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BOOK OF ABSTRACTS

Staking claims to ocean space through a failed large-scale marine protected area proposal

Hacer reclamos en espacio oceánico por la propuesta fallida de una área marina protegida

Jalonnement de revendications à l'espace océanique par une proposition ratée d'une aire marine protégée

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ABSTRACT

For nearly two decades, marine conservation advocates have promoted the designation of large-scale marine protected areas (LSMPAs) in the EEZs of small island states and territories as a way to address area coverage targets for global oceans conservation. These offshore spaces, early proponents argued, are too remote for people to use and are thus “politically less risky” than nearshore areas to use for conservation. This paper counters this assertion through an empirical examination of how the mistaken assumption that offshore spaces are unpeopled contributed to a failed LSMPA designation attempt in Bermuda.

Drawing on policy documents, speech transcripts, popular media, and 104 semi-structured interviews with key actors, it presents an analysis of the territorial narratives used to discursively (re)produce Bermuda’s EEZ during negotiations over the proposed Blue Halo from 2010-2015. Three major findings emerge. First, rather than a blank slate on which conservation values could be easily inscribed through an LSMPA designation, these narratives showed Bermuda’s EEZ to be a space deeply entangled with values, identities, and goals of diverse actors, both Bermudian and non-Bermudian. Second, the narratives that actors used revealed broadly overlapping values related to Bermuda’s EEZ, even among people promoting opposing governance outcomes. This demonstrates that, while no major regulatory changes occurred in Bermuda’s EEZ following the 2010-2015 negotiations, this outcome was far from inevitable. Third, despite a perception that “nothing happened” as a result of these negotiations, they still discursively (re)produced and altered Bermuda’s EEZ with implications for human-ocean interactions and governance options in the future.

Keywords: marine protected area, narratives, human dimensions, Bermuda,

Developing a Billfish Ecotourism Framework: Lessons from Popular Billfish Sportfishing Sites

Desarrollo de un marco de ecoturismo de marlines: lecciones de los sitios populares de pesca deportiva de marlines

Élaboration d'un cadre d'écotourisme pour les porte-épées : leçons tirées des sites de pêche sportive populaires pour les porte-épées

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ABSTRACT

Billfish sportfishing attracts ample tourism to coasts worldwide. As an avenue for ecotourism, billfish sportfishing has the potential for substantial contribution to local economy, livelihood, and sustainability. Billfish are a highly migratory species common in tropical and temperate areas of the Atlantic, Pacific, and Indian oceans and are highly sought after. This makes the possibility of billfish sportfishing ecotourism in a range of countries reasonably high. Billfish sportfishing promotes conservation of billfish stocks through catch and release practices and by reducing commercial pressure by offering an alternative means for economic growth. In order to maintain successful billfish ecotourism, several qualities must be present or addressed. Here, we examined three highly revered locations for billfish: Costa Rica, Los Cabos, Mexico, and Puerto Rico, to examine billfish sportfishing success and outcomes. The qualities most involved with successful sportfishing ecotourism were determined, along with areas for improvement and potential success indicators, creating a matrix of logistical, environmental, local, and management needs to promote environmentally mindful recreation.

Keywords: Billfish, ecotourism, sportfishing, management

An overview of research on microplastics in the wider Caribbean Sea

Un overview de las investigaciones sobre la contaminación por micro plásticos en el Caribe

Un aperçu de la recherche sur les microplastiques dans les Caraïbes

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ABSTRACT

La región del Caribe es considerada como un hotspot de biodiversidad pero también una de alta contaminación por plásticos y muy probablemente por microplásticos (MP). En esta revisión se localizaron 51 trabajos sobre MP en el Caribe efectuados por 45 autores. El 64% ha publicado en revistas científicas, 30% son Tesis y 6% capítulos en libros. Alrededor de 20 países han realizado investigaciones en este tema. Colombia, México, Bermudas y USA (Florida) han realizado el 61% de ellos. El tema de MP ha sido realizado en tres categorías: a) sedimentos (64%), b) agua (22%) y c) organismos marinos, peces en su mayoría (14%). El 53% de los estudios se han realizado sobre las playas.

Por lo que respecta a las técnicas de separación de MP, se encontraron siete, la principal es por densidad con alta concentración de NaCl, y tamizado (27.5%), la digestión con HCl, KOH, HNO₃, H₂O₂. Los análisis de las partículas de MP se realizan mediante un conjunto de métodos, destacando la espectroscopía infrarroja (FTIR), seguida de reflexión total atenuada (ATR), y en menor proporción espectrometría de masas, microscopía electrónica de barrido (SEM EDX), espectroscopia Raman, espectrofotometría de absorción atómica (AAS) y microscopia óptica.

Como resultados, 37% de los artículos reportan la abundancia de MP en número total, 11% lo reportan en número de MP/m² y 5% en MP/kg. Las tallas reportadas van de 6 a 6 600 micras. Sólo 45% de los estudios reportaron la talla de MP. Las formas reportadas fueron: esferas, filamentos, fibras, láminas, pellets, espumas (foam) sin descripción particular de ellas; al igual que una amplia gama de colores (blanco, negro, gris, azul, naranja, rojo, rosa, verde, amarillo, café). En el 37% de los trabajos se reportan el color de los MP. El mayor componente identificado de MP

Keywords: Micro plastics, Caribbean, Overview, pollution, techniques

A preliminary assessment of sargassum associated biodiversity: Implications for management

Una evaluación preliminar de la biodiversidad asociada al sargazo: implicaciones para la gestión

Une évaluation préliminaire de la biodiversité associée aux sargasses : Implications pour la gestion

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ABSTRACT

Over the past decade, mass accumulation and decomposition of pelagic sargassum along the coasts of Eastern Caribbean islands has resulted in negative socio-economic and ecological consequences. During influx events, mats approaching the coastline begin to break down and once beached result in management challenges for fisheries, tourism and nearshore coastal ecosystems. In-water harvesting has been suggested as a possible solution to minimise the impacts associated with beached sargassum. However, protection of the biodiversity associated with sargassum mats remains a primary concern. This study aims to examine spatial differences in the abundance and diversity of sargassum associated fauna at various distances from shore, and whether this is affected by changes in the species composition of sargassum influxes. Using a combination of net sampling and underwater video footage, biodiversity assessments were conducted inshore (< 50 m), mid-shore (50 - 500 m) and offshore (500 - 1000 m) from May to July 2021. Preliminary results indicate that while a variety of epiphytic and clinging fauna are abundant within inshore and mid-shore environments, macrofauna (valuable economic species) appear to have abandoned the mats this close to shore. Thus, in-water collection from inshore or mid-shore may very well prove to be an appropriate and ecologically sustainable management strategy to prevent significant shoreline strandings of the seaweed and/or to harvest fresh sargassum for use.

Keywords: Sargassum, Biodiversity, In-water harvesting

Heavy metals in the Atlantic Goliath Grouper in Trinidad

Metales pesados en el mero Goliath del Atlántico en Trinidad

Métaux lourds dans l'Atlantique Goliath Grouper à Trinidad

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ABSTRACT

The Atlantic Goliath Grouper, *Epinephelus itajara*, is threatened by pollution due to its shallow, coastal distribution. Heavy metals are some of the pollutants of concern as exposure may affect the health of the Atlantic Goliath Grouper, its prey and predators (e.g. humans). We investigated the concentrations of seven heavy metals: Cadmium, Nickel, Lead, Copper, Iron, Manganese and Zinc, in the dorsal fin tissue, liver, and stomach contents of Atlantic Goliath Grouper caught in Trinidad. The tissues were dried, digested and then run in the Atomic Absorption Spectrometer to obtain the concentration levels. The results showed the highest average levels of Iron, Zinc Copper and Cadmium in the liver, while the stomach contents were highest in Nickel and Manganese and the dorsal fin tissue highest in Lead. The relationship between fish length and dorsal fin tissue concentrations found Cadmium to have a significant negative relationship ($p=0.013$) and Lead a near significant negative relationship ($p=0.053$) indicating there may be higher levels of heavy metals in juvenile habitats or their prey. Manganese though demonstrated a significant positive relationship with length ($p=0.007$) and may bio accumulate or be limited during the juvenile life stage. Elevated levels of Lead in some dorsal fin tissue samples (comparable to the muscle that humans consume) is of concern for our health, but by most international standards the Atlantic Goliath Grouper tissues were below thresholds for the heavy metals we tested. Further study is needed on other heavy metals and pollutants, e.g. Mercury and petrochemicals, continued monitoring is recommended.

Keywords: pollutant concentrations, human health, bioaccumulation, stomach contents,

Community response to the threat of stony coral tissue loss disease in Utila, Honduras

Respuesta comunitaria ante la amenaza de la enfermedad de pérdida de tejido en corales duros en Utila, Honduras

Réponse de la communauté à la menace de la maladie de la perte de tissus des coraux durs à Utila, au Honduras

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ABSTRACT

La enfermedad de pérdida de tejido en corales duros o SCTLD por sus siglas en inglés, es una nueva enfermedad letal que afecta a más de 22 especies de corales duros y se ha extendido a lo largo de 16 países. En Honduras se detectó por primera vez en la isla de Roatán en septiembre del 2020, esto dio paso a la conformación del Grupo de Respuesta de SCTLD para Utila, grupo conformado por 3 organizaciones y voluntarios los cuales desde diciembre del 2020 realizan monitoreo mensual en 10 sitios alrededor de la isla, levantando información de línea base utilizando la metodología "Rover Diver" a manera de encuesta rápida para la identificación temprana de la enfermedad. Desafortunadamente, en junio del 2021 se identificaron las primeras colonias con presencia de SCTLD al norte de Utila, dando comienzo así a la etapa de intervención y capacitación a la comunidad para que puedan integrarse en las actividades que se tienen identificadas dentro del plan de intervención y monitoreo que se está desarrollando. Los próximos pasos están enfocados en una campaña de concientización con la comunidad, centros de buceo, pescadores y tomadores de decisiones, así como el establecimiento de un centro de conservación de corales.

Keywords: SCTLD, Honduras, Área Marina Protegida

Determining the Enabling Conditions and Actionable Steps in Successful Alternative Livelihood Projects (ALPs) within the Mesoamerican Reef (MAR) Region

Determinando las Condiciones Iniciales y Procesos que Conducen a Proyectos de Alternativas Económicas a la Pesca Exitosos en la Región del Sistema Arrecifal Mesoamericano (SAM)

Détermination des conditions favorables et des étapes réalisables dans la réussite des projets de moyens de subsistance alternatifs (ALP) dans la région des récifs mésoaméricains (MAR)

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ABSTRACT

Alternative Livelihood Projects (ALPs) aim to use community capacity and available resources to promote and create options for sustainable sources of revenue and reduce dependence on natural resources (Wright et al, 2015; McPherson, 2006). In the Mesoamerican Reef (MAR) region, the creation of other livelihood options to fishing can increase and diversify income (McPherson, 2006). The outcomes of ALP establishment can create a financial buffer against economic impacts caused by declining marine resources and climate change effects (McPherson, 2006). However, the variety of influential factors in ALP implementation can make successful strategy replication difficult (Brooks et al., 2012). Furthermore, limited literature documenting ALPs within the MAR region rarely detail context and project components. To provide more information to implementors, components of ALPs within the region were analyzed via a detailed literature review, open ended interviews, and statistical analysis to assess project assets of success. Results indicate projects have moved away from objectives exclusively related to conservation. Instead, surveyed projects main aims were to generate income, build communities' economic capacity, and advocate for a reduction in fishing dependence rather than a change in livelihoods. Financing was a key limitation impacting project progression. Enabling conditions were found in promoting social capital to involve the beneficiaries to want to conserve their resources and use of sustainable fishing practices. The results of this study can provide regional ALP managers actionable strategies for effective income diversification and ultimately reef preservation.

Keywords: Income Diversification, Mesoamerican Reef Region, Alternative Livelihood Projects, Fishing

Abundance and distribution of deepwater fishes in MesoAmerica

La Abundancia y distribución de peces de aguas profundas en Mesoamérica

L'abondance et répartition des poissons d'eau profonde en Méso-Amérique

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ABSTRACT

Deepwater fisheries in the MesoAmerican countries of Mexico, Guatemala, Belize, and Honduras are currently unmanaged, despite their importance to local economies and livelihoods. As fishes that live in waters deeper than 100 meters tend to have conservative life history strategies, they are likely to be more vulnerable to overexploitation than their shallow water counterparts, even under relatively low levels of fishing mortality. Most of the deepwater fish species captured in the western Caribbean are data deficient, with little data available on the ecology, life history, distribution, or abundance of these species. Fisheries-independent and dependent sampling of deepwater fishes in Belize in Honduras has revealed that several snapper species are common in the deepwater fisheries of both countries, though the nearshore fishing grounds in Honduras may be overexploited and grouper populations are likely extirpated in some areas. Preliminary analysis indicates that fish abundance and average size is higher in Belize in comparison to Honduras. Fishing grounds that are naturally protected by unfavorable ocean conditions may offer some respite to deepwater fish populations, but fishing effort is expected to increase in deeper waters throughout the region due to high local and international demand for high quality fish fillet.

Keywords: Deep sea, Belize, Honduras, small-scale fisheries, Lutjanidae

Abandoned Lost and Discarded Fishing Gear in the Caribbean - A Regional Approach

Artes de pesca abandonados, perdidos y desechados en el Caribe: un enfoque regional

Engins de pêche abandonnés, perdus et jetés dans les Caraïbes - Une approche régionale

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ABSTRACT

Abandoned, lost and discarded fishing gear (ALDFG or “ghost gear”) has been recognized as one of the most harmful forms of marine debris, affecting thousands of marine species and impacting significantly on global harvestable fish stocks. The Global Ghost Gear Initiative (GGGI) is a cross-sectoral alliance committed to driving solutions to lost and abandoned fishing gear worldwide. The GGGI has been engaging in the Caribbean since 2018, having been a regular observer and giving presentations on ALDFG at the Caribbean Regional Fishing Mechanism (CRFM).

The GGGI currently has a project in the Caribbean consisting of: 1) gathering data on gear loss rates in Caribbean fisheries in Jamaica, Grenada and Belize via fisher surveys; 2) creating predictive models on likely locations for ALDFG based on these surveys and oceanographic data; 3) trialing gear marking and recovery technology in Jamaica; 4) assessing end-of-life gear reception facilities in ports; 5) performing UAV surveys of near shore areas to determine presence of gear and informing a gear detection AI; 6) facilitation of ALDFG workshops based on the GGGI Best Practice Framework for the Management of Fishing Gear (BPF) in Belize and Jamaica to facilitate reciprocal learning with fishers and find effective local solutions and 7) collaborating with Cefas UK to trail a checklist for a parametric insurance product being developed by Cefas for the World Bank involving incorporation of the GGGI BPF into the checklist to encourage gear recovery ahead of major storm events to reduce gear loss and provide countries with lower premiums for natural disaster insurance;

We would like to give an overview of this project and its outcomes with the intention of expanding this work to other Caribbean countries to stimulate effective local and regional solutions to ALDFG.

Keywords: ALDFG, ghost gear, fishing gear, regional, solutions

Spatial and Temporal Variability of Herbivorous Fish on Bahamian Coral Reefs

Variabilidad espacial y temporal de peces herbívoros en los arrecifes de coral de las Bahamas

Variabilité spatiale et temporelle des poissons herbivores sur les récifs coralliens des Bahamas

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ABSTRACT

Herbivory is an important component of ecosystem function on coral reefs. Herbivorous fish contribute to a range of biological and physical processes within coral reef systems. Parrotfish (Scaridae) are one of the most important and dominant grazers that help to maintain the balance between corals and macroalgae on reefs. From 2011 to 2020, 36 islands were surveyed throughout The Bahamas using Atlantic and Gulf Rapid Reef Assessment (AGRRA) protocols. Data were used to assess temporal and spatial variability of herbivorous fish on Bahamian coral reefs. Our analyses indicate variability in mean biomass over space and time across six families: Scaridae (3721-2282 g/100 m²), Acanthuridae (601-903 g/100 m²), Kyphosidae (518-329 g/100 m²), Pomacanthidae (276-339 g/100 m²), Monacanthidae (279-0 g/100 m²) and Pomacentridae (13-89 g/100 m²). Patterns of spatial and temporal variability also occurred at the species level, with mean biomass of key grazing parrotfish around New Providence & Rose Island declining by 40% between 2011-2019. Stoplight parrotfish (*Sparisoma viride*), gradually declined in abundance from 2011 to 2013, but populations appear to have stabilized between 2015 to 2020. Queen parrotfish (*Scarus vetula*) and princess parrotfish (*Scarus taeniopterus*), gradually declined from 2011 to 2019 and increased their abundance in 2020. When we compared our results to a previous study conducted between 1982 and 2004, there were marked differences in species abundances of adult parrotfish across locations. Because threats to Bahamian and Caribbean reefs are escalating, this study highlights the importance of enhancing management strategies to protect parrotfish and other herbivorous fish assemblages, which are functionally important for maintaining healthy reef ecosystems.

Keywords: Biomass, Ecosystem function, Grazers, Herbivores, Parrotfish

Multi-species Coral Rescue in Response to the Stony Coral Tissue Loss Disease on the Florida Reef Tract

Rescate de Coral multiespecie en respuesta a la enfermedad de pérdida de tejido coral pedregoso en el tracto de arrecifes de Florida

Sauvetage de corail multi-espèces en réponse À la maladie de perte de tissu corallien de Stony sur le secteur de récif de la Floride

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ABSTRACT

The Florida Reef Tract (FRT) is experiencing an unprecedented disease outbreak described as Stony Coral Tissue Loss Disease (SCTLD). First reported near Miami in 2014, SCTLD has since spread to the northernmost extent of the FRT and southwestward into the Dry Tortugas National Park resulting in the mortality of thousands of colonies from >20 coral species, including primary reef builders and species listed under the Endangered Species Act. Efforts to identify the pathogen(s), determine the mode(s) of transmission, and develop potential intervention techniques are currently underway, but our limited understanding of SCTLD greatly impedes management efforts. A multi-agency Coral Rescue Team (CRT) was developed to: 1) design and implement a reef-tract wide coral collection plan for SCTLD-susceptible species, 2) preserve representative portions of the remaining genetic diversity of FRT corals in holding, and 3) plan for future propagation, restoration and reintroduction of such corals to the wild. The CRT has collected 2,212 corals ahead of the disease margin. Coral care plans are developed and rescue corals are currently being held at Florida-based non-governmental organizations and universities as well as long-term housing facilities from the Association of Zoos and Aquariums outside Florida. These facilities have started focusing on propagation, rearing, and induced spawning efforts. Lastly, the CRT has started genetic sampling to develop genetic markers. The genotypes will help the broader restoration community, while research from the spawn of rescue corals is currently underway to understand more specific restoration efforts along the FRT and will help to understand SCTLD-resilience between species.

Keywords: Stony Coral Tissue Loss Disease, Coral, Genetic Markers, Restoration, Florida

**The Caribbean Cetacean Society, a local network breaking the islands frontiers
for Cetacean conservation !**

**Caribbean Cetacean Society una red local que rompe las fronteras de las islas
para la conservación de los cetáceos !**

**La Caribbean Cetacean Society, un réseau local qui dépasse les frontières des îles
pour la conservation des cétacés !**

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ABSTRACT

The Caribbean host more than a third of the world's cetacean species. These animals travel great distances, and their distribution can include several countries between which they circulate regularly. On the scale of a large cetacean, the Caribbean is a unique space that these animals have used for longer than us, with no boundaries other than environmental parameters. It is therefore up to us to adapt and work together to break down our barriers, in order to protect them despite our differences – in legislation, language and culture – in each of our territories. Organizations undertaking quality field and policy work exist on many islands, but are often isolated. Projects aimed at enhancing collaboration within the region are limited in time and funding, and an organisation leeded by local scientist is needed to coordinate the differents actions on the long therm. The Caribbean Cetacean Society (CCS) is an NGO created in order to promote and improve the conservation of cetaceans through the coordination of a network of professional, associative and institutional actors. By breaking our frontiers in this pandemic crisis we have completed gaps in cetaceans diversity and distribution knowledge. When considering larger geographical area of studies news results are completing the previous studies made on the spermwhales social distribution and population estimate. These team work, is therefore needed to improve conservation in each islands.

Keywords: Cetacean, Cooperation, Marine Mammals, Spermwhales, Caribbean

The killer whale (*Orcinus orca*) in the Wider Caribbean Region: a review of their ecology, exploitation, and interactions with fisheries

La orca (*Orcinus orca*) en la Región del Gran Caribe: revisión de su ecología, explotación e interacciones con pesquerías

L'épaulard (*Orcinus orca*) dans la région des Caraïbes : un examen de son écologie, de son exploitation et de ses interactions avec la pêche

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ABSTRACT

Killer whales (KW, *Orcinus orca*) are occasional predators in the Caribbean, but their ecological roles and interactions with human activities such as fisheries are poorly understood. We reviewed published and unpublished records of sightings, strandings and captures between 1851 and 2021 from the Wider Caribbean Region (WCR). A total of 335 records were collated, including 76 interactions with their prey (particularly other cetaceans and sea turtles, 13%), with boats (28%), fishing gears (22%), and direct takes off St. Vincent and the Grenadines (SVG, 37%). Interaction with fishing gear included KWs apparently “inspecting” fishing aggregating devices in the French Antilles (17%) and fishing lines in Puerto Rico (5%). In addition, in Puerto Rico, a case of a male hooked in a fishing line, and then released, was reported to authorities by fishermen who participated in the release. In general, interaction with boats included bow-riding, wake-riding, and swimming at the side or under of the boat. Artisanal whaling operations based in the village of Barrouallie (SVG) take a minimum of 3.2 killer whales per year (2007-2017), and this number is most likely an underestimate. While the magnitude of operational interactions with fisheries remains unknown, Caribbean killer whales might be threatened by both unregulated whaling activities targeting cetaceans in SVG and entanglement in fishing gear. Our study reveals that the use of opportunistic sighting records and contributions from citizen-science initiatives are extremely valuable for conducting a preliminary assessment of the ecology of killer whales and their interactions with human activities.

Keywords: Bycatch, Direct hunts, cetaceans, Fisheries interactions, entanglement

The Caribbean fisheries of today and the future: Opportunities for a regional climate vulnerability assessment

Las pesquerías del Caribe de hoy y del futuro: Oportunidades para una evaluación regional de vulnerabilidad climática

Les pêcheries caribéennes d'aujourd'hui et de demain : Opportunités pour une évaluation régionale de la vulnérabilité climatique

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ABSTRACT

EDF is developing a set of climate-resilient fisheries principles in an effort to follow FAO's fundamental principles of climate-adaptive fisheries management and best practices to help guide adaptive management strategies using various tools such as bioeconomic models and assessments of the impacts of climate change in countries and regions around the world, including the Gulf of Mexico and Caribbean region. Part of this work includes conducting a Climate Vulnerability Assessment (CVA) to provide a clearer picture of regional climate risks, and the relative vulnerability of important fisheries species to climate change. The CVA approach is adapted for data-limited contexts, using variables of exposure (physical system change), and species-level sensitivity attributes. The outputs of the CVA include rankings of the relative vulnerability of species and their potential for future distribution shifts. The knowledge gained through the CVA process can promote the readiness of fisheries to respond to climate challenges and opportunities, and guide management policies that will work best for a changing ocean. During this session we will present initial findings from a CVA for important pan-Caribbean species and potential next steps. We will also provide an outline of our objectives for an upcoming CVA that we plan to conduct on specific recreational fisheries in the Caribbean. We look forward to gathering feedback from the GCFI community at that time.

Keywords: climate change, vulnerability assessment, Caribbean, fisheries, adaptive management

Biodiversity associated with the seagrass beds of the invasive species *Halophila stipulacea* in Guadeloupe Island (Lesser Antilles)

Biodiversidad asociada con las praderas marinas de la especie invasora *Halophila stipulacea* en la isla de Guadeloupe (Antillas Menores)

Biodiversité associée aux herbiers de l'espèce invasive *Halophila stipulacea* en Guadeloupe (Petites Antilles)

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ABSTRACT

The Seagrass species *Halophila stipulacea* has invaded the French Antilles Islands since 2006. In Guadeloupe Island, *H. stipulacea* has mainly colonized the sheltered leeward coasts and embayments between the surface to 60 m deep. Native *Syringodium filiforme* and *Halophila decipiens* were widely eradicated from the coasts of the Island. *Thalassia testudinum* seagrass beds better resisted, due to the highly developed structures of their rhizosphere. Nowadays, *Halophila* seagrass beds constitute the most important surface of seagrass beds on the coasts of Guadeloupe Island.

Benthic and fish communities associated with *Halophila* were studied and their biodiversity compared to those of the main native seagrass beds (*Thalassia* and *Syringodium*).

Concerning benthic communities, 161 macroorganisms (48 algae and 113 animals) were identified in the three types of seagrass beds: 135 in *Thalassia*, 72 in *Halophila* and 48 *Syringodium* seagrass beds. The community of *Halophila* seagrass beds appeared to be an impoverished subset of that of *Thalassia*.

A total of 181 fish species were recorded: 153 associated with *Thalassia*, 88 with *Halophila* and 19 with *Syringodium* seagrass beds. Most of them were juveniles. Fish abundances were similar in *Thalassia* and *Halophila* seagrass beds and the role of nursery of the seagrass beds created by the invasive species was equivalent to that of *Thalassia*.

Thus, in spite of its detrimental effect on native seagrass, *Halophila stipulacea* increases the bottom surface colonized by seagrass beds and provides ecosystems services in terms of biodiversity and nursery for benthic organisms and fish, some of them of commercial interest.

Keywords: Invasive species, *Halophila stipulacea*, Lesser Antilles, Benthic communities, Fish assemblages

Importance of the Stony Coral Tissue Loss Disease (SCTLD) on the reefs of Guadeloupe Island (Lesser Antilles)

Importancia de la enfermedad de pérdida de tejido en los corales duros (SCTLD : Stony Coral Tissue Loss Disease) sobre los arrecifes coralinos de la isla de Guadeloupe (Antillas Menores)

Importance de la maladie de perte de tissu corallien (SCTLD : Stony Coral Tissue Loss Disease) sur les récifs coralliens de de l'île de Guadeloupe (Petites Antilles)

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ABSTRACT

About fifty coral diseases are known around the world and about fifteen affect the Scleractinian corals of the French Antilles Islands. The last coral disease identified in the region appeared in Florida in 2014, following an episode of coral bleaching. Named "Stony Corals Tissue Loss Disease" (SCTLD), that disease spread to the Caribbean region and affected many countries and islands. It was observed for the first time in Guadeloupe Island in May 2020 and, like in Florida, after an episode of bleaching that stroke the corals of the island from September 2019 to January 2020.

On the reefs of Guadeloupe Island, about half of the stony coral species were affected by that disease. Among the species impacted some are more sensitive than others, that is to say in decreasing order of importance: *Diploria labyrinthiformis*, *Meandrina meandrites*, *Montastrea cavernosa*, *Orbicella faveolata*, *O. annularis*, *Colpophyllia natans*, *Siderastrea siderea*. The most resistant species appeared to belong to the Poritidae family (*Porites astreoides*, *P. divaricata*, *P. furcata*). Until now, the disease has spared the two endangered species of acroporid corals: *Acropora palmata*, and *A. cervicornis*, as well as their hybrid *A. prolifera*.

The evolution of tissue necrosis on the colonies reached 2 to 3 centimeters per day. In general, the issue was lethal after one week to one month according to the initial stage of the colonies.

