



UNIVERSITY OF
PLYMOUTH
School of Biological and
Marine Sciences

To grow (up) and defend?

Kelp polyphenolics and the Optimal Defense Hypothesis?

Andy Foggo, Alice Cobley, Miguel Richardson

-

School of Biological and Marine Sciences

University of Plymouth

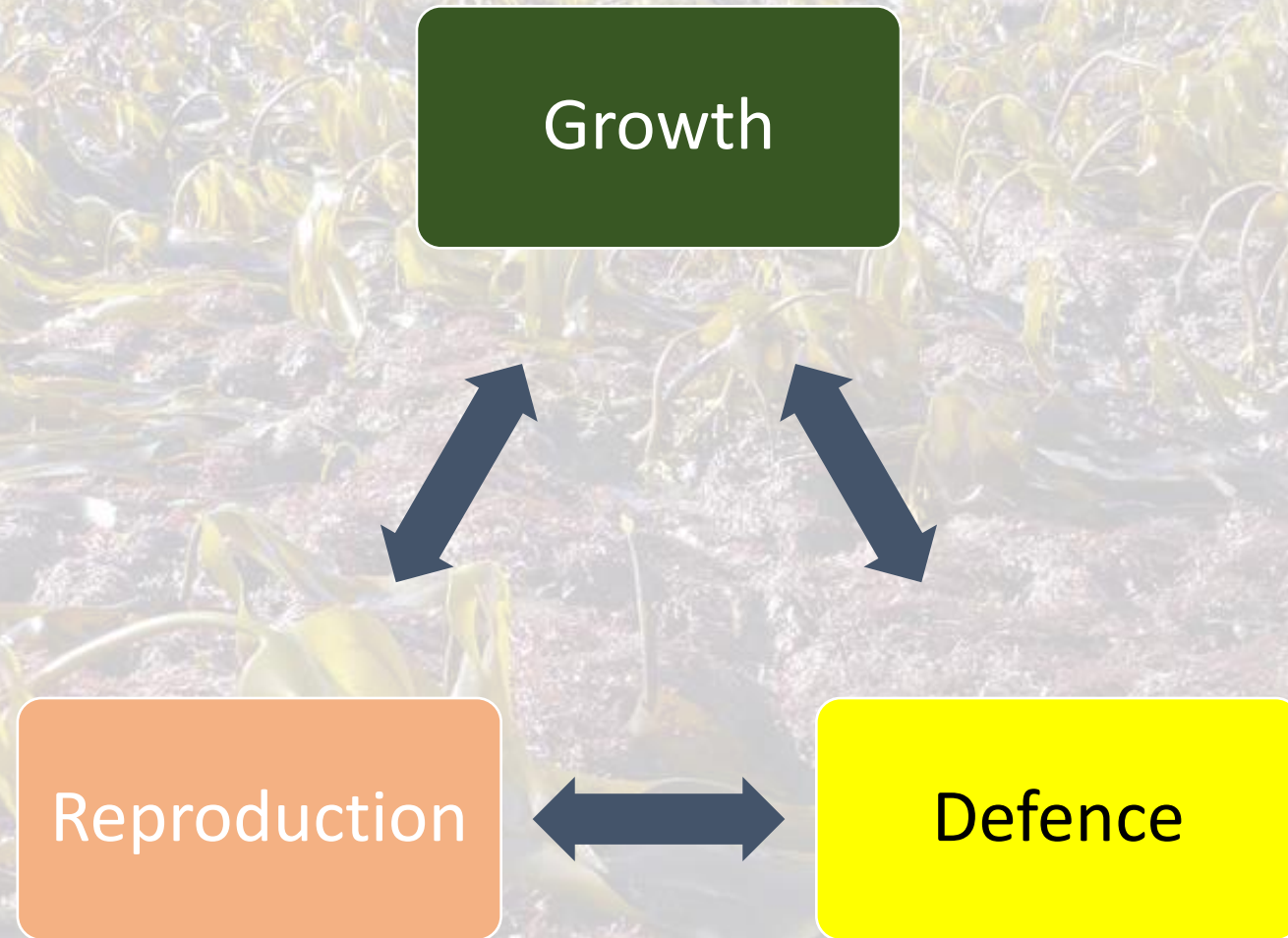
UK



There is no free lunch...

