



MANAGEMENT THERMAL
 RECOVERY MANGROVE STRUCTURE ACROPORA VENEZUELA FLORIDA COMMUNITY INDICATORS ECOSYSTEM
 PUERTO RICO CHANGE ERICO REGENERATION REEF INTERACTIONS DATA SECURITY
 WHITE RESERVE COMMUNITY BAND
 CYTOCHROME TESTUDINIUM DIVERSITY RESTORATION LIONFISH ECOSYSTEMS BEHAVIOR
 BLEACHING PREGNANCY SPONGE REHABILITATION HYDRODYNAMICS
 BIOSPHERE GOVERNANCE DISEASE

AMLC

ASSOCIATION OF MARINE LABORATORIES OF THE CARIBBEAN. BIENNIAL CONFERENCE CURACAO MAY 18-22, 2015

ORBICELLA SPECIES POPULATION EFFECTS CONNECTIVITY BLACK BENTHIC MESOPHOTIC HERBIVORY FISH
 INVASIVE COMMUNITIES SEDIMENTATION POISONING CERVICORNIS PROTECTED
 PLACQUE SPATIAL PHYSIOLOGY ALGAE CORAL CLIMATE PALMATE PTEROIS MICROBIOME

REEF REEF CONSERVATION MACROALGAE COASTAL
 VOLITANS FISHERIES ECOLOGY ZOOXANTHELLAE ACIDIFICATION ENDANGERED CIGUATERA DISTRIBUTION THALASSIA
 HEALTH CARIBBEAN VIRGIN ISLANDS STROMBUS SUCCESSION



PROGRAM: Overview of oral and poster presentations

MAY 17		
17:00	Registration (optional) and "ice breaker" on the beach at Carmabi	
END of DAY 0 (MAY 17)		
MAY 18		
8:00	Registration at the Hilton Hotel	
9:00	Official opening 37th AMLC Meeting	
9:30	PLENARY: DR. B. STENECK	The Eastern Caribbean: A laboratory for studying the resilience and management of coral reefs
10:30	Coffee break	
Time	Authors	Title
11:00	* <u>Lapointe B</u> , Herren L, Tarnowski, M, Dustan P	Shifting baselines: three decades of nitrogen enrichment on two Caribbean coral reefs
11:15	S <u>Camacho R</u> , Steneck R	Finding a new path towards reef conservation: Antigua's community-based no-take reserves
11:30	* <u>Lyons P</u> , Arboleda E, Benkwitt C, Davis B, Gleason M, Howe C, Mathe J, Middleton J, Sikowitz N, Untersteggaber L, Villalobos S	The effect of recreational scuba diving on the benthic community assemblage and structural complexity of Caribbean coral reefs
11:45	* <u>De Goeij JM</u>	Perspective on how fast and efficient sponge engines drive and modulate the food web of reef ecosystems
12:00	S <u>Dungan A</u> , Hall ER, DeGroot BC, Fine M	Lesion recovery of two scleractinian corals under low pH: implications for restoration efforts
12:15	* <u>Palmer SE</u> , Lang JC	The status of coral reefs and marine fisheries in Jamaica's Portland Bight Protected Area to inform proposed development decisions
12:30	Lunch (can be obtained at the Hilton, Carmabi (next to Hilton) or nearby restaurants and bars	
13:30	* <u>Mancera-Pineda JE</u> , Celis JS, Gavio B	Historical analysis of ciguatera incidence in the Caribbean islands during 31 years: 1980-2010
13:45	* <u>Smith TB</u> , Richlen ML, Robertson A, Liefer JD, Anderson DM, Morris Jr. JG, Parsons ML	Ciguatera fish poisoning: long-term dynamics of <i>Gambierdiscus</i> spp. on coral reefs in St. Thomas, US Virgin Islands
14:00	* <u>Parsons ML</u> , Richlen ML, Pitz K, Anderson DM, Ellsworth A, Leynse AK, Brandt A	How can the benthic behavior of <i>Gambierdiscus</i> influence ciguatera monitoring efforts?
14:15	* <u>Litaker W</u> , Holland W, Hardison R, McCall J, Elliott E, Bourdelais A, Baden D, Morris J, Tester P	Ciguatoxin concentrations in Caribbean lionfish
14:30	* <u>Tester PA</u>	How climate change is expected to affect ciguatera poisoning in the Caribbean
14:45	* <u>Suddleson M</u> , Magnien R, Dowgiallo M	Advancing research and management of ciguatera fish poisoning and related harmful algae in the United States and globally
15:00	Coffee break	
15:30	* <u>Kongler P</u> , Hammel J, Chua CM, Dries R, Jansson F, Leggat W, Kaandorp J	Quantitative 3D micro-CT analysis of <i>Acropora millepora</i> larvae from different developmental stages in future CO2 levels
15:45	S <u>Barreras RR</u> , Cabanillas-Terán N, Cuevas E, Sabat AM	Assimilative omnivory displayed by the sea urchin <i>Diadema antillarum</i> in the northeastern Caribbean
16:00	* <u>Bradley P</u> , Santavy DL, Gerritsen J, Jackson SK	Developing a biological condition gradient for the protection of Puerto Rico's coral reefs
16:15	S <u>Kindinger TL</u> , Albins MA, Hixon MA	Consumptive and non-consumptive effects of invasive lionfish on native herbivores: potential consequences for ecological resilience of coral reefs
16:30	* <u>Tewfik A</u> , Burns V, Gibson J	A comparison of fisheries-based and independent monitoring data at Glover's Reef Marine Reserve
16:45	* <u>Roye C</u> , Trench C, Hall K	A case study of ecological restoration in Portland cottage, Jamaica - is mangrove restoration worth the trouble?
17:00	* <u>Johnson A</u>	Science-based, Community-driven ocean management: The Blue Halo Initiative
17:30	Happy Hour (till 20h00) and Poster sessions at Carmabi	
END of DAY 1 (MAY 18)		

MAY 19				
8:30	Session chair: Jorge Cortez		* <u>Moulding AL</u> , Moore JA Recovery plan for elkhorn and staghorn corals	
8:45			* <u>Nemeth RS</u> , Armstrong RA, Singh H, García-Moliner G, Blondeau J, Kadison E, Herzlieb S, Whiteman E Characterizing mesophotic coral reef benthic communities: a comparative analysis of seabed Autonomous Underwater Vehicle (AUV) and scuba diver operated video camera	
9:00		S	<u>Randall CJ</u> , Van Woesik R Thermal stress and coral diseases in the Caribbean	
9:15			* <u>Yates KK</u> , Rogers CS, Herlan JJ, Brooks GR, Smiley NA, Larson RA Diverse coral communities in mangrove habitats suggest a novel refuge from climate change	
9:30		S	<u>Montilla LM</u> , Ramos R, Croquer A Enzymatic responses against anthracene are compromised in yellow band disease tissues of the reef-building species <i>Orbicella faveolata</i>	
9:45			* <u>Hackerott S</u> , Valdivia A, Cox CE, Bruno JF Low lionfish, no problem? The effect of lionfish on reef fish communities along the Mesoamerican barrier reef in Belize	
10:00	Coffee break			
10:30	PLENARY: DR. J. SANCHEZ		Ecological divergence and the fate of coral reefs	
11:30	Session chair: Jorge Cortez	S	<u>Duran A</u> , Burkepille DE, Collado-Vides L Herbivory and structural complexity as drivers of algal dynamics on a coral reef	
11:45		S	<u>Shantz AA</u> , Ladd MC, Shrack E, Burkepille DE Fish-derived nutrient hotspots shape coral reef benthic communities	
12:00			* <u>Cover M</u> , Marin O, Croquer A Effects of heat stress treatments on photosynthetic efficiency in healthy and yellow band disease tissues in the coral <i>Orbicella faveolata</i>	
12:15			* <u>Zawada DG</u> , Yates KK, Kellogg CA An integrated study of a reefscape in the Florida Keys	
12:30	Lunch (can be obtained at the Hilton, Carmabi (next to Hilton) or nearby restaurants and bars)			
13:30	Session chair: Aarom O'Dea	Special session: Historical ecology	* <u>Jackson J</u> Historical perspective, global change, and the adaptive management of Caribbean coral reefs	
13:45			S	<u>Binder B</u> , Boswell K, Taylor C Integrating local knowledge with fisheries technology to study fish spawning aggregations in south Florida
14:00				* <u>Cortés J</u> History of coral reef research in Latin America: the importance of local scientific communities for conservation
14:15				* <u>Cramer K</u> , Norris R, O'Dea A Reconstructing historical change in Caribbean reef ecosystems to pinpoint mechanisms of recent reef decline
14:30				* <u>Norris RD</u> , Trumbo S, cramer K, O'Dea A Fish teeth as an ecosystem proxy: biodiversity and productivity of the ancient Caribbean
14:45				* <u>O'Dea A</u> Size selective evolution in the Caribbean conch <i>Strombus pugilis</i>
15:00	Coffee break			
15:30	Session chair: Tali Vardi	S	<u>Aldana Aranda D</u> , Enríquez Díaz M, Paris- Limouzy CB Larvae behavior of queen conch, <i>Strombus gigas</i> in function of moon phases and depth	
15:45			* <u>Estep A</u> Ecological assessment and benthic mapping inform development of new coastal regulations in Barbuda	
16:00		S	<u>Agudo-Adriani E</u> , Cappelletto J, Cavada F, Croquer A Geometry of patches of the endangered species <i>Acropora cervicornis</i> explains the structure of their associated fish assemblages	
16:15		S	<u>Correia KB</u> , Gilliam DS Outplant success of nursery reared staghorn coral: spawning observations and fecundity	
16:30			* <u>Deutekom ES</u> , Dries RM, Allemand D, Kaandorp JA Spatial scleractinian coral calcification model	
16:45		S	<u>Benkwitt CE</u> , Hixon MA Movement and ecological effects of invasive lionfish across multiple habitats	
17:30	Happy Hour (till 20h00) and Poster sessions at Carmabi			
END of DAY 2 (MAY 19)				

MAY 20 DAY OFF AND/ OR FIELDTRIPS

Fieldtrip options

- [1] Diving. Please visit the AMLC webpage overviewing the possibilities (incl. diving at Eastpoint) for diving on Curaçao during the AMLC meeting.
- [2] Geological tour around the island with David Meyer and Leon Pors
- [3] Visit the Christoffel Park, the largest national park on Curaçao, and the Savonet Museum.
- [4] Dive Curaçao's deep reefs (320m) in the Curasub.

For more details, see: <http://www.amlc-carib.org/meetings/2015.html>

END of DAY 3 (MAY 20)

MAY 21				
8:30	Session chair: Laurie Richardson		S <u>Harper JW</u> , Mozumder P	Investigating stakeholders' preferences for coral reef research funding in Florida
8:45			S <u>Brandtneris VW</u> , Brandt ME, Glynn PW, Gyory J, Smith TB	Seasonal variability in energy content is greater in mesophotic corals
9:00			* <u>Hammock J</u> , Schulz K	Data dissemination tools for organism attributes and new data records
9:15			S <u>Pratte ZA</u> , Richardson LL	A comparison of transcriptomes of two closely related scleractinian coral species and their differential response to stressors
9:30			* <u>Galvan VM</u>	Active restoration of the endangered, <i>Acropora cervicornis</i> corals in the Dominican Republic
9:45			S <u>Brown T</u> , Rodriguez-Lanetty M	Analysis of proteins involved in immunological memory in a basal metazoan, <i>Exaiptasia pallida</i>
10:00	Coffee break			
10:30	PLENARY: DR. S. SANDIN		The struggle for existence: How competition reigns, especially when predation abounds	
11:30	Session chair: Julie Belmont	Special session: GCRMN	* <u>Belmont J</u> , McField M	Improving and revitalizing the global coral reef monitoring network (GCRMN) for the wider Caribbean: new monitoring guidelines and network structure
11:45			* <u>Vardi T</u> , Moore J	Corals and the US endangered species act: the need to improve accessibility of Caribbean reef data
12:00			* <u>McField M</u> , Alvarez Filip L, Drysdale I, Rueda M, Pott R, Giro A	2015 Mesoamerican reef eco-health report card
12:15			* <u>Debels P</u>	Linking monitoring & evaluation of the state of the environment to enhanced arrangements for the governance of shared living marine resources
12:30	Lunch (can be obtained at the Hilton, Carmabi (next to Hilton) or nearby restaurants and bars			
13:30	Session chair: Julie Belmont		* <u>Lang JC</u> , Kramer PR, Marks KW, Kramer PA	Extending the AGRR vision to include Caribbean reef monitoring
13:45			<u>Vega Thurber R</u> , Burkepille DE, Zaneveld JR, Shantz AA, Pritchard CE, McMinds R, Payet J, Welsh R, Correa AMS, Lemoine NP, Rosales S, Fuchs C	Tracing the impacts of overfishing, eutrophication, and thermal stress on corals and their microbiomes
14:00			* <u>Burkepille DE</u> , Zaneveld JR, Shantz AA, Pritchard CE, McMinds R, Payet J, Welsh R, Correa AMS, Lemoine NP, Rosales S, Fuchs C, Vega Thurber R	Top-down and bottom-up forcing of coral-algal-microbial interactions
14:15			* <u>Kolijn D</u>	Effectiveness of a multipurpose artificial underwater structure as a coral reef canopy: hydrodynamic and ecological connectivity
14:30			* <u>Bergfelt DR</u> , West KL	Reproductive endocrinology during pregnancy and pregnancy loss in bottlenose dolphins (<i>Tursiops truncatus</i>)
14:45			* <u>Engelen AH</u> , Frade PR, Aires T, Baraka S, Serrão E, Pabon JT, Vermeij MJA	A new coral on curacaoan reefs, comparison with an old invader
15:00	Coffee break			
15:30	Session chair: Judy Lang		* <u>Williams DE</u> , Miller MW, Bright AJ, Paus RE	Impact of the 2014 bleaching event on upper Florida Keys (USA) <i>Acropora palmata</i>
15:45			* <u>Ruzicka R</u> , Gleason D, Fogarty N	Investigating how coral recruitment and juvenile survivorship varies along the Florida Reef Tract
16:00			S <u>Kabay LB</u> , Gilliam DS, Lunz KS, Neely KL	Reproductive capacity of the pillar coral, <i>Dendrogyra cylindrus</i> , along the Florida reef tract
16:15			S <u>Ladd MC</u> , Shantz AA, Bartels E, Burkepille DE	Genotypic diversity and identity influence restoration potential of the threatened coral species <i>Acropora cervicornis</i>
16:30			* <u>Hundley Jr. PL</u> , Vaughan DE	Aquatic mesocosm design for effective climate change research
16:45			* <u>Marhaver KL</u> , Medina MM, Vermeij MJA	Progress in coral settlement at CARMABI: New tools and new species
17:30	Happy Hour (till 20h00)			
18:30	Banquet on the beach and terrains at Carmabi			
END of DAY 4 (MAY 21)				

MAY 22				
8:30	Session chair: Pedro Frade		* <u>Sherman C</u> , Appeldoorn R	Geomorphology of mesophotic coral ecosystems in Puerto Rico and US Virgin Islands
8:45			S <u>Speare KE</u> , Bruno JF, Darling ES, Goodbody-Gringley G	Combined effects of sedimentation and seawater temperature on the growth and development of juvenile coral spat
9:00			* <u>Weil E</u> , Croquer A, Soto D, Flynn K, Lucas M	Temporal dynamics of diseases of the sea-fan <i>Gorgonia ventalina</i> in la Parguera, southwest coast of Puerto Rico
9:15			* Giraldo C, Mesa M, <u>Gavio B</u> , Galeano E	Population dynamics of <i>Thalassia testudinum</i> in San Andres island, southwestern Caribbean
9:30			* <u>Kaandorp JA</u> , Chindapol N, Vermeij MJA	Towards a multi-scale model of the impact of flow on growth and form of branching scleractinian corals
9:45			* <u>Cróquer A</u> , Cavada F, Zubillaga AL, Agudo E	Is <i>Acropora palmata</i> really coming back? An analysis from los Roques, Venezuela
10:00	Coffee break			
10:30	PLENARY: DR. N. KNOWLTON		Success Stories in Coral Reef Conservation	
11:30	Session chair: Pedro Frade	Special session: Microbes	* <u>Frade PR</u> , Schwaninger V, Glasl B, Sintes E, Hill RW, Simó R, Herndl GJ	Coral dimethylsulfoniopropionate: responses to light and stress, and interrelations with bacterial assemblages in surface mucus
11:45			S <u>Waikel PA</u> , Gillevet PM, Richardson LL	Potential role of dimethylsulfoniopropionate in structuring the black band disease community of corals
12:00			S <u>Bhedi CD</u> , Prevatte CW, Lookadoo MS, Campagna SR, Richardson LL	Effect of temperature on quorum sensing signal molecules in black band disease heterotrophs
12:15			* <u>Peters EC</u>	Caribbean Acroporid tissue loss: toward a new paradigm of coral disease
12:30	Lunch (can be obtained at the Hilton, Carmabi (next to Hilton) or nearby restaurants and bars			
13:30	Session chair: Tyler Smith		S <u>Williams LM</u> , Brandt ME	The impact of coral species diversity on White Plague Disease transmission
13:45			* <u>Came L</u> , Kaufman L	Strengthening reef resilience via active Acroporid restoration: can 8 years' of results in Belize be replicated in other replenishment zones?
14:00			* Eddy C, Smith SR, Pitt JM, Chequer AD, <u>Goodbody-Gringley G</u>	Distribution and abundance of the invasive lionfish along a depth gradient in Bermuda: identification of deep reef "hotspots"
14:15			S <u>Mueller B</u> , van Duyl FC, Vermeij MJA	Shedding light on dissolved organic carbon release by benthic reef algae
14:30			* <u>Brandt ME</u> , Smith TB, Clemens E, Sevier M	Disease in the deep: coral white plague in mesophotic coral ecosystems
14:45			* <u>Hughes T</u>	Herbivory, recruitment failure, and four decades of slow regime shifts on Jamaican coral reefs
15:00	Coffee break			
15:30	Session chair: Mark Vermeij		S <u>Chamberland VE</u> , Vermeij MJA, Petersen D	Sexual coral restoration: shortened nursing periods and new settlement substrates improve the effectiveness of restoration methodologies
15:45			* <u>Adam TC</u> , Kelley M, Ruttenberg BI, Burepile DE	Resource partitioning along multiple niche axes drives functional diversity in parrotfishes on Caribbean coral reefs
16:00			* <u>Archer SK</u> , Layman CA	Presence of a second foundation species alters seagrass ecosystem structure and function
16:15			* <u>van Tussenbroek BI</u> , Molina Hernández AL	Patch dynamics and species shifts in seagrass communities under moderate and high grazing pressure by sea-turtles
16:30			S <u>Welicky RL</u> , Sikkell PC	Infection by the parasitic isopod, <i>Anilocra haemuli</i> on french grunt (<i>Haemulon flavolineatum</i>) is associated with changes in host movement patterns
16:45			* <u>Eytan RI</u> , Hellberg ME, Dornburg A, Near TJ	Historical biogeography of recently diverged coral reef fish lineages
17:00	Official closing of 37th AMLC Meeting			
17:30	Happy Hour at Carmabi (till 20h00)			
END of DAY5 (MAY 22)				

Accepted Posters (to be put up at Carmabi Monday and Tuesday)

Aldana-Arana A, Muciño-Márquez RE, Sánchez-Crespo M, Hernández-Almeida OU, Figueroa-Torres MG	S	First record of epibiont diatom from larval stage of shellfish gastropod <i>Strombus gigas</i>
Barber K, Middlebrooks M, Pierce S	S	<i>Cyerce antillensis</i> is a small marine sacoglossan sea slug that feeds on and inhabits siphonous green macroalgae
Beasley V, Brant M	S	White pox prevalence and its relation to the human pathogen, <i>Serratia marcescens</i> , in the US Virgin Islands
Beasley V, Duggan A, Mitchell S, Williams L, Arencibia M, Brown J, Primack A, Wyllie-Echeverria S	S	Seagrass biome protection in the USVI: a conservation biology perspective
Beggs LD, Barber T, McFarlane J	*	Worldwide reef ball coastal restoration
Carne L, Cho-Ricketts L	*	No evidence of reduced growth rate trade-off for <i>Acropora cervicornis</i> harboring symbiodinium <i>trenchii</i> (clade d1a) in southern Belize
Costaregni AR, Walker BK, Waters L, Chen C	S	The "our Florida reefs coastal use survey": an online survey to support stakeholder management recommendations for southeast Florida
Cover M, Marin O, Croquer A	*	Yellow band disease disrupts coral-zooxanthellae mutualistic relationship in the coral <i>Orbicella faveolata</i>
Cruz M, Schizas N	S	Population Structure of fireworm <i>Hermodice carunculata</i> in the Caribbean, eastern Atlantic and Mediterranean Sea
Dennis MM, Stewart K, Bergfelt D	*	Environmental factors associated with hatch success in St Kitts leatherback sea turtles (<i>Dermochelys coriacea</i>)
Diaz MRE, Valencia JDCS, Morales GIM, Aranda DA	*	Gametogenesis and oocyte size variability in the oyster <i>Crassostrea virginica</i> (Gmelin) from Veracruz lagoons, Mexico
Dillon E, O'Dea A, Cramer K, Norris R	S	Reconstructing Caribbean shark baselines using fossil dermal denticle assemblages
Engelen AH, Coelho N, Vermeij MJA, Serrão E	*	Molecular tools for population ecology and genetics of the proliferating seaweed <i>Lobophora variegata</i>
Enríquez Díaz M, Martínez Morales I	*	Effect of climate change on reproductive strategies of the eastern oyster <i>Crassostrea virginica</i> in tropical lagoon of the Mexican Gulf of Mexico
Farrell F, Hansen J, Illanes O, Verma A, Soto E	*	Disruption of the pathogenicity determinant protein a gene (pdpa) in <i>f. Noatunensis</i> subsp. <i>orientalis</i> results in attenuation and a greater susceptibility to oxidative stress.
Fisco D, Walker B, Kilfoyle K, Smith S, Spieler R	S	Reef fish spatial distribution and benthic habitat associations on the northern Florida Reef Tract
Frade PR, Elisabeth NH, Hay KB, Englebert N, Latijnhouwers KRW, Bak RPM, Vermeij MJA, Herndl GJ, Hoegh-Guldberg O, Bongaerts P	*	A specialized coral-symbiodinium-bacteria community deep down on a Caribbean reef
Fuchs C, Adam TC, Duran A, Burkepille DE	S	Sediment removal increases turf algae grazing and alters algal community composition on coral reefs
García E, Baptista C, Bastidas C, Bone D, Brett C, Debrot D, Lopez A, Nieves Rivas K, Papadakis J, Ramos R, Strubinger P	S	Environmental risk assessment, monitoring and management program of Centro Refinador Paraguana, Venezuela
García E, Bone D, Cróquer A, Farache G, Ramos R, Zubillaga AL	S	Cetoxmar: seven years assessing the impacts of the Venezuelan oil/gas industry on marine ecosystems
Gavio B	*	Seaweed biodiversity in the international biosphere reserve Seaflower, southwestern Caribbean
Glasl B, Herndl GJ, Frade PR	S	Corals use mucus to garden their microbiome and stay healthy
Goulié C, Aranda DA	S	Determining the home range required by the queen conch in Xel-Ha inlet, Quintana Roo, Mexico
Gowacki WA, Bell SS, Pierce SK	*	Confusion in a redescription of a kleptoplastic slug: <i>Elysia patina</i> (marcus 1980) ortea et al. (2005) is really <i>Elysia papillosa</i> (verrill 1901)
Henry DJ, Trench C	*	Seagrass Stabilization: a technique for coastal zone rehabilitation
Horricks R, Herbinger C, Lumsden JS	S	Regeneration in the Caribbean star coral <i>Montastraea cavernosa</i>
Hynes M, Lukowiak M, O'Dea A, Norris R, Cramer K	S	Millennial-scale ecological change in Caribbean sponge communities
Keller J, Wilson K, Reeve A	*	Presence of heavy metals and seasonal changes in groundwater flow direction have management implications for mangroves near Bovoni landfill, St. Thomas, USVI
Larson EA, Gilliam DS	S	Storm driven mortality and the impact on natural and outplanted <i>Acropora cervicornis</i>
Lewis C, Neely K, Richardson LL, Rodriguez-Lanetty M	S	Black band disease in pillar coral along the Florida reef tract
Martinez SJ, Cavada F, Agudo E, Cappelletto J, Croquer A	S	Distribution range and health status of the threaten staghorn coral <i>Acropora cervicornis</i> at Los Roques National Park

Matterson K, Easson C, Thacker R	S	Variable impact of top-down forces and photosymbiont-derived nutrition on Caribbean shallow-water sponges
McCammon AM, Tuttle LJ, Loerch SM, Nemeth D, Williams Jr EH, Sikkil PC	S	Ichthyological survey of ectoparasites on coral reef fishes from the northeastern Caribbean
McLain H, Anderson, R, Morrall C, Balza R, Nimrod S, Berg C	S	Changes in percent coverage of "frame-building" versus "weedy" corals in Grenada's near shore waters
McCullough M, Foster K, Jacoby C	S	A soft spot for sea fans: a study of gorgonia spp. off Little Cayman island
McMinds R, Fuchs C, Zaneveld JR, Burkepille DE, Vega Thurber RL	S	Eutrophication and algal competition induce blooms of possible pathogens in the coral mucus microbiome
Middlebrooks M	*	Phototactic behavior in the photosynthetic sacoglossan sea slug <i>Elysia clarki</i>
Molina-Ureña H	*	Management of lionfish invasion in Costa Rica: an overview five years after
Montañez-Acuña AA, Otaño-Cruz A, Mercado- Molina A, Suleimán-Ramos SE, Hernández-Delgado EA	?	No-take MPAs benefit low-tech staghorn coral (<i>Acropora cervicornis</i>) rehabilitation efforts: a case study from Culebra island, Puerto Rico
Ortiz D, Villamizar E, Noriega N	?	Spatial distribution, density, size structure and feeding of <i>Oreaster reticulatus</i> (echinodermata: asteroidea) in an environmentally heterogeneous touristic area of the Venezuelan Caribbean
Otaño-Cruz A, Montañez-Acuña A, Hernández-Delgad EA	S	Spatial patterns of coral reef benthic community structure across a land-based source pollution gradient in Culebra island, Puerto Rico: a baseline for watershed management
Pelikan KC, Fogarty ND	S	Petroleum pollutants cause egg degradation, lowered fertilization, and larval viability in variegated sea urchin, <i>Lytechinus variegatus</i>
Petsche C, Edwards C, Eynaud Y, Smith J	S	Benthic competitors influencing coral competition and aggression interactions on Palmyra atoll
Pickering V, Lawrence M, Buckley L, Wyllie-Echeverria S	S	Seagrass cultivation for conservation
Pinheiro HT, Rocha LA, Jessup ME, Chequer AD, Goodbody-Gringley G	*	First in situ assessment of mesophotic reef fish communities in Bermuda, western Atlantic
Piotrowski S, Foster G, Manfrino C	S	<i>Acropora palmata</i> , proponent or inhibitor of reef resilience: evaluating the role of dead-standing skeletons in future projections of coral reef recovery
Ramírez-Ramírez RD, Montilla LM, Cavada-Blanco F, Cróquer A	S	Identification of strengths and weaknesses of cooperative efforts within the wider Caribbean using a network approach
Roper Z, Brito-Millan M, Sandin SA	S	Frequency of fission and fusion in colonies of <i>Madracis mirabilis</i>
Ruzicka R, Gleason D, Fogarty N	*	Investigating how coral recruitment and juvenile survivorship varies along the Florida Reef Tract
Suarez-Ulloa V, Gonzalez-Romero R, Eirin-Lopez JM	*	Environmental epigenetics: a promising venue for developing next-generation pollution biomonitoring tools in marine invertebrates
Thomas SL, Trench C, Webber M	*	Assessment of initial seedling growth and survival and natural seedling recruitment at a mangrove restoration site in west Falmouth, Trelawney, Jamaica.
Valencia JS, Diaz ME, Morales IM, Arand DA	S	Abundance, distribution and reproductive activity of large marine gastropods in different habitats along Campeche Bay, México
Vallès H, Oxenford HA	*	Do fishpot catches and underwater visual fish surveys tell the same story along a gradient of fishing pressure in a small Caribbean island?
Valles H, Oxenford HA, Brathwaite A, Roach R, Goodridge R, Warren-Gittens S	*	What saved the corals in 2010? A comparison of the two worst mass bleaching events in Barbados
Verde A, Bastidas C, Cróquer A	S	Comparison of linear mortality and tissue regeneration rates in three coral species affected by white band and Caribbean ciliate infections
Villaba M, Gil MG, Croquer A	S	Quantification of problems of the CARICOMP method to describe coral communities: impacts on statistical inference
Vroom P, Peters E, Lumsden J	S	Regeneration in corallimorpharia

Abstracts of oral presentations

5/18/15 11:00 AM

Shifting baselines: three decades of nitrogen enrichment on two Caribbean coral reefs

Lapointe B, Herren L, Tarnowski, M, Dustan P

Coral reefs in the wider Caribbean region have experienced dramatic ecosystem change over the past three decades. Coral disease and die-off, combined with expansion of benthic algae and sponges, have transformed reefs in many parts of the Caribbean, especially those adjacent to increasing human activities. Long-term water quality monitoring at Looe Key in the Florida Keys since 1984 showed significant (> 100%) increases in dissolved inorganic nitrogen (ammonium + nitrate + nitrite) and chlorophyll a in the 1990s following increased flows of agricultural runoff from the Everglades. The enhanced eutrophication correlated with reduced dissolved oxygen (hypoxia), dramatic increases in coral disease and die-off, and expansion of benthic algae (crustose coralline algae, algal turfs, and frondose macroalgae) despite abundant populations of large-bodied mobile grazers (scarids, acanthurids). The long-term nutrient data also revealed how periods with increased flows of nitrogen-rich (high N:P ratio) water from the Everglades were followed by intense mass bleaching events in 1987, 1997 and 2014. Similar replacement of corals with benthic algae (primarily macroalgae) has occurred at Discovery Bay, Jamaica, over the past three decades. Although this "phase-shift" on Jamaican reefs has been widely attributed to overfishing and die-off of the *Diadema antillarum*, a comparison of baseline tissue nitrogen in the brown macroalga *Lobophora variegata* from 1987 with a re-sampling in 2013 showed significant enrichment between depths of 2 to 36 m. Macroalgal blooms on Discovery Bay reefs have very high N:P ratios, pointing to the importance of submarine groundwater discharge as a pathway for nitrogen enrichment. Stable nitrogen isotope values in macroalgae from both Looe Key and Discovery Bay suggest that both sewage and fertilizers are contributing anthropogenic nitrogen to these habitats. These case studies illustrate how nitrogen-fueled eutrophication is inter-linked to loss of biodiversity on coral reefs along developing tropical and subtropical coastlines.

Keywords: coral, eutrophication, nitrogen, phosphorus, phytoplankton, macroalgae

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Finding a new path towards reef conservation: Antigua's community-based no-take reserves

Camacho R, Steneck R

Most Caribbean reefs have undergone a phase shift from coral-dominated to algal-dominated ecosystems over the last three decades. Persistent algal biomass prevents reef recovery and is the result of fisheries or disease induced reduction in herbivory from grazing fish and sea urchins (*Diadema antillarum*) respectively. No-take reserves with high compliance have more herbivorous fishes, less macroalgae and more juvenile and adult corals. However, most Caribbean no-take marine reserves have very low compliance. Antigua and Barbuda's reefs are highly degraded and the lack of governmental resources prevents effective top-down management. My study works to create a "community-based, co-managed" no-take reserve managed chiefly by the users of the resource, with support from regional organizations. The reserve is designed as a demonstration project to illustrate to the fishing community the positive effects of limiting fishing pressure on herbivorous fish. More than 50% of the fishermen utilizing the study area (n=10) were interviewed in July and August 2014 to gain information about the history and status of fishing. Eighty percent of respondents indicated fishing was declining with over 50% citing overfishing as the principal reason. Sixty percent of participants said fishing practices were not sustainable and 60% provided fisheries related management recommendations. Individual discussions sessions and a group meeting with the fishermen were held in August, at the end of which all participants verbally supported the creation of the reserve and buoys demarcating the area were installed. Atlantic Gulf Rapid Reef Assessment surveys were used to collect baseline data on the reserve and control areas and will monitor the effect that the reserve will have on the marine ecosystem. Time will tell if this form of user-based management is a durable way to create and maintain no-take reserves.

Durante las últimas tres décadas, la mayoría de los arrecifes de coral del Caribe han sufrido un cambio de estado desde ecosistemas de arrecifes dominados por coral a arrecifes dominados por algas. La biomasa de algas previene la recuperación de los arrecifes, la cual ha sido resultado de la reducción de pastoreo por parte de peces herbívoros o reducción en el número de erizos de mar (*Diadema antillarum*), inducidos por la pesca y enfermedades, respectivamente. Las reservas marinas sin capturas con alto nivel de cumplimiento poseen más peces herbívoros, menos macroalgas y más corales juveniles y adultos. Sin embargo, la mayoría de las reservas marinas sin captura del Caribe tienen un muy bajo nivel de cumplimiento. Los arrecifes de coral de Antigua y Barbuda están altamente degradados y no poseen recursos gubernamentales para un efectivo manejo arriba-abajo. Mi trabajo de investigación pretende crear una reserva sin captura con "co-manejo basado en la comunidad",

manejado principalmente por los usuarios de los recursos, con apoyo de organizaciones regionales. La reserva está diseñada como un proyecto de prueba para ilustrar a la comunidad de pescadores los efectos positivos de limitar la presión de pesca sobre peces herbívoros. Más del 50% de los pescadores que usan el área de estudio (n=10) fueron entrevistados entre Julio y Agosto de 2014 para recopilar información sobre la historia y estado de la pesca. Ochenta por ciento de los entrevistados indicaron que la pesca está disminuyendo, con más de 50% indicando como principal causa la sobrepesca. Sesenta por ciento de los participantes indicaron que las prácticas de pesca no eran sustentables y un 60% propuso recomendaciones al manejo pesquero. Las sesiones de discusiones individuales y reuniones grupales con pescadores fueron realizadas a fines de Agosto, al final de las cuales todos los participantes apoyaban verbalmente la creación de la reserva, para lo cual se instalaron boyas demarcando el área. Los estudios de la Evaluación Rápida de Arrecifes del Golf del Atlántico fueron usados para recolectar datos de línea base y áreas de control, y monitorearan los efectos que la reserva tendrá sobre el ecosistema marino. El tiempo dirá si este tipo de manejo basado en los usuarios es una forma duradera para crear y mantener reservas sin captura.

Keywords: Antigua, coral reefs, community-based management, herbivory

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The effect of recreational scuba diving on the benthic community assemblage and structural complexity of Caribbean coral reefs

Lyons P, Arboleda E, Benkwitt C, Davis B, Gleason M, Howe C, Mathe J, Middleton J, Sikowitz N, Untersteigaber L, Villalobos S

Recreational SCUBA divers have documented effects on various benthic organisms and these effects are often strong in areas of high diving traffic. Although the threat that recreational SCUBA diving poses to the long-term survival of coral reefs is probably secondary to global and regional stressors such as warmer seawater temperatures and overfishing, recreational SCUBA diving is probably much easier to manage. Most research on the effect of SCUBA divers has focused on broken and abraded benthic organisms or the rate at which divers contact the substrate. Here, we examine the structural complexity and the benthic community assemblage at pairs of high-diver traffic and low-diver traffic sites in Bonaire, an island that hosts approximately 40,000 divers per year. There was roughly 10% less structural complexity in high-diver traffic than low-diver traffic areas, which is alarming given that the rugosity of the shallow reefs of Bonaire has already been reduced by 43% since the late 1970s. Different functional groups of benthic organisms were differentially affected by high-diving traffic. For instance, massive

corals such as *Orbicella annularis* were 31% less abundant at high than low-diver traffic areas, while gorgonians and sponges had similar abundances at high and low diver traffic areas. Previous studies on the resistance and resilience of tropical benthic reef organisms to physical disturbances suggest that stony coral are more prone to physical damage than others. We provide a number of possible management strategies that could be used to reduce the effect of recreational SCUBA divers on Bonaire and elsewhere. In particular, strategies to concentrate diving traffic away from areas of high stony coral abundance and toward areas of high gorgonian and sponge abundance may alleviate the effects of SCUBA divers and thus aid in the persistence of coral reefs.

Keywords: SCUBA diving, benthic community, physical disturbance, rugosity, Bonaire

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Perspective on how fast and efficient sponge engines drive and modulate the food web of reef ecosystems

De Goeij JM

Coral reefs are iconic examples of biological hotspots, highly appreciated because of their ecosystem services. Yet reefs are threatened by human impact and climate change, highlighting the need to develop tools and strategies to curtail changes in these ecosystems. Remarkably, ever since Darwin's early descriptions of coral reefs, scientists still debate how one of the world's most productive and diverse ecosystems functions in the marine equivalent of a desert. The common view on how highly productive systems cope with oligotrophic conditions has changed completely with the discovery of the sponge loop. It emphasized the pivotal role of sponges as driving force for efficient and fast energy and nutrient cycling within these ecosystems. Current coral reef food web models lacking sponge-driven resource cycling are therefore incomplete. The important role of sponges on tropical coral reefs also sparks the interest whether such sponge engines are present in other ecosystems with dense sponge populations. In this perspective I will discuss a novel concept for sponge-driven food webs in reef ecosystems. To this end I will identify and describe critical knowledge gaps existing at both organismal and community scale. Sponges need to be evaluated on functional traits (e.g. morphology, associated microbes, pumping capacity) in the uptake of different dissolved and particulate organic matter sources. At the community scale, we need to assess to what extent these different traits are a driving force or 'engine' in structuring reef ecosystems, from fuel input (e.g. primary producers), to engine output (driving and modulating the consumer food web). The resulting framework derived from a Caribbean reef will be implemented in a sponge-driven food web model to test and predict different future scenarios of reef community development.

Keywords: Sponge physiology; coral reef ecology; sponge-microbe interactions; DOM-cycling; food-web model

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Lesion recovery of two scleractinian corals under low pH: implications for restoration efforts

Dungan A, Hall, ER, DeGroot BC, Fine M

Environmental stressors are affecting coral reef ecosystems at an ever increasing rate. Evidence has shown that skeletal growth, tissue growth, reproductive output, and lesion repair of scleractinian corals could be greatly affected by decreased oceanic pH. Many reef systems are already experiencing deterioration; and restoration efforts are currently taking place. Some restoration techniques entail cultivation of coral microfragments in land-based pools under controlled conditions until they reach viable size for outplanting onto the reef. However, there are gaps in knowledge that need to be addressed through experimental research to support these restoration efforts including effects of future climate scenarios on the regeneration rate of tissue lesions on different size fragments. To address this, different size fragments (1cm² and 25cm²) of *Porites porites* and *P. astreoides* were inflicted with lesions and incubated in two pH treatments to follow short-term effects on recovery. After 9 days, lesion regeneration occurred in both species. Lesion recovery rate was significantly reduced at pH 7.6 for *P. porites* in both fragment sizes; while recovery rates of *P. astreoides* was reduced only in the larger fragments. *Symbiodinium* density was lower in larger fragments of *P. porites* and *P. astreoides* and was not affected by pH in either coral species. Chlorophyll a concentrations were not affected by pH or fragment size in this short term study. Total protein of *P. porites* was lower with reduced pH treatment in both fragment sizes; however total protein of *P. astreoides* was higher with reduced pH. In summary, effects on lesion recovery rate from pH and fragment size were species specific. This may be related to morphology or energetic constraints. Hence, restoration efforts should focus on resilient species and the effective fragment size, taking into account future environmental pressures.

Keywords: Coral, lesion recovery, pH, zooxanthellae, microfragments, restoration

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The status of coral reefs and marine fisheries in Jamaica's Portland Bight Protected Area to inform proposed development decisions

Palmer SE, Lang JC

In August 2013 the Government of Jamaica released plans to establish a large transshipment port within the Portland Bight Protected Area (PBPA), Jamaica's largest protected area. As limited information was available on coral reef health and fishery resources within the PBPA, a rapid assessment of its corals, benthos, and fishes was carried out from July-December 2014 using the AGRRA protocols. The coral reefs are shallow (~6m depth), fore and patch reefs with moderate to high wave exposure and variable water clarity. Average live coral cover at 12 reef sites varied from 11-28% (overall mean = 19.5%), however there is considerable within-site variability. Coral communities were dominated by *Porites astreoides* (29%), in addition to *Siderastrea siderea*, *Orbicella annularis*, *Undaria agaricitis*, and *Orbicella faveolata*. Total macroalgal cover (fleshy and calcareous) ranged from 15-50% and crustose coralline algae from <1-23%, further demonstrating high between-site variability. Total fish biomass was very low (3647g/100m²) although fish density was remarkably high (142/100m²). The fish assemblage was 50% parrotfish (predominantly *Scarus iseri*), 22% grunts (primarily *Haemulon aurolineatum* and *Haemulon flavolineatum*), and 17% surgeonfishes (principally *Acanthurus coeruleus* and *Acanthurus tractus*). Fishes were extremely small and mostly juvenile (parrotfish mean size = 8cm; 2% >20cm; snapper mean size = 14.5cm; 0% >40cm). Although ~25km west of Kingston, Jamaica's largest city and national commercial/industrial hub, the PBPA reefs exhibit live coral cover slightly above recent regional averages, small patches of higher live coral cover (35%), and are home to several IUCN endangered species. Further, the mangroves within the proposed Goat Islands development area contain high densities of fish and function as critically important nursery areas. If development proceeds it is imperative that mitigation tactics be employed to minimise collateral damage to these nationally important marine habitats. This project was made possible by a Waitt Foundation ROC grant.

