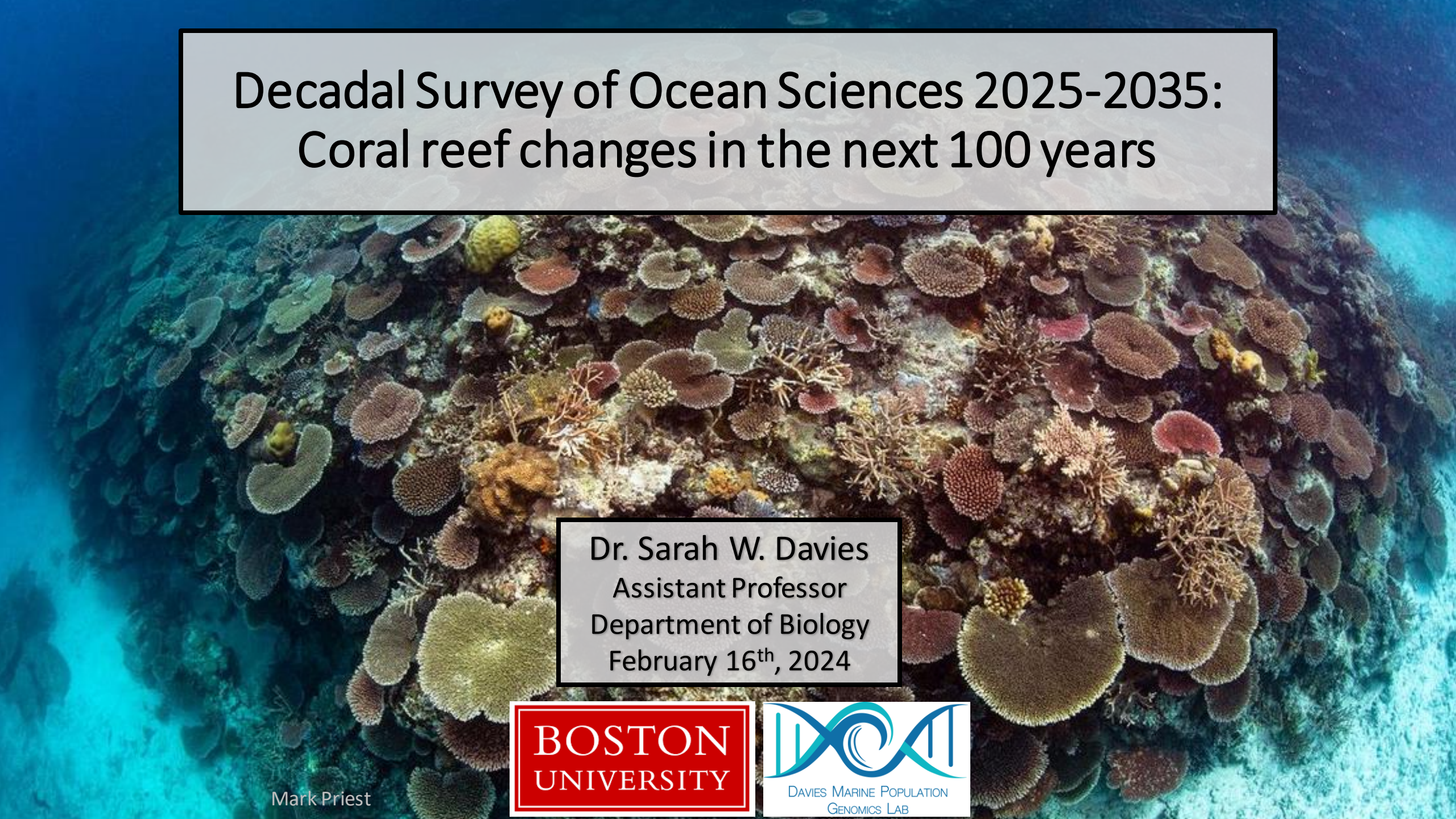
Decadal Survey of Ocean Sciences 2025-2035: Coral reef changes in the next 100 years

