Competition experiments of pCO2-conditioned clones in artificial communities; conducted in the Hutchins Laboratory, University of Southern California from 2009-2010

Website: https://www.bco-dmo.org/dataset/3813
Version: 2012-11-20

Project
» Experimental studies to understand and evaluate acclimation of marine plankton assemblages to increased CO2 and temperature (Plankton acclimation)

Contributors	Affiliation	Role
Caron, David	University of Southern California (USC)	Principal Investigator
Fu, Feixue	University of Southern California (USC)	Co-Principal Investigator
Hutchins, David A.	University of Southern California (USC)	Co-Principal Investigator
Schnetzer, Astrid	University of Southern California (USC)	Co-Principal Investigator
Tatters, Avery	University of Southern California (USC)	Contact
Groman, Robert C.		BCO-DMO Data Manager

Table of Contents

Dataset Description

The “Switch” competition experiments conditioned clones at each pCO2 were competed in artificial communities at two other pCO2 levels. This experiment was performed after 12-months.

A flow chart of the experimental design is shown in Figure 1, including collection and incubation of the natural bloom in a short-term (2 week) pCO2 experiment, isolation of cells of all four species from each pCO2 treatment, conditioning of the isolates at the pCO2 from which they were isolated for one year, and recombining isolates into artificial communities to compete for 2-week periods following 4, 8 and 12 months of conditioning. Growth rates of each species were assessed during conditioning in unialgal cultures at the 8-month timepoint, as well as in mixed communities during the initial bloom experiment and the 12-month artificial community experiment. These data are available as a separate data set called Dinoflagellate Evo.

Methods & Sampling

Clonal culture isolations

Three individual cells representing the four dominant genera were isolated from each incubation bottle at the end of the two-week incubation of the natural community, and maintained in long-term culture (52 weeks) at the pCO2 from which they were obtained under conditions of temperature, light, nutrients, CO2 bubbling, etc., identical to the 2-week natural community experiment. Cultures were maintained in exponential phase using autoclave-sterilized enriched seawater growth medium with semi-continuous weekly dilutions based on specific growth rates within each bottle, calculated as in Tatters et al. (2012). The approximate number of generations

during this time period was: *L. polyedrum* (48-62), *P. micans* (58-71), *Alexandrium* sp. (34-38) and *Gonyaulax* sp. (75-126).

Artificial community competition experiments

The conditioned clonal cultures were recombined into artificial communities after 4, 8 and 12 months in the same relative proportions and cell densities as the original natural bloom assemblage. The 8- and 12-month experiments used triplicate communities of all four species, but due to logistical limitations, the 4-month experiment used only *L. polyedrum*, *P. micans*, and *Alexandrium* sp. in duplicate communities. Because *Gonyaulax* sp. was not included in this preliminary 4-month experiment and replication was different, it is not fully comparable to the other experiments. The dinoflagellates in the artificial community trials were allowed to compete under identical experimental conditions of light, temperature, nutrient availability, and pCO2 for the same time period and diluted exactly as in the original natural bloom incubation. Samples were collected for cell counts and carbonate system parameters (Table 1) in all experiments.

Switch experiment

A triplicated CO2 switch experiment at the 12-month time point consisted of 'switching' low CO2-conditioned cell lines to medium and high CO2 (low --> medium and low --> high), medium CO2-conditioned cell lines to low and high CO2 (medium --> low and medium --> high), and high CO2-conditioned clones to low and medium CO2 (high --> low and high --> medium). The same experimental bottles employed in the 12-month artificial community experiments described above were used to provide appropriate controls of low --> low, medium --> medium, and high --> high. Other than the switched pCO2 treatments, protocols for these trials were exactly the same as in the other artificial community experiments.

Data Processing Description

For the 12-month switch competition trials, we used final cell abundances from all treatments to examine the comparative effects of differing pCO2 competition levels and differing pCO2 conditioning levels. Using a two-way crossed design for the ANOSIM routine, we tested the average effect on overall community structure and on the four individual species separately of pCO2 levels during competition removing differences in conditioning pCO2, and the average effect of conditioning pCO2 removing differences in competition pCO2 (Clarke and Warwick, 2001).