Keywords: Portland Bight Protected Area, Jamaica, coral reef health, reef fish assemblage, marine protected areas, coastal development

5/18/15 01:30 PM

Historical analysis of ciguatera incidence in the Caribbean islands during 31 years: 1980-2010

Mancera-Pineda JE, Celis JS, Gavio B

Ciguatera fish poisoning is a seafood-borne illness caused by the consumption of fish that have accumulated lipid-soluble ciguatoxins, produced by dinoflagellates of the genus *Gambierdiscus*, *Ostreopsis*, *Coolia* and *Prorocentrum*. The true extent of the disease and its impact on tourism and public health on the Caribbean Islands is poorly

understood. For this reason we analyze the incidence of ciguatera in the Caribbean states (CS) and San Andrés Island (SAI), looking for spatial and temporal trends. Through epidemiological reports obtained from CAREC (Caribbean Epidemiology Centre) and the Departmental Health Secretariat of San Andrés Island, has been calculated the per capita incidence of ciguatera in the period from 1980 to 2010 and from 2007 to 2011 for San Andres. Subsequently the data were analyzed using t tests, incidence rate ratio and rank correlation. The data showed that over the period 1980-2010 there were 10710 cases reported from 18 CAREC countries, with an average annual incidence of 42/100000. There was an increase between the periods 1980-1990 and 2000-2010, with an annual average calculated from reported cases of 34.2 and 45.2 / 100000 respectively. Montserrat presented the highest incidence in the region, 350 / 100000 and San Andres Island showed an incidence of 25/100000 inhabitants, reaching the eighth position among the analyzed islands. The rate ratio (average annual incidence 2000-2010 / average annual incidence 1980-1990) was 1.36, so there was a 32% increase in the average annual incidence among CAREC countries and almost 300% among the two time periods. The ciguatera incidence level in the Caribbean has increased over the last 31 years, with the Eastern Caribbean area with the highest incidence in the region. Considering that the development model of much of the region is based on the tourism industry and the fish is a major protein source for Caribbean communities, it can be concluded that ciguatera is a growing problem which is expected to increase in parallel with environmental change.

La ciguatera es una enfermedad causada por el consumo de peces que han acumulado ciguatoxinas liposolubles, producidas por dinoflagelados del género *Gambierdiscus*, *Ostreopsis*, *Coolia* y *Prorocentrum*. El verdadero alcance de la enfermedad y su impacto en el turismo y la salud pública es poco conocida. Por tal motivo, se analizó la incidencia de ciguatera en los estados insulares del Caribe (EIC) y en San Andrés Isla (SAI), en busca de tendencias espaciales y temporales. A través de los informes epidemiológicos obtenidos del Carec (Centro Epidemiológico del Caribe) y de la Secretaría de Salud Departamental de SAI, se calculó la incidencia per cápita de ciguatera en el período comprendido entre 1980 - 2010 para los EIC y 2007 - 2011 para SAI. Los datos fueron analizados mediante pruebas t, tasas de incidencia y análisis de ranking. Los resultados muestran que en el período 1980-2010 hubo 10710 casos registrados de 18 países del Carec, con una incidencia anual promedio del 42/100000. Asimismo, hubo un aumento entre los períodos 1980-1990 y 2000-2010, con un promedio anual calculado a partir de los casos reportados de 34.2 y 45.2 / 100000, respectivamente. Montserrat presentó la mayor incidencia en la región, 350/100000 y la isla de San Andrés presentó una incidencia de 25/100000 habitantes, ocupando el octavo lugar en comparación con las islas analizadas. La proporción de tasas para los países Carec (incidencia anual promedio de 2000 a 2010 / incidencia media anual de 1980 a 1990) fue de 1.36, por lo que hubo un aumento del 32% en la

incidencia anual promedio entre los países y casi el 300% entre los dos períodos de tiempo. El nivel de incidencia de ciguatera en el Caribe ha aumentado en los últimos 31 años, con el área del Caribe Oriental con mayor incidencia en la región. Teniendo en cuenta que el modelo de desarrollo de gran parte de la región se basa en la industria del turismo y el pescado es una fuente de proteínas importante para las comunidades del Caribe, se puede concluir que la ciguatera es un problema creciente que se espera que aumente de forma paralela a los cambios ambientales.

Keywords: Ciguatera, Caribbean, public health, San Andrés Island, resilience

5/18/15 01:45 PM

Ciguatera fish poisoning: long-term dynamics of *Gambierdiscus* spp. On coral reefs in St. Thomas, US Virgin Islands

Smith TB, Richlen ML, Robertson A, Liefer JD, Anderson DM, Morris Jr. JG, Parsons ML

The benthic dinoflagellate *Gambierdiscus* spp. creates the putative precursor toxins that ultimately lead to ciguatera fish poisoning (CFP); however, very little is known about the dynamics of natural populations of this genus on coral reefs and the dominant controls of their abundance and toxicity. This information is critical to the development of predictive models of whole reef toxicity and, hence, spatially explicit advice that minimizes CFP risk to sea-food consumers. We have examined quarterly to monthly changes in *Gambierdiscus* spp. abundance and cell-specific toxicity on natural (macroalgae) and artificial substrates from 2009 – 2015 on four long-term coral reef monitoring sites along the southern shelf of St. Thomas, an area hyperendemic for CFP. Along with *Gambierdiscus* spp. investigations, we collected environmental data (wind, waves, temperature, chlorophyll, nutrients, light) and biological data (benthic cover, coral health, algae heights, and fish communities). The abundance of *Gambierdiscus* spp. varied among and within years and showed dynamics that were both the same among sampling sites and decoupled. Multivariate analysis showed that *Gambierdiscus* abundance was most related to measures of benthic temperature. In addition, reef toxin loads from *Gambierdiscus* spp. showed variability among sites, with greater concentrations at offshore sites and from February to June. This project offers hope that proactive management of CFP from biological monitoring is possible.

Keywords: Ciguatera Fish Poisoning, *Gambierdiscus* spp., coral reef ecology, toxins

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How can the benthic behavior of *Gambierdiscus* influence ciguatera monitoring efforts?

Parsons ML, Richlen ML, Pitz K, Anderson DM, Ellsworth A, Leynse AK, Brandt A

Gambierdiscus is a genus of benthic dinoflagellates that contains some species capable of producing gambier-toxins, which are transferred to higher trophic levels via herbivory and predation. As the gambiertoxins move through the foodweb, they are biotransformed into ciguatoxins, which then biomagnify and bioaccumulate in higher trophic levels. People can then be exposed to the ciguatoxins (primarily through the ingestion of contaminated reef fish), resulting in ciguatera fish poisoning (CFP). CFP incidences often wax and wane over time, hypothetically in response to increases and decreases in *Gambierdiscus* densities, particularly those strains (species) capable of producing significant amounts of gambiertoxins. While researchers have studied the population dynamics of *Gambierdiscus* for some time, only recently have attempts been made to standardize sampling procedures and develop tools to more easily and accurately identify the various *Gambierdiscus* species present in the Greater Caribbean Region. The purpose of this talk is to present advances being made on these fronts over 3+ years of continuous field study, as well as challenges encountered over this time frame. In particular, data will be presented demonstrating how benthic behaviors (epiphytism and substrate preferences) differ among the various *Gambierdiscus* species, and how monitoring efforts need to account for these differences on spatial and temporal scales. The ultimate goal of these efforts will be to develop a flexible (yet standardized) monitoring protocol that can accommodate such variability in behavior while at the same time providing for an easy means to compare results across spatial and temporal scales.

Keywords: Ciguatera, Caribbean, Florida, *Gambierdiscus*, macroalgae, substrate

5/18/15 02:15 PM

Ciguatoxin Concentrations in Caribbean Lionfish

Litaker W, Holland W, Hardison R, McCall J, Elliott E, Bourdelais A, Baden D, Morris J, Tester P

With some notable exceptions, little is known about ciguatoxins (CTX) in Caribbean fishes or how CTX concentrations vary in different fish species. This study measured CTX in 163 lionfish collected from 11 locations throughout the Caribbean and off North Carolina. Lionfish were selected for this study because they are an invasive species causing widespread damage to reef ecosystems and Caribbean resource managers are interested in develop-

ing a fishery that could be used as an effective control strategy. However, a safe and effective control strategy depends on whether lionfish are more or less frequently toxic than other reef fish that are consumed by Caribbean subsistence fishers or harvested for commercial markets. This study adapted the fluorescent receptor binding assay (F-RBA) for brevetoxins developed by McCall et al. (2012; Harmful Algae 19:85-91) to measure CTX levels in lionfish. This adaptation works because both brevetoxins and ciguatoxins activate voltage-sensitive sodium channels in cell membranes. N2a cytotoxicity assays were also run for comparative purposes. Approximately 15% of the lionfish in this study were found to contain toxin levels above the FDA recommended limit of 0.1 ppb Caribbean C-CTX-1 equivalents when measured using the F-RBA. The N2a assays indicated a similar percentage of fish containing measurable CTX but estimated concentrations did not exceed the recommended 0.1 ppb safety level. In some locations none of the lionfish tested contained measurable CTX. The next steps will be to compare CTX levels in a wide variety of commonly consumed Caribbean reef fish to determine if they are more or less frequently toxic than lionfish from the same region. The results will be crucial in determining the extent to which development of a profitable lionfish fishery can be used to control this highly destructive invasive species.

Keywords: Lionfish, ciguatera, fishery management

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How climate change is expected to affect ciguatera poisoning in the Caribbean

Tester PA

Ciguatera fish poisoning (CFP) is a pantropical human health problem caused by the bioconcentration of algal toxins in marine food webs. The distribution and abundance of the toxin producing dinoflagellate genus *Gambierdiscus*, responsible for CFP, is positively correlated with water temperature. It is expected that climate induced changes will be reflected in the incidence rates of CFP as temperatures in the Caribbean Sea and Gulf of Mexico increase in coming decades. Historically, CFP has been most prevalent at relatively low latitudes (~35°N – 35°S) but recent evidence indicates some *Gambierdiscus* species also occur in subtropical-temperate locations. Currently, the highest CFP incidences in the Caribbean are reported from the eastern edge of the basin where water temperatures are stable and range between 26-30°C. As water temperatures increase, the areas where optimum *Gambierdiscus* growth can occur are expected to shift. This prediction has, in turn, lead to concerns that incidences of CFP may increase significantly, posing higher risks to human health. To better understand how rising water temperatures will affect the distribution of *Gambierdiscus* species in the Caribbean, we used published

Gambierdiscus growth rates in combination with projected water temperatures to model how the growth rates of five Caribbean species will change through the end of the 21st century. It is hypothesized these changes will include a northward progression of species formerly restricted to lower latitude environments and potentially, exclusion of some species where ocean temperatures exceed species-specific thermal tolerances.

Keywords: Ciguatera fish poisoning, *Gambierdiscus*, Climate change

5/18/15 02:45 PM

Advancing research and management of ciguatera fish poisoning and related harmful algae in the United States and globally

Suddleson M, Magnien R, Dowgiallo M

Ciguatera fish poisoning disease (CFP) is the most common form of algal toxin-induced seafood poisoning in the world, affecting tens of thousands of people annually. CFP outbreaks occur circumtropically, most heavily impacting island and coastal communities that depend upon reef fish for sustenance. However, outbreaks are found globally due to the worldwide distribution of many species in the seafood industry. NOAA's National Centers for Coastal Ocean Science, Center for Sponsored Coastal Ocean Research administers congressionally-authorized national harmful algal bloom (HAB) programs that fund competitive applied research in coastal waters under U.S. jurisdiction to promote greater understanding of HABs and develop means to mitigate their impacts on coastal ecosystems, human health, and economies in order to support informed, ecosystem-based management. NOAA is also engaged in international efforts to coordinate and cooperate on HAB research and management of global significance. CFP has long been an issue of concern for the U.S. and global HAB scientific communities, NOAA and partners such as the Intergovernmental Oceanographic Commission of UNESCO (IOC) and its member states are seeking to coordinate efforts in order to overcome some of the difficult challenges in mitigating CFP impacts world-wide. One major new initiative is the development of a coordinated Global Ciguatera Strategy to advance societally-important research. The purpose of this presentation is to provide context for the Status & Future of Ciguatera Research and Management of Ciguatera Fish Poisoning session that follows. Through it, NOAA and its partners seek to engage members of the AMLC to help identify research gaps and capacity building that will enable better assessment and prediction for CFP outbreaks and develop new technologies such as a test for the presence of ciguatoxin to help ensure more accessible and reliable safe access to marine resources.

Keywords: Ciguatera, Fish poisoning, HABs, Circumtrop-

ical, Research, Management

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Quantitative 3D micro-CT analysis of *Acropora millepora* larvae from different developmental stages in future CO2 levels

Konglerd P, Hammel J, Chua CM, Dries R, Jansson F, Leggat W, Kaandorp J

Ocean acidification may have a detrimental impact on the skeletogenesis of scleractinian corals. *Acropora millepora*, an extensively studied tropical coral species, is a great candidate for studying the micro-morphological changes in response to different environmental CO2 levels. Studying from its early-settlement stage is beneficial to keep track on the skeleton development responding to CO2 levels. To date, however, early skeletal formation in three dimensions has not been extensively studied due to the limitation of conventional imaging techniques. In this study, we quantified the properties and the morphological changes of the larvae of this species exposed to a range of CO2 levels during development by utilizing CT scans at micrometric scales to produce three-dimensional images. We then applied image-processing techniques to improve the quality of the images prior to quantitative measurements and analysis. These measurements included skeleton volume, surface area, porosity, solidity, height, thickness, fractal dimension, and particle size. Quantitative analysis showed no significant skeleton changes during development stages under different CO2 levels.

Keywords: None provided

5/18/15 03:45 PM

Assimilative omnivory displayed by the sea urchin *Diadema antillarum* in the northeastern Caribbean

Barreras RR, Cabanillas-Terán N, Cuevas E, Sabat AM

The sea urchin *Diadema antillarum* has been characterized as a generalist grazer; however, little is known about the species isotopic characterization, and its assimilation process in the Western Atlantic. The main goals of this study were to characterize the isotopic signatures of the sea urchin *D. antillarum*, its potential food resources, and determine the trophic position of *Diadema* using a stable isotopes approach. The study was conducted during February and October of 2013 at four shallow reefs of Puerto Rico Archipelago, where we collected samples of the sea urchins and its potential algal food resources. Temporal and spatial differences were not found on *D. antillarum* isotopic signatures of $\delta^{13}C$, but we found differences in

$\delta^{15}\text{N}$ among periods and collection sites. The Trophic enrichment factors (TEFs) ranged from 2.35 ± 0.11 to 3.24 ± 0.17 , and exhibited spatial and temporal significant differences. The lack of congruent polygons found in this study, and high TEFs reinforce the importance of invertebrates as potential resources of nitrogen. We conclude that our results support that *D. antillarum* must be considered an omnivore in terms of assimilation. Further studies, where invertebrates were included, will help to quantify the contribution of the whole food sources of *D. antillarum*.

Keywords: stable isotopes, omnivory, sea urchin, *Diadema antillarum*, Puerto Rico

5/18/15 04:00 PM

Developing a biological condition gradient for the protection of Puerto Rico's coral reefs

Bradley P. Santavy DL, Gerritsen J, Jackson SK

We introduce the application of the Biological Condition Gradient (BCG) to coral reefs: a conceptual model that describes how biological attributes of coral reef ecosystems might change along a gradient of increasing anthropogenic stress. Under authority of the Clean Water Act, the U.S. Environmental Protection Agency (EPA) is committed to protecting the biological integrity of the nation's waters, including marine coastal habitats such as mangroves, seagrasses and coral reefs. EPA has assembled a workgroup of 30 coral reef experts to develop the BCG for Puerto Rico's coral reefs. We anticipate that this BCG will be broadly applicable to Caribbean reefs, and that the process and framework can be transferred to other geographic regions. During a series of facilitated workshops and webinars these experts examined photos, videos and datasets to define ten attributes of reef condition. Each attribute provided information about the biological condition of a coral reef (including aspects of community structure, organism condition, and ecosystem function and connectivity). The experts used those attributes to define levels of biological condition along an anthropogenic stressor gradient, including a set of criteria to identify reference condition as a natural fully functioning system of reef organisms and communities. Results of this research include: 1) the BCG model for coral reef ecosystems, 2) a database of coral reef species for Puerto Rico and USVI that includes tolerances/sensitivities to various stressors, and 3) a publically available coral reef database for Puerto Rico and USVI survey data (residing on EPA's STORET Data Warehouse) that includes original data, a 'crosswalk' to move between data with different collection methods, and the final standardized data). Managers can use this BCG framework to: define biological expectations, interpret current condition of sites relative to management goals, track ecosystem responses to management actions and communicate environmental condition and outcomes to the public.

Keywords: Biological integrity, Clean Water Act, biological criteria, anthropogenic stressor gradient, biological condition

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Consumptive and non-consumptive effects of invasive lionfish on native herbivores: potential consequences for ecological resilience of coral reefs

Kindinger TL, Albins MA, Hixon MA

On Caribbean reefs, herbivorous fishes (especially parrotfishes) foster coral dominance by reducing the deleterious effects of benthic algae on corals. The voracious invasive lionfish (*Pterois volitans*) could reduce fish grazing via direct predation (i.e., "consumptive effects" or CEs) on native herbivorous fish populations, as well as by inhibiting native fish grazing behavior (i.e., "non-consumptive effects" or NCEs). We tested for invasive lionfish CEs and NCEs on native herbivorous fishes in the Bahamas. In June 2009, we manipulated lionfish density (low and high) on 10 paired large reefs. We surveyed fish populations and maintained lionfish treatments every 3-5 months thereafter. In July 2011, we quantified fish grazing behavior (visitation and bite rates) on algal-covered substrata placed in microhabitats differing in lionfish presence at the reef (low and high lionfish density) and within-reef scales (lionfish presence-absence in microhabitat). Lionfish significantly reduced the density of small herbivorous fishes by the end of the 2010 recruitment season (lionfish \times time interaction: LRT $P=0.002$). Lionfish also significantly decreased grazing behavior of small and large herbivorous fishes (all variables: LRT $P < 0.001$). As a result, lionfish indirectly reduced algal loss of substrata by 66-80%. Parrotfishes were driving the overall herbivorous fish community response, since it was the only herbivorous fish family affected by invasive lionfish CEs and NCEs. This study provides clear evidence of invasive lionfish having both CEs and NCEs on native herbivorous fishes, and strongly suggests lionfish NCEs are capable of diminishing the functional role of algal-removal via grazing by large herbivorous fishes. We suggest that invasive lionfish could have indirect effects on native benthic communities, whereby a lionfish-parrotfish-algae trophic cascade could potentially impair coral resilience on Atlantic reefs. We highlight the importance of long-term monitoring of native herbivorous fishes and benthic communities to detect acute and chronic impacts of this invasion.

En los arrecifes del Caribe, los peces herbívoros (especialmente Loros) fomentan la dominancia de coral mediante la reducción de los efectos nocivos de las algas bentónicas en los corales. El pez león invasor voraz (*Pterois volitans*) podría reducir el pastoreo de los peces a través de la depredación directa (es decir, "los efectos de consumo" o CES) sobre las poblaciones de peces herbívoros nativos, así como mediante la inhibición de la conducta de

pastoreo de peces nativos (es decir, “los efectos de no consumo” o NCE). Pusimos a prueba de CEs pez león invasoras y NCEs sobre peces herbívoros nativos en las Bahamas. En junio de 2009, manipulamos densidad pez león (baja y alta) en 10 grandes arrecifes pareadas. Se encuestó a las poblaciones de peces y mantuvimos tratamientos pez león cada 3-5 meses después. En julio de 2011, cuantificamos comportamiento de los peces de pastoreo (visitas y morder las tasas) sobre sustratos de algas cubiertas colocadas en microhábitats que difieren en la presencia del pez león en el arrecife (baja y alta densidad de peces león) y dentro de los arrecifes de escalas (pez león presencia-ausencia en microhábitats). Pez león redujo significativamente la densidad de pequeños peces herbívoros para el final de la temporada 2010 de reclutamiento (pez león × interacción en tiempo: LRT $P = 0.002$). El pez león también disminuyó significativamente el comportamiento en pastoreo de las pequeñas y grandes peces herbívoros (todas las variables: LRT $P < 0.001$). Como resultado, pez león reduce indirectamente la pérdida de algas de sustratos por 66-80%. Losoros conducían la respuesta global de la comunidad de peces herbívoros, ya que era la única familia de los peces herbívoros afectados por CEs pez león invasoras y NCEs. Este estudio proporciona evidencia clara de pez león invasor tener ambos CEs y NCEs sobre peces herbívoros nativos, y sugiere fuertemente NCEs pez león son capaces de disminuir el papel funcional de algas-eliminación a través de pastoreo de grandes peces herbívoros. Sugerimos que el pez león invasoras pueden tener efectos indirectos sobre las comunidades bentónicas nativas, por el que una cascada trófica de peces león-loro-algas potencialmente podría afectar la capacidad de recuperación de los arrecifes de coral del Atlántico. Destacamos la importancia de la vigilancia a largo plazo de los peces herbívoros nativos y las comunidades bentónicas de detectar impactos agudos y crónicos de esta invasión.

Keywords: predator-prey interactions, predation risk, antipredator behavior, trait-mediated indirect effects, trophic cascades, behavior

5/18/15 04:30 PM

A comparison of fisheries-based and independent monitoring data at Glover's Reef Marine Reserve

Tewfik A, Burns V, Gibson J

Marine reserves provide a critical tool within a broader ecosystem-based management agenda which often includes conservation of commercially targeted species. The ecological basis for conveying benefits of such a strategy to fisheries begins with the development of an optimal level of large, mature and highly fecund individuals within replenishment zones, which may allow: (1) net emigration of post-settlement animals ('spillover effect') and (2) net export of larvae ('recruitment effect'). Here we compare changes in population and community structure of

commercially fished species using catch data and in-water monitoring at Glover's Reef Marine Reserve over a seven year period (2007 – 2013). Queen conch (*Lobatus gigas*) and Spiny lobster (*Panulirus argus*) densities have increased both inside and outside the replenishment zone and changes in the fish community include increases of mixed predators (*Epinephelus striatus*), invertivores (*Lachnolaimus maximus*) and large herbivores (Parrotfish). However, despite a combination of replenishment zones, seasonal and permanent harvest prohibition, size limits and gear restrictions, variable patterns in catch per unit effort and unchanging or declining mean size and maturity of target species indicate some potential problems with monitoring strategies and compliance with regulations. Improvements in site type selection and surveillance strategies will enhance our understanding of ecological dynamics and impacts of management within the reserve.

Las reservas marinas constituyen una herramienta fundamental dentro de un programa de gestión basado en el ecosistema más amplio que a menudo incluye la conservación de las especies comercialmente dirigidas. La base ecológica para el transporte de los beneficios de una estrategia para las pesquerías, comienza con el desarrollo de un nivel óptimo de las personas grandes, maduros y muy fecundos dentro de las zonas de reposición, lo que puede permitir: (1) la emigración neta de los animales después de la liquidación (“efecto derrame”) y (2) la exportación neta de larvas (“efecto de la contratación”). Aquí comparamos los cambios en la población y la estructura de las comunidades de especies explotadas comercialmente a partir de datos de captura y monitoreo en el agua en la Reserva Marina de Glover Arrecife durante un período de siete años (2007-2013). Concha de la reina (*Lobatus gigas*) y la langosta común (*Panulirus argus*) densidades han aumentado tanto dentro como fuera de la zona de reposición y los cambios en la comunidad de peces incluyen incrementos de depredadores mixtos (*Epinephelus striatus*), invertivores (*Lachnolaimus maximus*) y grandes herbívoros (papagayo). Sin embargo, a pesar de una combinación de zonas de reposición, estacional y permanente prohibición de la cosecha, los límites de tamaño y restricciones de equipo, patrones variables en la captura por unidad de esfuerzo y que no cambia o disminución del tamaño de media y la madurez de las especies objetivo indicar algunos problemas potenciales con las estrategias de vigilancia y cumplimiento de la normativa. Las mejoras en las estrategias de selección y vigilancia de tipo sitio mejorarán nuestra comprensión de la dinámica y los impactos de la gestión dentro de la reserva ecológica.

Keywords: none provided

5/18/15 04:45 PM

A case study of ecological restoration in Portland cottage, Jamaica - is mangrove restoration worth the trouble?

Roye C, Trench C, Hall K

Jamaica has several towns and communities established within coastal Mangrove forests. Portland Cottage in the southern parish of Clarendon is one such community with a population showing varying levels of dependence on adjacent mangrove forests. The general area was hard hit by Hurricane Ivan (2004) which caused loss of human life, destruction of houses and the toppling of thousands of acres of mangrove trees. Extensive blocking of tidal channels occurred resulting in the slow die-off of over 50 hectares of mangrove, due to anoxic and hyper-saline conditions. In April 2012, the National Environment and Planning Agency with assistance from the UWI and EU funding embarked on the ecological restoration of 5 hectares of mangrove forest. This project sought to rehabilitate and ultimately restore the ecological character and functional capacity of the forest. Activities included the construction of tidal canals, planting of nursery grown saplings and collected propagules, and fencing to exclude grazing by goats. Project success was further enhanced by combining adaptive management techniques with intensive community involvement activities to train stakeholders and develop their skills in ecosystem monitoring. The twenty two (22) month monitoring recorded 40% survival of planted mangrove saplings, showing a 300% increase in mean height, and developed prop roots and/or pneumatophores. The number of volunteer seedlings increased by 350%. Transplanted and naturally recruited seedlings accounted for an impressive increase in overall seedling density of 21.19 seedlings per plot/m² from 8.29 per plot at time zero. A successful mangrove restoration requires more factors to be assessed than seedling survival and recruitment. However, the seedling survival in particular carries a heavy weighting in the evaluation process, as this indicates suitable tidal flow and hydrology in the transplant area. The almost two (2) year evaluation shows promising results for the ecological restoration approach in Jamaica.

Keywords: Mangrove rehabilitation, ecological restoration, Portland Cottage, Hurricane Ivan, NEPA, seedling recruitment

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Science-based, Community-driven ocean management: The Blue Halo Initiative

Johnson A

Successful management of ocean resources must be sup-

ported by the community, while being firmly grounded in science. The Waitt Institute's Blue Halo Initiative is based on that premise and takes the approach of partnering with governments and communities to envision, create, and implement sustainable ocean policies. For policy development in Barbuda (for the pilot project Blue Halo Barbuda), the most valuable data have been (a) historical ecology and anecdotes to combat shifting baselines, (b) socio-economic surveys to give policymakers political cover, (c) habitat maps and the participatory mapping software SeaSketch to enable stakeholders to consider ways to reach percent protection goals, (d) and heatmaps of fishing pressure so as to minimize displacement of fishers while maximizing conservation gains. For implementation and adaptive management, developing locally-run monitoring programs for reef ecosystems and fisheries landings will be key, as well as creation of a data management and visualization tool. Consistent outreach and distilling scientific information for the public is also key.

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Recovery plan for elkhorn and staghorn corals

Moulding AL, Moore JA

In 2006, elkhorn coral *Acropora palmata* and staghorn coral *A. cervicornis* were listed as threatened species under the United States Endangered Species Act (ESA), and in March 2015, NOAA Fisheries adopted a recovery plan for the two coral species. The recovery plan identifies a strategy for rebuilding and assuring the long-term viability of elkhorn and staghorn corals in the wild, allowing ultimately for the species' removal from the list of threatened and endangered species. The plan contains ten criteria which are targets by which to gauge species' recovery. The three population-based criteria provide a metric for abundance, genetic diversity, and recruitment; the seven threat-based criteria assess abatement of threats including disease, climate change, loss of habitat, land-based sources of pollution, predation, breakage, and inadequacy of regulatory mechanisms. Twenty-four actions, most with a number of associated sub-actions, provide direction for achieving the recovery criteria. The recovery actions include research and monitoring, reduction or elimination of threats and enhancement of the population by actively putting corals back on the reef. Removing elkhorn and staghorn corals from the list of threatened and endangered species can only occur if the species are recovered throughout their ranges. Thus, population abundance and trend information from the greater Caribbean is important for determining status of elkhorn and staghorn corals under the ESA. Although recovery plans are developed under U.S. law, the recovery plan for elkhorn and staghorn corals can be used as a guide for conservation of the species in other countries. Because threats to elkhorn and staghorn corals are both local and global in nature, recovery will require concerted effort on the part of domestic

and international communities.

Keywords: *Acropora palmata*, *Acropora cervicornis*, Endangered Species Act, recovery, management, coral

5/19/15 08:45 AM

Characterizing mesophotic coral reef benthic communities: a comparative analysis of seabed Autonomous Underwater Vehicle (AUV) and scuba diver operated video camera

Nemeth RS, Armstrong RA, Singh H, García-Moliner G, Blondeau J, Kadison E, Herzlieb S, Whiteman E

Mesophotic coral reefs can be extensive and potentially important components of tropical marine ecosystems. However, the depth limitations of conventional SCUBA and optical limits of satellite-based sensors have left reefs from intermediate depths (30 - 100 m) mostly unexplored. The use of advanced diving technology, remotely operated vehicles and the development of autonomous underwater vehicles provide greater accessibility to mesophotic reefs. Understanding the advantages and limitations of these various methods will help to drive technological developments and advance the study of mesophotic reefs. This paper describes a comparative analysis of four deep coral reef areas within the Red Hind Bank Marine Conservation District St. Thomas, US Virgin Islands which were surveyed with both a SeaBED autonomous underwater vehicle (AUV) and technical SCUBA diver operated digital video camera. Non-overlapping optical images of benthic habitats from 35 to 70 m depth were extracted from a single AUV transect per site which varied in length from 1 to 1.5 km. The AUV derived benthic data were compared to replicate 10 m SCUBA transects which ranged in depth from 35 to 40 m. Similarities in benthic composition included percent cover of scleractinian corals, sponges, bare substrata, and coral species diversity. Differences included percent cover of macro algae, crustose coralline algae, and gorgonians. Additional information was also extracted from transects and direct visual assessments including the condition of corals (percent bleaching and disease) and rugosity. Data from the two methods are compared and contrasted and the benefits and limitations of both discussed.

Arrecifes de coral Mesophotic pueden ser componentes extensos y potencialmente importantes de los ecosistemas marinos tropicales. Sin embargo, las limitaciones de profundidad de buceo convencional y límites ópticos de sensores satelitales han dejado arrecifes situados a profundidades intermedias (30 a 100 m) en su mayoría sin explorar. El uso de la tecnología de buceo avanzado, vehículos operados a control remoto y el desarrollo de vehículos autónomos submarinos proporcionan una mayor accesibilidad a mesophotic arrecifes. La comprensión de las ventajas y limitaciones de estos diversos métodos

ayudará a impulsar los avances tecnológicos y avanzar en el estudio de los arrecifes mesophotic. Este artículo describe un análisis comparativo de las cuatro áreas de arrecifes de coral de profundidad dentro de la Red Hind Banco Marina Distrito de Conservación de St. Thomas, Islas Vírgenes de los que fueron encuestados tanto con un vehículo autónomo submarino de los Fondos Marinos (AUV) y buzo técnico operado cámara de vídeo digital. Imágenes ópticas no acumulación de los hábitats bentónicos 35-70 m de profundidad fueron extraídos de un solo transecto AUV por sitio que variaba en longitud entre 1 y 1,5 kilómetros. Los datos bentónicos AUV derivados se compararon para replicar 10 m transectos SCUBA que iban en la profundidad de 35 a 40 m. Las similitudes en la composición del bentos incluyen el porcentaje de cobertura de corales, esponjas, escleractinios sustrato desnudo, y la diversidad de especies de coral. Las diferencias incluyen el porcentaje de cobertura de macroalgas, algas coralinas costrosas, y gorgonias. Información adicional también se extrajo de transectos y evaluaciones visuales directos, incluida la condición de los corales (porcentaje de blanqueo y de la enfermedad) y rugosidad. Los datos de los dos métodos se comparan y contrastan y los beneficios y limitaciones de ambos discutieron.

Keywords: Mesophotic reefs, coral reef assessment, remotely operated vehicles

5/19/15 09:00 AM

Thermal stress and coral diseases in the Caribbean

Randall CJ, Van Woesik R

Over the last half-century, new and emerging diseases have become a significant threat to the health of Caribbean corals, resulting in major declines in coral cover and in shifts in species composition. Since the earliest reported coral-disease outbreaks in the 1960s, researchers have been searching for key pathogens that cause coral diseases, yet many pathogens have remained elusive. Less attention has been given to the changing environment. Coral-disease outbreaks may be triggered by environmental stressors, such as high ocean temperatures, which weaken the corals' immune system or increase the virulence of pathogens. Ocean temperatures in the Caribbean, including minima, maxima, and rates of change, are all spatially and temporally heterogeneous. We recently found that locations that historically experienced frequent thermal anomalies (every 4–6 years) had a significantly higher risk of corals displaying white-sign diseases. We also found that rapid rates of increase in ocean temperatures, elevated thermal minima, and the breach of thermal maxima, were all strongly associated with locations supporting Caribbean acroporids with white-band disease. Together, these studies provide evidence that the frequency of thermal stress events, the magnitude of thermal maxima, and long-term rates of warming all interact to influence the prevalence of coral diseases in the Caribbean.

Desde la mitad del siglo pasado, enfermedades nuevas y emergentes, se han vuelto una amenaza significativa contra la salud de los corales del Caribe y han resultado en fuertes declives de la cobertura de coral y en cambios en la composición de especies. Desde las primeras epizootias de enfermedades de coral reportadas en los años 60s, los investigadores han estado buscando a los patógenos clave responsables de las enfermedades de coral, sin embargo, muchos patógenos han sido indeterminables. Menor atención se ha puesto al ambiente que está cambiando. Las epizootias de enfermedades de coral pueden ser disparadas por estresores ambientales, por ejemplo altas temperaturas del océano, los cuales debilitan el sistema inmune de los corales o incrementan la virulencia de los patógenos. Las temperaturas oceánicas en el Caribe, incluyendo máxima, mínima, y tasas de cambio, son heterogéneas tanto espacial como temporalmente. Recientemente encontramos que, en localidades que históricamente han experimentado anomalías térmicas frecuentes (cada 4-6 años), los corales tienen un riesgo significativamente mayor de tener signos blancos de enfermedad. También encontramos que, altas tasas de incremento en las temperaturas del océano, mínimos térmicos elevados y el exceder los máximos térmicos históricos estuvieron fuertemente asociadas a localidades Caribeñas con acropóridos con la enfermedad de la banda blanca. En conjunto, estos estudios aportan evidencia de que la frecuencia de eventos de estrés térmico, la magnitud del máximo térmico y las tasas a largo plazo de calentamiento, interactúan para influir en la prevalencia de enfermedades de coral en el Caribe.

Keywords: Coral diseases, thermal stress, climate change, Caribbean

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Diverse coral communities in mangrove habitats suggest a novel refuge from climate change

Yates KK, Rogers CS, Herlan JJ, Brooks GR, Smiley NA, Larson RA

Risk analyses indicate more than 90% of the world's reefs will be threatened by climate change and local anthropogenic impacts by the year 2030 under "business as usual" climate scenarios. Increasing temperatures and solar radiation cause coral bleaching that has resulted in extensive coral mortality. Increasing carbon dioxide reduces seawater pH, slows coral growth, and may cause loss of reef structure. Management strategies include establishment of marine protected areas where environmental conditions promote reef resiliency. However, few resilient reefs have been identified, and resiliency factors are poorly defined. We characterized the first natural, non-reef coral refuge from thermal stress and ocean acidification, and identified resiliency factors for mangrove-coral habitats. We measured diurnal and seasonal variations in tempera-

ture, salinity, photosynthetically-available radiation, and seawater chemistry; characterized substrate parameters; and examined water circulation patterns in mangrove communities where scleractinian corals are growing attached to and under mangrove prop roots in Hurricane Hole, St. John, US Virgin Islands. We inventoried coral species and quantified coral bleaching, mortality and recovery for two reef-building corals, *Colpophyllia natans* and *Diploria labyrinthiformis*, growing in mangrove-shaded and exposed (unshaded) areas. Over 30 species of scleractinian corals were growing in association with mangroves. Corals were thriving in low-light conditions from mangrove shading and at higher temperatures than nearby reef tract corals. A higher percentage of *C. natans* colonies were living shaded by mangroves, and no shaded colonies were bleached. Fewer *D. labyrinthiformis* colonies were shaded by mangroves, however more unshaded colonies were bleached. A combination of substrate and habitat heterogeneity, proximity of different habitat types, hydrographic conditions, and biological influences on seawater chemistry generate chemical conditions that buffer against ocean acidification. This previously undocumented refuge for corals provides evidence for potential adaptation of coastal organisms and ecosystem transition due to recent climate change.

Análisis de riesgo indican que más del 90% de los arrecifes del mundo se verán amenazados por el cambio climático y por los impactos antropogénicos locales para el año 2030 asumiendo ningún cambio en los escenarios climáticos. El aumento de temperaturas y radiación solar causa el blanqueamiento de los corales y como resultado su extensa mortalidad. El aumento de dióxido de carbono reduce el pH del agua de mar, disminuye el crecimiento de los corales y puede causar la pérdida de la estructura del arrecife. Estrategias de administración incluyen el establecimiento de áreas marinas protegidas donde las condiciones ambientales promuevan la sobrevivencia de los arrecifes. Sin embargo, algunos arrecifes sobrevivientes han sido identificados, pero los factores que determinan su sobrevivencia no han sido bien definidos. Nosotros caracterizamos el primer refugio natural de corales, no arrecife, definido por estrés termal y acidificación del océano, e identificamos factores de sobrevivencia para el hábitat de mangle-coral. Medimos variaciones diurnas y estacionales de temperatura, salinidad, radiación fotosintética disponible, la química del agua de mar; y la caracterización de parámetros de sustrato. También examinamos los patrones de circulación del agua en comunidades donde los corales escleractinio crecen pegados junto o en las raíces de los manglares durante el huracán Hole en San Juan, Islas Vírgines de los Estados Unidos. Estudiamos dos corales formadores de arrecife, *Colpophyllia natans* y *Diploria labyrinthiformis*, que crecieron en dos distintas áreas: expuestos a la sombra proveída por los manglares y sin sombra. De este estudio realizamos un inventario de las especies de corales y cuantificamos el blanqueado del coral, mortalidad y su recuperación. Como resultado más de 30 especies de corales escleractinio aumentaron en relación con los manglares. Los corales crecieron

saludablemente en condiciones de poca luz, debido a la sombra de los manglares y a temperaturas superiores en comparación a los corales de arrecife cercanos. Un mayor porcentaje de colonias *C. natans* vivían en la sombra que le proveían los manglares, por otra parte la colonia que no estaba expuesta a sombra presentaban blanqueado. Una menor cantidad de colonias *D. labyrinthiformis* estaban localizadas bajo la sombra de los manglares, pero de igual manera las colonias que no se encontraban en la sombra presentaron blanqueado. La combinación de sustrato y heterogeneidad en su hábitat, la proximidad de distintos tipos de hábitat, las condiciones hidrográficas, y las influencias biológicas sobre la química del agua de mar generan condiciones químicas que protegen contra la acidificación del océano. Este refugio de corales, que no había sido documentado, provee evidencia de la posibilidad de adaptación de los organismos costeros y de la transición del ecosistema debido al reciente cambio climático.

