



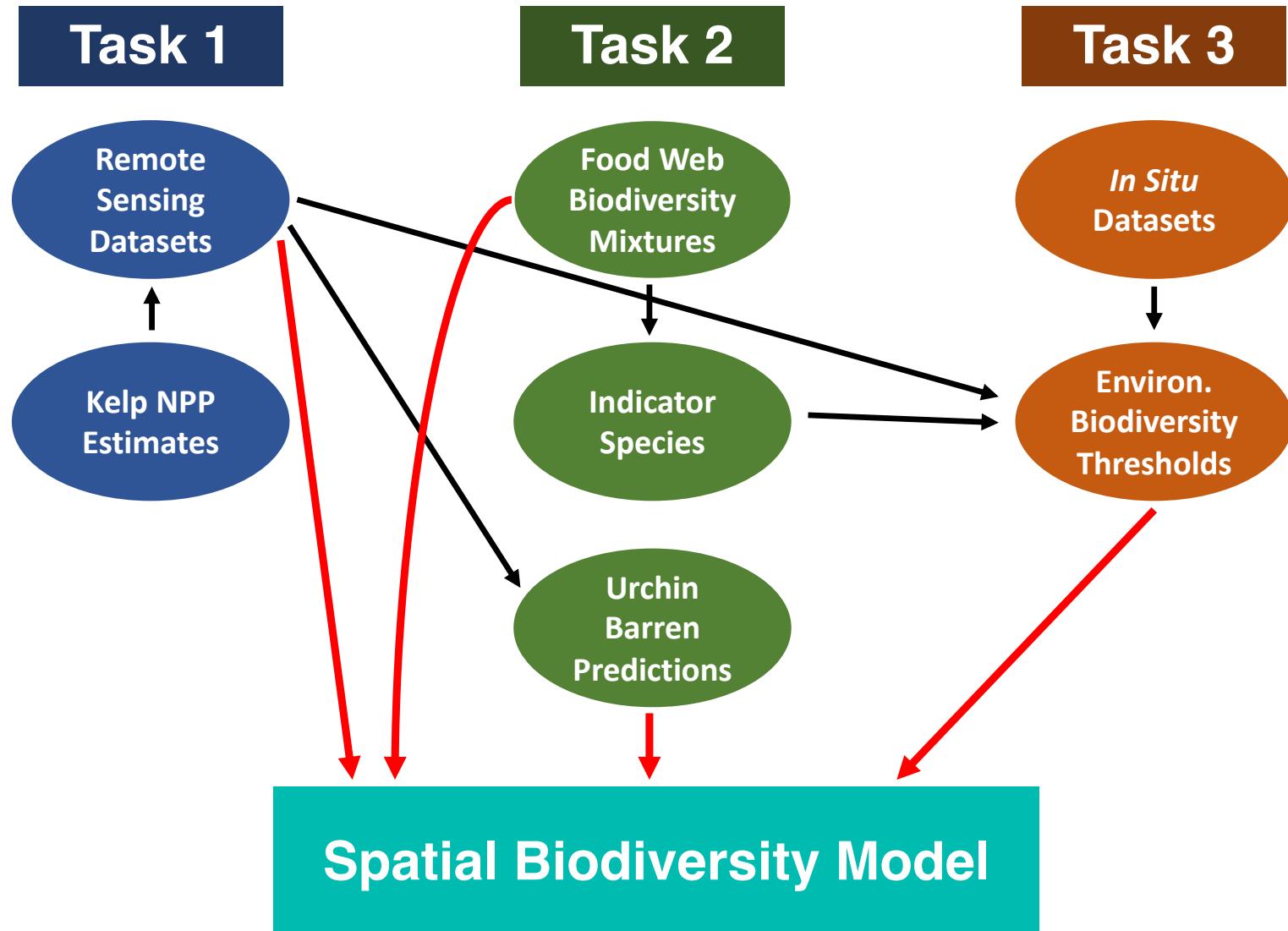
Assessing Spatial Biodiversity Dynamics in Kelp Forest Ecosystems using Spaceborne Remote Sensing

PI: Tom Bell (WHOI), Bob Miller (UCSB)

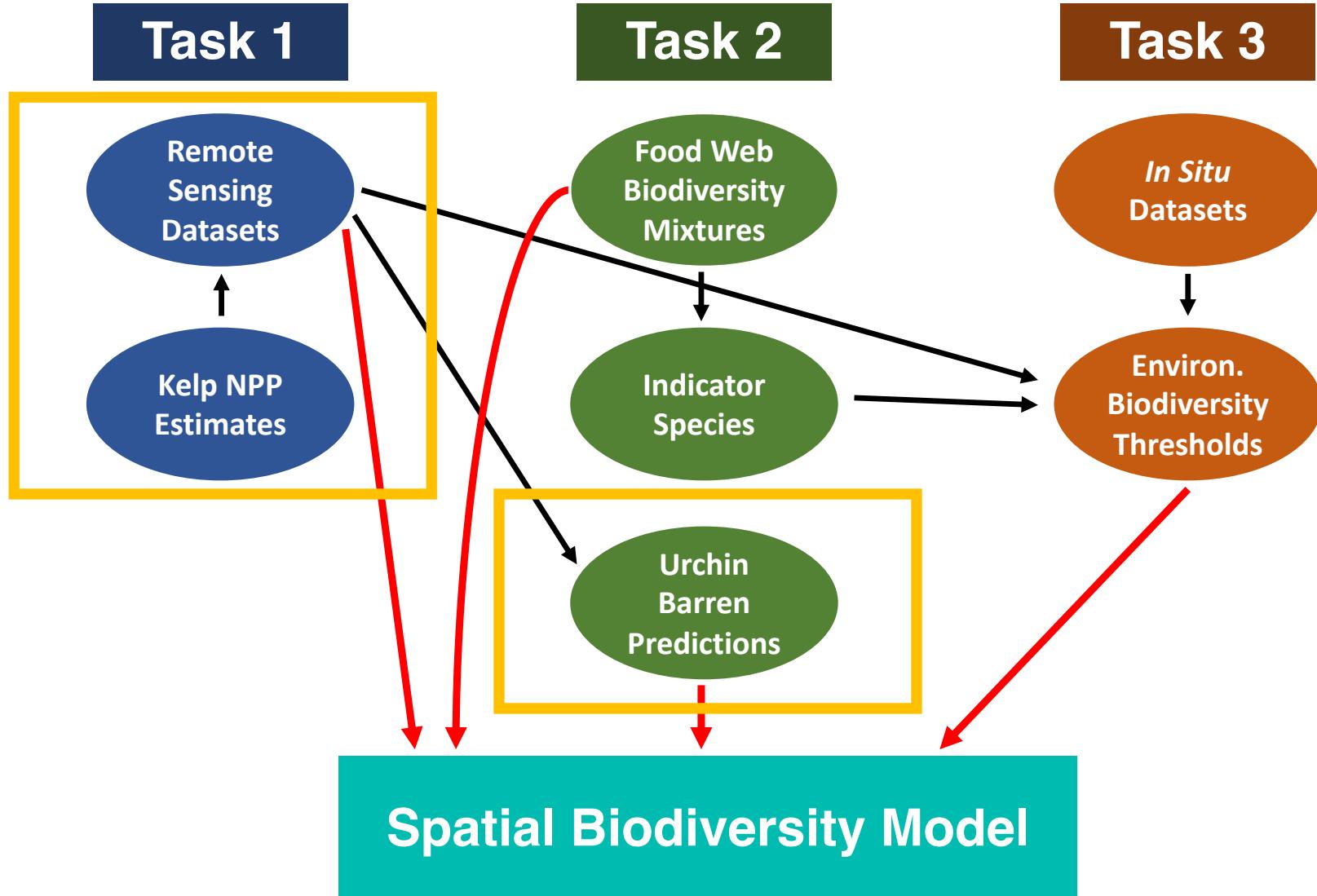
Overall Project Goals

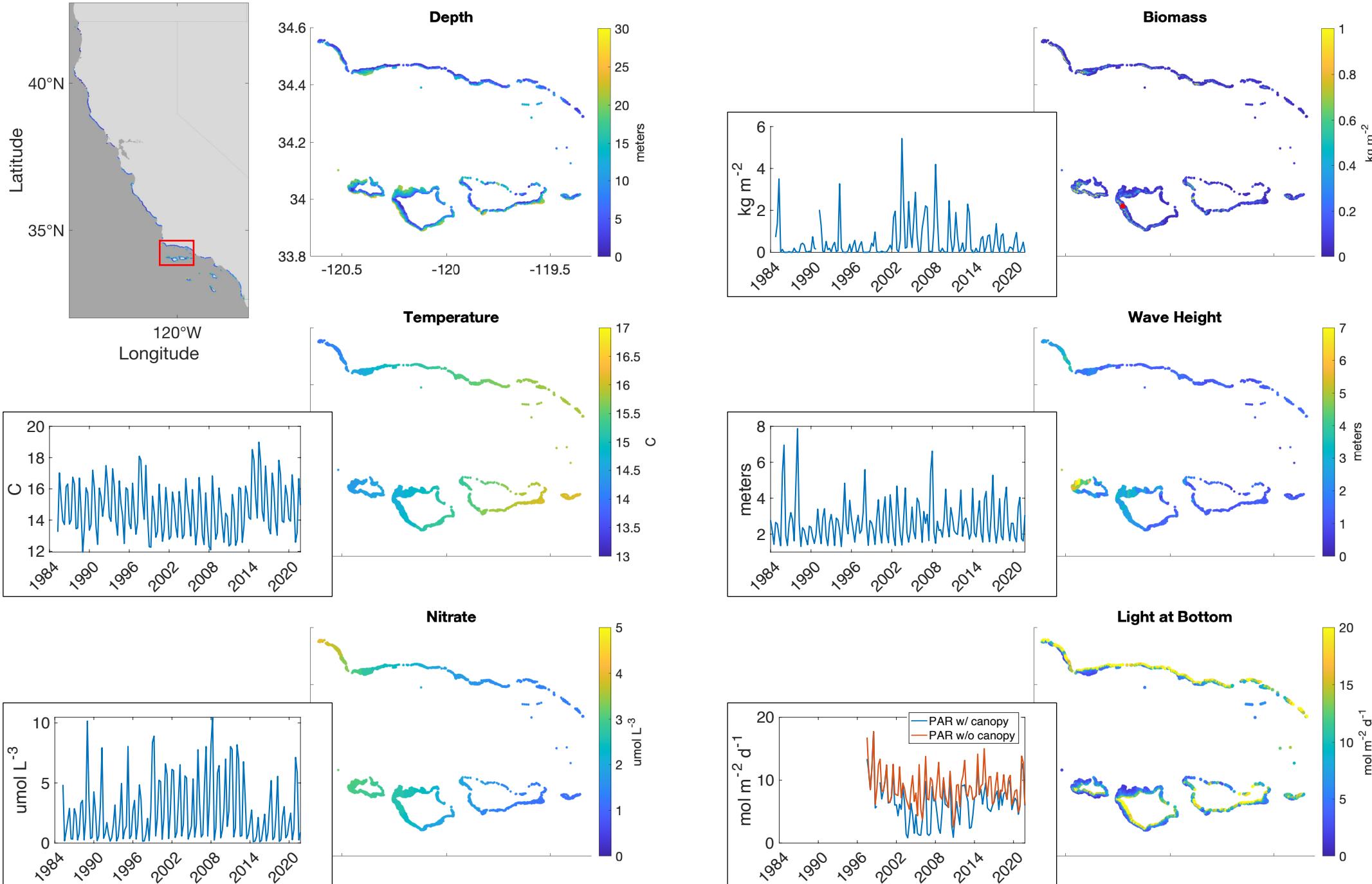
- Understand the biotic and abiotic drivers of kelp forest community state and develop a spatial model to predict biodiversity dynamics on subtidal rocky reefs in the Southern CA Bight.
- Leverage the strong foundation of prior work in the system together with remote sensing time series, a novel topological food web model, and multidecadal *in situ* biodiversity surveys.

