Improving Research on the Physiological and Ecological Responses to OA

BOG IV

A: What science needs to be done

1. OMICs:
   1. what, who, and where do we sequence?
   2. Can be used as broad indexes of diversity, species presence/absence, emergent processes of co-expression
   3. Need for curation standards and repositories
2. Autonomous Monitoring:
   1. Desire for Marine Labs and Sentinel Stations to co-locate chemical and biological sampling
   2. Use remotely sensing to inform lab experimental treatments

A: What science needs to be done

3. Adaptation/Evolution Studies:
    1. Cost of adaptation to organisms
    2. Behavioral Adaptation
    3. Lessons from examples where adaptation has occurred
4. Paleo-biology, -ecology
    1. Comparing historical responses to short term manipulations
    2. Need more reliable, high precision proxies
5. Organismal Physiology to Ecology
    1. Cellular/molecular processes (biomineralization, acid/base, other cell functions and processes)
    2. Limited by need for tools and microelectrodes
    3. Species demographics and interactions studies
9. Time Frame of Responses
    1. Duration of experiments and temporal scales of physiology, ecology, and adaptation
    2. Biorhythms in culture vs. in situ
    3. Recovery from ‘bottle shock’

A: What science needs to be done

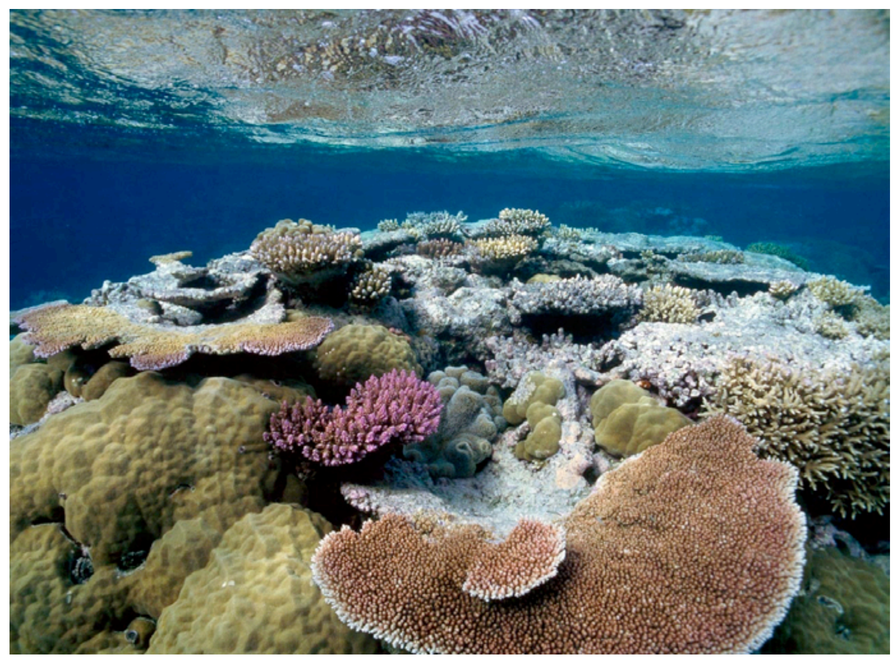
7. Extrapolating from the Lab to the Field: How do we scale up?
    1. Quantitative/theoretical ecology, mathematical frameworks and validation of these models
    2. Physiological tipping points at the population level (lessons from the lab and detection in the field)
    3. Multiple stressor studies and food-web interactions
8. Clearly Defining Terminologies and Best Practices

B: What can we learn from other systems? (e.g. terrestrial, freshwater)

1. Review examples where oceanographic and terrestrial data reflect well (e.g. continuous plankton recorder surveys)
2. Consider using genomically enabled model systems (e.g. *Arabidopsis*, *Drosophila*, and *Daphnia*)
3. Successes and challenges from the past
    1. Difficulties scaling from lab to field
    2. Importance of long-term monitoring at appropriate spatio-temporal scales
    3. Large scale manipulations and FACE/FOCE experiments (pros and cons)
    4. Acid rain, habitat fragmentation, and climatological effects
4. Land/sea connections and terrestrial processes driving chemistry
5. Limitations for the comparisons (dimensionality (2D vs. 3D), connectivity, omnivory)
6. Great Lakes research (NOAA), Santa Fe Meeting Report

C: What are the barriers to these approaches?

1. Infrastructure offerings/facilities
2. Common Language to breakdown interdisciplinary boundaries (biologists/mathematicians)
3. Education/exposure to stakeholders
4. Communicating science to policy makers



D: How to facilitate science?

1. Collaborations
    1. What groups can we identify? (e.g. regional, taxonomic)
    2. Working groups using existing infrastructure or following successful examples (Ideas Labs, NASCENT, NCEAS, GLOBEC, ASLO emerging issues)
    3. Develop programs that facilitate interaction at the graduate level
    4. Make contacts early on in research program, especially during proposal preparation to take advantage of cross-directorate RFPs
    5. List of analytical opportunities (chemistry, OMICs, nutrients, etc.)
2. Synthesis and Modeling
    1. Raise awareness of existing data sets and how to access them
    2. Reviews and Meta-analyses (3 published in 2010)
3. Finding Untapped Funding Resources
    1. Reach out to industry (e.g. workshops with fisheries)
    2. Philanthropic resources (e.g. donor research cruises)
    3. OCB or National Program/Interagency group in facilitation

E: What can we do NOW?

1. OCB Support on Specific Activities
    1. Summarization of what we know
    2. Best Practices for cross calibration of approaches/ methods (beyond chemistry) and clear definitions
    3. Scoping vs. Synthesis Workshops
    4. OA Gordon Research Conference?