

REPORT

Virtual seminar:

“Climate change-resilient fisheries
in the Caribbean”

Focus on Cuba, the Dominican Republic
and Puerto Rico



Virtual conference, Three sessions:

September 28th, October 5th and 12th, 2021



Summary

The webinar: "Climate change-resilient fisheries in the Caribbean - Focus on Cuba, the Dominican Republic and Puerto Rico" was held across three sessions on September 28, October 5 and 12, 2021. The Caribbean Biological Corridor (CBC), Environmental Defense Fund (EDF) and the United Nations Environment Programme (UNEP) Regional Office for Latin America and the Caribbean organized this event based on a joint vision of collaboration to achieve healthy oceans that allow the livelihood and well-being of coastal communities in the Caribbean region.

The event brought together 140 people from 16 countries and various institutions including government offices, academic and research centers, professionals in conservation and fisheries management, and representatives of international organizations including the Food and Agriculture Organization of the United Nations (FAO).¹

The themes of the seminar were based on the four [principles](#) proposed by the FAO² for adaptive management of fisheries to climate change and refer to management that is (1) effective, (2) participatory, (3) precautionary (i.e. addressing uncertainty and risks), and (4) adaptive. These topics were presented during 3 sessions by 19 panelists from Cuba, Puerto Rico, Dominican Republic, Mexico, Belize, Colombia, and the U.S. with the aim of highlighting information and regional and global efforts that support the development of fisheries and coastal initiatives resilient to climate change in the region. The seminar also sought to contribute to the creation of a greater sense of community around problems shared among the panelists and seminar participants. This was achieved through 3 facilitated discussions with the panelists based on questions from the audience.

Climate change and its impacts on fisheries

The [IPCC's fifth report](#) gives us clear evidence on global warming and its effects on our oceans. These impacts are affecting the abundance and distribution of fisheries, which sustain the livelihoods of more than 50 million people worldwide. These changes will affect the various regions and communities of the planet to varying degrees. It is projected that tropical areas will be the most affected, as the equatorial belt will experience temperature increases in its waters that will force migration of entire populations of marine creatures towards the poles and deeper waters in search of more temperate waters.

For these reasons, the Caribbean is considered one of the most vulnerable regions to climate change. Its more than 7000 islands make up an extraordinary cultural and natural mosaic housing 40 million people and a unique biodiversity on the planet. The 35 nations that make up the Caribbean base their economies mainly on tourism and fishing, activities that require healthy and resilient marine-coastal ecosystems to stay productive.

¹ During the three sessions, 97 people attended through Clickmeeting. We estimate that around 40 more people connected via Facebook.

² FAO - Adaptive management of fisheries in response to climate change ([LINK](#)). Page 9.

Fishing in the Caribbean is mainly small-scale or artisanal. The discussions of this seminar are primarily based on initiatives to support this sector. Working with small-scale fisheries³ presents several challenges including the wide variety of actors, fishing gear, boats, and other involved elements. Effective coordination between these components is a challenge that we hope to support with this seminar, based on resilience. For the purposes of this report, we define *resilience* as stated by the FAO: ⁴

"The ability to prevent disasters and crises, as well as to anticipate, absorb, welcome or recover from them in a timely, efficient and sustainable manner. This includes protecting, restoring, and improving livelihood systems from threats affecting agriculture, nutrition and food security."

Objective of this report

This seminar was the result of collaboration between various countries with the participation of NGOs, government offices and scientific and fisheries management institutions. We hope that the information shared during the seminar, part of which is included in this report, will be useful for the various actors in the Caribbean whose work is linked to resilience to climate change, marine conservation, and fisheries management. As we have heard repeatedly throughout the three sessions, climate change will continue to create impacts in the Caribbean region. We hope that this report can inspire commitments from institutions to better understand and manage the opportunities and risks linked to climate change through resilient formulas throughout the region and the world.



³ The Food and Agriculture Organization the United Nations (FAO) defines: "Artisanal or small-scale fisheries are traditional fisheries involving fishermen's households (as opposed to commercial enterprises), which use a relatively small amount of capital and energy, relatively small fishing vessels (if any), making fishing trips short, close to shore, and mainly for local consumption. They can be subsistence or commercial". However, there is no single definition that can capture the diversity and complexity of what constitutes small-scale fisheries.

⁴ <https://www.fao.org/capacity-development/resources/good-practices/resilience/en/>

Session 1 "Effective and participatory fisheries management systems"

Tuesday, September 28, 2021



*Photo by Giselle García Castro

The first session focused on "effective and participatory fisheries management systems", establishing a baseline on efforts around climate resilience in the world and the region.



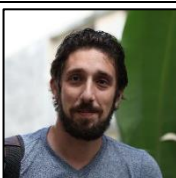


[Juan Carlos Duque](#) (Project Manager of the Biological Corridor in the Caribbean (CBC) of UNEP) opened the session highlighting the importance of maintaining the health of marine-coastal ecosystems as an indispensable requirement to enhance the economies of Caribbean communities. He also spoke about how pollution, biodiversity loss and climate change are factors that threaten the Sustainable Development Goals (SDGs) and how UNEP is working through the CBC applying climate resilience formulas. Next, [José \(Pepe\) Gerhartz](#) (Conservation Specialist of the CBC Secretariat) highlighted the importance of adequate fisheries management as a critical ally for marine conservation in the Caribbean. Pepe indicated how the CBC is expanding its geographic strategy to include not only the terrestrial but also the marine scope, with an outlook toward 2030 for achieving the goals in the region to reverse the processes caused by climate change that threaten ecosystems and communities. To conclude the words of welcome, [Eduardo \(Lalo\) Boné](#) (Senior Manager, EDF Fisheries Program in Cuba) highlighted the shared vision among the organizing institutions to protect the health of the oceans from a perspective of resilience to climate change. This vision requires fisheries management that reduces overfishing, restores, or maintains fishery resources, and is adaptable to climate change.

