Percent of coral cover in 3, 20x40 m transects,Panama, 1984-2010 (EPac Corals projects I-VII)

Website: https://www.bco-dmo.org/dataset/516561
Data Type: Other Field Results
Version: 1
Version Date: 2014-06-10

Project

» Ecological Effects of the 1982/83 El Nino-Associated Disturbance to Eastern Pacific Coral Reefs (EPac Corals 1982/83 El Nino: I)
» Effects of the 1982-83 El Nino Event on Tropical, Eastern Pacific Coral Reefs: Disturbance, Recovery and Retrospective Analyses (EPac Corals 1982/83 El Nino: II)
» El Nino Impacted Coral Reefs In The Tropical Eastern Pacific: Secondary Disturbances, Recovery and Modeling of Population and Community Responses. (EPac Corals 1982/83 El Nino: IV)
» Effects of the 1982-83 El Nino Event on Tropical Eastern Pacific Coral Reefs: Disturbances, Causes, Recovery and Retrospective Analyses (EPac Corals 1982/83 El Nino: III)
» El Nino Impacted Coral Reefs in the Tropical Eastern Pacific: Secondary Disturbances, Recovery and Effects on Community Diversity and Reef Growth (EPac Corals 1982/82 El Nino: V)
» El Nino-Southern Oscillation 1982-83 and 1997-98 Impacted Coral Reefs in the Equatorial Eastern Pacific Region: Effects, Recovery and Inter-ENSO Comparisons (EPac Corals 1982/82 El Nino: VI)
» El Nino-Southern Oscillation Disturbances On Eastern Pacific Coral Reefs: Patterns And Mechanisms Of Recovery (EPac Corals 1982/82 El Nino: VII)

Programs

» Tropical Eastern Pacific Coral Reefs (TEP Corals)
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Contributors	Affiliation	Role
Glynn, Peter	University of Miami Rosenstiel School of Marine and Atmospheric Science (UM-RSMAS)	Principal Investigator
Fong, Peggy	University of California-Los Angeles (UCLA)	Co-Principal Investigator
Copley, Nancy	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract

Total coral cover surveys were conducted at the Uva Island coral reef (7o48'46"N, 81o45'35"W), Gulf of Chiriquí, Panama from 1984 to 2010.

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Coverage

Spatial Extent: **Lat**:7.814 **Lon**:-81.759
Temporal Extent: 1984-06 - 2010-03

Dataset Description

Total coral cover surveys were conducted at the Uva Island coral reef (7^{o}48'46"N, 81^{o}45'35"W), Gulf of Chiriquí, Panama from 1984 to 2010.

Acquisition Description

Survey methods: Chain transect; Large quadrat (20 x 40 m); Small quadrat (4 x 5 m)

Assessment of coral cover on the study reef began in 1974 (Glynn 1976) and continued to 2010. This was accomplished by fixed chain transect sites (n = 10 transects per survey period, 1974 to 2010) and by sampling fixed 1 m2 plots (n = 11 plots per survey period, 1994 to 2010) as well as a single 4 × 5 m2 plot (n = 1, with the 20 m2 plot subdivided into 20 1 m2 quadrats, 1984 to 2010). Chain transects were established along the ~350 m long forereef base zone between 3 and 5 m depth, relative to the mean lower low water (MLLW) tidal datum, in the mid-1970s from strictly random site locations determined from an Uva Island reef grid map with numbered axes (Glynn 1976). A second set of 10 fixed transects was located upslope from the reef base in 1985 to monitor denser coral cover at slightly shallower depths following the 1982-1983 mortality event (Glynn et al, 2014, Fig. 1C). Most benthic sampling was conducted near, but not within the fish transects (see 'fish species counts') to minimize diver presence. During each of 20 survey periods, 10 to 20 chain transects were sampled. Coral species live cover and substrate type (e.g. rubble, turf algae, sponges) were enumerated according to the chain links (73 links m-1) resting on these categories. The chain transect sampling was designed to determine the advance or retreat of live coral cover along the deep reef base and slope zones. Coral monitoring was carried out at different times during the 5 to 7 d sampling periods, usually 2 to 3 d before the fish monitoring.

