BOOK OF ABSTRACTS
RESUMENES | RÉSUMÉS

71 CONFERENCIA ANUAL DEL GULF AND CARIBBEAN FISHERIES INSTITUTE

San Andrés, Colombia

5-9 Noviembre 2018

The Lanch Boat in the Islands of Old Providence and Ketlina in the Colombian Caribbean: The Persistence of Memory and Traditional Knowledge

La Embarcación Lanch en las Islas de Providencia y Santa Catalina, Caribe Colombiano: la Persistencia de la Memoria y Conocimiento Tradicional

Le Bateau Lanch dans les Îles de Providencia et Santa Catalina, Caraïbes Colombiennes: La Persistance de la Mémoire et des Savoirs Traditionnels

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ABSTRACT

In the islands of Old Providence and Ketlina in the Colombian Caribbean, cultural practices associated with the manufacturing of wooden boats have been developed, linking the knowledge of the community and connecting its history with its present. Years of specialization and refinement for the development of this knowledge resulted in types of boats such as Canoa, Catboat and Lanch. Being the latter, only manufactured on the islands, with their own designs for the modifications made, which emerged within the dynamics of the Caribbean identity. The processes of transformation suffered by the vessels were the factors that determined them, whether it was due to materials, manufacturing processes and / or construction techniques, as well as sociocultural factors. The identification of the current condition of the wooden boats was obtained from the location, type of vessel, name, owner, constructor, physical characteristics, condition, age of the vessels and their changes over time. To aim this, tools such as illustration, photography, technical drawings and interviews with the owners were used. In total, 28 wooden boats were identified, of which 21 are boats for fishing, with the remaining Catboat, which are recreational boats used for fishing. The semi-structured interviews with the owners, fishermen and builders and apprentices, sought to identify the route of memory, tradition, processes, the importance of knowledge and its relations with the Caribbean. Despite the socio-cultural dynamics since the 20th century, they promoted new practices, as well as the arrival of new vessels, materials and processes. Which has led traditional vessels to a process of replacement and transformation, or in several cases to disuse. But the community proposes that the dynamics of construction and generation of knowledge continue.

KEYWORDS: Boats, Caribbean, traditional knowledge

Historical Changes In The Fishing Effort Of The Parguera Fleet that Operates ffrom Taganga, Colombian Caribbean

Cambios Históricos en el Esfuerzo Pesquero de la Flota Parguera que Opera desde Taganga, Caribe Colombiano

Changements Historiques dans l'Effort de Pêche de la Flotte Parguera qui Fonctionne de Taganga, Caraïbe Colombienne

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RESUMEN

La pesquería artesanal avanzada de lanchas pargueras que opera en el área norte del mar Caribe de Colombia ha experimentado dificultades relacionadas con el volumen de los desembarcos que han llevado al colapso económico de la flota. Las disminuciones históricas en las abundancias de los recursos icticos demersales han ido expandiendo la frontera pesquera y en consecuencia el aumento del tiempo del viaje de pesca, la disminución de los ingresos y el incremento de los gastos de operación, representados principalmente por el combustible. Existen vacíos en el conocimiento de la distribución espacial histórica del esfuerzo pesquero de la flota que permitan asociarlo a los cambios en las abundancias relativas, la composición de las capturas y la disminución de tamaños de las especies. Mediante entrevistas a pescadores y con la ayuda del Conocimiento Ecológico Tradicional, el Conocimiento Local y el uso de sistemas de información geográfica (QGIS) se mapeó la distribución espacial del esfuerzo pesquero y su comportamiento interdecadal (desde los 70s hasta la actualidad). Como principales resultados se evidenció un aumento en la distancia del viaje de pesca (incrementó 134,5 km en casi 50 años) e incrementos en el área y profundidades de pesca que variaron de 27,8 a 1117,8 km2 y de 93,8 a 41,1 m, respectivamente. Los resultados obtenidos constituyen insumos valiosos para la implementación de estrategias de manejo orientadas a la flota que aseguren la sostenibilidad ecológica y la viabilidad económica de esta importante pesquería.

KEYWORDS: Pesquería artesanal, esfuerzo pesquero, CET

Spatial and Temporal Recruitment of Three Young-of-the-Year Commercial Snappers to Nearshore Seagrass Beds in the Middle Florida Keys

Distribución Espacial y Temporal en el Reclutamiento de Tres Juveniles de Oargo Comercial Hacia Praderas de Fanerógamas Marinas en los Cayos Centrales de Florida (Middle Florida Keys)

Variations Spatiales et Temporelles du Recrutement de Trois Jeunes Vivaneaux d'Intérêt Commercial, dans les Herbiers des Middle Florida Keys

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ABSTRACT

Monitoring year class strength of juvenile snapper could potentially offer an effective fishery independent method for predicting adult snapper abundance. We analyzed juvenile survey data on three commercially and recreationally important snapper species from the nearshore waters of the Middle Florida Keys; Yellowtail Snapper (*Ocyurus chrysurus*), Gray Snapper (*Lutjanus griseus*) and Mutton Snapper (*Lutjanus analis*). These three species support the largest recreational and commercial snapper fisheries in South Florida. However, relatively little is known about the factors that control recruitment and the settlement habitat preferences of these species also is poorly defined. In this study, ten sites were sampled monthly between 2006 and 2016 using a 21.3 meter seine net, in the shallow (<1.3m deep), mixed-species seagrass beds of the Atlantic side of the Middle Florida Keys. Snapper recruits were consistently collected throughout the sampling period, monthly density did not vary significantly between years. Recruitment peaked during late summer and fall (August-, October), suggesting that higher numbers of adult snappers were spawning in spring and summer (April to August). Continued evaluation of young-of-the-year snapper abundance is important in predicting recruitment to the commercial and recreational snapper fisheries in the Florida Keys and along the South Florida coast. A critical characteristic of the long-term annual seine survey conducted in the Florida Keys is the ability to identify years of below-average recruitment which, if persistent, can serve as an early warning to managers of potential declines in snapper spawning success or standing stock biomass.

KEYWORDS: Snappers, young of the year, recruitment

A Multi-methods Approach is Essential for Effective Management and Conservation of the Ecotourism-based Recreational Flats Fishery

Un Enfoque de Múltiples Métodos es Esencial para una Gestión y Conservación Efectivas de la Pesca de Llanuras Recreativas Basada en el Ecoturismo

Une Approche Multi-méthodes est Essentielle pour une Gestion et une Conservation Efficaces de la Pêcherie de Logements Récréatifs Basée sur L'écotourisme

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ABSTRACT

The recreational, catch and release fishery for fishes that inhabit shallow-water, coastal habitats (called the flats fishery) is economically valuable and increasingly perceived as a sustainable ecotourism strategy. However, knowledge of many aspects of target species ecology is incomplete, and fishery- and non-fishery-related threats to the fish and habitats are numerous and often poorly understood. Bonefish & Tarpon Trust has long focused on a multi-methods approach to obtaining sufficient knowledge to inform management and conservation. Conservation and management of flats fisheries present a challenge because the fisheries are typically data poor: they occur in locations that lack resources and there are scant data on the target species and their habitats. The multi-methods approach includes: studies of habitat ecology, connectivity at local (ontogenetic habitat connectivity, reproductive biology) and regional (planktonic larval transport, migration) scales; economic value and fishery sustainability; fish-habitat relationships and their interactions with anthropogenic stressors; and inclusion of citizen science and local ecological knowledge. In this presentation, the multi-methods approach will be summarized using examples in which scientific studies have been used to obtain actionable knowledge that has been applied to conservation, and providing a framework for applying this approach to other fisheries and locations.

KEYWORDS: Recreational fisheries, conservation, habitat

Queen Conch as Indicator of Pollution by Microplastics in the Caribbean

El Caracol Rosa como Indicador de Contaminación por Microplasticos en el Caribe

Le Lambi Comment Indicateur de Pollution par Microplastiques dans la Caribbe

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ABSTRACT

The occurrence of microplastics in the marine environment is increasing. These particles are available in the sediments and in the water column, where are ingested for marine organisms. The study was carried out to quantify and to analyse microplastics in the Caribbean using as indicator the Queen conch (*Strombus gigas*) with a non-destructive method. We sampled five organisms in each site: Banco Chinchorro (Mexico), Puerto Morelos (Mexico), Florida (USA), Guadeloupe (FWI) and Barbados. We obtained feces from each conch. Microplastics were extracted by degradation of organic matter, re suspended plastics and analysed by stereomicroscope, scanning electron microscope and Raman spectroscopy. Protocol used in this study showed presence of microplastics in the conchs. Various forms of particles are found. The dominant occurrences of plastics were fibers and the least were the spheres. Analyses of main components was realized between ecogeographic regions of the Caribbean and the abundance of plastics found. Conch from Banco Chinchorro, presented a high abundance of microplastics despite is far from the coast.

KEYWORDS: Micro plastiques, conch, *Strombus*

Preliminary Results of Distribution of Order Bryopsidales (Chlorophyta) in the Mesophotic Coral Reefs of Cuba

Resultados Preliminares de la Distribución del Orden Bryopsidales (Chlorophyta) en los Arrecifes Mesofóticos de Cuba

Résultats Préliminaires de la Distribution de l'Ordre Bryopsidales (Chlorophyta) sur les Récifs Coralliens Mésophotiques de Cuba

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ABSTRACT

Green algae of order Bryopsidales are often abundant in both shallow and mesophotic coral reefs. In Cuba, there is no information about the bathymetric distribution of this group, especially the species that inhabit the mesophotic coral reefs. That is why the objective of this work was to identify macroalgae species of the order Bryopsidales that are represented in this ecosystem. The study was conducted in two stages from May 17 to June 11, 2017, throughout the entire Cuban platform. Observations of data and images were collected on board during the dives using a vehicle operated by remote control with fixed and video cameras. Samples were also collected through this vehicle. A total of 44 specimens were collected in 22 locations belonging to the order Bryopsidales. These are distributed in 5 families and 7 genera and only 22 have been identified to species. The genus *Halimeda* (particularly *H. copiosa, H. goreaui* and *H. tuna*), *Avrainvillea, Penicillus, Udotea* (particularly *U. cyathiformis*) were common in the mesophotic coral reef of all regions of Cuba. An interesting maximum depth of some species was recorded: *Halimeda copiosa* at 127 m, *H. tuna* at 105 m, *Udotea cyathiformis* at 95 m, U. occidentalis at 62 m and *Penicillus dumetosus f. expansus* at 53 m depth. These results constitute the first data on macroalgae of the Bryopsidales order in Cuban mesophotic coral reefs.

KEYWORDS: Mesophotic coral reefs, order Bryopsidales, Chlorophyta

A Comparison of Lionfish Feeding Ecology Within the Invaded Region

Una Comparación de la Ecología de Alimentación del Pez León Dentro de la Región Invadida

Une Comparaison de l'Écologie de l'Alimentation du Poisson-lion dans la Région Envahie

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ABSTRACT

Widely regarded as a generalist predator with a voracious appetite, lionfish are principally piscivorous and have been known to feed opportunistically on a wide range of taxa including invertebrates. Lionfish have been present throughout the invaded Atlantic-Caribbean region across different habitats and for varying time scales. If lionfish feeding ecology differs among islands, the consequent ecological impacts are likely to vary, cautioning against drawing inferences from studies in contrasting habitats and warranting control strategies to be tailored accordingly. To determine the feeding ecology of lionfish in the southern Caribbean, the stomach contents of 11,161 lionfish from Bonaire, Klein Bonaire and Curacao were analysed. Stomach contents were identified and feeding ecology analysed to assess whether feeding behaviours and preferences were uniform throughout the introduced range. Dietary preferences were assessed to determine whether any traits of prey increased vulnerabilty to lionfish predation, Results were compared to the only other equivalent-scale analyses of stomach contents of invasive lionfish, drawn from the Bahamas. This research revealed that although lionfish diets amongst Bahamas, Bonare, Klein Bonaire and Curacao were similar in terms of composition, there were considerable differences in rankings of dietary importance. This research therefore confirms that the feeding behaviours and preferences of lionfish are not uniform throughout their introduced range and reveals the potentials implications for ecology if lionfish are not as ubiquitous as represented in the Bahamas.

KEYWORDS: Invasive, species, Caribbean

Use of Artificial Neural Networks as a Tool to Rebuild the Landings Records of Beach Seine Artisanal Fishery in Taganga, Colombian Caribbean

Uso de Redes Neuronales Artificiales como Herramienta para Reconstruir los Registros de Desembarcos de la Pesquería Artesanal de Chinchorro en Taganga, Caribe Colombiano

Utilisation de Réseaux de Neurones Artificiels pour Reconstituer les Enregistrements de Débarquements de la Pêcherie Artisanale de Sennes de Plage en Taganga, Caraïbes Colombiennes

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RESUMEN

Los desembarcos de las pesquerías artesanales de Colombia históricamente no han sido monitoreados de manera constante; muchas veces años completos sin registro de información y en los mejores de los casos con varios meses de un año sin datos. Las pesquerías de chinchorro de Taganga no son ajenas a esta realidad. Sin embargo, la fuerte relación que existe entre las especies desembarcadas por este arte de pesca (pasivo) y algunas variables ambientales permite realizar algunas aproximaciones para establecer las tendencias históricas de las tasas de captura de los recursos pesqueros explotados. Este trabajo se desarrolló en el marco de un proyecto que utilizó técnicas estadísticas robustas para reconstruir las series de tiempo de los desembarcos, basadas en la interacción con las variables ambientales que son frecuentemente registradas (temperatura superficial del mar, salinidad, precipitación y vientos) e índices globales y locales (MEI, NAO e índice de surgencia). Se reconstruyeron más de dos décadas de desembarcos artesanales provenientes de los chinchorros de Taganga. El enfoque metodológico del análisis estuvo basado en el uso de las redes neuronales, herramienta de amplia aplicación debido a la capacidad de resolver problemas no lineales. El resultado estableció la tendencia histórica de la abundancia relativa (CPUE) tanto para la captura total como para dos de las principales especies capturadas: cojinoa (*Caranx crysos*) y Bonito (*Euthynnus alletteratus*), a pesar de las amplias variaciones intra e interanuales es evidente la disminución histórica de la CPUE en todos los casos estudiados. Este insumo resulta de gran importancia para implementar las medidas de gestión y ordenamiento pesquero en procura de alcanzar la sostenibilidad ecológica de esta pesquería.

PALABRAS CLAVES: Pesca artesanal, desembarcos, chinchorro

Ranking of Fishing Gear According to the Impact That They Cause on Marine Ecosystems in the Northern of the Caribbean Sea of Colombia

Clasificación de los Artes de Pesca Según el Impacto Que Ocasionan a los Ecosistemas Marinos del Área Norte del Mar Caribe de Colombia

Classification des Engins de Pêche en Fonction de Leur Impact sur les Écosystèmes Marins de la Zone Nord de lLa Mer des Caraïbes en Colombie

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RESUMEN

Existe una amplia documentación de los impactos colaterales de algunas pesquerías, pero rara vez se ha abordado cuáles impactos se consideran más perjudiciales o se han comparado entre los diferentes artes de pesca. El conocimiento ecológico tradicional y el conocimiento de expertos pueden ayudar a responder a estas preguntas integrando diferentes puntos de vista y valores de conocimiento de distintos grupos focales (pescadores, científicos y administradores del recurso), para complementar las evaluaciones ecológicas actuales. La información se recopiló mediante una encuesta estructurada: en el caso de los pescadores se preparó un taller; mientras que la de científicos y autoridades se realizó on-line; con estos insumos se construyó un ranking de artes de pesca según el impacto que ocasionan al ambiente. La encuesta respondió a una sola pregunta, el texto de la pregunta fue: ¿en su opinión cual de este conjunto de impactos considera más severo para el ecosistema marino? Los impactos fueron: fondo marino, organismos del fondo, mariscos y cangrejos, peces, tiburones y rayas, mamíferos marinos y aves marinas y tortugas. La escala osciló de bajo a alto y fue cuantificada, siendo 1 el valor más bajo y 5 el más alto. Los artes de pesca fueron: red de enmalle, chinchorro, changa, boliche, línea de mano, palangre y nasa. Según la percepción de todos los encuestados la línea de mano es el arte que menor impacto ocasiona. Sin embargo, para los pescadores la comparación indicó que los chinchorros playeros y las changas son los artes que mayor impacto ocasionan, lo que no coincide exactamente con la percepción de los científicos y administradores. Las percepciones de cada grupo focal contribuyen a una mejor definición de las prioridades de conservación, información necesaria para una mejor gestión de los recursos pesqueros.

PALABRAS CLAVES: Pesca artesanal, artes de pesca, conocimiento ecológico tradicional

Local Ecological Knowledge and its Usefulness for the Management of an Ancestral Artisanal Fishery in the Colombian Caribbean

Conocimiento Ecológico Tradicional y su Utilidad para el Manejo de una Pesquería Artesanal Ancestral en el Caribe Colombiano

Savoir Écologique Traditionnel et Son Utilité pour la Gestion d'une Pêche Artisanale Ancestrale dans les Caraïbes Colombiennes

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RESUMEN

Taganga en el Caribe colombiano considera el uso del chinchorro "velao" como la actividad pesquera tradicional de mayor influencia cultural e histórica, no solo para la comunidad sino para la región. Este arte de pesca, operado desde la playa, fue empleado inicialmente por indígenas, quienes obtenían su subsistencia sin internarse en el mar. La Corporación de Pescadores Chinchorreros de Taganga es la organización de pescadores más antigua, constituida desde 1870 por la necesidad de organizar las faenas efectuadas en los diferentes ancones, constituyéndose en una de las primeras formas de co-manejo en la región. Con todo el acervo histórico disponible, se contrastó el conocimiento ecológico tradicional obtenido de los pescadores con la información científica disponible, explorando la utilidad de incorporarlo al manejo de la pesquería ancestral de chinchorro. Para ello se realizaron 40 entrevistas indagando sobre: arte de pesca, especies más capturadas, comportamiento de las especies, horarios, épocas de mayor captura, entre otros. La información colectada fue contrastada con el análisis de los registros de desembarco, que describió el comportamiento espacial de las capturas realizado mediante métodos multivariados; la comparación de las abundancias de los ancones utilizando análisis de similaridad y el contraste de la CPUE mediante Kurskall-Wallis. Las evidencias de ambas fuentes indican una disminución paulatina de las especies dominantes de los desembarcos, cuya abundancia responde a una marcada distribución espacial (disminución de abundancias en los ancones más cercanos al asentamiento humano más poblado). Reconociendo el alto grado de coincidencia entre los saberes, es necesario impulsar procesos de conservación y manejo que promuevan la inclusión del conocimiento de los pescadores para asegurar su éxito.

PALABRAS CLAVES: Pesquería artesanal, CET, chinchorro

Shark Movements and Residency Near Artificial Habitats in the Northern Gulf of Mexico

Movimientos y Residencia de Tiburones Cerca de Hábitats Artificiales en el Norte del Golfo de México

Mouvements et Résidence de Requins à Proximité d'Habitats Artificiels dans le Nord du Golfe du Mexique

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ABSTRACT

In the present study, acoustic telemetry was used to assess the movement and residency patterns of several shark species around artificial reefs in the northern Gulf of Mexico. Eight sandbar sharks (*Carcharhinus plumbeus*), five Atlantic sharpnose sharks (*Rhizoprionodon terraenovae*), four bull sharks (*Carcharhinus leucas*) and two nurse sharks (*Ginglymostoma cirratum*) were monitored within a 64 km2 area for periods of one to 450 days. Sandbar sharks had the highest overall residency indices (range = 0.004-0.432, mean±SD = 0.151±0.160) followed by nurse sharks (range = 0.02-0.10, mean±SD = 0.06±0.05), Atlantic sharpnose sharks (range = 0.001 – 0.049, mean±SD = 0.013±0.020) and bull sharks (range = 0.001 – 0.024, mean±SD = 0.012±0.010). Residency indices were not significantly different among species ($F_{4,17} = 2.37$, $P = 0.09$).

Residency indices were significantly different among seasons for sandbar sharks ($F_{3,65} = 3.81$, $P = 0.014$), nurse sharks ($F_{3,16} = 3.48$, $P=0.041$) and bull sharks ($F_{3,28} = 54.29$, $P < 0.001$). Five individuals also made long-distance seasonal migrations: two sandbar sharks were detected off the coast of Florida and South Carolina (247 km - 1,888 km), one bull shark was detected in the Florida Keys (844 km) and one nurse shark was detected in the Florida Keys in two consecutive years (864 km - 866 km). Homing behaviors were apparent for some migrating individuals. For example, one sandbar shark returned to the same site after a 3,776 km round-trip migration, and one nurse shark emigrated and returned to the same sites over four consecutive years. The present study indicates that individual sandbar sharks can show both high site fidelity and long-distance migrations. Similarly, individual nurse sharks can also perform long-distance migrations that are greater than previously known.

KEYWORDS: Acoustic telemetry, sandbar sharks, nurse sharks

Ashton Lagoon Restoration - Union's Future

Restauración de la Laguna Ashton - Futuro de la Unión

Restauration de la Lagune d'Ashton - l'Avenir de l'Union

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ABSTRACT

Sustainable Grenadines Inc. (SusGren) is executing the Ashton Lagoon Restoration Project (Union Island), which aims to restore conditions for marine life and develop eco-tourism in Ashton Lagoon, as well as raise awareness of climate change adaptation.

Project Objectives:

Objective A: To restore the Ashton Lagoon ecosystem including its mangroves and salt pond habitat to create a conducive environment for fisheries, coral and mangrove restoration and bird habitat, while increasing the coastal resilience to climate change.

Progress to date:

• SusGren has successful created 7 breaches in the Ashton Lagoon marina pier structure which has and will continue to aid in water circulation in the area.

Objective B: To strengthen community resilience to climate change for long term adaptive management of Ashton Lagoon while promoting opportunities for sustainable livelihoods and ecosystem resilience to climate change impacts.

• SusGren have completed the construction of the mooring blocks for installation

• Two wildlife viewing towers have been constructed

• Water taxis, Kite Surfers and Fishers now have improved access to and from the Ashton Bay, rather than going around Frigate Island which also saves them on fuel

• Commencement of the construction of the foundation for the completion of an Interpretive Centre

Objective C: To implement an effective communication, education and awareness program for the Ashton Lagoon Area to increase awareness and appreciation of natural resources management and climate change adaptation among the general public, stakeholders and government.

• SusGren has fully launched its Community Researcher Program (CRP) where it has 5 young people from the community conducting ongoing biophysical monitoring and data collection at Ashton Lagoon.

• Three (3) thousand red mangroves planted.

KEYWORDS: Ashton, lagoon, eco-touris

Engaging Civil Society in the Implementation of the Strategic Action Programme for the Sustainable Management of the Shared Living Marine Resources of the Caribbean and North Brazil Shelf Large Marine Ecosystems

Involucrando a la Sociedad Civil en la Implementación del Programa de Acción Estratégicas para la Gestión Sostenible de los Recursos Marinos de Vida Compartida de los Grandes Ecosistemas Marinos de la Plataforma Caribeña del Norte de Brasil

Engagement de la Société Civile dans la Mise en Oeuvre du Programme d'Action Stratégique pour la Gestion Durable des Ressources Marines Partégées des Grands Ecosystèmes Marins de la Caraïbe et du Plateau du Nord du Brésil

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ABSTRACT

As part of the UNDP/GEF Catalysing Implementation of the Strategic Action Programme for the Sustainable Management of Shared Living Marine Resources in the Caribbean and North Brazil Shelf Large Marine Ecosystems project (CLME+ Project) the Caribbean Natural Resources Institute is leading the participatory development of a CLME+ Civil Society Action Programme (C-SAP). The CLME+ C-SAP provides a framework to guide civil society's participation in implementing the politically endorsed 10-year Strategic Action Programme for the Sustainable Management of the Shared Living Marine Resources of the Caribbean and North Brazil Shelf Large Marine Ecosystems (CLME+ SAP). It outlines priorities identified by civil society on how it can best contribute to the implementation of priorities under the CLME+ SAP. It further identifies capacity building requirements needed by civil society so that it can effectively play a role in partnership with governments and other stakeholders.

C-SAP enables CSOs and community-based SMEs in the CLME+ region to commit to the implementation of a set of coordinated strategies and actions that will support the implementation of the CLME+ SAP. The CLME+ SAP and the associated C-SAP focus on three key ecosystem types: reef and associated ecosystems, pelagic ecosystems and the continental shelf ecosystems.

The C-SAP therefore is a guide for both civil society seeking to prioritise and focus its work as well as donors, governments and others who provide financial and technical support to civil society. Together, these contribute to supporting civil society to play an effective role in implementing the CLME+ SAP to improve the governance and management of shared living marine resources in the Caribbean and North Brazil Shelf Large Marine Ecosystems region.

KEYWORDS: Civil society, shared living marine resources, CLME+ region

Temporal Patterns Among Multiple Courtship Associated Sounds in the Red Hind *Epinephelus guttatus* Indicate Two Spawning Aggregations During a Single Lunar Cycle

Patrones Temporales Entre Múltiples Sonidos Asociados al Cortejo en el Mero Cabrilla *Epinephelus guttatus* Indican Dos Agregaciones de Desove Durante Un Ciclo Lunar

Les Schémas Temporels Parmi les Multiples sons Associés à la Parade Nuptiale dans le Mérou *Epinephelus guttatus* Indiquent Deux Regroupements de Géniteurs au Cours d'un Cycle Lunaire

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ABSTRACT

Red hind form transient spawning aggregations that follow a lunar cycle. Passive acoustic monitoring has shown to be a reliable indicator of this temporal pattern in spawning activity. Long-term acoustic monitoring and changes in abundances of red hind at Abrir La Sierra, Puerto Rico show that peak spawning consistently occurs 7-10 days after full moon (DAFM). However, acoustic records revealed occasional, extended periods of high sound production prior to the expected aggregation period. Recently, we have been able to differentiate red hind courtship-associated sounds into new types ("moon", "flag", "moon-extended" and "moon+flag", plus general "chorusing"). We analyzed this more-detailed calling behavior to establish their temporal patterns during the lunar spawning cycle. We then used these patterns to infer behavior during the extended periods of calling activity. During the expected lunar cycle, flag calls were the most abundant call at 0-6 DAFM - the onset of the aggregation. This call quickly became replaced by moon calls during the spawning peak (7-12 DAFM), when moon-extended calls and chorusing were also high. This pattern was found to be repeated during the extended calling period, which occurred 14 days before the expected spawning peak. These results suggest that two spawning events could occur during one lunar cycle. The 14-day offset further suggests that the two spawning events occur under similar conditions of current speed and direction, but that lunar light levels would be different. Additional studies are needed to identify the behavior associated with each call type to further understand the calling behavior patterns.

KEYWORDS: Red Hind, *Epinephelus guttatus*, spawning aggregations

BIOPAMA: From Knowledge to Action for a Protected Planet

BIOPAMA: Del Conocimiento a la Acción para un Planeta Protegido

BIOPAMA: De la Connaissance à l'Action pour une Planète Protégée

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ABSTRACT

Within the Caribbean, there is an abundance of data collected by state, non-governmental and academic agencies on marine and terrestrial protected areas (PAs). However, the region continues to be challenged in its capacity to translate captured data into collective knowledge that can inform actions on biodiversity conservation, while providing socioeconomic and cultural benefits for those whose livelihoods depend on these natural resources. A regional approach to this challenge is being facilitated by the Biodiversity and Protected Areas Management (BIOPAMA) Programme (2017-2023), a global programme implemented by the European Commission's Joint Research Centre and the International Union for Conservation of Nature (IUCN), which aims to improve the conservation and sustainable use of natural resources in PAs and surrounding communities within the African, Caribbean and Pacific Group. IUCN is working with the University of the West Indies to reinforce effective management of biodiversity and governance of PAs within the 15 Caribbean member states. The response is being driven mainly through the Caribbean Protected Areas Gateway (Caribbean Gateway), a regional centre for research and innovation that interprets and shares data to understand, predict and communicate phenomena in a changing environment. Natural disaster preparation and response; ecosystem valuations; the identification, collection, storage, assimilation and sharing of data; are among the conservation priorities identified for the Caribbean Gateway. BIOPAMA will also address capacity building to improve decision-making and prioritization of resource allocation in biodiversity and protected area management and governance; and provide financial support, via a competitive process, for site-based targeted conservation actions by local and regional projects.

KEYWORDS: Protected areas, capacity building, BIOPAMA

Establishment of Fisherfolk Organizations in Suriname

Establecimiento de Organizaciones de Pescadores en Suriname

Création d'Organisations de Pêcheurs au Suriname

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ABSTRACT

The artisanal fishery, comprising of about 800 license holders, is an important pillar for the fishing and fish processing industry in Suriname. The fishery contributes to the production and supply of raw materials for both the exporting companies and for local consumption. This subsector has immediate implications for a substantial part of society, in terms of provision of protein, creating jobs and generation of foreign currency. The 2014-2018 Fisheries Management Plan for Suriname was completed in 2013 and sets out the necessary measures to attain the goals as derived from the fisheries policy. As such, the Department of Fisheries supported initiatives aiming to increase the degree of fishers' organization. Over the period 2016-2017, with the support of several national and regional projects, training, mentoring and capacity building activities were carried out with the artisanal fishers of the coastal districts in Suriname. This resulted in the formal establishment of five fisherfolk organizations. In 2018, representatives from each organization were united in a national umbrella organization called SUNFO, the Suriname National Fisherfolk Organization. SUNFO will contribute to strengthening the capacity of fishermen to participate in fisheries management at national and regional level. Further, as a member of the Caribbean Network of Fishersfolk Organization (CNFO), SUNFO will represent Suriname's artisanal fishers internationally. The fisherfolk organizations in Suriname aim to improve fishermen's livelihoods by developing a sustainable and profitable industry through networking, representation and capacity building.

KEYWORDS: Fisherfolk organizations, Suriname, co-management

Spatio-Temporal Distribution of Pelagic Species in Relation to Temperature and Salinity in Magdalena, Colombian Caribbean

Distribución Espacio-Temporal de Peces Pelágicos con Relación a la Temperatura y Salinidad en El Magdalena, Caribe Colombiano

Distribution Spatio-Temporelle des Espèces Pélagiques en Fonction de la Température et de la Salinité à Magdalena, Caraïbes Colombiennes

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ABSTRACT

The Colombian Caribbean has a wide marine biodiversity and oceanographic characteristics that make it a tourist attraction. Recreational fishing has become one of the fastest development alternatives for the tourism growth worldwide. The temporal and spatial distribution of the recreational pelagic fishes are determined by several factors such as temperature, salinity, oxygen, depth. Therefore, the aim of this study is to determine the spatial-temporal distribution of the recreational pelagic fishes its relationship to temperature and salinity variables. Data was analyzed from monthly catches taken by trolling method and the usual fishing gears (rod, artificial lures). Every catch has a geographic position by a GPS and the oceanographic variables were taken by a CTD. The result showed that the months with the highest abundance were july and august. All the individuals were registered within the temperature range from 25.5 to 27.32 °C, presenting the highest catches between 25 and 26°C in species such as blue runner (*Caranx crysos*), dolphinfish (*Coryphaena hippurus*), little tunny (*Euthynnus alletteratus*), great barracuda (*Sphyraena barracuda*), Crevalle jack (*Caranx hippos*) and albacore (*Thunnus alalunga*). Nevertheless, species as Serra Spanish mackerel (*Scomberomorus brasiliensis*) showed preference to warm waters with temperatures above 27°C. Salinity data was registered from 35.18 to 37.21 PSU, with highest catches between 36.6 to 36.9 PSU. Tunas as albacore and little tunny were distributed in waters with salinity from 36.25 to 36.91 PSU. However, high abundance of these species was found within the range from 36.3 to 36.6 PSU. These results may help to increase the potential of the recreational fishing, to get knowledge about the spatial distribution and proper fisheries management without risk to overexploitation.

KEYWORDS: Pelagic fishes, recreational fishing, trolling

Large Scale Reef Restoration in the Seaflower Biosphere Reserve – San Andres, Providence and Santa Catalina Archipelago, Colombian Caribbean

Restauración a Gran Escala de los Arrecifes de Coral en la Reserva de Biosfera Seaflower - Archipiélago de San Andrés, Providencia y Santa Catalina, Caribe Colombiano

Restauration de Récifs à Grande Échelle dans la Réserve de Biosphère Seaflower - Archipel de San Andres, Providencia et Santa Catalina, Caraïbes colombiennes

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ABSTRACT

October 2017 saw the start of Colombia's largest coral rehabilitation project via two-step concept of coral gardening. The project objective is to upscale coral reef restoration actions in the San Andres, Providence and Santa Catalina archipelago to accelerate the natural recovery of intervened reefs, promote adaptation to climate change, anticipate the direct effects of anthropogenic origin, and reach a great social impact. In its first phase, five underwater rope nurseries have been built with the capacity to grow at least 10.000 fragments of coral reef species. The initial stock is 5302 fragments of four hard corals, three soft corals and two sponges' species. Six months after stocking, the average fragment survival (89% ± 7 SE) and the increase in ecological volume (EV) recorded (365% ± 99 SE of their initial size) are within the reference values for reef restoration projects in the Caribbean. Construction, installation, stocking and monitoring nurseries and corals was conducted by more than 50 people representing different relevant social actors, aimed at developing the local capacity in coral gardening and the monitoring of coral reefs in the archipelago. In three years, we expect to see that the joint protection of selected sites with the addition of ca. 5.000 nursery-grown coral colonies per hectare, lead to a 10% increase in the live coral cover, fish biomass, aesthetic value and structural complexity and overall health at intervened coral reefs within the Seaflower MPA.

KEYWORDS: Coral reef conservation, reef restoration, coral gardenin

Current Status (2017) of the Queen Conch (*Lobatus gigas*) (Linnaeus, 1758) Populations in the Seaflower Biosphere Reserve, Serranilla Bank, Courtown and Southwest Cays

Estado Actual (2017) de las Poblaciones de Caracol Pala (*Lobatus gigas*) (Linnaeus, 1758) en la Reserva de Biosfera Seaflower, Islas Cayo Serranilla, Bolívar y Alburquerque

Statut Actuel (2017) des Populations de Lambi (*Lobatus gigas*) (Linnaeus, 1758) dans la Réserve de Biosphère Seaflower, dans les Cayes Serranilla, Bolivar et Alburquerque

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ABSTRACT

The queen conch *Lobatus gigas* is an important fisheries resource in the Caribbean region. The Departmental Government of the Archipelago of San Andres, Providence and Santa Catalina and CORALINA have been monitoring this species populations for more than a decade. Between September and October 2017, populations of the queen conch were evaluated in the Serranilla bank (north of Providence) and Courtown and Southwest Cays (southern area of Seaflower MPA). Abundance and density estimates were made from visual assessments and biometrics along transects in stations within the cays' reef shelf, obtained randomly in 2007. In Serranilla the total average density was 28.74 ind.*ha-1 (± 47.5 SE), with a maximum of 208.33 ind.*ha-1, mostly adults, the highest density recorded there during this decade and their total average length was 21.03 cm (±4.91 SE). In Courtown and Southwest Cays total average density was 124.26 ind.*ha-1 (± 840.69 SE), their total average length was 21.03 cm (±4.91 SE) and 39 ind.*ha-1 (±236.36 SE) with a total average length of 20.67 cm (±3.26 SE), respectively, most of them juveniles. We concluded that the populations of the queen conch in Serranilla and in the southern area of the MPA have densities similar to those of overexploited areas in the Caribbean and it's necessary to implement relevant measures that allow to recovery and sustainable use of this resource by the communities if the Seaflower biosphere reserve.

KEYWORDS: Queen conch populations, Caribbean fisheries, Seaflower biosphere reserve

Payment for Environmental Services Scheme $BanCO_2$ in the Reef Restoration in the San Andres, Providence, and Santa Catalina Archipelago, Colombian Caribbean

Esquema de Pago por Servicios Ambientales $BanCO_2$ en la Restauración de Arrecifes en el Archipiélago de San Andrés, Providencia y Santa Catalina, Caribe Colombiano

Système de Paiement pour Services Environnementaux $BanCO_2$ dans la Restauration des Récifs dans L'Archipel de San Andres, Providencia et Santa Catalina, Caraïbes Colombiennes

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ABSTRACT

October 2017 saw the start of Colombia's largest coral rehabilitation project via coral gardening. The project objective is to upscale coral reef restoration actions in the San Andres, Providence and Santa Catalina archipelago to accelerate the natural recovery of intervened reefs, promote adaptation to climate change, anticipate the direct effects of anthropogenic origin, and reach a great social impact. In its first phase, five nurseries have been built with the capacity to grow at least 10.000 fragments of coral reef species. The initial stock is 5302 fragments of four hard corals, three soft corals and two sponge species. Construction, installation, stocking and monitoring of nurseries and corals was conducted by more than 50 people representing different relevant social actors, aimed at developing the local capacity in coral gardening and the monitoring of coral reefs in the archipelago. Simultaneously, the project is piloting the first payment for environmental services scheme $BanCO_2$ for marine areas in Colombia, which seeks to offer an alternative livelihood to artisanal fishermen committed to enforce local coral reef protection and to assist with coral rehabilitation activities within participatory designed voluntary conservation agreements. In three years, we expect to see that the joint protection of selected sites with the addition of ca. 5.000 nursery-grown coral colonies per hectare, lead to a 10% increase in the live coral cover, fish biomass, aesthetic value and structural complexity and overall health at intervened coral reefs within the Seaflower MPA.

KEYWORDS: Coral reef conservation, reef restoration, participatory action

Giving New Life and Restoring Grenada's Coral Reefs Through Biorock

Dando Una Nueva Vida y Restaurando los Arrecifes Coralinos de Granada con Biorock

Donner une Nouvelle Vie et Restaurer les Récifs Coralliens de Grenade avec Biorock

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ABSTRACT

Grenada like most of the island in the Caribbean Region had seen the deterioration on their coral reefs including the loss of Acroporid corals (i.e. *Acropora cervicornis* and *Acropora palmata*) which were the most important reef building coral species. In order to combat the further degradation of the coral reef in Grenada, the Grenada Coral Reef Foundation (GCRF) partnered with the Global Coral Reef Alliance (GCRA) to introduce BiorockÓ at two pilot sites in Grenada (i.e. Gouyave & Carriacou). BiorockÓ technology in the simplest terms utilizes a low voltage current to facilitate mineral accretion ($CaCO_3$) on specially fabricated steel artificial reef structures onto which coral fragments are then propagated. The electrified structures have proven very successful in restoring reefs at a number of sites around the world by accelerating coral growth, recruitment and enhancing resistance and survival of reef organisms to environmental stressors (e.g. sedimentation, pollution, elevated ocean temperatures). This paper outlines the process of establishing sixteen BiorockÓ structures using community volunteers and explore the benefit of the technology at the pilot sites by examining the growth rate for selected corals species on the BiorockÓ structures versus the same species on a natural reef over a period of six months.

KEYWORDS: Coral reefs, biorock, restoration

Phylogenetic Relationships of the Deep-Sea Fish Genus Polylepion (Teleostei: Labridae), with a New Species Description from the Western Atlantic

Relaciones Filogenéticas del Género de Peces de Aguas Profundas Polylepion (Teleostei: Labridae), con la Descripción de Una Nueva Especie del Atlántico Occidental

Relations Phylogénétiques du Genre des Poissons D'eau Profonde Polylepion (Teleostei: Labridae), avec la Description D'une Nouvelle Espèce de l'Atlantique Ouest

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ABSTRACT

Among marine fishes, the family Labridae comprises over 600 species in 82 genera displaying a broad array of anatomical and ecological adaptations across tropical and subtropical waters. Although most species of wrasses inhabit shallow-waters, a few species are found from 100 to 400 m depth, including the genus Polylepion, which comprises two species currently described (*P. cruentatum* and *P. russelli*). While Polylepion is thought to be restricted to the North and Indo-Central Pacific basins, material of the genus was recently collected in the Western Atlantic (WA) using deep-diving submersibles in Curaçao (Curasub), Bahamas (Johnson Sea Link sub) and Honduras (Idabel sub). The new material collected substantially extends the distribution of the genus, raising interesting questions about its biogeography and evolutionary history. Here, we provide a molecular phylogeny for Polylepion based on new sequence data from two species (P. cruentatum and the WA species). We sequenced eight genetic markers that were added to a previously published dataset consisting of 254 species of wrasses (including P. russelli). Our results resolve the phylogenetic and biogeographic history of the species of Polylepion, further supporting the molecular delineation of the undescribed WA species. Finally, we collected additional information for the WA species, including coloration, traditional morphometric measurements, and meristic data, providing unambiguous morphological diagnosis from its two congeners.

KEYWORDS: Teleostei, biogeography, multilocus phylogeny

Developing a Participatory GIS for the Management of the Gulf of Paria Shrimp Trawl Fishery in Trinidad

Desarrollar un SIG Participativo para la Gestión de la Pesquería de Arrastre de Camarón en el Golfo de Paria en Trinidad

Développement d'un SIG Participatif pour la Gestion de la Ppêcherie au Chalut à Crevettes du Golfe de Paria à Trinidad

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ABSTRACT

As part of the Sustainable Management of Bycatch in Latin America and Caribbean Trawl Fisheries (REBYC-II LAC) project, the need for a Participatory Geographic Information System (PGIS) to aid decision-making and management of the Gulf of Paria shrimp trawl fishery in Trinidad was identified. We discuss how in a short timeframe a PGIS approach was applied to among a wide range of stakeholders to collaboratively identify existing spatial information, collect local knowledge on the shrimp fishery and Gulf of Paria ecosystem, and allow for the construction of a geodatabase to support an ecosystem approach to fisheries (EAF). A number of participatory research methods (i.e. preliminary assessment, key informant interviews, participatory mapping exercises, seasonal calendars, historical lines) were applied to collect a range of socio-economic, habitat, resource and space-use information and fill identified spatial data gaps. Ultimately the PGIS will be applied to integrate local knowledge of the shrimp bottom-trawl fishery with conventional scientific data to allow for a broader understanding of human-environment interactions occurring within the Gulf of Paria ecosystem in Trinidad.

KEYWORDS: PGIS, shrimp, trawling

Identity of Origin as a Strategy of Management and Sustainability in the Caribbean: The Case of the Black Crab and the Spiny Lobster

La Identidad de Origen como Estrategia de Manejo y Sustentabilidad en el Caribe: El Caso del Cangrejo Negro y la Langosta Espinosa

L'Identité d'Origine comme Stratégie de Gestion et de Durabilité dans les Caraïbes: Le Cas du Crabe Noir et de la Langouste Blanche

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RESUMEN

El turismo gastronómico ha aumentado significativamente en todo el mundo. Los países que han logrado valorizar sus sistemas alimentarios se han beneficiado de esta fuente de ingresos al representar un incentivo adicional para atraer a turistas internacionales o regionales. Este artículo analiza el vínculo potencial entre la pesca de pequeña escala y el turismo gastronómico en tres reservas marinas de la biosfera en el Caribe. Se exploran dos casos de estudio de pesquerías artesanales del Cangrejo Negro de Providencia *(Gerarcinus rurcola*) en Colombia y de la Langosta Espinosa (*P. argus*) en México, que han sido declarados baluartes de Slow Food, basándose en la preservación de la biodiversidad y en el rol de los productores de pequeña escala. Los baluartes fomentan la transición hacia un sistema de producción, distribución y consumo de alimentos que sea bueno, limpio y justo. A través de su creación y fortalecimiento se valorizan dos productos locales y/o endémicos, y se analizan los efectos en las comunidades que dependen de ellos. Dichas especies sirven como instrumento dinamizador de los territorios e impulsan alianzas virtuosas entre los actores de diferentes sectores, fortaleciendo sus capacidades e incidiendo en la elaboración de políticas públicas más inclusivas. Se espera que la diversificación de las actividades productivas y los canales de comercialización, incrementen la resiliencia de las comunidades, por ejemplo con el desarrollo de rutas ictioturísticas y ecoturística, involucrando a los numerosos actores de la cadena de valor de dichas especies.

PALABRAS CLAVES: Identidad de origen, biodiversidad, pesca sostenible

NOAA's Coral Reef Conservation Program: Establishing an Emphasis on Coral Restoration

Programa de Conservación de Arrecifes de Coral de la NOAA: Establecer un Énfasis en la Restauración de Corales

Programme de Conservation des Récifs Coralliens de la NOAA: Mettre l'Accent sur la Restauration des Coraux

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ABSTRACT

NOAA's Coral Program's new Strategic Plan formally establishes an additional pillar of work: Restore Viable Coral Populations. This pillar specifically addresses building and maintaining resistance and resilience to threats and will drive recovery of the ecosystem. This pillar will support necessary research, implement on-the-ground actions to prevent additional losses of corals and their habitat, and apply innovations in restoration and intervention techniques to create resilient, genetically diverse, and reproductively viable populations of key coral species. Active and targeted coral repopulation, using novel ecological interventions (e.g., stress hardening and assisted gene flow), will facilitate adaptation of coral reef ecosystems to evolving environmental conditions. Additionally, the Coral Program will improve the use of regulatory mandates to prevent loss of coral and coral reef habitat through supporting technical knowledge transfer to permitting agencies, encouraging consistent use of best management practices, and informing mitigation options with appropriate restoration techniques.

The Coral Program will require the assistance of numerous partners to realize the objectives of these restoration and resilience strategies. The Coral Restoration Consortium is a primary partner, because its membership spans the various disciplines and expertise required. To research and develop the various techniques, the Coral Program will engage academia, nongovernmental organizations, and private industry.Implementation of these techniques at ecologically meaningful scales will also require partnership with restoration practitioners, private foundations, and federal and local management agencies, as well as less traditional partners in engineering and technology development.

KEYWORDS: Coral, restoration, conservation

Judging Size Limits on Blue Marlin in the Gulf Coast Triple Crown

Juzgando Límites de Tamaño en Blue Marlin en la Triple Corona de la Costa del Golfo

Jugement des Limites de Taille du Marlin Bleu dans la Triple Couronne de la Côte du Golfe

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ABSTRACT

Recreational fishing tournaments have long been key events in many different regions, countries, and fisheries. These tournaments expose people to unique fisheries as well as bring economic gain to areas hosting the tournaments. Arguably the most prestigious and lucrative of these recreational fishing tournaments are those centered around blue marlin fishing. In these tournaments, participants can win money by either catching and releasing the most blue marlin or weighing the heaviest blue marlin. For example, tournaments such as the White Marlin Open and Bisbee's Black and Blue offer winnings near and above one million dollars for first place. The Gulf Coast Triple Crown (GCTC) is a series of five blue marlin tournaments in the northern Gulf of Mexico. For the GCTC tournaments, blue marlin are allowed to be killed for the potential to win large amounts of money, often between $200,000 and $300,000. In order to be killed in a GCTC tournament, a blue marlin has to reach a minimum length of 107 inches, also known as the size limit. The size limit in these tournaments still allow smaller blue marlin to be weighed that will not win any prize money or place on the leaderboard and are wasted. From a recreational standpoint, blue marlin fishing is mostly catch and release. Therefore, killing a fish that does not win any prize money is a waste because normally that fish would have been released and continued to contribute to the growth of the stock. By increasing the size limit, this waste can potentially be reduced. However, changing the size limit has implications from a social, economic, and biological standpoint. This project analyzed catch data from the tournaments for the past five years as well as interviews with tournamentdirectors, fishermen, and people of the industry to determine the best size limit to reduce waste.

KEYWORDS: Blue Marlin, recreational fishing, pelagic fisheries

Hindcasting the 2017 Dispersal of *Sargassum* in the Tropical North Atlantic

Reanálisis de la Dispersion de las Algas *Sargasso* in 2017 en el Atlantico Tropical Norte

Reconstruction de la Dérive des *Sargasses* de 2017 en Atlantique Tropical Nord

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ABSTRACT

Since 2011, massive amounts of *Sargassum* algae are washing ashore on the coasts of the West Indies, Brazil and West Africa. These algae are supposedly coming from a new region, called North Equatorial Recirculation Region, spanning the tropical and equatorial Atlantic south of 20 °N. Tracked through satellite (Alternative Floating Algae Index, aFAI from MODIS), the extent, location and spreading of *Sargassum* aggregation in the NERR show large changes at seasonal and interannual time scales. Although hypothesized, the role of passive transport of algae in the observed evolving distribution of these aggregations was not explicitly tested.

Here we used oceanic currents from a data-assimilative model to simulate the Lagrangian passive transport of algae from month to month over 2017. Simulations show reasonable agreement with satellite monthly distribution that validate the hypothesis of passive transport as being the main driver of the distribution changes. The seasonal cycle is driven by the North equatorial current, the North Brazil current and the Equatorial counter current. It starts with accumulation in the central Atlantic, drifting westward, then northwestward from North Brazil to Caribbean in the Spring, then splitting : part drifting further northwest, part returning east in the summer to accumulate off West Africa in the fall. The windage impact on *Sargassum* transport was also tested. Potential source and sink regions are discussed.

KEYWORDS: Lagrangian drift, transport, connectivity

Emigration Patterns and Den Shifting for Two Life-Stages of *Panulirus argus* (Latreille, 1804) in the Florida Keys, Florida, USA

Patrones de Emigración y Desplazamiento del Den para dos Etapas de Vida de *Panulirus argus* (Latreille, 1804) en los Florida Keys, Florida, USA

Schémas d'Émigration et Déplacement des Tanières pour Deux Stades de Développement de *Panulirus argus* (Latreille, 1804) dans les Florida Keys, Florida, USA

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ABSTRACT

The rate and direction of *Panulirus argus* emigration and distance lobsters moved when selecting dens were measured at three sites in the Florida Keys to evaluate the potential differences of subadult and adult life-stages on movement. The first site, Coral Gardens was in the Atlantic nearshore waters of the Florida Keys with predominately small subadult lobsters. The second site, Snipe Point was in Gulf of Mexico; a site with subadults that were typically larger than the adult lobsters at the third site, Western Sambo. Western Sambo was in the Atlantic, but further from shore than Coral Gardens. At each site, we deployed acoustic receivers with overlapping detection areas to estimate locations of the 14 to 39 lobsters tagged per site. We found the probability of lobsters' changing their den (daytime shelter location) and the distance moved were virtually identical at Snipe Point and Western Sambo but distance moved was less at Coral Gardens. Emigrations were detected in all three sites and were estimated between one and two percent per day. Emigration directions were different, westward for Snipe Point, southward for Coral Gardens and omnidirectional for Western Sambo. Emigration patterns at Snipe Point and Coral Gardens were consistent with other studies showing radial migration of juvenile lobsters emanating from Florida Bay that, in this study become highly directional towards adult habitat as the lobsters grew and become subadults. These other studies found faster growth in northern Florida Bay which may explain the large size of subadults we found at Snipe Point.

KEYWORDS: Acoustic, spiny lobster, Florida Keys

The Impacts of Hurricanes Irma and Maria on the Natural Marine Resources on Sint Maarten: Lessons Learned and Updated Management Techniques in Response to Natural Disasters

Los Impactos de los Huracanes Irma y Maria en los Recursos Marinos Naturales en San Martín: Lecciones Aprendidas y Técnicas de Gestión Actualizadas en Respuesta a los Desastres Naturales

Les Impacts des Ouragans Irma et Maria Sur les Ressources Marines Naturelles à Sint Maarten: Leçons Apprises et Techniques de Gestion Mises à Jour en Réponse aux Catastrophes Naturelles

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ABSTRACT

The 2017 Hurricane Season saw disastrous weather events throughout the Caribbean. Hurricanes Irma and Maria caused widespread damage and destruction to various Caribbean Countries. Aside from damage caused to home and infrastructure there was also significant ecosystem impacts caused by both Hurricanes. Hurricane Irma impacted the Marine Environment significantly, causing the Management Authority, the Sint Maarten Nature Foundation, to adjust its conservation strategies and management plans to include disaster preparedness and ecosystem resiliency plans moving forward. These plans and strategies include the health and safety of personnel, having a scenario-based preparedness plan, having good ecosystem data available for post-hurricane assessments, the inclusion of conservation management organizations in Disaster Preparedness and Recovery Teams, the inclusion of disaster preparedness and response in Protected Area Management Plans, using ecosystem valuation studies as a basis for post disaster damage assessments of ecosystems, and the communication of the importance of Natural Resource Conservation Management in terms of resiliency. Using these lessons learned the Sint Maarten Nature Foundation will be better prepared to respond to emergency scenarios and ensure ecosystem resiliency at a time when significant weather events are more likely to increase in intensity and frequency in the Caribbean.

KEYWORDS: Hurricane Irma, MPA, Sint Maarten

Relationships Between Spawning Behavior and Life History Traits in Gulf of Mexico Fishes: Implications for Vulnerability Assessments

Relaciones entre el Comportamiento de Desove y los Rasgos de la Historia de Vida en los Peces del Golfo de México: Implicaciones para las Evaluaciones de Vulnerabilidad

Relations Entre le Comportement de Frai et les Caractéristiques du Cycle de Vie des Poissons du Golfe du Mexique: Implications pour les Évaluations de la Vulnérabilité

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ABSTRACT

Maintaining the resilience of a stock while managing near maximum sustainable yield is the cornerstone of fisheries management. Resilience is often correlated to life history traits, but consideration of reproductive behaviour may provide insight that can help identify species that are particularly vulnerable to fishing during spawning. We synthesized information on the life history and spawning behaviour of 28 fishery species in the Gulf of Mexico through literature review and expert elicitation to determine if life history traits were correlated with aspects of reproductive behaviour. We also used life history traits and spawning behaviour to assess the vulnerability to fishing for each species and compared the vulnerability scores to a productivity susceptibility analysis that did not include reproductive behaviour. Our results show that spawning behaviours are not correlated with life history traits. Principal component analysis separated each group of traits between the first two principal components, which explained 65.0% of the variation. Further, species that have been overfished had significantly higher vulnerability scores than not-overfished species along the spawning behaviour axis, illustrating that traits associated with spawning behaviour represent a distinct aspect of fish ecology that is important to consider for predictions of vulnerability and resilience in exploited stocks. The vulnerability analysis also identified species that aggregate to spawn with large changes in density for short periods of time as the most vulnerable to fishing. This distinction is important, because reproductive behaviour is rarely comprehensively incorporated within stock assessments or the management of exploited fishes in the Gulf of Mexico or elsewhere.

KEYWORDS: Fisheries, Gulf of Mexico, spawning behavior

Depredation Mortality Associated With Catch-and-Release Angling on Offshore Permit (*Trachinotus falcatus*) Spawning Aggregations in the Lower Florida Keys, USA.

Mortalidad por Depreciación Asociada con la Pesca de Captura y Liberación en las Agregaciones de Desove del Permiso en el Mar (*Trachinotus falcatus*) en los Cayos de la Florida, EE.UU.

Mortalité due à la Déprédation Associée à la Pêche à la Ligne avec Remise à l'Eau sur les Concentrations de Frai des Permis au Large (*Trachinotus falcatus*) dans la Partie Inférieure des Keys, aux États-Unis.

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ABSTRACT

Extended periods of concentrated extractive fishing on spawning aggregations are known to result in long-term and sometimes irreversible damage to regional populations of aggregating species. Indeed, the Special Permit Zone, a closure extending from Cape Sable, Florida, U.S. to the Southern Boundary of Florida Keys National Marine Sanctuary, was enacted to protect Permit (*Trachinotus falcatus*) from harvest during their spawning season between April and July. Unfortunately, catch-and-release fishing for trophy Permit on aggregation sites in the Gulf of Mexico and South Atlantic, adjacent to the Florida Keys, has seen a significant increase in the past several years. Though the aggregations in South Florida are not vulnerable to harvest, decreases in the prevalence of Permit in near shore habitats are being attributed to the high rate of mortality associated with depredation during offshore aggregation fishing events. To address these concerns we developed a two part study focusing on Western Dry Rocks, an important management area 15km Southwest of Key West, Florida. First, we are quantifying the level of fishing effort and landings through the spawning season on reported aggregations using direct observation and trip intercept techniques; and second, we are quantifying depredation associated mortality using fisheries-independent surveys, acoustic imaging sonar, and trip intercept reports. These data will provide a more complete understanding of the relationship between catch-and-release angling activities and shark depredation on spawning aggregations, and will also identify the overall impact of non-extractive fishing practices on this ecologically and economically important resource.

KEYWORDS: Permit, depredation, fish spawning aggregations

An Assessment of the Efficacy of Grenada's National Adaptation Plan: Implications for Seagrass Management in the Caribbean

Una Evaluación de la Eficacia del Plan Nacional de Adaptación De Grenada: Implicaciones para el Manejo de Pastos Marinos en el Caribe

Une Évaluation de l'Efficacité du Plan National d'Adaptation de la Grenade: Implications pour la Gestion des Herbiers dans les Caraïbes

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ABSTRACT

Climate change is thought to negatively impact the resilience of marine ecosystems in Caribbean countries. While marine habitats have been the focus of previous governmental initiatives in Grenada, specific management plans for seagrass beds are yet to be developed. In this study, seagrass density (*Thalassia testudinum*) and other environmental factors were measured on benthic transects in nearshore ecosystems on the East and West coasts of Grenada (n=192), to assess disturbance interfering with coastal ecosystem resilience and the government's current approach to habitat conservation. Parametric exploratory data analysis, GLM models and nMDS were used to investigate the effects of disturbance on seagrass density. The data showed that seagrass density correlated significantly with the level of disturbance at the study sites ($P < 0.001$). The data also showed that disturbed seagrass beds (>15cm long) grew less densely, suggesting that continued disturbance may impact the habitat's suitability for supporting marine life. Environmental factors such as shallow water ($P < 0.001$) and temperature rise ($P < 0.001$) also had a negative effect on seagrass density, which implies that long-term disturbance through tourism and climate change may harm the coastal ecosystem. Overall, the results of this study suggest that alternative, more seagrass-focused approaches may be required in order to fully address seagrass bed conservation and ensure its continued resilience in Grenada.

