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The Census of Marine Life in the Caribbean: A Biodiversity Program

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Abstract: The Census of Marine Life (CoML) is an international science program to assess and explain the diversity, distribution and abundance of marine life, past, present and future. The program has three major components which are historical, exploratory and modeling, all of which are integrated into an open source database (OBIS: Ocean Biogeographic Information System) for visualization and analysis. In the Caribbean, the program began in 2004 by reviewing the state of knowledge of marine biodiversity in 10 countries of the region, as well as the establishment of a link between the CoML and research programs and conservation initiatives. An historical project coordinated in the Caribbean deals with integrating, standardizing and synthesizing the data on the early human impact on mollusc populations in a global perspective. This project is generating a Human/ Molluscs Interaction Database (HMID) containing high quality historical data, descriptions and interpretations of worldwide events, patterns, processes, and products resulting from the interactions between humans and molluscs through time. Engaged exploratory projects in the Caribbean deal with the biodiversity of the nearshore in seagrass beds and rocky shores (NaGISA), and the deep sea (COMARGE). The Coral Reef (Caricoral) and microbes (ICOMM) projects are currently under organization in the region and have already established clear goals and an action plan for their implementation within a network. The participation of the Caribbean in the Ocean Tracking Network (OTN) has also been engaged. The Caribbean has contributed with the OBIS database through the SIBM (Sistema de Información Biogeográfica Marina) of the INVEMAR in Colombia. However, there is an urgent need of identifying literature and collections that can be digitalized, georeferenced and incorporated into OBIS. The CoML-Caribbean is open to new partnerships and collaborations both within and outside the region. Within the region, it seeks to (1) integrate researchers in marine biodiversity, (2) consolidate available information on marine biodiversity, (3) learn and exchange ideas about national and regional plans, priorities and conservation policies and (4) maintain a regional committee to support CoML projects. At a global scale, it also seeks to explore opportunities for regional and international cooperation in new developing projects related to marine biodiversity. Rev. Biol. Trop. 56 (Suppl. 1): 171-181. Epub 2008 May 30.

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The Census of Marine Life (www.coml. org) is an international science program with a growing global network of researchers in more than 70 nations engaged in a ten-year initiative to assess and explain the diversity, distribution and abundance of marine life in the oceans. The program is basically aimed to answer three questions: What lived in the oceans? What lives in the oceans? What will live in the oceans? It seeks to design and implement innovative biological sampling techniques for the marine environment and to incorporate a multitude of geo-referenced species and habitat information into a digital framework for visualization and analyses (O'Dor 2003). The program has three major components which are historical (History of Marine Animal Populations or HMAP), exploratory (Field Realm Projects) and modeling (Future of Marine Animal Populations or FMAP), all of which are integrated into an open source database (OBIS: Ocean Biogeographic Information System) for visualization and analysis.

The HMAP project answers the question of what lived in the oceans by documenting

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global marine biodiversity in the past, back to 500 - 2000 years before significant human impact. Its main questions are how the diversity, distribution, and abundance of marine animal populations has been altered over the last 2,000 years and by which factors, what has been the anthropogenic and biological significance of changes in marine animal populations and by what processes have marine ecosystems interacted with human societies (Holm 2005). The exploratory field projects are focused on specific marine regions, habitats or oceanic communities. These ocean realms include the coastal and nearshore zone, the hidden boundaries of the deep sea, the oceanic central waters, the ice oceans and the microscopic life in the oceans. Within each of these realms, there are several projects, collecting data on diversity, distribution and abundance using new technologies or techniques (Table 1). The FMAP project answers the question of what will live in the oceans by predicting changes in global biodiversity in response to fishing, pollution and climate change and hopes to reveal patterns of biodiversity and model hypotheses regarding the effects of climate change or human impact on biodiversity. All data from the projects is integrated into OBIS, a dynamic, global, 4-dimensional (space and time) digital atlas that provides freely, through the Internet, species location and abundance, integrated with environmental data, maps and model outputs linking these marine databases worldwide (Wood *et al.* 2005)

In parallel, the Outreach and Education component of the CoML has among its goals to inform the public about the potential and actual contributions of the program to knowledge in marine biodiversity. This knowledge provides an excellent tool not only for science, but also for managers and policy makers, for commercial and recreational fisheries, environmental and conservation groups and other stakeholders in the oceans.

