Ocean warming and marine heatwaves: Will these make temperate macroalgae increasingly vulnerable to tropical herbivores?

Presented by Louise Castro
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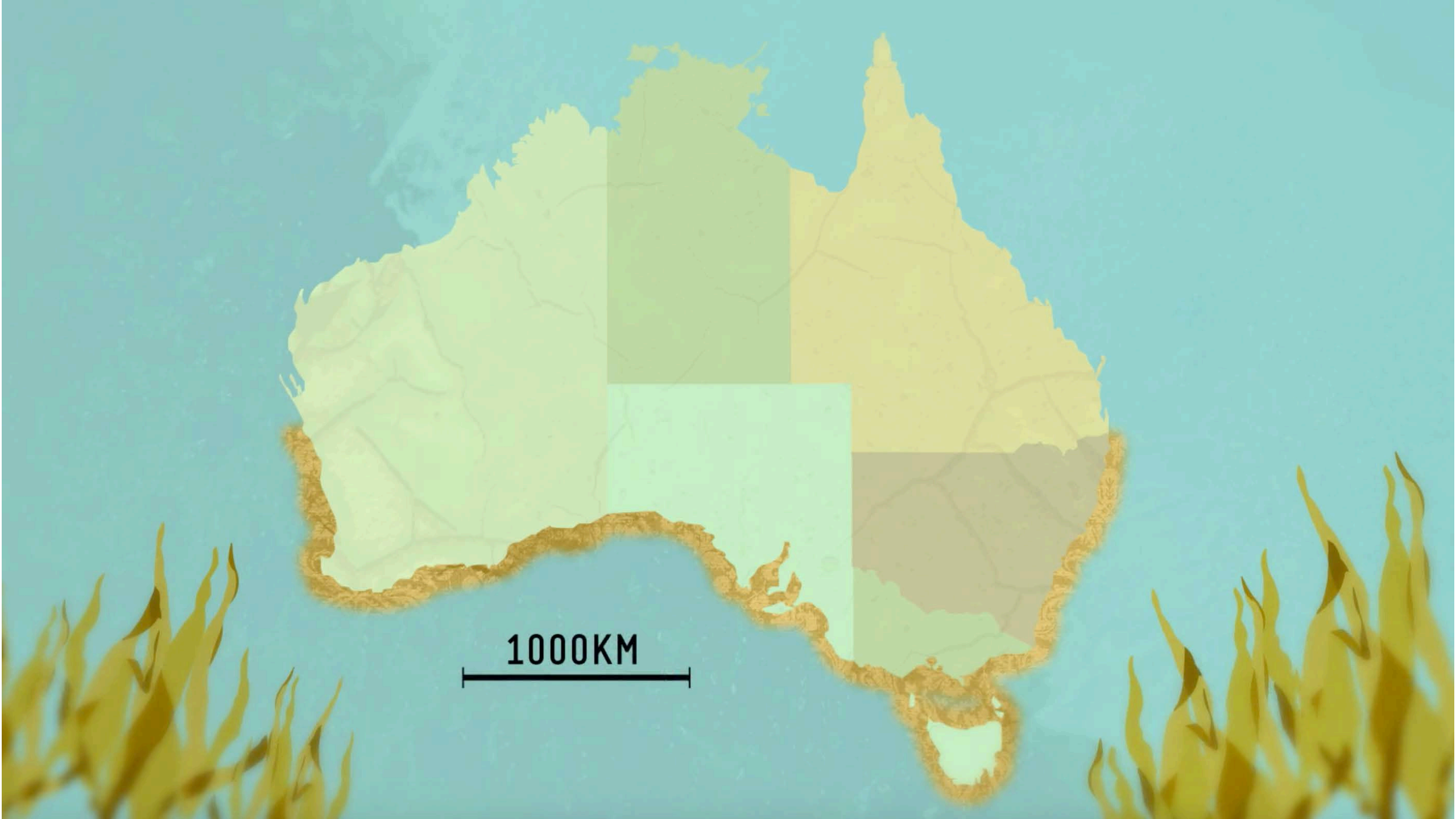
1000KM

SPECIAL ISSUE

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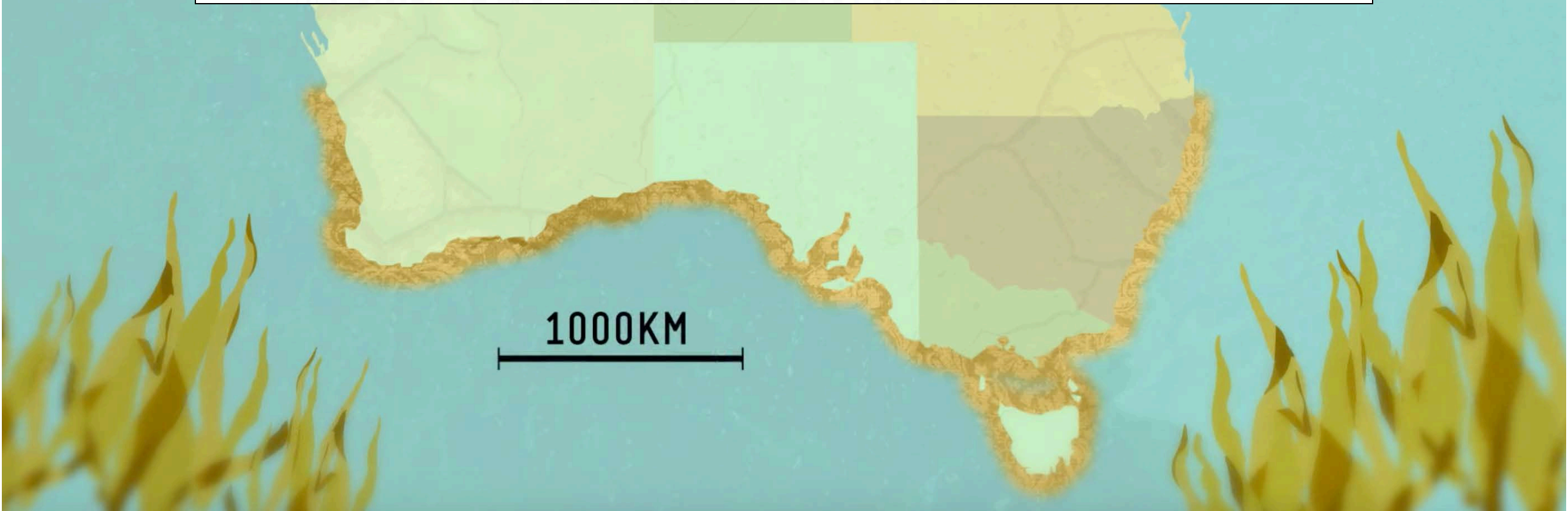
The 'Great Southern Reef': social, ecological and economic value of Australia's neglected kelp forests

Scott Bennett[A,B,I], Thomas Wernberg[A], Sean D. Connell[C, D], Alistair J. Hobday[E], Craig R. Johnson[F] and Elvira S. Poloczanska[G,H]



