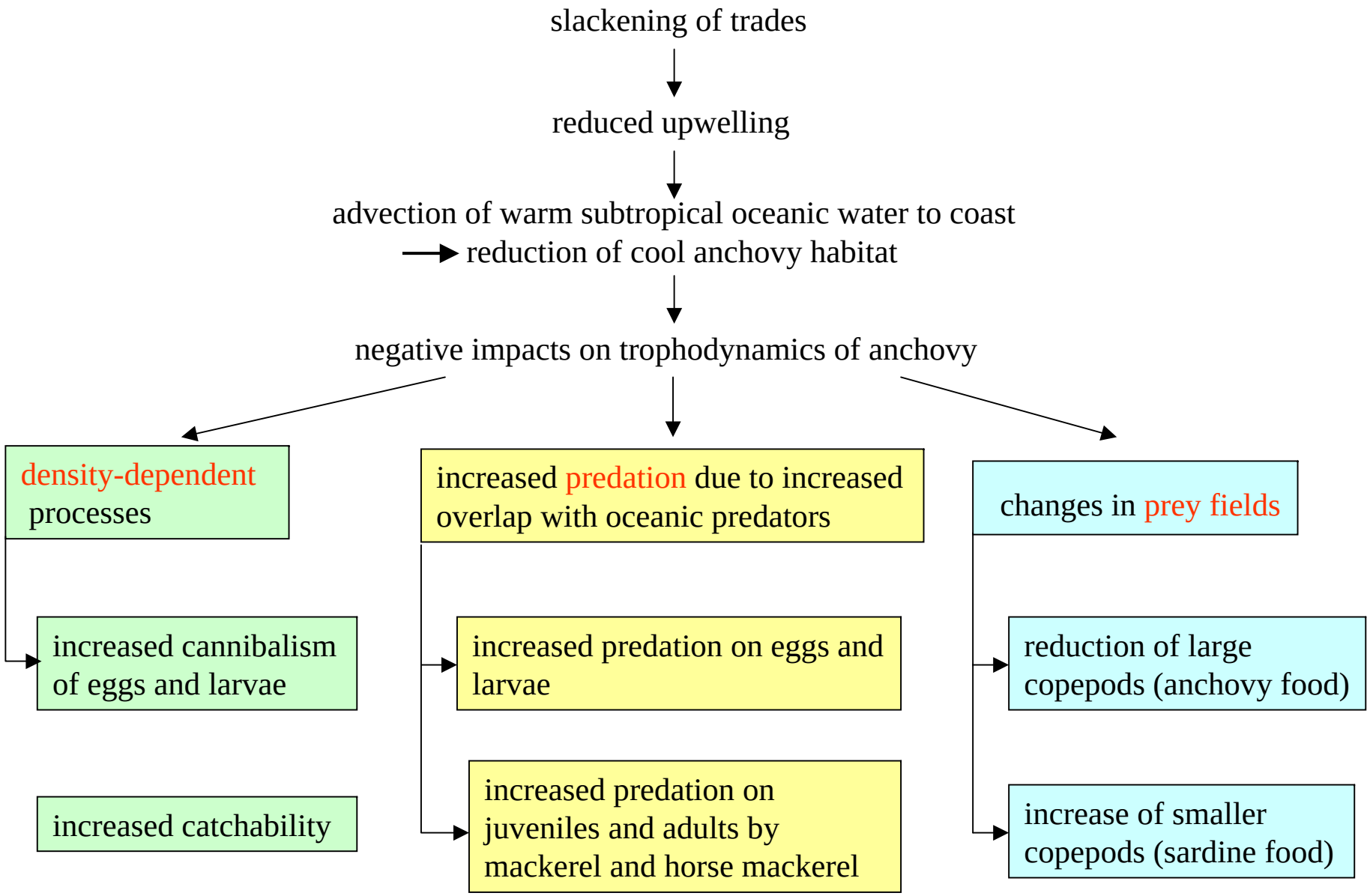
