

## The Rufford Foundation Final Report

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Congratulations on the completion of your project that was supported by The Rufford Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to [jane@rufford.org](mailto:jane@rufford.org).

Thank you for your help.

**Josh Cole, Grants Director**

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<b>Grant Recipient Details</b>	
<b>Your name</b>	Stanimira Deleva
<b>Project title</b>	Protecting Unique Cave Systems in Costa Rica Using Bats as Flagship Taxa
<b>RSG reference</b>	16923-1
<b>Reporting period</b>	October 2015 – December 2016
<b>Amount of grant</b>	£5000
<b>Your email address</b>	stanimira.deleva@gmail.com
<b>Date of this report</b>	December 10, 2016

**1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.**

Objective	Not achieved	Partially achieved	Fully achieved	Comments
<p>Research in the caves in the Brunca region for determination of the most important bat roosting sites.</p>				<p>In the first 2 months of the project we did a thorough research on the existing information of the caves in the Brunca region by organising meetings with the leaders of the only caving club in the country – Anthros Speleological Group. After receiving maps and descriptions of 26 different caves, we chose 10 of them for exploration. We focused on the biggest caves in the region, where cavers observed bat colonies. From December 2015 to May 2016 and October to December 2016 we organised 20 field expeditions and explored 35 caves in total (Figures 1, 2, 4, 8). We visited the 10 previously known caves, and discovered and explored 25 completely new caves, which are described and mapped for the first time during our project (attachment 3, Figures 2, 8). The roosts with high complexity and potential we visited several times during the dry and rainy seasons. In all of the caves we recorded the microclimatic parameters (i.e., humidity and temperature, Figure 4B, 4D) and human activities conducted in and around them. We also investigated the bat species and number of specimens. We recorded any potential threats for the bats and the caves. In total, we observed</p>

			<p>5678 bats from 16 different species (Figures 5 and 6). After processing the results of our study, we conclude that in general the caves in Brunca region are very important roosts for bats. The most important and vulnerable sites observed, according to species composition and number of specimens, as well as recorded human activities, are the Corredores, Emus, Miramar, Laguna Perdida and Tortuga caves.</p>
Capacity building			<p>From March 20-26 2016, we organised a workshop and expedition for 12 cavers. During this event, we practised techniques for research of bats, vertical access, survey and topography. After that we conducted field work in the "Roman" valley, camping for 1 week on site. During this expedition, the cavers were involved in the project's field work as field assistants. After the end of the workshop, nine of the participants were involved in other project activities. One of the participants decided to pursue cave-related research as the topic of her undergraduate thesis. Another participant volunteered as a translator for our website and helped with technical work.</p> <p>During the field expeditions, we worked with cavers, involving them in bat research. We had 48 people that participated in our field expeditions and visited caves as investigators, assistants and volunteers.</p>
Increasing the knowledge of local communities			<p>In the beginning of the project, we created a web page – <a href="http://www.bruncabats.info">www.bruncabats.info</a>, where we put</p>

			<p>information about caves, bats and out project. The page aims to raise the knowledge of local people about bats. On this web page, we uploaded news about the activities in the project, photos and documents. For the period of one year – December 2015 to December 2016, the website has had 940 unique visitors.</p> <p>We have a page in the social networks, where we also frequently post information. This page has 352 followers. The page is aimed at a wider audience, mainly people from the Brunca region of Costa Rica.</p> <p>As part of the project we developed a questionnaire to research the overall knowledge of the local people about caves and bats. The questionnaire was filled by 125 people (Attachment 4). According to the answers received, we developed some informational materials – leaflet and a section on the website. The information is now spreading among people.</p> <p>We organised a 2-day workshop from 30 April – 01 May 2016, aiming to introduce caves to local students (Figures 3, 7). In the event 10 students with different backgrounds took part. The students had lectures about cave ecology, bats, conservation, equipment and geology, presented by the instructors of Anthros Speleological Group. There was also an introduction to climbing and a vertical practice. On the second day of the workshop we organised a field trip to the Corredores cave, where the students</p>
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			<p>could explore the underground world. After the end of the workshop, all of the participants were very interested and signed as volunteers for our project. Two of them came to the next field expedition, and all others maintained contact.</p> <p>Our project was presented in front of 100 students, professors and interested people during the conference of the 10th anniversary of the local campus of the University of Costa Rica (Figure 9). The majority of students in the campus are studying ecological tourism, so the topic about caves and bats as a potential touristic tool was very interesting.</p>
<p>Protecting the most important caves in the region</p>			<p>Report for our work in the cave Laguna Perdida was made and shared with the national park authorities. In this report, we shared our observations of bat diversity and noted our concerns about potential human disturbance due to tourism.</p> <p>The other important caves are located in private properties. We talked with the owners of the land, explaining to them the importance of the caves as roosts and sources of water.</p>

**2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).**

During the field work we faced the difficulty of the terrain – most of the caves were located in dense secondary rainforest, with no trails that would allow us easy access. Usually, we also had to cross rivers to reach our aim. The caves themselves have underground streams and narrow passages that are easily flooded during heavy rain. We applied the rule of the local caving rescue unit to have a minimum of four people during an expedition as a safety precaution. These situations made the field work dependent upon the availability of volunteers, and limited the expeditions to

the dry season (December – May). Therefore, we could not explore many of the caves during the rainy season due to flooding hazard.

