CINDAQ
Centro Investigador del Sistema Acuífero de Quintana Roo

# 2021


## CINDAQ 2021 Annual Report

**Prepared by:**

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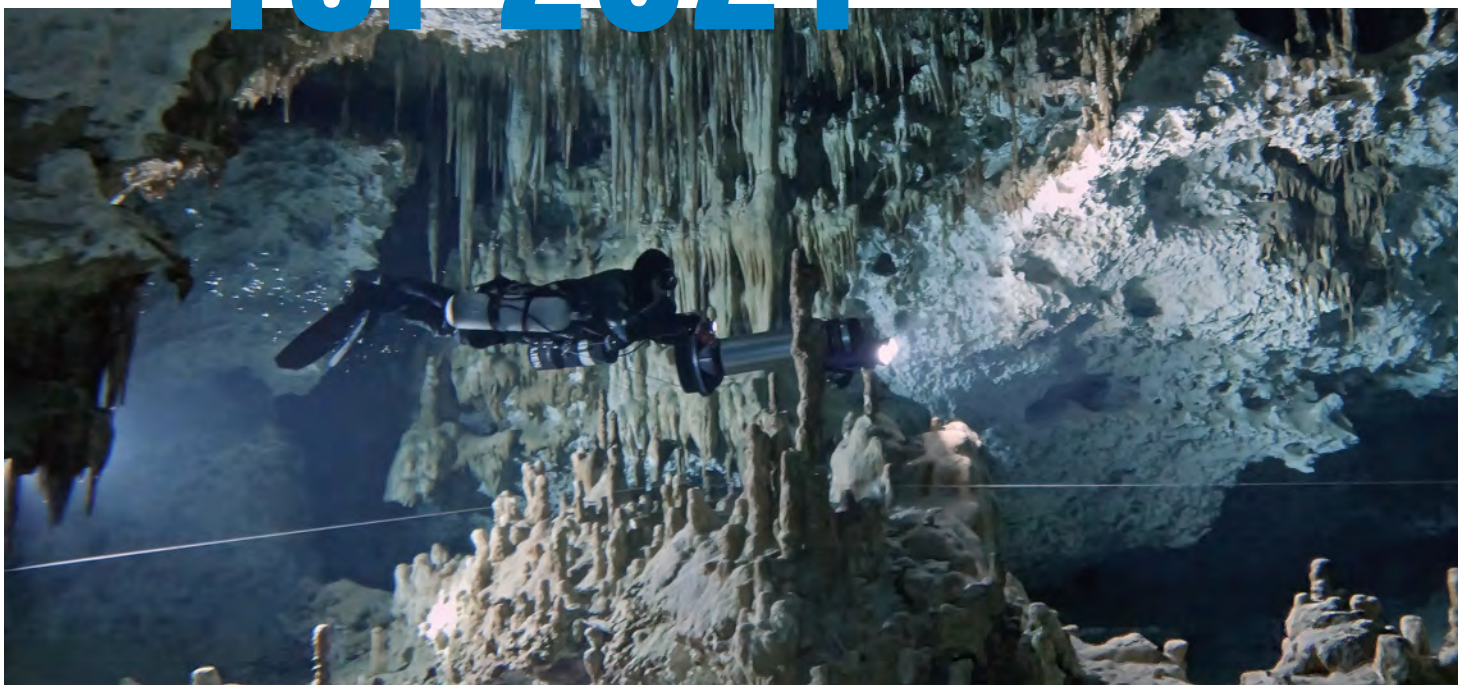
**Sam Meacham, Daniel Ponce Taylor**

Facilitate research, promote education and support the conservation
of natural and cultural resources associated with
cenotes and underground rivers of Quintana Roo, México

Explore

# CINDAQ Exploration for 2021



# Content




# EDITORIAL

## Surfacing vital knowledge

### A foundation for scientific work to help understand & protect the aquifer of Quintana Roo, Mexico

Rampant development continues to threaten one of Mexico's largest, most pristine and culturally significant aquifers. The coast of Mexico's Riviera Maya faces unprecedented growth (even in the face of a continuing global pandemic) that places it among the fastest growing regions of the world. Out of sight and mind, the flooded cave systems of the region play a crucial role as the conduits for freshwater moving from the jungle interior out to the Mesoamerican Barrier Reef.

The need to explore and better understand the aquifer of Northern Quintana Roo is important as it directly influences the health and economic wellbeing of the human population above it and the many ecosystems and wildlifew it nourishes from below. Due to the aquifer's extreme fragility and vulnerability to contamination, the development at the surface poses a significant long-term threat to the economic and social welfare of the region.

Cave diving explorers provide a critical knowledge base by mapping and documenting the subterranean waterways, providing a foundation for scientific work that ultimately can help us understand and protect the aquifer and the many ecosystems that it supports.

