





## WELCOME

to

### 50 YEARS OF CARIBBEAN MARINE RESEARCH: CHANGING SCIENCE, CHANGING ENVIRONMENTS, CHANGING PERSPECTIVES

It is our great pleasure to welcome all of you to the University of the Virgin Islands and the 33<sup>rd</sup> Scientific Meeting of the Association of Marine Laboratories of the Caribbean. Established in 1957, the AMLC is celebrating its 50<sup>th</sup> anniversary this year. To commemorate AMLC's contribution to half a century of marine science, we have designed a new logo which will carry us forward into the next century.

We have an exciting and well attended program this year focused on four keys areas: **Global & Regional Issues, Resource Management, Connectivity** and **Ecology**. AMLC has brought two excellent guest speakers, Dr. Rita Colwell and Dr. Craig Venter, to lead off this week's scientific program. We are also pleased to announce that this will be our first scientific conference featuring simultaneous English-Spanish translation in many years. This service and many other facets of this meeting were made possible through generous donations to AMLC. We want to take this opportunity to thank everyone who helped organize this conference including staff members of UVI's Center for Marine and Environmental Studies and AMLC's program committee. Thanks for a job well done!

During your time here we hope you will enjoy all that the US Virgin Islands has to offer. Due to our full program we have not included our traditional field trip day but have scheduled a number of trips throughout the week that you may take advantage of. In keeping with AMLC's mission we have provided many opportunities for social interactions which we hope will stimulate interesting discussions, foster collaborations and build friendships that will last a lifetime.

We wish you a successful and productive meeting and an enjoyable stay in St. Thomas.

**Rick Nemeth**

President, AMLC 2006-2007  
Director, Center for Marine and Environmental Studies  
University of the Virgin Islands.

**Steve LeGore**

AMLC Executive Director

# Program for the 33<sup>rd</sup> Scientific Meeting of the Association of Marine Laboratories of the Caribbean

<b>Monday, June 4, 2007</b>		
<b>8:00 AM REGISTRATION</b>		
<b>Time</b>	<b>Presenter</b>	<b>Title</b>
9:00 AM	<b>R. Nemeth</b>	<b>Welcome address by AMLC President</b>
9:05 AM	<b>L. Ragster</b>	<b>Welcome address by UVI President</b>
9:10 AM	<b>A. Barnes</b>	<b>Welcome address by DPNR Assistant Commissioner</b>
9:20 AM	<b>S. LeGore</b>	<b>Welcome &amp; Introduction of Dr. Colwell</b>
9:30 AM	<b>Dr. Rita Colwell</b>	<b>Keynote Address: “Marine Biotechnology in the 21<sup>st</sup> Century”</b>
10:00 AM	<b>COFFEE BREAK</b>	
<b>ECOLOGY</b>		
<b>Coral Growth, Calcification, Morphology</b>		
10:30AM	P. Miloslavich - chair	Reproductive biology of <i>Petalconchus cf. varians</i> (Caenogastropoda, Vermetidae) from the Venezuelan Caribbean
10:45 AM	I.M. Sandeman	Why coral calcification rates are higher in the light
11:00 AM	P. Spiniello	Carbon supply and demand on a coastal planktonic system, Morrocoy National Park, Venezuela
11:15 AM	A.T. Yñiguez	What’s in a form? Deciphering messages from the morphologies and growth patterns of <i>Halimeda</i> and <i>Dictyota</i>
11:30 AM	E.H. Gladfelter	Skeletal growth in <i>Acropora palmata</i> : its role in past competitive success and in future recovery
11:45 AM	M. Johnson	Using reef resilience principles to improve staghorn coral ( <i>Acropora cervicornis</i> ) restoration in the Florida Keys
12:00 PM	<b>LUNCH</b>	

**Monday, June 4, 2007**

**RESOURCE MANAGEMENT**

**Restoration**

1:15 PM	V.H. Garrison	Using naturally occurring fragments of elkhorn, staghorn and finger coral for reef restoration in the Caribbean
1:30 PM	J. Schittone	Monitoring the recovery of a coral reef following restoration after a large vessel grounding
1:45 PM	A. Thompson	El rol de las alianzas para la conservacion de los arrecifes coralinos – el caso de la alianza para el arrecife MesoAmericano de ICRAN (ICRAN-MAR)
2:00 PM	R. Garcia	Large-scale coral bleaching response plan for South Florida Reef Tract
2:15 PM	<b>COFFEE BREAK</b>	

**ECOLOGY**

**Ecology & Management of Deep (30-100m) Mesophotic Coral Reef Ecosystems**

2:45 PM	R. Ginsburg - chair	Mesophotic coral reefs are the frontier of reef exploration and research
3:00 PM	P. Yoshioka	Ecology, integrity & status of deep Caribbean coral reefs
3:15 PM	R. Ginsburg	Distribution of mesophotic deep water reef species in the Bahamas
3:30 PM	J. Rooney	Deep scleractinian coral reefs and multiple coral optima in the Hawaiian archipelago
3:45 PM	N. Santodomingo	Azooxanthellate coral communities of Colombian Caribbean
4:00 PM	C. Menza	A deep reef in deep trouble
4:15 PM	J.R. Garcia-Sais	Baseline characterization of the marine community associated with Agelas Reef, Isla Desecho, Puerto Rico
4:30 PM	<b>ADJOURN FOR DAY</b>	
6:00 PM	<b>COCKTAIL RECEPTION AND POSTER PRESENTATIONS</b>	

**Tuesday, June 5, 2007**

**8:00 AM REGISTRATION**

<b>Time</b>	<b>Presenter</b>	<b>Title</b>
8:15 AM	S. LeGore	Introduction of Dr. Venter
8:30 AM	Dr. Craig Venter	FEATURED SPEAKER

**CONNECTIVITY  
Genetics and Biodiversity**

9:15 AM	J.L. Stake - chair	Anonymous sequence markers for species-level phylogenetic analysis of the coral genus <i>Porites</i> (Scleractinia, Poritidae)
9:30 AM	E. Salas #	Connectivity and gene flow in <i>Stegastes partitus</i> (Perciformes: Pomacentridae) populations along Costa Rica and Panamá
9:45 AM	J. Hoffmann #	Recent thecideide brachiopods (Thecideoidea) in the Caribbean region – an unrecognized diversity
10:00 AM	D. Ruiz-Ramos #	Patterns of genetic polymorphism in the fire coral <i>Millepora</i>

**10:15 AM COFFEE BREAK**

**CONNECTIVITY  
Genetics and Biodiversity**

10:45 AM	P. Sammarco	Distribution, abundance, and genetic affinities of scleractinian corals throughout the northern Gulf of Mexico: the big picture
11:00 AM	A. Domingo	The missing link in the population biology of reef fishes: molecular ecology of larval dispersal in gobies
11:15 AM	A. Zubillaga #	A novel application of polyclonal antibodies to <i>in situ</i> detection of the larvae of <i>Acropora palmata</i> (Order: Scleractinia, Family: Acroporidae)
11:30 AM	J. García	Genetic variability of <i>Acropora cervicornis</i> and <i>A. palmata</i> in Puerto Rico

**11:45 AM LUNCH**

**Tuesday, June 5, 2007**

**RESOURCE MANAGEMENT**  
**Addressing Management Needs at Ecosystem Level**

1:00 PM	B. Devine - chair	Using GIS/GPS to characterize watersheds, evaluate land-based threats and map endangered marine populations
1:15 PM	E. Klein	The use of ecosystem-based models to select areas for the conservation of marine biodiversity in face of offshore gas exploitation in Venezuela
1:30 PM	M.E. Monaco	Characterization and assessment of the St. John, USVI mid-shelf area to support MPA management
1:45 PM	J.W. McManus	Managing coral reefs under changing stresses: information, simulation and interdisciplinary research
2:00 PM	M.A. Phillips #	Analysis of factors influencing southeast Florida coral reef community composition
2:15 PM	V.K. Kosmynin	Evaluation of methods to enhance reef restoration
2:30 PM	J.G. Foster	Acoustic surveys for discrimination of benthic habitats and biomass
2:45 PM	A. Nayegandhi	High-resolution geo-located imagery of benthic communities using the along track reef imaging system

**COFFEE BREAK**

**RESOURCE MANAGEMENT**  
**Marine Protected Areas**

3:30 PM	D. Aldana - chair	Mexican marine parks for restoring the Queen Conch <i>Strombus gigas</i>
3:45 PM	E. Kadison	Using hydro-acoustic tagging to determine the minimum size of fishery closures for protecting grouper spawning aggregations on the USVI
4:00 PM	P.M. Yoshioka	Fish mesograzers as ecological gatekeepers of coral reef communities
4:15 PM	C.E. Morrall	Marine protected area development in Grenada, West Indies
4:30 PM	A.R. Harborne	Reserve effects versus natural variation in coral reef communities

**ADJOURN FOR DAY**

**COCKTAIL RECEPTION AND POSTER PRESENTATIONS**

6:00 PM		
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**Wednesday, June 6, 2007**

**8:00 AM REGISTRATION**

**RESOURCE MANAGEMENT  
Assessment and Monitoring**

8:00 AM	T.J. Goreau - chair	Turks & Caicos Islands coral reef assessment methods: intensive vs. extensive field methods with non-parametric analysis
8:15 AM	T.J. Goreau	Turks and Caicos islands coral reef assessment results: Ecological and environmental interactions
8:30 AM	D. Gulko	CSI on coral reefs: developing standards for underwater injury investigation
8:45 AM	A. Rodriguez-Ramírez	Monitoreo de arrecifes coralinos en América sur tropical: Logros lecciones y perspectivas después de 8 años de trabajo cooperativo
9:00 AM	D.G. Zawada	A new towed platform for surveying benthic habitats
9:15 AM	R.N. Ginsburg	Progress in rapid reef assessments for routine censuses and acute ecological calamities
9:30 AM	S. LeGore	Rapid population assessment of marine ornamental fisheries target species in Western Puerto Rico
9:45 AM	W. Toller	The importance of herbivorous reef fishes (Scaridae and Acanthuridae) to the small-scale commercial fishery of St. Croix, U.S. Virgin Islands

**10:00 AM COFFEE BREAK**

**GLOBAL AND REGIONAL ISSUES  
Land-Sea Interactions**

10:30AM	H. Briceño -chair	Nutrient dynamics along a salinity gradient in the mangrove forest, Florida coastal Everglades
10:45 AM	J.N. Boyer	Relationship between water management and cyanobacterial blooms in Florida Bay, USA
11:00 AM	J. Blondeau	Monitoring terrigenous sedimentation rates on U.S. V. I. reefs: from near-shore to offshore
11:15 AM	R.H. Pierce	Assessing levels and effects of organic contaminants on marine mammals, especially Antillean Manatees, of the Wider Caribbean
11:30 AM	N.R. Buitrago #	Erosión costera en el Caribe Colombiano. Ejemplos: departamentos de Córdoba y La Guajira
11:45 AM	A. McCammon	Marine debris removal and monitoring effort at the Cas Cay Mangrove Lagoon Marine Reserve and Wildlife Sanctuary, St. Thomas, USVI

**12:00 PM LUNCH**

**Wednesday, June 6, 2007**

**GLOBAL & REGIONAL ISSUES**  
**Remote Sensing and Physical Oceanography**

1:15 PM	J.C. Brock - chair	Holocene sea level rise and the patch reef population in the northern Florida reef tract
1:30 PM	S. J. Pittman	Predictive mapping of fish species richness across shallow-water seascapes in the Caribbean
1:45 PM	R. Jaffe	Applications of optical properties determinations in surface waters for the assessment of dissolved organic matter in estuaries
2:00 PM	R.A. Watlington	Improved understanding of oceanic processes through an integrated Caribbean coastal ocean observing system
2:15 PM	R. Hays	An analysis of satellite-derived sea surface temperatures from Caribbean and Atlantic coral reef sites, 1982-2003
2:30 PM	D.J. Smith	Near-shore sea temperatures for St. Thomas
2:45 PM	N. Idrisi	Time series (2005-2007) of coastal currents on the shelf south of St. Thomas, USVI
3:00 PM	M. Vega-Rodriguez	Red mangrove litterfall dynamics and remote sensing of leaf area index in southwestern Puerto Rico

**COFFEE BREAK**

**ECOLOGY**  
**General**

3:45 PM	K. Lewis - chair	Abundance, distribution, and condition of the foraging populations of Green Sea Turtles ( <i>Chelonia mydas</i> ) around St. Croix and St. Thomas, USVI
4:00 PM	N.E. Chadwick	Anemone shrimp symbionts of Giant Sea Anemones on coral reefs: comparisons between the Red Sea and the Caribbean Sea
4:15 PM	S. Ratchford	Prevention of burial to host corkscrew anemones <i>Bartholomea annulata</i> by symbiotic snapping shrimps <i>Alpheus armatus</i>
4:30 PM	D. Aldana	Different reproductive strategies of American Oyster <i>Crassostrea virginica</i> in the Gulf of Mexico
4:45 PM	P. Susan #	Macrofauna bentónica asociada a bancos ostrícolas en las Lagunas Cost? Carmen, Machona y Mecoacán, Tabasco, México
5:00 PM	D. Banjoo	Assessment of biota quality in the Gulf of Paria, Trinidad and Tobago

**ADJOURN FOR DAY**

**Thursday, June 7, 2007**

**8:00 AM REGISTRATION**

**ECOLOGY**

**Coral Disease, Predation, Damage I**

8:15 AM	L.L. Richardson - chair	Toxin production and virulence factors in Black Band Disease on reefs of the Northern Caribbean
8:30 AM	K. Flynn #	Prevalence, distribution and virulence of Aspergillosis in <i>Gorgonia ventalina</i> (Gorgonacea: Gorgoniidae) populations in La Parguera, Puerto Rico
8:45 AM	J. Lentz #	Designing a methodology for the identification of significant coral disease clusters
9:00 AM	J.D. Voss	Coral disease dynamics and nutrient availability on reefs of the Northern Florida Keys and Lee Stocking Island, Bahamas
9:15 AM	M. Brandt	Coral disease and bleaching relationships in South Florida during the 2005-2006 bleaching event
9:30 AM	J. Miller	Coral bleaching and disease combine to cause catastrophic mortality on reefs in U.S.V.I.
9:45 AM	D. Williams	Effects of multiple hurricanes on <i>Acropora palmata</i> (Order: Scleractinia, Family: Acroporidae) in the Florida Keys (U.S.A.)

**10:00 AM COFFEE BREAK**

**ECOLOGY**

**Coral Bleaching**

10:30AM	T.B. Smith - chair	Searching for a refuge: impacts of the 2005 mass coral bleaching event on coral reefs of the U.S. Virgin Islands
10:45 AM	K. Woody	An assessment of the October 2005 coral bleaching event in and around Buck Island Reef National Monument, St. Croix, U.S. Virgin Islands
11:00 AM	S. Steiner	The impact of the 2005 bleaching episode on the stony corals of Dominica
11:15 AM	D.H. Green #	Coral recruitment along the southern coast of St. John, U.S. Virgin Islands: the influence of temperature in mediating spatio-temporal variation
11:30 AM	P.M.H. Gayle	Coral mortality and recovery on Jamaica's north shore reefs following the 2005 Caribbean Region bleaching event
11:45 AM	M.T. Schärer #	Prevalence of bleaching on scleractinian corals of Mona Island, Puerto Rico

**12:00 PM LUNCH**

**Thursday, June 7, 2007**

**ECOLOGY**

**Coral Disease, Predation, Damage II**

1:30 PM	E. Weil - chair	Status of coral and octocoral diseases / syndromes in Puerto Rico in 2006: preliminary results and general perspectives
1:45 PM	I.B. McRae - Kenny #	The incidence and prevalence of scleractinian coral diseases along the south coast of Jamaica
2:00 PM	J.L. Myers #	Culture, identification, DGGE analysis, and physiology of cyanobacteria associated with Black Band Disease of corals
2:15 PM	N.J. Quinn	The recent collapse of a rapid phase-shift reversal on a Jamaican coral reef
2:30 PM	T. Spitzack	Effects of bleaching and disease on elkhorn coral, <i>Acropora palmata</i> , in St. John, U.S. Virgin Islands
2:45 PM	<b>COFFEE BREAK</b>	
3:15 PM	K.B. Ritchie - chair	In search of mutualistic coral-associated bacteria
3:30 PM	L. Kaczmarek #	Sewage impact increases Black Band disease prevalence and might alter Black Band microbial community composition on reefs of St. Croix
3:45 PM	E. Weil	Local and geographic variability of the 2005 mass bleaching event in the wider Caribbean
4:00 PM	A.M. Szmant	New ciliate discovered that devours newly settled coral polyps
4:15 PM	D. Bone	Respuesta de los capiteldos (Annelida: Polychaeta) a variaciones de salinidad, Golfete de Cuare, Venezuela
4:30 PM	<b>ADJOURN FOR DAY</b>	
6:00 PM	<b>AWARDS DINNER – CORAL WORLD MARINE PARK</b>	

**Friday, June 8, 2007**

<b>8:00 AM REGISTRATION</b>		
<b>Time</b>	<b>Presenter</b>	<b>Title</b>
<b>ECOLOGY</b> <b>Reef Fish Ecology</b>		
8:30 AM	M.C. Paddock - chair	Assessing change on coral reefs: long-term trends in Caribbean reef fish abundance
8:45 AM	C. Rabascall	Abundancia y riqueza específica de la ictiofauna presente en cuatro estaciones del extreme north de la Península de Araya, Estado Sucre, Venezuela
9:00 AM	D. Nemeth	Among-site and between-species differences in monogenean parasite (Monopisthocotylea: Capsalidae) loads in two sympatric surgeon fishes (Perciformes: Acanthuridae) in the Virgin Islands
9:15 AM	C. Bastidas	Oceanic and coastal reefs in Venezuela 2003-2006: larger differences among sites than between shelf positions
9:30 AM	S. Frias-Torres	Behavior of juvenile goliath grouper, <i>Epinephelus itajara</i> , and its relevance for conservation
9:45 AM	A. Fariña	Variación Estacional De La Comunidad De Peces Asociados A Un Arrecife Rocosó Coralino Del Bajo Las Caracas, Estado Sucre, Venezuela
10:00 AM	<b>COFFEE BREAK</b>	
<b>CONNECTIVITY</b> <b>Recruitment / Habitat</b>		
10:30 AM	I. Nagelkerken - chair	What makes mangroves attractive fish habitat – their shallow depth. Cross-shelf location, or presence of structure
10:45 AM	K. Neely	Patterns of fish colonization on artificial reefs varying in live coral cover
11:00 AM	R.S. Nemeth	Identification of essential habitats for juvenile grouper in the U.S. Virgin Islands
11:15 AM	I. Nagelkerken	Utilization of shallow-water habitats by juvenile coral reef fishes in Bermuda
11:30 AM	A.M. Szmant	Settlement and post-settlement of the Caribbean scleractinian corals <i>Montastrea faveolata</i> and <i>Acropora palmata</i>
11:45 AM	S.M. Williams	Recruitment dynamics of <i>Diadema antillarum</i> in La Parguera, Puerto Rico
12:00 PM	<b>LUNCH</b>	

**Friday, June 8, 2007**

**SPECIAL SESSION  
Census of Marine Life**

1:15 PM	P. Miloslavich - chair	The census of marine life in the Caribbean: a biodiversity program
1:30 PM	E. Weil	Coral reef biodiversity in the wider Caribbean – new records of corals and the goals of the Census of Marine Life
1:45 PM	T.C. Shirley	Bulletin 89n Redux: Biodiversity of the Gulf of Mexico
2:00 PM	A. Antczak	A global perspective of human – mollusk interaction through history: the HMID Project
2:15 PM	A. Osorno	Implementación del protocolo NaGISA en praderas de pastos marinos ( <i>Thalassia testudinum</i> ) del Caribe Colombiano durante los años 2006 y 2007
2:30 PM	<b>COFFEE BREAK</b>	
3:00 PM	L.F. Artigas	Towards a Latin American and Caribbean international census of marine microbes: overview of some research directions
3:15 PM	M. M. Antczak	Insights into the Queen Conch ( <i>Strombus gigas</i> ) symbolism in the Caribbean: the claim for the contextual approach
3:30 PM	A. Gracia	Main results in the integrations of the marine biodiversity information system (SIBM) to OBIS
3:45 PM	J.J. Cruz-Motta	Natural geography in shores areas: the Venezuelan experience
4:00 PM	<b>STUDENT ACHIEVEMENT AWARDS FOR BEST PRESENTATIONS</b>	
4:30 PM	<b>ADJOURN MEETING</b>	

**Poster Program**  
**33<sup>rd</sup> Scientific Meeting of the Association of**  
**Marine Laboratories of the Caribbean**

ECOLOGY		
1	V. Acevedo-Soto	Effects of sedimentation on the distribution of the reef zoanthid <i>Palythoa caribaeorum</i>
2		
3	J.M. Calnan	Coral reefs in the US Virgin Islands: Trends and patterns of health across stress gradients
4	R.L. González-Marrero #	Role of staghorn coral <i>Acropora cervicornis</i> on coral reef fish recruitment
5	A.R. Harborne	Modeling the beta diversity of coral reefs
6	A. Humanes #	What does coral population size structure tell us?
7	A. López	Trophic structure of the fish community associated to seagrass meadow in Los Roques Archipelago National Park, Venezuela
8	M.Q. Lucas #	Molecular genetic analysis of three species of Caribbean <i>Porites porites</i> (Scleractinia: Poritidae)
9	B. Márquez	Biomasa y estructura de la comunidad zooplanctónica en dos estaciones de la Bahía de Mochima, durante 1998
10	B. Márquez	Abundancia de crustáceos decapodos asociados a las raíces sumergidas de <i>Rhizophora mangle</i> en la laguna de bocaripo, estado sucre, Venezuela
11	J. Mayre	Abundancia y riqueza de la macrofauna asociada a la fanerógama <i>Thalassia testudinum</i> (Bank ex König, 1805) en la localidad de los cachicatos, golfo de cariacó, Venezuela
12	E.L. McLean #	Patterns of associations and interactions among sponges and gorgonians
13	M. Medina	Variación estacional de la ictiofauna asociada a una playa de la Isla Caracas Oeste, Parque Nacional Mochima, Estado Sucre, Venezuela
14	A.E. Mercado-Molina #	Relation between water motion and size-specific survivorships of the demosponge <i>Amphimedon compressa</i>
15	M. Nelsen #	Modeling of population dynamics of the corkscrew anemone <i>Bartholomea annulata</i> on Caribbean coral reefs
16	E. Parish #	Macroalgal substrate affects movement of the long spined sea urchin <i>Diadema antillarum</i>
17	S.M. Pauls	Spatial and temporal variability in the prevalence of black band disease affecting the coral <i>Diploria strigosa</i> at Mochima Bay, Venezuela

## Poster Program

ECOLOGY		
18	J. Perez-Benitez	Interacciones competitivas directas en tres zonas del arrecife dos mosguises sur, P.N. Archipiélago Los Roques, Venezuela
19	S. Piontek	Preliminary list of fishes from the Smithsonian Tropical Research Institute expedition to Curacao with comparison to previously formulated lists
20	S. Rivero	Characterizing the deep zooxanthellate coral reefs of Puerto Rico with the seabed autonomous underwater vehicle
21	J. Rodríguez	Pequeños peces cripticos de arrecifes coralinos y areas adyacentes en el Parque Nacional Morrocoy y Refugio de Fauna Silvestre de Cuare, Venezuela
22	S. Rodriguez	Epidemiological dynamics of <i>Halofolliculina</i> sp. infections on <i>Acropora palmata</i> populations from Los Roques National Park, Venezuela
23	S. Romano	Multilocus phylogenetic analysis of Caribbean <i>Porites</i> (Scleractinia: Poritidae)
24	P. Rothenberger	Differential Diagnosis: The importance of multidisciplinary techniques in the investigation of the coral disease white plague type II
25	J.R. Sais	Baseline characterization of the marine community associated with Agelas Reef, Isla Desecho, Puerto Rico
26	M.I. Segnini	Evaluación citotóxica del extracto metanólico de <i>Fagara monophylla</i> en <i>Cyprinodon dearborni</i> (Ciprinodontiformes: Cyprinodontidae)
27	B.M. Soler #	Comparisons between nutrient concentration and dinoflagellate population density at two bioluminescent bays in Puerto Rico
28	A.M. Szmant	Settlement and post-settlement survivorship of the Caribbean scleractinian corals, <i>Montastraea faveolata</i> and <i>Acropora palmata</i>
29	E. Villamizar	2005 Bleaching monitoring in the Parque Nacional Archipelago de Los Roques, Southern Caribbean, Venezuela
30	L. Walters	Foraging by the long-spined sea urchin <i>Diadema antillarum</i> : Are unconsumed fragments perpetuating algal dominance on coral reefs?
31	E. Weil	Sexual reproduction in the Caribbean coral genus <i>Mycetophyllia</i> in La Parguera, Puerto Rico
32	A. Yranzo #	Taxonomy, depth distribution and coral overgrowth of encrusting octocorals in a coral reefs of the Parque Nacional Archipiélago de Los Rogues, Venezuela

# Poster Program

## Connectivity

33	S.R. Ketcham	Investigation of genetic connectivity of populations of <i>Diadema antillarum</i> in marine habitats of St. Croix and Puerto Rico
34	B. Todd #	Nutrient distribution across the insular shelf of Puerto Rico: assessment by algal tissue nitrogen

## Resource Management

35	J.A. Alfonso	Biomonitoring of potentially toxic metals in Venezuela coastal waters
36	U. Anlauf Toller	The Southgate coastal reserve - wildlife habitat and gateway to the St. Croix east end marine park
37	K.A. Coates	Conservation and management of seagrass habitat in Bermuda
38	V. Coehlo	Status of the reefs in Little Cayman, Cayman Islands, in 2006
39	B. Garcia #	Distribution of metals in Carenero Estuarine and coastal sediments, Venezuela
40	M. González-Rivero #	Comparative analysis of the previous (1999) and present (2006) conditions of some coral reefs in the national park "Archipiélago de los Roques"
41	S. Manuel	Mapping and monitoring seagrass habitat in Bermuda, year 1: species diversity and distribution
42	E. Tyner	Coral reef Ed-Ventures: a marine environmental education program for schoolchildren in Belize, Central America

## Global and Regional Issues

43	M. Boumedine	Towards finding descriptive patterns and building classification models for early predicting coral reef stress
44	V. Coehlo	Marine debris on Little Cayman coastlines
45	D. Fuentes Figuero #	Biomass coupling between phytoplankton and zooplankton in tropical ocean waters Influenced by the Orinoco river Plume
46	E. Klein	Dynamics of the Southern Caribbean upwelling system derived from remote sensing maps
47	I. Lundgren	Bleaching, and mortality of <i>Acropora palmata</i> at Buck Island reef national monument
48	C. Petrovic	Marine Science Education in the British Virgin Islands
49	C.J. Randall #	Elevated sea surface temperatures reduce survivorship and settlement of larvae of the scleractinian coral, <i>Favia fragum</i>
50	A. Rodríguez-Ramírez	The effects of coral bleaching in the Southern Tropical America: Brazil, Colombia, and Venezuela.
51	E. Tyner	Virgin Islands Marine Advisory Service (VIMAS)

## **AN EXPERIMENTAL REMOVAL OF A TERRITORIAL DAMSELFISH TESTS FOR CROSS-GUILD EFFECTS ON FISH HABITAT USE**

**M. E. Abate**, Boston University, Division of Natural Science, 871 Commonwealth Avenue, Boston, MA, 02215, USA [mabate@bu.edu](mailto:mabate@bu.edu)

Reproductive and foraging strategies of the bluehead wrasse (*Thalassoma bifasciatum*) result in daily contact with territorial damselfishes in shallow Caribbean back-reef areas. The reproductive success of a terminal male bluehead wrasse depends on attracting females to its spawning site which is often situated in the vicinity of damselfish habitat. Outside the daily reproductive period, terminal males are time-minimizing foragers that prefer motile, benthic meiofauna versus plankton, and they seek opportunities to prey on damselfish egg clutches. The fact that wrasses and damselfishes belong to distinct guilds has limited the examination of whether damselfish territoriality directly affects spatial habitat use by the bluehead wrasse. In a previous study in Discovery Bay, Jamaica, I found that terminal males increased foraging time within territories of threespot damselfish (*Stegastes planifrons*) when adults without egg clutches were distracted away for ten minutes. This opportunistic foraging response to seek prey hiding in filamentous algal gardens cannot be considered as a release from competition for space because the extensive gardens would not persist without damselfish defense against herbivores. A follow-up study at the same site tested for competition for space between terminal males and threespot damselfish by using hand-nets to remove 166 adults to increase distance between territory centers. Damselfish capture was followed by immediate release at two other sites to control for disturbance to the bottom. The size of the activity areas of terminal males was measured for fifteen minutes on different days before and after damselfish manipulation by marking the wrasse's location every minute with a flagged fishing weight and measuring the distances between the peripheral markers. An increase in activity area at the removal site is predicted if competition for space exists. This study aims to provide information about the broader impact of potential increases in rubble areas utilized by damselfishes on Caribbean reefs.

**Keywords:** bluehead wrasse, damselfish territoriality, interspecific competition, home range

## **EFFECTS OF SEDIMENTATION ON THE DISTRIBUTION OF THE REEF ZOANTHID *PALYTHOA CARIBAEORUM***

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*Palythoa caribaeorum* is a common zoanthid on the Caribbean. Populations of *P. caribaeorum* were monitored for six months at Enrique and Media Luna reefs in La Parguera, Puerto Rico to determine the effects of sedimentation on its distribution. On each reef three different habitats were selected; reef crest, reef front and sand plain. Three 10m<sup>2</sup> transects were surveyed for each habitat to estimate density and percent coverage. Sedimentation rates from the water column and bedload were collected using two different sediment traps. Average densities were higher at Media Luna (4.03 colonies/m<sup>2</sup> ± 0.96colonies/m<sup>2</sup>) than at Enrique (2.75colonies/m<sup>2</sup> ± 0.82 colonies/m<sup>2</sup>). No statistical difference was found (t-test: t=-1.017, df=22, P=0.320). Higher densities were observed at the crest zone of Media Luna (7.07 colonies/m<sup>2</sup> ± 0.46 colonies/m<sup>2</sup>) and in the fore reef of Enrique (3.63colonies/m<sup>2</sup> ± 2.65 colonies/m<sup>2</sup>). There was no significant difference in densities between zones within reefs (Enrique: Kruskal-Wallis, H=6.682, P=0.083; Media Luna: One way ANOVA: F=1.265, P=0.285). In contrast to density, percent coverage was higher at Enrique (8.07% ± 2.93%) than at Media Luna (4.35% ± 1.85%). No statistical difference was found between reefs but they were different between zones (Two way ANOVA, reefs: F= 2.645, P=0.123; zones: F=7.649, P=0.002), as it decreases along the reef zonation. The reef crest also has the highest amount of sedimentation from the water column and less bedload compared with the sand plain. The high percent coverage in the reef crest may be the result of strong wave action that cleans excess sand off colonies surfaces. The partial burial of the colonies by the sand could be decreasing their growth.

**Keywords:** *Palythoa caribaeorum*, Sedimentation, Distribution, Puerto Rico

## **EL ROL DE LAS ALIANZAS PARA LA CONSERVACION DE LOS ARRECIFES CORALINOS – EL CASO DE LA ALIANZA PARA EL ARRECIFE MESOAMERICANO DE ICRAN (ICRAN-MAR)**

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A nivel global, las alianzas son ampliamente percibidas como herramientas poderosas que permiten aumentar capacidades, apalancar recursos, fortalecer la participación cultural y facilitar la complementariedad de experiencias y acciones en torno a objetivos comunes. En el campo de la conservación, las alianzas han permitido reunir recursos y experiencias del sector público y el sector privado trayendo beneficios para las comunidades locales tanto a nivel técnico como financiero. La Red Internacional de Acción para los Arrecifes de Coral (ICRAN) es una alianza global dinámica e innovativa donde organizaciones líderes en ciencia y conservación de los arrecifes coralinos se unen en un esfuerzo mancomunado para contrarrestar el declive en la salud de los arrecifes del mundo. Por medio de alianzas, ICRAN crea acciones interrelacionadas y complementarias incentivando a sus socios a invertir en monitoreo y manejo de arrecifes en diferentes escalas. Uno de los objetivos principales de las actividades de ICRAN en el Caribe ha sido construir la capacidad “in-situ” para el manejo sostenible de arrecifes, resaltando el papel de las Áreas Marinas Protegidas (AMPs), de las comunidades locales y del sector turístico. En el caso de la Alianza para el Arrecife Mesoamericano de ICRAN, los objetivos primordiales son contribuir a minimizar impactos a la barrera arrecifal mesoamericana fomentando la adopción de prácticas sostenibles en las áreas de **turismo**, **pesquerías** y **manejo de cuencas**. Esta iniciativa, financiada por UN Foundation y USAID, reúne a importantes instituciones que coordinan actividades promoviendo la creación y el fortalecimiento de capacidades locales, la creación de una conciencia pública, el desarrollo de herramientas para toma de decisiones, la adopción de buenas prácticas y la construcción de alianzas con el sector privado. El proyecto busca igualmente coordinar sus esfuerzos con otras importantes iniciativas y proyectos en la región.

**Keywords:** Alianzas, Arrecife Mesoamericano, sector privado, mejores prácticas

## **MEXICAN MARINE PARKS FOR RESTORING THE QUEEN CONCH *STROMBUS GIGAS***

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*Strombus gigas* is a species important in the Caribbean countries. Its importance comes from the high exploitation levels ought to local demand for inner consumption, tourist market and international trade. In 2002, its catch volume was 3020 tons with a value of 3 million \$US. It has been placed as a commercially threatened species under CITES (Appendix II). In 2003, *S. gigas* was indexed at SPAWN trade and in 2003. *S. gigas* populations have been depleted in many areas and seriously diminished in others, where exploitation is still taking place due to its limited distribution range and accessibility, in low energy grass and algal beds. In Mexico, different measures have been taken to regulate exploitation, which include minimum size, lip thickness, and catch quotas, temporal and permanent fishing bans and marine parks as a measure to preserve reproductive stocks. The level of protections in the different marine parks of Mexico goes from a total fishing ban with high reinforcement, to controlled exploitation with little or no reinforcement. The impact of the marine parks on the populations of *S. gigas* is variable as the number of parks. Density of populations is an indicator used to know the exploitation levels for this species. In this study are presented data of density for *S. gigas* at Xel-Há, Chinchorro Bank and Alacranes reef *versu* managements measures in order to know if these MPA haven contributed to the conservation of *S. gigas* stock.

**Keywords:** Conservation, Management, Marine Park, *Strombus gigas*

## DIFFERENT REPRODUCTIVE STRATEGIES OF AMERICAN OYSTER *CRASSOSTREA VIRGINICA* IN THE GULF OF MEXICO

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Oyster fishery is one of the most important coastal fisheries of Mexico. Production from the Gulf of Mexico coast makes up 93.4% of national production. During 2002 it reached over 49 000 tons, with a value of 15\$US dollars. Production is based on natural beds, artisan farms and enhanced beds of the American oyster *Crassostrea virginica*. Besides its economic value, it is an important social employment activity, as many coastal communities find their income and work opportunities in this fishery. In Tabasco there are 1 371 oyster fishers in 14 cooperative societies, and 3 000 suckers, mainly women. There is an extensive bed management activity with seeding of collected spat. Even though, there is no management of the exploitation, except for a minimum legal size of 80 mm that is not respected, as oysters are grown in bundles the mean size is around 50 mm, and a temporal ban from may 15<sup>th</sup>-June 30<sup>th</sup> and 15<sup>th</sup> Septiembre-30 October. Reproductive cycles of oyster populations from three lagoons of Tabasco in the Gulf of Mexico are studied. This work describes the variations of the gametogenic activity and the reproductive cycle. Samples were taken from three banks, subject to different environmental and pollution conditions. Thirty oysters over 50mm of shell length were sampled monthly from each bank (Mecoacan, Machona and Carmen) for histological analysis of the gonad tissue. There were variations in gonad activity among localities, which reflects on the gametogenic cycle and spawning. In most cases a significant impact of reproductive patterns *versus* seasonality was detected, mostly during rains season. Spawn is present through the year and more intense and constant at Mecoacan, with a dominant pulse from April to November. At Machona and Carmen lagoons, it extends only from June to December or June-January, respectively. These differences in gametogenic cycle and spawning are a reflex of populations' recovery capacities under the different environmental conditions. Mecoacan is exposed to a higher organic urban discharge, presenting a shorter re absorption and undifferentiated periods, faster gametogenesis and a well defined spawn stage; with a high intensity spawning period with three peaks (May, August and October). Meanwhile the oyster population from Carmen and Machona presented a longer and more intense re absorption and undifferentiated stages, gametogenesis extends longer in time with a shorter percentage; maturity is shorter than oysters of Mecoacan. These differential reproductive behaviors have implications in management program for this species in Mexico. Oyster fishery in Tabasco lagoons has a temporal ban from May-June and September-October. In order to protected spawn stage temporal ban for this species was modified from June to October, and to permit a best recruitment.

**Keywords:** American Oyster, *Crassostrea virginica*, reproductive cycle, fisheries management

## **BIOMONITORING OF POTENTIALLY TOXIC METALS IN VENEZUELA COASTAL WATERS**

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Marine bivalves and plants have been extensively used as passive biomonitors to assess coastal aquatic environments, since they can accumulate trace metals and other substances. Bioaccumulation of Ba, Fe, Cd, Co, Cr, Cu, Mn, Ni, Pb, Ti, V, Sr and Zn was examined in the soft bodies of *Tivela mactroides* and *Crassostrea rhizophorae*, and in the *Thalassia testudinum* tissue, which were collected at six sites along the Venezuelan coast. Seagrass tissue was separated into leaf blades, roots/rhizomes and vertical shoots. Metal concentrations were directly determined by Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). Two certified reference materials were used to validate the methods. A one way ANOVA was performed in order to evaluate the statistical significance between the sites and species, for each metal considered. Turkey a posteriori tests were performed whenever the null hypotheses were rejected. Bioaccumulation of metals varied significantly among sampling sites and species. Although the highest concentrations observed for some metals were direct relationship with anthropogenic input, average content of trace metals measured in the present study are within the range with those found by other authors.

