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PRBO Conservation Science

Krill and Krill-Predators: Habitat associations in the dynamic Gulf of the Farallones, California

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Introduction

Euphausiids are a critical source of carbon in marine food webs.

Very little is known about their spatial and temporal distributions, abundance, and reproductive dynamics.

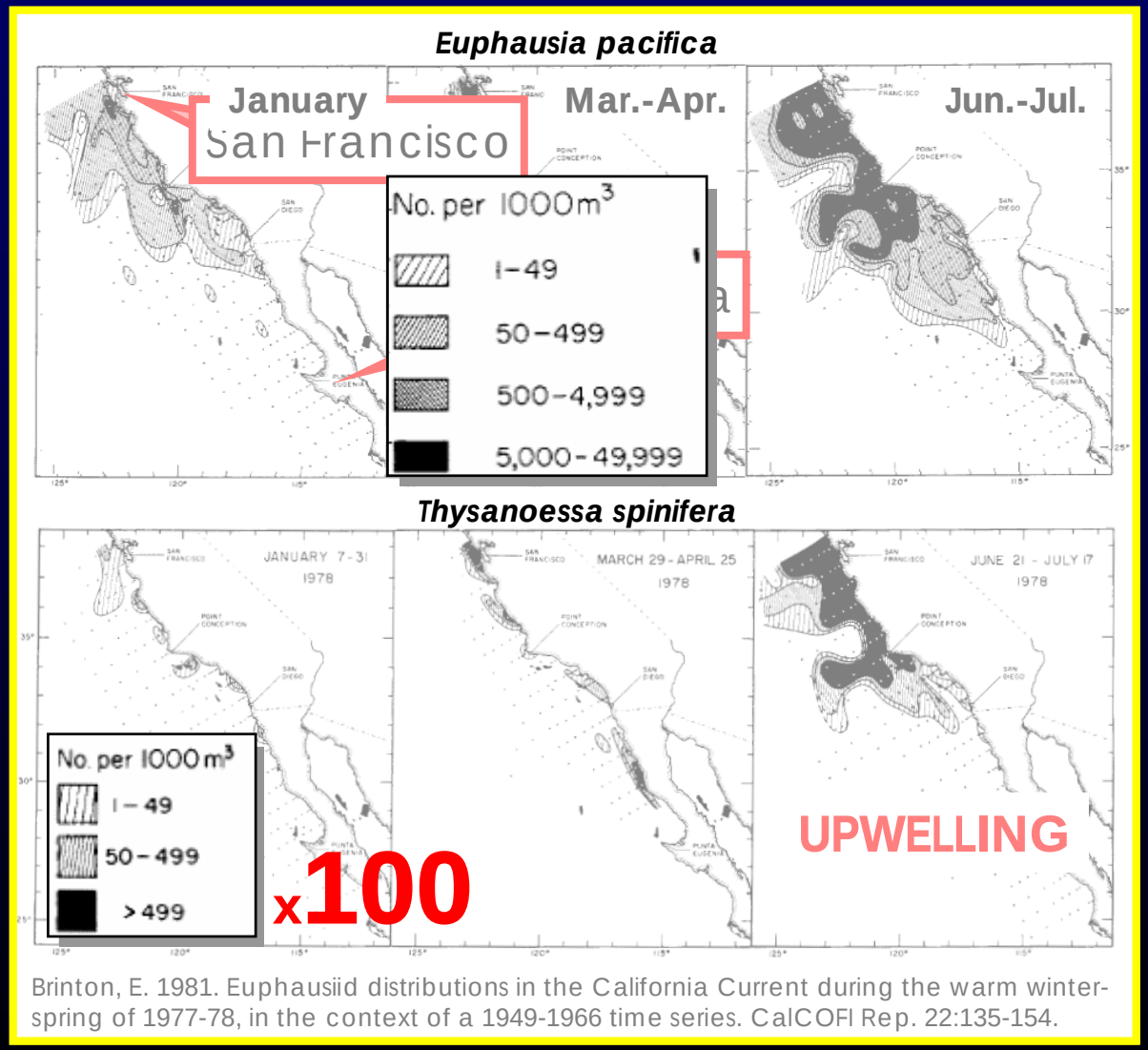
Krill in the California Current

E. pacifica

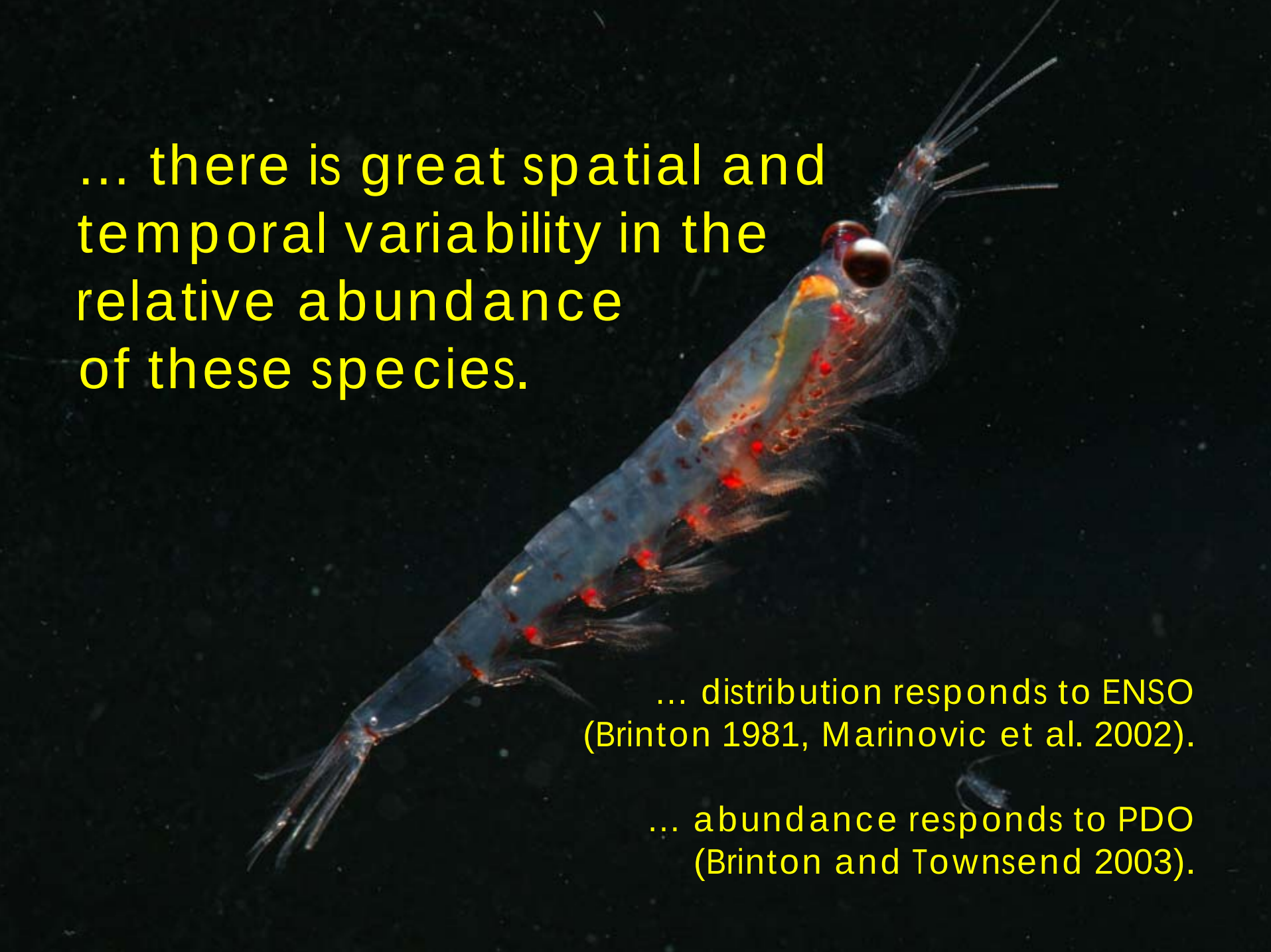
- More abundant
- Oceanic and shelf-break