Overall Project Structure



Overall Project Structure

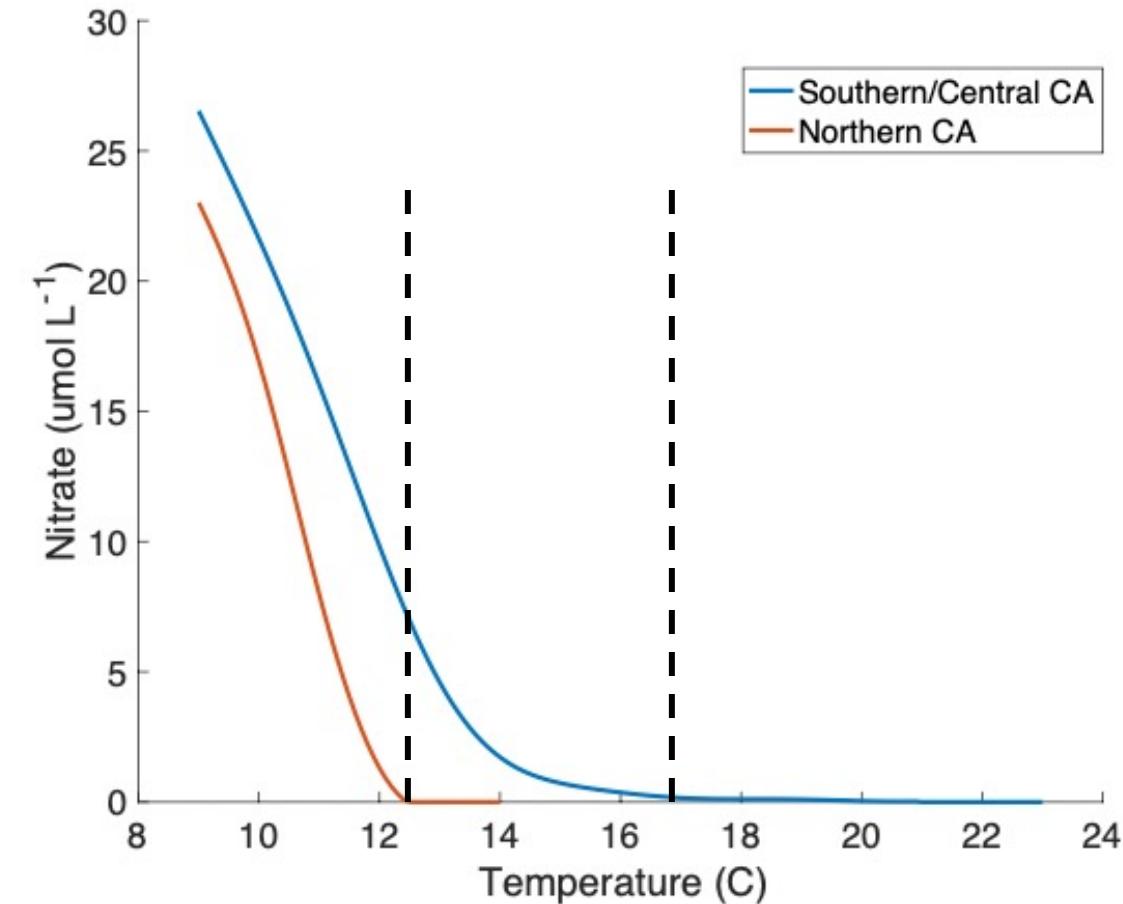
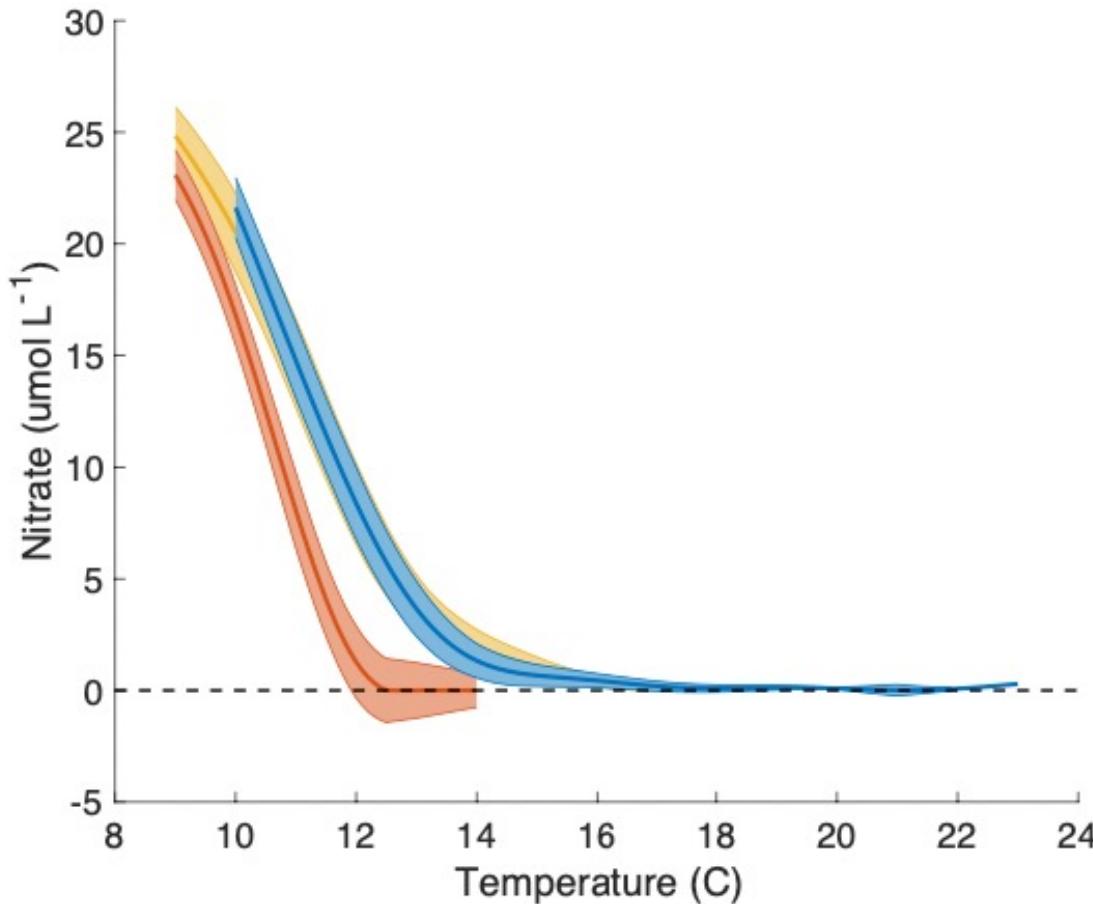




Q1: Was the loss and recovery of kelp canopy associated with the 2014 - 2016 marine heatwave related to temperature or nutrients?

Q2: Are there specific abiotic circumstances that are associated with the transition from kelp forest to urchin barren?

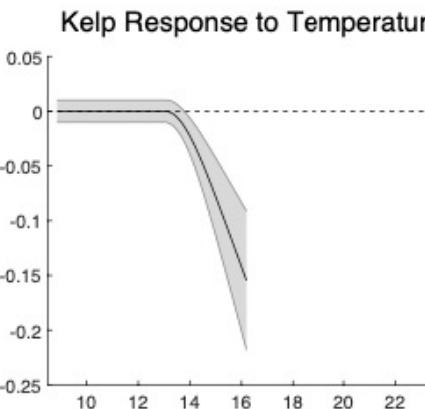
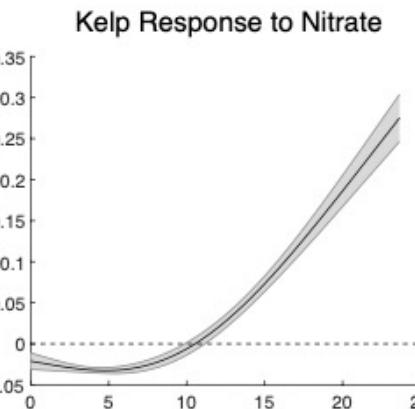
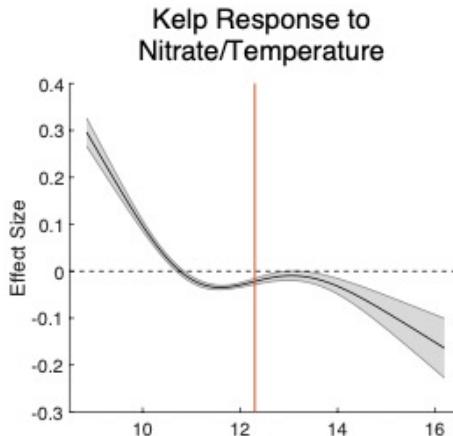
Temperature measurements yield different estimates of nitrate between Northern and Central/Southern CA



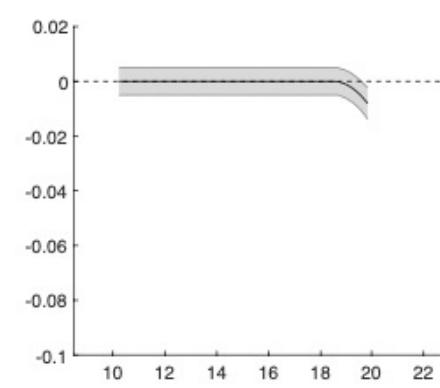
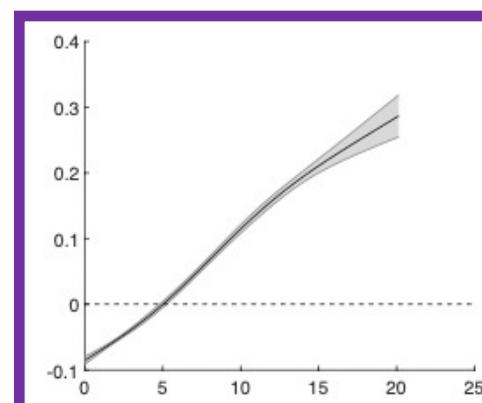
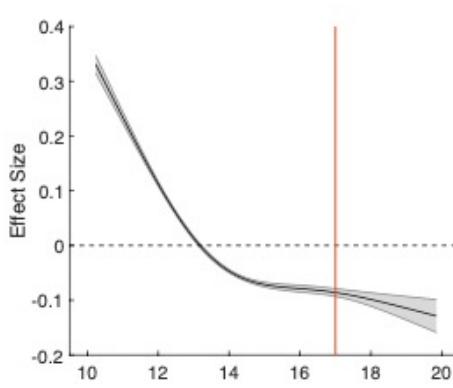
Differentiating the role of nitrate and temperature on kelp dynamics