THE REGIONAL APPROACH OF THE CENSUS OF MARINE LIFE: THE CARIBBEAN

The Census of Marine Life is committed to strengthening support for marine biodiversity research at the national or regional level. In this sense, several countries have either organized nationally or joined together regionally. Such organization was carried out by engaging scientists, funding agencies, conservation organizations, managers and policy makers within the Census of Marine Life umbrella and the guidance of the international Scientific Steering Committee. One of the first steps towards the organization of the regions were the KUU (Known, Unknown, Unknowable) workshops, which review what is known, what is unknown and what will remain unknowable of marine biodiversity and ecosystem structure within each nation in a regional context. Most of the reviews prepared for these KUU workshops have been published and constitute major contributions to research in marine biodiversity. Some examples of this are the special issue of Gayana, International Journal of Biodiversity, Oceanology and Conservation which published the proceedings of the First South-American Workshop on Marine Biodiversity held at Concepción, Chile in October 2002, the special issue of the Indian Journal of Marine Sciences: Coastal and Marine Biodiversity of Indian Ocean, which published the proceedings of the KUU workshop held in Goa, India in December 2003, and the publication by Miloslavich and Klein (2005) containing the proceedings of the KUU Caribbean Workshop held at Isla de Margarita, Venezuela in June 2004. The current National and Regional Committees (NRICs) of the Census of Marine Life are Australia, Canada, the Caribbean, China, Europe, Japan, Korea, Indian Ocean, Indonesia, South America, Sub-Saharan Africa, and the USA. The Arabian Sea will soon be joining the group. The main

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TABLE 1

Census of Marine Life exploratory projects by ocean realm (www.coml.org)

PROJECTS BY OCEAN REALM	GOALS
Coastal and nearshore zone	
NaGISA: Natural Geography in Shore Areas	To inventory and monitor biodiversity in rocky shores and seagrasses from the intertidal zone to up to 20 meters in depth.
CReefs: Coral Reef Ecosystem	To conduct a taxonomically diversified global census of coral reef ecosystems and to unify and improve access to coral reef ecosystem information.
GOMA: Gulf of Maine Area Census	To document patterns of biodiversity and related processes in the Gulf of Maine, aiming to establish an ecosystem-based management of the area.
POST: Pacific Ocean Shelf Tracking	To develop and promote the application of new electronic tagging technologies to study the marine life history of Pacific salmon.
Oceanic Central Waters	
TOPP: Tagging of Pacific Pelagics	To study migration patterns of large open-ocean animals and the oceanographic factors controlling these patterns by using electronic tagging technologies
CMarZ: Census of Marine Zooplancton	To assess on worldwide zooplankton species diversity, biomass, biogeographical distribution, genetic diversity, and community structure.
MAR-ECO: Mid-Atlantic Ridge Ecosystems	To study the macrofauna and community structures, as well the processes that control their distribution in the Mid-Atlantic Ridge.
Hidden Boundaries of the deep sea	
COMARGE: Continental Margins Ecosystems	To document and explain biodiversity patterns on gradient-dominated continental margins, including the potential interactions among their variety of habitats and ecosystems.
CeDAMar: Census of Diversity of Abyssal Marine Life	To document species diversity of abyssal plains and increase understanding of the historical causes and ecological factors regulating biodiversity and global change.
CenSeam: Census of Seamounts	To determine the role of global seamounts in the biogeography, biodiversity, productivity, and evolution of marine organisms, and to evaluate the effects of human exploitation.
ChEss: Chemosysnthetic Ecosystems	To study the biogeography, diversity, abundance and distribution of deep-water chemosynthetically driven ecosystems.
Ice Oceans	
ArcOD: Arctic Ocean Diversity	To inventory biodiversity in the Arctic sea ice, water column and sea floor from the shallow shelves to the deep by compiling existing data and taxonomic identification of existing samples, and by new collections focusing on taxonomic and regional gaps.
CAML: Census of Antarctic Marine Life	To inventory species of the Antarctic slopes and abyssal plains, the benthic fauna under disintegrating ice shelves and plankton, and the nekton and sea-ice associated biota (viruses to vertebrates). To assess critical habitats for Antarctic top predators and develop a coordinated network of interoperable databases for all Antarctic biodiversity data
Microscopic Ocean	
ICOMM: International Census of Marine Microbes	To inventory the ocean's microbial diversity by developing a strategy to catalogue all known diversity of single-cell organisms inclusive of the Bacteria, Archaea, Protista and associated viruses and to place this knowledge into appropriate ecological and evolutionary contexts.

goal of the NRICs is to identify research and data priorities for marine biodiversity in the region, as well as to build partnerships, explore funding opportunities for local science, and promote CoML to local audiences.

The Caribbean Region

The Caribbean Region extends over about 2,754,000 km² in which up to 40 politically independent countries and territories can be found, each with specific sovereignty claims and marine conservation management strategies. As such, research and conservation issues require integration and regional collaboration (Miloslavich and Klein, 2005). The Caribbean is considered a unique biogeographic region with endemic species and is among the top five world hotspots for marine and terrestrial biodiversity (Rivera-Monroy *et al.* 2004). Its complex geological history starting 130 millions of years ago and the emergence of the Isthmus of Panama in the Pliocene (around 3.0 to 2.8 Ma) had major effects on marine biodiversity. The isolation of the tropical American ocean into two different realms produced isolation and environmental change which resulted in increased evolutionary divergence and radiation of species living today in extensive coral reefs, mangroves, seagrass beds, deep-shelf ecosystems and partially isolated deep basins and trenches (Collins 1996).

