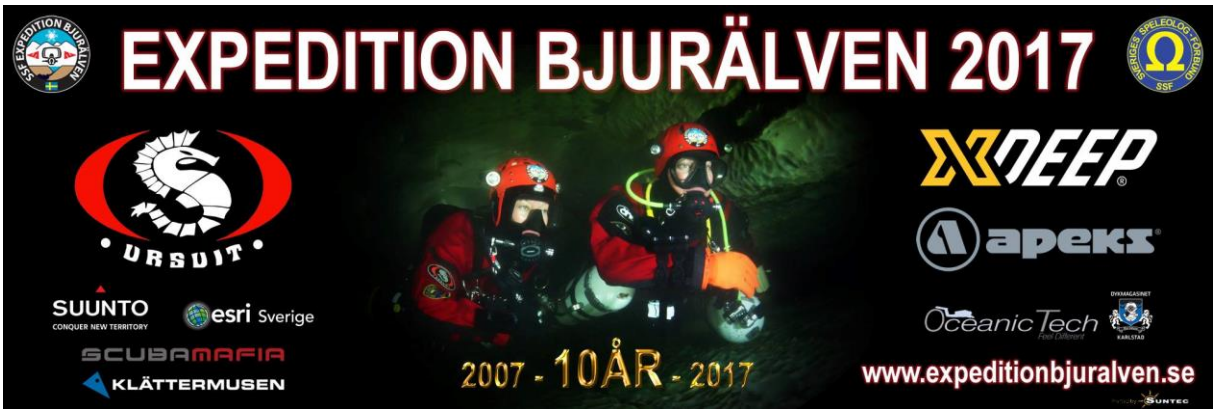
Expedition Bjurälven 2017 report



Expedition Bjurälven would like to express sincere gratitude to the main sponsors in 2017, Ursuk, Apeks and xDeep. Efficiency of our equipment is something we rely on. Using drysuits provided by Ursuk, Apeks regulators and sidemount harnesses from xDeep, we could reach longer into the limestone rock of the Bjurälven valley than we could ever imagine. Several other companies helped us achieve our goals safely in 2017: Oceanic Tech, Dykmagasinet in Karlstad, Klättermusen, Scubamafia and Suunto. Their products and support made the Expedition safer and helped us achieve our goals. Esri Sverige, Reel Diving, Leica Geosystems, Suntec, Äventyrsgruvan, Divetech as well as the Swedish National Land Survey are also acknowledged for their support of the expedition. The local authorities and population were backing us up 100% as usual, making the expedition possible. We would like to thank the people of Stora Blåsjön and authorities in Jämtland County, Ica Stora Blåsjön and Gäddede as well as Mikkes Skoteruthyrning for all their help.

Figure 1 Preparing for a dive in Bjurälven

Compiled by Dmitri Gorski

Bo Lenander, a member of the current expedition crew, discovered the entrance to the Dolinsjö cave in 1979. The first winter expedition to Bjurälven valley was launched in 2007, following several unsuccessful attempts to dive in the Dolinsjö cave. Previous attempts were unsuccessful mainly due to very strong current that rips through the cave system summertime, measuring up to 20 knots. In wintertime, the water is much calmer and hardly any current can be detected. Another factor in favor of conducting the expeditions wintertime is easier logistics. All the equipment can be transported to the cave entrance using snowmobiles, minimizing the risk of damaging the fragile vegetation in the national park where the cave is located. In 2008, divers of the second Expedition Bjurälven could enter the cave and map some 50 meters of the passages beyond the entrance. Thanks to excellent cooperation with the authorities and continuing support of the local population, diving and exploration in Bjurälven continues every year. Ten years since the first expedition, the official mapped length of the cave system is 2245 meters. Dolinsjö cave is Sweden`s longest water-filled cave and among the 120 longest underwater caves in the world.

Members list 2017

Pirre Sandberg	Dmitri Gorski	Andreas Johansson	Stina Gabrielsson
Kristian Lyberg	Petter Johansson	Oscar Svensson	Janne Suhanen
Micke Tilja	Bo Lenander	Robert Staven	Antti Apunen
Mats Fröjdenlund	David Thor	Ola Löfquist	Leif Sigvardsson
Johan Utas	Jonas Roos	Øyvind Hegle	Marcus Palmqvist
Stefan Barth	Amanda Lindberg	Ane Mengshoel	Marco Kupiainen

Figure 2 Expedition Bjurälven 2017 exploration team (Dmitri Gorski and Leif Sigvardsson are not in the photo)

Goals and summary

The overall goals of Expedition Bjurälven are:

1. Explore, map and document caves in the Bjurälven valley
2. Promote the caves in the area and the local community of Stora Blåsjön
3. Contribute to scientific research through cooperation with universities

After Expedition Bjurälven 2017, the official length of the Dolinsjö cave is 2245 meters. The cave is advancing on the list of Sweden`s longest caves (water-filled and dry) and is currently number six. Only 35 meters separate us from the 5th place. A significant effort was also devoted to exploring Bjurälvsgrottan, the upstream cave where all the water disappears into the ground to appear in Dolin lake and the other caves downstream. 272 meters of passages were mapped in Bjurälvsgrottan and we will be paying this cave more and more attention in the future. The collapse at the end of the line (EOL) in Dolinsjö cave proved to be very tough to negotiate and the cave did not grow in length upstream in 2017. The depth at the EOL is 18 meters.