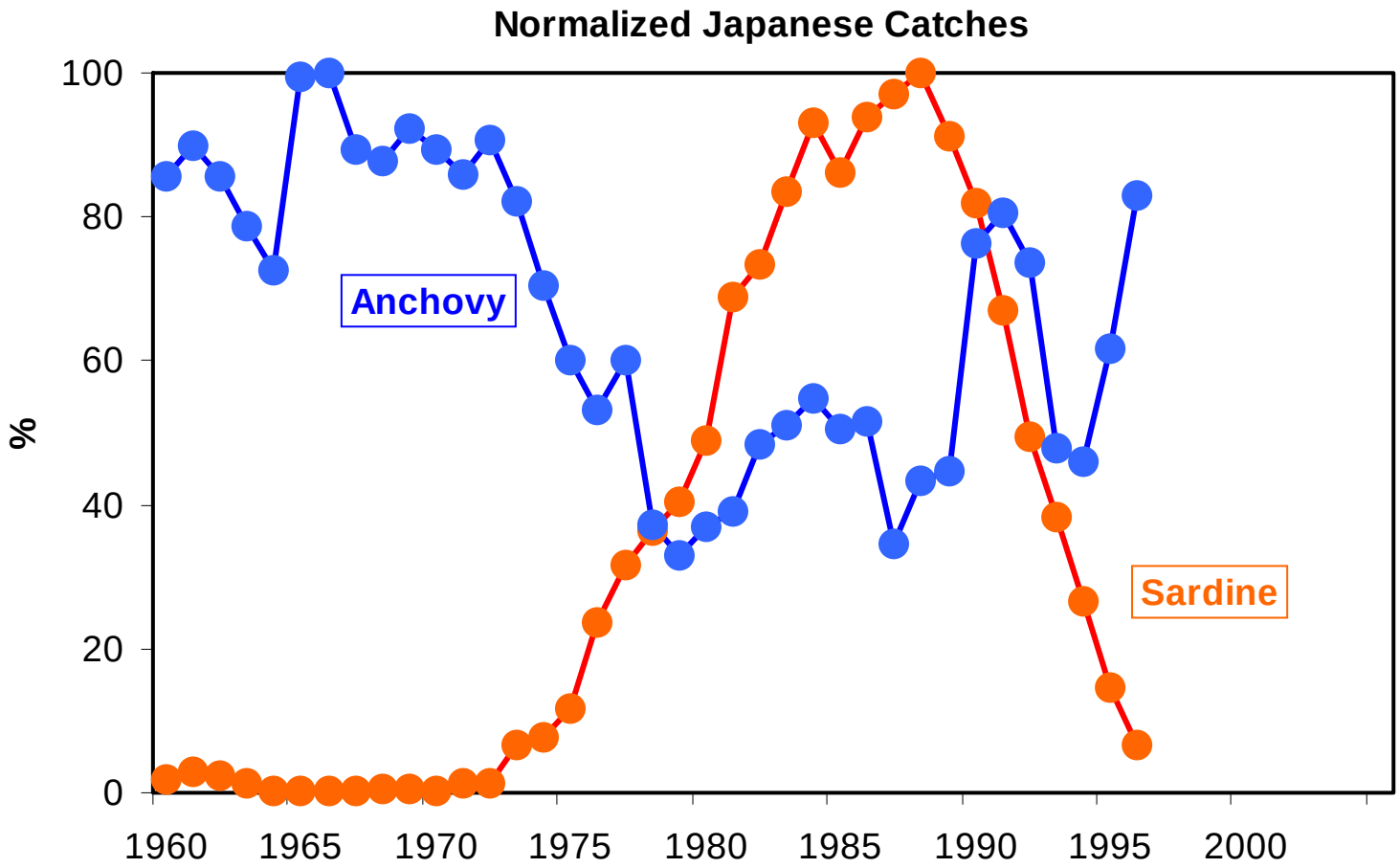
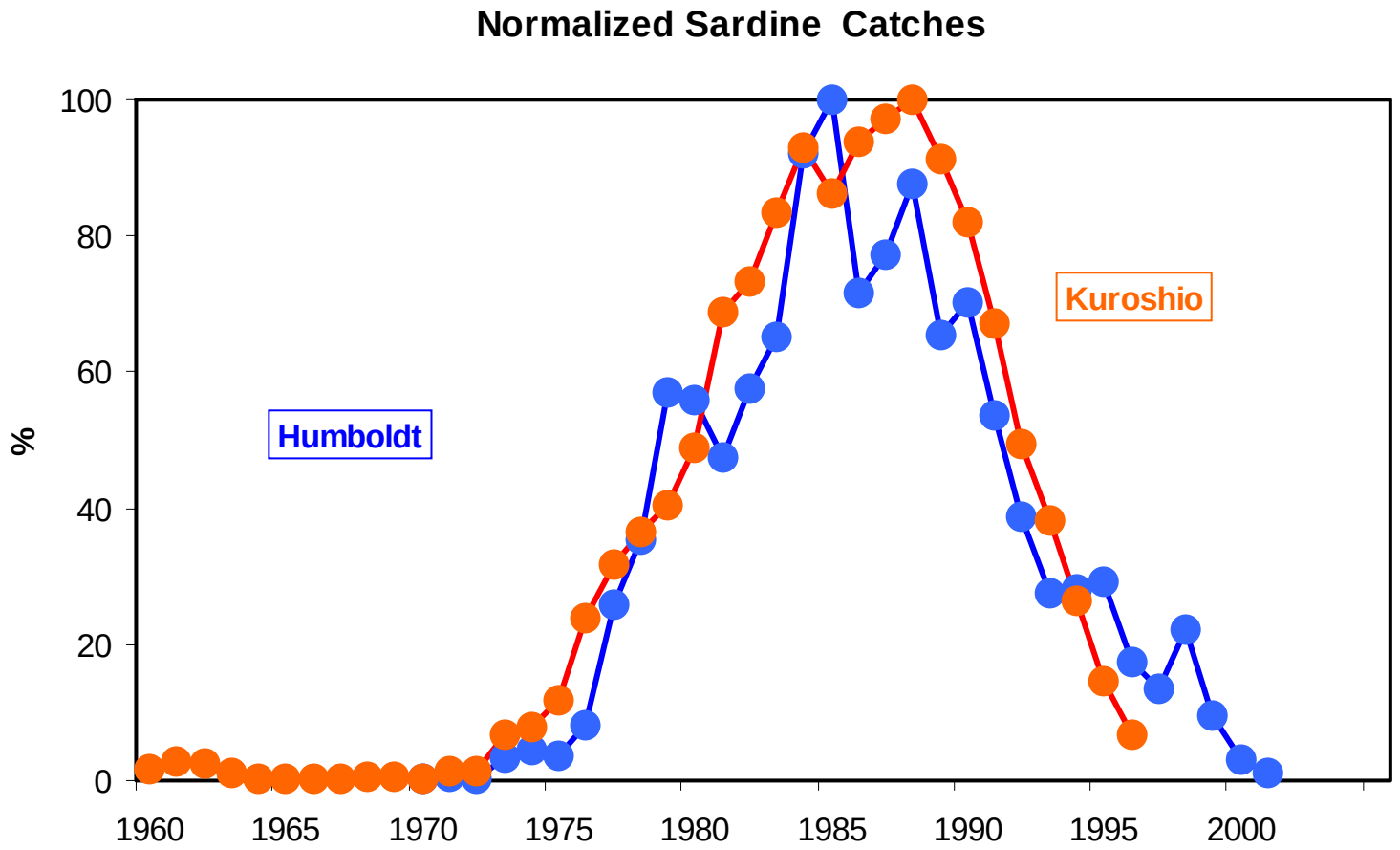
Observed Biological Changes in Humboldt Current 1968-71