The 1 m2 plots were located at the northern end of the reef in the reef slope and base zones representative of the fish transect substrate cover. The benthic composition and cover of the 1 m2 plots were drawn by divers underwater and then digitized using a flat - bed scanner, Adobe Photoshop and ImageJ software. Percent coral cover was determined by dividing the number of pixels representing coral within a quadrat by the total number of pixels in that quadrat. For each year of sampling of the 4 × 5 m2 plot, all 20 1 m2 quadrats were mapped and their composition and cover determined as in the 1 m2 plots above; these values were averaged to determine the total mean percent coral cover for each survey period. The 4 × 5 m2 plot was established by R. H. Richmond in the reef slope zone immediately following the 1982- 1983 El Niño event when coral cover on the forereef was reduced to near-zero values. This location was selected to monitor live coral recovery; it is situated at 1 to 2 m depth, between and slightly overlapping fish transects, Transects 1 and 2 (see Glynn et al, 2014, 'Fish monitoring'). Table S1 in the Supplement at www.int-res.com/articles/suppl/m495p233_supp.pdf summarizes all coral sampling records with information on time of sampling, season and number of samples completed.

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Related Publications

Glynn, P. W. (1976). Some Physical and Biological Determinants of Coral Community Structure in the Eastern Pacific. Ecological Monographs, 46(4), 431–456. doi:10.2307/1942565 [details]

Glynn, P., Enochs, I., Afflerbach, J., Brandtneris, V., & Serafy, J. (2014). Eastern Pacific reef fish responses to coral recovery following El Niño disturbances. Marine Ecology Progress Series, 495, 233–247. doi:10.3354/meps10594 [details]

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Parameters

Parameter	Description	Units
year	year	YYYY
month	month	MM
method	survey method: chain transect, large quadrat (20 x0 40 m), or small quadrat (4 x 5 m)	unitless
pcent_cover	percent of the quadrat surface covered with live coral	percent
replicate	replicate number or letter for a given survey method	unitless

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Deployments

Glynn_fish_transects

Website	https://www.bco-dmo.org/deployment/516249
Platform	Glynn_Uva_Island
Start Date	1980-01-13
End Date	2010-03-18
Description	Fish species surveys from 1980 - 2010 off Uva Island coral reef, Gulf of Chiriquí, Panama. 1980's: R/V Benjamin, Smithsonian Tropical Research Institute (STRI), research cruises supported by NSF 1990's: R/V Urraca, UNOLS fleet, (STRI), Republic of Panama, research cruises supported by NSF

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Project Information

Ecological Effects of the 1982/83 El Nino-Associated Disturbance to Eastern Pacific Coral Reefs (EPac Corals 1982/83 El Nino: I)

Coverage: Eastern Pacific

Effects of the 1982-83 El Nino Event on Tropical, Eastern Pacific Coral Reefs: Disturbance, Recovery and Retrospective Analyses (EPac Corals 1982/83 El Nino: II)