Nowadays, the abundance of the impacted coral species has drastically dropped. Fortunately, the recruitment of juveniles of those corals is observable even on the most affected reefs.

Keywords: Coral disease, SCTLD, Lesser Antilles, Guadeloupe Island, Caribbean

A Tale of Two Bahamian Fisheries: Using Social Science to Understand Management Implications of Fisher Behavior, Knowledge, and Perception

Una historia de dos pesquerías de las Bahamas: uso de las ciencias sociales para comprender las implicaciones de gestión del comportamiento, el conocimiento y la percepción de los pescadores

Un conte de deux pêcheries des Bahamas : utiliser les sciences sociales pour comprendre les implications de gestion du comportement, des connaissances et de la perception des pêcheurs

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ABSTRACT

Interdisciplinary approaches examining marine fisheries are vital to providing holistic views of these systems. Incorporating social science techniques helps provide researchers, managers, and policy makers with critical information on how stakeholders engage with fishery resources, how they interpret management and conservation efforts, and why they opt to embrace or ignore policies. Because these stakeholders are in constant contact with the resource, they possess a wealth of knowledge not often accessible to a researcher and have perceptions that impact how they engage within the fishery. Interweaving social considerations in fisheries work thus serves to provide a look beyond the ecological, biological, and physical to help give a broader perspective towards the quest for achieving sustainability. This poster will 1) highlight projects that utilize social science to conduct interdisciplinary investigations on two Bahamian fisheries (Caribbean spiny lobster (*Panulirus argus*) and parrotfish) and 2) provide considerations for utilizing social science in future fisheries research. One project used an approach examining biophysical forces impacting spiny lobster paired with chief human activities within the fishery where data from several models and surveys/interviews were coupled to help create a robust assessment. The other seeks to understand the social drivers of an emerging parrotfish fishery by conducting a socio-economic survey analyzing motivations, perceptions, and attitudes. In both fisheries, the potential for human-induced changes to the ecosystem highlights the need for inquiries acknowledging natural and anthropogenic impacts. These projects also demonstrate that holistic analyses of fisheries focusing on dynamics between social, ecological, and economical factors is essential for successful management.

Keywords: Fisheries Management, Social Science, Caribbean spiny lobster, Parrotfish, Interdisciplinary

Inspiring Bahamian Divers to Action Against SCTL D: A Pilot Study Applying the Values-Beliefs-Norms Theory to Predict Participation and Design Communications

Inspirando a los buzos de las Bahamas a actuar contra SCTL D: un estudio piloto que aplica la teoría de valores, creencias y normas para predecir la participación y diseñar comunicaciones

Inspirer les plongeurs des Bahamas à agir contre le SCTL D : une étude pilote appliquant la théorie des valeurs-croyances-normes pour prédire la participation et concevoir des communications

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ABSTRACT

Bahamian coral reefs are under increasing threat from Stony Coral Tissue Loss Disease (SCTL D). This has implications for not only the local fishing industries, but also for the local tourist economy, where diving is a major activity. A pilot survey was conducted with local divers in order to gauge their awareness of, knowledge, perceptions, and motivations regarding SCTL D. The Value-Belief-Norm (VBN) Theory was also utilized in the survey as a framework to evaluate the drivers of pro-environmental behaviors of divers related to proposed SCTL D actions, as well as to help assess the specific dynamics that motivate this group to contribute towards “Stopping the Spread” and to inform the designs of a variety of communications materials. We measured diverse; values, beliefs about SCLTD-related issues, norms for the intended activities, and behavior intentions on 5-point scales. Results from the surveys indicated that values, beliefs, and personal norms may be more important than social norms as motivators to participate in SCTL D actions. Additionally, we determined that efforts should be focused on individuals who are unsure if or who disagree that their personal actions can make an impact. This highlights the importance of creating messaging that reinforces people’s ability to make positive environmental impacts, as well as their personal obligations to assist in conservation efforts within their local areas. This work also presents an opportunity for similar studies to be conducted with different stakeholder groups (and in different locations impacted by SCTL D) to help craft more targeted, audience-specific communications around these issues that will help inspire people to action.

Keywords: Stony Coral Tissue Loss Disease, SCTL D, Value-Belief-Norms Theory, Conservation Behavior Change, Behavior Change Communications

Protecting Species and Places: A Partnership for Place and Species-Based Conservation

Protegiendo Especies y Lugares: Una Colaboración para Conservar Lugares y Especies

Protéger les Espèces et les Lieux: Un Partenariat pour la Conservation des Lieux et des Espèces

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ABSTRACT

Programs to protect threatened and endangered species and conserve important areas have overlapping conservation goals and can benefit from close collaboration. Here we provide an overview of this type of collaboration focusing on the Gulf and Caribbean. The Protecting Species and Places (PSP) conservation program was created by the National Oceanic and Atmospheric Administration (NOAA) Office of Protected Resources and Office of National Marine Sanctuaries to build partnerships to link and align place-based and species-based conservation efforts in U.S. waters and beyond. PSP has three main goals. The first is to improve coordination between marine protected area (MPA) management plans and species recovery plans to increase protection of species under multiple jurisdictions. The second is to identify conservation strategies and mechanisms to conserve species and places that fall outside MPA management and recovery plans. The third is to identify, support, and enhance interagency and international collaboration to conserve marine species and places. NOAA is involved in key international partnerships such as the Cartagena Convention's Protocol on Specially Protected Areas and Wildlife (SPAW) in the Wider Caribbean that includes species such as the Nassau grouper listed as endangered under the International Union for Conservation of Nature and threatened under the U.S. Endangered Species Act. By leveraging partnerships using the multiple NOAA offices engaged in the program, PSP promotes the conservation of species such as Nassau grouper and their habitats in support of efforts under SPAW and the Spawning Aggregations Working Group of the Western and Central Atlantic Fishery Commission.

Keywords: partnerships, conservation, Nassau grouper, collaboration,

Spatial considerations can determine net socioecological effects of artificial reefs on recreational fisheries and their management

Las consideraciones espaciales pueden determinar los efectos socioecológicos netos de los arrecifes artificiales en la pesca recreativa y su ordenación.

Les considérations spatiales peuvent déterminer les effets socioécologiques nets des récifs artificiels sur la pêche récréative et leur gestion

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ABSTRACT

Artificial reefs have been deployed with the intention of increasing fish habitat, enhancing recreational fishery opportunities, and providing socio-economic benefits to surrounding communities. Reefs can alter vital rates affecting fish populations, but they may also influence angler fishing behaviors. This means that artificial reefs not only increase fish populations and bolster economies, but also can increase fishing mortality that could eventually trigger stricter regulations. These effects may depend on the spatial placement of these reefs, though this has not been well evaluated. A system-level evaluation; accounting for feedbacks between habitat, fish, and anglers; is needed to anticipate unintended consequences and predict outcomes resulting from the deployment of artificial reefs. To better understand the possible outcomes of artificial reef implementation and spatial disposition, we developed a spatially explicit socioecological model representing a red snapper population and simulated how effects of artificial reefs and their placement affect the fishery. Our results demonstrate that simultaneously increasing socioeconomic fishery objectives (greater catch rates, more fishing effort) and conservation objectives (greater spawning biomass) would be very difficult to achieve; and are only possible if the placement of artificial reefs allow biological benefits to greatly outstrip augmented fishing opportunities. Under most placement scenarios, artificial reefs would often lead to depleted fish populations and restrictive regulations that could have undesired effects on nearby coastal communities. These results highlight the importance of understanding spatial dynamics of fish population and anglers and the need to consider fisheries management in the siting and decision-making of the implementation of artifi

Keywords: artificial reef, simulation, red snapper, recreational fishery

Regional Synthesis of Invasive Lionfish Citizen Science Programs in the Tropical Western Atlantic

Síntesis regional de programas de ciencia ciudadana sobre peces león invasores en el Atlántico occidental tropical

Synthèse régionale des programmes de science citoyenne du poisson-lion envahissant dans l'Atlantique Ouest tropical

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ABSTRACT

Indo-Pacific lionfish (*Pterois volitans* and *P. miles*) have established populations throughout the tropical Western Atlantic Ocean with demonstrable effects on native species, fisheries, biodiversity, and ecosystem processes. Effective management of this invasion has proved to be beyond the capacity of natural resource organizations alone and requires innovative approaches as well as collaboration among a diverse set of stakeholders. In response, organizations throughout the Western Atlantic region have mobilized citizen scientists to physically remove lionfish, raise awareness and collect important data needed to manage the invasion. Using a structured survey, we assessed 71 organizations' lionfish management approaches, perceived impact, obstacles, public participation, engagement with citizen scientists, and the importance of citizen scientists to lionfish research and management. We examined five case studies that demonstrate organizations' multi-pronged approaches to lionfish control and engagement of citizen scientists and other members of the public for monitoring, removal, and knowledge-sharing efforts. Our findings demonstrate the conservation value of citizen scientists to organizations and their efforts to monitor and control the invasion. The majority of organizations engaging citizen scientists could not conduct their work without them. The data gathered by most of these organizations contribute to scientific publications, management, and government agency research and/or policy.

Keywords: Lionfish, Citizen Science, Invasive Species, Public Engagement

One fish, two fish, twelve years of huge fish: An overview of The Great Goliath Grouper Count in Florida

Un pez, dos peces, doce años de peces enormes: Un resumen del gran recuento de meros Goliath en Florida

Un poisson, deux poissons, douze ans de poissons énormes : un aperçu du décompte des mérours du Grand Goliath en Floride

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ABSTRACT

Following decades of overfishing, harvest of Goliath grouper *Epinephelus itajara* in U.S. waters was prohibited in 1990. The population in Florida has responded well to protective measures and numbers have been rebuilding since the moratorium. However, stock assessment remains complicated and the full extent of recovery throughout their geographic range remains unclear. Since 2010, Florida Sea Grant and the Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute have coordinated an annual citizen science event to provide data as related to the distribution and abundance of Goliath grouper in Florida. During this “Great Goliath Grouper Count” trained volunteer divers collect data via underwater surveys at designated artificial reefs throughout Florida. What began as a regional effort in southwest Florida has expanded over the past twelve years to include sites in the northern Gulf of Mexico, Florida Keys and Atlantic coast of Florida. Every year during the first two weeks of June, divers complete standardized data reports that are compiled and submitted to management. To date, over 100 volunteers have spent more than 330 hours underwater and completed 726 surveys. Largest numbers of Goliath grouper were observed in southwest Florida, and were typically associated with high volume, high relief artificial reefs. Extension efforts promote collaboration with citizen scientists and allow for coordinated data collection over a broad geographic area within a relatively short period, aimed to assist policy makers in future management efforts related to this species.

Keywords: Goliath grouper, *Epinephelus itajara*, artificial reefs, citizen science, diver

The removal and reintroduction of Symbiodiniaceae in *Montipora capricornis*

La eliminación y reintroducción de Symbiodiniaceae en *Montipora capricornis*

L'élimination et la réintroduction des Symbiodiniaceae dans *Montipora capricornis*

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ABSTRACT

Coral reefs are a critical habitat in tropical ecosystems. They create a barrier that reduces storm surge, provide medicines, and are estimated to affect 25% of the fish in the ocean. Unfortunately, coral reefs around the world are dying at an alarming rate. Corals survive by having a symbiotic relationship with Symbiodiniaceae, a photosynthetic dinoflagellate that lives within the tissue of corals. Symbiodiniaceae uses photosynthesis to turn sunlight into glucose, glycerol and amino acids for its holobiont (coral host). Understanding the role that temperature plays in this relationship is crucial to understanding how to help corals survive mass bleaching events. This experiment tests the ability of the coral *Montipora capricornis* to expel its Symbiodiniaceae and gain a different species of Symbiodiniaceae. *M. capricornis* naturally has one of the most abundant species of Symbiodiniaceae from the genus *Cladocopium* (C15h). The *Cladocopium* sp. was purposefully expelled from the *M. capricornis* by increasing the water temperature of the tank, simulating rising temperatures in the ocean, to allow for the reintroduction of *Symbiodinium trenchii*, a *Durusdinium* sp. with a greater resistance to temperature change. The *S. trenchii* were cultured, and once the *M. capricornis* was successfully bleached, the *S. trenchii* was introduced. We sampled coral tissue to determine if the *S. trenchii* successfully replaced the original zooxanthellae, DNA and Chlorophyll A. In addition, oxygen concentrations in the coral boundary layer were measured in light and dark before, during, and after the bleaching to test the differences in oxygen production.

Keywords: Symbiodiniaceae, *Montipora*, Bleaching, Chlorophyll A, Coral

The impacts of *Halophila stipulacea* on growth and survival of economically important *Ocyurus chrysurus*

El impacto de *Halophila stipulacea* en el crecimiento y la supervivencia del económicamente importante *Ocyurus chrysurus*

Les impacts de *Halophila stipulacea* sur la croissance et la survie d'*Ocyurus chrysurus* d'importance économique

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ABSTRACT

As anthropogenic impacts increase, it is critical to understand how the consequences will affect commercially important fisheries species. Many of these species, like yellowtail snapper (*Ocyurus chrysurus*), depend on seagrass beds as critical nursery habitat. Since 2002, a non-native seagrass, *Halophila stipulacea*, has become widespread throughout the Caribbean, arriving in St. Thomas in 2013. The impacts of *H. stipulacea* on juvenile yellowtail snapper habitat is not well understood, yet, has the potential to disrupt essential fish habitats and reduce important fishery resources. Previous studies have demonstrated that *H. stipulacea* can reduce juvenile fish abundance, species diversity, and condition factor, suggesting that *H. stipulacea* may have a strong negative affect on growth and survival of juvenile reef fishes. In this study we analyzed the impacts of *H. stipulacea* on the settlement, mortality, and health of juvenile yellowtail snapper. Preliminary results suggest that there is a higher settlement frequency in *H. stipulacea* seagrass beds than in *Syringodium filiforme* seagrass habitats, however not than *Thalassia testudinum* seagrass habitats. Additionally, individuals caught in *H. stipulacea* seagrass habitats had a significantly higher condition factor, measurement of health, than individuals caught in native *S. filiforme*, but no significant difference than individuals caught in native *T. testudinum*. These data can be used in ecosystem-based fisheries management to better understand the best management practices for *H. stipulacea* in order to properly allocate resources for a more sustainable future for Caribbean reef fishes.

Keywords: *Ocyurus chrysurus*, *Halophila stipulacea*, USVI, Impacts, Fisheries Management

Status of Stony Coral Tissue Loss Disease across the northern coast of the Dominican Republic: What do we really know?

Estado de la Enfermedad de Pérdida de Tejido en Corales Pétreos en la costa norte de la República Dominicana: ¿Qué es lo que realmente sabemos?

Statut de la maladie de perte de tissu Stony Coral sur la côte nord de la République Dominicaine: Que savons-nous vraiment?

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ABSTRACT

Stony Coral Tissue Loss Disease (SCTLD) is a deadly condition recently described in the Caribbean. In six years it has spread out rapidly while killing major reef builders in the region. In the Dominican Republic (DR), the disease was first noticed in Cayo Arena in 2019. Since then, scattered reports of SCTLD affecting corals along the Northern Coast of the country have increased. However, the lack of a systematic monitoring program hampered local and regional comparisons on SCTLD prevalence in the DR. Here, we present the status of SCTLD across the Northern Coast of the DR across various spatial scales encompassing hundreds of meters to thousands of kilometers. We found high spatial variability on SCTLD prevalence across locations and sites. Higher prevalence was observed in Samaná Bay (6,5% - 59%), and Galeras (28,6% - 30,8%). All sites across the west northern coast had a prevalence below 5%, except for Sosúa (16,6%). However, about 80% of the colonies surveyed in this area likely died in 2019 during a prolonged SCTLD epizootic event which eradicated species such as *Dendrogyra cylindrus* and other meadrinids. New observations on active SCTLD affecting juveniles and recruits of *Pseudodiploria strigosa*, *Dichocoenia stockesii*, *Siderastrea siderea*, *Eusmilia fastigiata* and *Orbicella spp.* are presented. Furthermore, a new behavior of the sea star *Oreaster reticulatus* eating sloughing SCTLD tissues was observed. Our results indicate that SCTLD is a serious and poorly understood problem for coral reef health in the DR.

Keywords: Coral reefs, SCTLD, Epizootic event, Prevalence

In situ habitat assessment of mesophotic queen conch (*Auger gigas*) in the west coast of Puerto Rico

Evaluación del hábitat in situ del caracol rosado mesofótico (*Auger gigas*) en la costa oeste de Puerto Rico

Évaluation in situ de l'habitat du strombe géant (*Auger gigas*) mésophotique sur la côte ouest de Porto Rico

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ABSTRACT

Overfishing of queen conch has led to shifts in their distribution and population size in some Caribbean countries. In some of those locations, fishers have largely switched from harvesting conch by snorkeling to using scuba practices. In some instances, into the mesophotic conch habitat (>25m). Advances in technology such as camera sleds have been used to photograph and characterize marine species in a variety of habitats. Previous studies in the Caribbean have shown that camera sleds can be used to identify, measure, and study queen conch. To better understand mesophotic queen conch habitat use and composition, we used a camera sled to characterize queen conch siphonal length, age class, and environmental characteristics. To accomplish this, six-line transects of 2 hr duration at 25-60 m depths were completed in the mesophotic area during the summer of 2018 on the west coast of Puerto Rico. Queen conch observed densities ranged from 2.62 -140.10 conch ha⁻¹ and the relative abundance of conch was highest in the 35-40 m depth zone. The role of the mesophotic conch within fisheries stocks is still unknown. This is research provided unique information that could potentially aid in making management decisions for mesophotic conch.

Keywords: Queen conch, mesophotic, habitat assessment

Applications of electronic reporting to improve science and management in the Caribbean.

Aplicaciones de informes electrónicos para mejorar la ciencia y la gestión en el Caribe.

Applications des rapports électroniques pour améliorer la science et la gestion dans les Caraïbes.

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ABSTRACT

Effective fisheries management depends upon the collection of accurate and timely fishery-dependent data. Paper-based data collection systems often result in paper “silos” and inefficient input into management processes. As our oceans face every greater challenges, data collection must become more efficient, nimble and robust to allow managers to adapt harvest controls to ever-changing conditions. Digitization of data allows data management systems to make this evolution and enables the adoption of digital technologies that can facilitate wider fishery and community benefits. This presentation describes existing applications of electronic reporting around the world and identifies the benefits of electronic reporting as well as implementation considerations for the Caribbean region.

Keywords: electronic reporting, smartphone apps, data management

A Fishers Operated Pilot-Scale Queen Conch (*Aliger gigas*) Hatchery and Nursery Facility for Restoration and Sustainable Seafood Supply in Puerto Rico

Desarrollo de un Criadero y Vivero Piloto de Carrucho (*Aliger gigas*) Operado por Pescadores, para la Producción Sostenible y Restauración de Poblaciones Silvestres en Puerto Rico

Une écloserie et une pépinière à l'échelle pilote de lambi (*Aliger gigas*) exploitées par des pêcheurs pour la restauration et l'approvisionnement durable en fruits de mer à Porto Rico

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ABSTRACT

The queen conch, an important fishery species in the Caribbean, has been overfished. The conch “carrucho”TM fished in Puerto Rico are consumed locally. With the decline in populations in the Puerto Rico state and federal waters, closed seasons, and disruption of conch habitats from hurricanes, conch is a prime candidate to be aquacultured. The project goal (S-K NOAA Award NA19NMF4270029) is to assist with restoration of the queen conch fishery in Puerto Rico by producing 2,000 conch in a fishers-operated facility. In June 2021, the conch hatchery and seawater system were completed at the Naguabo Fishing Association. In June, the fishers started collecting two to three small pieces of conch egg masses per week during their fishing trips. In the hatchery, the egg masses incubate in a recirculating saltwater system. On the fourth day, each egg mass hatches in a 68-L larval tank. The conch veligers (larvae) are cultured for 21-25 days and fed microalgae. In July 2021, the first culture of larvae successfully metamorphosed in shallow trays in a recirculating tank system. Detrital seagrass blades were used as the metamorphic cue and provided food. Multiple batches of larvae will be raised in the “Naguabo Queen Conch Hatchery”. The recirculating juvenile nursery tank system is being installed to and conch will be cultured on sand substrate with a gel-diet for 12-months prior to release in nearby seagrass beds. This project serves as a model that can be transferred to other fishing communities in Puerto Rico and elsewhere

Keywords: Queen Conch, Aquaculture, Restoration, Fishers, Puerto Rico

eConch: eLearning for Growing Queen Conch (*Aliger gigas*)

eCaracol Rosado: Aprendiendo a Cultivar Caracol Rosado (*Aliger gigas*)

eLambis: Apprentissage en Ligne Lambis (*Aliger gigas*)

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ABSTRACT

The Queen Conch Lab is an aquaculture, conservation, research, and education program at Florida Atlantic University (FAU) Harbor Branch Oceanographic Institute. The program works with partners on community-based queen conch projects across the Caribbean. Culturally important, queen conch are prized for their pink shells and nutritious meat. Communities depend on conch as a source of food and income. As grazers, they play a key ecological role in seagrass habitats. Intense fishing pressure and habitat loss have resulted in declining queen conch populations. In 2020, the Queen Conch Lab established the ‘eConch: eLearning for Growing Queen Conch’ initiative as a strategy to address requests from Caribbean communities for information on how to grow conch for restoration, conservation, and sustainable seafood purposes. ‘eConch’ is an interactive online course being developed in partnership with FAU Center for Online and Continuing Education. The syllabus will feature eight modules that include video content, live virtual presentations, activities, and group discussions designed for a broad audience. This concept emerged based on findings from two focused planning sessions with site partners throughout the Caribbean that have signed up to beta test the course in 2022. The success of this initiative will be the implementation of a well-tested eLearning course on the cultivation of queen conch that can be offered to additional participants in the Caribbean. Wide-ranging distribution of this knowledge will benefit the species, the ecosystem, and the communities that depend on the fishery.

Keywords: Queen Conch, Aquaculture, Online Learning, Education, Caribbean

Multiple drivers of invasive lionfish culling efficiency in marine protected areas

Múltiples impulsores de la eficiencia de la eliminación de peces león invasores en áreas marinas protegidas

Multiple facteurs l'efficacité de l'abattage du poisson-lion envahissant dans les aires marines protégées

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ABSTRACT

Designing effective local management for invasive species poses a major challenge for conservation, yet factors affecting intervention success and efficiency are rarely evaluated and incorporated into practice. We coordinated regional efforts by divers to cull invasive lionfish (*Pterois* spp.) on 33 US Atlantic, Gulf of Mexico, and Caribbean protected coral reefs from 2013-2019 and estimated removal efficiency and efficacy as a function of environmental and habitat conditions, invasion status, and personnel expertise. Highly experienced individuals culling during crepuscular periods (<2hrs from sunrise/sunset) are three times more efficient (in terms of minutes) than novice divers during midday, suggesting 1) retention of experienced individuals is key for efficient programs, and 2) planning culls with personnel and time of day in mind increases the number of sites covered with the same effort. Lionfish behavior and habitat characteristics had little effect on removal efficiency and efficacy, but divers had higher capture success at reefs with higher lionfish densities. We suggest reefs with persistently <20 fish ha⁻¹ as low priority, given that impacts to native fauna are unlikely and culling effectiveness declines to <50% below this level. Incorporating efficiency factors in spatial management planning along with density estimates derived from remotely sensed data can ensure limited resources for control are extended across a greater range of invaded habitats

Keywords: invasive species, population control, functional eradication, removal efficacy, citizen science

Working towards sustainable financing on the three windward islands in the Dutch Caribbean

Trabajando hacia una financiación sostenible en las tres islas de barlovento del Caribe holandés

Vers un financement durable sur les trois îles au vent des Caraïbes néerlandaises

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ABSTRACT

Similar to other protected areas in the Caribbean, the organisations that manage the nature parks in the Dutch Caribbean face a structural shortage of sustainable sources of financing to fulfil their nature management tasks.

Wolfs Company and DCNA with support from WWF-NL assisted the Saba Conservation Foundation (SCF), St. Eustatius National Parks (STENAPA) and the Foundation for the Management and Conservation of Nature on Sint Maarten (SMNF) in strengthening their strategies to achieve sustainable financing of the National Parks in Saba, National Parks in St Eustatius and the Man of War Shoal Marine Protected Area, respectively.

However, during the project timeframe COVID happened and required a reorientation of project. These case studies will be used to showcase the process used to come up with the financing needs, financial plan, potential financing strategies and a plan of action to tap into the identified financing sources.

Focus will be on the nature of financing gap, barriers identified, number/diversity and types of financing strategies identified for possible implementation, the impact of COVID and current status of financing.

Keywords: Sustainable financing, Saba, St eustatius, St Maarten, MPA

Moored Fish Attracting Devices (FADs) in Dominica: Have they achieved their intended objectives?

Dispositivos atractores de peces amarrados (DCP) en Dominica: ¿Han logrado los objetivos previstos?

Dispositifs d'attraction de poissons amarrés (DCP) en Dominique : ont-ils atteint les objectifs visés ?

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ABSTRACT

Moored Fish Aggregating Devices (FADs) have been promoted in Dominica since the 1990s to help address management concerns of declining pelagic catches and heavy fishing pressure on the inshore demersal reef resources. However, their effectiveness has never been fully explored. In this study an assessment of 20 years of Government fishery catch and effort data (1994 - 2014) reveals a dramatic increase in the capture of offshore pelagic species, and an increase in fishing efficiency as catch per fishing trip. However, there has been no change in the catch or fishing effort in the inshore reef-associated fishery. As such, the introduction of FAD fishing in Dominica's small scale fisheries has been highly successful in meeting one objective of increasing overall fishery production, but has failed to alleviate fishing pressure on inshore reef species. Further study is needed to better understand the factors that continue to incentivize fishers to target demersal species, in order to understand how this fishery could be effectively managed in the future to reduce the fishing pressure and ensure sustainability of the reef resources.

Keywords: Moored FADs, Pelagic fishery, reef-associated fishery, Dominica, catch and effort

Mapping Exposure to Sargassum Impacts in Eastern Caribbean small island states as a basis for strategic management

Mapeo de la exposición a los impactos del sargazo en los pequeños estados insulares del Caribe oriental como base para la gestión estratégica

Cartographie de l'exposition aux impacts des sargasses dans les petits États insulaires des Caraïbes orientales comme base pour la gestion stratégique

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ABSTRACT

The negative impacts of sargassum seaweed influxes across the environment, society and economy in the Caribbean are generally well documented. However, impacts are not uniform across the region, in large part because the Caribbean is much less homogenous than is often perceived. Small island developing states (SIDS) are especially vulnerable to external shocks and lack the resources to mount an effective response. Fragmented coastlines and isolation from continental mainlands present logistical challenges. Spatial differentiation of the impacts would support more effective allocation of limited resources for management. This, however, is limited by the availability of consistent and systematic monitoring data. In this study, data extracted from publicly available aerial imagery (Google Earth) was used to map the spatial distribution of sargassum influx occurrence (exposure) on five Eastern Caribbean SIDS. Alongside this, existing spatial datasets were used to produce asset maps in multiple categories, particularly ecosystems assets, and economic assets for key sectors (tourism and fisheries). A template for a standard country profile consisting of key data relevant to assessment of sargassum influx impacts was developed and populated for each country. Exposure maps were overlaid with asset maps, and the exposure of specific asset categories was assessed quantitatively. While there are limitations, this allowed impacts to be differentiated by types of assets present/ absent. It is expected that this will be used as a basis for more detailed exposure analysis, further differentiation of impacts (for example by coastal morphology or coastal dynamics), vulnerability assessment of exposed assets, and strategic management responses.