**Keywords:** Biomonitors, potentially toxic metals, Venezuelan coast, mollusks

## **THE SOUTHGATE COASTAL RESERVE - WILDLIFE HABITAT AND GATEWAY TO THE ST. CROIX EAST END MARINE PARK**

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The St. Croix Environmental Association (SEA) is in the process of developing and constructing a new field station on the island of St. Croix, U.S. Virgin Islands. The basic facility will be built within the Southgate Coastal Reserve, which is owned and managed by SEA. The field station and its amenities are designed to accommodate the needs of visiting and local groups of students as well as visiting scientists. Surrounded by a diversity of protected coastal and marine habitats it offers endless opportunities for short and long-term marine and terrestrial research projects. In-depth studies by scientists from *The Coast & Harbor Institute, Woods Hole, Massachusetts* provided the background information needed to design an environmentally sensitive and sustainable Reserve Center, bird blinds, walking trails and other infrastructure improvements for the property. The results from these studies did not only assist SEA to determine the value of Southgate pond and its surrounding habitats but also provides an invaluable baseline for ongoing and future research and monitoring projects throughout several disciplines.

**Keywords:** Coastal reserve, protected habitats, field station, St. Croix

## **A GLOBAL PERSPECTIVE OF HUMAN – MOLLUSC INTERACTION THROUGH HISTORY: THE HMID PROJECT**

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The exploitation of marine molluscs impacts both human societies and the environment. Although molluscs have been considered to be quite resilient to human exploitation, overfishing of large vertebrates and shellfish was the major human disturbance to many of the world coastal ecosystems. The specific nature and dynamics of this disturbance have yet to be determined by historical research of long-term ecological changes. On the other hand, although modernization impacts and changes traditional village lifestyles of many peoples living in coastal zones and islands, molluscan resources continue to be a major staple in their diets and a source of income of many small-scale societies. Whilst the impacts of the marine molluscs on human societies have been widely researched, little attention have been paid to the early human impact on marine molluscs' populations. In consequence, our current understanding of the ecology, biomass, resilience, and population dynamics of marine molluscs harvested before recent times (19<sup>th</sup> – 20<sup>th</sup> century) is relatively poor. We argue that sustained efforts of interdisciplinary teams that may fully address mollusc exploitation in a historical perspective will allow formulating new hypotheses, generating explanatory models, and provide independent means to test and assess generalizations about the status of natural populations of molluscs before, during and after the long standing prehistoric harvesting. To assist the scientists and students around the world interested in the above mentioned themes, we introduce HMID (Human/Molluscs Interaction Database), the product of the CoML-HMAP programs, that consists of a WWW-available, WIKI, peer-reviewed, professionally maintained, free public accessed, worldwide referenced and comprehensive database, containing high quality historical data, descriptions, and interpretations of worldwide events, patterns, processes, and products resulting from the interactions between humans and molluscs through time.

**Keywords:** archaeomalacology, zooarchaeology, historical ecology

## **INSIGHTS INTO THE QUEEN CONCH (*STROMBUS GIGAS*) SYMBOLISM IN THE CARIBBEAN: THE CLAIM FOR THE CONTEXTUAL APPROACH**

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It is argued that when dealing with significance and meaning, the interpretation of the prehistoric, historical or contemporary data faces similar methodological problems. The cognitive processes involved both in the meaning attribution (made by the actors of the past) and in the interpretation of the meaning (made by the modern interpreters) are bounded to the social context and, therefore, require the use of regional, micro-contextual approach. The case study discussed here deals with the symbolism of the queen conch (*Strombus gigas*), on the Los Roques Archipelago, a group of oceanic islands located 135 km off the central coast of Venezuela. The islands were seasonally visited by the Amerindian groups from the mainland coast, between A.D. 1200 and the European conquest time. The ‘Valencioids’ transformed these oceanic islands into special economic areas of extraction of those marine resources that were unavailable or scarce on the continental coast. Hundreds of female pottery figurines and other artefacts were brought from the mainland to the islands to be used in the rituals performed by the shamans. This ceremonialism has been oriented to protect the island visitors from the anger of the spirits of the queen conch, the animal that had been exploited in great numbers and taken to the mainland for delayed consumption. The study clearly demonstrates the reciprocity in the human/molluscs interaction showing how the intensive exploitation of queen conch affected spiritual life of the Amerindians. This interpretation is derived from the long-term systematic contextual excavations and integrative analytical approach applied to the study of the Los Roques artefacts, especially the figurines. Indeed, such context-bounded interpretation cannot be transferred without restriction to any other historical and social realities. Thus, the regional and context-oriented studies are necessary to gather multiple meanings that the queen conch has evoked in the Caribbean through time.

**Keywords:** Queen conch symbolism, human/mollusc interaction, Los Roques pre-Hispanic figurines, Venezuelan islands

## TOWARDS A LATIN AMERICAN AND CARIBBEAN INTERNATIONAL CENSUS OF MARINE MICROBES: OVERVIEW OF SOME RESEARCH DIRECTIONS

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The International Census of Marine Microbes, the CoML-S.A. and the Caribbean-CoML supported the initiative of launching a regional ICoMM node (LACar ICoMM) in order to promote discussion about marine microbial studies currently carried at both the South American and the Caribbean regions, existing scientists, resources and possible orientations aimed at improving our knowledge of marine microbes and their biodiversity. We present an overview of some of the directions of current research on marine microbes in these regions. Concerning phytoplankton studies, the best known taxonomic groups are diatoms and dinoflagellates in Mexican marine waters, the number of taxa recorded being about 1400. On the other hand, estimates of bacterial and cyanobacterial dynamics in coastal and oceanic marine systems underscores the importance of various environmental states modulated by geographic and seasonal patterns and by the expression of large South American rivers on the Caribbean Basin productivity. One of the main issues of this survey was the determination of wet and dry seasonal patterns of bacterial dynamics in seascapes with moderate to absent river inputs, the establishment of a Caribbean wide distribution and range of bacterial dynamics including coral reef waters, upwellings, Orinoco river influenced waters, Caribbean Eddies enclosing Amazon waters, areas affected by *Trichodesmium* (N-fixation) blooms as well as oligotrophic areas. Microbial dynamics was also studied in Guianese coastal and shelf systems known for their important fisheries resources, under Amazon influence. Particular bacterial communities of big filamentous bacteria are being characterized in OMZ areas off Chile, Perú and Costa Rica. On the other hand, bacteria with ability of degradation of pesticides and hydrocarbons are monitored in coastal areas of the Colombian Caribbean, where 64 native marine bacterial strains were isolated from sediment samples. Furthermore, the microbial observatory established in Guanabara Bay (Brasil) constitutes a model for the study of threatened tropical systems.

**Keywords:** South America & Caribbean, marine microbial biodiversity, phytoplankton and bacterial dynamics, microbial bioremediation

## ASSESSMENT OF BIOTA QUALITY IN THE GULF OF PARIA, TRINIDAD AND TOBAGO

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The quality of oysters (*Crassostrea* sp.), green mussels (*Perna viridis*), and mangrove mok (*Mytella guyanensis*) were investigated at six shellfish harvesting sites (Chaguaramas, Caroni, Brickfield, Claxton Bay, Godineau and Cedros) in the Gulf of Paria, Trinidad during the dry and wet seasons of 2002. Sediment quality and physico-chemical parameters (dissolved oxygen, temperature, salinity and pH) were also determined. Tissue and sediment samples were analyzed for levels of polycyclic aromatic hydrocarbons (PAHs), and heavy metals (cadmium, chromium, copper, iron, nickel, lead, zinc and mercury). PAHs are known carcinogens, whereas heavy metals are toxic above certain threshold concentrations, hence the reason for monitoring levels in the environment.

Total PAH levels in shellfish tissues ranged from 33.1 – 1408.9 ng/g dry wt. whereas metal concentrations in shellfish tissue ranged from 0.02-3.07ug/g-cadmium, 0.26-4.74 ug/g-chromium, 4.01-144.54 ug/g-copper, 0.15-16.18 mg/g-iron, 0.98-23.1 ug/g-nickel, 0.01-1.29 ug/g-lead, 0.02-3.99 mg/g-zinc and 0.01-0.22 ug/g-mercury. Results indicated bioaccumulation of hydrocarbons, which were found at concentrations unacceptable for human consumption at Chaguaramas, Brickfield, Claxton Bay and Godineau. Results suggested that bioaccumulation of metals in bivalve tissue was more dependent on species than on quality of the associated sediment. Oyster tissue at all stations sampled contained unacceptable concentrations of at least one metal (copper, zinc, cadmium or nickel). Nickel was present at concentrations unacceptable for human consumption in green mussels at Chaguaramas, and in mok tissue at all stations sampled. No seasonal trends were apparent for hydrocarbons or heavy metals in tissue samples. PAHs found in the organism and sediment samples were mixtures of petrogenic (petroleum derived) and pyrolytic (combustion derived). Sources of metals included industrial waste, sewage/ domestic waste, agricultural waste and urban runoff. The investigation showed that these bivalves could be useful as sentinel organisms for monitoring bio-available pollutants in the environment. Follow-up and more intensive surveys are recommended for contaminated sites.

**Keywords:** Pollution monitoring, metals, hydrocarbons, bivalves

## OCEANIC AND COASTAL REEFS IN VENEZUELA 2003- 2006: LARGER DIFFERENCES AMONG SITES THAN BETWEEN SHELF POSITIONS

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Under the general prediction that oceanic reefs are less subject to anthropogenic disturbances than coastal reefs, we compared the community structure of corals and fishes among two sites at each of two localities, Los Roques and Morrocoy. For this we evaluated the benthic community on 10 permanent transect at each site, using the point intercept technique to estimate cover. Also, in these transect we evaluated the fish community using REEF and AGRRA assessment techniques. Larger differences occurred among sites separated by 10s of km, rather than localities separated across the shelf by 100s km, for the coral as well as for the fish community structure. Oceanic and coastal sites could be similar in coral community structure including species composition and cover. However, all sites differed in their fish community structure. Among sites, fish density varied from 21 and 254 individuals per 100 m<sup>2</sup>, whereas species richness varied between 32 in Morrocoy and 63 species in Los Roques. We were unable to detect temporal changes among the 14 benthic categories used to describe the coral reefs, being the cover very similar from 2003 and 2006. On the contrary, fish communities showed a large variability among years, indicating that a larger data set in time is required to assess changes among these sites. We detected white diseases, yellow band and the ciliate *Halofolliculina* sp. affecting coral colonies of all sites except CAY that has <5% coral cover. In particular, the prevalence of ciliate infections seemed to increase.

**Keywords:** Coral cover, coral diseases, reef fishes, monitoring, Venezuela, Los Roques, Morrocoy

## MONITORING TERRIGENOUS SEDIMENTATION RATES ON US VIRGIN ISLAND REEFS: FROM NEAR-SHORE TO OFFSHORE

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This study set out to explore reasons for the variability in terrigenous sedimentation rates on 10 reefs around St. Thomas, U.S. Virgin Islands. We applied spatial data sets of land-based threats at the watershed level to estimate the vulnerability of land to erosion and then quantified the influx of terrigenous soils on corresponding reef systems. Models of localized current patterns were also used to further strengthen our exploration. Monthly sedimentation rates on *Montastraea* dominated reef systems were obtained, as well as, estimations of coral health, including percent cover, disease prevalence and amount of bleaching. The amount of terrigenous sedimentation varied considerably among sites. Average rates, measured from December 2004 to December 2006, ranged from .082±.112 mg cm<sup>-2</sup> d<sup>-1</sup> (a deep offshore reef located on the shelf edge) to 5.808±5.407 mg cm<sup>-2</sup> d<sup>-1</sup> (shallow, near-shore reef) with a mean of 2.32± 3.823 mg cm<sup>-2</sup> d<sup>-1</sup> (±SD). Significant differences were found along an inshore-offshore gradient and a clear seasonal pattern was evident resulting in significantly different deposition rates on northward facing near-shore reefs. Although an overall correlation was not apparent between sedimentation rate and percent coral cover, results do indicate that high sedimentation rates negatively affect coral cover and hinder the ability of a coral to survive bleaching events. Watershed characteristics (i.e. size, slope, development) are important quantifiable elements that contribute to sediment runoff and were used in correlation analyses. It is important to note, however, that eroded soils have a lingering effect on, not only, adjacent near-shore marine communities by retention and resuspension, but an effect on 'downstream' marine communities as well. General current patterns on St. Thomas transport deposited soils from an East to West direction, which could contribute to the impact of downstream reefs, leading to non-significant differences between along-shore sites.

**Keywords:** Sedimentation, coral reefs, oceanography, Caribbean

## RESPUESTA DE LOS CAPITELIDOS (ANNELIDA: POLYCHAETA) A VARIACIONES DE SALINIDAD, GOLFETE DE CUARE, VENEZUELA

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Las costas venezolanas han estado sometidas a frecuentes e intensos periodos de lluvia en años recientes, lo que ha conllevado a cambios en la estructura y composición de las comunidades afectadas. En la costa nor-occidental, se han registrado alteraciones del componente biológico, consecuencia de estos eventos naturales. El presente estudio tuvo como finalidad evaluar los patrones de variación en la comunidad de poliquetos asociados a fondos blandos expuestos a variaciones de salinidad; comparando la información actual con la recabada en el 2000, luego de un periodo de precipitaciones extremas. Se hizo énfasis en la familia Capitellidae debido a que fue una de las más abundantes en ambos periodos. El sedimento en estos fondos presentó un alto porcentaje de arena y fango, y un contenido de materia orgánica mayor al 10%. El componente de las macrofitas estuvo representado por algas (*Halimeda incrassata*) y fanerógamas (*Thalassia testudinum*), con valores de biomasa muy bajos, y distribuidas en parches de pequeño tamaño. La densidad de poliquetos mostró diferencias temporales entre los meses de mayo, agosto y diciembre del 2004, con una reducción significativa para este último mes (KW,  $p=0,048$ ), principalmente de los organismos con tallas mayores a 1mm (reducción de un 85%), coincidiendo con disminuciones de la salinidad. Se colectaron 130 capitélidos, de 9 especies, de las cuales *Notomastus latericius* presentó la mayor abundancia relativa (30,16%), seguida por *Scyphoproctus sp* (24,60%). La diversidad de especies de la comunidad fue mayor para los meses de mayo y agosto debido a una mayor riqueza y equidad entre las especies, evidenciándose para estos meses una menor disimilitud en comparación con diciembre. La riqueza de especies, así como la abundancia total de individuos, disminuyó hacia el mes de diciembre; siendo la especie *N. latericius* la más abundante para mayo y agosto; mientras que para diciembre queda la comunidad representada sólo por: *Mediomastus californiensis* (53,33%) y *Capitella sp* (33,33%). Entre el año 2000 y 2004, sólo dos capitélidos *M. californiensis* y *N. tenuis* son comunes. También se observó que la riqueza de especies es menor en casi todos los meses en el año 2000 en comparación con el 2004. Para febrero del 2000, se encontró la menor diversidad, debido a la baja riqueza de especies y el aumento explosivo de *Capitella capitata* y *C. jonesi*. Las variaciones dadas en la riqueza de especies y densidades de esta familia, parecen indicar que la comunidad está expuesta a condiciones ambientales muy variables, lo cual pudiese atribuirse a cambios en los niveles de salinidad. Estas variaciones son características en la localidad estudiada, y podrían ser utilizadas como indicadores de cambios en la comunidad de poliquetos en fondos blandos expuestos a fluctuaciones ambientales.

**Palabras Claves:** salinidad, poliquetos, capitélidos, fondos blandos

## TOWARDS FINDING DESCRIPTIVE PATTERNS AND BUILDING CLASSIFICATION MODELS FOR EARLY PREDICTING CORAL REEF STRESS

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In order to assist researchers in assessing the impact of climate change on coral reefs, NOAA Integrated Coral Observing Network (ICON) stations collect, monitor and analyze large amount of oceanic and atmospheric in-situ data in the Caribbean region. The ICON expert system component aims at early predicting the effects of environmental factors such as sea temperature, wind speed and direction, light intensity, tides and water salinity on coral reef health. Supplementing this component with automated knowledge discovery capabilities would certainly contribute to enhancing ICON predictive abilities. This research employs data mining approaches in an attempt to unveil interesting new patterns and derive new models from historical data sets in order to aid in predicting coral reef stress. Descriptive patterns and their relevance are obtained by analyzing Lee Stocking Islands (Bahamas) ICON data sets from May 21, 2005 till December 31, 2005. Patterns are expressed in the form of rules such as “If event  $e_i$  occurs then event  $e_j$  also occurs”. Frequent patterns were observed between Pulse Amplitude Modulation (PAM) yield (indicator used in our study to assess coral stress) and light intensity, such as photosynthetically active radiation (PAR). Weaker relationships between PAM yield and salinity, as well and PAM yield and wind speed are found. In addition to rule patterns, several predictive models are derived from the same data sets. Current results show that 89% of the test instances are correctly classified with the Multi-layer Perceptron artificial neural network algorithm, against 80% with C4.5 decision tree algorithm. These preliminary results are encouraging and indicate that data mining techniques are promising approaches for tackling marine and environmental problems and should be further explored in conjunction with current modeling techniques where large environmental data sets are available.

**Keywords:** Coral Reef Stress, Patterns, Prediction, Data Mining.

## RELATIONSHIP BETWEEN WATER MANAGEMENT AND CYANOBACTERIAL BLOOMS IN FLORIDA BAY, USA

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Following the 2005 hurricane season, a large cyanobacterial bloom appeared in eastern Florida Bay. This bloom was triggered by a large increase in total phosphorus resulting from the combination of enhanced freshwater inputs due to flood control and disturbance from road construction along US Highway 1 between the Florida mainland and Key Largo. Low phytoplankton biomass and low productivity in eastern Florida Bay are the general rule, mainly due to the small amount of phosphorus available in the water column. At the time of the bloom, P and chlorophyll *a* concentrations greatly exceeded the normal values. The cyanobacterial community structure was investigated using PCR - DGGE primers specific to the 16S and ITS region, followed by sequencing. Cluster analysis confirmed distinct community types existed in different regions of the bay. The eastern bay community was dominated by 2 organisms from the same clade V of MC-A cluster: *Synechococcus* sp. WH 8101 and *Synechococcus* sp. CB 0201. These organisms possess high affinities for inorganic N and P, can use amino acids, possess alkaline phosphatase, produce siderophores (Fe > 10 nM), and do not contain phycoerythrin (need high light). The north central bay community was composed of *Synechococcus* sp. WH 8101, *Synechococcus* sp. RS 9708, and *Cyanobium* sp. PCC 9005. South central and western Florida Bay community dominated by *Synechococcus* sp. WH 8101 and *Synechococcus* sp. RS 9708 (same clade as WS 8101). The sediment community was composed of *Synechococcus* sp. RS 9708, *Synechococcus elongatus* PCC 6301 (prefers nitrate), *Aphanizomenon ovalisporum* ILC-149 (high P requirement, N<sub>2</sub> fixer), *Acaryochloris* sp. (contains CHLd, symbiotic with acidians), *Arthrospira* sp. PCC 7345 (Spirulina, filamentous). Bloom species were not found in sediments, therefore the benthos is not "seeding" the bloom. This bloom event demonstrates the extreme sensitivity of oligotrophic estuaries, like Florida Bay, to nutrient loading impacts.

**Keywords:** cyanobacteria, blooms, nutrients, genomics

## **CORAL DISEASE AND BLEACHING RELATIONSHIPS IN SOUTH FLORIDA DURING THE 2005-2006 BLEACHING EVENT**

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In late 2005 to 2006, severe coral bleaching was observed in many parts of the Caribbean including South Florida, and was soon followed by observations of disease outbreaks. Data is presented from a study that monitored populations of corals at two inshore and two offshore reef sites in the upper and middle Florida Keys on a weekly to bi-weekly basis over the course of the bleaching event. Bleaching and disease dynamics differed between inshore and offshore sites and inshore sites were ultimately more impacted. During the event, bleaching was found to differentially affect coral species both in severity and duration. The prevalence of white plague disease decreased during the bleaching event but then increased after recovery from bleaching had occurred. Conversely, black band disease increased significantly during the bleaching event and then decreased significantly after recovery from bleaching. Bleaching severity in colonies that developed infections during the event was significantly greater than those which did not develop infections. Average estimated tissue loss during and after the bleaching event was greater from disease than from bleaching. The potential relationship between bleaching and disease has previously been inferred based on studies with random sampling at time intervals separated by many months or even years. This study is unique in that it shows the dynamics of bleaching and disease within the same population of corals on a weekly to biweekly basis. The results suggest short-term dynamics that may be important in understanding the relationship between bleaching and disease susceptibility.

**Keywords:** coral bleaching, white plague disease, black band disease, coral monitoring

## **NUTRIENTS DYNAMICS ALONG A SALINITY GRADIENT IN THE MANGROVE FOREST, FLORIDA COASTAL EVERGLADES**

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Salinity levels in the Coastal Everglades Mangrove Forests of Florida (CEMF) are closely tied to water management practices by the South Florida Water Management District, in turn a function of precipitation rate. The freshwater end member (Everglades) is TOC and TN-rich (median TOC and TN, 11.07 and 0.62 ppm respectively) and TP-poor (median TOC= 0.0136 ppm), while the marine end member (Florida Bay) is TP-rich (median TP=0.0355 ppm) and TOC-TN-poor (median TOC and TN, 6.00 and 0.358 ppm respectively). Cumulative Rate of Variation (CRV) diagrams suggest that water mixing within CEMF is close to conservative for TOC, but non-conservative for TP and TN (mostly TON), underscoring the dynamics of nutrient remobilization from litter and soils and the contribution from ground waters. TP behaves conservatively from fresh waters up to salinities in the mid-Mesohaline range, where concentration increases peaking within the Polyhaline range. TN decreases moderately within the Mesohaline range and strongly at higher salinities. For inorganic N species, nitrification reaction rates ( $\text{NH}_4 \rightarrow \text{NO}_3$  and  $\text{NO}_3 \rightarrow \text{NO}_2$ ) decouple significantly in the 16 to 30 PSU range, where also SRP and CHLa increase substantially.

**Keywords:** Nutrients dynamics, mangrove forest, Everglades, CRV diagrams

## **BIOMASA Y ESTRUCTURA DE LA COMUNIDAD ZOOPLANCTÓNICA EN DOS ESTACIONES DE LA BAHÍA DE MOCHIMA, DURANTE 1998.**

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La biomasa y composición del zooplancton de la Bahía de Mochima fueron estudiadas en dos estaciones, una en la entrada de la bahía (estación A) y la otra interna (estación B), de enero a diciembre de 1998. Las muestras fueron colectadas por medio de calados oblicuos, a una velocidad de dos nudos durante 10 min. con una malla estándar de 255  $\mu\text{m}$  y 0,25 m de diámetro de boca a dos profundidades (0-5 y 10-15 m) en cada estación. Se analizaron los factores físicos-químicos como oxígeno, transparencia, salinidad, temperatura del agua e índice de surgencia. Los valores más altos de abundancia se registraron durante el período marzo-junio para luego descender a valores relativamente bajos entre agosto-octubre. Característicamente se encontró mayor densidad zooplanctónica en la estación B que en la A, mientras que las máximas densidades se situaron en la capa profunda (10 –15m) para ambas estaciones. Cualitativamente, la comunidad zooplanctónica de las dos estaciones fue muy similar, identificándose 33 y 30 grupos zooplanctónicos para la estación A y B, respectivamente. En general, las formas holoplanctónicas predominaron sobre las formas meroplanctónicas, lo que se debió, fundamentalmente a la presencia de copépodos, cladóceros, apendiculados, sifonóforos y quetognatos. El Meroplancton estuvo principalmente representado por larvas de crustáceos, moluscos, poliquetos y equinodermos. Los valores más altos de biomasa y densidad zooplanctónica coincidieron con períodos de respuesta a la intensidad de la surgencia e influencia de vientos, encontrándose en consecuencia niveles elevados de nutrientes y de clorofila *a*, baja temperatura y una mayor abundancia de zooplancton.

**Palabras claves:** Zooplancton, biomasa, análisis cualitativo, Bahía de Mochima

## **HOLOCENE SEA LEVEL RISE AND THE PATCH REEF POPULATION IN THE NORTHERN FLORIDA REEF TRACT**

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Airborne lidar remote sensing is a new way to survey shallow reef topography in fine detail, and the resulting information on reef morphology provides indications of prior sea level. We mapped the morphology of the northern Florida reef tract with NASA EAARL lidar topography, and used the results to assess the effect of Holocene sea level history on reef tract development. Following the creation of a lidar digital elevation model, we undertook geospatial analyses to capture the morphologic attributes of over 1000 patch reefs in the northern Florida reef tract, including depth, basal area, height, volume, and whole-reef, reef-rim and reef-top topographic complexity. Our morphometric analysis revealed that two populations of patch reefs exist in the northern Florida reef tract, and are associated with two distinct depth intervals below and above -7.7 m NAVD88. These 2 reef populations are different morphologically, which we attribute to the initial stages of reef development occurring during Holocene periods with different rates of sea level rise. The deep reef population morphology is consistent with a steady and relatively rapid sea level rise flooding the outer platform followed by a short (~1 K yr) near stillstand, resulting in the restricted lateral growth of reefs. The depth gap between the 2 reef populations is consistent with an abrupt jump in sea level near the end of the mid Holocene. Shallow reef population morphology and rugosity trends are consistent with sea level fluctuation around present day sea level during the late Holocene. Overall, our results are consistent with a recent eustatic sea level reconstruction based on oxygen isotope records from Red Sea sediment cores.

**Keywords:** lidar, Holocene sea level, patch reefs, Florida Keys

## COASTAL EROSION IN THE CARIBBEAN COAST EXAMPLES: CÓRDOBA AND LA GUAJIRA PROVINCES

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In the coastal zone in Cordoba and La Guajira provinces (Colombian Carib) were observed evidences of littoral erosion in a big scale. This phenomenon is affecting the different elements of the landscape, such as population, civil structures, national parks and a wide variety of ecosystems, all of them located in their shorelines. This situation alerted the Institute of Marine and coastal researchers (INVEMAR), which went deeply into the knowledge of erosion processes and their influence on the ecosystems, for the establishment of a base of the knowledge into geological marine component. By comparative analysis of aerial photographs and field survey, were determined the changes (erosion-sedimentation) occurred in the shoreline of these provinces. Both cases shown erosion rates, sometimes over 1.5 m/year; this erosive phenomenon brings significant loss of terrain and it generates negative impacts to the economy. The obtained data allowed us to define the causes of the erosive processes as strong hydrodynamic conditions, imbalance in sedimentary contributions, destruction of ecosystems, tectonic and the sea level rise. These processes are often multiplied by the human activities, which are showed as the improper construction of civil structures and the exploitation of materials such as sand and mangroves in an illegal way.

**Keywords:** Erosion, erosion rates, antropic interventions

## CORAL REEFS IN THE US VIRGIN ISLANDS: TRENDS AND PATTERNS OF HEALTH ACROSS STRESS GRADIENTS

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Coral reefs in the Caribbean have undergone major degradation in recent years due to both human and natural disturbances. We hypothesized that increasing anthropogenic pressure more heavily impacted nearshore reefs than those located further offshore. To test this hypothesis we used benthic cover, coral disease, and bleaching data collected on St. Thomas and St. John from 2001-2005. Four reef systems were examined in order to detect differences in the inshore to offshore reef gradient: nearshore, midshelf island, midshelf no island, and shelf edge. Benthic cover categories included coral, gorgonians, sponges, macroalgae, crustose coralline algae, dead coral with turf algae, and *Montastrea annularis* complex (MACX). There were numerous indications of increased coral reef degradation at nearshore relative to offshore sites. There were significant differences between strata for total coral cover ( $p < 0.0001$ ) and MACX ( $p < 0.0001$ ); coral cover increased in an offshore trend, with 36% cover on shelf edge sites and only 19% at nearshore sites. There was decreased overall health from offshore to inshore with the highest incidence of disease occurring nearshore. Differences in disease prevalence were largely the result of dark spots disease and yellow blotch disease ( $p < 0.0001$ ), both being over 3 times as high at nearshore sites than those offshore. Bleaching was also 1.5 times greater and significantly different at nearshore reefs than at the shelf edge sites ( $p < 0.0003$ ). Lastly, although the amount of old mortality was highest on nearshore reefs, the number of recently dead colonies on nearshore reefs was similar to shelf edge sites. The results of this study support our hypothesis; however, the level of recent mortality on offshore reefs highlights the fact that the reefs of the USVI are continuing to decline. The USVI is in need of greater adaptive management strategies in order to effectively conserve its highly valuable coral reefs.

**Keywords:** coral reefs, benthic cover, health, US Virgin Islands

## **ANEMONESHRIMP SYMBIONTS OF GIANT SEA ANEMONES ON CORAL REEFS: COMPARISONS BETWEEN THE RED SEA AND THE CARIBBEAN SEA**

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Giant sea anemones are conspicuous members of coral reef communities and serve as hosts for assemblages of anemoneshrimps, some of which are important cleaners of fish parasites. Such assemblages were quantified during surveys at Eilat, northern Red Sea, and St. Thomas, US Virgin Islands, Caribbean Sea. Giant sea anemones in the Red Sea (5 species) and Caribbean Sea (2 species) both hosted diverse assemblages of anemoneshrimps (6 and 5 species respectively). In each region, members of one anemoneshrimp species (*Periclimenes longicarpus* in the Red Sea and *P. pedersoni* in the Caribbean) formed social groups of up to 10-14 individuals per anemone in about 30-50% of host individuals, and served as major cleaners of fishes. Two other members of the genus *Periclimenes* (*P. brevicarpalis* and *P. ornatus*) occurred singly or as mated pairs in 9-13% of host anemones in the Red Sea, while individuals of *P. yucatanicus* in the Caribbean Sea exhibited a similar pattern. Also in each region, one species of mysid shrimp (*Idiomysis tturnamali* in Red Sea and *Heteromysis actinae* in Caribbean) formed shoals of up to 50 individuals among the tentacles of 10-34% of host anemones. One species of anemoneshrimp, *Thor amboinensis*, occurred in both regions but formed larger social groups in a higher proportion of host individuals (up to 90%) in the Red Sea than in the Caribbean Sea (only 2%). Unique to the Caribbean Sea was association between anemones and alpheid snapping shrimps (*Alpheus armatus* group), which occurred in about 35% of host individuals and appeared to benefit anemones by removal of encroaching sand (see other abstract). Patterns of obligate versus facultative association with sea anemones differed markedly between the regions. We conclude that anemoneshrimps may fill similar ecological roles in these two regions and have major impacts on giant sea anemone hosts.

**Keywords:** shrimp, sea anemone, symbiosis, diversity

## **CONSERVATION AND MANAGEMENT OF SEAGRASS HABITAT IN BERMUDA**

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Bermuda is a small, isolated, chain of oceanic islands located at 32.31°N, 64.77°W in the western Atlantic. Beds of tropical and subtropical seagrasses, *Thalassia testudinum*, *Syringodium filiforme*, *Halodule wrightii*, and *Halophila decipiens* are distributed from inshore bays out to the rim reef that encircles the platform. Recently, a study of seagrass habitat compared its distribution and extent in summer 2004 with prior estimates made in the early 1990s. These comparisons indicated that offshore beds of *S. filiforme* and *T. testudinum* had declined precipitously. The decline occurred in areas where anthropogenic impacts are not obvious and, thus, was unexpected. Efforts to understand the decline were restricted by the absence of substantive, recent, data about the marine environment on the Bermuda platform and by extremely limited data on the basic condition, ecology and biology of seagrass in Bermuda. Some plausible and possible factors were identified that might have driven the decline and a Seagrass Conservation and Management Program (SCAMP) was developed that could provide data related to those factors, as well as create increased protection for the remaining, healthy, beds. As one aspect of the SCAMP, a comprehensive, long-term, monitoring program of benthic habitat was initiated in 2006. The program includes extensive and intensive mapping of benthic habitat on the platform, establishment of monitoring sites in seagrass habitat, measures of water quality and of light penetration at all mapping stations, monthly measures of these at the monitoring sites, deployment of in situ temperature loggers at the monitoring sites, measures of seagrass bed "condition" through morphological and nutrient analyses of blades and shoots, and qualitative estimates of parrot fish and turtle grazing on the blades of *T. testudinum* and *H. wrightii*. The development and initiation of the Program resulted from very significant international collaborations.

**Keywords:** international collaboration, seagrass declines, turtle grazing

## MARINE DEBRIS ON LITTLE CAYMAN COASTLINES

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A coastal trash removal project was carried out in Little Cayman, Cayman Islands, in 2006 at two undeveloped sites that had never been cleaned prior to this study. Trash is brought to this relatively remote island mainly by currents. Little Cayman is located south of Cuba and west of Jamaica, and is elongated in the northeast – southwest direction. Two sites, each 200 meters long and about 10 meters wide, were selected. One site was on the south (windward) and the other on the north (leeward) side of the island. We identified 6 categories of debris: glass, metal, plastic, ropes & nets, shoes and styrofoam. All trash bags collected were weighted and the volume estimated. Nearly 3 to 4 times more trash was collected on the south side in comparison to the north side of Little Cayman. Plastics made up over 40% of the debris on both sides of the island. Shoes were the second most abundant debris on the leeward side (20%), while ropes & nets had higher relative abundance on the windward side (at least 10%). The greater overall amount of trash on the south side can be explained by its higher exposure to winds and large storms. The cause for the differences in the relative proportion of the types of debris within each site at the north-south locations is unclear. Labels on the debris were examined and revealed a wide range of origin including many Caribbean countries as well other parts of the world. Considering that Little Cayman has approximately 32 km of coastlines, we estimated that at least 218 thousand liters or 17 tons of garbage has arrived at these beaches over time. Such debris removal projects provide important insights into the impact of littering in coastal areas.

**Keywords:** Littering, beach clean-up, marine debris, marine pollution, coral reef.

## STATUS OF THE REEFS IN LITTLE CAYMAN, CAYMAN ISLANDS, IN 2006

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An assessment of nine spur and groove reef communities was conducted around Little Cayman Island in July and August of 2006. The south (windward) and north (leeward) sides of the island were surveyed utilizing the Atlantic and Gulf Rapid Reef Assessment (AGRRA) methodology. We compared marine park (no-take zones) and non-park sites in each oceanographic setting (windward/ leeward) regarding reef community health. Using 10 m transects and 25 x 25 cm quadrats, random surveys were conducted to collect information such as live coral cover, coral diversity, coral mortality, coral height and diameter, as well as disease and bleaching occurrences and macroalgal coverage. A total of 74 transects, 1067 corals and 350 quadrats were surveyed. Mean live coral cover was 17%, mortality was 23%, height 21 cm, diameter 32 cm, disease and bleaching frequency were 7% and 6% respectively, mean algal cover was 34%. No statistical differences were found in live coral cover, mortality and bleaching around the island. Coral size was larger on the south side and disease prevalence was greater on the north side of the island especially in the non-park area. *Montastraea* was the genus with the highest relative abundance, followed by *Agaricia* and *Porites*. The main difference in coral abundance around the island was a greater relative number of *Diploria* colonies on the south side. Macroalgal cover was highest in non-park areas, but the difference between protected and non-protected areas was only significant on the south side of the island.

**Keywords:** coral reef communities, marine reserves, monitoring, no take zones, marine protected areas

## NATURAL GEOGRAPHY IN SHORES AREAS: THE VENEZUELAN EXPERIENCE

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The NaGISA protocol was applied in different seagrass (*Thalassia testudinum*) and rocky shore areas in order to quantitatively describe, at different spatial scales, assemblages associated to these systems. NaGISA is a standardized sampling protocol implemented world-wide that is used in a hierarchical design where different spatial scales are considered: Region (20° by 20° squares in which the world has been divided), areas within regions (typically different countries within those squares), sites within areas (separated by 10's of k's). Within each of one of these sites (typically 3 in each country), similar sampling designs have been used using smaller spatial scales. In this paper we present data obtained in different sites of Venezuela that have been sampled using the NaGISA protocol in both seagrass and rocky intertidal ecosystems. The description of assemblages associated with rocky intertidal platforms considered four spatial scales sampled hierarchically: regions (separated by hundreds of kilometers), locations within regions (separated by tens of kilometers), sites within locations (separated by tens to hundreds of meters) and replicates quadrates (separated by meters). The description of assemblages associated with seagrasses considered three spatial scales: regions, sites and replicate quadrates. Descriptions of the assemblages associated with the two types of ecosystems are provided and, even though they are totally different, they showed similar patterns of distribution in terms of the spatial scales considered. In this sense, assemblages varied significantly at all the spatial scales considered in this study whereas and the largest components of variations were found among locations and among replicates.