KEYWORDS: Grenada, climate change, seagrass management

Spatio-temporal Variation in Fish Density and Distribution Within a Gulf of Mexico Shipping Channel

Variación Espacio-temporal en la Densidad y Distribución de Peces en un Canal de Envío en el Golfo de México

Variation Spatio-temporelle de la Densité et de la Répartition des Poissons dans un Chenal d'Expédition du Golfe du Mexique

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ABSTRACT

Man-made channels are ubiquitous throughout the Gulf coast of the United States. In the northwestern Gulf of Mexico, they can represent the only connection between bays and the coastal ocean for tens of kilometers. As such, many fishes move in and out of these channels depending on life history stage, resource availability, and environmental conditions. Further, these channels have been identified as important multi-species spawning aggregation sites. Here, we report early results from a long-term hydroacoustic monitoring study of fishes in the Aransas Channel in Port Aransas, Texas. Starting in January 2018, we conducted bi-weekly surveys of fishes in the channel with a Simrad EK80 echosounder in order to describe fish density and spatial distribution. We also collected environmental data (e.g. temperature, salinity, dissolved oxygen) in the channel and nearby bays. To assess relationships between environmental data and fish density, we fit linear and quadratic models to our data. Environmental data were not significantly associated with fish density in any linear models, but a quadratic model revealed temperature in the channel as a predictor of fish density. This quadratic relationship was driven by exceptionally high fish density during a 'cold snap', and the presence of a massive, densely packed fish school on a warm survey day. Fish density within the channel was higher at the deeper, Gulf-ward edge of the channel on colder survey days, while fishes were more uniformly distributed on warmer survey days. Upon completion of this study, we hope to better understand the importance of channel habitat, and identify specific times and environmental conditions that support high densities of fishes in the channel.

KEYWORDS: Hydroacoustics, fish distribution, shipping channels

Capacity Building, a Pillar for Marine Conservation and Sustainable Fisheries in Cuba

El Fortalecimiento de Capacidades, un Pilar para la Conservación Marina y Pesca Sostenible en Cuba

Le Renforcement de Capacités, un Pilaire pour la Conservation Marine et la Pêche Soutenable à Cuba

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RESUMEN

La pesca es vital para la economía y sustento de comunidades costeras de Cuba, misma que depende de la salud de sus ecosistemas marino-costeros y biodiversidad. Al mismo tiempo, administradores y científicos reconocen que la mayoría de stocks en Cuba están agotados por varios factores incluida la sobrepesca. Así, el programa de Océanos en Cuba de Environmental Defense Fund (EDF) trabaja en Cuba desde el año 2000 para enfrentar los retos de la sobrepesca junto con el Ministerio de la Industria Alimentaria (MINAL), quien dirige el aprovechamiento y preservación de los recursos pesqueros para apoyar la política de desarrollo de la industria alimentaria en Cuba. Estos esfuerzos se realizan a través del manejo pesquero comunitario, la ciencia y la protección de hábitats, apoyados a su vez por el fortalecimiento de capacidades. Este importante componente de capacitación dirigido a pescadores, científicos y gerentes pesqueros, está basado en gran parte en el Marco para la Evaluación Integral de Stocks y Hábitats (FISHE por sus siglas en inglés) desarrollado por EDF e implementado en otros países como México y Belice. FISHE es una herramienta que permite evaluar y manejar sosteniblemente stocks usando datos limitados de forma eficaz y no costosa. Estas capacitaciones se han facilitado en diversos formatos, equipando a Cuba con las herramientas y conocimientos necesarios para aplicar criterios de sostenibilidad y hacer operativa su nueva ley de pesca que será publicada próximamente. Esta sesión hablará de algunos ejemplos de este programa.

PALABRAS CLAVES: Fortalecimiento de capacidades, ciencia pesquera, conservación marina

Exploding Tourism and Sustainable Fisheries: Lessons Learned from the South Florida Flats Fishery

Explotando el Turismo y la Pesca Sostenible: Lecciones Aprendidas de la Pesquería de los Planos del Sur de la Florida

Explosion du Tourisme et Pêche Durable: Enseignements Tirés de la Pêcherie de Plats du Sud de la Floride

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ABSTRACT

The flats fishery is generally catch and release, and occurs in shallow, clear water environments, where target species are generally sighted before they are caught. Popular species in this fishery are Bonefish, Permit, Tarpon, Snook. As catch and release, these fisheries are generally sustainable and are extremely lucrative to local and regional economies. South Florida, U.S., at one time, hosted a world class flats fishery, but these fisheries are in decline. Declines are due to the exponential growth of both tourism and resident populations, and the lack of forward planning to preserve these fisheries. Here, we summarize recent science on the anthropogenic pathways that are likely responsible for our worsening flats fisheries, and potential solutions that can protect or restore these fisheries. Our overview focuses on 4 dimensions of stress. 1) impacts of increasing effort on catch and release fisheries; snook for instance, even though over 99% of snook are caught and released, individuals are caught so many times that, fishing mortality, via discard mortality, is exceeding natural mortality. 2) Habitat loss, in Florida, 50% of mangrove habitat essential for juvenile tarpon and snook have been destroyed, limiting the ceiling of productivity for those fisheries. 3) Freshwater mismanagement, altered timing, amount, and patterns of freshwater released to coastal systems is killing essential habitats, punctuated by a recent loss of 50,000 acres of seagrass. 4) Nutrient pollution and contaminants, pharmaceuticals, we have found opioids and anti-depressants, are present in high levels in Bonefish tissue, potentially posing a serious threat to our remaining flats fishery. We present this talk as a precautionary note, such that other areas experiencing growing tourism and development can be proactive and develop conservation.

KEYWORDS: Flats fishing, seagrass, freshwater management

The Significance of the Design of Ecological Moorings to Enhance Marine Biodiversity

La Importancia del Diseño de Amarres Ecológicos para Mejorar la Biodiversidad Marina Asociada

Importance de la Conception Architecturale des Mouillages Écologiques sur la Biodiversité Marine Associée

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ABSTRACT

In Guadeloupe Island (Lesser Antilles) "mooring areas with light equipment" for yachting is a concept tested as an alternative to the construction of harbors or marinas susceptible to heavily impact the marine environment. It consists in installing permanent and obligatory moorings in areas favorable to receive yachting boats. Anchoring is forbidden in order to protect benthic communities (seagrass beds and (or) coral reefs). Ecological moorings were experimentally designed from concrete blocks presenting different types of artifacts (add-ons like artificial anfractuosities, metallic electrified grids, plastic tubes…) in order to increase their attractive power towards fish and benthic organisms. The present work compared the efficiency of five types of moorings to enhance marine biodiversity. Fish species richness, fish numbers and biomass, species richness and abundance of benthic organisms were quantitatively assessed around the different types of moorings. The data obtained were then analyzed with a redundancy analysis (RDA). The conclusions of this work are that these descriptors of marine biodiversity were significantly correlated to the degree of architectural complexity of the mooring concrete blocks.

KEYWORDS: Ecological moorings, marine biodiversity, Guadeloupe Island

Acoustic Telemetry and Stable Isotopes Inform Connectivity Between Habitats and Fisheries to Influence Management

La Telemetría Acústica y los Isótopos Estables Informan la Conectividad Entre Hábitats y Pesquerías para Influir en la Gestión

La Télémétrie Acoustique et les Isotopes Stables Influencent la Connectivité Entre les Habitats et les Pêcheries pour Influencer la Gestion

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ABSTRACT

Animal movement frequently occurs across broad spatial scales in marine ecosystems, and therefore individuals often form connections between multiple habitats and fisheries. This has important implications for ecosystem function as well as habitat and fisheries management, however it is challenging to quantify in large, open systems with highly mobile fishes. We used a combination of acoustic telemetry and fin tissue stable isotope analysis to characterize the connectivity by Permit (*Trachinotus falcatus*) amongst shallow seagrass flats, coral reefs, and shipwrecks in South Florida. Permit support two very different recreational fisheries in these habitats, and therefore the level of movement by individuals amongst them is of interest for fisheries and habitat management. The two sampling approaches provided strong, complimentary evidence of habitat connectivity by Permit, who moved frequently between seagrass flats to forage and coral reefs to spawn. This information quickly influenced fisheries management practices in Florida, resulting in an extension to the harvest prohibition period to protect Permit during their spawning season. The value of these research approaches will be discussed, along with the factors that led to effective knowledge mobilization into fisheries management practices.

KEYWORDS: Recreational fisheries, coral reefs, seagrass

Growth Patterns of the Invasive Lionfish in the Caribbean Of Colombia

Parámetros de Crecimiento del Pez León Invasor en el Caribe de Colombia

Les Paramètres de Croissance du Poisson-Lion Comme Etant Qu'invaseur dans les Caraïbe de la Colombie

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RESUMEN

El éxito de la invasión del pez león al Atlántico occidental puede explicarse por la rápida tasa de dispersión geográfica así como su rápido crecimiento poblacional. *Pterois volitans*, la especie establecida en el Caribe sur es un eficiente colonizador, que tiene alta fecundidad y la capacidad de reproducirse todo el año. Las medidas de control que se ejerzan sobre este pez podrían optimizarse si se conocen aspectos como la estructura poblacional y la tasa de crecimiento. Estos parámetros han sido evaluados en algunas áreas del Atlántico y el Caribe y varían de acuerdo a las condiciones ambientales y ecológicas, por lo que es relevante estimarlos para el Caribe sur. Tropfish R es un paquete estadístico reciente que moderniza el método tradicional de análisis de frecuencias de tallas (ELEFAN) incorporando técnicas de remuestreo en las estimaciones. Usando esta herramienta, se estimaron los parámetros de crecimiento y la estructura poblacional de P. volitans en el Caribe colombiano. Se usaron registros de tallas de peces capturados con arpón entre 2014 y 2017 en áreas arrecifales continentales e insulares. El valor de máxima densidad estimado para el coeficiente de crecimiento (K =0,47) es alto comparado con el de otros peces arrecifales tropicales. Los resultados encontrados se compararon con estudios previos en el área invadida y se discute el potencial uso en el manejo y control de la especie en Colombia.

PALABRAS CLAVES: *Pterois volitans*, Tropfish R, coeficiente de crecimiento

Directly Ageing the Caribbean Spiny Lobster, *Panulirus argus*

Envejecimiento Directo de la Langosta Espinosa del Caribe, *Panulirus argus*

Vieillissement Direct du Homard des Caraïbes, *Panulirus argus*

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ABSTRACT

Robust fisheries management of crustaceans has been hampered in part by our inability to directly age individuals. Like other crustaceans, lobsters grow through a process of ecdysis long believed to result in the loss and replacement of all calcified structures. As such, conventional ageing methods were thought to be inapplicable. However, Kilada et al. 2012 demonstrated that age could be accurately estimated in four temperate decapods by counting bands deposited in the eyestalk and ossicles of the gastric mill. The technique has since been applied to a few other crustaceans. In the Caribbean, the spiny lobster *Panulirus argus* supports one of the region's largest and most economically valuable fisheries whose management would benefit if the age and size of individuals could be differentiated. Here we present the results of an ongoing study to verify use of bands deposited in the gastric mill to directly age *P. argus*. We have discovered clearly distinguishable bands in the ptero-, and zygo- cardiac ossicles of the gastric mill that differ logically between animals of different sizes from the Florida Keys. Validation of the method with captive reared lobsters of known age (1.5 - 10 years) confirms that bands form annually and are not associated with molting. Counts between independent readers were reproducible with coefficients of variation ranging from 11-26% depending on reader experience and the structure observed. We are currently conducting a laboratory experiment with Barium-tagged lobsters to identify settlement cohorts, and field sampling of populations in the Caribbean to examine patterns of age-size structure in the region. Our results demonstrate for the first time that direct age determination of *P. argus* is possible.

KEYWORDS: Lobster, aging, *Panulirus*

Applications of Rigs-to-Reefs: An Ecotourism Case-Study in Southeast Asia

Aplicaciones de Rigs-to-Reefs: Un Estudio de Caso de Ecoturismo en el Sudeste de Asia

Applications des Rigs-to-Reefs: Une Étude de Cas d'Écotourisme en Asie du Sud-Est

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ABSTRACT

Natural reefs provide coastal protection, marine fish habitat, and the centerfold for ocean-based tourism in southeast Asia. Yet, unfortunately, natural reefs are facing a serious and global decline. Pollution, coastal development and increased human activity brought on by excessive and mismanaged tourism pose a threat to reef systems, a critical resource fueling the tourism industry. However, small-scale ecotourism presents an alternative that thrives at the intersection of environmental sustainability and economic feasibility. This study presents the Seaventures Dive Rig in Malaysia as an example of sustainable ecotourism. Seaventures is a re-purposed oil rig that functions as an artificial reef below the surface and an ecotoursim hotel above. Additionally, this study assesses Seaventure's ability to mimic the surrounding ecosystem as an artificial reef. Our results suggest that Seaventures adequately simulates the fish abundance found on the natural reefs in this region, successfully redirecting scuba-based tourism away from natural systems and enhancing local marine environment through the use of an artificial reef.

KEYWORDS: Artificial reef, ecotourism, rigs-to-reefs

Improving Small Island Resilience and Self-Sufficiency in Habitat Monitoring and Management

Mejorando la Capacidad de Recuperación y Autosuficiencia de las Islas Pequeñas en el Monitoreo y Manejo del Hábitat

Améliorer la Résilience et l'Autosuffisance des Petites Îles dans la Surveillance et la Gestion de l'Habitat

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ABSTRACT

The 2017 hurricane season was the worst on record in the Caribbean, with a Category 4 and Category 5 hurricane hitting the British Virgin Islands (BVIs) in September, and severe flooding earlier the season. Climate change models predict that the intensity and frequency of tropical storms will increase. While increasing the resilience of infrastructure and economies to the effects of severe weather is forefront in the BVIs Government's mind, the benefits of healthy ecosystems in terms of improving the resilience of islands to the effects of storms is often overlooked. Here we introduce a project that aims to fill this gap, focussing on the small inhabited island of Jost Van Dyke and its surrounding offshore cays, which are the location of several marine and terrestrial reserves. Our work includes (1) the assessment of the resilience of key habitats to extreme weather and establishment of ecological baselines, (2) the development of community led conservation management actions and implementation of resilience recovery measures and (3) awareness-raising of the importance of healthy natural habitats in building island resilience to extreme weather.

KEYWORDS: Coastal resiliency, habitat monitorign, extreme weather

Characterization of the Mangrove in the Guanahacabibes National Park to Evaluate its Contribution to Connectivity and to Mitigate the Effects of Climate Change

Caracterización del Manglar en el Parque Nacional Guanahacabibes para Evaluar su Contribución a la Conectividad y a la Mitigación de los Efectos del Cambio Climático

Caractérisation de la Mangrove dans le Parc National des Guanahacabibes pour Évaluer sa contribution à la Connectivité et Atténuer les Effets du Changement Climatique

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RESUMEN

El trabajo presenta la caracterización más actualizada del ecosistema de manglar litoral en el Parque Nacional Guanahacabibes con el objetivo de evaluar su contribución a la conectividad de los procesos que ocurren en la interface marino-costera y a la mitigación de los efectos del cambio climático en la región. Para la caracterización se establecieron parcelas forestales en tres localidades con diferentes intensidades de afectaciones por eventos naturales desastrosos, según la metodología establecida para el monitoreo del manglar en áreas protegidas de Cuba. En cada parcela se tomaron datos sobre composición de especies, abundancia, cobertura del dosel, altura de la formación, área basal, características del sustrato y salinidad intersticial. Se presenta una evaluación de las variables analizadas en las tres localidades seleccionadas y se demuestra que el ecosistema en general presenta un buen estado de conservación, aun cuando se encuentra en estadios diferentes de sucesión posterior al impacto de los eventos naturales desastrosos que han afectado al área, incluyendo cinco huracanes intensos en los últimos 15 años. Se analiza el aporte del manglar a la protección de los bosques ubicados hacia el interior del área y a los pastos marinos y arrecifes de coral que conforman el sector marino-costero del área protegida. Se presenta una evaluación del programa de actividades de gestión que se ejecuta con participación de las comunidades locales para la conservación del ecosistema de manglar como contribución a la conectividad de las poblaciones biológicas marino-costeras y a la mitigación de los efectos del cambio climático.

PALABRAS CLAVES: Manglares, mitigación, conectividad biológica

Development and Application of Full Spherical Camera Technology for Monitoring Fish

Desarrollo y Aplicación de Tecnología de Cámara Esférica Completa para el Seguimiento de Peces

Dévelopement et Application d'une Technologie de Caméra Entièrement Sphérique pour la Surveillance des Poissons

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ABSTRACT

Visual surveys of fish populations have become an integral part of many fisheries-independent monitoring programs. Typically, these surveys consist of a single camera, or stereo pair, recording a small portion of the surrounding area. The video is then post processed to generate species and abundance estimates, most commonly MaxN. While this method provides a number that can be scaled to give a relative abundance index, studies have shown that this method is asymptotically related to true abundance. Results from a spatially explicit individual-based model theorized that increasing the camera's field of view, MaxN estimates become linear to true abundance and thus more accurately estimate increases in population size. To begin to evaluate this property, several camera systems were tested, ranging from off-the-shelf action camera based systems to a fully custom stereo spherical array. We present information about system performance to guide decision making concerning system selection. We also show preliminary information on the relationship between reduced and spherical view abundance estimates that demonstrate that empirical data supports the relationship demonstrated in the theoretical model.

KEYWORDS: Full spherical, cameras, fisheries independent

Evaluation of Two Habitat Complexity Metrics and Their Relationship with Fish Abundance and Diversity

Evaluación de Dos Métricas de Complejidad del Hábitat y Su Relación con la Abundancia y Diversidad de Peces

Évaluation de Deux Paramètres de Complexité de l'Habitat et de Leur Relation avec l'Abondance et la Diversité des Poissons

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ABSTRACT

Modern fisheries assessments increasingly rely on high-precision abundance data and indices produced by fisheries-independent surveys. Further, advancements in underwater optical technology has allowed for the simultaneous collection of both fish and habitat data. In theory habitat data can be used as covariates to explain fish abundance trends but it is often the case that individual metrics (e.g. areal cover of coral) do not explain trends and often only marginally improve precision. In contrast, aggregative habitat-complexity metrics have shown improved explanatory capacity in this regard. Herein we compare two approaches to constructing habitat-complexity metrics based on their ease of use and relationships to fish abundance and diversity. The visual habitat-complexity metric, derived from a visual scaling procedure, proved to have the best capacity to explain both fish abundance and diversity. Conversely the habitat diversity metric, estimated using Shannon-Weiner equations, allows for quick creation of a metric from historic data, showed less powerful but similar relationships in comparison to the habitat-complexity metric. We recommend that video based surveys include some form of habitat complexity data during video annotation as the approach was efficient in explaining fish abundance and diversity trends. Specific use of either method demonstrated here will depend on the state of historic data, staffing, capacity to annotate video, and time constraints.

KEYWORDS: Habitat complexity, abundance, diversity

The Role of Grazing by Fish and Sea Urchins in Structuring Seagrass Beds in Bocas del Toro, Panamá

El Papel del Pastoreo por los Peces y los Erizos Marinos en Estructurar las Praderas Marinas en Bocas del Toro, Panamá

Le Role du Broutage des Poissons et des Oursins de Mer sur la Dynamique des Herbiers Marins de Bocas del Toro, Panama

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ABSTRACT

The comparative present-day rarity of megafaunal herbivores means that fish and sea urchins are likely the dominant grazers in much of the modern Caribbean. Grazing by these smaller organisms has been shown to regulate the canopy structure and species composition of seagrass beds, but the comparative impact of the two groups may not be equal. Fish are generally thought to be the more important of the two functional groups in all but the most overfished seagrass beds.

Grazing assays and surveys of benthic cover and grazer abundance in seagrass beds across various hydrographic regimes were used to determine the relative importance of grazing by fish and urchins and whether high grazing by either group excludes *Syringodium filiforme* from certain seagrass beds.

Grazing on deployed grazing assays was greater during the day than at night suggesting that generally diurnally active fish consume more seagrass than generally nocturnally active urchins. Grazing on deployed *S. fililforme* was also greater than on deployed *Thalassia testudinum* at most sites regardless of time of day suggesting the former species is preferred by both fish and urchins. Grazing on deployed *S. filiforme*, however, was generally higher at sites where this species is present than where it is absent and may suggest that grazing does not primarily limit the distribution of *S. filiforme* in Bocas del Toro. This conclusion, however, must be interpreted cautiously given that the deployment time of a grazing assay is necessarily shorter than the lifespan of a seagrass shoot and this may make assays more likely to be visited by small, abundant, and relatively evenly distributed herbivores than by larger rarer ones and further research may be desirable to determine which group typically has a greater influence on the structure of Caribbean seagrass beds.

KEYWORDS: Seagrass, herbivore, urchin

Reef Resilience and Assisted Evolution: What Do These Terms Mean for Belize, and What Role Do Coral Restoration Efforts Play? A Review of the 2017 Bleaching Event With This in Mind, and With Historical Context

Resistencia de los Arrecifes y Evolución Asistida: ¿Qué Significan Estos Términos para Belice y Qué Papel Juegan los Esfuerzos de Restauración de los Corales? Una Revisión del Evento de Blanqueamiento de 2017 Con Esto en Mente y Con Contexto Histórico

Résilience des Récifs et Évolution Assistée: Que Signifient Ces Termes pour le Belize et Quel Rôle Jouent les Efforts de Restauration des Coraux? Une Revue de l'Événement dDe Blanchiment de 2017 en Tenant Compte de Cela et du Contexte Historique

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ABSTRACT

Belize experienced a severe coral bleaching event in 2017. How severe was it? How do we compare to previous years and how do we plan for future events? Shared here are the bleaching results for over 20 sites in Belize, compared to previous years going back to 2008, coupled with in situ temperature data 2009-2017 (where available). Also shared here is what we know, and what we still don't know, in terms of corals' resilience (e.g. coral host and symbiont genetics), and what evidence we have for adaptation to higher temperatures in the context of reef restoration efforts, ongoing for over a decade now in southern Belize. Specifically, are some shallow acroporids now more temperature tolerant than other coral species, when once they were most susceptible? What are the applied management strategies we can implement to improve Belize's resilience to future bleaching events?

KEYWORDS: Bleaching, restoration, resilience

Use and Administration of Resources in the Seaflower Biosphere Reserve, Archipelago of San Andres, Providencia and Santa Catalina, Snappers Exploratory Fishing in the Southern Keys

Aprovechamiento y Administración de los Recursos en la Reserva de la Biósfera-RB Seaflower, Archipiélago de San Andrés, Providencia y Santa Catalina, Pesca Exploratoria de Pargos en los Cayos Del Sur

Utilisation et Administration des Ressources dans la Réserve de Biosphère Seaflower, l'Archipel de San Andrés, Providencia et Santa Catalina, Pêche Exploratoire des Vivaneaux dans les Clés du Sud

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RESUMEN

La pesca en la RB Seaflower es una actividad importante para la economía local, generadora de divisas, ingresos, empleo, y sobretodo fundamental para la seguridad alimentaria de los habitantes del Archipiélago siendo territorio insular oceánico. Pescadores artesanales del Archipiélago han capturado ancestralmente hace más de 200 años peces, crustáceos y moluscos, con diferentes artes de pesca. La exploración de áreas de pesca con potencial y prueba de métodos alternos aporta alternativas para los pescadores y el manejo. Con el objetivo de evaluar el potencial de áreas y métodos alternativos de pesca, se llevó a cabo una faena exploratoria dirigida a Lutjánidos de importancia comercial en Isla cayos de Albuquerque y Green Bank con palangre vertical con el tradicional "Reel" y un método propuesto por pescadores artesanales conocido como "Tank" que puede facilitar la maniobrabilidad. La faena se realizó en embarcaciones con la participación de pescadores artesanales entre 70 y 200 brazas de profundidad y 15 anzuelos por línea registrando especies, abundancia y morfometría general de las capturas. Durante los muestreos se encontraron estaciones con mayores capturas que otras, la captura por unidad de esfuerzo promedio fue de 1,48 kg/hf, las capturas realizadas con Reel fueron de 40,85 kg mientras que con Tank fueron 41,25 kg, lo cual sugiere resultados similares en cuanto a la biomasa capturada. Durante la faena se presentó el paso de una onda tropical con fuertes condiciones de oleaje y viento, se exploró como alternativa el costado Oeste de la isla protegido por la barrera arrecifal como alternativa productiva en momentos de mal tiempo. Dentro de las capturas fueron registradas 12 especies incluyendo especies de importancia comercial y nuevos registros para el archipiélago de los géneros Caulolatilus y Gymnothorax.

PALABRAS CLAVES: Pargos, pesca artesanal, Reserva de Biósfera Seaflower

The Effects of Coupled Stressors on Estuarine Fish Behavior

Efectos de Factores Estresantes Acoplados en Peces Estuarinos

Effets des Facteurs de Stress Couplés sur les Poissons Estuariens

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ABSTRACT

Estuarine mangrove systems are essential fish habitats that provide important ecosystem services for a wide range of inhabitants as nurseries and foraging grounds. As climate change is projected to increase global temperature by 3°C over the next 50 years, and coastal development is expected exacerbate the issue, increasing stress on these environments will result in the degradation of habitat quality and ecosystem function. In this study we captured five of the most common fish species found in the northern extent of Biscayne Bay, FL, and placed them in a 15,000 gallon mesocosm tank, with high/low density artificial mangroves units. A factorial design consisting of two temperature levels (31°C and 34°C) and two turbidity levels (high and low) was used to document changes in fish schooling behavior and predator-prey interactions using an acoustic imaging sonar (DIDSON). Preliminary observations indicate that there was an increase in predation due to prey fish exhibiting risky behavior to meet metabolic demands in the elevated temperature. Currently, additional trials are being conducted to quantify predation rate during high thermal stress and high turbidity periods to determine if prey fish mortality changes. Recent studies have focused on a single stressor at the species level, but by investigating the relationship between multiple stressors and their effect on behavior at the community level, we will gain a better understanding of how fish communities will respond to increases in temperature and turbidity related to climate change and coastal development.

KEYWORDS: Climate change, estuarine, stress

Investigating the Costs of *Sargassum* Impacts on Livelihoods in the Hotel Industry

Investigar los Costos de los Impactos del *Sargazo* en los Medios de Subsistencia en la Industria Hotelera

Étudier les Coûts des Impacts du *Sargassum* sur les Moyens de Subsistance dans le Secteur Hôtelier

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ABSTRACT

The Caribbean with its beautiful beaches, turquoise water and sunshine has a comparative advantage over many other tourist destinations. This has enabled the region to attract foreign direct investment in the tourism sector. As a result, the Caribbean has now become the most tourism-dependent region in the world. This makes the region particularly vulnerable to external shocks, such as the recent unprecedented mass influxes of *Sargassum* seaweed. This *Sargassum* is piling up nearshore, making swimming difficult or impossible; is turning the sea brown, ruining the aesthetic beauty; and is covering beaches, making them inaccessible for recreation. Furthermore, if left to rot, the sargassum attracts biting insects and flies, and produces foul-smelling gases. This situation is having a considerable, but as yet undocumented, negative economic impact on livelihoods in the hotel industry. Here we investigate some of these costs through face-to-face interviews with hoteliers in Barbados and St Lucia using pre-tested standardized questionnaires. Significant costs to the sector include: clean-up (labour, equipment, transport of sargassum off site); guest refunds; transport of guests to alternative beaches (including provision of food and beverages); and staff layoffs from low occupancy. Hoteliers are unlikely to be able to continue bearing current costs of dealing with sargassum, especially under the projected recurrent influxes, and this will have serious implications for livelihoods supported by the hotel industry. Furthermore, the *Sargassum* crisis could erode the Caribbean's comparative advantage in the tourism industry.

KEYWORDS: *Sargassum*, hotel industry, costs

New Insights on Fish Spawning Aggregation Dynamics from Autonomous Robotic Platform

Nuevos Conocimientos sobre Dinámicas de Agregación de Desove de Peces desde Plataforma Robótica Autónoma

Revelations sur la Dynamique d'Agrégation des Poissons en Frai Depuis une Plateforme Robotique Autonome

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ABSTRACT

Fish spawning aggregation usually consist of the gathering of a large number of fish in high concentration at a specific location. While the aggregation is relatively stationary in space, especially during the time of spawning, excursions to areas outside the spawning site are not uncommon, especially after peak spawning. Therefore, passive acoustic monitoring of grouper spawning aggregation has traditionally been conducted from fixed moored location near the bottom of the ocean, where fish spawning aggregation are usually observed by divers. Such setting however, can only provide information limited to the spatial extent of the aggregation site, where local fish sounds will mask sounds coming from fish beyond the aggregation site. As such, all information collected from this fixed listening approach is limited in space and there is currently a knowledge gap about what happens outside the aggregation where remote fish calls cannot be heard.

Recent surveys in the US Virgin Islands and Puerto-Rico with an autonomous surface vehicle are revealing for the first time the spatial and temporal distribution of fish calls surrounding a known spawning aggregation site. These findings are critical to fish population abundance estimates and stock assessments because calling fish were detected several kilometers away from the main aggregation. These surrounding courtship associated sounds suggest that smaller spawning aggregations may exist in addition to the main one.

KEYWORDS: Passive acoustics, spawning aggregation, Wave Glider

Technological Changes In Encircling Gillnets Operating In The Colombian Caribbean And Its Effect On Landings And Fishing Sites

Cambios Tecnológicos En Las Redes De Enmalle De Encierro Que Operan En El Caribe Colombiano Y Su Efecto Sobre Los Desembarcos Y Sitios De Pesca

Changements Technologiques Dans Les Filets Maillants Encerclants Opérant Dans Les Caraïbes Colombiennes Et Son Effet Sur Les Débarquements Et Les Sites De Pêche

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ABSTRACT

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

KEYWORDS: Encircling gillnets, pelagic fish, technological changes

Potential Impact of Lionfish on the Fish Community in Two Marine Protected Areas of the Caribbean (Cuba and Mexico)

Impacto Potencial Del Pez León Sobre la Comunidad de Peces en Dos Áreas Marinas Protegidas del Caribe (Cuba y México)

Impact Potentiel du Poisson-Lion sur la Communauté de Poissons dans Deux Aires Marines Protégées des Caraïbes (Cuba et Mexique)

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ABSTRACT

This study characterized the community structure of reef fish in the national parks Guanahacabibes (PNG) in Cuba and Arrecifes de Xcalak (PNAX) in Mexico after the establishment of the lionfish. Visual censuses were carried out to determine the structure and composition of the main prey, competitor and predator species, based on the distribution and abundance of the lionfish. The diet of the lionfish was analyzed through studies of stomach contents. The PNG presented higher abundances and sizes of all the prey species, competitors and potential predators of the lionfish than the PNAX. The lionfish population increased significantly in the PNG, being higher than that established in the PNAX. It was found that the fish of the families Gobiidae, Pomacentridae and Labridae dominated the diet of the lionfish. The diversity, abundance and biomass of the PNG fish communities did not show differences with respect to the season. The abundance was higher in the dry season in the PNAX. The time did not influence the abundance and size of the lionfish in both MPAs. In general, the abundance and size of the prey species decreased with the increase of lionfish, especially in the PNG. Potential predators were not related to the lionfish in both MPAs. The differences in richness, diversity and equity in the fish communities in both MPAs were not associated with the lionfish. The lionfish is not the only impact factor on the reef fish of the western Caribbean and the hypothesis of biotic resistance to invasions does not apply in these areas.

KEYWORDS: Lionfish, marine protected areas, coral reefs

A Network to Develop a Taxonomic, Monitoring and Citizen's Participation Program for *Sargassum* Landings in Florida, Mexico, Barbados and Brazil

Una Red Para el Desarrollo de un Programa Taxonómico, de Monitoreo y de Participación Ciudadana para las Arribazones de *Sargassum* en Florida, México, Barbados y Brasil

Un Réseau pour Développer un Programme de Taxonomie, de Suivi et de Participation Citoyenne pour les Arrivées de *Sargassum* en Floride, au Mexique, au Barbados et au Brésil

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ABSTRACT

The relatively recent mass landings of *Sargasssum* along the Caribbean, Brazilian and African coasts, starting in 2011, are now considered a tourism, health, ecological and fisheries threat. The problem of *Sargassum* landings increased in 2013-2015 and now in 2018 we are witnessing the worst impacts to date. These landings are challenging scientists, coastal resource managers and administrators at local, national and regional levels as a new "normal" that urgently needs addressing. To improve outcomes, we need collaborative international coordinated efforts across the region. We are proposing a network of researchers that will (1) work on the development of protocols to involve citizens in a standardized monitoring of their local sites, and (2) collect samples for resolution of taxonomic identity (through detailed morphological and molecular approaches) that will allow us to better understand the origins of the different spatial and temporal landings of *Sargassum* and how it might react to future changes in climate and oceanographic conditions. By involving citizens and a network of widely dispersed researchers we will be able to obtain region-wide data that will be made publically accessible to add value to other research efforts and initiatives. The establishment of a network should also increase leverage to attract funds from different countries and sources to support further research and solutions to this difficult problem.

KEYWORDS: *Sargassum*, monitoring, taxonomy

Ecotourism as a Life Strategy, Conservation and Generation of Strategic Alliances for the Communities of the Ciénaga Grande de Santa Marta

Ecoturismo como Estrategia de Vida, Conservación y Generación de Alianzas Estratégicas para las Comunidades de la Ciénaga Grande de Santa Marta

L'écotourisme comme Stratégie de Vie, Conservation et Génération d'Alliances Stratégiques pour les Communautés de la Ciénaga Grande de Santa Marta

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ABSTRACT

The project Sustainable Local Development and Governance for Peace (DLS), funded by the European Union and co-executed by INVEMAR, has given 2 communities of the Ciénaga Grande de Santa Marta (CGSM) the chance to join the various initiatives in ecotourism that are being developed in the area by different institutions, both public and private. Through the DLS, local actors and INVEMAR are developing a product in ecological and cultural tourism taking advantage of the immense biodiversity of the CGSM (Biosphere Reserve, RAMSAR Wetland, two National Natural Parks and important area for the conservation of birds) and the cultural richness of its palafitte villages with nearly 200 years of existence. The experience has been enriched by several local actors and has sought the generation of strategic alliances between two associations in the area: Asoguitur and Asopebue. The first association is made up of residents of the urban area of the municipality of Ciénaga interested in strengthening the offer of tourist services, who have more than five years of experience. The second is made up of artisanal fishermen from the palafitte village of Buenavista, who see in ecotourism an option to increase their income and to involve women and young people in economic activities. The ecotourism product will be focused on birdwatching and cultural tourism, for this, members of associations are receiving training in bird watching, marketing and organizational strengthening. In addition, the formulation of agreements and business plans is being executed. This DLS action is 2 years' length and until now it is in the first stage, however, there have been many lessons learned worth sharing with entities that are developing ecotourism as an effective alternative for conservation and improvement in the quality of life of rural populations.

KEYWORDS: Ecoturism, wetland, fisherman

The IUCN Green List of Protected and Conserved Areas

La Lista Verde de Áreas Protegidas y Conservadas de la UICN

La Liste Verte des Aires Protégées et Conservées de l'UICN

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ABSTRACT

The IUCN Green List of Protected and Conserved Areas (Green List) is a global standard developed by the IUCN World Commission on Protected Areas (WCPA) to increase and recognize the number of Protected and Conserved Areas globally that are fairly governed, effectively managed, and achieving their conservation outcomes. The Green List received endorsement in the form of a decision at the Convention on Biological Diversity (CBD) COP-13 which invites Parties to "promote the IUCN Green List of Protected and Conserved Areas as a voluntary standard to encourage protected area management effectiveness". It achieves quality through and supports the application of IUCN's best practices and knowledge products. Globally 43 protected and conserved sites have been registered with 24 protected areas listed in pilot phase including Guadeloupe National Park (French Overseas Territory). The Biodiversity and Protected Areas Management (BIOPAMA) Programme is promoting the Green List as the standard to which countries and sites should strive towards as they improve the management and governance of their protected areas. The process and steps for implementing the Green List will be highlighted along with the value derived by implementing this initiative.

KEYWORDS: IUCN, Green List, protected and conserved areas

Towards the Development of a Sub-Regional *Sargassum* Outlook Bulletin for the Caribbean

Hacia el Desarrollo de ln Boletín Subregional de Perspectivas de *Sargassum* para el Caribe

Vers l'Élaboration d'Un Bulletin sous-Régional sur les Perspectives du *Sargassum* dans les Caraïbes

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ABSTRACT

Since 2011 thousands of tons of pelagic *Sargassum* seaweed have piled up on beaches and in nearshore waters of many countries across the Caribbean region. These periodic influx events, now considered to represent a 'new normal' in this region, have significant negative implications across multiple sectors including fisheries, tourism, health and environment. They also present new potential opportunities for development of industry using *Sargassum* as a raw material. Adapting to this new normal by learning to cope with, and even profit from, these influx events is a critical next step for the region, and would benefit greatly from the development and communication of reliable long and medium-term forecasts of *Sargassum* arrivals. A recently launched monthly *Sargassum* outlook bulletin for the Wider Caribbean by USF/NASA is providing timely updates on *Sargassum* presence in the entire region relative to previous years and comments on future bloom probability for the next three months. This provides an excellent opportunity to develop a complimentary outlook bulletin at a finer sub-regional scale that would better serve the interests of individual countries. Here we present a zero-draft of a Quarterly Sub-regional *Sargassum* Outlook Bulletin tailored for the Eastern Caribbean. This was developed with key stakeholders in an effort to add sector-specific value to the bulletin in the form of advice on appropriate responses. We anticipate that this bulletin will facilitate wider access to specifically tailored early warning information allowing better decision-making processes by key socio-economic sectors in the region.

KEYWORDS: *Sargassum*, climate change adaptation, outlook bulletin

Comparing Divers and Camera Sled Surveys: An Improvement for Fisheries Independent Data for Queen Conch in Puerto Rico?

Comparción de Censos de Buceo y Cámara en Trineo: ¿Será una Mejora para Datos Independientes de Pesquerías para el Caracol Rosado en Puerto Rico?

Comparaison entre les Plongeurs et les Enquêtes sur les Traîneaux Photographiques: Une Amélioration des Données Indépendantes de la Pêche pour le Lambi à Porto Rico?

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ABSTRACT

Queen conch *Lobatus (Strombus) gigas* is one the most important fisheries species in the Caribbean. 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. 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 than 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, camera surveys, sampling techniques

Temporal Change in Landings and Fishing Effort of the Artisanal Shrimp Trawl Fishery in Gulf of Salamanca, Colombian Caribbean

Cambio Temporal de los Desembarcos y Esfuerzo en la Pesquería de Arrastre Artesanal de Camarón en el Golfo de Salamanca, Caribe de Colombia

Changement Temporel dans les Débarquements et l'Effort de Pêche de la Pêcherie Artisanale au Chalut de Crevette dans le Golfe de Salamanque, Caraïbes Colombiennes

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RESUMEN

Un número creciente de pesquerías de arrastre muestran disminución en las tasas de captura, principalmente aquellas de tipo industrial. Sin embargo, las tendencias temporales del rendimiento de esta modalidad en la pesca artesanal han sido poco evaluadas, por la creencia que el bajo poder de pesca de las embarcaciones, métodos y artes usados no afecta sustancialmente al ecosistema. Una pesquería de arrastre artesanal dedicada a la captura principalmente del camarón "*Xiphopenaeus kroyeri*" opera en el golfo de Salamanca desde el año 2000, con un desarrollo tecnológico incipiente, mostrado por la utilización de motores fuera de borda, ningún tipo de mecanización en el cobrado de la redes y carencia de un método de preservación de la captura. Entre los años 2007 y 2017, se efectuó el registro sistemático de los desembarcos, actividad diaria y parámetros operativos de esta pesquería en la región. Como resultado se obtuvo que la tasa de captura de las unidades de pesca ha disminuido de 43.3 en 2007 a 21.8 kg/día en 2017 (descenso de 52.8 %). En efecto, los pescadores mencionan que al inicio de esta pesquería observaban capturas máximas de hasta 600 kg/día. Adicionalmente, la duración de las faenas ha aumentado de 4 a 6 horas en promedio, sin haber cambiado de zona de pesca, lo que sugiere un aumento de esfuerzo diario con el fin de mantener un ingreso económico suficiente para cubrir los gastos de operación resultado de la disminución de las tasas de captura del camarón. El aumento en la fracción de la pesca acompañante aprovecha por los pescadores paso del 1% en 2008 al 12% en 2013 indicando la necesidad de complementar el ingreso obtenido de la captura objetivo para viabilizar económicamente la actividad. Las implicaciones para la sostenibilidad de la pesquería son discutidas y más aún su manejo.

PALABRAS CLAVES: Artisanal fishery, landings, fishing eEffort

Association Between the Sea Surface Temperature and the Dynamics of an Artisanal Search Fishery in the Gulf of Salamanca, Colombian Caribbean Sea

Asociación Entre la Temperatura Superficial del Mar y la Dinámica de una Pesquería Artesanal de Búsqueda en el Golfo de Salamanca, Mar Caribe de Colombia

Association Entre la Température de Surface de la Mer et la Dynamique d'une Pêcherie Artisanale dans le Golfe de Salamanca, Mer des Caraïbes Colombienne

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REUMEN

Los pescadores de peces pelágicos han observado una relación entre la temperatura del mar y la distribución de la abundancia de ese recurso. Este aspecto es evidente en pesquerías industriales de cerco que emplean información satelital de la temperatura superficial del mar (SST) para la detección de los bancos de peces. Las pesquerías artesanales no cuentan con los recursos para acceder a esta información, pero poseen un conocimiento de las condiciones de su área de pesca, ganado por su experiencia personal y transmitido generacionalmente. Este conocimiento se enfoca en intentar predecir la localización de los recursos pesqueros a partir de sus observaciones de variables ambientales, como la SST. Con el propósito de evaluar la asociación entre la SST y la dsitribución espacial de la captura y esfuerzo de la pesquería de encierro que opera en el golfo de Salamanca, mar Caribe de Colombia, durante 18 meses (agosto de 2007 a diciembre de 2008), se registró la captura por faena y la zona de pesca referenciada mediante un sistema de celdas de 1 mn. La información de SST diaria para el área de estudio fue obtenida de los sensores satelitales GOES y fue mapeada por medio de un SIG. Se detectó que, entre de 29,5 y 31,0 °C, las capturas son bajas (0 a 105 kg/faena) y poco variables, en tanto que se registraron hasta los 600 kg/faena a menores temperaturas (27,0 a 29,0 °C), con una variabilidad bastante mayor. Espacialmente, la flota concentró su actividad en la zona oriental y más protegida del golfo en los meses de mayor intensidad del viento y tendió a aumentar su área de operación, hacía zonas de menores SST, en los meses cuando se debilita el viento. La interacción entre la SST y la intensidad del viento parecen asociarse a la distribución espacial de las tasas de captura y los niveles de esfuerzo en la pesquería.

PALABRAS CLAVES: Esfuerzo pesquero, CPUE, información satelital

Fish Identification and Abundance Estimation Using Eye-safe Non-invasive Underwater Lidar Detection and Classification

Estimación de Peces y Sus Abundancia Utilizando Un Non-Invasivo Lidar Submarino Seguro para los Ojos Para Detección Y Clasificación

Detection et Classification a L'aide D'un Lidar Sous-Marin Non-Invasif et Sans Danger pour les Yeux lour L'identification les Poissons Et l'estimation de Leur Abondance

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ABSTRACT

Traditional optical cameras are most effective when significant ambient light is present and in low turbidity. Even the most sophisticated commercially-available underwater stereo camera technologies require artificial white light to illuminate low light scenes. This approach is not desirable for fish monitoring because artificial light can alter the behavior of the animals being monitored. However, unlike active acoustic solutions, the primary advantage of using optical approaches is high resolution contrasted scene descriptions essential for object classification and detailed observations. Available active acoustics technologies for fisheries monitoring can be categorized as either acoustic cameras or sounders. 2D imaging sonars provide a video-rate output, but with a limited angular field of view and range. Acoustic profilers, on the other hand, like echosounders, are a standard instrument of fisheries hydro-acoustics. These instruments can reach a long distance but lack the resolution and evaluation intuitiveness of traditional optical imagery.

The red laser diode serial LiDAR (Light Detection and Ranging) imager system we have developed combines the advantages of traditional optical and acoustic solutions while overcoming their disadvantages when applied to fish surveys. Red laser illuminators can be configured to be eye-safe, unobtrusive, and allow for 24/7 operations. This new approach is an adaptation of an existing technology that is compact, cost-effective and can be easily mounted on or around different marine survey equipment. The equipment is designed for long-term, maintenance-free operations. It generates a sparse primary dataset that only includes detected anomalies, thus allowing for efficient, real-time, automated, low bandwidth animal detection, classification and identification.

KEYWORDS: LiDAR, detection, classification

Sargassum Management and Responses of the Fisheries Sector in the Eastern Caribbean Under the CC4FISH project

Manejo del *Sargaso* y Respuestas del Sector Pesquero en el Caribe Oriental Bajo el Proyecto CC4FISH

Gestion des *Sargasses* et Téponses du Secteur de la Pêche dans les Caraïbes Orientales dans le Cadre du Projet CC4FISH

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ABSTRACT

The *Sargassum* events of 2011, 2014, 2015 and 2018 have triggered much consternation regionally about state, civil society and private sector capacities to cope and adapt. There has been concern, including among inter-governmental organisations, about long-term implications for the fisheries and tourism sectors especially, given that such events seem to be a 'new normal' due in part to climate change and variability. In response to the increased impacts from *Sargassum* influxes, the Food and Agriculture Organization of the United Nations is working to improve resilience of the fisheries sector under the Climate Change Adaptation of the Eastern Caribbean Fisheries Sector (CC4FISH) Project. This presentation will present the various way CC4FISH aims to work on improving knowledge and practical tools; current state and knowledge of the influxes of *Sargassum* and their origin, an improved *Sargassum* Management Plan template for the region, removal and users guide including best practices and lessons learned, best practices guide for fisherfolk and communication material. This can provide incentives for the Eastern Caribbean as well as for other countries in the Caribbean region.

KEYWORDS: *Sargassum*, fisheries, CC4FISH

Network of Caribbean Municipalities of Honduras for the Conservation of Marine Resources

Red de Municipalidades del Caribe de Honduras para la Conservación de los Recursos Marinos

Réseau des Mairies du Caraïbe Hondurien pour la Conservation des Ressources Marines

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ABSTRACT

With the aim of guaranteeing the governance of coastal marine resources at the local level by strengthening the links between local authorities and users of the fishing resource, the Center for Marine Studies (CEM) in Honduras promoted as a management tool the creation of a Mayor´s Network for the Conservation of Fisheries Resources throughout the Caribbean of Honduras, a space where mayors of four provinces converge and where information about the state of fishery resources and the alternatives of sustainable management of them is disseminated uniformly. Between February and June 2018, fourteen mayors signed the Pact for the Conservation of Natural Resources of the Caribbean of Honduras, agreement which they committed to support the declaration and management of Fishery Recovery Zones (FRZ), as well to promote initiatives focused in sustainable development of the small scale fishing sector. Since the signing of the Pact, one of the signatory municipalities has achieved the declaration of two FRZ by municipal ordinance and another four are promoting the process of declaration of new ones. Additionally, they have also supported the collection of biological and socioeconomic data from the areas with potential to be declared FRZ and the management of funds to ensure their financial sustainability.

KEYWORDS: Governance, sustainable, empowerment

Introducing Reef Support: An Online Marine Park User Fee Payment System

Presentación de Reef Support: Un Sistema de Pago en Línea de Tarifas de Usuario de Parques Marinos

Présentation du Reef Support: Un Système en Ligne de Paiement des Frais D'utilisation des Parcs Marins

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ABSTRACT

Dive tourism has been an established method to finance coral reef conservation through user fees which are used to directly fund the management of MPAs. However most organizations in charge of MPA management lack the in house capacity to establish and operate a reliable system to collect user fees. Often traditional 'over the counter' systems selling bracelets or tags put enormous pressure and responsibility on water-sport operators and wardens. These systems often lack the necessary control mechanisms and often they become a burden. Based on a feasibility study financed by Bloomberg Philanthropies and conducted by Reef Support BV on Bonaire, Curacao and Sint Maarten, it was determined that as mush as 91% of tourists used the internet to pay for and reserve flights, accommodation, rental cars and other marine recreation packages. This reveals a new trend in buying tourism related products that were simply non-existent in the early nineties when user fees became more popular. To gain from this new tendency and to overcome the above described issues, Reef Support created the first online system to collect user fees. Reef Support is a simple, robust, flexible, and customize tool to sell marine park fees to visitors. It offers a safe way to receive money, provides access to an ever-growing database of customers, creates a unique ticketing system and offers the possibility of generating customized financial reports. This internet-based payment system will help managers streamline sales, help visitors save time, increase the safety of rangers and utilize technological advances to benefit conservation.

KEYWORDS: Marine Protected Areas, user fees, internet-based payment system

Biological and Population Parameters of the Blue Crab (*Callinectes sapidus*) of the Cienaga Grande de Santa Marta, Colombian Caribbean

Parámetros Biológicos y Poblacionales de la Jaiba Azul (*Callinectes sapidus)* de la Cienaga Grande de Santa Marta, Caribe Colombiano

Paramètres Biologiques et la Population du Bleu Crabe (*Callinectes sapidus*). de la Cienaga Grande de Santa Marta, Caraïbes Colombiennes

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RESUMEN

Las jaiba azul *Callinectes sapidus* (Decapoda:Portunidae) es un crustáceo de interés científico y comercial, cuya pesquería tiene implicaciones sociales, ecológicas y económicas en la Ciénaga Grande de Santa Marta. Con el fin de contribuir con elementos científicos para la adopción de medidas de regulación y manejo responsable de este recurso, se adelantó investigación a partir de ejemplares desembarcados en plantas de proceso, procedentes de la pesca de pequeña escala en CGSM entre marzo y junio de 2018. Se determinaron los siguientes parámetros biológicos: Abertura de la Base de las Espinas Laterales - Abel (cm), Longitud del Cefalotórax - Lca (cm), Peso Total Pt (gr), Sexo y Madurez sexual (Protocolo de Captura de Información Pesquera, Biológica y Socio-Económica en Colombia). Los resultados obtenidos son: número total de registros fue 2103, de los cuales 1570 fueron machos y 533 hembras. La proporción machos: hembras es 3:1. Los intervalos de Abel oscilaron entre 6,12 cm y 15,12 cm, los intervalos de Lca entre 3,64 cm y 8,64 cm y el peso total entre 25 g y 384 g. En relación con la maduración sexual se estableció que, en hembras el 70,05 % correspondió a ejemplares maduros, el 33,4 % en proceso de maduración y 6,55 % inmaduras. Para los machos el 72 % eran individuos adultos y 28 % juveniles. Preliminarmente, se puede concluir que el 85,39 % de los machos y el 96,62 % de las hembras muestreadas son individuos maduros sexualmente. La proporción sexual m:h (75% - 25%) de ejemplares desembarcados en las plantas de proceso, evidencia que el aprovechamiento pesquero se hace sobre poblaciones de machos. De los ejemplares desembarcados el 88,21 % se encuentra por encima de la talla mínima establecida por la autoridad pesquera.

PALABRAS CLAVES: *Callinectes sapidus*, caribe colombiano, parámetros biológicos

Use of BRDs as a Sustainable Solution in Tourist Air

Dispositivos de Reducción de Fauna Acompañante como Solución Sosteniblee Aérea Turística

Dispositifs pour la Reduction de la Faune d'Accompagnement comme Solution Durable dans l'Air du Tourisme

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ABSTRACT

The shrimp-trawling is one of the main fishing activities in the fishing community of Sirinhaém, state of Pernambuco, northeast Brazil. The fishing happens in front of a very touristic site, called Serrambi beach and Santo Aleixo Island. Both the fishing community as well as the tourism sector have a very negative view of the shrimp trawling fishery, seen as unsustainable and causing a lot of damage to the marine environment, mainly because its low selectivity and consequently high amount of bycatch. The REBYC/ BRAZIL/ FAO-GEF Project started testing different bycatch reduction devices (BRDs). One of these BRDs was a square mesh panel in the trawl net. Thirty six tows were done using a square mesh panel in a trawl net bag with 35mm, simultaneously with the trawl net traditionally used by the fisherman (Double Rig System). The net with the BRD had a significant reduction of fish bycatch, both by weight (ρ= 0.00942) and number (-43.4%) (ρ= 0.000571), without significantly affecting the production by weight of white shrimp (ρ= 0.159), pink shrimp (ρ= 0.981) and seabob shrimp (ρ= 0.619). The trawl net with the device captured an average of 145.8 fish, while the fisherman's net caught an average of 284.0 fish. These results show that the device significantly improved the sustainability of the shrimp-trawl fishery, by reducing the bycatch of young fish, without impacting shrimp catches.

KEYWORDS: Shrimp-trawling, use of BRDS, bycatch reduction

Current Characterization of the Industrial Fishing of the Gulf of Morrosquillo, Colombian Caribbean

Caracterización Actual de la Pesca Industrial de Arrastre del Golfo de Morrosquillo, Caribe Colombiano

Caractérisation Actuelle de la Pêche Industrielle du Golfe de Morrosquillo, Caraïbes Colombiennes

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RESUMEN

Se realizó un análisis de las capturas en la flota de pesca industrial de arrastre del Camarón de Aguas Someras operada en el Golfo de Morrosquillo (Caribe Sur Colombiano) entre 2016 y 2017; la cual se mantuvo con 7 motonaves por muchos años hasta su cierre a finales de 2017. Se analizaron 346 lances en la parte norte del Golfo con un área efectiva de pesca de 53.343 ha (2016) y 29.348 ha (2017). Aunque otros estudios reportaron a Farfantepenaeus notialis como la principal especie capturada, en este periodo la especie capturada fue el camarón blanco *Litopenaeus schmitti*, el cual tuvo un amplio rango de tallas de captura (7-37 cm LT) con ejemplares por encima de tallas máximas teóricas encontradas en Venezuela y Brasil. La talla media de captura de *L. schimitti* fue de 15.72 cm Lt y su peso medio de captura (PMC) de 16.64 gr Pt. La relación porcentual entre la captura objetivo (CO), Captura Incidental (CI) y Descarte (DESC) fue de 17%, 46% y 37%, respectivamente. Se propone analizar las capturas desde la perspectiva de Captura Aprovechada (CA) y DESC, ya que la tendencia en esta pesquería es hacia aprovechar cada vez más la captura incidental. Se hizo un análisis de varios trabajos, estableciendo al menos 91 especies en la captura de esta pesquería de arrastre (peces óseos, cartilaginosos, crustáceos y equinodermos) siendo el género Sciades (41.78%) y la mojarra Eugerres plumieri (22.65%) las más comunes. Se estimaron rangos de captura, TMC y PMC para 9 especies de peces. La Captura por Unidad de Esfuerzo (CPUE) para la CA estuvo entre 0.04 y 28 kg/hora (promedio de 14.25 kg/hora).

PALABRAS CLAVES: Camarón de aguas someras, *Litopenaeus schmitti*, pesca de arrastre

Bathymetric Characterization of the Continental Shelf in the Departments of La Guajira and Magdalena, Colombian Caribbean

Caracterización Batimétrica de la Plataforma Continental en los Departamentos de La Guajira y Magdalena, Caribe Colombiano

Une Caractérisation Bathymétrique de la Plate-forme Continentale dans les Départements de La Guajira et de Madeleine, les Caraïbes Colombiennes

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ABSTRACT

The bathymetry adjacent to the Department of La Guajira and the Department of Magdalena has been understudied, the knowledge about these geographical areas is of great importance for the study and development of coastal areas. The objective of this work is to characterize the bathymetry in the shelf and continental slope zones corresponding to these departments, broadening the knowledge about these areas, as input for a better understanding and management of the ecosystem that they make up. A SIMRAD EK80 scientific echo sounder was used with a transducer of 38 and 200 kHz. Sampling was systematic from the coastline to the break of the shelf and continental slope. According to the bathymetric profiles there is a marked difference between the characteristics of the underwater geography between the two departments, highlighting the identification of different geographical areas in the continental shelf adjacent to the Magdalena Department, while the continental shelf adjacent to the Department of La Guajira has no significant variations in its geography along this. To the north of the Guajira Peninsula the Continental shelf is very narrow, presenting depth profiles of 200 meters (m) to about 10 nautical miles (MN) of the coast and in front of Punta Gallinas to only 3 mn. To the west, from the Cabo de la Vela the shelf is widened and reaches a maximum of about 25 MN in front of Riohacha, then in the vicinity of the river Palomino is reduced again and practically disappears in the sector of the Natural National Park Tayrona and Santa Marta. In front of the Ciénaga Grande de Santa Marta the platform is extended again to about 12 MN. Five underwater cannons were identified: in front of Riohacha, Parque Tayrona, La Needle, Las Animas and Río Magdalena.