Despite that humans can be traced back in the Caribbean over six millennia, it is in the last 3 to 4 decades that this region has suffered a tremendous impact from anthropogenic activities such as over-fishing (Jackson *et al.* 2001), pollution and eutrophication leading to the degradation of water and land resources (Linton and Warner 2003), sediment run-off (Rivera-Monroy *et al.* 2004), diseases such as coral bleaching and mass mortalities of invertebrates (Lessios 1998, Harvel *et al.* 1999, Laboy-Nieves *et al.* 2001), habitat loss by human destruction or alteration (Myers et al. 2000, Brooks and Smith 2001), colonization by invasive species (Dulvy *et al.* 2003, Miloslavich 2007) and reduction of marine productivity

caused by the collapse of the coastal ecosystem (Jackson *et al.* 2001). These activities have led to a serious decline in marine biodiversity and to species extinction at an unprecedented rate (Solow 1995). The richness in marine biodiversity of the Caribbean, the continuous threats from tourism, maritime transportation and pollution, and the fact that human impact on biodiversity is poorly known (Loreau *et al.* 2001), demands the international collaboration of the scientific community to encourage regional analysis of existing data and to pursue basic research in some areas and ecosystems.

Given the richness and complexity in terms of history, culture, ecosystem and species diversity characterizing the Caribbean, as well as the environmental problems it is facing, it was a desirable goal to encourage regional collaboration, establish a baseline of available information and discuss future projects and actions. The Caribbean regional KUU workshop began as an idea in 2002 during the South-American KUU workshop, it was formally invited by the CoML Scientific Steering Committee in 2003 and it was held at Isla de Margarita, Venezuela in June 2004. The goals of the CoML Caribbean workshop were to (1) integrate researchers in marine biodiversity of the Caribbean region, (2) consolidate available information on marine biodiversity in the region, (3) learn and exchange ideas about national and regional plans, priorities and conservation policies, (4) explore the opportunities for regional and international cooperation in new developing projects related to marine biodiversity, and (5) create a regional committee to support CoML projects.

The workshop counted with the participation of a broad scientific community from Bermuda, Colombia, Costa Rica, Cuba, Dominican Republic, Jamaica, Mexico, Panama, Puerto Rico and Venezuela, representatives of research programs and institutions such as CARICOMP (Caribbean Coastal Marine Productivity), STRI (Smithsonian Tropical Research Institute), FishBASE, the Harte Research Institute (Gulf of Mexico studies) and IOCaribe (Intergovernmental Oceanographic Commission – Caribbean), conservation agencies such as

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CI (Conservation International) and TNC (The Nature Conservancy) and potential partners such as Petróleos de Venezuela (PDVSA), Chevron Texaco and Conoco Phillips. During this workshop, the Census of Marine Life invited the Caribbean region to establish collaborations and join several of its projects with immediate regional application, impact and relevance.

The major products of this workshop are the (1) engagement of Caribbean scientists with CoML projects, (2) establishment of a CoML-Caribbean committee and a regional network of marine biodiversity, and (3) publication of a review on Caribbean marine biodiversity. This publication gives and overview of what has been done in marine biodiversity research in 10 countries of the Caribbean (Bermuda, Colombia, Costa Rica, Cuba, Jamaica, Mexico, Panama, Puerto Rico, Dominican Republic, Venezuela, and prehispanic fisheries of the queen conch), it summarizes the major initiatives carried out in research (CARICOMP, STRI, FishBASE, HRI-GoM, IOCaribe) and conservation (CI, TNC, PDVSA, Chevron Texaco, and Conoco-Phillips) in the region and it incorporates a significant amount of scientific and gray literature, surpassing 800 references including scientific papers published in both international and local journals, technical reports, undergraduate theses and dissertations (Miloslavich and Klein, 2005). All the reviews contain a brief description of the oceanographic features of each of the country's ocean including the marine ecosystems that characterize it, a status of knowledge of marine biodiversity, the national initiatives to preserve marine life and the major threats against it. Each review also points out the unknown by identifying gaps for future research.

