Marine Introduced Species in the Southern Gulf of Mexico and Mexican Caribbean: A Checklist

Especies Marinas Introducidas en el Sureste del Golfo de México y Mar Caribe Mexicano: Un Listado de Verificación

Les Espèces Marines Introduites dans le Sud du Golfe du Mexique et les Caraïbes Mexicaines: Un Liste de Contrôle

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ABSTRACT

The number of introduced species in the marine environment has increased due to, among other factors, high demand in fisheries, aquaculture, and aquarium trade. Introduced species become invasive when they reach a widespread distribution and pose an environmental risk. The World Register of Introduced Marine Species recognizes about 1,844 species as alien or non-indigenous, but it is difficult to determine how introduced species become invasive and which is the damage inflicted to the environment. Various terms are used interchangeable referring to invasive species, such as non-indigenous, alien, introduced, invasive etc., but these terms may not mean the same. In Mexico, research has been concentrated mainly on invasive species in terrestrial and freshwater environments, with less attention devoted to marine species. In this work, we reviewed scientific databases and scientific journals (indexed in JCR) for publications using terms such as introduced, invasive, alien, or non-indigenous, for marine species in the southern Gulf of Mexico (off Tamaulipas, Veracruz, Tabasco, Campeche and Yucatan) and the Mexican Caribbean (off Quintana Roo). We built a checklist of 23 marine species (algae, jellyfish, coral, amphipod, shrimp, and fish) with potential of being invasive and discussed possible or null effects of their introduction.

KEYWORDS: Invasive species, Yucatan, introduced species, Mexico, Mexican Caribbean

Fisheries Management Technology Tools - Lessons, Challenges and Opportunities

Herramientas Tecnológicas de Gestión Pesquera - Lecciones, Retos y Oportunidades

Outils Technologiques de Gestion des Pêches - Leçons,Ddéfis et Opportunités

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ABSTRACT

In 2013, DIGEPESCA stablished a collaboration agreement with the Centre of Marine Studies (CEM) with the purpose of facilitating the modernization of the registration systems meant for the control and inspection of the fishing sector of the country. Since then, CEM has developed an online system to take on the General Fisherman Registry (RGP according to its Spanish acronym), which has progressively grown since its piloting in 2014. From 2015 on, regular improvements on the RGP have enabled to suit national license demands, reflected in an increase of 1,169 registries in 2015 to 3,510 for 2016. Nowadays, the app "Ourfish", which links with the RGP via a QR code printed in the licenses it issues, created to monitor fisheries by means of a mobile device, is being rolled out to serve as an electronic logbook aimed for merchants of fishery products acquired from small-scale fishermen. At present, there are twenty users, among fishmongers and fish collection centers, registering their daily transactions for several months now.

Nevertheless, the development of these applications has been considerably challenging, as it was not taken into account the magnitude and reality of the country at the time of its design. This has resulted in setbacks in both its use as in the analysis of the resulting data, to which CEM is providing a solution through the renovation of its underlying structures and platforms. These improvements will allow in the short-term and along the coastal and insular Atlantic zone of the country the deployment of the Ourfish app in at least 50 small-scale seafood-marketing centers. Such endeavor will generate the inflow of thousands of data on fishery production to the system, which will be possible to visualize for fisherman as for

national public authorities via an online dashboard.

KEYWORDS: Society, marine, government, innovation, digital

Atlas Marino del Caribe: Plataforma Tecnológica como Repositorio de Información para Soporte al Manejo Integrado Costero y la Gestión Basada en Ecosistemas de la Región

Caribbean Marine Atlas: Technological Platform as Information Repository to Support Integrated Coastal Management and Ecosystem-based Management for the Region

Atlas Marine des Caraïbes: Plateforme Technologiques pour Soutenir la Gestion Intégrée des zones Côtières et la Gestion Écosystémique de la Région

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RESUMEN

El Atlas Marino del Caribe trabaja en la operacionalización sostenible de una plataforma tecnológica digital en línea para la publicación de información geoespacial relevante que soporte el manejo integrado costero con especial énfasis en eventos naturales, cambio climático, biodiversidad, hábitats, pesquerías, fuentes de contaminación terrestre y manejo basado en ecosistemas para los grandes ecosistemas del Caribe. La plataforma se estructura fundamentalmente en la herramienta tecnológica de código abierto GeoNode, que consume y publica webservices enlazándolos a otras herramientas para visualización dinámica y usable de indicadores seleccionados (al menos 5) para la Región. Está implementándose para 12 países piloto interesados en ofertar su propia información geoespacial para consulta regional y nacional. La arquitectura tecnológica ofrece herramientas en línea para el almacenamiento y consulta de capas, mapas estáticos e interactivos, documentos asociados al contenido geoespacial, enlaces a otras fuentes de información del Caribe, noticias, calendario e indicadores que apuntan a contribuir al reporte nacional o regional de estrategias globales (Metas AICHI u Objetivos de Desarrollo Sostenible). La gestión de información promueve que a través de un Punto Focal Nacional, los países autogestionen su información bajo implementación de estándares y protocolos (metadato) acordes con la política de información. Colombia, como coordinación del proyecto brinda soporte, capacitación y ejerce control de calidad. Adicionalmente, el Atlas también sirve de repositorio de información espacial al proyecto hermano Caribbean Large Marine Ecosystems - CLME+, y además se vale de sinergias estratégicas con otras iniciativas (IODE) como SPINCAM, ICAN u OTGA. Posicionar el atlas como repositorio de referencia en el Caribe, es el reto.

PALBRAS CLAVE: Plataforma tecnológica, Caribe, gestión basada en ecosistemas, manejo integrado costero

Characterization of Cultivable Bacteria Associated to the Coral *Porites astreoides* in Guadeloupe Island and Demonstration of the Metabolic Activity of Isolated Strains

Caracterización de las Bacterias Cultivables Asociadas al Coral *Porites astreoides* en la Isla de Guadeloupe y Puesta en Evidencia de la Actividad Metabólica de las Cepas Isoladas

Caractérisation des Bactéries Cultivables Associées au Corail Porites Astreoides en Guadeloupe et Mise en Évidence de L'activité Métabolique des Souches Isolées

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ABSTRACT

Cultivable bacteria associated to the coral *Porites astreoides*, a dominant species in the Caribbean reefs, was studied in order to characterize beneficial bacteria for its health. A total of 224 bacterial strains were isolated by microbial culture. P. astreoides cultivated bacteria showed a predominance of Vibrionaceae (associated with coral tissue and mucus) and Bacillus (associated with sediment and seawater around coral colonies). Metabolic tests (antibiogram and antimicrobial tests) were applied to these bacterial strains. Twenty-four of them presented a high sensitivity to four tested antibiotics (oxytetracycline, penicillin, streptomycin and ampicillin). In parallel, pure clones of Photobacterium rosenbergii (C91 and C70 strains), *Pseudomonas plecoglossicida* (C89 strain), and *Vibrio vulnificus* (F11 strain) inhibited the growth of *V. splendidus*, a pathogen of the oyster *Crassostrea gigas*, suggesting a possible synthesis of antimicrobial metabolites by these bacteria. These results are consistent with the coral probiotic hypothesis established by Reshef et al. (2006), as well as the recent term « Beneficial Microorganisms for Coral » proposed by Peixoto et al. (2017).

KEYWORDS: Marine bacteria, holobiont, coral, *Porites astreoides,* antimicrobial activity, coral health

Determinación de la Ubicación y Dimensión de Ventanas de Escape para las Nasas Utilizadas en la Pesquería de Jaiba (*Callinectes sapidus*) en la Ciénaga Grande de Santa Marta, Caribe Colombiano

Determination of Location and Dimension of Escape Windows for Traps Used in the Fishery of Blue Crab (*Callinectes sapidus*) in the Ciénaga Grande de Santa Marta, Colombian Caribbean

Détermination de L'emplacement et de la Dimension des Fenêtres D'échappement pour les Nasses Utilisés dans la Êche de Crabe Bleu (*Callinectes sapidus*) dans le Ciénaga Grande de Santa Marta, Caraïbes Colombiennes

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RESUMEN

La pesquería de jaiba de la Ciénaga Grande de Santa Marta es esencial para las comunidades aledañas. Sin embargo, una fuerte presión de pesca ha conllevado a una sobrepesca por reclutamiento. Un amplio rango de tamaños de jaibas es capturado con nasas incluyendo un alto porcentaje de individuos inmaduros. Se determinó la dimensión y ubicación de ventanas de escape para que puedan salir los tamaños no deseados. A partir de videos grabados con una cámara sumergible se estudió el comportamiento y los sitios de preferencia de la jaiba dentro de la nasa, luego se diseñaron y ubicaron las

ventanas. El tamaño de las ventanas se estimó utilizando las siguientes relaciones morfométricas: Altura de la Base de la Espina Lateral (ABEL) vs Altura del caparazón y ABEL vs altura del cuerpo. Para establecer diferencias estadísticas entre las distribuciones de tamaño capturadas y la CPUE de nasas con o sin ventanas de escape se utilizó la prueba no paramétrica W de Mann-Whitney (Wilcoxon) para comparar las medianas. Los resultados de las relaciones fueron explicados mejor mediante una relación lineal según las siguientes ecuaciones: Lca = 0.5938*ABEL + 0.3102 y Alt = 0.3094*ABEL + 0.2934. El ABEL correspondiente a la talla de madurez se estimó en 63.3 mm. Se instalaron 4 ventanas rectangulares (21 mm de alto y 40 mm de largo), que fueron ubicadas en las esquinas inferiores. La estructura de tamaños capturada evidenció diferencias estadísticas ($p < 0.05$) mostrando una reducción de la captura de individuos inmaduros. Sin embargo, en términos de eficiencia en la captura no se presentaron diferencias entre las CPUE evaluadas. El uso extensivo de ventanas de escape en la pesca de jaibas podría favorecer la disminución de las tasas de capturas de individuos inmaduros y en consecuencia contribuir a la sostenibilidad de esta pesquería.

PALABRAS CLAVE: Relaciones morfométricas, nasas ventanas de escape, *Callinectes sapidus*

Parasitos Metazoos de *Euthynnus alletteratus* (Osteichthyes: Scombridae) en la Costa Central del Estado de Veracruz, México

Metazoan Parasites of *Euthynnus alletteratus* (Osteichthyes: Scombridae) in the Central Coast of the State of Veracruz, Mexico

Métazoaires Parasites de *Euthynnus alletteratus* (Osteichthyes: Scombridae) sur L' État de la Côte Centrale de Veracruz, un Mexique

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RESUMEN

Se examinaron las branquias y tracto digestivo de 29 ejemplares de bonito *Euthynnus alletteratus* capturados por la pesca artesanal de Chachalacas, Veracruz. Las muestras se fijaron en formaldehído al 10% para su revisión en el laboratorio. Para el procesamiento del material biológico se aplicó la técnica parasitológica acorde al grupo de parásito encontrado. Se realizó la identificación y descripción taxonómica de los parásitos y se calcularon los parámetros ecológicos de prevalencia, abundancia e intensidad promedio de infección. La parasitofauna de *E. alletteratus* incluye 15 especies: cuatro monogéneos, tres trematodos, un acantocéfalo, dos nematodos y cinco copépodos. Se colectaron 776 parásitos metazoarios, de los cuales, los trematodos representan el 74.7%, seguido por los acantocéfalos con 13.7%. Todos los hospederos estuvieron parasitados con al menos un individuo, excepto uno que no registró parásitos. El mayor número de parásitos registrados en un hospedero fue de 342 individuos. El mayor número de especies se registró en un hospedero con seis especies. Los valores de prevalencia alcanzados por las especies de parásitos en este hospedero, establecen al monogéneo *Hexostoma euthynni* (69%) como la especie más ampliamente distribuida en la población de hospederos, a la vez que el trematodo Brachyphallus parvus (65.5%) y el acantocéfalo *Rhadinorhynchus pristis* (62%) son las más abundantes y de las que se registran las infecciones más intensas (27.2 ± 70.9 y 5.9 ± 5.8, respectivamente), por lo que podría considerárseles como las especies más importantes para este hospedero. El presente estudio mostró que los bonitos *E. alletteratus* están infectados por una rica fauna de metazoarios parásitos que parecen ser una herramienta prometedora para inferir información sobre la biología y ecología del hospedero.

PALABRAS CLAVE: Helmintos, Acantocephala, monogenea, digenea, Golfo de México

Biomass Estimates of Common Octopus *Octopus vulgaris* in the Continental Shelf of Yucatan

Estimaciones de Biomasa de Pulpo Común *Octopus vulgaris* en la Plataforma Continental de Yucatán

Estimations de la Biomasse du Poulpe Commun *Octopus vulgaris* de la Plateforme Continentale du Yucatan

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ABSTRACT

Mexico occupies the third place for the world's highest catches of genus Octopus, whit increases in the past decade. Since the first records of 5,000 tons in 1949, the catch rate of *Octopus vulgaris* has peaked to 10,000 tons in 2014. However, the rate of exploitation and the status of the stocks across the different regions in Mexico, is less known. In this regard, the present study aims to estimate, for the first time, the common octopus' biomass, abundance and distribution on the continental shelf of Yucatan. Data was collected from four research cruises, two before (May and July) and two after (December and January) the fishing season. The biomass was calculated using three different numerical models (swept areas, stratified and geostatistical). The results show low variability in potential biomass between models, these can be explained by the difference in the statistical assumptions of the abundance's distribution (regionalized and homogeneous). Abundance estimations were higher during July and December (>20 org/km^2), which coincides with the end of the recruitment period. On the other hand, lower abundances were estimated during May and January, probably due to the higher natural mortality rates associated with the Octopus short life cycle.

KEYWORDS: Benthic, Campeche Bank, biomass, cephalopod, fishery

Telemetría Satelital de Tortugas Marinas desde el Caribe Colombiano

Satellite Telemetry of Sea Turtles from the Colombian Caribbean

Satellite Telemetry Tortues Marines de Caraïbes Colombien

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RESUMEN

La telemetría satelital, es una herramienta ampliamente utilizada para generar información de la ecología espacial de las especies migratorias y de sus posibles riesgos a nivel mundial. Gracias a la interacción de sus rutas trazadas con los ecosistemas presentes en los recorridos, dinámica oceanográfica y presiones antrópicas identificadas, se pueden establecer patrones de conectividad, junto a sus potenciales peligros. Por lo anterior, el Programa de Conservación de Tortugas y Mamíferos Marinos –ProCTMM y sus aliados, desde el 2009 iniciaron la implementación de transmisores en ejemplares de tortugas marinas que circundan el Caribe colombiano, con el propósito de describir los recorridos demarcados desde el país. Centrando los seguimientos en dos de las especies catalogadas en amenaza para la región y, enfocándose en los estadios juveniles, al evidenciarse los mayores vacíos de conocimiento durante esta etapa. A la fecha, se han introducido 5 individuos de Eretmochelys imbricata (LCC 31 - 76 cm; 21 y 697 días de transmisiones) y 2 de Caretta caretta, (LCC 25 - 48 cm; 9 - 78 días de transmisiones), portando dispositivos rectangulares SPOT 5 y 6 respectivamente con sensores de temperatura.

Las careyes mostraron una tendencia donde los juveniles tempranos, tomaron rumbos al oeste/noroeste a Centro América, mientras que los pre-adultos este/noreste al Norte de Sur América. Las caguamas optaron por recorridos más oceánicos con dirección noroeste, hacia las Antillas Mayores. La delimitación de los tramos obtenidos, contribuyen a la identificación de corredores biológicos para ambas especies, conectado áreas marinas protegidas y generando una línea base para que las autoridades competentes, formulen estrategias de manejo regional, que permitan la interconexión entre zonas de desarrollo, forrajeo y anidación en el Gran Caribe.

PALABRAS CLAVE: Transmisores, seguimiento, satelital, Carey Caguama, tramos, recorridos

Fishing Styles in the Caribbean Sea of Honduras

Estilos de Pesca en el Mar Caribe de Honduras

Styles de Pêche dans la Mer des Caraïbes du Honduras

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ABSTRACT

The ongoing process of transition in the small scale fishery sector of Honduras, where social relations are changing in a complex process of commoditization, has given rise to new modes of fishing livelihood strategies. The "traditional" artisanal fishing household, which relies on family labor and is partially integrated into markets, is only one of the different modes of fishing livelihood strategy that exists today in the coastal zone of northern Honduras. For a general description of the various fishing livelihood strategies in Honduras, we distinguishes three ideal types of fishing styles: capitalist, entrepreneurial and artisanal fishing. The capitalist mode mainly involves large corporate/industrial fishing linked to the export model. Entrepreneurial farming is of smaller size, but has also a distinct market focus and a logic of financial and industrial capital integration. Artisanal fishing is primarily characterized by family labor and family-owned boats and means of fishing. However, in Honduras there is a large group of fishermen without their own means of fishing, who work as laborers on other boats and/or lease space on boats for subsistence fishing. This group of fishermen will be added to the list of ideal types. Because they are ideal types, in reality the difference between them is blurred, and we can expect overlapping spaces and interactions among the four livelihood strategies. The different livelihood strategies are a result of how fisher households experience the broader transition process, their strategy for adapting to the institutional context and their effectiveness at negotiating with other actors. It's common to find all the livelihood strategies coexisting within the same geographic area.

KEYWORDS: Fishing styles, livelihood strategies, artisanal fishing

Mapping of the State of Health of the Coral Communities of Martinique Island (Lesser Antilles)

Mapa del Estado de Salud de las Comunidades de Corales de la isla de Martinica (Antillas Menores)

Cartographie de L'état de Santé des Communautés Coralliennes de la Martinique (Petites Antilles)

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ABSTRACT

During the "Madibenthos" scientific mission organized by the National Museum of Natural History of Paris in Martinique, a mapping of the state of health of the coral communities of the island was carried out. That was done by a

rapid estimation method of health status of coral communities which takes into account both the coral-algal phase shift and high sedimentation rate on the reefs. These two phenomena represent the main causes of degradation of the coral communities in the Lesser Antilles. Health status of benthic coral communities was divided in four classes (class 1: pristine reefs; class 2: still healthy reefs; class 3: damaged reefs; class 4: relictual coral assemblages. The work was carried out using direct observation by the authors, as well as by the examination of 8.980 photographs and 223 videos taken around the island by all the participants of the field trip. Data were consistent enough to establish the state of health for 268 sites around the island. Among them, 19 % were attributed to class 1, 17 % to class 2, 41 % to class 3 and 23 % to class 4. Depth did not present any significant influence. On the contrary, the reef communities situated on the windward coasts of the island were much more degraded than those located on the leeward coasts. This study has highlighted the urgency to improve the quality of the coastal waters around Martinique Island.

KEYWORDS: Caribbean coral communities, mapping, state of health, rapid assessment

Evaluation of the Content of Heavy Metals in Water, Sediment, and the Oyster *Crassostrea virginica* of Lagoon Mecoacán, Tabasco

Evaluación del Contenido de Metales Pesados en Agua, Sedimento y el Ostión *Crassostrea virginica* de la Laguna Mecoacán, Tabasco

Évaluation du Contenu des Métaux Lours dans L'eau, Sediment et le Ostron *Crassostrea virginica* de Lagoon Mecoacán, Tabasco

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ABSTRACT

Water, sediments and oysters (*Crassostrea virginica*) from the Mecoacán Lagoon were analysed in order to determine concentrations of cadmium, copper, zinc and lead. Lead was found in concentrations above permisible limits in water (8 times) and in high concentrations in sediment and oyster, such concentrations are considered a potential risk to living organisms in the channel as well as to humans. Accumulation factors decreased in the following order: Zn > Cu > Cd > Pb, and a high correlation between metal concentration in oyster and sediment was observed. Metal concentrations in water and sediments increased with decreasing distance from the coast of Sánchez Magallanes, Tabasco. This observation was not posible to realize in oysters, probably because some factors, such as age, size, sex and reproductive cycle were not taken into account.

KEYWORDS: Oyster, heavy metas, lagoon, Tabasco, bioacumulation

Density Effects on the Survival of the Juvenile Conch "Tote" *Pomacea flagellata* Under Laboratory Conditions in Tabasco, Mexico

Efecto de la Densidad en la Sobrevivencia de Juveniles del Caracol "Tote" *Pomacea flagellata* a Bajo Condiciones de Laboratorio en Tabasco, México

Effets de Densité dans la Survie du Conch "Tote" Juvenile *Pomacea flagellata* Sous Conditions de Laboratoire à Tabasco, Mexique

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ABSTRACT

Effects of density of organisms on survival percentage was determinate in juvenile of the conch "tote" *Pomacea flagellata*, egg masses were collected in the pond of aquaculture laboratory and incubated under laboratory conditions, at temperature (29 ± 1°C) to the hatching of the conchs. At hatching, the organisms were distributed in aquariums of 40 liter and fed with chaya (*Cnidoscolus aconitifolius*) at libitum during all experimental period of 30 days. Six different densities were evaluated (50, 100, 150, 200, 250 and 300 organism/aquarium), each one with two replicates. The highest survival percentage (88%) was obtained at the densities of 50 and 150 org/aquarium), whilst at density of 200 org/aquarium was registered the lower percentage of survival with the 71% of the live organisms at the end of the four week of the study.

KEYWORDS: Pomacea, density, survival, laboratory, caracol

Combining Grant Awarding with Technical Assistance and Training and to Build Capacity of Marine Protected Areas in the Caribbean: The Case of the CaMPAM-ECMMAN Small Grant Program

Apoyo Financiero con Asistencia Técnica y Adiestramiento para Mejorar la Capacidad de las Áreas Marinas Protegidas en el Caribe: el Caso del Programa de Pequeñas Donaciones CaMPAM-ECMMAN

Une Combinaison de Soutien Financier avec L'assistance Technique et la Formation afin D'améliorer la Capacité des Aires Marines Protégées dans les Caraïbes: Le Cas du Programme-ECMMAN CaMPAM Petites Subventions

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ABSTRACT

In 2013 The Nature Conservancy requested the UN Environment Programme in the Caribbean to coordinate a small grant program specific for the OECS countries as part of the Eastern Caribbean Marine Managed Areas project funded by the German government to increase the capacity to manage marine managed areas in the 6 countries of the Eastern Caribbean: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia, and Saint Vincent and the Grenadines. After a process of consultation with all actors involved (including each country focal points from relevant government agencies and the local NGOs that would eventually manage the projects), the program started in early 2014 with the establishment of the project procedure and the development of project proposals. Until March 2017, around $220,000 were awarded to each country with numerous benefits, namely: area management staff, fishers and other stakeholders trained and assisted by regional experts, environmental policy drafted, facilities built and equipped, biological and socioeconomic surveys implemented and monitoring programs established, local communities better educated of the importance of managing coastal resources sustainably, local and international governmental and non-governmental environmental

agencies closer collaborators. This paper examines the successes, shortcomings and lessons learnt from the implementation of the CaMPAM-ECMMAN SMG, the largest implemented by CaMPAM.