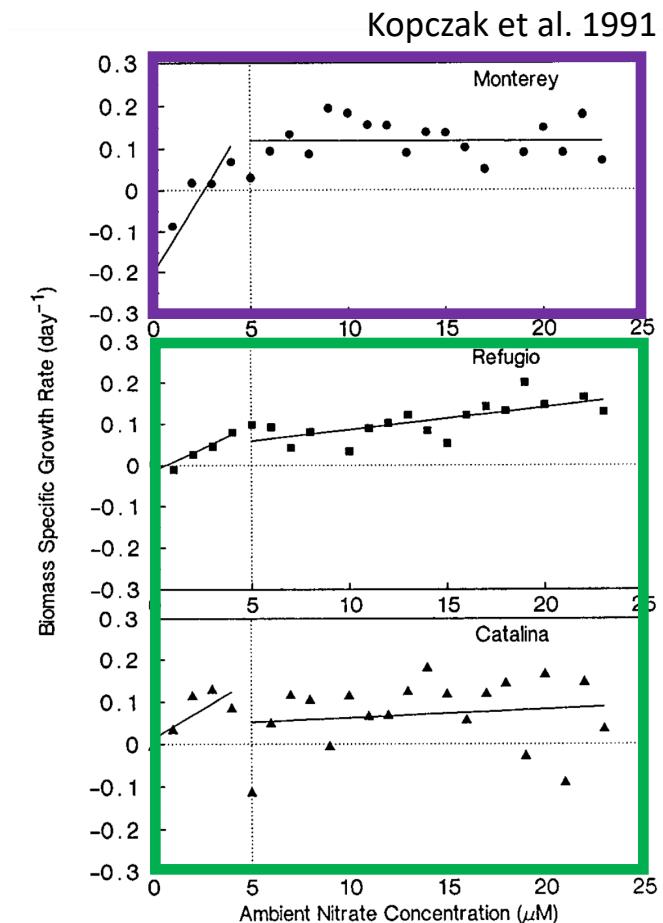
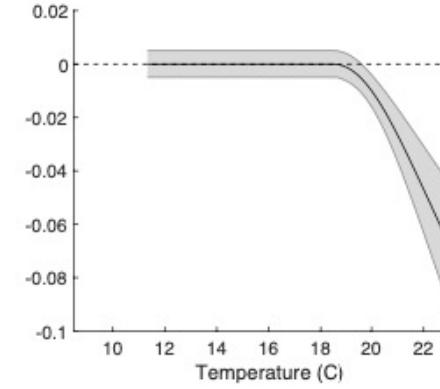
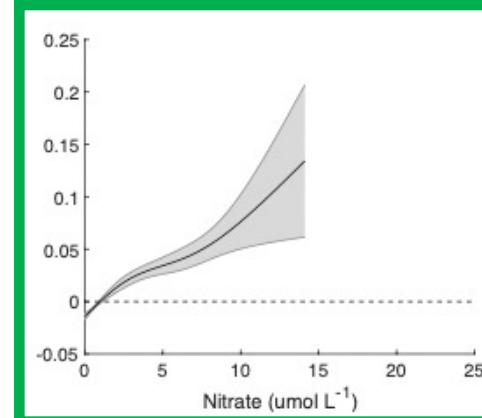
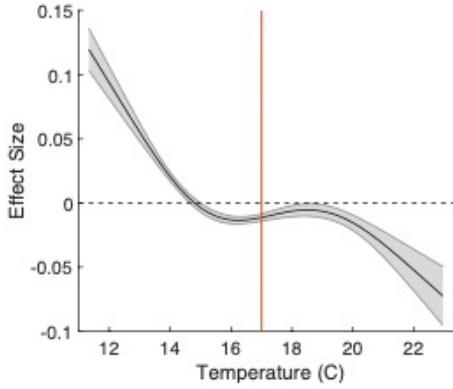
Northern CA



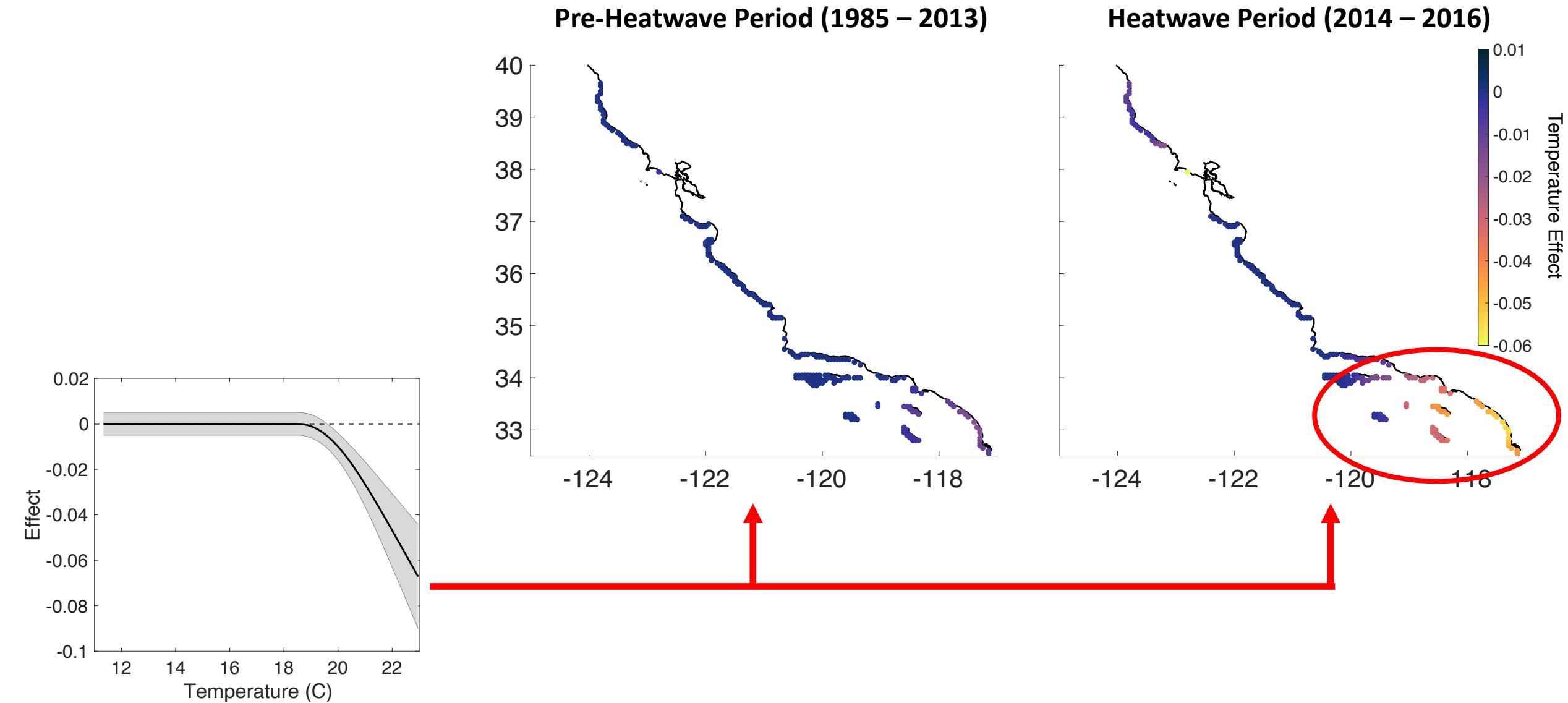
Central CA

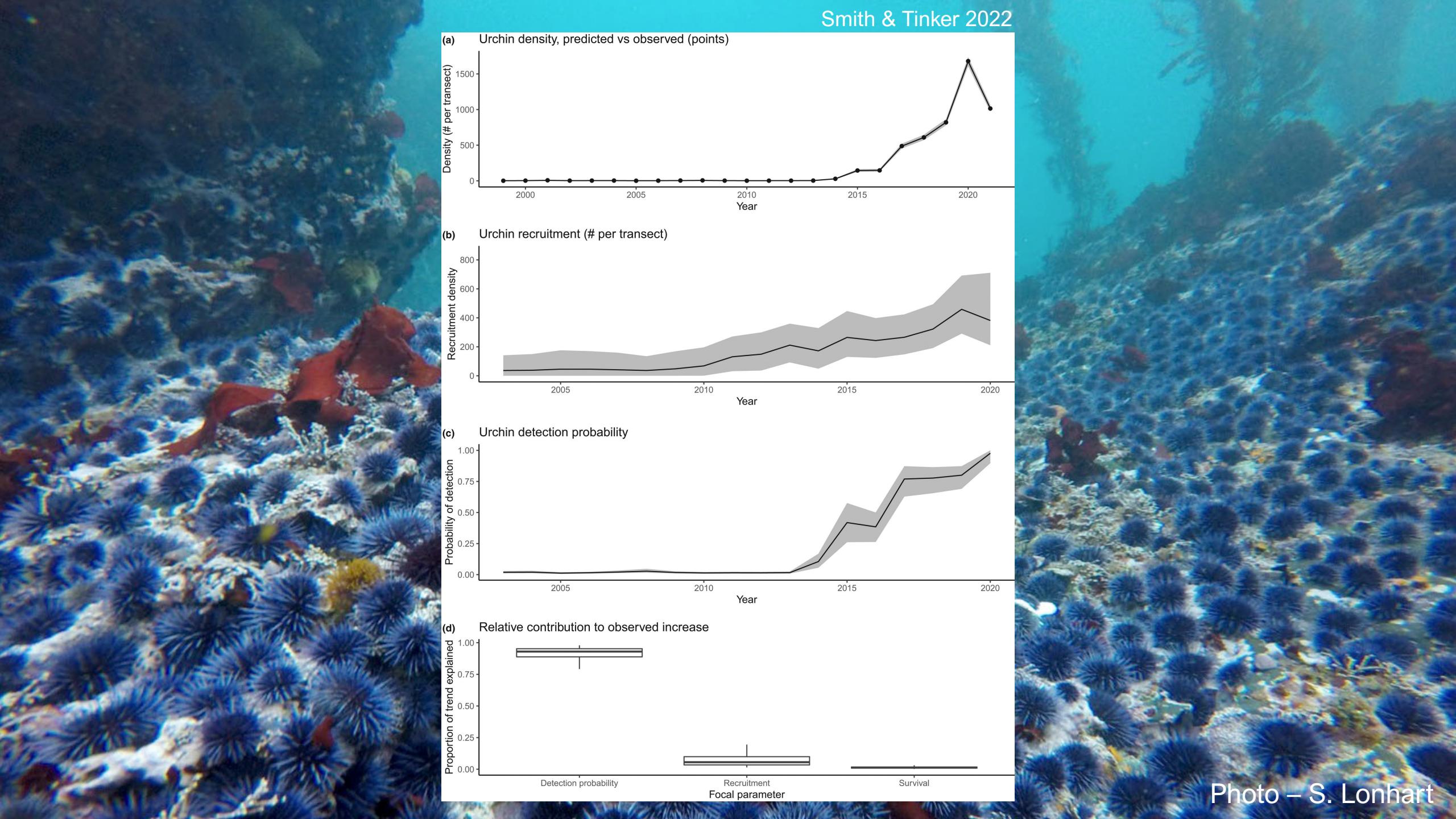


Southern CA

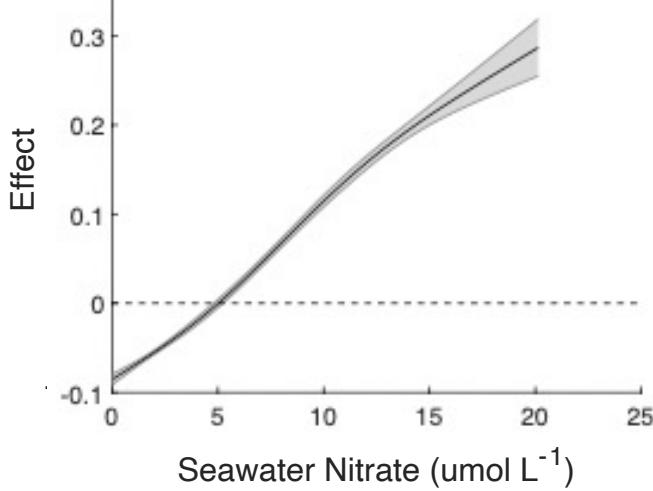
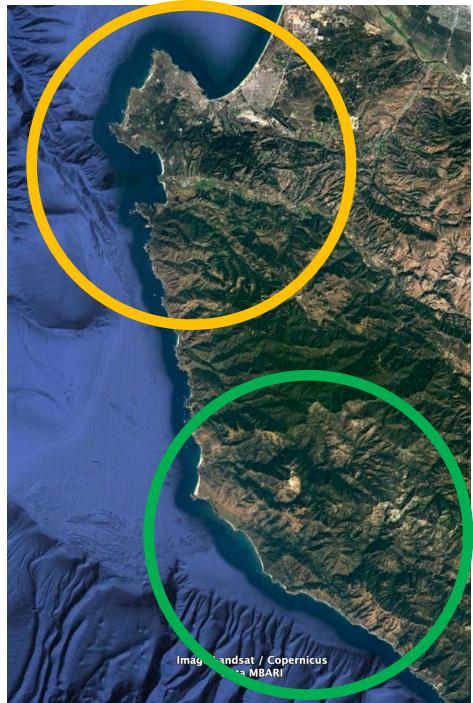


