BOEM
Bureau of Ocean Energy Management

MARINE BIODIVERSITY OBSERVATION NETWORK

SANTA BARBARA CHANNEL

Marine Science Institute
University of California Santa Barbara

Who we are

Principal/Associate Investigators



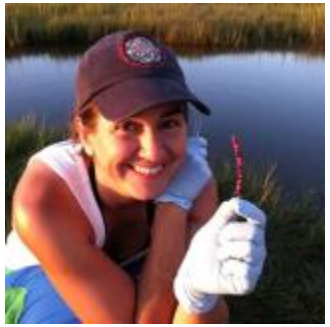

UCSB

Robert Miller, David Siegel, Craig Carlson, Daniel Reed, BS Manjunath, Deborah Iglesias-Rodriguez, Doug McCauley, Milton Love



Florida State University

Andrew Rassweiler



USGS

Kevin Lafferty

UCSD - SIO

John Hildebrand

NOAA – NMFS SWFSC

Andrew Thompson

Partners

Plumes and Blooms (NASA)

BOEM Pacific Region

Santa Barbara Coastal LTER (NSF)

Channel Islands National Marine Sanctuary

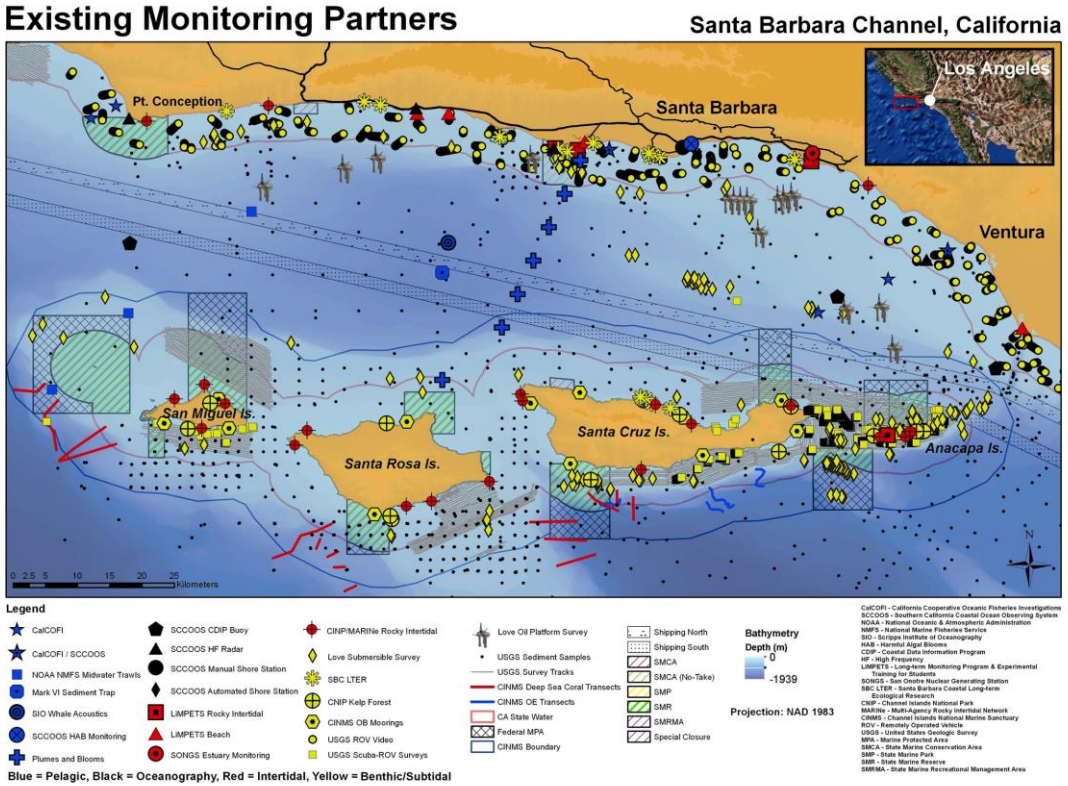
Southern California Coastal Water Research Project

Southern California Coastal Ocean Observing System (SCCOOS)

Channel Islands National Park

Gray Whales Count

CalCOFI



MARINE BIODIVERSITY OBSERVATION NETWORK
SANTA BARBARA CHANNEL

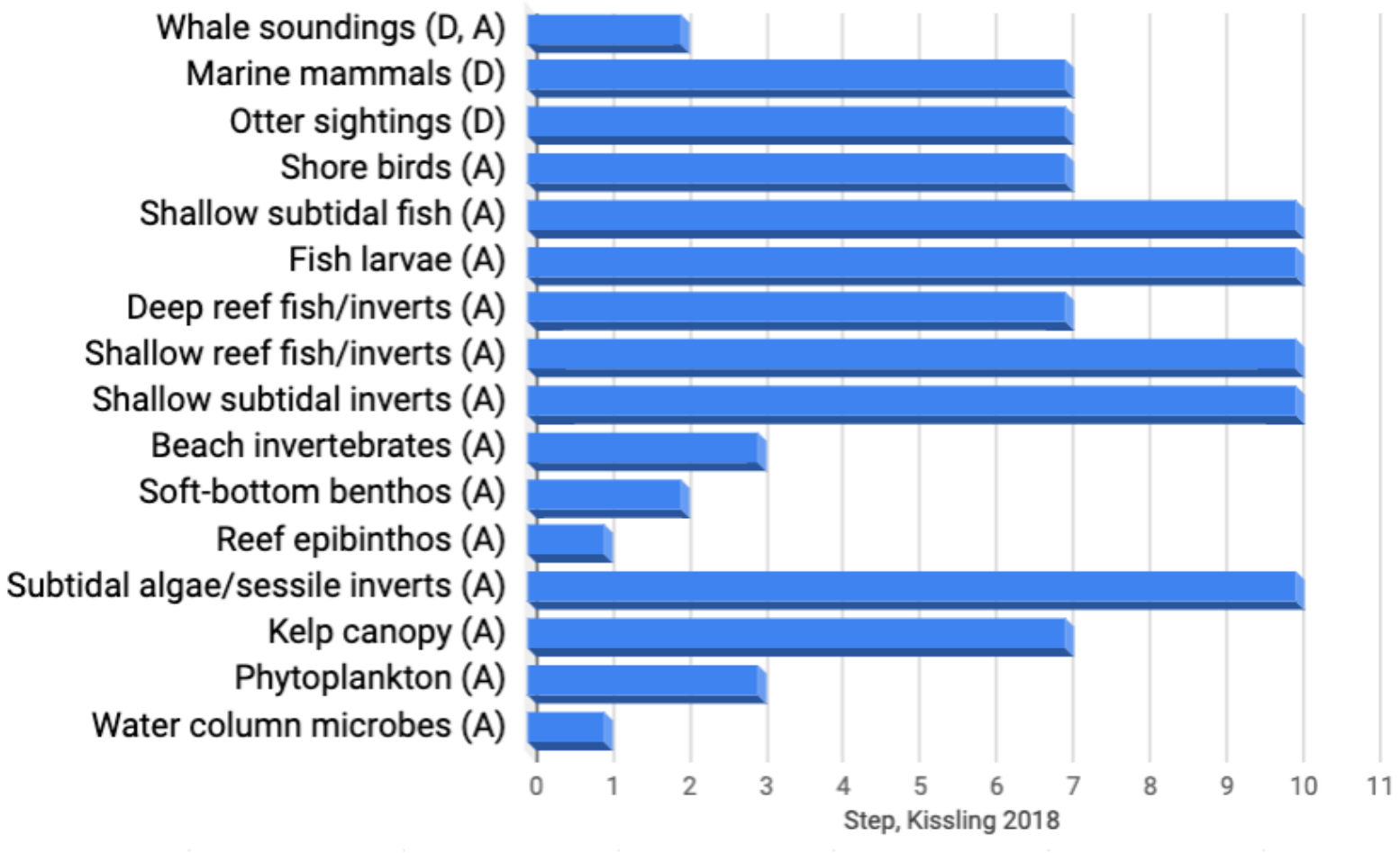
MBON Prototype:

1. Provide data to inform managers and society about patterns of biodiversity across taxa, space, and time
    - *Integrate existing data*
    - *Develop new methods & products*