KEYWORDS: Eastern Caribbean, marine managed area, capacity building, grant program, coordination

A Transatlantic Initiative Supports Exchanges Among Regional Networks of Marine Protected Managers Around the World and CaMPAM is at the Forefront

Una Iniciativa Trasatlántica Apoya Intercambios entre Redes Regionales de Gestores de Áreas Marinas Protegidas del Mundo y CaMPAM está a la Vanguardia

Une Initiative Transatlantique Soutient les Echanges entre les Réseaux Régionaux de Gestionnaires des Aires Marines Protégées du Monde et CaMPAM est à L'avant-garde

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ABSTRACT

After a first contact with MedPAN in 2010, CaMPAM continues to collaborate with this and other regional networks of MPA managers. Joint sessions with MedPAN, RAMPAO, NAMPAN and other regional networks were held at IMPAC3 in 2013 (a joint paper on the Mediterranean and Caribbean MPAs was published, click *here*), and at the Word Conservation Congress in 2016. What started with exchanges of coordinators to highlight the importance of regional networks to build MPA capacity has extended recently to site managers exchanges of the Caribbean, North and South America, Africa and Europe. This was possible thanks to the "Cooperation with Northern and Southern Transatlantic Dimension" project, supported by the European Union and aiming to establishing “transatlantic partnerships of marine protected areas’’. Site and networks managers have discussed the protection of species populations straddling the Atlantic Ocean, and management tools to increase resilience of coastal areas with intense tourism development and fishing. MPA managers from the Dominican Republic, The Bahamas, the Dutch Caribbean and Mexico (all members of CaMPAM Expert Team) shared their experience on participatory MPA management and coral reef research and monitoring, and discussed priorities and opportunities for a second phase to implement twinning projects designed to share good MPA management practices.
This initiative is based on the recognition that “There is enormous value in exchanging experiences beyond a single region: the identification of commonalities and differences in various biophysical and cultural scenarios is known to stimulate solutions to our own problems” and the managers claim that “You shall not manage alone”. CaMPAM encourages all actors to support transatlantic exchanges to enhance managers’ capacity.

KEYWORDS: Marine protected areas, regional networks of MPA managers, transatlantic, collaboration

Risk Map of the Lion Fish Invasion in the Mexican Caribbean

Mapa de Riesgo sobre la Invasión del Pez León en el Caribe Mexicano

Carte de Risque de L'invasion du Lionfish dans la Caraibe Mexicaine

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ABSTRACT

The lionfish (*Pterois volitans* / *miles* complex) is an invasive species that, since its first registration in the Caribbean, has changes the integrity and biodiversity of ecosystems. The lionfish has become a decade, in one of the most successful

invasive species, affecting inconsistently and even undervalued, the coral reef ecosystems of the Mexican Caribbean. The objective of the research is to generate maps of distribution and risk on the invasion of lionfish in the study sites of the northern, central and southern sites in the Mexican Caribbean. Data generation is performed using systematic and autonomous diving methodology, using harpoon type Hawaiian for capture. The average fish population density per hectare is heterogeneous in the region, fish abundance does not vary significantly between sites, but is significant in a vertical depth profile to the coastline. The number of organisms per hectare in the NPA of Chinchorro, a southern zone (with high conservation level), is similar to that reported in Playa del Carmen, central zone (without conservation status), presenting in both sites the largest sizes and abundances. In Isla Contoy and Punta Nizuc (average level of conservation), north zone, the abundance is smaller with respect to the center and south zone. There are no correlations between the density of the invasive species, the complexity of the background or the biodiversity between zones. The results of the analysis reflect that unimportant invasive species control efforts are applied in each zone. It is recommended to intensify the efforts of control of the species and its consumption while working towards a unique integrated management strategy with an ecosystem approach, where the conservation of local species, magnify control.

KEYWORDS: Lion fish, invasive species, NPA, biodiversity, Caribbean

Fishermen Perspectives on the Fishery Ban of Red Grouper *Epinephelus morio* (Teleostei: Epinephelidae) in Sisal, Yucatan, Mexico

Perspectivas de Pescadores sobre la Veda de Mero *Epinephelus morio* (Teleostei: Epinephelidae) en Sisal, Yucatán, México

Perspectives des Pêcheurs sur L'interdiction du Mérou Rouge *Epinephelus morio* (Teleostei: Epinephelidae) dans Sisal, Yucatan, Mexique

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ABSTRACT

The Red grouper, *Epinephelus morio*, is the most commercially important grouper in the northern Yucatan Peninsula, Mexico, but its fishery is overexploited despite the establishment of a seasonal ban (15 February to 15 March) since 2005. In 2017, the ban was extended to two months (1 February to 31 March). Despite declining conditions of the grouper fishery, the fishermen perspective, about the ban effectiveness and associated problems to the Red grouper fishery, has never been explored. In this study, semi-structured interviews were applied to 65 fishermen from Sisal, Yucatan, from September to November 2016. Results indicated 60% of fishermen accept the fishery ban; however, 92% agreed the ban is not enough for the Red grouper conservation. About 74% would be willing to have a ban extension but these latter fishermen have major concerns that the extension may negatively affect their earnings. We propose job alternatives, such as the eco-tourism, in order to compensate possible fishermen income loss.

KEYWORDS: *Epinephelus morio*, TEK, Yucatan, Fishermen perspective, Mexico

Effect of Ocean Near-future Predictions During Larval Period of the Queen Conch (*Strombus gigas*)

Efecto del Cambio Climático Durante la Vida Larvaria de (*Strombus gigas*)

Effet du Changement Climatique au Cours de la Vie Larvaire du Lambi (*Strombus gigas*)

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ABSTRACT

The increase in CO_2 emissions produces heating and reduced pH in the oceans, which can have negatives effects on many marine organisms, in particular those with calcified structures (i.e. mollusk), affecting mainly their larval stages. We studded *Strombus gigas*, an important gastropod in the Caribbean sea, to known the influence of near-future predictions (ocean warming and acidification) over larval growth, their survival and calcification ratios. Larval culture was realized maintain constant temperature and pH (supplying CO_2 continuously). We employing three treatments (Control = 28°C-pH 8.1, T1 = 28°C-pH 7.6, T2 = 31°C-pH 7.6) in triplicate. Growth (n = 30 larvae per age/treatment) and survival were evaluated in larvae of 0, 10, 20 and 30 days old. Calcification was evaluated in S. gigas larval shell from 0, 3, 10, 20 and 30* days old (*settlement) by EDX and RAMAN analysis. One-Way ANOVA (p(α0.05)) was realized to larval growth, survival and shell calcification. Treatment 2 showed higher values in growth rate over time (from 31.55 ± 18.84 to 23.73 ± 16.18µm; p (α0.05) < 0.0001). We observed a difference of 14.17% in survival rate between control and treatment 2 (p (α0.05) = 0.0148). Average calcium proportion was major in the control 35.10 ± 9.48% wt, without differences among treatments (p (α0.05) = 0.0875), moreover, the shell composition (aragonite and calcite) showed differences among treatments, where aragonite intensity (206 cm) was greater 858.07 ± 610.59a.u. at the control, and calcite (282 cm) was recorded only in the T2 with an average intensity of 457.63 ± 298.32a.u. Our results suggest that this specie could be adapted to warmer conditions, but the combination with an acidified environment could produce several issues in his composition and larval availability in future scenarios.

KEYWORDS: *Strombus gigas,* acidification, temperature, survival, calcification

Towards a Sustainable Exploitation of the Caribbean Fisheries

Hacia una Explotación Sostenible de la Pesca en el Caribe

Vers une Exploitation Durable des Pêches des Caraïbes

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ABSTRACT

Climate variability rather than the effects of fishing intensity rule catch trends in the long-term. This is particularly true in case of neritic stocks with short lives like sardines. In species with longer life span, is easier to detect the effects of fishing intensity, because their dependence on climate variability is less evident. In most cases, stock assessment usually is limited to the biological aspect, whilst the economic and social components are often neglected. Under this framework, the Caribbean fisheries are involved in a fuzzy cloud of socio-economic crisis leading to regulations based on good intentions rather than informed management decisions. In just a few cases, stock assessments have been applied to the most important fisheries like queen conch and spiny lobster. However, more than 60 species are exploited in the Caribbean and the Gulf of Mexico, with a biomass of 5.3 Million mt and an estimated Maximum Sustainable Yield of 2.65 Million mt; unfortunately, current yield and stock biomass suggest a 30% reduction respecting to values recorded a few years ago. A review of the status of some fisheries of the region, allows providing information for their management. Recommendations provided are addressed to improve stock assessments leading to attain sustainable exploitation.

KEYWORDS: Fisheries management, Caribbean Coral reef fisheries, spiny lobster, queen conch

Diversity of Native Reef Fish Communities in Two Protected Areas in the Caribbean Sea and its Relationship to the Invasive Lionfish

Diversidad de las Comunidades de Peces en Dos Áreas Marinas Protegidas del Caribe y su Relación con el Pez León

La Diversité des Communautés de Poissons dans Deux Aires Marines Protégées dans les Caraïbes et Ses Relations avec le Lionfish

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ABSTRACT

Lionfish (*Pterois volitans*) invaded the Caribbean region with the potential to alter the composition and structure of native coral reef fish communities. The objective of this study was to analyze the diversity indices of these fish communities potentially affected by lionfish predation and to compare with pre-invasion data. The study was undertaken in two Caribbean marine protected areas (MPAs): Guanahacabibes National Park (PNG) in W Cuba and Xcalak Reefs National Park (PNAX) in South Quintana Roo. We carried out visual censuses of fish species in reef habitats during the dry and rainy seasons of the period 2013 - 2015. For this, nine sites were defined and evaluated using stationary counts. Our results showed higher species richness (43.47 ± 5.14) and mean abundance (0.76 ± 1.25) in PNG than in PNAX (40.22 ± 4.96, 0.19 ± 0.46, respectively). Diversity decreased after the arrival of lionfish in a single site of PNG and in two sites of the PNAX, but apparently, these results are more related to the fishing activity effect than to the lionfish presence. Based on the results and assuming that changes in the native fish communities by lionfish may not yet be detected, we recommend to continue the monitoring community descriptions in order to detect future changes in native fish communities.

KEYWORDS: Diversity, invasive species, marine fishes, coral reef, predator effect

Socioeconomic Factors and Risk Perception of Sea Cucumber Migrant Harvesters in the Yucatan, Mexico

Factores Socioeconómicos y Percepción de Riesgo en Pescadores Migrantes de Pepino de Mar en Yucatán, México

Facteurs Socioéconomiques et Perception du Risque des Moissonneurs Migrateurs de Concombres de Mer au Yucatan, au Mexique

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ABSTRACT

Many people participating in the Yucatan, Mexico sea cucumber (Isostichopus badionotus) fishery come from inland communities and from other states, staying on the coast during fishing seasons. Hookah diving (HD) as a fishing method is a source of decompression sickness (DCS), carbon monoxide poisoning (COP), disabilities and death. Considering the HD risks, the aim of the study was to identify the socioeconomic cost and the risk perception of I. badionotus fishers.
The study was undertaken in two ports of the Yucatan northeastern coast during the 2017 fishing season. Yucatan inland and foreign (other states) fishers were surveyed about the fishery (catch per trip, catch value and fishing variable costs), stay expenses, diving accidents and HD risk perception.

Participants mean age was 33(±12) and range between 16 and 55 years-old, 76% were foreign fishers and the remaining from Yucatan inland communities. Per fishing trip, the mean catch was 130(± 47) kg and the revenue was US$79(±37), five times the incomes with scale species at their homeland. The main expenses were gasoline (36%), bedroom rent (13%), round trip ticket (8%), DCS insurance (2%), ice (10%) and meals (30%). Fishers agreeing that DCS is the main cause of accidents with a possible likelihood of occurrence also agree that COP is a source of risk but considered as an unlikely

likelihood of occurrence. Comparing risk perception of chronic diseases and its relation with diving-related accidents, the Yucatan inland fishers' perception was higher than the perception of foreign fishers. Regarding the labor issues, contract and life insurance are null, only a few employers sell DCS treatment insurance (US$50).

Economic incentives of the sea cucumber fishery drive the migration to the coastal area besides the risk of diving and the lack of formal labor contracts.

KEYWORDS: Sea cucumber, diving, small-scale fishers, decompression sickness. CO poisoning

Characterization of Small-scale Fisheries of the Yucatan Peninsula, Mexico: Complexity and Management Challenges

Caracterización de las Pesquerías de Pequeña Escala de la Península de Yucatán, México: Complejidad y Retos para el Manejo

Caractérisation de la Pêche Artisanale à la Péninsule du Yucatan, Mexique: Complexité de et Défis de Gestion

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ABSTRACT

Despite the significant contribution to food security, jobs, and foreign exchange, small-scale fisheries (SSF) receive less attention than industrial fisheries. SSF capture multiple species, use a diversity of gears, and land their catch all along the coasts. Under these conditions, the collection of information, monitoring, and management are difficult. This study illustrates how to characterize such complexity, using a case of small-scale fisheries of the Yucatan Peninsula, Mexico, and discusses the importance of such characterization for management. This is in order to generate a baseline that can support management decisions in the region. Analyzed data came from monthly official records of landings that cover 23 fishing communities of the area from 2006 to 2014. The frameworks used for the analysis define three subsystems: natural, human, and management. Therefore compiled data included landings of target species, catch value, fishing gears, the number of fishers, among other. These variables were contrasted between states and communities. Results show that the small-scale fishing fleet captures 18 target species groups, around 150 species, using 12 fishing gears. A total 25,917 fishers hold 3,758 permits, associated with 14,060 boats, however, the permits hold by fishers or organizations are unbalanced among stakeholders and communities. For instance, Yucatan and Campeche hold a higher number of permits, but more species are targeted in Campeche. Significant differences were observed among communities regarding target groups, total catch, and catch value. The results of this study show that the current management plans based on a single species approach do not account for the complexity of these fisheries and hence its viability is limited.

KEYWORDS: Small-scale fisheries, characterization, management implication, Yucatan Peninsula, complexity

Does Unoccupied Microhabitat Patch Size Affect Early Post-settlement Demographics in a Coral Reef Fish?

Influye el Tamaño de los Fragmentos de Hábitat Desocupados en la Demografía de un Pez de Arrecife Coralino que Acaba de Asentarse en el Arrecife?

La Taille des Fragments D'habitat Inoccupés Influence-T-Elle la Démographie d'un Poisson de Récif Corallien qui Vient de Recruter au Récif?

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ABSTRACT

Increases in frequency and intensity of physical disturbances under climate change will result in increases in microhabitat fragmentation and episodic mortality of resident fish populations, freeing previously occupied space. It is important to understand how the fragmentation of unoccupied habitat will affect the replenishment of fish populations, particularly soon after settlement, when fishes are most vulnerable. This study looks at the effect of microhabitat patch size on the abundance, survivorship and growth of newly settled bicolour damselfish *Stegastes partitus* in the absence of older resident fishes. We used standardized microhabitat settlement units arranged in two different patch size configurations, i.e. small (1 unit) and large (2x3 units), to monitor the abundance of bicolour recruits onto replicate size patches during a large natural settlement pulse. We expected that smaller patches would exhibit lower recruit abundance but higher density than larger patches because of their higher perimeter-to-area ratio. Consequently, we also expected stronger intra-cohort density-dependent effects on recruit growth and early-post settlement mortality in the small patches.

Over a three-week period, we recorded a total 225 bicolour recruits onto the experimental patches. As predicted, we found that the smaller patches had higher densities than larger patches, resulting in higher intra-cohort aggression in the smaller patches. However, we found no difference in recruit growth or mortality between patch sizes, indicating no measurable aggression effects on these demographic rates. Overall, our results indicate that bicolours readily tolerate high crowding soon after settlement and so this species might be little affected by fragmentation of unoccupied habitat when it is most vulnerable to mortality.

KEYWORDS: Reef fish, microhabitat, settlement, patch size

Comparing Divers and Camera Sled Surveys for Assessing Queen Conch Abundance in Puerto Rico

Comparción de Censos de Buceo y Cámara en Trineo para Evaluar la Abundancia de Carruchos (Caracol rosado) en Puerto Rico

Comparaison des Recensements de Plongée et de Traîneau pour Evaluer L'abondance de Carruchos (Escargot Rose) a Porto Rico

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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. Preliminary results of a study in Puerto Rico showed that surveys conducted with a digital camera sled produced higher estimates of density (#/ha) than diver survey methods, and

that measurements obtained using paired lasers were both more accurate and smaller from diver estimates. These results may lead to further applications or development of sled survey techniques, and improved data collection and analysis. Our research could improve the quality of information that can be used for management of queen conch in the Caribbean.

KEYWORDS: Queen conch, abundance, sampling techniques

Gobernanza de los Recursos Marinos Mediante la Gestión Integrada de la Pesca

Governance of Marine Resources through Integrated Fisheries Management

Gouvernance de Ressources Marines à travers de la Gestion Integrée de la Pêche

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RESUMEN

Según el Informe de Riesgo Climático, para el año 2017 Honduras ocupa el primer lugar como país vulnerable a los eventos climáticos extremos, situación que en buena medida es el resultado de la poca gestión integrada de los recursos por parte de las autoridades centrales por los vacíos legales y deficiente comunicación.

El Centro de Estudios Marinos, mediante la implementación de herramientas tecnológicas, la investigación social y científica encaminada a ampliar las áreas marinas protegidas y al desarrollo de las comunidades que dependen de los recursos marinos, ha generado información sobre el estado de estos recursos y de sus beneficiarios, datos que han descubierto la necesidad de que las autoridades centrales converjan, analicen e identifiquen soluciones en espacios formales para una adecuada toma de decisiones.

Como antecedente a esta coordinación interinstitucional se dio el reciente acuerdo establecido entra las autoridades de pesca y de áreas protegidas, quienes determinaron que próximas declaratorias de zonas de recuperación pesquera se realizarán con el visto bueno de ambas partes, sustituyendo de esta manera los acuerdos que venía realizando de manera unilateral el ente de pesca.

Ante la necesidad de formalizar el intercambio de información y definir protocolos para la toma de decisiones, en febrero de 2017 se reúnen seis instituciones relacionadas al tema de la gestión de los recursos marinos en lo que se conoce como Junta de Directores del Proyecto para el Manejo Sostenible de las Pesquerías Artesanales y la Protección de los Océanos.

En la Junta de Directores se mantendrá el debate en varios temas, especialmente la participación de las comunidades pesqueras, la gestión de las áreas marinas protegidas y el espacio marino en general, para lograr una buena gobernanza de los recursos marinos.

PALABRAS CLAVE: Gobierno, sociedad industria, artesanal, integral

Arrested Sexual Development in Queen Conch (*Strombus gigas*) Linked to Abnormalities in the Cerebral Ganglia

Desarrollo Sexual Retardada en el Cobo (*Strombus gigas*) Ligado a Anomalías en el Ganglio Cerebral

Retardé le Développement Sexuel dans la Lambi (*Strombus gigas*) Liés à des Anomalies dans le Ganglion Cérébral

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ABSTRACT

In the Florida Keys, queen conch (*Strombus gigas*) occur in two spatially distinct regions: nearshore in habitats immediately adjacent to the shoreline and offshore in habitats along the reef tract. Our previous research has demonstrated that nearshore queen conch are not reproductively active, showing deficiencies in their gonadal condition compared to their offshore counterparts. Since, sexual development in gastropods is controlled by hormones secreted by the cerebral ganglia, we hypothesized that the reproductive deficiencies found in nearshore queen conch may involve the cerebral ganglia. We collected nearshore and offshore conch and made histological comparisons of their gonads and cerebral ganglia. Our results confirmed that nearshore conch exhibited delayed gonadal maturity and reduced gametogenic output compared to offshore animals. These gonadal deficiencies were significantly correlated with abnormal cerebral ganglia histology (e.g., reduced number of ganglia cells, hypertrophy). In addition, we observed that nearshore conch had significantly lighter shells. This finding is particularly consequential since shell formation in gastropods is also mediated by hormones secreted by the cerebral ganglia. Given these results, it is apparent that the unidentified causative factor(s) behind the developmental and morphological anomalies in nearshore queen conch is targeting the cerebral ganglia and the effects cascade through the neuroendocrine system to gonad development and shell formation.

KEYWORDS: Florida Keys, gonads, reproduction, shell

Caracterización del Mercado de Tiburón en el Sureste de México

Characterization of the Shark Market in the Southeast of Mexico

Caractérisation du Marché de Requin dans le Sud-est du Mexqiue

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RESUMEN

Los tiburones son considerados reguladores poblacionales y predadores tope en la cadena trófica marina y han sido utilizados como fuente de alimento, empleo e ingresos para muchas comunidades costeras. Debido a la alta demanda del mercado por derivados de tiburón, principalmente aletas y cartílago, estos recursos se han visto amenazados por la creciente presión pesquera. A pesar de su importancia en el mercado nacional, la información existente sobre las fuentes, destinos y patrones de pesca, así como la red de valor de estos productos, es escasa, limitando acciones de manejo y conservación. El presente estudio se enfocó en el análisis de estos componentes. Para esto se utilizaron datos de registros oficiales de mercados, datos de capturas en cinco estados (2006 - 2014) y se aplicaron entrevistas a permisionarios y cooperativas en dos estados. Se realizaron análisis comparativos entre años y estados, y se mapeó el origen y destino de productos derivados de tiburón. Se identificaron 15 géneros de tiburón y un grupo de cazón. Los mayores volúmenes de captura comprenden al género Carcharhinus. Las redes de valor por las que se comercializa el tiburón en el Sureste de México varía entre estados ligeramente, siendo Veracruz el de mayor ingreso económico derivado de la pesca de tiburón y Quintana Roo el de menor ingreso. Campeche vende sus productos localmente, mientras que Veracruz presenta una amplia gama de destinos. Los entrevistados en Yucatán y Veracruz indicaron que el producto se vende local, nacional e internacionalmente, exportando

las aletas al mercado asiático. La principal presentación en la que se comercializa el tiburón en el Sureste de México es el filete y los precios muestran tendencias crecientes en los últimos años.

PALABRAS CLAVE: Sureste de México, mercados, tiburones, tendencias pesqueras, pesquerías

Evaluating the Recovery of a Nassau Grouper (*Epinephelus striatus*) Spawning Aggregation via Length-frequency Analysis from Underwater Laser Caliper Video

Evaluación de la Recuperación de una Agregación de Desove de Mero de Nassau (*Epinephelus striatus*) a través del Análisis de Frecuencia de Talla de un Video con Pinzas Láser Subacuático

Évaluation de la Récupération d'une Agrégation de Fraise de Nassau Grouper (*Epinephelus striatus*) par Analyse de Fréquence de Longueur à Partir d'une Vidéo D'étanchéité Laser Sous-marins In the Cayman Islands

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ABSTRACT

Nassau Grouper (*Epinephelus striatus*) have been historically exploited on fish spawning aggregations (FSAs) until protections were enforced in 2003 to inhibit take on both historical and active spawning sites. Since then a long-term monitoring project has been underway to assess the stock status of Nassau Grouper, an endangered species, on the remaining FSA off of Little Cayman Island and on historical sites in the sister islands of Grand Cayman and Cayman Brac. Here we conducted a length-frequency analysis of a Nassau Grouper spawning aggregation; to do so we used underwater caliper laser video captured in February of 2017. The intent of the research is to understand the size structure of the Nassau Grouper spawning stock to see if the species is recovering, in the form of new recruitment. 2017 length measurements were compiled and analyzed in combination with length data previously compiled during the years 2004-2015. Cumulative frequency distribution results of the first quartile of fish lengths for all years indicate an increase in the proportion of smaller fish in 2017 compared to 2004- a baseline year of recruitment reference as used in Heppell et al. (2012). Furthermore, 2017 calculated values of mean length and size diversity were comparable to previous years of recruitment in 2007 - 2010 as highlighted in Heppell et al., 2012. Therefore, 2017 may constitute a year of small adult Nassau Grouper recruitment.