Temperature Effects on Kelp During Marine Heatwave

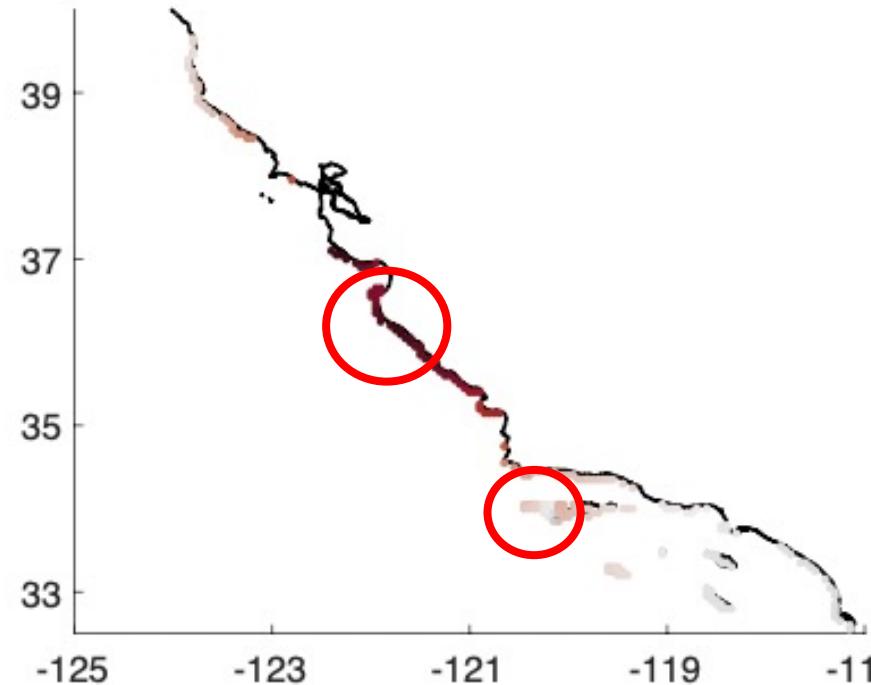




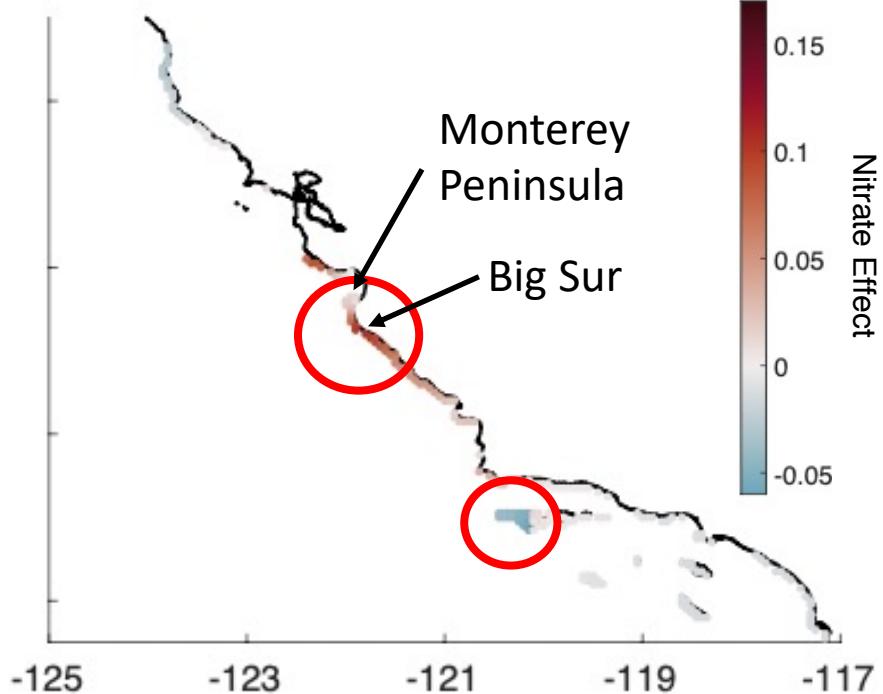
Nutrient Effects on Kelp Production During Marine Heatwave



Pre-Heatwave Period (1985 – 2013)



Heatwave Period (2014 – 2016)

