Biological samples and associated imagery collected by ROV SuBastian during the Octopus Odyssey R/V Falkor (too) expeditions Fkt230602 and Fkt231202 in Costa Rica in Jun and Dec 2023

Website: https://www.bco-dmo.org/dataset/1000298
Data Type: Cruise Results, Other Field Results
Version: 1
Version Date: 2026-06-04

Project
» Octopus Odyssey (OctoOdyssey)

Program
» Crustal Ocean Biosphere Research Accelerator (COBRA)

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Abstract
This dataset includes metadata and imagery of deep-sea biological specimens collected during the Octopus Odyssey expeditions (Fkt230602 and Fkt231202) aboard the R/V Falkor (too) in the Pampa Submarina region off the Pacific coast of Costa Rica. Sampling was conducted from 3-20 June and 3-14 December 2023 using the ROV SuBastian across six geologic features at depths between 500 and 3180 meters. The specimens, which are archived at the Museum of Zoology at the Universidad de Costa Rica, likely contain new species and new records for the area and contribute to understanding local and regional deep-sea biodiversity. Sampling was carried out under national research permits and guided by a collaborative biology team from the Universidad de Costa Rica, Universidad Nacional de Costa Rica, the Field Museum of Chicago, SpeSeas, and the Bigelow Laboratory for Ocean Sciences. The dataset follows the Darwin Core standard for documenting and reporting the occurrence data associated with each sampling event. A .zip file is provided in the supplemental documents and contains a set of subfolders, one for each sample, with in situ and laboratory images when available. The primary data file includes a relative path in the “associatedMedia” field, enabling each metadata record to be accurately linked to its corresponding imagery.

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Coverage

Location: Pampa Submarina, Costa Rica, Eastern Tropical Pacific (8.62–9.12° N, 87.28–86.94° W; 500–3180 m depth)
Spatial Extent: **N**:9.12 **E**:-86.94 **S**:8.62 **W**:-87.28
Temporal Extent: 2023-06-03 - 2023-12-14

Methods & Sampling

A. SAMPLE PROCESSING

Sampling was conducted across six main geological features in the Pampa Submarina region off the Pacific coast of Costa Rica, including several hills, knolls, a seamount, and the surrounding abyssal plain. Biological collections were carried out opportunistically during ROV *SuBastian* dives, guided by real-time observations of biodiversity and habitat characteristics. Specimens were primarily collected using the ROV's manipulator arms, while ROV nets or the slurp sampler were also used to retrieve delicate or mobile organisms.

Sampling aimed to capture a broad representation of taxonomic diversity across habitats and depth ranges, and will be used to assist with the identification of species in the ROV imagery collected. During the second cruise, efforts focused on collecting specimens that had not been sampled during the first expedition, to complement the existing collection and expand the taxonomic coverage of deep-sea fauna from the region.

Before each ROV recovery, the dive lead designated the team responsible for sample handling and preparation. The wet lab was organized in advance with labeled buckets, appropriate preservative solutions, and sample vials and containers. Upon ROV recovery, samples were transferred carefully into labeled buckets filled with chilled seawater or seawater from the ROV bioboxes in an attempt to maintain their condition. Specimens were handled with clean gloves to prevent contamination or physical damage. All samples were transferred to the cold lab to await further processing.

All specimens were photographed in the wet lab following standardized imaging protocols to ensure consistent documentation as soon as possible after recovery. A clean black or white matte background was used for all photographs, with uniform lighting, a measurement ruler and its label included in each frame. Each specimen was photographed with its label containing its unique sample code clearly visible, capturing dorsal, ventral, and lateral views. Preservation methods were tailored to specific taxa to optimize molecular and morphological integrity (see Preservation Methods below).

Subsampling was performed only after whole-specimen photography was completed. Each subsample received a unique code and was recorded in the shared Google Drive database. Subsamples were also photographed individually, using their respective suffix identifiers (e.g., *...001* in *recordNumber.* See Labelling section below).