Literature Cited

Clark, K. R., and R. M. Warwick. 2001. Change in marine communities: an approach to statistical analysis and interpretation. 2nd edition. PRIMER-E, UK.

[table of contents | back to top]

Data Files

File
switch_competition.csv (Comma Separated Values (.csv), 2.47 KB) MD5:d64bbe3e6a1abd5a420bd8bd6ef677fd Primary data file for dataset ID 3813

[table of contents | back to top]

Parameters

Parameter	Description	Units
CO2_partial_pressure	Start and end partial pressures	n/a
species	Species name	n/a
sample	Sample name, A, B, or C	n/a
growth_rate	Growth rate	divisions per day
count	Count of the cells	cell counts per mL

[table of contents | back to top]

Deployments

lab_Hutchins_09-10_plankton

Website	https://www.bco-dmo.org/deployment/58891
Platform	USC
Start Date	2009-09-20
End Date	2010-12-31
Description	Hutchins laboratory, University of Southern California Comparing short vs. long term acclimation of a dinoflagellate community Experiments conducted as part of project titled, "Experimental studies to understand and evaluate acclimation of marine plankton assemblages to increased CO2 and temperature".

[table of contents | back to top]

Project Information

Experimental studies to understand and evaluate acclimation of marine plankton assemblages to increased CO2 and temperature (Plankton acclimation)

Coverage: Bloom sample retrieved from near-shore water near Venice Beach, CA

Progressing ocean acidification and increasing sea surface temperature may significantly impact marine plankton community structure and community-level processes. Yet, our ability to predict specific responses is still limited because of the tremendous taxonomic complexity of microbial assemblages and the limitations of the methodological and experimental tools presently available to test specific hypotheses. Research to study community level effects due to a changing CO2/temperature regime often involve short-term field incubations that subject organisms to simulated 'greenhouse' conditions. A central question for understanding global climate change is whether the trends and patterns that are observed in communities during short-term manipulations can be extrapolated to the responses of fully acclimated plankton communities over decadal or longer timescales.

The specific objectives of this research program are: 1) to examine how protistan communities restructure in response to increased seawater CO2 concentrations and temperature in semi-continuous field incubation experiments, and 2) to evaluate if the dominant algal species that are isolated from either ambient or increased CO2 and temperature treatments in field experiments will re-establish dominance under the same conditions in acclimated laboratory culture competition studies. Changes in community structure of natural protistan assemblages in our experimental treatments will be followed using image-based methods (flow cytometry, FlowCAM and microscopy) in combination with state-of the art molecular tools (DNA fingerprinting). Molecular approaches have begun to reveal an incredible high diversity for marine microbes and stimulate debate in regard to the ubiquitous presence of a microbial 'Rare Biosphere' that is, the presence of a huge number of species that are present at extremely small percentages of the total abundance of microbes, among a much smaller percentage of dominant ones. Little is known about the ecological significance of these rare species, and the investigators hypothesize that change in CO2 and temperature will select for some of these members

that are inconspicuous under ambient conditions.

The unique aspect of this experimental approach is the combined use of field incubations that encompass entire natural microbial assemblages, with a series of laboratory culture competition trials that focus on the same groups of algae after extended acclimation, to evaluate the validity of short-term experiments that examine changing CO2 and temperature. First, field incubation experiments will be conducted to characterize changes in protistan community structure under ambient and future CO2/temperature regimes. Second, clonal algal strains will be isolated from dominant taxa in present day and greenhouse treatments, and cultivated for extended periods under their 'preferred' CO2/temperature conditions. Finally, mixtures of these acclimated strains will be competed against each other, to re-examine their responses to ambient and greenhouse conditions and compare them to the responses observed in the unacclimated field incubation experiments.

Two graduate students will make this project the focus of their Ph.D. research at USC, and undergraduate students will be involved in the field and laboratory work. Results from this research will be incorporated in lesson plans on microbial diversity and global climate change. Dissemination of data and results is planned on a project website. The PIs in this project also participate in an on-going, innovative, NSF-funded program (Centers for Ocean Science Education Excellence; COSEE-West) which focuses on personal involvement of faculty in a custom framework to allow an effective connection with K-12 teachers, thus improving math and science education in disadvantaged parts of Southern California.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0962309

[table of contents | back to top]