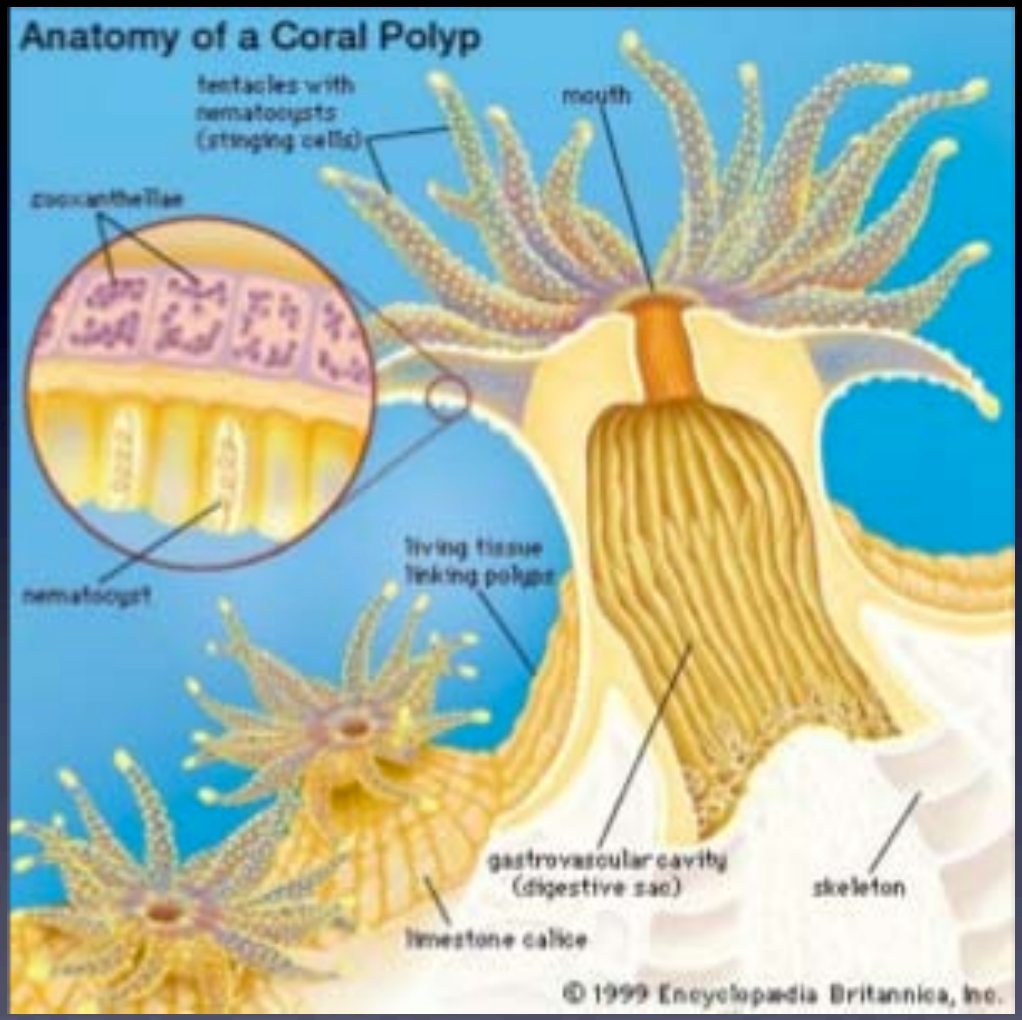
Coral Reef Responses to Global Climate Change: A genomic perspective

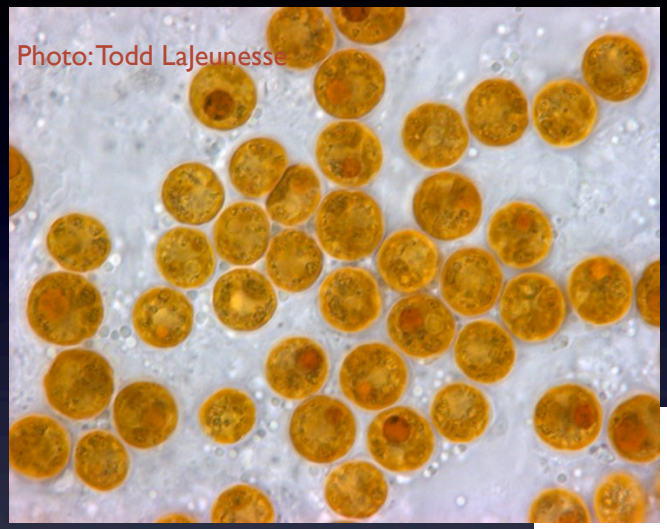
Mónica Medina
UC Merced

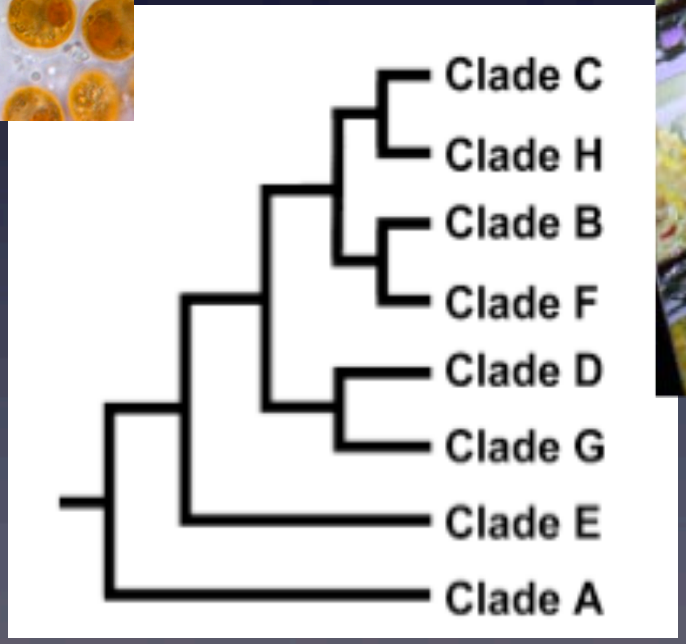
NOAA 82 Round Table
Fort Lauderdale, FL
June 27, 2012

