



Ecosystem-based Management and the application of a Decision Support System in the Wider Caribbean:

Lessons learnt from EBM Application in the Wider Caribbean: concept to action



Caribbean Environment Programme

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With the support of



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- The Italian company PROGES Planning and Developing Consulting (PROGES)
- The Ministry of Environment and Natural Resources of the Dominican Republic (MARENA)
- Reef Check Dominican Republic
- The Centre for Resource Management and Environmental Studies (CERMES), University of the West Indies (UWI), Cave Hill, Barbados
- The Gulf and Caribbean Fisheries Institute (GCFI)
- The International Union for Conservation of Nature (IUCN), BIOPAMA Programme
- The Nature Conservancy (TNC)
- Waitt Institute
- World Wide Fund for Nature (WWF) Guianas
- UNDP/UNOPS Sustainable Management of Shared Living Marine Resources in the Caribbean and North Brazil Shelf Large Marine Ecosystems project (CMLE+)

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Biodiversity for Sustainable Development in the Caribbean through Ecosystem-based Management (EBM)

Sharing Lessons Learnt from EBM Application in the Wider Caribbean: concept to action

Context and background

The Governments of the Wider Caribbean region adopted in 1983 the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (WCR), the Cartagena Convention.

AIMS OF THE SPAW PROTOCOL

- *Significantly increase the number, and improve the management of protected areas in the Wider Caribbean region, including support to national and regional conservation management strategies and plans;*
- *Support the conservation of threatened and endangered species and the sustainable use of natural resources to prevent them from becoming threatened or endangered;*
- *Develop a strong regional capability for the coordination of information exchange, training and technical assistance, in support of national biodiversity conservation efforts; and*
- *Coordinate activities with the relevant international biodiversity treaties and initiatives*

Conscious of the threat posed by unsound development to the integrity of the marine and coastal environment of the region, Contracting Parties further adopted in 1990 the **Protocol Concerning Specially Protected Areas and Wildlife**, the SPAW Protocol (BOX1). It is the only region-wide legally binding biodiversity treaty that protects critical marine and coastal ecosystems, while seeking to respond to the many challenges related to achieving sustainable development in the region.

Threats to biodiversity and conservation of marine environments have been identified and studied to various degrees over the last decades in the Caribbean. Among the major sources of anthropogenic pressures are unsustainable fisheries, habitat degradation and pollution which impact such ecosystems and benefits they offer to society, which may become aggravated due to climate variability and change (UNDP/GEF, 2013). Wider Caribbean countries are striving to seek meaningful and innovative solutions to tackle these increasing threats to the marine and coastal environments, and new approaches to improve their socioeconomic development. Such development is directly linked to the ability of ecosystems to maintain their diversity and productivity, and to provide a wide array of valuable services to people and to support their resilience. Healthy marine ecosystems provide food, storm protection, erosion control, nutrient cycling, recreation among many other ecosystem services. An integral solution requires transboundary governance through a holistic approach to manage natural resources, or in other words, the application of an ecosystem-based management (EBM) approach.

Over the last decades a number of international instruments and initiatives have concurred on the benefits of the EBM approach, progressing from traditional species-based management or from examining single issues to consider decisions based on a mixture of interacting elements and several ecosystems as a way to enhance livelihoods and reduce vulnerability resulting from historical reduction in resource abundance and climate change impacts, among other causes.

UNEP (2011) refers to EBM as "an approach that goes beyond examining single issues, species, or ecosystem functions in isolation. Instead it recognizes ecological systems for what they are: a rich mix of elements that interact with each other in important ways". (BOX 2)



BOX 2. Source: from UNEP (2011)

Despite a considerable number of instruments and policy fora's acknowledgement of the desire and need for an EBM approach to the maintenance of ecosystem services, concrete application of the EBM concept and Decision Support System (DSS) tools are still incipient in the Wider Caribbean region. The development of this complex process demands not only increased stakeholder capabilities but also the use of information systems to facilitate sound planning and proper allocation of priority actions emanating from resource management strategies.

The SPAW Subprogramme, which supports implementation of the SPAW Protocol, includes a specific component targeting the development of institutional capacity to effectively apply the Ecosystem-based Management (EBM) approach and tools for sound Marine Spatial Planning by promoting "the principles and values of good governance for the conservation and management of marine ecosystems in the region". Hence, SPAW is uniquely positioned to foster further knowledge and integration of EBM concepts and their application to enhance conservation and the maintenance of goods and services that such ecosystems provide.

As such, with the implementation of a 4-year project (2015-2019) entitled “Biodiversity for Sustainable Development in the Caribbean through Ecosystem Based Management”, UN Environment Caribbean Environment Programme (CEP) under the SPAW Protocol, has been leading a process to ensemble and test a methodology that analysed ecosystem bio-ecological and socioeconomic aspects utilizing a highly participative and inter-disciplinary group of stakeholders in the Dominican Republic in two pilot sites: Puerto Plata and Montecristi.

The overall goal of this project was to develop capacities and information systems as well as pilot test their application, that can be used by governments and non-governmental organisations, to support decisions on planning and managing coastal resources with an ecosystem-based management (EBM) approach.

Project implementation was possible thanks to the generous contributions from the Italian Ministry of Foreign Affairs and its Italian Agency for Cooperation and Development (AICS). With the support of the Italian company PROGES Planning and Development Consulting (PROGES) the transfer of knowledge on EBM and DSS application across the Wider Caribbean has been possible over the span of the project. Steps in the application of DSS to enable identification of priority actions include: an assessment of local conditions, the acquisition of data, the development of tables and matrices, the construction of management indicators and the establishment of relationships between ecosystem components. The Ministry of Environment and Natural Resources of the Dominican Republic (MARENA, in Spanish) along with other governments institutions and several non-governmental organizations throughout the Wider Caribbean are progressively working in line with the EBM concepts. They were all interested in having greater integration and collaboration.

Challenges and experiences gathered throughout project implementation along with main lessons learnt are shared in this document, hoping to present our experiences and illustrate a practical way of applying EBM-DSS tools to broad regional and global audiences, and in this way collectively contribute to advance the application of EBM solutions to resource management. The use of these innovative protocols and methods to enhance management of coastal and marine ecosystems, protect its biodiversity and increase expertise and skills of resource managers respond to increasing environmental and human threats are in compliance with the international commitments Caribbean countries have committed to achieve the UN Sustainable Development Goals in particular SDG 14. In the present report, the seven expected project’s results are documented, summarizing for each result the main achievements and analysing experiences and lessons learnt. The goal is to contribute to the development of future EBM-DSS applications in the Wider Caribbean realizing that further efforts will be required to advance priority actions on the ground, with extended mobilization of stakeholders and resources in the pilot areas and continued monitoring.

Globally, project results will need to be continually shared with other regions and at relevant fora with similar island context, such as the Global Islands Partnership (GLISPA) dedicated to promoting action to build resilient and sustainable island communities through strong

partnerships, which are critical to making these innovative solutions a reality. Lessons Learnt for each of the project's expected results are presented at the next section.

Project Results

- **R1:** Evaluate & expand existing *Regional Database of Marine Protected Areas (MPAs)*
- **R2:** Selection, planning & implementation of EBM/DSS pilot sites
- **R3:** Pilot sites management plans, & priority actions prepared and implemented
- **R4:** Promote & develop technical skills MPA practitioners to run the DSS
- **R5:** Establishment and sustainability of the DSS in regional systems
- **R6:** Document the monitoring and evaluation process for further institutionalization and replication of the methodology
- **R7:** Document pros and cons, its challenges and lessons learnt to promote expansion and further use of the methodology

Lesson Learnt from Project results

Result 1. The Regional Database of Marine Protected Areas improved by effectively applying the EBM approach in selecting data for target areas

The Caribbean Marine Protected Area Network and Forum (CaMPAM) is an integral component of the programme for implementation of the Protocol concerning Specially Protected Areas and Wildlife (SPA/W) under the Cartagena Convention. CaMPAM has developed a Marine Protected Area (MPA) database to provide detailed and standardised information on MPA in the Wider Caribbean with initial funding from Swedish International Development Cooperation Agency and over the last 20 years, also from other UN Environment partners and donors. The database has remained by far the most comprehensive source of MPA data and management information on the Wider Caribbean region.

