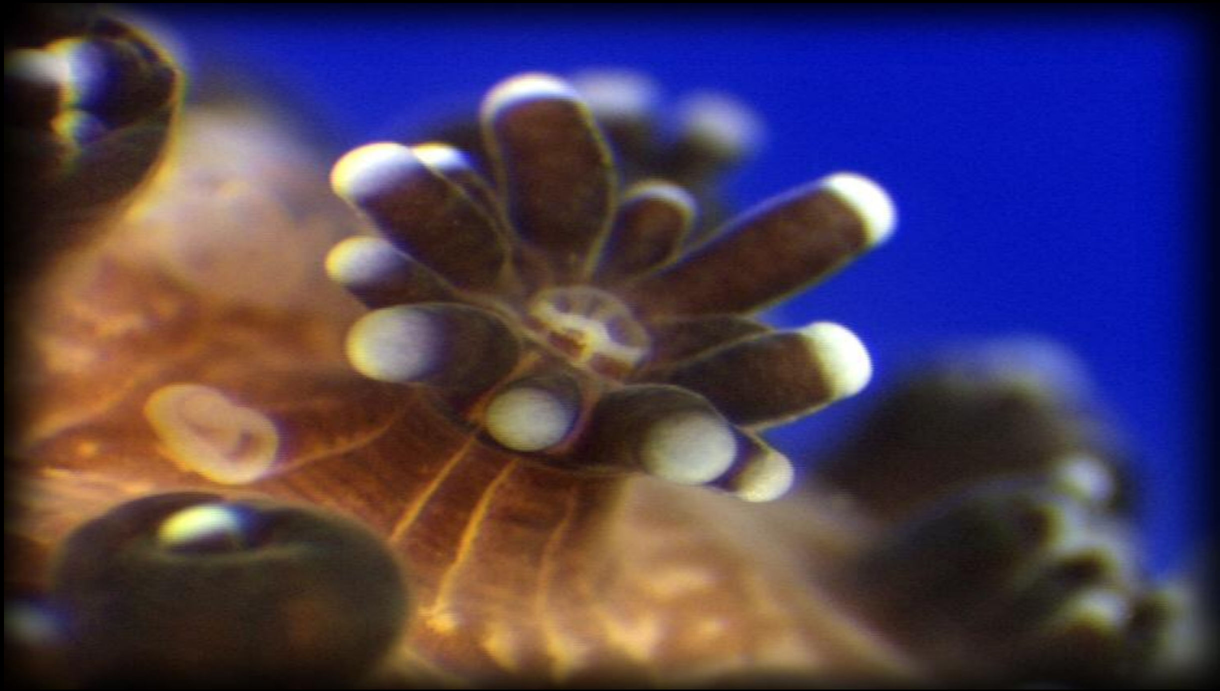
The Centre Scientifique de Monaco

« Conservation Physiology » to save coral reefs



GLOBAL WARMING

OCEAN ACIDIFICATION

