

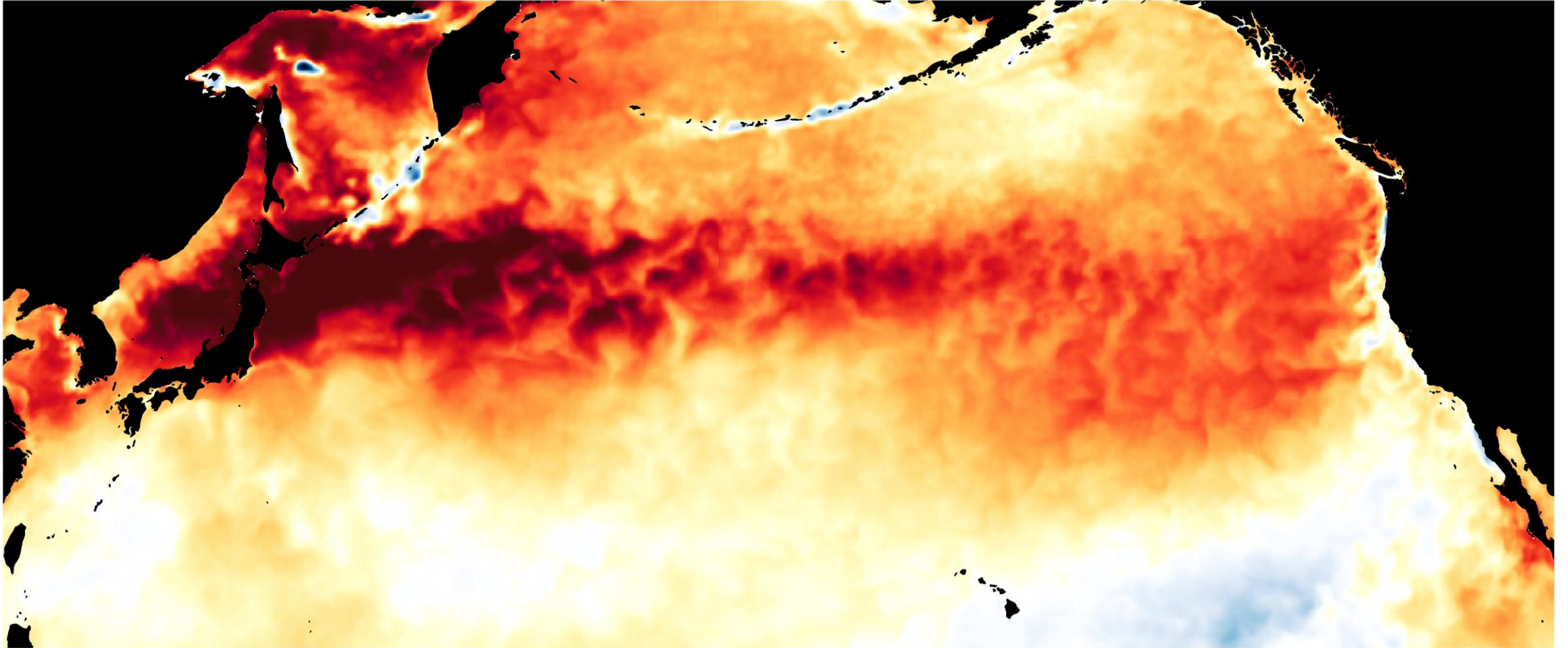
31 October 2024
PICES 2024 Honolulu, Hawaii
S7. BIO/HD Topic Session

Multi-decade northward shift of loggerhead sea turtle pelagic habitat as the eastern North Pacific Transition Zone becomes more oligotrophic

Dana K. Briscoe, Larry B. Crowder, George H. Balazs, Jeffrey A. Seminoff, Alberto Abreu,
Catherine A. Lee Hing, Masanori Kurita, Masanori Mori, Denise M. Parker, Marc R. Rice,
Tomomi Saito, Bianca S. Santos, Calandra N. Turner Tomaszewicz,
Noah Yamaguchi, Jeffrey J. Polovina