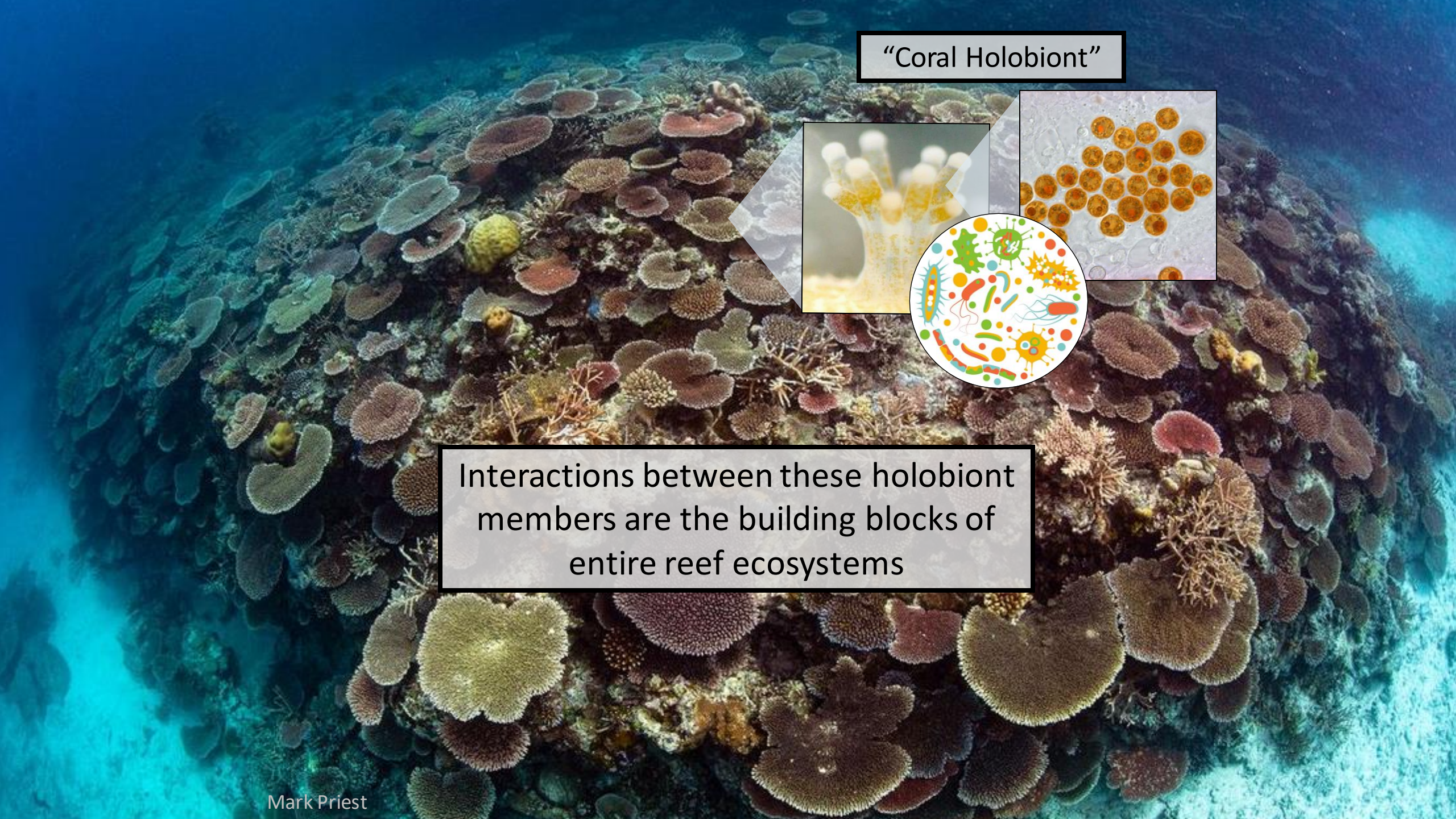


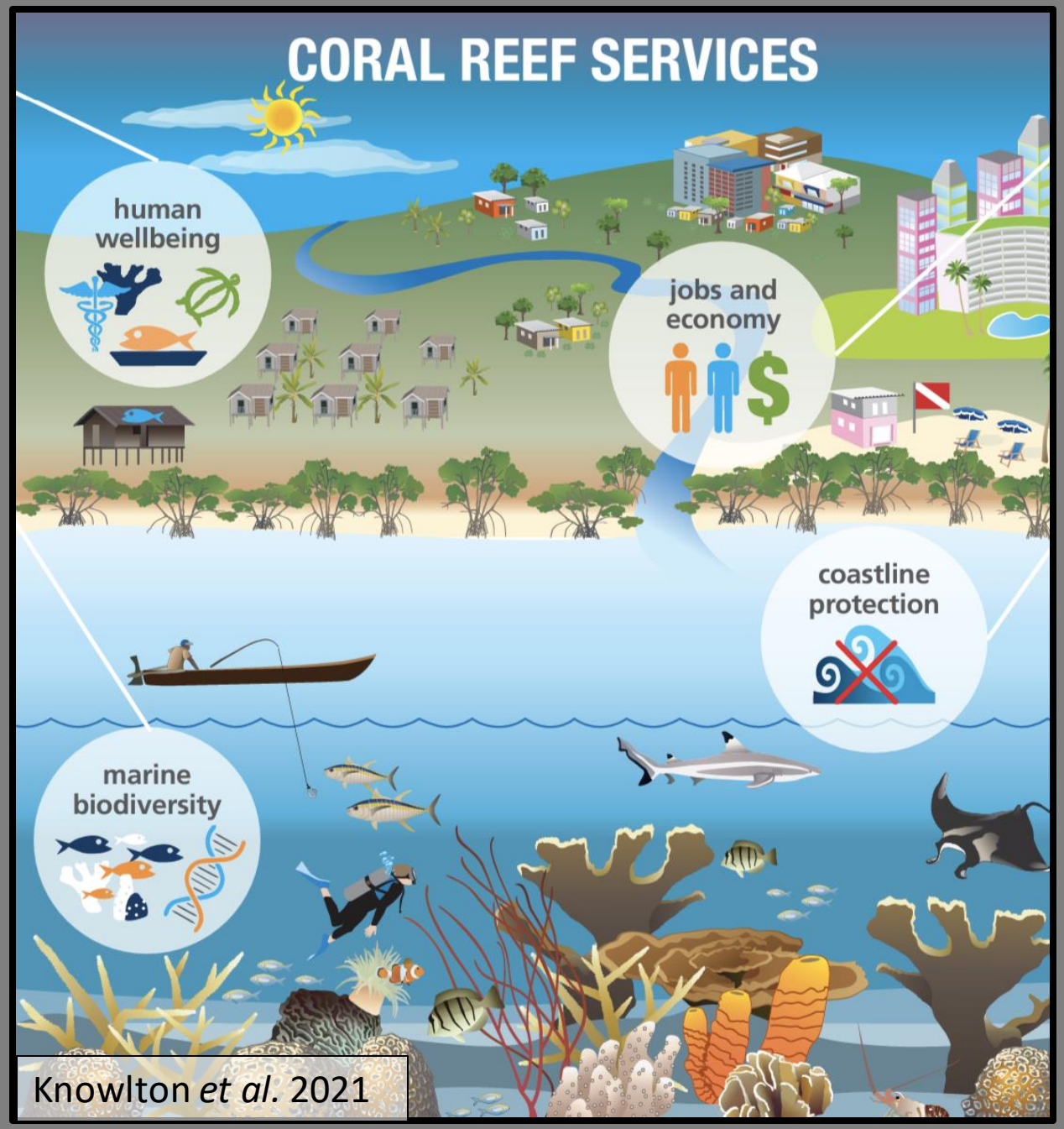
Dr. Sarah W. Davies
Assistant Professor
Department of Biology
February 16th, 2024

BOSTON UNIVERSITY

Davies Marine Population Genomics Lab

Mark Priest


“Coral Holobiont”
Interactions between these holobiont members are the building blocks of entire reef ecosystems
Mark Priest



Global economic value: US$10 trillion/year[1]

Socio-cultural benefits[2]:
13% of humans live within 100km of reefs
94% of small island nation populations

