

When is El Niño too hot to handle?: Evidence of a tolerance threshold for a marine top predator.



Photo by S. Peterson

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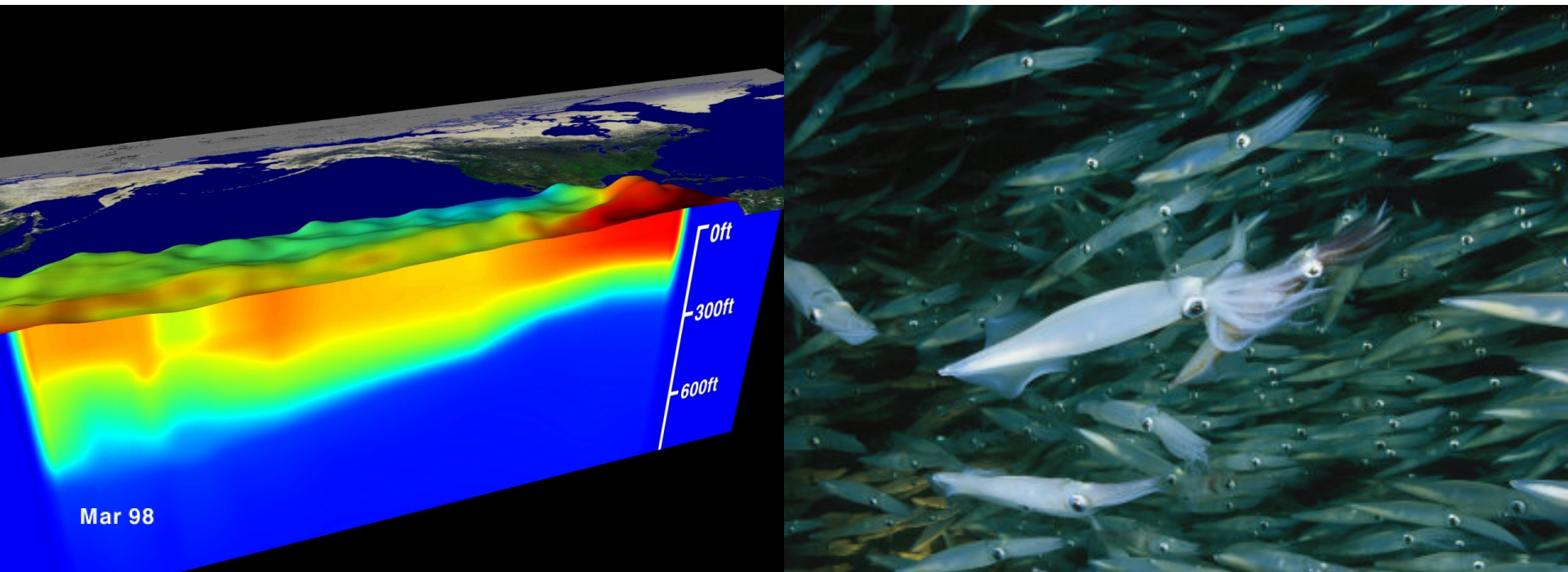
Introduction

How does changing climate impact
predators in pelagic systems?



Introduction

Changes in oceanographic conditions . . .



. . . could lead to changes in prey distribution and availability

Introduction

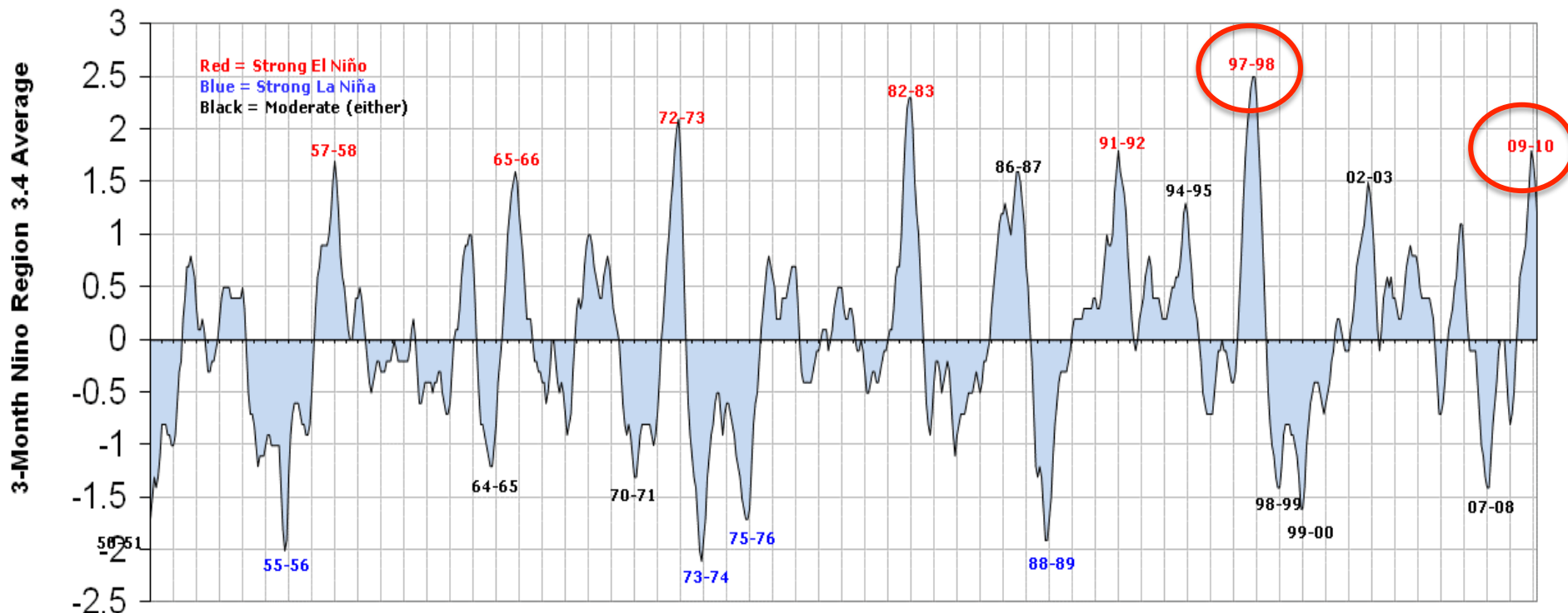
El Niño and Northern Elephant Seals

A Closer Look



Oceanic Niño Index (ONI)