Dominant species: *Ecklonia radiata*

Image credit: John Turnbull

AUD $500 million

Rock Lobster

Abalone

2010-2011 Marine Heatwave

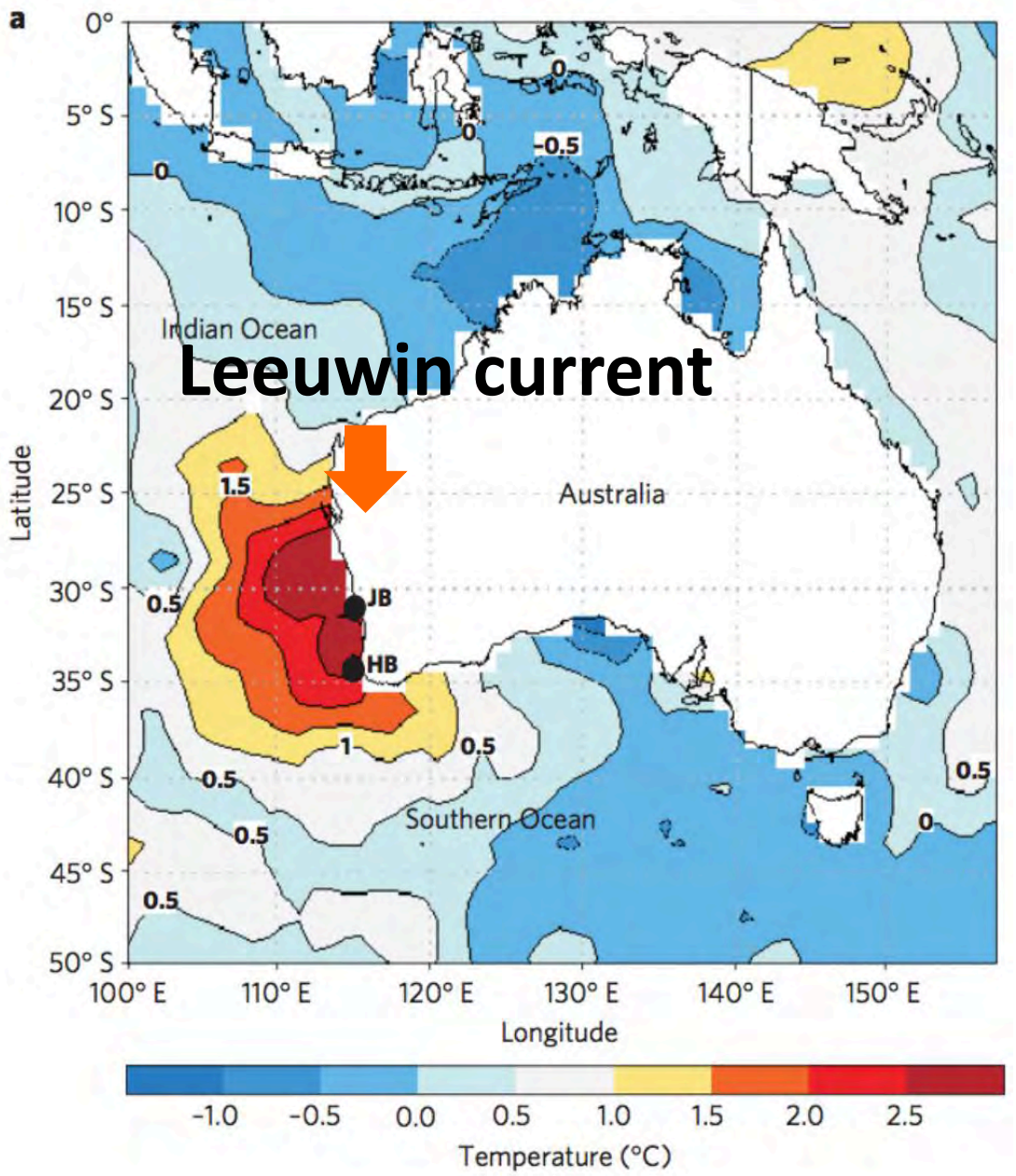


Figure adapted from Wernberg *et al*. 2012

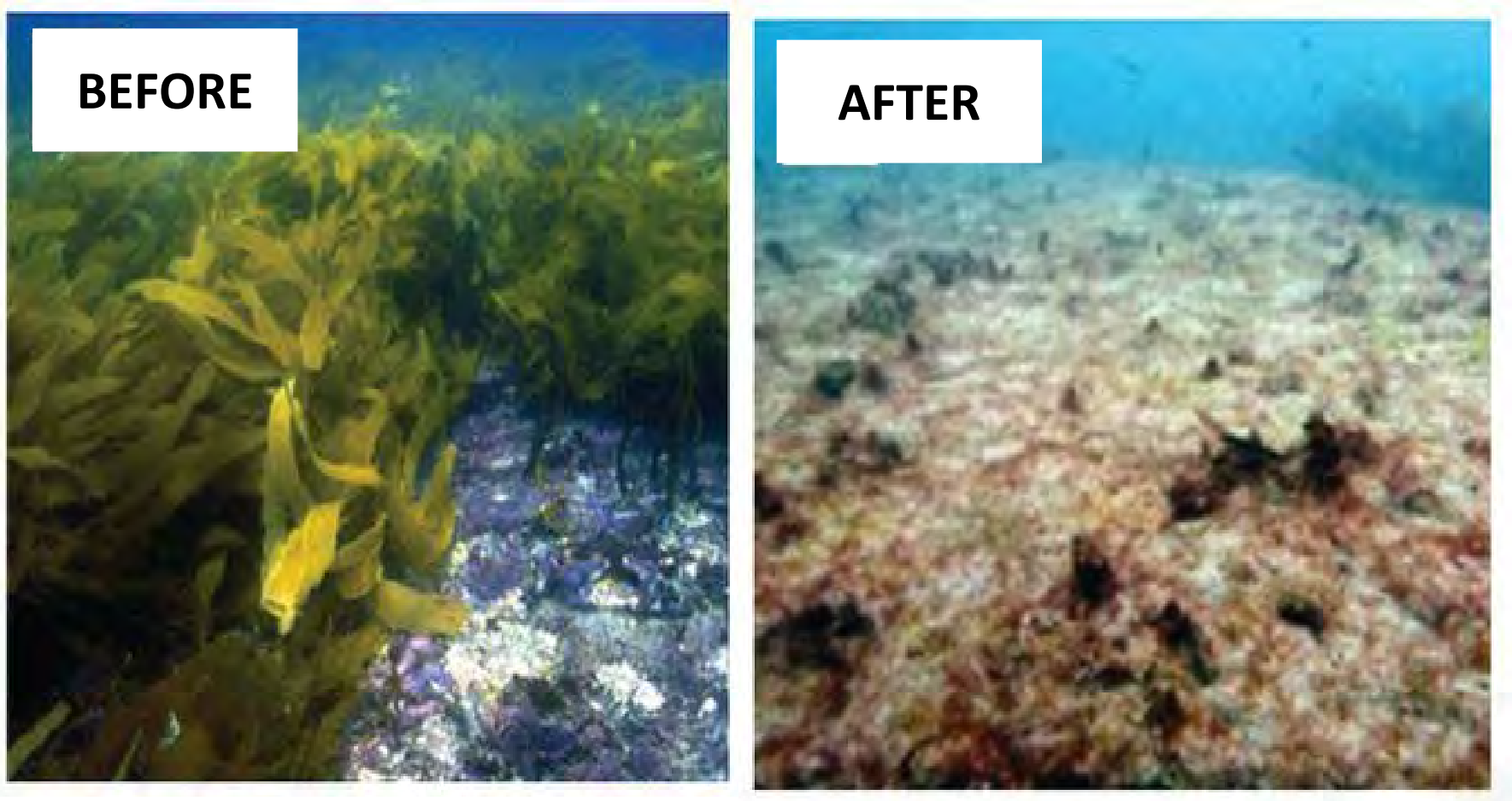


Figure adapted from Wernberg *et al*. 2016

Image credit: John Turnbull

Tropicalization

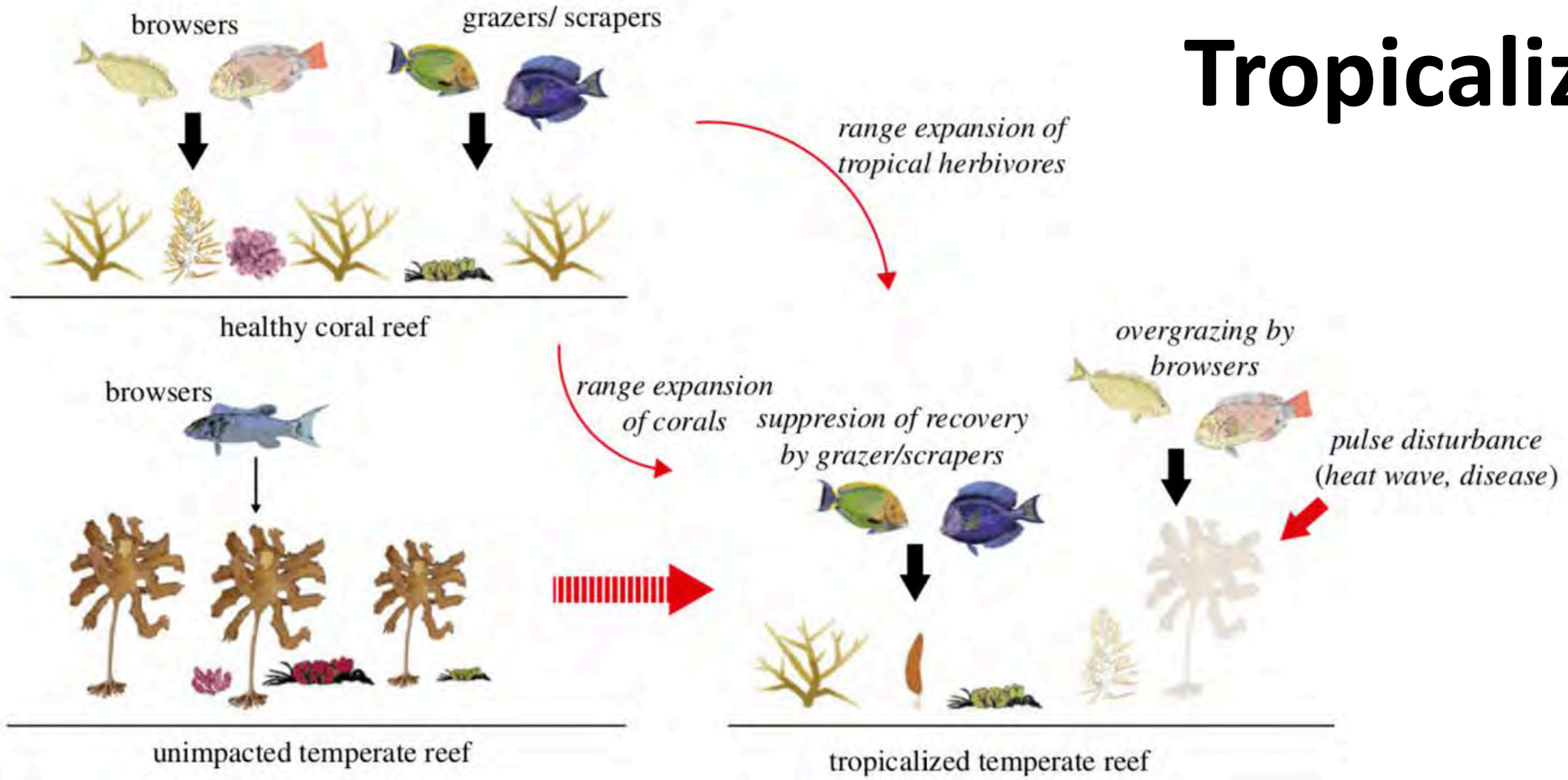


Figure from Vergés *et al.* 2014

Image credit: John Turnbull

Tropicalization

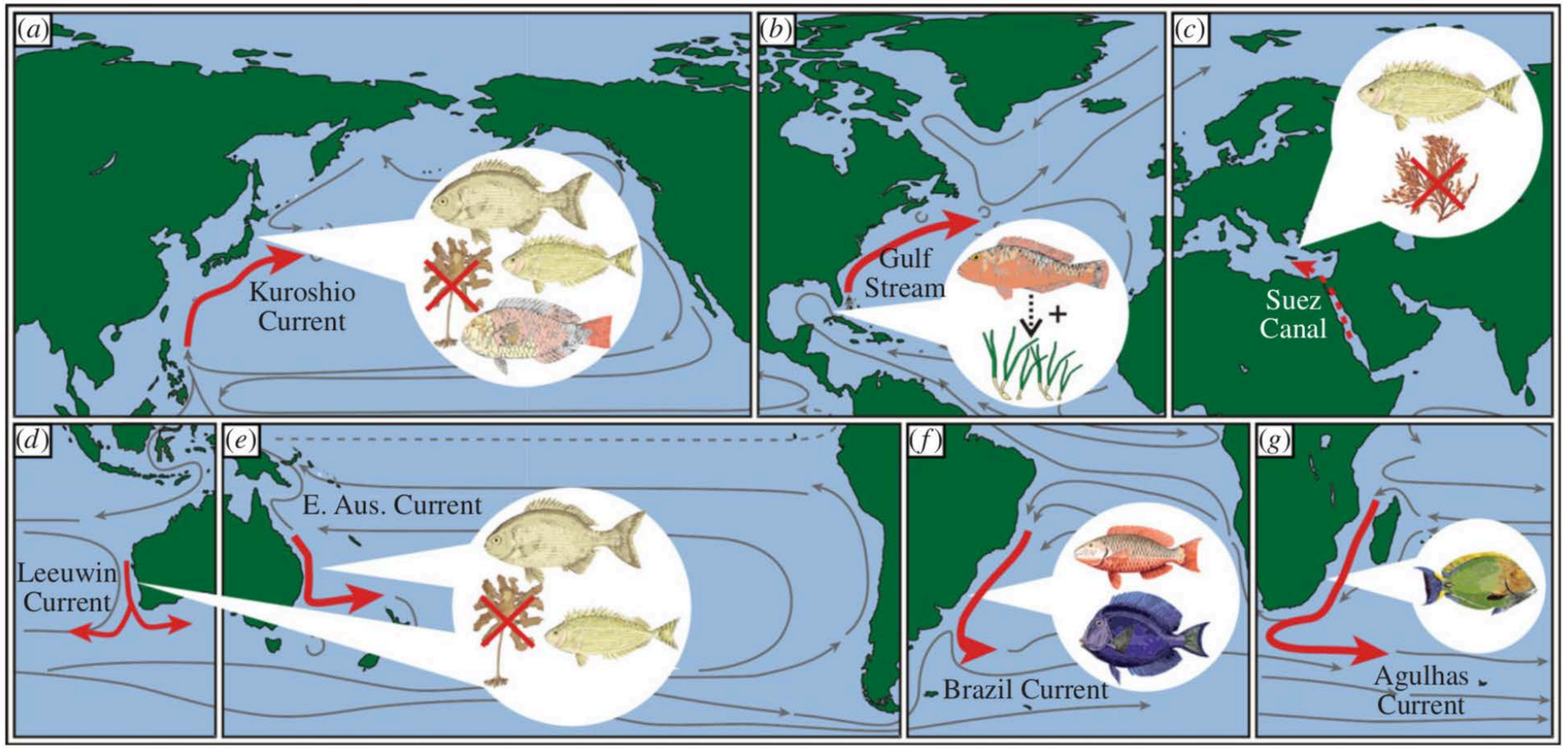


Figure from Vergés *et al.* 2014

Image credit: John Turnbull

Over-grazing from sea urchins

BEFORE **AFTER**

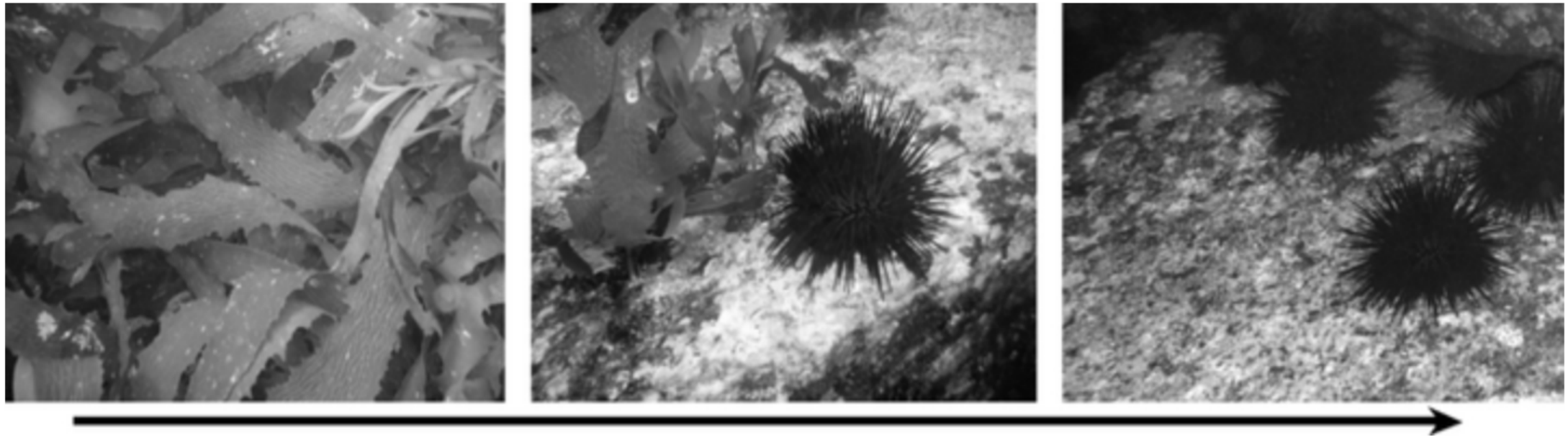


Figure from Banks *et al.* 2010

