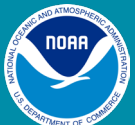


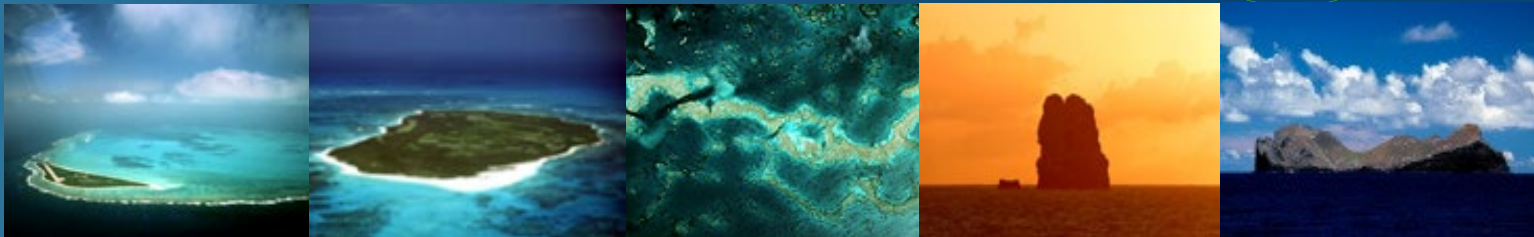
# Reef fish community changes along a gradient of invasive macroalgae cover in Papahānaumokuākea Marine National Monument



Chelsie W. W. Counsell, Heather Ylitalo-Ward  
PMNM (CIMAR Research Supervisor), DAR (Kaua'i District Biologist)

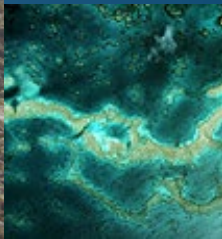
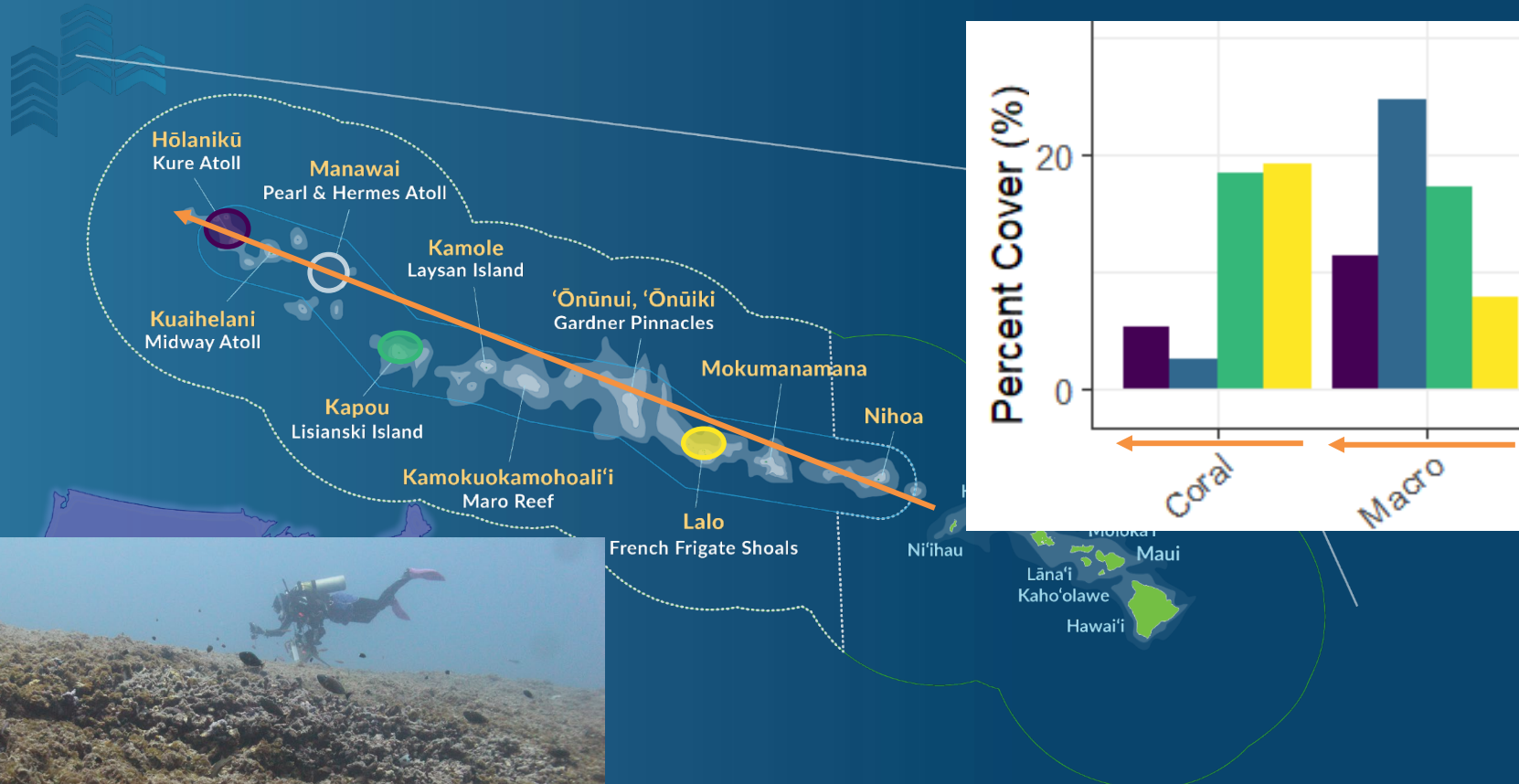


# Papahānaumokuākea Marine National Monument





# Papahānaumokuākea Marine National Monument



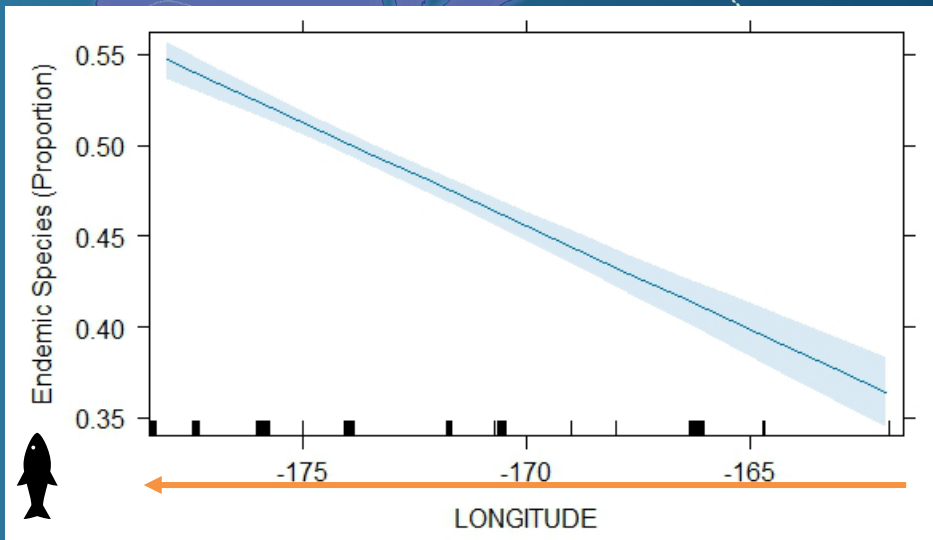
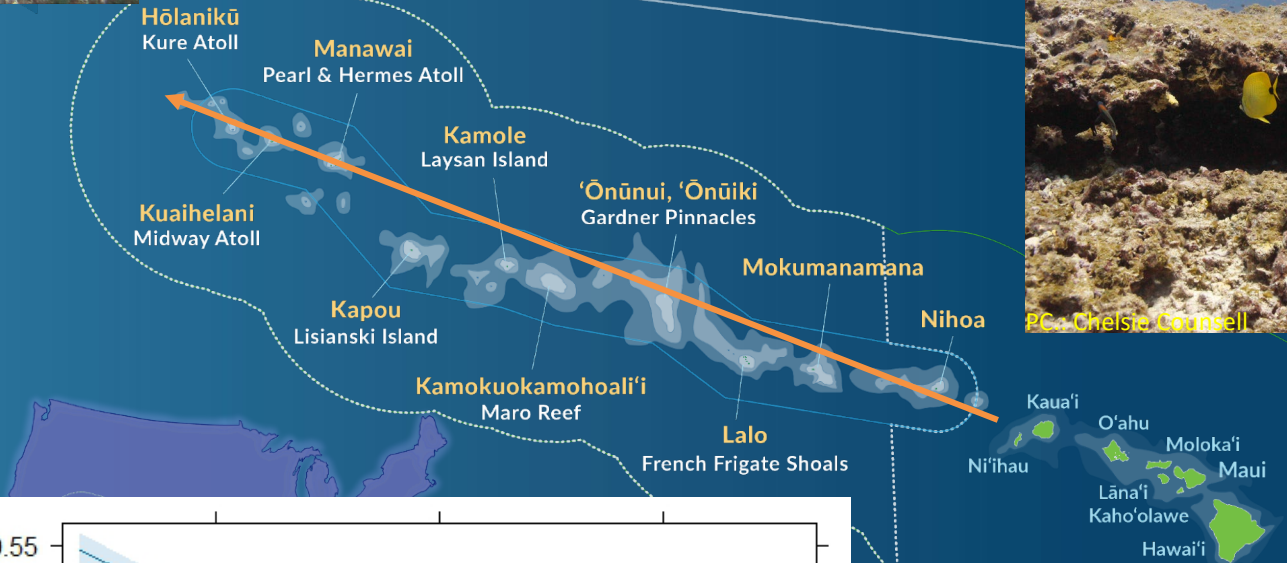
# Papahānaumokuākea Marine National Monument



