El Empoderamiento de las Mujeres de Yucatán, México por la Pesquería del Caracol Chivita (Mollusca Gastropoda), *Melongena corona bispinosa*

The Empowerment of Women in Yucatan, Mexico by the Conch Fishery of Chivita (Mollusca Gastropoda), *Melongena corona bispinosa*

La Participation des Femmes au Yucatan, Mexique dans la Pêche du Mollusque Gastéropode, Chivita, (*Melongena corona bispinosa*)

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RESUMEN

En la Península de Yucatán se localiza la laguna de Chelem (21°16′00″N y 89°45′00″W), en cuyas aguas habita el molusco gasterópodo *Melongena corona bispinosa*, llamado localmente "Chivita", ya que su concha presenta picos. Su pesquería representa una importante fuente económica y laboral. El 60% de las mujeres realiza la pesca de este organismo, mientras el 40% restante lo hacen niños y ancianos, aunque el permiso de captura el permiso de captura comercial la tienen los pescadores, varones. El volumen autorizado de captura es de cinco toneladas anuales de pulpa con un valor de 20 000 dólares americanos, sin embargo se extrajó un estimado de 10 veces más. La tasa de extracción per capita en promedio es de 2 kg•día-1•ind-1 de carne limpia, , siendo una de las pesquerías importantes en Yucatán. Hasta 2009 se considero una pesquería de subsistencia, sin embargo su captura no era para auto consumo, toda la captura se comercializaba, no quedando registrada ésta, lo que dificultaba su manejo y normativa, a partir de 2010 se autoriza como pesca comercial. Es un recurso que se utiliza en su totalidad. En el presente trabajo se presenta datos de la captura y de la participación que tienen las mujeres en esta pesquería, así como de su procesamiento, su comercialización, la manufactura de artesanías, analizando su contribución en el empoderamiento de la mujer rural yucateca de México.

PALABRAS CLAVES: Género, pesquería moluscos, Yucatan, *Melongena*, empoderamiento

Technological Changes in Encircling Gillnets Operating in the Colombian Caribbean and its Effect on Landings and Fishing Sites

Cambios Tecnológicos en las Redes de Enmalle de Encierro que Operan en el Caribe Colombiano y su Efecto sobre los Desembarcos y Sitios de Pesca

Changements Technologiques dans les Filets Maillants Encerclants Opérant dans les Caraïbes Colombiennes et Son Effet Sur les Débarquements et Les Sites de Pêche

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ABSTRACT

Encircling gillnets are known in the Gulf of Salamanca as "boliche", are active fishing gears which originally operated in the Ciénaga Grande de Santa Marta and from the 80s began to be used at sea for the purpose to capture medium pelagic fish. Despite operating as a purse seine, the principle of capture is gillnet. This work identified the main historical changes in constructive parameters of encircling gillnets and their effect on the magnitude and spatial distribution of catches. To get to know about current technical details of the gear in-situ measurements were performed, while historical were determined with semi-structured surveys to fishermen. To establish historical changes in CPUE and fishing sites the databases fishery landings were used. The results indicate that the main change in gear was the net height, which increased from 1 to 3 mesh (7 to 19 m), this adaptation was aimed of put nets at greater depths, and consequently the sinker in footrope was also amended. The border of this fishery expanded, reaching a maximum depth of 19 m in fishing hauls. CPUE increased 3.1 times between the start and end of the period evaluated (1994-2008). This study demonstrates the ability of fishermen to make technological changes to fishing gear and increase their catches. However, to determine the increase in profitability the cost should be studied because fishing is done currently ever further.

KEYWORDS: Encircling gillnets, technological changes, pelagic fish, Colombia, Caribbean Sea

Population Genomics of the *Sargassum* Biome

Genómica Poblacional de la *Sargassum* Bioma

La Génomique des Populations de L'*Sargassum* Biome

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ABSTRACT

The genus *Sargassum* includes over 350 primarily benthic species with only two recognized holopelagic representatives. Massive accumulations and strandings of holopelagic species of *Sargassum* on Caribbean, western African and Brazilian shores have reawakened interest in this important yet understudied brown macroalga that has been dubbed "the golden floating rainforest of the Atlantic Ocean". A rare form of *S. natans* referred to as *S. natans VIII* after the work of Parr in the 1930's, has been identified as the form accumulating in unprecedented quantities, but to date, no genomic data are available for any holopelagic *Sargassum* species. Our laboratory has been applying comparative metagenomics on known forms of the *Sargassum* holopelagic species: *S. fluitans III* and *S. natans I*, alongside the formerly rare, *S. natans VIII* to elucidate the relationships between the different forms, with the ultimate goal of producing population genomics markers with which to delineate different populations. In addition, amplicon sequencing strategies targeting the V6-V4 hypervariable region of the small-subunit ribosomal RNA gene of bacteria to better characterize the *Sargassum* microbiome reveal diverse assemblages of bacteria that include Cyanobacteria, Proteobacteria, Bacteroidetes, Firmicutes, Chloroflexi and Actinobacteria. As seen with species of *Sargassum* from Asia, comparative organelle genomics is useful in differentiating between Atlantic *Sargassum* species, however the holopelagic forms are very closely related compared to their benthic cousins. Despite gene synteny and high sequence conservation, the holopelagic *Sargassum* species differ in their ecology and distribution patterns, warranting a more in-depth examination of the holopelagic *Sargassum* biome as a whole.

KEYWORDS: Caribbean, Sargasso Sea, next-generation, biodiversity, bioinformatics

Reef Fish Assemblage Biogeography Along the Florida Reef Tract

Ensamble Biogeografíco de Peces Arrecifales a lo Largo del Tracto Arrecifal de la Florida

Reef Biogéographie Poissons D'assemblage le Long du Récif Tube Florida

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ABSTRACT

Temperature, depth, and major habitat type have a strong effect on the distribution of reef fish and thus affect reef fish assemblage variability across the seascape. The Florida Reef Tract is currently broken up into several geographic subregions; Dry Tortugas, Lower Keys, Middle Keys, Upper Keys, Biscayne, and southeast mainland Florida. Multiple distinct reef fish assemblage biogeographic regions have recently been identified in the southeast Florida sub-region at the margin of warm tropical water and cooler temperate waters. Different assemblages associated with distinct benthic habitats are seen along and across the reef tract at this juncture. This study willbuild upon previous work and use regionally consistent robust fishery independent visual reef census data to assess potential biogeographic assemblage regions throughout the rest of the

reef tract and compare those with the current geographic boundaries for southeast Florida. Multivariate data will be analyzed to determine similar assemblages and with which benthic habitat they associate. Spatial distribution of similarity clusters will be analyzed to determine assemblage extents. Defining region based on assemblage instead of geography informs the stratification of site placement and data analyses in future monitoring efforts such as the National Coral Reef Ecosystem Monitoring Program (NCREMP), South East Coral Reef Evaluation and Monitoring Project (SCREMP), and Florida Reef Resilience Program (FRRP). This will provide a baseline for future climate change and management studies.

KEYWORDS: Ecology, multivariate analyses, range shift, spatial distribution, community shift

Estuarine Community Response to a Shift of Weather-related Hydrographic Regimes Imposed by Climate Variability in Coastal Waters of Mississippi

Respuesta De Una Comunidad Estuarina a un Cambio De Régimen Hidrográfico Asociado Con Una Variación Climatica en La Costa De Mississippi

Réponse D'une Communauté D'estuaire par un Changement de Régime Hydrographique Associé Avec une Variation Climatica de la Côte du Mississippi

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ABSTRACT

The Gulf Coast Research Laboratory developed an independent fishery assessment and monitoring (FAM) program in 1974 to survey four fixed stations semi-monthly using a beam plankton net (BPL) and two fixed stations monthly using a 50-ft bag seine in coastal waters surrounding the Bay of Biloxi and continues to maintain this program today. During the past 42 years of the FAM program, 740,911 individuals from 120 species (107 finfish and 13 invertebrates) were collected with the BPL and 943,686 individuals from 135 species (124 finfish and 11 invertebrates) were collected with the 50-ft bag seine. Nonparametric multivariate analyses were used to compare indices of annual abundance and diversity of estuarine species from BPL and seine collections from the period 1974-2015. These indices were grouped separately by weather-related hydrographic years imposed by the coupling of the Atlantic Multi-decadal Oscillation (AMO) and North Atlantic Oscillation (NAO) phases. Analyses revealed an influence of the coupling of AMO and NAO phases on the abundance and composition of estuarine organisms in the study region. Estuarine species richness and abundance for the BPL were higher during the wet regime (1974-1994) and lower during the dry regime (1995-2015). Diversity metrics were relatively steady for the BPL and variable for the seine throughout the study period, as some species decreased, increased or were stable for both gears, and other species vanished or appeared. Further analysis will be able to quantify the influence of weather-related hydrographic characteristics imposed by climate variability on the estuarine community in Mississippi coastal waters.

KEYWORDS: Climate variability, Bay of Biloxi

Creating Awareness About Marine Protected Areas (MPAs) Among School Children in Grenada – A Participatory Education Approach

Crear Una Conciencia sobre las Áreas Marinas Protegidas (AMP) entre Niños de Edad Escolar en la Isla de Granada - Un Enfoque de Educación Participativa

Promotion de la Sensibilisation au Sujet des Aires Marines Protégées (AMP) Parmi les Étudiants en Grenada - Une Approche de L'éducation Basé sur la Participation

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ABSTRACT

The success of a Marine Protected Area (MPA) relies heavily on the attitudes of the local communities and how they perceive the strategies and plans put forward by Government. In the study area (Molinere-Beausejour Marine Protected Area (MBMPA), Grenada) numerous public awareness and outreach activities have been implemented to build support for the MPA for over five years. However, there's still an alarmingly large proportion of the communities that lack a full understanding of the purpose and importance of an MPA in that area. Studies suggest that children play an important role in developing a community's understanding of the environment because they can share information learnt with their families and communities. To create awareness about the MPA, a pilot program, "The Reef Guardian School Program" was designed following a participatory approach comprising of classroom and field activities. The main objective of this program was to improve the knowledge of students and create awareness about MPA management. The program was implemented in two schools: Uganda Martyrs R.C. School and Happy Hill Secondary School. This paper provides a critical overview of the program through the production of a collaborative art project which reflects student's views on "Marine Protected Areas". The researchers supervised the collaborative art work. Feedback was also gathered from parents through questionnaire survey. The findings of this study will help improve education programs on Marine Protected Area in Grenada and elsewhere in Caribbean.

KEYWORDS: Participatory education, Reef Guardian Program, Marine Protected Areas, Grenada

Conch: Shaping a Sustainable Fishery Through Science

Caracol Rosado : Formando Una Pesquería Sostenible Través De La Ciencia

Conch : Façonner U\une Pêche Durable Grâce à la Science

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ABSTRACT

Throughout the Caribbean, the Queen Conch (*Lobatus gigas* formerly called *Strombus gigas*) is considered a precious marine resource. Fisheries managers, researchers and some community members recognize there is a decline in conch populations in The Bahamas and regionally. This decline motivated a collective effort in The Bahamas by The Nature Conservancy (TNC), The Bahamas National Trust (BNT), the Department of Marine Resources (DMR) and other conservation partners to improve the sustainability of the conch fishery through the Conchservation Campaign. However, a major challenge to this effort was that little was known and documented about whether the general population of The Bahamas is aware of the status of the fishery, how they use and value conch, and whether they would support new conservation measures. To address this gap, a study of Bahamians' knowledge, attitude, and practices (KAP) about conch was conducted in 2015. In an effort to build upon the KAP Survey, TNC conducted an assessment of the national conch fishery. The 2016 National Conch Assessment included a comprehensive literature review on Queen Conch in The Bahamas, a stakeholder analysis on the local economic market and consumption rates and an evaluation of the fishery's management structure. This presenta-

tion will briefly highlight findings from both the KAP and the National Conch Assessment and will offer resource managers and decision-makers next steps for the sustainable use and management of the Bahamian Queen Conch Fishery.

KEYWORDS: Conch, TNC, fishery, sustainable, Bahamas

Identification of Nassau Grouper Eggs in the Plankton: Is Size a Valid Metric?

La Identificación de los Huevos Nassau Grouper en el Plancton: Es el Tamaño de Una Métrica Válida?

Identification des Oeufs Nassau Grouper dans le Plancton: Est la Taille D'une Métrique Valide?

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ABSTRACT

Nassau grouper are an important species in the Caribbean both in a fisheries context and because they contribute to tourism through enhanced diving experiences. However, the species has suffered dramatic declines through it range due to overfishing on fish spawning aggregations (FSAs) for the species. These spawning aggregations, occurring during the winter months in the central Caribbean, represent the total reproductive output for the species. It is thus important that we gain an understanding of the patterns of connectivity generated by FSA sites, and characterize the processes of egg/larval advection, diffusion, and planktonic ecology (feeding and predation). To do this, we evaluated the ability of a novel plankton sampler, the NetCam, to map the dispersal of Nassau grouper eggs from the FSA immediately post-spawning. The NetCam captures images of items passing through the cod-end of a plankton net. However, it is not clear what proportion of the eggs imaged by the NetCam are Nassau grouper. Using eggs from preserved samples taken during the NetCam deployment, we demonstrate at least 3 distinct size classes of eggs. Based on genetic analysis, these distinct classes belong to separate species. These findings suggest that images of fish eggs captured by the NetCam can reliably be identified to species, and are thus useful in characterizing the spatial ecology and early life history of Nassau grouper eggs.

KEYWORDS: Nassau grouper, identification, eggs, plankton, spawning aggregation

Importance of Recreational Fishery Data Collection: Dominican Republican

Importancia de la Recolección de Datos de Pesca Recreativa: Republica Dominican

Importance de la Collecte des Données de Pêche Récréative : Dominican Républicain

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ABSTRACT

The Dominican Republic is known for being reliant on the harvest of the country's marine resources, yet the country battles to utilize available data channels to develop responsible management practices. Lack of data utilization is especially apparent in the recreational fishery, being there is little national data collection from this fishery. Recreational anglers travel from all over the world to pursue pelagic species in the Dominican Republic. A recreational fishing industry throughout the coastal areas of the country means a large effort for these pelagic species, as well as a high catch rate. The effort and catch rate from recreational anglers could supply valuable data channels for ICCAT and similar pelagic fishery management organizations. Pelagic fishery managers rely heavily on the collection of accurate and quality data to determine proper management responses, having to utilize all possible channels due to the difficult nature of determining highly migratory spe-

cies local populations. Stock assessments employing inaccurate data will portray faulty populations resulting in improper management of these fisheries, endangering the species being studied, along with the communities dependent on them. Developed countries contain administrations responsible for conducting these studies and producing stock assessments. These administrations utilize quality data collections systems to assure they receive the most accurate available data to support their findings. Less developed countries, such as some throughout the Caribbean, do not have similar government entities to complete these stock assessments. Increasing fishery monitoring and data collection efforts could greatly benefit the stock assessments in previously data-poor fisheries.