T. spinifera

- Less abundant
- Shelf



Brinton, E. 1981. Euphausiid distributions in the California Current during the warm winter-spring of 1977-78, in the context of a 1949-1966 time series. CalCOFI Rep. 22:135-154.

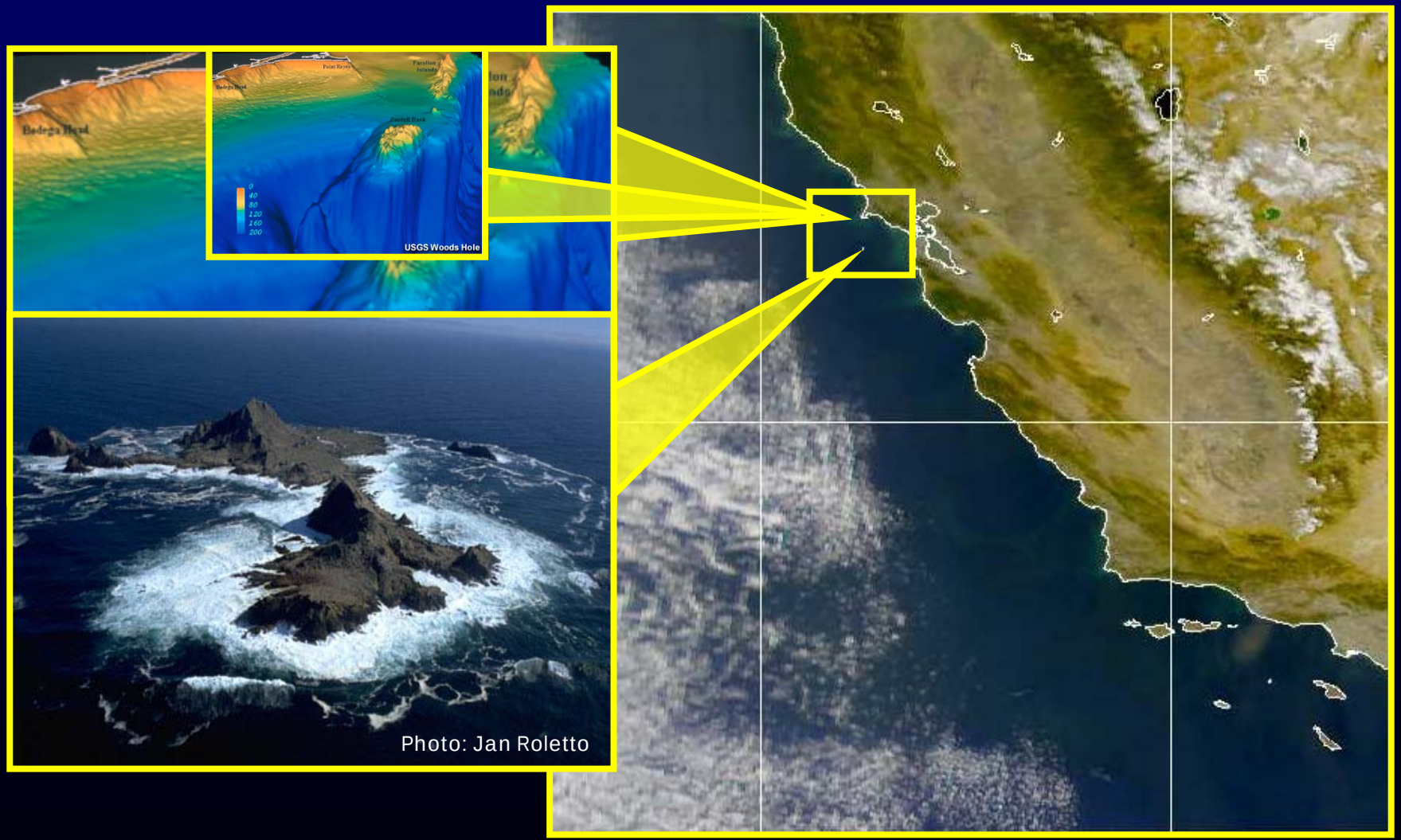


... there is great spatial and temporal variability in the relative abundance of these species.

... distribution responds to ENSO (Brinton 1981, Marinovic et al. 2002).

... abundance responds to PDO (Brinton and Townsend 2003).