**Keywords:** Intertidal rocky platforms, Seagrass, spatial variability, NaGISA.

## USING GIS/GPS TO CHARACTERIZE WATERSHEDS, EVALUATE LAND BASED THREATS AND MAP ENDANGERED MARINE POPULATIONS

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The connectivity of landscapes and seascapes is a field of study that has received significant interest in the past decade, especially on small, steep tropical islands where the connectivity is tight and watershed land use practices can negatively impact coastal marine resources in a big way. The use of Geographic Information Systems and Global Positioning Systems technology has become a common tool of researchers, especially for terrestrial ecosystems while their use in marine systems is slowly increasing. GIS/GPS technology is an effective tool and methodology to examine the patterns, trends and interplay between large watershed land areas, hydrological processes and the effects on nearshore marine communities. In this work, GIS/GPS technology is used to characterize three watersheds which differ in the level land use activities by creating a profile of the most important conditions and alterations. Topography, slope, geology, soils and precipitation combine to create a hydrologic system linking the landscape and seascape. GIS/GPS techniques are used to quantify the greatest threats to downstream communities, set conservation priorities and assist in long term monitoring. In the marine environment, ESA listed species *Acropora palmata* (*Elkhorn Coral*) has been the subject of intense conservation interest as a result of its importance as a keystone nearshore reef-builder. A surface water GPS protocol and use of a waterproof PDA are combined to add a spatially accurate component to the mapping of location and status of this endangered species.

**Keywords:** GIS, GPS, watershed characterization, Elkhorn corals

## THE MISSING LINK IN THE POPULATION BIOLOGY OF REEF FISHES: MOLECULAR ECOLOGY OF LARVAL DISPERSAL IN GOBIES

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Planktonic larval dispersal is of critical importance in the ecology, evolution and management of marine fish populations. However, there is little known about the scale and pattern of larval dispersal for most marine fish. A major obstacle to progress has been the impracticality of surveying distributions of the larvae of individual fish species in plankton communities. Identification by microscopy is labor intensive, often inaccurate and in many cases larvae can be identified only to the level of family. The family Gobiidae is the most diverse family of marine fishes, with more than 30 genera and approximately 125 species described for the Western Atlantic region. We surveyed the distribution of larval gobies in plankton samples from the Bocas del Toro Archipelago, Republic of Panama, and used DNA barcoding to identify individual larvae. Our study adds four additional species to the 11 previously reported as adults for the Bocas del Toro Archipelago. Over half of the larvae could be identified at least to genus. Larvae of *Coryphopterus eidolon*, which has not previously been reported from this region, were detected. Significant differences in larval assemblages were found for samples from different habitats. Highest larvae density and biomass were recorded in shallow nearshore waters (insular areas) during the windy dry season. Our results demonstrate the practicability of DNA barcoding to identify early developmental stages of fish; indicate that goby larvae aggregations occur close to adult benthic habitats and suggest some degree of retention of goby larvae in nearshore habitats.

**Keywords:** Planktonic larval dispersal, Gobiidae, Bocas del Toro Archipelago, DNA barcoding

## VARIACIÓN ESTACIONAL DE LA COMUNIDAD DE PECES ASOCIADOS A UN ARRECIFE ROCOSO CORALINO DEL BAJO LAS CARACAS, ESTADO SUCRE, VENEZUELA

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El Bajo las Caracas constituye un promontorio submarino, a 3 km de la costa, en el cual se realiza una importante pesquería artesanal. Su biota sumergida se desconoce por lo que se estudió la ictiofauna en un arrecife pétreo de particular interés. Se hicieron censos visuales mensuales, sobre un transecto de 40 x 2 m, de todas las especies observadas. Se contabilizaron 4907 peces pertenecientes a 80 especies, en 31 familias. Las más importantes respecto al número de especies fueron Scaridae (9), Serranidae (8), Hemulidae (7) y Labridae (5); mientras que las más abundantes incluyen a Scaridae (15,22%), Haemulidae (14,18%), Carangidae (13,88%), Labridae (12,59%), Acanthuridae (8,32%) y Chaenopsidae (7,52%). Las especies más abundantes fueron *Decapterus punctatus* (13,06%), *Thalassoma bifasciatum* (11,64%), *Haemulon chrysargyreum* (10,98%), *Acanthemblemaria* sp. (7,52%) y *Sardinella aurita* (6,93%). En todo el año, la riqueza osciló entre 32 y 45. El valor más alto ocurrió en agosto de 2005. El mayor registro de abundancia sucedió en marzo de 2006 mientras que el menor valor fue en diciembre 2005. Un Análisis de Componentes Principales para asociar los meses con las abundancias, reveló que los tres primeros ejes aportan el 88,42% de la variación acumulada, principalmente por *S. aurita*, *D. punctatus* y *H. chrysargyreum*. La variación restante es determinada, esencialmente, por las abundancias de *Thalassoma bifasciatum* y *L. griseus*. *S. aurita* se observó en los meses de julio 2005 y marzo 2006, coincidiendo con picos reproductivos ya registrados. Se identificaron 16 especies con interés comercial, entre las que destaca *Lutjanus griseus*, del cual se reporta una pequeña agregación reproductiva. El 38,75% de las especies hacen uso constante del espacio, incluyendo a *D. punctatus*, un pequeño pelágico no presente en otros arrecifes del país. Se registra también a *Gymnothorax milliaris* por primera vez para la zona de surgencia costera de Venezuela.

**Palabras clave:** *Decapterus punctatus*, *Sardinella aurita*, *Acanthemblemaria*, *Lutjanus griseus*.

## **PREVALENCE, DISTRIBUTION AND VIRULENCE OF ASPERGILLOSIS IN *GORGONIA VENTALINA* (GORGONACEA:GORGONIIDAE) POPULATIONS IN LA PARGUERA, PUERTO RICO**

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This ongoing study addresses the status and temporal dynamics of the fungal disease aspergillosis in populations of *Gorgonia ventalina* in La Parguera, Puerto Rico. Main goals include the assessment of temporal and spatial variability in prevalence, rates of advance and recovery. Ninety six band transects (10x2 m) at varying depths were surveyed in six reefs in winter and summer to assess differences in disease prevalence and distribution. Photographs of 60 tagged colonies were taken every two-three months for eight months. Amount of necrotic tissue was measured to monitor the progression/recovery from the disease over time. The prevalence of aspergillosis varied with season, depth, reef zone and the density of sea fans. During the winter of 2006, 9.85% of observed fans were infected, but this significantly increased to 17.02% (G test,  $p < 0.05$ ) during September. Mid-shelf reefs had significantly higher (G test,  $p < 0.05$ ) prevalence (25%) than inner (12%) and shelf edge (8%) reefs. Prevalence was higher (24%) in shallow habitats (<20 feet) than in intermediate depth (30 feet = 13%) and deeper habitats (>40 feet = 8%). Sites with high density of sea fans (>25 fans/20m<sup>2</sup>) had significantly higher (G test,  $p < 0.05$ ) prevalence (24%) than low (<5 fans/20m<sup>2</sup>, 11%) and medium (5-25 fans/20m<sup>2</sup>, 14%) density sites. Photographs of tagged colonies demonstrated a high variety of changes over time in diseased colonies. Although some lesions increased in size and new lesions were observed, many fans remained stable or recovered from infections. Some fans even regenerated some lost tissue. Although the prevalence in the summer was high, only 6% of fans had lesions greater than 25 cm<sup>2</sup>. Many infections were short-lived, and colonies were capable of regenerating tissue. With low prevalence and the potential for rapid recovery, this disease is not likely to be devastating to *G. ventalina* populations.

**Keywords:** Aspergillosis, octocoral disease, prevalence, virulence, Puerto Rico, Caribbean.

## **ACOUSTIC SURVEYS FOR DISCRIMINATION OF BENTHIC HABITATS AND BIOMASS**

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Acoustic systems may be used to detect and quantify the biomass of gorgonians, large barrel sponges, and submerged aquatic vegetation (SAV) in habitats not conducive to optical remote-sensing (i.e. areas with low water transparency or poor light penetration). Single-beam acoustic seafloor discrimination was used to describe the biota occurring on the benthic habitats of Palm Beach County, FL. The survey, encompassing an area of 155.9 km<sup>2</sup>, was conducted using a BioSonics echosounder and two multiplexed, single-beam digital transducers operating at frequencies and full beam widths of 38 kHz/10° and 418 kHz/6.4°, respectively. New post-processing techniques were developed using BioSonics Visual Bottom Typer and QTC Impact software to model the abundance and spatial distribution of SAV, foliose gorgonians and areas dominated by large colonies of the barrel-sponge *Xestospongia muta*. The acoustically predicted biomasses agreed well with the ground-truthing estimates of biomass. The overall accuracy for the three classes (Bare/Sparse/Abundant) of biomass was 79.6% for gorgonians and 61.7% for macroalgae, compared to the three-class pure-chance prediction of 33.3%. The overall accuracy for the two classes (Absent/Present) of *X. muta* was 86.1%, compared to the two-class pure-chance prediction of 50%. The patterns of within- and between-reef abundance of biota were used to produce spatially-continuous maps of the Palm Beach County submarine habitats for resource management utilization.

**Keywords:** Acoustic surveys, benthic habitat maps, Biosonics, QTC

## **BEHAVIOR OF JUVENILE GOLIATH GROUPEL, *EPINEPHELUS ITAJARA*, AND ITS RELEVANCE FOR CONSERVATION**

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Large groupers (genus *Epinephelus* and *Mycteroperca*) are extremely vulnerable to overfishing due to a combination of life history traits: slow growth, long life, late sexual maturity, strong site fidelity, and spawning aggregations. Goliath grouper, *Epinephelus itajara*, are critically endangered throughout the Caribbean, except in Florida, due to a fishing ban in U.S. federal and state waters since 1992. In adult *E. itajara*, specific behaviors such as being curious and unafraid of divers have been identified as an additional risk factor for overfishing. However, the behavior of juveniles and its relevance to conservation has been largely unexplored. This study examines the behavior of 52 juvenile *E. itajara*, along fringing red mangrove *Rhizophora mangle* shorelines of the Florida Keys, USA. Visual underwater surveys and digital video were used to record behavior. Several behaviors never before documented are described along with comparisons between juvenile and adult behavior. I discuss the conservation implications of ‘group size’, ‘habitat-specific activity’, ‘gaping’, ‘smoke-screen escape’ and ‘sleeping’.

**Keywords:** Grouper, behavior, conservation, Caribbean

## **BIOMASS COUPLING BETWEEN PHYTOPLANKTON AND ZOOPLANKTON IN TROPICAL OCEAN WATERS INFLUENCED BY THE ORINOCO RIVER PLUME**

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Oceanic food webs are among the most complex food webs in our planet. The flow of energy and cycling of elements through these systems rule many of the biogeochemical cycles on Earth. The carbon cycle and its organismal component “the biological pump” plays a major role in the Global Carbon budget. Primary producers, grazers and other microbes are major parts in such pump. This project focused on assessing the response of the zooplankton community components to variations in the phytoplankton assemblage along the Orinoco River plume dispersion axis. The plume extends through 1000 kilometers from the Gulf of Paria, where the river enters the Eastern Caribbean, up to the oligotrophic northeastern Caribbean. Samples for zooplankton community determination were taken during two cruises in the fall, the maximum discharge season. Three size classes of zooplankton were studied: nanozooplankton, microzooplankton (naked ciliates, tintinnids, heterotrophic dinoflagellates, nauplii and copepods) and mesozooplankton. In order to estimate biomass, cell biovolumes were estimated using geometric shapes that were analogous to the shape of the individual taxa. Results showed strong coupling between phytoplankton and grazer biomass for the Mesozooplankton – Microphytoplankton and Nanozooplankton – Picophytoplankton assemblages. No relationship was found between Microzooplankton and Nanophytoplankton biomasses. Microzooplankton biomass was found to be constant along the gradient, apparently not controlling its prey population. Overall there was a change in the community structure from larger cells to smaller cells with a dominance of nano size class in stations far from riverine input. In terms of group dominance within the microzooplankton community, naked ciliates dominated mostly all stations along the gradient with a change to tintinnids in the station least influenced by the river.

**Keywords:** Food web, Biological Pump, coupling, biomass, size class

## **DISTRIBUTION OF METALS IN CARENERO ESTUARINE AND COASTAL SEDIMENTS, VENEZUELA**

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Coastal systems, in particular the estuaries, are the first depositional environment to receive sediments transported from rivers to the oceans. In this work, the distribution of selected major and trace elements in Carenero estuarine and coastal sediments were studied. Recent sediments from twenty sites on studied area were analyzed by X-Ray Fluorescence spectrometry (XRF). Certified sediments and soils standard reference materials were used for calibration purposes and also to check the accuracy and precision of the XRF analysis. The bulk mineralogy of sediments was also determined. Our results suggest that the variation of grain size, organic content and anthropogenic enrichment, are the most important factors influencing the spatial distribution of metals concentrations of sediments from the Carenero estuarine.

**Keywords:** Estuaries, estuarine sediments, Carenero, XRF

## **GENETIC VARIABILITY OF *ACROPORA CERVICORNIS* AND *A. PALMATA* IN PUERTO RICO**

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Management decisions about the rapidly declining staghorn (*Acropora cervicornis*) and elkhorn (*A. palmata*) corals require knowledge of the standing genetic variability. Genetic variation of natural populations may be used as a proxy for the long term survival of populations or species. Over 100 colonies of *Acropora cervicornis* and *A. palmata* have been sampled from several reefs around Puerto Rico to assess levels of genetic variability. We used partial DNA sequences of the mitochondrial control region, a hypervariable region, to estimate levels of genetic connectivity in adjacent and geographically distant reefs. The control region proved to be a more useful molecular marker in *Acropora* at this geographic scale than other mitochondrial and nuclear markers which carry few to no mutations. So far, we have analyzed approximately half of the collected colonies of each *Acropora* species. Preliminary analysis shows that many of the reefs share haplotypes indicating genetic exchange between reefs. Genetic diversity ( $\pi$ ,  $\theta$ ) is significantly different among reefs. Analysis of molecular variance (AMOVA) suggests that most of the variability is observed within reefs than among reefs. Presence of multiple mitochondrial haplotypes in a reef suggests that asexual reproduction may not be the dominant mode of propagation. Extensive clonal propagation in a reef or region would lead to the presence of one to very few genotypes. An extensive map of genetic diversity of the two *Acropora* species may facilitate management decisions. Possible outcomes of our study include the identification of genetic hotspots (i.e. areas with higher than expected diversity) and genetically depauperate populations in need of restoration.

**Keywords:** *Acropora palmata*, *Acropora cervicornis*, mitochondrial control region, genetic variation

## **LARGE-SCALE CORAL BLEACHING RESPONSE PLAN FOR SOUTH FLORIDA REEF TRACT**

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Coral bleaching and associated climate change impacts in south Florida are increasingly recognized as major threats to coral reef biodiversity as well as the economies of reef-dependent commercial enterprises. With the frequency and intensity of climate-related impacts are expected to increase significantly in the coming decades, the Florida Reef Resilience Program (FRRP) was initiated some two years ago through discussions between the State of Florida, The Nature Conservancy (TNC), the National Oceanic and Atmospheric Administration (NOAA), and the Great Barrier Reef Marine Park Authority (GBRMPA). Ultimately, the FRRP seeks to improve management of coral reef resources by raising awareness and providing new tools to coral reef managers that enhance their ability to improve ecological conditions and economic sustainability of south Florida's coral reefs. The initial program focus has been to examine existing information and address gaps necessary to strengthening the science behind predicting coral reef vulnerability to climate change impacts in south Florida. One of the biggest gaps has been large scale quantitative information on the extent and magnitude of previous coral bleaching events. Drawing from the Reef Managers Guide to Coral Bleaching, a regional bleaching disturbance response plan was developed in early 2005 and implemented during 2005 and 2006. The plan involves an early warning volunteer program (Bleach Watch) followed by a rigorous bleaching survey of the entire reef track during peak thermal stress periods using trained experts drawn from management and academia. If the event is particularly severe, a follow-up impact survey is done in selected sub-regions 3-4 months after peak bleaching. The quantitative survey design is a nested 2-stage stratified random approach using 200x200 meter primary sites and 1x10 m secondary belt transects. All stony corals 4 cm and greater within the belt transects are identified to species, measured, and assessed visually for bleaching and disease. Bleaching intensity (summarized as a bleaching index from 0 to 3) averaged 0.7 in 2005 and 0.2 in 2006 based on 97 and 130 sites respectively. During both years there has been significant spatial and temporal variation in bleaching intensity and coral disease which can be correlated to a number of factors including thermal stress, light, and bleaching history. This presentation will review lessons learned in developing this large and ambitious program to date.

**Keywords:** Coral bleaching, climate change, resilience, south Florida

## BASELINE CHARACTERIZATION OF THE MARINE COMMUNITY ASSOCIATED WITH AGELAS REEF, ISLA DESECHEO, PUERTO RICO

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Agelas is a live hermatypic reef constructed over a vast deposit of large rhodolith nodules at depths between 45 – 70 m (148 – 230') on the southwestern insular slope of Isla Desecheo. The rhodolith substrate is colonized by encrusting brown algae (*Lobophora variegata*), large erect and branching sponges (*Agelas conifera*, *Agelas spp.*, *Aplysina spp.*) and lettuce corals (*Agaricia spp.*). The reef has very low topographic relief, as it lies over an essentially flat platform and massive corals do not contribute significantly to its rugosity. A total of 18 species of scleractinian corals, two hydrozoans (*Millepora alcicornis* and *Stylaster roseus*) and the antipatharian black wire coral (*Stichopathes lutkeni*) were identified from Agelas Reef. The combined mean substrate cover by nine species of scleractinian corals present within video-transects was 13.1 %. Irregular sheets or laminar growth by lettuce corals (*Agaricia spp.*) prevailed at depths between 45 and 53 meters, with a combined substrate cover of 8.9 %, representing 70 % of the total cover by scleractinian corals. Lamark's sheet coral (*Agaricia lamarki*) was the main species present. Sponges were the most important invertebrate component of the sessile-benthic community with an assemblage of (at least) nine species within transects, and a combined substrate cover of 28 %. The brown tube sponge (*Agelas conifera*) was the most prominent species within transects with a mean substrate cover of 5.9 %. A total of 40 fish species, including 33 present within belt-transects were identified from a depth of 50 m at Agelas Reef. The study mean abundance of fishes within belt-transects was 82.0 Ind/30 m<sup>2</sup> (range: 60 – 104 Ind/30 m<sup>2</sup>). An assemblage of five (5) species accounted for 78.8 % of the total fish abundance within belt-transects at Agelas Reef. The uniform, low-relief bathymetry of Agelas Reef, without large coral outcrops and overhangs, but with many small protective microhabitats created by branching sponges and plate corals appear to favor a resident ichthyofauna dominated by small territorial species. The bicolor damselfish (*Stegastes partitus*) was the numerically dominant species with a study mean abundance of 27.2 Ind/30 m<sup>2</sup>, representing 33.2 % of the total fish abundance within belt-transects. The blue chromis (*Chromis cyanea*), peppermint goby (*Coryphopterus lipernes*), sunshine chromis (*Chromis insolata*), and cherubfish (*Centropyge argi*) comprised the rest of the numerically dominant fish assemblage.

## USING NATURALLY OCCURRING FRAGMENTS OF ELKHORN, STAGHORN AND FINGER CORAL FOR REEF RESTORATION IN THE CARIBBEAN

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Coral reefs throughout the Caribbean have been damaged by hurricanes, diseases, coral predators, and human activities, particularly during the past two decades. Recovery has been limited and patchy. Although damaged coral reefs cannot be restored to their original condition, interest in reef restoration continues to increase. In a pilot restoration project involving community volunteers, we collected naturally occurring fragments of *Acropora palmata* (elkhorn coral), *A. cervicornis* (staghorn coral), and *Porites porites* (finger coral) from reefs in Virgin Islands National Park, St. John and transplanted them to degraded reefs at the same depth from which they were collected (1 to 3.5 m). Inert cable ties were used to attach coral fragments to dead coral substrate (usually *A. palmata*). Sixty transplanted fragments and an equal number of natural colonies of each species were measured and photographed at 6-month intervals during the first 2 years (June 1999–June 2001) and annually thereafter (through July 2004). Survival of natural and transplanted *A. cervicornis* and *P. porites* was very low (median lifetimes of 1.6 yr and 1.9 yr, respectively), with no significant difference across locations, by depth, or between transplant and natural/control colony status. Colony depth did not contribute significantly to *A. palmata* colony survival, but colony size and transplant/control status did. The median lifetime for *A. palmata* was 1.0 yr for transplant and 2.9 yr for control colonies when controlled for size effects, and 1.6 yr for transplant and 4.4 yr for control colonies when not controlled for size. Damage from storm swells was the most common cause of mortality or colony loss during this study, although mortality from disease and predation (corallivorous snails) also occurred. The project was highly successful in raising community awareness of coral reef degradation, the limitations of reef restoration, and the paramount importance of protecting coral reefs from damage.

**Keywords:** Coral reef restoration, *Acropora palmata*, *A. cervicornis*, *Porites porites*

## CORAL MORTALITY AND RECOVERY ON JAMAICA'S NORTH SHORE REEFS FOLLOWING THE 2005 CARIBBEAN REGION BLEACHING EVENT

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In September 2005, extensive coral bleaching was observed on the north coast of Jamaica. This bleaching event occurred in the wake of elevated sea surface temperatures observed in the Caribbean region during the summer of 2005. The local impact of this region-wide bleaching event was monitored between November 2005 and August 2006. Photo transects were conducted at Dairy Bull, Rio Bueno and Discovery Bay on Jamaica's north shore. In addition, one hundred and ten bleached corals were tagged at Monitor Reef (Discovery Bay) at depths ranging between 8.5m and 36.6m and their condition monitored over the same time period. The purpose of this study was to determine the extent of the coral bleaching at all sites and assess species specific mortality and recovery as a function of time and depth. The mean incidence of bleaching at all three locations decreased from 60.4% ( $\pm 23.48$  SD) to 22.19% ( $\pm 12.86$  SD) during the monitoring period. Initial bleaching observed at Monitor Reef was 63.92% ( $\pm 15.53$  SD) for shallow coral cover (8.5m) in contrast to the 80.04% ( $\pm 4.94$  SD) bleaching observed at depth (24.4m to 36.6m). By August 2006, these figures decreased to 10.33% ( $\pm 7.29$  SD) for the shallow and 17.56% ( $\pm 2.08$  SD) for deep coral. Total mortality of tagged corals in shallow water was 21% and 14% for corals tagged at deeper sites. *Agaricia* and *Montastrea* spp. were most affected in shallow water. At depth, *A. grahamae* seemed most susceptible to bleaching. *Montastrea* spp. appeared more robust but *Porites* spp. less hardy than their shallow water counterparts. Further studies are required to investigate the relationship, if any, between depth and the resilience and ability of various coral species to withstand the impacts of repeated bleaching events.

**Keywords:** Coral bleaching, mortality, recovery, resilience, Jamaica.

## MESOPHOTIC CORAL REEFS (30-100M) ARE THE FRONTIER OF REEF EXPLORATION AND RESEARCH

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The extended depth range of shallow, reef building genera has long been recognized from dredging in the Tropical Western Atlantic and confirmed with the observations and collections from research submersibles. These results show that reef corals occur regularly often with ~ 50% or more coral cover to depths of 60-80 meters with isolated specimens possibly to 100 m. The major structure-forming coral of these reefs are familiar shallow-water species, *Montastrea* spp. and *Agaricia* spp. These mesophotic reefs often contain sclerosponges, which have the potential for framework construction, and their skeletons can provide critical information about historical water properties, such as temperature and salinity. The high complexity of mesophotic reefs provides habitat for exploitable fish and shellfish, refuge for settling juvenile fish, spawning sites for commercial reef fish, potentially useful bioactive compounds and they are the focus of much scuba diving. Furthermore, these reefs, by virtue of their insulation from natural and anthropogenic near-surface impacts, may serve as refugia for fish, corals and invertebrates that could repopulate degraded shallow reefs. In the tropical western Atlantic (TNA) the major known habitats for mesophotic reefs are the steep slopes of barrier reefs and carbonate platforms and terraces and bank tops at depths of 30-80 m. Of these, the steep slopes may be the most extensive; a first estimate of their linear extent in the Caribbean and Archipelago of Bahamian Banks is some 24,200 km. If only part of this zone is colonized, the extent of mesophotic reefs could rival or exceed that of shallow-water reefs. The aerial extent of terraces and bank tops at the appropriate depth is unknown, but there is clear evidence that luxurious communities occur in this setting e.g. Flower Garden Banks, Sherwood Forrest in the Dry Tortugas, Pulley Ridge off Florida's southwest coast and Lang Bank in the Virgin Islands testify to the importance of this habitat. It seems likely that other occurrences of mesophotic reefs await discovery on Pedro Bank, the Nicaragua Rise and the southern margin of the Florida shelf. The development of rebreathers and the use of small research submersibles provide the much needed platforms to explore the largely unknown mesophotic reefs. This exploration has the potential to provide the much needed inventory of their occurrences, their inhabitants and their much needed interrelationships, their connectivity and resources.

**Keywords:** reef walls, submerged banks, research frontier

## **PROGRESS IN RAPID REEF ASSESSMENTS FOR ROUTINE CENSUSES AND ACUTE ECOLOGICAL CALAMITIES**

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In the two years since the AMLC endorsed the concept of “a long-term program for assessing representative reefs, their related biological communities, and relevant physical environmental parameters periodically into the future,” the Atlantic and Gulf Rapid Reef Assessment (AGRRA) Program has been laying the groundwork for a regional census. We are converting the AGRRA datasets into GIS layers that will allow parameterized queries to generate custom reports, analyzing certain coral data to identify sampling designs with minimal variance in population and community parameters, generating sampling domains stratified by principal environmental variables, and evaluating the suitability of all collected parameters as potential bioindicators, benchmarks or targets for managers. As bleaching events, like those of 2005 increase in intensity, the vital signs of traumatized reef corals must be monitored like those of victims of heart attacks because the impacts of both—life or death—are of greater significance than the traumas themselves. In response to the 2005, mass bleaching/subsequent mortality event in the Eastern Caribbean, we designed and successfully field-tested two new protocols to measure the direct effects of ecological catastrophes on live stony corals. Of particular value, we hope, to resource managers is the **BLAGGRA Line-intercept** method which is simple enough to be easily mastered by volunteers. It allows many sites to be assessed repeatedly and quickly up to a year following the termination of bleaching. The **BLAGGRA Full** protocol, designed for professional and paraprofessional divers, provides species-specific and size-specific data about coral health, allowing direct comparisons with “chronic condition baselines” based on the colonies (>133,000 from 1997-2004) in the AGRRA Database. Details regarding protocols, databases and summary products can be found at [www.agrra.org](http://www.agrra.org).

**Keywords:** Regional reef census, monitor bleaching impacts

## **DISTRIBUTION OF MESOPHOTIC DEEP-WATER REEF SPECIES IN THE BAHAMAS**

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In the Bahamas and many sites in the Caribbean, the deep fore-reef escarpment forms the mesophotic zone of high biological diversity and deep distribution of shallow-water species due to a combination of factors including suitable geomorphology, low sedimentation, and high light penetration. Dives with the *Johnson-Sea-Link* submersibles at hundreds of sites in the Bahamas since 1976 have documented this deep reef escarpment to extend from 60 to 150 m, below which is usually a talus slope of shallow-reef derived debris. The deepest known distribution of hermatypic corals (119 m, *Agaricia grahamae*; 113 m, *Montastraea cavernosa*) and algae (130 m, *Halimeda copiosa*) known in the Atlantic and Caribbean basins occurs in the Bahamas. Four species of hermatypic corals occurred to depths >100 m and average coral cover was 17% at 110-120 m off eastern San Salvador Island. This deep reef zone also had high diversity of sponges (206 taxa) of which 46% were exclusive to this zone. For both scleractinians and sponges, the eastern Bahamas and east side of the banks had greatest diversity and depth distribution due to lower sediment flux and greater light penetration. Our historical records from submersible dives throughout the Bahamas and Caribbean extend nearly 30 years and will be invaluable to marine managers in tracking natural and anthropomorphic changes in these deep reef ecosystems.

**Keywords:** Mesophotic, deep-water coral reefs, Bahamas

## **SKELETAL GROWTH IN *ACROPORA PALMATA*: ITS ROLE IN PAST COMPETITIVE SUCCESS AND IN FUTURE RECOVERY**

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Rapid and massive skeletal growth, among other successful life history strategies, enabled *Acropora palmata* to dominate the shallow water reef crest zone (0-5 m depth) in many areas throughout the Caribbean prior to the 1980s. *A. palmata* populations have suffered dramatic declines in the past 30 years. Present day *A. palmata* populations consist primarily of small patches, small colonies or recent recruits. Recovery in these populations will be dependent not only on branch growth, but to a great extent on the ability of the colony to expand at its base where the colony is attached to the substrate. The perimeter of the base is the edge-zone, where competition for space occurs. Prior skeletal studies of *Acropora* species have focused on axial or radial growth of the branches, but the recent ecological changes mentioned above prompt a consideration of growth at the edge-zones. Scanning Electron Microscopy is used to compare the skeletal morphology of the edge-zones of *A. palmata* colonies that abut other benthic species with the skeletal morphology of branch tips. In both regions, the distal edge of the skeleton consists of a lattice-like structure composed of rods that extend from the body of the skeleton and bars that connect these rods. Unlike axial or radial growth, effected through extension of axial and radial corallites respectively, the edge-zone lacks corallites. An actively extending skeleton is characterized by sharply pointed rods and partially developed bars in both the branch tip and the edge-zone; both regions also display a similar and well defined sequence of crystal deposition. In contrast, the edge-zones adjacent to spatial competitors terminated in blunt coalescing rods, and bars that were fully formed; the skeleton has ceased extension, although, perhaps only temporarily.

**Keywords:** *Acropora palmata*, coral skeleton, coral growth, competition

## **ROLE OF STAGHORN CORAL *ACROPORA CERVICORNIS* ON CORAL REEF FISH RECRUITMENT**

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*Acropora cervicornis* has suffered drastic declines in abundance in recent years, and is now listed as threatened species under the USA Endangered Species Act. Since *A. cervicornis* is structurally complex and often occurs in large monospecific patches, many scientists believe that this coral species is/was an important habitat for coral reef fish recruitment. Previous recruitment studies have used artificial structures, concentrated on specific fish species, or examined the general role of corals. This study will focus on the role of *A. cervicornis* on the recruitment of newly settled coral reef fish larvae. This coral may enhance recruitment because its complex physical structure may serve as refuge from predators. Structural complexity has been related to the abundance, diversity, and survival of fish recruits. Moreover, because its physical structure is unique among Caribbean corals (i.e. null functional redundancy), *A. cervicornis* may be especially critical for fish recruitment compared to other coral species, and therefore may play a major role in determining the abundance and diversity of coral reef fish. The proposed goal of this study is to determine the importance of *A. cervicornis* for the recruitment of newly settled coral reef fish larvae. In order to accomplish this task, the abundance and diversity of fish recruits will be surveyed in a two-factor design involving the density and condition (i.e. dead or alive) of *A. cervicornis*. More specifically, it will examine species-specific fish recruitment on *A. cervicornis*. Previous studies have indicated preferential recruitment of fish to specific microhabitats with some fish species settling preferentially on live corals.

**Keywords:** *Acropora cervicornis*, recruitment, habitat selection, coral reef fish.

## COMPARATIVE ANALYSIS OF THE PREVIOUS (1999) AND PRESENT (2006) CONDITIONS OF SOME CORAL REEFS IN THE NATIONAL PARK “ARCHIPIÉLAGO DE LOS ROQUES”

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The Archipelago of Los Roques was classified, in 1999, as one of the healthiest coral reef systems within the Wider-Caribbean zone. In order to carry out a comparative analysis of their previous (1999) and present (2006) health states, eight key localities were therefore selected for a re-evaluation. The AGRRA (Atlantic and Gulf Rapid Reef Assessment), benthic protocol, was employed in both assessments and an analysis of the data compiled, provided the following main results: a) The South and South-West reefs appear to be the healthiest of all, showing a higher live coral cover (60%), a lower partial mortality (20-29%) and a lower diseased colony frequency (5.6%). b) The reefs with the poorest health states were those located within the North and North-East areas, (i.e., those nearest to the main town), with a live coral cover of 34-6%, a partial mortality of 29-46% and a maximum diseased colony frequency of 19.8%. c) The health condition of the great majority of the studied reefs appears to have remained stable after eight years, without any important variance being evidenced through the main AGRRA health indicators (coral cover, mortality types, etc.), except by the incidence of disease, which has increased in some of the reefs. This increase of diseased colonies at a few locations is an important factor to be taken into consideration in the control and management of the reefs areas by the authorities of the park and in the predictions of scientists on the future health states of the different reefs of Los Roques. The differential condition among the northeast and southwest reefs of Los Roques could be attributed to their proximity to the main town (Gran Roque), to the dominant coral species at each site and to their sensibility to stressful elements like diseases, bleaching, storms, sedimentation, etc.

**Keywords:** AGRRA, Los Roques Archipelago, Health state, Venezuela.

## **TURKS AND CAICOS ISLANDS CORAL REEF ASSESSMENT METHODS: INTENSIVE VS. EXTENSIVE FIELD METHODS WITH NON-PARAMETRIC ANALYSIS**

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Turks and Caicos coral reef health is critical for fisheries, tourism, and shore protection from global warming and sea level rise. TCI has some of the best remaining reef in the Caribbean region, but corals are declining from episodic damage and progressively increasing environmental stress. Traditional assessment methods provide relatively little information because they cover too little area to accurately characterize habitats, miss large-scale patterns, and high intrinsic variability inhibits identifying changes or causes. Spatially extensive surveys provide more information, over larger areas, in less time, than intensive ones, revealing large-scale gradients that intensive methods are inherently unable to identify. Extensive surveys were carried out during early June 2006 by diving, snorkeling, towing, from shore, and from the air, covering North Providenciales from the northern west coast to eastern north coast, from southwest South Caicos to southeast East Caicos, and all around Grand Turk, including Gibbs Cay, and Round Cay. Since algae cover exceeds coral cover, and algae species are more sharply spatially zoned than corals, they convey more environmental information useful for management, so a special focus of the survey was identifying algae zonation across environmental gradients, rarely considered in reef assessment. 26 different ecological and environmental parameters were assessed in 47 different areas. Transects were chosen parallel and perpendicular to major environmental gradients and to span their ranges. Correlations between all pairs of ecological and environmental variables were assessed by non-parametric statistics because few variables are normally distributed. The matrix of all correlations and significance was calculated, providing improved insight into interactions between species and their relations to environmental gradients. All previously known causes of deterioration were confirmed, but many unexpected correlations were also identified. Extensive methods are far more cost effective and provide a new paradigm that should be much more widely used for management purposes.

**Key words:** large-scale extensive versus small scale intensive ecological assessment, environmental gradient analysis, non-parametric statistics, coastal zone management

## **TURKS AND CAICOS ISLANDS CORAL REEF ASSESSMENT RESULTS: ECOLOGICAL AND ENVIRONMENTAL INTERACTIONS**

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26 ecological and environmental parameters were assessed at 47 coral reef sites across the Turks and Caicos Islands. Live coral cover averaged 10-20%, maximum around 40%. Dead coral exceeded live coral at all sites. Several past mortality events from disease and high temperature were identified. There was little hurricane damage in most locations: old dead elkhorn corals were largely intact, but large areas of staghorn and finger coral rubble were seen in lagoons. Dead offshore elkhorn reefs, which protect the shoreline from erosion, are slowly crumbling from boring organisms. The intensity and frequency of hurricanes, along with sea level rise, will increase with global warming, greatly increasing future beach erosion. Stress from sedimentation was seen down-current from the Cruise Ship Port dredging site, and inshore where sediments are re-suspended by waves. Severe, but localized, coral disease was seen at many locations. Non-parametric statistical analysis of the data revealed that many diseases correlate with certain species of algae, which might be reservoirs for pathogens. High algae abundance was seen at almost all sites, with zoned gradients pointing towards nutrient sources. Most dive sites had little algae in shallows, but algae increased dramatically at the drop off edge into deeper water to the thermocline. In many shallow reefs algae indicated land-based nutrient sources from contamination by outflow of creeks, marinas, salinas, fish processing plants, hatcheries, or groundwater seepage. Surprisingly, very high levels of algae were also seen at many sites with no land-based nutrient sources. Spatial zonation of algae suggest nutrient sources from persistent localized upwelling of cold, deep, nutrient-rich water offshore. Green chlorophyll-rich surface water was noted at most sites affected by land-based sources as well as offshore upwelling, suggesting widespread natural nutrient stress backgrounds. The data are being used to develop national water quality management and restoration strategies.

Key words: Algae zonation, coral community assemblages, diseases, bleaching

### **MAIN RESULTS IN THE INTEGRATION OF THE MARINE BIODIVERSITY INFORMATION SYSTEM (SIBM) TO OBIS**

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Development in technology have made possible the integration of individual databases into shared datasets that allow dissemination of data and large-scale and long term analyses. A concrete example of this is the Ocean Biogeographic Information System (OBIS). Between 2005-2006 INVEMAR, executed procedures and task with the goal of integrating the data content in the Marine Biodiversity Information System of Colombia (SIBM) into the OBIS node Caribbean. In the project, the main goals were: 1. To georeference the collections of fishes, mollusks, echinoderms and cnidarians of the Museo de Historia Natural Marina de Colombia (MHNMC). 2. To establish and generate the software filters required to select the biological records that will be made available to the OBIS users, using a client server connected to INVEMAR. 3. To develop the necessary software to integrate the SIBM system to the OBIS network in consultation with user groups. For this, a temporal coverage between 1956 and 2007 was obtained, representing about 2.350 species with 16.661 distributional records for fishes, mollusks, echinoderms and cnidarians. The habitat coverage includes seashores (littoral), sublittoral seabed, mangroves, seagrasses, coral reefs, azooxanthellate coral communities, and continental margin soft bottoms. In the System, data bases in multimedia electronic format of the species stored in the MHNMC, as well the related information of their capture and identification according to standards already established, are combined. The SIBM is a key tool of access to scientific, technical and public levels on the marine and coastal Colombian biodiversity. This is a model of a Caribbean database accessible on-line and demonstrably useful integrated to OBIS.