KEYWORDS: Nassau Grouper, Cayman Islands, spawning aggregation, length-frequency, analysis, recruitment

Ways of Transfer of an Organochlorine Pesticide Along Marine Tropical Food Webs

Voies de Transfert d'un Pesticide Organochloré le Long des Réseaux Trophiques Marins Tropicaux

Vías de Transferencia de un Pesticida Organoclorado a lo Largo de las Redes Tróficas

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ABSTRACT

Chlordecone is a persistent organochlorine pesticide used in the banana fields of the French West Indies, from 1972 to 1993. Three marine habitats (mangroves, seagrass beds and coral reefs) of two study sites located downstream contaminated rivers were chosen to evaluate the level of contamination of marine food webs. Each food chain studied included suspended organic matter, primary producers (macroalgae, algal turf, seagrass), zooplankton, symbiotic organisms (corals, sea anemones), primary consumers (herbivores, suspension feeders, biofilm feeders), omnivores and detritivores (lobsters, fish), secondary consumers (carnivores 1: invertebrate feeders, planktivores) and tertiary consumers (carnivores 2: invertebrate and fish feeders) and piscivores.

Log-linear regressions of the concentrations of chlordecone *versus* nitrogen isotopic ratios ($\delta_{15}N$) were used to assess the bioaccumulation of chlordecone along trophic food webs. On each site, both phenomena (bioconcentration and biomagnification) were active on the transfer of chlordecone in marine organisms. In mangroves (*i.e.* close to the source of pollution), lower trophic magnification factors (TMF) indicated that bioconcentration prevailed on bioamplification phenomenon. In seagrass beds and coral reefs, the opposite phenomenon appeared: bioconcentration processes were less important and bioamplification pathway became dominant. Far from the source of pollution, molecules of chlordecone seemed to be transferred to organisms mostly *via* trophic interactions rather than water contact.

KEYWORDS: Chlordecone, $\delta_{15}N$, bioaccumulation, biomagnification, bioconcentration

Comparative Diet and Trophic Ecology of Red Snapper (*Lutjanus campechanus*), Vermillion Snapper (*Rhomboplites aurorubens*), and Blackfin Snapper (*Lutjanus buccanella*) in the Northwestern Gulf of Mexico

(*Lutjanus buccanella*) in the Northwestern Gulf of Mexico La Dieta Comparada y la Ecología Trófica del Pargo (*Lutjanus campechanus*), del Pargo Bermejo (*Rhomboplites aurorubens*) y del Pargo (*Lutjanus buccanella*) en el Noroeste del Golfo de México

Le Régime Alimentaire Comparé et L'écologie Trophique du Vivaneau Rouge (*Lutjanus campechanus*), le Vermillon des Vivaneaux (*Rhomboplites aurorubens*) et le Vivaneau (*Lutjanus buccanella*) dans le Nord-ouest du Golfe du Mexique

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ABSTRACT

Descriptions of the diet composition, trophic positions, and diet overlap among co-occuring species can provide a framework for management of these species and important habitat resources, particularly for ecosystem-based fisheries management. Collected from the shelf-edge banks of the northwestern Gulf of Mexico from 2015 through 2017, the diets and trophic ecology of 3 Lutanidae species, red snapper (*Lutjanus camprechanus*), blackfin snapper (*Lutjanus buccanella*),

and vermilion snapper (*Rhomboplites aurorubens*), were examined. Stomach contents were identified to determine the diet composition and diet overlap among species. Stable isotopes were used to identify the isotopic niche and overlap among species as a correspondent to define trophic niches. Analysis has yet to be complete, however, some general trends have been noted. Stomach content results have shown a higher contribution of small crustaceans in vermilion snapper compared to red snapper and blackfin snapper. Red snapper and blackfin snapper showed higher contributions of fish and crabs. Stable isotopes results indicate that vermilion snapper feed on a different carbon source than do that of red snapper and blackfin snapper. Red snapper and blackfin snapper were more similar in nitrogen ratios, indicating that they exist in similar trophic levels and that is potential for interspecific competition for prey resources.

KEYWORDS: Trophic Ecology, red snapper, vermilion snapper, blackfin snapper, Gulf of Mexico

Impulsar u Sustentar Procesos de Gestión Ecosistémica en el Caribe: Un Modelo-Piloto Regional en la República Dominicana

Promoting Ecosystem-based Management in the Caribbean: A Regional Pilot-template in the Dominican Republic

Promouvoir e Soutenir les Processus de Gestion Ecosystémique dans le Caribe: Un Model Régional en la République Dominicaine

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RESUMEN

El cartel ilustra los resultados del Proyecto Piloto Montecristi - Puerto Plata (República Dominicana), realizado conjuntamente entre ONU Medio Ambiente y la Agencia Italiana de Cooperación y Desarrollo en alianza con el Ministerio de Medio Ambiente y Recursos Naturales de la República Dominicana. Actualmente este proyecto piloto, focalizado en los espacios de las dos provincias costeras del país, se encuentra en fase avanzada de implementación, lo que incluye el establecimiento de un "modelo piloto" regional de sistema informático, metodologías y mecanismos de coordinación inter-institucional, para enlazar acciones de manejo sectoriales dentro de un marco integrado de Gestión Ecosistémica, creando un sistema de apoyo a la toma de decisiones denominado EBM-DSS. Los principales actores claves institucionales, sociales y económicos de las áreas piloto, se han conformado en un Grupo de Trabajo Interdisciplinario de más de 30 miembros. Durante cuatro ciclos de talleres de análisis participativo, este Grupo ha analizado las características del contexto eco-sistémico costero-marino e interpretado las necesidades locales para un desarrollo sostenible. El proceso de análisis se ha realizado mediante un conjunto de diagramas de casillas y flechas que define la estructura y las interacciones entre los distintos componentes de los sistemas biofísicos y humanos relevantes. También se ha desarrollado y calculado diversos Indicadores específicos, que servirán para lograr poner en marcha el sistema informático EBM-DSS. Este EBM-DSS se utiliza para definir un conjunto de medidas de manejo ecosistémico integrado de los espacios costeros y marinos piloto, y funciona como instrumento de planificación, mecanismo de seguimiento y cuadro de monitoreo de eficacia del proceso de Gestión Ecosistémica.

PALABRAS CLAVE: Gestión Ecosistémica (EBM - Ecosystem-Based Management), sistema de apoyo a la toma de decisiones (DSS - Decision Support System), ecosistemas costeros marinos

Expanding the Collection and Use of Climate Data in the Caribbean

Ampliación de la Recopilación y Utilización de Datos Climáticos en el Caribe

Élargir la Collecte et L'utilisation des Données Climatiques dans les Caraïbes

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ABSTRACT

NOAA's Atlantic Oceanographic and Meteorological Laboratory in Miami, Florida, USA is partnering with the Caribbean Community Climate Change Centre in Belmopan, Belize, CA to expand the Coral Reef Early Warning System (CREWS) monitoring network. CREWS is a network of oceanographic and meteorological monitoring stations situated at coral reef areas around the globe. The monitoring buoys collect near real-time data which are archived at NOAA and made available to the public through the Coral Health and Monitoring Program (CHAMP) www.coral.noaa.gov. The data are used to develop ecological forecasts for coral bleaching, hydrodynamic events, and other marine environmental events of interest to stakeholders including environmental managers, researchers, and the public. Funding support from the Caribbean Climate Change Adaptation and Risk Reduction Initiative was secured in 2017 and is being used to install monitoring stations at specified locations throughout the Caribbean. Project activities include: developing a network of hydro-meteorological stations in the region which will contribute to the World Meteorological Organization's Global Climate Observing System; operating a CREWS monitoring network in the region; generating coastal topographic and bathymetric information; creating a clearinghouse of electronic files of climate change data and information from the Caribbean region; developing evidence-based decision making tools alongside end-users; preparing protocols for the collection of, interpretation and sharing of information. The initiative expands the in situ CREWS monitoring network to improve the understanding of changes in marine conditions for informed management and decision making of shared marine resources.

KEYWORDS: Coral reef ecosystems, real-time monitoring, Caribbean

Lion King: Invasive Lionfish (*Pterois* sp.) Agonistic Behavior Observations

Rey León: Observaciones de Comportamiento Agonístico del Pez León Invasor (*Pterois* sp.)

Roi Lion: Observations sur les Comportements Agonistiques des Poissons Lions Envahissants

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ABSTRACT

Invasive lionfish (*Pterois* sp.) were first observed off southeast Florida in 1985 and are now established throughout much of the northwest Atlantic Ocean, Caribbean Sea, and Gulf of Mexico. Agonistic behavior has been observed in numerous reef fish species, including lionfish in aquaria and in their native range. However, there is a lack of documentation in the literature regarding the agonistic behavior of lionfish in their invaded range, despite several videos having captured aggressive actions. On July 26, 2017, two lionfish were observed at a small coral patch reef in Roatan, Honduras (16°19.783'N, 86°34.383'W) in 17 m of water, exhibiting behavior similar to what has been described in the literature. The

two lionfish were exhibiting what is described as 'high intensity acts' towards each other, including facial contact with the head and flanks of the other lionfish, as well as the venomous dorsal spines making direct contact with the opponent, resulting in several abrasions and punctures to both individuals. These acts of aggression continued at varying levels of intensity for approximately five minutes. The culmination of the agonistic behavior involved the quick retreat of the now subdominant lionfish (faded coloration), under temporary pursuit by the dominant lionfish (remained a darkened color). This documentation of agonistic behavior in invasive lionfish provides further evidence for their behavioral and ecological establishment in the invaded range and may affect future marine research, especially within invaded reef ecosystems.

KEYWORDS: Invasive species, Honduras, Caribbean, agonistic behavior

Best Practices for the Co-management of Offshore FAD Fisheries in Grenada

Buena Practicá para Co-gestión Pesquero en Grenada

Bonne Pratique pour Co-gestion des Pêches des Grenada

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ABSTRACT

Grenada Fisheries Division in collaboration with Japan International Agency have implemented Caribbean Fisheries Co-Management (CAIRIFICO) Project since May 2013. The target site is Grenville, east coast of Grenada, and the target fishery is fish aggregating devices' (FADs) fishing. The project aims to develop and implement the co-management of offshore FAD fishery in sustainable manner.

Grenville FAD Fishers Organization (GFFO) Inc. was registered as a non-profit organization on October 2014. About 120 fishers belong to GFFO and a weekly meeting is continuously held to discuss issues among them today. Several technical trainings such as the FAD design, contraction and deployment, the vertical dropline fishing and the ice box construction were provided during the project. Though those trainings, fishers improved their fishing techniques and the catch of large tunas has increased by approximately 300 % since 2013. In addition, GFFO established financials mechanism for the sustainable maintenance and additional deployment of FADs. All the members pay an annual member fee (XCD 20) and catch fee (XCD 5 per 50 pound), as a result, about XCD 35,000 is deposited in their special account so far.

Co-management activities help uniting fishers and no conflict is observed in Grenville today. The socioeconomic status of offshore fishers was dramatically improved last four years. In addition, the empowerment of fishers spread the vitalization of entire community.

KEYWORDS: Co-Management, FAD, Grenada

Primeras Estimaciones de Niveles de Captura Sostenibles de los Principales Recursos de Escama Ribereña en el Litoral Veracruzano: Un Enfoque Simple Basado en las Capturas

First Estimations of Maximum Sustainable Yield of Main Finfish Fisheries Caught on the Coast of Veracruz: A Simple Catch-based Approach

Premières Estimations du Rendement Maximal Durable des Principales Pêcheries de Poissons sur la Côte de Veracruz: Une Approche Simple Basée sur les Captures

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RESUMEN

En el estado de Veracruz la pesca es esencialmente costera y cuenta con un gran número de personas dedicadas a la actividad. Si bien la flota dirige su esfuerzo a una gran variedad de recursos pesqueros, un grupo importante en términos de volumen de captura son los peces óseos, también conocidos con el nombre genérico de escama. Las capturas anuales de este grupo presentan una tendencia a la baja que prevalece desde finales de los 1990s. La estimación del estado actual de los recursos que conforman este grupo es difícil ya que por lo general estas pesquerías carecen de información suficiente para realizar evaluaciones formales. En esta propuesta se aplica el método simple para estimar la captura al máximo rendimiento sostenible (CMRS) basado en las capturas comerciales e información básica poblacional (tasa de crecimiento intrínseca, capacidad de carga) de alrededor de los 15 stocks de peces más importantes capturados en el litoral veracruzano durante 1990 a 2014 que representan el 90% de la captura total registrada. Se encontró que cerca del 75% de los stocks presentaron capturas anuales promedio cercanas a la CMRS estimada, por lo que pueden catalogarse como pesquerías completamente explotadas; mientras que el resto de los stocks presentan capturas por debajo de dicho valor de referencia, lo que puede ser un indicador de una situación no deseable para dichas pesquerías, entre las que se encuentran los recursos pesqueros lisa y lebrancha, trucha y curvina y bagres.

PALABRAS CLAVES: Pesca de escama, pesquerias con pocos datos, maximo rendimiento sostenible, Veracruz, Mexico

Evaluation of the Satellite Transmitters' Behavior Using ARGOS System Used for Tracking Marine Turtles

Evaluación del Comportamiento de Transmisores Satelitales Usando el Sistema ARGOS Utilizados para el Rastreo de Tortugas Marinas

Évaluation du Comportement des Émetteurs Satellites Utilisant le Système ARGOS Utilisé pour le Suivi des Tortues Marines

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ABSTRACT

Studies of satellite telemetry of sea turtles are relevant to know their biology, so the performance of transmitters for location of individuals is transcendental. The objective of this work was to evaluate the transmission behavior and the location accuracy of satellite transmitters with the ARGOS System. Two Telonics satellite transmitters, model TAM4510-3 were used under controlled conditions and with different configurations: one by stages (CSteps), taking as reference periods of time of the movement stages of the sea turtles, and the other with programming of 24 H on (COpen) for the entire sampling time (12 d). They were placed in open skies and separated 1 m from each other, and the geographical coordinate was obtained with a GPS navigator (EGNOS) from an intermediate point between them for location reference. More than 55% of the signals were of the quality level (NC) 3, the maximum for ARGOS, followed by type 2 and B for both configurations (CSteps, n = 168, COpen, n = 222). Of type 0 were the least. It was observed that NCs with greater location accuracy were type 3, followed by type B and 2 with similar results. For both configurations the largest number of received

messages was registered in slot 3 (06:00 a.m. to 12:00 p.m. local time); While the smallest number was recorded in slot 1 (06:00 p.m. to 12:00 a.m.) for COpen and in slot 4 (12:00 p.m. to 06 p.m.) for CSteps. This information contributes with criteria elements for the spatial analysis of data derived from the ARGOS System, providing a reference of the potential errors that can be expected from the location of individuals tracked with these transmitter models, as well as the periods of better communication with the Satellites

KEYWORDS: Transmitters, performance, evaluation, configurations, sea turtles

Monitoreo de Peces Herbívoros en Ecosistemas Coralinos de República Dominicana Usando las Directrices de la Red Mundial de Monitoreo de Arrecifes de Coral (GCRMN), 2017

Monitoring of Herbivorous Fish in Coral Ecosystems of the Dominican Republic Using the Guidelines from the Global Coral Reef Nonitoring Network (GCRMN), 2017

Surveillence de Poissons Hervibores dans des Écosystèmes Coralliens en République Dominicaine en Utilisant de les Directives du Réseau Mondial de Surveillence des Récifs Coralliens (GCRMN en Anglais), 2017

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RESUMEN

Los arrecifes de coral son uno de los ecosistemas más productivos del planeta. La contaminación y el desarrollo turístico acelerado han resultado en sobrepesca, sedimentación y sobre crecimiento de algas en los arrecifes de Coral, lo que conduce a su deterioro, y una merma en productividad y los servicios ambientales que ofrecen. Siendo estos una fuente de equilibrio medioambiental, recursos y empleo para países insulares, se hace necesario elaborar estudios que determinen las acciones necesarias para mejorar las condiciones de estos ecosistemas, mitigar los efectos del cambio climático y reducir los efectos de acciones humanas.

Para dar continuidad a la documentación del estado de los arrecifes coralinos en la República Dominicana, se hizo un monitoreo donde se evaluó la densidad de peces arrecifales depredadores y herbívoros de seis áreas marinas protegidas alrededor de República Dominicana, en alianza estratégica de Reef Check RD, la Fundación Propagas, la Universidad de Maine, la Pontificia Universidad Católica Madre y Maestra y la Universidad Autónoma de Santo Domingo. Los peces herbívoros ayudan a mantener el crecimiento de algas bajo control, lo cual aumenta la supervivencia de corales juveniles, uno de los aspectos mas importantes para la resiliencia del arrecife. Se contaron, y se estimó el tamaño, de los peces en 120 transectos de 10 x 2 m alrededor del país.

La abundancia relativa de las especies depredadoras y herbívoras amenazadas por la actividad pesquera frente al estado de los arrecifes estudiados se analizó para determinar el impacto de la pesca y acciones (o no) de manejo locales, en comparación con datos de monitoreos de años anteriores.

PALABRAS CLAVE: Áreas marinas protegidas, monitoreo, GCRMN, arrecifes de coral, peces arrecifales

Diferencias Espacio Temporal Relacionadas con la Edad, el Hábitat y la Estrategia Depredadora en el Pez León

Spatial and Temporal Differences Related to Age, Habitat and Predatory Strategies in Lionfish

Différences Spacio-temporelles en Relation avec L'âge, le Choix de L'habitat et la Strategie de Prédation chez la Rascasse Volante

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RESUMEN

El pez león Pterois volitans es una especie invasora exitosa que ha logrado dispersarse ampliamente en el Caribe ocupando diferentes hábitats. Sobre el comportamiento y uso del hábitat de la especie se conoce poco, que son preferentemente activos en horas crepusculares y que durante el día se refugian en cavernas. El presente estudio se centró en identificar la relación de la conducta y talla (edad) del pez león con las características ambientales de su hábitat. Registramos mediante observaciones directas el comportamiento y uso de hábitat de 793 individuos en la costa Maya, Quintana Roo, México. Nuestros resultados identificaron tres actividades y cinco posturas, describiendo por primera vez la postura horizontal para cazar. Demostramos que los peces no son solitarios y pueden presentar actividad nocturna. Observamos diferencias conforme a la edad de los peces león, los juveniles muestran diversidad de conductas en distintos hábitats cazando preferentemente de noche, mientras que los peces más grandes pueden estar activos a lo largo del día y se encuentran en mayor proporción en zonas arrecifales. Nuestro estudio sugiere que estas diferencias pueden estar relacionadas con la depredación y las posibilidades de canibalismo. Esta flexibilidad conductual es una característica más de Pterois volitans que le ha permitido su éxito como especie invasora.

PALABRAS CLAVES: Grupo cacería, refugio, etología, habitat

Involving Fishing Professionals in Lionfish Trap Evaluation

Participación de Pescadores en la Evaluación de Trampas para Pez León

Utiliser les Pêcheurs dans L'évaluation du Piège à Poisson-lion

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ABSTRACT

Recent modifications to lionfish trap designs improve fishing efficiency and make it possible to engage the commercial fishing community in further evaluation. Following successful early tests with prototype traps, a folding "purse" design was developed to reduce size and enable transport of a larger number of traps on fishing vessels. Coupled with a streamlined fish aggregation device (FAD), the purse trap travels vertically through the water column during deployment and retrieval, reducing drag and facilitating fishing operations. The National Marine Fisheries Service in the U.S. is planning to seek further testing and refinements on these FAD-based, non-containment curtain traps by issuing Exempted Fishing Permits to selected fishing professionals who will also evaluate capture proficiency, trap effectiveness in different environments, and several areas of potential risk, including bycatch, habitat impacts, entanglement of marine mammals and turtles, and ghost-fishing. We also expect fishermen will help determine the most appropriate trap construction materials and techniques, gear configurations (ground tackle, harness, lines, and floats) and fishing techniques (e.g., single traps vs. trawls).

KEYWORDS: Lionfish traps, FAD, effectiveness, impacts

Cambios en las Abundancias y el Esfuerzo Pesquero en el Golfo de Salamanca Durante Diferentes Fases de las Operaciones Portuarias Carboníferas

Changes in the Abundance and Fishing Effort in the Gulf of Salamanca During Different Stages of Development of Coal Port Operations

Les Changements dans L'abondance et L'effort de Pêche dans le Golfe de Salamanca au cours des Différentes Phases des Opérations Portuaires de Charbon

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RESUMEN

El golfo de Salamanca (GdeS) constituye un área de importancia pesquera en el mar Caribe de Colombia. Sin embargo, desde la década de los 90 se iniciaron operaciones de almacenamiento y cargue de carbón mineral para exportación, limitando así las actividades de navegación y pesca en esta área. Con el objetivo de evaluar cambios en la captura y el esfuerzo pesquero en el GdeS durante diferentes fases de las operaciones portuarias carboníferas, se realizaron encuestas semiestructuradas a pescadores artesanales de las comunidades costeras del golfo: Tasajera, Puebloviejo, Ciénaga, Aeropuerto y Pozos Colorados. Se indagó sobre el estado actual e histórico de diferentes aspectos de la pesquería artesanal y se compiló información bibliográfica relacionada con estas pesquerías. Se compararon los inventarios de artes, embarcaciones y la composición de especies de la pesca artesanal del GdeS durante el período estudiado. Los resultados indican que los pescadores del GdeS experimentaron una disminución de las abundancias en las capturas en los sitios tradicionales de pesca, lo cual conllevó a desplazarse hacia el margen occidental de golfo, incrementando la distancia promedio a los sitios de pesca (24,62 ± 4,25 mn). En consecuencia, aumentó la duración del viaje de pesca en busca de mayores abundancias del recurso, modificando los caladeros tradicionales y ampliando la frontera pesquera artesanal. Paralelamente, han disminuido los tamaños de malla de las redes de enmalle y han aumentado el poder de pesca, mediante la incorporación de cambios tecnológicos en sus artes y embarcaciones, como estrategias para disminuir las consecuencias derivadas de la disminución de las capturas en las zonas cercanas a las instalaciones carboníferas y las prohibiciones implícitas para ejercer la pesca en estos sitios.

PALABRAS CLAVE: Pesquería artesanal, carbón, golfo de Salamanca, Mar Caribe de Colombia

Spatio-temporal Distribution of *Octopus maya* by Age

Distribución Espacio-temporal de *Octopus maya* por Edades

Répartition Spatio-temporelle de L'âge *Octopus maya*

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ABSTRACT

The knowledge about the distribution of the species and the environmental factors that determine it, are fundamental information for its conservation and sustainable management. The objective of the present study was to determine the spatial-temporal distribution of *Octopus maya* by age group and its relationship with environmental variables. Two-year georeferenced data (2012 - 2014) were obtained from the catch per unit effort and the size structure of *O. maya* catches of the small-scale coastal fleet of the Yucatan peninsula, Mexico. Through a modal progression analysis and a multimodel evaluation method, the best growth model for *O. maya* was determined and a length - age key in terms of probability was constructed. The Boosted Regresion Trees model was used to determine the relationship between the abundance of *O. maya*

and the sea surface temperature, depth, turbidity and season of the year. The results show an important concentration zone of young organisms (2 - 4 months old) off the coast of Sisal and Celestún. *Octopus maya* showed higher affinity at temperatures above 24°C but lower at 30°C in areas with low turbidity and at low depths (< 15 m). These preferences changed according to their age, so it's suggested that population movements may occur in search of conditions suitable for their age. These spatio-temporal variations in the age structure of *O. maya* can affect the catches of commercial fleets, so the present study provides relevant knowledge for the sustainable management of this resource.