Classical view of Coral Symbiosis



Symbidinium Diversity

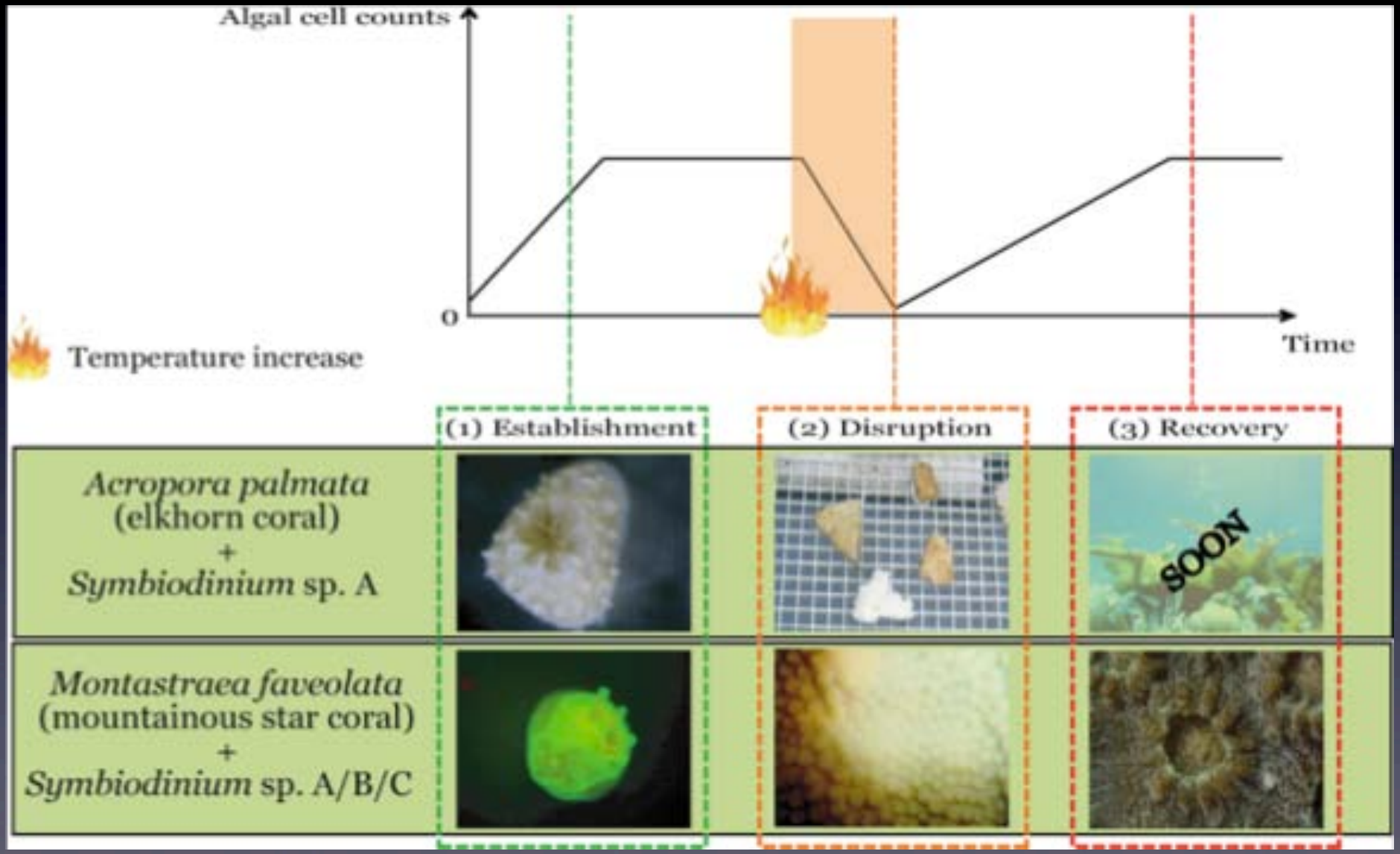




Coffroth and Santos 2005

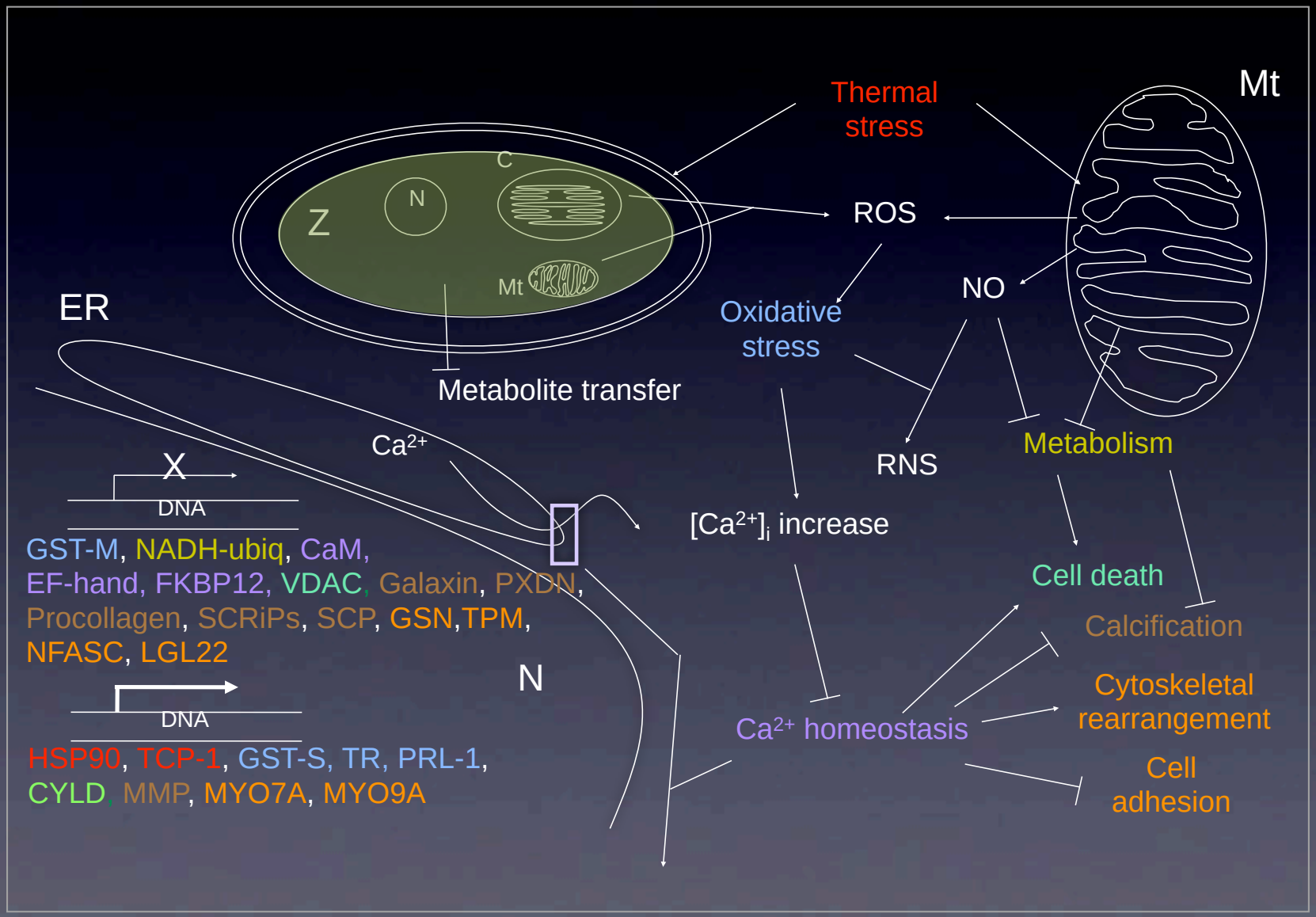
Thermally Induced Bleaching