At the onset of the EBM project, information in the CaMPAM database consisted of 320 MPAs from 33 Caribbean countries and territories, and a total of 65 fields compiling information in four main categories: identification, legal aspects, physical description and management issues. The database has been populated by voluntary contributions from MPA managers and other CaMPAM experts. Among main challenges experienced is the lack of dedicated long-term funding, many data gaps, for some countries more than others.

During project implementation, the CaMPAM database was independently evaluated and information for more than 80 MPAs have been revised and adjusted. Following recommendations from this evaluation, the structure of the database was simplified and reduced to a total of 45 fields with integration of more quantitative information being currently considered by UN Environment - CEP. Hence, as a significant achievement, CEP was able complete re-structuring of the database from a MS Excel File to a geospatial structure and expand its interactivity with users. In fact, currently, the database displays an online interactive map generated with QGIS Cloud platform, facilitating the specific searches for any of the fields and allowing the download of information in multiple formats: SHP package, KML, XLS or as a Web Mapping Service (WMS). Users also have the possibility to share photos, videos and audio through interactive buttons, and generate statistics and reports. In addition, an online strategy to continue its updating process has been prepared and is ready for use through a KoBo Toolbox application, which is easy to be accessed (via smart phones).

As a result of project implementation, the database contains information for a total of 1069 Caribbean marine and coastal MPAs from 44 countries, being interoperable with the Word Database on Protected Areas managed by the UN World Conservation Monitoring Centre (WCMC) with support from IUCN and its World Commission on Protected Areas (WCPA). It also allows for the addition of other quantitative fields, as needed in the future (Figure 1). The long-term success of this initiative and its use in the further development of EBM-DSS applications will require continued support from Caribbean MPA managers.

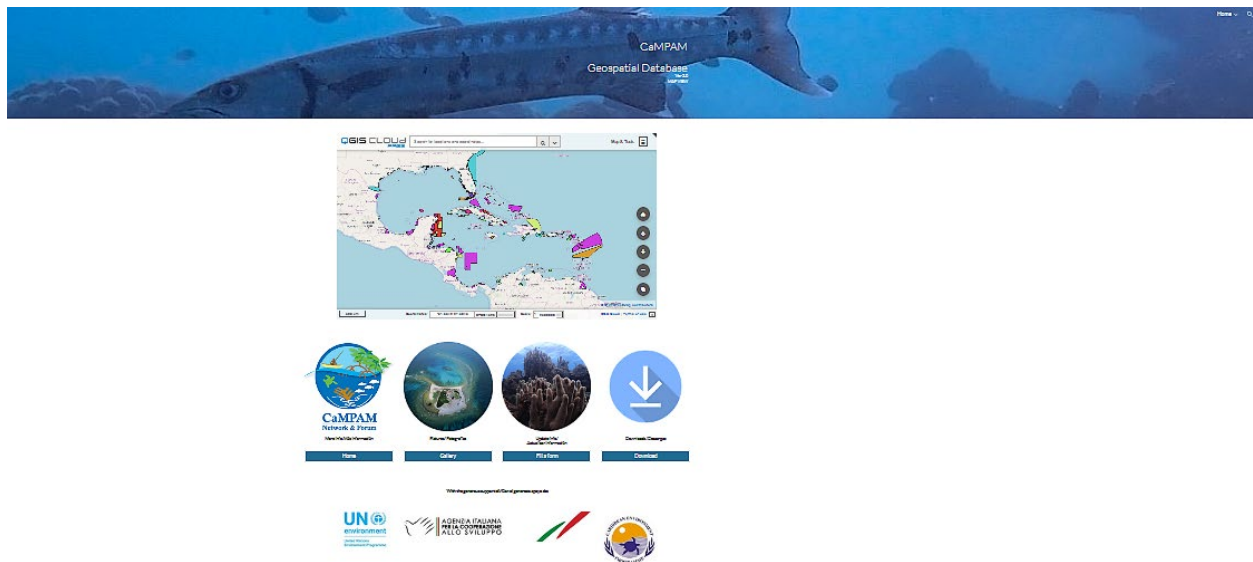


Figure 1. Web portal of the new CaMPAM MPA database.
<https://sites.google.com/cep.unep.org/campamgeospatialdatabase/home>.

Lessons to be highlighted	Lessons that demand further attention
This work allowed for strong collaboration among Caribbean MPA managers, and technical and financial support from many public and private organizations.	The use of online platforms requires good internet providers, which are not always available to all stakeholders.
The new CaMPAM geo-spatial database continues to be open and freely accessed, and in the re-structuration process only free software has been utilised, contributing to its wide use nationally, regionally, and globally.	Given the low contributions from MPA stakeholders when seeking support solely through online tools, direct personal contacts with local stakeholders is key to secure their engagement.
A friendly and comprehensive CaMPAM MPA database can now be accessed via online interactive maps, generating statistics and reports easily, better responding to users' needs.	The CaMPAM MPA database is a long-term initiative and as such require long-term funding, either through projects, increased and dedicated budget as well as greater participation from Wider Caribbean countries.
An updating strategy for this CaMPAM MPA database has been identified and ready to use. (CaMPAM MPDA Database)	In order to revised and re-structure its structure as more quantitative information become available, a small team with sufficient technical expertise is highly recommended.
New alliances with similar initiatives have developed and future work is being planned.	Aiming at building governance, CEP has taken the leadership to integrate multiple existing regional conservation initiatives to create a reference database harmonized with the WCMC WDPA. This will provide a unique integrated database where countries and partners can find the same information and standards across the whole region.
Results from project implementation and application of EBM-DSS have been shared at the regional level through Caribbean conferences and relevant fora.	The EBM-DSS has triggered the use of the tool for planning processes on MPAs. Organizing a special database containing bio-ecological and socio-economic data in the study areas in the Dominican Republic would improve its use.

Result 2. Selection of site specific and development of a DSS pilots test

In May 2015, a section of the Dominican Republic's north coast and adjacent marine environment, in the Provinces of Puerto Plata (1,811 km² and 321,597 inhabitants) and Montecristi (1,888.12 km² and 135,710 inhabitants), was selected as the project EBM-DSS pilot sites (Figure 2). Such a selection was made in recognition of the area's high ecosystem diversity (e.g. dry forest, mangroves, sandy beaches, seagrass and coral reefs), high historical value with

dozens of Spanish shipwrecks from the XVI and XVII centuries, and great socio-economic significance from fishing to animal husbandry, tourism and marine transportation (port infrastructure and marinas). In fact, these provinces have been declared “developing areas” to promote their agricultural production (rice, bananas, cocoa, vegetables, citric, coffee, cassava, plantain and sugar cane). The entire area was recently declared as the North Marine Sanctuary and administered by MARENA, encompassing seven protected areas in Puerto Plata and five in Montecristi.

In the June 2016, PROGES lead the first mission aimed to carry out a first general assessment of the area’s complexity and diversity and about 35 key stakeholders from local institutions and private organisations were contacted. As a result, project partners agreed to develop two separate pilots, one for Puerto Plata and a second for Montecristi, due to the differences in the area’s characteristics and interventions expected to be needed (Figure 5).

