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# **ÚLTIMA PATAGÔNIA: 20 ANOS DE EXPEDIÇÕES NO KARST DA PATAGÔNIA DO SUL E SUA CONTRIBUIÇÃO PARA A PRESERVAÇÃO CULTURAL**

*ULTIMA PATAGONIA: 20 YEARS OF EXPEDITIONS ON PATAGONIAN KARST ISLANDS AND ITS CONTRIBUTION TO CULTURAL PRESERVATION*

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## **Resumo**

Após duas primeiras viagens de reconhecimento em 1995 e 1997, sete grandes expedições (2000, 2006, 2008, 2010, 2014, 2017 e 2019) seguiram para as principais ilhas cársticas da Patagônia: Diego de Almagro (376 km<sup>2</sup>) e Madre de Dios (1043 km<sup>2</sup>). Em cada expedição, que acontece durante janeiro e fevereiro (verão austral), reunimos uma grande equipe de exploradores e cientistas (25 a 40 pessoas) participa. Os resultados deste projeto de longo prazo são de grande valor e têm fortes impactos em grande escala. Eles serão discutidos por tópico: LOGÍSTICA (dois meses de total autonomia em ilhas remotas, condições geográficas e meteorológicas desafiadoras, etc.); EXPLORAÇÃO (mais de 400 cavernas exploradas; as mais profundas com mais de 350 m e as mais extensas com mais de 3 km); CIÊNCIA (muitos projetos com universidades sobre temas como geologia, geomorfologia, espeleotemas, arqueologia, flora e fauna); EDUCAÇÃO (projetos educacionais desde 2010, acordo especial com o Ministério Francês da Educação Nacional e, desde 2019, com a escola de Puerto Edén, a vila habitada mais próxima de Madre de Dios); PATRIMÔNIO, CULTURA E COMUNIDADE (Madre de Dios é um bem nacional protegido desde 2007 e um pedido de classificação está sendo preparado para a UNESCO; além disso, achados arqueológicos contribuíram para enriquecer o trabalho de preservação cultural liderado pela comunidade Kawésqar de Puerto Edén); e DIVULGAÇÃO (publicação de relatórios e livros e distribuição de filmes, etc.).

**Palavras-chave:** exploração; preservação cultural; patrimônio mundial; estudos cársticos; aventura humana.

## **Abstract**

*After two first reconnaissance trips in 1995 and 1997, seven major expeditions (2000, 2006, 2008, 2010, 2014, 2017, 2019) have followed to the main karst islands of Patagonia: Diego de Almagro (376 km<sup>2</sup>) and Madre de Dios (1043 km<sup>2</sup>). In all expeditions, which take place during January and February (austral summer), a large team of explorers and scientists (25 to 40 persons) participate. Outcomes of this long-term project are of great value and have strong impacts on a large scale. They will be discussed by topic: LOGISTICS (2 months in total autonomy in an remote island, challenging geographical and meteorological conditions, etc.); EXPLORATION (over 400 caves explored; the deepest ones with more than 350 m and the longest ones with more than the 3 km); SCIENCE (many projects with universities on topics such as geology, geomorphology, speleothems, archaeology, flora and fauna; EDUCATION (educational projects since 2010, special agreement with the French Ministry of National Education, and, since 2019, with the school of Puerto Edén, the nearest inhabited village to Madre de Dios); HERITAGE, CULTURE AND COMMUNITY (Madre de Dios is a protected national asset since 2007 and a request for classification is being prepared for UNESCO; in addition, archaeological finds have contributed to enrich the work of cultural preservation led by the Kawesqar community of Puerto Eden); and OUTREACH (publication of reports and books, documentary films, etc.).*

**Keywords:** exploration; cultural preservation; world heritage; karst studies; human adventure.

## 1. INTRODUCTION

Seven major expeditions have been organized in the karst islands of southern Patagonia by Centre Terre: Diego de Almagro (376 km<sup>2</sup>) and Madre de Dios (1043 km<sup>2</sup>). These two islands, located at 50° of southern latitude, offer massifs of pure marbles interbedded with sandstones (Complex of Duque de York) and volcanic injections (dykes) in contact with the Patagonian batholith to the east. First mentions of limestones and of karst features in these islands date back to the 50ies (BIESE 1956, 1957) and only few studies have been published since (FORSYTHE & MPODOZIS 1979, CECIONI 1982). Late 90s and early 2000s, speleological recognitions were carried out by Italian, Hungarian and Polish teams.