2. Build a framework to facilitate MBON development under diverse circumstances

GEO BON

Progress, by Taxonomic Group



Focus on time series

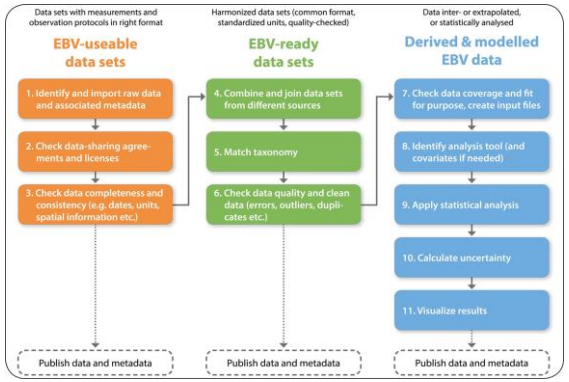
oldest: 35 yrs

youngest: 18 yrs

14 Data packages published

stable, immutable with DOI

Spanning taxa from microbes to whales

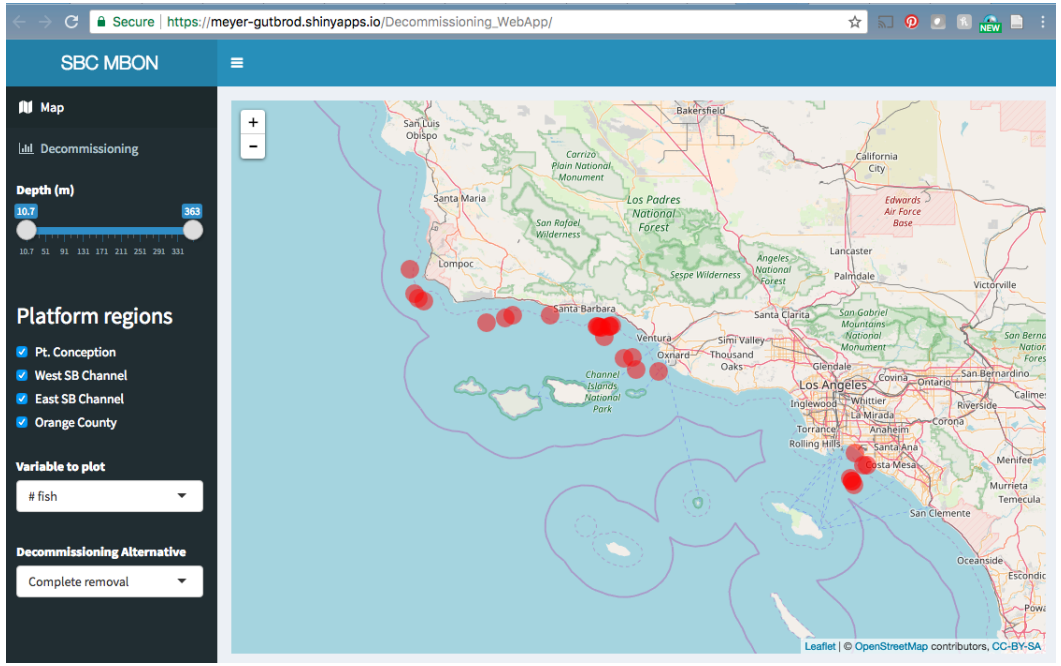


Measurement Class:

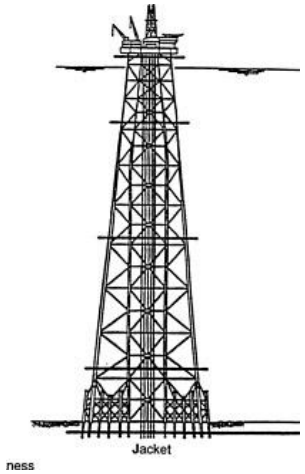
D: Occurrence (EBV “distribution”)

A: abundance or density (EBV “abundance”)

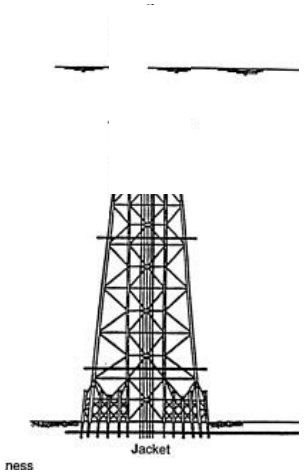
Net Environmental Benefit Analysis of offshore platform decommissioning alternatives



Leave in place



Partial Removal



Total Removal

Users:

- US Bureau of Ocean Energy Management
- CA State Lands Commission
- Petroleum industry (e.g. Exxon, Chevron, Venoco)

https://meyer-gutbrod.shinyapps.io/Decommissioning_WebApp/

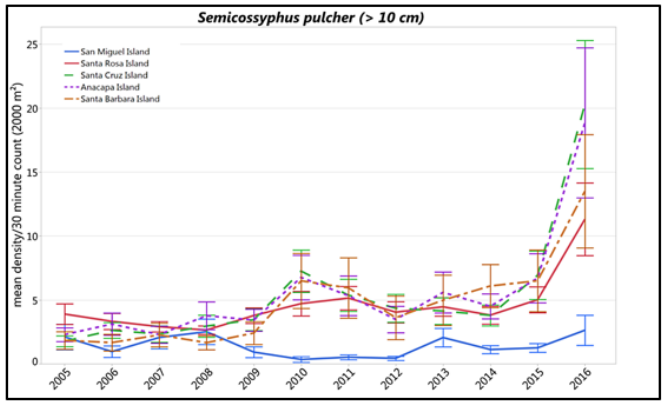
Meyer-Gutbrod et al., *in prep*

n of Condition Reports

California Sheephead Abundance in CINMS

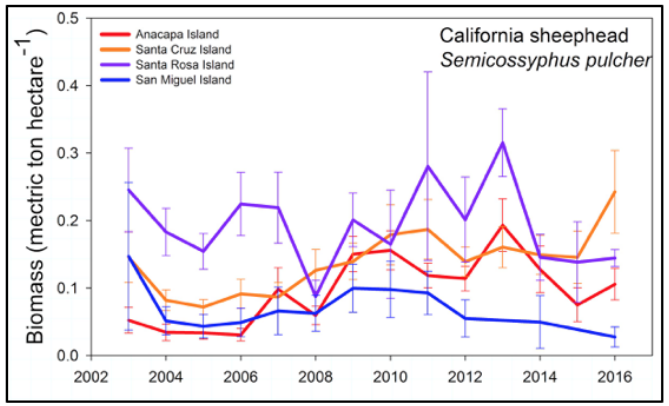
The California sheephead (*Semicossyphus pulcher*) is a large and beautiful fish that plays an important role in the food web of kelp forests and rocky reefs in southern California. Sheephead are also a popular sport fish for recreational and commercial fishing and a draw for SCUBA divers.

Abundance of California Sheephead

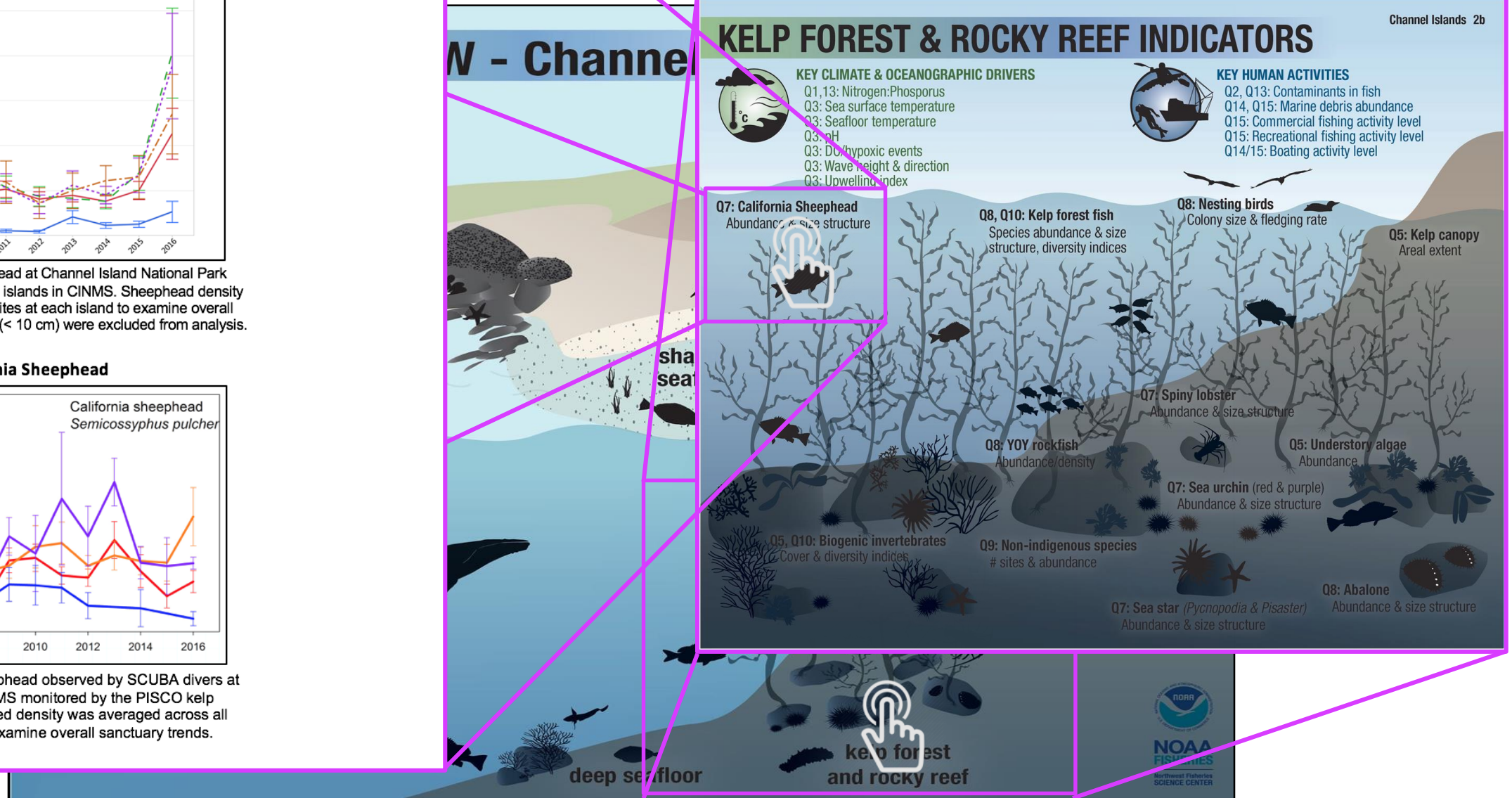


Average density of California sheephead at Channel Island National Park kelp forest monitoring sites at the five islands in CINMS. Sheephead density was averaged across all monitoring sites at each island to examine overall sanctuary trends. Note that juveniles (< 10 cm) were excluded from analysis.