CENSUS OF MARINE LIFE PROJECTS IN THE CARIBBEAN

Historical component: History of Marine Animal Populations (HMAP)

One of the most emblematic species of the Caribbean region is the Queen Conch,

Strombus gigas. This species has been exploited by humans for at least 1,500 years at the Los Roques Archipielago, where impressive accumulations of empty shells can be observed (Antczak and Antczak 2005). Based on information provided in Antczak and Mackowiak de Antczak (2005) and in discussions held at the Caribbean KUU workshop, the project Early Human Impact on megamolluscs (EHIM) was envisioned. The goals of this project were to integrate, standardize and synthesize the data on early human impact on marine molluscs in a global perspective. This project argues that sustained efforts of interdisciplinary teams that may fully address mollusc exploitation in a historical perspective will allow formulating new hypotheses, generating explanatory models and provide independent means to test and assess generalizations about the status of natural populations of molluscs before, during and after the long standing prehistoric harvesting. One of the activities carried out by the EHIM project was a workshop held at Isla de Margarita, Venezuela in 2005, which brought together specialists in archaeology, anthropology, mollusc biology and exploitation and paleoclimatologists, from Japan, Australia, New Guinea, India, South Africa, Brazil, Chile, Venezuela, Panama, USA, Canada, Denmark, England and Israel. The goals of this workshop were to present and discuss the advances of the knowledge in their areas or expertise, building a multidisciplinary perspective on the effects of the human and environmental impact on the marine mollusc resources along the Holocene, during the last 10,000 years, in different parts of the world. Two important products of this project are the publication of the workshop proceedings at the British Archaeological Report Series (Archaeopress, Oxford), and an interaction database, in construction, HMID (Human/Molluscs Interaction Database), that consists of a WWW-available, WIKI, peer-reviewed, professionally maintained, free public accessed, worldwide referenced and comprehensive database, containing high quality historical data, descriptions and interpretations of worldwide events, patterns, processes, and products

resulting from the interactions between humans and molluscs through time.

Exploratory component: Natural Geography in Shore Areas (NaGISA)

The concept of NaGISA is based on examining patterns of biodiversity at both global and local scales on rocky shores and seagrass beds by using a nested sampling design and a simple standardized protocol that includes passive and active sampling, as well as some assessment of physical parameters (Konar and Iken 2003, Rigby *et al*. 2005). To NaGISA, the world's ocean shorelines are divided into boxes of 20° longitude and latitude. Within each of these boxes, three distinct geographic areas are chosen, and within each area, three sites are selected. One of these sites or core site, should be sampled once every year, and the other two sites, or satellite sites should be sampled at least once within this decade. Besides estimating biodiversity coverage and abundance, this nested sampling design will allow to estimate the variability at each scale as well as to identify the scale at which most of the variability occurs (Benedetti-Secchi, 2007). On the other hand, NaGISA is also committed to develop educational products and capacity building, involving local communities as well as students of different levels.

NaGISA constitutes one example of international collaboration that goes beyond the Caribbean region. In this sense, three NaGISA workshops took place in 2006 involving Caribbean researchers, two joining the Caribbean-South American regions and one in the Indian Ocean. The first workshop, held at Morrocoy National Park, Venezuela and hosted by Universidad Simón Bolívar, involved the participation of NaGISA site coordinators from Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Jamaica, Peru, Uruguay, and Venezuela. The second workshop, held and hosted by the Discovery Bay Marine Laboratory in Jamaica involved the participation of NaGISA site coordinators from Jamaica, Curacao, Trinidad & Tobago, San Andrés Island (Colombia), Venezuela and Chile. The third workshop, hosted by KEMFRI (Kenyan Marine Fisheries and Research Institute) held at Mombasa, Kenya, involved representatives from Kenya, the Seychelles, Tanzania and Zanzibar, Mauritius, Mozambique, Egypt, South Africa, India, and Comoros. The goals of these workshops were to standardize the NaGISA protocol, to discuss about logistical problems, sampling adjustments, site selection criteria, taxonomic issues and funding. Regarding funding, the NaGISA protocol has proved to be of interest as a monitoring and educational program to assess environmental impact and involve the local communities. An example of this is a three-year project dedicated to monitor marine biodiversity along the Venezuelan coast with the support of Chevron.

Exploratory component: Caribbean Coral Reefs (CARICORAL)

Coral refs are the most diverse communities per unit area on Earth and the most diverse marine communities, yet they are poorly known taxonomically. There are possibly 30,000 total described taxa for Caribbean coral reefs, most of them macroscopic organisms, however, this is a small fraction, probably only between 5-10% of what actually inhabit these communities. Basic taxonomy represents one of the biggest gaps in our current knowledge of coral reef biodiversity. Fish, molluscs, echinoderms, scleractinian corals, algae and sponges are the best known taxa, but taxonomic problems still exist in most of the major sessile invertebrate groups. Also, even for the best known groups, we know very little about their basic biology (life history, reproduction and dispersion), ecology (local distribution, abundance, habitat associations, natural and anthropogenic threats) and biogeography (geographic distributions) (Reaka-Kudla, 2005).

