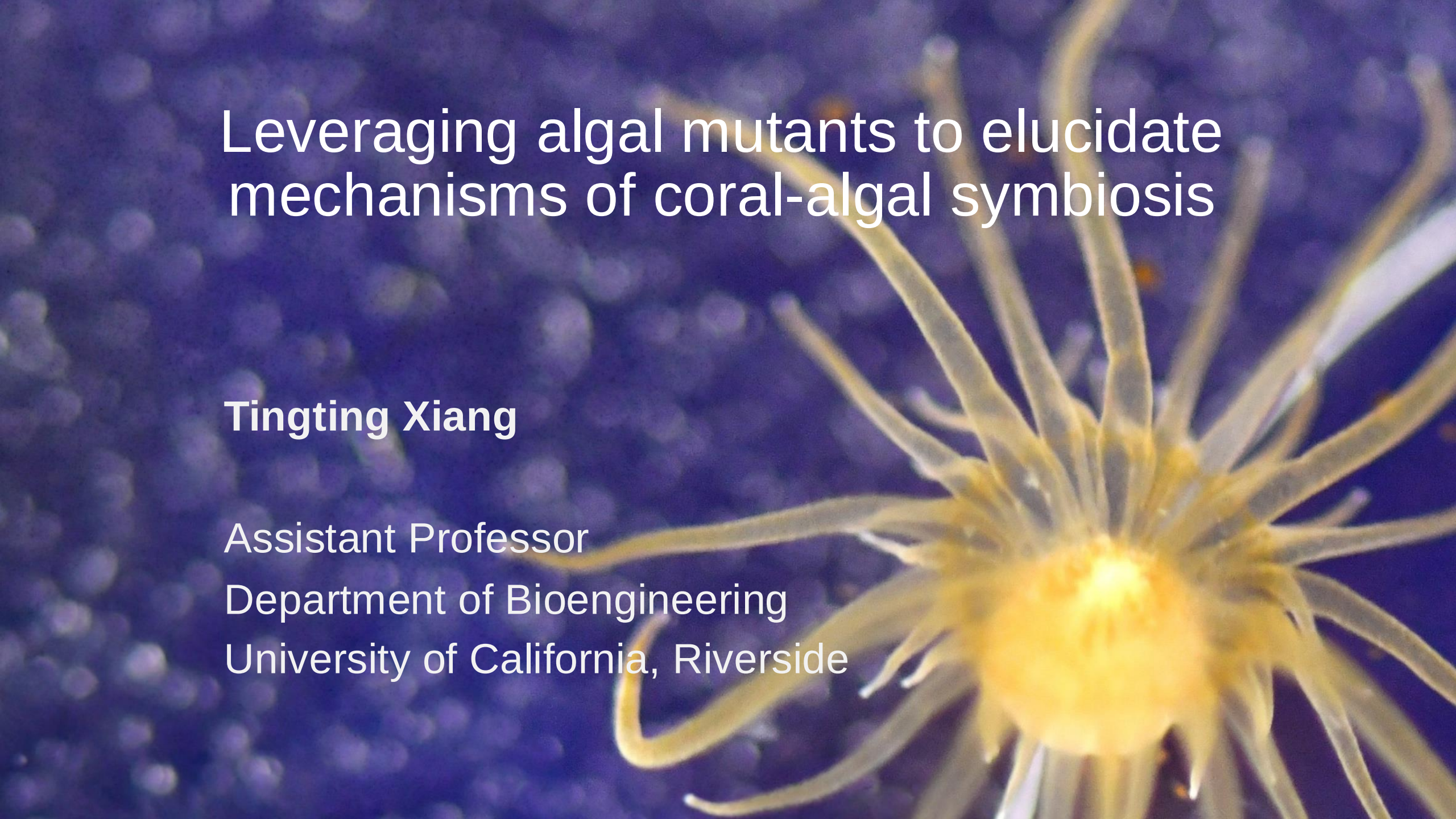


Leveraging algal mutants to elucidate mechanisms of coral-algal symbiosis

Tingting Xiang

Assistant Professor
Department of Bioengineering
University of California, Riverside

Coral reefs are the rain forests of the sea.

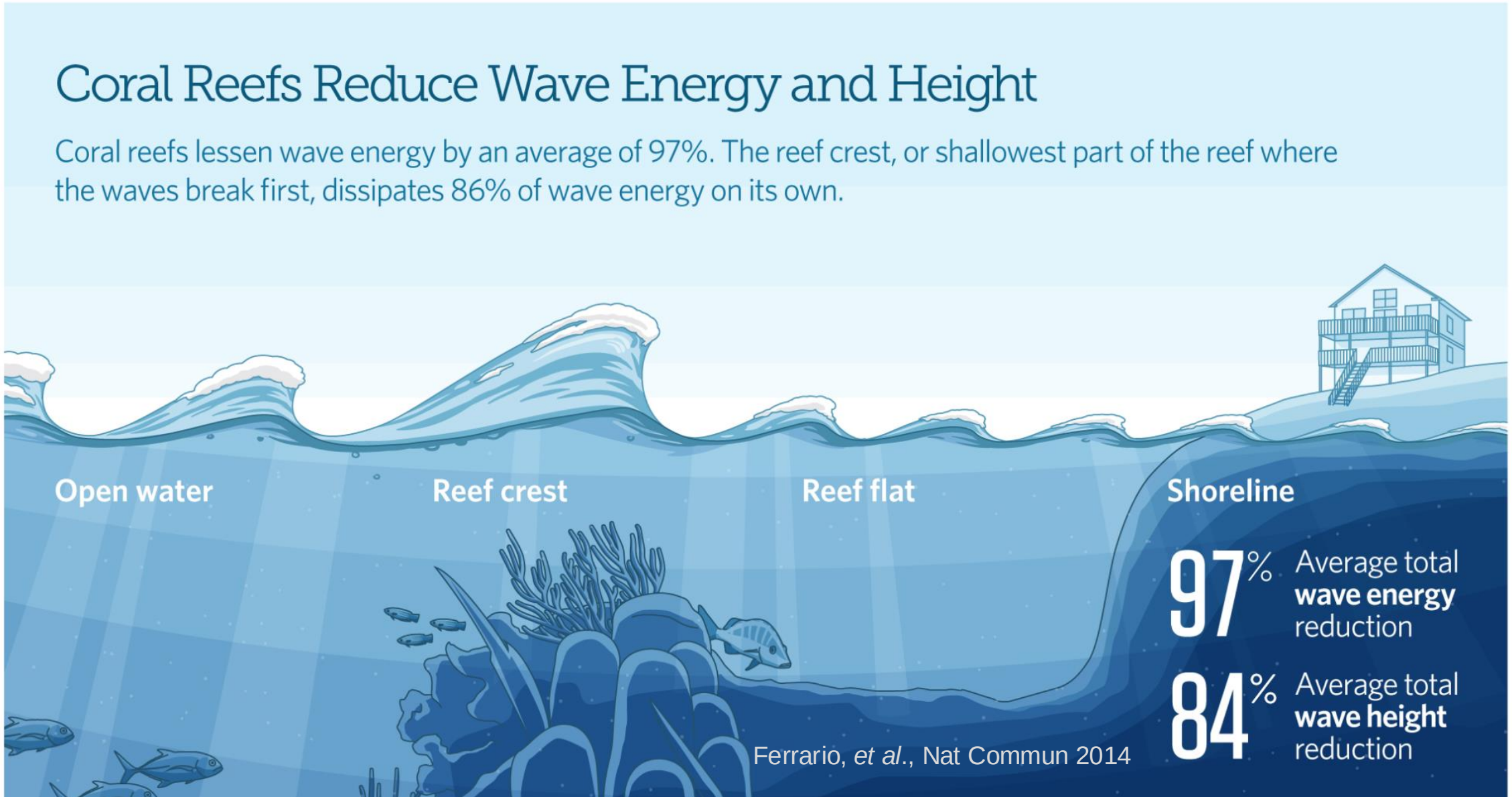
Coral reefs support jobs, tourism, and fisheries.