# OX BEL HA

We continued our efforts to resurvey, document and explore the entire Ox Bel Ha cave system. **Since 2018, 147,000 m of resurvey and 82,000 m of exploration** have been achieved by our team. In **2021** alone, a total of **57,000 m of cave were resurveyed**, and over **35,000 m of new cave passageways were explored**. Improvements were made to better integrate Ariane Cave Mapping software and our GIS database, allowing us to have updated maps availablem across cell phones, tablets and computers on the same day as work is completed. As a team, we can make more informed choices for the next day of diving which in turn leads to safer, more efficient diving. We appreciate the efforts of **Wetherbee Dorshow of Earth Analytic Inc** and **Sebastien Kister of Ariane** as we continue to build this platform. We also began to pay more attention to our comments and observations making special note of the presence of biology,

## 2021

| | |
|---|---|
| 56,686 M | RESURVEY |
| 35,060 M | EXPLORATION |
| 91,746 M | TOTAL WORK |

> "Ox Bel Ha continues to amaze us with its beauty"

charcoal, ocher, and possible prehistoric human activity on our survey data. Over time, and as these observations expand across the cave landscape, they will allow our scientific partners to better understand what we see within the caves and tailor their studies accordingly. Julien Fortin and Andreas Rosland developed a pragmatic method of mapping in order to increase their efficiency and safety while exploring. This is quickly becoming the modus operandi for the team, especially in Ox Bel Ha.

## A NEW PRAGMATIC MAPPING METHOD


Ox Bel Ha continues to amaze us with its beauty, complexity and obvious importance as a **vital link between the jungle environment and the sea**. We had the great fortune to observe jaguars on 4 separate occasions this year while driving on these jungle roads. We are also concerned about the future of this magnificent cave as Tulum continues to develop at a tremendous pace.

# SIAN KA'AN

Our previous exploration from Cenote Boca Paila from 2006 to 2016 hinted at the continuation of this system to the southwest. The significant size of the cave passage coupled with strong flow of water coming from the west/southwest pointed towards a group of very large cenotes 7 km in the Zona Nucleo. In early 2021, we were finally able to launch a three-phased project to access this interesting area. **Phase One**, in February, had the goal of

> An impressive cave in an area of critical value & importance: the Sian Ka'an Biosphere Reserve

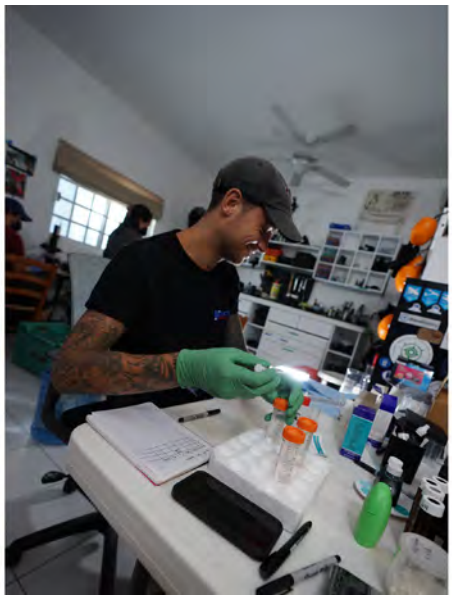
determining whether a helicopter could land in a small clearing close to one of these large cenotes. We succeeded in doing so and, upon landing, were able to breath-hold dive the cenote and determine that it was worthwhile to return with dive gear. **Phase Two** in October had our team return with dive gear, and the objective to confirm that there was indeed a significant cave. We also successfully achieved this objective, with **the cave being larger than anything we have seen here in close to 30 years of experience**!

An additional outcome was to provide reserve management with drone assessments of recent forest fire sites within the reserve, in addition to aerial observation and documentation from the helicopter. In 2022, we plan to begin **Phase Three**, which will see us establishing a base camp in the area to fully focus on exploring and documenting this amazing cave. We are all extremely excited about what this area will yield and how it will allow us to further demonstrate **the value and importance of the Sian Ka'an Biosphere Reserve**.

### SIAN KA'AN PROJECT IN 2021

- 2 HELICOPTER FLIGHTS INTO THE ZONA NUCLEO
- FOREST FIRE ASSESSMENT USING DRONES
- FIRST EXPLORATORY DIVE IN CENOTE TUUN JA

# VIROLOGY


This project has been designed by researchers from **University of California, San Diego (UCSD)** and **San Diego State University (SDSU)** and la **Universidad Nacional Autónoma de México (UNAM)**. CINDAQ collected water samples that allowed the research team to measure environmental data from several diverse underwater sites within the Sistema Ox Bel Ha cave system. The first stage of this project entailed collecting pH, temperature, nutrient, and dissolved oxygen of the environment, purification and 16S sequencing of bacteria found at each site, as well as quantitative microscopy of viruses and bacteria (virus to microbe ratio, "VMR"). Gene sequence data was phylogenetically sorted and identification will be made of known and previously unknown bacteria.

Final results are still forthcoming and we expect publication of this research by mid 2022.