Keywords: sargassum influxes, exposure mapping, asset mapping, small island developing states, coastal zone management

Algal symbionts in the genus *Breviolum* increase the susceptibility of corals to stony coral tissue loss disease (SCTLD)

Algas simbióticas en el género *Breviolum* aumentan la susceptibilidad de los corales a la enfermedad pérdida de tejido en corales escleractinios (SCTLD)

Les algues symbiotiques du genre *Breviolum* augmentent la vulnérabilité des coraux a la maladie de perte de tissu des coraux durs (SCTLD)

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ABSTRACT

Florida's Coral Reef is currently experiencing an unprecedented, multi-year outbreak of stony coral tissue loss disease (SCTLD), with the most highly susceptible species predominantly hosting algal symbionts in the genus *Breviolum*. We used a manipulative experiment to alter the algal symbiont communities in replicate cores of five species of Caribbean coral (*Colpophyllia natans*, *Diploria labyrinthiformis*, *Meandrina meandrites*, *Pseudodiploria strigosa*, and *Orbicella faveolata*) and tested whether these changes affected their susceptibility to SCTLD. We experimentally bleached and recovered a subset of cores to encourage algal associations in favor of *Durusdinium*, and then exposed them to SCTLD and compared their responses to control cores of the same genotype hosting native algal symbionts (*Breviolum* or *Cladocopium*). We found cores containing *Breviolum* were more susceptible to SCTLD and colonies exclusively hosting *Breviolum* were 2.5x more likely to present with SCTLD-lesions when compared with those with *Durusdinium*. These results suggest a hierarchy among Symbiodiniaceae in driving susceptibility to SCTLD (*Breviolum* >> *Cladocopium* > *Durusdinium* >> Symbiodinium). This differential susceptibility suggests either that algal symbionts (or their specific microbial associates) are the active targets of a SCTLD pathogen, or that hosting certain symbionts increases the susceptibility of the coral's immune system to SCTLD. We also assessed changes in holobiome composition (16S and 18S), host and symbiont gene expression, and histopathology. Our findings will help explain inter- and intra-specific variability in disease incidence and severity, with implications for interventions which could be applied to mitigate SCTLD impacts and/or restore affected reefs in the Caribbean.

Keywords: SCTLD, Coral mortality, Disease incidence, Algal symbionts, Coral disease

Progress Towards MPA Sustainable Financing by the MPACConnect Network

Avances en el financiamiento sostenible para las AMPs de la Red MPACConnect

Avancées dans le financement durable des AMP du réseau MPACConnect

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ABSTRACT

Despite various regional and international initiatives that seek to address sustainable financing, Caribbean marine protected areas (MPAs) still lack reliable, long-term sources of funding to enable them to fully achieve their management objectives. Various inventories exist that list, define and describe traditional and innovative approaches to financing. Case studies have been shared about successful examples of the implementation of financing strategies. Numerous guides, manuals and webinars seek to assist managers to identify and implement sustainable financing strategies. Yet the chronic under-funding of MPAs persists. This has only been exacerbated by impacts of COVID-19. Drawing on experience from the MPACConnect network, we will examine our past efforts to build capacity, to share best practices between sites, to network MPA managers with financing mentors and experts, and ultimately to generate unrestricted, sustainable funding for MPA management. This review is informed by the findings of the MPA management capacity assessment, by two peer-to-peer regional workshops on MPA financing, by peer mentorship to five MPAs and technical assistance for 14 site-specific projects to implement sustainable financing strategies. We highlight lessons learned about financial management for MPAs, the value of different tools applied by the network, the helpfulness of analytical approaches to financial planning, the feasibility of applying innovative but more complex financing strategies, and the impact of COVID-19 on MPA sustainable financing.

Keywords: MPACConnect, financing, networking

How do stone crab *Menippe mercenaria* fishing practices impact disease and trophic ecology?

¿Cómo impactan las prácticas de pesca del cangrejo piedra *Menippe mercenaria* en las enfermedades y la ecología trófica?

Comment les pratiques de pêche au crabe pierre *Menippe mercenaria* ont-elles un impact sur les maladies et l'écologie trophique ?

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ABSTRACT

Stone crab *Menippe mercenaria* represent an important and growing fishery in Florida and the Caribbean, but one with unique challenges for managers. It is a trap-based, claw-removal fishery wherein legal-sized claws are removed and live crabs returned to the water. Though laboratory and field studies suggest that only 20-40% of harvested animals survive the trauma of two claw harvest, landings suggest that at least a small portion of crabs (it is estimated that 4-13% of claws landed are regenerated) survive to regenerate claws and re-enter the fishery. Released crabs, including sublegal individuals, have been in traps for up to a month, where close contact with conspecifics could lead to rapid disease transmission. Crabs that survive harvest have limited access to prey, which could be detrimental to their nutritional condition, could lead to a trophic shift, and also could affect disease transmission. To examine disease and trophic structure of fished crabs, we collected stone crabs from Florida Wildlife Research Institute's regularly monitored traps in Cedar Key (n = 155) and Harbor Key (n = 128) in 2019-2020. All crabs were necropsied and screened for disease via histopathology and molecular diagnostics. Trophic status was assessed through carbon and nitrogen stable isotope analysis of the muscle and hepatopancreas to determine longer- and shorter-term diet, respectively. This study is the first to assess stone crab diet changes after harvest in the wild and will help managers better understand the impacts of harvest and whether returning animals to water affects disease ecology.

Keywords: disease, trophic ecology, stone crab, fishery,

Rhodobacterales, Rhizobiales, Desulfovibrionales, and Clostridiales are Significant Taxa Associated with Stony Coral Tissue Loss Disease in *Montastraea cavernosa* and *Orbicella faveolata*

Rhodobacterales, Rhizobiales, Desulfovibrionales y Clostridiales son taxones significativos asociados con la enfermedad de pérdida de tejido de coral pedregoso en *Montastraea cavernosa* y *Orbicella faveolata*

Rhodobacterales, Rhizobiales, Desulfovibrionales et Clostridiales sont des taxons importants associés à la maladie de la perte de tissus des coraux pierreux chez *Montastraea cavernosa* et *Orbicella faveolata*

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ABSTRACT

Since 2014, Florida's Coral Reef (FCR) has experienced a multi-year disease related mortality event, termed stony coral tissue loss disease (SCTLD). This disease affects over half of the reef-building species in Florida, has high rates of mortality and follows a contagious model of transmission. Despite this, researchers have been unable to determine definitive pathogen(s) for this disease. Some studies have indicated that SCTLD lesion progression can be slowed down or halted on some coral species with a specially formulated ointment laced with amoxicillin, suggesting that the presumptive pathogen(s) for SCTLD may have a bacterial component. Here, we used 16S ribosomal RNA (rRNA) sequencing to identify key differences in the bacterial community of apparently healthy and SCTLD-affected *Montastraea cavernosa* and *Orbicella faveolata* fragments. We also examined how the bacterial community changed over time (5%, 25%, 50%, and 75% progression of tissue loss) in each species. Overall, several bacterial taxa were repeatedly more abundant within diseased tissues compared with healthy tissue samples. In both species, orders Rhodobacterales, Rhizobiales, Desulfovibrionales and Clostridiales were found at higher relative abundances in disease samples compared to apparently healthy control samples. In *M. cavernosa*, the relative abundances of Clostridiales and Desulfovibrionales increased as the disease progressed. In *O. faveolata*, the relative abundance of Clostridiales increased as the disease progressed, and Chlamydiales were repeatedly more abundant in control *O. faveolata*. These results suggest that Rhodobacterales, Rhizobiales, Desulfovibrionales and Clostridiales may play a critical role in disease dynamics of SCTLD and future research should focus on identifying the function of these bacteria within diseased corals.

Keywords: stony coral tissue loss disease, *Orbicella faveolata*, *Montastraea cavernosa*, Florida's Coral Reef

Coral Bleaching in the Bonaire National Marine Park 2016-2020

Blanqueamiento de corales en el Parque Nacional Marino de Bonaire 2016-2020

Blanchiment des coraux dans le parc marin national de Bonaire 2016-2020

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ABSTRACT

Mass coral bleaching is becoming more frequent and widespread and poses a major threat to coral reefs worldwide. Mass coral bleaching is a response to thermal stress triggered by high Sea Surface Temperatures (SSTs) or ultraviolet radiation attributed to changing regional and global climate patterns. Since 2016, STINAPA Bonaire has surveyed the severity of coral bleaching in the Bonaire National Marine Park at 10 sites and at three depths (25, 10 and 5 m) on the leeward coast. Each year, corals exhibited signs of thermal stress including paling, partial bleaching, and full bleaching, but no mortality. Since 2016, the year with the lowest percentage of corals affected was 2018 (9%) and the year with the highest percent of corals affected was 2020 (61%). That same year, follow-up surveys at three sites on the deeper reef (35m) indicated up to 50% of colonies suffered either partial or complete mortality. Corals deeper in the water column were more susceptible to thermal stress in all years, but susceptibility trends by site were not consistent throughout the study. While addressing the global-scale causes of coral bleaching is daunting, STINAPA Bonaire monitors the severity of coral bleaching and helps develop local management strategies that may improve the resistance and resilience of coral reefs in the Bonaire National Marine Park to climate change.

Keywords: Bonaire, coral, bleaching, climate, resilience

Juvenile Goliath Grouper (*Epinephelus itajara*) habitat use and movement patterns in South Florida Estuaries

Uso del hábitat y patrones de movimiento del mero juvenil (*Epinephelus itajara*) en estuarios del sur de la Florida

L'utilisation de l'habitat et les schémas de déplacement du mérrou goliath juvénile (*Epinephelus itajara*) dans les estuaires du sud de la Floride

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ABSTRACT

Goliath Grouper populations have shown significant recovery in US waters following the closure of the fishery in 1990; however, despite a higher abundance of adults offshore and juveniles inshore, the extent of the recovery is unknown. Most research efforts to date have focused on adults offshore and their associated spawning aggregations, while less information exists on the juvenile stage that is dependent on mangrove estuaries that function as nursery habitat. We tagged juvenile Goliath Grouper in three south Florida estuaries that differ in their degree of urbanization and environmental conditions starting in 2017 using Vemco acoustic telemetry tags (V9 and V16; 440 days and 6.5 years battery life) to investigate habitat use and movement patterns. We tagged 30 juveniles (size range = 502 - 1132 mm TL) in the St. Lucie River and adjacent Indian River Lagoon; 8 juveniles (216 - 1130 mm TL) in the Caloosahatchee River and Charlotte Harbor; and 22 juveniles (270 - 846 mm TL) in Faka-Union and Pumpkin Bays of the Ten Thousand Islands. Movements by tagged fish within respective estuaries aligned with responses to changes in both salinity and temperature, depending on where the fish was initially tagged. Generally, fish moved out of rivers when freshwater flows increased and returned when salinity increased as flows declined. We also found that the timing of an expected ontogenetic shift to offshore habitat appears to coincide with winter cold fronts. Monitoring fish movements within human-altered systems will help us better understand the patterns in habitat utilization of this iconic species.

Keywords: Movement, Habitat, Mangrove, Estuary

Age And Growth Of Gray Snapper (*Lutjanus griseus*) In The Northern Coast Of The Yucatan Peninsula

Edad Y Crecimiento Del Pargo Prieto (*Lutjanus griseus*) En La Costa Norte De La Peninsula De Yucatan

Âge et croissance du vivaneau gris (*Lutjanus griseus*) dans la côte nord de la péninsule du Yucatan

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ABSTRACT

En el sur del Golfo de México, los meros (Epinephelidae, Epinephelinae) son el principal componente de la pesquería del estado de Yucatán, México. Debido a que esta pesquería está en fase de declive, el esfuerzo pesquero ha sido redirigido hacia especies de la familia Lutjanidae como el pargo prieto *Lutjanus griseus* (Linnaeus, 1758). La información sobre la biología de este pargo en Yucatán es escasa, lo cual perjudica el manejo sustentable de su pesquería.

Un total de 837 especímenes de pargo prieto (rango: 8.0 a 65.5 cm LT; 8 a 3,876 g PT) fueron colectados mensualmente a lo largo de la costa de Yucatán, seleccionándose una sub-muestra de 357 individuos (12.3- 65.5 cm LT; 756- 3,876 g PT) para el análisis de sus otolitos (sagittae). A partir de micro-cortes de otolitos se analizaron los anillos de crecimiento para determinar la edad de los individuos después de una validación por un análisis del incremento marginal (IM). El crecimiento de la especie fue evaluado mediante el modelo de von Bertalanffy.

El análisis del IM confirmó la formación anual de los anuli en los otolitos. La edad de los individuos fluctuó entre 0+ y 10 años, siendo los de 4 (n= 76), 3 (n= 66) y 5 años (n= 53) los más abundantes en la sub-muestra analizada y los 0+ (n= 3) y 10 años (n= 4), los más escasos. Los parámetros del modelo de crecimiento de von Bertalanffy para la población de pargo prieto de Yucatán fueron: L_{∞} = 68.54; k = 0.16, t_0 = -0.2346 y \emptyset' = 2.876. Los resultados obtenidos en el presente estudio fueron comparados con los de otras regiones de distribución de la especie.

Keywords: Edad, Crecimiento, Pargos, *Lutjanus griseus*, Yucatan

Predicting the potential distribution of a new Caribbean invader using a species distribution model

Predecir la distribución potencial de un nuevo invasor caribeño utilizando un modelo de distribución de especies

Prédire la distribution potentielle d'un nouvel envahisseur des Caraïbes à l'aide d'un modèle de distribution des espèces

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ABSTRACT

Predicting suitable habitat of an invasive species can aid resource managers in time-efficient and cost-effective monitoring and removal. Using the Software for Assisted Habitat Modeling, we tested four model algorithms to forecast potential range expansion of a new invader, *Neopomacentrus cyanomos* (regal demoiselle), in the Greater Caribbean. Models were built using independent training and testing data that contained presence and absence points observed in both the native and invasive ranges and a suite of environmental predictors. We compared models developed using native occurrences, non-native occurrences, and a combination of both. The Generalized Linear Model algorithm for all models performed similarly and ranked the same top three most important predictors to determine the distribution of *N. cyanomos*. Our model results suggest that suitable habitat for this species is relatively shallow (<50 m), includes both brackish and normal ocean salinities, and has low to moderate current velocity. The results also suggest that *N. cyanomos* could continue to expand its distribution into most tropical and sub-tropical coastal regions in the western Atlantic Ocean. Due to the lack of extensive natural reefs, the current invasion front in the Florida Panhandle may be an effective area to slow the spread of this species to South Florida through removal of individuals on artificial reefs. If the spread continues, South Florida may act as a gateway to islands in the northern Caribbean, as seen for lionfish. These findings are informative for raising awareness of this new invader and identifying Caribbean islands at risk for future range expansion.

Keywords: Invasive Species, Species Distribution Model, Conservation, Management,

Ecological consequences of the rapid spread of the Stony Coral Tissue Loss Disease in Cozumel

Consecuencias ecológicas de la rápida dispersión del Síndrome Blanco en Cozumel

Conséquences écologiques de la propagation rapide de la maladie de la perte de tissus coraux pierreux à Cozumel

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ABSTRACT

In the Caribbean, disease outbreaks have emerged as significant drivers of coral mortality. The Stony Coral Tissue Loss Disease (SCTLD) is a novel white plague disease first reported off the Florida coast in 2014, affecting >20 coral species. In December 2018, the SCTLD reached the SW coast of Cozumel, one of the healthiest reef systems in the Caribbean. In this study, we integrated data from multiple survey protocols conducted between July 2018 and April 2020 to track the progression of the outbreak in the SW Cozumel and to quantify the impacts of the SCTLD on coral communities and the benthic composition of reefs. We also investigated whether the coral bleaching event from Autumn 2019 further exacerbated coral mortality. Our findings showed that the SCTLD spread throughout the SW coast of Cozumel in only two months and reached a peak in five months. Species of the families Meandrinidae, Faviinae, and Montastraeidae reached between 33%-95% of mortality. The widespread coral die-off caused a significant decrease of coral cover followed by a rapid increase of algae. In November 2019, the thermal stress reached its maximum level; however, we did not find a significant increase in coral mortality; which suggests that coral communities were able to recover, despite being still affected by the SCTLD outbreak. The SCTLD is radically changing the ecology of coral reefs by decimating the populations of key reef-builders and reconfiguring the benthic assemblages. Restoration actions must be focused on fully addressing coral threats in order to improve the ecosystem resilience.

Keywords: SCTLD, reef monitoring, coral mortality, coral disease outbreak

Biofilms as a potential transport mechanism for Stony Coral Tissue Loss Disease (SCTLD) into new regions

Biopelículas como un mecanismo de transporte potencial para la enfermedad de pérdida de tejido de coral pétreo (SCTLD) en nuevas regiones

Les biofilms en tant que mécanisme de transport potentiel de la maladie de perte de tissu corallien caillouteux (SCTLD) dans de nouvelles régions

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ABSTRACT

Outbreaks of stony coral tissue loss disease (SCTLD) have occurred sporadically in the Caribbean. The spatial distributions of these outbreaks are inconsistent with natural transport processes and often occurred near ports, suggesting the potential for ship-mediated transport of the disease. Waterborne transmission of SCTLD has been demonstrated, indicating infected corals shed the unknown causative agent into the environment. Assuming this agent is microbial, its ability to form biofilms on and within ships (e.g., ballast water tanks) could represent a potential transport mechanism for the disease. Here we investigated whether coral-shed microbes are capable of biofilm formation and whether source coral differences (e.g. health status) are discernible in these biofilm microbial communities. Stainless steel plates (~7.50 cm x 5.75 cm) were cleaned, autoclaved, and added to mesocosms (n = 15) containing ~18L of UV-treated, 0.2 um-filtered seawater and either: SCTLD-infected corals (n = 10), healthy corals (n = 4), or no corals (n = 1). Plates were exposed to mesocosm water for three days, then preserved in RNAlater. Adhered biofilms were removed with sterile razor blades and a sterile buffer rinse. DNA was extracted and sequenced using bacterial / archaeal primers, and resulting sequences were analyzed with QIIME2. We determined that coral-shed microbes formed biofilms consisting of highly diverse microbial communities, and these communities reflect differences between source mesocosms. While it is currently unknown if the SCTLD pathogen is a member of these biofilm communities, this work suggests biofilms warrant additional investigation as a contributing factor in the spread of SCTLD.

Keywords: SCTLD, Coral, Disease, Biofilm, Bacteria

Determining drivers of detectability for reef fish species between marine survey techniques

Determinación de factores determinantes de la detectabilidad de especies de peces de arrecife entre técnicas de prospección marina

Déterminer les facteurs de détectabilité des espèces de poissons de récif entre les techniques d'enquête marine

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ABSTRACT

Accurately assessing reef fish community assemblages is an important feat for ecosystem health, fisheries regulations, and invasive species monitoring. However, several underwater surveying techniques exist to do this, each with benefits and drawbacks. Reef visual censuses (RVCs), or Standard visual censuses (SVCs), are the most efficient and commonly used but are thought to underestimate species densities compared to belt transect and species-specific roving surveys. We compared density estimates across reef fish species for all three survey types using data from the Florida Keys region to determine SVC performance and looked at these differences in relation to predictors such as habitat traits, survey traits, and species traits using linear mixed effects models. We additionally compared density and frequency of occurrence estimations across survey methods for all recorded species and SVC focal species and invasive lionfish individually. Variation was found in SVC performance compared to transect and roving surveys, with transect surveys recording higher densities across most species and roving surveys recording lower average densities and higher frequencies of occurrence for most, including two SVC focal species (red and black grouper) and lionfish. Several traits were significant predictors of density differences, including commonalities such as poorer SVC performance for cryptic species. Our results suggest variable SVC performance depending on the species and traits, and we caution managers to take species and habitat traits into account when designing accurate survey techniques.

Keywords: reef fish surveys, Florida Keys, survey comparison, reef visual census, survey performance

Overfishing of sea cucumbers and parrotfish: a major socio-ecological threat in Caracol Bay in the 3 Bays National Park

La sobrepesca de pepinos de mar y peces loro: una importante amenaza socioecológica en la Bahía del Caracol en el Parque Nacional de las 3 Bahías

La surpêche des concombres de mer et des poissons-perroquets : une menace socio-écologique majeure dans la baie de Caracol dans le Parc National des 3 baies

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ABSTRACT

Around the world, the thriving fishing industry employs several million people and provides food for trillions. In Haiti, for example, the fishing sector is a socio-economic activity with an important place in the national economy. This is the case in the Caracol bay, where artisanal maritime fishing represents one of the key sectors of the local economy. However, a major phenomenon is likely to deteriorate the stocks of fishery resources: overfishing. Therefore, the objective of this research is to show to what extent overfishing has adverse bioecological effects on parrotfish and sea cucumbers, which are purifying species for the marine environment. Through a mixed (quantitative and qualitative) and transdisciplinary methodology including the assembly of a biometric database with The Nature Conservancy (TNC), in situ scuba diving observations with Reef Check Haiti, focus groups and semi-structured interviews with fishermen and other local actors, the harms of this uncontrolled fishing were observed and discussed in depth. According to the results of the biometric and social survey on the two species studied, overfishing is indeed a major socio-ecological threat for Caracol Bay, as it leads to: the capture of immature species, the reduction of the reproductive potential of the species, the decline of abundance, the use of illegal fishing gear, the degradation of the coral reef and the abusive exploitation of mangroves. This is also linked to the social and economic precariousness of fishermen who unknowingly threaten their means of survival.

Keywords: Overfishing, Artisanal Fishing, Parrotfish, Sea Cucumbers, Social Precariousness

Bottom-up conservation: Using translational ecology to inform conservation priorities for a recreational fishery

Conservación de abajo hacia arriba: uso de la ecología traslacional para informar las prioridades de conservación para una pesquería recreativa

Conservation ascendante : utiliser l'écologie translationnelle pour éclairer les priorités de conservation d'une pêche récréative

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ABSTRACT

Translational ecology defines a collaborative effort among scientists and stakeholders to rapidly translate environmental problems into action. This approach can be applied in a fisheries management context when information needed to inform regulations is unavailable, yet conservation concerns exist. Our research uses a translational ecology framework to assess the stock status and develop research priorities for the Crevalle Jack (*Caranx hippos*) in the Florida Keys, U.S.A., a currently unregulated species. Interview data that compiled expert fishing guide knowledge were used to develop hypotheses tested using existing fisheries-dependent datasets to check for agreement among sources and assess the consistency of observed patterns. Six hypotheses were developed concerning the status and trends of the Crevalle Jack population in the Florida Keys, and four of these hypotheses received clear support, with agreement between guide observations and one or more of the fisheries-dependent datasets. The results of our study outline an effective translational ecology approach for recreational fisheries management designed to rapidly recognize potential management needs as identified by fishing guides, which allows for actionable science and proactive management.

Keywords: translational ecology, local ecological knowledge, recreational angling, fisheries management, unregulated species

Has the lionfish invasion of The Bahamas resulted in the predicted negative consequences to the fisheries sector?

¿La invasión del pez león a las Bahamas ha tenido las consecuencias negativas previstas para el sector pesquero?

L'invasion du poisson-lion aux Bahamas a-t-elle eu les conséquences négatives prévues pour le secteur de la pêche ?

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ABSTRACT

The invasion of Bahamian reefs in 2005 by non-native lionfish (*Pterois volitans*) attracted significant research investigating impacts on the coral reef community. Results led to dismal projections for the future of the island's reef-associated fisheries. However, 16 years later there is a knowledge deficit regarding the status of lionfish and whether the projections have come to pass. This study examines the current status of threats and opportunities presented by lionfish in The Bahamas fisheries sector through a literature review and stakeholder survey using face to face and phone interviews as well as an online survey instrument. The perceptions of 178 fishers revealed that 80% of them have not observed any changes in their targeted species. Furthermore, 52% do not perceive lionfish as a threat to their livelihood, and 40% report targeting lionfish. Of these, a few (23%) have begun to sell their lionfish catch, whilst 60% consume it themselves and 27% give it away. Of note however is the complaint from lobster fishers that lionfish take up room in the traps and thus reduce their catch. Several restaurants have adapted to the presence of lionfish by adding it to their menu, but complain that they cannot meet customer demand. Fishers report observing lionfish over a wide range of depths and on all fishing grounds, but most (65%) report low abundance (< 10 lionfish observed per fishing trip). In conclusion, it would appear that lionfish have not had the devastating impacts on the marine environment and fisheries that were initially predicted.

Keywords: lionfish, impacts, The Bahamas, reef-associated fishery,

Impacts of reduced human activity due to COVID-19 on reef fish populations in the Cayman Islands

Impactos de la reducción de la actividad humana debido al COVID-19 en las poblaciones de peces en las Islas Cayman

Impacts de la réduction de l'activité humaine due au COVID-19 sur les populations de poissons aux Îles Cayman

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ABSTRACT

In the Cayman Islands, the oceans have been quiet for over a year due to the lockdown and closed borders resulting from the COVID-19 pandemic providing a unique opportunity to study how fish populations react when human activities are minimized and the oceans are relatively “quiet”. In July 2020, when lockdown restrictions were initially lifted, we conducted in situ fish population surveys to estimate fish density, biomass and diversity at 5 sites in and around George Town Harbour, which acts as the cruise ship base for Grand Cayman. Surveys were repeated every other month through August 2021 and compared to baseline fish population data from AGGRA surveys completed pre-COVID in 2018. Fish abundance and diversity increased significantly in July 2020 compared to 2018, but began to gradually decline across all survey sites over the course of the survey period as local activities increased. The density and biomass of herbivorous species were also found to significantly increase after COVID yet remained at high levels throughout the study. These results indicate that fish populations were able to rebound when disturbance was removed, but even minimal levels of human activity had a negative impact on fish abundance and diversity. Understanding how fish populations respond to human activity, and therefore how/if their natural role in the reef ecosystem is interrupted or changed, can help support conservation and management strategies that aim to minimize loss to biodiversity through implementation of strategic development plans.

Keywords: COVID-19, Human Impacts, quiet ocean, community composition, biodiversity

Development of a policy analysis and comparison tool to support decision making and coherence in the context of marine debris management

Desarrollo de una herramienta de análisis y comparación de políticas para apoyar la toma de decisiones y la coherencia en el contexto de la gestión de desechos marinos

Development of a policy analysis and comparison tool to support decision making and coherence in the context of marine debris management

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ABSTRACT

The increasing abundance and impact of marine debris globally and its associated problematic transboundary nature, have created the need for harmonization and coherence of marine debris management strategies among regions. In this context, a number of policies also referred to as action plans are promoted at a local and regional level and more recently, inter-regional collaboration has increased. These policies seem to share common strategies which also reflects the categorizations of marine debris management measures developed by Chen (2015) and Williams and Rangel-Buitrago (2019) including knowledge, preventive, mitigating, removing and behavior-changing. Therefore, they constitute the framework within which marine debris reduction can be approached and monitored. This paper provides a proactive methodology for the development of a decision making tool based on seven (7) derived categories which aligns with the aforementioned categorizations of marine debris management measures. The method also includes a scoring evaluation against the categories and was applied to two regions within the Atlantic Basin that has recently agreed to inter-regional collaboration for tackling marine debris, including the North-East Atlantic (NEA) via the OSPAR Commission and the Wider Caribbean Region (WCR) via the Cartagena Convention. The results highlight the need for improvement in prevention in NEA and removal in WCR, a proposed conceptual coherence model and subsequent opportunities for inter-regional cooperation. The tool can be adapted in other cases providing an opportunity for comparative analysis, highlighting similarities and differences among regions, lessons learnt and a list of prioritized interventions in the context of marine debris management.