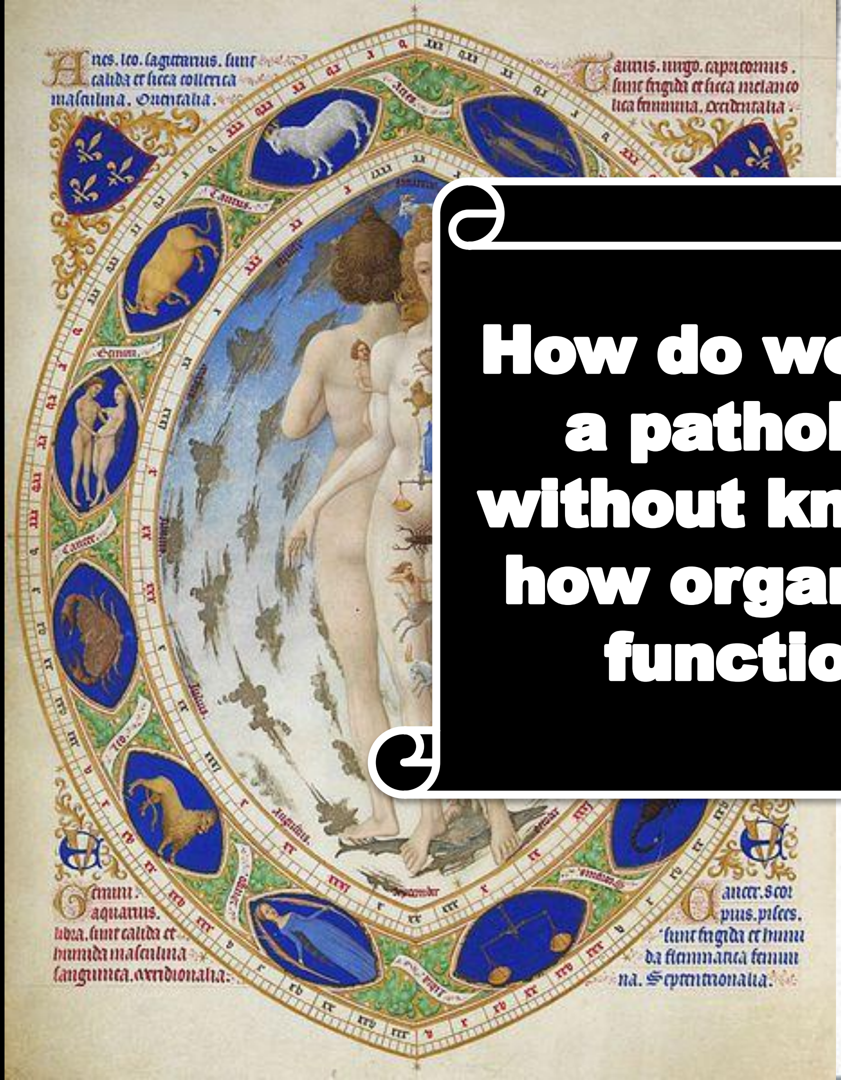
LOCAL STRESSORS

BIODIVERSITY

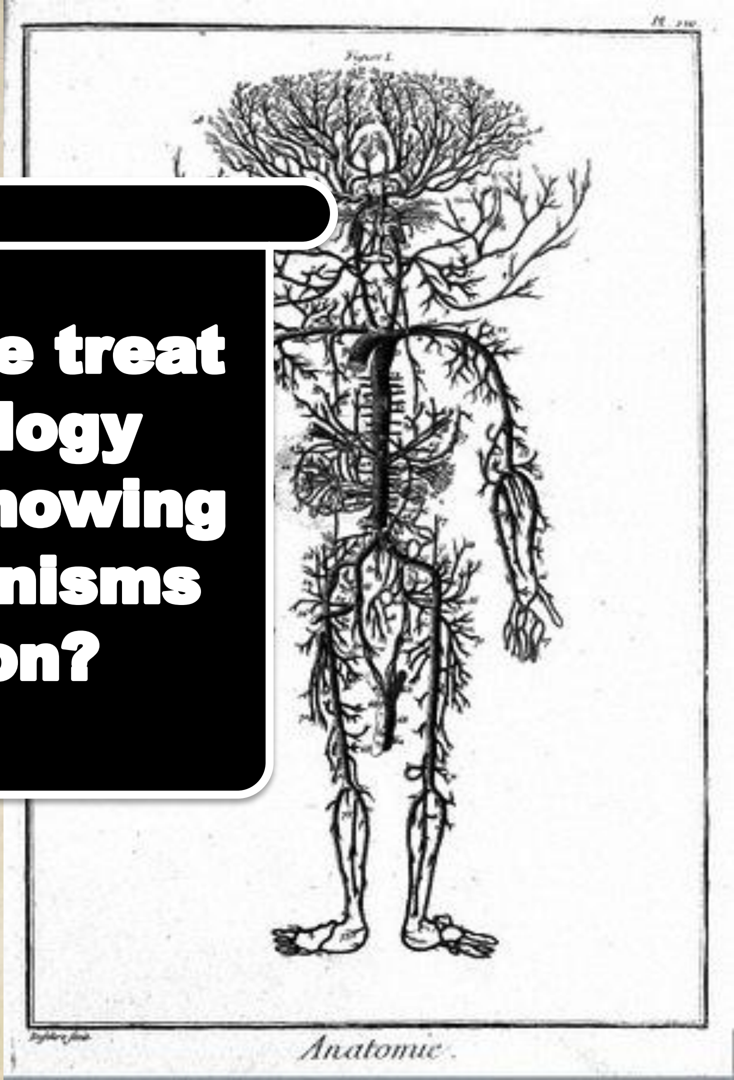
ECOSYSTEM SERVICES

Anatomical or zodiacal Man
XIVe s.

Arteries