Health Reef Ecosystems = Healthy People

Future socioeconomic viability of coral reefs uncertain

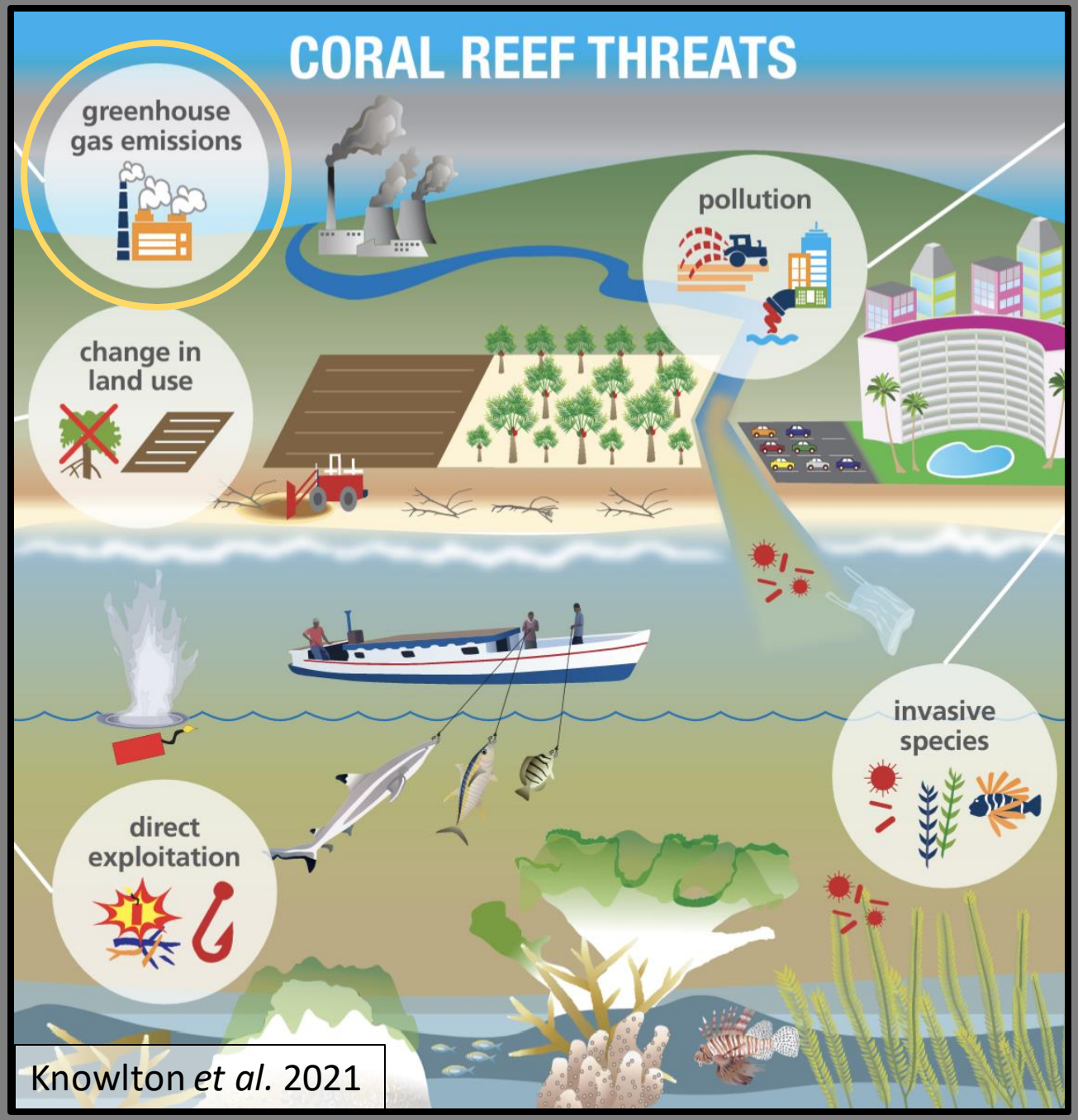
Coral Bleaching

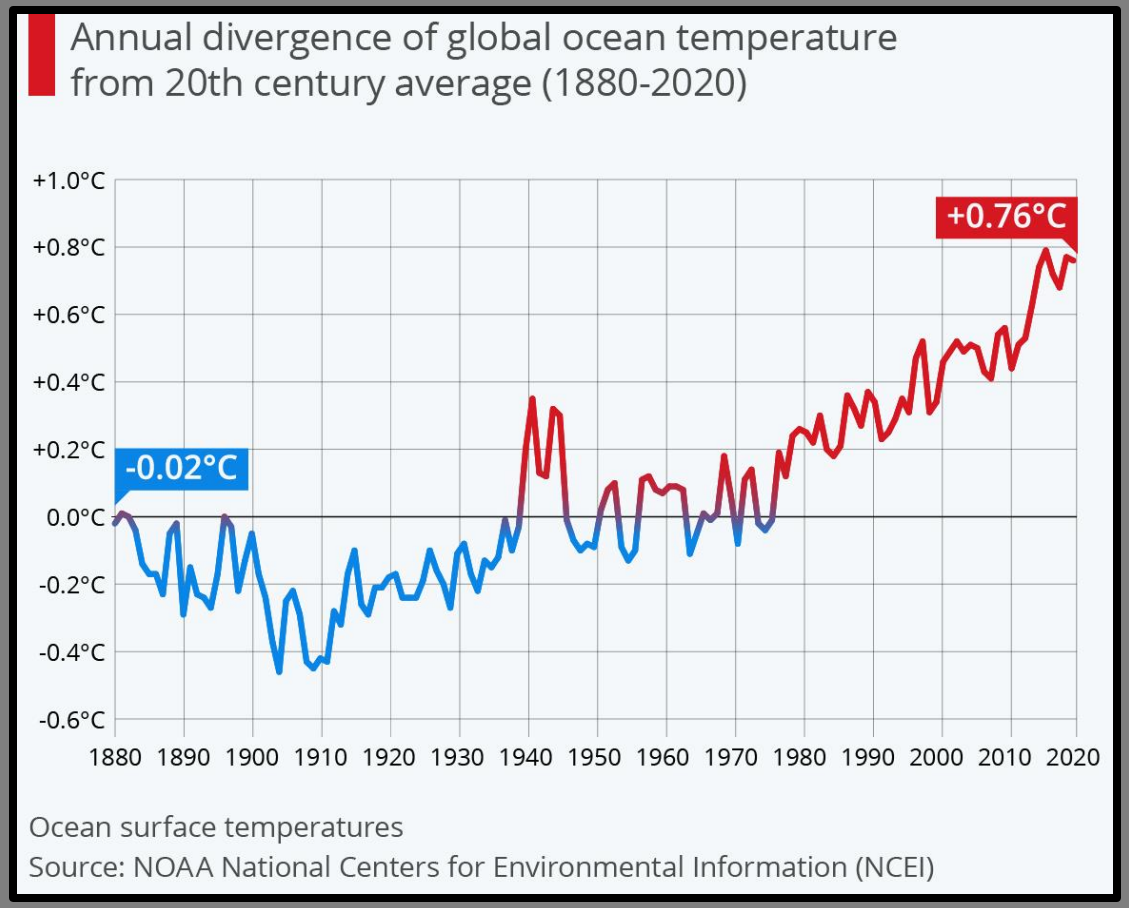
P. Marshall

Mark Priest

Coral Disease

Valerie Paul

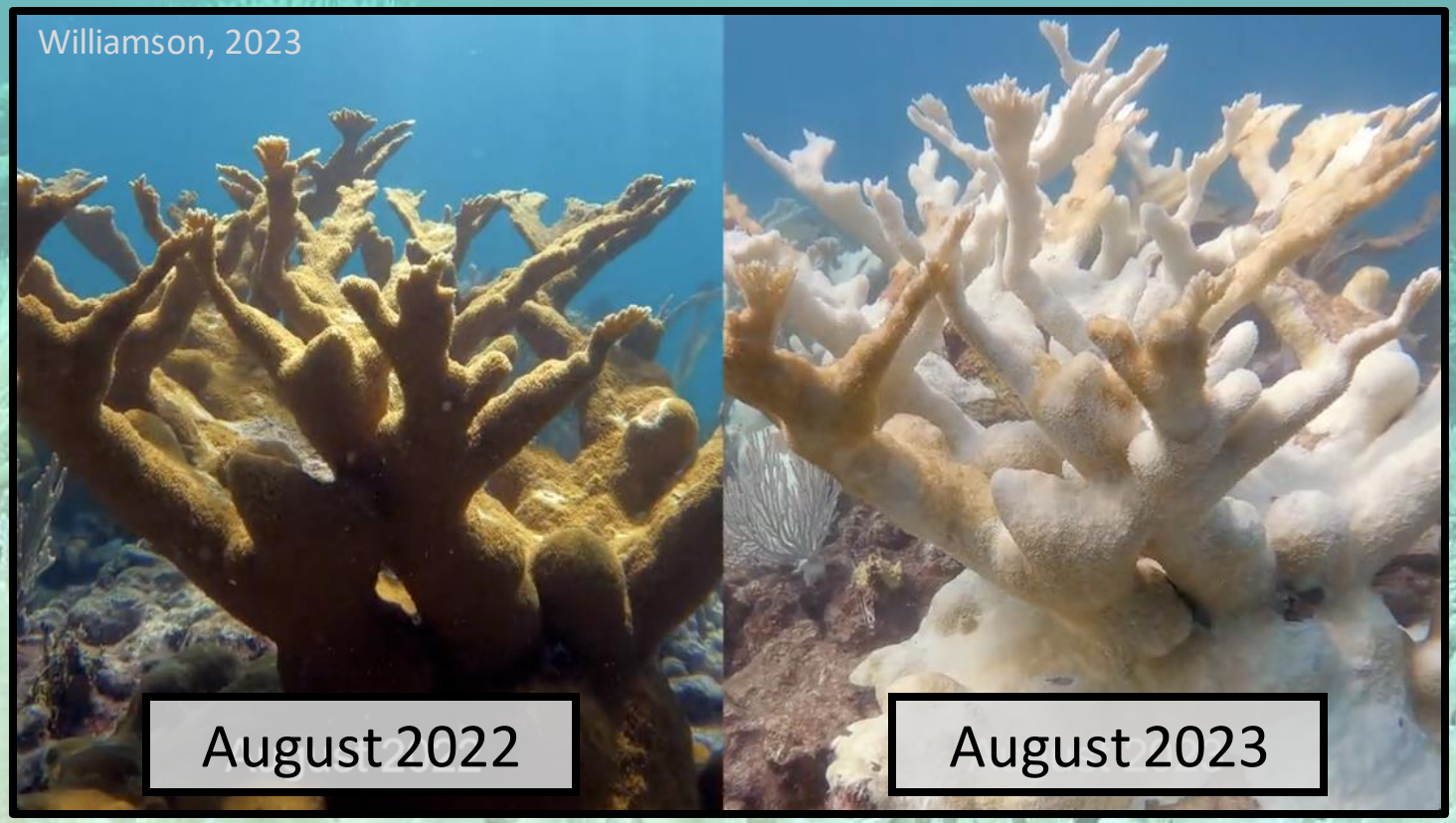




Coral reef cover is predicted to decline by up to 99% if global warming reaches 2°C above pre-industrial levels (IPCC 2018)