The estimated total economic value of coral reef services for the US as a whole is just over US $3.4 billion per year.

Example:
- Fisheries
- Tourism and Recreation

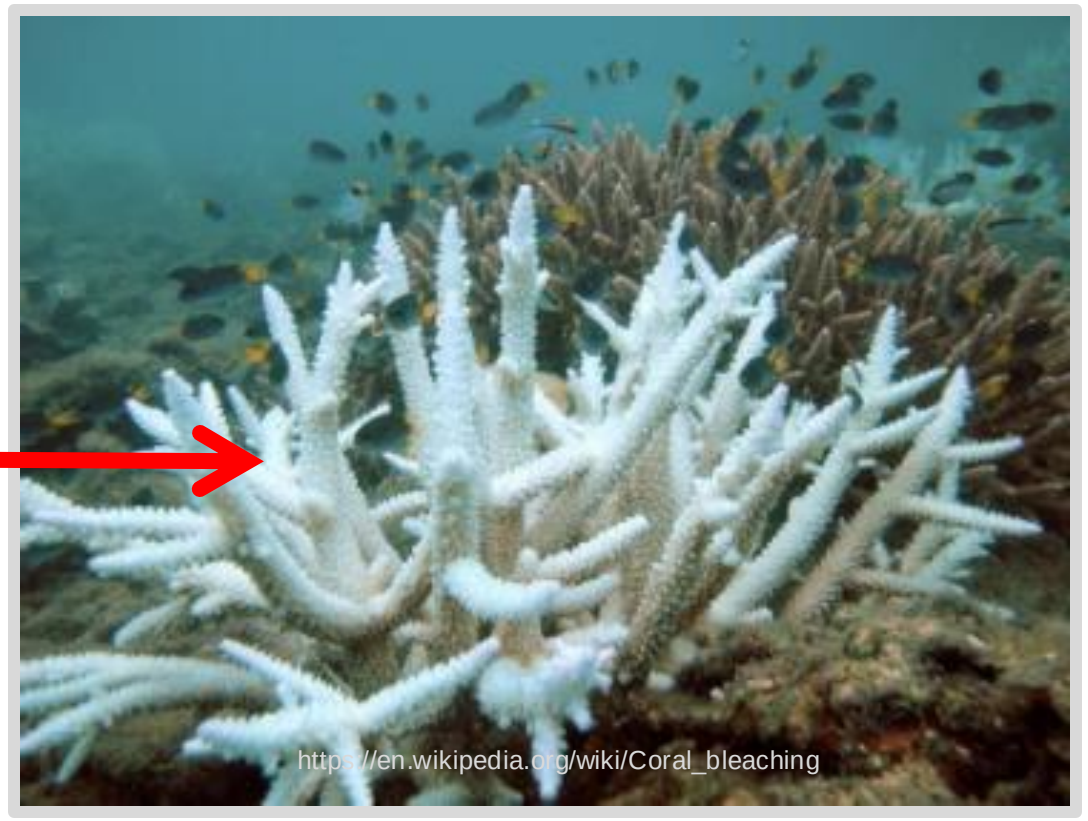
https://floridakeys.noaa.gov/corals/economy.html

Coral reefs protect shorelines by reducing wave energy by 97%.



Coral bleaching is a breakdown of symbiosis and loss of algae.

Healthy symbiosis

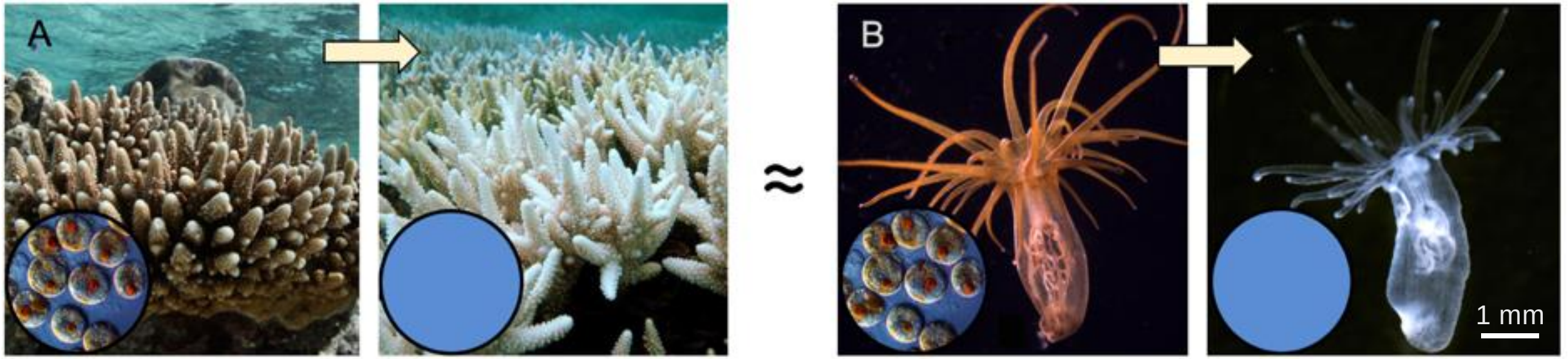


Symbiosis breakdown

Coral reefs are at crisis globally.

Understanding the biology of coral-algal symbiosis is essential for developing engineering strategies to save corals.

Aiptasia-Symbiodiniaceae is a model system to study coral-algal symbiosis.



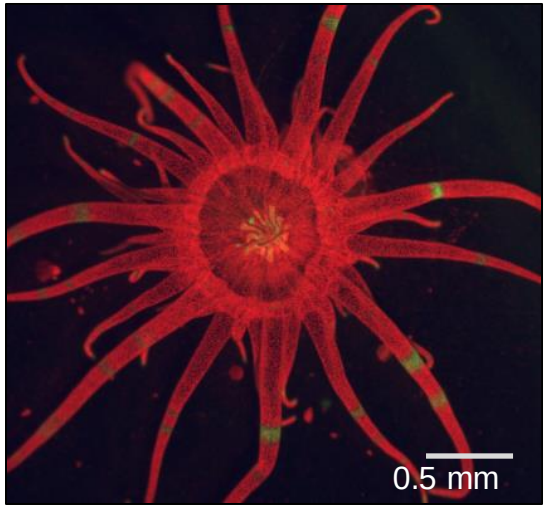
The small sea anemone Aiptasia spp.