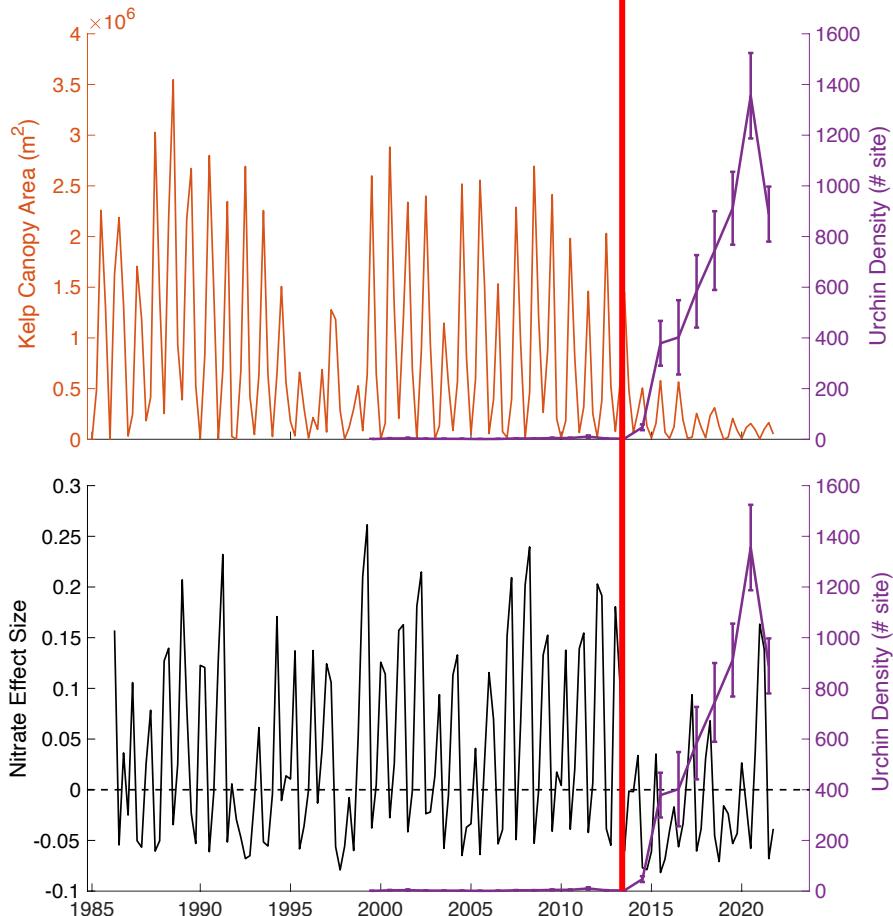


Nitrate Effect

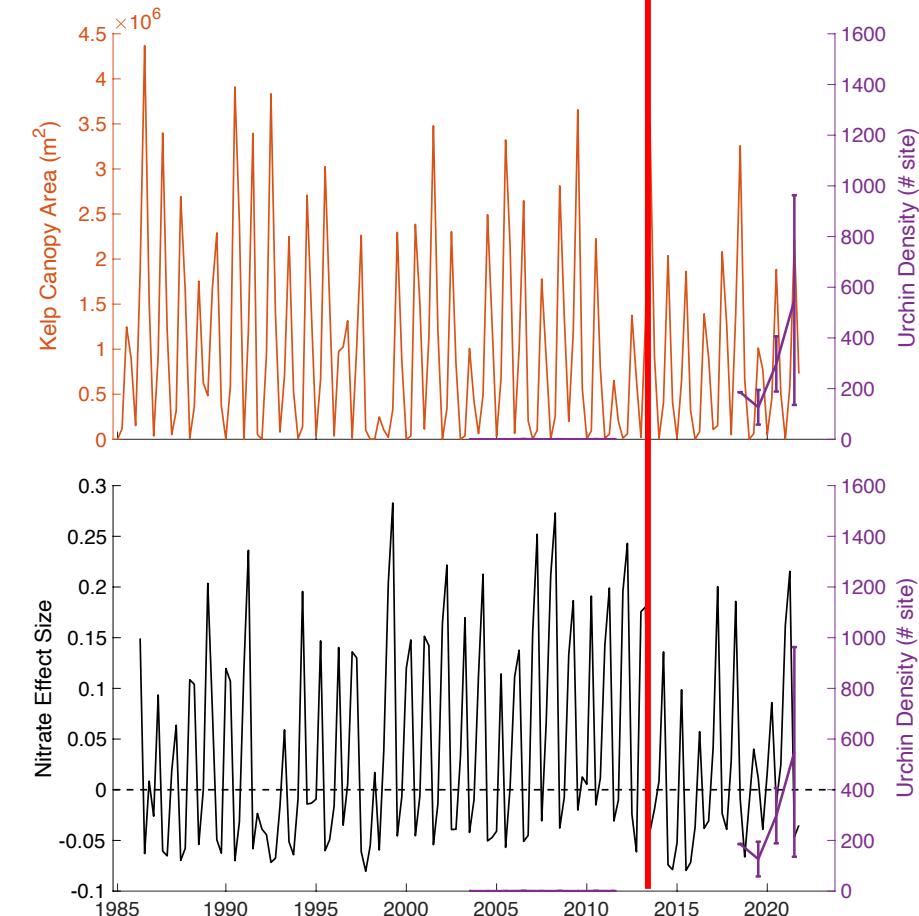
0.15
0.1
0.05
0
-0.05



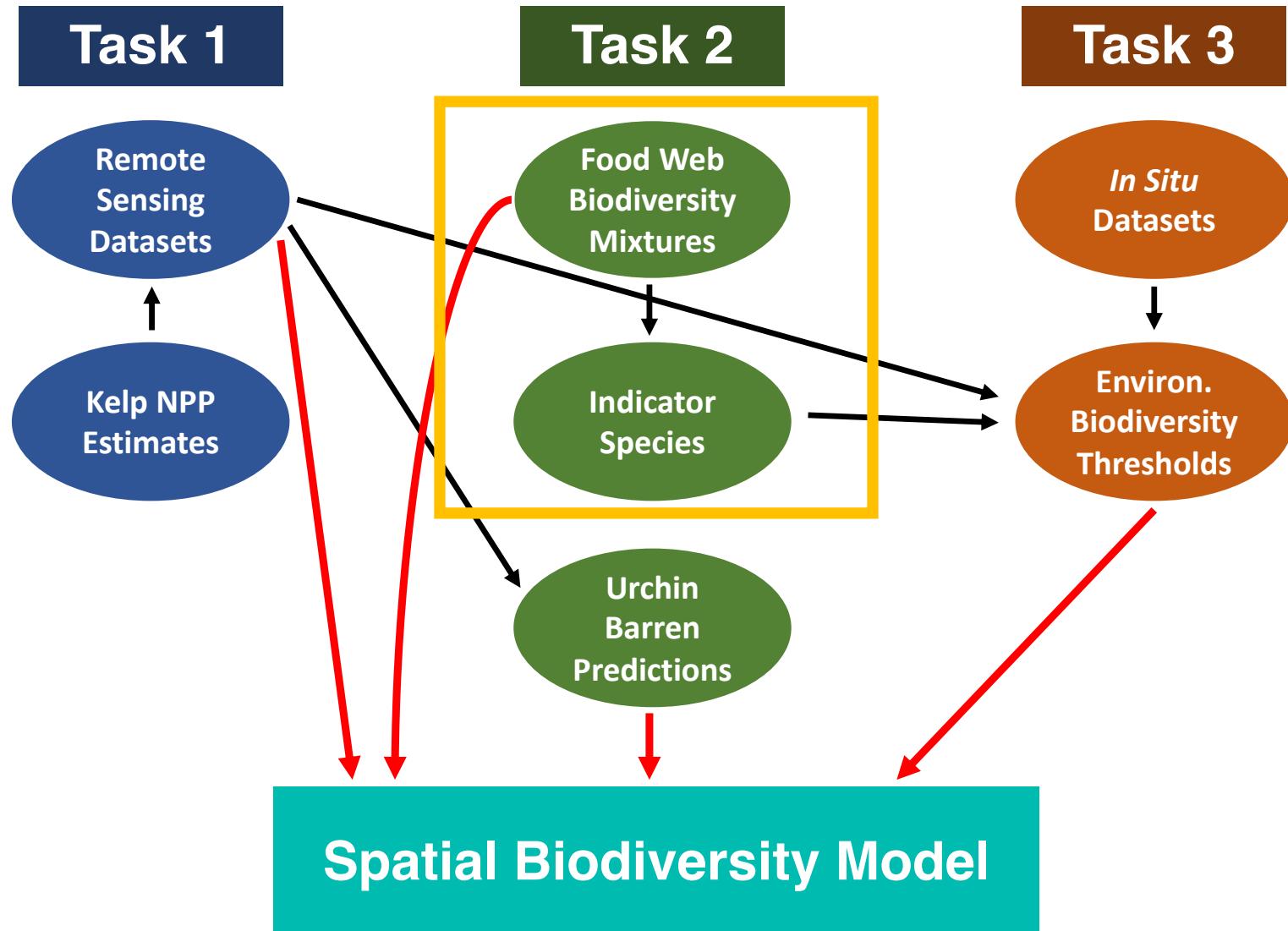
Monterey Peninsula



Big Sur

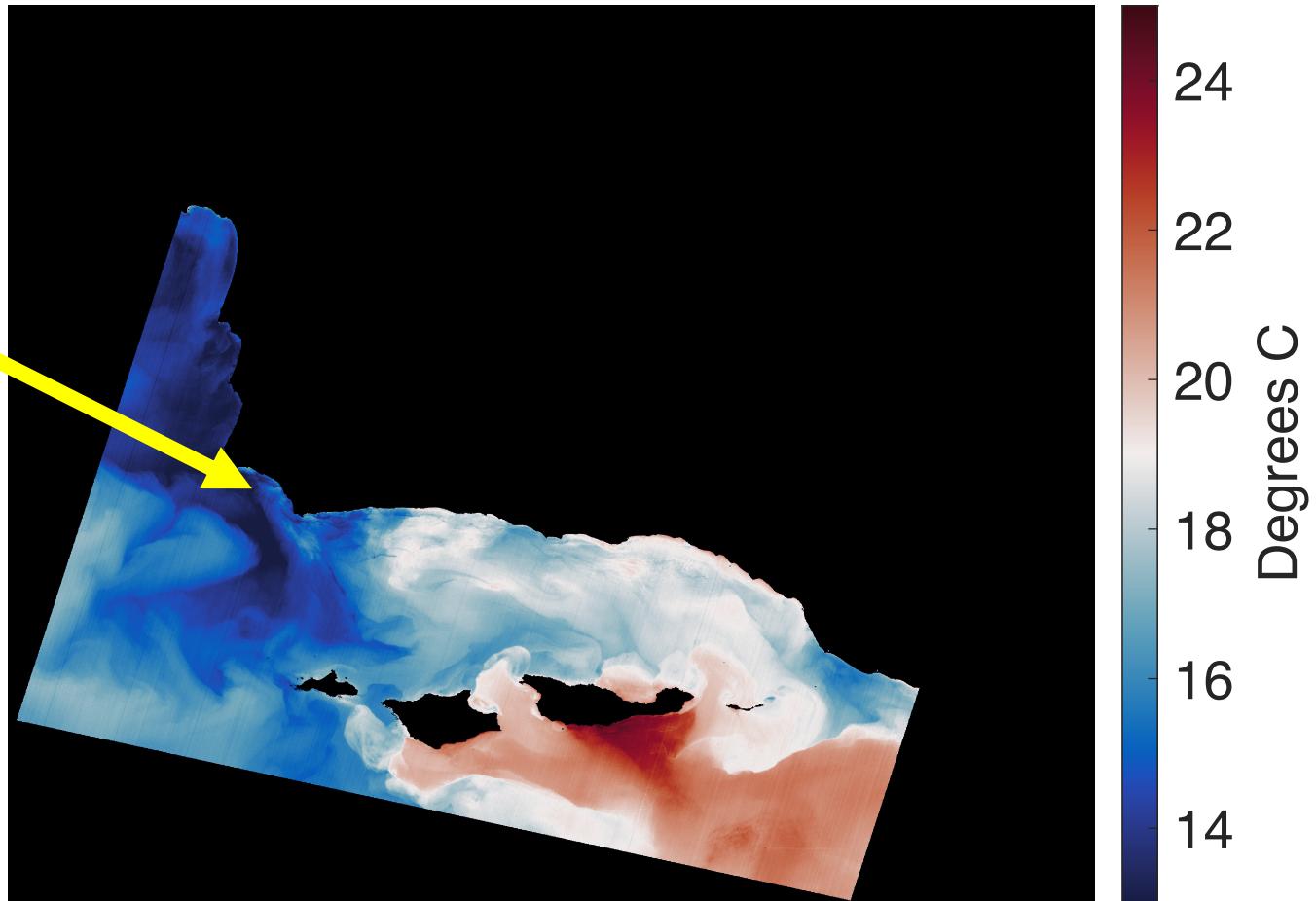


Overall Project Structure



Santa Barbara Channel, CA, USA

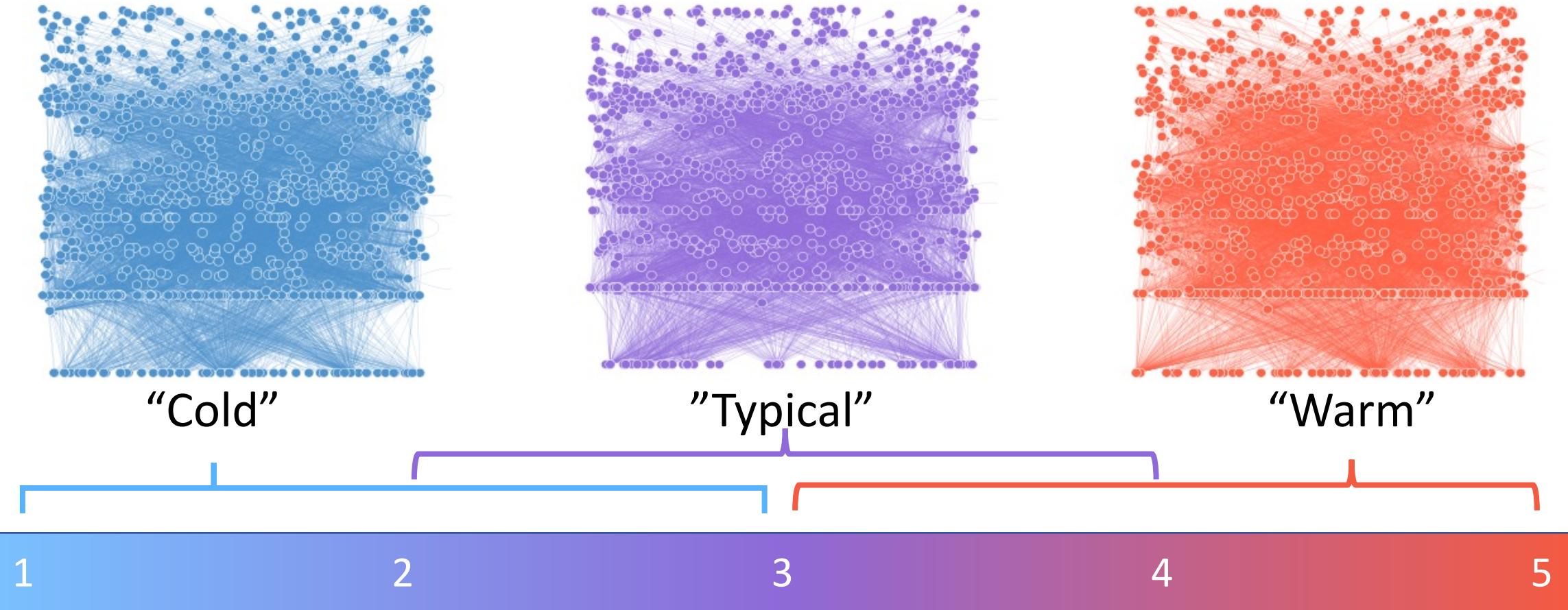
- Transition zone between two floristic provinces
 - Point Conception is key barrier
- Ideal zone to look at shifts in species distributions



Sea surface temperature from Landsat, October 22, 2017

Building thermal zone webs

- Used 5 “thermal zones” to construct 3 web versions:



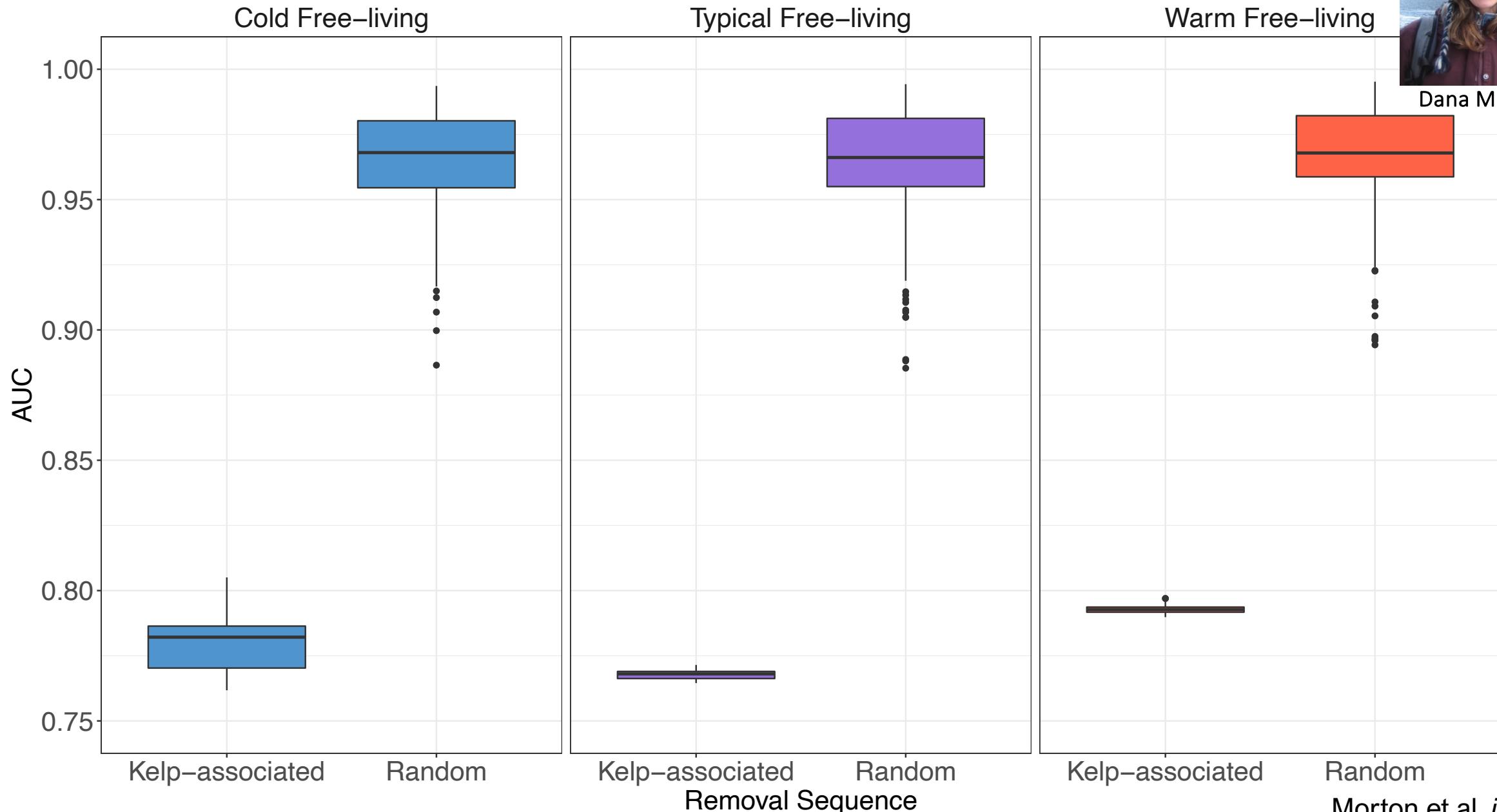
Species with limited thermal data were assumed present in all three versions.