Keywords: Mangrove coral refuge climate acidification bleaching

5/19/15 09:30 AM

Enzymatic responses against anthracene are compromised in yellow band disease tissues of the reef-building species *Orbicella faveolata*

Montilla LM, Ramos R, Croquer A

The increasing prevalence of coral diseases represents an important threat for coral reef resilience, particularly when additional stressful environmental factors such as the input of pollutants are present. Despite coastal pollution and coral diseases might represent a serious threat to coral reef health; there is paucity of controlled experiments showing whether the response of diseased and healthy corals to xenobiotic exposition differs. In this study, we exposed healthy and yellow band disease (YBD)-affected *Orbicella faveolata* colonies to three sublethal concentrations of anthracene, a common aromatic polycyclic hydrocarbon, in order to test if enzymatic responses to this hydrocarbon were compromised in YBD colonies. For this, a two-factorial fully orthogonal design was used in a controlled condition laboratory bioassay, with condition (two levels: healthy and diseased) and concentration (four levels: experimental control, 10, 40 and 100 ppb concentration) as fixed factors. A permutation-based analysis of variance (PERMANOVA) was used to test the size effects of condition and concentration on the specific activity of three enzymatic biomarkers: catalase, glutathione-s transferase and glutathione peroxidase. We found a significant interaction between the concentration of anthracene and the colony condition for catalase (Pseudo-F=3.84, df = 3, p< 0.05) and glutathione-s transferase (Pseudo-F = 3.29, df = 3, p< 0.05). Moreover, our results indicated that the enzymatic response to anthracene in YBD-tissues is compromised for the activity of these enzymes decreased

1.5-4 folds compared to healthy tissues. This suggests that under a potential scenario of increasing hydrocarbon coastal pollution YBD- affected *O. faveolata* might be more vulnerable to the deleterious effects of this xenobiotic.

El incremento en la prevalencia de enfermedades coraliñas representa una amenaza importante para la resiliencia de los arrecifes de coral, particularmente cuando están presentes factores ambientales de estrés como la descarga de contaminantes. Aunque la contaminación costera y las enfermedades coraliñas podrían representar una amenaza seria para la salud de los arrecifes coraliños, existe una ausencia de experimentos controlados indicando si la respuesta de corales saludables y enfermos difiere. En este estudio expusimos colonias de *Orbicella faveolata* saludables e infectadas con enfermedad de banda amarilla (EBA) a tres concentraciones subletales de antraceno, un hidrocarburo aromático policíclico para evaluar si la respuesta enzimática a este hidrocarburo se ve comprometida en las colonias con EBA. Para esto se usó un diseño experimental completamente ortogonal de dos factores en un bioensayo de laboratorio bajo condiciones controladas, con condición (dos niveles: sano y enfermo) y concentración (cuatro niveles: control experimental, 10, 40 y 100 ppb) como factores fijos. Se usó un análisis de varianza basado en permutaciones para probar el tamaño de efecto de la condición y concentración en la actividad específica de tres biomarcadores enzimáticos: catalasa, glutatión-s-transferasa y glutatión peroxidasa. Encontramos una interacción significativa entre la concentración de antraceno y la condición de la colonia para la catalasa (Pseudo-F=3.84, df = 3, p< 0.05) y la glutatión-s-transferasa (Pseudo-F = 3.29, df = 3, p< 0.05). Nuestros resultados indicaron que la respuesta enzimática al antraceno en tejidos con EBA se ve comprometida ya que la actividad específica de estas enzimas disminuyó 1,5 -4 veces en comparación con el tejido saludable. Esto sugiere que bajo un escenario potencial de contaminación en aumento por hidrocarburos, *O. faveolata* con EBA podría ser más vulnerable a los efectos deletéreos de este xenobiotic

Keywords: Anthracene, yellow band disease, *Orbicella faveolata*, biomarkers, corals

5/19/15 09:45 AM

Low lionfish, no problem? The effect of lionfish on reef fish communities along the Mesoamerican barrier reef in Belize

Hackerott S, Valdivia A, Cox CE, Bruno JF

Invasive predators can cause declines in the abundance and diversity of native prey. Indo-Pacific lionfish are invasive generalist predators widely assumed to be negatively affecting Caribbean coral reef fishes. Small-scale experimental and observational studies suggest that invasive lionfish can reduce the abundance and diversity of small

native prey. In contrast, evidence from a small scale and controlled observational field study highlight that the presence of lionfish had no effect on reef fish communities. Whether or how lionfish affect populations and communities of native fishes at larger, management-relevant scales is unknown. Our goal was to assess the effect of lionfish on coral reef fish communities in a natural setting, across a complex reef system. We quantified native reef fish abundance, species richness, and community composition at sixteen reefs along ~250 km of the Mesoamerican Barrier Reef in Belize from 2009 to 2013. Our four year longitudinal study spanned the lionfish invasion of this region, thus our sampling included fish community structure before and after the invasion. Surprisingly, we found no evidence that lionfish have had a measurable effect on reef fish abundance, species richness, or community composition across this scale. It is possible that more time and/or higher lionfish densities are necessary for the effects of lionfish to become apparent at a large geographic scale.

Especies depredadoras invasoras pueden causar la disminución de la abundancia y diversidad de presas nativas. El pez león del Indo-Pacífico es un depredador generalista invasor que se asume que está afectando negativamente a los peces de arrecife de coral del Caribe. Estudios experimentales y observacionales a pequeña escala sugieren que el pez león puede reducir la abundancia y diversidad de las presas nativas pequeñas. Por el contrario, resultados obtenidos en otro estudio observacional a pequeña escala sugiere que la presencia del pez león no afecta las comunidades de peces de arrecife. Por lo tanto, es desconocido si el pez león puede afectar las poblaciones y comunidades nativas de peces de arrecife a escalas más importante para el manejo. Nuestro objetivo fue evaluar el efecto del pez león en las comunidades de peces de arrecifes en un entorno natural y en un sistema de arrecife complejo. En este estudio, se cuantificó la abundancia, riqueza de especies y composición de la comunidad de pece arrecifales en 16 sitios a lo largo de ~ 250 km en la barrera arrecifal mesoamericana de Belice desde 2009 hasta 2013. Nuestro estudio cubre la invasión del pez león en esta región, por lo que los muestreos incluyen la estructura de la comunidad de peces antes y después de la invasión. Sorprendentemente, no se encontró evidencia de que el pez león ha tenido un efecto detectable en la abundancia de peces de arrecife, la riqueza de especies, o la composición de la comunidad a esta escala. Es posible que más tiempo y / o densidades más altas de pez león sean necesarias para detectar efectos de pez león a esta escala geográfica a lo largo del Arrecife Mesoamericano en Belice.

Keywords: Coral reefs, community composition, species richness, lionfish, *Pterois volitans*, invasive predators

Herbivory and structural complexity as drivers of algal dynamics on a coral reef

Duran A, Burkepile DE, Collado-Vides L

Community dynamics of macroalgae on coral reefs are often driven by herbivory and, to lesser extent, abiotic factors such as nutrient loading. While the structural complexity of coral reefs is known to influence fish community composition, its impact on algal dynamics remains unclear. This study addressed the independent and combined effects of herbivory and structural complexity on algal community dynamics of a coral reef in the Florida Keys, USA. We manipulated substrate position, by creating horizontal and vertical substrate using limestone tiles as a proxy of reef structural complexity, combined with two levels of herbivory by fishes, open (present) and enclosure (absent). We tracked algal community composition in all four treatments for one year. On horizontal tiles, exclusion of herbivores led to a successional sequence of early colonizing filamentous and turf forming species being replaced by foliose species, with articulated calcareous species eventually coming to dominate the substrate. Conversely, horizontal tiles in open treatments remained dominated by filamentous turf associated with sediment and cyanobacteria, with little macroalgae. In contrast, communities on vertical surfaces became and remained dominated (>50% cover) by crustose coralline algae (CCA) after six months regardless of the presence of herbivores. The absence of CCA on horizontal tiles likely can be attributed to high sediment loading that buried or limited their recruitment or establishment. The different algal composition of horizontal and vertical tiles suggests that reductions in the structural complexity of reefs might reduce the abundance of CCA and facilitate dominance of fleshy algae, likely resulting in a negative feedback on coral recruitment.

La dinámica de comunidades algales es generalmente controlada por herbívoros y en menor proporción por factores abióticos como el enriquecimiento de nutrientes. Mientras que la influencia de la complejidad estructural de los arrecifes coralinos ha sido ampliamente estudiada en comunidades de peces, su efecto sobre la dinámica algal es poco conocido. Este estudio evaluó el efecto independiente y combinado de los peces herbívoros y la complejidad estructural sobre la dinámica algal de un arrecife en los Cayos de la Florida, Estados Unidos. Como proxy de la complejidad estructural nosotros creamos diferentes posiciones del sustrato, vertical y horizontal con placas rocosas en combinación con áreas con presencia (abierto) y ausencia (cerrados) de peces herbívoros. La composición algal de las placas fue evaluada por un año en los cuatro tratamientos. En las placas horizontales la ausencia de herbívoros permitió una sucesión algal comenzando por especies filamentosas que fueron temporalmente substituidas por foliosas que a su vez fueron reemplazadas por articuladas calcáreas. Por el contrario, en placas horizontales con presencia de herbívoros, la comunidad algal se mantuvo dominada por especies filamentosas asociadas

con sedimentos y cianobacterias. Las comunidades de algas en superficies verticales se mantuvieron cubiertas por algas coralinas crostosas (CCA, > % 50 cobertura) después de los seis meses de sucesión. La ausencia de CCA en las placas horizontales pudiera ser atribuida a la cantidad de sedimentos que pudo cubrir o limitar el reclutamiento o establecimiento de estas. La diferencia en composición algal entre sustratos verticales y horizontales sugiere que una reducción de la complejidad estructural en arrecifes coralinos pudiera disminuir la abundancia de CCA y facilitar la dominancia de algas carnosas con posibles consecuencias negativas en el reclutamiento de corales.

Keywords: Macroalgae community, succession, herbivory, structural complexity

5/19/15 11:45 AM

Fish-derived nutrient hotspots shape coral reef benthic communities

Shantz AA, Ladd MC, Shrack E, Burkepile DE

Animal-derived nutrients play a strong role in structuring nutrient regimes within and between ecosystems. When animals undergo repetitive, aggregating behavior through time, they can create nutrient hotspots where rates of biogeochemical activity are higher than those found in the surrounding environment. In turn, these hotspots can influence ecosystem processes and community structure. We examined the potential for reef fishes from the family Haemulidae (grunts) to create nutrient hotspots and the potential impact of these hotspots on reef communities. To do so, we tracked the schooling locations of diurnally migrating grunts, which shelter at reef sites during the day but forage off reef each night, and the impact of fish schools on benthic communities. We found that grunt schools showed a high degree of site fidelity, repeatedly returning to the same coral heads and that these aggregations created nutrient hotspots around coral heads where nitrogen and phosphorus delivery was roughly 10 and 7 times the respective rates of delivery to structurally similar sites that lacked schools of these fishes. In turn, herbivore grazing rates at grunt-derived hotspots were approximately 3 times those of non-shelter sites, and coral growth was roughly 1.5 times greater. These differences led to distinct benthic communities with higher cover of crustose coralline algae and less upright fleshy algae. Our results suggest that schooling reef fish play an important role in mediating community structure on coral reefs and that overfishing may have important negative effects on the development of healthy coral reef communities. As such, management strategies must consider mesopredatory fishes in addition to current protection often offered to herbivores and top-tier predators. Furthermore, our results suggest that restoration strategies may benefit from focusing on providing structure for aggregating fishes on reefs with low topographic complexity, or focusing

the out-planting of nursery raised corals around existing nutrient hotspots.

Keywords: Nutrients, biogeochemical hotspots, coral reefs, nutrient cycling

5/19/15 12:00 PM

Effects of heat stress treatments on photosynthetic efficiency in healthy and yellow band disease tissues in the coral *Orbicella faveolata*

Cover M, Marin O, Croquer A

During the past decades the combined effects of thermal stress and coral diseases have challenged the resilience of coral reefs, particularly in the Caribbean region. There is compelling data suggesting a positive relationship between YBD prevalence, tissue mortality and thermal stress. Nevertheless, there is a lack of controlled experiments aimed to reveal the actual effect of thermal stress on YBD pathology. This study aimed to compare the response of photochemical activity of zooxanthellae in healthy and YBD tissues of the reef builder *Orbicella faveolata* under controlled conditions. For this, a three-factorial experiment was designed using thermal stress (with two levels: 26 and 29 C) and time of exposure to stress (with two levels: 48 and 96 h) as fixed factors and colony as a random factor. Colonies were collected in the field using chisel and hammer and set into 100 l containers for 1 h for acclimatization. Before transportation, photosynthetic efficiency (ETR, yield and Fv: Fm) was measured with a PAM fluorometer. Three fragments of each colony were randomly assigned to n = 3 aquaria (replicates) for each combination of treatments. An analysis of variance based on permutations (PERMANOVA) was performed to test the size effect of heat stress on ETR, yield and Fv: Fm; and also, to estimate the variance explained by colonies. We found that diseased colonies with no thermal stress had similar photochemical efficiency compared to healthy colonies with no stress. Although heat stress significantly reduced the photosynthetic activity in both, YBD and healthy tissues, the effect was more severe in the former than in the later. Finally, heat stress significantly increased the rate of tissue mortality of YBD tissue. Our results indicate that expected rising-temperature scenarios may accelerate the deleterious effects of YBD on infected hosts.

Keywords: None provided

5/19/15 12:15 AM

An integrated study of a reefscape in the Florida Keys

Zawada DG, Yates KK, Kellogg CA

Most coral reefs are currently contending with a number of potentially destructive factors driven by local-, regional-, and global-scale processes. Examples include overfishing, poor water quality, acidification, and ocean warming. Understanding the impact of these factors requires a better understanding of the interplay between various reef processes over a range of spatial scales and from the perspective of different scientific disciplines. For an 18-month period, we applied an integrated, reefscape strategy to study Crocker Reef, located in the upper portion of the Florida Reef Tract. Our approach coupled biogeochemical, sedimentological, and geophysical observations over a continuum of spatial scales (from mm to km) through co-located, autonomous instrumentation and coordinated in situ sampling. Specifically, we measured carbonate system parameters every hour; performed metagenomic analyses on near-benthic water samples; acquired current profiles every 10 minutes at 4 reef locations; and characterized reef morphology, benthic cover, and sediment production. With this data set, we are beginning to explain linkages between geochemical, metabolic, and physical processes related to issues of reef accretion/erosion, water quality, nutrient cycling, habitat distributions, and environmental conditions.

La mayoría de los arrecifes de coral están actualmente batallando contra una serie de factores potencialmente destructivos determinado por procesos de escala locales, regionales y globales. Ejemplos de estos factores incluyen la pesca excesiva, la pobre calidad del agua, la acidificación, y el calentamiento de los océanos. El entendimiento del impacto de estos factores requiere un mejor conocimiento entre la interacción de varios procesos en los arrecifes sobre un alcance de escala espacial y la perspectiva de diferentes ramas científicas. Por un período de 18 meses, se aplicó una estrategia integrada de paisajes arrecifal para estudiar el Arrecife Crocker, localizado en la parte superior del Tracto de Arrecife de Florida. Nuestro enfoque combinó observaciones biogeoquímicas, sedimentológicas y geofísicas sobre escalas espaciales (de mm a km) y ubicaciones similares por un período continuo, con instrumentación autónoma y coordinación de muestras in situ. Específicamente, se tomaron muestras de parámetros de sistema de carbonato, se realizó un análisis metagenómico de muestras de agua cerca de áreas bénticas; se adquirieron medidas, en intervalos de 10 minutos, de la corriente en distintos puntos de la columna de agua en 4 ubicaciones del arrecife; y se caracterizó la morfología del arrecife, de áreas bénticas, y de la producción de sedimentos. Con estos datos, estamos empezando a explicar la relación entre los procesos geoquímicos, metabólicos, y físicos relacionados a problemas de acreción y erosión de los arrecifes, a la calidad del agua, al ciclo de nutrición, a la distribución del hábitat y a condiciones de su ambiente.

Keywords; none provided

5/19/15 1:30 PM

Historical perspective, global change, and the adaptive management of caribbean coral reefs

Jackson J

The Global Coral Reef Monitoring Network documented historical changes on coral reefs throughout the wider Caribbean from 1970 to 2012 to evaluate the comparative importance of different anthropogenic drivers of reef degradation as an essential first step towards more effective reef conservation and management. Coral cover declined by half between 1970 and 1990 with little subsequent decline, while macroalgae increased five fold. Much of the early decline was due to outbreaks of coral and sea urchin disease in the 1980s, possibly due to introductions via the Panama Canal. Multivariate analysis also implicates overfishing and human population density as major anthropogenic drivers of coral decline, with extreme heating events and hurricanes of minor importance. Striking local exceptions to the regional pattern of decline also strongly support this conclusion: reefs strictly protected from overfishing and pollution have maintained high coral cover even after severe heating events and hurricanes. Protection against local impacts can significantly strengthen coral reef resilience against the inevitable future intensification of climate change.

Keywords: None provided

5/19/15 1:45 PM

Integrating local knowledge with fisheries technology to study fish spawning aggregations in south Florida

Binder B, Boswell K, Taylor C

The formation of Fish Spawning Aggregations (FSAs) is vital to the life history of many reef fishes, and represents the only reproductive opportunity for many aggregating species. Unfortunately, FSAs present an attractive and lucrative target for exploitation which has led to many cases of decline or extirpation. However, the integration of stakeholders into the design of fisheries management strategies has led to the discovery and protection of several spawning aggregations throughout the United States and Greater Caribbean. During June 2014 we began gathering historical knowledge from experienced South Florida fisherman to locate potential spawning aggregations; resulting in the identification of approximately 11 potential sites consisting of 6 economically important species, ranging in depth (5-65m) and habitat types, from Jupiter to Key Largo. To study these aggregations we are

coupling active acoustic and visual diver surveys to quantify relative abundance, biomass, and species composition on South Florida FSA sites. Species specific size and age structure within aggregations will be constructed from gonad and sagittal otolith collection, enabling inferences about reproductive potential. Additionally, we will test the hypothesis that FSAs have a significant effect on nutrient (Nitrogen and Phosphorus) flux in reef communities by comparing field nutrient sampling techniques with existing excretion and bioenergetics models. This research will enhance our understanding of the spatiotemporal distribution of FSAs, and address complex biogeochemical/ecological questions associated with FSAs. Those answers will assist in developing resource user driven management plans in southeast Florida, and provide a basis for implementing a minimally-invasive monitoring program in other regions. Furthermore, by incorporating fisherman into the scientific process we will enhance working relationships between scientists and resource users with whom we are increasingly reliant upon for scientific advancement.

Keywords: Local Knowledge, Fish Spawning Aggregations

5/19/15 2:00 PM

History of coral reef research in Latin America: the importance of local scientific communities for conservation

Cortés J

Planet Earth's major oceans can be divided into two marine biogeographic provinces in terms of reef-building corals, the Indo-Pacific and the Caribbean-Atlantic provinces, separated by the Central American Isthmus. Adjacent to the American continent there are three biogeographic subprovinces: Brazil, Caribbean and Eastern Tropical Pacific. Latin American countries border all three subprovinces. The first descriptions of reefs in Latin America were made by Christopher Columbus during his visit to the island of Hispaniola. Later, in the 19th Century, the famous naturalists Alexander von Humboldt and Charles Darwin documented observations of coral reefs in Mexico and Brazil, respectively. Since the late 19th century and to the mid to late 20th century, all the scientific information on coral reefs in Latin American was generated by foreign researchers. The first Latin American scientist that published about corals was the Cuban researcher Rafael Arango y Molina, in 1877. More than 70 years later, in 1949, another Cuban scientist, Pedro Pablo Duarte Bello, described some reefs from his homeland. Later, researchers from Puerto Rico and Mexico started publishing in the 1960's. It's not until the mid to late 1970's that an important number of publications on reefs by Latin American scientists and resident foreign scientists started to appear, increasingly doing so up to this day. Changes in quantity, quality, diversity, and the spatial and temporal extent

of research are truly significant when there is a well-established local scientific community. In many cases, this research translates into conservation of the coral reefs and communities.

Los océanos del planeta Tierra se dividen en dos grandes provincias biogeográficas en relación con los corales formadores de arrecifes, la provincia Indo-Pacífica y la provincia Caribe-Atlántica, separadas por el istmo centroamericano. Bordeando el continente americano hay tres subprovincias biogeográficas: Brasil, Caribe y Pacífico Tropical Oriental. Países latinoamericanos bordean las tres subprovincias. Las primeras descripciones de arrecifes en América Latina son las de Cristóbal Colón en su visita a la isla La Española. Posteriormente, los reconocidos naturalistas Alexander von Humboldt y Charles Darwin hicieron observaciones sobre arrecifes en el siglo XIX en México y Brasil, respectivamente. Desde finales del siglo XIX y hasta mediados y en algunos casos hasta casi hasta finales del siglo XX, toda la información sobre corales pétreos y arrecifes de la región era generada por científicos extranjeros. El primer científico latinoamericano que publica sobre coral es fue el cubano Rafael Arango y Molina en 1877. No es sino hasta 1949, que otro latinoamericano, Pedro Pablo Duarte Bello, también cubano, describe los arrecifes de su país. Posteriormente, aparecen algunas publicaciones de investigadores en Puerto Rico y México en la década de 1960. Hubo que esperar hasta la década de 1970 para empezar a ver trabajos importantes sobre los arrecifes de América Latina realizados por científicos latinoamericanos y extranjeros residentes, producción que continúa hasta la fecha. Es notorio el cambio en la cantidad, la calidad, la diversidad, la extensión espacial y temporal de las investigaciones cuando se ha logrado una comunidad científica local bien establecida.

Keywords: Change of paradigm, local scientific communities, American coral reefs, history

5/19/15 2:15 PM

Reconstructing historical change in Caribbean reef ecosystems to pinpoint mechanisms of recent reef decline

Cramer K, Norris R, O'Dea A

The recent widespread decline of Caribbean reef ecosystems has been attributed to bleaching and disease outbreaks, climate change, and ecological release of macroalgae by eutrophication and overfishing of herbivorous fishes. While coral bleaching and disease are recent phenomena, historical and paleoecological data suggest that recent declines may be the culmination of long-term human activities such as land-clearing and fishing. However, the dearth of quantitative data on Caribbean reef communities and environments predating the 1970s has hindered a clear understanding of the extent, timing, and mechanisms of recent ecological changes. We have

implemented a “retrospective monitoring program” for Caribbean reefs that reconstructs the abundance and composition of fish, coral, urchin and benthic foraminifera communities from analysis of their abundant remains in reef sediment cores we collected in Panama and Belize. Analysis and high-precision radiometric dating of the Panama cores revealed that declines in reef-associated organisms (corals, parrotfish, *Diadema antillarum* urchin) occurred around a millennium ago at two sites that underwent a transition from actively-accreting forereef to backreef rubble zones due to changing reef hydrology. At the remaining site, an actively-accreting forereef zone, similar but more rapid declines began in the 1800s that were associated with a shift in foraminiferal assemblages indicative of declining water quality. This study reveals that local anthropogenic disturbance – namely land clearing for large-scale agriculture – has been transforming Caribbean reef communities and environments for centuries and has contributed to the decline of reef herbivores. These findings emphasize the urgent need to incorporate effective land management and pollution controls into coral reef management schemes.

Keywords: Historical ecology, Panama, Belize, terrestrial run-off

5/19/15 2:30 PM

Fish teeth as an ecosystem proxy: biodiversity and productivity of the ancient Caribbean

Norris RD, Trumbo S, Cramer K, O’Dea A

Fish are virtually invisible in most paleontological reconstructions of ancient ecosystems. Consequentially, our reconstructions of reef communities and open ocean ecosystems tend to be focused on lower trophic levels—phytoplankton, zooplankton, benthic foraminifera, corals and molluscs. We are developing the paleontological record of fish teeth to reconstruct the high-trophic levels in marine ecosystems. Teeth are concentrated by acid dissolution of reef carbonates, stained to ease recognition, and identified with a modern reference collection. Fish teeth tend to be small since most fish use their teeth largely to hold prey in suction feeding, or have tooth batteries composed of many individual elements that fall apart after death. Ecologically, fish remains in reef sediments are dominated by teeth of coral-crushing fish along with micro-predators. Our work reveals remarkable contrasts between reef fish communities in the Caribbean and Pacific atolls; Pacific fish have teeth nearly twice the size as the same groups in the Caribbean. We attribute these differences between the Atlantic and Pacific fish assemblages to the gradual reduction in productivity of the Caribbean over the past 2 million years as revealed by new deep-sea export productivity records.

Keywords: Fish, Ichthyoliths, Productivity, Caribbean,

Reef.

5/19/15 2:45 PM

Size selective evolution in the Caribbean conch *Strombus pugilis*

O’Dea A

Intensive harvesting of the largest individuals from an ecosystem can impart strong directional selection to evolve a smaller size at reproduction. Conversely, prehistoric, low-intensity subsistence harvesting is not considered an effective agent of size selective evolution. Evidence from modern, archeological, and paleontological shells suggests that thousands of years of subsistence harvesting has imparted sufficient selection to result in evolutionary change in the Caribbean conch *Strombus pugilis*. Size at maturity declined significantly from pre-human (~7ka) to prehistoric times (~1ka), and again to the modern period in both the Dominican Republic and Panama. Estimates suggest that earliest prehistoric harvesters would have received over 60% more meat per conch than modern day harvesters. Moreover, areas in the Caribbean with low levels of harvesting pressure today have larger size at maturity suggesting that release from harvesting pressure using no-take areas could halt or even reverse deleterious size-selective evolution of this important marine resource. On-going isotope analyses aims to reveal if smaller size at maturity was driven by slowing growth rates or earlier maturity, or both.

Keywords: None provided

5/19/15 3:30 PM

Larvae behavior of queen conch, *Strombus gigas* in function of moon phases and depth

Aldana Aranda D, Enríquez Díaz M, Paris- Limouzy CB

The planktonic larval stage of gastropod mollusks queen conch, *Strombus gigas* has a variable duration (20-40 days) depending on the temperature and food. The abundance and geographical distribution of *S. gigas* larvae have been described in the Caribbean since the 90’s, but so far, the effects of the tidal and moon phases on the vertical behavior of conch larvae have never been studied. Here were carried out plankton tows at La Ceiba, Puerto Morelos, Quintana Roo (20°54’34” N-86°50’13” W) in June of 2014 to examine the abundance of *S. gigas* larvae over time and depth. Plankton samples were made near the surface (0.5m) and near the bottom (3.0m) of the bay around the full moon and new moon periods, covering two high and two low tides per day (n = 720 samples). Larvae of *S. gigas* were identified and average density and standard devi-

ation were calculated. The highest abundances of larvae were recorded during the full moon near the surface, at high tide and at the surface (1.95 ± 0.58 larvae.10m⁻³). Significant variation was recorded between abundance of larvae and depth, tidal coefficient and moon phases, indicative of tidal stream transport.

El estadio planctónica de la fase larval del moluscos gasterópodo Caracol rosa *Strombus gigas* tiene una duración variable en función de la temperatura y alimento que puede variar entre 20-40 días. Su distribución se rige por las corrientes (de Jesús Navarrete, 1999), pero también por su comportamiento de fototropismo positivo o negativo que va a presentar esta larva durante los estadios tempranos y tardíos de su desarrollo larval. El objetivo de este trabajo es conocer la abundancia y distribución vertical en función de los ciclos de las fases lunares y profundidad. Para conocer estos aspectos, se realizaron arrastres de plancton en la localidad La Ceiba, Puerto Morelos, Quintana Roo ($20^{\circ}54'34''\text{N}-86^{\circ}50'13''\text{O}$) en junio de 2014. Los monitoreos se hicieron en superficie (-0.5m) y fondo (-3.0m) durante Luna Llena y Luna Nueva cubriendo dos pleamares y dos bajamar por día ($n=720$ muestreas). La mayor densidad de larvas se registró durante Luna Llena en superficie con 1.95 ± 0.58 larvae.10m⁻³ durante la pleamar, presentando variación significativa entre la densidad larval con los coeficientes de marea y con las fases lunares indicando transporte larval.

Keywords: None provided

5/19/15 3:45 PM

Ecological assessment and benthic mapping inform development of new coastal regulations in Barbuda

Estep, A

The need for managers of imperiled fisheries to adjust their policies as fish populations and ecosystem health decline is well known. However, for many islands like Barbuda, there is very limited data to inform the development of new ocean governance policies. In April 2013, as part of the Blue Halo Initiative, we conducted 12 days of diver surveys for lobster, conch, fish, corals, and algae at 234 sites around the island. Sites were selected using stratified random sampling of target habitat classes. Limited non-random sampling of lobster was also conducted. These data were used to provide the local government of Barbuda a snapshot of the health of their fishery and how it compares within other islands in the region. In August 2014, after the local government considered the results of the assessment and feedback from stakeholders, comprehensive, new coastal regulations we signed into law.

5/19/15 4:00 PM

Geometry of patches of the endangered species *Acropora cervicornis* explains the structure of their associated fish assemblages

Agudo-Adriani E, Cappelletto J, Cavada F, Croquer A

In numerous studies, a series of methodological constraints to reproduce the actual structural complexity in reef systems might lead to conclude a lack of relationship between benthic and fish assemblages. In this study we calculated a series of geometrical indexes to evaluate the link between the geometry and other features of coral colonies and the structure of their associated fish assemblages. For this, we used discrete units (colonies) of *Acropora cervicornis* to combine 3D reconstruction and direct measurements from which length, height, surface, volume, number of branches and the percentage of live coral tissue, macroalgae, calcareous algae and sponges were determined. A total of 20 colonies with different structural features and separated by at least 5 m were chosen haphazardly. For each colony a visual census was conducted to determine the abundance and species composition of fishes and then a video was recorded from different angles. These videos were decomposed into stand-still pictures, later employed to produce a 3D reconstruction of each colony using VisualSFM and MeshLab software. The percentage of algae, coral tissue and other organisms was determined using the software CPCe. A multivariate regression linear model was built using DstLM (distance-base linear model) routine and resulting patterns were visualized with a DstRDA (distance-based redundancy analysis). We found significant linear correlations between fish abundance and length ($r = 0.54$, $p < 0.05$) and richness and volume ($r = 0.60$, $p < 0.05$). Our multivariate linear model explained up to 63% of the total variance of the fish assemblage ($r^2 = 0.6384$) including seven explanatory variables, but only length (14%), the percentage of algae (12%), number of branches (10%), and the volume (10%) were significant. Our results indicate that the geometry of each colony better explains the features of the associated fish assemblages regardless the percentage of live coral tissue of the colony.

Existen estudios donde las limitaciones para estimar complejidad estructural enmascaran la detección de correlaciones entre el bentos y la comunidad de peces. En este trabajo calculamos varios índices para evaluar la relación entre la geometría y otras características propias de colonias de coral y la estructura de los ensamblajes de peces asociados. Para ello utilizamos colonias discretas de *Acropora cervicornis* y combinamos reconstrucciones tridimensionales y mediciones directas para determinar largo, altura, superficie, volumen, número de ramas y el porcentaje de cobertura viva de tejido coralino, macroalgas, algas calcáreas, y de esponjas. Se eligieron de forma pseudo-aleatoria un total de 20 colonias cada una con diferente estructura física, y separadas por al menos 5 metros. En cada colonia se realizó un censo visual para

determinar la composición de especies y abundancia, y posteriormente se realizó un video desde diferentes ángulos. Estos videos fueron utilizados para producir reconstrucciones tridimensionales de las colonias usando el software Meshlab y VisualSFM. El porcentaje de tejido coralino, algas y otros organismos fue estimado usando el software CPe. Una modelo de regresión lineal multi-variado fue construido usando la rutina DStLM (modelo lineal basado en distancias), y los patrones resultantes fueron visualizados con un DstRDA (análisis de redundancia basado en distancias). Encontramos correlaciones lineales significativas entre abundancia de peces y largo de la colonia ($r = 0.54$, $p < 0.05$) y riqueza y volumen ($r = 0.60$, $p < 0.05$). Nuestro modelo lineal explico hasta el 63% de la varianza total de los ensamblajes de peces ($r^2 = 0.6384$), incluyendo siete variables explicativas, siendo significativas solamente el largo (14%), el porcentaje de algas (12%), el número de ramas (10%) y el volumen (10%) de las colonias. Nuestros resultados indican que la geometría de la colonia explica mejor las características de los ensamblajes de peces asociados independientemente del porcentaje de tejido coralino vivo.

Keywords: *Acropora cervicornis*, structural complexity, 3D reconstructions, reef fish

5/19/15 4:15 PM

Outplant success of nursery reared staghorn coral: spawning observations and fecundity

Correia KB, Gilliam DS

The staghorn coral (*Acropora cervicornis*) is a foundation species on Caribbean coral reefs which has experienced dramatic population declines to a level where natural population recovery is in question. With its listing as a US Endangered Species Act Threatened species, *A. cervicornis* has been identified as a high priority species in need of active restoration to promote population recovery. *Acropora cervicornis* coral nurseries have been identified as productive restoration methods to promote population recovery by increasing colony abundance and more importantly, by reducing the spatial gap between populations increasing the likelihood of successful sexual reproduction. Analogous to terrestrial plant nurseries, small branches (fragments) are taken from native donor colonies and grown in an offshore nursery to best mimic asexual reproduction. As the corals grow in the nursery, fragments or entire colonies can be transplanted onto the natural reef. Nova Southeastern University Oceanographic Center manages one such nursery offshore Broward County, Florida. The survivorship of nursery reared outplanted colonies has been well documented, however their sexual reproductive capacity is not yet fully understood. We are addressing this information gap by examining gamete abundance and development in natural, nursery, and outplanted *A. cervicornis* colonies. Tissue samples were

collected from each colony type for one week preceding the 2014 spawning event. Gametes were found in all colony types throughout the week at varying developmental stages. Gamete abundance and colony fecundity data were compared to field spawning observations. Fecundity results corresponded with observed spawning events. Natural colonies were highly fecund and mass spawned, outplant colonies had low fecundity and were not observed spawning, while nursery colonies were fecund but only exhibited partial spawning. While differences existed between the different colony types, they are likely a result of differing colony ages or stress from fragmentation and transplantation.

Keywords: *Acropora cervicornis*, spawning, fecundity

5/19/15 4:30 PM

Spatial scleractinian coral calcification model

Deutekom ES, Dries RM, Allemand D, Kaandorp JA

Scleractinian coral calcification is a complex process involving many biological, chemical, and physical sub-processes inside and around coral tissue. Many of these sub-processes have been researched individually. However, researching interactions, interdependencies and the calcification process as a whole has proven difficult in practice. To fully understand this complexity it is useful to research calcification on the scale of the entire physiological system and its interactions. A computational model can greatly facilitate this and help predict how external variations influence different sub-processes and ultimately calcification. Therefore, we developed a spatial model representing coral tissue in contact with the ocean and that integrates most sub-processes known to be important for calcification. These include: photosynthesis, respiration, ion transporter proteins, Carbonic Anhydrases, and relevant chemical and diffusion reactions. Using this model we researched the plausibility and relative importance of different theories surrounding calcification, such as: Light Enhanced Calcification (LEC), transcellular (biologically controlled) and paracellular (diffusion controlled) transport of ions to the site of calcification. From the simulations we can conclude that for calcification to take place, the transcellular pathway is at least needed. When the paracellular pathway is also implemented, leakage of important ions from the site of calcification occurs, reducing calcification to values non-comparable to experimental values. Implementing a calcium selective paracellular pathway does give higher calcification values. We also found that the consumption of CO₂ due to the photosynthetic process in the coral zooxanthellae, changes little in the calcification rate. This indicates that LEC is not caused by change in the CO₂ concentrations alone, but by another proposed mechanism. The results obtained in the simulations are qualitatively comparable to experimentally measured calcification rates and ion concentrations.

It is possible that additional types of transporter proteins, not yet found experimentally, need to be implemented to improve the results quantitatively in the near future.

Keywords: Calcification, spatial physiology model, scleractinian corals

5/19/15 4:45 PM

Movement and ecological effects of invasive lionfish across multiple habitats

Benkwitt CE, Hixon MA

Determining the ecological effects of non-native species in different habitats is crucial to understanding and effectively managing invasions. The Indo-Pacific red lionfish is an invasive predator that is causing drastic reductions in the abundance of small native fishes on coral reefs in the tropical western Atlantic. However, the short-term movements of lionfish between coral reefs and surrounding habitats, such as seagrass beds, and their ecological effects in these other ecosystems are largely unknown. To determine the extent to which lionfish utilize multiple habitats, we conducted behavioral observations of 115 lionfish on 24 patch reefs and surrounding seagrass beds in The Bahamas. Nearly half of all lionfish moved between patch reefs and seagrass areas at dawn and dusk, with a higher proportion of lionfish using the surrounding habitat when the focal patch reef had a greater density of lionfish. To determine whether these movements affect native fishes in the areas around coral patch reefs, we conducted a manipulative field experiment, maintaining 8 reefs with low lionfish densities and 8 reefs with high lionfish densities. We then monitored native fish communities both on the reefs and at varying distances from the reefs over the course of 8 weeks. There were significantly fewer native fishes on high-lionfish reefs than low-lionfish reefs. There were also significantly fewer native fishes on small satellite coral heads and standardized habitat patches up to 35 m away from high-lionfish reefs compared to low-lionfish reefs. These results suggest that lionfish feed substantially in the habitats surrounding coral patch reefs, especially at higher local lionfish densities, and are therefore having broader negative effects on native fish communities than previously documented. At the same time, management efforts that reduce lionfish densities on coral patch reefs may also reduce their impacts on native fishes in surrounding seagrass communities.

Keywords: Predation, foraging behavior, piscivory, coral reefs, seagrass, Pterois volitans

5/21/15 8:30 AM

Investigating stakeholders' preferences for coral reef research funding in Florida

Harper JW, Mozumder P

Heavily used and highly valuable, the Florida Reef is one of the world's most threatened ecosystems. Stakeholders from a densely urbanized coastal region in proximity to the reef system have recognized its degradation, but their understanding of climate change and commitment to pay for relevant research has been opaque. With an emphasis on recreational anglers, stakeholders were surveyed online about their marine activities, perceptions of resources and threats, and willingness to pay (WTP) for dedicated coral reef research funding in Florida. The majority of stakeholders are wealthy, well educated, and politically independent. Supermajorities of surveyed respondents favored the two taxation scenarios, and the scenario with matching federal funds earned higher support. In regression analyses, several factors emerged as significant contributors to stakeholders' preferences for Florida Coral Reef Research Funds, such as ownership of a sailboat, surfing activity, concern about coral reefs, and concern about climate change, with the latter indicating a recent shift of opinion. Status in terms of income and education were found insignificant, and surprisingly income was found to be negatively correlated with WTP. Perceptions through lenses of environmental and emotional attachments appear to dominate conventional status-based factors.

Keywords: coral reef research, climate change, stakeholder, Florida, anglers, willingness to pay

5/21/15 8:45 AM

Seasonal variability in energy content is greater in mesophotic corals

Brandtneris VW, Brandt ME, Glynn PW, Gyory J, Smith TB

Energetic responses of zooxanthellate reef corals along depth gradients have relevance to the thermal stress refugia potential of mesophotic coral ecosystems (MCE). Previous observations suggested that MCE in the Caribbean are thermally buffered during the warmest parts of the year and occur within or just below the chlorophyll maximum, suggesting abundant trophic resources. However, it is not known if mesophotic corals can maintain constant energy needs throughout the year with changing environmental and biological conditions (e.g., thermal stress, reproduction). The caloric content of tissues from the stony coral species *Orbicella faveolata* and *Agaricia lamarcki* was measured on the southern insular shelf of St. Thomas, US Virgin Islands (USVI) over five periods from April 2013 to April 2014. Four sites at depths of 6m, 25m, 38m and 63m were selected to capture energetic differences across the full vertical range of coral habitats in the USVI. Mesophotic colonies of *O. faveolata* exhibited a significant reduction in caloric content during the month of September 2013

compared to mid-depth and shallow colonies ($p=0.032$), whereas *A. lamarcki* experienced similar caloric variability, but with a significant reduction in energy status that occurred in July 2013 for colonies at sites deeper than 25 m ($p=0.014$). The results of calorimetric analyses indicate that *O. faveolata* may be at risk during late summer stress events, possibly due to the timing of reproductive activities. The low-point of *A. lamarcki* energy status, which may also coincide with reproduction, occurs seasonal thermal stress events, thus favoring this species in mesophotic habitats.