- Cnidarian closely related to corals
- Easy to culture
- Similar or identical Symbiodiniaceae endosymbionts
- Similar bleaching

PMID: 18501991

Aiptasia-Symbiodiniaceae is a model system to study coral-algal symbiosis.

Symbiodinium + Aposymbiotic *Aiptasia* → Symbiotic *Aiptasia*

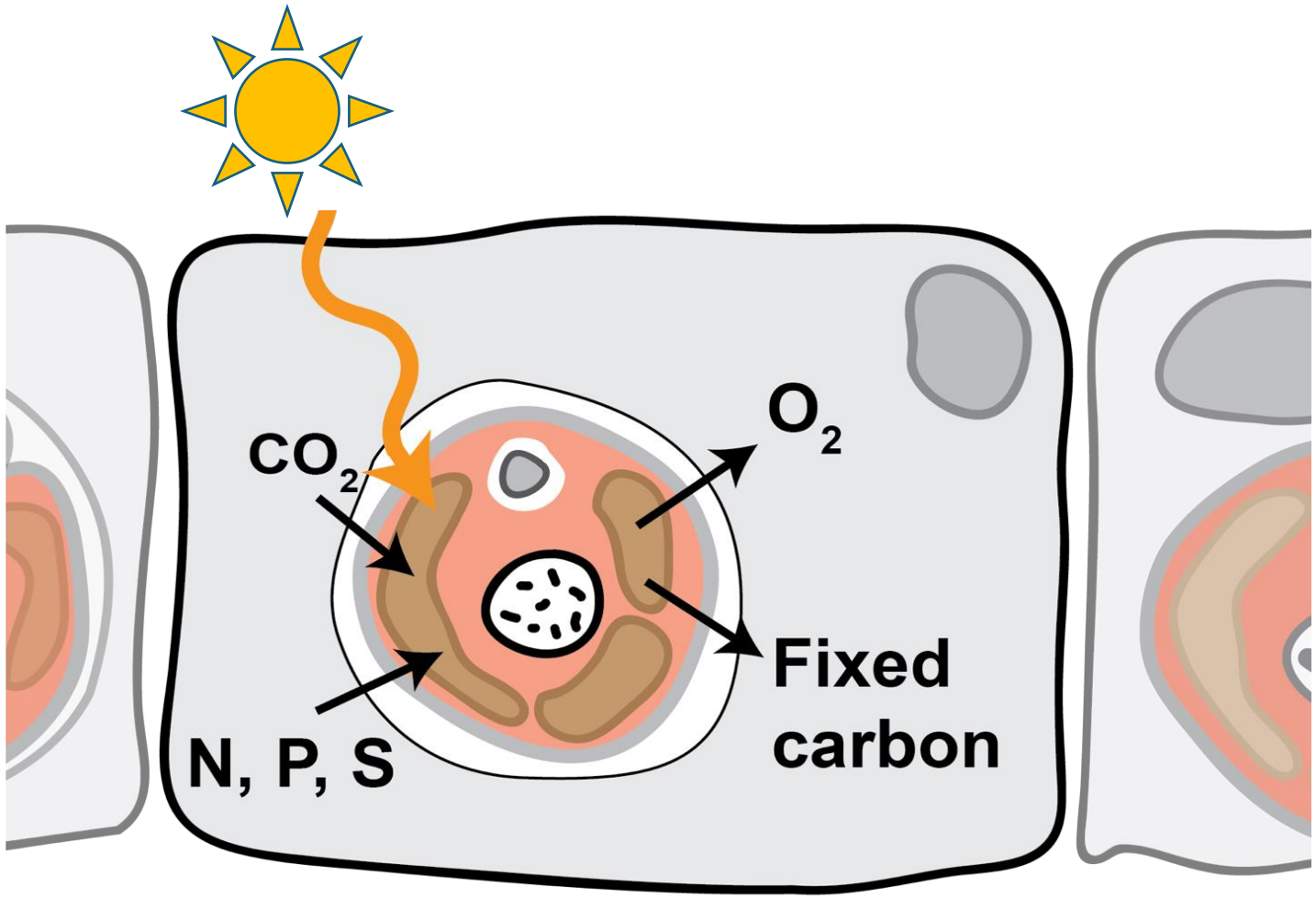


The small sea anemone Aiptasia spp.

- Can live without Symbiodiniaceae
- Can track symbiosis through algal fluorescence

PMID: 18501991
PMID: 27007034

Is photosynthesis required for symbiosis establishment?

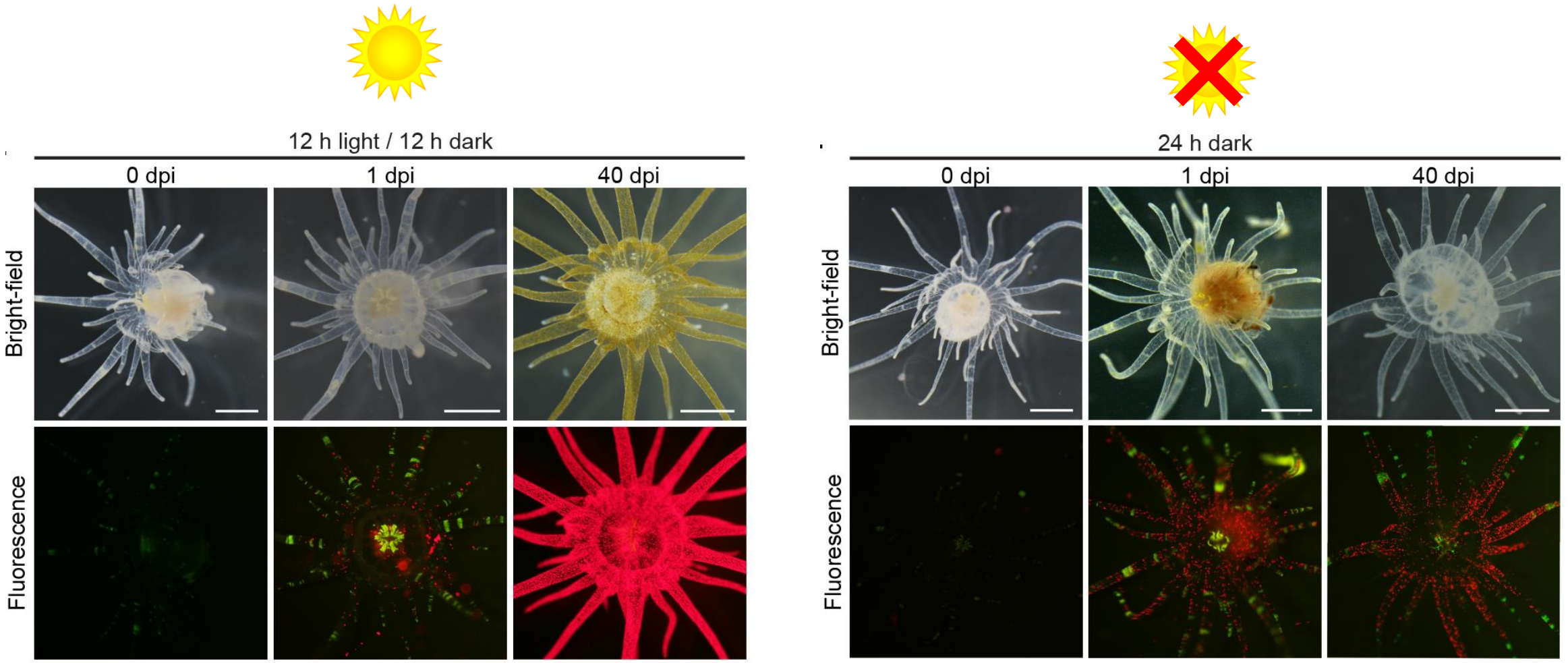


Is photosynthesis required for symbiosis establishment?