igraph{R}

Kelps and kelp-associated species loss

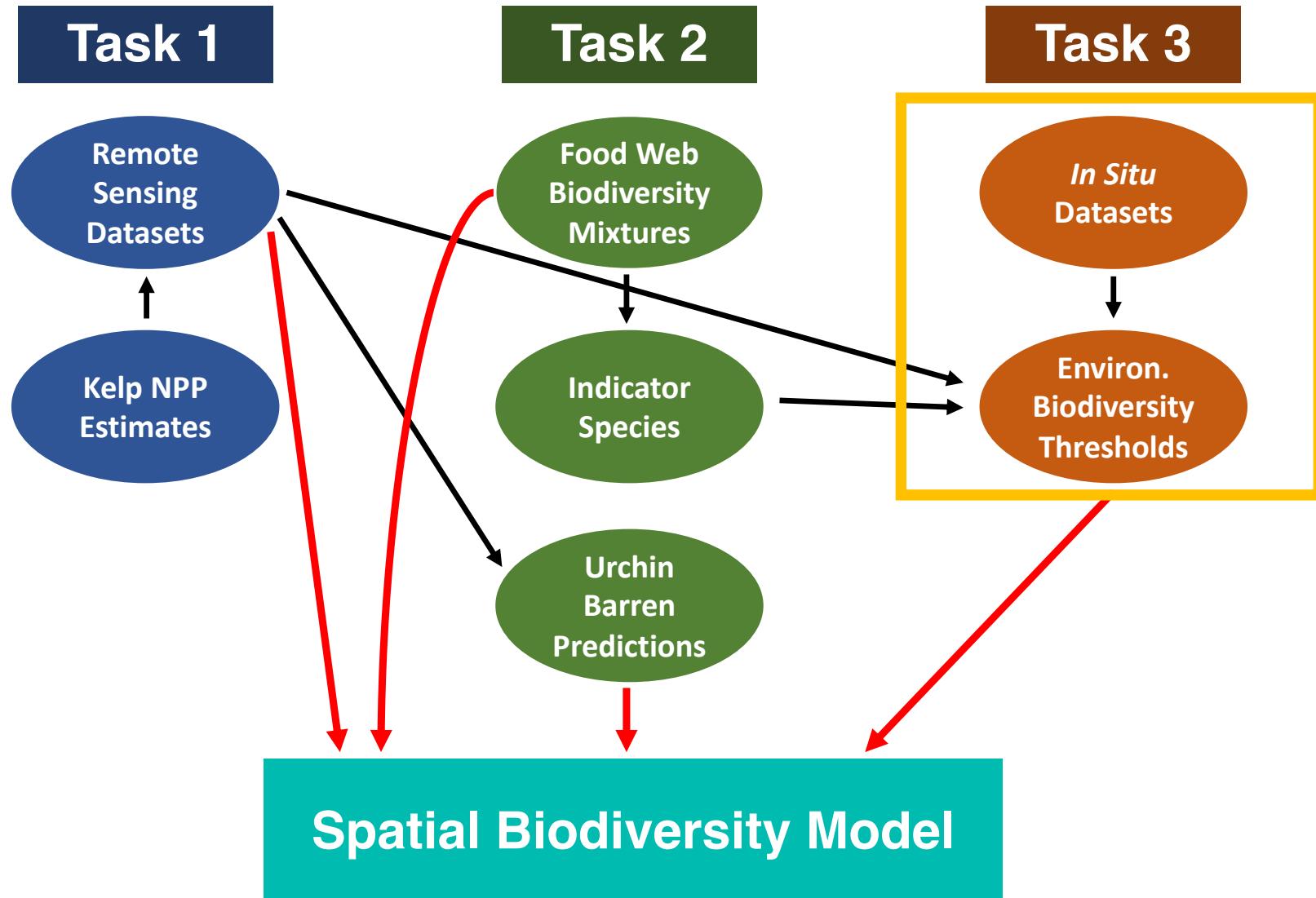


Dana Morton



Morton et al. *in prep*

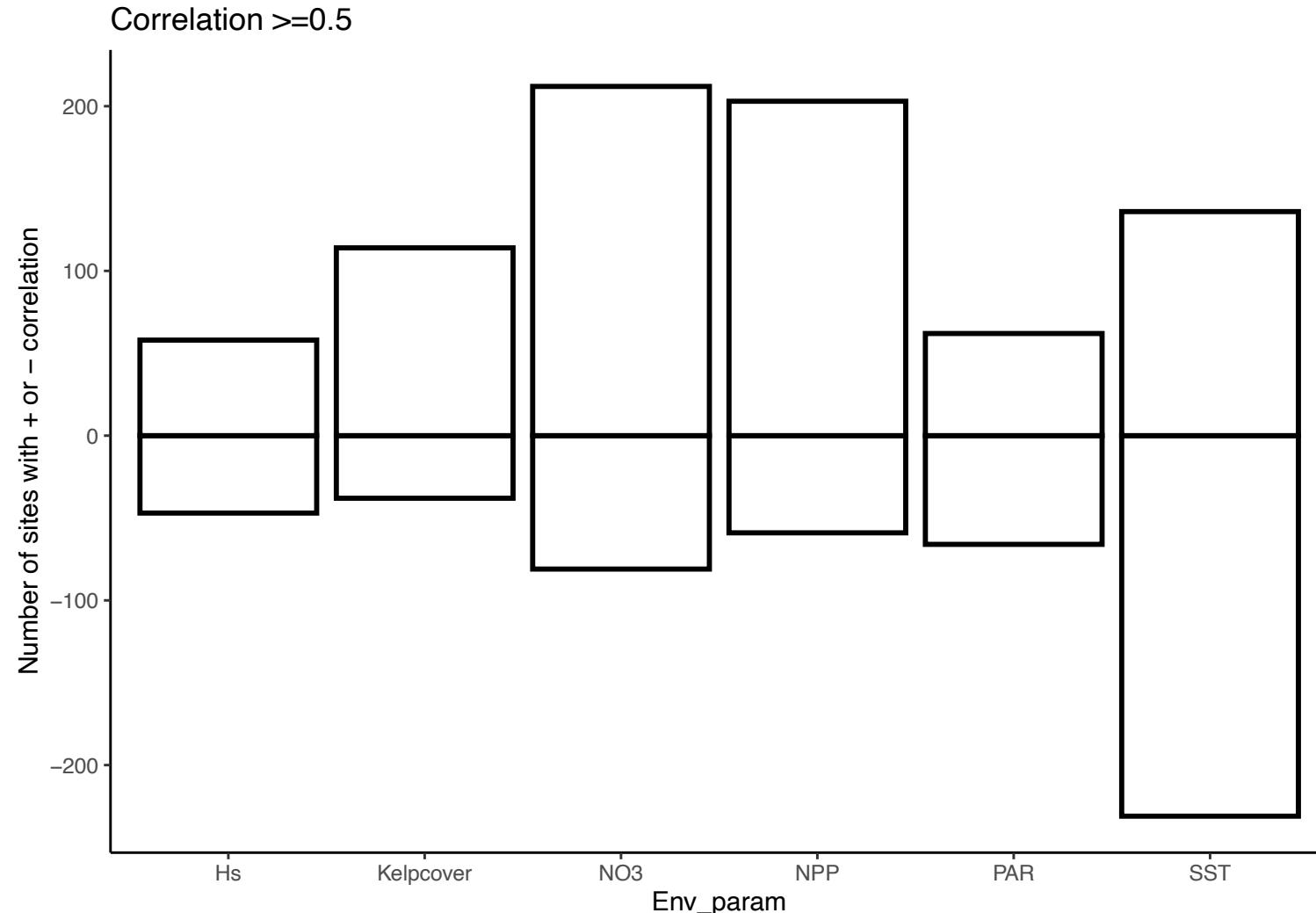
Overall Project Structure



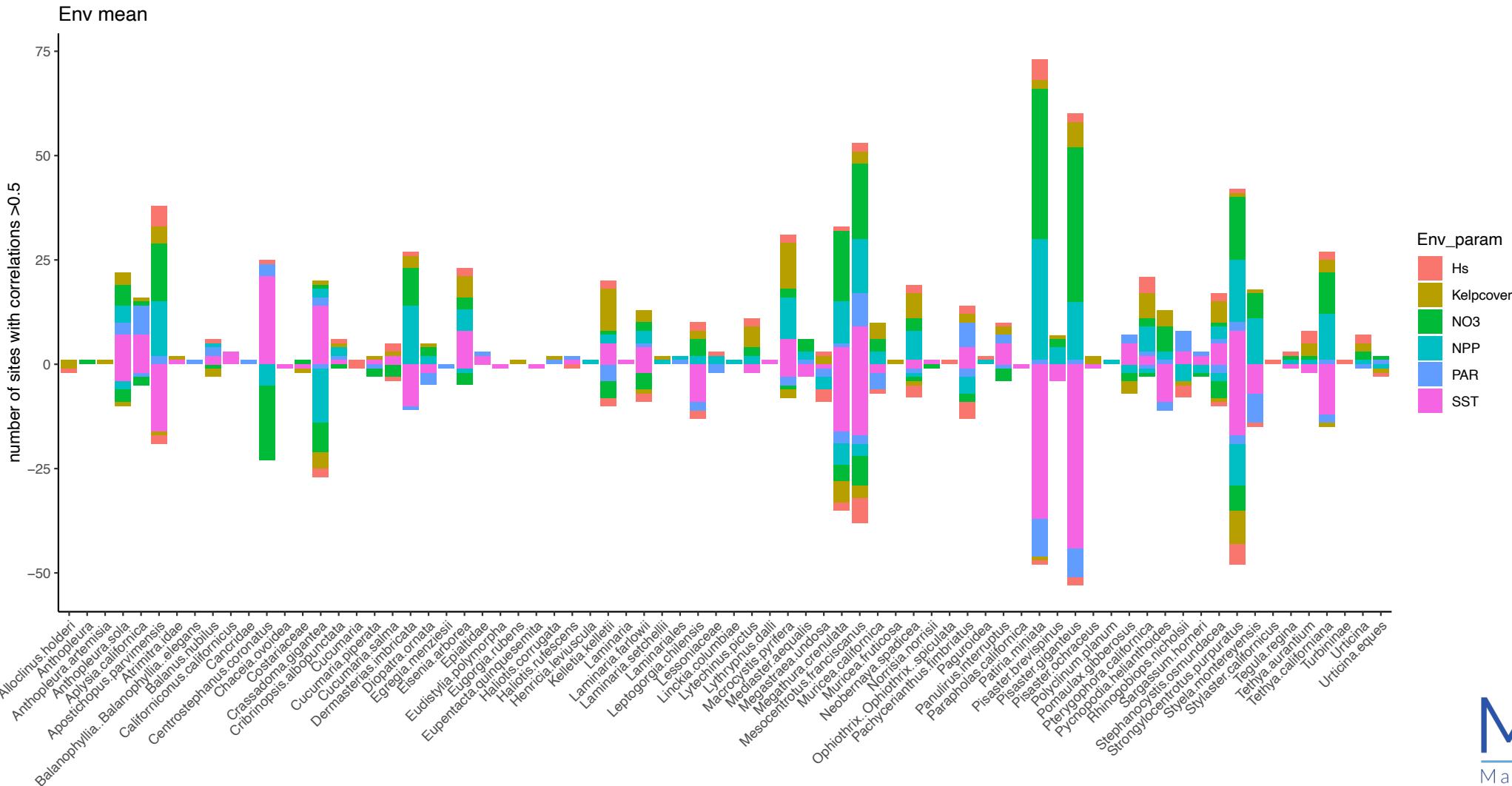
Number of correlations (≥ 0.5) with environmental variables across all spp & sites