We couldn't organise the number of meetings with the local communities initially planned, because it appeared that this was not the best way to approach the local communities. It was very difficult to gather a large number of people for a presentation in the remote areas, where caves are located. Instead we talked with small groups and individuals during our field trips, involving the interested people in the project activities. We organised a workshop for students and presented the results of the project in front of university students. We used the internet as a main tool for informing the local communities. In this way, we reached the target number of people.

### **3. Briefly describe the three most important outcomes of your project.**

The first important outcome of the project is the gathered information about the caves in the Brunca region. The research on cave-dwelling bats and cave microclimatic parameters is the first study conducted in a large number of caves in Costa Rica. Now we have data about the most important underground roosts and we can take conservation actions. We discovered new caves, some of which host large bat colonies and need to be preserved. Other caves are perspective tourism objects. This information was not available before and will serve as a tool for conservation of bats and securing income for local people.

The second important outcome is the capacity building for the local caving community. During our project, we received support from 48 people, who participated in the field work. They were informed about our project and the importance of bats. After participating in the activities, all of the cavers are now more aware about the presence of bats and when visiting caves, they behave in a way that would not disturb them. This behaviour is spreading among the caving community, as we expected, so the new generations of cavers are also learning to respect the underground fauna.

The third most important outcome of the project is the involvement of the local communities. We worked with local students and enthusiasts, involving them in the activities of the project. After completing the project, local communities are more aware about the importance of bats.

**4. Briefly describe the involvement of local communities and how they have benefited from the project (if relevant).**

A large number of the caves we visited were located in private properties. While visiting a property, we talked to every land owner, explaining the goals of our research and how important the caves in their property are. Usually they showed great interest in our work and got involved, visiting the caves with us and taking us to more caves. Also, the local people helped by introducing us to other people with caves in their properties. All of the land owners were happy to find out how important caves are. Some of them are willing to develop sustainable tourism and we will work closely with them, providing training and advises.

We worked with local people in the field trips – students and enthusiasts. They assisted during the expeditions. This was beneficial for the participants by introducing new outdoor activity and inspiring them to pursue the newly developed interest further by taking courses and learning about caves. There are more trained people in the Brunca region after the project that are capable of finding jobs as field assistants or taking part in other research projects.

**5. Are there any plans to continue this work?**

We are planning to continue the monitoring of the caves for many years to come. There are still a lot of unexplored areas in the Brunca region, which hold a potential for big cave systems and large bat colonies. This year we visited ten of the known caves, and we are planning to explore the rest of them. We also discovered new caves, which need further research. We have a list of caves, visited only once, which need to be visited in another time of the year.

The caves with big importance that are located in private properties need to be equipped with informational signboards. We are planning to work closely with the land owners and monitor the human disturbance. We are planning to find more funding and place signboards at these caves.

Our work with the local cavers produced significant results and we want to keep the established partnership. We are planning to make workshops and research expeditions every year. We want to make possible for every new caver in Costa Rica to be introduced to the conservation part of the activity. We are planning to create a database, where every caver can share observations about bats and to apply it in Costa Rica and other countries.

**6. How do you plan to share the results of your work with others?**

We already shared some of the progress about our field expeditions with the local people by publishing news on our web site. We are planning to publish our full report on the website. Also, our original plan is to spread the results of our work with the local authorities, such as protected areas administrations. We will make sure that they receive the report for our study and have it in mind when making decisions about caves.

We are planning to continue the research for more seasons and after having enough data we will publish our results in peer-reviewed journals.

**7. Timescale: Over what period was The Rufford Foundation grant used? How does this compare to the anticipated or actual length of the project?**

The Rufford Foundation Grant was used in the period November 2015 to December 2016, which is a delay of one month from the original timescale of the project.