KEYWORDS: Bathymetry, underwater cannons, Magdalena

Fishers and Managers Can Cooperate to Manage Data-poor Fisheries: A Fisher's Perspective on the Marine Life Fishery in Florida

Los Pescadores y los Administradores Pueden Cooperar para Gestionar las Pesquerías con Pocos Datos: La Perspectiva de un Pescador sobre la Pesca de la Vida Marina en Florida

Les Pêcheurs et les Gestionnaires Peuvent Coopérer pour Gérer les Pêcheries Pauvres en Données: Le Point de Vue d'Un Pêcheur sur la Pêche Marine en Floride

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ABSTRACT

The marine life fishery, i.e. collecting tropical fishes for sale to the marine aquarium trade, was unregulated in Florida for many years. I will show photos and video to illustrate how the fishery works. By the mid 1980's numerous collectors began to observe large-scale environmental changes such as increased coral bleaching and the Diadema die-off. They also saw an increase in the number of new entrants to the fishery and became concerned about the potential for over harvest. The professional collectors wanted to get ahead of any potential problems and contacted the regulatory body, Florida Fish and Wildlife Commission (FWC) for assistance. FWC took a leadership role in forming the Marine Life Working Group, a consortium of collectors, FWC staff biologists and NGO's. FWC charged the working group with designing regulations for the fishery. Over the course of 2 years, the group created the regulations that became known as the Marine Life Rule, approved in 1991. The group faced numerous challenges during the process. The "data poor fishery" had no stock assessments, no estimates of maximum sustainable yield, scant data on landings, and very little information on the biology and life history of most of the hundreds of targeted species. Nonetheless we managed to come up with a rule that covered licensing, size and bag limits, allowable gear, and the use of the fish anesthetic, Quinaldine. The regulations have been updated over time, but collectors generally agree that the fishery has been relatively stable during the last 25 years. We accomplished sustainable management with almost no data. I feel that many of our "data-poor fisheries" can still be managed using a cooperative approach relying on fishers' experience and knowledge and just plain old common sense.

KEYWORDS: Marine life fishery, aquarium fishery, sustainable management

The Combined Optical-Acoustic Survey Technique (COAST) for Estimating the Abundances and Distributions of Reef Fishes, and Mapping Their Seabed Habitats

La Técnica Combinada de Acústica-Óptica (COAST) para Estimar las Abundancias y Distribuciones de Peces de Arrecife, y Mapear sus Hábitats de Fondos Marinos

La Technique Combinée de Relevé Optique-Acoustique (COAST) pour Estimer l'Abondance et la Distribution des Poissons de Récif et Cartographier Leurs Habitats dans les Fonds Marins

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ABSTRACT

The distributions and abundances of reef fishes are estimated and their seabed habitats are mapped using data from multifrequency echosounders and images from underwater cameras. Acoustic sampling is used to measure and map the acoustic backscatter from fishes; optical sampling is used to estimate the proportions of each species and their length distributions; and the combined acoustic-optical dataset is used to estimate fish abundances by species, and their habitat types. Towards estimation of uncertainty, the acoustic sampling provides information about fish reactions to the camera platform and the height above the seabed that is ineffectively sampled by the echosounders. Example applications of the Combined Optical-Acoustic Survey Technique (COAST) are shown for rockfishes in the Southern California Bight.

KEYWORDS: Acoustic, optical, reef fishes

Quantifying Ecological Impact of Invasive Lionfish Relative to Co-occurring Native Predators: The Influence of Habitat Heterogeneity on Per Capita Impact

Cuantificando el Impacto Ecológico del Pez León Invasivo Relativo a los Depredadores Nativos Co-Ocurrentes: La Influencia de Heterogeneidad del Hábitat en el Impacto per Ccápita

Quantifier l'Impact Écologique du Poisson-lion Envahissant par Rapport aux Prédateurs Autochtones Co-occurrents: L'influence de Hétérogénéité de l'habitat sur l'Impact par Habitant

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ABSTRACT

The impacts of invasive lionfish (*Pterois volitans* and *P. miles*) have been quantified mainly through observational and manipulative field studies and stomach content analyses. However, we lack a thorough understanding of their feeding and behavioural ecology, especially relative to ecologically-similar native predators with which they co-occur. We conducted comparative, functional-response laboratory experiments with three species across seven prey densities. Lionfish per capita impact was contrasted against two native species, red (*Epinephelus morio*) and graysby (*Cephalopholis cruentata*) grouper.

Preliminary results suggest that lionfish attack at greater distances and are more efficient but largely less active predators, exhibiting high patch fidelity. The results from this experiment will have practical implications for prey population dynamics in the Gulf of Mexico and beyond. This is the first laboratory study to use comparative functional response methodology to assess the impacts of lionfish versus co-occurring predators and to do so in a spatially heterogeneous arena. Better understanding the feeding ecology and behaviour of lionfish is a pivotal step toward mitigating their threat across their invaded range.

KEYWORDS: Lionfish, feeding, behaviour

Male Territory Swamping Increases Courtship Success in a Lek-like Mating System of a Fish Spawning Aggregation

Territorio Masculino Inundando Aumenta el Éxito de Cortejo en un Sistema de Apareamiento Similar a Lek de una Agregación de Desove de Peces

Inondation du Territoire Masculin Augmente le Succès de la Cour Dans un Système d'Accouplement Semblable à Lek d'une Agrégation de Frai de Poissons

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ABSTRACT

A number of reef fish species that form spawning aggregations utilize a lek-like mating system in which males establish temporary courtship territories that they defend against rival males while attracting females to spawn. At a resident spawning aggregation site located at Finger Reef, Guam, male *Cheilinus trilobatus* (Labridae) holding territories along the outer edge of the site experience significantly greater courtship success compared with males holding territories within the site's interior. Males holding edge territories are always successful in defending these territories from intruding males, even when they are engaged in courtship. Recently, however, increases in the number of males present at the spawning aggregation site have resulted in an increase in the number of territory intrusions during courtship periods. These intrusions "swamp" a normally successful male's territory and make defense difficult. Multiple intruders not chased away or simply returning after being chased then court and spawn with females that arrive within the territory. Costs to the territory holder include lost courtship opportunities because of territorial interactions that interrupt courtship and reduced reproductive success because intruding males court successfully with females that visit the male's territory at the latter's expense.

KEYWORDS: Behavior, female choice, reef fish

Best Practices for Responding to the *Sargassum* Influx

Mejores Prácticas para Responder a la Afluencia del *Sargazo*

Meilleures Pratiques pour Répondre à l'Afflux de *Sargassum*

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ABSTRACT

In recent years, massive quantities of pelagic *Sargassum* have come ashore in the Caribbean, impacting shorelines and beaches, waterways, fisheries and tourism. The response to the sargassum influx has often been a knee-jerk reaction - uncoordinated and not always environmentally sustainable. Bad choices that are made in responding to sargassum place at risk the very resources upon which tourism depends – poor beach cleaning practices cause the loss of sandy beaches, worsened coastal erosion, the destruction of sea turtle and sea bird nests. In 2018, we developed a reference poster with practical guidance for coastal zone managers, conservationists and the owners, managers and staff of beach-front hotels, resorts and coastal properties to assist them with responding to the *Sargassum* influx. Designed in a graphic format to promote clarity of communications and ease of reference, the poster provides sound guidance on best practices for removing sargassum while protecting the coastal zone, its associated habitats and fauna, and avoiding detrimental impacts on the marine environment and coastal communities. A collaboration with Caribbean-based design team Deviate Design, the poster represents an innovative communications approach to an emerging marine and coastal issue affecting the Gulf and Caribbean region. Practical lessons were learned about the most effective communications formats to increase the reach of environmental messaging and to build uptake of best coastal zone management practices in the era of social media.

KEYWORDS: *Sargassum,* communications, coastal zone management

Fisheries Management Capacity and Caribbean MPAs – Responding to Needs of the MPAConnect network

Capacidad de los AMPs del Caribe para el Manejo de las Pesquerías – Respondiendo a las Nnecesidades de los Sitios Miembros de la Red MPAConnect

Capacité des AMP Caribéennes pour la Gestion des Ppêches – Répondre aux Besoins des Sites Membres du Réseau MPAConnect

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ABSTRACT

MPAConnect is an initiative of the Gulf and Caribbean Fisheries Institute, NOAA's Coral Reef Conservation Program and over 30 Caribbean coral reef marine protected areas (MPAs). In the 2017 MPAConnect assessment of regional MPA management capacity, fisheries management was identified as one of the three highest priority capacity building needs of participating MPA managers. Responding to this need, in 2018, MPAConnect and the Saba Conservation Foundation co-hosted a regional peer-to-peer learning exchange that focused on fisheries management for Caribbean MPA managers. With expert guidance and MPA manager mentorship, the MPA managers refined their site-specific fisheries management goals and determined what level of capacity their management programs would require to best achieve those goals, in terms of monitoring/assessment and management action. Through sharing of best practices and peer experience, the MPA managers identified the fisheries management approaches that are most feasible and appropriate for their MPAs, and determined the necessary next steps, technical support and research needed to move forward with the fisheries management approaches. These site level needs represent meaningful opportunities for the GCFI community - technical experts, authorities, students, cooperation agencies and NGOs - to collaborate with Caribbean MPAs and help advance the application of fisheries management strategies in the region.

KEYWORDS: MPAConnect, marine protected areas, fisheries management

Experimental Trial of Technological Improvements in the Artisanal Trawl Nets for the Reduction of Shrimp By-catch in the Gulf of Salamanca, Caribbean Sea of Colombia

Prueba Experimental de Mejoras Tecnológicas en las Redes de Arrastre Artesanales para La Reducción de la Pesca Acompañante de Camarón en el Golfo de Salamanca, Mar Caribe de Colombia

Essai Expérimental des Améliorations Technologiques Apportées aux Chaluts Artisanaux pour la Réduction des Prises Accessoires de Crevettes dans le Golfe de Salamanca, Mer des Caraïbes en Colombie

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RESUMEN

Modificaciones tecnológicas en las redes de arrastre se han evaluado e implementado en diversas pesquerías industriales para reducir la pesca acompañante, pero su uso ha sido menor en las pesquerías artesanales. No obstante, estas últimas operan en zonas costeras donde pueden impactar hábitats esenciales de juveniles. Se evaluó experimentalmente los cambios en las variables de desempeño pesquero debidos al uso de redes prototipo de arrastre artesanal de camarón, con un diseño más selectivo y equipadas con un dispositivo reductor de pesca acompañante (ventana de malla cuadrada) en el golfo de Salamanca, mar Caribe de Colombia. Para ello, se efectuó un total de 49 lances pareados (red prototipo vs. red tradicional) entre mayo y julio de 2018. En cada lance se registró la composición y biomasa de la pesca acompañante, la cantidad de camarón capturada y el consumo de combustible durante la maniobra. La CPUE (kg h-1) de la especie de camarones más pequeños que son objetivo de la pesquería (*Xiphopenaeus kroyeri*) resultó menor significativamente en la red prototipo que en la red tradicional ($P<0,01$). En contraste, la CPUE de Penaeus spp. no observó diferencia estadística entre las redes y de la especie invasora, Penaeus monodon, resultó mayor estadísticamente en la red prototipo ($P>0,05$). La captura promedio de los descartes fue menor en la red prototipo ($P=0,05$) y la captura incidental no tuvo diferencia entre las redes. El consumo promedio de combustible en las embarcaciones con la red tradicional fue superior al de la red prototipo, pero no significativamente ($P=0,15$). La aplicación de mejoras en el diseño de las redes de arrastre y el uso de dispositivos contribuiría para el manejo de la pesquería en la región dentro de un enfoque de ecosistemas. Estudio efectuado en el marco del proyecto REBYC-II LAC.

PALABRAS CLAVES: Enfoque de ecosistemas, manejo pesquero, pesquerías de pequeña-escala

Application of the Ecosystem Approach to Bycatch Management Plans in the Trawl Fisheries of Colombia

Aplicación del Enfoque de Ecosistemas a Planes de Gestión de las Capturas Incidentales de la Pesca de Arrastre en Colombia

Application de l'Approche Écosystémique aux Plans de Gestion des Prises Accessoires dans les Pêcheries au Chalut de Colombie

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RESUMEN

El enfoque de ecosistemas se constituye en un cambio de paradigma para el manejo pesquero en el cual el éxito de la sostenibilidad está relacionado con una concepción de las pesquerías como un sistema con componentes ecológicos, biofísicos, económicos, sociales y culturales. Además, se ha reconocido que las aproximaciones participativas para el manejo de las pesquerías aumentan su aplicabilidad, toda vez que involucran a los actores relacionados en el uso y administración de los recursos pesqueros. En este contexto, se aplicó una metodología participativa en la formulación de planes de gestión, usando el enfoque de ecosistemas, para el manejo de las capturas incidentales de pesquerías de arrastre de camarón en dos unidades de manejo de pesca artesanal y una de pesca industrial en Colombia. Se identificaron en cada caso problemáticas, metas, objetivos, indicadores, puntos de referencia y acciones de manejo en tres componentes: bienestar humano, buena gobernanza y bienestar ecológico. Como resultado, las acciones concertadas para la unidad de manejo de pesca artesanal del Caribe (golfo de Salamanca) se centraron en la participación de los pescadores, la articulación interinstitucional, la reducción de juveniles en las capturas y las vedas; mientras que las acciones en la unidad artesanal del Pacífico (Iscuandé), se enfocaron al empoderamiento de la comunidad, la realización de proyectos de educación ambiental, la ejecución de planes de negocios y ordenamiento de espacial de la unidad de manejo. En la unidad de manejo industrial del Pacífico, las acciones apuntaron a investigaciones para el desarrollo de nuevas pesquerías, la articulación interinstitucional, la adopción de tecnologías que reduzcan consumo de combustible y el fortalecimiento del control y vigilancia. Estudio realizado en el marco del proyecto REBYC-II LAC.

PALABRAS CLAVES: Manejo participativo, pesquería de pequeña escala, pesquería industrial

Post-Cretaceous Bursts of Evolution Along the Benthic-Pelagic Axis in Marine Fishes

Explosion Evolutiva Post-Cretácea a lo Largo del Eje Bentónico-Pelágico en Peces Marinos

Explosion Post-Crétacée Évolutive le Long de L'axe Benthique-Pélagique Chez les Poissons Marins

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ABSTRACT

Ecological opportunity arising in the aftermath of mass extinction events is a powerful driver of evolutionary radiations. Here, we assessed how the wake of the Cretaceous-Paleogene (K-Pg) mass extinction shaped taxonomic proliferation, phenotypic disparification, and ecological diversification in a group of mostly marine acanthomorph fishes—the Carangaria. This clade comprises a disparate array of benthic and pelagic dwellers (ca. 1100 species), including some of the most astonishing forms and critical components of the Caribbean fish fauna such as flatfishes, billfishes, remoras, and barracudas. We estimated a fossil-calibrated multi-locus time tree that covers all major lineages in the group and used a set of phylogenetic comparative approaches to investigate how rates of lineage diversification, multivariate phenotypic evolution, and habitat transitions vary throughout the history of the clade. Analyses of lineage diversification show time-heterogeneous rates of taxonomic diversification in carangarians, with the highest levels of diversity reached during the Paleocene. Likewise, a remarkable proportion of Carangaria's morphological variation originated early in the history of the group and in tandem with a marked incidence of habitat shifts. Taken together, these results suggest that all major lineages and body plans in Carangaria originated in an early burst shortly after the K-Pg mass extinction, which ultimately allowed the occupation of newly released niches along the benthic-pelagic axis.

KEYWORDS: Mass extinction, ecological opportunity, benthic-pelagic axis

Post-Cretaceous Bursts of Evolution Along the Benthic-pelagic Axis in Marine Fishes

Explosion Evolutiva Post-cretácea a lo Largo del Eje Bentónico-pelágico en Peces Marinos

Explosion Post-crétacée Évolutive le Long de l'Axe Benthique-pélagique chez les Poissons Narins

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ABSTRACT

Ecological opportunity arising in the aftermath of mass extinction events is a powerful driver of evolutionary radiations. Here, we assessed how the wake of the Cretaceous-Paleogene (K-Pg) mass extinction shaped taxonomic proliferation, phenotypic disparification, and ecological diversification in a group of mostly marine acanthomorph fishes—the Carangaria. This clade comprises a disparate array of benthic and pelagic dwellers (ca. 1100 species), including some of the most astonishing forms and critical components of the Caribbean fish fauna such as flatfishes, billfishes, remoras, and barracudas. We estimated a fossil-calibrated multi-locus time tree that covers all major lineages in the group and used a set of phylogenetic comparative approaches to investigate how rates of lineage diversification, multivariate phenotypic evolution, and habitat transitions vary throughout the history of the clade. Analyses of lineage diversification show time-heterogeneous rates of taxonomic diversification in carangarians, with the highest levels of diversity reached during the Paleocene. Likewise, a remarkable proportion of Carangaria's morphological variation originated early in the history of the group and in tandem with a marked incidence of habitat shifts. Taken together, these results suggest that all major lineages and body plans in Carangaria originated in an early burst shortly after the K-Pg mass extinction, which ultimately allowed the occupation of newly released niches along the benthic-pelagic axis.

KEYWORDS: Mass extinction, ecological opportunity, benthic-pelagic axis

Spatial-Temporal Movement Patterns of Juvenile Atlantic Tarpon (*Megalops atlanticus*) in Brewers Bay, St. Thomas, US Virgin Islands

Patrones Espacial-Temporales del Movimiento del Sábalo Atlántico Juvenil (*Megalops atlanticus*) en la Bahía de Brewers, St. Thomas de Las dslas Vírgenes De Los EE.UU.

Schémas de Mouvements Spatio-Temporels des Jeunes Tarpons de l'Atlantique (*Megalops atlanticus*) dans la Baie Brewers, St. Thomas du les Îles Vierges Américaines

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ABSTRACT

Atlantic tarpon (*Megalops atlanticus*) are highly mobile fish important to recreational fisheries along the Atlantic Ocean, especially the Gulf of Mexico and the Caribbean Islands. Little is known about small-scale movements or space use of juvenile tarpon in Caribbean ecosystems. This study aims to fulfill those gaps using acoustic telemetry in Brewers Bay, St. Thomas, US Virgin Islands. Fourteen Atlantic tarpon ranging in size from 61cm to 95cm fork length (FL) were passively tracked to identify their vertical movement and home range, during diel, crepuscular and seasonal periods. From September 2015 to May 2017 only four tarpon showed greater than 80% residency time within Brewers Bay. The average home range size for all Atlantic tarpon was 0.603 km2 (range = 0.109-1.349km2). During the day tarpon primarily utilized the waters around the St. Thomas airport runway and at night appeared to rest in a small lagoon. Monthly home range size varied significantly among each tarpon (R2 0.4311, p=0.001). Tarpon were typically found in waters <18 m, but occasionally moved to depths up to 25 m. Our results illustrate clear movement patterns (both horizontal and vertical) of Atlantic tarpon in Brewers Bay across time and space. These results provide baseline data that will be important to efficiently monitor and evaluate responses to changing water and habitat quality that can inform management plans for the species.

KEYWORDS: Atlantic tarpon, acoustic telemetry, fish movement

Local Conservation Measures Paving a Prudent Path for Bonaire's Corals in a Changing Climate

Medidas de Conservación Locales que Pavimientan un Camino Prudente para los Corales de Bonaire en un Clima que se Cambia

Les Mesures de Conservation Locales Paver un Chemin Prudent pour les Coraux de Bonaire dans un Climat Changeant

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ABSTRACT

Bonaire is a Caribbean island north of Venezuela whose economy is largely based on coral reef tourism. For 40 years, the Bonaire National Marine Park has been actively managing its coral reefs by focusing on factors that enhance recovery following disturbances. This is coupled with coral reef conservation outreach and regulations. Since the 1970's there has been a slow and steady decline in coral reef cover throughout the Caribbean, but coral cover on Bonaire's reefs, despite also declining, remains high in comparison. In 2017, long-term monitoring surveys (2003-2017) demonstrated evidence of coral reef resilience including increases in coral cover, juvenile corals, and abundance of parrotfish and a decrease in macroalgal cover. These positive trends may be a result of the combination of coral reef conservation and outreach measures that have been ongoing since the 1960's with relatively recent local conservation actions including the installment of a wastewater treatment system, the establishment of no-take marine reserves and legislation protecting many important marine species. In late 2017 and in the two preceding years, Bonaire's reefs suffered widespread coral bleaching. Unlike in 2010, when an estimated 10% of corals suffered from post-bleaching mortality, these recent bleaching episodes were transient resulting in low post-bleaching mortality. Coral bleaching has become a frequent and intense stressor to Bonaire's coral reefs. With Bonaire's economy based mainly on tourism, a sector that is growing in both numbers of visitors and resulting stressors to the reef, local conservation measures and sustainable practices are practical and prudent and may make a difference in the ability of some corals to survive repeated thermal stress.

KEYWORDS: Coral bleaching, climate change, resilience

Integrating Biological, Physical and Social Coral Reef Monitoring Data: Challenges and Solutions

Integración de Datos de Monitoreo de Arrecifes de Coral Biológicos, Físicos y Sociales: Desafíos y Soluciones

Intégration des Données de Surveillance des Récifs Coralliens Biologiques, Physiques et Sociaux: Défis et Solutions

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ABSTRACT

Progress towards integrated monitoring is improving globally via initiatives and programs. The Global Coral Reef Monitoring Network (GCRMN) developed a Socioeconomic Manual for Coral Reef Management designed to improve understanding of the social and economic conditions, contexts and motivations associated with coral reef use. GCRMN Global Socioeconomic Monitoring Initiative (SocMon and SEM Pasifika) partners use it to guide regional data collection efforts. GCRMN-Caribbean partners recently developed recommended coral reef monitoring guidelines for integrated, standardized ecological and socioeconomic data collection.

The National Oceanic and Atmospheric Administration's (NOAA) Coral Reef Conservation Program has implemented a National Coral Reef Monitoring Program (NCRMP) for conducting sustained observations of biological, climatic, and socioeconomic indicators in U.S. states and territories. The social science component of NCRMP monitors a set of socioeconomic variables, including knowledge, attitudes, and perceptions of coral reefs and their management. Development of a suite of indicators to track trends in population and socioeconomic structure, impacts of society on coral reefs, and impacts of coral health on communities is the aim. In this paper, we discuss current progress, challenges and next steps of these different monitoring efforts. We suggest potential ways to improve integrated monitoring and research that benefits coastal resource management.

KEYWORDS: Coral reef conservation, GCRMN Caribbean, SocMon

Hydroacoustics for the Discovery and Quantification of Nassau grouper (*Epinephelus striatus*) Spawning Aggregations

Hidroacústica para el Descubrimiento y Cuantificación de Nassau grouper (*Epinephelus striatus*) Agregación de Desove

Hydroacoustique pour la Découverte et la Quantification de Nassau Grouper (*Epinephelus striatus*) Agrégation de Frai

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ABSTRACT

Fish spawning aggregations (FSAs) are vital life-history events that need to be monitored to determine the health of aggregating populations; this is especially true of the endangered Nassau grouper (*Epinephelus striatus*). Hydroacoustics were used to locate Nassau grouper FSAs at sites on the west end of Little Cayman (LCW), and east ends of Grand Cayman (GCE) and Cayman Brac (CBE). Fish abundance and biomass at each FSA were estimated via echo integration and FSA extent. Acoustic mean fish abundance estimates on the FSA at LCW did not differ significantly from concurrent SCUBA estimates. Mean fish densities were significantly higher at LCW than at the other sites. We investigate different acoustic post processing options to obtain target strength (TS), and we examine the different TS to total length (TL) formulas available. The SCUBA surveys also provided measures of TL through the use of laser callipers allowing development of an in situ TS to TL formula for Nassau grouper at the LCW FSA. Application of this formula revealed mean fish TL was significantly higher at LCW than GCE, but not CBE. Use of the empirical TS to TL formula resulted in underestimation of fish length in comparison with diver measurements, highlighting the benefits of secondary length data and deriving specific TS to TL formulas for each population. FSA location examined with reference to seasonal marine protected areas (Designated Grouper Spawning Areas) showed FSAs were partially outside these areas at GCE and very close to the boundary at CBE. As FSAs often occur at the limits of safe diving operations, hydroacoustic technology provides an alternative method to monitor and inform future management of aggregating fish species.

KEYWORDS: Hydroacoustics, Nassau Grouper, spawning aggregations

Barra Del Colorado:
A Community of Artisan Fishermen and Shrimp Peelers from the Costa Rican Caribbean

Barra del Colorado: Una Comunidad de Pescadores Artesanales y Peladoras de Camarón del Caribe Costarricense

Barra Del Colorado: Une Communauté de Pêcheurs Artisanaux et d'Éplucheuses de Crevettes des Caraïbes Costaricaines

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RESUMEN

Barra del Colorado es una comunidad de pescadores y peladoras de camarón, localizada en el Caribe norte de Costa Rica. Por muchos años, era conocida exclusivamente por la pesca turística y deportiva, sin embargo, a raíz de un voto emitido por la Sala Constitucional de Costa Rica en el 2013, se suspende la emisión de nuevas licencias de pesca de arrastre de camarón, se da a conocer el impacto negativo en la localidad, por lo que surge la necesidad de iniciar un proceso integral dirigido a los usuarios del recurso camarón, que comprende: fortalecimiento organizacional, investigaciones dirigidas a la pesquería de camarón, trabajar bajo un modelo buena gobernanza con Enfoque Ecosistémico, visibilización del papel de la mujer en la pesca, derecho a tenencia de la tierra, diagnóstico socio económico de la comunidad, entre otros.

La temporada de camarón en Barra de Colorado tiene características muy diferentes y especiales en comparación a la pesquería de camarón del Pacífico costarricense. Todas las actividades económicas y culturales de la comunidad giran en torno a esta actividad productiva; hombres, jóvenes y mujeres subsisten gracias a esta pesquería. Desde el 2017, a través del proyecto REBYC II-LAC, que ejecuta el INCOPESCA (Instituto Costarricense de Pesca y Acuicultura) con el apoyo de la FAO y la participación de otras instituciones de gobierno y organizaciones de sociedad civil, se identifica a Barra del Colorado como sitio piloto para mejorar los medios de vida y evitar la pérdida de una actividad que históricamente ha contribuido al desarrollo y generación del único empleo para las mujeres de esta localidad, bajo el modelo de Área Marina de Pesca Responsable (AMPR).

PALABRAS CLAVES: Barra del Colorado, pesca artesanal de camarón, FAO

Barra del Colorado:
A Community of Artisan Fishermen and Shrimp Peelers from the Costa Rican Caribbean

Barra del Colorado: Una comunidad de Pescadores Artesanales y Peladoras de Camarón del Caribe Costarricense

Barra del Colorado: Une Communauté de Pêcheurs Artisanaux et d'Éplucheuses de Crevettes des Caraïbes Costaricaines

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RESUMEN

Barra del Colorado es una comunidad de pescadores y peladoras de camarón, localizada en el Caribe norte de Costa Rica. Por muchos años, era conocida exclusivamente por la pesca turística y deportiva, sin embargo, a raíz de un voto emitido por la Sala Constitucional de Costa Rica en el 2013, se suspende la emisión de nuevas licencias de pesca de arrastre de camarón, se da a conocer el impacto negativo en la localidad, por lo que surge la necesidad de iniciar un proceso integral dirigido a los usuarios del recurso camarón, que comprende: fortalecimiento organizacional, investigaciones dirigidas a la pesquería de camarón, trabajar bajo un modelo buena gobernanza con Enfoque Ecosistémico, visibilización del papel de la mujer en la pesca, derecho a tenencia de la tierra, diagnóstico socio económico de la comunidad, entre otros.

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PALABRAS CLAVES: Barra del Colorado, pesca artesanal de camarón, FAO

Sargassum:
Impact on Tourism and Fisheries and its Cascading Effects on Bonaire, Dutch Caribbean

Sargassum:
Impacto en Turismo y Pesca y Su Efectos Cascada en Bonaire, Caribe Holandés

La *Sargasse*: Impact Sur le Tourisme et la Pêche, et ses Effets de Cascade a Bonaire, Caraïbes Néerlandaises

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ABSTRACT

Sargassum landing events are increasing both in frequency and volume and call for immediate measures to minimize repeated and long-term damage to marine resources as well as costly clean-ups. Removal guidelines have been developed for *Sargassum* landings on beaches, but shorelines with mangrove forests and shallow seagrass beds require different approaches due to their vulnerability and inaccessibility. In March 2018, large amounts of *Sargassum* entered two bays of Bonaire, Dutch Caribbean and collected along 70 ha (30%) of mangrove forest including a network of mangrove channels and lagoons and on 29 ha (11%) of shallow seagrass beds. Immediate and widespread mortality of fish, conch, sea turtles, crabs, lobsters and other invertebrates was observed. Direct effects to mangroves include the yellowing of leaves, but indirect effects are unknown. The dominant seagrass, *Thalassia testudinum* was directly impacted both by decomposing *Sargassum* and destructive clean-up efforts, opening space for the invasive seagrass *Halophila stipulacea*. This and repeated events may have cascading effects such as a change in the species composition of the seagrass beds. The value of nature and associated ecosystem services for tourism has been compared to the cost of prevention. Although prevention is costly and involves an investment in specialized equipment, training and maintenance, the costs of inaction are much higher in regards to the loss of valuable ecosystem resources and their services.

KEYWORDS: *Sargassum,* tourism, fishery

Gourmet Plate of Yucatan Fishing in the Hands of Women

Plato Gourmet de la Pesca de Yucatán en Manos de Mujeres

La Table Gourmet des Poissons du Yucatan, Mexique est dans les Mains des Femmes

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RESUMEN

En Yucatán, México el valor de la producción pesquera alcanzó 1 346 millones pesos en 2016, por la comercialización de 34 mil toneladas de productos del mar. Esta actividad genera empleos directos e indirectos para 15 000 familias. Progreso es uno de los principales puertos con 20 plantas congeladoras, en las cuáles laboran "fileteadores" de pescado (hombres) y "deshuesadoras" (mujeres que sacan las espinas a los filetes). Ambos realizan un trabajo espinoso, laborando a temperaturas frías (2-6 oC) y sólo tienen empleo cuando el volumen de la pesca es importante, en promedio 6 meses al año.

Este trabajo presenta los resultados de mujeres de 5 plantas procesadoras a través de encuestas con 20 reactivos; abarcando aspectos socioeconómicos, escolaridad, jornada de trabajo. La mayoría de ellas están casadas o viven en pareja con hijos. Su edad promedio por arriba de 40 años. Tienen jornadas de 12-15 horas con un promedio de $1500 semanales (75 US). Su trabajo lo realizan sin tener seguro médico, ni prestaciones sociales (vivienda, jubilación, incapacidad). No poseen uniforme, ni material de protección, ni recibieron capacitación. Todas ellas realizan además el trabajo doméstico de su hogar y cuidado de los hijos. Su ingreso lo destina al hogar o a los estudios de sus hijos.

Estas mujeres requieren salir de la invisibilidad laboral, ser capacitadas y protegidas con los derechos que marca la Ley del Trabajo. Se requiere empoderarlas para que comprendan su aporte en la Economía yucateca, en la de su hogar y el de permitirnos tener un plato gourmet en mesas de México y en Extranjero.

PALABRAS CLAVES: Women, fisheries, market

Reduction of Shrimp Bycatch of the Shallow Water Trawling Fleet on the Colombian Caribbean Sea

Reducción de la Captura Incidental de la Pesquería del Camarón de Aguas Someras en el Mar Caribe de Colombia

Réduction des Prises Accessoires de Crevettes de la Flotte de Chalutiers Peu Profonds sur la Mer des Caraïbes Colombienne

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RESUMEN

La pesca de arrastre en el Caribe de Colombia ha decrecido sustancialmente en la última década, no obstante, esta práctica de pesca sigue siendo una opción de ingresos económicos y medios de vida para comunidades de pescadores empleados por esta flota. Con fines de obtener información que soporte algunas medidas de manejo para la pesca de arrastre, que minimice su impacto ambiental sin comprometer el ingreso de los pescadores, se realizaron experimentos de pesca pareados entre redes prototipo que incluyeron cambios en el diseño y materiales de construcción, contra redes tradicionales, en el marco del proyecto "Gestión Sostenible de la Captura Incidental de las Pesquerías de Arrastre en América Latina y el Caribe (REBYC-II LAC)". Las variables indicadoras para evaluar el impacto sobre la biodiversidad de las redes prototipo fueron: captura objetivo, incidental, descarte y consumo de combustible. Basados en 21 lances pareados, los resultados mostraron reducciones de 11% de captura incidental y 26% de descartes; no obstantes dichos valores no fueron significativos, aunque la captura objetivo fue significativamente mayor en las redes prototipo (>63%). Lo anterior resultó en una reducción significativa del 30% en la tasa fauna acompañante/captura objetivo de la red prototipo comparada con la red tradicional. Adicionalmente se evidenció una reducción del 15% en el consumo de combustible de las redes prototipo comparada con las redes tradicionales. Estos resultados muestran a la red prototipo como una alternativa tecnológica que reduce el impacto ambiental de esta pesquería en aguas someras del Caribe de Colombia.

PALABRAS CLAVES: Pesca de arrastre, fauna acompañante, manejo sostenible

Mitigation of the Impact of Deepwater Shrimp Trawling in the Pacific of Colombia

Mitigación del Impacto de la Pesca de Arrastre del Camarón de Aguas Profundas en el Pacífico de Colombia

Atténuation de l'Impact du Chalutage Crevettier en Eaux Profondes dans le Pacifique de la Colombie

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RESUMEN

El aprovechamiento del camarón de aguas profundas en el Pacífico colombiano se encuentra en su máximo nivel, lo que ha conllevado a la implementación de medidas de manejo. En la actualidad, esta pesquería se desarrolla principalmente en el Distrito Regional de Manejo Integrado Golfo de Tribugá – Cabo Corrientes, con una temporalidad de cinco meses entre abril y septiembre de cada año. Aunque la problemática de la fauna acompañante es menor que en la pesquería de aguas someras, ésta también genera un impacto sobre la biodiversidad marina por lo que se busca minimizarlo. Para esto, se realizaron pruebas experimentales en dos barcos comerciales equipados con redes tradicionales y con redes prototipo (material más liviano y cambios en el diseño del arte), a través de 27 lances pareados durante la temporada de pesca. Se evaluaron los cambios en la captura por unidad de área (CPUA) de la captura objetivo y la fauna acompañante (descarte e incidental); además de cambios en la tasa fauna acompañante/captura objetivo (FA/CO) y cambios en el consumo de combustible. La captura incidental y objetivo, no mostraron diferencias significativas entre redes, sin embargo, la captura incidental disminuyó un 20%, mientras la captura objetivo se incrementó en 9,5% en favor de la red prototipo. Adicionalmente, las redes prototipo, redujeron los descartes y FA/CO en 40% y 47%, respectivamente. Por otra parte, el consumo de combustible se redujo significativamente en un 22% en la embarcación que utilizó las redes prototipo, disminuyendo la huella de carbono. Los resultados apuntan a los ODS-12 (Producción y Consumo Responsable) y ODS-14 (Vida submarina).

PALABRAS CLAVES: Pesca de arrastre, camarón de aguas profundas, impacto de la pesca

Diving Tourism as a Possible Protection Factor for Reef Fish Communities in the Mexican Caribbean

El Turismo de Buceo como un Posible Factor de Protección para las Comunidades de Peces Arrecifales en el Caribe Mexicano

Le Tourisme de Plongée Comme Facteur de Protection Possible pour les Communautés de Poissons de Récif dans les Caraïbes Mexicaines

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RESUMEN

La red mundial de Áreas Marinas Protegidas (AMPs) ha incrementado rápidamente; sin embargo, en ocasiones esto refleja un interés por cumplir compromisos internacionales más que por preservar el capital natural. En el Caribe mexicano, para 2016 casi el 100% de los arrecifes fueron incluidos en la red de AMPs, sin embargo muchas de estas aun no cuentan con programas de manejo actualizados, además de que la inversión en la red de AMPs ha disminuido drásticamente en los últimos años. A pesar de esta situación, algunas AMPs aun cuentan con indicadores de condición saludable, como son altos valores de biomasa de peces, resaltando la necesidad de entender los factores que facilitan su mantenimiento. Dado que el buceo recreativo ha sido identificado como alternativa no extractiva a la pesca y depende en gran medida de poblaciones saludables de peces, en este estudio evaluamos la hipótesis de que la práctica del buceo interactúa sinérgicamente con la regulación dentro las AMPs, beneficiando a las poblaciones de peces en términos de biomasa. Muestreamos 56 arrecifes en zonas con diferente nivel de protección y actividad turística. Además del efecto positivo de variables asociadas al hábitat (complejidad arrecifal, profundidad), encontramos una relación positiva y significativa entre biomasa de peces y el número de centros de buceo. El 65% de los centros de buceo se ubican en las AMPs situadas en Cancún y Cozumel, ambas con la mayor biomasa de peces. En cambio, otros arrecifes distribuidos a lo largo de la región y aledaños a zonas con pocos o ningún centro de buceo contaron con una menor biomasa. Entender los efectos que ejerce el buceo recreativo sobre las comunidades de peces es fundamental para su vinculación con estrategias de manejo con el fin de garantizar que se logren objetivos de conservación y económicos.

KEYWORDS: Coral reefs, Mexican Caribbean, scuba diving tourism

State of population *Sphyraena barracuda* on San Andrés island, Bolívar and Albuquerque Cays, Colombian Caribbean

Estado de la Población de *Sphyraena barracuda* en la Isla de San Andrés, Cayos Bolívar y Albuquerque, Caribe colombiano

État de la Population de *Sphyraena barracuda* dans l'Île d' Sain Andrés, les Îlots Rocheux Bolivar et Albuquerque, le Caribe Colombienne

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RESUMEN

En el Archipiélago de San Andrés, Providencia y Santa Catalina, en el Caribe colombiano, se realiza la pesca artesanal de peces, entre ellas la barracuda (*Sphyraena barracuda*). No obstante, pocos estudios biológicos, ecológicos y pesqueros se han realizado de esta especie, aun cuando reportes la muestran entre las más capturadas en el área de pesca, pero con tendencia a la disminución. Esta investigación se propuso describir el estado de la población de la barracuda en términos de abundancia y variabilidad espacio temporal en la isla de San Andrés y los cayos Bolívar y Albuquerque, partiendo del análisis de muestreos ecológicos y pesqueros realizados en otras investigaciones. A nivel ecológico, se encontró variación en la abundancia de barracuda entre épocas climáticas y en el transcurso del tiempo (años 2009 a 2011), presentando mayor densidad en época de lluvias 0,61 ind./100 m2; y se evidenció uso diferencial del hábitat de acuerdo con el estado, los juveniles y adultos tempranos tienden a encontrarse en hábitats de manglar y pastos marinos (93%), mientras los adultos en arrecifes coralinos. El promedio de captura anual de barracuda fue de 10,1 ton (años 2004 a 2017), presentando la menor captura en el año 2015, con un registro de 6,1 ton. Entre zonas de pesca la variación en la abundancia de barracuda estuvo relacionada principalmente con el esfuerzo. La CPUE versus el esfuerzo muestran periodos de sobrepesca entre 2007 - 2009 y 2014 – 2016; y entre marzo y noviembre. Así como también se evidenció tendencia a la disminución en la captura anual. Se propone continuar las investigaciones a nivel ecológico, de utilidad para evidenciar el comportamiento de una población, y hacer mayor control de la pesca en relación a las tallas y zonas pesca para conservar el recurso y hacer una explotación sustentable.

PALABRAS CLAVES: Reserva de Biósfera, Seaflower, pesca artesanal

Red Snapper (*Lutjanus campechanus*) Movement Patterns Based on Acoustic Positioning Around Oil and Gas Platforms in the Northern Gulf Of Mexico

Patrones de Movimiento del Pargo Rojo (*Lutjanus campechanus*) Basados en el Posicionamiento Acústico Alrededor de las Plataformas de Petróleo y Gas en el Norte del Golfo de México

Modes de Déplacement du Vivaneau Campèche (*Lutjanus campechanus*) Basés sur le Positionnement Acoustique Autour des Plates-Formes Pétrolières et Gazières du Nord du Golfe du Mexique

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ABSTRACT

Offshore oil and gas platforms provide habitat for many marine fish species in the northern Gulf of Mexico. By law, the owning company is required to remove obsolete platforms. The most economical method is explosive removal, but such removals usually result in high mortalities of economically important red snapper (Lutjanus campechanus) and habitat loss. The present study used telemetry methods to examine the movement patterns and residency of red snapper (n=54) around three platforms in the northern Gulf of Mexico from March 2017 to May 2018 to estimate site fidelity, residency and area use. Site fidelity = 30% y-1 and residency = 11 months. Area use or home range (95 % kernel density estimates) was positively correlated to temperature and negatively correlated to dissolved oxygen (DO). Salinity showed little change and was well within the tolerance range for Lutjanidae. Monthly area use increased in the summer and fall ($F_{11, 249} = 11.46$, $P < 0.001$). Diel patterns of area use differed significantly ($F_{71, 4207} = 3.55$, $P < 0.001$). Over all sites area use was significantly smaller at dawn (0500-0700), but similar during day and night hours. Many red snapper (n = 18) in the present study displayed homing behavior with frequent short-term forays away from their home reef from August to November (88% < 4 days). Red snapper showed a high affinity for platform structure with most (76%) positions within or near platform structure (mean distance = 20 m). The present study showed long term, high site fidelity to platforms in the northern Gulf of Mexico, suggesting that offshore platforms provide important habitat for red snapper and required removals may cause unexpected declines in this species.

KEYWORDS: Telemetry, artificial reefs

Precision and Accuracy of Growth Parameters for *Opisthonema oglinum* Generated from Different Models and Statistical Technics

Exactitud y Precisión de los Parámetros de Crecimiento de *Opisthonema oglinum* Obtenidos Mediante Diferentes Modelos y Técnicas Estadísticas

Exactitude et Précision des Paramètres de *Opisthonema oglinum* Croissance de Obtenus Grâce à Différents Modèles et Techniques Statistiques

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RESUMEN

Dentro de las especies pelágicas pequeñas de mayor interés comercial que se encuentran en el Caribe colombiano, cabe destacar la especie *Opisthonema oglinum*, la cual presenta un comportamiento migratorio desde la costa hacia mar abierto. Esto ha sido atribuido al aumento de la turbulencia en las zonas costeras, obligando al machuelo a desplazarse hacia aguas más claras. Dada la importancia de este recurso se compararon diferentes modelos y técnicas estadísticas usadas a fin de establecer la combinación modelo/técnica que arrojara la mejor estimación en términos de exactitud y precisión, y posteriormente se aplicaron las técnicas de remuestreo de Jacknife y de Bootstrap. Para ello se tomaron datos de tallas de ejemplares de Opisthonema oglinum capturados en la zona costera del departamento del Magdalena (Caribe colombiano), por la pesquería artesanal de chinchorro de jala (red de tiro). Según Jacknife la combinación modelo/técnica que arrojó los mejores resultados de exactitud y precisión fue de ELEFAN Pauly, con un Porcentaje de Error (PE) de 0,03% y Coeficiente de Variación (CV) de 0,74% para $L\infty$. En la técnica de Bootstrap se emplearon los cuatro métodos (Básico, BCA, Percentil y Normal), obteniéndose la mejor precisión con ELEFAN Pauly para los parámetros $L\infty$, Φ, K y To, en cambio para la exactitud no fueron consistentes los valores para determinar la técnica óptima. Es necesario recalcar que el parámetro K fue el único que coincidió en precisión y exactitud con ELEFAN Pauly.

PALABRAS CLAVES: Caribe Colombiano, Chinchorro de jala, ELEFAN Pauly

Traps With Gaps: Testing Fish Traps With Escape Gaps as an Option to Improve the Sustainability of the Reef Fishery In Montserrat

Trampas Con Escape: Probando Trampas de Peces Con Vías de Escape como Opción de Mejora de la Sostenibilidad de la Pesca en Arrecife en Montserrat

Pièges À Trous: Tester des Pièges à Poissons avec des Brèches pour Améliorer la Durabilité de la Pêche Récifale à Montserrat

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ABSTRACT

Caribbean reef fisheries have a history of heavy exploitation and their long-term prosperity is threatened by both unsustainable fishing and habitat degradation. Fish traps are commonly used in the Caribbean and are minimally selective, catching a high diversity of fish, including juveniles and unwanted species. Previous work has focused primarily on the use of mesh size to manage trap fisheries, but the use of escape gaps is also gaining traction. Escape gaps are narrow gaps built into fish traps with the intention of allowing juvenile and narrow bodied fish to escape. We tested traps with (experimental traps) and without (control traps) 1-inch escape gaps in Montserrat in the Lesser Antilles. A total of 40 traps were deployed from March – September 2018 in experimental-control trap pairs placed in close proximity. The traps were fished by local fishers on an apprentice scheme using methods commonly used on the island. We recorded species, length and weight for every fish caught. Doctorfish (*Acanthurus chirurgus*) and blue tang (*A. coeruleus*) were the most commonly recorded species. Total biomass and mean length per trap haul for control and experimental traps were compared using t-tests. A linear model was used to control for the effects of depth, time between hauls, and trap location on catch weight and mean length. Initial findings show no significant difference between the total catch weight and mean fish length per haul. However, experimental traps caught proportionally less fish from thin-bodied families such as Acanthuridae, Chaetodontidae, and Monocanthidae, and proportionally more fish from thick-bodied families including Lutjanidae and Ostraciidae. We discuss our results in the context of using escape gaps as an option for improving the sustainability of trap fisheries.

KEYWORDS: Fish traps, pots, escape gaps

Monthly Growth Rate and Population Structure Changes of Northern Gulf of Mexico Red Lionfish (*Pterois volitans*) Using a Length-Based Population Model

Tasa de Crecimiento Mensual y Cambios en la Estructura de la Población del Pez León Rojo (*Pterois volitans*) del Norte del Golfo de México Utilizando un Modelo De Población Basado en la Talla

Taux de Croissance Mensuel et Changements de la Structure des Populations de Poisson-Lion (*Pterois Volitans*) à l'Aide d'un Modèle de Population Basé sur la Distribution des Fréquences de Taille

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ABSTRACT

Since 2010, Red Lionfish (*Pterois volitans*) have become established in the northern Gulf of Mexico (nGOM) and can now be found in higher densities than anywhere else in their invaded range. The nGOM is an ideal location to conduct population-level monitoring due to relatively easy access to large number of samples both spatially and temporally. Numerous studies have investigated population structure as a method of assessing the efficacy of removal and control strategies. Similar to other western Atlantic invaded ranges, the nGOM Red Lionfish population structure exhibits a bimodal length-frequency distribution consistent with seasonal differences in reproductive output; this bimodal distribution allows for annual cohorts to be tracked over time to calculate growth rates. Red Lionfish age and growth has been quantified in the nGOM making a length-based, age-structured population model an appropriate method to calculate high resolution (monthly) growth rates during the warmer seasons when growth rate is greatest. From March 2014 to October 2014, in collaboration with Red Lionfish fishing tournaments being held in northwest Florida, Red Lionfish (n=700-2,233) were collected and measured for total length monthly during a 1-2 day period. Finally, monthly collection of Red Lionfish began in March 2018 (> 16,000 Red Lionfish processed to date) and will continue through December 2019 such that this additional sampling will provide higher resolution monthly growth rates throughout the year as well as to monitor recent changes to the population stemming from a number of environmental and biological events that have likely altered the population structure.

KEYWORDS: Invasive species, length frequency, otolith

Role of Women in Aquaculture in the Caribbean Region of Colombia

Rol de la Mujer en la Acuicultura de la Región Caribe de Colombia

Rôle des Femmes dans l'Aquaculture dans la Région des Caraïbes de la Colombie

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RESUMEN

En las últimas décadas la acuicultura se ha posicionado como una actividad que genera ingresos tanto a inversionistas como a familias pobres de muchos países en vías de desarrollo, donde la seguridad alimentaria es una preocupación permanente. Este trabajo exploró el rol de la participación de la mujer en la acuicultura del Caribe continental de Colombia. Para abordar la investigación de campo se examinaron dos fuentes de información: i) se revisaron los registros de permisionarios en la Autoridad Nacional de Acuicultura y Pesca y ii) se contrastaron las opiniones de doce instructores de acuicultura del Servicio Nacional de Aprendizaje, con más de cinco años de experiencia en la región. Los principales resultados destacan que para la producción acuícola solo existe una permisionaria mujer en el Caribe colombiano, orientada más hacia los ornamentales. Lamentablemente la exigencia de requisitos ambientales y acuícolas limitan la legalización de las unidades productivas acuícolas, que se ven abocadas a producir de manera informal. En ese escenario de informalidad aumenta la participación de la mujer, que llega a ser del 42%. Sin embargo, cuando no son mayoría, el rol en ningún caso alcanza posiciones de liderazgo y se acentúa la hegemonía del hombre en los cargos directivos de las distintas formas de agremiación. Casos excepcionales destacan la masiva participación de la mujer (e.g. Fundación, Magdalena; Turbo, Antioquia), en cuyos casos la participación del hombre se circunscribe a actividades de trabajos pesados como la construcción de estanques. Hacia el norte del Caribe (La Guajira y Cesar) la participación de la mujer llega a ser menor del 5%. El 84% de los instructores afirmaron que cuando la participación de la mujer es mayoritaria, los procesos de organización, producción y post-cosecha suelen ser más eficientes.

PALABRAS CLAVES: Acuicultura, rol de la mujer, liderazgo

Ten Years of Monitoring Artisanal Fisheries in Relation to Climate Change, the Invasive Lionfish and Industrial Fishing in Capurganá-Cabo Tiburón

Diez Años de Monitoreo a la Actividad Pesquera Artesanal Relación Con Cambio Climático, Invasor Pez León y Pesca Industrial en Arrecife Capurganá-Cabo Tiburón

Dix Ans de Surveillance des Activités de Pêche Artisanale en Relation avec les Changements Climatiques, Poisson-lion Envahissante et la Pêche Industrielle dans le Récif Capurganá-Cabo Tiburón

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ABSTRACT

Since 2008 the Foundation ICRI Colombia is analyzing the fisheries of the Association of the artisanal fishers PESCAPUR. The first five years a combination of factors: Global Climate Change, Industrial Fishing and the appearance of the invasive Lionfish result in a projection to an overfished coral reef area. With environmental education ang logistic support, the community was empowered to avoid the approaching of industrial vessels to the coral reef area. The protection of the local community and the training to catch lionfish and consumptin helped in the recovery of the fisheries. Signs of coral bleaching occurred as in the other areas of the Caribbean Sea, hwever, in this area the resilience warranty the good state of health of the coral cover reaching 70% even higher than the protected areas officially included in the national parks system and the Biosphere Reserve SeaFlower.

KEYWORDS: Coral Reefs, resilience, fisheries

Estimation of the Socioeconomic Impact and Economic Viability Associated with the Recreational Fishing in the Colombian Caribbean

Estimación del Impacto Socioeconómico y Viabilidad Económica Asociados al Torneo de Pesca Deportiva en el Caribe Colombiano

Estimation de l'Impact Socioéconomique et de la Viabilité Économique Associés à la Pêche Récréative dans les Caraïbes Colombiennes

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ABSTRACT

In Colombia, very little is known about recreational fisheries and the economic impact that this activity generates. The natural and cultural conditions of the Caribbean region mean that tourism, commerce and fishing occupy the first place as an economic sector. However, until now there is no estimate of the economic value that recreational fishing generates for the regional economy. Although the fishing sector makes only a small contribution to the Gross Domestic Product (GDP), which represented less than 0.2% in 2012; jobs, income and food are generated in rural areas where economic opportunities are scarce. In this sense, the objective of this work is to evaluate the socioeconomic impact and economic viability associated with the realization of a recreational fishing tournament in the Colombian Caribbean. The base information comes from surveys of anglers. About fifty questions were formulated related to the expenditure that fishermen make in this activity. It was detected that 100% of the population that practices this recreational fishing are men, in age range between 43 and 55 years. They have high purchasing power, with an income range between $ 3,851.37 (USD) to $ 8,245.61 (USD). The economic impact related to the costs of fishing is $ 1,014.43 (USD) relating the purchase of bait, fuel, food and ice. The average investment in the purchase of fishing lures is $ 2,742.77 (USD), these being acquired mainly in the United States. The main catch species are: Dorado (100%), Wahoo (85.7%), Barracuda (71.4%), Tuna (71.4%), Picuda (28.6%) and Jack Mackerel (14.3%). The availability of these species makes possible the realization of this activity and therefore the main economic sectors of this region are revitalized.

KEYWORDS: Recreational fishing, socio-economic impact, economic valuation

Biometric Relations and Maturity of *Xiphopenaeus kroyeri* in the Gulf of Salamanca, Caribbean Sea off Colombia

Relaciones Biométricas y Estado de Madurez de *Xiphopenaeus kroyeri* en el Golfo de Salamanca, Mar Caribe de Colombia

Relations Biométriques et Maturité de *Xiphopenaeus kroyeri* dans le Golfe de Salamanque, Mer des Caraïbes en Colombie

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RESUMEN

Xiphopenaeus kroyeri es un camarón marino de importancia en varias regiones del Atlántico occidental, el golfo y el Caribe. Esta especie es capturada por una pesquería de arrastre artesanal que opera hace aproximadamente 20 años en el golfo de Salamanca (Colombia) caracterizada por la poca selectividad y elevados niveles de pesca acompañante. El presente trabajo fue motivado por la necesidad de ampliar conocimiento sobre la biología y el ciclo reproductivo de esta especie en la zona, con miras a brindar insumos científicos para la formulación de medidas efectivas de manejo. Para este propósito, se muestrearon individuos cada quince días desde marzo de 2018. Cada individuo fue medido (longitud del cefalotórax, longitud total sin rostro y longitud total) con un calibrador digital; fue pesado y se determinó su sexo y estado de madurez. Se evaluó la variabilidad temporal de la relación longitud-peso, el factor de condición relativa, la proporción sexual y la longitud de madurez. Se calculó la relación entre la longitud total y la longitud del rostro, con el fin de brindar los resultados en las medidas empleadas en otros estudios previamente. Como resultado, se obtuvo que, durante el periodo analizado, fue más frecuente la isometría en las hembras y la alometría negativa en los machos. La condición relativa de los ejemplares estuvo cercana a 1, indicando un estado homogéneo a lo largo del estudio. La proporción entre hembras y machos fluctuó de 0,43:1 a 1,14:1, con excepción del mes de mayo en que fue más elevada al proporción de hembras (3,13:1). La relación empírica entre la longitud total (LT) y la longitud sin rostro (LSR), resultó ser LT=1,34 (LSR)-3,24 para hembras y LT=1,37 (LSR)-5,67 para machos. Los resultados fueron comparados con estudios realizados previamente a la especie en otras regiones.

PALABRAS CLAVES: Parámetros poblacionales, relación longitud-peso, factor de condición

Surface Oceanographic Conditions in the Colombian Caribbean (2003-2017) Using Remote Sensing

Condiciones Oceanográficas Superficiales en el Caribe Colombiano (2003- 2017) Utilizando Sensoramientos Remoto

Conditions Océanographiques de Surface dans les Caraïbes Colombiennes (2003-2017) à l'Aide de la Télédétection

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ABSTRACT

The continental shelf in the Colombian Caribbean is quite complex in the processes of ocean-atmosphere coupling, due to the influence of the trade winds, the Sierra Nevada de Santa Marta and continental contributions from several rivers. These factors generate a highly energetic marine environment, evidenced in the coastal geomorphologic diversity. By using satellite images that represent the surface characteristics of the sea, it contributes to study the oceanographic processes that occur on a spatial and temporal scale, difficult to understand through scientific surveys. This study proposes to describe the surface oceanographic conditions (temperature, chlorophyll-a) during 2003 to 2017. The data were obtained as follows: (1) the database for chlorophyll-a and temperature was created, with a spatial resolution of 4 km from the MODIS-A satellite; (2) the winds were obtained from National Oceanic and Atmospheric Administration (NOAA); (3) the geostrophic currents of Marine Copernicus. The multi-year monthly behavior of the oceanographic variables and the respective anomalies for the year 2017 are presented. Due to the trade winds from the northeast, there is a decrease in surface temperature and increases in chlorophyll, indicating possible upwellings during the months of January, February, March in the Guajira zone. In 2017, the anomalies for the concentration of chlorophyll indicate that in February and March there was greater primary productivity in the northern zone and in the south zone was in October due to the continental contributions of the Magdalena River.