KEYWORDS: Recreational fishery, data collection, Dominican Republic, effort

The EU BEST Initiative: An Opportunity to Strengthen the Conservation and Sustainable Use of Biodiversity in 15 European Overseas Entities in the Caribbean

La Iniciativa Europea BEST: Una Oportunidad para Fortalecer la Conservación y el Uso Sostenible de la Biodiversidad en 15 Territorios del Ultramar Europeo en el Caribe

L'initiative Européenne BEST : Une Opportunité pour Renforcer la Conservation et L'utilisation Durable de la Biodiversité dans les 15 Territoires de L'Outre-Mer Européen de la Caraïbe

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ABSTRACT

The Caribbean includes 15 Regions (OR) and territories (OCT) of the European Union overseas , politically attached to United Kingdom, France and the Kingdom of the Netherlands. Those entities strongly contribute to the Caribbean Islands Biodiversity Hotspot with a rich biodiversity and a high number of endemic species They are home to 92 Key Biodiversity Areas, covering an area of 8090 km² and 43 ecological marine and terrestrial corridors , as identified and mapped by the BEST Caribbean Hub through during its Ecosystem profiling work. EU Overseas are thus key actors for the implementation of international and regional conservation targets and to foster Caribbean cooperation In this context and to address the serious threats faced by this exceptionally diverse territories, the European Parliament launched in 2010 the BEST initiative – Funding scheme for Biodiversity and Ecosystem Services in Territories of European Overseas – to support the conservation of biodiversity and sustainable use of ecosystem services including ecosystem-based approaches to climate change adaptation and mitigation in the EU ORs and OCTs. In line with this objective, the BEST 2.0 Programme, an innovative funding facility for small-scale and medium-scale field actions , seeks to enable, empower and strengthen local authorities and civil society organisations in the OCTs. We here propose to provide an overview of the BEST initiative and long term investment strategy, as well as to introduce 4 Caribbean BEST 2.0 Medium Grant awarded projects, the first results from 2016 Small Grants call and the up-coming 2017 BEST 2.0 Small Grants opportunity.

KEYWORDS: EU Overseas, BEST, biodiversity, conservation, funding

Age Frequency, Growth, Mortality, and PAH Levels of Roughtongue Bass, *Pronotogrammus martinicensis*, Following the Deepwater Horizon Oil Spill

Frecuencia Edad, Crecimiento, Mortalidad y los Niveles de HAP de Roughtongue Bass, *Pronotogrammus martinicensis*, Después del Derrame de Petróleo de Deepwater Horizon

Niveaux de Fréquence de L'âge, la Croissance, la Mortalité et de HAP de L'roughtongue Poisson, *Pronotogrammus martinicensis*, Après le Déversement de Pétrole de Deepwater Horizon

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ABSTRACT

The present study examined age frequency, growth, mortality, and polycyclic aromatic hydrocarbons (PAH) levels in roughtongue bass, *Pronotogrammus martinicensis,* from the Pinnacle reefs following the Deep Water Horizon (DWH) oil spill. Two sites were sampled: the Alabama Alps (west) 54 km from the DWH site, and Roughtongue Reef (east) 111 km from the DWH site. Seasonal samples of roughtongue bass were collected in Sep-Oct 2014 (n=190), Dec 2014 (n = 249), Mar 2015 (n = 310) and Jun-Jul 2015 (n = 360). Based on otolith aging (n=1090), resident fish were dominated by the 2009 and 2010 year classes. Von Bertalanffy growth parameters for all fish were L_∞ = 102.2, K = 0.60, and t_0 = 0.25. Growth rates were significantly lower for fish from Alabama Alps (n = 873; L_∞ = 100.7, K = 0.93, t_0 = 0.80) compared to fish from Roughtongue reef (n = 216; L_∞ = 86.3, K = 0.53, t_0 = -0.67; p = < .0001), and most likely linked to proximity and discharge from the Mississippi River. Total mortality Z = 1.73 and annual survival S = 18% (n = 1090). Polycyclic aromatic hydrocarbons(PAH) had mean = 50 ± 52.2, range = 0 to 220 ppb (n=38), were less than the marine lowest observed effects levels of 300 ppb, and did not differ between collection sites. Based on the dominance by the 2009 and 2010 year classes and low PAH levels, the present study showed no effect of DWH on this mesophotic reef species.

KEYWORDS: Roughtongue bass*, Pronotogrammus martinicensis*, age frequency, growth, PAH

When Water Control Strategies Meet Marine Fisheries: Linking Lake Okeechobee to Coastal Reef Fish Communities in South Florida

Cuando Estrategias de Control de Agua se Reunen con las Pesquerías Marinas: Enlazando el Lago Okeechobee a las Comunidades Costeras de Peces Arrecifales en el Sur de Florida

Quand les Stratégies de Contrôle de L'eau Rencontrent les Pêches Maritimes : Reliant Lac Okeechobee pour les Collectivités Côtières de Reeffish dans le Sud de la Floride

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ABSTRACT

Coastal coral reef fish communities are under continuously growing stress from climate variation and human activity. The most apparent being: sedimentation from coastal development and altered estuarine outflow resulting in reduced water quality. Here we present data from 33 hydroacoustic surveys at five natural and artificial reefs ranging from 20 - 45 m in depth, and examine the relationship between precipitation, outflow rates, changes in physical water characteristics, fish abundance, and schooling activity. Results suggest that human induced alterations to the drainage regime of Lake Okeechobee following severe rainfall events in the Fall of 2015 resulted in: 1) dramatic changes to the acoustic properties of coastal waters, 2) subsequent decreases in fish biomass, and 3) changes in schooling behavior and structure in the study region. While the precise mechanism is unclear, increased suspended sediment load is known to elevate the perception of risk in prey species, potentially explaining the emigration of prey fish biomass from the study region. Furthermore, in the context of fisheries management, this event occurred during the peak of goliath grouper spawning season and potentially disrupted

a mass spawning event for the ESA listed species. The links between water and fisheries management are not immediately apparent, but examination of these data offers new insight into the relationship between two high priority topics in South Florida, and identifies considerations for future management actions.

KEYWORDS: Fisheries acoustics, water management, sedimentation, reef fish communities

Treating Gender-blindness: Some Considerations for Caribbean Fisheries Projects Implemented at the Community Level

El Tratamiento de la Ceguera de Género: Algunas Consideraciones para Proyectos de Pesca del Caribe Implementadas a Nivel Comunitario

Traiter le Genre de Cécité : Quelques Considérations pour les Projets de Pêche des Caraïbes mis en œuvre au Niveau Communautaire

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ABSTRACT

Fisheries project interventions in the Caribbean implemented by state and non-state actors cannot contribute to the further development of the fishing industry if they remain gender blind. The condition of gender blindness refers to a failure to see gender as an influencing factor of the project. Many gender analysis tools exist to redress gender blindness and gauge the extent to which the needs and priorities of men and women are reflected in the project. The review illustrates how gender can be mainstreamed at various entry points of the project cycle, using a hybrid of the Harvard Analytical and Moser frameworks. It also reflects on some key gender considerations for non-state actors, particularly community-based organisations in the Caribbean applying for project funding under the GEF Small Grants Programme. This communication product is designed to gain attention of these groups as merely a simple attempt to treat gender blindness in fisheries projects at the community level.

KEYWORDS: Gender blindness, gender analysis, GIFT, fisheries, Caribbean

Lionfish Impact in St. Kitts, West Indies: What Are They Eating?

Impacto Del Pez León En St. Kitts, West Indies: ¿qué Están Comiendo?

l'impact Lionfish à Saint-Kitts, Antilles: Qu'est-ce Qu'ils Mangent?

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ABSTRACT

Lionfish native to the Indo-Pacific have recently been damaging ecosystems and reef wildlife as invasive species in the southeastern U.S. and the Caribbean. Because of differing fish community structures and environmental factors across geographic locations, it is essential to know which groups of fishes are being preferentially eaten in order to effectively manage these invasive fish. Using lionfish (*Pterois volitans/miles* complex) speared by divers from multiple dive sites around St. Kitts, lionfish stomachs were removed to identify prey items to the lowest taxonomic level possible. Some prey items could be identified morphologically using dichotomous keys, while others were semi-digested and required DNA barcoding. The lionfish and any items in the stomachs were measured: Total Length (TL) for whole fish, or maximum measurable length for digested items. For each collection site, lionfish length and ecological factors were assessed in relation to the size, number, and diversity of prey items identified. Stomach contents varied from zero to fifteen fish per stomach. Seven families of fish, ranging in length from 0.9 to 9.9 centimeters, and multiple invertebrate taxa, were found. This suggests an opportunis-

tic or generalist feeding strategy, which agrees with previous studies of lionfish diet. Assessing the damage that these invasive species may have on the ecosystem, whether by depleting juvenile fish populations or competition with native predators, may encourage the public and governments to take action to ameliorate the effects. Therefore, this study has the potential to be useful for fisheries and conservation management planning.

KEYWORDS: Lionfish, *Pterois*, invasive, stomach-contents, prey

Volunteers Make a Difference: Lionfish Distribution and Success of Removal Efforts in Little Cayman

Los Voluntarios Hacen una Diferencia: La Distribución del Pez León y el Éxito de los Esfuerzos de Eliminación en Little Cayman

Les Bénévoles Font une Différence: La Distribution Lionfish et le Succès des Efforts de Déménagement à Little Cayman

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ABSTRACT

Indo-Pacific lionfish, *Pterois* spp., have established themselves in the western Atlantic Ocean, Gulf of Mexico, and Caribbean Sea. Lionfish have the potential to severely damage the marine ecosystems that they have invaded. These invasive fish may significantly reduce native fish populations through a combination of direct predation and indirect competition for resources. To date, the most effective technique for managing lionfish populations is targeted removals with spears by SCUBA divers. Currently, local scientists, dive operators, and volunteers conduct weekly lionfish culls on Little Cayman, Cayman Islands. As part of a continued monitoring effort that began in 2011, data regarding lionfish catch per unit effort (CPUE) as well as total length and weight of all lionfish caught have been recorded for these lionfish culls. Transect surveys on select sites on Little Cayman have shown that targeted removals decrease lionfish density as well as size distribution. The long-term data set from a volunteer culling program further supports the positive effects of these efforts. Lionfish densities across culled sites within the marine parks were lower than those at unculled sites, and average total length was also significantly lower at culled sites. These are encouraging results, as they indicate that targeted lionfish removals can help control the lionfish population and thereby lessen the local impacts of this invasive species. Distribution and replenishment rate of lionfish populations around the island varies both spatially and temporally. This information can be applied to improve culling strategy and overall efficiency and effectiveness of the volunteer program.

KEYWORDS: Lionfish, invasive species, management, coral reef, Cayman Islands

Women as Fishers of the "Maxkil", *Libinia dubia* (Crustacea: Decapoda), a Bait for the Octopus Fishery in San Felipe, Yucatan, Mexico

Mujeres como Pescadoras de "Maxkil", *Libinia dubia* (Crustacea: Decapoda), Carnada para la Pesquería de Pulpo en San Felipe, Yucatán, México

Les Femmes comme les Pêcheurs du "Maxkil", *Libinia dubia* (Crustacea: Decapoda), Appât pour la Pêche de L' Octopus à San Felipe, Yucatan, Mexique

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ABSTRACT

For more than 20 years, a group of women from San Felipe, Yucatan, Mexico, within the natural protected area (NPA)

"Reserva de la Biosfera Ria Lagartos", has been dedicated to capture the "Maxkil" (*Libinia dubia*) which is a crab used as bait for the octopus' fishery in the northern Yucatan Peninsula, Mexico. These women assembled a regular "fisher cooperative" to catch this crab. The octopus' fishermen respect this group of women since these latter are the suppliers of fresh bait during the octopus fishing season. Actually, fishermen have created an alliance with this group of women since the octopus's fishery is time demanding (diurnal activity) while crab fishing is only conducted during night until down; thus, fishermen could not be capturing crab in the night and octopus in the day. Women obtain good revenues from the crab fishing which contributes to their family budget; however, social conflicts among women have reduced the members of this group. Efforts recently emerged from the authorities of the NPA and the Madrid Polytechnic University to implement a tourism alternative activity in which these women could conduct paid tours to visitors to watch the crab catching, but at the same time the women keep their fishing cooperative moving. The latter initiative is still incipient and a portion of the women is hesitant to participate. This work describes the women participation in the crab fishing and discusses advantages and disadvantages of this tourism alternative to be implemented.

KEYWORDS: Octopus, crab, Yucatan, fishery

Survival of Nassau and Tiger Grouper Early Life Stages from a Little Cayman, Cayman Islands Spawning Aggregation

La Supervivencia de los Primeros Estadios de Desarrollo de Nassau y de Mero Tigre desde una Little Cayman, Islas Cayman Agregación Reproductive

La Survie des Stades Précoces de la Vie Nassau et le Tigre Mérou d'un, Îles Caïmans Frayère Little Cayman

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ABSTRACT

The Grouper Moon Project, a collaboration with Reef Environmental Education Foundation (REEF) and the Cayman Islands Department of Environment, has generated nearly two decades of research pertaining to fish spawning aggregations in the Cayman Islands. During this time, the Cayman Island government has made major strides in protecting essential grouper spawning aggregation sites. Survival at early life stages is critical to the recovery and sustainability of these economic and ecologically important species in the Caribbean. During a 2016 spawning event in Little Cayman, scientists with the Grouper Moon Project collected embryos (Nassau grouper, *Epinephelus striatus* and tiger grouper, *Mycteroperca tigris*) *in situ* at fertilization. Collection from individual spawning rushes (10 Nassau and 6 tiger) allowed for comparison of maternal influence on embryo and larvae survival and condition. Fertilization rate, survival to hatch, larval survival without food and morphological measurements of embryos and larval were measured. Fertilization rate was high (>90%) for both species. Hatch success was consistently high for tiger grouper (98-100%), but varied between females of Nassau grouper (16-98%). Nassau grouper larvae survived without food 4-7 days post hatch (dph) at 26°C and 6-8 dph at 24°C. Tiger grouper larvae survived without food 6-8 dph at 26°C. Overall there was less variability in survival rates between females of tiger grouper and the larvae appear to be more robust to limited food availability at this early life stage. Maternal influence on embryo and larval condition and size may influence hatch success and larval survival, particularly in Nassau grouper.

