Annual coral colony surface area and perimeter measurements from Maui, Hawaii, 1999-2005 (HI Coral Reefs project)

Website: https://www.bco-dmo.org/dataset/535656
Version: 2014-10-16

Project
» CAMEO: Multiscale modeling of Hawaii's coral reef communities (HI Coral Reefs)

Program
» Comparative Analysis of Marine Ecosystem Organization (CAMEO)

Contributors	Affiliation	Role
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Dataset Description

Annual surface area measurements of coral colonies in images of 0.37m^2 quadrats at stations around Maui, Hawaii 1999- 2005 associated with the Hawaiʻi Coral Reef Assessment and Monitoring Program (Hawaiʻi - CRAMP).

Access to this data is restricted until June 2015. Please contact the M. Ross [mcolvin@hawaii.edu] for further information.

Methods & Sampling

Colony size and transition data were extracted from digital images of permanently marked quadrats provided by the Hawaii Coral Reef Assessment and Monitoring Program (CRAMP) and the Hawaii State Division of Aquatic Resources (DAR). In 1999, CRAMP/DAR established nine long-term monitoring locations around Maui, Hawaii (Jokiel et al. 2004) with two 100m transects at each location. In 1999, five 0.37 m2 quadrats were randomly located along each transect and permanently marked with stainless steel pins. These permanent quadrats were photographed annually from 1999 to 2005 (Brown 2004). At least five years of useable images are available for eight locations over that time period.

Data Processing Description

In each photoquadrat, every colony (defined as contiguous coral tissue) was traced and measured using

Adobe Photoshop CS5.1 (the scale bar was set for each image). Individual colonies were named and tracked from year to year, and we used a custom JavaScript to export these measurements from Photoshop. For QA/QC, we flagged and checked colonies with unusual perimeter to area ratio. Substantial further analysis of growth, mortality, fission, and fusion rates flagged anomalous colonies, which we checked and retraced or relabeled as necessary. The primary source of error in these measurements comes from parallax when the camera angle changes slightly from year to year; as a percent of area, this error is larger for smaller colonies.

Colony numbering code methodology: A distinct colony code was assigned. It applies to each physiologically distinct colony in the quadrat. Individual colonies of each species in each quadrat were numbered starting from 01. A physiologically distinct colony retained the same colony number across all years. If a colony recruited after the first year, the next number in the series would be used. In colonies that underwent fission, the largest colony retained the original number and any smaller colonies resulting from the fission event were given the same number as the parent colony (largest fragment) with the addition of a lowercase letter starting from 'a'. If a colony assigned a number/letter combination underwent fission, resulting colonies were given the same name as the parent with a second letter added to the end of the name. For instance, if colony 01 underwent fission and made one smaller colony, the larger colony would continue with the name 01 and the smaller colony would be named 01a. If, in a subsequent year, colony 01a underwent fission and made one smaller colony, the larger colony would retain the name 01a and the smaller colony would be named 01aa.

Each year, every colony was assigned a fate observed between year t and year t-1. D = death, I = fission (one colony splits into two or more colonies), M = fission and fusion (one colony undergoes both fission and fusion in one year), N = new (code given to the measurement of a colony in the first year of the project), R = recruit (new, small colony), S = survival (colony persists from year t to t+1), U = fusion (two physiologically distinct colonies merge into a single colony and take the name of the larger colony), X = phoenix (colony was present in year t-1, not visible in year t, but reappeared in year t+1).

When two colonies fused together, the largest colony retains its colony number and the smaller colonies (now a part of this larger colony) are not recorded in subsequent years. Fusee is the name of the large colony with which the smaller colony fused that year.

References:

Brown, E.K., Cox, E., Jokiel, P.L., Rodgers, S.K., Smith, W.R., Tissot, B., Coles, S.L., and Hultquist, J. (2004) Development of Benthic Sampling Methods for the Coral Reef Assessment and Monitoring Program (CRAMP) in Hawai'i. Pacific Science 58:2 pp. 145-158 doi: 10.1353/psc.2004.0013

Jokiel, P.L., Brown, E.K., Friedlander, A., Rodgers, S.K., and Smith, W.R. (2004) Hawai'i Coral Reef Assessment and Monitoring Program: Spatial Patterns and Temporal Dynamics in Reef Coral Communities. Pacific Science 58:2, pp. 159-174 doi: 10.1353/psc.2004.0018