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Why do we care about microbes?

Image credit: : “Bacteria isolated from the root system of a poplar tree.” by flickr user Oak Ridge National Laboratory under CC BY 2.0

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Why do we care about microbes?

HOLOBIONT

Image credit: : “Bacteria isolated from the root system of a poplar tree.” by flickr user Oak Ridge National Laboratory under CC BY 2.0

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Research Questions

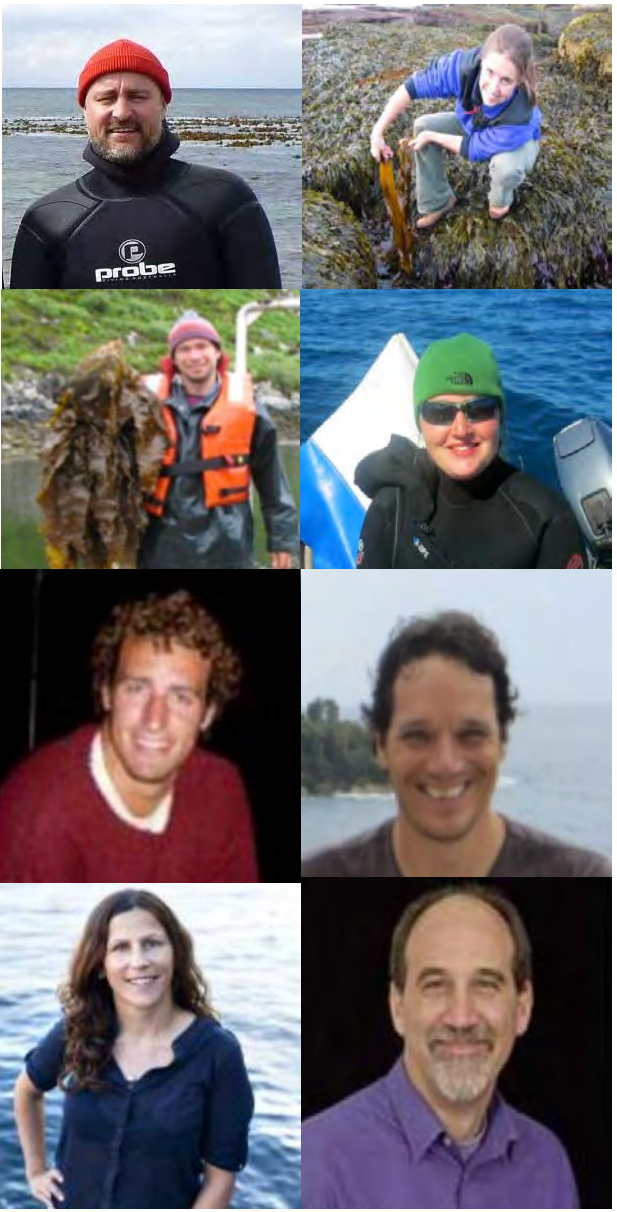
How do marine heatwaves and warmer ocean temperatures:

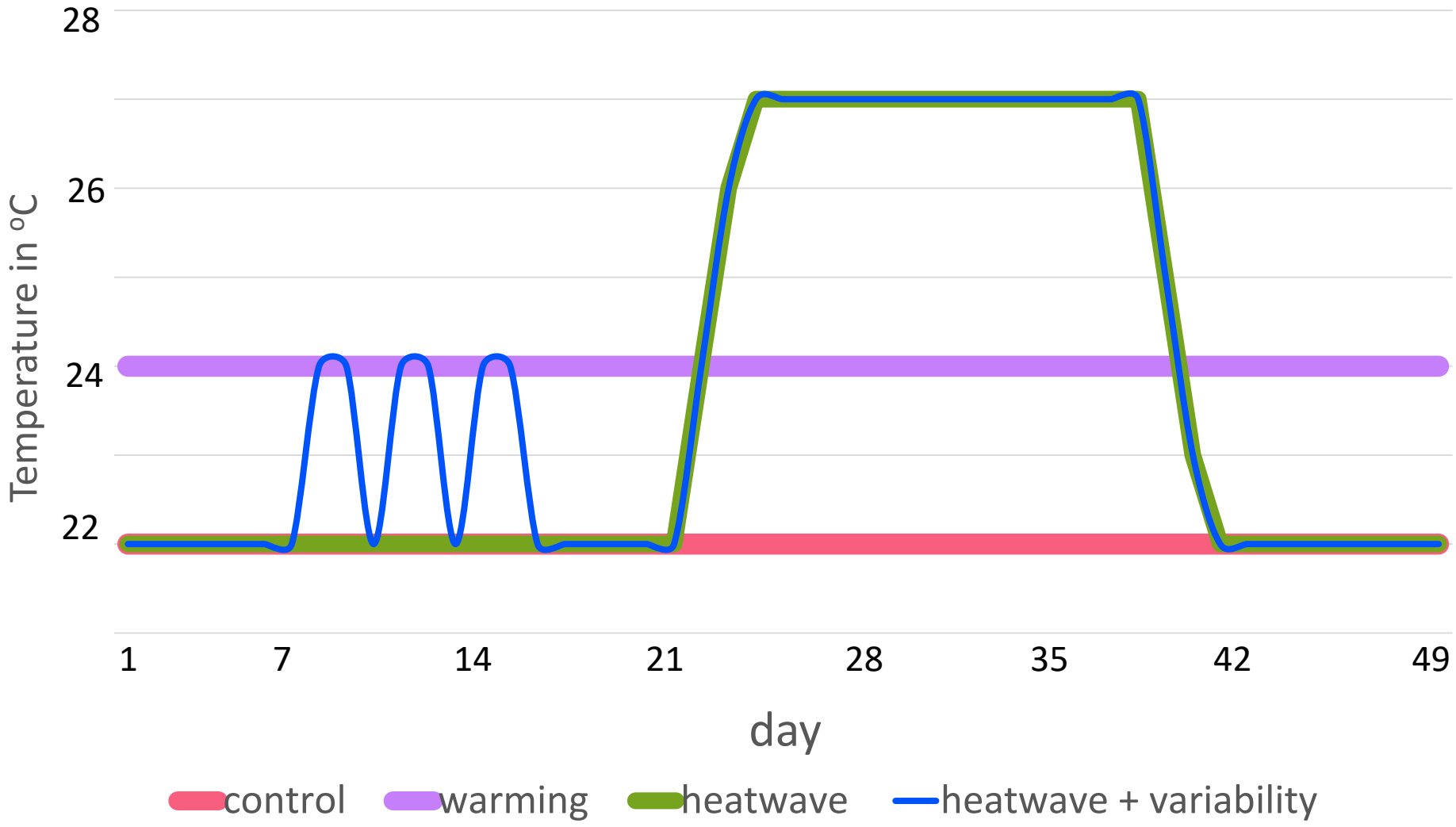
1. affect grazing?
2. impact the microbiome?