Two ways to address this question:

1. Can the symbiosis be established in the dark?

In the dark the algal cells can infect, but were not able to proliferate and increase their numbers.

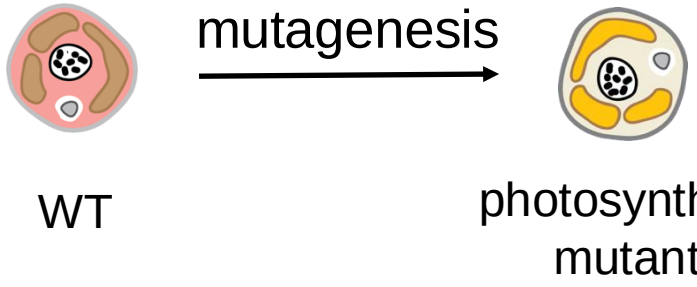


Is photosynthesis required for symbiosis establishment?

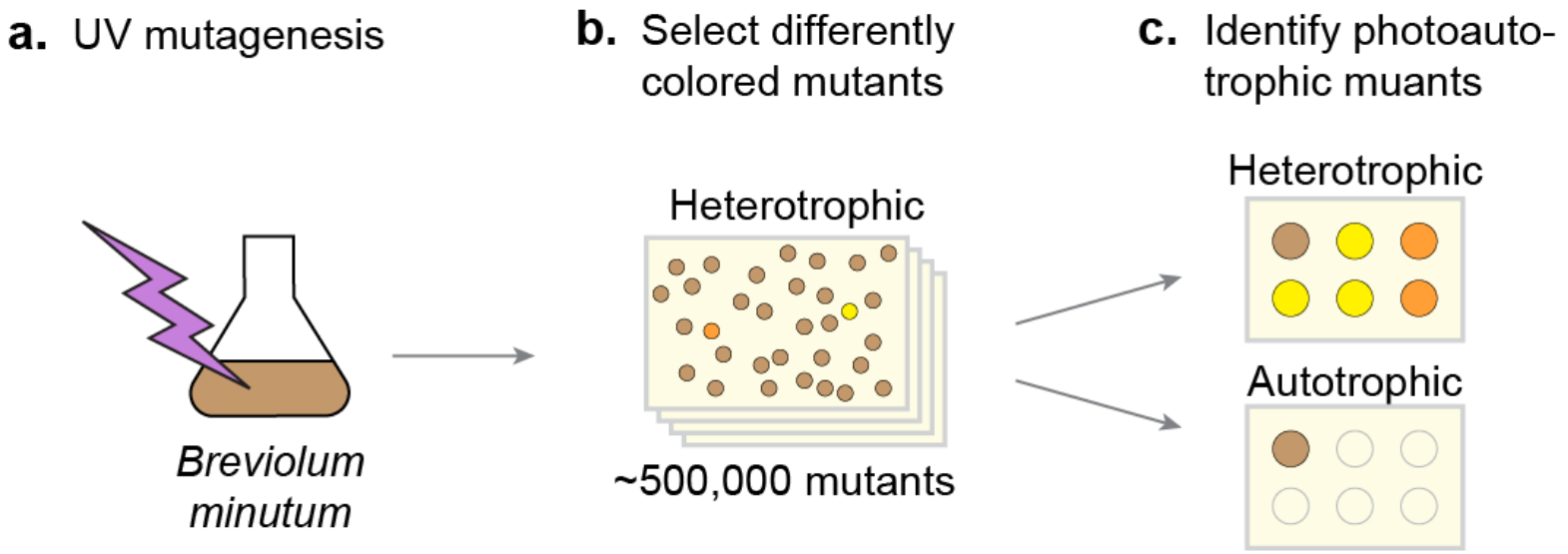
Two ways to address this question:

1. Can the symbiosis be established in the dark?

2. Can photosynthesis mutants infect and populate the host?



We have developed a pipeline to generate Symbiodiniaceae mutants.

