



ICMS

**20
25**



Aruba

FROM ISLANDS TO THE GLOBAL OCEANS - MAY 26-28, 2025



BOOK OF ABSTRACTS



The International Conference on Marine Science 2025 Aruba: From island to the global oceans is an event organized by the Corporation Center of Excellence in Marine Sciences - CEMarin.

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EDITORIAL

The International Conference of Marine Science - ICMS was created as a unique space for transdisciplinary dialogue on the challenges faced by our oceans and coastal societies. At CEMarin, we have promoted this initiative with the conviction that science, in connection with territories and their communities, can only advance when spaces are opened for the exchange of different forms of knowledge and disciplines.

In this edition, we chose Aruba Island as a setting and living lab. There, ecosystems - coral reef, mangroves, seagrasses - intertwine with tangible problems: conservation, restoration, access to water, energy transition, and public policy development. The island allowed us to see how local challenges become windows into global issues, and how applied science can generate solutions that transcend borders.

Two elements deeply marked this meeting. First, the richness of a transdisciplinary dialogue that brought together biologists, engineers, economists, sociologists, and decision-makers around an unified vision: rethinking islands as strategic spaces for sustainability. Second, the connection with real challenges, discussed openly between local communities and scientists, making the ICMS a pioneering forum for science applied to territory.

The participation of keynote and international speakers from different continents enriched this exchange with global perspectives: from Japan to Mexico, from the United States to Europe, and of course, with Latin American and Caribbean experiences. This diversity not only strengthened the scientific dialogue but also allowed us to share cultural visions, consolidating an unprecedented event.

Today, we proudly present the ICMS Proceedings, a legacy of knowledge, reflection, and proposals. These pages seek to extend the dialogue initiated in Aruba, inspiring new collaborations and reminding us that science, when designed and carried out for the territories, can become a driving force for real and sustainable solutions. We invite participants and future generations of researchers to continue along this collective path toward a more harmonious relationship between humankind, islands, and the ocean.

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Sincerely,

Dr. Andrés Fernando Osorio, CEMarin Executive Director and Professor at the Universidad Nacional de Colombia

Dr. Diego Acevedo, University of Aruba.

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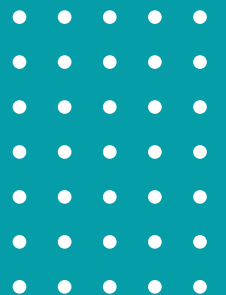


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KEYNOTE TALKS



**Insular perspectives: oceans, sustainability and
island scholarship**

Eric Mijts

University of Aruba

**Silent Game Changers in Sustainability? Technological Innovation
Narrative from Japan**

Anne McDonald

Sophia University of Tokyo

**Forecasting Tropical Cyclone Impacts: from coastal Flooding
to Water Quality**

Maitane Olabarrieta

University of Florida

**Iberostar Wave of Change, strategic approach
towards resilience**

Lyn Santos

Iberostar Group

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**Sustainable ocean – buzzword or viable concept for
real change?**

Thomas Wilke

Justus Liebig University

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ORAL PRESENTATIONS

Organized in alphabetical order, by participant's first name.

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Analysis of the challenges and future new methods for marine conservation in Japan's natural World Heritage sites: A case study of rule-making methods by stakeholders in the Ogasawara Islands

Ori, Akemi - a-ori-c4t@sophia.ac.jp

Sophia University - Global Environmental Studies

Japan has five World Natural Heritage sites (Shiretoko, Ogasawara, Yakushima, Shirakami-Sanchi, and Amami-Oshima, Tokunoshima, Northern part of Okinawa, Iriomote), all of them except Shirakami are island areas surrounded by the ocean. However, due to historical reasons, conservation of marine areas in Japan's national park system has lagged far behind that of land areas. Most of the measures against invasive species and conservation measures are limited to land areas. The concept of marine parks was finally introduced in 2010.

In this context, how to reflect the continuity of land and marine area conservation in World Natural Heritage value conservation policies is a major issue. In Shiretoko, a story of circulation between land and marine area is presented with drift ice as an element, but the institutional measures for marine area conservation are insufficient. In this context, the need to establish a marine area conservation system for World Natural Heritage sites has been strongly advocated by stakeholders in light of the recent coral bleaching phenomenon.

This report will focus on the issues surrounding the marine area of Ogasawara, clarifying the current legal, budget, and administrative system limitations and historical background for conservation, and examining the background to the establishment of Ogasawara's unique rules to cover for these, as well as how they can be applied to the current overtourism.

The fragile ecosystems of World Natural Heritage sites need to be conserved with local residents and municipality, analyzing Ogasawara approach, could be expected to give good case study which could be expanded another area.

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Climate Change and Its Impacts on Marine Ecosystems and Biodiversity

Pineda-Muñoz, Alexandra - bioalexa@gmail.com

National University of Colombia – Caribbean campus and CECIMAR

Pizarro, Valeria - vpizarro@perryinstitute.org - Perry Institute for Marine Science

Abril-Howard, Alfredo - aabrilhoward@gmail.com - National University of Colombia

Azcarate, Rubén - ruben.azcaratem@gmail.com – CORALINA Corporation

Caribbean coral reefs are in crisis, with climate change amplifying stressors on key reef-building species. *Acropora palmata*, critical for biodiversity and coastal protection, has suffered catastrophic declines, losing over 95% of its population since the 1980s. Yet, pockets of resilience provide hope for its future. This study presents a 30-year analysis (1992–2024) of *A. palmata* populations in the Seaflower Marine Protected Area (MPA), a UNESCO-designated Biosphere Reserve in San Andres Island.

While some reefs, like Little Reef, have seen cover drop from 45% in 1992 to 1.25% in 2024, others have not experienced mass die-offs and show signs of reproduction. The 2023 bleaching event alone caused an 11% population decline, compounded by hurricanes ETA and IOTA in 2020. These findings reveal *A. palmata*'s vulnerability to climate-induced thermal stress and extreme weather events.

Crucially, the persistence of stable and reproducing populations suggests that MPAs, while mitigating local stressors, are not sufficient to address global challenges. Integrated approaches are essential—combining coral nurseries, selective breeding for thermal tolerance, and adaptive management with efforts to reduce local pressures like pollution and overfishing.

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This study highlights the dual narrative of *A. palmata*'s decline and resilience, offering critical insights for enhancing conservation strategies in the face of intensifying climate threats. By leveraging the resilience of stable populations, we can work towards sustaining coral ecosystems and their invaluable ecological and socio-economic benefits. Our findings emphasize the urgent need for climate-adaptive conservation, making the case for a transformative approach to biodiversity protection in a warming world.

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Tracking the Unseen: Microbial Communities in Lesioned and Healthy Lobophora from Reef Ecosystems

Gavio, Brigitte - bgavio@unal.edu.co

National University of Colombia – Bogotá campus

Santos-Nieto, Santiago - ssantosn@unal.edu.co - National University of Colombia

Chaib De Mare, Maryam - mchaib@unal.edu.co - National University of Colombia

The health of marine macroalgae is tightly linked to ocean health, with implications for reef resilience. The brown alga Lobophora (Dictyotales, Phaeophyceae) plays a critical role in reef ecosystems as a benthic primary producer. However, thallus lesions observed in Lobophora populations from the Seaflower Biosphere Reserve suggest the presence of pathogenic interactions.

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These findings suggest that lesions in Lobophora are hotspots for microbial colonization, potentially driven by pathogenic fungi and microbial consortia. By identifying key microbial taxa linked to disease-like states, this research contributes to the understanding of how marine pathogens and microbial community shifts influence macroalgal health.

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Disaster Opportunism: Spatial Justice and Territorial Rights after Hurricane Iota in Providencia and Santa Catalina Islands

Velásquez-Calderón, Carolina - cvelasquez@fsu.edu

Florida State University - Department of Geography & African American Studies

Ortiz-Roca, Fady - fortizr@unal.edu.co - National University of Colombia

Santos-Martínez, Adriana - asantosma@unal.edu.co - National University of Colombia

When disasters occur, responses are often shaped by pre-existing agendas. Five years before Hurricane Iota devastated Providencia and Santa Catalina Islands Colombian Caribbean, in 2020, the Raizal People opposed the construction of a coast guard station in Bowden Bay by the national government, claiming threats to their maritory and rights. Presented as a national security measure in the context of territorial disputes with Nicaragua, the project moved forward despite Raizal opposition during the Prior Consultation process.

Hurricane Iota exacerbated existing vulnerabilities but also provided the Colombian State with an opportunity to consolidate power by advancing this controversial project. In response, the Raizal People mobilized to reclaim their territory and oppose militarization through the Dignity Camp, led primarily by fishers.

This resistance redefines disaster recovery as a contested process where spatial justice and governance are negotiated. Using qualitative methods, including literature review, official documents, and meeting minutes, this research explores the conflict between State-driven security narratives and the Raizal People's claims to territorial, environmental, and economic rights. The findings underscore how disasters become arenas where power and inequality are contested, perpetuating injustices or enabling transformative resistance.

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This case illustrates disaster capitalism, where land appropriation aligns with geostrategic interests to marginalize Indigenous and Afro-descendant peoples. By examining this conflict, the study confirms the connection between disaster recovery and structural change, emphasizing the importance of territorial rights in achieving spatial justice. It contributes to a broader understanding of how disaster responses can perpetuate inequalities or become pivotal moments for resistance and self-determination.