> The coming year and decade likely offer the last chance for international, regional, national, and local entities to change the trajectory of coral reefs from heading towards world-wide collapse to heading towards slow but steady recovery.

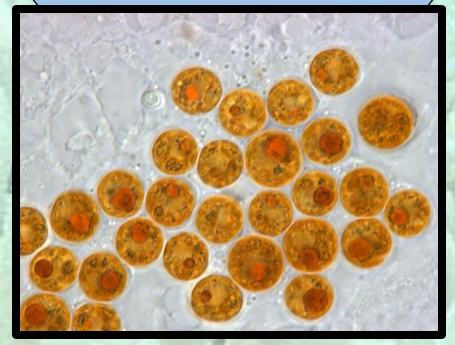
Knowlton *et al.* 2021



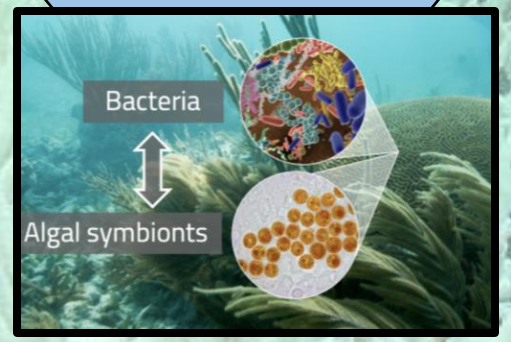
Why is predicting coral responses to climate change so challenging?