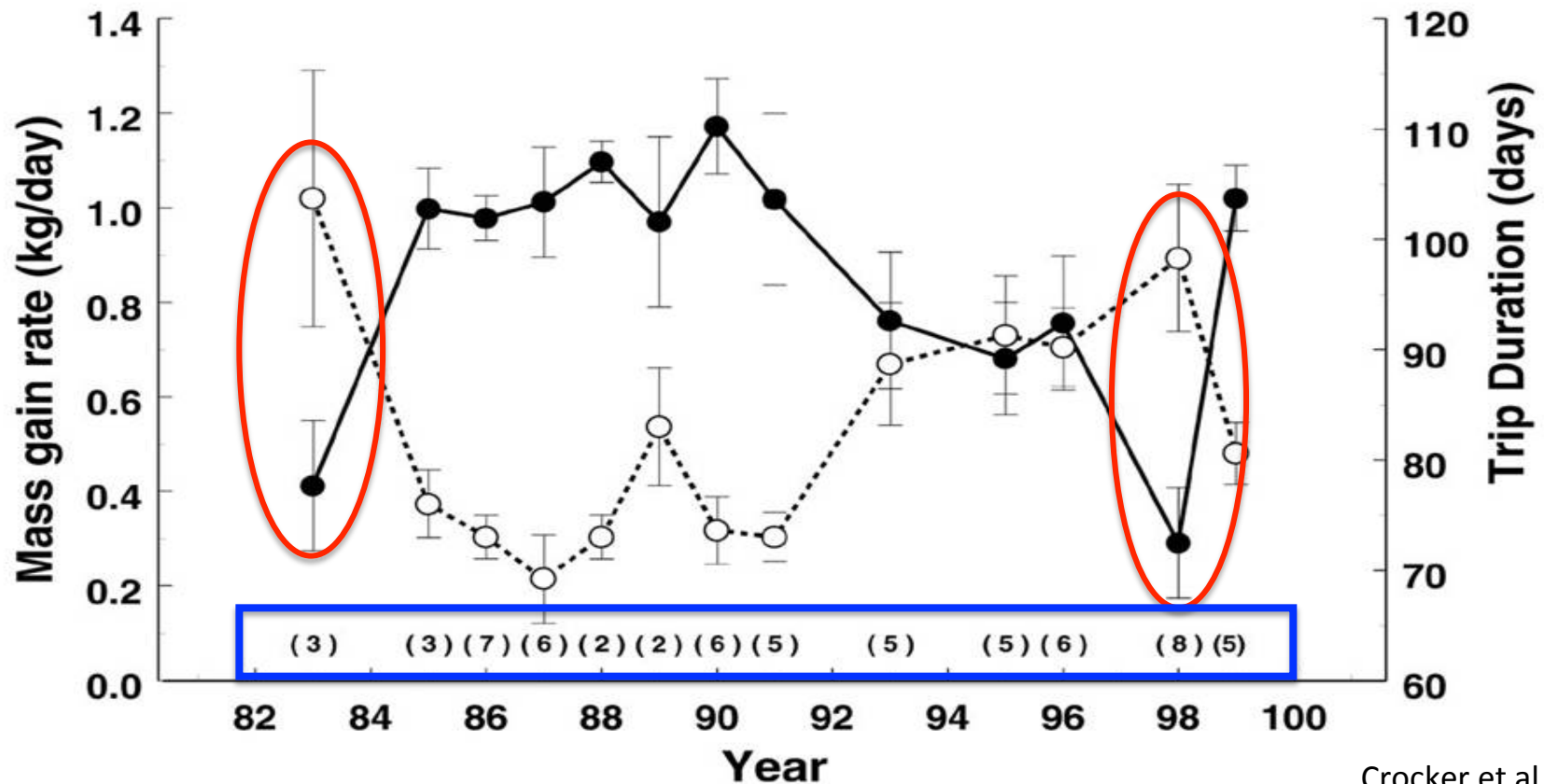
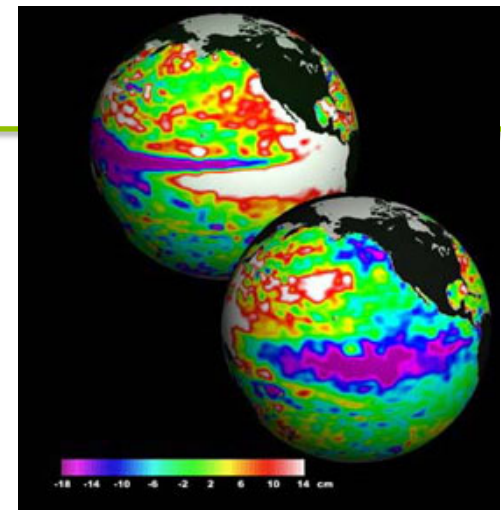
http://www.cpc.noaa.gov/products/analysis_monitoring/ensostuff/ens