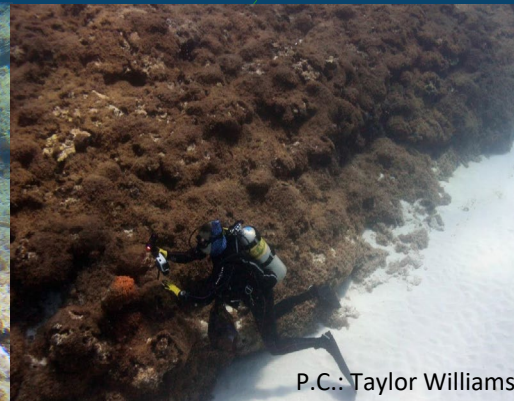
PC.: Chelsie Counsell



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# Papahānaumokuākea Marine National Monument



Research Question: How does *Chondria tumulosa* impact the broader reef community - specifically reef fishes?



Macroalgae is a natural part of coral reef ecosystem...

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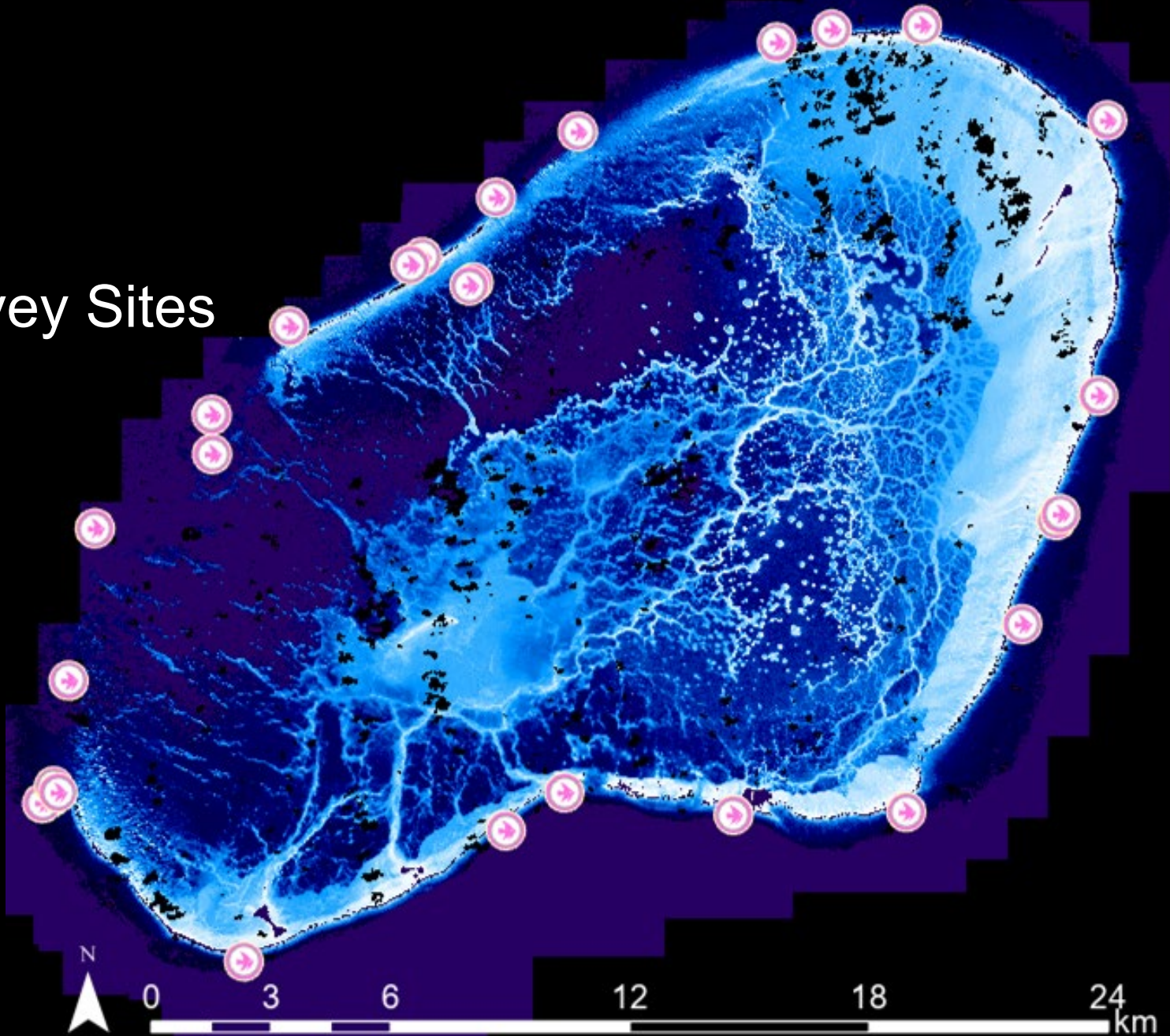
Macroalgae is a natural part of coral reef ecosystem...