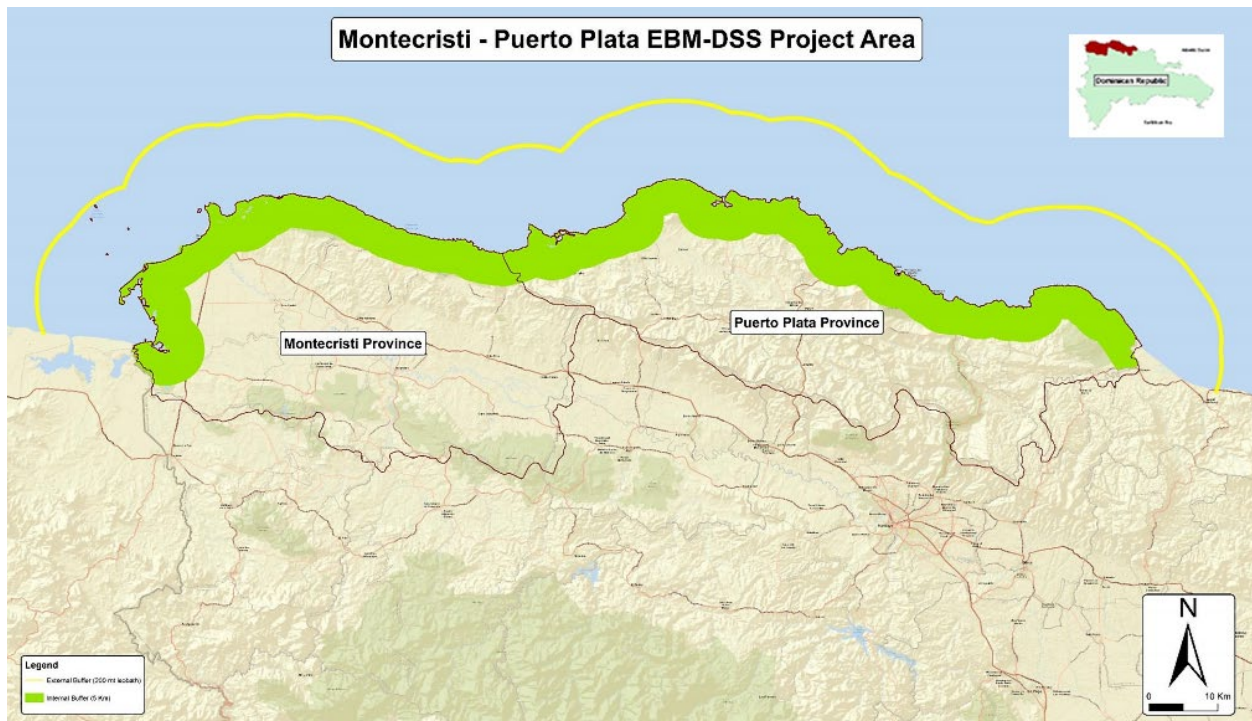


Figure 5. Location of pilot sites of Montecristi and Puerto Plata in the Dominican Republic. The area to be managed by EBM was included within a buffer of 5 km inland from the coastal edge (in green colour) and the marine space up to 200 m isobath (yellow line). Map generated by the Dominican Republic EBM-DSS Project working team.

A first workshop (October 2016) was organised with an interdisciplinary group to analyse the areas’ environmental, social and economic ecosystem context, and to identify their special conservation challenges. Four thematic groups were established: coastal and marine ecosystems, watershed, tourism and other economic activities, thus stakeholders subdivided by working

groups, discussed and agreed on current situation of the various ecosystem components, biodiversity conservation and infrastructure. During a second workshop (December 2016), the group constructed ecosystem matrices and box-and-arrows diagrams in order to establish links between biotic and abiotic components, ecosystems services provided, and patterns of use of these services (Figures 3-4). A third workshop (June 2017) produced a set of indices and indicators for the two DSS applications, thus allowing for integration of tabular data and generation of GIS layers/databases. Finally, a fourth workshop (December 2017) worked on identification of possible cause/effect relationships between the different ecosystem components needed for recommendations of priority management actions.

During 2018 and 2019, MARENA and PROGES guided the gathering of specific information, improvement of the online database with the ecosystem components, streamlined indicators, and collected field information to establish monitoring protocols, and to better assign responsibilities accordingly with the interdisciplinary group jurisdiction and capabilities. As a result, four EBM cards summarizing priority actions were produced: mangroves, wetlands, watersheds and agriculture for the Montecristi and watersheds whereas for Puerto Plata these focused on dry forest, karstic system and commerce.

This methodology developed by PROGES, consisting of a preparatory phase and four dedicated workshops were utilised in the establishment of the two EBM-DSS pilot projects in Dominican Republic using the proprietary software Integrated Spatial Planning (ISP) versions 4.0 and 5.0. In the process a written user manual for future applications was developed with training for capacity building delivered for various stakeholders in the Dominican Republic.

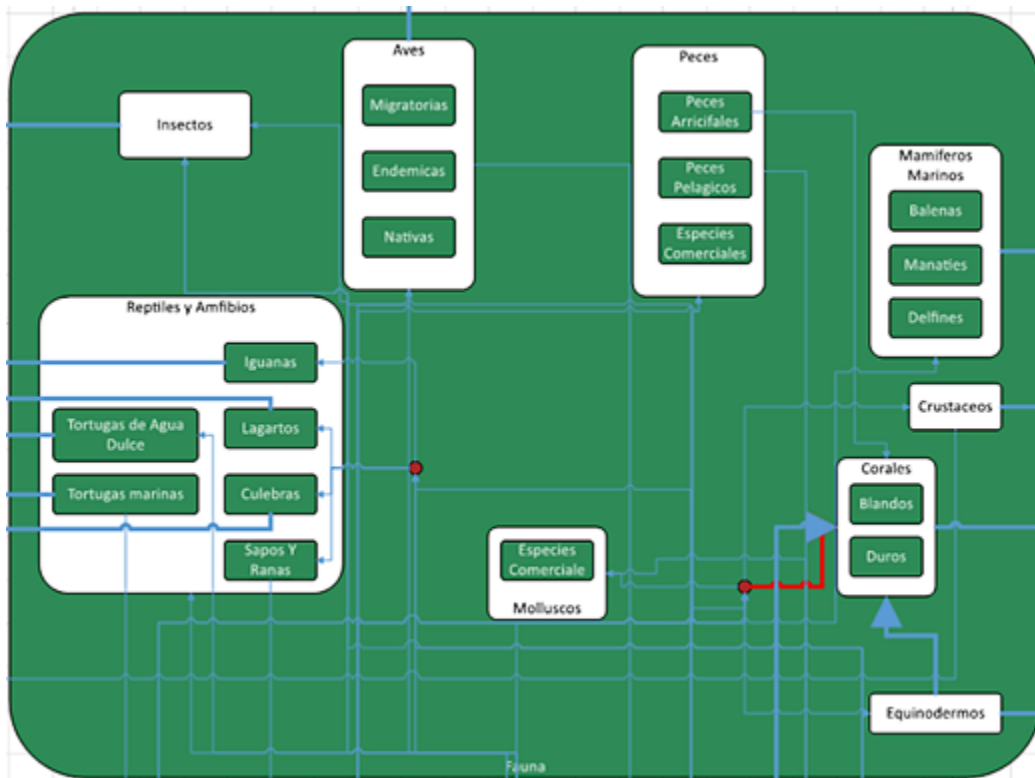


Figure 3. Example of the diagram structure and interactions for coastal and marine biodiversity.
Courtesy of PROGES.