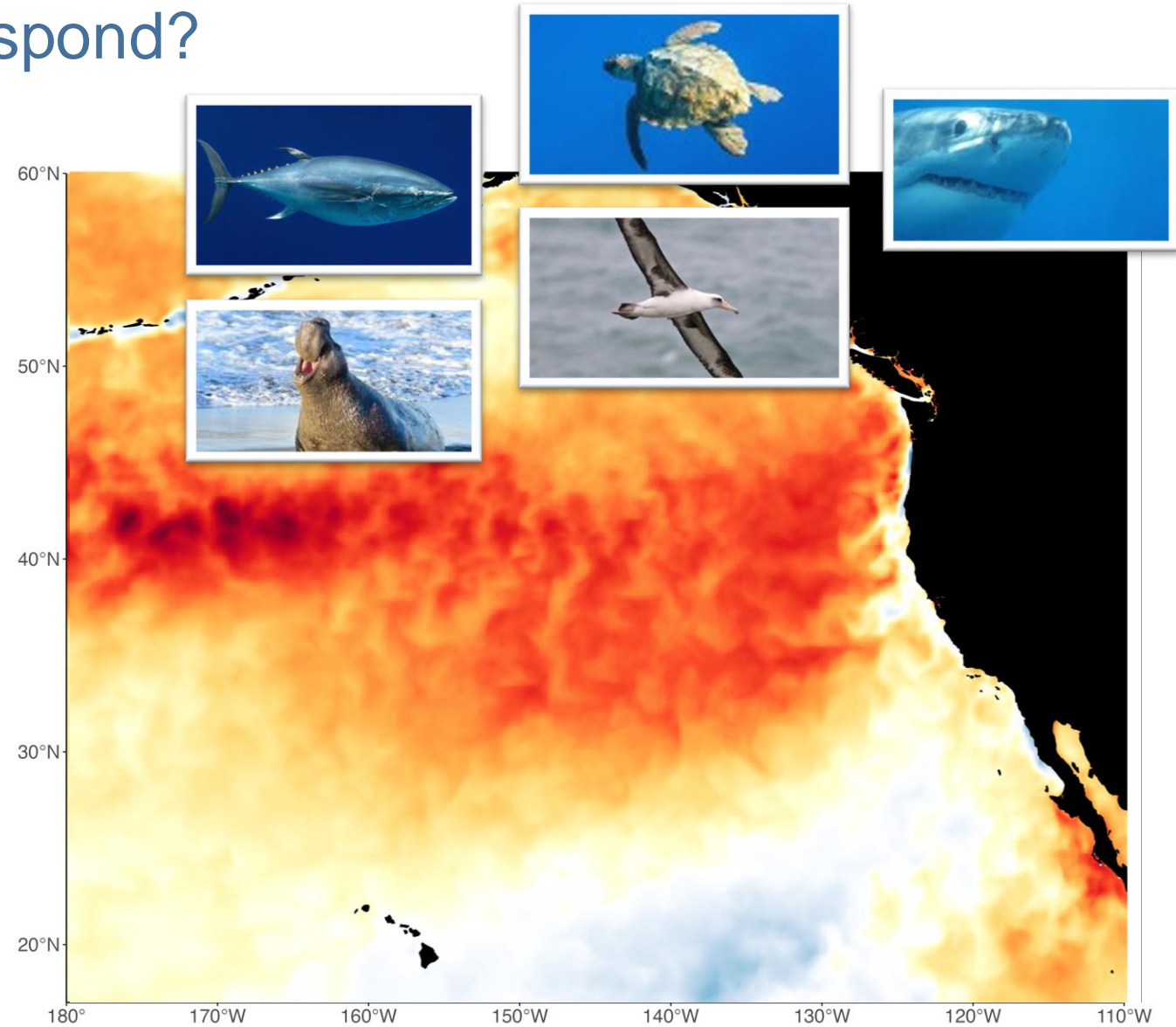
North Pacific Ocean Warming



NOAA Coral Reef Watch
SSTa Aug 2023

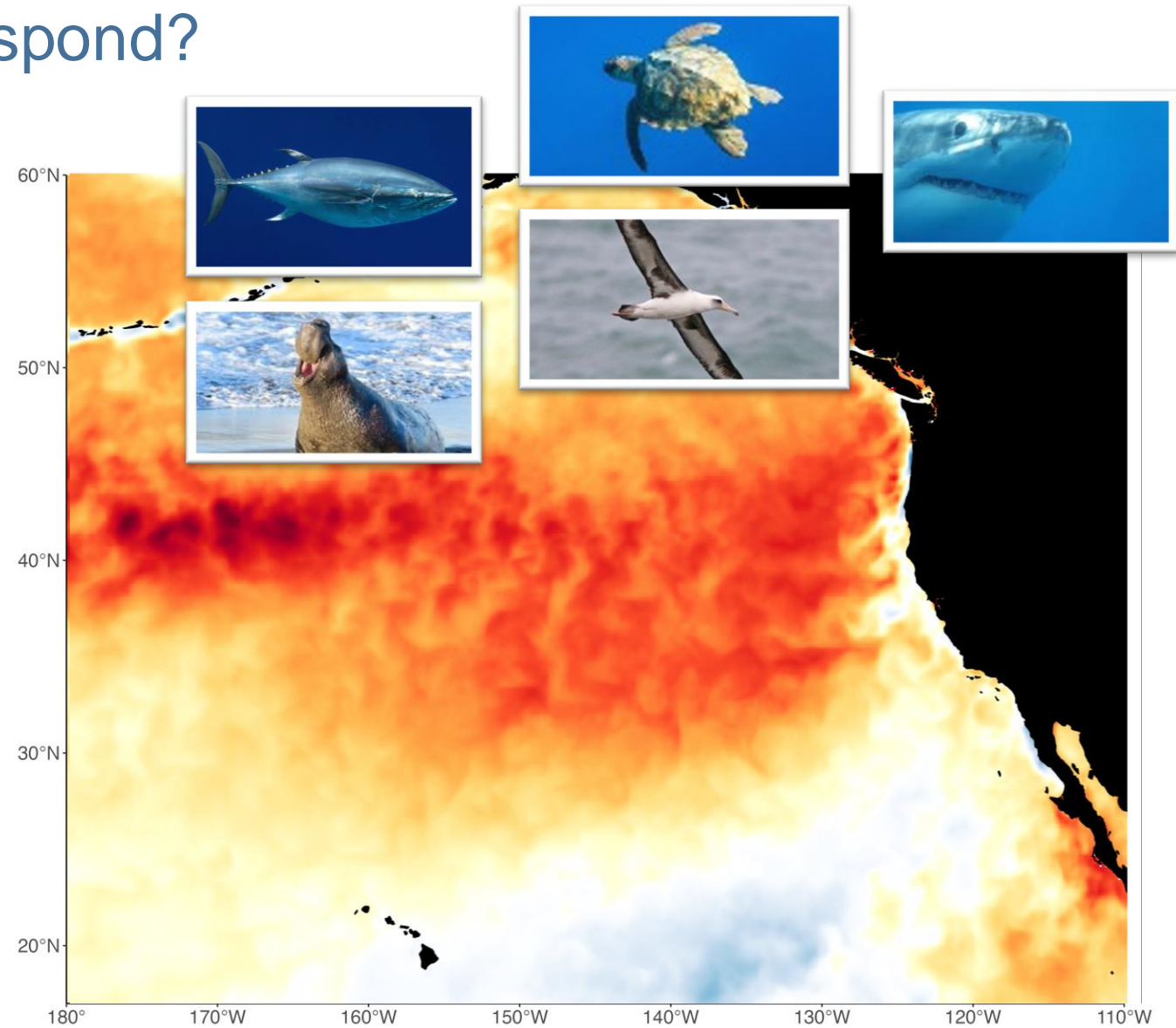
How Will Pelagic Species Respond?

- **Eastern North Pacific**
Biodiversity hotspot

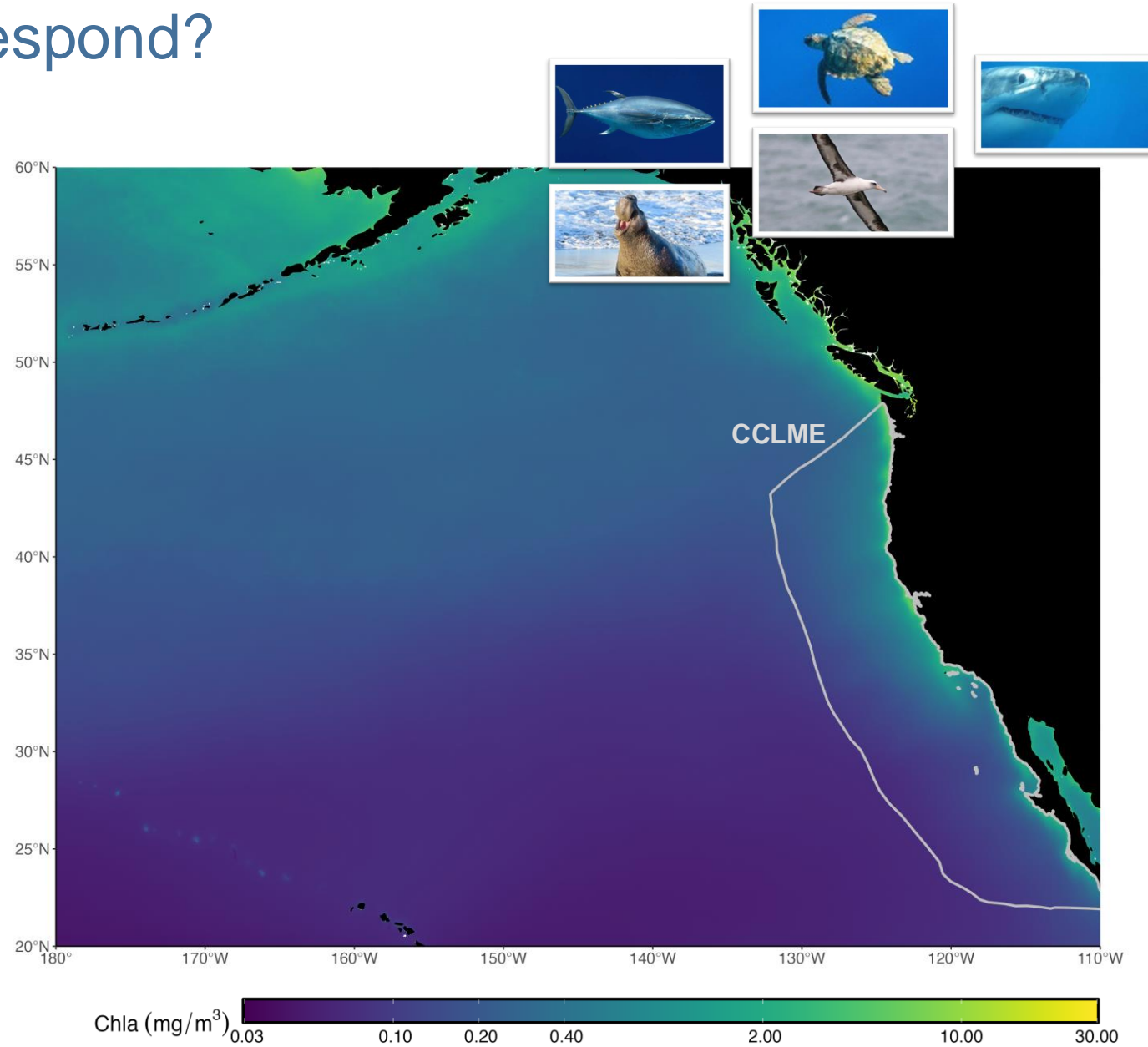


How Will Pelagic Species Respond?

- **Eastern North Pacific**
Biodiversity hotspot
- **Rapid rate of change**
Species must adapt | adjust
- **Habitat shifts**
New challenges for conservation & management