## **CORAL RECRUITMENT ALONG THE SOUTHERN COAST OF ST. JOHN, US VIRGIN ISLANDS: THE INFLUENCE OF TEMPERATURE IN MEDIATING SPATIO-TEMPORAL VARIATION**

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Studying the effects of temperature on scleractinian corals has been popularized by the increase in thermal bleaching events, but few studies have documented the effects of temperature on scleractinian larval settlement and post-settlement success. The goal of this study is to test for the effects of kilometer-scale variation in temperature on the recruitment of scleractinian corals. Experiments were initiated to quantify seawater temperature as well as the recruitment and post-settlement success of corals along the south coast of St. John, US Virgin Islands. To measure variation in temperature and recruitment, logging thermistors and settlement tiles were deployed at 5-6 m depth at 10 sites, and juvenile corals were tagged on limestone and granite substrata, both of which are common subtidally in St. John, to determine growth and mortality. Preliminary experiments in August 2006 revealed that granite was up to 0.5 °C warmer than limestone during the afternoon, and therefore it was hypothesized that juvenile corals would suffer greater thermal stress on the former compared to the latter. Thermistors, settlement tiles, and tags were deployed in August 2006, and the first census occurred in January 2007. Additional surveys will occur at 6-month intervals in order to capture seasonal effects in the factors mediating coral recruitment and post-settlement success. The preliminary results from the first surveys reveal (1) small-scale variations in seawater temperature that appear to be associated with rates of coral recruitment, and (2) patterns of post-settlement success that appear to be mediated by substratum type (i.e., granite versus limestone).

**Keywords:** Coral recruitment, spatio-temporal variation, thermal stress, post-settlement success.

## **CSI ON CORAL REEFS: DEVELOPING STANDARDS FOR UNDERWATER INJURY INVESTIGATION**

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The primary objectives of the ICRI Committee on Coral Reef Enforcement and Investigation are to (1) develop a training program and multi-layered toolkit on conducting coral reef enforcement and natural resource investigations, which can be adapted for use in any major coral reef region; and (2) run international training workshops to train coral reef resource managers, environmental assessment specialists, forensic investigators and litigators on conducting coral reef enforcement and natural resource investigations to support mediation, mitigation, restoration, litigation or prosecution. Types of investigation training will include vessel groundings; destructive fishing, illegal take, oil, chemical & sediment spills; pollution events including eutrophication; aquatic invasive species; and chronic sublethal events. The first of these field training workshops is scheduled for Central America in early 2008. The results of these efforts will be in the short term, the training of key individuals within each coral reef country in the international standards and protocols being developed for conducting defensible investigations of marine natural resource impacts on coral reefs to determine responsible parties, mitigative strategies and gather evidence for decision-making specifically tailored to regional coral reef issues and concerns. Over the long term we expect to see increased capacity within each country's marine resource management and enforcement efforts, specifically as it relates to improved investigative ability leading to increased success in prosecution, mediation, mitigation, restoration or litigation; along with greater public education and support resulting from these improved efforts. We also envision greater regional multi-country cooperation involving investigations and rapid response capabilities, including formation of regional rapid response teams to deal with large-scale and multi-country marine natural resource impact and injury investigations.

**Keywords:** Impact Assessment, Injury, Enforcement, Investigation

## RESERVE EFFECTS VERSUS NATURAL VARIATION IN CORAL REEF COMMUNITIES

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No-take reserves are a common tool for conservation in marine ecosystems. Despite much discussion of their benefits, data documenting reserve effects are surprisingly scarce. Several studies have also been criticised for a lack of rigour so that changes within reserves cannot be separated from underlying natural variation and attributed unequivocally to protection. We sampled both benthic and associated fish communities, stratified by habitat ('*Montastraea* reef' and 'gorgonian plain'), in a well-enforced coral reef reserve in The Bahamas. To distinguish reserve effects from natural variation, we compared changes inside and outside the reserve with those seen at equivalent spatial scales in other reef systems in the Bahamian archipelago that lack reserves. Reserve-level differences in benthic or fish communities not documented in other reef systems are categorised as 'robust' effects. Robust reserve effects were limited to *Montastraea* reefs. The reserve supported an average of  $\approx 17\%$  more fish species per site compared to outside the reserve. Specifically, the mean number of large-bodied grouper, damselfish and butterflyfish species were higher inside the reserve. Increases in fish biomass and differences in community structure inside the reserve were limited to groupers. Increased grazing pressure in the reserve has lowered macroalgal cover and caused previously-undocumented changes in benthic community structure compared to sites outside the reserve. Some reserve-level differences in fish communities were categorised as 'misleading' since equivalent differences were seen in other reef systems and are likely to be caused by natural intra-habitat variation. The Bahamas represents a relatively lightly-fished Caribbean system. However, cessation of fishing has still increased the mean number of species, the abundance of highly-prized fishes and altered benthic community structure. In certain habitats, reserves are clearly important for conserving fisheries and biodiversity. However, reserve effects must be separated from confounding variables to ensure conservation benefits are accurately reported and not oversold.

**Keywords:** The Bahamas, intra-habitat variation, sampling design, trophic cascades

## MODELING THE BETA DIVERSITY OF CORAL REEFS

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Quantifying the beta diversity (species replacement along spatio-temporal gradients) of ecosystems is important for understanding and conserving patterns of biodiversity. However, virtually all studies of beta diversity focus on one-dimensional transects orientated along a specific environmental gradient that is defined *a priori*. By ignoring a second spatial dimension and the associated changes in species composition and environmental gradients, this approach may provide limited insight into the full pattern of beta diversity. Here, we use remotely-sensed imagery to quantify beta diversity continuously, in two dimensions and at multiple scales across an entire tropical marine seascape. We then show that beta diversity can be modeled ( $0.852 \geq r^2 \geq 0.590$ ) at spatial scales between 0.5 and 5 km<sup>2</sup> using the environmental variables of mean and variance of depth and wave exposure. Beta diversity, quantified within a 'window' of a given size, is positively correlated to the range of environmental conditions within that window so that, for example, beta diversity increases with increasing variance of depth. By analyzing such relationships across seascapes, this study provides a framework for a range of disparate coral reef literature including studies of zonation, diversity and disturbance. Using supporting evidence from soft-bottom communities, we hypothesize that depth will be an important variable for modeling beta diversity in a range of marine systems. We discuss the implications of our results for the design of marine reserves.

**Keywords:** biodiversity, landscape ecology, U.S. Virgin Islands, wave exposure

## AN ANALYSIS OF SATELLITE-DERIVED SEA SURFACE TEMPERATURES FROM CARIBBEAN AND ATLANTIC CORAL REEF SITES, 1982-2003

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A database of monthly average sea surface temperatures (SSTs) from 1982-2003 has been developed from NOAA Tiros satellite infrared radiometric records. This record corresponds to geographic coordinates for 50 reef tracts throughout the Caribbean Sea and the adjacent Atlantic Ocean. The data represent part of a collective SST Atlas of Coral Reef Sites that we have prepared for 206 globally-distributed sites. The temperature series covers over two decades of active climate change and coral reef ecosystem responses, during which mass coral reef bleaching, emerging diseases, biodiversity losses, species mortalities, fisheries declines, and reef frame degradation have been reported. Reef ecosystem changes appear when monthly SST values approximate or exceed 1.0°C above warm season averages. Linear trendlines and regression coefficients for each site document both the degree and rate of temperature change, allowing comparisons to be made among sites. Coastal upwelling that circulates deep, cool and nutrient-rich water to the surface and alters the productivity of reef fisheries is evident from the SST data. Since ocean heat fuels hurricanes, the SST record also correlates with extreme event impacts upon reef sites. Maximum and minimum temperature trends, yearly variations in SST elevations, durations of exposure, and seasonal fluctuations may be analyzed from the database. These calibrated and comparative measurements also serve to determine how SST trends at any one site contrast or conform to neighboring upstream or downstream sites. Site-specific thermal records offer a basis for developing individualized management strategies and for formulating unique conservation policies for regional reefs. The differences among temperature trends in the database may account, in part, for the degradation of some and the relative sparing of other reefs. These data represent a 22-year historical record of thermal stress to coral reefs and indicate how SST patterns may signal early alerts for reef responses to persistent future climate change.

**Keywords:** sea surface temperature, coral reefs, Caribbean, Atlantic, ocean circulation

## RECENT THECIDEIDE BRACHIOPODS (*THECIDEOIDEA*) IN THE CARIBBEAN REGION – AN UNRECOGNIZED DIVERSITY

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Recent thecideide brachiopods are small sessile filter-feeders belonging to two subfamilies of the Thecideoidea, *Thecidellinae* and *Lacazellinae*. Two Recent Caribbean species are known so far, *Thecidellina barretti* (Davidson, 1864) and *Lacazella caribbeanensis* (Cooper, 1977). Representatives of these taxa live in cryptic habitats of coral reefs and are spread throughout the Caribbean. They are known for their unique mode of intensive brood care. Whereas *Lacazella caribbeanensis* can be found only in small numbers, *Thecidellina* specimens can be quite numerous and thus being important for reef building processes, because of their calcareous valves. In the past, samples of thecideide brachiopods from the Caribbean were often uncritically assigned to the known Caribbean species, mostly depending on their macroscopic resemblance and size. With genetic studies still to come, we - as a first step - here re-examined the skeletal structure of *Thecidellina* and *Lacazella* specimens by scanning electron microscopy. The material investigated comprises samples from different locations within the Caribbean and the Atlantic, e.g. Bahamas, Jamaica, ABC-Islands, Cayman Islands, Saba Bank and Cape Verde. Surprisingly, this investigation revealed a so far unknown morphological diversity of *Thecidellina* within the Caribbean, suggesting an unrecognized species complex. The internal structures offer a set of valuable discriminating characters and thus providing a basis for several new species descriptions. Although each investigated island seems to have its own distinct morphotype, there is no obvious correlation between the geographic distribution and the occurrence of these morphs. However, there is evidence for the co-occurrence of several species of *Thecidellina* in some of the Caribbean Islands. In contrast to this *Lacazella caribbeanensis* is morphologically indistinguishable within all of the Caribbean samples. As a next step we will compare the results of our morphological analyses with molecular data. For these investigations, suitable material is urgently needed.

**Keywords:** speciation, species complex, *Thecidellina*, *Lacazella*

## WHAT DOES CORAL POPULATIONS SIZE STRUCTURE TELL US?

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Coral colony size is a variable that evidence how populations answer to the environment or how their demographic life histories differ; therefore it has been used as useful method to evaluate the health state of a reef. It has been found that reefs under the influence of environmental degradation show discernible patterns in coral population structure caused by reduced recruitment and/or increased partial or whole mortality. The distributions of the coral populations under these conditions will become more skewed to the left in comparison with populations in a “pristine” environment. However, there are many biotic and abiotic factors that can affect the demography and dynamics of a coral population, which have to be considered when using this method. In this work, the size frequency distributions of *Diploria strigosa*, *Agaricia agaricites* and *Porites astreoides* at different depths (0-3 and 8-12 m) were compared between two reefs at Isla Larga, San Esteban National Park. The total area of each colony was considered as the size, and was estimated using the height, maximum and minimum diameter. When comparing the size frequency distributions of the same species in the same reef between the two depths intervals, all the species presented different distributions (Kolmogorov-Smirnov of two samples,  $p > 0.05$ ). When comparing the same species at the same depth between reefs, similarities were found only for *D. strigosa* for the deepest interval (Kolmogorov-Smirnov of two samples,  $p > 0.05$ ). The three species presented inter and intraspecific differences in their size frequency distributions between reefs and the depth intervals evaluated. Therefore additional parameters from the size frequency distributions are highly recommended for the determination of the health state of a reef and the design of environmental management plans.

**Keywords:** coral size frequency distributions, *Diploria strigosa*, *Agaricia agaricites*, *Porites astreoides*, Caribbean.

## TIME SERIES (2005-2007) OF COASTAL CURRENTS ON THE SHELF SOUTH OF ST. THOMAS, USVI.

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Here we analyze and present data on coastal ocean currents on the south shelf of St. Thomas, USVI over the period from early 2005 to mid 2007. The importance of understanding current patterns within this region relates to spawning aggregations of commercially important reef fishes that use the banks of the shelf edge as spawning grounds at various times of the year. Wind-driven component of the currents are influenced by the prevailing easterly trade winds that form the dominant westerly current flow and onshore downwelling system off the south of St. Thomas. The thickness of the upper mixed layer changes on a seasonal basis with a deep UML (~80 m) during the winter months from November to February, the thickness decreases through the summer to a minimum thickness in July and August of between 30 and 40 m. A deep chlorophyll maximum zone is typically associated with the interface between the UML and the first isopycnal layer. Currents shift to an easterly direction during the winter as frontal swells are generated off the North American continent. Lunar cycles typically show a strengthening of tidal currents during the new and full moons.

**Keywords:** coastal currents, tidal cycles, UML seasonal variability, deep chlorophyll maximum.

## APPLICATIONS OF OPTICAL PROPERTIES DETERMINATIONS IN SURFACE WATERS FOR THE ASSESSMENT OF DISSOLVED ORGANIC MATTER IN ESTUARIES

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A significant portion of major nutrients (N & P) in the Florida Coastal Everglades (FCE) is in a dissolved organic form, and as such DOM is important in fueling the microbial loop. While DOM sources and therefore its quality control its biogeochemistry, the environmental dynamics of DOM in many aquatic systems remain largely unknown. Seasonal and spatial variation of the composition of CDOM in the FCE, particularly in the subtropical estuary of Florida Bay was studied to better understand its source and biogeochemical processing. Several optical properties of surface waters, including three dimensional fluorescence excitation-emission matrixes (EEM) spectroscopy, in conjunction with parallel factor analysis (PARAFAC), proved to be a promising tool to assess qualitative variations in space and time of chromophoric DOM (CDOM). The data suggest that much of this variability can be explained based on seasonal primary productivity variation and special hydrological influences.

**Key words:** fluorescence spectroscopy, estuaries, dissolved organic matter, Florida Bay

## ABUNDANCIA Y RIQUEZA DE LA MACROFAUNA ASOCIADA A LA FANERÓGAMA *THALASSIA TESTUDINUM* (Bank ex König, 1805) EN LA LOCALIDAD DE LOS CACHICATOS, GOLFO DE CARIACO, VENEZUELA

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Se estudio la abundancia y riqueza de especies de la macrofauna bentónica asociada a una pradera de *Thalassia testudinum* en la localidad de Los Cachicatos, localizada en la costa norte del golfo de Cariaco, Edo.Sucre, Venezuela, durante los meses de noviembre de 2000 a diciembre de 2001. El material fue colectado con un nucleador de PVC de 0,015 m<sup>2</sup>, a profundidades comprendidas entre 0,70 y 1,0 m, y colocados en un tamiz de 1 mm de apertura de malla, donde fueron separados los organismos y la planta para su posterior estudio. La biomasa total de la pradera osciló entre 4.368,6 a 3.900,5 g/m<sup>2</sup>, con una densidad de tallos cortos de 1441 a 545 plantas/m<sup>2</sup>. Se colectaron un total de 1.474 organismos pertenecientes a 6 grupos taxonómicos (moluscos, poliquetos, crustáceos, equinodermos, sipuncúlidos y nemertinos), contenidos en 116 especies, siendo los moluscos con 739 organismos los más abundantes, seguido por los poliquetos con 647. Las mayores abundancias de organismos durante el período de estudio fueron observadas durante los meses de abril – julio, y septiembre, concordando con el período de surgencia, característico de la zona de estudio. En cuanto a la riqueza de especies, los moluscos también presentaron el mayor número con 56 especies, poliquetos con 49, equinodermos 6 y los crustáceos con 4. Se encontraron pocas relaciones entre la abundancia de organismos y riqueza de especies, con la biomasa de la fanerógama, sin embargo, los meses de mayor abundancia de organismos, coincidieron con altos valores de cobertura vegetal de *T. testudinum*, lo cual pudiera indicar que, a pesar de no existir una correlación tan acentuada, éstos se ven beneficiados de manera indirecta por la mayor biomasa de la planta, en el caso de los herbívoros, por mayor producción de materia orgánica, y para los bivalvos, por la protección de sus depredadores.

**Keywords:** Invertebrados, ecología, fanerógamas marinas, Caribbean.

## **USING REEF RESILIENCE PRINCIPLES TO IMPROVE STAGHORN CORAL (*ACROPORA CERVICORNIS*) RESTORATION IN THE FLORIDA KEYS**

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Significant declines in living coral coverage within the Florida Keys National Marine Sanctuary (and worldwide) have occurred in recent decades due to local, regional, and global threats. In particular, populations of the important reef building branching staghorn coral, *Acropora cervicornis*, have declined 80-90% throughout the Caribbean and western Atlantic since the late 1980's, and has recently been listed as threatened under the Endangered Species Act in May 2006. This project aims to restore degraded reefs in the Upper Keys by transplanting fragments of naturally occurring, and wild staghorn coral. Approximately 25 staghorn coral colonies naturally settled onto a privately owned live rock farm within Sanctuary waters in the Upper Keys. In addition to these 25 parent colonies, 22 wild colonies were collected, fragmented, and brought back to the live rock farm (coral nursery). All of these colonies were fragmented, and cemented to small cement casts, that remain on platforms within the coral nursery. The genotypic identity of these corals was also determined within the first six months. This genetic marker will serve as a tool that allows for long term tracking of recruitment and proliferation. In November 2006, these fragments were outplanted to four different restoration sites, located within different reef zones determined by the Florida Reef Resilience Program. These restoration sites will be monitored for coral growth rates, mortality, and the recolonization of reef-dwelling organisms. We expect to create a series of localized staghorn thickets following the rapid growth and expansion of the transplanted fragments. This project has now been expanded to three more sub-regions (Lower Keys, Miami transition, Broward), with future plans to expand to the Caribbean region.

**Keywords:** *Acropora cervicornis*, coral reefs, restoration, Florida Keys.

## **SEWAGE IMPACT INCREASES BLACK BAND DISEASE PREVALENCE AND MIGHT ALTER BLACK BAND MICROBIAL COMMUNITY COMPOSITION ON REEFS OF ST. CROIX**

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Black band disease (BBD) is a major cause of coral loss on tropical and subtropical coral reefs worldwide. Qualitative studies and observations suggest that human impact and pollution contribute to an observed increasing BBD prevalence. Additionally, quantitative studies have shown increased BBD disease progression rates associated with higher nutrients, and higher BBD prevalence associated with sewage-impacted sites. We are interested in determining the role of coral diseases, including BBD, in degradation of coral communities in sites impacted by human activity, especially sewage and nutrient input. We are also interested in how these environmental impacts affect the microbial community composition associated with BBD. Using molecular (16S rDNA) and traditional microbiological techniques, our lab has been investigating BBD and healthy coral microbial communities from several Caribbean locations with various levels of human impact. Our sites include two areas in the same St. Croix (U.S.V.I.) reef system, one of which is chronically exposed to raw sewage effluent and the other upstream and not impacted by sewage. BBD prevalence at the sewage impacted site was 2.7 % (n = 521), while it was 1.0 % (n = 1255) on the non-impacted nearby site. The coral communities of the two sites have been monitored in terms of size-class frequency distribution to assess long-term changes. Results indicate that changes in size-class frequency distribution are different in the presence of high disease prevalence and reflect a degraded population. The results of our molecular microbiological studies of BBD from the St. Croix sites also reveals a change in BBD microbial community composition, with more bacteria that are associated with toxin-producing dinoflagellates in samples from the polluted site. We have also compared this data set with studies of reefs at a pristine site (Lee Stocking Island, Bahamas) and a moderately impacted site (the Florida Keys). These results will be discussed and compared with the St. Croix study.

**Keywords:** Black-band disease, 16S rDNA, Caribbean, Coral population

## USING HYDRO-ACOUSTIC TAGGING TO DETERMINE THE MINIMUM SIZE OF FISHERY CLOSURES FOR PROTECTING GROUPEL SPAWNING AGGREGATIONS IN THE USVI.

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Spawning aggregations of reef fish are extremely vulnerable to over fishing and have been eliminated on many islands throughout the Caribbean. Managers of fishery resources have found that the most effective management tool for protecting vulnerable life history periods such as spawning is through seasonal and permanent fishery area closures. Critical to the accurate placement of these closure boundaries is the area occupied by fishes during spawning and the movement patterns associated with the aggregating species. In most cases this is largely unknown. The aim of this study was to determine the movement patterns, behaviors and reef areas associated with spawning aggregations of three commercially important groupers, red hind (*Epinephelus guttatus*), Nassau (*E. striatus*), and yellowfin (*Mycteroperca venenosa*), within two existing fishery closures in the USVI, the Marine Conservation District (MCD) and the Grammanik Bank. To accomplish this hydro-acoustic transmitters were inserted in ten fish of each species, both male and female, while fish were on the aggregation sites. The transmitters were detectable within 400m of 17 underwater receivers. Receivers were deployed in an array around the spawning grounds, outside of the closed areas and along the shelf-edge of the insular platform and were downloaded monthly. Migratory pathways and spatial and temporal movement patterns were identified for the three target species during their spawning seasons. Significant daily movement while on the aggregation sites was detected for all three species but especially for the Nassau and yellowfin grouper. The MCD, an area closed year-round to all bottom fishing, appeared adequate in size to protect red hind while the fish formed spawning aggregations. However the Grammanik Bank, a small seasonal area closure for Nassau and yellowfin grouper, did not encompass even daily movement patterns and left fish vulnerable to fishing during the spawning season.

**Keywords:** telemetry, Serranidae, spawning aggregations, fishery protected areas

## INVESTIGATION OF GENETIC CONNECTIVITY OF POPULATIONS OF *DIADEMA ANTILLARUM* IN MARINE HABITATS OF ST. CROIX AND PUERTO RICO

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The question of how far organisms disperse is a fundamental issue in ecology and is especially difficult to observe directly in marine ecology. In addition, a critical, known data gap for the management of coral reef ecosystems in the Caribbean concerns dispersal of the long-spined black sea urchin, *Diadema antillarum*. A great deal of evidence suggests that this urchin plays an important role in maintaining healthy coral reefs in this region, primarily by eating seaweed that might otherwise grow on top of corals. These urchins reproduce sexually by spawning. When their free-swimming larvae are kept in tanks, they grow for 1-2 months before metamorphosing into benthic adults. Because of the small size of these larvae, no direct measurements have been made of the extent of their dispersal in their natural habitats. The generally accepted paradigm concerning the dispersal of most species of marine larvae is that they are passively carried by currents. However, research indicates that a few species of marine larvae actively resist currents to remain in a particular area. The goal of this research is to indirectly investigate the dispersal of *Diadema antillarum* larvae by asking if there is genetic differentiation between populations of adults. Genetic differentiation could be caused by either divergence among genetically isolated populations or by different selective pressures operating on different geographic parts of a large connected population. To reduce the possible effects of selection, I will assess genetic variation of actin intron regions. Amplification of these regions by PCR will be followed by restriction analysis using enzymes that recognize polymorphic sites. I have obtained samples of *Diadema antillarum* tissue from four populations in marine habitats of St. Croix and Puerto Rico. I will present the results of this population genetic analysis and discuss future research directions and possible implications for coral reef management.

**Keywords:** connectivity, population genetics, *Diadema*, Caribbean

## BLEACHING, AND MORTALITY OF *ACROPORA PALMATA* AT BUCK ISLAND REEF NATIONAL MONUMENT

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Corals at Buck Island Reef National Monument, located north of St. Croix, USVI, experienced elevated sea surface temperatures in 2005, triggering a mass coral bleaching event. By monitoring three sites before, during, and after the event, National Park Service staff quantified the bleaching extent and the subsequent mortality of *Acropora palmata*. Back reef and forereef sites experienced almost double the mortality that the reef shelf site experienced. Additionally, the backreef site experienced bleaching impact first, followed by the forereef site and the reef shelf. The loss of approximately 66% of live *Acropora palmata* tissue on the back reef, 58% on the forereef, and 36% on the reef shelf is the most devastating loss of *Acropora palmata* at Buck Island Reef National Monument since the white-band disease outbreak of the 1970s. Given the recent listing of this species under the Endangered Species Act, managers might find this information useful to establish critical habitat, and to develop better monitoring protocol.

Keywords: *Acropora palmata*, Bleaching, US Virgin Islands, Buck Island Reef National Monument

## **THE INCIDENCE AND PREVALENCE OF SCLERATINIAN CORAL DISEASES ALONG THE SOUTH COAST OF JAMAICA**

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This is the first quantitative study of coral diseases on the south coast of Jamaica where the reefs are an important resource for artisanal fisheries and for both local and international tourism. From January 2006 to April 2007, nineteen (19) stations located along the south coast of Jamaica were sampled quarterly, using a permanently marked radial belt transect with a diameter of twenty meters. At each site the scleratinian diseases observed and the species affected were recorded. Additionally, diseased colonies were tagged and photographed to determine the rate of spread of the disease. The abundance and density of coral species, urchins and algae were also noted. Three diseases were observed: black band, white plague, and white band. Two syndromes were also noted: dark spot and yellow blotch/band. Results showed that: (1) the incidence of all diseases combined varied significantly over the year ( $p=0.0145$ ); (2) white plague disease varied significantly over the year ( $p=0.031$ ) being most abundant during April through December; (3) the incidence/prevalence of the other four diseases did not vary significantly throughout the year. Correlations were drawn between the density of disease and the following variables: coral density; algal density; physical factors such as temperature; and anthropogenic influences such as pollution outfalls and also the number and size of settlements within 15km of a site. This study is important because structural changes to the coastline caused by reef degradation would result in negative socio-economic impacts to both the tourism and artisanal fishing industries.

**Keywords:** Scleratinian coral disease, radial belt transect, urchin density, Jamaica.

## **DYNAMICS OF THE SOUTHERN CARIBBEAN UPWELLING SYSTEM DERIVED FROM REMOTE SENSING MAPS**

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The south-eastern margin of the Caribbean Sea is influenced by the output of major rivers and seasonal coastal upwellings. Both factors contribute to high levels of primary and secondary productivity. By using time series of remote sensing derived maps (AVHRR, MODIS) of sea surface temperature (SST) and chlorophyll concentration (Chla), we characterized the dynamics of the major upwelling areas in the coast of Venezuela and Colombia. We identified 10 upwelling foci in six different regions, with areas of emerging cold water ranging from 6 Km<sup>2</sup> to 1729 Km<sup>2</sup>. In the Cariaco upwelling system, the upwelling plume, defined under the 24.75°C horizontal isotherm, could cover up to 135.861 Km<sup>2</sup>. The upwelling phenomena is seasonal, starting with the increase of the zonal wind stress produced by the Trade winds in December until late April, with a second upwelling lasting a few weeks in June-July, not evident in all years. The response of the Chla to the decrease of SST is almost immediate with a lag of 0-15 days. In areas of high river inputs the estimation of Chla could be confounded by large amounts of suspended sediments and/or colored dissolved organic matter, reducing the accuracy and precision of the remote sensed estimates. Image analysis since 1993, suggest a large inter annual variation in duration and extension of the upwelling plumes. Years of 1997, 2001 and 2003 showed strong upwelling while 1994-1995 and 2004-2005 were particularly weak. The time series evidenced a significant raise in SST over the last three years, values that correspond very well with the global increment of sea temperature registered in the Cariaco oceanographic station.

**Keywords:** Upwelling, Sea Surface Temperature, ocean color, Caribbean Sea

## THE USE OF ECOSYSTEM-BASED MODELS TO SELECT AREAS FOR THE CONSERVATION OF MARINE BIODIVERSITY IN FACE OF OFFSHORE GAS EXPLOITATION IN VENEZUELA

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Offshore oil and gas exploitation in Venezuela represents a major threat to the marine biodiversity, considering the potential impacts derived from it at each of the stages of a major hydrocarbon exploitation program. In a joint effort between INTECMAR, The Nature Conservancy and Petróleos de Venezuela PDVSA, we used an ecosystem based modeling approach to select a portfolio of conservation areas that include ecosystems with high conservation health status at a minimal conservation cost. After selecting 21 conservation targets in a ecoregional configuration, their conservation status was evaluated and the major threats identified. The conservation goals were established between 30% and 100% of their total cover area (assigned by expert consultation). Major threats to the marine biodiversity such as river inputs to the sea, coastal development, maritime routes, ports, aquaculture farms, oil industry complexes and trawling areas, were mapped and evaluated. We combined the conservation costs (threats) and conservation targets in MARXAN, a simulated annealing algorithm that selects conservation units constrained to a parametrized boundary length of the areas, the penalty costs for non selection of targets and the clustering of the units. The results produced a portfolio of 20 areas adding 4.4 millions of hectares, representing 37.8% of the marine areas above 200 m depth. The selected areas were mapped in a GIS and intersected with the locations of future offshore developments. A set of specific conservation strategies were designed for the selected conservation targets as well as a set of best environmental practices for the oil industry.

**Keywords:** EBM, Marxan, MPA, offshore oil exploitation

## EVALUATION OF METHODS TO ENHANCE REEF RESTORATION

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The coral reefs of southeast Florida are offshore a highly urbanized area with a population exceeding 5 million people and three major shipping ports with over 6000 ships calling on an annual basis. Reef injury events are common and have been caused by ship groundings and marine construction activities such as channel dredging and cable placement. Restoration activities generally only include the reattachment of dislodged stony corals, removal of rubble, and boulder stabilization. The Florida Department of Environmental Protection has recognized these limited activities and is collaborating with Nova Southeastern University's Oceanographic Center to study ways to accelerate coral reef succession in damaged reef areas. The goal of this study is two-fold: 1) to examine the potential for natural recovery by examining coral recruitment to both damaged and control sites, and 2) to test several reef restoration enhancement methods. Baseline surveys indicate that juvenile coral density is higher at damaged reef sites than control sites, but rates of coral recruitment, growth, and mortality are being monitored. Comparison of materials commonly used in reef restoration indicates that concrete and limestone initially attract more coral recruits than other materials tested. Finally, the efficacy of transplanting gorgonians and sponges through fragmentation and of corals through relocation of juveniles are being assessed. Information gained from these studies will provide resource agencies with improved methods to promote reef restoration.

**Keywords:** coral, restoration, recruitment, transplantation

## **RAPID POPULATION ASSESSMENTS OF MARINE ORNAMENTAL FISHERIES TARGET SPECIES IN WESTERN PUERTO RICO.**

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Recent attempts to regulate the export marine ornamental fisheries in Puerto Rico encountered serious challenges rooted in information gaps concerning the nature and size of the fisheries and their impacts, as well as to communication deficiencies between resource managers and fishers. In response, regulators initiated a three-phase program to (1) characterize fisher numbers, methods and exports; (2) assess populations of exploited species; and (3) develop and propose appropriate fishery management approaches for subsequent application. This presentation summarizes the recently completed second phase of this program designed to produce population estimates of exploited species. This study evaluated wild populations of >20 fish and >20 invertebrate species target by the export fishery to develop minimum population estimates for comparison against annual harvest statistics. Field species counts in numerous habitat types were correlated with NOAA habitat maps to provide conservative population estimates, creating “at least as many as X” population totals useful for applying Precautionary Principal attributes to fishery management policy development. Impacts of the existing fisheries were determined to be low, but steady and dramatic increases in world demand for marine ornamentals will continue to build economic pressure for growth of these fisheries, creating urgency for development of rational management decision-making prior to the onset of uncontrolled growth.

**Keywords:** fisheries, ornamentals, fishery management, Puerto Rico

## **DESIGNING A METHODOLOGY FOR THE IDENTIFICATION OF SIGNIFICANT CORAL DISEASE CLUSTERS**

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Over the past three decades coral disease incidence has increased from sparse, localized sightings, to a virtual panzootic as disease sightings become commonplace among the world’s reef systems. The Caribbean has been hit the worst by these diseases, resulting in region wide declines of more than 95% of their once dominant reef building coral, *Acropora*. Here, I have applied the principals and methodology of Medical Geography to examine spatial patterns in coral disease in order to infer potential causal relationships with covariates. This is believed to be the first time that geographic information systems (GIS) and spatial statistics have been used together to examine spatial distributions in a coral disease. Mayor et al.’s (2006) data of diseased (white-band disease) and non-diseased *Acropora palmata* in the Buck Island Reef National Monument, collected during the summer of 2004 were used as the source. Disease Mapping and Analysis Program (DMAP) was used to calculate the rate of disease clustering. Statistical analyses found no significant difference between the calculated disease clustering rates of the corals plotted as individuals, or between those spatially joined for distances up to 30m, indicating that transect location data may be used in place of individual colonies if necessary. Buffers of 150 – 300m were deemed to be best-suited for detecting disease clustering within this dataset. Monte Carlo simulations run within DMAP on the disease clustering rates found three main areas of highly significant ( $P \leq 0.01$ ) disease clustering. Kernel density analysis of purely diseased data failed to detect all three of the significant areas. Future analyses should be performed on each of the three significant clustering areas, at both a geographic and microbial scales. In future coral data should also be reported as spatially precise numerator (diseased) and denominator (non-diseased) values allowing for even more sophisticated spatial analyses. This new approach should better facilitate both geographic and epidemiological studies of coral disease, as well as provide managers with information on the most vulnerable reef areas.

**Key Words:** Coral Disease Clusters, GIS, Spatial Analysis, *Acropora*

## **ABUNDANCE, DISTRIBUTION, AND CONDITION OF THE FORAGING POPULATIONS OF GREEN SEA TURTLES (*CHELONIA MYDAS*) AROUND ST. CROIX AND ST. THOMAS, USVI**

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Nesting behaviors of local resident and migrant sea turtle species have been studied in several locations around St. Croix. However, little has been done to assess the foraging population of sea turtles around the territory. The purpose of this study, therefore, was to assess the abundance, distribution, and physical condition of the foraging populations of green sea turtles around the islands of St. Croix and St. Thomas. Ten sites were sampled around the island of St. Croix and three on the island of St. Thomas. Sea turtles were caught, measured, tagged, scanned for injuries, and before release, tissues samples were collected for DNA analyses. A digital photograph log was created for each turtle and used to later quantify condition. No green turtles were caught around the island of St. Croix during the summer or winter of 2005. Thirteen green turtles were caught around St. Thomas during the summer and 28 during the winter. More turtles were caught at Brewer's Bay during both sampling periods. In the summer, all nine turtles caught at Brewer's Bay had some degree of carapace damage and one had an abnormal scute pattern. In the winter, twelve of the 14 turtles caught at Brewer's Bay had carapace damage and three turtles had abnormal scute patterns. One turtle had only three flippers and one had a hook lodged in its mouth. Although carapace damage of green turtles caught throughout the study was low, damage was significantly higher for turtles caught at Brewer's Bay compared to the other sites. Net avoidance was the most important factor in the poor capture rate around St. Croix, while green turtles around St. Thomas reacted passively to net capture. In the future, more in-water work will be needed to further understand how sea turtles utilize foraging habitats.

**Keywords:** Green Sea Turtles, Foraging, Carapace Damage, US Virgin Islands

## **TROPHIC STRUCTURE OF THE FISH COMMUNITY ASSOCIATED TO SEAGRASS MEADOW IN LOS ROQUES ARCHIPELAGO NATIONAL PARK, VENEZUELA**

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Seagrass beds have been recognized as important feeding grounds for juvenile and adult fishes of tropical marine areas providing food and refuge for many temporal and permanent fish species. In those environment complex and dynamics trophic interactions occur in space and time. The aim of this paper was to evaluate the trophic interactions of the fish community inhabiting a seagrass bed at northern of Venezuela. Dos Mosquises Sur key was the sample site which is located at southwest of Los Roques Archipelago National Park. Fishes were collected during a 24 hours cycle using a beach seine (7 mm mesh) and a "push-net" (1.0 mm mesh) in August 2005 and January 2006. The occurrence, number and weight (wet) of each prey ingested was estimated and the diet was expressed using an index of relative importance (IRI). A total of 1014 specimens belonging to fish 51 species were analyzed. The preys were grouped into 42 items. Crustacea was the main prey with harpacticoida Copepoda as the most important. The benthos (IRI: 60 %), vegetal debris (IRI: 11 %) , plankton (IRI: 8%) and nekton (IRI: 9 %) were the more ingested items. The trophic guilds identified were benthofagous (21 species), herbivorous (8 species), piscivorous (3 species) and zooplanktivorous (2 species). The global estimates of connectance, connectivity and chain length of the trophic network were 0.005, 3.19 and 4, respectively. The results obtained are in agreement with those reported for other Caribbean areas and indicate the importance of seagrass meadow as feeding ground for fish community. The benthos played an important role in the fish community analyzed therefore an alteration might produce changes in the fish trophic network.

**Keywords:** Tropical fish community, Seagrass meadow, Trophic network, Diet analysis.

## MOLECULAR GENETIC ANALYSIS OF THREE SPECIES OF CARIBBEAN *PORITES PORITES* (SCLERACTININA: PORITIDAE)

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Species boundaries in scleractinian corals are unclear due to overlapping intraspecific and interspecific variation of skeletal characters that are traditionally used to distinguish closely related taxa. The Poritidae is one of the most abundant extant scleractinian coral families and is found worldwide. The taxonomy of *Porites* is one of the most difficult because of their small and irregular corallite structures. In the Caribbean, three closely related species of branching *Porites* (*P. porites*, *P. furcata*, and *P. divaricata*) occur sympatrically. The overall shape of the colony is bushy and branch diameters range from thin (< 10 mm; *P. divaricata*) with an intermediate form (10-20 mm; *P. furcata*) to thick branches (> 20 mm; *P. porites*). Such morphological similarities make field identifications difficult and raise the question as to whether these are true species or one taxonomic unit. Nonetheless, past allozyme and morphometric data show some support of independent species status. We are currently investigating the utility of DNA sequences to differentiate the three branching species. The hypothesis being tested is that these three *Porites* species are genetically distinct. DNA sequences from the nuclear ribosomal DNA (ITS-5.8S) and three intergenic spacers of mitochondrial DNA (the control region and two introns) were PCR amplified, sequenced, and aligned. Preliminary data from the mtDNA sequences show no genetic differences among these species. Further analysis will determine if these results are due to 1) a lack of variability in chosen markers or 2) lack of genetic variation among these species. These data are critical as reliable taxonomy is necessary to manage and protect coral reef ecosystems.