The Gulf of the Farallones



Goal

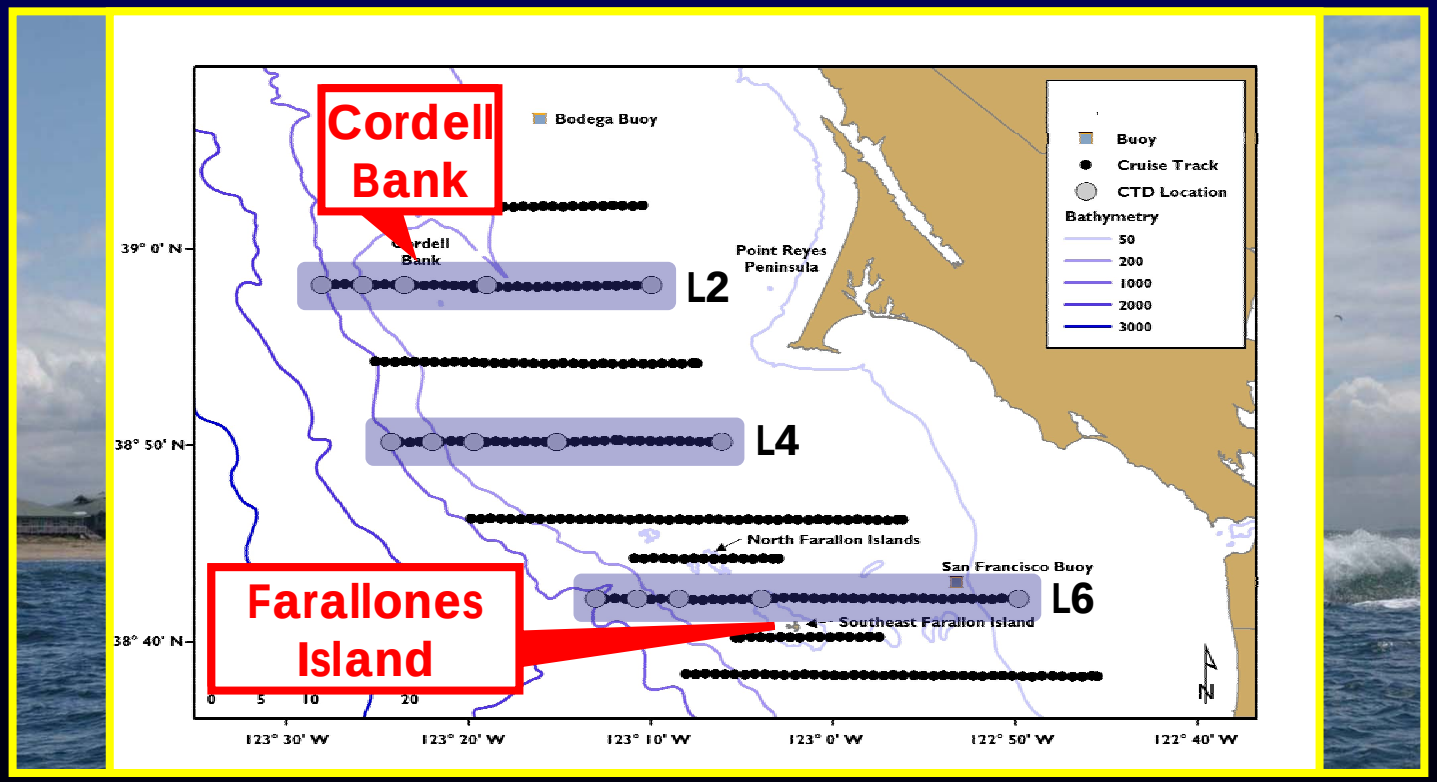
To determine how seasonal and interannual variability in oceanographic conditions affects the distribution and abundance of krill and krill-predators.

Hypothesis

Krill and krill-predators aggregate at predictable locations in the continental shelf and slope waters of the Gulf of the Farallones

Methods

- Research cruises onboard the R/V John H. Martin (MLML)
- Surveys from May to October 2004 and February to July 2005.
- Survey grid, 9 transects (total 300+ km), 3 oceanographic lines.



Methods

- Birds/mammals (standardized strip and line transects)
- Zooplankton/fish (hydroacoustics and nets)
- Oceanography (CTD casts and continuous CT and fluorometery)

Methods

4. Krill abundance and distribution

SIMRAD EK-60 with 38, 120, 200 kHz transducers

Calculated Fiedlers et al.' (1998) index of krill abundance as follows:

$$\Delta S_{Krill} = 0.5\ (S_{v120} + S_{v200}) - S_{v38}$$

S_{Krill} not converted to biomass, sample analysis not completed.

S_{Krill} integrated vertically (upper 50-m and 200-m).

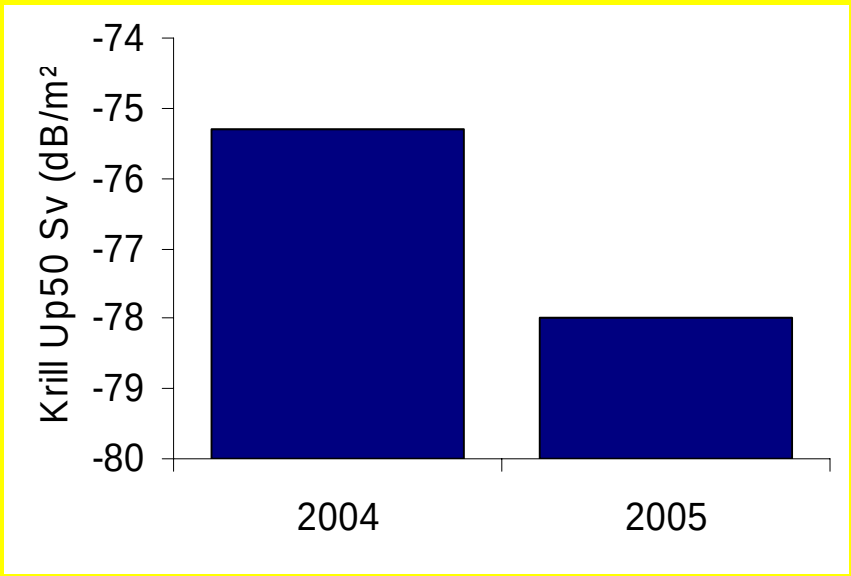
We modeled 3 levels of krill and krill-predator abundance in 3-km bins (Log+1 transformed). Forward stepwise ordered logistic regression for the analysis (NS variables were dropped)

Results

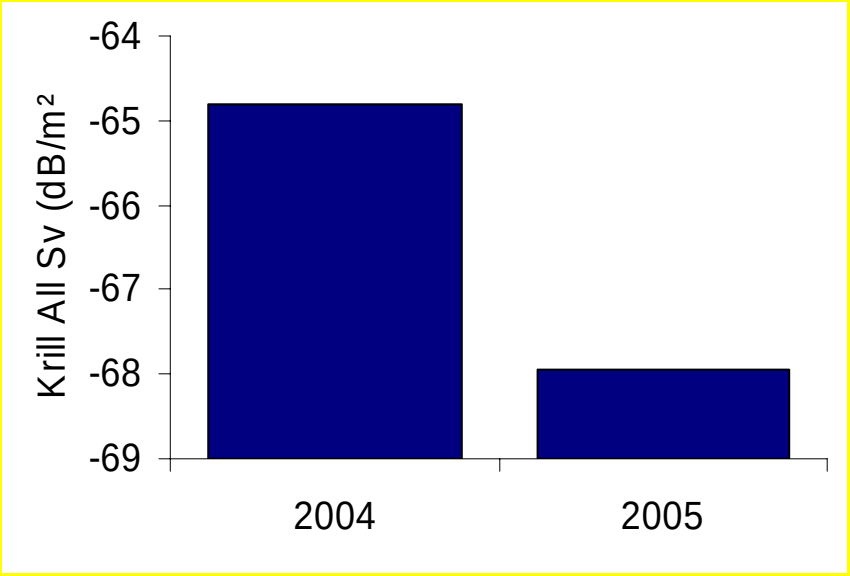
More krill in 2004 than 2005

(Ordered Logistic Regression, $p < 0.01$)