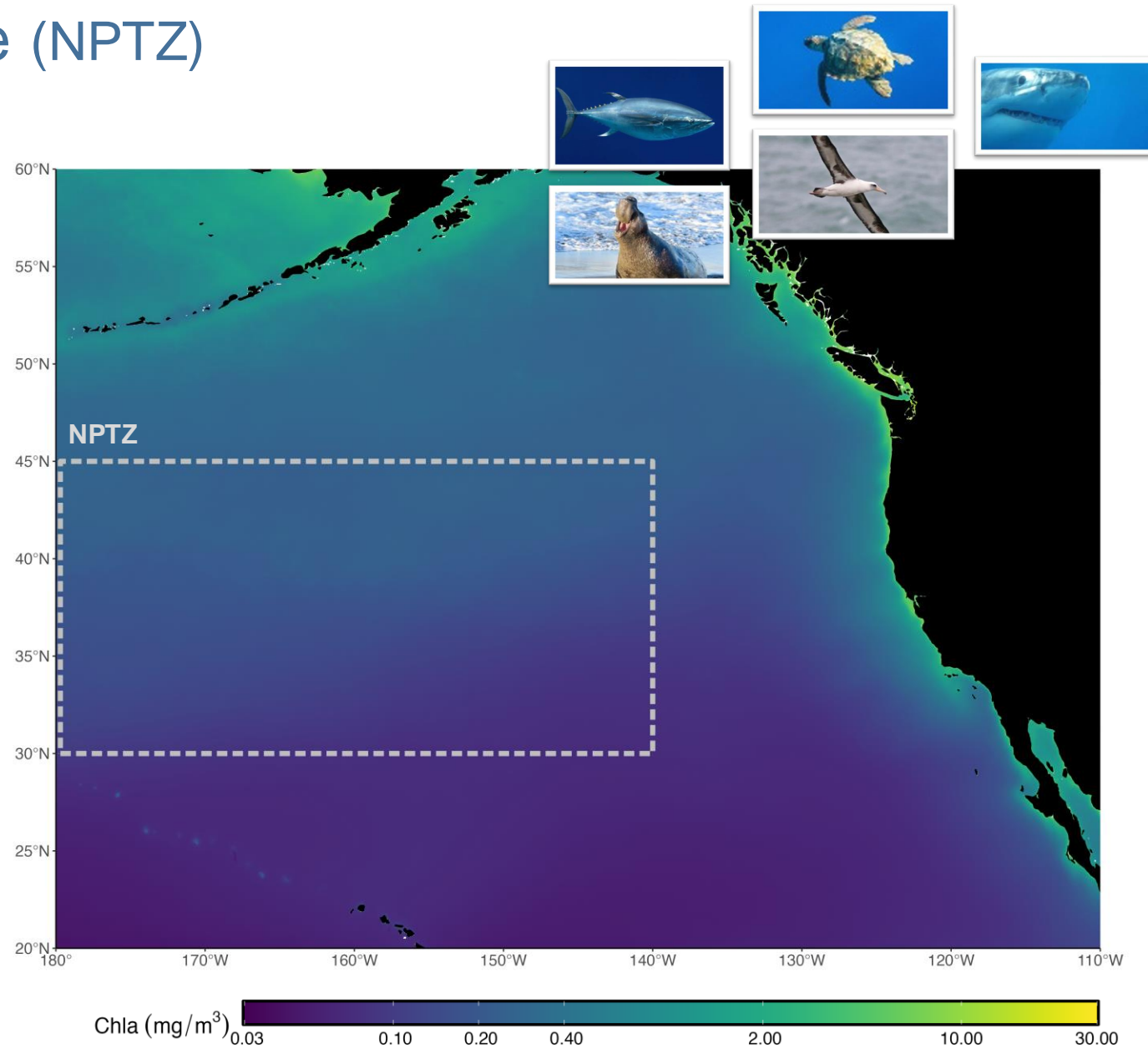


How Will Pelagic Species Respond?



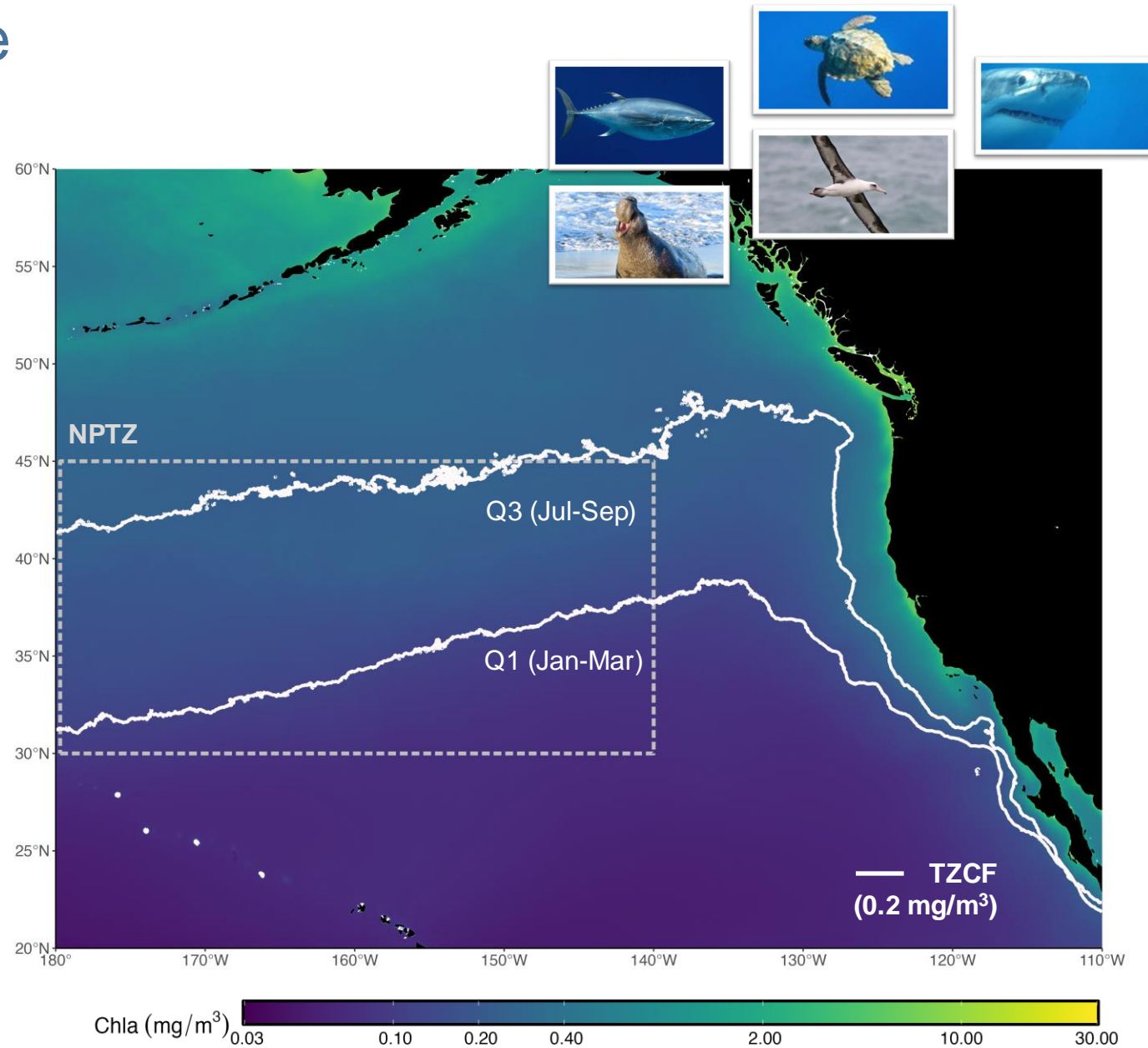
North Pacific Transition Zone (NPTZ)