Tools, mats, and equipment were cleaned with ethanol between samples to prevent cross-contamination. Image filenames were cross-referenced with entries in the biological spreadsheet to maintain data traceability between photographs and specimen metadata.

B. PRESERVATION METHODS

Cephalopods: When still alive upon recovery, individuals were euthanized with a 3% ethanol–seawater solution. Muscle tissue was preserved in 95% ethanol for molecular analyses, while additional tissues (e.g., skin, gills, salivary glands, gonads) were preserved in Zymo DNA/RNA Shield or 2% paraformaldehyde for microbiome and histological studies. Adult specimens were fixed in 10% buffered formalin prior to long-term storage in 70% ethanol. Eggs from brooding females were preserved in 95% ethanol.

Other Molluscs: Specimens were photographed and preserved in 95% ethanol.

Corals and Anemones: Branches or tissue samples (approximately 10 cm in length) were preserved in 95% ethanol for DNA analysis, with ethanol refreshed after 24 hours. Additional fragments of corals were air-dried for morphological reference.

Sponges: Sponge tissue was preserved in >90% ethanol, with the preservative refreshed after 24 hours to prevent dilution. In some cases, fragments were air-dried when appropriate for morphological examination.

Crustaceans and Echinoderms: Specimens were photographed following standard macro-organism protocols and preserved in 95% ethanol for morphological and molecular analysis.

Gelatinous Species (e.g., siphonophores, jellyfish): These delicate organisms were preserved in 95% ethanol or fixed in 10% buffered formalin prior to long-term storage in 70% ethanol to maintain structural integrity.

Preservative mixtures were prepared using standardized formulations:

- 70% Ethanol: 700 mL of 95% ethanol mixed with 300 mL of distilled water.
- 10% Buffered Formalin: 100 mL of 37–40% formaldehyde diluted in 900 mL of seawater.

C. LABELLING

The dataset follows Darwin Core standards. This dataset is an *occurrence core* derived directly from the collected samples. The descriptions of all included fields or column names in the dataset are explained in the **Parameters Metadata.**

eventID

eventID is a unique identifier created by combining CruiseID and DiveID (eventID: e.g., *Fkt230602-S0542*), where:

- **CruiseID:** Identifier for the Schmidt Ocean Institute expedition (e.g., *Fkt230602*).
- **DiveID:** Sequential number assigned to ROV *SuBastian* dives (e.g., *S0542*).

occurrenceID

Unique identifier for each taxonomic occurrence within the samples:

It follows the structure **eventID(CruiseID-DiveID)-SamplingNumber_SequentialRecord (e.g. Fkt230602-S0529-005_1)**, where:

- **eventID:** CruiseID-DiveID (e.g., Fkt230602-S0529).
- **SamplingNumber:** A sequential number corresponding to the master log of the expedition, where all sampling events were recorded (e.g., 005).
- **SequentialRecord:** A suffix to differentiate different biodiversity occurrences coming from the same eventID and samplingNumber (e.g., _1).

In some cases, one *recordNumber* (explained below) may correspond to more than one *occurrenceID.* This occurs when two attached individuals were stored as one sample (e.g., a coral with associated attached fauna). For example, the *recordNumber* FKt231202-141-B.OCT was assigned to an octocoral specimen with associated attached zoanthids. In this case, both the octocoral and the zoanthids were assigned separate *occurrenceID* values in the dataset.