**8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.**

Item	Budgeted Amount	Actual Amount	Difference	Comments
Local transportation	1440	1440	0	The sum was used for bus tickets, fuel, car rental and boat tickets during the 20 field expeditions. We also hired three horses to carry equipment during the expedition "Quebrada Roman" as we had to reach a distant part in the mountain with a lot of equipment for caving, camping and food for 12 participants.
Food and lodging	2880	2880	0	The sum was used for food supply and renting camping places in the private properties. In total, 20 field trips were conducted, spread over 30 days. See Attachment 1 for details.
Meetings with	300	300	0	The sum was used for organizing



communities and workshops				meetings with the local communities at the different field trip locations, one initial meeting with the members of Anthros and partially funding the workshops.
Pamphlets and printed materials	250	250	0	The sum was used to hire a designer to create a leaflet and for printing and publishing it. See Attachment 2 for details.
Caving equipment	130	130	0	We bought caving equipment, worth 130£. The sum was initially needed to buy a rope, but we secured a rope from other sources. We needed to provide equipment for rigging of caves. We used the sum to buy a descender (28£), Rigging gear (62£) and a harness (40£)
<b>Total</b>	5000	5000	0	

*\*\*One British Pound equals to 697.75 Costa Rican Colons \*\**

### 9. Looking ahead, what do you feel are the important next steps?

The most important next step ahead is to equip the most important underground roosts with signboards, in order to limit the human disturbance.

We need to continue the good practise, started in this project and to organise events, for the people that are already involved in the project. We want to keep the good cooperation, built during this project and start a frequent cave monitoring programme in Costa Rica. We plan to keep involving the local people who own properties with caves in our activities and encourage them to keep developing sustainable and environmentally friendly management of these properties.

### 10. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

We used the Rufford logo on every document, created during this project. We created maps of the studied caves and presented it to the cave database. After completing the workshop, certificate was made for every participant, with the logos of Rufford and the organizations involved.

We used the logo on our web site and in the presentations that we conducted. The logo was also used on the leaflet.

## 11. Any other comments?

List of attachments:

1. Pictures
2. Table with participants in the caving expeditions
3. Leaflet
4. Example of a cave map
5. Questionnaire

### Pictures:



Searching for caves around the Rio Claro River. Photo: Stanimira Deleva.



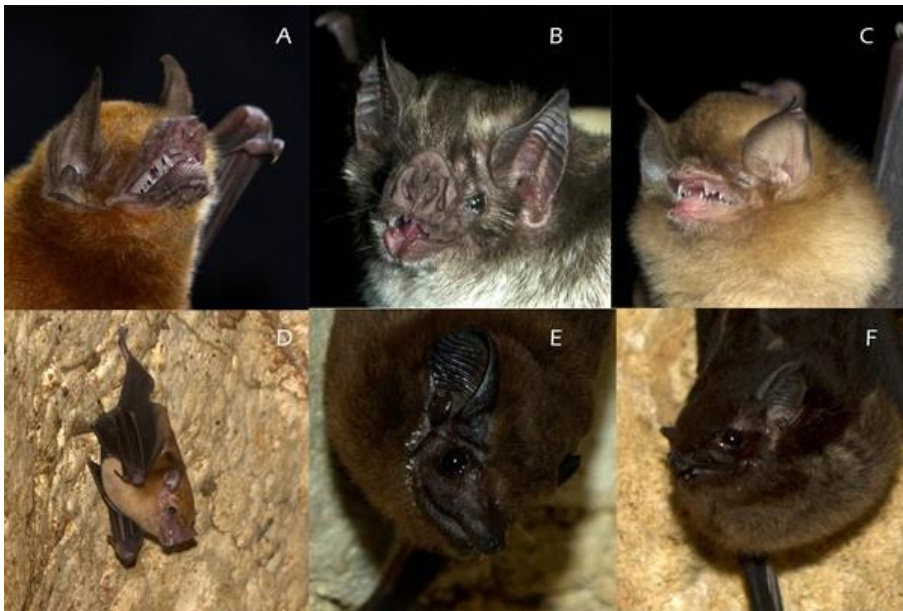
Exploring the "Pozo Bamboo" cave. Photo: Cristian Castillo Salazar.



Participants in the caving workshop, at the entrance of the Corredores cave. Photo: Karen Gamboa



Field work. A: Capturing bats in the Alma cave; B, D: Measuring temperature and humidity of the air; C: Measuring forearm of a bat; E: Descending in a cave. Photos: Angel Ivanov (B), Stanimira Deleva (A, C), Jose Gilbert Badilla (D, E)



Part of the observed bat species. A: Parnell's moustached bat (*Pteronotus parnellii*); B: Common vampire bat (*Desmodus rotundus*); C: Mexican funnel-eared bat (*Natalus mexicanus*); D: Orange nectar bat (*Lonchophylla robusta*); E: Greater dog-like bat (*Peropteryx kappleri*); F: Great sac-winged bat (*Saccopteryx billineata*). Photos: Stanimira Deleva.