Keywords: Wider Caribbean Region, North-East Atlantic, Marine debris, action plan, coherence

Broad-scale acoustic telemetry reveals long distance movements and larger home ranges for invasive lionfish on Atlantic coral reefs

La telemetría acústica a gran escala revela movimientos de larga distancia y áreas de distribución más amplias para el pez león invasor en los arrecifes de coral del Atlántico

La télémétrie acoustique à grande échelle révèle des déplacements sur de longues distances et des domaines vitaux plus vastes pour le poisson-lion envahissant sur les récifs coralliens de l'Atlantique

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ABSTRACT

Tracking studies for invasive lionfish (*Pterois volitans* and *P. miles*) in the Western Atlantic can provide key information on habitat use to inform population control, but to date have likely underestimated home range size and movement due to constrained spatial and temporal scales. We tracked 35 acoustically tagged lionfish for >1 year (March 2018-May 2019) within a 35 km² acoustic array within Buck Island Reef National Monument, St. Croix, U.S. Virgin Islands (10x larger than previous studies). Tracking lionfish at this scale reveals home range size is 3-20 times larger than previously estimated and varies more than 8-fold across individuals (48,000 m² - 385,000 m²; average: 101,000 m²), with estimates insensitive to assumptions about potential mortality for low-movement individuals. Lionfish move far greater distances than previously reported, with 37% of fish travelling >1 km from the initial tagging site toward deeper habitats, and one individual moving ~10 km during a 10-day period. Movement rates, home range size, and maximum distance traveled were not related to lionfish size (18 - 35 cm total length) or lunar phase. Lionfish movement was lowest at night and greatest during crepuscular periods, with fish acceleration (m s⁻²) increasing with water temperature during these times. Our results help reconcile observed patterns of rapid recolonization following lionfish removal, and suggest complex drivers likely result in highly variable patterns of movement for similarly sized fish occupying the same habitat. Culling areas; the average lionfish home range size identified here (i.e. ~10 hectares), or prioritizing habitat patches isolated by ~180m (radius of average home range) may minimize subsequent recolonization. If the shallow-deep long-distance movements observed here are unidirectional, mesophotic habitats

Keywords: invasive species, lionfish, acoustic telemetry, movement ecology, coral reef fish

Are mesophotic coral reefs a potential refuge for fishery targeted reef fish species in the US Virgin Islands?

¿Proveen refugio los arrecifes mesofóticos para especies importantes para las pescaderías de arrecife en las Islas Vírgenes de los Estados Unidos?

Les récifs coralliens mésophotiques sont-ils un refuge potentiel pour les espèces de poissons de récif par la pêche dans les îles Vierges américaines?

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ABSTRACT

The Deep Coral Reef Monitoring Program (DCRMP) was recently implemented to provide reef fish quantity (i.e., abundance, density) and size (i.e., length frequency) data for the mesophotic reefs off St. Thomas and St. John, US Virgin Islands. DCRMP surveys from 30 to 50m use the same survey design and Reef Visual Census methodology as NOAA's National Coral Reef Monitoring Program (NCRMP) that survey from 0 to 30m. Combined DCRMP and NCRMP fishery-independent surveys encompass the majority of the regional reef tract shelf (0 - 60m) and DCRMP surveys provide data from the portion of the reef tract commonly targeted by commercial fishers. Deeper surveys (n=162) occurred over three years and were compared to one year of NCRMP data (n=262). Of the 20 fishery target species tested, 40% (8 out of 20) of mature fish had significantly higher densities in the deeper surveys suggesting that for some species these deeper reefs may offer a potential refuge. Size distributions varied by species and survey depth, with some species such as yellowtail snapper (*Ocyurus chrysurus*), red hind (*Epinephelus guttatus*), and queen triggerfish (*Balistes vetula*) showing larger sizes more frequently in the DCMRP surveys, although, largest sizes classes were observed in both DCRMP and NCRMP surveys. Together DCRMP and NCRMP data can be used to provide accurate and unbiased information on fish sizes, densities, and habitat preferences to better inform U.S. Caribbean island-based fishery management actions.

Keywords: fishery-independent surveys, snappers and groupers, mesophotic reefs, SCUBA surveys, queen triggerfish

**Assessing the effectiveness of topical antibiotics in treating corals affected by
Stony Coral Tissue Loss Disease in Roatan, Honduras.**

**Evaluación de la efectividad del antibiótico como tratamiento para corales
afectados por la Enfermedad de Pérdida de Tejido en Corales Duro en Roatán,
Honduras.**

**Évaluation de l'efficacité d'antibiotiques topiques dans le traitement des coraux
affectés par la maladie de perte de tissus des coraux pierreux à Roatan, au
Honduras.**

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ABSTRACT

Caribbean stony corals have suffered an unprecedented decline on their populations since 2014 when Stony Coral Tissue Loss Disease (SCTLD) was first observed off the coast of Florida. This disease has since then spread across the entire Caribbean, impacting already vulnerable coral reefs. SCTLD was first observed in September 2020 on the South side of the island of Roatan, Honduras. Since then, this deadly disease has spread to the majority of the island and some sites have been highly impacted, showing a decrease on pillar and maze coral populations. In order to assess the effectiveness of topical antibiotic treatment to reduce the impact of SCTLD on the corals of Roatan, a subset of 226 corals on 7 sites were treated and reassessed on a monthly basis for three months. Treatment effectiveness was studied in 20 different species selected at random. Due to the reported high success in treating SCTLD lesions in the laboratory and in the field in Florida, amoxicillin plus Base 2B were selected as the treatment used for all corals. Effectiveness was highest on brain coral species (*Pseudodiploria strigosa*, and *Colpophyllia natans*) and star coral (*Orbicella faveolata*) but pillar corals and maze corals showed the lowest success rates. Unlike the results from previous studies in Florida, *Monstrastrea cavernosa* did not show the highest success rate in our study. Although the treatment with topical antibiotic was effective, many of the corals developed new lesions and a long-term solution should be explored to preserve genetic material of highly susceptible species.

Keywords: Stony coral tissue loss disease, Caribbean, antibiotic, susceptibility, disease treatment

Age and growth of Blackfin tuna (*Thunnus atlanticus*) in the Northern Gulf of Mexico

Edad y crecimiento del atún de aleta negra (*Thunnus atlanticus*) en el norte del Golfo de México

Âge et croissance du thon à nageoires noires (*Thunnus atlanticus*) dans le nord du golfe du Mexique

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ABSTRACT

Tunas are highly migratory species that are valuable components of recreational and commercial fisheries in the Gulf of Mexico (GOM). While overfishing has led to population declines in many large tunas (yellowfin *Thunnus albacares*, bigeye *Thunnus obesus*, bluefin *Thunnus thynnus*), the population status of the most abundant tuna in the region, blackfin tuna (*Thunnus atlanticus*), remains relatively unknown. There is currently no U.S. federal or state management for this fishery outside of Florida and basic life history information for blackfin tuna throughout their range is limited. Here we use an otolith-based aging approach to evaluate age and growth relationships for blackfin tuna in the northern GOM. Otoliths were collected from a total of 388 blackfin tuna captured in the northern GOM recreational fishery in Louisiana from 2014-2019. Overall, blackfin tuna ranged from 251-902 mm fork length (FL) (mean $\hat{\pm}$ SE = 717.99 \pm 7.23 mm). Males (n=274) ranged from 490-902 mm FL (mean = 764.17 \pm 5.27 mm), females (n = 75) from 480-860 mm FL (mean = 699.33 \pm 12.22 mm), with 39 individuals of unknown sex (mean = 429.41 \pm 27.00 mm). Transverse sections of the left otolith were used for analysis and annuli were enumerated by two independent readers. Von Bertalanffy growth models were fit to length-at-age data and sex-specific growth parameters were contrasted between males and females. Age and growth information from this study will improve our understanding of blackfin tuna life history in the GOM and provide critical baseline data needed for stock assessment.

Keywords: Age validation, Growth, Otolith, Von Bertalanffy, Scombridae

An Updated Red List Assessment of Endemic Reef-Building Corals in the Caribbean

Evaluación actualizada de la Lista Roja de corales de arrecife endémicos en el Caribe

Évaluation mise à jour de la Liste rouge des coraux de récif endémiques dans les Caraïbes

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ABSTRACT

Caribbean corals continue to experience extensive decline due to increased pressures related to climate change, disease, pollution, predation, and other anthropogenic stressors. To understand the impact of reef loss on the relative extinction risk of individual coral species, all 52 known Caribbean endemic corals have been reassessed for extinction risk under the Categories and Criteria of the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species. This is the first comprehensive review of the changing status of corals within the region since the previous Red List assessments in 2008. Estimates of individual species declines were calculated based on modeled live coral cover loss across several Caribbean subregions over the past 30 years (1989-2019) coupled with relative species' vulnerabilities and indicators of population resilience based on species traits. Although these recently completed Red List assessments use a different dataset to estimate decline than the original assessments conducted in 2008, the proportion of threatened coral species in the Caribbean has increased from approximately 25% to nearly 50%. If these data were available to the 2008 assessment process, our results indicate that Caribbean corals would have qualified for higher extinction risk categories. Based on this, we infer that, though remaining dangerously high, the rate of Caribbean coral decline has slowed in recent decades. However, coral cover loss alone is insufficient to determine individual species decline, there remains a need for more species-specific information and the incorporation of modeled data on the onset of annual severe bleaching events.

Keywords: IUCN Criteria, Red List, Reef-Building Coral, Coral Cover

Modification of a lobster trap to catch the invasive lionfish (*Pterois* spp.)

Modificación de una trampa langosta para capturar al pez león invasor

Modification d'un casier à homard pour capturer le poisson-lion envahissant (*Pterois* spp.)

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ABSTRACT

In the Western Atlantic, lionfish (*Pterois volitans* and *P. miles*) are highly invasive and can have negative impacts on ecosystems. Divers have reduced lionfish abundance in waters within SCUBA diving depths; however, the depth range of lionfish greatly exceeds common diving limits. Commercial spiny lobster (*Panulirus argus*) trappers in the Florida Keys (USA) occasionally catch lionfish in their wire-basket traps when fishing at depths between 30 and 100 meters. The goal of this project was to modify lobster traps to maximize lionfish catch in these deep waters while reducing non-lionfish bycatch. Modifications of throat type, throat location, escape gap, and bait type were evaluated to determine the best trap designs with respect to bycatch reduction and lionfish catch. The preferred trap design was then fished among a commercial fisherman's traps to directly compare trap performance. Simple modifications to these lobster traps increased lionfish catch and reduced bycatch. Critical elements of a species-specific lionfish trap include narrowing the top-entrance plastic throat to preclude entry of legal-sized lobsters and large fish and adding an escape gap to reduce the retention of small lobsters and fish. Bait type did not have a strong influence on lionfish catch. We postulate that the use of lionfish-specific traps as a commercial fishery for lionfish will need to be assessed by individual fishermen. Strategic use of modified traps could be used to remove lionfish, reduce their ecological impact, and enhance commercial fisher income when used as supplemental gear alongside existing lobster traps.

Keywords: Lionfish trap, Invasive species,

The Bioeconomic Paradox of the Commercial Lionfish Fishery

La Paradoja Bioeconómica de la Pesquería Comercial de Pez León

Le Paradoxe Bioéconomique de la Pêche Commerciale du Poisson-lion

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ABSTRACT

Commercialized harvest for invasive species harvest offers a compelling approach to concomitantly control their abundances and create market opportunities. However, harvest rates that result in ecologically meaningful reductions may surpass those that produce maximum sustainable yield (MSY) will result in harvest that is inefficient. We numerically examined this paradox with bioeconomic models of the nascent commercial spearfishery for invasive lionfish (*Pterois volitans*) on artificial reefs in the northern Gulf of Mexico. We estimated population parameters for carrying capacity (K) and intrinsic rate of growth (r) by fitting both biological production models and age-structured life history models. Estimates of K were robust while r-values were uncertain, range from 0.66 to 2.50. We then developed bioeconomic models to (1) run time-dynamic fisheries simulations and (2) estimate open access equilibrium solution points for stock, effort, and yield. Alternative scenarios considered the range of values for r-values and alternative economic conditions in terms of price, costs, and harvester stiffness. Even in the lowest r scenarios, lionfish populations demonstrated strong compensation and were robust to overfishing. Current harvest rates were well below those that produce MSY and were predicted to achieve only marginal reductions in the stock biomass from K. Alternative economic scenarios, however, suggest that changes in price and cost could increase harvest rates enough to reduce the population below the level that produces MSY. Collectively, these models quantitatively test key assumptions to commercialized invasive species harvest and numerically forecast how economic strategies (e.g., subsidies or marketing) could be applied to support lionfish and invasive species control.

Keywords: Lionfish, Bioeconomics, Population modelling, Invasive species, Fisheries management

Defining Property Amid Changing Governance in an Offshore Fish Aggregation Device (FAD) Fishery

Definiendo Propiedad en Medio de Cambios en la Gobernanza en una Pesquería de Dispositivos de Agregación de Peces (DCP) en Alta Mar

Changement dans la définition de la propriété des poissons causes par des changements de règlementation affectant les pêches en pleine mer qui utilisent des dispositifs de concentration des poissons

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ABSTRACT

Small-scale fisheries are vital to livelihoods in the Commonwealth of Dominica. Historically, small-scale fisheries were low input, nearshore, and reef-based, using nets or traps. Over the past three decades, many fishers have shifted to offshore pelagic species which required investment in larger, motorized vessels, gear, and fish aggregation devices (FADs). At the outset of the FAD fishery, there were few participants and competition around FADs was minimal. As the fishery gained in popularity, norms were developed at an inter- and intra-community level to govern use of the FADs deployed by private individuals or groups. As the fishery continued to grow, the Dominican Fisheries Division observed increased conflict from competition for the resource and a lack of understanding of or adherence to previously developed informal norms. In the past decade the government of the Dominica created policies to open FAD fishing opportunities to all fishers. Government policies have moved the FAD fishery from one with informally defined access restrictions and norms through the deployment of private FADs and development of informal rules of use to an open-access fishery where all FADs are public, and all fish aggregated around FADs are available to any fisher who opts to purchase a FAD license. The changes in governance around the FAD fishery has resulted in intended and unintended consequences which may be overall positive for fisher livelihood, negative for certain fishers, or neutral due to lack of enforcement capacity.

Keywords: Property Rights, Governance, Fish Aggregation Device, Dominica

Connectivity of Populations and Gene Flow in Tobago's Queen Conch Resources

Conectividad de las poblaciones y el flujo de genes de Caracol Pala, *Aliger gigas*, celebrada de Tobago

Connectivité des populations et flux génétique dans les ressources de lambi de Tobago

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ABSTRACT

Tobago's queen conch fishery has seen a continued decline in productivity since the 1970's due to a lack of proper monitoring or management. With unregulated and unmonitored harvesting, Trinidad and Tobago remains unable to report on the status of the queen conch fishery, leading to the continuation of poor management.

Focusing on juvenile stages, the dispersal of local conch resources at larval stages via current flow can be a key factor in depletion, taking into consideration the magnitude of currents found in and around the Tobago coastal region. As such, it is necessary to determine the population's genetic structure, and to further identify whether there is indeed the potential for larval transport of Tobago's conch stock via existing current patterns.

This study provides an improved understanding of connectivity of queen conch populations throughout the Caribbean, specifically in relation to population structures of queen conch in Tobago and their gene flow. It examines the potential for larval transport determining genetic linkages and analysing gene flow as a means of differentiating the conch populations.

Very little research has been done regarding Trinidad and Tobago's conch population, so this study will serve as a first look into the population structures, and possibly give new insight into better approaches that facilitate more effective management of the resource. It also constitutes a first step in understanding the queen conch metapopulation structure, which will in turn, call for more local actions for the recovery and conservation of Tobago's populations.

Keywords: *Aliger gigas*, queen conch, connectivity, gene flow, population genetics

Impacts of the rise in sea level in a coastal municipality of Colombia: local management of climate change

Impactos del ascenso en el nivel del mar en un municipio costero de Colombia: gestión local del cambio climático

Impacts de l'élévation du niveau de la mer dans une commune côtière de Colombie : gestion locale du changement climatique

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ABSTRACT

Los sistemas marino costeros son altamente sensibles a las amenazas del cambio climático, particularmente el municipio de Santiago de Tolú en el Caribe colombiano presenta alta amenaza, por tanto, la gestión local es fundamental. Al respecto, se realizó un análisis de los impactos debido al ascenso en el nivel del mar (ANM) en el municipio, que permitió proponer unas medidas de adaptación. Metodológicamente, se tuvieron en cuenta los planteamientos del Panel Intergubernamental de Cambio Climático (IPCC por sus siglas en inglés) sobre el comportamiento futuro de esta amenaza; se elaboró un modelo de ANM a partir de información secundaria oficial biofísica y socioeconómica recolectada para obtener las proyecciones a los años 2040 y 2100, a las escalas cartográficas 1:10.000 (zona urbana) y 1:100.000 (rural); esto se complementó con una visita de campo y talleres participativos para la validación del proceso. Como resultados se obtuvieron 11 indicadores de amenaza por ANM. Un incremento de 40 cm al 2100, afectaría el 100% de los manglares y playas, el 9,5% de las áreas agropecuarias; a nivel rural sería el 22% del área, el 13% de la población y el 16% de las viviendas, mientras en la zona urbana se inundaría el 63% del área, el 100% del área turística, el 50% de la población y viviendas, y el 87% de la zona portuaria. Frente a esto se propusieron medidas de adaptación como la adaptación basada en ecosistemas (AbE), mejoramiento de las condiciones socioeconómicas y en combinación con otras medidas duras de acuerdo a los estudios disponibles. Este análisis aporta al cumplimiento de la Ley colombiana 1931 del 2018 que establece las directrices para la gestión del cambio climático.

Keywords: Ascenso en el nivel del mar, Caribe colombiano, Gestión ambiental costera, impactos del cambio climático

Sound drifters and the detection of grouper spawning aggregations

Boyas de sonido a la deriva y detección de agregaciones de desove de mero

Dériveurs sonores et détection des concentrations de reproducteurs de mérours

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ABSTRACT

When groupers or other species gather at transient spawning aggregations, fisher scientists can efficiently collect data needed for sustainable management. Measures of fecundity, spawning frequency, harem size, sex ratio, and site fidelity all provide insights into the life history traits of the species. Spawner numbers and sizes can provide indices of abundance for the dispersed population. Changes in abundance, sizes or sex ratio can indicate intensity of fishing pressure. However, aggregated fish can also be more easily overexploitation than when dispersed at their home reefs. Although spawning aggregations have been fished historically, many of these sites are still unknown to scientists and managers and, therefore, are unavailable for research, monitoring and management. We have developed a low-tech approach to map the extent of known spawning aggregations and to identify previously unknown spawning sites. We deploy an array of drifters equipped with sound recorders to listen for the species-specific sounds of grouper courtship and spawning. Analyses of sound pressure levels and species-specific courtship calls from explorations off western and northeastern Puerto Rico have provided spatial definition for the red hind aggregation site at Abrir la Sierra (ALS) and have detected likely locations of undocumented fish spawning aggregation sites on the shelf near ALS and the shelf north of Culebra. Confirmation and monitoring of these newly identified aggregations provide new opportunities to understand and manage these valuable natural resources.

Keywords: spawning aggregations, soniferous fish, sound drifters, biophony, soundscape

A Cross-Sectorial Approach in the Monitoring and Treatment Efforts of SCTLD In The British Virgin Islands

Un enfoque intersectorial en los esfuerzos de seguimiento y tratamiento de SCTLD en las Islas Vírgenes Británicas

Une approche intersectorielle dans les efforts de surveillance et de traitement des SCTLD dans les Îles Vierges britanniques

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ABSTRACT

Stony coral tissue loss disease (SCTLD) was first sighted in the BVI in May 2020 at the RMS Rhone, the only marine park in the BVI. In this presentation, we describe collaborative response efforts including coral disease monitoring, treatment, outreach, funding and volunteer engagement.

By August 2020, SCTLD was confirmed at 11 reefs which are fisheries protected areas and popular dive sites. A Coral Strike Team was formed to combat SCLTD, bringing together government, non-profit organizations (NPOs), dive operators, and volunteers to track, tackle and slow the disease. In addition, educational outreach included billboards, a three-part cartoon series and a waterproof advisory imploring boaters about discharge measures. The Coral Strike Team's efforts were made possible by securing grants.

Monitoring efforts involved 30+ volunteers that were trained in theoretical and practical SCTLD sessions. Decontamination practices were adopted based on the guidelines directed by NOAA/MPA Connect. Dive operators and verified volunteers were grouped according to their home base and designated specific zones to observe, monitor, and treat affected corals.

Within nine months of establishing the Coral Reef Strike Team, the Team completed > 600 surveys and treated 5000+ individual coral colonies across 36 dive sites with the Base2Base antibiotic paste with amoxicillin. We present a summary of our monitoring and treatment efforts and an update on findings and progress. We describe how the establishment of a cross-sectorial partnership is a viable management option for safeguarding the coral reefs of the BVI and all of the ecosystem services they provide

Keywords: SCTLD, Coral

Fisheries Regulations to Protect the Parrot Fish Species and Healthy Oceans

Regulaciones pesqueras para proteger las especies de peces loro y océanos saludables

Règlement sur les pêches visant à protéger les espèces de poissons perroquets et la santé des océans

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ABSTRACT

Stopping the harvesting and consumption of Parrotfish (chub fish) is an ongoing challenge for our community in Barbuda. Barbuda is a part of the twin island state of Antigua and Barbuda. The fisheries department of both islands are aware that there has been a significant decline in coral reefs throughout the region since the 1970's. Understanding this, local governments have been legislating policies and controls since 2015 to curtail the harvesting of parrotfish.

In Antigua, harvesting of parrotfish is seasonal while in Barbuda there is a year round ban; harvesting parrotfish is prohibited.

The divergent legislative approach of the fisheries department in Antigua and Barbuda along with the immediate effect on the economic return from harvesting parrotfish makes adapting to the 2015 regulations onerous seeing as both islands utilize this fish for everyday use in restaurants and local markets

To activate the policies and raise awareness, barbudanGO has engaged in discussions and consultations with other organisations and as a result have launched a series of educational campaigns that promote sustainable fishing and mainly the discontinuation of the catching of parrotfish. A series of radio ads formulated with ecological information stressing the importance of the prohibition laws along with the fines attached to the harvesting of parrotfish in Barbudan waters are aired on local radio stations.

To further extend the reach of this message a cartoon animation competition was launched. Cartoonists throughout Antigua and Barbuda responded to this challenge and converted the radio ads into cartoons. These cartoon ads have been promoted on facebook pages of the cartoonists, barbudanGO and local media houses.

Keywords: Parrotfish

**Community Participation in Monitoring for Stony Coral Tissue Loss Disease in
St. Vincent and the Grenadines and Grenada**

**Participación de la comunidad en el monitoreo de la enfermedad por pérdida de
tejido de corales pétreos en San Vicente y las Granadinas y Granada**

**Participation communautaire à la surveillance de la maladie de la perte de tissus
des coraux pierreux à Saint-Vincent-et-les Grenadines et à Grenade**

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ABSTRACT

Stony Coral Tissue Loss Disease (SCTLD) has been a prominent issue in the Caribbean since it was first reported occurring outside of Florida and found in Jamaica in 2018. The disease spreads rapidly and affects more than 20 species of corals. While coral diseases are not uncommon on Caribbean coral reefs, SCTLD poses a more significant threat due to the high mortality rates, number and species of corals affected, and its large geographic range. Small island nations, such as St. Vincent and the Grenadines and Grenada, are particularly vulnerable because of their lack of resources to properly mitigate this disease. During a three-month period between October 2020 to December 2020 Sustainable Grenadines (SusGren) conducted training sessions for coral identification and SCTLD identification. Data was collected using roving diver methodology for SCTLD to determine prevalence of the disease. All susceptible corals were recorded, other diseases and bleaching were also observed and recorded. In total, 21 individuals were trained, with 34 hours spent training and 31 surveys were done. Based on the monitoring in St. Vincent and the Grenadines and Grenada we determined that SCTLD is not present. Since December 2020 monitoring has continued in Grenada and there has been some concern for SCTLD. Ongoing monitoring should continue to take place in the event that the disease spreads to these coral reefs. More education, awareness and training for stakeholders is important so that mitigation measures can be taken to properly deal with this disease.

Keywords: SCTLD, St Vincent, Grenadines, Grenada

Pelagic Sargassum in the Tropical Atlantic and the importance of West African/Gulf of Guinea consolidation areas.

Sargazo pelágico en el Atlántico tropical y la importancia de las áreas de consolidación de África Occidental / Golfo de Guinea.

Sargasses pélagiques dans l'Atlantique tropical et l'importance des zones de consolidation d'Afrique de l'Ouest/golfe de Guinée.

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ABSTRACT

The Tropical Atlantic has a seasonal recirculation pattern between May and October which retains pelagic Sargassum (*S. fluitans* and *S. natans*) in a broad region between Africa and Brazil, allowing time for significant growth in the warm, nutrient rich waters before it is dispersed to the Caribbean and North Atlantic or beached along the surrounding countries. Between November and April, however, the area is highly dispersive. Numerical experiments over multiple years show loss of 98% of all floating debris (no growth allowed) in the entire area within 3 years. In contrast to the highly dispersive western area (NE Brazil), the longest residence time in the Tropical Atlantic is found off West Africa and the Gulf of Guinea. This area, then is most appropriate for pelagic Sargassum origination, retention, consolidation, and proliferation. Unfortunately, this has also been the area most difficult to assess due to poor satellite coverage. But locally monitored Sargassum events in the Gulf of Guinea, recent high resolution satellite images, and surface circulation patterns in the eastern Tropical Atlantic suggest that this is an important retention region. Using climatological currents from satellite tracked drifters together with high resolution Satellite images, fate and timing of pelagic Sargassum in the eastern Tropical Atlantic is explored. These findings have implications for supporting longer-term forecasts to inform decision-making as it relates to Sargassum management and innovations.

Keywords: Pelagic Sargassum, Tropical Atlantic, Gulf of Guinea, West Africa, Forecasts

From data to change: single use plastic ban in Roatan Honduras

De los datos al cambio: prohibición de plástico de un solo uso en Roatán Honduras

Des données au changement : interdiction du plastique à usage unique à Roatan Honduras

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ABSTRACT

There is no effective infrastructure or state governance in the handling of domestic and industrial waste on Roatan. Existing dumps have many structural and operational defects and are generally located near the sea, creeks, and mangroves without proper containment. Furthermore, littering is common and causes numerous problems including blockage of natural drainage systems resulting in flooding and the proliferation of diseases: causing illness to local inhabitants.

To understand this problem on the island of Roatan and create change within the communities, we began conducting brand audits in 2018; a citizen science initiative that involves counting and documenting the brand found on plastic waste collected during clean ups to help identify the companies responsible for plastic production.

Data collected during reef, beach and creek clean ups indicated that the top five found were Coca Cola, Pepsi, Maruchan Inc, Ajegroup and Licorera Los Angeles. 8,589 pieces of plastic were collected between 2018 and 2019; 36% bottles (PET), 17% bags and wrapping (SL), 16% bottle covers (PP), 10% multilayered plastic (ML), 9% foam (PS), 7% others, 4% cleaning products (HDPE) and 1% construction material (PVC).