Multiple occurrences may also originate from the same sampling event. For example, the *occurrenceID* Fkt230602-S0529-005_1 and Fkt230602-S0529-005_2 were recovered from the same push core and were subsequently assigned different *recordNumber* and *occurrenceID* values. The occurrences can be distinguished by the final sequential suffix in the *occurrenceID*.

recordNumber

In the field, each biological sample was assigned a unique alphanumeric code (shown in the dataset as **recordNumber**) following the format:

CruiseID-SamplingNumber-SampleType-SubgroupCode.SubsampleNumber (the latter, if applicable) (e.g., *Fkt230602-004-B-OCT.001*), where:

- **CruiseID:** Fkt230602 or Fkt231202
- **SamplingNumber:** A sequential number corresponding to the master log of the expedition, where all sampling events were recorded.
- **SampleType:** Coded by the category of the main sampling event (*B = Biology; R = Rock; S = Sediment*). Additional details on how each sample was collected are provided in the dataset under the *samplingProtocol* field, which offers further methodological context.
- **SubgroupCode:** Identifies the broad taxonomic group of the specimen (ANE = Anemones, ANT = Black corals, CRU = Crustaceans, ECH = Echinoderms, HYD = Hydrozoa, MOS = Molluscs, OCT = Octocorals, OTH = Others, POR = Sponges, PULP = Octopus, UNK = Unknown, WOR = Worms, ZOA = Zoanthids). However, the detailed and reviewed taxonomic classification is also included in the dataset, following the WoRMS taxonomic hierarchy (kingdom, phylum, class, order, and family) associated with the provided *scientificName*. The field *taxonRank* is also provided, indicating the taxonomic level at which the organism was identified.
- **SubsampleNumber:** Applied consecutively for associated or derived samples (if applicable).

Physical labels accompanying each sample included the following information: sample code, tentative taxonomic identification, locality, date (DD/MM/YYYY), geographic coordinates (decimal degrees), depth (m), dive code, and relevant observations (substrate type, color, associated fauna, ROV storage box, and other remarks).

Data Processing Description

Sample metadata were compiled and verified using the cruise biological log maintained during both cruises. After each cruise, the dataset was reviewed to ensure consistency in sample codes, taxonomic annotations, and collection details. Representative images were selected for each specimen, including both in situ photographs captured by ROV *SuBastian* and laboratory images taken during processing. The information from both cruises was then integrated into a single dataset and formatted following the Darwin Core standard to structure the occurrence data.

BCO-DMO Processing Description

- Loaded data from "OctopusOdyssey_BiologicalSamples_Occurrences.csv" as table "res1" (CSV format, row 1 as header, treating "" and "nd" as missing values)
- Converted column "eventDate" from format "%d/%m/%Y" to ISO date format "%Y-%m-%d" (UTC), output type date
- Combined "eventDate" ("%Y-%m-%d") and "eventTime" ("%H:%M:%S") into new column "eventDateTime_UTC" in ISO datetime format "%Y-%m-%dT%H:%M:%SZ" (UTC)
- Reordered all columns to move "eventDateTime_UTC" near source fields
- Corrected a file path in the associatedMedia column, replacing "/SCICAM_20230609_185524551.jpg" with "/FKt230602-112-B.ANT-SCICAM_20230609_185524551.jpg"
- Output final table to "1000298_v1_oct_odyssey_bio_samples.csv"

Problem Description

Some samples were lost during the ROV ascent; however, because these events were recorded in the sample logs, they remain part of the dataset. Each case is clearly noted as “lost during recovery” to ensure transparency and completeness of the sampling record, and these entries are marked as MachineObservation rather than PreservedSpecimen in the basisOfRecord field.

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Related Publications

Cairns, S. D., Vaga, C. F., & Breedy, O. (2026). Records of Primnoidae (Octocorallia, Scleralcyonacea) from Costa Rican Pacific seamounts. Marine Biodiversity, 56(1). https://doi.org/10.1007/s12526-026-01621-9
Results

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Related Datasets

IsRelatedTo

(2024) **SuBastian ROV Sample Log.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-08-13 http://lod.bco-dmo.org/id/dataset/935534 [view at BCO-DMO]
Relationship Description: Occurrence data for Sample Log