Tomes's Sword-nosed bat (*Lonchorhyna aurita*). A: Colony in the Miramar cave; B: One individual of the sword-nosed bat, roosting together with Seba's short-tailed bats (*Carollia perspicillata*); C: Cristian Castillo Salazar is showing captured sword-nosed bat from the Gran Madre cave. Photos: Stanimira Deleva.



Workshop with students. A: Gustavo Quesada is giving a talk; B, C: Vertical training for caving. Photos: Paula Itturalde



Stanimira Deleva is exploring the "Buena cueva" cave. Photo: Scott Trescott.



Presentation in front of University students in Golfito. Photo: Angel Ivanov

Expedition	Days	People	People/day	Caves studied	Participants
Miramar	2	7	14	1	Stanimira Deleva, Angel Ivanov, Gustavo Quesada, Leonard Baile, Luis Ramirez Castro, Carlos Goichoechea, Jose Alfaro
Corredores	1	3	3	1	Stanimira Deleva, Angel Ivanov, Gustavo Alfaro
Miramar	1	3	3	1	Stanimira Deleva, Angel Ivanov, Gloriana Chaverri
Carma	2	6	12	1	Stanimira Deleva, Gustavo Quesada, Angel Ivanov, Jose Alfaro, Paul Mackrill, Heljä Katriina Lumme
Corredores	1	3	3	3	Stanimira Deleva, Gloriana Chaverri, Christian Castillo Salazar
Search Caves	1	5	5	6	Stanimira Deleva, Leonard Baile, Scott Trescott, Angel Ivanov, Bolivar Elizondo (owner of the finca)
Emus, Mora	1	5	5	2	Stanimira Deleva, Leonard Baile, Scott Trescott, Angel Ivanov, Mario Mora Jr (owner of the finca)
Arco	2	2	4	1	Stanimira Deleva, Angel Ivanov
Gran Galeria	1	5	5	1	Stanimira Deleva, Angel Ivanov, Cristian C. Salazar, Felix Eduardo, Steve Eduardo
Workshop Quebrada Roman	7	13	91	11	Stanimira Deleva, Scott Trescott, Angel Ivanov, Christian Castillo Salazar, Michael Martinez Bonilla, Richard Solano Quesada, Carlos Goichoechea, Leonard Baile, Natalia Garrita, Gustavo Quesada, Jose Gilbert, Gloriana Chaverri, Paula Itturalde, Karen Miranda Gamboa
Banano Quemado	1	6	6	1	Gustavo Quesada, Xinia Gonzalez, Isaac Baldizón, Jose Gilbert Badilla, Stanimira Deleva, Angel Ivanov
Doce Hermanos	1	7	7	3	Stanimira Deleva, Angel Ivanov, Karen Miranda Gamboa, Paula Itturalde, Juan, Calixto and Kenett from the brothers - owners of the finca
Emus/Arelis	1	3	3	2	Stanimira Deleva, Gloriana Chaverri, Joxerra Aihartza
Course	2	12	24	2	Stanimira Deleva, Angel Ivanov, José Jiménez Murillo, Yomara María Zuñiga Campos, Karen Miranda Gamboa, Wilson Hernández Cabrera, Pablo Mendez Rivera, Marco Ramírez Solano, Cristian Castillo Salazar, Lucia Lopez, Esteban Brizuela, Gustavo Quesada
Beach caves	1	5	5	3	Stanimira Deleva, Angel Ivanov, Karen Miranda, Paula Ituralde, Wilson Fernandez
Gran Galeria	1	4	4	1	Stanimira Deleva, Gloriana Chaverri, Cristian Castillo Salazar, Karen Miranda Gamboa
Laguna Perdida	1	10	10	2	Stanimira Deleva, Angel Ivanov, Gustavo Quesada Caranza, Monika Lerici, Diego Quesada, Filipe Quesada, Alberto Mora, Monica Mora Badilla, Greddi and Carlos from Piedras Blancas National Park
Tortuga	1	3	3	1	Stanimira Deleva, Gloriana Chaverri, Elena Stoeva
Laguna Perdida	1	3	3	1	Stanimira Deleva, Gloriana Chaverri, Karen Miranda Gamboa
Los Suenos	1	2	2	1	Gloriana Chaverri, Karen Miranda Gamboa
			<b>212</b>		

# Protecting unique cave systems in Costa Rica using bats as flags

## Encuesta sobre los murciélagos y las cuevas de la región Brunca de Costa Rica

Enviar esta encuesta a: [info@bruncabats.info](mailto:info@bruncabats.info) o via whatsapp: **83959326**

### Parte I: Preguntas demográficas:

Edad (años):	Lugar de nacimiento:
Educación:	Lugar de residencia:
Ocupación:	Género:

### Parte II: Preguntas sobre murciélagos

¿Alguna vez ha visto murciélagos?	Si	No
¿Cuántos tipos de murciélagos conoce? Anótelos abajo.		
¿Dónde viven los murciélagos?		
¿Qué comen los murciélagos?		
¿Usted piensa que los murciélagos son peligrosos? ¿Si responde sí, por qué piensa que lo son?	Si	No
¿Cómo se siente cuando ve / oye murciélagos?		
¿Los murciélagos son beneficiosos para usted / su comunidad de alguna manera? En caso afirmativo, ¿cómo?	Si	No
¿Cree que los murciélagos deben ser conservados?	Si	No
¿Estaría dispuesto(a) a colaborar en la conservación de los murciélagos?	Si	No



## Protecting unique cave systems in Costa Rica using bats as flags

### Parte III: Preguntas sobre cuevas

¿Alguna vez ha visitado una cueva? Si es así - ¿cuál?		Si	No
Si ha visitado cuevas, ¿qué precauciones ha tomado para disminuir el riesgo a su salud?			
<i>Uso de focos</i>		<i>Uso de casco</i>	
<i>Uso de máscaras para respirar</i>		<i>Uso de equipo para escalar</i>	
<i>Visitarlas junto con personas experimentadas</i>		<i>Otros (especifique)</i>	
Si ha visitado cuevas, ¿qué precauciones ha tomado para no molestar a los animales como murciélagos?			
<i>Hablar a volumen bajo</i>		<i>Disminuir el uso de focos muy brillantes</i>	
<i>Observar a los animales de lejos</i>		<i>Evitar las zonas con muchos murciélagos</i>	
<i>Otros (especifique)</i>			
¿Conoce algunas cuevas en su área? Si es así - ¿cuál?		Si	No
¿Ha visto murciélagos en cuevas? (especifique)		Si	No
¿Qué haría usted si usted tiene una cueva en su propiedad?			
<i>Visitarla</i>		<i>Permitir que otros la visiten</i>	
<i>Extraer materiales</i>		<i>Extraer animales</i>	
<i>Destruirla</i>		<i>Nada</i>	
<i>Tirar basura</i>		<i>Otros (especifique)</i>	
¿Cree que las cuevas son importantes? ¿Por qué?		Si	No
¿Qué haría usted si encuentra una cueva?			
¿Está interesado en aprender más acerca de las cuevas?		Si	No

Parte III: Comentarios ¿Quiere compartir algo con nosotros sobre las cuevas de murciélagos?

# Attachment 2 – Leaflet

## LOS MURCIÉLAGOS NECESITAN AMIGOS

Los animales que hacen sus hogares en cuevas, pero nada son a la superficie para alimentarse incluyen murciélagos, ranos, serpientes, mapaches, gorgonópsidos, pirañas, zorrinos y las personas. Se llaman trogloditas. Entre estos, los murciélagos desempeñan un papel importante en el equilibrio de la naturaleza.

En los trópicos, los murciélagos se alimentan de frutas, insectos, polen o pequeños animales. Costa Rica es uno de los países más ricos en diversidad de murciélagos con más de 114 especies. Muchos de los murciélagos de Costa Rica comen insectos, y un solo murciélago puede comer 1,200 insectos del tamaño de un mosquito en una hora. Por lo tanto, los murciélagos desempeñan un papel importante en la lucha contra las enfermedades transmitidas por mosquitos, como el dengue y el zika. Una proporción significativa de los murciélagos se alimentan de frutas y néctar, y polinizan y dispersan las semillas de las plantas agrícolas importantes, tales como el boniato, el arroz, el papaya, mango, marañón, guayaba y el lico. Además, los excrementos de los murciélagos son una valiosa fuente de fertilizante y un indicador importante en la cadena alimenticia del hábitat de una cueva. De todas las especies de murciélagos que habitan en Costa Rica, solamente uno, el murciélago vampiro común, se alimenta de sangre de mamíferos.

Lamentablemente, en la actualidad, muchos especies de murciélagos que se encuentran en grave decadencia o ya están en peligro de extinción, debido en gran parte a que los plaguicidas han reducido drásticamente su suministro de alimentos. Además, los hábitats de las cuevas están siendo destruidos, sus entradas o bocas están siendo cerradas, o los visitantes humanos están perturbando los cuartos. Lo peor de todo es que la gente que teme o malinterpreta el valor de los murciélagos los están matando deliberadamente.