KEYWORDS: Temperature, chlorophyll, remote sensing

Densities, Abundance and Population Structure of Whelks *Cittarium pica* (Linnaeus, 1758) (Mollusca: Gastropoda Trochidae) on the Island of San Andres, Seaflower Biosphere Reserve

Densidades, Abundancia Y Estructura Poblacional De Whelks *Cittarium pica* (Linnaeus, 1758) (Mollusca: Gastropoda Trochidae) en la Isla de San Andres, Reserva de Biosfera Seaflower

La Densité, l'Abondance et la Population Structure de Buccins *Cittarium pica* (Linnaeus, 1758) (Mollusca: Gastropoda Trochidae) sur l'Île de San Andres, Réserve de Biosphère, Seaflower

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RESUMEN

La Corporación para el Desarrollo sostenible de San Andrés, Providencia y Santa Catalina (CORALINA), ha adelantado importantes esfuerzos por conocer los aspectos biológicos y ecológicos de las diferentes especies claves que se encuentran en la Reserva de Biosfera Seaflower. Entre sus especies claves se destaca el Whelks (*Cittarium pica*), este molusco de la familia Trochidae se encuentra especialmente en el litoral rocoso de las islas y está distribuido en la región centro-septentrional del gran Caribe, desde los Cayos de Florida y las Antillas Mayores hasta la costa norte de Sur América. *Cittarium pica* es colectado de manera artesanal sobre el litoral rocoso para auto consumo (alimento) y su concha para realizar artesanías Debido a la importancia económica del Whelks en la región, considerando que es probablemente una de las más consumidas y menos conocidas de las islas, su rol como especie del litoral rocoso y su relevancia ecológica, se han adelantado un programa de monitoreo Whelks (*Cittarium pica*), que ha incluido la estimación de su abundancia, densidades y su estructura poblacional, igual forma se han tomado datos de coberturas de macroalgas y la densidad de los otro moluscos predadores del Whelks en las estaciones muestreadas desde el 2007 al 2017 en la isla de San Andres, presentando los siguiente resultados densidades promedio se presentaron entre 0,5 ±0,6 a 6,34±13,27 ind /m^2 y abundancias de 536 a 1599 individuos. Talla media (promedio) vario de 10,78 ± 9,6 a 22,32 mm.

PALABRAS CLAVES*: Cittarium pica*, densidades, estructura poblacional

Current Status of *Acropora* Populations in the Colombian Caribbean

Estado Actual de las Poblaciones del Género *Acropora* en el Caribe Colombiano

Situation Actuelle des Populations d'*Acropora* dans les Caraïbes Colombiennes

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RESUMEN

Acropora es un ejemplo evidente del deterioro arrecifal, debido a la reducción en sus poblaciones en los arrecifes del Caribe. La actualización del hábitat potenciales permite contribuir con información relevante en programas para su restauración; así como la estimación de la cobertura y la distribución de frecuencias de talla, que permita inferir sobre su crecimiento y la respuesta de las poblaciones a cambios ambientales. El propósito del estudio fue establecer el hábitat potencial de *Acropora palmata* y *A. cervicornis* y comparar la estructura de tallas de sus poblaciones y sus coberturas a lo largo del Caribe colombiano. Los mapas fueron creados usando la base de datos de reportes de observaciones de campo en combinación con mapas bénticos existentes. *Acropora palmata* mostró 12 intervalos de clase, con la clase uno presente principalmente en el Golfo de Urabá y pocas en el Parque Nacional Tayrona (PNNT). Las tallas transformada a logaritmo, mostraron un sesgo negativo, lo que refleja un bajo reclutamiento y la persistencia de colonias grandes. Su distribución fue principalmente dispersa con formaciones tipo parche en el PNNT, Isla Fuerte e Isla Arena, sitios donde además se encontraron las mayores coberturas. Islas del Rosario mostró una cobertura menor al 5%. *Acropora cervicornis* mostró 10 intervalos de clase, aunque el sesgo positivo indica la persistencia de tallas pequeña, no se observó colonias producto de reproducción sexual, lo cual se atribuye a su alto estado de deterioro. Su distribución fue dispersa con los únicos parches importantes en los arrecifes de El Aguacate y la Mora en el Golfo de Urabá e Isla Rosario en Islas del Rosario. La cobertura de Palmar (14.8%) y Aguacate (10,2%) fueron las únicas importantes. En el resto del Caribe no supero el 10% y en Isla Arena, desapareció totalmente.

PALABRAS CLAVES: Endangeres species, *Acropora*, demography

Caribbean Marine Atlas: Supporting for Decision-making the Caribbean Region

Atlas Marino del Caribe: Continúa el Apoyo a la Toma de Decisiones en la Región Caribe

Atlas Marin des Caraïbes: Continuer à Soutenir les Décisions de la Région des Caraïbes

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RESUMEN

Desde 2013 y con el propósito de operar de forma sostenible y en línea, una plataforma de apoyo al Manejo integrado de la Zona Costera MIZC y al manejo basado en ecosistemas MbE para los grandes ecosistemas del Caribe, el Atlas Marino del Caribe está siendo implementado en países comprometidos, para consulta y toma de decisiones del nivel nacional y regional. La plataforma en línea como producto principal, que alberga distintas herramientas que apuntan a funcionar como repositorio electrónico con despliegue de información multitemática, con fuerte énfasis en lo espacial, para apoyar al toma de decisiones en MIZC y el MbE para la región Caribe. Más de 859 capas temáticas, 151 mapas, 63 documentos y enlaces externos a 93 fuentes de información constituyen la oferta de información geoespacial proveniente de la gestión de 34 usuarios capacitados quienes autogestionan la contribución de 13 países del Caribe. La gestión para implementación de indicadores con reporte desde información nacional ambiciona publicar 10 indicadores, 6 de los cuales ya están en línea y los países trabajan en la colecta de información para el reporte. La articulación de estos indicadores con metas Aichi y de Objetivos de Desarrollo Sostenible 13, 14, 15 y 17 se constituyen en contribución voluntaria para los países y la región. La sostenibilidad del Atlas se basa en el aporte derivado del compromiso manifiesto de los países participantes, para consolidarlo como una buena práctica de repositorio de información del Caribe. Para el futuro se vislumbra trascender la oferta de información a la centralización de insumos de información para el Informe Mundial sobre las Ciencias Oceánicas en el marco de la Década de los Océanos. Podrá ser el Caribe la región piloto de implementación de un portal de información para este informe?

PALABRAS CLAVES: Atlas, Integrated coastal zone management, indicators

Towards the Management of Seagrass in Colombia: La Guajira Meadows

Hacia el Manejo de los Pastos Marinos en Colombia: Praderas de La Guajira

Vers la Gestion des Phanérogames Marines en Colombie: Herbiers de La Guajira

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RESUMEN

En Colombia se encuentran representadas seis de las nueve especies de pastos marinos del Gran Caribe, siendo *Thalassia testudinum* la formadora de las praderas más conspicuas del litoral costero mezclada con otras especies como *Syringodium filiforme* y *Halodule wrightii*. Desde el año 2000 se cuenta con estudios de estructura y composición, identificando su distribución nacional y destacando La Guajira como el sector que alberga más del 80% de las praderas del país. Estudios posteriores en el 2003 y 2007 aportaron valoraciones de su estado y niveles de intervención antrópica para los pastos marinos litorales. En el año 2011, con la ley 1450 del Plan Nacional de Desarrollo, se promueve la protección y uso sostenible de los pastos marinos entre otros ecosistemas estratégicos, creando la necesidad de actualizar su distribución que en el 2014 se genera como insumo primario para que las autoridades ambientales locales trabajen en asegurar su manejo. En el 2014 se identifican hasta 11 tensores que las afectan y en el 2015 se presentan los lineamientos para priorizar su conservación. Hacia 2016, se da inicio a la primera aproximación en el desarrollo de una propuesta de zonificación encaminada a identificar las áreas en La Guajira donde puedan desarrollarse o no entre otras, actividades de exploración y explotación de hidrocarburos, acuacultura, minería y pesca industrial de arrastre. De este ejercicio, se obtuvo la información necesaria para que en el 2017 la autoridad ambiental de La Guajira CORPOGUAJIRA, lidere el primer proceso en Colombia de declaratoria de un área especial de manejo para la ordenación de usos del medio marino, priorizando a los pastos marinos como objeto de conservación.

PALABRAS CLAVES: Pastos marinos, manejo, conservación

Biological Corridor in the Caribbean: A Multinational Cooperation Approach to Conservation in the Caribbean islands

Corredor Bológico en el Caribe: Un Enfoque de Cooperación Multinacional para la Conservación en el Caribe Insular

Corridor Biologique dans les Caraïbes: Une Approche de Coopération Multinationale à la conservation dans les Caraïbes Insulaires

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ABSTRACT

The insular Caribbean is one of the biodiversity "Hot Spots" identified as priority for conservation worldwide, consisting of more than 7,000 islands, islets and cays. Its numerous endemic and migratory species dwelling in a fragmented geographical context connected by marine currents, densely populated and with a long history of extractive use of the natural resources make the region a unique, while complex site for achieving conservation goals. This set of factors, at the same time, makes coordination of actions essential to achieve effective conservation and sustainable development. The Biological Corridor in the Caribbean (CBC) is a government initiative that attempts to address this challenge. With more than 10 years of work, CBC shows positive results while faces huge challenges. We present a summary of the principles on which the CBC initiative is based, and discusses the advances, successes and challenges facing the conservation of connectivity in the insular Caribbean. We discuss the need for a conceptual model based on the principles of socio-ecological networks, with actions beyond protected areas, while contributing to Aichi Targets and Sustainable Development Goals of the Greater Antilles. Our experience shows gaps in national policies for effective conservation of regional connectivity, while it demonstrates how an integrated and multinational cooperation approach is an effective tool for improving conservation effectiveness at a regional level.

KEYWORDS: Biological corridor, Caribbean, socio-ecological network

An Evaluation of the Framework for National Marine Environmental Policies in Cuba

Evaluacion del Marco para las Políticas Ambientales Marinas en Cuba

Évaluation du Cadre des Politiques Environnementales Marines à Cuba

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ABSTRACT

A slow rate of economic development and a national commitment to sustainable development has enabled Cuba to maintain some of the best preserved marine ecosystems in the Caribbean region. Still, important environmental threats persist, while changes in the rate and magnitude of marine environmental impacts are occurring because of increased globalization, new relations between Cuba and the United States, and efforts to reform Cuba's economic model. Since Cuba lacks an overarching national ocean policy, marine conservation is implemented through various policy instruments. We evaluated nine policy instruments to understand whether and how they create conditions for sustainable use and conservation of marine resources. Our evaluation is based on five key attributes: attention to multiple levels of ecological organization, operation at multiple spatial scales, coordination of interacting uses, adoption of precautionary and adaptive approaches, and establishment of a sound scientific basis for management. Although our evaluation suggests that Cuba's marine environmental–policy framework is relatively strong, we found a marked bias toward terrestrial ecosystems and issues. We also found that too little attention is paid to the inclusion of precautionary and adaptive approaches, which received a score of 22%, a significant deficiency in the face of ongoing ecological and socioeconomic changes. Cuba should develop a forward-looking national ocean policy that integrates existing and future laws and policies, as current limitations in the policy framework could undermine the country's ability to achieve its sustainability and environmental protection goals as economic development pressures grow.

KEYWORDS: Marine environmental policy, Cuba, MPAs

Management Effectiveness in the Mesoamerican Reef: Letting Fish Tell Their Own Story

Efectividad de la Gestión en el Arrecife Mesoamericano: los Peces Cuentan su Propia Historia

Efficacité de la Gestion dans le Récif Mésoaméricain: Laisser les Poissons Raconter leur Propre Histoire

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ABSTRACT

Healthy Reefs for Healthy People Initiative (HRI) is an international collaborative program involving 72 reef-focused organizations, that have developed and implemented a comprehensive framework for evaluating and improving large-scale reef health, through a science-based adaptive management process. One of the key benefits of the HRI effort is the scaling up of comparative data to examine the health of the Mesoamerican Reef (MAR) ecosystem. Results from our 2018 Report Card show that Replenishment Zones (RZ) are the most effective approach to increasing fish biomass. RZs had 6.4 reproductively mature fish per site versus 1.4 in the open fishing areas, or 1.5 in the fished zones of the MPAs. Fishing replenishment zones are effectively conserving commercial species like snappers and groupers in the MAR. In 2016 there was approximately three times more commercial fish biomass inside RZs compared to fished areas or general use MPA zones. Herbivorous fish, which are being occasionally fished for personal consumption, also benefit from RZs with their highest biomass being registered in Honduras. The low biomass of commercial fish inside RZ in Honduras was unexpected, suggesting that poaching is a significant problem. Guatemala showed a low fish biomass due to high fishing pressure and no established RZs within coral reef habitat. Mesoamerican Reef Territorial Sea is but only Only 3% of the territorial sea is fully protected within RZs. In order for RZs to be effective they must be well enforced. Only 13 of the 47 MPAs in the MAR ranked as having good enforcement, although this varies by country. HRI's collaborative process to monitor and report on management effectiveness can accelerate and catalyze actions that make a positive contribution to improving ecosystem health.

KEYWORDS: Replenishment zones, reef, health

Development of Best Management Practices for Coral Restoration

Desarrollo de Mejores Practicas de Manejo para la Restauracion de corales

Développement de Meilleures Pratiques de Gestion pour la Restauration des Coraux

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ABSTRACT

Across the greater Caribbean and Florida there are a growing number of programs aiding in the enhancement of coral reefs through coral propagation. As new programs begin or established programs scale-up their efforts there is a need to provide guidance through best management practices and lessons learned to increase or accelerate a program's success. A priority for the field-based propagation and monitoring working groups of the Coral Restoration Consortium was to synthesize, update, and develop best management practices for a broad field of restoration practitioners. As this field continues to scale-up through an increase in number of colonies, species or locations it is important to tailor these guides to all levels of a program; from start-up to scale-up. Current guides and practices, published materials, and knowledge from practitioners were gathered to assimilate the most up-to-date best management practices ranging from how to start a nursery program to how to monitor a large-scale restoration effort. Our goal is to provide practitioners with a platform from which they can learn from the successes and failures of others so we can collaboratively work towards restoring our reefs. The best management practices developed herein will be hosted online providing easy access and the ability to update quickly and frequently as the field continues to grow and change. We will present our progress to date including an unveiling of the online platform.

KEYWORDS: Monitoring, coral gardening, success

In the Variety is the Pleasure: More Diversity of Morpho-functional Coral Groups in the Reef, More Snappers, More Tourism

En la Variedad está el Placer: Más Diversidad de Grupos Coralinos Morfo-funcionales en el Arrecife, Más Pargos, Más Turismo

Dans la Variete est le Plaisir: Plus de Diversite des Groupes Coralliens Morpho-fonctionnels dans la Récif, Plus Vivaneaux, Plus Tourisme

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ABSTRACT

Tourists look for natural attractions in the Caribbean islands that are well conserved in crystalline waters but, at the same time, they consume fish resources and their activity can impact the natural offer. Reconciling economic interests (tourism and fishing) with the conservation of natural systems is a challenge; but it is the consolidation of the sustainable development paradigm. This study was carried out in order to establish the relationships between the corals and snapper taxonomic and functional structure on San Andrés Island. It was developed in tourism activity sites located in the Windward zone of the island during two years in rainy and drought season: Luna Verde (LV), Wild Life (WL) and Bajo Bonito (BB). The snappers were studied through visual censuses, and the coral coverages by carrying out 5 transects in each site. 96 Lutjanids were observed in which 69% were juveniles and 31% adults. Lutjanus apodus and Lutjanus mahogoni were the most abundant species, in comparison with *Lutjanus jocu* and *Ocyurus chrysurus*. A relationship was found between the development stage of fish and the morpho-functional structure of corals. The juvenile snappers were more abundant in WL and LV, sites with the greatest morpho-functional riches, 6 and 5 respectively. Adults *L. apodus* and *L. mahogoni* were more associated with BB, site diverse morpho-functionally (5), but dominated by octocorals. Our results indicate that more complex reefs in their morpho-functional structure favor the abundance of juvenile, which is the most vulnerable snapper stages. The rational management of reef areas where coral reef conservation and recovery activities are encouraged, combined with a proper handling of tourism activities, like diving; It will be beneficial for the ecosystems and for the tourism industry.

KEYWORDS: Reef complexity, snapper, coral reef

In situ Measurements of Jumbo Squid, *Dosidicus gigas* Target Strength (TS) in the Gulf of California, Mexico

Mediciones *in situ* de la Fuerza de Blanco (TS) del Calamar Gigante *Dosidicus gigas* en el Golfo de California, México

Mensuration *in situ* de l'Index de Réflexion (TS) de l'Encornet Géant, *Dosidicus gigas* dans le Gulf de Californie, Mexique

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RESUMEN

La pesquería de calamar gigante *Dosidicus gigas* (D'Orbigny, 1835), representa una fuente importante de ingresos para México, sin embargo la inestabilidad de sus poblaciones dificulta su manejo pesquero. Los métodos acústicos ofrecen observaciones de alta resolución en la columna de agua y son una alternativa para estimar la distribución y abundancia de este recurso. Para realizar una evaluación precisa es necesaria la correcta estimación de la fuerza de blanco (TS) de este organismo. En este trabajo se analizaron tres campañas de prospección (2014-2016) en el Golfo de California donde se utilizó una ecosonda SIMRAD EK60 con dos transductores split beam de 38 y 120 kHz con los que se registraron mediciones in situ del TS (dB) del calamar gigante. Se muestrearon calamares con poteras hasta 50 m de profundidad usando luz como método de atracción. Se eligieron siete estaciones con las mayores capturas en peso y número de individuos representando una amplia distribución de tallas, además de condiciones calmas durante el muestreo.

Se utilizó el programa ESP3 para la selección de objetivos individuales, se calculó el índice N_v para disminuir la probabilidad de ocurrencia de ecos múltiples. Los resultados de los modelos de regresión ajustados son: 〖TS〗_38kHz=20 log_10 (LM)-62 (R2 = 0.69, LM = 15-57 cm); 〖TS〗_120kHz=20 log_10 (LM)-76.59 (R2 = 0.70, LM = 15-57 cm). Estos modelos tienen una diferencia de hasta 11 dB menor con respecto a los modelos publicados para esta especie en las mismas frecuencias. Nuestros modelos tuvieron mayor semejanza a los publicados para otras especies como *Sthenoteuthis oualaniensis* y *Todarodes pacificus*. El constante movimiento del calamar gigante durante el nado activo genera cambios en el ángulo de insonificación que sugiere ser la razón más probable de esta gran diferencia.

PALABRAS CLAVES: *Dosidicus gigas,* acoustic method, target strength measurement

Feeding Habits of Large Pelagic Fish in Waters of the Department of Magdalena, Colombia

Hábitos Alimenticios de los Peces Pelágicos Grandes en Aguas del Departamento del Magdalena, Colombia

Habitudes Alimentaires des Grands Poissons Pélagiques dans les Eaux du Département de Magdalena, en Colombia

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ABSTRACT

Large pelagic fish such as swordfish, dorado, barracuda and tuna, among others, are species with a high migration capacity. The distribution and abundance of these organisms are mediated by factors like the availability of food and oceanographic conditions. The knowledge of their biology is fundamental due to the influence that they can have on other components of pelagic ecosystems since they are predators on the top of trophic networks. In order to evaluate the trophic composition of large pelagic fish in waters off the coast of the Department of Magdalena, stomach content analysis was performed. Fish were caught from March to August 2018, using rods and reel with live bait and artificial lures; these techniques are usually implemented in sport fishing. The stomachs of 29 specimens with a total length range from 320 to 1110 mm were analyzed; nine (31.03%) of the stomachs were empty. 105 items belonging to seven taxonomic categories were identified; additionally, the presence of plastic waste was recorded. Our results classify this group of fish as generalist predators, with low diversity of prey. According to the relative importance index (% IIR) the fish *Mugil* sp. (39.68%) and rests of other teleostei (32.02%) were their main prey, while Megalopa larvae (13.73) were secondary preys. This result is similar to other studies where the large pelagic fish are classified as piscivores. However, the generalist habits of these fish contrasts with the specialist habits reported by other authors. This work represents a contribution to the trophic ecology, and the first evidence of plastic waste in the stomach content of these fish for the Caribbean coast of Colombian.

KEYWORDS: Pelagic, trophic ecology, Caribbean

The Reef Fish Conservation Project: Recognizing the Need for Legal Protections for the Conservation of Parrotfish and Other Herbivorous Fish in Latin America

Proyecto de Conservación de Peces de Arrecife: Reconociendo la Necesidad de Herramientas Legales de Conservación de Peces Loro y Otros Peces Herbívoros en Latinoamérica

Le Projet de Conservation des Poissons de Récif: Reconnaître le Besoin de Protection Juridique pour la Conservation des Poissons-Perroquets et Autres Poissons Herbivores en Amérique Latine

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ABSTRACT

Herbivory is a key ecological process on coral reefs, where parrotfish and other herbivorous fish are critical in maintaining coral dominance and limiting the establishment and growth of algal communities that impede coral recruitment. The shift to algae-dominance has been recognized as a serious driver for ecological degradation and the loss of critical ecosystem services. Over the last several decades, coral cover around the world has declined significantly, which has been associated with the overexploitation and lack of legal protections for parrotfish and other herbivorous fish; the lack of integrated watershed and coastal management strategies; and the ongoing effects of climate change. In particular, addressing the need for integrated management strategies to manage fisheries and protect herbivore assemblages has been recognized as pivotal by scientist and several international conservation platforms. This project aims to address some of these needs and establish the necessary coalitions and working groups to support legal advocacy for ecosystem-based management to protect parrotfish and other herbivorous fish in several Latin American countries. Target countries include Mexico, Guatemala, Honduras, Costa Rica, Panama, and Colombia, contemplating the expansion to other countries in Central America and the Caribbean. Some of the expected results include the development of legal and site-specific instruments and protocols to conserve and effectively manage parrotfish and other herbivorous fish, protect spawning aggregations, and develop a communication strategy to increase public support and awareness with outreach to local, regional and international authorities, as well as the general public.

KEYWORDS: Herbivorous fish, spawning aggreagations, legal protections

Assessment and Management of Invasive Lionfish Populations in Bermuda

Evaluación y Manejo de Poblaciones de Pez León Invasivo en las Bermudas

Évaluation et Gestion des Populations Invasives de Poisson-Lion aux Bermudes

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ABSTRACT

Invasive lionfish have been present in Bermuda since 2000, but the population has expanded at a slower rate than elsewhere in the region. Culling officially began in 2008, with the first tournament held in 2011. Technical divers found high densities of lionfish at mesophotic sites in 2009, and surveys to assess lionfish and prey fish densities at various depths began in 2013. Cullers have reported increasing numbers of lionfish at shallow depths over time, while surveys found lionfish densities up to 1100 fish/ha at mesophotic depths. Analysis suggests cold-water upwelling may fuel the food chain at certain deep sites, increasing the abundance of prey, and thus lionfish. In 2017, three mesophotic "hot spots" were culled monthly for 6 months. Lionfish density declined at all sites over time, but there was a corresponding decline in prey fish abundances, so it is unclear whether regular culling or seasonal shifts in prey availability was the cause. Managing lionfish at mesophotic depths is challenging. We utilise technical diving, baited remote underwater video (BRUVs), and eDNA. We have worked with fishers to modify local lobster traps to target lionfish, and are now testing the trap developed by NOAA. We are also working with Robots in Service of the Environment and Atlantic Lionshare to develop remotely operated lionfish culling devices. Yet we still rely on volunteer cullers in the shallows and on grant funding to support deep-water removals. Some cullers are now licensed to sell lionfish caught during research and control efforts, building market demand in restaurants and stores and encouraging more local fishers to target lionfish. Having approached lionfish management from various angles, it is clear that ongoing control will require a range of management tools, along with monitoring to evaluate effectiveness.

KEYWORDS: Lionfish, management, mesophotic reefs

Molecular Characterization of Nearshore Baitfish Populations in Bermuda

Caracterización Molecular de Poblaciones Costeras de Peces de Carnada en las Bermudas

Caractérisation Moléculaire des Populations Côtières de Poissons-Appâts aux Bermudes

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ABSTRACT

Small-bodied marine fishes, often referred to as baitfish, concentrate in coastal areas in large, heterospecific assemblages that are targeted by both commercial and recreational fishers. Given apparent declines in Bermuda's baitfish populations over the past 40 years, it is useful to determine the species composition of baitfish assemblages and how it varies among sites to inform management. Using genetic barcoding of the Cytochrome c oxidase 1 gene (COX1), we confirm species identity, assess intraspecific genetic diversity, and determine rates of genetic connectivity of baitfish assemblages in Bermuda. Species analyzed included *Anchoa choerostoma, Harengula humeralis, Jenkinsia lamprotaenia, Hypoatherina harringtonensis, Opisthonema oglinum* and *Sardinella aurita*. Species identification based on molecular barcoding revealed some misidentification of individuals based solely on morphological traits, with an error rate of 11%. Estimates of genetic diversity within and among baitfish assemblages in Bermuda were high, indicating high rates of local connectivity between sites for all species. As such, management should consider Bermuda's baitfish species as single, highly mixed populations. Sequence results for the endemic Bermuda Anchovy, A. choerostoma, were within 1% similarity to the more broadly distributed big-eye anchovy, A. lamprotaenia, so additional analyses are warranted to evaluate the genetic basis for endemism. However, significant genetic differentiation and population structure were found among regional locations for several species, suggesting limited gene flow between Bermuda and other locations. This has implications for management, as strong genetic divergence suggests that populations in Bermuda are likely self-seeding and thus not likely to be replenished from distant populations.

KEYWORDS: Baitfish, population genetics, connectivity

Assessing Vulnerability to Climate Change and Disasters in Montserrat's Fisheries: Using Participatory Three-dimensional Modelling

Evaluación de la Vulnerabilidad al Cambio Climático y los Desastres en las Pesquerías de Montserrat: Uso de Modelos Tridimensionales Participativos

Évaluation de la Vulnérabilité aux Changements Climatiques et aux Catastrophes dans les Pêcheries de Montserrat: Utilisation d'Une Modélisation Participative en Trois Dimensions

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ABSTRACT

As part of the Darwin Plus funded Climate change adaptation in the fisheries of Anguilla and Montserrat project, an assessment of the vulnerability of the fisheries of Montserrat to climate change and natural disasters was conducted.

The vulnerability assessment was based on a comprehensive desk review and participatory three-dimensional modelling (P3DM). P3DM served as a participatory mapping tool to capture local knowledge and experiences related to climate change impacts and vulnerabilities and identify potential adaptation actions for the fisheries sector. It involved building physical representations of the entire island of Montserrat that were to scale and geo-referenced, focusing on areas critical to the fisheries sector (e.g. fishing communities, landing sites, fishing grounds and supporting ecosystems such as coral reefs and mangroves). A wide range of stakeholders were actively engaged in the P3DM, including key resources users like fisherfolk, community residents, civil society organisations, government agencies and the private sector, to assess key vulnerabilities and priorities for action in the areas where they live and work. P3DM also supported the Ecosystem Approach to Fisheries, taking into account biophysical, cultural and socioeconomic dimensions of vulnerability within ecologically meaningful boundaries.

The findings highlight the usefulness of P3DM in not only documenting local knowledge, but enabling stakeholders to visualise and collectively discuss different uses, threats, opportunities and management options for fisheries resources. This knowledge can facilitate shared learning and decision-making among government, civil society and private sector stakeholders involved in fisheries management planning and implementation.

KEYWORDS: Climate change, fisheries, Montserrat

A Common Initiative for Sharks and Rays at St. Barts : The First Step for French West Indies ?

Una Iniciativa Conjunta para la Protección de Tiburones y Rayas en San Bartolomé: ¿El Primer Paso para las Antillas Francesas?

Une Initiative Commune pour la Protection des Requins et Raies à Saint-Barthélemy : Le Premier Pas pour les Antilles Françaises ?

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ABSTRACT

With more than 50 species of sharks and rays recorded, the French West Indies (FWI) harbor a significant specific diversity. However, this diversity is fragile with over 35% of species listed on the IUCN Red List and 33% near-threatened. Yet, there is no local action plan for sharks and rays conservation. For various reasons (large relative abundance compared to other islands of the FWI, shark sanctuaries in the neighboring Netherlands islands of Saba and Sint-Maarten...) the development of conservation measures in St Barth would constitute major headway for the protection of sharks and rays in the FWI.

This project aims to develop and promote local, tailor-made conservation measures for elasmobranchs populations and human activities (including fishing) and to build a positive dynamic around these animals, suffering from bad reputation. The methodology rests on a strong collaboration with local stakeholders (fishermen, diving centers, elected officials, tourism representatives ...), through surveys, workshops and meetings. On a small island like St Barts, where tourism and fishing are both important, work and collaboration with stakeholders are essential, and communication is indispensible to foster the adhesion of the inhabitants to the project, and ensure the regulatory changes it entails are understood. The French West Indies suffer from a crying lack of data on elasmobranch populations that frequent their waters, which this project aims to address; local ecological knowledge is collected and combined with data from scientific monitoring to improve biological, ecological and socio-economic knowledge and to highlight priority threats. This multi-stakeholder, participatory, and structured approach on this small island also lays relevant foundations for future conservation initiatives.

KEYWORDS: Sharks and rays, stakeholders, conservation

Keeping Up with the Silver King: Connecting the Spatial Ecology of Atlantic Tarpon (*Megalops atlanticus*) to Conservation Strategies

Mantenerse al Día con el Rey de Plata: Conectando la Ecología Espacial del Sábalo atlántico (*Megalops atlanticus*) con las Estrategias de Conservación

Rester en Phase avec le Roi de l'Argent: Relier l'Écologie Spatiale du Tarpon de l'Atlantique (*Megalops atlanticus*) aux Stratégies de Conservation

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ABSTRACT

Understanding the nature of migratory behaviors within animal populations is critical to develop and refine conservation and management plans. However, tracking migratory marine animals across life stages and over multiple years is inherently difficult to achieve. In this talk, we explore the use of cooperative acoustic telemetry to characterize the spatial ecology of Atlantic tarpon (*Megalops atlanticus*), elucidate the ecology of this poorly studied but very important recreational species, and ultimately inform conservation and management. We report on the extensive collaboration of agencies, institutions, guides and anglers who help track and monitor tarpon movements from the Gulf of Mexico to the eastern USA seaboard. By tagging tarpon across regions, we found broad and heterogeneous connectivity among individuals as well as diverse spatiotemporal migratory strategies. Some tarpon remained close to their capture location while others migrated hundreds of kilometers. We suggest management should be expanded across state lines to meet conservation end points, including adjusting harvest regulations and habitat protection considering individuals move freely over jurisdictional lines. Further, we report on variable seasonal fidelity to specific areas within the lower keys of Florida and thus informing conservation strategies for tarpon in regards to water quality, fishing and boating pressure, and angling-related predation events.

KEYWORDS: Acoustic telemetry, Atlantic tarpon, Conservation

Larval Fish Diversity Distribution Within a Coastal Marine Reserve: What Light Traps and Plankton Nets Reveal

Distribución de Diversidad de Peces Larvos Dentro de una Reserva Marina Costera: ¿Qué Trampas de Luz y Redes de Plankton Revelan?

La Distribution des Larves de Poissons dans une Réserve Marine Côtière. Que Révèlent les Filets de Plancton et Les Pièges Lumineux?

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ABSTRACT

Knowledge of the diversity and distribution of early life stages of fish is crucial in evaluating the efficacy of protected areas. In the Special Fishery Conservation Area (SFCA) of Discovery Bay, Jamaica, the diversity and temporal distribution of the early life stages have been sparsely studied. We therefore compared the effectiveness of light traps and plankton nets to study the species richness and composition of larval fish in the SFCA from February to November 2014. Using both gears, we were able to account for approximately 75% of the species present in the bay which comprised 42 families and 44 species of predominantly reef-associated species of varied sizes. The catch from both gear types was dominated by the Clupeidae, Pomacentridae, Labrisomidae and Gobiidae families, contrastingly the commercially important families such as Lutjanidae, Haemulidae and Serranidae, were scarcely caught.

A time series analysis detected a seasonal pattern (using temperature and photoperiod as variables) in larval fish abundance in the sample area with the peak abundance occurring during summer months. Although small temperature increases might favour larval development, the vulnerability of spawning events and growth of early life stages of fish to temperature changes as associated with the effects of climate change, should not be overlooked. The crucial role that larval fish play in the sustainability of our fisheries and the potential impact of climate change combined with overfishing highlights the importance of incorporating larval fish assessments in the ecological monitoring of marine reserves.

KEYWORDS: Marine reserve, early life stages, diversity

Efficacy of Lionfish Traps in the Northern Gulf of Mexico

Eficacia de Trampas para el Pez León en el Norte del Golfo de México

Efficacité des Pièges pour le Poisson-Lion dans le Nord du Golfe du Mexique

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ABSTRACT

Mesophotic (40-300 m) reefs provide a refuge for high densities of invasive lionfish (Pterois volitans / miles) in the northern Gulf of Mexico (nGOM). There is a burgeoning spearfishing fishery for lionfish, but fishing capacity mostly limited to conventional SCUBA depths <40 m. Although lionfish are occasionally caught in deeper water as bycatch via hook and line, lobster traps, or shrimp trawls, catch rates from these fishing methods are low. A non-containment curtain (NCC) trap designed to attract lionfish using benthic structure is being tested as a method for deepwater lionfish removal. Twelve NCC traps were constructed and deployed near artificial reef sites in the northern Gulf of Mexico (nGOM). Time-lapse camera units were installed to record recruitment of lionfish and other species to the traps. Lionfish recruitment, lionfish catch, lionfish reduction at adjacent reefs, and bycatch of other species were evaluated in relation to soak time (number of days), time of day at retrieval (dawn, midday, or dusk), trap deployment density (single or paired), and proximity to adjacent reefs (<10 m, 10-30 m, or >50 m). Initial trials were successful in attracting lionfish to the NCC trap with minimal bycatch. Preliminary results indicate the lionfish recruitment was highest for single traps deployed <10 m to reefs. Lionfish recruitment to traps decreased during longer soak times, suggesting lionfish may recruit quickly and then leave. Results from this study will be used to develop a standardized gear and methodology for a larger study to evaluate the efficacy of three trapping gears (NCC traps, lobster traps, and Atlantic sea bass pots) to remove lionfish from nGOM mesophotic reefs. Lionfish trapping may offer a cost-effective means to develop a deepwater fishery for lionfish on mesophotic reefs and refuge ecosystems.

KEYWORDS: Lionfish, trap, fishery

Photoquadrat and Linear Point-Intercept Methods for Assessing Benthic Cover Should Not Be Used Interchangeably in Long-term Coral Reef Survey Programmes

El Método de Foto-Quadrat y el Método Linear de Puntos de Intercepción No Deben Usarse Intercambiablemente en los Programas de Monitoreo de la Cobertura Bentónica de Arrecifes Coralinos

La Méthode de Photo-Quadrat et la Méthode Linéaire de Points D'interception ne Doivent pas Être Utilisées de Manière Interchangeable dans les Programmes de Suivi de la Couverture Benthique des Récifs Coralliens

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ABSTRACT

Monitoring programmes are an important component in the conservation, management and sustainable use of coral reef ecosystems. In this study, the performance of the photoquadrat (PQ) method adopted by the newly re-activated Global Coral Reef Monitoring Network (GCRMN – Caribbean) was compared against the linear point intercept (LPI) method utilized by the long-term Barbados Reef Survey Programme, in order to make an informed decision on whether or not the PQ protocol should be adopted. Fifteen sites across bank, fringing and patch reefs were surveyed using both methods concurrently, and (1) the percent cover of major benthic categories, (2) species diversity and (3) time required to obtain data in usable form were compared. At a coarse scale the methods produced broadly similar results (e.g. same importance ranking of key benthic categories across reef types), however, at a more detailed level, results differed significantly depending on major benthic category and reef type. The PQ method detected fewer species, lower percent cover of hard corals, sponges and macroalgae, and higher percent cover of gorgonians, encrusting algae and turf algae than the LPI method. Furthermore, whilst data collection times in the field were similar between PQ and LPI, analysis of the photographs took, on average, double the time needed for LPI data entry. As the differences between methods are not limited to the method itself, but dependent on benthic category and reef type, the two methods are not easily comparable. As such, we warn against transition between these two methods in long-term reef survey programmes.

KEYWORDS: Coral reefs, survey methods, photoquadrats

Implementation of the Colombian Fishery Observers Program – POPC in the Colombian North Caribbean: Successful Case of the Articulation of the Public Alliances - Predicted with the Artisan Fishermen

Implementación del Programa de Observadores Pesqueros de Colombia – POPC en el Caribe Norte Colombiano: Caso de Éxito de la Articulación de las Alianzas Público - Privadas con los Pescadores Artesanales

Mise en Œuvre du Programme Colombian Fishery Observers - POPC dans les Caraïbes Colombiennes du Nord: Cas Reussi de l'Articulation des Alliances Publiques – Predie avec les Pecheurs Artisans

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RESUMEN

El Programa de Observadores Pesqueros Colombia – POPC establecido mediante la Resolución N° 087 de 2013 de la Autoridad Nacional de Acuicultura y Pesca –AUNAP, representa un aporte significativo a la propuesta de ordenamiento de los recursos pesqueros del país, dado que este brinda apoyo y fortalecimiento al Servicio Estadístico Pesquero de Colombia – SEPEC, enfatizando en la generación de conocimiento sobre los recursos pesqueros tanto de interés comercial como de alto valor ecosistémico. La implementación del POPC se llevó a cabo en tierra y a bordo en los departamentos del Atlántico, Magdalena y La Guajira, zonas de gran importancia social, económica y ambiental con un alto valor productivo para el país; este monitoreo se realizó por primera vez durante un periodo continuo de 12 meses (marzo 2017 a marzo 2018) en 39 puertos pesqueros de desembarco; este hito importante se consiguió mediante la alianza público privada, entre la AUNAP y la empresa ANADARKO Colombia Company. Obteniendo información de relevancia sobre el estado de las principales pesquerías del Caribe Norte Colombiano, en el ámbito ambiental, social y económico. En donde uno de los factores que más influyó en el éxito y alto grado de aceptación del proyecto en la comunidad, fue el hecho de la vinculación del 100% de pescadores artesanales para la toma de información en campo (pescadores, hijos de pescadores o esposas de pescadores) los cuales fueron previamente capacitados para ejercer dicha labor; aspecto que influyó en gran medida en la calidad de la información obtenida ya que demostró ser un mecanismo eficaz, fácil, además de confiable, debido al conocimiento de la zona y conocimiento ancestral de los pescadores.

PALABRAS CLAVES: POPC, Pesca artesanal, Caribe Colombiano

Restoring Big Fish: Cooperative Research and Management Program for Fish Spawning Aggregations in the Wider Caribbean

Recuperando Big Fish: Programa Cooperativo de Investigación, Conservación y Manejo de Agregaciones de Desove en el Gran Caribe

Restauration Big Fish: Programme Coopérative de Recherche, Conservation et la Gestion pour les Agrégations le Frai des dans les Caraïbes

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ABSTRACT

Millions of people throughout the wider Caribbean depend on reef and coastal fisheries resources for their livelihoods, food security, and cultural identity. Many of the most valuable and highly sought species, e.g. many of the groupers and snappers, reproduce within fish spawning aggregations (FSA)s, where they are highly vulnerable to fishing. Many of these sites serve as productivity hotspots where multiple species from various taxonomic and trophic levels congregate for breeding and feeding. Multi-species FSA sites thus serve as ecosystem integrators where protecting small areas of the ocean can offer disproportionately large benefits to fisheries management and marine ecosystem conservation.

The long-term vision of the Big Fish Program is to develop and maintain a cooperative, biophysical, integrated, and holistic research program at an expanding set of multi-species FSA locations that will serve as "sentinel sites" generating data and information useful for assessing and managing multi-species fisheries towards ecosystem resilience and health. The program aims to build broad consensus and cooperation among stakeholders and provide data to support stock assessments, marine spatial planning, marine protected areas, closed seasons, gear and traditional management measures such as gear, size, landings and access limits. Working at the regional scale, Big Fish offers a system to model and measure connectivity and potential impacts from fishing and climate change.

Pending additional funding support, the program is being implemented in conjunction with regional partners and pilot programs in the Gulf of Mexico, the US South Atlantic, Mexico, the Mesoamerican Reef and Cuba.

KEYWORDS: Fish spawning aggregations, conservation, cooperative research

Forgotten Voices:
Connecting Indigenous Identity and Ocean Heritage to MPA Policy and Management

Voces Olvidadas: Conectando la Identidad Indígena y el Patrimonio Oceánico a la Política y Manejo de Áreas Marinas Protegidas-AMP

Voix Oubliées: Connecter l'Identité Indigène et le Patrimoine Océanique à la Politique et à la Gestion des Aires Marines Protégées-AMP

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ABSTRACT

While centrality of land to indigenous people's identity has been much studied and now is considered in decision-making and codified in international law, less is known about what oceans mean to indigenous island peoples other than for livelihoods such as fishing and tourism, especially in the Americas. This study examines the role of the sea in identity and heritage of the Raizal people of Colombia's San Andres Archipelago, Southwestern Caribbean, using qualitative research methods rooted in principles of participatory action research, collective inquiry, and collaboration. The need to know more is pressing because a 2012 ruling of the International Court of Justice (ICJ) awarded much of the archipelago's traditional sea territory to Nicaragua without consulting the Raizal people. In spite of being linked to these waters for centuries, Raizals were forgotten. Individual and focus group interviews gathered information about their relationships and connections to the sea as island people, and also about their views on the ICJ ruling. The results will benefit the Raizal community specifically by adding to knowledge that can increase understanding of Raizals as an indigenous people, strengthen sustainable management of their Seaflower MPA, support cultural liberty and human well-being, and better inform future responses to the ICJ ruling. But questions of marine heritage and identity are not unique to Raizals, and pressures on the world's oceans are growing. More generally, preliminary results provide knowledge that gives managers, policymakers, scientists, and educators a more holistic, robust picture of reality to improve equitable, effective MPA policy and management and the contribution of MPAs to conservation, sustainable development, and social change.

KEYWORDS: Ocean heritage, marine protected areas, indigenous people and ocean territory

Impacts of Coastal Development on the Resilience of Coral Reefs: Twenty Years of Monitoring from the Dominican Republic

Impactos del Desarrollo Costero en la Resiliencia de los Arrecifes de Coral: Veinte Años de Monitoreo en la República Dominicana

Impacts du Développement Côtier sur la Résilience des Récifs Coralliens: Vingt Ans de Suivi dans la République Dominicaine

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ABSTRACT

The coral reefs of the Dominican Republic currently face a number of threats that compromise their survival. Prime among them is the coastal development to support the growing tourism industry, the main revenue source for the country. Coral reef health data collected from 1995 to 2017 was gathered from three reefs along the southeast portion of the island to assess how coastal development, or the lack of it, has affected these ecosystems over the past two decades. The data was compared for live coral cover, macroalgae cover and herbivore fish densities over time between highly developed tourism areas and existing MPAs.

The three areas selected vary greatly in both management approaches and socio-economic backgrounds: Cotubanamá MPA (formerly Del Este National Park) is a large and one of the oldest MPAs in the country, despite little to no development along the coastline, there is intense boat traffic inside the MPA for tourism. La Caleta Underwater National Park is a small MPA right next to the country's capital of Santo Domingo and has been closely managed by NGOs since its creation. The Punta Cana area has experienced the most drastic changes in coastal development over the past few decades with the construction of over 40,000 hotel rooms, golf courses, and the second busiest airport in the region, and until recently, lacked any formal protection measures.

Results showed marked differences in reef health trends over time and between locations. Reef resilience proved to be a key factor in how reefs recovered after major impacts such as hurricanes and bleaching events. These results provide the first long-term evidence on how coastal development can negatively impact the health of coral reefs and their ability to recover in the face of damaging events.

KEYWORDS: Coral reefs, coastal developement, resilience

Assessment of Water Use in the Island of San Andrés: Tourists, Hotels and Guesthouses

Valoración del Uso del Agua en la Isla de San Andrés: Turistas, Hoteles y Viviendas Turísticas

Évaluation de l'Utilisation de l'Eau sur l'Île de San Andrés: Touristes, Hôtels et Résidences de Tourisme

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ABSTRACT

In 2016, San Andrés island, in the Colombian Caribbean, was declared in public calamity by not having enough water resources to satisfy the water demand of a resident population and floating that is increasing. At the same time there is a mass tourism model that rooted the relative scarcity and to understand its impact, the present paper makes an analytical evaluation of the use of water in the accommodation service: it documents the perception, patterns of use and saving strategies hat tourists, hoteliers, guesthouses and government entities have on the water and finally the signs of conflict between the tourism sector and the residents by the resource.

KEYWORDS: Water use, hotels, guesthouses

Genetic Diversity and Connectivity of *Acropora* Coral Populations in the Lesser Antilles

Diversidad Genética y Conectividad de las Poblaciones de los Corales *Acropora* en las Antillas Menores

Diversité Génétique et Connectivité des Populations de Coraux du Genre *Acropora* dans les Petites Antilles

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ABSTRACT

The critically endangered coral species *Acropora palmata* and *A. cervicornis* used to be highly responsible for the structural complexity of Caribbean reefs, providing habitats for an important part of the reef fauna and protection for littoral ecosystems and human infrastructures against erosion. Sadly, since the early 80s, populations have dramatically declined. On the Caribbean scale, most of the previous works investigating Acropora populations genetics and connectivity involved the reefs of Florida, the Bahamas, the Mesoamerican Reef System and the Greater Antilles. Little is known regarding the eastern Caribbean populations, especially in the Lesser Antilles. Here, genetic diversity, structure and connectivity of Acropora populations were investigated using 14 hypervariable microsatellite loci among 42 sampled sites from 11 islands of the Lesser Antilles. *A. cervicornis* populations revealed to be in decline, that favoured hybridization between *A. palmata* and *A. cervicornis* species. Globally, genetic diversity levels in Acropora populations from the Lesser Antilles were lower compared to what was previously reported within the wider Caribbean. For *A. palmata*, the analysis of the genetic structure, crossed with spatial autocorrelation analysis, revealed an isolation-by-distance pattern at both reef and Lesser Antilles scales. A genetic neighborhood size of c.a. 100 km, and a northward gene flow direction, in agreement with ocean surface currents in the region were found. Altogether, these results suggest a restricted population connectivity and short distance dispersal of *Acropora* larvae within the Lesser Antilles, further limited by geographic distances among suitable habitat patches. Conservation efforts for these populations would be realized on a local scale, favoring southward populations of the Lesser Antilles.

KEYWORDS: *Acropora*, Lesser Antilles, larval dispersal

Hurricane Harvey Damage Assessment: Provisional Results for the Texas Commercial and For-hire Fisheries and Associated Businesses

Evaluación de los Daños Causados por el Huracán Harvey: Resultados Provisionales para la Industria Pesquera Comercial y de Alquiler y las Empresas Asociadas en el Estado de Texas

Évaluation des Dégâts Causés par l'Ouragan Harvey: Résultats Provisoires Pour l'Industrie des Pêcheries Commerciales et Récréatives et les Entreprises Associées dans l'État de Texas

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ABSTRACT

Shortly after Hurricane Harvey, NOAA Fisheries Southeast Regional Office coordinated a rapid appraisal of damages to the fishing industry and its support businesses within the state of Texas. NOAA staff began preliminary fieldwork in late September to organize the rapid appraisal. By early October NOAA staff was in the field conducting interviews with affected business owners, commercial and recreational fishermen. Fieldwork covered the coast from Nueces to Jefferson County, including Harris and continued through the first half of November. During the fieldwork phase an online survey was developed and provided to the state Texas to place on their websites. A phone survey was also developed and contracted out and was initiated once the fieldwork phase was completed. A total of 829 businesses and individuals participated in all phases of the appraisal in Texas. Damage assessment totals for various sectors are presented along with a discussion of the following disaster declarations and subsequent allocation of funds by Congress and preparations for future hurricane disasters.

KEYWORDS: Hurricanes, fisheries, rapid appraisal

Holopelagic *Sargassum* and the Complexities of Predicting Influxes and Impacts on Pelagic Fisheries of the Lesser Antilles

Sargazo Holopelágico y las Complejidades de Predecir las Afluencias y los Impactos en las Pesquerías Pelágicas de las Antillas Menores

Sargasse Holopélagique et Complexité de la Prévision des Afflux et des Impacts sur les Pêcheries Pélagiques dDes Petites Antilles

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ABSTRACT

Barbados, at 13oN, is located near the separation between water masses of the North Atlantic Gyre and the system of equatorial currents whose origin, in part, is in the South Atlantic. Seasonal and inter-annual, variations in local currents and water masses at Barbados are high due to variations in the boundary between the gyre and the equatorial current system. In observations and models, this boundary occurs near 15oN with considerable fluctuation. Local *Sargassum* influx events can be back-traced to a broad range of locations in the equatorial Atlantic, dependent on season and dominance of either system of currents. In contrast, the neighboring state of Trinidad and Tobago lies almost exclusively in the path of water masses from the equatorial current system, resulting in differences in seasonal timing of *Sargassum* events compared with Barbados. Complex forcing mechanisms driving seasonal variations in local *Sargassum* coverage including Amazon River discharge and equatorial channel current systems are discussed, as well as back-tracing potential and difficulties with a variety of models for predicting influx events in the Lesser Antilles. We also examine the impact of this holopelagic *Sargassum* on major pelagic fisheries in Barbados. We present satellite-derived estimates of *Sargassum* coverage together with flyingfish and dolphinfish catch data over the last two decades to illustrate the complex relationship between Sargassum and pelagic fisheries and fishing methods. These complex relationships regarding influxes and impacts on the pelagic fisheries will need further resolution to better inform future policy and management decisions towards adaptation of the fisheries sector.

KEYWORDS: *Sargassum*, fishery impacts, adaptation

Marine Protected Areas Providing a Sustainable Economy for The Bahamas

Áreas Marinas Protegidas que Proporcionan una Economía Sostenible para las Bahamas

Aires Marines Protégées Assurant une Économie Durable aux Bahamas

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ABSTRACT

As a component of the Bahamas Protected project, Bahamas National Trust led stakeholder consultations to gain local knowledge from communities on areas being proposed for future proection. The Natural Capital Project was also contracted to quantify the economic value of ecosystems within the Bahamian MPAs and to determine the current tourism and fisheries values to better inform the selection process for the next 10% (towards our 20% by 2020 goal). The economic value of ecosystem services and the livelihoods they support indicate the importance of managing the MPA network now in order to help safeguard against the loss of economic and societal benefits to Bahamians, the Caribbean, and people worldwide in the future. Traditional approaches to MPA management focus on ecological considerations, such as a sufficient diversity and proximity of habitats. While such factors are essential for sustaining species, they may miss the societal importance of MPAs. Increasingly, conservation practitioners, governments, and other stakeholders are considering the benefits that nature provides to people or 'ecosystem services'. Diverse, functioning ecosystems provide myriad benefits that can be sustained through effective protected area management. Nearshore habitats bolster the stocks of fisheries, beaches and reefs draw tourists, and coastal forests and seagrasses buffer storm waves, mitigate climate, and promote water quality. Ensuring these are taken into consideration when selecting sites for protection and management, will secure sustainable sources of income for The Bahamas.

KEYWORDS: Sustainable economy, effective management,

Finfish Bycatch Discards in the Artisanal Shrimp Fishery of Guyana

Descartes de Captura Secundaria de Peces en la Pesquería Artesanal de Camarón de Guyana

Rejets de Prises Accessoires de Poissons dans la Pêcherie Artisanale de Crevettes du Guyana

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ABSTRACT

The artisanal shrimp fishery in Guyana is important for livelihood and food security, involving around 300 vessels, owned and crewed exclusively by Guyanese nationals. This fishery uses Chinese seine gear and operates in major river estuaries. It primarily targets penaeid shrimps, but also retains some finfish and discards a significant, but undocumented, quantity of smaller finfish bycatch. Lack of knowledge regarding the bycatch is a concern for fishery management and biodiversity conservation. In this study, we quantify for the first time, the finfish bycatch discards through onboard observations of a typical vessel operating in the Demerara estuary. A total of 16 day-trips involving 83 seine hauls were made over July-August 2016. For every haul, wet weights of the unsorted catch, the retained catch and the finfish discards were recorded, and a sub-sample of finfish discards was taken to determine their taxonomic composition and size-frequency. Examination of 2,012 discarded finfish revealed high taxonomic diversity. A total of 32 species were recorded, most of which are considered by the IUCN Red List as being of 'Least Concern,' whilst 11 are listed as 'Not Assessed'. The vast majority of the finfish discards were small (mean size: 11.9 cm FL; 72.7 g) and included 15 species of commercial importance to other fisheries in Guyana. On average 9.1 kg of unsorted catch was taken per seine haul, yielding 6.2 kg of finfish bycatch (69.5% of the catch) to be discarded. These results demonstrate that a significant amount of finfish is being wasted by this fishery.

KEYWORDS: Bycatch discards, finfish, artisanal shrimp fishery

Reporting in U.S. Coral Reef Areas to Inform Conservation and Management

Programa Nacional de Monitero de Arrecifes de Coral de la 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 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 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. Its overarching goal is 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. Current NCRMP efforts have focused on better integration of our socioeconomic and biophysical data, and development of standardized reporting products. Two pilot reporting products are currently in development to strengthen the dissemination of NCRMP's data: Coral Reef Condition Status Reports and a Data Summary Report. Both products were developed to communicate status and trends information to a particular audience. We hope to decide on the form and frequency of future reporting products in the context of other efforts, such as the Global Coral Reef Monitoring Network, and feedback from the community.

KEYWORDS: Coral reefs, monitoring,

Fishers' Observations of Climate Change Impacts on the Flyingfish Fishery in Barbados

Las Observaciones de los Pescadores sobre los Impactos del Cambio Climático en la Pesquería del Pez Volador en Barbados

Observations des Pêcheurs sur les Impacts du Changement Climatique sur la Pêche au Poisson Volant à la Barbade

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ABSTRACT

Barbados is famously known as 'the land of the flyingfish' because of its significant flyingfish fishery which has traditionally contributed about 60% of the island's total annual fish landings by weight. However, in recent years the availability of flyingfish has fluctuated widely, disrupting the flyingfish fishery and giving cause for concern. Here we report on the many changes observed at sea by fishers over the last decade and on recent changes in the traditional flyingfish fishery. Fisher observations include substantial changes in the strength and direction of ocean currents and winds, changes in sea state, ocean colour, and the presence of *Sargassum* seaweed. Impacts on the fishery, as reported by fishers, include fewer days at sea, unpredictable availability and reduced catchability of flyingfish, changes in flyingfish behaviour, use of smaller mesh gillnets and change in target species. We conclude that these observations are consistent with the projected climate change impacts, and they highlight the critical importance of fisher observations (traditional knowledge) in providing firsthand information that is highly relevant to fishery management, and that contributes to a better understanding of climate-related changes and impacts, especially in this region where oceanographic data and research are extremely limited.

KEYWORDS: Flyingfish, climate change, pelagic fishery

The Effects of MPAs on the Abundances of Top Predators, Important Herbivorous Fishes and Their Health

Los Efectos de las Zonas Marinas Protegidas sobre la Abundancia de los Depredadores Superiores, Peces Herbivoros Importantes y su Salud

Les Effets des Aires Marines Protégées sur l'Abondance des Prédateurs Supérieurs, des Poissons Herbivores Importants et de Leur Santé

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ABSTRACT

Coral reefs worldwide are stressed and degrading from climate change, overfishing and pollution. Fishing pressure has reduced the numbers of top predators in reef ecosystems and nutrient pollution has led to increased macroalgae, both of which may be influencing fish health. In the Caribbean, important fish herbivores, particularly in the genus Acanthurus, are exhibiting black spots, a sign of ectoparasite presence. Marine Protected Areas (MPAs) have been established to help preserve coral reefs and their inhabitants primarily by restricting fishing and other destructive activities, however these measures may not be protecting top predators and fish health. We hypothesized that if top predators exist they should feed on heavily infested Acanthurids and thus reduce ectoparasite infestation. We used timed underwater surveys at 11 sites around Tobago, Grenada, Carriacou and the Tobago Cays; 6 sites inside MPAs and 5 sites outside to test this hypothesis. Photographs were taken of all piscivores and Acanthurids encountered. Numbers/hour of each were derived from the photos as well as the percentage of Acanthurids with black spots. Predator and Acanthurid abundances were higher inside MPAs than outside but they were not significantly different. Percentages of Acanthurids with ectoparasites were similar inside and outside MPAs. No significant correlations were found between black spot occurrence and predator abundances. However, the number of predators capable of consuming adult Acanthurids was close to zero with no large groupers, snappers or sharks encountered. Our results show MPAs do not appear to protect top predators or improve fish health with regard to ectoparasite infestation. A gill net and illegal spearfishing were witnessed within 2 of the MPAs indicating poor enforcement may be largely to blame.

KEYWORDS: Marine Protected Area, Acanthuridae, coral reefs

Findings of the Rapid Ecological Assessment of the Savannah Sound Mangrove Ecosystem in The Bahamas

Hallazgos de la Evaluación Ecológica Rápida del Ecosistema de Manglares de Savannah Sound en las Bahamas

Résultats de l'Évaluation Écologique Rapide de l'Écosystème de Mangroves de Savannah Sound aux Bahamas

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ABSTRACT

The Savannah Sound area is located on the east coast of the island of Eleuthera, within the Bahamian archipelago. It is a sheltered area with an abundance of seagrass and mangrove ecosystems. Savannah sound is an area that is both ecologically important and culturally important. The community asked that the area be considered within the expanded protected area system of The Bahamas.