**Keywords:** *Porites*, molecular systematics, Caribbean,

## MAPPING AND MONITORING SEAGRASS HABITAT IN BERMUDA, YEAR 1: SPECIES DIVERSITY AND DISTRIBUTION

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Bermuda is a small, isolated, chain of oceanic islands located at 32.31°N, 64.77°W in the western Atlantic. Beds of tropical and subtropical seagrasses, *Thalassia testudinum*, *Syringodium filiforme*, *Halodule wrightii*, and *Halophila decipiens* are distributed from inshore bays out to the rim reef that encircles the platform. Recently, a study of seagrass habitat compared the distribution in summer 2004 with prior estimates of abundance made in the early 1990s. Results of the comparison indicated that offshore beds of *S. filiforme* and *T. testudinum* had declined precipitously, due to unknown causes. Accordingly, a comprehensive long-term monitoring program of benthic habitat was initiated in 2006. From the initial survey, we have obtained significant new data on seagrass species composition, distribution and abundance in Bermuda. *Syringodium filiforme* is the most widely distributed species followed by *H. decipiens* and then *H. wrightii* and *T. testudinum*. *Halophila decipiens* is found growing to 21.9 m and *S. filiforme* to 15.8 m. Spatial distribution and depth ranges of the grasses are different than previously reported for Bermuda, in particular for *H. decipiens*. *Halophila decipiens* is currently widespread on the platform, whereas earlier documents described it as rare or uncommon; we found *H. decipiens* plants year round (August, 2006 through March, 2007) and ripe fruits were on the plants from at least August through December. Healthy beds of *S. filiforme* and *H. wrightii* were documented in central parts of a major semi-enclosed basin, where seagrass beds were not reported in studies done in the late 1990s or in 2004, and which are subject to increasing disturbance by ferries and cruise ships. Seagrass beds in Bermuda are important developmental feeding grounds for juvenile green turtles and are heavily grazed across the platform, thus understanding and managing this habitat is very significant to the health of this geographically wide-ranging, endangered species.

**Keywords:** *Halophila decipiens*, Environmental Mapping, Fruiting Period

## **ABUNDANCIA DE CRUSTÁCEOS DECAPODOS ASOCIADOS A LAS RAÍCES SUMERGIDAS DE *Rhizophora mangle* EN LA LAGUNA DE BOCARIPO, ESTADO SUCRE, VENEZUELA.**

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Los bosques de mangle, son ecosistemas de muy alta productividad en los cuales se encuentran asociados gran cantidad de invertebrados, siendo los crustáceos uno de los grupos más abundantes. El presente estudio tuvo como objetivo estudiar la abundancia de crustáceos decápodos asociados a las raíces sumergidas del mangle rojo (*Rhizophora mangle*) en la laguna de Bocaripo, localizada en la zona norte del estado Sucre, Venezuela. Las muestras fueron colectadas entre febrero del 2005 y enero del 2006, en cinco estaciones, donde se escogieron al azar dos raíces mangle y en el laboratorio se procedió a separar y fijar en formalina al 3% todos los organismos. Se colectaron 197 ejemplares pertenecientes a la clase Malacostraca, Orden Decapoda contenidas en 6 familias (Portunidae, Panopeidae, Xanthidae, Grapsidae, Majidae y Porcellanidae), 10 géneros, y 17 especies. La familia con mayor número de especies fue la Panopeidae con 5 especies y 77 ejemplares (*Panopeus herbstii*, *P. bermudensis*, *P. occidentalis*, *Euripanopeus abbreviatus* y *Hexapanopueus padensis*); siendo *Panopeus herbstii* con 56 individuos, la especie con mayor número de ejemplares para todo el estudio. La familia Porcellanidae con 4 especies y 31 ejemplares (*Petrolisthes armatus*, *P. politus*, *P. tridentatus* y *P. galathinus*) fue la segunda en abundancia y finalmente la familia Majidae presentó el menor número de especies (1) y ejemplares (2). La mayor abundancia de crustáceos se registró en el mes de diciembre (30 ind.), con una riqueza específica de 7 y la menor abundancia correspondió al mes de noviembre con 2 individuos y 2 especies. La abundancia total por estación fluctuó entre 13 y 91 individuos, siendo la estación 5 la que presentó los mayores registros de abundancia en casi todos los meses, esto posiblemente debido a las condiciones ambientales e hidroquímicas (salinidad y temperatura) y a la mayor disponibilidad de microhabitats en esta estación.

**Palabras claves:** abundancia, crustáceos decápodos, mangle rojo.

## **ASSESSING HABITAT QUALITY IN CHESAPEAKE BAY: APPLICATION OF RNA:DNA INDICES TO BLUE CRAB (*CALLINECTES SAPIDUS*, RATHBUN, 1896)**

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Blue crab (*Callinectes sapidus*) is common to a wide range of estuarine habitats along the eastern seaboard of the Americas. Despite its broad distribution, the abundance of crabs in several regions including in the Chesapeake Bay have declined due to exploitation and habitat alteration. Resource managers have tried a range of tools and techniques to assess the status of the blue crab in the Chesapeake Bay. Patterns of habitat-specific production are currently unknown. One technique for measuring habitat-specific production that has proven successful with fishes and other crustaceans is to measure short-term growth using the ratio of RNA:DNA in sample tissues of an organism. This technique has not been validated for blue crab. The objective of this project was to test experimentally the potential of this technique to assess habitat quality and growth of the blue crab in the Bay. Crabs from a wide range of sizes were exposed to three food regimes for one week. After this week, muscle samples from three legs of each crab were extracted for nucleic acids analysis. Nucleic acids concentration in crabs was strongly affected by crab size, tissue type and ration. However, no significant relations were found between factors. As the exploratory nature of this project, other areas should have to be explored to improve this technique for later use in blue crab stock management.

## MARINE DEBRIS REMOVAL AND MONITORING EFFORT AT THE CAS CAY MANGROVE LAGOON MARINE RESERVE AND WILDLIFE SANCTUARY, ST. THOMAS, USVI

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Environmental education, business, and community organizations are collaborating in an effort to beautify and learn from the Cas Cay Mangrove Lagoon Marine Reserve and Wildlife Sanctuary on St. Thomas, US Virgin Islands. The recently established Virgin Islands Mangrove Research and Conservation Coalition (VIMRCC) is supported by The Gulf of Mexico Foundation, NOAA and the EPA to facilitate a yearlong education, clean-up, and environmental quality monitoring program. Clean-up activities are scheduled four times throughout the year and environmental quality measurements are taken periodically with the help of community volunteers. Volunteers gain scientific skills to assess environmental quality, aid in educating fellow community members about our precious mangrove ecosystem, and help make the mangrove sanctuary a safer, cleaner place for its inhabitants. Due to variation in habitats within the 721-acre reserve from shallow mud and seagrass beds to thick mangrove stands, different approaches for debris removal are necessary. Kayaks and an electric dinghy are used to reach shallow areas along the perimeter of the inner mangrove lagoon while motorized boats are used to reach deeper areas on the perimeter of the outer Cas Cay mangrove lagoon. The water-based teams pull odd shaped debris such as buckets, boat batteries, propane tanks, and tires from the red mangrove trees, *Rhizophora mangle*, that line the waters edge. Land based crews remove debris from accessible shoreline areas home to the black mangrove trees, *Avicennia germinans*. The land-based crews pick up debris introduced from a nearby road such as food wrappers and drink bottles. Areas with high concentrations or extremely large debris are tagged with GPS coordinates and mapped to document impacted areas and facilitate future removal. Environmental variables are measured with a Hydrolab multiparameter water quality instrument to determine habitat quality at areas of perceived heavy impact and areas of lighter impact. Visual and Hydrolab surveys at newly established *R. mangle* propagule sites during the sampling periods will help determine how and where the mangrove system is developing. This project integrates debris removal with baseline data for mangrove restoration and public education and will serve as a model to mangrove restoration in the USVI.

**Keywords:** Mangroves, monitoring, outreach

## PATTERNS OF ASSOCIATIONS AND INTERACTIONS AMONG SPONGES AND GORGONIANS

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Substrate space is often acknowledged as the major limiting resource for sessile invertebrates on coral reefs. Sponges may circumvent substrate space limitation through epibiotic associations on other organisms. In this study we describe the associations and interactions between sponge and gorgonian species in La Parguera on the southwest coast of Puerto Rico. Associations are random (non species-specific) in the sense that the highest abundances of sponges are found on the more abundant gorgonian taxa. For instance sponges, such as *Desmapsamma anchorata*, *Dysidea janiae*, *Iotrochota birotulata* and *Monanchora barbadensis* occurred most frequently on abundant gorgonians such as *Pseudopterogorgia* spp., *Gorgonia ventalina*, *Pseudoplexaura* spp. An exception is the species-specific association between *Desmapsamma anchorata* and *Briareum asbestinum*, a gorgonian occurring in relatively low abundance. Interactions were highly variable. For the 14 most abundant gorgonian taxa, 10 were negatively affected by sponges through mechanisms such as differential growth (smothering), allelopathic effects and aggressive behavior. For three taxa no interaction effects were evident (i.e. neutral interactions). Finally, sponge associations with *Briareum* benefited both organisms (mutualistic). These results indicate that the variable interactions may play a major role in the biodiversity of epibiotic organisms.

**Keywords:** Association, gorgonian, interaction, sponge

## MANAGING CORAL REEFS UNDER CHANGING STRESSES: INFORMATION, SIMULATION, AND INTERDISCIPLINARY RESEARCH

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Coral reef managers need to know what might happen given a change in reef stressors or management policies to which portions of a reef system and to which groups of reef users. A successful management decision is one that lies at the intersections of feasibility in terms of politics, economics, sociology, and ecology, and is usually one in which well-informed stakeholders participated. Often, decision-making must incorporate entire watersheds, and consider up-current and down-current dependencies and consequences in the ocean. The most successful computer-based tools used by coral reef managers to support decision making under these complex conditions have been Geographic Information Systems (GIS). In Data Navigator South Florida, we have extended the capabilities of GIS for these purposes via user-friendly online technology, decision-tree algorithms to provide access to large volumes of watershed and oceanographic information, and automated downloading of satellite information from other websites. With the Buck Island Agent-based Ecological Simulation (BIAES) System, we have prototyped a tool that provides hypothetical scenario-testing simulation in map-formats. There is a need to extend these capabilities more comprehensively, with field parameterized, fully-tested, multi-scale simulation capabilities wherein the simulations draw on GIS-based information, and provide outputs (with clear indications of uncertainties) in GIS formats. Simulations should be aimed not at point predictions, but at identifying the ranges of potential outcomes of changes to the socioeconomic-biophysical system. Properly developing, parameterizing, and testing such simulations will require well-organized, long-term interdisciplinary research at watershed scales and across appropriate oceanic distances, preferably conducted in comparative ways in numerous reef systems globally. These studies can be tied to participatory coastal management activities for maximum effectiveness. Major improvements in coral reef decision-making could be achieved with proper organization, international collaboration, and consolidations of expertise, facilities, and funding.

**Keywords:** Participatory Integrated Coastal Management, Geographic Information Systems, Decision Support Tools, Interdisciplinary Research.

## VARIACIÓN ESTACIONAL DE LA ICTIOFAUNA ASOCIADA A UNA PLAYA DE LA ISLA CARACAS OESTE, PARQUE NACIONAL MOCHIMA, ESTADO SUCRE, VENEZUELA

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La isla Caracas Oeste se encuentra en el norte del Parque Nacional Mochima, hacia el oriente del país. Para aportar al conocimiento de su ictiofauna, se realizaron capturas mensuales de peces en una playa arenosa del sector de sotavento, entre enero y diciembre de 2006. Se empleó una red tipo chinchorro playero, de 50 m x 1,5 m. Se capturó un total de 22784 individuos, pertenecientes a 66 especies en 30 familias, para una biomasa aproximada de 208 kg. Las familias más importantes respecto al número de especies fueron Haemulidae (9), Scaridae (6) Carangidae (5) y Belonidae (4). Las especies más abundantes fueron *Jenkinsia lamprotaenia* (6693), *Haemulon aurolineatum* (5401), *Haemulon boschmae* (2607) y *Haemulon flavolineatum* (659); mientras que las más importantes respecto a la biomasa (g) resultaron ser *Haemulon aurolineatum* (80445), *Tylosurus crocodrilus* (20871), *Mugil curema* (9882) y *Sparisoma chrysopterum* (9863). El análisis de agrupamiento de los meses, respecto a las abundancias de los peces, reveló la formación de un grupo general, separándose los meses de junio, enero y noviembre, en orden por disimilitud. El mayor número de individuos se presentó en junio (6620); mientras que la mayor biomasa se capturó en agosto (39620) coincidiendo con una de las abundancias más bajas. La menor abundancia se obtuvo en febrero (189) y la menor biomasa en diciembre (990). El número de especies más alto se registró en noviembre (29) y el más bajo en febrero (9). El índice de diversidad más elevado se reflejó en marzo (3,15 bits/ind) y el menor en abril (1,06 bits/ind). Las especies accidentales representaron la mayoría (53%), seguidas por las accesorias (26%) y sólo el 21% fueron constantes. Se evidencia una comunidad cambiante, con bajo porcentaje de especies constantes y la ocurrencia de grandes cardúmenes estacionales así como una alta cantidad de individuos juveniles.

**Palabras Clave:** Haemulidae, *Jenkinsia lamprotaenia*, *Haemulon aurolineatum*, Caribe

### A DEEP REEF IN DEEP TROUBLE

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The well-documented degradation of shallower reefs which are often closer to land and more vulnerable to pollution, sewage and other human-related stressors has led to the suggestion that deeper, more remote offshore reefs could possibly serve as sources of coral and fish larvae to replenish the shallower reefs. Yet the distribution, status, and ecological roles of deep (> 30 m) Caribbean reefs are not well-known. In this report, an observation of a deep reef which has undergone a recent extensive loss of coral cover is presented. In stark contrast to the typical pattern of coral loss in shallow reefs, the deeper corals were most affected. This report is the first description of such a pattern of coral loss on a deep reef.

**Keywords:** Coral Reef, Deep, Coral Mortality, Caribbean

## RELATIONSHIP BETWEEN WATER MOTION AND SIZE-SPECIFIC SURVIVORSHIPS OF THE DEMOSPONGE *AMPHIMEDON COMPRESSA*

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Life history processes of sessile marine organisms may be more related to size than age. Therefore, size-specific survivorship may provide valuable insights into life history processes and their responses to environmental factors. In this work, colony survivorships of two populations of the demosponge *Amphimedon compressa* were studied for one year at Las Pelotas (LP), a reef experiencing low water motion, and at Media Luna (ML), a reef exposed to high water motion. Overall survivorship did not differ statistically between sites (LP: 67%, or 71 ex 106; ML: 76%, or 91 ex 120;  $X^2_1=1.759$ ,  $p=0.185$ ). To determine if survivorship was size dependent, sponges were classified in three height classes: small (<10 cm), medium (10-20 cm), and large (>20 cm). At LP survivorship did not differ among size classes ( $X^2_2=0.570$ ,  $p=0.752$ ) with survivorship varying from 63-70%. In contrast, survivorship at ML was size-specific ( $X^2_2=20.240$ ,  $p<0.001$ ) with lowest survivorship (<40%) for the largest size class and the highest survivorship (85.7%) for the smallest size class. The high mortality of large sponges may be a consequence of fragmentation due to drag forces caused by high water motion. These results suggest that water motion may be an important factor controlling and structuring populations of *A. compressa*.

**Keywords:** Sponge, water motion, fragmentation, size-specific survivorship

## THE CENSUS OF MARINE LIFE IN THE CARIBBEAN: A BIODIVERSITY PROGRAM

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The Census of Marine Life (CoML) is an international science program to assess and explain the diversity, distribution and abundance of marine life, past, present and future. The program has three major components which are historical, exploratory and modeling, all of which are integrated into an open source database (OBIS: Ocean Biogeographic Information System) for visualization and analysis. In the Caribbean, the program began in 2004 by reviewing the state of knowledge of marine biodiversity in 10 countries of the region, as well as the establishment of a link between the CoML and research programs and conservation initiatives in the Caribbean. An historical project coordinated in the Caribbean deals with integrating, standardizing and synthesizing the data on the early human impact on mollusk populations in a global perspective. Results of the first phase of this project are being edited for publication in the British Archaeological Report Series. Engaged exploratory projects in the Caribbean deal with the biodiversity of the nearshore in seagrass beds and rocky shores (NaGISA), the deep sea (CoMargE), tagging of ocean pelagics and the ocean tracking network (TOPP and OTN). The Coral Reef (C-Reef) and the Microbe (ICOMM) projects, are currently under organization in the region, and have already established within a network, clear goals and an action plan for their implementation. The Caribbean has contributed with the OBIS database thru the SIBM (Sistema de Información Biogeográfica Marina) of the INVEMAR in Colombia, however, there is an urgent need of identifying literature and collections that can be digitalized, georeferenced and incorporated into OBIS. The Caribbean Large Marine Ecosystem (CLME) Project was identified as a potential partner for the CoML for the effective transboundary governance of living marine resources, and the AMLC network represents an excellent opportunity for more engagement of Caribbean scientists into CoML projects.

**Keywords:** Caribbean, marine biodiversity, Census of Marine Life

## **REPRODUCTIVE BIOLOGY OF *PETALOCONCHUS* cf. *VARIANS* (CAENOGASTROPODA, VERMETIDAE) FROM THE VENEZUELAN CARIBBEAN**

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The vermetid *Petalconchus varians* is widely distributed in the West Atlantic, from Bermuda and Florida to Brazil. A large population of this vermetid was found in the intertidal zone, living attached to the rocks of the Plantacentro power plant intake channel, forming clumps of massive calcareous tubes of brown shells measuring about 5-7 mm in diameter. Population density was around 240 ind/m<sup>2</sup>. The soft bodies are orange and there is a sexual dimorphism between males and females, the female having a slit along the dorsal side of the mantle, which coincides with the line of attachment of the egg-capsules in the internal side of the shell. The egg capsules are attached individually and in parallel to the internal side of the shell by a stalk that measured 0.3mm. Females brood between 1-9 egg-capsules/female. Egg-capsules measured around 1.8mm in length and 1.1mm in width throughout development to an early veliger stage, and then grow significantly in size probably due to a change of permeability to seawater ( $p < 0.01$ ). Each egg-capsule contains about 123 white eggs, which measure  $150 \pm 25$   $\mu$ m in diameter. Between 16 and 25 embryos develop, the rest are ingested as nurse eggs. Hatching takes place as veliger larva, the shells are white with red pigmentation and measure around 460 $\mu$ m in length, no foot was observed at hatching. No relationship was found between female size and the number of brooded egg-capsules, nor between female size and the number of developing embryos ( $p > 0.05$ ). Histological sections of the gonads showed growing and mature oocytes in the same individual, indicating, along with the fact that egg-capsules can be found at all times, that the species reproduces throughout the year. The potentiality of this family of becoming invasive species is discussed.

**Keywords:** Vermetidae, Caribbean, development, reproduction, egg-capsules

## **PREDATION RATE OF *Coralliophila abbreviata* (NEOGASTROPODA: CORALLIOPHILIDAE) ON CORAL REEFS OF MORROCOY NATIONAL PARK, VENEZUELA**

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*C. abbreviata* is a tropical gastropod of the Caribbean sea. This gastropod has shown itself to be an important corallivore. The objective of this work is to estimate the predation rate of *C. abbreviata* on some coral species in coral reefs of Morrocoy National Park, Venezuela. The localities were Cayo Sombrero and Cayo Peraza. We evaluated the rate on six coral species: *Montastraea annularis*, *Colpophyllia natans*, *Diploria strigosa*, *Agaricia tenuifolia*, *D. labyrinthiformis* and *Agaricia agaricites*. We used three experimental treatments. On treatment 1 we marked colonies with buoys that had been predated by *C. abbreviata*. The treatments 2 and 3 we used exclusion cages. For treatment 2 was the colony with its predator and the treatment 3 was the control (only the colony). The injuries to the colonies were measured each 4 days a month at least. The predation rate in treatment 1 varied depending on the coral species. The major rate was on *C. natans* (3,7 cm<sup>2</sup>/Ind/day) and the minor rate were on *D. strigosa*, *D. labyrinthiformis* y *M. annularis* (0 cm<sup>2</sup>/Ind/day). On treatment 2 we only detected predation activity in 2 colonies, one of them was *M. annularis* with 0,153 cm<sup>2</sup>/Ind/day and the other one was *A. agaricites* with 9 cm<sup>2</sup>/Ind/day.

**Keywords:** *Coralliophila abbreviata*, corallivore, predation rate, Morrocoy Nacional Park

## **CHARACTERIZATION AND ASSESSMENT OF THE ST JOHN, USVI MID SHELF REEF AREA TO SUPPORT MPA MANAGEMENT**

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Marine protected areas are an important tool for management of marine ecosystems. Despite their utility, ecological design criteria are often not considered or feasible to implement when establishing protected areas. In 2001, the Virgin Islands Coral Reef National Monument (VICRNM) in St John, US Virgin Islands was established by Executive Order. The VICRNM prohibits almost all extractive uses. Surveys of habitat and fishes inside and outside of the VICRNM were conducted in 2002–2004. Areas outside the VICRNM had significantly more hard corals, greater habitat complexity, and greater richness, abundance and biomass of reef fishes than areas within the VICRNM. The administrative process used to delineate the boundaries of the VICRNM did not include a robust ecological characterization of the area. Because of reduced habitat complexity within the VICRNM, the enhancement of the marine ecosystem may not be fully realized or increases in economically important reef fishes may take longer to detect.

## **MARINE PROTECTED AREA DEVELOPMENT IN GRENADA, WEST INDIES**

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A range of initiatives were undertaken to advance the Moliniere Marine Protected Area (MPA) from a legislative stage. Moliniere is a near shore reef system on the west coast of Grenada. Working closely with the Grenada Fisheries Division, a participatory stakeholder approach was employed. Biological resources within the MPA were surveyed and mapped with the assistance of a team of trained local volunteers. A range of water quality parameters were assessed. MPA resource usage by the local community and by SCUBA diving and day charter companies was determined via questionnaires and submission of data respectively. The Grenada Fisheries MPA legislation was reviewed and a MPA zoning revision was proposed. Support for MPA development was obtained from key stakeholder groups by holding informal and formal meetings and through information sharing. Moliniere reefs are dominated by macroalgae. Water quality was found to be generally good. Moliniere was the most frequented dive site in the tourist belt in the south of Grenada in the fall of 2005. Over 50% of the local community reported to use the MPA for recreation. Grenada is a signatory to the Convention on Biodiversity and as such has committed to establishing a network of representative and effectively managed protected areas at sea by 2012. Implementation and enforcement of an effective management plan for the Moliniere MPA and other existing and proposed MPAs within Grenada is urgently needed.

**Key Words:** MPA, participatory approach, Caribbean, resource

## CULTURE, IDENTIFICATION, DGGE ANALYSIS, AND PHYSIOLOGY OF CYANOBACTERIA ASSOCIATED WITH BLACK BAND DISEASE OF CORALS

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Black band disease (BBD) is a pathogenic microbial consortium that migrates across coral colonies lysing coral tissue and exposing coral skeleton. It is visually dominated by filamentous cyanobacteria, which are subjected to an environment with a migrating oxygen/sulfide interface that frequently results in simultaneous light and sulfide-rich conditions. While sulfide inhibits oxygenic photosynthesis in most photosynthetic organisms (including cyanobacteria), the BBD cyanobacteria must have the relatively rare ability to switch photosynthetic strategies to adapt to and survive in the presence of sulfide. In order to assess the physiological capabilities of BBD cyanobacteria we isolated seven cyanobacteria from BBD and confirmed the presence of these isolates in the BBD community using DGGE. The isolates were obtained from BBD on the coral hosts *Siderastrea siderea* (4 isolates), *Porites lutea* (2 isolates), and *Montastraea annularis* (1 isolate). Cloning and sequencing of the 16S rRNA gene revealed that four of the isolates were most closely related to the genus *Geitlerinema* and DGGE results confirmed that these cyanobacterial isolates were present in the BBD field samples from which they were isolated. Sequencing of the 16S rRNA gene of the other three cyanobacterial isolates revealed that they were closely related to the genus *Leptolyngbya*. DGGE analysis indicated the presence of a cyanobacterial ribotype that was 99% similar to this genus in one field sample from the Bahamas. Photosynthetic experiments were conducted for each isolate by measuring the photo-incorporation of [<sup>14</sup>C] NaHCO<sub>3</sub> under various light intensities and culture conditions (presence vs. absence of sulfide). We determined that six of the BBD cyanobacterial isolates were able to conduct sulfide-resistant oxygenic photosynthesis. This is the first study to demonstrate the ecological significance of these cyanobacterial genera in BBD.

**Keywords:** Black band disease, cyanobacteria, *Geitlerinema*, *Leptolyngbya*

## WHAT MAKES MANGROVES ATTRACTIVE FISH HABITAT – THEIR SHALLOW DEPTH, CROSS-SHELF LOCATION, OR PRESENCE OF STRUCTURE?

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Mangroves are an attractive fish habitat because they provide shelter and food for juvenile fishes. However, because mangroves are almost always located in shallow water and in sheltered (i.e., lagoonal, estuarine or bay) environments, the degree to which the latter two factors contribute to the attractiveness of mangrove prop-roots as a fish habitat is unknown. Here we examine these two untested factors, in addition to the effect of removal of mangrove structure. Artificial Mangrove Units (AMUs) were placed at multiple depths and along a gradient from an embayment to, and including, the coral reef. Total fish density and species richness in the embayment was higher at 2 and 3 m depth than at 1 m depth, indicating that shallow water is not a prerequisite for the attractiveness of mangrove prop-roots as a fish habitat. Total fish density and species richness was equally high or sometimes higher on the coral reef than in the embayment, indicating that placement of mangroves in a sheltered lagoonal environment is not a driving factor in the attractiveness of mangrove prop-roots either. After three weeks, removal of AMUs did not have a negative effect on total fish density or species richness, except for nursery species in the embayment which completely collapsed, highlighting the importance of these habitats for specific species. This study suggests that although prop-roots of Caribbean fringing mangrove forest are a suitable habitat for a wide range of fish species, they are utilised as a fish habitat largely because of the structure they create, and not their cross-shelf location nor their depth.

**Keywords:** Coral reef fish, Artificial mangrove units, Structure, Caribbean.

## UTILISATION OF SHALLOW-WATER HABITATS BY JUVENILE CORAL REEF FISHES IN BERMUDA

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In the Caribbean at least 17 coral reef fish species are highly associated with mangrove/seagrass habitats during their juvenile stage. For some species the dependence on these habitats appears to be very high. On Bermuda, the surface area of mangroves is very low, whereas a very large shallow shelf with patch reefs is present providing potential shelter and feeding habitats for fishes. The water on the shelf near the coastline is shallow, relatively murky, and is located far away from the fringing reef where most fish predators occur. In this respect it partly resembles mangrove/seagrass habitats, and may thus function as an alternative juvenile habitat. We here test this hypothesis for 8 of the 17 aforementioned fish species, using visual census surveys. Size-frequency distributions showed that juveniles of herbivores were mainly found on the shelf reefs and were absent from the mangroves and seagrass beds. This may be related to the much larger surface area (with substratum covered by edible algae) provided by the former. For juveniles of the zoobenthivores, the mangroves showed a high, or the highest, relative abundance of all habitats, even though their surface area was small. This indicates that for these species the dependence on mangroves is probably high. For the benthic/pelagic feeder *Ocyurus chrysurus*, the most important habitat was the shelf patch reef system and boulders along the shoreline. This is in great contrast to other studies that showed the high dependence of this species on mangroves and/or seagrass beds. The largest size classes of most species were found on the fringing reef, suggesting an ontogenetic shift from shallow to deeper water habitats. The present study shows that in cases where alternative shallow-water habitats other than mangroves and seagrass beds occur in large surface areas, some mangrove/seagrass-associated species can be flexible in their habitat selection.

**Keywords:** Coral reef fish, Habitat utilisation, Nursery, Caribbean

## HIGH-RESOLUTION, GEO-LOCATED IMAGERY OF BENTHIC COMMUNITIES USING THE ALONG TRACK REEF IMAGING SYSTEM

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The United States Geological Survey's (USGS) Along Track Reef Imaging System (ATRIS) is a boat-mounted instrument that acquires continuous digital images of shallow-marine substrates. This system is deployed on a small vessel and incorporates subsystems for navigation, real-time differential GPS positioning, autonomous digital camera benthic imaging, and acoustic bathymetric surveying. The ATRIS system, operational since Fall 2004, has been used to study seagrass beds in Tampa Bay, Florida, and coral reef environments in Biscayne National Park and Dry Tortugas National Park, Florida. An ATRIS survey was conducted in 2006 to study the benthic communities around the Caribbean island of Tobago in collaboration with the Buccoo Reef Trust. The survey resulted in the acquisition of 30,000 geo-located images and over 90,000 bathymetric measurements. Given the voluminous data sets acquired by each ATRIS survey, analyzing the numerous images presents several challenges for resource managers and scientists alike. In order to make these images and data accessible to the end user, a DVD product was developed. The DVD-based image browser, presented in an HTML format, allows the user to access a series of images along the boat track by clicking select regions on a map. Each image is geo-referenced and available in a format readable by standard GIS-software. The HTML interface also allows the data to be served up and accessible via a web server. The data and images are also made available in a Keyhole Markup Language (KML) interface. The KML interface can be loaded in a 3-D visualization application, such as Google Earth, allowing ATRIS images to be superimposed on the virtual globe of the Earth surface.

**Keywords:** coral reef imaging, remote sensing, Caribbean, Google Earth

## **PATTERNS OF FISH COLONIZATION ON ARTIFICIAL REEFS VARYING IN LIVE CORAL COVER**

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Distribution patterns of coral reef fishes have occasionally highlighted live coral cover or habitat complexity as preferred habitats, but rarely have these two variables been examined independently. Structures providing identical complexity and shelter but differing in coral content can be used to experimentally isolate the relative importance of coral tissue in fish immigration and recruitment. Sixteen such reefs, eight containing live coral and eight containing dead coral, were set up and monitored to document the colonizing fish populations in Curacao, Netherlands Antilles. Overall, fish abundance was found to be higher on reefs containing live coral, but community measures such as species richness and diversity did not differ between live and dead structures. This is not to say that the composition of each reef population was the same; differences in species composition, intensity of settlement pulses, and age structure of the populations were found between treatments. Habitat preferences among fishes included strong associations with both live and dead coral, but for a majority of species were insignificant between treatments. These results are compared to species-habitat correlations measured at a series of forty 9 m<sup>2</sup> plots on a nearby natural reef. Many of the community parameters and species preferences seen on artificial reefs displayed like correlations on the native reef. This suggests that habitat selection drives local abundances and affects community structure for some species, while for others, variables unrelated to habitat, such as stochastic dispersal or differential competition and predation, are driving forces. The results suggest possible responses of fish communities, at a species-specific level, to changes in live coral cover.

**Keywords:** Reef fish, community structure, artificial reefs, Curacao

## **MODELING OF POPULATION DYNAMICS OF THE CORKSCREW ANEMONE *BARTHOLOMEA ANNULATA* ON CARIBBEAN CORAL REEFS**

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Demographic processes in Caribbean sea anemones are poorly understood. Information on patterns of recruitment, growth, mortality and lifespan are important for understanding the potential for recovery of these common reef organisms following disturbances. The corkscrew anemone *Bartholomea annulata* is particularly amenable to the application of population dynamic modeling because individuals are solitary and large, and may be monitored easily for long periods on shallow reefs. Although reef anemones can locomote, they rarely vacate their holes due to a high risk of predation, making them good candidates for long-term population studies. We monitored populations of *B. annulata* at 2 coral reef sites on St. Thomas, US Virgin Islands during 2006-2007. Data on changes in the population were used to construct transition matrices that provide information on how to manage current populations as well as predict the size and structure of future populations. Preliminary analysis revealed highly dynamic populations with rapid turnover of individuals. Long-term application of this model will determine the crucial life stages for conservation and lead to recommendations for management of the ornamental fishery that is based on these anemones and their associated anemoneshrimps. Individuals of *B. annulata* contain a diverse assemblage of anemoneshrimps, some of which may enhance the survival of host anemones and thus reduce their rate of population turnover (see other abstracts). Thus, demographic models need to take into account the effects of mutualistic interactions in this symbiotic complex.

**Keywords:** Population modeling, sea anemone, ornamental fishery, shrimp

## AMONG-SITE AND BETWEEN-SPECIES DIFFERENCES IN MONOGENEAN PARASITE (MONOPISTHOCOTYLEA: CAPSALIDAE) LOADS IN TWO SYMPATRIC SURGEONFISHES (PERCIFORMES: ACANTHURIDAE) IN THE VIRGIN ISLANDS

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One of the challenges of managing marine reef fish populations and their associated ecosystems is identifying how components of habitat affect the growth, reproductive success, morbidity/mortality, and distribution of managed species. Compounding this is the impact of human activity on habitat. One aspect of habitat quality that has received little attention is risk of disease and parasitism. This study focuses on a particularly detrimental external fish parasite, monogenean trematodes (*Neobenedenia*). Monogeneans were quantified from the skin of two species of surgeonfishes collected at four sites in the U.S. and British Virgin Islands. Sampling localities were chosen based on their accessibility and variation in degree of degradation, and thus potential variation in water quality and biodiversity. Parasite loads among blue tang (*Acanthurus coeruleus*) varied significantly among sites (mean # parasites ranged from 0.1 to 7.7 per fish). Of the 90 ocean surgeonfish (*A. bahianus*) collected only 3% were infected with monogeneans compared with nearly 55% of the similar-sized blue tang from the same sites. Among infected fish, blue tang had a significantly higher parasite load compared to ocean surgeonfish. To determine if ocean surgeonfish are less susceptible to infection by monogeneans, both species were cleaned of parasites and translocated from Flat Cay to a uniform aquarium where they were exposed to high densities of monogeneans. Significantly more blue tang became infected (100%, vs. 58% in ocean surgeonfish), with infected blue tang gaining significantly more parasites than ocean surgeon. Thus, we conclude that differences in parasite loads between the two surgeonfish in the wild reflect physiological differences that affect their susceptibility, rather than behavioral variation in microhabitat use or visits to cleaning stations (which were not present in the experimental tank). Variation in parasite loads among sites may indicate effects of habitat variation on fish health and fish population structure.

**Key Words:** parasites, surgeonfish, monogenean, habitat.

## IDENTIFICATION OF ESSENTIAL HABITATS FOR JUVENILE GROUPERS IN THE US VIRGIN ISLANDS

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Knowledge of habitat selection at all life stages of coral reef fishes is key information in designing marine protected areas. Little is known about the life cycle of juvenile serranids, especially settlement habitats and the transition from juvenile to adult stages. Fish surveys in the USVI found few juvenile groupers in typical coral reef habitats from 5 to 40 m depth. The purpose of this study was to survey a variety of habitats in shallow (<5m) coastal waters for the presence of juvenile groupers. Habitat data were collected from all grouper species observed in the field from 27 sites on St. Thomas (June 2003 to September 2006) and 16 sites on St. John (December 2005 to September 2006). Juvenile red hind and Nassau were the most common species and showed an affinity to specific habitat types. Red hind were evenly distributed across most sites but most commonly found on coral and patch reef habitats in St. Thomas and rocky reefs on St. John. Nassau were locally abundant in certain bays and were most common on isolated wrecks and coral heads which were surrounded by *Thalassia* seagrass or dense macroalgae on St. Thomas. In St. John Nassau were most common on shallow cobble and boulder shorelines adjacent to seagrass beds (both *Thalassia* and *Syringodium*). On both islands, red hind and Nassau < 10 cm were typically associated with coral rubble and colonies of *Porites porites* coral or on dead coral clumps covered with macroalgae. There is a further need to look at whether a mosaic of different habitats best defines essential habitat rather than just a single habitat type. Effective MPA designation then becomes related not just to protecting samples of each important habitat types but also the spatial relationship between these habitat types.

**Keywords:** Serranidae, recruitment, juvenile nursery habitat.

## **IMPLEMENTACIÓN DEL PROTOCOLO NaGISA EN PRADERAS DE PASTOS MARINOS (*Thalassia testudinum*) DEL CARIBE COLOMBIANO DURANTE LOS AÑOS 2006 Y 2007**

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Este trabajo se ha venido llevando a cabo en La Bahía de Chengue (Parque Nacional Natural Tayrona- PNNT, Caribe colombiano). Dicha bahía corresponde a una zona intangible dentro de un Área Marina Protegida (AMP) en donde solo se permite la investigación y educación ambiental. Chengue presenta fondo somero y aguas calmadas con desarrollo de praderas de pastos marinos (11° 19.252'N - 74° 7.614'W) en donde siguiendo el Protocolo NaGiSA se realizaron dos muestreos, uno durante el año 2006 (época lluviosa) y otro en 2007 (época seca). La especie de pasto predominante en Chengue es *Thalassia testudinum*, la cual crece sobre fondo de cascajo compuesto principalmente por esqueletos de corales como *Agaricia tenuifolia*, *Porites porites*, *Diploria* spp. y *Siderastrea siderea*. Mientras que para *T. testudinum* se calculó un promedio en el muestreo de 2006 de 444 ±71.91 vástagos/m<sup>2</sup>, y un peso promedio seco de 71.47 ±15.54 g, para el 2007 se presentaron promedios mayores (603.20 ±100.89 vástagos/m<sup>2</sup>, y peso seco de 95.76 g ±14.95). Entre las macroalgas asociadas a *Thalassia* la más dominante fue la calcárea *Halimeda opuntia*. En las muestras de sedimento se encontró macrofauna de los Phylum Sipuncula, Mollusca, Annelida, Crustacea, Echinodermata y Chordata; siendo Mollusca el que presentó mayor número de especies y de individuos para ambos muestreos, seguido por Annelida. Para el 2006 se contaron 86 individuos distribuidos en 24 morfotipos; y para el 2007, 110 individuos y 46 morfotipos. La especie más abundante para ambos muestreos fue el gasterópodo herbívoro *Cerithium eburneum*. La implementación del Protocolo NaGISA y su ejecución a largo plazo permitirá tener mejor conocimiento del funcionamiento y dinámica de la comunidad de pastos marinos y su diversidad asociada en Bahía Chengue. Esta información es clave en el proceso de fortalecimiento de los planes de manejo y conservación del AMP-PNNT.