During the Caribbean KUU workshop, the CARICORAL group was formed. Their discussions indicated that in the region, there is a wealth of information about coral reef biodiversity at local scales, however, much of this information is in the grey literature. In this sense, one of the major needs to have a better

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understanding and knowledge of these ecosystems in the region is to synthesize and integrate all this information and in this way, develop a picture of what is known about Caribbean coral reef biodiversity. During a recent workshop in Panama in 2007, the CARICORAL group formulated a plan of action to validate and synthesize the existing reef literature in the region. The goals are to (1) update and summarize the available taxonomic information in the region, (2) digitalise all this information (after having it reviewed, summarized and synonymies having been clarified) and produce an electronic database uploadable into OBIS, (3) use this information to identify taxonomic gaps (the unknown: which groups are understudied), and (4) design an approach to do a rapid and efficient census/sampling to increase our knowledge of the unknown and produce updated species lists of these groups for the wider Caribbean

The expected outcomes of the CARICORAL project will be (1) an updated reference list, including grey literature, in digital format to be available in the CoML webpage, (2) an updated list of Caribbean coral reef taxa – verification of doubtful species – synonymies, and (3) the incorporation of all verified and georeferenced data into OBIS.

Exploratory component: Continental Margins (COMARGE) and Chemosynthetic Ecosystems (ChEss)

In the last decade, the Universidad Nacional Autónoma de Mexico (UNAM) has been exploring the deep sea of the south western sector of the Gulf of Mexico, including the continental slope (1,630-1,860 m) and the abyssal plain (3,720-3,830 m), onboard the UNAM's R/V Justo Sierra (SIGSBEE Cruises, 1997-2005). This abyssal plain reaches the largest depth found in the Gulf of Mexico (3,900 m) (Escobar-Briones *et al*. submitted). Surveys have been focused on the analysis of community structure in terms of taxonomic composition, abundance and biomass. UNAM also hosted recently (January 2007) an international workshop on biogeographic classification

systems in open ocean and deep seabed areas beyond national jurisdiction which counted with the participation of Mexico, USA, United Kingdom, Canada, Poland, Russia, Australia, New Zealand, France and Portugal. The discussions of this workshop were aimed to develop and apply such classification systems at both national and regional levels that might assist in ongoing development, particularly in areas beyond jurisdiction. Specific points in discussion were the key concepts and methods of biogeographic classification systems, how to elaborate the basic principles for identification, selection and application of these systems, which are the methods to describe and delineate distinct areas and how to draw maps showing potential boundaries for biogeographic realms, provinces or ecological regions. UNAM, COMARGE and ChEss have established an action plan to link both research initiatives. Their specific activities include (1) to link the database from Caribbean Sea and Gulf of Mexico or Intra-Americas Seas, which is available either from cruises, from the scientific literature or technical reports, (2) to participate in small and large scale workshops, (3) to discuss future cruises in the Caribbean Sea and Gulf of Mexico, and (4) to contribute to taxonomic workshops and expand to CeDAMar (Abyssal Ecosystems) and other programs such as the above mentioned workshop on Biogeographic Classification Systems.

Exploratory component: International Census of Marine Microbes (ICOMM)

Microbial communities are key in the marine environment since they define the magnitude and pathways of organic matter, nutrient and energy dynamics. Despite microbial metabolism and productivity are presently being described in some ecosystems, there is little information on microbial dynamics and community composition for the planktonic and benthic realms of many neritic and oceanic regions. This information is important to have a better understanding of biogeochemical processes and gradients in open waters and muddy and calcareous sediments, bioremediation, coral

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diseases, macro/epibiotic relationships and the importance of endosymbionts in the production of pharmacologically important compounds, pollution and climate change. In the Caribbean and South American regions, microbial diversity assessments from marine systems are very limited, representing a huge information gap (Artigas, unpublished).

To fill in this gap, a Latin American and Caribbean International Census of Marine Microbes (LACAR- ICoMM) has been established. LACAR-ICOMM constitutes a network of marine scientists of both regions working in diverse areas of microbiology in coastal and oceanic systems, working with the Prokarya and Eukarya domains. This network aims to share knowledge, experience, sampling facilities and methodologies of the different research laboratories within the regions, to promote the development of joint and multidisciplinary projects, and to focus on capacity building (courses, training workshops and meetings). This group is constituted by researchers from Argentina, Chile, Colombia, Mexico, Brazil, Puerto Rico, Venezuela, France and French Guiana. To accomplish these goals, the LACAR-ICOMM has prepared a proposal to the ICOMM Steering Committee seeking to improve knowledge of the patterns of distribution of microbial diversity of coastal and oceanic regions in the Caribbean and South America and to carry out new collection of samples in the mentioned regions, especially in zones not presently included in ongoing studies. Samples will be collected from a diverse set of microbial habitats including the water column, sediments and symbionts found in estuarine, coastal and oceanic realms of the region. The most relevant products of this network are the unique microbial collection, the development of standard sampling protocols aimed to reduce expenses of extraction, purification and preservation of genetic material to a minimum, raising public interest and the uploading of data into OBIS.