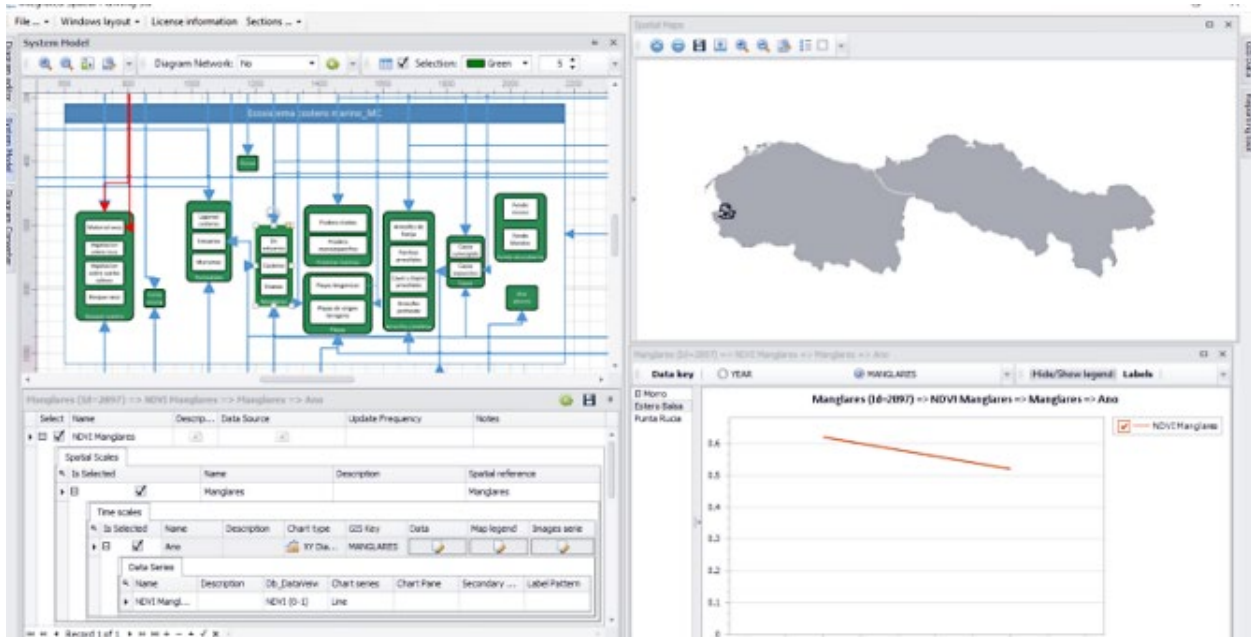


Figure 4. Visualisation of the Dominican information in the ISP software. The main window of the software has the system diagram of one of the pilot areas (top left), maps (top right), the list of the indicators with the temporal and spatial options (bottom left), tables or charts (bottom right).

The success of the DR two pilot project is directly linked to the high and active participation of the interdisciplinary group, comprised of around 50-60 different key actors with diverse skills and degrees of knowledge and experiences, capable of analysing the various topics involving EBM/DSS analysis and recommendations. This remains a dynamic process that demands permanent communication and engagement strategies at local and national levels in order to obtain balanced and comprehensive recommendations.

Lessons to be highlighted	Lessons that demand further attention
The broad participation of stakeholders with different expertise proved essential for completion of the EBM-DSS pilots. Stakeholders had good knowledge and understanding of the ecosystems in question and a positive attitude.	The interdisciplinary group is dynamic and requires permanent close contact and commitment of the coordinating agency in order to keep its engagement in planning activities.
The EBM-DSS needs substantive specific information, from different institutions and many ecosystem components, organized in a functional database, with means of data verification. Improving the efficiency of	Information gathering can be a slow process, demands political and administrative approval and defined protocols for standardization of data. Often information is not available in digital format or needs to be

standardized data collection is essential in the establishment of proper indices and indicators needed in EBM-DSS process.	extracted from published and unpublished technical reports. Procedures for data sharing should be established as early as possible in the process. It usually requires written user agreements and inter-sectoral cooperation.
Enabling effective communication to local audiences is needed to maximize intake and enhance ownership of the EBM-DSS process and results.	The visualization of a specific part of the system can become complex, a compromise should be found between realistic descriptions of the system and a detailed, but not confusing, diagram.
Monitoring and analysis of physical-chemical and biological parameters are key in understanding and defining the current state of the ecosystems to be managed, for the project period and beyond, to assess its effectiveness.	The use of a proprietary software requires future users to have a funding mechanism in place. There were calls for the use of free software, even if not with the same capabilities, as well as for less manual data entries in the ISP software.
The ISP software package is a desktop-based application that has been designed for use of non-technical and non-scientific persons, runs in Microsoft Windows and is great in visualizing the various ecosystem components and subcomponents, integration of several type of data and generation of reports, tables and maps and other associated figures.	Participatory analysis (interdisciplinary groups) can lead to biased recommendations if a complete representation of stakeholders is not available.
EBM-DSS can be a complex process that ends in a set of streamlined priority actions, and their effective implementation would need to integrate all available resources, including those from other projects with similar objectives.	

Result 3. Systemic management plans and priority management actions

The collective construction of these EBM-DSS pilots are summarized in management options for at least two of the ecosystem components for each working area: mangrove and coral reefs ecosystems in Montecristi, and mangrove, agriculture and watersheds in Puerto Plata, based on detailed analysis of the EBM cards. The NDVI (Normalized Difference Vegetation Index) is one of the indicators used to help in identifying patterns of change, which may vary across various mangroves patches. The analysis considered three different kinds of ecosystem services provided by mangroves: provision, regulation and support, and cultural (Figure 5).

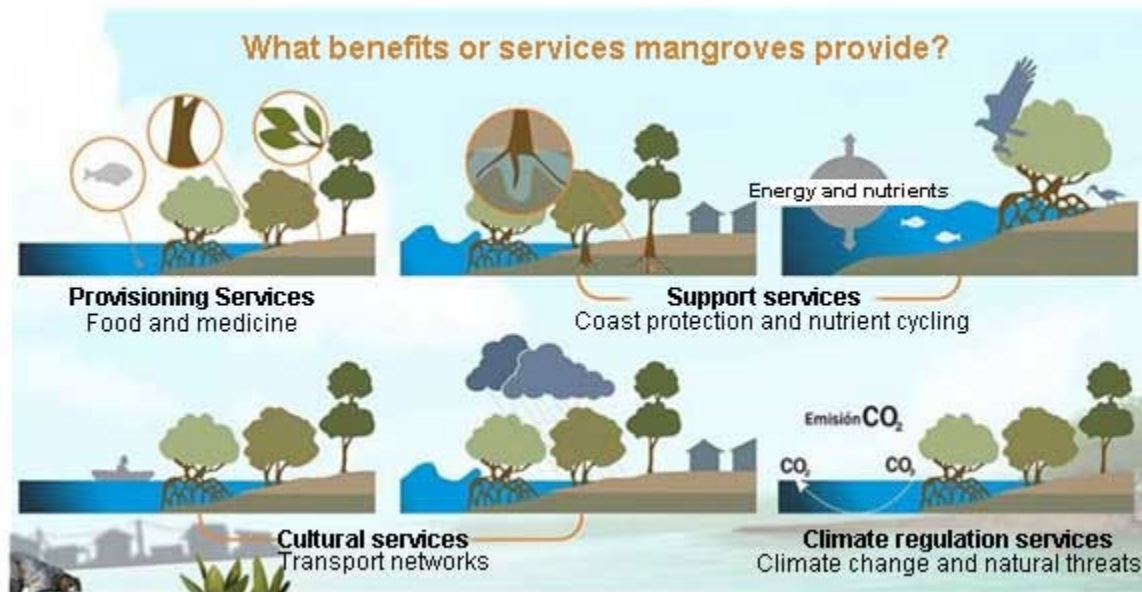


Figure 5. Main ecosystem services considered for mangroves in Dominican Republic. Courtesy of PROGES.

The proposed 11 priority actions for mangrove and coral reef ecosystems contemplated the establishment of a special inter-disciplinary working group and meeting strategies under the coordination of MARENA to continue data collection and improvement of the associated databases, the revision and updating of inter-institutional agreements and integrated planning to increase synergy among various projects and key actors, such as other ministries, universities, NGO's, private enterprises and local entities¹. With this new way of planning and interacting, management actions developed are expected to improve and conserve mangrove ecosystems in Montecristi and Puerto Plata.