Introduction

The 1998 El Niño

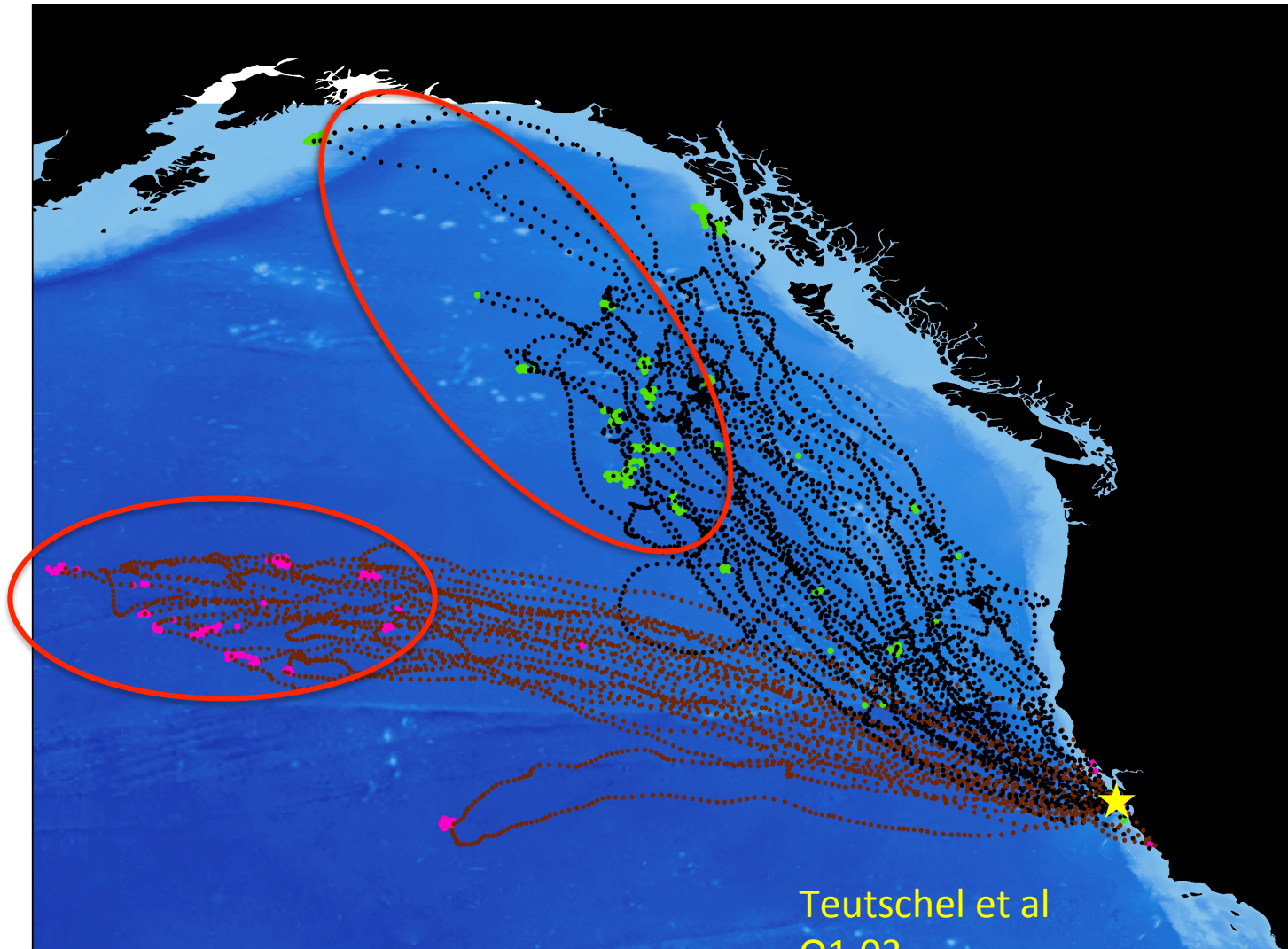
Adult female elephant seals traveled longer but did worse.