*Chondria tumulosa* is covering reefs in some areas

We expect this shift in benthic cover impacts reef fish diversity & abundance

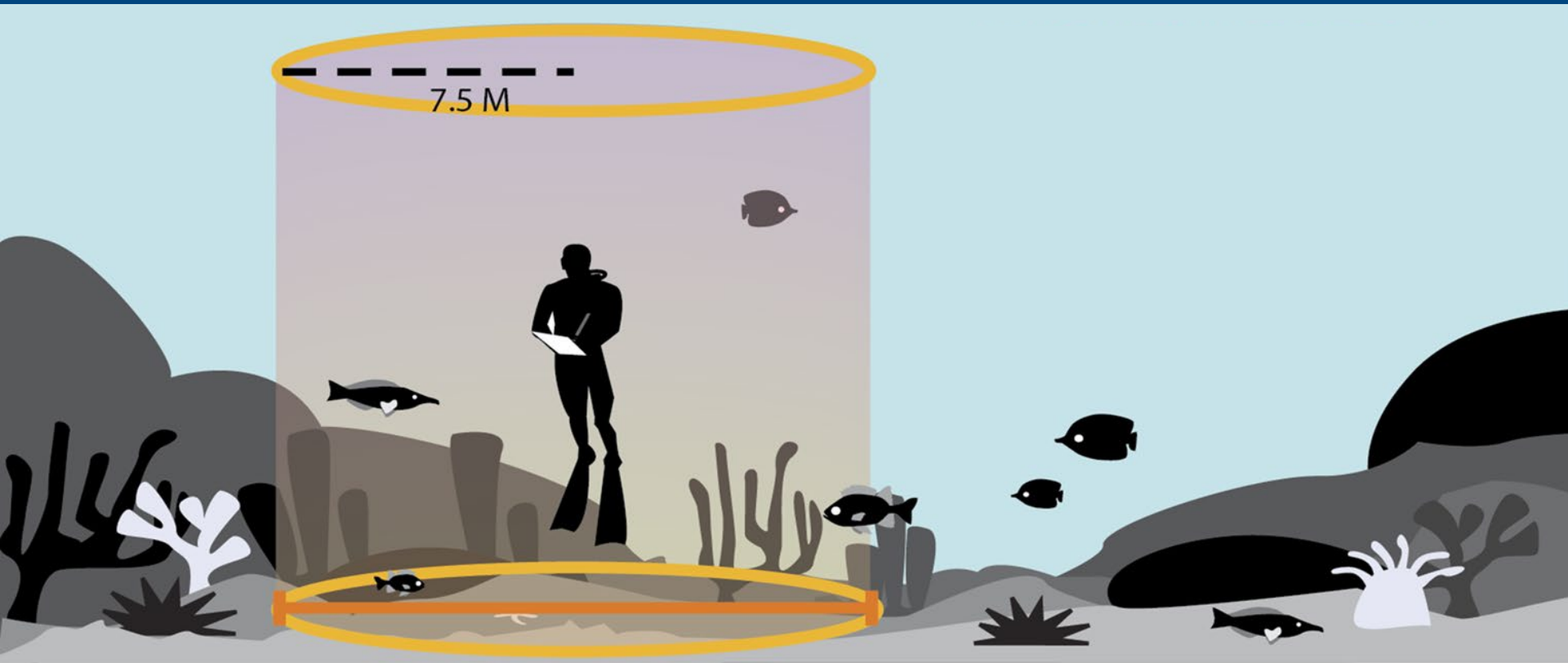


# Survey Sites



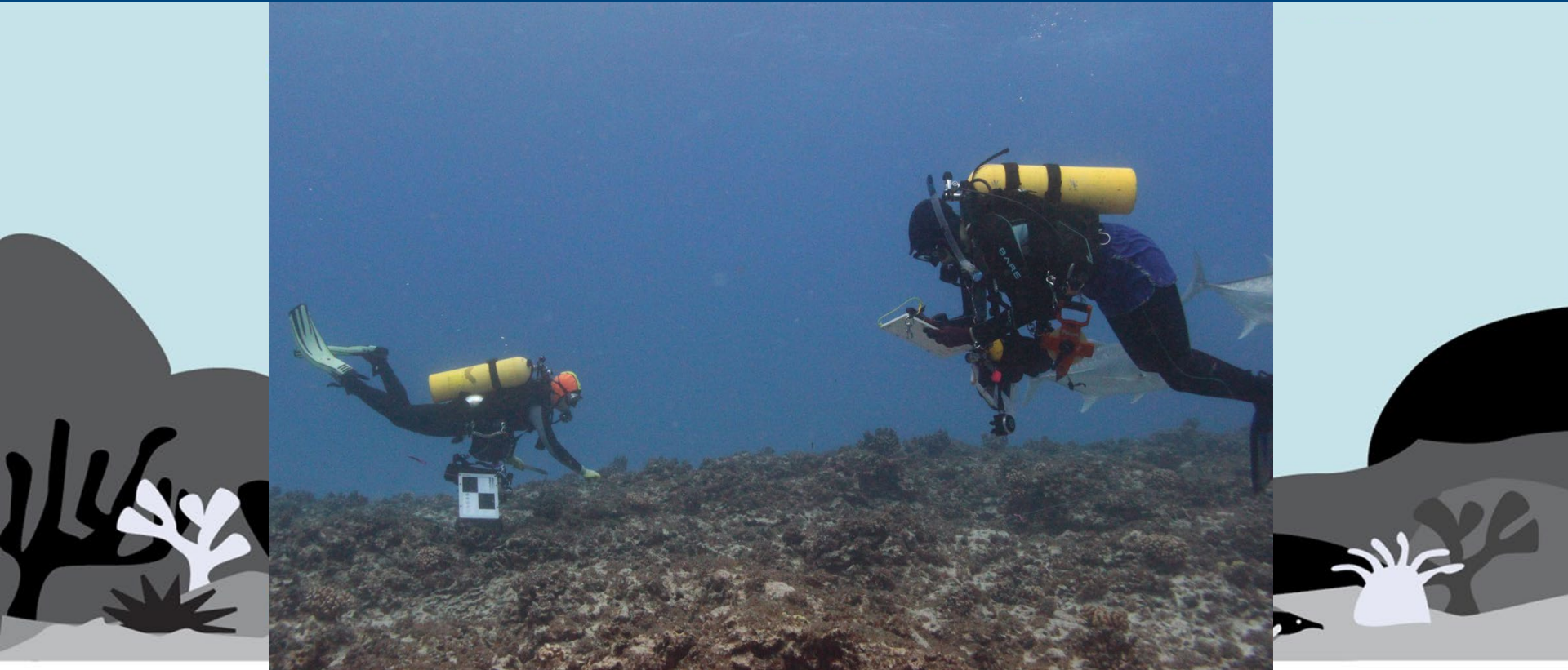
# Survey Methods

Stationary Point Counts (SPC) - fish survey method used for NOAA's reef ecosystem monitoring in PMNM