Keywords: Coral Reefs, mesophotic, energetics, calorimetry

5/21/15 9:00 AM

Data dissemination tools for organism attributes and new data records

Hammock J, Schulz K

TraitBank is the structured data service of the Encyclopedia of Life. Launched in 2014, it currently hosts 9 million data records for 1.7 million taxa, including trait records (eg: cell size, life history traits) and other attributes including administrative ones (eg: IUCN status, type specimen repository). Marine datasets include verbal localities from WoRMS, habitat categories from AlgaeBase, water temperature ranges based on known occurrence records from OBIS, and literature derived datasets including cell masses of phytoplankton and tissue mineralization types of algae and invertebrates. Hosted records include all available metadata, including detailed attribution, url of data source if online; organism information including sex and life stage; date, locality and method information for field studies, and any other fields provided by the source. TraitBank is not a repository. Most hosted records are deposited with a scholarly publication, or an institutional or aggregator database. Presence in TraitBank makes individual records findable by EOL search (http://eol.org/data_search) or web search engine. Search results on EOL are available by CSV download and records are available to semantic web applications via a JSON-LD web service, including all metadata. Fresh Data is a data search service in development primarily for the Citizen Science community, funded by NSF. Interested occurrence data providers will register to be indexed. Their data will be deposited at GBIF, using the IPT, if possible, and in TraitBank otherwise (eg: presence/absence or abundance data, if GBIF cannot accommodate them). Searchers can query the index for recent records by time, location and taxonomic group. Registered researchers will also be able to save and publish their data queries, which will alert them if new data appears matching their criteria, and alert the data provider that their data was delivered to a subscriber.

Keywords: data access, search tools, semantic web

5/21/15 9:15 AM

A comparison of transcriptomes of two closely related scleractinian coral species and their differential response to stressors

Pratte ZA, Richardson LL

Pseudodiploria strigosa and *Diploria labyrinthiformis* are two closely related scleractinian corals, which are known to have different susceptibilities to disease and bleaching. *P. strigosa* is generally more prone to disease, while *D. labyrinthiformis* bleaches more readily. Both bleaching and disease are implicated to increase with elevated temperatures and or acidification. This study compared the gene expression of the two coral species seasonally over 18 months (in situ), with sampling every 6 months. Laboratory experiments were also conducted to examine the effects of temperature increase and acidification. 357 transcripts were differentially expressed seasonally (field data), and 266 in the laboratory experiments. Transcripts associated with cell regulation and metabolism, stress, protein regulation and metabolism, fatty acid and lipid synthesis were highly differentially expressed in both experiments. In all conditions, *P. strigosa* displayed more differentially expressed genes (compared to controls) than *D. labyrinthiformis*. The higher number of differentially expressed genes may indicate that *P. strigosa* is more sensitive to environmental changes, thereby making it more susceptible to disease. Conversely, *D. labyrinthiformis* may fail to respond to environmental changes, leaving it more prone to temperature induced bleaching. This study demonstrates that although closely related, these two species express genes differently, possibly explaining the observed differences in susceptibility to bleaching and disease.

Keywords: Transcriptomics, Gene Expression, *Diploria*, *Pseudodiploria*, warming, acidification

5/21/15 9:30 AM

Active restoration of the endangered, *Acropora cervicornis* corals in the Dominican Republic

Galvan VM

People living in coastal tropical island communities depend on the social, ecological, and economical services that coral reefs offer for all or part of their livelihoods. Nonetheless, coral health worldwide continues to decline due to a variety of natural and anthropogenic factors. These declines threaten the ecosystems services reefs provide. One example of a drastic coral decline is the loss of >95% of the *Acropora cervicornis* corals over the last 40 years, prompting their listing for protection under the Endangered Species Act in 2006. In the Dominican Republic (D.R.), we are mitigating this problem by utilizing an active restoration technique called "Coral

Gardening” to promote the propagation of *A. cervicornis* for reef restoration efforts. Countrywide, there are now 11 coral nurseries with over 3,000 fragments being propagated, equivalent to some 2.3 km of tissue. Additionally, 21 unique genotypes are being monitored representing the largest genotypic diversity being tracked for *A. cervicornis* in the Caribbean excluding Florida. Outplanting activities to date have seen the establishment of some 60 transplant sites with 45 outplant sites established in Punta Cana alone. Through 2013, the Punta Cana coral nursery continued to be the most productive nursery in the D.R. with more than 1,900 fragments or some 1,665 meters of tissue being propagated and 21 outplant sites established. In 2014, 24 new outplants sites were established and 10 high performing sites expanded utilizing an estimated 1.56km of tissue distributed in 3,877 nursery reared coral colonies; this efforts represents one of the largest restoration attempts for this species in the Caribbean to date. Other studies have shown that outplanted corals have been observed to grow as well, or better than protected nursery corals, which provides reasons for optimism for the recovery of this species through active restoration.

Residentes de comunidades costeras en islas tropicales dependen de los servicios sociales, ecológicos, y económicos que ofrecen los arrecifes coralinos para su sustento. Sin embargo, la salud de los arrecifes continua deteriorándose a nivel mundial a causa de factores tanto naturales como antropogénicos. Este continuo deterioro amenaza los servicios que los arrecifes proveen. Un ejemplo drástico del deterioro es la pérdida de >95 % del coral *Acropora cervicornis* durante los últimos 40 años, impulsando su clasificación como especie “Amenazada” bajo el Acta de Especies en Peligro de Extinción de los E.E.U.U. en el 2006. En la Republica Dominicana (D.R.), estamos mitigando este problema utilizando una técnica de restauración activa llamada “Jardinería de Corales” para la propagación de *A. cervicornis* y nuestros esfuerzos de restauración. A nivel nacional, hoy en día, existen 11 viveros de coral con >3,000 fragmentos siendo propagados, equivalente a 2.3km de tejido. Adicionalmente, 21 distintos genotipos están siendo monitoreados representando la mayor diversidad genotípica siendo monitoreada de *A. cervicornis* en el Caribe, excluyendo a Florida. Actividades de restauración hasta la fecha han visto el establecimiento de unos 60 sitios de trasplantes con 45 de ellos en Punta Cana. En el 2013, el vivero de coral de Punta Cana continuo siendo el vivero más productivo en la R.D. con >1,900 fragmentos o ~1,665m de tejido siendo propagados y 21 sitios de trasplante establecidos. En el 2014, 24 nuevos sitios de trasplante fueron establecidos y 10 sitios de alta productividad expandidos utilizando ~1.56km de tejido distribuido en 3,877 colonias del vivero; este esfuerzo representa uno de los esfuerzos de restauración mas extensivo para esta especie en el Caribe hasta la fecha. Otros estudios han indicado que los corales trasplantados están creciendo igual o más rápido que los del vivero cual nos da optimismo para la recuperación de esta especie.

Keywords: Coral Restoration, *Acropora*, coral gardening,

ecosystem restoration, Endangered Species, Dominican Republic

5/21/15 9:45 AM

Analysis of proteins involved in immunological memory in a basal metazoan, *Exaiptasia pallida*

Brown T, Rodriguez-Lanetty M

Coral diseases outbreaks have been rapidly increasing on reefs worldwide. Our understanding of how corals respond to the agents causing these diseases remains limited. It is unknown if corals possess a form of immunological priming which would allow them to respond faster to secondary encounters with the same pathogen. In order to test this hypothesis we used the cnidarian model system, *Exaiptasia pallida* and challenged the anemones with the coral pathogen *Vibrio coralliilyticus* under sub-lethal conditions followed subsequently with a lethal challenge. The results indicate that *E. pallida* displays a form of immunological memory as primed anemones showed an increased survival compared to non-primed anemones during a lethal challenge. We further aimed to identify proteins involved in this immunological memory response by comparing anemones that were exposed to a sub-lethal bacterial challenge to those that were not prior to the lethal challenge. The lapsed time between sub-lethal and lethal challenge was 4 weeks. Total extracted proteins were examined using a 2D DIGE expression profile. The analysis revealed that a molecular response was significantly associated with the immunological priming phenomenon. We discovered 88 differentially expressed proteins between the treatments with 50 of them up regulated in primed anemones. Of these differentially expressed proteins identified on the gels, 25 were selected for further identification using mass spectrometry. The molecular response associated with the immunological priming documented in this study suggests a complex cellular regulation involving various proteins, including heat shock protein 70 and 60, fructose bisphosphate aldolase, calumenin, and actin. Furthermore we propose a working model to explain the molecular mechanism mediating immunological memory in this basal metazoan.

Keywords: Coral disease, *Aiptasia pallida*, immunology, proteomics, immunological memory

5/21/15 11:30 AM

Improving and revitalizing the global coral reef monitoring network (GCRMN) for the wider Caribbean: new monitoring guidelines and network structure

Belmont J, McField M

One of the key findings of the last Global Coral Reef

Monitoring Network (GCRMN) report on the status and trends of Caribbean coral reefs highlights the weaknesses and inefficiency of the coral monitoring network, partly due to the lack of information dissemination and inconsistency in application of monitoring methods throughout the region. The GCRMN in the Caribbean suffers from reduced functionality at three levels: data collection, information archiving and dissemination, and internal network communication. Coupled with challenges of securing adequate funding as a means to support systematic and sustainable coral reef monitoring, this has potentially contributed to losses of information and capacity building due to major gaps in the exchange of approaches and expertise within the region. To address the urgent need for more effective coral reef monitoring in the Wider Caribbean region, a workshop was convened from 6-8 August 2014 in Curacao, to improve the regional cooperation through the GCRMN. New coral reef monitoring minimum guidelines were proposed for ecological data collection as well as the introduction of such for sustained collection of socioeconomic information. Those minimum requirements should enhance long-term monitoring of Caribbean coral reefs and regional comparison of data across sites, and improve current management and conservation efforts, particularly in relation to Marine Protected Area (MPA) Networks. The structure of the previous GCRMN Caribbean network was also identified as a major challenge for the sustained functioning of the regional network. The proposed new network model, with the support of, and led by a Steering Committee and a regional coordinator, will be instrumental as an information and exchange platform for the Wider Caribbean region and all relevant actors. This paper examines efforts towards the improvement and revitalization of the GCRMN for the Wider Caribbean region for enhanced and sustained ecological and socio-economic monitoring of regional coral reefs. Reference: Workshop of the Global Coral Reef Monitoring Network (GCRMN) in the Wider Caribbean: Review, improve and revitalize the network and the nodes for more effective coral reef monitoring and data. Curaçao, 6th - 8th of August 2014 (26 participants). <http://www.car-spaw-rac.org/?Caribbean-Coral-reef-monitoring.566>

Una de las principales conclusiones del último informe de la Red Mundial de Monitoreo de Arrecifes Coralinos (GCRMN, siglas en inglés) sobre la situación y tendencias de los arrecifes de coral del Caribe subraya la ineficiencia de la red de monitoreo, en parte debidas a la ausencia de difusión de la información y las incoherencias en la aplicación de métodos de monitoreo en la zona. El GCRMN en el Caribe sufre de una funcionalidad limitada en tres niveles: la colecta de datos, el archivo de los mismos y la difusión de la información y la comunicación dentro de la red. Junto con las dificultades de garantizar un financiamiento adecuado y sostenible para apoyar el monitoreo sistemático de los arrecifes de coral, las deficiencias significativas en el intercambio de experiencias en la región han potencialmente contribuido en la pérdida de información y aumento de capacidad. Para remediar a la necesidad de

un monitoreo más eficaz, se realizó un taller en Curacao del 6 a 8 de Agosto, 2014, para mejorar la cooperación regional a través de la GCRMN. Se propusieron guías mínimas para la recolección de datos ecológicos, así como la introducción de recolección de información socioeconómica regular. Estos requisitos mínimos deberían mejorar el seguimiento a largo plazo de los arrecifes de coral del Caribe y la comparación regional de los datos, mejorar la gestión y los esfuerzos actuales de conservación, en particular en relación con las Redes de Áreas Marinas Protegidas (AMP). La estructura de la red anterior también fue identificada como un desafío importante para un funcionamiento sostenido. El nuevo modelo propuesto de la red, con el apoyo de un Comité Directivo y un coordinador regional, será fundamental como plataforma de información y intercambio para la región del Gran Caribe y todos los actores relevantes.

Keywords: GCRMN, Caribbean, coral reef, monitoring, data

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Corals and the US endangered species act: the need to improve accessibility of Caribbean reef data

Vardi T, Moore J

Within the continental United States and its territories, NOAA has significant infrastructure to conduct coral reef monitoring; however, under the U.S. Endangered Species Act (ESA), NOAA is required to report on the status and trends of listed corals "throughout their range." As such, NOAA has a vested interest in supporting international efforts to coordinate information on the seven ESA-listed corals, *Acropora palmata*, *A. cervicornis*, *Orbicella annularis*, *O. faveolata*, *O. franksi*, *Dendrogyra cylindrus*, and *Mycetophyllia ferox*. Because this list includes primary reef-building species, we are presented with not only a legal, but an ecological mandate. To appropriately assess and ultimately recover U.S. corals, we need to understand the status of these species across the entire Caribbean basin. Currently, under its National Coral Reef Monitoring Program (NCRMP), NOAA captures a bi-annual "wide but thin" snapshot of ecological, climate, and socio-economic information in Florida, Puerto-Rico, Flower Gardens Banks, and the U.S. Virgin Islands. The data protocols are not designed to provide quantitative information on any one species, but rather to describe the ecosystem as it evolves over time, and to contextualize local monitoring efforts. While the information collected has long-term value for U.S. reefs, addressing the pace of reef degradation, the species-specific nature of the ESA, and connectivity within the Caribbean basin, requires consolidation of existing cross-basin information and the collection of more detailed information on the listed corals. A more deliberately coordinated system for sharing Caribbean reef data is necessary to implement the ESA, and NOAA is commit-

ted to helping support such a system, by working collaboratively with regional partners, supporting research and monitoring on ESA-listed corals, and providing storage space in a long-term data archive. Ultimately, a well-constructed data sharing system will benefit not only the US, but the region as a whole.

Dentro del territorio continental de Estados Unidos y sus territorios, NOAA tiene una infraestructura significativa para llevar a cabo el monitoreo de arrecifes de coral; sin embargo, bajo la Endangered Species Act de Estados Unidos (ESA), NOAA está obligado a informar sobre la situación y tendencias de los corales que figuran “en toda su área de distribución.” Como tal, la NOAA tiene un interés en el apoyo a los esfuerzos internacionales para coordinar información sobre las siete de la ESA corales, *Acropora palmata*, *A. cervicornis*, *Orbicella annularis*, *O. faveolata*, *O. franksi*, *Dendrogyra cylindrus* y *Mycetophyllia ferox*. Debido a que esta lista incluye especies de arrecifes de primaria, se nos presenta no sólo una mandato legal, sino un mandato ecológico. Para evaluar de manera adecuada y en última instancia, recuperar US corales, tenemos que entender la situación de estas especies en toda la cuenca del Caribe. En la Programa Nacional de Monitoreo de Arrecifes de Coral (NCRMP), NOAA capta una instantánea bianual “amplia pero fina” de los sistemas ecológicos, el clima y la información socioeconómica en Florida, Puerto Rico, jardines de flores Bancos, y la Virgen de EE.UU. Islas. Los protocolos de datos no están diseñados para proporcionar información cuantitativa sobre cualquier especie, sino más bien para describir el ecosistema a medida que evoluciona con el tiempo, y para contextualizar los esfuerzos de monitoreo local. Si bien la información recogida tiene valor a largo plazo para los arrecifes de Estados Unidos, frente al ritmo de la degradación de los arrecifes, la naturaleza específica de la especie de la ESA, y la conectividad dentro de la cuenca del Caribe, requiere la consolidación de la información cruzada cuenca existente y la colección de más detallada información sobre los corales enumerados. Un sistema coordinado más deliberadamente para compartir datos de los arrecifes del Caribe es necesario implementar la ESA, y NOAA se compromete a ayudar a apoyar un sistema de este tipo, al trabajar en colaboración con los socios regionales, apoyo a la investigación y el seguimiento en los corales de la ESA-lista, y proporcionar espacio de almacenamiento en un archivo de datos a largo plazo. En última instancia, un sistema de intercambio de datos bien construido no sólo beneficiará a los EE.UU., pero la región en su conjunto.

Keywords: Policy, endangered, coral, U.S., data management

5/21/15 12:00 PM

2015 Mesoamerican reef eco-health report card

McField M, Alvarez Filip L, Drysdale I, Rueda M, Pott R, Giro A

The Healthy Reefs Initiative (HRI) is a multinational effort of over 60 NGOs, research institutions, donor organizations and government departments collaborating to enhance conservation efforts in the Mesoamerican Reef. HRI generates biennial, user-friendly Report Cards on the health of the reef and Eco-Audits that evaluate each country's degree of implementation of management actions. The majority of the 248 reefs surveyed in the 2015 Report were found to be in poor (40%) or fair (34%) condition. However, 17% are in critical condition, mainly due to the low biomass of commercially important fishes and high fleshy macroalgae cover. Only 9% of sites, mainly in the Bay Islands (Honduras), ranked as good or very good. The simplified reef health index is based on ranked values for coral cover, fleshy macroalgal cover, herbivorous fish biomass and commercial fish biomass. A temporal comparison with previous Report Cards (data from 2006 – 2014) reveals that the biomass of key commercial fishes (snappers and groupers) fluctuated, but increased nearly 65% to 1023 g/100m², still below what is considered a healthy Caribbean reef. Coral cover remained around 16-18% over the last 5 years, which is up from 10% in 2006. Herbivorous fish biomass (Acanthurids and Scarids) was relatively high (2604 g/100m²) and generally increased over the time period. However the cover of fleshy macroalgae also steadily increased from 13% - 23% cover, suggesting that pressures from land, such as nutrient enrichment, are also leading drivers of ecosystems dynamics in the region. In the few sites where *Diadema* was relatively abundant (over 1 ind/m²) the cover of fleshy macoralgae was considerably lower (>10%). Collectively producing routine report cards on the health of the reef, followed by detailed evaluation of management actions, provides a valuable tool for stimulating public awareness and catalyzing swifter more comprehensive reef management actions.

La Iniciativa Arrecifes Saludables (HRI) es un esfuerzo multi-institucional de más de 60 organizaciones asociadas, incluyendo organizaciones no gubernamentales locales e internacionales, instituciones de investigación, donantes y departamentos gubernamentales, para mejorar los esfuerzos de conservación en el Arrecife Mesoamericano. HRI genera regularmente un Reporte de la Salud Ecológica del Arrecife Mesoamericano que pueda utilizarse y entender fácilmente, así como un Informe de Avances que evalúa el grado de ejecución de las acciones de gestión de arrecifes recomendadas por el conjunto de todas las organizaciones. La mayoría de los 248 sitios muestreados en el Reporte de la Salud Ecológica del Arrecife Mesoamericano 2015 permanecen en un estado malo (40%) o regular (34%). Sin embargo, 17% están en un estado crítico de salud, debido principalmente a la baja biomasa de peces

de importancia comercial y la alta cobertura de macroalgas carnosas. Solo el 9% de los sitios, principalmente en las Islas de la Bahía (Honduras) tuvieron una ponderación de salud buena a muy buena. El índice simplificado de salud arrecifal pondera los valores de cobertura de corales vivos, cobertura de macroalgas carnosas, biomasa de peces herbívoros y biomasa de peces comerciales. Una comparación temporal basada en Reportes de Salud anteriores (datos colectados entre 2006 y 2014) revela que la biomasa de peces comerciales clave (pargos y meros) fluctuó, pero aumentó casi un 65% a 1,023 g/100m², siendo esta cifra aún baja de lo que se espera en un arrecife del Caribe saludable. La cobertura de coral se mantuvo alrededor de 16 a 18% en los últimos 5 años, el cual aumentó desde 10% observado en 2006. La biomasa de peces herbívoros (Acanthuridos y Scaridos) fue relativamente alta (2,604 g/100m²) y, en general aumentaron durante todo el periodo de tiempo de monitoreo. Sin embargo, la cobertura de macroalgas carnosas también aumentó de manera constante, subiendo de 13% a 23%, lo que sugiere que las presiones provenientes de tierra adentro, como el enriquecimiento del agua por la entrada de nutrientes, también están afectado la dinámica de los ecosistemas de la región. En los pocos sitios donde los erizos *Diadema* fueron relativamente abundantes (más de 1 ind/m²) la cobertura de macroalgas carnosas fue considerablemente más baja (> 10%). Los Reportes de Salud Ecológica del arrecife, publicados de manera rutinaria y seguidos de la evaluación detallada de las acciones de manejo, proporcionan una valiosa herramienta para catalizar la conciencia pública, promueven acciones de manejo de arrecifes más completas y rápidas, todas a gran escala.

Keywords: None provided

5/21/15 12:15 PM

Linking monitoring & evaluation of the state of the environment to enhanced arrangements for the governance of shared living marine resources

Debels P

The Large Marine Ecosystem (LME) concept, developed by the US National Oceanic and Atmospheric Administration (NOAA), defines a meaningful geospatial unit for the implementation of an ecosystem-based management (EBM) approach. Since 1995, the Global Environment Facility (GEF) has provided financial support to cover the initial incremental costs of enhancing the transboundary collaboration required to adopt this approach in the Caribbean and North Brazil Shelf LMEs. Scientific and technical fact-finding through the Transboundary Diagnostic Analyses conducted under the GEF/UNDP "CLME Project" pointed to weaknesses in data availability and accessibility, and weaknesses in governance arrangements as two of the main root causes of key environmental problems such as habitat degradation, pollution, and unsus-

tainable fisheries. A 10-year Strategic Action Programme for sustainable shared living marine resources management, the "CLME+ SAP", was consequently developed in 2013 and politically endorsed at the regional level. The SAP has been shaped on a proposal for a multi-level, nested Regional Governance Framework. Renewed financial support from the GEF will see the implementation of the SAP catalysed through the follow-up "CLME+ Project" (2015 - 2019). Component 5 of the CLME+ Project aims to tie the development of monitoring & evaluation (M&E) systems on the state of marine environment (and associated living resources, incl. corals) to such enhanced institutional framework. Formal M&E mandates and enhanced partnerships will allow the region to gradually move from the more ad hoc, opportunistic approaches to M&E from the past to a more systematic, long-term approach, which will enhance data accessibility and allow scientists and decision-makers to better evaluate results from investments, and as such facilitate adaptive, and more effective management.

Keywords: CLME+, Large Marine Ecosystems, Governance, Monitoring & Evaluation, Strategic Action Programme

5/21/15 13:30 PM

Extending the AGRRA vision to include Caribbean reef monitoring

Lang JC, Kramer PR, Marks KW, Kramer PA

The AGRRA initiative was launched in 1998 in order to rapidly assess the structure and function of western Atlantic reef crests and high-relief fore reefs. We have refined the methodology as the diversity of surveyed reef habitats has increased, learning from practitioners who have contributed over 2,000 surveys to the AGRRA database. Improved habitat descriptors and an online data-entry tool were piloted in 2014, allowing more streamlined data processing. Interactive graphical output is currently in development. AGRRA data frequently feature in quantitative evaluations of reef condition, including ecosystem report cards (an outreach communication tool pioneered for the Caribbean area by the Healthy Reef Initiative). AGRRA was designed to represent large areas like shelves, countries or ecoregions with stratified random surveys conducted every 5-10 years. Its protocols have been variously adapted to address questions at smaller spatial (e.g., MPA) and temporal (annual or bi-annual) scales. In response, we are introducing recommendations on how to use AGRRA in statistically robust monitoring applications that are adaptable to diverse ecological settings and sensitive to local variations in management capacity, funding and goals.

Keywords: AGRRA, Caribbean, monitoring, methods, reefs

5/21/15 13:45 PM

Tracing the impacts of overfishing, eutrophication, and thermal stress on corals and their microbiomes

Vega Thurber R, Burkepile DE, Zaneveld JR, Shantz AA, Pritchard CE, McMinds R, Payet J, Welsh R, Correa AMS, Lemoine NP, Rosales S, Fuchs C

Global climate change and local stressors such as overfishing and eutrophication threaten the health of coral reefs. The mechanisms by which these stressors intersect and contribute to coral mortality are challenging to demonstrate in situ. To overcome these barriers, we have conducted various short and long term (e.g. ½ to 3 years) in-field experiments in the Florida Keys, simulating overfishing and nutrient loading. We have traced the cascading impacts of these stressors on coral's competitive environment, microbiome dynamics, and health over time and across a range of temperatures. Overall we have found that inorganic nutrient exposure (particularly nitrogen) results in increased coral disease and bleaching, but importantly that removal of nutrients results in quick recovery of the reef. We have also found that increases in coral-algal competition resulting from overfishing and nutrient addition, combine with seasonal thermal stress to disrupt coral microbiology, linking coral microbiome disruptions by local stressors to subsequent coral tissue loss and mortality at stressful temperatures. Thus, we will present evidence to suggest that reducing local stressors like runoff and extensive fish harvests may help improve coral resistance to thermal stress brought on by climate change.

Keywords: None provided

5/21/15 14:00 PM

Top-down and bottom-up forcing of coral-algal-microbial interactions

Burkepile DE, Zaneveld JR, Shantz AA, Pritchard CE, McMinds R, Payet J, Welsh R, Correa AMS, Lemoine NP, Rosales S, Fuchs C, Vega Thurber R

There is a long-running debate in coral reef ecology about how reef communities are shaped by top-down (herbivory) and bottom-up (nutrient availability) forces. We have been expanding on the theme of top-down control of coral reef communities to address how top-down and bottom-up forcing interact to impact macroalgae, corals, and coral-associated microbes. In our three-year experiment in the Florida Keys we have shown that excluding herbivorous fishes results in dramatic changes in both the abundance and species composition of benthic algae, including dramatic increases in upright algae such as *Amphiroa* spp., *Sargassum* spp., and tall filamentous turfs. The combination of herbivore exclusion and nutrient loading

increased algal cover by 5.7 fold above controls by the end of the experiment, more than either herbivore exclusion (4.1 fold) or nutrient loading alone (3.1 fold). But, importantly, increasing nutrient availability relaxes top-down control resulting in more macroalgae even when herbivores are present. These changes in algal abundance led to decreased growth and survivorship of corals. Although corals in control plots gained tissue, every other treatment induced tissue loss and 6 to 9-fold increases in mortality. Coral mortality was significantly concentrated in summer and fall, the two hottest seasons, suggesting that, although we observed little visible coral bleaching, temperature or other seasonal factors interacted with treatment effects to produce mortality. Increases in coral-algal competition and seasonal thermal stress disrupted coral microbiomes in distinct patterns that correlated with increased coral tissue loss and mortality. Further, we uncovered a novel mechanism of nutrient-dependent coral mortality following parrotfish predation and associated changes in the microbiome. Taken together our recent data suggest that herbivores exert significant top-down control and nutrients bottom-up control not only on algal abundance and coral growth and survivorship but also on the coral microbiome. Thus, reducing local stressors may help improve coral resistance to global stressors brought on by climate change.

Keywords: None provided

5/21/15 14:15 PM

Effectiveness of a multipurpose artificial underwater structure as a coral reef canopy: hydrodynamic and ecological connectivity

Danker K

The following study focused on artificial underwater structures (a.k.a. artificial reefs) in a coral reef environment to mitigate the natural and anthropogenic pressures facing reef systems worldwide. The research question was stated as: "Establishing a method to determine if a multipurpose artificial underwater structure (MAUS) can perform the functions of a natural canopy cover on a coral reef flat". To investigate this both ecological and hydrodynamic parameters were considered. The MAUS selected for the investigation is composed of a canopy of 1000's of interlocking synthetic hooks known as ground consolidators (GCs). This investigation employed both a physical and numerical model. The relevant parameters required to assess the research question were found by obtaining the flow characteristics inside the canopy and wave induced hydrodynamic dampening across the canopy. Wave driven velocities were observed in a 1:5 scale GC canopy model and used to assess the success of larval recruitment. In addition to ecological considerations in the canopy, the bulk-wave height reduction was computed. These components allows for canopy design and schema-

tization in a numerical model application. A link between the bulk wave-height reduction and internal wave driven velocities within the canopy is desirable to understand the connectivity of hydrodynamics and larval recruitment. The evidence collected in this study gives an indication of an artificial reef arrangement which can provide a suitable climate for the establishment, and long-term vitality of a benthic community within its pore structure. The study is unique in that it incorporates various fields to bridge the gaps needed to present a more complete and comprehensive design guideline for MAUS concepts. Additional outcomes from this study include a more thorough oversight and understanding of the required changes and considerations needed to improve current interpretation of porous canopy media.

Keywords: Artificial Reef Larva Recruitment Corals Hydrodynamics

5/21/15 14:30 PM

Reproductive endocrinology during pregnancy and pregnancy loss in bottlenose dolphins (*Tursiops truncatus*)

Bergfelt DR, West KL

An overview of results from a series of novel studies is presented to highlight hormonal data generated retrospectively through immuno-analysis of archived serum and urine samples from bottlenose dolphins with successful (live births) and unsuccessful (perinatal losses) pregnancy outcomes. The studies encompassed 9 aquatic facilities involving 19 dolphins and 28 pregnancies (15 successful and 12 unsuccessful). In-house radioimmunoassays (RIA) or commercial enzyme immunoassays (EIA) were used to analyze a total of 300 to 400 samples for progesterone, relaxin, thyroid hormones, and cortisol. Hormonal results were normalized to month or expected month of parturition (Month 0) and statistically analyzed over Months -12 to 0 of gestation to determine the effect of pregnancy outcomes, time, and interaction. In dolphins with successful pregnancies, serum concentrations of progesterone increased during early to mid-pregnancy and decreased during late pregnancy, whereas serum concentrations of relaxin were low during early pregnancy but increased mid-pregnancy to high concentrations during late pregnancy. In a separate study, serum concentrations of thyroid hormones (total and free T3, T4) were highest during early, intermediate during mid, and lowest during late gestation in dolphins with successful pregnancies. Preliminary results of a recent study with cortisol indicated urine concentrations were relatively unchanged throughout pregnancy except for an apparent increase prior to parturition in dolphins with successful pregnancies. In dolphins with unsuccessful pregnancies, mean serum hormone concentrations were lower from early to late pregnancy compared to successful pregnan-

cies for progesterone (25 to 37%), relaxin (29 to 42%), and thyroid hormones (10 to 37%). In 2 of 7 dolphins with unsuccessful pregnancies, urine cortisol concentrations were higher (14 to 20%) compared to dolphins with successful pregnancies. In conclusion, the temporal hormonal relationships have basic and applied implications to better understand the nature of pregnancy loss and diagnosis and assess pregnancy status in captive and wild dolphins.

Keywords: Bottlenose dolphins, pregnancy, pregnancy loss, reproductive endocrinology, immuno-analysis

5/21/15 14:45 PM

A new coral on Curaçaoan reefs, comparison with an old invader

Engelen AH, Frade PR, Aires T, Baraka S, Serrão E, Pabon JT, Vermeij MJA

Human activities have moved organisms around the globe since the early discovery journeys, but have increased to unprecedented levels. Only a fraction of the introduced organisms establishes outside its native range. It is estimated that after climate change and habitat destruction biological invasions impact ecosystems most dramatically. Recently, a new cup coral was encountered on Curaçaoan reefs. We combined classical and molecular taxonomy to obtain insights into the identity of this species. Field observations suggest this species is highly successful, increasing its abundance and distribution over the last years. We compare this new species with the only previous invasive cup coral *Tubastrea coccinea* on the island that has become a permanent member of coral reefs throughout the eastern Caribbean. Although coral colonies are smaller than those of *T. coccinea*, they possess larger polyps when extended and are positioned less cryptic on the reefs. Hence, the species shows similarities to the recent invader *Tubastrea tagusensis* in Brazil. These characteristics might point towards a greater possible impact on native reef organisms. A microbiome comparison based on next generation 16S rRNA amplicon sequencing shows a clear differentiation among compartments (mucus, tissue and gastric cavity), but no differentiation between the newcomer and *T. coccinea* within any of the compartments. Future implications of the newcomer will be discussed.

Keywords: Biological invasion, cup coral, microbiome Curaçao

5/21/15 15:30 PM

Impact of the 2014 bleaching event on upper Florida Keys (USA) *Acropora palmata*

Williams De, Miller MW, Bright AJ, Paus RE

In late summer 2014 severe bleaching was observed in the upper Florida Keys *Acropora palmata* population. Bleaching was first observed in late-August and peaked in mid-September after daily average water temperatures were above 30°C for nearly 2 months. Tagged colonies in twenty-four 150m² study plots at seven fore reef sites monitored for the past 4-10 years were assessed at three to five surveys conducted between June 2014 and February 2015. Colony size and % live was used to estimate live tissue area at each survey. Bleaching severity was visually ranked on a scale of 0-5 at each survey, and bleaching prevalence was calculated as the percent of live tagged colonies displaying even the mildest bleaching. Both prevalence and severity were highest at the mid-September survey and varied widely between sites, but all study plots had at least some mildly bleached colonies. By October some of the more mildly affected colonies began to regain their normal color, while those that were more severely affected remained bleached or began to die. By November very few surviving colonies showed any signs of paling or bleaching, however the more severely bleached tissue was now dead. Additionally, disease-like rapid tissue loss was observed on colonies that were never observed bleached, and on colonies that were bleached in September, even after regaining their normal color. Between June 2014 and February 2015 an average of 25% (+/- 27% SD) of (tagged) colonies in the study plots died. However, live tissue area estimates at the February 2015 survey, indicate a loss of 1/3rd of live *A. palmata* tissue from these sites in the upper Florida Keys from the June 2014 survey.

Keywords: Acroporid, elkhorn, heat stress, zooxanthellae, disease

5/21/15 15:45 PM

Investigating how coral recruitment and juvenile survivorship varies along the Florida Reef Tract

Ruzicka R, Gleason D, Fogarty N

Populations of reef-building corals have not recovered significantly in the Florida Keys even though management actions focused on achieving this goal have escalated over the last several decades. There is a general consensus among scientists that recruitment failure and poor juvenile survivorship have contributed to this lack of coral recovery, but the extent to which these processes have impeded reestablishment is unclear. The Coral Reef Evaluation and Monitoring Project (CREMP) has monitored selected reefs in the Florida Keys since 1996 and the project has successfully documented how numerous stressors have altered reef community composition over the last two decades. This presentation will review the current status of reefs in the Florida Keys and preview a

new intensive effort to characterize coral recruitment and juvenile survivorship across the Florida Reef Tract and use a combination of methods to compare settlement rates on tiles and natural reef substrate. The spatial scale of the project is the largest of its kind in Florida and spans the entire Florida Reef Tract. An additional goal this project is to identify collaborators and/or partners in other regions of the Caribbean so that rates of recruitment and juvenile survivorship can be compared with those obtained in the Florida study.

Keywords: None provided

5/21/15 16:00 PM

Reproductive capacity of the pillar coral, *Dendrogyra cylindrus*, along the Florida reef tract

Kabay LB, Gilliam DS, Lunz KS, Neely KL

The pillar coral, *Dendrogyra cylindrus*, has been commonly described as widely distributed, but rare throughout the Caribbean. In Florida specifically, there have been few observations of pillar coral and the current population status is relatively unknown, although geologic records indicate that historical abundance may have been higher. Along with various environmental and anthropogenic impacts, reproductive limitation may also be contributing to species decline and limiting recovery. *Dendrogyra cylindrus* is a gonochoric, broadcast spawner; synchronously releasing gametes from single-sex colonies into the water column. This characteristic reproductive mode combined with the already rare occurrence of adult colonies may be making it difficult for fertilization to occur; however, the sexual reproductive capacity of this regional population has not yet been studied. Due to its recent designation as Threatened under the US Endangered Species Act, efforts to better understand population status and reproductive behavior is needed to promote species conservation and recovery. In this study, survey data for 573 *D. cylindrus* colonies along the entire Florida Reef Tract (FRT) have been recorded. To investigate reproductive capacity, tissue samples were collected from 94 colonies within 15 sites distributed along the FRT and were prepared via histological techniques. The sex of each colony, gamete sizes, and number of gametes per polyp were recorded and analyzed to determine reproductive potential (fecundity) of individual colonies and also the sex ratio both regionally and also individually for higher density sites. Results from this effort provide essential data to support future conservation and management strategies for this FRT population and comparative data for other Caribbean populations.

Keywords: Conservation, coral reproduction, fecundity, histology

5/21/15 16:15 PM

Genotypic diversity and identity influence restoration potential of the threatened coral species *Acropora cervicornis*

Ladd MC, Shantz AA, Bartels E, Burkepile DE

The decline of coral ecosystems worldwide has prompted the development of active restoration strategies to accelerate the recovery of degraded coral reefs. However, our knowledge of factors that influence restoration success lags far behind restoration activity. Genetic diversity can influence processes that transcend population, community and ecosystem dynamics. Here, we investigated the influence of genotypic diversity and identity on the growth, bleaching resistance and survival of nursery raised *Acropora cervicornis* transplants to identify candidate genotypes for active coral restoration. Cumulative survivorship varied more than 3-fold among genotypes while rates of coral growth varied by more than 200%. Importantly, both growth and mortality were significantly influenced by the interaction between coral outplant genotypic diversity and genotype. Our findings identify important differences in the performance of nursery-raised *A. cervicornis* genotypes and suggest that restoration practitioners should consider both genotype and outplant design when selecting corals for future restoration activities.

Keywords: Restoration, coral reefs, diversity, *Acropora cervicornis*

5/21/15 16:30 PM

Aquatic mesocosm design for effective climate change research

Hundley Jr. PL, Vaughan DE

As an important link between in situ field studies and small scale laboratory experiments, Mesocosm based experiments and models are becoming increasingly popular in climate change and related biogeochemistry research such as ocean acidification and eutrophication. Good mesocosm design addresses ecosystem modelling and resilience, systems complexity, experimental repeatability, operational reliability and cost effectiveness, thus allowing the researchers to focus on the science with minimal distraction from "the system". As these authors see it, the mesocosm research platform should be designed and built upon several key subsystems: 1) seawater supply, 2) tanks and aquaria, 3) biological, chemical and physical environmental quality control, and 4) integrated instrumentation and control devices. Seawater supplies must often be treated and stored prior to delivery to achieve desired water quality. Tanks and aquaria must be of the right size and quantity for replication. Environmental control must accommodate target species and life forms as well inci-

dental and introduced biodiversity. Instrumentation and control systems must robust, user-friendly and conducive to data capture. This presentation will summarize complexity, reliability and cost attributes for several subsystem solutions, and provide an integrated approach to good, aquatic mesocosm design that is matched to climate change research objectives.

Como un importante vínculo Los experimentos con mesocosmos entre estudios del campo in situ e investigaciones del laboratorio del pequeña escala, se han vuelto más popular en los estudios del cambio climático y los investigaciones bioquímicas relacionadas tales acidificación oceánica y la eutrofización. El diseño bueno de mesocosmos se trata la modelización de ecosistemas y la resiliencia, complejidad del sistema, repetibilidad de los experimentos, la fiabilidad del funcionamiento y relación costo-eficacia, lo cual permite que los investigadores enfoquen en la ciencia con distracción mínima del "sistema". En opinión de estos autores la plataforma de investigación mesocosmo debería ser diseñado y construido encima de varios subsistemas claves: 1) suministro de agua de mar, 2) los estanques e acuarios, 3) control de la calidad ambiental biológica, química, y física 4) con instrumentación y aparatos de control integrada. A menudo el suministro de agua de mar debería ser tratado y almacenado para lograr la calidad del agua deseada. Los estanques e acuarios deben ser el tamaño y cantidad correcto para la replicación. El control del medio ambiente debe acomodar los especies y formas de vida objetivos y la biodiversidad fortuita e introducida además. La instrumentación y los aparatos de control deben ser robustos, fáciles de usar y conductores a la recogida de datos. Esta presentación resumirá la complejidad, fiabilidad y atributos del costo de varios soluciones de subsistemas y proveerá enfoque integrado del diseño mesocosmo acuático lo que es ideal para a los objetivos de investigaciones del cambio climático.

Keyword: Climate change, eutrophication, mesocosm, ocean acidification, seawater

5/21/15 16:45 PM

Progress in coral settlement at CARMABI: New tools and new species

Marhaver KL, Medina MM, Vermeij MJA

Recent work at CARMABI has produced a number of new research tools and breakthroughs in the field of coral larval settlement. Most significantly, we successfully reared larvae and settlers of the threatened pillar coral *Dendrogyra cylindrus* for the first time. Although the spawning behavior of this dioecious species makes larval rearing more challenging than in hermaphroditic spawners, the tight temporal timing of spawning that we observed across days and years should enable expanded research on this species across the Caribbean. Working with a variety of

spawning and brooding coral

species, we have also begun testing technologies to enhance larval settlement in the field and lab. Using 3-D printed plastic tiles, we identified color and surface preference for a number of coral species. This will enable future development of underwater surfaces specifically designed to attract corals. We have also identified a variety of cultured bacterial isolates in the laboratory that can individually trigger larval settlement. These bacteria are currently being tested to determine whether they increase the survivorship of out-planted coral settlers on the reef. Overall we hope this progress

will allow for increased effort, and innovation, to increase coral settlement rates on Caribbean reefs.