Introduction

Foraging Strategies of Female Northern Elephant Seals

An opportunity to see within population effects of climate variability

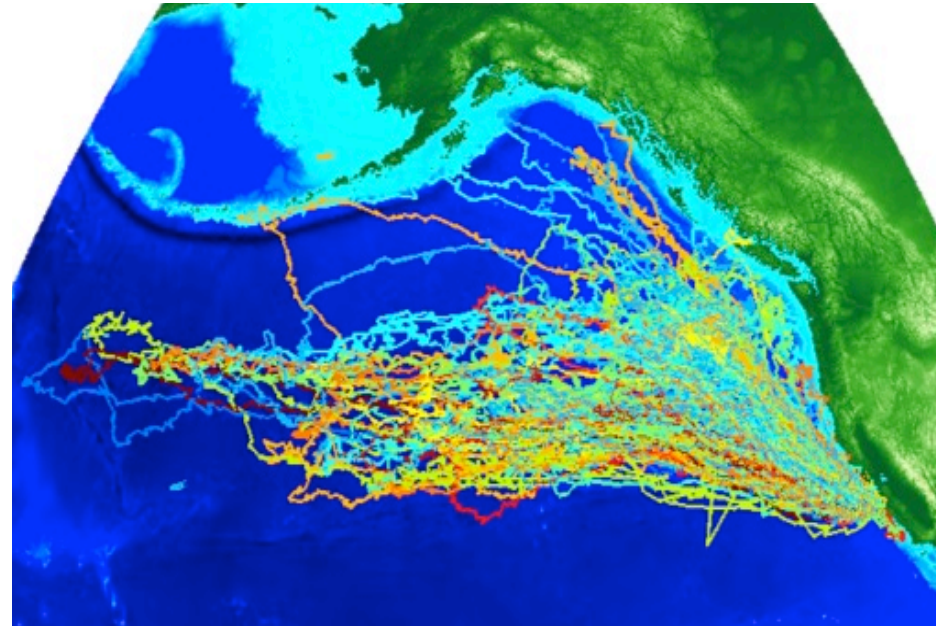


Teutschel et al
01.03

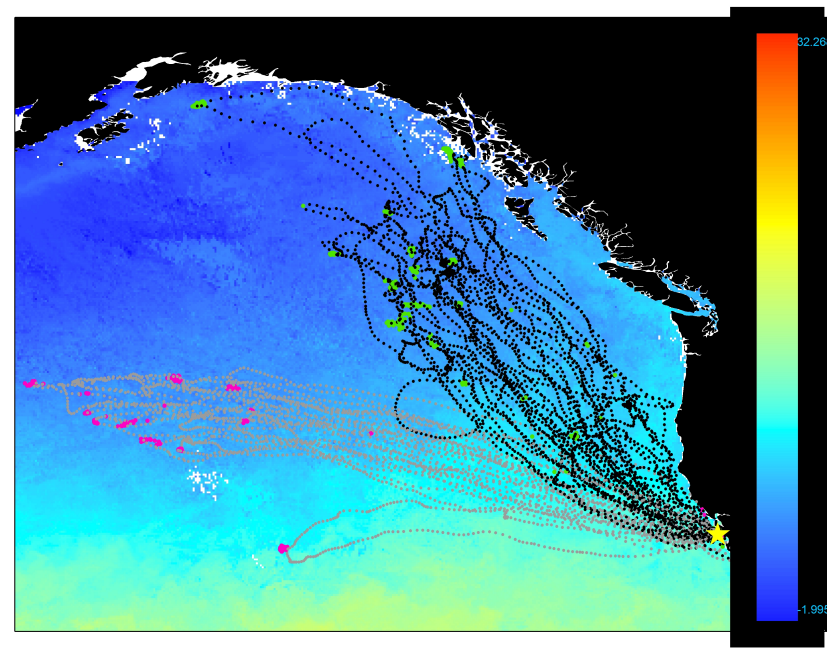
Introduction

Study Questions:

1. Did the 2010 El Niño affect female Northern Elephant beyond the scope of normal yearly variation?



2. Did the 2010 El Niño differentially impact the foraging success of coastal vs. pelagic foragers?



Methods

Northern Elephant Seals: (*Mirounga angustirostrum*)

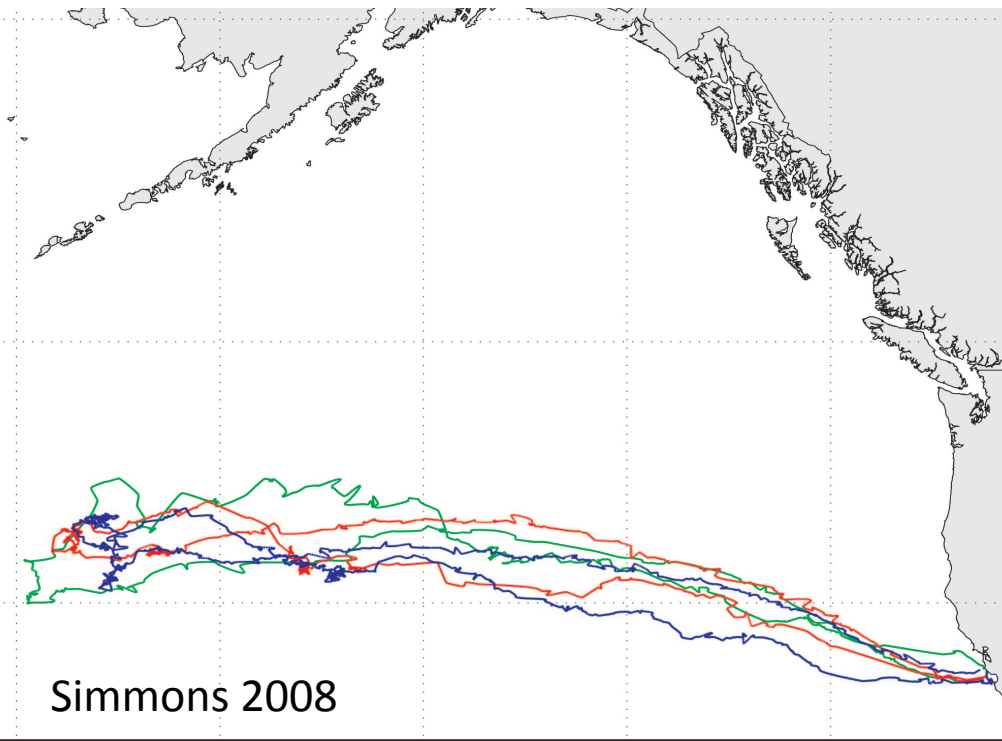
- Study site: Año Nuevo State Reserve, CA
- Long-term data set (n = 110)
- All 2010 animals had a previous control track from a non El Nino post-breeding migration
- Coastal (n = 10) and pelagic (n = 8) foragers



Data Collected

- Mass and body composition
- Blubber biopsies
- Tags deployed
 - MK10AF Fastloc GPS
 - SPOT 4 and SPOT 5 Argos transmitter
 - MK9 TDR