# KANXOC

We returned to the Kanxoc Ejido in May to follow up with our 2020 visit. The main cenote, while large and beautiful, did not offer much underwater. We were also shown two other cenotes, one of which promising, but starting in a dry cave with low oxygen levels forcing us to abort our descent on ropes until we figure out how to safely return and dive. Single day projects like this are a great way for us to get into the field, see new areas, and connect or reconnect with the local Maya communities. **We are grateful to the local Ejiditarios from Kanxoc** for the invitation and to the **Ejiditarios of Pac Chen** who provided their skills in vertical rope work to get the divers in and out of the water.

# BRAZIL

From September 1-13, 2021, CINDAQ team members Julien Fortin, Christophe Le Maillot, and Sam Meacham collaborated with **GUE Brazil** on an exploration project in Brazil, with the objective of creating a high resolution vector map of a cave with accurate geographic placement of all features within.

The project was organized by GUE Brazil under the direction of **Dr. Sergio Rhein Schirato, Susanne Schumacher Schirato and Alexandre Jardim**.

CINDAQ was invited to participate because of our expertise in both cave survey/ cartography and documentation of underwater cave sites. This project was an opportunity for us to adapt our skills and expertise to a completely new and remote area and put them to the test. We are pleased with the results and have realized that, based on what we accomplished during this project, there is potential for us to help build capacity for teams working in similar environments around the world, not to mention remote areas in our own region.

> "Putting our expertise to the test in a new environment: working with GUE Brazil"

**RESULTS OF 6 DAY BRAZIL PROJECT:**

- CAVE RESURVEY: 1,000+ M
- HIGH RES CAVE MAPPING & 3D MODEL: 1250 M
- DRONE ORTHOPHOTO/3D MODEL: 539 HA
- PHOTOGRAMMETRY: 3 MODELS
- MEDIA: 2000+ PHOTOS, 6 HOURS OF VIDEO
- DATA MANAGEMENT: 330 GB, 8000+ FILES
- SEARCHABLE, SHARABLE ARCHIVE

# CAVE MONITORING

Whereas exploration, survey and mapping allow us to take a snapshot of the physical features of the cave at a given point in time, installing sensors in the cave to measure flow, temperature, salinity, water level or any other information and building an architecture to access that data **in real time** would potentially open new fields of investigation for our scientific partners and reveal previously unnoticed patterns throughout the cave systems.

**Dr. Richard Wylde**, has put his wealth of scientific knowledge and experience into the drafting of a concept to implement this idea.

# BIOLOGY

**Dr. Fernando Alvarez** of the **Universidad Nacional Autónoma de México's (UNAM) Instituto de Biología** is the leading expert on the fauna of Mexican anchialine caves. With him, we designed a data collection template that includes all of the relevant information he requires for observation and collection of biological samples.

A preliminary study of some samples show the presence of the remipede Xibalbanus tulumensis in cenote Gemini II, the isopod Cirolana yucatana in Cenote Anselmo and **a possible undescribed species** of polychaete (Annelida) from Cenote Gemini II. The latter is of interest since this organism was captured in freshwater. Normally, the species in that group are marine.

All these records and others to be examined in the coming months represent, in any case, the southernmost occurrences of these species along the coast of the Mexican Caribbean. CINDAQ also collected photographic and video records of what seem to be new species in two more invertebrate groups.

*Pictures courtesy of Dr. Tom Iliffe*

# SCIENCE PROJECT

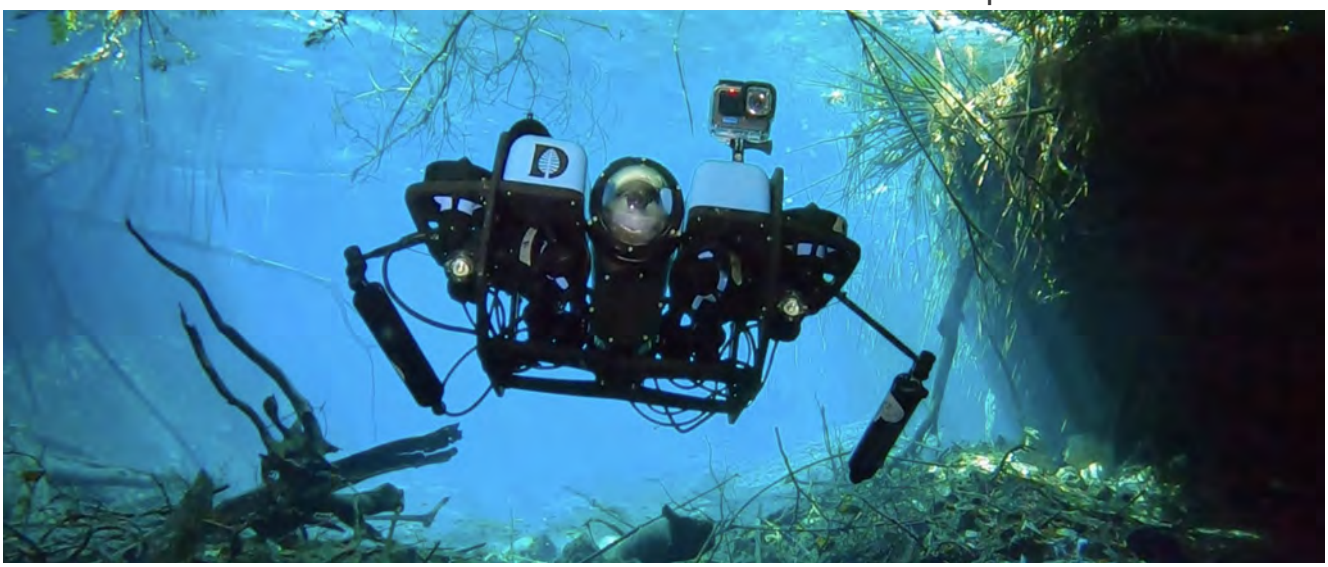
**Dr. Eduard Reinhardt** celebrated his 15th year studying the aquifer and caves of Quintana Roo. Over these years, he has pioneered the understanding and historical recreation of the area's aquifer. Apart from the usual microfossil sediment and algae work, we experimented with new tools and methods of sample collection to better understand the intricacies of the karst environment. Although his students at McMaster University were not able to travel for field work, they will play an important role in further lab work and data analyzis.