To begin, Dr. [Manual Barange](#) (Director of FAO's Fisheries and Aquaculture Resources and Policy Division) delivered the keynote address: [FAO's Proposed Steps for Resilient Adaptation to Climate Change](#). His speech highlighted the importance of guiding fisheries management through the "science of adaptation", whose goal is not the stability of a fisheries system, but rather its ability to respond to changes. Dr. Barange stated the challenges in implementing this approach, including its complexity, effective messaging for maximizing opportunities, and increased consumer awareness. He explained that *"the impacts of climate change on fisheries are not only about minimizing damage or maintaining the status quo, but also about maximizing opportunities."* The presentation was a call to action based on the science of adaptation that highlights opportunities and international collaboration, even when not all the knowledge is available. Given the close relationship between fishing communities and our oceans, it is not feasible to simply "get everyone out of the water;" this would be irresponsible and lazy. What is required is dynamic and ambitious management action, and there is no greater motivation than climate change to heed this call.

Later, four speakers from Cuba, the Dominican Republic and Puerto Rico presented on different experiences including (i) regional ecological and socioeconomic connectivity in the Caribbean, (ii) legal frameworks aligned with coastal resilience efforts, (iii) current situation of fisheries and (iv) case studies on

effective management. Table 1 summarizes the information on the presentations on day 1 with the theme "effective and participatory fisheries management systems". This table includes links to the videos for each presentation.

Table 1. Presentations day 1, Tuesday 28 September:
"Effective and participatory fisheries management systems."

Speaker	Presentation
	<p>1. Manuel Barange. <i>Director.</i> FAO Fisheries and Aquaculture Resources and Policy Division.</p> <p>KeynoteLecture: Steps proposed by FAO for resilient adaptation to climate change. Adaptation from previous symposium in August 2021. (English version also available HERE)⁵</p>
	<p>2. José Gerhartz. <i>Senior conservation specialist.</i> Caribbean Biological Corridor (CBC)</p> <p>Experience of the Biological Corridor in the Caribbean as a coordinated system of subregional environmental governance and platform for South-South cooperation.</p>
	<p>3. Raidel Borroto. <i>Director.</i> Cuban Fisheries Research Center (CIP)</p> <p>The new fisheries law in Cuba, an instrument to face climate change and promote coastal resilience through adaptive management.</p>
	<p>4. Raúl González Pantaleón. <i>Department Head, Education, Training, Fisheries and Aquaculture Extension.</i> Dominican Fisheries and Aquaculture Council of the Dominican Republic (CODOPESCA)</p> <p>Current situation of fishery resources in the Dominican Republic.</p>
	<p>5. Raimundo Espinoza. <i>Director.</i> Conservation ConCiencia. Puerto Rico.</p> <p>Fisheries management, climate change and coastal resilience in Puerto Rico.</p>

⁵ The original English version was presented during July 2021 at the U.S.-Japan Workshop on the Future of Fisheries in a Climate-Changing World. This version was translated into Spanish to be presented at this seminar with the permission of Dr. Manuel Barange.

Facilitated Discussion: Session 1

At the end of the presentations, [Raimundo Espinoza](#) (Director of Conservation ConCiencia) facilitated a discussion⁶ where the presenters answered attendees' questions. The first topic discussed was around the need to share national and regional reports on threatened species. According to [Pepe Gerhartz](#), such mechanisms do not exist, but they are necessary. Implementation would require agreements between countries to define protocols and rules for data standardization, a function that the CBC could include in its strategy.

Then followed the challenges for the cultivation of the mollusk *Strombus gigas*, known as *cobo* in Cuba, *garrucho* in Puerto Rico, *caracol rosado* (queen conch) in Mexico and many other names around the region. In the case of Puerto Rico, [Raimundo Espinoza](#) mentioned the need to adopt policies, legal frameworks, and incentives consistent with the specific contexts of each locality. Otherwise, these measures may be counterproductive and hinder development. In the case of Cuba, Pepe highlighted the importance of aquaculture as part of the food security strategy in Cuba, as well as its development mainly in freshwater systems. Pepe also highlighted the challenges of the use of introduced species, which on the one hand tend to produce high yields, but on the other hand cause damage to ecosystems, making it important to explore other pathways such as mariculture.

The discussion continued on the status of international fisheries agreements in the insular Caribbean. [Raul González](#) spoke about agreements between the Dominican Republic and Central America. However, other speakers stressed that such agreements are non-existent in the Greater Antilles and that interactions are limited to informal interactions between colleagues. All agreed on the need to know more about the existing accords between countries and that such regional agreements will be of great benefit to the region. **Nicasio Viña** (Technical Director, Caribbean Biological Corridor, UN Environment Programme) added that the CBC is a mechanism created to facilitate the coordination of nations across the region, recognizing that national actions alone are not enough. Nicasio also stressed the need to increase regional efforts to identify environmental services provided by individual countries (such as rehabilitation of mangroves or spawning areas), managed and prioritized with a regional vision.

Raúl González then delved into the challenge of the misinterpretation of the precautionary principle in the Dominican Republic. He stressed that this principle does not imply prohibition of activity, but rather action with caution and attention to effectiveness. Finally, the speakers shared the challenges of applying sustainable management in small-scale fisheries, whose fishing gear and target species are mostly multi-species in nature, with disperse fleets whose size hinders their monitoring. Raúl emphasized the importance of adopting applicable regulations that consider the system complexity without imposing harsh restrictions too suddenly. Finally, Pepe mentioned some of the advances in Cuba to connect science with fishing communities, a critical component for the success of any intervention.

⁶ This discussion is available [HERE](#) from 01:32:00 (format – Time:Minute:Second)

Lessons learned: Day 1

The opening message of [Dr. Manuel Barange's](#) keynote speech is clear and encouraging:

We must act now to maximize opportunities despite not having all the pieces of a complex problem. The path to achieving resilience to climate change is through the science of adaptation.

Fortunately, there are many mechanisms that are already working successfully in the Caribbean region to follow this call to action. [Pepe Gerhartz'](#) presentation described the operations and raison d'être of the Caribbean Biological Corridor (CBC) as a platform to facilitate coordinated work between leaders, administrators, institutions and other actors within the framework of sustainability. The CBC recognizes that conservation efforts are fruitless if we do not work alongside the sustainability of human systems in the region. Pepe highlighted the fishing sector as an excellent example of this premise, where the transformation of fishing practices requires a strengthening of governance systems and integration and cooperation between countries, all while taking climate change into account. Only through this approach will it be possible to strengthen resilience in both social and natural systems.