**Palabras Clave:** Fanerógamas, Protocolo NaGISA, Chengue, Caribe colombiano

## **ASSESSING CHANGE ON CORAL REEFS: LONG-TERM TRENDS IN CARIBBEAN REEF FISH ABUNDANCE**

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Coral reef ecosystems are under threat worldwide (Hughes et al. 2003). It is estimated that 30% of coral reefs are already severely degraded, and close to 60% may be lost in the next three decades (Wilkinson 2000). However, our understanding of the scope and ramifications of these changes is still limited. Quantitative estimates of the loss of coral cover have only recently been published (Gardner et al 2003), and there is currently no estimate of the extent of change in reef fish abundance despite increasing natural and anthropogenic pressures upon these organisms. The aims of this project are: (1) to assemble, for the first time, all available information on temporal changes in fish communities on Caribbean coral reefs, and (2) to analyze these data to test predictions about how abundance and community composition change with variation in habitat structure and fishing intensity. A comprehensive search of data on reef fish density data conducted over multiple years has revealed a paucity of studies that have evaluated temporal trends in Caribbean reef fish abundance. Initial analyses of data compiled from both published and unpublished sources from throughout the Caribbean region will be presented.

**Keywords:** Caribbean, reef fish, temporal change

## MACROALGAL SUBSTRATE AFFECTS MOVEMENT OF THE LONG SPINED SEA URCHIN *DIADEMA ANTILLARUM*

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Ever since the mass die-off of the echinoid herbivore *Diadema antillarum* in the 1980s, coral reefs in the Caribbean have undergone a major phase shift from coral to algal dominance. In laboratory feeding trials, urchin grazing rates depended largely on the species of macroalgae. To determine if field movement patterns were affected by algal species, urchins were collected and numerically tagged in Brewers Bay, St. Thomas, US Virgin Islands. The urchins were separated into either a control or experimental groups. The control group was placed on a rocky substrate at a depth of 1-2m with little/no algae present while the experimental group was placed on high densities of the brown alga *Dictyota spp.*, the green alga *Caulerpa sertularioides*, or the green alga *Halimeda opuntia*. The movement of the urchins was monitored every 2-3 hr during darkness for 8-10 hours and the distance traveled was recorded. All three treatment groups were significantly different from one another in terms of distance moved; with the least movement on *C. sertularioides* (1.1-1.7 m per night) and the most movement on *Dictyota spp* (3.3-4.1 m per night). Urchins placed on bare substrates moved between 3.1-3.7 m per night on average. The results suggest that urchin grazing patterns are dramatically affected by the type of macroalgae. Urchins are believed to be the key to a return of high coral dominance; however, if urchins do not return in high enough densities then perhaps the lack of competition will allow urchins to be more particular in their diet, and thus not remove species of algae most fiercely competing with corals. Urchins traveled greater distances when placed on *Dictyota spp.* or *Halimeda opuntia*, perhaps because they are not as palatable as other algae. Determining grazing patterns of *Diadema* based on the presence of specific species of macroalgae may allow for a better assessment for the ability and likelihood of coral reefs to regain dominance in the Caribbean.

**Keywords:** sea urchin, movement, grazing, macroalgae

## SPATIAL AND TEMPORAL VARIABILITY IN THE PREVALENCE OF BLACK BAND DISEASE AFFECTING THE CORAL *DIPLORIA STRIGOSA* AT MOCHIMA BAY, VENEZUELA

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Black Band is a coral lethal disease that affects massive corals in the Caribbean that are dominant reef builders. *Diploria strigosa* is one of the most susceptible species to Black Band Disease (BBD). In Mochima Bay (Venezuela) it is the most abundant scleractinian coral and the only species affected by BBD. To determine the spatial and temporal variability of BBD, the prevalence and rate of advance were followed over six months (November 2004 - June 2005) at six sites along the Mochima Bay. On each site an area of 120 m<sup>2</sup> (20 x 6 m) between 1 and 3 m depth were surveyed. All colonies of *D. strigosa* (n= 701) were counted and checked for BBD. To estimate the rate of advance (cm/month), in each site 3-4 disease colonies were tagged with nails behind the disease/tissue interface, and the width of the band was measured. BBD was observed at every survey only in the three sites near the mouth of the bay. In the inner sites BBD did not occurred. A significant spatial and temporal variability occurred, and the prevalence ranged from 1.4 to 12.38 %. The greatest prevalence (11.2 to 12.38%) and width of the band (2 cm) were found in El Atracadero during November-January when the water temperature was 30°C, and after declined from April to June (3.45 to 5.75%). In others sites the prevalence ranged from 1.4 to 3.85% during the study period. Average rate of advance band varied across months from 3.11 (±1.56) to 4.41 (±1.8) cm/month, and between sites from 3.73 (±1.8) (Punta Garrapata) to 5.05 (±2.12) cm/month (El Atracadero). These observations suggest that unfavorable environmental factors such as elevated water temperature and nutrient enrichment (coastal upwelling and anthropogenic nutrient enrichment) may be associated with BBD in Mochima Bay.

**Keywords:** coral, Black Band Disease, Bahía de Mochima, Venezuela

## MARINE SCIENCE EDUCATION IN THE BRITISH VIRGIN ISLANDS

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Historically, the public educational systems of the British Virgin Islands, and all Overseas Territories (OT), were patterned after those of the United Kingdom (UK). All OT's are administered by the Foreign and Commonwealth Office in London. This relationship provided technical assistance and educational support in the form of structured curricula patterned after the UK model. The inclusion of marine science in the school curriculum was peripheral at best. At the primary levels, marine science was introduced as a minor topic in general science and in geography. The situation was similar in middle school and high school programs. Since the school curriculum reflected UK standards, there was little opportunity to introduce topics of local relevance and interest. Also, the curricula were designed to prepare students for standardized exams such as the GCE or the regional CXC. Thus, there was little interest in teaching subjects not directly related to the examination requirements. Furthermore, as high school students advanced toward the O Level and A Level curricula, courses became even more structured with little room for local variation. Until relatively recent years, marine science received cursory coverage except as an occasional elective. Teacher education programs reinforced this approach. Few teachers received sufficient meaningful training, or could schedule class time, in the marine sciences. Toward the close of the 20<sup>th</sup> Century, this began to change. New emphasis was placed on incorporating subjects of regional, local, and cultural significance into the academic curriculum. This culminated in the BVI Government forming a Curriculum Reform Committee to review, and revamp where necessary, the education process throughout the Territory. In 2005, the committee developed a marine science curriculum for the secondary level. This program is under review and full implementation is expected within two years. In addition to the public schools, there are several private schools, both religious and non-sectarian. While these schools may follow the public school curricula, they have more opportunity to meet local needs. Today, these schools are launching innovative programs in marine science and environmental studies. The emphasis of new curricula is to harmonize the need to teach to international standards while providing courses of study of greater relevance to the local environment.

## ANALYSIS OF FACTORS INFLUENCING SOUTHEAST FLORIDA CORAL REEF COMMUNITY COMPOSITION

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The southeast Florida reef system lies offshore a heavily populated and urbanized coast. These high latitude reefs are not only affected by their geography but also by anthropogenic factors that accompany an urban area such as dredging activities, ship groundings, waste water outfalls, runoff and beach erosion. Sedimentation has been shown to influence stony coral community composition including dominance, abundance, cover, diversity, and colony size. Using annual monitoring data collected since 2000, the southeastern Florida reef community is being analyzed to examine if and how sedimentation and other factors such as depth, distance from shore and distance from port channels might influence community composition. All data was collected by SCUBA divers conducting 30m<sup>2</sup> belt transect surveys at 24 sites offshore Broward County (southeast), Florida within a depth range of 6 to 18 meters. Stony coral data included colony size, abundance, diversity, percent cover, and mortality. Sponge and octocoral density were collected to gather a more complete picture of community composition. Three sediment bottles at each annually monitored site were collected every 60 days. Weight and grain size of the contents were analyzed and used to determine sedimentation rates at each site. Additionally, the reefs off the southeast Florida coast can be categorized into unique habitat types. These habitat types are also being considered when studying reef community composition and its relationship to sedimentation and other factors.

**Keywords:** Coral, sedimentation, community composition, southeast Florida

## **ASSESSING LEVELS AND EFFECTS OF ORGANIC CONTAMINANTS ON MARINE MAMMALS, ESPECIALLY ANTILLEAN MANATEES, OF THE WIDER CARIBBEAN**

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Scientists and conservationists in the Caribbean region are concerned about levels and effects of several types of persistent organic contaminants, including pesticides, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and herbicides in the environment. Local levels of contamination have often been poorly assessed, and levels in and effects on local wildlife, including marine mammals, are largely unknown. The latter are especially vulnerable because of their long lifespans and the tendency of many organic contaminants to accumulate in blubber and other lipid reserves. Tissues of marine mammals elsewhere in the world sometimes contain remarkably high levels of organic contaminants, especially organochlorines (pesticides and PCBs); PAHs have been virtually unexamined in marine mammals from most locations. Although cause and effect relationships between contaminant body burdens and pathology or survival largely remain undemonstrated, scientists feel that reproduction and survival of some marine mammal populations may be affected by persistent contaminants. The Antillean manatee (*Trichechus manatus manatus*) is broadly distributed in waters of the Caribbean; body burdens of contaminants in manatees may reflect regional or local contamination that could also affect humans and other species. Recent work in Mexico has documented PCBs in blood of manatees. We expect to find high levels of certain contaminants in coastal environments, and we fear that marine mammals, including manatees, may be biological sinks for these chemicals, making these animals good sentinels of environmental health. Monitoring programs should focus on index sites where contamination is a particular concern; at such locations, we recommend that scientists rigorously correlate known and relevant indices of toxicological effects (using genomic and proteomic assays) with definitive chemical analyses. This monitoring approach should use tissues of deceased animals and biopsies of living animals, as available. Assessments of contaminant levels in manatees should be accompanied by similar evaluations of sediments.

**Keywords:** organic contaminants, marine mammals, manatees, environmental health

## **PRELIMINARY LIST OF FISHES FROM THE SMITHSONIAN TROPICAL RESEARCH INSTITUTE EXPEDITION TO CURACAO WITH COMPARISON TO PREVIOUSLY FORMULATED LISTS**

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In 2005 the Smithsonian Tropical Research Institute sponsored a collecting trip to Curacao and Klein Curacao, as part of a grant to Ross Robertson, to document the fishes of the greater Caribbean region. The Curacao Sea Aquarium provided lab space, diving support and boats for the research team. Collections were made at 29 stations during January 2 – 13, 2005. Most of the collections were made using rotenone, which is the only effective method of collecting cryptic fishes. A total of 6,114 specimens representing 119 taxa was collected. Along with those documented by Metzelaar (1919), Fishbase and several web based museum collections, we present our findings from Curacao to document a preliminary list of fishes from that region.

**Keywords:** Curacao, Faunal List, Rotenone

## **PREDICTIVE MAPPING OF FISH SPECIES RICHNESS ACROSS SHALLOW-WATER SEASCAPES IN THE CARIBBEAN**

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Effective management of coral reef ecosystems requires accurate, quantitative and spatially explicit information on patterns of species richness at spatial scales relevant to the management process. We combined empirical modeling techniques, remotely sensed data, field observations and GIS to develop a novel multi-scale approach for predicting fish species richness across complex seascapes in the U.S. Caribbean. We evaluated the performance of three different modeling techniques 1) multiple linear regression; 2) neural networks; and 3) regression trees. Regression trees performed best with an overall map accuracy of 75%; 83.4% when only high and low species richness classes were evaluated. This model also provided good predictions in two geographically distinct regions indicating a high level of generality in the habitat variables selected. Our integration of empirical modeling techniques with spatial technologies provides a potentially important new tool in support of ecosystem-based management for coral reef ecosystems. We report on our efforts to improve upon predictive accuracy using newly available high resolution multibeam and lidar data and sophisticated machine learning algorithms for predictive modeling.

**Keywords:** Predictive modeling, fish species richness, bathymetric complexity, multi-scale

## **THE RECENT COLLAPSE OF A RAPID PHASE-SHIFT REVERSAL ON A JAMAICAN CORAL REEF.**

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The community structure of most Caribbean reefs has changed dramatically since the 1980s. Invoking a chemistry analogy, Hughes (1994) termed the change a “phase shift” to describe the change from a coral dominated habitat to one dominated by macroalga on the north coast of Jamaica over a period of 17 years. The loss of coral cover is exemplified by the demise of *Acropora* spp. in Discovery Bay. Dense, monospecific high relief thickets of *Acropora palmata* (elkhorn coral) and *A. cervicornis* (staghorn coral) were characteristic of shallow and intermediate depth coral communities in the Caribbean prior to the late 1970s. In the early 1980s, *A. cervicornis* live coral cover was >21% at several sites around Discovery Bay, but was extirpated by 1987. No large population of *Acropora* reestablished for nearly two decades. In 2005, it was reported that *A. cervicornis* cover increased at Dairy Bull from 0.6% in 1995 to about 23% in January 2004 (Idjadi *et al.* 2006). During this period of recovery, there was no decrease in fishing pressure or increase in herbivorous animals during the period of recovery. An isolated population of *A. cervicornis* exhibited a similar coral cover at Rio Bueno. In 2005 both populations of *A. cervicornis* bleached. However, the two populations responded differently. The *A. cervicornis* population at Dairy Bull was decimated by the bleaching event and, subsequently, was attacked by *Coralliophila*. *A. cervicornis* cover reduced to <0.5% in June 2006. The population at Rio Bueno recovered from the bleaching event with little decrease in cover. Coral recruitment was examined deployed over three spawning periods on Dairy Bull Reef, Jamaica. Only two *Acropora* spat recruited to the tiles – one in 2003 and one in 2005. *Acropora* recruitment represented <0.1% of the total spat recruiting to the tiles during the entire sampling period.

**Keywords:** Coral reefs, Discovery Bay, recruitment, bleaching

## **ABUNDANCIA Y RIQUEZA ESPECÍFICA DE LA ICTIOFAUNA PRESENTE EN CUATRO ESTACIONES DEL EXTREMO NORTE DE LA PENINSULA DE ARAYA ESTADO SUCRE VENEZUELA**

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La Península de Araya se encuentra en la región Nor-oriental del estado Sucre, Venezuela. Es considerada como una zona de alta productividad pesquera artesanal. Con el fin de aportar conocimientos acerca de la ictiofauna presente en el área, se realizaron muestreos mensuales desde mayo del (2007) hasta Diciembre (2007). Las capturas fueron efectuadas mediante el empleo de una red tipo “chinchorro playero” de 1,50 m x 50 m, con una abertura de malla de 0,7 cm, en cuatro estaciones diferentes: dos en el sector Barlovento y dos en Sotavento. Se determinó la biomasa total y el número de individuos por especie, en cada estación. Se capturó un total de 11459 ejemplares, pertenecientes a 84 especies, agrupadas en 67 géneros y 39 familias. Los valores de riqueza superan los previamente reportados en la zona. Las familias con mayor número de especies fueron Carangidae (12), Haemulidae (8) y Scianidae (7); mientras que las más abundantes fueron: Clupleidae (3655), Haemulidae (1788), Gerridae (1318), Mugilidae (1278) y Scianidae (1105). Las especies con mayor número de individuos fueron *Chirocentron bleekermanus* (1666), *Eucinostomus argenteus* (1294), *Mugil curema* (1277) y *Orthopristis ruber* (1127). El análisis de agrupamiento arrojó una mayor similitud entre las estaciones 1 y 2, correspondientes al sector de sotavento, siendo la estación ubicada más al norte (barlovento) la más disímil. Algunas de las especies con mayor abundancia, constituyen consumidores primarios que pueden servir de alimento para especies mayores de peces, lo cual, unido a la alta proporción de individuos juveniles capturados, hacen de estas playas lugares de particular interés ecológico, por lo que su protección resulta necesaria.

**Palabras claves:** *Chirocentron bleekermanus*, *Eucinostomus argenteus*, Carangidae, Caribe.

## **ELEVATED SEA SURFACE TEMPERATURES REDUCE SURVIVORSHIP AND SETTLEMENT OF LARVAE OF THE SCLERACTINIAN CORAL, *FAVIA FRAGUM***

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High temperature anomalies associated with global warming have been shown to be responsible for a reduction in live coral cover on reefs. Prolonged episodes of warmer seawater temperatures are known to cause adult corals to undergo bleaching after which the corals may die. However, the effect of elevated temperatures on early life-stages of corals remains poorly studied. If elevated temperatures reduce survival and settlement of coral larvae, the recovery of coral populations will be impeded. Temperature effects on the survivorship and settlement of *Favia fragum* larvae were observed during a series of laboratory experiments. Larvae maintained at elevated temperatures (30-33 °C) exhibited reduced survivorship and settlement abilities from those maintained at control temperatures (27-29 °C). The observed decrease in survivorship corresponded with the induction of settlement. A transplant experiment showed that larvae maintained for a 48 hour settlement period at control temperatures survived and settled poorly when transplanted to elevated temperatures. Larvae maintained for the same settlement period at elevated temperatures survived and settled more successfully when transplanted to control temperatures. Additionally, larvae maintained at elevated temperatures for an extended period of time had severely reduced settlement abilities at ambient temperature. These results indicate that *Favia fragum* larvae are sensitive to and negatively impacted by elevated temperatures. The settlement step appears to be particularly sensitive to temperature. We suggest that this developmentally complex metamorphosis is a life-stage of corals that is likely impacted by elevated temperatures.

**Keywords:** *Favia*, temperature effects, coral larvae, coral settlement

## PREVENTION OF BURIAL TO HOST CORKSCREW ANEMONES *BARTHOLOMEA ANNULATA* BY SYMBIOTIC SNAPPING SHRIMPS *ALPHEUS ARMATUS*

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Sea anemones may be important hosts for obligate crustaceans and facultative fish symbionts on Caribbean coral reefs, yet little is known concerning their population dynamics. Rates of population turnover and recovery from disturbances by host sea anemones can have major impacts on their shrimp symbionts, with cascade effects on the parasite loads of reef fishes, since some anemone shrimps are cleaners. We have initiated a study on population dynamics of the corkscrew anemone *Bartholomea annulata* and its crustacean symbionts on two reefs at St. Thomas, U. S. Virgin Islands. Over the first six months of this study we observed dramatic declines in the abundance of host sea anemones within our study sites. Some of this loss may be due to possibly burial of anemones by shifting sands at the reef-sand interface. During December 2006, we observed burial of anemones by mounds produced by the lugworm *Arenicola cristata*. Approximately 2/3 of the anemones we sampled lived at the interface of rock and sand where they are vulnerable to burial. Tank experiments at UVI demonstrate that an obligate crustacean symbiont, *Alpheus armatus*, reduced burial of anemone hosts by removing encroaching sand from around the base of the anemone. At our study sites, 96% of this species of snapping shrimp was found on *B. annulata* living at the rock/sand interface, while 4% were found on anemones on other surfaces. *A. armatus* is known to protect *B. annulata* from predation by fireworms *Hermodice carunculata*, but this shrimp's role in protecting its host and home may extend to burial prevention as well.

**Keywords:** corkscrew anemone, anemone shrimp, burial, symbiont

## TOXIN PRODUCTION AND VIRULENCE FACTORS IN BLACK BAND DISEASE ON REEFS OF THE NORTHERN CARIBBEAN

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Black band disease (BBD) of corals is a complex, polymicrobial infection that migrates as a distinct mat across the surface of coral hosts, lysing coral tissue. We have been investigating the etiology of this disease using microbiological, molecular, and biochemical techniques. Multiple toxins and virulence factors are involved in disease pathogenesis. On a community level, aerobic respiration by BBD microorganisms results in anoxic zones in the middle and base of the 1 mm thick band. This zone can extend up into the diffusive boundary layer above the mat at night. The anoxic conditions select for sulfate-reducing bacteria, which generate toxic sulfide that accumulates to concentrations in the band that are lethal to coral. Experiments using the sulfate-reduction inhibitor Na molybdate revealed that while sulfide production is not required for coral tissue lysis and disease progression in an actively migrating band, it is required for disease initiation. We have recently detected a second BBD toxin, the cyanotoxin microcystin. Using HPLC/MS we detected microcystin in 22 field samples of BBD from reefs of the northern Caribbean (Bahamas and the northern Florida Keys), but not from the eastern Caribbean (St. Croix, U.S.V.I.) or the Philippines. The cyanotoxins saxitoxin and anatoxin-a were not present in any of these samples. Microcystin was produced in cyanobacterial cultures (*Geitlerinema* and *Leptolyngbya*) isolated from BBD, with toxic activity confirmed by the protein phosphatase inhibition assay. Additionally, we have constructed 12 clone libraries from BBD samples and sequenced 687 clones. Within these we have consistently detected 16S rRNA gene sequences that most closely match bacteria associated with Paralytic Shellfish Toxin (PST) producing dinoflagellates, suggesting additional BBD toxins. The effects of the BBD toxins we have identified to date include poisoning of respiratory electron flow (sulfide) and inhibition of protein phosphatase, nuclear protein phosphatase, and possible induction of apoptosis (microcystin).

**Keywords:** Black band disease, coral disease, toxins, virulence

## IN SEARCH OF MUTUALISTIC CORAL ASSOCIATED BACTERIA

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Bacteria, the first organisms on earth, have undergone evolution for over 3 billion years. Bacteria are responsible for the production of oxygen in our atmosphere, the appearance of the first eukaryotes, and the eventual evolution of plants and animals. This long evolutionary period, along with the rapid evolutionary rate of prokaryotes, has resulted in an immeasurable range of prokaryotic functional diversity present in the oceans that is likely to play an important role in the evolution of symbiosis with other marine organisms. We recently showed that corals harbor antibiotic-producing bacteria within their surface mucus. Furthermore, antibiotic properties present in the coral mucus, itself, can select for antibiotic producing bacteria and against other types of potentially opportunistic bacteria, suggesting that corals regulate the composition and activities of surface bacterial associates (Ritchie, 2006). Since the coral system as a whole (coral, symbiotic dinoflagellates, and associated bacteria) cannot be easily separated for experimentation, it is difficult to show whether coral associated bacteria produce the total antibiotic effect found on the coral surface *in situ*, or whether there are multiple contributors to this innate immune defense. In an attempt to address antibiotic production, cultures of the coral symbiotic dinoflagellate, *Symbiodinium* spp., were examined. However, attempts to achieve axenic cultures by antibiotic treatment, in combination with other physical methods, have historically resulted in an initial crash of the dinoflagellate cultures followed by the eventual reappearance of bacterial associates. To date, a thorough assessment of bacteria present in *Symbiodinium* cultures has not been initiated. Both culture-based and molecular methods were used to identify bacteria in association with seven different *Symbiodinium* clades in culture. Bacteria in common between different *Symbiodinium* clades include members of the *Roseobacter* clade and *Marinobacter* species. Future studies will identify functional roles of bacterial mutualists in *Symbiodinium* cultures and within the coral host.

**Keywords:** coral bacterial mutualism, *Symbiodinium*, symbiosis, antibiotic production

## CHARACTERIZING THE DEEP ZOOXANTHELLATE CORAL REEFS OF PUERTO RICO WITH THE SEABED AUTONOMOUS UNDERWATER VEHICLE

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Deep zooxanthellate coral reefs live within the euphotic zone between shallow insular shelf environments and the deep ocean. This important habitat remains largely unknown since it lies beyond the range of safe diving operations and requires the use of submersibles or other technologies for benthic characterizations. In 2004 seven Seabed Autonomous Underwater Vehicle (AUV) phototransects were performed in three areas of Puerto Rico (La Parguera, Guanica, Vieques). The high-resolution digital imagery acquired by the Seabed AUV provided quantitative assessments of the deep coral reefs including species richness and diversity, percent cover, and reef geomorphology. Preliminary results are presented for two transects from La Parguera. The depths sampled by the AUV ranged from 20-112 m. Percent cover of five main categories were recorded: scleractinian, macroalgae, gorgonians, sponges, black corals. Scleractinian corals (mainly *Agaricia* sp.) were found up to 91 meters depth. Coral dominance (up to 62 % cover) in shallow depths is shifted to sponge dominance (up to 33 % cover) in deeper areas. Gorgonians, which rapidly disappear after 40 m are replaced by black corals. The depth of maximum percent cover for all the groups other than scleractinians is around 50-60m, which seems to coincide with the lower limit of scleractinian distribution and increasing availability of bare substrate. Space is a limiting factor in coral reefs and there seems to be a shift of major benthic groups when corals are no longer dominant. Future plans include the analysis of the remaining AUV phototransects, the assessment of autotrophy versus heterotrophy in these environments, and the role of incident spectral irradiance on community structure and the maximum depth of scleractinians.

## PEQUEÑOS PECES CRIPTICOS DE ARRECIFES CORALINOS Y AREAS ADYACENTES EN EL PARQUE NACIONAL MORROCOY Y REFUGIO DE FAUNA SILVESTRE DE CUARE, VENEZUELA

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El Parque Nacional Morrocoy y el Refugio de Fauna Silvestre de Cuare, dos áreas marino costeras de la región nor-occidental de Venezuela, presentan entre sus ambientes dominantes a los arrecifes coralinos, los cuales tienen una importante ictiofauna asociada y que ha sido objeto de diversos estudios de caracterización. Estos estudios sin embargo, tienden a excluir a grupos de pequeños peces crípticos que se encuentran asociados a estos arrecifes, debido en gran parte a las metodologías empleadas, lo que genera un importante vacío de información en cuanto a la riqueza de especies ícticas de estos ambientes. En este trabajo se actualiza esta información empleando un método de colecta selectiva por succión, con lo cual se reportan para estos ambientes arrecifales y áreas adyacentes un total de 29 especies de peces crípticos, de los cuales seis pertenecen a la familia Blenniidae (*Entomacrodus nigricans*, *Hypleurochilus springeri*, *Lupinoblennius dispar*, *Ophioblennius atlanticus*, *Parablennius marmoratus* y *Scartella cristata*), siete a la familia Chaenopsidae (*Acanthemblemaria rivasi*, *Chaneopsis resh*, *Emblemaria pandionis*, *Emblemariopsis bottomei*, *Emblemariopsis ramirezi*, *E. randalli* y *Stathmonotus stahli*), una especie a la familia Dactyloscopidae (*Dactyloscopus foraminosus*) que representa además un nuevo registro para Venezuela, tres especies pertenecen a la familia Labrisomidae (*Paraclinus marmoratus*, *Malacoctenus aurolineatus* y *M. gilli*), una a la Tripterygiidae (*Enneanectes pectoralis*) y once representan a la familia Gobiidae (*Bathygobius soporator*, *Coryphopterus glaucofraenum*, *C. personatus*, *Elacatinus (Elacatinus) chancei*, *E.(E) randalli*, *E. (Tigriogobius) dilepis*, *E. (T.) macrodon*, *E. (T.) pallens*, *E. (T.) saucrus*, *Gnatholepis thompsoni* y *Nes longus*). Con este estudio se incorporan 27 nuevas especies a los listados previos realizados para estas localidades, incrementando así en más de un 25% la riqueza de especies ícticas en los mismos, lo que resalta la importancia de incorporar a estos grupos de pequeños peces crípticos bentónicos en los trabajos de caracterización de la ictiofauna regional.

**Keyword:** Pequeños Peces crípticos arrecifales, arrecifes coralinos, Blenniidae, Gobiidae.

## THE EFFECTS OF CORAL BLEACHING IN THE SOUTHERN TROPICAL AMERICA: BRAZIL, COLOMBIA, AND VENEZUELA

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Massive coral bleaching occurred in the Southern Tropical America region through 2005, apparently associated to unusually high sea surface temperatures. The beginning of the bleaching event was not synchronic: it was first observed at Itacolomis Reefs (Brazil in April 2005), whereas in the Santa Marta (Colombia) began six months later (October 2005). Surveys made at 156 sites in Brazil, Colombia and Venezuela suggest that this bleaching event was the strongest in the last decades for the Region. Bleaching occurred mainly in shallow zones, but the severity was not homogeneous along the coast in Southern Tropical America. Percentage of bleached colonies ranged greatly from 0 to 100% among surveyed sites. Bleaching was observed on several coral species but only few species had mortality (e.g. *Acropora cervicornis*, *A. palmata*, and *D. labyrinthiformis*). Coral reefs less affected by bleaching seem to be related to upwelling zones in the Caribbean. Understanding this differential response to widespread bleaching events is essential to identify more resistant coral reefs, which will be critical as future sources for resilience.

**Keywords:** Coral reefs, bleaching, Southern Tropical America

## **MONITOREO DE ARRECIFRES CORALINOS EN AMÉRICA SUR TROPICAL: LOGROS, LECCIONES Y PERSPECTIVAS DESPUÉS DE 8 AÑOS DE TRABAJO COOPERATIVO**

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En el marco de la Red Global de Monitoreo de Arrecifes Coralinos (GCRMN) y con el apoyo financiero de UNEP-RCU/CAR, el Instituto de Investigaciones Marinas y Costeras (INVEMAR), ha estado coordinando el desarrollo del nodo regional de la red para el sector sur de América tropical (STA). Desde fines de 1999, investigadores expertos de cinco países (Costa Rica, Panamá, Colombia, Venezuela y Brasil) han estado colaborando para ello. Entre las acciones adelantadas se incluyen: (1) elaboración de un análisis de las capacidades y necesidades para el monitoreo de arrecifes en la región, (2) incremento de las actividades de monitoreo en los países del nodo, (3) contribución a los informes globales de la GCRMN, (4) realización de reuniones de intercambio y coordinación, y (5) evaluación de fenómenos regionales como el blanqueamiento coralino del 2005. Los arrecifes coralinos en STA han sufrido cambios importantes en los últimos 30 años, en particular durante los ochentas, por causas naturales y antropogénicas. Si bien la cobertura coralina viva ha sufrido pérdidas importantes en muchas áreas arrecifales, y las algas han pasado a ser el elemento dominante, todavía se encuentran niveles altos de cobertura coralina en numerosas localidades del Caribe (promedios de 20-40%) y del Pacífico (promedios mayores de 40%). La región STA cuenta con buena experiencia y personal calificado para el monitoreo de arrecifes, pero la capacidad financiera para mantener y expandir los programas es baja. Es esencial expandir la cobertura geográfica de los programas de monitoreo, ya que la proporción de áreas coralinas evaluadas sigue siendo muy baja. A pesar de la importancia de los arrecifes coralinos y las evidencias de su deterioro en la región STA, existen pocas políticas y leyes gubernamentales que promuevan específicamente el manejo sostenible y la conservación de dichos ecosistemas.

**Keywords:** Arrecifes coralinos, monitoreo, GCRMN, América sur tropical.

## MULTILOCUS PHYLOGENETIC ANALYSIS OF CARIBBEAN PORITES (SCLERACTINIA:PORITIDAE)

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Resolution of species boundaries in scleractinian corals is problematic. Relationships among species are difficult to resolve even with a combination of characters. Yet the ability to recognize species and understand relationships among closely related species is essential for coral reef ecology and conservation. The genus *Porites* is one of only eight cosmopolitan scleractinian genera and is an important component of coral reefs worldwide. In the Caribbean six different species occur sympatrically but studies based on multiple characters have not clearly resolved relationships within the genus and the taxonomic status of some species is unclear. We are using a multilocus phylogenetic approach to test the following hypotheses suggested by research by other workers: 1) the branching species *P. divaricata*, *P. furcata*, and *P. porites* are each monophyletic; 2) color morphs of the massive species *P. astreoides* are monophyletic; and 3) *P. branneri* (encrusting with a distinct bluish color) is genetically identical to *P. astreoides*. Samples were collected from St. Thomas, USVI and analyzed morphometrically. Three mitochondrial gene regions (the putative control region and two mitochondrial introns) and one nuclear gene region (the ribosomal internal transcribed spacers), are being PCR amplified from genomic DNA extractions and sequenced (a total of 1100 bp). Massive and branching species form two distinct clades approximately 3% different from each other. Branching species appear to be more similar to a branching Indo-Pacific species (*P. compressa*, used as an outgroup) than to *P. astreoides*. There are no sequence differences between color morphs of *P. astreoides* or between the three branching species. The relationship of *P. branneri* to the other species remains unresolved. Continuing analyses will more clearly resolve relationships among these taxa and determine whether lack of genetic variability is due to invariant markers or to recent divergence of closely related species.

**Keywords:** *Porites*, molecular systematics, Caribbean

## DEEP SCLERACTINIAN CORAL REEFS AND MULTIPLE CORAL OPTIMA IN THE HAWAIIAN ARCHIPELAGO

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Hawaiian coral reefs have been actively studied and mapped for well over half a century. Observations of their distribution and the physical factors controlling Hawaiian coral reefs have been available in the scientific literature for decades, and generally suggest that the availability of light limits coral growth to a critical depth of 30-40 m or shallower. Exposure to long period swell is usually said to control reef distribution and structure within this zone, and a depth of 12 m has been reported as optimal for reef accretion at most locations in the Hawaiian archipelago. It has come as a surprise, therefore, when recent research activities revealed the presence of scleractinian coral reef communities markedly deeper than the reported optimal depth. Actively growing, healthy, and covering higher percentages of the substrate than their shallower counterparts, these reefs have been documented at depths ranging between 30 and at least 75 m. Those at intermediate depths (~30-50 m) consist of a mix of deep and shallow water coral species whereas from the limited data currently available individual deep (>50 m) reefs consist of a single or very limited mix of species. These new observations suggest that multiple coral optima may exist within different depth zones along a given shoreline, tentatively proposed here as ranging from 0-30 m (shallow), 30-50 m (intermediate) and 50-100+ m (deep). We hypothesized that the distribution of reefs within each zone is controlled by a suite of physical factors, and is characterized by a general pattern of community structure and development unique to that zone. The roles of deep and intermediate reefs within the larger coral reef ecosystem can only be speculated on, but the range of threats facing coral reefs today suggests that this topic warrants investigation.

**Keywords:** Hawai'i, deep scleractinian coral reefs, coral optima, coral community structure

## DIFFERENTIAL DIAGNOSIS: THE IMPORTANCE OF MULTIDISCIPLINARY TECHNIQUES IN THE INVESTIGATION OF THE CORAL DISEASE WHITE PLAGUE TYPE II

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White plague type II (WPL II) is a disease of particular interest throughout the Caribbean and Western Atlantic. Known to affect at least 18 species of reef building corals, WPL II characteristically destroys apparently healthy tissue at rates of 2–10 cm per day and as a result has the potential to dramatically alter large areas of reef very rapidly. This investigation probed fundamental questions about the bacterial community composition associated with WPL II-diseased and apparently healthy coral tissue from *Montastraea annularis* (complex) colonies at St. Croix, USVI and Lee Stocking Island, The Bahamas. Triplicate 1.6-cm diameter cores of diseased and apparently healthy tissue and skeleton were collected in situ using SCUBA. Coral tissue microflora were analyzed using a combination of molecular fingerprinting, microbial culturing, partial 16S rRNA gene sequencing and histological examination. Working hypotheses included (1) causative agents are opportunistic pathogens normally present in the host or its environs rather than a novel, obligate pathogen; (2) corals exhibiting signs of WPL II disease from different geographical regions harbor differing microbial communities in normal and diseased tissues; (3) corals exhibiting signs of WPL II disease harbor different microbial communities in healthy and diseased tissue; and (4) the WPL II disease process is the result of a broad shift in the microbial community (dysbiosis). Principal coordinate analysis (PCO) of length heterogeneity (LH-PCR) fingerprints of the bacterial community on unaffected corals and apparently healthy tissue from diseased corals suggests both inter-colony similarities and variation between pairs. Diseased samples were more similar to each other than to the other samples. Microflora on the Bahamian corals differed markedly from that on the USVI corals. Of the 66 bacterial operational taxonomic units (OTUs) from whole community genomic DNA extracts, 18 were culturable on half-strength Marine Agar (a 27% match). Sixty-eight percent of total bacterial community abundance was represented by culturable OTUs. Results of this study highlight both the need to utilize multidisciplinary techniques when investigating coral diseases and the importance of probing differences between reef areas. Different pathogens and sources of pathogens between reef sites may necessitate diverse management strategies to effectively address coral diseases.

## PATTERNS OF GENETIC POLYMORPHISM IN THE FIRECORAL *MILLEPORA*

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The hydrozoan genus *Millepora* is an important component of tropical reefs contributing to the carbonate structure. Virtually nothing is known about the genetic polymorphism within and between *Millepora* species in the Caribbean. In a region where the worrying decline of scleractinian corals has attracted the attention of the scientific community, research in *Millepora* biology is limited. The objective of this work is to make a molecular characterization of the *Millepora* populations of Puerto Rico and adjacent islands. Samples of the two known morphotypes of *Millepora alcicornis* were collected from the islands of Mona, Desecheo, Culebra and the southwestern coral reef system of Puerto Rico (La Parguera). Using PCR, a DNA segment of the COI was amplified from each specimen. Sequence analysis of 120 *Millepora* colonies resulted in a total of 50 haplotypes, most of them occurring around the island of Mona and La Parguera. These two locations shared 8 haplotypes, while the other locations shared one or two. AMOVA analyses revealed that the within-population component of variability was significantly larger than the among-population component, implying the absence of population structure. Fu's  $F_s$  neutrality test indicated an excess of rare mutations in *Millepora* colonies of Mona ( $P = 0.006$ ) suggesting a population expansion. We used our COI data to test the hypothesis of Mona Passage as an effective biogeographic barrier of marine fauna.