Ecklonia radiata

Sargassum linearifolium

Tripneustes gratilla



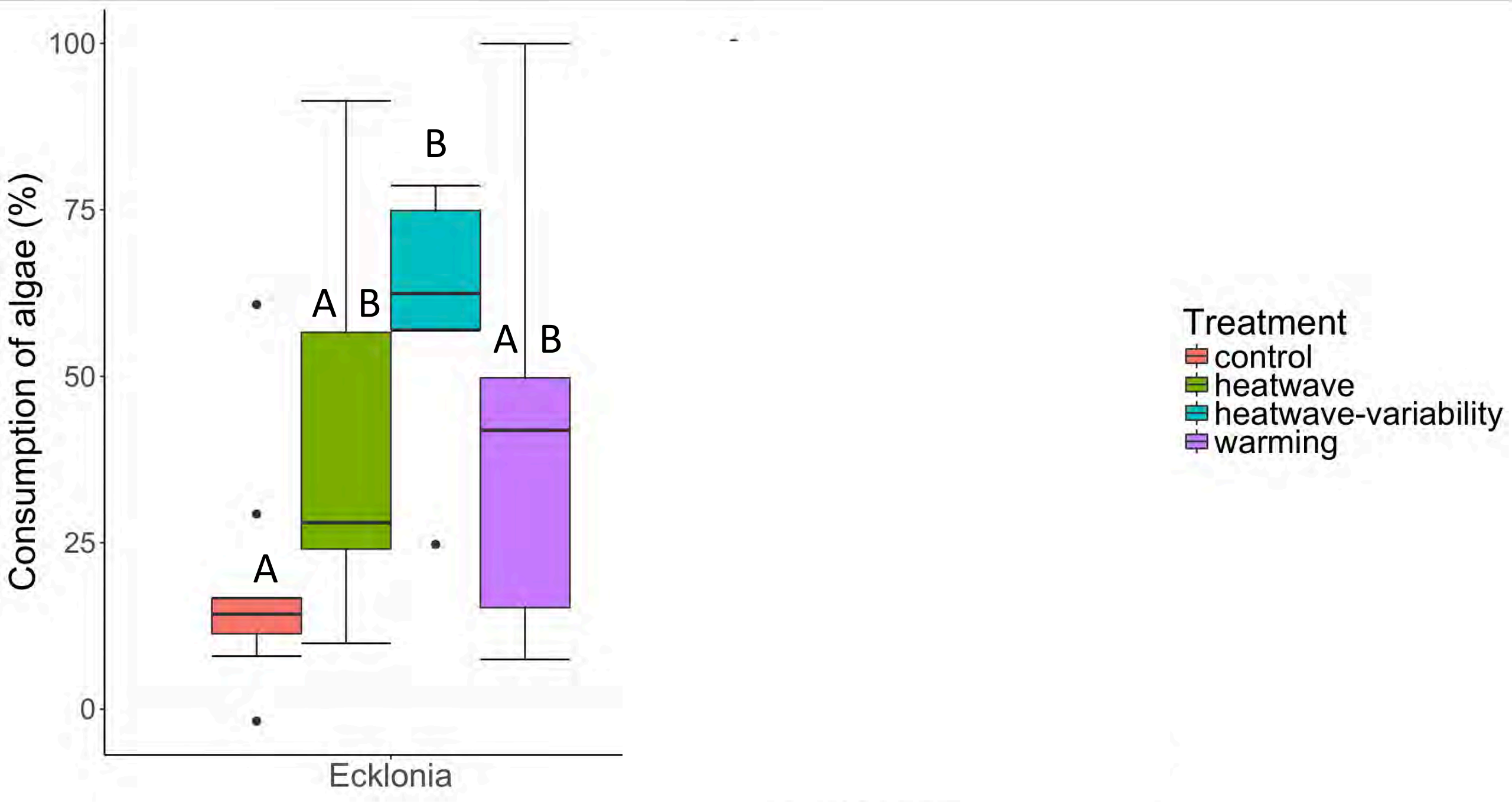

28
26
24
22
Temperature in °C
1
7
14
21
28
35
42
49
day
control
warming
heatwave
heatwave + variability

