

Cave Diving Exploration
Izvor Licanke, Fužine, Croatia
2019 Final report.

21st June 2019 – 30th June 2019

Cave Diving Group Great Britain
Global Underwater Explorers

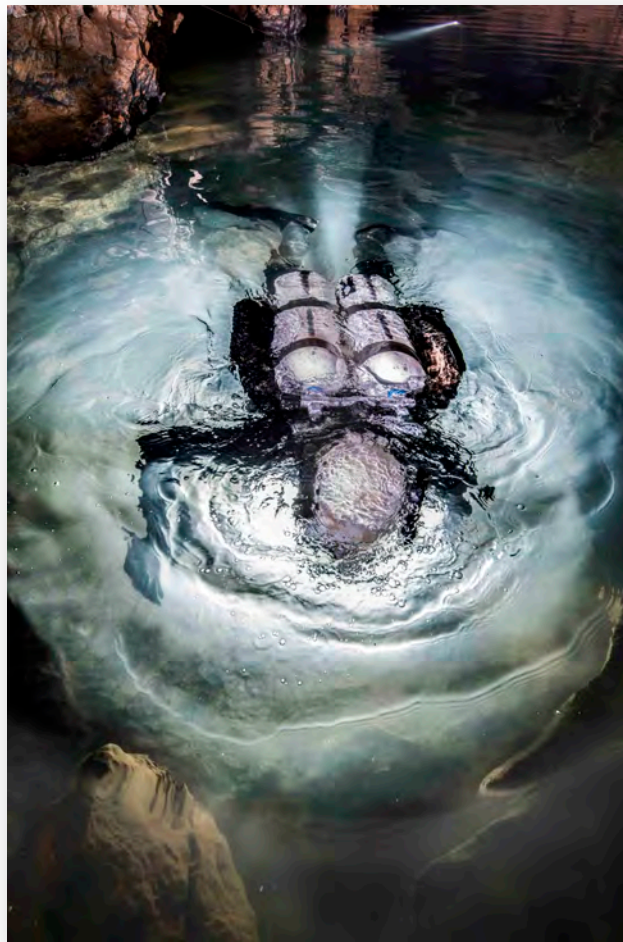


Image: Mark Burkey

Detailing the 2019 underwater exploration and documentation of the cave, Izvor Licanke.
2019 publication.

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Abstract

The objective of the expedition was to explore virgin cave passages both underwater and above, using advanced cave diving and caving techniques.

The cave is called Izvor Licanke and it is in Fužine, Croatia, near Rijeka.

In it's fifth year, the team was organized by expedition leader and exploration diver, Christine Grosart.

The cave had not been explored since 1999 and after a reconnaissance, a team was built to pick up where previous explorers had left.

Three exploration divers were involved along with their underground support team, all of which were required to cave dive to enter the cave system.

Excellent surface support was available this year and will hopefully continue in future projects.

The expedition went to plan with three exploratory dives conducted and 601 metres of new cave passages, both underwater and above, discovered.

This brought the total length of the cave to 1.5 Km, of which 1,125 metres has been discovered by this team.

The exploration was successful with no incidents and a survey of the new cave was conducted with numerical results as well as video imagery of the new discoveries.

The new discoveries yielded two new sumps and to the team's excitement, the end of sump 2.

Introduction

History of exploration of Izvor Licanke.

1992

The first sump was first dived by Tihomir KOVACEVIC, Zeljko PSENICA and Boris WATZ (D.I.S.K.F. Zagreb) for 40metres distance and maximum depth 6 metres.

1998

Frank Vasseur (FR), with the support of local cavers and divers, explored the second sump to a depth of 36 metres, at 140m distance underwater.

Project Background

May 2015

Krnica Dive Centre, well known to Richard Walker (GB) and Christine Grosart (GB), was able to obtain government permits to access cave diving sites across Croatia.

Many divers passing through the popular wreck diving centre were also cave diving trained and so a reconnaissance cave diving week was put together under the project name 'Project Morpheus'.

Christine Grosart joined the trip and among other sites, was able to dive a site called Izvor Licanke.

Very little was known about the site but it had a man made entrance which facilitated a pumping/potable water filtration station for the local town of Fužine.

Christine made a dive through the first sump with dive partner Anton Van Rosmalen (NL) and found it to be only 5 metres deep and about 40 metres long.

They surfaced in a large cave passage with underground lakes to be passed. The divers were inappropriately kitted out for caving in drysuits and twinsets, so they retreated to try and find out more about the cave system.

On surfacing the divers were met by the local workers at the pumping station who produced an old Corel Draw survey of the cave, which detailed a second sump after some 400 metres of 'dry' caving. Coupled with the dive line in sump 1 which had orange tags, a telltale sign of a French cave diver called Frank Vasseur, Christine located an online report of his exploration in the cave in 1998 and 1999.

Frank explained that government permissions had been lost and nobody had dived the cave since. Owing to customary politeness, Christine asked Frank if he would mind if she continued exploring the cave, as he had not been there for about 20 years. Frank was very happy for her to do this and explained as best his memory would allow how the underwater line ended 'wide open'.

The expectation was that there was a significant opportunity to map completely uncharted territory, film it and as a by-product, highlight an expedition run by a woman who was also a lead explorer.

July 2015

Christine returned later in the summer with her partner Richard Walker to attempt exploration of the second sump using lightweight sidemount techniques. They ran into difficulty as the second sump seemed elusive and they kept running into dead ends in high-level passages.

It was also deemed that a lightweight approach without support was not appropriate in this cave and help was sought.

June 2016

Christine and Richard returned with support from Rick Van Dijk (NL) and were able to locate sump 2. Using sidemount techniques to facilitate an easier 'carry' to the sump and a decompression gas cylinder each, the divers located the end of Frank Vasseur's exploration line 136 metres distance into sump 2 at 36 metres depth.

Christine dived ahead and laid a further 42 metres of line in distance which coincidentally went to 42 metres depth before their gas reserves forced them to turn the dive.

June 2017

Christine and Richard returned with reinforcements. Rick Van Dijk supported in between sumps, along with Ash Hiscock (GB) and Mark Burkey (GB), a renowned cave photographer.

Using multiple cylinders (6 each) Christine and Richard extended the line a further 99 metres with the maximum depth reaching 50 metres.

The aim was to produce a film about the exploration and document the project in both images and video.

June 2018

The same team returned with the addition of Roberto Varesko (HRK) helping to carry the equipment underground. Ash was invited to join the 'sharp end' of exploration and Christine, Richard and Ash all used rebreathers rather than open circuit which increased logistical efficiency.

Between them over three dives they extended the underwater passage in sump 2 by another 247 metres, with much of the cave passage remaining at an average depth of 45 metres.

Christine produced a short film about the project that was shown at the 2018 Kendal Mountain Festival.

Mark Burkey shot high quality images and video of the project and several articles were published in Descent, Diver and Dutch Speleo magazines.

Christine gave several talks on the project at the Dive Show (UK), Hidden Earth National Caving Conference (UK), Cave and Wreck night (NL), Global Underwater Explorers Conference (USA), Severnside Sub Aqua Club.

Location and Maps

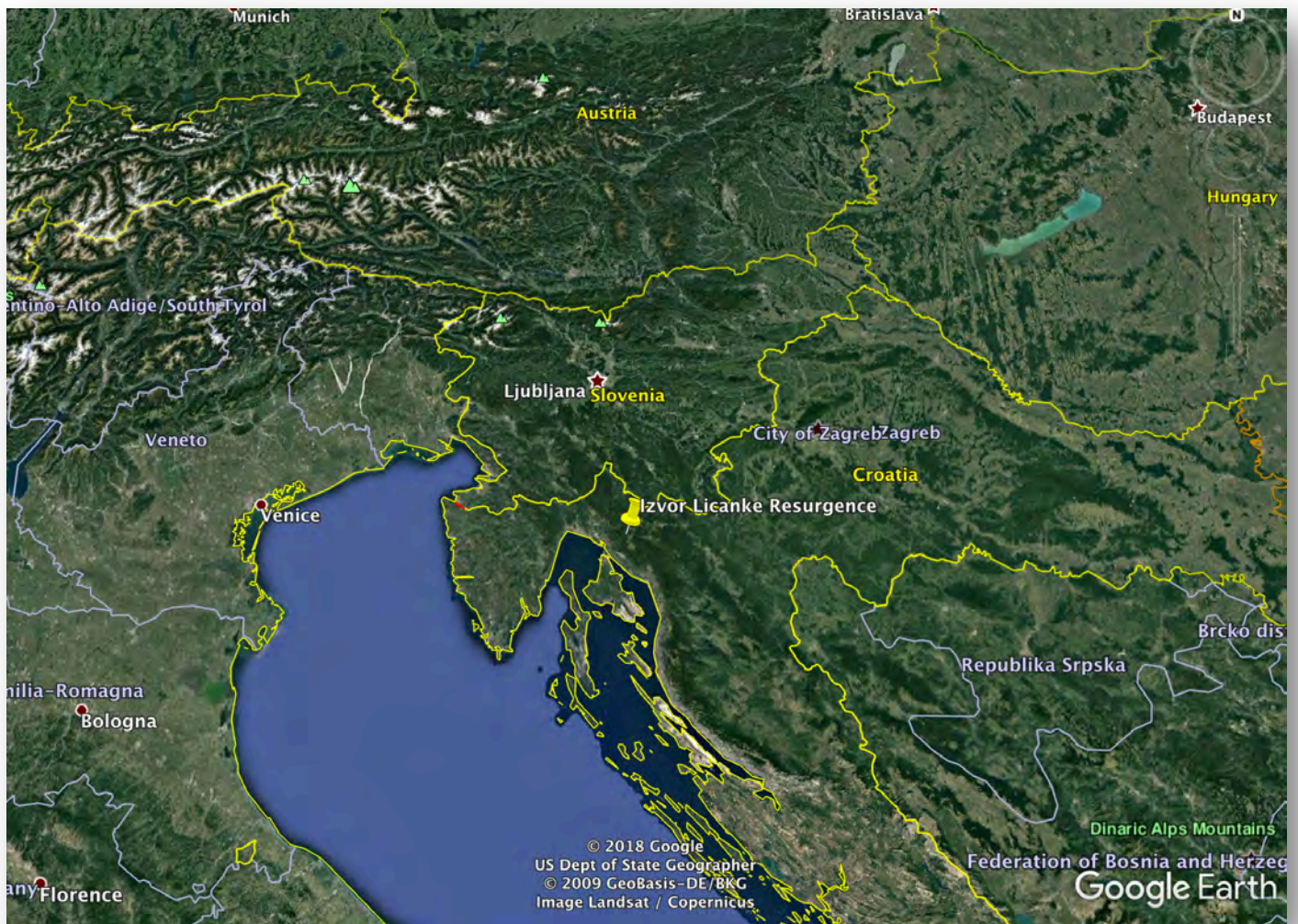
Izvor Licanke resurgence:

Latitude: 45° 19.720'N Longitude: 14° 42.094'E

Town: Fužine

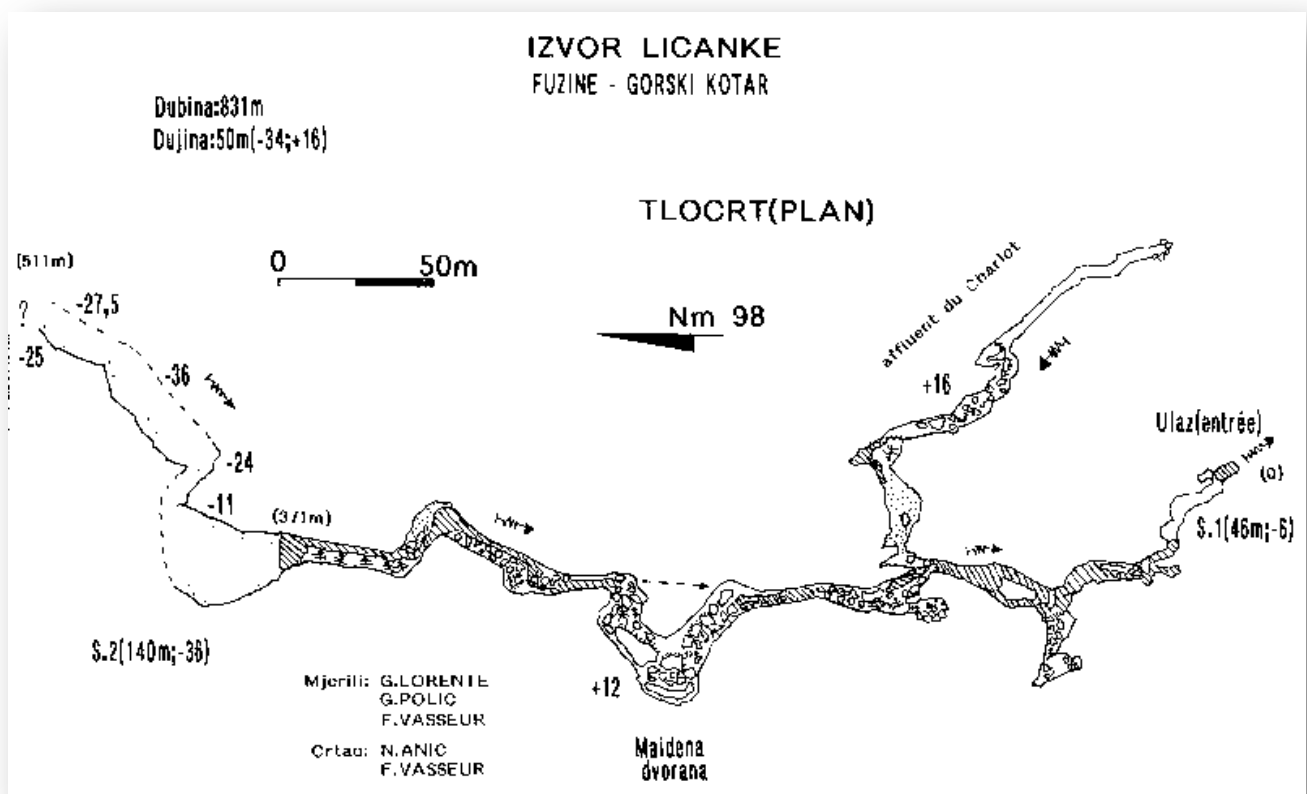
Country: Croatia

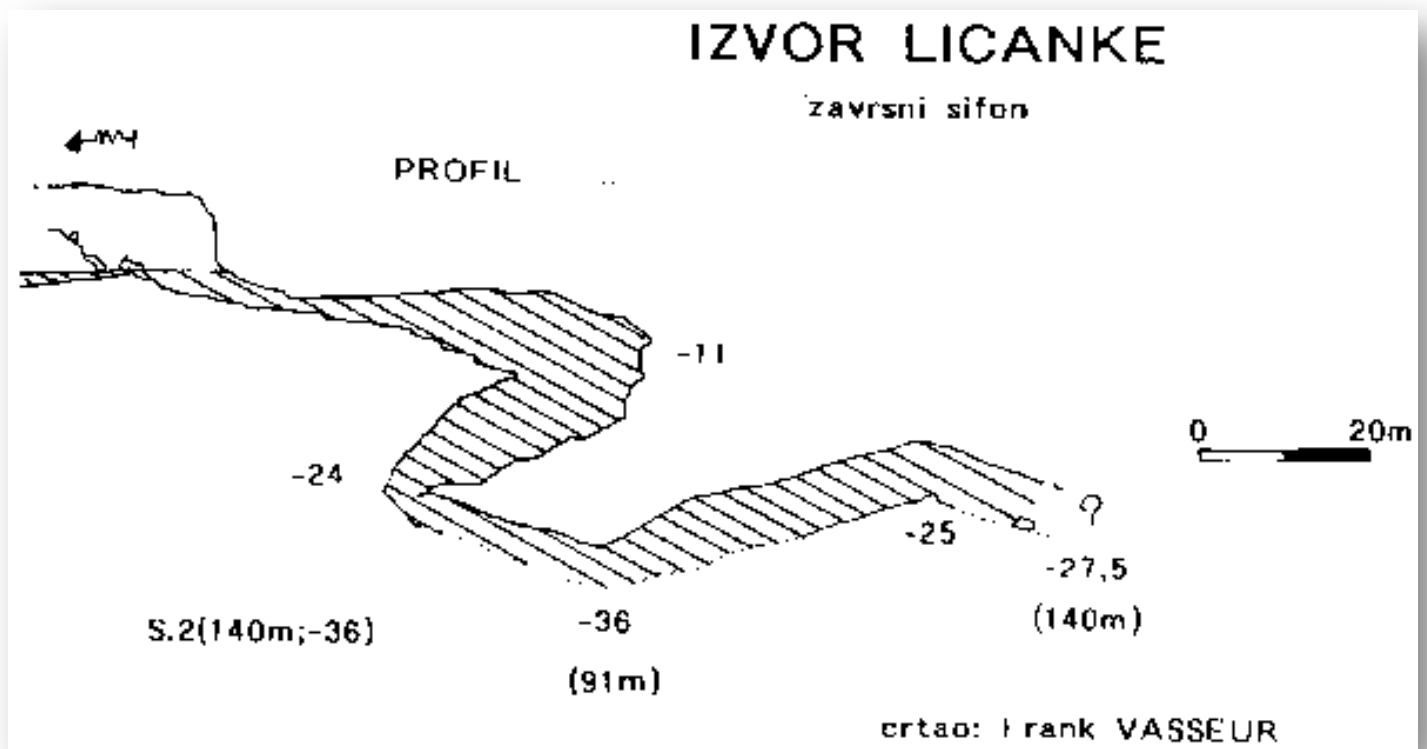
Map source: Google Earth Pro™



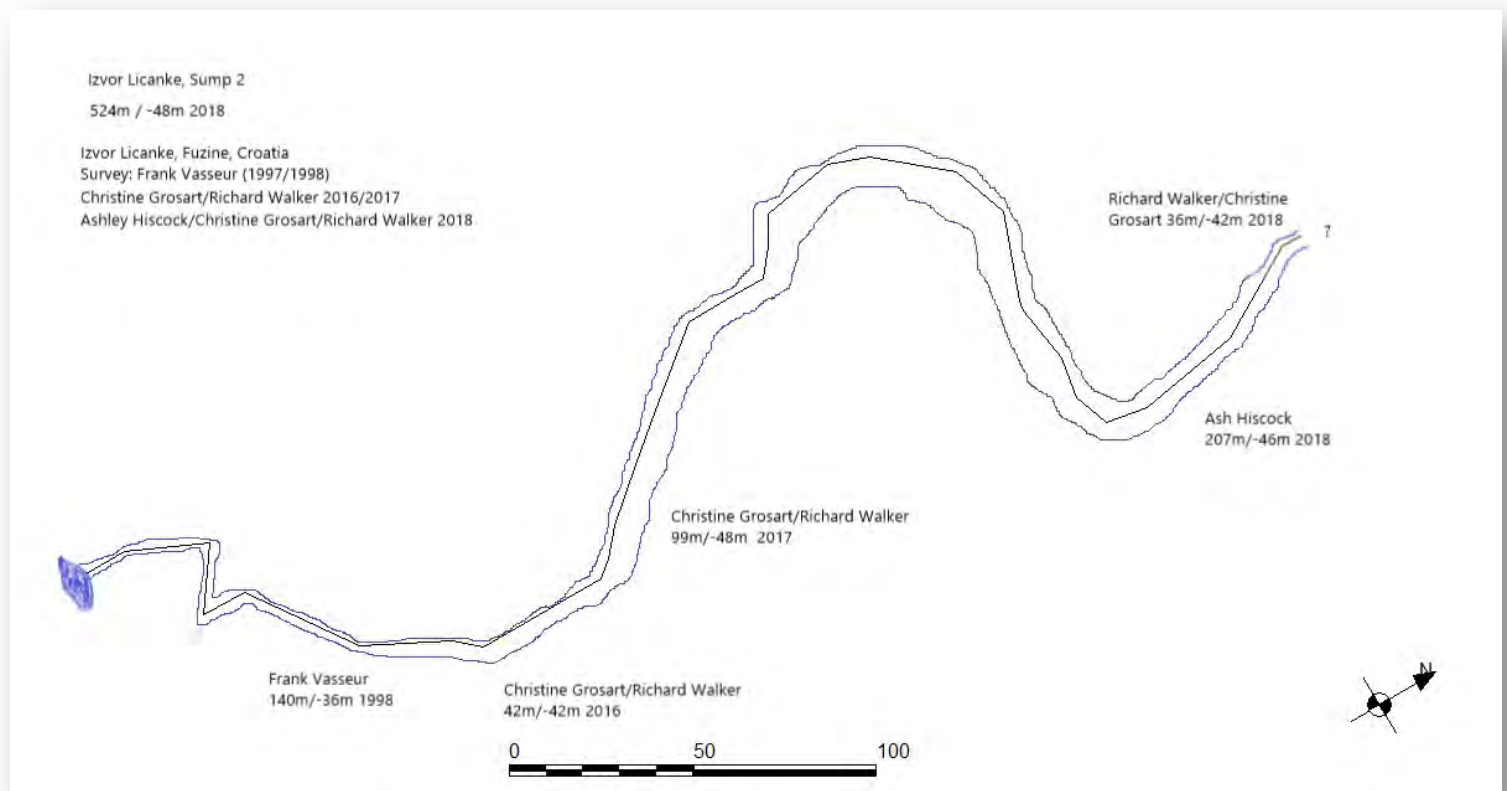


1998 Survey of Izvor Licanke, sump 1 leading to sump 2. Source: Plongeesout.com





2018 Survey of Izvor Licanke sump 2. Source: Christine Grosart (GB)



Expedition members 2019

Christine Grosart

(Great Britain)

Expedition leader/Exploration Diver

- FdSc Paramedic / Offshore Dive Medic
- Caving Instructor
- Record Breaking Cave Diver
- Cave Diving Group (GB) Examiner
- Global Underwater Explorers Tech 1/Cave 1
- IANTD Full Cave
- KISS CCR
- 20 years caving experience
- 15 years cave diving experience
- 10 years in cave diving exploration, with the end of the line in 3 caves in France and one in Croatia.

Richard Walker PhD

(Great Britain)

Exploration Diver

- Professional diving instructor (CCR/Technical/DPV) Global Underwater Explorers
- Instructor Evaluator – Global Underwater Explorers
- PhD medical physics
- Cave 2 qualified - Global Underwater Explorers
- Cave Diving Group (GB) qualified diver.
- 3000 dives
- Project cave diver on Karst Odyssey (Bosnia), WKPP support diver (USA), cave diving exploration in France.

Rick Van Dijk

(Netherlands)

Support

- Marketing Manager for Holland's largest union
- Qualified Cave Diver (Global Underwater Explorers)
- Caving for 5 years
- Member of Speleo Netherlands, Wessex Cave Club (UK) and The Red Triangle (BE)
- Diving since 1991
- Project Manager for Conservation Initiative Project Baseline
- Committee member of water board Greater Amsterdam
- Supporting Izvor Licanke project since 2015

Ash Hiscock

(Great Britain)

Exploration Diver

- Student of Philosophy

- Exploration cave diver/climber e.g Pozo Azul, Quincoces De Yuso, Herault (France), Ressel (France), Port Miao, Mount Elbrus – new route (2015), Karakoum (2014-16), Oyu Le Madre.
- Cave Diving Group Qualified
- Exploration diver/underground logistics Izvor Licanke Project

Mark Burkey

(Great Britain)

Support/Video/Images

- Rope access Level 3
- Caving for 10 years
- Cave Diving Group diver
- Award winning cave photographer
- Documenting and photographing caves worldwide
- Member of 3D scanning project for world's largest chambers
- Photographer for National Geographic

Roberto Varesko

(Croatia)

Support/Logistics

- Dive Master at Krnica Dive Centre
- Accommodation and local logistics
- Technical diver
- Support diver/underground porter

Rita Mallinson Cookson

(Great Britain)

Support

- Student of Linguistics
- Caving for 10 years
- Member of Imperial College Caving Club
- Member of Cave Diving Group
- Underground/beyond sump support

Jessica Burkey

(Great Britain)

Surface Support

- Rope Access Technician, level 3
- Director of 'Lifechangingadventures', outdoor expeditions
- Caving for 14 years
- Surface coordinator, media, food and accommodation management for Licanke project 2019.

Fieldwork

Background

This project began in 2015 during a project to explore several cave resurgences in the regions of Otocac and Rijeka. Licanke had not been further explored since 1998 and was the focus of our attention.