KEYWORDS: Nassau grouper, tiger grouper, larvae, embryo, survival

Approaches to Lionfish Control in Belize: Do NTZs Need Additional Support?

Estrategias por el Control del Pez Leon en Belice: Es Necesario un Apoyo Adicional por las Zonas Prohibidas?

Approches au Contrôle du Poisson Lion au Belize: Est ce Que les Zones Interdites a la Pêche Ont Besoin de Soutien Supplémentaire?

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ABSTRACT

Invasive red lionfish (*Pterois volitans*) were first recorded in Belize in December 2008. With generalist diets, a novel predation strategy and rapid reproduction and growth, lionfish are considered a major threat to Caribbean coral reefs. Lionfish focused surveys in two Belizean marine reserves in 2014 were used to assess two control mechanisms: an annual lionfish fishing tournament in Gladden Spit and Silk Cayes Marine Reserve (GSSCMR) and regular culls with a volunteer programme in Bacalar Chico Marine Reserve (BCMR). GSSCMR exhibited higher densities of lionfish than BCMR (GSSCMR: 77.8±34.7 ind.ha-1, n=12; BCMR: 30.1±9.7 ind.ha-1, n=31), though high variance made it impossible to draw any conclusions related to management. In 2015, lionfish control approaches were also assessed across five marine protected areas. Survey effort balanced reef type (forereef vs. backreef) and management zone NTZ vs. open access. Overall, surveys found few lionfish, and density was low (9.9±4.1 ind.ha-1, n=50) compared to estimates in other parts of the Caribbean. Both lionfish density and prey fish biomass were significantly different between reef regions, but did not vary with protection status or depth. At 14-22% of sites, primarily within NTZs, density was above predicted ecological threshold levels, and average observed density was within error of median and conservative threshold predictions. While these results point to the effectiveness of existing efforts, they highlight a critical need to develop mechanisms for lionfish control inside NTZs, to ensure they function as effective replenishment zones.

KEYWORDS: Invasive species, lionfish, *Pterois volitans*, Marine Protected Areas, management

Using In-situ Length Data to Test a Data-poor Stock Assessment Model and Stock Status of Protected Aggregating Fish Species *Epinephelus striatus*

Usando Datos de Longitud In Situ para Probar un Modelo de Evaluación y Evaluar el Estado del Stock de Datos de los Pobres de las Especies Protegidas de Concentración de Peces *Epinephelus striatus*

En Utilisant des Données In-situ Longueur de Tester un Modèle D'évaluation des Stocks et des Ânes État des Stocks de Données Pauvres des Espèces Protégées de Poissons Agrégeant *Epinephelus striatus*

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ABSTRACT

The Nassau grouper (*Epinephelus striatus*) is an aggregating Caribbean fish species that has been listed as endangered by the IUCN primarily due to overfishing. In 2001, a historical spawning site off the west end of Little Cayman Island was

re-discovered by fishermen and quickly over harvested, prompting the Cayman Islands government to protect spawning sites from fishing. Length measurements were taken in-situ by SCUBA for years 2004 through 2016 using a parallel laser-video calipers. Here we report length-frequency trends through time and use them to fit a recent data-poor stock assessment model, the length-based spawning potential ratio (LB-SPR). We compare the resulting SPR estimates to an independent index of abundance from a mark-recapture model, and make recommendations for extending the LB-SPR method.

KEYWORDS: Length-frequency, assessment, Nassau grouper

Where Are We Now? A Ten Year AGRRA Summary of Little Cayman Reefs, Cayman Islands

¿Dónde Estamos Ahora ? Resumen de Diez Años de AGRRA En los Arrecifes de Pequeño Caimán, Islas Caimán

Où Sommes-nous ? A Dix Années Résumé AGRRA des Récifs Little Cayman, Îles Caïmans

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ABSTRACT

The phrase "shifting baselines" is a concept that has been widely accepted among the marine scientific community for years. It is a term describing a change in how a system is measured against a previous reference point, which may be significantly different from an even earlier reference point of the same system. The Caribbean Sea's benthic and pelagic communities have been subject to a shifting baseline data collection series for decades, describing the rapid change of coral reefs over a short period of time. While most reef communities throughout the Caribbean are on the decline in regards to coral cover and fish biomass, Little Cayman reefs offer some positive outlook to the future. Here we address a ten year dataset of the reefs surrounding Little Cayman, Cayman Islands using the Atlantic and Gulf Rapid Reef Assessment (AGRRA) benthic habitat assessment and fish diversity surveys, documenting major changes against earlier studies. Datas show that historically influential reef framework builders such as the *Acroporids*, *Montastraeas*, and *Orbicellas* show a significant population decline in comparison to the newly dominate *Agaricias*, *Undarias*, and *Siderastreas*. Competition on Little Cayman reefs is high with the macroalgal populations of*Lobophora*, *Halimeda*, and *Padina* increasing by 80% over the past ten years. Datas also show a significant change in fish diversity, particularly the now protected Nassau Grouper (*Epinephelus striatus*).

KEYWORDS: AGRRA, coral, benthic, fish, community

Selectividad de Anzuelos en la Pesquería de Líneas de Mano que Captura Ojo Gordo (*Selar crumenophthalmus)*

Selectivity of Hook in the Handline Fishery for Bigeye Scad (*Selar crumenophthalmus*

Sélectivité des Hameçons dans les Lignes à Main qui Capture Sélar Coulisou (*Selar crumenophthalmus*

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RESUMEN

Selar crumenophthalmus es un pelágico importante en los desembarcos artesanales del Caribe colombiano. La captura

se realiza principalmente en los periodos de luna nueva, con el uso de lámparas a gas propano y con la particularidad de utilizar carnada artificial de silicona en los anzuelos. Esta pesquería se está viendo afectada por la poca información que existe entorno la selectividad de los anzuelos. El propósito de este estudio fue determinar la relación entre los tamaños de anzuelos tipo J (tradicional Kirby) No.12, 13 y 14. En total se muestrearon 1312 individuos durante cuatro periodos de luna nueva. El software Pasgear 2 fue utilizado para determinar parámetros de selectividad. Para establecer diferencias entre la CPUE y los tamaños de anzuelo y entre la longitud total y los rangos de profundidad de captura se llevaron a cabo análisis de varianza a una vía. Durante los experimentos se capturaron individuos entre 20,4 y 33,8 cm LT. El promedio de la longitud total (±SE) fue determinado para cada anzuelo. Las longitudes óptimas calculadas mediante el modelo log-normal fueron: 32,2, 30,0 y 24,0 cm para los tamaños de anzuelo No. 12, 13 y 14, respectivamente. En consecuencia, los anzuelos No. 12 y 13 capturan individuos maduros (>24 cm), solo el uso del No. 14 debe ser examinado, ya que la longitud optima de captura coincide con la longitud en que casi todos los individuos están maduros ($L_{90\text{-}100\%}$). Los resultados constituyen un insumo para los administradores pesqueros, quienes contaran con información fiable que puede ser objeto de aplicación directa al manejo de esta pesquería.

PALABRAS CLAVES: Selectividad de anzuelos, líneas de mano, *Selar crumenophthalmus*, Mar Caribe de Colombia

Comparing Divers to Camera Sled Surveys: The Future for Queen Conch Assessment?

Comparer les Sondages de Plongée et Caméra Luge: Est-ce L'avenir pour L'évaluation de la Conche Reine?

En Comparant les Plongeurs à Caméra Traîneau Sondages : L'avenir pour Évaluation de Strombe Géant ?

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ABSTRACT

Queen conch *Lobatus (Strombus) gigas* is one the most important fisheries species in the Caribbean with annual landings worth > US$30 million. Landings have declined in Puerto Rico since the 1980's due to overfishing. Currently queen conch harvest is prohibited in the Exclusive Economic Zone (EEZ) in Puerto Rico. Abundance estimates in Puerto Rico are conducted by scuba divers at intervals of 3 years, but limited availability of trained divers for conducting surveys has been an obstacle to complete coverage. Diver surveys are also limited by depth and time, whereas camera surveys are not, and provide a permanent photo record of observations. This project will determine if camera sled surveys can provide equivalent or better data in a more efficient manner than scuba surveys. If the camera sled is determined to be an equivalent or better system for resource surveys, it may lead to further applications or development, and improved data collection and analysis. Results of this project will improve the quality of information that can be used for management of queen conch in the Caribbean.

KEYWORDS: Queen conch, surveys, camera sled, assessment

Strengthening Data Collection and Research, FIRMS and WECAFC Collaborations, Supporting Fisheries Management and Monitoring in the Wider Caribbean

El Fortalecimiento de la Recopilación de Datos y la Investigación, las Empresas y la COPACO Colaboraciones, Apoyar la Gestión de la Pesca y la Vigilancia en el Gran Caribe

Renforcement de la Collecte des Données et de la Recherche, les Entreprises et la COPACO Collaborations, Soutien à la Gestion des Pêches et de Surveillance dans la Région des Caraïbes

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ABSTRACT

Improving fisheries data and information collection in the wider Caribbean was highlighted at the Western Central Atlantic Fishery Commission (WECAFC) 14th and 15th sessions. Gaps in fishery statistics and impediments in analysis and information dissemination (regionally and nationally) were key factors impeding management in the region. Activities undertaken through WECAFC and the FAO, FRMS project responding to the need for improvements in data collection and monitoring in the wider Caribbean are summarized. Achievements in 2015 and 2016 are summarized including: 1) the WECAFC-FRMS 2016 regionalworkshop on data collection, analysis, sharing and reporting, 2) development and publishing of regional Marine Resources Fact Sheets and inventories focusing on spiny lobster, conch, and flying fish, 3) definition of action plans supporting national data collection programs, 4) draft minimum data requirements, and 5) identification of deficiencies in national capacities. Activities to be undertaken in 2016 and beyond are described including: 1) finalization of the pilot RDB for the three pilot species in the CRFM region, 2) extension of the RDB to the OSPESCA region, 3) establishment of a WECAFC transversal working group on fishery statistics and data collection, 4) identification of focal projects aimed at improving logistical and technical capacities, 5) completion of FRMS inventories and Fact sheets in the CRFM region, and 6) identification of external linkages for advancing the initiatives undertaken to improve data collection, and information management with the aim to provide sound data for use in stock assessment and monitoring of marine resources in the wider Caribbean.

KEYWORDS: Data collection, fishery management, WECAFC region, CRFM, OSPESCA

Catch Me If You Can: Assessment of Invasive Lionfish (*Pterois volitans*) Behavior on Little Cayman, Cayman Islands to Aid Culling Efficiency

Atrápame si Puedes. Evaluación del Comportamiento Invasivo del Pez León (*Pterois volitans*) en Pequeño Caimán, Islas Caimán Para Ayudar en la Eficiencia de su Erradicación

Attrape-moi si Tu Peux: Étude du Comportement de L'invasive Rascasse Volante (*Pterois volitans*) à Little Cayman (Îles Caïmans), Afin D'améliorer L'efficacité de son Éradication

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ABSTRACT

Control of the invasive lionfish (*Pterois volitans*) is of high priority throughout the Caribbean to aid in the protection of coral reefs against the effects of increased predation. Due to few predators, competitors, parasites or disease, culling programs have been the primary means of removal and management. Concerns have been raised that increased culling pressure selects for more cryptic, wary individuals, making spearing increasingly difficult. To assess any potential correlation between behavior and culling intensity, the cryptic and evasive behaviors of lionfish were surveyed (n = 400) during midday and dusk dives at 28 sites around Little Cayman. Sites included three unculled sites, 13 sites of low culling intensity, and 10

sites of high culling intensity. Findings revealed a decrease in size and abundance and an increase in wary behavior of lionfish at culled sites during the day. Behavior variability was highest at culled sites during the day and corresponded with a greater mean cryptic score, a greater proportion of highly hidden individuals, and a greater proportion of individuals that would flee from divers. This suggests that some individuals may have become wary of divers due to high culling intensity. However, regular culls on Little Cayman, which have removed over 18,000 fish in total, have not increased cryptic or evasive behavior of lionfish at dusk. Overall this study found that evening culls provide greater accessibility to the lionfish population and should be employed whenever possible for enhanced spearing efficiency.

KEYWORDS: Lionfish, *Pterois volitans*, behavior, Cayman Islands, culling

Grupos Funcionales y Estructura Comunitaria de la Ictiofauna Capturada por la Pesqueria de Pequeña Escala en el Mar Caribe de Colombia: Una Visión Histórica

Functional Groups and Community Structure of Fishes Captured by Small-Scale Fishery in the Caribbean Sea of Colombia: A Historical View

Groupes Fonctionnels et Structure Communautaire de Poissons Capturé par la Pêche Artisanale dans la Mer des Caraïbes de Colombie: Une Vue Historique

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RESUMEN

La pesquería de pequeña escala tiene importancia socio-económica, particularmente en países en vía de desarrollo, y se ha atribuido que provoca un menor deterioro ecológico que la pesquería industrial. No obstante, evidencias de sobre-explotación en los recursos objetivo de pesquerías de pequeña escala, hacen fundamental que se evalúe su variabilidad espacial y temporal. Para ello, se analizaron desembarcos de la pesca artesanal desde 1994 hasta 2008 en tres ecoregiones del Caribe de Colombia. Los 196 taxones de las capturas se categorizaron en 6 grupos funcionales (según hábitat: demersales y pelágicos; según tamaño corporal: grandes, medianos y pequeños). Se analizó el cambio temporal de la CPUE de cada grupo funcional por ecoregion (golfo de Salamanca - GS, Tayrona y Palomino) por arte de pesca (Palangre, Red de enmalle y Red de tiro). Se evaluaron cambios espacio-temporales en la estructura de la comunidad de la ictiofauna capturada empleando técnicas mutivariadas (NMDS, ANOSIM). La CPUE promedio de demersales grandes fue superior con redes de enmalle en la ecoregión Tayrona y con palangres en GS; las mayores CPUE de demersales medianos se registraron con redes de tiro en GS y Palomimo. La CPUE de pelágicos grandes y medianos tuvieron variaciones temporales amplias en todas las ecoregiones y la CPUE de pelágicos pequeños resultó significativamente superior en GS. No se encontró un patrón claro de variación espacio-temporal en la estructura comunitaria de los peces capturados en la región. La CPUE tendió a disminuir con el tiempo tanto en el dominio pelágico como demersal.