Experimental Strategy



Buschiazzo et al, in prep

A Transcriptome-Based Model of Coral Bleaching



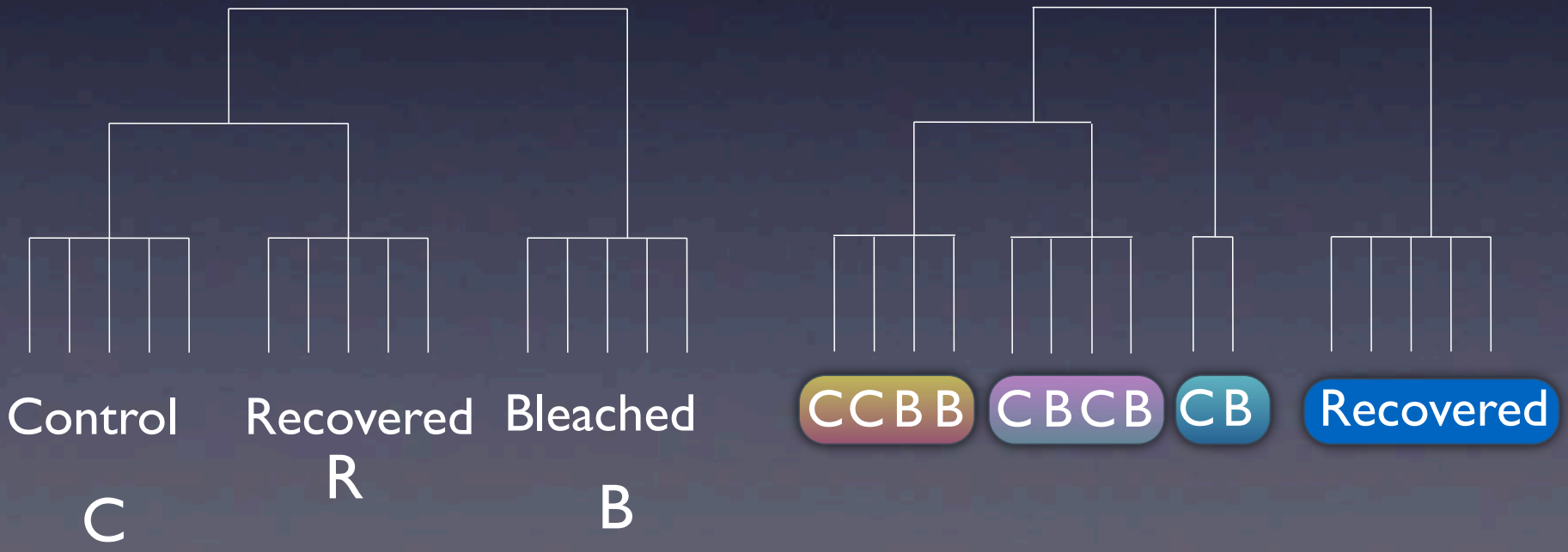
M. faveolata 1,300 features & *A. palmata* 2,000 features