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Ocean Literacy Principles and low-cost hands-on science experiments for kids from kindergarten to highschool

Mettes, Christie - christie@metabolic.nl

Metabolic Foundation – Based in Aruba

In 2021, the United Nations launched their Decade of Ocean Science for Sustainable Development (2021-2030), The 'Ocean Decade', provides a convening framework for a wide range of stakeholders across the world to engage and collaborate outside their traditional communities to trigger nothing less than a revolution in ocean science.

A key tool in achieving the goals set out by the Ocean Decade is Ocean Literacy, a concept that has been developed by UNESCO as 7 key principles for understanding the ocean. The National Marine Electronics Association (NMEA) has worked to develop a teaching guideline for taking these 7 principles to students at 4 different grade levels: K-2, 3-5, 6-8 and 9-12.

However, educational material specifically connected to each Ocean Principle and grade level is still hard to find. As a small island state, Ocean Literacy is of key importance for Aruba. However, after sitting down with different teachers we found that it was not yet an element within the local curriculum.

To work towards this issue, Metabolic Foundation has turned NMEA's guidelines and a set of open access educational Canva templates from World Ocean Day to develop a series of 28 educational booklets, one for each grade level and ocean principle, adjusted to the Aruban context. We are currently in the process of testing the activities with kids, and the next step is to translate the booklets from English to Dutch and Papiamentu.

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Mangrove Forests as Refugia for Corals: A Literature Review on Climate Change Resilience and Restoration Benefits

Wodehouse, Dominic - dominic@mangroveactionproject.org
Mangrove Action Project – Philippines

Egging, Alison - ali@mangroveactionproject.org - Mangrove Action Project USA

Michie, Laura - laura@mangroveactionproject.org - Mangrove Action Project UK

Mangrove forests are globally recognized as vital ecosystems, providing a multitude of ecological and societal benefits. Their restoration not only enhances carbon sequestration, coastal protection, and fisheries support but also strengthens biodiversity and climate resilience. For local communities, restored mangroves serve as natural buffers against extreme weather events, safeguard livelihoods through sustainable fisheries, and offer cultural and recreational value.

Beyond these well-established benefits, research highlights a novel role for mangroves as refugia for corals under climate change stress. Unique environmental conditions in mangrove habitats—such as shaded canopies, fluctuating salinities, and attenuated water temperatures—can mitigate thermal stress and ocean acidification, enabling corals to survive and even thrive in otherwise challenging conditions. Diverse coral communities documented in mangrove systems suggest these habitats provide an overlooked but critical lifeline for coral survival as traditional reef ecosystems degrade.

This presentation synthesizes practical restoration work from Mangrove Action Project (MAP) and findings from a comprehensive literature review, highlighting the connection between mangrove restoration and coral resilience. It explores case studies demonstrating how restored mangroves can amplify their ecological benefits by supporting diverse marine and terrestrial species, while also serving as an adaptive strategy for coral conservation in the face of global climate challenges.

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Participants will learn about the benefits of mangrove restoration for ecosystems and communities, the integration of mangrove and coral conservation to enhance coastal resilience, and practical advice on adapting community-based mangrove restoration to support coral restoration.

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Transforming Food Systems and Enhancing Resilience in Island Territories: A Socioecological Approach

Salazar, Erika - e.salazar@atuca.org

Sophia University of Tokyo & ATUCA Foundation

Enrique de Jesús Morales Acuña - emoralesacu1980@gmail.com - CIIDIR

Diana Cecilia Escobedo Urias - CIIDIR

Norma Patricia Muñoz Sevilla – National Polytechnical Institute, México

Jean R. Linero Cueto - Magdalena University

Marine Heatwaves (MHWs) are events characterized by abnormally warm waters in oceanic areas whose origin is due to a combination of oceanic and atmospheric processes (air-sea heat flux, horizontal temperature advection, and other physical factors). Due to their potential ecological and socio-economic impacts, they have recently been the subject of a significant research effort. Here, we identify the presence and spatio-temporal variability of MHWs in the Southern Region of the California Current System (SRCCS) during 1982-2021 using OSTIA Level-4P daily SST data. The results show that ~44% of the analyzed days experienced MHW events with intensities between 1–4°C above the 1990-2020 climatology.

Three coastal regions of high variability were identified: Magdalena Bay, Punta Eugenia, and North Punta Eugenia, where MHWs reached intensities >3.5°C. First mode of variability (54.8% explained variance) is characterized by an east-west gradient with maximum variance in coastal regions. The maximum intensities of the MHWs occurred during summer and autumn. Empirical Orthogonal Functions (EOFs) and Wavelet spectral analysis showed that the interannual variability was associated with El Niño-Southern Oscillation (ENSO), with notable events during 1991-1992, 1997-1998, and 2014-2015.

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The spatiotemporal evolution suggests a complex interaction between regional processes like El Niño California and large-scale phenomena such as ENSO, and warming periods of the central tropical Pacific and northeastern Pacific simultaneously, particularly during spring-summer transitions. It is suggested as mechanisms modulating the seasonal and interannual variability of MHW in the SRCCS, with potential ecological consequences in one of the world's most productive systems.

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Differential Impacts of Subaerial Exposure and El Niño Warming on Coral Reefs at Gorgona Island, Colombia, During the 2023-24 Global Coral Bleaching Event

Zapata, Fernando A. - fernando.zapata@correounivalle.edu.co

University of El Valle

The 2023-24 El Niño event, culminating in the 4th Global Coral Bleaching event confirmed by NOAA in April 2024, severely impacted coral reefs across all major ocean basins, including the Eastern Tropical Pacific (ETP). While widespread coral bleaching and mortality were reported from Mexico to Colombia, the reefs of Gorgona Island, Colombia, exhibited a unique response, shaped by the interaction of El Niño warming and extreme tidal emersion.

In Gorgona Island and nearby Utría Inlet, significant coral bleaching and mortality occurred in mid-2023, coinciding with extreme low tides in February 2023 and February 2024. This study compared changes in live coral cover between 2022 and 2024 across shallow and deep reef areas to disentangle the relative impacts of El Niño warming and subaerial exposure. Coral mortality in shallow areas was severe, driven by prolonged tidal emersion events, while deep reef areas exhibited more moderate declines in coral cover, attributed to thermal stress. Differential susceptibility among coral taxa was also observed, with massive corals (e.g., Pavona) more affected by bleaching than the dominant branching corals (Pocillopora).

The resilience of Gorgona's corals to thermal stress stands in contrast to the devastation reported for other ETP reefs. The results highlight Gorgona's thermotolerant coral populations as a critical resource for regional reef restoration efforts. These findings underscore the importance of understanding local stressors, such as subaerial exposure, in shaping coral reef responses to global climate phenomena.

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Forty years of characteristics, seasonal and interannual variability of marine heatwaves in southern region of California Current System

Gutiérrez-Cárdenas, Gabriel Santiago - ggutierrezc2100@alumno.ipn.mx

Universidad de Bogotá Jorge Tadeo Lozano

Enrique de Jesús Morales Acuña - emoralesacu1980@gmail.com - CIIDIR

Diana Cecilia Escobedo Urias – CIIDIR

Norma Patricia Muñoz Sevilla - Instituto Politécnico Nacional, México

Jean R. Linero Cueto - Magdalena University

The health of marine macroalgae is tightly linked to ocean health, with implications for reef resilience. The brown alga *Lobophora* (Dictyotales, Phaeophyceae) plays a critical role in reef ecosystems as a benthic primary producer. However, thallus lesions observed in *Lobophora* populations from the Seaflower Biosphere Reserve suggest the presence of pathogenic interactions.

To investigate this, we conducted a molecular analysis of microbial communities associated with both healthy and lesioned *Lobophora* thalli. High-throughput sequencing of the 18S rRNA gene (V9 region) revealed higher microbial richness in lesioned tissues, with lesion samples containing, on average, twice as many microbial features as healthy samples, indicative of a potential disease state.

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Geo-Regional Perspectives on Blue Economy Research: Analyzing Trends in Europe and LATAM

Taborda, John-Alexander - jtaborda@unimagdalena.edu.co
University of Magdalena

Javier Antonio de la Hoz Maestre - jdelahez@unimagdalena.edu.co – Magdalena Univ.

Saez-Casado, María Isabel - msc880@ual.es – Almería University / CEIMAR

The Blue Economy has emerged as a cornerstone for sustainable development, integrating economic growth with marine ecosystem preservation. This study employs bibliometric analysis and Latent Dirichlet Allocation (LDA) to explore global research trends in the Blue Economy, with a focus on Europe and Latin America (LATAM). By analyzing a comprehensive dataset of publications from the last two decades, we identify key thematic clusters, including marine renewable energy, sustainable fisheries, bioresources, and coastal tourism. The comparative regional analysis reveals distinctive priorities and trajectories in Europe and LATAM.

European research is primarily driven by the European Union's Green Deal, emphasizing offshore renewable energy, circular economy strategies, and advanced marine spatial planning. These efforts reflect a focus on achieving decarbonization and long-term sustainability through cutting-edge technologies and integrated governance frameworks. In contrast, LATAM research highlights community-based approaches, sustainable aquaculture, and the socio-economic impacts of marine conservation. These themes align with regional challenges related to local development, resource equity, and social inclusivity. This geo-regional analysis not only identifies overlapping and divergent trends but also provides insights into future research directions. Opportunities for enhanced global collaboration and interdisciplinary approaches are identified, particularly in addressing shared challenges such as climate resilience and ocean governance.