PALABRAS CLAVES: Ecologia de peces, pesqueria artesanal, variabilidad temporal, estadistica multivariada, desembarques

The Abundance and Distribution of Invasive Lionfish (*Pterois volitans* and *P. miles*) in Bermuda

La Abundancia y Distribución del Invasivo Pez León (*Pterois volitans* y *P. miles*) en las Bermudas

L'abondance et la Distribution de Poissons Lions Envahissant (*Pterois volitans* et *P. miles*) aux Bermudes

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ABSTRACT

Invasive lionfish (*Pterois miles* and *P. volitans*) have spread rapidly throughout the western Atlantic, and are now established from North Carolina to Venezuela. Generalist, opportunistic predators with a broad diet and no natural predators themselves, lionfish can have substantial impacts upon native fish communities wherever they are found. In 2000, Bermuda was the first location outside the United States to detect invasive lionfish. To better understand their potential impact and provide a baseline against which to judge population growth, underwater visual surveys were conducted at multiple depths around the Bermuda platform to map the distribution of lionfish and look for patterns in abundance. Captured lionfish provided information on biomass and size-frequency distributions with depth. Lionfish sightings and captures reported by the public, fishermen and researchers added further insights into distribution patterns. Our surveys show that lionfish densities are greatest at mesophotic depths (>30m) around Bermuda, particularly off the south shore of the island where the seabed slopes steeply and provides deep and shallow habitats in close proximity. However, lionfish have been reported all across the shallow platform from a variety of natural and artificial habitats, with some indications that greater numbers may be present in shallower waters during the winter. Interestingly, greater proportions of both the smallest and largest lionfish size classes are found in shallow waters. At present, lionfish are found at lower densities around Bermuda than in other locations across the invaded range, suggesting that the local population is expanding at a slower rate than observed elsewhere.

KEYWORDS: Lionfish, abundance, distribution, Bermuda

Life History Characteristics of Invasive Lionfish (*Pterois* Species) in Bermuda

Características del Ciclo Vital del Invasivo Pez León en las Bermudas

Caractéristiques du Cycle de Vie de les Poissons-lion Envahissantes aux Bermudes

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ABSTRACT

Since the first reported sighting of invasive lionfish (*Pterois volitans* and *P. miles*) in the Atlantic Ocean over 30 years ago, growing evidence suggests they may have a dramatic negative impact upon native ecosystems and demersal communities. While invasive populations expanded rapidly in most locations following their initial establishment, the lionfish population in Bermuda, the first location outside of the United States to be invaded, appears to be growing at a slower pace. This study investigated the life history characteristics of the invasive lionfish population in Bermuda, examining population structure, growth rates, size-at-maturity, reproductive seasonality and fecundity, in order to understand and model popula-

tion dynamics and thus potential impacts on Bermuda's coral reef ecosystem. Annual growth rings in lionfish otoliths were counted to describe population structure and to establish size-at-age, which was then utilized to estimate growth parameters using von Bertalanffy growth models. Macroscopic and histological staging of ovaries, calculations of gonadosomatic and hepatosomatic indices, and enumerations of mature oocytes were used to describe reproductive seasonality and capacity. Lionfish in Bermuda appear to grow faster and attain larger sizes than they do in their native range or elsewhere in the invaded range. However, they also reach maturity at larger sizes and have a shorter spawning season, possibly as a result of Bermuda's cool winter seawater temperatures. These characteristics could mitigate or delay any ecological impact that invasive lionfish may have on marine ecosystems in Bermuda.

KEYWORDS: Invasive lionfish, life history, growth, reproduction, Bermuda

Dietary Niche Partitioning of Red Snapper (*Lutjanus campechanus*), Vermillion Snapper (*Rhomboplites aurorubens*), and Blackfin Snapper (*Lutjanus buccanella*) in the Northwestern Gulf of Mexico

Dietética Nicho de Partición de Pargo (*Lutjanus campechanus*), Pargo Bermellón (*Aurorubens rhomboplites*), y el Pargo de Aleta Negra (*Lutjanus buccanella*) en el Noroeste del Golfo de México

Dietary Niche Partitionnement du Vivaneau Rouge (*Lutjanus campechanus*), Vermillon Vivaneau (*Rhomboplites aurorubens*), et le Vivaneau Blackfin (*Lutjanus buccanella*) dans le Nord-Ouest du Golfe du Mexique

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ABSTRACT

Niche partitioning is the process by which coexisting species differentiate in their patterns of resource use. Samples are being collected to examine if dietary niche partitioning permits the coexistence of three sympatric snapper species (Red Snapper *Lutjanus camprechanus*, Blackfin Snapper *Lutjanus buccanella*, and Vermilion Snapper *Rhomboplites aurorubens*) in the offshore shelf-edge banks of the northwestern Gulf of Mexico. Gut content analysis will provide a qualitative estimation of diet composition revealing prey preferences and niche breadth. Stable isotope ratios of $\delta^{15}N$ and $\delta^{13}C$ will elucidate patterns in niche breadth and overlap on both a temporal and spatial scales. Results may show a wide niche breadth from pelagic and benthic preys, as these species are known to be opportunistic feeders. Slight differences in feeding behavior may reveal that interspecific competition for prey is low and that species are separated in terms of trophic niche, enabling their coexistence. Examining niche partitioning will increase the basic knowledge of blackfin snapper ecology in the Gulf of Mexico, as little is known about this ecologically important species in the region.

KEYWORDS: Trophic ecology, red snapper, vermillion snapper, niche partitioning, Gulf of Mexico

A Brief Review of Various Fishing Gears Associated with Lionfish Captures and Removals

Una Breve Revisión de los Varios Artes de Pesca Asociados con la Captura y Retiros del Pez Leon

Une Revue Bref de Mécanismes Divers de Pêche Associés au Poisson-papillon Capture et Des Déménagements

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ABSTRACT

Invasive lionfish (*Pterois miles* and *Pterois volitans*) continue to thrive in the western Atlantic and Caribbean. Their success has been attributed to their environmental tolerance, broad appetite, high fecundity, prey naivety, and lack of predators. Their population has been shown to be successfully managed through their capture and removal, usually via spearfishing. However, there have been other accounts of lionfish being successfully captured with other fishing methods. This compilation briefly reviews the various fishing gears associated with theses captures including fish traps, light traps, nets and seines, as well as the use of rod and reels; with hopes to evoke new management options to combat the lionfish invasion.

KEYWORDS: Lionfish, removal, capture, fishing gears, management

Facilitating a Management Plan for the Pearl Cays Wildlife Refuge, Nicaragua

Facilitando un Plan de Manejo para el Refugio de Vida Silvestre de Los Cayos Perlas, Nicaragua

Faciliter un Plan de Gestion pour la Wildlife Refuge Perle Cays, Nicaragua

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ABSTRACT

The Pearl Cays are located offshore of the central Caribbean coast of Nicaragua and encompass an area of approximately 700 km^2. The marine and coastal ecosystem is comprised of coral reefs, seagrasses, mangroves, islands, rivers, and creeks that provide habitat for fish, shellfish and endangered species of sea turtles. The upland watershed is inhabited by indigenous coastal communities who depend upon the ecosystem services generated by these habitats. In 2010, the region was declared a wildlife refuge, however, limited support has been directed to develop a management plan to protect and guide the sustainable use of the natural resources. A lack of a comprehensive synthesis of the Pearl Cays ecosystem consisting of baseline information about the habitats and inhabitants is needed to move forward. A synthesis that emphasizes participation from the communities living in this region is recognized as a first step in developing a plan that provides protection and wise use of resources, or ecosystem-based management. The Wildlife Conservation Society's (WCS) Nicaragua Marine Program secured funding to facilitate ecosystem-based management of the refuge using an integrated ecosystem assessment approach. WCS has partnered with the Bluefields Indian and Caribbean University (BICU) to facilitate the management planning process with governmental and non-governmental entities. The goal of the project is to develop a community-driven management plan to guide conservation and stewardship of shared resources, using local knowledge to build a comprehensive understanding of the Pearl Cays Wildlife Refuge system.

KEYWORDS: Marine Protected Area, coral ecosystem, management, Nicaragua, ecosystem services

Developing Decision Support Tools for Coral Reef and Marine Resources Management: A Case Study from Southeast Florida

El Desarrollo de Herramientas de Soporte de Decisiones para el Arrecife de Coral y la Gestión de los Recursos Marinos: Un Estudio de Caso en el Sureste de Florida

Développer des Outils D'aide à la Décision pour la Gestion des Récifs Coralliens et des Ressources Marines: Une Étude du Sud-est de la Floride de Cas

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ABSTRACT

Decision support tools are developed to assist coral reef managers in understanding impacts to marine resources for informed decision making. From 2010 to 2014, informational conversations, interviews, and surveys were conducted with 19 coral reef and marine resource managers in southeast Florida. These interactions were used to develop a needs assessment of the types of data and information needed by resource managers and a preferred design for accessing or delivering a decision support tool to end users. Three discovery prototypes were created then tested and evaluated with managers using pre/post surveys. All managers stated that the tools were moderately useful and most stated they would use the tools to support decision making in the future. More importantly, the authors learned two things from project: 1) there are variations in the roles and responsibilities of resource managers such as, science data managers or project managers that can influence the use of decision support tools, and 2) resource managers may struggle with addressing far-field influences on resources, but it is important to have real-time information about the condition of the reefs to relay information to stakeholders.

KEYWORDS: Decision support , coral reefs, marine resources, management

Restoration Inmediate Action to Reef Damaged by Stranding National Park Puerto Morelos

Acciones Inmediatas de Restauracion a Colonias de Coral Dañados por un Encallamiento en el Parque Nacional Arrecife de Puerto Morelos

Activites de Récupération Coral Endommagées par Echouement Parc National Arrecife de Puerto Morelos

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ABSTRACT

Strandings are a constant threat in the Mesoamerican reef, although their frecuency is not high, the impacts can cause irreversible damage to destroy not only the living community, but th substrated dormed by thousands of years. On July 16, 2016 al 18:30 a 60 ft boat ran aground in Puerto Morelos Reef National Park (20° 54´35´´ N; 86°50´7.5") 300 m^2 damaging

reef. The fact was reported to PROFEPA and PGR perform action requesting rescue damaged coral colonies. The impact of the boat caused fragmentation of at least 20 branched colonies of the species *Acropora palmata* and more than 40 of the genus *Unidaria* spp., the release of a massive colony of large size, *Pseudodiploria strigosa, t*wo colonies of the species *Orbicella anullaris* and the breaking of the limestome structure leaving loose material. Primary restoration action for *A. palmata* were: the choice and fixation in the same area of the larger fragments (147 parts), the placement of small fragments in a dome for recovery mesh (165 parts). Fragments and detached genus *Undaria* spp. colonies were again fixed on the substrate. Massive detached colonies wereplaced in original position trying to rebuild his form with the detached fragments. The affected area and restored colonies were markes. Administrative and criminal proceedings have not concluded, financing monitorin site is expected.

KEYWORDS: Stranding, restoration, reef, MPA, *Acropora*

Valorization of *Sargassum* Through the Preparation of Carbon Materials for Supercapacitor Electrodes and Water Treatment

Valorización de *Sargassum* a Través la Preparación de Materiales de Carbón para Electrodos de Supercondensadores y Tratamiento de Aguas

Valorisation des *Sargasses* par la Préparation de Matériaux Carbonés Utilisés en Tant Qu'électrodes de Supercondensateurs ou pour le Traitement des Eaux

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ABSTRACT

Since 2011, there is a growing concern of significant build-up of *Sargassum fluitans* and *natans*, observed along Caribbean beaches, leading to negative economic and environmental impacts on these islands. Therefore, it is now critical to develop strategies to mitigate this problem while valorizing this invasive biomass. One approach that holds great promise deals with the development of novel adsorbents or carbons derived from this biomass, which could allow producing new value added materials for water treatment or energy storage applications. In this work, carbons materials were obtained via pyrolysis of *Sargassum fluitans* at temperatures between 600 and 900°C. Textural and chemical characterizations were performed on the alga and its activated carbons using Scanning Electron Microscopy, X-ray Photoelectron spectroscopy, thermogravimetric and nitrogen adsorption techniques. An organic dye, methylene blue (MB), was used as model pollutant, commonly found in wastewaters. The adsorptive removal capacities of MB by the prepared carbons were investigated. Kinetics and isotherms were obtained and modeled to evaluate the sorption capacities and dynamic behavior of the dye. Results showed that the performance of this low-cost material were very similar to those obtained from carbon materials prepared from more conventional precursors; thus opening growing perspectives for their application in such area. The electrochemical characteristics of carbons were also evaluated for potential application as supercapacitors using cyclic voltammetry, galvanostatic charge/discharge and electrochemical impedance spectroscopic methods. The capacitance values reached 95 F/g, which indicate that such material is an attractive example for the development of electrodes with promising electrochemical properties.

KEYWORDS: *Sargassum*, carbon material, water treatment, supercapacitor, methylene blue adsorption

Healthy Reefs for Healthy People: A Proven, Collaborative, Science-based Adaptive Management Program for Coral Reefs

Arrecifes Saludables para Gente Saludable: Un Programa Colaborativo de Gestion Basado en la Ciencia para los Arrecifes de Coral

Récifs Sains pour les Personnes en Bonne Santé: Un Programme de Gestion Collaborative Basée sur la Science pour les Récifs Coralliens

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ABSTRACT

Healthy Reefs for Healthy People Initiative (HRI) is a globally unique international collaborative program of coral reef -focused research, management and conservation organizations dedicated to safeguarding the Mesoamerican Reef –MAR- in Mexico, Belize, Guatemala and Honduras. HRI and its partners work to improve management and decision-making by the region's varied reef management organizations, thereby enhancing the reef's health and resiliency. The MAR 2015 Report Card included 248 sites, surveyed for living coral cover, fleshy macroalgal cover, herbivorous fish biomass (parrots and surgeonfish) and commercially important fish biomass (snappers and groupers), which form a Reef Health Index score –RHI-. The 2015 regional RHI was 'fair" (2.8 out of 5), showing an improvement over the last assessment. The 2016 Eco-Audit measured an increased rate of implementation of management actions, as compared to the previous years, with an overall"fair" score. The most progress has been made in the establishment of MPAs and no-take zones, while the lease progress has been made in improving sewage treatment. The collaborative process of producing report cards on the health of the reef, followed by evaluation of management actions (Eco-Audits), provides a valuable system for catalyzing public awareness and achieving better reef management on a large scale. HRI has developed its successful process and suite of tools over the last decade in the MAR and now seeks to enlarge it's geographic scope into other parts of the Caribbean, working with the GCRMN and others to promote standardization, data sharing, and readily useful reporting and communications strategies.