XVIIe s.
Wiliam Harvey

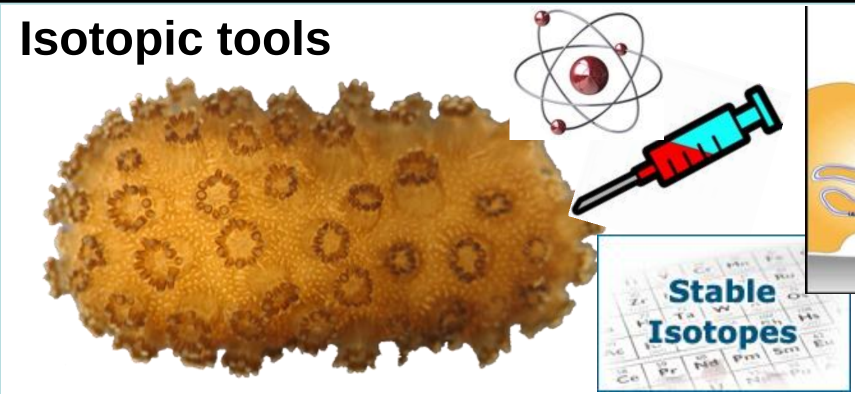


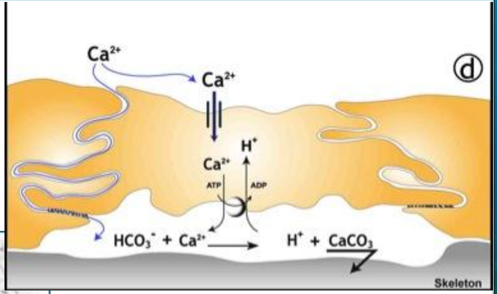
How do we treat a pathology without knowing how organisms function?