Even though the highest peaks (Monte Roberto, etc.) reach up to 750 m.a.s.l., most of the explored zones are located between 200 and 400 m of altitude. These remote islands are subject to a humid subpolar climate which is characterized by huge precipitations (more than 7 m/year, MAIRE et al. 1999) and strong winds coming from the Pacific Ocean. Seasonal differences in climate are not very pronounced. Temperatures at sea level range between 8°C in the morning to 12°C in the afternoon. Sunny days are rare (less than 50 days per year) but, in those days, temperature may rise to 20°C in summer. Such conditions are very promising for the formation of caves and of specific erosion patterns over the ground that are unique in the world.



**Figure 1:** A “rock mushroom” called the King located in the centre of the Madre de Dios archipelago. Unique erosion karst patterns on the surface. Photo: S. Jaillet

## 2. LOGISTICS

Logistics is the key to this sort of remote and marine environments! Madre de Dios and Diego de Almagro are more than 200 km away from the first inhabited place and they can only be reached by boats. Climatic and marine conditions pose additional difficulties in accessing the sites. On site, teams must be autonomous and independent for two months. A team relief is scheduled at the end of the first month, however, conditions may not be favourable to restock the camp with provisions. Thus, everything must be anticipated and planned (equipment, food, caving and diving material, satellite communication, medicines, gasoline, gas, repair tools, etc.). During the first expeditions on Madre de Dios (2000 to 2010), which focused on the southern part of the island, teams could use the facilities at the Guarello mine to lodge and store the material. However, following expeditions (2014, 2017 and 2019) to Diego de Almagro and the northern areas of Madre de Dios required the building of huts and platforms to ensure a basic level of comfort for the teams.

Remoteness also imposes special attention to communication, medical assistance, rescue, etc. which must be anticipated to ensure the security of the teams on the field. In case of accident or illness, arrangements must be coordinated with emergency services for the evacuation of injured or sick people, which usually needs to be by air and coordinated with the Armada de Chile.

## 3. EXPLORATIONS

From the base camp, explorations can be during the day or last several days with portage and installation of advanced camps. Advanced camps are usually installed during the first month of the expedition and they are continuously occupied by turning teams of 4 to 6 persons. Day trips mainly concern diving explorations, scientific campaigns, video sequences, and exploration of cavities near the camp. The organization of the exploration trips depend on the weather (even if criteria must be a bit flexible) and on the availability of the boats.

Over all the expeditions, more than 400 caves have been inventoried, ~300 in Madre de Dios and ~100 in Diego de Almagro.

Three types of caves may be distinguished: (i) alpine caves that open on the elevated karst areas (i.e., > 200 m.a.s.l.); (ii) caves that open along the shoreline or a few meters above; and (iii) caves that

open below the sea level, and which can be explored only by divers.

Alpine caves are mostly vertical and formed by a series of shafts which may open in a “collector” when reaching the impervious basement (ex: Jackpot cave, Lágrimas de la Madre cave, etc.).

Caves of lower elevation usually correspond to epiphreatic conduits that form a few meters above the actual sea level (ex: 3 Entradas más Una cave, Punta Blanca cave, Petite Chinoise cave, etc.). These caves usually have conduits of big dimensions (>4 m in diameter) and long developments due to its labyrinthine organization. Such is the case of 3 Entradas más Una cave and Punta Blanca cave with more than 3 km in length.

Caves or shelters which open close to the shorelines might often be interesting from the archaeological point of view. On the coast of Madre de Dios two major paleontological and archaeological caves have been discovered (MAIRE et al. 2009):

- The Whale’s cave which entails entire skeletons of whales and sea lions, some of them being older than 3’200 years, and including a species of whale that is now extinct.