KEYWORDS: Management, conservation, Mesoamerican Reef, MPA, actions

Management of *Sargassum* Strandings: Preliminary Figures of Volumes, Weights and Costs from the Experience of the French Antilles

El manejo de *Sargazos* Varados Cifras Preliminares de Volúmenes, Pesos y Costos la Experiencia de las Antillas Francesas

Gestion des Échouages de *Sargasses* : Premiers Chiffres de Volumes, Poids et Coûts D'après L'expérience des Antilles Françaises

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ABSTRACT

1. Arrivals of *Sargassum*

The marine phenomenon that caused these arrivals in the French Antilles in 2014 and 2015 is new. It seems the same as that observed for a long time in the southern United States, but geographically separate. An analogy between the two phenomena comes to probability of these arrivals and, based on last year coastal survey by the State services, a scenario of strandings for several years is defined by intensity and frequency.

2. Evolution of *Sargassum* after stranding
The consolidation *of Sargassum*, their fermentation and odor, their drying are poorly documented, different from green algae's; changes overtime are summarized in volumes and weights.
3. Possible collection and valorisation systems
Technical and especially economic viability of many possible pathways is not demonstrated yet. Only a small number of collection, drainage and recovery systems are actually proven
4. Provisional management scheme optimized in quantity and cost
It results from the combination of coastal configuration types, amounts of arrivals and unit costs of collection and recovery of stranded algae in the context of the French Antilles.
5. Some questions to scientists and operational
More precise estimates are possible if quantification protocols are followed in the future.

KEYWORDS: Volumes, costs, strandings, Guadeloupe, Martinique

The Effects of Lionfish at Flower Garden Banks National Marine Sanctuary in the Northwest Gulf of Mexico

Los Efectos del Pez Leon en el Santuario Marino Nacional Flower Garden Banks en el Noroeste del Golfo de México

Les Effets du Poisson-lions la Flower Garden Banks Sanctuaire Marin National dans le Nord-ouest du Golfe du Mexique

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ABSTRACT

Lionfish (*Pterois volitans/miles*) are invasive predators that have become established throughout the western Atlantic Ocean, Caribbean Sea, and now the Gulf of Mexico. With their voracious appetites, wide habitat distribution, prolific reproduction, and lack of natural predators, lionfish can cause declines in native reef fish and invertebrate species. Lionfish were first observed in the Gulf of Mexico in 2009, and sighted at Flower Garden Banks National Marine Sanctuary (FGBNMS) in 2011. To better understand the effect of lionfish on native reef species, we quantified reef fish abundance, density, and biomass from FGBNMS coral reef long-term monitoring visual fish survey data before the invasion began in 2010 through 2016. We also investigated the diet of FGBNMS lionfish from stomach content analysis, examining prey preferences, sizes, and temporal patterns. While lionfish populations demonstrated different patterns among the three banks of FGBNMS since the invasion began in 2011, we have found no evidence that lionfish have had a negative impact to native species. Ongoing study will help clarify how lionfish may impact FGBNMS native species, making the continuation of long-term monitoring programs vital in the detection and documentation of invasive species and time-sensitive management issues.

KEYWORDS: Lionfish, coral reef, Gulf of Mexico, monitoring, sanctuary

Lionfish Invasion of Paleo-coral Reefs at Mesophotic Depths Off the South Texas Coast

Invasión del el Pez León en los Paleo-arrecifes Coralinos en las Profundidades Mesofóticas en la Costa Sur de Texas

Invasion de Paléo-récifs Coralliens par le Poisson Lion à des Profondeurs Mésophotiques Au-delà de la Côte Sud du Texas

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ABSTRACT

Indo-Pacific lionfishes *Pterois volitans* and *P. miles* were first reported from the northwestern Gulf of Mexico (GOM) in 2010 and at mesophotic depths in 2012 (28 Fathom Reef). Mesophotic coral ecosystems (MCEs) are found at intermediate depths of the photic zone between 30-100 m and can often extend to depths over 150 meters. The South Texas Banks in the northwestern GOM are a MCE comprised of over 20 major paleo-coral reef structures occurring between the 60 and 80 m depth contours that have been utilized by fisherman since 1890 for their abundance of Lutjanid and Serranid species. In this study, mesophotic fish communities were surveyed using ROV video at ten South Texas Banks during two expeditions (2012 and 2014). In 2012, a single lionfish was observed at the northernmost of six banks surveyed (Baker Bank). In 2014, a total of twenty lionfish were recorded from three of the northernmost of five banks surveyed (Hospital, North Hospital, and Southern banks). The numbers of lionfish recorded in 2014 ranged from 1 individual at Hospital Bank to 13 individuals at Southern Bank. Thus, the initial lionfish invasion of the paleo-coral reefs off the South Texas coast was likely captured by these two sampling events. Habitat suitability modeling was used to predict the eventual invasion of lionfish to the southernmost group of banks. The use of presence-only models in addition to continual monitoring of these banks will provide insight into the future impacts of lionfish on the mesophotic fish communities in the GOM.

KEYWORDS: Mesophotic reef, Gulf of Mexico, reef fish communities, habitat suitability mapping, *Pterois volitans*

Challenges and Strategies for the Implementation of the Voluntary Small-Scale Fisheries Guidelines Gender Equity and Equality Principle

Desafíos y Estrategias para la Aplicación de la Directrices Voluntarias de Pesca en Pequeña Escala Equidad de Género y el Principio de Igualdad

Défis et Stratégies pour la Mise en Œuvre du Lignes Directrices de la Pêche à Petite Échelle Équité Entre les Sexes Volontaire et le Principe de L'égalité

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ABSTRACT

Gender equity and equality is the fourth guiding principle of the Voluntary Guidelines for Securing Sustainable Small-scale Fisheries (henceforth the Guidelines), and sits within its wider human-rights framework. The Guidelines contains acknowledgement of the roles of women in the small-scale fisheries value chain, the need for gender equity and equality in access to human well-being resources, and the need for equal gender participation in fisheries governance. While the inclusion of gender in the Guidelines is unprecedented and encouraging, effective implementation is the critical next step. Part of the implementation process will include the creation of culturally and regionally-specific information that allows local agencies to recognize and prioritize gender needs. To provide an example of the diverse and interacting issues related to the implementation of the gender equity and equality principle, the poster is presenting some case studies from different countries and regions. The objective is to highlight the context-specific issues that should be considered in the implementation process and focus on the many barriers to gender equity and equality in small-scale fisheries. It is also outline the different gender approaches that could be used to implement the guidelines, and suggest a gender transformative approach. Such an

approach focuses on illuminating root causes of gender injustice and inequality, and requires on-going examination of power relationships as well as capacity development for women and marginalized groups.

KEYWORDS: Equality, equity, gender, SSF Guidelines

Bonefish Pond Mangrove "Restoration" Monitoring

Bonefish Pond Monitoreo de Manglares "Restauración"

Bonefish Étang Mangrove "Restauration" Surveillance

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ABSTRACT

Since 1958, New Providence Island has lost 57% of its mangroves. Roads and other coastal development have fragmented the remaining mangrove systems. Reduction in mangrove area, and increases in mangrove fragmentation, impairs the nursery function of mangroves. One of the largely intact mangrove systems on New Providence is within Bonefish Pond National Park, but even here, development prior to the creation of the park has altered parts of the mangrove system. In 2013, a team of researchers transplanted over 600 red mangrove *(Rhizophora mangle)* trees to a selected the mangrove rehabilitation site within the Bonefish Pond National Park as part of the Global Environment Facility Full-size Project. The restoration consisted of converting a dead-end dredged channel that served no nursery function into a mangrove fringed tidal creek capable of supporting fish and invertebrate populations. Restoration activities consisted of increasing hydrographic connectivity of the channel to surrounding waters and transplanting mangroves. Transplanted trees included those from the restored dredged channel; young trees from the nurseries at the Atlantis resort; propagules from another creek site and small trees dug from a freshwater lake. They were planted using a variety of transplantation methods and variable densities in 10m long plots along the restored channel to determine which approach had greater growth and survivorship. Researchers monitored the success of the transplants over the past two years measuring survivorship and growth metrics (height, new branches, and new prop roots) to determine the most appropriate methodology of mangrove transplantation for the Bahamian environment.

KEYWORDS: Coastal wetlands, restoration, national park, fisheries

Experimental Transplantation of Acropora Corals in Guadeloupe Island for Restoration Purposes

Expérimentation en Vue de la Restauration des Coraux du Genre Acropora en Guadeloupe

Transplantación Experimental de los Corales del Género Acropora en la Isla de Guadeloupe con el Fin de Restauración

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ABSTRACT

Acropora palmata (Lamarck, 1816) and *A. cervicornis* (Lamarck, 1816), two key species of Caribbean coral reefs were added in 2008 to the IUCN Red List as critically endangered species. The purpose of this study was to demonstrate the fea-

sibility of the breeding and transplantation of *Acropora* corals in Pigeon islets (Guadeloupe). The potential influence of environmental factors and coral genotype on their growth was tested. Forty samples of *A. cervicornis, A. palmata* and their hybrid *A. prolifera* were transplanted in Pigeon Islets. The samples were either hung in open water or fixed on an A-frame form grid. The survival and the ponderal growth of the nubbins have been followed over a period of 109 days. Genetic analyses were conducted on both algal symbionts and coral host. Nine different genotypes of *Acropora cervicornis*, five of *A. palmata* and two of *A. prolifera* were identified, but all sampled corals sheltered clade A3 symbionts. The survival rates of the 3 species were high: 100% for *Acropora cervicornis* and *A. prolifera* and 97.5% for *A. palmata*. Over the study period, the weight of *A. prolifera* nubbins increased of 144%. For *A. cervicornis* and *A. palmata* the increasing rate was respectively of 113% and 57%. Regarding the nursery method, nubbins of the 3 species showed a better weight increase when they were hung in open water. However, no significant influence of environmental factors, as well as sample genotype could be associated with coral growth, under the experimental conditions of the present study.

KEYWORDS: Acropora corals, Caribbean Sea, growth, restoration

Nula Recuperación de la Abundancia de *Isostichopus badionotus* (Selenka, 1867) Después de una Intensa Explotación Pesquera en Yucatán, México

No Recovery of the Abundance of *Isostichopus badionotus* (Selenka, 1867) After an Intense Fishing Exploitation in Yucatan, Mexico

Pas de Reprise de L'abondance de *Isostichopus badionotus* (Selenka, 1867) Après une Surpêche Intense au Yucatan, au Mexique

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RESUMEN

El pepino de mar Isostichopus badionotus fue objeto de una intensa explotación pesquera de 2010 a 2012 en el noroeste de la península de Yucatán. Al inicio de la pesca se llegaron a registrar abundancias de 0.062 – 0.196 ind/ m^2 pero después de tres años de explotación la abundancia decreció a un nivel de 0.003 – 0.006 ind/m^2. De 2013 a 2015 esta zona de pesca entró en veda salvo pequeños periodos de explotación donde el esfuerzo de pesca fue prácticamente nulo, por lo que se esperaría un aumento en la abundancia de esta especie. El objetivo del trabajo fue determinar el grado de recuperación de la abundancia de I. badionotus después de tres años y medio de veda. Se llevaron a cabo transectos por buceo de 10 m de longitud por 4 m de ancho en el área de pesca de pepino de mar frente a la costa de Sisal, Yucatán, en abril de 2012 y en agosto – octubre de 2015, para obtener estimaciones de abundancia en ind/m^2. Los resultados mostraron que en lugar de que se hubiera presentado una recuperación de la población, las mediciones de abundancia en 2015 fueron aún menores que en el 2012, de 0.0004 – 0.001 ind/m^2. Al igual que en otras poblaciones de pepino de mar, se sugieren periodos largos para la recuperación de la abundancia. Debido a la importancia ecológica de la especie y al valor económico que representa este recurso en las comunidades costeras de la región, resulta imprescindible realizar investigaciones que puedan sustentar programas de repoblamiento.

PALABRAS CLAVES: Sobrepesca, abundancia, repoblamiento

Hábitos Alimenticios de la Doncella de Pluma *Lachnolaimus maximus* (Perciformes: Labridae) en la Costa Norte de Yucatán, México

Food Habits of Hogfish *Lachnolaimus maximus* (Perciformes: Labridae) from the North Coast of Yucatan, Mexico

Régime Alimentaire de *Lachnolaimus maximus* (Perciformes: Labridae) de la Côte Nord du Yucatan, Mexique

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RESUMEN

Lachnolaimus maximus es una especie de alto valor comercial catalogada como "Vulnerable" por la UICN para toda su área de distribución geográfica (Golfo de México y Mar Caribe). El análisis de su dieta aporta información fundamental para describir y explicar mediante programas como el Ecopath y Ecospace, el aspecto funcional de las redes tróficas en las cuales está involucrada, y por ende para la conservación y el buen manejo pesquero de la especie. El objetivo del estudio fue caracterizar la composición de la dieta y sus variaciones espacio-temporales, ontogénicas y entre sexos de la población del sur del Golfo de México (Banco de Campeche). Esto se realizó por medio del análisis de contenido estomacal, tomando en cuenta la eficiencia del esfuerzo muestral evaluado con el modelo de Clench, para una caracterización precisa de la dieta. La composición de la dieta fue analizada usando el índice de importancia relativa (IIR). La variación de los componentes alimenticios se evaluó a través de un análisis multivariado no paramétrico (PERMANOVA), completado con una prueba de igualdad de varianzas mediante la función betadisper. Se analizaron 193 tractos digestivos con contenido estomacal, identificándose 186 componentes alimenticios, que corresponden al 69% de la dieta teórica predicha por el modelo de Clench. De estos componentes se logró identificar el 35% a nivel especie. Los grupos taxonómicos fundamentales fueron las clases Mollusca y Crustacea que representaron el 68 % y 44% de IIR respectivamente. Los resultados obtenidos del análisis multivariado indicaron diferencias significativas en la composición de la dieta entre las regiones y tallas establecidas (F=2.49, P=0.004; F=2.60, P=0.004; respectivamente), pero no fueron significativas para las temporadas climáticas y el sexo de los individuos.