Integration: Ocean Biogeographic Information System (OBIS)

The Colombian system of marine biodiversity "Sistema de Información de Biodiversidad Marina" (SIBM) of the Museo de Historia Natural Marina de Colombia (MHNMC) at the Instituto de Investigaciones Marinas y Costeras (INVEMAR), is a key tool at the scientific, technical and public level to access information on the marine and coastal Colombian biodiversity. It provides online information on nearly 14,000 catalogued lots of more than 2,000 species preserved at the MHNMC museum and more than 15,000 bibliographic references (Díaz et al. 2005). The INVEMAR, made an agreement with CoML-Caribbean to incorporate the SIBM database into OBIS. During 2006-2007, the tasks carried out within this agreement were to (1) georeference the collections of fishes, molluscs, echinoderms and cnidarians of the MHNMC, (2) establish and generate the software filters required to select the biological records that will be made available to the OBIS users, using a client server connected to INVEMAR, and (3) develop the necessary software to integrate the SIBM system to the OBIS network in consultation with user groups. The data included now in OBIS has a temporal coverage between 1956 and 2007, which represents about 2,350 species and 16,661 distributional records for fishes, molluscs, echinoderms and cnidarians. The habitat coverage includes seashores (littoral), sublittoral seabed, mangroves, seagrasses, coral reefs, azooxanthellate coral communities and continental margin soft bottoms. A second phase of the project between the SIBM and OBIS will include distributional records for macroalgae, sponges and crustaceans. This system constitutes a model of a useful Caribbean database, accessible on-line and integrated to OBIS.

In Mexico, the biodiversity databases created at the Instituto de Biología are con-

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tained at the Unidad de Informática para la Biodiversidad (UNIBIO) of the Instituto de Biología, Universidad Nacional Autónoma de Mexico (UNAM). This institute has also agreed to coordinate efforts to incorporate its data into OBIS in the short term. Other data soon to be loaded into OBIS is the collection of the Agenda Morrocoy, an inter-institutional, multidisciplinary project carried out between 2000-2003, and deposited at the Museo de Ciencias Naturales, Universidad Simón Bolívar (USB) in Venezuela. This database will be organized in the OBIS spreadsheets and incorporated to the system through one of the South American OBIS sub-nodes (Brazil). Besides continuing to strengthen the link between the SIBM, UNAM, USB and OBIS, the CoML-Caribbean hopes to identify more biodiversity databases in the Caribbean that could be converted into digital format, including GIS specifications, and improve in this way the regional and global access to the data.

OTHER ACTIVITIES OF THE COML-CARIBBEAN AND FUTURE ACTIONS

Since its establishment in 2004, the Caribbean Committee of the Census of Marine Life has been involved in different CoML projects as well as seeking to establish partnerships and working relationships with other projects and organizations in the region. Examples of these are the global Ocean Tracking Network (OTN), the Caribbean Large Marine Ecosystem (CLME) Project, the Barbados Coastal Zone Management Unit (CZMU) and the organization of special sessions in regional meetings such as the Gulf and Caribbean Fisheries Institute and the Association of Marine Laboratories of the Caribbean (AMLC). The CoML-Caribbean has also supported research activities in the region leading to an increase in knowledge in marine biodiversity. An example of this are the electronic guides with databases on neotropical fish identification, biology and zoogeography coordinated at the Smithsonian Tropical Research Institute, which will be available freely online and will include new surveys and descriptions from fish species found in remote and previously unexplored zones in the Caribbean.

The Ocean Tracking Network (OTN) is a conservation project conducting a comprehensive examination of marine life and ocean conditions and how these change as the Earth's temperature increases. This project aims to monitor ocean's conditions and how animals respond to them by tagging and tracking thousands of marine animals around the world, from fish to birds to polar bears, using acoustic sound waves and receivers separated by 1 km intervals placed at the ocean floor. At the same time, measurements of ocean depth, temperature and salinity providing a record of climate change will be built from the data for analysis and application leading to a global standard for ocean management. In the Caribbean, a link is being established with the OTN that involves the participation of Mexico and Cuba, since the possible locations of coastal curtains of hydrophones to detect fish and vertebrate migrations from the Caribbean and the Gulf of Mexico will be installed in the straits between Cuba and the Yucatán Peninsula, and between Cuba and Florida. The Caribbean Large Marine Ecosystem (CLME) Project "Engaging Partners for Effective Transboundary Living Marine Resource Governance" has also become a partner for the CoML since there are some areas of the project in which collaboration would maximize the benefits for both organizations and avoid the duplication of efforts in obtaining data. The Coastal Zone Management Unit (CZMU) in Barbados was established in 1995 with the long-term objective of developing and implementing a Coastal Zone Management Plan for the island. Currently, the CZMU carries out three research projects at the Marine Research Section (MRS), which are (1) Temporal Changes in Coral Reef Communities, (2) Coral Bleaching and Mortality Study and (3) Coral Disease Study. Linkages between the CZMU and the CoML can also assist in increasing regional knowledge of coral reefs and associated ecosystems through engagement with NaGISA and CARICORAL.