It was also a pleasure to assist **Dr Ioannis Rekleitis** and his students from the University of South Carolina and his underwater robotics research, along with **Dr. Alberto Quattrini Li** and his students from Dartmouth College to test a prototype autonomous cave mapper.They first tested a single action camera for tracking its trajectory in conjunction with a sparse representation of the environment, and examined the effect of percolation during loop-closure operations. Data was also collected utilizing a sensor suite containing stereo cameras, Inertial Measurement Unit (IMU), water depth sensor and a pencil beam scanning sonar. It is expected that the stereo camera along with the sonar sensor will provide more accurate results than a single camera.

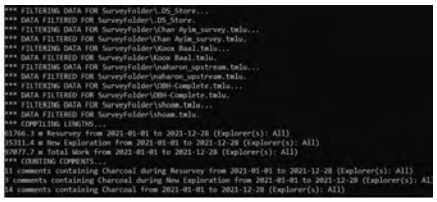
Next, a custom-made autonomous underwater vehicle was deployed in the open water area of the cenotes and in the caves with two main goals. First, to collect data using a camera, an IMU, a water depth sensor, a multi-beam sonar, and controllable dive lights, with the robot carried by a diver.

This was the first time such a collection of sensors has been deployed in this environment. The data will be used to understand the utility of a multi-beam sonar in detecting obstacles and open spaces, as well as for 3D reconstruction. The second goal was to test some primitive autonomous behaviors. The Dartmouth robot was deployed inside the cave and performed preprogrammed motions autonomously. During these maneuvers, sensor data was also collected which will allow the team to better design the full autonomy of the robot.

Special thanks to the 22 volunteer GUE divers from 8 countries
who dedicated their time and abilities to facilitate these important studies.



# DATA MANAGEMENT



Over the past 25 years, CINDAQ has collected a wealth of data pertaining to all aspects of the aquifer, the bioregion and the local communities. While the value of the collected data is undeniable, the CINDAQ team became increasingly aware of the need for a comprehensive system to store, sort, access and share the available information, which previously was spread over various media without any centralized tool that would allow us to leverage it for future scientific and exploration projects.

Based on this idea, three main objectives were defined and achieved in 2021: build a hardware infrastructure and define methods to store past and future CINDAQ data, sort through existing data from the past 25 years and store it into the new infrastructure, and set up tools to access and share this data, both within the CINDAQ team and with external partners.

With our data management system now solidly in place, we have begun to integrate the information stored with our GIS infrastructure. As we begin to develop and expand on this, we will be able to help scientists not only visualize the spatial distribution of our data specific to their field of study, but to also query and quickly reference it.

> "Leveraging the collected data and sharing it with scientists"