KEYWORDS: *Octopus maya*, distribution, growth model, length – age, key, catch-per-unit effort

Contamination of Scleractinian Corals by Microplastics in Guadeloupe Island (Lesser Antilles)

Contaminación de Corales Petreos por Microplásticos en la Isla de Guadeloupe (Antillas Menores)

Contamination de Coraux Scléractiniaires par les Microplastiques en Guadeloupe (Petites Antilles)

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ABSTRACT

Plastics contaminate the oceans worldwide. Microplastics are defined as plastic particles with a size comprised between 2 μm and 5 mm. While the contamination by microplastics of seawater and fish has been well documented, the contamination of corals has only been demonstrated *in vitro*. However, corals are key organisms in reef ecosystems and their contamination by microplastics could represent a critical threat for this environment, justifying an assessment of that pollution in reef habitats.

In Guadeloupe (Lesser Antilles), three sites have been studied to evaluate the level of contamination of Scleractinian corals by microplastics. They were located on the East (windward), West (leeward) and North coasts of the island in order to encompass different marine conditions. In each site, three co*ral colonies belonging to four coral species were collected: Agaricia agaricites, Siderastrea siderea, Porites astreoides* and *Orbicella faveolata*. Living tissues of each sample were dissolved using hypochlorite sodium. Then, microplastic particles were sorted under a binocular microscope and photographed. Image processing was used to count the number of particles of plastics found inside each coral colony and to sort them according to their morphology (fragment, fiber…).

Globally, 87.5 % of the sampled colonies contained microplastics, with a varying proportion of fragments and fibers according to species and sites. The size of the polyps was not significantly related to the level of contamination of the polyps. The site presenting the less contaminated corals appeared to be the most exposed to open oceanic waters and relatively sheltered from coastal anthropogenic activities. This preliminary study has revealed the importance of the contamination of Caribbean reef corals by microplastics.

KEYWORDS: Microplastic pollution, Caribbean, scleractinian corals, coral reef

Primeros Resultados sobre el Estudio del Proceso de Mordida del Mero Americano *Epinephelus morio* Utilizando un Modelo Biomecánico

First Results on the Study of the Bite Process of the American Mero *Epinephelus morio* Using a Biomechanical Model

Premiers Résultats sur L'étude de la Morsure du Mérou Rouge *Epinephelus morio* au Travers de L'utilisation d'un Modèle Biomécanique

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RESUMEN

La comprensión de los mecanismos de la toma de alimento en los peces teleósteos puede lograrse a través del estudio de la morfología funcional. El uso de modelos biomecánicos permite analizar la relación que existe entre las estructuras del sistema músculo-esquelético del cráneo involucradas en la alimentación y su funcionamiento. Con el propósito de caracterizar el proceso de mordida de uno de los depredadores topes de los ecosistemas tropicales y subtropicales, se analizó 14 medidas morfométricas de estructuras músculo-esqueléticas del cráneo de 208 especímenes de mero americano (24.5-73.8 cm de longitud total), capturados en aguas costeras de Yucatán, México. Por medio del uso del programa MandibLever (versión 3.5), el cual se basa en el principio mecánico de la palanca de tercer grado, estas medidas permitieron obtener los valores de las ocho variables biomecánicas más importantes relacionadas con el funcionamiento de la mandíbula de los peces: duración de mordida (Dm; ms), fuerza de mordida (Fm; N), Torque (Tq; Nm), Ventaja mecánica efectiva (Vm), velocidad de cierre (Vc; cm/ms), trabajo (Tb; Nm), poder muscular (Pm; W) y poder (P; W/kg). Los valores de las variables biomecánicas proporcionados por tres de las simulaciones ofrecidas por MandibLever (boca abierta, semi-cerrada y cerrada) fueron analizadas tomando en consideración las dos subdivisiones A2 y A3 del músculo abductor mandibular. Las variables predominantes fueron: Vc y Pm (A2) y Dm, Tb y P (A3) para la boca abierta y semi-cerrada y Fm, Tb y P (A3) para la boca cerrada. La aplicación de un PCA, revelo que solamente cinco de las variables estudiadas (Fm, T, Vc, Tb y Pm) caracterizaron el proceso de mordida del mero americano.

PALBRAS CLAVE: Biomecánica, alimentación, ontogenia, mordida, Epinephelidae

Identifying Key Biodiversity Areas for Marine Vertebrates in the Greater Caribbean

Identificación de Áreas Clave de Biodiversidad para Vertebrados Marinos en el Gran Caribe

Identification des Principaux Domaines de la Biodiversité pour les Vertébrés Marins dans la Grande Caraïbe

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ABSTRACT

Effective allocation of limited conservation resources is important for the preservation of global biodiversity. Well-established protected areas increase the likelihood of preserving species and habitats most at risk of extirpation, but traditional methods of choosing their placement using biological proxies are sometimes inadequate for targeting biodiversity conservation. A methodology for identifying Key Biodiversity Areas (KBAs), determined by specific criteria and thresholds, was proposed in 2016 by International Union for the Conservation of Nature (IUCN). These are founded on the principles of vulnerability and irreplaceability to iteratively identify sites where species and habitats are most urgently in need of protection. KBAs for marine vertebrates in the Greater Caribbean are identified using species-specific threat statuses, distribution, occurrence and population data. A number of KBAs are triggered within the boundaries of existing sites of conservation importance, such as Alliance for Zero Extinctions sites and Important Bird and Biodiversity Areas, while others are identified at sites previously unknown for their potential conservation value. These proposed KBAs

provide spatial biodiversity data for local stakeholders and resource managers to refine plans for regional and national protected area networks to ensure they include sites most important to biodiversity conservation.

KEYWORDS: Key biodiversity areas, marine protected areas, vulnerability, irreplaceability, Caribbean

Composition of Parrotfish (Labridae: Scarinae) in the Parque Nacional Arrecife Alacranes, Southern Gulf of Mexico

Composición de Peces Loro (Labridae: Scarinae) en el Parque Nacional Arrecife Alacranes, Sureste del Golfo de México

Composition de Poissons Perroquet (Labridae: Scarinae) dans le Parc National de Récif Alacranes, Sud du Golfe du Mexique

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ABSTRACT

Parrotfish (Labridae: Scarinae) are ecologically and functionally important species in coral reefs, where their different feeding habits allow them to influence the structure of benthic communities. In this study, we quantified the composition and structure of parrotfish species in the Parque Nacional Arrecife Alacranes (PNAA). This reef is located 130 km off the northern Yucatan Penisula, Mexico, where anthropogenic disturbance is relatively low compared to that in coral reefs in the Mexican Caribbean. We quantified parrotfish structure over two depth ranges: one shallow (1.5 to < 10 m) and one deep (12 and 18 m) in the Leeward and Windward zone, where a total of 14 species were recorded. Parrotfish species presented high abundance and large sizes, where the most abundant were Scarus guacamaia, S. coelestinus, S. coeruleus and Sparisoma viride. Parrotfish in the PNAA seem to be one of the best structured fish assemblages of the Yucatan Peninsula in terms of species richness, abundance, and size.

KEYWORDS: Parrotfish, assemblage, herbivorous fish

Movement and Habitat Use of Whale Sharks (*Rhincodon typus*) Tagged in the Northern Gulf of Mexico

Movimiento y Hábitat de Tiburones de Ballena (*Rhincodon typus*) Embarcados en el Golfo Norte de México

Mouvement et Utilisation D'habitat de Tablons de Bien-vert (*Rhincodon typus*) Tagged dans le Golfe du Nord du Mexique

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ABSTRACT

Whale sharks (*Rhincodon typus*) are typically solitary animals; however, in the northern Gulf of Mexico they form large aggregations at shelf-edge banks during summer. While there is an understanding of their seasonal distribution in the region, knowledge of movements once they leave aggregation sites is limited. Here we report the movements of 44 satellite tagged whale sharks within the Gulf of Mexico from 2008-2014. Most sharks were tagged at an aggregation site off the coast of Louisiana. State-space modeling was applied to movement data to generate most probable tracks and used to

analyze seasonal trends in distribution. Sharks ranged from 4.6-12.2 m total length (n = 44; mean 7.9 ± 0.3 m SE) with a male to female ratio of 5:1. Mean number of days-at-liberty was 97 days (± 15 SE) and all but four individuals remained within the Gulf of Mexico. Shark movements occurred throughout Gulf of Mexico with a net southward movement during cooler months. Additionally, several sharks moved into the Caribbean Sea, demonstrating connectivity among documented aggregation sites in the western North Atlantic Ocean. These broad movements necessitate multinational, cooperative efforts to improve management whale sharks in the western North Atlantic Ocean.

KEYWORDS: Whale sharks, aggregations, *Rhincodon typus*

Preliminary Results of a Fishery Independent Trap Survey of Marine Reserve and Fishing Areas on the South Coast of Antigua

Resultados Preliminares de una Encuesta de Pesca Independiente de la Trampa de la Reserva Marina y de las áreas Pesqueras en la Costa del Sur de Antigua

Résultats Préliminaires d'une Enquête sur les Piétons Indépendants de Pêche de la Réserve Marine et des Zones de Pêche sur la Côte Sud d'Antigua

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ABSTRACT

Fish traps (pots) were used to collect data on reef fish communities inside and outside of a major marine reserve (Cades Bay Marine Reserve) on the south coast of Antigua. The objectives were to: 1) obtain baseline primary data on various fisheries metrics (catch rate, species size, species diversity, catch rate and size for the invasive red lionfish, *Pterois volitans*, etc.) inside the protected area and adjacent unprotected areas; 2) evaluate the effectiveness of the marine reserve as a fisheries management tool; and 3) assess the status of the reef fishery and the impact of fish traps on fish communities. There was no significant spatial variability in the catch rate (kg per trap hauled) ($p > 0.05$) inside and outside the protected area. In most cases, the mean sizes for the main reef fish families (Acanthuridae, Haemulidae, Scaridae, Serranidae, Lutjanidae, etc.,) and the Caribbean spiny lobster (*Panulirus argus*) were not significantly different inside and outside the marine reserve ($p > 0.05$); pooled mean sizes for the various species were generally greater than the size at 50% maturity indicating that growth overfishing was restricted. The sustainability of the trap fishery with respect to mitigating juvenile retention was attributed to previous management strategy of protecting nearshore, shallow juvenile habitats (< 20 m) and shifting fishing effort to deeper, offshore areas (≥ 20 m). This along with the 2013 legislative requirement for biodegradable panels in traps should improve the long-term sustainability of the trap / reef species fishery.

KEYWORDS: Protected area, trap survey, reef fishery, Antigua, fisheries, management

Risk Perception of Diving Among Small-scale Fishers: A Qualitative Risk Assessment

Percepción de Riesgo del Buceo entre Pescadores de Pequeña-escala: Una Evaluación Cualitativa del Riesgo

La Perception du Risque de la Plongée chez les Pêcheurs de Petite Taille: Une Évaluation Qualitative du Risque

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ABSTRACT

In many small-scale fisheries in the Gulf of Mexico as well as in many coastal fisheries around the world, the hookah diving is the fishing method and gear used to harvest high-value species like sea urchin, sea cucumber, queen conch and spiny lobster, among others. However, diving related-accidents such as decompression sickness and carbon monoxide poisoning was associated with the fishing method, causing disabilities and death among small-scale fishers and negatively impact the social and economic status of households and coastal communities. Currently, there is also misunderstanding among fishers concerning diving risks. This study reports using a qualitative risk analysis the fishers perception of the likelihood of undesired health threatening events occur as a result of hookah diving, and the corresponding perceptions of impacts or consequences of such accidents. These risk perceptions were contrasted with actual hookah accidents occurring in the spiny lobster and sea cucumber small-scale fisheries in northeastern ports of the Yucatan coast. According to fishers, decompression sickness is a major problem with a possible likelihood of occurrence and disabilities can result as a consequence. Risk perception among older fishers was higher compared to the younger fishers, as well as, in married divers compared than single divers. In the 2014 - 2015 fishing season, 116 HBO2T to 111 divers were provided during the spiny lobster season and 157 HBO2T for 98 divers during the sea cucumber season. The method allows for identification of priority decisions relevant to the need for appropriate fishing technologies, fishers' capacity building in health precautionary measures, and increased community awareness of possible consequences of current fishing technology.

KEYWORDS: Small-scale fishery, risk assessment, hookah diving, fishers, risk perception

Fisheries Co-management Rules and Regulations: Toward Caribbean Fisheries Co-management Project

Reglas y Reglamentos de Cogestión de las Pesquerías: Para el Proyecto de Cogestión de las Pesquerías del Caribe

Règles et Règlements de Cogestion des Pêches : Vers le Projet de Cogestion des Pêches des Caraïbes

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ABSTRACT

The anchored FADs, Fish Aggregating Devices, which are located around 10-20 miles from shore in Caribbean water and fishers operate for day trip, tend to create a problem of conflict, e.g. congestion of users in Commonwealth of Dominica FADs, owners did not want other fishers to operate around the FADs, furthermore they fought on the land when they returned from sea.

FADs user group and government have been trying to reduce the conflict by the introduction of fishery co-management in Dominica.

A typically defined as a partnership arrangement between government and the local community of resource users (FAO). For instance, six eastern Caribbean Courtiers have practiced FADs Co-management by Caribbean Fisheries Co-management Project (CARIFICO) during 2013 to 2018.

During the project, some of the key issue are highlighted, that is the declaration of its ownership and supporting program for FADs sustainability financially. Consequently, in other words, FADs fisher group and government share the responsibility of managing the FADs by informal fisher's rules and/or formal government's regulations, as well as created its financial mechanisms.

In this poster, assuming that successful co-management level are categorized by the conflict and financial mechanism levels, the six countries case are examined. However, each country are at different stages after the four projects and still progressing, the result could extend to further discussion and improvement of the project, and share in the Gulf and Caribbean Region.

KEYWORDS: Fish Aggregating Devices, FADs, co-management, ownership

Evaluación de la Variabilidad Genética de *Caretta caretta* y *Chelonia mydas,* a Partir de ADN Mitocondrial, Sector Nororiental del Caribe Colombiano

Genetic Variability Evaluation of the *Caretta caretta* and *Chelonia mydas,* from Mitochondrial DNA, Nororiental Sector Colombian Caribean

Evaluation Variabilité Génétique *Caretta caretta et Chelonia mydas*, Basée sur l'ADN Mitochondrial, Secteur Nord Colombien del Caribe

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RESUMEN

Desde el año 2013 el ProCTMM, viene adelantando estudios tendientes a evaluar la variabilidad genética en estadíos juveniles de *Caretta caretta*, provenientes de zonas de anidación de los departamentos de Magdalena y La Guajira y de *Chelonia mydas*, dispuestos a procesos de rehabilitación, a causa de la pesca incidental, mientras transitan por el sector de estudio. Mediante técnicas de frotis bucal y tejido dérmico, se realizaron extracciones de ADN y amplificación de segmentos de 800 bp, usando los cebadores LCM15382 y H950; posteriormente, se secuenciaron e identificaron en Genbank para un total obtenido de 63 secuencias de ADNmt de *C. caretta* y 24 de *C. mydas*. Revelando por primera vez, la presencia de 4 haplotipos para *C. Caretta*: dos de origen basal que definen la presencia de los haplogrupos CC-A1.4 y CC-A2.1 y dos derivados CC-A17.1 y CC-A43.1, registrados a nivel global en regiones del Atlántico oeste, Atlántico este y Mediterráneo, particularmente, en áreas de forrajeo. Para *C. Mydas*, se hallaron 5 haplotipos CM-A1.1, CM-A3.1, CM-A8.1, CM-8.2, CM -A5, siendo este último el más frecuente y ancestral y al igual que los demás, reconocidos en las principales zonas de alimentación y reproducción de Tortuguero, Isla Buck, Isla Aves, Surinam y Brasil. Lo anterior sugiere una alta diversidad genética en el Caribe nororiental colombiano, posiblemente debido a la edad geológica y estabilidad ambiental de la región, la cual proporciona las condiciones adecuadas para sus procesos ecológicos: reproductivos, de desarrollo y desplazamiento en sus rutas migratorias, favorecidas por las macrocorrientes globales y microcorrientes locales, brindándose, información haplotípica relacionada con agregaciones a nivel mundial, destacándose la contribución del lugar, en el mantenimiento de sus colonias anidantes y poblaciones en general.

PALABRAS CLAVE: Caribe colombiano, tortugas marinas, variabilidad genetica, haplotipos, vonservación

Capacity Building in Fishing Communities of the Gulf of Mexico

Promoción de Capacidades en Comunidades Pesqueras del Golfo de México

Renforcement des Capacités dans les Communautés de Pêcheurs dans le Golfe du Mexique

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ABSTRACT

The management of artisanal fisheries, especially those that are part of natural protected areas, must include the participation of fisheries, academic, and governmental sectors, in order to get a real sustainability. The fishery community of Antón Lizardo, Veracruz, Mexico, has made efforts to get a recognized participation in the core of decision of the governmental sector and in the management of fisheries resources, but no success has been obtained. A multidisciplinary group of the Universidad Veracruzana has been working in this community through the establishing of a training program which has two approaches, the enforcement of management skills, and the promotion of good management of artisanal fisheries in natural protected areas. The main achievements showed that all members of two cooperative societies are aware and committed with the conservancy of natural resources, they understand their function in the ecosystems, and they are worry and recognize the necessity of strengthen the team work. These two societies are developing as references and models for other fishery communities. The inclusion of the academic sector, in the development of fishery communities, enforces the management and conservancy actions of resources in natural protected areas, it also provides tools to social actors in order to get a better organization and involvement in the decision making that affect their own benefit and the sustainability of natural resources, in addition to promoting the economic and social development of the region.

KEYWORDS: Tools for fisheries management, artisanal fishing communities, fishing in protected areas, Gulf of Mexico

Some Effects of Hurricanes on Ichthyoplankton in the Upper Mixed Layer

Algunos Efectos de Huracanes en Ichthyoplankton en la Capa Mixta Superior

Quelques Effets des Hurricanes sur Ichthyoplankton dans la Couche Superieure Mixte

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ABSTRACT

In September of 2004 Hurricane Ivan crossed over the continental slope and shelf off Mississippi in the Gulf of Mexico as a category 3-5 storm. The Naval Research Laboratory (Stennis Space Center) located an array of upward beaming Acoustic Doppler Current Meters (ADCP) directly under the path of the hurricane, measuring current profiles, temperature and pressure at the depth of the instruments, and amplitude of acoustic return (echo). In this project, we are evaluating the effects of the resulting intense currents, waves and mixing on ichthyoplankton in the water column due to passage of the hurricane. The ADCP examined here, was deployed from May-October 2004 in ~ 60 m of water depth near the edge of the continental shelf. Significant wave heights of ~ 18 - 20 m and current amplitudes exceeding 200 cm/s were experienced at this site. Echo amplitudes changed dramatically over the entire water column (~ 60 m). Echo amplitude grew rapidly upward from the bottom and downward from the sea surface. Prior to the hurricane passage, clear diurnal signals were evident in echo amplitude in the upper 25 m of the water column. After passage, echo amplitudes in the upper layer were heavily diminished and remained so for the next 6 weeks until termination of mooring deployment, although echo amplitudes from below the mixed layer returned to normal. There is a significant link between echo returns and the presence of ichthyoplankton. Hurricane Ivan had a large impact on an area noted for a strong summer production.

KEYWORDS: Ichthyoplankton, ADCP, hurricanes

NOAA's National Coral Reef Monitoring Program: Integrated Ecosystem Monitoring and Reporting in U.S. Coral Reef Areas to Inform Conservation and Management

Programa Nacional de Monitero de Arrecifes de Coral de da NOAA: Monitoreo e Informes Integrados de Ecosistemas en Áreas de Recife Coral de los Estados Unidos para Informar la Conservación y la Gestión

Le Programme National de Surveillance du Reef Coral de NOAA: Surveillance Intégrée de L'écosystème et Déclaration dans les Zones de Recherche Coral des États-Unis pour Informer la Conservation et la Gestion

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ABSTRACT

The National Oceanic Atmospheric Administration's Coral Reef Conservation Program (CRCP) strives to protect, conserve, and restore coral reef resources, including reef associated fisheries, by maintaining healthy ecosystem function. Since 2013, CRCP has supported the National Coral Reef Monitoring Program (NCRMP) to collect biological, physical, and socioeconomic data throughout the U.S. Atlantic, Caribbean, and Pacific coral reef areas. The overarching goal of this effort is to collect the information needed to gauge the changing conditions of U.S. coral reef ecosystems and support well-informed ecosystem-based conservation and management. NCRMP is a long-term approach to provide an ecosystem prospective via monitoring fish, benthic, climate, and socioeconomic variables in a consistent and integrated manner, to provide information supporting NOAA and our State, Territorial, and other Federal partners efforts to more effectively manage and conserve our nation's coral reefs. NCRMP's fishery-independent surveys gather data on reef fish abundance, size and species to better understand the status of reef fish populations. This work presents our current efforts in Florida, USVI, Puerto Rico and Flower Garden Banks to standardize methodologies and reporting to support the uptake and utilization of this data for management of coral reef fisheries.

KEYWORDS: Coral, reef fish, fishery-independent surveys

Improving Long-term Coral Reef Monitoring in the Wider Caribbean region: GCRMN-Caribbean Accomplishments for 2016

Mejorar el Monitoreo a Largo Plazo de los Arrecifes de Coral en el Caribe: Avances del GCRMN Caribe para el Año 2016

Améliorer le Suivi à Long Terme des Récifs Coralliens dans la Région des Caraïbes : Les Progrès du GCRMN Caraïbes pour L'année 2016

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ABSTRACT

Long-term, robust coral reef monitoring coupled with strategic reporting are essential drivers for ecosystem-based management and regional policy processes. There has been a move towards revitalizing the Caribbean component of the Global Coral Reef Monitoring Network (GCRMN). The foundation for restructuring the network was launched in August 2014, and the first three years of the GCRMN-Caribbean have seen the confirmation of a dynamic network, which has been bolstering its presence and regional acknowledgement. An expert steering committee and members-at-large have enabled the network to achieve substantial progress. GCRMN-Caribbean bio-physical guidelines have been improved and tested at several sites; communication and experience sharing have increased considerably; capacity building actions have been implemented for coral reef practitioners with a special focus on MPA managers; and there has been collaboration with

major Caribbean programmes. This paper reports on the progress of the GCRMN-Caribbean in 2016: the implementation of the GCRMN-Caribbean bio-physical guidelines at different sites (Sint Marteen and Bermuda), the development of socio-economic guidelines for an integrated monitoring approach, and the start of the “Building capacity for coral reef and human dimensions monitoring within the Wider Caribbean" project, within a workshop-based training program to increase regional capacity for integrated bio-physical and socio-economic monitoring. Besides its achievements for the year, this paper also reports on GCRMN-Caribbean network challenges and next steps.