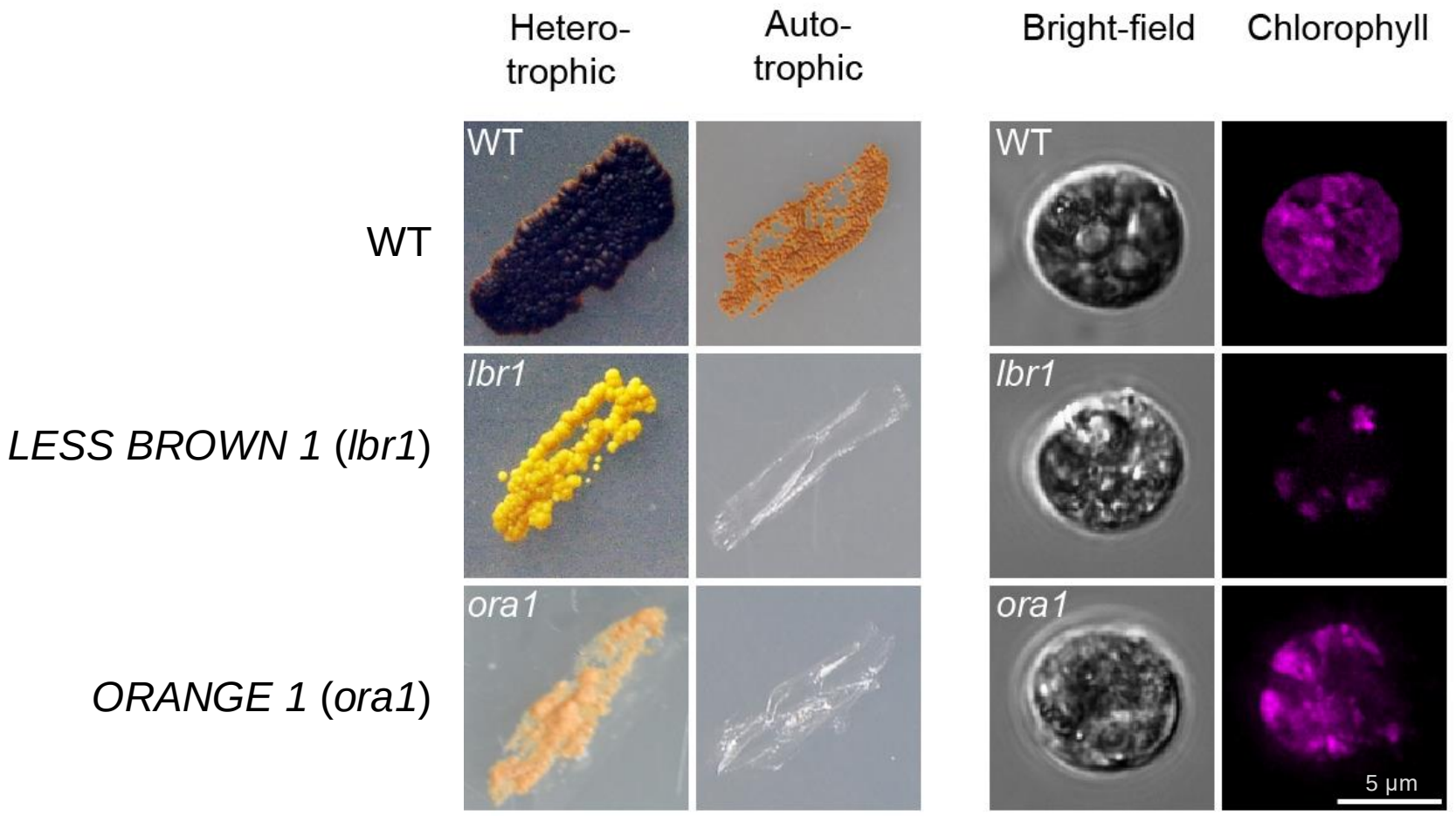


Dr. Robert Jinkerson

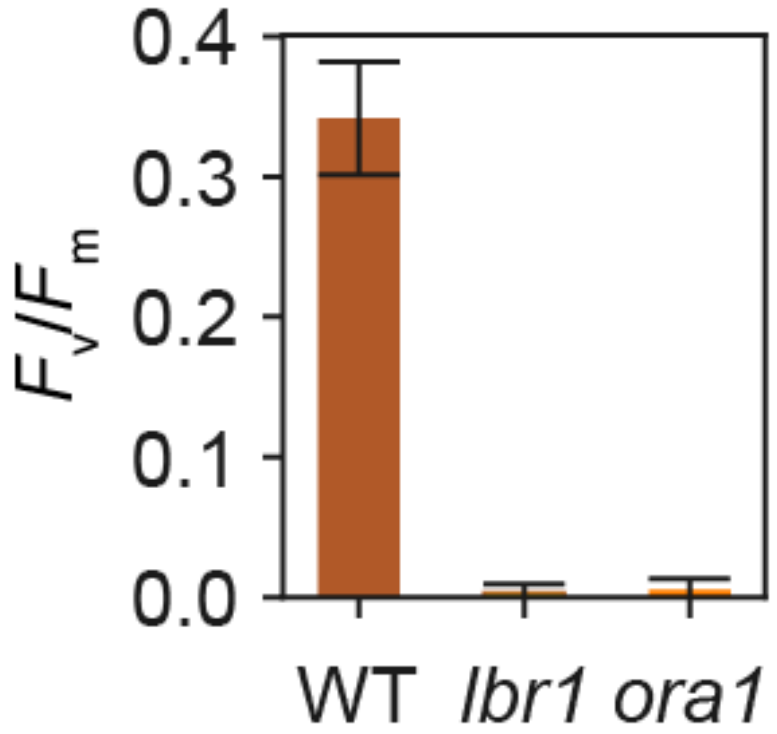
Joseph Russo

PMID: 35504283

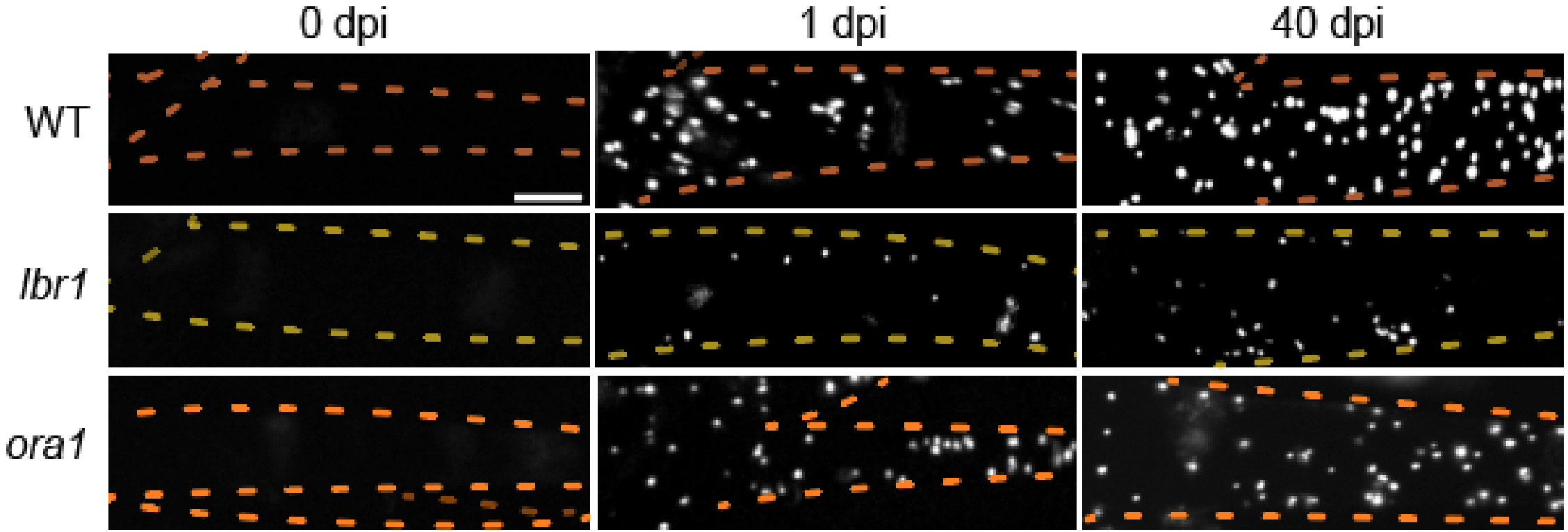
Breviolum minutum SSB01 photosynthesis mutants were generated.



The photosynthesis mutants were confirmed deficient of photosynthetic function.

