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Workshop Report

# Deep-sea Coral Taxonomy Workshop, Colombia 2019

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## Abstract

Corals are some of the conspicuous taxa in deep-sea ecosystems. Yet, characterizing coral diversity is difficult and requires a combination of both morphological and genetic data. Many leading coral taxonomy experts are close-to retirement or have already retired. It is now imperative that the hands-on expertise that these taxonomists have – much of which is not captured in manuscripts or books – is transferred to the next generation. The Deep-Sea Coral Taxonomy Workshop, funded by a Lounsbery award from the Deep-Sea Biology Society, aimed to provide a training opportunities and build taxonomic capacity in Colombia and Latin America. Workshop participants examined the deep-sea coral diversity of the southern western Caribbean, a poorly explored region. The three-day workshop was based mainly on hands-on activities focused on octocorals and black corals, and included introductory talks to the taxonomy of these groups and identification activities using specimens. Thanks to the workshop, it was possible to review and update the classification database of the Makuriwa Marine Natural History Museum collection. Additionally, four new species from the families Clavulariidae, Plexauridae and Gorgoniidae were identified and will be described in the near future.

## Keywords

Octocorals, Black Corals, South America, Taxonomy Training

## Date and place

The Deep-sea Coral Taxonomy Workshop was held at the Marine Natural History Museum of Colombia - Makuriwa, part of the Institute of Marine and Coastal Research – INVEMAR, in the city of Santa Marta, Colombia, during December 2-4 2019.

## Introduction

Corals are some of the most iconic taxa in marine ecosystems, with over 70% of all coral species found in the deep-sea. Coral taxonomy is difficult and has rapidly changed as molecular data is combined with morphological observations. As their shallow-water counterparts, deep-sea corals suffer from taxonomic issues due to hybridization, character lability, recent speciation, and phenotypic plasticity, among others (Forsman et al. 2015, Dueñas and Sánchez 2009). Although molecular techniques are now commonly employed to confirm the identification of specimens, traditional taxonomy is essential for the initial identification of species and paramount for the description of new ones. A new synthesis, or integrative taxonomy, requires stronger expertise in both molecular and morphological aspects (Sheth and Thaker 2017), and this is why traditional taxonomy must be kept alive (Bik 2017).

Many leading coral taxonomy experts are close to or already retired, and their positions are unfortunately not being replaced. It is now imperative that their expertise and knowledge is transferred to emerging taxonomists (early-career scientists, promising students, and museum staff), much of which is nearly impossible to acquire via manuscripts or books. Workshops are an excellent way in which knowledge is transferred from an expert to more than one emerging taxonomist at a time.

The Makuriwa Museum holds the largest deep-sea coral collection in Colombia, with 2631 lots from the southern Caribbean and the Pacific, product of two decades of sampling. Many of these samples come from deep-sea coral formations in the Colombian Pacific and Caribbean, including the Deepwater Corals National Natural Park, a Marine Protected Area created specifically to protect deep-sea coral ecosystems. Although the curators who have worked in the Makuriwa Museum have worked to identify the specimens, hundreds of lots remain virtually untouched. The knowledge of deep-sea biodiversity in the Caribbean has increased in the last years. However, most of it remains unexplored. For this reason, it was crucial to have emerging taxonomists, students, and local scientists gain taxonomic expertise by working alongside leading coral taxonomy experts to shed some light not only on taxonomic identification, but in deep-sea coral biodiversity.

## Aims of the workshop

### Goals

The Deep-Sea Coral Taxonomy Workshop brought together international deep-sea coral taxonomy experts, emerging taxonomists, students, and local scientists to:

1. provide a training opportunity for the next generation of deep-sea coral taxonomists;
2. nurture taxonomic capacity building in Colombia and Latin America broadly; and
3. advance the knowledge of deep-sea coral diversity in the southern western Caribbean.

### Agenda

The workshop was mainly a hands-on experience that focused on the study of Octocorallia and Antipatharia. The activities during the workshop included introductory talks about the taxonomy of these groups, a tour through the Makuriwa Museum and identification activities focused on different octocoral and black coral families using biological samples (Table 1, Fig. 1).

Table 1.

Agenda for the Deep-Sea Coral Taxonomy Workshop.

| Date | Time | Activity | Place | Responsible |
|---|---|---|---|---|
| Dec 2 | 8:15 - 8:30 | Registration | Auditorium | |
| | 8:30 - 9:00am | Welcome, introduction of participants | Auditorium | Luisa |
| | 9:00 - 10:00am | Introduction to Octocoral Taxonomy | Auditorium | Phil and Odalisca |
| | 10:00 - 10:30am | Coffee break | | |
| | 10:30 - 11:30m | Introduction to Black Coral Taxonomy | Auditorium | Tina |
| | 11:30 - 12:00am | Safety instructions for working at the collection | Collection | Catalina and Cristina |
| | 12:00 - 1:30pm | Lunch | Cafeteria | |
| | 1:30 - 3:00pm | Hands on: Octocorals | Collection | Phil and Odalisca |
| | 3:00 - 3:15pm | Coffee break | | |
| | 3:15 - 5:30pm | Hands on: Octocorals | Collection | Phil and Odalisca |
| Dec 3 | 8:30 - 10:30am | Hands on: Octocorals | Collection | Phil and Odalisca |
| | 10:30 - 10:45am | Coffee break | | |
| | 10:45 - 12:30pm | Hands on: Octocorals | Collection | Phil and Odalisca |
| | 12:30 - 2:00pm | Lunch | Cafeteria | |
| | 2:00 - 3:15pm | Hands on: Octocorals | Collection | Phil and Odalisca |
| | 3:15 - 3:30pm | Coffee break | | |
| | 3:30 - 5:30pm | Hands on: Octocorals | Collection | Phil and Odalisca |

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|---|---|---|---|---|
| Dec 4 | 8:30 - 10:30pm | Hands on: Black Corals | Collection | Tina |
| | 10:30 - 10:45am | Coffee break | | |
| | 10:45 - 12:30pm | Hands on: Black Corals | Collection | Tina |
| | 12:30 - 2:00pm | Lunch | Cafeteria | |
| | 2:00 - 3:15pm | Hands on: Black Corals | Collection | Tina |
| | 3:15 - 3:30pm | Coffee break | | |
| | 3:30 - 5:00pm | Hands on: Black Corals | Collection | Tina |
| | 5:00 - 5:30pm | Closing Remarks | Auditorium | Luisa and Cristina |


Figure 1. doi

Photographs representing different activities, and samples seen during Deep-Sea Coral Taxonomy Workshop, Colombia 2019.

## List of participants

The workshop included the participation of Phil Alderslade (CSIRO, Australia), Tina Molodtsova (P.P. Shirshov Institute of Oceanology RAS, Russia), Juan A. Sánchez (Universidad de Los Andes, Colombia) and Odalisca Breedy (Universidad de Costa Rica, Costa Rica) as taxonomy experts. Eighteen participants, from 6 different countries in America and Europe, gathered for the three-day workshop at the Makuriwa Museum in INVEMAR, where we had access to the deep-sea coral collection. Participants were represented by undergraduate students, graduate students, postdocs, early career researchers, and professors (Fig. 2, Table 2).

Table 2.
List of participants for the Deep-Sea Coral Taxonomy Workshop.

| Name | Role | Affiliation | Country | Career Stage |
|---|---|---|---|---|
| Luisa F Dueñas | Organizer | Universidad Nacional de Colombia | Colombia | Assistant Professor |
| Cristina Cedeño | Organizer | Invemar | Colombia | Researcher / Curator |
| Juan A Sánchez | Expert | Universidad de Los Andes | Colombia | Full Professor |
| Phil Alderslade | Expert | CSIRO | Australia | Senior Researcher |
| Tina Molodtsova | Expert | P.P. Shirshov Institute of Oceanology | Russia | Senior Researcher |
| Odalisca Breedy | Expert | Universidad de Costa Rica | Costa Rica | Full Professor |
| Sandra Pareja | Participant | Invemar | Colombia | Graduate student |
| Katherine Mejía | Participant | Invemar | Colombia | Graduate student |
| Viviana Sanchez | Participant | Universidad Nacional de Colombia | Colombia | Undergraduate student |
| Carlos E Gomez | Participant | Universidad de Los Andes | Colombia | Posdoctoral researcher |
| Salome Buglass | Participant | Charles Darwin Foundation | Ecuador | Early Career Researcher |
| Ralf Cordeiro | Participant | Federal Rural University of Pernambuco | Brazil | Full Professor |
| Giovanni Chimienti | Participant | University of Bari | Italy | Assistant Professor/ Researcher |
| Poppy Keogh | Participant | Memorial University of Newfoundland | Canada | Graduate student |
| Antonella Lavorato | Participant | Universidad Autónoma de Baja California | Mexico | Graduate student |
| Néstor Ardila | Participant | Ecomar / Universidad Nacional de Colombia | Colombia | Associate Professor/ Researcher |
| Livia Loiola | Participant | Independent researcher | Brazil | Independent researcher |
| Milena Benavides | Participant | Corales de Profundidad National Natural Park | Colombia | Graduate student |
| Renata Arantes | Participant | Universidade Federal de Santa Catarina | Brazil | Posdoctoral researcher |
| Ana Lucía Pico | Participant | Universidad de Córdoba | Colombia | Graduate student |
| Nelson Manrique | Participant | Okeanos S.A.S. | Colombia | Researcher |

| Name | Role | Affiliation | Country | Career Stage |
|---|---|---|---|---|
| Andres F. Molina | Participant | CCCP-DIMAR | Colombia | Graduate student |
| Marco Garzón | Participant | Universidad de Magdalena | Colombia | Assistant Professor/ Researcher |
| Adriana Sarmiento | Participant | Universidad de Los Andes | Colombia | Doctoral student |


Figure 2. doi

Workshop Participants. Left to right, back row: Giovanni Chimienti, Nelson Manrique, Sandra Pareja, Katherine Mejía, Livia Loiola, Ana L. Pico, Cristina Cedeño. Middle row: Milena Benavides, Odalisca Breedy, Juan A. Sánchez, Poppy Keogh, Luisa F. Dueñas, Tina Molodtsova, Phil Alderslade, Ralf Cordeiro. Front row: Néstor Ardila, Andrés F. Molina, Viviana Sánchez, Salome Buglass, Adriana Sarmiento, Antonella Lavorato, Carlos E. Gómez, Marco Garzón, Renata Arantes.

## Key outcomes and discussions

During the Workshop, 111 samples of the Cnidarian collection were identified, of which 30 corresponded to samples collected in the Pacific region of Colombia (Malpelo and Riscales) and the remaining 81 samples were collected in the Colombian Caribbean. Antipatharia was represented by 37 samples from the families Antipathidae, Aphanipathidae, Myriopathidae and Stylopathidae; three of them of the dry collection and the remaining 34 from the wet collection. Octocorallia was represented by 74 samples from the families Acanthogorgiidae, Chrysogorgiidae, Ellisellidae, Gorgoniidae, Keroeididae, Primnoidae, Plexauridae, Spongiodermidae and Pennatulidae; 20 samples from the dry collection and 54 from the wet collection. Additional octocoral samples were provided by the Museum from the Los Andes University which included specimens from the families Paragorgiidae and Coralliidae.

Thanks to the workshop, in a three-day activity, it was possible to review and update the taxonomic classification of 111 samples from the collection. This particular task would have taken months to achieve for the curator on her own. Additionally, four new species from the families Clavulariidae, Plexauridae and Gorgoniidae were identified and will be described in the near future.

This workshop, the first of its kind in Latin America, provided a unique opportunity for capacity building in the region, and advanced knowledge of deep-sea coral biodiversity in the Caribbean. We are confident this workshop built long-lasting networks of collaborators that will carry-on the taxonomic work in this important animal group.

## Acknowledgements

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## Funding program

The workshop was funded by the Deep-Sea Biology Society (www.dsbsoc.org) through the Lounsbery Workshop Award, given to LD.

## Hosting institution

Universidad Nacional de Colombia and Institute of Marine and Costal Research-INVEMAR.

## Author contributions

All authors with the exception of SH participated in the Workshop. SH contributed with the organization of the event. LD and CCP led the workshop organization. LD chaired the sessions and drafted the manuscript. JS helped in the organization and contributed as a taxonomy expert. All authors commented and edited the manuscript.

## Conflicts of interest

The authors declare no conflict of interest.

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