DeSalvo et al 2009, 2010, 2011

Bleaching & Recovery

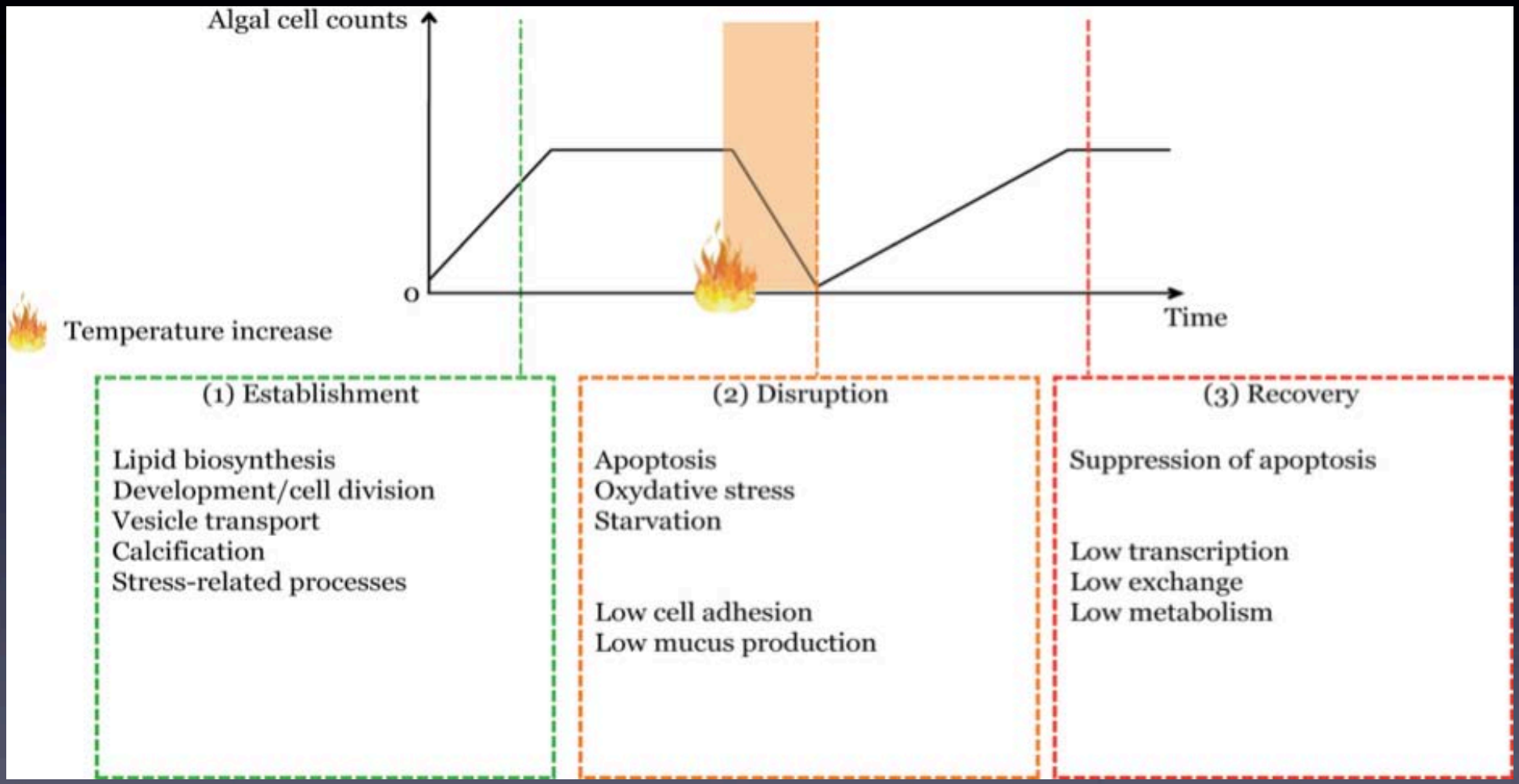
Expected vs. Actual Outcome

C B R



DeSalvo*, Sunagawa* et al 2010

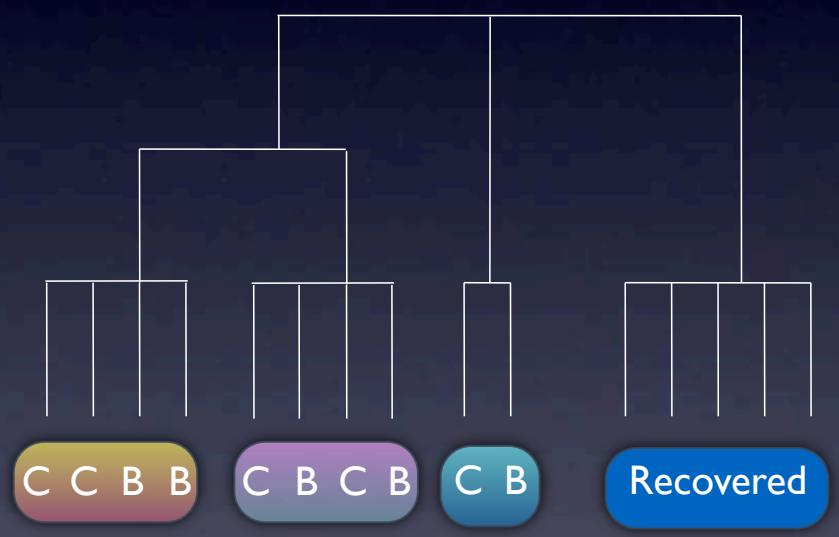
Over-represented categories DEGs



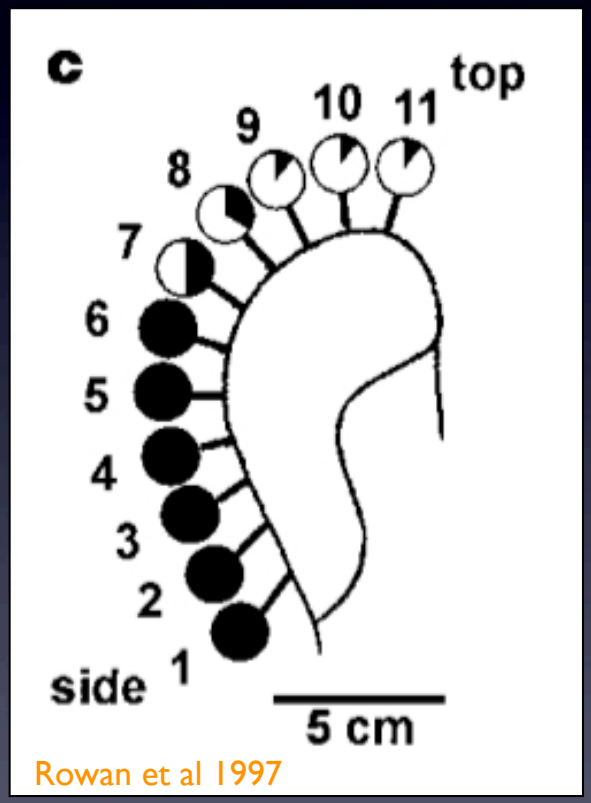
lineage-specific | conserved