Unrecognized coral genetic diversity

Enormous algal genetic diversity

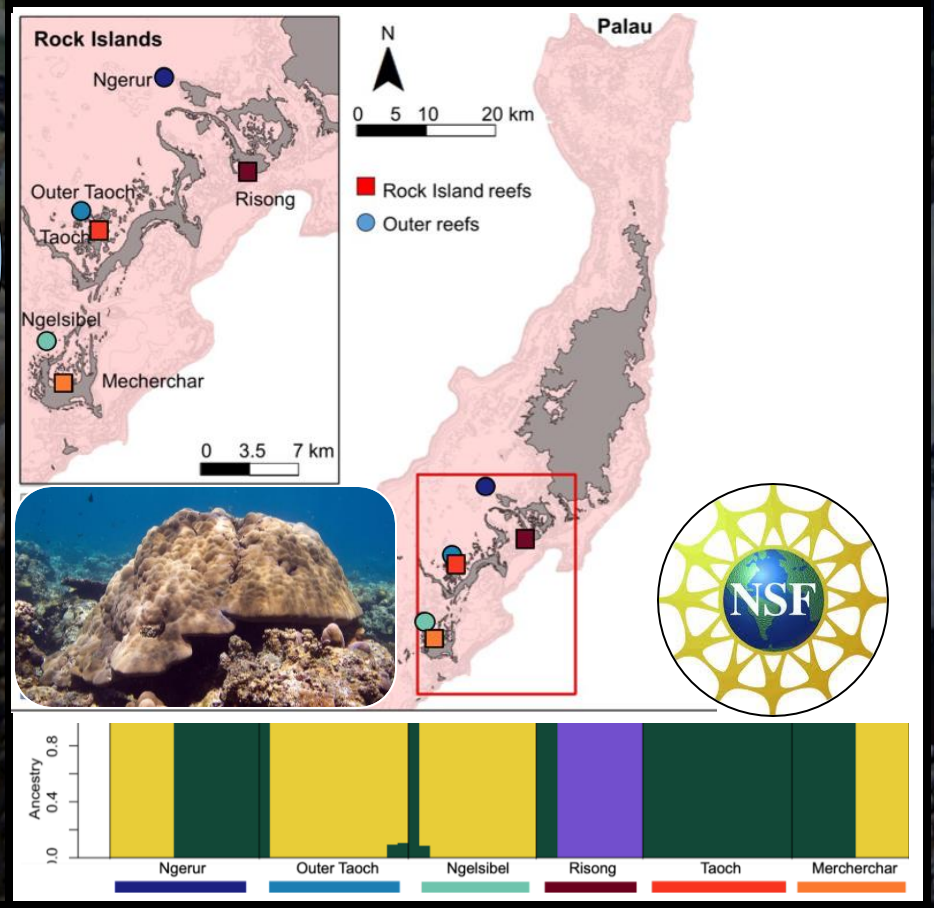


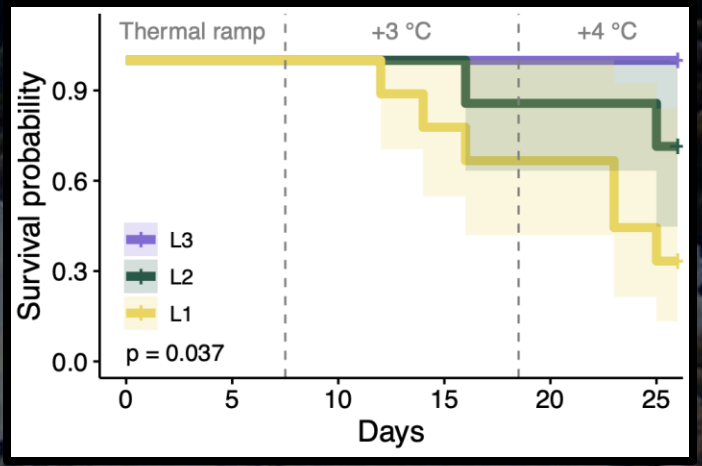
Holobiont Interactions



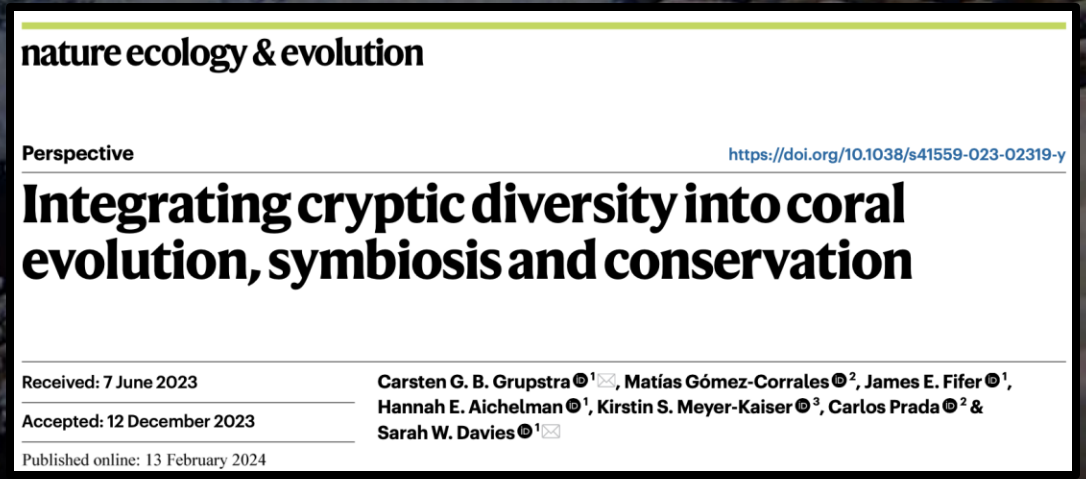
Why do some corals win and others lose?