Abundance of California Sheephead

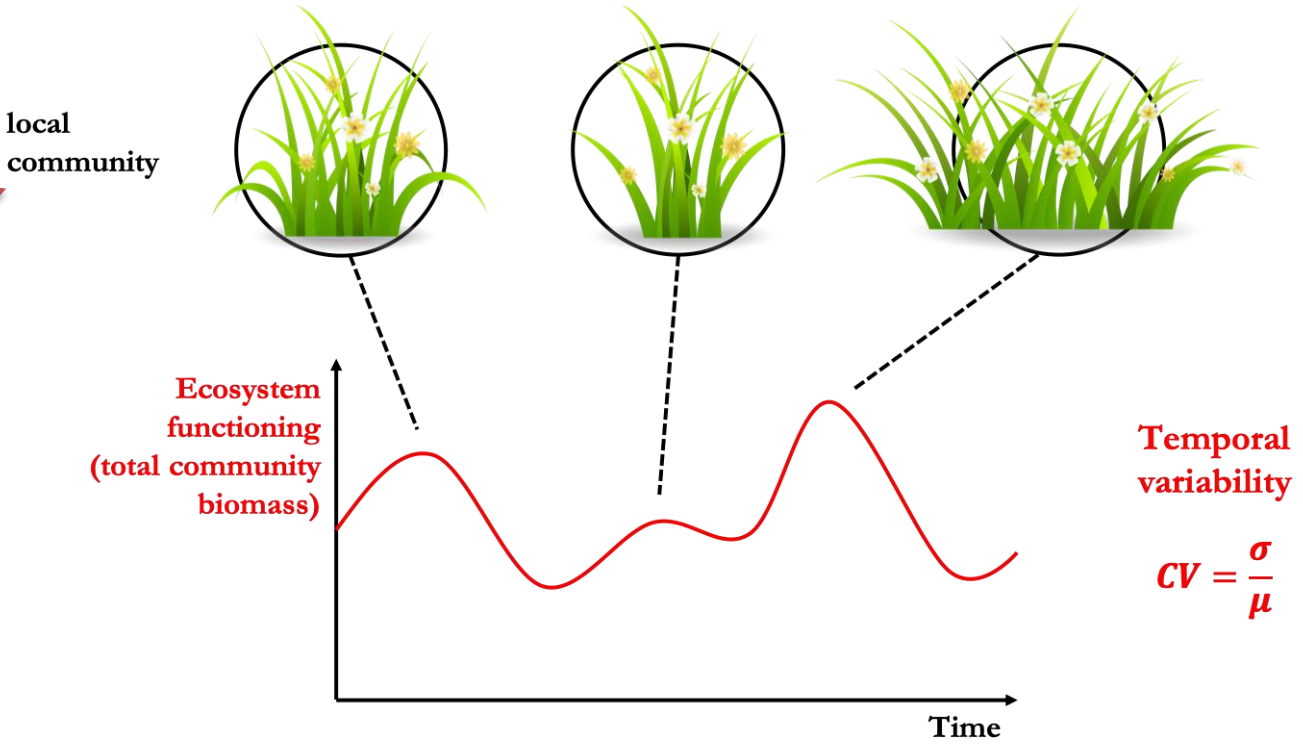


Average density of California sheephead observed by SCUBA divers at 14 sites across four islands in CINMS monitored by the PISCO kelp forest monitoring program. Observed density was averaged across all monitoring sites at each island to examine overall sanctuary trends.



How does biodiversity affect ecosystem function and stability?

Understanding the factors that dampen variability of biomass production is a core concept of Ecology

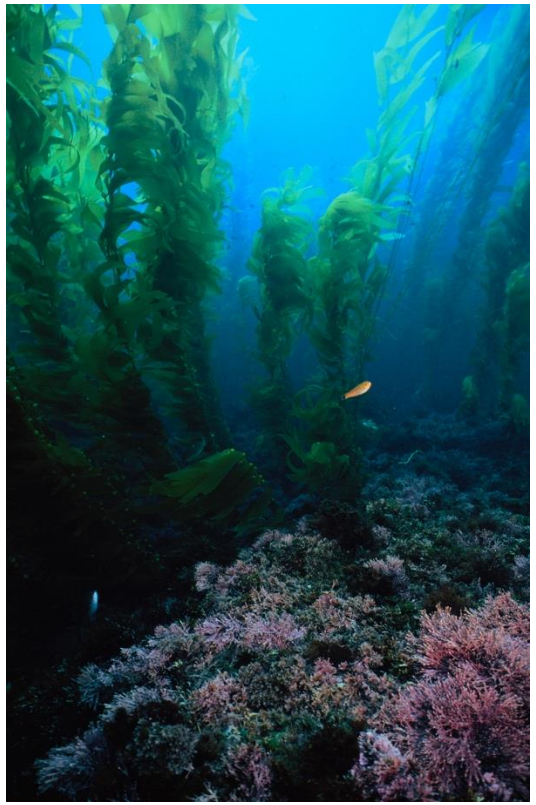


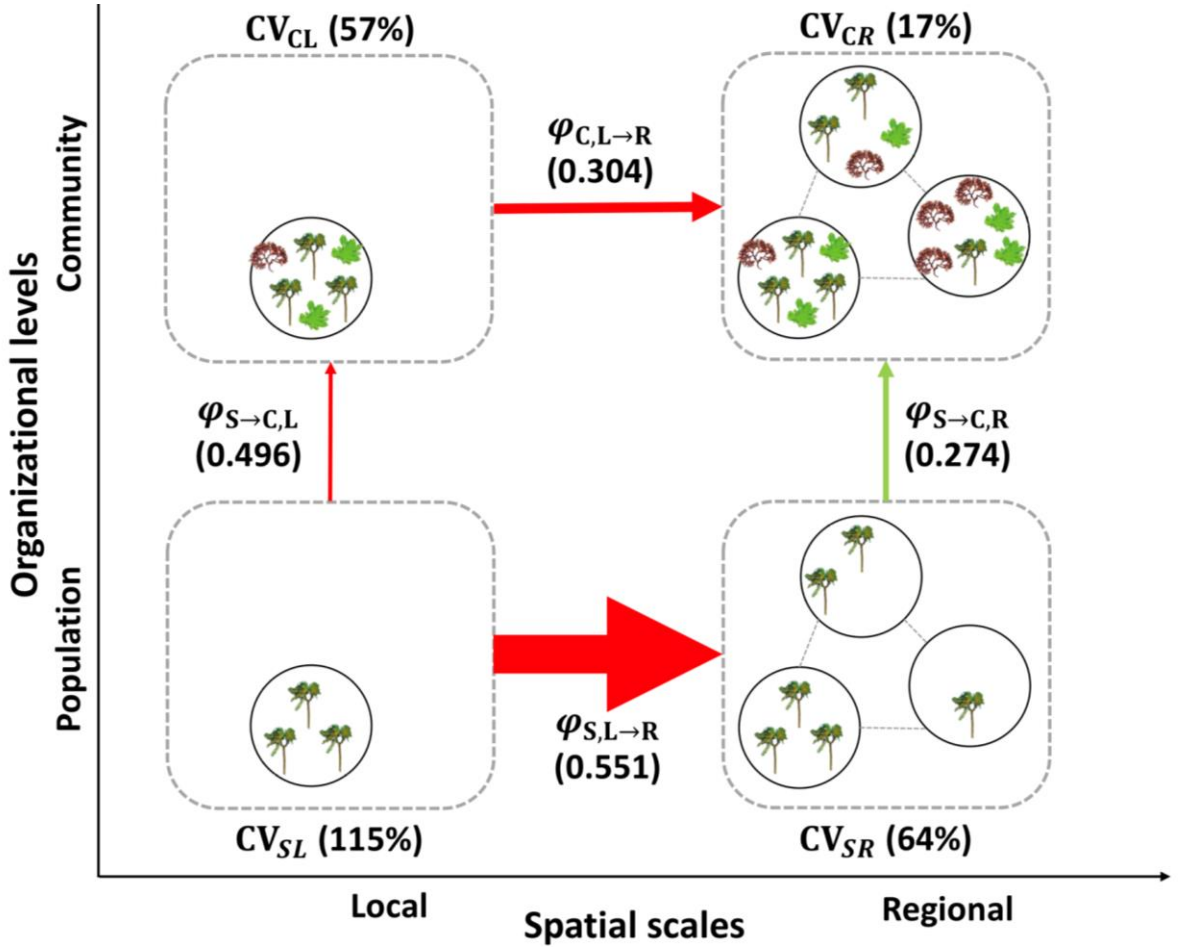
However, most empirical and theoretical studies which have investigated ecological variability and its relation with biodiversity have focused on local scales

Species diversity begets stability

Real-world ecosystems are complex: from populations of single species to multi-species communities to metapopulations and metacommunities

Asynchronous species dynamics trumped asynchronous spatial dynamics to stabilize metacommunity biomass in the kelp forest understory

