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

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 (< 1.3 m 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

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

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

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

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-tourism

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

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

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 Biorock® at two pilot sites in Grenada (i.e. Gouyave & Carriacou). Biorock 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 Biorock® 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 Biorock® 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

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

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

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

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

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

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

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

Growth Patterns of the Invasive Lionfish in the Caribbean Of 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

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

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

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

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

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

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

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

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

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

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

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

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

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) 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

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

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

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, desarrollo de un diagnóstico socioeconómico 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, identificaron 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

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

Mitigation of the Impact of Deepwater Shrimp Trawling in the Pacific of 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 inci-

dental 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

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

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

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 artisanal

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

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

Role of Women in Aquaculture in the Caribbean Region of 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 orna-

mentales. 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 postcosecha suelen ser más eficientes.

PALABRAS CLAVES: Acuicultura, rol de la mujer, liderazgo

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

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

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

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

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

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

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 indica-

dores 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

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

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

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

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 compo-

sition 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

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

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

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

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

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

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

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. Exam-

ination 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

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

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

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 seatruth 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

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

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

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

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

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

PALBRAS CLAVES: Pesca artesanal, Reserva de Biosfera Seaflower, captura

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

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

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

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

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

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

Seaflower Biosphere Reserve NIMD-PMA and Regional Parks Financial Sustainability

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

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 genera-

tors 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

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 intergovernmental 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

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, 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

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

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

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 experi-

ment 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. Isolationmay 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

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

State of the Deep Sea Megainvertebrate Communities in the Caribbean of 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

Integral Management of Yellowtail in Honduras´ 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 pop-

ulations 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

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

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

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 Trini-

dad. 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

Cambios Históricos en las Tasas de Captura de los Diferentes Tipos de Pesquerías de Redes de Enmalle de la Costa Guajira (Caribe Colombiano)

Historical Changes in the Catch Rates of the Different Types of Guajira Coast Gill Net Fisheries (Colombian Caribbean)

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 ecotourism 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, restoration

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 instru-

ments 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

De la Investigación a la Incidencia Política: Acuerdo de Pesca Entre Pescadores Industriales y Artesanales en un Área Marina Protegida del Pacífico Colombiano

From Research to Political Incidence: Fishing Agreement Between Industrial and Artisanal Fishermen in a Protected Marine Area of the Colombian Pacific

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

Descartes de la Pesquería de Arrastre Artesanal de Camarón en el Golfo de Salamanca, Caribe de Colombia

Discards of the Artisanal Shrimp Trawl Fishery in the Gulf of Salamanca, Colombian Caribbean Sea

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 *Stellifer* 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

Swordfish Management: 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 Management : 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

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

Caracterización de la Comunidad Arrecifal de Isla Arena Mediante el Uso de Imágenes Aéreas y actualización de sus Unidades Ecológicas

Characterization of Isla Arena's Reef Community Through the Use of Aerial Images and Actualization of its Ecological Units

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

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, Sea-grasses and Local Communities: Governance and Experiences Exchange of the Integral Management of Biodiversity and its Services at the Caribbean (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

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 pro-

jects 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*

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

Cambios en la Tecnología de Pesca para Mejorar los Índices de Rentabilidad Económica con Responsabilidad Ambiental de la Pesca de Arrastre en Colombia

Changes in Fishing Technology to Improve the Economic Profitability Indexes with Environmental Responsibility of the Trawl Fishery in 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

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 pro-

moting 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, enviromental 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

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

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

Impactos del Cambio Climático en el Turismo de la Zona Costera del Caribe Colombiano

Impacts of Climate Change on Tourism in Colombian Caribbean Coastal Zone

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

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