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Data Files

File
coral_colony_size.csv (Comma Separated Values (.csv), 975.15 KB) MD5:277cd89bd21b62c3c6b331e7ae6a872f Primary data file for dataset ID 535656

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Parameters

Parameter	Description	Units
island	island name	unitless

site	site name: HonN = Honolua Bay North; HonS = Honolua Bay South; Kahe = Kahekili Beach Park; KanB = Kanahena Bay; KanP = Kanahena Point; Molo= Molokini; Olowaa = Olowalu; Papa = Papaula; Puam = Puamana	unitless
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
depth	average depth of the transect to nearest meter.	meters
quadrat	photoquadrat number	1 to 5
species	species name	unitless
colony	colony identification code	unitless
year	year colony photo was taken	YYYY
allfate	string of characters representing all of the fates observed for that colony up to the current year	unitless
fate	code describing colony activity over previous year: D = death; I = fission (one colony splits into two or more colonies); M = fission and fusion (one colony undergoes both fission and fusion in one year); N = new (code given to the measurement of a colony in the first year of the project); R = recruit (new; small colony); S = survival (colony persists from year t to t+1); U = fusion (two physiologically distinct colonies merge into a single colony and take the name of the larger colony); X = phoenix (colony was present in year t-1; not visible in year t; but reappeared in year t+1)	unitless
fusee	the name of the larger colony with which the smaller colony fused	unitless
area	surface area of the colony as measured from photograph	cm^2
perimeter	perimeter of the colony measured in the photoquadrat image	cm^2

peri_area	ratio of perimeter: area	unitless

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Instruments

Dataset-specific Instrument Name	camera
Generic Instrument Name	Camera
Dataset-specific Description	digital camera
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

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Deployments

Donahue_2014

Website	https://www.bco-dmo.org/deployment/535678
Platform	lab UHawaii_SOEST
Start Date	1999-01-01
End Date	2005-12-31
Description	Long term monitoring of coral reefs.

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Project Information

CAMEO: Multiscale modeling of Hawaii's coral reef communities (HI Coral Reefs)

Coverage: Hawaiian Islands

From the NSF award Abstract:

A key challenge in the effective management of marine ecosystems is translating from small scale studies of distribution and dynamics to the regional scale of management action. In many marine ecosystems, including the Hawaiian Archipelago, there are extensive survey data of nearshore communities from multiple investigators, representing a huge investment of resources. Often, these data are underutilized and remain of limited use to managers. In the Hawaiian Archipelago, at least seven separate entities are engaged in surveys of coral reef communities, with varying degrees of coordination. The synthesis of these data requires integrated modeling approaches at multiple scales. This study builds on an existing database and extends two existing models: the Coral Recovery Model (CRM) of stochastic coral recovery after disturbance and the COMBO model of the synergistic impacts of increasing acidification and temperature on coral reefs. Extending from this prior work is the application of two innovative modeling approaches (scale transition theory and fundamental niche modeling) to predict coral community composition and dynamics at the regional scale. Fundamental niche modeling uses multiple data fitting approaches (regression, machine learning, etc) to describe the relationship between species and their environments, using a split dataset for training and validation. This approach can generate a predictive and validated spatially continuous model of species distribution from discrete data points. The scale transition modeling will use the completed database of species distributions as the landscape on which species interactions occur. These interactions are described by a local model, here, based on recruitment, growth, and mortality from the Coral Recovery Model. In scale transition theory, the local model plus landscape information on the distribution and co-distribution of organisms and their environments predicts how a species assemblage responds (locally and regionally) to changes in biotic and abiotic factors on the landscape.

This project will generate four products relevant to ecosystem-based management of the Hawaiian Archipelago, resulting in significant impacts beyond the research community: (1) A Hawaiian Archipelago-wide GIS database of coral distribution, benthic community data, fish surveys, and other data gathered by CRAMP, NPS (National Park Service), various divisions in NOAA, the Hawaii Division of Aquatic Resources, and other sources into a single GIS database; (2) Validated, predictive, and spatially continuous maps of coral species distribution throughout the Archipelago; (3) A validated Coral Recovery Model for coral reef mitigation in the Main Hawaiian Islands; (4) Prediction of coral community response to climate change throughout the Hawaiian Archipelago, based on known and predicted coral distributions and the COMBO model.