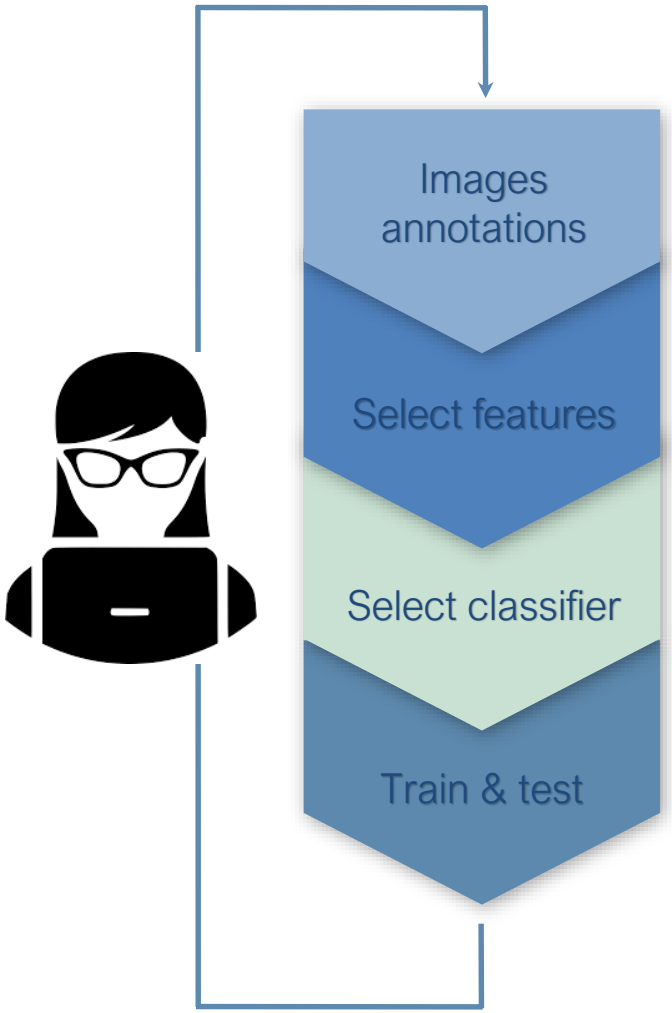




Lamy et al. 2019, *Ecology,* Wang et al. 2019*, Ecography*

New Products: Deep learning for image analysis

Typical machine learning



Engineer required throughout

Time consuming (months)

Only works on specific type of data

Deep learning

Benefits

- Generalizes to your data
- Fully automated - no feature selection
- High accuracy

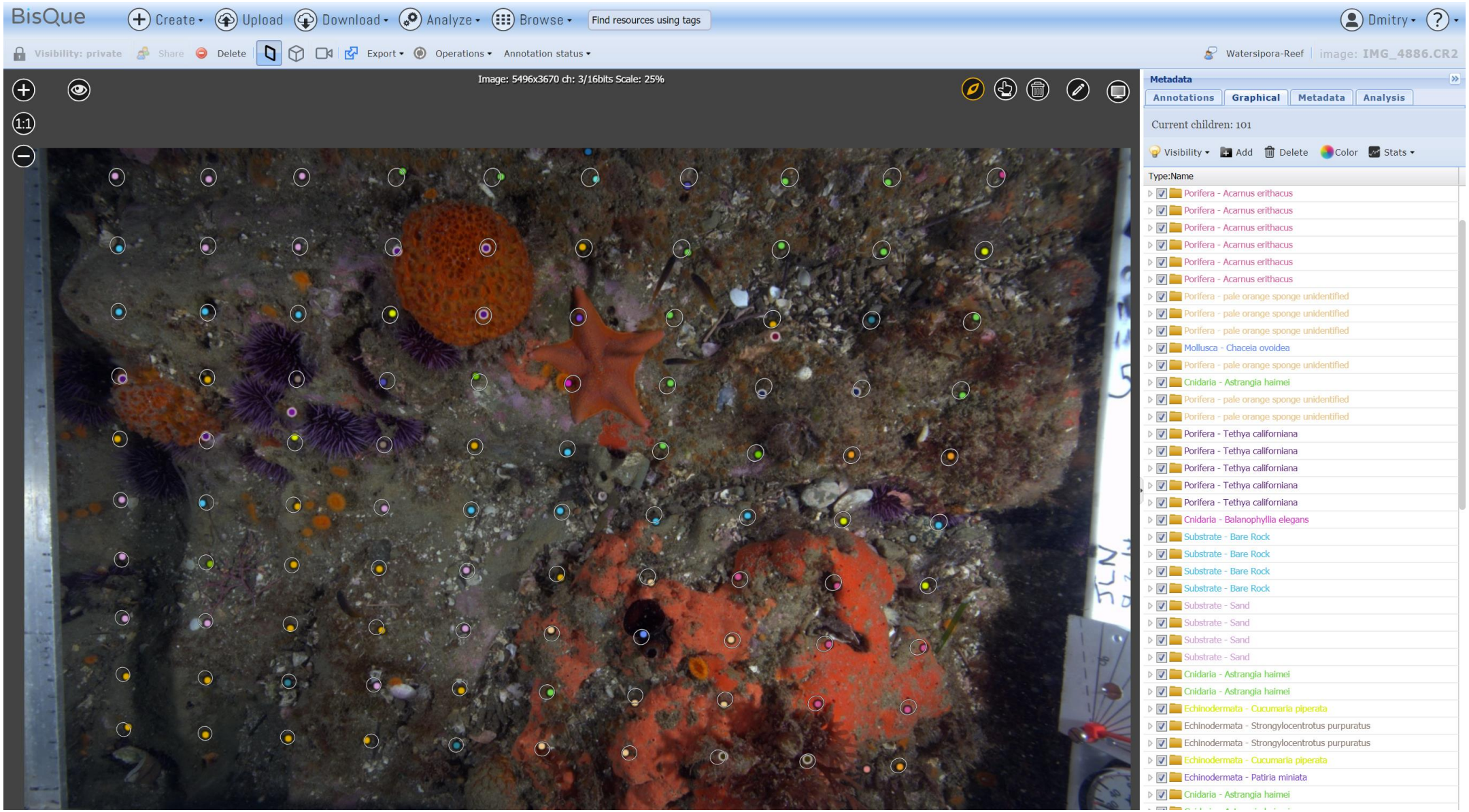
Leverages

- Scalable services
- Annotation system
- Cluster processing
- Fast classification on GPUs