As a pilot project, the final management proposal resulting from the DSS process includes a complete analysis for the four selected ecosystems inside the two EBM-DSS pilot areas, with analysis of the current state and changes overtime, and priority actions for a) monitoring, b) conservation, c) evaluation/feedback. Management actions developed for one ecosystem may vary from one area to the other depending on the results of the detailed analysis. In addition, the management proposal includes recommended technical/scientific actions for each ecosystem considered. The description of the methodology and the outcomes of the final management proposal were presented during a final project workshop.

In order to secure the successful implementation of priority recommended actions, including those outside of MARENA jurisdiction, they are encompassing activities from the Coastal

¹ A similar analysis for the other three selected ecosystems followed the same procedure described above, but not are presented in this summary document.

Biodiversity and Tourism (*Biodiversidad Costera y Turismo*, BCyT) project, a GEF (Global Environmental Facility) funded project aimed at gathering data to ensure conservation of the biodiversity needed to respond to the increasing vulnerability in the coastal environments, while at the same time representing an opportunity for the sustainable development of tourism and associated physical infrastructure. Together they will contribute to the improvement of the database in the study area, feed key indicators of the EBM-DSS system, and in this way give continuity to the results of both projects. Other aspects to explore in the near future include the maritime, fisheries and enforcement authorities, in order to facilitate the way forward in responding to other threats from pollution, illegal activities and unplanned agricultural development.

Lessons to be highlighted	Lessons that demand further attention
Active stakeholder participation along each step of the EBM-DSS methodology is essential for the successful conclusion of the pilot projects. Good quality standardized data and indicators based on that are crucial components.	Availability of funding and other human and logistic resources may affect achievements; thus, good planning is needed to keep trust and enrolment among stakeholders.
Implementation of management proposals based on DSS concepts will need a permanent EBM inter-sectoral coordinating unit with good understanding and skills to enable decision-making for planning, zoning and regulations at the national level.	Feedback and evaluation of the effectiveness and performance of the management proposal needs long-term monitoring and adjustments when required.
Synergies among different projects being implemented in a given country such as the Dominican Republic are essential for efficiency and sustainability of results.	Further develop and consolidate coordination mechanisms in the Dominican Republic to ensure data standards and sharing are sustained beyond the span of a particular project. The experiences from the two pilot sites in the Dominican Republic, indicate that sustainability will also come from dissemination of EBM-DSS principles at local level as other Projects, i.e. <i>Biodiversidad Costera y Turismo</i> (BCyT) and the <i>Red Arrecifal Dominicana</i> have actively pursued and are now in the process of establishing their own Integrated Spatial Planning application.

Result 4. Technical skills of MPA practitioners are developed to provide adequate institutional capacity

Responding to the mandate of the SPAW Protocol to strengthen MPAs in the Wider Caribbean, the *Caribbean Marine Protected Area Network - CaMPAM* – was created over 20 years ago. Since then, the SPAW Secretariat and the SPAW Regional Activity Center (hosted by the Government of France in Guadeloupe) have provided the resources to develop a platform for assisting countries with training, communication, and financial and technical assistance. These resources, although limited, have contributed to expedite the transfer of knowledge and lessons learned to enhance MPA management across the Wider Caribbean region. Over the years, institutional partners with a similar mandate and many individuals have contributed with funding, expertise and logistics resources to implement a series of MPA strengthening activities, including the CaMPAM Training of Trainers (ToT) courses.

The CaMPAM ToT course is a two-week training activity designed originally in 1999 but updated with every planned capacity building session. From 1999 to 2015, 11 regional courses (each with 12-21 trainees) were delivered in MPAs of Saba, Dominican Republic, St. Lucia, the US Florida Keys, Trinidad and Tobago, Mexico, Belize, Guadeloupe and Grenada. The courses are enriched by exercises and visits to the local MPA; lectures by local experts; and exchanges with local communities with innovative and sustainable fishing/tourism practices. At every course, an evaluation session is held to allow the course coordinator to gather feedback from participants to improve the training programme and future courses. The ToT course remains as one of the most valued CaMPAM programme.

During project implementation, two new ToT trainings were delivered, thus contributing significantly with building capacities of nine MPA practitioners across most of the Wider Caribbean countries and overseas territories, as presented below:

- XII edition of the regional ToT course in Puerto Plata, Dominican Republic (26 Sep - 7 Oct 2016): 24 participants from eight Spanish speaking countries and 11 instructors/facilitators participated (Figure 6). The theoretical and practical training focused on the understanding and application of the EBM and the DSS tools by providing scientific information, promoting exchanges of experiences, highlighting the importance of communication strategies, and analysing case studies. Videos, field trips, interviews, and other strategies were utilised as educational tools to demonstrate the concepts of ecosystem complexity and connectivity. Additional seven course follow-up in-country activities were developed by participants (May-Dec 2017), in Cuba, Colombia, Venezuela, Panama, Belize, Puerto Rico and Dominican Republic as presented in Table 1. The completion of this ToT training course was possible thanks to the partnership with Reef Check Dominican Republic and MARENA.



Figure 6. XII edition of the CaMPAM regional ToT in Dominican Republic. Courtesy of ToT participants.

Table 1. Summary of follow-up activities at the national level subsequent to the XII CaMPAM ToT edition (Spanish speaking countries)

Organization / Country	No. participants	Main achievements / benefits
Centro Nacional Áreas Protegidas Ciénaga de Zapata Biosphere Reserve, Cuba	30 participants 23 MPAs managers 6 instructors, 3 ToT participants	Training on ecosystem services, economic valuation of coastal and marine resources. Standardization of monitoring protocols.
INPARQUES Parque Nacional Morrocoy, Venezuela	14 participants, 100% INPARQUES rangers 4 instructors, 1 ToT participant	Strengthening skills and knowledge of INPARQUES personnel in recognition of ecosystem services, monitoring and planning protocols. Integration and communication strategies were promoted.
HJR Reefscaping & Departamento Recursos Naturales, Puerto Rico	28 participants 5 instructors, 2 ToT participants	Increased knowledge of coral reef ecosystems and understanding of protected species regulatory framework. Improvement of communication strategies.
Fundación Omacha, CORALINA, Parques Nacionales, Colombia	489 participants in 18 local and national mini-workshops 3 ToT participants	Improved education and communication strategies and disseminated? knowledge acquired in the ToT course. All participants obtained? documentation in digital format contained in specially generated USB memory for training.
Universidad de Panamá, Áreas Protegidas – MiAmbiente,	24 participants 5 instructors, 2 ToT participants	Exchange experiences among parks rangers (Pacific and Caribbean). Greater understanding of oceanographic processes, monitoring protocols & research processes.

Organization / Country	No. participants	Main achievements / benefits
Fundación MarViva, Panamá		
MARENA & Fundación Punta Cana, Dominican Republic	117 participants 6 instructors, 6 ToT participants	Preparation of a special presentation for different groups of fishermen. Better understanding of marine ecosystems dynamics, analysis of fishing threats, including illegal fishing. Better communication strategies.

- XIII CaMPAM ToT regional course Cave Hill Campus, Barbados (16-26 April 2018): 21 participants, 14 English speaking countries, 9 instructors (Figure 7). Dedicated technical support was provided by the Centre for Resource management and Environmental Studies (CERMES), University of the West Indies (Cave Hill Campus) in Barbados.
- Additional funding for this training was received through a partnership established with IUCN/BIOPAMA project. Course contents were similar to the XII edition. Additional four small grants allowed the development of course follow-up activities at the national level (Table 2).



Figure 7. XIII edition of the CaMPAM regional ToT in Barbados. Courtesy of ToT participants.