Through this data a ban on plastic bags, plastic straws, and a phase out of foam was proposed to the local municipality; the campaign consisted of collecting signatures in communities, via change.org, implementing plastic bag diets (consisted of exchanging a reusable bag for a plastic bag in supermarkets and communities), a race to promote a plastic free Roatan and other meetings with local government to advocate for change. In 2019, the proposed ban as well as plastic bottles was approved by the municipality.

Keywords: Single-use plastic, Ordinance, Citizen science, Brand audits, Data

Spatial Patterns of Trawling Vessels around Louisiana's Artificial Reefing Zones

Patrones espaciales de los barcos de arrastre dentro de las zonas de arrecifes artificiales de Louisiana

Schémas spatiaux des chalutiers dans les zones de récifs artificiels de la Louisiane

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ABSTRACT

The Gulf of Mexico has the most extensive Rigs-to-Reefs (RtR) programs in the world with over 500 platforms adopted into state artificial reefing programs. Other regions of the world have struggled to establish their own RtR programs due in part to opposition of commercial fisheries utilizing trawling gear for harvest. Therefore, it is critical that regulators identify space-use patterns of trawling vessels before establishing reefing areas designated for RtR conversions. To better understand how trawlers operate within the same space as artificial reefs, we analyzed a dataset of satellite-based trawling activity within Louisiana's artificial reefing zones from January 2016 - December 2020. The Louisiana Artificial Reef Program (LARP) is comprised of nine reefing zones containing artificial reefs created from over 120 decommissioned oil and gas platforms and thereby serves as a model case study for trawler - reef interactions. Trawling effort inside reefing areas greatly increased from 2016 to 2020. On average, trawling vessels detected inside of the reefing zones maintained approximately four km from artificial reefs, likely to avoid gear loss from entanglement. Therefore, reefed platforms may establish a de facto non-trawl zone for up to 23 km² around a reef. As the world moves away from offshore oil and gas production and towards offshore renewable energy, numerous oil and gas platforms will be proposed as reefing candidates. Therefore, prior to reefing, regulators must consider the spatial implications that a reef may have on all members within the Blue Economy operating within the same finite space.

Keywords: Rigs-to-Reefs, Artificial Reefs, Trawling

Plastic Pollution in the Caribbean Large Marine Ecosystem (CLME): Status and Future Perspectives

Contaminación plástica en el gran ecosistema marino del Caribe (CLME): estado y perspectivas futuras

Pollution plastique dans le grand écosystème marin des Caraïbes (CLME) : état des lieux et perspectives d'avenir

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ABSTRACT

The Caribbean Large Marine Ecosystem (CLME), the most biodiverse region in the Western Tropical Atlantic Ocean, contains numerous coastal and marine ecosystems that provide crucially important habitats for a diverse assemblage of resident and migratory organisms. The survival of local communities within the CLME is inextricably connected to these ecosystems due to the reliance of locals on their numerous ecosystem services. Internationally, plastic pollution has been highlighted as a key anthropogenic stressor to coastal and marine ecosystems whereby plastic debris poses a threat to organisms that inhabit such ecosystems as well as compromises the ability of such ecosystems to deliver key services. The objective of the present study was to provide a comprehensive review of the (i) state of the environment as it relates to plastic debris in the CLME and, (ii) impact of plastic debris on marine biodiversity within the CLME. Literature included in this review were (i) peer reviewed, (ii) published between 1980 to 2020, (iii) conducted within coastal/marine ecosystems within the CLME. This review summarizes the state of knowledge regarding plastic debris in the CLME, with a specific focus on the spatial distribution, transport and fate, sources and observed impacts. Existing knowledge gaps were identified and future research initiatives were proposed. From a regional perspective, these findings are particularly important to guide future research initiatives that aim to address the UN's Decade of Ocean Science priority area of "A Clean Ocean", where the sources of pollution are identified and removed.

Keywords: Plastic Pollution, Caribbean, Marine Debris, Biodiversity, Marine Conservation

The Distribution, Composition and Management of Drifting Fish Aggregating Devices (dFADs) in the North Atlantic Ocean

Distribución, composición y gestión de dispositivos de agregación de peces a la deriva (dFAD) en el océano Atlántico norte

La distribution, la composition et la gestion des dispositifs de concentration de poissons dérivants (dFAD) dans l'océan Atlantique Nord

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ABSTRACT

Drifting Fish Aggregating Devices (dFADs) are a gear accessory utilized on a global scale by commercial fishers to increase the catch size and efficiency of harvesting target pelagic fishes such as tuna. Despite their widespread use, there are few scientific estimates of the total number of abandoned or beached dFADs in the Atlantic Ocean and Caribbean Basin or the compliance of dFAD use with t-RFMO recommendations. Previous studies have mapped the beaching location of dFADs based on beaching locations determined by rate of drift, but this study is the first of its kind, analyzing true beaching events. This study identifies the beaching location, composition, and the compliance of stranded dFADs with ICCAT Rec. 19-02 in the western North Atlantic and Caribbean Sea using citizen science census data reported over social media. Abandoned, lost, or otherwise discarded (ALDFG) dFADs were reported on the shores of the Gulf of Mexico, along the Atlantic coast of the United States and 17 Caribbean Island nations, with reports in Scotland, Ireland, and Brazil. Sixty-one (22.8%) dFADs were reported as having beached in United States National or State Parks, MPAs (both domestic and foreign), as well as foreign conservation areas. Furthermore, a total of 119 (72.12%) of photo-documented dFADs were noncompliant. It is our recommendation that the distribution of abandoned lost, and otherwise discarded dFADs be surveyed in the North Atlantic Ocean to gain better understanding of the scope of dispersal and construction and to advise best practices for t-RFMO management of dFADs.

Keywords: Drifting FAD, ICCAT Recommendations, t-RFMO, Marine Debris, ALDFG

**The fish and invertebrate community associated with the invasive seagrass,
Halophila stipulacea in St. Eustatius**

**La comunidad de peces e invertebrados asociada con la hierba marina invasora
Halophila stipulacea en San Eustaquio**

**La communauté de poissons et d'invertébrés associée à l'herbier envahissant
Halophila stipulacea à Saint-Eustache**

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ABSTRACT

Invasive species are an issue worldwide as humans and their global activities easily transport organisms long distances. One such species of seagrass, *Halophila stipulacea*, has spread from its native range in the Red Sea, to the Mediterranean Sea and subsequently to the Caribbean Sea where it has become widespread. This study evaluated the biodiversity associated with these new expansive seagrass beds to see if there may be some positive attributes associated with the invasion. In many areas, *H. stipulacea* is outcompeting native seagrasses likely leading to decreases in biodiversity and habitat complexity, but in other areas, it is populating once sandy substrate and possibly having the opposite effect. We surveyed two sites at both shallow and deeper depths off the leeward coast of St. Eustatius, using both belt transect and quadrat surveys. Divers identified and counted all fishes present within each belt transect and took pictures of 1m² quadrats placed along each transect for analysis of the seagrasses and associated sessile species. The findings revealed a dominance of *H. stipulacea* (65.23% cover) and less than 2% cover of the native seagrasses: *Syringodium filiforme* and *Halodule wrightii*. More than 50 species of fishes were identified within or very close to the *H. stipulacea* beds. Approximately 25 species of algae, 21 molluscs, 18 crustaceans, 8 echinoderms, 4 polychaete worms, 14 sponges and 11 cnidarians were also encountered. The transition from sand to *H. stipulacea* appears to be increasing biodiversity and providing new ecological functions and services, highlighting the need for further study.

Keywords: invasive species, biodiversity, habitat complexity, Caribbean Sea, community ecology

Winners and losers of reef flattening: A trait-based assessment of Florida coral reef fishes

Ganadores y perdedores del aplanamiento de arrecifes: una evaluación basada en rasgos de los peces de arrecifes de coral de Florida

Gagnants et perdants de l'aplatissement des récifs : une évaluation basée sur les traits des poissons des récifs coralliens de Floride

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ABSTRACT

Anthropogenic stressors are causing widespread coral mortality in the Caribbean, leading to negative carbonate budgets and decreased structural complexity, which ultimately threatens reef functioning and ecosystem services. Trait-based analysis can build generic frameworks of how species respond to environmental change, and we use this approach to better understand implications of reef flattening on fishes. Using surveys from 3,999 Florida reef and hardbottom sites, we used boosted regression trees to model biophysical and anthropogenic factors correlated with the abundance of 109 fish species. We isolated the relative importance of structural complexity and coral cover for each species, categorizing species with positive associations as likely future “losers” (more abundant on complex reefs) or negative associations as “winners” (more abundant on flat reefs). Using Blomberg’s K, we determined phylogeny did not explain relationships with complexity or coral cover. Instead, we tested if morphological, behavioral, and functional traits mediate species’ responses to reef degradation. Eight traits explained 65% of variation of species’ association with complexity, and seven traits explained 38% of association with coral cover. These findings indicate that smaller, streamlined generalists are more likely to be ecological winners on flattened reefs. Additionally, degraded reefs will likely have decreased predation, thus hindering resilience and recovery. Identifying these important traits provides a better understanding of how fishes interact with complexity and allows us to predict general assemblage-wide responses to flattening. Finally, these results suggest that specific ecological functions will be lost or severely diminished as reefs continue to degrade.

Keywords: Coral reefs, Trait-based analysis, Reef fishes, Habitat loss, fisheries

Seascape attributes driving mangrove-associated fish assemblages in South Biscayne Bay

Atributos del paisaje marino que impulsan los conjuntos de peces asociados a los manglares en el sur de la Bahía de Biscayne

Attributs du paysage marin à l'origine des assemblages de poissons associés à la mangrove dans le sud de la baie de Biscayne

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ABSTRACT

Coastal ecosystems are heterogeneous and made up of a mosaic of different communities. Mangrove-associated fish assemblages are responding to a variety of environmental factors, including seascape attributes, like mangrove area, seagrass coverage, and proximity to adjacent habitat patches. Different fish species and life history stages do not respond universally to the same seascape attributes or at the same spatial scale, so multiple scales should be considered when looking at seascape drivers of assemblage composition. IBBEAM has been conducting fish surveys along mangrove shorelines in Southern Biscayne Bay, providing years of fish assemblage data. Seascape attributes were quantified for buffer zones around survey sites of different radii ranging from 50 m to 600 m. Fish assemblages and seascape attributes were analyzed to determine at what spatial scale different seascape attributes had the largest influence on fish assemblage composition.

Keywords: Seascape, Fish Assemblage, Mangrove

Characterizing Sargassum Accumulations along the Coastline using Satellite Data and Google Earth Engine

Caracterización de las acumulaciones de sargazo a lo largo de la costa utilizando datos satelitales y Google Earth Engine

Caractérisation des accumulations de sargasses le long du littoral à l'aide de données satellitaires et de Google Earth Engine

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ABSTRACT

Massive Sargassum influxes into the Wider Caribbean Region and West African coast have negatively affected both social and ecological systems since 2011. Current monitoring efforts using satellite data are being conducted but are mainly limited to offshore waters. Therefore, we developed a method to characterize Sargassum accumulations along the coastline and to understand their spatial and temporal dynamics. Using the online platform Google Earth Engine, we analyzed Sentinel-2 MultiSpectral Instrument (MSI) satellite imagery for Sargassum occurrence from 2015 to 2021 for La Parguera, Puerto Rico. A combination of MSI reflectance bands and several vegetation and water quality indexes were used with a Random Forest classification algorithm. Field data was collected to calibrate and validate the classification product, which achieved 90% overall accuracy. Our classification model can identify both fresh and decomposing Sargassum, as well as the brown tide (chromophoric dissolved organic matter) generated from decomposing Sargassum. We identified hotspots of Sargassum accumulation that persisted throughout the study period and assessed their spatial and temporal dynamics. Findings of this research provides high spatial resolution information for resource managers and researchers to understand the impacts of these ongoing events and to identify areas where mitigation efforts are needed to be focused.

Keywords: monitoring, Sargassum hotspots, Sentinel-2, spatio-temporal dynamics, Puerto Rico

Abandoned, Lost and Discarded Fishing Gear (Derelict gear) in Eastern Caribbean Small-Scale Fisheries: A Legal Gap Analysis

Los aparejos de pesca abandonados, perdidos o descartados en las pesquerías del Caribe Oriental: Un análisis de brechas en el marco legislativo

Engins de pêche abandonnés, perdus et jetés (engins abandonnés) dans la pêche artisanale des Caraïbes orientales : une analyse des lacunes juridiques

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ABSTRACT

Derelict fishing gear is a challenge not only for large industrial fleets but for small-scale fisheries as well. While significant gaps in knowledge exist regarding the scale of the challenge in the context of Eastern Caribbean small-scale fisheries, a number of studies have signaled the need to manage this threat.

Following is a gap analysis of the legal landscape relevant to derelict fishing gear in the countries of the OECS and Barbados. This analysis focuses on identifying gaps in the national legislation framework for these islands. To assess legislative gaps an assessment matrix has been developed, guided by recommended best practice approaches for preventing and mitigating against the impact of derelict fishing gear as developed by the Food and Agriculture Organisation and other global initiatives.

This assessment has found there is a significant regulatory gap for the effective management of derelict gear within the OECS and Barbados. Outdated and missing fisheries laws, lack of marine pollution instruments focused on marine-sources of waste, and complexities related to the multi-gear nature of the fisheries have resulted in a policy and regulatory landscape that falls short of effectively addressing this threat at the national level. Few regulatory provisions exist that effectively contribute to the prevention and/or mitigation of derelict fishing gear. While most States have legislative provisions that allow for the marking of fishing gear few include traceability requirements or technical measures aimed at mitigating impact of derelict gear. This review has highlighted the need for legislative reform to effectively manage this threat.

Keywords: Derelict fishing gear, Eastern Caribbean Small-scale fisheries, Legislative Framework, Gap Analysis,

Clash or understanding? The case of fishery co-management on Bonaire

¿Luchar o comprender? El caso de la cogestión pesquera en Bonaire.

Affrontement ou compréhension? Le cas de la cogestion des pêcheries à Bonaire.

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ABSTRACT

As part of the strategy to develop economically viable and community-supported sustainable fisheries, WWF-NL is active in the Dutch Caribbean municipality Bonaire. The success of these activities is dependent on participation and support from the fisheries community itself, which has not been forthcoming in the past.

In this context, WWF-NL worked on the establishment of a fisheries cooperation on Bonaire. Working closely with local fishermen, as well as other stakeholders responsible for (sustainable) management of the fisheries sector, we identified, analyzed, and sought for solutions for the bottlenecks inhibiting the co-management of the sector.

Co-management was concluded to be a preferred method to achieve successful and effective fisheries management on the island. However, the conditions for effective co-management system were yet to put in place. In a second study, we identified which preconditions for effective co-management were present on Bonaire and which were lacking according to existing theories. We examined whether indeed the presence or absence of these preconditions affected the implementation journey of co-management on Bonaire.

Keywords: Co-management, Dutch Caribbean, Cooperative

Characterizing and Comparing U.S. Marine Fisheries Ecosystems: Successful Factors in Moving Toward Ecosystem-Based Fisheries Management

Caracterización y comparación de ecosistemas pesqueros marinos de EE. UU.: factores exitosos para avanzar hacia la ordenación pesquera basada en ecosistemas

Caractérisation et comparaison des écosystèmes des pêches marines des États-Unis : facteurs de réussite dans l'évolution vers une gestion des pêches fondée sur les écosystèmes

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ABSTRACT

Implementing ecosystem-based fisheries management requires a comprehensive examination of fisheries ecosystem components. Determining the relative prominence among these components is warranted given the many issues facing marine ecosystems. We characterized U.S. marine fishery ecosystems by compiling a multidisciplinary view of coupled socioecological system (SES) indicators for each ecosystem. From these we ascertained the determinants for successful Living Marine Resource (LMR) management. We found that biological productivity was a major driver determining the level of fisheries biomass, landings, and LMR economic value for a given region, but human interventions can offset this basal production. We observed that good governance could overcome certain ecosystem limitations, and vice-versa, especially as tradeoffs across sectors intensify. We also found that U.S. regions perform well in terms of certain aspects of LMR management, with unique successes and challenges observed in all regions, including the northern Gulf of Mexico and U.S. Caribbean. While attributes differ, transferrable commonalities for successful management across regions include having: stock status identified; stable but attentive management interventions; tracking broader ecosystem considerations; landings/biomass exploitation rates typically <0.1; areal landings typically <1 t km²y⁻¹; ratios of landings/primary production typically <0.001; and explicit consideration of socioeconomic factors in management. Here we emphasize cross-regional comparisons among SES indicators, with a focus on U.S. temperate, subtropical, and tropical ecosystems.

Keywords: ecosystem-based fisheries management, productivity, governance, ecosystem indicators, socioecological systems

Overview of Spiny Lobster *Panulirus argus* Puerto Rico's Commercial Fishery Carapace Length Data 1990-2019.

Resumen de los Datos de Longitud de Carapacho en la Pesca Comercial de Langosta Espinosa *Panulirus argus* de Puerto Rico, 1990-2019.

Aperçu des données de longueur de carapace de la pêche commerciale de la langouste *Panulirus argus* à Porto Rico 1990-2019

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ABSTRACT

Puerto Rico's Commercial Fishery is artisanal, multispecies and multigear. Spiny lobster *Panulirus argus* is one of the three species most landed in pounds in Puerto Rico since the 1980s. This species has been caught by fish traps, lobster traps and through Scuba Diving. The Commercial Fisheries Statistics Program (CFSP) of the Department of Natural and Environmental Resources (DNER) has been collecting landings data since 1969 and bio-statistical data since 1985. The spiny lobster had been protected by DNER with a minimum legal size of 89mm carapace length since 1985. This paper will show the trends in lobster carapace length from commercial landings since 1990-99; 2000-2009 and 2010-2019. A total of 9,690 lobsters where carapace length measured by CFSP port samplers during 1990-99; 15,464 during 2000-2009; and 27,790 were measured during 2010-2019. The average carapace length for 1990-2009 was 95.7 mm; during 2000-2009 it was 101.5 mm; and for 2010-19 it was 103.1 mm. T test has shown extremely significant differences occurred among every data set. The paper will mention differences in the lobster fishery methods and the observations of the port sampler in this fishery for the last 30 years.

Keywords: Spiny Lobster, Fisheries Statistics, Commercial Fisheries, Puerto Rico, Commercial Landings

Puerto Rico's Commercial Fishery Census 2019: The fishing industry in the two years after Hurricane María

Censo de pesca comercial de Puerto Rico 2019: la industria pesquera en los dos años posteriores al huracán María

Recensement de la pêche commerciale de Porto Rico 2019 : l'industrie de la pêche dans les deux années qui ont suivi l'ouragan María

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ABSTRACT

Puerto Rico's Commercial Fishery is artisanal, multispecies and multigear. Spiny lobster *Panulirus argus* is one of the three species most landed in pounds in Puerto Rico since the 1980's. This species has been caught by fish traps, lobster traps and through Scuba Diving. The Commercial Fisheries Statistics Program (CFSP) of the Department of Natural and Environmental Resources (DNER) has been collecting landings data since 1969 and bio-statistical data since 1985. The spiny lobster had been protected by DNER with a minimum legal size of 89mm carapace length since 1985. This paper will show the trends in lobster carapace length from commercial landings since 1990-99; 2000-2009 and 2010-2019. A total of 9,690 lobsters where carapace length measured by CFSP port samplers during 1990-99; 15,464 during 2000-2009; and 27,790 were measured during 2010-2019. The average carapace length for 1990-2009 was 95.7 mm; during 2000-2009 it was 101.5mm; and for 2010-19 it was 103.1mm. T test has shown extremely significant differences occurred among every data set. The paper will mention differences in the lobster fishery methods and the observations of the port sampler in this fishery for the last 30 years.

Keywords: Fishery Census, Puerto Rico, Hurricane Impact, Resilience, Socioeconomic

Puerto Rico's DNER Fisheries Research Laboratory, 50 Years Monitoring Fisheries, a look into the achievements and future challenges.

Laboratorio de Investigaciones Pesqueras DRNA de Puerto Rico, 50 Años de Monitoreo de la Pesca, una mirada a sus logros y desafíos futuros.

Laboratoire de recherche sur les pêches DNER de Porto Rico, 50 ans de surveillance des pêches, un aperçu des réalisations et des défis futurs.

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ABSTRACT

The Fisheries Research Laboratory (FRL) was established in August 1971. At that time it was part of the Department of Agriculture of the Commonwealth of Puerto Rico. In 1979 the FRL was transferred to the Corporation of Marine and Lacustrine and Resources (CODREMAR). In 1990, the FRL was transferred to the Department of Natural and Environmental Resources (DNER). During the last 50 years the FRL's mission was and continue to be monitoring the fisheries resources of Puerto Rico. The Commercial Statistics Program, the SEAMAP Project, and the Fish Reproduction Research Program contributed to develop closed seasons, legal, minimum sizes, forbid fishing gears, and many other management actions to conserve the fishery resources. One important aspect in the FRL success is that the institution worked in harmony with the fishers to collect the data and to choose the species to be studied and managed.

This paper will present some of the most relevant FRL achievements and future challenges to continue the mission to successfully conserve the fishery resources.

Keywords: Puerto Rico, Fisheries, Landings, Reef Fish, Conservation

Thinking of stewardship in Caribbean small-scale fisheries

Pensando en la rectoría en la pesca artesanal del Caribe

Réflexion sur l'intendance dans la pêche artisanale des Caraïbes

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ABSTRACT

Some recent projects in Caribbean small-scale fisheries (SSF) have either explicitly focused on the concept of stewardship throughout their project cycle, or have implicitly incorporated this notion at various points. Yet, Caribbean fisheries authorities and fisherfolk organisations do not normally talk of stewardship in their everyday interactions. Some associate it with the Marine Stewardship Council and invoke an image of marginalisation of SSF in the competitive process of globalised eco-labelling. Others appreciate that the term can also be applied to instruments and initiatives that they favour such as the enlightenment provided by the SSF Guidelines. It seems that this potentially powerful, but sometimes abstract and misunderstood, notion needs to be further examined in the light of recent experience in project implementation. I attempt to do this by reflecting on some of the related quests in which I have been involved. Within this introspection I conclude that several facets of stewardship could be strengthened by better integration from policy to practice, since there is merit in institutionalising the concept in SSF.

Keywords: Stewardship, small-scale, fisheries, ,

Food web modeling to assess interactions between artificial reefs and natural reefs

Modelo de redes tráficas para evaluar las interacciones entre arrecifes artificiales y naturales

Modélisation du réseau trophique pour évaluer les interactions entre les récifs artificiels et les récifs naturels

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ABSTRACT

Artificial reefs are widely used to provide additional habitat for fishes; enhancing diving and fishing. Artificial reefs often have higher densities of predators that could affect nearby natural reefs, but there are few quantitative studies on how these reefs interact. This study focused on Aquarius Reef Base (ARB), an underwater habitat offshore of the Florida Keys, and 14 natural reef sites spanning 4 habitats, on the surrounding Conch Reef to examine the spatial subsidy needed to support the artificial reef food web. Fish biomass at each habitat was quantified via fish surveys and species were organized into functional groups. Using Ecopath and additional parameterization from previous research, food web models were created for ARB and the natural reef habitats. ARB's food web was found to have a large predator biomass with insufficient prey biomass to sustain the population, suggesting that these predators must forage on nearby natural reefs where the predator/prey ratio is smaller. Between 0.57km² and 1.79km² of natural reef is estimated to be a sufficient spatial subsidy for the large predatory biomass at ARB when the biomass, as determined by the seascape around the artificial reef, is added. We are unaware of other studies using Ecopath to determine spatial subsidy required by an artificial reef, and further studies are needed to expand this work to other artificial reefs that vary in size and fishing pressure. The management implications suggest that the placement of future artificial reefs needs to balance the aim with potential impacts on nearby natural reefs.

Keywords: artificial reef, food web, Ecopath, interactions, modeling

Local intervention efforts lead to species-specific reductions in stony coral tissue loss disease (SCTLD) prevalence in the United States Virgin Islands

Los esfuerzos de intervención local conducen a reducciones específicas de especies en la prevalencia de la enfermedad por pérdida de tejido de coral pétreo (SCTLD) en las Islas Vírgenes de los Estados Unidos

Les efforts d'intervention locaux conduisent à des réductions spécifiques aux espèces de la prévalence de la maladie de la perte de tissus des coraux durs (SCTLD) dans les îles Vierges américaines

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ABSTRACT

Stony coral tissue loss disease (SCTLD) was first observed in St. Thomas, United States Virgin Islands in January of 2019. In merely one year, the disease spread to reefs around the entire island of St. Thomas and to the neighboring island of St. John. Due to the rapid progression of lesions on corals affected by SCTLD, the benthic communities at affected sites were significantly impacted. In the present study, we monitored permanent radial transects at multiple sites around St. Thomas and St. John in order to quantify disease prevalence among species through time and compare disease dynamics at sites with and without treatments (i.e., antibiotic paste application, amputation, culling). Transects were established prior to SCTLD emerging at a site and then monitored at 1 week, 4 weeks, 6 weeks, 6 months, 1 year, and 1.5 years after first observations of SCTLD. At all sites, disease prevalence was highest approximately one month after initial observation of disease and declined through the remainder of the monitoring period. When all susceptible species were considered, there was no effect of treatment on disease prevalence nor incidence among sites. However, there was lower prevalence of diseased *Orbicella* spp. at treated sites than non-treated sites, likely because this is the most commonly treated species. This suggests that localized treatments can reduce disease pressure but the effect is species-specific. After only a few months of being affected by SCTLD, coral cover declined, and communities shifted to less diverse compositions. These results suggest intense treatment efforts are most valuable within the first month of disease at a site. Further research should investigate treatment techniques that have a range of impact beyond a single lesion to reduce effort required to preserve maximum coral diversity.

Keywords: SCTLD, coral disease, intervention, monitoring,

Complicating Conservation: How Marine Genetic Resources Challenge High Seas Biodiversity Negotiations

Complicando la conservación: Cómo los recursos genéticos marinos desafían las negociaciones sobre biodiversidad en alta mar

Complicquer la conservation : comment les ressources génétiques marines remettent en cause les négociations sur la biodiversité en haute mer

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ABSTRACT

After years of informal efforts, the parties to UNCLOS have begun negotiating an international legally binding instrument to address governance gaps that have impeded attempts to conserve biodiversity in areas beyond national jurisdiction (ABNJ). Though the mandate of these negotiations is to address the conservation and sustainable use of marine biodiversity, states have used this platform to advance competing claims regarding rights of access, ownership, and control of ocean territory and its resources. Small island developing states, including those in the Caribbean, have pressed for mechanisms to ensure in the sharing of monetary and non-monetary benefits associated with marine genetic resources (MGRs) as they are translated to knowledge beyond ocean space. These efforts are complicated by challenges in defining MGRs, interactions with existing regimes such as fisheries management, and the mobility of the resources within ocean space. This presentation examines how MGRs reveal the limitations of existing governance regimes such as area-based management tools, suggesting the need to develop creative management regimes that go beyond territorial approaches to address the resource itself.

Keywords: Biodiversity, High Seas, Areas Beyond National Jurisdiction, Governance, SIDS

A case study on the offspring of *Pseudodiploria strigosa* affected by Stony Coral Tissue Loss Disease (SCTLD).

Caso de estudio sobre la descendencia de *Pseudodiploria strigosa* afectada por la enfermedad de pérdida de tejido o síndrome blanco (SCTLD).

Une étude de cas sur la progéniture de *Pseudodiploria strigosa* affectée par Stony Coral Tissue Loss Disease (SCTLD).