Keywords: larval behavior, settlement, bacteria, coral reproduction, *Dendrogyra cylindrus*

5/22/15 08:30 AM

Geomorphology of mesophotic coral ecosystems in Puerto Rico and US Virgin Islands

Sherman C, Appeldoorn R

A general geomorphic characterization and classification of insular mesophotic habitats (depths of ~ 50 to 100 m) around Puerto Rico and the US Virgin Islands is presented. Sites are divided into two broad categories of platform or slope. Platforms are designated as insular shelves or isolated banks. Slopes are designated as low gradient (< ~ 30°), steep/high gradient (~ 30-70°) or wall (>70°). Other closely linked factors are also considered including degree of exposure to prevailing seas, occurrence and depth of prominent breaks in slope gradient, proximity to shore and other sediment sources and seafloor roughness/rugosity. Sites examined extend from Mona Island eastward along the southern insular margin of Puerto Rico into the Virgin Islands to Lang Bank off the eastern end of St. Croix. As with the distribution of shallow reefs, mesophotic coral ecosystem (MCE) development is patchy and closely linked to the factors outlined above. Platforms typically have a low-relief, rubble-covered seafloor and limited MCE development dominated by algae and sponges. Low-gradient, rubble-covered slopes are the most common mesophotic habitat encountered and typically associated with more exposed settings. They have limited to moderate MCE development that is concentrated along breaks in slope gradient, which often occur at depths of ~ 50-60 m. High-gradient, high-rugosity slopes are typically associated with more sheltered settings and have the best developed MCEs with dense concentrations of large colonies of *Agaricia* spp. The geomorphology of these sites is dominated by large buttresses that are the locus of MCE development separated by narrow grooves that serve as the primary conduits for downslope sediment transport.

Vertical walls typically display very limited MCE development, likely due to a reduced availability of light. A transition to a vertical escarpment at depths ranging from ~ 55 to 90 m generally marks the local lower limit of MCE development.

Keywords: Mesophotic coral ecosystem (MCE), geomorphology, insular platform, insular slope, US Caribbean

5/22/15 08:45 AM

Combined effects of sedimentation and seawater temperature on the growth and development of juvenile coral spat

Speare KE, Bruno JF, Darling ES, Goodbody-Gringley G

Coral reefs are threatened by anthropogenic impacts worldwide, resulting in widespread reef degradation. Resilience and recovery of reefs are, in part, dependent on recruitment of juvenile corals. Here we investigated the impacts of two known stressors to coral reefs, sedimentation and increased water temperature, on juvenile coral spat. To test the hypothesis that sedimentation and thermal stress have a synergistic negative impact on the growth and development of juvenile coral spat, *Favia fragum* spat were exposed to four experimental treatments: warm-filtered (~30°C;5µm), warm-unfiltered, ambient-filtered (~25°C;5µm), and ambient-unfiltered. After 8-weeks, growth and zooxanthellae density were highest in the ambient-filtered treatment compared to all other treatments. Chlorophyll concentration per zooxanthellae increased in single stress treatments (warm-filtered and ambient-unfiltered) relative to the ambient-filtered treatment, suggesting that increased chlorophyll is a mechanism of photosynthetic compensation for zooxanthellae loss. Notably, there was no difference in survival between the ambient-filtered (86.2%), ambient-unfiltered (91.7%), and warm-filtered treatments (89.1%), indicating that coral spat may be able to tolerate exposure to sedimentation and increased temperature in isolation. Survival was significantly reduced, however, in the warm-unfiltered treatment (54.4%), demonstrating that the combined effects of sedimentation and increased temperature may have a greater impact on survival than either individual stress.

Keywords: Coral recruitment, coral reefs, sedimentation, thermal stress, multiple stressors, interactive effects

Temporal dynamics of diseases of the sea-fan *Gorgonia ventalina* in la Parguera, southwest coast of Puerto Rico

Weil E, Croquer A, Soto D, Flynn K, Lucas M

Gorgonia ventalina is one of the most abundant and widespread octocorals in the Caribbean. The intricate fan network facilitates food capture, photosynthesis, gas exchange and waste disposal. It is also a good trap for waterborne pathogens. *G. ventalina* is susceptible to a suite of diseases of which Aspergillosis (ASP) is the most conspicuous causing local and geographic population declines. In this study, health conditions of all sea fans were assessed between 2003 and 2012, along four permanent band transects (10 x 2m) in each of three depth habitats (1-5; 6-10 and >15m), in each of two inshore (Pelotas and Enrique) and two mid-shelf (Media Luna and Turrumote) fringing reefs, and 8-12 band transects in each of two offshore deep bank reefs off La Parguera, southwest coast of Puerto Rico. Results showed significant increases in mean total disease prevalence in 2005 (39.4 ± 5.6%) and 2010 (62.7 ± 6.9%), two years with high thermal anomalies. Mean prevalence of (ASP) varied between 14.1 % (± 2.3%) in 2003 and 29.1 (± 5.3%) in 2006, a significant increase in incidence (50%) in three years. Mean prevalence of *Gorgonia* multifocal purple spots (GMFPS) increased significantly from zero in 2003 to 34.1% (± 4.3%) in 2011. Growth anomalies (GA) and other ailments had low prevalence. *Gorgonia* waste syndrome (GWS) is a new disease first observed in offshore reefs in 2010, and by 2012, its mean prevalence was up to 11%. Red band (RBD), black band (BBD), and cyanobacteria blooms were seasonal. Mean prevalence of total diseases, GMFPS and ASP were significantly different across depth habitats over time (ANCOVA, $p < 0.0001$). No significant differences in prevalence were found across the inshore-offshore gradient. GMFPS and total disease prevalence covaried significantly ($r^2 = 0.68$; $p < 0.05$) with water temperatures, indicating a positive relationship between global warming and disease increasing prevalence.

Gorgonia ventalina es uno de los octocorales más abundantes y de distribución geográfica más amplia en el Caribe. La morfología del abanico facilita la captura de alimento, fotosíntesis, intercambio de gases y eliminación de residuos, pero también es una trampa para patógenos. *G. ventalina* es susceptible a varias enfermedades, entre las cuales, Aspergillosis (ASP) es la más conspicua, causando mortalidades poblacionales significativas. En este estudio, la salud de todas las colonias presentes se chequeo en cuatro transectas de banda permanentes (10x2m) en cada uno de tres intervalos de profundidad (1-5; 6-10 and >15m), en cada uno de dos arrecifes internos (Pelotas and Enrique), dos intermedios (Media Luna and Turrumote), y en 8-12 transectos en cada uno de dos arrecifes de banco al borde de la plataforma insular de La Parguera, Puerto Rico, entre 2003 y 2012. Resultados muestran incrementos significativos de prevalencia total de enfermedades en 2005 (39.4

± 5.6%) y 2010 (62.7 ± 6.9%), dos años con fuertes anomalías térmicas. Prevalencia promedio de ASP varió entre 14.1 (± 2.3%) (2003) y 29.1 (± 5.3%) (2006), un incremento en incidencia del 50% en tres años. Prevalencia promedio de “*Gorgonia* multifocal purple spots” (GMFPS) aumentó significativamente de cero (2003) a 34.1% (± 4.3) (2011). Tumores (GA) y otros síndromes mostraron baja prevalencia. Una nueva enfermedad se observó en 2010, “*Gorgonia* waste syndrome” (GWS) y para 2011, su prevalencia era 11% (± 2.3%). Banda roja (RBD), banda negra (BBD) y blooms de cianobacterias se ocurrieron estacionalmente. Prevalencia promedio del total de enfermedades, ASP y GMFPS varió significativamente entre profundidades (ANCOVA, $p < 0.0001$). No hubo variación significativa en prevalencia de enfermedades entre la costa y el borde de la plataforma insular. La variación en prevalencia del total de enfermedades y de GMFPS mostró un correlación positiva y significativa ($r^2 = 0.68$; $p < 0.05$) con el incremento en la temperatura del agua como consecuencia del cambio climático.

Keywords: *Gorgonia ventalina*, diseases, temporal variability, Puerto Rico, Caribbean

5/22/15 09:15 AM

Population dynamics of *Thalassia testudinum* in San Andres island, southwestern Caribbean

Giraldo C, Mesa M, Gavio B, Galeano E

Seagrass beds are strategic coastal ecosystems, which provide several goods and services to the marine environment. However, their annual loss (7%) is among the highest on planet. Studies on population dynamics of seagrasses, such as estimation of mortality, recruitment, and life span of the shoots, are useful parameters to evaluate the bed health and may help provide better management strategies for the conservation of this ecosystem. The objective of this research was to evaluate the population dynamics of seagrass beds of *Thalassia testudinum* in San Andres island, in the Southwestern Caribbean. We chose five study sites: Bahía Honda (BH), La Mansión (LM), Rocky Cay (RC), Spratt Bight (SB) and Harbour (HA). The Leaf Emergence Rate (LER) was determined by leaf punching all short shoots (SS) within six 0.02 m² quadrants quarterly at the sites in 2010 and 2011. The mean leaf emergence rate was 0,046 leaves SS-1 d⁻¹. Age structure, mean SS age and longevity were calculated extracting 1m² from each site and counting all leaf scars. The mean SS age varied greatly among sites and ranged between 1,42 (BH) and 4.05 (SB) years. The maximum age of the SS ranged from 5.7 years in BG to 14.9 years in SB. BH showed the highest recruitment (0,60/year), and highest mortality rate (0,42/year), while SB presented the lowest recruitment (0,11/year) and mortality rate (0,18/year). Despite the high recruitment in BH, the very high mortality of young shoots does not allow the SS to live long. Variation of different

environmental factors at microscale may be responsible of the great variation observed among seagrass beds, which are less than 6 km apart.

Keywords: *Thalassia testudinum*, leaf emergence rate, International Biosphere Reserve Seaflower

5/22/15 09:30 AM

Towards a multi-scale model of the impact of flow on growth and form of branching scleractinian corals

Kaandorp JA, Chindapol N, Vermeij MJA

Many branching scleractinian corals tend to develop symmetrical growth forms. A long-standing question is whether radial symmetrical colonies have emerged due to environmental conditions, such as water movement, or the genetic blueprint. To address this issue, we used a computational approach to study whether bi-directional currents cause the radial symmetrical morphology of representative branching corals. Using advection-diffusion equations, we linked a three-dimensional coral growth model to simulate this, by varying bi-directional flow environments. We investigated the relative importance of flow to the corresponding symmetry of the simulated morphologies by changing the Peclet number. We compared the simulated results with in situ collected and CT-scanned colonies of the genus *Madracis* and the species *Pocillopora verrucosa*. The comparisons were based on 10 distinct morphometric traits comprising local morphometric traits, i.e. relevant to the local geometric property of the colony, and symmetry-oriented traits, that involve the measurement of how internal branches change relatively to the direction of the incoming flow. Our results show that morphometric characteristics of simulated corals under bi-directional flow environments correspond with those of real colonies. The three-dimensional advection-diffusion and growth model is in principle suitable to investigate the influence of changing carbonate chemistry and stagnant zones on the growth process. During the presentation we will show some first examples of how we plan to couple the advection-diffusion model with a simple physiological model.

Keywords: Morphogenesis, scleractinian corals, hydrodynamics

5/22/15 09:45 AM

Is *Acropora palmata* really coming back? An analysis from Los Roques, Venezuela

Cróquer A, Cavada F, Zubillaga AL, Agudo E

Ten years ago, we studied the distribution and status of

Acropora palmata at Los Roques because the actual status of this species in Los Roques was unclear after its regional collapse. We aimed to produce a baseline study putting the status of *A. palmata* in Los Roques in a regional context. At that time, our results suggested that this species had the potential to come back at least in 12 surveyed sites. This conclusion was based upon high abundance, low disease prevalence, high genetic diversity and a dominance of sexual reproduction in these populations. However, we recognized that the potential of recovery could be hindered depending on local and regional threats. In 2014, we decided to re-evaluate the status of this species by increasing the number of sites from 12 to 106 and by taking into account local threats. Our results show that *A. palmata* had a restricted distribution being present in 15% of the surveyed sites. Large stands of dead colonies were common throughout the archipelago. In most cases live colonies were large adults (© 2m height); however, partial mortality and degradation of living tissues were also very common (45%) and also most of the colonies (44.78%) were located on degraded reefs. In the past 8 years, two massive bleaching events occurred in Los Roques; the last one decreasing live coral cover to unprecedented levels (40-45%) in the archipelago. These events might have produced significant mortality for this species. Moreover, a growing local tourism industry, which has become massive and the concomitant increase of pressure on ecosystems goods and services are both becoming a problem of serious concern. Our results suggest that increasing use conflicts within the MPA and global threats such as ocean warming could prevent the recovery of this vulnerable species in Los Roques.

Diez años atrás estudiamos la distribución y el estatus de *Acropora palmata* en Los Roques debido a que el estatus actual de esta especie no estaba claro luego del colapso regional de sus poblaciones. Nuestro objetivo fue producir una línea base de la especie en Los Roques, dentro del contexto regional. En ese entonces, nuestros resultados sugirieron que estas poblaciones tenían el potencial de recuperarse, al menos en los 12 sitios muestreados. Esta conclusión se basó en la alta abundancia, diversidad genética y dominancia de reproducción sexual encontradas en estas poblaciones. Sin embargo, reconocimos que el potencial de recuperación podría verse disminuido, dependiendo de amenazas locales y globales. EN 2014, decidimos re-evaluar el estatus de la especie incrementando los sitios de muestreo de 12 a 106 y tomando en consideración amenazas locales. Los resultados de esta re-evaluación muestran que la especie actualmente posee una distribución restringida a 15% de los sitios, mientras que a lo largo del archipiélago se identificaron grandes porciones de *A. palmata* con mortalidad vieja. En la mayoría de los sitios las colonias adultas eran de gran tamaño (~2m); sin embargo la mortalidad parcial también fue común (45%) y muchas de las colonias (44.78%) se encontraban en arrecifes degradados. En los últimos 8 años, dos eventos masivos de blanqueamiento ocurrieron en Los Roques; el último disminuyendo la cobertura de tejido vivo a niveles sin precedentes (40-50%). Estos eventos pu-

dieron haber producido una mortalidad significativa para la especie. Además el crecimiento reciente de la industria turística y la concomitante presión sobre los bienes y servicios ecosistémicos del Parque, se han convertido en serios problemas. Nuestros resultados sugieren que el incremento en conflictos de uso dentro del parque y las amenazas globales como el calentamiento de los océanos podrían prevenir la recuperación de esta especie en Los Roques.

Keywords: *Acropora palmata*, status, recovery, threats, surveys, Los Roques

5/22/15 11:30 AM

Coral dimethylsulfoniopropionate: responses to light and stress, and interrelations with bacterial assemblages in surface mucus

Frade PR, Schwaninger V, Glasl B, Sintes E, Hill RW, Simó R, Herndl GJ

Dimethylsulfoniopropionate (DMSP), a sulfur substance often implicated in climate regulation, is copiously produced by coral holobionts and thought to play a role in structuring coral-associated bacterial communities. We tested the hypothesis of a linkage between DMSP availability within coral tissues and the community dynamics of bacteria in coral surface mucus. We determined coral DMSP concentrations in situ at a reef location on Curaçao in three coral species (*Meandrina meandrites*, *Porites astreoides* and *Siderastrea siderea*) at two sampling depths (5 and 25m depth) and daytimes (dawn and noon). DMSP concentrations (range: 4-400 nmol cm⁻² coral surface) varied with host species-specific traits such as Symbiodinium cell abundance, but not with depth or time of collection. An experimental approach showed coral holobionts respond to stress (air exposure) by doubling their DMSP concentration. We further characterized the phylogenetic affiliation of mucus-associated bacteria by clone libraries targeting three main subclades of the bacterial DMSP demethylase gene (*dmdA*), whose abundance was then quantified by qPCR against a reference housekeeping gene (*recA*). Relative demethylase gene abundance (*dmdA/recA*) ranged from 1-19% for subclade A/2, 0.1-9% for C/2 and 2-75% for D/3. Overall, higher availability of DMSP corresponded to lower relative abundance of *dmdA* genes, a counterintuitive result, however likely explained by a competing DMSP degradation pathway (cleavage) favored under higher DMSP concentrations. Moreover, the DMSP-*dmdA* relationship was not constant across all host species or bacterial *dmdA* subclades, suggesting the existence of distinct DMSP microbial niches and/or varying *dmdA* DMSP affinities. This is the first study providing a quantification of *dmdA* gene assemblages in corals and linking related changes in the community dynamics of DMSP-degrading bacteria to DMSP availability. Our findings suggest DMSP mediates the

interplay between corals and microbes, highlighting the importance of sulfur compounds for microbial processes in corals and for the resilience of coral reef ecosystems.

Keywords: None provided

5/22/15 11:45 AM

Potential role of dimethylsulfoniopropionate in structuring the black band disease community of corals

Waikel PA, Gillevet PM, Richardson LL

The significance of dimethylsulfoniopropionate (DMSP) in the biogeochemical sulfur flux from the marine to terrestrial environment was first described more than 40 years ago. Since that time, the function of this abundant sulfur compound has expanded to include osmolyte, cryoprotectant, predation deterrent, bacterial carbon and sulfur source, and bacterial chemoattractant. Once thought to be produced solely by photosynthetic organisms (primarily marine phytoplankton), DMSP was recently shown to be produced by the coral animal with increased production during thermal stress. Combined with previous metagenomic evidence that more than 65% of microbial genera implicated in DMSP metabolism are associated with corals, this suggests that DMSP may influence the structure of coral-associated bacterial communities, including those of disease. This study examined four black band disease (BBD) metagenomes generated by next generation sequencing with Illumina technology. Preliminary analysis using the MG-RAST platform suggests that both the demethylation and bacterial cleavage pathways involved in DMSP metabolism may play a role in structuring the BBD community. To date, more than 2000 sequences associated with DMSP metabolism have been identified among the four metagenomes. Specifically, sequences associated with genes *dmdA* (demethylation pathway) and *dddD* (bacterial cleavage) were identified in all four metagenomes. Additionally, genes *dddL*, and *dddR* were identified in three of the four BBD metagenomes. Elucidating the role of DMSP in structuring the BBD community will improve our understanding of the dynamics within this disease community and provide insight into the etiology and persistence of BBD as well as other coral diseases.

Keyword: Dimethylsulfoniopropionate, black band disease, DMSP, BBD

5/22/15 12:00 PM

Effect of temperature on quorum sensing signal molecules in black band disease heterotrophs

Bhedi CD, Prevatte CW, Lookadoo MS, Campagna SR,

Richardson LL

One of the most intricate and damaging coral diseases is black band disease (BBD) which is comprised of four contributing microbial groups (photoautotrophs, sulfide oxidizers, sulfate reducers and heterotrophs) that act in conjunction for BBD progression. Of these, the heterotrophic bacteria have been recently shown to produce quorum sensing (QS) signal molecules, including AHLs (acyl homoserine lactones) which have been acknowledged to contribute to a variety of virulence factors in bacterial infections worldwide. BBD strikes corals when sea water temperature exceeds 28 °C. Hence the predominant goal of this project was to evaluate the influence of temperature on QS signal production by heterotrophic bacteria isolated from BBD. 38 isolates from surface mucopolysaccharide layer (SML) of healthy corals (HSML), 36 from healthy SML of BBD infected corals (BSML) and 156 from BBD were assessed for production of quorum sensing signal molecules by a *Chromobacterium violaceum* CV026 bioassay. 24 QS positive heterotrophic bacteria were then exposed to varying temperatures (24°, 27°, 30° C), to assess the role of temperature on abundance of AHLs using LC-MS/MS. Out of a total of eight AHLs that were detected, 3OHC4 was found to be most abundant (17 of the 24 isolates), followed by C6 (13 out of 24 isolates). Statistical analysis of the results has revealed each AHL to be affected to a varying degree, with 3OHC4, 3OHC5 and 3OHC6 being the most significantly affected. Further analysis will be required to determine the exact effect on BBD pathogenesis, however, these results are a strong indication that temperature does influence QS signal production and abundance by BBD heterotrophs. Understanding the effect of temperature on AHL production will further assist in decrypting the role of quorum sensing in BBD pathogenesis and community structure, with the aim of discerning the etiology of one of the most destructive coral diseases.

Keywords: Black band disease, Quorum sensing, Coral, Acyl Homoserine Lactones

5/22/15 12:15 PM

Caribbean Acroporid tissue loss: toward a new paradigm of coral disease

Peters EC

Beginning in the early 1970s, scientists at the West Indies Laboratory, St. Croix, U.S. Virgin Islands, reported tissue loss occurring in the elkhorn corals (*Acropora palmata*) forming the reef crest at Tague Bay. Similar incidents were observed throughout the Caribbean, resulting in partial to complete mortalities of elkhorn and staghorn (*A. cervicornis*) and their hybrid (*A. prolifera*) corals, with marked depletion of their populations. Four categories of acute to subacute tissue loss (focal, multifocal, or diffuse), not

associated with predation by corallivores, have now been identified on Caribbean acroporids, based on rate and pattern of tissue loss: white-band disease type I (WBD-I), white-band disease type II (WBD-II), white pox or white patch disease (WPD), and rapid tissue loss (RTL). Several bacteria have been associated with the tissue losses and one shown by Koch's postulates to cause this type of damage; however, results of most studies have been inconclusive, indicating a possible role for abiotic pathogenesis and a need to use other diagnostic tools. These species are now being propagated asexually by reef scientists and managers to restore reefs and increase opportunities for natural spawning and recruitment, but fragments in nurseries and outplanted fragments sometimes succumb to tissue loss. New experiments and method developments began with the discovery, by molecular analyses, of Rickettsiales-like organisms (RLOs) in the tissues of staghorn corals. Histopathological examinations have shown them to be present in diseased and apparently healthy acroporids sampled in the early 1980s at Tague Bay and widespread in present populations. These bacteria are the primary pathogen. The new paradigm of acroporid tissue loss disease must recognize the involvement of the entire holobiont, an infectious agent that kills the coral mucocytes (not just dysbiosis in the surface mucopolysaccharide layer), and functional impairment in cellular processes distant from the tissue loss margin.

Keywords: *Acropora* spp., Caribbean Sea, white-band disease, white pox, rapid tissue loss, pathogens

5/22/15 13:30 PM

The impact of coral species diversity on White Plague Disease transmission

Williams LM, Brandt ME

Coral diseases have increased in severity over the past thirty years. One disease that has been shown to cause widespread mortality is white plague (WP). Although this disease affects more than 30 species of coral in the Caribbean, very little is known about how it is transmitted among species or how species-specific characteristics may affect transmission. In the US Virgin Islands, this disease primarily affects *Orbicella* species. WP is positively correlated with *Orbicella* abundance but not with other susceptible species abundances, suggesting that this species group may be a preferred host and may facilitate transmission. Therefore, promoting factors that increase coral species diversity could decrease the spread of WP. This project used laboratory experiments to investigate WP transmission among multiple species in order to understand species-specific responses to disease. Healthy and diseased colony subsamples of *Orbicella annularis*, *Porites astreoides* and *Siderastrea siderea* were assigned to either treatments or controls. Treatment corals were placed in tanks with diseased corals of either the same or

different species and monitored for signs of disease. Corresponding controls were placed in tanks with apparently healthy corals. We expect that intraspecific transmission rates will be higher than interspecific transmission and that the highest rate of transmission will occur between healthy and diseased *O. annularis* colonies. This project is the critical next step to understanding the behavior of this disease among diverse Caribbean reefs.

Keywords: White plague disease, host, transmission

5/22/15 13:45 PM

Strengthening reef resilience via active Acroporid restoration: can 8 years' of results in Belize be replicated in other replenishment zones?

Carne L, Kaufman L

Coral restoration efforts have become accepted widely as an active management tool but still lack a realistic sense of scale, achievable goals and success indicators. Since the Caribbean acroporids are listed by the IUCN as 'Critically Endangered', a general goal of restoration efforts is to prevent their extinction. More specific goals are to restore lost ecosystem services like shoreline protection, fisheries enhancement, biodiversity preservation, and provisioning of aesthetic and economic services for the tourism industry. Continuity is key to ecosystem service values, which requires that the restored coral community be (1) self-sustaining and self-propagating, and (2) resilient against persistent insults. Genetic diversity must be addressed regardless of propagation methods (sexual versus asexual). Longevity may can be increased by identifying coral genotypes that are resilient to thermal stress, disease and/or predation. How much genetic diversity is needed? What amount of coral coverage, and placed where, is needed to trigger natural regenerative processes at larger scales? Presented here are data from eight years' of acroporid restoration efforts at Laughing Bird Caye National Park, Belize, where over 17,000 nursery-grown acroporid fragments are have been out-planted. Data were acquired on host and algal clade diversity, rates of growth and survival, bleaching history, reproductive (spawning) indicators, methods for measuring live coral cover over time, methods to assess changes in fish biomass on out-planted sites, and mechanisms to include local community members in the work. We suggest realizable goals and success indicators, offer guidance for expanding restoration efforts to new sites, and recognize Marine Protected Areas and stakeholder involvement as key to coral restoration.

Los esfuerzos en pro de la restauración de Coral se han convertido en aceptado ampliamente como una herramienta de gestión activa pero aún falta un sentido realista de la escala, metas alcanzables y los indicadores de éxito. Desde el Caribe acroporí figuran en la lista de la UICN como "En Peligro Crítico", un objetivo general de

las iniciativas de restauración es para evitar su extinción. Más objetivos específicos para restaurar servicios de los ecosistemas como protección del litoral, la pesca mejora, conservación de la biodiversidad y de la provisión de servicios estética y económica para la industria del turismo. Continuidad es la clave de los valores del servicio los ecosistemas, que requiere que la comunidad de coral se restaura (1) autosostenido y multiplicación, y (2) resistentes contra los insultos. Diversidad genética debe abordarse independientemente de métodos de propagación (sexual y asexual). La longevidad puede aumentarse mediante la identificación de los genotipos que son resistentes al estrés térmico, la enfermedad y/o la depredación. La diversidad genética es necesario? ¿Qué cantidad de cobertura de coral, y se coloca donde es necesario para desencadenar procesos regenerativos natural a una escala mayor? Aquí se presentan son los datos de ocho años de los esfuerzos en pro de la restauración de los acroporidos en Laughing Bird Caye, Belice Parque Nacional, donde más de 17.000 cultivados en viveros acroporidos son fragmentos han sido plantados. Los datos fueron adquiridos en el host y clado diversidad algal, las tasas de crecimiento y supervivencia, corales, historia reproductiva (desove) indicadores, los métodos de medición de cubierta de coral vivo con el tiempo, los métodos para evaluar los cambios en biomasa de peces en sitios plantados, y mecanismos para promover la participación de los miembros de la comunidad local en el trabajo. Le sugerimos objetivos realizables y los indicadores de Éxito, ofrecen orientación para ampliar los esfuerzos en pro de la restauración de sitios nuevos, y reconocer las Áreas Marinas Protegidas y la participación de los interesados directos como un actor clave para restauración de coral.

Keywords: Caribbean acroporids, restoration, genetic diversity, success indicators

5/22/15 14:00 PM

Distribution and abundance of the invasive lionfish along a depth gradient in Bermuda: identification of deep reef "hotspots"

Eddy C, Smith SR, Pitt JM, Chequer AD, Goodbody-Gringley G

Invasive lionfish are now ubiquitous throughout the Caribbean, having established themselves in a variety of marine habitats, including coral reefs, mangroves, sea grass beds, coastal estuaries and deep waters up to 300m. High densities of lionfish are drastically affecting biodiversity and community structure of reef fish communities, and could constitute the most significant ecosystem change since the beginning of industrialized fishing. Little is known about the size and distribution of the lionfish population and how they are impacting fish and invertebrate populations in Bermuda. We surveyed lionfish densities in a 25x10 m quadrat on 12 reef sites at each of five

depth bands (10 m, 20 m, 30 m, 45 m, and 60 m). Concurrently, six prey fish surveys were conducted at each site by counting and identifying all fish less than 15 cm encountered along a 30 m transect. We found distinct distribution patterns of lionfish with depth, where densities increased significantly on deeper reefs. At the deepest sites surveyed (60 m), lionfish densities reached an average of 347 fish per hectare. Although there was no significant difference in prey density with depth, the greatest densities were found at the deepest sites (60 m), seemingly driven by an abundance of three species (*Paranthias furcifer*; *Chromis bermudae*; *Chromis insolatus*). Diversity, on the other hand, decreased with increasing depth, with mean species richness values of 29 and 24 at shallow (10-30 m) and deep (45-60 m) sites, respectively. These data imply that lionfish densities on deep reefs are not related to prey fish density, but rather are likely due to physical features of these sites such as decreased wave energy. However, the presence of lionfish on deep reefs may be reducing prey fish diversity by preferentially targeting certain species. Further analyses of feeding behavior and gut content need to be performed to determine the impact of these invasive populations on mesophotic reef populations.

Keywords: none provided

5/22/15 14:15 PM

Shedding light on dissolved organic carbon release by benthic reef algae

Mueller B, van Duyl FC, Vermeij MJA

Benthic algae release a substantial part of their photosynthetically fixed carbon as dissolved organic carbon (DOC) into the surrounding water. This algal DOC plays a crucial role in the carbon cycling on coral reefs and is considered to be a main driver in coral-algal interactions. While an increasing number of studies focuses on the fate and consumption of DOC by microbes and sponges, the environmental factors that drive the DOC release are less well understood. Therefore, we investigated the effect of (1) light, (2) nutrients, and (3) their combined effects on the DOC release of reef algae. To test the effect of light, we determined the DOC release rates of three common reef algae under different light intensities. These incubations were complemented with in situ measurements to test whether light availability can serve as a predictor for elevated DOC concentrations in close proximity to the reef alga *Dictyota* sp.. In a second set of incubations the DOC release of turf algae was determined at two light levels (reduced and full light) and two nutrient treatments (natural and enriched sea water), following a factorial design. All three reef algae tested released DOC and this release followed a positive relation with light. While elevated DOC concentrations near *Dictyota* sp. were encountered in situ, light availability did not prove to be a good predictor for the occurrence of elevated DOC concentrations. In

natural sea water the DOC release of turf algae followed a positive relation with light. When nutrients were added, DOC release rates at both light levels were comparable to those of the natural sea water treatment at full light. These findings suggest that both light and nutrient availability affect the DOC release of benthic reef algae and that nutrients determine whether a positive relation with light prevails.

Keywords: DOC, light, nutrients, benthic algae

5/22/15 14:30 PM

Disease in the deep: coral white plague in mesophotic coral ecosystems

Brandt ME, Smith TB, Clemens E, Sevier M

Mesophotic coral ecosystems (MCE) represent potential refugia from local stressors and climate change. MCE often reside at depths and at distances from shore that protect them from the negative effects of runoff and other nearshore anthropogenic activities. They also typically experience cooler thermal environments, potentially buffering them from thermal stress that leads to bleaching. In the US Virgin Islands, both shallow reefs and MCE experienced declines in coral cover following the 2005 mass bleaching event due in large part to outbreaks of the disease white plague. However, declines on shallow reefs were more drastic, reducing coral cover to 10% or less, while MCE continued to support high cover, approx. 30%, of the same species. Since the 2005 event, white plague has been nearly absent from shallow reef sites while continuous levels of disease in the MCE are possibly hindering the regrowth of coral lost during the 2005 event. Our records of gross visual characteristics and histopathological analysis suggest that white plague signs from MCE and shallow reefs represent the same disease. Our spatial data also suggest that the disease is clustered at multiple scales. We therefore hypothesize that continuous levels of white plague in MCE are due to density-dependent disease transmission dynamics and that a lack of hosts are limiting transmission in shallow reef systems, resulting in lower disease incidence.

Keywords: Coral disease, white plague disease, Mesophotic coral ecosystems, US Virgin Islands

5/22/15 14:45 PM

Herbivory, recruitment failure, and four decades of slow regime shifts on Jamaican coral reefs

Hughes T

Until Hurricane Allan struck Jamaica in 1980, coral cover

routinely exceeded 50%, *Acropora palmata* and *cervicornis* were abundant, and macroalgae cover was typically 1 or 2%. Fish abundances were low, and the primary macro-herbivore was *Diadema antillarum*. The die-off of *Diadema* in 1983 resulted in an unprecedented bloom of macroalgae that overgrew corals and prevented new recruitment. Thirty years later, *Diadema* remains absent at most locations that have been repeatedly censused along the north coast. It has begun to recover at a small number of sites, although where it is present its density is still below pre-1983 levels. Mortality and recruitment failure of corals and of *Diadema* are the primary drivers of two alternate trajectories. The prevalent trajectory over the past 40 years is characterized today by the continued absence of *Diadema*, >95% macroalgae, and almost no corals. Much less commonly, *Diadema* has partially returned, macroalgal cover has declined to approximately 5-10%, and coral cover now exceeds 30%. However, no coral species today has yet reached its former abundance of the 1970's, *Acropora* has virtually disappeared, and the contemporary assemblage structure is widely divergent from the classical descriptions of Goreau and others. The partial recovery of coral cover indicates the critical role of herbivory by *Diadema*, and the importance of recruitment in shaping alternative regime-shifts.

Keywords: Corals, herbivory, *Diadema*, recruitment, regime shifts

5/22/15 15:30 PM

Sexual coral restoration: shortened nursing periods and new settlement substrates improve the effectiveness of restoration methodologies

Chamberland VE, Vermeij MJA, Petersen D

At present, sexual coral restoration methods are too costly and labor-intensive to be applied on scales large enough to face with coral reef decline in its current geographical scale. Coral larvae are generally settled onto artificial substrates and raised in land-based or ocean nurseries for several months to years to allow recruits to reach a larger size before they are outplanted. However, maintaining nurseries and manually outplanting each individual substrate is time consuming and expensive. Here, we tested whether the effectiveness of restoration efforts could be improved by 1) shortening ex situ nursing periods from 1.5 years to two weeks, and by 2) developing new settlement substrates (i.e., the tetratriangles) that can be outplanted in a time- and cost-effective way. We report for the first time the successful outplanting and long-term survival (1.5 year) of large numbers of *Acropora palmata* recruits reared from gametes. After 1.5 years, 47% of the substrate units on the reef still harbored one or more well-developed recruit, compared to 10% for those kept in a land-based nursery. This shortened nursing period also reduced the costs to produce a single 1.5 year old A.

palmata-substrate unit from US\$71 to US\$9. *Favia fragum* larvae settled on the tetratriangles in large numbers (70% of the larvae settled) and were deployed onto the reef two weeks post-settlement. Each tetratriangle was outplanted in less than 20 seconds by simply wedging the substrate unit into a small crevice in the reef structure. After 6 months, >65% of the tetratriangles had remained in place and still harbored at least one live *F. fragum* recruit. This new settlement substrate significantly reduces costs and labor associated to current outplanting techniques. Our findings describe two promising approaches by which restoration efforts could be scaled up in a logistically and economically viable manner.

Keywords: Sexual coral reproduction, *Acropora palmata*, coral propagation, cost-benefit analysis, tetratriangles, outplanting

5/22/15 15:45 PM

Resource partitioning along multiple niche axes drives functional diversity in parrotfishes on Caribbean coral reefs

Adam TC, Kelley M, Ruttenberg BI, Burepile DE

Over the last several decades, corals have declined and algae have increased on many Caribbean reefs. Parrotfishes play a key role in controlling algae, and there is increasing concern that fisheries targeting parrotfishes could compromise the functioning of reef ecosystems. Different species of parrotfishes are likely to play unique functional roles, and effective management requires understanding the level of functional diversity present within the parrotfish guild. We investigated functional diversity among Caribbean parrotfishes by documenting habitat-use, diet-selection, and foraging behavior of nine species in the Florida Keys National Marine Sanctuary. We found large differences in diet selection that were well predicted by phylogenetic history, with closely related species feeding on similar types of algae. Fishes in the genus *Scarus* targeted filamentous algal turfs, crustose coralline algae, and endolithic algae and avoided macroalgae, while fishes in the genus *Sparisoma* preferentially targeted macroalgae. However, species with similar diets were dissimilar in other attributes, including the habitats they frequented, the types of substrate they fed from, and the spatial scale over which they foraged. These differences indicate that species that appear to be functionally redundant when looking at diet alone exhibit high levels of complementarity when we consider multiple functional traits. By identifying key functional differences among parrotfishes, we provide critical information needed to manage parrotfishes to enhance the resilience of coral-dominated reefs and reverse phase shifts on algal-dominated reefs throughout the wider Caribbean.

Keywords: Biodiversity, fishing, functional group, herbiv-

ory, parrotfish

5/22/15 16:00 PM

Presence of a second foundation species alters seagrass ecosystem structure and function

Archer SK, Layman CA

Foundation species form the structural basis for many ecosystems and are characterized by positive interactions with community members. Multiple foundation species often co-occur within the landscape, frequently increasing diversity beyond that expected from either species in isolation. Seagrasses are a classic example of foundation species which form large beds, creating structured habitat both above and below ground and influencing important ecosystem processes. Sponges, which can also be foundation species, alter the physical environment in many ways including provisioning of structured habitat which is utilized by numerous invertebrates and fishes. Although sponges are a common component of seagrass beds, there is a paucity of knowledge regarding how the two types of species interact to structure associated communities. In a long-term experiment we determined the effect of a sponge, *Ircinia felix*, on the structure of a *Thalassia testudinum* dominated seagrass bed on Abaco Island, The Bahamas. In June 2013, fifteen 25m² plots were established; five containing a single, live *I. felix*, five with a polypropylene model sponge, and five controls. Seagrass density, community structure, growth and nutrient content, as well as macroalgae, macroinvertebrate, and fish abundance and diversity were measured prior to live or model sponge placement. All variables have been measured twice a year in July and November since establishment. By November 2014, plots containing live *I. felix* contained significantly more species-rich fish and macro-invertebrate communities. Over the course of the experiment, there was no significant change in the shoot density of *T. testudinum*; however, in plots containing an *I. felix* the shoot density of *Syringodium filiforme* and *Halodule wrightii* increased significantly. Taken together, these results show that the presence of a sponge may increase diversity of seagrass communities.

Especies de la Fundación son la base estructural para muchos ecosistemas y se caracterizan por interacciones positivas con los miembros de la comunidad. Especies fundación Múltiples menudo co-ocurren dentro del paisaje, aumentando con frecuencia la diversidad más allá de lo esperado de cualquiera de las especies aisladas. Los pastos marinos son un ejemplo clásico de especies fundamentales que forman camas grandes, creando hábitat estructurado tanto por encima como por debajo del suelo y afectar los procesos ecosistémicos importantes. Esponjas, que también pueden ser especies fundamentales, alteran el entorno físico de muchas maneras, incluyendo la provisión de hábitat estructurado que es utilizada por nu-

merosos invertebrados y peces. Aunque las esponjas son un componente común de las praderas marinas, hay una escasez de conocimientos sobre cómo los dos tipos de especies interactúan para estructurar las comunidades asociadas. En un experimento a largo plazo a fin de determinar el efecto de una esponja, *Ircinia felix*, de la estructura de una cama de hierba marina *Thalassia testudinum* dominado en la isla de Abaco, Bahamas. En Junio de 2013, se establecieron quince parcelas de 25m²; cinco que contiene una sola, *I. felix* vivo, cinco con un modelo de polipropileno esponja, y cinco controles. Seagrass densidad, estructura de la comunidad, el crecimiento y el contenido de nutrientes, así como macroalgas, macroinvertebrados, y la abundancia de peces y la diversidad se midieron antes de vivir o colocación modelo esponja. Todas las variables se han medido dos veces al año, en julio y noviembre desde el establecimiento. En noviembre de 2014, las parcelas que contienen en vivo *I. felix* contenían un número significativamente mayor de peces y macro - invertebrados comunidades ricas en especies. En el transcurso del experimento, no hubo ningún cambio significativo en la densidad de brotes de *T. testudinum*; Sin embargo, en las parcelas que contienen un *I. felix* la densidad de brotes de *Syringodium filiforme* y *Halodule wrightii* aumentó significativamente. Tomados en conjunto, estos resultados muestran que la presencia de una esponja puede aumentar la diversidad de las comunidades de algas marinas.

Keywords: none provided

5/22/15 16:15 PM

Patch dynamics and species shifts in seagrass communities under moderate and high grazing pressure by sea turtles

van Tussenbroek BI, Molina Hernández AL

We studied 2 seagrass beds in the Mexican Caribbean grazed by green turtles. Puerto Morelos received a moderate grazing impact (< 20% of the area was grazed), whereas at Akumal, 45-55% of the bed was grazed. At Puerto Morelos, leaf elongation rates of the seagrasses *Thalassia testudinum*, *Syringodium filiforme* and *Halodule wrightii* were lower in grazed than ungrazed areas. At Akumal, leaf growth rates were lower than at Puerto Morelos, but differences in leaf growth rates in grazed and ungrazed areas were not significant. Average above-ground seagrass biomass decreased at grazing: at Puerto Morelos from 134.4 to 13.4 dry g m⁻², and at Akumal from 50.3 to 6.6 dry g m⁻². At Puerto Morelos, the turtles practiced rotational grazing maintaining grazed patches for 13 months to >2 years, creating a mosaic of grazed, ungrazed patches and areas recovering from grazing. The abundance of the faster growing *H. wrightii* and rhizophytic algae increased in the grazed areas, whereas that of *T. testudinum* decreased. Abundance of *S. filiforme* decreased when the turtles opened-up new grazing areas, but it

remained stable afterwards because the turtles usually avoided consumption of this seagrass. Full recovery of the grazed patch to pre-grazed conditions has not yet been observed, thus will more than 2 years. At Akumal, the system approached carrying capacity for grazing, and the turtles had abandoned their rotational feeding habit. Here, the dominant climax seagrass *T. testudinum* became less abundant from 2008 until 2012, resulting in a less patchy landscape with low seagrass biomass and higher prevalence of the early seral species *H. wrightii*.