Table 2. Summary of follow-up activities at the national level subsequent to the CaMPAM XIII ToT edition (English speaking countries)

Organization / Country	No. participants	Main achievements / benefits
Nelson's Dockyard National Park Antigua and Barbuda	26 participants 2 ToT participants	Analyzed historic rapid assessment of selected marine and coastal ecosystems on the marine environment around the park, to further populate the Dept. of Environment's database.
Hol Chan Marine Reserve (HCMR) Belize	26 participants 1 ToT participants	Educating new key stakeholders in this MPA, including issues related to their activities within the boundaries of the Reserve. management actions. Stakeholders have a general feeling that HCMR has begun to recognize the importance of their different sectors, their contributions, and the need to include them into the decision-making process.
Oracabessa Bay Fish Sanctuary Jamaica	45 participants, 1 ToT participant	Conducted a self-assessment exercise and the discussions with the Sanctuary stakeholders (MPA staff, local fishers, and others) showed that EBM is clearly much bigger than a fish sanctuary and they do not have the authority to implement full EBM approach. Help to improve ability for habitat data collection and to raise the awareness of EBM among our staff members.
Soufriere Marine Management Area (SMMA) and Pointe Sable Environment Protection Area (PSEPA) St. Lucia	50 participants, 2 ToT participants	Responded to the need of increasing the understanding of the PSEPA residents about Environmental Protection Areas (EPA), its resources and regulations. Education was seen as great management tool.
Trinidad and Tobago	12 community leaders, 1 ToT participant	An Introduction to Community Small Business Planning was conducted with the support of the Environmental Management Authority. They highlighted how livelihoods of many communities are dependent on the assets of protected areas. They recognized the need to increase knowledge and opportunities through community business plans and business proposals.

Other educational activities were conducted, which are presented within other project results.

Lessons to be highlighted	Lessons that demand further attention
Dedicated theoretical and practical ToT courses have proved to be one of the most valued activities of the CaMPAM programme, and essential as reinforcement of EBM concepts and understanding of DSS tools.	Two weeks of training can be demanding in resources, thus shortening and focusing on practical activities has been suggested to strengthen training activities in the future.
The ToT course contents are adaptable to specific needs, and with the support of the region experts integrate latest scientific advances and emerging issues of relevance to the region	Written course manuals are available, but they demand regular updates, thus a special strategy need to be enforced. Online tools are good alternatives to be considered.
A CaMPAM expert group was established and may collectively contribute in re-structuring and strengthening future editions of ToT course.	The viability of follow-up activities is dependent on the availability of funds and/or support from partner organisations. A strategy for resource mobilization dedicated to small-scale MPA grants needs consideration.
Follow-up activities at the national level significantly expand training benefits and support exploring innovative solutions to the management of protected areas, hence they are considered key to the sustainability of ToT courses.	

Through the efforts fostered under the EBM-DSS Project, partnerships were concluded with regional organisations, both governmental and non-governmental, as well as academia and other stakeholders. In addition, counterpart financial contributions were secured to carry out project activities, such as the CaMPAM ToT course 13th session in Barbados (above) and the 2017 Regional Workshop on EBM-MSP in Merida (see Result 5 below).

CaMPAM has been an important backbone of marine protected areas conservation and management in the Wider Caribbean for over 20 years. Many MPA managers in the Caribbean developed their professional career through this programme. Thirteen editions of the ToT with almost 100 local follow-up training activities, dozens of grants and an active communication platform have been implemented by UN Environment-CEP with donors and partners' support, as part of its MPA capacity building programme. Communication and exchanges on MPAs are promoted through the CaMPAM email circulation List, (with ca. 1000 subscribers and ca. 30 messages posted per month). Detailed information on CaMPAM training, communication and financial assistance tools are available in the [CaMPAM website](#), and in [Bustamante et al.](#) (2018).

It is clear that MPA management is a main driver in the region and has the potential to become the basis for regional application of DSS methodology. Further collaboration among institutions and projects will be vital for effective funding and continued capacity building under CaMPAM, which could be expanded to include partnerships with private sector and focus on specific sites in the region.

Result 5. Support the uptake of regional DSS applications, conservation and sustainable management of coastal and marine resources

The future development of EBM-DSS applications in the Wider Caribbean has received the support of the UN Environment – CEP and the Regional Activity Centre for SPAW Protocol (SPAW-RAC) through the development of regional workshops, as described below:

- “Marine Spatial Planning and Decision Support Systems in the Wider Caribbean Workshop”, Merida, Mexico (November 5, 2017): Carried out in coordination of the 70th GCFI annual meeting, it aimed at an assessment of the region’s institutional capacities, learning about existing approaches and methods in Marine Spatial Planning (MSP) and DSS and exploring increased collaboration with governments a local and international partners. The possibilities for combination of the PROGES method and MSP Caribbean initiatives were also explored. The workshop was attended by 50 participants from across the Wider Caribbean including partners, government representatives, experts, and non-governmental organisations. Their recommendations were captured in four working groups: MSP processes, stakeholder engagement, data collection and mapping, and enforcement and compliance (Table 3).

Table 3. Lessons learned and recommendation from the MSP and EBM regional workshop

Working group	Recommendations
MSP Processes	<ul style="list-style-type: none"> - Main challenges to MSP process include government commitment to incorporate MSP into MPA networks, as well as into legislation and designations of new protected areas. - It is important to use friendly language and terminology (noted the usefulness of using UNESCO terminology). - Additional challenges include poor data management for designation of best areas and conservation alternatives; low government commitments to SDGs and other factors; lack of understanding of new technology developments; variable stakeholder engagement; limited funding; low governance to handle transboundary issues; complex institutional frameworks; need for good performance indicators; and better understanding of ecosystem services.
Stakeholder engagement	<ul style="list-style-type: none"> - Management expectations and evaluation of miss-information was critical to increase stakeholder engagement. Core message is that “one size does not fit all”, and stakeholder engagement is context specific. It is important to incorporate the various ecosystem components and all stakeholders. - Including in the process, for instance, issues concerning physical conditions, and ethnic and cultural aspects was seen as important to address beyond the scope of MSP in order to properly engage stakeholders. - It was seen as essential to develop incentives and address deficiencies that result from gap analysis, create opportunities and consider the ability for intergenerational

	<p>expansion; legal institutions (formal and informal) linked/guided by the various processes.</p> <ul style="list-style-type: none"> - Networking requires that both aspects (people and ecology) be integrated, which relates back to governance under formal law and legal mandate, as well as informal processes, to allow this to happen. - Engagement requires the use of key words, and considerations such as key species, gender/generational processes, and not being focused solely on specific products.
Data collection and mapping	<ul style="list-style-type: none"> - The need for the natural flow into habitat data, and challenges in region regarding data collection was highlighted. - There are data gaps in terrestrial extractives and socioeconomic data needed for MSP/DSS. - Available data is sometimes out of date. - It is important to continue progress made in developing standards for data collection and analysis. - Information needs to be used in a meaningful way - several geospatial technologies could be utilized, building on the strengths of entities and institutions already using them. - Progress via regional monitoring protocols such as the Global Coral Reef Monitoring Network (GCRMN) for coral reefs, are relevant to analyse results based on standardized data collection. There are other examples that can be used to guide ecosystem-based data collection, efforts in the region should include the need to incorporate both bio-physical and socioeconomic aspects. - Ecosystem and “blue services” (blue economy) have data gaps that need to be addressed.
Enforcement and compliance	<ul style="list-style-type: none"> - Socioeconomic factors affect legal processes and need to be considered at different levels. There is need to develop awareness and recommendations for enforcement authorities. - Acknowledged that there will never be a 100% rate of compliance with regulation. - Constant threats call for adaptive responses, for which purpose a “bottom-up approach” is promising. MSP enforcement is facilitated by an “intelligence-based approach” sharing patrolling mechanisms, training and education based on science and monitoring. - It is important to build awareness to reach various stakeholders: the “top-down approach” in this case is also necessary. - Adjust the message as time passes. Be creative to pass the message to stakeholders, increase understanding, consistency, and transparency. - Community engagement is very important, especially in regard to perception and encouraging community involvement and trust. - Effective enforcement requires innovative technology.