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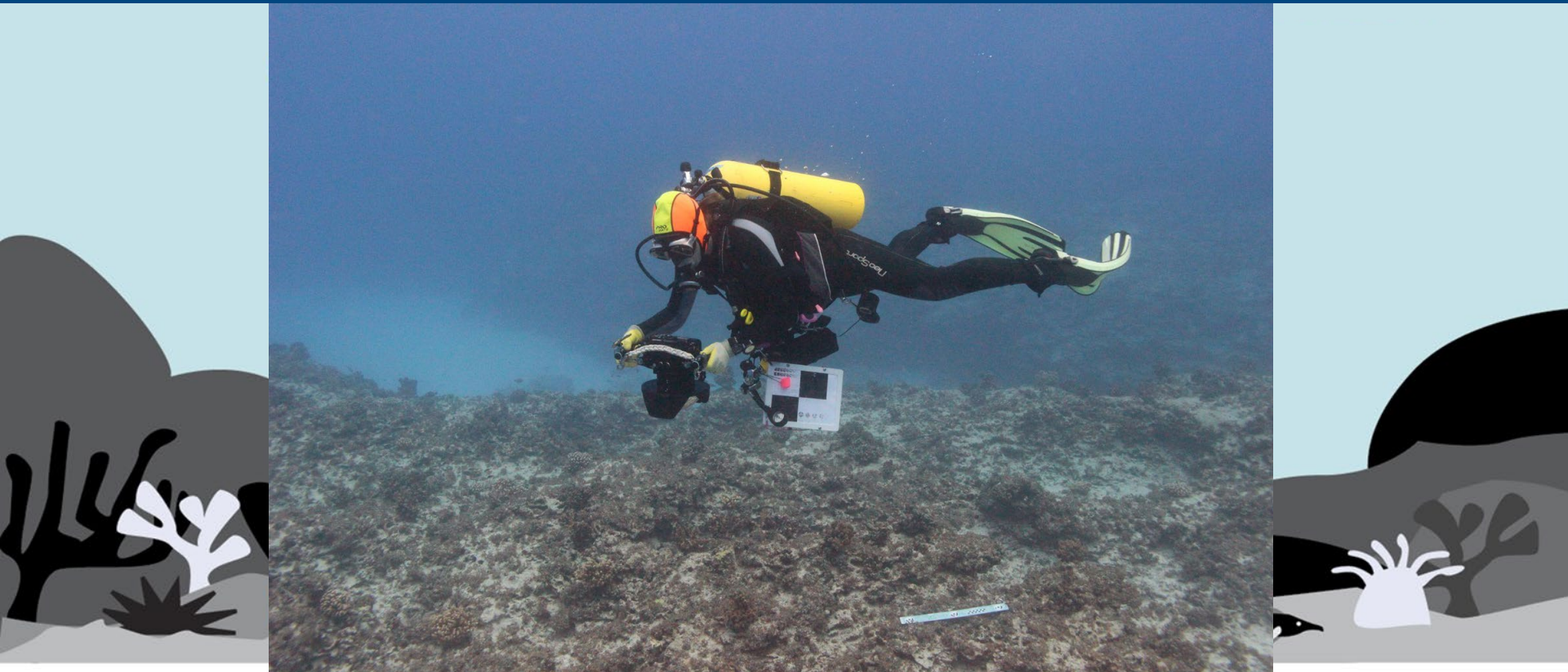
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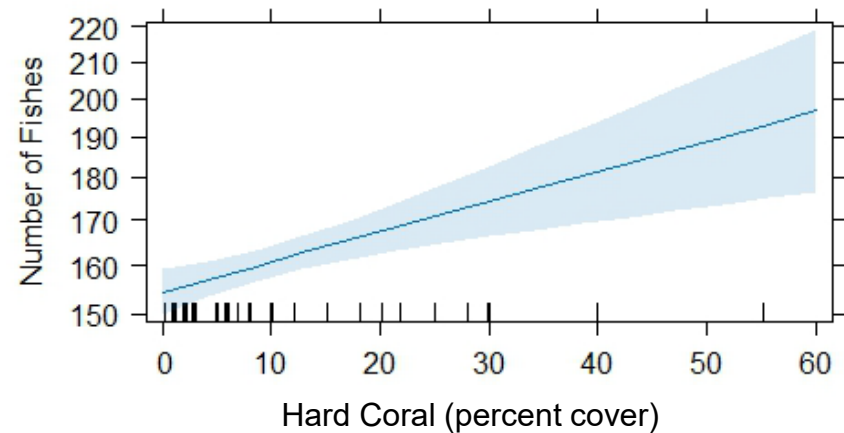
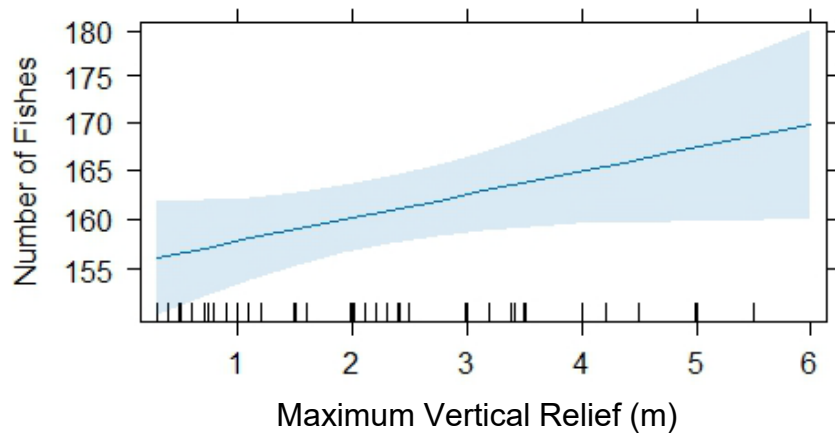
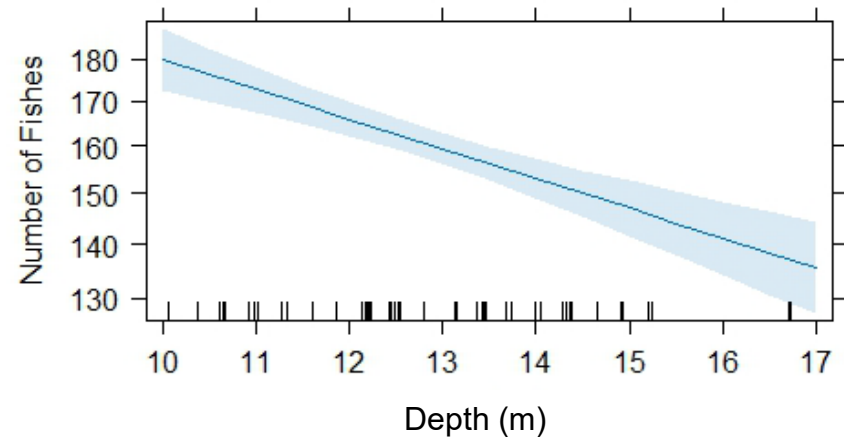
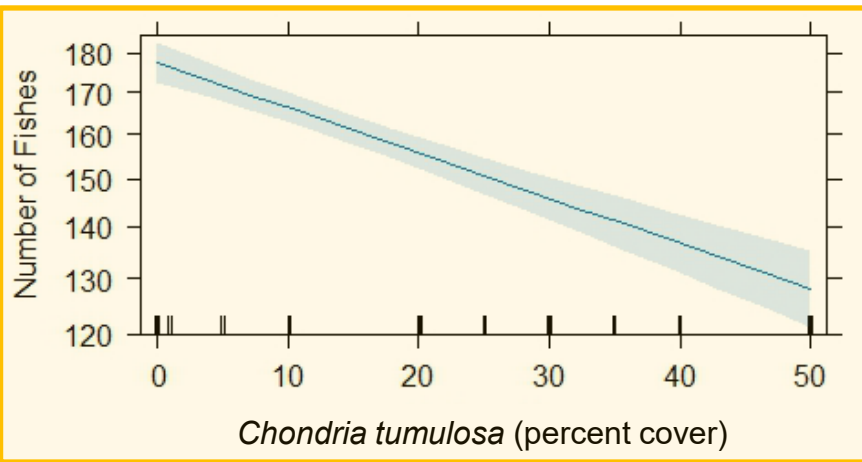
Stationary Point Counts (SPC) - fish survey method used for NOAA's reef ecosystem monitoring in PMNM

Paired with Structure from Motion (SfM) photography of the reef habitat - high resolution 3D models of the reef