The expedition organiser had experience and expertise in multi-sump cave diving exploration and the project was ideal for her skill set and that of her team.

Licanke was reported to be 'ongoing' with the underwater passage in sump 2 still 'wide open' so a project was set up to go and continue extending this cave.

The resurgence exit area is heavily man made and has pumping filters used to filtrate water for both drinking and hydropower for the local town of Fužine.

Our exploration and associated survey is of great interest to the local water company as they have no data at all of where the water is coming from or the quality of it upstream. At the beginning of this expedition, the team had discovered 524 metres of new cave, all underwater. The limit of exploration lay 895 metres from the entrance, including the first sump and the subsequent "dry" cave on the approach to sump 2.

Planning

Primarily the planning was done by expedition organiser Christine Grosart. Ash Hiscock concentrated on underground logistics such as food and the base camp next to sump 2. Maurizio Grbac from Krnica Dive arranged the government permits and made arrangements for his dive centre to loan the cylinders required and fill them with the specified gasses.

Richard Walker assisted with arranging the purchase of Suex Scooters. Christine Grosart called upon a friend, Clare Pooley, who loaned the use of two Halcyon back up scooters for the project.

Roberto Varesko kept in contact with the water board at Fužine for regular updates on weather conditions and water levels at the cave. They sent images of the resurgence pool a few weeks prior to the trip.

Aims

The aim of this years project was to continue exploring the ongoing cave system and to survey the new cave passages to grade 2 or 3. In addition, as with every expedition here the intention was to document the mission using underwater video and cave photography.

Methods

Survey

Underwater surveying techniques vary slightly from standard cave survey techniques. It is desirable to record survey data when new cave is discovered, ideally for a BCRA (British Cave Research Association) grade 3 survey. This is the highest grade survey that can be reasonably expected underwater. It comprises:

Grade 3: A rough magnetic centerline. Horizontal and vertical angles measured to $\pm 2.5^\circ$; distances measured to $\pm 50\text{cm}$; station position error less than 50cm after closing loops. Compass calibration taken from local magnetic variation.

In practice, underwater cave surveys are somewhere between a grade 2 and grade 3 survey.

A clinometer is not used, but instead a depth gauge used to measure the topography.

For direction, Christine used a Silva™ walking compass early in the week. Later on, Ash used a digital compass, which formed part of his Shearwater™ diving computer.

For distance, the new dive line is knotted every 3 metres and divers count the knots underwater between survey stations and translate into metres for the survey.

A rough visual estimate of passage size (Left, Right, Up, Down) is made at each station.

The accuracy or ability to record passage dimensions depends on the visibility. The camera footage post-dive is also useful here.

Passage drawing on exploration dives typically is only 'a' level, where only the centerline is drawn.