Estudiamos 2 praderas de pastos marinos en el Caribe mexicano ramoneadas por las tortugas verdes. Puerto Morelos recibió un moderado impacto (< 20% de la superficie fue ramoneado), pastoreo mientras que en Akumal, 45-55% de la cama fue pastoreado. En Puerto Morelos, las tasas de crecimiento de las hojas de los pastos *Thalassia testudinum*, *Syringodium filiforme* y *Halodule wrightii* fueron inferiores en las áreas pastoreadas que los que no recibieron impacto de herbivoría. En Akumal, las tasas de crecimiento foliar fueron inferiores que las en Puerto Morelos, pero no se encontraron diferencias entre las áreas si y con pastoreo por parte de las tortugas. La biomasa por encima del suelo disminuyó con el pastoreo: en Puerto Morelos de 134.4 a 13.4 g seco m⁻² y en Akumal de 50.3 a 6.6 g seco m⁻². En Puerto Morelos, las tortugas practicaban pastoreo rotacional manteniendo los parches durante 13 meses a > 2 años, creando un mosaico de parches pastoreo, sin pastoreo y recuperando del pastoreo. La abundancia de las algas de *H. wrightii* y algas rizofíticas aumentó en las zonas de pastoreadas, mientras que la de *T. testudinum* disminuyó. Abundancia de *S. filiforme* disminuyó cuando las tortugas abrieron nuevas zonas de pastoreo, pero permanecía estable luego porque las tortugas suelen evitar el consumo de esta fanerógama. Todavía no se ha observado recuperación completa de las áreas pastoreadas a condiciones previas al pastoreo, así será más de 2 años. En Akumal, el sistema se acercó a capacidad de carga para el pastoreo, y las tortugas habían abandonado sus hábitos de alimentación rotatoria. Aquí, el pasto climax *T. testudinum* llegó a ser menos abundante desde 2008 hasta 2012, lo que resulta en un paisaje menos variado con una biomasa más baja de pastos marinos y la dominancia de la especie colonizadora *H. wrightii*.

Keywords: *Chelonia mydas*, plant-herbivore interactions, rhizophytic algae, rotational grazing, seagrass

5/22/15 16:30 PM

Infection by the parasitic isopod, *Anilocra haemuli* on french grunt (*Haemulon flavolineatum*) is associated with changes in host movement patterns

Welicky RL, Sikkel PC

Risk of parasitism may be an important contributing cause or consequence of animal movement patterns. The

diel movement patterns of French grunt, a common Caribbean coral reef fish, are well documented and known to connect reef and seagrass habitat. In the northeastern Caribbean, French grunt are known to be infected by *Anilocra haemuli*, one of the largest, most conspicuous ectoparasitic isopods. Studies on *Anilocra* infection have demonstrated that infection reduces host-swimming performance and may alter host behavior. We tested predictions of the hypothesis that *A. haemuli* infection influences the movement patterns of host French grunt, specifically whether short-distance daytime movements and/or reef-seagrass migration was associated with infection. We conducted focal observations on infected and uninfected fish during daytime resting and dusk migration periods. We also conducted daytime and nocturnal reef surveys, documenting changes in *A. haemuli* prevalence of infection. We found infected fish move significantly less than uninfected conspecifics during the day, and observed 100% of uninfected and 37.5% of infected fish departing the reef during dusk. Prevalence of infection was significantly greater at night compared to daytime. We suggest *A. haemuli* infection alters host movement patterns and parasitism may therefore indirectly influence trophic connectivity between reef and seagrass ecosystems.

Keywords: Diel activity patterns, coral reef, fish aggregation, Haemulidae, movement

5/22/15 16:45 PM

Historical biogeography of recently diverged coral reef fish lineages

Eytan RI, Hellberg ME, Dornburg A, Near TJ

It is difficult to employ phylogenetic models of historical biogeography for nascent species due to population genetic processes such as incomplete lineage sorting, which result in paraphyletic or polyphyletic phylogenetic trees. Species tree methods accommodate incomplete lineage sorting; however, it is difficult to assign individual gene sequences to a putative species for recently diverged and morphologically cryptic taxa. One approach to overcoming the problem of incomplete lineage sorting is to delimit species using multi-locus DNA sequence data prior to phylogenetic analyses. In this study we combine species delimitation methods with species tree inference and likelihood based analyses of the historical biogeography of a group of recently diverged lineages of the Caribbean reef fish species *Acanthemblemaria spinosa*. By combining these methods, we are able to determine the timing and direction of colonization of *A. spinosa* lineages throughout the Caribbean. Specifically, we ask if lineages have dispersed in the direction of prevailing surface currents and if colonization has been stepwise throughout the Caribbean. The methods we employ here may provide a useful framework for inferring the historical biogeography of recently diverged lineages.

Es difícil emplear modelos filogenéticos de la biogeografía histórica para especies nacies debido a procesos genéticos de la población, como linaje incompleta clasificación, que se traducen en los árboles filogenéticos parafiléticos o polifilético. Métodos de árboles de especies acomodan linaje incompleta clasificación; sin embargo, es difícil asignar secuencias de genes individuales a una especie putativos para taxones recientemente divergido y morfológicamente críptico. Un enfoque para superar el problema de clasificación incompleta linaje es delimitar especies utilizando multi-locus datos de la secuencia de DNA antes de los análisis filogenéticos. En este estudio se combinan especies métodos de delimitación con la inferencia especies de árboles y la probabilidad análisis basados de la biogeografía histórica de un grupo de linajes divergieron hace poco del Caribe especies de peces de arrecife *Acanthemblemaria spinosa*. Mediante la combinación de estos métodos, estamos en condiciones de determinar el tiempo y la dirección de la colonización de los linajes *A. spinosa* en todo el Caribe. En concreto, nos preguntamos si los linajes se han dispersado en la dirección de las corrientes superficiales que prevalecen y si la colonización ha sido escalonadamente en todo el Caribe. Los métodos que empleamos aquí pueden proporcionar un marco útil para inferir la biogeografía histórica de los linajes divergieron hace poco.

Keywords: none provided

Abstracts of poster presentations

First record of epibiont diatom from larval stage of shellfish gastropod *Strombus gigas*

Aldana-Arana A, Muciño-Márquez RE, Sánchez-Crespo M, Hernández-Almeida OU, Figueroa-Torres MG

The epibiosis occurs frequently on the shells of some marine crustaceans, which often serve as substrate for various species of algae, viruses, or fungi, there is few information on the symbiotic associations between diatoms and ciliates. Particularly with marine planktonic crustaceans, has been reported between the epibiont diatom *Pseudohimantidium pacificum* with the copepod *Farranula gibbula*. In mollusks was found in the literature, epibiont partnerships with diatoms. The objective of this study was to determine if the gastropod mollusk *Strombus gigas* in its larval stage pre and post metamorphic had some sort of the symbiotic with diatoms. To the above was carried out collecting egg masses in the environment, the larvae were cultivate in seawater filtered 5 μm and fed with a monoalgal culture of *Nannochloropsis oculata*. The larva was maintained in culture during their larval stage, with total water changes every 48 h at a density of 100 larvae \times L-1 and fed a ration of 1000 cells algal \times Larva-1. Larvae 80 μm sieved and subsequently fixed in glutaraldehyde, and subsequently passed cacodylate an alcohol series to absolute alcohol. Subsequently were processed at critical point for observation in scanning electron microscopy. We analyzed 11 larvae aged 11-44 days for analyzing the structure of the shell and its epibionts. All larvae had diatoms, having itself identified five genera *Amphora*, *Cocconeis*, *Diploneis*, *Nitzschia* and *Thalassionema*. Three larvae of 44 days were completely covered by the diatom *Thalassionema cf. nitzschioides*, whose average abundance was ± 500 organism \times mm, followed by *Amphora* sp. with ± 50 organism \times mm, possibly by opportunistic capacity of *T. cf. nitzschioides* forming chains. These results are the first record of diatoms in the larval stage of the mollusk *S. gigas*.

La epibiosis se presenta con frecuencia sobre los caparazones de algunos crustáceos marinos, que a menudo sirven de sustrato a diversas especies de algas, virus, u hongos, existiendo poca información sobre las asociaciones simbióticas entre diatomeas y ciliados. Particularmente con crustáceos planctónicos marinos, se ha reportado la epibiosis entre la diatomea *Pseudohimantidium pacificum* con el copépodo *Farranula gibbula*. En moluscos no se encontró en la literatura consultada, asociaciones epibióticas con diatomeas. Por lo anterior, el objetivo del presente trabajo fue conocer si el molusco gasterópodo, *Strombus gigas* en su fase larval pre y post metamórficas presentaban algún tipo de asociación de epibiosis con diatomeas. Para lo anterior se llevo a cabo la colecta de masas de huevos del medio natural, las larvas fueron cultivadas en agua de mar filtradas a 5 μm y alimentadas con un cultivo monoalgal de *Nannochloropsis oculata*. Las larvas se mantuvieron en cultivo durante su fase larvaria, con recambios totales de agua cada 48 h a una densidad de 100 larvas \times litro⁻¹ y se alimentaban con una ración de 1000 células algales \times Larva⁻¹. Las larvas se tamizaron a 80 μm y posteriormente se fijaron en

glutaraldehído, cacodilato y posteriormente se pasaron en una serie de alcoholes hasta alcohol absoluto. Posteriormente se procesaron a punto crítico para su observación en microscopía electrónica de barrido. Se analizaron 11 larvas de edades entre 11-44 días para analizar la estructura de la concha y sus epibiontes. Todas las larvas presentaron diatomeas, habiéndose identificado cinco géneros *Amphora*, *Cocconeis*, *Diploneis*, *Nitzschia* y *Thalassionema*. Tres larvas de 44 días estuvieron completamente cubiertas por la diatomea *Thalassionema cf. nitzschioides*, cuya abundancia promedio fue de ± 500 organismos \times mm, seguida de *Amphora* sp. con ± 50 organismos \times mm, posiblemente por la capacidad oportunista de *T. cf. nitzschioides* que forma cadenas. Estos resultados son el primer registro de diatomeas en epibiosis en la fase larval del molusco *S. gigas*.

Keywords: Epibiont, diatom, gastropod, *Strombus gigas*

Cyerce antillensis is a small marine sacoglossan sea slug that feeds on and inhabits siphonous green macroalgae

Barber K, Middlebrooks M, Pierce S

C. antillensis can be found throughout the Caribbean and Florida in warm shallow waters. The body of *C. antillensis* is covered in long translucent appendages called cerata. These dorsal appendages can be autotomized, likely as a defensive mechanism, when the slug is threatened. After autotomization the cerata begin contracting, which may distract predators and allow the slug to escape. Cerata that have been autotomized can be regenerated. In this experiment *C. antillensis* were collected from the algae *Penicillus capitatus* in Tarpon Springs, FL, placed into separate containers, and agitated until cerata became autotomized. After autotomization cerata contraction times and regeneration rates were measured and recorded. Autotomized cerata were able to continue contracting for as long as 30 minutes. Complete regeneration of cerata took between 5-15 days. This study demonstrates the potential for how quickly *C. antillensis* is able to recover from sub-lethal predation events.

Keywords: sea slug, regeneration, cerata, anti-predatory defense, autotomy

White pox prevalence and its relation to the human pathogen, *Serratia marcescens*, in the US Virgin Islands

Beasley V, Brant M

Coral disease has been widespread throughout the Caribbean in recent years. *Acropora palmata* is a once dominant Caribbean coral species that has been particularly decimated by disease (Patterson, et al., 2002; Gardner et al., 2003). Acroporid serratiosis, or white pox disease, has been a major contributor to its demise (Sutherland et al., 2004). The causative agent of white pox in the Florida Keys is known to be the bacterial pathogen *Serratia marcescens* (also found in the human gut) (Patterson et

al., 2002). However, it is unknown whether white pox signs in the US Virgin Islands are the same etiology as that observed in the Florida Keys, because similar signs may represent different etiologies (Pollock et al. 2011). This study examines the relationship between the occurrence of *S. marcescens* and white pox disease in *A. palmata* populations in the US Virgin Islands. Sampling occurred at 3 sites varying in anthropogenic influence, where *A. palmata* populations were locally abundant and white pox disease was known to occur. Coral mucus samples were analyzed from diseased and healthy *A. palmata* along with healthy *S. siderea* (used as a procedural control) using qPCR to determine the presence and abundance of *S. marcescens*. Water samples were also analyzed with qPCR to determine presence of *S. marcescens* and other enterococcus. Prevalence of disease was also measured at sample sites using circular plots. This study will provide the first evidence for Acroporid serratiosis in the US Caribbean.

Keywords: *Acropora palmata*, *Serratia marcescens*, White pox disease, Virgin Islands, Coral disease

Seagrass biome protection in the USVI: a conservation biology perspective

Beasley V, Duggan A, Mitchell S, Williams L, Arencibia M, Brown J, Primack A, Wyllie-Echeverria S

According to Short and Wyllie-Echeverria (1996) seagrasses are in decline globally. Two seminars were held in fall of 2013 and spring of 2014 where the students studied the state of seagrass science in the USVI. Following quantitative review methods established by Duarte (1999), the biological literature for studies on seagrass species in the US Virgin Islands were searched. A bibliometric analysis showed that between 1995 and 2013 the highest number of papers written on USVI seagrasses in one year was 3. The papers covered habitat, human disturbance, population dynamics, natural disturbance, reproduction, physiology, distribution, and paleoecology. A GIS analysis of seagrass distribution maps in the USVI showed that the seagrass distribution maps from 1999 and 2001 could not be compared to because different mapping methods were used to create them. In order to quantify seagrass distribution and density as well as bathymetry a pilot study was conducted using hydroacoustics to map submerged aquatic vegetation. We looked into the possibility that protected swimming and snorkeling zones might provide an “umbrella effect” and protect seagrasses as well and surveyed many of the USVI beaches to determine which ones had protected areas. References: Duarte C. M. 1999. Seagrass ecology at the turn of the millennium: challenges for the new century. *Aquatic Botany* 65 (1-4): 7-20. Short F. and S. Wyllie-Echeverria. 1995. Natural and human-induced disturbance of seagrasses. *Environmental Conservation* 23: 17-27

Keywords: Seagrass, United States Virgin Islands

Worldwide reef ball coastal restoration

Beggs LD, Barber T, McFarlane J

As a result of natural disasters and human impact, coral reefs,

marshes, oyster beds, mangroves and other marine habitats are in need of preservation and restoration. Worldwide there has been a significant loss of marine ecosystems. Research has shown a need to: increase juvenile fish habitats, increase oysters in estuaries, protect shoreline, increase sediments in marshes. Reef Balls® were selected for the projects because: the design and testing of the product demonstrated the quality and characteristics to meet project needs. Reef Balls utilize pH balanced, marine-grade concrete, with a textured surface and without environmental toxins. Reef Balls® were designed to mimic natural ecosystems. Reef Balls® have a history of staying where they are placed. The process involved a site survey, permitting, deployment and monitoring of the modules. Reef Balls have been placed in various ecosystems around the world. The success of Reef Balls has been demonstrated over the past 22 years with projects in over 60 different countries. Studies and analysis of data collected from numerous sites have shown Reef Balls to be an excellent material for: fish habitat, mangrove restoration, breakwater for beach stabilization and nourishment, oyster bed development, coral transplanting and preservation, as well as the reestablishment of living shorelines. Reef Balls have been successful in meeting the objectives of marine restoration projects around the world.

Como resultado de los desastres naturales y el impacto humano, arrecifes de coral, marismas, lechos de ostras, los manglares y otros hábitats marinos están en necesidad de conservación y restauración. Worldwide ha habido una pérdida significativa de los ecosistemas marinos. La investigación ha demostrado la necesidad de: aumentar los hábitats de peces juveniles, aumentar las ostras en los estuarios, proteger la costa, aumentar los sedimentos en los pantanos. Arrecife Balls® fueron seleccionados para los proyectos debido a que: el diseño y prueba del producto demostraron la calidad y las características para satisfacer las necesidades del proyecto. Reef Balls utilizan pH balanceado, de grado marino de hormigón, con una superficie texturizada y sin toxinas ambientales. Arrecife Balls® fueron diseñados para imitar los ecosistemas naturales. Arrecife Balls® tienen una historia de permanecer donde se colocan. El proceso consistió en una inspección del lugar, permisos, implementación y seguimiento de los módulos. Reef Balls se han colocado en diferentes ecosistemas de todo el mundo. El éxito de Reef Balls se ha demostrado en los últimos 22 años, con proyectos en más de 60 países diferentes. Estudios y análisis de los datos recogidos de numerosos sitios han mostrado Reef Balls ser un excelente material para: hábitat de los peces, la restauración de manglares, rompeolas para la estabilización de la playa y la nutrición, el desarrollo criadero de ostras, trasplante de corales y conservación, así como el restablecimiento de las líneas costeras que viven. Reef Balls han tenido éxito en el cumplimiento de los objetivos de los proyectos de restauración marinos de todo el mundo.

Keywords: World Wide Marine Restoration

No evidence of reduced growth rate trade-off for *Acropora cervicornis* harboring *Symbiodinium trenchii* (clade d1a) in southern Belize

Carne L, Cho-Ricketts L

Active restoration began at Laughing Bird Caye National Park (LBCNP) in 2006 and six *in-situ* nurseries were established in 2009 to scale up the effort. Host and symbiont genetics were analyzed on 23 acroporids. Corals housing *Symbiodinium* Clade D spp. purportedly have high resistance to what are now semi-regular bleaching events. Because this thermal tolerance is thought to come with a trade-off of reduced growth rates, experiments in 2012 compared growth rates between multiple *Acropora cervicornis* genets housing Clade A3 or *S. trenchii* (D1a) cultured on ropes in two nurseries. The corals harboring *S. trenchii* (D1a) symbionts (N=61) grew an averaged 2.8 cm/month +/-0.08 cm/month; corals harboring A3 symbionts (N=61) averaged 2.4 cm/month growth +/-0.07 cm/month; $t(60)=-3.15$, $p<0.0025$. Growth rate experiments using Total Linear Extension (TLE) were repeated in 2013, using only two distinct genotypes of *A. cervicornis* harboring either symbionts A3 or *S. trenchii*, in two nursery locations. There were significant differences in growth rates when the two host-symbiont combinations were compared. The corals housing *S. trenchii* (D1a) (N=60) averaged 19.3 cm/month +/- 1.2 cm/month and the corals housing A3 (N=55) averaged 13.9 cm/month +/- 1.0 cm/month; $t(54)=-5.44$, $p<0.0001$. When growth rates between two nursery sites, one at 2 m, one at 5 m, were compared independent of clade, there were also significant differences, with all corals growing faster at the shallow nursery. These results suggest that there are few trade-offs in growth for colonies of *A. cervicornis* harboring populations of stress-tolerant *Symbiodinium trenchii*, in these *in-situ* nursery conditions in southern Belize, and that here, shallow nurseries promote faster growth than deeper sites. Genetic analyses of both partners in the coral holobiont should be mandatory tool in active restoration efforts to better track resilience over time.

Recuperación activa comenzó a reír Bird Caye National Park (LBCNP) en el año 2006 y seis euros *in situ* se establecieron viveros en 2009 a escala. Host y simbioses genética se analizaron acropi el 23. Vivienda Corales *Symbiodinium* clade D spp., supuestamente tienen alta resistencia a lo que ahora son semi-regular de corales. Porque esta tolerancia térmica se cree que vienen con el intercambio de una disminución de la tasa de crecimiento, la realización de experimentos en 2012 en comparación las tasas de crecimiento entre varios *Acropora cervicornis* ginetas vivienda clado A3 o *S. trenchii* (D1a) cultivadas en cuerdas en dos viveros. Los corales que albergan *S. trenchii* (D1a) simbioses (N= 61) creció un promedio 2,8 cm/mes / -0,08cm/mes; corales albergan A3 simbioses (N= 61) promedio 2,4 cm/mes crecimiento / -0,07 cm/mes; $t(60) = -3.15$, $p<0,0025$. Tasa de crecimiento Total experimentos de extensión lineal (TLE) se repite en 2013, con la utilización de sólo dos genotipos de *A. cervicornis* refugio o simbioses A3 o *S. trenchii*, vivero en dos lugares. Hubo diferencias significativas en las tasas de crecimiento cuando las dos combinaciones de simbioses se compararon. Los corales vivienda *S. trenchii* (D1a) (N= 60) promedio 19,3 cm/mes / - 1,2 cm/mes y los corales vivienda A3 (N= 55) promedio 13,9 cm/mes / - 1,0 cm/mes; $t(54) = -5,44$, $p<0.0001$). Si las tasas de crecimiento entre los dos en los viveros, uno en 2m, 5m de frente independiente de clade, también hay diferencias significativas, con todos los corales crecen más rápido en el vivero poco profundas. Estos resultados sugieren que hay algunos inconvenientes en el crecimiento de las colonias de *A. cervicornis* albergan poblaciones de resistentes al

stress *Symbiodinium trenchii*, en estas condiciones de vivero *in situ* en el sur de Belice, y que aquí, viveros superficial promover un crecimiento más rápido de lugares más profundos. Análisis genéticos de las dos partes de la coral holobiont herramienta debería ser obligatorio en los esfuerzos en pro de la restauración de un mejor seguimiento resistencia en el tiempo.

Keywords: none provided

The “our Florida reefs coastal use survey”: an online survey to support stakeholder management recommendations for southeast Florida

Costaregni AR, Walker BK, Waters L, Chen C

High concentrations of human activities in southeast Florida have resulted in pressures and associated impacts that adversely affect the coastal marine environment. The Our Florida Reefs (OFR) community planning process has engaged local stakeholders to make management recommendations alleviating the human pressures on Southeast Florida's reefs, to balance reef-use and protection. An opt-in online survey was created to gather spatial information on where and how people used the coastal marine environment in southeast Florida (Miami-Dade to Martin counties) in the past year. Through an interactive map, the survey allows people to choose an activity, location, and how many days that area was visited. As of January 15th, 2015, over 150 surveys were completed. This resulted in over 1,000 data points mapped, representing over 40 activities. Data were compiled into a map format to determine spatial use patterns within and amongst different user groups. These maps provide valuable information on ways to address user conflicts and conserve the environment. The survey data, along with many other scientific and social data, are being programmed into an interactive decision support tool that the OFR community working groups (CWGs) will use to evaluate spatial relationships, understand trade-offs, and develop spatial plans for the protection of Southeast Florida's reefs.

Keywords: Reefs, Southeast Florida, Management, Survey, Conservation, Coastal Use

Yellow band disease disrupts coral-zooxanthellae mutualistic relationship in the coral *Orbicella faveolata*

Cover M, Marin O, Croquer A

Yellow Band Disease (YBD) is a syndrome that affects *Orbicella* species, a genus comprising the dominant reef-building corals of the Caribbean region. It is believed that YBD-pathogens target the zooxanthellae rather than the coral hosts for YBD tissues suffer significant reductions of zooxanthellae and also because structural damages on their symbiotic algae have been observed. Nevertheless, comparisons of photosynthetic performance between healthy and YBD corals are scarce. This paper aimed to compare the photosynthetic efficiency from healthy to YBD tissues and its impact on tissue biomass. For this, three samples were collected from each of five healthy (H) and a set of fifteen YBD colonies. For YBD corals, apparently healthy (AH), transition (TR) and YBD tissues were collected to measure quantum yield and ETR as proxies of photosynthetic performance. In addition, these samples were fixed in p-formaldehyde, decalcified in 10% v/v HCl solution and dried for 48 h to determine the biomass of coral tissues. Both the chlorophyll-a concentration and the density of zooxanthellae were estimated using standard procedures. These variables were then correlated with quantum yield and ETR. An analysis of variance based on permutations (PERMANOVA) to test whether the YBD has any effect on the estimated variables was also performed. We found a 60-70% reduction in photochemical activity decrease ($F= 5.5$, $df = 3$, $p<0.05$) and zooxanthellae density ($F= 6.7$, $df = 3$, $p<0.05$) from healthy and diseased tissues. The coral biomass decreased by an order of magnitude in YBD lesions compared to healthy tissues, showing a significant and positive correlation with yield ($r = 0.77$, $p < 0.05$) and ETR ($r = 0.81$, $p < 0.05$). These results indicate that YBD disrupts the coral-zooxanthellae mutualistic relationship and supports that not only the structure but also the function of these algae is being affected by the disease.

Keywords: none provided

Population Structure of fireworm *Hermodice carunculata* in the Caribbean, eastern Atlantic and Mediterranean Sea

Cruz M, Schizas N

The bearded fireworm *Hermodice carunculata* is an important invertebrate scavenger distributed in reefs worldwide. *Hermodice carunculata* is an ideal species to work with because of its biphasic life style (planktonic larvae and benthic adults). Ecologically, this is a very important species inhabiting the coral reefs, since as a facultative corallivore it preys upon corals and has been shown to transfer pathogenic agents between coral colonies. The effects of predation on certain reef groups can be substantial. For example Witman (1988) calculated that tissue predation by fireworms on fire corals exposed 12.9 cm² per 1 m² per day of skeleton to algal colonization. There exists limited data on the genetic population structure of *H. carunculata* because its cryptic nature. There have been ambiguous findings in past studies. One study used morphology to differentiate East and West Atlantic populations and propose the presence of multiple fireworm species. However, another study used modern

molecular techniques to confirm that *H. carunculata* is indeed a 'cosmopolitan species' and show that the morphological differences do not reflect the observed genetic population structure. Genetic analyses provide valuable information regarding population structure, gene flow and demographic history of any species. We utilized sequence data from two mitochondrial markers (cytochrome c oxidase subunit I, cytochrome b) to examine the genetic diversity of *H. carunculata* from several locations in Caribbean, East Atlantic and Mediterranean. There is substantial genetic diversity within *H. carunculata* and preliminary evidence suggests the presence of at least two cryptic species in multiple locations.

Keywords: fireworm; *Hermodice carunculata*; cytochrome c oxidase subunit I; cytochrome b; population structure

Environmental factors associated with hatch success in St Kitts leatherback sea turtles (*Dermochelys coriacea*)

Dennis MM, Stewart K, Bergfelt D

Anthropogenic causes have resulted in substantial decline in leatherback sea turtles (*Dermochelys coriacea*) in the Caribbean region. The species has a high rate of embryonic death for unknown reasons; hence, protection of eggs and successful hatching are critical for population recovery. Our study is designed to identify key risk factors of the nest environment associated with poor hatching success and to describe the pathology of nonviable late stage leatherback embryos and hatchlings. Preliminary data show differential hatch success on two beaches in St Kitts, in association with differences in pollution and industrial activity at one nesting site compared to the other. Developmental anomalies and lesions to indicate infectious diseases have been not been observed in preliminary histopathological evaluation of late stage embryos or dead-in-nest hatchlings. Field investigations are underway to examine the association between poor hatch success and physical sand characteristics, presence of marine litter, micro-plastics, and exposure to heavy metals and organic contaminants, including endocrine-disrupting chemicals. This study has immediate implications for nest management, including planning nest relocation or hatchery-rearing. Embryo environmental contaminant levels comprise an important contribution to baseline values in sea turtles locally and more broadly and could be used as a bioindicator that the nesting site ecosystem and public health are at risk.

Keywords: none provided

Gametogenesis and oocyte size variability in the oyster *Crassostrea virginica* (Gmelin) from Veracruz lagoons, Mexico

Diaz MRE, Valencia JDCS, Morales GIM, Aranda DA

A study of gametogenesis and oocyte size variability was carried out from January to December 2011 in the lagoons of Pueblo Viejo, Tamiahua and Tampamachoco north of Veracruz, Mexico. Histological sections of the 90 oysters' gonads were observed and four gonadal stages were identified: I) rest, II) gametogenesis, III) maturation and IV) spawning. Comparison between

reproductive stages and lagoons showed difference between oysters of Pueblo Viejo versus oysters of Tamiahua and Tampamachoco lagoons. The number of oocyte observed was 5 256 oocytes at Tamiahua oysters, 4 665 at Tampamachoco and 3 939 at Pueblo Viejo. On the other hand the oocyte sizes at maturation stage was different between oyster of Tamiahua (30.37 μm) versus oysters of Tampamachoco (34.07 μm) and Pueblo Viejo (32.84 μm) lagoons. In the spawning stage the gonad displayed two oocytes types, i.e. unreleased cells and the cells resulting from oogonia multiplication, there were two modal oocytes classes ($6 \pm 1.19 \mu\text{m}$ and $36 \pm 1.0 \mu\text{m}$). High temperature values were correlated with the oysters maturation stage in Tampamachoco and Tamiahua, while spawning was associated with low salinity in the same lagoons. The greater abundance of organisms at rest stage was associated with the lowest values of temperature observed at Tamiahua and Tampamachoco. Nevertheless, the low salinity, were associated with a greater abundance of oysters at rest stage in the lagoon of Pueblo Viejo. The results of oocytes diameter and histological gonad examination from Veracruz lagoons showed a continuous reproductive cycle, and the same reproductive pattern for oyster of Tamiahua and Tampamachoco lagoons even though the oocyte size was lower for Tamiahua oysters. This study combines qualitative and quantitative characteristics for an evaluation of reproductive stages in *C. virginica*.

Keywords: Reproduction, oocyte size, American oyster, Veracruz

Reconstructing Caribbean shark baselines using fossil dermal denticle assemblages

Dillon E, O'Dea A, Cramer K, Norris R

Mounting evidence suggests that shark populations worldwide have been decimated by overfishing, reef degradation, and pollution, but to precisely what extent remains unknown. This project aims to help reveal "pristine" Caribbean shark communities by extracting fossil shark dermal denticles from mid-Holocene (~7ka) in situ Caribbean reefs in Panama and the Dominican Republic and comparing them to dermal denticles from equivalent modern reefs in both regions. The number of denticles can be used as a proxy for the relative abundance of sharks, and shark families are documented to have distinctive denticle morphologies, allowing a comparison of both the size and taxonomic composition of shark assemblages over time. We have currently excavated sediment from fossil and modern reefs in Bocas del Toro, Panama. Carbonate in the sediments is digested using acetic acid, and the dermal denticles are picked. They are well-preserved but sparse; roughly 8 kg of reef sediment yields an average of 30 denticles. Thus far, we have extracted ~150 denticles representing four different functional morphotypes and three families (Carcharhinidae, Ginglymostomatidae, and Sphyrnidae). Preliminary results suggest that dermal denticles accumulated approximately three times faster in fossil sediments than in modern sediments and that there was a greater diversity of denticle morphotypes in the past. These data will ultimately assist in the establishment of more accurate conservation goals for reef sharks in the Caribbean.

La evidencia creciente sugiere que las poblaciones de tiburones

en todo el mundo han sido diezadas por la pesca excesiva, degradación de los arrecifes, y la contaminación, pero se desconoce hasta qué grado precisamente. El objetivo de este proyecto es ayudar a revelar las comunidades "prístinas" de tiburones en el Caribe. Vamos a extraer denticulos dérmicos de tiburones fósiles en arrecifes Holocenos (~7 ka) en Panamá y República Dominicana y estos compararlos con denticulos de arrecifes modernas equivalentes en ambas regiones. Se puede utilizar el número de denticulos en el sedimento como un marcador de la abundancia relativa de tiburones. También, las familias de tiburones tienen denticulos con morfologías distintivas, lo cual permiten una comparación del tamaño y composición taxonómica de los arreglos de tiburones entre el pasado y el presente. Hemos excavado sedimentos de arrecifes fósiles y modernos en Bocas del Toro, Panamá. Digerimos el carbonato en los sedimentos con ácido acético antes de recuperar los denticulos. Ellos están bien preservados pero escasos; hay un promedio de 30 denticulos en aproximadamente 8kg de sedimento. Actualmente, hemos extraído ~150 denticulos que representan cuatro morfologías funcionales diferentes y tres familias (Carcharhinidae, Ginglymostomatidae, y Sphyrnidae). Los resultados preliminares sugieren que los denticulos se acumularon aproximadamente tres veces más rápido en los sedimentos fósiles que en sedimentos modernos y que había una mayor diversidad de morfologías de denticulos en el pasado. Estos datos ayudarán en el establecimiento de metas de conservación más objetivas para tiburones en el Caribe.

Keywords: Functional morphology, overfishing, paleoecology, pre-human, shark communities, shifting baselines

Molecular tools for population ecology and genetics of the proliferating seaweed *Lobophora variegata*

Engelen AH, Coelho N, Vermeij MJA, Serrão E

Worldwide coral coverage is decreasing on tropical reefs, whereas algae become more abundant. Over the last decades, the brown isomorphic biphasic seaweed *Lobophora variegata* has become a dominant reef member on most reefs from 40 to 10 m depth around Curaçao. In the past, this species was more confined to its current lower distribution depth and abundances were considerable lower. Although the species has functioned as the first model species for coral-seaweed interaction studies, many aspects of its ecology have still been unexplored. By developing the first microsatellites markers for this species we hope to gain insights in cryptic species, the relative roles of vegetative vs. sexual reproduction, haploid vs diploid life phase, diversity and population differentiation across geographical scales (from cms to Caribbean wide) and depth and dispersal capabilities of the species. Here we will present the first preliminary insights these new markers have provided as well as their future potential.

Keywords: *Lobophora*, microsatellites, molecular ecology, connectivity, diversity

Effect of climate change on reproductive strategies of the eastern oyster *Crassostrea virginica* in tropical lagoon of the Mexican Gulf of Mexico

Management is based on a minimum legal size of 80 mm and several seasonal bans that vary along the coast of the Gulf of Mexico. We describe the gonad development cycle of *Crassostrea virginica* (Gmelin 1791) in Tamiahua lagoon (21°22' 23.7"N y 97°26'44.1"W), Gulf of Mexico for the years, 60s, 80s, 2000 and 2010. Significant differences in duration and intensity were observed among reproductive stages, associated with different environmental conditions. In the 60s, average of temperature in Tamiahua lagoon was 20 °C and salinity 17 PSU. Gonadal cycle of *C. virginica* was characterized by subsequent gonadal stages with a clear rest period, then gametogenesis, later maturity and spawning. In 2010, average temperature was 27 °C with a maximum of 32°C and salinity fluctuated from 24 to 34 PSU. Under these environmental conditions, reproductive cycle of oyster was characterized by an intense and continuous gametogenesis throughout the year. Maturity and spawning presented the same pattern with a peak between June to September. Although *C. virginica* is eurythermal and euryhaline species, these parameters affect gametogenesis, condition index and spawning of this species. The warm ranges of current temperature in this lagoon are causing oysters reproduce continuously throughout the year. However the larvae could not find food availability throughout the year and their mortality rate is higher. Global warming could be an environmental reason affecting negatively the rate of recruitment of this species and therefore the rehabilitation of banks.

La pesquería del ostión americano *Crassostrea virginica* es una de las pesquerías costeras más importantes de México. La gestión se basa en un tamaño mínimo legal de 80 mm y vedas estacionales que varían a lo largo de la costa del Golfo de México. En el presente trabajo se describe el ciclo de desarrollo de las gónadas de *Crassostrea virginica* (Gmelin 1791) en la Laguna de Tamiahua (21 ° 22 ' y 97 ° 23.7" N 26' 44.1" W), Golfo de México para el año, 60s, 80s, 2000 y 2010. En los años 60, el promedio de la temperatura en la Laguna de Tamiahua fue 20°C y salinidad 17 PSU y su ciclo gonadal se caracterizó por presentar etapas gonadales secuencias, con un período de descanso claro, posteriormente una fase de gametogénesis, luego de madurez posteriormente de desove. En 2010, la temperatura media fue de 27°C, con un máximo de 32°C y la salinidad fluctuó 24-34 PSU. En estas condiciones ambientales, el ciclo reproductivo se caracterizó por un gametogénesis, madurez y desove continuos durante todo el año. Aunque *C. virginica* es una especie euritermal y eurihalina. Las gamas cálidas actuales de esta laguna están causando que el ostión se reproduzca de forma continua durante todo el año. Sin embargo las larvas no encuentran disponibilidad de alimentos durante todo el año y su tasa de mortalidad es más alta a mayores temperaturas. El calentamiento global podría ser una razón ambiental que afecta negativamente la tasa de reclutamiento de esta especie y, por tanto, la rehabilitación de sus bancos.

Keywords: Global warning, gonad development, eastern oyster, *Crassostrea virginica*

Disruption of the pathogenicity determinant protein a gene (pdpA) in *F. noatunensis* subsp. *orientalis* results in attenuation and a greater susceptibility to oxidative stress

Farrell F, Hansen J, Illanes O, Verma A, Soto E

Francisella noatunensis subsp. *orientalis* (Fno) is an emergent warm-water fish pathogen and the causative agent of francisellosis in tilapia (*Oreochromis* sp). The Fno pdpA gene encodes the *F. tularensis* pathogenicity determinant protein A-homologue. In *F. tularensis*, pdpA has been shown to be necessary for intracellular growth and virulence; however, the role of the Fno pdpA gene in the pathogenesis of piscine francisellosis is unknown. In this project, the virulence of two different marker-based Fno pdpA mutants (Δ pdpA-1 and Δ pdpA-2) generated in opposing polarity and its wild type parent strain was investigated following immersion challenges in hybrid red tilapia (*Oreochromis* sp.). Fingerlings were challenged with 6 different concentrations of each strain in 10 gallons of static fresh water at 25°C for 1 h. Mortalities were recorded twice daily for a period of 21 days, and bacterial concentrations in the spleen were evaluated by bacterial plate counts in survivor fish 21 days post-challenge. Both mutant strains were highly attenuated when compared to the wild type parent strain. The Lethal Dose (LD)₅₀ in both mutants was greater than 2x10⁶ CFU per ml of water; whereas the LD₅₀ in the WT strain was 891 CFU per ml of water. The polarity in the mutation caused greater attenuation in the Δ pdpA-2 strain when compared to the Δ pdpA-1. No Δ pdpA-2 bacterium was recovered from any of the surviving fish; resulting in a Infective Dose (ID)₅₀ greater than 1x10⁷ CFU/ml of water. On the other hand, the infective dose of the Fno Δ pdpA-1 and WT strain was estimated to be 6.8x10⁶ and <200 CFU/ml. Additionally, oxidative mediated killing was investigated utilizing hydrogen peroxide at varying concentrations. Compared to the Δ pdpA, the wild type parental strain was more resistant to oxidative killing. This data identifies the pdpA gene product as an important virulence factor in Fno.

Keywords: Tilapia

Reef fish spatial distribution and benthic habitat associations on the northern Florida Reef Tract

Fisco D, Walker B, Kilfoyle K, Smith S, Spieler R

The Florida Reef Tract (FRT) extends from the tropical Caribbean up the southeast coast of Florida into a temperate environment where tropical reef communities diminish with increasing latitude. Analyses of benthic habitat maps between Miami-Dade and Martin Counties have been used previously to define specific ecological sub-regions. Different benthic community metrics throughout the region show general latitudinal trends, but comprehensive regional benthic and fish studies are lacking. This study uses data from a comprehensive survey of reef fish to quantify their spatial distribution along the FRT and define where the community shifts from tropical to temperate. A total of 1,072 reef fish visual census surveys were conducted to assess reef fish populations on randomly-selected sites of all marine hardbottom habitats shallower than 33 m depth between the Miami River and St. Lucie inlet over the course of two years. Multivariate analyses were used to investigate differences

in assemblages among sites associated with previously defined sub-regions and benthic habitats. There were two distinct communities, a highly variable one associated with shallow habitats (<12 m) and a more homogeneous one in deeper habitats (12-33 m). The Broward-Miami shallow reef fish assemblage differed significantly from the assemblages further north on similar habitat type. The deep assemblage was similar in the southern regions, but shifted towards a more variable assemblage of temperate species in the North Palm Beach and Martin regions. There was a significant peak in species richness in the South Palm Beach region. This change occurred near the Lake Worth inlet at the Bahamas Fracture Zone where the Florida current diverges from the coast and changes in benthic communities have been identified. North of this location, the reefs encounter more intense and more frequent cold water temperature spikes which lead to a change in the reef fish and benthic community constituents.