Upper 50-m



Upper 200-m

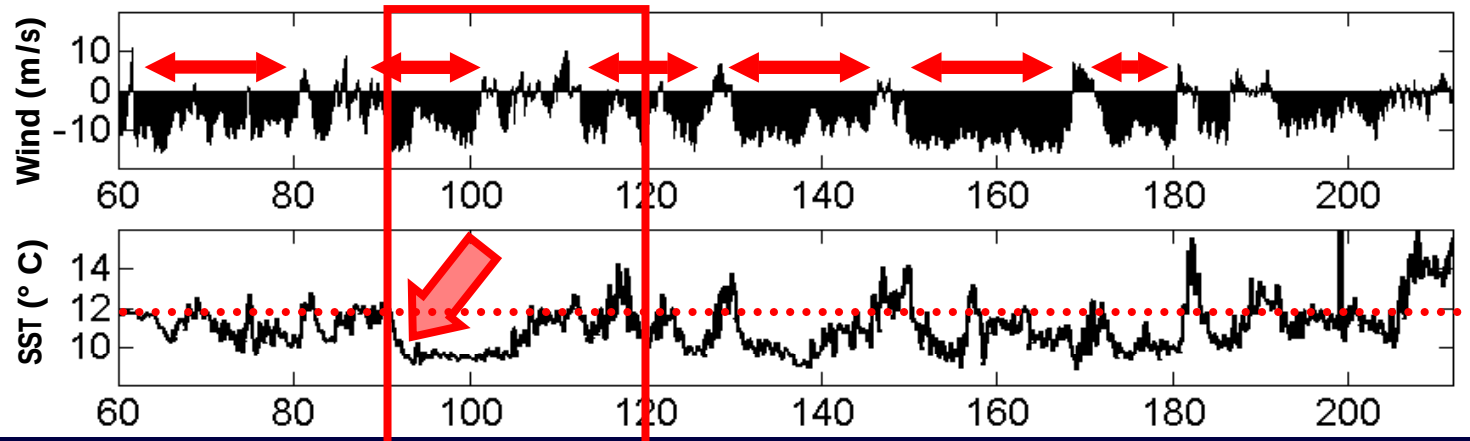


Results

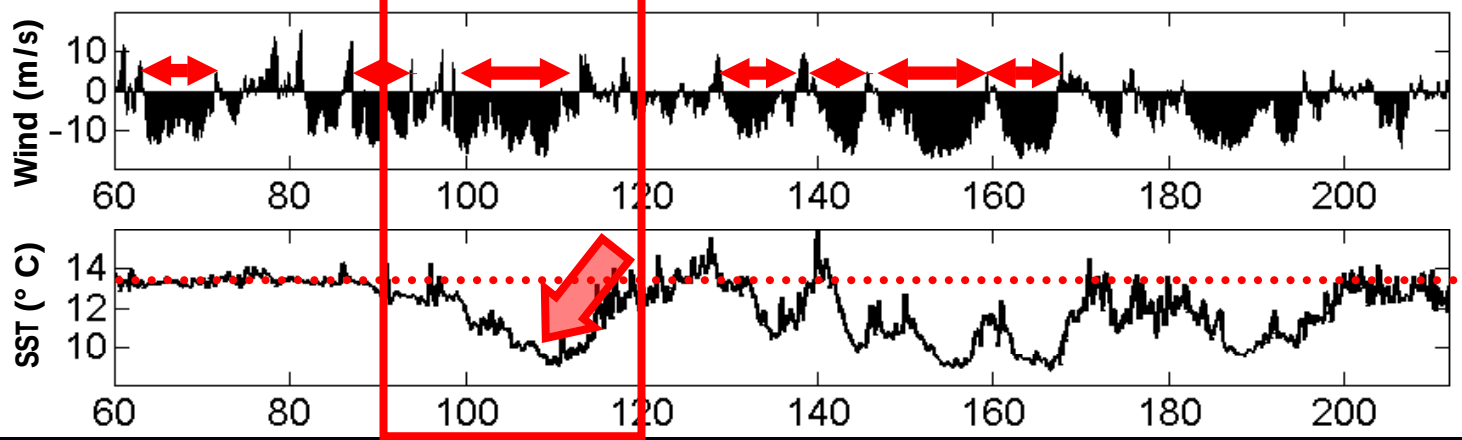
2004 and 2005 were very different...

Alongshore wind and SST; Bodega (46013)