We attempt to gauge some passage dimension where possible so it would be fair to say our survey meets somewhere between grades 'b' and 'c' where attempts are made to measure passage at most stations and separate walls are drawn in that approximate the passage size.

Innovative Technology

Paralenz Dive Camera

We were very fortunate to have the use of a Paralenz dive camera, which came into being around 2016. Rated to 250m depth, the camera is robust and compact. It has a slightly wide-angle lens and is capable of 4K video.

The camera tracks the dive profile so it is uniquely possible to pick any point on the dive and view the video from that exact point. This is particularly useful for reviewing the dive and filling in cave passage details on the survey as the whole dive is recorded including depth, time, profile and temperature.

She-P

Women have always run into difficulties when doing long, cold and deep dives in drysuits. It is imperative that divers are well hydrated and this becomes even more critical when decompression is involved.

Very few women delve into technical diving and one of the reasons is the inability to pass water during the dive. Their male counterparts have had this solved for many decades with the use of sheaths and pee valves installed in drysuits but owing to the female anatomy, a viable solution did not appear until 2006 when it was invented by Dutch female cave diver, Heleen Graauw.

This innovation has been a game changer for all female technical and cave divers and removes the only other option which was ugly, uncomfortable and eco-hostile adult diapers. Christine has used the She-P silicone device for the last 3 expeditions and it even survives the caving trip to and from sump 2. It is not too much to say that this expedition may have been cut short some time ago for a woman, without this innovative device.

Field Data

Survey data is recorded on Wetnotes (underwater writing pads) and filmed on the Paralenz Dive Camera.

An initial centerline survey is drawn using basic survey software (Winkarst) and a higher detailed survey is planned using more powerful survey software.

Results

The results of the three exploration push dives concluded the following:

Dive 1: Christine Grosart, Richard Walker. 51 metres of new passage at a maximum depth of 41 metres. The passage started to trend upwards in sump 2 and the divers turned the dive at a depth of 34 metres.

Dive 2: Richard Walker, Ash Hiscock. 66m of new passage in sump 2 which surfaced. Ash got out of the water and investigated 277m (approx. distance) of new dry cave passage, which ended in another sump.

Dive 3 (Sump 3): Ash dived sump 3 for 57m distance and a maximum depth of 10 metres. This surfaced and he discovered a short section (6 metres) of dry cave between sump 3 and sump 4.

Dive 4 (sump 4) Ash Hiscock. Sump 4 was dived for 129m surveyed underwater passage with a maximum depth of 26 metres.

Total new cave explored in 2019 (centerline) = 601 metres

Total Cave Length now stands at: 1496m (centerline distance only)

Total Cave explored by UK team since 2015: 1125 metres.

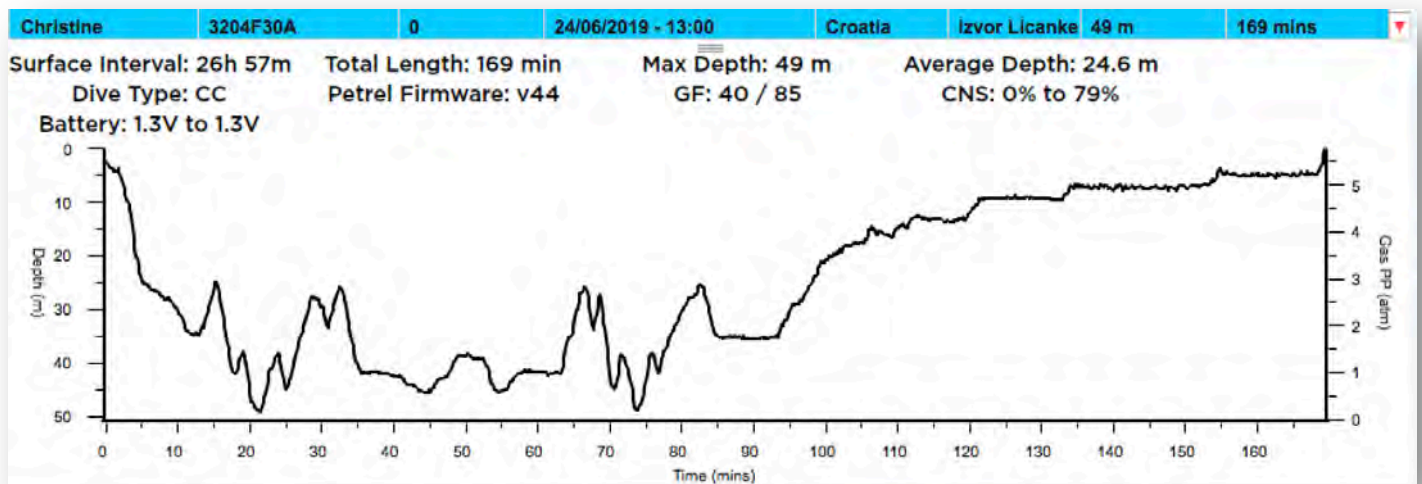
Water temperature: 7 degrees C

Visibility in sump 1 and sump 2 – 6 metres and a little milky.

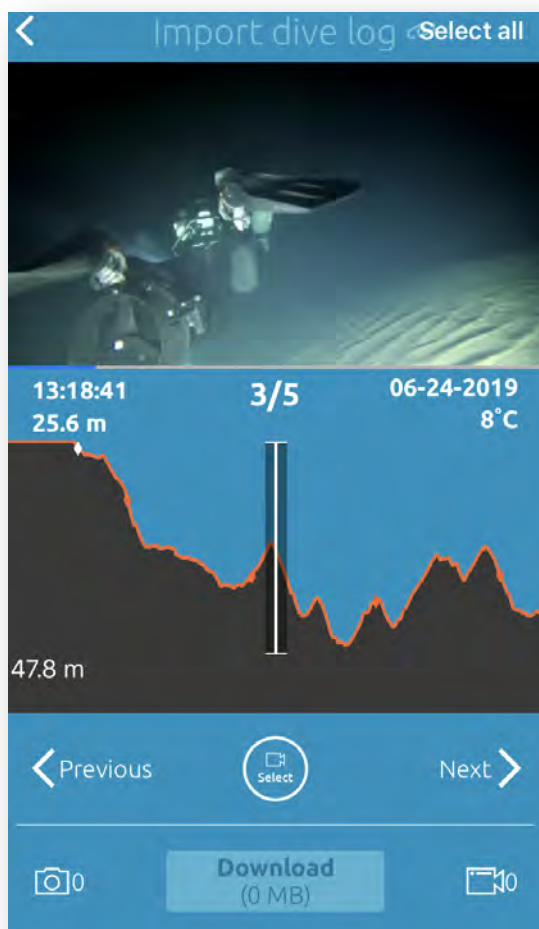
Visibility in sump 3 and sump 4 reported as crystal clear (10-15 metres approx.)

Surface weather was about 23 degrees and sunny/cloudy for the whole week with the occasional thunderstorm and downpour overnight but this did not seem to affect the underground conditions, probably due to the extensive vegetation on the surface above the cave.

Example profile of dive 1. Diver: Christine Grosart. Computer: Shearwater Petrel 1



Example images from the Paralenz dive camera, showing the video overlaying the dive profile 2019.



Project Modifications

It was expected that the cave may surface at some point but whilst it had remained between 40 and 50 metres in depth, we always planned for the worst that it would go deeper and even longer underwater, perhaps never even surfacing at all.

On the second dive the second sump indeed surfaced which meant small changes to the surveying techniques (estimated distances) and an adjustment to diving logistics as we now no longer needed a third bailout bottle for each diver.

Discussions and conclusions

The team often suspected that sump 2 may surface shortly but equally, given that many resurgence caves in Croatia had reached depths in excess of 100 metres, the team was always expecting the sump to continue for a longer distance with the threat of trending ever deeper.

It was with some relief that the sump has surfaced and now appears to be a multi-sump system with manageable length sumps discovered.

The cave is still trending north and heading straight into the mountains north of the lake and appears to be passing beneath a mountainous, perched lake.

We do not know if this is the catchment area for this cave or not and dye testing is not permitted owing to the water being used for human consumption.

It has been made known to us that water samples from sumps 2, 3 and 4 would be welcomed by the local water board as they do not have any information on the resurgence water or its pathway.

Our plans are to return in 2020 and take samples from each sump.

The dry passages beyond sump 2 require accurate survey and we plan to return with a Disto-X survey device to enable accurate survey.

We would also like to photograph the new dry passage and document the formations that have been noted in higher level passages.

Conservation goes hand in hand with our cave exploration and all equipment and items are removed (except dive line) after each expedition and any formations discovered will be noted and documented at the time of discovery.

The kitting up/de-kitting area both inside and outside the cave is checked daily for any litter or trace of the team's presence.

Administration and logistics

Destination Area

Fužine is notable for the sparsity of information available both on the internet and in the local tourist information office!

All sources give a variation of the following:

Fužine originated in the 17th century, when the Zrinski family began digging iron ore and the name of the site originated. 'Fužinarstvo' is the word used for mining and iron ore processing.

Fužine's tourists have been visiting since the end of the 19th century, more precisely since 1874, when the first organized group of guests from the Croatian Littoral in the area was recorded. More 100 years before that, there was a stopping place along the Karolina Road, where first travellers and tourists visited.