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The study underscores the importance of aligning regional research priorities with global sustainability goals to foster an equitable and resilient Blue Economy. By providing actionable insights, this research supports policy development and strategic initiatives tailored to the unique needs of Europe and LATAM while advancing global Blue Economy strategies.

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Ciguatera in the Seaflower Biosphere Reserve: Projecting the Approach on HABs to Assess and Mitigate Their Impacts on Public Health, Fisheries and Tourism

Mancera Pineda, José Ernesto - jemancerap@unal.edu.co

National University of Colombia – Bogotá campus

Gavio, Brigitte - bgavio@unal.edu.co - National University of Colombia

Santos-Martínez Adriana - asantosma@unal.edu.co - National University of Colombia

Arencibia-Carballo, Gustavo - garen04@gmail.com – CIP, La Habana

Prato, Julian - jprato@unal.edu.co - National University of Colombia

Microalgae constitute the basis of marine food webs. However, the massive growth of some species and the toxicity of others may represent a serious threat to human health, fisheries, mariculture, and tourism. Evidence shows that global warming, climate change, nutrients, and sewage discharge favor microalgal blooms, which are becoming more frequent, intense, and lasting. In the Caribbean Sea, ciguatera poisoning, one of the syndromes caused by toxic dinoflagellates, has increased its incidence in the past three decades.

Despite the potential risks, there is no management plan for this and other harmful algal blooms (HABs) in San Andres Island, Colombia. We analyze the presence of toxic dinoflagellates along with the incidence of ciguatera in the Seaflower Biosphere Reserve (SBR).

Considering that effective climate change adaptation and mitigation decisions are based on relationships between science and society, involving a wide variety of analytical methods to evaluate associated risks and benefits, we propose to evaluate the potential effects of HABs, focusing on the economic value of their impacts on fishing and tourism.

We propose an early warning system conceptual model, based on a monitoring program, as a strategy to contribute to the governance and the management effectiveness of the different institutions of the SBR.

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Who will construct tropical reefs in the aftermath of climate change and ocean acidification? The role of innovation

Sánchez, Juan-Armando - juansanc@uniandes.edu.co

University of Los Andes - Biological Sciences

Santos-Nieto, Santiago - ssantosn@unal.edu.co - National University of Colombia

Chaib De Mare, Maryam - mchaib@unal.edu.co - National University of Colombia

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Conceptual Model of Compound Flooding on San Andres Island

Osorio-Cano, Juan David - jdosori0@unal.edu.co

National University of Colombia – Caribbean campus

Rosero-Melo, Lizbeth Daniela - lroserom@unal.edu.co - National University of Colombia

Montoya, Rubén Darío - rmontoya@udemedellin.edu.co – University of Medellín

Osorio, Andrés Fernando - afosorioar@unal.edu.co - National University of Colombia

Floods are among the most common and dangerous natural disasters globally. Recent studies emphasize the importance of integrating hydraulic, hydrological, and oceanic models to address "compound floods," which result from simultaneous or successive effects. Neglecting these interactions can lead to underestimating flood magnitude. For example, Rey et al. (2021) highlighted that omitting wave-induced setup and swash in storm surge models can underestimate flood levels, especially in island environments like San Andrés. This Caribbean Island is particularly vulnerable to hurricanes, storms, strong winds, low-pressure systems, and rising sea levels.

While advancements have improved coupling between hydraulic and oceanic models, a clear conceptual methodology to identify primary flood causes and applicable wave theories remains lacking. Such a methodology is crucial for selecting appropriate modeling tools and parameters. This study developed a conceptual model to characterize factors contributing to compound floods on San Andrés Island, focusing on elements like wave-induced run-up, infragravity waves, meteorological tides, astronomical tides, and long-period sea level variations. Long waves, generated by wind shear and pressure fields like storm surges, significantly influence coastal dynamics, amplifying nearshore. Field measurements in San Andrés' reef lagoon revealed that infragravity waves contribute substantially to run-up on dissipative beaches.

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Conceptualizing these factors is essential, as drainage systems are limited by conditions at sea discharge points. Preliminary results, including field observations and simulations, underscore the importance of a coupled conceptual model to guide numerical modeling and ensure accurate flood assessments based on scenario-specific conditions.

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Scientific Tourism as a Sustainable Alternative: A Review of Practices and Impacts in Caribbean and Pacific Islands

Gómez, Juan Ricardo - jrgomez@javeriana.edu.co
Javeriana University – Ecology and territory

Salazar, Erika - e.salazar@atuca.org – Sophia University of Tokyo

Castro, Alejandra - castro.alejandra@javeriana.edu.co - Javeriana University

Díaz, Andrés - andres@adventuretravel.biz - Adventure Travel Trade Association

Hall, Iain - iain@islandsi.co – Japan Island Sustainability Institute

McDonald, Anne - annemcdonald@sophia.ac.jp - Sophia University of Tokyo

Islands, particularly in the Caribbean and Pacific regions, are renowned for their natural beauty, making them prime destinations for tourism. The tourism industry significantly contributes to the GDP of these regions, often driving local economies toward heavy reliance on tourism. However, the dominant form of tourism—commonly referred to as “sun and sand tourism” or “beach tourism”—has led to considerable impacts on local biodiversity, natural resources, and cultural heritage.

Scientific tourism has emerged as a sustainable alternative, promoting more responsible practices that integrate conservation, science, education, and sustainable development. This approach engages both scientific and non-scientific visitors in immersive activities that contribute to generating knowledge about the islands’ natural resources.

Key activities in scientific tourism include mangrove and coral restoration, bird watching, wildlife and ecosystem monitoring, and cultural immersion through agroecological farming, aquaculture, or traditional fishing practices. This study reviews the development of scientific tourism in Caribbean and Pacific islands, focusing on its conceptual frameworks, documented impacts, and existing gaps that must be addressed to ensure its long-term sustainability.

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Climate Risk and Adaptation Strategies in Rock Oyster Aquaculture: A Case Study from Ama Town, Japan

Kabeshita-Bolton, Julia - j-kabeshita-3o4@eagle.sophia.ac.jp
Sophia University of Tokyo – Global Environmental Studies

McDonald, Anne - annemcdonald@sophia.ac.jp - Sophia University of Tokyo

Hall, Iain - iain@islandsi.co – Japan Island Sustainability Institute

Climate change is increasingly affecting the ability of land-based food systems to provide reliable sources of nutrition, prompting intergovernmental organizations to promote the intensification and expansion of sustainable aquaculture practices. However, this sector is also facing significant challenges due to climate change impacts.

Open-system coastal aquaculture, such as oyster farming, is particularly vulnerable to impacts from unpredictable changes in environmental conditions, including warming sea surface temperatures, ocean acidification, and extreme weather events, which are already affecting the profitability and sustainability of these systems.

This study focuses on Rock oyster (*Crassostrea nippona*) aquaculture in Ama Town, Shimane Prefecture, Japan, to assess the level of climate change adaptation currently exhibited by small-scale oyster farms. It investigates local ecological knowledge, production methods and farmer perspectives to gauge the level of current adaptive capacities. The study then compares the findings with results from ecological risk assessments conducted for the farms under both current and projected climate scenarios to identify additional strategies that could help farmers build resilience.

The goal is to identify key risks and vulnerabilities, assess the effectiveness of existing adaptation measures, and propose pathways to enhance adaptive responses at a site-specific level. Findings will contribute to the development of climate-resilient aquaculture systems, helping to safeguard livelihoods and ensure the continued provision of sustainable sources of blue foods.

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Characterization Of Whale-Watching Tourism of Humpback Whales in the Gulf of Tribugá, Colombian Pacific

Girón-Castaño, Laura Valentina - laura.giron@correounivalle.edu.co

University of El Valle – Biology

Vallejo Ortega, Ann - carole.vallejo@oceancommunityconservation.org - R&E

Avila, Isabel C - isabelc.avila@gmail.com – ITAW, TiHo

Giraldo, Alan - alan.giraldo@correounivalle.edu.co - University of El Valle

Whale-watching tourism of humpback whales is a rapid-growing industry worldwide. It started in 1994 in Colombia and since 2001 preventive recommendations for responsible whale-watching have been promoted. Despite its socioeconomic benefits, the inadequate implementation and regulation of the activity carry negative effects on whales. Adherence to whale-watching recommendations has been under-researched in the country, especially in the North Pacific.

Thus, the objective was to evaluate the adherence to whale-watching recommendations in the Gulf of Tribugá. Data was obtained during the breeding season between July and September in 2023 from tourist vessels.

Enforcement of whale-watching was evaluated through adherence to recommendations: the approaching maneuver, classified as direct or indirect; distance established among vessels and whales at the beginning of the encounters ([0-50m), [50-100m) or ≥ 100 m); the number of vessels performing simultaneously the activity on the same group of whales; the duration of sightings; and engine's position throughout the event of whale-watching. Results depicted that four out of five whale-watching recommendations were followed, but not strictly: 90% of approaches were indirect; there was only one vessel in 57% of cases; the engine was kept on during 78% of sightings, and the mean time spent with a group of whales was 16 minutes (it is recommended up to 30 minutes). Nevertheless, only 14% of vessels met the recommended distance (≥ 100 m). This work contributes to characterize the whale-watching tourism in the Gulf of Tribugá, and can be used to strengthen preventive and regulatory control measures required for tourist operations in the Colombian North Pacific.