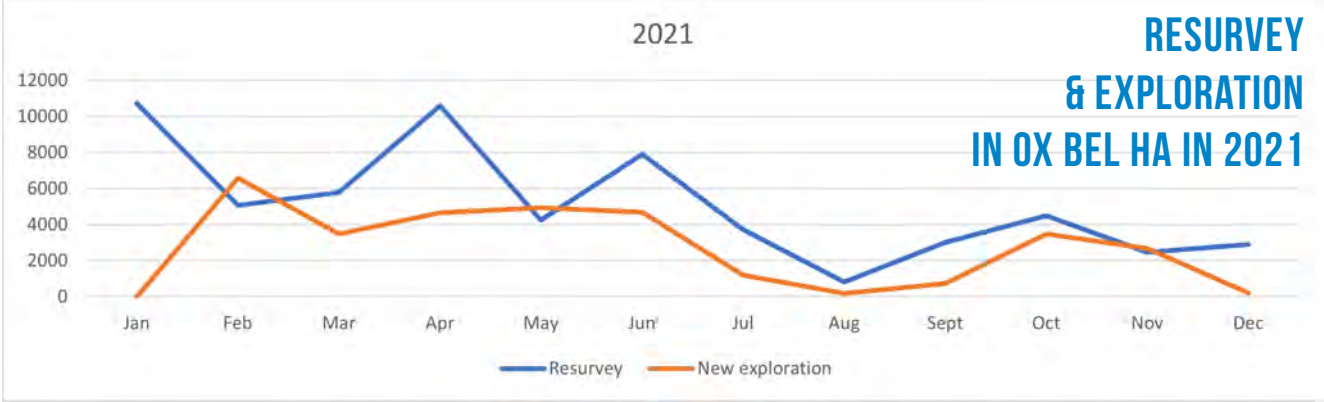
While a geo-located file structure has proven very useful we also started leveraging more advanced tools to mine data from these files. We can now extract information allowing us to monitor exploration progress by cave system, team member, time period, or to parse all survey comments to try and identify patterns in the cave.

In order to ensure that none of this data or the effort put into organizing it is getting lost, we implemented a triple backup system. All data storage procedures have been documented in comprehensive SOPs to make sure that they can be maintained by all current and future team members.

## CINDAQ DATA : KEY FIGURES

- 15.26 TB, 540,335 FILES, 27,551 FOLDERS
- 350,000 PICTURES & 16,500 VIDEOS
- 20,000+ PICTURES TAGGED AND SEARCHABLE
- 3 COPIES OF ALL CINDAQ DATA
- MULTIPLE WAYS OF ACCESSING THE DATA

## RESURVEY & EXPLORATION IN OX BEL HA IN 2021



# KO'OX HANAL

## A total of $41,000 USD raised

**$19.3** USD spent for each food pack

**2,050** family food packs delivered to date

**41** deliveries made

## What we have delivered:

- 36,900 eggs
- 2,060 lt oil
- 6,156 packets cookies
- 4,100 kg oatmeal
- 4,110 kg rice
- 2,120 kg sugar
- 1,852 lt bleach
- 12,300 kg beans
- 8,200 rolls toilet paper
- 7,990 kg pasta
- 3,214 bars soap
- 2,260 kg salt
- 8,200 kg corn flour

## Supported communities

- **70** families — Pac Chen — 11 visits
- **135** families — Tres Reyes — 3 visits
- **20** families — Francisco Uh May — 10 visits
- **40** families — El Naranjal — 9 visits
- **30** families — San Juan de Dios — 10 visits
- **55** families — Punta Laguna — 1 visits

### All about the communities

In January we concluded our Ko'ox Hanaal food relief effort. As COVID eased and travel restrictions relaxed, the communities we helped were able to get back on their feet.

Over the 8 months that we operated, we raised a total of $41,000 USD. This allowed us to make a total of over 40 combined visits to the communities of Pac Chen, San Juan de Dios, Francisco Uh May, El Naranjal, Tres Rios, and Punta Laguna.

The infographic on the left shows the incredible impact we were able to have on these communities. We thank all of those who contributed to this effort.

## A HUGE THANK YOU

to all of you who generously donated to the Ko'ox Hanal project.

Your contribution to this efforts is what allowed us to help over 350 families in a time of great need.

# UNESCO

We are very proud to announce that in June of 2021 our application to become **an accredited NGO for the 2001 UNESCO Convention on Underwater Cultural Heritage** was accepted.

The accreditation recognizes our commitment to following the best practices outlined in the convention to study and protect underwater archaeology. Fred, Chris and Sam were all able to upgrade their levels of certification from the Nautical Archaeology Society to 'Award in Maritime Archaeology' in time to present it with our application. The Award in Maritime Archaeology recognizes each team members 200 credits from Maritime Archaeology Courses, Events or Fieldwork, and at least a 2,000 word archaeological report.

UNESCO

Organización de las Naciones Unidas para la Educación la Ciencia y la Cultura

La protección del patrimonio cultural subacuático

**BUENA PRÁCTICA CONVENCIÓN UNESCO 2001 PARA LA PROTECCIÓN DEL PATRIMONIO CULTURAL SUBACUÁTICO**

**We are the first NGO to be accredited that works in the underwater cave environment** and only one of seventeen NGOs worldwide to have accreditation

We are grateful to the help we received from Dr. Roberto Junco Sanchez and Arq. Helena Barba Meinke of INAH-SAS, Chris Underwood of the ICOMOS-International Council of Underwater Cultural Heritage (ICUCH), and Mark Beattie-Edwards of the Nautical Archaeology Society. CINDAQ's accreditation opens doors for funding opportunities and to a network of scientists around the world for us to learn from and share experiences.