Lake from Fužine. Image: Christine Grosart

Fužine is located 730 metres above sea level, in the southwestern part of Gorski Kotar, surrounded by picturesque mountains, with centuries-old pine forests and beautiful lakes.

To this day, Fužine benefits from the development of very good road links, close to the motorways.

Fužine is known for its clean mountain air. From the surrounding peaks (Bitoraj 1385 meters, Visevica 1428 m, Tuhobic 1106 m, Preradovic 885 m) there are beautiful views of the wooded areas of Gorski Kotar and the nearby lakes, villages Vrata, Lič and Fužine, karstic Licko polje, sea, coast and Kvarner islands.

Today there are three reservoir lakes: Bajer, Lepenica, and Potkos.

The Licanke riverbed is 20.4 km long. It runs under Rogozna and Petehovac in Gorski Kotar and runs through the upper part of Fužine and rises on Ličko polje near Liča.

Under the name of Dubračina, it rises again in Vinodol near Mali Dola and in Crikvenica it joins the Adriatic Sea.

Along with the construction of a dam, in 1952 the artificial lake Bajer was formed in Fužine. This makes Fužine a significant tourist and fishing destination in the Primorje-Gorski Kotar County.

Research

The website 'Plongeesout' is particularly useful as it documents the exploration of Izvor Licanke in the 1990s. Frank Vasseur, the original exploration diver of sump 2, was extremely useful and helpful as far as his memory would allow.

Technology such as Google Earth Pro are extremely useful for getting a handle on the geography of the area and for overlaying our cave survey.

The local water board of Fužine monitor water levels and temperatures all year round multiple times a day and they were very happy to make this data available to us so that we could spot trends in the water levels according to rainfall and try to ascertain the size of the catchment for this underground river system.

Water level data example image from the 2018 expedition.

Data source: Water board of Fužine.

Date / Time of reading / Water level height at measuring station (Just downstream of the resurgence of Licanke) in cm.

	A	B	C	D	E
63494	8.6.2018. 20:14:52	19			
63495	8.6.2018. 20:20:19	19			
63496	8.6.2018. 20:25:47	19			
63497	8.6.2018. 20:31:14	19			
63498	8.6.2018. 20:36:42	19			
63499	8.6.2018. 20:42:10	19			
63500	8.6.2018. 20:47:37	19			
63501	8.6.2018. 20:53:05	19			
63502	8.6.2018. 20:58:32	19			
63503	8.6.2018. 21:04:00	19			
63504	8.6.2018. 21:09:28	19			
63505	8.6.2018. 21:14:55	19			
63506	8.6.2018. 21:20:23	19			
63507	8.6.2018. 21:25:50	19			
63508	8.6.2018. 21:31:18	19			
63509	8.6.2018. 21:36:46	19			
63510	8.6.2018. 21:42:13	19			
63511	8.6.2018. 21:47:41	19			
63512	8.6.2018. 21:53:08	19			
63513	8.6.2018. 21:58:36	19			
63514	8.6.2018. 22:04:04	19			
63515	8.6.2018. 22:09:31	19			
63516	8.6.2018. 22:14:59	19			
63517	8.6.2018. 22:20:26	19			
63518	8.6.2018. 22:25:54	19			
63519	8.6.2018. 22:31:22	19			
63520	8.6.2018. 22:36:49	19			
63521	8.6.2018. 22:42:17	19			
63522	8.6.2018. 22:47:44	19			
63523	8.6.2018. 22:53:12	19			
63524	8.6.2018. 22:58:40	19			
63525	8.6.2018. 23:04:07	19			
63526	8.6.2018. 23:09:35	19			
63527	8.6.2018. 23:15:02	19			
63528	8.6.2018. 23:20:30	19			
63529	8.6.2018. 23:25:58	19			

Velika Ličanka0 +

Normal View Ready

Training and Equipment Testing

Photography

Mark Burkey is an award winning cave photographer. Self taught, he is now in demand worldwide and has been commissioned for National Geographic as well as recording the (now) dry cave passage of the Thai Cave Rescue.

Whilst we had reasonable cave photographers on the project, they did not have the capacity to carry all the equipment through the cave, conduct the dive and organize the logistics and shoot images and video as well.

We needed someone whose sole job it was to document the project.

Mark Burkey had only scuba dived once on his honeymoon over a decade previous and due to his lack of diving experience, we immediately discounted him as any photographer would need to pass sump 1 (40m long/5m deep) safely many times throughout the expedition.

In the absence of anyone else suitable, it was pointed out to Christine that she had 3 months to teach Mark from scratch, enough to safely pass the first sump.

After a discussion with Mark – who had already been following the project via talks at the National Caving Conference, Hidden Earth – he was available on the trip dates. He and Christine set about a very intensive 3 month, in-water training programme and Mark applied himself 100%.

The outcome was a new member of the Cave Diving Group and a very competent and skilled diver who is now flourishing in caves all over Europe.

This was somewhat over and above the original plan of being just good enough to safely pass a short and shallow sump!

[Mark Burkey Cave Photographer](#)

[Mark Burkey - Learning to cave dive](#)

Closed Circuit Rebreathers

Exploring sump 2 was originally done on open circuit scuba, using cave diving techniques and gas rules.

However, owing to the continuing distance and depth of sump 2, the logistics of carrying 6 large diving cylinders each, plus decompression gasses, was becoming unworkable.

In 2018 the team switched to Closed Circuit Rebreathers (CCR - see glossary). Ash and Richard already had extensive experience with CCR but Christine had yet to need nor purchase one.

As a direct result of this project she bought a KISS CCR unit and modified it to suit the purposes of the project. She spent a year in 2017 learning to dive the unit and getting up to expedition level by training on a regular basis.

Scooters (Diver Propulsion Vehicles)

Owing to the cold water temperature and ever increasing threat of even more decompression the longer this cave got, it made sense to introduce scooters to the project. Scooters are battery-powered torpedo-like tubes with propellers that tow the diver through the water at a much greater speed than they could swim.



Christine and Suex scooter. Image: Richard Walker

We judged that we needed 4, so that each diver would have two on any dive. They would have a primary scooter and tow a smaller, back up scooter behind them. This meant that the bailout gas logistics could stay the same as the year before, even though the cave would undoubtedly get longer.

The limitations on this plan were the loss of ability to scooter owing to visibility.

The visibility was not excellent – only about 6 metres and milky – so it was possible to scooter but the divers needed to take care to preserve the visibility.

Three scooters were purchased between the three divers and we were very grateful of the assistance from Suex Scooters who made the purchase more manageable.

Two smaller Halcyon scooters were loaned for the project by Mrs Clare Pooley and we are very grateful to her for her generous assistance.

On receipt of the scooters, several dives were undertaken to ensure they were weighted and trimmed properly and to brush up on towing skills.

This reduces the amount of time that the divers would spend at depth and thus, decrease the amount of decompression obligations they would build up.

Any way of reducing the decompression obligation in 7 degrees of water was very welcome.

They came with a downside and that is transporting them through the dry cave between sumps 1 and 2.

Scooters are extremely expensive (circa £6k new, each) and the handles and propellers are easily damaged.

Logistics

Permissions and Access

Permission for this cave access is required from the government of Croatia. This was arranged for the team by local contacts. Permits and identification were available at all times should the authorities need to inspect them.

Evidence of permission was submitted to the Mount Everest Foundation.

Fund Raising and Financing

Expedition organiser Christine Grosart applied for a grant through the Ghar Parau Foundation and this connected with the Mount Everest Foundation.

Ghar Parau granted an award of £350.

Mount Everest Foundation granted an award of £900.

The remainder of the expedition (approximately £13,500) was self-funded by the individuals on the team.

Summary of costs:

Travel £250 per person (non Croatia)
Accommodation £140 per person per night (£1120)
Roberto Varesko salary (local logistics) £200
Food £20 per day per head (£1120)
Suex Scooter £3000
Suex Scooter £3500
Suex Scooter £4000
Total cost of expedition: £14,690

Ghar Parau funding was paid via BACS directly into the organisers account. A separate savings account was set up for the funding. Mount Everest Foundation sent a cheque, which was paid into the same account.

These funds covered the accommodation costs and payment for Roberto. A cash withdrawal was made and the landlady of the accommodation in Fužine was paid in full in local currency, Kuna.

Insurance

Individuals on the expedition obtained their own insurance. The primary companies used were: British Caving Association foreign cover; Divers Alert Network (DAN) and Snowcard (expedition level). Costs ranged from annual cover (£250) to individual trip cover – caving and cave diving (£60).

The policies covered decompression sickness, diving related illness, caving injuries and rescue. European cover for EHIC was also still valid.

All insurance was self-funded and no claims were made.

Travel and Transport

Mark Burkey, Jess Burkey and Rita Mallinson Cookson flew to Pula from the UK.

Christine Grosart, Richard Walker and Ash Hiscock drove from the UK to Croatia and took some items for those that flew.

Rick Van Dijk drove to Croatia from the Netherlands.

Robbie Varesko lives in Croatia and drove to the cave himself.

Diving cylinders were collected from Krnica dive centre and driven to the cave location.