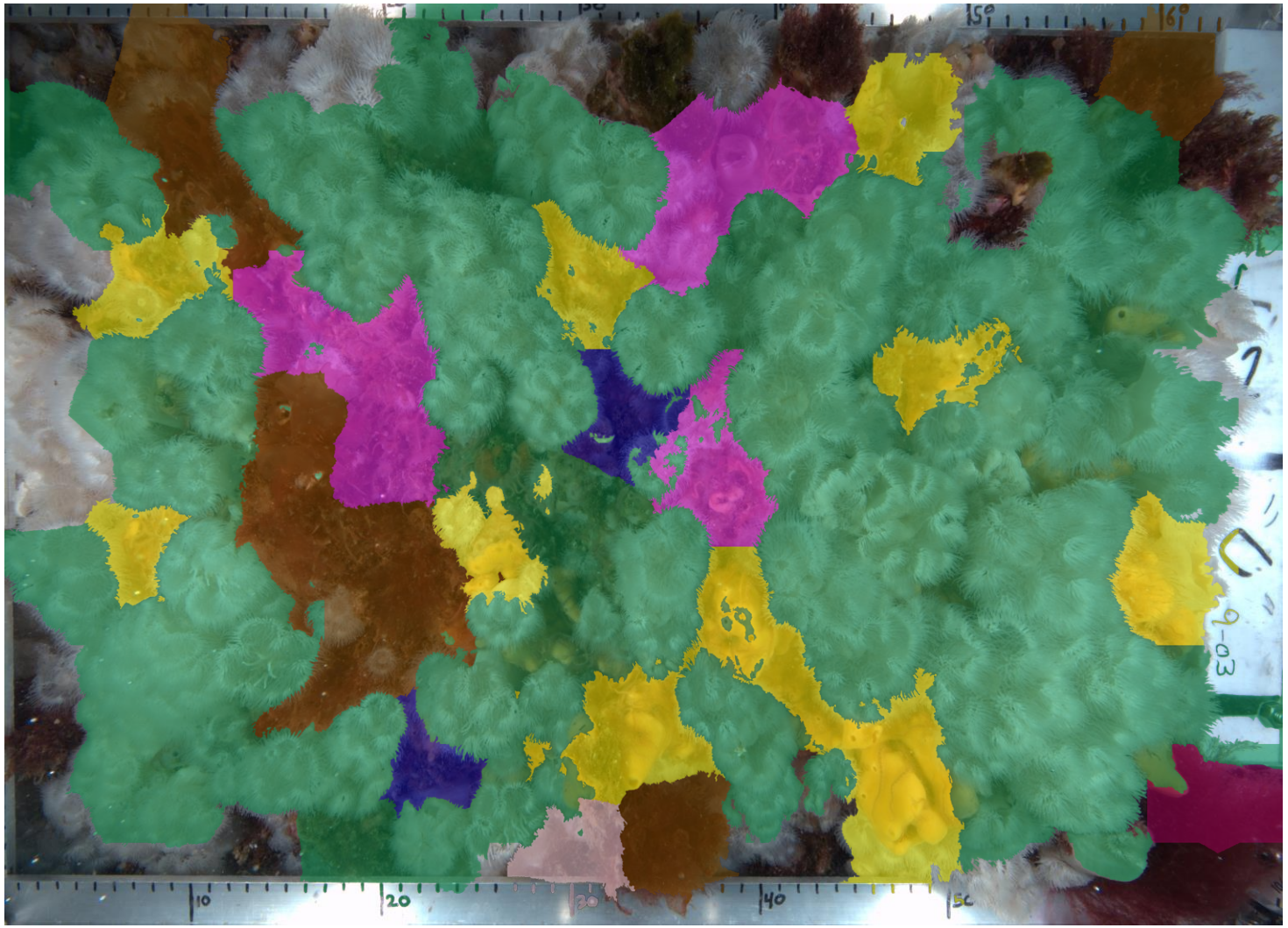
BisQue | ViQi

mage management & annotation

BisQue | ViQi



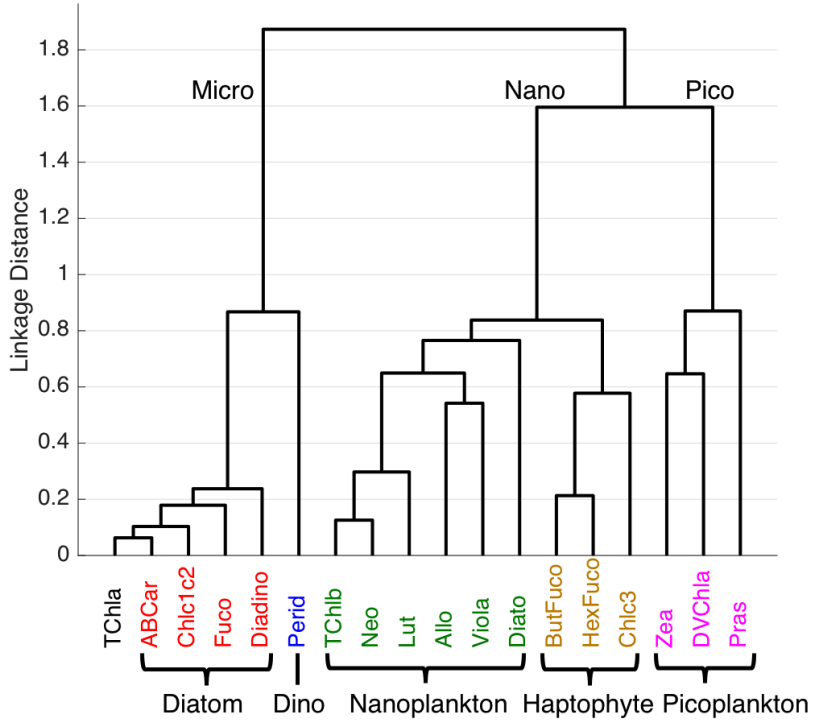
Identification & segmentation



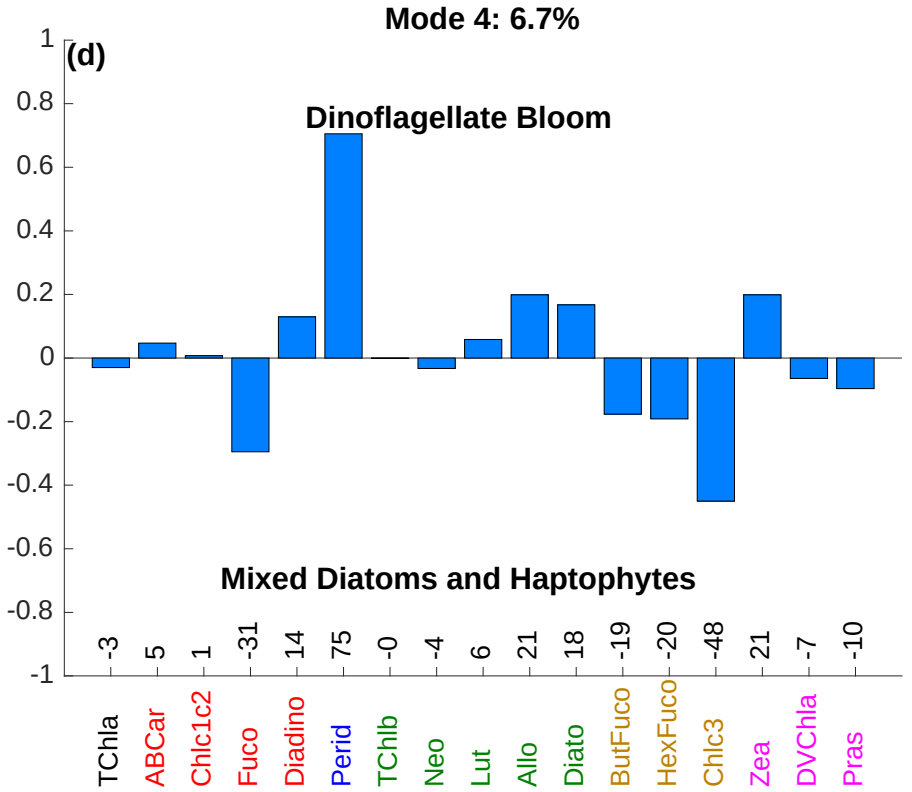
New Products: Remote Sensing

Phytoplankton functional diversity

Phytoplankton pigment communities defined with cluster, EOF analyses as proxy for PFTs



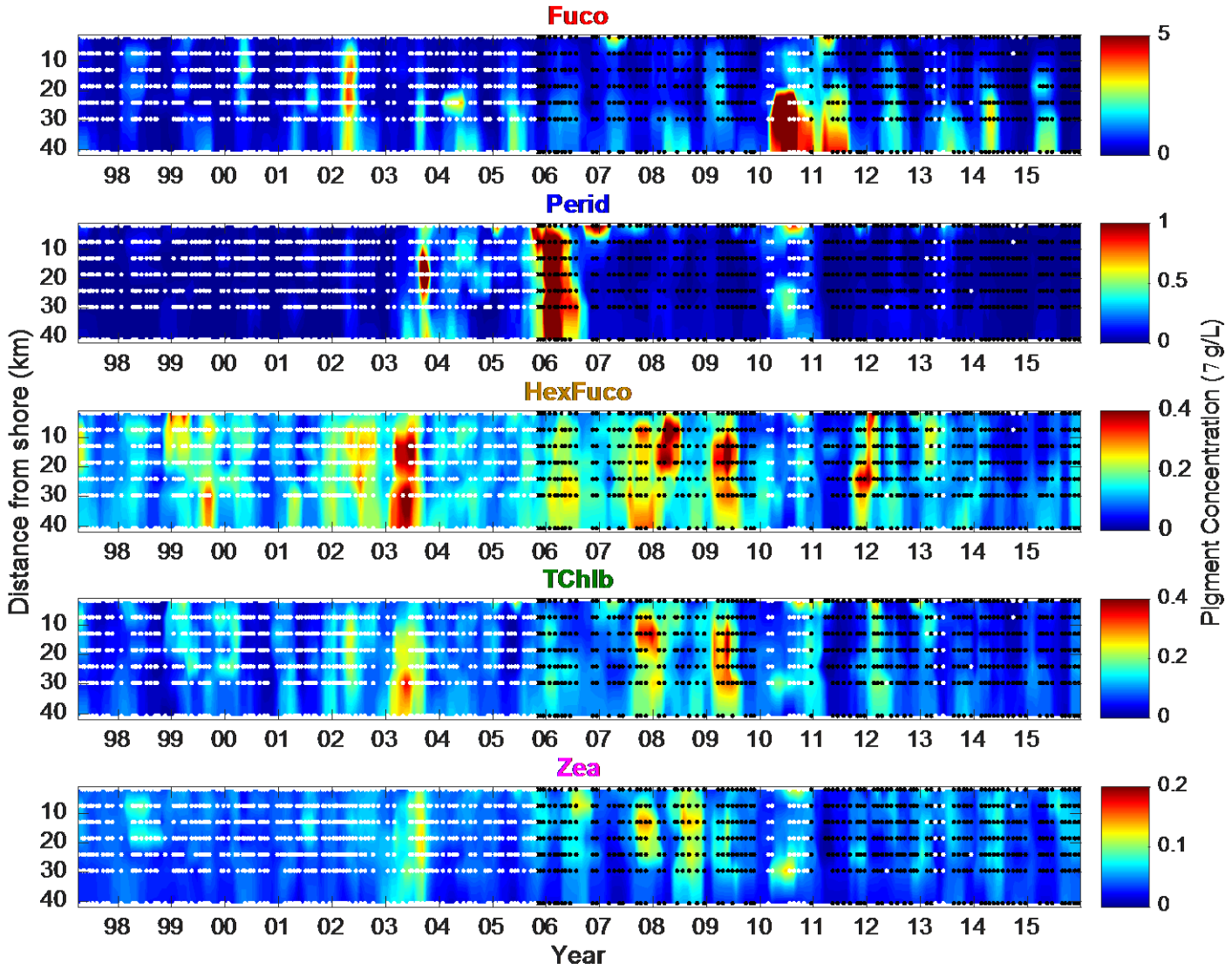
Bio-optically modeled PFTs give us the links to PACE/ESBG



JOURNAL OF GEOPHYSICAL RESEARCH
Oceans
AN AGU JOURNAL

Catlett and Siegel, 2018.

Bio-Optical Models Extend Biomarker Pigment Time Series



Model Retrievals	R^2
TChlb (green algae)	0.815
HexFuco (haptophytes)	0.733
Fuco (diatoms)	0.856
Perid (dinoflagellates)	0.887
Zea (picoplankton)	0.541
Pigment EOF Mode 1 (Early upwelling mixed bloom)	0.884
Pigment EOF Mode 2 (Diatoms vs. mixed nano-/pico-plankton)	0.852
Pigment EOF Mode 3 (Pico-plankton vs. haptophytes)	0.454
Pigment EOF Mode 4 (Dinoflagellates vs. mixed diatoms/haptophytes)	0.809