More information can be found on https://en.unesco.org/underwater-heritage

# MEETINGS

Although most of us would prefer to just go diving, meetings and partnerships can shape the value of our time spent underwater. Our expertise can provide scientific and technical advice to the municipalities and elected representatives, who should then take the provided documentation and conclusions and transform them into municipal and local regulations.

This year we have maintained and established new partnerships with parallel organizations including Centinelas del Agua, Cenoteando/UNAM Sisal, UCSD/QUALCOMM, UNAM, Comisión Nacional de Área Naturales Protegidas (CONANP).

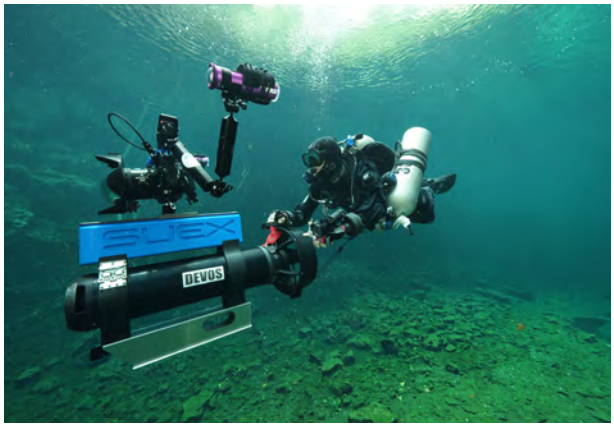
## PARTNERSHIPS & MEETINGS 2021

- MEMBER OF MUNICIPAL WATERSHED COMMITTEES
- NEW PARTNERSHIPS SIGNED WITH LOCAL ORGANIZATIONS
- ATTENDED SUSTAINABLE AND SOCIAL SUMMIT
- A TTENDED SESSIONS FOR THE ECOLOGY COMMISION AND THE TOURISM AND ECOLOGY COMMISSION, SOLIDARIDAD
- ATTENDED SESSIONS FOR AGENDA TULUM

# MEDIA

The information and imagery surrounding our work can be a very useful tool in generating awareness and understanding. We are **continually improving our video production abilities** both underwater and at the surface. We were able to capture images in a range of local cave environments, as well as a significant amount of underwater and topside B-roll that was captured to accompany the wealth of interview footage we collected throughout the year.

Given the success of the media we created for the Mina publication, our goal is to now record short **interviews with all of the scientists we work with**. In doing so, we can highlight the research conducted, and the role that CINDAQ plays in their work. When publications are submitted,




the scientists will have ready-made videos and images to accompany them. With improvements to our equipment inventory and further training, Fred was able to record individual interviews with 8 scientists with whom we worked recently. Additionally, we began a series of interviews with the original pioneers of exploration in the area, and ourselves.

# PRESENTATIONS & PUBLICATIONS

## Public Presentations

In January, Fred gave a presentation about La Mina at the Sayab Planetarium in Playa del Carmen.

Sam presented as part of a roundtable discussion on La Mina for the Explorers Club of New York in January. The presentation can be seen on the following link: www.cindaq.org/lamina-explorersclub

On January 22, Fred and Chris co-presented at the annual Cave and Wreck night held virtually from Amsterdam, The Netherlands.

Sam gave a public presentation to the Nautical Archaeology Society in March. See more: www.cindaq.org/NAS-sam

Sam gave a presentation to the Nautical Archaeology Society's annual congress. See more: www.cindaq.org/NAS-video


## Publications

The following are publications either directly or indirectly associated with CINDAQ in 2021:

Chatters, James C., Blaine W. Schubert, Vid Petrovic, Alberto Nava Blank, Dominique Rissolo, Joaquin Arroyo-Cabrales, Vera Tiesler, and Pilar Luna Erreguerena (2021). The Macrotaphonomy of Late Pleistocene Human and Animal Remains in Hoyo Negro, Quintana Roo, Mexico. In Tratamientos Mortuorios del Cuerpo Humano: Perspectivas Tafonómicas y Arqueotanatológicas, edited by Vera Tiesler, Centro de Estudios Mexicanos y Centroamericanos, Mexico City, Mexico.

Chatters, James C., William O. Adams Jr., Diana Arano Recio, Dominique Rissolo, and Helena Barba Meineke (2021). Use of a Novel, Low-Cost 3D CT-Scan Viewer by the Hoyo Negro Project, Quintana Roo, Mexico. In Proceedings of the Joint International Congress, 9th Arqueológica 2.0 & 3rd GEORES, pp. 534-537. Editorial Universitat Politecnica de Valencia, Spain.

Huang, Corly, Qiming Chen, Vid Petrovic, Dominique Rissolo, and Leanne Chukoskie (2021). Interactive Game-Based Exploration of an Underwater Paleontological Site. Proceedings of the 7th International Conference of the Immersive Learning Research Network (iLRN), pp. 85-89. Immersive Learning Research Network.