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Parameters

Parameter	Description	Units
eventID	Unique identifier for the sampling event, structured as cruiseID-DiveID (e.g. FKt230602-S0529)	unitless
occurrenceID	Unique identifier for each occurrence record within the samples, structured as eventID-SamplingNumber_SequentialRecord (e.g., Fkt230602-S0529-005_1), where eventID corresponds to CruiseID-DiveID (e.g., Fkt230602-S0529), SamplingNumber is the sequential number recorded in the expedition master log for sampling events (e.g., 005), and SequentialRecord is a suffix distinguishing multiple biodiversity occurrences derived from the same eventID and SamplingNumber (e.g., _1)	unitless
associatedOccurrences	Reference to any other related occurrences (e.g., symbionts, associated fauna)	unitless
recordNumber	Identifier given to the occurrence at the time of recording	unitless
institutionCode	The name (or acronym) in use by the institution having custody of the object(s) or information referred to in the record (in all cases MZUCR: Universidad de Costa Rica, Museo de Zoologia)	unitless

institutionID	An identifier for the institution having custody of the specimens or information referred to in the record. In all cases, Universidad de Costa Rica, Museo de Zoologia, (GBIF Code: MUCR, GBIF Identifier: 44dcc317-1bee-4dda-ba59-b78c4a185c9d)	unitless
collectionCode	The name identifying the collection from which the record was derived (e.g. Cnidaria, Mollusca)	unitless
catalogNumber	An identifier for the record within the museum collection (e.g. MZUCR-10560-01)	unitless
associatedMedia	A list of media associated with the occurrence. In this dataset, it corresponds to the relative path to the folder containing in situ and laboratory images for each occurrence, when available	unitless
basisOfRecord	The specific nature of the data record (PreservedSpecimen, MachineObservation)	unitless
occurrenceStatus	A statement about the presence or absence of a Taxon at a Location (i.e. present)	unitless
disposition	The current state of a sample with respect to a collection (e.g. in collection, missing, destroyed)	unitless
organismQuantity	A number or enumeration value for the quantity of organisms (eg. 1, 25, many)	unitless
organismQuantityType	The type of quantification system used for the quantity of organisms (e.g. individuals)	unitless
occurrenceRemarks	Comments or notes about the occurrence, including field notes	unitless
verbatimIdentification	A string representing the taxonomic identification as it appeared in the original record	unitless
scientificName	Full scientific name of the organism at lowest taxonomic level	unitless
identificationQualifier	A controlled value to express the determiner's doubts about the identification (e.g., cf.)	unitless
scientificNameID	An identifier for the nomenclatural details of a scientific name, following WoRMS database (e.g. urn:lsid:marinespecies.org:taxname:146142)	unitless

scientificNameAuthorship	The authorship information for the scientificName formatted according to the conventions of the applicable nomenclaturalCode (as in WoRMS)	unitless
taxonRank	The taxonomic rank of the most specific name in the scientificName (e.g. Genus, Species, Family, Order, Class, Phylum)	unitless
kingdom	The full scientific name of the kingdom in which the Taxon is classified	unitless
phylum	The full scientific name of the phylum or division in which the Taxon is classified	unitless
class	The full scientific name of the class in which the Taxon is classified	unitless
order	The full scientific name of the order in which the Taxon is classified	unitless
family	The full scientific name of the family in which the Taxon is classified	unitless
projectTitle	Title of the research project under which the sampling event was conducted	unitless
projectID	Identifier for the project that contributed to the sampling event	unitless
eventDate	Date when the sampling event associated with the occurrence was recorded	unitless
eventTime	Time when the sampling event associated with the occurrence was recorded, HH:MM:SS (UTC)	unitless
eventDateTime_UTC	Datetime when the sampling event associated with the occurrence was recorded (UTC)	unitless
decimalLatitude	Geographic latitude of the occurrence, expressed in the coordinate reference system specified by geodeticDatum	decimal degrees
decimalLongitude	Geographic longitude of the occurrence, expressed in the coordinate reference system specified by geodeticDatum	decimal degrees
maximumDepthInMeters	Maximum depth where the occurrence was recorded	meters
minimumDepthInMeters	Minimum depth where the occurrence was recorded	meters