24 cave researchers participated in the expedition in 2017, making it the largest expedition so far. This included 1 new diver and 3 dry cavers, who were invited to join the expedition to help exploring dry caves in Bjurälven valley such as Bjurälvsgrottan.

The weather put up with a few surprises also during the 2017 Expedition. After several days with good and stable conditions, the whole basecamp was suddenly flooded by the rising water in the Dolin lake. Warmer weather and some rain were probably the reason. This might also be the reason for the water level being so high in the cave this year. Many dry passages shrank to less than half of their normal length, making them easier to navigate while carrying all the dive gear.

Substantial amount of high-quality photo material was collected this year. A series of short movies about the 2017-expedition formed a blog, where followers on social media could see the progress of the expedition through the week.

On its tenth anniversary the Expedition was rewarded the honour of carrying the New York Explorers Club flag. These flags have been to the bottom of the ocean and to the moon, to have one of them with us was a commemoration of what we have achieved in the last ten years. We were also awarded the title of “Good Ambassadors” by the tourist ministry of the County of Jämtland. The award was motivated by our success in the exploration of the Bjurälven cave system and our contribution in putting Stora Blåsjön and Strömsund municipality on the international cave exploration map.

Exploration and mapping

91 dives were performed during the expedition in 2017, see Figure 3. This was fewer compared to the year before, which can be explained by the weather conditions and a few cases of illness (flue) during the expedition week. Total dive time decreased compared to 2016 as well, and divers spent 148 hours in the cave (including the dry sections between the sumps) during the expedition week, see Figure 4. This can be explained by the fact that the exploration dives to the end of the line were much shorter in 2017 due to the partially flooded dry passages. Average dive time decreased somewhat, see Figure 5.