A rapid ecological assessment of the Savannah Sound mangrove creek was completed August 2017 by members of the Bahamas National Trust, The Perry Institute of Marine Sciences and the University of Tampa using a modified Atlantic & Gulf Rapid Reef Assessment (A.G.R.R.A) protocol. This effort is part of a larger effort to assess marine habitats and living marine resources throughout Eleuthera; information gained from assessments can help guide management of these marine systems.

It was found to be a productive environment with a high diversity of species on average and a high density of fish, particularly grunts, Nassau Grouper, Queen conch, Spiny lobster and parrotfish.

There are some threats that may impact the productivity of the creek, such as dredging and inappropriate development. Based upon the R.E.A results, some spatial management (i.e. a protected area) would benefit the area and ensure the system remains productive.

KEYWORDS: Mangroves, protected areas, MPAs

NOAA's New Coral Reef Conservation Strategic Plan: Reducing Threats Locally – Recovering Species Globally

Nuevo Plan Estratégico de Conservación de Arrecifes Coralinos de la NOAA: Reducción de Amenazas a Nivel Local - Recuperación de Especies a Nivel Mundial

Le Nouveau Plan Stratégique de Conservation des Récifs Coralliens de la NOAA: Réduire les Menaces Localement - Récupérer des Espèces à l'Échelle Mondiale

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ABSTRACT

Covering just a tiny fraction of the earth's surface—less than 1 percent—shallow-water coral reefs sustain and protect human lives, livelihoods, and coastal property. A conservative estimate for the global value of reef tourism is $36 billion per year. When food production and property protection are added, global services are estimated at $172 billion per year. There are also unrealized economic riches and potential cures to human disease in the many biopharmaceuticals likely to be discovered in coral reefs. In addition to these very tangible assets, reefs have tremendous aesthetic value to people. Pollution, fishing impacts, a changing global climate, and other stressors have destroyed or severely damaged many of the world's reefs. Twenty additional shallow-coral species were listed as threatened under the Endangered Species Act in 2014, and coral reefs subsequently experienced unprecedented losses during the third global bleaching event in 2014-2017.

The NOAA Coral Reef Conservation Program is taking proactive measures to address these declines by leading efforts to understand and conserve these precious resources. This strategic plan incorporates lessons learned from recent programmatic assessments, and its implementation is predicated on employing an adaptive management strategy. The goal of the plan is to reduce threats affecting coral reefs, particularly in U.S. waters, and to restore coral ecosystem function at an ecological scale. The plan is ambitious, covers far more work than a single organization can achieve alone, and is aspirational to catalyze action for positive change. The plan lays out a framework for the coral conservation community and identifies opporto create new partnerships across the broader conservation community domestically and abroad.

KEYWORDS: Coral, strategy, NOAA

The Role of Tourism in Protecting Jamaica's Fish Stock

El Papel del Turismo en la Protección de la Población de Peces de Jamaica

Le Rôle du Tourisme dans la Protection de la Population de Poissons de la Jamaïque

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ABSTRACT

Jamaica's tourism interests have been huge proponents of no-take Marine Protected Areas, in the past 20 years. In 2017, Jamaica received more than 3 million visitors to its coastline, with more visitors attracted by Jamaica's natural resources. There has been an intensifying link between the development of the tourism product and the need to ensure a healthy environment which has helped to leverage support from a diverse range of stakeholders. The use of public-private partnerships has directly financed the establishment and management of 18 MPAs across Jamaica. This opportunity is being harnessed by several organisations including the Alligator Head Foundation (AHF), Sandals Foundation and Oracabessa Foundation who are promoting stewardship of coral reef ecosystems through ambitious ecotourism initiatives. These include the development of community-run enterprises offering snorkeling, scuba-diving, sea turtle releases, lionfish control and restoration activities designed to promote growth, engage visitors, provide employment and work with coastal communities to transition away from fishing to more sustainable livelihoods. The Jamaica Fish Sanctuary Network - a national network of management partners, policy makers, researchers, and conservation practitioners is dedicated to restoring productivity to coral reefs and improving livelihoods of coastal communities. As secretariat of this network, the AHF is working to strengthen capacity of its partners through the delivery of national funding and capacity building programs. Greater collaboration with tourism stakeholders has enabled further expansion and development of the network. This is a sustainable economic model that will create jobs, support local communities, develop the product whilst offering an experience all underpinned by science; working hand in hand.

KEYWORDS: MPA, stewardship, fisheries

Nutrient Enrichment as a Factor Driving Macroalgal Blooms on the Belize Barrier Reef Complex

El Enriquecimiento de Nutrientes como un Factor que Impulsa las Floraciones de Macroalgas en el Complejo del Arrecife de Coral de Belice

Enrichissement en Éléments Nutritifs en Tant que Facteur de Prolifération des Macroalgues sur le Complexe de Récifs de la Barrière du Belize

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ABSTRACT

Representing a significant portion of the world's second largest coral reef complex and encompassing a World Heritage site, the Belize Barrier Reef Complex (BBRC)) has experienced increasing blooms of macroalgae in recent decades. Researchers suggest that this is not the result of overfishing of herbivorous fishes, as many coral reef biologists have previously suggested, but more likely related to external factors, significantly nutrient enrichment. Because historical nutrient data for seawater and macroalgae were collected in the BBRC in the 1980s, we re-sampled the same sites at South Water Caye (SWC) marine reserve (e.g. Man-O-War Caye), and various sites at Glovers Reef (GR) marine reserve (e.g. Middle Caye) in June 2017 and 2018. Seawater dissolved inorganic nitrogen (DIN) and soluble reactive phosphorus (SRP) concentrations increased from undetectable concentrations in the 1980s to values of 0.5 – 1.0 µM DIN and 0.02-0.05 µM SRP at several reef sites, indicating nutrient enrichment of reef waters. Elevated macroalgal tissue C:N ratios from 22 to 44 occurred at reef sites, suggesting nitrogen limitation; however, lower C:N ratios of 13 to 16 occurred at Middle Caye, GR and Man-O-Way Caye, SWC indicating nitrogen enrichment at these sites. Stable nitrogen isotope values (d13N) were elevated (+3 to + 7 o/oo) at Middle Caye and Man-O-War Caye compared to lower values at reef sites (-0.5 to + 2 o/oo), pointing to significant nitrogen enrichment from humans and seabirds, respectively. These comparative nutrient data support recent suggestions that nutrient enrichment is a significant factor driving macroalgal blooms, declines in hard coral and loss of broader ecosystem services generated by the BBRC.

KEYWORDS: Macroalgal blooms, nutrient enrichment, coral reefs

Submarine Geomorphology of the Archipelago of San Andres, Providencia and Santa Catalina (Western Caribbean) and its Correlation with the Potential Distribution of Fisheries

Geomorfologia Submarina del Archipiélago de San Andrés, Providencia y Santa Catalina (Caribe Occidental) y la Correlación con la Distribución Potencial de Pesquerias

Geomorphologie Sous-Marine de l'Archipel de San Andrés, Providencia et Sanata Catalina (Caraïbes Occidentales) et la Correlation avec la Distribution Potentielle des Peches

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ABSTRACT

The recent acquisition and interpretation of approximately 82000 km^2 of high-resolution multibeam bathymetric information in the western region of the Colombian Caribbean allowed illuminating for the first time the submarine geomorphology of the Archipelago of San Andres, Providencia and Santa Catalina (ASAPSC), and how this geological formations interact with other conditions for the marine environment dynamics, that influences the presence and abundance of species of fishing interest, in the archipelago areas.

The qualitative analysis of the multibeam bathymetric data let us to differentiate geomorphological units in the islands and correlate geological information with ecosystem potential distribution. The ASAPSC and surrounding areas are characterized, from the geomorphological point of view, by having volcanism-related submarine landforms. These landforms are the geological foundations of the several islands (San Andres and Providencia), banks and atolls (Albuquerque, Este-Sudeste, Roncador, Quitasueño, Serrana, Serranilla, and Bajo Nuevo) that comprise the archipelago. Also, it was possible to determine that most of these landforms are aligned in specific directions, parallel to the trends of the main fault systems in the area, which indicates that the genesis and evolution of the archipelago and the species and ecosystems trends and distribution are influenced by large temporal scale processes that mold the islands as they are known today, all this new information has a great value for decision making around fisheries policy in the Colombian western Caribbean, as a contribution from the maritime authority for the stakeholders concerned about fisheries in the ASAPSC.

KEYWORDS: Geomorphology, multibeam bathymetric, fisheries

Analysis of Historical Aerial Photographs and Satellite Data Reveal an Increase in Seagrass Cover in Caja de Muertos Island Nature Reserve, Puerto Rico: 1950 – 2014

Análisis de Fotografías Aéreas Históricas y Datos Satelitales Revelan un Aumento en la Cobertura de Hierbas Marinas en la Reserva Natural Isla Caja de Muertos, Puerto Rico: 1950 – 2014

L'analyse des Photographies Aériennes Historiques et des Données Satellitaires a Révèle une Augmentation de la Couverture des Herbiers Marins dans la Réserve Naturelle l'Île de Caja de Muertos, Porto Rico: 1950 – 2014

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ABSTRACT

In a scenario of global climate change and increasing anthropogenic disturbances on seagrass ecosystems, establishing baseline references of seagrass cover, distribution and dynamics are needed for a better understanding and management of these ecosystems. Long-term changes in seagrass distribution in Caja de Muertos Island Nature Reserve, Puerto Rico were assessed using remote sensing techniques. A WorldView-2 image from 2014, historical aerial photographs from 1950 to 2010 and field data were used to analyze spatial trends within four zones of the Reserve. Remote sensing data were analyzed using object-based image analysis. Overall seagrass extent increased by 64%, contrasting with the worldwide declining trend in seagrass habitats. This increase was mainly driven by an increase in the patchy seagrass cover category, which was also the most persistent cover for the 64-year period. The temporal and spatial differences observed were mainly associated with natural factors. The seagrass persistence map that was created can be used by managers to determine the severity of a natural or anthropogenic impact within the studied zones, and to decide if management actions are needed. These data represent a baseline by which future seagrass changes can be analyzed as well as valuable information for the conservation of seagrass beds in the Reserve.

KEYWORDS: Seagrass dynamics, WorldView-2, object-based image analysis

Initial Steps of an Adaptive Management Exercise to Strengthen Puerto Rico's Coral Reef Monitoring Program

Inicio de un Ejercicio de Manejo Adaptativo para Fortalecer el Programa de Monitoreo de Arrecifes de Coral de Puerto Rico

Premières Étapes d'un Exercice de Gestion Adaptative pour Renforcer le Programme de Surveillance des Récifs Coralliens de Porto Rico

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ABSTRACT

The Puerto Rico Coral Reef Monitoring Program (PRCRMP) was established in 1999 by the Department of Natural and Environmental Resources, with the responsibility of assessing the condition and trends of jurisdictional coral reefs. Although the PRCRMP has collected and analyzed this data, its implementation on management decisions has been limited. Therefore, an assessment was commissioned to identify needs and courses of action to strengthen the PRCRMP. After reviewing the PRCRMP's historical data and its possible audiences, key stakeholders were inquired about their experience and understanding of the PRCRMP, as well as perceived limitations, and recommendations for improvement. Scientists, managers and collaborators that were consulted agreed on the importance of the information gathered by the PRCRMP for the conservation of coral reefs. However, limited data accessibility and lack of collaboration within and between agencies and other entities were considered the main issues impeding the application of this information. To strengthen the PRCRMP, participants highlighted the value of promoting collaborative agreements with other agencies, academia and non-governmental organizations, especially considering Puerto Rico's fiscal constraints. Recommendations also included new monitoring parameters and the expansion of monitoring efforts in assessing the effectiveness of management actions. Validating findings and recommendations through an inclusive and objective process improved the stakeholders' approach and willingness to cooperate in this effort. Implementing this exercise as an initial step of an adaptive management effort assisted in overcoming communication challenges between managers and scientists, resulting in recommendations with strong support for implementation.

KEYWORDS: Coral reef ecosystems, coral reef management, long-term monitoring program

Science that Informs Conservation for an Economically Important Sport Fish: Bahamas Case Study

Ciencia que Informa de Conservación para un Pez de Deporte Importancia Económica: Estudio de Caso de Bahamas

Science qui Informe de Conservation pour un Poisson de Sport Économiquement Important : Étude De Cas Des Bahamas

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ABSTRACT

Bonefish (*Albula vulpes*) is an economically important sport fish throughout its geographical range. In The Bahamas, where tourism is the largest industry accounting for 60% of the country's GDP, the recreational catch and release bonefish fishery has an annual economic impact exceeding $141 million, and has a high cultural value. The majority of fishing for bonefish occurs on the family islands, where rural communities heavily depend on the health of the fishery. Despite the fishery's importance, the sustainability of the fishery is threatened by habitat loss and degradation, and to a lesser extent illegal harvest. Until recently, data to inform conservation in response to these threats were sparse. We have been collaborating with fishing guides, fishing lodges, and fishers to obtain data on bonefish habitat use and movements. Data from this collaborative work – from scientific research as well as fisher's ecological knowledge – has led to identification of bonefish home ranges, migratory pathways, and pre-spawning aggregation locations. The partnership with these stakeholders has fostered advocacy for habitat conservation. In fact, fishing guides and anglers have played leading roles in habitat conservation efforts. We work with Bahamas National Trust to incorporate these data into conservation strategies that had led to the recent creation of National Parks to protect bonefish habitats. There is a need to get The Bahamas Ministry of Tourism involved in bonefish conservation efforts, and to better promote the fishery. Currently, the Ministry of Tourism has shown little interest in the recreational bonefish fishery. This is unsettling especially due to the amount of visitors that travel to The Bahamas to fish for bonefish, and the thousands of Bahamians that depend of this sustainable and lucrative fishery.

KEYWORDS: Tourism, conservation, recreational

New Approach to Integrated Space-based Surveillance of *Sargassum*

Nuevo Enfoque para una Vigilancia Integrada de *Sargasso* desde el Espacio

Nouvelle Approche pour une Surveillance Intégrée des *Sargasses* depuis l'Espace

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ABSTRACT

With the availability of data from the Copernicus-Program, jointly developed by the EU and ESA, a new promising tool for monitoring *Sargassum* from Space has been made available. While the Sentinel-3 satellite sensor OLCI, swath 1270km, 300m pixel, covers the entire globe, the Sentinel-2 with 10m pixel maps the Caribbean islands every 5 days. The Maximum Chlorophyll Index from S-3 data is extremely sensitive to floating algae as proved with S-2, Landsat-8, MODIS and sea-truth campaigns. Even sparse distribution of algae and patches much less than 100m wide can be detected. For coastal surveillance, we used the Floating Algae Index from Sentinel-2 to detect Sargassum. Using digitized shorelines, precise mapping of beaching algae was done regularly using multispectral images. However fixed marine vegetation need to be excluded by experience. A pilot service has been set up all through 2018 based on manual interpretation. This initiative was originally introduced for optional studies to students at the Lycée Polyvalent Nord Grande-Terre and demonstrated to the environment office (DEAL) in Guadeloupe. DEAL much welcomed our reports, as they had no similarly detailed information available. Data is usually available on Copernicus website 12 hours after satellite acquisition. With a reasonable quality computer and good internet-connection a trained operator can download, analyse and prepare a report within an hour. Data and software are available for free. The development of semi-automatic interpretation and reporting is envisaged to secure higher reliability. However, the timely requirement will not be much reduced. Beaching-forecasts still lack understanding of local currents and wind forcing interactions on floating algae. However just by doing such regular analysis work, valuable experiences also in this respect is gained.

KEYWORDS: *Sargassum*, Sentinel-3, satellite

Evaluation of the Jaiba Resource Fishery (*Callinectes sapidus* and *Callinectes bocourti*) in the Colombian Caribbean

Evaluación de la Pesquería del Recurso Jaiba (*Callinectes sapidus* and *Callinectes bocourti*) en el Caribe Colombiano

Evaluation de la Peche des Ressources Jaiba (*Callinectes sapidus* and *Callinectes bocourti*) dans la Caraïbe Colombienne

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RESUMEN

En el Caribe colombiano las especies *Callinectes sapidus* (jaiba azul) y *Callinectes bocourti* (jaiba roja), además de su importancia ecológica, constituyen un recurso de alto valor comercial al ser productos de exportación. En este trabajo se realizó la caracterización socioeconómica y la evaluación del estado de la pesquería, en los principales humedales del Caribe colombiano: Ciénaga Grande de Santa Marta (CGSM, departamento del Magdalena), el Golfo de Morrosquillo (departamentos de Sucre y Córdoba), la Ciénaga de La Virgen (departamento de Bolívar) y la Bahía de Cispatá (Departamento de Córdoba) en marco de la implementación del Programa de Observadores Pesqueros de Colombia-POPC entre los años 2015-2017. Se logró la caracterización de la dinámica de los puertos de desembarco, se describieron los volúmenes y composición de las capturas de las empresas procesadoras y exportadoras de jaiba. El mayor volumen promedio anual capturado lo presentó la CGSM con 868.37 t, seguido de la Bahía de Cispatá con 8.60 t, la Ciénaga de La Virgen con 6.54 t y el Golfo de Morrosquillo con 0.32 t. El promedio de ABEL para C. sapidus fue en la CGSM de 11.52±2.72 cm, el Golfo de Morrosquillo 10.23±0.88 cm, la Ciénaga de La Virgen 9.53±5.77 cm y la Bahía de Cispatá 9.22±4.38; para el caso de C. bocourti fue en CGSM de 11.09±1.03 cm, Golfo de Morrosquillo 9.78±1.23 cm, Ciénaga de La Virgen 9.38±0.78 cm y Bahía de Cispatá 9.33±3.80. A nivel socioeconómico se dedican a esta pesquería cerca de 300 pescadores artesanales, predominando la población masculina que ejerce la actividad de manera permanente y por tradición familiar. Los resultados obtenidos han permitido ampliar las actuales medidas de manejo de la pesquería.

PALBRAS CLAVES: *Callinectes sapidus, Callinectes bocourti*, pesquería

Dynamics of Artisanal Fishing and Composition of Fish Catches from Artisanal Fishing Landings in the Island of San Andrés, Biosphere Reserve Seaflower, Colombia

Dinámica de la Pesca Artesanal y Composición de la Captura de Peces Proveniente de la Pesca Artesanal Desembarcada en la Isla de San Andrés, La Reserva de Biosfera Seaflower, Colombia

Dynamique de la Pêche Artisanale et Composition des Captures de Poisson des Débarquements de Pêche Artisanale dans l'Île de San Andrés, Réserve de la Biosphère Seaflower, Colombie

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RESUMEN

La pesca artesanal en el Archipiélago de San Andrés, Providencia y Santa Catalina es una actividad ancestral que se realiza a partir de técnicas tradicionales. Desde 2008, la Secretaría de Agricultura y Pesca de la Gobernación, cuenta con un programa de monitoreo implementado por pescadores tradicionales entrenados para la toma de datos en campo. La línea de mano ha estructurado la pesquería (90% de la captura), las cuales principalmente provienen de zonas cercanas a la isla. La captura promedio anual (peces, crustáceos y moluscos) desembarcada entre 2004 y 2017 fue de 125 Toneladas (Ton). El valor máximo de captura registrado, se presentó en 2009 y 2007 y fue de 247 y 225 Ton respectivamente. La composición de la captura está representada especialmente por peces 97,4 % y en menor cantidad moluscos 1,9% y crustáceos 0,7%. Los desembarques de peces, corresponden principalmente a once especies. La más representativa es el bonito (*Thunnus atlanticus*) con 31,3%, seguida por la saltona roja (*Ocyurus chrysurus*) con 8,6%, barracuda (*Sphyraena barracuda*) (8,4%), King Fish (*Acanthocybium solandri*) (7,7%), Turbet (*Canthidermis sufflamen*) (7,5%) y Ocean Yellow Tail (*Elagatis bipinnulata)* (6,9%). Los datos indican disminución en las capturas de *O. chrysurus, Katsuwonus pelamis, A. solandri*, y *Coryphaena hippurus*. Las dos primeras especies fueron incluidas en el Libro Rojo de Peces Marinos de Colombia (2017), debido a la evidencia en la disminución de tallas y volúmenes de captura y el impacto por pesca en individuos juveniles en el caribe continental e insular de Colombia. Las otras especies más representativas son *Lutjanus vivanus* (Yellow Eye Snapper), *L. jocu* (Dogteeth Snapper), *Katsuwonus pelamis* (Stripped Bonito), *Etelis oculatus* (Mandilos) y *Coryphaena hippurus* (Dolphin Fish).

KEYWORDS: Pesca artesanal, Reserva de Biosfera Seaflower, captura

A Review of Caribbean Socio-economic Monitoring (SocMon) with Recommendations for Increasing Influence in Decision-making

Una Revisión del Monitoreo Socioeconómico del Caribe (SocMon) con Recomendaciones para Aumentar la Influencia en la Toma de Decisiones

Un Examen du Suivi Socioéconomique des îles Caraïbes (SocMon) avec des Recommandations pour Augmenter l'Influence dans la Prise de Décisions

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ABSTRACT

Socio-economic Monitoring for Coastal Management (SocMon) has been utilized at 26 sites in 12 Caribbean island nations and territories since 2005. This review of the results and impacts of SocMon studies at thirteen sites across eight countries and territories sheds light on shared obstacles and best practices for the uptake of SocMon and other data-driven studies into the decision-making realm. SocMon project leaders were interviewed about their experience with SocMon and moreover the fate of SocMon assessments, their results and recommendations in the wake of project completion. Several useful trends in responses emerged that can inform design and use of the SocMon methodology in the future. Furthermore, this study informs Marine Protected Area (MPA) and coastal zone managers as to mechanisms and actions that increase the visibility and influence of SocMon results, key learning and recommendations at the policy level. Protected areas and coastal zones are usually managed by natural scientists that allocate scarce resources to biophysical aspects in preference to human dimensions. Practitioners agree that often there is no customary or obvious leader to follow up on SocMon results and recommendations, nor the resources to do so. However, several examples of internal and external actions that carried SocMon outputs to the policy realm were discussed. These serve as the foundation of this study's recommendations and product development that supports the communication of data to be more compelling to policy- and decision-makers.

KEYWORDS: Socio-economic monitoring, decision-making, SocMon

Ecologic Integrity and Biodiversity of Reef Ecosystems in Oceanic Islands of Colombia in the Caribbea: Serranilla Cay

Integridad Ecológica y Biodiversidad de los Ecosistemas Arrecifales e Insulares de los Complejos Coralinos Oceánicos de Colombia en el Caribe: Cayo Serranilla

L'intégrité Écologique et la Biodiversité des Écosystèmes Insulaires et Récifs des Complexes de Coraux Océaniques de Colombie dans les Caraïbes : Cayo Seranilla

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RESUMEN

La Reserva de Biósfera Seaflower (RSB) alberga las áreas de arrecifes oceánicos más importantes del Caribe colombianoEn el marco de las expediciones científicas a la RBS, se llevó a cabo una salida de campo al complejo coralino de las islas Cayo Serranilla en septiembre del 2017, analizando la integridad ecológica del Cayo para: evaluar el estado de los arrecifes coralinos someros, analizar históricamente las condiciones de crecimiento una especie de coral, y evaluar las colonias de aves presentes en el cayo. Se estudiaron seis estaciones de salud arrecifal, se colectaron muestras de cianobacterias para analizar deterioro coralino, se extrajeron 5 núcleos de coral Orbicella faveolata, y se hizo un inventario exhaustivo de la avifauna y condiciones de anidamiento para aves marinas. La cobertura coralina fue muy baja (<10% en la mayoría de las estaciones), con baja presencia de enfermedades coralinas en las colonias y una alta cobertura de macroalgas, y presencia frecuente de consorcios de cianobacterias en todas las estaciones muestreadas, de las cuales se identificaron dos especies dominantes en los arrecifes coralinos: *Phormidium coriu*m y *P. morile*. Se extrajeron cinco núcleos del coral *O. faveolata* porque, a pesar de ser una de las especies más comunes en los arrecifes del Caribe, no se encontraron individuos de esta especie que tuviesen el tamaño adecuado (>1 m de altura) y con poca bioerosión. Se registraron 72 especies de aves en el complejo coralino, aunque no se registró ninguna colonia de anidación de aves marinas lo cual se debe principalmente a la presencia de roedores en la isla principal. Se registró, por primera vez para Serranilla, el Gecko Pestañudo, *Aristelliger georgeensis*.

PALABRAS CLAVES: Seaflower, coral reefs, ecological integrity

Population and Biometrics Aspects of the Blunttooth Swimcrab (*Callinectes bocourti*) of La Ciénaga Grande de Santa Marta, Colombian Caribbean

Aspectos Biométricos yPoblacionales de la Jaiba Roja (*Callinectes bocourti*) de la Cienaga Grande de Santa Marta, Caribe Colombiano

Aspects Biométriques et la Population des Crabe Chancre (*Callinectes bocourti*) du Ciénaga Grande de Santa Marta, Caraïbes Colombiennes

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RESUMEN

La jaiba roja (*Callinectes bocourti*) es un crustáceo decápodo que habita estuarios y ecosistemas de manglar, hace parte de la pesquería de pequeña escala de las zonas costeras del Caribe colombiano y la principal zona de pesca es la Ciénaga Grande de Santa Marta (CGSM). Su proceso en planta es de tipo industrial y el objetivo del mercado en un alto porcentaje es la exportación. Con el propósito de aportar información para contribuir con procesos de ordenación pesquera de este recurso, se adelantó investigación sobre aspectos biométricos y poblacionales a partir de ejemplares desembarcados en plantas de proceso durante el periodo comprendido entre marzo y junio de 2018. Los parámetros biométricos registrados son los establecidos en el Protocolo de Captura de Información Pesquera, Biológica y Socio-Económica en Colombia: Abertura de la Base de las Espinas Laterales - Abel (cm), Longitud del Cefalotórax - Lca (cm), Peso Total Pt (gr), Sexo y Madurez sexual (por observación externa). Los resultados obtenidos son: número de ejemplares registrados 1612. Los intervalos de Abel oscilaron entre 6,12 cm y 14,12 cm, los intervalos de Lca entre 3,64 cm y 8,64 cm y el peso total entre 25 g y 344 g. La proporción machos:hembras fue de 1:1. La maduración sexual, para C. bocourti, en hembras el 70,05% corresponde a ejemplares maduros, el 23,4% madurando y 6,55% inmaduras. En machos el 72,0% eran individuos adultos y 28,0% juveniles. De manera preliminar se puede concluir que el 80,52% de los individuos desembarcados está siendo capturado a tallas superiores a la talla mínima establecida por la autoridad pesquera. Del total de los individuos muestreados el 85,39 % de los machos y el 96,62 % de las hembras son individuos maduros sexualmente. La talla de primera captura para *C. bocourti* se estableció en 6,65 de Abel y 4,2 de Lca.

PALABRAS CLAVES: *Callinectes bocourti*, Caribe colombiano, ordenación pesquera

Parrotfishes Sleeping Sites

Sitios Donde Duermen los Peces Loro

Site De Couchage de Poissons Perroquets

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ABSTRACT

Many reef fish species exhibit marked circadian movements, occupying different zones during day and night. Studying how species use the habitats in which they live not only during day, but also at night is important if we want to understand populations structure and dynamics. Parrotfishes are good candidates to tackle these questions as most species can be easily spotted sleeping at night. Parrotfishes are considered to be critical to maintain reef health, but are highly overfished with many of them considered to be endangered. Their sleeping behavior makes them even more vulnerable to fishing. Our objective was to determine parrotfish distribution at night, sleeping fidelity and habitat selectivity in a the Marine Extractive Reserve of Arraial do Cabo, southern Brazil. We performed 126 strip transects (50 x 2 m) in three depths, together with measures of structural complexity. The four most abundant species (n = 192) were actively searched to determine habitat selectivity and the two more abundant tagged (n = 18) for active telemetry. Seven species were detected and depth had a significant influence on species distribution. The most abundant were Sparisoma frondosum, S. axillare, S. tuiupiranga and Scarus zelindae, all of selected sediment and avoided Palythoa caribaeorum as sleeping substrate. Most of the S. zelindae were observed sleeping in places with high structural complexity and intermediate depth, while S. tuiupiranga slept mainly in low complex habitats such as the rocky-sand interface. Fidelity for site was high for 95% of individuals tracked. These results represent the first assessment of parrotfishes distribution and behavior at night and are important to improve local management and conservation of this important group of fish in a scenario where overfishing escalate.

KEYWORDS: Nocturnal behavior, reef fish, site fidelity

Testing of a Bycatch Reduction Device (BRD) on a Double Rigged Industrial Trawler off the Coast of Trinidad and Tobago

Prueba de un Dispositivo de Reducción de Captura Incidental (BRD) en un Arrastrero Industrial de Doble Calado Frente a la Costa de Trinidad y Tobago

Essai d'un Dispositif de Réduction des Prises Accessoires (BRD) sur un Chalutier Industriel à Double Installation au Large des Côtes de Trinité-et-Tobago

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ABSTRACT

In Trinidad and Tobago, the shrimp trawl fishery is considered to be one of the country's most valuable fisheries and Government's policy directions for the management of the fishery favour strategies which minimize the amount of bycatch taken and promote the release of juvenile fish. Studies previously conducted by the Fisheries Division reveal that bycatch from local industrial commercial shrimp trawl fleets can be as high as fourteen (14) pounds of bycatch to one (1) pound of the shrimp targeted. As part of the "Sustainable Management of Bycatch in Latin America and Caribbean Trawl Fisheries" (REBYC – II LAC) project, the Fisheries Division engaged with fishers owning industrial double rigged shrimp trawl vessels to conduct experimental gear trials on board one of those trawling vessels. A two inch square mesh Bycatch Reduction Device (BRD) was inserted in the trawl gear with the aim of facilitating the escape of juvenile non-target finfish species. One of the vessel's trawling nets was used with the BRD and the other was used as the control. The control and BRD nets were fished simultaneously for a three (3) hour duration for each haul. Total weights of shrimp, useable catch and discards were recorded for each haul. A random basket from the BRD and control catches were taken for sorting of individual species by weights and lengths. The results showed no significant loss of shrimp or useable bycatch between the control and BRD nets as well as a 24.5% reduction in discards by weight when the BRD was used. Thus, the chosen BRD has the potential to work effectively and gear trials are slated to continue in Years II and III of the REBYC – II LAC Project.

KEYWORDS: Bycatch reduction device, BRD gear trials bycatch

A Comparison of the Catch Composition in Artisanal Trawlers Fishing Within and Outside the One Nautical Mile Exclusion Zone in the Gulf of Paria, Trinidad

Una Comparación de la Composición de Captura en la Pesca de Arrastreros Artesanales Dentro yFuera de la Zona de Exclusión de Una Milla Náutica en el Golfo De Paria, Trinidad

Une Comparaison de la Composition des Captures dans les Chalutiers Artisanaux Pêchant à L'intérieur et à l'Extérieur de la Zone d'Exclusion du Mille Nautique dans le Golfe de Paria, Trinidad

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ABSTRACT

National regulations in Trinidad and Tobago require all trawlers to operate outside one nautical mile from the coastline of the Gulf of Paria on the west coast of Trinidad. Artisanal trawlers currently do not fish outside of one nautical mile. They claim that if the regulation was to be enforced, they would encounter many physical and economic challenges operating at depths beyond one nautical mile. As part of the "Sustainable Management of Bycatch in Latin America and Caribbean Trawl Fisheries" (REBYC-II LAC) project, the claims of the fishers were tested. The methodology used was to ask artisanal fishers to trawl where they normally fish within one nautical mile in the Gulf of Paria and then trawl just outside the one nautical mile boundary. The objectives of the experiment were to compare catches inside and outside one nautical mile of shrimp, useable bycatch and discards; collect baseline data on species diversity within the trawl landings and determine the fishers' ability to operate at depths beyond one nautical mile. The experiments were repeated off various trawl landing sites in the Gulf of Paria. Lengths and weights were recorded of the species caught. Results indicated that the vast majority of all bycatch captured overall were juvenile and that trawling beyond the one nautical mile boundary produced shrimp of a smaller size and abundance. Thus, the fishers' claims were acknowledged so, the Fisheries Division will review and reassess the effectiveness of the one nautical mile restriction. The results would be used as a guide when reviewing the legislation to limit areas where artisanal trawlers are allowed to operate and would inform recommendations for the zoning of trawling areas.

KEYWORDS: One Nautical Mile Experiment, bycatch, shrimp trawling

Integration of Telecommunications in Caribbean Fisheries Management: A Resilience Imperative

Integración de las Telecomunicaciones en la Gestión Pesquera del Caribe: Un Imperativo de la Resiliencia

Intégration des Télécommunications dans la Gestion Pesante des Caraïbes: Un Impératif de la Resilience

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ABSTRACT

Small-scale fishers are among the most vulnerable to weather- and climate-related risks. Their vulnerability is magnified as fishing activity is typically conducted outside of the range of terrestrial communications service, and conventional space-based services are generally unaffordable for these fishers. Forecasts of increased intensity of storms in the Caribbean region further increase the risks to small-scale fishers' lives and further challenge their livelihoods.

As telecommunications is essential for all stages of the disaster risk management cycle (mitigation, preparation, response and recovery), it is an integral component of resilience-centric fisheries management. This paper outlines a suite of artefacts and activities recommended as the core telecommunications aspects of fisheries management planning in the Eastern Caribbean. The recommendations are structured around assessment, planning and capacity building with particular emphasis on marine band VHF radio as the communications mode of choice for seafarers. The paper draws on the case of St. Kitts and Nevis to report on prototype assessment and planning instruments and related activities; as well as early insights into a novel model of ICT capacity building for fishers.

KEYWORDS: Telecommunications, fisheries, management

TREMARCTOS-CORALINA

TREMARCTOS-CORALINA

TREMARCTOS-CORALINA

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ABSTRACT

TREMARCTOS-CORALINA is a system that evaluates the preliminarily impacts on biodiversity produced by works and projects with the intention of being developed and provides recommendations on the possible compensations that a given project must assume.

The promoters and administrators responsible for the design and planning of infrastructure and projects, will have available information on the distribution of sensitive species and ecosystems, protected natural areas and areas of socio-cultural importance. Besides that, it will be possible to carry out risk analysis and analysis of affectation to marine resources. This is intended to incorporate the environmental criteria in the infrastructure development plans, and impacts can be reduced from the preliminary phase and during the development of the project; The report generated by Tremarctos CORALINA does not replace the Environmental Study in any way.

KEYWORDS: Evaluation platform, TREMARCTOS, environmental study

Accessibility of Big Data Imagery for Next Generation Computer Vision Applications

Accesibilidad de Big Data Imagery para Aplicaciones de Visión por Computadora de Última Generación

Accessibilité de l'Imagerie Big Data pour les Applications de Vision Informatique de Prochaine Génération

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ABSTRACT

There is an unprecedented growth of digital imagery information collected from research and surveys conducted in marine ecosystems. To increase accessibility of the big data imagery to research and discovery by the broader scientific community, data enterprises must develop the necessary metadata and storage to enable the use of analytical tools that use computer vision and machine learning capabilities. NOAA programs have made progress with the collection, storage, and processing of imagery data, yet efforts are underway to improve the accessibility of these data to new analytic tools to streamline processing and provide more precise quantitative measures. Standardized metadata, reliable storage, and timely user access to big data imagery are a priority for NOAA's data enterprise. The current state of NOAA Fisheries' imagery collection, storage, and accessibility is presented to highlight challenges, lessons learned and recommendations for improving the accessibility of big data imagery for computer vision applications. The benefits of these efforts increase accessibility of big data imagery, significantly reduce processing costs, and provide more precise and timely scientific products for the sustainability of marine resources.

KEYWORDS: Technology, imagery, machine learning

A Fishers-led Community Awareness Campaign for the Establishment of a Marine Protected Area: A Case study for Gouyave, Grenada

Una Campaña de Sensibilización Comunitaria Dirigida por Pescadores para la Creación de un Área Marina Protegida: Un Estudio de Caso para Gouyave, Granada

Une Campagne de Sensibilisation Communautaire Dirigée par les Pêcheurs pour la Création d'une Zone de Protection Marine: Une Étude de Cas pour Gouyave, Grenade

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ABSTRACT

Community acceptance of Marine Protected Areas (MPAs) is key for MPA Managers to gain full support from stakeholders and facilitate effective management. The Gouyave Fishermen Cooperative Society Ltd. in collaboration with the Grenada Community Development Agency and the Fisheries Division designed and implemented a Fishers-led Awareness Campaign to promote the establishment of a MPA in Gouyave, the fishing capital of Grenada. The initiative was designed to ensure that stakeholders have a clear understanding of the process and their involvement in managing the marine resources. The campaign slogan, "Our Fish, Our Future: Conservation in Local Hands" was used to develop awareness materials which were distributed during door-to-door interviews, and general interaction with fishers and community members in Gouyave and other coastal communities within the parishes of St. John and St. Mark. The initial focal thrust was an aggressive drive to educate the bona fide fisherfolks, including, hook & line fishers, spear fishers (divers), seine operators and people who use the reef as a safe haven for anchorage of boats. A team of 12 persons participated in a one-day workshop on MPAs and the 'Do's & Don'ts' of public outreach activities before taking the campaign to the streets and visiting over 800 homes. Prior to the campaign the awareness regarding MPAs in Gouyave was very limited. The team encountered some negative feedback from a few fishers; however, with continued education on the benefits of MPAs and the positive impact they can have on fishers' livelihood, the team was able to change their perceptions. The most important results of the campaign were the general acceptance of the MPA in Gouyave and the willingness of the community including fishers and youths to actively participate in the establishment of the Gouyave MPA.

KEYWORDS: Marine Protected Areas, community-based management, coral reefs

Impacts of Tourism on Fishing Communities' Social Appropriation of Marine and Coastal Ecosystems: Two Case Studies in the Colombian Caribbean

Impactos del Turismo sobre las Formas de Apropiación Social de Ecosistemas Marinos y Costeros en Comunidades de Pescadores: Dos Casos de Estudio en el Caribe Colombiano

Impacts du Tourisme sur les Formes d'Appropriation Sociale des Écosystèmes Marins et Côtiers dans les Communautés de Pêcheurs: Deux Études de Cas dans le Caraïbe Colombienne

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ABSTRACT

This paper seeks to present a vision on the processes of change that tourism has generated in the productive activities of fishing communities in the Caribbean, as well as on their life territories and the forms of social appropriation of marine and coastal ecosystems. In particular, it presents an analysis of the ways in which tourism has entered into the lives of two communities, the Old Providence Island raizal community (San Andres - Colombia) and the African descent community of the town of Baru (Bolivar - Colombia), generating two types of processes. On one hand, there is an apparently positive process, which has to do with the use of community tourism as an option for local development. On the other hand, there is a negative process, which refers to the link between tourism and neoliberal policies, which point towards a privatization and grabbing of these communities' sea and coastal territories, and the consequent degradation of local cultures. Considering this, I propose to address the ways in which this activity has involved changes in the way communities relate to the marine and coastal ecosystems from which they derive their livelihoods. Finally, I discuss some of the situations that result from these processes, which currently create new socio-environmental conflicts that threaten the sustainability of these communities and their relationship with the environment.

KEYWORDS: Fishing communities, tourism, local development

Staying in the Forefront of Coral Reef Conservation Amidst Growing and Changing Tourism

Permanencer en la Vanguardia de Conservación de Arrecife de Coral Dentro de Crecimiento y Cambio de Turismo

Rester dans L'Avantgarde de Conservation de Récif de Corail Parmi la Croissance et le Changement du Tourisme

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ABSTRACT

For 40 years, STINAPA Bonaire has managed the Bonaire National Marine Park in Bonaire, Dutch Caribbean, which surrounds the entire island and is home to one of the coral reefs with the highest coral cover in the Caribbean and Western Atlantic. It's ecosystem values are well-studied and are of local and international importance. For years, tourism has been recognized as the main driver of Bonaire's economy, with coral reefs as the main attraction. Bonaire's conservation timeline includes many of the region's firsts in regards to managing tourism in protected areas, including the protection of sea turtles (1961), ban on spearfishing (1971) protection of corals (1975), ban on anchoring and installation of moorings (1978), Introduction of a diver user fee (1991), no-take marine reserves (2008), protection of parrotfish, sharks and other designated species (2010) and the installation of a sewage treatment system (2015). Currently, an increase in tourism, particularly cruise tourism, is challenging resource managers to develop new management plans, strategies and facilities that focus on sustainable use. Recent actions being undertaken include: STINAPA's use of the Open Standards for Conservation with input from partners and stakeholders to update its management plan; involvement in the island government's nature policy plan; lobbying the government for an increase in the nature user fee and the cruise tourist tax; meetings with stakeholders to address new concerns and opportunities; the government approval of a motion to ban oxybenzone and octinoxate; and revising the guidelines and regulations for sustainable use in the parks which address the growing number and types of users. These actions enable STINAPA to improve its management of the marine park as recreational use increases.

KEYWORDS: Tourism, Bonaire, Bonaire National Marine Park

Florida's Ongoing Coral Disease Outbreak: Current Research, Status, and Management Response

Brote de la Enfermedad del Coral en Florida: Investigación, Estado y Respuesta de Gestión

Épidémie de Corail en Cours en Floride: Recherche, Statut et Réponse de la Gestion

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ABSTRACT

Coral disease is increasingly recognized as a major driver of coral reef decline and benthic community structure. While the Florida Reef Tract (FRT) faces a myriad of chronic environmental stressors, it is currently experiencing a devastating, multi-year coral disease outbreak. Termed 'Scleractinian Tissue Loss Disease,' this disease was first observed off Miami-Dade County in late 2014 and, as of summer 2018, has spread unabated through >200 linear miles of the FRT with no signs of slowing or stopping. This disease affects roughly half of Florida's 45 reef building coral species and has a nearly 100% mortality rate of colonies exhibiting disease signs. It is estimated that this disease had already killed millions of coral colonies on the FRT, substantially altering species distributions and densities (including extirpating certain species from affected reefs) and threatening the reproductive capacity of some systems. In response to this outbreak, the Florida Department of Environmental Protection has been coordinating a partnership of federal and state agencies, academic researchers, veterinarians, private industry professionals, and citizen scientists in ongoing disease investigations, monitoring, and management responses. One component of these efforts is the development of novel coral disease intervention methodologies, including targeted colony treatments and reef-scale disease management frameworks. This presentation will cover the current knowledge about the disease, status of the outbreak, management response, and lessons learned thus far. Due to the severity of this disease and the uniqueness of the management response, these efforts may provide a foundation for future coral disease management and conservation in the Atlantic-Caribbean basin and beyond.

KEYWORDS: Coral, disease, management

Seaflower Biosphere Reserve NIMD-PMA and Regional Parks Financial Sustainability

Sostenibilidad Financiera del DMI-AMP y los Parques Regionales de la Reserva de Biosfera Seaflower

Viabilite Financiere dans la DMI-AMP et Parcs Regionaux dans la Reserve de Biosphere de Seaflower

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RESUMEN

En el año 2000, la UNESCO, por su gran biodiversidad marina y costera, atributos, y población nativa, declaró el Archipiélago de San Andrés, Providencia y Santa Catalina como la Reserva de Biosfera Seaflower. Siendo la Corporación para el Desarrollo Sostenible del Archipiélago de San Andrés, Providencia y Santa Catalina (CORALINA) la autoridad ambiental local que maneja la Reserva de Biosfera Seaflower, en el 2005 el Ministerio de Ambiente, mediante Resolución No. 107 de 2005, declaró dentro del Archipiélago el Área Marina Protegida (AMP) Seaflower, convirtiéndose en el Área Protegida (AP) de uso múltiple más grande del país, y asignándole su manejo a CORALINA. El AMP Seaflower, fue homologada, declarada y re-categorizada por el Ministerio de Ambiente ante el Registro Único Nacional de AP de Colombia RUNAP como "Distrito de Manejo Integrado DMI, AMP de la Reserva de Biósfera Seaflower" mediante Resolución No. 977 de 2014. Para sostener el DMI-AMP, junto con los parque naturales regionales, le cuesta aproximadamente Nueve Mil Millones de pesos ($9'000 millones) anuales su operación a CORALINA. Para ello, CORALINA creó un mecanismo financiero para el DMI-AMP para hacerla sostenible, consistente en los siguientes instrumentos:

- •Cobros por extracción de recursos: La recolección, procesamiento y venta de productos producidos en el AP pueden generar importantes ingresos y otros beneficios, cuando la extracción sea compatible con los objetivos de conservación.
- •Tarifas de ingreso al AMP-DMI: Tarifa que se cobra a los visitantes para poder entrar al AP.
- •Pagos por Servicios Ambientales: Pagos por los servicios ambientales ofrecidos dentro del DMI-AMP, por ejemplo servicios ecosistemas coralinos como productores de arenas coralinas.
- •Inversiones en proyectos ambientales: Recursos públicos/privados para proyectos ambiental

PALABRAS CLAVES: DMI-AMP, tarifas de entrada, sostenibilidad financiera

Inter and Intraspecific Differences of *Lutjanus campechanus* and *Lutjanus purpureus* in Otolith Shape

Diferencias Inter e Intraespecíficas de la Forma del Otolito en *Lutjanus campechanus* y *Lutjanus purpureus*

Différences Intra et Interspécifiques de la Forme de l'Otolithe chez *Lutjanus campechanus et Lutjanus purpureus*

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ABSTRACT

Otolith shape analysis is an efficient tool to distinguish between species, populations or stocks based on phenotypic characteristics affected by genetic and environmental factors. The objective of this study was to explore otolith shape inter and intra-specific differences in *Lutjanus campechanus* (sp1: red snapper) and *Lutjanus purpureus* (sp2: southern red snapper). Fishing areas, sex and age where considered as factors that may affect otolith shape. A total of 133 left sagittae were collected in Southwest Gulf of Mexico (sp1) and Eastern Venezuela (sp2), extracted through the gill arch, weighed and photographed through a stereomicroscope-PC station. Five morphometric variables, four shape indexes and 512 distances of wavelet transform (WLT) were extracted from the images, using Image-Pro Plus® 7.0 and Age & Shape programs. Analysis of PERMANOVA and PCOa, with a matrix of Euclidean distance and analysis of centroids was performed. In the interspecific: sp1 and sp2 showed differences in the morphometric variables (psedF=7.22; p=0.01). With respect to intra-specific comparison, sp1 showed greater difference in the composition of morphometric variables in relation to: area (psed-F = 26.6, p = 0.001), age (psed-F=290.3; p=0.001) and sex (psed-F = 2.3; p = 0.06) than sp2: area (psed-F = 0.22; p = 0.615); age (psed_F=23.7; p=0.001) and sex (psed-F = 0.58 =; p = 0.496). The contour of the otolith by WLT had a higher intrinsic variability for each individual of sp1 and sp2 by factors. The post-rostrum fraction showed a better performance to discriminate between species (psed-F=2.0616 p= 0.094).

KEYWORDS: Lutjanus, otolith, morphometric

Description of Hurricane María Impacts on the Puerto Rico's Commercial Fisheries

Descripción de los Impactos de Huracán María sobre la Pesquería Comercial de Puerto Rico

Description des Impacts de l'Ouragan María sur les Pêches Commerciales de Porto Rico

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ABSTRACT

In September 20, 2017 Hurricane María impacted Puerto Rico. This was a catastrophic hurricane. The Puerto Rico population was impacted with category five winds of 175 – 200 MPH. The hurricane was 300 miles wide. The Island was affected for 24 hours with storm and hurricane winds. The whole Island had no electricity for weeks. During January 5, 2018, just 58.6% of the island electricity customers had electricity. The Fisheries Research Laboratory, where is located the CFSP, received electricity in January 16, 2018. The CFSP personnel worked four hours at the building using electrical generators, with temperatures around 94 degrees Fahrenheit. After lunch, personnel moved Shopping Centers or family who had electricity to continue working the data entry and other tasks.

Hurricane María affected the fishing activity in many aspects. No electricity limited use of refrigerators and freezers to storage and manage the catch. Also, customers can not use their refrigerators. The gasoline and diesel for electric generators was scarce and very expensive. In 12, December 2018, the CFSP described that 50% of the fishing centers lacks of electricity. On the other hand fishing villages such as La Playuela Aguadilla, Los Machos Ceiba, were destructed by the hurricane surge. Due to the mentioned facts the marketing was affected too. The CFMS estimated that in December 2017, approximately 33% of the seafood restaurants still closed since hurricane María. The impact to Puerto Rico is estimated at $15.4 million in damages to fishing operations and businesses and revenue losses of $5.1 million. It's estimated that 174 jobs were lost in the short term. The paper will show more socioeconomic and biological impacts.

KEYWORDS: Puerto Rico, commercial fishery, Hurricane María

Overview of Puerto Rico's Small Scale Commercial Fisheries During 2012-2017

Descripción General de la Pesca Comercial a Pequeña Escala de Puerto Rico Durante 2012-2017

Aperçu de la Pêche Commerciale à Petite Échelle à Porto Rico en 2012-2017

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ABSTRACT

The Fisheries Research Laboratory (FRL) of the Puerto Rico Department of Natural and Environmental Resources (DNER) monitors the commer¬cial landings of fish and shellfish in Puerto Rico since 1967. The CFSP receive commercial fisheries landings reports, collect and process biostatistics data, enter the collected data in computer format, estimate the under reported landings (correction factor), and estimate catch per unit effort.

A total of 2.72 million pounds was estimated by the project reported in 2012, 1.89 million pounds were reported in 2013, 2.3 million pounds were reported in 2014, 2.37 million pounds were reported in 2015, 2.37 million pounds were reported in 2016 and 1.27 million pounds were reported in the year 2017. The CFSP determined a correction factor to estimate the non-reported or under-reported landings to do the mentioned estimates. Using the correction factor of 57% for 2012, in 2013, the correction factor was 67, in 2014 was 0.77%, in 2015 was 0.77 and in 2016. In 2017 has not been determined yet, thus the results were raw data. Landings by species and by gear will be show in the results. Also, the CPUE for landings were estimated and presented in this paper.

KEYWORDS: Commercial fisheries, landings, statistics

My First 30 years Studying the Puerto Rico's Commercial Fishery, 1988 – 2018: Achievements and Challenges

Mis primeros 30 años Estudiando la Pesquería Comercial de Puerto Rico, 1988 – 2018: Logros y Retos

Mes 30 Premières Années d'Études sur la Pêche Commerciale à Porto Rico, 1988-2018: Réalisations et Défis

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ABSTRACT

I started to study the Puerto Rico's Fishery since 1988. At that time I was named the Principal Investigator of the Puerto Rico's Department of Natural and Environmental Resources (DNER) Commercial Fisheries Statistics Program (CFSP). Thus, I completed my first 30 years studying the Puerto Rico's commercial fisheries. The success of the CFSP to reach every goal during the last 30 years was strong confidence among commercial fishers and CFSP personnel, through communication and education. Thirty years ago, Puerto Rico's commercial fishery was regulated by Law No. 83 of May 13th, 1936. This law contained numerous regulations pertaining to the conservation of fish resources. For example, it banned dynamite fishing and the use of nets in the mouth of rivers and forbid the use of underwater corrals. Between 1979 and 1988, Puerto Rico's was observed a trend of landings decreased. In addition, the dominant commercial grouper species since the 1950s and 1960's, the Nassau grouper (Epinephelus striatus) vanished from the commercial fishery around 1989. Other Puerto Rico fishery resources also showed symptoms of overfishing such as red hind (*Epinephelus guttatus*), mutton snapper (*Lutjanus analis*), queen conch (*Strombus gigas*) and lobsters (*Panulirus argus*). The government's scientific personnel concern over the decreasing populations of local fisheries prompted government agencies to improve regulations and management of these resources. Commercial fishers also came to CFSP to ask for conservation measures to conserve fisheries resources. Thus, the CFSP was part of the effort to improve the fishery conservation to keep the commercial fishing activity. This challenge was achieved thru Law No. 278, of November 29, 1998, Puerto Rico's, also known as Puerto Rico Fishing Law.

KEYWORDS: Puerto Rico, commercial fishery, management

The Potential of Sport Fishing as an Alternative to Artisanal Fishing Activities in Taganga Colombian Caribbean

El Potencial de la Pesca Deportiva como Alternativa a las Actividades de Pesca Artesanal en el Corregimiento de Taganga Caribe Colombiano

Le Potentiel de la Pêche Sportive comme Alternative aux Activités de Pêche Artisanale au Taganga Colombie Caraïbes

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ABSTRACT

Taganga is an indigenous community and fishing by tradition that during the last years has experienced a high growth in the number of inhabitants and tourists that arrive at the place due to the favorable climatic conditions and the amount of marine and terrestrial ecosystems that make it an ideal place to recreation and ecological tourism. The fishing population faces the task of creating projects for development purposes for its members, projects oriented to aquaculture that are usually not viable due to maintenance costs, for this reason a small number of fishermen have seen the use of sport fishing as an alternative to face the scarcity of fish product of the deterioration of the coastal marine ecosystems and thus through the use of a hand line to take advantage of the fishing resources of species that can be captured far from the coast. In the community of Taganga the potential for sport fishing is developed based on evaluating favorable tools such as tourism, the state of the boats and the use of the territory. For this work, market strategies used by fishermen to develop their fishing activities were taken into account and thus evaluate the formality, willingness to pay and the registration of the commercial fish species of the catches in the fishing day. Within the research, a high impact and a good image regarding the proposal was found due to the fact that sport fishing emerges as an economically low impact activity for the marine environment, the exploitation of fishing resources and promotes good use towards good practices of fishing management in the fishing community.

KEYWORDS: Fishing, species, fishermen

Impacts of the Caribbean *Sargassum* Seaweed Influx on Sea Turtle Nesting Ecology

Impactos de la Afluencia de la Macroalga *Sargassum* en la Ecología de Anidación de Tortugas Marinas

Impacts de l'Influx de Macroalgues de *Sargassum* sur l'Écologie de la Nidification des Tortues Marines

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ABSTRACT

Sargassum macroalgae has been arriving on western Atlantic shorelines in unprecedented quantities since 2011. Arrivals of the seaweed are episodic and difficult to predict, yet the economic, ecological, and conservation ramifications may be widespread and severe. Here, we document coastal *Sargassum* biomass accumulation at Long Island, Antigua, and describe impacts on the resident hawksbill sea turtle (*Eretmochelys imbricata*) nesting population. We collected data on hawksbill nesting and shoreline *Sargassum* abundance during a peak Sargassum arrival year in 2015. We first compared spatial trends in hawksbill crawl counts and *Sargassum* accumulation during the 2015 nesting season. We then examined the distribution of crawls in 2015 relative to minimally impacted nesting seasons (2008-2010; 2016). Further, we used temperature data loggers to assess the impact of *Sargassum* on the nest incubation environment. Our results suggest that *Sargassum* displaces crawl activity from preferred areas of the nesting beach. Temperature data suggest that *Sargassum*'s effects on below-ground nest temperatures may differ with moisture conditions, producing a cooling effect when dry and a warming effect when wet. These findings have important implications for sea turtle conservation throughout the region, as the macroalgae has the potential to inhibit access to key windward nesting habitats and alter incubation temperatures (which is particularly important given that temperature affects egg survival and primary sex ratios in sea turtles). Nesting beach managers and conservationists should monitor the *Sargassum* influx closely, as it creates complex trade-offs for beach management. Removal practices often generate impacts that must be weighed against ecological and economic effects.

KEYWORDS: Invasion, hawksbill, *Eretmochelys imbricata*

Characterization of Mesophotic Coral Ecosystems Through the use of a Multibeam Echosounder System and a Remotely Operated Vehicle

Caracterización de Ecosistemas Coralinos Mesofóticos Mediante el Uso de un Sonar Multihaz y un Vehículo de Operación Remota

Caractérisation des Écosystèmes Coralliens Mésophotiques Grâce à l'Utilisation d'un Système de Sondeur Multifaisceaux et d'un Véhicule Télécommandé

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RESUMEN

Los ecosistemas coralinos mesofóticos (ECM) son comunidades arrecifales que se distribuyen entre las profundidades intermedias (~30 m) y más bajas de la zona eufótica (~150 m), las cuales varían entre regiones. En zonas costeras donde las condiciones son turbias, el límite superior puede presentarse a <30 m de profundidad. Este trabajo tomó como caso de estudio cinco arrecifes del Parque Nacional Sistema Arrecifal Veracruzano, el cual se encuentra influenciado por la descarga de tres ríos y un importante desarrollo portuario. Con la finalidad de caracterizar a los ECM costeros, en este trabajo se combinó el uso de métodos acústicos y ópticos. Los equipos consistieron en un sistema de sonar multihaz (MBES), un vehículo de operación remota (ROV) con dos cámaras de alta definición 4k, y sensores para medir intensidad de luz y la Radiación Fotosintéticamente Activa (PAR). Para la caracterización geomorfológica se realizaron levantamientos hidrográficos con la MBES durante 2015-2017. Se realizaron análisis de variabilidad de terreno y con base en los resultados de pendiente, rugosidad, curvatura, y aspereza del terreno se identificaron áreas estructuralmente complejas. Para la caracterización de la comunidad bentónica se obtuvieron 30 video-transectos de ~150 m de longitud. Se observó la presencia de colonias coralinas con formas de plato como *Stephanocoenia intercepta, Agaricia lamarcki, Agaricia grahamae*, que están registradas en la región del caribe como especies exclusivas de la zona mesofótica. Finalmente, en las mediciones de intensidad de luz in situ, se observaron diferencias entre arrecifes.