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A process-based version of Shifting Baselines Syndrome in reef ecological studies

Vermeij, Mark - carmabilog@gmail.com

Carmabi Foundation – Curaçao

Coral reef ecology relies on ecological theory to test existing and new ideas about the factors underlying reef functioning. Such theories are often derived from past studies whose findings might no longer hold true due to new ecological settings that have arisen in the wake of powerful and diverse anthropogenically-driven changes. Recent changes on Caribbean reefs have occurred from so many varied stressors, that the ecological processes once understood to be the most important structuring mechanisms (such as herbivory and point-source pollution) are no longer predictive of the organismal abundance and composition of shallow reef communities.

Using long-term (~40 years) and high-resolution spatial data (130 sites) from Curacaoan reef communities, we show that the ability to identify the most powerful structuring processes on Caribbean reefs (e.g., coastal development, pollution, coral recruitment, fishing) often depends on the decade in which such studies were conducted. Using present day surveys to test the relative importance of historic drivers of reef composition can lead to the false conclusion that they are not, or were never, ecologically important. This will result in their lessened consideration in management or conservation frameworks, often in favor of “trendier” candidates.

We posit that a process-based version of the Shifting Baselines Syndrome therefore exists, in which historically important factors are neglected or forgotten. Failure to recognize the recent decoupling of ecological drivers and resulting patterns will result in a lessened ability to understand present-day patterns in reef community composition and a failure to recognize the importance of the ecological processes that actually served as the most important historic drivers of reef growth or decline.

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Ecosystem Co-Design towards resilient coasts

Zimmer, Martin - martin.zimmer@leibniz-zmt.de

Leibniz Centre for Tropical Marine Research, ZMT

Helfer, Véronique - veronique.helfer@leibniz-zmt.de - ZMT Bremen

"Nature-based Solutions (NbS) to the many challenges humankind is currently facing compel by combining direct benefits to society and local actors with measures to improve biodiversity. Among them, Ecosystem Co-Design is the concept of establishing ecosystems in degraded or newly emerged habitats that provide most efficiently those ecosystem services that are most needed locally or regionally, e.g., coastal protection. Decisions are based on participatory governance and stakeholder-engagement towards co-designing aims and actions.

This approach can encompass construction and geo-engineering activities, thus, allowing for interaction with technical solutions. Hybrid solutions, such as green-grey infrastructure, merge the best of both worlds and reduce the risk of malfunctioning or failure.

These concepts will be introduced and critically discussed from scientific, societal, ethical and legal perspectives."

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Governance of Marine Protected Areas Under the EBSA Methodology in Areas Beyond National Jurisdiction

Lastra-Mier, Roberto Enrique - robertolastra@mail.uniatlantico.edu.co

University of El Atlántico – Faculty of Legal Sciences

"The governance of marine protected areas in areas beyond national jurisdiction presents significant challenges for global marine conservation. Ecologically or Biologically Significant Marine Areas (EBSAs), identified under the Convention on Biological Diversity, are essential ecosystems for global biodiversity and ocean health. However, their effective implementation is hindered by jurisdictional gaps and complex international regulatory frameworks.

A robust and coherent international regulatory framework is necessary, incorporating the provisions of the Treaty on Biodiversity in Areas Beyond National Jurisdiction and harmonizing with the United Nations Convention on the Law of the Sea. Institutional action is critical, requiring the establishment of a global governance body under the CBD to coordinate efforts, ensure inclusivity, and foster regional and multilateral agreements for transboundary area management.

Sustainable financing mechanisms, such as an international conservation fund and payments for ecosystem services, are vital to address financial constraints, particularly in developing countries. Monitoring systems based on advanced technologies, including satellite surveillance and artificial intelligence, must be implemented to ensure continuous oversight.

Inclusive governance should integrate local communities and indigenous knowledge, ensuring their active participation in planning and management. Furthermore, conflict resolution mechanisms, such as international arbitration tribunals, and stringent regulatory enforcement are essential to address disputes and illegal activities.

This integrated approach aims to establish effective governance for EBSAs in areas beyond national jurisdiction, safeguarding biodiversity and promoting sustainable ocean management for future generations."

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Currents of Connectivity: Genetic Exchange and Ocean Circulation in Dutch Caribbean Scleractinian Corals

López-Márquez, Violeta - violeta.lopez@ua.aw

University of Aruba – Arts and Science

Scherpereel, Colin - colin.scherpereel@uclouvain.be - UC Louvain

Hellemans, Bart - bart.hellemans@kuleuven.be - KU Leuven

Mijts, Eric - eric.mijts@ua.aw - University of Aruba

Hanert, Emmanuel - emmanuel.hanert@uclouvain.be - UC Louvain

Volckaert, Filip A.M. - filip.volckaert@kuleuven.be - KU Leuven

Marine dispersal dynamics are key to shaping the genetic connectivity and resilience of reef ecosystems. This study investigates the impact of ocean circulation and coral reproductive strategies on the genetic connectivity of *Diploria labyrinthiformis* (broadcast spawner) and *Favia fragum* (brooder) across Aruba, Bonaire, and Curaçao. The reproductive mode plays a critical role in population genetic structuring: brooders exhibit higher genetic differentiation due to limited larval dispersal, while broadcast spawners disperse more extensively, aided by longer pelagic larval durations.

Using 3D hydrodynamic simulations of the Caribbean Current coupled with an individual-based model, we explored abiotic connectivity patterns for these two species. Microsatellite genotyping reveals pronounced genetic structuring in *F. fragum*, occasional long-distance dispersal events, and evidence of source-sink dynamics. In contrast, *D. labyrinthiformis* exhibits lower genetic differentiation, consistent with its broader dispersal potential.

These findings underscore the complex interplay between ocean currents and reproductive strategies in driving genetic connectivity. By advancing our understanding of population dynamics in reef-building corals, this research provides valuable insights for conservation planning and the long-term sustainability of coral reef ecosystems in the Dutch Caribbean.

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Strengthening Risk Management through Knowledge Generation and Social Innovation in the Archipelago of San Andrés, Providencia, and Santa Catalina - Seaflower Biosphere Reserve, Colombian Caribbean

Santos-Martínez, Adriana - asantosma@unal.edu.co

National University of Colombia – Caribbean campus

Velásquez-Calderón, Carolina - cvelasquez@fsu.edu - Florida State University

Mancera, José Ernesto - jemancerap@unal.edu.co - National University of Colombia

Osorio, Andrés Fernando - afosorioar@unal.edu.co - National University of Colombia

This interdisciplinary project aims to enhance the resilience of the Archipelago of San Andrés, Providencia, and Santa Catalina - Seaflower Biosphere Reserve, Colombian Caribbean, to tropical cyclones and marine pollution by integrating scientific knowledge, technological innovation, and social engagement. Launched in October 2022 and set to run for three years, the initiative leverages the expertise of 10 local and national institutions, engaging researchers, professors, students, and community members in a collaborative effort.

The project is structured around 13 interconnected activities, each led by specialized institutions, to address two key objectives: 1. Enhancing Science, Technology, and Innovation (STI) Capabilities for disaster preparedness, response, and recovery from tropical cyclones and marine pollution. 2. Implementing Ecosystem Conservation and Water Resource Management Initiatives to mitigate social, environmental, and economic vulnerabilities.

Core activities include post-disaster analyses, vulnerability assessments, storm surge modeling, risk communication strategies, experimental marine farming, mangrove restoration, coral reef rehabilitation, green business modeling, and integrated risk management systems. These efforts align with a shared vision of reducing vulnerabilities while fostering community, ecological, and economic resilience. The project's outcomes are transformative, resulting in a research book, specialized courses, academic articles, and technical reports.

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It also incorporates innovative solutions, such as artificial reef balls, ecosystems nurseries, while supporting local capacity-building through collaborative research and hands-on training.

By combining diverse methodologies, convergence science, and cross-sector collaboration, this project exemplifies how risk management can integrate scientific knowledge and social innovation to empower communities and protect ecosystems in the face of climate challenges.

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Plastic pollution in coastal-marine zones: an assessment of macroplastic waste on two beaches in Tumaco, Colombia

Ramírez-Orozco, Alejandro - alamirezor@unal.edu.co
National University of Colombia – Medellín campus

Bohórquez-Alzate, Hanna Lucieth - National University of Colombia

Cano-Londoño, Natalia Andrea - University of Twente

Zárate-Yepes, Carlos Alberto - National University of Colombia

Carvajal-Flórez, Elizabeth - ecarvajalf@unal.edu.co - National University of Colombia

Plastic pollution in marine and coastal zones is a critical environmental issue, as the ecosystems within these regions are essential for biodiversity and human well-being. This study aimed at characterizing the macroplastic waste and quantifying their mass over five consecutive days on El Bajito and El Morro beaches in Tumaco, in the Colombia's Pacific coast. To identify different types of macroplastic litter (plastic materials larger than 5 mm), the methodology described in OSPAR (2010) was followed. Sampling routes of 100 meters were established on each beach, covering the area from the intertidal to the supralittoral (back of the beach) zone. All visible macroplastic items were identified and recorded on paper forms, accompanied by photographic documentation.