March to July, 2004

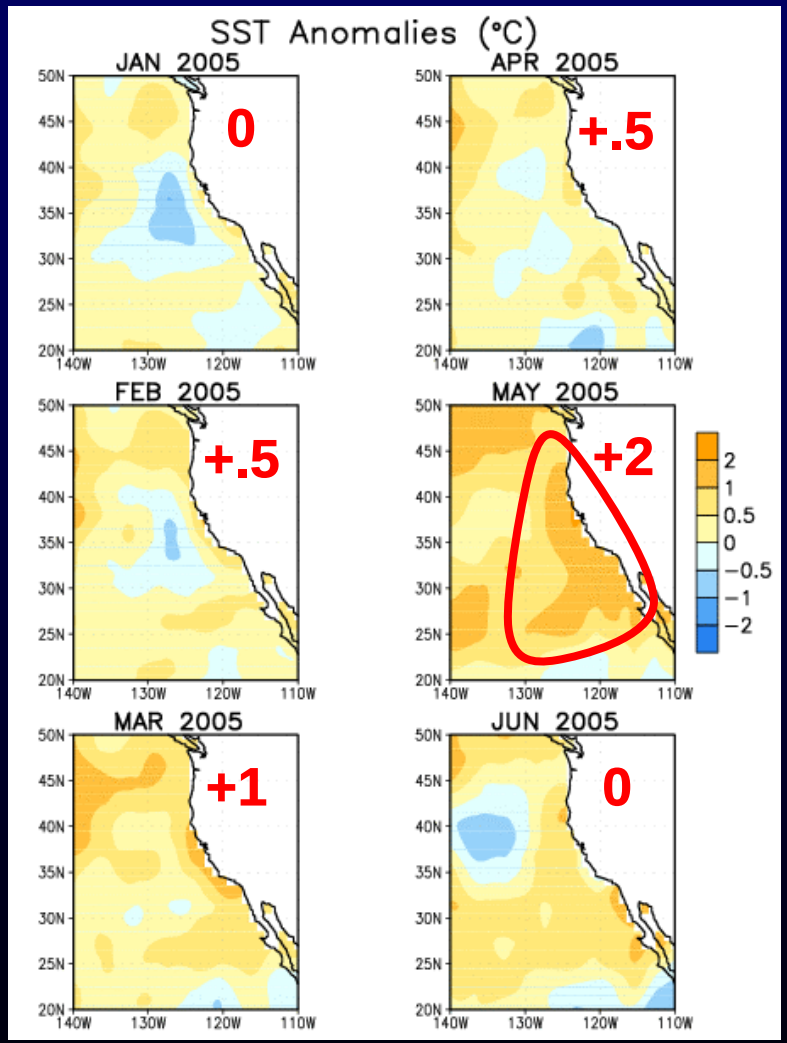


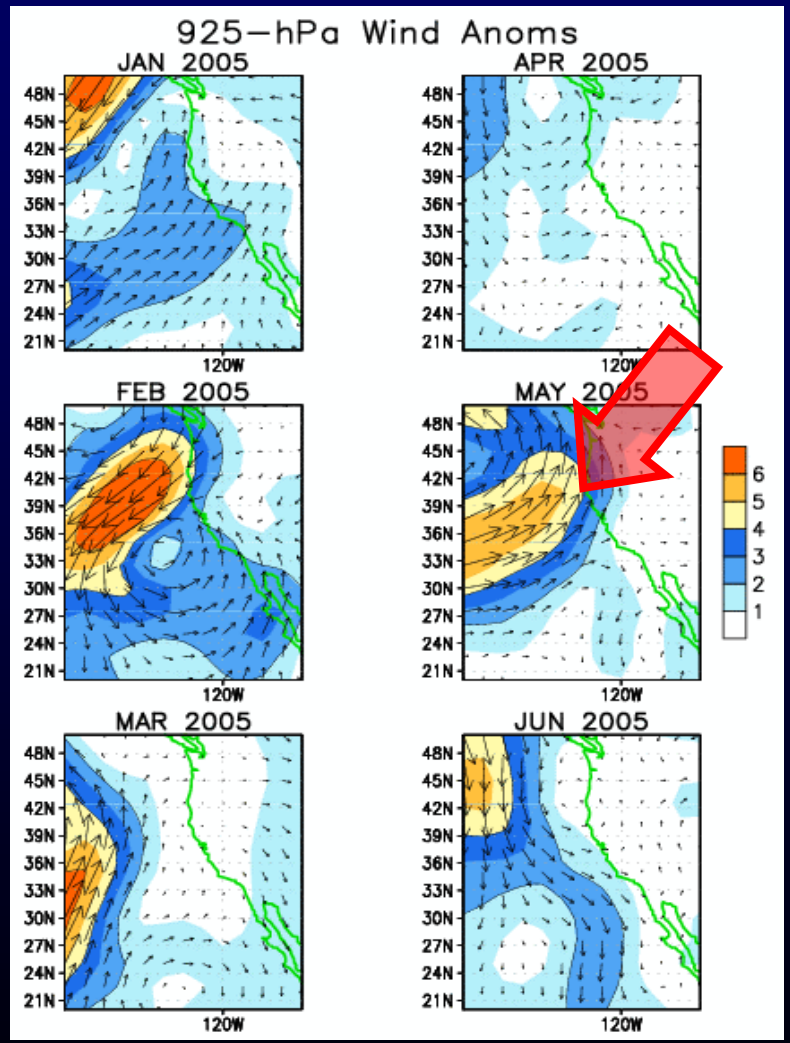
March to July, 2005



APRIL

SST and low-level wind anomalies; 2005

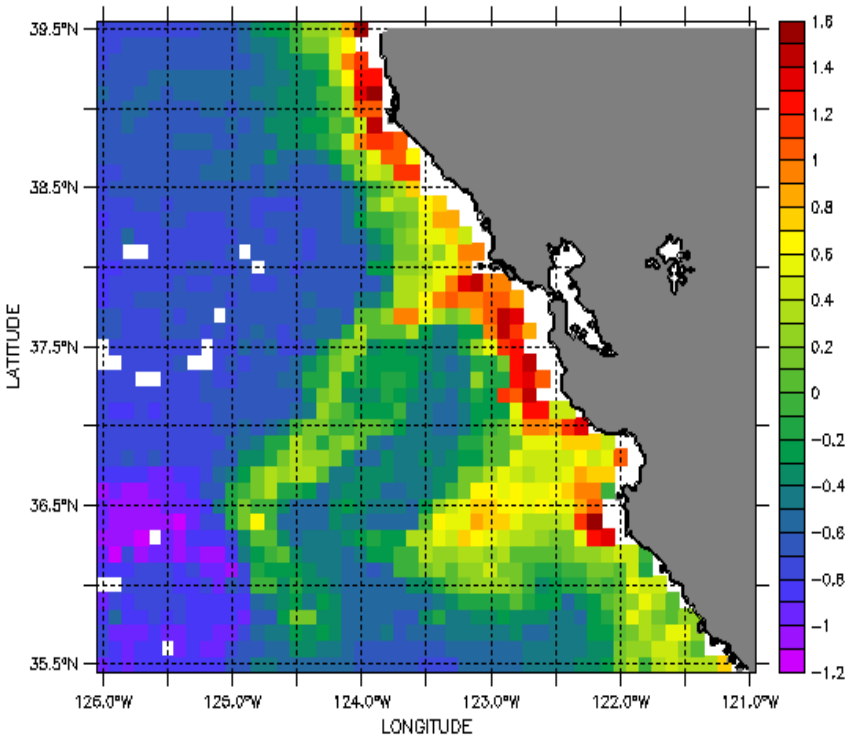




Figures: Vernon Kousky (vernon.kousky@noaa.gov)

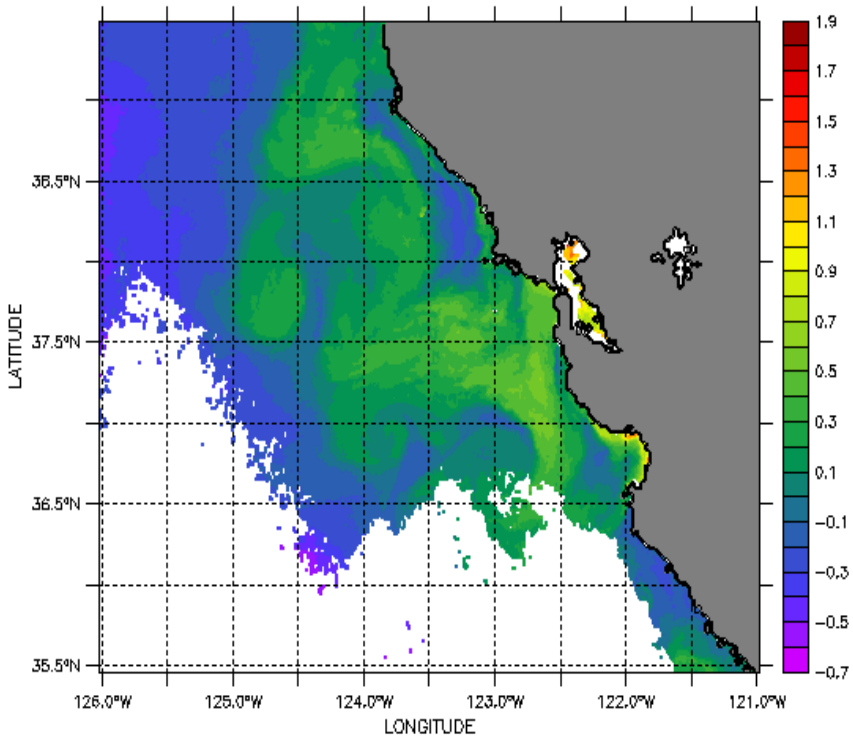
Chlorophyll distribution along central CA