PALABRAS CLAVES: *Lachnolaimus maximus*, dieta, Golfo de México

Using Age and Nutrition Parameters to Gain a More Comprehensive Understanding of Groupers in Louisiana Waters

El Uso de Parámetros de Edad y Nutrición para Obtener una Comprensión Más Completa de Meros en Louisiana Aguas

Utiliser les Paramètres D' âge et de la Nutrition à Acquérir une Compréhension Plus Complète de Mérous dans les Eaux de la Louisiane

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ABSTRACT

Other than recreational and commercial catch data, there is little information on groupers from the Gulf of Mexico (GoM) off Louisiana. The economic value and lack of information about members the family Epinephelidae make them a priority for stock assessments. The purpose of this research is to gain much needed information about these data-poor species, which includes data on age and growth and nutritional condition. Grouper species are being sampled from six natural banks and at several oil and gas platforms in the northern GoM. Growth increments, or annuli, are being counted on sectioned sagittal otoliths to determine length at age for several species. This will be used to derive von Bertalanffy growth curves that will provide information concerning L∞ and W∞. Nutritional condition will be derived from a BIA (Biological Impedance Analysis) device. The BIA has been field tested by taking measurements on red snapper, which we catch more consistently in the GoM, and tissue samples taken from the same fish were processed in the laboratory using a bomb calorimeter. A predictive model of nutritional condition was constructed from impedance values and the caloric density estimat-

ed in the laboratory using bomb calorimetry. The BIA may be a useful tool in quickly understanding the nutritional condition of the groupers we collect. One advantage of using BIA is that it is non-destructive, making it possible to release the fish alive if necessary. Nutritional information combined with growth rate will yield important information on GoM groupers off the coast of Louisiana.

KEYWORDS: Groupers, otoliths, age and growth, nutrition, BIA (Biological Impedance Analysis)

The Lionfish, *Pterois volitans* as Fishery Resource in the Dominican Republic

El Pez León, *Pterois volitans* como Recurso Pesquero en la República Dominicana

Lionfish, *Pterois volitans*, comme une Ressource pour la Pêche rn République Dominicaine

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ABSTRACT

The presence of lionfish in catch composition of fisheries landings is evaluated. At coastal landing sites, the lionfish catch data was gathered by CODOPESCA´s enumerators who recorded catch composition, effort, catch volume and socioeconomic data in logbooks. The preliminary results show that in several landing sites *Pterois. volitans* accounted for more than 50% of total catch and it is being sold as a delicacy. We analyze the role of lionfish as actual and potential source of income for coastal fishers. The importance of fishing tournaments and the involvement of tourist sector and diving operators in management and control of lionfish invasion is discussed.

KEYWORDS: Lionfish, fisheries, resource, income, CODOPESCA

Characterization of the Deep Water Snapper Fishery in Puerto Rico During 1998 - 2015

Caracterización de la Pesquería de Pargos de Aguas Profundas en Puerto Rico Durante 1998 - 2015

Caractérisation de la Pêche de Vivaneaux Profondes Eaux de Porto Rico au Cours de 1998 - 2015

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ABSTRACT

Puerto Rico's commercial fisheries shown dramatic changes during the last 40 years. During the 1960's and 1970's the most used fishing gear were fish traps. Later during 1980's and 1990's most used fishing gear were hook and line. During the 2000-to 2015, most of popular fishing method was SCUBA diving. The deep water snapper (DWS) has been the most important finfish fishery in Puerto Rico since 1970's. During the mentioned 1970-1990, there were approximately 25 fishing vessels 40 feet length or larger dedicated to DWS. The mentioned vessels travel from Puerto Rico to close neighbors Islands as Dominican Republic, Bahamas, Turk Caicos and others. From 1990's to the present there was observed that approximately 150 fishing vessels of 22-25 feet length has been used successfully for the DWS fishery. There are five species of DWS in Puerto Rico, silk snapper *Lutjanus vivanus*, blackfin snapper *Lutjanus bucanella*, queen snapper *Etelis oculatus*, vermillon snapper *Rhomboplites aurorubens* and cardinal snapper *Pristipomoides macrophthalmus.* On the other hand, in 2004, the DWS fishery was managed by the Department of Natural and Environmental Resources (DNER) and the NOAA Fisheries. This paper will show the trends in deep water snappers landings data, and also discuss management ac-

tions to protect these resources.

KEYWORDS: Puerto Rico, deep water snapper fisheries, landings, management, socioeconomic

Portrait of the Ornamental Commercial Fishery of Puerto Rico During 2010 - 2015

Semblanza de la Pesca Ornamental Comercial de Puerto Rico Durante 2010 - 2015

Portrait de L'ornement de la Pêche Commerciale de Porto Rico au Cours de 2010 - 2015

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ABSTRACT

The Puerto Rico Fishing Regulations #7949, limited the commercial ornamental fishery just to 29 species of fish and shellfish. The commercial ornamental fishers must obtain a license and a special permit to legally establish their business. They are obligated by Puerto Rico's Fishery Regulations 7949 to report they catch to the Puerto Rico's Department of Natural and Environmental Resources (DNER) thru the Commercial Statistics Program. The data collected from the commercial ornamental fishers has been entered in computers and analyzed by the authors.

A total of 163,828 individual were caught and reported from ornamental commercial fishers in Puerto Rico during 2010-15. The most caught reported species was the Royal Gramma (*Gramma loretto*), representing 21% from the total catch (34,851 fishes). Follow by Blue chromis (*Chromis cyanea*) 10%, Emerald crab *(Mythrax sculptus*) 9%, Green banded goby (*Tigrigobius multifasciatus*) 9% and Yellowhead Jawfish (*Opistognathus aurifrons*) 7%, Approximately 70% of the catch was exported from Puerto Rico to other countries. On the other hand, it was estimated that $400,000 resulted from the wholesale ornamental fishery activity. This paper discusses the number of individuals caught by species and by year. A total of 10 fishermen settled their commercial ornamental fish landings. Also, the paper will discuss the price per species and gross profit of this fishery.

KEYWORDS: Puerto Rico, ornamenthal fishery, conservation, socioeconomic, reef fishes

Fatty-acid Biomarkers and Tissue-specific Turnover: Validation from a Controlled Feeding Study in Juvenile Atlantic Croaker (*Micropogonias undulatus*)

Cambios en la Composición de ácidos Grasos en el Hígado y el Músculo de Peces Juveniles Experimental, *Micropogonias undulates*

Les Changements dans la Composition des Acides Gras dans le Foie et les Muscles des Poissons Juvéniles Expérimentale, *Micropogonias undulatus*

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ABSTRACT

Fatty-acid (FA) profiles of liver and muscle tissue from juvenile Atlantic croaker *Micropogonias undulatus* were exam-

ined over a 15 week diet-switch experiment to establish calibration coefficients (CC) and improve understanding of consumer–diet relationships for field applications. Essential FAs [docosahexaenoic acid (DHA), 22:6n-3 and eicosapentaenoic acid (EPA), 20:5n-3] decreased and 18:2n-6 increased in tissues of M. undulatus fed diets with increasing proportions of terrestrial v. marine lipid sources. Non-linear models used to estimate the incorporation rate and days to saturation of per cent 18:2n-6 in tissues showed that livers incorporated 18:2n-6 faster than muscle, but the proportions of 18:2n-6 in muscle were higher. CCs were established to determine proportions of FA deposition in tissues relative to diet. Many CCs were consistent amongst diet treatments, despite growth and dietary differences. The CCs can be used to discern FA modification and retention within tissues and as tools for future quantitative estimates of diet histories. Incorporation rates and CCs of 18:2n-6 were applied to a sub-set of field samples of wild M. undulatus to understand habitat use and feeding ecology. Altogether, these results suggest that FAs provide a time-integrated measure of diet in aquatic food webs and are affected by tissue type, growth rate and the influence of mixed diets.

KEYWORDS: Calibration coefficients, diet, feeding ecology, linoleic acid, Atlantic croaker

Influence of Oceanographic Features on Abundance and Distribution of Carangid Fishes in the Northern Gulf of Mexico

Influencia de Caracterísicas Oceanográficos en la Abundancia y Distribución de Peces Cárangidos del Golfo de México Norte

Influence des Caractéristiques Océanographiques sur L`abondance et Distribution des Poissons Carangidés dans le Nord du Golfe du Mexique

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ABSTRACT

Relationships between abundance of carangid (jacks) fishes and physical oceanographic features were examined in the northern Gulf of Mexico (GoM). Oceanographic features included mesoscale eddies, the Mississippi River plume and frontal regions where eddies and the river plume intersect, identified by combining satellite and shipboard measurements of temperature, salinity and sea surface height anomaly (SSHA). Generalized additive models where used to explore complex relationships between carangid abundance and physical oceanographic data. Carangid abundance was related to increased temperatures (>28.5°C), decreased salinities (< 32), and low (-10 to 10 cm) to moderate (10 to 30 cm) SSHA, suggesting concentration of fishes at frontal convergence zones between the river plume and mesoscale eddy water masses. The five most abundant carangid species collected were: Selene setapinnis (34%); Caranx crysos (30%); Caranx hippos (10%); Chloroscombrus chrysurus (9%) and Trachurus lathami (8%). Gear-specific differences were identified with a large, dual-warp midwater trawl (LMT) collecting more carangid fishes (86% of the total catch) that were larger (median standard length [SL] = 23 mm) compared to the Multiple Opening and Closing Net and Environmental Sensing System (MOCNESS), which collected fewer (14% of the total catch), smaller (median SL=10 mm) carangids. Results indicate strong links between physical oceanographic features and carangid distribution in the northern GoM, with increased abundance occurring in plume and frontal areas that support higher nutrients and productivity.

KEYWORDS: Carangidae, generalized additive models, Mississippi River, Gulf of Mexico

Consolidación de un Grupo de Restauración Comunitario en el Parque Nacional Arrecifes de Xcalak

Consolidation of a Coral Restoration Community Group in the National Park Reefs of Xcalak

Consolidation D'un Équipe Communauté de Restauration des Récifs dans le Parc National Récif de Xcalak

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RESUMEN

En 2014 Oceanus A.C. y sus socios comenzaron a trabajar para fortalecer la capacidad de recuperación y el potencial de adaptación de los arrecifes de coral y para promover la recuperación de las especies asociadas de peces e invertebrados. Con este objetivo implementaron un Programa de Restauración del Arrecife Mesoamericano (MAR), con especial énfasis en la recuperación de áreas de no pesca. Las técnicas consisten la utilización de viveros de coral y el trasplante de miles de colonias cada año en sitios seleccionados a lo largo del MAR. Como la restauración de coral es un trabajo intensivo, el programa también incluye la participación de la comunidad y tiene varios propósitos: asegurar el apoyo local y mantener la supervisión de los viveros de coral en el sitio; contar con capacidades locales para la continua participación de voluntarios; la generación de ingreso adicional para los participantes y el autofinanciamiento del programa. La participación se realiza a través de un Programa de Certificación de Guías. El primer grupo fue entrenado en Xcalak, Quintana Roo. Los participantes han recibido capacitación en técnicas de restauración y actualmente llevan a cabo actividades sobre la base de un programa estratégico a 5 años, con el objetivo de trasplantar al menos 1000 colonias anualmente en su localidad. Para promover el beneficio económico se han consolidado como un grupo turístico que se centra en las actividades de restauración como parte de los servicios, se ha mejorado la infraestructura y se ha generado un Manual de Procedimientos para Guías de Restauración. Esta iniciativa pretende replicarse en los diferentes sitios a lo largo MAR, donde el programa de restauración se lleva a cabo.

PALABRAS CLAVES: Restauracion, arrecifes, comunidad, coral, turismo

Length-weight Relationship of Parassi Mullet *Mugil incilis* (Hancock, 1830) in the Cordoba´s Caribbean Sea

Relación Longitud-peso de la Anchova *Mugil incilis* (Hancock, 1830) en el Mar Caribe Cordobés

Le Rapport Poids-longueur des Mulet Parassi *Mugil incilis* (Hancock, 1830) dans la Mer des Caraïbes de Cordoba, Colombie

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ABSTRACT

The Parassi mullet *Mugil incilis* (Hancock, 1830) is a commercially important fish in the insular and continental colombian Caribbean. 356 individuals were collected for this study and the length-weight relationship and condition factor were estimated through TW = aTLb and Cf = TW/TLb, respectively. The sizes ranged between 18.9 and 45.0 cm TL, the total weight between 62.0 and 718.0 g, the mean length in the catch was 29.2 cm TL, and was observed that 42.0% of females were caught below the length at first maturity estimated for the species. 219 females, 132 males and 5 undifferentiated were

found, with sexual proportion female: male 1.7:1, differently than expected; and sexual dimorphism in size, reaching larger sizes females than males. The length–weight relationship for both sexes was TW = 0.018 (± 0.09) TL 2.78 (± 0.06), n = 356, r = 0.97, with negative allometric growth coefficient and high correlation. The growth coefficient ranged between 2.23 (January) and 3.09 (July l), being isometric six months of the year and negative allometric in the rest, with significant statistical difference between them. The condition factor ranged from 0,006 (July) and 0.103 (January), without statistically significant differences; confirming the premise of the inverse relationship between this parameter and the growth coefficient of length-weight relationship of Parassi mullet.

KEYWORDS: Growth, population dynamic, condition factor

Consolidación de la Biotecnología para el Cultivo de Caracol Rosado *Lobatus gigas*

Consolidation of Biotechnology of *Lobatus gigas* Queen Conch Aquaculture

Consolidation de la Biotechnologie pour *Lobatus gigas*

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RESUMEN

El caracol rosado *Lobatus (=Strombus) gigas* es un recurso de alto valor comercial que ha sido sobreexplotado en el Caribe. En México existe una veda por 5 años que termina en el año 2017, por lo que cobra importancia definir el potencial de cultivo de la especie. El INAPESCA ha trabajado en este tema; en 1983 logró desarrollar técnicas para producción de juveniles hasta 5 cm con fines de repoblamiento. En el año 2003, se optimizaron las técnicas de producción a mediana escala para cultivo larval, y juveniles en 3 estadios en sistemas controlados, semicontrolados y marinos. Se trabajó en la elaboración de dietas y búsqueda de valor agregado, y se logró perfeccionar el rendimiento de la Unidad de Producción Piloto para el cultivo de juveniles en mar. Actualmente quedan 3 puntos críticos por resolver en el ciclo del cultivo: La alta tasa de mortalidad en los cultivos en etapa larval, elaborar un alimento comercial para juveniles en cultivo, y el manejo de reproductores para evitar colecta de masas ovígeras del medio silvestre. Recientes investigaciones sobre el papel de las algas simbiontes en el desarrollo larval permite plantear un escenario de alta eficiencia en el cultivo del caracol, por lo que el INAPESCA pretende realizar la adaptación de la técnica de cultivo de larvas y determinar su eficiencia a escalas productivas; así mismo ampliar los estudios para la formulación de una dieta para diferentes estadios de la etapa juvenil, y continuar con las experiencias del confinamiento de adultos reproductores para la obtención de masas ovígeras en cautiverio. Bajo esta perspectiva se puede pensar en la obtención de semilla de caracol bajo un esquema rentable.