The talks from [Raidel Borroto](#), [Raúl González](#) and [Raimundo Espinoza](#) illustrate various formal and informal mechanisms that contribute to achieving fisheries sustainability goals based on resilience to climate change. They also highlight various common challenges in the region such as illegal fishing, misperceptions about the objective of fisheries management (i.e., "to regulate is to prohibit"), and the ecological and socio-economic impacts of overfishing. On the one hand, Raidel described Cuba's new fisheries law as an innovative legal instrument that requires fisheries management on the island to be guided by the best available science and adaptive approach. He also explained the function of the Consultative Committee for Fisheries as a participatory platform that includes the voices of various sectors and actors guided by the best available science. Likewise, Raúl described the various fisheries management instruments in the Dominican Republic based on monitoring, control and surveillance based on their respective fishing law. On the other hand, Raimundo provided several examples of how the self-directed uses and customs in Puerto Rico's fishing communities are based on sustainability practices that benefit both fishermen and the marine environment at the same time. One such example is the island-wide ban on shark finning imposed by the fishermen themselves. In both cases, there is a clear recognition of the alarming state of marine and fishery resources, as well as the need to adopt measures to recover, stabilize or mitigate them, especially in the face of climate change impacts. Finally, some of the reflections of the discussion facilitated between panelists and participants highlighted the importance of developing management measures that meet the needs and specific characteristics of different contexts, connecting science with fishing communities using the information available.

Session 2 "Management systems that address uncertainty and risks."

Tuesday, October 5, 2021








*Photo by Noel López

The second day focused on "management systems that address uncertainty and risks" and was moderated by Sofía del Castillo (Climate Change Adaptation Specialist, UNEP Regional Office for Latin America and the Caribbean).

[Abel Centella](#) (Director, Climate Center at the Cuban Institute of Meteorology (INSMET)) opened the second session with his keynote lecture "Climate Change Scenarios in the Caribbean Region". According to Abel, *life in the Caribbean revolves around climate*, - which he explained through five key elements, the 5 "Cs" in Spanish. His vision is based on the fact that we are going through a climate **crisis** (1) that can be addressed only through multidisciplinary and international **Collaboration** (2). Fortunately, there are effective mechanisms in the Caribbean that generate more and more useful information that provides better **clarity** (3) around regional patterns, making them compatible with global models. This has increased our **understanding** (4) of this challenge, making even more evident the need to increase our **Capacity** (5) to transform science into action.

Following Abel's talk, we listened to four presentations with case studies from the region illustrating (i) fisheries governance, (ii) the role of protected areas in adapting to climate change, (iii) global principles for climate resilience and (iv) studies on climate vulnerability in fisheries. Table 2 summarizes the information on the presentations on the second day with the theme "Management systems that address uncertainty and risks". This table includes links to the videos for each presentation.

Table 2. Presentations day 2, Tuesday 5 October.
"Management systems that address uncertainty and risks."

Speaker	Presentation
	<p>1. Abel Centella. <i>Director.</i> Climate Center of the Institute of Meteorology of Cuba (INSMET). Climate change scenarios in the Caribbean region</p>
	<p>2. Jeannette Mateo. <i>National Professional Aquaculture Value Chain Officer.</i> FAO in the Dominican Republic. Progress in fisheries governance and management in the Dominican Republic.</p>
	<p>3. María Rosa García Hernández. <i>Aspiring Researcher.</i> National Center for Protected Areas (CNAP) Natural protected areas in Cuba and programs based on ecosystem-based adaptation as part of the strategy to address climate change</p>
	<p>4. Erica Cunningham. <i>Director.</i> EDF's Humboldt Current and South American Oceans. <i>Interim Associate Vice President.</i> Latin American Oceans Program. Principles for Supporting Climate Change Resilient Fisheries from EDF's Oceans Program</p>
	<p>5. Rafael Ortiz. <i>Senior Director of Oceans and Fisheries.</i> EDF-Mexico. Climate vulnerability analysis in the Caribbean region</p>

Facilitated discussion: Session 2

The discussion was facilitated by **Sofía del Castillo** (Climate Change Adaptation Specialist of the UNEP Regional Office for Latin America and the Caribbean). In addition to the five speakers, **Julieta González Méndez** (Assistant Researcher at the National Center for Protected Areas – CNAP) and **Arnoldo Bezanilla** (Researcher at the Center for Atmospheric Physics – INSMER) joined as panelists in this discussion.

[María Rosa García](#) and [Juliett González](#) addressed the first issue on the role that marine protected areas in Cuba play in climate resilience, as well as the ways in which various actors are involved in such efforts. They shared some of the work of various Cuban scientists on the effects of population spillage⁷ within



protected areas into surrounding fishing areas, including studies in National Parks by [Dr. Fabián Pina](#) (Jardines de la Reina) and [Dr. Jorge Angulo](#) and [Zenaida Navarro](#) (Punta Francés). They also described the environmental education and awareness components that form part of the management plans in Cuba's network of protected areas, designed to engage the vast range of actors including decision makers, fishermen and conservation professionals.

The discussion also touched upon opportunities and challenges of the methodologies and tools available to understand the potential impacts of climate change on natural and human systems. [Abel Centella](#) spoke about the predominance of tools and methodologies for atmospheric and non-oceanic systems, as well as the differences and limitations between models at global and regional scales, to call attention to the importance of creating models on a smaller scale and with a more oceanic approach. Abel and the other speakers (Pepe [Gerhartz](#), [Erica Cunningham](#), and Rafael [Ortiz](#)) also pointed out the need to incorporate a spatial dimension to existing analyses in order to have more robust Geographic Information Systems (GIS) that can help with decision making. These GIS can be achieved using existing layers of information such as species and population distributions, climate variables, and locations of coastal communities, resulting in varying degrees of climate vulnerability. [Erica Cunningham](#) gave the example of a free [app](#) developed by the University of California, Santa Barbara designed to project potential changes in population distribution caused by the impacts of climate change.