Unrecognized coral genetic diversity





Functional variation within a "species"

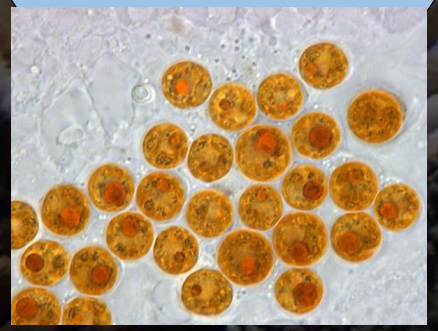


Cryptic lineages in 24 coral genera

Recommendation: International sampling efforts across 'species' ranges that include leadership by local and Indigenous communities

Why do some corals win and others lose?

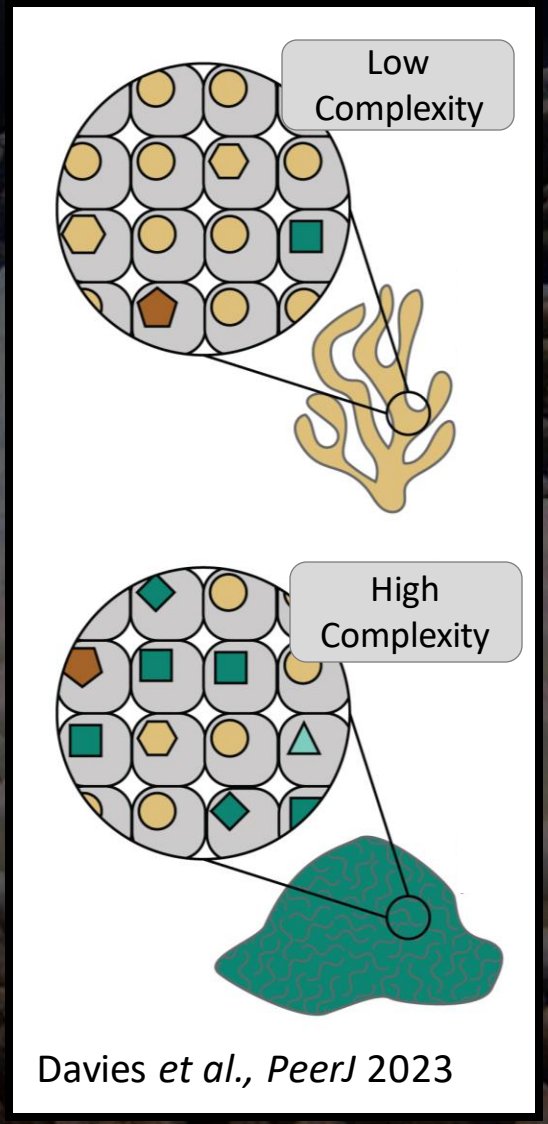
Enormous algal genetic diversity



PeerJ

Building consensus around the assessment and interpretation of Symbiodiniaceae diversity

Sarah W. Davies[1], Matthew H. Gamache[2], Lauren I. Howe-Kerr[3], Nicola G. Kriefall[1], Andrew C. Baker[4], Anastazia T. Banaszak[5], Line Kolind Bay[6], Anthony J. Bellantuono[7], Debashish Bhattacharya[8], Cheong Xin Chan[9], Danielle C. Claar[10], Mary Alice Coffroth[11], Ross Cunning[12], Simon K. Davy[13], Javier del Campo[14], Erika M. Díaz-Almeyda[15], Jörg C. Frommlet[16], Lauren E. Fuess[17], Raúl A. González-Pech[2,18], Tamar L. Goulet[19], Kenneth D. Hoadley[20], Emily J. Howells[21], Benjamin C. C. Hume[22], Dustin W. Kemp[23], Carly D. Kenkel[24], Sheila A. Kitchen[25], Todd C. LaJeunesse[26], Senjie Lin[27], Shelby E. McIlroy[28], Ryan McMinds[29], Matthew R. Nitschke[6], Clinton A. Oakley[13], Raquel S. Peixoto[30], Carlos Prada[31], Hollie M. Putnam[31], Kate Quigley[32], Hannah G. Reich[31], James Davis Reimer[33], Mauricio Rodriguez-Lanetty[7], Stephanie M. Rosales[34], Osama S. Saad[35], Eugenia M. Sampayo[36], Scott R. Santos[37], Eiichi Shoguchi[38], Edward G. Smith[39], Michael Stat[40], Timothy G. Stephens[8], Marie E. Strader[41], David J. Suggett[30,42], Timothy D. Swain[43], Cawa Tran[44], Nikki Traylor-Knowles[4], Christian R. Voolstra[22], Mark E. Warner[45], Virginia M. Weis[46], Rachel M. Wright[47], Tingting Xiang[39], Hiroshi Yamashita[48], Maren Ziegler[49], Adrienne M. S. Correa[3] and John Everett Parkinson[2]