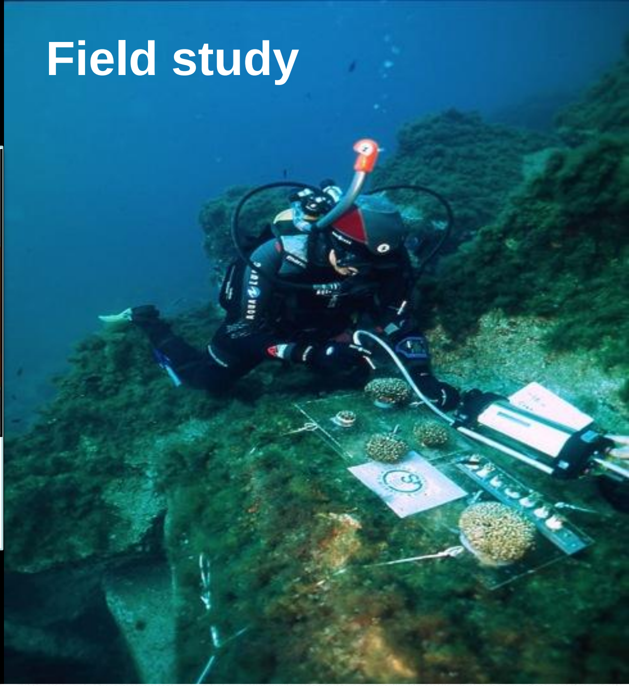


Application of modern biological methods to the study of basic coral physiology

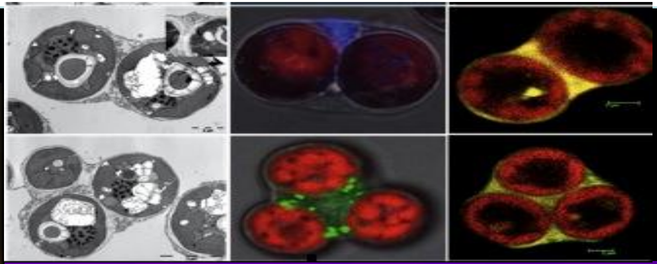
Isotopic tools

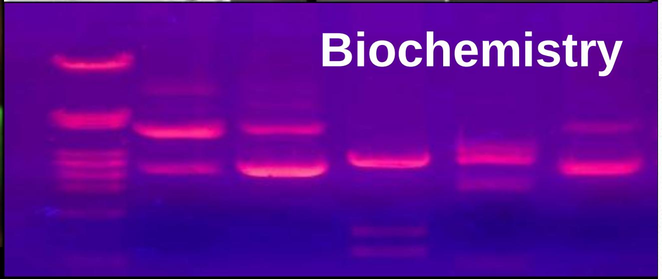


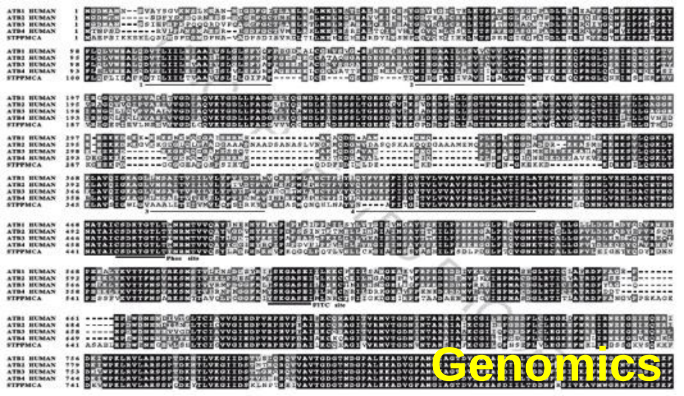




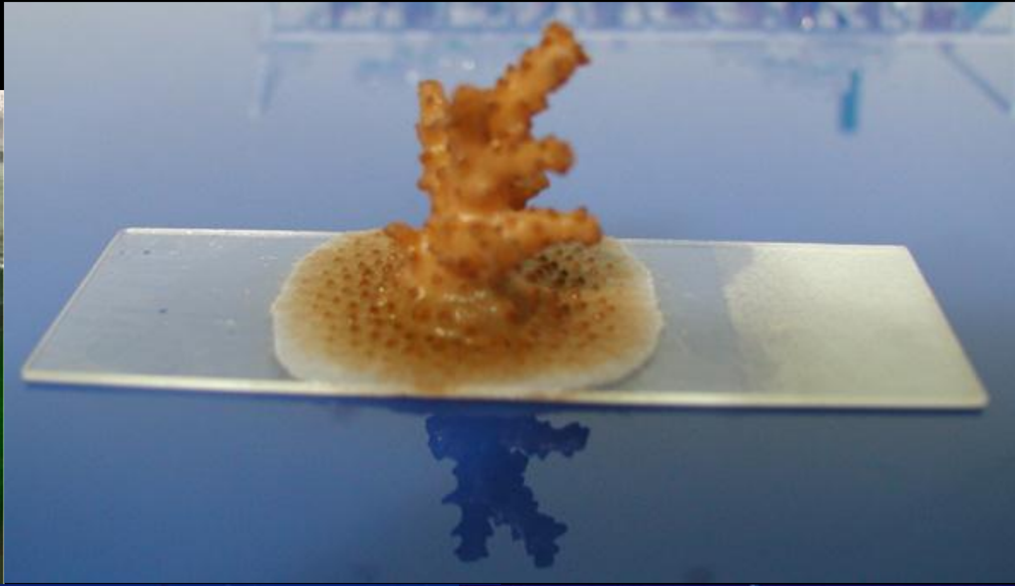
Microscopy







Development of coral culture under controlled conditions




Conservation Physiology
Volume 1 • 2013
10.1093/conphys/cot001
SEB Society for Experimental Biology