The panelists also highlighted the need to increase coordination of efforts among the various Caribbean nations, recognizing the complexity of the region involving different cultures, languages and governance systems. [Jeannette Mateo](#) and [Pepe Gerhartz](#) spoke about existing regional mechanisms that are not necessarily linked to fisheries, but whose principles of regional coordination can serve as a platform and model that facilitate the implementation of policies aimed at sustainability and resilience. These examples include the Cartagena Convention and the Regional Activity Centre for Caribbean Species and Specially Protected Areas ([CAR-SPAW](#)). Jeannette mentioned how the CAR-SPAW includes marine species shared in the Caribbean, but that each country must work at the national level to achieve regional goals, thus protecting species vital to ecosystems such as sharks, rays and herbivores such as parrotfish (family Scaridae). Pepe reiterated how the Caribbean Biological Corridor (CBC) promotes south-south cooperation with objectives based on the conservation and connectivity of ecosystems throughout the Caribbean region, where sustainable fisheries management is a vital component. [Erica Cunningham](#) added that global mechanisms such as the Global Environment Facility ([GEF](#)) and the United Nations Development Program ([UNDP](#)) can offer learnings at the global level that prioritize the ecosystem approach by connecting conservation with fisheries management.

⁷ Net movement of individuals from marine reserves towards the areas of fishing around these reserves.

Lessons learned: Day 2

[Pepe Gerhartz](#) proposed two key questions to reflect on the topic discussed on the second day:

- (1) *What are the effects that climate change impacts could produce on species, communities and ecosystems?*
- (2) *To what extent are we prepared to adapt to these changes and adopt a new paradigm in the short term?*

Several panelists identified the challenges and solutions to answer these questions. On the one hand we find the complexity of scientific language generated around climate change, coupled with the need to create messages accessible to various users at all levels. Fortunately, there are various efforts to improve the communication of science through environmental education programs, generation of easily and flexibly accessible tools (in most cases free of charge), as well as the use of various channels to socialize these advances that include the use of radio, television and social networks. Another challenge is to have information across various time and geographical scales depending on the needs of users. Likewise, the speakers shared various tools whose purpose is to use the existing information to fill these gaps.

Thus, the discussions of this second day highlight the need to (1) continue to generate and update information at various scales to facilitate decision-making at different levels, (2) the need to continue promoting platforms that facilitate international coordination and cooperation to have more tools and information to deal with the impacts of climate change, (3) the importance of continuing to adopt interdisciplinary, multisectoral and systemic approaches to prepare us for the new paradigms that are coming with climate change, and (4) the inextricable connection between conservation efforts and socio-economic development in the region.

Finally, we include in this section Table 4 with a summary of the challenges and priority areas for fisheries governance and management at the regional level presented by Jeannette Mateo, National Professional Officer of Value Chain and Aquaculture, FAO in the Dominican Republic



Table 4. Summary of challenges and priority areas for fisheries governance and management at the regional level presented by Jeannette Mateo, National Professional Officer of Value Chain and Aquaculture, FAO in the Dominican Republic

Challenges for governance

- Limited budget and infrastructure resources
- Illegal activities at the transnational level beyond the fishing sector
- Low user participation in decision-making
- Low level of national-scale implementation of management strategies and plans
- Decision making not always based on the best available information
- Lack of adoption and implementation of regional agreements

Priority areas for governance and management at the regional level

- Regulation of fishing efforts and prevention of overfishing
- Combating illegal, unregistered and unreported fishing (IUU)
- Evidence-based decision-making and best available information
- Participation of all actors in decision-making
- Public awareness
- Strengthening voluntary data collection and reporting
- Disaster Risk Management
- Mitigation of and adaptation to climate change
- Building alliances
- Regional cooperation
- Visibility of women in the fisheries sector
- Fisheries authority strengthened in legal, technical, logistical and budgetary terms

Priority areas for governance and management at the national level (context of the Dominican Republic that can be applied to other countries)

- Better organized fisheries sector with strengthened administrative capacities – community leadership and cohesion in fishing communities
- Respect for traditional practices with increased quality and food safety
- Diversification of products and markets: offer online sales, social networks promotion, home delivery
- Sustainable financing for fisheries management
- Establishment of revolving funds and promotion of savings
- Promoting fish consumption as a nutrient-dense food
- Fostering strong relationships between buyers and sellers
- Increased social services and disaster insurance
- Collaborative governance between users and government
- Traceability along fisheries value chains
- Strengthening links with the tourism sector

Session 3 "Adaptive fisheries management systems."



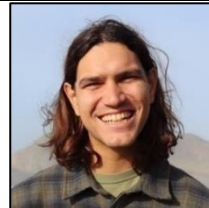
Tuesday, October 12, 2021



*Photo by Noel López

The third day focused on "Adaptive Fisheries Management Systems" moderated by Valerie Miller (Director, EDF Fisheries Program in Cuba). The third session covered five presentations on (i) the use of climate variables in fisheries management, (ii) the role of aquaculture as a strategy for adaptation to climate change, (iii) participatory processes in fishing communities and (iv) adaptive management of multi-species fisheries. Table 3 includes links to the videos for each presentation.

Table 3. Presentations day 3. Tuesday 12 October.
"Adaptive fisheries management systems."

Speaker	Presentation
	<p>1. Romina Alzugaray. <i>Researcher</i>. Cuban Fisheries Research Center (CIP).</p> <p>Case study of climatic variables and lobster in Cuba</p>
	<p>2. Carlos Guillermo Barreto Reyes. <i>Advisor</i>. National Fisheries Authority (AUNAP) of Colombia</p> <p>Aquaculture in the face of climate change: risks and solutions.</p>
	<p>3. Nicolás Gómez Andújar. Oregon University and Marine Environment Society</p> <p>Participatory processes in fishing communities in Puerto Rico.</p>



4. **Nicanor Requena**. *Consultant*, EDF
Belize Fisheries Program

[Adaptive management of multi-species fisheries in Belize](#)



5. **Dr. Loretta Roberson**. *Researcher*.
Marine Biological Laboratory and
University of Puerto Rico

[Aquaculture as a strategy for adaptation to climate change](#)

Facilitated discussion: Session 3

The third day's discussion was facilitated by **Pepe Gerhartz**. [Nicanor Requena](#) began by explaining some measures taken to enforce regulations within marine protected areas (MPAs), including the mandatory use of logbooks as a requirement for license renewal, the application of consequences for infractions (determined by the fishermen themselves), as well as education efforts on such regulations highlighting the benefits for communities and ecosystems. Nicanor also explained how the operation of these MPAs is planned in coordination with the zoning of fisheries management plans. This is carried out by an advisory council made up of local authorities, fishermen and managers who review the plans every five years, through a very detailed public consultation process as part of the national law in an effort to integrate the voices of all the actors involved.