Keywords: none provided

A specialized coral-symbiodinium-bacteria community deep down on a Caribbean reef

Frade PR, Elisabeth NH, Hay KB, Englebert N, Latijnhouwers KRW, Bak RPM, Vermeij MJA, Herndl GJ, Hoegh-Guldberg O, Bongaerts P

The composition, ecology and environmental conditions of mesophotic coral ecosystems thriving near the lower limits of their bathymetric distribution are only poorly studied. We combined visual submersible surveys (aboard the Curasub, Substation Curaçao), temperature monitoring, a coral growth experiment, and genotyping of the coral host, its photosynthetic endosymbiont assemblages (*Symbiodinium*) and associated bacterial communities, to provide the first comprehensive assessment of a lower mesophotic coral community (60-100 m) in the Southern Caribbean. The lower mesophotic zone of Curaçao harbored a specialized coral community consisting of predominantly *Agaricia grahamae*, *Agaricia undata* and a “deep-water” lineage of *Madracis pharensis*, plus rare occurrences of *Montastraea cavernosa*, *Agaricia lamarcki* and *Stephanocoenia intersepta*. All three predominant species exhibited large colonies down to their rather abrupt lower distribution limits, and were associated with “deep-specialist” *Symbiodinium* genetic types (determined by rRNA ITS2-DGGE). Microbial community composition (16S rRNA gene sequencing) was mostly host-specific but certain bacterial taxa were exclusively present in the lower mesophotic zone. Surprisingly, fragments of *A. grahamae* exhibited growth rates at 60 m similar to those observed for shallow *Agaricia* colonies (2-3 cm year⁻¹), but showed bleaching and (partial) mortality when transplanted to 100 m. As compared to light or substrate availability, which do not seem to be limiting at the study site, the strong decrease of temperature with depth (by about 5°C from 40 to 100 m depth) may play an important role in determining lower depth limits of mesophotic coral communities at Curaçao and the Southern Caribbean region. Our research suggests that the lower mesophotic and its depth-specific coral-endosymbiont assemblages and associated bacteria represent a specialized community comprising distinct domains of life, hence warranting particular attention for science as well

as adequate protection.

Keywords: mesophotic reefs, submersible, coral distribution, zooxanthellae, coral microbiome, Curacao

Sediment removal increases turf algae grazing and alters algal community composition on coral reefs

Fuchs C, Adam TC, Duran A, Burkepille DE

Many abiotic factors threaten coral reefs, including sedimentation from terrestrial runoff and storm activity. Sedimentation has negative effects on corals, reducing coral growth and reproduction and damaging live tissue. Corals also compete with turf algae growing on the reef, and herbivorous fishes can facilitate coral growth by grazing on these algae. Herbivorous fishes adjust their feeding behavior across small scales, but effects of sediment cover on algal grazing have not been well-studied on Caribbean reefs. We conducted a sediment removal experiment to test impacts of sediments on fish grazing and benthic community composition in the Florida Keys. We found that removing sediments from 0.25 m² plots resulted in an increase in grazing and a decrease in algae relative to control plots. This suggests increased sedimentation may further harm corals by reducing algae removal by grazing fish. Continuing analysis will investigate differences in the herbivorous fish assemblages that fed on different plot types, and benthic algae community composition within the plots.

Keywords: herbivory, sedimentation, Florida Keys, algae grazing

Cetoxmar: seven years assessing the impacts of the Venezuelan oil/gas industry on marine ecosystems

García E, Bone D, Cróquer A, Farache G, Ramos R, Zubillaga AL

During the past few years, oil companies have increased their efforts to find new gas/oil wells offshore the Venezuelan coast. The aim of these companies is to improve the production of fossil fuels in the short term; unfortunately such activities often impose serious threats to marine life at various temporal and spatial scales. The exploration and exploitation of gas and oil frequently overlaps with the distribution of vulnerable ecosystems such as coral reefs, seagrass meadows and mangroves; which may jeopardize human health. Thus, the regulation of such activities based on environmental risk assessments (ERAs) and robust monitoring programs must be a priority. Since 2008, the Centro de Toxicología Marina (CETOXMAR) has conducted a variety of environmental monitoring programs aimed to detect the impacts of oil/gas exploration and exploitation on different marine ecosystems using radial designs combined with the beyond BACI (Before-After-Control-Impact) approach. This work is aimed to show some examples from our experience to show the impact of our studies on Venezuelan legislation. In seven years we conducted more of 35 projects including 8 ERAs, 10 BACI-monitoring programs, 14 toxicity assays and 4 remediation campaigns. We have also produced unique environmental and biological base-lines where data was scarce or not available (e.g. Plataforma Deltana). We have detected significant impacts

of oil/gas exploration-exploitation across both; the continental shelf and offshore of the Venezuelan. We have participated workshops to communicate our results to different stakeholders including managers and policy makers. Our results have been used by the Ministry of the Environment to establish specific; and previously inexistent, legislation to provide the guide lines for a responsible operation of the local and foreign oil industries operating in Venezuela (PDVSA, REPSOL, Halliburton, Statoil, Chevron).

Durante los últimos años, las compañías petroleras han aumentado sus esfuerzos para explorar nuevos pozos de gas y petróleo costa afuera en Venezuela. El objetivo de estas empresas es aumentar la producción de combustibles fósiles en el corto plazo; sin embargo, estas actividades usualmente amenazan la vida marina a diferentes escalas espacio-temporales. Por su distribución y magnitud estas actividades pueden afectar los ecosistemas vulnerables, como los arrecifes de coral, praderas de pastos marinos y manglares; así como la salud humana. Por lo tanto, la regulación de este tipo de actividades en base a las evaluaciones ambientales de riesgo (ERA) y los programas de seguimiento debe ser una prioridad. Desde 2008, el Centro de Toxicología Marina (CETOXMAR) ha llevado a cabo una variedad de programas de monitoreo ambiental encaminadas a detectar los impactos de la exploración de gas y explotación de petróleo en diferentes ecosistemas marinos utilizando diseños radiales combinados con BACI. Este trabajo tiene como objetivo mostrar algunos ejemplos de nuestra experiencia para evaluar el impacto de nuestros estudios sobre la legislación venezolana. En siete años se han llevado a cabo más de 35 proyectos, entre ellos 8 ERA, 10 programas BACI-monitoreo, 14 ensayos de toxicidad y 4 campañas de remediación. Se han producido también líneas bases ambientales y biológicas únicas (e.g. la Plataforma Delta-na). Con estos estudios, se han detectado impactos significativos de la exploración y explotación de gas y petróleo en la plataforma continental y costa afuera. Así mismo, hemos participado en talleres para comunicar nuestros resultados a diferentes partes interesadas, incluyendo los administradores y los responsables gubernamentales. Nuestros resultados han sido utilizados por el Ministerio del Medio Ambiente para tratar de establecer una legislación dirigida a un manejo responsable de la industria petrolera en Venezuela (PDVSA, REPSOL, Halliburton, Statoil, Chevron).

Keywords: Environmental impacts, monitoring, BACI, oil exploitation, Venezuela

Environmental risk assessment, monitoring and management program of Centro Refinador Paraguana, Venezuela

García E, Baptista C, Bastidas C, Bone D, Brett C, Debrot D, Lopez A, Nieves Rivas K, Papadakis J, Ramos R, Strubinger P

The environmental risk assessment monitoring and management program of Centro Refinador Paraguana (CRP) is aimed to define areas with greatest hazards for the marine biota with the goal of designing specific remediation alternatives for these potentially-impacted areas. For this, four annual campaigns were conducted from 2011 to 2014 across 20 sites distributed in a gradient from points adjacent to the CRP up to several hun-

dred of kilometers away this chronic source of pollution. During this period, samples from the water column and the sediments were collected to determine the concentration of organic and inorganic pollutants as well as the structure of the macrobenthic community. Our results showed that the concentration of pollutants in the water column ranging between 0-4.6 ppm (A&G) and 0-10.3 ppm (TPH) exceeded the limits set by the National Standard. Inorganic elements such as Al, Fe, Zn, Ni, V and Hg were also detected in the water column; however, all of them were below the allowed levels of toxicity. As for sediment, the presence of contaminants is detected ranging between 524-45080 ppm (A&G) and 59-35106 ppm (TPH), exceeding the limit suggested for contaminated sediments, and severe levels of enrichment for mercury (5-10) and extremely severe for cadmium (>50), particularly in sites near the CRP Cardon. The benthic community structure was dominated by polychaetes among 18 different taxonomic groups. The opportunistic family Capitellidae was more abundant at sites close to the CRP where highest levels of pollution were recorded. The results clearly indicate that areas representing the major threats to marine life are close to the CRP. Therefore, urgent and special management strategies as well as specific remediation measures aimed to reduce or ameliorate the impacts of oil pollution on marine ecosystems must focus around these sites.

El Plan de Evaluación de Riesgo Ecológico Ambiental del Centro Refinador Paraguana (CRP) tiene por objeto definir las zonas con mayores riesgos para la biota marina con el objetivo de diseñar alternativas de remediación específicas para estas áreas potencialmente impactadas. Para ello, se llevaron a cabo cuatro campañas anuales desde 2011 hasta 2014 en 20 sitios distribuidos en un gradiente de puntos adyacentes al CRP. Durante este periodo, se recogieron muestras de la columna de agua y de sedimentos para determinar la concentración de contaminantes orgánicos e inorgánicos, así como la estructura de la comunidad macrobentónica. Nuestros resultados mostraron que la concentración de contaminantes en la columna de agua oscilaron entre 0-4.6 ppm (AyG) y 0-10.3 ppm (TPH) superando los límites establecidos por la Norma Nacional. Se detectaron elementos inorgánicos tales como Al, Fe, Zn, Ni, V y Hg en la columna de agua; sin embargo, todos ellos estaban por debajo de los límites de toxicidad. En cuanto a los sedimentos, se detectó la presencia de contaminantes con valores entre 524-45080 ppm (AyG) y 59-35106 ppm (TPH), superando el límite sugerido para sedimentos contaminados, y niveles de enriquecimiento severos para el mercurio (5-10) y extremadamente severos para el cadmio (>50), en particular en sitios cercanos al CRP Cardón. La estructura de la comunidad bentónica estuvo dominada por poliquetos entre 18 grupos taxonómicos diferentes. La familia oportunista Capitellidae fue la más abundante en los lugares cercanos al CRP, donde se registraron los niveles más altos de contaminación. Los resultados indican que las áreas que representan las principales amenazas para la vida marina están cerca del CRP. Por lo tanto, las estrategias de manejo y las medidas específicas de remediación deben centrarse en torno a estos sitios con la finalidad de reducir los impactos por hidrocarburos en los ecosistemas marinos.

Keywords: ecological risk, pollutants, macro benthic community, monitoring, refinery, Venezuela

Seaweed biodiversity in the international biosphere reserve Seaflower, southwestern Caribbean

Gavio B

The International Biosphere Reserve Seaflower lies in the Southwestern Caribbean, and it is known for the integrity and diversity of its marine ecosystems. However, scientific studies on the diversity of macroalgae have been scarce. The most recent checklist, dating 2003, recorded only 201 species in a marine territory of almost 300.000 km², of which about 5000 are shallow environments, ideal for the proliferation of seaweeds. Recent surveys have shown a much more diverse flora than previously recorded; in particular, the small, epiphytic red algal flora has been largely overlooked in the past. In the present work we register 362 taxa, 53 Cyanophyta, 167 Rhodophyta, 42 Phaeophyceae and 100 Chlorophyta. Of these, 92 species are new additions for the archipelago, and another 134 species are new records for Colombia, for a total of 226 new taxa. We describe a new diminutive species of red alga, *Crouania pumila* sp. nov. With this contribution, we have increased the seaweed biodiversity of the archipelago by 115%, and the marine flora of Caribbean Colombia by 24.8%. In the field, we observed a previously unknown diversity of cyanobacteria, some of which are potentially toxic and may damage the reef organisms they grow on.

Keywords: *Thalassia testudinum*, leaf emergence rate, International Biosphere Reserve Seaflower

Corals use mucus to garden their microbiome and stay healthy

Glasl B, Herndl GJ, Frade PR

Poritid corals exhibit an unusual mucus release strategy, in which the surface mucopolysaccharide layer is shed cyclically as a conspicuous, aged sheet. Although microbes are well-recognized members of the coral holobiont, little is known about the short-term dynamics of mucus-associated microbial communities under natural conditions or after disturbances. We examined the natural variability of microbial communities associating with the mucus layer of *Porites astreoides* and followed the fate of the coral holobiont after disruption of the natural mucus microbiome (through antibiotics treatment). Prokaryotic community composition was studied over time by 16S-rRNA gene sequencing of coral mucus, seawater and sediment collected at Curaçao. The bacterial community structure differed significantly between mucus and the adjacent seawater and sediment. However, bacterial communities of aged-mucus sheets and sediments were highly similar, suggesting either similar substrate conditions in both habitats leading to a compositional convergence of the two communities or a continuous exchange due to the incorporation of aged-mucus into sediments and the resuspension of sediment particles onto coral surfaces. Oscillations of coral mucus-associated microbes related to mucus ageing, during which prokaryotic abundance increased 2-fold leading to a prevalence of opportunistic and potentially pathogenic bacteria in aged-mucus. We therefore propose that the process of ageing and the release of mucus sheets in *P. astreoides* play a key role in maintaining beneficial microbes. Furthermore, disturbance experiments with

mucus-associated bacterial community showed that the fate of the *P. astreoides* holobiont (recovery versus mortality) relates to the degree of disruption of its mucus microbiome. Recovery of *P. astreoides* colonies after disturbance and resistance against opportunistic bacteria depend on the persistence of an intact core mucus microbiome (dominated by Endozoicimonaceae and Oxalobacteraceae). This study supports the view that the natural prokaryotic community inhabiting coral mucus crucially contributes to coral health and hence, to coral reef resilience.

Keywords: microbial ecology, antibiotics, coral reef, prokaryotic community, succession, bacteria

Determining the home range required by the queen conch in Xel-Ha inlet, Quintana Roo, Mexico

Goulié C, Aranda DA

The inlet Xel-Há has been demonstrated as a beneficial marine reserve for both adults and juveniles population of the over-fished Queen conch along the Caribbean. While several long-term movement studies of conches have been conducted, only one drew conclusions on daily displacements and habitat use. The aim of the present study was to determine the home-range used by *Strombus gigas*, in function of their weight, in the Xel-Há inlet, in order to manage the conservation program. To reach this goal, 300 individuals were marked, weighed and measured at the Bocana site. Each individual was followed every day during one hour, recording their position every ten minutes with stakes so as to then measure distances, angles and orientation of the conch using a meter tape, protractor and compass. The area was determined by drawing convex polygons formed using the software Autocad. A total of 221 individuals (weight 39.7-4000g and shell length 70-245mm) were followed from 3 to 28th February 2015 with a majority of 85 individuals between 1400 and 1800g and between 170 and 215 mm. The average speed was 2.28 ± 2.22 cm.min⁻¹ without tendency with conch weight or size. Home-range area of conch varied from 0.664 ± 0.7 m².h⁻¹ (weight < 800g) to 0.178 ± 0.1 m².h⁻¹ (weight > 2400g) with an average of 0.329 ± 0.1 m².h⁻¹. So, juveniles require more space than adults. However, weight and size are not the only parameters influencing conch displacements because conch used less area on cloudy days than on sunny days.

Se ha demostrado que la caleta Xel-Há es una reserva marina importante para las poblaciones de adultos y juveniles del sobrepesca caracol rosa en el Caribe. Varios estudios de movimientos de largo plazo de caracoles se han realizados mientras que solamente un estudio ha sido hecho sobre el desplazamiento diario de estos organismos a fin de conocer su utilización del hábitat. El objetivo de este trabajo fue conocer el área utilizada por *Strombus gigas* en función del peso en la caleta Xel-Há para adecuar programas de conservación de esta especie. Trescientos individuos fueron marcados, pesados y medidos en el sitio de Bocana. Los caracoles fueron monitoreados a diario individualmente durante una hora marcando sus posiciones cada diez minutos con estacas. Posteriormente, se midieron distancias, ángulos y orientaciones de los caracoles con una cinta métrica, un transportador y una brújula. El área se determinó dibujando los polígonos convexos con el programa Autocad. En total, 221 in-

individuos (peso 39.7-4000g y talla 170-215mm) fueron rastreados del 3 al 28 de Febrero de 2015 con una mayoría de 85 individuos entre 1400 y 1800 gramos y entre milímetros. La promedia velocidad era de $2.28 \pm 2.22 \text{ cm} \cdot \text{min}^{-1}$ sin tendencia con el peso y la talla de caracoles. El área que requieren los caracoles varía de $0.664 \pm 0.7 \text{ m}^2 \cdot \text{h}^{-1}$ (peso < 800g) a $0.178 \pm 0.1 \text{ m}^2 \cdot \text{h}^{-1}$ (peso > 2400) con una área promedia de $0.329 \pm \text{m}^2 \cdot \text{h}^{-1}$. Entonces, juveniles requieren más espacio que los adultos. Sin embargo, el peso y la talla no son los únicos parámetros que influyen los desplazamientos de caracoles porque se observa que estos organismos utilizan una área más importante en días soleados que nublados.

Keywords: Home-range, Queen conch, *Strombus gigas*, daily displacements, marine reserves

Confusion in a redescription of a kleptoplastic slug: *elysia patina* (marcus 1980) ortea et al. (2005) is really *elysia papillosa* (verrill 1901)

Gowacki WA, Bell SS, Pierce SK

Sacoglossan sea slugs have a well-known ability to sequester chloroplasts from their algal food source within specific digestive cells (= kleptoplasty). Many species also utilize the photosynthetic products from the stored chloroplasts. This phenomenon has been examined in a variety of sacoglossan species, but detailed life histories are only known for a few large and charismatic slugs. We have recently begun studying a comparatively smaller-sized kleptoplastic slug from seagrass/rhizophytic algal beds in Tarpon Springs, FL, as well as the Florida Keys, that consumes the alga *Penicillus capitatus*. However, very little additional information is known about the slug. We initially identified the slug as *Elysia patina* (Marcus 1980) based on a redescription by Ortea et al. (2005). However, we report that Ortea et al.'s (2005) classification of *E. patina* was incorrect. We base this claim on the following: 1) scanning electron microscopic examination of radular teeth, 2) observations of heart morphology and major blood vessels, 3) careful comparisons of Ortea et al.'s (2005) paper with the species descriptions in previous literature and consultation with a colleague, Patrick Krug (California State University, Los Angeles). In fact, we found that Ortea et al.'s (2005) descriptions of radular, cardiovascular and external morphology for *E. patina* exactly match the original descriptions of *E. papillosa* (Verrill 1901). In turn, the redescription of *E. papillosa* in Ortea et al. (2005) is also incorrect, and as such neither description should be used. Reference: Ortea, J., Caballer, M., & Moro, L. (2005). *Elysia papillosa* Verrill, 1901 y *Elysia patina* Marcus, 1980, (Mollusca: Sacoglossa: Elysiidae) dos nombres para cuatro especies. *Vieraea*, 33, 495-514.

Keywords: Sacoglossan, *Elysia papillosa*, *Elysia patina*

Seagrass Stabilization: a technique for coastal zone rehabilitation

Henry DJ, Trench C

Jamaica's north coast is a vibrant area of economic expansion as it responds to tourism, other commercial interests and residential development activity. Associated infrastructural demands have exacerbated natural and anthropogenic impacts on already

stressed coastal ecosystems. . Between 1998 and 2003, more than 100 acres of the dominant seagrass species (*T. testudinum*) have been destroyed due to ill-conceived or poorly executed development projects. A mitigation strategy of a recent north coast port development project stipulated specific retributive actions in lieu of the anticipated loss of essential seagrass acreage. It spoke in part to the development of alternative methods to rehabilitate existing areas of seagrass degraded by high wave energies. One such method examined ways to stabilize the eroded edges of *Thalassia* beds with the hope of increasing seagrass acreage and the stability of that ecosystem as a whole. 200 m of "leeward" seagrass bed edge were stabilized using bags of and seagrass mulch. "Blowouts" were filled with these bags to the level of the original substrate and pinned in place with metal rebar pins. After 8 months, approximately 70% of the stabilized edge remained intact and *Thalassia* shoots were observed sprouting through the bags. The remaining 30% showed continued erosion with no new growth of meristem, shoot or leafy seagrass material. Control sites demonstrated a mean erosion rate of 0.3m per month. Rehabilitation of eroding seagrass beds appears to be a feasible mitigation option.

Keywords: *Thalassia testudinum*, erosion, coastal zone rehabilitation

Regeneration in the Caribbean star coral *Montastraea cavernosa*

Horricks R, Herbing C, Lumsden JS

Absolute coral cover in the Caribbean has decreased more than 70% since the 1970s. Given this extreme decline it is critical to determine the factors that most strongly affect coral regeneration in this region. *Montastraea cavernosa* is one of the most commonly encountered scleractinian species at intermediate (10-20m) depths despite the drastic reduction in coral cover that the Caribbean has sustained. 12mm diameter x 2mm deep circular lesions were made on 124 healthy *M. cavernosa* colonies at 10-12m depths in marine regions of interest in the coastal waters of Grenada and Carriacou and photographed weekly. Images were captured every 0.5m along 0.5m x 30m long belt transects near targeted coral heads both inside and outside marine protected areas. Water samples were collected weekly for organic nutrient component analysis. Analysis of benthic diversity as a proxy for ecosystem health, benthic coral cover, organic nutrient levels, and the presence of a marine protected area will be examined for their potential impact on *M. cavernosa* tissue regeneration rates. If any of these factors have a significant effect on coral regeneration a predictive model may be generated in order to determine which regions should be prioritized for their potential positive influence on scleractinian coral regeneration.

Keywords: *Montastraea cavernosa*, regeneration, diversity, MPA, Grenada

Millennial-scale ecological change in Caribbean sponge communities

Hynes M, Lukowiak M, O'Dea A, Norris R, Cramer K

The siliceous spicules of sponges preserve exceptionally well in reef sediments after sponges die. Cores of approximately 3m each were extracted from three reefs in Bocas del Toro to explore changes in sponge communities over the last 1-3 thousand years. Spicules were extracted every 5cm along the cores and identified to morphotype using an in-house reference collection. Of the 13 morphotypes observed monoaxial and spheroidal spicules dominated. We observe that moving up-core towards the present day, the relative abundance of spheroidal spicules increases. This clear pattern occurs in each of the three reefs which are geographically separate, implicating a region-wide driver. Spheroidal spicules in Bocas are only produced by the demosponges *Placospongia intermedia* and *Geodia papyracea* that have previously been observed to increase in abundance as reefs degrade. *Placospongia* and *Geodia* also represent the principal diet of Hawksbill turtles and their increase may have been driven by historical declines in spongivory. This preliminary data is intriguing and would greatly benefit from further study.

Keywords: none provided

Presence of heavy metals and seasonal changes in groundwater flow direction have management implications for mangroves near Bovoni landfill, St. Thomas, USVI

Keller J, Wilson K, Reeve A

Groundwater hydraulic head, sediment cores, and near-surface temperatures were used in an integrated approach to better understand the physical processes governing a mangrove system in St. Thomas, United States Virgin Islands. Water and sediment sampled from this ecologically important and protected wetland were tested for heavy metals potentially originating from the adjacent Bovoni landfill. Vertical and horizontal groundwater flow directions were determined using hydraulic head data measured in 19 wells from January to November 2014. Sediment cores were used to provide a stratigraphic context and to infer past environmental conditions. Subsamples from these cores were analyzed for dry bulk density, organic content through loss on ignition, and select heavy metals using electron microscopy. A one-dimensional finite difference heat transport model was calibrated to temperature data collected at depths of 0, 7, 14, and 21 cm by adjusting vertical groundwater velocity and sediment porosity. Groundwater flow directions, inferred from hydraulic head data, changed seasonally. Groundwater flowed from the island, into the mangrove swamp and to the ocean during the majority of the study period. Flow reversal occurred after months of little to no precipitation (January to May) with flow from the ocean into the mangrove swamp. Trace metal concentrations of Cr, Ni, Sn, and Zn from 23 to 105 µg/L were measured in water samples. Sediment particles, 4-20 µm in diameter, were identified near the landfill containing Bi, Cr, Sn, Ti, and Zn. The heat transport model produced velocities in the range of $\pm 1e-7$ to $\pm 1e-9$ m/s, indicating very slow flushing of the system. Our data suggest that the mangrove system buffers the outer lagoon by trapping sediments and by delaying water fluxes from the upland to the lagoon. These results are relevant to local managers and to landfill closure plans.

Keywords: Groundwater, Mangroves, Trace Metals

Storm driven mortality and the impact on natural and outplanted *Acropora cervicornis*

Larson EA, Gilliam DS

Coral reefs have declined and recovery is challenged due to localized threats and the increase in intensity and frequency of environmental impacts. *Acropora cervicornis* has suffered from great losses since the 1970's due to disease and storms. To capture what impact storms, disease and predation have on this species two *A. cervicornis* patches were intensely studied thrice annually between 2008 and 2014, evaluating percent coral cover, census of colony size class, colony fate tracking and the presence of disease and predation. In addition to natural populations, 960 nursery reared *A. cervicornis* colonies were outplanted early 2012 to eight reef sites within Broward County, FL. Each colony was monitored for survival and the presence of disease, predation and fragmentation at one and three months, then quarterly for one year post transplantation. In 2012, Tropical Storm Isaac and Hurricane Sandy created increased wave heights, strong winds and elevated rainfall for an extended period of time over southeast Florida and the Florida Keys, during the months of August and October, respectively. Following the passing of these storms the prevalence of disease and fragmentation on both natural and outplanted *A. cervicornis* populations were higher than previously recorded for these populations. The occurrence of disease was four times greater than any other monitoring event within the patches, there were over two times the number of fragments counted and up to 60% of the outplanted corals were lost at each site due to disease or fragmentation following the passing of both storms. Based on these data there is strong evidence that as the frequency of storms increase the intensity and prevalence of disease events on corals will also increase.

Keywords: *Acropora cervicornis*, storm damage, population recovery

Black band disease in pillar coral along the Florida reef tract

Lewis C, Neely K, Richardson LL, Rodreguez-Lanetty M

Black Band Disease was first documented in the Caribbean in early 1970 and now occurs in many species of coral worldwide. This disease is considered to be a major contributor to loss of live coral cover on critical reef-building coral, especially throughout the Caribbean. It is characterized by a reddish-black cyanobacterial mat which can move quickly over the surface of susceptible corals, destroying live tissue and leaving bare coral skeleton in its wake. Black Band Disease (BBD) is most prevalent during summer and early fall when water temperatures exceed 28°C. Here we document for the first time the susceptibility of Pillar Coral (*Dendrogyra cylindrus*) to BBD along the Florida Reef Tract, following the mass bleaching event that occurred on Florida's reefs during August and September 2014. BBD was first observed in *D. cylindrus* in the Upper Keys in August and was positively confirmed by its distinctive morphological characteristics. Further observations of BBD occurred in *D. cylindrus* in the Middle and Lower Keys in September and October. Active

BBD infections in *D. cylindrus* throughout the reef tract persisted into December, even as water temperatures dropped to 21.5°C, well below 27.5°C, considered to be the cessation threshold for active BBD in other susceptible coral species.

Keywords: none provided

Distribution range and health status of the threaten staghorn coral *Acropora cervicornis* at Los Roques National Park

Martinez SJ, Cavada F, Agudo E, Cappelletto J, Croquer A

Over the past 30 years, *Acropora cervicornis* have experienced a decline throughout its distribution range in the Caribbean, to the point of falling within the critically endangered category of the IUCN Red List. Although, high mortality and shifts in its original distribution range have been noticed in this species at Los Roques during the last decade, the population status of this species has not been assessed. The aim of this study was to establish the status and actual range of distribution of the *Acropora cervicornis* population(s) at Los Roques as a prime base-knowledge for effective conservation strategies. For this, a total of 130 sites across the archipelago were surveyed. At each site, a 20x500 m geo-referenced area was covered by four observers to determine abundance, morphological description of patches and health status of this species. Morphological description was qualitatively assessed according to four categories: continuous (stands), dispersed (stands aggregations), scattered patches and isolated colonies. Abundance of each category was classified as abundant, common, uncommon and rare depending on their frequency of appearance. Our results indicate that *A. cervicornis* has a constrained distribution range within the archipelago, occurring in less than 40% of the surveyed sites. This species was most likely found in shallow and protected habitats (i.e., sand flats), although isolated colonies were also found at exposed areas. Dispersed and scattered patches were much common than continuous stands; with white band disease occurring at most of the surveyed sites. Broken stands surrounded by rubble which indicate recent or old mortality of this species were common on the majority of surveyed sites. Thus, our results indicate that local conservation strategies are urgently needed for deterioration of *A. cervicornis* population(s) is becoming evident at Los Roques. “

En los últimos 30 años *Acropora cervicornis* ha experimentado un descenso en su rango de distribución a lo largo del Caribe hasta el punto de caer en la categoría de peligro crítico en la Lista Roja de la IUCN. A pesar de que en la última década se ha notado una alta mortalidad y cambios en la distribución de esta especie en Los Roques, su estado poblacional no ha sido evaluado. El objetivo de este estudio fue establecer el estado y el rango de distribución actual de las poblaciones de *A. cervicornis* en Los Roques como base primordial de conocimiento para futuras y efectivas estrategias de conservación. Por esta razón se realizaron censos de 130 localidades en todo el archipiélago. En cada localidad se cubrió un área geo-referenciada de 20x500 m por cuatro observadores para determinar abundancia, descripción morfológica de los parches y estado de salud. Las descripciones morfológicas fueron evaluadas cualitativamente en cuatro categorías: parches continuos, dispersos, disgregados y colonias

aisladas. La abundancia de cada categoría se clasificó dependiendo de su frecuencia de aparición en: abundante, común, poco común y raro. Nuestros resultados indican que *A. cervicornis* posee una distribución restringida en el archipiélago, apareciendo en menos del 40% de las localidades censadas. Esta especie es más propensa a ser encontrada en hábitats someros y protegidos (p.e., arenales de baja pendiente), pero en algunos casos se encontraron colonias aisladas en zonas expuestas. Los parches disgregados y dispersos fueron más comunes que los parches continuos; en donde la enfermedad de banda blanca se observó en la mayoría de las localidades. Asimismo, parches interrumpidos y rodeados de cascajos, indicando mortalidad reciente o vieja fueron comunes en las localidades. Nuestros resultados sugieren que estrategias locales de conservación son necesarias debido al deterioro evidente de las poblaciones de *A. cervicornis* en Los Roques.

Keywords: *cervicornis*, distribution, white band disease, population assessment

Variable impact of top-down forces and photosymbiont-derived nutrition on Caribbean shallow-water sponges

Matterson K, Easson C, Thacker R

Recent evidence suggests that top-down factors (predation) primarily determine the diversity and abundance of sponges in reef environments. In the Caribbean, one-third of the dominant sponge species host high densities of photosynthetic cyanobacteria, with some sponges deriving significant nutritional benefit from this symbiosis. To test whether these symbioses play a role in structuring sponge communities, we examined the interactive effects of predation and irradiance on the growth of 6 sponge species. Sponges were held in a two-factor field experiment that manipulated irradiance and predation in situ for 6 weeks. Sponges hosting high densities of photosymbionts had lower growth and cyanobacterial abundance under reduced irradiance irrespective of the presence of predators, indicating that shading had a greater impact on holobiont biomass than predation. In contrast, sponges lacking cyanobacteria displayed significantly reduced growth in uncaged treatments, supporting the contention that top-down forces influence growth of some sponge species. *N. rosariensis*, which hosts high densities cyanobacterial symbionts, demonstrated higher growth rates under shaded conditions when predators were excluded than in uncaged treatments, suggesting that an interactive effect of irradiance and predation can influence growth. These results suggest that sponge communities in the Caribbean are likely structured by multiple factors varying in importance among species, and highlight the necessity of examining multiple ecological variables in combination when examining the forces that structure communities.

Keywords: Sponge; Symbiosis; Top-down; Photoautotrophy

Ichthyological survey of ectoparasites on coral reef fishes from the northeastern Caribbean

McCammon AM, Tuttle LJ, Loerch SM, Nemeth D, Williams Jr EH, Sikkil PC

The capsalid monogenean *Neobenedenia melleni* (MacCallum 1927) has been reported from hosts in both the Indo-Pacific and Atlantic, although specimens from the tropical western Atlantic are believed to be *N. paraguayensis*. Most reports on tropical western Atlantic hosts for this “species” come from captive hosts or from opportunistic field collections. To better understand the wild host range of *Neobenedenia* in the Caribbean region, a total of 1000 individuals representing 82 species from 28 families, were surveyed. *Neobenedenia paraguayensis* was found on a total of 33 host species, from 17 families, resulting in 20 new host records. A large proportion (70%) of species for which we surveyed at least 5 individuals were found to host *N. paraguayensis* while only 12% of species with sample sizes of ≤ 5 had *N. paraguayensis* infections. Thus, it seems likely that negative results were an artefact of low sample sizes. While species may vary in susceptibility, these data suggest a wide host range for *N. paraguayensis* in the Caribbean region.

Keywords: Caribbean, Ectoparasite, Ichthyofauna, Monogenea, Parasite

Changes in percent coverage of “frame-building” versus “weedy” corals in Grenada’s near shore waters

McLain H, Anderson, R, Morrall C, Balza R, Nimrod S, Berg C

In recent years the Island Nation of Grenada has implemented measures to safeguard the marine and coastal environments within a number of Marine Protected Areas. Regulation of fishing and recreational activities in Grenada’s Marine Protected Areas was implemented in 2010. Annual ecological evaluations of the coral communities inside and outside the Moliniere-Beausejour MPA have been conducted since 2008. Annual comprehensive assessments of percent substrate cover and fish population estimates are ongoing. This information is provided to the Grenada Fisheries Division Biologists to inform management practices. This new, but related, investigation uses digital pictures from the ongoing study. These pictures, taken in 2009 through 2014 along twenty permanent transects (four at each of the five sampling sites), were used to quantify changes in percent coverage of two coral taxon over this five year period. *Siderastrea* sp. was chosen to represent “frame-building” corals and *Porites astreoides* to represent “weedy corals.” In stressed environments, such as those in which there is enriched sedimentation from river effluents, studies indicate weedy corals tend to dominate frame-building corals. This study evaluates the annual change in percent coverage of these representative species in Grenada’s southwestern nearshore waters, which are exposed to agricultural and urban runoff. Percent coverage was determined using ImageJ software to measure the area of coral colonies in a prescribed quadrat. Annual percent coverage for each species was compared (ANOVA, $p < .05$).

Keywords: nearshore coral, coral cover, frame-building corals

A soft spot for sea fans: a study of gorgonia spp. off Little Cayman island

McCullough M, Foster K, Jacoby C

Gorgonia ventalina and *G. flabellum*, two common species of sea fans, are often overlooked in favor of studies that focus on the rising bleaching rates of calcifying corals. This study describes the demographics of *Gorgonia* spp. off Little Cayman under “normal” (non-disturbance) summer environmental conditions (average seawater temperature = 30.3°C, maximum temperature = 31.4°C). Length, width, and health status of sea fans were recorded within 10x4m² belt transects (n=25) and 7.5x7.5m² quadrats (n=11). Belt transects were used at six deeper sites (3.6-17.4m) by scientists on scuba whereas quadrats were used at two sites shallow enough for snorkeling (0.1-2.4m). In total, 1019 sea fans were observed: 949 were healthy (93.1%), 46 fans had Aspergillosis fungal infections (4.5%), 15 were partially encrusted by algae (1.5%), 5 were partially encrusted by fire coral (0.5%), and 3 were partially encrusted by unidentified green sponge (0.4%). The mean density (\pm standard error) was 0.43 \pm 0.04 colonies m⁻². Size class (SC) frequency distributions were determined based on lengths, a known proxy for age: SC1 (≤ 15 cm) = 204 fans, SC2 (16-25cm) = 224 fans, SC3 (26-35cm) = 211 fans, SC4 (36-50cm) = 245 fans, and SC5 (>50cm) = 135 fans. Maximum length recorded in this study was 112cm. Caribbean gorgonians can grow up to 180cm in length between their second to fifth years, tapering off and growing a few additional centimeters during subsequent years, suggesting the majority of the population is less than five years old. Further studies are needed to determine whether the Little Cayman population is still developing or has reached a stable, mature state with growth limited, perhaps, by local oceanic conditions. The results of this project can be used as a reference standard for comparison of *Gorgonia* spp. demographic changes that may accompany future disturbance events and climate change in Little Cayman.

Keywords: gorgonian; sea; fan; Little; Cayman; reference

Eutrophication and algal competition induce blooms of possible pathogens in the coral mucus microbiome

McMinds R, Fuchs C, Zaneveld JR, Burkepile DE, Vega Thurber RL

Coral reef ecosystems are in decline worldwide as a result of numerous anthropogenic stressors. Two of the most detrimental stressors, overfishing and eutrophication, harm corals while directly benefitting algal growth. Thus, as corals disappear, they are often replaced by communities of macroalgae. However, the direct mechanisms by which macroalgae outcompete corals are unclear. One possible mechanism is through alteration of the coral microbiome. By shading, exuding nutrients or toxins, or vectoring of pathogens, algae may disrupt the normal interactions between corals and their microbial symbionts and ultimately lead to disease and the death of the coral. To analyze the effects of algal competition on the composition of the coral microbiome, we performed an experiment at Pickles Reef in the Florida Keys. We placed uniform clonal fragments of *Orbicella faveolata*, an important Caribbean reef-building coral, in direct contact with samples of the common algae species *Dictyota dichotoma*, *Sargassum polyceratum*, and *Halimeda tuna*, as well as a ‘mock algae’ to control for abrasive effects on the coral. These treatments were replicated within an additional nutrient

enrichment treatment that simulated the effects of eutrophication. Algal tissue and coral mucus were collected every two weeks, and the coral fragments themselves were collected after eight weeks of exposure. Communities of fungus, bacteria, and archaea from these tissue and mucus samples were determined using multiplexed multi-marker deep amplicon sequencing. Initial analyses show that contact with all algae species induced blooms of microbial taxa related to the bacterial genera *Leptospira*, a known human pathogen, and *Flexibacter*, a known fish pathogen. The effect of nutrient enrichment on the abundance of these taxa was dependent on the species of algae. Further, we demonstrate that these bacteria are normal, low-abundance members of the coral mucus microbiome that are not directly vectored by algal contact. These results suggest that algal contact somehow weakens the ability of corals to control populations of normally occurring pathogenic bacteria, and that this may be an important mechanism by which high algal abundance causes coral death.

Keywords: coral macroalgae disease competition microbiome

Phototactic behavior in the photosynthetic sacoglossan sea slug *Elysia clarki*

Middlebrooks M

A number of species of sacoglossan sea slugs are able to photosynthesize by sequestering chloroplasts ingested from green coenocytic algae inside of their own cells, a process known as kleptoplasty. Because these slugs acquire energy from photosynthesis they are likely to exhibit positive phototaxy, orienting towards and spending more time in the light. However, the benefits of photosynthesis are often not permanent for these animals and most of the species that sequester chloroplasts will eventually lose their ability to photosynthesize over time due to either digestion or chloroplast degradation from exposure to light. Therefore as the ability to photosynthesize declines sacoglossans may exhibit a variety of mechanisms to delay the degradation of chloroplasts from light. *Elysia clarki* is a kleptoplastic sacoglossan sea slug that can photosynthesize for over three months after feeding. Previous studies have demonstrated that the slug can synthesize chlorophyll a which may aid chloroplast maintenance. Eventually, however, the sequestered plastids will degrade from exposure to light. The intention of this study is to determine *E. clarki*'s response to light and if they exhibit any behavioral mechanisms to reduce chloroplast degradation. The phototactic response of *E. clarki* was tested in the laboratory using time lapse photography in aquaria where half of the aquarium was shaded and the other half exposed to direct light. Recently fed *E. clarki* display positive phototaxy, spending most of the time in the light and primarily avoiding the shaded half of the aquarium. This is not surprising for recently fed slugs, which are benefiting from photosynthesis. It not yet known, however, if starved slugs would attempt to limit their exposure to light to avoid further damage to chloroplasts.