- From *plant apparency* to the *optimal defense hypothesis*, *resource availability hypothesis*, the *source-sink balance hypothesis*, the *carbon-nutrient balance hypothesis* and the *growth-differentiation balance hypothesis*, common themes include:
 - **Cost** as a driver, partitioning of a finite resource base
 - Terrestrial green plant bias
 - Constitutive and induced defense by polyphenolics

Plant resource budget



To grow or defend? (Herms & Mattson 1992)



UNIVERSITY OF
PLYMOUTH
School of Biological and
Marine Sciences

VOLUME 67, No. 3

THE QUARTERLY REVIEW OF BIOLOGY

SEPTEMBER 1992



THE DILEMMA OF PLANTS: TO GROW OR DEFEND

DANIEL A. HERMS

The Dow Gardens, 1018 West Main Street

Midland, Michigan 48640 USA and

Department of Entomology, Pesticide Research Center, Michigan State University

East Lansing, Michigan 48824 USA

WILLIAM J. MATTSON

USDA North Central Forest Experiment Station, East Lansing, Michigan 48823 USA and

Department of Entomology, Pesticide Research Center, Michigan State University

East Lansing, Michigan 48824 USA

Algae: surprisingly like Viridiplantae....



UNIVERSITY OF
PLYMOUTH
School of Biological and
Marine Sciences

Cellular metabolism producing 'secondary' metabolites is highly conserved:

shikimate pathway

mevalonate pathway

Acetyl co-A

Phaeophyte phlorotannins serve as herbivore deterrents, digestion inhibitors, antimicrobial agents, wound healers, anti-fouling agents, antifungal agents and UV screens

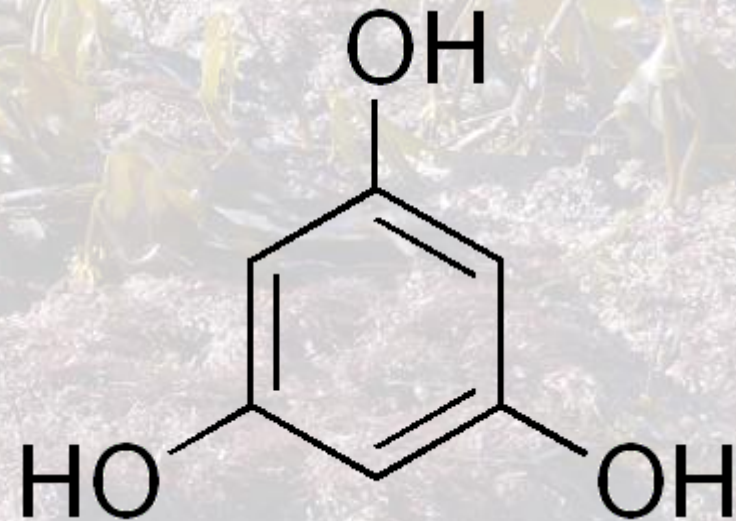
But algae are NOT plants



UNIVERSITY OF
PLYMOUTH
School of Biological and
Marine Sciences

Phlorotannins have well-documented primary roles in algal physiology and development

Algal cell-wall constituents
Preventing polyspermy
Zygote cell wall formation
Holdfast adhesion



To grow *and* defend? (Arnold & Targett 2003)



UNIVERSITY OF
PLYMOUTH
School of Biological and
Marine Sciences

Algal phlorotannins serve serial functions, as free, reactive agents with transitional *defensive* (secondary) function. Active growth = low levels of measurable reactive polyphenols.

Can algae grow *and* defend?

Does defense show ontogenetic pattern?

Does climate change pose a challenge?