- Forage habitat & key oceanographic boundary



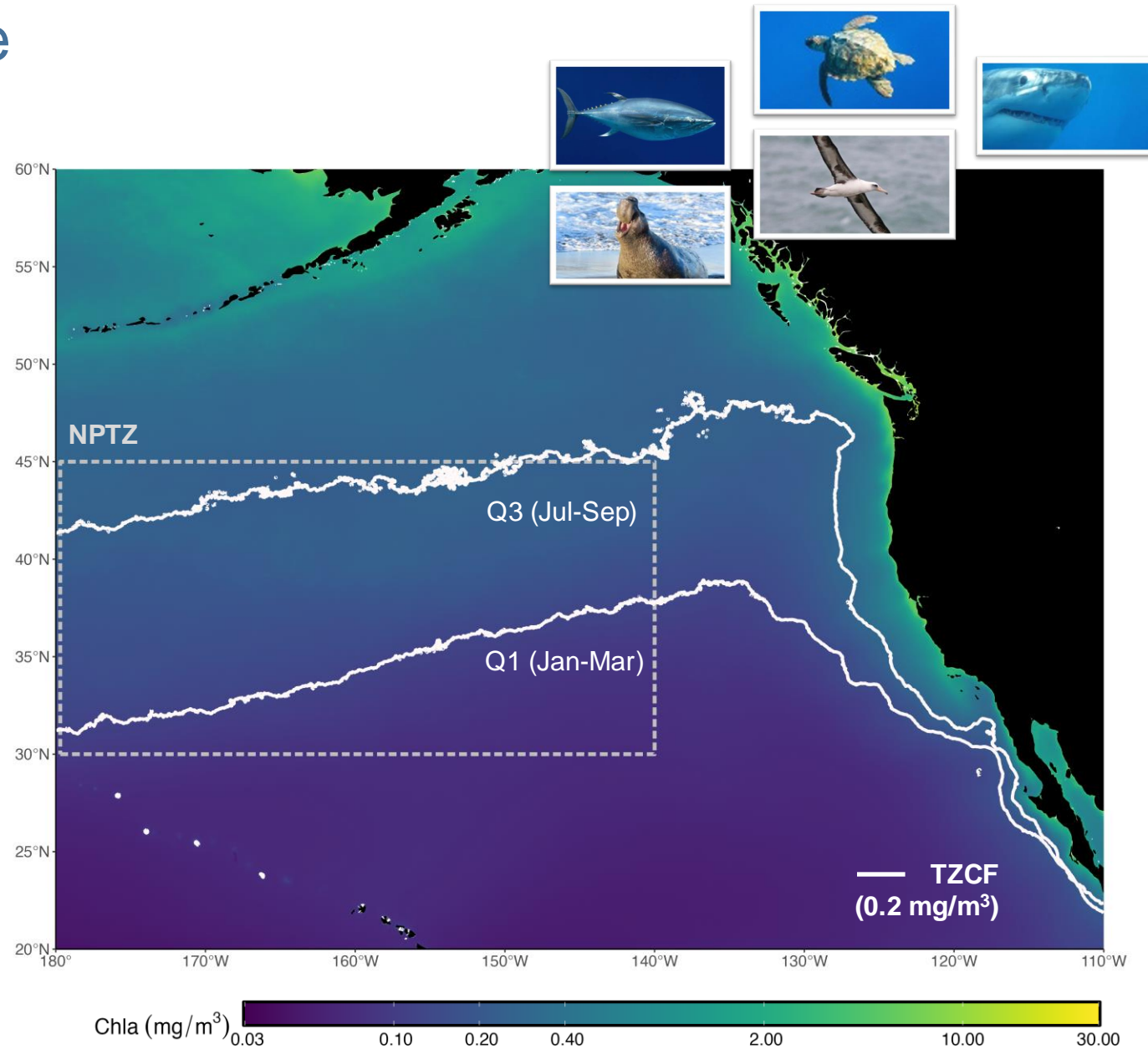
North Pacific Transition Zone

- Forage habitat & key oceanographic boundary
- Transition Zone Chla Front (TZCF)

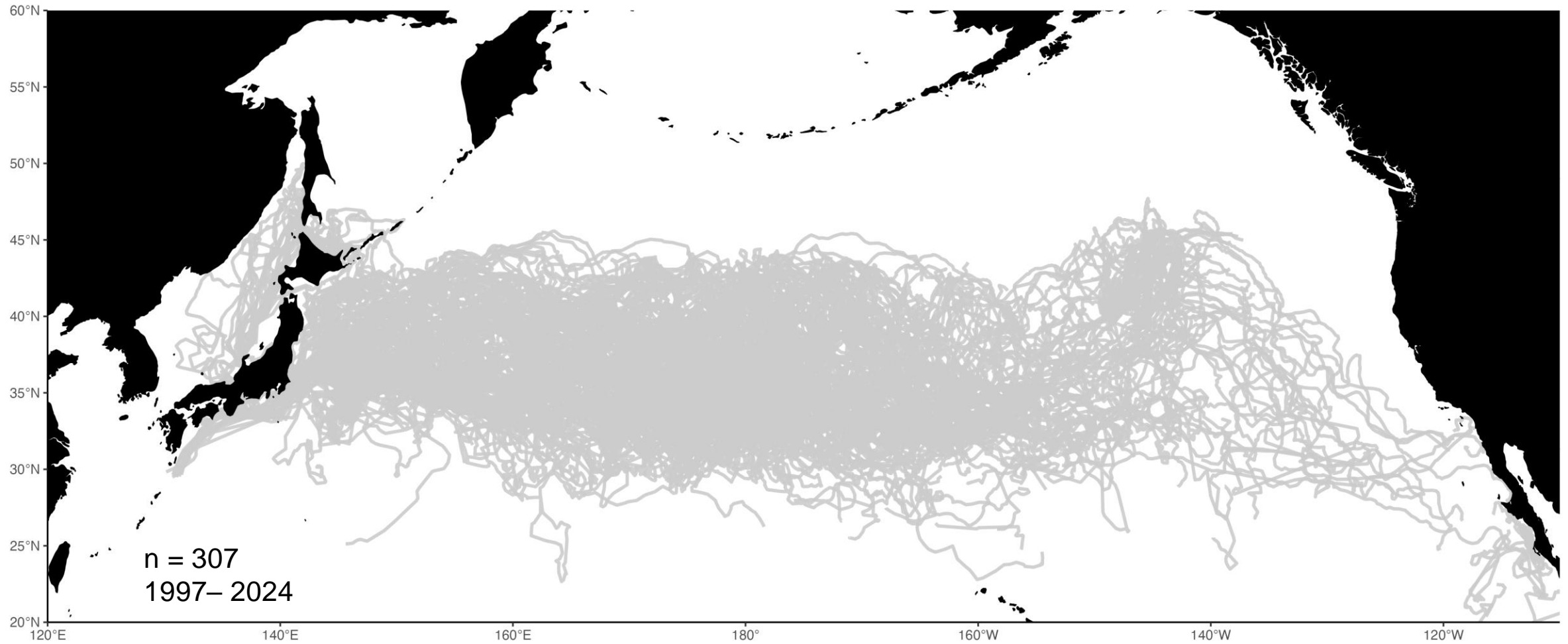


North Pacific Transition Zone

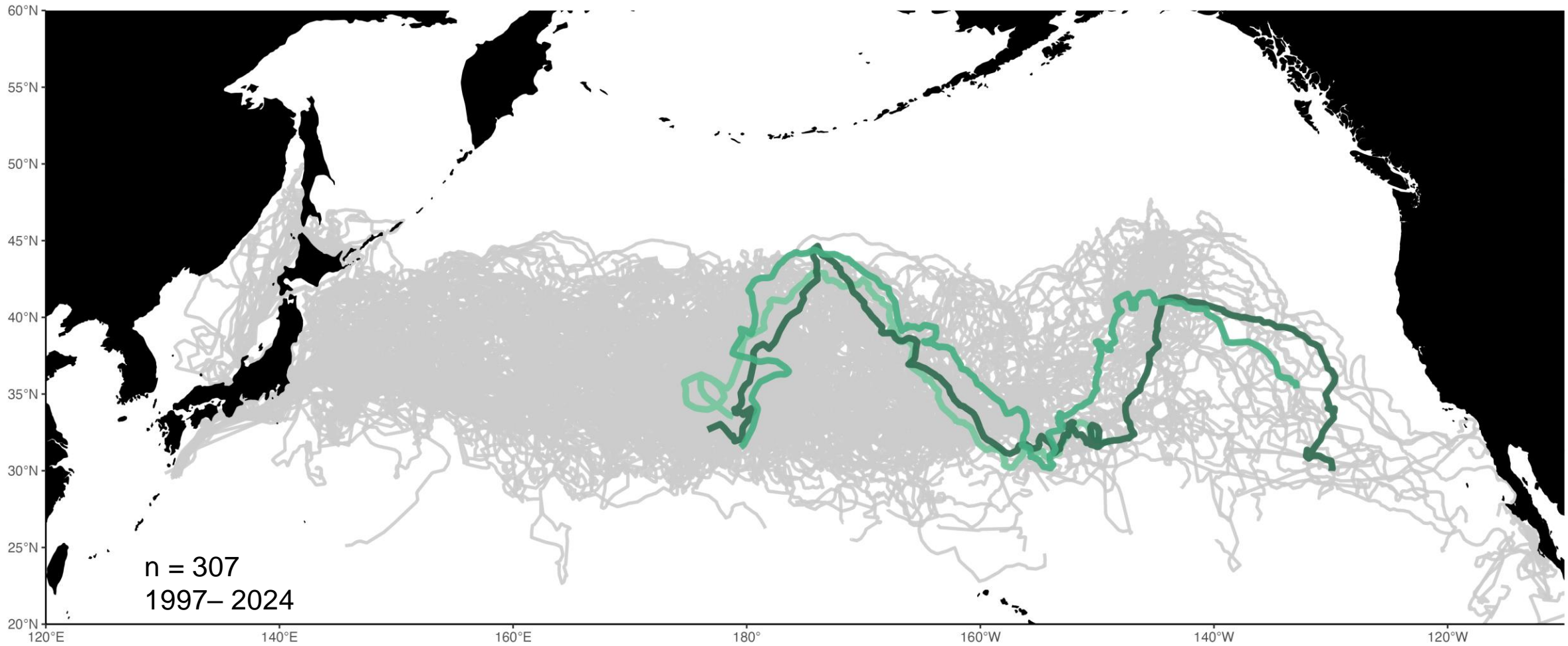
- Forage habitat & key oceanographic boundary
- Transition Zone Chla Front (TZCF)
- Expansion of oligotrophic waters ($< 0.2 \text{ mg/m}^3$)
- Short-term studies & model projections ...
Gaps at decadal scale



North Pacific Loggerhead Sea Turtles (*Caretta caretta*)



North Pacific Loggerhead Sea Turtles (*Caretta caretta*)



Research Objectives

A stylized map of the North Pacific Ocean region. The landmasses of North America, Alaska, and the Hawaiian Islands are shown in black. The ocean area is white. A horizontal line represents the North Pacific Transition Zone (NPTZ), located roughly between 30°N and 40°N latitude. The Hawaiian Islands are shown as a series of small black dots extending from the bottom center towards the top left.