PALABRAS CLAVES: Caracol rosado, cultivo de larvas, producción de semilla, *Strombus gigas*

Do SocMon Caribbean Data Tell Us Anything About Gender in Fisheries?

¿Los Datos de SocMon Caribe Nos Dicen Algo Acerca de la Cuestión del Género en el Sector de la Pesca?

Les Données de SocMon Caraïbes Nous Disent-elles Quelque Chose sur la Question du Genre dans le Secteur de la Pêche?

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ABSTRACT

Within the region (and globally) there is a persistent data and knowledge gap on gender in fisheries despite the existence in some countries of national gender action plans (draft or implemented); national fisheries policies (draft or imple-

mented); and the inclusion of gender equality and equity as a guiding principle in the FAO Voluntary Guidelines for Securing Sustainable Small-scale Fisheries, that all attempt to mainstream gender in fisheries social-ecological systems (SES). A number of socio-economic assessments have been implemented at coastal and fisheries management sites and communities throughout the Caribbean as components of Global Socio-economic Monitoring Initiative for Coastal Management (SocMon) projects implemented by the Centre for Resource Management and Environmental Studies, at The University of the West Indies. While these assessments have not deliberately investigated gender aspects of fisheries, sufficient sex-disaggregated socio-economic data on small-scale commercial and subsistence fisheries have been collected to warrant exploratory gender analysis. This poster aims to provide gender insight from selected SocMon fisheries-related assessments and it complements applied interdisciplinary research and outreach being conducted by the Gender in Fisheries Team (GIFT) and led by UWI-CERMES to better understand and assist with policy and practice concerning gender in Caribbean small-scale fisheries.

KEYWORDS: Gender, GIFT, socio-economic assessments, Caribbean

Examining Changes in Southeast Florida Parrotfish Assemblages

Examinando Los Cambios en los Emsambles de Peces Loros en el Sureste de Florida

Changements Examineraient du Sud-est Florida Ensembles de Parrotfish

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ABSTRACT

Loss of herbivores, thermal stress due to climate change, and disease outbreaks are among the factors leading to the degradation of Caribbean coral reefs. Although much attention has been focused on the loss of Diadema in the 1980's, until recently, the importance of parrotfishes as grazers has been less researched. Parrotfishes are a major component of the diverse assemblage of herbivorous fishes on coral reefs and possess the unique ability to remove all functional groups of algae. Parrotfishes have declined in much of the Caribbean largely due to fishing practices. In southeast Florida, they are not a historically heavily fished family, however changes in populations are still possible. Temperatures are consistently rising due to climate change which can cause changes in the proportions and densities of benthic organisms, particularly in algal dominated reefs. Parrotfish assemblages could be affected by these changes because they are some of the dominant primary grazers on the southeast FL reefs. There has also been speculation that parrotfish are being fished more now than in the past. Here we examine population trends in the last 20 years within the parrotfish family in southeast Florida. Six hundred and sixty-seven fisheries-independent visual census surveys were conducted in Broward County between 1998 and 2002 and 639 sites were surveyed between 2012 and 2014. Data on temporal changes between the two time periods will be presented. Outcomes from this study can be used to strengthen the management of parrotfishes in southeast Florida.

KEYWORDS: Coral reef, ecology, fisheries, herbivory, climate change

Las Aplicaciones de Fundación MarViva: La Tecnología al Servicio de la Pesca y el Consumo Responsable

MarViva's Applications: Technology for Fishing and Responsible Consumption

Applications MarViva: La Technologie pour la Pêche et la Consommation Responsable

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RESUMEN

La Fundación MarViva es una organización no gubernamental, regional, cuya misión es impulsar la conservación y el uso sostenible de los recursos marinos y costeros, a fin de garantizar un Pacífico Tropical Oriental biodiverso, saludable y generando bienestar para las presentes y futuras generaciones. Una de nuestras líneas de acción es fomentar la pesca y el

consumo responsable, a través de procesos que involucren la participación ciudadana. Para ello ha querido aprovechar las herramientas tecnológicas actuales, para lo cual ha desarrollado las aplicaciones: Guía Semáforo para el Consumo Responsable de Pescado de Mar en Costa Rica, Panamá y Colombia, y Vigilantes del Mar. La primera tiene como objetivo el orientar a los usuarios sobre el aprovechamiento responsable de pescado, ofreciendo listados de especies de importancia comercial, cuya captura, comercialización y consumo deberían imitar el funcionamiento de un semáforo: verde (adelante), amarillo (precaución) y rojo (alto). También busca diversificar los hábitos de consumo, tratando de reducir la presión pesquera sobre aquellas especies con mayor demanda en los mercados, y es un insumo que complementa el esfuerzo del sector comercial en el proceso de obtener y mantener la certificación del Estándar de Responsabilidad Ambiental para la Comercialización de Pescado de Mar de Fundación MarViva. Por su parte, la segunda herramienta permite hacer reportes sobre actividades irregulares que afecten la navegación, el ambiente y los recursos marino costeros, contribuyendo con las autoridades en sus labores de supervisión, control y seguimiento frente a presuntas infracciones y/o delitos que atenten contra los recursos del mar en las provincias de Chiriquí y Veraguas, Panamá. Las aplicaciones pueden descargarse gratuitamente a través de las plataformas iOS y Android.

PALABRAS CLAVES: Pesca responsable, consumo responsable, sostenibilidad, aplicaciones, Panamá

Fishing Aggregating Devices Can Entangle Sperm Whales

Dispositivos de Concentración de Peces Pueden Enredar los Cachalotes

Les Dispositifs de Concentration de Poissons Peuvent Enchevêtrer les Cachalots

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ABSTRACT

The Stranding and Distressed Marine Mammals Network of Guadeloupe FWI reports two cases of sperm whale entanglements. The first one in 2013 involved a dead calf entangled by its tail fluke peduncle in a mass of ropes, nets and plastic cans that a mature female had taken by the opposite end in her lower jaw. The rescue team, trained just days before in a joint IWC and SPAW workshop, was able to free the female by breaking up the calf's body. It was impossible to determine the cause of the entanglement, but it was assumed to be a local Fishing Aggregating Device (FAD). The composition of the mass of ropes and nets was suggestive of material commonly used in the manufacture of artisanal FADs. Sperm whales, especially young ones, are observed occasionally interacting with these devices. Subsequently in 2015, an entanglement in a FAD was positively identified with the case of a badly entangled juvenile female. The rescue team, assisted by several agencies from Guadeloupe, was able to rescue the animal after a complicated intervention. The team also had to deal with the fisherman and made sure to save the FAD device, which is the main type of fishing used in the region. Estimates show that there are 250 up to 1000 or more FADs in Guadeloupe waters. About 200 sperm whales are coming and going in family groups in these same waters. These crucial events, compounded by growing cases of entanglements of other cetaceans reported in Guadeloupe waters, have to urge the Caribbean communities to develop mitigation actions such as preventing rope and net lost or discarded at sea and specifically devising entanglement-proof devices.

KEYWORDS: Entanglement, fishing aggregating devices, sperm whales, strandings

Creative Allocation Strategies for Under-exploited Fisheries

Estrategias De Asignación Creativas para la Pescquerias de baja Explotacion

Stratégies D'allocation Créatives pour la Pêche Sous-Exploitées

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ABSTRACT

Many contemporary fisheries management issues concentrate on controlling, and often reducing, effort. However, there exist those examples where the acceptable biological catch of a recreationally and commercially important species is not harvested annually, with this trend occasionally persisting for several years. Concurrently, the allocation of the acceptable biological catch between recreational and commercial fishing sectors can often prove contentious, regardless of whether the combined harvest of a species from both sectors reaches the acceptable biological catch. Reallocation between fishing sectors may be requested of resource managers when there exists foregone yield in a fishery, especially if one sector is catching its portion of the acceptable biological catch while another is not. We explore new methods of sharing allocation between fishing sectors when foregone yield may exist in a fishery. These methods prevent overfishing from occurring while simultaneously increasing fishing opportunities on a year-to-year basis.

KEYWORDS: Management, allocation, fisheries

Primeras Estimaciones de Mortalidad Natural del Pepino de Mar *Isostichopus badionotus* (Selenka, 1867)

First Estimates of Natural Mortality of Sea Cucumber *Isostichopus badionotus* (Selenka, 1867)

Premières Estimations de la Mortalité Naturelle de Concombre de Mer *Isostichopus badionotus* (Selenka, 1867)

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RESUMEN

La tasa de mortalidad natural (M) es un parámetro clave en la evaluación de poblaciones explotadas, además ha sido ampliamente reconocida la necesidad de contar con estimaciones de mortalidad natural por edad debido a que ésta decae rápidamente en las primeras etapas del ciclo de vida para llegar a una etapa aproximadamente estable alrededor de la madurez sexual. El objetivo del trabajo fue estimar por vez primera las tasas de mortalidad natural durante el ciclo de vida de *Isostichopus badionotus*, especie que es objeto de intensa explotación pesquera en diferentes zonas del Caribe y Golfo de México. Las estimaciones se realizaron por el método de mortalidad a la edad de Chen y Watanabe y por el método de intervalos gnomónicos (GIM). Se simularon cuatro escenarios para los dos métodos en donde la edad de primera madurez sexual fue utilizada como variable de cambio (1, 1.5, 4 y 5 años). Se obtuvieron estimaciones bajo el escenario "promedio" (1.5 años) para el estadio juvenil de M=2.16–2.36 año-1 (rango intercuartil) y para el estadio adulto de M=0.39–0.43 año-1 mediante GIM. Las estimaciones por el método de Chen y Watanabe fueron de M=0.73–2.23 año-1 para los primeros dos años de vida y de M=0.21–0.97 año-1 del tercer año de vida en adelante. Se consideran más robustas las estimaciones de GIM debido a que proporcionó estimaciones de M acordes a todo el ciclo de vida, situación que no ocurrió con el método Chen y Watanabe que no reflejó las altas tasas de mortalidad de los estadios larvarios. Las estimaciones proporcionarán mayor certidumbre a los modelos de evaluación poblacional para un adecuado manejo de las pesquerías.

PALABRAS CLAVES: Pepino de mar, evaluación pesquera, mortalidad a la edad

Aquaculture and Stock Enhancement of the Red Snapper – A Pilot Program in Mississippi

Acuicultura y el Mejoramiento de la Población de Pargo Rojo – Un Programa Piloto en Mississippi

Aquaculture et Soutien de Stock pour le Vivaneau Campeche – Un Programme Pilote dans L'état du Mississippi

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ABSTRACT

The northern red snapper *Lutjanus campechanus* support major commercial and recreational fisheries in the Gulf of Mexico. Severe harvest restrictions have stimulated research investigating aquaculture of the species for stock enhancement and commercial production. A pilot stocking program is currently being implemented in Mississippi in collaboration between the University of southern Mississippi and the Mississippi Department of Marine Resources. Objectives of the project include developing the production of juveniles in intensive systems and evaluating the potential for stocking hatchery-reared juveniles on artificial reef habitats deployed in Mississippi coastal waters. The production of juveniles is currently limited by the unreliable spawning activity of captive broodstocks and the low survival rates through larval development. Egg production relies on induction of gamete maturation in wild-caught brooders using chorionic gonadotropin which leads to variable egg quality potentially impacting the viability of pre-feeding larvae. Red snapper larvae then require copepods as an initial feed and the survival rates through the larval culture phase are still low (<10% in most trials). Current research focuses on evaluating feeding protocols incorporating the results of larval nutrition studies to improve survival and on scaling-up the production of copepod live feeds. Hatchery juveniles are being released on artificial fish and monitoring in the near term will focus on assessing their survival shortly after release using trapping and acoustic tagging approaches. A genetic program is also in development and aims to assist with the spatial management of releases through studies of population structure and local adaptation of regional populations.

KEYWORDS: Aquaculture, stock enhancement, red snapper, *Lutjanus campechanus*

Climate Regimes and Occurrence of *Sargassum* in the U.S. Gulf of Mexico

Regimenes Climatologicos y la Ocurrencia de Sargazo Pelagico en el Golfo de Mejico, U.S.A.

Régimes Climatiques et Présence de *Sargassum* dans le Golfe du Mexique

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ABSTRACT

Sargassum is a floating, holopelagic, macroalgae that occurs in continental shelf and offshore waters across the Gulf of Mexico (GOM). It often accumulates in mats and windrows to form a structured habitat and is a source of food and refuge for a diverse assemblage of fish and invertebrates.Yearly differences in the abundance and distribution of pelagic *Sargassum* may contribute to the variation observed in recruitment of some marine fishes. Long-term temporal data on distribution and abundance of *Sargassum* in the GOM is lacking, but there is a time series of occurrence of *Sargassum* associated with ichthyoplankton surveys conducted by NOAA, National Marine Fisheries Service under the Southeast Area Monitoring and Assessment Program (SEAMAP). From that data set, the monthly percentages of ichthyoplankton samples associated with *Sargassum* were calculated for square degree areas of longitude and latitude across the region of the Gulf of Mexico in U.S. territorial waters (USGOM). Presence of *Sargassum* was compared under differing

climatological regimes using a nonparametric two-related-samples test (Wilcoxon signed ranks test). The warm phase of the Atlantic Multi-decadal Oscillation (AMO) and the negative phase of the decadal North Atlantic Oscillation (NAO) were significantly correlated with occurrence of *Sargassum* across the area of study. These regimes are associated with weather-related hydrographic characteristics in the North Atlantic, neritic zones of Central America, and the GOM that influence rates of reproduction, growth, and dispersion of pelagic *Sargassum*.

KEYWORDS: Climate, *Sargassum*, AMO, NAO

Progress in Developing Conch Products from Waste

El Progreso en el Desarrollo de Productos a Partir de Residuos de la Concha

Les Progrès Réalisés dans le Développement de Produits de Conque à Partir de Déchets

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ABSTRACT

Strombus Gigas Alliance, a non profit organisation based in Belize, has been working with local communities in different parts of the Caribbean to better utilise new and old conch in a sustainable and commercially viable manner. This presentation will review the opportunities, challenges and successes that SGA and its associates have faced to create increased income and employment from a product where 85% of the material is thrown away or underutilised!