May 2004



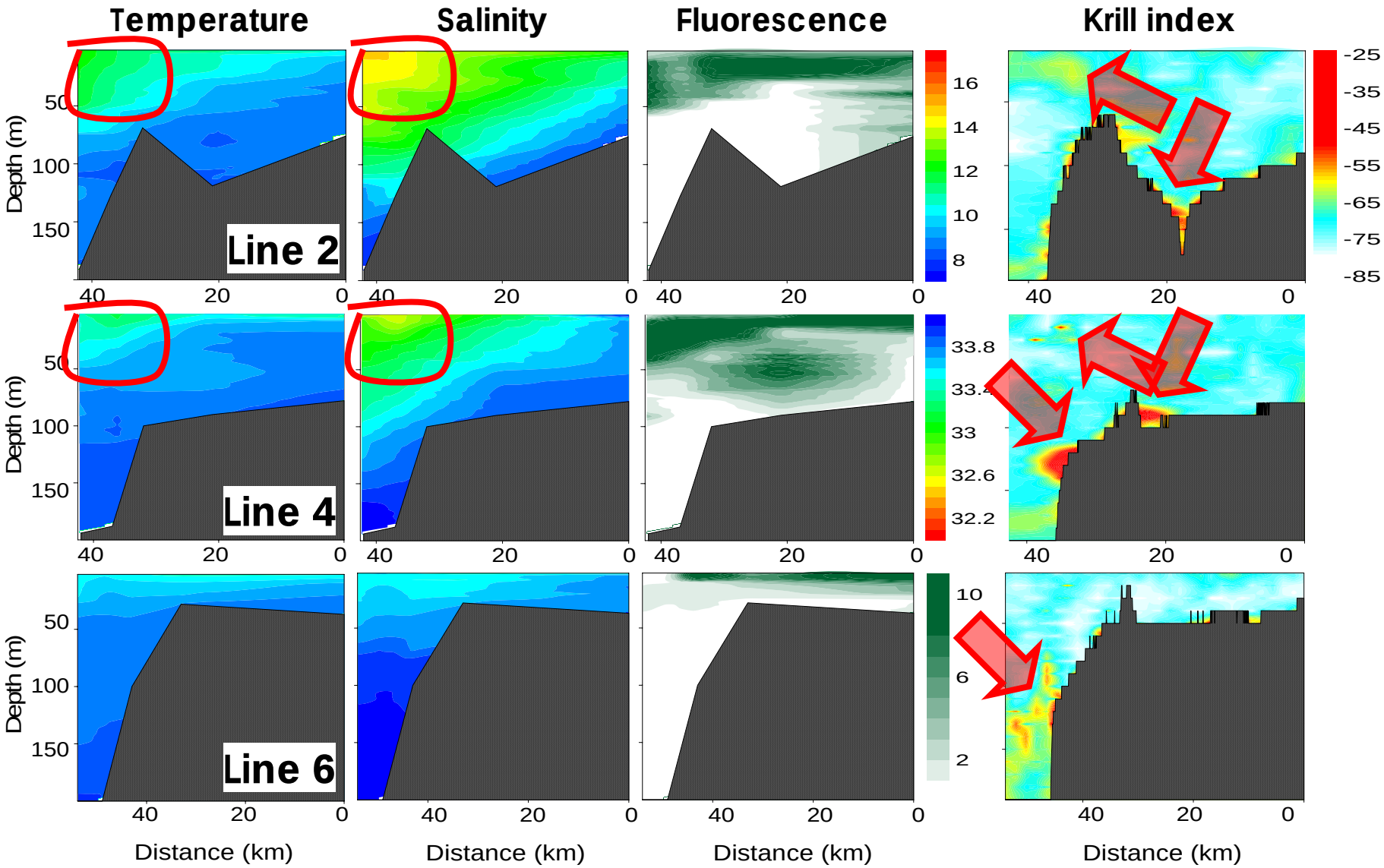
Chlorophyll a pigment concentration: 8-day (mg m^{-3})

May 2005

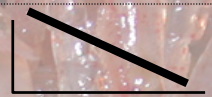
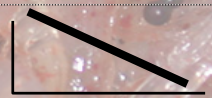


Chlorophyll a 3-day (mg m^{-3})

Krill aggregations (... an example)