Wildlife Computers



Simmons 2008

Analysis

Metrics

Morphometrics

- Total Mass Gain (kg)
- Mass Gain Rate (kg/day)
- Percent Mass Gain
- Total Energy Gain (mJ)
- Energy Gain Rate (mJ/day)

Tracking: State-Space Behavioral Switching Model

- Trip Duration
- Total Time in Foraging Mode
- Total Time in Transit Mode
- Percent Time in Foraging Mode
- Total Foraging Bouts
- Mean Foraging Bout Duration

Breed et al 2009,
Jonson et al 2003, 2005

Statistical Analyses

Paired Tracks

- Paired T-tests
- Wilcoxon tests

Grouped by Year

- Anova with post-hoc Tukey-Kramer
- Wilcoxon Signed Rank

Programs – Jmp and R



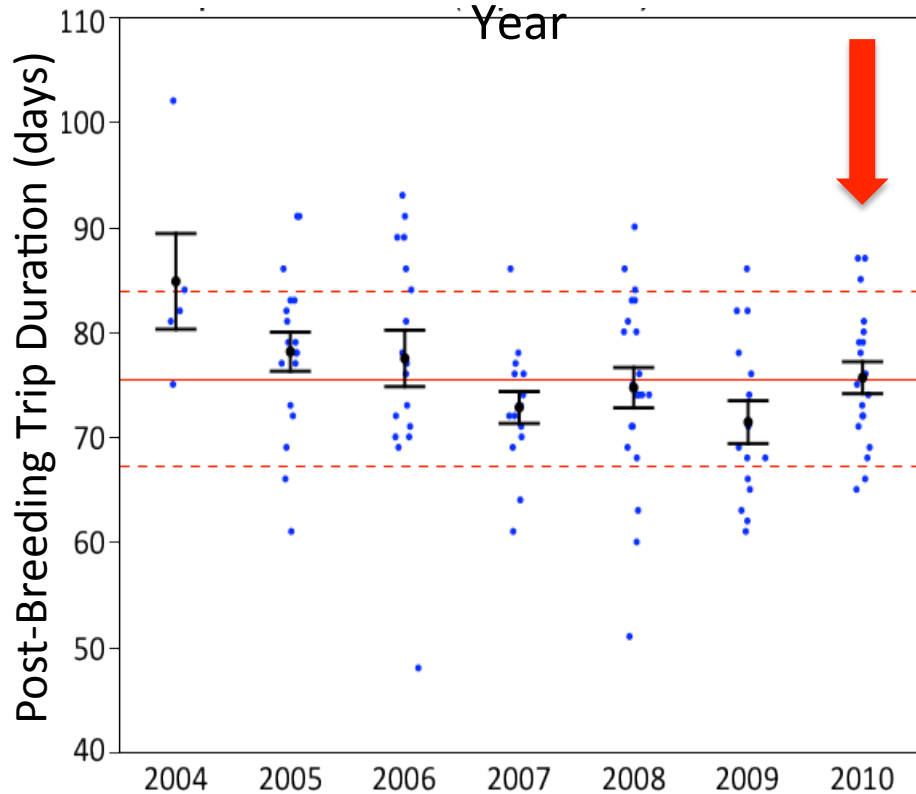
S. Peterson

Results

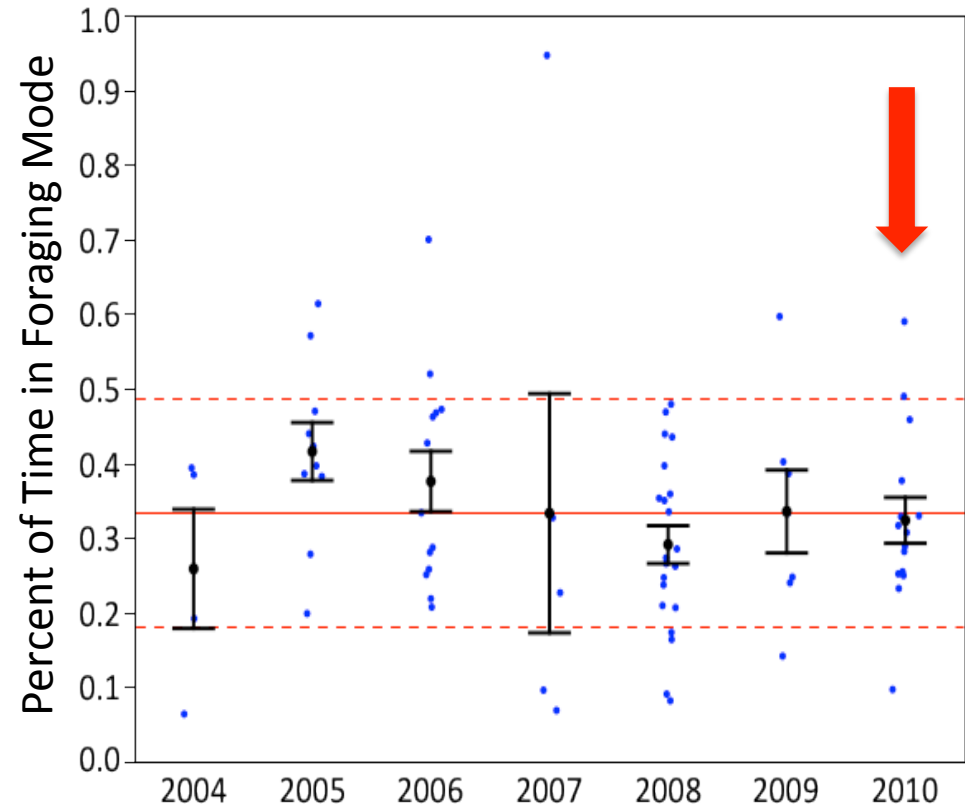
2010 El Niño and Yearly Variation

The 2010 El Niño did not exceed the range of normal yearly variation

Post-Breeding Trip Duration by Year