KEYWORDS: GCRMN-Caribbean, coral reef monitoring, bio-physical guidelines, socio-economic guidelines, capacity building

Macroalgal Blooms in the Belize Barrier Reef Complex: Evidence of Long-term Nutrient Enrichment

Bloqueos de Macroalgas en el Complejo de Barreras de Belice: Evidencia de Enricuecimiento a Largo Plazo de Nnutrientes

Macroalgal Blooms dans le Complexe de Barrier do Corail de Belize: Preuve de Enrichissement de Nutriments a Long Terme

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ABSTRACT

Phase-shifts from coral to macroalgal dominated reef systems have been well documented throughout the wider Caribbean region. Although some biologists consider herbivore loss through disease and overfishing to be the causal factor, recent reef surveys in Belize indicated that expanding macoalgal blooms are not related to loss of herbivorous fishes. To assess the possible role of long-term nutrient enrichment, macroalgae from several mangrove and reef sites in the Belize Barrier Reef Complex (BBRC) were re-sampled in June 2017 and compared with previous tissue nutrient (carbon:nitrogen:phosphorus; C:N:P) data collected in the late 1980s. Comparative sampling sites included Man-O-Way Cay, Twin Cays, Tobacco Reef, and Curlew Reef. In addition, the 2017 sampling included collection of macroalgae from a variety of habitats at Glover's Reef that are experiencing macroalgal blooms. The dried macroalgal tissue was processed and analyzed for stable carbon and nitrogen isotopes, as well as C:N:P ratios. The comparative nutrient data showed significant increases in the N:P and C:P ratios at all sites since the late1980s, with parallel decreases in the C:N ratio. These data provide preliminary evidence of long-term nitrogen enrichment of the BBRC, which could explain the expanding macroalgal blooms without loss of herbivorous fishes. Macroalgae in the lagoon and fore reef habitats at Glover's Reef also had high N:P and C:P ratios, suggesting that this offshore location is also experiencing nitrogen enrichment. Stable nitrogen isotope values in the macroalgae were dependent on location, with some sites reflecting enriched values typical of wastewater, and other sites more depleted values typical of nitrogen fixation, fertilizers, and atmospheric deposition.

KEYWORDS: Belize, macroalgae, carbon, nitrogen, phosphorus

Rubia *Ocyrus chrysurus* Capture by the Artisanal Fishery in Antón Lizardo, Veracruz, México

Captura de Rubia *Ocyurus chrysurus* por Pesca Artesanal en Antón Lizardo, Veracruz, México

Prises du Poisson 'Vivaneau Queue Jaune' *Ocyurus chrysurus* par la Pêche Artisanale à Antón Lizardo, Veracruz, Mexique

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ABSTRACT

The rubia, *Ocyrus chrysurus*, has an important predator-prey relationship within the coral reef systems as well as an important economic resource for the artisanal fisheries. Because of this, it is important to evaluate the capture of the artisanal fishery and determine the sexual maturity through their length, weight and sex during a seven months survey in Antón Lizardo, Veracruz. In order to separate the fish according to their sex, male, female and juveniles, 30 individuals of different lengths were selected. Four sexual maturity stages were differentiated: the first for juvenile fish and three for mature, male or female. A total of 201 organisms were captured between March and September of 2016, adults were captured in a higher quantity during May (48) and the least number in June (7), for juveniles, the highest capture was in September (9) and were not present in March and May. The sex ratio was 1:1 and juveniles were only the 15% of all capture. The mean standard length for juveniles was 21 cm and the mean total length was 29.1 cm. For adults (males and females combined) the mean standard length was 29 cm and the mean total length was 40.5 cm. The weight-length relationship for juveniles was W = - 0.573L1.993 and for adults W = - 1.654L2.752 which is a negative allometric type of growth with a b < 3, and which was statistically different between juveniles and adults. The capture per unit of effort (CPUE) was higher in March, May and September, capturing up to 50% of the total with hooks # 4 and # 6. It is recommended to stop using hooks numbers 2, 3 10 and 15 since they target juvenile individuals. In this locality more adults than juveniles were captured between March and September. If this trend continues, probably the juvenile recruitment will be favored at the long term consequently a higher economic gain.

KEYWORDS: *Ocyurus chrysurus,* maturity, sexual allometry, CPUE

Habitat Preference of Sea Cucumber *Isostichopus badionotus* (Selenka, 1867)

Preferencia de Habitat del Pepino de Mar *Isostichopus badionotus* (Selenka, 1867)

Préférence D'habitat du Concombre de Mer *Isostichopus badionotus* (Selenka, 1867)

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ABSTRACT

The sea cucumber *Isostichopus badionotus* is heavily exploited in the Caribbean and Gulf of Mexico. However the knowledge about its ecology is very limited, especially of the factors that influence its distribution. The objective of this work was to determine the habitat preference of I. badionotus. From August 2015 to July 2016 off the coast of the port of Sisal in the northwest of the Yucatan peninsula, Mexico, information of density of organisms per square meter was obtained by means of dive transects. The characteristics of the benthic community were also obtained through analysis of videotransects, as well as granulometry, organic matter content of the sediment, temperature, salinity and dissolved oxygen of thewater of the sea floor and depth. The relationship between habitat variables and I. badionotus presences was examined by assembling distribution models of species such as random forest, artificial neural networks and generalized additive models, among others. The results show a higher probability of presence in areas with green algae coverage, depth greater

than 20 m, temperature between 20 and 24ºC, with high percentage of organic matter in the sediment and coarse grain size. The potential spatial distribution model of I. badionotus shows a greater probability of being present to the northwest of the study area above the 20 m isobath. The results are considered determinants for the design of Fishing Reserves, essential as a measure of conservation and fishery management.

KEYWORDS: Distribution, sea cucumber, fishery model, refuge

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 du Labre Capitaine *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 correspondieron 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.

KEYWORDS: Labridae, dieta, Gulf of Mexico

Exploring Factors Determining the Sensitivity of Reef Fish Assemblages to Ocean Warming

Explorar Factores que Determinan la Sensibilidad de los Ensamblajes de Peces de Arrecife para Calentamiento de los Océanos

Explorer les Facteurs qui Déterminent la Sensibilité des Assemblages de Poissons de Récif de Réchauffement de L'océan

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ABSTRACT

Ocean warming is expected to impact biodiversity and fisheries in the tropics through shifts in species' distributions, leading to local extinctions and changes in species composition of catches. However, regional-scale patterns may differ

from global trends due to in the influence of important environmental factors such as ocean warming and habitat availability. Here we use the Mean Temperature of the Catch to test the hypothesis that, for the period of 1971 – 2010, regional variation in species-turnover of exploited reef fish assemblages among nine Caribbean countries can be explained by differences in the rate of warming, species' thermal preferences and available reef habitat across the region. Sea surface temperature and the mean temperature of the catch displayed rates of increase of 0.14°C/decade and 0.19°C/decade respectively, slightly higher than the global average and more so when compared to the global average for all tropical fisheries. These rates also varied across across the nine countries, ranging from 0.04 – 0.18 °C/decade for sea surface temperature and 0.10 – 0.62°C/decade for the mean temperature of the catch. Four countries displayed asymptotic MTC trends, explained by stark declines in *Scomberomorus regalis*, a species of particularly low thermal tolerance. Finally, model comparisons revealed that the interaction between the rate of sea surface temperature change and available reef habitat best explained regional variation in the rate of change in the mean temperature of the catch. These results suggest that reef fish communities in areas with less available reef habitat may be more sensitive to ocean warming and future decreases in available habitat, driven by climate or human stressors may exacerbate this relationship.

KEYWORDS: Ocean climate, coral reef, fish community, Caribbean, island biogeography

Vulnerabilidad de los Hábitat de las Tortugas Blanca (*C. mydas*) y carey (*E. imbricata*) ante la Actividad Petrolera en la Zona sur del Golfo de México

Vulnerability of Critical Habitats of Green (*C. mydas*) and Hawksbill Turtles (*E. imbricata*) to Oil Activity in the Southern Gulf of Mexico

Vulnérabilité de L'habitat Essentiel de la Tortue Blanche (*C. mydas*) et la Tortue Imbriquée (*E. imbricata*) à L'industrie Pétrolière dans le Sud du Golfe du Mexique

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RESUMEN

En el Golfo de México (GoM) se encuentran hábitats de gran importancia para la reproducción, alimentación y refugio de las tortugas marinas, catalogadas en peligro de extinción. Para preservar estas especies es necesario ejercer acciones para la conservación de sus hábitats, los cuales se han visto afectados por diversas actividades humanas que cambian en su intensidad de impacto y distribución geográfica a lo largo del GoM. En los últimos años la preocupación ha aumentado por la liberación de nuevas áreas para la exploración y extracción de hidrocarburos en aguas someras y profundas en el GoM, por lo que se busca identificar los impactos acumulados de 5 fuentes de presión que afectan a los hábitats de las tortugas marinas blanca (*C. mydas*) y carey (*E. imbricata*) así como cuantificar su vulnerabilidad a las actividades petroleras. Para esto se obtuvo información disponible sobre la distribución espacial de 3 de sus hábitats críticos (arrecifes de coral, praderas de pastos marinos y sargazo pelágico), 5 fuentes de presión que afectan a las tortugas marinas, las áreas contractuales de exploración y extracción de hidrocarburos y las zonas de salvaguarda donde se prohíbe la realización de cualquier actividad petrolera. Se utilizó información de transmisores colocados a 44 hembras anidantes (n = 28 verde y n =16 carey) para determinar sus zonas de agregación y corredores migratorios y se realizó una consulta a expertos en tortugas marinas por medio de encuestas para obtener una jerarquización de las fuentes de presión en las distintas zonas del GoM. Determinar la vulnerabilidad de estos hábitats ayuda a entender cómo son afectados por las actividades humanas y detectar cuales los más susceptibles; esto podría ser utilizado como una herramienta de manejo para la conservación de las tortugas marinas.

PALABRAS CLAVE: Transmisores satelitales, fuentes de presión, arrecifes coralinos, praderas de pastos marinos, sargazo marino

Historical Reconstruction of Red Snapper (*Lutjanus campechanus*) Size-at-Age

Reconstrucción Histórica del la Talla a la Edad del Red Snapper (*Lutjanus campechanus*)

Reconstruction Historique des Red Snapper (*Lutjanus campechanus*) Taille à L'âge

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ABSTRACT

Red snapper have remained an economically important fishery in the Gulf of Mexico since the mid-1800s, and thus have been subject to many years of constant fishing pressure and exploitation. The objective of this study was to examine size and age structure and growth rates of red snapper over time. Previously collected age and growth data (n = 31,445) were examined from 1995 until present in order to preform a multi-decadal size-at-age analysis. Indices such as ENSO events, fishing mortality and spawning stock biomass were used to identify potential trends in the growth across year and age classes. Variation in growth rate coefficients (K) and mean lengths-at-age exist in the data; however, the extent to which ENSO phenomena and/or anthropogenic pressures are sources of these differences is unknown. The information gained from this research will be used in the next benchmark SEDAR assessment for red snapper, and provides critical insight to changing population dynamics for the species over time.

KEYWORDS: Red Snapper, size-at-age, growth, multi-decadal, ENSO

Egg Morphometrics and Fertilization Rates from Recovering and Unexploited Populations: Nassau Grouper and Tiger Grouper in the Cayman Islands

Morfometría de los Huevos y Tasas de Fertilización de las Poblaciones que se Recuperan y Explotadas: Mero de Nassau y Mero Tigre en las Islas Caimán

Morphométrie des Oeufs et Taux de Fécondation des Populations de la Récupération et Exploitées: Le Mérou de Nassau et le Mérou du Tigre dans les Îles Caïmans

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ABSTRACT

Nassau grouper (*Epinephelus striatus*) and Tiger grouper (*Mycteroperca tigris*) are species of reef fish known to form spawning aggregations. Throughout the year, these fish are solitary, posing a challenge for local fisherman, but during their annual mass aggregation they are easily exploited; resulting in declines of many Nassau grouper aggregations throughout their range. This study takes place on Little Cayman Island in the Cayman Islands. The Cayman Islands have passed strong protections for Nassau grouper spawning aggregations, resulting in one of the largest known aggregations being located on Little Cayman Island. Despite protections elsewhere, other aggregations have failed to recover. Some hypothesize that fertilization rates could be a cause of the populations' failure to increase. This study focuses on analyzing the fertilization rates of the grouper populations in Little Cayman from 2014 - 2017 using various methods. A series of statistical analyses were used to evaluate the method of egg collection; compare egg morphometrics between spawning batches, and measure overall fertilization rates. Fertilization rates for Nassau grouper and Tiger grouper, during this time period on Little Cayman, represent an optimal rate for recovering unexploited populations. These rates can be used as a baseline to compare against other populations and to also aid in recovery plans.

KEYWORDS: Nassau Grouper, Tiger Grouper, spawning aggregations, egg morphometry, fertilization rates

Descripción de la Dieta del Pez León (*Pterois volitans*) en el Sistema Arrecifal Veracruzano, Suroeste del Golfo de México

Diet Composition of Lionfish (*Pterois volitans*) in the Veracruz Reef System, Southwestern Gulf of Mexico

Composition D'alimentation du Lionfish (*Pterois volitans*) dans le Système de Verre de Veracruz, Golfe du Sud-Ouest de Mexique

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RESUMEN

El pez león (*Pterois volitans*) es nativo de Indo-Pacífico y ha invadido el Atlántico occidental, desde la costa este de EUA hasta el este de Venezuela, incluyendo el Gran Caribe y el Golfo de México. En 2012 fue registrada por primera vez en el Sistema Arrecifal Veracruzano (SAV) y poco tiempo después se estableció plenamente en este sistema del suroeste del Golfo de México y a la fecha nada se sabe acerca de sus hábitos dietarios en esta nueva distribución. Con el objetivo de determinar el espectro trófico, la amplitud y el tipo de dieta, la contribución relativa por presas y evaluar la variabilidad espacial dentro del SAV de estos descriptores, se analizó el contenido estomacal de 656 individuos de P. volitans capturados de agosto de 2013 a diciembre de 2014 en 18 de los 23 arrecifes que componen al SAV. El intervalo de talla de los peces analizados fue de 9.2 a 40.5 cm LT y predominantemente fueron capturados en la parte sur del SAV. El espectro trófico del pez león del SAV consta de 18 taxa. Su dieta está basada casi exclusivamente en peces teleósteos (96% IIR) y especializada (Bi = 0.071) en *H. burekae* (55% IIR), especie endémica del Golfo de México. La contribución de crustáceos en la dieta es marginal y depende de la talla. Tanto el espectro dietario y especializado, así como el porcentaje de estómagos con al menos un ítem alimentario reconocible (43%), son sustancialmente menores respecto de otros sitios invadidos, lo que sugiere menor disponibilidad de presas probables en el SAV que en otras regiones invadidas. La especialización de la dieta del pez león en el SAV, es completamente contraria a lo documentado en cualquier otra parte del Atlántico occidental, donde se ha determinado que se trata de un depredador eminentemente generalista.

PALABRAS CLAVE: Pez león, alimentación, *Pterois volitans*, sistema arrecifal Veracruzano, xuroeste Golfo de México, especie invasora

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

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

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

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ABSTRACT

In 2014 Oceanus and its partners began implementing a Regional Reef Restoration Program (RRP) with special emphasis on recovering no-take areas to promote recovery of associated species of fish and invertebrates. Restoration techniques developed by Oceanus involve the construction of nurseries planted with coral fragments at selected sites at the Gulf of Mexico and the Mexican Caribbean, and the transplant of thousands of colonies every year. As coral restoration is

labor intensive, the Program includes community involvement for various purpouses: (i) To secure local buy-in for setting up monitoring and scaling up of coral nurseries; (ii) to build local capacities for the continued engagement of local volunteers and personnel; (iii) to promote economic benefit in the short term for the participants and; (iv) for self-sustainability of the progam. Community involvement is managed through a Guide Certification Program. The first restoration community group was trained in Xcalak, Quintana Roo, a small fishing community inside a marine protected area. Participants have received training in restoration techniques and are now carrying out activities montly based on a 5-year strategic program, with the objective of trasplanting at least 1000 colonies every year. To promote economic benefit, they have consolidated a group that will be focus on restoration activities as part of their tourist services, improving infrastructure and service. This initiative is planned to be replicated in the different sites where the RRP is carried out. The consolidation of local restoration teams will help to multiply efforts, increasing restoration sites for recovery of the ecosystem, and generating in paralell, benefits to the comunity and a strategy for self-sustainability of the Program.

KEYWORDS: Restoration, Xcalak, local community, coral reef

Changes in Coral Cover, Coral Size Distribution, and Fish Density in Reef Restoration Sites of the Mexican Caribbean

Cambios en la Cobertura Coralina, Distribución de Tallas de Corales y la Densidad de Peces en Sitios de Restauración de Arrecifes del Caribe Mexicano

Changements dans la Couverture Corallienne, la Distribution des Tailles de Corail et la Densité des Poissons dans les Sites de Restauration des Récifs des Caraibes Mexicaines

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ABSTRACT

Three years ago Oceanus and its partners started a Reef Restoration Program focused on strengthening resilience and the adaptation potential of coral reefs in the Gulf of Mexico and the Mexican Caribbean. The Program involves the transplant of thousands of colonies every year and identification of genetic material from healthy donor populations to increase diversity in restoration sites, thereby promoting natural resilience and resistance to climate change and local stressors. To date it have started efforts in a total of 17 restoration sites. After this time, sites are starting to show visible changes of recovery. Monitoring of transplants has indicated success in survival and growth, which will mean sexual maturity in a short time and subsequent sexual reproduction. Results from initial monitoring in 2017 have shown, that on average, 80% of the transplanted colonies from previous years have survived for more than two years in the restoration sites. Due to the continuous input of new colonies (small sizes), cover of living tissue in each colony ranges from 1.5 cm^2 to 86 cm2 with an average of 17cm^2. According to some authors, size can be an indicator of sexual maturity. In sizes starting from 60 cm^2 of living tissue, colonies are in the first stages of sexual maturity, with 7% of the colony already able to reproduce. According to field results to date, at least 10% of the total of colonies already transplanted, at least in Xcalak, are in this stage. After achieving that size, every additional year of growth, the proportion of the colony that spawns will increase according to maturity. Sexual reproduction of transplanted colonies is the ultimate goal, as it will start the multiplier effect of restoration, sending hundreds or thousands of genetically diverse larvae and recruits to new sites on the reef.

KEYWORDS: Restoration, coral reef, coral growth, fish density, coral cover

Línea Base Biológica para Zonas de Recuperación Pesquera en el Caribe de Honduras

Biological Baseline for Fishing Replenishment Areas in the Honduran Caribbean

Ligne de Base Biologique pour les Zones de Conservation des Pêches dans les Caraïbes du Honduras

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RESUMEN

Comunidades pesqueras del Caribe hondureño, en su preocupación por el declive de sus pesquerías, han propuesto proteger áreas que ayuden a la recuperación del recurso marino declarando zonas de recuperación pesquera (ZRP). Con el fin de respaldar esta iniciativa, se previó la necesidad de levantar una línea base biológica del recurso marino en las áreas a declarar, en donde, se utiliza un protocolo que evalúa el estado del recurso, siguiendo criterios biofísicos, indicadores biológicos y conocimiento tradicional de las comunidades pesqueras. Este protocolo ha sido aplicado en dos áreas del país: Utila y Roatán, los resultados reflejan que las familias de peces loros (Scaridae) son los más abundantes sobrepasando la media de la región, posicionando a este grupo según el índice de la salud Arrecifal (ISA) en categoría de "Muy bueno". así mismo, las especies comerciales importantes para la pesca, cuentan con un ISA en estado "Critico", debido a una presión de pesca. Sin embargo, se determinó en acuerdo con las comunidades pesqueras en proteger las especies de langosta espinosa (*Panulirus argus*), caracol reina (*Lobatus gigas*) y pepino de mar (*Holothuria mexicana*) determinándolas como especies focales, ya que las áreas propuestas para ZRP cuentan con hábitat marinos ideales para sitios de agregación y crianza para dichas especies. Con un manejo adecuado, se podrá alcanzar el efecto de desborde deseado que beneficiará económicamente a las comunidades pesqueras aledañas. Los resultados de este estudio de línea base biológica, ayudará a determinar a través del tiempo con monitoreos biológicos comparativos, si la acción de manejo de la ZRP está ayudando a la recuperación del recurso marino de la zona.

PALABRAS CLAVE: Hábitats marinos, ecología marina, caribe hondureño, especie de interés commercial

Financial Sustainability of the Fishing Replenishment Zones of Guanaja, Bay Islands

Sostenibilidad Financiera de las Zonas de Recuperación Pesquera de Guanaja, Islas de la Bahía

La Viabilité Financière des Domaines de la Pêche, de Récupération Guanaja Bay Islands

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ABSTRACT

Aware of the ecological and economical importance of the marine ecosystems, fishermen via alliances with stakeholders are implementing actions in order to achieve the creation of a network of Fishing Replenishment Zones (FRZ). This zones are permanent protected species in which any type of extraction or captures are prohibited, possess diversity of marine species and constitute the optimal habitat for the reproduction, growth and refuge. This prohibition allows that after a certain period of time of effective protection, fish grow in size and number, and having such an increase in fishes, this migrate to other areas; generating a spillover effect. A big challenge for the management of the FRZ that are being stablished in the country is the financial topic. An identified opportunity is the "Ecotax", create by the country's National Congress. This Ecotax finances the protected areas and wildlife fund (FAPVS according Spanish acronym), administered by the National Forestry and Conservation Institute (ICF). This fund is meant to finance management and conservation initiatives of the country. In Guanaja, which features two FRZ with an area coverage of 15.63 km^2, enabled the establishment of an environmental fund. This fund stems from the voluntaries contributions of tourists that visit the island (USD$10/p). Of the total recollected, 33% goes to BICA, 33% for the EMU, 33% for the groups of organized fisherman and 1% for administrative expenses. The environmental fund finances the following activities: implementation environmental educa-

tion program at 5 educational centers; support 260 marine patrols; and strengthening of two fishermen´s associations. In order to further promote the environmental fund is of the upmost priority to perform studies on economic viability or the FRZ in its different productive sectors.

KEYWORDS: Ecological, economical, fund, productive fisherman

Reproductive Biology of Striped Mojarra *Eugerres plumieri* (Cuvier, 1830) in the Cordoba Caribbean Sea, Colombia

Biología Reproductiva de la Mojarra Rayada *Eugerres plumieri* (Cuvier, 1830) en el Mar Caribe Cordobés, Colombia

Biologie de la Reproduction de Striped Mojarra *Eugerres plumieri* (Cuvier, 1830) dans la Mer des Caraïbes de Cordoba, Colombie

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ABSTRACT

Reproductive ecology of Striped mojarra *Eugerres plumieri* in the Cordoba´s Caribbean Sea, Colombia, was studied. 405 Individuals with total length (TL) ranged between 10.0 and 35.7 cm and total weight (TW) ranged between 11.6 and 740.0 grams were collected. The gonads were placed in Gilson solution, the Holden & Raitt scale was applicated and sexual proportion, maturity index, spawning season, length at first maturity, ovocites's diameter and fecundity were estimated. 229 females, 151 males and 25 undifferentiated were found, with sexual proportion female: male 1.5:1, differently than expected, and sexual dimorphism in size, since females reach larger sizes than males. Length at first maturity was estimated in 20.3 cm TL for both sexes, similar value to the length at first maturity estimated for the species in the Cienaga Grande de Santa Marta, Colombia. Several sizes of oocytes were found, with average diameter of 344 microns for mature oocytes and average fecundity was estimated in 300,000 oocytes by spawning batch. The results achieved suggest that Striped mojarra is a fish whose spawning season extends during the year with partial spawning, small oocytes and high fecundity associated to the ovaries´s weight.