Emmanuel Buschiazzo, in preparation

Landscape Ecology of Algal Symbionts



DeSalvo*, Sunagawa* et al 2010

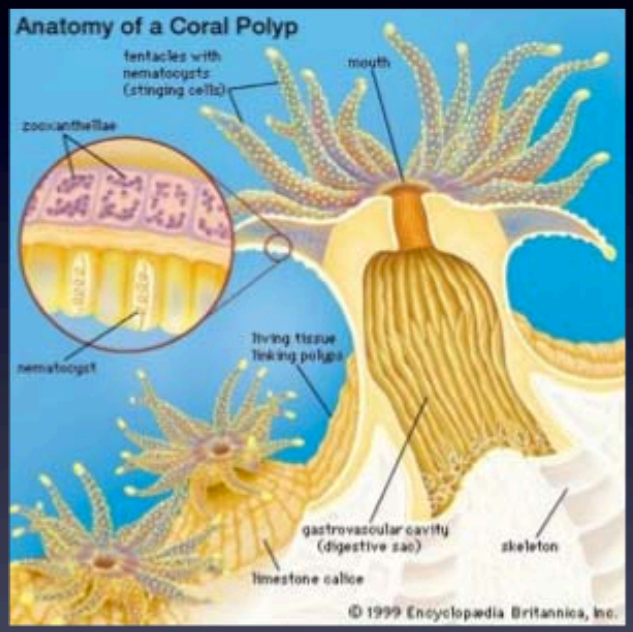


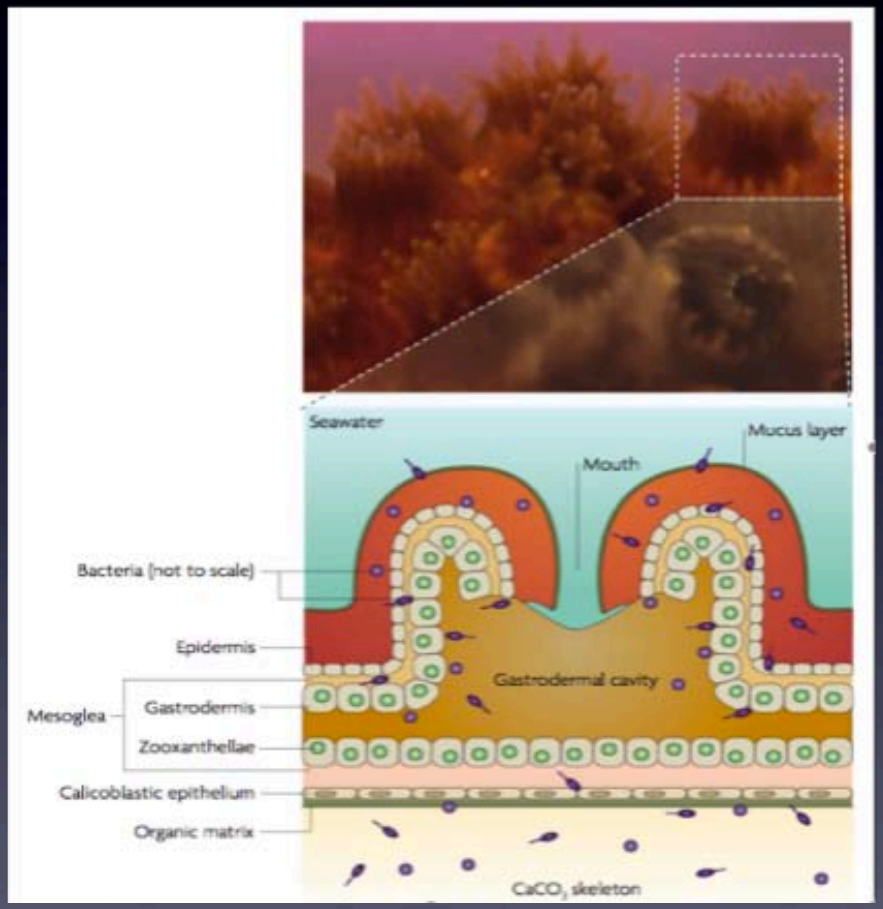
Rowan et al 1997

M. faveolata provides a naturally occurring "landscape"

A changing view of coral symbiosis