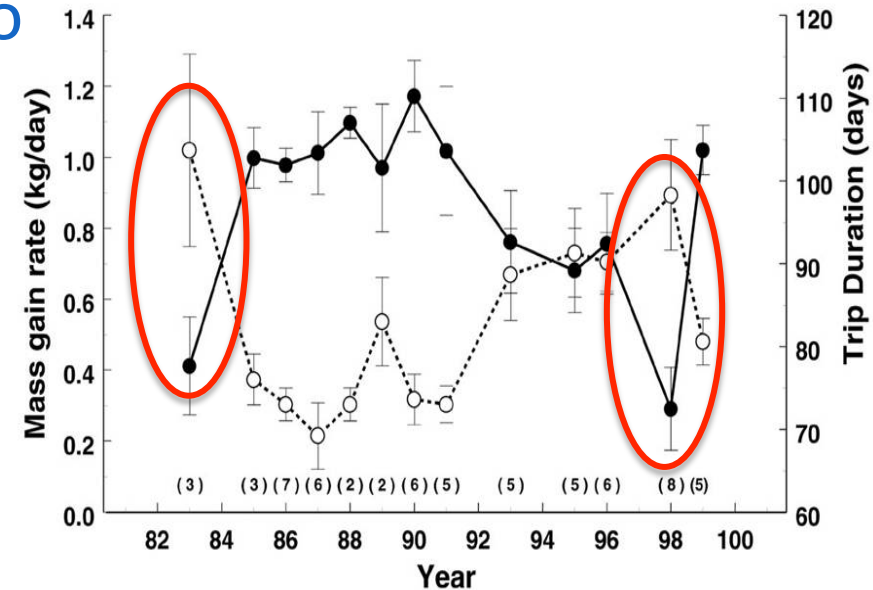
Percent Time in Foraging Mode by Year



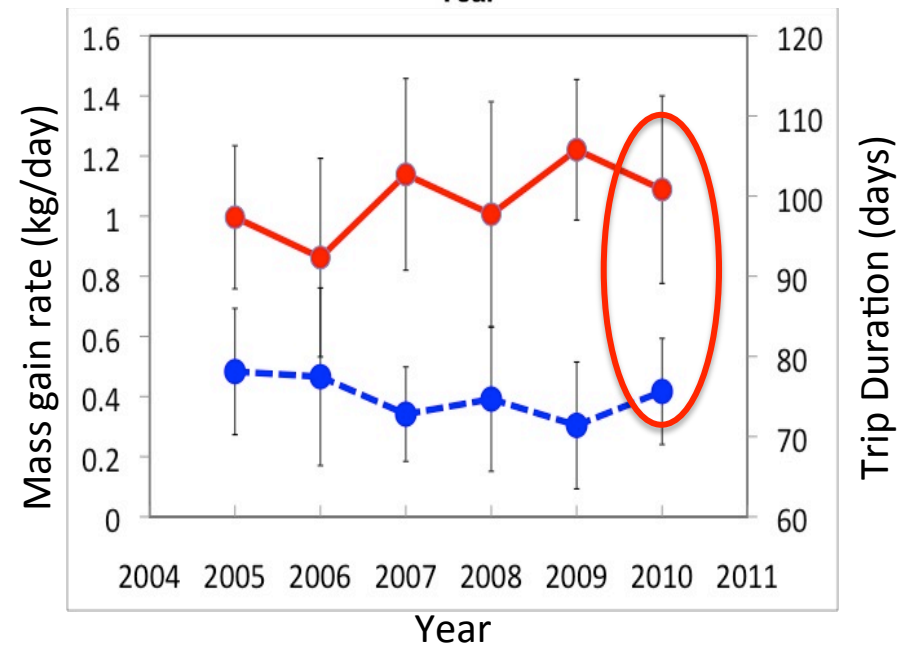
Results

Comparison with the 1998 El Niño

1998 El Niño – females traveled longer but did worse



2010 El Niño – female's travel time and condition were within normal variation

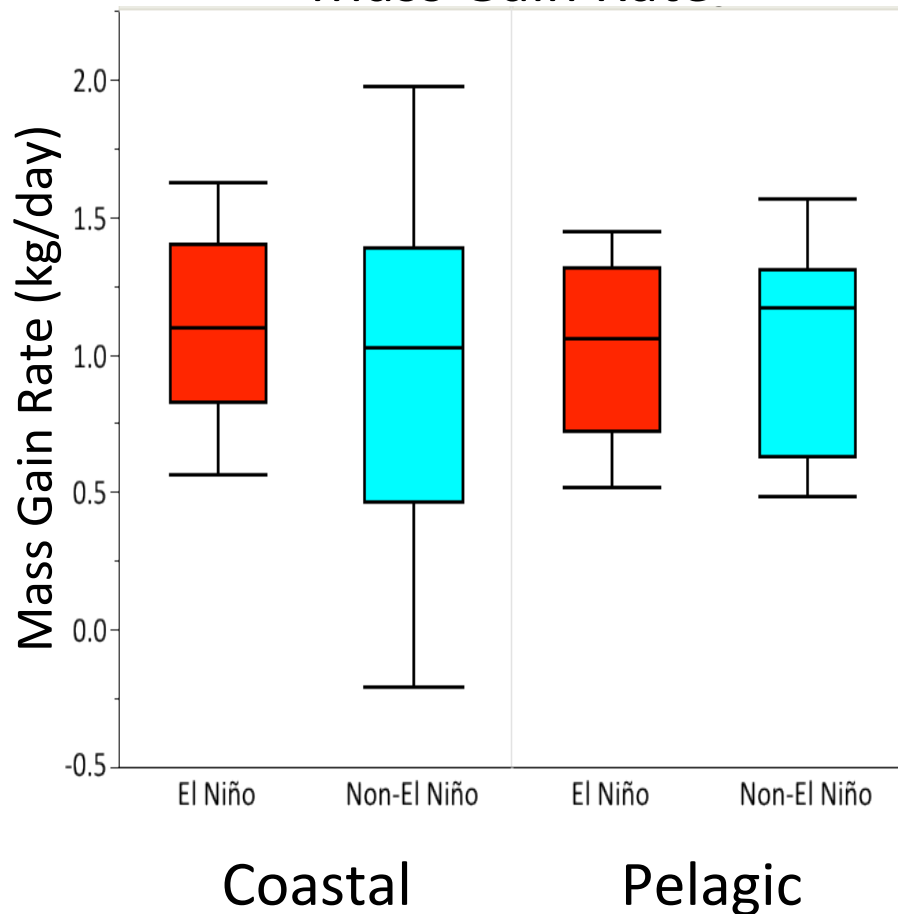


Results

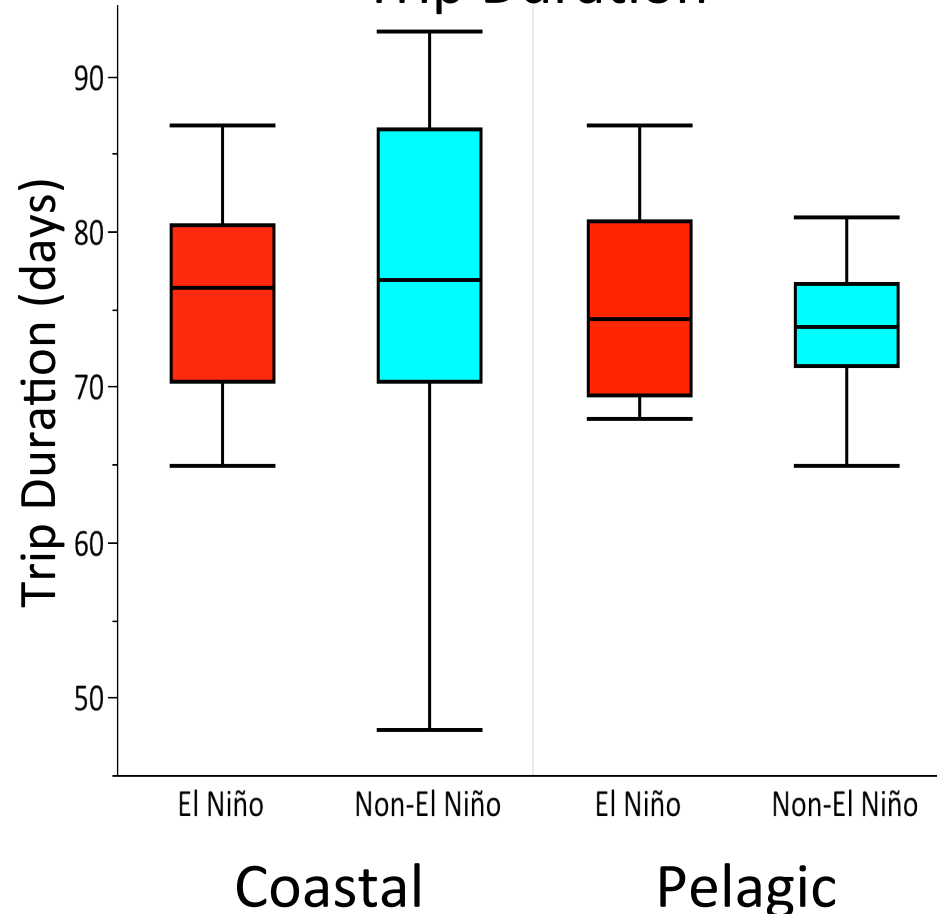
Coastal vs. Pelagic Foragers in 2010 El Niño

