

DATA MANAGEMENT PLAN

Introduction - Data management will be coordinated by the Principal Investigator/Program Director (PI/PD) (Dr. Koch) and carried out by all project participants. The plan encompasses policies, standards, and data preservation and archival.

I. Data Description and Type - Our experiments and mechanistic studies will generate physiological, biochemical and ecological data. The raw physiological data will primarily be used to construct physiological response models and parameters. Ecological data that will be generated include growth and calcification rates of marine macroalgae; more specific characteristics of sites of calcification and crystal morphology in response to treatments will also be generated. We will also be generating educational materials in the form of posters for viewing at the Gumbo Limbo Lab (see proposal Broader Impacts).

II. Existing Data - The experiments proposed are primarily focused on generating new data. However, our recent synthesis of the literature on this topic published in *Global Change Biology* entitled “Climate change implications for tropical macroalgae, seagrasses and their ecosystems” (Koch et al. 2013) provides a platform to further our understanding of how marine autotrophs will respond to predicted OA and warming. We have also utilized our existing experimental data and ongoing research on macroalgal effects of OA and temperature to optimize our mesocosm experiments and set the number of replicates required based on power analysis ($n = 6-9$); these data have led us to include multiple aquaria for treatments ($n = 9$) to increase our replication. Our ongoing research will also provide a community-level response of macroalgae to OA x temperature x light interactions; ongoing settlement plates and reef substrate with several fleshy and calcareous species are being examined in ongoing experiments in the experimental system. These results will be available to compare to organismal, mechanistic data acquired in this study. We also have preliminary data that is presented in the proposal and ongoing experiments on 4 levels of $p\text{CO}_2$ and initial physiological and inhibitor optimization studies (Koch and Joles) for *Halimeda discoides*.

III. Metadata – Data will be archived with the Biological and Chemical Oceanography Data Management Office (BCO-DMO; <http://bcodmo.org/>) to enhance the dissemination and meta-analysis of the data generated in this project. We will also upload data, reports and manuscripts generated from our research to SOFIA (South Florida Information Access; <http://sofia.usgs.gov/index.htm>) database. Metadata information and datasets will be published using an established XML specification, Ecological Metadata Language (EML). We will also work with COSEE Florida to ensure the wider dissemination of our educational materials.

IV. Data Organization/Storage and Backup - Raw data will be recorded into numbered lab books; data will be copied and stored into notebooks on a weekly basis. The raw data files will be in Microsoft Office Excel using the following formatting: Project, Experiment, Species, Parameter, Date (e.g., Mech1HalimedaPI08012014); files generated in statistical, modeling and image software programs will conform to a similar systematic standard file naming. We will also set up a secure ftp site where all researchers on the project can readily access newly generated data files and post messages and discussions.

V. Quality Assurance - Digital data will be verified once put into the database with field logs. Outliers will be flagged when data are being collected to ensure the possibility of re-running assay or analyses. PIs will work closely with PhD students to ensure they are following quality control protocols and are following metadata recording standards. Regular meetings will also be set up to discuss any problems that arise in data collection and/or analyses amongst the group.

VI. Policies for access and sharing and provisions for appropriate protection/privacy - The scientific data generated will not have any ethical and privacy issues. Data collected under the project will be made available to the public with as few restrictions as possible. We plan for publication of most data with

metadata after primary publication of results, or at most two years after the completion of the study. The following are conditions for use of our data:

1. The user of data agrees to contact the data owner (i.e., the project investigator responsible for data) prior to publishing. Where appropriate, users whose projects are integrally dependent on our data are encouraged to consider collaboration and/or co-authorship with the data owner.
2. The user agrees to cite our project in all publications that use our data by including the following statement in the Acknowledgments using this statement: "Data were provided by the [PROJECT NAME] Project funded by the US National Science Foundation ([AWARD NUMBER])".
3. The user agrees to send the full citation of any publication using our data to our project email address.
4. Users are prohibited from selling or redistributing any data provided by our project.
5. Extensive efforts are made to ensure that online data (from website) are accurate and up to date, but we will not take responsibility for any errors that may exist.
6. Any violation of the terms of this agreement will result in immediate forfeiture of the data and loss of access privileges to other project data sets.

VII. Audience, Policies and provisions for re-use, re-distribution – The primary users of the scientific data from our experimental work will be resource managers, scientists and government representatives. Our scientific data and experimental set up will be of interest to other scientists working on climate and CO₂ impacts on marine ecosystems. Because of the anticipated interest in the data, Dr. Koch will update her personal web site and lab facebook page to highlight project results on an annual basis and disseminate the data to date in the annual reports to NSF and upload to metadatabases. Drs. Koch and Bowes will attend international meetings and OA workshops to present our results and write several manuscripts based on our work on the effects of *p*CO₂ and temperature and their interactive effects on important marine autotrophs. We will seek out modelers who are working in this area and ensure their accessibility to our data in a collaborative effort to parameterize and validate climate change models working on tropical marine ecosystems (e.g., reefs).

VIII. Plans for Archiving and Preservation of Access - All raw data materials, copied logs in notebooks, files, reports/documents/manuscripts and information gained in film production will be retained at FAU by Dr. Koch for the period of 3-10 years. We anticipate that most of the synthesized data will be reported in manuscripts and reports to NSF; thus, will be stored in the journal archives electronically and at NSF, as well as in formal databases (described above).

IX. Responsibility for Data Management – Dr. Koch will have the responsibility to manage all data and ensure that it is placed into the formats above. Drs. Koch, Bowes and Zhang will be responsible for designing and implementing the YEAR 1 mechanistic experiments, subsequent analyses and publications. Dr. Koch will have responsibility for the YEAR 2-3 growth and physiology experiments in the mesocosm and calcification measurements and analyses. Dr. Zhang will have responsibility for Rubisco and pigment measurements and training PhD students on these assays. The ftp site will facilitate data sharing amongst personnel on the project and assist in managing the data and working as a team. Dr. Koch will be responsible for integrating results into manuscripts and uploading data into metadatabases (above).

X. Budget – No specific budget is requested for the data management protocols outlined above, as they are standard operating procedures and are embedded into the research budget of the proposal.