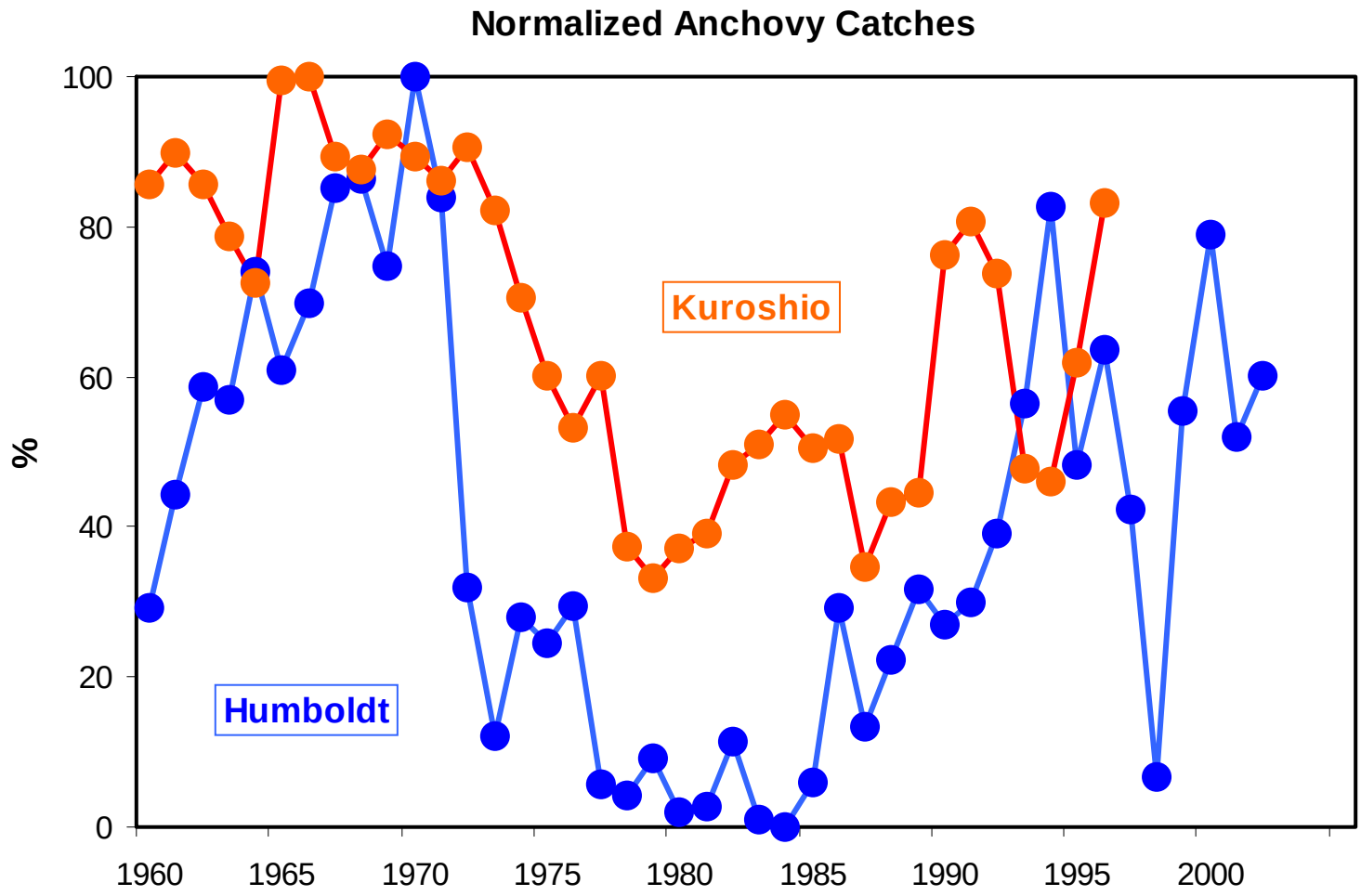


Mechanisms of Regime Shifts in Humboldt Current – Causal Relationships



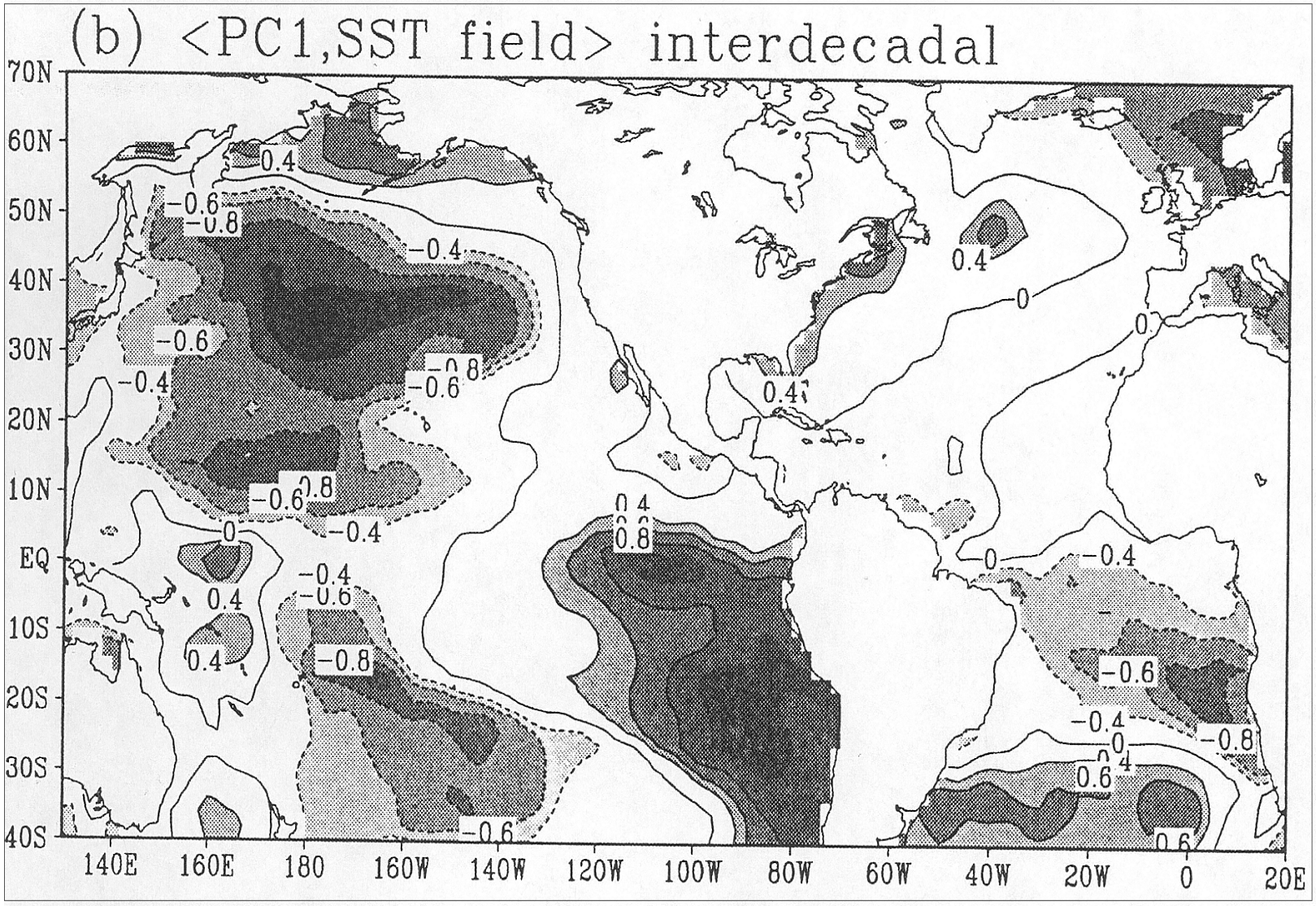

Normalized Japanese Catches
%
100
80
60
40
20
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
Anchovy
Sardine


Normalized Sardine Catches
100
80
60
40
20
0
%
1960
1965
1970
1975
1980
1985
1990
1995
2000
Humboldt
Kuroshio


Normalized Anchovy Catches
100
80
60
40
20
0
%
1960
1965
1970
1975
1980
1985
1990
1995
2000
Kuroshio
Humboldt