Keywords: phototaxis, kleptoplasty, photosynthesis, sea slug, gastropod

Management of lionfish invasion in Costa Rica: an overview five years after

Molina-Ureña H

The first sighting of lionfish (*Pterois volitans*) in Costa Rican Caribbean reefs in April 2009, prompted an immediate response from academia, government, and local communities. Today, two major potential threats loom over the waters of southern Central America: an invasion to the Pacific coast, and ciguatera poisoning for a lionfish fishery. Since 2009, four stages of management approaches have been applied. The first effort, led by the National System of Conservation Areas (SINAC) of the Environment Ministry (MINAE), established an Inter-institutional Task Force (LITF-CR). This LITF was based on local decision-making by resource managers, technically supported by academia, but with little to none active collaboration from local communities. The second moment was a long hiatus in decision-making and action-taking, with no SINAC staff assigned to take charge of the in situ efforts and data collection. Simultaneously, local fishing communities started their own process of participative action by developing a network and formalizing their standing as a working group. The South Caribbean Artisanal Fishers' Association (APACS) was created in August 2011. An ongoing third stage (Sep 2013 – today) started when the Viceministry of Waters and Seas took over the leadership. The task force was reactivated, as a National Commission on Lionfish Control, a multi-sectorial entity overseeing control, research, and impact mitigation. National and regional strategic plans were developed. Ongoing research focuses on toxin biochemistry, ecological and economic impacts, development of a lionfish fishery and market, and participatory monitoring. Control efforts are led by APACS, supported by NGO funding. A fourth step expands efforts, by involving international cooperation, preparations for imminent invasion to Eastern Pacific waters, elaboration of a Preventive Management Plan for the Pacific coast, and designing collaboration networks on both coasts. The strong drive of local communities together with improved means of intersectoral communication made the latter phases possible.

El primer avistamiento de pez león (*Pterois volitans*) en los arrecifes caribeños de Costa Rica en Abril 2009, generó una respuesta inmediata de la academia, el gobierno y las comunidades locales. Hoy en día, dos potenciales eventos amenazan las aguas del sur de América Central: una invasión a la costa Pacífica, y eventual riesgo de intoxicación por ciguatera en la pesquería de pez león. Desde 2009, hemos pasado por cuatro tipos de enfoques de manejo. El primer esfuerzo, liderado por el Sistema de Áreas de Conservación (SINAC), del Ministerio de Ambiente (MINAE), estableció un Grupo de Trabajo Interinstitucional de Pez León (CIPL). La CIPL se basó en la toma de decisiones a nivel local por los administradores de recursos, con apoyo técnico de la academia, pero sin colaboración activa de las comunidades locales. El segundo momento fue un largo hiato en la toma de decisiones y acciones, por la ausencia de personal de SINAC asignado como responsable de las acciones in situ y recolección de datos. Simultáneamente, las comunidades pesqueras locales empezaron su propio proceso de acción participativa, al desarrollar redes de comunicación y formalizar su estatus. La Asociación de Pescadores Artesanales del Caribe Sur (APACS)

se creó en agosto 2011. Una tercera etapa (setiembre 2013 hasta hoy) empezó cuando el Viceministerio de Aguas y Mares tomó el liderazgo del proceso. El grupo de trabajo se reactivó bajo la forma de Comisión Nacional de Control de Pez León (CNCPL), una entidad multisectorial que supervisa el control, la investigación y la mitigación de impactos. Se desarrollaron planes estratégicos a nivel nacional y regional. Actualmente, los estudios científicos se enfocan en la bioquímica de las toxinas, impactos ecológicos y económicos, desarrollo de pesquerías de pez león y su mercadeo. APACS lidera los esfuerzos de control localmente, apoyados por financiamiento de ONGs, para monitoreo participativo. Una cuarta fase expande las iniciativas, mediante la cooperación internacional, las preparaciones para una inminente invasión a las aguas del Pacífico Oriental, la elaboración de un Plan de Manejo Preventivo para la costa Pacífica, y el desarrollo de redes de colaboración en ambas costas. Estas últimas dos fases fueron posibles gracias al fuerte impulso y motivación de las comunidades locales y a la mejora en la comunicación intersectorial.

Keywords: invasive species, *Pterois volitans*, reef ecosystems, governance, Central America, lionfish fishery

No-take MPAs benefit low-tech staghorn coral (*Acropora cervicornis*) rehabilitation efforts: a case study from Culebra island, Puerto Rico

Montañez-Acuña AA, Otaño-Cruz A, Mercado- Molina A, Suleimán-Ramos SE, Hernández-Delgado EA

Long-term Caribbean-wide Acroporid coral decline has resulted in significant loss of coral reefs' topographic complexity, ecosystem functions, and ecological services. There is a need to mitigate these losses by restoring healthy coral cover and ecosystem's resilience. Threatened *Acropora cervicornis* outplanting using low-tech coral nurseries as donor source has been identified as a viable rehabilitation alternative that possesses a key community-based management approach to rehabilitate depleted reefs. Nevertheless, in order to fully recover structural and functional characteristics of a degraded ecosystem, there is still a need to address local ecological factors that might stress coral outplants. In this study, we compare demographic success of *A. cervicornis* outplanted within and outside Canal Luis Peña no-take Natural Reserve, Culebra Island, Puerto Rico, as well as different substrate biotope treatments. Mean overall survival rates of outplanted corals were 82% at Bahía Tamarindo (BTA), within MPA, and 81% at Punta Soldado (PSO) control site after 12 months of monitoring. Coral mortality among outplants was habitat and site-specific. Survival rates at BTA averaged 85% at elevated rocky outcrops, but only 78% at areas adjacent to sand that were heavily impacted by sediment bedload, runoff, and sediment resuspension during tropical storm Isaac during August 2012. In the other hand, a mean 88% survival rate was documented at PSO in rocky outcrops substrate, and 73% in outplanted areas adjacent to sand. Coral mortality at overfished PSO was largely related to predation impacts by fireworm (*Hermodice carunculata*) and corallivore snails (*Coralliophilla abbreviata* or *C. caribbaea*). Overall coral outplant growth and branch production resulted substantially higher at BTA than at PSO control site outside the MPA. These results highlight MPAs

indirect benefits (i.e., more robust fish assemblages, higher herbivory rates) for enhancing rehabilitation efforts efficiency. Nevertheless, strong governance, law enforcement, and MPA management is vital in order to reach successful outcomes, as well as maintaining them.

Keywords; coral reef rehabilitation, staghorn coral, *Acropora cervicornis*, MPA

Spatial distribution, density, size structure and feeding of *Oreaster reticulatus* (echinodermata: asteroidea) in an environmentally heterogeneous touristic area of the Venezuelan Caribbean

Ortiz D, Villamizar E, Noriega N

Ensenada Morrocoy is a heterogeneous area where populations of sea star *Oreaster reticulatus* have been successfully settled. Nevertheless, in touristic areas such as Morrocoy National Park, this species is more vulnerable to human extraction and to habitat modification. Due to this, the main objective of this study was to compare spatial distribution, population density, size structure and feeding of *O. reticulatus* in several habitats at Ensenada Morrocoy. Daily samplings were made in May and June 2014. The environmental study consisted in measuring some physicochemical parameters, the assessment of substratum and the analysis of sediments in several habitats. Thirty belt transects (200 m² each one), located among ten sampling sites all over Ensenada Morrocoy, were placed to survey the population and to measure the radius (R) of individuals. Overall, 234 individuals were observed mainly inhabiting sand patches, seagrass beds (with dominance of *Halophila decipiens* and *Thalassia testudinum*) and mixed bottoms. Sand bottoms dominated by *H. decipiens* were not previously recorded as habitat of *O. reticulatus* in Venezuela and the Caribbean. Density ranged from 2,3 to 9,75 ind/100 m², being the highest in sandy patches. Mean size was the highest in seagrass dominated by *H. decipiens* (R=15,5 cm) and the lowest in seagrass beds of *T. testudinum* (R= 10,5 cm). The population structure was composed of 90,2% adults and 9,8 late juveniles. These juvenile individuals were found mainly on substrata dominated by seagrass *T. testudinum* (36%), suggesting that this may function as a recruitment habitat for this species in Ensenada Morrocoy. *O. reticulatus* is as an omnivorous grazer and was observed feeding on sand, seagrass leaves and macroalgae, being similar to that reported in previous records in the Caribbean Sea.

La alta heterogeneidad ambiental de la Ensenada Morrocoy ha favorecido al establecimiento de *Oreaster reticulatus*. No obstante, en lugares altamente turísticos como el Parque Nacional Morrocoy, esta especie es vulnerable a la explotación humana y a la alteración de su hábitat. El objetivo general de este estudio fue comparar la distribución espacial, densidad, talla y alimentación de *O. reticulatus* en distintos hábitats de la Ensenada Morrocoy. Se realizaron muestreos diurnos en mayo y junio de 2014. Se midieron algunas variables ambientales, se evaluó la cobertura del sustrato y se caracterizó el sedimento. Se utilizaron 30 bandas-transectas de 200 m², colocadas en 10 sitios a lo largo de la Ensenada Morrocoy, en donde se contaron los individuos observados y se midió su radio (R). La dieta de *O. reticulatus* se

evaluó levantando los individuos encontrados, observando si el estómago estaba evertido y la naturaleza del sustrato. En total, se observaron 234 individuos, principalmente sobre parches arenosos, fondos dominados por fanerógamas (*Halophila decipiens* y *Thalassia testudinum*) y fondos mixtos. Previamente no se habían descrito los fondos dominados por *H. decipiens* como hábitat de *O. reticulatus* en Venezuela y el Caribe. La distribución fue aleatoria en la mayoría de los hábitats. La densidad osciló entre 2,3 y 9,75 ind/100 m², siendo máxima en hábitats arenosos. La talla promedio fue mayor en los hábitats dominados por *H. decipiens* (R=15,5 cm) y menor en praderas de *T. testudinum* (R=10,5 cm). La población estuvo conformada en su mayoría por adultos (90,2%) y juveniles en estadio tardío (9,8%), los cuales fueron observados principalmente en praderas de *T. testudinum* (36%), sugiriendo que éste podría ser hábitat de reclutamiento en la Ensenada Morrocoy. *O. reticulatus* es una especie omnívora, la cual se observó alimentándose principalmente sobre arena, fanerógamas y macroalgas, coincidiendo con lo reportado en otras localidades del Caribe.

Keywords: *Oreaster reticulatus*, sea star, population density, habitats, Venezuela, Caribbean

Spatial patterns of coral reef benthic community structure across a land-based source pollution gradient in Culebra island, Puerto Rico: a baseline for watershed management

Otaño-Cruz A, Montañez-Acuña A, Hernández-Delgad EA

Water quality degradation is one of the major threats to coral reefs worldwide. Chronic disturbance due to land-based source pollution (LBSP) could have severe impacts on coral reef benthic community structure trajectories, leading to significant coral cover decline across large spatial scales. Our objective was to provide a baseline characterization of coral reef benthic community structure at eight sites across a water quality stress gradient in Culebra Island, Puerto Rico. Sites were subdivided in three regions: Inner, Mid and Outer reefs, and in three depth zones (<5 m, 5-10 m, >10 m). Data were collected during July 2013 using 30-45 random photo-transects/site, and 5 replicate, high-definition images/transect. Chlorophyll a and horizontal water transparency were assessed on triplicates at each site. Overall benthic community structure was significantly different among regions (PERMANOVA, $p < 0.0001$), across sites ($p < 0.0001$), and depth zones ($p < 0.0001$). Mean percent coral cover ranged from 4.8% across inner reefs towards 26.9% across outer reefs. Horizontal water transparency ranged from 13.5 to 45 m across the LBSP gradient, while chlorophyll-a ranged from 3.78 to 1.35 $\mu\text{g/L}$. Percent coral cover showed a significant linear increase in with increasing water transparency ($r^2 = 0.8959$, $p = 0.0004$), while it showed a non-linear decline with increasing chlorophyll a ($r^2 = 0.6887$, $p = 0.0108$). Macroalgae was a dominant component of degraded coral reefs with mean cover of 49% across near-shore reefs and declining to 39% on outer reefs. Threatened Staghorn coral (*Acropora cervicornis*) was more abundant across outer regions ($p < 0.0001$) and across outer sites ($p < 0.0001$). No significant difference was observed among depth zones. Benthic community composition patterns, mostly in macroalgae, were key indicators of LBSP stress. Consistent monitoring will provide meaningful data to determine the effective-

ness of watershed management efforts that aim to improve water quality to boost coral reef resilience, ecological functions, benefits and services to humans, and adaptation to future climate.

Keywords: Land-based source pollution, Benthic community structure, Watershed management, Watershed restoration efforts, Culebra Island

Petroleum pollutants cause egg degradation, lowered fertilization, and larval viability in variegated sea urchin, *Lytechinus variegatus*

Pelikan KC, Fogarty ND

Echinoderms occupy keystone positions in many vulnerable ecosystems. Recent mass polluting events have led researchers to examine the effects of petroleum products and dispersants on the benthic environment and associated organisms. Yet every day, recreational and commercial ships release bilge water containing a mixture of oil and gas on imperiled coral reefs and sea grass beds. The effect of this daily petroleum input into our marine environment has been largely overlooked. Historically, researchers have examined different interactions involving chemicals and sperm integrity. In this study, we focused on the integrity of the eggs by examining the effect of oil and gasoline on gamete integrity, fertilization success, and larval viability of the sea urchin, *Lytechinus variegatus*. Scanning electron microscopy revealed eggs were highly degraded when exposed to low levels of these pollutants. Statistical analysis reveals a significant difference in fertilization and larval viability between the controls and oil and gas treatments. Additionally, the presence of petroleum products, including the lowest dose, reduces the occurrence of polyspermy. This study is beneficial to coastal zone and coral reef management who monitor coral reefs and surrounding ecosystems.

Keywords: Echiniods, Toxicity, Fertilization, Petroleum, SEM

Benthic competitors influencing coral competition and aggression interactions on Palmyra atoll

Petsche C, Edwards C, Eynaud Y, Smith J

Coral reefs are highly complex and taxonomically diverse. Corals are constantly contending with adjacent benthic competitors for space, a limited resource. Coral competition can be seen through numerous ways such as coral aggression by means of mesenterial filaments, overgrowth and shading. These competitive interactions can be categorized into win, loss, and neutral interaction zones. We were interested to see if the identity of the benthic competitors influence the outcome frequency of interaction and if there is a difference in the frequency of outcomes between different coral growth forms. To determine this, photos were collected from September 2009 to September 2012 along four transects with ten permanent photoquadrats per transect along the fore reef at Palmyra Atoll. All hard corals and major algal groups were digitized and designated. Interactions between focal coral species (*Pavona varians* and *Favia stelligera*) representing two dominant growth forms- encrusting and massive respectively- and adjacent benthic functional groups were scored

as coral win, neutral, or coral loss to determine frequency of interactions. Photos from 2009 were examined as an individual time point along with analyzing the photo time series. Analysis suggests that the identity of benthic competitors influence the outcome of the interactions for both growth forms. We plan to use linear measurements and percentage of colonial interactions with adjacent benthic functional groups to ascertain possible rates of change such as growth and mortality fluctuations.

Keywords: none provided

Seagrass cultivation for conservation

Pickering V, Lawrence M, Buckley L, Wyllie-Echeverria S

We designed a project to assist Coral World Ocean Park with the development of a seagrass exhibit. To do this, we tested whether or not outside tanks in direct sunlight or under shade would make a better habitat for growing seagrass in land-based aquaria. In early summer 2014, we removed experimental units of *Thalassia testudinum* (native) and *Halophila stipulacea* (invasive) from Brewers Bay and placed these in outside tanks, plumbed with flowing seawater. After units were placed in the tanks we measured for shoot density, leaf height, fluorescence, light intensity and temperature for four weeks. We found that the height of both seagrass species decreased during the project, but *T. testudinum* had a much greater loss of height in both light regimes. Shoot density for both sunny and shaded treatments of *T. testudinum* increased; whereas, the *H. stipulacea* shoot density decreased dramatically in both treatments. Furthermore, measurement of fluorescence indicated that *T. testudinum* growth, in full sunlight, responded favorably to tank conditions whereas *H. stipulacea* treatments were stressed in the sunny tanks. However, for both species fluorescence was much lower in full-sun tanks than in the field and shaded tanks. This indicates that the stress levels are highest in units growing in the full sunlight conditions of shallow tanks. We conclude that growing seagrass in shaded tanks might be the most appropriate habitat for growing these seagrass species in controlled conditions.

Keywords: Seagrass, Aquarium Cultivation, Public Education, Conservation

First in situ assessment of mesophotic reef fish communities in Bermuda, western Atlantic

Pinheiro HT, Rocha LA, Jessup ME, Chequer AD, Goodbody-Gringley G

This study represents the first in situ assessment of mesophotic reef fish communities in Bermuda. Five mesophotic reefs, ranging from 50 – 80m deep, comprising biogenic reef and rhodolith bed habitats on the southern shore of the island were sampled through underwater visual censuses (UVCs) and video recordings. At each site, two to six surveys were conducted (26 surveys total), by counting all species encountered within 1m of either side of a 30m transect for a total area of 60m² per survey. Total length (LT) of each fish was estimated by eye and classified into 5cm classes and used to estimate fish biomass. A total of 60 fish species, including twenty-nine depth range expansions

were recorded. Three endemics, *Chromis bermudae*, *Diplodus bermudensis* and *Holacanthus bermudensis*, and one invasive Pterois spp were also recorded. An average of 7.28 (SE=1.05) species were recorded per UVC, in an abundance of 34.0 (SE=11.8) ind. per 60m² and biomass of 13.3 (SE=4.8) kg per 60m². Planktivorous fishes are the most abundant trophic guild, followed by roving herbivores, mobile invertebrate feeders and macro-carnivores. In terms of biomass, however, roving herbivores are the biggest contributors, followed by macro-carnivores, mobile invertebrate feeders and sessile invertebrates. Within the mesophotic zone in Bermuda, species richness, abundance and biomass were found to increase with depth, which differs from the pattern observed at most mesophotic reef systems. While overall species richness at these mesophotic sites is similar to some shallow water sites in Bermuda as well as other Caribbean mesophotic areas, biomass is lower than that observed in pristine areas and efforts to protect Bermuda's mesophotic reefs are therefore encouraged.

Keywords: Bermuda, range expansion, lionfish, mesophotic

Acropora palmata, proponent or inhibitor of reef resilience: evaluating the role of dead-standing skeletons in future projections of coral reef recovery

Piotrowski S, Foster G, Manfrino C

Once the primary framework builder and one of the most abundant corals in the Caribbean, *Acropora palmata* have experienced up to a 95 percent decline since the 1980's throughout their historic range from Biscayne National Park, Florida in the North to Venezuela in the South. Many factors have been attributed to this steep decline, particularly coral bleaching, storm damage, and the spread of the species-specific white pox disease caused by the pathogen *S. marcescens*. Dense stands of dead-standing *A. palmata* colonies are now prevalent throughout the Caribbean; structural framework devoid of live coral tissue and overgrown by algae and soft corals. Much work has been done to describe the recruitment and recovery of *A. palmata* throughout this region, but the role of the *A. palmata* skeletons themselves as settlement substrate for other framework builders has yet to be investigated. In this study, 7.5m X 7.5m quadrats containing a minimum of five standing-dead *A. palmata* colonies were surveyed for coral cover on the colonies themselves, as well as on the surrounding substrate. The species assemblages on the *A. palmata* colonies differed from those on the substrate, suggesting that once deceased, *A. palmata* act as impediments to coral reef recovery. Not only are key framework building corals not settling on the *A. palmata* colonies, but those opportunistic species that do are either: a) likely to exhibit low survivorship long term due to the deterioration of the *A. palmata* skeletal framework by storm damage and bioeroding organisms such as boring molluscs and sponges, or b) dominate the substrate with their competitively advantageous reproductive strategies, potentially causing shifts in benthic community structure. However, these erect, relic structures could serve as prime settlement substrate for new *A. palmata* recruits, potentially contributing to population recovery throughout the Cayman Islands and the entire Caribbean Sea.

Keywords: *Acropora palmata*, recovery, benthic, community structure

Identification of strengths and weaknesses of cooperative efforts within the wider Caribbean using a network approach

Ramírez-Ramírez RD, Montilla LM, Cavada-Blanco F, Cróquer A

Strategic planning for conservation of coral reefs is focused on building resilience by an integrated management approach based on cooperative efforts. Here, we built a connectivity network of Caribbean researchers using the papers presented at AMLC scientific meetings as a proxy of collaboration among organizations for five decades. We aimed to evaluate the usefulness of this analysis as a tool for identifying regional research gaps, key organizations that function as hubs and prioritizing research efforts on a regional scale. For this, we extracted key information published in the AMLC proceedings and special issues from 1957 to 2013. Co-authorship among different organizations was used as edges, while country, study site and organization were used as nodes according to the network. Overall, the number of collaborations increased in time from an average of 0.89 organizations per research in the 60s, to 3.8 in the first decade of the millennium. However, the number of isolated nodes and components suggests that most of these collaborations were kept in small groups. The organizations with the highest value of intermediation (i.e., betweenness centrality) were the University of West Indies for the Antilles; the University of Puerto Rico for Puerto Rico and Florida; the Universidad Nacional Autónoma de México for Meso America and finally The Universidad de Oriente and the INVEMAR for South America. This result indicates that these institutions act as hubs and might constitute key partners in regional collaborative efforts in the near future. Results also indicate that coral reefs in Florida and Puerto Rico were the most frequently studied locations in the region. Our analysis shows the necessity of strengthening cooperative links between USA and Puerto Rican institutions with other research centers in the Caribbean for a most cost-effective conservation efforts in the region.

La planificación estratégica para la conservación de los arrecifes de coral se centra en aumentar la resiliencia mediante el enfoque de manejo integrado basado en esfuerzos de cooperación. En este trabajo, construimos varias redes de conectividad de investigaciones del Caribe utilizando los trabajos presentados en reuniones científicas de la AMLC como proxy de la colaboración entre organizaciones durante cinco décadas. El objetivo fue evaluar la utilidad de este análisis como una herramienta para identificar las brechas de investigación a nivel regional. Para ello, extrajimos información clave publicada en las actas de la AMLC y números especiales de 1957 a 2013. La co-autoría entre las diferentes organizaciones se utilizó como enlace, mientras que los países, sitios de estudio y las organizaciones fueron utilizados como nodos de acuerdo a la red. En general, el número de colaboradores aumentó en el tiempo de 0,89 organizaciones por investigación promedio en los años 60 a 3,8 en la primera década de este milenio. Sin embargo, el número de nodos y componentes aislados sugiere que la mayoría de éstas se mantuvieron en grupos pequeños. Las organizaciones con

el mayor valor de centralidad (i.e., “Centralidad por intermediación”) fueron la Universidad de West Indies en las Antillas, la Universidad de Puerto Rico para Puerto Rico y Florida, La Universidad Autónoma Nacional de México para Meso América y la Universidad de Oriente y el INVEMAR para América del Sur. Este resultado indica que estas instituciones actúan como focos de conexión y podrían crear socios claves en los esfuerzos de colaboración regionales en el futuro próximo. Los resultados también indican que los arrecifes de coral en la Florida y Puerto Rico fueron los lugares más frecuentemente estudiados de la región. Nuestro análisis muestra la necesidad de fortalecer los vínculos de cooperación entre los institutos de Estados Unidos y Puerto Rico con otros centros de investigación en el Caribe para estrechar esfuerzos para la conservación maximizando la relación costo-efectividad.

Keywords: Complex Network, Caribbean, Collaborative efforts, Institutions

Frequency of fission and fusion in colonies of *Madracis mirabilis*

Roper Z, Brito-Millan M, Sandin SA

In coral population ecology, it is important to study fission/fusion events, how they change through time, and ultimately their role on coral persistence. This research focuses on the frequency of fission and fusion in colonies of the pencil coral, *M. mirabilis*, from the Caribbean island of Curacao across a 5 yr period. Additionally, qualitative comparisons of fission/fusion frequency data to local weather patterns were also undertaken to explore the hypothesis that there will be significantly more fission and fusion in *M. mirabilis* colonies during unfavorable weather conditions. Five year bi-annual photographic time series were taken from permanently marked quadrats in Curacao. PhotoQuad, a free downloadable program, was utilized to digitize the photos. Fusion occurs, but is rare (<0.1% at all times). Less than 0.1% of the colonies broke apart (fission) in all the time series except for one period (2010-2011). This spike in fission can be correlated to the sudden increase in rainfall from 2009-2011. Average proportional colony growth shows that most surviving colonies experienced net growth. This exploration is important for understanding the relationships between environmental and ecological demographic events happening within a Caribbean coral reef. This project was funded by the University of California Office of the President.

Keywords: none provided

Investigating how coral recruitment and juvenile survivorship varies along the Florida Reef Tract

Ruzicka R, Gleason D, Fogarty N

Populations of reef-building corals have not recovered significantly in the Florida Keys even though management actions focused on achieving this goal have escalated over the last several decades. There is a general consensus among scientists that recruitment failure and poor juvenile survivorship have contributed to this lack of coral recovery, but the extent to which

these processes have impeded reestablishment is unclear. The Coral Reef Evaluation and Monitoring Project (CREMP) has monitored selected reefs in the Florida Keys since 1996 and the project has successfully documented how numerous stressors have altered reef community composition over the last two decades. This presentation will review the current status of reefs in the Florida Keys and preview a new intensive effort to characterize coral recruitment and juvenile survivorship across the Florida Reef Tract and use a combination of methods to compare settlement rates on tiles and natural reef substrate. The spatial scale of the project is the largest of its kind in Florida and spans the entire Florida Reef Tract. An additional goal this project is to identify collaborators and/or partners in other regions of the Caribbean so that rates of recruitment and juvenile survivorship can be compared with those obtained in the Florida study.

Keywords: none provided

Environmental epigenetics: a promising venue for developing next-generation pollution biomonitoring tools in marine invertebrates

Suarez-Ulloa V, Gonzalez-Romero R, Eirin-Lopez JM

Environmental epigenetics investigates the cause-effect relationships between specific environmental factors and the subsequent epigenetic modifications triggering adaptive responses in the cell. Given the dynamic and potentially reversible nature of the different types of epigenetic marks, environmental epigenetics constitutes a promising venue for developing fast and sensible biomonitoring programs. Indeed, several epigenetic biomarkers have been successfully developed and applied in traditional model organisms (e.g., human and mouse). Nevertheless, the lack of knowledge in most ecologically and environmentally relevant organisms has hampered the application of these tools in a broader range of ecosystems, most notably in the marine environment. Fortunately, that scenario is now changing thanks to the growing availability of complete reference genome sequences along with the development of high-throughput DNA sequencing and bioinformatic methods. Altogether, these resources make the epigenetic study of marine organisms a reality. By building on this knowledge, the present work provides a timely perspective highlighting the extraordinary potential of environmental epigenetic analyses as a promising source of rapid and sensible tools for pollution biomonitoring, using marine invertebrates as sentinel organisms. This strategy represents an innovative, groundbreaking approach, improving the conservation and management of natural resources in the oceans.

Keywords: None provided

Assessment of initial seedling growth and survival and natural seedling recruitment at a mangrove restoration site in west Falmouth, Trelawney, Jamaica

Thomas SL, Trench C, Webber M

Drastic reductions in mangrove communities, chiefly facilitated by anthropogenic activities have prompted mangrove rehabilitation projects. Mangrove rehabilitation projects are

intended to restoring mangroves and the ecological services they provide, while discouraging further negative human impacts. The study assesses initial seedling growth and survival during mangrove restoration in West Falmouth, Trelawny, affected by charcoal burning. A holistic rehabilitation approach was applied to the degraded site, including the removal of solid waste and plant debris that obstructed natural tidal movement carrying seedlings. Nursery reared seedlings of *Rhizophora mangle* and *Avicennia germinans* were transplanted March 2014. Three plots were established in which natural seedling recruitment, transplant survival and growth (height and number of leaves), and salinity were monitored at regular (monthly) intervals over eleven months via permanent transects. At eleven months seedling survival was higher for *R. mangle* than *A. germinans* (65% vs. 58% respectively) Natural recruitment was higher for *A. germinans* than *R. mangle* (120 vs. 7). Correlation and ANOVA tests confirmed that the number of leaves varied significantly between plots ($p=0.001$) and species ($p=0.001$). Seedling height varied significantly between species with *A. germinans* being taller than *R. mangle* seedlings. ($p=0.001$). The site shows early signs of successful restoration with the occurrence of natural seedling recruitment, and average transplant growth rates of 5-7 cm over the eleven month period. Initial debris removal and leveling works deemed critical to successful restoration. The data suggests that conditions in the area are more favourable towards the establishment of *A. germinans* seedlings.

Keywords; Mangrove rehabilitation, charcoal burning, anthropogenic activities, natural recruitment, *Avicennia germinans*, *Rhizophora mangle*

Abundance, distribution and reproductive activity of large marine gastropods in different habitats along Campeche Bay, México

Valencia JS, Diaz ME, Morales IM, Arand DA

The catch of multi specific gastropods in Campeche Bay is the most important fishery of the Gulf of Mexico. The abundance and distribution of large gastropod species were determined in 120 station of the Campeche Bay by underwater visual surveys in summer (2009-2011), based on transects of 300 m² from 2 m to 12 m isobaths. In addition, sediment grain sizes, salinity, temperature and oxygen were measured. Coarse and medium sand were the sediments most abundant. The West Indian chank shell, *Turbinella angulata* and lightning whelk, *Busycon perversum* were the most abundant, with a mean density of 0.0023 ind/m² and 0.0009 ind/m², respectively. Milk conch *Lobatus costatus* had a density of 0.0005 ind/m² and horse conch *Triplofusus giganteus* with 0.0001 ind/m². The West Indian chank shells and horse conchs were the most widely distributed along Campeche bay, milk conchs were most abundant in seagrass beds, whereas lightning whelks were found predominantly in sand banks. Peak of reproductive activity was observed from March to Jun in seagrass beds as in sand banks. All species need the sandy substrate during spawning to cover and protect the eggs and that deposits calcareous egg capsules. It is recommended establish a protected area, seagrass beds and sand banks as spawning area of these

species in order to maintain the adult spawning stock.

Keywords: Abundance, distribution, reproductive activity, gastropods, Campeche Bay

Do fishpot catches and underwater visual fish surveys tell the same story along a gradient of fishing pressure in a small Caribbean island?

Vallès H, Oxenford HA

Management of Caribbean coral reef fish communities would benefit from the use of simple indicators of the state of exploited reef fish communities. This would facilitate monitoring and help improve communication across different stakeholder groups. Monitoring fishpot catches and conducting underwater visual censuses (UVC) are two conventional survey approaches that can be used to obtain data on simple fish metrics (i.e. fish biomass, fish density, average fish body size) to inform about trends in fish communities. However, the data provided by each approach will be subject to different sampling biases, raising questions about the validity of comparing fish metric trends between approaches. In this study, we surveyed six shallow fringing reefs along a fishing pressure gradient on the west coast of Barbados using both fishpots and UVC concurrently. We then compared spatial trends in the aforementioned fish metrics at different levels of data aggregation (i.e. species, family, trophic status, and community levels) between the two survey approaches. Overall, we found low consistency between approaches for most metrics, except for fish biomass, density, and average fish size of parrotfishes at the family level. Further, in both approaches, family-level average parrotfish size exhibited the strongest association with the fishing pressure gradient. These findings suggest that simple metrics derived from the entire parrotfish community are the most comparable between fishpots and UVC, while highlighting the value of average parrotfish size as an indicator of fishing effects.

La gestión de la pesca en arrecifes coralinos del Caribe se beneficiaría del uso de indicadores simples del estado de las comunidades de peces de arrecife. Esto facilitaría el seguimiento del estado de estas comunidades y ayudaría a mejorar la comunicación entre los diferentes grupos implicados en la gestión de estos recursos. El monitoreo de las capturas en nasas y los censos visuales submarinos (CVS) representan dos métodos convencionales de obtención de métricas simples (la biomasa de peces, la densidad de peces, y el tamaño medio de los peces) para informar sobre las tendencias en las comunidades de peces. Sin embargo, los datos facilitados por cada método estarán sujetos a diferentes sesgos de muestreo, lo que plantea dudas sobre la validez de comparar las tendencias observadas entre métodos. En este estudio, se usaron nasas y CVS simultáneamente para muestrear seis arrecifes coralinos de poca profundidad a lo largo de un gradiente de presión de la pesca en la costa oeste de Barbados. Luego, se comparó las tendencias espaciales en la biomasa de peces, la densidad de peces, y el tamaño medio de los peces, a diferentes niveles de agregación de datos (es decir, a nivel de: especie, familia, estado trófico, y comunidad) obtenidas usando cada método. En general, se encontró niveles bajos de consistencia entre métodos. Los únicos casos en los que los dos

métodos mostraban buena consistencia eran para las métricas de los peces loro agregados a nivel de familia. Además, en ambos métodos, el tamaño medio de los peces loro (a nivel de familia) exhibió la asociación más fuerte con el gradiente de la presión pesquera. Estos resultados sugieren que las métricas simples derivadas de la comunidad de peces loro son los más comparables entre nasas y CVS, y confirman la utilidad del tamaño medio de pez loro como un indicador de los efectos de pesca.

Keywords: fishing pressure; cora reef; reef fisheries; parrotfishes; ecological indicators

What saved the corals in 2010? A comparison of the two worst mass bleaching events in Barbados

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Barbados' tourism industry relies heavily on the ecosystem services provided by its coral reefs. Predictions of increasing incidences of mass coral bleaching events with associated high levels of coral mortality over the coming decades highlight the vulnerability of the local economy to climate change impacts and the need to begin quantifying and comparing the effects of these events to better understand their impacts on coral health. This study sought to compare and analyse the mass coral bleaching events experienced by Barbados in 2005 and 2010. Coral bleaching response (as percent of colonies bleaching) and subsequent mortality (as cumulative loss of live coral cover) were monitored at six reef sites on the west and south coasts of the island every four months for one year following the onset of a bleaching response in the summers of 2005 and 2010. Despite the similarity in sea water temperature between the two events, the levels of coral bleaching and mortality were considerably higher in 2005 (initial level of bleaching 74.8% of all coral colonies, average level of bleaching over the year was 38.2% and cumulative mortality was 26% of live coral cover) than in 2010 (initial level of bleaching 49.7%, average 35.3% and cumulative mortality 8%). Potential explanations include acquired resistance of at least some coral species and/or conferred protection by the passage of a chlorophyll-rich water mass in 2010.

La industria turística de Barbados depende en gran medida de los servicios de ecosistema proporcionados por sus arrecifes de coral. Las predicciones sobre el aumento de la incidencia de eventos de blanqueamiento y consecuente mortalidad de corales en las próximas décadas ponen de relieve la vulnerabilidad de la economía local a los impactos del cambio climático y la necesidad de comenzar a cuantificar y comparar los efectos de estos eventos para entender mejor sus impactos sobre salud de los corales. Este estudio trata de comparar y analizar los eventos de blanqueamiento masivo de coral experimentados por Barbados en 2005 y 2010. El blanqueo de corales (porcentaje de colonias blanqueadas) y la mortalidad posterior (pérdida acumulada de cobertura de coral vivo) fueron monitoreados en seis arrecifes en la costa oeste y sur de la isla durante un año después de la aparición de blanqueo en los veranos de 2005 y 2010 y a intervalos de cuatro meses. A pesar de la similitud de los perfiles de temperatura del agua del mar entre los dos eventos, los niveles de blanqueamiento y consecuente mortalidad de coral fueron

considerablemente más altos en 2005 (nivel inicial de blanqueamiento: 74,8% de todas las colonias de coral; nivel promedio de blanqueamiento durante el año: 38,2 %; mortalidad acumulada: 26% de cobertura de coral vivo) que en 2010 (nivel inicial de blanqueamiento: 49.7 %; nivel promedio: 35,3 %; mortalidad acumulada: 8 %). Las posibles explicaciones incluyen la resistencia adquirida por algunas especies de coral y / o protección conferida por el paso de una gran masa de agua rica en clorofila en el 2010.

Keywords: mass bleaching, coral mortality, Barbados

Comparison of linear mortality and tissue regeneration rates in three coral species affected by white band and Caribbean ciliate infections

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The Caribbean ciliate infection (CCI) and the white band (WBD) are diseases that affect a variety of hosts; and both have been associated with rapid rates of coral tissue loss, which contributes with declining trends of coral cover in Caribbean coral reefs. In this study we compared the mortality rates associated to CCI in three species of corals with different growth forms: *Orbicella faveolata*, *Orbicella annularis* and *Acropora cervicornis*. We also determined and compared mortality rates in colonies of *A. cervicornis* bearing WBD and CCI. The study was conducted at two locations in Los Roques Archipelago National Park between April 2012 and March 2013. In *A. cervicornis* the mean rate of tissue loss was similar for WBD (0.08 ± 0.02 cm/day) and CCI (0.07 ± 0.02 cm/day). However, the mean mortality rate of CCI in *A. cervicornis* was faster than the one recorded in the massive species *Orbicella faveolata* (0.04 ± 0.01 cm/day) and *O. annularis* (0.03 ± 0.005 cm/day), respectively. Tissue regeneration rates were ten times lower than the mortality rates for all diseases regardless the coral species. This study provides the first documentation of tissue mortality and linear regeneration rates from CCI colonies with massive morphology. Results from this study supports the importance of CCI as a potential risk in the reduction of coral cover in three species of great importance as reef builders.

La infección de ciliados del Caribe (ICC) y la enfermedad de banda blanca (EBB) afectan a una gran variedad de hospedadores y han sido asociadas con rápidas tasas de pérdida de tejido, lo que contribuye con la pérdida de cobertura coralina en los arrecifes del Caribe. En este trabajo se compararon las tasas de mortalidad asociadas a ICC en tres especies de coral con diferentes formas de crecimiento: *Orbicella faveolata*, *Orbicella annularis* y *Acropora cervicornis*. Además se determinaron y contrastaron las tasas de mortalidad de tejido que producen la EBB y la ICC para esta última especie. Este estudio se realizó en dos localidades del Parque Nacional Archipiélago Los Roques entre Abril de 2012 y Marzo de 2013. En *A. cervicornis* la tasa de mortalidad por la EBB (0.08 ± 0.02 cm/día) fue similar a la de ICC (0.07 ± 0.02 cm/día). Sin embargo, en la ICC, el promedio de las tasas de mortalidad sobre *A. cervicornis* fue más rápido que el registrado para *Orbicella faveolata* (0.04 ± 0.01 cm/día) y *O. annularis* (0.03 ± 0.005 cm/día). Las tasas de regeneración de tejido fueron diez veces menores a las tasas de mortalidad para

ambas enfermedades independientemente de la especie de coral. Este estudio provee la primera documentación de las tasas de mortalidad y de regeneración de tejido producidas por la ICC en colonias con morfología masiva. Este estudio presenta evidencias de la importancia que tiene la ICC como riesgo potencial en la disminución de cobertura coralina en tres especies de gran relevancia como constructoras de arrecifes.

Keywords: Caribbean ciliate infection, White band disease, *Orbicella annularis*, *Orbicella faveolata*, *Acropora cervicornis*, rate of tissue mortality

Quantification of problems of the CARICOMP method to describe coral communities: impacts on statistical inference

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Monitoring programs are extremely valuable to detect changes in space and time from historical data. Their success is determined in part by the possibility to discriminate authentic spatial and temporal variability from methodological errors. CARICOMP is among the oldest coral reef monitoring programs of the wider Caribbean with a data base that has expanded for more than 20 years in numerous countries. In Venezuela, this program has failed to detect evident trends of decline of coral reef health for over 19 years. Herein, we studied the set of methodological errors associated with the CARICOMP method and how these errors inflated the probability of retaining a false null hypothesis (i.e., wrongly conclude that no change has occurred). For this, we compared the errors of experts and beginners who estimated the cover of different substrates in three transects using chains and mosaics from digital videos during two different days of observation. The mean error was calculated as the absolute difference between consecutive observations made by each observed for each of the substrates divided by the number of substrates evaluated. We found that the mean error using the chains increased two to seven fold when data collected by a beginner was compared to the data gathered by the expert. The magnitude of this error varied among transects. When the less-experienced observer used mosaics this error was reduced from 11.9 to 0.89%, 7.9 to 1.2% and from 3.6 to 1.01 % in transects 1, 2 and 3, respectively. The same trend was recorded for the experimented observer; however, the difference between the chain method and the mosaics seldom exceeded 5%. For the majority of substrates, we reduced the sampling error, which in turn increased statistical power for the same sample size, Alfa and effect size, regardless the level of expertise of the observer.

Keywords: CARICOMP, chain, digital mosaics, coral reefs, community structure

Regeneration in corallimorpharia

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Sessile animals are frequently at risk of injury due to predators, competition, and environmental and anthropogenic impacts. The ability to regenerate lost tissue or new individuals is an important survival mechanism. Corallimorpharia species in the phylum Cnidaria are easily maintained and readily regenerate

new individuals from small fragments of tissue. They are closely related to Scleractinia and possess the potential to be a model species for regeneration in corals. The process of regeneration and normal histology in this group is not described. A limited number of studies have used histology to describe the cellular process of regeneration in other corals. Fragmentation, followed by morphological description of the regenerative process will be performed over a period of several weeks. This work will create a basis for future research regarding the effects of environmental and intrinsic factors on regeneration of Corallimorpharia.

Keywords: regeneration, Corallimorpharia, coral, wound repair