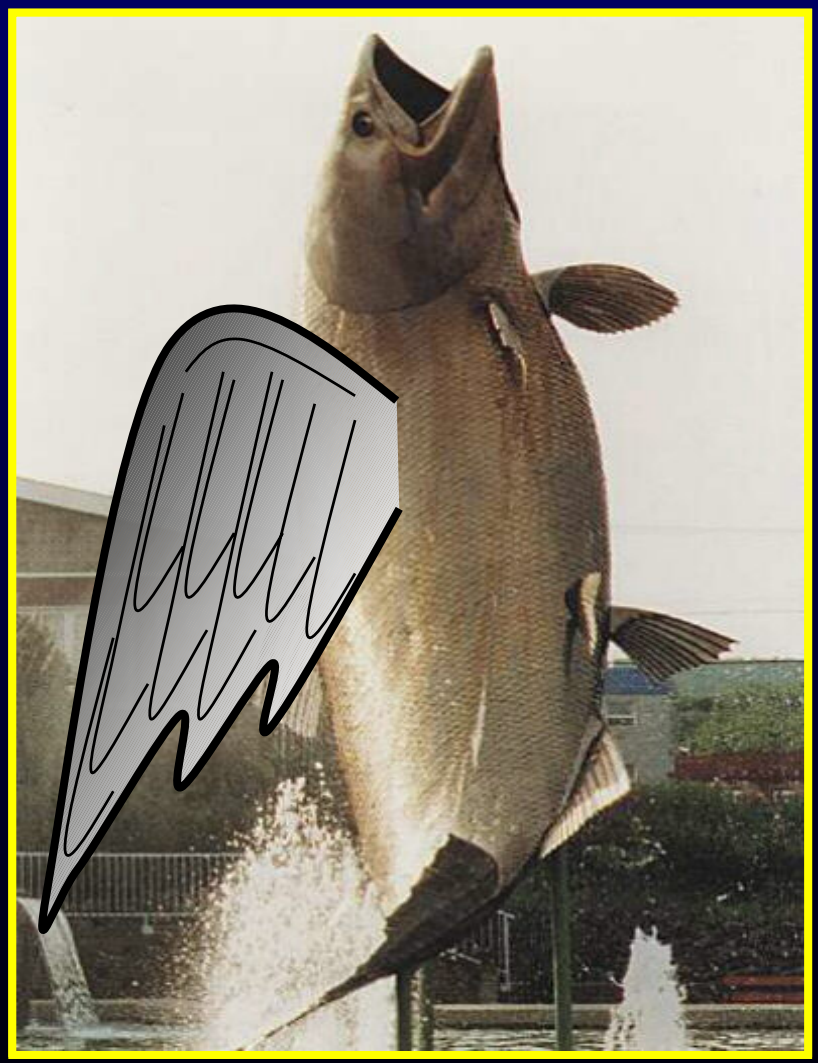


Krill habitat associations

	Upper 200-m
Year	
Month	
Latitude	
Island (SEFI)	
Cordell Bank	
Depth	
Steep bathymetry	
Fluorescence	
LR X^2 =	205.6
p =	0.001


Well… so what???

Salmon with wings (i.e, Cassin's Auklets)



Small birds (23 cm; 150-200 g)

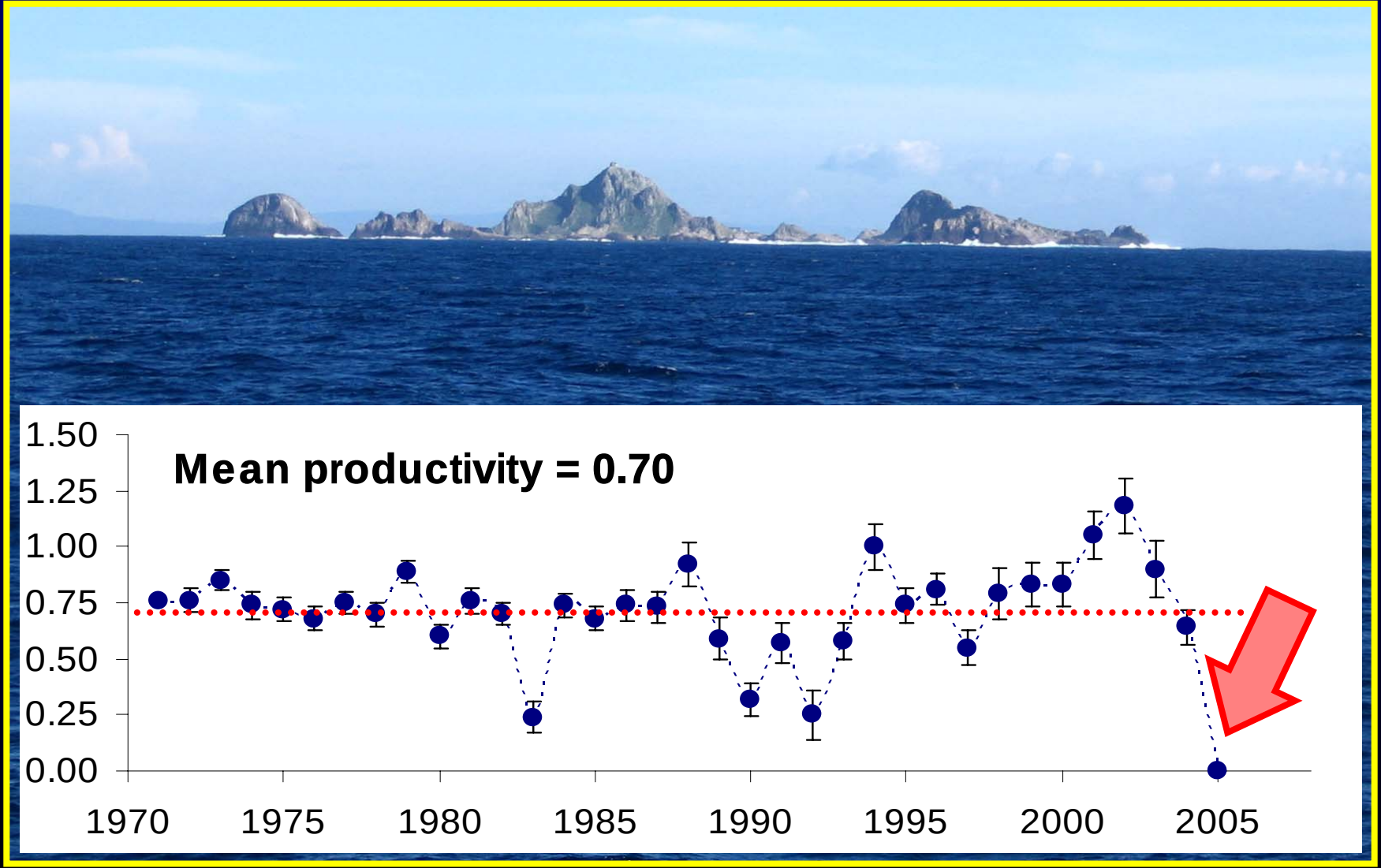
Dive 40 m (20-80 m)

Zooplanktivorous **80% krill**

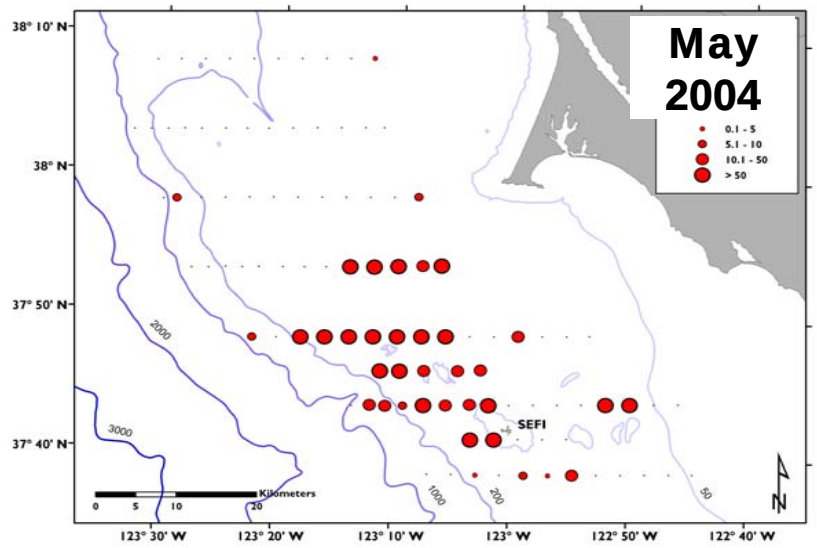
Bird productivity is correlated with krill abundance