KEYWORDS: Sexual maturity, fecundity, spawning season, reproductive ecology

Structure and Functioning of the Trophic Web of Gulf of Salamanca, Colombian Caribbean

Estructura y Funcionamiento de la Red Trófica del Golfo de Salamanca, Caribe Colombiano

Structure et Fonctionnement de la Web Trophique du Golfe de Salamanque, Colombien Caraïbes

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ABSTRACT

A mass-balance model (Ecopath) of 19 components was elaborated for the gulf of Salamanca, based on the AUNAP landings information for 2013 and discards of trawls operating in the gulf. The consumption and production of the components were derived from the 1997 model. Structural and functional changes were evaluated in the trophic network that have occurred in the last two decades with the help of estimates of biomass, trophic levels, 15 ecosystem attributes and mixed

trophic impact. This suggests changes in the structure and function of gulf of Salamanca, related to the reduction of biomass, trophic levels and loss of maturity. It has consequences in the stability of the system and the capacity of withstand natural or man-made alterations. The detritus exerts bottom-up control in the trophic network due to the impacts that it has in the ecosystem. The artisanal fishery operating in the Gulf has more impacts on the upper part of the food web, noting that the impact of artisanal trawling is localized and generates less impacts than other types of gears (e.g. gillnet).

KEYWORDS: Gulf of Salamanca, trophic web, Ecopath with Ecosim, ecological attributes

Towards a Participatory Management Model Through an Advisory Fishery Council: The Case of the Gulf Corvina in the Gulf of California

Hacia un Modelo de Manejo Participativo a través de un Comité Consultivo: El Caso de la Curvina Golfina en el Golfo de California

Vers un Modèle de Gestion Participative à travers un Comité Consultatif : Le Cas du Acoupa du Golfe dans le Golfe de Californie

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ABSTRACT

The gulf corvina (*Cynoscion othonopterus*) fishery captures an endemic fish of high social and economic importance in the Upper Gulf of California. This fishery has gone through important changes since the implementation of rights-based management (RBM) in 2011, including the establishment of an Advisory Corvina Fishery Council. The analysis showcased in this presentation comes from the yearly surveys that EDF de Mexico implements in each of the four communities participating in the fishery. These surveys collect data on fishing costs and revenue, commercialization, subsidies and other government programs, as well as fishermen's perceptions on the corvina fishery's management, governance and biological performance. Our analysis shows that respondents perceive that RBM has brought about social and economic benefits, even if there are still opportunities for improvement. In the context of these results, we discuss the role of the Advisory Corvina Fishery Council as an example of governance body, and as a stakeholders participation model that could be used in other regions of Mexico and particularly in the Grouper fishery of the Yucatán Peninsula.

KEYWORDS: Governance, finfish, small-scale fisheries, rights-based-management

Caracterización de las Operaciones de Pesca de una Flota Multi-específica: Caso de Estudio en Sisal, Yucatán, México

Fishing Operations Characterization of a Mixed Fleet: Case Study at Sisal, Yucatan, Mexico

Caractérisation des Opérations de Pêche d'une Flotte Multispécifique: Cas D'étude à Sisal, Yucatan, Mexique

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RESUMEN

Las pesquerías artesanales son multi-especies y multi-artes, que se realizan principalmente en países en desarrollo. A pesar de su naturaleza multi-específica, su evaluación y manejo han sido con un enfoque uniespecífico, el cual no siempre ha sido exitoso. La evaluación y el manejo de este tipo de pesquerías son complejos por la diversidad de especies objetivo y

el uso de múltiples artes de pesca. Con el fin de entender la dinámica de estas pesquerías se ha desarrollado el enfoque de métiers, que son una combinación de arte de pesca, ensamblaje de especies y sitio de pesca. Lo anterior contribuye a entender la complejidad de este tipo de pesquerías. En este estudio se analizan las operaciones de la pesca artesanal en Sisal, Yucatán, México para entender su dinámica. De agosto de 2016 a julio de 2017 se obtuvieron datos para: 1) conocer la percepción de los pescadores sobre sus actividades de manera global a través de entrevistas estructuradas; y 2) caracterizar las operaciones de pesca usando entrevistas semi-estructuradas mensuales durante los desembarques. Destaca en los resultados, que los pescadores coinciden en que la abundancia y talla de las tres especies que históricamente han contribuido con los mayores volúmenes y divisas han disminuido. El mayor número de especies (21) fueron capturadas con cordel. Los viajes de pesca con jimba-cordel presentaron el mayor tiempo de pesca, mientras el uso de palangre se dio en zonas de mayor profundidad. Los mayores costos de viaje e ingresos fueron con palangre. Los resultados de este estudio resaltan la dinámica y complejidad de una pesquería multi-específica, donde el enfoque basado en métiers mostró ser apropiado. Se discute sobre la utilidad de dicho enfoque en el monitoreo de las operaciones de pesca y por ende la evaluación y manejo de pesquerías multi-específicas.

PALABRAS CLAVE: Pesca artesanal, multi-especies, multi-artes, métiers, México

Driving Market Demand Toward Sustainable Seafood Products

Empujando a Demanda del Mercado hasta el Pescado Sustentable

Demande de Conduite vers des Produits de Fruits de Mer Durables

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ABSTRACT

Since the global commercial fishing industry adopted large-scale, industrial level fishing techniques and technology in the 1970s, a majority of global fish stocks have been overfished or are subject to overfishing. Although there has been many positive steps taken by national governments and multinational regulatory bodies to combat overfishing of target species and non-target species, regulatory policy has proven a timely and expensive process in making the global fishing industry more sustainable. As with many other environmental issues, a market based approach is necessary in helping expedite change. Consumers hold significant clout in driving demand that places positive pressure on commercial fisheries and the bodies regulating them to instill more sustainable fishing practices. Unfortunately, quality, price, and geography, not sustainability, are currently the major drivers in purchasing behavior among consumers. The majority of consumers don't understand how the seafood products they purchase violate their concerns regarding marine sustainability. Awareness and sustainable seafood marketing campaigns should increase their focus on educating the consumer more on the specific reasons behind why certain products are sustainable (or unsustainable), e.g. how gear types affect target and non-target species. Presenting the consumer with this sort of information will aid in creating a strong post-exposure preference that influences purchasing behavior.

KEYWORDS: Demand, consumer, sustainable seafood, education

Contributions to the Diversification of Artisanal Fisheries in the Marine and Coastal Area of the Department of Magdalena, Colombian Caribbean

Aportes a la Diversificación de las Pesquerías Artesanales en el Área Marina y Costera del Departamento del Magdalena, Caribe Colombiano

Des Contributions à la Diversification de la Pêche Maritime Artisanale et de la Zone Côtière Département de Magdalena, Caraïbes Colombiennes

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ABSTRACT

In the Colombian Caribbean, most artisanal fisheries are at maximum exploitation or over-exploited levels. Therefore, the future development of the artisanal fisheries sector should focus on the search for new fishing resources and alternative fishing techniques that make its exploitation economically attractive without jeopardizing its sustainable exploitation. One of the most relevant problems of artisanal fisheries in the Department of Magdalena is the lack of technology related to fishing activity. The objective of the project was to evaluate the potential of deep fishes and crustaceans (100 - 400 m) as an alternative for artisanal fisheries development in the Department of Magdalena. It was found a potential fishing resource that can be constituted as an alternative of artisanal fishing development. However, it requires the acquisition of capture technology equipment such as Echo sounder, GPS and mechanized gears to access these deep-water resources by artisanal fishing.
Link: https://youtu.be/DpmM-EepDPM

KEYWORDS: Atisanal fishing, deep-sea resources, technology, Caribbean, Colombia

Evaluation of Energy Efficiency in the Process of the Brown Sea Cucumber in Yucatán

Evaluación la Eficiencia Energética en el Proceso del Pepino de Mar Café en Yucatán

Détermination de Lefficacité Énergétique dans le Processus de Décoction de Bêche-de-mer en Yucatan

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ABSTRACT

Energy efficiency of butane gas consumption was determined. The data were collected were during processing a batch of 374 kg of brown sea cucumber, Isostichopus badionotus, in a fishing cooperative in the state of Yucatan. Based on these data, it was calculated that the total heat, for heating the cooking water and cook sea cucumber, was approximately 67,370 kcal. By comparing these data with real-butane gas consumption, in the practice were consumed 12.64 kg and theoretically requires 6.33 kg of butane gas. Finally, it was shown that there is an energy loss of about 50% mainly due to heat dissipation to the environment because of rudimentary systems for cooking.

KEYWORDS: Sea cucumber, *Isostichopus badionotus*, energy efficiency

The New Gulf and Caribbean Research-GCFI Partnership: A Peer-reviewed, Open Access option for Publication of GCFI Manuscripts

La Nueva Asociación entre Gulf and Caribbean Research y GFCI: Una Opción Revisada por Pares y de Acceso Abierto para la Publicación de Manuscritos del GFCI

Le Nouveau Partenariat entre Gulf and Caribbean Research et GFCI: Une Option D'accès Libre, Évaluée par des Pairs, pour la Publication des Manuscrits GFCI

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ABSTRACT

Peer-reviewed publication of work presented at annual GCFI meetings is important for many GCFI members. Thus in 2017, GCFI initiated a partnership with the Gulf and Caribbean Research (GCR) journal for publication of peer-reviewed, Open Access articles. The GCR was founded in 1961 by Gordon Gunter as a publication of the Gulf Coast Research Laboratory and was titled Gulf Research Reports; that name persisted through 1999. The name was changed to Gulf and Caribbean Research in 2000 to better reflect the scope of manuscripts, and the journal was published in traditional hard-copy format through 2013. GCR migrated to a fully online delivery platform in April 2015 (http://aquila.usm.edu/gcr/) and offers a hybrid publication format: 1) Open Access for a fee; or 2) the abstract only available online for no fee. GCR focuses on coastal and marine resources from the Gulf of Mexico and Caribbean Sea; ~75% of the papers published are on fisheries-related topics and 25% are from the Caribbean area including Mexico. All papers published since 1961 (n = 511) have functional doi's; papers from the most recent five years of publication are available for a nominal charge, while all earlier papers are Open Access. In 2016, GCR published the first in a series of Open Access invited articles from eminent senior scientists with a significant history of research in the Gulf of Mexico and Caribbean Sea called 'Ocean Reflections.' The first GCFI Partnership article was published in July 2017, and three more Partnership articles are currently in review. Submission of articles based on GCFI presentations for peer-review and free Open Access publication is available to all GCFI members in good standing.

KEYWORDS: Gulf and Caribbean Research, GCFI, partnership

The Effects of Hard-bottom Habitat Degradation on the Ecology and Biology of the Florida Stone Crab *Menippe mercenaria* from the Florida Keys

Los Efectos de la Degradación del Hábitat del Hábitat en la Ecología y la Biología del Cangrejo de Piedra de Florida *Menippe mercenaria* de los Cayos de la Florida

Les Effets de la Dégradation de L'habitat du Fond dur sur L'écologie et la B crabe de Pierre de la Floride *Menippe mercenaria* des Florida Keys

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ABSTRACT

The stone crab *Menippe mercenaria* supports one of the most economically important fisheries in the southeastern United States, with Florida leading overall landings. Hard-bottom in the Florida Keys is an important habitat for Florida stone crabs and is characterized by a porous limestone substrate covered by sponges, octocorals, macroalgae and a thin layer of sediment. Over the past three decades cyanobacteria blooms have periodically occurred in Florida Bay, resulting in mass sponge mortalities. Mostly juvenile and young adult *M. mercenaria* are predominantly found residing in hard-bottom in solution holes and under loggerhead sponges *Spheciospongia vesparium*. Blooms have decimated populations of this

sponge and the loss of habitat appears to affect the population structure and condition of the stone crabs that reside in impacted areas. Our research is examining the effects of hard-bottom degradation on stone crab nutritional condition, population size structure, site fidelity and whether *M. mercenaria* use chemical cues from sponges or macroalgae to navigate their home range. The results of this study will increase our understanding of the effects of habitat degradation on an important member of the benthic community in the Florida Keys.

KEYWORDS: Stone crab, Florida, habitat degradation

Procesamiento del Pepino de Mar en la Costa de Yucatán y sus Implicaciones en el Manejo de la Pesquería

Processing of Sea Cucumber on the Coast of Yucatan and Its Implications on the Fishery Management

Procesamiento du Pepino de Mar sur la Côte de Yucatán et ses Implications dans la Gestion de la Pesquería

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RESUMEN

Se analizan diferentes técnicas de procesamiento del pepino de mar *Isostichopus badionotus* empleadas en la costa de Yucatán durante el desarrollo de la pesquería de esta especie. Se presentan los cambios en las tallas y pesos durante las etapas de su procesamiento, así como las fórmulas para su conversión. Los datos del presente trabajo provienen de experimentos realizados durante las temporadas de pesca 2011 y 2012, así como de mediciones en ejemplares frescos y procesados durante el periodo 2010 a 2017. Los rendimientos del peso entero al peso eviscerado pueden variar de 62 a 67%, mientras que del peso eviscerado al primer cocimiento varían de 24 a 30%, y del eviscerado al salmuerado de 18 a 20%. En esta tercera etapa, si los ejemplares se salan sin permitir que se forme el agua de sal, se obtiene un rendimiento de 22.5 a 23.3% a partir del peso eviscerado. La etapa final del procesamiento, el secado, da un rendimiento de aprox. el 7%. Se recomienda estandarizar el método de procesamiento que permita obtener el mejor rendimiento sin afectar la calidad y establecer una talla y pesos mínimos para su exportación en estado seco. Para el control de las exportaciones de ejemplares en estado seco, se recomienda una talla mínima de 7 cm de longitud dorsal o 6 cm de longitud ventral, con un peso mínimo de 12 g.

PALABRAS CLAVE: Pepino de mar, técnicas de procesamiento, relaciones talla-peso, manejo pesquero, Yucatán

Healthy Fisheries Need Healthy Fishermen: An Overview of the Work-related Health Problems of the Artisanal Diving Fishermen of Yucatan, Mexico

Las Pesquerías Saludables Necesitan Pescadores Saludables: Una Visión General de los Problemas de Salud Relacionados con el Trabajo de los Pescadores Artesanales de Yucatán, México

Les Pêches Saines Ont Besoin de Pêcheurs en Bonne Santé: Un Aperçu des Problèmes de Santé Liés au Travail des Pêcheurs de Plongée Artisanale du Yucatan, Au Mexique

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ABSTRACT

Small-scale fishermen of the state of Yucatan, Mexico use surface supplied compressed air via hookah systems in order to dive and increase their catches to support their livelihoods. Using this hookah technology, they are able to extract greater catches and exploit novel fisheries, but they also dive beyond accepted safety guidelines leading to decompression sickness (DCS). As many as 75% of Yucatan fishermen will suffer from DCS, with permanent disability and death in the most severe cases. Although these dangers are present year-round, the sea cucumber fishery, begun in the past several years for the export market, has proven highly lucrative yet highly dangerous for these fishermen with many cases of both disabling DCS and death. We illustrate not only the diving behavior and health problems of the fishermen, but also the logistical challenges in providing effective treatment. Additional health risks arise from locally manufactured air compressors that often contain significant amounts of oil in the volume tanks in excess of safety standards as well as no system for separating the compressor air intake and exhaust, leading to carbon monoxide poisoning. In 2014, an intervention to separate intake and exhaust gases was implemented aboard seven boats in Rio Lagartos. During subsequent visits, we observed fishermen's recognition of this health risk and the proliferation of the gas separation system throughout the fleet. Future studies will focus on behavioral interventions that we hope will lead to improved diving practices and fewer cases of diving injuries and fatalities.

KEYWORDS: Artisanal fishery, sea cucumber, dive, medicine, healthcare

Helmintos Parásitos de *Lutjanus campechanus* (Poey, 1860) en la Zona Central del Estado de Veracruz, México

Helminth Parasites of *Lutjanus campechanus* (Poey, 1860) in the Central Zone of the State of Veracruz, Mexico

Helminthes Parasites de *Lutjanus campechanus* (Poey, 1860) dans la Zone Centrale de L'état du Veracruz, Mexique

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RESUMEN

El huachinango, *Lutjanus campechanus* (Poey, 1860) es una de las especies de mayor importancia comercial, siendo el principal componente de la pesquería de lutjanidos a lo largo de la plataforma continental del Golfo de México. A pesar de ser una especie de relevancia biológica y un recurso valioso de pesca en la región, su helmintofauna parásita a escala local es poco conocida en comparación con otras especies de lutjanidos. Por tanto, en este trabajo determinamos la composición de especies parásitas de *L. campechanus* capturados por la pesca artesanal en la barra de Chachalacas, Veracruz, en el sur del Golfo de México. Se examinó el tracto digestivo (estómago e intestino) de 22 individuos. Para el procesamiento del

material biológico se aplicó la técnica parasitológica acorde al grupo de parásito encontrado. Se realizó la identificación y descripción taxonómica de los parásitos y se calcularon os parámetros ecológicos en parasitología: prevalencia (P), intensidad promedio de infección (I) y abundancia (A). lSe colectaron 155 helmintos parásitos pertenecientes a 10 especies, de las cuales 3 son trematodos, 2 cestodos, un acantocéfalo y 4 nematodos. El trematodo *Metadena* sp. fue la especie con mayor prevalencia y abundancia, representando el 72% de los helmintos colectados, seguido por el nematodo *Hysterothylacium reliquens* (10%). Ocho de las 10 especies de helmintos se registran como adultos en el intestino, indicando que actúa principalmente como hospedero definitivo, aunque para *Anisakis* sp.; *Hysterotylacium* sp. y el acantocéfalo *Serrantis sagittifer* actúa como hospedero intermediario. La presencia de larvas de nematodos podría suponer un problema de zoonosis en la región. El registro de estos parásitos se asocia a los hábitos alimenticios del hospedero debido a que todas las especies son transmitidas tróficamente.

PALABRAS CLAVE: Helmintos, *Lutjanus campechanus,* Veracruz

Un Enfoque Multi-institucional para Modelos Bioeconómicos Pesqueros en Cuba

A Multi-institutional Approach to Bio-economic Fishery Models in Cuba

Une Approche Multi-institutionnelle pour des Modèles Bioéconomiques pour la Pêche à Cuba

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RESUMEN

Los ecosistemas marino-costeros y la biodiversidad en Cuba sustentan la actividad de alrededor de 10,000 embarcaciones y 50,000 personas relacionadas con la pesca repartidas en cuatro zonas pesqueras. Se pescan invertebrados de alto valor comercial como la langosta y el camarón rosado, junto con más de 50 especies de peces y condrictios de importancia comercial. Al mismo tiempo, administradores y científicos reconocen que la mayoría de stocks en Cuba están agotados. Además, el incremento del turismo y el desarrollo costero aumentan la presión sobre estos recursos y su hábitat. Estos factores ponen en riesgo la salud de los ecosistemas marino-costeros de la isla de los que depende el futuro de la economía de comunidades costeras y de la industria pesquera. Por estas razones, se creó un grupo de trabajo multi-institucional para aplicar un modelo bioeconómico que evalúe reformas de manejo pesquero que permitan recuperar stocks agotados, alcanzar metas de producción y de conservación. Se utilizó una versión adaptada al contexto cubano del modelo bioeconómico upside con parámetros específicos para pesquerías prioritarias incluyendo estimaciones de mortalidad por pesca atribuida a pesca ilegal, para estimar estado actual y beneficios potenciales de captura, ganancia económica y biomasa, contrastando distintos escenarios de manejo. Se comenzó con un modelo piloto en la plataforma suroriental donde se captura el 40% de la producción total de escama. Los stocks priorizados se escogieron a partir de un estudio de Productividad y Susceptibilidad. Los resultados obtenidos ayudarán a trazar una visión del potencial de pesquerías multi-específicas con la aplicación de reformas de manejo sustentables.

PALABRAS CLAVE: Modelo bioeconómico, Cuba, multi-institucional pesquería, sustentable reforma manejo

Metazoarios Parásitos de *Sardinella aurita* (Clupeiformes: Clupeidae) en la Costa Central del Estado de Veracruz, México

Metazoan Parasites of *Sardinella aurita* (Clupeiformes: Clupeidae) in the Central Coast of the State of Veracruz, Mexico

Métazoaires Parasites de *Sardinella aurita (*Clupeiformes: Clupeidae) sur Létat de la Côte Centrale de Veracruz, un Mexique

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RESUMEN

Se examinaron las branquias y tracto digestivo de 54 ejemplares de S. aurita capturados por la pesca artesanal en Chachalacas, Veracruz; para determinar sus metazoos parásitos, analizar sus niveles de infección y discutir las posibles causas del establecimiento de la relación parásito-hospedero. Las muestras se fijaron en formaldehído al 10% para su posterior análisis en el laboratorio. La extracción y procesamiento de los parásitos se realizó de acuerdo a las técnicas establecidas. La determinación taxonómica se llevó a cabo con literatura especializada para cada grupo de parásito. Para caracterizar las infecciones se determinaron los patrones ecológicos de prevalencia, abundancia e intensidad media propuestos por Bush et al. (1997). Todos los especímenes de *S. aurita* estuvieron parasitados por al menos una especie de metazoario parásito. Se obtuvieron 3112 individuos pertenecientes a cuatro especies: un monogéneo, dos digéneos y un copépodo. El digéneo *Aphanurus* sp. fue la especie con mayor prevalencia y abundancia, representando el 59% de los metazoarios parásitos colectados. Así mismo, registró los valores más altos de prevalencia e intensidad media de infección (100% y 34 ± 15 gusanos por hospedero parasitado, respectivamente), seguido por *Hemiurus* sp. con el 96% y 22 ±12 gusanos por hospedero parasitado, respectivamente. La composición de metazoarios parásitos de *S. aurita* es similar a lo registrado en otros peces clupeidos, en donde digéneos endoparásitos destacan cuantitativamente. La alimentación de *S. aurita*, la cual está predominantemente compuesta por copépodos zooplanctónicos, puede favorecer la transmisión de estos parásitos, que muchos de ellos actúan como hospederos intermediarios de digéneos. Con este estudio, aportamos información sobre los metazoos parásitos de S. aurita para el Golfo de México.

PALABRAS CLAVES: Helmintos, monogéneos, digéneos, copépodos, Golfo de México

Direct Assessment of Biomass, Spatial Distribution, and Current State of Southern Pink Shrimp Fishery (*Farfantepenaeus notialis*) in the Colombian Caribbean

Evaluación Directa de la Biomasa, Distribución Espacial y Estado Actual de la Pesquería del Camarón Rosado (*Farfantepenaeus notialis*) en el Caribe Colombiano

Évaluation Directe de la Biomasse, de la Distribution Spatiale et de L'état Actuel de la Pêche au Sud de la Crevette Rose (*Farfantepenaeus notialis*) dans les Caraïbes Colombiennes

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ABSTRACT

The shallow-water shrimp fishery is one of the most important socio-economic resources in the Caribbean region, with *Farfantepenaeus notialis* being the target species. The present study aims to evaluate the biomass and spatial distribution of the shallow water shrimp in the Colombian Caribbean. The direct evaluation was carried out by means of a fisheries research survey in the months of October and September of 2013. The highest biomass values of *F. notialis* were found in

the south of the Colombian Caribbean, within the first five nautical miles (n.mi.) of the coast, between depths of 20 and 50 m, this result was contrasted by the low values of biomass that were obtained in the north zone, within the five nautical miles and depths of 40 and 50 m. Results of association between CPUA of *F. notiali*s and habitat variables show significant associations ($p < 0.001$) with temperature, salinity, distance to coast and depth. The higher values of CPUA were associated with temperatures between 27.5 to 28.0 ºC, salinities between 35.60 to 35.90 psu, and distance to coast between 3 to 7 n.mi. and depths between 30 to 45 m. Currently, the shallow-water shrimp fishery is in a recovery phase.

KEYWORDS: Southern pink shrimp, direct assessment, distance to coast, Caribbean, Colombia

Is Mangrove Restoration Worth the Effort?

¿Vale el Esfuerzo la Restauración de Manglares?