**Keywords:** Hydrozoan, Mona Passage, genetic polymorphism, connectivity

## CONNECTIVITY AND GENE FLOW IN *STEGASTES PARTITUS* (PERCIFORMES: POMACENTRIDAE) POPULATIONS ALONG COSTA RICA AND PANAMA

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Estimates of connectivity and gene flow within and among coral reef fish populations is of critical importance for both conservation and for our understanding of reef ecosystems. Dispersal potential of marine organisms along the coral reefs in Costa Rica and northwestern Panama, was assessed by determining the genetic structure of bicolor damselfish (*Stegastes partitus*) populations. Adults were sampled from five reefs located along ~120 km of the coastline, and were genotyped at 12 microsatellite loci. There were significant differences among all the populations based on exact tests ( $\chi^2= 108.18$ , d.f. = 24,  $p < 0.001$ ), however  $F_{st}$  values were low (global  $F_{st}= 0.006$ ), and in some cases not significantly different. Interestingly; the differentiation does not follow isolation by distance pattern. Additionally, we ran genotype assignment tests to assess the origin of juvenile fish collected in one of the locations. The results suggest that the recently settled juveniles are not spawned in that location. This might indicate that the recruitment episodes are changing drastically through time. Our results suggest chaotic dispersal at this scale, probably with larvae coming from the sampled sites but also elsewhere, indicating that marine organisms with a similar larval duration should be managed internationally between Costa Rica and Panama, and probably at an even larger scale.

**Keywords:** *Stegastes partitus*, connectivity, gene flow, dispersal.

## DISTRIBUTION, ABUNDANCE, AND GENETIC AFFINITIES OF SCLERACTINIAN CORALS THROUGHOUT THE NORTHERN GULF OF MEXICO: THE BIG PICTURE

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The the Flower Garden Banks (FGB) occur in the northern Gulf of Mexico (GOM) along with thousands of oil/gas platforms. The platforms are providing hard substratum in shallow water where none existed prior to the Pleistocene. This has facilitated the biogeographic extension of Caribbean reef fauna. We quantified the distribution and abundance of scleractinian corals, hermatypic and ahermatypic, by surveying 6-20 platforms along four transects across the continental shelf: (T-I) Corpus Christi, TX; (T-II) Lake Sabine, TX; (T-III) Terrebonne Bay, LA; and (T-IV) Mobile, AL. We also assessed genetic affinities between the 48 platforms and the E- and W-FGB to  $\leq 37$  m depth, collecting coral tissue samples for molecular genetics analysis by AFLP. The western limit for hermatypes was near the shelf edge in T-IV. The highest densities of hermatypic corals were at the shelf edge, ~175-225 km offshore, in T-II&III. Some hermatypes were found in T-IV (Mobile) - probably their eastern limit. The ahermatypic corals (*Tubastraea coccinea*, *Oculina diffusa*, *Phyllangia americana*) were generally absent inshore and in the north-central region, but otherwise relatively uniformly distributed. Lower salinities, temperatures, or oxygen levels may be excluding corals from the latter region. Coral species diversity peaked on platforms near the FGB. Genetic analyses performed on *Madracis decactis* and *Tubastraea coccinea* (an invasive species) from T-III&IV revealed high self-recognition and site fidelity in *M. decactis* at both sites, with some recognition across the Mississippi River. In *T. coccinea*, cross-recognition between platforms was higher within a transect, but near-absent across the river mouth. The Mississippi River is an effective biogeographic barrier to dispersal. These two brooders are highly effective at colonizing patchy habitats at this scale – particularly *T. coccinea*. The broadcasters *Diploria strigosa* and *Montastraea cavernosa* were rare or absent over most of the Gulf, indicating less effective dispersal capabilities.

**Keywords:** coral, Gulf of Mexico, offshore platforms, genetic affinity

## WHY CORAL CALCIFICATION RATES ARE HIGHER IN THE LIGHT

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Low concentrations of calcium ions ( $\text{Ca}^{2+}$ ) are maintained in living cells by the Ca-ATPase calcium pump of the plasma membrane. The presence of a calcium pump in corals has been confirmed and its temperature related breakdown underlies coral bleaching. There is mounting evidence from stable calcium isotope ratios in the skeleton for involvement of a calcium pump in coral calcification. This study aims to explain why observed calcification rates are higher during the day than at night. Hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) produced by zooxanthellae during photosynthesis passes easily through cell membranes.  $\text{H}_2\text{O}_2$  is known to cause lipid peroxidation of the plasma membrane and make it leaky to  $\text{Ca}^{2+}$ . Lipid peroxidation was measured for *Agaricia agaricites* and *Montastrea faviolata* held in the light. It doubled from 0.29 to 0.57  $\mu\text{Mol.cm}^{-2}$  (n=11) over the first 2-3 hours then slowly decreased over the next six hours. Glutathione, which in many organisms acts as a lipid peroxidation repair system, was also found at a mean level of 79  $\mu\text{g.cm}^{-2}$  (n=14) and probably accounts for the slow reduction of levels of lipid peroxide. A model of calcification, following Adkins et al (2003), is presented in which calcification takes place from the extracellular calcifying fluid (ECF) between the calcicoblastic layer and the skeleton. The Ca-ATPase calcium pump drives calcification by actively transporting  $\text{Ca}^{2+}$  into the ECF and setting up pH and carbon dioxide ( $\text{CO}_2$ ) gradients that enhance the passive diffusion of  $\text{CO}_2$  and the formation of calcium carbonate. In light,  $\text{H}_2\text{O}_2$  produced by zooxanthellae diffuses into the calcicoblastic layer. Lipid peroxidation takes place and the plasma membrane becomes leaky to  $\text{Ca}^{2+}$ . The calcium pump has to work harder to maintain low internal levels of calcium and thus more is actively transported into the ECF to be deposited as calcium carbonate.

**Keywords:** Coral calcification, Ca-ATPase calcium pump, Hydrogen peroxide, Lipid peroxidation

## AZOOXANTHELLATE CORAL COMMUNITIES OFF COLOMBIAN CARIBBEAN

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Deep coral reef ecosystems are receiving increasing attention worldwide because they are known to be important biodiversity hotspots of high biological and socioeconomic value. As a result of the explorations carried out by the Colombian Marine and Coastal Research Institute (INVEMAR) between 1998-2002 along the Colombian Caribbean continental shelf and upper slope, the occurrence of azooxanthellate coral banks was suspected at three sites (from the northern to southern Colombian Caribbean coast): off La Guajira Peninsula, at a water depth of 70 m; off Santa Marta, at 200 m, and nearby the San Bernardo Archipelago, at 150 m). Each site exhibited particular bottom features (relief and substrate), suggestive of reef structures. This study was carried out to characterize biological and geological features of the continental margin where these communities off San Bernardo-Rosario Islands flourish. These azooxanthellate habitat-forming corals develop in deep waters adjacent to shallow fringing coral reefs. The principal habitat-forming corals species found were *Madracis myriaster* (Milne-Edwards and Haime, 1849) and other branching *Madracis* species. These communities rest on sandy mud bottoms over the shelf break in depths ranging from -180 to -120 m. *Madrepora* sp., antipatharians and gorgonians were collected directly attached to adjacent limestone hardgrounds. The azooxanthellate coral habitats were found on areas of irregular topography (channels, small mounds) and nearby sites with evidence of benthic mud-gas seepage from beneath the seafloor. Irregular topography and gas seeps might be important factors contributing to the settlement and accumulation of coral communities, but the mechanisms involved are not fully understood. Questions remain pertaining to the possible linkage between shallow and deep water corals in the Caribbean region.

**Keywords:** Azooxanthellate coral, continental margin, mud diapirs, Caribbean.

## PREVALENCE OF BLEACHING ON SCLERACTINIAN CORALS OF MONA ISLAND, PUERTO RICO

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Throughout the Caribbean region coral reefs suffered high water temperature anomalies during late 2005. In Puerto Rico bleaching of coral colonies occurred throughout the archipelago, across species and depths and attained medium to high severity with 50-100% of corals affected. Mona Island was no exception, despite its isolated, uninhabited and oceanic environment, the water temperature surpassed 30.5° C and bleaching was widespread. Benthic video transects were used to characterize the prevalence of bleaching on scleractinian corals at randomly selected. Still images of each transect were analyzed with Coral Point Count with Excel extensions (CPCe) software. Coral species were identified and ranked in a categorical scale (1-unbleached through 5-completely bleached) in order to quantify the colony's condition and determine the proportion of bleached coral. Overall 41% of corals presented some degree of bleaching with a peak during November of 2005, and the proportion of recently dead coral tissue increased in the following months. The proportion of unbleached corals increased towards the end of the sampling period in March 2006. Dominant reef building species of the *Montastrea annularis* complex were bleached in greater proportions and remained in affected longer. Spatial, temporal and species variability during the bleaching event must be considered an important factor the evaluation of bleaching impacts.

**Keywords:** coral, bleaching, Mona Island, Puerto Rico

## MONITORING THE RECOVERY OF A CORAL REEF FOLLOWING RESTORATION AFTER A LARGE VESSEL GROUNDING

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This document presents the results of the monitoring of a coral reef injured by the M/V *Wellwood* vessel grounding incident of August 4, 1984. This grounding occurred in the Florida Keys National Marine Sanctuary. The National Marine Sanctuary Program (NMSP), within NOAA, is responsible for the restoration and monitoring of the injured reef. NMSP's restoration monitoring program tracks patterns of biological recovery, determines the success of restoration measures, and assesses the resiliency of sites over time. To evaluate restoration success, reference habitats adjacent to the restoration site are concurrently monitored to compare the condition of restored reef areas with "natural" coral reef areas unimpacted by the vessel grounding. Additionally at this site, impacted—but unrestored—areas at the damage site were followed. Restoration was completed in July 2002, and monitoring events of all three areas occurred in 2004 and 2006. This report presents the results of both monitoring events. Recruit-sized populations were monitored in both years of three Orders of coral: Gorgonacea, Anthoathecata and Scleractinia; and size-class frequency distributions of the three were determined. In 2004, Gorgonacea densities were significantly different across the three areas; they no longer were in 2006. Results in both years indicated a higher proportion of smaller size-class members at the restored site. For Anthoathecata, whose members were composed solely of one Genus, *Millepora*, populations were not significantly different in 2004, but did evidence difference by 2006. As for the Gorgonians, the smallest size classes of the Milleporans were most evident in the restoration area. With regard to Scleractinia, overall densities, as well as populations of some individual species were analyzed. In addition, biodiversity indices were calculated. For both 2004 and 2006, overall densities were not significantly different; biodiversity indices were mixed between years. Scleractinians also evidenced a greater proportion of small size-classes in the restored area.

**Keywords:** coral, grounding, restoration, monitoring

## **EVALUACIÓN CITOTÓXICA DEL EXTRACTO METANÓLICO DE *Fagara monophylla* EN *Cyprinodon dearborni* (CIPRINODONTIFORMES: CYPRINODONTIDAE)**

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En la búsqueda de especies nativas que puedan ser utilizadas en toxicología, *Cyprinodon dearborni* es una de las especies con características propias, que cumple tal condición. Hasta la fecha son muy pocos los trabajos en esta dirección. El objetivo de este trabajo fue evaluar los cambios en las concentraciones de ADN, ARN y Proteínas en el músculo de este pez tratado durante 48 h con una dosis subletal del extracto metanólico de una Rutaceae (*Fagara monophylla*). Se disectó el músculo epaxial de *C. dearborni* y se cuantificaron los ácidos nucleicos y las proteínas por los métodos fluorométrico y colorimétrico, respectivamente. Otra parte del tejido se cortó en trozos de 1 mm para ser procesados por técnicas rutinarias de microscopía electrónica de transmisión. Los resultados obtenidos revelaron que los niveles de ácidos nucleicos (ARN y ADN) y proteicos totales disminuyeron significativamente ( $p < 0,05$ ) con relación a los peces no expuestos. Las observaciones en el MET muestran alteraciones patológicas en el tejido de aquellos organismos expuestos al extracto, tales como: atrofia con una disposición no paralela de las miofibrillas, sistema sarcotubular hinchado y sistema neuromotor desorganizado. Se puede inferir que *C. dearborni* es una especie sensible a las sustancias orgánicas y puede ser utilizado como indicador toxicológico. Asimismo, el extracto de *F. monophylla* tiene efectos deletéreos a nivel celular en este pez, es decir posee un posible efecto piscicida.

**Palabras claves:** Actividad citotóxica, *Cyprinodon dearborni*

## **BULLETIN 89 REDUX: BIODIVERSITY OF THE GULF OF MEXICO**

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For decades the only comprehensive reference for the Gulf of Mexico has been the US Fish and Wildlife Bulletin 89 ("The Gulf of Mexico - It's Origins, Waters, and Marine Life"), published in 1954; in recent years it has been primarily of historical use. We are in the process of updating this highly-referenced volume with partners in the US, Mexico, and Cuba. This state-of-knowledge compilation has grown to 7 volumes: Ecosystem-based Management; Economics; Geology; Biota; Physical Oceanography; Chemical Oceanography; and Human Issues. The Biota volume has engendered a Biodiversity of the Gulf of Mexico Project, consisting of two phases. Phase I is the compilation of a complete inventory of all marine species in the Gulf of Mexico in book form, described above, and includes the habitat, depth, geographic distribution, and references for each species in the inventory. The last of the 70 chapters (all various groups of flora and fauna) have been received and are undergoing final editing and review. This massive effort includes over 13,000 species listed by 123 authors from 71 institutions in 14 countries. It will be one of the few inventories anywhere in the world of all species from a large marine ecosystem. The volume will be submitted to Texas A&M University Press in summer 2007. Phase II of the Biodiversity Project will be the conversion of the biota inventory into a searchable, digital database available on the Internet for widespread use and application. The project will be useful for providing life history information; identifying knowledge gaps; following trends in threatened, endangered and invasive species; mapping patterns of species richness and endemism; and standardizing taxonomy. Both phases of the project will have broad application in conservation and management efforts.

## NEAR-SHORE SEA TEMPERATURES FOR ST. THOMAS

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The Virgin Islands Microscale Weather Modeling (VIMWM) project, sponsored by VI-EPSCoR, seeks to provide detailed weather forecasting in the Caribbean. Critical to accurate forecasting is knowledge of real-time, near-shore bulk sea temperatures. The near-shore bulk sea temperatures around the island of St. Thomas have been measured, using digital thermometers, GPS units, and the UVI marine facilities of the Biocomplexity in Caribbean Coral Reefs (BCCR) program. Data was taken in November and December of 2006, and again in April of 2007. This data, along with off-shore bulk temperatures derived from concurrent satellite images, were utilized to produce an algorithm. The algorithm will allow real-time near-shore bulk sea temperatures to be estimated more accurately from satellite data. In addition to its role in weather forecasting, the algorithm will provide BCCR and other researchers with real-time estimates of the near-shore temperatures that can be used in investigations in such areas as coral health.

**Keywords:** sea temperatures, weather forecasting, coral health

## SEARCHING FOR A REFUGE: IMPACTS OF THE 2005 MASS CORAL BLEACHING EVENT ON CORAL REEFS OF THE US VIRGIN ISLANDS

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From September to December of 2005, the NE Antilles suffered the worst warm water event on record. Intensive and extensive monitoring of corals around St. Croix, St. John, and St. Thomas, USVI showed that bleaching was severe in scleractinian corals; an average of 60% of coral cover was bleached across all sites (N = 24). On a colony-by-colony basis, a low prevalence of low severity bleaching was evident for five years preceding the event (16% of colonies, 10% - 50% of colony surface, N = 5036). During the peak of the event, most corals were bleached (73%, N = 1671) with high severity (50-90% of the colony surface). During the recovery phase (January to May), both the prevalence (33%, N = 1881) and severity (10% - 50% of colony surface) of bleaching decreased, reaching near pre-bleaching prevalence (20%, N = 1363) and severity (<10% of colony surface) by June of 2005. The prevalence of diseases increased during recovery, from 1% to 7%. This was predominantly due to an unprecedented, territory-wide outbreak of white plague, with prevalence increasing from less than 1% to 4%. The combination of these disturbances caused recent partial and whole colony mortality to nearly quadruple in prevalence from 7% (prior to and during the bleaching) to 25% (during recovery). The net effect was a 38% reduction of coral cover over all monitored reefs. As predicted, potential coral reef refugia in deep water (>30 m) adjacent to cooler oceanic water did not suffer substantial bleaching (only 5% of cover). However, they did experience high prevalence of white plague (7%) and loss of coral cover (22%). This suggests strong, but unobvious, stress on potentially naïve coral faunas or the possibility of the spread of disease from stressed and susceptible shallow coral populations. Deep reefs may only be a partial refuge from the escalating impacts of increasing tropical sea surface temperatures.

**Keywords.** Coral bleaching, disease, mortality, refuge.

## COMPARISONS BETWEEN NUTRIENT CONCENTRATION AND DINOFLAGELLATE POPULATION DENSITY AT TWO BIOLUMINESCENT BAYS IN PUERTO RICO

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Bioluminescent bays are unique natural marine ecosystems. Some of their principal characteristics are that they are relatively shallow, surrounded by mangrove systems and have a narrow entrance to the sea. Two bioluminescent bays in Puerto Rico (Bahía Bioluminiscente and Puerto Mosquito) were surveyed monthly throughout one year (January 2003 to December 2003). The main objective of this study was to determine whether the differences in population density of the principal dinoflagellate populations between the two bays were due to differences in nutrient concentrations. This study confirms that there was a significant difference between the two bays: *Pyrodinium bahamense* is the numerically dominant species of dinoflagellate at Puerto Mosquito, with an annual average concentration of 286,411 cells/l. The annual average concentration at Bahía Bioluminiscente was 50,618 cells/l. However, at Bahía Bioluminiscente *Ceratium furca* dominated over *P. bahamense* part of the year with an annual concentration of 97,850 cells/l; the concentration in Puerto Mosquito was 11,172 cells/l. A two-way ANOVA test found no significant differences in nutrient concentrations between Bahía Bioluminiscente and Puerto Mosquito. Therefore, this study suggests that nutrient concentration may not be the causal factor of the differences in dinoflagellate populations between the two bays.

**Keywords:** *Pyrodinium bahamense*, *Ceratium furca*, nutrients, Bioluminescent Bays

## CARBON SUPPLY AND DEMAND ON A COASTAL PLANKTONIC SYSTEM, MORROCOY NATIONAL PARK, VENEZUELA

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In order to evaluate the carbon balance on a planktonic system, the relationship between phytoplankton primary production and zooplankton carbon demand were estimated on a temporal and spatial scale. Five sites were chosen according to their differences in N:P ratio, water turbidity and proximity to either river sources, mangrove and seagrass systems or oceanic influence. Seasonal variations were accomplished by measurements of the correspondent variables during dry and rainy season. Measurements of carbon offer were attained by estimation of phytoplankton primary production following the oxygen method, while zooplankton carbon demand was evaluated through measurements of secondary production and the amount of carbon assimilated, using the percentages of assimilation and ingestion efficiency reported on the literature. Primary production values range from 3,517 to 90,028 mg C/m<sup>3</sup>/h and were highly variable on either temporal and spatial scale. As for the zooplankton secondary production, values range from 6,34 to 5.386,55 mg C/m<sup>3</sup>/day, generating a total carbon demand values ranging from 24,36 to 20.685,67 mg C/m<sup>3</sup>/day. The carbon demand of the zooplankton community followed the spatial and temporal dynamics of the carbon offer by phytoplankton primary production, although the correlation between this two variables was weak, suggesting a poor coupling on the pelagic carbon supply-demand system. On the spatial scale, the carbon balance (supply/demand) showed negative values on areas closer to the coast and positive values for the oceanic locations, which might imply that phytoplankton carbon fluxes seem to be less important for the coastal food web where zooplankton is obtaining the demanded carbon by detrital or allochthonous sources.

**Keywords:** pelagic food web, phytoplankton, zooplankton, carbon balance

## **CORAL BLEACHING AND DISEASE COMBINE TO CAUSE CATASTROPHIC MORTALITY ON REEFS IN US VIRGIN ISLANDS**

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Record-breaking warm water temperature during 2005 led to extensive coral bleaching in the Northeast Caribbean. Monitoring at five high coral cover (average 21.4%) study reefs within Virgin Islands National Park and Buck Island Reef National Monument revealed >90% of the coral cover bleached. Corals began to regain color in October 2005 as water temperatures decreased, and minimal coral mortality was detected. Continued monitoring from November 2005 through October 2006, showed tremendous increase in coral disease, primarily white plague, with prevalence rates 4-80 times that observed before bleaching. Disease mortality caused a catastrophic loss of 51.5% of the coral cover in just one year. Cover loss by species was also dramatic; *Agaricia agaricites* decreased an average of 78%, primarily from bleaching. *Colpophyllia natans* decreased 87%, primarily from disease. *Montastraea cavernosa* bleached less than other corals and did not decrease in cover, however, the major reef building coral, *M. annularis* (complex), (comprising nearly 80% of the coral cover at these sites) declined 51%. At the end of 2006, coral cover at the five study sites averaged only 11.0%. The substantial outbreak of disease immediately following the wide-spread and prolonged bleaching event strongly suggests a connection between coral bleaching and disease. While coral mortality from bleaching events has been well documented this study shows that only with frequent (greater than annual) monitoring would the post-bleaching mortality patterns and presence of pathogenic disease be detected.

**Keywords:** Bleaching, Disease, Ecology, Caribbean coral

## **EFFECTS OF BLEACHING AND DISEASE ON ELKHORN CORAL, *ACROPORA PALMATA*, IN ST. JOHN, U.S. VIRGIN ISLANDS**

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Before the late 1970s, elkhorn coral, *Acropora palmata*, grew in nearly mono-specific stands and was the main reef-building coral at depths less than 10m in the US Virgin Islands (USVI). In the mid 1970s and 1980s, white band disease and hurricanes caused a precipitous decline (up to 90%) in *A. palmata* throughout the Caribbean, including St. John, USVI. In May 2006 this species was listed as threatened under the Endangered Species Act. Using Global Positioning System (GPS), we have mapped and surveyed about 4000 *A. palmata* colonies at 14 sites around St. John. Size, disease, physical damage and predation were documented and colonies were photographed, while genotypic diversity was sampled at six sites. To provide a "snapshot" of the *A. palmata* population, thirteen sites with 3627 colonies were surveyed in late 2004 for prevalence of white pox (average 9.2%) and white band (1 colony affected), and population size structure (colonies <0.5m diameter were dominant). White pox prevalence increased dramatically with size (diameter: <10 cm = 2.3%, 11-50 cm = 9.6%, 51-100 cm = 24.0%, >100 cm = 34.2%). At five sites, monthly monitoring surveys revealed temporal changes in *A. palmata* populations. In late summer 2005, *A. palmata* bleached for the first time on record in association with record-high temperatures. For some sites, bleaching caused more complete mortality during the year than disease, predation and physical breakage. At the four sites followed during the bleaching event 11.8-37.5% of colonies suffered at least partial mortality from bleaching, with 3.7-14.3% suffering complete mortality. Disease appeared to be positively correlated with seawater temperatures throughout many survey periods. New fragments followed *in situ* at one site over 22 months showed survivorship to be 59.5% (N=205). The monitoring program around St. John, provides baseline data for future work and insight into population dynamics of *A. palmata*.

**Keywords:** *Acropora palmata*, population dynamics, disease, bleaching

## ANONYMOUS SEQUENCE MARKERS FOR SPECIES-LEVEL PHYLOGENETIC ANALYSIS OF THE CORAL GENUS *PORITES* (SCLERACTINIA, PORITIDAE)

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Molecular systematic studies in scleractinian corals have demonstrated the need for taxonomic reevaluation at all levels. However, the types of molecular markers needed to generate reliable species-level phylogenies are currently unavailable. We developed single-copy nuclear DNA markers (scnDNA) from partial genomic libraries of *Porites compressa*. The markers were analyzed individually and in concatenation for species of *Porites* with distributions in the western Atlantic and Caribbean. The genus *Porites* has many unresolved taxonomic questions and provides an ideal system in which to test these markers. We amplified homologous sequences from specimens of *P. compressa* and six other species of *Porites* (*P. astreoides*, *P. branneri*, *P. colonensis*, *P. divaricata*, *P. furcata*, and *P. porites*). The markers were tested and found to be specific to coral tissue and did not amplify any contaminant DNA that may have been present from symbiotic zooxanthellae. As expected, individual markers did not perform as well as the combined dataset during phylogenetic analyses. Though limited in sample size, the combined phylogeny was able to differentiate most recognized species of *Porites* examined. *P. astreoides* was more closely related to *P. compressa* than to congeners from the Caribbean while *P. colonensis* and *P. branneri* formed monophyletic clades. The three ramose species (*P. porites*, *P. furcata*, *P. divaricata*) did not form monophyletic clades but were clustered together. The lack of divergence between sequences from these species indicates that they do not currently represent distinct lineages. Our results demonstrate that anonymous sequence markers should be valuable for phylogenetic studies of *Porites*.

**Keywords:** Caribbean, scleractinian corals, single-copy nuclear markers, *Porites*

## THE IMPACT OF THE 2005 BLEACHING EPISODE ON THE STONY CORALS OF DOMINICA

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In 2005, the Atlantic and Gulf Rapid Reef Assessment protocol (AGRRA v. 4) was implemented for the first time in Dominica between October 20 and November 18. Simultaneously, elevated sea surface temperatures were leading to the most severe bleaching episode so far recorded for the Caribbean. Nineteen of the 20 species within the survey were affected. Only *M. mirabilis*, a common coral in Dominica and often forming large mono-specific assemblages (500 m<sup>2</sup> and larger) appeared to be tolerant to the conditions in late 2005. The occurrence of pale, partially bleached or completely bleached colonies exceeded 50% in 13 of these species, and 76 % of all colonies ( $n = 1475$ ) had some symptom of bleaching. In an effort to assess the impact of this event on Dominica's stony corals, the sixteen sites studied in 2005 were revisited in 2006 (October 17 – November 25) and resurveyed using the same methods. Twenty of the 23 species within the survey were affected, yet the occurrence of pale, partially bleached or completely bleached colonies exceeded 50% in only four of these species. Twenty-six percent of all colonies ( $n = 1407$ ) had some symptom of bleaching. However, the abundance of live colonies decreased by 9.7% to 1.06 colonies · m, while the overall live coral cover decreased by 28% between 2005 and 2006. *A. agaricites* was among the most affected species and a common coral on Dominica's reefs until 2005, yet absent in the 2006 survey. Similarly, *P. astreoides* which constituted close to 30% of the island's live scleractinian coral cover in 2003 was reduced by 60% in one year. The 2005 bleaching episode in Dominica followed those of 2003 and 2004, each of which led to reductions in live coral cover. Given the increasingly chronic nature of such events, and the still poorly managed and mitigated local disturbances of sediment runoff (quarries, coastal development), contamination (solid waste, sewage, pesticides, defoliants) and over-fishing (spear fishing, traps, seine nets) Dominica's marginal reef systems reefs are exposed to an unprecedented load of stressors.

**Keywords:** bleaching, corals, mortality, Dominica

## MACROFAUNA BENTÓNICA ASOCIADA A BANCOS OSTRÍCOLAS EN LAS LAGUNAS COSTERAS CARMEN, MACHONA Y MECOACÁN, TABASCO MÉXICO.

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El ostión *Crassostrea virginica* es nativo de la costa norteamericana del Atlántico. En México se distribuye desde Laguna Madre, Tamaulipas hasta Celestún, Yucatán. Habita en áreas estuarinas y esporádicamente en aguas marinas. Este ostión tiene importancia comercial, social y ecológica. A nivel ecológico los bancos que forma *C. virginica* proveen hábitat para invertebrados que viven en asociación con este. En el presente trabajo se realizaron muestreos durante las temporadas de secas, lluvias y nortes, en ocho bancos ostrícolas de las Lagunas de Mecoaacán, Carmen y Machona, en Tabasco. Los bancos seleccionados fueron Puente de Ostión, Del Bajo, 87, Largo, Pinzon, Macayo, Los Jiménez y Chichal. En cada banco se muestrearon cinco cuadrantes de 20 x 20 cm, equivalentes a 1 m<sup>2</sup>. Para cada cuadrante se registraron las especies del bentos asociado a los bancos ostrícolas obteniéndose su número, el peso húmedo total y el peso seco. Se calculó la diversidad  $\alpha$  puntual mediante el los siguientes Índices: Índice de diversidad de Shannon-Wiener, dominancia de Simpson y el Índice de Margalef. En la temporada de secas los valores mas altos de los tres índices se registraron en los bancos Del Bajo y Largo ( $H = 0.666$ ,  $\lambda = 4.033$ ,  $D_{Mg} = 4.716$ ,  $H = 0.559$ ,  $\lambda = 2.468$  y  $D_{Mg} = 4.623$ ). Para la temporada de lluvias son el banco 87 y Largo ( $H = 0.713$ ,  $\lambda = 3.748$ ,  $D_{Mg} = 8.219$ ,  $H = 0.678$ ,  $\lambda = 3.234$  y  $D_{Mg} = 7.48$ ) los que registraron los valores mas altos de éstos índices, finalmente durante la temporada de nortes los bancos Puente de Ostión, Largo y Los Jiménez fueron los de mayor diversidad alfa puntual ( $H = 0.48$ ,  $\lambda = 1.889$ ,  $D_{Mg} = 6.06$ ,  $H = 0.914$ ,  $\lambda = 7.293$ ,  $D_{Mg} = 8.419$  y  $H = 0.903$ ,  $\lambda = 6.846$ ,  $D_{Mg} = 6.493$ ). La salinidad es la variable ambiental que tiene mayor influencia sobre la diversidad de especies durante las tres temporadas.

**Palabras clave:** Banco ostrícola, diversidad, dominancia, macrofauna bentónica, salinidad

## NEW CILIATE DISCOVERED THAT DEVOURS NEWLY SETTLED CORAL POLYPS

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Newly settled coral polyps are microscopic, <1 mm in diameter, and undetectable in the field by divers studying coral recruitment. Thus, little is known about the ecology, including sources of mortality, of these earliest life stages. Novel approaches to the study of newly settled corals includes seeding cultured planulae onto field-conditioned substrates, and microscope observation to follow polyp growth and survivorship. The use of a blue light source that excites the green fluorescent protein (GFP) in some coral polyps, helps in polyp detection against complex substrate compositions. Using this approach, we discovered a new ciliate predator that rapidly devours newly settled coral polyps. The ciliates, likely belonging to a new genus of ciliates in the Class Litostomatea, attack the polyps in 'packs', feeding on one polyp at a time and completely strip tissues off a polyp skeleton in less than 2 hrs. After gorging, they encyst and go into a resting phase. Disturbing the cyst causes the ciliate to resume mobility within a minute or two. The ciliates were discovered when working with larvae of the Faviid Scleractinian, *Favia fragum*, but also preyed on polyps of *Porites asteoides* and *Agaricia humilis*. Many *F. favia* polyps have high concentrations of GFP in their tissues, and the ciliates incorporated the GFP, zooxanthellae and intact nematocysts into their cytoplasm. The ciliates feeding on fluorescent polyps became obvious using the blue light source. Without this lighting the ciliates may have escaped detection. We hypothesize the ciliates remain in a resting phase and revive periodically to search for food. Adding new larvae to old substrates with no evidence of ciliates lead to a resurgence of active predation. These ciliates, if widely distributed and able to feed on other species of corals, have the potential to be a major factor in coral post-settlement survivorship and recruitment.

**Keywords:** coral recruits, ciliates, predation, *Favia fragum*

## SETTLEMENT AND POST-SETTLEMENT SURVIVORSHIP OF THE CARIBBEAN SCLERACTINIAN CORALS, *MONTASTRAEA FAVEOLATA* AND *ACROPORA PALMATA*

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Recovery of Caribbean coral populations decimated by bleaching, diseases and other causes will depend on their ability to recruit and replenish depleted populations. We studied the settlement preferences and post-settlement survivorship of *Montastraea faveolata* (summer 2005), and settlement preferences of *Acropora palmata* (summer 2006) in La Parguera, PR. In 2005, larvae of *M. faveolata* preferentially settled on the undersides of experimental plates conditioned at three study sites along an inshore to offshore gradient of terrestrial influence. Plates from the offshore “Buoy” site attracted 30 % more settlement than did those conditioned at the nearshore “Pelotas” reef site. No settlers survived at the Buoy where adults corals were very bleached, and only ca. 3 % survived the first three months at Pelotas. Temperature stress during the fall 2005 bleaching event is hypothesized to be responsible for the high post-settlement mortality. In 2006, *M. faveolata* did not spawn in La Parguera, presumably because they were still weakened from the 2005 bleaching event, but we were able to raise large numbers of larvae of *A. palmata*. A multi-factorial experiment was conducted with this species, manipulating light and grazing, to examine the hypothesis that these factors are responsible for the substrate characteristics that attract coral larvae to settle on the under-surfaces. *A. palmata* larvae in earlier experiments had been found to preferentially settle on upper surfaces. Contrary to expectations, most (ca. 70 %) *A. palmata* larvae also selected the under-surfaces of experimental blocks for settlement, regardless of experimental treatment. Statistical analysis of the substrate characteristics of the experimental settlement surfaces from both experiments is in progress. A better understanding of settlement choices by coral larvae, by examining in detail the characteristics of surfaces that attract the most larval attachment, may help in the design of methods to enhance coral recruitment and survivorship rates.

**Keywords:** coral recruitment, settlement, *Montastraea faveolata*, *Acropora palmata*

## NUTRIENT DISTRIBUTION ACROSS THE INSULAR SHELF OF PUERTO RICO: ASSESSMENT BY ALGAL TISSUE NITROGEN

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The concentration of tissue nitrogen in macroalgae may be a useful indicator of nutrient enrichment because algal tissue is responsive to small changes in nutrient availability and integrates changes over time. A preliminary survey was conducted to investigate possible presence of an inshore to offshore gradient in  $\delta^{15}\text{N}$  and %N tissue content of selected macroalgal species in the coastal waters of La Parguera in southwestern Puerto Rico. Nutrient fluctuations are expected, due to variable rainfall and anthropogenic inputs. A total of thirty four species of algae were examined. Both *Dictyota bartayresiana* and *Lobophora variegata* were present from mid shelf sites to the edge of the insular shelf and grow in a variety of light and depth conditions. These species both displayed significantly greater means of total  $\delta^{15}\text{N}$  tissue content in the inner versus outer portions of their distribution (2.4‰ (SE = 0.1) vs. 0.6‰ (SE = 0.3) for *D. bartayresiana* and 2.4‰ (SE = 0.2) vs. 0.8‰ (SE = 0.2) for *L. variegata* respectively). *Acanthophora spicifera* was present at inshore and mid shelf sites. There were indications of the same trend found in this species; however, differences were not significant. Among the other algal species examined, there was no cross shelf tissue nutrient trend.

**Keywords:** Caribbean, tissue nutrient concentration, algae, nitrogen

## **THE IMPORTANCE OF HERBIVOROUS REEF FISHES (SCARIDAE AND ACANTHURIDAE) TO THE SMALL-SCALE COMMERCIAL FISHERY OF ST. CROIX, U.S. VIRGIN ISLANDS**

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The small-scale commercial fishery of St. Croix, U.S. Virgin Islands is heavily reliant on inshore fisheries resources from coral reef ecosystems. Commercial fishers use a variety of primarily artisanal gears to harvest a wide diversity of finfishes and invertebrates from nearshore waters. This paper explores the growing commercial importance of two herbivorous reef fish species-groups: parrotfishes (Scaridae) and surgeonfishes (Acanthuridae). Data for reported commercial landings and port samples were reviewed to examine time-series trends in landings of scarids and acanthurids. Data for bycatch rates were included when known. Results indicate that during the past decade landings of scarids have increased by > 200 % to become the most important finfish species-group landed in the St. Croix commercial fishery. Acanthurid landings were an order of magnitude less than scarid landings by weight and showed a smaller increase (~ 125 %) during the same period. A pronounced shift in parrotfish landings by gear type also occurred during this period: the proportion of scarids taken in traps decreased from 46% to 8% of total scarid landings, while the proportion of scarids taken by nets and scuba-associated methods increased to ~ 75 % of total parrotfish landings. These observations indicate that local commercial fishers have refined their ability to selectively target parrotfishes resulting in larger harvests. Compared to other fisheries in the U.S. Caribbean (St. Thomas/St. John and Puerto Rico), the observed herbivore removal rates by St. Croix commercial fishers are exceptionally high. Intervention by fisheries management agencies is needed to prevent over-exploitation of reef fish herbivores by the St. Croix commercial fishery. Ideally, local fisheries management action will involve an ecosystem-based approach, which incorporates knowledge of the vital ecological role of herbivorous reef fishes on coral reefs. Alternate management scenarios are discussed in terms of their practical application to the St. Croix commercial fishery by local fisheries management authorities.