Statistical analyses included Mann-Whitney and Kruskal-Wallis tests to assess differences in daily accumulation and composition. Results showed that daily accumulation was significantly higher at El Bajito (9.567 kg/day) than at El Morro (1.912 kg/day), with a Mann-Whitney p-value of 0.032. The average number of macroplastic items per 100 meters was also higher at El Bajito (108 items) than at El Morro (67 items). However, the average composition of plastic types did not differ significantly between sites ($p = 0.065$). HDPE was predominant at El Bajito (5.174 kg/day), while LDPE dominated at El Morro (0.596 kg/day). Only El Bajito showed statistically significant differences in composition (Kruskal-Wallis $p = 0.012$).

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While the quantity of macroplastic waste varies considerably, the types of plastics are relatively similar, highlighting the need for site-specific mitigation strategies based on both accumulation and composition. These data will help local communities for designing a community-based waste management system.

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**Influence of environmental variables on the accumulation of mercury in sediment
in artisanal fishing areas of the Colombian Pacific**

Molina, Andrés - aemolinas@unal.edu.co

National University of Colombia – Palmira campus

Arboleda, Ingrid - ijarboledam@unal.edu.co - National University of Colombia

Duque, Guillermo - gduquen@unal.edu.co - National University of Colombia

Cogua, Pilar - rosa.cogua00@usc.edu.co - Santiago de Cali University

Marine sediments play a key role in the biogeochemical cycle of mercury because they act as sinks, facilitating its accumulation and making it available to enter the food web. This study aims to determine the environmental variables that influence mercury accumulation in marine sediments from traditional artisanal fishing areas. For this purpose, THg concentration was measured in 16 sediment samples, collected in two sites of the Colombian Pacific, during two climatic seasons.

The salinity, pH, ORP, temperature, depth and transparency of the water column associated with each sediment sample were evaluated and the grain size and organic matter (OM) content were determined. Sediment mercury concentration ranged from 0,003 to 0,150 $\mu\text{g/g}$ for an average value of $0,059\pm 0,045$ $\mu\text{g/g}$. THg concentration varied between climatic seasons, with significant statistical differences [$p(\text{PERM})=0,002$], being higher in dry season ($0,090\pm 0,039$ $\mu\text{g/g}$), and lower in rainy season ($0,027\pm 0,021$ $\mu\text{g/g}$).

Moderate contamination according to the Potential Contamination Index and low risk according to the Ecological Risk Index were found in the sediments of the two sites. All variables were evaluated through a generalized additive model (GAM), the model showed positive correlations only with OM (explained deviation = 68.9%). THg concentrations were elevated in sediments with higher organic matter input, presenting similar patterns between OM and THg (they were higher in the dry season).

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These processes were modeled from OM in other studies in estuarine zones adjacent to the study area, where OM could represent the transport and accumulation pathway of THg. According to the correlations found, OM could be the main factor influencing the temporal variations of THg in sediments. In addition, despite the low THg concentrations found in the sediments, high contamination is evident in fishes caught in the same areas.

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Dendrochronological insights into growth modelling and sustainable management of Rhizophora mangle in Cispata Bay, Colombia

Valderrama, David - dvalderramaca@unal.edu.co

Aguiar, Valeria - vaquiar@unal.edu.co

National University of Colombia – Medellín campus

Polanía, Jaime - jhpolaniv@unal.edu.co - National University of Colombia

Orrego, Sergio Alonso - saorrego@unal.edu.co - National University of Colombia

The growing threat of climate change and deforestation could be mitigated through mangrove conservation and management, a critical point in global environmental efforts. One of the biggest challenges in managing tropical forests, especially mangroves, is obtaining reliable information on tree age and growth. This study uses dendrochronological and biometric analyses to provide silvicultural information on Rhizophora mangle, a dominant and heavily logged species in Cispata Bay, Colombia.

Twenty cross-sections were analyzed, and a non-linear regression model was fitted to calculate diameter as a function of age. The sampled trees ranged in age from 36 to 117 years and in diameter from 16.6 to 46.0 cm, from which it was possible to calculate a life expectancy of 387 years for red mangrove individuals. This age corresponds to the time required for an individual to reach its maximum diameter, indicating that the forest studied is relatively young. The average diameter growth rate was 0.28 cm/year, and it would take 27 years to reach 10 cm, the minimum diameter for logging in the study area. The maximum current annual increment (CAI) was observed to be 0.42 cm/year at 23 years, while the mean annual increment (MAI) of maximum diameter was 0.39 cm/year at 42 years.

The results indicate that dendrochronology has a high potential to provide valuable information for the management of mangrove ecosystems in tropical areas. The information provided is critical for guiding sustainable mangrove management practices and is useful for improving existing forest management plans in Cispata Bay, Colombia.

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Community-Based Conservation Agreements: A Rotational Fisheries Management Model for the Seaflower Biosphere Reserve

Ortiz-Roca, Fady - fortizr@unal.edu.co

ProSeaLand – Sea, Land and Culture Old Providence Foundation

Márquez-Calle, German - gemarquezc@gmail.com - ProSeaLand

Velásquez-Calderón, Carolina - cvelasquez@fsu.edu - FSU

The Seaflower Biosphere Reserve, a UNESCO site in the Western Caribbean, encompasses the Seaflower Marine Protected Area (MPA), contains 77% of Colombia's coral reefs, and sustains the livelihoods of the Raizal people. However, the reserve's fisheries face severe degradation due to climate change, overfishing, illegal practices by foreign fishers, and reef damage caused by unsustainable methods like lobster traps, as well as the inherent difficulty of law enforcement across the vast expanse of the archipelago.

These issues are compounded by coral diseases and the aftermath of Hurricane Iota (2020), which intensified fishing pressure in certain areas after destroying key vessels. To address these challenges, an alternative rotational fisheries management model has been proposed. Through voluntary conservation agreements between Raizal fishers and authorities, this model establishes no-take zones on a rotational basis, allowing some areas to rest and recover while others are fished sustainably. Inspired by traditional rotational systems, this approach enables the recovery of fish stocks and coral reef health, ensuring sustainable yields and ecosystem services like hurricane protection and tourism opportunities.

The model includes collaborative surveillance mechanisms involving fishers and authorities, promoting compliance and deterring illegal activities. Participatory monitoring, research, and education are central to fostering community ownership and strengthening the system. Fishers remain actively involved in sustainable practices, ensuring economic continuity while safeguarding marine biodiversity. By empowering the Raizal people to manage their marine resources, this model aligns biodiversity conservation with cultural heritage, socioeconomic resilience, and the potential to restore fisheries and reef ecosystems.

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Floristic Composition and Diversity of Macroalgae in Bolívar Cay

Cárdenas-Barón, Fernando - bfcardenasb@unal.edu.co

National University of Colombia – Bogotá campus

Gavio, Brigitte - bgavio@unal.edu.co - National University of Colombia

The Seaflower Biosphere Reserve is located in the Colombian Caribbean and encompasses the San Andrés and Providencia archipelago. Since 2015, this reserve has hosted multiple scientific expeditions to study its biodiversity and ecology. This study is based on the Seaflower 2022 expedition, during which East Southeast Cay (Cayo Bolívar) in the southern section of the reserve was visited. A total of 23 stations were surveyed, and samples were collected through SCUBA diving. The samples were preserved in ethanol for later transport, identification, and preparation for herbarium storage at the National University of Colombia, Bogotá campus.

In this study, part of the macroalgae community was analyzed from five sampling stations, where a total of 119 taxa were identified. Among these, four new records for the Colombian Caribbean were reported: *Acrochaetium barbadense* (Vickers) Børgesen 1915, *Rhipiliopsis reticulata* (C.Hoek; Farghaly & Denizot, 1979), *Lobophora guadeloupensis* N.E.Schultz, F.Rousseau & L.Le Gall 2015, *Lobophora schneideri* C.W.Vieira 2019, and one new species, *Pseudobryopsis basiglabra* sp. nov. Red algae (Rhodophyta) represented the group with the highest number of taxa (60 species), followed by green algae (Chlorophyta, 33), brown algae (Phaeophyceae, 15), and cyanobacteria (Cyanophyta, 11). The records were distributed among 66 genera, 21 orders, and 38 families.

Previously, 44 species had been identified for Cayo Bolívar. With this study, the list has increased to 144 records, representing a 69.4% increase in algal diversity. This work presents partial results from a larger project focused on investigating the community structure, temporal variation, and diversity of marine macroalgae in the Albuquerque and Bolívar Cays within the Seaflower Biosphere Reserve.

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From river to sea: Biogeochemical cycles detection on sediments in three contrasting coastal environments

Flórez-Ríos, Hernán David - hernan.florez@correounivalle.edu.co

University of El Valle - Biology

Castillo-Giraldo, Andrés - andres.casBilo.g@correounivalle.edu.co - UniValle

López-Álvarez, Diana - dilopezal@unal.edu.co - National University of Colombia

Coastal ecosystems are fundamental in carbon sequestration, nutrient cycling, and climate regulation, yet these are increasingly affected by environmental change. Microbial communities drive biogeochemical cycles (carbon, nitrogen, and sulfur), influencing greenhouse gas fluxes and overall ecosystem stability. Understanding their functional diversity and adaptability is crucial for predicting potential climate-related impacts on marine environments.