Sara Gonzalez



Number of sites with correlations ($>=0.5$) with environmental parameters

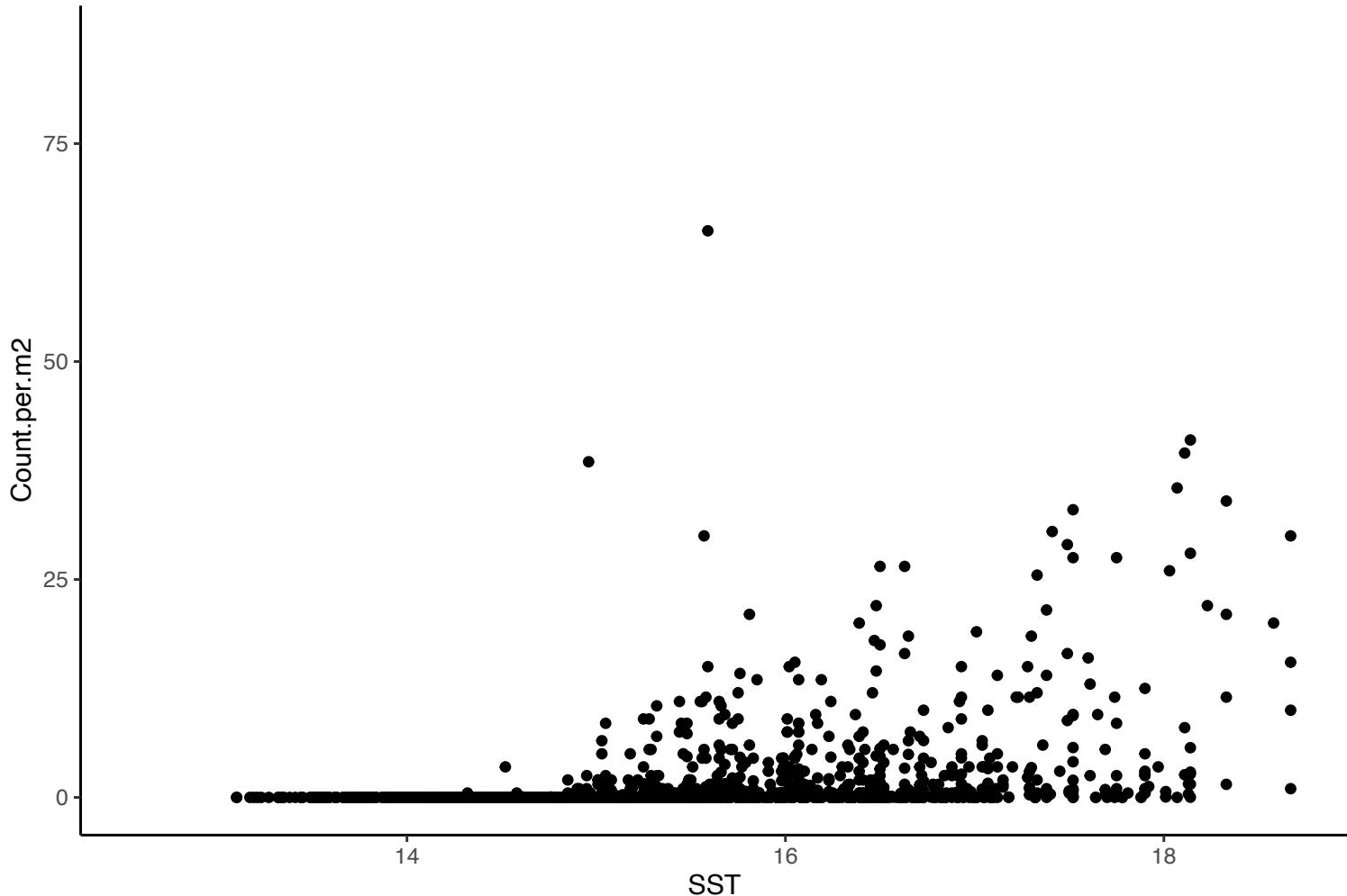


MBON
Marine Biodiversity
Observation Network

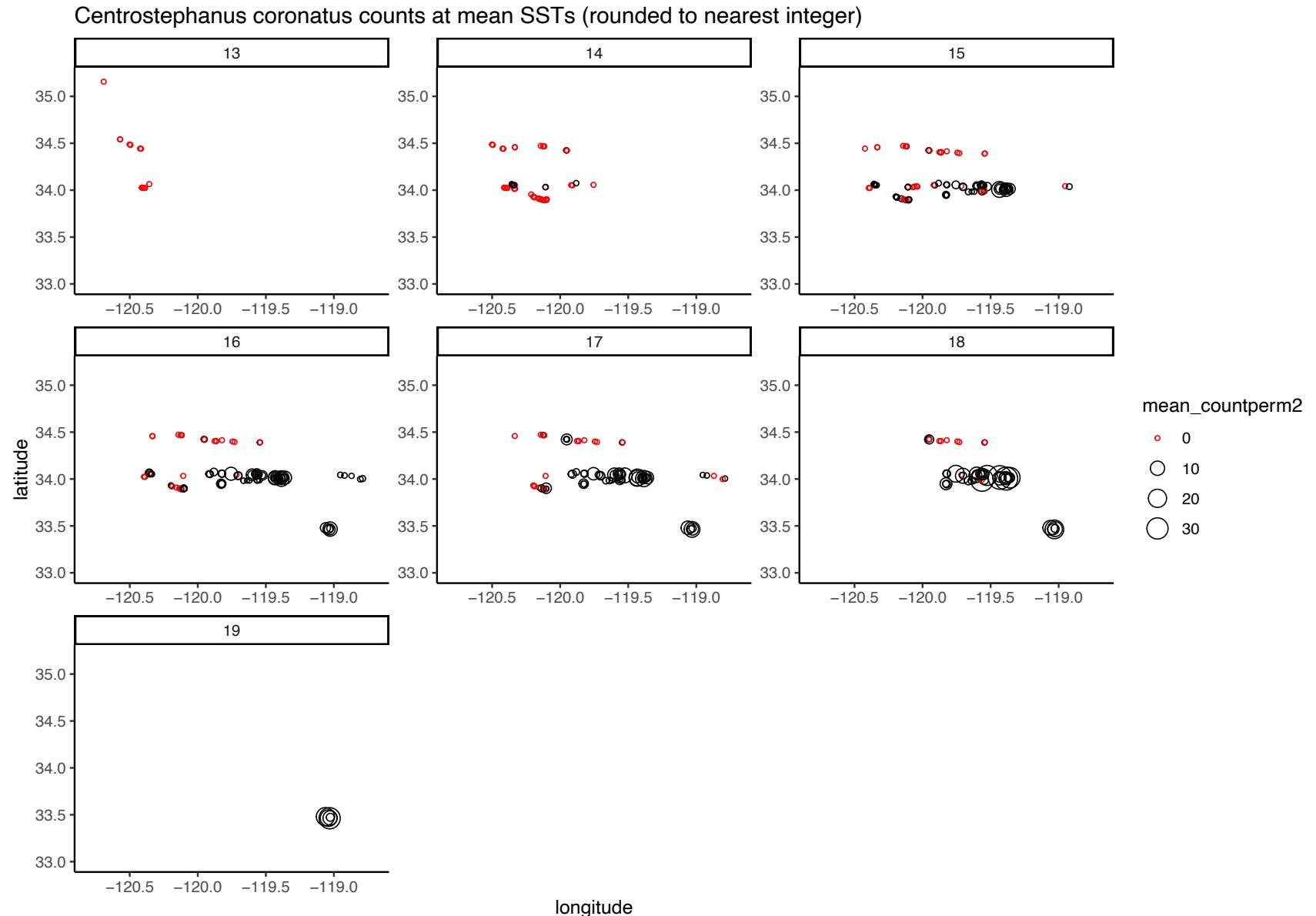
Centrostephanus coronatus (crowned urchin) mean SST



Centrostephanus coronatus – all sites, all years



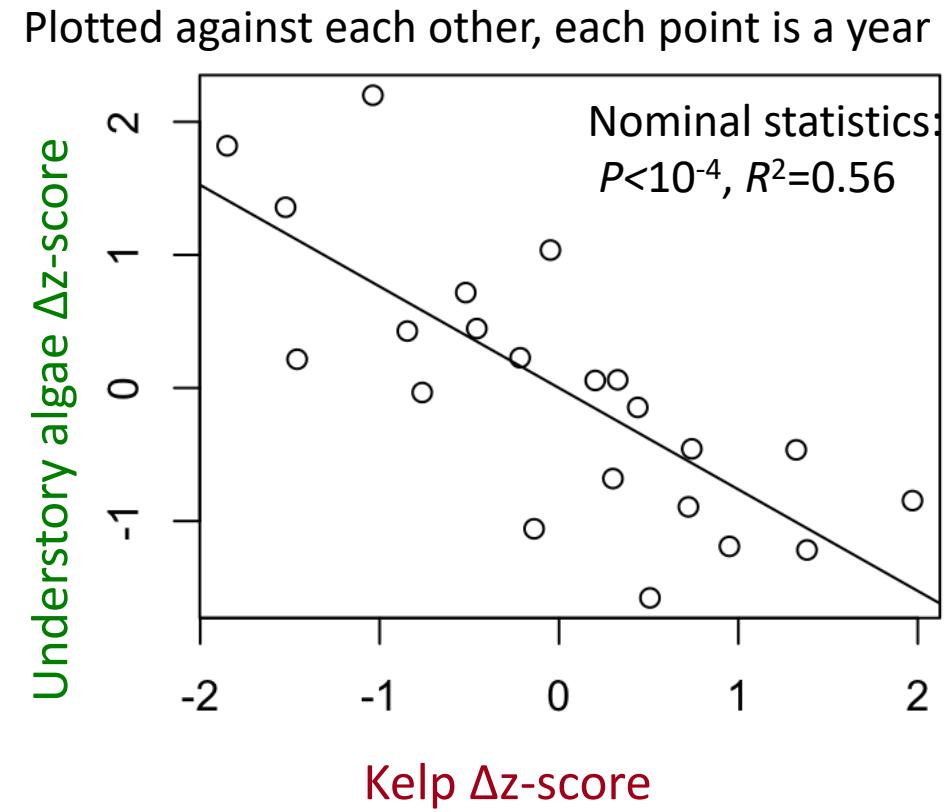
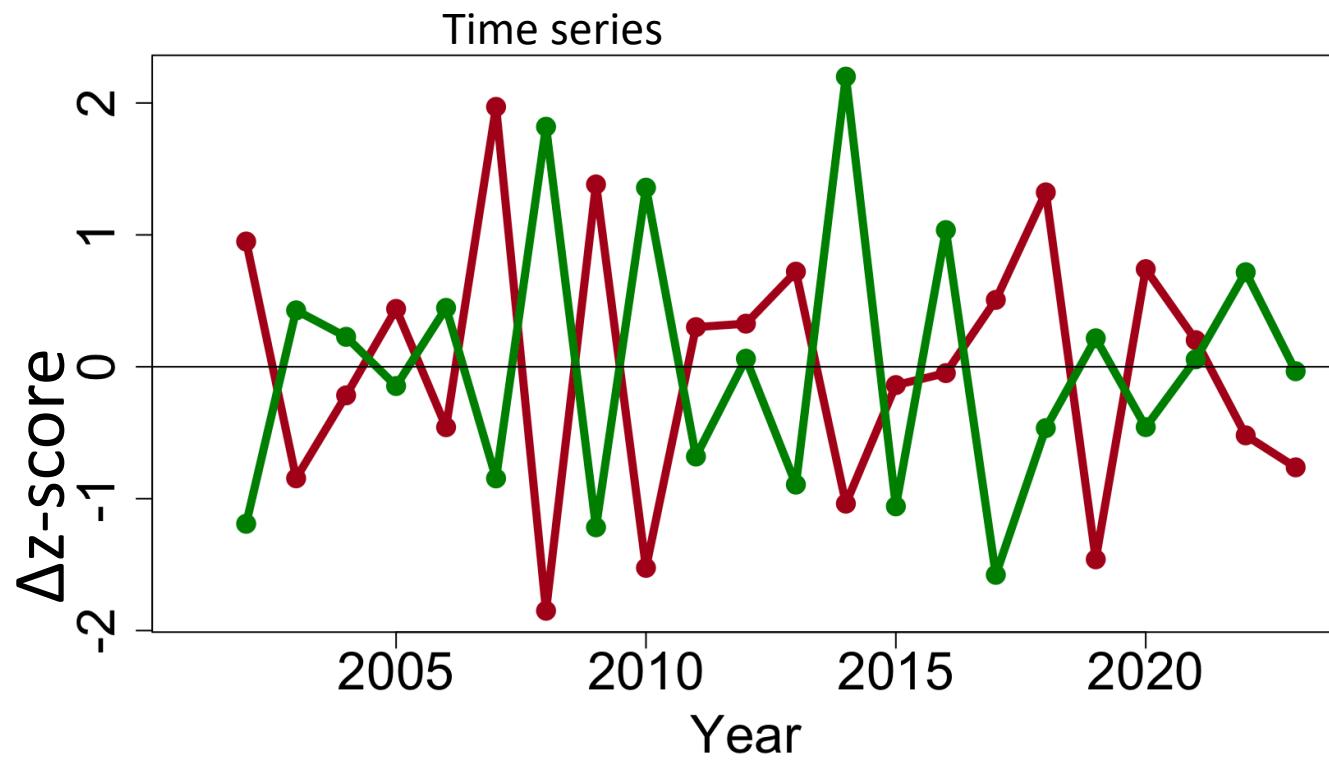
Variation in *C. coronatus* counts by site & SST