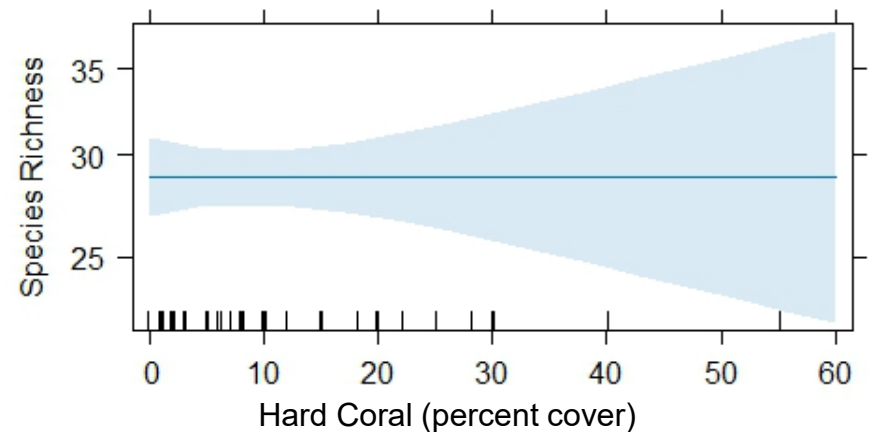
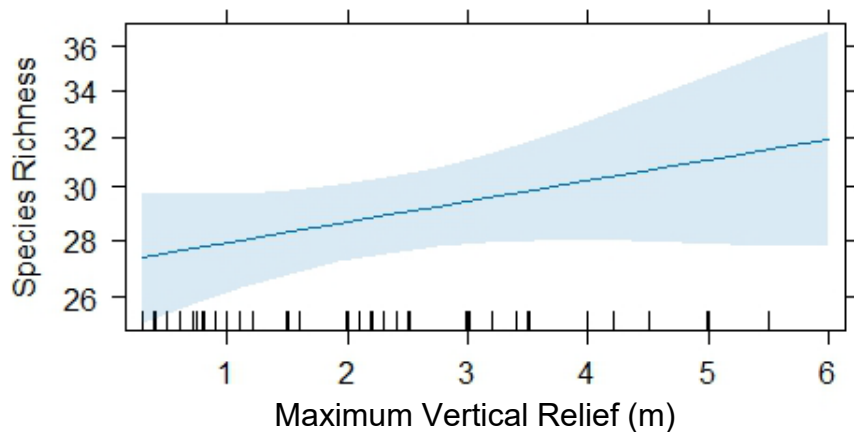
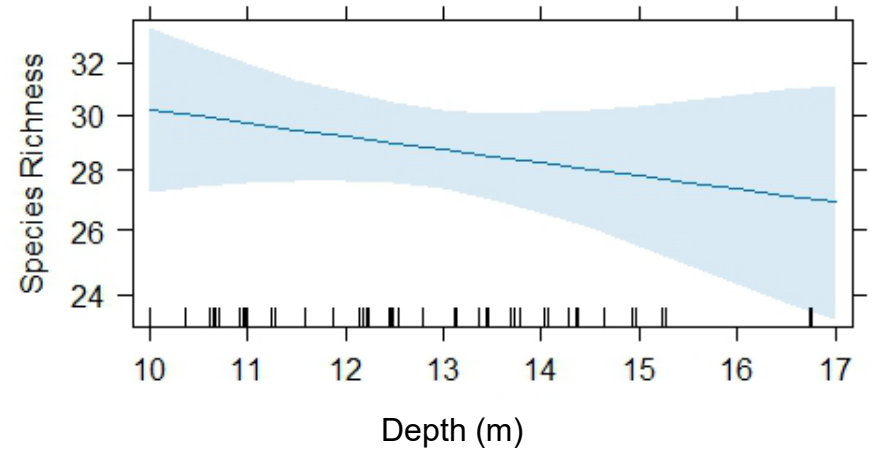
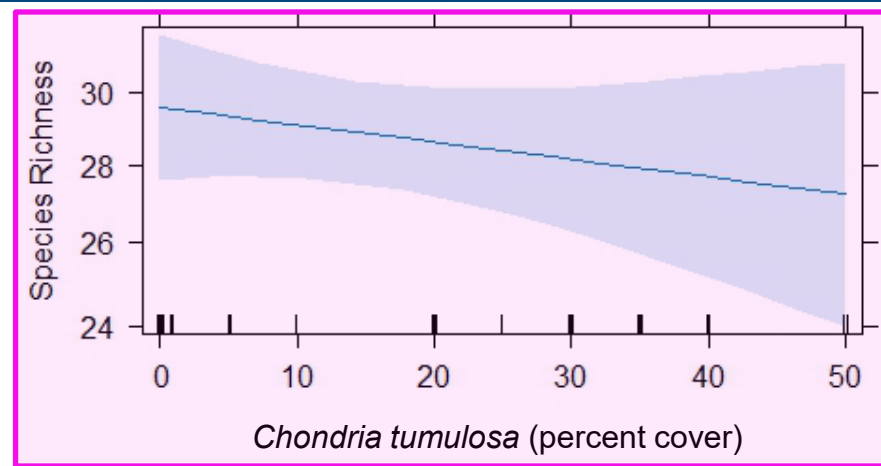
# Impacts to Reef Fish Community

Total **number of fishes** decreases as *Chondria tumulosa* cover increases (linear model,  $p < 0.000001$ )



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Patchiness of *Chondria tumulosa* mats & cryptic presence might be limiting impact on reef fishes for now.



# Research Question: How does *Chondria tumulosa* impact the broader reef community - specifically reef fishes?

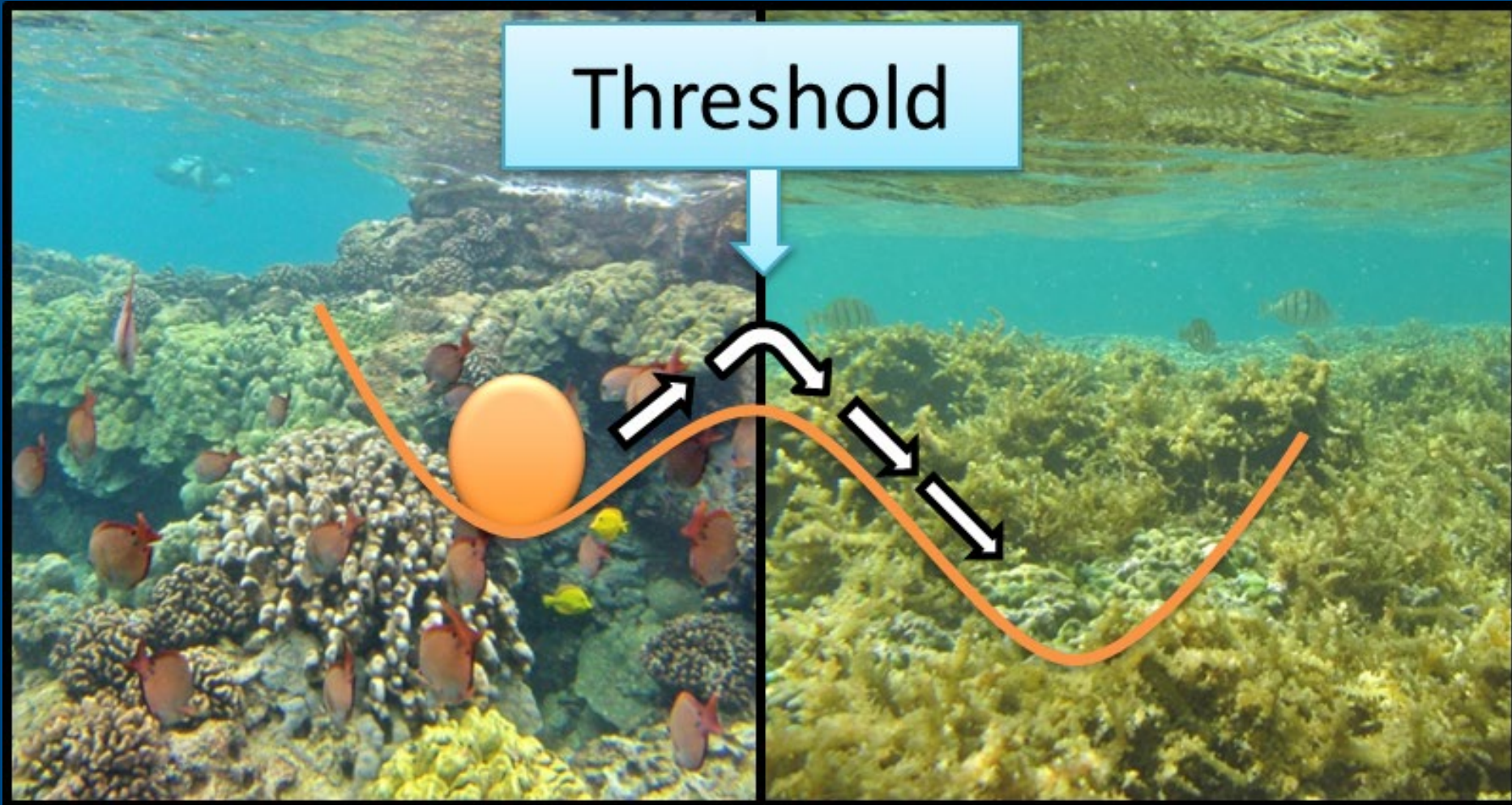


Macroalgae is a natural part of coral reef ecosystem...