Publications resulting from this project:

Hoeke, R. K.; Jokiel, PL; Buddemeier, RW; Brainard, RE. "Projected Changes to Growth and Mortality of Hawaiian Corals over the Next 100 Years,", v.6, 2011.

Jokiel, Paul L. "The reef coral two compartment proton flux model: A new approach relating tissue-level physiological processes to gross corallum morphology,"*Journal of Experimental Marine Biology and Ecology, v.409, 2011, p. 1.*

Franklin, Erik C.; Jokiel, Paul L.; Donahue, Megan J. "Predictive modeling of coral distribution and abundance in the Hawaiian Islands,"*MARINE ECOLOGY PROGRESS SERIES*, v.481, 2013, p. 121-132.

Hoeke, Ron K.; Jokiel, Paul L.; Buddemeier, Robert W.; Brainard, Russell E. "Projected Changes to Growth and Mortality of Hawaiian Corals over the Next 100 Years,"*PLOS ONE*, v.6, 2011, p. e18038.

Jokiel, Paul L.; "The reef coral two compartment proton flux model: A new approach relating tissue-level physiological processes to gross corallum morphology,"*JOURNAL OF EXPERIMENTAL MARINE BIOLOGY AND ECOLOGY*, v.409, 2011, p. 1-12.

Jokiel, Paul Louis; "Ocean acidification and control of reef coral calcification by boundary layer limitation of proton flux", *BULLETIN OF MARINE SCIENCE*, v.87, 2011, p. 639-657.

Kuffner, Ilsa B.; Jokiel, Paul L.; Rodgers, Ku'ulei S.; Andersson, Andreas J.; Mackenzie, Fred T. "An apparent "vital effect" of calcification rate on the Sr/Ca temperature proxy in the reef coral Montipora capitata," *Nature Geoscience*, v.13, 2012, p. 114-117.

Jokiel P. L. "Coral reef calcification: carbonate, bicarbonate and proton flux under conditions of increasing ocean acidification,"*Proc R Soc B*, v.vol. 28, 2013, p. 20130031.

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Program Information

Comparative Analysis of Marine Ecosystem Organization (CAMEO)

Website: http://www.nsf.gov/geo/oce/programs/CAMEO_Webpage.jsp

CAMEO Science Plan (2012).

The Comparative Analysis of Marine Ecosystem Organization (CAMEO) program was implemented as a partnership between the NOAA National Marine Fisheries Service and National Science Foundation Division of Ocean Sciences. The purpose of CAMEO was to strengthen the scientific basis for an ecosystem approach to the stewardship of our ocean and coastal living marine resources. The program supported fundamental research to understand complex dynamics controlling ecosystem structure, productivity, behavior, resilience, and population connectivity, as well as effects of climate variability and anthropogenic pressures on living marine resources and critical habitats. CAMEO encouraged the development of multiple approaches, such as ecosystem models and comparative analyses of managed and unmanaged areas (e.g., marine protected areas) that can ultimately form a basis for forecasting and decision support. Central to the program was the emphasis on collaborations between academic and private researchers and federal agency scientists with mission responsibilities to inform ecosystem management activities. (adapted from CAMEO website)

This funding opportunity implemented CAMEO research by supporting the development of research tools and strategic approaches through the following types of proposals:

1. Development of strategies and methodologies for comparative analyses that can be applied consistently across spatial and temporal scales and ecosystems, and that facilitate the design of decision support tools for marine populations, ecosystems and habitats.

2. Development of models that address key scientific questions by comparing ecosystems and ecosystem processes. Models that are geographically and temporally portable, and that incorporate assessment of modeling skill, are particularly encouraged.

3. Retrospective studies that analyze, re-analyze or synthesize existing information (historic, time-series, ongoing program, etc.) using a comparative approach.

4. Studies that integrate the human dimension within ecosystem dynamics. The CAMEO program seeks to promote interdisciplinary research using comparative approaches to link marine ecosystem research with the social and behavioral sciences in new and vital ways.

To guide program priorities, a Science Steering Committee was formed through Dr. Linda Deegan and the initial Scientific Planning Office at the Marine Biological Laboratory in Woods Hole, MA. This Committee was designed to provide scientific advice and broad direction to NOAA and NSF regarding the CAMEO program.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1041673

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