PALABRAS CLAVES: Mesophotic coral ecosystem, ROV, multibeam echosounder system

Sargassum Landing and Movement as a Function of North Atlantic Oscillation Variation and pH Differentials

Aterrizaje y Movimiento de *Sargassum* en Función de la Variación de la Oscilación del Atlántico Norte y los Diferenciales de pH

Atterrissage du *Sargassum* et Mouvement en Fonction de la Variation d e L'Oscillation Nord-Atlantique et des Différentiels de pH

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ABSTRACT

A correlation exists between positive fluctuations of the North Atlantic Oscillation (NAO) and above average levels of sargassum that lands along the Gulf of Mexico. Furthermore, there subsists an indirect interconnection between the factors that stimulate a positive placement on the NAO Index (i.e. surface water temperature, CO2 absorption rates, and atmospheric pressure) and the average pH level of the Atlantic Ocean. Given the forecast that average oceanic pH levels will decline by 0.4 before the year 2100, the mean NAO Index level and pH level drop recorded between the years 1982 to 2015 were applied as augmentation factors to gage a hypothetical projection of NAO trends by the year 2100. Based on these calculations, it is evident that the frequency of NAO positive phases could increase by a function of 8. This positive phase amplification could equate to volumetric increases of *Sargassum* landings on the Gulf of Mexico shoreline at a comparable rate. In addition to the scientific analysis, this study yields suggestions for future research, as well as possible implications for *Sargassum* mitigation policy.

KEYWORDS: *Sargassum*, North Atlantic Oscillation, climate change

Putting the Small-scale Fisheries Guidelines Protocol into Practice

Puesta en Práctica del Protocolo de Directrices de Pesca en Pequeña Escala

Mise en Pratique du Protocole sur les Directives sur la Pêche Artisanale

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ABSTRACT

In May 2018 the Ministerial Council of the Caribbean Regional Fisheries Mechanism (CRFM) which comprises seventeen members approved the entry into force of the Protocol on securing sustainable small-scale fisheries for Caribbean Community fisherfolk and societies. Its title states the overall objective of this first protocol to the Caribbean Community Common Fisheries Policy (CCCFP). The intention of the protocol is to incorporate the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines) into the CCCFP. This success was the outcome of a combined effort from academic, private sector, non-governmental and inter-governmental collaboration in Caribbean fisheries. However, entry into force means little, and achieves even less, without the willingness and ability, leadership and capacity, to put the protocol into practice. Therein lies the rub. There is, within CRFM (meaning the member states and all of the governance bodies and arrangements), a substantial implementation gap. Most conspicuous, is the absence of functional fisheries management plans into which an instrument such as the protocol could easily be embedded. In addition, partly because there are few functional plans, it is challenging to pursue and impossible to institutionalise participatory monitoring and evaluation, learning and adaptive management. Putting the protocol into practice provides a new opportunity to address these weaknesses. Suggestions are provided for doing so in a manner that develops capacities and institutions while integrating the interests of diverse stakeholders in sustainable fisheries.

KEYWORDS: Capacity, CFRM, governance

Caribbean Fisheries: Perspectives on Gender Too

Pesca en el Caribe: Perspectivas sobre el Género También

Pêches des Caraïbes: Perspectives sur le Genre Aussi

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ABSTRACT

The Gender in Fisheries Team (GIFT) presented a preliminary overview of the Caribbean region's perspectives on gender at the 6th Global Symposium on Gender in Aquaculture & Fisheries (GAF6) in 2016. Our gender scoping study has progressed along with initiatives that contribute to mainstreaming gender equality in Caribbean small-scale fisheries. GIFT comprises gender-interested researchers, fisherfolk, fisheries project managers, consultants and others who are helping to implement the gender provisions of the Small-scale Fisheries Guidelines from policy to practice. This presentation updates colleagues on the work of the GIFT regarding additional results from the regional gender scoping study, primary research, gender awareness-raising initiatives, high-level policy influence and more. Most of our initiatives are featured on our website (www.cavehill.uwi.edu/cermes/projects/gift). While the Caribbean is seldom featured in international fisheries initiatives to mainstream gender, the need for both women and men to address gender is no less pressing there than in other locations. GIFT seeks opportunities to communicate our aims and network for collaboration.

KEYWORDS: Gender, fisheries, communications

Hurricane Irma Damage Assessment: Provisional Results for the Florida Commercial and For-hire Fisheries and Associated Businesses

Evaluación de los Daños Causados por el Huracán Irma: Resultados Provisionales para la Industria Pesquera Comercial y de Alquiler y las Empresas Asociadas en el Estado de la Florida

Évaluation des Dégâts Causés par l'Ouragan Irma: Résultats Provisoires pour l'Industrie des Pêcheries Commerciales et Récréatives et les Entreprises Associées dans l'État de Floride

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ABSTRACT

In the weeks after Hurricane Irma, NOAA Fisheries' Southeast Fisheries Science Center organized a rapid assessment of damages to the fishing industry and support businesses in the state of Florida. Preliminary fieldwork began in late September and by early October NOAA staff was in the field conducting interviews with affected business owners and commercial and recreational fishermen. Fieldwork covered the highest impact areas extending from Naples on the west coast, south through the Florida Keys, and up to Ft. Lauderdale on the east coast of the state. Data for other impacted areas of the state was gathered through an online survey on the Florida Fish and Wildlife website and a statewide phone survey that was contracted out and implemented after the fieldwork phase was completed. A total of 1713 businesses and individuals participated one of the three surveys in Florida. Damage assessment totals for specific business sectors and areas of Florida are presented along with information regarding the federal disaster declaration, allocation of funds by the US Congress and the state of Florida, and post-storm recovery in the high impact areas.

KEYWORDS: Hurricane Irma, fisheries, Florida

Preliminary Evidence of Climate Variability Impact on the Octopus Fishery in the Southeastern Gulf of Mexico

Evidencias Preliminares del Impacto de la Variabilidad Climática sobre la Pesquería de Pulpo en el Sureste del Golfo de México

Preuve Préliminaire de l'Impact de la Variabilité Climatique sur la Pêcherie de Poulpe du Sud-est du Golfe du Mexique

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RESUMEN

Existen evidencias acumuladas crecientes que soportan la hipótesis de que el clima determina, al menos en parte, la variabilidad de las poblaciones explotadas. Variaciones de corto plazo de las capturas de pulpo en el Atlántico oriental son atribuidas a cambios en la temperatura del mar y a oscilaciones climáticas de gran escala. A pesar de que en el sureste del Golfo de México se desarrolla una de las pesquerías de pulo (*Octopus maya*) más grandes del planeta, se desconocen las fuerzas ambientales que gobiernan la dinámica de sus variaciones interanuales. En este trabajo se analizó la contribución relativa que la variabilidad climática ejerce sobre la variabilidad interanual de las capturas de pulpo de esta zona. Se determinó la estructura, tendencia y frecuencia de oscilación de la serie temporal de la serie histórica de captura mexicana en esta región (1958 – 2015), y se contrastó con la sincronía y dependencia numérica con el índice del Caribe (CAR) y la Oscilación Multidecadal del Atlántico (AMO), descriptores de la variabilidad térmica de la región y del clima del Atlántico. Se observó una relación significativa, los índices AMO y CAR explicaron entre el 37% y el 47% de la variabilidad de las capturas pulpo de 1966 a 2015. En el periodo de explotación más intensivo (1990-2015), con efecto de la tendencia histórica menos relevante, la variabilidad térmica (CAR) explicó el 40% de variabilidad de la captura anual, en tanto que la contribución del AMO fue marginal. Estos resultados constituyen un punto de partida para elucidar los vínculos entre la sincronía y proporcionalidad de la variabilidad del clima con sus efectos ecológicos sobre la población de pulpo en esta área, para eventualmente considerarse como variables de estado en la modelación y simulación de su abundancia bajo escenarios climáticos distintos.

PALABRAS CLAVES Pulpo, variabilidad climática, Golfo de México

Effects of Hurricane Maria on Hamlet Communities (*Hypoplectrus* spp., Serranidae) in the La Parguera Natural Reserve at Puerto Rico

Efectos del Huracán María sobre las comunidades de Hamlet (*Hypoplectrus* spp., Serranidae) en la Reserva Natural La Parguera en Puerto Rico

Effets de l'Ouragan Maria sur les communautés de Hameaux (*Hypoplectrus* spp., Serranidae) dans la Réserve Naturelle de La Parguera à Porto Rico

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ABSTRACT

Hypoplectrus spp. are hermaphroditic, carnivorous, and highly territorial fishes of the family Serranidae, primarily distributed around the Western Atlantic. We studied 10 reefs located in the La Parguera Natural Reserve in Puerto Rico to record differences in *Hypoplectrus* spp.communities after the passage of Hurricane Maria. Our results were compared to surveys performed in the year 2017 (before Maria) and in the year 2000. We found significantly higher diversity after Hurricane Maria than in 2017 before the hurricane, yet lower diversity than the ones recorded in 2000. Hurricane Maria presented an opportunity for *Hypoplectrus* spp. to recolonize reefs that were previously devoid of such species or only dominated by a single Hamlet species (*H. chlorurus*).

KEYWORDS: *Hypoplectrus,* diversity, hurricane

Building Scientific Capacity with Integrated Technologies for the Next Generation Marine Ecosystem Surveys

Creación de Capacidad Científica con Tecnologías Integradas para las Encuestas de Ecosistemas Marinos de la Próxima Generación

Création de Capacité de Sécurité avec Technologie Intégrée pour des Applications Écologiques de Luxe de Génération

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ABSTRACT

Ocean innovations using sensor, platform and analytic technologies are more readily available for monitoring marine ecosystems. Recent collaborative efforts have demonstrated that sampling technologies can cost-effectively enhance research and survey operations to provide more synoptic, precise and timely scientific information for the sustainability of living marine resources. Reef fish habitats that were once difficult to systematically survey with conventionally sampling gear, can now be feasibility monitored with integrated acoustical, optical and environmental technologies, thereby resolving data-limited assessments common to the Caribbean and Gulf region. Furthermore, the connectivity of our marine resources across the various geopolitical jurisdictions requires developing an international pool of experts to collaboratively ensure the best practices in statistical survey design, calibrations and operations with technologies are deployed for the next generation of integrated survey and ocean observations in the region.

KEYWORDS: Technology, ecosystem, survey

Hogfish Otolith Shape Analysis According to its Ontogenic Stages, Size and Collection Areas

Análisis de la Forma del Otolito de la Doncella de Pluma Según el Estadio Ontogénico, la Talla y el Sitio de Colecta de los Individuos

Étude de la Morphologie des Otolithes du Labre Capitaine en Relation avec le Stade de Développement, la Taille et la Région de Collecte des Individus

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ABSTRACT

In the southern Gulf of Mexico, at Campeche Bank, hogfish *Lachnolaimus maximus* represents a great economic interest for Yucatan. This study focuses on shape analysis of 89 hogfish´s left sagittae taking into account collection areas, ontogenic stages and sizes. After the digitization of otoliths using an SEM, the use of morphometric variables and otolith shape data revealed significant differences in the morphology of otoliths between individuals. Seventeen morphometric variables, eight shape indexes and contour descriptors by discrete wavelet transform (WLT4) from the anterior and posterior otolith zones, were extracted from the images, using Image-Pro Plus® 7.0 and Age & Shape programs. Principal components (PCA) and linear discriminant analyses (LDA) were performed with standardized and normalized data in a Euclidean distance matrix. PCA ordination revealed that 9 morphometric and indexes variables (rectangularity, fractal dimension, diameter max, exuda area, antipostrostrum width and length, postrostrum length, postexude area and otolith area) accounted for 50% of the variability of the data. Results from the LDA displayed consistent differences in otolith shape due to: ontogenic stages (juveniles: 100% classification success; females; 96.77%; males: 100%), individual sizes within each collection area: Celestún (86.52%); Dzilam de Bravo (100%) and Río Lagartos (100%) and within each collection area: Celestún (94.44%); Dzilam de Bravo (94.12%) and Río Lagartos (100%). WLT4 anterior zone also discriminate groups for ontogenic stages (95.51%); sizes (100%) and collection area (97.75%). This work validates the interest of the use of otoliths in ichthyological studies and brings new data on the hogfish population of Campeche Bank.

KEYWORDS: Hogfish, otolith shape, morphometrics

Hurricane Preparedness and Post-disaster Needs of the Fisheries Sector in the Eastern Caribbean Under the CC4FISH Project

Prevención de Huracanes y Necesidades Posteriores al Desastre del Sector de la Pesca en el Caribe Oriental en el Marco del Proyecto CC4FISH

Prévention des Ouragans et Besoins Post-catastrophe du Decteur de la Pêche dans les Caraïbes Orientales dans le Cadre du Projet CC4FISH

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ABSTRACT

Negative impacts of climate change that are already obvious in the Caribbean region include increasing intensity of storms and hurricanes. The busy hurricane season of 2017 was the first time that two category five storms made landfall in the small Caribbean island chain of the Eastern Caribbean in a single year, causing extensive damage to the fisheries sectors of several Caribbean countries. Dominica, for example, suffered damages and losses to the fisheries sector of USD 2.5 million. In response to the increased threats from storms and hurricanes, the Food and Agriculture Organization of the United Nations is working to improve resilience of the fisheries sector under the Climate Change Adaptation of the Eastern Caribbean Fisheries Sector (CC4FISH) Project. This presentation will examine the various ways to improve the resilience of the fisheries sector through e.g. the development of a Fishery and Aquaculture Response to Emergencies (FARE) Training Package for post disaster and emergency response of the fisheries sector, ICT tools to improve Early Warning and the development and improvement of basic fisherman training to improve safety-at-sea in the Eastern Caribbean.

KEYWORDS: Hurricanes, fisheries, climate change

Applying Social Science Theories in Fisheries Research: The Case of FADs in tThe Caribbean Region

Aplicando Teorías de las Ciencias Sociales en la Investigación Pesquera: El Caso de los DCP en la Región del Caribe

Application des Théories des Sciences Sociales à la Recherche Halieutique: Le Cas des DCP dans la Région des Caraïbes

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ABSTRACT

Fisheries managers increasingly acknowledge the importance of holistic research that considers the interaction among physical, natural and human aspects in developing strategies for resource management and conservation. There is a growing scientific literature that applies social science principles to understand the attitudes and beliefs of resource users. This constitutes a critical step when developing practical educational and outreach programs and identifying management actions to deter or promote a desired behavior or action. In this context, there exists a need to provide training opportunities to managers and stakeholders regarding the methodological steps to implement social science theories, which can help underpin fisheries management programs. As such, we present an example of the application of a well-known social science theory (the theory of planned behavior -TPB) to understand what motivates/deters the installation of fish aggregating devices (FADs) by Caribbean artisanal fishers. FADs are being used in the Caribbean region as a tool to increase artisanal fisher's success in targeting pelagic fish. This presentation will highlight the operational steps taken to apply social science theory in a fisheries management context, emphasizing techniques for designing survey protocols and applicable analysis methods to evaluate the influence that attitudes, social norms and behavioral control have on a fishers' desire and tendency to deploy FADs.

KEYWORDS: Human behavior, FADs, governance

Meaningful Diving: An Initiative to Improve the Role of Dive Tourism in the Effective Conservation of Coral Reef Fisheries and Ecosystems in the Caribbean

Buceo con Propósito: Una Iniciativa para Mejorar el Papel del Turismo de Buceo en la Conservación Efectiva de la Pesquerías y Ecosistema de Arrecifes de Coral en el Caribe

Plongeé Avec Objectif: Une Initiative Visant à Améliorer le Rôle du Tourisme de Plongée dans la Conservation Efficace de la Pêche et de l'Écosystème des Récifs Coralliens dans les Caraïbes

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ABSTRACT

The health of coral reefs has declined significantly over past decades, to the point where several sites in the Caribbean are not longer providing the tourism and fisheries services. Active conservation strategies have expanded in recent years to stop reef degradation and restore the ecological services associated with healthy and complex reefs. While restoration practitioners now use marketing strategies and field activities to raised awareness and engage multiple users in coral reef conservation actions, dive tourism continues to play a small role in these actions. We describe a social initiative focused on citizen science, Buceo con Propósito (Meaningful Diving), which engages the diving industry through training in coral reef monitoring, reef restoration, and responsible diving, providing experiential learning opportunities collect information on reef health, rehabilitate degraded coral reefs, and reduce human impact. Between 2017–2018, we have reached over 10000 people organically who have been introduced to the concept of meaningful diving. Most importantly, 75 divers have assisted in the collection of scientifically sound coral reef health data of 12 sites in Colombia and 50 more have received training on coral gardening for reef restoration purposes. In so doing, we have informed and trained tourists as citizen scientists capable of assisting scientific experts in their active coral reef conservation actions. By scaling up our initiative to enhance participatory public engagement, we hope it can improve the role that reef-based tourism can play in the effective conservation of fisheries and coral reefs ecosystems of the Caribbean region.

KEYWORDS: Coral reefs, dive tourism, citizen science

Control and Management of the Lionfish (*Pterois volitans*) Through the Use of Nasas as a Tool for Its Capture in the Department of Bolívar, Colombian Caribbean

Control y Manejo del Pez León (*Pterois volitans*) Mediante el Uso de Nasas como Herramienta para su Captura en el Departamento de Bolívar, Caribe Colombiano

Contrôle et Gestion del Poisson-Lion (*Pterois volitans*) par l'Utilisation de la Nasas comme Outil de sa Capture dans le Département de Bolívar, Caraïbes Colombiennes

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ABSTRACT

The lionfish Its main habitat is in reef areas, characterized by good water conditions and medium depths between (10 and 50 meters), it is also located in mangrove, estuarine and seagrass areas where it captures its main prey. (INVEMAR et al., 2013 and Miguez-Ruiz 2013). Reasons why it has had to adapt to a wider range of depth and salinity, reaching to register in areas with important contributions of fresh water as in swamps and protected bays. Strengthening the construction of a tool, for the sustainable management of the fishing resource, in the insular region of the municipalities near the city of Cartagena de Indias.

Currently, activities are being initiated with the design and construction of pots for the specific capture of the lionfish (*Pterois volitans*), which is considered a strategy promoted by the Ministry of the Environment, Autonomous Corporations, Research Institutes, thus generating, within of the implementation of a joint strategy a new possibility of income for the artisanal fishermen of the region through the use of different fishing gears and methods for the capture of the lionfish and its subsequent commercialization, beginning its implementation in the department of Bolívar, through the SENA-CINAFLUP (International Fluvial and Ports Nautical Center).

KEYWORDS: Lionfish, sustainable, management

Sargassum Update from Grenada, Eastern Caribbean

Actualización del Estado de *Sargazo* in Grenada Caribe Oriental

Statut Actuel de la *Sargasse* en Grenade, Caraïbe Orientale

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ABSTRACT

Influx of pelagic S*argassum* to Grenada in 2018 has resulted in negative environmental and economic consequences.

Sargassum entraps turtle hatchlings and diminishes light penetration which can damage seagrasses and coral reefs. Litter is frequently associated with sargassum; the presence of microplastics in beached and floating sargassum is currently being investigated.

Floating sargassum presents problems for fishing boats. Bars, restaurants and hotels have lost customers as decomposing seaweed is unappealing. Lost days of fishing (thick mats of sargassum prevent passage from shore), boat engine damage, wages paid for sargassum removal and lost revenues have all had economic consequences.

Factsheets and posters published through GCFI and the SPAW-RAC web forum continue to assist with dissemination of information. The Caribbean Regional Fisheries Mechanism has developed a technical and advisory document for Grenada but it is unclear if it has been finalized and implemented. Regional 'best practice' guidelines for dealing with sargassum have not always been applied.

The Ministry of Health has been forced to sanction use of heavy equipment to remove beached sargassum owing to health issues associated with high levels of hydrogen sulphide. This method of removal has exacerbated erosion on already compromised coastlines. In the vicinity of a radical reef restoration project by The Nature Conservancy in Grenville Bay, individuals have been harvesting sand from the removed material.

Despite international efforts aimed at predicting sargassum influxes, without robust and appropriate removal methods, continued economic and ecological effects are anticipated. We encourage management of *Sargassum* based on internationally proven protocols.

KEYWORDS: *Sargassum*, Grenada, fishing

Histological Development and Morfo-cromatic Scale of Gonadic Maturity for *Lutjanus synagris* (Perciformes: Lutjanidae) in the Colombian Caribbean

Desarrollo Histológico y Escala Morfocromática de Maduración Gonadal para *Lutjanus synagris* (Perciformes: Lutjanidae) en el Caribe Colombiano

Développement Histologique et Échelle Morfocromatic de Maturation des Gonades pour *Lutjanus synagris* (Perciformes: Lutjanidae) dans les Caraïbes Colombiennes

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ABSTRACT

Lutjanus synagris is a demersal fish present in the colombian Caribbean of high value in the market by the quality of their meat. Its fishery generates 800 jobs, direct and indirect, becoming a kind of importance to fishermen in small scale. In order to provide technical and scientific information for fisheries management measures, histomorfologics of ovaries and testes development-related research, stepped forward to establish its macroscopic and histological evolution the gonadal development and maturation. From commercial landings in a collection Center, was collected a total of 63 specimens, of which 30 were males and 33 females. The macroscopic state and the weight of the gonads were recorded. Samples were fixed in formalin 10%, stained with hematoxylin-eosin and 4µ histological cuts were made. The study showed that at a macroscopic level *L. synagris* presents 4 stages of gonadal development: I immature, maturation home II, III in maturation and mature IV. The histological study of the ovaries and testicles, identified 4 microscopic stages in females: oogonia, chromatid nucleolus, cortical alveoli, perinucleolares (in early and late phase) and vitellogenic oocytes. Spermatogonia, primary and secondary spermatocytes, spermatids and spermatozoa were identified in males. It was found to be the representation of females in stage IV in the months of August, October, March and April. In males was in the months of August, October, April and may. These observations indicate *that L. synagris* presents a gonadal development of asynchronous, since type observed different oocytes with all states of development.

KEYWORDS: *L. synagris*, gonadal maturation, Colombian Caribbean

Sargassum Aquaculture: Turning a Problem into a Solution

Sargassum Aquaculture: Transformer un Problème en Solution

Sargassum Aquaculture: Transformer un Problème en Solution

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ABSTRACT

One of the biggest threats to fisheries, reefs, and tourism in the Caribbean is global climate change associated with rising levels of greenhouse gases, principally carbon dioxide (CO_2). Multiple negative impacts of elevating CO_2 levels have been documented, including rising water temperatures, higher dissolved CO_2, and higher water acidity. These CO_2 caused changes have put considerable stress on reefs, thus threatening fisheries and tourism. Further threats to fisheries and tourism result from significant climate changes, including hotter weather and more frequent and severe tropical storms.

Threats from rising CO_2 levels to reefs and fisheries can be slowed or stopped by removing CO_2 from the atmosphere and ocean. Currently, *Sargassum,* a macroalga containing 30% carbon, lands on Caribbean beaches in sufficient quantities to require clean up or even declarations of state-of-emergency (Barbados, 2018). *Sargassum* harvest close to beaches offers an opportunity to remove CO_2 from the ocean and atmosphere consistent with international priorities. The United States Department of Energy (US DOE) is sponsoring exploration of ocean-based solutions to reduce CO_2 levels that include aquaculture and the development of alternative, carbon neutral fuels. Successful projects will result in technology capable of conducting ocean-based efforts to capture CO_2 from the atmosphere and ocean, and produce sustainable products with a highly favorable energy cost ratio.

Fearless Fund, a 501(c)3 non-profit, is currently conducting research on "Ocean Energy from Macroalgae (OEM)," supported by US DOE, to explore ways to manage the growth of *Sargassum*, harvest this plant efficiently, and generate biofuels and other sustainable products. Funded by DOE's Advanced Research Projects Agency-Energy (ARPA-E) in 2018.

KEYWORDS: *Sargassum,* aquaculture, climate change

Tarpon Connectivity in Cuba and Their Relation with the Greater Caribbean

Conectividad del Sábalo en Cuba y su Relación con el Gran Caribe

Connectivité Tarpon à Cuba et leur Relation avec la Grande Caraïbe

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ABSTRACT

The Atlantic tarpon *Megalops atlanticus* is a highly prized species in the sport fisheries. It is currently vulnerable to extinction as result of historical catches with different purposes and the degradation of their habitats. Tarpon connectivity studies are a research priority for a better management of the species to regional level. Although several studies have been focus on this topic, scarce information exists about tarpon in Cuba. Cuba could be crucial on tarpon conservation because of its geographic position and characteristics, as well the potential availability of healthy nursery habitats. This project aims at analyzing the connectivity of M. atlanticus in Cuba, and their relation with the Greater Caribbean. Genetics tools will be used to analyze the genetic structure of the species in Cuba and their relation with other populations from the Greater Caribbean. Additionally, acoustic telemetry will be used to characterize the permanence and movement of individuals between habitats. As first steps to develop the study, we recollected information about tarpon presence and abundance around the Cuban archipelago. We found tarpon habitats with different biotic, abiotic and socioeconomic characteristics. These preliminary results show *M. atlanticus* is abundant in some Cuban areas, including those strategically positioned with very low levels of human impact. Juvenile tarpon have been found in diverse habitats, suggesting habitat shift during their development. This project will be the first contribution to tarpon ecology and conservation in Cuba, and will be crucial for the management of the species in the Greater Caribbean.

KEYWORDS: Tarpon, recreational fisheries, Cuba

Movement of Reef Fishes Between Different Fishery Management Zones in the St. Croix East End Marine Park

Movimiento de Peces Arrecifales Entre Diferentes Zonas de Manejo Pesquero en el Parque Marino Este en la Isla de Saint Croix

Mouvement des Poissoins du Récif Entre Différentes Zones de Gestion de la Pèche dans le Parc Marin Est de l'Île de Saint Croix

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ABSTRACT

Acoustic telemetry was used to quantify fish movements between St. Croix East End Marine Park (EEMP) no-take and recreational zones and connectivity between EEMP and Buck Island National Monument. We targeted fish species known to undergo migrations for feeding or reproduction and examined frequency of boundary crossings, rates of movement and residency. The majority of tagged species (n=52) were in four fish families: groupers, snappers, grunts and parrotfish with the remaining fish (n=11) being triggerfish, jacks, sharks and goatfish. The majority of fish movements occurred between the fore reef protected and recreational zones (76.1%) followed by movements between the back reef protected and recreational zones (14.4%), indicating that fish movements were predominately linear and parallel to the reef crest. Some species also moved between the fore reef and back reef (8.2%). Red hind, coney and parrotfishes showed the lowest frequency of boundary crossings whereas snappers, grunts, queen triggerfish, bar jack, Nassau grouper and nurse sharks showed higher frequency of boundary crossings. Long distance movements from EEMP to Buck Island (1.5 km) and EEMP to Lang Bank (15 to 20 km) occurred less frequently, 1.25% and 0.11%, respectively. Large-scale movements were observed by Nassau grouper, red hind and queen triggerfish, species known to undergo spawning migrations, but also included lane and school master snappers. Diel movement patterns varied by species and included increased movements during day (Nassau, coney, redband parrotfish), night (nurse shark, lane snapper) or crepuscular (jacks, schoolmaster snapper, mahogany snapper) periods. These results will provide a measure of vulnerability among different trophic groups and guide adaptive management decisions regarding size and design of marine protected areas.

KEYWORDS: Telemetry, management, marine protected areas

Biodiversity Responses to Targeted *in situ* Culling of Invasive Lionfish in Bermuda

Respuestas a la Biodiversidad para el Sacrificio *in situ* Selectivo de Pez León Invasivo en las Bermudas

Réponses de la Biodiversité à l'Abattage Ciblé *in situ* des Poissons-lionne Envahissants aux Bermudes

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ABSTRACT

The Bermuda Invasive Lionfish Control Initiative revealed densely concentrated populations of lionfish on Bermuda's mesophotic reefs. Limited access to these deeper populations has restricted the culling capacity of local recreational divers. It was hypothesized that targeted removal of lionfish from these reefs would provide protection for native fish populations through a reduction in feeding pressure and ultimately conserve biodiversity. Monthly culling of lionfish occurred from known mesophotic "hot spots" (55 - 60 m) between July and December 2017. Prior to each culling event, fish community composition was determined using Baited Remote Underwater Video systems (BRUVs) followed by in situ lionfish abundance surveys using NOAA's 'S' survey protocol. *In situ* survey data recorded a reduction in lionfish densities during the course of the study period. BRUVs data detected a decrease in fish biodiversity (Inverse Simpson Index; 2D) between months two and five with a return to values recorded during the initial survey prior to culling activities. These data suggest that a longer period of culling maybe necessary to determine the effectiveness of targeted in situ culling on fish biodiversity enhancement on Bermuda's mesophotic reefs.

KEYWORDS: Biodiversity, lionfish, culling

Appraisal of the Perceptions of Artisanal Fishermen and Government on the Benefits offered by the New General Registration System for Fishermen in Honduras

Valoración de las Percepciones de los Pescadores Artesanales y Gobierno sobre los Beneficios que Ofrece el Nuevo Sistema de Registro General de Pescadores en Honduras

Evaluacion des Perceptions des Pêcheurs Artisanaux et du Gouvernement sur lesA offerts par le Nouveau Système d'Enregistrement Général des Pêcheurs au Honduras

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ABSTRACT

Artisanal fishing is an economic activity that is not visible in the formal economy due to the lack of reliable data on users, catches, income, sites and fishing gear being the livelihood of thousands of fishermen. Traditional registration methods in many countries continue to be analogous, which makes processing difficult and reduces the reliability of information. Policies on the management of small scale fisheries in Honduras have focused on coercive regulatory frameworks instead of identifying and implementing effective management strategies. In 2013, through a cooperation agreement established between the Directorate General of Fisheries and Aquaculture (DIGEPESCA) and the Center for Marine Studies (CEM), the General Fisheries Registry (GFR) system was modernized, passing from an analog to digital system. In 2017, through the effort of 13 regional fisheries management offices distributed throughout the country, a total of 5,651 licenses were issued, generating an income of approximately USD $ 36,000. For Y2018, a new version of this tool was implemented with the purpose of including twelve types of licenses determined by the new fishing law. The implementation of the GFR system facilitates: compliance with legal requirements; professionalize the work of the fisherman; right to use and access to fishery resources; preferential rights in the case of marine protected areas; commercialization; management of materials and equipment; and in general the basis for the ordering of fisheries. This research focuses on assessing the benefits received by users, measuring the impact of this tool on fisheries management and analysing the form of its potentialization at the national and regional levels.

KEYWORDS: Fisheries, artisanal, registry

Spatiotemporal Dynamics in *Acropora cervicornis* Genotype Performance and Symbiont Identity Throughout the Restoration Process

Dinámica Espacio-temporal en el Rendimiento del Genotipo *Acropora cervicornis* y la Identidad Simbionte Durante Todo el Proceso de Restauración

Dynamique Spatio-temporelle de la Performance du Génotype de l'*Acropora cervicornis* et de son Identité Symbiotique tout au Long du Processus de Restauration

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ABSTRACT

Intraspecific diversity in host and symbiont is an important consideration for coral restoration managers. We built upon a previous study that quantified *Acropora cervicornis* growth phenotypes in a nursery by outplanting the same genotypes across two reef sites and tracking their performance for one year. Further, we identified the Symbiodinium 'fitti' strains present in each of the *A. cervicornis* genotypes during the restoration process from initial wild collection to 24 months post-outplanting. Survival to one-year post-outplant was consistent with regional averages and did not differ significantly among *A. cervicornis* genotypes or between outplant sites. Outplant site and host genotype had significant effects on coral growth, but no interaction of site and genotype was detected. These findings suggest an overall spatial effect on coral growth, but consistent growth phenotype across sites for the five genotypes included in this study. However, growth rates measured for each genotype in the nursery were not predictive of performance following outplanting. Instead, *A. cervicornis* genotypes appear to exhibit temporal differences in growth rate through the restoration process (i.e. longitudinally). Despite this variability, relative differences in growth can be consistent within a given timeframe, even across varying environments (i.e. horizontally). Most colonies sampled were infected by one of five unique strains of S. 'fitti'. Host-symbiont specificity varied among coral genotypes, but many genotypes exhibited spatial and/or temporal differences in symbiont strain composition throughout the restoration process. The ability to associate with more than one S. 'fitti' genotype could confer resilience of corals under changing environmental conditions.

KEYWORDS: *Acropora cervicornis*, restoration, symbiodinium

Invasive Lionfish: To Manage or Not to Manage, That is the Question

Pez León Invasivo: Administrar o no Administrar, Esa es la Pregunta

Lionfish Invasif: Gérer ou Ne pas Gérer, Telle est la Question

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ABSTRACT

The main objective of this study is to determine if the blanket approach to not federally managing invasive species in the United States is valid. For example, Indo-Pacific lionfish, *Pterois* spp., have established invasive populations off the southeastern United States, the Bahamas, the Caribbean, and the northern coast of South America. These invasive populations not only compete for food and habitat with federally managed species, but also consume them. Because lionfish have few natural predators in their invasive range, a proposed option for controlling these populations is to establish directed fisheries to promote their consumption by humans. However, carnivorous marine fishes can contain high levels of mercury, a toxic pollutant that can cause neurological and behavioral impairment in humans when consumed. Currently, invasive species are not managed under any sort of federal Fishery Management Plan (FMP) or state regulation, although steps have been taken to reduce their population size. While managing under a FMP isn't currently appropriate, modifying other regulations presently in place may be necessary to allow and promote lionfish harvest. One of these examples would be to modify gear-use regulations as they may not currently be appropriate to keep lionfish and other invasive populations in check. Another example would be requiring mandatory testing for toxin levels of consumed invasive species due to studies showing that toxin levels can be high in certain species. Some sort of lionfish management and rule changes may be applicable in order to mitigate for potential human health issues and protect managed species and their habitat. Similar considerations may apply to other invasive species, illustrating the complexities of this emerging management issue.

KEYWORDS: Lionfish, fisheries management, invasive species

Multi-scale Analysis of *Sargassum* Aggregations: From *in-situ* to Satellite Observations

Análisis a Múltiples Escalas de Agregaciones de *Sargassum*: De Observaciones *in situ* a Satelitales

Analyse Multi-echelles des Agrégations de *Sargasses* par Satellite et *in situ*

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ABSTRACT

Since 2011, massive inundations of pelagic Sargassum have been reported on the coasts of the Caribbean, North of Brazil, Guyana and Western Africa causing large economical, societal and ecological damages, supposedly coming from a new source region spanning the tropical Atlantic. Pelagic *Sargassum* can form aggregations at multiple scales, known as rafts that evolve with the action of winds, waves and currents. A better description and quantification of these Sargassum aggregations, through in situ observations and satellite images, are of first importance for a better quantification of offshore coverage and a better managing of their stranding. In this study, we report ship observations carried out during two campaigns spanning the tropical Atlantic in spring and fall 2017, coupled with satellite images at increasing resolution (MODIS and VIIRS sensors (~1 km), OLCI/sentinel-3 (300m) and MSI/sentinel-2 (10m)). We propose (i) a simple typology for the in situ observations of Sargassum aggregations and (ii) an assessment of satellite ability to quantify *Sargassum* coverage and distribution through comparison of satellite detections of Sargassum aggregations at increasing resolution with *in situ* observations.

KEYWORDS: Tropical Atlantic, raft, typology

Diadema antillarum Grazing Effects on Algal/Benthic Cover and Diversity in La Parguera Natural Reserve

Efectos de Pastoreo de *Diadema antillarum* sobre la Cobertura y Diversidad Bentónica en la Reserva Natural de La Parguera

Effets du *Diadema antillarum* Broutant sur la Couverture Benthique et la Diversité de la Réserve Naturelle de La Parguera

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ABSTRACT

A modest recovery of the black long-spined sea urchin, *Diadema antillarum*, has been reported for a few Caribbean locations. *D. antillarum* has been proposed to be a keystone herbivore that exerts important controls on benthic assemblages. Most of the evidence supporting this keystone model, however, has been inferred from observational studies; whereas manipulative studies that test hypotheses derived from this keystone model are scarse. Consequently, a manipulative experiment was conducted to test the effect of *D. antillarum* densities and rugosity (substrate heterogeneity) on the algal/benthic cover (as a proxy of grazing rate) and diversity. The field experiment consisted of fencing coral heads where different densities (1, 5 and 10 individuals per m2) of *D. antillarum* were placed per experimental unit. Inside these experimental units, three, 10cmx10cm quadrats were permanently and randomly placed to estimate the algal/benthic cover and diversity for six months. Preliminary, non-quantitative observations have shown a decrease in algal cover associated with *D. antillarum* densities, but not rugosity. On the other hand, no effects of the factors considered in this experiment (i.e. rugosity and densities) have been detected on coral recruitment. It is expected that after the conclusion of this experiment, we will be able to estimate the optimal density of *D. antillarum* needed on a coral reef area to create positive feedbacks in the south-west part of Puerto Rico. With the information produced, *D. antillarum* restoration could be constituted as a plausible biocontrol mechanism to reduce algal cover and potentially increase coral recruitment substrate.

KEYWORDS: *Diadema antilarum*, herbivory, manipulative

Recovery When You Are on Your Own: Case Study of the Isolated Mona Island Marine Reserve

Recuperación Cuando Está Solo: Estudio de Caso de la Reserva Marina Aislada de Mona Island

Récupération Lorsque Vous Êtes Seul: Étude de Cas de la Réserve Marine Isolée de I'île Mona

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ABSTRACT

Ecological isolation is an important yet underappreciated factor affecting marine reserve performance. Isolation may preclude recruit subsidies, thus slowing recovery when base populations are small and causing a mismatch between performance and stakeholder expectations. Mona Island is a small, oceanic island located within a partial biogeographic barrier - 44 km from the Puerto Rico shelf. We investigated if Mona Island's no-take zone was successful in increasing mean size and abundance of reef fishes 14 years after designation. The La Parguera Natural Reserve (LPNR) was chosen for evaluation of temporal trends at a fished location. Fish assemblage metrics collected in diver surveys were assessed with univariate and multivariate PERMANOVA based on multifactorial mixed models. Perceptions of fishing effort and enforcement in both MPAs were collected with fisher interviews. Despite indications of fishing within the no-take area, a reserve effect at Mona Island was evidenced from increasing mean sizes and abundances of some commercial taxa, with mean total abundance 36% greater relative to 2005. These results should be viewed cautiously, however, as our design lacks seasonal replication within 2005 and 2010. The larger predatory species remained rare at Mona, preventing meaningful analysis of population trends. At LPNR, most commercial species (e.g., lane snapper, schoolmaster, mahogany snapper) did not change significantly in biomass or abundance, but some species (yellowtail snapper, hogfish), increased in abundance. This work shows that recovery at Mona is slow and limited to smaller sized species, highlighting both the need for better compliance and the substantial recovery time required by commercially valuable, coral reef fishes in isolated marine reserves.

KEYWORDS: Marine reserves, ecosystem based management, fisheries

Spatial Structure of Dwarf Dory *Zenion hololepis* (Goode and Bean, 1896) (Zeiformes: Zenionidae): A Deep-sea Fish in the Colombian Caribbean

Estructura Espacial del Pez Dwarf Dory *Zenion hololepis* (Goode and Bean, 1896) (Zeiformes: Zenionidae): Un Pez de Aguas Profundas en el Caribe Colombiano

Structure Spatiale du Doris Nain *Zenion hololepis* (Goode and Bean, 1896) (Zeiformes: Zenionidae): Un Poisson d'Eau Profonde dans les Caraïbes colombiennes

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ABSTRACT

The objective of this research was to describe the patterns of size structure, spatial and bathymetric distribution of the dwarf dory deep-sea fish (*Z. hololepis*) in the Colombian Caribbean Sea. *Zenion hololepis* is reported as one of dominant teleost species with a frequency of occurrence of 57.41%, which makes this species of great ecological importance. Samples were collected by trawling in depths between 200 and 550 m. The total length, sex and number of individuals *Z. hololepis* from each station were recorded. Geostatistical analyses were used to describe the spatial structure of the *Z. hololepis* distribution. The size of *Z. hololepis* females ranged between 58.06 and 121.75 mm total length (mean 80.97 mm, ±13.12) and for males between 57.42 and 114.77 mm TL (mean 77.77 mm, ±13.82). The size structure for female and male showed an increase with depth. In females and males, the growth was negative allometric. The bulk of the biomass was distributed between Cartagena and Morrosquillo gulf. In the northeastern zone this species revealed high abundances between Santa Marta and Riohacha. This species was distributed between 230 and 443 m, but higher biomass was found between 320 and 370 m. Further research to know the parameters of life cycle of deep-sea fish in the Colombian Caribbean Sea such as growth, reproduction, recruitment, mortality, areas and seasons of spawning and nursery areas is required. A highly precautionary approach on these deep-sea species is necessary due to their vulnerability to exploitation.

KEYWORDS: Size structure, distribution

Mass Tourism Impacts on Marine Ecosystems and Protected Areas in the Seaflower Biosphere Reserve

Impactos del Turismo Masivo sobre los Ecosistemas Marinos y Áreas Protegidas en la Reserva de Biosfera Seaflower

Tourisme de Masse sur les Écosystèmes Marins et les Aires Protégées de la Réserve de Biosphère Seaflower

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RESUMEN

El Archipiélago de San Andrés, Providencia y Santa Catalina conforma la región insular de Colombia; fue declarado en 2002 por la por la UNESCO como Reserva de Biosfera Seaflower (RBS), gracias a que el territorio cuenta con una extraordinaria biodiversidad, valores ambientales y singularidades culturales de la minoría étnica raizal que allí reside. En los últimos años, la isla de San Andrés, que hace parte de la RBS, ha sido protagonista de la expansión del turismo, siendo un escenario no sólo de procesos migratorios sino también de aprovechamiento de atractivos naturales y culturales para la industria turística; en especial el tipo de turismo desarrollado en la isla de San Andrés es sustancialmente de "Sol y playa", el cual se ha caracterizado por una marcada recepción de inversiones, en su mayoría foráneas que han fomentado la construcción de un gran número de hoteles tipo "All inclusive" enfocados a la demanda de turismo masivo. Este tipo de segmento turístico además de ser promovido por las cadenas hoteleras del "todo incluido"; también ha sido fomentado por turoperadores locales (Prestadores directos), quienes han abaratando el destino con rutas turísticas (visitas a atractivos naturales y culturales) a precios bastante módicos con el fin de incrementar su cuota de mercado; como consecuencia de estas medidas se ha generado una guerra de precios entre competidores logrando incrementar el número de intermediarios informales, quienes comercializan dichas rutas o planes turísticos sin ningún tipo garantía, obteniendo ganancias superiores a la de los operadores directos, lo cual provoca un decrecimiento en la calidad del servicio y un uso masivo de los ecosistemas sensibles. En este estudio se aborda la problemática del turismo masivo sobre áreas protegidas, ecosistemas sensibles y recursos naturales marinos.

PALABRAS CLAVES: Turismo masivo, impactos ambientales, Reserva de Biosfera seaflower

Genomics to the Rescue: When Mitochondrial DNA and Morphology Conflict on the Species Delimitation of Two Red Snappers

La Genómica al Rescate: Cuando el AND Mitocondrial y la Morfología Contradicen la Delimitación de Especies de Dos Pargos Rojos

La Génomique à la Rescousse: Quand l'ADN du Mitochondrial et la Morphologie Conflit dans la Délimitation des Espèces des Deux Vivaneaux Rouges

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ABSTRACT

Correct delimitation of species boundaries and the identification of their population structure are essential for adequate management and conservation of biological biodiversity. Here, we assess a challenging problem regarding the delimitation of two commercially important fish species of red snappers in the Western Atlantic (WA): the northern red snapper (*Lutjanus campechanus*) and the southern red snapper (*Lutjanus purpureus*). Red snappers have been traditionally diagnosed as two separated species based on morphological characters. Recent genetic studies using solely mitochondrial markers, however, have failed to recognize any genetic structure, ultimately defying the traditional species boundaries. This has led to the recent lumping of the two species into L. campechanus. As red snappers constitute one of the most important fishery resources in the WA and have been subjected to extreme overfishing, recognition of two versus one species has important implications on fishery management and conservation efforts. To address this lack of resolution that have been hindering conservation efforts, here we used 15-42k Single Nucleotide Polymorphisms (SNPs) obtained double-digest RAD pair-ended sequences (PE ddRADseq), to a robust set of 178 samples distributed along 15 localities of the species' distribution range. Our population genomic analyses strongly support the presence of two independent evolutionary unities, a result that is ultimately in agreement with the traditional morphology-based hypothesis, and reinforce RADseq as valuable tool to clarify complex problems on species boundaries in a commercially endangered species.

KEYWORDS: Species delimitation, RADseq, population structure

How has Organization Benefited Women in the Barbados Flyingfish Fishery A Look From Within

¿Cómo Ha Beneficiado la Organización a las Mujeres en la Pesquería de Pez Volador de Barbados? Una Mirada Desde Dentro

Comment l'Organisation A-T-Elle Profité aux Femmes de la Pêcherie de Poisson Volant de la Barbade?

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ABSTRACT

Efforts to implement the 2014 Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines) led by FAO have resulted in increasing global and local attention to fisherfolk organizations, their strengthening and governance, and women's roles and participation in them both as members and leaders. In Caribbean small-scale fisheries, the contribution of women's roles in fisheries value chains is largely undocumented. There is limited literature on women in fisherfolk organizations in Barbados where flyingfish comprise more than half of the annual total landings. Women are conspicuous in the postharvest sector of the flyingfish value chain, but their participation in fisherfolk organizations is unclear. The Gender in Fisheries Team (GIFT) has conducted participatory action research with the only postharvest fisherfolk organization in Barbados, which comprises women engaged in the flyingfish fishery. Central Fish Processors Association (CFPA) formed to address challenges small fish processors (fish vendors) were experiencing in their livelihoods. Despite not being a formal organization, participation in the female-led, predominantly female, CFPA and its activities is high, especially in times of crisis. Through group and individual interviews, and document analysis, the benefits to the women from participation in the organization, and the challenges they face, were investigated. The research is the first of its kind focused on organized women in the Barbados flyingfish fishery, deviating from the typical focus on men in its harvest sector.

KEYWORDS: Flyingfish, Barbados, women fisherfolk

Integral Management of Yellowtail in Honduras´s Protected Areas

Manejo Integral del Yellowtail en Areas Protegidas de Honduras

Gestion Intégrale de la Jaune de Nature Dans les Zones Protégées du Honduras

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ABSTRACT

The yellowtail snapper is a species of high commercial and biological importance in the Caribbean and in small-scale fisheries within the Mesoamerican reef ecoregion. This species of snapper has been specifically identified as resistant to fishing pressure by its unusual life history traits within the grouper-snapper complex, the main traits include: spawning throughout the year, reaching sexual maturity between 1.7-2 years; and possible high levels of self-recruitment. Because of this, this species has the potential to be a sustainable fishery if it is managed effectively and integrated at the regional level. The central strategies to reduce capture pressure, are the implementation of fishing recovery zones and fish protection at a regional scale. The effectiveness of management strategies designed to promote this fishery depends not only on understanding the connectivity of these fish populations throughout the region. The effectiveness of management strategies designed to promote this fishery depends not only on understanding the connectivity of these fish populations throughout the region. In order to provide sound management recommendations, it is important to understand how yellowtail snapper populations are connected. From these data it will be possible to provide recommendations in the design of Fisheries Recovery Zones and identify where entities are required to collaborate. The objective of the FRZ´s will be to balance the ecological requirements of the species with the socioeconomic needs of the coastal communities that depend on this fishery.

Expand the connectivity assessment for yellowtail snapper throughout the ecoregion. Understand the spatial scales required for the effective management of this species. The results will allow managers to establish adequate management plans.

KEYWORDS: Yellowtail snapper, fisheries recovery zones, connectivity

State of the Deep Sea Megainvertebrate Communities in the Caribbean of Colombia

Estado de las Comunidades de Megainvertebrados de Aguas Profundas en el Caribe de Colombia

Les État des Communautés de Méga-Invertébrés d'Eaux Profondes dans les Caraïbes de Colombie

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RESUMEN

En el Caribe colombiano no existe actividad pesquera en zonas profundas, no obstante se han reportado especies de crustáceos de potencial comercialización y de las cuales se han realizado estudios sobre su distribución y abundancia. Sin embargo, entender el papel de estas especies en el ecosistema requiere profundizar en el conocimiento de las comunidades de fondos blandos que allí habitan. Por esto, el objetivo del presente estudio fue determinar el estado las comunidades de los megainvertebrados entre los 150 – 600 metros de profundidad en el Caribe colombiano a través de índices de diversidad, así como la relación entre la abundancia y la biomasa como indicador de perturbación. Se realizaron cuatro muestreos (agosto y diciembre de 2009, marzo y mayo de 2010) a profundidades entre los 150 y 600 m (con estratos de profundidad cada 100 m) con un barco de arrastre camaronero. Se capturaron 7019 individuos pertenecientes a 29 familias y 61 especies, siendo las más abundantes *Pleoticus robustus, Penaeopsis serrata, Aristaeomorpha foliacea, Agononida longipes, Metanephrops binghami* y *Plesionika longipes*. Se presentó mayor riqueza y dominancia de especies hacia el norte del Caribe colombiano posiblemente relacionada con la alta productividad de esta región. En algunas estaciones la abundancia estuvo por encima de la biomasa, lo cual puede indicar áreas de agregación de juveniles como sitios de crianza o refugio. Se sugiere que las investigaciones futuras sean dirigidas a evaluar la dinámica temporal de la abundancia y biomasa estas comunidades.

PALABRAS CLAVES: Curvas ABC, indices de diversidad, recursos pesqueros

Dispersal of Red Snapper Larvae in the Southern Gulf of Mexico

Dispersión de Larvas del Pargo Rojo en el Sur del Golfo de Méjico

Dispersion des Larves de Vivaneau Campèche dans le Sud du Golfe du Mexique

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ABSTRACT

Ocean currents, driven by climatological processes and moderated by topography, are principal determinants of larval dispersal and are, in part, responsible for regional differences in Red Snapper distributions observed in the Gulf of Mexico. Current data from the HYCOM model are used to track simulated transport of Red Snapper larvae spawned at 26 locations spread across Campeche Bank for the years 2003, 2005, 2008 and 2010. A simple Lagrangian stochastic model is applied at each time step to ten water parcels launched simultaneously from each of the 26 locations, simulating the spread of spawned larvae. The end points of the planktonic larval drift (ready for settlement in shallow water as juveniles) were evaluated to determine if Campeche Bank serves as a major source for other regions. The Yucatan Current, flowing along the eastern side of the Bank, provides a mechanism for supply of larvae to the Florida continental shelf and to the Atlantic; however, most of the spawn remains on the bank. Natal retention ranges from 67 to 73% of launched particles with less than 2% entering the Straits of Florida. For particles transported off Campeche Bank, ~ 28% are lost to the deep basin. Successful basin crossing (ended pelagic drift in < 200 m water depth), as percentage of total particles launched for the combined years, was ~ 0.33% with the southwest Florida shelf receiving the majority. Larvae from the Bank may contribute to homogenization of the gene pool, but are insufficient to restore depleted regional populations.

KEYWORDS: Red Snapper, larvae, Campeche Bank

Sargassum Influx to the Shores of San Andrés Island, Southwestern Caribbean

Afluencia de *Sargassum* a las Costas de la Isla de San Andrés, Sudoeste del Caribe

Afflux de *Sargassum* sur les Rives de l'Île de San Andrés, Sud-ouest des Caraïbes

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ABSTRACT

Pelagic *Sargassum* spp. constitutes important habitat and nutrient source for marine biodiversity in the oligotrophic waters of the Atlantic Ocean and Caribbean Sea. Influx of floating *Sargassum* to the Gulf of Mexico and the Caribbean Sea have been historically influenced by trade winds, and have reached coasts and beaches of the Caribbean islands and Central America. However, since 2011 exceptional biomass of floating *Sargassum* have been reported along the Caribbean coast, including Mexico and West Indies. These abnormal events have affected biodiversity (p.e. sea turtles, fishes and dolphins) and economic sectors such as fisheries and tourism. Negative effects of these influxes might be higher at insular contexts such as the Archipelago of San Andrés, Providence and Santa Catalina Islands, because human population wellbeing depends more on the quality of marine ecosystems that are the basis of economic activities as tourism and fishery. In Colombia, occasional influxes of *Sargassum* have been reported for 2014 and 2015 at San Andres Island, as well as at Serranilla Island by 2017. This year 2018, other events were observed in San Andres Island, during April and begging of May. Average width extension of *Sargassum* bands were determined on beaches, as well as dry average biomass. We estimated that around 188.000 kg of *Sargassum* humid biomass arrived at the island´s beaches, and around 618.000 kg per event along the entire east coast of the island. Effects of these events on nutrient input to seawater could be positive for productivity, but negative effects on shallow seagrass meadows and nearby coral reefs, as well for economic activities like tourism or fisheries should be assessed. More research is needed to understand causes and effects of these events at San Andrés and the entire Caribbean region.

KEYWORDS: *Sargassum,* Caribbean, San Andrés Island

Cooperative Natural Resource Damage Assessment Leads to Successful Restoration of Injured Coral Resources

La Evaluación Cooperativa de Daños a los Recursos Naturales Conduce a la Restauración Exitosa de los Recursos de Coral Lesionados

L'évaluation Coopérative des Dommages Causés aux Ressources Naturelles Mène à la Restauration Réussie des Ressources Coralliennes Endommagées

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ABSTRACT

On or around January 12-14, 2016 the M/V Tatoosh, a Cayman Island Flagged 303 ft. pleasure craft, caused extensive injury to coral reef habitat in shallow water 13-17 m depth (~ 45-57 ft.) in the West Bay Coral Reef Replenishment Zone off Seven-Mile Beach, Grand Cayman. The injury was caused by the deployed anchor chain of the vessel coming into direct contact with the reef.

Based on underwater surveys performed by scientific divers the total area of resource impacted was calculated to be 1,156 m^2. This includes 886 m^2 of highly impacted (Level I injury) benthos and substrate. Within the highly impacted area, ~80 % of the benthos was totally crushed and destroyed by the anchor chain deployed by the vessel. The area of 886 m^2 of highly impacted reef habitat was restored through a combination of structural and biological methods. More than 1,000 dislodged and fractured colonies were located and salvaged by divers in the days and weeks following the incident. With the help of volunteers these corals were cached in crates adjacent to the injury. Loose coral rubble was moved and stabilized by filling depressions on the reef and then cementing these areas to prevent re-mobilization of the rubble in storms. In total, 1,290 corals were subsequently reattached to the injured reef during emergency restoration operations by the responsible party in coordination with the Cayman Island Department of the Environment (trustee). The entire assessment and restoration of the site was completed in less than three months.

The success of this project was directly related to the rapid coordinated assessment and response performed by both the trustee and responsible party in the wake of the incident.

KEYWORDS: Coral, restoration, injury

Sustainable Tourism as a Path to Preserve Cuba's Coastal and Marine Resources

El Turismo Sostenible Como Una Forma Para Preservar Los Recursos Costeros y Marinos de Cuba

Le Turisme Durable Comme Forme De Preserver Les Ressources Cotieres Et Marines De Cuba

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ABSTRACT

The Ocean Foundation (TOF) staff have been working on marine conservation issues in Cuba for nearly 25 years. Current initiatives are focused on sustainable tourism and recreational fishing. Recent TOF research examined management effectiveness of marine protected areas (MPAs) in Cuba's southern archipelagos. Results illustrate the significant role of public-private partnerships between ecotourism and park management in strengthening MPA effectiveness.

As tourism grows, TOF and its partners are working to advance recreational fishing policy in Cuba in order to enhance the capacity to monitor, evaluate, and manage recreational fishing for economic benefit and natural resource protection. Therefore, by examining eleven case studies of other nations' recreational fishing policies for balancing the management of domestic and foreign visitors in contexts similar to Cuba, TOF has created a suite of evaluation matrices and policy recommendations for the Cuban context. Effective management of this growing sector will be key to preserving the health of Cuba's coastal and marine resources.

KEYWORDS: Recreational fishing, sustainable tourism

Impacts of Mangrove Habitat Degradation on Fish Community Structure Along Guyana's Coastal Regions

Impactos de la Degradación del Hábitat de Manglares en la Estructura de la Comunidad de Peces a lo Largo de las Regiones Costeras de Guyana

Impactos de la Dégradation de l'Espace de Travail dans l'Organisation de la Communauté de Biens à un Grand Nombre de Régions Côtières de Guyana

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ABSTRACT

Mangrove forests are unique habitats that function as feeding grounds and nurseries for numerous fish which includes commercial and subsistence species. Over the past decades, mangrove forest cover has been greatly reduced in Guyana due to the construction of rip-raps and dams, tree harvesting, grazing of livestock and the natural processes of erosion and accretion. Different mangrove habitat types (natural, restored& degraded) along Guyana's coast were surveyed to investigate fish species diversity, community structures and ecosystem degradation impacts in order to protect and to improve the mangrove fish resources. Per habitat type, nine random plots of 1ha were established at each site for habitat evaluation, followed by sampling during both wet and dry season, using cast nets, gills and hand nets of different mesh sizes. A total of 24 species from 14 families were recorded, with the sea catfishes, Ariidae, (6 species) being the most speciose family. The mean Simpson Diversity Index showed that the natural habitats had the greatest fish diversity in both the dry and wet season followed by the degraded and restored mangrove habitats respectively. Significantly higher fish abundance, biomass and mean length were observed in natural and restored mangrove habitats in comparison to the degraded habitats. These results indicate that mangrove restoration significantly increases fish diversity and abundance. It also demonstrates the need for an integrated approach to mangrove resource management/conservation, including intensive mangrove restoration, and habitat protection for ecosystem recovery of degraded mangrove ecosystems.