*Chondria tumulosa* is covering reefs in some areas

Decreasing reef fish abundance & shifting community composition

# Coral Reefs: Phase Shifts?



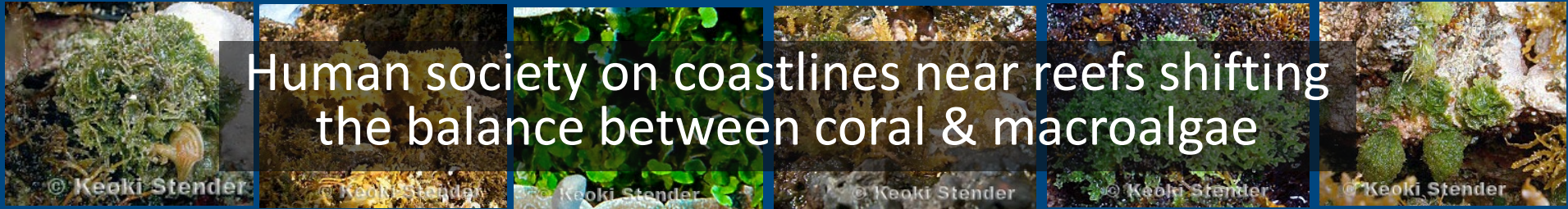
# Macroalgae Growth in Coral Reef Ecosystems



Fishing decreases herbivores, decreasing grazing



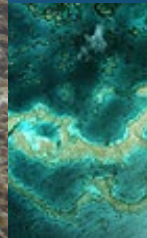
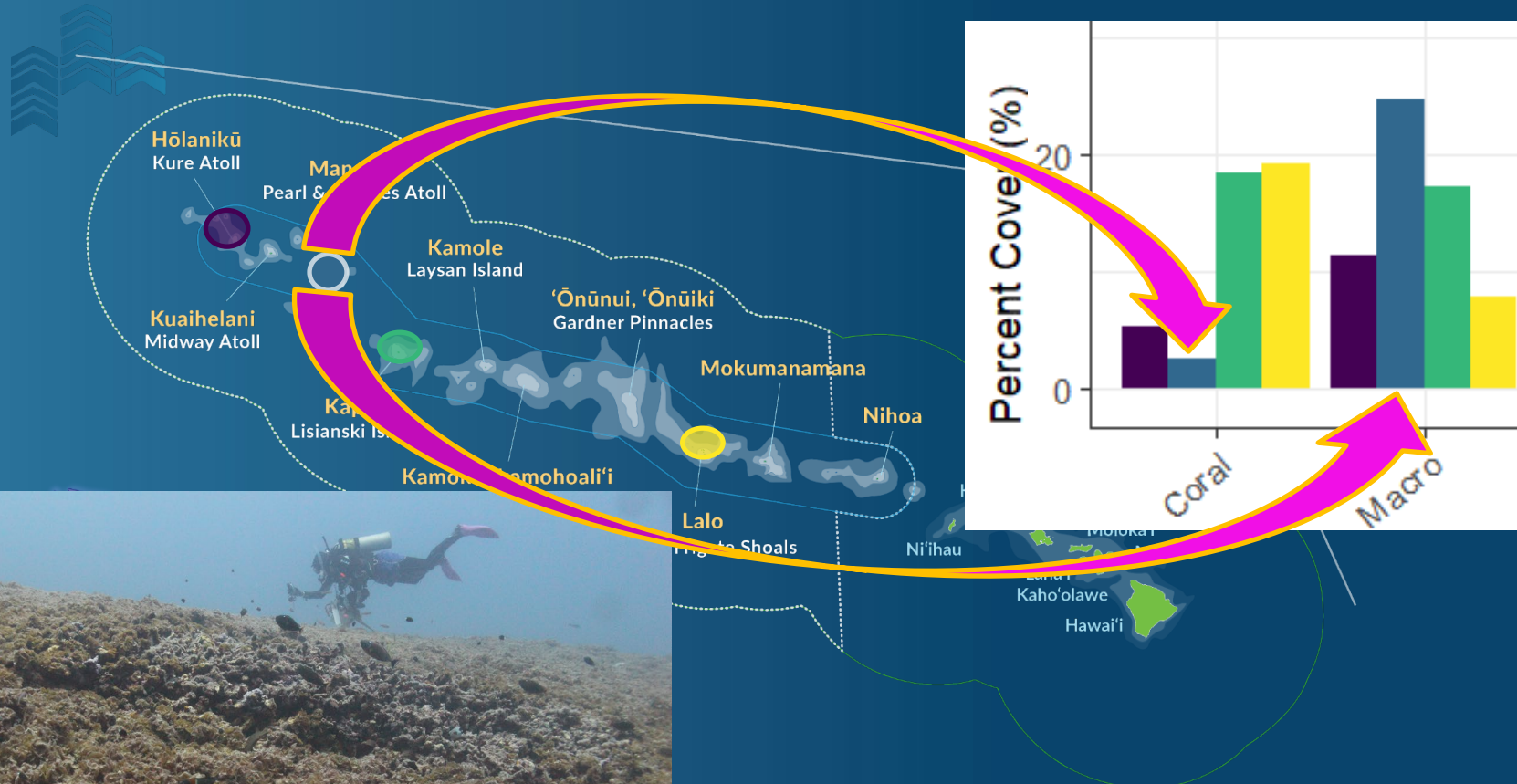
Human society on coastlines near reefs shifting the balance between coral & macroalgae



Increased runoff (fertilizer & sewage) increases nutrients



# Papahānaumokuākea Marine National Monument



# What is influencing growth of *Chondria tumulosa* in PMNM?

## Hōlanikū

Confirmed presence in 2023 primarily in the lagoon  
≤10% cover

In 2024  
at 2 out of 23 survey sites ★  
<1% cover (tucked in pukas)

## Kuaihelani

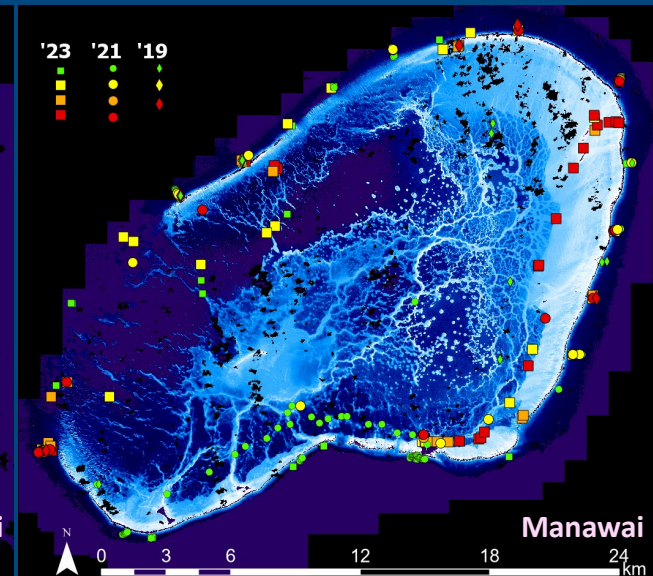
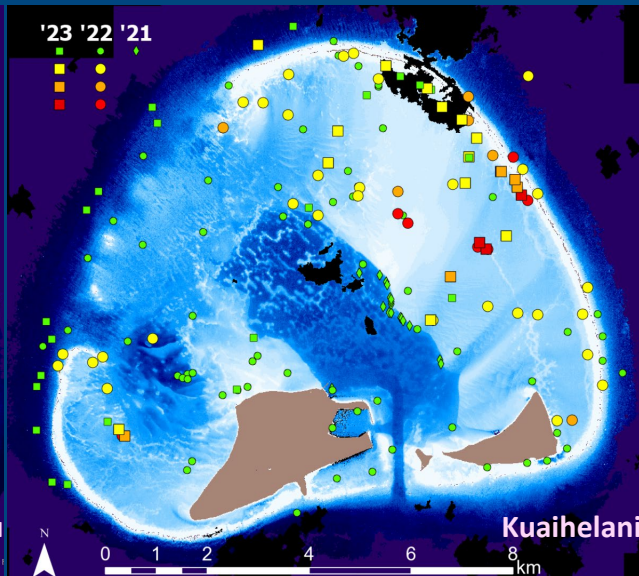
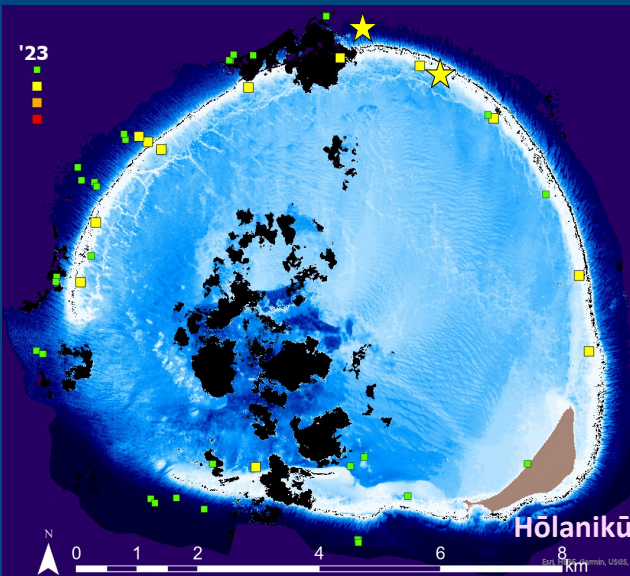
Confirmed presence in 2022 primarily in eastern lagoon

In 2023  
surveyed >2 mi of western forereef <1% found at 1 location;  
lagoon has areas with > 40%

## Manawai

Confirmed presence in 2016 (lagoon ~6x larger than H/K)

In 2019, 2021, 2023, & 2024  
forereef & lagoon sites with high coverage;  
evidence of upwelling & transit of nutrients out of lagoon



*Chondria tumulosa* cover from in water surveys conducted by trained scientists on SCUBA & snorkel.