**Keywords:** herbivorous reef fishes, coral reef fisheries management, St. Croix, U.S. Virgin Islands

## **FORAGING BY THE LONG-SPINED SEA URCHIN *DIADEMA ANTILLARUM*: ARE UNCONSUMED FRAGMENTS PERPETUATING ALGAL DOMINANCE ON CORAL REEFS?**

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Scientists and resource managers have hypothesized that the return of the keystone herbivore *Diadema antillarum* to Caribbean coral reefs will dramatically reduce algal biomass and enable corals to once again dominate these systems. On reefs in St. Thomas, USVI we are beginning to address this question by testing urchin foraging preferences and following the fate of unconsumed algal fragments. Many genera of macroalgae (e.g. *Dictyota*, *Halimeda*, *Caulerpa*) are known to asexually propagate via vegetative fragmentation. If large numbers of fragments of these macroalgae are created by *Diadema*, then algal biomass may actually increase rather than decrease on reefs. We have tested a range of species of macroalgae with urchins (test diameter: 4-7 cm) starved for 48 h. In 12-h trials, no fragments of any algal species were generated in running seawater chambers without urchins (controls) and urchins created no/few fragments of *Dictyosphaeria cavernosa*, *Acanthophora spicifera*, *Laurencia papillosa* and *Padina sanctae-crucis*. Alternatively, individual urchins created up to 54 fragments of *Dictyota menstrualis*, 28 fragments of *Halimeda opuntia*, and 11 fragments of *Caulerpa sertularioides* (primarily blades). Survival and attachment of these fragments was 56%, 4%, and 45%, respectively. Our results suggest that *Diadema* may be able to increase algal biomass on reefs; we plan to continue our trials to look at urchins starved for longer time periods and when multiple urchins compete for limited food.

**Keywords:** macroalgae, fragmentation, sea urchins, coral reef phase shift

## **CORAL REEF ED-VENTURES: A MARINE ENVIRONMENTAL EDUCATION PROGRAM FOR SCHOOLCHILDREN IN BELIZE, CENTRAL AMERICA**

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Healthy, well-managed reef systems are of great importance to coastal communities in many tropical countries, but local knowledge of reef ecosystems may be limited, and the study of coral reef natural history commonly is not a part of school curricula. Nonetheless, coral reefs are an ideal topic for teaching even young schoolchildren about fundamental oceanographic, ecologic, and conservation principles. As an outgrowth of a multi-year basic research program to monitor the health of coral reefs in Belize, and in cooperation with the Hol Chan Marine Reserve on Ambergris Caye, students and faculty from Smith College initiated the Coral Reef Ed-Ventures Program in summer 2000. Now in its seventh year, Smith student teachers and up to 70 Belizean schoolchildren from San Pedro, ages 7 to 11, participate in an intensive two-week summer program to learn about coral reefs. The goals of the program are to increase understanding of a healthy reef ecosystem, to explore how various organisms interact within the reef, and to develop an appreciation for threats to the reef and how to conserve reef resources. The curriculum emphasizes a methodology of critical thinking and inquiry-based science learning – helping children develop observation and recording skills is an integral part of active, hands-on classroom and field trip-based learning experiences. Lessons focus on marine science with a multi-disciplinary and multi-arts approach. This year the Smith student teachers were assisted by a U.S. Peace Corps volunteer and the Education Coordinator at Hol Chan. New innovations to the program included a full-day workshop for all teachers in the San Pedro public elementary school. The workshop focused on using the reefs, beaches, and other local resources as tools for teaching. A pilot reef conservation program also was initiated at a more advanced level for children over age 11 who had graduated from last year's program.

**Keywords:** Coral reef ecology, environmental education, Hol Chan Marine Reserve, Belize.

## **VIRGIN ISLANDS MARINE ADVISORY SERVICE (VIMAS)**

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The Virgin Islands Marine Advisory Service (VIMAS) is a cooperative program between the University of the Virgin Island's Center for Marine and Environmental Studies and the University of Puerto Rico Sea Grant College Program. With agents on both St. Thomas and St. Croix, VIMAS works to inform and educate citizens about ocean resources and marine careers. Educational outreach is accomplished through classroom presentations, field trips, and participation in community events such as the Agricultural Fair and Eco Fair, with the goal of increasing the public's awareness and understanding of marine resources and marine affairs. VIMAS often assists in coastal planning and decision-making in order to foster a balance between development and the islands' living and non-living resources. VIMAS agents serve on advisory committees examining local fisheries, nonpoint source pollution, and the development of the East End Marine Park. VIMAS conducts long-term biological monitoring on coral cover, diversity and disease, sedimentation rates, and coastal water temperatures.

**Keywords:** Coral reef ecology, environmental education

## RED MANGROVE LITTERFALL DYNAMICS AND REMOTE SENSING OF LEAF AREA INDEX IN SOUTHWESTERN PUERTO RICO

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Mangroves are tropical and subtropical marine plants that can cover up to 75% of coastlines. These highly productive ecosystems serve as habitats for a large number of vertebrate and invertebrate species. In southwestern Puerto Rico arid mangrove forests are dominated by the red mangrove *Rhizophora mangle*. The overall objective of this research is to determine primary production of *R. mangle* using *in situ* techniques and remote sensing. Measuring leaf area index (LAI) and litterfall are essential for the determination of mangrove productivity. LAI, which is defined as the total leaf area per surface ground area is directly related to the photosynthetic capacity of mangrove forests. LAI was measured *in situ* using a ceptometer and estimated using remote sensing techniques. Preliminary results indicate a positive relationship between LAI field measurements and the Normalized Difference Vegetation Index (NDVI) obtained from IKONOS satellite data. Litterfall results indicate a tendency for this parameter to increase with higher precipitation and wind velocities. The spatial and temporal patterns of LAI in La Parguera will be discussed.

**Keywords:** Red mangrove, Leaf Area Index, Litterfall, Remote Sensing

## INTERACCIONES COMPETITIVAS DIRECTAS EN TRES ZONAS DEL ARRECIFE DOS MOSQUISES SUR, P.N. ARCHIPIÉLAGO LOS ROQUES, VENEZUELA

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La diversidad de especies, su distribución y abundancia en un arrecife coralino es afectada por muchos factores, tanto físicos como biológicos, como son la competencia y la depredación. La competencia tiene lugar cuando dos o más organismos explotan un mismo recurso limitante, (como son la luz, el alimento, el agua o el espacio), afectando negativamente los demás organismos. Si se considera sólo a los organismos sésiles (esponjas, corales, octocorales y zoántidos), la competencia por espacio es obviamente un factor importante en estas comunidades, por lo que es considerado junto con la luz, entre los principales recursos limitantes del sistema. Este estudio se realizó en el arrecife tipo franjeante del Cayo Dos Mosquises Sur, del Parque Nacional Archipiélago de los Roques, un sistema oceánico con bajo impacto antropogénico y considerado como uno de los arrecifes más sanos en el Caribe. El arrecife de Dos Mosquises Sur, se caracteriza por presentar su alta diversidad de especies coralinas, siendo *Montastraea annularis*, *Colpophyllia natans* y *Madracis mirabilis* las especies dominantes y una alta cobertura coralina (7,200cm<sup>2</sup>/m<sup>2</sup>) a “profundidad intermedia” (3-18m). En cada zona del arrecife: a.-plataforma (entre 3 a 7m de prof.), b.-cresta (7-13m de prof.) y c.-talud (>13m de prof.), se delimitaron cinco (5) parcelas de 20m<sup>2</sup>, se contaron y se clasificaron las interacciones intra e inter-específicas directas encontradas y se identificaron los organismos involucrados. Se identificaron tres tipos de evidencias competitivas: “tejido lesionado”, sobrecrecimiento y “sin daño”, siendo el primero el más frecuente en el arrecife y el sobrecrecimiento aumentó con la profundidad. El mayor número de interacciones competitivas directas fueron encontradas en la zona del talud y las interacciones interespecíficas fueron las más frecuentes en el arrecife.

**Palabras clave:** corales escleractínidos, Competencia, Arrecife coralino, Venezuela.

## **2005 BLEACHING MONITORING IN THE PARQUE NACIONAL ARCHIPIELAGO DE LOS ROQUES, SOUTHERN CARIBBEAN, VENEZUELA.**

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Los Roques archipelago, is the most important oceanic coral reef system of Venezuela. The bleaching condition of some coral and patch reefs from there was monitored since August 2005 to March 2006. At each reef, from four to six areas of 40 m<sup>2</sup> were delimited (5–9 m and 12–17 m. depth), and the normal, pale or bleach condition of all colonies were registered. Surveys were done in August (pre-bleaching phase), October (supposed maximum time bleaching), November, and in March (post bleaching phase). Temperature records were taken with Hobo data loggers each 15 minutes. The highest temperature was registered between October 7th and 8th, with a maximum between 29.35 and 30°C. Bleaching was only evident the first week of November and extended to shallow and deep zones of reefs. The bleaching was from intermediate to low intensity. A very low proportion of colonies of the total monitored, were completely bleached (0,80%) and a higher number were partially bleached ( 20,79%). An interesting and exceptional case is *Leptoseris cucullata*. From the total number of colonies observed (only nine), 80% were bleached. On the other hand, *Porites astreoides* was the species with highest partial bleaching (81-100%), but only seven colonies were affected at this bleaching level. Not all the different species of the reefs bleached at the same time. *Palythoa caribaeorum*, *Millepora alcicornis*, *Millepora complanata*, *Diploria labyrinthiformis* and *Montastraea faveolata* were the first affected species. Bleaching recovery was almost total at the end of March, however some colonies of *M. faveolata* had medium pale spots. Compare with other Caribbean reefs, our results were very positive. However, in a meddium and long term, in an ecological time scale, the effects of the bleaching over Los Roques reefs will depend of the annual frequency, intensity and permanency of the overheating water.

**Keywords:** bleaching, Los Roques, South Caribbean, reefs

## **CORAL DISEASE DYNAMICS AND NUTRIENT AVAILABILITY ON REEFS OF THE NORTHERN FLORIDA KEYS AND LEE STOCKING ISLAND, BAHAMAS**

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Coral reefs in the northern Florida Keys (NFK) and those near Lee Stocking Island (LSI) in the Bahamas' Exuma Chain were quantitatively surveyed in June-August of both 2002 and 2004 to assess coral disease dynamics and potential relationships between coral diseases and ambient nutrients. Disease occurrence, prevalence, and spatial distributions were recorded for black band disease (BBD), dark spots syndrome (DSS), white plague type II (WP), and yellow band disease (YBD). Total disease prevalence was greater in the NFK than LSI in both 2002 and 2004, while overall nutrient concentrations were similar in both regions. Although host species susceptibility was variable across space and time, massive framework scleractinians, including *Montastraea annularis* and *Siderastrea siderea*, along with relatively smaller *Meandrina meandrites* and *Dichocoenia stokesi*, were most susceptible to disease. DSS lesions were found exclusively on *S. siderea* in both regions. Based on correlations among measured nutrients (dissolved inorganic nitrogen, nitrate, nitrite, ammonium, and soluble reactive phosphate), dissolved inorganic nitrogen (DIN) and total phosphorous (TP) were selected as proxy variables for nutrient availability. Regression analyses indicated significant positive relationships between DIN and BBD prevalence in both the NFK and LSI, and a negative relationship with TP near LSI. This study is one of the few that have quantitatively addressed the potential difference in coral disease dynamics between human-impacted (NFK) and relatively pristine (LSI) reef systems.

**Keywords:** coral health, nutrients, black band disease, coral disease prevalence

## **IMPROVED UNDERSTANDING OF OCEANIC PROCESSES THROUGH AN INTEGRATED CARIBBEAN COASTAL OCEAN OBSERVING SYSTEM**

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Connectivity, indications of climate change, coral reef health, oceanic conditions for storm intensification, fisheries assessments, larval recruitment and tsunami propagation are examples of areas of ocean science that can be advanced with increased availability of data, modeling capabilities, scientific collaborations and with the ocean observations necessary to support these. Advances in the understanding of every oceanic process that concerns scientists, marine resource managers, disaster managers and other decision makers require improved understanding of sea surface temperature, circulation, air-land-sea interactions, sea floor bathymetry, eddy propagation and many other factors in which regional informational needs remain unfulfilled. To address this situation, the University of Puerto Rico and the University of the Virgin Islands, with the support of the consortium of federal US agencies named Ocean.US, have organized CaRA, the Caribbean Regional Association. As part of a national system of similar organizations, CaRA is charged with assembling expertise and synergistic collaborations and with developing the observational infrastructure, inventories of databases and data management protocols into an integrated observing system to the Caribbean region with the needed information and understanding of the ocean and its processes. Presently finalizing its organizational structure and engaging its user community, CaRA's most challenging commitment is to promoting the financing, emplacing, operating and maintaining of needed real-time observational assets.

**Keywords:** CaRA, Ocean.US, ocean observing system, regional association

## **CORAL REEF BIODIVERSITY IN THE WIDER CARIBBEAN-NEW RECORDS OF CORALS AND THE GOALS OF THE CENSUS OF MARINE LIFE**

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Increasing reef deterioration and lack of consensus on the status of many Caribbean coral reef species are current challenging problems. Many published species lists are for restricted geographic areas and mostly based on older, usually incomplete descriptions and classification keys lacking good diagnostic characters, which can confuse interpretation of biogeographic and biodiversity patterns in the region. For most of the modular organisms (corals, octocorals, sponges, bryozoans, zoanthids, hydrozoans, etc) taxonomic problems posed by the natural morphological variability of modular structures and colonies have been exacerbated by: (1) the longstanding emphasis on the importance of non-genetic sources of variation, (2) the use of very few specimens and characters (3) lack of quantitative multivariate (morphometrics, genetic, ecology, behavior, etc.) and statistical analyses, and (4) lack of information about the natural variability, the ecology, and the geographic range of the taxa being studied. Scleractinian corals are a good example of a well known group that still presents taxonomic problems in 20 of the 27 (78%) genera described for the Caribbean, and one recently described genus, *Goreaugyra*, has a doubtful status [only one specimen (holotype) has ever been found]. Recent multivariate approaches suggest a much more diverse and specialized coral fauna that could significantly increase the total number of zooxanthellate species in the region (+/- 80). *Montastraea*, *Meandrina*, *Agaricia*, *Acropora*, *Porites*, and *Madracis* are some of the most important reef building genera for which new evidence has clarified some of the taxonomic problems. The Census of Marine Life is a world-wide program to characterize the diversity of life in the ocean. The Caribbean chapter (Caricoral) would be started during the AMLC and has as a mayor goal, the compilation of the most extensive and quality list of species of organisms inhabiting coral reefs in the region. For this, the CoML needs the collaboration of taxonomist and biologists in countries around the Caribbean to provide the much needed information on the local species diversity. This information will be entered by each person in the OBIS system, a database program that will compile and store the information.

**Keywords:** Biodiversity, Caribbean, Census of Marine Life, Scleractinian corals

## DEEP-CRES - ECOLOGY, INTEGRITY & STATUS OF DEEP CARIBBEAN CORAL REEFS

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Deep Caribbean reefs are largely unexplored, mainly due to the limitations of submersibles, ROV's and AUV's. This program grows from expertise developed under CRES 2002 and consists of a multidisciplinary team (biology, geology, chemistry, physics) to study the biology and ecology of deep reefs off La Parguera, PR. ROV surveys will guide initial work, but key to the program is the development of deep-diving (100m) capability for detailed manipulative work and sampling. Work capitalizes on the close proximity of UPRM's marine station to deep-reefs and adjacent shallow, CRES 2002 study sites. Research is driven by 24 specific hypotheses within 3 objectives: **Characterization** – species compositions and changes in space and time, disease prevalence and dynamics, genetic variability, reproduction and recruitment, plus the current and historical environment affecting reef distribution and function. Work includes still/video photography, specimen collection, repeat sampling and experimental manipulations. **Connectivity** – the relationship and ecological flow between deep and shallow reefs using taxonomic, genetic, reproductive and recruitment studies, and simulation modeling. Can deep reefs seed threatened shallow species, or are deep reefs dependent upon larval import from shallow reefs? **Vulnerability** – new/different species, small populations, slow growth and close proximity to land potentially make Caribbean deep reefs unique yet vulnerable to anthropogenic stress. A comparative site at Ponce, associated with a deep sewer outfall and river/harbor-borne sedimentation and turbidity will be studied in terms of species composition and distribution, disease prevalence and dynamics, reproduction, recruitment, and genetic variability under the assumption that all will be negatively impacted due to these (empirically measured) stressors. The project utilizes the resources of the Caribbean Coral Reef Institute for program administration, webpage support and dissemination of results to pertinent management agencies. A scientific management committee will ensure proper scheduling and completion of all activities.

**Keywords:** Deep coral reefs, species composition, diseases, connectivity.

## LOCAL AND GEOGRAPHIC VARIABILITY OF THE 2005 MASS BLEACHING EVENT IN THE WIDER CARIBBEAN

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The mass-bleaching event of 2005-06 was the worst on record for the Caribbean. During late summer and Fall of 2005 most reefs in the eastern and northern Caribbean were completely white. Disease and bleaching surveys were done during this period in 2 reef sites in each of 6 geographically distant countries across the wider Caribbean (Panamá, Curacao, Grenada, Grand Cayman, Puerto Rico and Bermuda). Five 20x2 m (20m<sup>2</sup>) permanent band transects in each of three depth intervals (0-4, 5-10 and >15m) (N= 15 transects/reef) in each of two reefs per country were surveyed. All coral, octocoral, hydrocoral, zoanthid and sponge colonies were counted and checked for bleaching signs to assess the prevalence (%) of bleaching at different spatial scales. Mean prevalence at the community level and in major reef-building corals were compared with a nested ANOVA. Spatial patterns of bleaching for each particular coral genus were tested with a chi square test and further inferred with a correspondence analysis (CA). Overall, mean prevalence at the community level was highly variable ( $19.4 \pm 24\%$ ) in the wider Caribbean. Bleaching was significantly lower in the northern Atlantic ( $0.5 \pm 0.6\%$ ) compared to the northern ( $20.6 \pm 22.9\%$ ) and southern Caribbean ( $25 \pm 24.9\%$ ). At the community level, bleaching was significantly higher ( $F = 14.9$ ,  $df = 3$ ;  $p = 0.003$ ) in Grenada ( $53.3 \pm 11.8\%$ ) compared to Puerto Rico ( $29.3 \pm 28.8\%$ ), Panamá ( $20.9 \pm 19.7\%$ ), Cayman ( $12.8 \pm 11.5\%$ ), Curacao ( $0.57 \pm 0.68\%$ ) and Bermuda ( $0.51 \pm 0.56\%$ ). At the population and genera levels bleaching prevalence reached high values (90-95%) in many of the important reef-building genera in the Caribbean (*Montastraea*, *Agaricia*, *Diploria*, *Colpophyllia*, *Siderastrea*, *Porites*, *Millepora* and *Stephanochoenia*) mostly in the eastern and northern Caribbean (Grenada and Puerto Rico). Some of these populations were bleached for several months (5-6 in some cases) and significant bleaching-related mortality was observed in *Agaricia*, *Montastraea*, *Mycetophyllia*, *Siderastrea* and *Millepora* was observed for the first time in southwestern Puerto Rico. Disease out-breaks (white plague and yellow band syndrome) followed the onset and peak of the bleaching period making it difficult to discriminate between bleaching-related and disease related mortalities.

**Keywords:** Bleaching, wider Caribbean, prevalence, mortality.

## **STATUS OF CORAL AND OCTOCORAL DISEASES/SYNDROMES IN PUERTO RICO IN 2006: PRELIMINARY RESULTS AND GENERAL PERSPECTIVES**

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During the past decades coral diseases have increased in numbers and prevalence world-wide. There is growing evidence indicating that in Puerto Rico, coral diseases might be the most important factor in the current degradation of these communities. Most of the information however, was collected off La Parguera and Desecheo. Here we present preliminary assessments of the number and prevalence of coral diseases and bleaching from 13 reefs in three geographic areas, from the east, southwest and western coast of the island. Surveys were conducted during the Summer-Fall of 2006 with few sites surveyed in 2005. Results are compared with data collected in Desecheo and 9 reefs of La Parguera since 1999. Most common disease/syndromes were white plague (WP), white band (WB), Caribbean yellow band (YBS), dark spots (DSS), and aspergillosis (ASP). Average prevalence at the community level was highly variable at all spatial scales (habitats within reefs, reefs within regions and across regions) but relatively low overall ( $5.96 \pm 10.2\%$ ). One reef each in the three regions had significantly higher mean prevalence compared to the others (Culebrita=  $10.11 \pm 7.2\%$ , Turrumote=  $33.97 \pm 15.3\%$ , and Desecheo=  $11.01 \pm 7.1\%$ ). Bleaching mean prevalence was low but variable ( $7.2 \pm 11.2\%$ ), mostly pale colonies from the 2005 bleaching event. WP-II was significantly more prevalent on the east ( $5.86 \pm 7.6\%$ ) and YBS was more prevalent on the southwest and west ( $5.82 \pm 12.0\%$ ) compared to all other reef areas. Both these syndromes show a significant increase in prevalence in La Parguera and Desecheo since 1999. Spatial and temporal variability in number and prevalence of diseases highlights the importance of long term monitoring programs to better understand the dynamics of the disease problem. Conclusions based in short time series or single surveys should be avoided. Increase of coral reef MPAs is proposed as a mechanism to enhance the potential recovery of degraded coral reefs.

**Keywords:** Coral diseases, Caribbean, Puerto Rico, prevalence

## SEXUAL REPRODUCTION IN THE CARIBBEAN CORAL GENUS *MYCETOPHYLLIA* IN LA PARGUERA, PUERTO RICO

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Current reef degradation trends undermine the importance of knowing the life history characteristics of important reef species. Corals can reproduce both sexually and asexually, little information exist on the reproductive biology of most Caribbean scleractinian species. This study included the characterization of the reproductive biology and fecundity of four species of *Mycetophyllia* (*M. ferox*, *M. aliciae*, *M. lamarckiana*, and *M. danaana*) in La Parguera, Puerto Rico. Tissue samples from five colonies of each species were collected monthly for 14 months, fixed, decalcified, dehydrated, embedded in paraplast, sectioned and stained with Heidenhain's Aniline-Blue for observation under the microscope. Results confirmed previous observations for *M. ferox* and that the other three species were also brooding hermaphrodites but with different timings of gametogenesis and brooding season. Differences in the onset of gametogenic cycles were found for three of the four species, *M. ferox* (June-January), *M. aliciae* (June-May), *M. lamarckiana* (August-July), and *M. danaana* (May-May). *M. aliciae* only showed planulae development until stage I in March-April and *M. danaana* had planulae year around. In contrast *M. ferox* and *M. lamarckiana* showed different brooding seasons from December-May (6 months) and August-May (9 months) respectively. There were significant differences in fecundity among the species, except between *M. lamarckiana* and *M. danaana*. *M. ferox* had significantly lower fecundity (3.2 eggs/polyp) and *M. danaana* (30.68 eggs/polyp) and *M. aliciae* (25.81.eggs/polyp) the highest. *M. lamarckiana* (14.43 eggs/polyp) was intermediate. The different oocyte stages I-IV varied, with *M. ferox* showing the smallest eggs. The sexual pattern and mode of development of the four species of *Mycetophyllias* in Puerto Rico was similar to other Musiids in the Caribbean (*Isophyllia*, *Mussa* and *Scolymia*). The gametogenetic cycle showed synchronization with moon cycles in *M. ferox* and *M. danaana* (full moon) and *M. aliciae* and *M. lamarckiana* with first quarter moon. The onset of gametogenesis was when temperatures started to arise and the brooding period was during winter time.

**Keywords:** *Mycetophyllia*, reproductive biology, scleractinian coral, Caribbean, gametogenesis

## **EFFECTS OF MULTIPLE HURRICANES ON *ACROPORA PALMATA* (ORDER: SCLERACTINIA, FAMILY: ACROPORIDAE) IN THE FLORIDA KEYS (U.S.A.)**

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The Elkhorn coral, *Acropora palmata*, has historically dominated the Caribbean reef crest through prolific clonal reproduction. This species is thought to be well adapted to survive and even proliferate during physical disturbances, such as moderate intensity hurricanes. Since 2004, we have monitored approximately 200 randomly selected tagged colonies of *A. palmata* in fifteen 150m<sup>2</sup> study plots on 5 reefs in the upper Florida Keys. Surveys of the size and condition of randomly selected tagged colonies (i.e. colony surveys) were conducted quarterly, and surveys of the number, size, and colony type classification ('branching', 'remnant', 'encrusting,' or 'attached fragment') of all colonies within the study plots (i.e. plot surveys) were conducted approximately annually. Between July and October of 2005, 4 hurricanes affected the Florida Keys, producing maximum wind speeds on the reef tract of 44 to 65kts. Plot surveys documented an average loss of 55% of live tissue (estimated by a 'live area index') following the hurricanes. The percentage of the population classified as 'branching' colonies decreased from 67% to 41% while 'remnant' type colonies (isolated patches/crusts of tissue on standing skeleton) increased from 11% to 32%. Although some of the lost branches were present as loose fragments, within 3 weeks after Hurricane Dennis 70% of the 380 fragments observed in the study plots were dead or rapidly losing tissue. Over the course of all plot surveys, only 33 loose fragments were observed to attach to the substrate. However, 28 'attached fragments' died or were broken loose over this same period. In sum, the 2005 hurricane season resulted in a substantial loss of *A. palmata*, and yielded relatively few asexual recruits. Furthermore the asexual and sexual fecundity of the remaining population is compromised for the near future due to the lack of branches and loss of live tissue.

**Keywords:** fragment, recruitment, disturbance, Caribbean

## **RECRUITMENT DYNAMICS OF *DIADEMA ANTILLARUM* IN LA PARGUERA, PUERTO RICO**

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Temporal and spatial variations of recruitment by *Diadema antillarum* post-larvae were examined at three reefs from different shelf locations in La Parguera, Puerto Rico: Las Pelotas (inner reef, 3m depth), Media Luna (external reef, 10m depth) and Old Buoy (shelf-edge reef, 20m depth). Recruitment was analyzed from settling plates built from astroturf installed at various depths on individual mooring lines. There were a total of three replicate settlement plates for each depth on each reef. At Old Buoy, plates were placed at 20m, 12m and 6m, Media Luna at 10m, 8m and 5m, and 3m and 2m at Las Pelotas. The duration of experiments was from September 2005 to September 2006. Plates were collected and replaced during the first week of each month. A total of 277 recruits of *Diadema* were collected in this study. Recruits were only collected at the shelf-edge reef (Old Buoy), with the exception of two recruits observed at Media Luna during October 2005. There was a significant difference of settlement between months sampled at Old Buoy, with a peak of 123 settlers in July 2006. *Diadema* recruits were collected every month at Old Buoy, except in March 2006. *Diadema* settlement was positively correlated with water temperature, defining a "season" of higher recruitment during the summer. In addition, there was also a significant difference of recruitment between depths at Old Buoy, with more settlement observed on the upper plates at 12m (3.6 settler/plate, SD=6.3) and 6m (3.12 settler/plate, SD=5.3) than at the bottom plates (0.36 settler/plate, SD=0.9). Predation may play a role in the survival rate of settlers and the recovery of the *Diadema* populations at the inshore reefs in La Parguera, Puerto Rico.

**Keywords:** *Diadema antillarum*, recruitment, predation, Caribbean

## **AN ASSESSMENT OF THE OCTOBER 2005 CORAL BLEACHING EVENT IN AND AROUND BUCK ISLAND REEF NATIONAL MONUMENT, ST. CROIX, US VIRGIN ISLANDS**

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NOAA's Biogeography Team and the National Park Service's South Florida Caribbean Network (NPS-SFCN) have been conducting biannual coral reef monitoring within the Buck Island Reef National Monument (BIRNM) and East End Marine Park (EEMP), St. Croix, USVI, since 2000. During October 16-30, 2005, widespread coral bleaching was observed, preceded by 10 weeks of higher than average water temperatures (28.9-30.1°C). Random transects (25 x 4 m) over hard bottom habitats (N=93) were conducted, and approximately 48% of live coral cover was bleached. Only two of 26 coral species did not exhibit signs of bleaching, and species-specific bleaching patterns were variable throughout the study area. Bleaching was evident at all depths (1.5-28 m) and a weak but significant correlation ( $r^2=0.159$ ,  $P=0.0023$ ) was observed. A follow-up study was conducted during December 12-14, 2005 to evaluate possible coral recovery or mortality. Using similar methodology, but reduced sampling effort (N=18), approximately 8% of the coral cover was completely bleached and 20.5% was partially bleached or pale. Recently dead coral (bare skeleton or colonized by turf algae or cyanobacteria) comprised 4% of the coral cover. Transects were conducted at depths between 5.4-20.1 m, and no significant correlations between depth and bleached coral were observed. During the next scheduled monitoring in April 2006, bleached corals were observed but in much reduced frequency and severity, and turf algae cover increased significantly. Limited information currently exists on the recovery periods of bleached corals as well as the spatial extent, causative factors, and the overall impact of bleaching on coral reef ecosystems. If mass bleaching events are to reoccur with increasing frequency, then coral reef managers will need as much information as possible to better understand bleaching and to determine the best options for managing these resources.

**Keywords:** coral bleaching, St. Croix, coral monitoring, resource management

## **WHAT'S IN A FORM? DECIPHERING MESSAGES FROM THE MORPHOLOGIES AND GROWTH PATTERNS OF *HALIMEDA* AND *DICTYOTA***

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The growth patterns of macroalgae in three-dimensional space can provide important information regarding the environments in which they live, and insights into changes that may occur when those environments change due to anthropogenic and/or natural causes. To decipher these patterns and their attendant mechanisms and influencing factors, a spatially-explicit model has been developed. Using the model SPREAD (SPatially-explicit REef Algae Dynamics), which incorporates the key morphogenetic characteristics of clonality and morphological plasticity, the influences of light, temperature, nutrients and disturbance on how the dominant macroalgae in the Florida Reef Tract grow and occupy space are investigated. The model species, *Halimeda* and *Dictyota* spp. are modular organisms, with an "individual" being made up of repeating structures. These species can also propagate asexually through clonal fragmentation. These traits lead to potentially indefinite growth and plastic morphology that can respond to environmental conditions in various ways. The growth of an individual is modeled as the iteration of discrete macroalgal modules whose dynamics are affected by the light, temperature, and nutrient regimes. Fragmentation is included as a source of asexual reproduction and/or mortality. Model outputs are the same metrics that are obtained in the field, thus allowing for easy comparison. The vertical and horizontal growth form and patterns of *Halimeda tuna*, *H. opuntia*, and *Dictyota* sp. under varying environmental conditions are presented and compared to those found in independent field sites in the Florida Reef Tract. These mosaics of experiments and scenario-running in models have enabled us to tease out potential mechanisms and factors responsible for the growth patterns observed in reality.

**Keywords:** macroalgae, agent-based modeling, growth patterns, Florida Keys

## FISH MESOGRAZERS AS ECOLOGICAL GATEKEEPERS OF CORAL REEF COMMUNITIES

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Predation (grazing) plays a critical role in the structure and function of coral reef communities. In general attention on fish has focused on the keystone role of large-sized (apex) predators as sharks and groupers. In this report we present observational and anecdotal evidence that fish mesograzers (i.e. intermediate-sized fish about 15 cm long) also play a critical role in the ecology of coral reefs. Mesograzers include various parrotfish (Scaridae), wrasse (Labridae) and surgeonfish (Acanthuridae) species that feed on relatively small prey. We describe mesograzers as gatekeepers in the sense that they control the entry of small (newly recruited) prey individuals into coral reefs. In contrast, larger keystone predators control the “post entry” abundances of larger sized prey. The difference in prey sizes of keystone and gatekeeper species is important because many prey species enjoy a refuge in size from predators/grazers. Larger prey individuals with chemical or structural defenses would be unaffected by keystone species but would be vulnerable to gatekeepers when small and inconspicuous. As a result the suite of prey species controlled by gatekeepers and keystone predators differs to some degree. The difference in prey species controlled by gatekeeper and keystone species is probably best exemplified by members of the fouling community which are often found on artificial substrates (ship wrecks, buoy lines, etc.) but are usually absent or rare in coral reefs. Such species include the octocoral *Carijoa (Telesto) reesei*, the sponge *Tedania ignis*, the tunicate *Ascidea nigra* and the anemone *Aiptasia tagetes*. We believe that gatekeepers play a key role in various aspects of coral reef ecology including (1) biofouling in mariculture operations, (2) coral reef restoration, (3) invasive species, (3) alternative stable points, and (4) species succession.

**Keywords:** Gatekeeper species, keystone species, predation/grazing, fouling community

## TAXONOMY, DEPTH DISTRIBUTION AND CORAL OVERGROWTH OF ENCRUSTING OCTOCORALS IN A CORAL REEF OF THE PARQUE NACIONAL ARCHIPIÉLAGO DE LOS ROQUES, VENEZUELA.

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Encrusting octocorals (Cnidaria: Octocorallia) are considered highly competitive organisms. The overgrowth is the main competitive mechanism of encrusting octocorals. The borders of their colonies are often in close contact with many other organisms of the reefs, which compete for space. The distribution of encrusting octocorals that overgrowth corals in the reef of Dos Mosquises Sur (Los Roques, Venezuela) was evaluated. For this, along perpendicular transect lines between 4 to 30 m. deep, the presence and depth of each encrusting octocoral was registered. Since the difficulties to identify these gorgonians species “in situ”, small samples of the colonies were collected and examined microscopically at the laboratory using the Bayer’s (1961) Key for their identification. The gorgonians external morphology (number of polyps/unit area, distance between calyx, coloration, texture, thickness of cortex and medulla) and spicules characteristics (form, coloration, wide, long) were registered. The 70 % of the samples was identified as *Erythropodium caribaeorum* (Anthothelidae) and 30 % as *Briareum polyanthes* (Briareidae). *E. caribaeorum* has a wider distribution in the reef (between 4 and 29 m.) while *Briareum* was only distributed until 8 m. deep. The main coral species overgrewed by these gorgonians were *Montastrea annularis* and *Madracis mirabilis* on the shallower depths (>8m.) and *Stephanocoenia intersepta* at deeper reef zones. Only differences in the measures of the skeletal elements were found, with spicules at shallower reef zones being wider and longer for both families of gorgonians. This pattern could be the result of the prevalent strongest currents on the shallow areas of the reef. The higher frequency of occurrence and wider distribution of *E. caribaeorum* along depth found in this study, suggest this octocoral, play an important role in the competitive interactions in Dos Mosquises Sur reef. Further studies of the biology, ecology and interaction with corals of this encrusting gorgonian must be done.

**Keywords:** encrusting octocorals, coral scleractinians, overgrowth, taxonomy, depth distribution

## A NEW TOWED PLATFORM FOR SURVEYING BENTHIC HABITATS

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Maps of coral ecosystems are needed to support many conservation and management objectives, as well as research activities. Examples include ground-truthing aerial and satellite imagery, characterizing essential habitat, assessing changes, and monitoring the progress of restoration efforts. To address some of these needs, the U.S. Geological Survey developed the Along-Track Reef Imaging System (ATRIS), a boat-based sensor package for mapping shallow water benthic environments. ATRIS consists of a digital still camera, a video camera, and an acoustic depth sounder affixed to a moveable pole. This design, however, restricts its deployment to clear waters less than 10-m deep. To overcome this limitation, a towed version has been developed, referred to as Deep ATRIS. The system is based on a light-weight, computer-controlled towed vehicle that is capable of following a programmed diving profile. The vehicle is ~1-m long with a ~60-cm wing span and can carry a wide variety of research instruments, including CTDs, fluorometers, transmissometers, and cameras. Deep ATRIS is currently equipped with a high-speed (20 frames/s) digital camera, custom-built LED lights, and a nadir-looking altimeter. The vehicle dynamically adjusts its altitude to maintain a 2-m height above the seafloor. The camera has a 28° field-of-view and captures color images that are 1360 x 1024 pixels in size, covering a 1.04-m x 0.78-m area. GPS coordinates are recorded for each image. A gigabit ethernet connection enables the images to be displayed and archived in real-time on the surface computer. Deep ATRIS has maximum tow speed of 5 knots and an operating depth limit of 30-m. With an improved tow cable, the operating depth can be extended to 100-m. Here, we present results from the initial sea trials in Tampa Bay, Florida, USA, and discuss the utility of Deep ATRIS in mapping coral reef habitats.

**Keywords:** Habitat mapping, digital imagery, benthic surveys

## A NOVEL APPLICATION OF POLYCLONAL ANTIBODIES TO *IN SITU* DETECTION OF THE LARVAE OF *ACROPORA PALMATA* (ORDER: SCLERACTINIA, FAMILY: ACROPORIDAE)

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One of the central interests in marine ecology is to assess the connectivity among populations; the proportion of larvae or propagules that migrate from one population to the other as well as the identification of potential sources for these propagules. Addressing such questions for reef corals is difficult because direct estimation of the number of coral larvae exchanged among populations after spawning is almost impossible. A new application of ELISA (Enzyme-Linked Immunosorbant Assay) is presented here as a feasible and reliable technique to detect coral larvae (*Acropora palmata*) in plankton samples. Plankton samples were collected daily over nine days including pre-spawning, spawning and post spawning days (August 10<sup>th</sup>-18<sup>th</sup>, 2006) from a number of sites offshore of La Parguera, Puerto Rico. Immunoassays were performed on each sample using antibodies generated by injecting crude extracts of *A. palmata* larvae into rabbits. The threshold for detection (sensitivity of the technique) was 3 larvae per 5 min plankton tow. Few larvae were detected in the samples collected prior to spawning (August 10<sup>th</sup>-11<sup>th</sup>). The highest numbers of larvae were detected on August 14<sup>th</sup>, 15<sup>th</sup> and 16<sup>th</sup> (spawning dates); lower numbers were also detected near some reefs on post-spawn dates. In La Parguera, currents normally flow from east to west which helps explain the following results: 1) only a few larvae were detected in the eastern samples, and there are few *A. palmata* populations upstream of La Parguera; 2) reef sites with more larvae were detected in western-most locations near sites with the largest populations of *A. palmata* (Margarita and Media Luna). These data suggest that this ELISA assay will be useful for tracking the movements of planktonic coral larvae and for assessing connectivity between reefs.

**Keywords:** coral larvae, *Acropora palmata*, ELISA immunoassay, polyclonal antibodies