[Dr. Loretta Roberson](#) and [Carlos Barreto](#) answered several questions about the role of aquaculture in contributing to food security while seeking solutions to the potential negative impacts of this activity. Both highlighted the importance of strengthening coordination and collaboration mechanisms at the regional level and prioritizing research, thus facilitating access to information between countries and the use of pilot



projects that can guide other efforts. This regional platform can have a greater influence for decision-makers in each country to adopt the recommendations issued by experts that include exploring systems with filter-feeder organisms and omnivores (in contrast to carnivorous species that pose various challenges such as feedstock generation), promotion of large-scale crops low in capital & technological intensity such as macroalgae, or the requirement of environmental licenses for certain activities such as shrimp farming in mangroves. Carlos spoke of the advantages

of creating a regional action plan, giving as an example the plans adopted for the conservation of shark management (i.e. those of [Colombia](#) and [Cuba](#)). He also indicated that, due to the current lack of sufficient lines of research, it would be important to do field experiments based on an empirical approach.

[Romina Alzugaray](#) explained how good practices and methodologies of the lobster fishery in Cuba can be applied to other fisheries such as shrimp, and vice versa. Romina, along with [Ofelia Morales](#) (director of the scaly fish department at the Cuban Fisheries Research Center), talked about how to extrapolate using

indices of environmental parameters to estimate lobster abundance for calculation of maximum permissible quotas to be applied to shrimp.

Lessons learned: Day 3

This third day focused on adaptive fishing systems. Several speakers highlighted the importance of using science to guide adaptive fisheries management, especially when taking into account the impacts of climate change. They also stressed the importance of translating scientific language into messages suitable for diverse audiences, including decision makers. [Nicolás Gómez's](#) presentation on participatory processes in fishing communities in Puerto Rico provides an excellent reference to guide policies and strategies that prioritize the adaptive approach. His presentation highlights the importance of building and strengthening social cohesion in fishing communities as a prerequisite for connecting fisheries science, management and policies with work in the water. In the context of adaptation, his message is clear:

"Relationships matter."

Nicolás explained how the strengthening of the social fabric facilitates the development, communication and implementation of fisheries management policies and guidelines, whether of an official nature as well as informal agreements developed within the communities. Nicolás also emphasized the advantages of organized groups such as cooperatives. Many speakers agree with Nicolás proposing the strengthening of cooperation platforms not only at the local level, but also at the regional level given the intrinsic biological and socioeconomic correlations that predominate throughout the Caribbean region.

[Romina Alzugaray](#) illustrated the success achieved in Cuba in stabilizing the populations of spiny lobster in Cuba thanks to the adoption of a solid adaptive fishery management that involves the analysis of various biological and socioeconomic variables. She also highlighted the close relationship between human activities and climate variability, presenting illustrative evidence that the frequency and intensity of cyclones, coupled with the effects of reservoir construction, have direct impacts on species with complex life cycles such as the locust, affecting their recruitment trends: the more cyclones and reservoirs, the lower the recruitment figures. Romina recommended the use of adaptive management to incorporate a diverse set of biological and socioeconomic variables into the design of various management scenarios for meeting the goals of fisheries sustainability. Lobster fisheries in Cuba apply this adaptive management successfully, including climatic variables that allow for scenario projections that help guide this successful adaptive approach.

[Nicanor Reguena](#) also shared interesting examples of the application of innovative adaptive management approaches in Belize. These practices include a pioneering and ambitious national system of marine protected areas that protects 23.5% of the country, with spatial management units (TURF⁸) where each fisherman is assigned two areas in which to concentrate their fishing activity. According to Nicanor (like Nicolás), the success of these systems is based on their collaborative nature, where an advisory committee for each fishing area, made up of the fishermen themselves, together with authorities and managers, facilitates the development and implementation of local rules. This high level of social cohesion makes it possible to solve complex problems such as those in multispecies fisheries, where dozens of species with different biological and socioeconomic attributes are caught at the same time. Nicanor explained how a management plan is being developed for the multi-species scale fishery in Belize using an approach called

⁸ For its acronym in English - Territorial Use Rights for Fishing ([TURF](#)).

"fish baskets", which groups fish with similar characteristics (vulnerability and population status) into management groups. This approach is designed to support fisheries with limited data to implement fisheries management with already-available information that can be adapted in the future.

[Dr. Loretta Roberson](#) and [Carlos Barreto](#) provided a very broad overview of how aquaculture can be a viable strategy for adaptation. At the same time, they emphasized the challenges that this activity entails and the need to increase research to adopt schemes that do not damage natural and human systems (e.g., shrimp farms in mangroves and unsustainable salmon farms). Loretta gave a very broad overview of seaweed cultivation based on three pilot projects in Puerto Rico, Florida, and Belize. These involve a diverse group of collaborators working on design, impact modeling, growth studies, algae quality characterization, communication to the public, socioeconomic analysis and life cycles. She highlighted some main characteristics, including the requirement of very simple technologies that also employ a large headcount of labor, as well as the great potential for scaling and implementation in areas where no conflict with other uses results. She also highlighted several challenges, such as the need to evaluate the suitability of sites, availability of environmental data, identification of target species, lack of knowledge about diseases, and the difficulty of obtaining permits. Loretta and Carlos emphasized the importance of working more closely with governments to facilitate the adoption of sustainable aquaculture practices around the world. Currently, there are many gaps in regulatory and governance issues that present many obstacles in operationalizing this type of activity.



Foto de Noel López

Conclusion

Experts from Cuba, Puerto Rico, the Dominican Republic, Belize, Colombia, the United States and Mexico shared ideas, research and case studies on the challenges and advances to apply in the water the four principles proposed by FAO for the adaptive management of fisheries to climate change.