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ABSTRACT

During the summer of 2018, a high mortality event of 22 species of corals was associated with Stony Coral Tissue Loss Disease (SCTLD) in the Mexican Caribbean, with *Pseudodiploria strigosa* being the second most affected species. Therefore, its prevalence on the reef and its larval propagations are of concern. In this study, the performance of the offspring obtained from a colony affected by SCTLD (more than 50% tissue loss) and a healthy colony (100% apparently healthy tissue) of *P. strigosa* was followed. In the first phase gametes obtained from a spawning event in August 2020 were collected in Puerto Morelos reef and combined in the laboratory for its breeding. Gamete fertilization, larval settlement yield, and recruits rearing yield in aquariums (4 and 12 months) were obtained. After crossing the gametes, a 95% fertilization was obtained. The embryonic development time was normal. Ten days after offering substrates to the larvae, a settlement yield of 22.39 % of initial embryos was obtained. Aquarium rearing performance at 4 months was 3.27% and 1.72% after 12 months of initial embryos. Growth ranges from 1 to 6 polyps per colony. The coral recruits acquired the symbiont naturally by the water and substrates provided, without direct inoculation of a specific symbiont. The second phase will consist of transplanting the recruits on two reefs in Puerto Morelos to record the performance of these offspring under natural conditions.

Keywords: Larvae, Fertilization, Larval propagation, Settlement, Outplant

Defining the reproductive biology of two species of cownose ray, *Rhinoptera bonasus* and *Rhinoptera brasiliensis*, in the northern Gulf of Mexico

Definición de la biología reproductiva de dos especies de cownose ray, *Rhinoptera bonasus* y *Rhinoptera brasiliensis*, en el norte del Golfo de México

Définition de la biologie de la reproduction de deux espèces de raies cownose, *Rhinoptera bonasus* et *Rhinoptera brasiliensis*, dans le nord du golfe du Mexique

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ABSTRACT

Historically, the Cownose Ray (*Rhinoptera bonasus*) was considered the only Rhinopterid residing in the northern Gulf of Mexico (GOM); however, recent studies have confirmed the presence of the Brazilian Cownose Ray (*R. brasiliensis*) throughout this region. As the two species are externally indistinguishable, the confirmation of *R. brasiliensis* confounds previous life history studies of *R. bonasus* in the GOM. Neither Rhinopterid is managed by state or federal fisheries programs; however, the new interest in sport fishing for cownose, and its frequent use as bait by recreational anglers and commercial fishers, has put more pressure on their populations. In order to maintain these populations, it is vital that the life history of both species is fully investigated. To date, 209 *R. bonasus* (118 males and 74 females) ranging in size from 346-930 mm disc width and 67 *R. brasiliensis* (44 males and 23 females) ranging in size from 444-1030 mm disc width have been collected. Here we show initial results for reproductive timing and seasonality, and gestation periods for both species. Analyses indicate a gestation period of 11-12 months with *R. bonasus* females pupping in June and *R. brasiliensis* females pupping in June and July. The smallest mature *R. bonasus* observed were: 659 and 678 mm disc width; while *R. brasiliensis* were 741 and 705 mm disc width, females and males respectively. Defining the life history for these two species is this first step toward developing a fisheries management plan and ultimately ensuring the future sustainability of these batoids.

Keywords: Life history, Elasmobranch, Batoid

Reproductive Parameters of Female Red Snapper Differ Across Depth

Los parámetros reproductivos del pargo rojo hembra difieren según la profundidad

Les paramètres de reproduction du vivaneau rouge femelle diffèrent selon la profondeur

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ABSTRACT

Red Snapper (*Lutjanus campechanus*) is one of the most targeted species in the northern Gulf of Mexico recreational fishery; however, their reproduction is not fully understood. Previous reproductive studies have focused on differences between structures with limited inclusion of depth. We compared several reproductive parameters of female Red Snapper across three depth strata from a 5-year study. A total of 1,026 females (168-795 mm FL) were captured on artificial structures via vertical longline sampling from three depth strata (shallow: <20 m, mid: 20-49 m, and deep: 50-100 m) off the Mississippi coast during March-November 2016-2020. Gonadal tissue was excised from each fish, weighed, and preserved for histological processing and fecundity analysis. No significant differences between depth strata were present for either the percentage of oocytes in oocyte maturation or GSI. There was a significant relationship between the occurrence of reproductively active females (RA, spawning capable and actively spawning phases) and depth ($X^2=32.06$, $p<0.001$), and the percentage of RA females increased from 29% to 56% from shallow to deep water. Batch fecundity and relative batch fecundity were highest in deep depths but there were no significant differences among depth strata. Spawning interval (number of days between spawning) calculated using the post-ovulatory follicle method was significantly shorter at deep depths (2.12 days) compared to mid (4.53 days) and shallow (4.06 days) depths ($X^2=22.619$, $p=0.001$). Our results suggest that female Red Snapper have a greater reproductive potential in deep water and this information will be important for future stock assessments and management decisions.

Keywords: Reproductive Potential, Fecundity, Spawning, Histology, Gulf of Mexico

Caribbean-Centered Collaborations in Response to Stony Coral Tissue Loss Disease in 2021

Colaboraciones Enfocadas Hacia el Caribe en Respuesta a la Enfermedad de Pérdida de Tejido de Coral Duro en 2021

Collaborations centrées sur les Caraïbes en réponse à la maladie de perte de tissu corallien pierreux en 2021

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ABSTRACT

As Stony Coral Tissue Loss Disease (SCTLD) continues to be identified throughout the Wider Caribbean Region (WCR), the efforts of Florida's SCTLD Response Caribbean Cooperation Team, MPACConnect and the Atlantic and Gulf Rapid Reef Assessment program have increased in order to build the capacity of regional stakeholders who are either actively responding to SCTLD in their waters or preparing for its possible detection. Since 2020, capacity building efforts have included the:

- hosting of monthly status-update meetings of regional organizations working to address SCTLD, with bi-monthly meetings engaging regional managers and practitioners;
- coordination of capacity building learning exchanges and workshops;
- facilitation of online training on disease identification, monitoring, interventions and response planning;
- establishment of a small grants program to support the development and implementation of SCTLD intervention and action plans;
- coordination of networking opportunities that build connections and share practical experiences amongst resource managers, field practitioners and scientists; and the
- development of SCTLD resource materials, including:
 - upgrades to web-based data tools;
 - survey data sheets;
 - planning tools for SCTLD monitoring and response;
 - outreach materials on SCTLD detection;
 - fact sheets on monitoring and the use of antibiotics to treat SCTLD; and
 - instructional videos on SCTLD prevention, surveillance and treatment.

Collaborations fostered amongst regional field practitioners have improved their ability to respond to the disease and educate/engage stakeholders. Joint ventures are currently being developed with researchers investigating the causes of SCTLD and testing new treatment methods. These efforts help support effective monitoring and treatment practices throughout the WCR.

Keywords: Stony coral tissue loss disease, capacity building

Spatio-temporal patterns and recruitment of young of the year snappers: mutton snapper (*Lutjanus analis*), lane snapper (*L. synagris*), schoolmaster snapper (*L. apodus*), gray snapper (*L. griseus*) and yellowtail snapper (*Ocyurus chrysurus*) (Lutjanidae) in the Middle Florida Keys between 2007-2019

Patrones espacio-temporales y reclutamiento de pargos jóvenes del año: pargo criollo (*Lutjanus analis*), pargo rayado (*L. synagris*), pargo amarillo (*L. apodus*), pargo gris (*L. griseus*) y pargo colirubia (*Ocyurus chrysurus*) (Lutjanidae) en los Cayos Centrales de Florida entre 2007-2019

Schémas spatio-temporels et recrutement des jeunes vivaneaux de l'année : vivaneau mouton (*Lutjanus analis*), vivaneau des chemins (*L. synagris*), vivaneau maître d'école (*L. apodus*), vivaneau gris (*L. griseus*) et vivaneau à queue jaune (*Ocyurus chrysurus*) (Lutjanidae) dans les Middle Florida Keys entre 2007-2019

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ABSTRACT

Recruitment is a major factor in the establishment and sustenance of local population structures of reef fishes. Insights on temporal and spatial recruitment variability are crucial to understanding the population dynamics of these commercially and recreationally targeted species. The distribution, abundance and recruitment variation of young-of-the-year mutton snapper (*Lutjanus analis*), lane snapper (*L. synagris*), schoolmaster snapper (*L. apodus*), gray snapper (*L. griseus*), and yellowtail snapper (*Ocyurus chrysurus*) were examined in relation to environmental parameters and habitat in the Middle Florida Keys between 2007 and 2019. Interannual variability in juvenile abundance was high, with 3 to 50-fold differences in mean predicted abundance between the highest and lowest producing years by species. Predicted abundances of mutton, lane, schoolmaster, and yellowtail were lowest in 2010, the year of a historic cold spell in South Florida. In contrast, juvenile gray snapper abundance was highest in that year. Strong seasonal trends were seen in abundance indices for all species, with peak predicted abundances all occurring in the fall. Among spatial and environmental variables, within-site differences in distance from shore, aquatic vegetation type, and aquatic vegetation cover were the most important predictors of abundance. Gray, lane, and schoolmaster all had pronounced, positive associations with *Halodule wrightii*, while yellowtail abundance was significantly explained by *Thalassia testudinum* cover. Our findings underscore species-specific life history differences among shallow water snappers and provide management-relevant information on year class strength in the Florida Keys.

Keywords: recruitment, snapper, seagrass, settlement,

Methodological Direction And Support To The Management And Environmental Planning Of The Colombian Coastal Zone

Direccionamiento Metodológico Y Apoyo A La Gestión y el Ordenamiento Ambiental De La Zona Costera Colombiana

Orienteation Methodologique Et Soutien A La Gestion Et La Planification Environnementale De La Zone Cotiere Colombienne

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ABSTRACT

La zona costera colombiana, se encuentra inmersa en diversos procesos de desarrollo económico y social que la hacen un territorio en constante cambio el cual demanda una adecuada planificación, para prevenir poner en riesgo la estabilidad de los ecosistemas marinos y costeros sin desfavorecer el desarrollo sostenible. Bajo este precedente y con el fin de apoyar la gestión y el ordenamiento ambiental de la zona costera Caribe y del Pacífico colombiano, el equipo técnico del INVEMAR, ha desarrollado una base metodológica a partir de experiencias en distintos procesos que se han llevado a cabo en el transcurso de 25 años, constituyéndose en la base para el marco normativo nacional. Esta base metodológica está compuesta por 3 fases: levantamiento de información (primaria o secundaria) de las áreas de estudio, caracterización y diagnóstico por componente, y análisis de información a partir de un diagnóstico integrado o una evaluación ambiental integral. El desarrollo de esta base metodológica ha generado importantes resultados, resaltándose aquí para los últimos seis años aportes técnicos a procesos de zonificación ambiental de la zona costera, aportes técnicos a la elaboración de planes de manejo de unidades ambientales costeras, actualización del plan de manejo para un área marina protegida y un sitio Ramsar, así como la generación de insumos técnicos para el desarrollo de estrategias de conservación, de uso sostenible o para el análisis de selección de categorías de manejo de áreas protegidas. De estas últimas acciones, se destacan el diseño e implementación del Subsistema de Áreas Marinas Protegidas en Colombia y el desarrollo de ejercicios metodológicos enmarcados en planificación espacial marina con aportes al manejo en seis zonas marinas en Colombia.

Keywords: zona costera, ordenamiento ambiental, planes de manejo, zonificación ambiental, metodología

Comparative analysis of liquid fish silage fertilizer versus urea on the plant vegetative and yield performance of Pak-choi (*Brassica rapa* subsp. *chinensis*)

Análisis comparativo de fertilizante líquido para ensilaje de pescado versus urea en el rendimiento vegetativo y de rendimiento de la planta de Pak-choi (*Brassica rapa* subsp. *Chinensis*)

Analyse comparative de l'engrais liquide d'ensilage de poisson par rapport à l'urée sur les performances végétaives et de rendement de la plante de Pak-choi (*Brassica rapa* subsp. *chinensis*)

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ABSTRACT

Large quantities of Seafood Processing By-Products (SPBPs) are carelessly dumped in open rivers. SPBPs can be used as an alternative organic fertilizer in the form of liquid fish silage (LFS). The effectiveness of LFS of bangamary (*Macrodon ancylodon*) as a fertilizer was compared to urea for pak-choi production; using two different concentrations of 5% and 10% and urea at a rate of 160 kg/N ha⁻¹. Plant vegetative (leaf length, number of edible leaves, leaf area index (LAI), pigment content) and yield performance (head weight) were assessed. After 14 days of fermentation the LFS pH value was within range of 3.4-3.6 and contained 1.85% N, 3.12% P and 0.13% K; with no heavy metals or E. coli detected. Results indicated that plants treated with 5% LFS produced the highest plant growth, yield, LAI and pigment content comparable to urea. While, tissue analysis in plants treated with 10% LFS had highest percentages of N, P, K. This study concludes, SPBPs can successfully be converted into LFS and used as a plant fertilizer; it recommends the use of 5% LFS since pak-choi production was the greatest. However, further studies are recommended to substantiate these results.

Keywords: Liquid fish silage, seafood processing by-products, organic fertilizer, yield performance, pak-choi

The First Steps: Determining Essential Fish Habitat for Queen Snapper (*Etelis oculatus*) in Puerto Rico Using Ensemble Species Distribution Modeling

Los Primeros Pasos: Determinando el Hábitat Esencial de Peces Para el Pargo Reina (*Etelis oculatus*) en Puerto Rico Utilizando Modelos de Distribución de Especies por Conjuntos

Les premières étapes : déterminer l'habitat essentiel du poisson pour le vivaneau royal (*Etelis oculatus*) à Porto Rico à l'aide de la modélisation de la distribution des espèces d'ensemble

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ABSTRACT

As the third most landed species (by total pounds “ as determined by Puerto Rico commercial landings 2012-2017), queen snapper (*Etelis oculatus*) is of interest from an ecological and management perspective yet little is known about its detailed distribution patterns and the habitats it utilizes. As a relatively deep-water species (100 - 500 m), it is difficult to develop expansive occurrence datasets due to limited opportunities and costly field sampling. With fishing activities progressively expanding into deeper waters, its critical to gather data on deep-water fish populations to identify essential fish habitats (EFH). The first step in determining EFH requires simple presence/absence data for a species for either some or all portions of its geographic range. However, in the U.S. Caribbean, the critically data-deficient nature of this species has made this challenging.

In this work, we investigated the use of ensemble species distribution modeling to predict queen snapper distribution along the coast of Puerto Rico, specifically the western, northeastern, and southeastern regions. Terrain attributes derived from multibeam bathymetric data were combined with occurrence data collected through a NOAA National Marine Fisheries Service fishery-independent video and hook and line survey to develop ensemble models unique to each sampling region. The models facilitate the analysis of fish distribution and fish-habitat relationships at different spatial scales. Our results are a first step in determining EFH and distribution of this species in Puerto Rico, and further highlight the importance of investigating the role spatial scale and other contributing factors play in our understanding of species-environment relationships.

Keywords: deep-water snapper, essential fish habitat, habitat suitability, ensemble species distribution modeling, Puerto Rico

**Using fish count surveys to examine the spatial and temporal distribution of the
invasive lionfish *Pterois volitans* in the Florida Keys**

**Uso de encuestas de conteo de peces para examinar la distribución espacial y
temporal del pez león invasor *Pterois volitans* en los Cayos de Florida**

**Utilisation d'enquêtes sur le dénombrement des poissons pour examiner la
distribution spatiale et temporelle du poisson-lion envahissant *Pterois volitans*
dans les Florida Keys**

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ABSTRACT

This paper presents trends in lionfish distribution in the Florida Keys from 2009 to 2020. The relative abundance and geographic expansion of the red lionfish *Pterois volitans* were tracked using the Volunteer Fish Survey Project from the Reef Environmental Education Foundation (REEF). This program uses volunteer snorkelers and SCUBA divers to record fish abundance at locations across the globe. Metrics analyzed include changes in relative abundance, number of locations observed per year, percent of surveys observed per year, and the differences in these metrics when comparing “experts” and “novices” per the classification system made by REEF. Regression analysis and significance tests were used to identify correlation over time. Although there is a positive correlation between the number of locations that have lionfish and time, the percentage of surveys conducted in the Florida Keys identifying lionfish has declined over time. We also examine the importance of citizen science in academic research, highlighting the need to continue support for organizations like REEF and others that engage in collecting and distributing data via citizen science.

Keywords: lionfish, distribution, invasion, citizen science, REEF

**Goliath Grouper (*Epinephelus itajara*) population trends in Florida, USA:
Evaluating objective evidence of assumed recovery**

**Tendencias de la población del mero goliath (*Epinephelus itajara*) en Florida:
Evaluación de la evidencia objetiva de la supuesta recuperación**

**Tendances des populations de mérrou goliath (*Epinephelus itajara*) en Floride:
Évaluation des preuves objectives du rétablissement présumé**

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ABSTRACT

Goliath Grouper (*Epinephelus itajara*) have been protected in Florida since 1990, following near extirpation of the species throughout its range due to severe overfishing and habitat degradation. Based largely on anecdotal reports of increases in incidental catch of the species, the Florida Fish and Wildlife Commission recently held a hearing to consider opening the fishery to limited take under the assumption that it has largely recovered. Because of no-take protections for the last 31 years, however, the state has limited data to objectively assess the population status of the species. Here, we develop a time-series model of Goliath Grouper densities across the last 3 decades using 1) data from the Reef Environmental Education Foundation (REEF) Volunteer Fish Survey Project, a citizen-science monitoring program ongoing since 1993, and 2) a long-term fisheries-independent diving-based fish survey in South Florida. We find that while the population appears to show strong growth over the first 20 years of the time series, in recent times it has been in decline. The reasons for this decline are unclear, but likely involved a combination of both anthropogenic (incidental catch) and natural (red tide) stressors. Regardless of the causes, our findings indicate that any implemented level of take from a limited fishery will serve to exacerbate ongoing declines in this critically endangered species.

Keywords: citizen science, endangered species, reef fish, ,

Florida Fish and Wildlife's adaptive control strategies to combat invasive lionfish

Estrategias de control adaptativo de Florida Fish and Wildlife para combatir el pez león invasor

Stratégies de contrôle adaptatif de Florida Fish and Wildlife pour lutter contre le poisson-lion envahissant

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ABSTRACT

Labeled the worst marine invasion to date, lionfish and their effects on environmental resources are a priority topic for resource managers throughout the invaded range. The Florida Fish and Wildlife Conservation Commission recognizes that lionfish management requires a cooperative effort between government and stakeholders. This collaboration requires that the public understand the potential threats that can result from invasive species and what they can do to help prevent or mitigate these impacts. The FWC Lionfish Program was established in 2014 to accomplish this goal as well as encourage diver involvement, support research and the development of innovative harvest methods, and promote the commercial lionfish market. The program has several components including a traveling outreach booth, “Become the Predator” workshops, school programs, assistance for tournaments and research projects, and incentive-based removal programs. Since its inception, the FWC Lionfish Program has connected with over 58,000 attendees at its workshops, presentations, and other sponsored events. The program has also recorded nearly 240,000 lionfish harvested through its sponsored tournaments and incentive-based removal programs. Adaptive outreach, education and control strategies are necessary to keep up with the progression of the invasion. The agency will continue to identify, support, and develop innovative control mechanisms as well as opportunities for regulatory changes and incentive programs to increase participation in lionfish harvest.

Keywords: lionfish

Networking and partnering to tackle the challenge of being sustainable, holistic, and pragmatic: lessons learnt from an Ecosystem Based Management Decision Support System pilot application in the Caribbean and its spreading in the Mediterranean and the Red Sea.

Creación de redes y asociaciones para abordar el desafío de ser sustentable, holístico y pragmático: lecciones aprendidas de una aplicación piloto del Sistema de apoyo a la toma de decisiones de gestión basada en ecosistemas en el Caribe y su expansión en el Mediterráneo y el Mar Rojo.

Mise en réseau et partenariat pour relever le défi d'être durable, holistique et pragmatique : leçons tirées d'une application pilote de système d'aide à la décision pour la gestion basée sur les écosystèmes dans les Caraïbes et sa propagation en Méditerranée et en mer Rouge.

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ABSTRACT

Challenges, experiences and lessons learnt throughout the 4-years (2015-2019) “Biodiversity for Sustainable Development in the Caribbean through Ecosystem Based Management” project (executed by UN Environment - Caribbean Environment Programme under the SPAW Protocol), are illustrated to disseminate the outcomes of the Ecosystem Based Management Decision Support System (EBM-DSS) Dominican pilot, and to briefly describe how these experiences strengthened the foundations of an ongoing project in the Mediterranean and the Red Sea (Mediterranean Forum For Applied Ecosystem-Based Management, MED4EBM). The Dominican Ministry of Environment and Natural Resources (MARENA) and the EBM-DSS team guided the gathering of specific information, the establishment of the online database and the decision support software tool based on the ecosystem components and their indicators. Monitoring and management protocols were established with responsibilities assigned to the various member-organisations of the interdisciplinary working group according to their respective institutional mandates and capabilities. A special EBM-DSS Unit was also established within MARENA for the routine handling the EBM-DSS database and software tools valorising synergies with the Project Biodiversidad Costera y Turismo (BCyT, funded by the GEF). The crucial role of effective networking and partnering and the vision for developing EBM-DSS applications to further spread EBM in coastal and marine domains are also discussed, drawing a parallel with the EBM-DSS experiences of the MED4EBM project (2019-2022), currently ongoing in the Mediterranean and the Red Sea and funded by the ENI CBC MED Programme.

Keywords: EBM-DSS, Natural resources, Sustainable development, Synergies, Networking

Leadership in Caribbean fisherfolk organisations: a profile, capacities and gaps, and strengthening

Liderazgo en las organizaciones de pescadores del Caribe: un perfil, capacidades y brechas, y fortalecimiento

Leadership dans les organisations de pêcheurs des Caraïbes : profil, capacités et lacunes, et renforcement

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ABSTRACT

Organisational leadership is one of the most important roles for both women and men in the fishing industry. Enabling fisherfolk collective action and strengthening or development of their capacity, especially in relation to leadership, is important to the successful implementation of the 2014 Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines) and the realisation of sustainable fisheries and stewardship. Through the FAO-implemented Developing Organisational Capacity for Ecosystem Stewardship and Livelihoods in Caribbean Small-scale Fisheries (StewardFish) project, UWI-CERMES undertook a fisherfolk organisation leadership assessment and gender analyses in fisherfolk organisations in each of seven project countries – Antigua and Barbuda, Jamaica, Saint Lucia, Barbados, St. Vincent and the Grenadines, Belize, and Guyana - to better understand gaps in leadership competencies of women, men and youth in the region. The findings of both of the analyses were used to inform leadership training specifically for women and youth.

This three-part poster sequel provides a baseline of knowledge on fisher organisation leaders and fisherfolk leadership in Caribbean Regional Fisheries Mechanism Member States. It provides a better understanding of gaps and capacities in fisherfolk leadership; examines how gender, youth and leadership intersect, influence each other and constrain equal participation in and access to decision-making; and describes strategic and targeted capacity development for fisherfolk organisation leaders. Our work confirms some already known information on fisherfolk organisations, documenting this and new information.

Keywords: Leadership, Fisherfolk organisations, Profile, Gender analysis, Capacity building

Testing coral probiotics as an in situ treatment for stony coral tissue loss disease

Prueba de probióticos de coral como tratamiento in situ para stony coral tissue loss disease

Tester les probiotiques coralliens comme traitement in situ du stony coral tissue loss disease

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ABSTRACT

Stony coral tissue loss disease (SCTLD) has spread throughout Florida's Coral Reef causing extensive mortalities in over 21 species of reef-building corals and resulting in the local extinction of some species. Adding to the mounting devastation by SCTLD in Florida, this disease has recently been found in 17 other countries or territories throughout the Caribbean. Current treatments for SCTLD do not provide protection from future infection and may have adverse effects on the local environment. Here, we investigate the effectiveness of using coral-derived probiotics as an in situ treatment for SCTLD-affected corals. Bacterial strain McH1-7, isolated from a disease-resistant colony of *Montastraea cavernosa*, successfully stopped disease progression and transmission during aquarium trials with diseased corals. McH1-7 was also tested for safety on a variety of stony coral species and showed no negative effects over 21 days. Using this knowledge, we developed and tested different methods of deploying the probiotics to treat whole diseased *M. cavernosa* colonies with McH1-7 at reef sites in Broward County, FL. Prototype deployment methods included a weighted bag to treat whole coral colonies as well as a sodium alginate-based paste that could be applied directly to the lesion. Corals were treated and monitored for months for signs of disease progression. 3D models were also created of each coral to compare disease progression over time. This is the first in situ study testing the practicality and effectiveness of using coral probiotics to treat a coral disease.

Keywords: Probiotics, SCTLD

Stony Coral Tissue Loss Disease (SCTLD) spread in an artificial coral community: from coral susceptibility to management suggestions

Propagación de la enfermedad de pérdida de tejido en corales duros en una comunidad de coral artificial: de susceptibilidad en los corales a sugerencias de manejo

Stony Coral Tissue Loss Disease (SCTLD) propagé dans une communauté de coraux artificiels : de la sensibilité des coraux aux suggestions de gestion

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ABSTRACT

Stony Coral Tissue Loss Disease (SCTLD) is a severe threat to Caribbean reefs. Its impact on coral populations results in rapid reef deterioration, and we are still working to understand the disease and how to stop the spread. Between November 2020 and February 2021, about 1900 coral colonies from 24 species were relocated from the Nassau cruise port to the Lighthouse Harbour preceding the commencement of nearby construction. Prior to relocation, corals in the port area exhibited good health and no SCTLD. Conversely, SCTLD was present at the Lighthouse Harbour. This relocation project was an opportunity to study the spread of SCTLD within a coral community, and to better understand species susceptibility. Monthly monitoring of individually tagged corals (n=50) began in November 2020. In February 2021, monitoring was expanded to include photomosaic plots (n=14), such that most of the relocated corals were observed. Two weeks after relocation, SCTLD affected all colonies of *Meandrina meandrites* and 70% of *Eusmilia fastigiata*. After four weeks, an additional 5 species were infected, which increased to 8 after 12 weeks, and 14 in 6 months. During the monitoring period, a total of 3 species become locally extinct and 4 species near local extinction. The exoskeletons of certain species, degraded within weeks of reaching total mortality, and most colonies were no longer identifiable without tag or photomosaic evidence. This shows that baseline data is critical for obtaining local extinction data. Additionally, our study shows that it may be possible to use species-specific infection rates and mortality to estimate the arrival of SCTLD to an area. This information can be used to better understand the interspecies and intraspecies spread, track the edge of the disease as it and to prioritize treatment areas to slow the spread

Keywords: Stony Coral Tissue Loss Disease, The Bahamas, Disease spread, Coral species susceptibility

The adaptative process of improving fisheries management of vulnerable fish spawning aggregations in the Caribbean: the case of Nassau grouper and mutton snapper

El proceso de adaptación para mejorar la ordenación pesquera de agregaciones reproductivas de peces vulnerables en el Caribe: el caso del mero Nassau y el pargo sama

Le processus adaptatif d'amélioration de la gestion des pêcheries des bancs de frai vulnérables dans les Caraïbes : le cas du mérrou de Nassau et du vivaneau ovin

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ABSTRACT

Decades of Nassau grouper (*Epinephelus striatus*) population decline from overfishing resulted in a critically endangered listing by IUCN. Similarly, significant declines in mutton snapper (*Lutjanus analis*) populations resulted in its near threatened status. Both transboundary coral reef fishes form spawning aggregations during a couple of weeks annually, associated with full moon periods, between December and March for the former and April to June for the latter species.