Sullivan, Richard M. , Peter J. van Hengstum, Jeffrey P. Donnelly, Anne E. Tamalavage , Tyler S. Winkler , Shawna N. Little, Luis Mejita-Ortiz , Eduard G. Reinhardt, Sam Meacham, Courtney Schumacher, Robert Korty (2021) Rising Hurricane Activity During the Maya Classic and Postclassic Period. Ready for submission.

## Theses/Dissertations

Przybyla, Joy (2021). Chen Mul Modeled Type Effigy Censers, Maya Caves, and their Relationship with Ritual Practices: Emerging Evidence from Quintana Roo, Mexico. Masters Thesis, Department of Anthropology, Georgia State University.

## Conference Papers and Posters

Calantropio, Alessio, Dominique Rissolo, and Evan Kovacs (2021). Pre- and Self-Calibration of Underwater Cameras for Photogrammetric Documentation of Submerged Archeological Sites. Paper presented at Arqueológica 2.0 9th International Congress/3rd GEORES-Geomatics and Preservation, Valencia, Spain (virtual).

Chatters, James C., William O. Adams Jr., Diana Arano Recio, Dominique Rissolo,

# PRESENTATIONS (CONT.)

and Helena Barba Meineke (2021). Use of a Novel, Low-Cost 3D Ct-Scan Viewer by the Hoyo Negro Project, Quint. Roo, Mexico. Presented at Arqueológica 2.0 9th International Congress/3rd GEORES-Geomatics and Preservation, Valencia, Spain (virtual).

Chatters, James, PhD (2021). Surmounting the Problems of Radiometric Dating in the Submerged Caves of the Yucatan: The La Mina and Hoyo Negro Examples. Geological Society of America Annual Meeting, Portland, Oregon, USA, October 10-13, 2021.

Chatters, James C., Dominique Rissolo, Alberto Nava Blank, Vid Petrovic, Blaine Schubert, Helena Barba (2021). Documentación Digital y Acceso Virtual de la Cueva Sumergida Hoyo Negro, Quintana Roo, México. Paper presented at the Congreso Iberoamericano de Arqueología Náutica y Subacuática, Cádiz, Spain.


Fortin, Julien, Meacham, Samuel, Devos, Frederic, Le Maillot Christophe, Dorshow, Wetherbee (2021). From Underwater Cave Survey in Yucatan Mexico, to Geographical Information System (GIS): Concrete Case Study of Replicable Workflow Linking Data Acquisition to Scientific Data Exploitation. Geological Society of America Annual Meeting, Portland, Oregon, USA, October 10-13, 2021.
See more: www.cindaq.org/gsa2021

Huang, Corly, Qiming Chen, Vid Petrovic, Dominique Rissolo, and Leanne Chukoskie (2021). Interactive Game-Based Exploration of an Underwater Paleontological Site. Paper presented at the 7th International Conference of the Immersive Learning Research Network (virtual).

Macdonald, B.L., Reinhardt, E., Chatters, J., Late Pleistocene Ochre Mining in The Caves of The Yucatan Peninsula, Mexico. Geological Society of America Annual Meeting, Portland, Oregon, USA, October 10-13, 2021.

Meacham, Samuel, Fred Devos, and Christophe Le Maillot (2021). 'La Mina: El descubrimiento, documentación y cartografía de un sitio prehistórico submarino en Quintana Roo, Mexico' presented at the XV Congreso Nacional Mexicano de Espeleología, Playa del Carmen, México.
www.cindaq.org/espeleo_congreso2021

Reinhardt, E., Conant, A., Kovacs, S., Devos, F., Meacham, S., Calcite Raft Geochemistry as a Groundwater Level Proxy for Paleoindian Access in La Mina (Sagitario) and Hoyo Negro (Sac Aktun) Caves, Quintana Roo, Mexico. Geological Society of America Annual Meeting, Portland, Oregon, USA, October 10-13, 2021.

Rissolo, Dominique and Eric Lo (2021). Documentación Digital de la Arquitectura Subterránea de Quintana Roo. Poster presented at the XV Congreso Nacional Mexicano de Espeleología, Playa del Carmen, México.

Rissolo, Dominique (2021). An Overview and Synthesis of Paleocoastal Research on the Yucatan Peninsula. Paper presented at the 86th Annual Society for American Archeology Meetings (virtual).