All diving equipment was moved to and from the site using personal vehicles and self funded fuel.

Food and Accommodation

The team who flew in directly were picked up by other team members from Pula airport and shared transport with the team who had vehicles to Fužine.

Accommodation was arranged in Fužine, which is a wooden hunting lodge, with ample rooms for up to 10 people.

The accommodation has a large outside area for managing drying gear, fixing dive equipment and parking.

The accommodation had 2 bathrooms, a kitchen, large dining room and plenty of power outlets. Unfortunately the WiFi was very poor.

Food was purchased from the local village supermarket and most evenings were spent in the local pizzeria. Jess Burkey cooked for the team using local produce on 2 occasions.

Local tap water was potable.

Communications

The team leader communicated via email prior to the expedition to arrange permits, accommodation and chaperone. Internet in the region is poor so the team relied on mobile phone communication which was also used for internet.

Specialist Equipment

All cave diving expedition equipment is specialist and adapted for the environment which is fairly unique.

The closed circuit rebreathers and scooters (Suex XK1) were the most specialised as they needed to have adequate scrubber time and be compact enough to carry through the cave. The scooters needed to have enough battery range for several dives and be fast enough to cross the second sump without incurring much or any decompression.

The Suex XK1 scooters fitted this purpose perfectly and the carry packs specially designed for carrying these scooters on the back, were excellent and only needed minor modification to stop them slipping.

Risks and Hazards

Cave Diving is an inherently risky activity but this is relative and dependent on experience and risk mitigation.

As sump 2 is cold and was expected to be extended even further, risk of decompression sickness is always a real concern. Each diver on the expedition is aware of how to recognize and treat DCI and the nearest recompression chamber is in Rijeka which is a 1-hour drive away.

The biggest risk to the expedition was rainfall and the effect this would have on the visibility in sump 2. This would be problematic as the divers needed the ability to scooter and poor visibility would prevent this or slow down the transit time to and from the point of exploration.

This would have a knock on effect to the amount of bail out gas they would need to carry. The local water board were very helpful and sent the team images of the resurgence pool and water levels data and a decision to go ahead was made only 4 days prior to the trip beginning.

Medical Arrangements

Expedition leader Christine Grosart is an HCPC registered Paramedic and offshore diver medic. She brought sufficient medical equipment such as suturing kits, splints, pain killers, basic airway resus kit, cannulation pack and fluids and trauma kit. All members of the expedition have experience of cave rescue and first aid qualifications.

An oxygen therapy set was available on site.

Good mobile signal was available outside the cave on site. Jess Burkey remained on the surface and was briefed on call-out times each day.

No illnesses or injuries were encountered.

Environmental and Social Impact

The water from Izvor Licanke resurgence is used for providing hydropower to the local town of Fužine and is also a source of drinking water prior to processing.

Divers and cavers upstream of the resurgence inevitable cause some turbidity by disturbing sediment.

This has not appeared to have caused any problems for the local hydro plant.

The team recycled all possible waste using the receptacles at the accommodation and left no trace in or outside of the cave following the expedition.

The team has a good relationship with the local hydro plant and has even photographed and changed underwater filters for them at their request.

Photography and Videography

Mark Burkey is an award winning cave photographer and he was invited onto the project to document it and was trained to cave dive in order to do so.

Christine Grosart is an underwater videographer and film-maker and has made a documentary style film about the project. The film was premiered in 2018 at the Kendal Mountain Festival.

[The Master Cave: Trailer](#)

Media is a very important part of the project for many reasons, not least because there are so few female cave divers running their own expeditions worldwide and leading original exploration themselves.

Excellent images of the project can be found here:

[Izvor Licanke Project Images](#)

Methods

DSLR cameras needed to be dived through sump 1 in dry tubes and then re-packed into more manageable camera boxes on the far side.

Likewise, flash guns and bulbs for still images needed to be kept dry and protected from damage or water ingress.

Underwater video cameras (Paralenz) are depth rated, likewise the underwater video lights which required protection but could get wet without issue.

The underwater camera and lights were mounted on a specialised scooter mount made by Suex™.

The dive base at sump 2 was well lit by 50,000 lumen video lights (as used in National Geographic cave shoots) so photography could be far more 'candid'.

Media

Images have been used in conjunction with articles on the project in the following publications:

Diver Magazine / Divernet

[The Exploration of Izvor Licanke](#)

Descent Magazine

Wessex Cave Club Journal

Cave Diving Group newsletter

Talks on the expedition have been given at:

UK Dive show (Dive 2018)

Cave and Wreck Night, Netherlands

Global Underwater Explorers Conference, Florida

Hidden Earth National Caving Conference, UK

Expedition Diary

Day 1

Saturday 22nd June 2019

The team arrived at Krnica dive centre and began preparing diving equipment. This is where the diving cylinders were rented and filled to requirements. The exploration divers built, checked and tested the rebreathers.

All diving gasses were labeled, analysed for oxygen and helium content and regulators tested. The cylinders were placed in tackle bags ready for transporting through the cave. The dry tube was packed and weighted for transportation through the first sump. This was necessary to keep 'dry' gear dry such as warm clothing, food and camera equipment.

The team then travelled in the afternoon up to Fužine. The first stop was at the cave entrance to Licanke to check the water levels and visibility.

Visibility was an estimated 6 metres and water levels average for this time of year.

All the bailout cylinders were lowered into the water and stored ready for transportation the next day.

Day 2

23rd June 2019

Transportation and set up day.

The divers all dived through sump 1 (40m/-6m) carrying all the exploration cylinders, dry tube and required equipment.

Richard Walker had a minor rebreather malfunction which required attention that was best addressed on the surface, so this rebreather was taken out of the cave.

The exploration divers carried the other rebreathers in themselves and the team ferried 10 bailout bottles to the second sump.

The Suex scooters required careful management to avoid expensive breakages. This was managed by using back-packs provided by Suex specifically designed with cam bands and padding for transporting scooters.

These proved excellent and the team made astonishing time to sump 2 with four scooters, all bailout bottles and sundry equipment.

A dive base camp was set up at sump 2 to enable a comfortable environment for dive preparation, a kitchen for hot food and drink and a clean area for camera equipment.

Newest team addition, Rita, was given some training on the return from sump 1 in perfecting finning techniques and some minor adjustments to her equipment made to improve efficiency.

During the day Jess bought food for the team for breakfast.

Day 3

24th June 2019

Exploration day 1

Push divers: Richard Walker, Christine Grosart

Richard had fixed his rebreather overnight and carried this into the cave first thing. Christine dived through first and went straight to sump 2 to begin setting up the Light Motion video lights and Paralenz dive camera on the scooter nose cone for filming the dive.

The support team followed to sump 2 and began setting up camp. Mark began setting up camera equipment including a 50,000 lumen video light.

Ash carried in some extra cylinders so that he could set off quickly down to 24 metres to drop off the decompression bottles and the scooters ready for the divers.

Robbie assisted Christine in kitting up and Ash assisted Rich.

Both divers got into the water and visibility was milky and no more than 6 metres.

Mark shot video and photos as the divers prepared to set off into sump 2.

Rich and Christine took the primary scooters and 3 bottom stages down to 24 metres where they picked up the back up scooters as well.

They dived through the low gravel slope and set off scootering at a low speed due to the poor visibility and reached the end of the 2018 line on time after 20 minutes scootering.

They dropped the 3rd bottom stage and both scooters and Richard tied in the new line reel while Christine deployed her survey wetnotes and compass.

As Richard laid the new line, the cave stayed at 42 metres to begin with. Then it started to rise sharply up a steep boulder slope. The divers were concerned about the cave getting shallower at this stage as they had limited oxygen in the rebreathers. Multiple, significant ascents would eat into that oxygen reserve, which is required for the final ascent, so Christine terminated the dive at 38 metres depth and they headed home.

The divers were able to scooter home at a reasonable pace and dropped off the scooters and 3rd bailout stage close to home just before the final ascent.

The divers conducted their decompression schedule. Christine had a pee-valve balance issue and ended up quite wet beneath her drysuit and this added to the thermal issues during decompression.

Total Dive time: 169 minutes

Bottom time: 119

Decompression time: 50 minutes

New line laid: 51 metres

Time spent laying new line: 10 minutes

Average Depth: 42 metres

Maximum Depth: 49 metres

Day 4

25th June 2019

Interval day

A small team (Rick Van Dijk, Robbie Varesko and Rita Mallinson Cookson) headed into the cave to carry in some cylinders and another scooter and removed one decompression bottle to replace with another.

This only took a couple of hours.

The remainder of the day was spent uploading images from the trip so far and preparing a rebreather for the next day's dive.

The team also prepared camera gear for the next dive and underground food and warm gear for an expected even longer dive time.

Day 5

26th June 2019

Exploration day 2

Push Divers: Ash Hiscock, Richard Walker

Richard and Ash carried rebreathers to sump 2 and the rest of the team sorted the camp ready for hot food and set up video lights.

Richard and Ash picked up the staged scooters and bail-out gas at the 35m staging point and headed further into the cave.