This study investigated microbial and viral communities involved in biogeochemical cycling across three contrasting coastal habitats, such as river, mangrove, and sandy beach, near the Uramba-Bahía Málaga National Park, Colombian Pacific. Using metagenomic sequencing, microbial taxonomic composition was assessed (Kaiju) and genes associated with carbon sequestration, nitrogen fixation, sulfate reduction, and methane metabolism were identified (diTing). Key findings revealed significant functional shifts across environments, suggesting that microbial metabolic capabilities play a key role in nutrient turnover, organic matter degradation, and gas exchange regulation.

The high variability in nitrogen-fixing and methane-cycling genes indicated that microbial responses to environmental conditions may modulate greenhouse gas emissions in these ecosystems. Additionally, the approximation for detection of horizontal gene transfer (HGT) mediated by bacteriophages highlighted the potential for microbial communities to rapidly adapt to changing climate conditions, influencing long-term ecosystem resilience. Given the critical role of microbial-driven biogeochemistry in regulating atmospheric CO₂ and N₂O fluxes, it was identified the need to integrate microbial functional analysis into climate impact assessments and conservation strategies aimed at mitigating environmental change in coastal ecosystems.

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Evaluation of Bioaccumulation and Estimated Daily Intake of Mercury in fish of interest to artisanal fisheries in the Colombian Caribbean

Arboleda, Ingrid - ijarboledam@unal.edu.co

National University of Colombia – Palmira campus

Molina, Andrés - aemolinas@unal.edu.co - National University of Colombia

Duque, Guillermo - gduquen@unal.edu.co - National University of Colombia

Cogua, Pilar - rosa.cogua00@usc.edu.co - Santiago de Cali University

The presence of mercury has a high environmental impact on aquatic ecosystems and negative effects on human health, mainly in the inhabitants of coastal areas due to its frequent consumption through fishery resources. In this study, species and biological factors that reduce mercury exposure were identified from the bioaccumulation factor (BF) and daily consumption limits.

Total mercury was determined in fish muscle (dry weight) from 2 families with 4 species in the Colombian Pacific and Caribbean. The fish were collected using two fishing gears (Gill net and hook line) in exclusive artisanal fishing zones during the years 2023 and 2024. Mercury transfer was also analyzed using the BF and the daily consumption limits for each species were evaluated. The average mercury concentration in sediments was $0,027\pm 0,020$ $\mu\text{g/g}$ in the Pacific and $0,008\pm 0,005$ $\mu\text{g/g}$ in the Caribbean.

The species with the lowest BF in the Pacific was jack mackerel (*Chloroscombrus orqueta*) with a value of $13,728\pm 4,544$ and red snapper (*Lutjanus purpureus*) with a value of $47,280\pm 27,660$ in the Caribbean. The BF in fish from high trophic levels in the Pacific and the Caribbean was significantly higher than in low trophic levels. According to habitat, a higher BF was presented in the demersal species of the Pacific ($34,737\pm 21,211$), while for the Caribbean it was presented in the pelagic species ($65,319\pm 53,140$).

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According to the daily consumption limits for the Pacific, the species with the highest portion of acceptable consumption was *Opisthonema medirastre* with more than 30 g daily in both rainy and dry seasons. While for the Caribbean it was *Rhomboplites aurorubens* in the rainy season with more than 30 g per day and *Caranx crysos* in the dry season with more than 10 g per day.

These results are in agreement with other studies carried out in the Pacific and the Caribbean, in which the efficiency of mercury transfer is greater from the sediment and where the trophic level has a significant influence on mercury accumulation. It is recommended that the community consume species with low BF, which are generally of low trophic levels.

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Salinity effect on the propagation of three mangrove species (*Rhizophora mangle*, *Laguncularia racemosa* and *Avicennia germinans*) under nursery conditions – with a view to improving restoration processes

Medina-Calderón, Jairo Humberto - jhmedinac@unal.edu.co

National University of Colombia – Caribbean campus

Robles-Sánchez, Alejandra - arobless@unal.edu.co - National University of Colombia

Mancera, José Ernesto - jemancerap@unal.edu.co - National University of Colombia

Mora, Rafael - ramorab@unal.edu.co - National University of Colombia

The restoration of marine ecosystems is essential to reduce the vulnerability of coastal populations to threats from the marine environment. In the case of mangrove, one of the most important actions is the propagation of plants in nurseries. Therefore, the objective of this study is to determine the effect of salinity on the growth and mortality of *R. mangle* *L. racemosa* and *A. germinans* mangroves species.

Within the study, three pools with sea water were adapted in the nursery of the Botanical Garden of Universidad Nacional de Colombia (San Andrés Island), where the hydroperiod was simulated. In each of the pools, three salinity ranges were maintained (low 16-20, medium 30-34 and high 40-45 PSU), to demonstrate the growth and survival responses of each species to this physicochemical factor. In each pool, 60 propagules were planted for species, and growth, survival, number of leaves and presence of herbivores were monitored.

The growth rates obtained allowed us to determine that an increase in salinity decreases the growth rate in each species. *L. racemosa* presented an inverse relationship between survival and salinity, and highest mortality among species. In *A. germinans*, the lowest mortality occurred in medium salinity (3%), and in *R. mangle*, the lowest mortality occurred at low and high salinity (2%). The study indicate that *L. racemosa* is more susceptible to nursery conditioning. *A. germinans* and *R. mangle* presenting survival rates are higher during nursery conditioning, indicating greater tolerance to salinity changes.

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Advancing Marine Protected Area Research: Trends, Topics, and Insights from a Global Perspective

De la Hoz-Maestre, Javier Antonio - jdelahez@unimagdalena.edu.co

University of Magdalena – Engineering

Narváez, Juan Carlos - jnarvaez@unimagdalena.edu.co - University of Magdalena

Fernández-Gómez, María José - mjfg@usal.es - University of Salamanca

Marine Protected Areas (MPAs) are essential tools for conserving marine biodiversity and promoting sustainable ocean use. These zones provide crucial ecosystem services, including climate regulation, food security, and socio-economic benefits. To uncover global research trends and guide future conservation strategies, this study employed a novel methodological approach that combines Latent Dirichlet Allocation (LDA), an unsupervised machine learning technique for topic modeling, with HJ-Biplot, a multivariate statistical method for visualizing relationships between topics, countries, and journals.

By analyzing scientific publications from 1983 to 2023, the study revealed a steady growth in MPA-related research, driven by international collaborations and leadership from countries such as the United States, Australia, and the United Kingdom. Emerging research topics with positive trends include climate change impacts, genetic connectivity, habitat classification, seabird foraging ecology, and ecosystem services. These findings highlight a shift toward addressing complex ecological and socio-economic challenges through interdisciplinary research.

This integrated approach provides a comprehensive understanding of the evolving priorities in MPA research. It offers actionable insights to guide future studies and policymaking, ensuring MPAs continue to enhance biodiversity conservation and support global sustainability objectives.

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The Neowave wave energy converter: Technical and financial approaches

Montoya Posada, José Luis - writeus@neowaveenergy.co

Neowave Energy – StarttUp Company

The world's waves can potentially give clean energy to around 500 million homes. Worldwide wave energy devices have declined or continue their developing works but with high costs and both complex designs and manufacturing processes.

Neowave is a Colombian-engineered wave energy converter, point absorber type, inspired by breathing dynamics and the jellyfish shape. This scalable design is conformed with basic, standard, and commercial parts, its manufacturing and assembly processes are simple, and it has a stackable configuration. The full-scale current design has a 300KW capacity for a maximum of 6 meters high and 10 seconds period waves.

A remotely operated maintenance system was designed to reduce the operation costs and visits to the installation location and extend its useful life. A remotely operated control system was designed for the device's adaptation to different wave energy densities, a harmonical movement with waves, a turn-off mode during maintenance labors, and a survivor mode during storms.

Two utility patents were conceded for those systems. A functional small-scale prototype was manufactured and tested, and the proof of concept was validated in a water level change mechanism, getting a TRL 4. A technology assessment process showed promising aspects. A more detailed 1:30 scale functional prototype is being fabricated for tests in a wave flume.

Computational simulations will start for the PTO and device geometry interactions analysis with ocean conditions. Financial analysis shows profitability and potential reductions for its LCoE. Environmental and social aspects are highly considered.

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Innovative Use of Sargassum Biomass for Mangrove Restoration in a Greenhouse on San Andrés Island, Colombia

Palacios-Rocha, Juan Andrés - jpalaciosr@unal.edu.co
National University of Colombia – Bogotá campus

Brigitte Gavio bgavio@unal.edu.co - National University of Colombia

Medina-Moreno, Jairo - jhmedinac@unal.edu.co – National University of Colombia

Fornaris-Hurtado, Nelsith - nfornarish@unal.edu.co - National University of Colombia

Mangroves, especially *Rhizophora mangle*, are crucial for coastal ecosystems by providing erosion control, carbon sequestration, and habitats for marine life. San Andrés Island, Colombia, part of the Seaflower Biosphere Reserve, faces increasing pressures on its coastal ecosystems. This study evaluates various substrates for the growth of *R. mangle* seedlings under greenhouse conditions, simulating natural tidal cycles.

A total of 80 seedlings were used, with 20 seedlings per treatment. The substrates tested included locally sourced clay soil, compost from organic waste, compost with Sargassum biomass, and natural mangrove soil from Old Point. Seedlings were maintained for 120 days under a controlled flooding regime, alternating between submerged in seawater and dry periods.