Experimental set-up

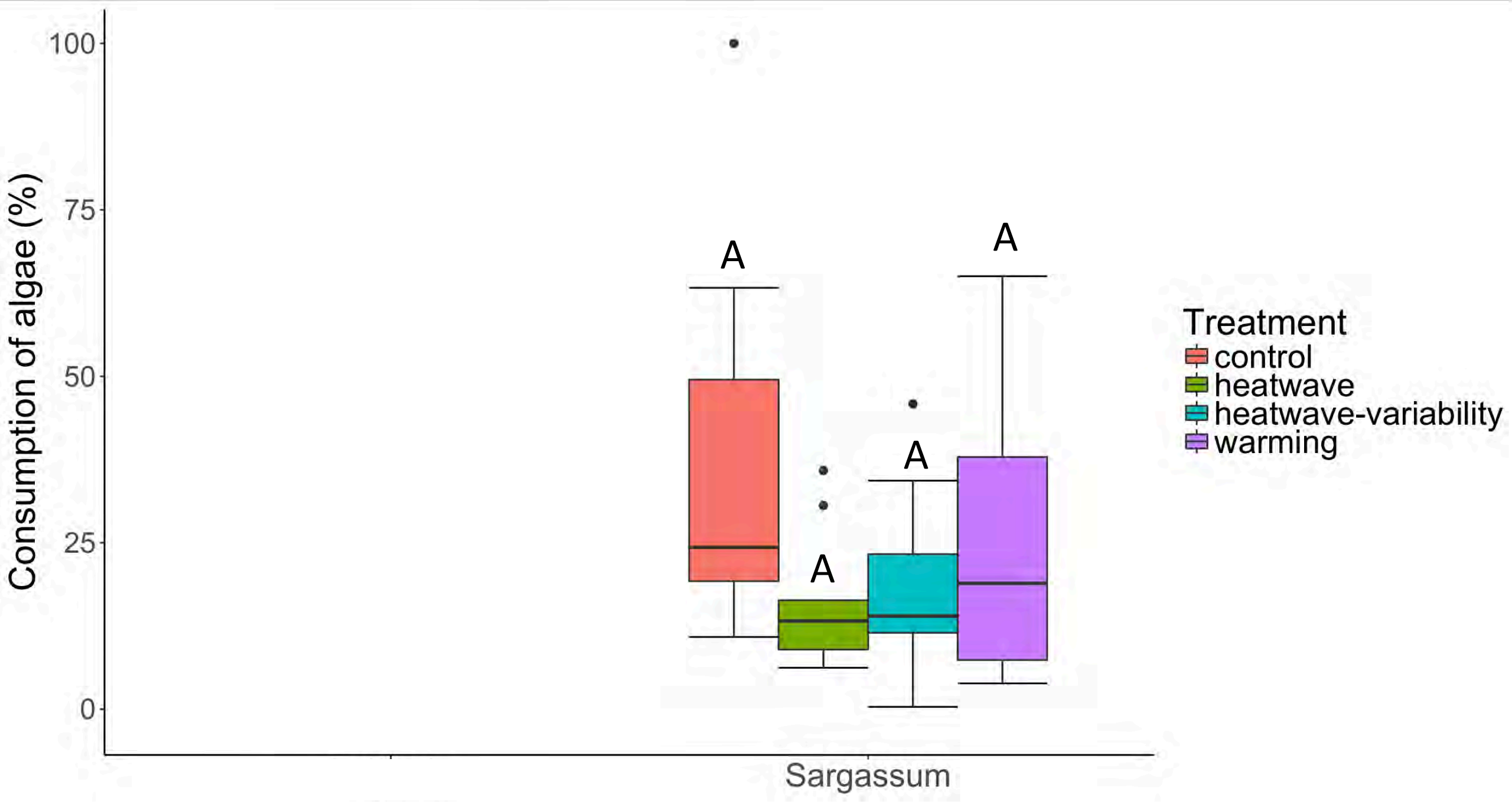
Temperature treatments

Feeding assays

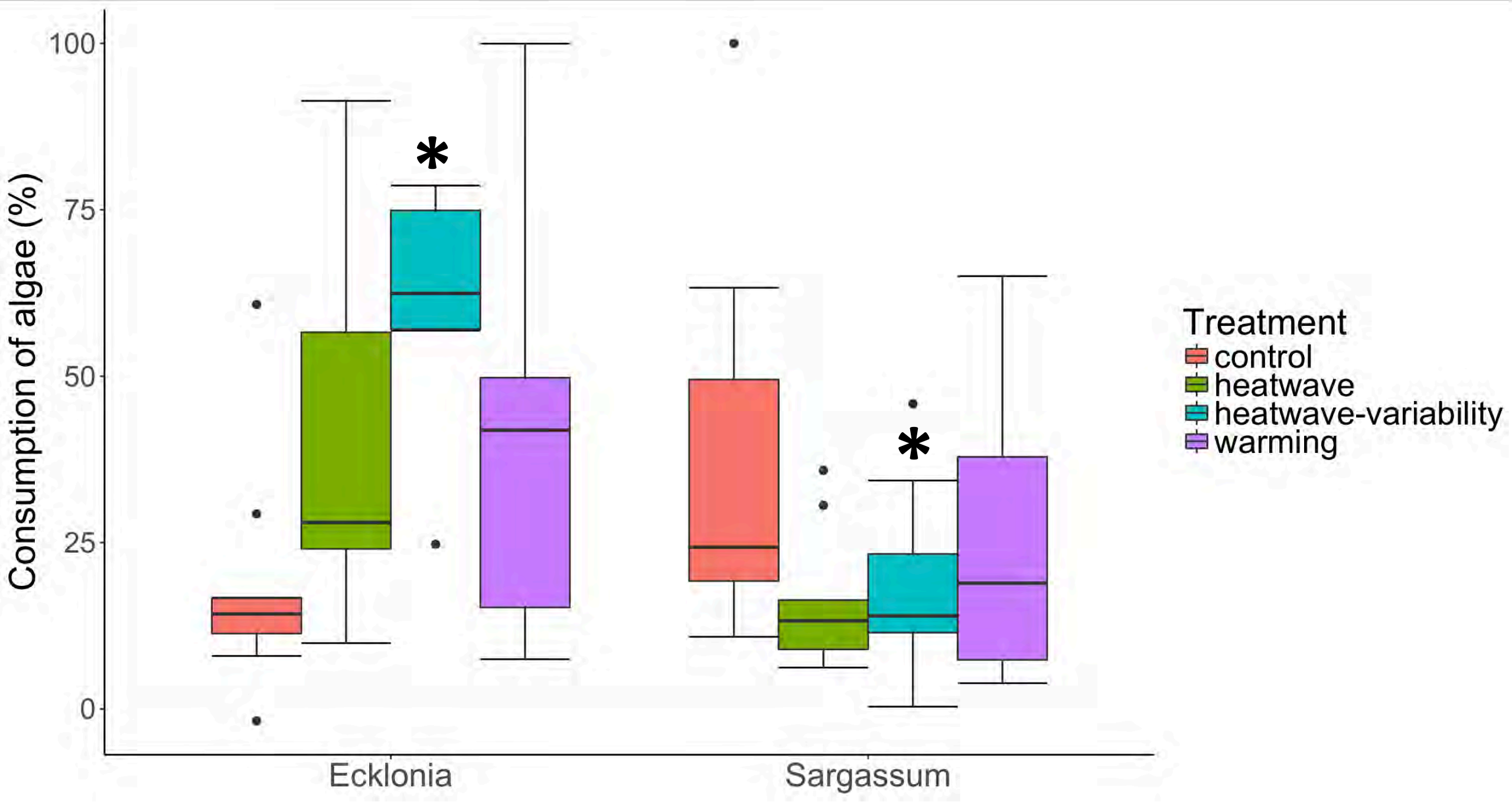
Image credit: John Turnbull



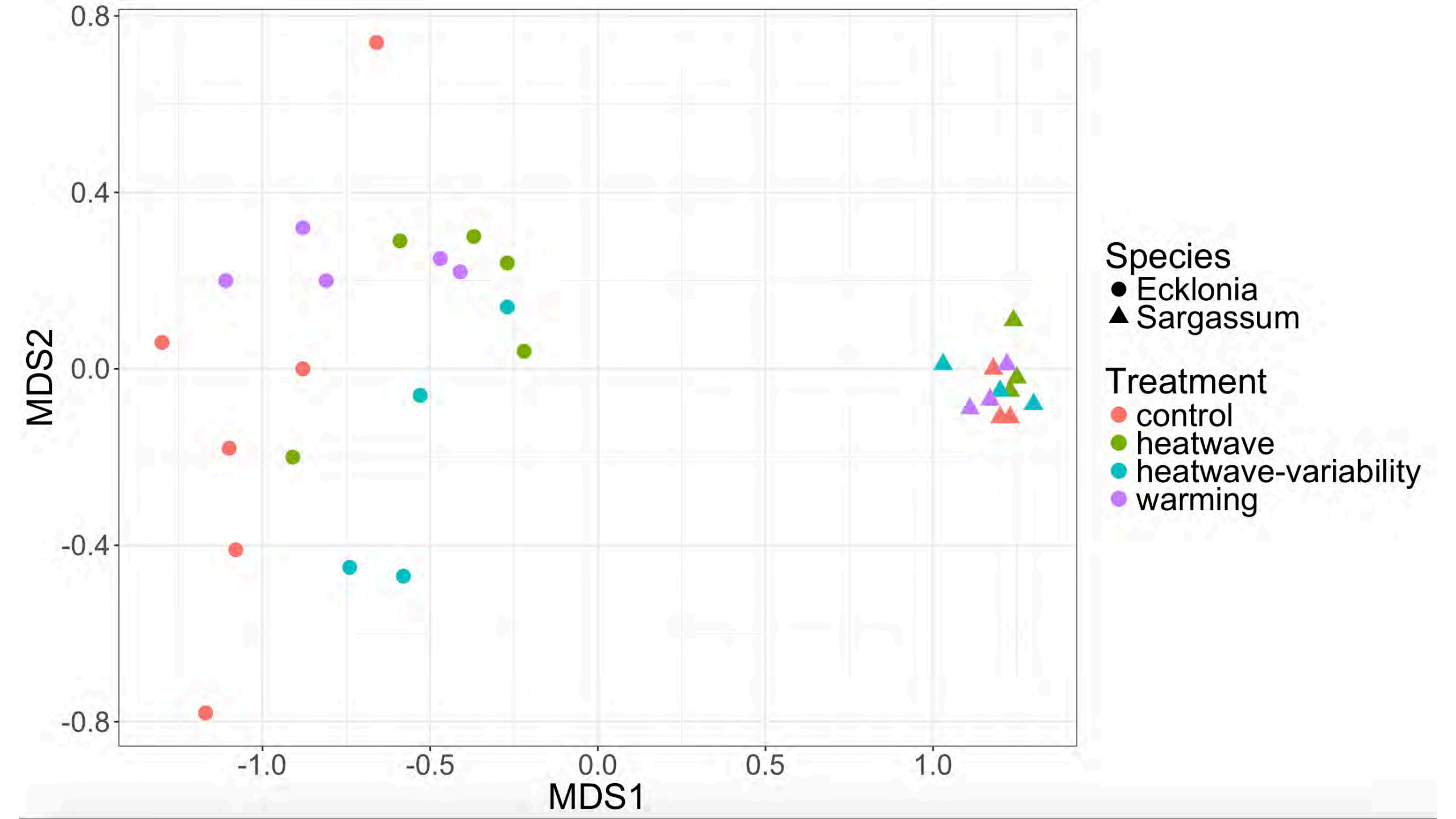
Letters group treatments that are not statistically different from each other