No significant differences in trip duration or morphometrics

Mass Gain Rate



Trip Duration

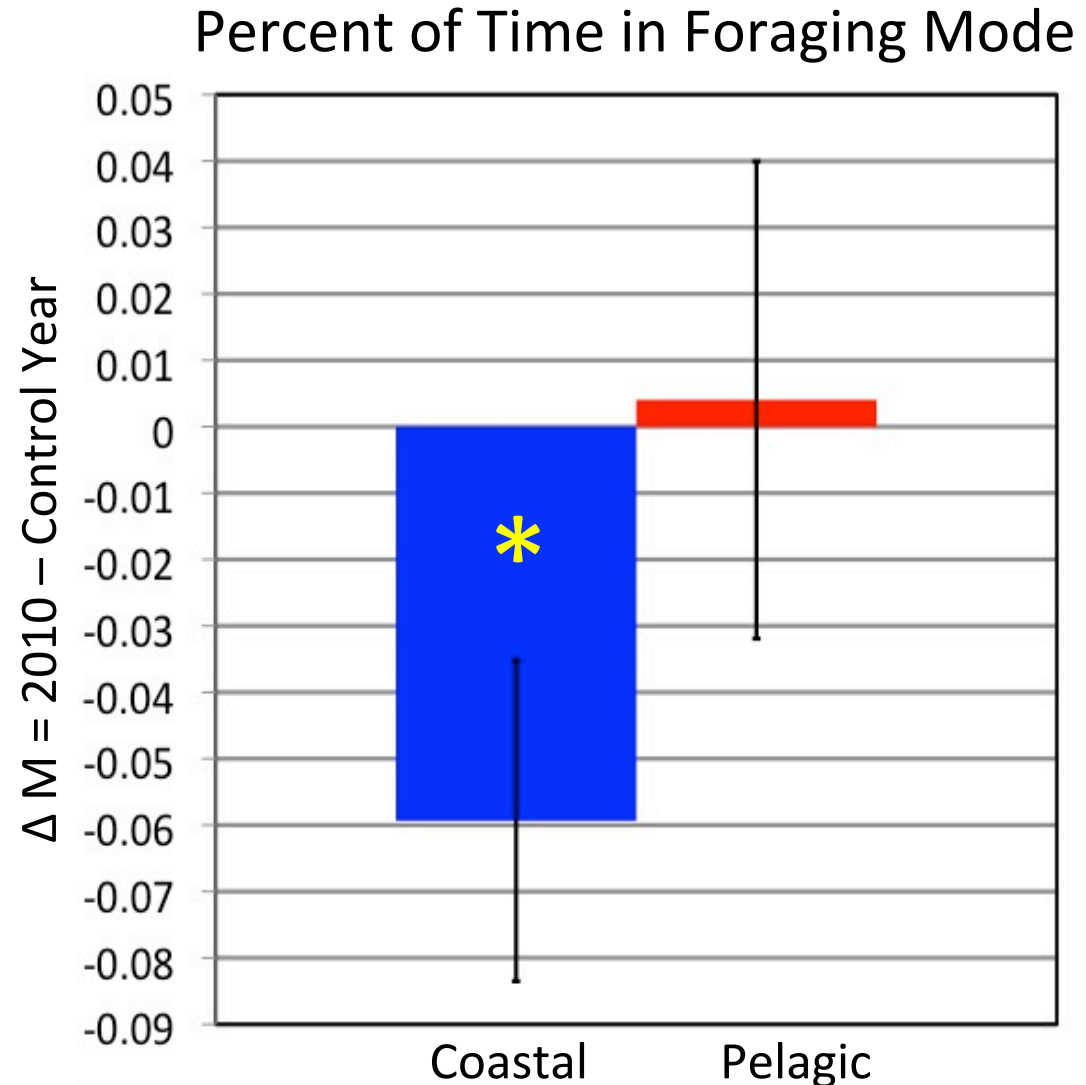


Results

Coastal vs. Pelagic Foragers

2010 El Niño

Coastal foragers spent a significantly longer percent of time in foraging mode than pelagic animals.



Conclusions

Summary

- No 2010 El Niño effects found when comparing the population as a whole.

Suggests a threshold severity in El Niño may be needed before northern elephant seals are negatively impacted.

BUT . . . On closer examination

- Coastal foraging females spent a greater percentage of their time in foraging mode than pelagic foragers.



Conclusions

Implications

- Coastal foraging female elephant seals may be more vulnerable to climate variability.
- El Niño events predicted to increase in frequency and intensity.
- Consequences on differential survival and reproduction of coastal females → evolutionary changes.
- Global warming effects may push the overall population past their tolerance threshold.

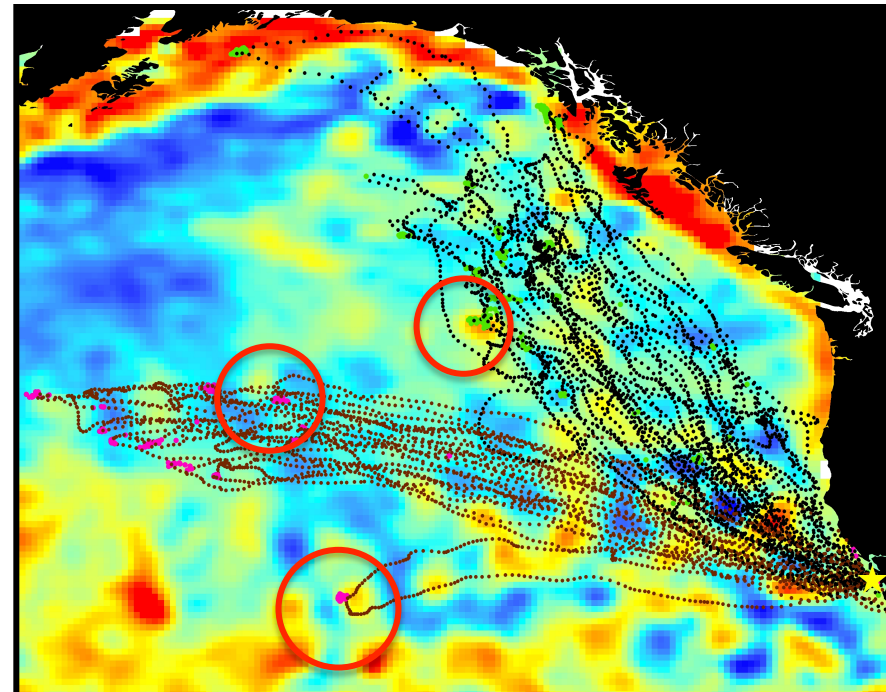


Future Directions



- Analyze fatty acids for evidence of a diet change during El Niño.
- Examine oceanographic variables associated with seal foraging for differences between El Niño years.

- Combine data sets from the previous study with the TOPP data set.
- Examine the dive data, especially drift dive rate, for additional differences in foraging due to the 2010 El Niño.



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Thank You