1) Identify oceanographic trends within the NPTZ in the last 27 years

2) Characterize higher trophic level response to climate induced changes

Provide the first empirical evidence of important multi-decadal trends within the NPTZ

Methods | NPTZ Trends

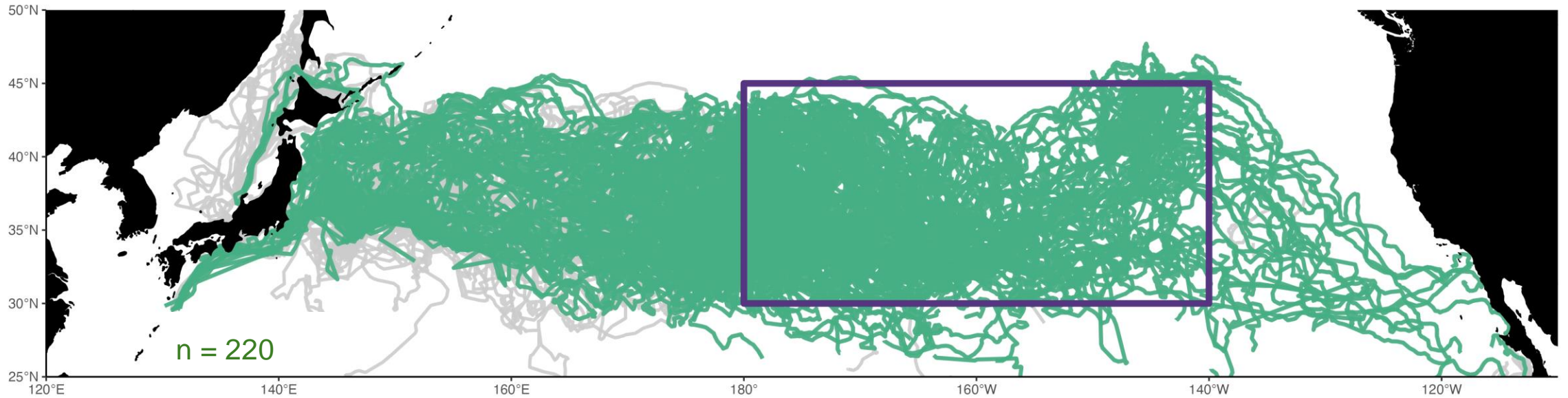
- SST
- Chla
- Oligotrophic Area ($< 0.2 \text{ mg/m}^3$)
- Turtle Latitude

Methods | NPTZ Trends

- SST
 - Chla
 - Oligotrophic Area ($< 0.2 \text{ mg/m}^3$)
 - Turtle Latitude
1. Calculate spatial means : Sept 1997 – Sept 2024
Monthly, Q1 (Jan-Mar), & Q3 (Jul-Sep), annual
 2. Generalized Additive Mixed Models (GAMMs)
 $y \sim s(\text{seasonal}) + \text{trend}$
 3. Discrete year groups
1997-2000 | 2004-2008 | 2010-2013 | 2023-2024

Methods | NPTZ Trends

- Turtle Latitude | 1997-2013 (n=167) & 2023-2024 (n=53)