After some 25 minutes of scootering, the end of the line was reached. Ash tied in a reel, left the scooters behind, and began and started a methodical search exploring the vertical cliff face that had marked the end of the previous effort. The top of this underwater cliff face leveled off at approximately 20m depth, and the way on was along a "v" shaped gulley. Rich joined Ash at a depth of around 3m. A surface pool was clearly visible and the pair surfaced into an air-filled chamber with water flowing in from an obvious, ongoing passage after exploring 81m of new underwater passage.

Ash crawled out the water and started removing gear to go explore the dry passage. On looking at the wrong side of sump 2 he noticed that the end of this dive was a perfect phreatic shape but this morphed into a large rift approximately 2m wide and 10m high that he continued to walk along to explore. After approximately 50m this turned into a boulder breakdown for 20m which Ash crawled along to discover more rift. This rift continued for the next 200m across mostly large rift passage with small sections of deep lake in beautiful phreatic passage. After a total of 277m of dry passage in addition to the 81m in sump 2, Ash discovered sump 3 which descended quickly in good visibility. Unfortunately, lack of adequate reserves in suit inflate gas forced a return rather than diving sump 3 on this day.

Day 6

27th June 2019

Exploration day 3

Push Diver: Ash Hiscock

The support team carried numerous cylinders into the cave for Ash, who entered last and slowly. The plan for the day was for Ash to dive sump 3 to give more information to plan next years logistics. Whilst Ash was diving, Mark Burkey was put in charge of underground logistics to give him some experience in this role and tasked with packing up the camp from the start of sump 2 and managing the packing and removal of all unnecessary diving gear back to sump 1.

Ash set off into sump 2 after quickly gearing up with the help of first Mark and then Christine. Passing sump 2 in 13 minutes, Ash surfaced in the dry section. Removing the two large 12L steel cylinders and 11.1L aluminium cylinder, Ash continued along the 277m of dry passage with the rebreather and suit bottle up to sump 3. He then returned to carry his aluminium bailout cylinder, fins, and ancillary equipment up to sump 3. At sump 3 the exploration reel was tied on and Ash prepared his equipment to dive.

The sump descended in large phreatic passage to -10m and then turned hard left to go up a slope to surface in another large rift after a total distance of 60m. Excitedly Ash tied off the exploration reel to secure his line home and then removed his gear quickly. After a

grand total of 10m of new dry gallery in a large rift, Ash went around a corner and discovered sump 4.

The exploration reel was quickly removed from the end of sump 3 and tied to the beginning of sump 4. Ash geared up at the end of sump 3 as no suitable gearing up spot existed at sump 4, the entry to this being a phreatic pot immediately descending to depth.

Starting to explore sump 4 Ash quickly descended to -30m and continued along a passage with several side leads which were left unexplored as the main way on continued along large diameter phreatic passage in good visibility. After approximately 100m a large rift ascending from -30 to -10 was found. This was ascended to find a continuing phreatic passage. This was followed for approximately 70m to a final depth of 7m before the line ran out and further exploration was not possible. After tying off the line, Ash turned around to survey the new explorations and return back home.

Upon surfacing on the home side of sump 2 Ash found Mark and Rick waiting for him who immediately swooped in to hear the news, and Ash was pleased to find everything except the material he used to dive had been removed from the cave. Mark and Rick continued to bag up Ash's dive material and remove it from the cave, whilst Ash continued on a steady trip out the cave alone.

Day 7 **28th June 2019**

Clean up day

Richard, Mark and Christine headed into the cave to recover the remaining scooters and cylinders from sump 2. This was done fairly quickly and time was then set aside to take photos in sump 1 of various items of dive gear for media and talks. One bag of camping items had liberated itself somewhere between sump 1 and sump 2 and Ash had a quick dive foray to go back in and find it, which he did.

Conclusion

The expedition achieved the primary aim that was to extend this cave and exceeded expectations by surfacing and becoming "multi-sump".

A total of 601 metres of new cave passage both underwater and above water was discovered and a centreline survey achieved.

The long, deep sump 2 surfaced and this has made exploration challenging in a different way but in terms of duration and exposure underwater, has reduced the logistical headache at least for now.

Further exploration requires caving beyond sumps with sump 2 presenting a committing challenge to reduce or avoid decompression on the far side of the sump.

Future logistics will need to take into consideration an injured diver beyond a long, cold sump and decompression and recompression considerations.

The level of complexity in sump 2 has decreased while the level of complexity for exploring the two further sumps has increased.

The team has gathered important information about the cave, which is valuable to the local water board and community.

The team plans to return in 2020 to continue exploring sump 4.

Acknowledgements

Ghar Parau Foundation
<http://www.gharparau.org.uk/>

Mount Everest Foundation
<https://www.mef.org.uk/>

Krnica Dive Centre, Croatia
<https://www.krnica.com/>

Suex Scooters
<https://www.suex.it/>

Clare Pooley

Fourth Element
<https://fourthelement.com/>

Halcyon Dive Systems
<http://www.halcyon.net/>

Ursuit Oy Drysuits
<https://www.ursuit.com/en/dry-suits>

Dive Proof
<https://diveproof.com/>

Appendices

Inventory of equipment, 2019

Christine	Rich	Krnica Dive list	Ash	Rick van D	Mark	Robbie	Rita
Personal Kit				Wetsuit	Wife		
KISS Rebreather - complete	JJ Rebreather	Chris Twinset 32%	Cylinders	O2 booster	Semi dry	Wellies ? check	Ash's regs
Santi 9mm Hood to trim	Fourth Element semi dry (to get)	Rich Twinset 32%	2x20L 15/55 230bar	Helmet and light for Robbie	Helmet/light	Twinset 32%	Ash's wing
Tool kit and spares	Gavin standard body dry tube	Rita Sidemount steel 12s or Ali 80s	2x20L 10/70 230bar	KISS Rebreather backmount	back up lights	Semi dry	Matt Jenkinson's Scurion
New cells - to fit	Ratchet straps for dry tube	Trimix bank for CCR - 15/55	20L O2 200bar	Sidemount KISS - SMIR (BOB)	harness	helmet and light	5mm gloves
Right hand bailout reg	24kg lead for drytube	Oxygen Bank - enough for 6 dives to fill 3 litre cylinders	2x12L 18/45 230bar	Twinset 32%	wing		Needs semi-dry
4 left hand bail out regs	3 litre suit inflation rigged	Lead for drytube = 24kg ish	AI80 18/45 210bar	Twinset wing	twinset regs		Wellies
Dry Gloves	Suit inflation reg	Mark Twinset 32%	AI80 35/25	Twinset harness	fins		Wetsocks
Fleece Gloves	Line Reel x 2	6 x ali 80s with 15/55	2xAI80 50% 220bar	Twinset regs	masks		Harness
Spare Blue gloves	Exploration Line	2 x ali 80s with 50%	AI80 O2 200bar	18L left 21/	search reel		Fins
Wet Gloves (caving)	Decanting Whip green	2 x ali 80s oxygen	AI80 air	18L right	knife		Masks x 2
Wet Socks	Drysuit	Robbie twinset 32%	4x7L air	Righthand bailout reg	gloves		Search reel
Semi Dry	Wellies	Wellies x 3 pair. 5.5, 8.5, 9	2x3L ali air	Lefhand bailout reg	Wet Socks		Line cutter/knife
new size 7 wellies	Helmet	Small bag x 2	3L steel air	3L alu inflatorbottle	Boots		hips: 41 inch, waist 31, chest 40, shoulders 17 across
Size 9 wellies - Rich's	Rude nora new light	Medium bag x 1	2x3L O2	Helmet and light			Sleeping bag
Fins	Boots	Rocket tube x 1	2x3L 10/70	2x backup lights helmet	Camera gear:		Batteries & chargers
Computer batteries	wet socks	Green tarp		Bastard shoes	DSLR & Lens		Compass
Twinset wing	wet gloves (caving)	Line reel 3/4 full - approx. 300m knotted.	Reg Bags	Fins to fit the bastards (to buy)	Radio Trigger		Lots of little diving lights
Twinset harness	Sleeping bag	Belt x 2	4x Main Regs	Masks x 2	Video Camera		Necklace
Twinset regs	Get regs back from Colin Stratton	Screwgates x 10	6x Stage Regs	2x CCR 3L O2	Tripod		Wetsuit + shortie
Helmet	Drytube	Slings x 4	6m O2 Reg	2X CCR 3L 10/70	4 x hand held Video Lights		Need to bring: caving gloves
Back up torch	Reel and knotted line - Krnica	BDH x1	Suit Reg	2x 80cft O2	1 x X Light (50,000 Lumen)		Need to bring: buff
Batteries for back up torches	Spare line - Krnica	Spool of line. Heavy. 4mm.		1x 40cft O2	4 x Stobes		Need to bring: snoopies
Masks x 2		Elbow pads x 2 pair	Main Drysuit	Oxygen safety kitt	Reflectors / Cases		Thermals
Knife for RB - sharpen		Rope x 20m	2x Drysuit	Drytube for food+basecampstuff	Laptop		Hood