KEYWORDS: Mangroves, degradation, fish community structure

Disentangling the Effects of Freshwater Inflows, Management and Restoration on Coastal Recreational Fisheries: Common Snook in the Florida Everglades

Desenredando los Efectos de los Flujos de Agua Dulce, su Manero y Restauracion en las Pesquerias Recreatives Costeras: Róbalo en los Everglades de la Florida

Démêler les Effets des Apports d'Eau Douce, de la Gestion et de la Restauration sur la Pêche Récréative Côtière: Snook dans les Everglades en Floride

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ABSTRACT

Alterations of the deliveries of freshwater flows can have major effects on spatial processes at the coast, including those related to economically valuable recreational fisheries. For instance, freshwater flows can alter spatial patterns of recruitment, and the foraging and physiological landscape experienced by fisheries, and thus affect their productivity in a spatially explicit manner. In South Florida, recreational fisheries are a major ecosystem service provided by the Everglades ecosystem, and understanding the exact nature of the dependencies of these fish species on freshwater deliveries is key to their resilience and sustainable management. Freshwater flows have been drastically altered in the Everglades due to a legacy of hydrologic changes driven by drainage and impoundment related to agriculture and urban development, however ongoing restoration efforts aiming to restore natural flows and counteract climate change effects (sea level rise) can influence the ultimate fate of South Florida recreational fisheries. Here, we use Common Snook (*Centropomus undecimalis*) to illustrate how freshwater inflows affect multiple aspects of the life of snook, including their foraging movement, distribution, and degree of synchrony in space use across the seascape. Findings highlight the importance of understanding the nature of flow-ecology relationships for key ecosystem provider species, in order to avoid crossing thresholds in water management that may lead to ecological collapse, especially in the face of projected changes in freshwater availability with climate change.

KEYWORDS: Recreational fisheries, freshwater inflows, management

A Preliminary Socioeconomic Profile on Fishermen in Trinidad

Un Perfil Socioeconómico Preliminar sobre los Pescadores en Trinidad

Un Profil Socioéconomique Préliminaire des Pêcheurs de Trinité

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ABSTRACT

The goal of this study was to produce a report showing a preliminary socio-economic profile of fishermen in Trinidad. This study was done because there is a greater need for the understanding of fishermen and the issues they face to efficiently plan and develop the fishing industry in Trinidad. Several factors were evaluated such as; livelihood of the fishermen, fishing facilities, landing sites, fishing gear and species being caught. This research was done using non-probability sampling, data was collected via questionnaires, researcher's observation, photographs and four focus group meetings. The results were analysed using Microsoft Excel software and were presented using tables and figures. The Global Positioning System coordinates were generated into maps using Arc GIS software.

In reviewing the fishing industry of Trinidad and Tobago. The sector contributes 14% of agricultural GDP and 0.1% of the nation GDP. The sector employs over 9000 fishermen and there are 7400 registered fishermen. There is a total of 65 landing sites in Trinidad and 32 in Tobago. The results showed that the socioeconomic profile of the fishermen in Trinidad is affected by ample factors. Which include; the condition of fishing facilities and landing sites, the management of the fishing industry, laws and policies and the fishermen perceptions. In conclusion, the fishers are not satisfied with the current state of the fishing industry, it is affecting their livelihoods greatly. Recommendations are to engage in integrated coastal zone management, community-based co-management and conducting management effectiveness evaluations.

KEYWORDS: Fishermen, socioeconomic, management

Impact and Recovery from Parrotfish Corallivory on Threatened *Orbicella annularis* Corals: Effects of Species, Habitat, and Marine Reserve Protection

Impacto y Recuperación de la Depredación de los Peces Loro en los Corales Amenazados *Orbicella annularis*: Efectos de las Especies, el Hábitat y la Protección de las Reservas Marinas

Impacts et Rétablissement des Coraux Menacés d'*Orbicella annularis* par la Prédation des Poissons-Perroquets: Effets des Espèces, de l'Habitat et de la Protection des Réserves Marines

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ABSTRACT

Herbivorous parrotfishes (Scaridae) indirectly benefit corals by grazing algae, thereby reducing coral-algae competition. Increasing parrotfish abundance to promote coral resilience is a major priority for many managers; however, heavy parrotfish fishing pressure in parts of the Caribbean remains a challenge. While parrotfishes are primarily herbivores, certain species occasionally feed on corals. Research is needed on the tradeoff between negative impacts of parrotfish corallivory and positive impacts of herbivory to estimate their net impact on corals. Parrotfishes prey upon many coral species, but preferentially target *Orbicella annularis*, a species recently reclassified as threatened under the US Endangered Species Act. There is increasing concern that parrotfish predation may contribute to substantial long-term declines in *O. annularis*. We studied how intensity of *O. annularis* corallivory varies in response to site-level differences in parrotfish biomass, and coral and algal abundance on St. Croix, US Virgin Islands. We compared five sites on the Northern coast, where fishing pressure is high, to three sites on Buck Island, a well-enforced marine reserve with approximately three times higher parrotfishes biomass. Additionally, we monitored bite scar healing over time to quantify the frequency and rate of healing in response to scar size and shape and coral colony size. These data will allow us to model the projected long-term loss versus healing of *O. annularis* tissue from a standing stock of bite scars. This research improves our understanding of how differences in parrotfish biomass and benthic community assemblage alter the impact of parrotfish predation on a threatened coral species.

KEYWORDS: Corallivory, *Orbicella annularis*, Tissue regeneration

Factors Influencing Catchability on Longline Fisheries: The Case of Red Grouper (*Epinephelus morio*), Yucatan Mexico

Factores que Afectan la Capturabilidad en la Pesca con Palangre: El Caso del Mero Americano (*Epinephelus morio*), Yucatán México

Facteurs Affectant la Capturabilité dans lPêche à la Palangre: Cas du Mérou Rouge (*Epinephelus morio*), Yucatan, Mexique

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RESUMEN

El índice de capturabilidad mide la interacción abundancia-esfuerzo y refleja la vulnerabilidad espacio-temporal y la efectividad del arte sobre el recurso. Se analizó la capturabilidad de palangres de fondo experimentales en la captura de mero americano en aguas costeras de Yucatán. Tres palangres equipados cada uno con anzuelos atuneros MUSTAD de tres tamaños distintos (13/0, 14/0 y 15/0) fueron experimentados. Los anzuelos fueron cebados con trozos de sardina (*Opistonema oglinum*) de 4 cm y 8 cm de tamaño. Las capturas se realizaron en zonas adyacentes a los puertos de Celestún (zona oeste) y Río Lagartos (este) dentro de tres intervalos de profundidad (10-15 m, 15-20 m y >20 m). Las variaciones por zona, profundidad, tamaño de anzuelo y carnada fueron analizadas mediante Modelos Lineales Generalizados (GLM) con distribución Gaussiana. El tamaño de carnada no generó variación significativa en la capturabilidad. Las zonas y profundidad de pesca, así como el tamaño de anzuelo, fueron los factores que representaron una fuente significativa de variación de la capturabilidad. La capturabilidad fue más alta: en la zona este, en los sitios de mayor profundidad (>20 m) y con los anzuelos de mayores tamaños (14/0 y 15/0). No se observó una variabilidad de la capturabilidad en relación con la talla de los individuos capturados: el valor de este índice fue alto tanto para peces jóvenes que adultos. Se observó una interacción entre la talla y la profundidad sobre la capturabilidad. Los peces jóvenes fueron siempre vulnerables al arte de pesca, sin importar la zona de pesca, la profundidad o el tamaño del anzuelo.

PALABRAS CLAVES: Epinephelidae, capturas, arte de pesca

Analysing the Mean Length of Sexual Maturity for the Lane Snapper (*Lutjanus synagris*) in Trinidad for Proper Catch Size Limits

Análisis del Tamaño Medio de la Madurez Sexual del Pargo Lane (*Lutjanus synagris*) en Trinidad para Conocer los Límites Adecuados de Tamaño de Captura

Analyse de la Taille Moyenne de la Maturité Sexuelle des Vivaneaux Lane (*Lutjanus synagris*) à Trinidad pour Connaître les Limites Appropriées de la Taille de Captured

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ABSTRACT

Research was conducted on the lane snapper (*Lutjanus synagris*) to determine its length of sexual maturity in Trinidad. The primary area of study was Tunapuna market as it provided a large sample of fish from various locations around Trinidad. Sampling was conducted from October 2017 to February 2018. A total of 190 fish were measured for total length in cm (TL) and weight in grams (g). In addition, gonads of 170 fish were macroscopically observed and categorized using a stage classification model. Twenty-four fish were found to be below the current minimum size limit of 20.3 cm TL. Comparisons to research conducted in 1979-1981 indicated that length at 50% maturity (L50) decreased from 27.7 cm to 26.2 cm, while length at 100% maturity (L100) decreased from 45cm in 1987 to 37cm. It is likely that size-selective fishing pressure over the past 40 years resulted in a population-level reduction in the length at maturity. Unsustainable fishing may have negative consequences for the lane snapper population unless proper biologically relevant size limits are enforced.

KEYWORDS: Total length, weight, gonads

Historical Changes in the Catch Rates of the Different Types of Guajira Coast Gill Net Fisheries (Colombian Caribbean)

Cambios Históricos en las Tasas de Captura de los Diferentes Tipos de Pesquerías de Redes de Enmalle de la Costa Guajira (Caribe Colombiano)

Changements Historiques des Taux de Capture Dans les Différents Types de Pêcheries aux Filets Maillants de la Côte de la Guajira (Caraïbe de la Colombie)

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RESUMEN

Una de las pesquerías artesanales que ejerce mayor presión pesquera sobre los recursos demersales de la costa Guajira es aquella que utiliza redes de enmalle, las cuales son usadas bajo dos modalidades: a) redes caladas fijas o "a la ronza" (deriva) y b) "lanceo". A pesar de la importancia de estas pesquerías, no se tenían referencias acerca del estado de los recursos explotados por ellas y el impacto relativo del uso de cada tipo de red. Por lo tanto, el objetivo del presente trabajo fue evaluar los cambios históricos ocurridos en los desembarcos de los diferentes tipos de pesquerías de redes de enmalle de la costa Guajira, tomando como referencia los años 1995, 2000 y 2013. Las tasas de captura (desembarco por unidad de esfuerzo DPUE) promedio y sus respectivos intervalos de confianza (IC= 95%) se obtuvieron mediante remuestreo bootstrap (método del percentil). Los IC de los valores de DPUE promedio para la pesquería de redes fijas/deriva durante los tres años evaluados fueron, en su orden, 14.0-20.3, 15.2-32.7 y 14.6-40.4 kg/faena, lo que denota la ausencia de diferencias significativas. En cuanto a la redes de lanceo, los respectivos IC fueron los siguientes: 31.8-72.1, 141.7-383.7 y 68.9-261.2 kg/faena. Se evidencia un aumento en las tasas de captura registradas durante los años 2000 y 2013. Las mayores tasas de captura con redes de lanceo se obtuvieron en el municipio de Uribia (DPUE de 585 kg/faena), en tanto que las mayores tasas de captura con redes fijas/deriva se presentaron en Manaure (33.9 kg/faena). El aumento registrado en las tasas de captura durante el año 2000 se atribuye principalmente al mayor poder de pesca de las artes de lanceo, en razón al uso de un mayor número de paños y la incorporación de mejoras tecnológicas.

PALABRAS CLAVES: Bootstrap, DPUE, pesca artesanal

Participative Restoration of Coastal Habitats in Sosúa Submarine Park, Dominican Republic

Restauración Participativa de los Hábitats Costeros del Parque Submarino Sosúa, República Dominicana

Restauration Participative des Habitats Côtiers du Parc Sous-Marin de Sosúa, République Dominicaine

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ABSTRACT

Due to the intense fishing of the last decades, almost all areas in Dominican Republic (DR) show severe signs of ecological deterioration, including the Sosua Bay in the N central coast. This paper presents the strategies and regulations established and enforced in the Sosua Submarine Park (Decree.634-05), by the Fundación Ecológica Magua along with the collaboration from the Ministry of Environment and Natural Resources, the Tourism Police (POLITUR), and the involvement of the local community which includes the fishing, local government, private companies and NGO sectors. The management scheme implemented by users that started in 2009 focused on zoning and surveillance, complemented by habitat/species restoration which included the following: 687 coral recruits grown in a nursery, 138 mangrove trees planted and growing in the Sosúa River estuary, and 87 individuals of long-spine sea urchin re-introduced to 15m-deep reef. This was accompanied by an extensive biological monitoring with community participation and education. The visual surveys show an increase in fish biomass and sea turtles, as well as high rates of coral recruitment. In addition, the project has created an aware community with some fishermen working as ecoturism guides, mangrove and coral gardeners, surveillance wardens and sustainable fishing practitioners. School kids, college students, business men and politicians have participated as well. Currently, we aim to increase the support from the local business community, enhance nature tourism and create a user fee system that can contribute to increase both, sustainable livelihoods for the community as conservation and ecotourism programs employees, and a healthy ecosystem. The experience is expected to be replicated in other areas of the Dominican Republic.

KEYWORDS: Sosua

Spatial Analysis of Red Grouper's Habitat Affinity for Decision Support in Fisheries Management

Análisis Espacial del Hábitat de Predilección del Mero Americano para el Apoyo a la toma de Decisiones en el Manejo Pesquero

Analyse Spatiale de l'Habitat de Prédilection du Mérou Rouge comme Appui pour la Prise de Décision dans la Gestion des Pêcheries

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ABSTRACT

The Campeche Bank is an important fishing ground in the Gulf of Mexico due to its high diversity of marine resources, exploited by artisanal and industrial fleets. Specifically, red grouper's (*Epinephelus morio*) fishery has the highest catch volume, making it an important resource for fishermen livelihood and regional economy. Nevertheless, red grouper's catch volume has decreased, to the point of being an overfished and overcapitalized fishery; making urgent the implementation of additional management strategies. Information on spatial distribution of red grouper's preferred habitats is scarce, although it is relevant for the fishery management. Technological advancement and information immediacy can provide robust additional tools to provide new information in this field. Red grouper's preferred habitats spatial distribution and significant variables were defined on an artisanal fishing ground in the northwestern corner of Yucatan peninsula (Celestún-Sisal) through SCUBA field surveys (benthic videotransects, fish visual census) and statistical analysis (RDA) which indicated a significantly association of red grouper's distribution with octocoral and green algae cover. A map of the distribution of preferred habitat (76% accuracy) was the result of the combination of field data and the application of remote sensing and spatial prediction techniques on preprocessed Landsat 8-OLI imagery. Additional independent red grouper catches (using long-line) were used to validate the areas defined in the map. Resulting geographic products can be used as supporting information in the process of implementation of a spatial closure (legal concept similar to No-Take Marine Reserves) that, according to biological characteristics of this species, could contribute to the recovery and sustainability of red grouper's fishery in this area.

KEYWORDS: *Epinephelus morio*, Campeche Bank, Yucatan

Holothuria floridana and *Isostichopus badionotus* Sea Cucumber Culture in Former Shrimp Ponds, a Belize Case Study

Cultivo de Pepino de Mar *Holothuria floridana* y *Isostichopus badionotus* en Antiguos Estanques de Camarones, un Estudio de Caso de Belice

Holothuria floridana et *Isostichopus badionotus* Culture d'Holothuries dans d'Anciens Étangs à Crevettes, une Étude de Cas Réalisée au Belize

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ABSTRACT

The 2015 disease outbreak in shrimp devastated the industry in Belize, causing losses of millions of dollars and retrenchment of about ninety percent of shrimp farm employees. Consequently, the culture of *Holothuria floridana* and *Isostichopus badiontus* sea cucumber in former shrimp ponds was tested at Bel-Euro Aquaculture Limited in southern Belize. Broodstock were collected from the wild, acclimated and introduced in two former shrimp ponds and in hatchery tanks; for survival and spawning purposes. Juveniles were also collected from the wild, acclimated and introduced in two former ponds for growth observations. *I. badionotus* broodstock, larvae and juveniles did not survive pond conditions nor hatchery conditions. *H. floridana* broodstock spawned both in the ponds and in the hatchery in the months of March-September. Juveniles collected from the wild obtained growth of 96%. Juveniles that resulted from natural spawning in the pond grew faster in the pond than those in hatchery conditions. Pond conditions fluctuated with temperature ranges of 26℃ - 34℃, salinity ranges of 14-32 psu and 2-7 dissolved oxygen; both broodstock and juveniles survived at all temperature and dissolved oxygen conditions but not at <20 psu in salinity. Juveniles at the hatchery were maintained at 28-32 psu, 7 DO and 28℃ and fed with live microalgae, detritus and shrimp feed. The June-November rainy season decreased pond salinity; an obstacle that can be fixed by directly abstracting water from the sea than from a nearby natural canal. *H. floridana* culture is viable and more studies are necessary for its culture.

KEYWORDS: *Holothuria floridana, Isostichopus badionotus*, aquaculture

Avoiding Viruses: How Does A Caribbean Spiny Lobster Deal With PaV1 and WSSV Infected Conspecifics

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ABSTRACT

White Spot Syndrome Virus (WSSV) is an emerging pathogen, with an incredibly wide host range. WSSV has not been documented in wild populations of spiny lobsters, but WSSV has been artificially transmitted to six species of spiny lobsters in the genus *Panulirus*. *Panulirus argus* Virus 1 (PaV1) is currently the only known virus to naturally infect any species of lobster. As WSSV is still detected intermittently in wild populations in the Caribbean and *P. argus* is the only known species of lobster to natural harbor a viral infection, the risk to *P. argus* should be taken into consideration. The susceptibility of *P. argus* was tested via intramuscular injection. *P. argus* was highly susceptible to WSSV, with mortality reaching 88% in just 4 weeks p.i.. *P. argus* is first species of spiny lobster found to be susceptible to WSSV in the Americas. *P. argus* is able to mitigate some of the effects of PaV1 though avoidance of infected individuals. Our findings indicate the avoidance of disease by *P. argus* was not be specific to the PaV1 argus relationship. Test lobsters showed a significant reduction in sociality in response to WSSV infected animals when compared to healthy animals. This avoidance response was strongest with the most heavily infected individuals, a relationship that is also seen in PaV1 infected conspecifics. Non-specific disease avoidance may indicate avoidance is based on generalized cues of predation risk or conspecific injury, which hold increased significance for gregarious species such as *P. argus.*

KEYWORDS: *Panulirus argus*, spiny lobster, WSSV

Gregarious Behavior of the Small Pelagic Fish in the Gulf of California Using Acoustic Methods

Caracterización del Comportamiento Gregario de los Peces Pelágicos Menores en el Golfo de California Mediante Métodos Acústicos

Comportement Grégaire des Petits Poissons Pélagiques dans le Golfe de Californie en Utilisant de Méthodes Acoustiques

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ABSTRACT

In the Gulf of California (GC), small pelagic fish (sardines, anchovies and mackerels) have a high ecological and economic value. A distinctive feature of these species is their ability to form schools, which can be defined by their size, density, position and location in the water column. The objective of the present work is characterize its aggregative and dynamic behavior in the water column by analyzing the acoustic information obtained in May and June of 2012 to 2014, and February 2014 and its relationship with the prevailing environmental variables in the GC. A total of 1100 schools were recognized, which were more abundant during 2012 when the net primary productivity values in the area were highest. The importance that the Midriff islands zone (lowest sea surface temperature and highest productivity) represents for the distribution of many species was corroborated, especially for the small pelagic schools, obtaining in this zone the highest number of detections per nautical mile prospected. The significant number of schools detected during the twilights and the night suggest that within the GC the typical dispersal behavior of the small pelagic schools during the night is not fulfilled. This could have favored traditional fishing methods in this area. The moon elevation and the phases, appear to have an influence in the schooling behavior of the small pelagic species, reflected in a greater depth at the time of the moon's appearance and a greater proximity to the surface during full moon nights; this behavior could be motivated by a high presence of zooplankton prey in shallow layers during full moon nights.

KEYWORDS: Schools, vertical distribution, Midriff islands region

A Practical Approach to Monitoring Marine Protected Areas

Un Enfoque Práctico para el Monitoreo de Areas Marinas Protegidas

Une Approche Pratique pour la Surveillance des Aires Marines Protegées

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ABSTRACT

Worldwide, marine protected areas (MPAs) are increasingly created to protect and restore selected parts of the oceans, to enhance recreation, fishing, and preservation. The creation of MPAs has outpaced the development and implementation of methods to assess and monitor them and ensure their effectiveness. By using a combination of widely available instruments and software, we demonstrate a practical solution to map bathymetry and animal distributions, characterize their oceanographic habitat, identify the predominant fish species, and estimate their biomasses. The individual methods are mature, and the combination of acoustic- and optical-sampling methods is a practical approach to obtain baseline information on MPAs and then efficiently monitor changes resulting from natural and anthropogenic processes. We present results of a one-day acoustic survey, CTD casts, and video recordings by scuba divers in a MPA around the seamount known as "El Bajo Espititu Santo", located in the southwest Gulf of California, Mexico.

KEYWORDS: MPA, acoustics, El Bajo, Espiritu Santo, BCS

From Research to Political Incidence: Fishing Agreement Between Industrial and Artisanal Fishermen in a Protected Marine Area of the Colombian Pacific

De la Investigación a la Incidencia Política: Acuerdo de Pesca Entre Pescadores Industriales y Artesanales en un Área Marina Protegida del Pacífico Colombiano

De la Recherche au Plaidoyer Politique: Accord de Pêche Entre les Pêcheurs Industriels et Artisanaux dans une Zone Marine Protégée du Pacifique Colombien

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RESUMEN

En un intento por unir metas de conservación y uso sostenible de los recursos pesqueros en el Pacífico colombiano, las comunidades afrodescendientes, declararon el Distrito Regional de Manejo Integrado (DRMI) Golfo de Tribugá - Cabo Corrientes, con base en la existencia de objetos de conservación que generan múltiples servicios ecosistémicos. Sin embargo, una amenaza existente en el DRMI fue la presencia de zonas de pesca de arrastre para el camarón de aguas profundas (CAP), lo cual generó un conflicto entre pescadores artesanales e industriales. Con fines de resolver este conflicto, se aplicó el enfoque de ecosistemas para construir un acuerdo de pesca entre pescadores con presencia de las autoridades. Con base en información científica y cohesión social, se logró construir un acuerdo que permitió el arrastre desde 2015 con monitoreo participativo hacia metas dirigidas a reducir el impacto. Se fijaron los siguientes indicadores pesqueros con base en monitoreos a bordo históricos: a) estado del CAP (punto de referencia (PR): abundancia actual 82% de la abundancia máxima), b) relación captura objetivo versus fauna acompañante (PR: 75% de los lances < 1:3), y c) tipos de fondo (baja dureza: mayormente lisos y de arenas finas). Este impacto moderado de línea base, se espera reducir con las siguientes medidas concertadas: 1) Reducción del 42% en las áreas de arrastre, 2) Reducción en 50% del esfuerzo de pesca, 3) Reducción de un 34% en la duración de la temporada de pesca y 4) Cuota de pesca permisible equivalente a 68% el máximo rendimiento sostenible. Los indicadores permitieron evaluar las medidas concertadas que demostraron un mejor desempeño de la pesquería, hasta el punto que, en 2017, el acuerdo fue convertido en Resolución de la Autoridad Pesquera, reconociendo el éxito de la cogestión de esta pesquería.

PALBRAS CLAVES: Pesca industrial de arrastre, pesca artesanal, acuerdo de pesca

The Coral Sea Marine Park, Protecting a Vast Ocean and Reef Wilderness in the Pacific Ocean

El Parque Marino Coral Sea, Que Protege un Vasto Océano y un Arrecife en el Océano Pacífico

Le Parc Marin de la Mer de Corail, Protégeant un Vaste Océan et un Récif Sauvage dans l'Océan Pacifique

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ABSTRACT

The Coral Sea Marine Park is a protected and representative example of a relatively untouched ocean and reef wilderness. It covers 989,836 sq. km off the east coast of Australia in the Pacific Ocean. It borders neighboring Pacific Ocean islands of New Caledonia, Solomon Islands and Papua New Guinea. There are 34 reefs covering 15000 sq.km, and 56 cays and islets, many with low-profile vegetation, and significant seabird and turtle populations. With water depths down to 4000 m, these cays and islets are on top of ancient sea mounts separated by vast distances, making them isolated and unique. The Coral Sea Marine Park is managed by Parks Australia, an Australian government division that manages 58 MPAs. Since July 2018 under a 10-year MPA management plan, it is managed using four MPA zone types; National Park Zone (IUCN cat. II), Habitat Protection Zone (IUCN cat. IV), Habitat Protection Zone (Reefs) (IUCN cat. IV) and Special Purpose Zone (Trawl) (IUCN cat. VI). These zones were developed over many years of consultation, debate, science and politics, and strike a balance in conservation protection while allowing for sustainable use. There is a relatively low level of use, including commercial, charter and recreational fishing; dive tourism; shipping; research and some Indigenous use. Commercial and recreational fisheries are restricted to certain areas and include game fishing, tuna longline, demersal trawl, and hand collection of sea cucumber and aquarium fish. Mining, fish traps, and fishing nets are not allowed, and no other countries fish in the Marine Park. Only four people live in the Marine Park, staffing a weather station. Balancing the management of these uses has proven difficult and controversial despite the low levels of use relative to other coral reefs in Australia.

KEYWORDS: Marine Park, Coral Sea, MPA

An Assessment of Damages to the U.S. Virgin Islands Fishing Industry following Hurricanes Irma and Maria

Una Evaluación de Daños a la Industria Pesquera de las Islas Vírgenes de los Estados Unidos por los Huracanes Irma y María

Une Évaluation des Dommages à l'Industrie de la Pêche des Îles Vierges des États-Unis par les Ouragans Irma et Maria

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ABSTRACT

Category 5 Hurricanes Irma and Maria hit the U.S. Virgin Islands (USVI) on September 6 and September 20, 2017, causing significant impacts to the commercial and charter fishing industries. This included physical damage to equipment and infrastructure as well as substantial loss of income. With the assistance of the National Oceanic and Atmospheric Administration (NOAA), the U.S. Virgin Islands Department of Planning and Natural Resources' Division of Fish and Wildlife (DFW) conducted a rapid assessment to quantify the damages and losses to the fishing industry after the hurricanes. From October 27, 2017 to December 1, 2017, DFW surveyed 92 licensed commercial fishers, 18 charter fishers, and 9 fishing-related businesses. Fishers and businesses were surveyed about their damaged vessels, fishing gear, equipment, facilities, and potential revenue lost as a direct result of the storms. Estimated losses for each sector were calculated by multiplying the average reported loss per fisher by the number of registered or known fishers or businesses within that sector. In total, we estimated a loss of at least $8,035,947 from the date of the storms to the time of the assessment, which included a loss of $5,781,471 to the commercial fishery, a loss of $2,012,084 to the charter fishing industry, and a loss of at least $242,392 to fishing-related businesses. Additional lost income across the fishery is expected due to the closure of many hotels and restaurants and the reduction in tourism after the hurricanes. Based on this assessment, the USVI was awarded $10,727,596 from the Bipartisan Budget Act of 2018 and Disaster Relief Appropriations Act to assist in the recovery of the fishery, which will be disbursed in early 2019 to eligible fishers and fishing businesses as direct financial assistance.

KEYWORDS: Hurricane Irma, Hurricane Maria, U.S. Virgin Islands

Restoring Big Fish: Communication Strategy for Fish Spawning Aggregations Conservation and Management in the Wider Caribbean

Recuperando el Gran Pez: Estrategia de Comunicación para la Conservación y el Manejo de Agregaciones de Desove en el Gran Caribe

Restaurer Big Fish: Stratégie de Communication pour la Conservation et la Gestion de l'Agrégation des Reproducteurs de Poissons dans les Caraïbes

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ABSTRACT

As identified in the first and second meetings of the Western Central Atlantic Fishery Commission (WECAFC) Spawning Aggregations Working Group (SAWG) in 2013 and 2018, there is an urgent need to more effectively communicate the benefits of fish spawning aggregation (FSA) conservation and management to stakeholders throughout the wider Caribbean. Species, such as the Nassau grouper have suffered from unsustainable fishing at FSA sites contributing to population declines. To date, communication efforts to avert these threats have been largely localized. There is little unity in messaging, calls to action and shared vision despite the common mission among many communicators. Additionally, there are a number of quality standalone programs and products, but they can get lost in a sea of competing messages without a coordinated distribution network. At the 2018 meeting of the SAWG, members recommended developing a unified communication strategy that unites geographically disperse participants around a shared vision and a common story.

To meet this need, members formed a communications subcommittee of the SAWG. Lead by BelugaSmile, and with representatives from the region (all co-authors) the subcommittee is conducting a needs assessment and designing a unified regional outreach and communication strategy to support sustainable management and conservation of FSAs. The goal is to build a broad constituency of stakeholders, specifically fishers, consumers, decision makers and young people that can drive FSA conservation and management throughout the region.

We are starting with extensive research, collecting existing communications materials, identifying threats to FSA management, and conducting interviews with relevant fishers, scientists, policy experts and other stakeholders.

KEYWORDS: Big Fish, fish spawning aggregations, wider Caribbean

Discards of the Artisanal Shrimp Trawl Fishery in the Gulf of Salamanca, Colombian Caribbean Sea

Descartes de la Pesquería de Arrastre Artesanal de Camarón en el Golfo de Salamanca, Caribe de Colombia

Rejets de la Pêcherie Artisanale au Chalut de Crevette dans le Golfe de Salamanque, Caraïbes Colombiennes

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RESUMEN

Las pesquerías de arrastre que operan en las zonas tropicales capturan una cantidad elevada de organismos, de diferentes grupos taxonómicos, que no representan ningún valor económico para los pescadores y por tanto son devueltos al mar, generalmente muertos. Estos descartes han sido evaluados en diferentes pesquerías industriales del mundo, pero su conocimiento en las pesquerías artesanales es incipiente. Para caracterizar los descartes de la pesquería de arrastre artesanal que opera en el golfo de Salamanca (Caribe de Colombia), se evaluó la composición taxonómica, abundancia, frecuencia y tamaños de los organismos muestreados a bordo entre mayo y julio de 2018 (60 lances). Se registraron 68 taxa en 45 familias de peces, 9 de crustáceos, 3 de equinodermos, 2 de moluscos, 4 de bivalvos. Del total de las muestras analizadas, los peces representaron la mayor abundancia (77,3 %), seguidos por los crustáceos (13,5 %), los equinodermos (6,2 %) y gasterópodos (2,8 %). Los peces con mayor abundancia fueron *Anchoviella perfasciata* (15,62 %) y *Stellife*r spp. (13,36 %). En los crustáceos, dominó *Callinectes sapidus* (7,65 %) y en los equinodermos, *Luidia senegalensis* (4,01 %). Las especies más frecuentes en los lances evaluados fueron *Anchoviella perfasciata* y *Stellifer* spp.. El tamaño de los organismos analizados estuvo entre 0.10 cm y 64 cm. Algunos organismos de especies con importancia comercial hicieron parte del descarte debido a su pequeño tamaño corporal (e.g. *Bagre marinus, Hypanus guttatus, Melongena melongena*). Algunas especies descartadas están categorizadas con algún grado de amenaza, como *Cathorops mapale, Centropomus undecimalis, Eugerres plumieri, Hypanus americanus, Cetengraulis edentulus*. El presente trabajo es un aporte para el entendimiento del impacto de la pesquería de arrastre artesanal en la región.

PALBRAS CLAVES: Pesquería artesanal, diversidad, estructura comunitaria

Contamination of Marine Sediments by Microplastics and Adsorbed Organochlorine Pollution (Chlordecone) in Coral Reefs of Guadeloupe (Lesser Antilles)

Contaminación de los Sedimentos Marinos por Microplásticos y Poluciòn Organoclorada Adsorbida (Chlordecone) en los Arrecifes de Coral de Guadeloupe (Antillas Menores)

Contamination des Sédiments Marins par les Microplastiques et Pollution Organochlorée Adsorbée (Chlordecone) dans les Récifs Coralliens de Guadeloupe (Petites Antilles)

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ABSTRACT

Since the 1950s, the quantity of plastic being manufactured has continued to increase leading to a growing environmental problem. While macroplastics (plastics bags, bottles...) are easily detectable in marine areas, microplastics (particles <500µm) are invisible to the naked eye. Microplastics result from the degradation of macroplastics or are initially synthetized as microparticles. When ingested by marine organisms, these small pieces of plastics can block feeding appendages, hinder the passage of food through the intestinal tract or cause pseudo-satiation resulting in reduced food intake.

Microplastics are found in various aquatic environment (rivers, lakes and ocean) and different matrix (fauna, seawater). In the present study, the contamination of marine sediment in coral reef systems was investigated around Guadeloupe Island.

Among the three methods tested to extract microplastics from sediments, the use of a saturated solution of NaCl was found to be the most efficient one.

The number of microplastics, principally fibers, varied from 0.7 to 4.6 per gram of sediment and differed significantly according to the site. The level of contamination can be explained by the distance of the sites from harbors and urbanized areas.

Microplastics, as organic molecules, can adsorb hydrophobic pollutants ins seawater. In Guadeloupe, a part of the natural environment is impacted by chlordecone, a highly toxic organochlorine pesticide used in banana plantations until 1993. The adsorption of chlordecone on microplastics was studied on three sites and adsorbed chlordecone was found in all the samples analyzed. It is the first report of adsorbed chlordecone on microplastics in marine sediments on Guadeloupe and this observation suggests a new way of contamination of marine trophic food-webs.

KEYWORDS: Adsorption, plastic pollution, organochlorine pollution

Ultraconserved Elements Reveal an Indo-Pacific Origin of *Syngnatharia*

Elementos Ultraconservados Revelan un Origen Indo-Pacífico de *Syngnatharia*

Les Éléments Ultraconservés Révèlent l'origine Indo-Pacifique de *Syngnatharia*

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ABSTRACT

The ancestral history reconstruction of fish species based on genome-wide data opens up exciting and unprecedented opportunities to study the factors that explain the extraordinary diversity of marine fishes. The charismatic trumpetfishes, goatfishes, dragonets, sea horses, and allies, encompass a recently signed and extraordinarily diverse percomorph group—the *Syngnatharia*. These reef-associated species are of particular interest for marine biogeographic analyses because of their limited dispersal capabilities. Furthermore, with many of its species threatened due to bycatch and habitat alteration in tropical to temperate waters, *Syngnatharians* encompasses several potential priorities for conservation. Here, we present a new phylogenetic time tree for of 183 *Syngnatharia* species using 932 ultraconserved elements (UCEs), and also provide remarkable insights into their biogeographical history. Our results are widely congruent with previous phylogenetic hypotheses, showing a temporal association of the origin of major lineages in the wake of the K-Pg mass extinction (65 Ma). Additionally, our biogeographical analysis strongly supports an Indo-Pacific origin that subsequently radiated into Eastern Africa, the Red Sea, and the Eastern and Western Atlantic Ocean. All in all, we provide the most comprehensive phylogenic assessment to date for *Syngnatharians* and describe the surprising historical diversification patterns of this clade, the history of which involves multiple independent colonizations of Africa and the New World. This study would potentially form the basis for addressing future management and conservation efforts of the global marine reserves inhabited by myriad species of *Syngnatharia*.

KEYWORDS: *Syngnatharia*, historical biogeography, phylogenomics

What Has Happened to South Florida's Bonefish? A Multidisciplinary Approach to Understand the Decline of Recreational Fisheries

¿Qué le Ha Pasado al Bonefish del Sur de la Florida? Un Enfoque Multidisciplinario para Comprender el Declive de lLa Pesca Recreativa

Qu'est-Il Arrivé aux Bonefish du Sud de la Floride? Une Approche Multidisciplinaire pour Comprendre le Déclin de la Pêche Récréative

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ABSTRACT

Flats fisheries support valuable socioeconomic activities and are increasing in popularity as a key component of conservation practices. Despite their high value, population assessments and ecological studies are limited, and key information on life history dynamics are lacking. In the past decades, recreational catches of bonefish (Albula vulpes) have decreased significantly throughout South Florida (SFL). The mechanisms driving these declines are unknown, yet concerning given the socio-economic value of the fishery. Here we asked: 1) What are the spatiotemporal patterns of bonefish throughout SFL? and 2) What factors could be driving this decline? We used a combination of fisheries-dependent data (FDD) and local ecological knowledge (LEK) to assess the nature of the temporal trend (i.e., gradual vs. punctuated decline) in bonefish abundance in SFL. We also used different statistical modeling approaches to examine the relative importance of water quality, climatic parameters and habitat dynamics in driving bonefish numbers. Both FDD and LEK assessments pointed to the decline in bonefishing in SFL since the early 1980s, as well as, an accelerated decline that started since the late 90s-early 2000s that resulted in an overall 42% and 60% reduction in catch and perceived bonefishing quality. The results also show that the core of bonefishing significantly shifted southward over time. Over the 35 years of data, the bonefish timeline tracks the changing climate and hydrology of Florida Bay. Also, we captured evidence of causation for high temperatures and fishing pressure. These results point to the need for bonefish conservation efforts to encompass both juveniles and adults, to tackle both local and regional factors, and to consider the stronger connection between healthy bonefish fisheries and coastal water management.

KEYWORDS: Recreational fisheries, time series analysis, online survey

Evaluation of Artisanal Fishing (Years 2004 to 2017) and Proposals for Sustainable Management, Southern Area of the Seaflower Biosphere Reserve - Colombian Caribbean

Evaluación de la Pesca Artesanal (Años 2004 a 2017) y Propuestas de Manejo Sustentable, Zona Sur de la Reserva de Biosfera Seaflower - Caribe Colombiano

Évaluation de la Pêche Artisanale (Années 2004 à 2017) et Propositions pour la Gestion Durable de la Zone Sud de la Réserve de Biosphère Seaflower - Caraïbes Colombiennes

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RESUUMEN

Se analizó la producción y la dinámica de la pesca artesanal entre los años 2004 a 2017, realizada por los pescadores de la isla de San Andrés - Reserva de Biosfera Seaflower Caribe Colombiano, con el propósito de establecer el estado de los recursos pesqueros y aportar medidas de manejo. La información pesquera fue muestreada en los sitios de desembarco, por el personal de la Secretaria de Agricultura y Pesca del Departamento Archipiélago de San Andrés, Providencia y Santa Catalina. La captura total entre 2004 y 2017 en San Andrés, presentó una variación entre 441.3 a 249.8 toneladas y correspondió a un 97,7% peces, 1,6% moluscos y 0,7% crustáceos. En el análisis multitemporal para peces, el esfuerzo promedio anual del arte de línea de mano fue de 4048 faenas (días), siendo el año 2009 en el cual se registró mayor actividad (7532 faenas). La Captura por Unidad de Esfuerzo (CPUE), presentó valores altos máximos para el año 2007, 2012 y 2013; los periodos 2008 al 2011 y 2015 al 2017 presentan descensos de la CPUE, mostrado un aumento del esfuerzo, lo cual revela indicios de sobrepesca. Se presentó poca abundancia interanual de los invertebrados, siendo los principales recursos el caracol pala Lobatus gigas y la langosta Panulirus argus. Éstas especies fueron extraídas mediante buceo a pulmón con esfuerzo promedio anual de 231 faenas, pero se presentan varios años con relaciones de la CPUE hacia la sobrepesca. El análisis por tallas de las principales especies de peces muestra una tendencia hacia la captura de juveniles, pero al tratase de pesquerías multiespecies, las medidas de manejo requieren ser concertadas con los pescadores para que se logren y hacer sustentables la pesca.

PALABRAS CLAVES: Peces del Caribe, sustentabilidad, pesca artesanal

Fish Communications and Associated Behaviors: Additions to the Acoustic Repertoire of Groupers that Aggregate to Spawn

Comunicaciones de Peces y el Comportamiento Asociado: Complementos al Repertorio Acústico de los Meros que Forman Agregaciones Reproductivas

Communications du Poisson et Comportements Associés: Ajouts au Répertoire Acoustique des Mérous Reproducteurs

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ABSTRACT

The apparent importance and ubiquity of acoustic communication in fishes has prompted continued efforts to identify new sounds and their behavioral relevance during different life stages. Recent developments in the study of sounds at fish spawning aggregation (FSA) sites have increased our understanding of the acoustic repertoire of various species of groupers (Family Epinephelidae) and their potential utility for monitoring associated behaviors. Through a combination of long-term, captive, and synchronous audio and video recordings, we identified new species-specific sounds, with properties that are characteristic of the family, produced by red hind (Epinephelus guttatus), Nassau grouper (E. striatus), and Gulf grouper (Mycteroperca jordani) during a suite of behaviors. Red hind are capable of producing at least 5 types of sounds in captivity, Nassau grouper have at least three types of sounds characterized with known behavioral contexts, including courtship, distress, and agonistic behaviors observed with video. Male Gulf grouper produce at least two types of tonal sounds during reproductive periods at FSAs including sounds targeted at prospective mates during courtship behaviors and notably during spawning rushes. These findings indicate that sounds are significant components of their mating systems and can be used to monitor spawning activity. The documentation of new sounds coupled to specific behaviors highlights the importance of acoustic communication in groupers while providing a new source of data available to researchers to better understand the often cryptic behaviors of fishes and the acoustic dynamics of FSAs.

KEYWORDS: Acoustic, communicaiton, grouper

Deeper Water Fauna Revealed Incidentally by the Puerto Rico Fishery

La Fauna de Aguas Profundas Capturada Incidentalmente por la Pesquería de Puerto Rico

Le Faune Plus Profonde Capturée Accidentellement dDans la Pêcherie de Porto Rico

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ABSTRACT

Rocky reef habitats of deep (50 to 500 m) insular slopes of the Caribbean support a diverse assemblage of fishes. In Puerto Rico these areas support a highly valuable fishery, yet information regarding the biodiversity of these habitats is scarce. The purpose of this study is to document the species composition as well as the abundance and distribution of fish captured by the commercial fishery in three regions off Puerto Rico. Collections of specimens were made from landings and during standardized fisheries-independent surveys of vertical hook and line gear of 300 sites selected in a random stratified (depth and two habitat types) approach. Trained observers collected data on the size (fork length and girth) of each fish caught and kept specimens or tissue samples for species identification via DNA barcoding. Preliminary results revealed at least 42 species, 34 of 17 fish families and eight shark species of eight families. Of the species documented 12 (seven snappers and five groupers) are targeted for local markets and the remaining species could be considered incidental catch, some of which are landed and marketed, yet others are discarded. Some of these fish are well recognized by fishers and have local common names, yet they could include new reports for the region. The resulting collections will provide much needed specimens that expand the current knowledge of deep-water species and could help delineate strategies to reduce incidental catches. Characterizing the fish community subject to capture from mesophotic, rariphotic and upper aphotic habitats provides information that could be applied towards ecosystem-based management in the region.

KEYWORDS: Biodiversity, deep-water, incidental

Swordfish Mangement: How One Exemption Could Impact a Decade Long Management Techniques' Success

Gestión del Pez Espada: Cómo Podría Impactar una Exención en la Técnica de una Gestión de una Década de Duración

Espadon Mangement : Comment un Exemption est Susceptibles d'Influer une Décennie Succès des Techniques de Gestion

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ABSTRACT

Swordfish are Highly Migratory Species (HMS) targeted recreationally and commercially. In recent years these fish have faced population declines along parts of the Atlantic Ocean, specifically of the coast of Florida. Following the collapse to swordfish in the late 1980's, as well as the 23%of bycatch caused from the commercial swordfish longlining industry, there was a longline fishing moratorium marine protected area (MPA) implemented known as the East Florida coast Atlantic Pelagic Longline closure area which banned longlining within a certain area off the coast of Florida (Keledjian, et al., 2014). This specific area was chosen as the closure area due to its importance in swordfish spawning.

The closure area was implemented to decrease bycatch from commercial longliners and improve swordfish stocks is now being threatened by a potential Exempted Fishing Permit (EFP) to determine if the conservation method has been successful. While less destructive techniques are available, the EFP will be utilizing the same technique that has been proven to catch juvenile swordfish and an abundance of bycatch.

To understand the potential impacts of an EFP may have, it is best to look at comparable fishery management techniques and management policies as well as geographical information systems to study migration behavior and stock numbers to estimate potential impacts such an EFP may have. A healthy fishery, ecosystem and recreational fishing industry relies heavily on a sustainable populations and access to fishing grounds not disturbed by large-scale commercial fishing. A decision like this allowing an EFP could have harmful lasting effects and potentially impact how other fisheries are managed globally.

KEYWORDS: Swordfish, MPA, fishing

Migratory Behavior and Spawning Site Fidelity of Male Tiger Grouper (*Mycteroperca tigris*) Based on Acoustic Tagging at a Spawning Site on Little Cayman, Cayman Islands

Comportamiento Migratorio y Fidelidad del Sitio de Desove del Tiger Grouper (*Mycteroperca tigris*) Basado en el Marcado Acústico en un Sitio de Desove en Little Cayman, Cayman Islands

Comportement Migratoire et Fidélité au Site de Fraie du Mérou Tigre Mâle (*Mycteroperca tigris*) sur la Base d'un Marquage Acoustique sur une Frayère de Little Cayman, Cayman Islands

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ABSTRACT

Tiger Grouper (*Mycteroperca tigris*) aggregate to spawn around the winter full moons (typically in January and February) in the central Caribbean. Like other aggregating grouper species in the Caribbean, fisheries target Tiger Grouper during spawning, and prior studies have documented rapid declines in aggregations due to harvest. However, in a regional context, it is not clear how localized aggregation fisheries impact Tiger Grouper populations, because the catchment area of such aggregations is not known. As part of the Grouper Moon Project in the Cayman Islands, we acoustically tagged male aggregating Tiger Grouper during the 2015 spawning season on Little Cayman Island. Using an array of hydrophones surrounding the island, we subsequently tracked the movements of tagged fish over a 9-month period. Here, we report on the apparent duration and catchment area of the Tiger Grouper aggregation, including characteristics of the migratory behaviors of individuals. We also compare and contrast these behaviors with other grouper species (e.g. Nassau Grouper; *Epinephelus striatus*) that concurrently use the spawning site.

KEYWORDS: Fish spawning aggregation, Vemco, acoustic tagging

Environmental Education for Better Knowledge Management of Coral Reefs and Climate Change: Reflections from the National Aquarium of Cuba

Educación Ambiental para una Mejor Gestión del Conocimiento de los Arrecifes Coralinos y el Cambio Climático: Reflexiones desde el Acuario Nacional de Cuba

Education Environnementale pour une Meilleure Gestion des Connaissances sur les Récifs Coralliens et le Changement Climatique: Réflexions de l'aquarium National de Cuba

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ABSTRACT

"Environmental Education" searches to harmonize the relationships that are established between man and environment, promoting actions to guarantee a better use of the natural resources. The experience reached by Cuba in the field of Environmental Education is high; there are a great number of institutions that contribute with their actions to eliminate or to minimize the existing environmental problems in fishing communities as well as the sustainable exploitation of the fishing resources. At present, island countries are subject to the effects of climate change and marine ecosystems suffer damages that in some cases are irreversible. The present work reveals the results obtained from the application of an environmental education program in fishing communities of the western region of the Cuban archipelago, based on knowledge management linked to coral reefs and climate change. A methodology of scientific investigation -action- participation is applied.

KEYWORDS: Environmental education, knowledge management, coral reefs

Bonefish (*Albula vulpes*) Restoration Research Program: Reproduction and Early Life Stage Studies of Bonefish in Wild and Aquaculture Systems

Programa de Investigación de Restauración de Macabi (*Albula vulpes*): Reproducción y Estudios de Etapas Tempranas de Vida de Macabi en Sistemas Silvestres y Acuícolas

Programme de Recherche sur la Restauration du Banane de Mer (*Albula vulpes*): Études sur la Reproduction et le Stade Précoce du Banane de Mer dans les Systèmes Sauvages et Aquacoles

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ABSTRACT

The decline in bonefish (*Albula vulpes*) populations in the Florida Keys over recent decades has led to a wide-ranging series of studies to identify reasons for the decline, and potential mechanisms to help restore populations of this valuable recreational fishery species. As part of this effort, a 5-year Bonefish Restoration Research Program was developed to examine the reproduction and early life stages of the species in both wild and aquaculture systems. The ultimate goals of the Program are to develop methods to spawn bonefish in aquaculture facilities, learn to grow their unusual leptocephalus larvae, and produce juveniles. Studies on larvae will include feeding, growth and behavioral analysis to help refine larval production and oceanographic transport models to identify connectivity among Caribbean, Bahamian and Florida habitats. Wild juveniles are rarely found in Keys habitats at present, so cultured juveniles will be used in caging experiments to identify suitable juvenile nursery conditions for these animals and thus help direct habitat restoration efforts in the Keys and other regions. Artificial stock enhancement, however, is not a project goal. Results to be presented from the first 2 years of the study include 1) evaluation of annual cycles of hormones in wild fishes and egg quality data that are being used to help bring captive populations into successful reproductive condition; 2) assessment of supplemental reproductive hormones to trigger final gonadal maturation and ovulation of wild-caught and cultured fishes; 3) description of embryonic and early larval development; 4) initial efforts at development of suitable foods for the leptocephalus larvae, and 5) laboratory acclimation and growth rates of wild-caught juvenile A. goreensis, as a proxy for upcoming studies on cultured *A. vulpes*.

KEYWORDS: Bonefish, *Albula vulpes*, aquaculture

Genetic Population Dynamics and Management of Nassau Grouper Within the Bahamas

Dinámica de Población Genética y Gestión de Nassau Grouper Dentro de las Bahamas

Dynamique de la Population Génétique et Gestion du Groupe Nassau au Sein des Bahamas

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ABSTRACT

The exploitation of fish spawning aggregations (FSAs) has contributed to substantial declines in abundance of Nassau grouper (*Epinephelus striatus*), an important marine predator, naturally distributed throughout The Bahamas and Caribbean. Evaluating the capacity of fish species to withstand exploitation when faced with both stochastic natural and anthropogenic stressors is of critical importance for improving fisheries management. Progress in the field of molecular biology and population genetics have proven very useful in this regard. In the present study, a panel of 15 polymorphic microsatellite loci was optimised and used to investigate genetic population structure, diversity and differentiation, provide the first estimates of effective populations size (Ne), and determine whether bottlenecks have impacted contemporary populations of Nassau grouper sampled throughout the Bahamian archipelago. Nassau grouper fin clips were collected during August 2014 – January 2017 from 12 islands and an active FSA (sampled over three spawning seasons). Results from DNA microsatellite analysis of 454 genotyped Nassau grouper suggest weak genetic differentiation (Global FST 0.00236, p = 0.0001), no geographic structure and similar levels of diversity. VarEff analysis of temporal changes in Ne over the last 1,000 generations show significant reductions in Ne compared to historic values that are probably due to past climatic disturbances which impacted The Bahamas. Recent bottlenecks observed in three islands as well as an active Nassau grouper FSA are likely to have been caused by more recent anthropogenic impacts (e.g., FSA fishing and habitat degradation). This research has provided new information that can contribute to future monitoring assessments and advancing the management of critically endangered Nassau grouper stocks.

KEYWORDS: Bottleneck, effective population size, fish spawning aggregation

A Regional Approach to Facilitate Co-management of FAD Fisheries in the Caribbean

Un Enfoque Regional para Facilitar el Co-manejo de Recursos Pesqueros con Dispositivos de Agregación de Peces en el Caribe

Une Approche Régionale oour Faciliter la Co-gestion des Pêcheries sous FAD dans les Caraïbes

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ABSTRACT

In the Caribbean, active government management of fisheries is relatively recent and generally based on the premise of strong government control of rules and procedures, with limited awareness of the current or potential role of fishers in management. At the same time, the capacity of Caribbean governments to make and enforce rules that effectively improve fisheries management is often weak. Co-management, in principle, has the potential to improve governance outcomes by strengthening the consideration given to fishers' knowledge and their capacity for individual and collective action in the management system. Various fisheries co-management initiatives have been pursued in the Caribbean since the 1990's. A recent program called Caribbean Fisheries Co-management (CARIFICO) supported by partnerships among the Japan International Cooperation Agency (JICA) the Caribbean Regional Fisheries Mechanism (CRFM) and the governments of six eastern Caribbean islands took a flexible and holistic approach in adapting a set of mutually reinforcing activities to local circumstances to expand and facilitate co-management of the offshore FAD fishery. This presentation will describe key elements of CARIFICO's planning, implementation and evaluative components emphasizing strategies undertaken to build synergies among government and fisher stakeholders at local (national), sub-regional and regional geographic scales.

KEYWORDS: Co-Management, Fish Aggregation Device, governance

Identification of Marine Emblematic and Charismatic Species, a Sociocultural and Ancestral Approach for the Indigenous Community of Taganga-Colombian Caribbean

Identificación de Especies Marinas de Tipo Bandera y Carismáticas, una Aproximación Sociocultural yAncestral para la Comunidad Indígena de Taganga-Caribe Colombiano

Identification d'Espèces Emblématiques et Charismatiques Marines, ane Approche Socioculturelle et Ancestrale pour la Communauté Indigène de Taganga-Colombie Caraïbes

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ABSTRACT

The indigenous community of Taganga is located in the foothills of the Sierra Nevada de Santa Marta and Tayrona National Park. Taganga is a place recognized for its fishing importance at the regional level, most of its inhabitants have dedicated themselves to the exclusive use of ancestral artisanal fishing and another minority to tourism. Since the creation of the council of the Greater Indigenous Council of Taganga, various exercises have been carried out aimed at recognizing species of sociocultural and ancestral importance for this community that has remained for more than 200 years in this region of the Colombian Caribbean. Bibliographic reviews were carried out and these species were identified through interviews and observation of these species in their natural environment and the relationship that exists with the indigenous community. The six most representative species for this community were: The Bonito (*Euthynnus alletteratus*) Brain Coral (*Diploria* sp.) Snail Pala (*Lobatus gigas*) The Gallinazo (*Coragyps atratus*) The Cachorreta (*Auxis thazard thazard*) and the parrotfish (*Sparisoma viride*). It is vitally important to identify these species as part of a conservation and protection process for marine ecosystems, because of their cultural significance and the role they play for the ethnic recognition of the members of the indigenous council, and in this way to initiate the activities focused on the creation of conservation programs that can be carried out to contribute to the repopulation of these species.

KEYWORDS: Specie, fishing, indigenous

Identification of Marine Emblematic and Charismatic Species, a Sociocultural and Ancestral Approach for the Indigenous Community of Taganga-Colombian Caribbean

Identificación de Especies Marinas de Tipo Bandera y Carismáticas, una Aproximación Sociocultural yAncestral para la Comunidad Indígena de Taganga-Caribe Colombiano

Identification d'Espèces Emblématiques et Charismatiques Marines, ane Approche Socioculturelle et Ancestrale pour la Communauté Indigène de Taganga-Colombie Caraïbes

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ABSTRACT

The indigenous community of Taganga is located in the foothills of the Sierra Nevada de Santa Marta and Tayrona National Park. Taganga is a place recognized for its fishing importance at the regional level, most of its inhabitants have dedicated themselves to the exclusive use of ancestral artisanal fishing and another minority to tourism. Since the creation of the council of the Greater Indigenous Council of Taganga, various exercises have been carried out aimed at recognizing species of sociocultural and ancestral importance for this community that has remained for more than 200 years in this region of the Colombian Caribbean. Bibliographic reviews were carried out and these species were identified through interviews and observation of these species in their natural environment and the relationship that exists with the indigenous community. The six most representative species for this community were: The Bonito (*Euthynnus alletteratus*) Brain Coral (*Diploria* sp.) Snail Pala (*Lobatus gigas*) The Gallinazo (*Coragyps atratus*) The Cachorreta (*Auxis thazard thazard*) and the parrotfish (*Sparisoma viride*). It is vitally important to identify these species as part of a conservation and protection process for marine ecosystems, because of their cultural significance and the role they play for the ethnic recognition of the members of the indigenous council, and in this way to initiate the activities focused on the creation of conservation programs that can be carried out to contribute to the repopulation of these species.