Perspective

What is conservation physiology? Perspectives on an increasingly integrated and essential science†

Steven J. Cooke[1,*], Lawren Sack[2], Craig E. Franklin[3], Anthony P. Farrell[4], John Beardall[5], Martin Wikelski[6], and Steven L. Chown[5]

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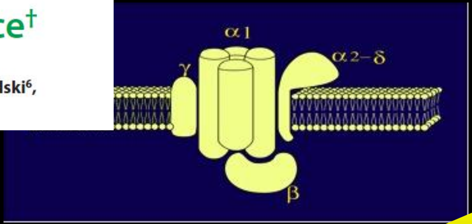
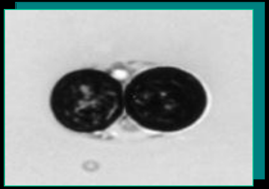
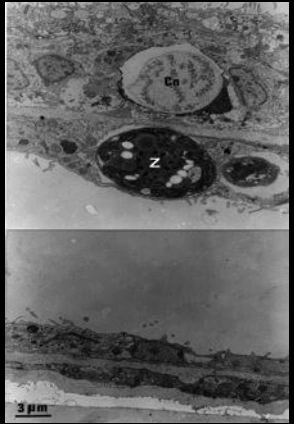
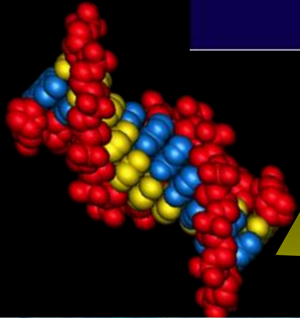