PC1: Coastal Station SSTA off Peru/ Chile
ERSSTA: Global

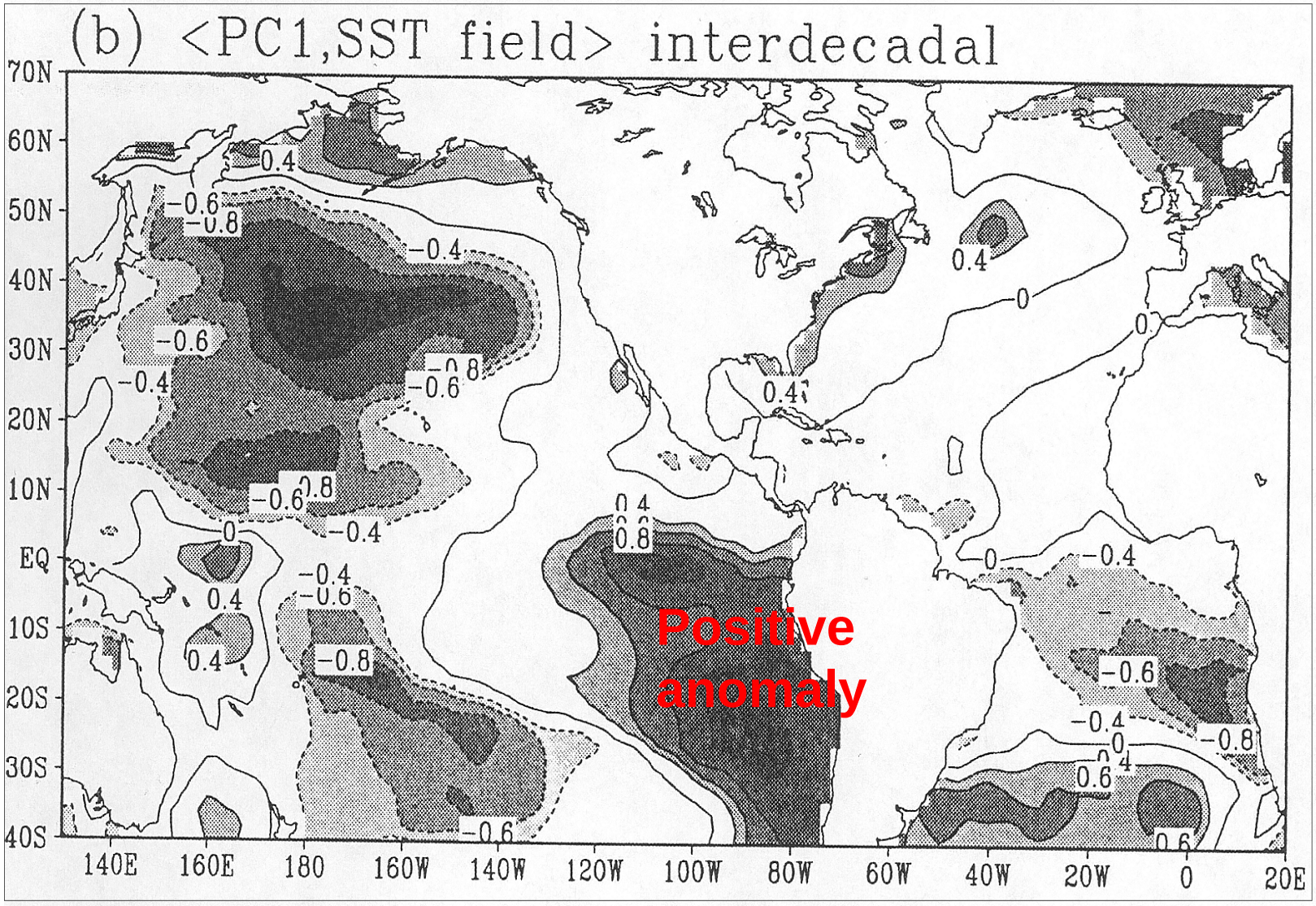
Correlation Coeff. R>0.63 (95%)



Montecinos et al. 2003 (Fig.4b)

PC1: Coastal Station SSTA off Peru/ Chile
ERSSTA: Global

Correlation Coeff. R>0.63 (95%)



Montecinos et al. 2003 (Fig.4b)