Coverage: Eastern Pacific

The severe 1982-83 ENSO (El Nino Southern Oscillation) event caused historically unprecedented and catastrophic disturbances to the Eastern Pacific coral reefs. In the aftermath of this event, disturbances to the reefs have continued and may have accelerated. Coupled with low coral recruitment, reef recovery could well take many years. The ecological effects and cause(s) of this regional disturbance have been investigated by a team of Latin and North American colleagues and students in Costa Rica, Panama, and Ecuador (Galapagos Islands) from 1983 to 1984 (Smithsonian Institution support) and from 1985 to 1987 (NSF support). This proposal focuses on coral reef recovery, disturbance processes per se, and retrospective analyses to be studied by a multidisciplinary, international team. Secondary or delayed disturbance effects that will be studied are (a) the disruption of biotic barriers allowing predator (Acanthaster planci) entry to coral prey refugia, (b) predator (corallivore) concentration on surviving coral prey, (c) post-El Nino sea urchin bioerosion of damaged reef frames, (d) damselfish colonization of damaged massive corals, and (e) damselfish/sea urchin/corallivore interactions vis-a-vis massive coral survival. Recovery processes will be studied chiefly with respect to the recruitment of calcifying organisms (corals and coralline algae) onto formerly occupied reef surfaces including examiniation of patch size, character of colonists (asexual or sexual propagules), and relative abundances of surrounding species. Retrospective studies (sclerochronology, oxygen and carbon stable isotope analyses, cadmium analysis, and fluorescent banding patterns) will also be performed on coral cores dating back at least to 1601 to provide a long-term record of ENSO disturbances. Since it is likely that major El Nino disturbances are recurring events, such information should provide a firm basis for understanding the processes controlling coral reef development and distribution in the tropical

eastern Pacific.

El Nino Impacted Coral Reefs In The Tropical Eastern Pacific: Secondary Disturbances, Recovery and Modeling of Population and Community Responses. (EPac Corals 1982/83 El Nino: IV)

Coverage: Eastern Pacific

This research will continue a long-term study that has focused on ecological disturbances to eastern Pacific coral reefs that accompanied the sever and historically unprecedented 1982-83 El Nino-Southern Oscillation (ENSO). The study involves international collaboration with host-county research teams and primary field sites in Costa Rica, Panama, and the Galapagos Islands (Ecuador), areas heavily impacted by the 1982-83 ENSO. Dr. Glynn will lead the research to continue (a) with the physical and biotic monitoring of eastern Pacific coral reefs initiated in the early-mid 1970s, (b) investigating the responses of different coral species to ENSO stressors, (c) studying coral reproductive ecology as it relates to recruitment success, and (d) documenting coral community recovery. New research directions include (e) remote sensing, which will attempt to link coral bleaching/mortality with local and global scale sea surface temperatures by means of synoptic and repeated measurements, and (f) modeling of coral population and community dynamics based on mechanistic relationships between temperature, predation, coral growth, and survivorship derived from field monitoring and experimental results. Because important secondary disturbances are still occurring and reef recovery has been slow, it is necessary to continue this study in order to understand the variety of changes involved and the full impact of a major disturbance on eastern Pacific coral survival and reef building. We are hopeful that ENSO warming disturbances can provide some insight to the probable changes in coral reefs worldwide if projected global warming causes repeated and/or protracted sea temperature increases comparable to the 1982-83 ENSO.

Effects of the 1982-83 El Nino Event on Tropical Eastern Pacific Coral Reefs: Disturbances, Causes, Recovery and Retrospective Analyses (EPac Corals 1982/83 El Nino: III)

Coverage: Eastern Pacific

This long-term study focuses on the ecological disturbances to eastern Pacific coral reefs that accompanied the severe and historically unprecedented 1982-83 ENSO (El Nino-Southern Oscillation) event. During the first 3-year segment (1985-87) of the study a strong causative link

was established between prolonged sea warming and numerous kinds of primary disturbances. During the first and second 3-year (1988-90) study periods the team of workers involved in this study have (a) demonstrated the importance of several secondary (long-term) disturbance processes, (b) revealed the extent of recovery and continuing reef destruction to date, and (c) provided some indication of the frequency of severe El Nino disturbances to coral reefs in an historical context. Because some important secondary disturbances are still occurring, and reef recovery has been slow (Costa Rica, Panama) or non-existent (Galapagos Islands), it is necessary to continue with this study in order to understand the variety of changes involved and the full impact of a major disturbance on coral reef survival and the potential for continued reef building. ENSO warming disturbances can provide some clues to the probable changes in coral reefs worldwide if global warming causes repeated and/or protracted sea temperature increases comparable to the 1982-83 El Nino event.