- “Regional Workshop on Ecosystem-Based Management and Application of Decision Support Systems in The Wider Caribbean Region”, Panama City, Panama (December 4 - 6, 2017): provided theoretical and practical training to 41 MPA practitioners in the Wider Caribbean Region illustrating EBM concepts and practical exercises utilising data from Dominican Republic pilots. In this way, government officials, non-governmental organisations and resource managers, as well as recognised scientists and experts analysed and worked with the special application developed by PROGES. Various participants expressed interest in developing future applications utilising this step-by-step methodology and indicated potential foreseen uses of the DSS software in their countries. For instance, to tackle responses to catastrophic events (powerful hurricanes),

as in the case of the lesser Antilles, or challenging ecosystem recovery actions, as in the case of mangroves in the Colombian Caribbean coast.

- “Special Session On the Project Biodiversity for Sustainable Development in the Caribbean through Ecosystem Based Management (EBM-DSS)”, Panama City, Panama (December 5, 2018): conducted in association with the 8th Meeting of the SPAW Protocol, Scientific and Technical Advisory Committee, where 14 government representatives, 6 nongovernmental organisations and project partner representatives, were briefed about the status of project implementation and discussed next steps for technical and political support in order to make significant progress in the use of EBM approach and DSS tools at a regional scale.

Through in-depth analysis and technical discussions at the regional EBM-DSS workshops (Figure 8), participants acquired skills and an overview of the kind of complex topics involved when developing EBM implementation approaches, or planning for specific applications either at national or regional scales. The ISP tool developed by PROGES was seen as one flexible enough that every step can function as a stand-alone part towards solutions. Such regional workshops also allowed for comparisons of the ISP with other software like Seasketch, Marxan, and MSP which have similar purposes, and currently are being utilized by different organisations in the region. While each one has pros and cons, they can certainly complement each other, depending on specific needs (Figure 9).

Regional workshop in Merida, 2017



Regional workshop in Panama, 2017



EBM Special session, Panama, 2018



Figure 8. Broad participation in regional workshops exploring potential use of the project's EBM/DSS tools.

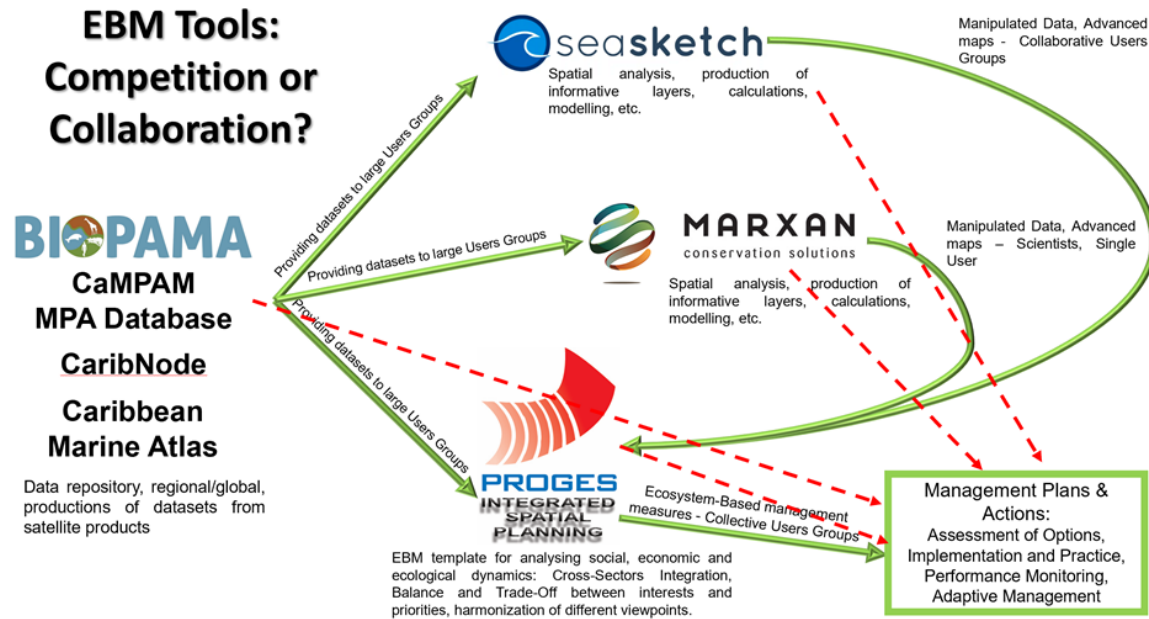


Figure 9. Relationship among different software/tools designed for EBM application and in use in the Wider Caribbean

Lessons to be highlighted	Lessons that demand further attention
MPA management represents an important focus for up taking of EBM-DSS methodology in the region. The DSS methodology is robust to address emergency/catastrophic events.	The availability of data quality can be a bottleneck in the development of other EBM-DSS applications, especially if countries have insufficient capacities for the data compilation needed for the development of feasible indicators.
It is important to promote synergies and partnerships in developing EBM-DSS applications among current/future initiatives in the region, thus build-upon plans and programmes should be an-going effort.	EBM-DSS needs to be enhanced through social media in order to provide greater dissemination of EBM-DSS importance and applications across the region and global scales.
Dissemination of the type of products resulting from EBM-DSS applications are needed to increase buy-in and uptake of EBM in the region.	Gap analysis to guide DSS design and criteria, is considered a first step in many EBM tools, making it a good starting point to explore further development of DSS applications.
Workshops' participants recognised the need for a second phase of the EBM-DSS project, thus continuation / expansion of pilots and strengthening of Regional Nodes are both envisioned.	Support dialogue and secure commitment from partner institutions to assume the role of Regional Nodes

EBM concepts and tools demand continued public awareness and education programmes, and step by step guidance to successfully complete specific applications.	Replicate the social media campaign at the regional level on EBM and consider focusing at the national levels on partnership with relevant institutions and stakeholders
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Result 6. Technical, operational and financial topics for the establishment of new DSS sites

In order to explore the possibility of establishing new DSS site applications, UN Environment – CEP took advantage of having spread the concepts and tools of EBM-DSS application via regional workshops and through two pilot sites in Dominican Republic to develop a strategy to establish EBM-DSS regional nodes. In this context, a regional node was foreseen as a central institutional hub for EBM-DSS uptake by leading the following steps:

- organize public awareness and education activities,
- increase capacity development beginning with their own in-depth training,
- help in the dissemination of awareness materials,
- identify potential development of small-scale pilot applications within its collaborators,
- develop practical training activities for further identification of potential pilot sites applications.

In this way, the first target was the establishment of the EBM-DSS regional node for English speaking countries, with CERMES as the lead institution. The selection was based in recognition of their long history of active involvement in the conservation of natural resources in the Eastern Caribbean, successful role in conducting the XIII edition of the ToT course and their current involvement in other regional projects dedicated to improve governance and sustainable fishing initiatives across the region. They developed a dedicated web page (<https://www.cavehill.uwi.edu/cermes/projects/ebm-dss/project-home.aspx>) project fact sheet, published the protocol and the ISP software, provided useful links for specific literature, among others. In addition, CERMES led an initiative to submit a manuscript to a scientific journal where discussions on the EBM benefits are presented. This manuscript was a joint effort among project partners.

CERMES, as the lead EBM-DSS regional node is now in a position to foster new opportunities for DSS pilots at local, national and regional levels and across audiences (academia, public and private sectors). However, they have also stated clearly their interest in continuing promoting the PROGES methodology only if it is a part of a toolbox where other EBM software are also considered and promoted.