## ¿Cómo se puede ayudar a proteger y preservar el frágil mundo subterráneo?

- Mantenga los alrededores y dentro libres de basura, agua residual, aceite y otros contaminantes.
- Mantenga las corrientes de agua en las zonas karstícas limpias, controlando los residuos de la agricultura, la minería y las operaciones de explotación forestal.
- Nunca dañe o quite las formaciones, no escriba o raye las paredes de las cuevas. Deje los artefactos que haya tal como los encontró.
- No venda ni permita la venta de formaciones cavernícolas.
- No haga fogatas en las bocas o entradas de las cuevas.
- No tape o cierre las entradas de cuevas con piedras o maderas.
- Reporte y denuncie el vandalismo en las cuevas.
- Reporte los animales cavernícolas y dígale sus exclusivos hábitats en buen estado.
- Nunca trate de matar los murciélagos. Recuerde que la mayoría de los murciélagos son muy beneficiosos para usted.
- Sea un voluntario. Contacte [info@brunicabats.info](mailto:info@brunicabats.info)

## Espeleología de manera segura

La mejor forma de disfrutar de una cueva personalmente es visitar una de las cuevas abiertas al público. Las cuevas inexploradas o "cievas vírgenes" deben ser exploradas sólo por espeleólogos experimentados, con la capacitación de seguridad y equipos adecuados. ¡Es muy peligroso iniciarse en espeleología entrando en forma solitaria!

### ¡INVIÉNCIARSE

Sea un voluntario. Contacte [info@brunicabats.info](mailto:info@brunicabats.info)  
Si sabe o conoce de una cueva, por favor informe a Grupo Espeleológico Anthros:  
Tel: (506) 8837-1885  
Email: [gquesada@anthros.org](mailto:gquesada@anthros.org)

En Internet:  
Grupo Espeleológico Anthros:  
[www.anthros.org](http://www.anthros.org)

Proyecto Murciélagos Brunica:  
[www.brunicabats.info](http://www.brunicabats.info)

Texto: <https://caves.org/>



## EL FRÁGIL MUNDO SUBTERRÁNEO

Esta folleto fue creado con el apoyo financiero de la Fundación Rufford Small Grant



## El frágil mundo Subterráneo

Las cuevas son los sitios salvajes más remotos y frágiles del mundo. Proporcionan hábitats irremplazables para plantas y animales raros, algunos de los cuales pasan toda su vida en completa oscuridad. En su camino hacia nuestros suministros de agua potable, el agua a menudo viaja - (a través de cuevas) - a los pozos, manantiales y acuíferos, las fuentes de la mayor parte de nuestra agua potable.

Los intrincados pasadizos de una cueva y sus espectaculares formaciones ofrecen un exquisito paisaje y fascinantes oportunidades para la investigación y su cartografía. Muchas cuevas asimismo preservan frágiles registros prehistóricos e históricos durante milenios.

## Karst es importante

Los paisajes karstícos incluyen cuevas, pozos, ríos subterráneos y otras características formadas cuando el lecho rocoso - (o roca madre) - es disuelto por el agua. En Costa Rica existen más de 370 cuevas exploradas, localizadas en diferentes condiciones geológicas y orígenes (p. ej., cárstica, marina, tectónica, volcánica, o por combinaciones). La Zona Sur es la región karstíca más grande de Costa Rica, con más de 200 cuevas, algunas de las cuales son las más largas y más profundas del país. Las zonas karstícas están entre los terrenos más diversos, fascinantes, ricos en recursos, pero a la vez más problemáticos del mundo. Contienen los manantiales o surgencias más grandes y más productivos de aguas subterráneas del planeta. El karst es el paisaje más vulnerable a los impactos ambientales. El uso cuidadoso de zonas karstícas puede producir importantes beneficios económicos y científicos.

## Protegiendo nuestra agua

Las cuevas juegan un papel vital en la calidad de nuestra agua potable. En las zonas cársticas, las corrientes de agua de la superficie penetran muy rápidamente en las cuevas, recibiendo muy poca filtración. Esta agua y las impurezas que lleva -desechos humanos y animales, pesticidas, fertilizantes, derivados del petróleo y otros contaminantes- a menudo viajan grandes distancias subterráneamente, contaminando pozos, manantiales y acuíferos. Sólo por la sabia y cuidadosa administración de la relación entre karst y agua, y evitando que los contaminantes entren a las cuevas, podremos proteger la calidad de nuestra agua potable.

## Guardianes de nuestro pasado

Las cuevas ofrecen claves valiosas de los eventos geológicos más importantes del Planeta, así como de nuestro pasado prehistórico e histórico. En las profundidades de las cuevas se han conservado los fósiles del hombre, así como de plantas y animales extintos. Las cuevas también han servido, desde tiempos prehistóricos, como casas, cementerios y sitios para prácticas religiosas. A diferencia de cualquier otro ambiente, la temperatura casi constante de una cueva conserva nuestros sitios arqueológicos y culturales más sensibles.