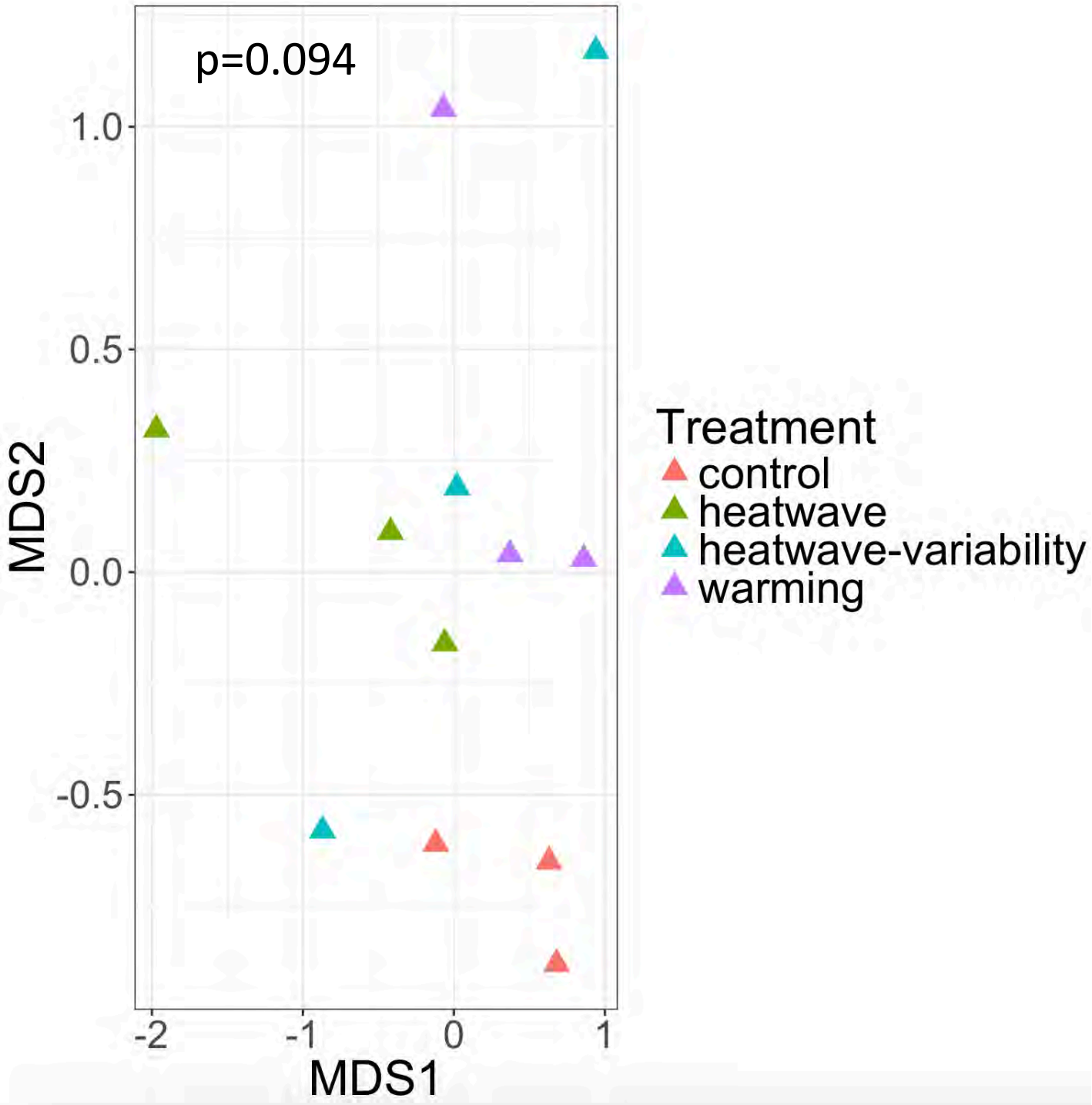


Letters group treatments that are not statistically different from each other

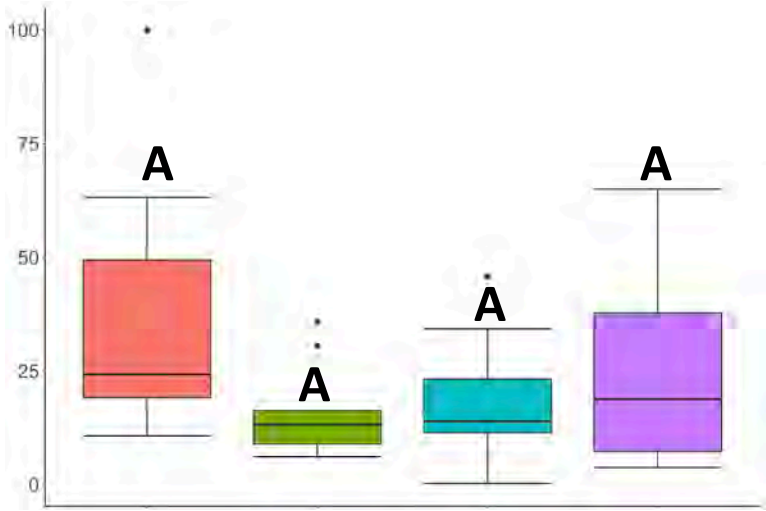


Asterix indicates treatments that are statistically different from each other


0.8
0.4
0.0
-0.4
-0.8
MDS2
-1.0
-0.5
0.0
0.5
1.0
MDS1
Species
Ecklonia
Sargassum
Treatment
control
heatwave
heatwave-variability
warming