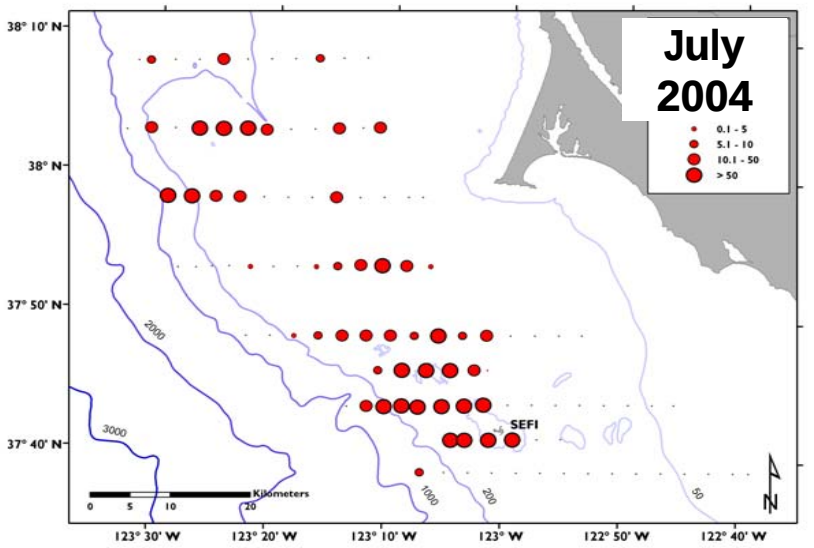
(Abraham and Sydeman 2004)

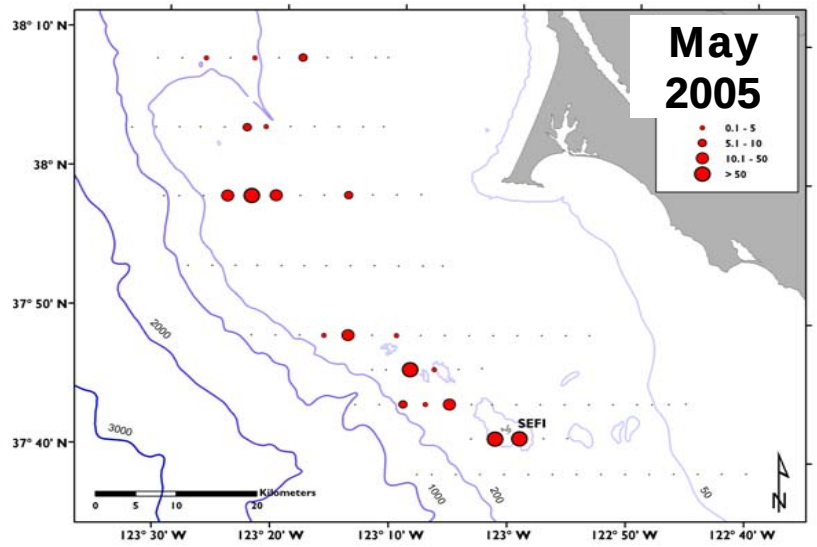
Worst year on record for auklets on SEFI

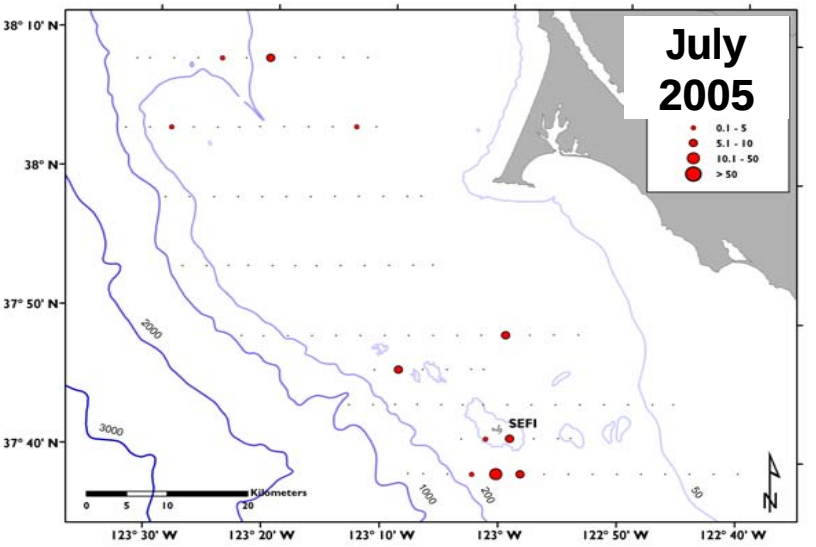


Cassin's auklets distribution

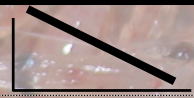
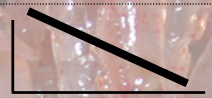
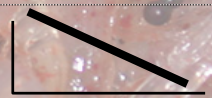
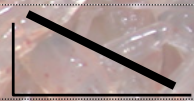








Krill / krill-predator habitat associations

	Upper 200-m		Auklets
Year		=	
Month		≠	
Latitude		≠	
Island (SEFI)			
Cordell Bank		=	
Depth			
Steep bathymetry		=	
Fluorescence			
LR X^2 =	205.6		54.6
p =	0.001		0.001

Conclusions

1. Unusual weather conditions in 2005 (warmer SST, decreased winds) resulted in low krill and krill predator abundance off central California in 2005 than 2004.

2. Krill and krill predators aggregated at predictable locations near Cordell Bank and other areas of rough topography such as the shelf break and submarine canyons.

- This is a work in progress… (15 cruises, next 3 years)

Acknowledgements

Sue Abbott, Jamie Hall, Dave Johnston, Brandy Johnson,
Carol Keiper, Brenna Langabeer, Derek Lee, Shanon Lyday,
Jason Yakich, Pete Warzybok, Sophie Webb

Lee Bradford and Kurt Brown, R/V John H. Martin

Bay Model, US Army Corps of Engineers
Lifeboat Station, Point Reyes National Seashore
Spud Point Marina, Sonoma County Regional Park
Mr. George Nunez, Point St. Joseph Fish Company

Jan Roletto, Gulf of the Farallones National Marine Sanctuary
Dan Howard, Cordell Bank National Marine Sanctuary

Nina Karnovsky, Pomona College
Nancy B. Kachel, PMEL/NOAA
Mariano Gutierrez, IMARPE

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Moore Family Foundation
Resources Legacy Fund Foundation

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