Experiment

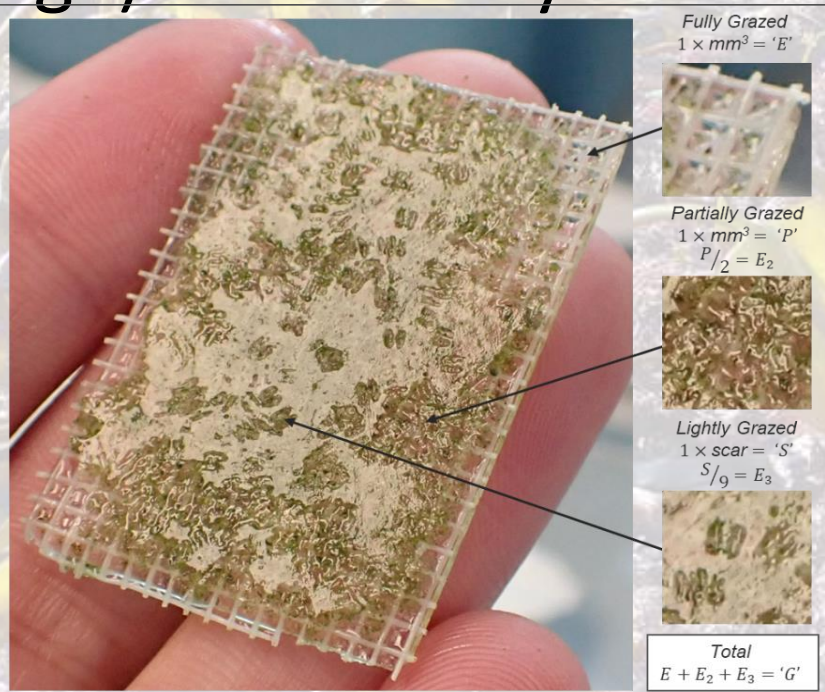


1 native species – *Laminaria hyperborea*, 1 non-native - *L. ochroleuca*

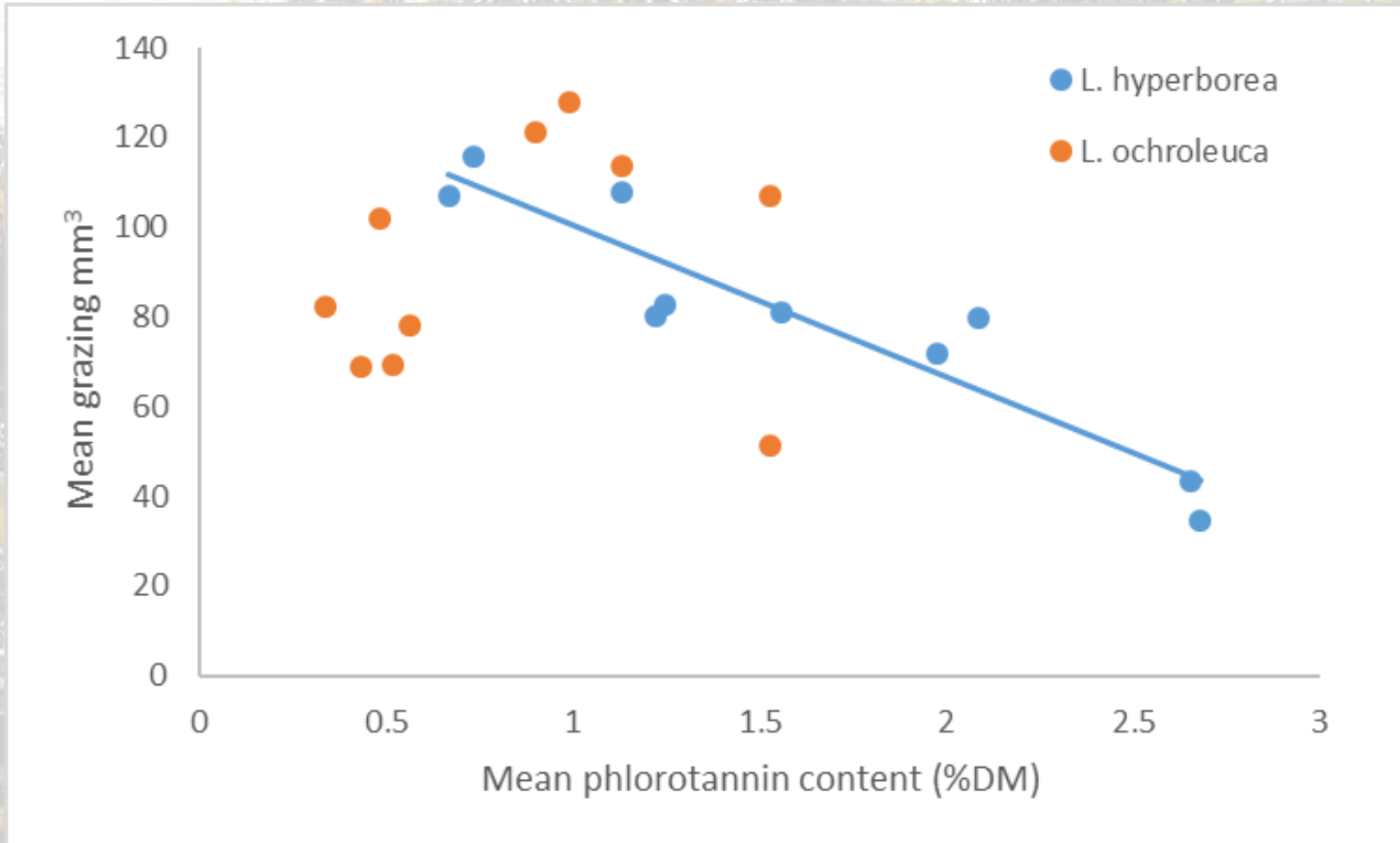
2 tissues – stipe (ex-holdfast) and frond (ex-meristem)