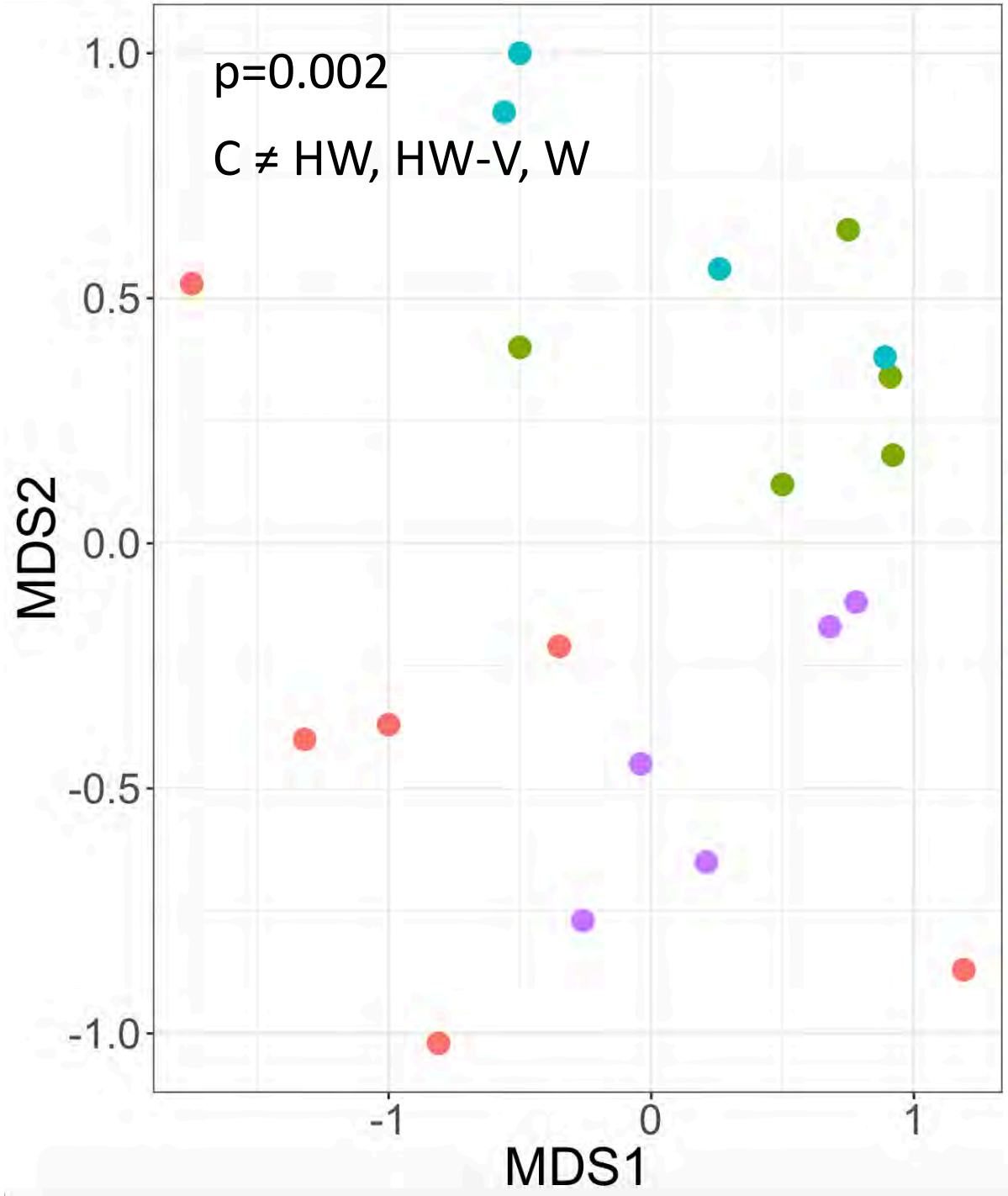


Sargassum

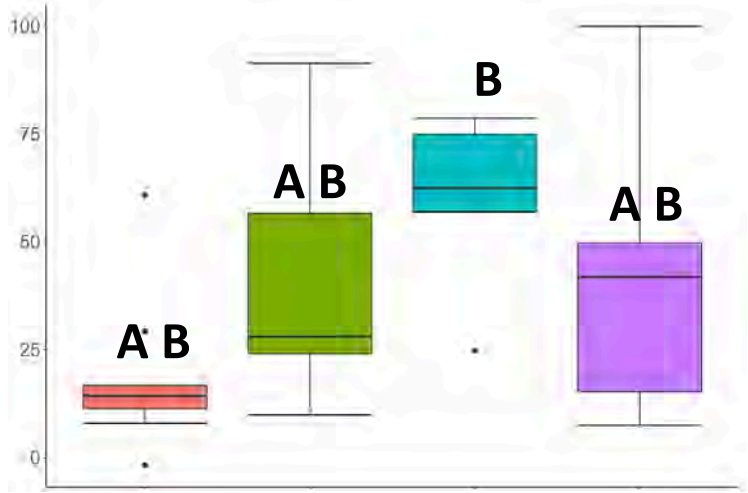


Urchin Consumption Results

Ecklonia



Treatment
- control
- heatwave
- heatwave-variability
- warming



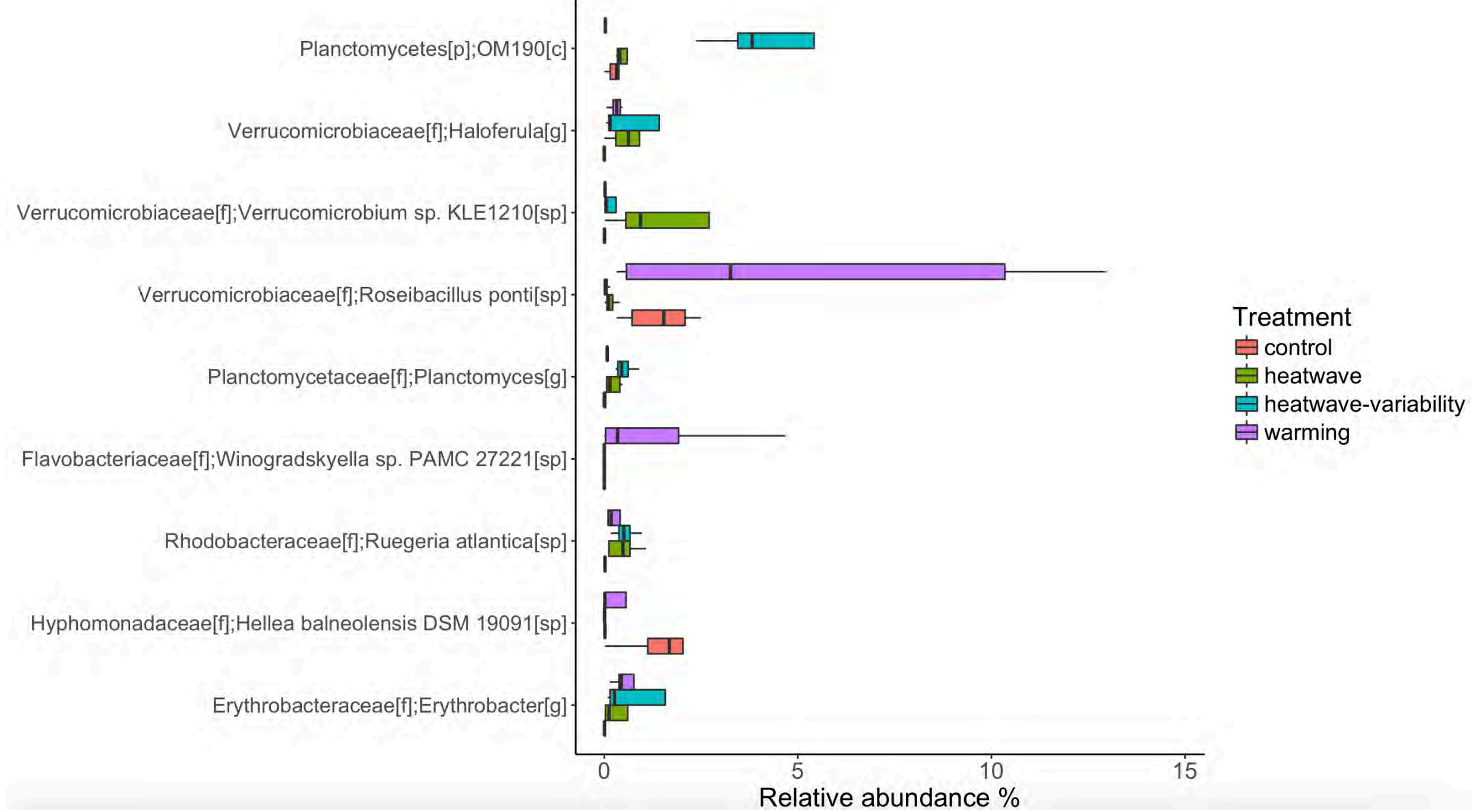
Urchin Consumption Results

OTU = Operational Taxonomic Unit

- Group of bacteria with 97% similar gene sequences

- A taxonomic unit of bacteria

Image credit: John Turnbull



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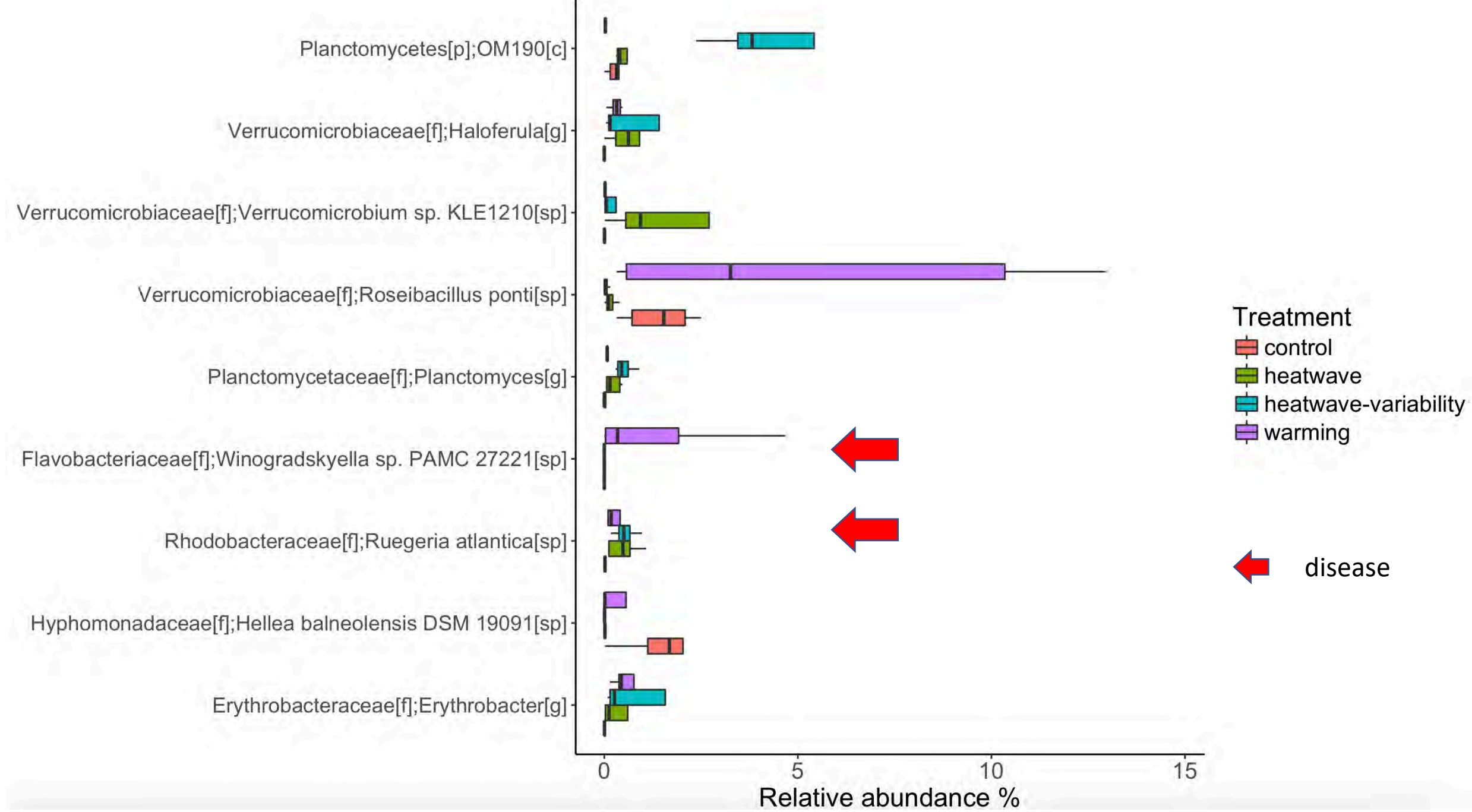

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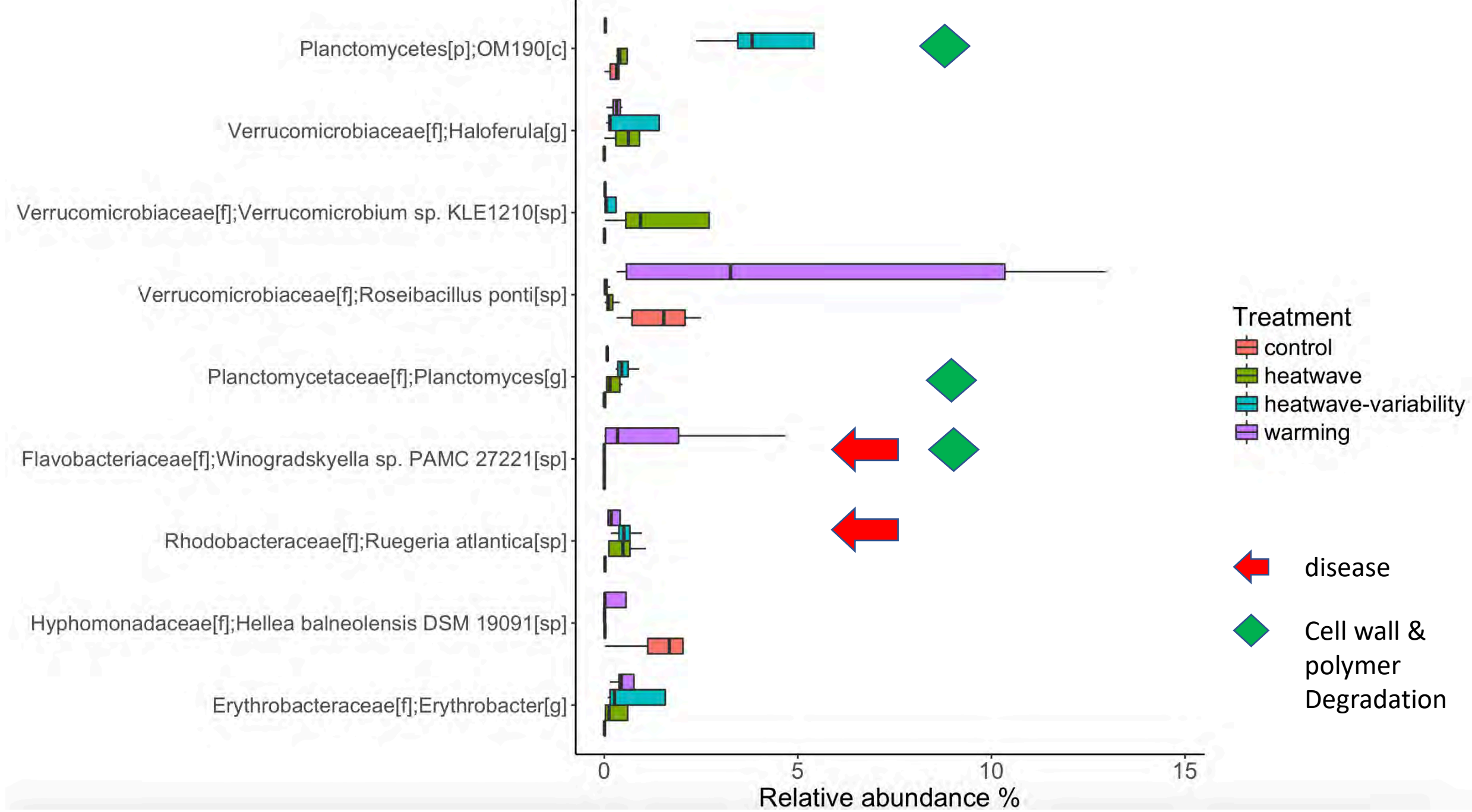

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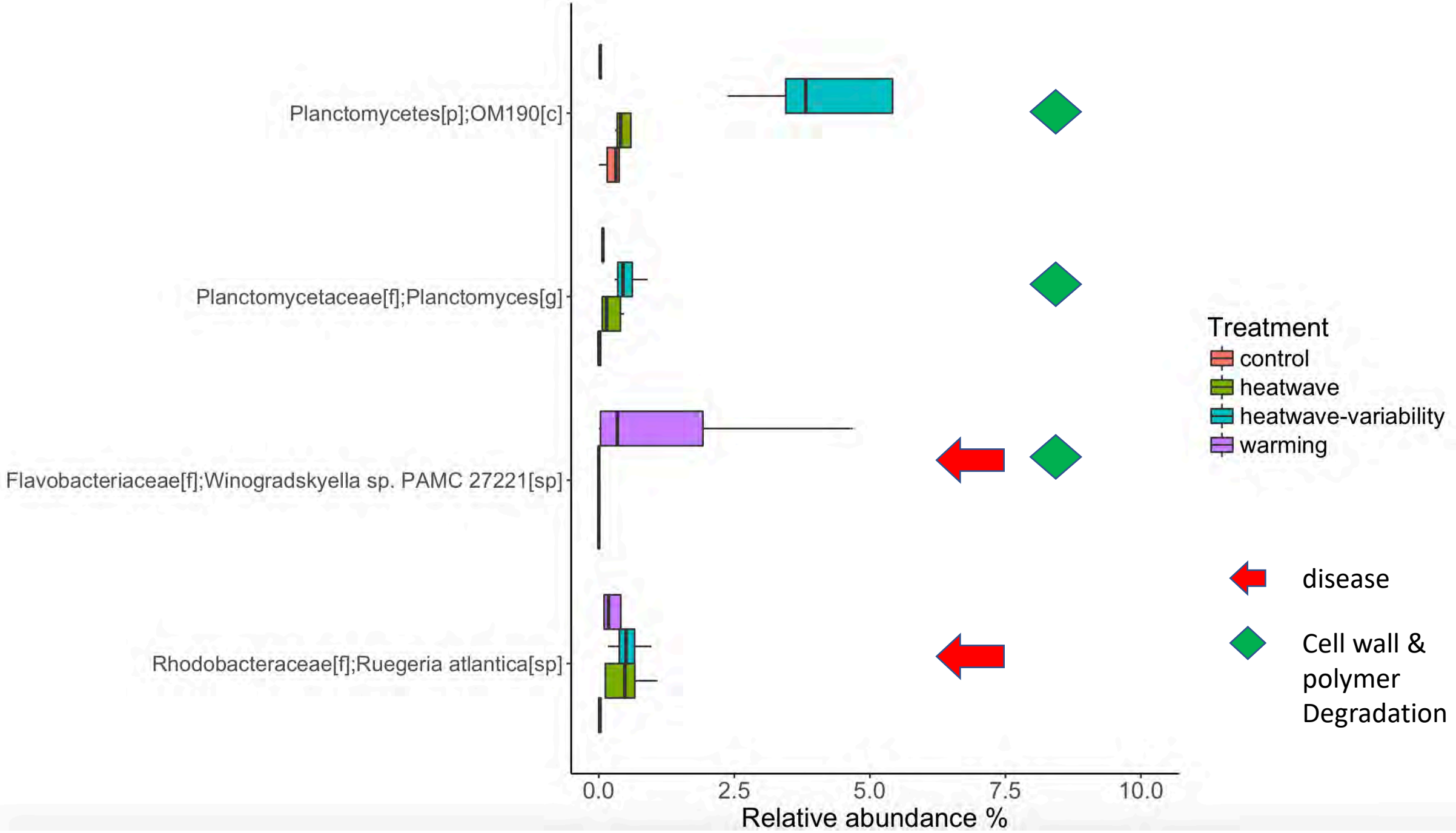