To improve management of both species and secure active fishers' engagement along with other key stakeholders, in 2012 the WECAFC/CFMC/OSPESCA/CRFM Working Group on Spawning Aggregations (SAWG) was established in an effort to increase implementation and/or effectiveness of regional conservation measures.

At its fourth meeting (2019) the SAWG adopted a Regional Fish Spawning Aggregation Fishery Management Plan focused on Nassau grouper and mutton snapper (FSAMP), which is expected to be adopted by the Commission at its 18th Session in 2022. With six objectives and 16 priority actions, the FSAMP seeks to increase inter-sectoral coordination thereby ensuring harmonized planning for effective implementation and management across the Caribbean. Simultaneously, the SAWG developed a regional communication strategy called "Recovering Big Fish" that initiates a 3-year public engagement campaign with the feature film "Big Fish" that is currently in production and to be launched in 2022. While these efforts initially focused on two iconic species, the concept and approach developed are applicable to other aggregation-spawning fishes.

Both the FSAMP and the communication strategy utilize an Ecosystem Approach to Fisheries and respond to changing and cumulative threats of human or natural origin, including climate change.

Keywords: Nassau grouper, mutton snapper, fish spawning aggregations, management plan, communication strategy

Variation on barrier reefs compositions and implications for wave attenuation ecosystem service at San Andrés Island, Seaflower Biosphere Reserve, Colombian oceanic Western Caribbean

Variaciones en la salud barreras arrecifales e implicaciones para el servicio ecosistémico de protección costera en la isla San Andrés, Reserva de la Biosfera Seaflower, Caribe Occidental oceánico colombiano

Variation de la composition des récifs-barrières et implications pour le service écosystémique d'atténuation des vagues sur l'île de San Andrés, réserve de biosphère de Seaflower, océanique colombien des Caraïbes occidentales

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ABSTRACT

Coral barrier reefs protect coasts, people and economies at Caribbean insular territories that are exposed yearly to waves and cyclones, but these ecosystems have been affected by climate change and bad decision making about management of coastal areas. Improvement on consciousness about the importance of these ecosystems for people wellbeing, business, and nature itself might enforce better management and decision making for sustainability and Ecosystem Based Adaptation (EBA). To do that, we evaluated coastal protection ecosystem service at two different areas at San Andrés Island as a case of study, to better show decision makers about the importance of healthy reef barriers for wellbeing. For that, we registered field wave height attenuation (January to March 2021) and evaluated reef barrier condition using aerial and subaquatic surveys. Our results showed differences on wave attenuation between both sites (up to 89% and up to 79%). Waves at forereef reached up to 3.2 m (10.5 feet) height (Hs), were reduced up to 20 cm (0.7 feet) due to barrier reef, we found differences between reef species composition and other attributes between sites, showing insights of degradation on the less wave attenuating reef that presented severe coastal erosion on its beach. These dumping on coastal protection service bring to economic and wellbeing losses. Our results are being included on a communication strategy with economic, social, and environmental perspectives to encourage decision makers at Caribbean to invest on a better management and protection strategy to improve coral barrier reefs health as Nature Based Solutions-NBS for sustainability.

Keywords: Management, Coastal Protection, Sustainability, Climate Change, Ecosystem Services

Atlantic Sailfish (*Istiophorus albicans*) Distribution off the East Coast of Florida from 2003 to 2018 in Response to Sea Surface Temperature

Distribución del pez vela del Atlántico (*Istiophorus albicans*) frente a la costa este de Florida de 2003 a 2018 en respuesta a la temperatura de la superficie del mar

Répartition du voilier de l'Atlantique (*Istiophorus albicans*) au large de la côte est de la Floride de 2003 à 2018 en réponse à la température de surface de la mer

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ABSTRACT

The Atlantic sailfish (*Istiophorus albicans*) ranges from 40°N to 40°S in the Western Atlantic Ocean and has great economic and recreational value for sport fishers. Off the east coast of Florida, recreational fishing boats often target this species due to its size, speed, and strength. This project aimed to determine the relationship between sea surface temperature (SST) and the distribution of Atlantic sailfish caught and released over a fifteen-year period (2003 to 2018). Tagging information was collected from The Billfish Foundation and NOAA who have the most extensive programs for billfish. Using the time and location of each reported sailfish, a satellite-derived SST value was obtained for each point. The purpose of this study was to determine if sea surface warming was associated with changes in sailfish distribution. On average, sailfish were caught at $26.16 \pm 1.70^{\circ}\text{C}$ ($\bar{x} \pm \text{s.d.}$) over the fifteen-year period. The most sailfish catches occurred at temperatures ranging from 25.2°C to 25.5°C. Over the fifteen-year period sailfish catches decreased at lower temperatures (23°C and 24°C) and at 31°C. At 25°C and 30°C there was no change in catch numbers of sailfish. From 26°C to 29°C there was an increase in the number of sailfish. Based on these results, increasing ocean temperatures will have an impact on distribution and habitat utilization of sailfish. Warming sea surface temperatures create a need for more policy and regulation to protect the Atlantic sailfish and related highly migratory billfish species.

Keywords: sailfish, billfish, sea surface temperature, climate change, recreational fishing

Using fisher-contributed secondary fins to fill critical shark-fisheries data gaps

Uso de aletas secundarias aportadas por pescadores para llenar vacíos críticos de información en pesquerías de tiburones

Utilisation d'ailerons secondaires fournis par les pêcheurs pour combler les lacunes critiques dans la pêche aux requins

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ABSTRACT

Developing-world shark fisheries are typically not assessed or actively managed for sustainability; one fundamental obstacle is the lack of species and size composition catch data. We tested a new and potentially widely applicable approach for collecting these data: mandatory submission of low-value secondary fins (anal fins) from landed sharks by fishers and use of the fins to reconstruct catch species and size. Visual and low-cost genetic identification were used to determine species composition, and linear regression was applied to total length and anal fin base length for catch-size reconstruction. We tested the feasibility of this approach in Belize, first in a local proof-of-concept study and then scaling it up to the national level for the 2017-2018 shark-fishing season (1,786 fins analyzed). Sixteen species occurred in this fishery. The most common were the Caribbean reef (*Carcharhinus perezii*), blacktip (*C. limbatus*), sharpnose (Atlantic [*Rhizoprionodon terraenovae*] and Caribbean [*R. porosus*] considered as a group), and bonnethead (*Sphyrna cf. tiburo*). Sharpnose and bonnethead sharks were landed primarily above size at maturity, whereas Caribbean reef and blacktip sharks were primarily landed below size at maturity. Our approach proved effective in obtaining critical data for managing the shark fishery, and we suggest the tools developed as part of this program could be exported to other nations in this region and applied almost immediately if there were means to communicate with fishers and incentivize them to provide anal fins. In summary, this program could be a model for collecting urgently needed data for developing-world shark fisheries globally.

Keywords: shark fishery management, shark fins, anal fins, body length regression, shark conservation

Defining a protocol for recreational scuba diving carrying capacity within a marine protected area (MPA)

Definiendo un protocolo para la capacidad de carga del buceo recreativo dentro de un Área marina protegida (AMP)

Définir un protocole pour la capacité d'accueil de la plongée sous-marine récréative au sein d'une aire marine protégée (AMP)

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ABSTRACT

Honduras has over 91 protected areas, however only 28 of them are legally declared coastal and marine protected areas. Roatan is one of the 3 protected islands within the Bay Islands National Marine Park (PNMIB). Roatan, is located in the Mesoamerican reef (MAR) region. Its economy is dependent on tourism having over 1 million tourists each year. A big part of this tourism is motivated by scuba diving related activities. The objective of this thesis is to obtain scientific information that will help local and international decision makers in Roatan in their aim to protect Roatan's coral reefs and the communities that depend on it for their livelihoods. To do this we selected 10 dive sites representative of the majority of dive sites of the island and assessed their Carrying Capacity.

In addition, we evaluated the role of different factors related to recreational scuba diving that could place coral reefs in risk (level of certification/experience and lionfish spear).

Keywords: Carrying Capacity, Scuba diving, MPA, Lionfish spear, Certification level

Impact of sanitation best management practices on human and coral reef health: Half Moon Bay, Honduras case study

Impacto de las buenas prácticas en la gestión del saneamiento en la salud humana y de los arrecifes de coral: estudio de caso de Half Moon Bay, Honduras

Impact des meilleures pratiques de gestion de l'assainissement sur la santé des humains et des récifs coralliens : étude de cas de Half Moon Bay, Honduras

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ABSTRACT

In the past years, macroalgae cover has nearly doubled along the Mesoamerican Reef (MAR) and there has been a significant increase in diseases linked to waterborne pathogens. However, to date there is limited work on the impact of Sanitation Best Management Practices (SBMPs) on human and coral reef health in the region. Here, we present the case study of Half Moon Bay (Roatan, Honduras) where after 15 years of implementing SBMPs from the bottom-up, both marine water quality and coral disease have improved.

We carried out a thorough literature review and stakeholder interviews to understand the SBMPs implementation process in Roatan. We analyzed enterococcus data in marine waters (2013 - 2020) from the monitoring program led by the Bay Islands Conservation Association, data on connections to the sewage treatment plant from Polo's Water Board (2014-2019) and data on coral diseases from the Healthy Reefs Initiative (2014, 2016 and 2018); to determine the changes in pathogens through time and their impact on the reef.

According to our data the creation and strengthening of a local water board was key for the implementation of SBMPs by improving transparency; currently 99.65% of accessible connections in West End have been connected to a sewage treatment plant which meets national standards and has developed cost-effective processing methods. Moreover, long term marine water quality data was important in the implementation of SBMPs, providing leverage to advocate [GB2] for investment in sanitation. Since 2017, enterococcus levels have decreased 2 orders of magnitude. Consequently, in 2019 Half Moon Bay was declared a Blue Flag Beach. Furthermore, coral disease in the area of influence of the sewage treatment plan dropped to 0% after the implementation of SBMPs, demonstrating that they are key for both human and coral health.

Keywords: Sanitation Best Management Practices, Water quality, Mesoamerican reef, Sanitation, Coral reef

**Building Capacity for Sustainable Fisheries Management in the U.S. Caribbean:
Queen triggerfish age, growth, and maturity**

**Creando capacitación para el manejo sustentable de las pesquerías en las aguas
del Caribe de E.E.U.U.: Edad, crecimiento y madurez sexual del peje puerco**

**Renforcement des capacités pour la gestion durable des pêches dans les Caraïbes
des États-Unis : âge, croissance et maturité des balistes royaux**

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ABSTRACT

The primary goal of fisheries management is to ensure the long-term sustainable harvest of species and minimizing the ecological impacts while at the same time balance the cultural, economic, and food security needs of a jurisdiction. This is often achieved through a relatively complex and scientifically rigorous stock assessment process that results in management recommendations. One of the most important suits of inputs for this involves documenting the age structure of a stock. In the U.S. Caribbean, no current information is available on queen triggerfish population age structure, sex-specific and combined growth rates, and age-at-sexual maturity despite the importance of queen triggerfish as one of the top commercially landed reef fish species. The objectives of our ongoing research on queen triggerfish life history are: 1) Investigate age, growth, and mortality across the US Caribbean Island-based management platforms; 2) Document reproductive biology, including size- and age-at-sexual maturity, reproductive seasonality, and reproductive potential/output. To-date, we have collected and processed 2,154 samples from across the U.S. Caribbean 67-473 mm FL. Radiocarbon ageing validation for age estimates from sagittal otoliths resulted in an age range of 0-23 y. Age estimates from over 2000 samples resulted in the following VBGF parameter estimates: $L_{\infty} = 435$ mm FL; $K = 0.14$ and $t_0 = -0.85$. The largest and oldest queen triggerfish, including mega-spawner females, occurred in deeper shelf waters (> 30 m depth). Commercial spearfishing efforts mainly target plate-size triggerfish so a reservoir of mega-spawners may exist in deeper waters around the U.S. Caribbean. Our findings provide critical information to assist fisheries managers in evaluating the current stock status of this species.

Keywords: Queen triggerfish, Age and growth, Fisheries, Reproductive biology, Maturity

The impact of trap confinement on the condition of the Florida stone crab
Menippe mercenaria

El impacto del confinamiento de trampas en la condición del cangrejo de piedra de Florida
Menippe mercenaria

L'impact du confinement des pièges sur l'état du crabe pierre de Floride
Menippe mercenaria

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ABSTRACT

Stone crab fishery landings in Florida are typically valued at > \$30 M annually. The commercial fishery is claw only, meaning that live animals are returned to the water once one or both claws have been removed. Because stone crabs can regenerate their claws, the fishery is often thought of as sustainable. Recent stock assessments and fishing mortality studies suggest that many animals do not survive claw removal and that the fishery is in danger of being overfished. Trap reduction policies have been implemented to regulate the fishery and increase the stone crab population, but this has appeared to shift fishing behavior, including the time lapse between trap pulls (i.e., soak time). To investigate the effects of soak time, we conducted trap studies of crab condition in both fall and spring at the northern (Cedar Key, Florida) and southern (Marathon, Florida) regions of the fishery to account for geographic and temperature variation. Lab-based simulations have been conducted under winter conditions and trials in summer conditions will be completed by September 2021. Initial results suggest that with increasing soak time crabs become nutritionally depleted but reflex impairment tests show no neurological impacts. Claw removal has been documented as a traumatic event for stone crabs, with less than half of crabs surviving after both claws are removed. Understanding how time spent in traps affects the condition of a crab before claw-removal will allow for a more accurate mortality assessment and potentially be used to manage the Florida stone crab fishery more sustainably.

Keywords: Stone crab, Soak time, Trap fishery

Characterization of the queen conch (*Aliger gigas*) artisanal fishing prior and after the five-year ban at Chinchorro Bank Biosphere Reserve, Mexico

Caracterización de la pesca artesanal del caracol rosado (*Aliger gigas*) antes y después de la veda de cinco años en la Reserva de la Biosfera del Banco Chinchorro, México

Caractérisation de la pêche artisanale du lambi (*Aliger gigas*) avant et après l'interdiction de cinq ans dans la réserve de biosphère de Chinchorro Bank, Mexique

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ABSTRACT

The queen conch *Aliger gigas* (Linnaeus, 1758) is one of the most important fishery resources in the Caribbean. However, due to its biological characteristics and its high commercial demand, its populations have been overexploited. In Mexico, Chinchorro Bank is the only site where extraction of this resource is allowed through catch quotas, however, due to its drastic population decline and fishing pressure, in 2012 a temporary ban was established that ended in 2017. This study describes and compares the artisanal fishing of the queen conch for the last catch season in 2011 and the second catch season after the ban in 2018. A total of 14 fishing sites were identified, the fishermen preferred the sites located in the central zone of Chinchorro Bank. An increase in CPUE was observed between fishing seasons, probably due to the queen conch recovery for the five-year ban; however, the volume of queen conch that has been allowed for each fishing season was analysed and reflected a historical decrease for the last 30 years, which may be attributed to a decrease in population densities. Using shell length (SL) and lip thickness (LT) from a total of 4805 organisms a decrease in the mean size and size structure of queen conch is observed between fishing seasons, however, there was an increase in lip thickness due to population growth. The results indicate that the queen conch population dynamics at Chinchorro Bank has been affected due to the overexploitation of the resource. The fishermen have increased their catches of sublegal conchs and conchs that have not reached sexual maturity, due general decrease in SL. For the implemented ban to have the expected results, an increase in surveillance as well as an integrated management between stakeholders (fishers, consumers, authorities among others) is recommended.

Keywords: queen conch, Chinchorro Bank, minimum size limit, artisanal fishing, ban

Perception of artisanal fishermen on the invasion, control and affectation of lionfish in the Mexican Caribbean.

Percepción de los pescadores artesanales sobre la invasión, control y afectación del pez león en el Caribe Mexicano.

Perception des pêcheurs artisanaux sur l'invasion, le contrôle et l'affectation du poisson-lion dans les Caraïbes mexicaines.

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ABSTRACT

Durante la última década, la investigación sobre las percepciones públicas del ambiente marino ha crecido de manera significativa y se ha convertido en una herramienta útil para los encargados de formular políticas públicas, manejadores, conservacionistas, científicos y educadores. En este sentido el conocimiento tradicional de los pescadores puede proporcionar información única que deben ser integrados en los aspectos ecológicos, económicos, sociales e institucionales para un mejor manejo de los ecosistemas acuáticos y sus amenazas como lo son las especies invasoras. En la región del Caribe y Mediterráneo, se han realizado estudios de percepción social para conocer el conocimiento general sobre la invasión del pez león, destacando que la población tiene un conocimiento general sobre las afectaciones del pez león, por ello el presente estudio presenta los primeros resultados sobre la percepción y conocimiento del sector pesquero sobre la invasión del pez león, su control, aprovechamiento y afectaciones a diversos sectores como el ambiental y socioeconómico en la Reserva de la Biosfera Banco Chinchorro y Parque Nacional Arrecifes de Xcalak en el Caribe Mexicano. Entre los principales resultados destaca que a 11 años de invasión el 100% de los pescadores conocen y han capturado al pez león, sin embargo, actualmente solo el 83% continúan realizando capturas frecuentemente y lo utilizan para autoconsumo debido a su excelente sabor. Los pescadores artesanales observan la invasión del pez león como una amenaza a los ecosistemas costeros y en menor medida a la economía pesquera y salud personal, por último los pescadores observan en la actualidad mayores amenazas a los ecosistemas y economía como el cambio climático, el sargazo y contaminación marina.

Keywords: Pez león, percepción, especie invasora, Caribe Mexicano, Banco Chinchorro

**Building Capacity for Sustainable Fisheries Management in the U.S. Caribbean:
Age and growth of blackfin snapper from Caribbean waters.**

**Creando capacitación para el manejo sustentable de las pesquerías en las aguas
del Caribe de E.E.U.U.: Edad y crecimiento del pargo aleta negra de las aguas
del Caribe.**

**Création d'une formation pour la gestion durable des pêches dans les eaux de la
Caraïbe des États-Unis : Âge et croissance du vivaneau à nageoires noires des
eaux de la Caraïbe.**

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ABSTRACT

Little peer-reviewed published research exists on life history for Caribbean deepwater snapper species (queen, blackfin, cardinal, wenchman, vermilion, silk), yet these species combined support the most important fishery throughout much of the US Caribbean. Starting in 2013, we have worked collaboratively with local fishers to fill in these critical gaps for all of these species. We continue to try and leverage our expertise, efforts, and preliminary collections to obtain federal funding to support this extensive work. Blackfin snapper is a medium-sized snapper species and occurs in the western Atlantic from waters of North Carolina in the Southeastern U.S., Bermuda, Gulf of Mexico, throughout the Caribbean and as far south as northeastern Brazil. Our research objectives are: 1) Investigate age, growth, and mortality of blackfin snapper across the US Caribbean Island-based management platforms; 2) Document reproductive biology for blackfin snapper, including size- and age-at-sexual maturity, reproductive seasonality, and reproductive potential/output. To-date, we have collected and processed for life history research 713 blackfin snapper samples across the U.S. Caribbean from fisheries-dependent (FD) and -independent (FI) sources ranging in size from 35 - 527 mm FL. We have estimated ages for 200 of the samples. Ages range from 0-47 y, expanding longevity for this species by 20 y. A first step in our efforts was to establish a radiocarbon chronology for the northern Caribbean, then we validated age estimates for 10 blackfin snapper, including the one that was 47 y. Our preliminary findings on blackfin snapper highlight that the current understanding of this species age and growth parameters derived mainly from fish collected the southeastern U.S. do not accurately reflect the U.S. Caribbean population.

Keywords: ageing validation

Recovery breeds reorganization: changes in migratory and spawning behaviors of Nassau Grouper (*Epinephelus striatus*) across 2 decades of population growth in Little Cayman, Cayman Islands

La recuperación genera reorganización: cambios en los comportamientos migratorios y de desove del mero de Nassau (*Epinephelus striatus*) a lo largo de 2 décadas de crecimiento de la población en Little Cayman, Cayman Islands

Réorganisation des races de rétablissement : changements dans les comportements migratoires et de reproduction du mэрou de Nassau (*Epinephelus striatus*) au cours de 2 décennies de croissance de la population à Little Cayman, iles Caïmans

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ABSTRACT

Over the last 2 decades, the population of Nassau Grouper (*Epinephelus striatus*) on Little Cayman has more than tripled, driven by adaptive and concerted management actions. Today, the population is likely more than 8,000 individuals on an island less than 12 km in length, and 1.5km in width. Throughout this recovery, we have used a whole-island acoustic array, coupled with acoustic tagging of individuals, to monitor the reproductive behaviors of the species. We found that, as the population recovered, individuals: 1) were less likely to visit alternate potential spawning sites before arriving at the main spawning site (i.e. migrated over less distance during spawning season), and 2) took less time to spawn and return to home reefs (i.e. spent less time at the spawning site during spawning season). We hypothesize that these changes are due to the strengthening of social cues for both migration and spawning brought about by increased fish density. It may also be that learned behaviors and an increase in the ratio of repeat spawners in the population (older individuals) have contributed to this reorganization. Under the assumption that our findings are generalizable to other regions of the Caribbean with overfished populations, they suggest a behavioral mechanism for the lack of population recovery following a course of heavy harvest and subsequent protection. That is, heavy harvest is simultaneously causing population decline, and eroding the social fabric underlying healthy spawning behaviors.

Keywords: Nassau Grouper, Fish Spawning Aggregation, reproductive migration, fish behavior,

Population genomics and acoustic telemetry of Nassau grouper reveal fine-scale population structure and origins of aggregators

La genómica de la población y la telemetría acústica del mero de Nassau revelan la estructura de la población a escala fina y los orígenes de los agregadores

La génomique de la population et la télémétrie acoustique du mérrou de Nassau révèlent la structure de la population à petite échelle et les origines des agrégateurs

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ABSTRACT

Nassau grouper are globally critically endangered and a key fishery species in The Bahamas and parts of the Caribbean, with an urgent need for better management. Within The Bahamas, restriction-site-associated DNA sequencing (RAD-seq) and acoustic telemetry were used to establish demographic structure, diversity and connectivity, and identify the origins of Nassau grouper using an active fish spawning aggregation (FSA). RAD-seq analysis of 94 Nassau grouper sampled from nine locations generated 13,241 single nucleotide polymorphisms (SNPs). Discriminate analysis of principal components and analyses of molecular variance provided evidence in support of population sub-structuring across The Bahamas. Environmental association tests were used to explore relationships between potential loci under selection, and the gene ontology for these SNPs were identified following alignment against the available genome for red spotted grouper. Data suggest that for Nassau grouper, some environmentally-linked loci are under positive selection. Associated acoustic telemetry data suggest the likely origins of five individuals, which travelled one-way distances of up to 176 km from the FSA in the central Bahamas to two sites within the Exuma Cays Land and Sea Park - a no-take marine protected area. Analyses of high-resolution SNPs (including candidate loci under selection) revealed patterns of spatial structure and genetic connectivity not reflected by telemetry data alone. Nassau grouper from Exuma and Long Island appear to have genetic signatures that differ from other islands and from the Hail Mary FSA. Collectively, these findings provide novel information on the intraspecific population dynamics of Nassau grouper within The Bahamas.

Keywords: FSAs, population genetics, selection, SNPs, telemetry

Caribbean hogfish population demographics

Demografía de la población de pez cerdo del Caribe

Démographie de la population de hogfish des Caraïbes

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ABSTRACT

The effective and sustainable management of fisheries species requires a detailed understanding of their life history strategies. Wrasse species occur in temperate and tropical regions and support productive fisheries across the globe. Hogfish *Lachnolaimus maximus* is a popular recreational and commercial wrasse species throughout its range in the northern hemisphere of the western Atlantic, Gulf of Mexico, the Caribbean. In the U.S. Caribbean, hogfish ranks in the top 10 most important commercial reef fish fisheries species and is highly prized by recreational anglers. Despite its popularity and value to local fisheries, a lack of published information exists on hogfish age, growth, and reproductive biology for Caribbean populations. This study is the first to comprehensively describe age, growth, and reproductive biology for hogfish in the U.S. Caribbean and the first to utilize the ¹⁴C chronometer to directly validate the accuracy of ageing hogfish by counting opaque zones on sagittal otolith sections. Fisheries-dependent samples provided insights into the fished population. Our study supports previous research documenting hogfish is a monandric protogynous hermaphrodite species, characterized by a low male to female sex ratio, is moderately long-lived with a maximum age of 20+ y, and sexually matures within the first few years of life. Hogfish females appear to have a protracted spawning season encompassing at least 11 months of the year. Future life history research on U.S. Caribbean hogfish should target fishery-independent samples caught with a variety of gear types to better understand the population as a whole. Going forward, continued monitoring of hogfish life history parameters in this region is essential.

Keywords: ageing validation

Impacts of cruise ship anchoring during COVID-19: Lessons worth sharing

Impactos del fondeo de cruceros durante COVID-19: lecciones que vale la pena compartir

Impacts de l'ancrage des navires de croisière pendant COVID-19 : des leçons à partager

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ABSTRACT

The Government of Barbados welcomed cruise ships during the early COVID-19 period of 2020, offering them safe harbour and use of the island's port facilities, at a time when many other countries were turning them away. A total of 28 cruise ships were allowed to anchor along the west and south coasts of the island during this period (1 March - 1 September, 2020). This study examines the 132 anchoring events of these cruise ships, assesses their impacts on coastal marine habitats and reveals weaknesses in coral conservation policy. Thousands of square metres of coral habitat were badly damaged as a consequence of permitted anchoring. This damage has negative implications for the island's nearshore fisheries and tourism that rely heavily on healthy reef ecosystem services. The huge anchors and hundreds of metres of chain required to secure these mega-vessels, and the wide arc covered by the vessels as they swing at anchor were poorly understood when anchoring locations were assigned. The study highlights important lessons learned regarding the extent of critical coral habitat that can be damaged by cruise ship anchoring; the lack of suitable anchoring grounds for cruise ships in the coral rich waters of Barbados; and the policy response of the Barbados government. These harsh lessons deserve to be shared with other cruise ship destinations across the Caribbean, to prevent similar unnecessary losses to the region's coral reefs on which many national economies depend for fisheries and tourism.

Keywords: cruise ships, coral reefs, anchor damage, anchor chain, Barbados

Influencing Governance and Conservation of the Simpson Bay Lagoon, Saint Martin Through the First Economic Valuation Study of a Caribbean Island Coastal Lagoon

Influir en la gobernanza y la conservación de la laguna de la bahía de Simpson, San Martín a través del primer estudio de valoración económica de una laguna costera de una isla del Caribe

Influencer la gouvernance et la conservation de la lagune de Simpson Bay, Saint-Martin grâce à la première étude d'évaluation économique d'une lagune côtière d'une île des Caraïbes

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ABSTRACT

Coastal ecosystems and associated fisheries throughout the world are negatively impacted by intense development, pollution, and also frequently by a lack of political will and active governance to implement conservation strategies that would reverse ecological declines. Since economic considerations are often the basis for political decision-making, economic valuation studies have been used to quantify the value of these resources and position them as an asset that contributes to the local economy. Building on this approach, a project conducted by Sem Duijndam, Hanna Fralikhina, and Anne Molenaar during internships with the non-profit organization Environmental Protection in the Caribbean (EPIC) resulted in a publication in the *Journal for Nature Conservation* (56 (2020) 125845), and meetings with diverse stakeholders to inspire active governance to implement education, research, and policy to protect and restore the ecological health of the Simpson Bay Lagoon, Saint Martin. The methodology applied included three cost-benefit scenarios for the Simpson Bay Lagoon, which is one of the largest lagoons in the region. The study employed a choice experiment, embedded in a larger household survey among residents of Saint Martin. The data revealed that the Simpson Bay Lagoon in its current environmental state is worth \$12.1 million annually. Three coastal management scenarios were also evaluated which demonstrated significant increases in Lagoon value. These scenarios outperformed the business-as-usual scenarios and demonstrated that a do-nothing approach by decision-makers would result in economic losses to the community. EPIC has built on the work conducted by these interns and continues to seek innovative approaches to share the projects' data and outcomes to influence governance that results in long-term conservation.