Results showed that compost from organic waste promoted the best growth, with an average height of 26.71 cm, followed by clay soil and Sargassum compost at 25.19 cm and 24.42 cm, respectively. Natural mangrove soil resulted in the lowest growth at 20.79 cm.

The use of Sargassum biomass is particularly promising, providing a sustainable alternative to large quantities of seaweed washing up on the island's coast. This study supports the use of local, sustainable resources for mangrove restoration, offering insights for future restoration efforts across the Caribbean.

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Green-Gray Infrastructure adoption on San Andrés, Providencia and Santa Catalina Archipelago development

Torres-Toro, Juan Diego - jtorresto@unal.edu.co
National University of Colombia – Medellín campus

Cantillo, Gyszel - gyszel@blueindigofoundation.org - Blue Indigo Foundation

Osorio-Cano, Juan David - idosori0@unal.edu.co - National University of Colombia

Maya, María Fernanda - mfmaya@blueindigofoundation.org - Blue Indigo Foundation

Osorio, Andrés Fernando - afosoria@unal.edu.co - CEMarin

Nature-based Solutions (NbS) are actions aimed at protecting, conserving, restoring, sustainably using, and managing terrestrial, freshwater, coastal, and marine ecosystems—whether natural or modified—to effectively and adaptively address social, economic, and environmental challenges. At the same time, NbS provide benefits for human well-being, ecosystem services, resilience, and biodiversity. Given Colombia's rich biodiversity, these strategies hold significant potential as tools for sustainable development in marine-coastal territories.

Within the framework of NbS, Green-Gray Infrastructure (GGI) combines natural green elements with traditional gray infrastructure to create more comprehensive, robust, and cost-effective solutions. This approach allows for a wide range of applications depending on the balance between green and gray components.

The Archipelago of San Andrés, Providencia, and Santa Catalina has been a key site for studying and conserving corals, seagrasses, and mangroves through various management and restoration strategies. These include Marine Protected Areas (MPAs), coral and mangrove nurseries, and GGI initiatives such as artificial reefs. However, the accelerating impacts of climate change are exacerbating biodiversity loss and increasing the vulnerability of the islands' populations and ecosystems.

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An assessment conducted in the archipelago through field surveys and interviews with local organizations revealed current needs, infrastructure trends, a balance between strategy types and local stakeholders' recognition of GGI concept. This suggests the early adoption of the 'working with nature' principle. The findings will support the integration of GGI strategies into local policies and plans, building on current efforts to promote sustainable development in the archipelago.

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Shifting from Beach Tourism to Nature-Based Tourism: Islands' New Approach to Sustainable Tourism

Gómez, Juan Ricardo - jrgomez@javeriana.edu.co

Javeriana University – Ecology and territory

Salazar, Erika - e.salazar@atuca.org – Sophia University of Tokyo

Castro, Alejandra - castro.alejandra@javeriana.edu.co - Javeriana University

Díaz, Andrés - andres@adventuretravel.biz - Adventure Travel Trade Association

Hall, Iain - iain@islandsi.co – Japan Island Sustainability Institute

McDonald, Anne - annemcdonald@sophia.ac.jp - Sophia University of Tokyo

What are beaches? What drives tourists to visit them? Isn't it their natural beauty? So why not approach sun and sand tourism—or beach tourism—in a more responsible way?

Tourism on islands, particularly sun and sand tourism, revolves around beaches and coastal areas, which are complex and fragile ecosystems. These areas are rich in life, hosting unique biodiversity and cultural heritage. While beach tourism is often an important economic driver for island economies, its sustainability is crucial. By understanding the negative impacts of tourism and implementing effective mitigation measures, we can continue to benefit from this economic activity without compromising the health of our oceans and coasts.

The transition toward sustainable and regenerative tourism in beaches and coastal areas requires a collective and long-term effort. This shift involves a multidisciplinary approach and active engagement from all stakeholders including governments, tourism companies, local communities, and tourists themselves. Key elements of this transitional strategy include sustainable planning and management, active participation of local communities, education and awareness-raising among stakeholders, the promotion of regenerative tourism practices, public-private collaboration, and socio-ecological monitoring.

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These strategies aim to preserve and restore natural ecosystems while supporting economic development. By adopting nature-based solutions, island destinations can mitigate the environmental and social impacts of beach tourism and ensure resilience for future generations. This work outlines a conceptual framework for mainstreaming sustainable practices into tourism and provides actionable insights and case studies to guide the development of responsible tourism models that safeguard coastal ecosystems.

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Archaeal-dominated microbial communities of marine salt crusts at the intersection of the Gulf of California and the Sonoran Desert in Mexico

Luis E. Servín-Garcidueñas - lservin@enesmorelia.unam.mx

Cristal Ramos Madrigal - cristal.ram.mad@gmail.com

National Autonomous University of Mexico – Microbiomics Laboratory

Martínez-Romero, Esperanza - emartine@ccg.unam.mx - CCG, UNAM

The coastal region of the Sonoran Desert on the Gulf of California in northern Mexico contains habitats for exploring the diversity of understudied microbial life. In arid regions by the sea, evaporation of seawater on coasts can lead to the formation of extensive areas with salt deposits. Salt crusts exhibit harsh physicochemical conditions, such as high salinity, high solar radiation, high temperatures and desiccation.

Microorganisms of marine origin, with biotechnological potential, can be naturally enriched in salt crusts. Despite these interesting characteristics, these microbial communities have so far received limited attention. In this study, bacterial and archaeal diversity profiles of salt crust samples from coastal regions of the Sonoran Desert were analyzed using culture-dependent and culture-independent methods.

The analysis was carried out by isolating microorganisms using a range of culture media and obtaining environmental DNA for amplicon sequencing of 16S ribosomal genes. Taxonomic analyses showed the abundance of the Archaea domain in all samples, with a predominance of the phylum Halobacterota. As for bacteria, the most abundant phyla were Firmicutes, Bacteroidota and Proteobacteria.

Bacteria belonging to the phylum Firmicutes were successfully cultured and isolated. In total, 106 genera of bacteria and archaea were identified. Interestingly, Halophilic archaea of the genera Natronococcus and Halalkalicoccus accounted for about 50% of the sequences. This study represents a basis for future studies focusing on the diversity of microorganisms at the marine-desert interface of the Sonoran region in Mexico.

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Benthic Communities of the Navigator Bank, Yuruparí Ridge, Colombian Pacific

Dueñas, Luisa F. - lduenasm@unal.edu.co

National University of Colombia – Bogotá campus

Ardila, Néstor - nestor.ardila.e@gmail.com - Universidad of El Rosario

Bessudo, Sandra - sbessudo@fundacionmalpelo.org - Malpelo Foundation

Friedlander, Alan - amfriedlander@ngs.org - Pristine Seas, National Geographic

Goodell, Whitney - wgoodell@ngs.org - Pristine Seas, National Geographic

Mayorga, Juan - marine.data.science@ngs.org - Pristine Seas, National Geographic

Sala, Enric - esala@ngs.org - Pristine Seas, National Geographic

Timmers, Molly - mtimmers@ngs.org - Pristine Seas, National Geographic

Thompson, Chris - chris.d.h.thompson1@gmail.com - Pristine Seas, National Geographic

The Navegador Seamount, located on the Yuruparí Ridge, is one of the most remote seamounts in the Colombian Pacific. Although preliminary studies consider it a key element in the connectivity of pelagic megafauna within the Tropical Eastern Pacific, little is known about its benthic structure. To complement the biodiversity baseline in the region and provide solid scientific information for decision-makers, the National Geographic Pristine Seas-Colombia expedition was conducted between March and April 2022. During the expedition's first phase, the Navegador Seamount was explored. Aboard the vessel Argo and the manned submersible DeepSee, five dives were conducted to document benthic and benthopelagic fauna at depths ranging from 150 to 268 meters.

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Four dives focused on the visual characterization of communities, while the final dive collected some of the most representative benthic invertebrates. The exploration of the Navegador Seamount revealed unique deep-sea ecosystems, where six main habitat types were identified, including a total of 79 taxa belonging to nine phyla. Noteworthy among them were habitat-forming corals and sponges, some representing first records for the country; even a new species. Although this study presents on going results, the remarkable biodiversity, uniqueness, and endemism of the area are evident. The evidence presented thus far justifies the protection and management of this critical area, which is important not only for benthic but also pelagic communities in the Colombian Pacific, and the whole Tropical Eastern Pacific region.

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The Role of Actors in Mangrove Forest Management in Myanmar

Thuzar-Nyein, Lwin - lwin_thuzar.nyein@mailbox.tu-dresden.de

Technical University of Dresden – Environmental Sciences

Schusser, Carsten - carsten.schusser@tu-dresden.de - Technische Universität Dresden

Giessen, Lukas - lukas.giessen@tu-dresden.de - Technische Universität Dresden

Karthe, Daniel - Karthe@unu.edu - United Nations University

The utilization and management of mangrove forests in Myanmar remain a complex and ongoing challenge, resulting in the degradation of mangrove forest ecosystems. The implementation of the mangrove replantation program is not yet optimal. Furthermore, the way in which mangrove forests are governed and the utilization of these forests in different management practices at the ground level remain underexplored areas of research. Therefore, this study was conducted to understand the typology of actors on the utilization and conservation of mangrove resources, and the power dynamics of these actors to implement their desired mangrove management practices. The case study was conducted in two distinct mangrove forest areas in Myanmar: a high-disturbance mangrove forest area in the delta region and a low-disturbance mangrove forest area in the lower coastal region of Myanmar. Using Actor center power (ACP) theory, the sequential design was applied to identify the actors and the extent of their power in mangrove management practices. Actors' network analysis identified 25 actors in the delta region and 13 actors in the coastal region. The actors who manifested incentive power were a group of small-scale business and civil society organizations. In contrast, the actors who exercised coercion power element were local government units in both study regions. However, how these holding powers were exercised on mangrove practices varied from region to region. In Delta, small-scale businessmen have converted mangrove forests to either shrimp farming or mangrove-shrimp farming systems. However, crab and charcoal production and mining have been the most prominent mangrove management practices at the small-scale business and community levels of the coastal region.