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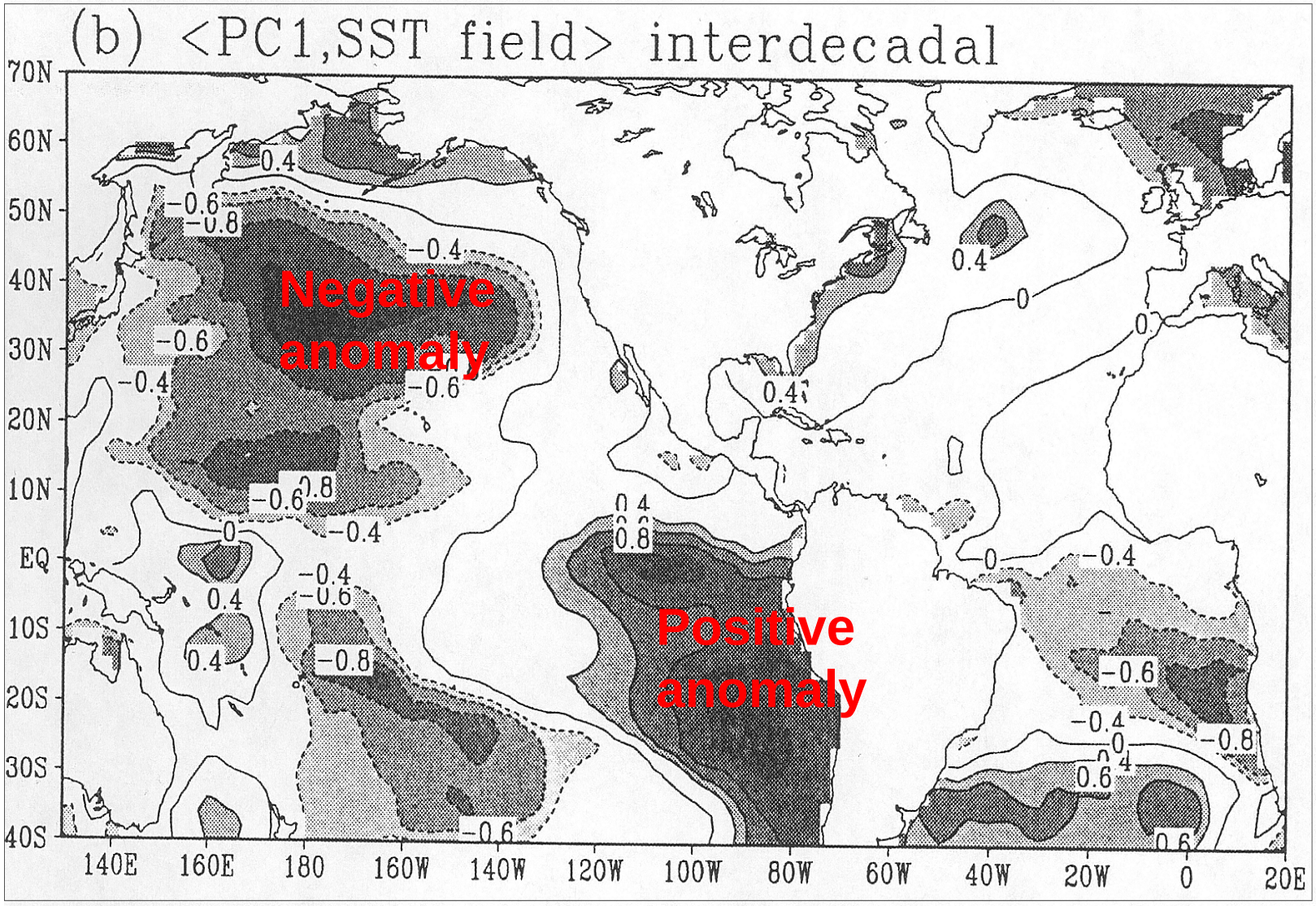

Montecinos et al. 2003 (Fig.4b)

Shift anchovy-sardine Peru:	**1968-1970**
Shift anchovy-sardine Japan:	**1966-1972**
Shift MLD shallow-deep Kuroshio:	**mid-1960s**
Shift sardine-anchovy Peru:	**mid-1980s**
Shift sardine-anchovy Japan:	**mid-late 1980s**
Shift MLD deep-shallow Kuroshio:	**1985**

Dynamics of mixed layer depth Kuroshio (Yasuda et al., 2000, *Prog. Oceanogr*. **47**)

Conclusions:

- **Anchovy and sardine dynamics in Humboldt Current driven on decadal scale**

- **El Niño: short-term perturbation for Peruvian anchovy**

- **Famous anchovy collapse in Peru BEFORE 1972/73 El Niño (at least initiated)**

- **Major changes in dynamics of anchovies and sardines in Humboldt and Kuroshio Currents in late 1960s-1970 and mid-late1980s**

- **No evidence for major changes in mid-1970s**
  > compare presentations by Schwing et al. (Monday) & by Tian et al. ; Japan Sea (Tuesday)

- **Evident “teleconnection” between dynamics of small pelagics in Humboldt and Kuroshio Currents**

Major Question:

- **What drives the “teleconnection” between the two systems?**