Keywords: Economic Valuation, Caribbean, Coastal Management, Environmental Education, Choice Experiment

Can reef sediments serve as a stony coral tissue loss disease reservoir?

¿Pueden los sedimentos del arrecife servir como reservorio SCTL D?

Les sédiments rificaux peuvent-ils servir de réservoir SCTL D?

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ABSTRACT

Since its first appearance off Miami in 2014 following the dredging of Government Cut, stony coral tissue loss disease (SCTL D) has spread rapidly throughout Florida's coral reef tract & to numerous Caribbean territories. It has been shown through transmission experiments & hydrodynamic modeling that the disease is waterborne & highly infectious at both local & regional scales. We conducted a high-replication transmission experiment to determine whether reef sediments can also serve as an SCTL D reservoir. Coral fragments in independent 0.5 L vessels with flow-through seawater were exposed to disease-inoculated reef sediments using entire infected colonies (communal inoculation) or ~5 cm² coral fragments (acute inoculation). We identified that reef sediments were able to transmit SCTL D to fragments of the species *Orbicella faveolata* & *Montastraea cavernosa*, albeit at lower rates as direct contact with diseased coral tissue. Transmission rates differed between species & treatments, with the initial onset of SCTL D lesions occurring at 10.3 ±2.8 & 12.2 ±1.9 d following exposure to communally-inoculated sediments. Exposure to acutely-inoculated sediments, however, resulted in disease transmission within 22 h for both species, suggesting temporal/spatial variation in distribution of SCTL D pathogens in sediments. Histological examination confirmed the presence of SCTL D across all disease treatments & microbial community profiling identified taxonomic differences among healthy & diseased sediments. This experiment determined that reef sediments can serve as an SCTL D reservoir, indicating a critical need to understand the roles of coastal development activities (e.g. port dredging & beach renourishment) on SCTL D transmission, as well as to evaluate management actions to mitigate further spread of SCTL D throughout Caribbean reefs.

Keywords: SCTL D, stony coral tissue loss disease, disease transmission, coastal development, coral reef management

Optimizing stony coral tissue loss disease intervention strategies through whole-transcriptome gene expression profiling

Optimización de las estrategias de intervención de SCTLD a través del perfil de expresión génica del transcriptoma completo

Optimisation des stratégies d'intervention contre la perte de tissus des coraux durs grâce au profilage de l'expression génique du transcriptome entier

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ABSTRACT

Stony coral tissue loss disease (SCTLD) has become a significant threat to the persistence of Caribbean coral populations since its first observation off Miami, Florida in 2014. Due to its high mortality rate & rapid spread throughout Florida's coral reef tract & to an increasing number of Caribbean jurisdictions, there is a priority for disease intervention strategies that may mitigate the spread of SCTLD across individual coral colonies & reef populations. We conducted an in situ experiment in southeast Florida to assess molecular responses prior to & two weeks following antibiotic intervention on SCTLD-affected *Montastraea cavernosa*. The intervention treatment included isolating disease lesions by trenching with application of CoreRx Base 2B plus amoxicillin. In a complementary ex situ study, we infected fragments of nursery-cultured *M. cavernosa* & *Orbicella faveolata* with SCTLD in order to compare gene expression profiles among uninfected & infected clonal individuals. Global gene expression profiling using Tag-Seq indicated strong differences between diseased & healthy corals, with evidence that antibiotic application also influenced gene expression. Further, transcriptomic patterns of seemingly-resistant corals shared similarities to those with lesions, suggesting early stages of SCTLD infection occurring prior to the development of visible lesions. In addition to increasing our understanding of SCTLD transmission, this study aims to provide resource managers with an assessment of intervention strategies at the molecular level & to identify biomarker genes that may indicate disease resistance in genotypes used for coral restoration efforts. These results also contribute to improved predictions of coral reef health in Southeast Florida & feasibility assessments of intervention efforts following disease outbreaks.

Keywords: SCTLD, transcriptomics, Tag-Seq, antibiotics, coral reef management

A Community-based Participatory Approach to Vulnerability Analysis with Adaptation Planning for Pelagic Sargassum Influxes in the Eastern Caribbean: a Saint Lucia Case Study.

Un enfoque participativo basado en la comunidad para el análisis de vulnerabilidad con planificación de adaptación para los afluentes de sargazo pelágico en el Caribe oriental: un estudio de caso de Santa Lucía

Une approche participative communautaire de l'analyse de la vulnérabilité avec une planification de l'adaptation pour les afflux de sargasses pélagiques dans les Caraïbes orientales : une étude de cas de Sainte-Lucie.

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ABSTRACT

This research evaluates the vulnerability of three rural communities in Saint Lucia, namely, Dennery, Micoud and Praslin, to anomalous pelagic sargassum influxes. This research has employed community-based participatory approaches to develop indicators of the three components of vulnerability, namely exposure, sensitivity and adaptive capacity.

Using the Community-based Participatory Approach developed by ActionAid, a mixed methods approach was utilized for data collection. This included household surveys and census data (quantitative methods) and key informant interviews with high-level policy makers, focus group meetings with the fisherfolk from each community and community meetings (qualitative methods). A special focus of this research is “the Voice of the Invisible” which includes the poor, the disabled, women and minority groups like Rastafarians, who are often excluded from data collection processes. This research ensures that their “voices” are heard and their views captured through a participatory video where they explore issues, voice concerns or can simply be creative and tell their stories.

This paper presents the preliminary analysis of the household surveys, key informant interviews and focus group meetings and community members telling their story through participatory videos.

Keywords: sargassum, participatory approach, vulnerability, community-based, adaptive planning

Microbiome Characterization of Healthy and Diseased *Meandrina meandrites* and the Impact of Antibiotics on the Microbiome

Caracterización del microbioma de *Meandrina meandrites* sanas y enfermas y el impacto de los antibióticos en el microbioma

Caractérisation du microbiome des *Meandrina meandrites* saines et malades et impact des antibiotiques sur le microbiome

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ABSTRACT

Meandrina meandrites is highly susceptible to stony coral tissue loss disease (SCTLD) and is one of the first coral species to die during outbreaks. The normal microflora of *M. meandrites* is understudied, despite the potentially critical roles they play in nutrient cycling, thermal resilience, and defense against pathogens. This study characterizes the mucosal microbiomes of healthy *M. meandrites* colonies from the Florida Keys, the Cayman Islands, and Belize, using the V4 region of the 16S rRNA gene. Diseased colonies from the Florida Keys were also sampled before and after antibiotic treatment during separate ex situ SCTLD experiments in order to characterize how the resident microbiomes were impacted. Similar to other coral microbiomes, Alphaproteobacteria and Gammaproteobacteria were the most abundant bacterial classes found across all samples. The most abundant taxa across samples are from the family Terasakiellaceae, which has been previously observed in healthy *M. meandrites* samples. Both biogeography and health state shaped microbiome composition. The antibiotic treatment stopped disease progression on treated colonies and microbiomes shifted stochastically after antibiotic treatment, suggesting that each colony responds differently to this disruption. The results of this study provide a baseline characterization of the *M. meandrites* microbiome that can be used to inform coral propagation efforts as well as how antibiotic treatments affect *M. meandrites*.

Keywords: stony coral tissue loss disease, *Meandrina meandrites*, microbiome, antibiotics, coral

Policy recommendations for the Mediterranean lionfish invasion based on lessons from the Western Atlantic

Recomendaciones de política para la invasión del pez león del Mediterráneo basadas en lecciones del Atlántico occidental

Recommandations politiques pour l'invasion du poisson-lion en Méditerranée sur la base des enseignements tirés de l'Atlantique Ouest

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ABSTRACT

The Indo-Pacific lionfish invasion in the Western Atlantic is considered one of the most harmful of any known marine fish invasions. The more recent Mediterranean invasion is foreseen to adversely impact the already declining state of marine resources. Lionfish are generalist predators that reduce native species biodiversity and consume commercially, recreationally, and ecologically important native species. Population control of this invasive species has been the primary management action taken to mitigate its numerous negative impacts. Volunteer scuba divers using spears have successfully controlled lionfish on a local scale in parts of the Western Atlantic, and here we highlight the urgent need to permit similar spearfishing efforts in the Mediterranean. Using examples of successful policy changes in the Caribbean, USA, and Cyprus, specific advice is presented for Eastern Mediterranean countries to amend current restrictions and permit well-managed lionfish culling by scuba divers. We also urge coordination of regional practices for detecting, monitoring and controlling populations.

Keywords: culling

Changes in invasive lionfish age structure following the emergence of an ulcerative skin disease

Cambios en la estructura de edad del pez león invasivo tras la aparición de una enfermedad ulcerosa de la piel

Changements dans la structure d'âge du poisson-lion envahissant suite à l'émergence d'une maladie ulcéreuse de la peau

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ABSTRACT

In recent years, invasive lionfish (*Pterois volitans/miles*) populations have spread rapidly throughout the northern Gulf of Mexico (GOM). Their lack of predators and superior life history traits have allowed their populations to increase dramatically since first being detected in the GOM in 2010. An ulcerative skin disease was observed in 2017. Shortly after the outbreak, a 79% decrease in lionfish population densities and more than an 80% decline in recruitment was observed. Although the source of the disease is still unknown, a 50% decline in catch per unit effort following the outbreak suggests the disease was likely a contributing factor to lionfish population declines. The objective of this project is to evaluate how the disease and population decline affected the 2020 lionfish population structure. From May 17-23, 2020, volunteer scuba divers armed with spears, collected 365 lionfish from 26 sites. Total length and sex was determined for each lionfish prior to removing sagittal otoliths. Otoliths will be sectioned (300 μ m) and age will be estimated by enumerating annuli. Statistical analysis will be performed to evaluate differences in age structure pre- versus post-disease. Results from this study will provide a better understanding of the GOM lionfish population's response to the ulcerative skin disease, including potential year-class failure following the disease outbreak and age classes that may have been affected. This information will be an important contribution to future studies and management of invasive species.

Keywords: lionfish, disease, Gulf of Mexico, population decline, population structure

Criteria for the environmental management of the Ramsar site Estuarine Delta System of the Magdalena River Ciénaga Grande de Santa Marta, Colombian Caribbean

Criterios para la gestión ambiental del sitio Ramsar Sistema Delta Estuarino del río Magdalena Ciénaga Grande de Santa Marta, Caribe colombiano

Critères pour la gestion environnementale du site Ramsar Système du delta estuarien de la rivière Magdalena Ciénaga Grande de Santa Marta, Caraïbes colombiennes

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ABSTRACT

Colombia, al ser parte de la Convención internacional de humedales Ramsar, tiene como tarea la gestión de los humedales del país. El sitio Ramsar CGSM es uno de los humedales costeros más importantes de Colombia, que presenta conflictos y tensiones ambientales que ponen en riesgo su sostenibilidad a largo plazo. En aras de generar insumos técnicos para su gestión ambiental se realizó un análisis espacial de 15 criterios ambientales, que permitieron identificar nueve áreas de manejo que orientan el ordenamiento del territorio y facilita la articulación entre los diferentes instrumentos de planificación. Los criterios analizados fueron valorados y organizados espacialmente aplicando parámetros multicriterios como la presencia/ausencia, grado de perturbación y nivel de riesgo (alto, medio y bajo) y finalmente mediante herramientas de Sistema de Información Geográfica fueron superpuestos con la zonificación y ordenamiento existente para el área. Los resultados obtenidos fueron retroalimentados y validados con las diferentes entidades claves para la gestión ambiental del área y se constituyen en un insumo clave para la actualización del Plan de manejo del sitio Ramsar CGSM.

Keywords: Planificación ambiental, Humedal, Zona costera y Caribe, Desarrollo sostenible,

Spatial Variations In Isotopic Niches Of Two Herbivorous Fishes In The Caribbean Reefs

Variaciones espaciales en nichos isotópicos de dos peces herbívoros en los arrecifes del Caribe

Variations spatiales des niches isotopiques de deux poissons herbivores dans les récifs des Caraïbes

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ABSTRACT

Climate change, organic pollution and overfishing have led to major ecological disturbances in coral reefs, including the ‘coral-algal phase-shift’ phenomenon. Facing such ecological disturbance, ecological roles of herbivorous fish, which naturally regulate algal biomass, are becoming crucial for the future of the reefs.

In the present study, we asked if the two species of herbivorous fishes commonly found in the Caribbean (*Sparisoma viride* and *Acanthurus coeruleus*) adapt their feeding patterns function to their habitat, and if spatial variations can be observed in their isotopic niche.

On four study sites located in Guadeloupe, 10 to 20 individuals per species were collected. Isotopic signatures (C and N) were measured in muscles to define the isotopic niche of each fish species using the model SIBER.

The main results show that isotopic signatures of fish vary spatially, suggesting different isotopic ratios of the ‘baseline’ among site. Moreover, on each site, ellipses representing the isotopic niche of each species never overlap, indicating that the two species display independent niche.

To conclude, the absence of overlap between niches of *Sparisoma viride* et *Acanthurus coeruleus* indicate an ecological complementarity between the two fish species in term of resource use and, by consequence, algal regulation.

Keywords: *Sparisoma viride*, *Acanthurus coeruleus*, Ecological complementarity, Stable Isotope, Reef ecology

Investigating imposex and reproductive anomalies in Queen Conch, *Aliger gigas*, around Port Everglades, FL

Investigación de anomalías reproductivas e imosexuales en el caracol rosado, *Aliger gigas*, alrededor de Port Everglades, FL

Enquête sur l'imposex et les anomalies de la reproduction chez le strombe géant, *aliger gigas*, autour de Port Everglades, Floride

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ABSTRACT

In 2008, the International Maritime Organization banned the use of organotins, such as tributyltin (TBT). Organotins are released from antifouling paints and can eventually lead to reproductive failure, lower fecundity, abnormal embryonic development, and decrease larval survival. Despite the ban, organotins can persist in the environment for decades, thus still posing a threat to susceptible species. In gastropods, organotin exposure can lead to the development of a condition known as imposex (a condition where females develop male reproductive appendage) and in severe cases, the vaginal opening is blocked, resulting in sterility. In the natural environment, imposex is almost exclusively associated with organotin exposure, to the point that imposex in gastropods is used as a biomarker for TBT contamination. In 2018, we found that over 40% of female Queen Conch adjacent to an industrial seaport, Port Everglades, Florida, had imposex. The Port Everglades conch had similar gonadal health and engage in reproductive activities at the same frequency as Florida Keys aggregations without imposex; however abnormal egg masses were found and previously identified in other studies. Adult Queen Conch will be collected, marked if laying an abnormal egg mass, and sexed/imposexed at the Port Everglades aggregation. I will report any correlation between imposex females and naked egg masses and describe the incidence of imposex within the aggregation. There may be other endocrine disruptors that might be causing imposex at Port Everglades, but the overwhelming evidence from the literature suggests organotin exposure. Future studies should include sediment and tissue assays to confirm organotin presence and concentration.

Keywords: imposex, queen conch, reproduction, organotin,

Insights into Marine Protected Area management throughout the Wider Caribbean Region

Información sobre la gestión de áreas marinas protegidas en toda la región del Gran Caribe

Aperçu de la gestion des aires marines protégées dans toute la région des Caraïbes

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ABSTRACT

Throughout the Wider Caribbean Region (WCR), a total of 644 designated marine protected areas (MPAs) exists. Some of the key elements related to management include assigned IUCN management categories, ownership types, existence of management plans and the presence or absence of no-take areas. The majority of WCR MPAs are designated as Habitat/Species Management Area and are predominantly state owned and governed. Unfortunately, a lack of reported information makes it difficult to accurately report on the existence of management plans and presence of no-take areas. Management of MPAs can be assessed via Protected Area Management Effectiveness (PAME) evaluations, which assesses the extent to which MPAs are protecting values and achieving goals and objectives. The evaluation includes six elements which look at context, planning, inputs, processes, outputs and outcomes. Based on the Global Database on Protected Area Management Effectiveness (GD-PAME), approximately 75% of WCR MPAs have not had any such evaluations and for those that have undertaken PAME evaluations, the majority (57%) have only had a single evaluation. The Caribbean Protected Areas Gateway, a regional resource and information hub, has been building capacity and facilitating such assessments throughout 2018-2021. Said assessments have highlighted residential and commercial development, biological resource use and harm, human intrusions and disturbance and pollution as major threats to MPAs. The processes, outputs and outcomes elements appear to be the weakest areas of management, however, the development/updating of management and operational plans, enhancement of capacities, securing sustainable financing, the utilisation of scientific data and local/indigenous knowledge and employment of an ecosystem-based management approach could improve management.

Keywords: MPA, Protected Area Management Effectiveness, Caribbean Protected Areas Gateway

Elemental composition of holopelagic Sargassum along Jamaica's coast

Composición elemental del sargazo holopelágico a lo largo de la costa de Jamaica

Composition élémentaire de Sargassum holopélagique le long de la côte de la Jamaïque

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ABSTRACT

The influx of large masses of the macroalgae Sargassum has impacted coastal activities regionally, including Jamaica. To address these nuisance blooms, including the possible valorisation of the algae, studies including elemental investigations have been undertaken. One hundred and five fresh Sargassum samples were collected from across six sites along Jamaica's coast inclusive of the species *S. fluitans* III and *S. natans* (morphotypes I & VIII). Neutron activation analysis was used to analyse the samples for the elements, Al, As, Br, Ca, Cl, Co, Cs, Eu, Fe, K, La, Mg, Rb, Sb, Sc, Sm, Sr, & Zn. The Direct Mercury Analyzer (DMA-80) was used to analyse for Hg. Statistical analysis, including factor analysis, Kruskal-Wallis ANOVA and agglomerative hierarchical clustering (AHC), were used to discern patterns in the holopelagic species collected for this study. The results of the elemental analysis indicated high levels of the potentially toxic metalloid arsenic and relatively low concentrations of the potentially toxic metal mercury in all species. The results of the statistical analysis indicated that there are significant differences in the levels of some elements (Al, Cl, Co, Fe, Hg, K, La, Mg, Rb, & Sm) in *S. fluitans* III, *S. natans* I and *S. natans* VIII and that that location and by extension residence time in coastal waters before collection may influence elemental content. The study also suggested more similarity between *S. fluitans* III and *S. natans* VIII compared to *S. natans* I. The study fills the gap in knowledge on species composition needed for valorization interests.

Keywords: Sargassum fluitans, Sargassum natans, Elemental Analysis, Jamaica, Multivariate Analysis

A review of Florida's limited-entry, marine life fishery sector: Lessons on how to build social capital in support of a sustainable industry

Una revisión del sector pesquero de vida marina de entrada limitada de Florida: lecciones sobre cómo generar capital social en apoyo de una industria sostenible

Un examen du secteur de la pêche de la vie marine à accès limité en Floride : leçons sur la façon de créer un capital social à l'appui d'une industrie durable

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ABSTRACT

Florida's marine life (tropical fish and invertebrate) fishery represents a small, specialized fishery sector comprised of dedicated collectors and other fishers who harvest ornamental species as bycatch. As demand increased for tropical fish and invertebrates in the aquarium industry in the 1990s, concerns were sounded among several collectors who decided to engage with Florida's Fish and Wildlife Conservation Commission to limit participation and establish harvest rules (size limits, bag limits, etc.), in effect to ensure a sustainable fishery facilitated by a high degree of trust, cooperation, and engagement between stakeholders and management.

Our study reviewed the history of the process, identified its outcomes, and assessed its effectiveness, focusing on the reasons why the industry felt it needed to embrace limited entry, adopt harvest rules, and work closely with a management agency. We used an online questionnaire to survey 19% (n= 41) of the existing participants in the fishery, obtaining data on the marine life sector, the usefulness of the existing rules, and fishery's sustainability. We also conducted 17, in-depth interviews with marine life collectors who provided rich, qualitative information on how they engaged with the fishery, their reasons for wanting to participate with management, their views on limited entry, and their perceptions concerning the program's future and its adoption as a model for other fisheries.

This case represents an important example of co-management and provides insights on stakeholder-management cooperation, especially where engagement is initiated early and throughout the process and where outcomes incorporate meaningful stakeholder collaboration.

Keywords: Fisheries, Co-management, Florida, marine life,

Numerical simulations of the transport and dispersal of fish eggs and early larvae from marine protected areas (MPA) in the US Virgin Islands and off the Eastern Puerto Rico shelf

Simulaciones numéricas del transporte y dispersión de huevos y larvas de peces desde Áreas marinas protegidas (AMP) en las Islas Vírgenes de Estados Unidos y en la plataforma continental del este de Puerto Rico

Simulations numériques du transport et de la dispersion des œufs de poisson et des premières larves des aires marines protégées (AMP) des îles Vierges américaines et du plateau oriental de Porto Rico

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ABSTRACT

The main goal of the present study is to assess the connectivity between spawning locations and recruitment grounds for commercially important fish species that spawn in marine protected areas in the US Virgin Islands and off the Eastern Puerto Rico shelf. To simulate the transport and dispersal of fish eggs and early larvae from spawning locations we have implemented a very high-resolution unstructured circulation model based on the FVCOM numerical model. This circulation model has been validated in detail by comparing model predictions to CARICOOS buoy data, ADCP data obtained as part of the project, and surface current data from CARICOOS' high-frequency radar (HFR) systems. A 3D offline particle tracking model embedded in FVCOM has been modified to include active vertical movement parameterized by species-specific larvae characteristics to accurately predict the dispersal of early-stage target species. The main focus of the egg and larvae transport simulations on two commercially important reef fish species: red hind (*Epinephelus guttatus*) and mutton snapper (*Lutjanus analis*). The statistical fish larvae data for initializing the transport model was obtained from larval abundance cruise surveys conducted by Southeast Fisheries Science Center (CFMC) in 2019, which provided the vertical distribution of larval abundance in the mixed layer. In this paper we show the results of the egg and larvae transport simulations including visualizations of transport pathways, an analysis of self-recruitment patterns, as well as connectivity matrices between MPAâ€™s and recruitment locations.

Keywords: Connectivity, Spawning Aggregation, Recruitment, Ocean Model, FVCOM

Yellowtail snapper age and growth in northern Caribbean waters

Edad y crecimiento de la colirrubia en aguas del norte del Caribe

Âge et croissance du vivaneau à queue jaune dans les eaux du nord des Caraïbes

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ABSTRACT

Yellowtail snapper *Ocyurus chrysurus* is an important fisheries species in the US Caribbean; in waters of Puerto Rico, it ranks second for reef fishes in terms of annual total commercial landings. However, a paucity of information exists concerning basic life history information for Caribbean yellowtail snapper populations. This study provides the first comprehensive documentation of age, growth, and reproductive biology of yellowtail snapper from the Caribbean and is the first to directly validate age estimation in this species. Sampling of 1731 yellowtail snapper occurred in Puerto Rico and the U.S. Virgin Islands during 2013-2021 from fisheries-dependent and -independent efforts. Fish ranged in size from 68-690 mm (total length) and in age from 0-26 years. Regression equations were calculated to determine length-length and length-weight relationships using total length (TL), fork length (FL), standard length (SL), and weight. Total length and age data fit to a von Bertalanffy growth curve for all samples combined from across the U.S. Caribbean, but not including the cast net age-0 samples, yielded the following relationship: $TL_t = 537[1 - e^{-0.11(t + 3.32)}]$. Yellowtail snapper in the U.S. Caribbean demonstrated a male to female sex ratio of 1:1.14 and exhibited year-round spawning with a peak spawning period in April. Age validation was conducted comparing bomb radiocarbon¹⁴C measured in snapper eye lenses formed during the first year of life. Information from this study can be used by fisheries resource managers when evaluating the health of the yellowtail snapper fishery in the region.

Keywords: ageing validation

Monitoring coral diseases in the Dominican Republic: an inclusive plan to understand a serious threat for Caribbean corals

Monitoreo de enfermedades de coral en la República Dominicana: un plan inclusivo para comprender una seria amenaza para los corales del Caribe

Évaluation des maladies des coraux en République Dominicaine: un plan inclusif pour comprendre une menace sérieuse pour les coraux des Caraïbes

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ABSTRACT

Coral diseases have been impacting coral reefs for decades, changing the structure and function of these ecosystems. Most recently, Stony Coral Tissue Loss Disease (SCTLD) illustrates the long-term impact an emerging disease may have on coral reefs. Affecting over 20 coral species, the disease was first described in 2014 in the Florida Keys and has since rapidly spread across the Caribbean in six years. In 2019, a series of colonies bearing signs similar to SCTLD were observed at the reef of Cayo Arena, in the Northern Dominican Republic (DR). Since the first report, various NGOs and recreational divers have reported similar conditions in the Northern Coast. In 2020, the Dominican Reef Network and its members developed a monitoring plan to assess the status of coral diseases on the island. This document focuses on three areas: (1) science: aimed at data collection on coral diseases (2) local participation: involvement of multiple stakeholders and (3) education/communication: raising awareness and developing local capacity. Local stakeholder integration fills up gaps in sensitive data collection necessary for informing managers and policymakers about the impacts of coral disease in important tourism areas, which highly depend on healthy reef ecosystems. As a result of this effort, information will be shared to contribute to the understanding of the spatial and temporal dynamics of coral diseases across the DR. In this way, we will be able to identify host ranges and susceptible species habitats while increasing local awareness about this threat to coral biodiversity in the DR.

Keywords: Coral reefs, SCTLD, Disease, monitoring plan,

SCTLD In The Turks & Caicos Islands - A Case Study

SCTLD en las Islas Turks y Caicos: un estudio de caso

SCTLD aux Îles Turks & Caicos - Une Étude de cas

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ABSTRACT

SCTLD arrived in the Turks and Caicos Islands (TCI) in January 2019. This presentation reviews how the Turks & Caicos Reef fund (TCRF) has worked to document, track and manage the disease. We present monitoring findings about the spread of the disease and species affected. Through a network of volunteers conducting Roving Diver Surveys we were able to track the spread of SCTLD eastward along the north shore of the Caicos islands as well as southeastward on the Turks Bank. SCTLD invaded forereefs in all areas of the TCI in approximately two years. The 32 species of stony corals recorded with tissue loss during these surveys currently give the TCI the highest record for affected taxa in the region. We present the results of various treatment trials conducted using Ocean Alchemists products; namely Base2B with Amoxicillin and the non-antibiotic Coral Cure D (CCD). 250+ colonies were treated with B2B/Amoxicillin and monitored over 8 months resulting in 90%+ success rate. In May 2021 TCRF began conducting test trials of CCD and we present the findings from 3+ months. We describe public engagement and outreach efforts via Zoom sessions, talks and events that have generated volunteers and funding. We also comment on long-term restoration plans including the potential role for a land-based stony coral nursery to help preserve the genetic diversity of the TCI's reefs.

Keywords: SCTLD, intervention, treatment, volunteers, Turks & Caicos Islands