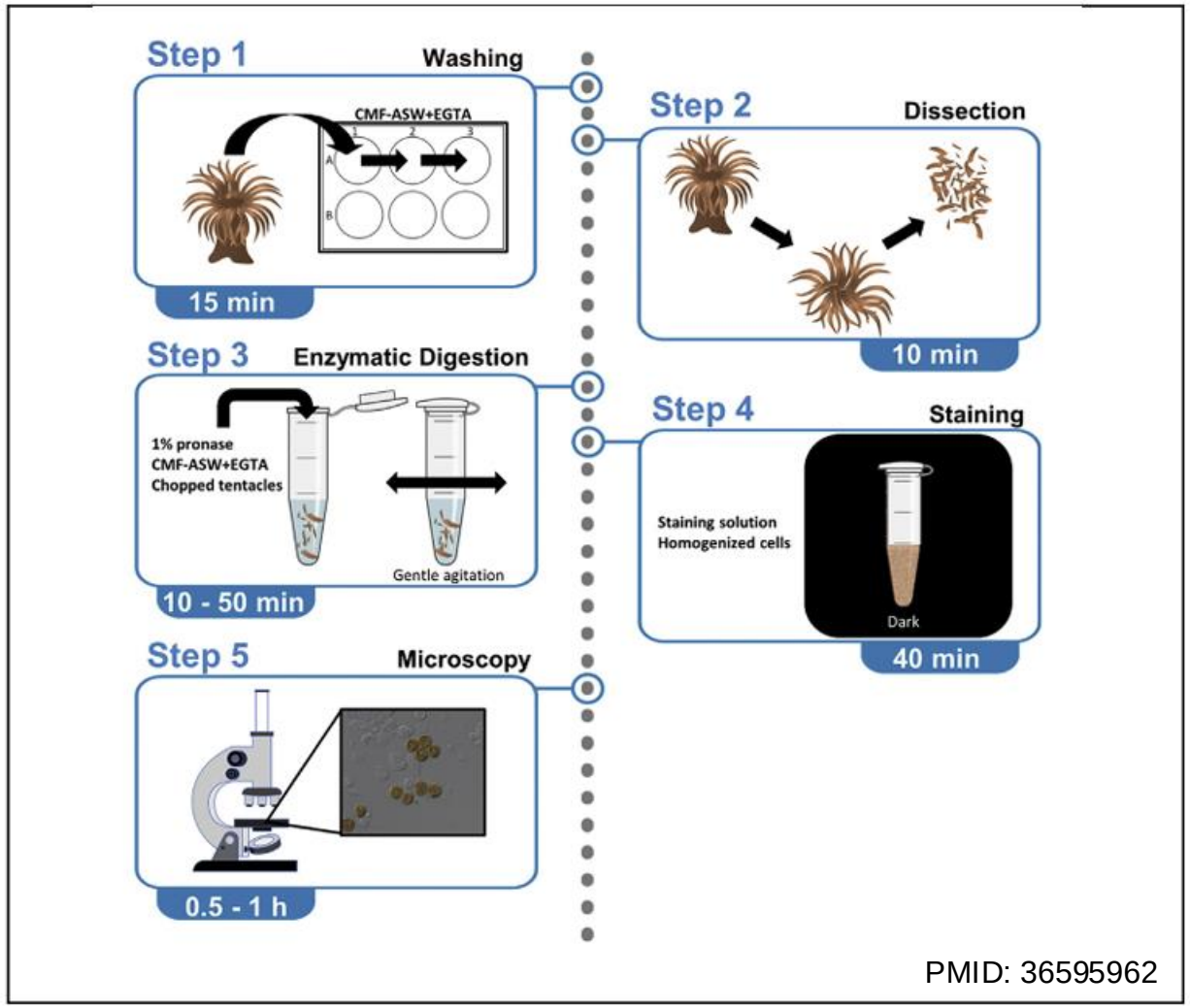


SSB01 photosynthesis mutants can infect Aiptasia.



Protocol

Single-cell dissociation of the model cnidarian sea anemone *Exaiptasia diaphana*



PMID: 36595962

Andrea L. Kirk,
Tingting Xiang

akirk11@uncc.edu (A.L.K.)
txiang@engr.ucr.edu (T.X.)

Highlights

Procedure for an efficient dissociation of sea anemone and coral tissue

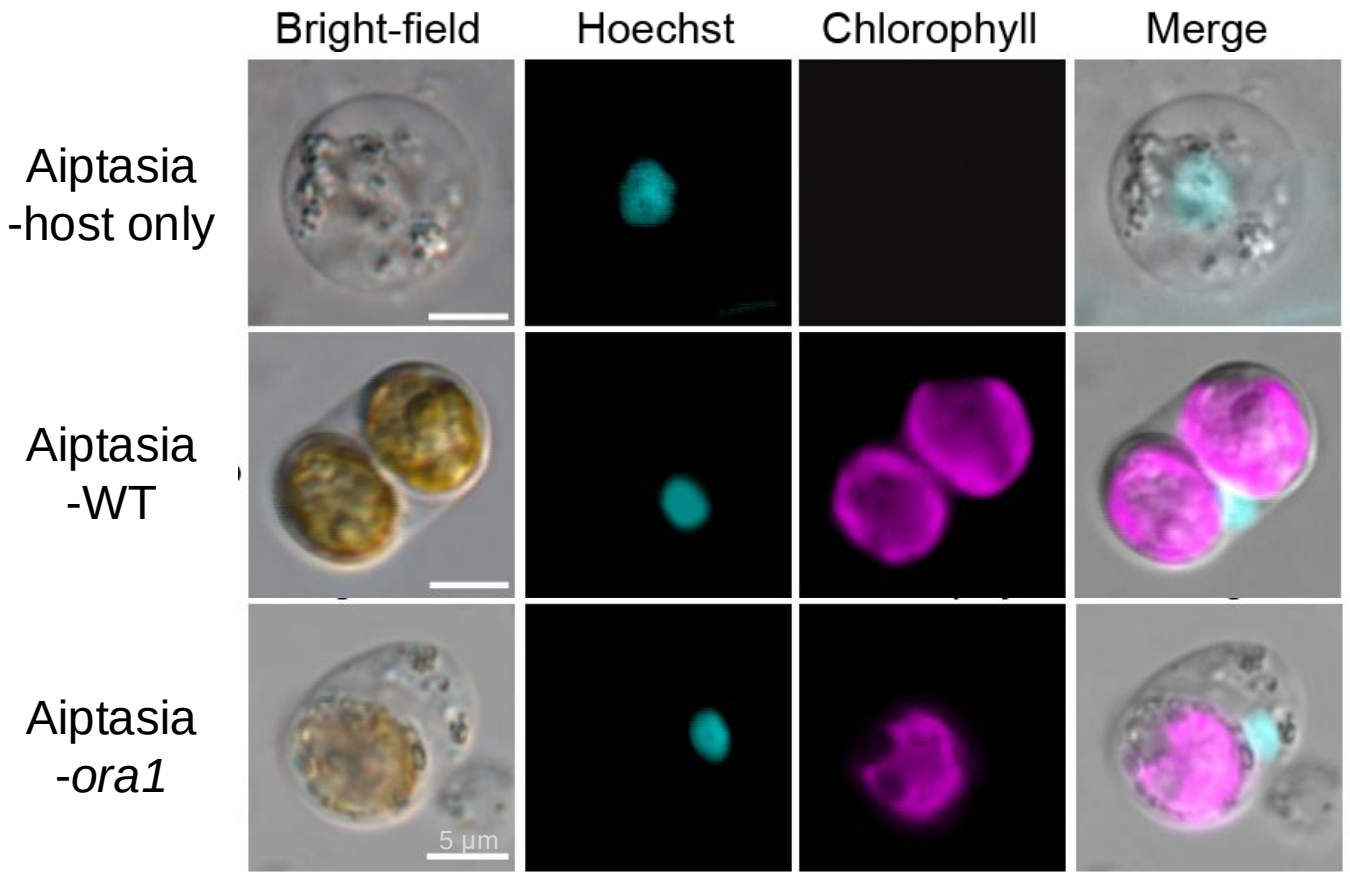
A linear model depicting the correlation between dissociation time and tentacle mass