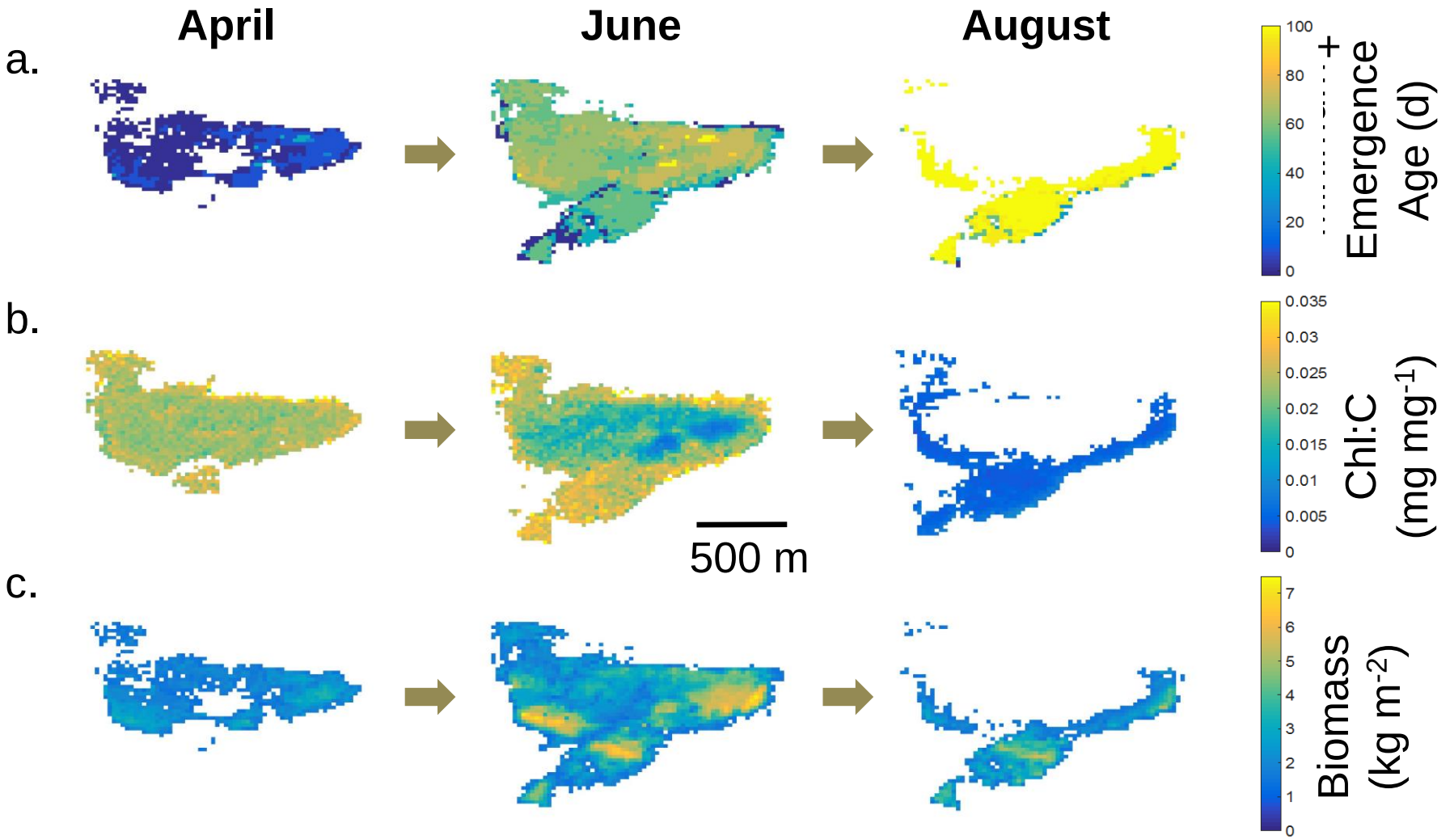
*Catlett et al., in prep.

New Products: Remote Sensing

Kelp condition, age, and forest extent

AVIRIS
Airborne Visible / Infrared Imaging Spectrometer

Bell & Siegel in prep
Bell et al. L&O 2018



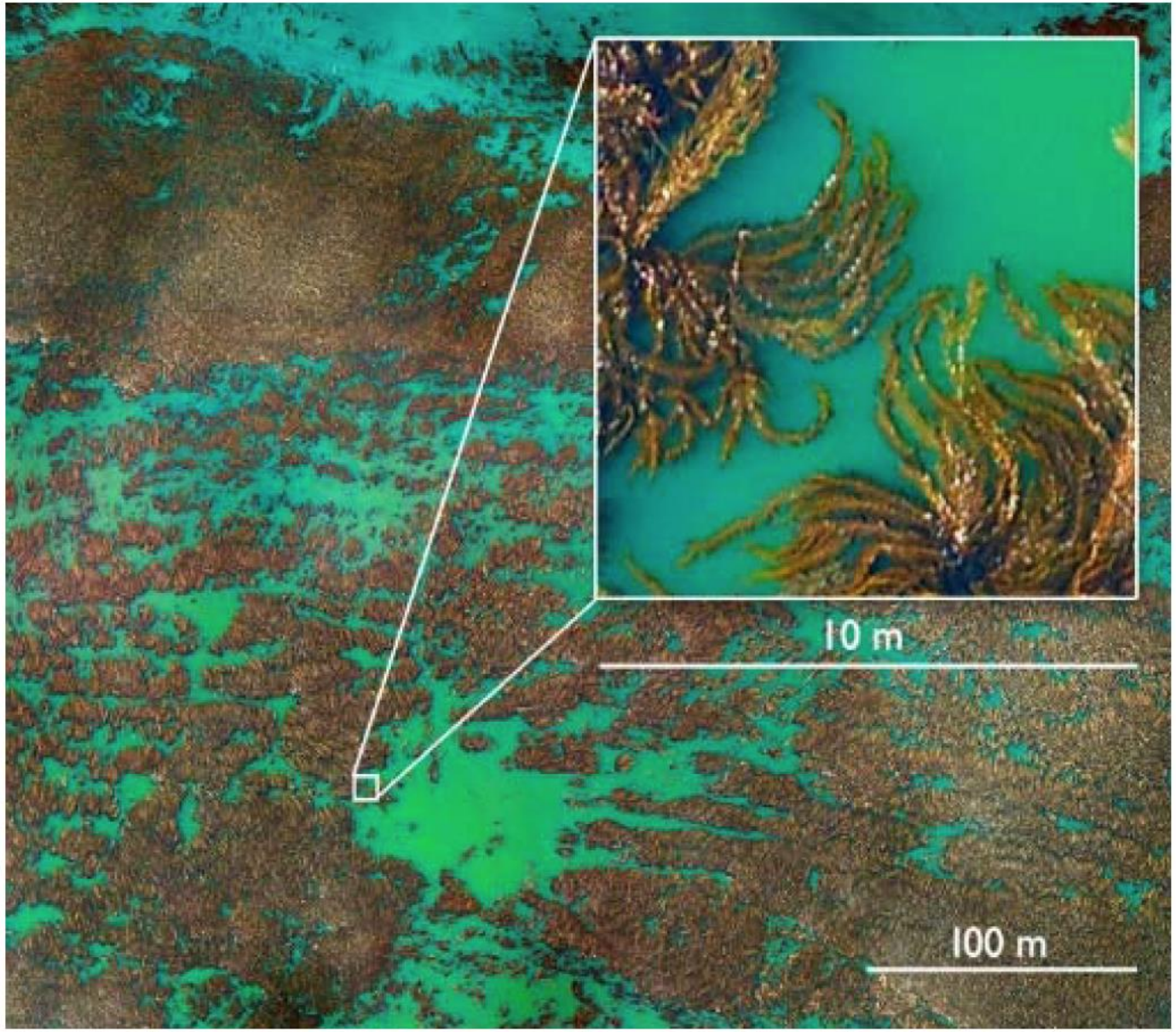
arpa·e

U.S. DEPARTMENT OF ENERGY

SAMS

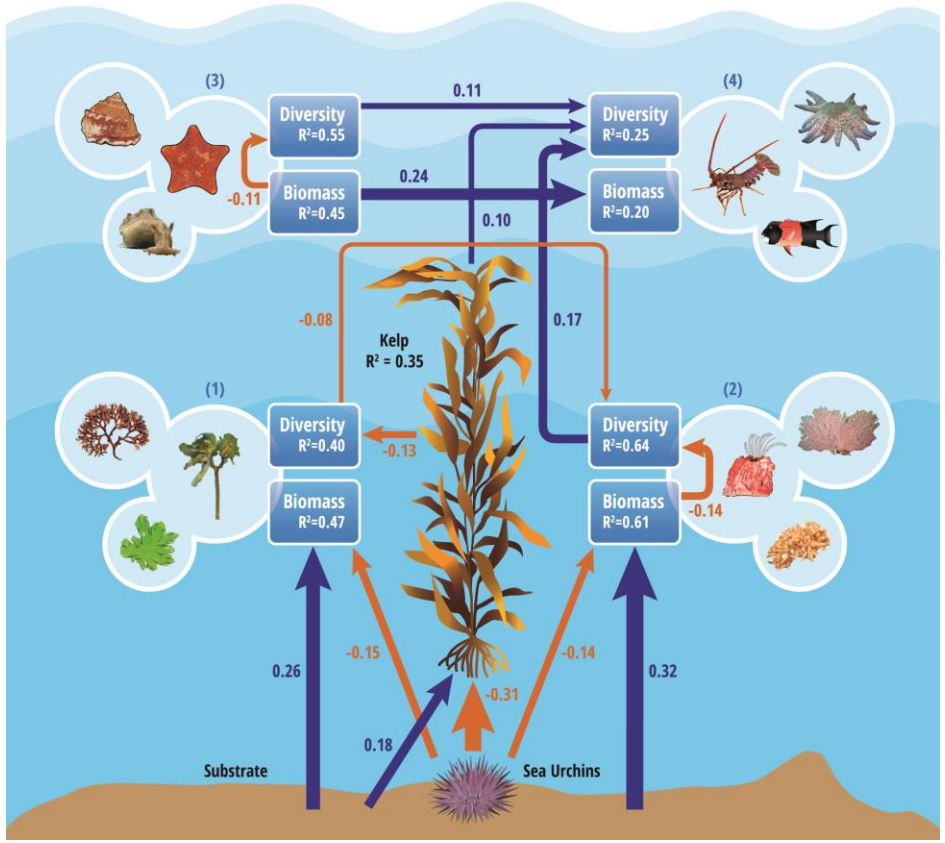
Scalable **A**quaculture **M**onitoring **S**ystem