Polyphenolics of tissues of different stipe diameters (proxy for age) assessed by Folin-Ciocalteu assay

48h agar-based feeding trials of consumption of tissues from different aged individuals (by stipe diameter) by *Steromphala cineraria* (consumption expressed as mm^3 consumed)

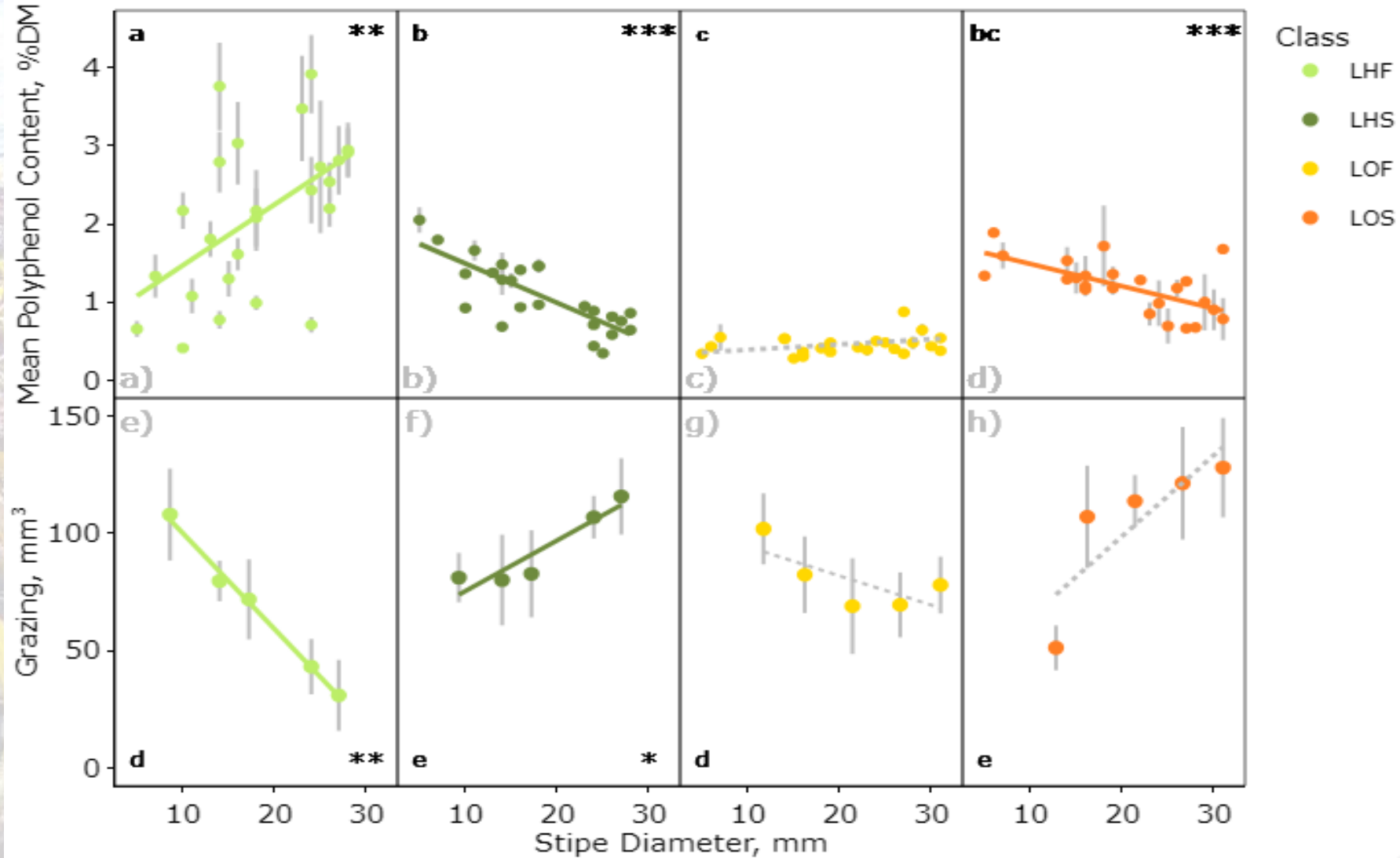


Results



Reactive phlorotannin content correlates well with consumption, at least in native species

Results cont.