The Coral Holobiont

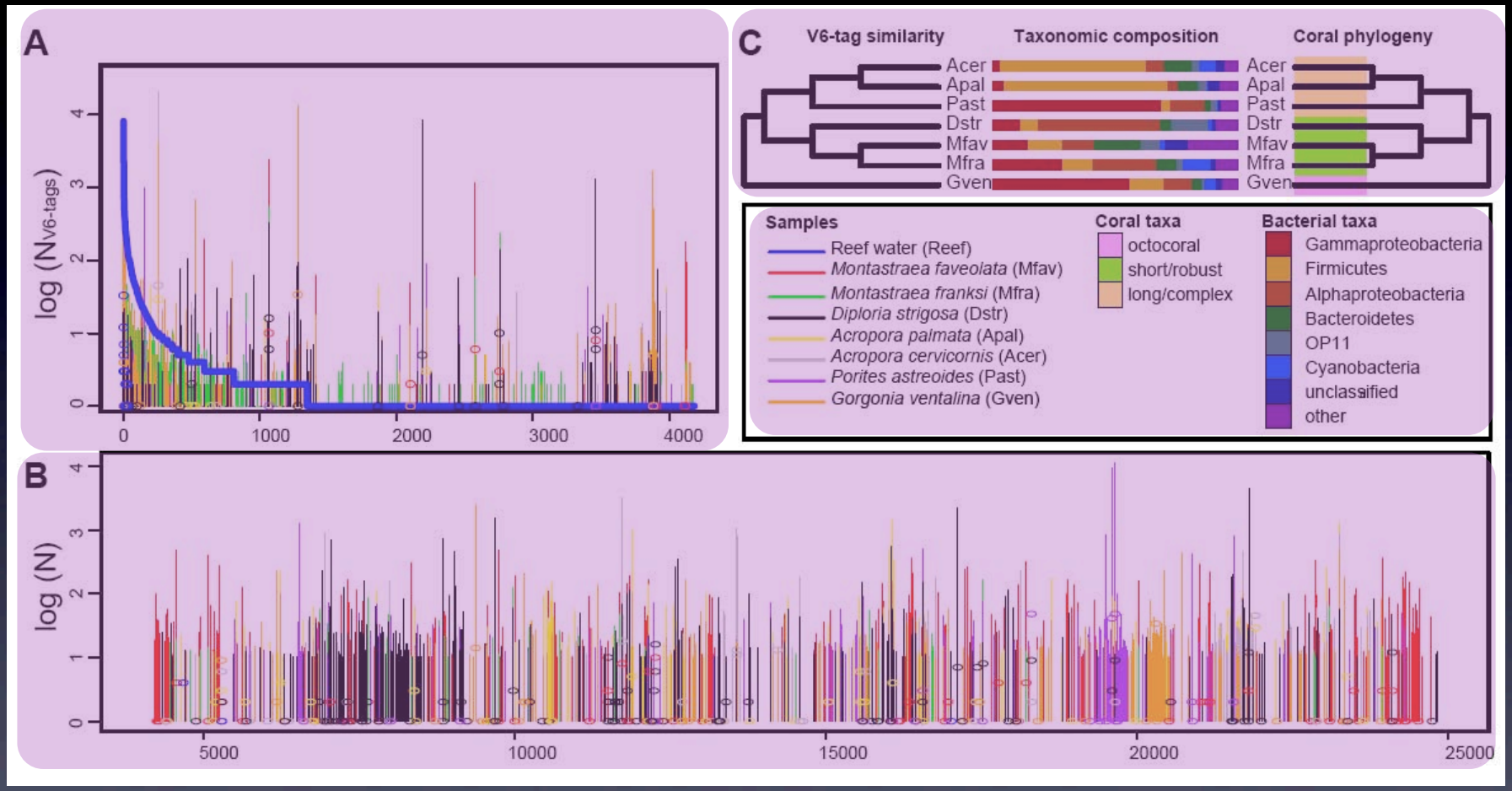




prokaryotes, protists, fungi, viruses

Rohwer *et al.* 2002; Rosenberg *et al.* 2007, Ritchie 2006

Coral Microbial Diversity



- Hinted co-evolution between microbiome and coral hosts
- Corals harbor an extremely rich "rare biosphere"