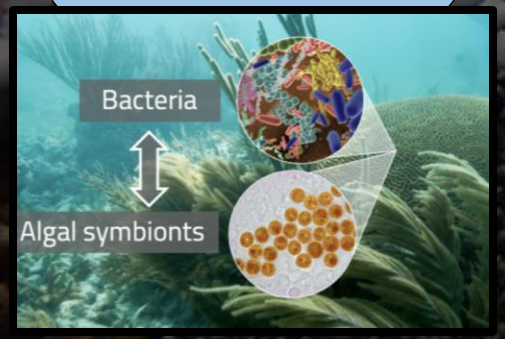
Davies *et al.*, *PeerJ* 2023

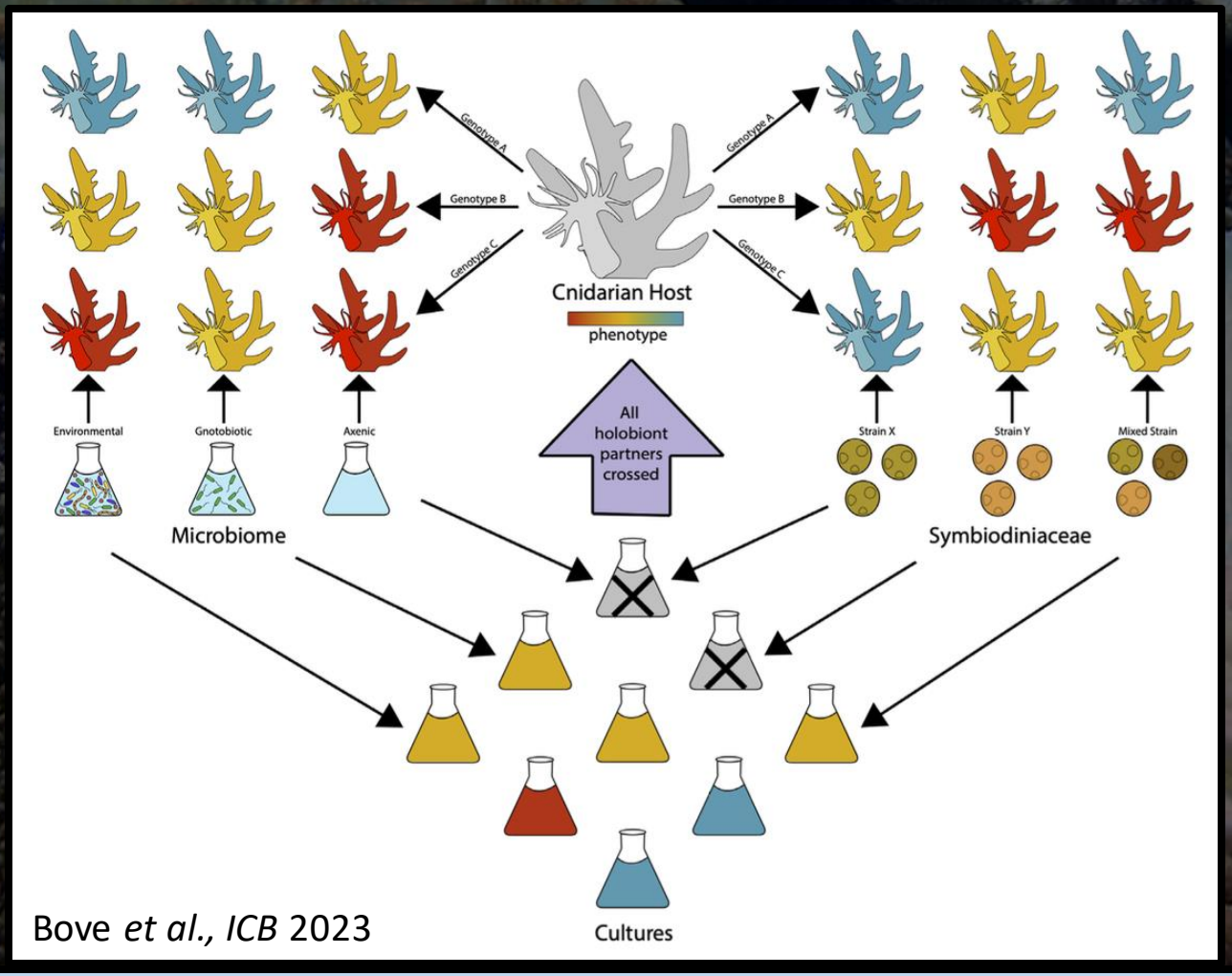
Recommendations:

1. Technological advancements for assessing diversity
2. International collaborations to link diversity with function
3. Expand accessible culture collections and taxonomy

Why do some corals win and others lose?

Holobiont Interactions





Bove *et al., ICB* 2023

Different host-symbiont-microbiome combinations might yield novel phenotypes under climate change

Recommendation: Research on mechanisms underlying how holobiont interactions are shaped by changing oceans

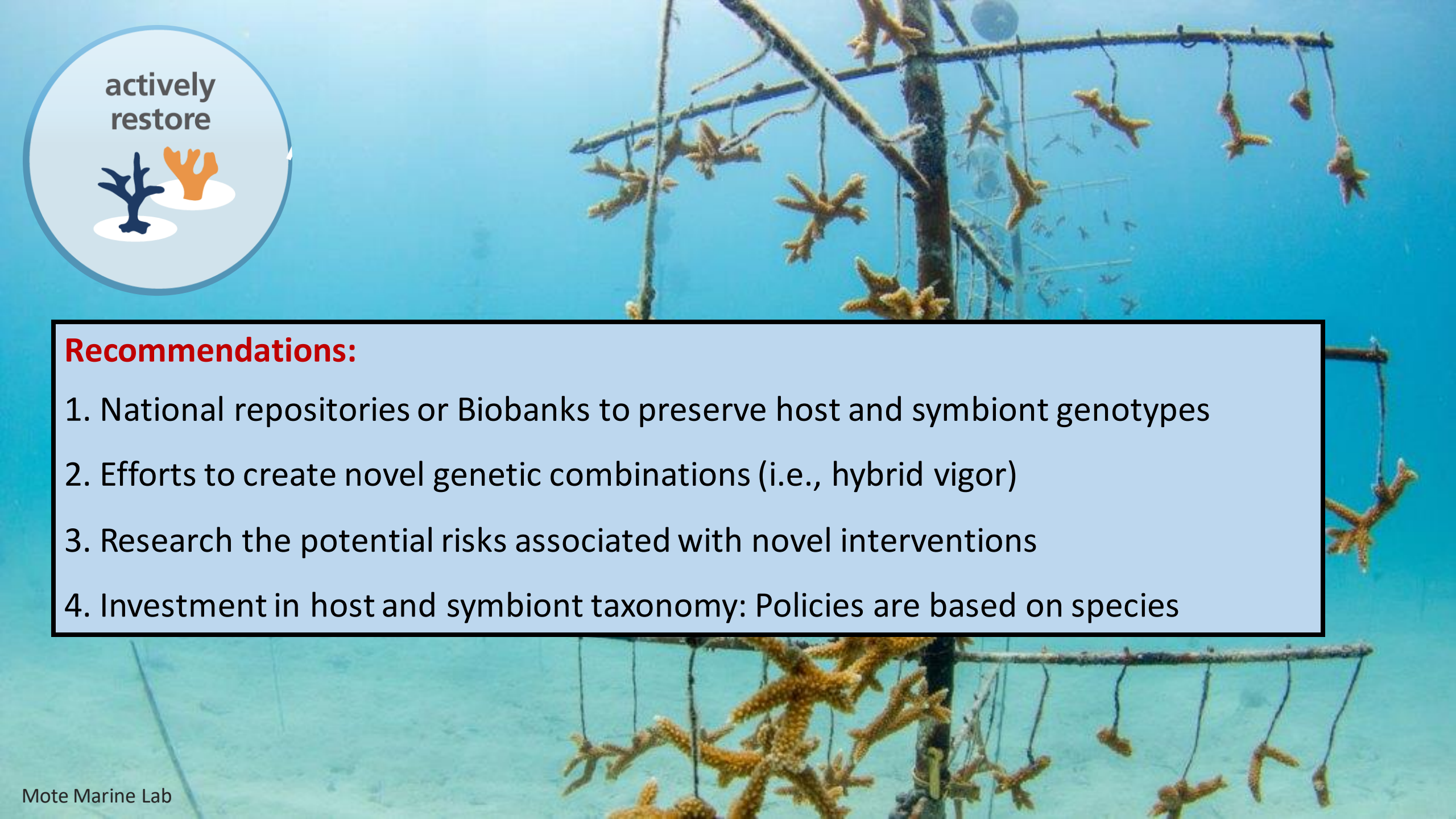
Efforts to mitigate warming and improve local conditions are paramount