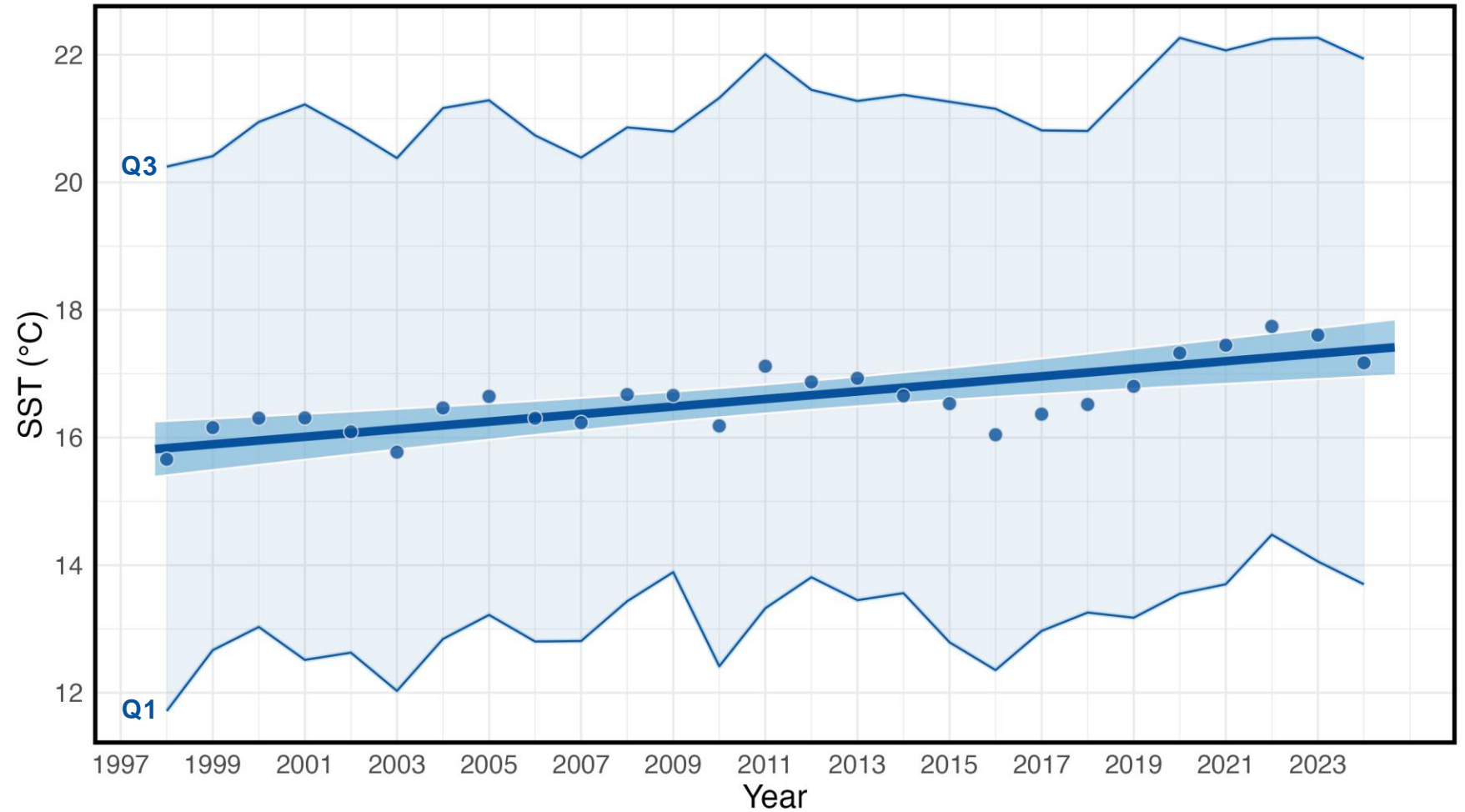


Results | NPTZ Trends

- SST
- Chla
- Oligotrophic Area
- Turtle Latitude

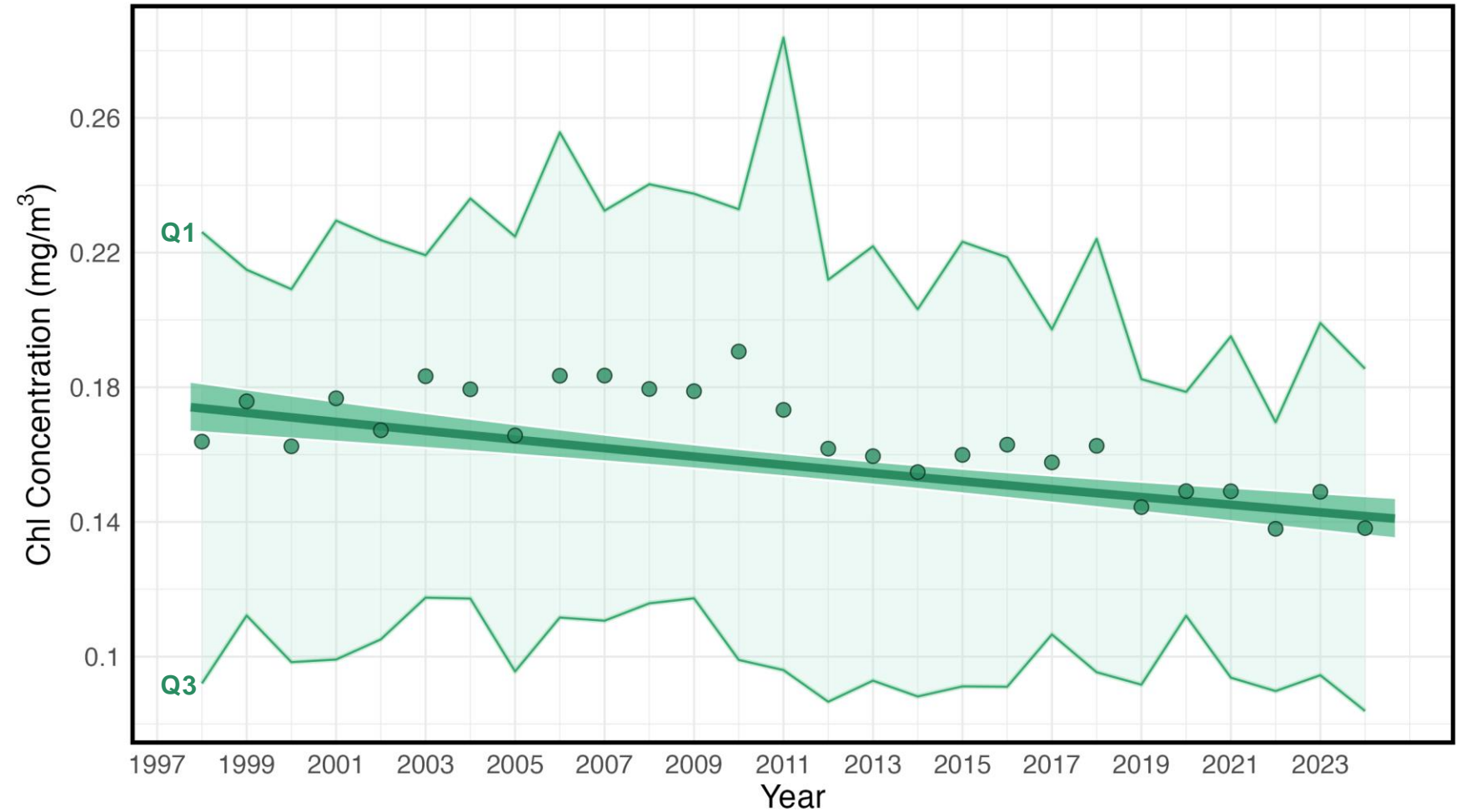
Results | NPTZ Trends

- SST
- Chla
- Oligotrophic Area
- Turtle Latitude



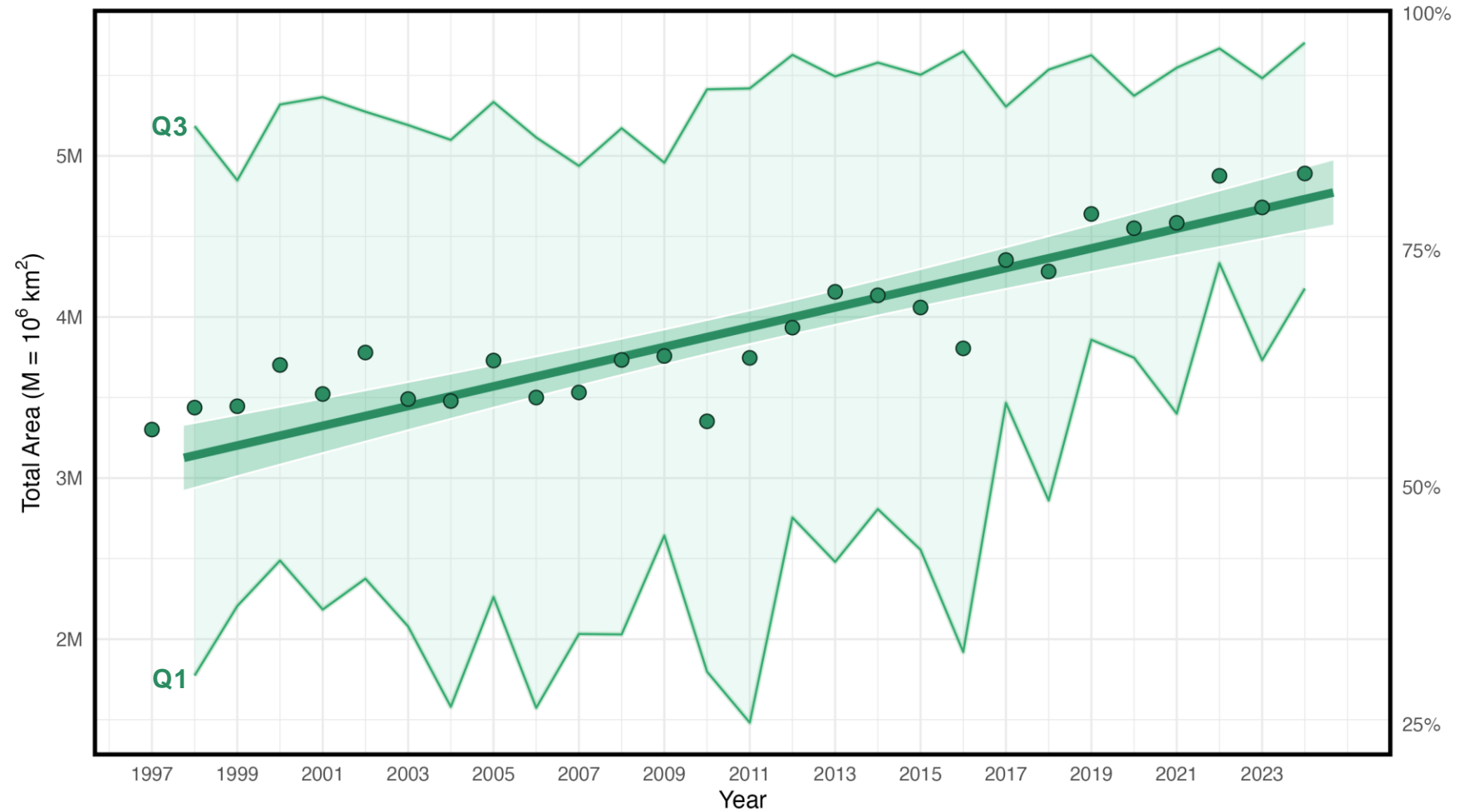
Results | NPTZ Trends