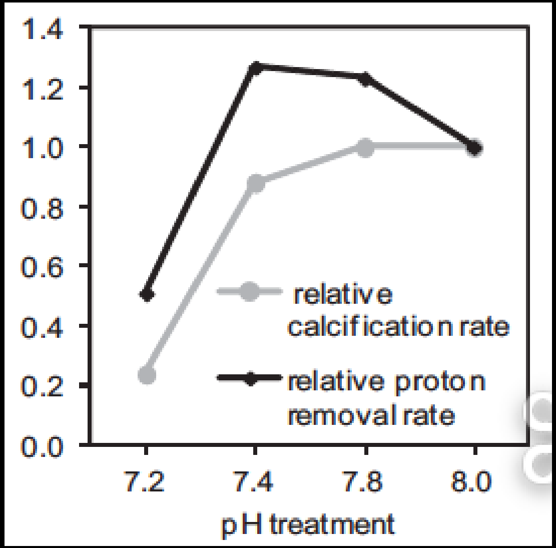




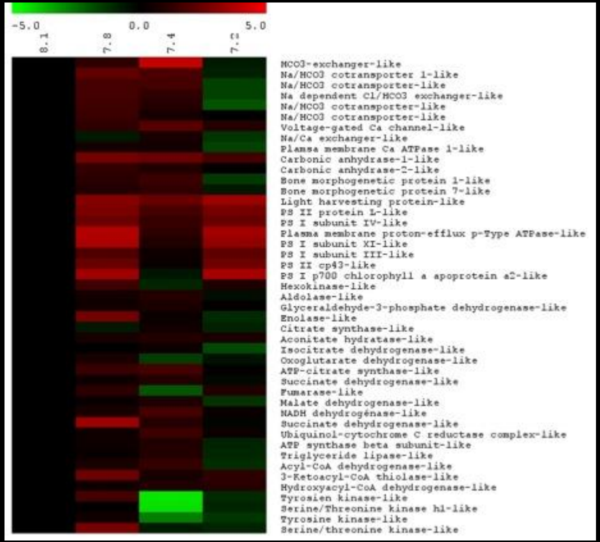
From reefs to genes

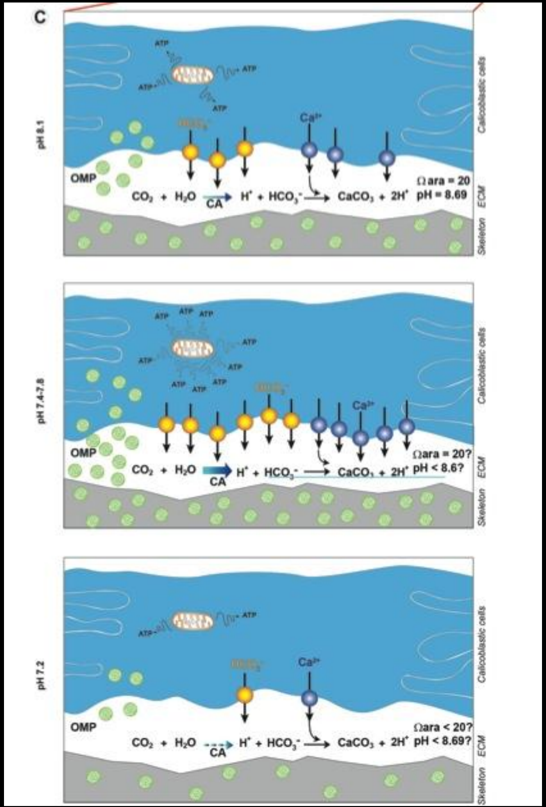
Conservation Physiology

Physiology



Genomics

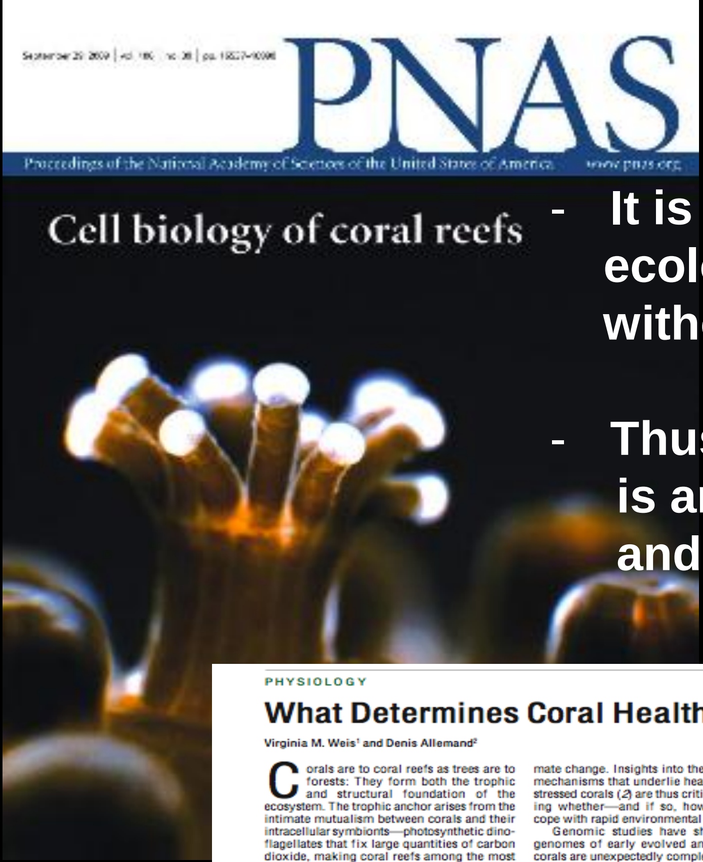




- Identification of a threshold (**tipping point**)
- Species-dependent

➡ **Provide tools to support management decisions**

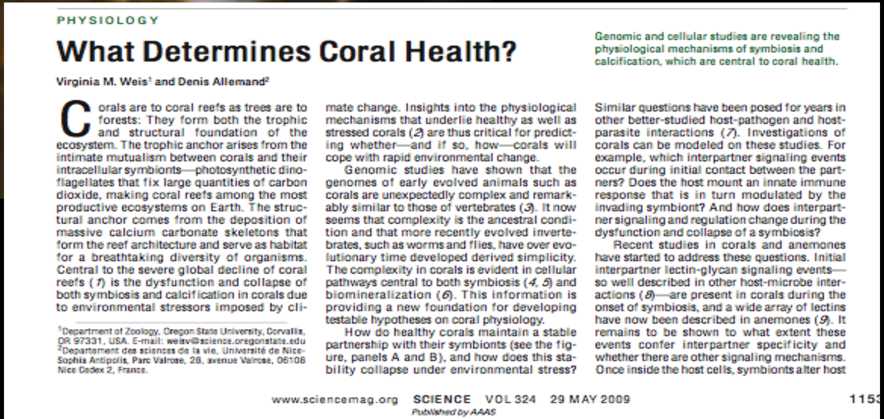
Venn et al 2013 PNAS; Vidal-Dupiol et al 2013 Plos One



TAKE-HOME MESSAGE

- It is totally unrealistic to want to predict the ecological outcomes of global environmental change without understanding basic physiological mechanisms

- Thus basic research from Genomics to Ecology is an essential step for environment management and decision-making



PHYSIOLOGY

What Determines Coral Health?

Genomic and cellular studies are revealing the physiological mechanisms of symbiosis and calcification, which are central to coral health.

Virginia M. Weis[1] and Denis Allemand[2]

Corals are to coral reefs as trees are to forests: They form both the trophic and structural foundation of the ecosystem. The trophic anchor arises from the intimate mutualism between corals and their intracellular symbionts—photosynthetic dinoflagellates that fix large quantities of carbon dioxide, making coral reefs among the most productive ecosystems on Earth. The structural anchor comes from the deposition of massive calcium carbonate skeletons that form the reef architecture and serve as habitat for a breathtaking diversity of organisms. Central to the severe global decline of coral reefs (*1*) is the dysfunction and collapse of both symbiosis and calcification in corals due to environmental stressors imposed by climate change. Insights into the physiological mechanisms that underlie healthy as well as stressed corals (*2*) are thus critical for predicting whether—and if so, how—corals will cope with rapid environmental change.