- The Pacific cave (JAILLET et al. 2010) which presents the first wall paintings that can be attributed to the sea nomads (Kawesqar ethnic group).

In 2014, on Diego de Almagro Island, a second cave with paintings was discovered close to the sea level (Augusta cave). Wall signs are less refined and more degraded than in the Pacific cave, but they remain spectacular given the context.

#### 4. SCIENCIES

These expeditions in hostile and remote areas bring together all scientific disciplines. The first is the geographic exploration, which has been completed by the mapping and processing of satellite images. In earth sciences, research has first focused on the role and magnitude of dissolution surfaces via the monitoring (anemometer, 3D) of the hydro-aeolian morphologies: “rock comets” and “rock mushrooms”. Bathymetric measurements of several fjords revealed the existence of underwater glacio-karstic depressions. Climatic conditions were also established thanks to the installation of several hydro-meteorological stations (Tarlton). The hydrology of a few resurgences was measured by sensors over several months (flow, temperature). Caving explorations allowed to work on paleoclimatology through the sampling and the study of speleothems and glacial detrital deposits (varves). In geology, collaboration with Chilean

researchers has contributed since 2000 to the thesis of LACASSIE REYES (2003) on the Metamorphic Complex and that of SEPÚLVEDA VÁSQUEZ (2011) on the Denaro Complex.

Research in biology (mainly botanic and zoology) have been made in close collaboration with Chilean researchers. Regarding flora, a new species of fern, *Asplenium patagonicum*, was discovered in 2014. In 2019, a new line of botanic research on bryophytes started (400 samples under analysis). The study of the fauna led to the discovery of a new underground amphipoda (*Ruffia patagonica*), a new genus and two species and of crustaceans. Also, three bats species have been identified, one of them for the first time detected in such southern latitudes. In marine biology, red coral (*Errina antarctica*) has been recognized in the Seno Barros Luco for the first time. Microbiology has been the subject of preliminary research in peat bogs and in caves, with the detection of methane fed bacteria.

These expeditions are a mix of sport and scientific activity and require strong interdisciplinary and specialization. In addition, since expeditions are auto financed, they rely on the support from private (associations) and public (universities) organisations. Due to the impact of this research and exploration work on the knowledge about the natural and cultural value of these places, the most important consequence on site has been the authorization to build a scientific base in 2017-2019 that allows research to continue under better conditions.



**Figure 2:** The lapiaz surface of the North camp with view to the Pacific ocean. Photo: LH Fage

#### 5. HERITAGE, CULTURE AND COMMUNITY

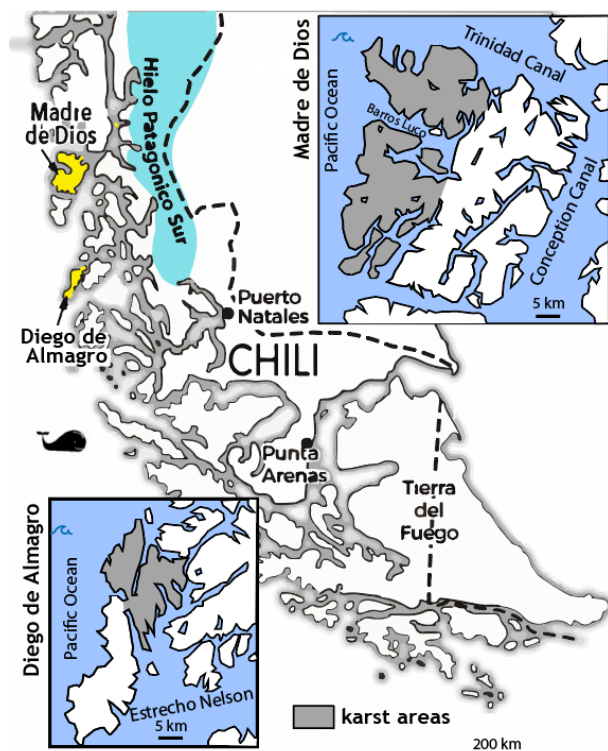
Over the years, Centre Terre has established a fruitful relationship with public authorities and local communities in Chile.