samplingProtocol	Protocol for sampling	unitless
verbatimLocality	Original locality string exactly as recorded	unitless
locality	Standardized or interpreted locality name	unitless
country	Country where the sample was collected	unitless
waterBody	Major water body where the event took place (e.g., Pacific Ocean)	unitless
locationID	Identifier for the geographic place or region (i.e., Marine Regions ID)	unitless
eventRemarks	Notes or comments about the environmental context or event	unitless
geodeticDatum	Datum upon which geographic coordinates are based (e.g., EPSG:4326)	unitless
preparations	Description of specimen preservation or processing steps	unitless
organismRemarks	Additional remarks or observations about the organism	unitless
recordedBy	Names of persons who recorded or collected the organism	unitless
identifiedBy	Names of persons who identified the organism	unitless

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Instruments

Dataset-specific Instrument Name	high-definition imaging systems
Generic Instrument Name	Camera
Dataset-specific Description	The ROV is equipped with manipulator arms, a slurp sampler, biological collection nets, and high-definition imaging systems for in situ documentation.
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	
Generic Instrument Name	Camera
Dataset-specific Description	All specimens were photographed in the wet lab following standardized imaging protocols to ensure consistent documentation as soon as possible after recovery. A clean black or white matte background was used for all photographs, with uniform lighting, a measurement ruler and its label included in each frame. Each specimen was photographed with its label containing its unique sample code clearly visible, capturing dorsal, ventral, and lateral views.
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	slurp sampler
Generic Instrument Name	Multi-chamber Suction Sampler
Dataset-specific Description	The ROV is equipped with manipulator arms, a slurp sampler, biological collection nets, and high-definition imaging systems for in situ documentation.
Generic Instrument Description	An underwater device that collects animals and other samples under gentle suction and deposits them into a collection chamber. Also known as an oceanographic 'slurp' sampler. The primary components are an electrical or hydraulic pump, outlet hose connected to collection chamber, and inlet hose.

Dataset-specific Instrument Name	remotely operated vehicle (ROV) SuBastian
Generic Instrument Name	ROV SuBastian
Dataset-specific Description	All biological samples and associated imagery were collected using the remotely operated vehicle (ROV) SuBastian, operated by the Schmidt Ocean Institute aboard the R/V Falkor (too).
Generic Instrument Description	ROV SuBastian is operated from the research vessel Falkor and the R/V Falkor(too). The ROV is outfitted with a suite of sensors and scientific equipment to support scientific data and sample collection, as well as interactive research, experimentation, and technology development. More information available at https://schmidtocean.org/technology/robotic-platforms/4500-m-remotely-op...

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Deployments

FKt230602

Website	https://www.bco-dmo.org/deployment/935537
Platform	R/V Falkor (too)
Start Date	2023-06-01
End Date	2023-06-22
Description	Operator: Schmidt Ocean Institute Project Octopus Odyssey Start Port: Puntarenas, Costa Rica End Port: Puntarenas, Costa Rica See additional information at R2R: https://www.rvdata.us/search/cruise/FKt230602

FKt231202

Website	https://www.bco-dmo.org/deployment/935539
Platform	R/V Falkor (too)
Start Date	2023-12-02
End Date	2023-12-15
Description	Operator: Schmidt Ocean Institute Project: Octopus Odyssey (Too) Start Port: Balboa, Panama End Port: Golfito, Costa Rica See additional information at R2R: https://www.rvdata.us/search/cruise/FKt231202

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Project Information

Octopus Odyssey (OctoOdyssey)

Website: https://schmidtocean.org/cruise/octopus-odyssey/

Coverage: Central Eastern Pacific offshore Costa Rica

Brief Overview:
The first Octopus Odyssey expedition took place from June 2 to June 21, 2023 on R/V Falkor (too). The second expedition, Octopus Odyssey (too) took place from December 2 to December 15, 2023. Both expeditions explored The Dorado Outcrop, one of Costa Rica's "Off-Axis seamounts on the complex Cocos Plate. These two cruises featured early career training activities and international capacity-sharing elements that were integrated into the NSF-funded COBRA program. In addition to the NSF award, this project was also supported by Schmidt Ocean Institute, Blue Nature Alliance, and Bigelow Laboratory for Ocean Sciences.

More information is available from Schmidt Ocean Institute at:
https://schmidtocean.org/cruise/octopus-odyssey/
and
https://schmidtocean.org/cruise/octopus-odyssey-too/

Detailed Description:
Seamount ecosystems support highly diverse animal communities on the seafloor and the surrounding ocean, yet the diversity, connectivity and ecosystem services of these environments is poorly understood. The Pacific Ocean margin of Costa Rica contains a range of seamount habitats, from the rough terrain of the southwestern margin to the sparser terrain of the northwest margin. While the southwestern terrain has previously been surveyed (including by R/V Falkor in 2019) and some seamount areas are already protected, far less is known about the ecosystems of the northwestern terrain. In 2013/2014 unique animal behaviors and hydrothermal venting were discovered using ROV Jason and HOV Alvin on a small feature in the northwestern terrain. Namely, extensive aggregations of octopus were observed at a place called the Dorado Outcrop, located in areas of diffuse venting of slightly warmed hydrothermal fluids. At the time of discovery, it was unclear if these aggregations could be considered nurseries, since no viable eggs were observed with brooding mothers.

Two expeditions of the RV Falkor (too) were planned for 2023 to return to this region to ask new questions about the connection of life, rocks, and fluids around these seafloor features. The team wanted to answer questions, such as:

- Are there viable octopus nurseries hosted on seamounts offshore Costa Rica?
- If yes, are the octopus nurseries active at a different time of year?
- Do octopus brooding in hydrothermal springs have different microbiomes as compared to other octopus, and are those microbiomes connected to the microbes in the hydrothermal springs or surrounding rocks?
- Are the hydrothermal spring fluids unique, representing different trends in fluid-rock-life reactions, or do they represent a single altered fluid?
- Are there seasonal trends in biodiversity on the seafloor or in the water above?

In June of 2023, an international team traveled to this region aboard R/V Falkor (too) for the Octopus Odyssey Leg 1 expedition Fkt230602 with a major goal to determine if the eggs at the nursery were viable, as past expeditions to the outcrop had never seen evidence of developing embryos. From 2-21 June 2023, we conducted 14 dives with ROV SuBastian to explore six seafloor features (only one of which had ever been explored before), augmented by 13 full-water-column CTD Niskin Rosette casts and six multibeam surveys. We had roughly 229 hours of ROV operations in the water (172 hours on the seafloor + 57 hours of ascent/descent), resulting in 208 hours of video. The longest ROV dive was approximately 35 hours and the deepest depth of ROV exploration was 3178 m. We had 285 sampling events during the ROV dives: 150 primary biological specimens (plus associates), 66 sediment push cores, 28 ROV Niskin samples of bottom water, 13 squeezer fluid samples, 30 rock samples. This also included deployments of 22 different experiments planned for recovery in December 2023, and recovery of 2 experiments from the Dorado Outcrop deployed in 2014. We also conducted 31 video transects. Operations went very smoothly, although some transit between sites had to be diverted due to long line fishing in the area, and one medical evacuation required transit to port before returning to site. On the first ROV dive at the nursery in June, we witnessed baby octopus hatching, confirming our primary hypothesis that there are viable octopus nurseries in this region. We also found the fifth known octopus nursery in the world on a different seafloor feature 30 nautical miles away. Exploration of the six seafloor features on the expedition revealed an incredibly rich biodiversity and biogeography of life on ancient volcanoes offshore Costa Rica. We also documented additional evidence of the hydrogeology of the region – how water moves in, out, and through oceanic crust. This data can inform why volcanoes and earthquakes in Costa Rica vary as different types of seamounts and oceanic crust subducts beneath overriding plates.

In December 2023, the Octopus Odyssey (too) Leg 2 team returned to this region on RV Falkor (too) on expedition Fkt231202 to ask new questions about biodiversity in the region and to recover experiments to track the hydrogeology of the area. From 1-15 December 2023, Octopus Odyssey (too) conducted twelve full-ocean depth ROV dives with ROV SuBastian, augmented by five full-ocean depth CTD Niskin Rosette casts, and multibeam operations resulting in 7416 km2 of coverage in Costa Rican waters. We had roughly 104 hours of ROV operations (55 hours on the seafloor + 49 hours of ascent/descent). This has resulted in approximately 141 hours of video. The longest ROV dive was a little over 16 hours and the deepest depth of ROV exploration was 3179 mbsl. We had 241 sampling events with the ROV in the water: 93 primary biological specimens, 14 sediment push cores, 21 ROV Niskin samples, 20 rock samples, and 51 fluid samples collected with a third-party SUPR sampler. On the ship, we collected an additional 66 secondary associate biological samples from primary specimens, bringing the total number of samples to 307 (this does not include subsamples). We also conducted 23 video transects. For the most part, our operations went according to schedule. No ROV operations were ended early due to operational issues, although one dive was aborted on launch due to a ground fault in a third-party instrument; this was quickly resolved and the dive restarted. One dive ended early due to a fishing long-line drifting towards the vessel; we recovered early then re-dove on the site after the long-line passed by. Communications with fishing boats and the fisheries ministry, enabled by the Berth-of-Opportunity Observer from Instituto Costarricense de Pesca y Acuacultura (INCOPESCA), helped prevent further issues in the area. The biggest finding of the return expedition was confirmation that the octopus nurseries offshore Costa Rica support baby octopus throughout the year, not just in the summer rainy season. Scientists onboard witnessed spectacular scenes of the first moments of life, as baby octopus emerged from their eggs, including traveling with one hatchling for an epic journey over 150 m up into the water. Immature eggs were also observed to have tiny octopus embryos inside. Having two expeditions to the same region in one year was essential for confirming this finding. Moreover, the seamounts offshore Costa Rica support at least four new species of deep-sea octopuses, based on the collection of specimens from both Octopus Odyssey expeditions in June and December 2023. This is an unprecedented biodiversity of octopus in this small area especially at these depths.

Equally as important as achieving the scientific objectives was the objective to continue the theme of capacity

sharing, early career development, and raising awareness of deep-sea heritage in Latin America. The international Octopus Odyssey and Octopus Odyssey (too) teams gathered to achieve collaborative co-production of knowledge and training with Costa Ricans, honoring the work in Costa Rica's waters. Spanish-speaking scientists were given priority for dive lead watches to enable livestream narration in Spanish, and priority for leadership experience. Ship-to-shore engagements were also prioritized for Spanish-speaking audiences, particularly in Costa Rica. These efforts were intended to raise the profile of the deep-sea heritage in Costa Rica ahead of the 2024 UN Ocean Conference meeting taking place in Costa Rica in June 2024. Over 300 biological specimens collected on the two expeditions are archived at the Museum of Zoology at the University of Costa Rica, enabling current and future generations of students and researchers to develop expertise in regional deep-sea animals. It is likely that many of the specimens collected represent new species and new records of known species for the region. Rock and sediment samples collected on the expeditions are revolutionizing the understanding of the complex geological origins and processes occurring on this part of the seafloor. Surprisingly, initial analysis of microfossils in sediments reveals that seafloor sediments are millions-of-years old, indicating strong currents, dissolution and scouring. In addition, fossils of beaked whales were found on numerous outcrops. All microfossils and macrofossils are archived in the Paleontology collection at the Central American School of Geology at the University of Costa Rica for continued study, with additional mineralogical samples shared with the Global Marine Minerals Program at the U.S. Geological Society. Finally, bathymetric and subbottom profile mapping data conducted on the OctoOdyssey expeditions was used to define the diverse seafloor features in this region to then propose official names to GEBCO. This naming effort is being led by Costa Rican scientists in consultation with the Costa Rican Committee on Nomenclature; the new proposed names were unanimously approved by the committee and will now be included on Costa Rican maps.

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Program Information

Crustal Ocean Biosphere Research Accelerator (COBRA)

Coverage: global

NSF Abstract:
The deep seafloor covers two-thirds of Earth's surface area, but there is limited understanding of the deep-ocean ecosystems and resources and the ability of these ecosystems to withstand human impacts. Human uses such as deep-sea mining and carbon sequestration are poised to fundamentally alter physical, chemical, and biological conditions of the seafloor and surrounding environments. These activities have the potential to rival negative effects from bottom fishing and other human impacts to the deep sea, yet the science to inform and evaluate the impacts of these new industries is lacking. The Crustal Ocean Biosphere Research Accelerator (COBRA) project connects diverse stakeholders and experts – interdisciplinary academic and government scientists, private institutions, policy makers, industry experts and other stakeholders – through virtual meetings to coordinate efforts. The goal is to generate new knowledge and inform decision-making relating to emergent industrial uses of the deep ocean and decrease the likelihood of serious harm to the environment while maintaining the broad benefits that society currently enjoys.

The COBRA network of networks has nine key partners that bring access to international science and crustal ocean exploration assets (Ocean Exploration Trust, Schmidt Ocean Institute, Ocean Networks Canada, Cluster Ocean Floor at MARUM, and C-DeepSea), to experts that provide science-based recommendations to policy makers (Deep Ocean Stewardship Initiative working groups, including the Challenger 150 program), to governmental groups responsible for assessing crustal ocean resources (USGS Global Marine Minerals Group), and to experts in team science (CREDITS program). COBRA unites these partners in a common mission to accelerate research on the structure, function, resilience, and ecosystem services of the crustal ocean biosphere to inform decision making. COBRA will help to close knowledge gaps by facilitating dedicated and coordinated expedition and observatory efforts combined with emergent characterization approaches. In parallel, COBRA will train at least 50 globally distributed early-career researchers in ocean exploration, science, and policy through innovative virtual expedition leadership training and support two dozen international research exchanges that promote team science collaboration, diversity, equity, and inclusivity. COBRA will also establish a web-based search portal that points to all data types deposited in appropriate internationally accessible data repositories to promote data discovery and accelerate knowledge transfer and collaboration.

The Accelerating Research through International Network-to-Network Collaborations (AccelNet) program is designed to accelerate the process of scientific discovery and prepare the next generation of U.S. researchers for multiteam international collaborations. The AccelNet program supports strategic linkages among U.S. research networks and complementary networks abroad that will leverage research and educational resources to tackle grand scientific challenges that require significant coordinated international efforts.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

Description:

The mission of the Crustal Ocean Biosphere Research Accelerator (COBRA) is to accelerate research on the structure, function, resilience, and ecosystem services of the crustal ocean biosphere to inform decision making. The goal is to generate new knowledge and inform decision-making relating to emergent industrial uses of the deep ocean, such as deep-sea mining and subseafloor carbon sequestration, and decrease the likelihood of serious harm to the environment while maintaining the broad benefits that society currently enjoys. COBRA will help to close knowledge gaps by facilitating dedicated and coordinated expedition and observatory efforts combined with emergent characterization approaches. In parallel, COBRA will train at least 50 globally distributed early-career researchers in ocean exploration, science, and policy through innovative virtual expedition leadership training and support two dozen international research exchanges that promote team science collaboration, diversity, equity, and inclusivity. COBRA will also establish a web-based search portal that points to all data types deposited in appropriate internationally accessible data repositories to promote data discovery and accelerate knowledge transfer and collaboration.

Affiliated Programs:
C-DEBI, IODP, OOI, DOSI, Schmidt Ocean Institute, Ocean Exploration Trust, Ocean Networks Trust

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Funding

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