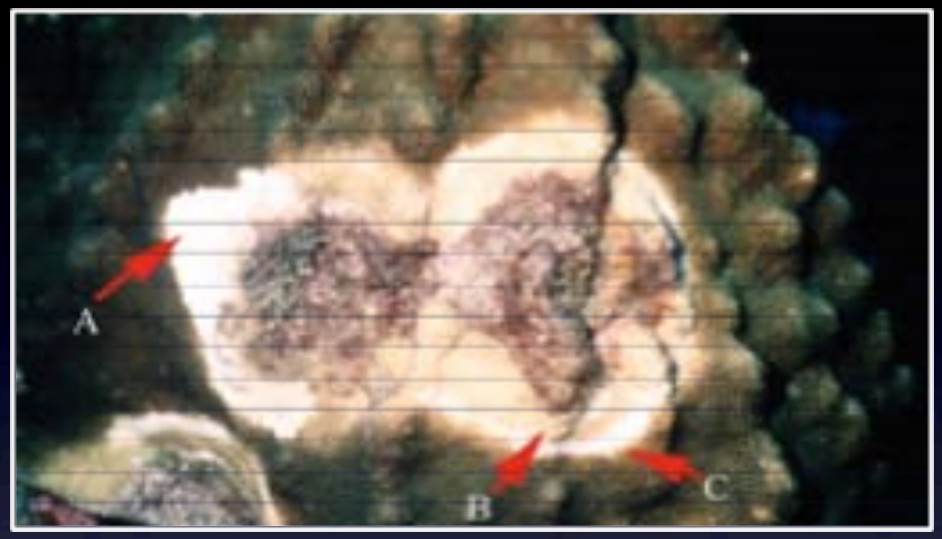
Sunagawa et al 2010

How variable is a core microbiome?

Case Study: Yellow Band Disease (YBD)

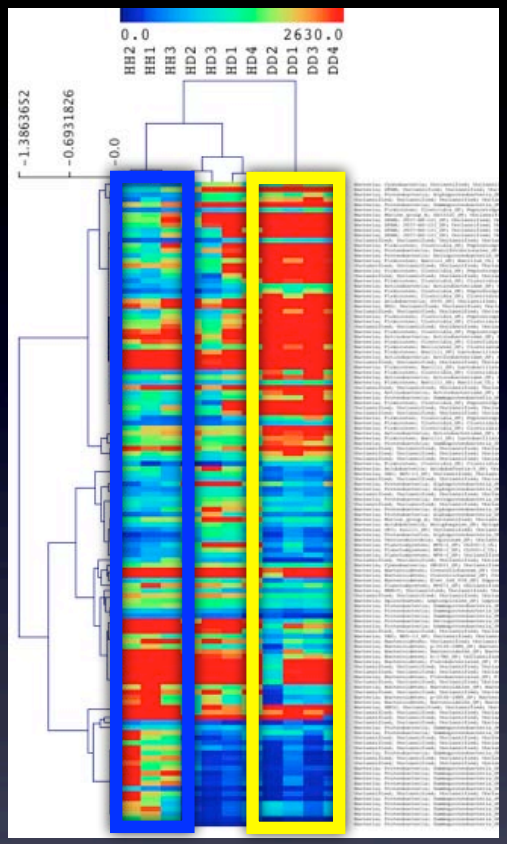
Montastraea spp. & *Colpophyllia natans*

- light/dark yellow bands (7-10cm/yr)
- Kills *Symbiodinium* initially, ultimately killing the host
- 4 *Vibrio* spp.