PIs: Siegel, Bell, Cavanaugh, Miller, Nidzieko, Nelson, Reed

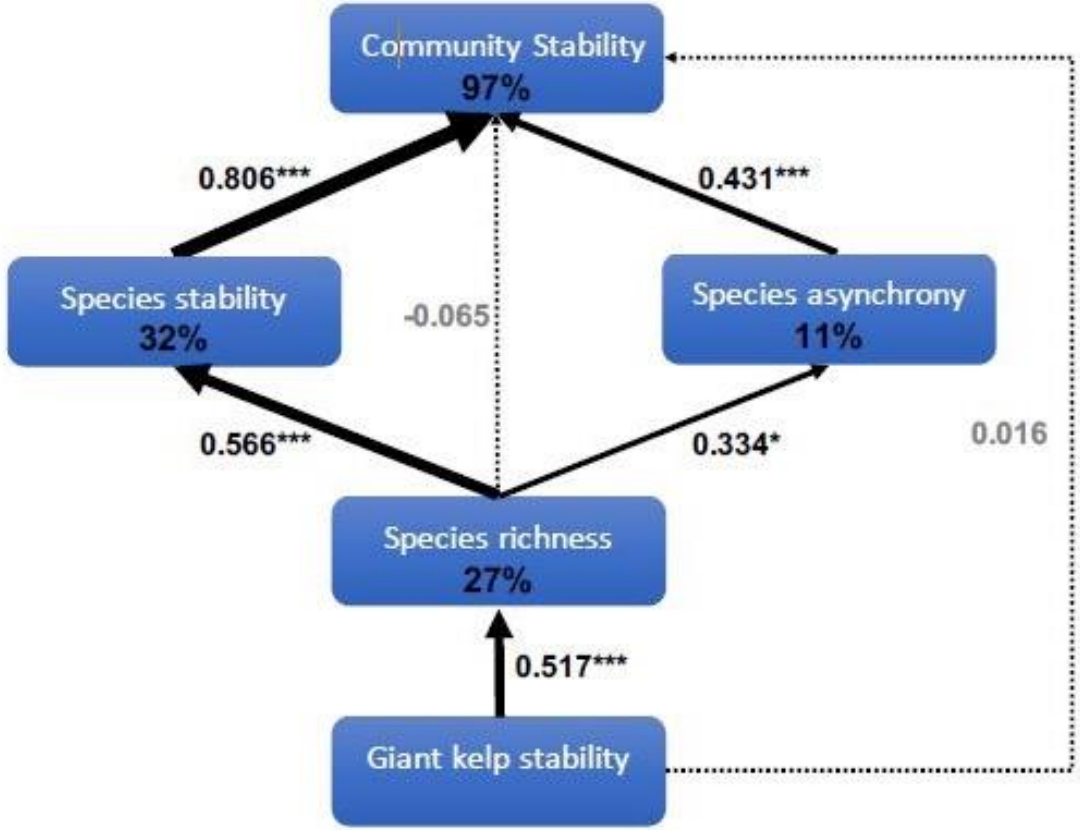


Giant kelp creates a diverse ecosystem

Giant kelp increases biodiversity through physical engineering



Giant kelp stability indirectly stabilizes the community via its effect on biodiversity



Miller et al. 2018, *Proc. Royal Soc. B.*, Castorani et al. 2018 Ecology

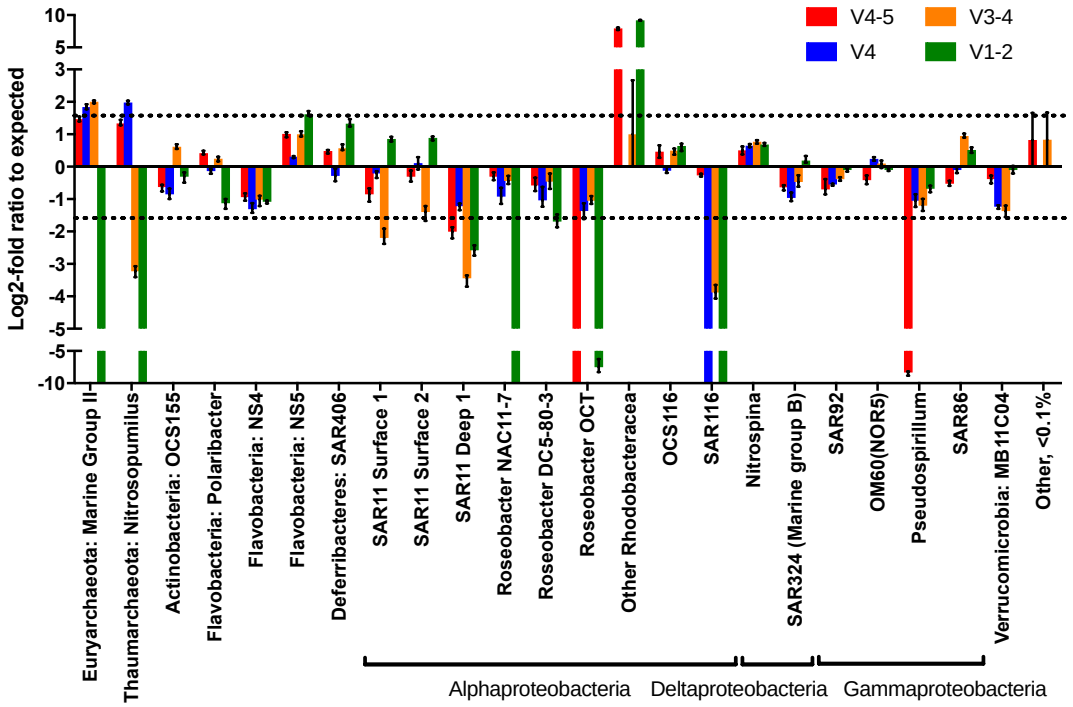
Lamy et al. Ecology *in review*

New Products: Genomics

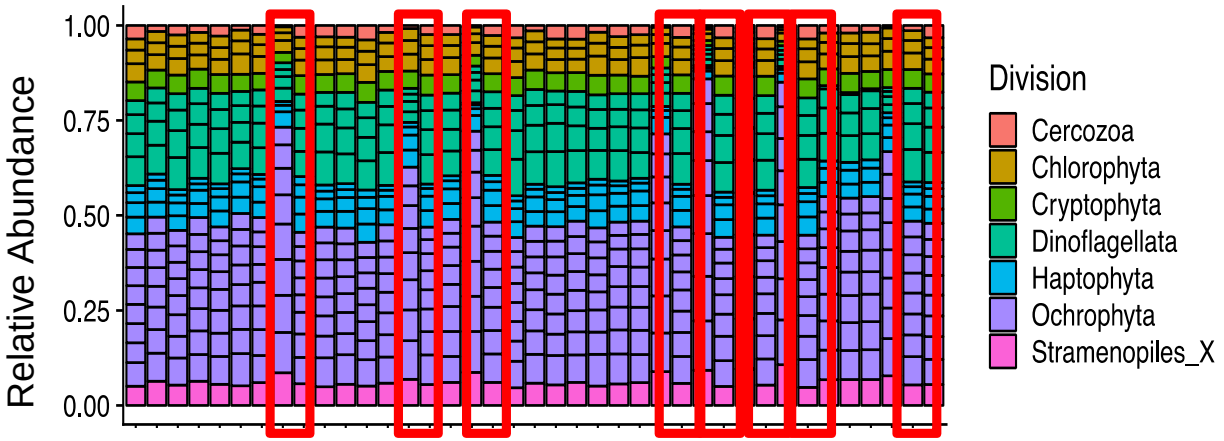
Microbial and phytoplankton diversity & community structure

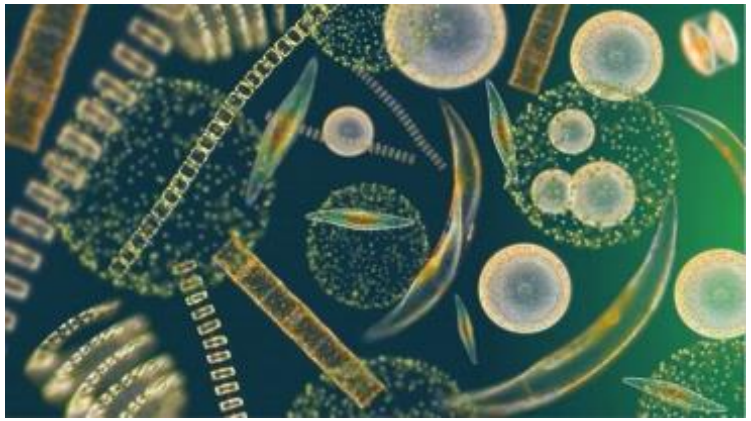
environmental microbiology
Environmental Microbiology (2018) **00**(00), 00–00 doi:10.1111/1462-2920.14091

Mock community deviation from expected abundance with four different primer sets:



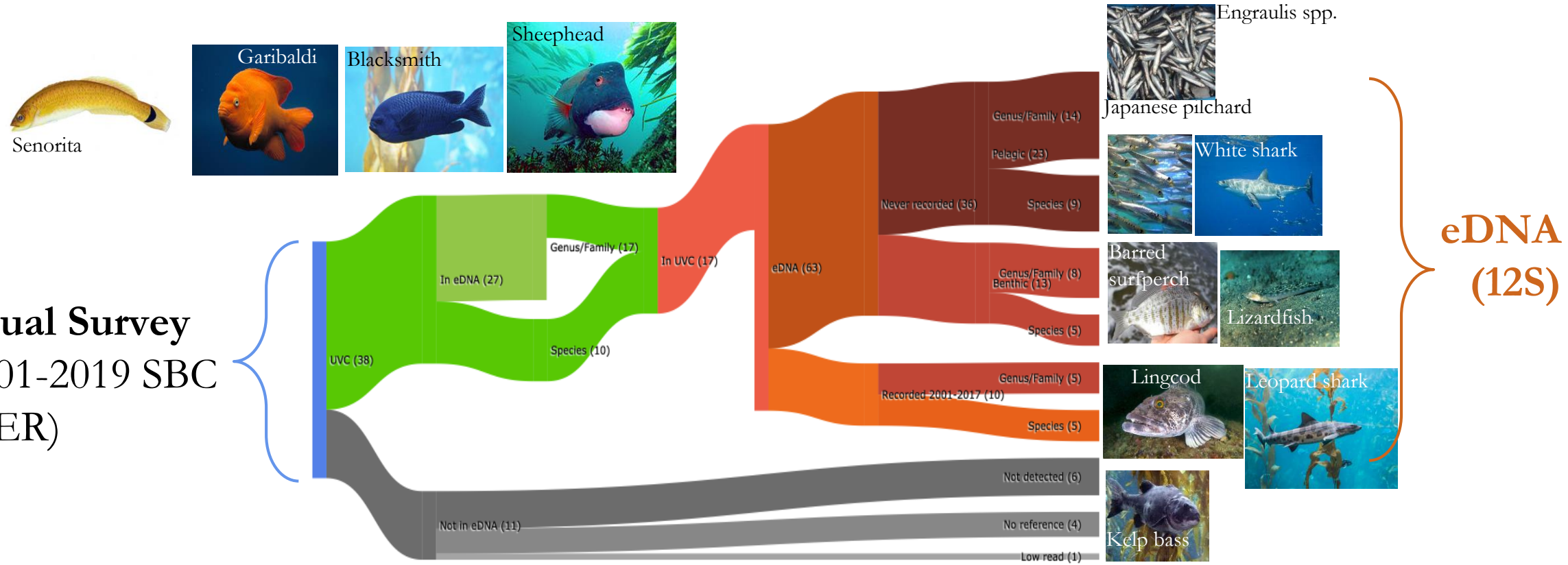
Mock communities revealed unexpected issue with common methods





Wear et al. 2018, Catlett et al. 2018, submitted

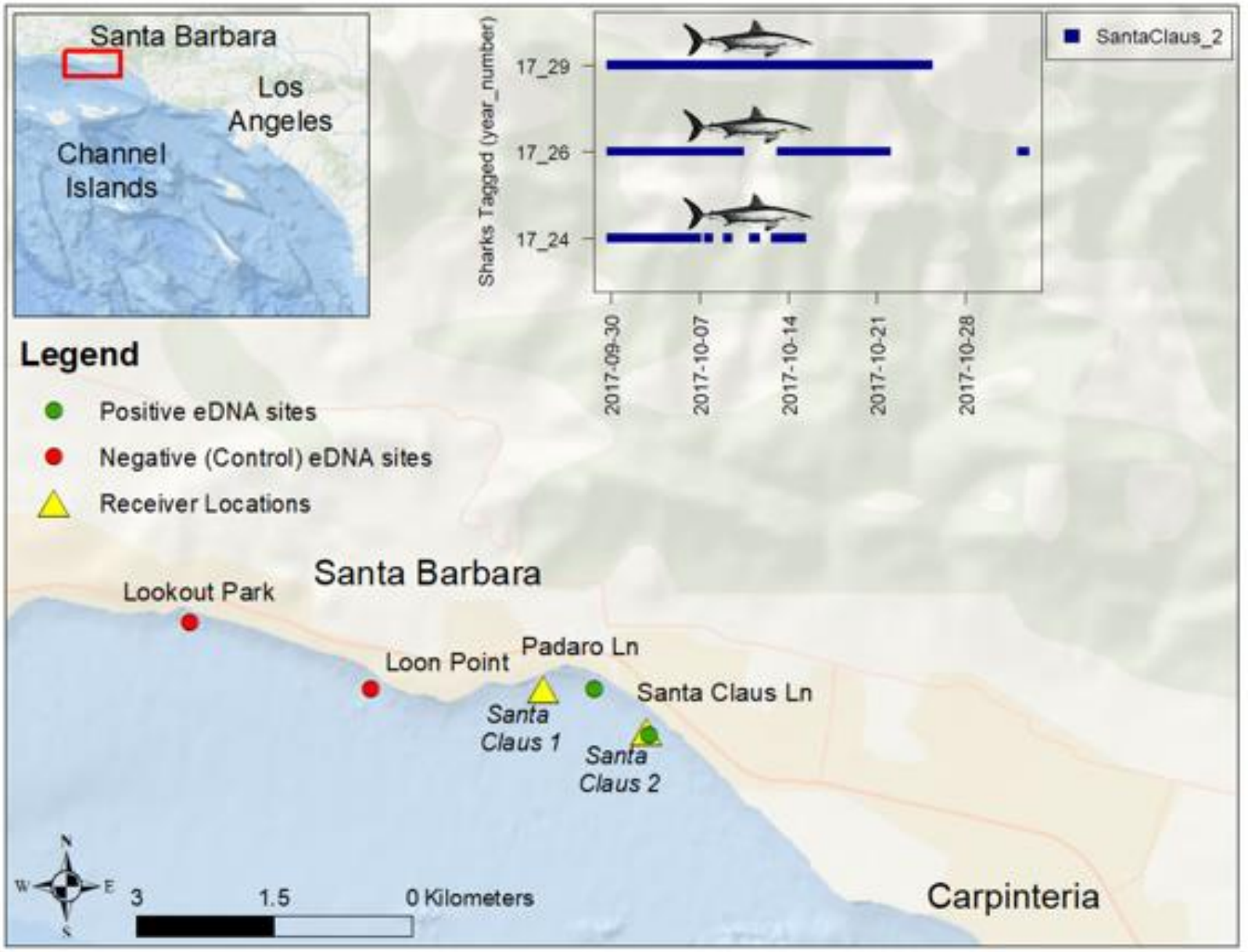
Environmental DNA captures the fine scale and hierarchical spatial structure of kelp forest fish communities



Spatially stratified sampling of 49 water samples on 27 transects across 11 rocky reefs

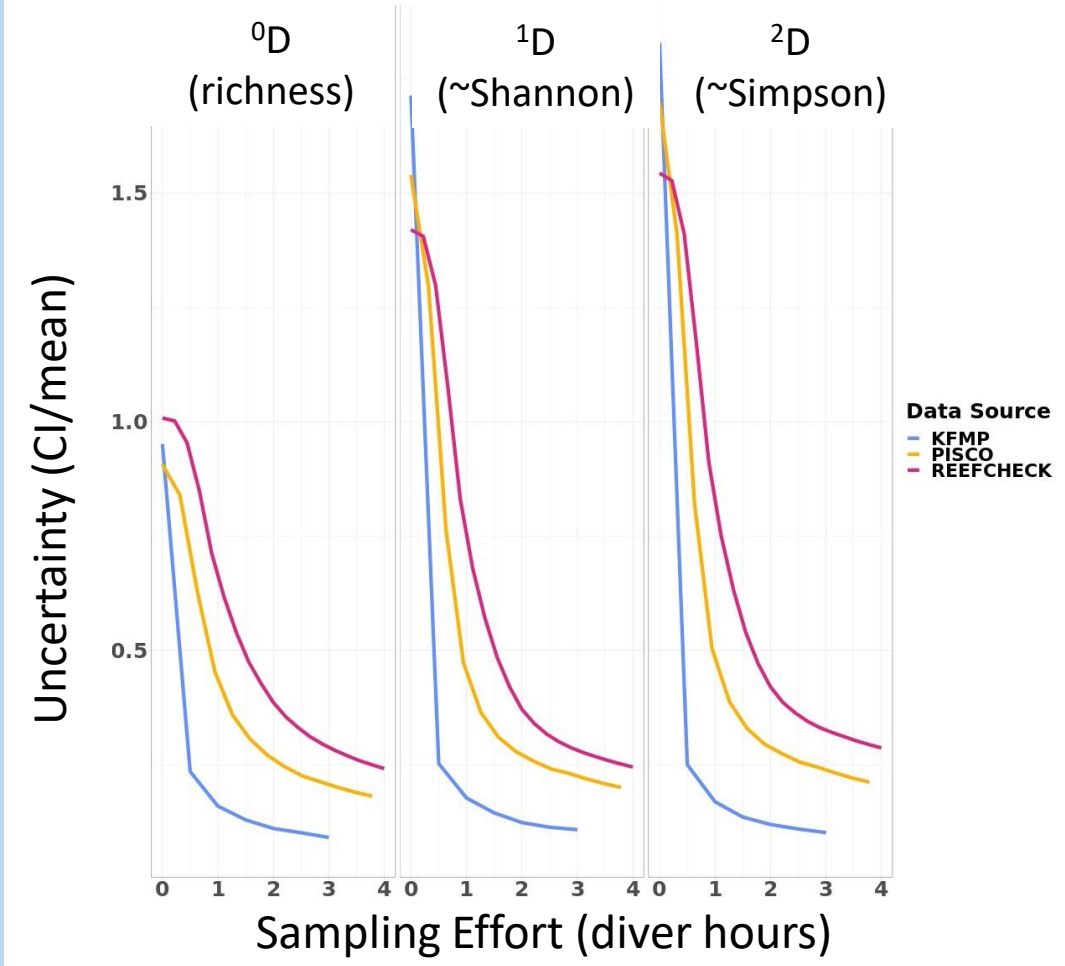
Lamy et al., in prep.

eDNA and Acoustic Telemetry Detection of Great White Sharks



Lafferty et. al 2018, Frontiers Mar. Sci.

Compare sampling efficiency across methods:



Compare power to detect change: