7th INTERNATIONAL SYMPOSIUM
DEEP-SEA CORALS
CARTAGENA COLOMBIA - 2019

The International Symposium on Deep-Sea Corals is the premier meeting for scientists, explorers, managers, policymakers, industry specialists and students to exchange ideas and share knowledge of deep-sea and cold-water corals and their ecosystems. Topics of this meeting include biodiversity, ecology, evolution, environment, climate, fisheries, sponges, associated fauna, mesophotic ecosystems, anthropogenic impacts, technology, and conservation.

This was the 7th edition of the symposium, which has been running every 2-4 years since 2000. This is be the first time the symposium took place in Latin America, and the second time in the southern hemisphere. This was also the first time that the symposium was organized with support from the Deep-Sea Biology Society.

The 7th International Symposium on Deep-Sea Corals (ISDSC7) took place at the Intercontinental Hotel in Cartagena de Indias, Colombia, between July 29 - August 2, 2019. The symposium had 169 attendees who presented 81 talks and 66 posters.

Organizers

Santiago Herrera (Lehigh University, USA)
Juan Armando Sánchez (Universidad de los Andes, Colombia)
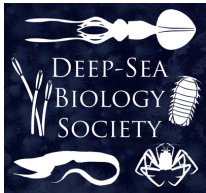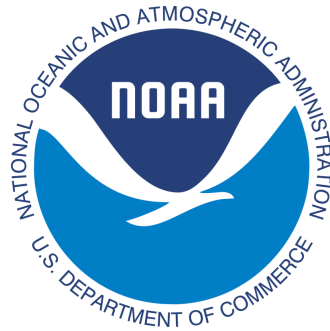**Luisa Dueñas** (Universidad Nacional de Colombia).

Steering Scientific Committee

- Erik Cordes (Temple University, United States; ISDSC6 organizer)
- Peter Etnoyer (National Oceanic and Atmospheric Administration, United States)
- Carlos Gomez (Universidad de los Andes, Colombia)
- Andrea Gori (Università del Salento, Italy)
- Tom Hourigan (National Oceanic and Atmospheric Administration, United States)
- Marcelo Kitahara (Universidade Federal de Sao Paulo, Brazil)
- Sandra Maier (NIOZ Royal Netherlands Institute for Sea Research, Netherlands; student representative)
- Asako Matsumoto (Chiba Institute of Technology, Japan)
- Kirrily Moore (Tasmanian Museum and Art Gallery, Australia)
- Nancy Prouty (United States Geological Survey, United States)
- Andrea Quattrini (Harvey Mudd College, United States)
- Ana Riesgo (Natural History Museum of London, England)
- Murray Roberts (University of Edinburgh, Scotland; ISDSC2 organizer)
- Laura Robinson (University of Bristol, England)
- Nadia Santodomigo (Natural History Museum of London, Colombia/England)
- Timothy Shank (Woods Hole Oceanographic Institution, United States; ISDSC6 organizer)
- Michelle Taylor (University of Essex, England)
- Di Tracey (National Institute of Water and Atmospheric Research, New Zealand; ISDSC4 organizer)
- Joana Xavier (University of Porto, Portugal/University of Bergen, Norway)
- Chris Yesson (National Oceanography Centre, England)

Local Support Committee

- Alberto Acosta (Pontificia Universidad Javeriana Bogotá)
- David Alonso (INVEMAR)
- Mauro Antonio Maza Chamorro (Universidad Tecnológica del Bolivar)
- Nestor Ardila-Espitia (ECOMAR)
- Milena Benavides (PNN Corales de Profundidad Investigaciones)
- Adriana Bermudez Tobon (Universidad de Cartagena)
- German Daniel Rivillas Ospina (Universidad del Norte Barranquilla)
- Andres France (Universidad Jorge Tadeo Lozano)
- Carlos Gomez (Universidad de los Andes, Colombia)
- Alejandro Henao (Universidad de Cartagena)
- Mateo Lopez Victoria (Pontificia Universidad Javeriana Cali)
- Gabriel Navas (Universidad de Cartagena)
- Vladimir Puentes (Anadarko CC)
- Paula Andrea Zapata Ramirez (Universidad Pontificia Bolivariana Medellín)

Sponsors

Time	MONDAY - July 29	TUESDAY - July 30	WEDNESDAY - July 31	THURSDAY - August 1	FRIDAY - August 2
07:45		Check-in *Foyer I*	Check-in *Foyer I*	Check-in *Foyer I*	Check-in *Foyer I*
08:00					
08:15		Open. Remarks *Aguamarina I &*	Announcements *Aguamarina I*	Announcements *Aguamarina I*	Announcements *Aguamarina I*
08:30		Keynote: Marco Taviani	Keynote: Andrea Quattrini	Keynote: Sam Vohsen	Keynote: Erik Cordes
08:45					
09:00		Nicholas Hitt (E)	Santiago Herrera (D)	Karin Steffen (J)	Chris Yesson (G1)
09:15		Emyr Martyn Roberts	Carla Zilberberg	Meredith Everett	Martha Patricia Vides Casado
09:30		Guillem Corbera Pascual	Anna Patova	Andrea Gori	Salome Buglass
09:45		Hye-Won Moon (C3)	Chris Caldow (C3)	Heidi Meyer	Jorge Cortés
10:00		Coffee Break *Foyer I*	Coffee Break *Foyer I*	Coffee Break *Foyer I*	Coffee Break *Foyer I*
10:15					
10:30	Free Morning	Tim Shank - WITHDREW	Thomas Hourigan	Stephanie Liefmann	Cristina Cedeño-Posso
10:45		Marie F. Creemers	Elizabeth Duncan (C3)	Bárbara de Moura Neves	Zoleka Filander
11:00		David Price (F1)	Kristopher Benson	Ulrike Hanz (F2)	Vonda Wareham Hayes (G2)
11:15		Katriina Juva	Pål Buhl-Mortensen	Martijn Bart	Charles Messing
11:30		Frank Parrish	Aimée Komugabe-Dixson	Teresa Morganti	Juan Carlos Marquez
11:45		Jim Barry	Antonella Lavorato (H)	Laura Contreras Vega	Matt Dornback (B1)
12:00					
12:15					
12:30		Lunch Break (lunch provided)	Lunch Break (lunch provided)	Lunch Break (lunch provided)	Lunch Break (lunch not provided)
12:45					
13:00					
13:15					
13:30		Keynote: Di Tracey	Keynote: Nadia Santodomingo	Leslie Wickes	Keynote: Patricia Puerta
13:45	Roundtable PNN Corales de Profundidad			Janina V. Büscher	
14:00	*Aguamarina I & II*	Alan Williams (C1)	Íris Sampaio (I1)	Sebastian Hennige (A1)	Steven Auscavitch (B1)
14:15		John Olson	Peter Etnoyer	Elizabeth Gugliotti	Laurence De Clippele
14:30		Tabitha Pearman	Erin E. Easton	Carlos Gomez	Berta Ramiro Sánchez
14:45		Tina Molodtsova	Candice Untiedt	Maria Montseny	Matthew Poti
15:00		Coffee Break *Foyer I*	Coffee Break *Foyer I*	Coffee Break *Foyer I*	Coffee Break *Foyer I*
15:15	Check-in *Foyer I*				
15:30		Heather Coleman	Catherine McFadden	Danielle De Leo	Nissa Kreidler
15:45	DSBS Early Career Happy Hour	Cherisse Du Preez (C2)	Ana Navarro Campoy (I2)	Alexis Weinnig (A2)	Julian Mariano Burgos (B2)
16:00		Geoff Shester	Isabela Seiblitz	Ian Rocha	Owen Anderson
16:15	Poster set up	Milena Benavides-Serrato	Raissa Hogan	Sandra Brooke	Andrew Davies
16:30	*Oceanika*	Lightning Talks & Poster Session I	Lightning Talks & Poster Session II	Lightning Talks & Poster Session III	Closing Remarks & Awards
16:45		*Aguamarina III & IV*	*Aguamarina III & IV*	*Aguamarina III & IV*	
17:00					
17:15					
17:30		Changing Ocean Enviroments	Connectivity	Technical Advances	
17:45		Ecological Interactions	Natural History	Biogeography	
18:00	Opening Reception	Mgmt. & Conservation	Systematics & Evolution	Habitat and diversity	Closing Banquet *Kanuu Restaurant, Oceanika Lounge and*
18:15	*Oceanika Lounge and Pool Bar*		Anthropogenic stressors		*Pool Bar*
18:30		DSBS Student Event	DSBS Annual General Meeting		
18:45		*Oceanika Lounge*	*Aguamarina I & II*		
19:00					
19:15					
19:30					
19:45					
20:00					
??:??					

Previous Symposia

ISDSC 6 (2016) Boston, USA
Organizers: Erik Cordes (Temple U), Timothy Shank (WHOI)
Program and Abstracts
Proceedings

ISDSC 5 (2012) Amsterdam, The Netherlands
Organizers: Tjeerd van Weering (NIOZ), Furu Mienis (NIOZ)
Program and Abstracts
Proceedings

ISDSC 4 (2008) Wellington, New Zealand
Organizers: Di Tracey (NIWA), Helen Neil (NIWA)
Program and Abstracts
Proceedings

ISDSC 3 (2005) Miami, United States
Organizers: Robert Brock (NOAA NMFS), Robert George
Program and Abstracts
Proceedings
Proceedings 2

ISDSC 2 (2003) Erlangen, Germany
Organizers: Andrew Freiwald, J Murray Roberts
Proceedings

ISDSC 1 (2000) Halifax, Canada
Organizers: S.Gass, J.H.Willison
Proceedings

Code of Conduct

The ISDSC7 adopted the Code of Conduct developed by the organizers of the 4th International Marine Conservation Congress (published by **Favaro et al. 2016**) and followed during the 15th Deep-Sea Biology Symposium. The ISDSC has traditionally been a friendly, professional, respectful, and inclusive environment, and we want to keep it that way. All symposium participants, including presenters, sponsors, organizers, and volunteers must agree to this Code of Conduct in order to be allowed to be part of the symposium.

Any behaviors that violate this code were encouraged to be reported to deepseacoral2019[at]gmail.com. We committed to respond to reports in a respectful and timely manner, while ensuring privacy.

Examples of Expected Behaviors

• Treat everyone with respect and consideration, including symposium participants, venue staff and other hotel guests.
• Communicate openly and thoughtfully with others and being considerate of the multitude of views and opinions that are different than your own.
• Be respectful and mindful in your critique of ideas.
• Be mindful of your surroundings and of your fellow participants.
• Maintain a safe and appropriate physical and emotional distance in all interactions.
• Maintain a professional and friendly but non-sexual dialogue at all times with all participants.
• Do not discriminate based on gender or gender identity, sexual orientation, age, disability, physical appearance, body size, race, religion, national origin, language, or culture.
• Do not film presentations.

These behaviors were expected by all symposium participants during presentations, social hours, events, parties, and in the internet and social media.

Side Events

Roundtable PNN Corales de Profundidad
Where: Aguamarina I & II (check-in first at the symposium registration table in the Foyer)
When: 14:00-16:00, July 29 2019 (check-in 13:30)
Who: All symposium participants and invited guests
The Parque Nacional Natural Corales de Profundidad (Spanish for Deep-sea Corals National Natural Park) is a protected area recently created by the Colombian government. The marine area, close to Cartagena's coast, hosts a high abundance of deep-sea corals and high diversity of invertebrates. Park management is ensured by a team of dedicated professionals eager to make the natural area sustainable in the long term through conservation of the deep-sea coralline formations and through ongoing scientific investigation. This roundtable, organized by the team at Deep-Sea Corals National Natural Park of Colombia, was an event held on July 29th, as part of the start of the 7th International Symposium on Deep-Sea Corals. During this meeting national and international stakeholders gathered to discuss project ideas and identify areas of collaboration. This roundtable was an opportunity to meet with key players in the fields of industry (oil, telecommunications, energy), technology, research, and management, and to generate cooperation opportunities.

DSBS Early Career Happy Hour
Where: Oceanika Lounge
When: 16:00-17:00, July 29 2019
Who: Early Career Researchers
The Deep-Sea Biology Society hosted a happy hour mixer for Early Career Researchers (post-PhD, but pre-tenure or equivalent) during the symposium.

DSBS Student Event
Where: Oceanika Lounge
When: 18:30-19:30, July 30 2019
Who: Students
The Deep-Sea Biology Society hosted a student-mixer event on the evening of the 30th of July. This event provided an informal opportunity for students to network, form collaborations, and gain insights on the range of positions and skills set required pertaining to a range of different marine science careers. This student-mixer event took a career fair "speed-dating" approach, where students were granted time to interact with experts from different sectors.

DSBS Annual General Meeting
Where: Aguamarina I & II
When: 18:30-19:30, July 31 2019
Who: DSBS members and symposium participants
The Society held its Annual General Meeting (AGM) at the ISDSC7. The AGM agenda included reports on the DSBS activities since last year's AGM, news on upcoming events, presentation of awards, approval of the DSBS financial report (to be sent to members in a separate email), open discussion for all members, and a free social event.

Awards

DSBS Travel Awards

The ISDSC7 organizers together with the **Deep-Sea Biology Society** (DSBS) sponsored 20 travel awards to the 7th International Symposium on Deep-Sea Corals (ISDSC7) in Cartagena, Colombia. **These awards were open to any members of the society** and could be used towards any costs associated with attendance and presentation (oral or poster) at the symposium. If you are not a member yet, you can become one at **https://dsbsoc.wildapricot.org**. The maximum amount that could be requested was £750. Awards were be based on both the quality of the abstract and evidence of financial need. Successful applicants were required to write a short blog post, report or video blog for the Society website about their experience at the Symposium.

DSBS Travel Awardees

- Antonella Lavorato (Universidad Autonoma de Baja California Sur, Mexico)
- Bárbara de Moura Neves (Department of Fisheries and Oceans, Canada)
- Beatriz Mejia-Mercado (Florida State University, USA)
- Candice Untiedt (CSIRO & University of Tasmania, Australia)
- Daniel Lauretta (Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Argentina)
- Danielle De Leo (Florida International University, USA)
- David Price (University of Southampton, UK)
- Giovanni Chimienti (University of Bari Aldo Moro, Italy)
- Guillem Corbera Pascual (University of Southampton, UK)
- Íris Sampaio (University of the Azores, Portugal)
- Janina Vanessa Büscher (GEOMAR Helmholtz Centre for Ocean Research, Germany)
- Krista Greeley (Memorial University of Newfoundland, Canada)
- Leslie Wickes (Thrive Blue LLC, USA)
- Luke McCartin (Woods Hole Oceanographic Institution, USA)
- Maria Montseny, (Institut de Ciències del Mar, Consejo Superior de Investigaciones Científicas, Spain), declined
- Nicholas Hitt (Victoria University Of Wellington, New Zealand)
- Nissa Kreidler (NOAA & Humboldt State University, USA)
- Phil Alderslade (CSIRO, Australia)
- Salome Ursula Buglass (Charles Darwin Foundation, Ecuador)
- Tabitha Pearman (National Oceanography Centre Southampton, UK)
- Ulrike Hanz (Royal Netherlands Institute for Sea Research, Netherlands)

DSBS Prizes for Best Student and Early-Career Talks and Posters
The DSBS awarded one-year free membership to the society and a cash prize to the best student and best early-career oral and poster talks at the ISDSC7. Runners up in each category also received prizes.

Publication Prize for Best Student and Early-Career Talks
Frontiers in Marine Science also provided a publication fee waiver to the winners of the best Student Talk and best Early-Career Talk awards. This waiver only applied for papers submitted to the symposium proceedings Research Topic.

DSBS Best Student and Early-Career Talks and Posters Awardees

BEST EARLY-CAREER TALK
- WINNER: Barbara de Moura Neves (Fisheries and Oceans Canada)
- RUNNER UP: Laurence de Clippele (University of Edinburgh, UK)

BEST STUDENT TALK
- WINNER: Ana Navarro Campoy (Universidad Católica del Norte, Chile)
- RUNNER UP: Martjn Bart (University of Amsterdam, Netherlands)

BEST EARLY-CAREER POSTER
- WINNER: Giovanni Chimienti (University of Bari Aldo Moro, Italy)
- RUNNER UP: Andia Chaves Fonnegra (Florida Atlantic University, USA)

BEST STUDENT POSTER
- WINNER: Keir Macartney (University of New Hampshire, USA)
- RUNNER UP: Guillem Corbera Pascual (University of Southampton, UK)

Session Topics

(A) Anthropogenic stressors (impacts from single to multiple stressors on organisms, communities and ecosystems [e.g. warming, oxygen decrease, ocean acidification, pollution, physical damage]; resilience and recovery; restoration)

(B) Biogeography, environmental controls and mapping (patterns of community composition, diversity, and distribution; habitat mapping and suitability modeling)

(C) Conservation and management of deep-sea coral and sponge ecosystems (identification of vulnerable biogenic habitats [VMEs, EBSAs, etc.], biodiversity conservation, fisheries MPA design, legal instruments and governance [national or high seas e.g., ABNJ]; deep-sea mining)

(D) Connectivity & phylogeography (population connectivity, population genetics, phylogeography and microevolutionary patterns; larval dispersal)

(E) Corals and changing ocean environments (paleo-oceanography and historical environmental reconstructions; biomineralization; modeling impacts of climate change, ocean acidification, and future habitat suitability)

(F) Ecological interactions (biogeochemical cycling, alterations of ocean chemistry, and carbon sequestration; links with surrounding ecosystems; hydrodynamics and food supply, trophic ecology, and bentho-pelagic coupling; habitat provision, symbiotic relationships, parasites)

(G) Habitat and diversity characterization (exploration, biodiversity surveys, discovery)

(H) Organismal biology & natural history (reproduction, development, growth, behavior, disease, physiology)

(I) Systematics & evolution (taxonomy, fossil record, molecular phylogenetics, and macroevolutionary patterns)

(J) Technical advances and novel methods (experimental design, eDNA, omics, microbiome, imaging technologies, machine learning/AI, photogrammetry, time-series; marine natural product discovery, biotechnology)

Session List

SESSION	CHAIRS
Anthropogenic stressors	Di Tracey, Andrea Gori
Biogeography, environmental controls and mapping	Andrea Quattrini, Santiago Herrera
Connectivity & phylogeography	Chuck Fisher
Conservation and management of deep-sea coral and sponge ecosystems	Tom Hourigan, Chris Yesson
Corals and changing ocean environments	Martha Nizinski
Ecological interactions	Nadia Santodomingo, Carlos Gomez
Habitat and diversity characterization	Peter Etnoyer, Erik Cordes
Organismal biology & natural history	Vonda Wareham
Systematics & evolution	Luisa Dueñas, Asako Matsumoto
Technical advances and novel methods	Juan Sánchez

Daily Schedule of Talks, Posters, and Events

⚡ Indicates Lightning Talk

MONDAY · July 29

13:30	CHECK-IN & POSTER SETUP · Foyer & Aguamarina III & IV
14:00	PNN Corales Profundidad Townhall · Aguamarina I & II
16:00	DSBS EARLY CAREER MIXER · Oceanika Lounge
17:00	OPENING RECEPTION · Pool Bar & Oceanika Lounge

TUESDAY · July 30

7:45 CHECK-IN

8:15 OPENING REMARKS - Aguamarina I & II

8:30 CORALS AND CHANGING OCEAN ENVIRONMENTS · AGUAMARINA
Mediterranean Deep Sea Corals: from Past to Future – KEYNOTE
Marco Taviani, ISMAR-CNR Bologna, Italy

9:00 3000 years of southwest Pacific gyre variability reconstructed from deep-sea black corals
Nicholas Hitt, Victoria University Of Wellington, New Zealand

9:15 Predicting the response of sponge-suitable habitat to environmental change
Emyr Martyn Roberts, University of Bergen, Norway

9:30 Temporal and spatial variability of a Mediterranean Cold-Water Coral Mound evolution over the last 200 kyrs: the Cabliers Coral Mound Province
Guillem Corbera Pascual, University of Southamtpon, UK

9:45 Occurrence of cold-water corals and their potential roles in shallow Antarctic glacial embayment
Hye-Won Moon, National Marine Biodiversity Institute of Korea, South Korea

10:00 BREAK

10:45 ECOLOGICAL INTERACTIONS · AGUAMARINA
Macrofauna associated with the sponge Vazella pourtalesi and ecological interactions in a monospecific sponge ground on the Scotian Shelf (NS, Canada)
Marie F. Creemers, IMAR/ Okeanos/ University of the Azores / MARE -Department of Oceanography and Fisheries, Portugal

11:00 The fine-scale landscape ecology of cold-water coral reef habitats.
David Price, University of Southampton, UK

11:15 Tidal dynamics control on cold-water coral growth: A high-resolution multivariable study of eastern Atlantic cold-water coral sites
Katriina Juva, GEOMAR Helmholtz Centre for Ocean Research, Germany

11:30 Comparative observations of flow intensity around Hawaiian deep-sea corals.
Frank Parrish, NOAA Pacific Islands Fisheries Science Center, USA

11:45 Does predation play an important role in the population dynamics of deep-sea corals?
Jim Barry, Monterey Bay Aquarium Research Institute, USA

12:00 LUNCH

13:30 CONSERVATION AND MANAGEMENT OF DEEP-SEA CORAL AND SPONGE ECOSYSTEMS · AGUAMARINA
State of knowledge of deep-sea corals in the New Zealand region – 10 years on what key information needs remain – KEYNOTE
Dianne Tracey, National Institute of Water & Atmospheric Research NIWA, New Zealand

14:00 Assessing deep-sea coral recovery from trawling impact needs to account for natural variation in coral distribution and presence of natural refuges
Alan Williams, CSIRO, Australia

14:15 Quantifying the overlap of trawl fisheries with deep-sea corals and sponges in the Aleutians Islands, Alaska.
John Olson, NOAA National Marine Fisheries Service, USA

14:30 Determining coral density thresholds for identifying structurally complex vulnerable marine ecosystems in the deep sea
Tabitha Pearman, National Oceanography Centre Southampton, UK

14:45 Coral and sponge communities of potential mineral resources in the deep-sea: an overview
Tina Molodtsova, P.P. Shirshov Institute of Oceanology RAS, Russia

15:00 BREAK

15:30 CONSERVATION AND MANAGEMENT OF DEEP-SEA CORAL AND SPONGE ECOSYSTEMS · AGUAMARINA
History of Deep-sea Coral Protection in U.S. Waters
Heather M. Coleman, NOAA Deep Sea Coral Research and Technology Program, USA

15:45 How protecting Ecologically and Biologically Significant Areas (EBSAs) is putting deep-sea corals and sponges on the map: a Canadian story
Cherisse Du Preez, Fisheries and Oceans Canada

16:00 A Win-Win for Deep Sea Corals and Fishermen: Increasing Seafloor Protections While Restoring Fishing Opportunities off the USA West Coast
Geoff Shester, Oceana, USA

16:15 Deep-Sea Corals National Natural Park: An Unique Marine Protected Area in Colombian Caribbean Sea
Milena Benavides-Serrato, PNN Corales Profundidad, Colombia

16:30 POSTER SESSION - Aguamarina III & IV

18:30 DSBS STUDENT EVENT - Oceanika Lounge

Corals and changing ocean environments - POSTERS

POSTER 1 - Corals and changing ocean environments - ABSTRACT ISDSC7_002
Cold-water corals as silent sentinel of ocean acidification and global warming in the Southern Ocean
Marco Taviani ISMAR-CNR Bologna Italy

POSTER 2 - Corals and changing ocean environments - ABSTRACT ISDSC7_004
Living Acesta excavata associated with cold-water corals in the Mediterranean extends Atlantic oxygen isotope calibration to high temperatures
Marco Taviani ISMAR-CNR Bologna Italy

POSTER 3 - Corals and changing ocean environments - ABSTRACT ISDSC7_009
The mesophotic-bathyal coral Dendrophyllia cornigera in a changing ocean.
Marco Taviani ISMAR-CNR Bologna Italy

Ecological interactions - POSTERS

POSTER 19 - Ecological interactions - ABSTRACT ISDSC7_119
Associations between deep-sea structure-forming species and deep-sea fishes on a pristine island in the Northwestern Hawaiian Islands
Beatriz E. Mejia-Mercado Florida State University USA

POSTER 20 - Ecological interactions - ABSTRACT ISDSC7_121
Compound Specific Isotope Analysis of Amino Acids Increases Our Understanding of Caribbean Sponge Trophic Ecology in the Mesophotic Zone
Keir Macartney University of New Hampshire USA

POSTER 21 ⚡ Ecological interactions ⚡ ABSTRACT ISDSC7_126
Environmental factors driving megabenthic faunal distributions on the East and West wall of the most eastern branch of Whittard Canyon
Sofia Ledin Royal Netherlands Institute for Sea Research NIOZ Netherlands

POSTER 22 - Ecological interactions - ABSTRACT ISDSC7_129
First fauna observations of Caramarí Bank: a mesophotic coral ecosystem
Cristina Cedeño-Posso Instituto de Investigaciones Marinas y Costeras INVEMAR Colombia

POSTER 23 ⚡ Ecological interactions ⚡ ABSTRACT ISDSC7_131
Functional and Phylogenetic Diversity of Fishes in Deep-Sea Coral Habitats along the southeastern U.S. coast
Andrea Quattrini Harvey Mudd College USA

POSTER 24 - Ecological interactions - ABSTRACT ISDSC7_134
Octocorals and brittle stars: Recording an unknown relationships in the Colombian Pacific Ocean
Giomar H. Borrero-Pérez Instituto de Investigaciones Marinas y Costeras INVEMAR Colombia

POSTER 25 ⚡ Ecological interactions ⚡ ABSTRACT ISDSC7_135

Patterns of Coral Symbiont Distributions Among Deep Waters of Atolls, Islands, Reefs and Seamounts in the Phoenix Islands Protected Area
Luke McCartin Woods Hole Oceanographic Institution USA

POSTER 26 - Ecological interactions - ABSTRACT ISDSC7_136
Spatial distribution and temporal dynamics of deep-sea corals from Santos Basin, Southeastern Brazil
Nayara Ferreira Carvalho Universidade de São Paulo Brazil

POSTER 27 - Ecological interactions - ABSTRACT ISDSC7_156
Molluscan assemblage time series: new proxy for environmental & ecosystem dynamics of cold-water coral mounds?
Chelsea Korpanty MARUM-University of Bremen Germany

Conservation and management of deep-sea coral and sponge ecosystems - POSTERS

POSTER 37 - Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_044
Coral Reefs on the High Seas: Supporting the Establishment of the First Large-Scale Marine Protected Areas of Coral Reefs on the High Seas
Daniel Wagner Conservation International USA

POSTER 38 - Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_046
Deep-sea data measurements and gaps identified by NOAA's Office of Ocean Exploration and Research
Katharine Egan NOAA Office of Ocean Exploration and Research USA

POSTER 39 - Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_049
Geo-referenced Deep-Sea Coral Database of the Northwest Atlantic Submarine Canyons
Elisabeth McElwee Woods Hole Oceanographic Institution USA

POSTER 40 - Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_051
Isidella elongata: a Mediterranean critically endangered deep-sea coral worthy of urgent protection
GIOVANNI CHIMIENTI University of Bari Aldo Moro Italy

POSTER 41 ⚡ Conservation and management of deep-sea coral and sponge ecosystems ⚡ ABSTRACT ISDSC7_053
Overview on the distribution of cold-water corals in the Mediterranean Sea
Giovanni Chimienti University of Bari Aldo Moro Italy

POSTER 42 - Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_056
SENSIMAR Project–Sensitive Marine Environments of SE Brazil
Guarani Cavalcanti PETROBRAS Brazil

POSTER 43 ⚡ Conservation and management of deep-sea coral and sponge ecosystems ⚡
ABSTRACT ISDSC7_058

The EXPRESS Cruise: A multidisciplinary, collaborative research cruise to study deep water ecosystems off the California and Oregon Coasts.
M. Elizabeth Clarke NOAA Northwest Fisheries Science Center USA

POSTER 44 ⚡ Conservation and management of deep-sea coral and sponge ecosystems
⚡ ABSTRACT ISDSC7_060

Vulnerable Marine Ecosystems along the Mediterranean Outflow Water: megabenthic communities from the western Mediterranean to the Azores
Patricia Puerta Instituto Español de Oceanografía Spain

POSTER 45 - Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_152

Deep-sea coral ecosystems off southeastern and southern Brazilian slope
Guarani Cavalcanti PETROBRAS Brazil

POSTER 46 ⚡ Conservation and management of deep-sea coral and sponge ecosystems ⚡
ABSTRACT ISDSC7_155

Using technology-based mapping approaches towards MSP in Colombia: preliminary results for Corales de Profundidad Colombian National Natural Park
Paula Andrea Zapata Ramírez Universidad Pontificia Bolivariana Colombia

WEDNESDAY · July 31

7:45	CHECK-IN
8:15	ANNOUNCEMENTS - Aguamarina I & II

8:30 CONNECTIVITY & PHYLOGEOGRAPHY · AGUAMARINA
Genomics Elucidates Species Boundaries and the Role of Water Mass in the Evolution of Paramuricea – KEYNOTE
Andrea Quattrini, Harvey Mudd College, USA

9:00 Comparative phylogeographic patterns of connectivity for mesophotic and deep-sea corals in the Gulf of Mexico
Santiago Herrera, Lehigh University, USA

9:15 Genetic diversity and connectivity of the corals Lophelia pertusa, Solenosmilia variabilis and Madrepora oculata in the Southwestern Atlantic
Carla Zilberberg, Universidade Federal do Rio de Janeiro, Brazil

9:30 Genetic diversity and structure of Vazella pourtalesi sponge grounds of the Scotian Shelf
Anna Patova, University of Bergen, Norway

9:45 CONSERVATION AND MANAGEMENT OF DEEP-SEA CORAL AND SPONGE ECOSYSTEMS · AGUAMARINA
U.S. West Coast Deep-Sea Coral Initiative: Design and Implementation in Support of Resource Management
Chris Caldow, NOAA Channel Islands National Marine Sanctuary, USA

10:00	BREAK

10:30 CONSERVATION AND MANAGEMENT OF DEEP-SEA CORAL AND SPONGE ECOSYSTEMS · AGUAMARINA

NOAA's Deep Sea Coral Research and Technology Program: A Decade of Research for Deep-Sea Conservation
Thomas Hourigan, NOAA Deep Sea Coral Research and Technology Program, USA

10:45 Facilitating Conservation and Management of Deep-Sea Corals and Sponge Ecosystems through Partnerships, Education and Outreach
Elizabeth Duncan, NOAA Channel Islands NMS & Cardinal Point Captains, USA

11:00 Restoration activities planned for mesophotic and deep benthic communities impacted by the Deepwater Horizon oil spill in the northern Gulf of Mexico
Kristopher Benson, NOAA Restoration Center, USA

11:15 ORGANISMAL BIOLOGY & NATURAL HISTORY · AGUAMARINA

Environmental control of cold-water coral reef morphology
Pål Buhl-Mortensen, Institute of Marine Research, Norway

11:30 Growth rate variability in deep-sea black corals from the Tasman Sea
Aimée Komugabe-Dixson, Ministry for Primary Industries, New Zealand

11:45 Reproductive cycle of the black coral Antipathes galapagensis in the Bay of La Paz, Gulf of California, Mexico
Antonella Lavorato, Universidad Autonoma de Baja California Sur, Mexico

12:00	LUNCH

13:30 SYSTEMATICS & EVOLUTION · AGUAMARINA

Genetic diversity of Colombian deep-sea corals – KEYNOTE
Nadia Santodomingo, Natural History Museum London, UK

14:00 Are museums plummy or octocorals mummies? A DNA barcoding library for the NE Atlantic and Mediterranean Swiftia Duchassaing & Michelotti, 1864
Íris Sampaio, University of the Azores, Portugal

14:15 Revisionary systematics in the wake of Deepwater Horizon Oil Spill: Molecular Lineage of Swiftia, Hypnogorgia, and Muricea
Peter Etnoyer, NOAA, USA

14:30 Revelations from mitogenome studies of western Gulf of Mexico octocorals
Erin E. Easton, University of Texas Rio Grande Valley, USA

14:45 Testing the utility of a novel target-enrichment bait approach in a morphologically and complex genus of octocoral
Candice Untiedt, CSIRO & University of Tasmania, Australia

15:00	BREAK

15:30 SYSTEMATICS & EVOLUTION · AGUAMARINA

A robust, time-calibrated phylogeny from sequence-capture of UCEs and exons sheds light on skeletal evolution in class Anthozoa
Catherine McFadden, Harvey Mudd College, USA

15:45 Evolutionary history of the Scleractinian corals distribution
Ana Navarro Campoy, Universidad Católica del Norte, Chile

16:00 Adding leaves to the tree: are micrabaciids the first diverging lineage within Recent corals?
Isabela Seiblitz, Federal University of Sao Paulo, Brazil

16:15 Phylogeny of Northeast Atlantic Deep-sea Pennatulacea
Raissa Hogan, National University of Ireland Galway, Ireland

16:30 POSTER SESSION - Aguamarina III & IV

18:30 DSBS ANNUAL GENERAL MEETING Aguamarina I & II

Connectivity & phylogeography - POSTERS

POSTER 8 - Connectivity & phylogeography - ABSTRACT ISDSC7_061
Abandoned and lost fishing gears as stepping stones for cold water coral colonization in the deep Mediterranean Basin
Marco Taviani ISMAR-CNR Bologna Italy

POSTER 9 - Connectivity & phylogeography - ABSTRACT ISDSC7_068
Population structure of the deep-water coral Madracis myriaster (Pocilloporidae: Anthozoa) in the Colombian Caribbean: Preliminary results
Lina M. Barrios Manchester Metropolitan University UK

Organismal biology & natural history - POSTERS

POSTER 10 - Organismal biology & natural history - ABSTRACT ISDSC7_105
Are all black corals so slowly growing: estimations of black corals growth rates from the maritime heritage site
Tina Molodtsova P.P. Shirshov Institute of Oceanology RAS Russia

POSTER 11 ⚡ Organismal biology & natural history ⚡ ABSTRACT ISDSC7_107
Deep-sea corals fecundity assessment in southeastern Brazil
Nathalia Bastos IEAPM Brazil

POSTER 12 - Organismal biology & natural history - ABSTRACT ISDSC7_108
Ecophysiology of Lophelia pertusa and Madrepora oculata from Formigas seamount (Azores): the influence of different water masses
Núria Viladrich Institut de Ciències del Mar Consejo Superior de Investigaciones Científicas Spain

POSTER 13 ⚡ Organismal biology & natural history ⚡ ABSTRACT ISDSC7_110
Environmental drivers of white plague disease on mesophotic coral reefs in the U.S. Virgin Islands
Andia Chaves Fonnegra Florida Atlantic University USA

POSTER 14 - Organismal biology & natural history - ABSTRACT ISDSC7_111
First observation of massive grazing by sea urchin on bamboo corals on a seamount in the South Atlantic
Pål Buhl-Mortensen Institute of Marine Research Norway

POSTER 15 - Organismal biology & natural history - ABSTRACT ISDSC7_112
Growth Band Microanalysis of Sea Pens in the Laurentian Channel, Newfoundland
Krista Greeley Memorial University of Newfoundland Canada

POSTER 16 - Organismal biology & natural history - ABSTRACT ISDSC7_114
In situ growth rates of three scleractinians at an anamolous deep coral mound in the southeastern US.
Sandra Brooke Florida State University USA

POSTER 17 - Organismal biology & natural history - ABSTRACT ISDSC7_116
Local-scale effects of reef geomorphology on the growth of Lophelia pertusa
Guillem Corbera Pascual University of Southampton UK

POSTER 18 - Organismal biology & natural history - ABSTRACT ISDSC7_118
The age and growth of New Zealand deep-sea Antipatharia: Bathypathes patula
Peter Marriott National Institute of Water & Atmospheric Research NIWA New Zealand

Systematics & evolution - POSTERS

POSTER 28 ⚡ Systematics & evolution ⚡ ABSTRACT ISDSC7_010
A revision of Trans-Pacific cold water coral, genus Calcigorgia (Cnidaria, Octocorallia, Acanthogorgiidae) with three new species.
Asako K. Matsumoto Planetary Exploration Research Center - Chiba Institute of Technology Japan

POSTER 29 - Systematics & evolution - ABSTRACT ISDSC7_012
A study of endemic Hawaiian Xeniidae (Octocorallia, Alcoyonacea) with a description of four new species and re-description of Sarcothelia edmondsoni
Grace Tuthill Brigham Young University - Hawaii USA

POSTER 30 - Systematics & evolution - ABSTRACT ISDSC7_015
Diversity is our strength: Mitochondrial genomes of North Atlantic Corals
Chris Yesson Zoological Society of London UK

POSTER 31 - Systematics & evolution - ABSTRACT ISDSC7_018
Genetic evaluation of deep-sea mushroom soft corals supports all previously reported genera
Tina Molodtsova P.P. Shirshov Institute of Oceanology RAS Russia

POSTER 32 - Systematics & evolution - ABSTRACT ISDSC7_019
Phylogenetic relationships among octocoral species at bathyal depths in the Phoenix Islands Protected Area based on mitochondrial genetic barcodes
Steven Auscavitch Temple University USA

POSTER 33 - Systematics & evolution - ABSTRACT ISDSC7_021
RAD-seq exploration of cryptic variation in common, wide-spread coral taxa
Meredith Everett NOAA-NWFSC & Lynker Technologies USA

POSTER 34 - Systematics & evolution - ABSTRACT ISDSC7_026

Together Under the Sea: Microbiomes as diversification drivers in Mesophotic and Deep-sea octocorals

Diana Vergara Universidad de los AndesColombia

POSTER 35 - Systematics & evolution - ABSTRACT ISDSC7_027
What should you do if the new genera outweigh the years?

Phil Alderslade CSIRO Australia

POSTER 36 - Systematics & evolution - ABSTRACT ISDSC7_153
First visual occurrence data for deep-sea cnidarians in the South-western Colombian Caribbean

Luisa Dueñas Universidad Nacional Colombi

Anthropogenic stressors - POSTERS

POSTER 65 - Anthropogenic stressors - ABSTRACT ISDSC7_140
Coral Transcriptomic Response to Oil and Dispersant

Amanda Glazier Temple University USA

POSTER 66 - Anthropogenic stressors - ABSTRACT ISDSC7_145
Effects of Corexit® 9500 on the Polychaete Ophryotrocha sp. reproduction – a long-term toxicity test

Marcia Reynier LABTOX – Laboratory of Environmental Analysis LTDA Brazil

THURSDAY · August 1

7:45 CHECK-IN

8:15 ANNOUNCEMENTS - Aguamarina I & II

8:30 TECHNICAL ADVANCES AND NOVEL METHODS · AGUAMARINA

A survey of deep-sea coral microbiomes reveals potential symbioses including potentially parasitic eukaryotes and chemoautotrophic bacteria – KEYNOTE
Samuel Vohsen, Pennsylvania State University, USA

9:00 Integrating metabolome and microbiome along a depth gradient in boreal demosponges
Karin Steffen, Uppsala University, Sweden

9:15 Combining eDNA and traditional surveys to study biodiversity in seamount communities
Meredith Everett, NOAA-NWFSC & Lynker Technologies, USA

9:30 Monitoring Cold-Water Coral Gardens using an Autonomous Underwater Vehicle and Quantitative Video Analysis
Andrea Gori, Università del Salento, Italy

9:45 Using AUV imagery to investigate spatial patters of arctic sponge ground megafauna and demersal fish species
Heidi Meyer, University of Bergen, Norway

10:00 BREAK

10:30 <mark>ECOLOGICAL INTERACTIONS · AGUAMARINA</mark>

Feeding ecology and competition between indicator taxa of Atlantic Vulnerable Marine Ecosystems
Stephanie Liefmann, University of Edinburgh, UK

10:45 Functional roles of cold-water Nephtheidae soft corals
Bárbara de Moura Neves, Fisheries and Oceans Canada

11:00 Food sources of an Arctic deep-sea sponge ground
Ulrike Hanz, Royal Netherlands Institute for Sea Research NIOZ, Netherlands

11:15 Dissolved organic carbon (DOC) is the main fuel for sponges that sustain biological hotspots in the deep-sea
Martijn Bart, University of Amsterdam, Netherlands

11:30 Trophic ecology of the bacteriosponge Geodia forming giant landscapes at Langseth Ridge, Arctic, 87°N
Teresa Morganti, Max Planck Institute for Marine Microbiology, Germany

11:45 Conceptual Model Of The Energy Flux In Zooplankton Community Associated With Mesophotic Corals In The Deep-Sea Corals Park, Colombian Caribbean
Laura Contreras Vega, Universidad de Cartagena, Colombia

12:00 LUNCH

13:30 <mark>ANTHROPOGENIC STRESSORS · AGUAMARINA</mark>

Crumbling reefs: a natural ocean acidification laboratory in the Northeast Pacific
Leslie Wickes, Thrive Blue LLC, USA

13:45 Growth and bioerosion/dissolution rates of Lophelia pertusa studied in situ and in the laboratory under simulated ocean acidification and warming
Janina V. Büscher, GEOMAR Helmholtz Centre for Ocean Research, Germany

14:00 Will we lose the reefs of the deep (and how will we know)?
Sebastian Hennige, University of Edinburgh, UK

14:15 Warm-water anomalies in the mesophotic depth range of the Southern California Bight with implications for gorgonian octocorals
Elizabeth Gugliotti, NOAA Deep-sea coral ecology lab, USA

14:30 Effects of temperature increase on the metabolic performance of the cold-water coral Lophelia pertusa
Carlos Gomez, Universidad de los Andes, Colombia

14:45 Ecological restoration of cold-water coral gardens on the Mediterranean continental shelf
Maria Montseny, Institut de Ciències del Mar, Consejo Superior de Investigaciones Científicas ICM-CISC, Spain

15:00 BREAK

15:30 <mark>ANTHROPOGENIC STRESSORS · AGUAMARINA</mark>

Genome-wide investigations elucidate coral responses to anthropogenic disturbance
Danielle De Leo, Florida International University, USA

15:45 Influence of Temperature and pH on the Phenotypic and Transcriptomic Response of Lophelia pertusa to Oil and Dispersant Exposure
Alexis Weinnig, Temple University, USA

16:00 Effects of barite exposure on Lophelia pertusa using a recirculation system
Ian Rocha, LABTOX – Laboratory of Environmental Analysis LTDA & IEAPM/UFF, Brazil

16:15 Effects of bentonite, barite and drill cuttings on larvae of the cold-water coral Lophelia pertusa
Sandra Brooke, Florida State University, USA

16:30 POSTER SESSION - Aguamarina III & IV

Technical advances and novel methods - POSTERS

POSTER 4 - Technical advances and novel methods - ABSTRACT ISDSC7_032
DECODE: an online platform for sharing annotated Deep-Sea Coral data using a georeferenced framework
Felipe Porfírio Universidade de São Paulo Brazil

POSTER 5 - Technical advances and novel methods - ABSTRACT ISDSC7_033
Deep-sea community diversity on the U.S. West Coast: what traditional and eDNA surveys can contribute to fisheries management
Meredith Everett NOAA-NWFSC & Lynker Technologies USA

POSTER 6 - Technical advances and novel methods - ABSTRACT ISDSC7_035
Leveraging telepresence and GIS technology to create rapid substrate distribution maps from ROV video and support studies of deep-sea corals
Peter Etnoyer NOAA USA

POSTER 7 ⚡ Technical advances and novel methods ⚡ ABSTRACT ISDSC7_037
New analysis tools for 'data rescue' of deep-sea coral observations from 30 years of submersible dives in the southeast USA
Enrique Salgado NOAA NCCOS & CSS USA

Biogeography, environmental controls and mapping - POSTERS

POSTER 47 - Biogeography, environmental controls and mapping - ABSTRACT ISDSC7_078
Mediterranean Cold Water Corals: many provinces or just a single superprovince? Scientific considerations and management implications
Marco Taviani ISMAR-CNR Bologna Italy

POSTER 48 ⚡ Biogeography, environmental controls and mapping ⚡ ABSTRACT ISDSC7_070
Best practices for spatial predictive modeling to support effective management of deep-sea corals and sponges
Arliss Winship NOAA NCCOS & CSS USA

POSTER 49 - Biogeography, environmental controls and mapping - ABSTRACT ISDSC7_080
Significant Differences in Coral Species Composition, Distribution, and Habitat Assemblages Among Northeast Atlantic Submarine Canyons
Taylor Heyl Woods Hole Oceanographic Institution USA

Habitat and diversity characterization - POSTERS

POSTER 60 - Habitat and diversity characterization - ABSTRACT ISDSC7_096

First observations of living Cold Water Corals surrounded by fishing grounds in Blanes Canyon (NW Mediterranean)

Fabio C. De Leo Ocean Networks Canada & University of Victoria Canada

POSTER 61 - Habitat and diversity characterization - ABSTRACT ISDSC7_097

First sight of mesophotic octocoral communities (40-60 m) of the Colombian Pacific coast

Katherine Mejía-Quintero Instituto de Investigaciones Marinas y Costeras INVEMAR Colombia

POSTER 62 - Habitat and diversity characterization - ABSTRACT ISDSC7_101

New records of deep-water corals of the Colombian Pacific: A contribution to increase of knowledge in the Tropical Eastern Pacific

Erika Montoya-Cadavid Instituto de Investigaciones Marinas y Costeras INVEMAR Colombia

POSTER 63 - Habitat and diversity characterization - ABSTRACT ISDSC7_102

Occurrence and distribution of the coral Dendrophyllia ramea off Cyprus (eastern Mediterranean)

Covadonga Orejas Instituto Español de Oceanografía Centro Oceanográfico de Baleares Spain

POSTER 64 - Habitat and diversity characterization - ABSTRACT ISDSC7_106

Black corals of the Whittard Canyon, Ireland

Raissa Hogan National University of Ireland Ireland

FRIDAY · August 2

7:45	**CHECK-IN**

8:15	**ANNOUNCEMENTS - Aguamarina I & II**

8:30 **HABITAT AND DIVERSITY CHARACTERIZATION · AGUAMARINA**
What are the limits for deep-sea coral distribution? – KEYNOTE
Erik Cordes, Temple University, USA

9:00 Coral dominated Vulnerable Marine Ecosystem (VME) observations in the Davis Strait, west Greenland
Chris Yesson, Zoological Society of London, UK

9:15 Habitat classification of the Deep-sea Coral National Natural Park of Colombia
Martha Patricia Vides Casado, Instituto de Investigaciones Marinas y Costeras INVEMAR, Colombia

9:30 Characterisation of seamount associated benthic habitats and communities in the Galapagos Marine Reserve
Salome Buglass, Charles Darwin Foundation, Ecuador

9:45 Deep-sea biology research in Costa Rica
Jorge Cortés, CIMAR, Universidad de Costa Rica, Costa Rica

10:00	**BREAK**

10:30 HABITAT AND DIVERSITY CHARACTERIZATION · AGUAMARINA

Madracis coral gardens in the Deep-sea Corals Natural National Park (Colombia): all we know and we still need to know

Cristina Cedeño-Posso, Instituto de Investigaciones Marinas y Costeras INVEMAR, Colombia

10:45 Diversity and biogeographic patterns within the South African azooxanthellate coral fauna

Zoleka Filander, Department of Environmental Affairs & Nelson Mandela University, South Africa

11:00 Updates on the distribution of deep-sea corals in the Northwest Atlantic: a fourteen-year perspective (2005-2019)

Vonda Wareham Hayes, Fisheries and Oceans Canada

11:15 Ecology, distribution and time-series analyses of mesophotic and deep-water coral assemblages on a tropical island slope, Isla Roatán, Honduras

Charles G. Messing, Nova Southeastern University, USA

11:30 Record of mesophotic coral habitats in the northern Colombian Caribbean

Juan Carlos Marquez, Instituto de Investigaciones Marinas y Costeras INVEMAR, Colombia

11:45 BIOGEOGRAPHY, ENVIRONMENTAL CONTROLS AND MAPPING · AGUAMARINA

Exploring the applicability of basin-scale oceanographic regimes to understanding deep-sea coral and sponge distributions

Matt Dornback, Mississippi State University & NOAA NCEI, USA

12:00 LUNCH

13:30 BIOGEOGRAPHY, ENVIRONMENTAL CONTROLS AND MAPPING · AGUAMARINA

Cold-water coral responses to water mass properties: influence of Mediterranean waters into the Atlantic communities – KEYNOTE

Patricia Puerta, Instituto Español de Oceanografía, Spain

14:00 Abiotic drivers of deep-sea coral species distribution and community assembly on rugged submarine features in the Phoenix Islands Protected Area

Steven Auscavitch, Temple University, USA

14:15 Mapping oxygen consumption rates in the cold-water coral reef, the Mingulay Reef

Laurence De Clippele, University of Edinburgh, UK

14:30 Improving the understanding of biogeography of VME indicators in the deep North Atlantic

Berta Ramiro Sánchez, University of Edinburgh, UK

14:45 Characterizing Potential Distributions of Deep-Sea Corals and Sponges Offshore the US West Coast through Spatial Predictive Modeling

Matthew Poti, NOAA NCCOS & CSS, USA

15:00 BREAK

15:30 BIOGEOGRAPHY, ENVIRONMENTAL CONTROLS AND MAPPING · AGUAMARINA

Habitat Suitability Mapping for Southern California Deep Sea Corals and Sponges

Nissa Kreidler, NOAA & Humboldt State University, USA

15:45 Predicting the distribution of vulnerable marine ecosystems in the Nordic Seas

Julian Mariano Burgos, Marine and Freshwater Research Institute, Iceland

16:00 Lessons learnt from the development of habitat suitability models for deep-sea corals in the South Pacific Ocean
Owen Anderson, National Institute of Water & Atmospheric Research NIWA, New Zealand

16:15 Towards transparency and reproducibility in environmental covariates for deep-sea species distribution modeling
Andrew Davies, University of Rhode Island, USA

16:30 Wrap up · Awards · Aguamarina I & II

17:30 CLOSING BANQUET

Abstracts

Corals and changing ocean environments - TALKS

TALK - Corals and changing ocean environments - ABSTRACT ISDSC7_154
TUESDAY Morning · 8:30 · Aguamarina Ballroom
Mediterranean Deep Sea Corals: from Past to Future – KEYNOTE

Marco Taviani, ISMAR-CNR Bologna, Italy

The integration of historical data, experimental studies in tank, and genetic characterization is pivotal to inform about patters of coral reactivity in face of unstable environmental scenarios. The Mediterranean Basin offers a valuable stage to tackle with the dynamic response of corals to global and regional perturbations both natural and anthropic. Here, the presence since the Miocene of extant-type deep sea corals, including frame-building colonial species, is a consolidate fact. Understanding whether this presence was continuous or suffered times of partial or complete demise is a key-point for future projections on coral survival in a changing ocean. Although based upon fragmentary information, Plio-Pleistocene situations demonstrate considerable changes in the structuring of extant deep water coral communities through time and the occurrence of selective extinctions. It is important to notice that significant rearrangements in Mediterranean deep water coral populations in the past predate the current abnormal increase of carbon dioxide in the atmosphere, calling for factors other than ocean acidification in controlling coral wellness. In this perspective, studies on coral behaviour under changing pH scenarios provided controversial results about coral resilience, with some consensus that under current projections ocean acidification will not impact dramatically coral growth in the Mediterranean Sea. Paleoceanographic studies on late Pleistocene to Holocene deep water corals in the Mediterranean Sea have shown that time of deoxygenation strongly influenced their survivorships up to a drastic decline in the eastern basin, followed up by a progressive

but yet incomplete recovery. Geological and experimental evidence increasingly supports the view that temperature is one fundamental variable in determining the fate of deep water corals. It likely accounts for the selective demise of various coral taxa during the early and late Pleistocene in the Mediterranean Sea, and may prove to be a challenging factor in the near future as well. Importantly, as revealed by geological data and tank experiments, the resilience of corals to temperature changes (as for ocean acidification) differs among individual coral taxa, likely heralding those with better chances to cope with future changes.

TALK - Corals and changing ocean environments - ABSTRACT ISDSC7_001
TUESDAY Morning · 9:00 · Aguamarina Ballroom
3000 years of southwest Pacific gyre variability reconstructed from deep-sea black corals

Nicholas Hitt, Victoria University Of Wellington, New Zealand
Helen Neil, National Institute of Water and Atmosphere
Daniel Sinclair, Victoria University Of Wellington
Stewart Fallon, Australian National University
Aimée Komugabe-Dixson, Ministry for Primary Industries

The South Pacific Gyre (SPG) is the largest ocean gyre on earth. It plays an integral role in the global climate system by modulating climate and marine productivity patterns from Australia to South America. The SPG's western boundary current, the East Australian Current (EAC), delivers subtropical oligotrophic waters to high latitudes creating mild and stable climates. Simultaneously, high levels of primary productivity are fostered by the subpolar nutrient rich waters of the Sub-Tropical Front. Recently, strengthening mid-latitude westerlies have driven an acceleration of the EAC, creating a 'hotspot' in the southwest Pacific where warming is up to 4x the global average. These changes are often attributed to anthropogenic climate change. However, instrumental records only span a few decades and high-latitude paleoclimate proxies predominately provide insight to long-term ocean dynamics not relevant to anthropogenic timescales. This leaves a crucial gap in understanding the decadal-millennial variability of SPG circulation and marine productivity. Here we present five high-resolution reconstructions of late Holocene southwest Pacific productivity and ocean circulation using carbon and nitrogen isotopes (d13C, d15N) and sea-surface radiocarbon reservoir ages from New Zealand deep-sea black corals. Our paleo-ocean reconstructions span the last 3000 years and show decadal and millennial-scale variability in radiocarbon reservoir age and d13C, and centennial-scale variability in d15N. We interpret our reservoir age results as shifts in EAC strength and our d13C results as changes in phytoplankton community structure. Our d15N results are largely decoupled from the d13C timeseries and reflect variability in either source nitrate, export production or marine trophic level. Our results suggest that the recent changes in SPG strength and the decline in marine productivity may not be unique to the past century and should be accounted for in climate forecasts.

TALK - Corals and changing ocean environments - ABSTRACT ISDSC7_006

Predicting the response of sponge-suitable habitat to environmental change

Emyr Martyn Roberts, University of Bergen, Norway
Annette Samuelsen, Nansen Environmental and Remote Sensing Center
Andrew Davies, University of Rhode Island
Hans Tore Rapp, Universitetet i Bergen

In the North Atlantic Ocean, there are a number of well-known deep-sea sponge ground types, including monospecific grounds of the glass sponge Vazella pourtalesi (on the Scotian Shelf, off Nova Scotia) and of Pheronema carpenteri (along the European and northwest African continental shelves and slopes, and off the Azores archipelago). So-called 'ostur' sponge grounds are also relatively widespread at mid-to-high latitudes. These are multispecific aggregations (up to 50 sponge species) dominated by large astrophorid (tetractinellid) demosponges, and in particular members of the genus Geodia. We have constructed habitat suitability models (HSMs) for two species of Geodia: Geodia barretti and Geodia hentscheli, which often dominate a 'boreal' and an 'arctic' type of ostur, respectively. Ensemble models (employing a range of different modelling algorithms) were trained using present day occurrence records and environmental conditions. Spatial predictions of suitable habitat were made for the present day North Atlantic and into the recent past, using simulated near-bed environmental conditions for the period 1948-2015 output by the coupled physical-biogeochemical HYCOM-ECOSMO ocean model. This model was in turn forced by a Global High Resolution Climate Reconstruction (ECHAM6). Unlike future projections, where no validation data yet exists, some historic occurrence records (and indeed past climate data) are available with which to validate hindcast models and assess uncertainty. Initial results suggest decadal-multidecadal oscillations in suitable habitat spatially at a number of key locations. We explore the factors driving these changes and any longer-term shifts that may be occurring under climate change. We also discuss the implications of changes in habitat suitability to actual species/habitat distributions, identify areas of potential extirpation, colonisation, and refugia from climate change, and present plans to project to future climate scenarios.

TALK - Corals and changing ocean environments - ABSTRACT ISDSC7_007
TUESDAY Morning · 9:30 · Aguamarina Ballroom
Temporal and spatial variability of a Mediterranean Cold-Water Coral Mound evolution over the last 200 kyrs: the Cabliers Coral Mound Province

Guillem Corbera Pascual, University of Southamtpon, UK
Claudio Lo Iacono, Institut de Ciències del Mar (CSIC), Barcelona, Spain
Christopher D. Standish, National Oceanography Centre, United Kingdom
Orestis Katsamenis, University of Southamtpon
Jürgen Titschack, MARUM Centre for Marine Environmental Sciences, University of Bremen, Germany
David Van Rooij, University of Ghent, belgium
Gavin L. Foster, University of Southampton

Eleni Anagnostou, GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany
Veerle A.I. Huvenne, National Oceanography Centre, United Kingdom
Ricardo Aguilar, OCEANA, Madrid, Spain

Cold-water corals are key species of benthic marine ecosystems and sensitive to climate change. Nonetheless, the paleo-oceanographic setting in which coral mounds developed in the Mediterranean Sea during the last 200 kyr still needs to be properly understood. This study describes the coral deposits and corresponding ages of two gravity cores, 9 and 11 m long, acquired at the Cabliers Coral Mound Province (CCMP) (Alboran Sea, W Mediterranean). The first core was collected from the northernmost region of the province, at 313 m depth, whereas the second was acquired 16 km to the SW, at 437 m depth. Both cores showed dense coral deposits, dominated by Lophelia pertusa and Madrepora oculata, within a muddy sediment matrix. CT-scan data quantification revealed variable coral preservation patterns and maximum coral/sediment ratios of ~50 vol.%. Over one hundred coral samples have been dated by U/Th laser ablation. The northern core exhibited a mound aggradation of 8.8 m between 13.7 and 1.2 ka BP. The most thriving conditions occurred during the Bølling-Allerød interstadial (avg. 179 cm kyr-1), followed by a slower but continuous aggradation until the present (avg. 52 cm kyr-1), suggesting suitable conditions for coral growth persisted through the last 14 kyr. In contrast, the youngest coral deposit found on the top of the southern core is 9.2 kyr old. This core showed a mound aggradation of 10.5 m in >300 kyr (avg. 35 cm kyr-1), indicating less favourable environmental conditions for mound formation. Mound demise in southern Cabliers generally occurred during highstand sea-level stages, when the interface between Atlantic and Mediterranean water masses shifted upwards, probably preventing the corals from a sufficient food supply. The contrasting mound development patterns observed between North and South Cabliers suggest that this province yields important insights on how local changes in oceanographic conditions can have crucial implications on coral mound growth.

TALK - Corals and changing ocean environments - ABSTRACT ISDSC7_005
TUESDAY Morning · 9:45 · Aguamarina Ballroom
Occurrence of cold-water corals and their potential roles in shallow Antarctic glacial embayment

Hye-Won Moon, National Marine Biodiversity Institute of Korea, South Korea
In-Young Ahn, Korea Polar Research Institute
Kyu-Cheul Yoo, Korea Polar Research Institute

Four octocorals (Arntzia gracilis, Thouarella (Thouarella) antarctica, Onogorgia nodosa and Tenuisis microspiculata) have been found by SCUBA diving from two glacial coves (Marian Cove and Potter Cove) in King George Island, where glacier retreat is proceeding fast for the past several decades. Within the depths surveyed (<40 m), these octocorals were found to occur at relatively stabilized substrates at a depth of deeper than 30 m where ice scouring is likely much less frequent than at shallower depths. In addition these habitats were distant from the submerged glaciers or the glacier-runoff sources. One of them, Arntzia gracilis, known as an Antarctic endemic species, was first reported from a water depth of less than 40 m in Antarctica. It is noteworthy that distinct growth rings were formed in the calcareous

stem of A. gracilis, which suggests the utility of this species and possibly the other species as biomarkers or proxies for environmental consequences induced by climate change. We also investigated reproductive development of natural populations of A. gracilis and O. nodosa by tagging and taking subsamples for microscopic analysis during a period of an austral summer season. Gonads of A. gracilis were observed within the axial coenenchyme. On the other hand, in the field, release of orange planulae of O. nodosa was observed during full moon in December 2012. The different reproductive features and strategies of the two species are likely crucial to understand of the distribution pattern of the octocorals in the rapidly warming Antarctic glacial embayment.

Corals and changing ocean environments - POSTERS

POSTER 1 - Corals and changing ocean environments - ABSTRACT ISDSC7_002
TUE Morning • 16:30 • Aguamarina
Cold-water corals as silent sentinel of ocean acidification and global warming in the Southern Ocean

Marco Taviani, ISMAR-CNR Bologna, Italy
Paolo Montagna, ISMAR-CNR, Via Gobetti 101, 40129, Bologna, Italy
Claudio Mazzoli, Department of Geosciences, University of Padova, Via Gradenigo 6, 3513, Padova, Italy
Malcom McCulloch, School of Earth and Environment, UWA Oceans Institute and ARC Centre of Excellence for Coral Reef Studies, The University of Western Australia, Crawley, WA, 6009, Australia
Julie Trotter, School of Earth and Environment and UWA Oceans Institute, The University of Western Australia, Crawley, WA, 6009, Australia

Attempts to decipher the role of the Southern Ocean in modulating past-climate is particularly difficult due to the relative scarceness of calcium carbonate-precipitating organisms, such as foraminifera, which are commonly used as paleoclimate archives in other oceans. Waters south of the Polar Front become undersaturated with respect to aragonite and calcite. Cold-water corals are one of the few calcifying organisms that can cope with corrosive and subfreezing environments, being therefore potential candidates for reconstructing temperature and pH records at high resolution (annual) over centennial timescales. Trace elements and boron isotopes were measured in four specimens of the scleractinian coral Flabellum from the Ross Sea, Antarctica at depths between 390 and 760 m. The specimens were sub-sampled along the growth axis and analysed using both quadrupole and multi-collector-ICPMS methods. The temperature-sensitive element (Li/Mg) and the boron isotope pH proxy show a consistent pattern between different transects within each specimen, with excellent reproducibility, suggesting minimal influence from 'vital effects'. Both the Li/Mg-derived temperatures and the boron isotope-derived pH of the younger portion of the corals are consistent with in-situ instrumental values. Importantly, these corals record a general trend of decreasing pH over the past few decades (~0.025 pH units/decade), as well as both warming (~0.15 °C/decade) and cooling trends which depend

on the ambient water masses (High Salinity Shelf Water vs. Circumpolar Deep Water). Specific geochemical signals trapped in Antarctic corals are shown to be robust proxies for the physical and chemical properties of the water masses in which the corals grew. In particular, the Li/Mg and boron isotopic composition of the coral Flabellum vary with temperature and pH respectively, providing a new tool to reconstruct the variability of these key parameters for the Southern Ocean water masses.

POSTER 2 - Corals and changing ocean environments - ABSTRACT ISDSC7_004
TUE Evening · 16:30 · Aguamarina
Living Acesta excavata associated with cold-water corals in the Mediterranean extends Atlantic oxygen isotope calibration to high temperatures

Marco Taviani, ISMAR-CNR Bologna, Italy
Matthias Lopez-Correa, ISMAR-CNR Bologna, Italy
André Freiwald, Senckenberg am Meer, Wilhelmshaven, Germany

The extant limid bivalve Acesta excavata is commonly associated with cold-water corals in the Recent North Atlantic and likewise associated with Pleistocene occurrences in the Mediterranean. Radiocarbon dated suites of A. excavata show a presence of the bivalves during cold-phases of Dansgaard-Oeschger cycles during the Last Glacial, along with few Holocene occurrences. Oxygen isotope records from this dated material offer snapshots of past deep-water temperatures across the last 50 ka. Our preceding longitudinal screening of Acesta spp. from 72°N to 54°S in the North Atlantic for their oxygen isotope composition, show equilibrium precipitation of oxygen isotopes between 6 and 10°C. A new Recent find of A. excavata offered the rare opportunity to extend the recent calibration to high temperatures at 14.8°C. This specimen was recovered alive during R/V Minerva cruise Anomcity_2016 from the Gulf of Naples in the Tyrrhenian Sea with the ROV POLLUX III from a vertical cliff at 360 to 320 m depth near the NW head of Anton Dohrn Canyon. Associated filter-feeding rock-wall fauna include the cold-water scleractinian corals Lophelia pertusa, Madrepora oculata, Desmophyllum dianthus, Javania cailleti and the deep-water oyster Neopycnodonte zibrowii, In the modern Mediterranean with high ambient salinity of ~38.7 PSU, the correction for modern seawater oxygen isotope composition is pivotal. Reconstructed temperatures of 14.58 ± 0.75°C coincide then within error with the measured ambient temperature of 14.5°C at the site. Also, Mediterranean A. excavata precipitates its external calcite at expected isotopic equilibrium.

POSTER 3 - Corals and changing ocean environments - ABSTRACT ISDSC7_009
TUE Evening · 16:30 · Aguamarina
The mesophotic-bathyal coral Dendrophyllia cornigera in a changing ocean.

Marco Taviani, ISMAR-CNR Bologna, Italy
Giorgio Castellan, ISMAR-CNR Bologna, Italy
Lorenzo Angeletti, ISMAR-CNR Bologna, Italy
Paolo Montagna, ISMAR-CNR Bologna, Italy

Ocean warming is expected to deeply modify marine ecosystems up to jeopardize the ecological status of scleractinian coral life worldwide. Heat-waves are threatening shallow-water coral reefs from tropical to temperate latitudes, where several mass mortality events have occurred in the last 10 years. In this scenario, the arborescent scleractinian Dendrophyllia cornigera is an endangered (IUCN Red List) temperate coral occurring at intermediate-depth from the mesophotic zone (ca. 40 m) to highly complexity structures at twilight depths (ca. 120 m) of the Eastern Atlantic Ocean and Mediterranean Sea. Besides, it represents a secondary component in cold-water-coral situations with Madrepora oculata and Lophelia pertusa at bathyal depths. However, D. cornigera only rarely forms important bioconstructions at any depth, one such exception being the Amendolara Seamount, in the Ionian Sea in ~100-120 m water depth. Available evidence from literature records, coupled with newly acquired Remotely Operated Vehicle data in the Mediterranean Sea, provide an updated view of the distributional range of D. cornigera. Averaged temperature values extrapolated from the coral's occurrence in the wild document a ~7-17°C range. Our results suggest that the natural thermal tolerance of this eurybathic coral may represent an edge for its survival in a progressively warming ocean, perhaps even taking advantage in the long term of a concomitant decline of more thermal-sensitive reef-forming calcifiers.

Technical advances and novel methods - TALKS

Technical advances and novel methods - ABSTRACT ISDSC7_028
THURSDAY Morning · 8:30 · Aguamarina Ballroom

A survey of deep-sea coral microbiomes reveals potential symbioses including potentially parasitic eukaryotes and chemoautotrophic bacteria – KEYNOTE

Samuel Vohsen, Pennsylvania State University, USA
Iliana Baums, The Pennsylvania State University
Charles Fisher, The Pennsylvania State University

The microbiomes of shallow-water corals play important roles such as nitrogen fixation, while those of deep-sea corals are understudied. To characterize the microbiomes of deep-sea corals, we collected samples from over 30 species, water, and sediment from across the Gulf of Mexico for 16S sequencing. Coral microbiomes were distinct from the water and sediment and differed between even closely related species. Single microbes often dominated the microbiomes of particular coral species and may be symbionts. One is an apicomplexan (eukaryote) that dominated Leiopathes glaberrima with a plastid genome that partially encoded chlorophyll biosynthesis. Closely related apicomplexans were found in a variety of other coral taxa and like others in this group may be parasitic. We also found a novel bacterium of the Mollicutes in Callogorgia delta. This bacterium had a functionally and physically reduced genome suggesting a symbiotic lifestyle. FISH microscopy revealed large aggregates of bacteria within the mesoglea and specific probes are under development to confirm their identity. Finally, the octocoral Paramuricea sp. B3 from a site with active cold seeps were dominated by Thioglobus, a close relative of the sulfide-oxidizing endosymbionts of Bathymodiolus spp. This bacterium was not present in the surrounding water, sediment, or

co-occurring scleractinian corals. Its genome revealed the potential to oxidize reduced sulfur compounds and fix carbon via the Calvin cycle and we confirmed that these pathways were transcriptionally active. Furthermore, its relative abundance in the coral was correlated with the depletion of carbon-13 and nitrogen-15 in coral tissue and therefore incorporation of chemoautotrophic primary production into the coral holobiont. This suggests that the diet of Paramuricea sp. B3 may be supplemented with chemoautotrophy by a Thioglobus symbiont. Altogether, this work discovered several potential symbioses which may prove important to deep-sea corals.

Technical advances and novel methods - ABSTRACT ISDSC7_034
THURSDAY Morning · 9:00 · Aguamarina Ballroom
Integrating metabolome and microbiome along a depth gradient in boreal demosponges

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Ida Erngren, Analytical Chemistry, Department of Medicinal Chemistry, Uppsala University, Uppsala, Sweden
Jakob Haglöf, Analytical Chemistry, Department of Medicinal Chemistry, Uppsala University, Uppsala, Sweden
Leontine E. Becking, Department of Fisheries and Oceans, Bedford Institute of Oceanography, Dartmouth, Canada. Marine Animal Ecology, Wageningen University & Research, Wageningen, The Netherlands
Hauke Smidt, Laboratory of Microbiology, Wageningen University & Research, Wageningen, The Netherlands
Igor Yashayaev, Wageningen Marine Research, Wageningen University & Research, Den Helder, The Netherlands
Ellen Kenchington, Wageningen Marine Research, Wageningen University & Research, Den Helder, The Netherlands
Paco Cárdenas, Pharmacognosy, Department of Medicinal Chemistry, Uppsala University, Uppsala, Sweden
Detmer Sipkema, aboratory of Microbiology, Wageningen University & Research, Wageningen, The Netherlands.

Background Sponges are associated with a rich and diverse microbiome and metabolome, and it has been hypothesised that bacteria are the main producers of natural products isolated from the sponge holobionts. Thus, investigating environmental and microbial contributions to the sponge holobiont natural product production is relevant for bioprospecting and understanding deep-sea ecology. Aim We aim to generate high-throughput microbiome and metabolome data of demosponges along a depth gradient to (1) investigate their variations with depth and (2) generate hypotheses about which bacteria produce natural products. Methods We assessed microbiome by amplicon sequencing and metabolome by UPLC-HRMS in three boreal deep-sea demosponges (Geodia barretti, Stryphnus fortis, Weberella bursa) sampled along a slope in the North Atlantic Davis Strait (244–1481 m depth). (1) We used OPLS models to address microbiome and metabolome

variations related to sample depth and (2) built microbial interaction networks to designate candidate producers of the anti-biofouling compound barettin isolated from G. barretti (2). Results We found that depth has a pronounced effect on microbiome and metabolome (1) with a shift around 1000 m. There is signal of a deep-sea microbiome, and we found an increase of putative osmoprotectants with depth. In addition, known bioactive compounds for G. barretti decreased below 1000 m depth. From the microbial interaction network (2), we suggest OTUs belonging to the phyla Chloroflexi, Acidobacteria, Proteobacteria and Gemmatimonadetes as producers for the anti-biofouling compound barettin. Conclusion Specimens from lower bathyal depths have a unique microbiome and metabolome, and therefore have an inherent potential for future bioprospecting. Variation of the production of bioactive compounds could further be interpreted as response to ecological variation. Integrative omics can help generate hypotheses on natural product production.

Technical advances and novel methods - ABSTRACT ISDSC7_030
THURSDAY Morning · 9:15 · Aguamarina Ballroom
Combining eDNA and traditional surveys to study biodiversity in seamount communities

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Cherisse Du Preez, DFO Canada
Tom Hourigan, NOAA-DSCRTP
Christopher Kelley, Hawaii Undersea Research Laboratory
Tammy Norgard, DFO Canada
Linda Park, NOAA-NWFSC
Nicole Raineault, Ocean Exploration Trust

Seamounts are important habitats in the deep-ocean and are increasingly the focus of national and international conservation efforts. Their structure and local community composition vary depending on location, form, and local oceanic conditions. As with other deep-sea habitats, seamounts can be challenging environments for exploration and surveys. Corals and sponges can be difficult to identify visually, and motile organisms may avoid detection. Sampling is often limited and it is impossible to sample every individual in large, diverse communities. Environmental DNA (eDNA) studies provide a unique way to begin to address whole community diversity on seamounts, capturing a snapshot of a local community and allowing detection of numerous taxa from a single water sample. During the 2018 E/V Nautilus season, 36 eDNA samples were collected at five seamount communities off British Columbia, and 25 eDNA samples were collected from nine seamounts in the Papahānaumokuākea Marine National Monument. These sampling efforts targeted areas of dense coral and sponge communities, which were highly variable among locations. Representative samples of coral and sponge individuals, as well as high resolution video and still images were collected over the course of the same dives. Combining high throughput amplicon sequencing of the eDNA samples, including markers developed for octocorals, black corals, sponges, and fish, with traditional video and DNA barcode analysis, we have explored whole community diversity around these seamounts. This provides critical baseline information of the structure of these communities for future management of these protected areas.

THURSDAY Morning • 9:30 • Aguamarina Ballroom

Monitoring Cold-Water Coral Gardens using an Autonomous Underwater Vehicle and Quantitative Video Analysis

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Maria Montseny, Institut de Ciències del Mar (ICM-CSIC)
Cristina Linares, Universitat de Barcelona
Laura Garriga, Institut de Ciències del Mar (ICM-CSIC)
Carlos Dominguez-Carrió, Institute of Marine Research (IMAR)
Núria Viladrich, Institut de Ciències del Mar (ICM-CSIC)
Patricia Baena, Institut de Ciències del Mar (ICM-CSIC)
Marc Carreras, Universitat de Girona
Narcís Palomeras, Universitat de Girona
Nuno Gracias, Universitat de Girona
Josep-Maria Gili, Institut de Ciències del Mar (ICM-CSIC)

Cold-water coral gardens are among the most complex benthic communities on the Mediterranean continental shelf. They are dominated by gorgonians, soft corals and sponges, and host a highly diversified associated fauna. These ecosystems are extremely vulnerable to bottom-contact fishing activities, including bottom trawling and artisanal fishing with trammel nets and longlines. Cold-water gorgonians are long-lived and slow-growing species, and consequently the impacts caused by fishing activities can have far-reaching and long-lasting effects on their populations. Consequently, it is urgent to establish measures to conserve these paramount deep-sea ecosystems. In this line, Marine Protected Areas and Fishing Restricted Areas have been established to protect cold-water coral reefs and coral gardens. However, to evaluate the effectiveness of any conservation measure, regular monitoring are needed, but their application in the deep-sea still remains a challenge. To advance in the development of effective monitoring of coral gardens in deep-sea protected areas, we quantified gorgonian abundance, size structure and partial/total mortality by means of quantitative video analysis of transects recorded with an Autonomous Underwater Vehicle (AUV) on the continental shelf of Cap de Creus (Spain). Three AUV transects were recorded in 2018 following the same path of ROV transects recorded in 2012, at 100 m depth. One of these transects was repeatedly recorded, by instructing the AUV to perform additional passes with side displacements to the left and to the right of the central track. By comparing the results obtained from all the recordings, we determined the viability of using AUVs for the monitoring of cold-water coral gardens. Moreover, the suitability of using georeferenced photo mosaics was tested to monitor gorgonian survival. Finally, by comparing the results obtained in 2012 and 2018, we estimated the changes occurred in gorgonian populations over a six-year period.

THURSDAY Morning • 9:45 • Aguamarina Ballroom

Using AUV imagery to investigate spatial patters of arctic sponge ground megafauna and demersal fish species

Heidi Meyer, University of Bergen, Norway
Martyn Roberts, University of Bergen & Bangor University
Hans Tore Rapp, University of Bergen & NORCE, Norwegian Research Centre
Andrew Davies, University of Rhode Island & Bangor University

Arctic sponge grounds form important deep-sea habitats for cold-water fauna in the high latitudes of the North Atlantic. Sponges of the Geodia, Stelletta, Asconema, Trichasterina, and Schaudinnia genera are critical for these communities because they provide numerous ecological services (e.g. structure and refuge) for inhabiting megafauna and fish species. While more research has been conducted on deep-sea sponge ground community composition and broad-scale distribution in recent years, there is a lack of investigation of the small-scale spatial patterns occurring within these habitats. It is these small-scale patterns that provide insight into the biotic factors and ecological drivers operating within deep-sea ecosystems. We used autonomous underwater vehicle (AUV) imagery to investigate the fine-scale spatial patterns produced by the major megafauna and demersal fish within an arctic seamount sponge ground. Most fauna showed even distributed within the sample area; however, some species displayed clear spatial preferences that closely followed depth contours. These patterns could not be explained easily by the abiotic variables collected and biotic factors are thought to influence the observed patterns at this scale. The imagery also revealed valuable insight into the fish community inhabiting the sponge ground. The commercially important Greenland Halibut (Reinhardtius hippoglossoides) was abundant within the sample area and the presence of Arctic Skate (Amblyraja hyperborea) eggs suggests the area is used as a nursery. AUV imagery has great potential for studying fine-scale spatial patterns in benthic megafauna (and fish), and can undoubtedly be useful to future deep-sea conservation and management efforts.

Technical advances and novel methods - POSTERS

POSTER 4 - Technical advances and novel methods - ABSTRACT ISDSC7_032
THU Evening • 16:30 • Aguamarina
DECODE: an online platform for sharing annotated Deep-Sea Coral data using a georeferenced framework

Felipe Porfírio, Universidade de São Paulo, Brazil
Daniel de Matos Couto, University of São Paulo, Oceanographic Institute
Linda Gwen Waters, University of São Paulo, Oceanographic Institute
Nayara Carvalho, University of São Paulo, Oceanographic Institute
Guarani Cavalcanti, Centro de Pesquisa da Petrobras - CENPES (Petrobras Research Center)
Paulo Yukio Gomes Sumida, University of São Paulo, Oceanographic Institute

Deep-sea corals (DSC), despite being globally widespread, are relatively poorly studied and mapped in comparison to their shallow water counterparts. In Brazil, the ratio of deep-water to shallow-water coral species is approximately 4:1. Just like shallow tropical corals, some DSC species can form reef-like structures with great ecological importance, providing habitat for a

number of associated species and functioning as biodiversity aggregators. Until now, most DSC studies have been concentrated in developed countries with greater funding availability for research projects. The aim of this project is to create an online platform for the storage and sharing of deep sea image data from the South Atlantic sea floor, focused on ROV (remotely operated vehicle) videos recorded by the Brazilian Oil and Gas Company PETROBRAS over the last two decades. For this, a web portal will be created through cooperation between PETROBRAS (SENSIMAR Project) and the University of São Paulo (USP), housed on a server at USP's Oceanographic Institute. Interested scientists will be able to access the repository including video, image, and physical oceanography data. The data will be organized into a geographic information system framework, where the registered users can make queries according to their interest. It will also allow users to input additional video annotations, creating new information which will be inserted into the database. Availability of open access data, a globally growing phenomenon, is particularly important in developing countries, providing access to large volumes of data collected by increasingly sophisticated instrumentation that is otherwise prohibitively expensive for researchers in these regions. Our goal is to provide an influx of new data from a sparsely studied region in the South Atlantic, optimizing the use of the already existing data to solve scientific problems and expand fundamental knowledge of ecological structure and function in the deep sea.

POSTER 5 - Technical advances and novel methods - ABSTRACT ISDSC7_033
THU Evening · 16:30 · Aguamarina
Deep-sea community diversity on the U.S. West Coast: what traditional and eDNA surveys can contribute to fisheries management

Meredith Everett, NOAA-NWFSC & Lynker Technologies, USA
Elizabeth Clarke, NOAA-NWFSC
Tom Laidig, NOAA-SWFSC
Linda Park, NOAA-NWFSC
Nicole Raineault, Ocean Exploration Trust
Diana Watters, NOAA-SWFSC

Since 2006, various coral and sponge communities have been managed as key essential fish habitat (EFH), and modifications to protected areas continue to be made based on the most current research available. In collaboration with partners from the Ocean Exploration Trust (OET) and EXpanding Pacific Research and Exploration of Submerged Systems (EXPRESS),, environmental DNA (eDNA) samples were collected at multiple sites along the west coast of the U.S. to assess the presence of deep-sea coral and fish species. Samples were collected in national marine sanctuaries, as well as in areas spanning recently proposed fisheries boundary changes. These samples both establish important baseline information for previously unsurveyed areas, including areas of proposed management modification, and assist with monitoring of recovery in areas closed in 2006. By sequencing amplicons for octocorals and fishes from the same samples and comparing to comprehensive reference libraries of west coast species, we have detected a wide range of species in diverse coral communities, and from controls taken outside these areas. The fish species identified ranged from commercially important benthic species, including rockfishes (Sebastes spp.) and lingcod (Ophiodon elongatus), to pelagic species, such as ocean sunfish (Mola mola), and benthic species rarely observed in visual surveys, such as red brotula (Brosmophycis

marginata). Multiple octocoral species were detected, from across all families. Species range from very common gorgonians, such as Swiftia spp., to bamboo corals (Isididae), to sea pens (Pennatulacea). Analysis of eDNA assists with detection of species that are small or not in the immediate visual range of the ROV. Using this tool, we have begun to better characterize patterns of biodiversity associated with deep-sea coral communities, key data for fisheries managers to help assess impacts on these communities.

POSTER 6 - Technical advances and novel methods - ABSTRACT ISDSC7_035
THU Evening · 16:30 · Aguamarina

Leveraging telepresence and GIS technology to create rapid substrate distribution maps from ROV video and support studies of deep-sea corals

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Rachel Bassett, NOAA affiliate with CSS, Inc
Caitlyn Ruby, Mississippi State University
Adam Skarke, Mississippi State University
Mashkoor Malik, NOAA

Benthic imagery from remotely operated vehicles (ROV) offers a rich data source to study ocean biota. To study deep-sea coral communities using this data, it is necessary to determine the density of biota, substrate composition, and area observed by the cameras. Although ROV video observation methods are advanced; methods to determine substrate and seafloor area observed in benthic imagery are lacking. This project devised a method for substrate annotation with data from NOAA ship Okeanos Explorer telepresence enabled ROV cruises in 2018 and 2019 using the vocabulary of the Coastal and Marine Ecological Classification Standard (CMECS). The substrate annotations were completed using live broadcast ROV benthic video and an online annotation tool (SeaTubeV2) accessible from shore. A standardized annotation schema was developed to capture observed CMECS geoform, biotic community and water column components. However, the substrate component required a finer spatial scale and additional detail. Accordingly, a shorthand method was created for real-time annotation of primary and secondary substrates at 1 minute intervals. The results were exported from SeaTube v2 software as a CSV file with navigation data and time-stamped video frame grabs. The geological annotation points were then converted to continuous polygons, based upon the view angle geometry of the forward-looking ROV camera, using a Python script in ArcGIS. The total observed area during the ROV dives was computed from the average width of the images multiplied by the distance traveled. The dive maps, thus constructed, provide insights into spatial distribution of substrate and biota. In the near future, the Python script will be ported into open source GIS software (e.g., QGIS) and made available on a public code repository. This degree of automation and the ability to visualize complex geo-spatial relationships within ROV data were not previously possible from telepresence-based surveys.

POSTER 7 ⚡ Technical advances and novel methods ⚡ ABSTRACT ISDSC7_037
THU Evening · 16:30 · Aguamarina

New analysis tools for 'data rescue' of deep-sea coral observations from 30 years of submersible dives in the southeast USA

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Rachel Bassett, NOAA NCCOS CSS
Arliss Winship, NOAA NCCOS CSS
Bethany Williams, NOAA NCCOS CSS
Matthew Poti, NOAA NCCOS CSS
Peter Etnoyer, NOAA NCCOS

Two studies are currently characterizing the spatial distribution of deep-sea corals with regional scale environmental variables, to provide information to the U.S. Bureau of Ocean Energy Management (BOEM) to support its environmental and decision-making assessments for energy and minerals management. A BOEM funded 'data rescue' effort drawing from 30 years of deep-sea benthic surveys was conducted to support new habitat suitability models for deep-sea corals in the southeast US region. Data from eighteen different human occupied vehicles (HOVs) and remotely operated vehicles (ROVs) were acquired from fourteen federal, academic, and private research institutions. Still photos were analyzed using a new image annotation database called MADbAT. Still photographic and video data were combined with original survey files, dive reports, and publications, to produce records of presence and absence of deep-sea corals. The area sampled was estimated for each observation. An R-script was developed for QA/QC, comparing reported depths to interpolated depth and known vertical distribution of each taxon. The results of this effort produced rescued data from 830 ROV and HOV dives in the Southeast US region, with a total coverage of 815,000 square meters of seafloor, ranging from 50 to 3,300 meters depth. The study produced distribution information for 125 taxa of deep-sea corals. The top three most frequently encountered taxa across all depths were the reef-forming scleractinian Lophelia pertusa; the mesophotic gorgonian Nicella; and the unbranched black coral Stichopathes. The information provided by this 'data rescue' is being combined with bathymetry, substrate, water chemistry, and other predictive oceanographic variables to predict the probability of occurrence for select coral taxa while properly accounting for survey effort. The habitat suitability models will provide regional-scale maps showing the relative probability of occurrence of deep-sea corals.

Connectivity & phylogeography - TALKS

Connectivity & phylogeography - ABSTRACT ISDSC7_067
WEDNESDAY Morning · 8:30 · Aguamarina Ballroom
Genomics Elucidates Species Boundaries and the Role of Water Mass in the Evolution of Paramuricea – KEYNOTE

Andrea Quattrini, Harvey Mudd College, USA
James Adams, Harvey Mudd College
Louise Allcock, NUI Galway

Scott France, Univ. Louisiana Lafayette
Matt Galaska, Lehigh University
Jordi Grinyo, Institute de Ciències del Mar in Barcelona
Pablo Lopez-Gonzalez, Universidad de Sevilla
Vonda Wareham-Hayes, Fisheries and Oceans Canada
Erik Cordes, Temple University
Santiago Herrera, Lehigh University
Catherine McFadden, Harvey Mudd College

Paramuricea is one of the most common genera of octocorals inhabiting the deep North Atlantic, enhancing habitat complexity in deep-sea environments. We used a Restriction-Site Associated Sequencing (RADSeq) approach to first delimit species and then examine how depth and water mass influence the evolution of this genus. RADSeq was completed for 47 specimens from the Mediterranean Sea, and Whittard Canyon in the NE Atlantic, and from the Labrador Sea, Gulf of Maine, and Gulf of Mexico in the NW Atlantic. With a dataset of 7,983 loci (700,393 bp; 7,953 bi-allelic SNPs), we used coalescent and allele-sharing methods to delineate nine mesophotic and deepwater species. Results indicate widespread distribution of species across the N. Atlantic, with further population structure between regions. Notably, species boundaries suggested by these methods are highly incongruent with the conventionally-used mtMutS octocoral barcode, indicating that the mtMutS gene performs poorly in species delimitation of Paramuricea. We used ancestral reconstruction methods to explore historical biogeography relative to different water masses, regions, and depths. Preliminary analyses suggest that Paramuricea rapidly diversified from mesophotic to deeper depths in the N. Atlantic ~5MYA, with two major deepwater clades found primarily in water masses characterized by median temperatures of either <8 or >8 °C. Furthermore, diversification of extant clades into distinct water masses occurred infrequently. For example, species diversified into North Atlantic Deep Water just once. Deep water masses may have facilitated the spread of Paramuricea spp. across the Atlantic, while also preventing dispersal and/or recruitment across different water mass boundaries. Water masses with their associated abiotic characteristics, particularly temperature, may play a more important role than depth per se in the biogeography and species diversification of this enigmatic genus of deep-sea coral.

Connectivity & phylogeography - ABSTRACT ISDSC7_062
WEDNESDAY Morning · 9:00 · Aguamarina Ballroom
Comparative phylogeographic patterns of connectivity for mesophotic and deep-sea corals in the Gulf of Mexico

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Matthew Galaska, Lehigh University
Guangpeng Liu, Georgia Institute of Technology
Annalisa Bracco, Georgia Institute of Technology
Peter Etnoyer, NOAA NCCOS
Andrea Quattrini, Harvey Mudd College

Conservation of vulnerable marine ecosystems is imperative in the light of global ocean change and increasing anthropogenic disturbances. To help address these issues, marine

protected areas (MPAs) have been established in an effort to manage and reduce the overall impact of anthropogenic activities and serve as a key strategy for restoration of benthic communities in response to catastrophes such as the Deepwater Horizon (DWH) oil spill in the Gulf of Mexico. As marine systems are often considered "open" with few barriers to gene flow, understanding what factors promote or impede genetic connectivity over depth and horizontal spatial scales of key structure forming foundation species is important for management and conservation. Species that occupy deeper depth ranges are hypothesized to have greater genetic connectivity than shallow water species, implying that management plans need to be tailored to communities of varying depths. To address these concerns, we have investigated the genetic connectivity of four different coral species occupying three putative depth ranges: mesophotic (70-150 m), upper continental slope (400-1,100 m), and lower continental slope (1,300-2,400 m). Further, we have incorporated physical oceanographic modeling approaches with our population genomic analyses. We will present comparative population genetic structure at different depths, including directionality analyses, and relative rates of genetic exchange among coral populations with integrated outcomes from predictive larval dispersal models. These results were produced in collaboration with resource managers and will be utilized in management decisions for conservation and restoration of benthic habitats in the Gulf of Mexico.

Connectivity & phylogeography - ABSTRACT ISDSC7_064
WEDNESDAY Morning • 9:15 • Aguamarina Ballroom

Genetic diversity and connectivity of the corals Lophelia pertusa, Solenosmilia variabilis and Madrepora oculata in the Southwestern Atlantic

Carla Zilberberg, Universidade Federal do Rio de Janeiro, Brazil
Pedro Leocorny, Universidade Federal do Rio de Janeiro
Marcelo V. Kitahara, Universidade Federal de São Paulo
Cheryl Morrison, USGS
Katia C.C. Capel, Centro de Biologia Marinha - USP

Deep-water coral reefs are highly diverse ecosystems, which have been suffering from anthropogenic impacts. High levels of genetic diversity and connectivity are often related to the ability of a population to persist large impacts, increasing the resilience of the population. The scleractinian corals Lophelia pertusa, Solenosmilia variabilis and Madrepora oculata are cosmopolitan species and also the most important Brazilian deep-water reef builders. The present study aims to evaluate levels of genetic diversity and connectivity of these three species at three basins in the Southeastern coast of Brazil (Santos, Campos and Espírito Santo), ranging over 600 km and including samples from approximately 200 to 1120 meters depth, collected by SENSIMAR project -PETROBRAS. Levels of genetic diversity, estimated by five microsatellite loci for each species, differed among species, with L. pertusa having the highest level, followed by M. oculata and S. variabilis. The lowest diversity of S. variabilis could be a consequence of the use of heterologous primers. Even with high levels of genetic diversity, heterozygous deficiencies were found for all species at most basins. Bayesian analyses of genetic structure suggest that there are two structured populations of L. pertusa, with no clear geographic pattern. For M. oculata, however, analyses suggest three genetic clusters, with one possibly being depth related. Contrasting to the other two species, no evidence of genetic structure was found for S. variabilis, suggesting one single panmictic

population for this species. The present study is the first to evaluate levels of genetic diversity and connectivity of deep-water coral populations in the Southwestern Atlantic and shows that within the same region, divergent levels of genetic diversity and connectivity can be found among different species.

Genetic diversity and structure of Vazella pourtalesi sponge grounds of the Scotian Shelf

Anna Patova, University of Bergen, Norway
Pedro Ribeiro, University of Bergen
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The glass sponge Vazella pourtalesi (Hexactinellida, Rossellidae), a large vase-shaped sponge, forms dense "monospecific" grounds on the Scotian Shelf (Canada) which are unique for the species and have not been observed elsewhere to date. These grounds were recently shown to influence community structure, as well as enhance the abundance and density of epibenthic megafauna. However, other aspects of the biology and ecology of this species are largely lacking. Further, portions of this habitat have been under fishing pressure, particularly from bottom trawling targeting rockfish and pollock. In 2013, the Government of Canada established two sponge conservation areas – in the Emerald Basin and Sambro Bank - to protect 259 km2 of sponge habitat. It is not certain if this area is sufficient to fully protect the genetic diversity of the sponge grounds, and sustaining existing populations remains a concern. Knowledge of sponge biology and ecology is needed in order to evaluate the effectiveness of the current closed areas. Similar to other sponges, V. pourtalesi has the ability to reproduce both sexually and asexually and it is conceivable that this fishing has altered the genetic diversity of the sponges in the fished areas. The main goals of this study were to: (1) investigate the spatial patterns of genetic diversity and structure of Vazella pourtalesi across the Scotian Shelf; and (2) compare these genetic parameters in areas open and closed to fisheries. We used Restriction-site Associated DNA marker sequencing (RADseq) to genotype V. pourtalesi individuals at thousands of single nucleotide polymorphisms. A population genomics approach was used to infer population genetic diversity and differentiation. This study improves our understanding of the genetic patterns of deep-sea sponge grounds and the vulnerability of these grounds to human impacts. It will ultimately inform ongoing management and conservation strategies as well as potential restoration activities.

POSTER 8 - Connectivity & phylogeography - ABSTRACT ISDSC7_061
WED Evening · 16:30 · Aguamarina

Abandoned and lost fishing gears as stepping stones for cold water coral colonization in the deep Mediterranean Basin

Marco Taviani, ISMAR-CNR Bologna, Italy
Lorenzo Angeletti, ISMAR-CNR Bologna, Italy

The current perception of anthropic-introduced litter in the marine domain is its obvious negative impact on resident biological communities. One such category includes purposely-abandoned or lost fishing gears whose presence is widely documented on most Mediterranean cold water coral (CWC) sites. Longlines and nets are by large the commonest impact seen on CWC, often entangling corals and associate sedentary organisms. However, abandoned and lost fishing gears with impressive CWC fouling have been found at sites whose contour conditions are unsuitable to the CWC establishment, namely oversilted canyons or mud-draped seafloor. The first case-study refers to lost crab traps recovered in 2006 at 382 m from the Caulonia Canyon incising the Calabria margin in the Ionian Sea (Lat. 38°18.2'N; Long. 16°29.8'E). No CWC presence on natural substrates is known from this site but one gear recovered from the bottom appeared intensely colonized by hundreds of live Desmophyllum dianthus, a solitary cup coral. Part of the material was used for molecular biology and geochemistry purposes. A second remarkable such findings is related to a deep pockmark area off Gela in the Strait of Sicily (Lat. 36°45.65'N; Long. 14°00.17'E, at ca. 830 m). Here nylon shreds associated with concrete weights forming the cannizzi fishing gear, were used as substrate by hundreds of D. dianthus, the bathyal bivalve Delectopecten vitreus and a few colonies of Lophelia pertusa and Madrepora oculata. Remarkably, all this abundant CWC growth on artificial substrata is located on the trajectory of the Levantine Intermediate Water which is the main water mass controlling the CWC distribution in the Mediterranean Basin. The lost fishing gears serve, therefore, as stepping stones for CWC propagule colonization along the path from the major Apulian CWC grounds (Bari Canyon and Santa Maria di Leuca provinces) westwards.

POSTER 9 - Connectivity & phylogeography - ABSTRACT ISDSC7_068
WED Evening · 16:30 · Aguamarina

Population structure of the deep-water coral Madracis myriaster (Pocilloporidae: Anthozoa) in the Colombian Caribbean: Preliminary results

Lina M. Barrios, Manchester Metropolitan University, UK
Diana C Ballesteros Contreras, Manchester Metropolitan University-INVEMAR
Richard F Preziosi, Manchester Metropolitan University

In 2013 an important step in the construction and management of Marine Protected Areas-MPA in the Colombian Caribbean was made by the declaration of the first Deep Corals National Park (PNNCP). Inside this National Park and MPA the coral Madracis myriaster (Pocilloporidae: Cnidarian) was found, indicating a special habitat for many species of fishes and invertebrates. However, the discovery of the deep coral highlighted the lack of information about this deep ecosystem regarding the distribution, genetic diversity and the connectivity of the dominant species, M. myriaster, in Colombia and in the Caribbean region. In order to understand the connectivity among coral populations we developed 36 new molecular markers (microsatellites) for M. myriaster, using the bioinformatics tool Pal Finder, developed by the Preziosi Lab at Manchester Metropolitan University. We have tested the primers and obtained amplification for 33 loci, and we are in the process of genotyping 34 samples collected between 2000-2016 in locations around the MPA by the Institute for Marine and Coastal Research – INVEMAR (Colombia) and Manchester Metropolitan University-MMU (UK). The results will allow us to determine the vulnerability of these populations and their capacity to adapt to natural stochastic and anthropogenic effects (resilience). In addition, the new information could be used to develop tools for the management plan of the new National Park.

Organismal biology & natural history - TALKS

Organismal biology & natural history - ABSTRACT ISDSC7_109
WEDNESDAY Morning · 11:15 · Aguamarina Ballroom
Environmental control of cold-water coral reef morphology

Pål Buhl-Mortensen, Institute of Marine Research, Norway
Hanna Sundahl, Institute of Marine Research

595 individual coral reef mounds built by Lophelia pertusa (Desmophyllum pertusum) were surveyed with towed video on the Norwegian shelf and shelf break from 62 to 71°N at depths between 103 and 493m. The reefs displayed a unimodal bathymetric distribution with 62% of the reefs between 250 and 350 m depth. Counted at 10 depth intervals the peak of reef abundance was 340-350 m. This depth range reflects the common depth range of ridges, iceberg ploughmarks and other topographic features of the Norwegian shelf where hard substrates and elevated currents occur. Below this depth, reefs were much less common. The lower distribution limit fits with the depth influenced by the cold Arctic Intermediate Water with temperatures below 2 °C. Live coral was observed on 58 % of the reefs, and on average live coral habitat covered 59% of the reefs. The height and horizontal extension of reefs were positively correlated and reflected different types of linear relationships depending on the general topography. The ratio between height and linear extension was higher in steep terrain compared with level areas or small topographic structures such as morainic mounds and iceberg ploughmark. In steep sloping terrain (i.e. below the shelf break) reef covered a depth range of up to 57 m, whereas for flat areas the reefs covered a range of up to 27 m. In this presentation we discuss how currents and food supply shape and structure the reef

habitat within the framework of physical forcing factors represented by temperature, and topography.

Growth rate variability in deep-sea black corals from the Tasman Sea

Aimée Komugabe-Dixson, Ministry for Primary Industries, New Zealand
Ron Thresher, Oceans and Atmosphere Flagship, Hobart Australia
Stephen Eggins, Research School of Earth Sciences, The Australian National University, Canberra Australia
Stewart Fallon, Research School of Earth Sciences, The Australian National University, Canberra Australia

Black corals (Anthozoa, Antipatharia) are ecosystem engineers, playing an important role in the structure and function of deep-water communities. Black corals develop dense colonies that support diverse species including pelagic fisheries. However, black corals are highly susceptible to anthropogenic disturbance, and their ability to recover is poorly known due to lack of data. Here, we present important age and growth rate data from deep-sea corals from the Tasman Sea. Ages were determined by laser ablation multi-collector inductively coupled plasma mass spectrometry (LA MC ICPMS), and ranged from 300 to >4500 years. Increase in skeletal girth over time (radial growth rates) was measured for all corals, and this ranged from 5 to 130 µm yr-1. LA MC ICPMS analyses reveal non-linear growth across a branch cross-section. The variability in growth rates within the same individual suggests alternating external and internal factors may drive growth across the organism's lifespan. These findings highlight the complex growth patterns of black corals, with implications extending to other colonial cnidarians.

Reproductive cycle of the black coral Antipathes galapagensis in the Bay of La Paz, Gulf of California, Mexico

Antonella Lavorato, Universidad Autonoma de Baja California Sur, Mexico
Carmen Rodriguez Jaramillo, Centro de Investigaciones Biológicas del Noroeste, CIBNOR
Hector Reyes Bonilla, Universidad Autonoma de Baja California Sur

The species Antipathes galapagensis has been object of an intensive fishery in the Eastern Tropical Pacific area. Despite its importance as a habitat-forming species, there is no information about its basic biology. The objective of the present study is to describe its reproductive cycle and strategy. The sampling was carried out monthly from January to December 2018 on 30 marked colonies and others colonies randomly chosen at Bajo La Partida, Archipelago Espiritu Santo-La Paz bay, and It will continue throughout the next reproductive season. The samples are processed histologically following the general methodology of alcohol dehydration, inclusion in paraffin, cuts at 4µm and staining in

Hematoxylin-eosin and the slides are observed under the microscope and photographed for further analysis. For the first time, different stages of gonadal development in males and females are described for the specie, determining the mean diameter and the size range of oocytes for each oogenesis substages. The specie is an external spawner, adopting the partial spawning strategy, since a polyp in state III (mature) presents at the same time previtellogenic, vitellogenic and postvitellogenic oocytes. The specie Antipathes galapagensis shows evidence of sequential hermaphroditism and considering that the mature males present a smaller size of sexual maturity than the females, this species can be considered protandric hermaphrodite. The estimated size of sexual maturity is 100 cm high for females and 80 cm high for males. The gonadic development begins in the month of May (development and maturation), reaches the reproductive peak in the months of September and October where the highest frequency of mature females and males, and partial spawning are observed. The reproductive cycle shows a correlation with the increase of sea temperatures in the study area that reached the maximum around September to October.

Organismal biology & natural history - POSTERS

POSTER 10 - Organismal biology & natural history - ABSTRACT ISDSC7_105
WED Evening · 16:30 · Aguamarina
Are all black corals so slowly growing: estimations of black corals growth rates from the maritime heritage site

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Christopher Kelley, Hawaii Undersea Research Laboratory, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa
Meagan Putts, Hawaii Undersea Research Laboratory, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa
Virginia Moriwake, Hawaii Undersea Research Laboratory, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa
Sarah Bingo, Hawaii Undersea Research Laboratory, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa
John Smith, Hawaii Undersea Research Laboratory, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa

Commonly black corals are considered extremely long-lived animals. Species of genus Leiopathes (Antipatharia Leiopathidae) demonstrate one of the slowest growth rates known for marine invertebrates with one colony of L. annosa from Hawaii being aged at 4265 yrs with radial growth rates <5 mkm yr-1 (Roark et al 2009). In contrast, time estimations for shallow-water black corals of families Myriopathidae and Antipathidae based on direct visual observations revealed much faster growth rates with Cirrhipathes cf. anguina demonstrating exceptional rates of linear growth up to 159 cm yr-1 (Bo et al 2009). Growth rates of black corals below SCUBA depths are rarely approximated. On September 27, 2017 the NOAA Ship Okeanos Explorer and ROV Deep Discoverer performed a non-invasive video survey of maritime heritage site, the USS Baltimore. This late 19th-century protected cruiser was

scuttled in 1944 and re-discovered only in 2016 off O'ahu (Hawaii) at depth of ~600 meters. Abundant fauna on the ship's remains documented in September 2017 included brisingid sea stars, a diversity of corals, hydroids, anemones, tunicates, sponges, bivalves and fishes. None of corals observed at the USS Baltimore can be older than 70-73 yrs. One of the most abundant black coral species observed on deck of the ship was Umbellapathes helianthus (Schizopathidae). The discoidal crown of pinnules in Umbellapathes is formed by termination of apical growth of the main stem and disproportional growth and pinnulation of lower pinnules. Measured colonies from USS Baltimore had crowns of pinnules 20-25 cm in diameter and stalks 20-25 cm long with basal diameters of 4-6 mm. All measurements corresponded well to those reported by Opresko (2005) for the holotype of U. helianthus (USNM 1024968) and to colonies observed during the CAPSTONE (2015-2017) project. We suppose that the complex morphogenesis of U. helianthus colonies occurs at much earlier stage and subsequently only radial growth can be observed.

POSTER 11 ⚡ Organismal biology & natural history ⚡ ABSTRACT ISDSC7_107
WED Evening · 16:30 · Aguamarina
Deep-sea corals fecundity assessment in southeastern Brazil

Nathalia Bastos, IEAPM, Brazil
Carolina Terra, Brazilian Navy's Department of Marine Biotechnology (IEAPM, Brazil)
Lourença Vieira, Brazilian Navy's Department of Marine Biotechnology (IEAPM, Brazil)
Caio Mota, Brazilian Navy's Department of Marine Biotechnology (IEAPM, Brazil)
Halésio Barros, Petrobras Research and Development Center (CENPES, Brazil)
Ricardo Coutinho, Instituto de Estudos do Mar Almirante Paulo Moreira, Brazil

In this study, we aim to determine the fecundity of the main Brazilian cold-water coral reef habitat forming species. The data presented are still preliminary and will be used later to estimate the corals reproductive effort along a bathymetric gradient over Brazil's southeastern continental slope. The fecundity was investigated through sequential cuts on the polyps of Madrepora oculata (Moc), Solenosmilia variabilis (Sva), Lophelia pertusa (Lpe) and Enallopsammia rostrata (Ero), followed by further histological preparations to reveal the female oocytes and make it possible to count those cells in a microscope and then assess it's reproductive stage. The number and size of the oocyte cells were also compared to the polyp's volume to investigate the possible relations of these variables with the species reproductive strategies. Colonies of Lpe collected in May 2017 presented most of the analyzed polyps with male or female gametes, reaching 7.665 oocytes in a single polyp, high number of oocytes compared to previous studies. The Sva species had the highest average fecundity rate so far, 12.307 (± 415) oocytes per cm3. Lpe presented a mean of 4.201 (± 1.441) oocytes per cm3. The Moc species presented 1.431 (± 19) oocytes per cm3 whereas Ero presented a fecundity rate of 581 (± 23) oocytes per cm3. In Moc, stage III oocytes reached a maximum diameter of 370 µm in a 0.017 cm3 polyp. A 650 µm oocyte III was found in Ero in a polyp with 0.034 cm3, the species presented the largest oocyte as it was also observed by previous study. Sva presented the maximum oocyte III of 150 µm in a polyp of 0.07 cm3. Lpe presented oocyte III of maximum 100 µm and is the species that has larger polyps, fertile polyps reached up to 2.80 cm3. The present study contributes to the refinement of information on the life strategies of those corals, helping to define better management actions for their conservation.

POSTER 12 - Organismal biology & natural history - ABSTRACT ISDSC7_108
WED Evening · 16:30 · Aguamarina

Ecophysiology of Lophelia pertusa and Madrepora oculata from Formigas seamount (Azores): the influence of different water masses

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Andrea Gori, Università del Salento
Juancho Movilla, Instituto Español de Oceanografía, Centro Oceanográfico de Baleares
Cristina Gutiérrez-Zárate, Institudo do Mar, Universidade dos Açores
Maria Rakka, Institudo do Mar, Universidade dos Açores
Ángela Mosquera, Instituto Español de Oceanografía, Centro Oceanográfico de Canarias
Alberto Aparicio, Instituto Español de Oceanografía, Centro Oceanográfico de Baleares
Pedro Velez-Belchí, Instituto Español de Oceanografía, Centro Oceanográfico de Canarias
Covadonga Orejas, Instituto Español de Oceanografía, Centro Oceanográfico de Baleares

Water masses have been identified as potential important drivers of cold-water corals (CWC) distribution. In the North-East Atlantic, Mediterranean Outflow Water (MOW) has been related to CWC occurrence. The MOW flows from the Strait of Gibraltar into the Atlantic Ocean as an intermediate water mass characterized by high salinity and temperature in comparison to surrounding waters. It has been hypothesized that MOW driven the CWC colonization of North-East Atlantic after the last glacial period, promoting transport of coral larvae and generating suitable environmental conditions and dynamic oceanographic processes enhancing coral growth. Several seamounts inhabited by the CWC Lophelia pertusa and Madrepora oculata, are directly influenced by the MOW along its way west to Azores Islands. To advance in the exploration of the possible influence of MOW on the past and current distribution of Atlantic CWC, this study experimentally assessed growth and metabolism (respiration, excretion and calcification) of Lophelia pertusa and Madrepora oculata, under the influence of Mediterranean and Atlantic waters.

POSTER 13 ⚡ Organismal biology & natural history ⚡ ABSTRACT ISDSC7_110
WED Evening · 16:30 · Aguamarina

Environmental drivers of white plague disease on mesophotic coral reefs in the U.S. Virgin Islands

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Outbreaks of white plague (WP) disease have caused significant regional declines of reef-building Caribbean corals. Due to a greater availability of epidemiological data, studies have primarily focused on shallow coral reefs. In the U.S. Virgin Islands, however, coral WP disease prevalence appear to be higher on upper mesophotic (> 30 m) coral reefs when compared with shallow reefs (< 30 m), and may be inhibiting coral recovery after environmental disturbances. The aim of this study was to investigate temporal and spatial patterns of WP prevalences across shallow and mesophotic coral reefs in the U.S. Virgin Islands in relationship to potential environmental drivers. We recorded WP prevalences at 13 reef sites (5 shallow, 3 mid-depth, and 5 mesophotic reefs) across the south shelf of St. Thomas approximately monthly between 2012 and 2015. The influence of environmental factors on disease prevalence was investigated using Bayesian inference with generalized linear mixed-effect models. We found that WP disease prevalence was higher on mesophotic than on shallow or mid-depth reefs, and WP tended to increase during the beginning of the rainy season (June-August) on all reefs. Of the 12 abiotic and biotic environmental factors tested, higher levels of water turbidity was the most important factor affecting the prevalence of WP. Other factors that increased WP included elevated temperature, degree heating weeks (a measure of thermal stress accumulation), and higher percentage cover of corals, sand, algae and cyanobacteria. While higher levels of oxygen and salinity reduce WP prevalence. In addition, elevated temperature and thermal stress accumulation allowed for the long-term persistence of WP disease on mesophotic reefs but not on shallow reefs, indicating a possible temperature threshold for WP occurrence.

POSTER 14 - Organismal biology & natural history - ABSTRACT ISDSC7_111
WED Evening · 16:30 · Aguamarina
First observation of massive grazing by sea urchin on bamboo corals on a seamount in the South Atlantic

Pål Buhl-Mortensen, Institute of Marine Research, Norway
Fran Ramil, University of Vigo
Sara Castillo, University of Vigo

During a survey with R/V Dr Fridtjof Nansen to the Discovery seamounts in the southern Atlantic four seamounts were surveyed with multibeam echosounder (bathymetry), remotely operated vehicle (video observations) and bottom grab (sediments and macrofauna). The overall objective of the survey was to conduct basic mapping and identification of vulnerable marine ecosystems (VMEs) that could be impacted negatively from fishing activities. Some of the areas studied are currently closed to fishing whereas others are being or have been fished for Patagonian toothfish. The seabed was surveyed at depths between 400 and 1800 m, with ROV at 14 locations. VME-indicator organism (gorgonians, black corals, lace corals and solitary stone corals) were observed at all locations, with varying taxonomic compositions and

dominance. No evidence of human footprint was observed, but extensive grazing on bamboo corals (Keratoisis sp.) by an un-identified sea urchin (Echinidea) was observed at one location at depths between 850 and 960m. Most of the observed colonies had naked skeleton areas lacking tissue and polyps. 31% of the colonies contained urchins, some of them with more than 20 individual urchins. Such massive grazing on cold-water corals has never been observed earlier. The impact of urchins was observed over the stretch of the 200 m long video transect, with broken, partly live colonies and dead skeleton fragments locally aggregated by the seabed topography. It was not possible to tell whether this is a natural, and possibly cyclic phenomenon or caused by an external pressure. Given the longevity and slow growth of the corals, the ongoing grazing must represent a short event.

POSTER 15 - Organismal biology & natural history - ABSTRACT ISDSC7_112
WED Evening · 16:30 · Aguamarina
Growth Band Microanalysis of Sea Pens in the Laurentian Channel, Newfoundland

Krista Greeley, Memorial University of Newfoundland, Canada
Evan Edinger, Department of Geography, Department of Biology, Memorial University of Newfoundland
Graham Layne, Department of Earth Sciences, Memorial University of Newfoundland
Barbara Neves, Northwest Atlantic Fisheries Centre, Department of Fisheries & Oceans Canada

Understanding the mechanisms by which sea pens (Octocorallia) construct growth rings is valuable as sea pens, like other cold-water corals, may be considered indicators of vulnerable marine ecosystems (VMEs), being a conservation priority in some parts of the world. Growth rates, ages, and elemental compositions were analyzed for sequential growth rings in five taxa of deep-water sea pens (Anthoptilum, Pennatula, Kophobelemnon, Funiculina, and Protoptilum) collected from the Laurentian Channel area of interest (AOI) in the Northwest Atlantic. Samples were collected using the remotely operated vehicle (ROV) ROPOS in 2017 from depths of 400-600 m. Cross sections of the axes were examined using Scanning Electron Microscopy (SEM) to determine the number of growth rings and major element variations within each growth ring. With the SEM, elements Mg, Ca, Sr and Na were observed to occur naturally in both the light and dark bands with discrete enclaves of S- and Cl-bearing minerals that are believed to not be part of the skeleton. Trace element microanalysis of Mg/Ca, Sr/Ca, Ba/Ca and Na/Ca in the axis was performed using Secondary Ion Mass Spectrometry (SIMS). Measurements show that the number of elemental ratio cycles match the number of growth rings, generally ranging from 5-15, and imply that the growth rings are annual. Growth measurements for each species were variable, with radial extension rates (mm/year) averaging 0.35 for Anthoptilum, 0.57 for Pennatula, 0.09 for Funiculina, 0.19 for Kophobelemnon, and 1.1 for Protoptilum, and linear extension (cm/year) averaging 7.3 for Anthoptilum, 2.1 for Pennatula, 3.5 for Funiculina, 1.4 for Kophobelemnon, and 6.3 for Protoptilum. Average heights across all samples taken together was 30.9 cm. These data will be applied to separate studies to provide insight into the monitoring of marine protected areas (MPAs) and reaching conservation goals.

WED Evening · 16:30 · Aguamarina

In situ growth rates of three scleractinians at an anamolous deep coral mound in the southeastern US.

Sandra Brooke, Florida State University, USA

Deep coral reefs in the southeastern USA are constructed primarily by Lophelia pertusa, with structural contributions by Madrepora oculata. Enallopsammia profunda is a less common reef building species in this region, and is endemic to the western Atlantic. The average temperatures of the deep coral reefs in this region ranges from ~6-8oC. In August 2018, the Deep Search project (funeded by BOEM, NOAA and USGS) explored a series of mound features that were mapped earlier that year by the NOAA Ship Okeanos. These features were Lophelia bioherms in depths of ~850- 690 m, with an unusually high percentage cover of live coral. The temperature and oxygen profiles at these sites were very different from most of the coral mounds in the region, with temperatures of ~5oC at 800m, with a rapid increase to 9-10oC at ~ 750 m. The tops of the mounds were colonized by yellow, heavily calcified morphotypes of Enallopsammia cf profunda apparently thriving at 11oC. During the 2018 cruise, fragments of Lophelia pertusa, Enallopsammia profunda and Madrepora oculata were collected from the using the ALVIN submersible, stained with Calcein and redeployed the following day at 695m, close to the original collection site. These fragments were collected in April 2019 (9 months after deployment) and were assessed for survival and growth. Growth rates were measured using the calcein stain bands, and a novel 3D modeling technique was also applied to assess volumetric change in the fragments over time. Survival of all species was high but growth was lower than documented for these species elsewhere in the region and in the literature. This presentation will discuss the observed growth rates in the context of the unusual environmental conditions at this newly explored deep coral area.

WED Evening · 16:30 · Aguamarina

Local-scale effects of reef geomorphology on the growth of Lophelia pertusa

Guillem Corbera Pascual, University of Southampton, UK
Claudio Lo Iacono, Institut de Ciències del Mar (CSIC), Barcelona, Spain
Gonzalo Simarro, Institut de Ciències del Mar (CSIC), Barcelona, Spain
Jordi Grinyó, Laboratoire d'Ecogéochimie des Environments, Sorbonne Université, France
Stefano Ambroso, Institut de Ciències del Mar (CSIC), Barcelona, Spain
Veerle A. I. Huvenne, National Oceanography Centre, United Kingdom
Furu Mienis, Royal Netherlands Institute for Sea Research (NIOZ), Netherlands
Marina Carreiro-Silva, Institute of Marine Research, University of Azores, Portugal
Inês Martins, Institute of Marine Research, University of Azores, Portugal
Covadonga Orejas, Instituto Español de Oceanografía (IEO), Centro Oceanográfico Baleares, Spain
Ann Larsson, University of Gothenburg, Sweden
Sebastian Hennige, University of Edinburgh, United Kingdom
Andrea, Gori, Università del Salento, Italy

Despite cold-water coral reefs are considered biodiversity hotspots, very little is known about how the reef structure changes the flow patterns at a local scale, and how this affects coral growth in different regions of the reef. In this study, we performed a flume experiment to evaluate the effect that a unidirectional flow interacting with a coral reef has on the growth of Lophelia pertusa. The coral reef structure was made of dead coral framework (15 cm tall, 90 cm wide and 60 cm long) and was placed in a 7 m flume. The reef structure size was scaled to real reef dimensions and the flume water depth was enough that the deflection of the free surface was negligible. Five coral nubbin replicates were placed at 6 different positions within the flume, incubated under a constant water flow of 0.1 m s-1 and fed daily for two months. Four of these positions were within the reef and the other two were located 1 and 3 m behind it. Measurements revealed increased current speed and turbulence above the frontal part of the reef, while its backside was characterised by an almost stagnant flow and reduced turbulence. At ~35 cm behind the reef, negative vertical velocity and turbulence increased, indicating vertical mixing. Coral nubbins located at the frontal part of the reef presented an enhanced average growth (buoyant weight measurements) in comparison to those located at the rear. Similarly, the nubbins located 1 and 3 m after the reef also presented a higher average growth than the ones at the backside of the coral structure. The contrasting trends observed in coral growth show the strong influence that the coral reef has on the water flow patterns, which in turn affects food availability to the corals on different positions along the reef. This suggests that at a local scale, coral reef structure has an indirect effect on coral growth and thus it could be speculated that the morphology of these complex geomorphological features is auto-regulated by the own corals.

POSTER 18 - Organismal biology & natural history - ABSTRACT ISDSC7_118
WED Evening · 16:30 · Aguamarina
The age and growth of New Zealand deep-sea Antipatharia: Bathypathes patula

Peter Marriott, National Institute of Water & Atmospheric Research (NIWA), New Zealand
Dianne Tracey, National Institute of Water & Atmospheric Research (NIWA)
Helen Bostock, National Institute of Water & Atmospheric Research (NIWA)
Nicholas Hitt, Victoria University of Wellington (VUW) & National Institute of Water & Atmospheric Research (NIWA)
Stewart Fallon, Australian National University (ANU)

Ten individual colonies of the Antipatharian black coral species Bathypathes patula were selected for this ageing study. Corals were selected based on their size, completeness of the colony (whole colony from base to tip), and the regional water mass within which they grew. Corals from the Chatham Rise and the Bay of Plenty were selected as the water masses for these two New Zealand regions are reasonably well understood, and this work supports other comparable ageing work on deep-sea corals in these areas. Thin section preparations of the main-stem of the ten specimens were observed with compound microscopes. Two interpretation protocols were defined to describe the zone structure observed, both coarse and fine zones, and counts were made of these structures. Four of the specimens were also sampled for radiocarbon assay. The radiocarbon isotope (14C) age data results were used to independently verify if either of the developed zone counting protocols reflected annual periodicity. Neither method was verified, indicating the developed zone counting protocols

could not be used to generate reliable age estimates for B. patula. Twenty radiocarbon results were used to derive the age and growth rates estimates presented here. The radiocarbon results from this work show B. patula to be a long-lived species, attaining ages in excess of 385 years, with linear growth rates of 5.2–9.6 mm.yr-1, and radial growth rates ranging from 11.1–35.7 m.yr-1. The delicate nature of these organisms along with their longevity and slow growth rates means a low resilience to, and low recoverability from, anthropogenic activities such as fishing and mining.

Ecological interactions - TALKS

Ecological interactions - ABSTRACT ISDSC7_124
TUESDAY Morning · 10:30 · Aguamarina Ballroom

Diverse Epifaunal Associations within Deep-Water Corals of the Phoenix Islands Protected Area (PIPA)

Tim Shank, Woods Hole Oceanographic Institution, USA
Taylor Heyl, WHOI
Luke MCartin, WHOI
Elisabeth McElwee, WHOI
Steve Auscavitch, Temple University
Erik Cordes, Temple University
Randi Rotjan, Boston University

Deep-sea corals provide habitat for a diverse array of symbiotic species with functional specificities in association with coral hosts. To date, more than 2500 species from 5 phyla: Cnidaria, Annelida, Mollusca, Arthropoda and Echinodermata occur as symbionts with deep-water corals. Several studies have shown specific relationships between corals and associated symbionts, however, little is known about the regional diversity and ecological requirements of these interactions, and the strategies that maintain relationships among coral species and symbionts. In March and October 2017, we conducted the first deep-water biological surveys within the largest and deepest UNESCO World Heritage Site on Earth, the Phoenix Islands Protected Area. We investigated the symbiotic partnerships among cold-water corals and their associated fauna: their composition, distribution, functional diversity, degree of host specificity. Assigning accurate species-level identifications of coral symbionts from video collected by remotely operated vehicles can be extremely difficult. To assess symbiont diversity and coral host and epifaunal relationships, more than 77 coral collections with symbiotic epifauna were obtained and more than 75 coral-associated were genetically barcoded. Multi-gene barcodes and genealogies of symbiotic fauna, including ophiuroids, munid and chirostylid crabs, gastropods, and egg masses reveal a higher than anticipated phylogenetic diversity of symbionts and an apparent greater amount of host-associate specificity. We discuss the genetic diversity, regional phylogenetic species diversity and ecological function of specific associations. These data combine to form a baseline of deep-sea coral ecosystem diversity and biogeography along with frequency and specificity of coral-

associated communities critical to evaluating the future impact of changing oceanographic conditions, host/habitat availability, and of marine protected areas on deep-sea ecosystems.

Ecological interactions - ABSTRACT ISDSC7_133
TUESDAY Morning · 10:45 · Aguamarina Ballroom
Macrofauna associated with the sponge Vazella pourtalesi and ecological interactions in a monospecific sponge ground on the Scotian Shelf (NS, Canada)

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Deep-sea sponges are key key ecological and structural elements of the benthos providing habitat and food to various species. Considered vulnerable marine habitats, sponge grounds have been shown to enhance biodiversity. Recent studies highlighted the megafauna diversity in unique aggregations of the glass sponge Vazella pourtalesi on the Scotian Shelf. Yet, ecological links between V. pourtalesi and its associated fauna remain largely unknown. This study aims to quantify V. pourtalesi associated macrofauna and characterise V. pourtalesi functional ecology at the individual level. Three V. pourtalesi clumps were collected by ROV in a conservation site on the Scotian Shelf. Epifauna was suctioned in situ and 16 sponges were visually inspected under stereomicroscope for fauna collection. Fauna proportions were

calculated from relative abundances related to total number of individuals. Sponge microstructure was characterized by micro-CT and external biometrics were measured. Sponges were divided into three size categories to investigate the structural role. Lipids, proteins and sugars were quantified in sponge tissue, and stable isotopes in sponge, fauna and particulate organic matter for trophic analysis. Medium-sized sponges were dominated by amphipods (43.6% of total abundance) while bivalves abounded on spicules of small and large sponges (31.1% and 38.9%). All clumps had high proportions of copepods (16.7%-26.8%) and isopods (14.6%-44.1). Ophiuroids were abundant on large sponges while polychaetes, decapods, anemones and forams were mostly associated to small and medium sponges, suggesting an influence of sponge size on fauna assemblages. The trophic role of V. pourtalesi will be discussed for food provision and organic composition. This first insight into V. pourtalesi fauna diversity and structural role provides baseline information for understanding the ecological role of sponge aggregations which is essential to sustainably manage such valuable ecosystems.

Ecological interactions - ABSTRACT ISDSC7_137
TUESDAY Morning · 11:00 · Aguamarina Ballroom
The fine-scale landscape ecology of cold-water coral reef habitats.

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To identify and quantify ecological spatial patterns, which are driven by various factors (biotic and abiotic) at different scales, landscape ecology statistical descriptors and tests are used. These have only more recently been applied to marine habitats by using photomosaics, notably in shallow-water coral reef research. Particularly, fine- to medium-scale patterns (<1-10 metres) have seldom been quantified in deep-sea habitats, but can provide fundamental ecological insights. Cold-water coral reefs formed by Lophelia pertusa and Madrepora oculata are traditionally mapped and surveyed with multibeam echosounders and video transects, missing the resolution and/or coverage to undertake fine-scale, sub-metric quantification of spatial patterns. However, photomosaics constructed from imagery collected with remotely operated vehicles (ROVs), are becoming a prevalent research tool and can reveal novel information about geological and ecological processes at the scale of individual coral colonies. We investigated the fine-scale distribution of organisms among cold-water coral mounds by utilising orthorectified photomosaics. Two mini-mounds in contrasting NE Atlantic locations were surveyed; Piddington Mound (Belgica Mound Province) and the Explorer Mound (Explorer Canyon). All organisms were counted and geotagged, including reef building scleractinian coral. Ripleys K function test was used to establish whether organisms were distributed with complete spatial randomness (CSR), a uniform distribution or a clustered pattern. Substrate and structural complexity are expected to drive reef building coral and reef inhabitant distribution depending on the niche that they occupy. Most organisms, showed a departure from CSR, displaying clustered patterns,

indicating fine-scale affinity to local environmental drivers within the habitat across a range of fine to medium scales. These data provide novel and detailed insights into fine-scale habitat heterogeneity and microhabitats.

Tidal dynamics control on cold-water coral growth: A high-resolution multivariable study of eastern Atlantic cold-water coral sites

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Cold-water corals (CWCs) cover distinct parts of the water column on continental margins. The quest to determine the critical thresholds for their occurrences has led to a set of ranges of environmental factors, such as near sea-floor flow velocities, water mass characteristics and carbon chemistry, which are believed to set the ideal environmental conditions. These parameter ranges are used in global habitat suitability models, but how these individual factors control and limit the development of CWCs is not yet fully understood. Our goal is to investigate the impact of varying ocean dynamics on CWC habitats and to explain why CWCs have such confined settling areas. For this purpose, high-resolution physical, biogeochemical, and ecosystem data from seven CWC sites on the eastern margin of the Atlantic, from the sub-arctic to the subtropical southern hemisphere are used. The chosen CWC sites are dominated by the scelaractinian reef-forming coral Lophelia pertusa and represent a wide range of hydrographic, hydrodynamic and morphologic settings. We found that across all sites, a distinct tidal flow is observed and that high tide flow and its relaxation are not symmetric. Living and healthy corals are concentrated at sites, where high tide creates local upwelling that allow recycling of sinking material with each tidal cycle. This process combines the hydrodynamics to several environmental factors and supports energy and food supply for filter-feeding corals. Our analysis provides new insights on CWC occurrences in the modern ocean, and might help to understand the CWC growth and distribution of a changing ocean, in the past and in the future.

Comparative observations of flow intensity around Hawaiian deep-sea corals.

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Thomas Oliver, NOAA PIFSC

Fifteen instruments placed close to deep sea corals on the slopes of 3 islands in Hawaii showed the mean current flow rates differed significantly by site and taxa. Measurements for some of the 19 coral taxa observed were limited to one island site while others were

measured at all sites. Patches of coralids were measured at separate sites with the "red" Hemicorallium laauense found at areas with the lowest flow (0.5-4.9 cm/s) and the "pink" Pleurocorallium secundum seen at a higher level flow sites (12.6-18.4 cm/s) with little overlap between. A patch of Narella gigas and N. muzikae were observed only at the site with the highest flow (18.4-21.7 cm/s). Measurements of bamboo coral (Acanella dispar) and the parasitic zooanthid, gold coral (Kulamanamana haumeaae) that colonizes bamboo, were made at all three sites with flow ranging from (2.8-18.9 cm/s). The number and maximum size of gold coral colonies were negatively correlated with increasing flow, but this was not seen for the bamboo colonies. Although preliminary, these observations provide some insight as to how flow regimes form coral patches and influence diversity in deep-sea coral communities.

Ecological interactions - ABSTRACT ISDSC7_125
TUESDAY Morning · 11:45 · Aguamarina Ballroom
Does predation play an important role in the population dynamics of deep-sea corals?

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Erica Burton, MBNMS NOAA
Andrew DeVogelaere, MBNMS NOAA
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Tom Guilderson, LLNL/UCSC
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Deep-sea corals are known for their slow growth and great longevity, apparently plodding slowly through life in dark, cold waters for centuries or more. In contrast, at least some coral predators (e.g., sea stars) appear to romp along at a much quicker tempo, preying on corals at rates that seemingly outpace the capacity of corals to recover. Does predation on juvenile and adult coral colonies affect the demographic rates of coral populations? We have attempted to evaluate the incidence and importance of predation on several deep-sea coral taxa at depths of 800-1300 m at Sur Ridge, off the central California coast. Surveys were performed along benthic video transects to measure the incidence of potential predators and other epibionts on coral taxa. Several coral colonies were marked and revisited over 2-3 years to assess changes in polyp cover in relation to predator occurrence. We performed manipulative experiments to assess the behavioral response of predatory sea stars (Hippasteria spp.) exposed to portions of coral colonies from several taxa (Paragorgia arborea, Keratoisis sp., Isidella tentaculum). While the incidence of predators and other epibionts was low on all three coral taxa, I. tentaculum had the lowest epibionts density, presumably related to the shield of nematocyst-laden tentacles at the base of colonies. Short field experiments indicated that the basal branches of I. tentaculum were repellent to the sea stars, which quickly leapt (at a sea star pace) from basal tentacles, but began feeding on I. tentaculum branches covered with feeding polyps. Sea stars placed on Keratoisis sp. and P. arborea branches were not repelled. Repeated observations of isidid colonies under active predation

by Hippasteria spp. or large nudibranchs (Tritonia tetraquetra) or both indicated that these predators can denude entire coral colonies within months. How can corals survive this apparent paradox of rapid predation damage amidst the slow tempo of coral colony life?

Feeding ecology and competition between indicator taxa of Atlantic Vulnerable Marine Ecosystems

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Tina Kutti, Benthic resources and processes, Institute of Marine Research, Bergen, Norway
Sebastian Hennige, School of Geosciences,University of Edinburgh, United Kingdom
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Murray Roberts, School of Geosciences,University of Edinburgh, United Kingdom

Cold-water corals and sponge grounds meet the criteria of Vulnerable Marine Ecosystems (VMEs) as defined by the UN. Despite such international policy imperatives we lack basic understanding of ecological interactions between VME indicator taxa, including competition for food under different conditions, such as water flow and food concentrations, which are likely to change in response to climatic change. To assess competition between VME indicator species present in Norwegian waters feeding efficiency under varying flow and food scenarios was measured for indicator species: a coral (Lophelia pertusa), sponges (Geodia barretti, Phakellia ventilabrum, Stryphnus sp.), and a bivalve (Acesta excavata). Feeding efficiency was measured as Clearance Rate (CR) of particles 1-16 µm in size from natural seston. Trends suggest that all the specimens feed more efficiently on larger particles. Evidence suggests A. excavata is more efficient in low food treatments and L.pertusa in high food treatments. These species have higher CR at medium to low flow speed treatments. When comparing species across all treatments, G.barretti, P.ventilabrum and Stryphnus sp. have a higher CR at medium flow speed/normal food and high flow/high food treatments. These preliminary results suggest that all species compete for the same particle sizes but have different CRs under varied conditions. Competition was also studied for the octocorals Viminella flagellum and Dentomuricea meteor, VME indicator taxa found on the Condor Seamount, Azores. Here, food consumption was measured as the assimilation of 13C and 15N isotopically labelled food, under two flow treatments. Trends suggest that D. meteor had a higher assimilation in high flow when compared to V.flagellum. The relationship was opposite but not as strong for low flow treatment. Dentomuricea meteor had a higher assimilation when tested separately under the two flow treatments. This indicates that D. meteor might be a more effective feeder.

Functional roles of cold-water Nephtheidae soft corals

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Cold-water soft corals in the family Nephtheidae are widespread in the Northwest (NW) Atlantic and Eastern Canadian Arctic. They are vulnerable to bottom fishing gear and are frequently caught as bycatch. In comparison to gorgonians and sea pens, soft corals have been less studied in these regions and little is known about their ecology. Here we explored two main functional roles played by soft corals: the provision of habitat and their role in benthic food webs. We examined over 4000 soft coral colonies and bottom trawl bycatch data, mainly collected during Fisheries and Oceans Canada Research Surveys in the NW Atlantic (2005-2017). We assessed their role as habitat for basket stars (Gorgonocephalus sp.), an important component of the benthos in deep-water systems worldwide. We reveal that all five soft coral species studied host basket stars: Gersemia rubiformis, G. fruticosa, Duva florida, Pseudodrifa sp. and Drifa glomerata, the latter showing the highest occurrence rates at 32%. Eight-five percent of all associated basket stars had disk diameters <5 mm, and the majority was positioned in the upper-middle portion of the colonies. Data on $\delta13C$ and $\delta15N$ stable isotopes and lipids/fatty acids indicate that soft corals can feed on variable sources, both planktonic and benthonic. For example, a soft coral collected in an Arctic cold seep environment had an unusually high proportion of hydrocarbons and bacterial fatty acids, indicating incorporation of seep sources in the coral's diet. The small size of basket stars, along with the preferred position on the colonies, and stable isotopes data on corals and associated basket stars indicate that soft corals act as nurseries for the latter and are used as platforms for feeding. They also play a key role in benthic food webs and nutrient cycling. Soft corals are vulnerable to benthic fishing activities, and their removal might have greater implications to ecosystem health that are not yet fully understood.

Ecological interactions - ABSTRACT ISDSC7_130
THURSDAY Morning · 11:00 · Aguamarina Ballroom
Food sources of an Arctic deep-sea sponge ground

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Philip Riekenberg, Netherlands Institute for Sea Research
Jasper de Goeij, University of Amsterdam
Martijn Bart, University of Amsterdam
Erik Wurz, Wageningen University and Research
Anna de Kluijver, Utrecht University
Hans-Tore Rapp, University of Bergen
Gert-Jan Reichart, Royal Netherlands Institute for Sea Research and Utrecht University
Furu Mienis, Netherlands Institute for Sea Research

Deep-sea sponges appear globally below a depth of 150 m, where they can form dense sponge grounds, being hotspots of biomass and biodiversity comparable to cold-water coral reefs. So far it is anticipated that these ecosystems rely on organic matter sinking from the surface towards the bottom. However, the amount of organic matter reaching the deep-sea is limited. In order to assess the food sources as well as the trophic relationships in such a food-deprived ecosystem, we carried out long-term observations using a benthic lander, as well as analyzed the food web at an Arctic sponge ground. Vertical organic matter flux was measured by a sediment trap and most common members of the benthic community as well as the anticipated food sources were collected. Long-term observations showed that the vertical flux only accounts for 1-17% of the respired carbon. The isotopic ratios of carbon and nitrogen nevertheless showed that suspended organic matter is a food source for the benthic fauna. δ15N increased per trophic level by 4.6‰, compared to a generally assumed value of 3.4‰. Suspended matter built the base of the food web moving to suspension feeders and predators. Low microbial abundance sponges formed unexpectedly the highest trophic level with a δ15N of 17-21‰. High microbial sponges classified in a lower trophic level together with suspension feeding fauna of around 9‰. The high microbial sponges showed further a surprisingly high δ13C of -18‰ compared to other suspension feeding fauna of about -23‰. The compound specific analysis of the nitrogen isotopes of amino acids indicated that these high microbial sponges may function as a kind of primary producers, due to their bacterial and archaeal symbionts fixing dissolved carbon, which could be the reason for their high δ13C. This mechanism combined with an extremely high recycling rate, indicated by the uncommonly high trophic enrichment between trophic levels, could supply and preserve enough energy in this ecosystem.

Dissolved organic carbon (DOC) is the main fuel for sponges that sustain biological hotspots in the deep-sea

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Deep sea sponges are ubiquitous components of various deep sea ecosystems including coral reefs and deep-sea sponge grounds and aggregations. Despite the generally barren, food-limited deep sea environment, these ecosystems are known to be hotspots of biodiversity and organic carbon cycling. The role sponges play in the biogeochemical cycling of sponge-dominated deep sea ecosystems is still largely unknown, but can be understood by assessing sponge energy budgets. We combined ex situ and in situ (at the sea floor; 250–1000 m water depth) incubation experiments to qualitatively and quantitatively assess how sponges utilize and recycle carbon in deep sea sponge-dominated ecosystems. We investigated various sponge types: hexactinellids (glass sponges) and demosponges, high

and low microbial abundant sponges (HMA and LMA, respectively) and various growth forms (encrusting and emerging growth forms). We found that particulate organic carbon sources (i.e. bacteria and phytoplankton) were readily taken up by all sponges, but can only account for 2–35% of the sponges' minimal metabolic requirements, based on respiration measurements. Dissolved organic carbon (DOC) was found to make up the majority (87-98%) of the sponge diet. Subsequent experiments with 13C-tracer labelled bacteria and DOC, revealed that bacterial carbon was assimilated efficiently in sponge tissue (68-97%), whereas up to 68% of the DOC taken up was respired, and that the utilization of different carbon sources varied between sponges types. The highest assimilation efficiencies for bacterial carbon were found in LMA sponges, whereas highest assimilation efficiencies for DOC were found in HMA sponges. These results imply that DOC is a major source of carbon for deep sea filter feeding organisms such as sponges and that due to their abundance, sponges can have a significant effect on global carbon cycling.

Ecological interactions - ABSTRACT ISDSC7_139
THURSDAY Morning · 11:30 · Aguamarina Ballroom
Trophic ecology of the bacteriosponge Geodia forming giant landscapes at Langseth Ridge, Arctic, 87°N

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Autun Purser, Alfred Wegener Institute Helmholtz Center for Polar and Marine Research
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Hans Tore Rapp, University of Bergen
Jack Middelburg, University of Utrecht
Antje Boetius, Max Planck Institute for Marine Microbiology & Alfred Wegener Institute Helmholtz Center for Polar and Marine Research

During the Polarstern expedition PS101 to the Central Arctic, Langseth Ridge 85-87°N, dense populations of the bacteriosponge Geodia were discovered covering a chain of three seamounts (Karasik, Central and Northern mounts) at 500-1000m water depth. This sponge assemblage, dominated by Geodia parva and G. hentscheli, represents the densest accumulation of sponges known from northern seas. These sponges were observed to sit on a layer of dead tubeworms and mussel shells likely being remnants of past seep or vent biomass. This unique sponge landscape represents a biodiversity hotspot in the Arctic Ocean, raising the question as to its food supplies and the functional role of its microbial symbionts. To investigate the carbon and energy sources that fuel this community we measured stable carbon and nitrogen isotope signatures (δ13C and δ15N respectively) together with fatty acid compound-specific isotopes of sponge tissues, sediments, associated macrofauna, and particulate organic matter (POM) in the water. The sponge isotope signatures indicate that planktonic POM is not a main food source for these species, but they display a δ13C similar to the tubes and sedimenting sea-ice algae. The sponge isotope signatures do not match typical chemolithoautotrophic profiles of symbiotic life from venting seamounts and stable isotope patterns of fatty acids confirm that sponges obtain food heterotrophically. Under-ice primary production is limited and deposition of ice algae biomass alone cannot nourish such giant sponge accumulations. We observed long spicule tracks on the substrate, indicating crawling locomotion by the sponges, that is possibly related to food availability. Here we

suggest that the dense sponge populations live from the remnants of past vent communities (e.g. chitin tubes) with the help of their microbial symbionts and they slowly crawl across the substrate that is their main reservoir of food.

Ecological interactions - ABSTRACT ISDSC7_122
THURSDAY Morning · 11:45 · Aguamarina Ballroom
Conceptual Model Of The Energy Flux In Zooplankton Community Associated With Mesophotic Corals In The Deep-Sea Corals Park, Colombian Caribbean

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Alejandro Henao Castro, Universidad de Cartagena
Gabriel Navas, Universidad de Cartagena

Mesophotic coral ecosystems are located between 30 and 150 m depth, and even when they constitute unique communities, they have not been enough studied due to the high cost for the available technologies. The zooxanthellae of these ecosystems have a low photosynthesis rate, and the zooplankton becomes the primary food resource of the coral colonies. The purpose of this work was to build a conceptual model about the energy flux in the zooplanktonic community, based on qualitative data about the community composition and its trophic structure. We chose five stations at the top of the submarine mountain and in each of them we filtered 24 L (45 µ mesh opening) of seawater with a device designed to take zooplankton specimens right on top of the reef substrate. Samples were analyzed to obtain the taxonomic composition and categorized according to its trophic spectra. Herbivores dominated in both composition and abundance with 50 and 78%, respectively. Taking into account that the average depth of the community was 40 m, the dominance may be influenced by certain physicochemical events such as the deep chlorophyll maximum, which has been found at that depth around the zone. For this community the energy flows from the phytoplankton and bacteria to zooplankton, starting from herbivores (tintinnid, nauplii, some foraminifera, some copepod), going to omnivores (radiolarian, some foraminifera, some copepods), then to predators (polychaeta, cnidarian, some crustaceans and hydrozoan) and finally, it goes to corals and other zooplanktivores. This trophic network is similar to others in pelagic communities, and may have the same role as in shallower reefs, being an important component for the species structuring the reef and associated organisms.

Ecological interactions - POSTERS

POSTER 19 - Ecological interactions - ABSTRACT ISDSC7_119
TUE Evening · 16:30 · Aguamarina
Associations between deep-sea structure-forming species and deep-sea fishes on a pristine island in the Northwestern Hawaiian Islands

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Nicole B. Morgan, Florida State University
Mauricio Silva, Florida State University
Amy R. Baco, Florida State University

In the deep-sea, association of fishes with structure-forming deep-sea corals and sponges may be obligate or facultative. Known obligate relationships for fishes are so far rare, but include use of specific deep-sea coral species for reproduction (e.g., egg nurseries) or for shelter. Facultative associations occur when deep-sea fishes indiscriminately use different species of deep-sea corals or sponges as refuge, for feeding, and/or reproduction. Gaining a better understanding of the nature of associations of fishes and structure formers is critical as corals and sponges are increasingly impacted by anthropogenic activities such as trawling and mining. A better understanding of which species are involved will provide insights into whether functional associations exist and how these associations can change when there is a variation in community structure. Necker Island, located in the Northwestern Hawaiian Islands, is protected from fisheries activities as part of the Papahānaumokuākea Marine National Monument. Approximately 20,150 AUV photos taken from 3 sides of Necker Island at depths of 250-650 m were used to identify deep-sea fish species and deep-sea corals and sponges. Preliminary results show that 84 fish species occur in the same images with at least one of 57 deep-sea structure-forming coral or sponge species. Fish families with the most common occurrences in images with corals or sponges include Moridae, Sternoptychidae, and Neoscopelidae. Coral and sponge families with the most common occurrence in images with fishes include Caryophylliidae, Chrysogorgiidae, Anthoptilidae, Alcyoniidae, and Pheronematidae. Moridae and Sternoptychidae most often co-occurred with Caryophylliidae, Alcyoniidae and Anthoptilidae. Sternoptychidae also co-occurred with Pheronematidae, while Neoscopelidae showed high association with Chrysogorgiidae. Ongoing work aims to determine the types of associations as well as within seamount variation in these patterns.

POSTER 20 - Ecological interactions - ABSTRACT ISDSC7_121
TUE Evening · 16:30 · Aguamarina
Compound Specific Isotope Analysis of Amino Acids Increases Our Understanding of Caribbean Sponge Trophic Ecology in the Mesophotic Zone

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Michael Lesser, University of New Hampshire
Marc Slattery, University of Mississippi

In the Caribbean sponges show a predictable increase in percent cover as depth increases from shallow (<30 m) to mesophotic (30-150 m) depths. This appears to be driven by increased food availability at depth, particularly in the form of heterotrophic picoplankton. Since sponges are predicted to generally increase throughout the Caribbean, understanding what factors control their distribution is critical. Bottom-up processes appear to be a significant factor, and stable isotopic analyses have become increasingly informative about their trophic ecology. The use of compound-specific isotopic analysis of amino acids (CSIA-AA) of δ13C and δ15N should provide increased resolution on sponge trophic ecology into the mesophotic zone. Using CSIA-AA on three sponges from the Caribbean we see that as depth increases the δ13CAA and δ15NAA values become enriched which indicates that sponges rely more heavily on particulate organic matter (POM) consumption in the

mesophotic zone. The δ13CAA and δ15NAA values of these sponges also reflect a species-specific trophic strategy involving both host consumption of POM and dissolved organic matter (DOM) and subsequent reprocessing by their microbiome. The use of CSIA-AA has the potential to increase our understanding of sponge trophic strategy and highlights the complexities of studying these important coral reef organisms.

POSTER 21 ⚡ Ecological interactions ⚡ ABSTRACT ISDSC7_126
TUE Evening · 16:30 · Aguamarina
Environmental factors driving megabenthic faunal distributions on the East and West wall of the most eastern branch of Whittard Canyon

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Furu Mienis, NIOZ, Royal Netherlands Institute for Sea Research
Gerard Duineveld, NIOZ, Royal Netherlands Institute for Sea Research
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The heterogeneous topography in canyon systems interacts with the hydrography, generating distinctive currents and numerous varieties of habitats suitable for a large number of species, among them cold water corals. In addition, submarine canyons are regarded as major conduits for organic matter transport from the continental shelf to the food limited deep sea. Together, these variables allow for high biomass and species diversity and therefore canyons have been characterised as hotspots for fauna. During two cruises with RV Pelagia the most eastern branch of the Whittard Canyon system (NE Atlantic) was visited. Our main aim was to study megabenthic faunal abundance and diversity on the East and West wall of the branch, since we hypothesized that these will differ due to different morphological characteristics. To study habitat and megabenthic faunal variability tethered video transects were made and in addition environmental variables like temperature and oxygen were measured. Acquired video data were analysed by applying distance and depth as factors. Substrate changed rapidly along canyon transects with distance and depth but also between the canyon walls. The eastern wall consisted mostly of soft sediment (37%) and cliffs (38%) while the western wall was highly dominated by soft sediment (71%). Distinct faunal patterns were observed with depth and between canyon walls. Pennatulaceans were the most abundant fauna on both canyon walls until a 1000m depth where hard and soft coral abundance increased though hard corals were absent on the western wall at comparable depths. This distribution is related to substrate differences on each wall as well as particle density and hydrodynamics. In addition, habitat variation is most likely linked to other environmental factors such as slope angle and sedimentary/suspended organic matter content.

POSTER 22 - Ecological interactions - ABSTRACT ISDSC7_129
TUE Evening · 16:30 · Aguamarina
First fauna observations of Caramarí Bank: a mesophotic coral ecosystem

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Katherine Mejia-Quintero, Instituto de Investigaciones Marinas y Costeras, INVEMAR, Colombia
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David Alonso-Carvajal, Instituto de Investigaciones Marinas y Costeras, INVEMAR, Colombia

The Caramarí Bank is located in the northeastern side, out of the Deep-sea Coral National Natural Park of Colombia, NE-SW direction between the 70 m and 200 m isobaths. Is an elongated shape geoform that combines geological and biotic processes, via structural lifting through mud domes and via the colonization of coral formations. During an exploration carried out on April 7 2018, using ROV Eloy V, two video surveys were made between 70 and 120 m deep. A total of 4 hours 33 minutes of video surveys were analyzed for interpretation of images and identification of benthic macro-habitats and main faunal groups present and visible with this technology. The Bank is a mesophotic ecosystem (MCE) characterized by a macro-habitat of hard bottom and rhodolith beds with associated fauna, dominated by coralline algae, leafy and articulated algae, sponges (tubes, chimneys and barrels), cnidarians (hard corals, black corals and soft octocorals), echinoderms (sea cucumbers, unstalked crinoids and ophiuroids), bryozoans (arborescents and encrusting cheilostomatids) and rocky fishes. These first observations of the partially protected Caramarí bank, evidence the diversity of areas surrounding the Deep-sea Coral National Natural Park and contribute to the relatively unexplored mesophotic coral ecosystem in Colombia. Overall, this preliminary study highlights that they are ecosystems with high species richness and that required further research efforts and monitoring to assess the ecological integrity, impacts and connectivity with other MCEs and shallow reefs.

POSTER 23 ⚡ Ecological interactions ⚡ ABSTRACT ISDSC7_131
TUE Evening · 16:30 · Aguamarina
Functional and Phylogenetic Diversity of Fishes in Deep-Sea Coral Habitats along the southeastern U.S. coast

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Tara McIver, AquaCo

Reef fish communities characteristic of deep-sea coral habitats at depths of ~400-800 m have been well documented off the southeastern U.S. coast in the western North Atlantic. This study, a component of DEEPSEARCH, builds on a decade of previous work in the region to investigate both functional and phylogenetic diversity of fish assemblages occupying Lophelia pertusa habitats. These biodiversity measures can be useful in guiding conservation priorities, while providing a more in-depth understanding of ecosystem function. To estimate functional diversity, we compiled traits for all fish species documented from recently collected ROV video data (2017-2018) and previously published ROV and otter trawl data (2000-2014). Traits chosen for analyses included diverse attributes of fish ecology, such as trophic breadth, trophic group, water column position, and maximum size, which are known to influence fish functional roles. To examine whether unique or endemic lineages were

present at deep-coral habitats, we calculated Faith's Phylogenetic Diversity metric using the ray-finned fish tree of life in the R package fishtree. Diversity estimates were calculated for fish assemblages occupying both L. pertusa habitats and off-reef habitats to determine whether deep-sea coral bioherms exhibit higher functional and/or phylogenetic diversity compared to off-reef habitats. Abundant fish species representing 84% of all fishes observed at deep-sea coral habitats were Laemonema melanurum, Nezumia spp. Hoplostethus mediterraneus, Hoplostethus occidentalis, Synaphobranchus sp. and Eptatretus lopheliae. Hoplostethus mediterraneus, H. occidentalis and Eptatretus lopheliae were exclusively observed on coral rubble or coral habitat. This study is ongoing and future work will include comparing results from deep-sea coral habitats to other rugged, deep-sea habitats (e.g., cold seeps, coral gardens, submarine canyons) in the region.

POSTER 24 - Ecological interactions - ABSTRACT ISDSC7_134
TUE Evening · 16:30 · Aguamarina

Octocorals and brittle stars: Recording an unknown relationships in the Colombian Pacific Ocean

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Brittle stars are recognized as octocoral epizoic organisms, both in shallow and deep environments. In these relationships, ophiurans benefit directly by being elevated, facilitating their feeding by suspension, and passive protection by octocoral. However, the octocorals do not seem to benefit or be harmed by this relationship. During the Tumaco Offshore Project (2012-2013) developed by the Institute of Marine and Coastal Research-INVEMAR with the support of the National Agency of Hydrocarbons-ANH, samplings were carried out on soft bottoms of 13 localities in an unexplored area offshore of the Colombian Pacific, through trawls with an epibenthic net (9 × 1 m opening, 2.5 knots for 10 min). As part of the results, 218 specimens belonging to the species Astrodia cf. excavata (Lütken and Mortensen, 1899) associated with several colonies and fragments of octocoral Callogorgia sp. were collected. This association was found in a single station located at 668 m depth. The size and coloration of the colonies of Callogorgia sp. and the approximate number of ophiuroids associated with each one are recorded. Additionally, color of the live specimens, size, presence of mature gonads (by direct observation), and evidence of arm regeneration are reported for the ophiurans. Associations of brittle stars (genus Asteroschema sp.) with Callogorgia species have been recorded for the Caribbean Sea; however, this finding is relevant because it constitute the first report of this interaction for the Tropical Eastern Pacific. Both species, Astrodia cf. excavata and Callogorgia sp. would represent new records for the Colombian Pacific Ocean contributing to the biodiversity inventories.

POSTER 25 ⚡ Ecological interactions ⚡ ABSTRACT ISDSC7_135
TUE Evening • 16:30 • Aguamarina

Patterns of Coral Symbiont Distributions Among Deep Waters of Atolls, Islands, Reefs and Seamounts in the Phoenix Islands Protected Area

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Taylor Heyl, Woods Hole Oceanographic Institution
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Steven Auscavitch, Temple University
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Timothy Shank, Woods Hole Oceanographic Institution

In 2017, two expeditions on the NOAA Ship Okeanos Explorer and Schmidt Ocean Institute's R/V Falkor were conducted with the shared goal of documenting coral communities in the deep waters of the Phoenix Islands Protected Area (PIPA). Twenty-three ROV surveys of 17 atolls, islands, banks and seamounts collected approximately 206 cumulative hours of seafloor imagery, and made 83 coral and symbiont invertebrate collections within the protected area. We annotated the occurrence of over 50 morphologically distinct deep-sea coral symbiont morphotaxa and their antipatharian, octocoral, and scleractinian hosts. We merged these annotations with ROV navigation, depth and environmental data. The resulting dataset was analyzed for differences in the composition of coral symbiont communities among the surveys. Statistically significant clustering of symbiont community composition was observed with depth and among host coral taxa. Symbiont richness among ROV surveys was significantly related to coral community richness, as well as survey depth range, linear distance and duration. Additionally, to corroborate identifications of symbiont taxa from the imagery analysis, we barcoded chirostylid squat lobsters and ophiuroids using mitochondrial 16S and COI. This work is novel in its approach of systematically identifying coral symbiont relationships in the deep-sea while analyzing their distribution within a region and with depth. Our findings represent significant gains in our understanding of these little known interactions, and have implications for the conservation and management of PIPA: a massive (405,755 km2) no-take Marine Protected Area including unexplored deep-sea habitats in the Central Pacific.

POSTER 26 - Ecological interactions - ABSTRACT ISDSC7_136
TUE Evening • 16:30 • Aguamarina

Spatial distribution and temporal dynamics of deep-sea corals from Santos Basin, Southeastern Brazil

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Felipe Porfírio, Universidade de São Paulo
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Paulo Yukio Gomes Sumida, Universidade de São Paulo

Deep-sea corals are among the most significant ecosystem engineers around the world. In Brazil, they occur only in deep waters in conjunction with cold currents, and their comprehension is essential since they constitute a rich natural reservoir of biodiversity. In the present study (part of SENSIMAR Project-PETROBRAS, a Brazilian oil & gas company), we are evaluating the spatial variation and temporal dynamics of deep reefs communities in Santos Basin (Southeastern Brazil). Samples were generated from a database of coral images collected by remotely operated vehicles (ROVs) during environmental assessment operations of Petrobras. Further image samples will be collected using a camera lander moored at a 250 m depth in the same basin. ROVs images are being analyzed to determine deep-sea coral species richness and abundance for different depths. Preliminary results comprise a total of nine phyla identified from 2,274 organisms registered between 200-1000 m depth. Cnidarians represented 59% of the records, with 15 families and 33 species. Most of the identified species are scleractinians from the family Caryophyliidae. The hard coral Solenosmilia variabilis, a habitat constructor, had the greatest relative abundance and highest frequency of occurrence, with >90% found between 700-1000 m depth. Coral richness significantly differed between depths (Kruskal-Wallis: H = 27.49, df = 5, p < 0.001), with more species between 900-1000 m. Temperature, salinity and current intensities varied widely between depth and site, impacting the distribution of live deep-sea corals. This work is ongoing; future image analysis will include both a larger set of ROV tracks and time sequence analysis from fixed lander images. Access to high-resolution data on a large spatial scale permitted by partnerships such as this, allow connections to be made between physical environments and biological changes, clarifying understanding of the structure and functioning of these communities.

Molluscan assemblage time series: new proxy for environmental & ecosystem dynamics of cold-water coral mounds?

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Cold-water corals (CWC) contribute to biodiversity and serve as ecosystem engineers on continental margins worldwide. Coral mounds – built by the interplay of biological, sedimentological, and oceanographic processes – provide deep sea habitats for a variety of macrobenthic taxa (e.g. molluscs, sponges, bryozoans, crustaceans, echinoderms). When compared with off-mound palaeoceanographic records, coral mound records provide stratigraphic and ecological insights about the temporal and spatial drivers and dynamics of mound and deep sea ecosystem formation. While surficial spatial patterns of mound macrobenthic communities have been described, their temporal ecological relationship with mound formation is largely unexplored. Therefore, this study aims to 1) assess quantitatively temporal ecological trends of coral mound molluscan assemblages, and 2) correlate those data with coral growth and palaeoceanographic records. Our goal is to determine if and how a fossil molluscan assemblage time-series can act as a proxy to the biological, sedimentological, and oceanographic factors influencing CWC mound development.

Preliminary results from a coral mound gravity core from the Alboran Sea (western Mediterranean, last ~13.2 ka) indicates that throughout the core bivalves are more abundant and diverse than gastropods, yet these taxonomic groups yield generally similar downcore trends in abundance and diversity. Peak molluscan assemblages (defined by high abundance and or diversity) are significantly similar in composition and primarily alternate, rather than coincide, with periods of pronounced coral growth, which are associated with high productivity during the Bølling-Allerød interstadial (13.5-12.8 ka) and Early Holocene (11.3-9.8 ka). Additional ecological and statistical assessments as well as comparison with adjacent cores will refine our understanding of the ecological relevance of molluscan assemblages to coral mound formation.

Systematics & evolution - TALKS

Systematics & evolution - ABSTRACT ISDSC7_017
WEDNESDAY Afternoon · 13:30 · Aguamarina Ballroom
Genetic diversity of Colombian deep-sea corals – KEYNOTE

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Conservation of marine biodiversity in Colombia deserves special attention, not only for being one of the top megadiverse countries but also for its geographically strategic position between the Atlantic and the Pacific, each with distinct geological, oceanographic and climatic features. In this study, we performed DNA barcoding of corals from expeditions carried out during the last 20 years in the Colombian Caribbean Sea by the Marine and Coastal Research Institute (Invemar) and kept as repositories in the Marine Natural History Museum (Makuriwa Museum). We target samples collected during the expeditions Macrofauna I (1998-1999), Macrofauna II (2001-2002), Corpoguajira (2004), and Marcoral (2005). Specimens were selected from localities in three main areas: 1. the Marine Protected Area "Deep-water corals" (150-500 m), 2. Santa Marta deep-water coral communities (200-500 m), and 3. La Guajira coral gardens (50-150 m). A total of 125 specimens from 93 species were sequenced (45 Alcyonaria, 30 Scleractinia, 12 Antipatharia, three Zoantharia, and three Pennatulacea) with the COI barcode and six other order-specific primers. Phylogenetic analyses using available information in Genbank for Caribbean corals show that about a quarter of our dataset represents new additions of species to the Cnidarian Tree Life. Our outcomes also highlight the value of museum collections for the development of DNA barcode libraries.

Systematics & evolution - ABSTRACT ISDSC7_014
WEDNESDAY Afternoon • 14:00 • Aguamarina Ballroom

Are museums plummy or octocorals mummies? A DNA barcoding library for the NE Atlantic and Mediterranean Swiftia Duchassaing & Michelotti, 1864

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DNA barcoding is commonly presented as a solution to the shortage of taxonomists and to speed up the pace of species discovery. However, if the database of DNA sequences of the known species, with which the other sequences are compared to, is not based in properly identified specimens, the DNA barcoding will not be accurate as a tool to identify species. Considering the limited taxonomic knowledge in Octocorallia, DNA barcoding may be a good alternative taxonomic tool when rooted in name-bearing, reference specimens and morphological data. A museum-based DNA barcoding library was built using the extended octocoral mitochondrial DNA barcode based in three molecular markers (COI + igr1 + mtMutS) and the nuclear ribosomal – DNA Internal Transcribed Spacer 2 (ITS2). In this case study, the genus Swiftia Duchassaing & Michelotti, 1864, is part of the most diverse and abundant octocoral family of Holaxonia, the Plexauridae, forming deep-sea ecosystems in the NE Atlantic Ocean and the Mediterranean Sea. Three species hypotheses, included in the last taxonomic revision of the genus in 1977, were also tested by integrating morphology, molecular biology and zoogeography (Grasshoff, 1977). So far we proved that European Natural History Museums are indeed plummy by storing octocoral reference specimens useful for morphology and genetics. Our work lays the foundations for further research in biogeography, shifts of distribution ranges, discovery of biodiversity hotspots, evolution and conservation of octocorals. Reference Grasshoff, M. (1977) Die Gorgonarien des östlichen Nordatlantik und des Mittelmeeres: III. Die Familie Paramuriceidae (Cnidaria: Anthozoa). "Meteor - Forschungs - Ergebnisse, D27, 5–76.

Systematics & evolution - ABSTRACT ISDSC7_023
WEDNESDAY Afternoon • 14:15 • Aguamarina Ballroom
Revisionary systematics in the wake of Deepwater Horizon Oil Spill: Molecular Lineage of Swiftia, Hypnogorgia, and Muricea

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Andrew Shuler, NOAA affiliate with CSS, Inc
Caroline Vill, College of Charleston
Thomas Greig, NOAA

Genetic analyses can provide critical information to assist restoration activities in the wake of environmental assaults, like the Deepwater Horizon (DWH) oil spill in the northern Gulf of Mexico (GoMx). The damage assessment for the DWH spill showed that several species of gorgonian octocorals on rocky reefs in the mesophotic zone (50-150 m) had significantly more injury post-spill compared to pre-spill conditions, but genetic diversity was unknown at the time. To meet the goals of restoration activities, this study set out to evaluate the mtDNA mutS and CO1+ igr gene regions of two injured taxa, from across the GoMx. DNA sequences were cross-referenced with museum specimens using BLAST. Results from the mtDNA mutS gene in samples of Swiftia exserta (n = 278) revealed three haplotypes in S. exserta, but no significant differences among phenotypic color morphs. Only one haplotype was found among presumptive Hypnogorgia pendula (n = 314). Homology searches for both species revealed inconsistencies with online data bases as presumptive Hypnogorgia samples exhibited high homology with Muricea pendula. Similarly, the S. exserta sequences failed to match other S. exserta sequences in GenBank, but they matched museum specimens. Phylogenetic analyses conducted using a subsample of octocoral mutS sequences in Genbank in conjunction with our data, revealed evidence of extreme divergence within the Swiftia. This is problematic as S. exserta is the type species for this genus. Our results indicate that the genera Hypnogorgia, Muricea, and Swiftia will require additional taxonomic analyses and possibly a systematic revision. To build upon these findings, sclerite morphology will be closely examined using scanning electron microscopy, and the nuclear marker 28S will be used to verify these findings. Other genera of gorgonian octocorals were injured by the spill (Thesea, Placogorgia, Paramuricea), and these may also benefit from inclusion into a larger molecular analysis.

Systematics & evolution - ABSTRACT ISDSC7_022
WEDNESDAY Afternoon · 14:30 · Aguamarina Ballroom
Revelations from mitogenome studies of western Gulf of Mexico octocorals

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The continental shelf of the western Gulf of Mexico is a wide, muddy shelf punctuated by a few protruding reefs at mesophotic depths (30-150 m). These reefs provide essential habitat for abundant and diverse marine communities. Most of our knowledge of the octocorals on these reefs is obtained from video surveys and samples collected at the Flower Garden Banks National Marine Sanctuary but few detailed morphological analyses and genetic studies have been conducted on the collected samples. Because octocorals can be difficult to assign to species from images and the intraspecific and interspecific morphological variations are not well understood for many octocoral taxa, their diversity may be under or overestimated at

these reefs. In addition, traditional barcoding regions for octocorals often reveal few to no genetic differences within species or closely related species. To identify new potential barcode regions and to determine whether genetic analysis of the collected octocorals reveal different diversity patterns, we obtained mitogenomes for octocoral morphospecies. Dozens of new primers were designed and at least three potential barcode regions were identified. Preliminary mitogenome data reveal field identifications are often inaccurate, some morphospecies consist of multiple distinct lineages, some morphospecies are genetically distinct from species reported from the region, and target mitogenome regions that may better resolve interspecific differences than the standard barcoding regions used for octocoral studies.

Testing the utility of a novel target-enrichment bait approach in a morphologically and complex genus of octocoral

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Catherine McFadden, Harvey-Mudd College
Christopher Burridge, University of Tasmania

Octocoral taxonomy is based on separating forms according to morphological characters deemed to represent different species. The octocoral genus Chrysogorgia comprises >70 nominal species, varying widely in morphological features suggesting that this group should be split. Molecular studies have showed that this group is monophyletic, although data are from a relatively small subset of species. Molecular markers, such as mtMutS and multigene barcode regions (eg. mtMutS-28s), have limited utility for elucidating deep phylogenetic relationships and often are unable to discern among closely related species. The recent development of universal target enrichment baits for octocorals demonstrated the potential for this approach to resolve deep to shallow-level relationships within the Octocorallia. We applied this methodology to a large set of species in the genus Chrysogorgia to determine whether there was a genetic basis for splitting this group into several genera that were designated a priori and based on detailed morphological examination. Two probe sets designed to target exons and ultraconserved elements (UCEs) were used during target enrichment of 96 taxa. Following Illumina sequencing and Spades assembly we recovered 1682 of 1886 targeted loci for the exon and 1333 of 1496 targeted loci for the UCE probe set. Loci recovered per sample was highly variable and was related to the age of the sample (2-60 yrs) and DNA extraction concentration (1.27-1181.29 ng/µl). The mean number of loci recovered per sample was 892.29 ± 279.32 and 765.92 ± 235.65 for the exon and UCE probe sets, respectively. Phylogenetically informative sites ranged from 44.43% – 41.58% for 50% and 75% coverage matrices for both probe sets. Maximum likelihood analyses recovered highly resolved trees with topologies supporting the separation of Chrysogorgia into several genera. This approach can be successfully applied to degraded museum specimens of up to 60 years old.

Systematics & evolution - ABSTRACT ISDSC7_011
WEDNESDAY Afternoon · 15:30 · Aguamarina Ballroom

A robust, time-calibrated phylogeny from sequence-capture of UCEs and exons sheds light on skeletal evolution in class Anthozoa

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Brant Faircloth, Louisiana State University
Estefania Rodriguez, American Museum of Natural History

The anthozoan cnidarians (e.g., corals, sea anemones) are an ecologically important and diverse group of marine metazoans that includes some of the deep sea's most important ecosystem engineers. Our understanding of the evolutionary relationships among the ~7500 species within this class is, however, deeply flawed. Molecular phylogenetic studies have revealed widespread homoplasy in morphological characters and widespread polyphyly at the ordinal, family, and genus levels. Resolution of both deep and shallow nodes in the anthozoan phylogeny has been hindered by a lack of phylogenetically informative markers that can be sequenced reliably across taxa whose divergence may pre-date the Cambrian. Using available anthozoan genomes and transcriptomes, we designed a set of 16,306 target-capture baits for enriching both ultraconserved elements (720 loci) and exons (1071 loci). Target enrichment conducted on 221 species recovered 1788 loci, with a mean of 896 ± 240 loci per species. These data were combined with data from 10 available anthozoan genomes and four medusozoan outgroups to construct a highly resolved, maximum likelihood phylogeny using a 912-locus dataset with 50% taxon occupancy. Time-calibrating the phylogeny using 10 fossil data points in a Bayesian framework produced robust estimates of diversification times, elucidating the timing of diversification of morphological characters, including skeletal type. Results indicate multiple gains and losses of skeletal types over time, particularly throughout the Octocorallia. Notably, major radiations of groups with aragonitic and calcitic skeletons occurred ~225 and 175 MYA respectively, coinciding with times when paleoclimate seas favored those conditions. In addition to resolving evolutionary relationships at the ordinal and family level, preliminary data suggest that this approach will also facilitate delimitation of species, offering a more versatile alternative to other phylogenomic methods, such as RADSeq.

Systematics & evolution - ABSTRACT ISDSC7_016
WEDNESDAY Afternoon · 15:45 · Aguamarina Ballroom
Evolutionary history of the Scleractinian corals distribution

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Processes driving biodiversity patterns along the bathymetric gradient are not well known at the global scale. Scleractinian corals are a current conservation focus owing to their ecological importance and susceptibility to extinction from environmental change. These species have a wide biogeographic distribution, with two main functional groups: zooxanthellate, which distribution is restricted to the photic zone, and azooxanthellate, widely distributed in the water column, while a third small group is facultative (both traits). Understanding the evolutionary interaction between these groups from their origin in the Paleozoic to their current distributions is critical to predict the group's destiny. In the present work, we used a new phylogenetic tree and known species distribution in a 3D space to test hypotheses about the Scleractinia origin, the origin of zooxanthellaes and the evolution of the distributional ranges in the horizontal space together with the bathymetric gradient. The phylogenetic tree used is the most robust existent tree, with 3688 sites of four molecular markers for 532 species. Ancestral state inference analyses were performed on the sample of trees and indicated that the ancestor of the group was azooxanthellate (Paz=0.71, Pz=0.02, Pb=0.27), with a three times higher transition rate from az-species to z-species. The minimum, maximum and mean depth showed a high phylogenetic signal ($\lambda>0.9$) compared to the latitudinal (λmean=0.72, λmin=0.86, λmax=0.39) and longitudinal distribution (λmean=0.34, λmin=0.57, λmax=0.71). The origin of the group was obtained with a phylogenetic geographical model that accounts for varying speeds of movement and it was placed at 670 m of depth (min 34, max 1200 m), -5.61 latitudinal degrees (min -44.87, max 27.63) and -54 longitudinal degrees (min -162, max 113). Evolutionary patterns show resilience of the deep species distribution with multiple colonisations of the shallow environment and zooxanthellae gain.

Systematics & evolution - ABSTRACT ISDSC7_013
WEDNESDAY Afternoon • 16:00 • Aguamarina Ballroom

Adding leaves to the tree: are micrabaciids the first diverging lineage within Recent corals?

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Marcelo Kitahara, Federal University of Sao Paulo

In Scleractinia molecular phylogenies, the azooxanthellate families Micrabaciidae and Gardineriidae form the "Basal" clade. Herein we refine the evolutionary position and also composition of this clade by sequencing mitochondrial genomes (mtgs) of three Micrabaciidae. To date, Gardineria hawaiiensis (Gardineriidae) was the only mtg from a Basal clade representative. DNA from Letepsammia superstes, L. formosissima and Rhombopsammia niphada was extracted from museum specimens and sequenced with Illumina chemistry. Reads were filtered with Trimmomatic and assembled on Mitobim using

Sanger sequences of the same species as baits. Circularity was assessed with Mitobim and annotation was performed in MITOS. Mtgs of L. superstes and R. niphada are complete/circular, while that of L. formosissima lacks part of 16S. In L. formosissima and L. superstes, mtgs are 19040 and 19073bp long, respectively, while R. niphada totals 19618bp. Despite their size difference, they follow the main scleractinian architecture. Nucleotide sequences from protein coding genes were aligned (CLUSTALO) with published data (Scleractinia and Corallimorpharia) and submitted to PhyML (model selection by AIC, 500 bootstrap samples). Under the GTR+G+I model, Micrabaciidae was recovered as monophyletic and sister to Gardineriidae+Complex+Robust. Although Rhombopsammia is not clearly separated from Letepsammia, it has been hypothesized that R. niphada could be a transition from Letepsammia to Rhombopsammia. The position of G. hawaiiensis is uncertain since it was recovered with low support as sister to Robust+Complex. While our results contradict previous molecular phylogenies, anatomical similarities between Micrabaciidae and Corallimorpharia in addition to its morphological dissimilarities to gardineriids support the former's divergence before Gardineriidae. Future work includes estimating divergence times and using paleoenvironmental data to conjecture about these families' future towards climate change.

Phylogeny of Northeast Atlantic Deep-sea Pennatulacea

Raissa Hogan, National University of Ireland Galway, Ireland
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Chris Yesson, Institute of Zoology (IoZ), Zoological Society of London, UK
Louise Allcock, Ryan Institute, Zoology Department, National University of Ireland, Galway

Pennatulacea (sea pens) is one of the most distinctive and abundant groups of corals in the deep sea. Their specialised morphological characteristics, including different types of polyps, led sea pens to be described as "one of the strangest wonders" when first reported in the early part of the 17th century. They have a broad distribution from tropical zones to the poles and from shallow waters to depths reaching more than 6000 m. According to global habitat suitability analyses for cold-water corals, sea pens have the widest potential habitat range. Despite their importance, there are only two studies that address their phylogeny, and only one focused on deep-sea species. Both studies used two mitochondrial genes for their analyses. We used newly sequenced mitochondrial genomes and the nuclear rRNA gene cluster (18S, ITS1, 5.8S, ITS2, 28S) from 18 species present in the Northeast Atlantic in conjunction with two mitochondrial genomes from GenBank. Our data include eleven genera and ten families and encompass almost all genera present in the Northeast Atlantic and deep-water globally. Maximum Likelihood and Bayesian Inference phylogenies constructed separately from whole mitochondrial genomes and nuclear rRNA recovered similar topologies. All phylogenetic trees based on mitochondrial genomes recovered four well-supported clades, which corroborated with previous phylogenetic studies. Kophobelemnidae was recovered as a well-supported monophyletic group. Distichoptilum appears to be nested within Pennatula, with Protoptilum sister taxon to this clade. The phylogeny supports previous studies suggesting a shared common ancestor for Pennatulidae and Protoptilidae. Umbellula Anthoptilum were recovered as well-supported

sister taxa. However, one species of Umbellula was outside this clade, and was instead recovered as sister to Halipteris. Therefore we found Umbellula to be polyphyletic. This genomic scale phylogeny presents the best view of sea pen evolution to date.

Systematics & evolution - POSTERS

POSTER 28 ⚡ Systematics & evolution ⚡ ABSTRACT ISDSC7_010
WED Evening · 16:30 · Aguamarina
A revision of Trans-Pacific cold water coral, genus Calcigorgia (Cnidaria, Octocorallia, Acanthogorgiidae) with three new species.

Asako K. Matsumoto, Planetary Exploration Research Center - Chiba Institute of Technology, Japan
Leen P. van Ofwegen, Naturalis Biodiversity Center
Frederick, M. Bayer, National Museum of Natural History

The cold water octocoral of the Acanthogorgiid genus Calcigorgia is commonly found from cold subarctic Pacific, Aleutian to Alaskan water. One of the most well reported species of the genus is Calcigorgia beringi (Nutting, 1912). However, very few people noticed that it was not valid species until this year. C. beringi was first described by Nutting (1912) as Leptogorgia beringi. it was transferred to the genus Stenogorgia by Kükenthal (1919). Later on the genus Stenogorgia was synonymized with Swiftia by Deichmann (1936). Finally, the species was transferred to the genus Calcigorgia by the late Dr. Bayer (USNM: National Museum of Natural History, Smithsonian Institution, Washington D.C., USA) in his unpublished manuscript we have at our disposal. Because of this manuscript, the database of the USNM mostly referred to these specimens of the species as C. beringi. However, the genus and the status of C. beringi was never revised. The total 55 specimen of the genus Calcigorgia, from Japan, Sea of Okhotsk, Bering Sea, Alaskan waters, and NW of North American coast have been examined. The four known species, Calcigorgia beringi (Nutting, 1912), C. japonica Dautova, 2007, C. matua Dautova, 2018 and C. spiculifera Broch, 1935 are re-described. Three new species, C. gigantea sp. n. from Aleutian, C. gracilis sp. n. and C. pacifica sp. n. from Japan are described and depicted, bringing the total number of Calcigorgia species to seven (Matsumoto, Ofwegen, Bayer, 2019). C. simushiri, Dautova 2018 is synonymized with C. spiculifera Broch, 1935. A neotype for C. spiculifera has been designated. Finally, Leptogorgia, Stenogorgia or Swiftia beringi now become scientifically valid Calcigorgia beringi. Reference ASAKO K. MATSUMOTO, LEEN P. VAN OFWEGEN & FREDERICK M. BAYER 2019 A revision of the genus Calcigorgia (Cnidaria, Octocorallia, Acanthogorgiidae) with the description of three new species. Zootaxa 4571 (1): 001–027 DOI: http://dx.doi.org/10.11646/zootaxa.4571.1.1

POSTER 29 - Systematics & evolution - ABSTRACT ISDSC7_012
WED Evening · 16:30 · Aguamarina

A study of endemic Hawaiian Xeniidae (Octocorallia, Alcoyonacea) with a description of four new species and re-description of Sarcothelia edmondsoni

Grace Tuthill, Brigham Young University - Hawaii, USA
Esprit Heestand Saucier, Brigham Young University - Hawaii
Ashlin Cooper, Brigham Young University - Hawaii

The Hawaiian blue soft coral, Sarcothelia edmondsoni Verrill, 1928, is one of five octocorals in the Hawaiian Islands. Despite its vibrant blue color and prominent placement in many identification resources describing fauna found around the Hawaiian Island chain, there has been a lot of confusion surrounding its distribution and morphology. Sarcothelia edmondsoni was described from an aquarium specimen and was never observed in situ (Verrill, 1928). Because of this, the description is broad and inaccurate. Alderslade found that prolonged exposure to flawed aquaria conditions can have an effect on the physical appearance of soft corals (Alderslade, 2000) and sclerite morphology (pers. obs.). Additionally, due to the lack of diversity across the Hawaiian Islands and little interested in non-reef building corals S. edmondsoni has gone relatively unnoticed and under studied since its description despite its exponential seasonal growth patterns and susceptibility to local detrimental habitat conditions. We aim to re-describe S. edmondsoni using morphological and genetic analysis. We examined over 50 newly collected colonies of S. edmondsoni and discovered there are five morphologically distinct stoloniferan corals; four of which are new to science. Morphological and genetic analysis show that four are new Sansibia species. The fifth is consistent with the current S. edmondsoni description. The description and re-description of these corals will help to clarify confusion on the large variation once thought to exist within S. edmondsoni. Additionally, the discovery of four new species doubles the known diversity of Hawaiian octocorals in the region and can lead to insight of speciation, genetic diversity, and isolation.

POSTER 30 - Systematics & evolution - ABSTRACT ISDSC7_015
WED Evening · 16:30 · Aguamarina
Diversity is our strength: Mitochondrial genomes of North Atlantic Corals

Chris Yesson, Zoological Society of London, UK
Raissa Hogan, National University of Ireland, Galway
Kevin Hopkins, Zoological Society of London
Barbara Neves, Fisheries and Oceans Canada
Nick Barrett, Zoological Society of London
Louise Allcock, National University of Ireland, Galway

Accessibility of next generation sequencing platforms has led to an explosion on genomic level information. The relatively small mitochondrial genome is now relatively simple to sequence, and is useful for assessing many evolutionary questions. However, there are relatively few published full coral genomes, and few of these are for cold or deep water species. Here we examine seapens and black corals collected from Whittard Canyon, along with seapens and nephtheid corals from Davis Strait, to assess mitochondrial diversity in a variety of cold water corals. We present the use of next generation sequencing to recover the mitochondrial genomes of seapens (Pennatulacea, N=18), black corals (Antipatharia, N~20)

and cauliflower corals (Nephtheidae, N=6). We demonstrate high variability of mitochondrial genomes and multiple gene order arrangements, including some novel arrangements not previously reported. Umbellula species show a high diversity of genome arrangement, including potentially the first bi-partite genome observed in corals. Several species of Nephtheidae appear to have lost the MutS region. The loss of the MutS region in the Nephtheidae has important implications for its use as a coral barcoding region. Mitogenome analysis is a valuable tool for assessment of cold water coral diversity and has the potential to reveal new insights into the evolution of this group.

POSTER 31 - Systematics & evolution - ABSTRACT ISDSC7_018
WED Evening • 16:30 • Aguamarina
Genetic evaluation of deep-sea mushroom soft corals supports all previously reported genera

Tina Molodtsova, P.P. Shirshov Institute of Oceanology RAS, Russia
Catherine McFadden, Department of Biology, Harvey Mudd College

Until recently all red deep-sea mushroom soft corals (Octocorallia: Alcyonacea) were considered to belong to a single genus, Anthomastus. In 2013 three previously synonymized genera— Pseudoanthomastus, Heteropolypus and Bathyalcyon—were resurrected based exclusively on morphological characters (form of colony and sclerites). Phylogenetic relationships of deep-sea mushroom soft corals have never been studied, and only a few sequences for a limited number of species, often with problematical identity, are available in GenBank. To evaluate the validity of the four hitherto reported genera and their relationships we sequenced three gene regions (mtMutS, COI, 28S) for 100+ specimens of red dimorphic and trimorphic alcyoniids. Based on morphological studies they were provisionally determined as Anthomastus, Pseudoanthomastus, Heteropolypus and Bathyalcyon, or with problematical identity. The collection included material from the North Atlantic, Gulf of Mexico, Bermuda, North Pacific, Hawaii, California, Solomon Islands, New Caledonia, Vanuatu, Wallis and Futuna, Galapagos, Kerguelen Plateau, Walters Shoals, Mozambique Channel, and Tasmania. Our preliminary results show that (1) red dimorphic and trimorphic alcyoniids represent a family-level group comprising multiple genera; (2) species identified as Anthomastus, Pseudoanthomastus, Heteropolypus and Bathyalcyon form distinct clades, congruent with their morphology; (3) in addition to previously described genera we can discern four undescribed genus-level groups, each including 1-5 species. While the three genes used (mtMutS, COI, 28S) separate the different genera quite well, species within genera were not separated reliably. All Bathyalcyon species sequenced were genetically nearly identical, and very few differences were found between different species of Pseudoanthomastus.

POSTER 32 - Systematics & evolution - ABSTRACT ISDSC7_019
WED Evening • 16:30 • Aguamarina
Phylogenetic relationships among octocoral species at bathyal depths in the Phoenix Islands Protected Area based on mitochondrial genetic barcodes

Steven Auscavitch, Temple University, USA
Abigail Keller, Temple University
Erik Cordes, Temple University

Recent explorations in the equatorial central Pacific have yielded a significant number of deep-water coral collections from sparsely sampled localities, several of which have resulted in new species descriptions and significant range extensions for species found on remote seamounts, islands, and atolls. Despite expanding collection inventories, many deep-water coral taxa still remain challenging to identify based on flexibility in morphological characteristics or few published molecular references, thus hindering broader biogeographic and phylogenetic analyses. DNA barcoding provides one methodology to identify and compare a large number of specimen collections while simultaneously exploring their evolutionary relationships. Species and genus-level relationships from phylogenies of the mitochondrial MutS and COI genes for 121 octocoral collections primarily from the families Chrysogorgiidae, Primnoidae, Isididae, Plexauridae, Coralliidae, and Victorgorgiidae. In all, 65 putative species within 25 genera were resolved within the Phoenix Islands Protected Area when compared with published sequences of widely distributed deep-water octocoral species. These results also provide new mitochondrial gene sequences for recently described species from the central Pacific. This work also demonstrates the utility in using molecular barcodes, in addition to morphological analyses, in the Octocorallia as a method for initially identifying genera and species from collected specimens during exploratory cruises to refine morphospecies relationships from video analyses.

POSTER 33 - Systematics & evolution - ABSTRACT ISDSC7_021
WED Evening · 16:30 · Aguamarina
RAD-seq exploration of cryptic variation in common, wide-spread coral taxa

Meredith Everett, NOAA-NWFSC & Lynker Technologies, USA
Linda Park, NOAA-NWFSC

Taxonomy and systematics in deep-sea corals is the subject of ongoing revisions. Many species descriptions are historic and modern technologies such as molecular barcoding and modern microscopy methods can reveal cryptic variation not previously observed. This may be true even in taxa which appear relatively cosmopolitan. This study uses high-throughput RAD sequencing to explore genetic variation in several widespread taxa from U.S. waters: Halipteris spp., Chromoplexaura marki/Swiftia spauldingi, and Gersemia spp. In Halipteris spp., more than 600 SNPs were identified in individuals from across the U.S. west coast. Clustering analysis on these markers revealed two well supported clusters, bifurcating by depth, which appear to be potential cryptic species. Morphological differences between these two clades can also be observed, but these do not follow the previously defined patterns of morphological variation among Halipteris spp. DNA barcoding work with two putative species, Chromoplexaura marki and Swiftia spauldingi, failed to distinguish between these groups despite examination of almost 2Kb of mitochondrial sequence, and including multiple haplotypes. RAD sequencing was undertaken to attempt to separate these taxa. While individual clusters could be detected in the 1,300 SNPs discovered, the patterns observed were more consistent with those of isolated populations than those of separate species. Finally, many alcyonacean corals from Alaska to California have been traditionally

identified as Gersemia rubiformis. Following on previous work suggesting some of these may actually belong to the genus Alcyonium, genetic data including both molecular barcoding and genotyping by sequencing suggest that individuals identified as G. rubiformis in the Northeast Pacific may represent as many as three separate species from both Gersemia and Alcyonium.

POSTER 34 - Systematics & evolution - ABSTRACT ISDSC7_026
WED Evening · 16:30 · Aguamarina
Together Under the Sea: Microbiomes as diversification drivers in Mesophotic and Deep-sea octocorals

Diana Vergara, Universidad de los Andes,Colombia
Juan Sanchez, Universidad de los Andes

Gorgonian corals are known microcosms conformed by host, zooxanthellae symbionts, endosymbionts and a huge number of microbes. Nevertheless, holobiont interactions are poorly studied specially in mesophotic and deep-sea ecosystems. Muricea (Plexauridae: Octocorallia) provides a unique evolutionary model because of its condition of amphiamerican and aposymbiotic nature. Using population genomics and microbial metabarcoding, we studied phylogenetic relationships inside the genus and its associated bacterial community. In addition, we compared the microbiome information between species with and without zooxanthellae found in the Muricea genus from the Caribbean Sea, Gulf of Mexico and Tropical Eastern Pacific (TEP) in shallow, mesophotic and deep-sea environments. Furthermore, evolutionary patterns correlating hosts and its microbiome were evaluated to better understand the biology of octocoral-microbial symbiosis. We are testing the possibility that selected endosymbiotic bacterial groups coevolve in an adaptive radiation fashion, most likely in response to new ecological opportunities.

POSTER 35 - Systematics & evolution - ABSTRACT ISDSC7_027
WED Evening · 16:30 · Aguamarina
What should you do if the new genera outweigh the years?

Phil Alderslade, CSIRO, Australia

The aim of this poster is to stimulate octocoral taxonomists to investigate some putative new octocoral genera, many recently collected from the Southwest Pacific Ocean, and expand our knowledge of the biodiversity of this group. Knowledge accumulated after a long career in science can often be very valuable in providing ideas and incentives for others working in the same discipline, especially for those who may have more recently chosen that speciality. The tacit part of such accumulations often moves unnoticed through communities of fellow researchers via normal interaction, but explicit facts must be intentionally passed on if not to be lost when individuals move on. Over my long career involving octocoral taxonomy (some 45 years), many potential taxonomic projects have come to light. Some of these languish on mental shelves gathering the dust of unfulfilled neurotransmitters, some fade in written

notes laid down when handwriting was common, while others are more recent discoveries from benthic biodiversity programs in the deep sea environments off southern Australia and New Zealand. At the twilight (or is it evening?) of this career, the Symposium is an ideal event at which to identify some taxonomic opportunities for the consideration of other workers. Although there is an overwhelming need for comprehensive taxonomic revisions of known octocoral genera, it is also important to continue describing new ones. This poster lists and briefly illustrates some of these putative new genera taken from two sources: literature and recent collections. Of those taken from the literature, a few, or perhaps many, will be known to some taxonomic colleagues, but at present these taxa appear to remain untouched. However, the majority of those identified from deep water collections obtained by Australia's CSIRO and New Zealand's NIWA over the last 20 years, will, in all likelihood, not have been seen before and the samples should offer a better chance of effective sequencing.

POSTER 36 - Systematics & evolution - ABSTRACT ISDSC7_153
WED Evening · 16:30 · Aguamarina

First visual occurrence data for deep-sea cnidarians in the South-western Colombian Caribbean

Luisa Dueñas, Universidad Nacional, Colombia
Cristina Cedeño-Posso, Instituto de Investigaciones Marinas y Costeras - INVEMAR
Alejandro Grajales, American Museum of Natural History
Santiago Herrera, Lehigh University
Estefanía Rodriguez, American Museum of Natural History
Juan A. Sánchez, Universidad de los Andes
Jorge León, Anadarko Colombia Company
Vladimir Puentes, Anadarko Colombia Company

Attention to the deep-sea environment has increased dramatically in the last decade due to the rising interest in natural resource exploitation. Although Colombia holds a large submerged territory, knowledge of the seabed and its biodiversity beyond 1,000 m depth is very limited. During 2015–2017, Anadarko Colombia Company (ACC) carried out hydrocarbon exploratory activities in the South-western Colombian Caribbean, at depths between 375 m and 2,565 m. Capitalising on available data resources from these activities, several cnidarian species were observed in ROV and towed camera surveys. We analysed over nine hours of video and 5,066 still images from these surveys, identifying organisms to the lowest possible taxonomic level. The images and associated data presented here correspond to 108 observations of deep-sea cnidarians, including seven new records for the Colombian Caribbean. Given the paucity of research and funding to explore the deep-sea in Colombia, the present dataset comprises the largest deep-sea Cnidaria imagery inventory to date for the Colombian Caribbean.

Conservation and management of deep-sea coral and sponge ecosystems - TALKS

Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT
ISDSC7_057
TUESDAY Afternoon · 13:30 · Aguamarina Ballroom
State of knowledge of deep-sea corals in the New Zealand region – 10 years on what key information needs remain – KEYNOTE

Dianne Tracey, National Institute of Water & Atmospheric Research (NIWA), New Zealand
Freya Hjorvarsdottir, Previously Department of Conservation (DOC) now Ministry for Primary Industries (MPI)
Debbie Freeman, Department of Conservation

The need to understand the ecosystem role, function, and value of deep-sea corals and associated fauna has become a priority for researchers in recent decades. Knowledge of coral fauna has advanced substantially in the New Zealand and wider South Pacific region since the days of the l'Astrolabe and Terra Nova Voyages, and the work by Ralph & Squires (1962) and Cairns (1982; 1995). Information reviews; taxonomic and molecular studies; several spatial distribution and habitat suitability modelling exercises; and age and growth research, have all contributed to a fuller understanding of this key group in the deepsea. Risk assessments however highlight that large knowledge gaps remain. We provide a summary update on what is now known about the regions deep-sea corals: their distribution, biology, the oceanographic and geological environment in which they are located, and recent radiocarbon age data indicating high longevity (e.g., colony ages of 752–1123 years were measured for Madrepora oculata and a growth rate of 0.3–0.8 mm /yr; Goniocorella dumosa colonies are younger, 372–422 years but also have a slow growth rate of 0.5 mm /yr). The relevance of the research to date and how we support the development of initiatives and options for effective policy-setting and management of deep-sea corals are described. Research needs such as addressing distributional gaps, fisheries bycatch identification and recording and coral species interactions, and the lack of knowledge of recovery rates from various impacts are identified as a key focus along with data paucity on coral productivity. While addressing both the gaps and research priorities is key, it is acknowledged that effort also needs to focus on the ecosystem role as a whole to ensure the sustainability of the coral groups in New Zealand waters.

Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT
ISDSC7_041
TUESDAY Afternoon · 14:00 · Aguamarina Ballroom
Assessing deep-sea coral recovery from trawling impact needs to account for natural variation in coral distribution and presence of natural refuges

Alan Williams, CSIRO, Australia
Franziska Althaus, CSIRO
Thomas Schlacher, University of the Sunshine Coast
Malcolm Clark, NIWA
Mark Green, CSIRO
Candice Untiedt, CSIRO
Nic Bax, CSIRO

Information on the recovery of deep-sea coral communities following bottom trawling impacts is a key knowledge gap for international efforts to protect vulnerable marine ecosystems. To measure recovery it is important to be confident about where and when impacts occurred. On seamounts, this is because it is possible to falsely identify (1) areas that are naturally coral-free as having being impacted, and (2) un-impacted areas as recovered areas. A recent study of seamounts south of Tasmania, Australia, revealed that these false positive interpretations of impact and recovery may occur because some seamounts appear never to have had extensive thickets of stony corals as had been previously assumed, and even the most heavily trawled seamounts have 'natural refuges' that were not impacted. This talk will outline methods and criteria established to define the recognisable signs of trawling and describe faunal changes in areas that were impacted.

Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT
ISDSC7_055
TUESDAY Afternoon · 14:15 · Aguamarina Ballroom
Quantifying the overlap of trawl fisheries with deep-sea corals and sponges in the Aleutians Islands, Alaska.

John Olson, NOAA National Marine Fisheries Service, USA
Chris Rooper, DFO Fisheries and Oceans - Canada
Scott Smeltz, Alaska Pacific University

Deep-sea coral and sponge communities in the Aleutian Islands are important habitat features for many life stages of commercially important fish targets, including Atka mackerel, Pacific cod, and rockfish. The effects of commercial fishing activities on deep-sea corals and sponges has been difficult to quantify due to a lack of spatially-explicit fishery data, bottom contact by different gear types, undetermined location of corals and sponges, and the susceptibility and recovery dynamics these structure-forming invertebrates (SFI). To address these challenges, a fishing effects model was developed in the North Pacific to integrate spatially explicit VMS data with target-specific gear configurations for over 40,000 bottom trawls since 2003. Fishery observer coverage for Aleutian Island trawl fisheries is nearly 100 percent and records catch species composition. Species distribution models provide presence data for coral, sponge, Primnoidae, and Stylasteridae. A simple spatial overlap analysis of the trawl footprint indicates trawl fisheries are extremely aggregated and spatially distinct for three main targets – mackerel, cod, and rockfish. Across the Aleutian Islands, trawl fisheries affect less than 10% of areas of the highest probability of presence for SFIs. Patterns in spatial variation exist longitudinally, from about 5% in the eastern, 10% in the central, and 20% in the western Aleutians. This footprint analysis depicts maximum overlap, as it does not account for bottom contact, estimated at between 20 and 100% for AI fisheries, or susceptibility or recovery of SFIs. However, this analysis does provide valuable information for fishery managers evaluating impacts on SFIs.

Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT
ISDSC7_047

Determining coral density thresholds for identifying structurally complex vulnerable marine ecosystems in the deep sea

Tabitha Pearman, National Oceanography Centre Southampton, UK
Ashley Rowden, National Institute of Water & Atmospheric Research and Victoria University of Wellington
David Bowden, National Institute of Water & Atmospheric Research
Owen Anderson, National Institute of Water & Atmospheric Research
Malcolm Clark, National Institute of Water & Atmospheric Research

Vulnerable marine ecosystems (VMEs) are at risk from the impacts of deep-sea trawling. Identifying the presence of VMEs in high seas fisheries management areas has to date relied mainly on presence records, or on habitat suitability models of VME indicator taxa (e.g., the stony coral species Solenosmila variabilis) as a proxies for the occurrence of VMEs (e.g., deepwater coral reefs). However, the presence or predicted presence of indicator taxa does not necessarily equate to the occurrence of a VME. There have been very few attempts to determine density thresholds of VME indicator taxa that relate to a "significant concentration" which supports a "high diversity" of associated taxa, as per the current criterion for identifying structurally complex VMEs (FAO 2009). Without knowing such thresholds, identifications of VMEs will continue to be subjective, impeding efforts to design effective spatial management measures for VMEs. We used seafloor video and still image data from the Louisville Seamount Chain to model relationships between the densities of live coral 'heads' (from video) and individual polyps (from stills), as well as percent cover of live and dead coral matrix, and the number of other taxa present. Analyses were conducted at three spatial scales; 50 m2 and 25m2 for video, and 2 m2 for stills. Model curves exhibited initial steep positive responses reaching thresholds at 0.28 m-2 (50 m2) and 0.64 m-2 (25 m2) for coral 'heads', and 1.2 m-2 (2 m2) for polyps. Both live and dead coral cover were positively correlated with the number of associated taxa up to a threshold of approximately 30% cover, for all spatial scales. The thresholds identified for coral 'heads' are higher than the threshold (0.11 m-2) used previously to identify VMEs, based on a more subjective definition of a coral reef (Rowden et al. 2017). We discuss the results in the context of past and future efforts to develop criteria for identifying VMEs.

Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_042
Coral and sponge communities of potential mineral resources in the deep-sea: an overview

Tina Molodtsova, P.P. Shirshov Institute of Oceanology RAS, Russia
Christopher Kelley, Hawaii Undersea Research Laboratory, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa
Lénaick Menot, Laboratoire Environnement Profond, Ifremer, Centre de Bretagne
Les Watling, Department of Biology, University of Hawaii at Manoa

Depletion of commercially valuable minerals on land and increased need of such resources for modern electronics and manufacturing is attracting attention to deep-sea mineral deposits such as cobalt crusts, manganese nodules, phosphorites, polymetallic sulfides and even deep-sea ooze. In a few years we expect intensive exploitation in the deep-sea both inside and outside national jurisdiction. Corals and sponges are characteristic component of deep-sea ecosystems including potential mining sites. Being suspension-feeders, these organisms would be inevitably impacted by deep-sea mining, that will aim at depths below those already affected by commercial fishery. Possible adverse impact can include not only direct removal of the hard substrate and direct removal and damage of colonies, but also burial with sediment and abrasion of substrate available for settlement, increase of sedimentation rates causing clogging, preventing feeding and respiration and also adverse impact of toxic mineral particles released during the mining process. Deep-sea corals and sponges are characterized by extremely slow growth rates and, as it already have been seen from fishery impacts, they may take decades to centuries to restore, especially after removal of appropriate substrata. At the same time, corals and sponges are key organisms in benthic-pelagic coupling; they may play a crucial role as a refuge, feeding ground and nursery for a number of fish and invertebrate associates, thus increasing the cumulative impact of their loss. We summarize here the available data on coral and sponge communities of solid deep-sea ore deposits, possible mechanisms driving their diversity, and existing gaps in our knowledge. Sampling effort at potential cobalt crusts and polymetallic sulfides mining sites is critically low and cannot be expected to be sufficient prior to exploitation phase.

Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_050
TUESDAY Afternoon • 15:30 • Aguamarina Ballroom
History of Deep-sea Coral Protection in U.S. Waters

Heather M. Coleman, NOAA Deep Sea Coral Research and Technology Program, USA
Thomas F. Hourigan, NOAA Deep Sea Coral Research & Technology Program
Renee King, NOAA Office of Habitat Conservation
L. Matthew Dornback, NOAA National Centers for Environmental Information
Robert McGuinn, NOAA National Centers for Environmental Information

The United States has been protecting deep-sea corals and sponges from fishing impacts since the early 1980s, and new ocean observations are accelerating conservation efforts. Each U.S. regional Fishery Management Council has now protected portions of the deep-sea, although area size, impetus for creation, fishing regulations, and mechanisms of protection have varied greatly. This presentation reviews coordinated steps that Councils and the National Oceanic and Atmospheric Administration (NOAA) have taken to advance habitat conservation for these vulnerable and slow-growing organisms. NOAA's Deep Sea Coral Research and Technology Program works with Councils and other resource managers, researchers, NGOs, and fishermen to develop research priorities that guide data collection to directly inform conservation action. Compilation of both new and historic coral location data is also beginning to allow extrapolation from study sites to larger areas relevant to cross-regional management. The Deep Sea Coral Research and Technology Program's database maintains these data, associates them with photographs and oceanographic information, and makes them publicly available. Maps shown in this presentation display these data

overlaid with areas currently protected from various types of fishing impacts and by various legal mechanisms across Fishery Management Council regions over time and according to depth. Sharing this information visually tells the story of deep-sea coral and sponge protection and lessons learned, and can inform evaluation of future conservation options.

Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_157
TUESDAY Afternoon · 15:45 · Aguamarina Ballroom

How protecting Ecologically and Biologically Significant Areas (EBSAs) is putting deep-sea corals and sponges on the map: a Canadian story

Cherisse Du Preez, Fisheries and Oceans Canada
Tammy Norgard, Fisheries and Oceans Canada

To meet national and international conservation commitments, the Canadian Government is working towards establishing an Offshore Pacific Marine Protected Area (MPA). The Area of Interest for future protection was announced after a dense cluster of Ecologically and Biologically Significant Areas (EBSAs) was identified within the Canadian Offshore Pacific Bioregion, with corals and sponges as the predominant species of interest. To mitigate physical threats to these fragile habitat-creating animals, an interim closure prohibiting bottom-contact fishing was recently put into effect by Fisheries and Oceans Canada (DFO) while the MPA planning process continues. With the increased need for scientific guidance to develop effective management and monitoring plans, there is a corresponding need for baseline information. A fundamental barrier to area-based conservation—and the focus of our science program—is information on where species live. This challenge is made more difficult with increasing area and, at 140,000 km2, the proposed MPA is larger than the entire country of Nicaragua. Through collaborative efforts, we've started to resolve the abundance, diversity, and distribution of corals and sponges in the large proposed MPA, as well as the locations of deep-sea oases of life and the likely locations that will likely continue to be vulnerable despite protection.

Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_040
TUESDAY Afternoon · 16:00 · Aguamarina Ballroom

A Win-Win for Deep Sea Corals and Fishermen: Increasing Seafloor Protections While Restoring Fishing Opportunities off the USA West Coast

Geoff Shester, Oceana, USA
Ben Enticknap, Oceana
Brianne Mecum, Oceana
Ashley Blacow, Oceana
Susan Murray, Oceana

In April 2018, the United States Pacific Fishery Management Council took final action to amend its Pacific Coast Groundfish Fishery Management Plan to substantially increase

seafloor habitat protections from bottom fishing gears while reopening historical bottom trawling grounds enabling fishermen to access recovering groundfish species. Building on previous protections established in 2006, the Council's action will protect over 90% of the United States West Coast Exclusive Economic Zone from bottom trawl fishing (739,434 km2). The action follows Oceana's approach of freezing the bottom trawl footprint on a precautionary basis while designating a network of conservation areas to protect priority habitats sensitive to bottom trawling, including deep-sea coral and sponge ecosystems. The Council designated 53 new or modified conservation areas while reopening specific soft-bottom areas that were previously closed to trawling to recover overfished species that have now successfully rebuilt. Together these modifications increase coastwide protections for hard, mixed, and soft substrates; seamounts; submarine canyons; known and predicted coral, sponge, and pennatulid locations; and National Marine Sanctuaries. At the same time, the opening of previously closed areas will restore approximately 25% of fishing effort that was previously displaced by regulatory closures. The action includes the protection of the deep-sea ecosystem at depths greater than 3,500 m from all bottom contact fishing in an area totaling 319,014 km2, setting an important conservation precedent relevant to other deep-sea activities. Through a comprehensive conservation campaign, the NGO Oceana participated in the stakeholder process, submitted a coastwide conservation proposal, provided GIS analyses, mobilized support and media attention, and conducted scientific expeditions with remotely operated vehicles documenting new coral and sponge locations and their co-occurrence with managed fish species.

Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT
ISDSC7_045
TUESDAY Afternoon • 16:15 • Aguamarina Ballroom
Deep-Sea Corals National Natural Park: An Unique Marine Protected Area in Colombian Caribbean Sea

Milena Benavides-Serrato, PNN Corales Profundidad, Colombia
Milena Marrugo, Professional Planning
Sebastián Martínez-Silva, Deep-Sea Corals National Natural Park Voluntary

Deep-Sea Corals National Natural Park, declared as a protected area by the Colombian government in April 2013, is part of the National System of Protected Areas and Subsystem of Marine Protected Areas (MPA) of Colombia. More than 30 km away from the nearest continental coast, it is one out of three localities identified in the Colombian Caribbean with a significant abundance of deep corals and high biodiversity. It's located in front of Bolivar, Cordoba and Sucre departments. The location and characteristics of the ecosystems make it a unique protected area. It is estimated that together with some deep coralline formations, the MPA has approximately 40% of the marine biodiversity present of the edge of the continental shelf and upper slope and includes 67% of deep-coralline formations of the Colombian Caribbean. Conservation objectives aim to protect deep-sea coral formations as well as the goods and services for the region. Conservation of this MPA represents a great opportunity for research and a new management challenge as well. A limited budget, difficult access to new technologies and low professional retention are among some of the challenges that standout. However, the MPA has a control and surveillance protocol, a monitoring program and a research portfolio. This has been achieved through strategies such

as remote sensing platforms used for tracking vessels. We have cooperation agreements with the Colombian Navy, national and international universities and diving academies. This has allowed for the establishment of joint actions for management, reducing pressures, and increasing knowledge. In addition, in an effort to support decision-making, we created the Scientific Advisor Committee, with the participation of national and international experts in marine sciences, with an opportunity for a dialogue between academics and MPA managers, also hoping to include local fishermen´s knowledge in the near future.

Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_059
WEDNESDAY Morning • 9:45 • Aguamarina Ballroom
U.S. West Coast Deep-Sea Coral Initiative: Design and Implementation in Support of Resource Management

Chris Caldow, NOAA Channel Islands National Marine Sanctuary, USA
Elizabeth Clarke, NOAA Northwest Fisheries Science Center
Heather Coleman, NOAA Deep-Sea Coral Research and Technology Program
Elizabeth Duncan, NOAA Channel Islands National Marine Sanctuary
Meredith Everett, NOAA Northwest Fisheries Science Center
Tom Hourigan, NOAA Deep-Sea Coral Research and Technology Program

Cost in terms of time and funding to explore, characterize and study the deep sea (>50m) is often prohibitively expensive, yet this ecosystem is vital to many nations' fishery resources and is home to a diverse array of organisms. With limited funding available, the United States National Oceanic and Atmospheric Administration's (NOAA) Deep-Sea Coral Research and Technology Program (DSCRTP) has effectively and efficiently focused its geographic and topical scope while broadening their alliances and partnerships. Recently, the DSCRTP launched their 2018-2021 West Coast Deep-Sea Coral Initiative (WCDSCI) focused on the U.S. contiguous west coast states. The initiative began with the establishment of a steering committee that includes representatives from across the agency. Once formed, the committee hosted a Science Priorities Workshop bringing together experts from across federal and state agencies, tribes, NGOs, academia, and museums to inform selection of research and funding priorities. Over 40 individuals from across the agencies or institutions participated. The input from this workshop led to the formation of three overarching priorities: 1) Gather baseline information from areas subject to fishing regulation changes; 2) Improve our understanding of known deep-sea coral bycatch "hot spots"; and 3) Explore and assess deep-sea coral resources within NOAA National Marine Sanctuaries on the west coast. Within these priorities, funded activities include: 1) mapping; 2) visual surveys; 3) modeling; 4) species identification, genetics and connectivity; and 5) education and outreach. The commitment of funding from DSCRTP helped galvanize commitment from additional partners into a coast wide campaign focused largely on the priorities identified at the workshop. This focus and suite of partnerships has the WCDSCI uniquely poised for success to carry out their mission and supply resource managers with the information they require across this under studied ecosystem.

Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT
ISDSC7_052
WEDNESDAY Morning · 10:30 · Aguamarina Ballroom
NOAA's Deep Sea Coral Research and Technology Program: A Decade of Research for Deep-Sea Conservation

Thomas Hourigan, NOAA Deep Sea Coral Research and Technology Program, USA
Heather Coleman, NOAA Deep Sea Coral Research & Technology Program
Robert McGuinn, 2. Northern Gulf Institute, NOAA National Centers for Environmental Information

The United States National Oceanic and Atmospheric Administration (NOAA) established the Deep Sea Coral Research and Technology Program in 2009 as the first U.S. program dedicated to providing scientific information to inform the management of deep-sea coral ecosystems. The Program focuses on 1) developing alliances and partnerships; 2) conducting 3-4 year regional field research and analysis initiatives on deep-sea biogenic habitats; and 3) creating frameworks for data and information to guide management. In the decade since, our program and partnerships have supported integrated research initiatives and smaller targeted projects in every U.S. region, from the Bering Sea to the U.S. Caribbean, and from New England Seamounts to American Samoa. We have supported advances in predictive habitat modeling, developed the first comprehensive deep-sea coral species list for U.S. waters, and made information from past and new research available through our data portal (deepseacoraldata.noaa.gov). Here we present highlights from this body of research and show how our Program's findings and information have catalyzed U.S. deepwater conservation action. As we enter our second decade, deepwater ecosystems will face new challenges from expanding economic activities in offshore waters and changing ocean conditions. We explore directions that our research, partnerships, and approaches are moving in order to meet these challenges and to better support both national and international marine conservation.

Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT
ISDSC7_048
WEDNESDAY Morning · 10:45 · Aguamarina Ballroom
Facilitating Conservation and Management of Deep-Sea Corals and Sponge Ecosystems through Partnerships, Education and Outreach

Elizabeth Duncan, NOAA Channel Islands NMS & Cardinal Point Captains, USA
Laura Francis, NOAA Channel Islands National Marine Sanctuary
Chris Caldow, NOAA Channel Islands National Marine Sanctuary

Conservation is both a social and biological challenge where public support of policy measures can be the key to implementation success. With human and environmental stressors on the rise, particularly with the increasing and competing uses of the world's oceans, creating effective conservation management systems is crucial to ensure the health of many nations' marine resources. Generally, garnering public support to sustain vulnerable ecosystems can be challenging, but this is particularly true for remote ecosystems such as deep-sea coral and sponge communities. However, advancements in the tools and

technology available to both researchers and educators have increased the public's' access to the deep-sea. This presentation explores the resources and partnerships available to the United States West Coast Deep-Sea Coral Initiative (WCDSCI; 2018-2021) that will support the research, education, and outreach objectives of the research program. Examples include the National Marine Sanctuaries' free online deep-sea community curricula, SeaSketch's web-based interactive mapping tools, at-sea tele-presence technologies, and partnerships with aquaria with deep-sea exhibitions. Ultimately, education and outreach targeting both the public and managers will provide decision makers with the best available information about deep-sea corals, sponges, and fishes.

Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_149
WEDNESDAY Morning · 11:00 · Aguamarina Ballroom
Restoration activities planned for mesophotic and deep benthic communities impacted by the Deepwater Horizon oil spill in the northern Gulf of Mexico

Kristopher Benson, NOAA Restoration Center, USA

The Deepwater Horizon oil spill caused natural resource injuries in US waters of the northern Gulf of Mexico from Texas to Florida. Federal and state agencies (Trustees) are utilizing funds from a Natural Resources Damage Assessment settlement to restore those natural resources and the services they provide. The Trustees have released a draft restoration plan that includes four proposed projects at an approximate cost of $126 million to help restore mesophotic and deep benthic communities (MDBC) injured by the oil spill. The projects were developed with substantial public input and evaluated against regulatory criteria and Trustee priorities beginning in 2017, by a team of subject matter experts from across the Trustee agencies. The projects comprise an integrated portfolio of activities to be implemented at an unprecedented scope and scale over a 7-8 year period, in an iterative approach to improving understanding of and restoring these communities. The project portfolio encompasses a) mapping, ground-truthing, and predictive habitat modeling; b) habitat assessment and evaluation; c) active management and protection; and d) development of coral propagation techniques. Implementation of the restoration portfolio will substantively advance science supporting restoration, conservation, and management related to MDBC. The emphasis on monitoring and adaptive management in the project recommendations reflects the need for information about these communities to inform or augment efforts at establishing protections and management for them or actively restoring them. The restoration plan incorporates a phased approach to project implementation intended to allow for detailed planning for the large and complex suite of activities as well as engagement with a broad array of entities involved in mesophotic and deep coral restoration and science, to address critical uncertainties and inform adaptive decision-making as the projects develop further and are implemented over time.

POSTER 37 - Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_044
TUE Evening · 16:30 · Aguamarina
Coral Reefs on the High Seas: Supporting the Establishment of the First Large-Scale Marine Protected Areas of Coral Reefs on the High Seas

Daniel Wagner, Conservation International, USA
Aulani Wilhelm, Conservation International, Center for Oceans
Ginny Farmer, Conservation International, Center for Oceans
Ashleigh McGowern, Conservation International, Center for Oceans
Adam Smith, Conservation International, Center for Oceans
Kristina Gjerde, International Union for the Conservation for Nature, Global Marine and Polar Programme
Richard Pyle, Bernice P. Bishop Museum
Alan Friedlander, University of Hawaii at Manoa, Department of Biology
Michael Conathan, Aspen High Seas Initiative, The Aspen Institute
Ingrid Irigoyen, Aspen High Seas Initiative, The Aspen Institute

Coral reefs are often heralded as the rainforests of the sea due to their remarkably high levels of biodiversity, and thus have a long history of protection in nearshore waters within the jurisdictions of coastal states. However, as with many other marine ecosystems, coral reefs have not yet been protected in areas beyond national jurisdictions, commonly known as the high seas, in large part due to the lack of a legal framework that is in place to protect high seas habitats. The United Nations recently initiated negotiations to develop the legal framework that would enable protections of high seas habitats for biodiversity conservation. The Coral Reefs on the High Seas Initiative seeks to directly support this effort through a coordinated campaign in 2019-2021 that aims to conduct targeted scientific explorations, raise political support, and advance international policy. The end of the two-year strategy will coincide with the final negotiations of the United Nations Treaty on High Sea Biodiversity, and thereby proactively generate the scientific evidence, international partnerships, and political support that is necessary to establish marine conservation areas on the high seas. With only 4-8% of our oceans currently being protected, and over 60% of the world's oceans lying on the high seas, protection of these remote areas offers our only real hope of achieving global targets of protecting 30% of our planet by 2030, and thereby arresting global declines in biodiversity.

POSTER 38 - Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_046
TUE Evening · 16:30 · Aguamarina
Deep-sea data measurements and gaps identified by NOAA's Office of Ocean Exploration and Research

Katharine Egan, NOAA Office of Ocean Exploration and Research, USA
Amanda Netburn, NOAA Office of Ocean Exploration and Research

James Murphy, NOAA Office of Ocean Exploration and Research
Daniel Wagner, NOAA's Office of Ocean Exploration and Research & Cherokee Nation Strategic Programs
Megan Cromwell, NOAA National Centers for Environmental Information & Mississippi State University Northern Gulf Institute
Derek Sowers, NOAA's Office of Ocean Exploration and Research & Cherokee Nation Strategic Programs
Adrienne Copeland, NOAA Office of Ocean Exploration and Research

Deep-sea corals and sponges provide critical habitat for commercially important fisheries species and have the potential to produce compounds with biomedical applications. Despite their importance, there continues to be a lack of information about deep-sea corals and sponges as well as other deep ocean organisms due to depth and technological limitations. Distribution and abundance remain unknown, and it remains difficult to collect specimens for identification, DNA sequencing, and chemical isolation. A National Oceanic and Atmospheric Administration (NOAA) Office of Ocean Exploration and Research (OER) working group has synthesized a comprehensive list of data types and measurements currently collected during OER expeditions aboard NOAA Ship Okeanos Explorer. The group has further summarized the deep-sea community's data needs by mining workshop reports and other community-driven outputs for recommendations to address knowledge and data collection gaps. High priority data types that are not currently included in standard Okeanos Explorer operations include environmental DNA (eDNA), which can provide taxonomic identities of a full range of organisms. This group is evaluating the feasibility of collecting other high-priority data types, such as microbiome and microbial composition, nutrients, carbon, particulate matter, metals, and ocean sound, and implementing new measurements into operations. The current data measurements and future improvements will help in addressing deep-sea knowledge gaps, and inform the conservation and management of the deep sea.

POSTER 40 - Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_051
TUE Evening · 16:30 · Aguamarina
Isidella elongata: a Mediterranean critically endangered deep-sea coral worthy of urgent protection

GIOVANNI CHIMIENTI, University of Bari Aldo Moro, Italy
Emanuela Fanelli, Università Politecnica delle Marche (Italy)
Andrea Gori, University of Salento (Italy)
Pilar Marin, Oceana (Spain)
Francesco Mastrototaro, University of Bari Aldo Moro (Italy)
Chryssi Mytilineou, Hellenic Centre for Marine Research (Greece)
Covadonga Orejas, Instituto Español de Oceanografía (Spain)
Maria del Mar Otero, International Union for the Conservation of Nature (Spain)
Patricia Puerta, Instituto Español de Oceanografía (Spain)
Sandrine Vaz, Institut français de recherche pour l'exploitation de la mer (France)

The bamboo coral Isidella elongata (Esper, 1788) is a Mediterranean near-endemic deep-sea species with a wide bathymetric distribution (200-1600 m depth) throughout the basin. This gorgonian can form large aggregations on compact muddy bottoms, known as Isidella gardens, often targeted by deep-sea fishery. These gardens represent hot-spot of biodiversity, acting as refuge and nursery areas for many species, including some of high commercial interest as red shrimps (Aristeus antennatus and Aristeomorpha foliacea). Isidella populations are highly vulnerable to bottom contact fishing gears such as bottom trawling, and they have experienced a dramatic decrease in occurrences and population densities in the last decades due to increasing fishing pressure in deep bottoms. For this reason, I. elongata has been categorised as critically endangered by IUCN, and it has been included in the Annex II of the Protocol SPA/BD to the Barcelona Convention. However, urgent conservation measures are needed in order to protect the last I. elongata populations and, consequently, to preserve their associated community, including species of commercial interest whose stocks are currently depleted. This process has to involve the fishery sector together with scientists. For this reason, a call to acquire data from both scientific surveys and fishing vessels has just started, in order to understand the global distribution of I. elongata and to identify priority areas for its conservation. This will allow to comply with UNGA Resolutions 59/25, 61/105 and 64/72 regarding the protection of Vulnerable Marine Ecosystems.

POSTER 41 ⚡ Conservation and management of deep-sea coral and sponge ecosystems ⚡
ABSTRACT ISDSC7_053
TUE Evening · 16:30 · Aguamarina
Overview on the distribution of cold-water corals in the Mediterranean Sea

Giovanni Chimienti, University of Bari Aldo Moro, Italy
Marzia Bo, University of Genova (italy)
Francesco Mastrototaro, University of Bari Aldo Moro (Italy)

Cold-water corals (CWCs) are among the main habitat formers of the deep Mediterranean Sea, hosting a lush diversity of species and playing a crucial ecological role. The term CWC sensu lato groups taxa of cnidarians with a more or less pronounced frame-building ability with forest-forming anthozoans, both on hard and soft bottoms. CWC species are mainly present below 200 m in depth and are able to form large aggregations such as coral frameworks (e.g., Madrepora oculata, Lophelia pertusa), coral forests (e.g., Antipathes dichotoma, Leiopathes glaberrima, Parantipathes larix, Callogorgia verticillata, Viminella flagellum) and sea pen fields (e.g., Funiculina quadrangularis, Kophobelemnon stelliferum). The distribution of these CWCs in the Mediterranean Sea is here reviewed and discussed from a biogeographic point of view, taking into account the known geographical areas of occurrence and the bathymetric ranges of distribution. This overview represents a solid base for the identification of potential and strategic new Fishery Restricted Areas (FRAs) within the Mediterranean Sea, aiming to protect these important vulnerable marine ecosystems. CWCs communities develop in a mosaic-like pattern due to the interaction between particular topography and a combination of cold, oxygenated and trophic-carrying water masses, along the main paths that such currents follow within the basin. This aspect has to be taken into account to plan proper management strategies needed in the near future, for a desirable network of FRAs. The results also highlight that dense and structured soft-bottom CWC communities are still present in areas accidentally protected from trawl fishing, such as

where hard-bottoms are also present or where trawling is forbidden. Particularly urgent is the need for protection of the last living gardens of the bamboo coral Isidella elongata, considered common until fifty years ago but now critically endangered due to trawl fishing.

SENSIMAR Project–Sensitive Marine Environments of SE Brazil

Guarani Cavalcanti, PETROBRAS, Brazil
Priscila Silva, Research and Development Center Leopoldo A. Miguez de Mello - PETROBRAS
Ana Paula Falcão, Research and Development Center Leopoldo A. Miguez de Mello - PETROBRAS
Maria Patricia Curbelo Fernandez, Posgraduate Program in Ecology- IB- Universidade Federal do Rio de Janeiro (UFRJ)
Halesio Barros Neto, Research and Development Center Leopoldo A. Miguez de Mello - PETROBRAS
Celio Jonck, Research and Development Center Leopoldo A. Miguez de Mello - PETROBRAS

From 2004 to 2011, the Research and Development Center (CENPES) of Brazilian Oil, Gas and Energy Company- PETROBRAS implemented a detailed deep-sea coral assessment study in Campos Basin (SE Brazil) to subside its environmental management in deep waters. By the first time, high resolution geophysical data and remotely operated vehicle images were evaluated for studing the biology and ecology of the main coral species (Cavalcanti et al., 2017). In order to enhance our knowledge in these communities and to improve environmental management tools, Petrobras started in 2016 SENSIMAR Project, a broad five-year project to study sensitive environments, deep-sea corals and rhodolith beds along the Brazilian southeastern continental margin, where are located the major offshore oil and gas production fields in the country. The work has been carried out in a collaborative way between the CENPES and Brazilian and Norwegian Institutions. This effort includes mapping and characterization of benthic and demersal communities from three basins between 200 and 1200m depth. In addition, the strategy includes population studies of the key coral species, connectivity, genomics and reproductive effort. In parallel, the impact of offshore activities will be evaluated through laboratory and field experiments. Results of all this initiatives are presented during this Symposium. The Project also aims to promote human resources formation and dissemination of knowledge of the deep-water coral science in Brazil. In this way, the project encouraged the rise of the Brazilian Network of Deep-Sea Coral Specialists that includes a national symposium. SENSIMAR project will promote significant advances in deep-sea coral research in the South Atlantic Ocean and will enable the use of scientific information to support the environmental management.

The EXPRESS Cruise: A multidisciplinary, collaborative research cruise to study deep water ecosystems off the California and Oregon Coasts.

M. Elizabeth Clarke, NOAA Northwest Fisheries Science Center, USA
Jeff Anderson, Nature Imagery
Meredith Everett, NOAA NWFSC
Tom Laidig, NOAA SWFSC
Nancy Prouty, USGS Pacific Coastal & Marine Science Center
Erica Fruh, NOAA NWFSC
Diana Watters, NOAA SWFSC
Curt Whitmire, NOAA - NWFSC
Abigail Powell, Lynker Technologies

From October 11 through November 7, 2018, a multidisciplinary team from multiple U.S. federal government agencies, as well as academia, initiated a new phase of collaborative science along the West Coast of the U.S. This research was part of the EXpanding Pacific Research and Exploration of Submerged Systems (EXPRESS) campaign which targets deep-water areas off the West Coast off the U.S. and NOAA's West Coast Initiative on Deep-Sea Coral and Sponges. The ecological management goals of the EXPRESS cruise were to: 1. Collect Essential Fish Habitat (EFH) baseline data at 12 sites where fishing regulations will change in 2020. 2. Revisit previously surveyed EFH sites and document changes over time. 3. Ground-truth cross-shelf deep sea coral habitat suitability models . 4. Collect coral and sponge samples for taxonomic verification, genetic barcoding, and population connectivity studies 5. Expand the use of new deep-sea coral technologies for exploration. The EXPRESS campaign provided the nexus for planning and operational priorities, aimed at maximizing data collection for multiple disciplines in an efficient and cost-effective manner. To implement this plan, the team utilized a bottom-tracking autonomous underwater vehicle (AUV), a piloted remotely operated vehicle (ROV), and a CTD rosette on a rotating, 24-hour operational basis. Vehicle dives were collaboratively planned before the cruise and adjusted during the cruise to accommodate environmental considerations and dynamic ecological observations of interest. Over the course of the 27-day cruise, 24 AUV and 37 ROV dives were conducted. The ROV collected over 100 coral, sponge, and rock samples. Over 100 water samples were collected from 22 CTD casts. Analyses of samples are underway and some preliminary data will be presented. In addition, the progress of several projects utilizing data from this cruise will be reported separately.

POSTER 44 ⚡ Conservation and management of deep-sea coral and sponge ecosystems ⚡
ABSTRACT ISDSC7_060
TUE Evening · 16:30 · Aguamarina
Vulnerable Marine Ecosystems along the Mediterranean Outflow Water: megabenthic communities from the western Mediterranean to the Azores

Patricia Puerta, Instituto Español de Oceanografía, Spain
Covadonga Orejas, Instituto Español de Oceanografía
Jordi Blasco-Ferre, IMAR- University of Azores
Marina Carreiro-Silva, IMAR- University of Azores
Carlos Dominguez-Carrió, IMAR- University of Azores

Cristina Gutiérrez-Zárate, IMAR- University of Azores
Ángela Mosquera-Giménez, Instituto Español de Oceanografía
Telmo Morato, IMAR- University of Azores
Olga Reñones, Instituto Español de Oceanografía
Jesús Rivera, Instituto Español de Oceanografía
José Luis Rueda, Instituto Español de Oceanografía
Yaiza Santana, IMAR-University of Azores
Javier Urra, Instituto Español de Oceanografía
Pedro Velez-Belchí, Instituto Español de Oceanografía

Deep-sea habitats and associated megabenthic communities were explored and characterized using underwater images obtained during the MEDWAVES cruise (ATLAS project) in 4 different geomorphological features (seamounts and mud volcano) along the Mediterranean Outflow Water (MOW) pathway from the western Mediterranean in Seco de los Olivos bank, the Mediterranean-Atlantic transition in the Gulf of Cadiz, the Ormonde seamount off Portugal, and the Formigas seamount in Azores, in the mid-North Atlantic. These features host multiple Vulnerable Marine Ecosystems (VMEs) such as cold-water coral reefs (e.g. Madrepora oculata-Lophelia pertusa), gorgonian gardens (e.g. Acanthogorgia spp, Narella spp., Viminella flagellum) or sponge aggregations (e.g. Asconema setubalense) among others. The MOW pathway influences the megabenthic communities of these four features along a decreasing gradient of this warmer and saltier water mass. New VME records are characterized in this study and the potential influence of MOW in composition and distribution of megabenthic communities is discussed.

POSTER 45 - Conservation and management of deep-sea coral and sponge ecosystems - ABSTRACT ISDSC7_152
TUE Evening · 16:30 · Aguamarina
Deep-sea coral ecosystems off southeastern and southern Brazilian slope

Guarani Cavalcanti, PETROBRAS, Brazil
Maria Patricia Curbelo-Fernandez, Universidade Federal do Rio de Janeiro
Renata Arantes, Universidade Federal de Santa Catarina
Livia Loiola, Control Ambiental Sustentabilidade e Meio Ambiente S.A
Ana Paula Falcão, Petrobras
Alexsander Lima, Petrobras

Deep-sea corals can build three-dimensional structures of ecological relevance, serving as sites for breeding, nesting and feeding of several benthic and demersal faunal groups. Off the Brazilian coast, the integration of acoustic information with ROV images has been an effective tool for a better understanding of these environments. Petrobras, in partnership with research institutes and universities, coordinates these efforts in order to deepen the knowledge of the ecosystems along the Brazilian Atlantic coast (Campos, Espírito Santo and Santos basins). Mapping underwater features indicative of deep-sea corals was made from the interpretation and compilation of data obtained by side scan sonars, multibeam echosounders, sub bottom profilers, and 3D reflection seismic. The surveys occurred from the break of the slope (150m) to depths greater than 2,500m. Reflective targets identified from the geophysical data as potential coral ecosystems were visited with ROV to obtain

background images and sampling. L. pertusa, S. variabilis, M. oculata, E rostrata and Dendrophyllia sp. were observed between 200 and 1200m. The bathymetric distribution varied among the studied basins and the species were found being part of different communities: coral mounds, Lophelia reefs and associated with autogenic carbonates. Campos Basin concentrates the majority of the information, and the coral ecosystems were found from 550 to 1200m depth, except some shallower formations at the Albacora erosive terrace. On the other hand, E. Santo is poorly known, and scarce and isolated records range from 450 to 1000m. Last, but not least, Santos Basin coral ecosystems occur from 200 to 1000m, arranged in discreate bathymetric ranges. Knowing the actual distribution and composition of the various coral ecosystems off the Brazilian coast is crucial to allow a better comprehension of the pressures on these peculiar environments distributed along the continental slope of the Southwestern Atlantic Ocean.

POSTER 46 ⚡ Conservation and management of deep-sea coral and sponge ecosystems ⚡
ABSTRACT ISDSC7_155
TUE Evening · 16:30 · Aguamarina

Using technology-based mapping approaches towards MSP in Colombia: preliminary results for Corales de Profundidad Colombian National Natural Park

Paula Andrea Zapata Ramírez, Universidad Pontificia Bolivariana, Colombia
Clare Fitzsimmons, Newcastle University
Juan David Santana, Oceanographic and Hydrographic Research Center of Colombia (CIOH)
Rafael Esteban Vásquez, Universidad Pontificia Bolivariana
Carlos Alejandro Zuluaga, Universidad Pontificia Bolivariana
Milena Marrugo, Parques Nacionales Naturales de Colombia - PNN
Alejandro Henao, Parques Nacionales Naturales de Colombia - PNN
Gustavo Gutierrez, Oceanographic and Hydrographic Research Center of Colombia (CIOH)
Stephanie Pauwels, Parques Nacionales Naturales de Colombia - PNN
Mario Guzman, Centro de Innovación y Tecnología ICP, ECOPETROL S.A

Barriers for the development of management plans on deep-sea habitats in Colombia is that they have not been mapped with sufficient accuracy and spatial resolutions, and that there are no existing regulatory frameworks and policy mechanisms that help standardizing and regulating activities occurring on the deep sea. One of the main goals of the National Politics of the Ocean and the Coastal Spaces (in Spanish PNOEC)" of Colombia (2016-2028), is to establish marine spatial planning (MSP) approaches that allow making compatible different visions, policies, plans and actions on the territory by 2028. Based on the PNOEC, this work addresses the development of a technology-based methodology as tool towards MSP decisions of marine areas in the Colombian seas. Using high-resolution bathymetry collected in 2015 by CIOH, we mapped different activities (e.g.: fishing activities, submarine cables, oil & gas, etc.) that has been occurring, in and around of the Corales de Profundidad National Natural Park. We generated information of the geophysical substrate properties in the area (depth, slope, aspect, and rugosity), and geomorphic zones (upper reef flats, upper reef slopes, mesophotic slope, mesophotic shelf, and mid-slope) that are clue for forecasting the precise location and distribution of the known presence of deep-sea corals in the Park. It is important to note that despite there have been attempts to characterize the corals in the Park, their precise distribution and current status remain unknown. In an attempt to fill-in

this gap and to ground-truth the preliminary results described here, we conducted a research cruise in 2018 on board of the R/V ARC-Roncador, but weather conditions did not allow fulfilling the planned activities. Hence, next efforts are focusing on finding support to complete the integrative mapping approach to provide a standard method and to contribute with data to achieve the Sustainable Developments goals for the 2030 agenda

Biogeography, environmental controls and mapping - TALKS

Biogeography, environmental controls and mapping - ABSTRACT ISDSC7_073
FRIDAY Morning · 11:45 · Aguamarina Ballroom
Exploring the applicability of basin-scale oceanographic regimes to understanding deep-sea coral and sponge distributions

Matt Dornback, Mississippi State University & NOAA NCEI, USA
Tom Hourigan, NOAA DSCRTP
Robert McGuinn, NGI MSU & NOAA NCEI DSCRTP
Scott Cross, NOAA NCEI
David Sallis, NGI MSU & NOAA NCEI DSCRTP
Heather Coleman, NOAA DSCRTP

Openly available databases housing deep-sea data are increasing in number, size, and quality. The NOAA Deep Sea Coral Research and Technology Program's National Deep-Sea Coral and Sponge Database has over 700,000 occurrence records and has undergone scientific reviews for quality and consistency. NOAA's World Ocean Database (WOD), the world's largest collection of oceanographic measurements, had a major new release in 2018 and now contains over 15 million stations. ESRI's Ecological Marine Units harness the WOD data along with other datasets to classify the ocean into statistically significant regions in three dimensions. These three large databases allow us to ask large-scale questions of deep-sea corals and sponges. For this presentation we ask, what oceanographic variables affect distributions of deep-sea corals and sponges in the Pacific Ocean and what are major taxas' nominal oceanographic regimes? The database records are curated to reduce bias and combined. The new dataset is then statistically analysed to determine the most important oceanographic variables associated with coral and sponge locations. Finally, the regional oceanographic climatologies where specific taxa are present are characterized.

Biogeography, environmental controls and mapping - ABSTRACT ISDSC7_072
FRIDAY Afternoon · 13:30 · Aguamarina Ballroom
Cold-water coral responses to water mass properties: influence of Mediterranean waters into the Atlantic communities – KEYNOTE

Patricia Puerta, Instituto Español de Oceanografía, Spain
Carlos Dominguez-Carrió, IMAR - University of Azores

Marina Carreiro-Silva, IMAR - University of Azores
José Luis Rueda, Instituto Español de Oceanografía
Javier Urra, Instituto Español de Oceanografía
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Jordi Blasco-Ferre, IMAR- University of azores
Yaiza Santana, IMAR- University of Azores
Cristina Gutiérrez-Zárate, IMAR- University of Azores
Telmo Morato, IMAR- University of Azores
Ángela Mosquera-Giménez, IMAR- University of Azores
Pedro Velez-Belchí, Instituto Español de Oceanografía
Jesús Rivera, Instituto Español de Oceanografía
Covadonga Orejas, Instituto Español de Oceanografía

The occurrence, distribution and density of cold-water corals (CWC) in the deep-sea are strongly correlated to the substrate type, which generally defines the presence of different communities. However, the role of water mass properties in situ (e.g. temperature, salinity, oxygen) on the presence of CWC species have been less investigated. We analyzed and compared the responses of this CWC species in four locations along a gradient of different water masses properties, which varied from Mediterranean (warmer, saline and with lower oxygenation) to more Atlantic water influence (colder, fresher and highly oxygenated). Some species were commonly found along the gradient, such as the reefs dominated by Madrepora oculata-Lophelia pertusa or the gorgonian gardens characterized by Acanthogorgia spp. Conversely, Flabellum chunii aggregations or Narella spp and Viminella flagellum gardens were characteristic of particular locations. Most of these species presented a remarkable response to temperature, as expected considering the previous knowledge. However, common effects of other water mass properties were observed in these CWC across the different locations. For instance, very small variations in dissolved oxygen concentrations might affect the abundance of Flabellum chunii and Acanthogorgia spp. as well as the occurrence of reef-forming corals in the Mediterranean-Atlantic transition. This high sensitivity to oxygen concentration was also observed in the gorgonian Acanthogorgia hirsuta at the location more influenced by the Atlantic waters. Notably, the distribution and abundance of the Narella gorgonians, which has a strong Atlantic affinity, was strongly correlated with high salinities in the water masses, a particular characteristic of the Mediterranean waters. Despite of further investigations are required, these results suggest an important link between the biodiversity and biogeography of CWC species and the export of Mediterranean waters into the Atlantic Ocean.

Biogeography, environmental controls and mapping - ABSTRACT ISDSC7_069
FRIDAY Afternoon · 14:00 · Aguamarina Ballroom
Abiotic drivers of deep-sea coral species distribution and community assembly on rugged submarine features in the Phoenix Islands Protected Area

Steven Auscavitch, Temple University, USA
Mary Deere, Temple University
Abigail Keller, Temple University
Randi Rotjan, Boston University
Timothy Shank, Woods Hole Oceanographic Institution

Erik Cordes, Temple University

The Phoenix Islands Protected Area (PIPA) is a model for large marine protected area development and maintenance, but baseline records of the protected biodiversity in its largest environment, the deep sea (>200m), are lacking. Expeditions to the region in 2017 on the R/V Falkor and NOAA ship Okeanos Explorer were among the first to explore the deep-water biodiversity on numerous seamounts, islands, and atolls inside PIPA. We present deep-water coral species distribution and community assembly patterns with respect to different seafloor features and abiotic variables at bathyal depths. Remotely operated vehicle transects were assessed for coral morphospecies abundances on the slopes of islands, atolls, submerged reefs, and seamounts in the Phoenix Islands between 150-2500m. Rapid species turnover with increasing depth was found in the upper 600m of the water column. Environmental changes, including a salinity minimum at 800m and oxygen minimum at 1100m, associated with intermediate water masses were observed to have significant effects on community structure. Increasing dissimilarity was also found to occur between coral assemblages lying below 1500m which suggests that, in addition to water masses, other abiotic factors may influence the community assembly at lower bathyal depths. Within PIPA, more than half of all morphospecies were found to occur on seamounts, yet these features only represented 24% of the total coral abundance. Half of all Scleractinian occurrences, including most framework-forming species, were found to occur below the aragonite saturation horizon, which was identified at 600m from Niskin bottle measurements. These results underscore the geographic and oceanographic complexity associated with deep-sea coral communities that remain under-characterized in the equatorial central Pacific, but also the additional effort that needs to be put forth to effectively establish baseline ecological metrics across area and depth in the region.

Biogeography, environmental controls and mapping - ABSTRACT ISDSC7_077
FRIDAY Afternoon • 14:15 • Aguamarina Ballroom
Mapping oxygen consumption rates in the cold-water coral reef, the Mingulay Reef

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Lorenzo Rovelli, Nordcee, Department of Biology, University of Southern Denmark, Denmark
Georgios Kazanidis, School of GeoSciences, University of Edinburgh, United Kingdom
Berta Ramiro Sanchez, School of GeoSciences, University of Edinburgh, United Kingdom
Johanne Vad, School of GeoSciences, University of Edinburgh, United Kingdom
Simone Turner, School of GeoSciences, University of Edinburgh, United Kingdom
J. Murray Roberts, School of GeoSciences, University of Edinburgh, United Kingdom

The Mingulay Reef located off the West Coast of Scotland, has the ecosystem engineers Lophelia pertusa and Spongosortites coralliophaga as the resp. dominant substrate forming coral framework and sponge. Predictive models and maps of cold-water coral habitats are useful tools to understand the factors that control the distribution and function of these organisms. There is increasing evidence that cold-water coral communities are regions of intensified carbon cycling, and depending on certain organisms' biomass it is expected to find spatial variation within and between a reef's respiration activity. In this study, the surface area of the dominant coral L. pertusa and the sponge S. coralliophaga were calculated from

Mingulay Reef 1 images and converted to estimated biomass values and oxygen consumption rates. The environmental variables that control the variation in coral and sponge biomass and thus oxygen consumption were explored and used to create a predictive map. The aim of this study is to be advancing our understanding of the complexity, i.e. the variability and distribution of cold-water coral community metabolism, by mapping the spatial distribution of oxygen consumption activity within a cold-water coral reef.

Biogeography, environmental controls and mapping - ABSTRACT ISDSC7_075
FRIDAY Afternoon · 14:30 · Aguamarina Ballroom
Improving the understanding of biogeography of VME indicators in the deep North Atlantic

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Lea-Anne Henry, The University of Edinburgh
Telmo Morato, IMAR-University of Azores
Gerald Taranto, IMAR-University of Azores
Marina Carreiro-Silva, IMAR-University of Azores
José Manuel González-Irusta, IMAR-University of Azores
Pablo Durán Muñoz, Spanish Institute of Oceanography
Mar Sacau, Spanish Institute of Oceanography
Ana García-Alegre, Spanish Institute of Oceanography
Covadonga Orejas, Spanish Institute of Oceanography
Ellen Kenchington, Bedford Institute of Oceanography, Fisheries and Oceans Canada
Jake Rice, Bedford Institute of Oceanography, Fisheries and Oceans Canada
Zeliang Wang, Bedford Institute of Oceanography, Fisheries and Oceans Canada
Steve Ross, Center for Marine Science, University of North Carolina-Wilmington, US
Lenaick Menot, Laboratoire Environnement Profond, IFREMER, France
Dierk Hebbeln, University of Bremen, Germany
J. Murray Roberts, The University of Edinburgh
Bramley Murton, National Oceanography Centre, UK

Understanding patterns of marine biogeography is essential for the adequate management of deep-sea ecosystems under increasing multiple human pressures. Identifying and delineating ocean regions that harbour unique species is important because these regions need to be accounted for and given adequate spatial management. While biogeographic approaches based on physiognomic proxies are not adequate to solely explain the patterns of biodiversity of complex habitats in the deep North Atlantic, the evolutionary history and biological factors of species must also be accounted for when defining faunal boundaries. It was recognised that biogeography of complex deep-sea habitats such as those created by some Vulnerable Marine Ecosystem (VMEs) indicator taxa is especially poorly known. In this work we aimed to identify naturally similar areas that represent the distribution of complex benthic habitats in the deep North Atlantic. Integrating all available data from public repositories and the literature, we mapped species diversity and richness using a data driven approach analysing the distribution of VME indicator species. We then assessed the association of these clusters with high-resolution environmental variables, namely temperature, salinity, dissolved oxygen, pH, aragonite and calcite. Distinct bioregions across the deep North Atlantic were found, with three main consistent areas: the Mid-Atlantic Ridge

south of the Azores, the Corner and New England Seamounts and the northern north Atlantic, highlighting the importance of plate tectonics as a determinant for biogeography. Besides this spatial structure, we also expect environmental drivers to have an influence at different scales on the composition and distribution of the bioregions. Our analysis suggest that the full range of biogeographic regions should be considered in management decisions to avoid risk losing species and adhere to Convention on Biological Diversity obligations to conserve biological diversity.

Characterizing Potential Distributions of Deep-Sea Corals and Sponges Offshore the US West Coast through Spatial Predictive Modeling

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M. Elizabeth Clarke, NOAA NMFS Northwest Fisheries Science Center
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Michael Coyne, CSS, Inc. & NOAA National Centers for Coastal Ocean Science
Arliss Winship, CSS, Inc. & NOAA National Centers for Coastal Ocean Science

Multiple agencies manage marine resources in the Northeast Pacific Ocean offshore the US West Coast. Information about the spatial distribution of sensitive biota, such as deep-sea corals and sponges (DSCS), is critical for making environmentally sound decisions related to offshore activities such as commercial fishing and energy development. Spatial predictive modeling is a cost-effective tool for identifying potential habitat in broad areas where data are sparse. For the area offshore the US West Coast, models of predicted suitable habitat were generated at 200 m resolution for ~50 DSCS taxa. DSCS occurrences were extracted from the NOAA National Deep-Sea Corals and Sponges Database. This included a large number of records from recent high-resolution visual surveys. For each taxon, a statistical model was used to relate occurrence locations to information describing the environmental conditions at these locations, including measures of seafloor topography, surficial sediment character, and oceanography. Models were fit using maximum entropy (Maxent) methods, a common approach for modeling presence-only data. Unlike in previous studies that have modeled distributions of deep-sea biota using Maxent, models were fit as regularized generalized linear models following the recent interpretation of Maxent as a point process. Two steps were taken to reduce the effects of spatial sampling bias on model predictions. First, background location data were selected from the broader set of occurrence data for all taxa. Second, occurrence data were assigned to cross-validation folds for model fitting and testing using spatial blocking. In addition, a stepwise model selection procedure was used to choose an optimal set of environmental predictors for which model performance and

complexity were balanced. Model outputs include maps of the predicted distribution of suitable habitat, spatially explicit depictions of prediction uncertainty, and measures of model performance.

Biogeography, environmental controls and mapping - ABSTRACT ISDSC7_074
FRIDAY Afternoon • 15:30 • Aguamarina Ballroom
Habitat Suitability Mapping for Southern California Deep Sea Corals and Sponges

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Andre Buchheister, Humboldt State University
Mark Henderson, California Cooperative Fish and Wildlife Research Unit

Deep-sea coral and sponge species (DSCS) are some of the longest-lived marine species and their complex, three-dimensional structure provides habitat for demersal fish and invertebrates. Until recently, the relationship between DSCS and fish species in the Southern California Bight was not fully understood; however, recent work on benthic assemblages in Southern California revealed relationships between several DSCS and demersal fishes. Habitat suitability maps, which predict where these DSCS species may occur, are needed to understand what areas of suitable habitat are currently protected and what areas are still exposed to potential destruction. In this study, we used Generalized Additive Models (GAMs) to identify environmental factors that are the best proxies for predicting DSCS occurrence. We explored seven main categories of environmental variables which have been hypothesized or demonstrated to affect the distribution of DSCS species of interest. These variables include (1) bottom currents using Regional Oceanographic Modeling System, (2) temperature, (4) depth, (5) seafloor slope, (6) surface primary productivity, and (7) dissolved oxygen. All variables were chosen due to their influence on DSCS physical and/or metabolic needs. We then used these models to develop habitat suitability maps for several species of DSCS that were associated with increased occupancy of 26 species of demersal fishes. These maps expand the current knowledge of DSCS distributions in southern California and provide a tool to inform management decisions, such as where to draw boundaries for new areas of conservation and protection.

Biogeography, environmental controls and mapping - ABSTRACT ISDSC7_079
FRIDAY Afternoon • 15:45 • Aguamarina Ballroom
Predicting the distribution of vulnerable marine ecosystems in the Nordic Seas

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Lene Buhl-Mortensen, Institute of Marine Research, Norway
Pål Buhl-Mortensen, Institute of Marine Research, Norway
Steinunn Hilma Ólafsdóttir, Marine and Freshwater Research Institute, Iceland
Petur Steingrund, Faroe Marine Research Institute, Faroes Island
Stefán Áki Ragnarsson, Marine and Freshwater Research Institute, Iceland

In the deep waters of the Nordic Seas and adjacent areas, several benthic habitats such as cold-water coral reefs, coral gardens, and deep-sea sponge aggregations have been classified

as vulnerable marine ecosystems (VMEs), due to their uniqueness, limited spatial extent, physical fragility, and slow recovery rate. In the last decade observations carried out by habitat mapping programmes in Norway, Iceland and more recently in the Faroes have substantially increase the knowledge on the distribution of VMEs in the Nordic Seas. Nevertheless, large areas have not been explored due to the cost and logistics of obtaining observations in the deep-sea. Habitat suitability models can be used to predict the distribution of VMEs and their indicator species. Here we present results of modelling effort carried out by the NovasArc project (2016-2018) in the area between Greenland Sea and the Norwegian Sea, and between 56°N and the Svalbard archipelago. Models for over 30 taxa of VME indicator species using a maximum entropy approach (MaxEnt) were developed based on an extensive database compiled from habitat mapping surveys, bycatch data from bottom fish surveys, and records published in reports and peer reviewed publications. Niche overlap measures were used to identify groups of taxa likely to be found in similar locations. The combined output of all models was used to identify areas of potentially high VME indicator diversity that should be targets of exploration and conservation efforts. The resulting maps represent an increase in the knowledge on the potential distribution of VME´s in arctic and sub-arctic waters, allowing for the evaluation of interactions with fisheries and other anthropogenic activities and providing an important input for managers.

Biogeography, environmental controls and mapping - ABSTRACT ISDSC7_076
FRIDAY Afternoon · 16:00 · Aguamarina Ballroom
Lessons learnt from the development of habitat suitability models for deep-sea corals in the South Pacific Ocean

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Ashley Rowden, NIWA
Malcolm Clark, NIWA
David Bowden, NIWA
Susan Jane Baird, NIWA
Di Tracey, NIWA

Statutory requirements to mitigate the effects of fishing on species such as corals and the habitats they form, have led to a more than decade-long process of developing and refining habitat suitability models for a range of coral taxa in the South Pacific, centred around New Zealand. Outputs from these models can be used to inform spatial management of fishing and other anthropogenic impacts in the region. Initially, single-method, broad-scale models based on global databases of environmental variables were used to predict habitat suitability for deep-sea corals over the entire South Pacific. Subsequent field testing of these models highlighted inadequacies in input variables, and their poor predictive power limited their application. Later models then focussed on the New Zealand region with an improved set of input variables, combining predictions from multiple methods to produce ensemble models with associated maps of spatial variability in precision. In addition, fine-resolution models were built for a section of the Louisville Seamount Chain. By combining detailed species data from camera transects and terrain variables from bathymetry surveys, small-scale patterns in species distribution were revealed that can be used to inform within-seamount management practices. Testing of these and other models, using independent data acquired from camera surveys, confirmed an improvement in model performance over time. Furthermore, this

assessment highlighted the superiority of sampling techniques that minimise the frequency of false zeros, such as camera surveys, over less efficient methods such as sleds. No matter how accurate these models might be for the present day, new models are needed to predict changes in suitable areas for coral survival due to future increases in ocean temperature and acidity, and to help design future-proof protection measures. Some preliminary models are presented based on outputs from Earth System Models, and associated challenges discussed

Biogeography, environmental controls and mapping - ABSTRACT ISDSC7_081
FRIDAY Afternoon · 16:15 · Aguamarina Ballroom
Towards transparency and reproducibility in environmental covariates for deep-sea species distribution modeling

Andrew Davies, University of Rhode Island, USA

The deep ocean is one of the most challenging and expensive habitats on earth to study, and as such it remains relatively poorly explored, particularly with respects to species distributions. In recent years, the use of marine species distribution modelling (MSDM) has proliferated, in part due to (1) the urgent need to better conserve and manage deep-sea species and habitats and (2) an increase in the amount of readily available environmental and species data. However, many studies still do not adequately describe how environmental datasets were created, leading to issues in reproducibility of covariates. In addition, studies only rarely account for or explain sources of uncertainty in their environmental covariates. In this paper, several available oceanographic datasets and the approaches used to generate them are reviewed and contrasted against a new bathymetric upscaling approach. Using MSDMs of sponges and corals as examples, the utility and drawbacks of such upscaling is demonstrated at a variety of model scales. Given we are emerging into an era of open access, we present a community-driven data portal that will improve sharing of input (environmental data, species data), output (predictor and uncertainty surfaces) and computer code (R or Python) amongst MSDM practitioners, leading to improved transparency, reproducibility and confidence in deep-sea species distributions.

Biogeography, environmental controls and mapping - POSTERS

POSTER 47 - Biogeography, environmental controls and mapping - ABSTRACT ISDSC7_078
THU Evening · 16:30 · Aguamarina
Mediterranean Cold Water Corals: many provinces or just a single superprovince? Scientific considerations and management implications

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Lorenzo Angeletti, ISMAR-CNR Bologna, Italy
Paolo Montagna, ISMAR-CNR Bologna, Italy

Beginning with Santa Maria di Leuca (SML) discovered first, extended grounds of living scleractinian cold water coral (CWC) in the Mediterranean Sea have been categorized in the literature as 'CWC provinces'. Besides SML, Mediterranean CWC provinces are Bari Canyon, Strait of Sicily, Sardinia, Catalan-Provencal-Ligurian canyons, Alboran Sea, and the newly discovered Tuscan Archipelago province. Besides, a number of punctiform occurrences are also known, e.g. Tricase and Dohrn canyons, Gela Basin, shipwrecks. All major CWC sites and most of the 'minor' occurrences recognized thus far in the Mediterranean Basin, are disposed along the path of the Levantine Intermediate Water (LIW). The general perception is that LIW is the conveyer belt securing connectivity among these mosaic-like CWCs. Although the very concept of CWC province has yet to be satisfactorily formalized, the sequence of discontinuously interconnected Mediterranean CWC sites may be taken as an argument to consider the Mediterranean Sea either as a single province, or, perhaps more conveniently, as a superprovince. Whatever this semantics per se obviously artificial, this hydrological interconnection needs to be accounted for to establish best management policies ensuring the conservation of these Vulnerable Marine Ecosystems. We propose that priority pertains to those CWCs which are likely the primary parental situations in shedding propagules westwards. The primary node is identified by the Apulian CWC grounds (Bari Canyon, SML). All subsequent 'nodes' are along the LIW trajectory and their prioritization should consider the presence of the main CWC engineers (Madrepora oculata, Lophelia pertusa) and of remarkable associated species. The sequel of priority 'nodes' are the Apulian (Bari Canyon-Santa Maria di Leuca), Strait of Sicily, Dohrn Canyon, South Sardinian, Cassidaigne Canyon and Alboran CWC grounds with others to be added after the assessment of biological diversity and ecological functioning.

POSTER 48 ⚡ Biogeography, environmental controls and mapping ⚡ ABSTRACT ISDSC7_070
THU Evening · 16:30 · Aguamarina
Best practices for spatial predictive modeling to support effective management of deep-sea corals and sponges

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James Thorson, NOAA Alaska Fisheries Science Center, Seattle, WA, USA
Elizabeth Clarke, NOAA Northwest Fisheries Science Center, Seattle, WA, USA
Heather Coleman, NOAA Deep Sea Coral Research and Technology Program, Silver Spring, MD, USA
Bryan Costa, NOAA National Centers for Coastal Ocean Science, Santa Barbara, CA, USA
Samuel Georgian, Marine Conservation Institute, Seattle, WA, USA
David Gillett, Southern California Coastal Water Research Project, Costa Mesa, CA, USA
Arnaud Grüss, School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA, USA
Mark Henderson, US Geological Survey California Cooperative Fish and Wildlife Research Unit, Arcata, CA, USA and Humboldt State University, Arcata, CA, USA
Jerry Hoff, NOAA Alaska Fisheries Science Center, Seattle, WA, USA
Thomas Hourigan, NOAA Deep Sea Coral Research and Technology Program, Silver Spring, MD, USA
David Huff, NOAA Northwest Fisheries Science Center, Hammond, OR, USA

Nissa Kreidler, Humboldt State University, Arcata, CA, USA
Jodi Pirtle, NOAA Fisheries Alaska Regional Office, Juneau, AK, USA
John Olson, NOAA Fisheries Alaska Regional Office, Anchorage, AK, USA
Matthew Poti, NOAA National Centers for Coastal Ocean Science, Silver Spring, MD, USA and CSS Inc., Fairfax, VA, USA
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Andrew Shelton, NOAA Northwest Fisheries Science Center, Seattle, WA, USA
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Resource managers in the USA and worldwide are tasked with identifying and mitigating trade-offs between human activities in the deep sea (e.g., fishing, energy development, and mining) and their impacts on corals and sponges. Spatial predictive modeling provides a cost-effective means of identifying potential coral and sponge habitat over large areas that can inform management decisions and data collection. Here we report on the conclusions of a workshop convened to define best practices for deep-sea coral and sponge spatial predictive modeling, especially in the context of data collection and management applications. Managers typically want information regarding deep-sea coral and sponge encounter probabilities, densities, and sizes, defined at basin-wide scales and validated using subsequent, targeted data collections. To realistically achieve these goals, we recommend integrating available data sources in spatial predictive models including fine-scale visual sampling and other resource surveys (e.g., fisheries trawl surveys). When possible, we recommend against using models fitted only to presence data, which are difficult to validate and can confound density with sampling effort. Models fitted to presence-absence and density data are preferred alternatives. Ensembles of models can provide robust predictions, while multi-species models leverage information across taxa and facilitate community inference. Other important considerations are spatial scales of environmental predictor variables, residual spatial autocorrelation, and quantification of prediction uncertainty. To facilitate use of models by managers, predictions should be expressed in units that are widely understood and should be validated at an appropriate spatial scale using a sampling design that provides strong statistical inference. We present case studies for the Pacific Ocean that illustrate the advantages and disadvantages of different data collection, modeling, and validation approaches.

POSTER 49 - Biogeography, environmental controls and mapping - ABSTRACT ISDSC7_080
THU Evening · 16:30 · Aguamarina
Significant Differences in Coral Species Composition, Distribution, and Habitat Assemblages Among Northeast Atlantic Submarine Canyons

Taylor Heyl, Woods Hole Oceanographic Institution, USA
Luke McCartin, WHOI
Elisabeth McElwee, WHOI
Martha Nizinski, Smithsonian Institution
Timothy Shank, WHOI

Submarine canyons are among the most productive habitats in the deep sea and may enhance local and regional species diversity. There is a increasing need to locate and define the composition and distribution of deep-water corals and sponges (often referred to as vulnerable marine ecosystems) in canyons for the management and conservation of living resources in the face of growing interest in energy extraction and fisheries activities. Toward this end, recently developed habitat suitability models were used to predict deep-sea coral locations in Northeastern United States canyons (NEUSC). Over the past seven years (2012-2019), surveys were conducted using towed camera systems, ROVs and a submersible from 45 surveys in 24 major canyons within the NEUSC systems, including: Toms, Hendrickson, Veatch, Gilbert, Ryan, Powell (2012), Munson, Block, Alvin, Atlantis, Welker, Heezen, two minor canyons (2013), Washington, Accomac, Leonard, Wilmington, Spencer, Lindenkohl and Carteret canyons (2014), Dogbody, Chebacco, File Bottom, Heel Tapper, Welker, Sharpshooter and Clipper canyons (2015), Alvin, Block and one minor canyon (2016) and Lydonia Canyon (2018), in order to characterize the faunal distribution and habitat within these ecosystems. We employed molecular systematic identification of collected representative deep-water coral associated communities, specifically, single gene genealogies using mitochondrial gene COI, 16S, and MSH1 to groundtruth the imaging surveys. We present results from more than 15 taxa, specifically including the black corals Bathypathes and Parantipathes, soft corals Anthamastus and Acanthogorgia, stoloniferous coral Clavularia, plexaurid corals Swiftia and Paramuricea, the primnoid coral Thourella and the bamboo coral Acanella. The biogeographic patterns were correlated with nine habitat types. Significant differences in species composition and distribution appeared to be driven by depth and habitat.

Habitat and diversity characterization - TALKS

What are the limits for deep-sea coral distribution? – KEYNOTE

Erik Cordes, Temple University, USA

Through increased exploration and ocean floor mapping, we are discovering that deep-sea corals are everywhere. Octocoral and antipatharian colonies can appear on the smallest rocks (or nodules) down to abyssal depths. Scleractinian corals were thought to be limited by aragonite saturation state, but recent findings of solitary corals and even colonial forms in waters undersaturated with respect to aragonite challenge that notion. There are correlations between coral distribution and other oceanographic conditions (including temperature, dissolved oxygen, food availability, water mass boundaries, etc.) but what is the relative significance of these factors and how are they affected by the geomorphology of the habitat? Are the more random biological processes of reproduction, dispersal, and recruitment more significant than these oceanographic conditions? Are there other important interspecific biological interactions that we are still not taking into account? Even once a coral arrives and

begins to grow, under what conditions can the transition occur from isolated individuals to assemblages and interacting communities of coral gardens and cold-water coral mounds? We will discuss recent studies that address some of these questions and explore the information required to answer others.

Habitat and diversity characterization - ABSTRACT ISDSC7_043
FRIDAY Morning • 9:00 • Aguamarina Ballroom
Coral dominated Vulnerable Marine Ecosystem (VME) observations in the Davis Strait, west Greenland

Chris Yesson, Zoological Society of London, UK
Stephen Long, Zoological Society of London
Bridget Sparrow-Scinocca, Imperial College London
Kirsty Kemp, Zoological Society of London
Mona Fuhrmann, Zoological Society of London
Nanette Hammeken-Arboe, Greenland Institute of Natural Resources
Martin Blicher, Greenland Institute of Natural Resources

Documentation of vulnerable marine ecosystems (VMEs) is an important process for marine spatial planning. In Greenland this work has been opportunistic and ad-hoc, despite the potential impact on VMEs from the widespread and economically important benthic trawl fisheries in the region. Here we present our efforts at documenting potential VMEs in the region, based on low-cost benthic video sled surveys across a spectrum of fishing effort in the Davis Strait, west Greenland. We report new insights into previously unseen deep-sea environments, and potential VMEs based on UN-FAO and North Atlantic Fisheries Organisation (NAFO) guidance. We report a selection of coral dominated habitats in the deep (650-1500m) muddy habitats in the region of the offshore Greenland Halibut fishery (NAFO 1C&D). Bamboo corals (Acanella arbuscula), sea pens (Halipteris finnmarchica) and cup corals (Flabellum albastrum) have been found at colony densities up to 6.5 m-2. At such abundance, they contribute considerably to structural complexity, on otherwise homogeneous, soft, muddy substrates. It is suggested that these may therefore be important components of these deep-sea habitats and potentially be VMEs. A new candidate VME is proposed. We identify a soft coral garden habitat, on stony substrate, on the western slope of the Toqqusaq Bank, Davis Strait spanning at least 100km of shelf break. Abundant and structurally important taxa in this community include soft corals of family Nephtheidae with a colony density of 5.8 m-2. These represent important findings as few VMEs have been formally identified and/or received protection within Greenlandic waters. The candidate coral garden VME is spatially bounded by the Coldwater Prawn and Greenland Halibut fisheries, creating a potential conflict with industry. This represents an important development in our understanding of VMEs in the North Atlantic with implications for the management and conservation of marine ecosystems in Greenland.

Habitat and diversity characterization - ABSTRACT ISDSC7_098
FRIDAY Morning • 9:15 • Aguamarina Ballroom
Habitat classification of the Deep-sea Coral National Natural Park of Colombia

Martha Patricia Vides Casado, Instituto de Investigaciones Marinas y Costeras (INVEMAR), Colombia
Cristina Cedeño Posso, Marine and Coastal Research Institute - Invemar
David Alonso Carvajal, Marine and Coastal Research Institute - Invemar
Alejandro Henao Castro, Deep-sea Coral National Natural Park – PNNCPR
Milena Marrugo, Deep-sea Coral National Natural Park – PNNCPR

The recently described cold water coral province at the central Colombian Caribbean margin, triggered the declaration of the Deep-Water Coral National Natural Park over an extension of 142.195 ha with depths ranging from 34 to 1234 m. The province consists of numerous clumped 20 to 40 cm high coral colonies that are developed over 4 to 11-degree slope, sea floor elevations between 150 and 170 m and textured soils of soft and not very compact ridges. The ridges are colonized by a vivid cold-water coral ecosystem that covers the upper flanks and summits. The rich coral community is dominated by the composition of Thalamophylia riisei, Madracis myriaster, Madracis asperula, Madrepora carolina and Scleracis guadalupensis and D Diodogorgia nodulifera, associated with an equally rich benthic megafauna occurrence. Based on a detailed digital terrain model, 11 sectors were chosen to perform video and photography transects using a Diavolo II remote operation vehicle. In each sector a transect of 1 km was carried out sometimes doubling the time where needed in dependence of benthic complexity. From the 11 sectors, four covered mesophotic areas with depths between 48 and 139 m; the remaining 7 were done over aphotic areas with depths between 108 and 332 m. After images description and interpretation, a guide was generated with nine different types of substrate and habitat surrounding the coral formations of the Park. Most of the habitats constitute representative habitats, such us soft bottom with solitary corals and soft bottom with scattered fauna. Among the distinctive habitats the hard bottom with associated fauna and the boulders with attached fauna, are the basis for the construction of the general habitat map. This information in being used for the management and monitoring of this unique protected area.

Habitat and diversity characterization - ABSTRACT ISDSC7_084
FRIDAY Morning · 9:30 · Aguamarina Ballroom
Characterisation of seamount associated benthic habitats and communities in the Galapagos Marine Reserve

Salome Buglass, Charles Darwin Foundation, Ecuador
Salome Buglass, Charles Darwin Foundation
Leigh Marsh, University of Southampton
Camila Arnes, Charles Darwin Foundation
Pelayo Salinas-Leo, Charles Darwin Foundation, Pristine Seas, National Geographic Society

Owing to the volcanic history of the Galapagos Archipelago hundreds of shallow and deep-sea seamounts rise from its seafloor. Bound by the Galapagos Marine Reserve since 1998, prohibiting all extractive activities except artisanal hand-line fishing, these seamount ecosystems possibly represent some of the most pristine seamount environments in the Eastern Pacific. Yet currently our knowledge about seamounts is restricted to handful of geological studies, while their biodiversity and ecosystems have remained unexplored. In

2015, a two-bodied Remote Operated Vehicle (ROV), piloted aboard the EV Nautilus, explored and video-surveyed deep-sea benthic communities on five seamounts and two lava flows. Qualitative and quantitative image analysis enabled the first characterisation of the megafauna and habitats at ~200-3400 m depth. So far 241 morphospecies have been distinguished, among which Echinoderms and Cnidarians are the most species-rich phyla. The seamounts present seven distinguishable habitat types, of which four are potentially vulnerable marine environments (VMEs), such as cold-water corals, and sponge and coral gardens. The highest morphospecies diversity and more VME candidates were found at 200-1400 m depth. The findings suggest that seamounts support biologically important communities and should be considered for designation as no-take zones. This is the first large-scale characterization of Galapagos deep-sea benthic invertebrate megafauna across a wide range of previously unexplored ecosystems and is a first step to study future changes that may result from anthropogenic impacts to the planet's climate and oceans.

Habitat and diversity characterization - ABSTRACT ISDSC7_085
FRIDAY Morning · 9:45 · Aguamarina Ballroom
Deep-sea biology research in Costa Rica

Jorge Cortés, CIMAR, Universidad de Costa Rica, Costa Rica
Odalisca Breedy, CIMAR, Universidad de Costa Rica
Beatriz Naranjo-Elizondo, CIMAR, Universidad de Costa Rica
Erik Cordes, Temple University

Deep-sea biological research in Costa Rica, using human and remotely operated underwater vehicles started two decades ago. Before then, and even after, sampling was with dredges and drags. Initial research was by German teams, between 1999 and 2003; in addition to their geophysical and geochemical work, they photographed the organisms of cold methane seeps on the Pacific margin of Costa Rica. Starting in 2007, researchers of the University of Costa Rica have been studying the deep areas of Isla del Coco using the 450 m capability submersible DeepSee. On four occasions, since 2009 deep regions of the Pacific margin and offshore seamounts have been studied using HOV Alvin. In 2019 the ROV SuBastian was used to explore offshore seamounts that area present from the coast to south of Isla del Coco. Ten species of scleractinian corals, two of calcified hydroids, six of black corals and 14 octocoral species have been collected and photographed, some might be new species. Most of the scleractinians and hydroids have also been reported from the Galápagos Island. The sites where many of these species are found are classified as vulnerable marine ecosystems. Proposals are being discussed for the protection of these deep-water habitats. More research is necessary to have a better picture of the deep-sea corals of Costa Rica, and much more deep-sea research is needed in the Eastern Tropical Pacific.

Habitat and diversity characterization - ABSTRACT ISDSC7_100
FRIDAY Morning · 10:30 · Aguamarina Ballroom
Madracis coral gardens in the Deep-sea Corals Natural National Park (Colombia): all we know and we still need to know

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Andrea Polanco, Instituto de Investigaciones Marinas y Costeras, INVEMAR, Colombia
Giomar H. Borrero-Pérez, Instituto de Investigaciones Marinas y Costeras, INVEMAR, Colombia
Erika Montoya-Cadavid, Instituto de Investigaciones Marinas y Costeras, INVEMAR, Colombia
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Adriana Gracia C., Programa de Biología, Universidad del Atlántico, Colombia
Adibe Cárdenas-Oliva, Instituto de Investigaciones Marinas y Costeras, INVEMAR, Colombia
Vanessa Yepes-Narváez, Instituto de Investigaciones Marinas y Costeras, INVEMAR, Colombia
Milena Benavides-Serrato, Parque Nacional Natural Corales de Profundidad, Colombia
Nadiezhda Santodomingo, Earth Sciences Department, Natural History Museum, London, UK

The Deep-sea Corals Natural National Park (IUCN category II), hosts highly diverse communities in which Madracis spp. are the reef framework builder. The branches of Madracis form small bushy colonies at the continental shelf margin (120-202 m depth). These communities were first discovered in 2001 during the Macrofauna expeditions (trawling) and then further mapped and characterized in the campaign Marcoral (2005) (grabs and rock dredges). Detailed maps and the first footages were obtained using ROV and video-assisted grabb during the expeditions PNN Corales Profundidad (2015) and PNN Madracis (2016). This study summarizes the advances in the knowledge of the park through these 4 expeditions and captures the whole picture of their rich fauna. There are five areas in which Madracis colonies occur, but only in two of them, at the southwest, Madracis gardens thrive. The diverse associated fauna includes 322 species of Cnidaria (50 spp), Bryozoa (70 spp), Annelida (13spp), Mollusca (117 spp), Echinodermata (39 spp) and Fish (33 spp). It is important to highlight ten gastropod mollusks, nine bryozoan species and four annelids are new records to the Colombian Caribbean; the brittlestar Ophiosyzygus disacanthus have only been found associated to these coral gardens and the first sight of an adult fish Pareques iwamotoi. Voucher specimens are repositories of the Makuriwa Museum and data are available in SiBM linked to OBIS. The Madracis gardens of the park represent the only azooxanthellate coral communities recorded in the Southwestern Caribbean to date. All efforts must be invested in detailed studies of these unique habitats to better understand their structure, associated fauna, interactions, and their possible links with other deep-sea communities of the region. This valuable information is urgently required to highlight the ecological importance of these exceptional coral habitats, to monitor their development and to improve the design and management of this MPA.

Habitat and diversity characterization - ABSTRACT ISDSC7_088
FRIDAY Morning · 10:45 · Aguamarina Ballroom
Diversity and biogeographic patterns within the South African azooxanthellate coral fauna

Zoleka Filander, Department of Environmental Affairs & Nelson Mandela University, South Africa
Marcelo Kitahara, Universidade Federal de São Paulo, Departamento de Ciências do Mar, Santos, Brazil
Helmut Zibrowuis, Station Marine d'Endoume, Rue de la Batterie de Lions, Marseille, France
Stephen Cairns, Department of Invertebrate Zoology, Smithsonian Institution, Washington DC, United States of America

Kerry Sink, South African National Biodiversity Institute, Cape Town, South Africa
Amanda Lombard, Coastal and Marine Research, Nelson Mandela University, Port Elizabeth, South Africa

South Africa is ranked among the countries displaying the highest species richness per unit area. Despite this abundance, many invertebrate taxa in the region are still poorly characterized. The South African azooxanthellate Scleractinian (Anthozoa), being one of these groups, was last reviewed by Boshoff in 1980. Although more recent regional publications have reported on some species, there has not been a faunistic review that accounts for the country's species diversity. Moreover, numerous unidentified specimens representing over three decades of sampling effort have accumulated. In this study the authors update the state of knowledge of South African azooxanthellate coral species; specimens, particularly those within the extensive collections of the Iziko South African and Smithsonian Museum, were morphologically examined and identified. Other sources considered include historic data from open-online databases, associated species data from recent research surveys, and that from published literature. To date the study has resulted in the addition of 48 species to the previously known fauna, of which 91 % are range extensions and the remaining are potentially new species (with one new genus), raising the total number of known species to 109 – across 10 families. As expected, species richness increased from the cold nutrient-rich Atlantic Ocean (west coast) to the warm oligotrophic Indian Ocean (east coast). Despite the high reported species richness, the East coast had the lowest number of records. Species richness was highest above 600 m deep. Further to sharing these regional patterns and comparing them to five other bioregions (Southwestern Atlantic, Southern cold-region of South America, Southeastern Atlantic, Southwestern Indian ocean, and the Sub-Antarctic and Antarctic region), we hope to illustrate how such foundational knowledge contributes to ensuring an increase in the protection status of deep-coral ecosystems in South Africa.

Habitat and diversity characterization - ABSTRACT ISDSC7_104
FRIDAY Morning · 11:00 · Aguamarina Ballroom
Updates on the distribution of deep-sea corals in the Northwest Atlantic: a fourteen-year perspective (2005-2019)

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Kent Gilkinson, Fisheries and Oceans Canada
Wojciech Walkusz, Fisheries and Oceans Canada
Evan Edinger, Memorial University of Newfoundland

Our knowledge on deep-sea corals in Eastern Canada has expanded significantly since first described at the 5th International Deep-Sea Coral Symposium in 2005. Known species distributions can range from Baffin Bay, Canadian Arctic to The Grand Banks of Newfoundland and international waters. Here we provide an update on deep-sea coral distributions in this region using data from incidental by-catch from Stock Assessment Surveys, Fisheries Observer Program and Local Ecological Knowledge (LEK). Majority of corals were collected by Fisheries and Oceans Canada, with supplementary material from missions using Remotely Operated Vehicles and drop camera systems. We report over 70 species for eastern Canada including: 37 alcyonaceans, 9 antipatharians, 8 solitary scleractinians, 16

pennatulaceans and stylasterids. This represents an increase of 40 species in comparison to 2005 data. There are up to nine and six confirmed species of Antipatharian and Alcyoniidae mushroom corals respectively, compared to only one of each in 2005Similarly, we report at least five species of Nephtheidae soft corals in the region, compared to two in 2005. Recent work on soft corals indicate they play an important habitat-provision role in deep-sea ecosystems. Sensitive Benthic Areas (SBA) with large-scale habitat-forming bamboo corals and sea pens have been identified in recent years. Also, LEK indicates SBAs are not restricted to the continental edge and slope, with deep pockets found near shore. In 2005 there were no conservation measures in place to protect deep-sea corals in Newfoundland and Labrador. Since then, Canada has made significant contributions to the conservation and protection of deep-sea coral and sponges with seven new fishing closures in 2018, and a large deep-sea Marine Protected Area to be announced in 2019. Data presented has contributed significantly towards the identification of SBAs and the advancement of our understanding of benthic biodiversity in Eastern Canada.

Habitat and diversity characterization - ABSTRACT ISDSC7_091
FRIDAY Morning • 11:15 • Aguamarina Ballroom
Ecology, distribution and time-series analyses of mesophotic and deep-water coral assemblages on a tropical island slope, Isla Roatán, Honduras

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Peter J. Etnoyer, NOAA CCEHBR
Karl A. Stanley, Roatan Institute of Deepsea Exploration
Tomasz K. Baumiller, University of Michigan
Thomas C. Shirley, Texas A&M University- Corpus Christi, Harte Research Institute

Shore-based submersible operations, from 2008 to 2017 so far, have allowed us to examine megabenthic assemblages along the island margin of Isla Roatán from depths of <100 to 750 m, including repeated observations of the same organisms. Sessile habitat-forming taxa are dominated by at least 15 morphological species each of octocorals (e.g., Plexauridae, Primnoidae, Coralliidae, Isididae, and Ellisellidae) and sponges (Demospongiae and Hexactinellida), with fewer taxa and numbers of Scleractinia (Lophelia pertusa, Dendrophyllia alternata, Madracis myriaster, and solitaries), Antipatharia and Zoanthidea. Other important taxa include abundant and diverse Crinoidea. Epifaunal assemblages associated with corals include at least 24 macroinvertebrate species (e.g., Asteroschema laeve (Ophiuroidea) and Chirostylus sp. (Decapoda: Anomura)), with the highest diversity of epifauna on the antipatharian Plumapathes sp. and stony coral D. alternata. Taxa exhibit vertical zonation as expected (e.g., Nicella in 100-200 m; Plexauridae in 300-700 m), but many were observed only in restricted local habitats within their depth ranges, perhaps associated with specific topographic and near-bottom hydrodynamic conditions. Repeated observations of a few octocoral colonies show predation, recolonization, and epibiont host fidelity, as well as a multi-year decline of a plexaurid octocoral (presumably Paramuricea sp.) and loss of its resident ophiuroids. The shore-based submersible provides a relatively inexpensive platform from which to carry out time-series observations of otherwise rarely visited mesophotic and deep coral assemblages.

Habitat and diversity characterization - ABSTRACT ISDSC7_103
FRIDAY Morning • 11:30 • Aguamarina Ballroom
Record of mesophotic coral habitats in the northern Colombian Caribbean

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Cristina Cedeño-Posso, Invemar
Humberto Guarin, Ber t Instruments

Little is known about deep coral systems in the Colombian Caribbean, however, thanks to exploration for the oil and gas industry, some mesophotic and deep zones have been explored. In this study, a side-scan sonar survey was conducted in an area of 40 km2, between 80 and 210 m deep, off the coast of La Guajira. Forty anomalies were identified and later visually verified using a Remote Operation Vehicle (ROV). The anomalies were concentrated in a fringe with an abrupt depth change between 85 and 150 m. 40% of the anomalies consisted of soft bottoms, 47.5% were mixed bottoms and 12.5% were structured bottoms with coral presences. Sporadic presence of soft corals such as sea fans and sea whips (probably Stichopathes sp.) was recorded in the mixed bottoms. Colonial hard corals (<100 cm) and solitary corals, crinoids and sponges were also recorded on the gravel. These organisms, although not generally considered reef builders, constitute a microhabitat for a diverse number of invertebrate species. On the other hand, structured bottoms with the presence of corals were scarce and apparently, these are not structures of biogenic origin, as would be expected in a coral reef type system. However, given their structure, they are consolidated as habitats that congregate species of different types and shelters in an area dominated by unrelieved bottoms. The presence of Coenosmilia arbuscula and Madrepora carolina, considered habitat-forming species, stands out. Also recorded was a soft coral, possibly of the genus Achantogorgia sp., and a cup coral consistent with the description of Coenosmilia arbuscula. These structures provide habitat for a diverse community of both epibenthic species (soft corals, hard corals, crinoids and sponges) and mobile species, mainly fish.

Habitat and diversity characterization - POSTERS

POSTER 50 - Habitat and diversity characterization - ABSTRACT ISDSC7_082
THU Evening • 16:30 • Aguamarina
Advances on Mesophotic Coral Communities Research from Oil and Gas Exploration in the Colombian Caribbean

Nelson Manrique-Rodríguez, Aquabiosfera S.A.S. & Okeanos S.A.S., Colombia
Laura Muñoz, Okeanos S.A.S
Claudia Sánchez, Aquabiosfera S.A.S
Fabián Cortés, Aquabiosfera S.A.S.

The Colombian Caribbean continental shelf contains extensive mesophotic habitats that support diverse communities of fish and invertebrates. Baseline researches developed for offshore oil and gas exploration in Colombia by Ecopetrol and Repsol have contributed in locating mesophotic ecosystems in the continental shelf of La Guajira. The present study contains the characterization of sessile benthic communities and its associated fauna from images obtained with a remote operated vehicle (ROV), assessing these potential mesophotic habitats in terms of structure. This research shows the location of mesophotic hard bottoms registered inside two polygons established for exploration between 100 to 200 m depth. Composition, density and community structure were estimated, in addition, the potential factors that regulate community structure were also identified. Organisms of groups such as Arthropoda, Chordata, Cnidaria, Echinodermata, Mollusca and Porifera were registered. The frequency of occurrence of these organisms was mainly represented by cnidarians (corals, octocorals, sea pens, sea whips and hydroids), echinoderms (crinoids, sea stars and urchins) and chordates (fish). Threatened and invasive species were identified, as well as, the communities were described and compared in three sampling moments (before, during and after drilling activities). The data collected supports the early research of these ecosystems in Colombia, directly evaluating the continued efforts to mitigate the impacts that could be caused by exploratory activity in the two evaluated areas, following the guidelines dictated by the National Authority of Environmental Licenses ANLA for offshore exploration in Colombia.

POSTER 51 - Habitat and diversity characterization - ABSTRACT ISDSC7_083
THU Evening • 16:30 • Aguamarina
Bryozoan fauna of the Parque Nacional Natural Corales de Profundidad, Colombian Caribbean

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Paola Flórez, Departamento de Estratigrafía y Paleontología, Universidad de Granada, España

The Parque Nacional Natural Corales de Profundidad exhibit mesophotic and deep-sea coral ecosystems that host a highly diverse associated biota. Biological communities and sedimentary facies of these ecosystems were investigated during the Invemar-Marcoral expedition (2005). The bryozoan species composition, its distribution and roles in deep tropical habitats are the aims of this study. Bryozoans are common producers of fossil and modern marine carbonate sediments, and a main component of bioclastic deposits. In the area studied, bryozoan skeletons represent around 1% of the sediments, which have mainly been characterized as sandy muds. Samples were collected from the continental shelf break, at depths of between 100 and 300 m, with a Van Veen dredge (28 effective collections) and a rock dredge (4 samples). The sediment samples collected were washed and sieved through a 2 mm mesh. Bryozoan specimens appear in 19 of the 32 sampled stations. A total of 76 species have been identified, 70 belonging to the order Cheilostomatida and six to Cyclostomatida. The principal colony-forms were encrusting (69%), narrow branched (11%), free-living (7%), foliose (5%), palmate (5%) and articulated (3%). Although tissue, membranes, and chitinous appendages are not preserved in the examined specimens, the damage of skeletons is relatively low, suggesting that colonies of the identified species may thrive close

to the sampling point. The encrusting colonies were found growing over rubble of corals, calcified macroalgae, coralline algae, mollusc shells, other bryozoans, polychaetes galleries, foraminifera, and pebbles. Twelve species are new records to the Colombian Caribbean Sea.

Deep-sea corals from Mar del Plata submarine canyon (Southwestern Atlantic Ocean off Argentina).

Daniel Lauretta, Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Argentina
Carolina Bernal, Museo Argentino de Ciencias Naturales Bernardino Rivadavia
Nadia Cerino, Museo Argentino de Ciencias Naturales Bernardino Rivadavia
Jessica Risaro, Museo Argentino de Ciencias Naturales Bernardino Rivadavia
Pablo Penchaszadeh, Museo Argentino de Ciencias Naturales Bernardino Rivadavia

Deep-sea coral exploration has been scarce in Argentinean waters, especially in the northern region. Few expeditions have been made to the area, where the HMS Challenger (1873-1876) and the Walther Herwig (1960's and 1970's) expeditions took samples near Mar del Plata submarine canyon (up to 1200 m). During 2012 and 2013 three biological expeditions were made to Mar del Plata submarine canyon, and 64 sampling stations were made, from 200 to 3500 m depth. Here we present the results of the diversity of stony corals (Scleractinia), black corals (Antipatharia), zoantharians (Zoantharia), stylasterids (Hydrozoa: Stylasteridae), sea pens (Pennatulacea) and primnoids (Alcyonacea: Primnoidae) found. Corals were present in most of the stations, from 201 m to 3282 m depth. Stony corals were more abundant in number of specimens, with at least 10 species, most within Flabellum, Javania and Fungiacyathus. Primnoids were the more abundant group in number of species (at least 20), distributed mostly within Convexella, Heptaprimnoa, Onogorgia, Plumarella, Primnoella and Thouarella. Stylasterids and sea pens presented about the same number of species (14 and 13 respectively) within Cheiloporidion, Conopora, Crypthelia, Errina, Errinopora, Errinopsis, Inferiolabiata, Lepidopora, Sporadopora, Stellapora and Stylaster for stylasterids, and Anthoptilum, Kophobelemnon, Distichoptilum, Umbellula, Protoptilum, Malacobelemnon, Amphiacme and Funiculina for sea pens. Few specimens of zoantharians were found, all within Epizoanthus. Finally, 11 specimens of Dendrobathypathes grandis (Antipatharia) were found, the only black coral reported for the southern region of the southwestern Atlantic Ocean off Argentina. Two new species were described, and several more are been described. Despite the low quantity of works dealing with deep-sea corals in Argentina so far, the group is abundant and diverse. Corals are most likely to be present all along the Argentinean sea (specially beyond 200 m depth).

Discovering the corals on Rio Grande Rise, South Atlantic: towards a biological baseline study and conservation concerning deep-sea mining activities

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Yuri Vinícius da Encarnação, Instituto Oceanográfico da Universidade de São Paulo
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The Rio Grande Rise (RGR) is a distinct feature located in the South Atlantic, adjacent to the Middle Atlantic Ridge. RGR has become a region of great commercial and scientific interest, due to its potential for mining of cobalt-rich ferromanganese (FeMn) crusts with high contents of E-tech elements. In 2013, the International Seabed Authority (ISA) signed a contract allowing the exploration of selected areas of RGR by Brazil. ISA demands a comprehensive biological baseline studies and an assessment of the possible environmental impacts of mining, which is required for future exploitation. Scarce information about biology is available for RGR, except for a few fish records produced by exploratory fishing from 1970s to 1980s. Here we show preliminary results obtained in two cruises in 2018 that collected benthic organisms with rock dredges and video transects made with a remote underwater vehicle (RUV). Sponges, stony corals and black corals are among the most abundant fauna collected and seen in the videos observed along the edges of the main rift. RUV dives showed very heterogeneous habitats along transects, ranging from places dominated by corals and sponges to regions practically destitute of megafauna. The most commonly seen organisms were gardens of Sarostegia oculata, a sponge that mimics the framework of branched corals, the black coral Stichopathes sp., the scleractinian Enallopsammia rostrata and several bamboo corals (Family Isididae). In addition, many epibionts were discovered on corals and sponges, specially annelids, barnacles and crinoids. Many FeMn crust areas displayed a high abundance of vulnerable marine ecosystem indicator species, emphasizing the importance to create an environmental management plan for RGR towards future mining activities. This work was funded by FAPESP grants 2014/50820-7 and 2017/11884-8

POSTER 54 - Habitat and diversity characterization - ABSTRACT ISDSC7_089
THU Evening · 16:30 · Aguamarina
Diversity of Astrophorida from deep-water sponge grounds of the Caribbean

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Maria Belen Arias, Natural History Museum, London, UK
Giomar Borrero-Pérez, Instituto de Investigaciones Marinas y Costeras, INVEMAR, Colombia
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Astrophorida is one of the most diverse (>820 species) and worldwide distributed orders of demosponges. These sponges are common colonisers of hard and soft-bottoms in a broad bathymetrical range. In hard-bottom habitats on the outer shelf and upper slope, astrophorids can dominate ecosystems in terms of abundance and biomass forming sponge grounds, providing an important habitat to host a high diversity of fish and marine invertebrates. Although sponge grounds are highly diverse, ecologically and biologically important, yet they have very little research and conservation attention. In this study, we aimed to investigate the diversity of Astrophorida from recently discovered sponge grounds

in the Colombian Caribbean. As part of a barcoding cooperation project between the Natural History Museum (London, UK) and the Museum Makuriwa (Santa Marta, Colombia), we got access to unique specimens collected by the Marine and Coastal Research Institute (INVEMAR) in three Caribbean localities between 320 and 400 m depth. The high abundance of sponges together with a high diversity of fish, crustaceans, echinoderms and bryozoans that occur in these habitats are a clear indication of the existence of sponge grounds in the region. We preformed the genetic characterisation of the astrophorids (COI and 28s markers) in these habitats, and our preliminary phylogenetic analyses suggest a high diversity of astrophorids, including 13 species the families Geodiidae, Ancorinidae, Calthropellidae, Vulcanellidae and Pachastrellidae. About half of them could be new species for science and important records of species previously known only for the North East Atlantic. These newly discovered sponge grounds are located adjacent to the Seaflower Marine Reserve of Biosphere in an area with potential future exploitation of energy and mineral resources. Our findings support the need for the creation of a Marine Protected Area to secure the survival of these unique and vulnerable marine ecosystems.

Ecological units in the mesophotic coral ecosystems of San Andrés island, Colombian Caribbean.

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Juan David González, Instituto de Investigaciones Marinas y Costeras - Invemar
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Coral formations between 30-150 m depth are globally known as mesophotic coral ecosystems (MCEs), because light attenuation. MCEs are characterized by the presence of light-dependent corals and associated biotic communities. The study of MCEs, and mesophotic environments in general, is still incipient in Colombia. Here we present preliminary results of the exploration of MCEs in San Andrés island, and a first approach to the definition and characterization of its ecological units. In march and april 2008 six Closed Circuit Rebreather dives until 70 m depth were done in three spots 200 m apart in the Nirvana sector, western side of San Andrés island, during which three divers made pictures, videos, samples collection and fish counts between 40-70 m depth. Between 40-50 m it is found a deep pre-reef terrace that turns suddenly into the reef slope with ≥ 80° of inclination, which deepens to around 200 m deep. In the terrace (40-50 m depth), the main biotic components are octocorals, sponges and scattered hard corals, corresponding with the Octocorals-Sponges-Mixed coral ecological unit. The upper slope (50-70 m depth) is an irregular wall with crevices and small ledges, in which some coralline sand that slides off the terrace accumulates. In this zone, some barrel, tubular and branched sponges, branching octocorals, branched and whip black corals and scattered hard corals, mainly Agaricia spp., are the conspicuous biotic components. This scenery corresponds with the Agaricia spp.-Mixed coral ecological unit. The biota recorded in this preliminary work in the Nirvana sector of San Andrés island amounts for 128 species, 65 among Cnidaria, Porifera, Tunicata and

Algae, and 63 fish species, three of them are new reports for San Andrés island, two are threatened species and one is an invasive alien species (i.e. lionfish).

THU Evening • 16:30 • Aguamarina

Evidence of deep-sea corals (Octocorallia: Primnoidae) in the Gerlache Strait – Antarctica

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Gorgonians are one of the major contributors to the 3-dimensional structure of Antarctic benthic communities, forming the octocorals forest; but few studies have been conducted in Polar Regions. As part of the Antarctic scientific agenda, The Institute of Marine and Coastal Research – INVEMAR, developed the Biogerlache-Antarctica project on Gerlache Strait. The aim of the project was the characterization of the Antarctic fauna, in order to create a biological baseline knowledge, which generates and expand the information to define possible areas of conservation. Benthic samples were collected in Gerlache Strait during the first Scientific Expedition from Colombia to Antarctica: "Expedición Caldas" (2014 - 2015), onboard of the Colombian Navy ship "ARC 20 de Julio" using shipek grab sampler. The colony fragment of the subclass Octocorallia has been deposited in the Museum of Marine Natural History of Colombia – MAKURIWA of INVEMAR. The size of the specimen does not exceed 1.6 cm in length and has a total of 20 twigs arranged in a spiral with respect to the central axis. The morphological analysis was carried out, specifically using the spicules (sclerites) that compose the octocoral to determined that the specimen belonged to the family Primnoidae (Octocorallia); which is distributed all over the planet, being especially common in the Antarctic seas and the Southern Ocean in depths greater than 400 m. Taking into account these morphological characteristics of the family, an exhaustive analysis of the sample was made, taking the identification of the specimen to the genus Thouarella, characterized by pinnate colonies with dichotomous branching, polyps are produced on all sides of the branches pointing upwards, which are covered by rows of sclerites in the form of scales. To increase our knowledge in this deep-sea corals area we need to improve technics and monitoring as the use nondestructive technologies such as remotely-operated vehicles (ROVs).

THU Evening • 16:30 • Aguamarina

Exploring mesophotic communities on unchartered shallow seamount in the Galapagos Marine Reserve

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Alize Bouriat, Charles Darwin Research Station
Tom Glebas, VideoRay

On top of the Galapagos geologic platform sit hundreds of shallow seamounts locally known as "Bajos". Rising 100-400 m from the seafloor, many bajos are known for being key fishing sites among local artisanal fishermen inside the Galapagos Marine Reserve. Yet, due the technical challenges of researching in deep waters, currently no information exists about the mesophotic communities that inhabit these seamounts. To close this knowledge gab, we lead a pilot study using commercial remotely operated vehicles (ROV) to explore and survey these benthic communities. Attached to the ROV, we employed a stereo-video system to carry out ~35 m long transect replicates at four different depths between 40-200 m. Based on qualitative image analysis, we here present preliminary findings about the different communities encountered, which include soft coral gardens, rhodolith and deep-sea sponge beds, and the discovery of a deep-water kelp forest new to the Eastern Tropical Pacific.

POSTER 58 - Habitat and diversity characterization - ABSTRACT ISDSC7_094
THU Evening · 16:30 · Aguamarina

First assessment of the fish fauna into the Parque Nacional Natural Corales de Profundidad

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Direct observations of the biota of the Parque Nacional Natural Corales de Profundidad (PNNCPR) has taken almost two decades to be accomplished, after some studies have revealed a complex and diverse ecosystem that gave this MPA its name. While the composition of the fish species in the Colombian shallow continental shelf is well known, the outer shelf and upper slope are poorly documented because of previous sampling difficulties. A first exploration of the Park´s fish fauna was done using two different approaches, video-images captured with ROV and drift camera (CADEM) and visual censuses made by rebreather divers. Here we present the results of both methods to offer a first description of the ichtyofauna living within 35-332 m within the park boundaries. Surveys along the MPA using a ROV in a 12 days expedition on September 2015 and a CADEM in a 5 days expedition on November 2016, resulted in 19 sites sampled within 48-332 m and 46.4 videotape hours analyzed to identify 49 fish taxa. Three expeditions on 2017, resulted in 11 rebreather dives between 35-50 m, six sampled sites in Bajo Frijol bank and a total of 76 fish species registered with Labridae, Serranidae and Balistidae as the most species rich families and Clepticus parrae, Centropige argi, Canthigaster rostrata, Halichoeres cyanocephalus, Balistes vetula, Cephalopholis cruentata, C. fulva, Serranus baldwini, S. tabacarius, S. tigrinus, S. tortugarum and Pterois volitans as the most common species. In total 99 different species were registered for the area based on both methods. Several commercially important fishes inhabits the MPA (e.g. Nassau grouper, Black grouper, Mutton snapper, Dog teeth snapper), now also recognized as a common habitat for invasive lionfish P. volitans, a threat to the native biodiversity. This study highlights the relevance of the park to preserve these populations and the sustainability of this region of the Colombian Caribbean.

POSTER 59 - Habitat and diversity characterization - ABSTRACT ISDSC7_095
THU Evening · 16:30 · Aguamarina
First images of the deep-sea corals of the Salas y Gomez Ridge

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The Salas y Gomez Ridge is an ~2,200-km-long seamount chain in the southeast Pacific. Prior to 2019, the only studies on these seamounts were from mesophotic depths near Easter Island and Las Desventuradas and trawls from expeditions (most conducted in the 1970s and 1980s). A deep-tow camera system was deployed at 200-1000 m at eight seamounts and islands. Here, we present some of the first images of the deep-sea corals observed during these surveys.

POSTER 60 - Habitat and diversity characterization - ABSTRACT ISDSC7_096
THU Evening · 16:30 · Aguamarina
First observations of living Cold Water Corals surrounded by fishing grounds in Blanes Canyon (NW Mediterranean)

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During the ABIDES Project, 20 ROV dives were conducted along the Catalan margin (NW Mediterranean) targeting heavily exploited continental slope fishing grounds, with the aim of exploring the impact of bottom trawling activities on the sedimentary environment and deep-sea benthic communities. During 7 dives conducted in Blanes Canyon, Cold Water Corals (CWCs) were discovered at several locations, always associated with the presence of exposed rocky outcrops. The occurrence of living CWCs in this canyon had not been documented before, and represented an unexpected finding. The most developed CWC community was found at the canyon head region on a steep (i.e., vertical and overhanging) canyon wall at the western canyon flank. This wall spanned from 650 to 500 m depth and was covered by large colonies of Madrepora oculata and Lophelia pertusa. Dense aggregations of the solitary coral Desmophyllum dianthus, the black coral Parantipathes larix and the oyster Neopycnodonte zibrowii were also observed on this wall. Deeper surveyed areas within the canyon revealed the presence of large isolated colonies of L. pertusa at depths ranging from

765 to 864 m, and small colonies of M. oculata observed in most dives, being found as deep as 680 m. The detailed spatial distribution of the fishing pressure in Blanes Canyon indicates that these CWCs communities are completely surrounded by active fishing grounds. The indirect impacts of bottom trawling on CWCs by smothering –exposing them to elevated fluxes of poorly nutritive resuspended particles– might have unforeseen consequences, and for instance prevent them to expand and colonize other suitable areas within this canyon, or even perish. The deep-sea fisheries being conducted in Blanes Canyon and on the Catalan continental slope are common along the entire Mediterranean margin, and therefore, other deep CWC communities already found (or yet to be discovered) in trawled submarine canyons might be facing the same impacts.

POSTER 61 - Habitat and diversity characterization - ABSTRACT ISDSC7_097
THU Evening · 16:30 · Aguamarina
First sight of mesophotic octocoral communities (40-60 m) of the Colombian Pacific coast

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The soft corals are usually one of the main biotic components in the rocky reefs of the Tropical Eastern Pacific. With high diversity, abundance and endemism, octocoral communities host a characteristic invertebrate fauna and associates a rich fish fauna. Octocoral studies in Colombian Pacific are still few and located, nonetheless these has reported 22 species in total, and has shown the importance of these organisms due to their ecological interactions, evolutionary relationships and abundance in rocky reefs. An underwater exploration of 15 rocky sites during 2018 in the northern Colombian Pacific, which consider a 10-60 m depth gradient, allowed the recognition of a particular mesophotic community of "white octocorals" between 40-60 m depth. To evaluate octocoral abundance and species richness, coral colony counts in lineal transects (10x1 m) were made on six sites, considering a shallow zone (10-20 m), a middle zone (20-30 m) and a deep zone (>40 m), only two of these sites having the mesophotic zone. Preliminary results show 28 octocoral species for the northern Colombian Pacific, eight are new records for the country, four of them restricted to the deepest zone (mesophotic). In the mesophotic octocoral community ten species of three families were found, most of them being white colored. The average abundance in that community (40-60 m depth) was 8.3 colonies/m2 ± 3 (DE), being less than calculated values in the shallow and middle zones. However, this is just a first glance, and this whitish octocoral community is still virtually unexplored, becoming obvious that more sampling efforts are needed to quantify the mesophotic diversity of the region. Finally, our study confirms that octocoral diversity in the northern Chocó is the highest of Colombian Pacific, and expose a rare mesophotic octocoral community did not reported until now in Colombia.

POSTER 62 - Habitat and diversity characterization - ABSTRACT ISDSC7_101
THU Evening · 16:30 · Aguamarina

New records of deep-water corals of the Colombian Pacific: A contribution to increase of knowledge in the Tropical Eastern Pacific

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The Colombian Pacific comprises an area of about 339.500 km2 that includes Marine Protected Areas of regional interest, some of which are part of the Marine Corridor of the Eastern Tropical Pacific-CMAR. The knowledge of the deep environments biodiversity of this part of the territory is scarce. For this reason, the Institute of Marine and Coastal Research-INVEMAR with the support of the National Agency of Hydrocarbons-ANH conducted the Tumaco Offshore Project (2012-2013). The study carried out a biological and physical baseline survey in an unexplored offshore area of the Colombian Pacific between 200 and 1000 m depth (hydrocarbon exploration blocks TUM OFF 6 and 7). The samples were obtained by epibenthic trawls on soft bottoms at 13 stations using a small modified net (9 × 1 m opening, 2.5 knots for 10 min). In two stations, sampled at 530 and 668 m depth, the octocorals Callogorgia sp., Umbellula sp.; the scleractinians Polymyces cf. fragilis (Pourtalès, 1868) and Caryophyllia sp., and the antipatharia Stichopathes cf. spiessi Opresko & Genin, 1990 were collected. Morphological characteristics of the species, their abundances, and biological associations (when they were evident) were recorded. With the exception of the solitary coral Caryophyllia sp., all the species captured represent first records for the country. Likewise, at least two new records are assumed for the deep Tropical Eastern Pacific and the distribution ranges known for some species are extended. These results provide novel information to complement the general knowledge gap of deep-water corals in the region. At the same time, the data extend the biological reference information useful for making decision of management and conservation in offshore areas by environmental authorities.

POSTER 63 - Habitat and diversity characterization - ABSTRACT ISDSC7_102
THU Evening · 16:30 · Aguamarina

Occurrence and distribution of the coral Dendrophyllia ramea off Cyprus (eastern Mediterranean)

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The occurrence and abundance of deep-water corals in the Levantine Mediterranean Sea is still largely unknown. This work, whose results have been recently published, is the first

attempt to quantitatively describe a Dendrophyllia ramea population discovered in 2015 on the outer insular shelf off eastern Cyprus. The D. ramea population we studied is the deepest ever described until now in the Mediterranean Sea . Video transects were conducted by means of a remotely operated vehicle (ROV), revealing the presence of a population of D. ramea growing on a sandy seafloor at a 125-170 m depth range. Population density was quantified, with maximum values of 6 colonies m-2 and average densities of 1.6 ± 1.4 (SD) colonies m-2. The occurrence of the species on sedimentary grounds makes it particularly vulnerable to the physical impact of fishing gears, as in the case of bottom trawling. This work analyses the spatial distribution of the coral population and is a first attempt to characterize its habitat, as well as the threats for this species, which is included Annex II of Barcelona Convention.

POSTER 64 - Habitat and diversity characterization - ABSTRACT ISDSC7_106
THU Evening • 16:30 • Aguamarina
Black corals of the Whittard Canyon, Ireland

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In parts of the Whittard Canyon, a submarine canyon on the Irish Atlantic margin, black corals (order Antipatharia) are remarkably common. Antipatharians are widely distributed in all oceans and occur in water depths from just a few meters down to >8000 m. During cruise CE14009 of RV Celtic Explorer to Whittard Canyon in June 2014, we collected HD image data and black coral samples for taxonomic and genetic work (not yet complete), using ROV Holland I. We have analysed 65 hours of HD videos from seven ROV dive events in depths ranging from 580 to 2820 m, and recorded more than 2000 black coral specimens. Two ROV dives, each 8 – 10 hours long, climbing from depths of approximately 1400 m to 900 m, and 1100 m to 900 m, and a third 15-hour dive, climbing from 1400 m to 600 m, each recorded more than 500 black coral specimens. Preliminary estimates of density and data on black coral distribution based on these three dives and four other dives that revealed fewer specimens suggest that Stichopathes is by far the most abundant genus, representing 1,550 of all records. However, there were also more than 100 records of each of Bathypathes, Parantipathes and Antipathes. Working to identify black coral specimens that we collected, we present in situ photographs, light microscopy and SEM images of what appears to be 15 morphotypes of black corals, represented by one species of each of the genera Antipathes, Dendrobathypathes, Telopathes and Trissopathes, two species of Leiopathes, Parantipathes, Stichopathes, and Stauropathes, three species of Bathypathes.Molecular sequence data produced to date, based on mitochondrial intergenic regions, lack sufficient variation to effectively delimit species. Understanding what drives their spatial distribution is paramount to ensuring future protection of these vulnerable taxa.

Anthropogenic stressors - TALKS

Anthropogenic stressors - ABSTRACT ISDSC7_141
THURSDAY Afternoon · 13:30 · Aguamarina Ballroom
Crumbling reefs: a natural ocean acidification laboratory in the Northeast Pacific

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Ocean acidification (OA) over the next century will leave most known cold-water coral (CWC) reefs exposed to seawater that is undersaturated with aragonite and corrosive to their dead skeletons. Laboratory experiments and reports of Lophelia pertusa below the aragonite saturation horizon (ASH) have led to the assumption that CWC ecosystems may persist under future acidification conditions. This assumption does not consider the effects of OA to the larger reef framework or dead skeleton that comprises the bulk of the three-dimensional structure. The shallow ASH of the Northeast Pacific creates a natural laboratory for investigating the effects of OA on CWC in future ocean conditions. The current study utilized ROV surveys (n=707 2003-2015) to document the distribution of L. pertusa, in the Southern California Bight. Though widely distributed (n=171) at 313-66 m depth, the majority of sites had only sparse live patches. Aragonite saturations at L. pertusa sites were between 0.68-1.86. L. pertusa sites that had substantial cohesive reef framework, consisting of live and dead coral, were limited to shallow sites (169-66 m, n=14). The highest frequency and abundance of L. pertusa was found in the Channel Islands National Marine Sanctuary, where surveys targeted collections and characterization of reef framework above and below the ASH. Sites that experience persistent undersaturation (> 170 m) had an absence of dead-reef framework and lacked structural complexity. The absence of complexity in undersaturated conditions indicates a loss of structural integrity that we attribute to dissolution of dead reef-framework. This study set the stage for a cross-disciplinary collaborative investigation of the coral that employed in situ, structural and mechanical analyses to provide an explanation for the loss of reef complexity. The rapid shoaling of the ASH in this region provides an unprecedented opportunity to assess the ecosystem-scale effects of OA on CWC reefs.

Anthropogenic stressors - ABSTRACT ISDSC7_147
THURSDAY Afternoon · 13:45 · Aguamarina Ballroom
Growth and bioerosion/dissolution rates of Lophelia pertusa studied in situ and in the laboratory under simulated ocean acidification and warming

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Coral reef resilience depends on the balance between reef growth (carbonate accretion) and degradation (bioerosion/passive chemical dissolution). Changes in environmental conditions are likely to affect the two processes differently, thereby shifting their balance. In cold-water corals (CWCs), field or laboratory estimates of accretion-erosion processes are scarce. Growth responses of L.pertusa to future environmental changes was so far solely investigated on live corals, disregarding potential effects on dead framework and limiting our ability to assess the potential of CWC reef ecosystems to cope with environmental changes. Here, we present net growth rates of live L.pertusa as well as dissolution/bioerosion rates of dead coral framework assessed in a one-year in situ experiment in different environmental settings in Norwegian reefs and in a 13-months laboratory study with gradually increasing temperature and/or pCO_2 conditions. Determined in-situ net growth of live L.pertusa did not significantly differ between inshore (fjord) and offshore (open shelf) reef settings. Bioerosion rates were significantly higher on-reef in the fjord compared to off-reef deployments in- and offshore. In the laboratory, live L.pertusa and dead coral framework were negatively impacted by elevated pCO_2, while warming did not affect or slightly increase net growth of live and dead corals. The combination of both factors led to mitigation of the negative effects of acidification on calcification, while degradation of dead corals was significantly increased under acidification alone and in combination with warming. Comparing rates of net accretion of live corals with degradation rates of dead framework provides insight on the relevance of both processes in CWC ecosystems. With regard to likely accelerating chemical bioerosion and reduced growth of corals under acidification, the balance of reef accretion and degradation may be shifted towards higher biogenic dissolution in the future.

Will we lose the reefs of the deep (and how will we know)?

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Leslie Wickes, Thrive Blue
Fiona Murray, University of Edinburgh
Murray Roberts, University of Edinburgh
Peter Etnoyer, NOAA National Centers for Coastal Ocean Science

Cold-water coral reefs are under threat from ocean acidification, ocean warming and deoxygenation. Tools have been developed to predict the risk of tropical coral bleaching, but there is no similar tool or routine set of measurements that currently exist to assess cold-water coral reef health. Cold-water corals (CWCs) create a complex, 3-dimensional habitat comprising of dead coral skeleton supporting live corals, and this supports a diversity and abundance of marine life. The dead coral skeleton contributes the majority of mass to CWC reefs, and it is this portion that is at particular risk of dissolution from ocean acidification. We present micromechanical, microscopy and synchrotron radiation computed tomography data from long-term experiments and in situ samples taken from reefs already living below the aragonite saturation horizon in the Northeast Pacific. These techniques allow us to assess coral skeleton structure from aragonite crystal to reef length scale. Results demonstrate that there was no change in live or dead coral (in situ and experimental) stiffness or hardness on

the micrometre scale when exposed to aragonite undersaturated conditions. However, there was a significant increase in porosity of up to 28% over 12 months in the outer walls of dead skeleton exposed to such conditions. This was not observed in live coral. This increase in porosity in dead coral skeleton decreased its maximum bearable mechanical stress, increasing its fragility and potential for mechanical failure. These increases in porosity observed in in situ samples as well as in experimental samples, highlight the risk of skeletal structural failure leading to habitat loss and the timescales this occurs over. Through understanding this process, we can quantify the risk as well as timescales of future CWC habitat loss, and model this based upon ocean chemistry to provide routine measurements to assess future CWC reef health.

Warm-water anomalies in the mesophotic depth range of the Southern California Bight with implications for gorgonian octocorals

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In recent years, 'marine heatwave' events have affected multiple ecosystems along the California coast, including kelp beds, sea stars, and pelagic ecosystems. The effect of heatwaves on cold-adapted, deep-water corals is unknown. Mortalities of gorgonian octocorals were observed along the California coast below 20 m. These mortalities were hypothesized to be a result of warm-water anomalies. This study deployed temperature loggers in 2016 at 20, 50, 100, and 200 m in the Channel Islands National Marine Sanctuary (CINMS) to characterize warm-water anomalies in the mesophotic depth range. The in situ temperature variability observed during the 2015-2016 ENSO event informed a laboratory study to determine the upper thermal limit of the common gorgonian octocoral Adelogorgia phyllosclera, using a series of temperature assays. Warm-water anomalies in the CINMS were frequently observed at 50 and 100 m, with most of these anomalies occurring during strong ENSO months. The laboratory temperature assays suggested that the upper thermal limit of A. phyllosclera was 20 °C, which was exceeded occasionally during the 2015-2016 ENSO event at depths that A. phyllosclera is known to occur. This study indicates that gorgonian octocorals at mesophotic depths are frequently exposed to warm-water anomalies that last 1.5-3.8 hours on average and that these anomalies are near the upper thermal limits of A. phyllosclera. These results provide evidence that warm-water anomalies during the 2015-2016 ENSO event could have contributed to the gorgonian mortalities observed in 2016, either directly or indirectly. Further monitoring is needed to understand the threat of ocean warming to gorgonian octocorals living at mesophotic depths.

Effects of temperature increase on the metabolic performance of the cold-water coral Lophelia pertusa

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Water temperature is one of the main variables that determines cold-water coral distribution worldwide. Lophelia pertusa has a narrow temperature tolerance (6 – 12°C) and upper thermal limit at 15°C. This species has the capacity to form extensive calcium carbonate aggregations, thus creating complex habitat for a variety of associated species. As part of a large initiative to explore new areas of deep-sea habitats in the South-East US, a large deep-sea coral reef composed by L. pertusa was located off the coast of South Carolina at 650-700 m depth. Owing to the rarity of these aggregations and the unusual environmental conditions of this geographic area, with regular arrival of warm surface waters, the main aim of this study was to understand the physiological response of L. pertusa to the natural variation in temperature in this region. Short-term experiments were performed replicating the environmental maximum (14°C) and minimum (8°C) temperature variation in the coral metabolism and feeding. We found 100% survival in the temperature range tested for the length of the experiment. Nevertheless, temperature had an effect in the metabolic functions by increasing the respiration rates at 14°C by ~50% relative to the ambient temperature of 8°C. To further characterize the metabolic response, feeding assays (capture rate of Artemia) were performed at the same temperature range with an overall two-fold decrease in feeding rates in the 14°C compare to ambient temperature, thus increasing the probability of temperature-induced metabolic stress. These results highlight the sensibility and the importance of temperature variation in the metabolic performance of deep-water corals, particularly in the South-East US, where climate change predictors forecast an increase in the frequency and duration of incursion of surface, warm waters to deeper habitats where L. pertusa grow and form unique habitats.

Anthropogenic stressors - ABSTRACT ISDSC7_142
THURSDAY Afternoon · 14:45 · Aguamarina Ballroom

Ecological restoration of cold-water coral gardens on the Mediterranean continental shelf

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Deep gorgonian species on the Mediterranean continental shelf are among the most frequent bycatch taxa. These species have traits, such as long lifespans and slow growth, that make them very vulnerable to the impacts caused by fishing activities, which can have far-reaching and long-lasting effects for these highly biodiverse communities. Hence, restoration and mitigation actions are crucial to enhance and speed up the natural recovery of these impacted populations. For this reason, we carried out a first pilot field study on the continental shelf of Cap de Creus (NW Mediterranean, Spain), where bycatch gorgonians were collected from artisanal fishermen and transplanted in artificial structures deployed at 85 m depth. We monitored the survival of transplanted individuals using a Remotely Operated Vehicle (ROV). Transplanted colonies showed high survival (87.5%) during the first year. Subsequently, to explore the viability of a large-scale and low-cost restoration method, gorgonians were transplanted on cobbles that were returned to the continental shelf, gently throwing them directly from the sea surface. The best cobble type and gorgonian size were evaluated to maximize the correct landing of the transplants and their subsequent maintenance in upward position. This last method, called "badminton effect", was successfully applied during a fishing season, where 450 bycatch gorgonians were recovered and returned to the continental shelf (80-100 m depth). Few months later, an Autonomous Underwater Vehicle (AUV) survey showed that the majority of the transplants remained upward and survived. The success of these methods highlights the feasibility of large-scale and low-cost restoration actions with promising results for the conservation and recovery of mesophotic and cold-water coral gardens.

Anthropogenic stressors - ABSTRACT ISDSC7_146
THURSDAY Afternoon · 15:30 · Aguamarina Ballroom
Genome-wide investigations elucidate coral responses to anthropogenic disturbance

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Santiago Herrera, Lehigh University
Stephen Lengyel, Temple University
Andrea Quattrini, Harvey Mudd College
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The 2010 Deepwater Horizon (DWH) disaster and subsequent cleanup efforts released an unprecedented amount of oil and chemical dispersants into the deep Gulf of Mexico (GoM). Detrimental impacts have since been documented to deep-sea coral communities. However, little is known regarding the genome-wide consequences of this anthropogenic disturbance in situ or the underlying influences on cellular processes that ultimately manifested into the observed physical damage. As the frequency of human-induced disturbances increases in deeper waters due resource extraction, pollution and global climate change, further investigations into how deep-sea corals respond to environmental stress at the cellular level will improve our understanding of their resiliency to these challenges. In this study, we used a transcriptomics approach to investigate the responses of the octocoral Paramuricea biscaya, exposed in situ to oil and dispersant laden flocculant in the aftermath of the DWH. This was the most common coral species impacted by this environmental disaster and corals of this genus have likewise been subjected to numerous anthropogenic disturbances in the Mediterranean Sea. Our investigations suggest that spill impacted corals had a diminished capacity to maintain crucial cellular mechanisms for coping with environmental stress likely linked to high metabolic demands, though elevated stress response proteins likely enabled partial colony survival. Gene expression profiles indicate oxidative stress responses, innate immunity, and wound repair pathways play a fundamental role in deep-sea coral responses to environmental contaminants. This novel dataset presents the first deep-sea octocoral transcriptome and will be useful towards the development of biomarkers for future spill response and monitoring efforts. Further, this study contributes to our fundamental understanding of deep-sea coral stress responses, whether it be from anthropogenic or natural stressors.

Influence of Temperature and pH on the Phenotypic and Transcriptomic Response of Lophelia pertusa to Oil and Dispersant Exposure

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Lophelia pertusa is among the most abundant and wide-spread deep-sea corals and acts as the foundation for deep-sea ecosystems in most of the world's oceans. These organisms are under increasing anthropogenic threat, including global ocean change and oil extraction. This study implemented a series of multi-stressor experiments to assess the effects of variation in pH, temperature, and oil/dispersant exposure and their interactions. Four

experiments exposing L. pertusa colonies to various environmental conditions (pH:7.9&7.6; temp:8&12°C) and hydrocarbon exposure (oil, dispersant, & oil+dispersant) for 24 hours followed by a recovery period were performed. L. pertusa's phenotypic response was assessed by observations of polyp behavior, mucous secretion, and tissue loss at four points during exposure and recovery. In all four experiments the coral's average health significantly declined during 24 hours of exposure to dispersant but remained constant during exposures to oil or oil+dispersant. In the first stage of recovery polyp health quickly returned to a pre-exposure state under ambient temperature (8°C) even after exposure to dispersant. However, the combination of increased temperature (12°C) and dispersant exposure resulted in a delay in recovery. Tissue was collected before and during the exposures to examine L. pertusa's molecular level response through gene expression. Much of the variance in differentially expressed genes was related to treatment type (oil, dispersant, oil+dispersant), not by environmental condition (pH and temperature). Dispersant alone elicited the strongest response, with >2,000 differentially expressed genes (FDR < 0.05; FC >1). In comparison, ~900 genes were differentially expressed in response to oil + dispersant and only 5 genes were differentially expressed in response to oil alone. Discerning the corals' ability to recover after short-term exposures will illuminate their resilience and recovery potential in their natural habitats.

Anthropogenic stressors - ABSTRACT ISDSC7_143
THURSDAY Afternoon · 16:00 · Aguamarina Ballroom
Effects of barite exposure on Lophelia pertusa using a recirculation system

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Barite is composed by fine particles that can affect Cold Water-Corals. In this study, the effects of barite smothering on Lophelia pertusa were assessed in an aquaria-based experiment with water recirculation system. Corals were collected by ROV in Santos Basin, at 206-247m depth, during SENSIMAR Project-PETROBRAS. Colonies were acclimated for 80 days prior to the experiments in 100L natural filtered (0.5µm) seawater aquaria, with controlled salinity (35) and temperature (11°C) in darkness. The experiment was conducted in 20L cone-shaped aquaria, adapted with an individual water recirculation system (12L.h-1), using synthetic seawater. Each exposure to suspended barite particles (50 and 100mg.L-1) plus a control group were maintained in triplicate. Three nubbins with 3-8 polyps were accommodated vertically in the aquaria and acclimated for 7d before experiments start. They were fed three times a week with 300 Artemia sp. nauplii.L-1 (<24h). The experimental design simulated two cycles of discharge, followed by a recovery cycle of 7d, totalizing 35d. The barite was added continuously with a peristaltic pump (0.18L.h-1). Mortality was checked after the experiment. Three polyps in each nubbin were monitored twice a day regarding behavior levels. Time-lapse photos were also taken. The mean turbidity was 53.48±27.66 and

139.75±76.48 for 50 and 100mg.L-1 barite treatment, respectively. After 35d, total polyp survival in control was 100%, while in 50 and 100mg.L-1 were 94.2% and 93.6%, respectively, with no significant difference between treatments (Kruskal-Wallis, p=0.558). Polyp activity was different between treatments (Kruskal-Wallis, p<2.2e-16), with both exposed aquaria displaying higher activity than control. Mucus production was observed after the first cycle of discharge in both treatments, and none in control. L. pertusa showed resilience to sedimentation of barite. The recirculated system designed for this experiment was adequate for barite exposure.

Anthropogenic stressors - ABSTRACT ISDSC7_144
THURSDAY Afternoon • 16:15 • Aguamarina Ballroom
Effects of bentonite, barite and drill cuttings on larvae of the cold-water coral Lophelia pertusa

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Fossil fuels remain the largest global energy source, and energy industry operations have moved into progressively deeper waters as coastal resources are depleted. Fossil fuel operations require extensive seafloor drilling, which creates sediment plumes, and releases drilling fluids and cuttings into the marine environment. Drilling operations can occur close to sensitive marine ecosystems, such as deep-water corals, with potential negative effects from increased sediment load. While there have been several studies on effects on adult corals, there is very little information on potential drilling operations on early life history stages. The objective of this study was to define tolerance limits of L. pertusa larvae to different drilling waste components under a range of exposure concentrations, and also assess post-exposure recovery. Larvae of different ages (8 and 21 days) were exposed to a range of concentrations of Bentonite, Barite and Drill cuttings. Larval sensitivity was assessed using the concentration at which 50% of the larvae showed behavioral effects (EC50) or lethal effects (LC50). Larvae showed the greatest sensitivity to Bentonite, followed by Barite and Drill cuttings, with older larvae showing more sensitivity than younger larvae. Post exposure recovery was fairly high under experimental conditions, but how these data translate to field conditions is unknown. Responses of zooplankton to drilling wastes and other operational materials should be taken into consideration in management decisions. However, these fauna are almost impossible to study in the field, so ex situ experiments can provide insight into potential impacts of energy industry activities on this important group.

Anthropogenic stressors - POSTERS

POSTER 65 - Anthropogenic stressors - ABSTRACT ISDSC7_140
THU Evening • 16:30 • Aguamarina
Coral Transcriptomic Response to Oil and Dispersant

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The deep sea is the world's largest habitat and faces many threats, including resource extraction. These practices come with risks to the ecosystem and its incredible faunal diversity. In 2010, the Deepwater Horizon oil spill in the Gulf of Mexico was an iconic example of the negative effects of these practices. Little is known about how the oil and dispersant used to mitigate the effects of the spill impact cold-water corals, species that create framework and habitat for a plethora of other animals. The work that has been done addressing this suggests the dispersant elicits a stronger physiological response from corals than does the oil. To understand the cellular impacts of these stressors on the corals, we analyzed transcriptomic responses of Callogorgia delta and Paramuricea b3 after a 12 hour exposure to oil, dispersant, oil and dispersant, or a seawater control with both bulk oil and a water accommodated fraction (WAF). Concentrations were selected based on sub lethal effects found in the physiological study: ~25 ppm for the bulk-exposure series and ~50 μM oil and 35 mg/L dispersant for the WAF-exposure series. Genotype had the largest effect on expression patterns, followed by treatment. All the treatments had similar levels of differentially expressed genes when compared to the control (1.1%-5%) and more genes were differentially expressed between genotypes (27%-32%) than between treatments. This suggests that each genotype undergoes unique cellular processes and these processes are more influential in expression patterns than are those related to the response to the oil, dispersant, or oil and dispersant treatments. Resource extraction is a continuing threat to the deep-sea ecosystem with little understanding of the responses of, and potential outcomes for the biota. These responses are unique and need to be fully researched before more destructive practices are set in motion.

POSTER 66 - Anthropogenic stressors - ABSTRACT ISDSC7_145
THU Evening • 16:30 • Aguamarina
Effects of Corexit® 9500 on the Polychaete Ophryotrocha sp. reproduction – a long-term toxicity test

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Chemical dispersants are considered to be effective against offshore oil spills, however they may be harmful. Ophryotrocha species are free-living polychaetes used for ecological and ecotoxicological studies. The deep-water specimens used in this study were collected in association with Lophelia pertusa. They were collected by ROV in Santos Basin, Brazil at 208-252m depth, during SENSIMAR Project-PETROBRAS. Since 2012 Ophryotrocha have been cultured at Labtox in 15L natural filtered (0.45μm) seawater aquaria, under controlled salinity

(35) and temperature (11ºC), in darkness and fed 3x a week. Individuals of ~2.7mm, with no oocytes, were selected and exposed to different dispersant concentrations to determining the lethal (CL50; 96h) and chronic (45 days) thresholds. Twenty polychaetes were distributed among 4 replicates of each tested nominal concentration (0.1; 1.0; 10.0; 100; 200; 400 and 800ppm) plus a control in glass dishes with 50mL each. They were observed every day and the dead polychaetes were counted and removed. After 96h the surviving ones were transferred to clean water, distributed 2 individuals in each flask. They were cultured along 45d, and daily observed for mortality, first breeding, number of eggs and time for hatching. The survival after 45d in both control and lower concentrations (≤200ppm) was 100%. However, in 400 and 800ppm all the polychaetes died in the first 96h. The lethal concentration after 96h was 166.31ppm (IC=129.10-214.26ppm). There was no significant difference (p=0.05) in time for the first breeding between control (21d) and 200ppm (20d). However, the average number of eggs decreased from 91 to 57 while the development time until hatching increased from 13 to 18d with concentration increasing. Ophryotrocha sp. is an alternative to evaluate the effects of Corexit® 9500 in deep-water. It is easily cultured and its reproductive characteristics present technical advantages to evaluate the toxicity of substances.