Isolation of a single-cell suspension containing intact Aiptasia host cells

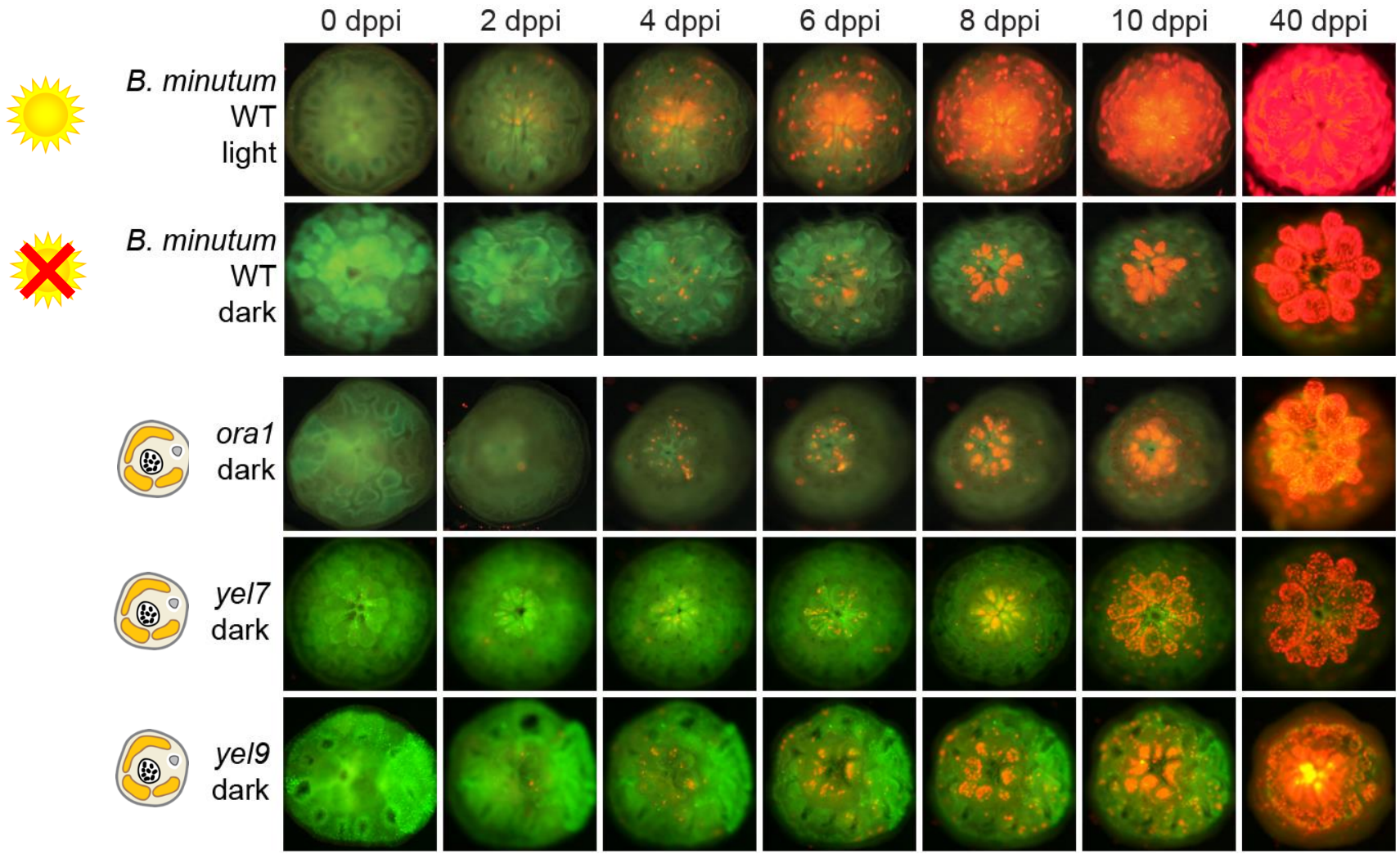
Protocol for fluorescent staining and microscopy of

Andrea Kirk

The photosynthesis mutant cells are maintained intracellularly without photosynthesis.