Through research collaboration and partnerships, the CoML-Caribbean will continue strengthening the marine biodiversity network in the region by coordinating its current and future efforts and maintaining the linkage with CoML international projects and committees. The Caribbean scientific community has agreed that there are specific needs in the region regarding marine biodiversity, both, at an immediate term and within the next decade such as taxonomic expertise, new inventories of species, exploration of unstudied habitats, coordination of field studies, management of specimen collections, production of electronic databases and establishment of a regional network of collaboration, information exchange and fund raising.

RESUMEN

El Censo de la Vida Marina es un programa científico internacional que estudia la diversidad, distribución y abundancia de la vida marina en el pasado, presente y futuro. El programa tiene tres componentes principales: el histórico, el exploratorio y de modelización, los cuales están integrados en una base de datos de libre acceso (OBIS) para su visualización y análisis. En el Caribe, el programa comenzó en el 2004 con la revisión del estado del conocimiento de la biodiversidad marina en 10 países de la región, así como con el establecimiento de un enlace entre el CoML y algunos programas e iniciativas de investigación y conservación. El proyecto histórico coordinado en el Caribe tiene como foco la integración, estandarización y síntesis de datos acerca del impacto histórico humano sobre poblaciones de moluscos en una perspectiva global y está generando una base de datos de interacción Humanos/Moluscos (HMID). Los proyectos exploratorios están enfocados en la biodiversidad en comunidades de litorales rocosos y praderas de fanerógamas (NaGISA), así como en el océano profundo (COMARGE y ChEss). El proyecto de Arrecifes Coralinos (CARICORAL) y el de Microorganismos (ICOMM) han establecido una red de comunicación, objetivos claros y un plan de acción para su implementación. La participación del Caribe en el Ocean Tracking Network (OTN) también ha comenzado. El Caribe ha contribuido con OBIS a través de la base de datos del Sistema de Información Biogeográfica Marina (SIBM) de Colombia. Sin embargo, existe la necesidad urgente de identificar colecciones y literatura que pueda ser digitalizada, georeferenciada e incorporada en OBIS. El CoML-Caribe, promueve la cooperación tanto regional como global; sus objetivos son (1) la integración de los investigadores en biodiversidad marina, (2) consolidar la información existente en biodiversidad marina, (3) aprender e intercambiar ideas acerca de planes nacionales y regionales, prioridades y políticas de conservación, y (4) mantener un comité regional para apoyar los proyectos del CoML.

Palabras clave: Caribe, biodiversidad marina, censo de la vida marina.

REFERENCES

Aantczak, A. & M. M. Mackowiak de Antczak. 2005. Pre-hispanic fisheries of the Queen Conch, *Strombus gigas*, on the Islands off the Coast of Venezuela, p. 213-243. *In*: P. Miloslavich & E. Klein (eds). Caribbean Marine Biodiversity. DEStech Publications, Inc, Pennsylvania, USA.

Benedetti-Secchi, L. 2007. Biodiversity and Sampling Design, p.7-10. *In*: P. R. Rigby, K. Iken & Y. Shirayama (eds). Sampling Biodiversity in Coastal Communities. NaGISA Protocols for Seagrass and Macroalgal Habitats. Kyoto University Press, Japan.

Brooks, T. & M. L. Smith. 2001. Caribbean catastrophes. Science, 294: 1469-1471.

Collins, L. S. 1996. Environmental changes in Caribbean shallow waters relative to the closing of the Central American Isthmus, p. 130-167. *In*: J. B. C. Jackson, A. F. Budd & A. G. Coates (eds). Evolution and Environment in Tropical America. The University of Chicago Press, Chicago, USA.

Dulvy, N. K., Y. Sadovy & J. D. Reynolds. 2003. Extinction vulnerability in marine populations. Fish, 4: 25-64.

Escobar-Briones, E. G., C. Díaz & P. Legendre (submitted). Meiofaunal community structure of the deep-sea Gulf of Mexico: variability due to the sorting methods. Deep-Sea Research I.

Harvell, C. D., K. Kim, J. M. Burkholder, R. R. Colwell, P. R. Epstein, D. J. Grimes, E. E. Hofmann, E. K. Lipp, A. D. M. E. Osterhaus, R. M. Overstreet, J. W. Porter, G. W. Smith & G. R. Vasta. 1999. Emerging marine diseases – climate links and anthropogenic factors. Science 285: 1505-1510.

Holm, P. 2005. History of Marine Animal Populations, p. 249-251. *In:* P. Miloslavich & E. Klein (eds). Caribbean Marine Biodiversity. DEStech Publications, Inc, Pennsylvania, USA.

Jackson, J. B. C., M. X. Kirby, W. H. Berger, K. A. Bjorndal, L. W. Botsford, B. J. Bourque, R. H. Bradbury, R. Cooke, J. Erlandson, J. A. Estes, T. P. Hughes, S. Kidwell, C. B. Lange, H. S. Lenihan, J. M. Pandolfi, C. H. Peterson, R. S. Steneck, M. J. Tesner & R. R. Warner. 2001. Historical overfishing and the recent collapse of the coastal ecosystems. Science 293: 629-638.

Konar, B. & K. Iken. 2003. Natural Geography in Shore Areas (NaGISA): The nearshore component of the Census of Marine Life, p. 35-47. *In:* K. Iken & B. Konar. Proceedings of the Arctic Biodiversity Workshop: New Census of Marine Life Initiative. University of Alaska, Fairbanks, USA.

Laboy-Nieves, E. N., E. Klein, J. E. Conde, F. Losada, J. J. Cruz & D. Bone. 2001. Mass mortality of tropical marine communities in Morrocoy, Venezuela. Bull. Mar. Sci. 68: 163-179.

Lessios, H. A. 1998. Mass mortality of *Diadema antillarum* in the Caribbean: What have we learned? Ann. Rev. Ecol. Sys. 19: 371-393.

Linton, D. M & G. F. Warner. 2003. Biological indicators in the Caribbean coastal zone and their role in integrated coastal management. Ocean Coast. Manage. 46: 261-276.

Loreau, M., S. Naeem, P. Inchausti, J. Bengsston, J. P. Grime, A. Hector, D. U. Hooper, M. A. Huston, D. Raffaelli, B. Schmid, D. Tilman and D. A. Wardle. 2001. Biodiversity and ecosystem functioning: current knowledge and future challenges. Science 294: 804-808.

Miloslavich, P. 2007. Marine Invasions in Venezuela, p. 24. *In:* Osman, R. & T. Shirley (eds). Proceedings and final report of the Gulf of Mexico and Caribbean Marine Invasive Species Workshop. Held at Harte Research Institute for Gulf of Mexico Studies. Texas A&M University - Corpus Christi, Corpus Christi, Texas. February 26-27, 2007. Publisher by Harte Research Institute for Gulf of Mexico Studies and Smithsonian Environmental Research Center, USA.

Miloslavich, P. & E. Klein. 2005. Linking marine biodiversity research and conservation in the Caribbean, p. 3-18. *In:* P. Miloslavich & E. Klein (eds). Caribbean Marine Biodiversity. DEStech Publications, Inc, Pennsylvania, USA.

Myers, N., R. A. Mittermeir, C. G. Mittermeir, G. A. B. da Fonseca & G. Kent. 2000. Biodiversity hotspots for conservation priorities. Nature 403: 853-858.

O'Dor, R. K. 2003. The unknown ocean: the baseline report of the Census of Marine Life Research Program". *Consortium for Oceanographic Research and Education*. Washington, D.C. 28 p.

Rigby, R., T. Kato & Y. Shirayama. 2005. An introduction to the Natural Geography in Shore Areas (NaGISA) Project, p. 255-257. *In*: P. Miloslavich & E. Klein (eds). Caribbean Marine Biodiversity. DEStech Publications, Inc, Pennsylvania, USA.

Rivera-Monroy, V. H., R. R. Twilley, D. Bone, D. L. Childers, R. C. Coronado-Molina, I. C. Feller, J. Herrera-Silveira, R. Jaffe, E. Mancera, E. Rejmankova, J. E. Salisbury & E. Weil. 2004. A conceptual framework to develop long-term ecological research and mangement objectives in the wider Caribbean region. BioScience 54: 843-856.

Solow, A. R. 1995. Estimating biodiversity: calculating unseen richness. Oceanus 38: 9-10.

Wood, J. B., P. Y. Zhang, M. J. Costello & J. F. Grassle. 2005. An introduction to OBIS. www.iobis.org p. 253-254. In: P. Miloslavich & E. Klein (eds). Caribbean Marine Biodiversity. DEStech Publications, Inc, Pennsylvania, USA.