La Restauration des Mangroves Vaut-Elle L'effort?

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ABSTRACT

Jamaica has several towns and communities established within or in close proximity to coastal mangrove forests. Portland Cottage is located in the largest protected area in the island, the Portland Bight Protected Area, and is one such community with a population showing varying levels of dependence on the adjacent mangrove forests. The general area was severely affected by Hurricane Ivan (2004), which caused loss of human life, destruction of houses and the toppling of hundreds of acres of mangrove trees. Extensive blocking of tidal channels occurred resulting in mangrove die-off, due to anoxic and hyper-saline conditions.

In April 2012, the National Environment and Planning Agency with assistance from the European Union (EU) embarked on the ecological restoration of approximately 5 hectares of mangrove forest in Portland Cottage. This project sought to rehabilitate the ecological character and functional capacity of the forest. Activities included the construction of tidal canals, planting of nursery grown seedlings and propagules from the surrounding forest, fencing to exclude grazing by goats and capacity building of stakeholders.

The mangrove forest pilot project in Portland Cottage has responded positively to the ecological restoration approach. The results showed a 40% survival of planted mangrove saplings with development of prop roots and/or pneumatophores. Transplanted and naturally recruited seedlings accounted for an impressive increase in overall seedling density and mean height of 127% and over 100% respectively relative to Time Zero (September 2012) as well as a 1:2 ratio of transplanted versus naturally recruited seedlings.

KEYWORDS: Jamaica, mangroves, restoration, protect areas, habitat

Sagittae Morphology of Economically Important Fishes from Southern Gulf of Mexico

Morfología de la Sagitta de Peces de Importancia Comercial del Sur del Golfo de México

Morphologie de la Sagitta de Poissons D'importance Commerciale du Sud du Golfe du Mexique

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ABSTRACT

Otoliths, calcium carbonate concretion of fish inner ear, are used to determine age and growth, for taxonomic purposes, to reconstruct life history in individuals and to discriminate fish stocks. Sagittae morphological characteristics were described in twenty species of highly economical important fishes form southern Gulf of Mexico. These species belong to the Epinephelidae (Groupers), Labridae (Wrasses) and Lutjanidae (Snappers) families. Scanning electron microscopy was

used to obtain digital images in which morphological characteristics of the inner face of the sagitta (saccular otolith) were recorded. Sagittae were air dried, gold and platinum sputter-coated, and mounted on an aluminum stub using double-sided carbon tape. Images were acquired through a SEM Phillips XL 30 at 25 KV. Right and left sagittae measurements recorded, using the image processing software Image Pro Plus, were: area (Ao, mm^2), aspect (Aso, %), fractal dimension (Fo), sulcus length (SL, mm), cauda length (CL, mm), ostium length (OSL, mm), rostrum width (RW, mm), and rostrum length (RL, mm). Subsequently, shape indices such as percentage of the sulcus length occupied by the cauda (CL/SL, %), percentage of the sulcus length occupied by the ostium length (OSL/ SL, %) and rostrum aspect ratio (RW/RL, mm) were calculated. To date it is the first description of the sagittae morphology for these species in the area.

KEYWORDS: Otolith morphology, commercial fishes, southern Gulf of Mexico

Helmintos Parásitos Intestinales de Algunos Tiburones en la Costa Central del Estado de Veracruz, México

Intestinal Parasitic Helminths of Some Sharks in the Central Coast of the State of Veracruz, Mexico

Helminthiases Quelques Requins dans la Côte Centrale de L'état de Veracruz, Mexique

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RESUMEN

Se registran los helmintos intestinales de ocho tiburones pertenecientes a cuatro especies: *Carcharhinus plumbeus* (n = 1), *Galeocerdo cuvier* (n = 1), *Isurus oxyrhinchus* (n =3) y *Squatina dumeril* (n = 3), capturados por la pesca artesanal en Chachalacas, Veracruz, en octubre-noviembre de 2014 y octubre de 2015. Cada intestino se colocó en una bolsa de plástico con formaldehído al 10% y se transportaron al laboratorio. Se determinaron 20 especies pertenecientes a seis órdenes. Se colectaron 619 individuos helmintos, de estos, 615 son cestodos de 19 especies y cuatro nematodos de una especie. Los órdenes Trypanorhyncha y Phyllobothriidea registraron el mayor número de especies con ocho y seis, respectivamente. El número de especies de helmintos por especie de tiburón varió de cuatro en *S. dumeril* a seis en *I. oxyrhinchus* y *G. cuvier*. Todos los tiburones estuvieron parasitados con al menos una especie de parásito. El mínimo de helmintos parásitos registrados en un tiburón fue de uno (*I. oxyrhinchus* y *S. dumeril*), mientras que G. cuvier registró el mayor número con 253 individuos. Los cestodos *Aberrapex* sp.; *Calyptrobothrium* sp. y *Paraorygmatobothrium* sp., se registraron una sola vez en *S. dumeril*, *I. oxyrhinchus* y *G. cuvier* con un solo individuo, mientras que *Thysanocephalum crispum* registró el mayor número con 208 individuos en G. cuvier. El cestodo *Disculiceps pileatus* se registra por primera vez en *C. plumbeus*. Los hábitos alimenticios y la especificidad hospedatoria son factores importantes que influyen en la composición de especies de helmintos parásitos en estos tiburones. Con estos datos ampliamos la distribución geográfica, el registro de nuevos hospederos y contribuimos al conocimiento de los helmintos parásitos de elasmobranquios en México, un componente integral de la biodiversidad que es necesario estudiar y valorar.

PALABRAS CLAVE: Cestodos, nematodos, Golfo de México, playa, Chachalacas, elasmobranquios

Output and Conversion Factors Obtained from the Dehydration Process in Yucatan, Mexico Sea Cucumber

Factores de Conversión y Rendimiento Obtenidos del Proceso de Deshidratacion del Pepino de Mar en Yucatan, Mexico

Performance et les Facteurs de Conversion Provenant de la Déshydratation du Processus dans le Yucatan, Mexique Holothurie

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ABSTRACT

The commercial fishing of sea in the Yucatan Peninsula cucumber began starting in 2013. These privileges are subject to the fisheries 2012 National Charter, which establishes the resource management and the regulatory measures of minimum size. The monitoring and control of the fishing quotas of the sea on the coasts of Yucatán cucumber is made through processed weight to live weight conversion, based on the studies conducted by the National Fisheries Institute (INAPESCA). However, these conversion factors used only processed weight loss and such a subjective way conversion factors, it could apply which can generate differences with the producers, because there is not a standardized method. So, the present study carried out in the laboratory of exploitation of marine resources of the technological Institute of Mérida, with sea cucumbers *Isostichopus badionotus* aims get conversion factors and yield of cucumber in a standardized process of dehydration. A cooperative sea cucumber specimens were obtained. The stages of the process of dehydration were: first cooking and salted. It was performed in triplicate, then a material balance for each stage, and the average yield of sea cucumber was: 16. 67 ± 0.74%, corresponding to a conversion factor of 6.0. This conversion factor obtained for this study serve to validate processing to live weight, weight conversion resulting in better monitoring and control of quotas allocated to fishermen, favouring a responsible and sustainable fishing.

KEYWORDS: Sea cucumber, *Isostichopus badionotus*, dehydration, conversion factor

Distribución Potencial de las Comunidades de Manglar en México Utilizando Modelos Correlativos de Nicho

Potential Distribution of Mangrove Communities in Mexico Using Correlative Niche Models

Distribution Potentielle des Communautés de Mangrove au Mexique Utilisant des Modèles Corrélatifs de Niche

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RESUMEN

Los manglares son ecosistemas altamente productivos, proporcionando gran riqueza biológica y variedad de servicios ambientales (barreras naturales, sumideros de CO_2, zonas de protección, crianza y desove para especies comerciales). México es el cuarto país con mayor extensión de manglar a nivel mundial y la Península de Yucatán posee el 55% de ellos, siendo a su vez una zona muy productiva en cuanto actividad pesquera de alto valor comercial. A pesar de estos beneficios, la cobertura se pierde a un ritmo acelerado debido a las actividades humanas. El objetivo de este trabajo es estimar la distribución potencial de las comunidades de manglar en México por medio de Modelos Correlativos de Nicho (MCN) utilizando: 1) ocurrencias de cuatro especies de manglar, y 2) una selección de variables ambientales. Los datos de ocurrencia se obtuvieron depurando bases digitales, y seleccionando dos subconjuntos (calibración y validación). Las capas bioclimáticas, de suelo y topografía se obtuvieron de bases globales. Los datos se procesaron con MaxEnt 3.3.3 k, realizando combinaciones con diferentes parametrizaciones. La evaluación fue con el criterio de Akaike y curvas ROC. La

distribución del manglar generada por MCN se comparó con la distribución generada por medio de imágenes satelitales de la Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. Los resultados muestran diferencias importantes atribuibles a que se proyectan ambientes favorables para el manglar. En México, este es el primer trabajo donde se utilizan MCN para caracterizar la distribución potencial del manglar. Los resultados son de utilidad en la toma de decisiones para conservación y manejo de estos importantes ecosistemas costeros al identificarse espacios potenciales para su distribución.

PALABRAS CLAVE: Manglare,s comunidades, distribución, modelos, nicho

"Boat to Boat" a MPA Management Approach to Increase Stakeholder Involvement from Fishing Communities in Northern Belize

"Boat to Boat" un Enfoque de Gestion Zonas Marinas Protegidas para Aumentar la Participación de las Partes Interesadas en las Comunidades Pesqueras del Norte de Belice

"Boat to Boat" dans des Aires Marines Protegees, une Approache de la Gestion pour Augmenter la Participation des Parties Prenantes au Sein des Communautes de Peche du Nord au Belize

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ABSTRACT

The management of Marine Protected Areas (MPA's) involves the application of a wide range of strategies that aim to create a balance between people and the environment. Along with securing long-term sustainable funding, the next biggest challenge is working with stakeholders that have direct positive and negative impacts on the resources within the MPA. One such important stakeholder group is fishers who depend on the resources within the Lighthouse Reef Atoll (LHRA) and MPA to support their livelihoods. Despite working in the fishing communities of Chunox, Copper Bank and Sarteneja, for more than 20 years through various programs, projects and communication mediums, the Belize Audubon Society (BAS) has seen that changing perceptions, fishing practices and influencing livelihoods of fishers takes several generations. Over the last five years, key factors identified between the MPA managers and the fishers due to their fishing practices was the communication gap and meeting fatigue in the villages. These traditional fishers of LHRA and by extension Blue Hole Natural Monument and Half Moon Caye Natural Monuments use sailboats and stay at sea for 5-10 days per trip. Taking this into account, BAS pioneered and embarked on a new strategy called the "Boat to Boat" outreach, to maximize the number of fishers engaged in Community Outreach efforts. This approach has helped to increase the number of fishers that are engaged, increased the amount of valuable information obtained from fishers, builds trust which ultimately assists with enforcement efforts, allow for hands-on interaction between fishers and MPA managers, and sharing research and monitoring findings. In addition, it also provides a gateway for strengthening of relationships between these two groups that are vital to the successful management of MPAs.

KEYWORDS: Fisher, MPA, “Boat to Boat”, Belize Audubon Society, Lighthouse Reef Atoll

Densidad y Talla del Pez León y su Relación con Variables Ambientales y Ecológicas en Arrecifes Coralinos del Caribe Mexicano

Density and Size of Lionfish and its Relationship with Environmental and Ecological Variables in Coral Reefs of Mexican Caribbean

Densité et Hauteur de Lionfish et sa Relation avec les Variables Environnementales et Écologiques dans les Récifs Coralliens des Caraïbes Mexicaines

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RESUMEN

El pez león, es el primer pez marino en invadir y establecerse en la costa oeste del Océano Atlántico. A partir de su primer registro en México en 2009, se implementaron acciones de control poblacional para tratar de minimizar su invasión y los impactos sobre las comunidades nativas. El objetivo de este estudio fue cuantificar su abundancia en tres localidades del Caribe mexicano. La densidad y biomasa promedio se consideraron intermedias con respecto a lo reportado en otros sitios. La muestra estuvo constituida por adultos reproductores (80%). Asimismo la densidad de pez león fue igual o mayor que la registrada para las especies de meros. El microhabitat estuvo dominado en un 78% por coberturas de macroalgas, algas coralinas y sustrato abiótico. Por último este estudio evaluó la contribución de 10 variables (tres ambientales y siete ecológicas) que podrían explicar el éxito de su invasión reflejado en la densidad y tallas. La profundidad, la biomasa de presas y densidad de depredadores potenciales fueron los factores que mejor explicaron la variación de las densidades del pez león, mientras que la densidad de presas contribuyó significativamente en la variación de las tallas. Los resultados pueden sugerir que: 1) el pez león se encuentra en densidades intermedias en el Caribe mexicano, 2) prefiere hábitats que le proporcionan resguardo, 3) las mayores abundancias se encuentran en zonas de mayor profundidad y con abundancia de presas disponibles y 4) los depredadores nativos no ejercen la función de biocontrol significativo que reduzca el éxito invasor de *P. volitans*. Se recomienda priorizar acciones de manejo y control en arrecifes que reúnan las características antes mencionadas, las remociones serían más significativas y contribuirían a la conservación de las comunidades nativas que habitan en el arrecife.

PALABRAS CLAVE: *Pterois volitans*, Caribe mexicano, depredadores nativos, microhábitat, presas

How Small-scale Fisheries in the Yucatan Peninsula Have Evolved? Expert Eye's Perceptions

¿Cómo Han Evolucionado las Pesquerías de Pequeña Escala dn Yucatán? La Visión del Ojo Experto

Comment la Pêche à Petite Échelle dans la Péninsule du Yucatan A-T-Elle Évolué? Les Perceptions de L'oeil d'un Expert

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ABSTRACT

Elder fishers represent a critical source of information about historical changes in fisheries. Through time they have accumulated detailed knowledge about their resources, fishing practices, and environmental conditions that impact both users and fishing communities. This study seeks to understand the development of the small-scale fisheries in the Yucatan coast since the 1950s to date, looking at resource availability, fishing operations, market, and different challenges and

constraints faced by small-scale fishers over decades. To do so, information from interviews, statistical data, and literature were analysed. In-depth interview was applied to fishers ranging 59-81 years old in Dzilam de Bravo fishing community. Resource depletion, lack of opportunities, capacity enhancing, and openness of new fisheries were principal triggers for changing conditions. Replacement of main target species, such as sharks by others like sea cucumber and octopus were reported by fishers; these changes were also evident in catch trends of official records. Fiberglass vessels, outboard motor, and efficient fishing gears replaced the small wooden vessels "cayucos", paddles, and organic fibers used 60 years ago, which allowed fishers to move to deeper waters far from the coast. Weather conditions remain among the most mentioned issues that make them vulnerable yet, while product conservation and commercialization no longer concern fishers, young fishers' inexperience, piracy, addictions, and immigration were cited among those impacting fishing communities nowadays. Traditional knowledge has proved to be a powerful tool in fisheries assessment; learning about historical changes can define a different base line when assessing fisheries and dealing with management and conservation.

KEYWORDS: Traditional knowledge, small-scale fisheries, fishing operations, governance, Yucatan Peninsula

Primeras Aportaciones de los Aspectos Oceanográficos en el SAR, "El Blanquizal", Xcalak, Quintana Roo, México, Mediante Observaciones *in situ*

First Contributions of the Oceanographic Aspects in the SAR, "El Blanquizal", Xcalak, Quintana Roo, Mexico, through *in situ* Observations

Premières Contributions des Aspects Océanographiques dans le SAR, "El Blanquizal", Xcalak, Quintana Roo, Mexique, à Travers des Observations *in situ.*

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RESUMEN

En el Mar Caribe Mexicano se han detectado y comprobado ocho Sitio de Agregación Reproductiva (SAR) distribuidos a lo largo de la Costa Maya, entre ellos resalta el SAR denominado "El blanquizal de Santa Julia" o "El Blanquizal" ubicado dentro del polígono del Área Natural Protegida Arrecifes de Xcalak, Quintana Roo, México. Dicho sitio es históricamente conocido por pescadores de la región y por el arribo de diversas especies de importancia comercial. A la fecha los estudios que vinculan la relación entre procesos hidrodinámicos con sitios de agregación reproductiva, son nulos. El presente trabajo pretende mostrar resultados previos sobre los patrones hidrodinámicos del SAR "El Blanquizal", obtenidos a partir de mediciones *in situ* a través del uso de métodos lagrangeanos, los cuales consistieron en la liberación de boyas integradas con GPS. Adicionalmente, se realizaron observaciones con ADCP y lances de CTD con el objetivo de conocer la variación del campo de velocidades de la corriente y estructura termohalina. Los resultados observados mostraron una amplia variabilidad en la capacidad difusiva del sitio de estudio (de K = 0.14 m^2/s a K = 4.51 m^2/s), siendo esta afectada principalmente por el factor viento y la interacción de las corrientes con la batimetría. Así mismo, se presenta una batimetría actualizada del sitio con datos de profundidad obtenidos de los recorridos con el ADCP e información de diversas fuentes para ser utilizada en modelación numérica. Estos resultados representan las primeras descripciones de los procesos oceanográficos de un SAR en el Caribe Mexicano y sus posibles efectos en la dispersión inicial de huevos de peces.

PALBRAS CLAVE: Xcalak, hidrodinámica, agregaciones reproductivas,

Dinámica de la Pesca Artesanal Entre los Años 2004 a 2016 en el Área de Influencia de la Isla de San Andrés, Reserva de Biosfera Seaflower, Caribe Colombiano

Dynamics of Artisanal Fishing Between 2004 and 2016 in the Area of Influence of the I sland of San Andres, Seaflower Biosphere Reserve, Colombian Caribbean

Dynamique de la Pêche Artisanale Entre 2004 et 2016 dans la Zone D'influence de L'île de San Andres, Réserve de la Biosphère du Seaflower Colombiennes, des Caraïbes

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RESUMEN

En la Reserva de Biosfera Seaflower se realiza la pesca artesanal principalmente por parte de la comunidad raizal. La Gobernación Departamental - Secretaría de Agricultura y Pesca, implementó monitoreos de desembarco de pesca artesanal en el sistema SIPEIN (SAPD, 2017), los cuales fueron analizados para conocer la dinámica y hacer propuestas de manejo. El análisis multitemporal se realizó por grupos de recursos, arte de pesca y con variables de desempeño pesquero como Captura, Esfuerzo y Captura por Unidad de Esfuerzo CPUE y el Rendimiento Máximo Sostenible RMS, con los modelos de producción excedente Schaefer y Fox. En San Andrés la captura total anual entre 2004 y 2016, presentó una variación entre 44,13 a 249,48 toneladas. Siendo las capturas, en un 98,5% de peces (104 especies), 1,03% moluscos y 0,52% crustáceos (2 especies cada uno). El esfuerzo promedio anual para el arte línea de mano fue 4118 faenas; con un máximo en 2009 de 7532 faenas. En buceo el esfuerzo promedio anual fue 223 faenas. La CPUE de línea obtuvo un máximo de 41 Kg/faena en 2007; entre 2008 al 2011 y 2014 y 2015, se presentó un descenso de la CPUE, pero aumento en el esfuerzo, lo cual revela indicios de sobrepesca. El modelo producción excedente, muestra una tendencia que podría tener un punto de referencia limite, RMS cercano a los 204.48 toneladas/año; pero se debe tener en cuenta que se trata de pesquerías multi-especies. Es necesario tomar medidas de manejo para garantizar la sustentabilidad ambiental.

PALABRAS CLAVE**:** Evaluación de recursos, pesca artesanal, San Andrés Isla, Reserva de Biosfera Seaflower Caribe colombiano

Variaciones en el Reclutamiento y Biomasa Desovante del Pulpo Rojo (*Octopus maya*) en la Península de Yucatán Durante las Temporadas de Pesca 2007-2016

Variations in Recruitment and Spawning Stock Biomass of the Red Octopus (*Octopus maya*) in the Yucatan Peninsula during Fishing Seasons 2007-2016

Variations en Recrutement et Biomasse Reproduction de L'octopus Rouge (*Octopus maya*) dans la Péninsule de Yucatan Pendant les Saisons de Pêche 2007-2016

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RESUMEN

La pesquería de pulpo rojo (*Octopus maya*) es la más importante en la península de Yucatán por los volúmenes de captura, principalmente en los estados de Yucatán y Campeche. En los últimos 19 años, los niveles de captura del recurso han oscilado entre 9,500 (1998) y 28,377 ton (2016). En este estudio se realizó un análisis de población virtual (APV) por sexo considerando que con base en la estructura de edades en las capturas, los machos y las hembras se reclutan a la

pesquería a edades diferentes. De esta manera, con el APV se estimaron los niveles de reclutamiento (número de organismos de 4 meses de edad para los machos y 5 meses para las hembras) y la biomasa de la fracción desovante por temporada de pesca (agosto-diciembre). De acuerdo al APV, en la temporada de pesca 2008 se estimaron los valores mensuales de reclutamiento y biomasa desovante consistentemente más bajos de toda la serie; y en 2012 y 2015 se estimaron valores de biomasa desovante más altos. En 2012, estos valores de biomasa se obtuvieron en septiembre y octubre; mientras que en 2015, el mayor de biomasa se obtuvo en noviembre, que de hecho corresponde al más alto de la serie disponible al momento. Con relación al número promedio de reclutas, se obtuvo para temporada 2015, los valores más altos de toda la serie para el periodo de agosto a noviembre, con una tendencia a incrementarse desde agosto y en noviembre alcanza el mayor valor de reclutamiento de toda la serie, para en diciembre volver a disminuir a un valor cercano al promedio general de la serie. De acuerdo a la dinámica del pulpo rojo en la península de Yucatán, los sobrevivientes de los picos masivos identificados tanto en biomasa como en reclutamiento son los que se reproducen hacia finales del año y constituyen el stock parental de las cohortes que a su vez se reproducirán durante la veda.

PALABRAS CLAVE: APV, estructura de edades, pulpo maya, Península de Yucatán

Developing a Fishery Management Plan for the Bahamas Spiny Lobster Fishery

Elaboración de un Plan de Gestión Pesquera para la Pesquería de Langosta Espinosa de las Bahamas

Élaborer un Plan de Gestion des Pêches pour la Pêche au Homard Epineux de Bahamas

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ABSTRACT

The Bahamas hosts one of the world's largest spiny (or rock) lobster fisheries, with landings ranging from six to ten thousand tons per season. The industry is comprised of an industrial sector that utilizes most of the Bahamian banks and a small-scale sector that fishes closer to home ports; together, the sectors' spiny lobster landings account for most of Bahamas' fishery exports, with frozen tails sold mainly to the US and France. Since 2009, from when the fishing industry applied to be certified under the Marine Stewardship Council (MSC) to allow for greater access to the European Union fishery market, the spiny lobster fishery has undergone several changes as part of a fishery improvement project (to aid in certification).

A key initiative to improve the strategic management of The Bahamas spiny lobster fishery was the finalization of a fishery management plan (FMP), developed in conjunction with stakeholders over an iterative and participatory process in 2016. The steps in the FMP process included a literature review and analysis, stakeholder interviews and working group discussions, and fishing community workshops. The information obtained from these steps was used to identify management deficiencies and opportunities. Presented as suite of management options across disciplinary boundaries, the FMP created 37 priority-based measures (activities) that would promote sustainability.

The FMP listed three measures as paramount to the effective management of the spiny lobster fishery: A census of the fishery participants, vessels, and gear; a licensing system to account for fishery effort; and a reporting system to fishery landings. Each measure will greatly improve the information base required to evaluate and predict changes in fishery stocks and to best accommodate participation in the fishery sectors.