- SST
- **Chla**
- Oligotrophic Area
- Turtle Latitude



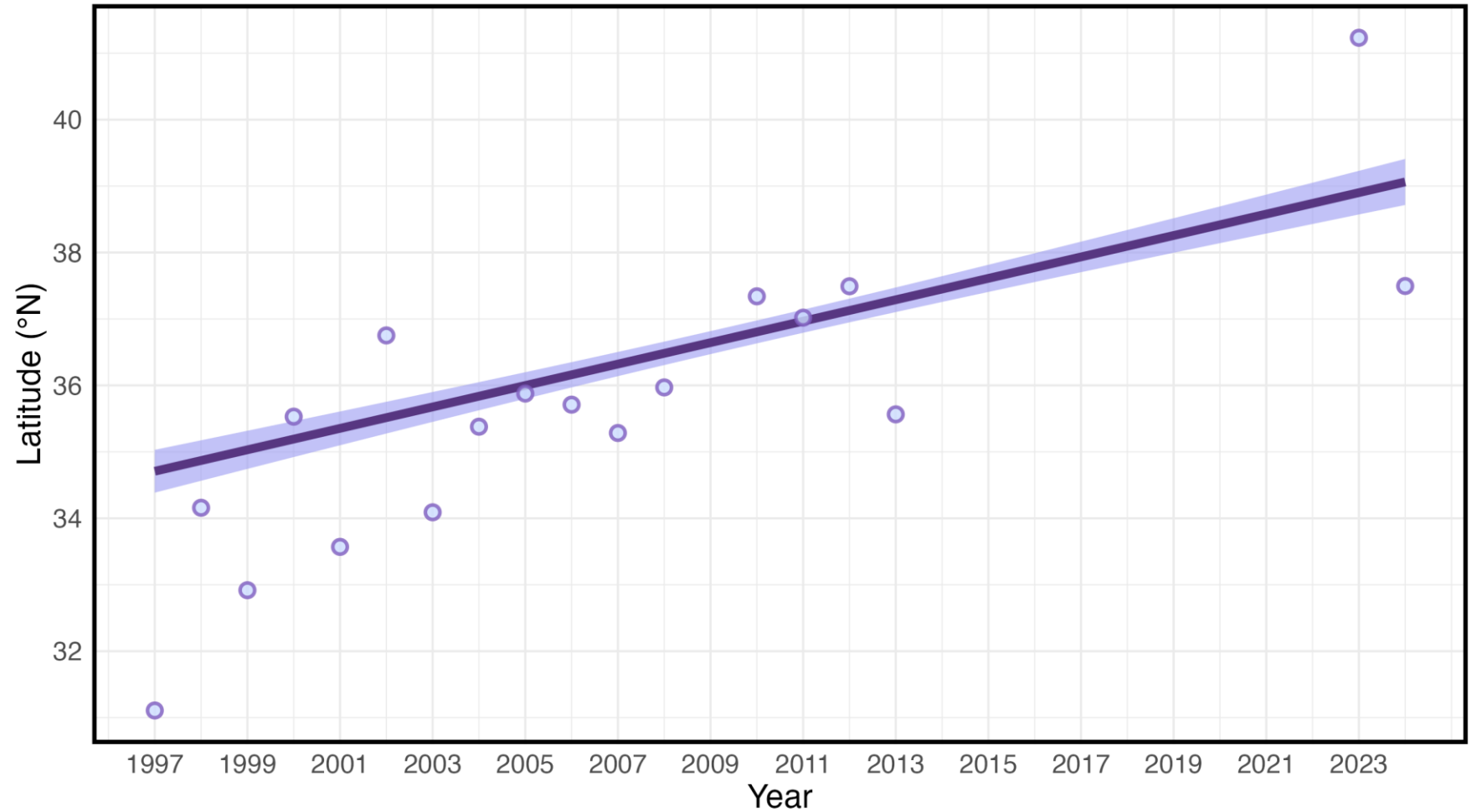
Results | NPTZ Trends

- SST
- Chla
- Oligotrophic Area ($< 0.2 \text{ mg/m}^3$)
- Turtle Latitude

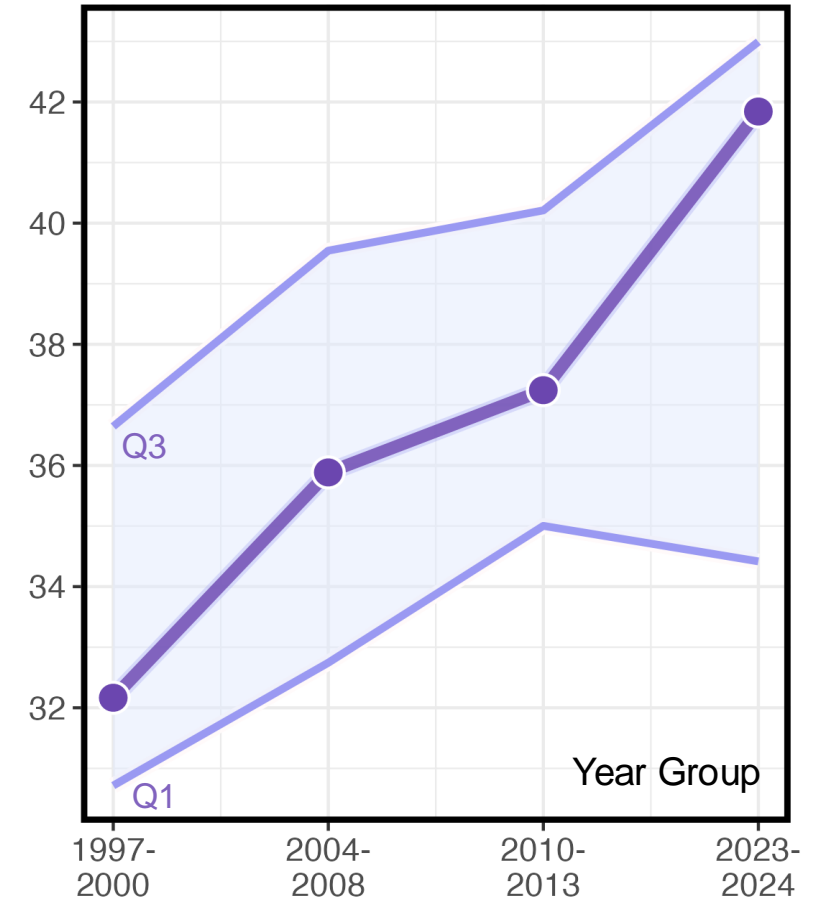
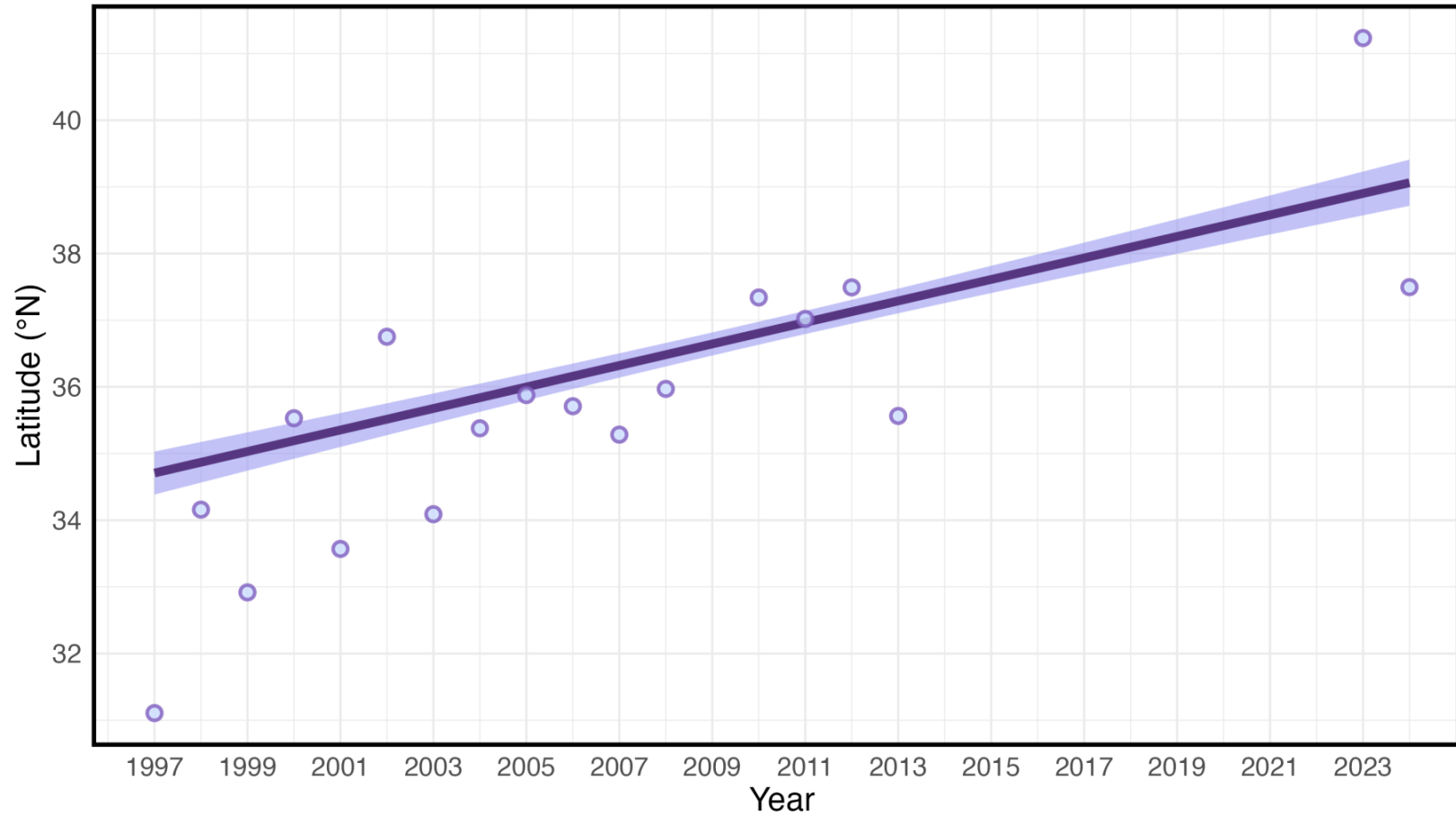