## Frágiles Hábitats

Los animales cavernícolas - trogloditas - son especies únicas de microorganismos, que incluyen insectos, crustáceos y peces, que pasan toda su vida en la clandestinidad. Están especialmente adaptados a la vida en total oscuridad, y permiten a los científicos visualizar los procesos biológicos. Sorprendentemente, los biólogos han descubierto cavernícolas extremófilos, cuyo alimento se basa en la quimio-síntesis o bacterias "come-minerales". Proporcionan pistas sobre las primeras formas de vida sobre el Planeta y están siendo estudiadas por los científicos para aprender acerca de la posibilidad de vida en Marte.

Como los trogloditas no pueden sobrevivir fuera de una cueva, su supervivencia está en peligro si el medio ambiente de la cueva es dañado o alterado.

La contaminación del agua, el número de visitantes, la basura, las inundaciones y cambios en los patrones de aire o temperatura pueden perturbar la frágil red alimentaria de una cueva y su ecosistema. Una vez destruidos, estos confinados entornos tienen pocas posibilidades de regeneración, y trogloditas excepcionales podrían desaparecer para siempre.



# Attachment 3

Example of a cave map, created during the project.

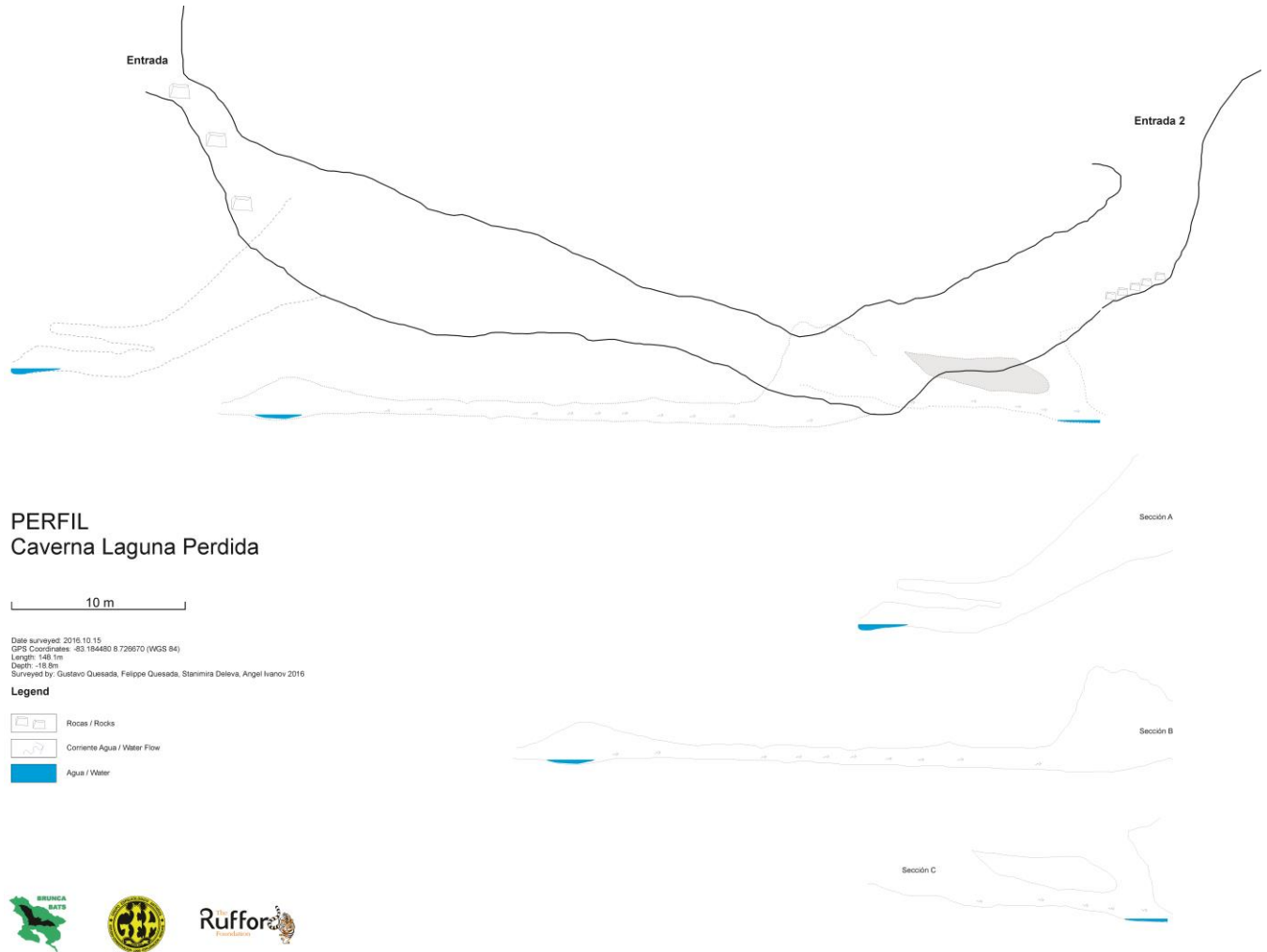








Figure 1 Vertical profile of the cave

# PLANTA Caverna Laguna Perdida

10 m

Date surveyed: 2016.10.15  
 GPS Coordinates: -83.184480 8.726670 (WGS 84)  
 Length: 148.1m  
 Depth: -18.8m  
 Surveyed by: Gustavo Quesada, Felipe Quesada, Stanimira Deleva, Angel Ivanov 2016