KEYWORDS: Conch, waste, commercial, sustainable use

Participatory Sensing Marine Debris: Current Trends and Future Opportunities

Participación Sensorial de los Escombros Marinos: Tendencias Actuales y Future Oportunidades

Participative Debris Sensing Marine: Tendances Actuelles et Possibilites Futures

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ABSTRACT

The monitoring of litter and debris is challenging at the global scale because of spatial and temporal variability, disconnected local organizations and the use of paper and pen for documentation. The Marine Debris Tracker (MDT) mobile app and citizen science program allows for the collection of global standardized data at a scale, speed and efficiency that was not previously possible. Additionally, the app itself serves as an outreach and education tool, creating an engaged participatory sensing instrument. This instrument is characterized by several aspects including range and frequency, accuracy and precision, accessibility, measurement dimensions, participant performance, and statistical analysis. Also, important to MDT is open data and transparency. A web portal provides data that users have logged allowing immediate feedback to users and additional education opportunities. The engagement of users through a top tracker competition and social media keeps participants interested in the MDT community. Over a million items have been tracked globally, and maps provide both global and local distribution of data. We will present current usage and engagement, participatory sensing data distributions, choropleth maps of areas of active tracking, and statistical analysis. Preliminary statistical analysis indicates differences in NOAA region debris characterization. The Northeast, Pacific Northwest, Alaska and Pacific Island, and Gulf of Mexico NOAA regions have significantly more fishing gear than in other tracked NOAA regions. An average of 20% of the total debris was fishing gear in these regions, whereas, approximately less than 2% was fishing gear in the remaining regions.

KEYWORDS: Marine debris, marine protection, participatory , sensing, citizen science

Using a Remotely Operated Vehicle to Estimate Fish Community Structure at Natural Reefs in Northwestern Gulf of Mexico

Utilización de un Vehículo Teledirigido para Estimar la Estructura de la Comunidad de Peces en los Arrecifes Naturales en el Noroeste del Golfo de México

Utilisation D'un Véhicule Télécommandé pour Estimer la Structure des Communautés des Poissons dans les Récifs Artificiels dans le Nord-ouest du Golfe du Mexique

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ABSTRACT

There are many different types of natural reefs in the northwestern Gulf of Mexico (GOM), which accommodate diverse reef-associated species. In addition to natural reefs, oil and gas platforms function as artificial reefs and almost 250 species of reefs associated fishes have been observed at these structures. Characterizing fish communities is challenging in these complex marine habitats due to both the large vertical relief of platforms and the complicated morphology of natural reefs. A remotely operated vehicle (ROV) based methodology will be tested for utility to rapidly characterize the assemblages of fishes associated with platforms and natural reefs in the northwestern GOM. Depth-interval-transects (DITs) will be conducted to document fish distributions and community structures at oil and gas platforms. On natural reefs, both DITs and the line transects will be carried out to characterize fish distributions and structures. Video obtained with the ROV will be analyzed for species composition, abundance and habitat complexity around platforms and on natural reefs. Qualitative acoustical camera imagery will also be acquired with a BlueView 2D® imaging sonar mounted on the ROV. Fish can be detected and measured with the Blueview while video data are being collected. Since Blueview has a larger effective viewing range, data from video and the sonar will be combined to maximize the amount of biological information attainable during our surveys. Preliminary surveys on Bright and Sidner Banks demonstrate that the ROV provided a great deal of useful information about fish community and habitat information on natural reefs.

KEYWORDS: Remotely operated vehicle, fish community, artificial reefs, natural reefs, Gulf of Mexico

Antigua and Barbuda Fish Aggregating Device Co-management Cost Benefit Analysis

Antigua y Barbuda Cogestión y Análisis Coste-beneficio de los Dispositivos de Agregacion de Peces

Dispositif de Concentration Antigua-et-Barbuda Fish Co - Gestion de L'analyse Coûts-avantages

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ABSTRACT

A cost and benefit analysis was conducted on Fish Aggregating Device (FAD) co-management in Antigua and Barbuda waters for the first three years of the Caribbean Fisheries Co-management Project (CARIFICO). The FAD introduction and co-management program is a collaborative effort between the Fishers and the Fisheries Division in six Organization of Eastern Caribbean States (OECS) countries with Support from CARIFICO through the Japan International Cooperation Agency (JICA). The objectives of the study were to: 1) calculate the ideal FAD licence/user fee for the local resource users; 2) establish the average annual cost of FADs set in the waters around Antigua and Barbuda; and 3) make a determination on the economical sustainability of the FAD fishery beyond the CARIFICO project.

KEYWORDS: Co-management, FAD, cost and benefit

Criminal Fish Investigation (CFI): Cracking the Case of the Villainous Lionfish by Transforming Science Into Education

Investigación Criminal de Pescado (TPI) : Descifrando el Caso del Malvado Pez León Mediante la Transformación de la Ciencia en la Educación

Enquête de Poisson Criminel (FCI) : Cracking le Cas du Lionfish Crapuleux en Transformant la Science dans L'éducation

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ABSTRACT

The scale of the ecological impact of lionfish can be challenging to demonstrate to a nonscientist in a classroom environment. Described here is an interactive workshop that bridges science and education into a hands-on activity delivered at the Little Cayman Research Centre (LCRC). A short presentation culminated with an introduction to the "Criminal Fish Investigation (CFI)". The classroom was transformed into a "crime scene" with lionfish and prey playing the "villain" and "victims", respectively. Here students interact with four workstations; 1) A lionfish dissection allowed students to investigate how morphological characteristics and traits (predation strategy, expanding stomach, high fecundity, venomous spines) make lionfish the "perfect villain". 2) Students identified a number "victims" visually using identification books. 3) Often fish were too digested to identify visually and species specific fish scales were used as "fingerprints" of "victims". Students used microscopes to match pre-fixed "fingerprint" slides to randomly assorted pictures of "fingerprints". 4) When victims were identified students selected the location of the "crime" by placing the "victims" within their microhabitat on the "crime board". The workshop was tested on over 90 students and teachers as part of residential courses at the LCRC. Twenty-two surveys collected after the workshop indicated an increase in understanding of lionfish biology (109%), ecological impacts (87%) and management strategies (102%). Students were all challenged to eat lionfish with 72% stating they would "definitely" consume lionfish after the workshop. The CFI workshop proved effective in translating science to a thought provoking educational activity.

KEYWORDS: Lionfish, education, ecology, communication, workshop

Interim Report and Future Plan of Caribbean Fisheries Co-management Project

Informe de lo Realizado y Plan a Futuro del Proyecto de Co-gestión Pesquero en Caribe

Rapport de Réalisations et Futur Plan du Projet de Co-gestion des Pêches des Caraïbes

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ABSTRACT

Fishery resources in developing countries are under pressure mainly caused by overexploitation, environmental degradation and insufficient management. Thus, the management practices for the sustainable utilization of fishery resources need to be developed and implemented. Today, co-management is recognized as one of the effective management tools for the small-scale fishery engaged by the majority of fishers in the Caribbean island states. Caribbean Fisheries Co-management (CARIFICO) Project (2013 – 2018) under the technical cooperation of Japan International Cooperation Agency (JICA) has been implemented in collaboration with local fishers, Fisheries Division, Caribbean Regional Fisheries Mechanism (CRFM) Secretariat and JICA in six OECS countries. The purpose of this project is to develop a fisheries co-management approach suitable for each target country and to share its good practices in the Caribbean region. CARIFICO consists of three pilot projects, 1) FAD fishery co-management in six OECS countries, 2) conch resources co-management in St. Lucia, and 3) fish pot co-management in Antigua and Barbuda. The purpose of this presentation is to provide information about the achievement and future plan of CARIFICO. Specifically, the approaches of FAD fishery co-management produced fruitful outcomes such as, the improvement of fisher's livelihood, the establishment of collaborative relationship between fishers and government, the formulation of FAD fisher cooperatives, the registration of FAD user rules and the

collection of FAD user fees. Those outcomes will serve to secure the sustainability of FAD fishery co-management as well as to apply for the establishment of new co-management approaches in the different fishing industries and/or fishing communities.

KEYWORDS: Fishery co-management, FAD, conch, fish pot

Systematic Approach to the Postmortem Examination of the Queen Conch (*Lobatus gigas*)

Enforque Sistemático para la Examinación Post-Mortem de la Concha Reina (*Lobatus gigas*)

Enforque Sistemático para la Examinación Post-Mortem de la Concha Reina (*Lobatus gigas*)

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ABSTRACT

The queen conch, *Lobatus gigas*, is an iconic gastropod, traditionally a significant dietary protein source for the Caribbean. *L. gigas* is now commercially threatened, but little is known regarding diseases which may put depleted populations at further risk. To assess disease status of *L. gigas* in our region, we aim to describe a systematic technique for post-mortem examination. A variety of approaches for euthanasia, viscera extraction, dissection, and tissue preservation were explored using 32 conchs collected from St. Kitts and procedures were selected which provided optimal exposure of anatomy while requiring the least dissection. Conch are initially sedated by immersion in magnesium sulphate (3g/4L seawater) in order to facilitate removal from the shell without tearing of viscera. A hole in the shell is made to allow visualisation of the columnellar muscle which must be carefully severed while avoiding adjacent viscera. Subsequently, the body is extracted from the shell by placing steady traction on the operculum. Euthanasia is achieved by making a 1 cm sagittal incision through ganglia located immediately posterior to the eye stalks. Four incisions are then required for full visualization of tissues: the first opens the mantle cavity; a second 'V' cut accesses the pericardium; the third reveals the intestinal loop, kidney and nephridial gland; lastly the gastrointestinal lumina are opened. Tissue fixation with Davidson's solution was found to have lessor post-sampling mucous production than with 10% neutral-buffered formalin. A necropsy guide was developed which will facilitate disease diagnosis in L. gigas.

KEYWORDS: Queen conch, gastropod, Lobatus gigas, necropsy, dissection

On the Risks of Adapting Broad Ecological Theories for Specific Management Purposes: The Case of the Invasive Lionfish in the Western Atlantic

Riesgos Asociados con la Aplicación de Teorías Ecológicas Universales a Problemas Específicos de Manejo de Ecosistemas: El Caso de la Invasión del Pez León

Sur les Risques D'adaptation Grandes Théories Écologiques à des Fins de Gestion Spécifiques: Le Cas du Lionfish Envahissantes dans L'Atlantique Ouest

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ABSTRACT

Given its ability to yield predictions for very diverse phenomena based only on two parameters – body size and temperature –, the Metabolic Theory of Ecology (MTE) has earned a prominent place among ecology's efficient theories. In a sem-

inal article, the leading proponents of MTE claimed that the theory was supported by evidence from a Pauly (1980) dataset on natural mortality, biomass, and environmental temperature for 175 fish stocks spanning tropical, temperate and polar locations. We demonstrate that the evidence presented by MTE's proponents is flawed because it fails to account for the fact that Pauly re-estimated environmental temperatures for polar fish as ´physiologically effective temperatures´ to correct for their "abnormally" high natural (mass-corrected) mortalities, which on average turned out to be similar to (rather than lower than) the mortalities recorded for temperate fish. Failing to account for these modifications skews the coefficients from MTE regression models and wrongly validates predictions from the theory. It is important to point out these deficiencies given MTE's broad appeal as a theoretical framework for applied ecological research. In a recent application, MTE was used to estimate biomass production rates of prey fish in a model of invasive Indo-Pacific lionfish predation in Bahamian reefs. It is shown that the MTE coefficients may lead to a drastic overestimation of prey fish mortality and productivity rates, leading to erroneous estimations of target densities for ecological control of lionfish stocks.

KEYWORDS: Lionfish, invasive species, metabolic theory of ecology

Reef Fish Assemblage Biogeography in Southeast Florida

Biogeografía en el Ensamble de Peces Arrecifales en el Sureste de Florida

Reef Biogéographie Poissons D'assemblage dans le Sud de la Floride

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ABSTRACT

The Florida Reef Tract extends from the tropical Caribbean up the southeast coast of Florida into a temperate environment where tropical reef assemblages diminish with increasing latitude. A three-year comprehensive fishery-independent survey was used to quantify reef fish spatial distribution in southeast Florida and define where the assemblage shifts from tropical to temperate. A total of 1,676 reef fish visual census samples were conducted on hardbottom habitats between the Miami River and St. Lucie inlet. Multivariate analyses were used to investigate differences in assemblages among sites. Depth, general habitat (reef or hardbottom), and slope explained the main dissimilarities between assemblages. A general trend of cold-tolerant temperate fish dominated the northern assemblages and more tropical species dominated further south. Seven reef fish assemblage biogeographic regions were determined. In shallow habitats the data clustered in three spatial regions: One south of Hillsboro inlet, one in Northern Palm Beach south of Lake Worth inlet, and one north of Lake Worth inlet. The assemblage in deep habitats mainly split in close proximity to the Bahamas Fracture Zone south of Lake Worth Inlet. The presence of reef habitat aided in splitting the southern assemblage regions from the northern all-hardbottom assemblage regions in both the shallow and deep habitats. Substrate relief was significantly correlated with the differences in the northernmost deep assemblages but did not appear to affect the remainder of the shallow and deep assemblages.

KEYWORDS: Spatial distribution, latitudinal gradient, tropical, temperate, habitat associations

Movement and Oceanographic Preferences of Scalloped Hammerheads (*Sphyrna lewini*) in the Gulf of Mexico

Movimiento y Oceanográficos Preferencias de Tiburón Martillo (*Sphyrna lewini*) en el Golfo de México

Mouvement et Océanographiques Préférences de Requin-marteau Halicorne (*Sphyrna lewini*) dans le Golfe du Mexique

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ABSTRACT

Information on movement and habitat use of large marine predators is needed to identify important areas for proper conservation and implement sound spatially explicit management strategies. Identifying important habitat(s) and the mechanisms responsible for movement is inherently difficult due to the mobility of large marine predators as they often move across multiple ecosystems or habitats. Moreover, patterns of habitat use and residency are influenced by dynamic oceanographic conditions (e.g., mesoscale eddies or currents) and distribution and movement of prey resources. The objective of this study was to better understand movement dynamics of Scalloped Hammerheads (Sphyrna lewini) throughout the Gulf of Mexico (GOM) using Smart Position or Temperature (SPOT) transmitting tags attached to the dorsal fin. A total of 38 Scalloped Hammerheads were captured and tagged throughout the northern GOM consisting of 33 individuals with movement data ranging from five to 479 days at large. Mean number of days at large was 146 ± 24.3 (standard error, SE) with a mean size at tagging of 159 ± 5.3 SE cm fork length (FL) (range: 102-220 cm FL). Movement patterns are being analyzed relative to remotely sensed oceanographic parameters including sea surface temperature, salinity, sea surface height anomaly, chlorophyll concentration and bathymetry. In addition, Bayesian state-space switching models are being used to examine directed movement and residency periods of individual sharks. Results will provide critical information on fine-scale habitat use and movement patterns that can be used to improve predictability models to highlight priority areas and environmental preferences of Scalloped Hammerheads throughout the GOM.

KEYWORDS: Shark, movement, habitat use, scalloped hammerheads, Gulf of Mexico