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Demographic consequences of disease in a habitat-forming seaweed and impacts on interactions between natural enemies

Alexandra H. Campbell,[1,2,3,5] Adriana Vergés,[1,2,3] and Peter D. Steinberg[1,2,3,4]

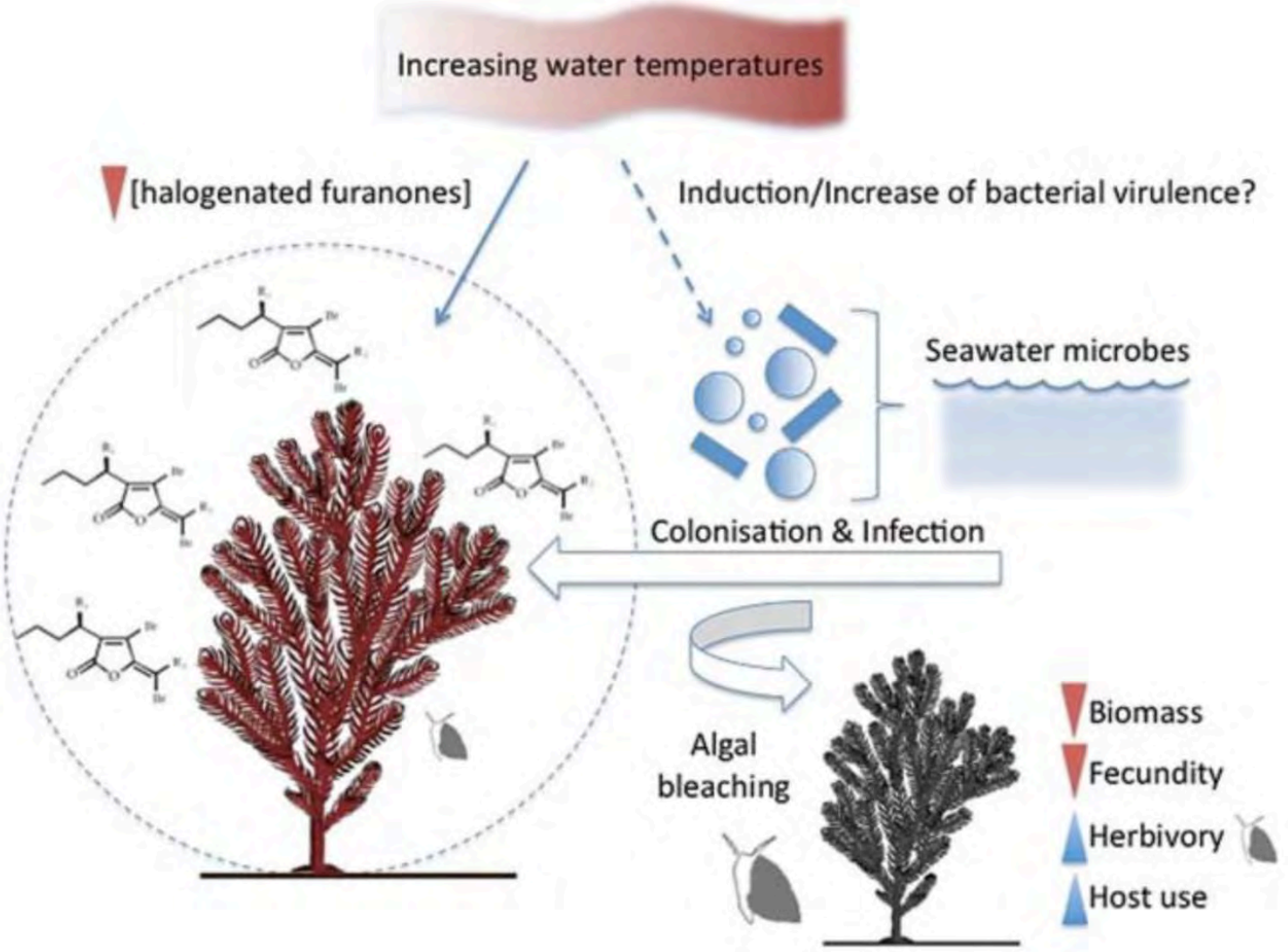
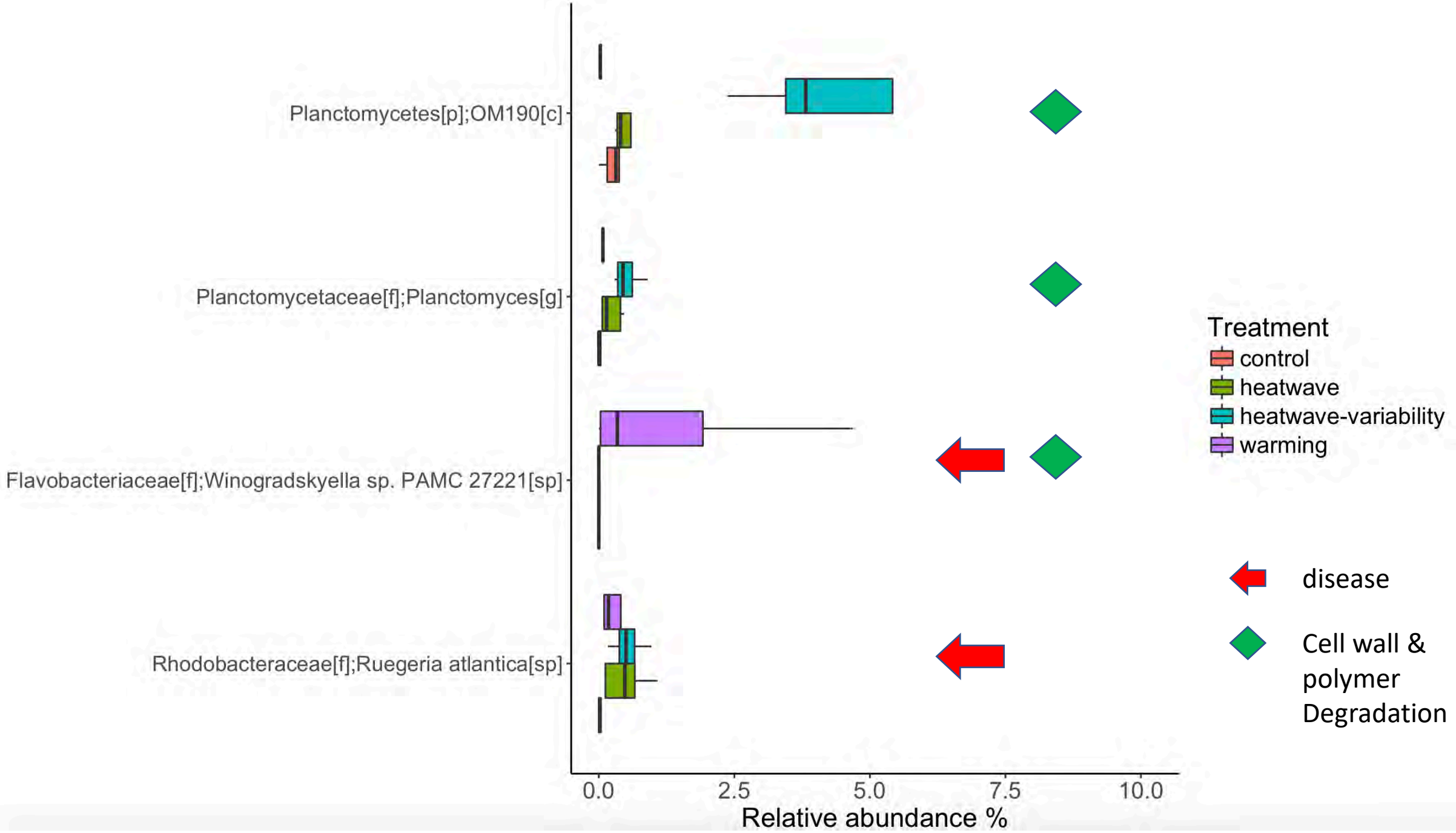


Figure from Campbell *et al*. 2012



([p] = Phylum, [c] = Class, [o] = Order, [f] = Family, [g] = Genus, [s] = species)

To sum up:

Ecklonia:

- More susceptible to herbivory under a heatwave event
- Environmental stress alters the microbiome
- Bacteria associated with disease & degradation of macroalgal polymers could increase its palatability to grazers like *Tripneustes.*

Sargassum:

- Appears to be the more resilient macroalgae under temperature stress

Image credit: John Turnbull

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Peter Steinberg, CMB, Sydney Institute of Marine Science
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Melinda Coleman, NSW Department of Primary Industries
Symon Dworjanyn, Southern Cross University
Sandra Straub, University of Western Australia, Oceans Institute and School of Biological Sciences
Thomas Wernberg, University of Western Australia, Oceans Institute and School of Biological Sciences

Image credit: John Turnbull