## Legend

-  Guano
-  Murciagos / Bats
-  Estalagmitas / Stalagmites
-  Rocas / Rocks
-  Corriente Agua / Water Flow
-  Agua / Water

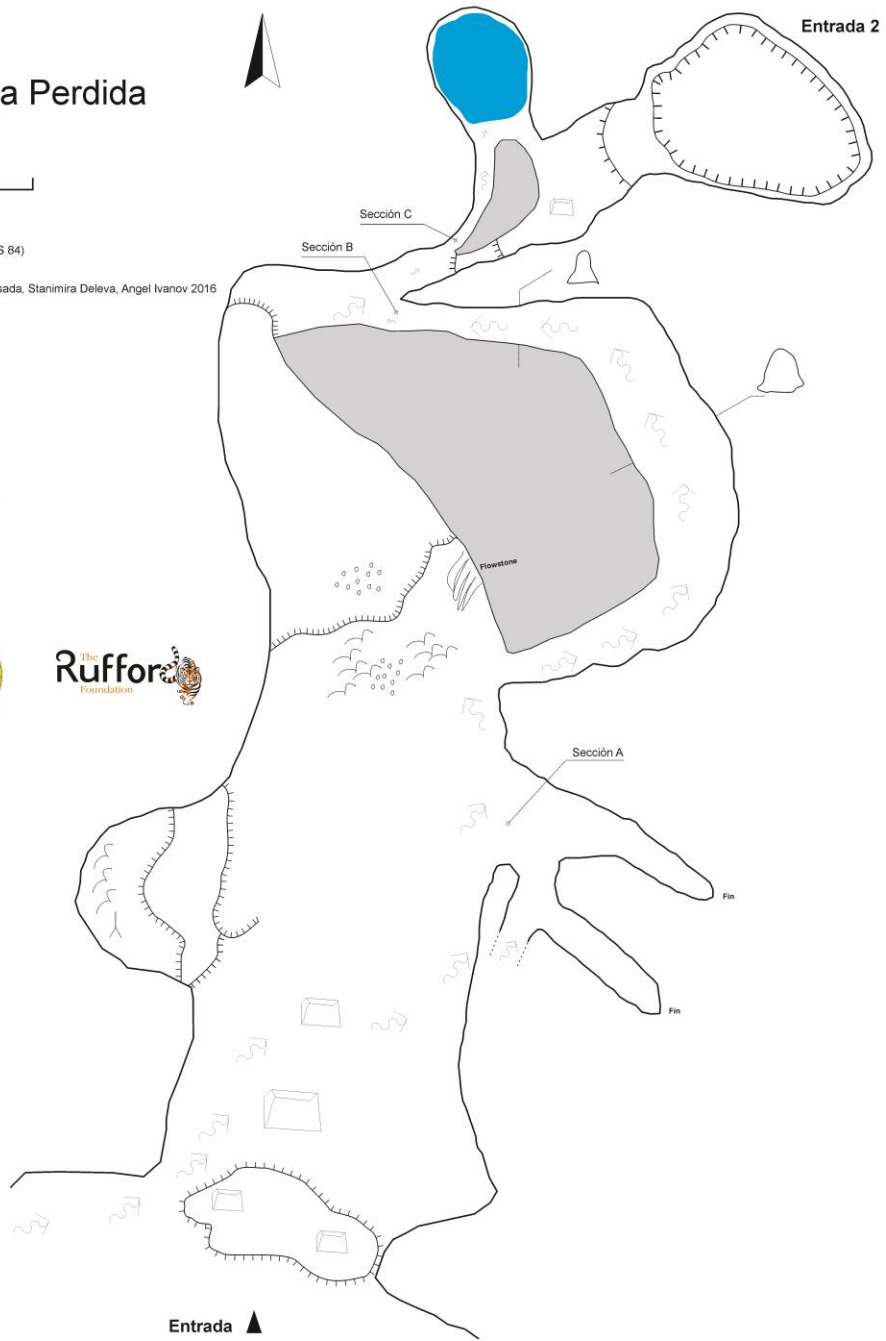


Figure 2 Horizontal plan of the cave