0% 1-10% >10-40% >40% Maps produced in ArcGIS Pro (on 4m bathymetry USGS base maps)

# What is influencing growth of *Chondria tumulosa* in PMNM?

Carpets covering reefs at Manawai may not be the next step at other PMNM atolls, growth may be strongly driven by bottom up & top down forces



Photo credit: Brian Hauk

# What do we do next?

Monitor for growth (Manawai & other atolls with & without known presence)



Keep learning more about its ecology & environmental conditions for growth

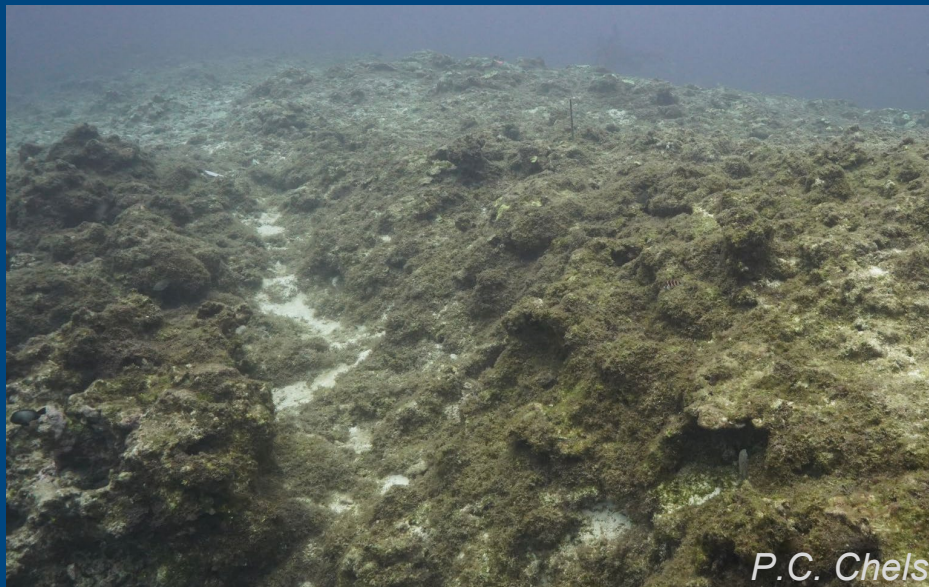


Find origin location & improve BMPs to effectively minimize risk of spread

# What do we do next?

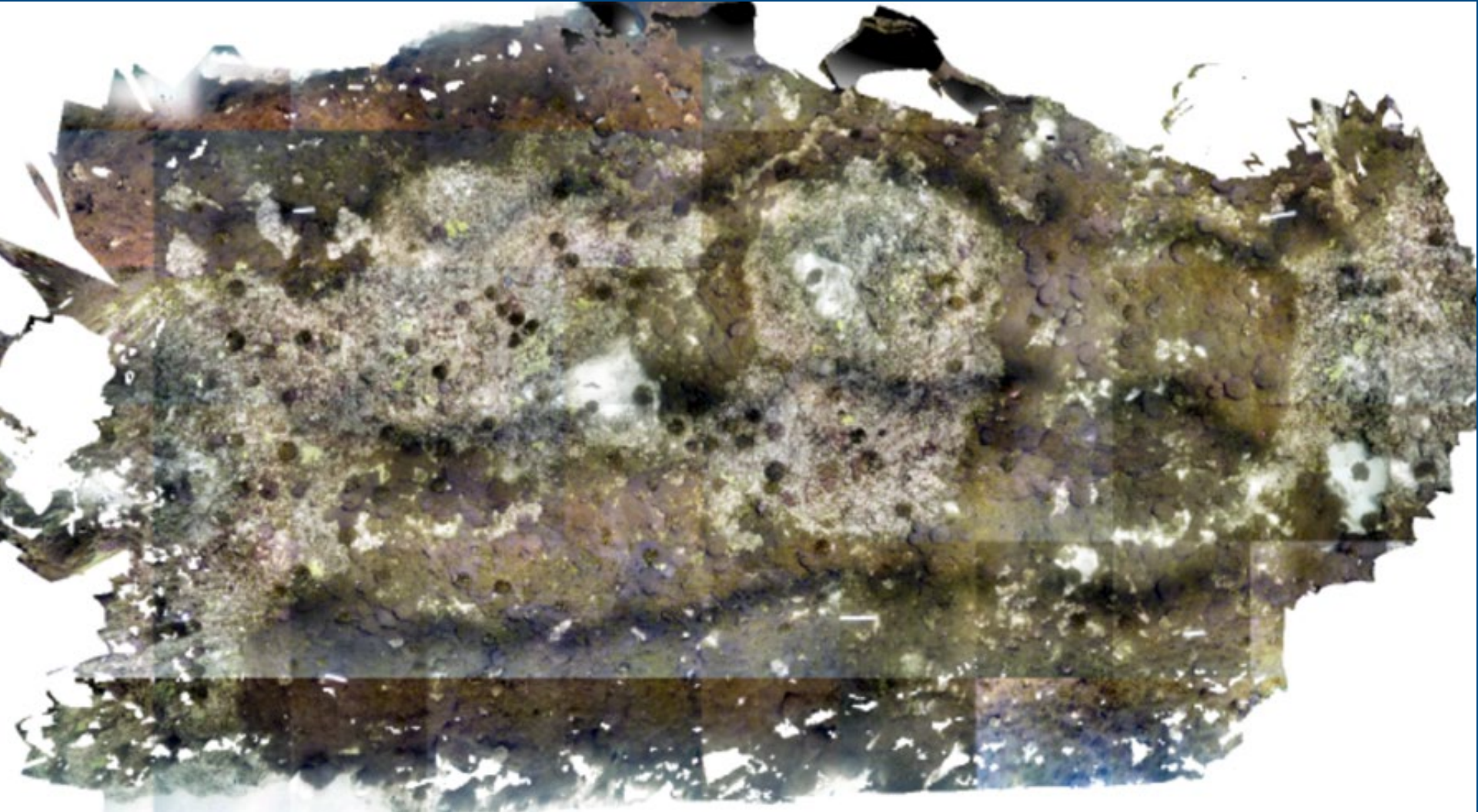
Directly track temporal trends in *Chondria tumulosa* at permanent sites

- Sept. 2024 – established 2 *Chondria tumulosa* Long Term Monitoring sites on the leeward side of Manawai (40-60 feet deep)
- Reef fish surveyed & 30 m x 5 m reef transect SfM conducted at each site