Genomic studies have shown that the genomes of early evolved animals such as corals are unexpectedly complex and remarkably similar to those of vertebrates (*3*). It now seems that complexity is the ancestral condition and that more recently evolved invertebrates, such as worms and flies, have over evolutionary time developed derived simplicity. The complexity in corals is evident in cellular pathways central to both symbiosis (*4*, *5*) and biomineralization (*6*). This information is providing a new foundation for developing testable hypotheses on coral physiology.

How do healthy corals maintain a stable partnership with their symbionts (see the figure, panels A and B), and how does this stability collapse under environmental stress? Similar questions have been posed for years in other better-studied host-pathogen and host-parasite interactions (*7*). Investigations of corals can be modeled on these studies. For example, which interpartner signaling events occur during initial contact between the partners? Does the host mount an innate immune response that is in turn modulated by the invading symbiont? And how does interpartner signaling and regulation change during the dysfunction and collapse of a symbiosis?

Recent studies in corals and anemones have started to address these questions. Initial interpartner lectin-glycan signaling events—so well described in other host-microbe interactions (*8*)—are present in corals during the onset of symbiosis, and a wide array of lectins have now been described in anemones (*9*). It remains to be shown to what extent these events confer interpartner specificity and whether there are other signaling mechanisms. Once inside the host cells, symbionts alter host

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Thank you…