An important ocean scales:
Decadal Oscillations & Fish Regimes

Spatial-scales

Natural Climate Variability & Ocean Ecosystems
Spatial-scales

Natural Climate Variability & Ocean Ecosystems

An important ocean scales:
Decadal Oscillations & Fish Regimes

Decadal Time Scales:
Basin Wide Variability
(1) Pacific Decadal Oscillation
(2) North Atlantic Oscillation
Long-term fluctuations in Fish Stocks

An example from the Pacific Ocean
Sardine Eggs Distribution & Ocean Temperatures

1996

9603JD
March 21 - April 7, 1996
Composite AVHRR Image

Sardine eggs / m³
- 30 eggs / m³
- 15 eggs / m³
- 8 eggs / m³
- 2 eggs / m³

1997

9703JD
March 11 - April 7, 1997
Composite AVHRR Image

Point Conception

Egg sampling in the California Current (Pacific Ocean)
Checkley et al. 2000
Regional Climate Indices track Fish Stocks

Warm/Cold Phases may be linked to Fish

Fig. 5. Selected regional climate time series with PDO signatures. Dotted vertical lines are drawn to mark the PDO polarity reversal times in 1925, 1947, and 1977. Bars are shaded as in Fig. 1, with the shading convention reversed for the BC/Washington streamflow index.
Regional Indices & Basin-scale Climate

Most of the regional indices reflect large-scale climate variations in the North Pacific they can be summarized.

Pacific Decadal Oscillation Index
Atmospheric Driver of Mean Climate (not steady)

January Mean Sea Level Pressure

Long Term Mean slp millibars

Aleutian Low

Mean Sea Level Pressure

Negative Phase

Positive Phase

Monthly values for the PDO index: January 1900–August 2004
Pacific Decadal Oscillation

positive phase

negative phase

monthly values for the PDO index: January 1900–August 2004
Pacific Decadal Oscillation and Salmon Stocks

PDO

Western Alaska Sockeye

Central Alaska Sockeye

Central Alaska Pink

Southeast Alaska Pink

Columbia Chinook

US West Coast Coho
Basin-scale Climate Indices and Global Climate

1976 Regime Shift?
A null hypothesis to explain climate driven “regime-like” transitions in ecosystem species

Examples from instructors research:

E. Di Lorenzo and M. D. Ohman

http://www.pobex.org
Ecosystem exhibit “regime-like” behavior

(from Hare and Mantua 2000, modified by Sheffer et al. 2009)
Ecosystem exhibit “regime-like” behavior

QUESTION:

Are these real regime shifts?

(from Hare and Mantua 2000, modified by Sheffer et al. 2009)
Ecosystem exhibit “regime-like” behavior

QUESTION:

What do these regime-like changes tell us about the dynamics of ecosystem variability?

(from Hare and Mantua 2000, modified by Sheffer et al. 2009)
Zooplankton observations in the California Current
Zooplankton
observations in the California Current


Zooplankton

observations in the
California Current

Nyctiphanes simplex

Euphausia pacifica
Why do some zooplankton time series exhibit sudden and prolonged transitions on decadal scales?
GOAL:

Develop a null hypothesis or conceptual model of ecosystem variability driven by climate forcing.
GOAL:

Develop a null hypothesis or conceptual model of ecosystem variability driven by climate forcing.
Atmosphere