Alternating cover of remotely sensed giant kelp canopy vs. understory algae



Year-to-year change in summer understory algae cover (in-situ sampling by SBC LTER)
Year-to-year change in Q2 kelp biomass estimated from Landsat



Questions?
tbell@whoi.edu

Dana Morton



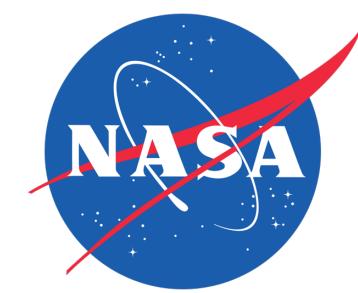
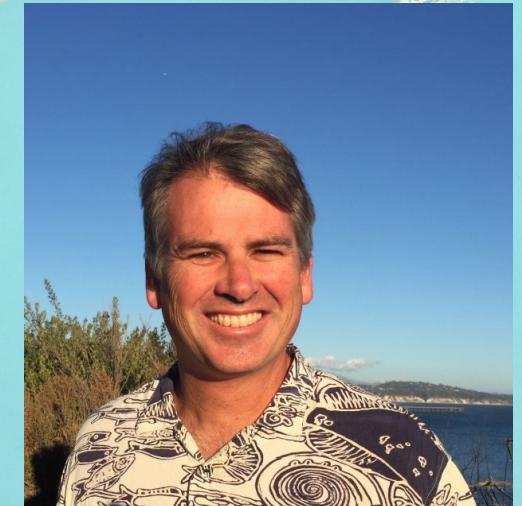
Sara Gonzalez



Tom Bell



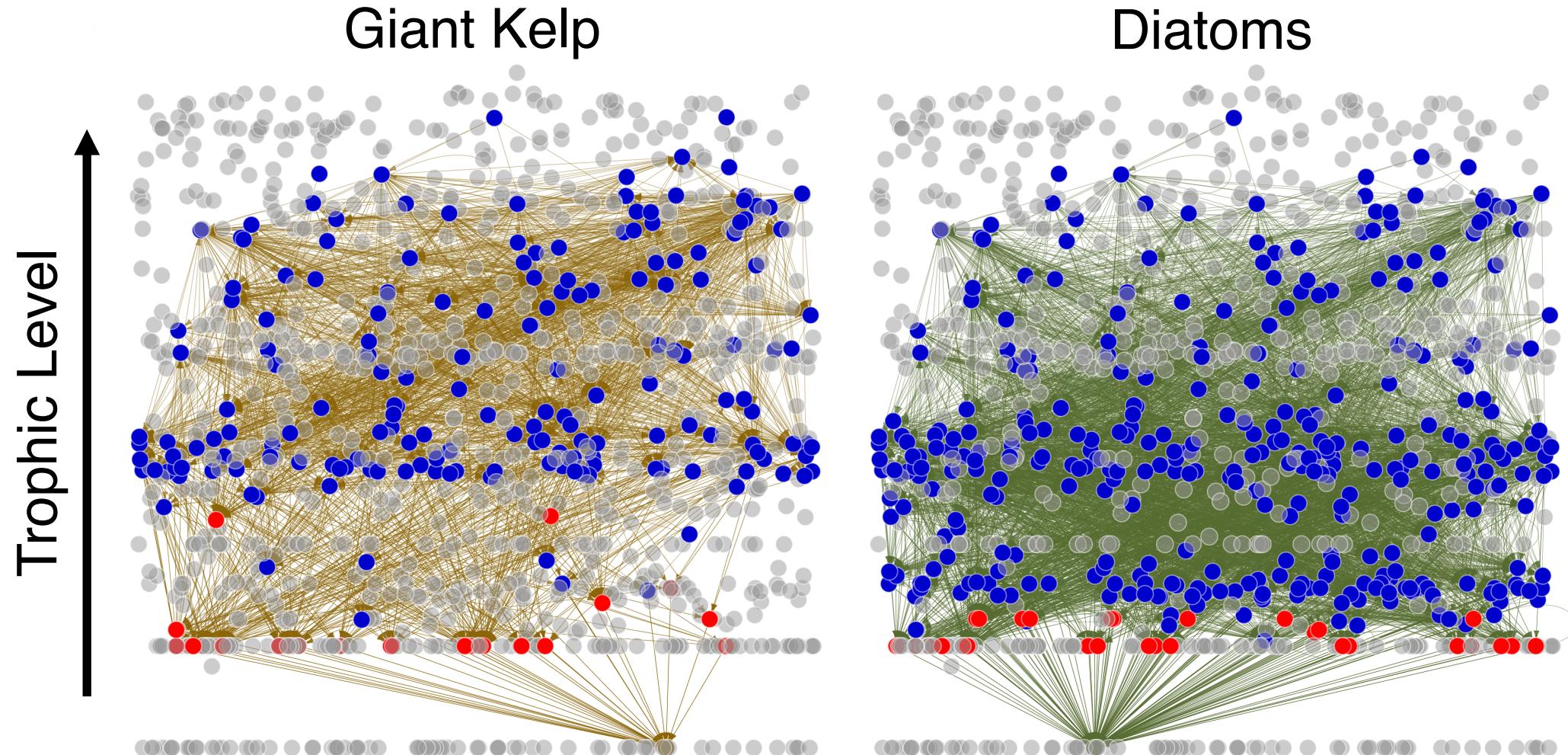
Bob Miller



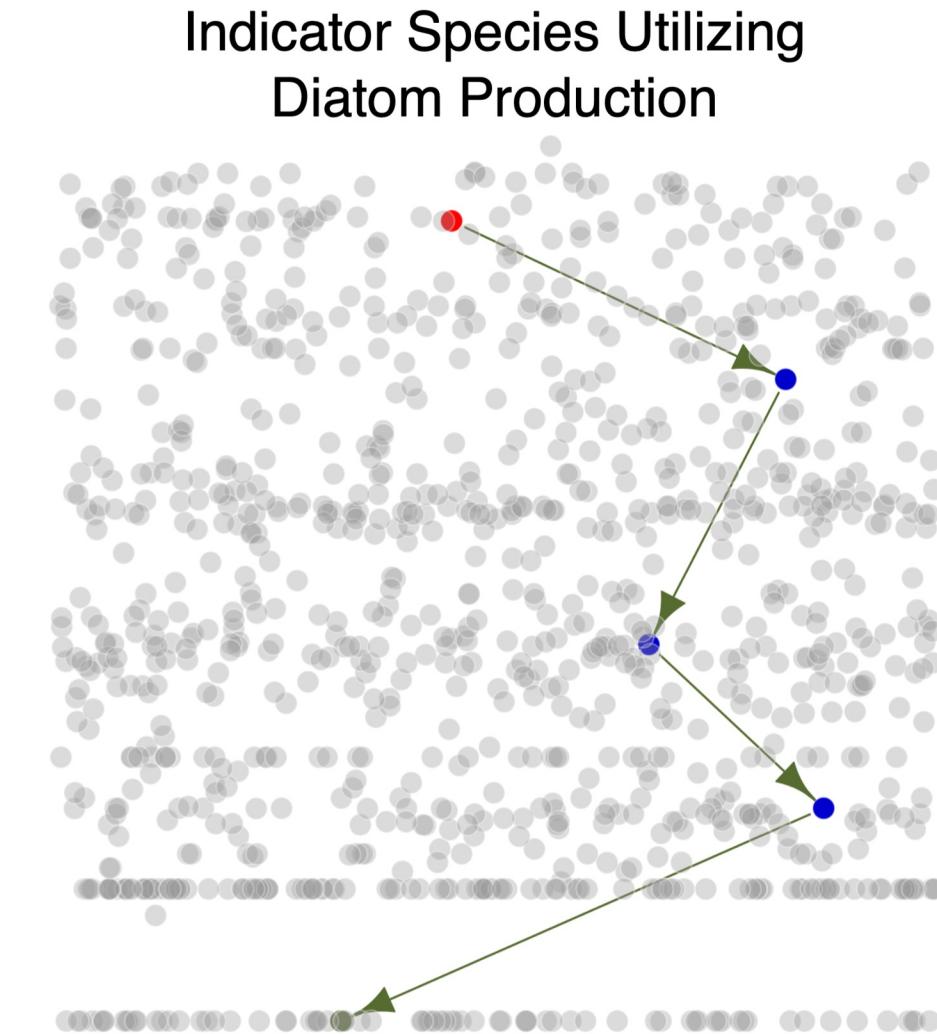
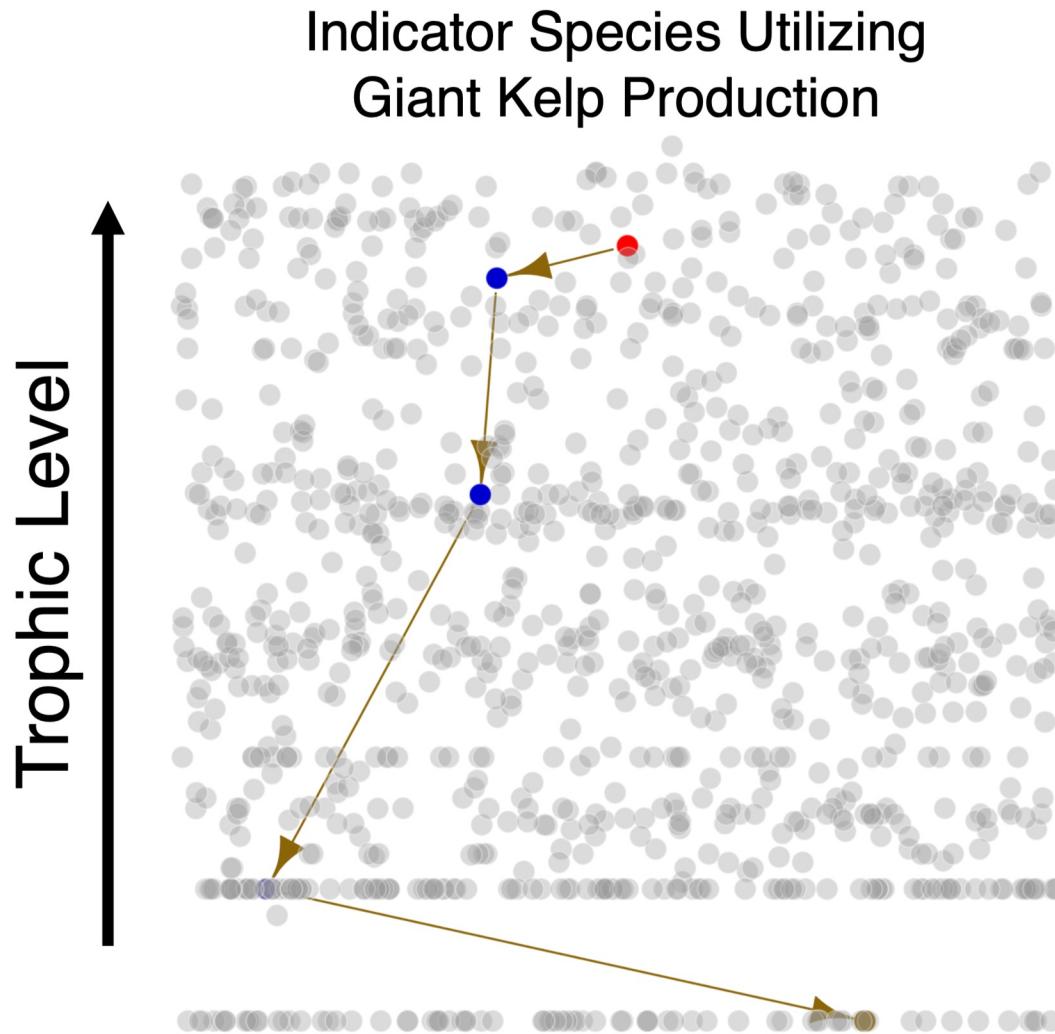
MBON
Marine Biodiversity
Observation Network



Energy flow from different production sources



Identify indicator species for each production source



Relate *in situ* time series of species to environmental drivers