The UN Environment – CEP also invested efforts in the establishment of a second EBM-DSS regional node, for Spanish speaking countries, particularly with INVEMAR, the Marine and Coastal Research Institute in Colombia and the National Parks Special Unit also in Colombia. Despite common interests, it was not possible to materialize this initiative, due to time span and administrative delays in finalizing contracts. Nonetheless, both organisations remain interested

in becoming the EBM-DSS regional node for Spanish speaking countries and agreed to collaborate if a second phase proposal can be developed.

A third attempt was explored, with the Royal Netherlands Institute for Sea Research (NWOI) looking at the establishment of an EBM-DSS regional node for the Dutch speaking Caribbean, and potentially further partnership with neighboring French speaking countries. They were very enthusiastic regardless their late engagement in the project, which indeed is an opportunity which can be developed taking into account the Dutch Caribbean Nature Alliance, their regional network for protected areas aimed to assist park management and conservation organisations on the islands of Aruba, Bonaire, Curaçao, Saba, St. Eustatius and St. Maarten.

The expectation is to involve and establish functional linkages among the EBM-DSS regional nodes which will require follow-up and strengthening of cooperation at all levels. With the goal of facilitating uptake and integration, this cooperation can be developed on the basis of:

- cataloguing biodiversity,
- conducting data gap analysis,
- identifying stakeholders and ecosystems in most need,
- developing scenario analysis,
- monitoring and evaluating,
- developing/updating management plans, and
- provide management options recommended by decisions support systems.

It is envisioned that new pilots of EBM-DSS applications will deal with planning responses for catastrophic events or to explore viable ecosystem restoration measures, but specifics need to be developed through a second phase proposal.

Communication among EBM-DSS regional nodes as well as project stakeholders was encouraged by CEP through the use of Teamwork platform, kindly provided by SPAW-RAC. A dedicated platform was assigned for the EBM-DSS project stakeholders since March 2019. Teamwork allowed for sharing materials, documents and information, exchange experiences in resource management, and for the collective construction of preliminary agenda for future work. A total of 79 participants from the Wider Caribbean were part of this EBM group.

In addition, a social media campaign was launched by UN Environment – CEP Communication’s Programme. The campaign commenced on May 1, 2019 and ended on May 31, 2019. Pre-campaign messages were posted on April 29 and 30 using Facebook and Twitter. Target audiences (on both platforms) were policymakers; experts and researchers in the field of marine biodiversity and related areas; general public. Languages: English, Spanish and French. Posts were created using technical data from the project proposal, reports, assessment results, meeting outcomes and other material, including photos, from partners. Other sources such as articles and infographics relating to marine biodiversity and ecosystems were also used to diversify the material uploaded.

In Twitter, 25 campaign messages were posted, with most impressions (539) received for the Tweet that described the relevance of ecosystem-based management in the Caribbean (also highest engagements: 13). In comparison, in Facebook, 36 posts were made (once a day, from Monday to Friday), with the greatest interactions seen in English messages compared to Spanish and French (3,847; 1,505; 1,410). The poster from the Nature Conservancy on biological diversity and ecosystems that was published on the second day of the campaign received the most interactions.

Lessons to be highlighted	Lessons that demand further attention
<p>EBM-DSS applications deals with complex situations that can be facilitated through functional regional nodes, that share similar cultural and political conditions. By working together, they can disseminate successful experiences and confront common challenges, thus replicating and upscaling proper management regimes within and beyond national boundaries.</p>	<p>There is a need to keep building up synergies with other regional initiatives such as IUCN-BIOPAMA project, GEF-CLME+, EBM Tools Network, and UN Environment-CaMPAM Network. The integration of private organisations and other key stakeholders are also relevant in developing successful EBM pilot applications.</p>
<p>New EBM-DSS site applications should conduct gap analysis, determine local capacities to use available data, collect good quality data at all levels, define indicators and state recommended priority actions, thus requiring the integration and collaboration among stakeholders at national and regional levels.</p>	<p>Interested partners need to work together in identifying sustainable financing mechanisms to support the role EBM-DSS regional nodes across the region.</p>
<p>The DSS methodology developed by PROGES has proven strong/robust enough and can be considered when planning future EBM-DSS pilot sites.</p>	<p>EBM-DSS site applications success is linked to the continued building of capacities through training, guidance and development of training products.</p>
<p>Communication strategies and protocols among EBM-DSS regional nodes must be developed in order to maintain active participation and engagement.</p>	<p>The sharing of the successes and lessons learnt from the EBM-DSS pilots is recommended as part of the enrolment of key stakeholders.</p>
<p>Social media offers several valid alternatives to reach broad audiences, and should therefore be highlighted in raising interest about EBM management in the Wider Caribbean region. Their use is recommended at all times.</p>	<p>For good communication, EBM messages should be simple and clear, and utilise local languages looking at having active responses on various stakeholders.</p>

Result 7. Consolidation and dissemination of project outputs and integration into relevant UN Environment Programmes

Thanks to this project, it was possible to disseminate EBM concepts and DSS tools to a diverse community not only across the Wider Caribbean region, but also to larger international forums, such as the following:

Miami, Florida (19 - 21 May 2015): Experts and project partners participated at a TNC regional workshop for “Developing a Shared Vision for Improved Access for Information in Marine Protected Areas Management”. The regional online platform including Caribbean Ocean Biogeographic Information System (OBIS) and Global Biodiversity Information Facility (GBIS) were noted as two relevant databases in structuring future applications of the regional DSS.

Panama City, Panama (9 - 13 November 2015): Marine Spatial Planning and its linkages with the EBM project were presented at the 68th Annual GCFI Conference. Presentations were made on strengthening the effectiveness and sustainability of planning and management processes in coastal and marine areas of the eastern tropical Pacific, the Gulf of Mexico. The EBM-DSS project sponsored a total of 6 participants.

Rome, Italy (7 - 9 March 2016): UN Environment-CEP representatives participated in the 10x20 Initiative- Conference on Marine Protected Areas towards strengthening the partnership with the main EBM-DSS project donor.

San Juan, Puerto Rico (19 – 22 April 2016): UN Environment-CEP participated in the Coastal-Marine Ecosystem Based Management (EBM) Tools Training Workshop aimed at advancing work on coastal and marine EBM in the Wider Caribbean.

Miami, Florida (1 - 4 November 2016): Evaluation of CaMPAM programmed was presented at the STAC7 Meeting of the SPAW Protocol.

Grand Cayman, Cayman Islands (7 - 11 November 2016): 13 oral presentations with 7 sponsored participants took part of the MPA Session at the 69th GCFI Annual Meeting.

Merida, Mexico (6 - 10 November 2017): 11 oral presentations with 7 sponsored participants took part of the MPA Session at the 70th GCFI Annual Meeting.

San Andres Island, Colombia (5 - 9 November 2018): 14 oral presentations with 10 sponsored participants took part of the MPA Session at the 71st GCFI Annual Meeting.

Lima, Peru (October 14-17, 2019): International launch of the re-structured CaMPAM MPA database was presented at the III Latin American and Caribbean Congress of Protected Areas, organized by IUCN.

Punta Cana, Dominican Republic (4 - 8 November 2019): 9 oral presentations with 1 sponsored participant took part of the MPA Session at the 72nd GCFI Annual Meeting. Final results of the project pilots and the online CaMPAM MPA database were presented.

Lessons to be highlighted	Lessons that demand more attention
Exchange of ideas and fruitful discussions gathered at scientific and dedicated events proved effective in securing stakeholder's ownership needed for EBM-DSS applications.	For successful results at international meetings, preparation of good technical documents, presentations and other supplementary materials are needed. This demands time and good knowledge and understanding of the EBM processes.
GCFI is an important regional forum to present and engage a broad range of MPA users, scientists, managers and fishermen on EBM concepts and application. Its MPA session supported by UN Environment-CEP has proven successful for more than 15 years.	