Policy challenges: corals, currents and CO_2 emissions do no respect political boundaries

Recommendation: Urgent need for incentives and mechanisms for multinational collaborations

Broader engagement with multinational stakeholders will bolster science and conservation

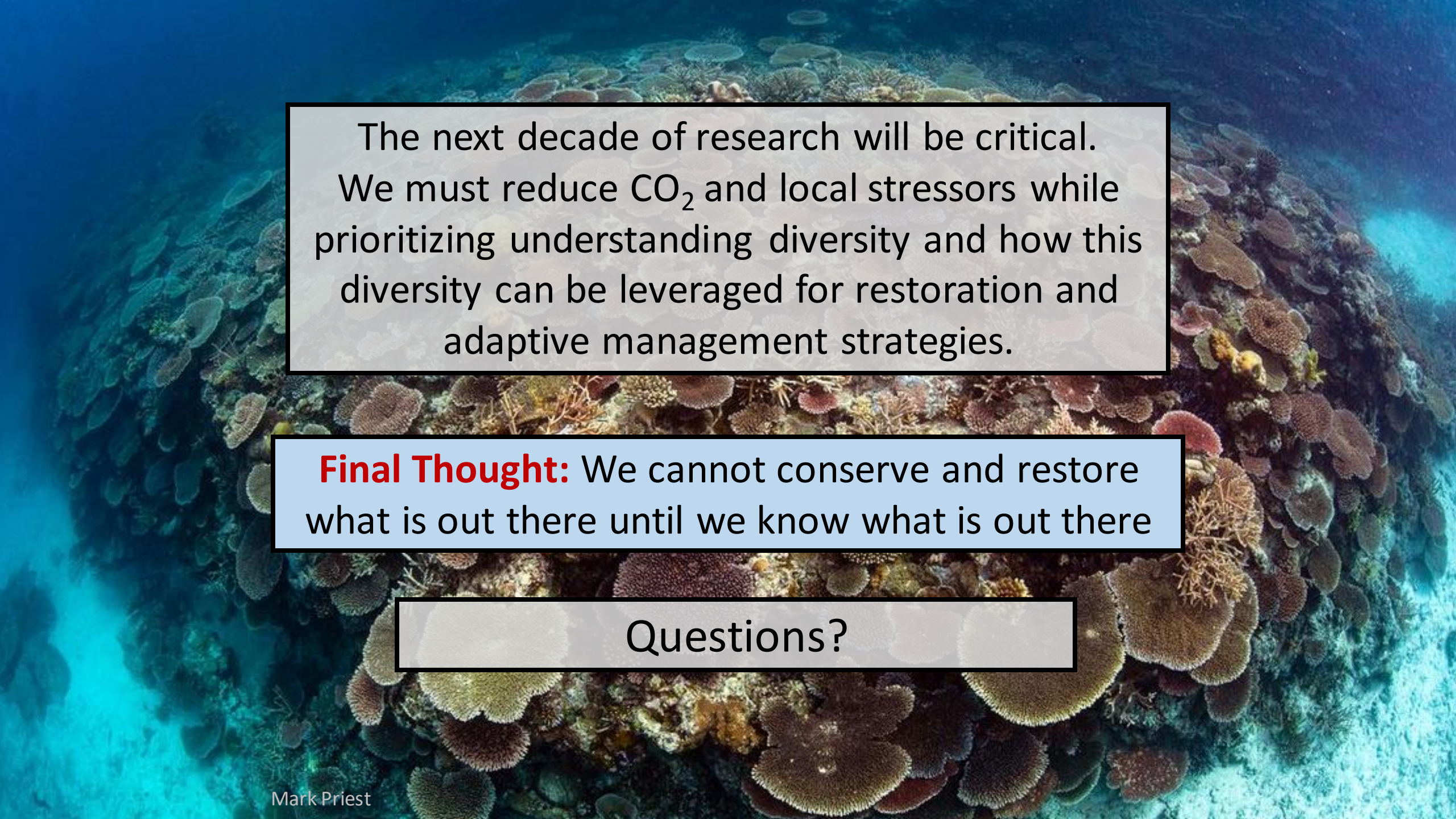
Knowlton *et al.* 2021



Recommendations:

1. National repositories or Biobanks to preserve host and symbiont genotypes
2. Efforts to create novel genetic combinations (i.e., hybrid vigor)
3. Research the potential risks associated with novel interventions
4. Investment in host and symbiont taxonomy: Policies are based on species

Mote Marine Lab



The next decade of research will be critical. We must reduce CO_2 and local stressors while prioritizing understanding diversity and how this diversity can be leveraged for restoration and adaptive management strategies.

Final Thought: We cannot conserve and restore what is out there until we know what is out there

Questions?

Mark Priest

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Grupstra CGB, Gómez-Corrales M, Fifer J, Aichelman HE, Meyer-Kaiser K, Prada C and SW Davies. Integrating cryptic diversity into coral evolution, symbiosis, and conservation. *Nature Ecology Evolution.* http://doi.org/10.1038/s41559-023-02319-y

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