The first principle on effective fisheries management was illustrated by several experiences. Cuba's recent fisheries law provides a regulatory framework that requires the use of science as a prerequisite for ensuring effective fisheries management. Fisheries management in the Dominican Republic – as in Cuba – encourages the application of the precautionary principle and warns that more work must be done with various actors so that this approach is not perceived as a resounding ban on fishing, but as a necessary measure for the benefit of fishing. The Puerto Rico case studies provide examples of how informal mechanisms created within fishing communities should be included as part of effective fisheries management. Several examples highlighted the importance of coordination and collaboration among countries in achieving common regional goals. Fortunately, existing mechanisms such as the Caribbean Biological Corridor have a vision and platforms aligned with this approach to regional collaborative work.



The second principle on participatory fisheries management was illustrated by studies in fishing communities in Puerto Rico that show the importance of cooperativism as a platform to facilitate communication, collaborative processes, and the application of standards in the water. The fisheries advisory council named in Cuba's fisheries law is another example of mechanisms to promote inter-institutional and multidisciplinary participation. Studies to learn more about the potential and challenges of aquaculture in

Colombia, Puerto Rico, Belize and Florida highlight the need for participatory and collaborative work centers to continue filling the complex information gaps in this sector.

There is significant progress in the region on the third precautionary systems principle that addresses uncertainty and risks that include the existence of models at the national and regional levels to project climate scenarios at various scales. Such models are the product of multidisciplinary and intergovernmental efforts but still require a lot of work to cover more specific and broader regional and temporal scales so that they can more accurately inform decision-making. EDF's work to drive the adoption of "climate-smart" fisheries management strategies offers a critical path to setting socio-economic and environmental objectives for management. This critical path incorporates existing tools and offers mechanisms to incorporate the voices of various actors in the generation of knowledge and decision-making. Climate vulnerability analysis (CVA) is one of these tools, designed to assess the degree of vulnerability of different marine species to the impacts of climate change in order to make management decisions now and in the future.

Adaptive fisheries management systems were illustrated with pioneering aquaculture practices in different parts of the region, as well as the use of science and climate variables to guide adaptive management in lobster fisheries in Cuba.

While fostering a greater sense of community around shared challenges, we are encouraged by the high level of participation of all participants and hope that the session has helped create a stronger network for collaboration across the region. We believe that the session was an effective space that has allowed reflection and discussion towards the various components of resilience in the Greater Antilles. We recognize that there is a lot of work at the local, national and regional levels throughout the Caribbean that was not represented at this event, but we will look for opportunities to foster this exchange in the future.

The more than 7000 islands that make up the Caribbean have accumulated valuable experiences across centuries in coping with inclement weather. However, the present and future challenges posed by climate change are unprecedented in human history. Fortunately, as discussed at this event, there are many state-of-the-art efforts available to address these challenges. To conclude this report, we offer a summary (Table 5 below) of several tools available to the various actors involved with fisheries management and marine conservation in the Caribbean and the world that were addressed during this event, as well as an annex with the biographies and contact details of the speakers. We hope that they will be useful and that they will encourage work between countries. We have a long way to go. Let's navigate it together, guided by science and collaboration.



Table 5. Summary of tools available to support fisheries management and marine conservation, presented during this seminar

Tool	Description
1. Fisheries forecasts and adaptive strategies. https://emlab-ucsb.shinyapps.io/fishcast2/	Developed by the University of California, Santa Barbara, designed to project potential changes in population distribution caused by the impacts of climate change.
2. Framework for Integrated Stock and Habitat Evaluation (FISHE) http://fishe.edf.org/	Developed by EDF. FISHE is a process designed to provide scientific guidance for sustainable and climate change resilient fisheries management from a collaborative perspective.
3. Climate Vulnerability Assessment (CVA)	Tool adapted by EDF from the work of Hare et al (2016) "A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast U.S. Continental Shelf" and which is part of the FISHE tools portfolio (see above). Preliminary results presented at this seminar were obtained through these tools: <ol style="list-style-type: none"> a. Template in Excel adapted from Hare et al (2016) with annotations to facilitate its collaborative application. b. Example of CVA applied in three hypothetical fisheries in the Caribbean. Its use is intended only as a reference for potential users. c. Guide to applying the Excel-based tool in the context of fisheries with limited data.
4. Hub for small-scale fisheries https://ssfhub.org/	The Small Scale Fisheries Resource and Collaboration Centre (or Hub) is an online, interactive and multilingual platform for small-scale fishers, fisheries workers, and their communities and allies.
5. Matriz de métodos para apoyar el manejo pesquero http://fishe.edf.org/method-matrix	The methods matrix contains all the assessment methods presented within the FISHE process (see tool 2 in this table), organized by the types of data they require and the management questions they can help answer.
6. Academia Virtual de Pesquerías https://fisherysolutionscenter.edf.org/virtual-fisheries-academy	EDF's Virtual Fisheries Academy is a free platform created to support managers, fishermen, scientists and other fisheries stakeholders in strengthening their knowledge and skills to design fisheries solutions compatible with socioeconomic and environmental goals.

Appendix: Biographies and contact details of Panelists



Manuel Barange

Director of the Fisheries and Aquaculture Resources and Policies Division of the Food and Agriculture Organization of the United Nations (FAO)

<https://www.fao.org/fishery/nems/40838/fr>

Biologist Manuel Barange is the Director of the Fisheries and Aquaculture Resources and Policy Division of the Food and Agriculture Organization of the United Nations, as well as an honorary professor at the University of Exeter. Barange formerly served as Deputy Executive Director and Director of Science at the Plymouth Marine Laboratory and Chairman of the Scientific Committee of the International Council for the Exploration of the Sea. From 2000 to 2010 he was Director of the International Projects Office of GLOBEC Global Ocean Ecosystem Dynamics, one of the first major programs working on climate change and marine systems. Dr. Barange obtained his bachelor's degree in Biology (with a specialization in Zoology and Ecology) in 1986 from the University of Barcelona, Spain. He did his PhD in Marine Ecology at the Sea Fisheries Research Institute (SFRI) in Cape Town, South Africa, awarded by the University of Barcelona, as he wished for the late Professor Ramon Margalef to be the chair of the awards committee.