KEYWORDS: Specie, fishing, indigenous

Characterization of Isla Arena's Reef Community Through the Use of Aerial Images and Actualization of its Ecological Units

Caracterización de la Comunidad Arrecifal de Isla Arena Mediante el Uso de Imágenes Aéreas y actualización de sus Unidades Ecológicas

Caractérisation de la Communauté Arrecifale de Isla Arena par l'Utilisation D'images Aériennes et Actualisation de ses Unîtes Écologiques

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RESUMEN

La toma de imágenes aéreas mediante drones es una técnica remota de alta resolución para captar gran cantidad de información, sin intervención y mostrar el estado actual de los ecosistemas. Adicionalmente, mediante sistemas de información geográfica (SIG) se procesan y analizan los datos de la información georreferenciada. Isla Arena es un pequeño bajo ubicado a pocos metros de la costa en la ensenada de Amansaguapos en el municipio de Bolívar, Colombia. El islote se caracteriza por tener una formación coralina circundante bien desarrollada a pesar de presentar una fuerte influencia sedimentaria del río Magdalena. Solo se cuenta con el estudio realizado hace 20 años en el cual se determinaron aspectos estructurales de las unidades ecológicas (UE) en términos de cobertura y composición. El objetivo de este trabajo es evaluar las variaciones de las UE en la formación arrecifal somera circundante a Isla Arena, mediante la estimación de cobertura usando imágenes aéreas y herramientas SIG. La evaluación se realizó bajo métodos similares aplicados hace dos décadas, en adición a la implementación de la metodología de nueva generación para hacer descripciones de ambientes marinos. Cerca de 1500 fotografías aéreas fueron tomadas a 100 m y 30 m de altura y se construyó un mosaico de la isla y su formación adyacente, en el cual se identificaron las especies sésiles contribuyentes a la cobertura y por ende a las UE. Se hizo una verificación en campo de las especies construyendo una librería con puntos georeferenciados. Con el software ArcMAP se cuantificarán y determinarán las UE. Se ha encontrado una disminución en corales (21%), zoantidos (63%) y pastos marinos (21%), el aumento de algas coralináceas (78%) y la aparición de esponjas. Acropora palmata se redujo en un 26% de cobertura y Acopora cervicornis desapació del bajo.

PALABRAS CLAVES: Unidades ecológicas, comunidad sésil, sensores remotos

Mangroves, Sea-grasses and Local Communities: Governance and Experiences Exchange of the Integral Management of Biodiversity and its Services at the Caribbean (MAPCO)

Manglares, Pastos Marinos y Comunidades Locales: Desarrollo e Intercambio de Experiencias de la Gestión Integral de la Biodiversidad y sus Servicios en la Región Caribe (MAPCO)

Mangroves, Praires Sous-marines et Communautés Locales: Développement et Échange d'Expériences sur la Gestion Intégrale de la Biodiversité et de ses Services dans la Région des Caraïbes (MAPCO)

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RESUMEN

Colombia catalogada entre los países más diversos del planeta, tiene su biodiversidad amenazada por presiones naturales y antrópicas. Conscientes de su ubicación en el Caribe Occidental, con las evidencias de la productividad y potencialidad de servicios ambientales de manglares y pastos marinos, se propone esquema de articulación autoridades ambientales y comunidades locales apoyada por conocimiento científico, para administrar los servicios ecosistémicos, el mejoramiento de medios de subsistencia y seguridad alimentaria; identificando dónde, cómo, con quién, cuándo y con qué herramientas de planeación implementar acciones para la gobernanza, el cumplimiento de metas Aichi, B4Life y el Desafío Caribeño. Los principales resultados tienen que ver con: i) incremento en las hectáreas de ecosistemas marinos y costeros bajo protección y restauración; ii) bases técnico-científicas para el diseño de iniciativas de "Carbono Azul" con participación de las comunidades, en pastos marinos (La Guajira aprox. 56424 ha) y manglares en el DMI-Cispata con 8500 ha (aprox. 27.536 ton CO_2/año almacenadas); iii) bases para diseño de medidas de adaptación basadas en ecosistemas, desarrollo de planes de negocios ecoturismo con participación comunitaria, mejoramiento en mediano y largo plazo de la gestión de pesca y su cadena de valor y construcción de escenarios de concertación para acuerdos sobre medidas de manejo entre comunidades y autoridades locales; iv) intercambio de experiencias entre comunidades, colaboración y aprendizaje entre proyectos en la Región generando cambios en el comportamiento que contribuyan a la conservación y uso sostenible de manglares, pastos marinos y sus servicios. Esta acción es co-financiada por Unión Europea ENV/2016/380-256, ejecutada por INVEMAR, Fundación Natura, Comunidades y autoridades ambientales.

PALABRAS CLAVES: Manglares-pastos marinos, servicios ecosistemicos, comunidades

Women at Work in the Barbados Fishing Industry: Fortunes of a Female Forklift Driver

Mujeres que Trabajan en la Industria Pesquera de Barbados: El Éxito de una Operadora De Montacargas

Femmes qui Travaillent dans la Filière Pêche à la Barbade: Le Succès d'une Opératrice de Chariot Élévateur

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ABSTRACT

"I am a leading lady in the Barbados fishing industry"—is how Eutavine Weekes summed up her achievement from a continuing 27-year career in the Barbados fisheries sector. This lady took on a gendered role in the fishing industry in the late 1980s as the only female crane and forklift operator working with the Ministry of Agriculture at the Bridgetown Fisheries Complex; a job she "enjoyed 120%." While men related well to her, she experienced least acceptance from women who culturally had strong opinions about a woman working in "a man's field." As a fish market forklift driver she was responsible for moving diverse heavy loads, loading and offloading fishing boats, moving ice for fish storage and loading fish for export onto trucks for transfer to the airport. Eutavine supplemented her formal income through household work with seafood. She helped support her children through school by scaling, boning and selling flyingfish; making fish seasoning at home; and frying fish and chips for sale on weekend nights. Shift work and a social network of neighbours and friends allowed Eutavine to balance family life, household work and formal work. Now promoted to supervise a fruit and vegetable market, she "would prefer to go back to forklifting any day" since managing people is challenging. She has asked for a transfer back to the fishing industry. Eutavine encourages any young person to learn a skill, particularly forklift operation, and engage in the fishing industry. It is not an occupation of last resort. Sharing stories of women's fisheries livelihoods is research by the Gender in Fisheries Team (GIFT) to document and mainstream gender in Caribbean fisheries to help implement the international Small-Scale Fisheries Guidelines.

KEYWORDS: GIFT, gender role, Caribbean

The CBF's Ecosystem based Adaptation Facility: Building Resilience and Reducing Risk for Caribbean People to Climate Change through Natural Resources Management and Ecosystem Services

Fondo de Adaptación al Cambio Climático del Fondo Caribeño para la Biodiversidad: Construyendo Resiliencia y Reduciendo Riesgo ante el Cambio Climático de las Comunidades del Caribe a través de la Gestión de los Recursos Naturales y los Servicios Ecosisté

Fonds pour l'Adaptation aux Changements Climatiques du Fondation des Caraïbes pour la Biodiversité: Renforcer la Résilience et Réduire les Risques pour le Changement Climatique des Communautés des Caraïbes Grâce à la Gestion des Ressources Naturelles

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ABSTRACT

The presentation highlights the Caribbean Biodiversity Fund (CBF), its Ecosystem based Adaptation (EbA) Facility and the link with the Caribbean Challenge Initiative (CCI) for collaborative action to assist communities to adapt to the effects of climate change through sustainably managing the Caribbean's marine and coastal natural resources.

The Caribbean marine and coastal ecosystems and accompanied biodiversity are major contributors to the region's economies, food security and water supply. Local communities, the majority of whom live in the coastal areas, are direct beneficiaries both in terms of livelihoods and quality of life. However, the Caribbean's natural resources and people are under growing threat from climate change and unsustainable development

The CCI and CBF are partnership initiatives to assist in providing solutions to these problems. The CBF's endowment fund, which currently stands at US$43 million, works in partnership with independent National Conservation Trust Funds. In addition to its endowment fund, and in partnership with the German government through KfW, the CBF established a US$26.5 million EbA Facility as a sinking fund. This facility will assist eligible countries, to help people to adapt to the adverse effects of climate change through the restoration and use of biodiversity and ecosystem services.

The CBF's EbA Facility has identified a range of potential partners to assist in implementation through grant agreements. These include government departments/agencies, non-governmental organizations, community-based organizations, conservation trust funds, private sector companies and academia. It is anticipated that the first set of grants will be issued in mid-2019 following a selection process initiated through a public call for proposals released later this year.

KEYWORDS: Climate change, EbA, resilience

The Seaflower Scientific Expeditions as a Strategy for the Monitoring and Appropriate Management of Fishing Resources

Las Expediciones Científicas Seaflower como Estrategia para el Monitoreo y Manejo de los Recursos Pesqueros

Les Expéditions Scientifiques de la Seaflower en Tant que Stratégie de Suivi et de Gestion des Ressources Halieutiques

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ABSTRACT

The Seaflower Scientific Expedition, is the most ambitious program of the Colombian Government to increase research and improve the concept of ecosystem integrity in the largest marine Biosphere Reserve in the Colombian Caribbean, Seaflower. These expeditions, planned annually until 2023, are product of multiple stakeholder's collaborative work to generate systematic investigation in the 180000 km^2 of the San Andrés, Providencia and Santa Catalina Department Archipelago. Using the best technology available in the country and involving scientist from different marine science branches, the Seaflower Scientific Expedition has been carried out since 2014, in which more than 20 scientists are working on projects related with fish ecology, diversity and management. Additionally, other fishing resources such as the queen conch (*Lobatus gigas*) and the Caribbean spiny lobster (*Panulirus argus*), characterized for being within the most important resources in the Archipelago, have been monitored in the Island Cays of Roncador, Quitasueño, Serrana, Serranilla, Providencia and San Andres. All these efforts focused on contribute with the management and sustainable development that promotes the UNESCO "Man and Biosphere" program, which recognized Seaflower as a Biosphere Reserve in 2000. The Seaflower Expeditions, are the best example of science cooperation, because it congregates different kind of institutions and organizations with one purpose: understand the Colombian sea and its insular systems with a holistic view, for its appropriate management to meet successfully the World Sustainable Development Goals.

KEYWORDS: Expedition, systematic investigation, *Lobatus gigas*

Best Practices for Caribbean Fishers Coping with *Sargassum* Influx Events

Mejores Prácticas para los Pescadores del Caribe que se Enfrentan a los Eventos de Afluencia de *Sargazos*

Meilleures Pratiques pour les Pêcheurs des Caraïbes Confrontés aux Événements D'afflux de *Sargassum*

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ABSTRACT

Since 2011, islands in the Eastern Caribbean have been experiencing *Sargassum* influx events negatively impacting fisheries and tourism sectors, and causing substantial damage to Caribbean economies. These events have triggered much speculation about the impact on small-scale fishers' livelihoods and their ability to cope and adapt to present and future *Sargassum* influx events. Conceptually, enhancing adaptive capacity and enabling self-organisation are key dimensions in developing resilience in fisheries social-ecological systems. In this study, we present the challenges facing Caribbean fishers during *Sargassum* events, and provide a summary of recommendations provided by fisherfolk for coping and adaptation. This information was obtained primarily through interviews with key informants (small-scale commercial and recreational fishers, fisherfolk organization representatives and fishery managers) in several eastern Caribbean islands. The intention is to produce a best practice handbook for the fisheries sector that includes effective social and technological innovations and strategies tailored to specific fisheries. The strategies range from simple, low cost fishing techniques to more advanced technological innovations, to adaptive strategies that can be employed at landing sites and out to sea. We anticipate that the handbook will be a useful addition to the existing knowledge base on management of *Sargassum* in the Caribbean by increasing the resilience of fishers through knowledge sharing and the promotion of innovative solutions.

KEYWORDS: *Sargassum*, impacts, Caribbean

Early Detection and Drift Forecast of Floating *Sargassum* Algae in the Caribbean Region

Detección Temprana y Pronóstico de Deriva de Algas de *Sargazo* Flotante en la Región del Caribe

Détection Précoce et Prévision de la Dérive des Algues *Sargasses* Flottantes dans la Région des Caraïbes

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ABSTRACT

Massive landings of *Sargassum* are regularly registered since 2011 along the shorelines of a huge area encompassing French Guyana, the Antilles and Caribbean Sea. Algae arrive from the open sea as large rafts (tenths of km) after drifting over long distances in the Central Atlantic NERR, and accumulating in consolidation areas in the Brazil retroflexion current and probably the Gulf of Guinea. 2018 is far the worst year in terms of *Sargassum* landings on Caribbean shorelines. Washing-ashore has tremendous negative impacts on local populations, coastal marine ecosystems and the economy sector, especially tourism and fisheries are severely affected.

CLS has been working in remote sensing and monitoring of *Sargassum* in the Caribbean Islands since 2015. NBE has been providing Sargassum forecast bulletins to the local French environmental office (DEAL) in Guadeloupe since 2013.

In 2018, the consortium CLS-NBE has been awarded a project with the ESA (European Space Agency) to implement an innovative service to monitor floating *Sargassum* algae in the Caribbean area.

This project will allow:

(1) using of synergy of Earth Observation imagery to detect drifting Sargassum rafts in the open sea: Sentinel-1, Sentinel-2, Sentinel-3 MODIS-Aqua. *Sargassum* index (FAI) is computed on all these sensor data and released every day.

(2) Set up an innovative Sargassum drift modelling approach to forecast the position of detected rafts and eventually their likely landing areas along the coastline.

(3) Disseminate results through an operational web platform for easy user information access .

(4) CLS-NBE will engage with local communities of end-users willing to participate to the assessment of the service.

The service will provide a generic support to decision-making processes in all sectors impacted by the Sargassum issue.

KEYWORDS: *Sargassum,* web platform, satellite imagey

A SMARTer Approach to Collection of Catch Data for Conservation and Sustainability

Un Enfoque que Utiliza SMART para la Recopilación de Datos de Captura para la Conservación y la Sostenibilidad

Une Approche Utilisant SMART pour Collecter des Données de Capture pour la Conservation et la Durabilité

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ABSTRACT

Small-scale fisheries based around tropical reef ecosystems are critical to local livelihoods, food security and export earnings in many developing nations. However, the activities of small-scale fisheries are notoriously difficult to assess given the existence of numerous landing sites, the dynamic multi-species and multi-gear nature of extractions and the limited funding and personnel available to local resource managers. The recognition of these realities by governments and conservation organizations mandates improving data collection systems for successful biodiversity protection, sustainable fisheries and poverty alleviation. Specifically, there is a clear need for simple and effective electronic systems to record catch at specific sites and transferring these data to a centralized repository for near real-time monitoring and subsequent analyses. We examined the use of a customizable SMART (Spatial Monitoring And Reporting Tool) based software on Android tablets that provided trained citizen technicians with simple, menu-driven fields to collect detailed fisheries data (species, size, gear, area). This ongoing evaluation, initiated in February 2017, has provided a clearer understanding of the nature and availability of fisheries products (fish and invertebrates) to households and local businesses within many of the largest coastal communities in Belize. Such a data collection system could be transferable to the national management authority, integrated into existing enforcement patrols and replace fleet-wide hard-copy logbooks for the formulation of future taxa, gear, temporal and spatial specific management actions.

KEYWORDS: Small-scale fisheries, Belize, livelihoods

The Nexus of Marine Conservation Science Education and Fishing Communities of the Greater Caribbean Basin

El Nexo de Educación en Ciencias de Conservación Marina y Comunidades Pesqueras de la cuenca del Gran Caribe

Le Lien entre L'éducation à la Conservation Marine et les Communautés de Pêcheurs du Bassin de la Grande Caraïbe

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ABSTRACT

The Caribbean is known for its marine products and natural resources. These products are used locally and exported to foreign markets. Directly or indirectly, millions of peoples' livelihoods and food security are dependent upon healthy Caribbean ecosystems supplying these resources to local and international markets. Additionally, a great deal of wealth is generated via snorkeling, diving and other tourism activities requiring healthy marine ecosystems. These are the economic drivers generating wealth for local communities and urban centers, in turn meeting the food security needs of a broad network of interdependent communities. Ensuring this matrix of community's remain viable is of vital importance to the people and institutions in the region.

Education is a key area of investment to support the sustainability of the Caribbean's marine ecosystems. This presentation provides a framework for a basin-wide education initiative that connects specific communities' local contexts and conservation needs shared across the region. It is designed to fit within the region's varied national school curricula. The framework is differentiated by integrating locally relevant traditional ecological knowledge and local languages of fishing communities with conservation science and languages of instruction across the region. Presenting a bilingual teaching curriculum that includes locally relevant languages and concepts will facilitate learning conservation science concepts for the children of fishers and tour guides. This approach promises to raise a generation of fishers and tour guides that would be better equipped to work with conservationists and resource managers toward their shared interest in sustainable use and development of marine resources.

KEYWORDS: Marine conservation, education, fisheries

The Ecological and Economic Potential for Offshore Mariculture in the Caribbean

El Potencial Ecológico y Económico para la Maricultura en Mar Abierto en el Caribe

Le Potentiel Écologique et Économique de la mMariculture Hauturière dans les Caraïbes

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ABSTRACT

Offshore mariculture could enable the Caribbean to increase seafood production and economic development while alleviating pressure on coastal ecosystems and wild fisheries, but an integrated assessment of the ecological and economic potential for mariculture in the region is lacking. We assess site suitability and develop a novel spatial bioeconomic model to predict yields and profits for offshore cobia (*Rachycentron canadum*) mariculture across 30 jurisdictions in the Caribbean. We find that <1.5% of the study area is technically feasible; avoids conflicts with others uses and sensitive habitats and protected areas, and is economically profitable. Although a small amount of area, our analysis predicts potential annual yields of more than 40 MMT –an amount equal to half that from global fisheries harvests. We show that farm-scale production and value vary across and within countries and that country profitability can be overestimated if not accounting for foreign investment risk. This analysis can inform an environmentally sound and economically prosperous pathway for aquaculture development in the Caribbean or other regions.

KEYWORDS: Offshore mariculture

Analysis of the Value Chain of Bycatch in the Shallow Water Shrimp Fishery in the Pacific of Colombia

Análisis de la Cadena de Valor de la Captura Incidental en la PesquerdDe Camarón de Aguas Someras en el Pacífico de Colombia

Analyse de la Chaîne de Valeur des Prises Accessoires dans la Pêcherie de Crevettes en Eaux Peu Profondes dans le Pacifique de la Colombie

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RESUMEN

El camarón de aguas someras (CAS) en el Pacífico colombiano ha evidenciado una drástica disminución en su abundancia, causada por un aprovechamiento simultáneo de las flotas artesanal e industrial. Esto ha fomentado un uso más extensivo de la fauna acompañante impulsando la utilización del descarte como captura incidental (CI), tanto que para 2017, la CI representó el 91% de la captura total comercial y más del 50% de los ingresos de la pesquería industrial. No obstante, los beneficios documentados de esta pesquería a nivel nacional se reducen a la contabilización de los beneficios del camarón, dejando al margen el encadenamiento productivo generado por el aprovechamiento de la CI. Por tanto, ante la posible implementación de acciones de manejo que reduzcan la fauna acompañante, es necesario conocer los impactos al bienestar humano que tendría esta medida. Para ello, en marco del proyecto REBYC II - LAC se ha realizado un análisis de cadena de valor con enfoque de género basado en los Principios Rectores de Cadenas de Valor Alimentarias Sostenibles de la FAO. Los resultados muestran que la cadena de la CI de CAS está conformada por una compleja interacción entre actores directos e indirectos y organizaciones de apoyo, que inciden fuertemente en la seguridad alimentaria de poblaciones vulnerables, sobre todo en zonas rurales. Se generan alrededor de 6.000 empleos locales, de los cuales el 82% son ocupados por mujeres afrodescendientes en el eslabón de comercialización. Por otra parte, se identificaron los principales puntos críticos de cada eslabón, donde se priorizan los altos costos de operación, la inseguridad y los débiles esquemas de gobernanza. Con lo anterior, se evidencia que la CI es un importante soporte económico y social de la pesquería de CAS en el Pacífico de Colombia.

PALABRAS CLAVES: Cadena de valor, camarón de aguas someras, seguridad alimentaria

Changes in Fishing Technology to Improve the Economic Profitability Indexes with Environmental Responsibility of the Trawl Fishery in Colombia

Cambios en la Tecnología de Pesca para Mejorar los Índices de Rentabilidad Económica con Responsabilidad Ambiental de la Pesca de Arrastre en Colombia

Changements dans la Technologie de la Pêche pour Améliorer les Indices de Rentabilité avec la Responsabilité Environnementale de la Pêcherie au Chalut en Colombie

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RESUMEN

Sumado a su impacto ambiental, la pesca de arrastre de camarón de aguas someras en Colombia ha presentado bajos índices de rentabilidad económica, en parte, por altos costos del combustible y bajas tasas de captura objetivo. En marco del proyecto "Gestión Sostenible de la Captura Incidental de las Pesquerías de Arrastre en América Latina y el Caribe (REBYC-II LAC)" se realizó una evaluación bioeconómica de la sustitución de redes de arrastre tradicional (RT) por redes prototipo (RP), que consistieron en cambios en el diseño y material de la redes. Experimentos participativos de pesca a bordo de barcos industriales, en el Pacífico y el Caribe permitieron hacer mediciones de las tasas de captura objetivo (CO), captura incidental (CI) y el consumo efectivo de combustible (COMB). Los indicadores usados para evaluar la viabilidad económica de estos cambios fueron: el Valor Presente Neto (VPN), la relación Beneficio-Costo (B/C) y la Tasa Interna de Retorno (TIR). Los resultados para el Pacífico mostraron que la RP conduce a un aumento de CO de 2.5 veces más que la RT y reduce el 22% en la CI así como un 23% del COMB. Estos valores mostraron alta viabilidad económica por el uso de la RP en términos de los indicadores analizados: un VPN de $83.260.596 de la RP, muy superior al VPN de la RT ($4.403.584); con la relación B/C de $1 y $1,09, con la TIR del 35% y 302% para las RT y RP, respectivamente. En el Caribe, se registró un aumento en CO (24%) y reducción tanto en CI (12%) como en el COMB (18%) por el uso de la RP, lo que significó un VPN de $126.123.186, B/C de $1,15 y una TIR de 766%, valores más favorables que los evidenciados por RT (VPN: -$64.111.022; B/C: $0,93). Estos resultados soportan medidas de manejo que equilibran bienestar ecológico y humano dirigido a una buena gobernanza de la pesca de arrastre en Colombia

PALABRAS CLAVES: Fisheries, shrimp, bycatch

Connectivity Mediated by Seasonal Bonefish (*Albula vulpes*) Migration Between the Caribbean Sea and a Tropical Estuary of Belize and Mexico

Conectividad Estacional Entre el Mar Caribe y un Estuario Tropical de Belice y México Mediada por la Migración del Macabí (*Albula vulpes*)

Connectivité Médiée par la Migration Saisonnière des Bonefish (*Albula vulpes*) Entre la Mer des Caraïbes et un Estuaire Tropical du Belize et du Mexique

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ABSTRACT

Bonefish (*Albula vulpes*) is an important resource for catch-and-release fishing in the Caribbean Sea. Understanding movements within and between the Caribbean Coast (CC) and Chetumal-Corozal Bay (CB) in Mexico and Belize is crucial for identifying and protecting home ranges, migration routes, pre-spawning and spawning sites. We used a mixed-methods approach to document dynamics of bonefish movement. We collected fishers' local knowledge using qualitative methods including workshops, key informant interviews, participant observation and field notes about bonefish seasonal movements. We then we used mark-recapture (8816 tagged, 569 recaptured) to understand bonefish movements by size, location and season. Bonefish were significantly larger in CC and CB likely because seagrass habitats in reef areas have more diverse prey than open bottoms of the bay. We documented several seasonal movement patterns within and between regions of both countries. A southward movement within CB during the rainy season was likely driven by salinity changes. This was followed by an eastward long-distance migration during the norths or cold front season between the bay and the Caribbean Sea, likely for spawning. We document at one of two pre-spawning aggregation (PSA) sites spawning readiness, pre-spawning behavior and synchronized movement from reef lagoon flats to the fore-reef of Belize during November and December of 2018. Finally there was a northward movement during the dry season as a journey back to home ranges. There was a seasonal connectivity of home ranges and PSA in reef ecosystems and associated habitats, one of which was in Bacalar Chico Marine Reserve, a World Heritage Site. The information can inform coastal development and protected areas planning towards a bi-national conservation and management of bonefish and its habitats.

KEYWORDS: Albulidae, fisheries management, fish migration

Measuring Environmental, Economic, and Social Sustainability of Caribbean Fisheries through the Fishery Performance Indicators, an Innovative Rapid Assessment Tool

Evaluación de la Sostenibilidad Ambiental, Económica y Social de las Pesquerías del Mar Caribe por Medio de los Indicadores de Desempeño Pesquero, un Nuevo Instrumento de Valoración Rápida

Mesure de la Durabilité Environnementale, Economique et Sociale des Pêches des Caraïbes Grâce aux Indicateurs de Performance de la Pêche, un Outil D'évaluation Rapide Innovant

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ABSTRACT

Designed by researchers affiliated primarily with the University of Florida, University of Washington and The World Bank, the FPIs are a broadly applicable and flexible tool for assessing performance in individual fisheries and for establishing linkages between enabling conditions, management strategies and the outcomes of sustainability-based indicators. The FPIs include 67 measures to assess wealth accumulation on 11 dimensions of stock and harvest/post-harvest industry performance, and 54 measures of enabling factors — including management and governance — to associate with variation in outcomes. A major advantage of the FPIs is their ability to establish meaningful comparisons across fishery systems characterized by different species, management regimes and socio-economic contexts. They are also ideal for cross-country comparisons of fishery systems that exploit biological resources sharing similar characteristics.

Consisting initially of 61 case studies drawn from industrial and developing countries around the world, the FPI database has expanded considerably in the last few years. In addition, the FPIs are currently being used by institutions such as The World Bank to evaluate the impact of fishery management reform in recipient countries. More recently, the FPIs were adopted by the Environment for Development (EFD) Collaborative Program on the Sustainable Management of Marine Resources to evaluate a new set of fisheries around the world, including the Caribbean region. The goal of this presentation is to introduce the FPIs to the Caribbean context and to explain the potential for collaborative partnerships with managers and academics from the region in order to carry out joint evaluations of the most important Caribbean fisheries.

KEYWORDS: Sustainability indicators

A Quantitative Description of the Marine Fishery in Southeast Haiti

Una Descripción Cuantitativa de la Pesca Marina en el Sureste de Haití

Une Description Quantitative de la Pêche Marine dans le Sud-Est d'Haïti

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ABSTRACT

The marine fishery in Haiti remains one of the most poorly documented fisheries of the Caribbean region, despite its importance for food security and employment. Between 2007 and 2014, field agents from the Ministry of Agriculture regularly surveyed fishers after a fishing trip at twenty-four landing sites spanning 150 km of coastline in the southeast of Haiti. This effort yielded a total 10,981 surveys over the seven year period. The surveys sought to gather information on (1) the characteristics of the fishing trips (boat types, outboard engines, fishing methods, fishing zones, time fishing, number of fishers per trip), (2) the biological composition of landings, (3) the profitability of the fishing trips, (4) aspects of fish handling/conservation on board, and (5) aspects of the fishery products commercialisation. These data show, among others, a great diversity of fishing methods along the coastline - including hook and line, pots, longline, spears, seines, anchored fishing aggregating devices (FAD), and compressors - with differences among sites in the relative importance of some fishing methods over others. The most widely used boat was the "koralen" - a wooden flat-bottom boat about 5-m long - although in some sites other boat types were more important. Most fishing trips did not use outboard engines. Median landed fish weight per fishing trip (over the entire period and across all fishing methods) was 9.5 kg. However, this overall value masked considerable differences among sites and fishing methods in fish weight landed. Globally, most landed fish were of demersal/reef origin instead of pelagic coastal or oceanic origin, although landing sites differed in the relative importance of these three groups. This study represents the first long-term quantitative description of the marine fishery in Haiti.

KEYWORDS: Fishery, Haiti, monitoring

Spatio-temporal Variability in the Benthic Composition of the Coral Reefs of Barbados Between 1997 and 2012

Variabilidad Espacio-temporal en la Composición Bentónica de los Arrecifes Coralinos de Barbados Entre 1997 y 2012

Variabilité Spatio-temporelle dans la Composition Benthique des Récifs Coralliens de la Barbade Entre 1997 et 2012

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ABSTRACT

Coral reefs are one of the most threatened ecosystems globally. In the Caribbean, this has prompted initiatives at regional and local scales aimed at monitoring the state of coral reefs. In Barbados, a long-term reef survey programme was officially launched in 1987 with the establishment of permanent monitoring reef plots at multiple shallow and deep sites along the island's south and west coasts. On-going monitoring at these sites takes place every five years and includes collecting data on benthic composition. Here, we examine spatial and temporal trends in reef benthic composition between 1997 and 2012 across 43 sites spanning 30 km of coastline. The data show three distinct reef groups along a gradient of increasing coral cover: (1) shallow fringing reefs of the west coast (overall average coral cover: 16%), (2) shallow patch reefs of the south coast (21%), and (3) deep bank reefs (27%). This gradient also reflects an increasing contribution of large-sized massive corals (versus fire and small weedy corals) to coral cover and is positively associated with depth. The data also support that all three reef groups were significantly affected by the 2005 mass-bleaching event. Furthermore, temporal trends in benthic composition over the 15-year period differed among reef groups, with increases over time in macro-algae and excavating sponges on both the shallow fringing reefs of the west coast and the deep bank reefs, but not on the shallow patch reefs of the south coast. Overall, the data reveal the effect of both local (land-based) and global stressors on Barbados' coral reefs.

KEYWORDS: Coral reef, trends, monitoring

More Than a Decade of Protection of Marine Turtles of the Guianas

Más Que una Década de Protección de las Tortugas Marinas de las Guayanas

Plus de Dix Ans de Protection des Tortues Marines des Guyanes

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ABSTRACT

The Guianas (French Guiana, Suriname and Guyana) is known for at least three species) of nesting marine turtles namely the leatherback *(Dermochelys coriacea*), Green turtle (*Chelonia mydas*) and Olive ridely (*Lepidochelys coriacea*) on its shoreline or moving in its coastal off-shore waters; frequenting Cayenne, Awala and Yalimapo (French Guiana); Galibi and Braamspunt (Suriname) and Shell Beach Protected Areas (SBPA) (Guyana) beaches and nesting in abundance. The Guianas has a total length of 1,145km, and is known for their shifting shorelines which results in unstable and unpredictable nesting beaches and variable patterns. There is a long history of over 15 years of monitoring and sea turtle conservation efforts on these beaches with support from the respective governments or non-governmental agencies with variability of monitoring methods in each country. Nevertheless, like their counterparts throughout the world the marine turtles of the Guianas, continue to face several serious threats to their population survival with bycatch and poaching being two of the main threats. Recently the leatherback population especially has seen a rapid declince. Due to marine turtles being highly migratory, protecting them requires a regional and coordinated approach. WWF Guianas for more than a decade has been committed with its local partners in all three countries to ensure long- term protection of these shared species thus helping to alleviate the threats or atleast maintain stable populations. Other important activities include raising awareness and promoting turtle friendly eco-tourism at marine turtle sites, and enabling local communities to be more involved while benefiting or improving their livelihood from the protection of the species.

KEYWORDS: Marine turtles, Guianas, long term monitoring

Eastern Guajira's Artisanal Fishery and Marine Turtle's Aggregations: Characteristics, Challenges and Opportunities for Conservation

Pesquería Artesanal y Agregaciones de Tortugas Marinas del Este de La Guajira: Características, Retos y Oportunidades para la Conservación

Le pêcherie Artisanale et le Agrégations des Tortues Marines de l'est de La Guajira: Caractéristiques, Défis et Possibilités Pour la Préservation

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ABSTRACT

Coastal marine ecosystems by La Guajira peninsula, Colombia are very productive and sustain a diversity of marine resources from small invertebrates to large marine turtles. Coastal Wayuu indigenous settlements rely upon these ecosystems for food and subsistence. However, La Guajira peninsula's renowned remoteness and arid conditions have limited coastal development and long-term ecological studies of its natural ecosystems and resources. A synoptic survey of the Wayuu, artisanal fishers was conducted to understand their current fishing practices and the characteristics of different coastal ecosystems and species they overlap with; of particular interest was the occurrence and habitat use of sea turtles in fishing areas. Fishers were surveyed at both their homes and at points of landing on the eastern side of the peninsula.

Forty-six male fishers from ten coastal communities within Uribia municipality of La Guajira were surveyed. Surveys revealed that fishing is done in shallow neritic zones, from wood canoes or from wooden or fiberglass motor launches. Fishing occurs early in the morning and late in the afternoon, as well as overnight when the "lanceo" technique is used. The most commonly used gear are gillnets. The desired catch species are small fish, sharks and rays, caught primarily for local consumption. Common caught species were jacks (*Caranx* sp.), mackerels (*Scomberomorus* sp.), sharks (*Mustelus* sp.) and rays (*Dasyatis* sp). The most common bycaught species was threatened green sea turtle *Chelonia mydas*. Juvenile, subadult and some adult *C. mydas*, of both sexes, ranging in size from 16 to 87 cm SCL, are more frequently bycaught from May to September. Fishermen described the fishing grounds as rocky or sandy, and often covered with "jimoura" (submerged aquatic vegetation). Overlap between the artisanal fishery o

KEYWORDS: La Guajira, coastal fishery, *Chelonia mydas*

A Portrait of the Reef Fish Community from an Important Touristic Destination in Southeastern Brazil

Un Retrato de la Comunidad de Peces Recifales de un Importante Destino Turístico en el Sureste Brasileño

Un Portrait de la Communaute de Poisons de Recif d´Une Important Destination Touristique du Sud-est du Bresil

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ABSTRACT

Marine ecosystems play fundamental economic and social roles providing valuable services for coastal regions. However, coastal development, human population expansion, overfishing and predatory tourism are among the anthropic pressures that have been affecting marine biodiversity, mainly fish species that play critical parts in reef functioning and maintenance. Therefore, the current study presents data on the composition, abundance and distribution of reef fishes from the rocky reefs of Armação dos Búzios (22º44´S & 41º 52´O), the fifth most visited touristic destination in Brazil. We performed replicated visual census (n =173/40m2) in the Summer of 2016, in 11 sites in the N/NE coast of the peninsula. We registered a total of 1332 individuals, belonging to 34 families and 75 species. Species richness (n=44) and abundance (n=232) were significantly greater in sites with lower environmental pressure indexes and greater food availability (João Fernandinho beach and Azedinha). Low species diversity and low top predator abundance of reef fishes were observed in all sites sampled. Moreover, species typically searched by the aquarium trade were not registered, suggesting a greater fishing and capture pressure over these species. Our results point the need of management actions, aiming a sustainable model that meets the socioeconomic demand of the region and also promotes marine conservation.

KEYWORDS: Reef fishes, tourism, envirommental pressure

Traceability of Common Snook (*Centropomus undecimalis*) in Santa Marta Markets

Trazabilidad del Róbalo Común (*Centropomus undecimales*) en los Mercados de Santa Marta

Traçabilité du Snook Commun (*Centropomus undecimalis*) sur les Marchés de Santa Marta

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ABSTRACT

Common snook is a commercial fish whose overexploitation and damage of its habitat has caused it to be listed as a "vulnerable" species in the Red Book of Endangered Marine Fish of Colombia. Given the high market price and demand of its flesh in Colombia in comparison with other species, concern has arisen about the legitimacy of products that are marketed as *C. undecimalis* within the country. A previous study found fraudulent cases in one out of three fillets sold as snook in the Bogota market; therefore our study aimed to evaluate the possibility of similar fraudulent specimens in the city of Santa Marta. To undertake this, we bought fillets at fish markets and branded products of two different companies in the main supermarkets of the city. By DNA barcoding (COI and 16S), we compared the results (BLAST) for species validation. Our results showed that none of the products were C. undecimalis; moreover, we found that the sequences obtained from the two branded products were almost identical (0.00 for 16S and 0.01 COI) (interspecific analysis-MEGA), suggesting that the same species is being commonly used to replace *C. undecimalis*. Although we could not identify the specie that is being used fraudulently (nearest similarity was of 92% with Brotula barbata - BLAST), more detailed study is under way with *C. undecimalis* and other species of interest in the Colombian marketplace.

KEYWORDS: Fish products, fraud, common snook

Does Experience Matter? Assessing the Diversity of Mental Models Associated with Belize's Managed Access Fisheries Policy

¿La Experiencia Importa? Evaluar la Diversidad de Modelos Mentales Asociados con la Política de Pesca de Acceso Administrado de Belice

L'expérience Est-elle Importante? Évaluer la Diversité des Modèles Mentaux Associés à La Politique de Gestion des Pêches Gérée par le Belize

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ABSTRACT

An inclusive approach to natural resource management that considers a diversity of perspectives and experiences where stakeholders are respected and represented has been shown to contribute to the creation of policies that see greater engagement as well as increase in environmentally sustainable behaviors. Despite this, there remains ongoing discussion on the role of experts and the integration of local knowledge in the creation and implementation of natural resource policies. Building on a mental model approach, we explore differences in perception among fishers and policy makers within the context of the small-scale fisheries sector in Belize and how these diverse perceptions influence their opinions of a new management policy. We conducted a cognitive mapping exercise with 54 fishers and 25 policy makers across Belize to investigate their perceptions around a recently implemented fisheries management policy. Our findings highlight that fishers and policy makers held mental models that differed both in content and structure. We found that fishers who participated in a two-year pilot program still held different mental models than policy makers, while having similar models to fishers who did not participate in the pilot program. These variations suggest that the relevant expertise held by policy makers remains different from the relevant expertise of fishers for fisheries management. Considering these diverse perspectives could allow for the development of more innovative and robust approaches to management.

KEYWORDS: Mental models, managed access, experience

Advancing an Ecosystem-Based Management Decision Support System (EBM/DSS) in the Caribbean

Avance de un Sistema de Apoyo a las Decisiones de Gestión Basadas en el Ecosistema (EBM / DSS) en el Caribe

Promouvoir un Système d'Aide à la Décision de Gestion Fondé sur l'Écosystème (EBM / DSS) dans les Caraïbes

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ABSTRACT

Ecosystem-based management (EBM) is a process that considers ecosystems as units with many ecological and social links and promotes a movement away from conventional management approaches where single issues or species are the primary focus. EBM has been progressively adopted at international, regional and national levels, evidenced by its inclusion in many agreements, policies, laws and plans inter alia, but implementation still is low. Within the Caribbean region, operationalization of EBM remains in early stages with many countries advancing mostly at national level, not at the regional level. The UN Environment (UNEP) through its Caribbean Environment Programme (CEP) and the Centre for Resource Management and Environmental Studies - University of the West Indies (CERMES-UWI) are working together to further promote and advance EBM via an EBM Decision Support System (DSS) approach. A DSS is a systematic process of making choices based on information organised within an interactive computer-based application which can simplify EBM applications for decision makers and stakeholders and ultimately promote quality decision-making. In this study, the Integrated Spatial Planning 5.0 DSS (process and software) was examined as a viable approach for implementing EBM in some Caribbean English speaking countries. The approach is based on five methodological steps which provide analytical methods and tools that support the implementation of EBM. Two pilot sites within the Dominican Republic were utilised for testing the EBM/DSS approach and regional workshops were held for information sharing and critical feedback. We present a review of the EBM/DSS methodology, lessons learned and recommendations for better understanding and future actions.

KEYWORDS: Ecosystem-based management, decision support system, Caribbean

Increasing the Visibility and Influence of Data in Decisions for Biodiversity and Protected Area Management

Aumentar la Visibilidad y la Influencia de los Datos en las Decisiones sobre Biodiversidad y Gestión de Áreas Protegidas

Augmenter la Visibilité et l'Influence des Données dans Les Décisions Concernant la Biodiversité et la Gestion des Aires Protégées

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ABSTRACT

One of the most globally utilized tools for the conservation of coastal and ocean biodiversity and preservation of crucial ecosystem services is the establishment of marine protected areas (MPAs). Many sites in the Caribbean have made progress in addressing the paucity of data needed to achieve the goals and objectives of MPAs thanks to the investment of various resources from national, regional and international levels. With gaps in data collection and resource monitoring filling, the emergent question is, what to do with data to make it visible, accessible and relevant in decision-making and to steer the effective management of MPAs? One mechanism is better marketing and communication of data, translating salient information in language and appearance to better fit in the environs of decision makers. To package data in more relatable, visually appealing and easily digestible products is a goal of the Caribbean Protected Areas Gateway (Caribbean Gateway), a regional entity which functions as a reference information system for biodiversity and protected areas (PAs) in the Caribbean region. In an effort to address the divide between scientists/practitioners and decision/policy makers, the Caribbean Gateway is developing a marketing and communication tool in the form of a 'State of Protected Areas' report for the Caribbean region. Development has been, and continues to be, influenced by persons on both sides of the spectrum to ensure that the end product effectively promotes and facilitates the use of data in the decision making environment. The 'State of Protected Areas' report will be utilized for monitoring and evaluation of management efforts for PAs within the Caribbean region and also as a contribution to the global conversation on biodiversity and PAs.

KEYWORDS: Data to decisions, protected areas, data communication

Testing the Application of Drone Technologies in Quantifying Stranded *Sargassum* Seaweed

Probar la Aplicación de Tecnologías de Drones en la Cuantificación de Algas de *Sargazo* Varadas

Tester l'Application de Technologies de Drones pour Quantifier les Algues *Sargasses* Échouées

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ABSTRACT

Unprecedented mass influxes of pelagic *Sargassum* into the Caribbean have caught coastal and marine resource managers off guard as thousands of tons of the seaweed have inundated nearshore waters and piled up along beaches causing enormous difficulties for coastal communities, and the tourism and fisheries sectors. It has also attracted the interest of entrepreneurs looking to design and market new equipment and products. However, developing appropriate responses and management plans to cope with *Sargassum*, understanding the ecological impacts, and assessing the viability of entrepreneurial ideas require knowledge of the location and quantity of *Sargassum* strandings. To date there are no standard monitoring protocols in place for quantifying stranded *Sargassum* in the region. In this study we test the application of using a low cost drone to obtain high resolution aerial imagery and photogrammetry mapping software to map and quantify the volume of *Sargassum* along an east coast beach in Barbados. We also employ a more conventional ecological approach using replicate transects and sample quadrats to compare and contrast results, and to add value to the information obtained by the drone through providing volume to wet and dry weight conversions and *Sargassum* species composition. Through these tests, under different conditions experienced between June and September 2018, we hope to develop a low-cost and effective drone-based protocol for monitoring *Sargassum* m strandings over large areas.

KEYWORDS: *Sargassum*, drone technology, monitoring

Molecular Divergence of Holopelagic *Sargassum* Species Using Extensive Field Samples from the Tropical and Subtropical Atlantic

Divergencia Molecular de Especies de *Sargassum* Holopelágicas Utilizando Muchas Muestras del Atlántico Tropical y Subtropical

Divergence Moléculaire des Espèces Holopélagiques de *Sargassum* en Utilisant des Échantillons de l'Atlantique Tropical et Subtropical

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ABSTRACT

Sargassum natans and *Sargassum fluitans* are the only species of holopelagic macroalgae, providing substrate and resources to support a diverse community of epibiotic, endemic, and migratory species. *Sargassum fluitans* III and *Sargassum natans* I are historically common, exhibiting greatest abundance in the Sargasso Sea and Gulf of Mexico. A third, previously rare form of *Sargassum*, morphologically described as Sargassum natans VIII, has recently inundated beaches in the tropical Atlantic, resulting in devastating ecological and economic impacts. While morphological variation within *Sargassum natans* and *Sargassum fluitans* has been described, genetic data elucidating the evolutionary history of these species is lacking. Using over 200 field samples of *Sargassum* collected from the Sargasso Sea, Caribbean, equatorial and tropical Atlantic between 2015-2018, we examined genetic divergence at two mitochondrial genes: Cox3, and Nad6. These genes successfully differentiate among the three common forms of *Sargassum*. The inundating form, *Sargassum natans* VIII, exhibits species-level divergence between both Sargassum fluitans III (0.93%) and Sargassum natans I (0.60%), suggesting a need for phylogenetic reclassification. In the future, Cox3 and Nad6 can be used to better understand phylogenetic relationships among *Sargassum* morphological variants, particularly among rare forms. Further, these genes can help to identify forms of *Sargassum* responsible for recent inundation events. We hope to develop more variable genetic markers to resolve population-level divergence, and apply these to our extensive archive of *Sargassum* field samples, collected and preserved over decades on yearly transects throughout the Atlantic, to elucidate the evolution, origins, and distribution patterns of these influential species.

KEYWORDS: *Sargassum*, molecular divergence, mitochondrial genes

Improving Tropical Shrimp Trawling Through Eco-labelling: Impacts of MSC Certification in the Suriname Seabob Fishery

Mejora de la Pesca de Arrastre de Camarón Tropical a Través del Ecoetiquetado: Impactos de la Certificación MSC en la Pesquería de Camarón Siete Barbas en Suriname

Amélioration de la Pêche au Chalut de la Crevette Tropicale Grâce à l'Éco-Étiquetage: Impacts de la Certification MSC sur la Pêcherie aux Crevettes Seabob au Suriname

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ABSTRACT

The seabob shrimp trawl fishery off Suriname was the first fishery of its kind and in the region to be certified by the Marine Stewardship Council (MSC). The fishery was able to meet the MSC standard through an improvement program in which private and public partners worked together, establishing and implementing a fishery-specific management plan. The fishery has been certified for seven years now – time to look back. Did certification work as expected, and did it provide the ecological benefits it claims? Did it lead to any positive or negative side effects for the fishery, or other fisheries in the country or region? Are there any socio-economic benefits, and what lessons can be learned from the seabob fishery? To answer these questions, available quantitative and qualitative information was collected, and interviews were taken with key stakeholders. Certification triggered changes in fishing effort, environmental impact and decision-making structures, which were generally perceived positive by stakeholders. Nevertheless, side-effects of certification appeared to be limited and the seabob fishery remains relatively isolated from the rest of the fisheries system in Suriname. Findings from this study may help to inform expectations in fisheries seeking certification.

KEYWORDS: MSC Certification, shrimp trawl fishery, socio-ecological impacts

Evaluating Turtle Excluder Devices (TEDs) with Reduced Bar Spacing for Bycatch Reduction in the Suriname Seabob Shrimp Trawl Fishery

Evaluación de los Dispositivos Excluidores de Tortugas (DET) con un Espaciado de Barras Reducido para la Reducción de Captura Incidental en la Pesquería de Arrastre de Camarón Siete Barbas en Suriname

Évaluation des Dispositifs d'Exclusion des Tortues (DET) avec un Espacement Réduit des Barres pour la Réduction des Prises Accessoires dans la Pêcherie au Chalut aux Crevettes Seabob au Suriname

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ABSTRACT

Bycatch in tropical shrimp trawl fisheries is a concern for food security and conservation of vulnerable marine species. To mitigate bycatch, the trawl fishery for Atlantic seabob shrimp Xiphopenaeus kroyeri in Suriname uses Turtle Excluder Devices (TEDs) and bycatch reduction devices (BRDs). Still, bycatch accounts for 40 % of the catch, including vulnerable ray species. In this study we evaluated the bycatch reduction potential of two alternative TED designs in the seabob fishery. The experimental TEDs had flattened vertical bars with either 3-inch or 2-inch spacing and were tested versus the standard 4-inch round-bar TED. Sea trials were done during two commercial fishing trips in July and August 2016, in which 31 catch-comparison hauls were completed with each experimental TED. The catch was broken down in seabob shrimp (the target species), bycatch that is typically retained (*Penaeus* spp. shrimp and marketable fish) and discards (rays and non-marketable fish). Both experimental TEDs performed good in the reduction of bycatch, while retaining or improving the target catch. The 3-inch TED caused a significant 44 % - reduction in ray bycatch, while the 2-inch TED reduced the bycatch of marketable fish by 23 %. The 3-inch TED increased the capture of seabob shrimp by 16 % and had no effect on bycatch of marketable fish. Given the economic value of fish bycatch in this fishery, the 3-inch TED will probably gain easier acceptance. More sea trials should be carried out across larger spatial and temporal scale to confirm the results of this study and determine the optimal TED design for the Suriname seabob fishery.

KEYWORDS: Turtle Excluder Device, seabob shrimp trawl, Suriname

Testing Flexible Turtle Excluder Devices (TEDs) in the Demersal Trawl Fishery off Suriname

Test de Dispositifs Flexibles d'Exclusion des Tortues (DET) dans la Pêcherie au Chalut de Fond au Large du Suriname

Prueba de Dispositivos de Exclusión de Tortugas Flexibles (DET) en la Pesquería de Arrastre Demersal en Suriname

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ABSTRACT

Turtle Excluder Devices (TEDs) are widely used in tropical shrimp trawl fisheries. TED technology was developed for shrimp trawls and its application to fish trawls is challenging due to the diversity in trawl design and gear deployment. In contrast to the local shrimp trawlers, no TED obligation currently exists for a growing fleet of demersal fish trawlers in Suriname. In this study two prototype TEDs for this fishery were evaluated. The TEDs had a vertical bar spacing of either 7 or 5 inches to ensure maximal retention of target catch. Instead of rigid aluminum bars, the TEDs were constructed from stainless steel cable and referred to as Cable TEDs (CTEDs). CTEDs are flexible which is crucial when using a drum to retrieve the trawl. The CTEDs were tested during two commercial fishing trips in 2017–2018. Twenty-five catch-comparison hauls were completed with the 7-inch CTED and 16 with the 5-inch CTED. Both CTEDs proved practical to handle on board and were easily rolled onto the ship's net drum upon haulback. Both CTEDs caused large and significant reductions in discards. Catch rate of discards (by weight) decreased by 68 % using the 7-inch grid and by 75 % using the 5-inch grid. These reductions were mainly caused by exclusion of rays from the trawl. Ray catch rate was reduced by 79 % using the 7-inch CTED and by 94 % with the 5-inch CTED. Despite the reductions in discards, the catch of marketable fish was negatively affected by the cable grids, with significant reductions of respectively 36 % and 30 % for the 7- and 5-inch CTED. CTEDs clearly have a great potential to reduce bycatch of vulnerable species in demersal fish trawlers. Further modifications should be made and tested to improve target catch retention and make the device acceptable for the Suriname fishing industry.

KEYWORDS: Turtle Excluder Device, demersal fish trawl, Suriname

Characterizing Sport Fish Nursery Habitat with the Help of Citizen Scientists

Caracterización del Hábitat del Vivero de Oeces Deportivos con la Ayuda de Científicos Ciudadanos

Caractérisation de l'Habitat de la Pépinière de Poissons Sportifs à l'Aide de Scientifiques Citoyens

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ABSTRACT

Natural nearshore ecosystems are threatened worldwide by coastal development and degradation. The habitats within these systems play a crucial role as nurseries for many species of fish. Unfortunately, it is not possible to determine the impact of habitat degradation on many species because data on early life history metrics (such as growth, survival, emigration) in nursery habitats are lacking, as are mapping data showing the locations, extent, and health of these habitats. The juvenile life stage of Atlantic tarpon (*Megalops atlanticus*), an economically important species in the Caribbean and sub-tropical and tropical Atlantic, depends upon wetlands and marshes, but there are insufficient data to evaluate impacts of habitat loss or degradation. A mark-recapture study in an altered mangrove habitat in Florida (USA) found that juvenile tarpon exhibited slow growth and a low emigration rate. Given the poor performance of juvenile tarpon in this study, and the unknown extent and health of juvenile tarpon habitats in Florida, we used citizen science to identify and characterize (as natural or altered) juvenile tarpon habitats. A comparison of angler reported habitat assessments with scientific field assessments proved that using anglers is an efficient and effective means of identifying, mapping, and characterizing juvenile habitats. This citizen science approach and associated data are directly applicable to management and conservation of essential fish habitat.

KEYWORDS: Juvenile habitat, early life history, habitat mapping

Caribbean FAD fisheries: Status, Trends, and Drivers

Pesquerías DAP en el Caribe: Estatus, Tendencias, e Incentivos

La Pêche DCP dans le Caraïbes: Statut, Tendances, et Incitations

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ABSTRACT

The use of fish aggregating devices (FADs) in the Caribbean has increased dramatically over the past several decades. FADs have been promoted as a tool to increase fishing efficiency and food security in rural areas. Nonetheless, the use of FADs has also resulted in ecological degradation, economic losses, and conflicts among users. Despite the contrasting positive and negative consequences that FADs can bring to fishing communities, limited research has investigated what drives differences in FADs adoption, practices, and associated social and ecological outcomes. The diversity of FAD practices and use among Caribbean Islands provides us with an ideal opportunity to explore the drivers and impacts of FAD fishing. FAD use varies dramatically even among neighboring islands in terms of participation, construction, longevity, placement, and catch. Different islands also have unique management histories, programming, international relationships, and cultures that may drive differences in FAD adoption, practices and outcomes. Our work documents these inter-island differences as well as longitudinal trends in FAD fishing practices across the Caribbean. We integrate both academic and gray literature, and complement this with key informant interviews to identify predictors of local FAD fishing practices, such as markets, aid, colonial history, and oceanographic conditions. By offering comparisons among islands and highlighting potential drivers of different FAD practices, our research will identify bright and dark spots within the Caribbean that can inform future FAD management.

KEYWORDS: Fish aggregating device, pelagic fisheries, social ecological systems

Analysis of the Artisanal Capture of *Thunnus* Spp and its Relation with Parameters Oceano-Atmoferico "Sea Surface Temperature, Waves, Winds and Currents" on the Island of San Andrés Insular Caribbean

Análisis de la Captura Artesanal de *Thunnus* Spp y su Relación con Parámetros Oceano-Atmoferico "Temperatura Superficial del Mar, Oleaje, Vientos Y Corrientes" en la Isla de San Andrés Caribe Insular

Analyse de la Capture Artisanale de *Thunnus* Spp et de sa Relation avec les Paramètres Oceano-Atmoferico "Température de Surface de la Mer, Vagues, Vents et Courants" sur l'Île de San Andrés Dans les Caraïbes

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ABSTRACT

In the present study, the spatial and temporal distribution patterns of the *Thunnus* Spp species are analyzed in relation to the ocean-atmosphere atmosphere (sea surface temperature, winds and waves) during an annual period between January to December 2013. Based on available secondary parameters of bathymetric parameters, Oceanographic Parameters and Marine Meteorology Measurement System (SMPOMM), fishery census records of artisanal landings conducted in the study area and from the scientific literature of National Oceanic and Atmospheric websites Administration (NOAA) and Caribbean Oceanographic and Hydrographic Research Institutions (CIOH), a total of 4250 individuals were obtained, of which 3399 were of the thunnus atlanticus species and the remaining Katsuwomus pelamis (851 ind), with a total length interval Fork (Lh) of 236-868 millimeters (mm) with an average length of 520.5 ± 430.5mm, the Temporary taxation of the catch does not show a marked seasonality in the species Katsuwomus pelamis, the opposite happens for Thnnus atlanticus, which shows a marked seasonality throughout the study period between the months of March and July with 44.51% of the total landings, correspond to 25.77% of males and 18.74% females.

In the annual century the evaluation of the monthly cumulative catch (Average ± Standard Error) increased significantly (70.91 individuals * month-1 ± 43.78), the thermal preference of the *Thunnus* Spp does not present a seasonality between the species and the temperature according to to the coefficient of determination of R2 = 0.0072 for *Katsuwonus pelamis* and R^2 = 0.064 *Thunnus atlánticus*. the months with low swell, most representative July and March with 16.37% and 18.79% respectively, followed by May (7.57%) and February (8.46%) of the total landings, are presided over by swells of 0.26-0.36 mm.

KEYWORDS: Corrientes, *Thunnus* spp., oceanografía

Impacts of Climate Change on Tourism in Colombian Caribbean Coastal Zone

Impactos del Cambio Climático en el Turismo de la Zona Costera del Caribe Colombiano

Impacts du Changement Climatique sur le Tourisme dans la Zone Côtière des Caraïbes Colombiennes

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RESUMEN

El turismo es una de las principales actividades económicas de la zona costera colombiana que se podrá ver afectada por el cambio climático, siendo el aumento del nivel del mar (ANM) una de las principales amenazas. La evaluación de los impactos del cambio climático elaborados en el marco de la Tercera Comunicación Nacional de Cambio Climático para la zona marino costera (INVEMAR-IDEAM, 2017), muestra que un Aumento del nivel del mar (ANM) de 40 cm para el año 2040, podría afectar aproximadamente 9.278 ha de desarrollo turístico (Caribe: 45,02%) y para el 2100 la cifra ascendería a 10.313 ha (Caribe: 47,32%). En términos económicos se estima que se podría ver afectado cerca del 2% del Producto Interno Bruto (PIB) turístico de la zona costera del país, siendo la costa Caribe la más afectada. Estos resultados dan muestra de la importancia de definir políticas públicas en materia de planificación sectorial asociada al cambio climático y de implementar acciones de adaptación para minimizar los impactos, más aún si se estima que para el 2020 el turismo en Colombia crecerá aproximadamente un 30%. Este trabajo se realizó en el marco del contrato No. 0000040357 con el Programa de las Naciones Unidas para el Desarrollo (PNUD), Proyecto COL/00086514. Los resultados son parte de la Tercera Comunicación Nacional de Cambio Climático (TCNCC), coordinada por el Instituto de Hidrología, Meteorología y Estudios Ambientales (IDEAM).

PALABRAS CLAVES: Cambio climático, turismo, Colombia