Steele, Riley, Reinhardt, Eduard, Zhu, Juliet, Devos, Frederic and Meacham, Samuel (2021). Sediment Accumulations from the Boca Paila Cave System located in the Sian Ka'an Biosphere of the Yucatan Peninsula Provide Evidence on Recent Sea-level Rise and formation of the classic Maya canal system. Geological Society of America Annual Meeting, Portland, Oregon, USA, October 10-13, 2021

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The Honorable
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Secretary of Ecology and the Environment

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Dr. Silvina Vigliani

**INAH Yucatan**
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**INAH Quintana Roo**
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**2021 Exploration/Resurvey Team:**

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**MCEP / CINDAQ December 2021 Science Project Participants**

Rick Van Beerendonk, Martijn Blommaert, Laurent Dahan, Richard Van De Logt, Fred Devos, Maurits Dobbelaar, Ragna Duquesnoy, Julien Fortin, Peter Gartner, Shannon Hannan, Hervig Hoffmann, Chris Le Maillot, Sam Lensgraf, Stefan Loeve, Sam Meacham, Dr. Alberto Quattrini Li, Dr. Eduard Reinhardt, Dr. Ioannis Rekleitis, Roman Rosenberger, Monica Rosner, Manuela Schoch, Klaus Werzinger, Marios Xanthidis

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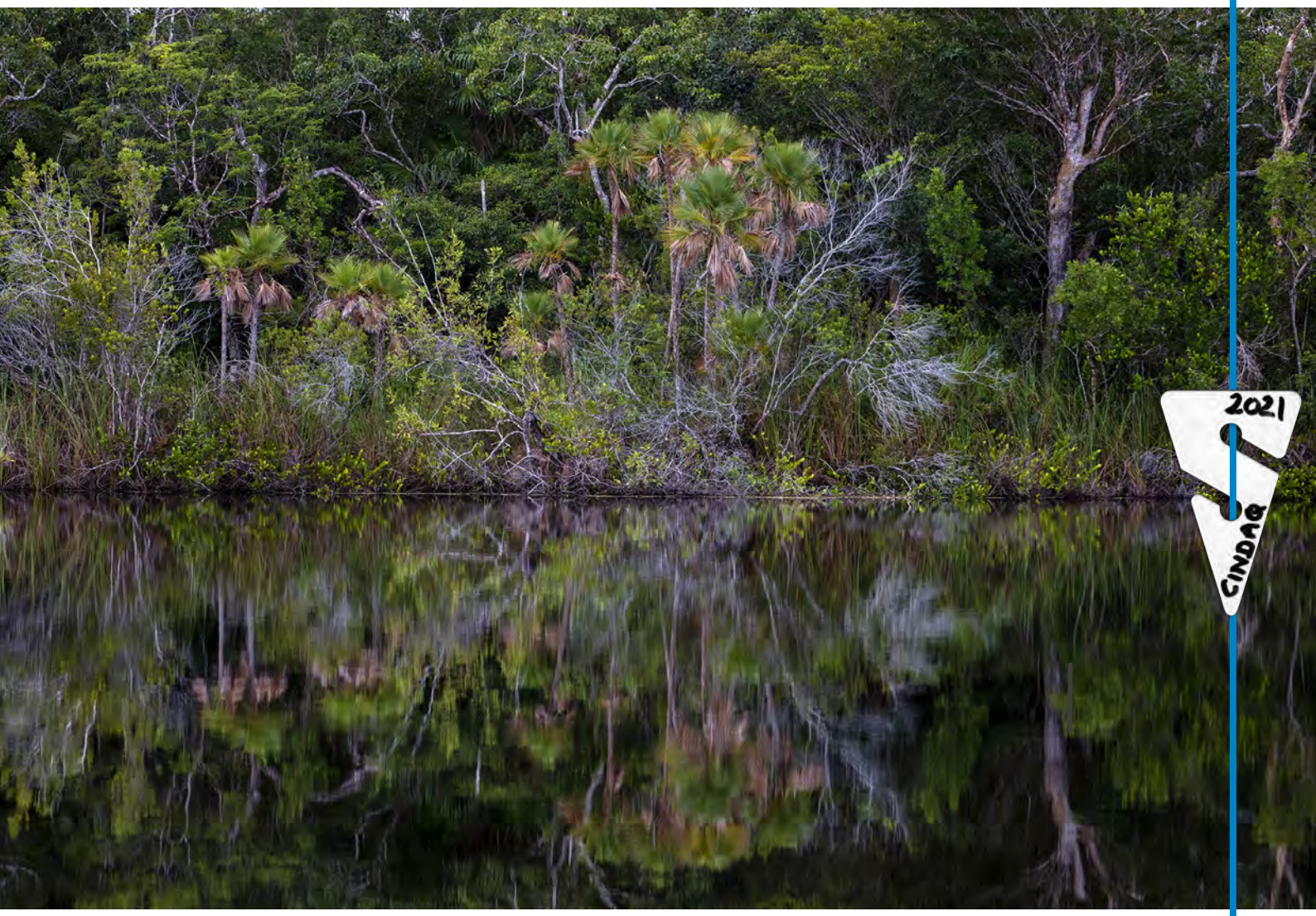
Centro Investigador del Sistema Acuífero de Quintana Roo




If you have any questions or would you like to like to learn how to support us, please feel free to contact us at **outreach@cindaq.org**

# CINDAQ 2021 Exploration Report

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**Sam Meacham, Daniel Ponce Taylor**

Facilitate research, promote education and support the conservation
of natural and cultural resources associated with
cenotes and underground rivers of Quintana Roo, México