El Nino Impacted Coral Reefs in the Tropical Eastern Pacific: Secondary Disturbances, Recovery and Effects on Community Diversity and Reef Growth (EPac Corals 1982/82 El Nino: V)

Coverage: Eastern Pacific

This project will long term study that has focused on ecological disturbances, causes, and the responses of eastern Pacific reef coral populations and reef communities during and following the severe and historically unprecedented 1982 1983 El Nino / Southrn Oscillation (ENSO) event. This study involves strong international collaboration with host country research teams working at several field sites in Costa Rica, Panama, and the Galapagos Islands (Ecuador), all areas that were severely affected during the 1982 1983 ENSO disturbance. This study will continue with (a) monitoring the physical and biological conditions of eastern Pacific coral reefs initiated in the early to mid 1970s, (b) investigating the responses of different coral species to ENSO stressors (chiefly positive sea temperature anomalies) under controlled microcosm conditions, (c) studying coral reproductive ecology as it relates to recruitment success in field surveys, and (d) documenting coral community recovery or changes leading to alternate, non reef building communities. New research directions initiated in 1994 will be pursued, namely (e) an attempt to link coral bleaching/mortality with local and global scale sea surface temperature (SST) anomalies, and (f) modeling the size structure of coral populations and coral community dynamics based on mechanistic relationships between temperature, predation, coral growth, and survivorship derived from field monitoring and experimental results. In addition, (g) analyses of the molecular genetic structure of the different zooxanthella taxa found in eastern Pacific corals to assess the importance of zooxanthellae diversity in explaining the variability in patterns of coral bleaching, and (h) recovering coral populations, to assess their genetic structure and diversity in relation to population size and distance from source

populations, will be investigated.

El Nino-Southern Oscillation 1982-83 and 1997-98 Impacted Coral Reefs in the Equatorial Eastern Pacific Region: Effects, Recovery and Inter-ENSO Comparisons (EPac Corals 1982/82 El Nino: VI)

Coverage: Eastern Pacific

This project will occur over a five year period to continue and conclude a long-term study that has focused on ecological disturbances, causes, responses and recovery of eastern tropical Pacific (ETP) reef?building coral populations and reef communities in relation to the severe 1982?1983 El Nino?Southern Oscillation (ENSO) event. With the occurrence of the very strong 1997?1998 ENSO, two "one hundred year events" only 15 years apart, an unprecedented opportunity is at hand to study and compare the effects of consecutive major perturbations on community responses and recovery. This study involves strong international collaboration with host?country research teams working at several field sites in Costa Rica, Panam.6, and Ecuador (including the Gal6pagos Islands), all areas that were severely affected during the ENSO disturbances of 1982?83 and 1997?98. Several aspects of this study will be continued, namely (a) monitoring the physical and biological conditions of eastern Pacific coral reefs initiated in the early?to?mid 1970s~ (b) investigating the responses of selected zooxanthellate coral species to ENSO stressors (chiefly positive sea temperature anomalies), (c) retrospective climate studies from coral skeletal isotopic signatures, (d) coral reproductive ecology as it relates to recruitment success in disturbed communities, (e) coral community recovery or changes leading to alternate, non?reef building communities, (f) the linking of coral bleaching/mortality with local and global-scale sea surface temperature (SST) anomalies, including both high and low temperature extremes, and (g) modeling the size structure of coral populations and coral community dynamics based on mechanistic relationships between temperature, predation, coral growth and survivorship derived from field monitoring and experimental results. Additionally, studies initiated in 1997 will also be continued, namely (h) analysis of the molecular genetic structure of zooxanthella taxa symbiotic with eastern Pacific corals to assess the importance of zooxanthella diversity in explaining the variability in patterns of coral bleaching and mortality/survivorship of host corals, and (i) assessment of the genetic structure and diversity of recovering and recently stressed coral populations in relation to stress resistance, population size and distance from source populations. New initiatives will include (j) coral?algal?herbivore interactions, and (k) trophodynamic/benthic community structure modeling in high SST?stressed upwelling and non-upwelling environments in order to assess the effects of ENSO perturbations and recovery processes on coral reef framework growth.