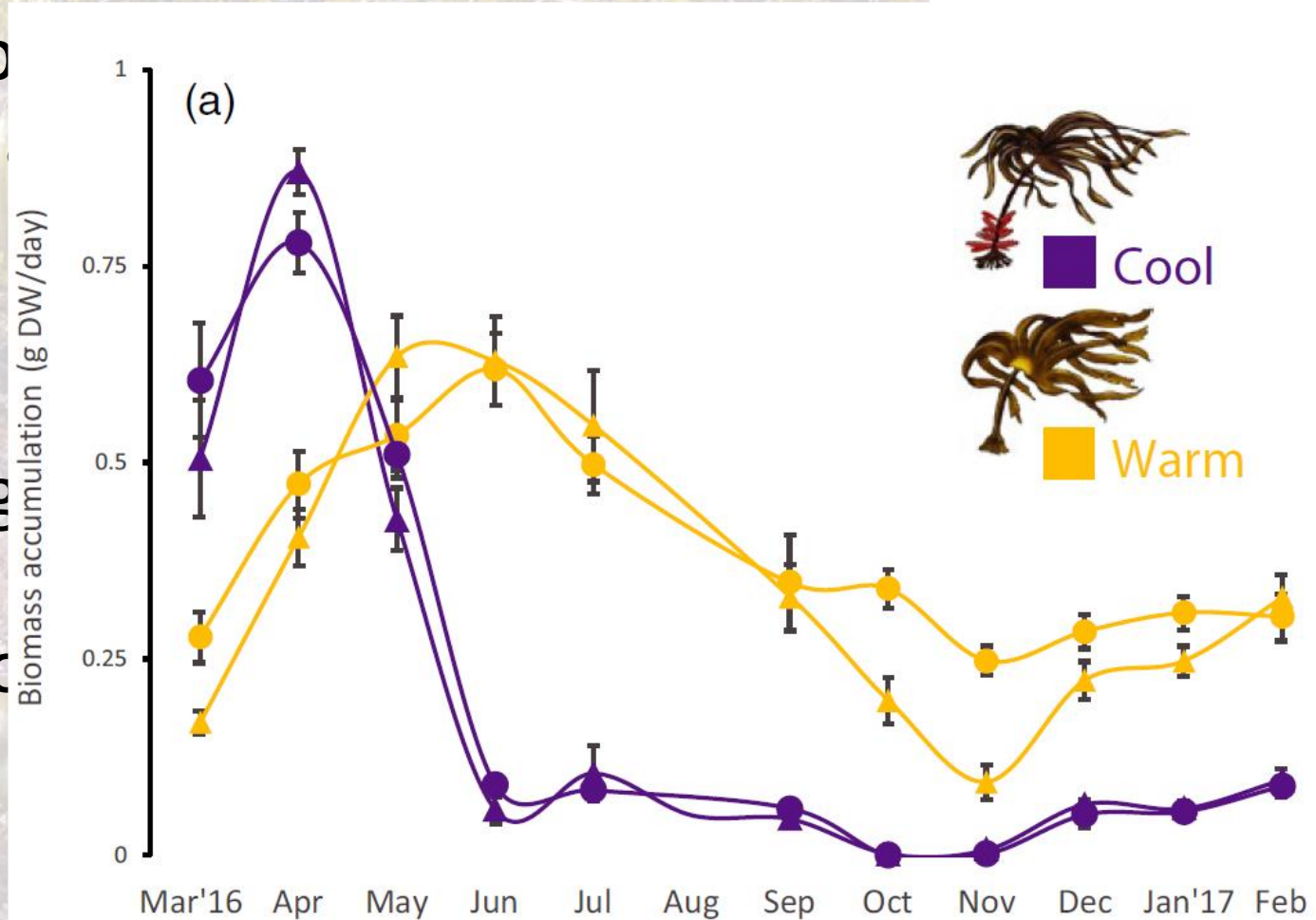
Implications

Neither kelp appears to be ab
- Stipe defence declines

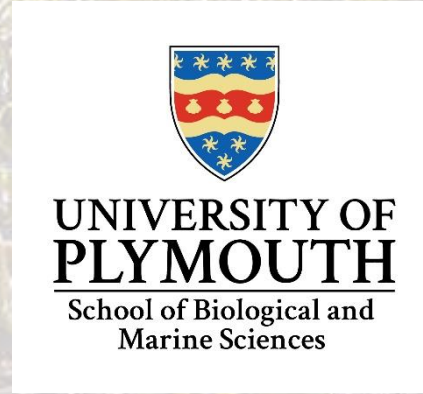
Timing is all-important

Optimal defense in a changing

Defense in algae not straightfo



Thanks to:



and...Dan Smale, Albert Pessarrodona, Luka Wright, Matt Hargrave, Mick Hanley, Louise Firth, Tony Knights, Pippa Moore, Ross Coleman, Martin Speight, Dave Bilton, UoP Technicians, The Marine Biological Association of the UK, over 30 years' worth of UG + PG students