The significance of the discoveries made up to 2006 led the Chilean Ministry of Public Assets to declare Madre de Dios archipelago as “Protected National Asset”, a protection type specific to areas directly managed by it. A first cooperation agreement followed in 2016, whose aim is to have Madre de Dios declared as UNESCO World Heritage.

Another key-partnership is with the Corporación Nacional Forestal (CONAF), the Chilean forestry service, which administers the Chilean national parks where Diego de Almagro Island and the Tempanos glacier are located. Results of Centre Terre’s work are being included in the new parks’ management plans.

Equally significant are the bonds forged with the Magellan region, especially, with the Kawesqar community of Puerto Eden because of the discovery of Kawesqar burials (2000), cave paintings in the Pacific Cave (2006), archaeological findings (shelters, whalebone hut), which have partly helped redefine old assumptions regarding the Nomads of the Sea and contributed to the efforts made by the Kawesqar community residing in Puerto Eden to preserve their culture and identity. They have indeed adopted some of the cave paintings in their flag.

Additionally, a new cartographic long-term project recently started considers an update of toponyms with the ancestral names or, if not available, their translation in Kawesqar.



**Figure 3:** Islands of Diego de Almagro and Madre de Dios are in the Patagonian archipelago.

## 6. OUTREACH

To promote the results of the explorations, a big effort is put on media coverage. Thereby Centre Terre targets different publics: cavers and scientists’ communities, institutional and financial partners, schools, and the public.

Communication toward cavers is made via updates on the website (about 20’000 views per month during the expedition) and social media. Results of the expedition are published in specialized magazines and a full report in two languages (French, Spanish) is printed and made available on the website.

Communication toward the scientist’s community is made through the publication of articles in scientific journals. To gain visibility, Centre Terre runs a very active Research Gate account<sup>1</sup> with about 16 collaborators in different areas (geology, archaeology, etc.). Half of the expedition report concentrates on the scientific results (14 contributions in 2019).

Regarding institutional and financial partners, a win-win partnership strategy is developed on a case-by-case basis about media coverage. Partners of the expedition usually receive a set of products-oriented pictures as well as a selection of beautiful and impressive pictures they can use for their own marketing purposes.

The communication to schools is also a priority for Centre Terre. At the beginning of each expedition, a complete scholar program is elaborated in collaboration with school *academies* in France. In Chile, an educational project has been developed through the Asociación Espeleológica de Patagonia, a sister association created in Chile in 2017 with the school of Puerto Eden (more details in the communication about Centre Terre’s educational projects presented to this congress).

Finally, Centre Terre does not forget to communicate to the public via articles in the local press, magazines (GEO, National Geographic, Terre Sauvage, etc.), exhibitions and the production/diffusion of documentary films (52 or 90 minutes) on public television channels or at film festivals. Last documentary film "Ultima Patagonia" broadcasted for the first time in prime time on Saturday, October 12, 2019, reached nearly 900,000 viewers in France and 500,000 in Germany!

These actions show the importance that Centre Terre attaches to the valorisation of its discoveries. They contribute to the outreach of the association and,

more broadly, to the positive image of caving around the world.

## 7. CONCLUSION

After 20 years of exploration of the karst islands of Madre de Dios and Diego de Almagro, remarkable discoveries and a colossal scientific work have revealed part of this geomorphological heritage, unique in the world. Aspects and partnerships mentioned hereby show that the outreach of "Ultima Patagonia" expeditions goes beyond the scope of usual speleological expeditions and offers many perspectives for new projects related to the

exploration, the documentation and the valorisation and protection of new zones. It may even have incidence in the preservation of cultural material and immaterial assets. The next expedition will focus on the northern part of Madre de Dios (shores of the Egg fiord) and on the Peel glacier (austral part of the Southern Ice Field). This was initially planned for January-February 2021, but, because of COVID-related restrictions, it has been postponed to 2023.

Ultima Patagonia, made up entirely by volunteers, will last a while longer. We hope these ambitious projects will help show the importance of speleology to society and to the world.

## 8. ACKNOWLEDGMENTS

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1 <https://www.researchgate.net/project/ULTIMA-PATAGONIA-exploration-research>