KEYWORDS: Fisheries, fishery management, spiny lobster, *Panulirus argus*, The Bahamas

Commercial Fishermen's Willingness to Harvest Lionfish: A Multi-disciplinary Analysis of the Potential Supply in the US Virgin Islands

Entender la Voluntad de los Pescadores Comerciales de Pez León de la Cosecha: Un Análisis Multidisciplinar de la Fuente para un Mercado de Pez León en las Islas Vírgenes

Comprendre la Volonté des Pêcheurs Commerciaux de Récolter les Poissons-papillons : Une Analyse Multidisciplinaire de la Fourniture d'un Marché de Poissons-papillons dans les Iles Vierges Américaines

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ABSTRACT

The rapid expansion and ecological effects of invasive lionfish are well-documented (Morris and Akins 2009, Albin and Hixon 2008). Early control efforts focused on eradication often relied on paid or volunteer efforts, and efforts to engage recreational divers, often through competitions such as lionfish derbies (Trotta et al. 2014, Forrester 2014). However, this approach is inefficient, expensive, and can pose safety concerns for unskilled lionfish handlers (Bogdanoff et al. 2014). Instead, developing seafood markets for lionfish could be a more effective option for long-term suppression (Hixon 2014, Bowden 2014). Until now, a rigorous assessment of the viability of creating a market for lionfish as a local food source was unavailable. We present an analysis of the potential supply for lionfish as food from spatial, qualitative, and quantitative perspectives. This includes considering commercial fishermen's willingness to harvest lionfish and the price required to motivate lionfish targeting. Fishermen's knowledge of potential barriers to harvest (including perceived presence of ciguatera toxin and presence of lionfish) are mapped, and cultural barriers to harvesting lionfish are analyzed. Outreach efforts to address these barriers are also briefly discussed This is the first of two proposed presentations reporting on the findings and outcomes of a two-year NOAA-funded project to assess the viability of a lionfish market in St. Croix and St. Thomas, in the US Virgin Islands.

KEYWORDS: Lionfish, *Pterois volitans*, US Virgin Islands, markets, supply

Overview of Caribbean Fisheries Co-management Project

Visión de Conjunto de Co-gestión Pesquero en Caribe

Vue D'ensemble de Co-gestion des Pêches des Caraïbes

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ABSTRACT

Fishery resources in the Caribbean region are under pressure due to overexploitation, environmental degradation and inadequate 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 of St. Kitts and Nevis, Antigua and Barbuda, Dominica, St. Lucia, St. Vincent and Grenadines and Grenada, Caribbean Regional Fisheries Mechanism (CRFM) Secretariat and University of Florida/Florida Sea Grant. The purpose of this project is to develop the fisheries co-management approaches suitable for each target country and to share its good practices in the Caribbean region. CARIFICO consists of three pilot projects, 1) the co-management of fish aggregating device (FAD) fishery 2) the co-management of conch fishery, and 3) the co-management of fish pot.

The purpose of this presentation is to provide overall information about the strategies, activities and outputs of CARIFICO. In addition to this presentation, 1) the good practices of fishery co-management specifically in Antigua and Barbuda, St. Lucia and Grenada, 2) the socioeconomic impacts of FAD fishery co-management and 3) the opportunities for fisheries co-management will be presented. The series of presentation may serve to apply for the development and promotion of fishery co-management approaches in the Caribbean region.

KEYWORDS: Co-management, FAD, conch, fish pot

Use of Melanin from *Octopus maya* from Yucatan as Antibacterial Agent

Uso de la Melanina del pulpo *Octopus maya* de Yucatán como Agente Antibacteriano

Utilisation de Mélanine de *Octopus maya* comme Agent Antibactérien

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ABSTRACT

In the Yucatan Peninsula there are marine organisms that sustain a sustainable fishing activity, such as the octopus *Octopus maya* that is the main octopus in Yucatan, and first national place in capture and sale (SAGARPA 2016).

The Mayan octopus is endemic to the Yucatan Peninsula, it contains a great diversity of metabolites, which are susceptible to generate the elaboration of various drugs. (Blanco et al. 2007). *Octopus maya* octopus ink is a fish by-product that has melanin, a substrate that has been attributed to endless properties and applications for humans.

Studies using the metabolites contained in the melanin of molluscs have been carried out, in the case of the Mayan octopus, it is tried to establish if any metabolite present in the melanin of the mollusk is susceptible to be used as an antimicrobial agent against some common bacteria in the medium and Hence the possibility of producing a product that serves this purpose.

To determine the antimicrobial activity of the octopus melanin of Yucatan octopus, using the *bacterium Salmonella typhi* ATCC 14028, to produce a natural antimicrobial that combats salmonellosis.

KEYWORDS: *Octopus maya*, actividad antimicrobiana, *Melanina*, *Salmonella,* endémico

Diet Composition of Yellowtail Snapper, *Ocyurus chrysurus* (Bloch, 1971) Captured by the Artisanal Fishery of Antón Lizardo Veracruz, México

Composición de la Dieta del Pez Rubia *Ocyurus chrysurus* (Bloch, 1971), Capturados por la Pesqueria Artesanal de Antón Lizardo, Veracruz, Mexico

Composition du Régime Alimentaire du Poisson Vivaneau Queue Jaune *Ocyurus chrysurus* (Bloch, 1971) Capturé par la Pêche Artisanale à Anton Lizardo, Veracruz, Mexique

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ABSTRACT

The yellowtail snapper (*Ocyurus chrysurus*) is a marine species living on hard substrates mostly in coral reefs; it is an important economic resource and an important ecological role in the predator-prey relationship. Because of this the interest arise to study the feeding habits of individuals captured by the artisanal fishery of Antón Lizardo in the National Park Veracruz Reef System by analyzing the diet by sex development (juvenile and adult), by sex (male and female) and in general. The stomach content of 190 organisms were analyzed captured between March and September 2017. The frequency of occurrence (FA), relative abundance %N), the Levins standardized diet amplitude (Be), and the Shannon-Weiner diversity index (H') were calculated. In general, the diet was composed by 25 items of five Phylla: Arthropoda, Annelida, Mollusca, Echinodermata and Chordata. For the Arthropoda five families and one genus were identified, for Annelida one Class, for the Mollusca were identified two families with one genus each, for the Echinodermata one class was identified, and for the Chordata two families were identified. The main prey was fish remains (29.37%) and crustacean (20.24%), and the genus Lucifer as a secondary prey with 10.71%. *O. chrysurus* was a specialist species as shown by the Levins index value of 0.2 and the Shannon-Weiner diversity value of 0.95. The yellowtail snapper can be considered as zooplankton and zoobenthos carnivore.

KEYWORDS: *Ocyurus chrysu*rus, red trófica, diversidad, zooplancton carnivore, zoobenthos carnivore

Why Teach Fundamental Marine Conservation Concepts in Schools in Mayan Fishing Communities Using Maya (Yucateco) as the Language of Instruction?

¿Por qué Enseñar Conceptos Fundamentales de Conservación Marina en las Escuelas de las Comunidades Pesqueras Mayas Usando Maya (Yucateco) como el Idioma de Instrucción?

Pourquoi Enseigner des Concepts Fondamentaux de Conservation Marine dans les Écoles des Communautés de Pêche Mayas Utilisant Maya (Yucateco) comme Langue D'enseignement?

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ABSTRACT

The greater Caribbean basin is a multi-ethnic and multi-linguistic region hosting a large variety of coastal and marine social/ecological systems. These provide habitats for ecologically and commercially important species, and support the well-being of coastal populations. It is thus crucial to reduce the pressure on these habitats and species, and empower these peoples with the knowledge to protect and use their resources sustainably. One way to achieve this goal is to teach the same fundamental marine conservation concepts across the region. Yet, considering the multiple linguistic and cultural contexts

in the region, it becomes necessary to provide conservation education resources using local indigenous languages. One of these languages, the Maya (Yucateco), is the mother tongue of more than 800 000 people in the Yucatán Peninsula in México and northern Belize. "U taak'inil Caribe" or Treasures of the Caribbean, are marine science educational instruments created by "Ajkanan K'ak'náabo'on Ma' Su'up'il" or Marine Conservation without Borders. They are preparing twenty bilingual chapters in Yucatec/Spanish and Yucatec/English focused on species, ecosystems, and local issues of the marine environment. The curriculum aims to target fishers and students from preschool through 6th Form in an institutional setting in Mayan communities in México and Belice. It also aims to promote cultural and language conservation. Some locations in Belice and México where these curricula would be useful are Celestún, Telchac, Xel-Há, 'Chunox, Yo Creek and Sarteneja (Belize's largest fishing village), to name a just a few.

KEYWORDS: Marine conservation, education, Yucatec Maya, language, conservation, Ichil Maya

Fundamental Marine Conservation Concepts Should be Taught in Fishing Communities Using Native Languages as the Language of Instruction

Los Conceptos Fundamentales de Conservación Marina deben ser Enseñados en Comunidades de Pesca Usando Lenguas Nativas como el Idioma de Instrucción

Conceptos Fundamentales de Conservación Marina se les deben Enseñar en las Comunidades Pesqueras con Lenguas Nativas como Lengua de Instrucción

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ABSTRACT

Marine resources provide significant benefits to the Caribbean region by providing food security, livelihood, and employment at the local level. Much of the local catch is exported to provide significant foreign exchange which, providing significant economic gains which ties the country with international consumers. It is imperative that these resources be protected from over-exploitation and used sustainably if that these marine products are to be available in the future. One way to achieve this goal is to teach the same fundamental marine conservation concepts across the region. Such a program would also protect and strengthen all national and local economic structures dependent upon healthy marine ecosystems.

An individual's mother tongue connects him/her to their ethnic group, shapes their identity, and strengthens pride and self-worth. Language is integral in affirming and maintaining wellbeing, self-esteem and a strong sense of identity. Languages contain complex nuances connecting people's culture and their surrounding ecosystems. Cultural heritage and knowledge is passed on throughout each generation by language. A wealth of evidence associates health, education, and employment with general wellbeing and culture. Indigenous languages connect people to their culture. Educating fisher-folk and youth in their home language allows them to engage and improve marine governance in the region. As shareholders local peoples should be involved in using local mechanisms and local culture to integrate their knowledge to chart their course into the future. Our program provides poly-lingual teaching materials that can used in many areas of the region.

KEYWORDS: Marine conservation, education, indigenous languages

Evidence of Variable Growth Rates in Hogfish (*Lachnolaimus maximus*) Depending on Reef Tract

Evidencia de Tasas de Crecimiento Variables en Boquinete (*Lachnolaimus maximus*) Dependiendo del Área de Arrecife

Preuve de Taux de Croissance Variable dans Labre Capitaine (*Lachnolaimus maximus*) Selon la Superficid des Récifs

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ABSTRACT

Hogfish (*Lachnolaimus maximus*) is a reef-associated fish species found in the western Atlantic Ocean, which supports a moderate commercial and recreational fishery. For the past three years, this U.S. fishery has been under review and found to be overfished in East Florida. However, the majority of life history data used for this assessment was collected solely in the Florida Keys. Previous studies used in the most recent assessment reported significantly stunted growth rates of hogfish in regions closer to high human population density in comparison to distant locations, such as the Dry Tortugas islands. This study examines the age-length relationship of hogfish populations in Broward County, Florida (USA), which has a much larger human population and more accessible reefs than the Florida Keys. In this study, over 170 hogfish were collected from 2016-2017 and aged using otolith analysis. The findings indicate that, despite the higher human population in Broward County, the observed growth rate was higher than the Florida Keys. In addition, growth rates of hogfish collected from different reef tracts which run parallel the coast were significantly different. In contrast with prior studies, the most accessible reef tract (ca. 4 - 6 m deep) had a significantly higher growth rate than the outermost reef (ca. 15-25 m deep). This data demonstrates the importance of factoring in sample location when determining regional growth rates of a species and should be a consideration for resource managers when assessing a fishery stock.

KEYWORDS: Hogfish, *Lachnolaimus maximus*, growth rate

Comportamiento Espacial y Perfil de las Capturas de la Flota Ribereña de Yucatán, México

Spatial Behavior and Profile of the Small-scale Fleet Catches in Yucatán, México

Comportement Spatial et Profil des Captures de la Pêche Artisanale en Yucatán, Mexique

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RESUMEN

En el estado de Yucatán la actividad pesquera es de gran importancia, ya que genera beneficios tanto económicos como de bienestar social. La flota ribereña del estado de Yucatán es multi-específica y multi-arte y está conformada por aproximadamente 4,400 embarcaciones que operan a lo largo de la zona costera. En este trabajo, se analizó el comportamiento espacial de la flota y el perfil de las capturas. La información para generar este trabajo incluyó el monitoreo de la captura de 1,910 viajes de pesca realizados entre 2013 y 2016, en 11 comunidades pesqueras. Además, se aplicaron entrevistas al capitán de cada embarcación para registrar información de la operación de pesca en relación a: zona, profundidad de operación y arte de pesca. Con el programa Quantum Gis se generaron mapas que permitieron identificar las zonas de pesca utilizadas por los pescadores de seis comunidades (Celestún, Sisal, Progreso, Dzilam de Bravo, San Felipe y Rio Lagarto). Se identificaron 47 especies de peces en la captura de esta flota, un molusco (*Octopus maya*) y un crustáceo, de las cuales sólo cinco fueron especies objetivo: mero rojo (*Epinephelus morio*), rubia (*Lutjanus synagris*), canané (*Ocyurus chrysurus*), boquinete (*Lachnolaimus maximus*) y langosta (*Panulirus argus*). Se identificaron patrones de comportamiento de los pescadores entre comunidades pesqueras que reflejan similitud en la composición de sus capturas.

PALABRAS CLAVE: Flota ribereña, comunidades pesqueras, perfil de las capturas, Quantum GIS

A Preliminary Analysis of Marine Fishery Catches Along Southeast Haiti

Un Análisis Preliminar de las Capturas de la Pesca Marina en el Sureste de Haití

Une Analyse Préliminaire des Captures de la Pêche Maritime le Long du Sud-est d'Haïti

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ABSTRACT

With estimates of up to 50,000 fishers and one of the largest coastlines in the insular Caribbean, the marine fishery in Haiti remains one of the least documented in the region. Here, a large dataset of fishery landing surveys conducted between 2007 and 2014 and spanning approximately 150 km of coastline along southeast Haiti is rigorously analysed for the first time. The results of this analysis will shed light onto the socio-economic and biological components of the marine fishery in Haiti.

KEYWORDS: Marine fishery, Haiti, artisanal fishery, fishery landings, catch composition

Estado de la Invasión del Pez León *Pterois volitans* en el Caribe Continental Colombiano, Monitoreo a Escala Nacional

State of the Invasion of Lionfish *Pterois volitans* in the Continental Caribbean Colombian Coast, Nationwide Monitoring

État de L'invasion Lionfish *Pterois volitans* Continental Caraïbes Colombien, Surveillance Nationwide

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RESUMEN

Las invasiones biológicas se consideran la segunda causa de pérdida de biodiversidad en ambientes marinos después de la degradación del hábitat, el pez león *Pterois volitans* se ha convertido en un invasor en el Atlántico occidental que puede poner en peligro la integridad de la trama alimentaria marina y los ecosistemas en los que se encuentre . Para evaluar el estado de la invasión del pez león en los arrecifes someros del Caribe continental colombiano, el INVEMAR con apoyo del Minambiente desarrolló un monitoreo a escala nacional durante los años 2015 y 2016. Se visitaron 56 estaciones en seis localidades costeras del país: Rosario, San Bernardo, Capurganá, Isla Fuerte, Tayrona y Salmedina, encontrándose peces león en el 89% de ellas. Para el 2015 la mayor densidad de pez león se reportó para Isla Fuerte (390 ± 80 Ind/ha) y para el 2016 en Capurganá (130 ± 90 Ind/ha). La mayor talla fue 420 mm LT en el 2015 en Rosario y la menor fue 22 mm LT (Tayrona) en 2016. Hubo diferencias estadísticamente significativas en la densidad promedio de pez león en el 57.98 % de las estaciones entre años, observándose aumento en las estaciones de Capurganá y Salmedina, lo cual posiblemente está asociado con características intrínsecas de las localidades como por ejemplo el poco buceo debido a la lejanía de ambas zonas y la profundidad en Salmedina. En las demás hubo una disminución en la densidad entre años, observación que fue compartida por actores locales (ej. pescadores, guardaparques, buzos). Sin embargo los únicos trabajos publicados para años anteriores en el Caribe continental colombiano corresponden al Tayrona y muestran una disminución en las densidades y las tallas del pez león entre estos años para esta localidad, haciendo necesario más trabajos de este tipo para poder estimar la dinámica de la invasión en el país.

PALABRAS CLAVE: *Pterois volitans,* invasión, Colombia

Juvenile Population Dynamics of Families Lutjanidae and Serranidae in the Northern Gulf of Mexico, with Respect to the Loop Current and other Hydrographic Features

Dinámica de la Población Juvenil de las Familias Lutjanidae y Serranidae en el Norte del Golfo de México, con Respecto a la Corriente de Bucle y otras Características Hidrográficas

Dynamique de la Population Juvénile des Familles Lutjanidae et Serranidae dans le Nord du Golfe du Mexique, en ce qui Concerne le Courant de Boucle et D'autres Caractéristiques Hydrographiques

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ABSTRACT

The Gulf of Mexico (GoM) is a uniquely dynamic environment with a variety of hydrographic features and oceanographic processes taking place. These features include; the Loop Current, cyclonic and anticyclonic eddies, and the Mississippi River Plume. These important features are major drivers of the biological processes occurring in the GoM and are directly responsible for the extent to which the Deep Water Horizon Oil Spill (DWH) spread throughout the Gulf. The relationship these features have on the long term community assemblages of Families Lutjanidae and Serranidae has been of great interest from both biological and economic standpoints. These families are home to some of the most economically important fisheries in the GoM and represent some of the larger predators found in reef ecosystems. Identifying the role these features play in the transportation of larval and juvenile nearshore species to offshore environments is vital to resource managers. Using historical data collected shortly after the DWH Oil Spill via the NOAA Natural Resource Damage Assessment (NRDA) in 2011 as a baseline, we plan to analyze the community assemblages of lutjanids and serranids in the Northern GoM. In conjunction with this data, cruises conducted by the Deep Pelagic Nekton Dynamics of the Gulf of Mexico (DEEPEND) Consortium from 2015 - 2017 will be analyzed to identify the natural variability of species assemblages for lutjanids and serranids. In comparing these two data-sets we hope to identify the potential long term affects the DWH Oil Spill may have had on these fish assemblages and the faunal composition of these two families in an oceanic setting.

KEYWORDS: Lutjanidae, Serranidae, Gulf of Mexico, oceanography, juvenile

Selectivity, Abundance, and Density of Males and Females of *Callinectes sapidus* on the Coast of Yucatan

Selectividad, Abundancia y Densidad de Machos y Hembras de *Callinectes sapidus* en la Costa de Yucatán

Sélectivité, L'abondance et la Densité des Mâles et des Femelles de *Callinectes sapidus* sur la Côte du Yucatan

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ABSTRACT

A mark-recapture method was used to make sex-related estimates of the selectivity of the fishing gear, abundance and density of the Atlantic blue crab (*Callinectes sapidus*) on the northern coast of the Yucatan Peninsula, using both the Jolly-Seber model and the density by catchability (CPUE * q), both derived from data obtained from a period of six consecutive fishing days. For this purpose, 52 traps were used, divided into four transects placed parallel to the coastline. The traps were placed at dusk and checked at dawn, standardizing the fishing effort in 17 hours trap-1 day-1. A total of 614 crabs

were captured, of which 594 did not register marks and 20 were recaptured with mark. The sex ratio male: female throughout the capture was 1:3.78. In relation to size (carapace width, CW), a different sex ratio was also observed for almost all size classes. The selectivity of the fishing gear or first catch size (L50) was estimated at 142.3 and 153.3 mm CW, for females and males, respectively. The catch per unit of effort (CPUE) was estimated in 0.15 (males) and 1.92 (females)/trap organisms. According to the Jolly-Seber model, the average abundance of males was 347 organisms and 2912 for females, resulting in a population of 3,259 crabs. Based on these estimations of abundance by sex, it was observed that the density for males was 0.0039 crabs/m^2 (39 males per hectare) and for females of 0.0323 crabs/m^2 (323 females per hectare). Meanwhile, based on to the catchability density (CPUE * q), similar densities of 0.0340 males/m^2 and 0.0243 females/m^2 were observed.

KEYWORDS: *Callinectes sapidus*, Jolly–Seber model, catchability, CPUE, density

Shrimp Fishery Bycatch in the Bay of Campeche. Is it a Problem?

La Captura Incidental en la Pesca de Camaron en la Bahía de Campeche ¿Es un Problema?

Les Captures Accessoires dans Pêche à la Crevette dans le Baie de Campeche. C'est un Problème?

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ABSTRACT

Information from shrimp fishery observers program of was analyzed. It recorded discard and retained bycatch from pink shrimp (*Farfantepenaeus duorarum*) fishery in the Bay of Campeche during the 2016-2017 fishing season. 578 trawls were analyzed. We obtained estimates of shrimp catch, retained bycatch (RB) and discard bycatch (BD) rates of fishing season. The RB was 15.17% ± 1.57 (SE) and DB was 52.56 % ± 2.04. Months with the highest RB and DB values were December 2016 and January 2017. The fishing season rate of shrimp catch- bycatch ratio was 1: 3.93. 82 species were register in DB and 39 species in RB. Results show us that shrimp catch: bycatch rates found are low compared with other regions of the world. This situation is possibly result of adequate use of try net, the turtle excluder devices use, the empirical knowledge of the captains and the implementation of closed season.

KEYWORDS: Pink shrimp, *Farfantepenaeus duorarum*, bycatch, Campeche

Innovative Technologies Used for Ocean Observing

Innovadoras Tecnologías Utilizadas para la Observación de Océano

Les Technologies Innovantes Utilisées pour L'observation de L'océan

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ABSTRACT

The National Science Foundation funded Ocean Observatories Initiative (OOI) deploys and operates a variety of state of the art, ocean observing instruments. The instruments are deployed in seven ocean and coastal arrays in the North and South Atlantic and Pacific oceans. The OOI manages and integrates data from the over 800 instruments deployed among its seven arrays. Instruments are located on a myriad of platforms including gliders, AUVs, surface buoys, profilers, inductive mooring cables, and seafloor junction boxes. Overall there are nearly 75 models of specialized instrumentation used throughout the OOI that collect over 200 unique data products. The types of instruments used in the arrays are Fluorometers, HD Digital Cameras, Acoustic Doppler Current Profilers, Bio-acoustic sonar and many more. http://oceanobservatories.org/

Each year the instrument manufactures improve their instruments which in turn allows the OOI to increase its ocean observing capabilities. These technologies will continue to evolve for the foreseeable future, thus enabling GCFI members to increase data collection and their understanding of our oceans and seas.

The data collected from the OOI instruments can be analyzed and used to support reef surveys and wildlife movement. The instruments and technologies can also be used to analyze the impact of storms, seismic events and man made events like oil spills, on our reef systems. The way we use ocean observing technologies, is just as important as the technologies themselves. Instruments deployed on moorings can be moved to collect information, in anticipation of seasonal events and migratory patterns of sea life. Underwater autonomous vehicles can travel long distances while collecting data. The knowledge gained from using these technologies will increase man's understanding.

KEYWORDS: Technologies, ocean observatories, AUV platforms