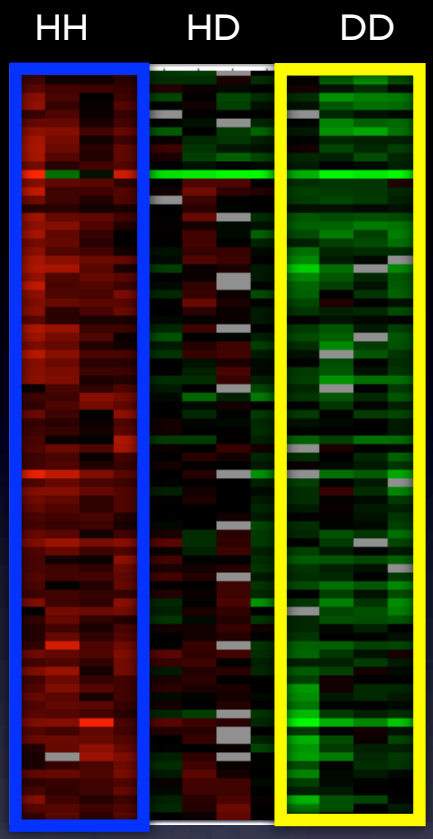


Collin Closek in progress

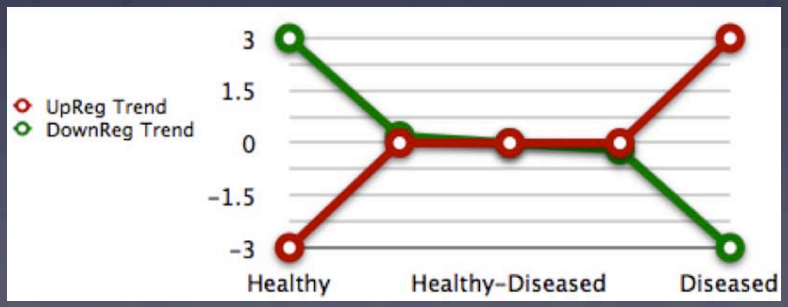
Microbial Diversity & Host Response



Healthy vs. Healthy-Diseased vs. Diseased
One-way ANOVA, $\alpha = .01$



SAM analysis, $\alpha = .01$

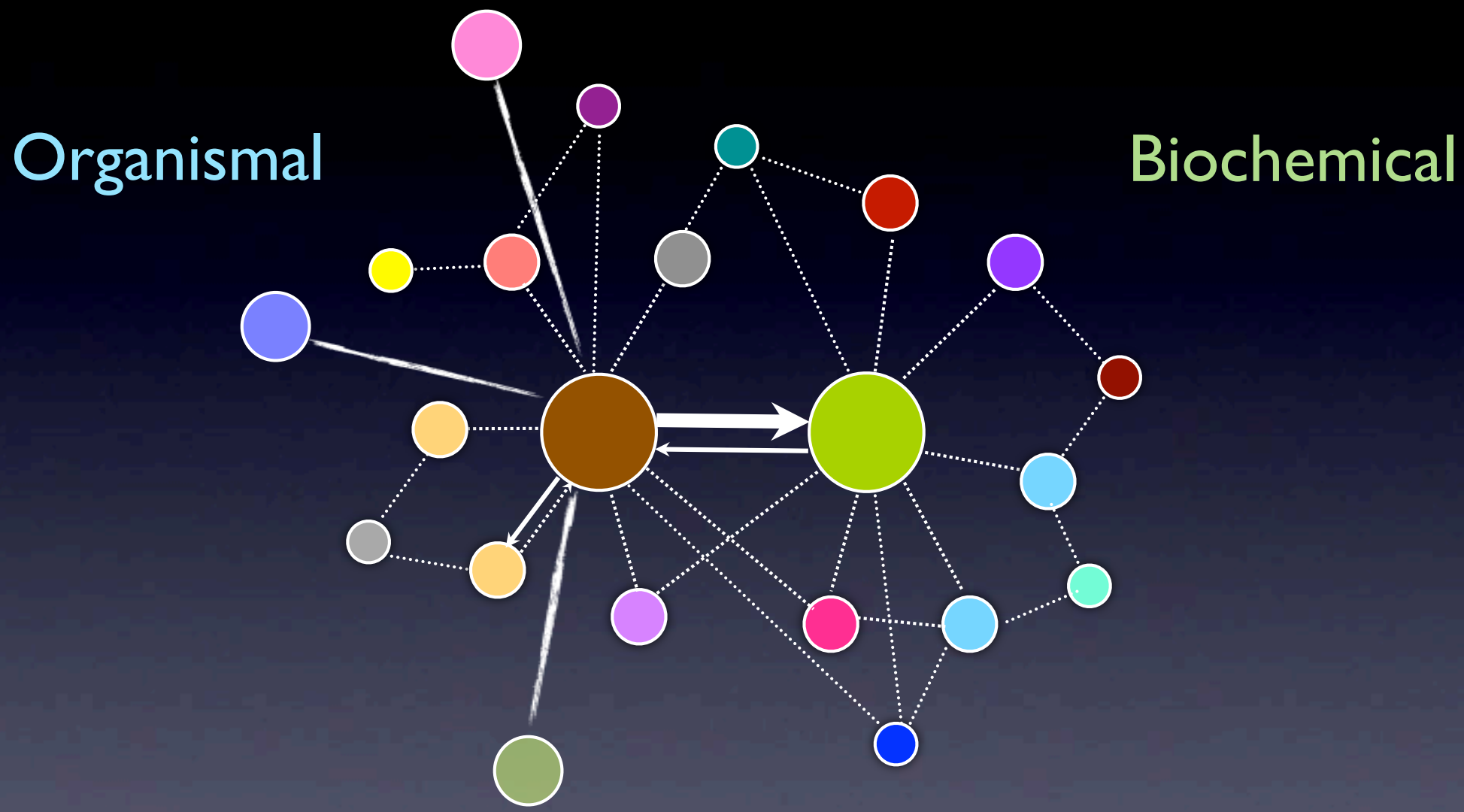


80% of the genes have a continuous regulation trend

G phylochip, Full length bacterial 16S, Enriched for
aribbean coral microbes

M. faveolata 3G array ~11K features

A Network View of the Holobiont



Microbial communities predominantly enhance the gene repertoire that enables the host to cope with perturbations

Acknowledgments

Michele Weber
Emmanuel Buschiazzo
Shini Sunagawa
Michael DeSalvo
Collin Closek
Chris Voolstra
Erika Diaz
Bishoy Hanna
Jodi Schwarz
Alejandro Reyes
Aubrie O'Rourke

Smithsonian Tropical Research Institute
Universidad Nacional Autónoma de México

Roberto Iglesias
Hiroaki Kitano
Gary Andersen
Cheryl Woodley

Yuriana Aguilar
Andres Estrada
Paul Fisher

DoE, UC Mexus, Canon Foundation, ICoMM