Eduardo (Lalo) Boné Morón

Senior Program Manager, Oceans in Cuba at EDF

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Lalo is the Senior Manager of EDF's Cuba Oceans Program and, in this role, leads partnerships to develop and implement projects that support the sustainability and conservation of fisheries. As part of this work, Lalo helps build and strengthen learning networks that provide collaborative work platforms for fishing communities, scientists, managers, and conservationists. He also connects this work to EDF's broader efforts in Latin

America and the Caribbean by designing regional strategies and exchanges for the sustainable management of multi-species fisheries using an ecosystem-based approach. Eduardo is a biologist from the Autonomous University of Mexico (UNAM) and an Industrial Engineer from the Autonomous Technological Institute of Mexico (ITAM). He holds a double Master's Degree in Conservation Leadership from Colorado State University (CSU) and Colegio de la Frontera Sur in Mexico (ECOSUR).



José (Pepe) L. Gerhartz

Conservation specialist. Secretariat of the Biological Corridor in the Caribbean

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José L. Gerhartz is a Cuban geographer graduated from the University of Havana with more than 35 years of experience in spatial planning, geographic information systems, protected areas, and biodiversity conservation. He was Senior Specialist in Conservation Planning at the National Center for Protected Areas of Cuba (CNAP); worked as an Information Officer for the Caribbean of the Network of Small Island Developing States (SIDS Net) at the University of the West Indies, Kingston, Jamaica, and has worked as an independent consultant providing advisory services on marine conservation policies, planning and management of marine protected areas. From 2006 to 2015 he was director of WWF's conservation program in Cuba, where he led numerous projects in marine conservation, protected areas, climate change and fisheries sustainability. He worked on the design of the National System of Protected Areas of Cuba, developed the methodology for the management plans of that country, and led the design of the marine protected area network and analysis of conservation gaps using Marxan software.



Juan Carlos Duque

Project Manager, Caribbean Biological Corridor, United Nations Environment Programme (UNEP)

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Juan Carlos Duque is the Project Manager of the Caribbean Biological Corridor, part of the United Nations Environment Programme (UNEP), Office for Latin America and the Caribbean. He has worked for UNEP for more than 5 years in projects such as the Poverty and Environment Initiative, the Amazon Protected Areas Integration Project, and with experience in various biodiversity and conservation issues, such as the review of national biodiversity strategies, Blue Economy strategies, and support in the Regional Action Plan for Ecosystem Restoration.



Raidel Borroto

Director, Cuban Fisheries Research Center (CIP)
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Raidel graduated with a bachelor's degree in biological sciences from the University of Havana in 2011. Currently, he is the Director of the Fisheries Research Center (CIP). He has completed postgraduate studies in the Department of Biology at the Marine Research Center, University of Havana.

Raidel worked on the preparation of standard operating procedures for the monitoring of sea cucumbers, sharks and rays. He has published five articles on fisheries biology topics and developed identification guides for shark and ray species of commercial importance in Cuba. He also collaborated in the elaboration of the National Sharks Action Plan of the Republic of Cuba.



Raimundo Espinoza

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Raimundo Espinoza is the founder and executive director of Conservación ConCiencia. He previously served as the Nature Conservancy's founding Cuba Program Director and then

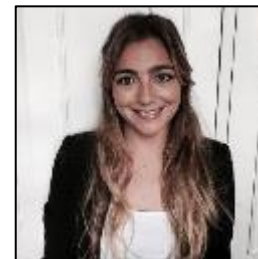
facilitated the historic first government-to-government action between the United States and Cuba in Everglades National Park. Mr. Espinoza has extensive experience in coral reef conservation and management and was also responsible for establishing the Nature Conservancy operation in Puerto Rico. Prior to the Nature Conservancy, he received the prestigious NOAA Coral Reef Management Fellowship in Puerto Rico (2008-2019). He served as an advisory delegate to the government of Puerto Rico on the Caribbean Challenge Initiative and has worked closely with commercial fishers, local NGOs and governments throughout the Caribbean and Latin America to create unique opportunities to promote conservation actions in the soil and sea. Mr. Espinoza holds a Bachelor of Science in Environmental Studies from Pace University and a Master of Science in Sustainable Development and Conservation Biology from the University of Maryland.



Raúl González Pantaleón

Department Head, Education, Training, Fisheries and Aquaculture Extension, Dominican Fisheries and Aquaculture Council of the Dominican Republic (CODOPESCA)
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Master's Degree in Environmental Management and Natural Resources. In charge of the training, education and extension department of CODOPESCA. University professor at the Autonomous University of Santo Domingo. Research professor at Pedro Henríquez Ureña University, Santo Domingo, Dominican Republic.



Sofía del Castillo

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Sofía del Castillo, Argentina. Master in Climate, Land Uses and Environmental Services (Paris-Saclay University). She works as a specialist in adaptation to climate change in the United Nations Environment Program, supporting the countries of the Latin American and Caribbean Region in the formulation and execution of policies and projects to address climate change. She has led the development of adaptation projects that were approved by different international funds, including the Green Climate Fund and the Adaptation Fund. She has knowledge and experience in addressing cross-cutting issues relevant to robust climate policies, such as the gender and community approach, nature-based solutions and sustainable development goals.



María Rosa García Hernández

Aspiring Researcher at the National Center for Protected Areas (CNAP)

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Graduated with a degree in Biology in 2016 from the University of Havana. In 2021, she began working at the National Center for Protected Areas, where she currently holds the position of Aspiring Researcher. Participates in the coordination of technical, methodological and training work for the management of Marine Protected Areas; and conducts research aimed at the biodiversity of these sites. She is a Master's student in the Marine Biology and Aquaculture program at the Center for Marine Research, focusing on studies on sponge ecology in mesophotic reefs. She has presented her work results in several national and international scientific events, and in two scientific publications. She is a member of the Cuban Society of Zoology.



Erica Cunningham

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Erica Cunningham is the Humboldt Current (Chile and Peru) program director for the Environmental Defense Fund Climate-Smart Fisheries program. Erica has been working in more than 10 countries over a decade to find, develop, and implement sustainable solutions to improve fisheries management, fisherman lives, and the marine ecosystem. From a young age Erica has had a passion for nature. Erica is a political scientist, with her master's degree in international development and environmental public policy from Johns Hopkins University in Washington DC, United States. Erica also has her certification in environmental conflict negotiation from the Udall Institute for Environmental Negotiation.