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Despite the efforts of civil society organizations and local government units in implementing mangrove replantation programs, the influence of these entities over other actors remains limited and ineffective at the ground level. Different community actors preferred to relocate mangrove forests to rice farming, subsistence farming, mangrove-crab production, and the utilization of mangrove wood for firewood production. Despite these community actors exercising subsistence-level activities, over half of the residents in the Delta region were classified as poor, with a considerable reliance on mangrove resources. In the coastal region, the charcoal production undertaken by a few actors resulted in notable mangrove forest degradation. Therefore, the hidden power dynamics of mangrove forest management largely remain in the remote areas of Myanmar, driving the changes in these ecosystems.

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First records of two rays and three bony fishes for the Galapagos Islands

Mossbrucker, Magdalena - me.mossbrucker@hotmail.com

Hochschule Rhein-Waal / Charles Darwin Foundation

Salinas-de-León, Pelayo - pelayo.salinas@fcdarwin.org.ec - Charles Darwin Foundation

Acuña-Marrero, David - davidacu74@gmail.com – Charles Darwin Foundation

Cundy, Megan - megcundy@gmail.com - University of Western Australia

Fierro-Arcos, Denisse - denisse.fierro@fcdarwin.org.ec - University of Tasmania

Suárez-Moncada, Jenifer M. - jmsuarez@galapagos.gob.ec - Galapagos National Park

Rastoin, Etienne - etienne.rastoin@postgrad.curtin.edu.au - Curtin University

The Galapagos Islands lie within the oceanic ecoregion of the Tropical Eastern Pacific, which has a unique fish assemblage composition due to the influence of several ocean currents and El Niño Southern Oscillation (ENSO) events.

In the El Niño phase of these events, water temperature changes facilitate the movement of fish species between oceanic ecoregions, as well as across the Eastern Pacific Barrier. Here, we present five new fish records for the Galapagos Marine Reserve based on underwater imagery. These include two rays (*Mobula thurstoni* and *Myliobatis longirostris*) and three bony fishes (*Lobotes pacifica*, *Lutjanus colorado* and *Sphyrna stellata*).

Of these, the first species is proposed as potentially resident to the Galapagos, and the latter four as vagrant species in the Galapagos until further sightings can conclusively determine their status. The effects of ENSO, the use of underwater video technology, and the importance of up-to-date and accurate species listings to understand the impact of the climate crisis are discussed.

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Innovative 3D-Printed Artificial Reefs Could Mitigate Beach Erosion and Create New Marine Habitats in Aruba

Colvee, Marina - themarinelab.co@gmail.com

Debrot, Denise - ddebrot@gmail.com

Vives-Moreno, Jaime - hello@themarinelab.co

The Marine Lab – Coastal restoration

Rodríguez, Sebastián - sebastian@greenfisharuba.com - The Marine Lab

Coastal erosion poses a significant threat to Aruba's beaches, driven by wave action, climate change, and disruptive coastal infrastructure. This degradation endangers ecological habitats, such as sea turtle nesting sites, and jeopardizes the island's tourism-dependent economy. This study examines the potential of innovative 3D-printed artificial reefs to address these challenges by mitigating beach erosion and fostering marine biodiversity.

Using advanced 3D-printing technology, artificial reefs were designed to replicate natural reef structures. These precision-engineered reefs, constructed with environmentally friendly materials, aim to dissipate wave energy, reduce shoreline erosion, and create complex habitats conducive to marine life. Preliminary simulations demonstrate that these reefs effectively lower wave energy and erosion rates. Within months of deployment, the structures are expected to attract diverse marine species, promoting ecosystem development.

The integration of 3D-printing technology with ecological principles presents a scalable solution for coastal protection and habitat restoration. This dual-purpose approach offers a sustainable strategy to safeguard Aruba's shorelines while enhancing biodiversity. This work invites engagement from researchers, policymakers, and stakeholders to explore the adoption of artificial reef technology as a practical intervention for global coastal challenges.

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Assessing Structural Connectivity of Caribbean Coral Reef, Mangroves, and Seagrass Using Remote Sensing

Becker, Tatiana - tatiana.becker@ua.aw

University of Aruba – Academic Foundation Year

In the Caribbean, coral reefs, mangroves, and seagrass ecosystems frequently co-exist and interact in intricate ways. Numerous studies have highlighted the interdependency of these ecosystems through processes such as nutrient cycling, species habitat sharing, and coastal protection. Maintaining the connectivity between these ecosystems is crucial for preserving biodiversity, enhancing ecosystem resilience, and supporting coastal livelihoods. Consequently, conservation efforts must prioritize the integrity of these connections rather than treating each habitat type separately.

While existing research has primarily focused on the functional connectivity of these coastal ecosystems—addressing ecological interactions and species movement—the structural connectivity, which examines how the physical arrangement and spatial configuration of ecosystems influence their interdependency and resilience, remains relatively understudied.

Recent advancements in remote sensing technologies, such as accessible high-resolution spatio-temporal satellite imagery, can help us bridge this knowledge gap. This proposed research seeks to leverage these technologies to map and evaluate the structural connectivity of coral reefs, mangroves, and seagrass beds in the ABC islands and potentially across the broader Caribbean region.

The study will assess a range of structural connectivity proxies, including distance between habitats, boundary lengths, patch size, shape complexity, presence of barriers, and the number of patches. Ground-truthing will be conducted to validate these assessments, ensuring robust and reliable results.

The findings will offer valuable insights for conservation managers and NGOs and provide critical input for tools like MarxanConnect, aiding the design and implementation of marine protected areas (MPAs). This will enhance efforts to preserve ecosystem connectivity and resilience.

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Plastic Pollution in Lobsters from the Colombian Caribbean

Arana-Rengifo, Victoria Andrea - victoriaarana@mail.uniatlantico.edu.co

University of El Atlántico - Chemistry

Santos, Adriana - asantosma@unal.edu.co - National University of Colombia

Trilleras, Jorge - jorgetrilleras@mail.uniatlantico.edu.co - University of El Atlántico

Grande, Carlos - carlosgrande@mail.uniatlantico.edu.co - University of El Atlántico

Medina, Jairo - jhmedinac@mail.uniatlantico.edu.co - National University of Colombia

Orozco, Karollayn - kkorozco@mail.uniatlantico.edu.co - University of El Atlántico

García, Carlos - carlosgarciaa@mail.uniatlantico.edu.co - University of El Atlántico

García, Roberto - robertogarcia@mail.uniatlantico.edu.co - University of El Atlántico

Mancera, Ernesto - jemancerap@unal.edu.co - National University of Colombia

Sierra, Cesar - casierraa@unal.edu.co - National University of Colombia

Microplastic (MP, <5 mm) pollution in aquatic environments affects marine species, including lobsters, as MPs accumulate in their gills and gastrointestinal tract (GIT), impairing development and posing a risk to the human food chain through MP exposure. In this study, twelve lobsters were sampled across two climatic seasons (high and low precipitation) in three departments of the Colombian Caribbean: Atlántico, Magdalena, and San Andrés Islas.

The average MP count in the gills of the 36 individuals was 7.6 ± 1.6 MPs/individual during the first season and 12.36 ± 1.2 MPs/individual during the second. For the GIT, the averages were 9.7 ± 1.3 and 17.7 ± 2.9 MPs/individual, respectively. Fibers were more prevalent in the first sampling (58.8% in gills and 46.9% in GIT) with sizes ranging from 1–5 mm, whereas fragments dominated in the second sampling (47.2% in gills and 40.9% in GIT) with sizes ranging from 0.05–0.25 mm.

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Chemical characterization using μ -ATR-FTIR revealed that 34.8% of the fibers in the gills were polyester, while polyethylene films (14.1%) and polypropylene (3.8%) were predominant in the GIT, along with fragments of other polymers such as polyurethane and resins. These findings provide critical insights into the main sources of MP pollution and their exposure pathways in lobsters, supporting the development of targeted solutions to mitigate this issue at its source.

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**Ideas for Innovative Technologies to Target
Deepwater Invasive Lionfish**

Patrick van Brakel

Lionfish Snack Aruba

<https://thelionfishsnackaruba.com/>

Citizen Science in Action — Surfside and Beyond

Christie Mettes & Tatiana Becker

Metabolic Foundation

<https://science.brenchies.com/en/home/>

**How can assisted sexual reproduction be achieved when colonies are
far apart or spawn on different days?**

Nichole Danser & Brooke Ceci

Scubble Bubbles

<https://scubblebubbles.org/>

Nature Through the Lens — Shaping the Dutch Caribbean Storyline

WOW! The Nature Film Project

<https://wowthenaturefilm.com/>

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