Results | NPTZ Trends

- SST
- Chla
- Oligotrophic Area
- Turtle Latitude

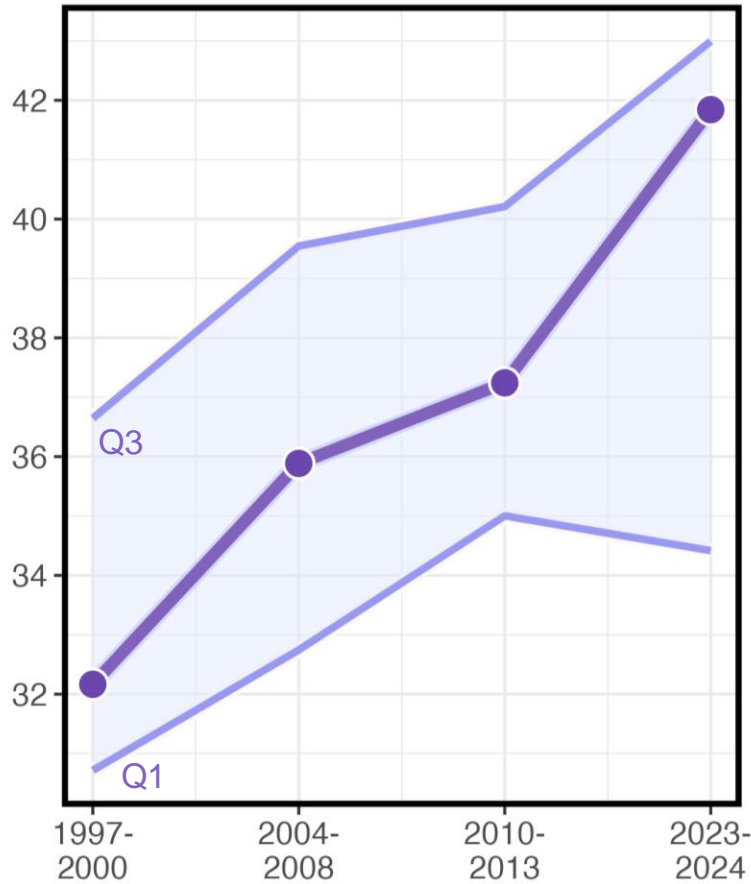


Results | Mean Loggerhead Latitude within the NPTZ

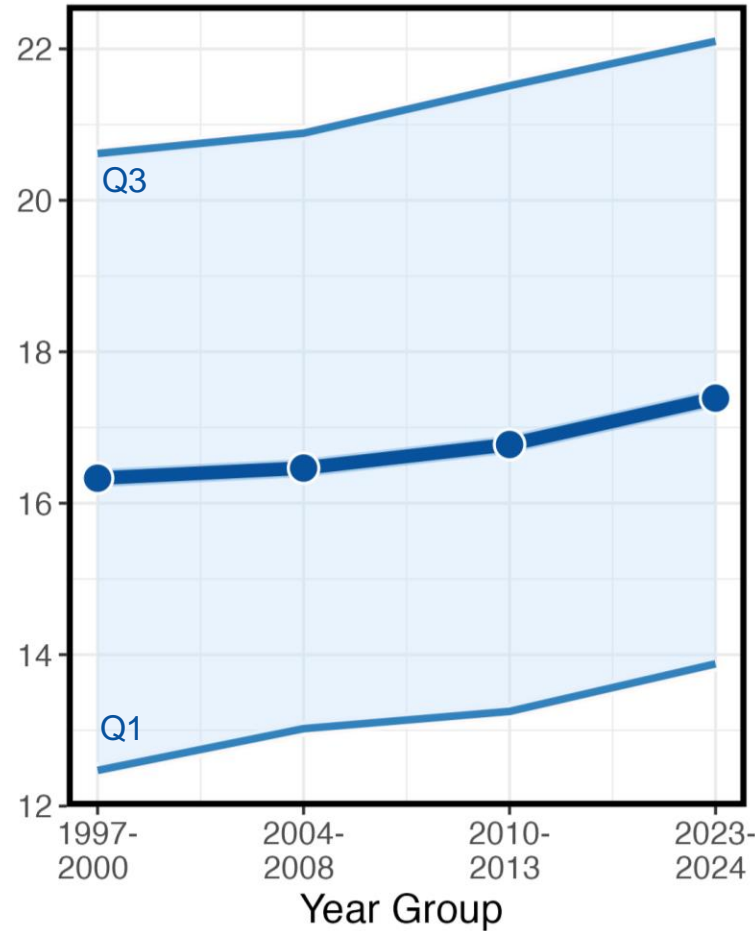


Results | Discrete Year Groups: Turtles, SST, and Chla

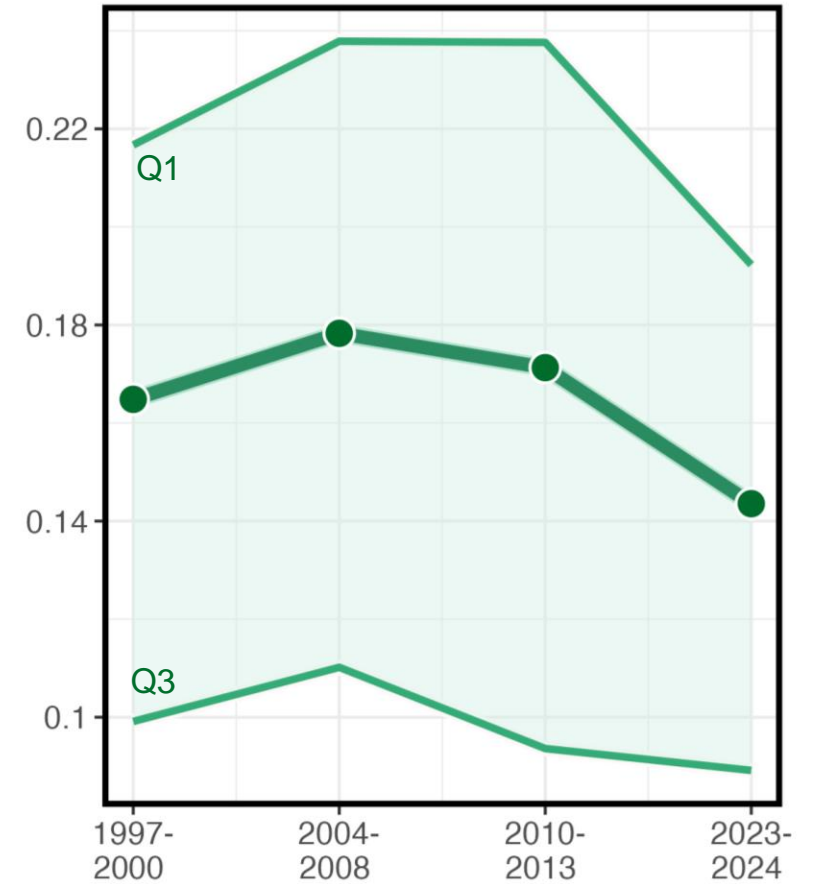
y axis: Mean Turtle Latitude (°N)



y axis: Mean SST (°C)



y axis: Mean Chla (mg/m³)



Summary

Over the past 27 years:

- NPTZ has warmed by 1.6°C
 - Chla concentrations have decreased by almost 20% since 2011
 - Experienced 28% increase in total oligotrophic habitat
 - Greatest rate of change in winter
 - In response, loggerhead habitat has shifted north 450-600 km (exceeding global average¹)
- This sentinel species dataset documents significant ecosystem response
- Evidence of multi-decadal trends offers insights for management approaches in a changing ocean





Loggerhead **STRETCH**

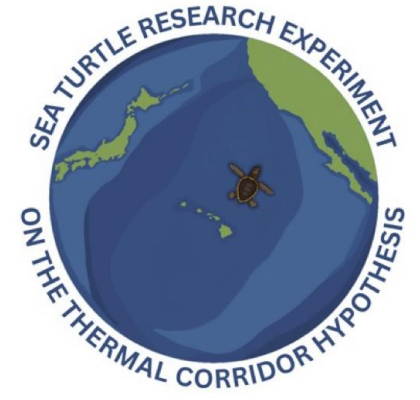
Sea Turtle Research Experiment on the Thermal Corridor Hypothesis

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Thank you!



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PORT OF NAGOYA
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