Abel Centella

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Centella currently works at the Center for Atmospheric Physics of the Institute of Meteorology (INSMET) in Cuba. INSMET is an institution that provides meteorological services, but it is also a research center in the meteorological and climate fields, being a pioneer in the research of climate impacts in Cuba and adaptation assessments at the national level. Centella's field of action relates to investigations of climate variability, climate change, regional climate modelling, extreme weather events and drought. He was the Head of the Climate Center, later Scientific Director of INSMET and finally Director of Basic Systems (operational services).



Jeannette Mateo

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She has a degree in biology from the Autonomous University of Santo Domingo (UASD), obtained the title of Master of Science in Biological Oceanography from the University of Puerto Rico; completed studies in the health area applicable to the fishing sector, at the United Nations University, Iceland; international fisheries law, at the University of Wollongong, Australia; aquaculture at the Politécnico Internazionale Per Lo Sviluppo Industriale ed Economico in Italy, and the International Cooperation and Development Fund in Taiwan. She is a specialist in International Relations of the Caribbean, from the Latin American Faculty of Social Sciences and the Technological Institute of Santo Domingo.



Rafael Ortiz

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Since 2012, he has been working with the Environmental Defense Fund, currently leading the Oceans program in Mexico, where he works for responsible fishing and resilient communities, through the strengthening of science, participation, governance, management,

regulatory framework and technology. He is a Marine Biologist graduated from the Autonomous University of Baja California Sur, with a master's degree in Use, Management and Harnessing of Natural Resources from CIBNOR, and a Ph.D. in Ecology from Humboldt University and the Leibniz Institute of Freshwater Ecology and Fisheries in Berlin, Germany.



Valerie Miller

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Valerie is the director of EDF's Cuba Oceans Program. In this role, she cultivates partnerships between a multinational group of government, academic and civil society partners to help develop and implement fisheries management and marine conservation projects in Cuba that can benefit the wider Gulf of Mexico and Caribbean region. Valerie began working with EDF in 2012 and supported the Cuban government's development of its

National Action Plan for the Conservation and Sustainable Management of Sharks, the implementation of a community-based sustainable fisheries project, and the creation of a new training course in Sustainable Fisheries Management. taught at the University of Havana. She holds a dual master's degree in Conservation Leadership from Colorado State University and El Colegio de la Frontera Sur in Mexico. Valerie is from Texas and lives in Austin with her husband (Diego) and dogs (Mozart and Roux).



Carlos Guillermo Barreto Reyes

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Marine Biologist with specialization in population dynamics and diploma in Multivariate Analysis, with experience in analysis of information of fisheries resources, analysis of statistical information, with 40 years of experience in information management in

research of the fisheries resources of Colombia and management of biostatistical databases. He participated in the research group with the program of evaluation of Colombian fisheries resources on board the research vessel FITJOF NANSEN; I was regional director in charge of INDERENA, coordinator of the group For the Proposal of Global Fisheries Quotas for Colombia. Advisor in fisheries resources research in several NGOs.



Romina Alzugaray

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Romina is a Cuban scientist specializing in stock assessment and population dynamics. Some of her recent work includes studies on the impact of illegal fishing on the sustainability of fisheries and the development of a bioeconomic model to guide sustainable management in Cuba. During the last 10 years, she has dedicated herself to research projects to understand the interactions between fisheries and the

status of the exploited stock in Cuba, focusing on high-value commercial species such as lobster and shrimp. She is a biologist with a master's degree in Marine Ecology and obtained a scholarship to complete the Fisheries Training Program at the United Nations University in Iceland. Currently, Romina is a PhD student at the University of Havana.



Nicolás Gómez Andújar

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Nicolás is a young environmental scientist from the island of Culebra in Puerto Rico. Nicolás has collaborated in multiple ecological restoration efforts, cultivating and transplanting endangered corals. Nicolás holds a bachelor's degree in Environmental Sciences, a degree for which he completed a dissertation characterizing the ecological vulnerability of coral

reefs in Playa Flamenco in order to inform good coastal management. Since 2017 he has been part of the Community Advisory Board for the Collaborative Management of the Luis Peña Canal Reserve, where he has contributed to the education and custody of this natural heritage. Nicolás also just graduated from a master's degree in marine resource management through Oregon State University, where he has researched strategies to enhance Puerto Rico's commercial fisheries from an adaptive governance perspective. Nicolás believes in the use of science to guide participatory and transparent decisions in order to preserve ecological integrity, promote island sustainability, and prioritize the well-being of vulnerable populations in the face of the multiple challenges facing the insular Caribbean.



Nicanor Nolasco Requena

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Nicanor is EDF's Project Manager in Belize. Nic has over 20 years of experience working in marine conservation and fisheries management in Belize and the Mesoamerican reef region. Nic has been directly involved in the establishment of three marine reserves in Belize and in the identification, monitoring and protection of 13 of the most important reef fish

aggregation sites in Belize. He was recognized by The Nature Conservancy during the many years he worked in the management and protection of reef fish aggregation and in the establishment and management of marine reserves. He has done extensive work with local fishing communities, in the establishment of marine protected areas in Belize, the expansion of replacement areas (non-extraction areas) and the revision of the Belize National Fisheries Act.



Loretta Roberson

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Researcher at the University of Puerto Rico and the University of Puerto Rico, Loretta holds a bachelor's degree in Biology from California State University and a PhD in Biological Sciences from Stanford University. In 2003 she became Adjunct Professor and later Assistant Professor at the campus of the University of Puerto Rico, Río Piedras, where she developed and directed the Center for Renewable Energy and Sustainability that focused on the

use of macroalgae as biomass for biofuels, as well as the Center for Environmental Neuroscience of Puerto Rico with a focus on the impact of water quality on coastal ecosystems. In 2016 she joined MBL, where she is now an Associate Scientist. Her research focuses on the development of large-scale marine macroalgae farms and how they can be used to mitigate climate change and protect sensitive ecosystems such as coral reefs.