El Nino-Southern Oscillation Disturbances On Eastern Pacific Coral Reefs: Patterns And Mechanisms Of Recovery (EPac Corals 1982/82 El Nino: VII)

Coverage: Eastern Pacific

This comprehensive and interdisciplinary study, focusing on El Nino-Southern Oscillation (ENSO) disturbances to eastern Pacific coral reefs, will broaden understanding of the impact and responses of coral reef ecosystems to climate change, particularly sea warming events and associated perturbations. The project is led by Dr. Peter Glynn and builds on a 35-year database of physical and biological studies, and involves a coordinated Latin American/U.S. network of teams working principally in Costa Rica, Panama, Colombia, and Ecuador (mainland and Galapagos Islands). Intellectual merit. The chief objectives of this project are to continue and expand investigation into the causes of coral reef decline (both immediate and long-term), and the responses of reef coral populations, communities and ecosystem function in relation to ENSO disturbances. Key directions are investigations into mechanisms supporting documented rapid recovery, limitations to recovery that provide insight into ecosystem function, and the potential for eastern Pacific reefs to act as model systems to understand future impacts of global change in other reef systems. Three elements of special significance that justify continuation of this multifaceted study are: (1) the long-term data base of eastern Pacific coral reef structure and reef-associated community composition pre-dating the first documented coral bleaching events of the 1980s, (2) the causal relationship between global warming and reef degradation with demonstrable effects on coral community structure, coral growth and reef accretion, and coral framework erosion, and (3) assessing future response potential and the capacity for acclimatization/adaptation in light of cumulative past responses. New initiatives in the continuing project include (a) experiments relating coral reproduction and algal symbiont community structure during periods of temperature change, (b) characterization of deep reef thermal conditions vis-a-vis coral refugia, (c) field observations/experiments to compare effects of reef framework loss on metazoan recruitment, species diversity, and feeding rates, (d) coring reef frames to reveal taphonomic signatures of known ENSO events in order to determine the frequency of previous events, (e) relating carbonate chemistry of reef waters, e.g., pH, alkalinity and aragonite saturation states, to coral skeletal growth and density, (f) investigations into trophic structure complexity using N, C and S isotopes, (g) genetic structure of coral host and symbiont populations utilizing molecular and ribosomal DNA and protein electrophoresis to document shifts in thermally-tolerant groups, and (h) modeling of energy flow and ecosystem trophic processes and complexity. Broader impacts. Peer reviewed publications now number 60, contributing to the disciplines of oceanography, paleoecology/paleoclimatology, geology, disturbance ecology (community recovery, phase shifts), trophodynamics, population dynamics (coral reproduction and recruitment, modeling, genetic structure and connectivity), and symbiont ecology. To date, 107 graduate and undergraduate students from Panama, Ecuador, Costa Rica, Colombia and the

USA (plus 9 other countries) have participated in the project, resulting in the completion of 39 Ph.D. dissertations, M.S. theses and Honors reports. Students are trained in field methods for physical and biological sampling, species identifications, underwater and laboratory experiments (including instrumentation, design and data analysis), and train others in their respective countries. These studies of ecological processes have aided in the establishment and management efforts of marine protected areas in Costa Rica (Cano Island National Park), Panama (Coiba National Park), and Ecuador (Galapagos National Park). In addition to international efforts, collaborator Peggy Fong has mentored 2 to 6 undergraduate researchers per quarter at UCLA over the last 10 years, many of whom are under-represented minorities in the federally supported outreach program.

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Program Information

Tropical Eastern Pacific Coral Reefs (TEP Corals)

Coverage: Tropical eastern Pacific

Tropical Eastern Pacific Coral Reefs (TEP Corals)

Coverage: Tropical eastern Pacific

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Funding Source	Award
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