Wetnotes - Gemma to design survey		Helmet x 1	2x Drysuit Boots	3x Drysuit	Shed load of chargers		Swimsuit
CCR Oxygen bottles x 2			2x zip grease	lead for drytube			
Diluent bottles x 2			lots x catheters				
3 litre suit inflation			Thermovlave				
Carry handle for KISS			Bestard Boots				
Suit inflation reg			3x Hoods				
Drysuit			Undersuit Bag				
Santi Undersuit			Base top				
Pink thermal			PS leggings				
Fourth Element Thermal vest			Fat socks				
Halcyon hand held torch and batts and chargers			Heated Vest				
D-Timer			Doormat				
Compass			Undersuit				
Snoopies			KUBI Bag				
Exploration Compass			Main KUBIs				
Analyser			Back up kubis				
Gas Tape			Inner Gloves				
ADV valve stem - narked			Wrist String				
ADV diaphragm - spare			Spare kubis				
Scooters			Spare o-rings				
XK1 x 2			CCR				
Suex camera mount			KISS				
Chargers x 2			Main Box				
Carry pack - Suex x 2			Sidemount harness	Ash CTD			
Halcyon scooters x 2			Wing	Spares			
Halcyon scooter chargers x 2			Notebook	12mm Bungee			
Slings			Deco Bag	3mm Bungee			
Warm socks - new			Camelbak	3mm Cord			
Goodman handle			Wetsuit Search reel	3xCells			
Tackle bags - WCC			2xdrysuit search reel	6mm Bungee			
Scooter bags - Rich to check			Reels	6mm Cord			
Paralenz			Music Player	Blanking plugs			
Paralenz charger			Compass	BOV Spares			

micro SD			Computer	Breathing Hoses			
Bungee			Knives	Button Gauges			
light motions x 2			Helmet with lights	Counterlungs			
Snoopies for light motions			Fins	Cylinder jubilees			
Karabiners			3x Mask	Cylinder plugs			
Tarpaulin			Fin Biner	Cylinder Valves			
Cave food			lots wetgloves	Drysuit repair kit			
Plastic bags for lime			lots caving gloves	Drysuit seals			
Rocket tubes			lead	Dump OPV, wing			
Daren drums			Heater Battery	Dump valve drysuit			
Tackle bags - home			Barbolight	Inflate valve drysuit			
Dry bag for dry gloves for inside daren drum			reg necklace	Inflator Hoses			
Bungee (buy)				KISS O-rings			
Necklace			Scooters	Mouthpieces			
Leashes			Suex	O2 grease			
New halcyon mask			Piranha	O-rings (general)			
New pressure gauges x 4			Other	Parts regs			
Clare's scooters and chargers			Small roll mat	Piston Clips			
She-P			Foil Bag	ppO2 display			
New She-P glue			Stove	Reg Hoses			
Normal Diving shoes			In cave toolkit	Reg OPVs			
Airbed			In cave spares kit	Reg Service Kits			
Kayak bits			lots tacklesacks	SPG hoses long			
Camping box - thin down			lots daren drums	SPG hoses short			
Sleeping bag			rocket tube x 3	SPGs			
Clothes bag			Small drytube	Stickers			
			Sleeping bag	tat rope			
			Inflatamat	Tools			
			Bivi bag	Tub Sorb			
			SRT Kit	Zip Grease			
			200m rope				
			Furry	Electrics Box			
			Oversuit	2x Extension Cord			
			Wetsocks	4x EU adaptors			

			Heater Charger	9v Batteries			
			Instant Camera	AA Batteries			
			Instant charger	AAA Batteries			
			Piranha Charger	Barbolight Charger			
			Scurion Charger	Go-pro			
			Suex Charger	Go-pro charger			

Raw survey data Izvor Licanke, 2016 – 2019
Christine Grosart, Richard Walker, Ashley Hiscock.

Station From	Station To	Distance m	Compass	Depth m	Left m	Right m	Up m	Down m	Comments
1	2	12	0						follow right wall from sump pool
2	3	24	24						
3	4	20	125						
4	5	13	0						switch from right to left wall
5	6	36	55						
6	7	26	27						station 7 is franks line
7	8	9	40	27	0.5	8	2	0	station 7 is franks line
8	9	24	0	40	1	8	2	0	
9	10	6	0	42	1	8	2	0	
10	11	3	0	42	1	8	3	0	
11	12	9	0	38	0.2	8	3	0	station 12 is 2016 end
12	13	6	320	39					station 12 is 2016 end
13	14	9	310	39					
14	15	18	320	43					
15	16	12	320	45					
16	17	12	320	48					
17	18	18	320	48					
18	19	12	0	46					
19	20	12	0	43					station 20 is 2017 end
20	21	9	310	42					station 20 is 2017 end
21	22	9	300	40					
22	23	21	350	40					
23	24	12	20	43					
24	25	24	40	46					
25	26	18	70	40					
26	27	27	110	29					
27	28	3	100	28					
28	29	18	80	35					

29	30	12	100	32					
30	31	12	70	26					
31	32	12	10	28					
32	33	30	350	34					station 33 is ash 2018
33	34	9	330	34	2	4			station 33 is ash 2018
34	35	21	330	41					
35	36	6	0	42					station 36 is christine 2018
36	37	12	300	42	0	2			station 36 is christine 2018
37	38	12	340	44	1	4			
38	39	15	325	45	3	10			
39	40	12	280	42	3				
40	41	15	260	38					41 is last tie off Chris & Rich 2019
41	42	9	280	29					41 is first tie off Ash & Rich 2019
42	43	6	310	20					
43	44	30	60	4					
44	45	21	330	0					Station 45 is surface – end of sump 2
45	46	15	340	0					45-46 first leg of dry cave after sump 2
46	47	30	330	0					
47	48	10	335	0					
48	49	5	70	0					
49	50	5	350	0					
50	51	7	215	0					
51	52	4	35	0					
52	53	5	10	0					
53	54	3	80	0					
54	55	30	350	0					
55	56	5	285	0					
56	57	5	310	0					
57	58	20	25	0					
58	59	5	330	0					
59	60	10	305	0					
60	61	15	330	0					
61	62	30	330	0					
62	63	20	335	0					
63	64	8	20	0					
64	65	15	330	0					
65	66	30	335	0					Station 66 end of dry section after sump 2
66	67	9	350	2					Station 66 start of sump 3 leg
67	68	9	50	5					
68	69	18	350	10					
69	70	9	320	5					
70	71	12	270	0					Station 71 is end of sump 3 – 2019
71	72	6	330	0					Station 71 is start of dry passage end of sump 3

72	73	9	80	8					Station 72 end of dry section / start of sump 4
73	74	12	30	12					
74	75	12	20	16					
75	76	15	350	18					
76	77	18	20	27					
77	78	3	340	26					
78	79	6	350	26					
79	80	9	350	25					
80	81	12	10	25					
81	82	12	20	23					
82	83	6	0	22					
83	84	3	40	10					
84	85	12	10	10					Station 85 is end of line sump 4 – AH

Web Links

Descent magazine [Centre Spread](#)
Diver magazine [Article](#)
The Master Cave [Film Link](#)
Film Trailer [The Master Cave: Trailer](#)
WetWellies [Blog](#)
Paralenz [Blog](#)

Distribution list

Ghar Parau Foundation

Bibliography

Plongeesout
<https://www.plongeesout.com/>

Cave Diving Group Newsletter
<https://cavedivinggroup.org.uk/newsletters/>

Glossary of caving and cave diving terminology.

Bailout: Open circuit cylinders used to breathe in an emergency should the divers rebreather malfunction.

CDG: Cave Diving Group (Great Britain). One of the oldest diving organisations in the world, the CDG was formed in 1946 for the purposes of cave diving in Great Britain and training divers and cavers to explore underwater caves.

Disto-X: Digital cave surveying device

GUE: Global Underwater Explorers. Non profit diving training organization, originating in the United States with cave diving and now globally at an internationally renowned high standard.

HCPC: Health Care Professions Council

IANTD: International Association of Nitrox and Technical Divers. Technical and cave diving training agency

KISS: KISS rebreathers; brand name of a model of manual rebreather, built in the USA.

Open Circuit: SCUBA (self contained underwater breathing apparatus). Breathing gas compressed to approximately 200 x atmospheric pressure is delivered to the diver via a pressure reducing valve. The diver inhales from a mouthpiece and exhales into the water via the same mouthpiece.

Rebreather (Closed Circuit Rebreather/CCR): Machine that recirculates the divers breathing gas, instead of venting every exhaled breath into the water. This significantly improves efficiency over regular SCUBA, but comes with the risk of increased complexity.

Scooter: Diver Propulsion Vehicle (DPV). Torpedo shaped machine with a propeller, that tows a diver along at greater speed than they could swim. This reduced the amount of effort and time in covering distance underwater and this in turn reduces the amount of time spent at depth, thus reducing decompression obligations.

Sidemount: British Cave Diving technique of mounting diving cylinders on the side of the divers body rather than on the back, to enable passing small underwater passageways.

Sump: Completely flooded section of cave passage, which requires diving to pass.

Twinset: Two cylinders tied together, worn on the divers back and manifolded together.

Tackle Bag: Heavy duty PVC coated cordura bags designed specifically for carrying loads through caves.

Regulator: Device that reduces cylinder pressure to ambient pressure enabling the diver to breathe from it.

WKPP: Woodville Karst Plain Project. Cave exploration project in the USA, comprising the famous Wakulla Springs.