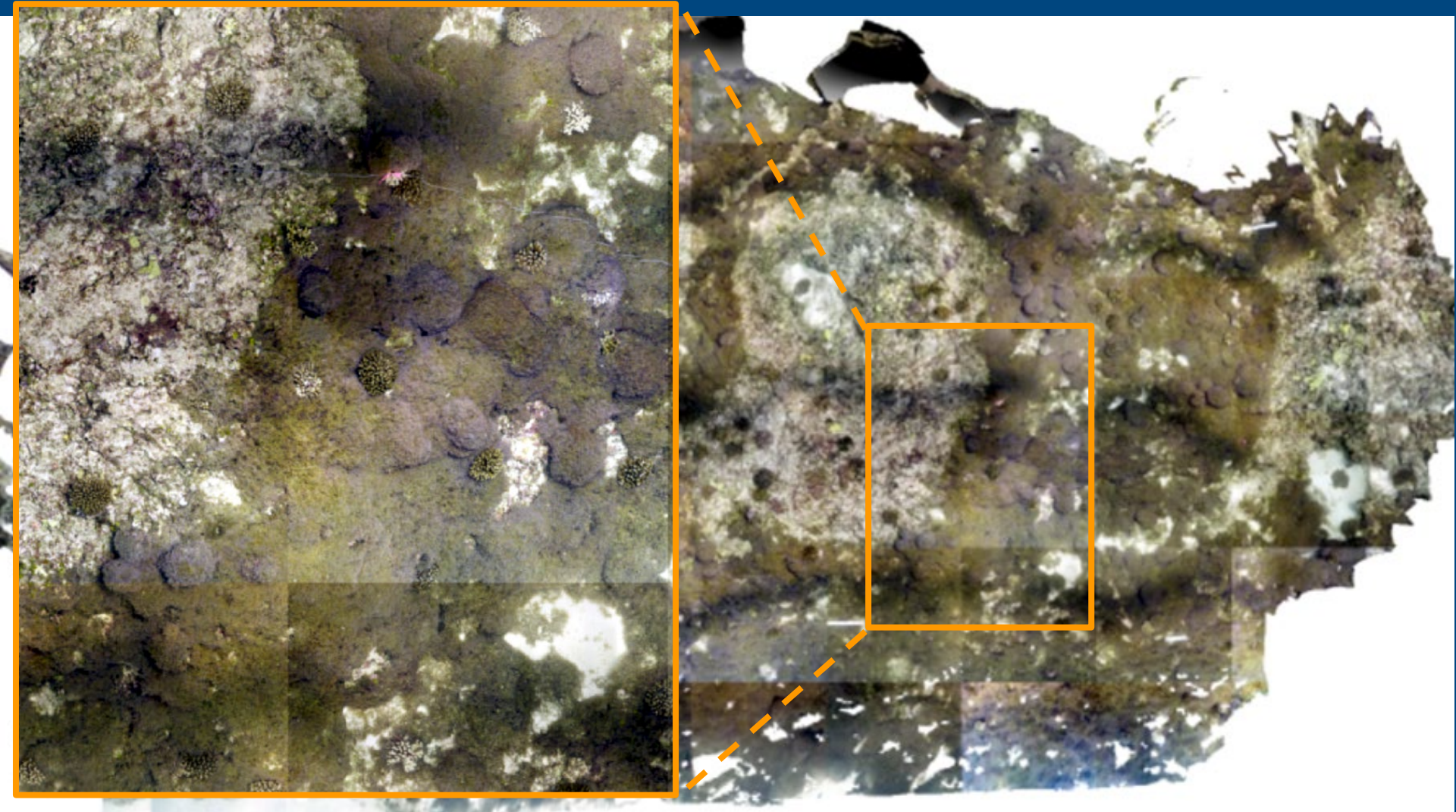




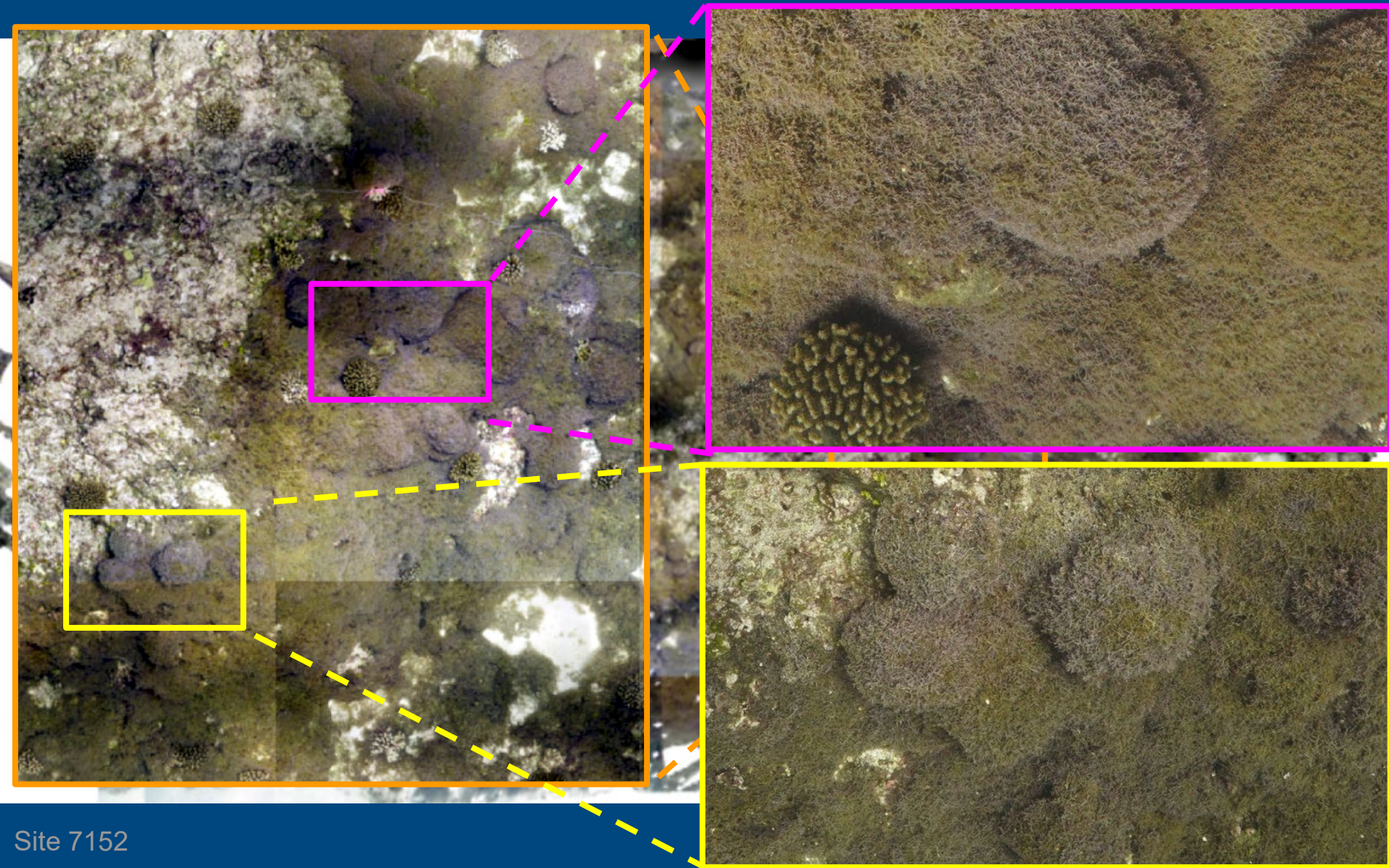
Next Step: Use SfM to measure *C. tumulosa* growth at permanent sites



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- Reef fish surveyed & 30 m x 5 m reef transect SfM conducted at each site
- Removal efforts (7.5 hours labor → 47 lbs *C. tumulosa* removed)
  - UH Hilo partner using this sample to investigate chemical composition / palatability
- SfM repeated post removal → can directly measure changes in benthic cover from removal & when we revisit sites next summer



# Conclusions

- Alien Invasive Species are a serious threat to marine ecosystems even within a very remote & protected National Monument
- *Chondria tumulosa* is impacting the reef fish community at Manawai, decreasing fish abundance & shifting the community composition
- There is room for optimism that *C. tumulosa* might not carpet reefs at other PMNM atolls nor at all Manawai reefs
- Need to learn more about the ecology of *C. tumulosa* – this includes temporal tracking & palatability of this algae for reef fish dynamics



# Mahalo Nui

to PMNM team for supporting this research (Brian Hauk helped develop the research question, Jason Leonard operated small boat for daily field ops, Colt Davis helped to process photo data, & Khrista Nichols helped create some of the figures),

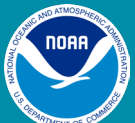
to the NOAA Dive Center for dive operations support (especially Mikey Kent & Sean Digre),

to NOAA/ONMS & NFWF for supporting the research expedition,

& to the captain & crew of the Kahana II (Hawai'i Research Group) for smooth ship operations in support of the research expedition.



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