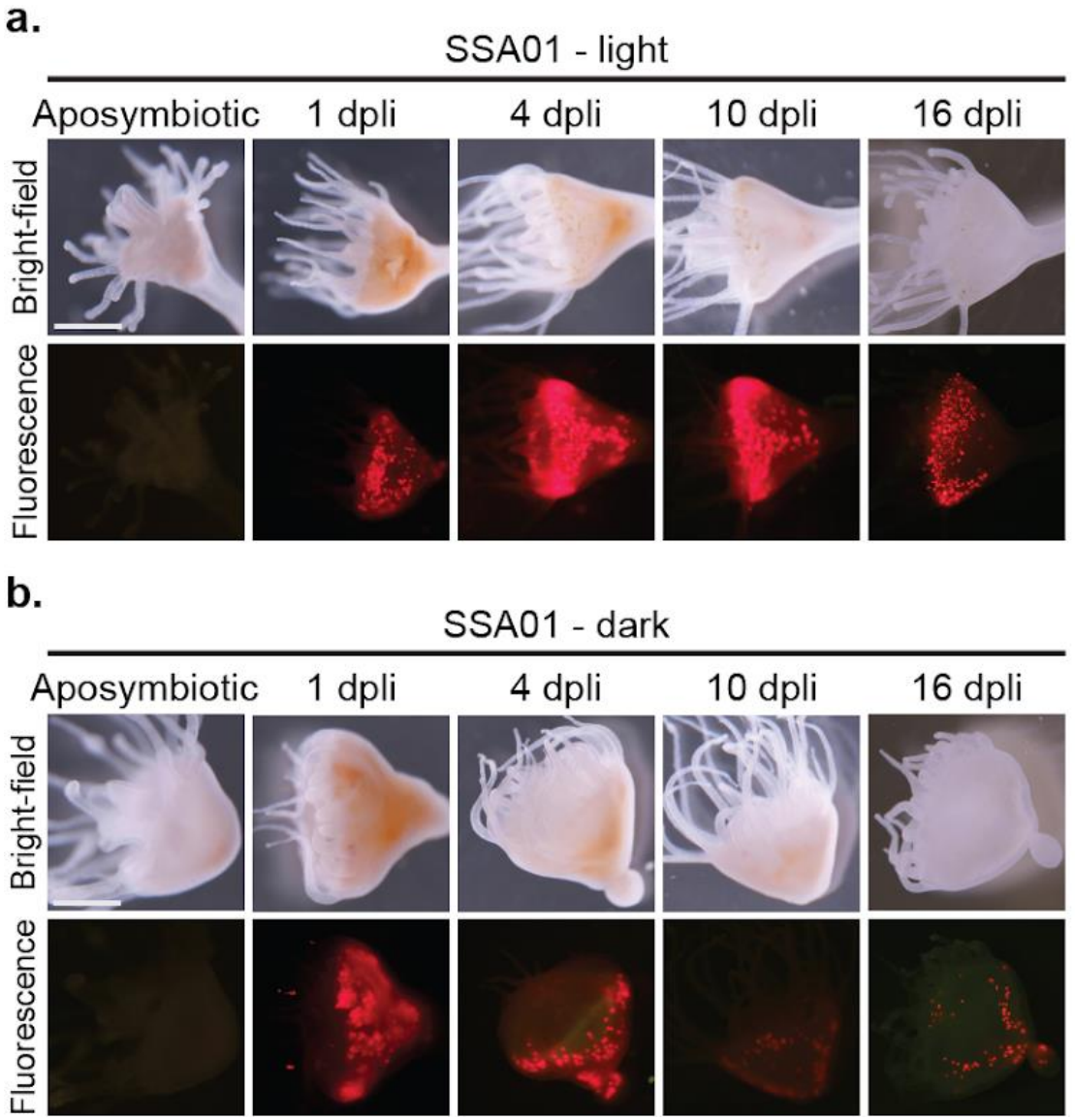


Symbiodiniaceae infect, proliferate, and maintain within coral polyps without photosynthesis.



Dr. Masayuki Hatta
Ochanomizu University

Symbiont infection occurs without photosynthesis in the jellyfish *Cassiopea xamachana*.



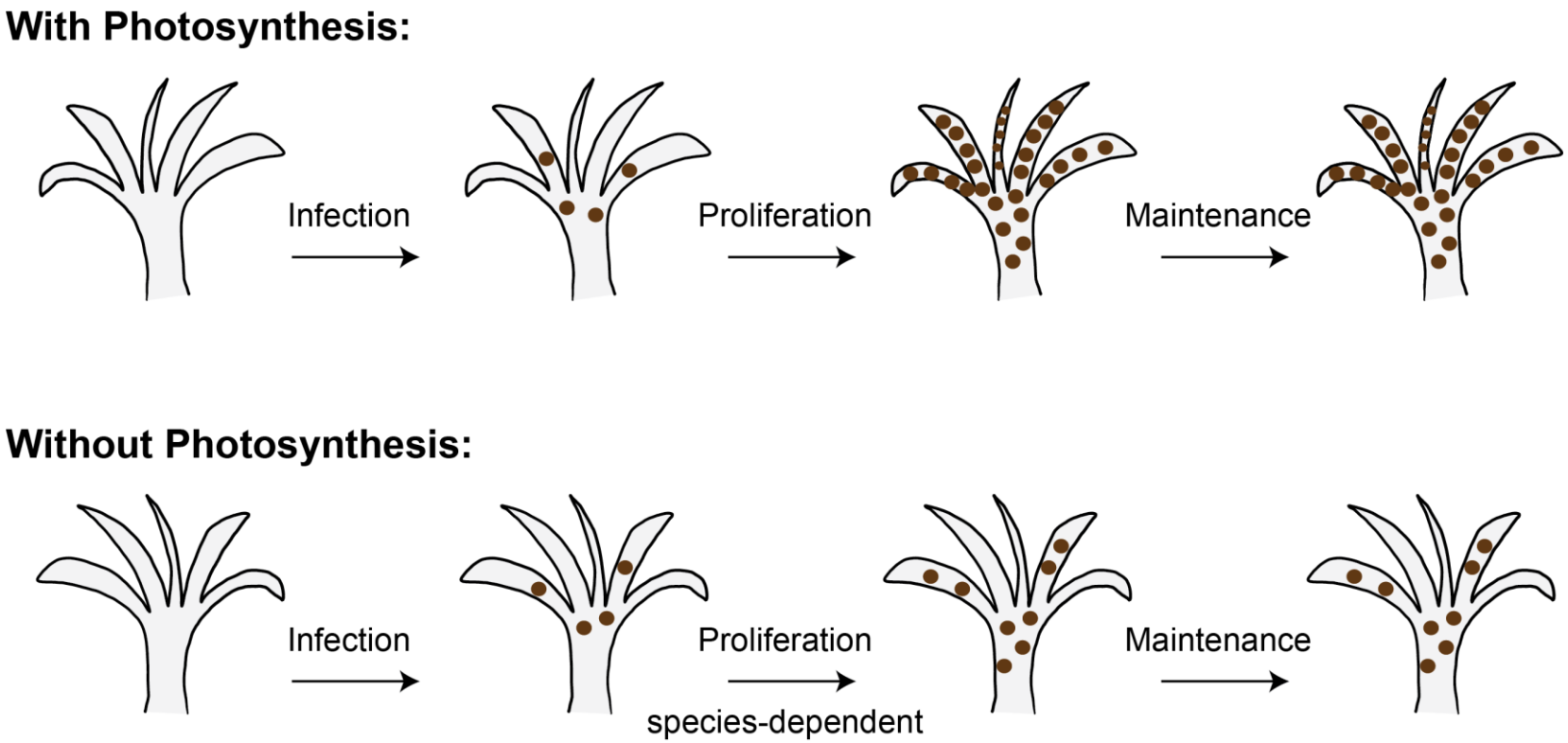
Dr. Mark Martindale
University of Florida

Dr. Casandra Newkirk

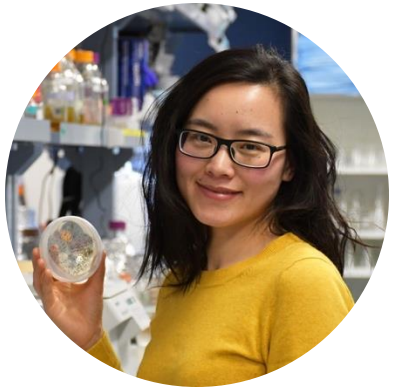
Summary and Model

1) Photosynthesis is **NOT** required for Symbiodiniaceae to infect Aiptasia, coral, or Cassiopea.

•Evidence: Infection proceeds independent of photosynthesis in all cnidarian-Symbiodiniaceae relationships evaluated.



Xiang Lab Team



Tingting Xiang
Principal Investigator

Casandra Newkirk
NSF Postdoc Fellow

Andrea Kirk
PhD Student

Stephanie Peak
Visiting PhD Student

Eric Huitt
PhD student

Amy Do
MS student

Tori Stoenner
Undergraduate

Sarrah Furniturewala
Undergraduate

Acknowledgments

Xiang Lab
Andrea Kirk
Casandra Newkirk

Carnegie Institution
Arthur Grossman

Greenleaf Lab
Georgi Marinov
Alexandro Trevino

Pringle Lab
John Pringle

University of Florida
Mark Martindale

Ochanomizu University
Masayuki Hatta

University of Miami
Andrew Baker
Emily Yeager

Jinkerson Lab at UCR
Robert Jinkerson
Joseph Russo

University of Guam
Christopher Lobban

University of Copenhagen
Johan Andersen-Ranberg
Daniel Poveda

Funding