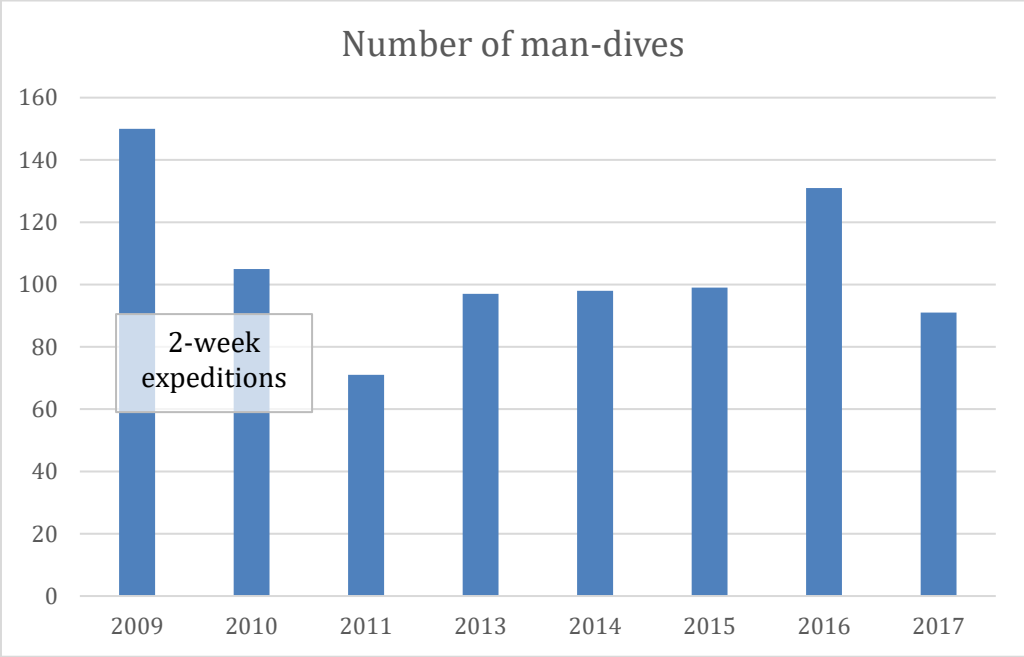


Figure 3 Dive statistics for Expedition Bjurälven

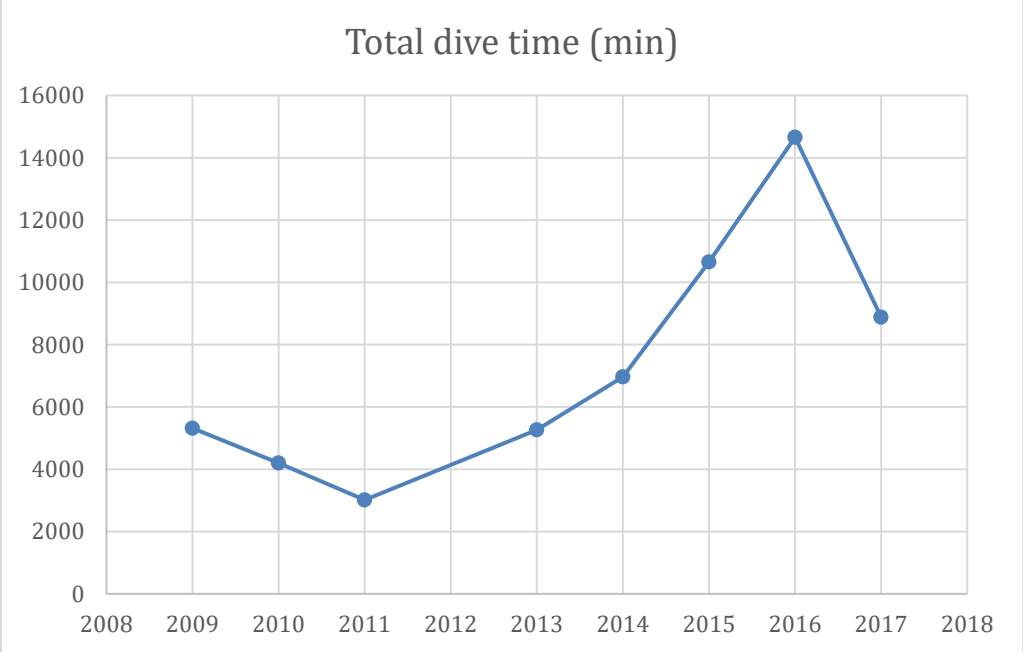


Figure 4 Total dive time during the expedition

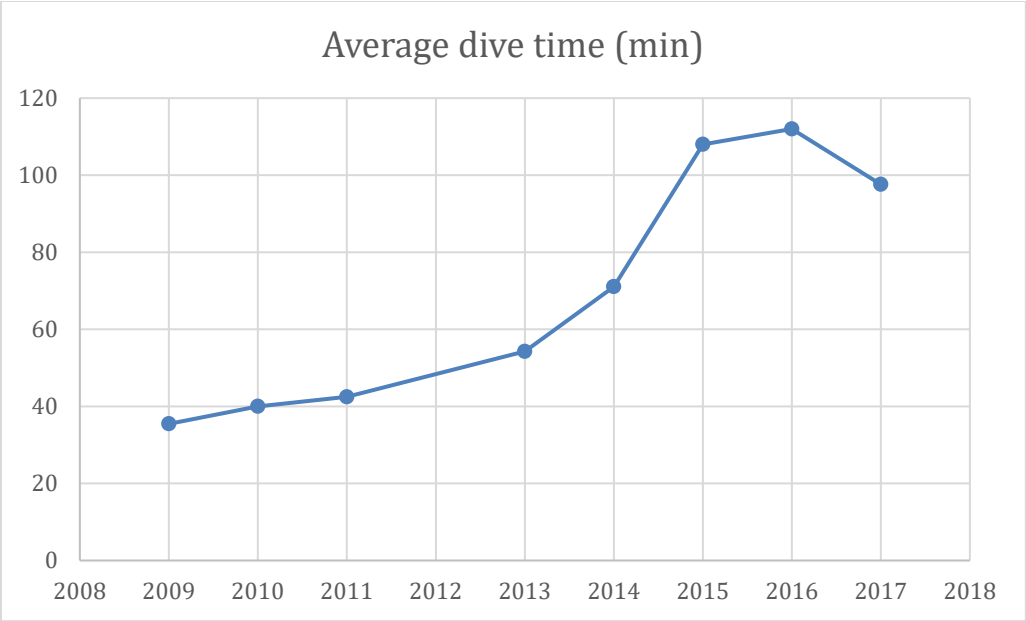


Figure 5 Average dive time per dive

Since the exploration at the end of the line did not give any significant results this year, more focus was given to the exploration of the side tunnels closer to the entrance. The next cave entrance (the D3 cave) is located only a few hundred meters downstream in the Bjurälven valley. Some of the passages closer to the entrance might lead in that direction. Normally, these passages are tight and often blocked with sand and gravel, which was the reason for them being left unexplored for so long.

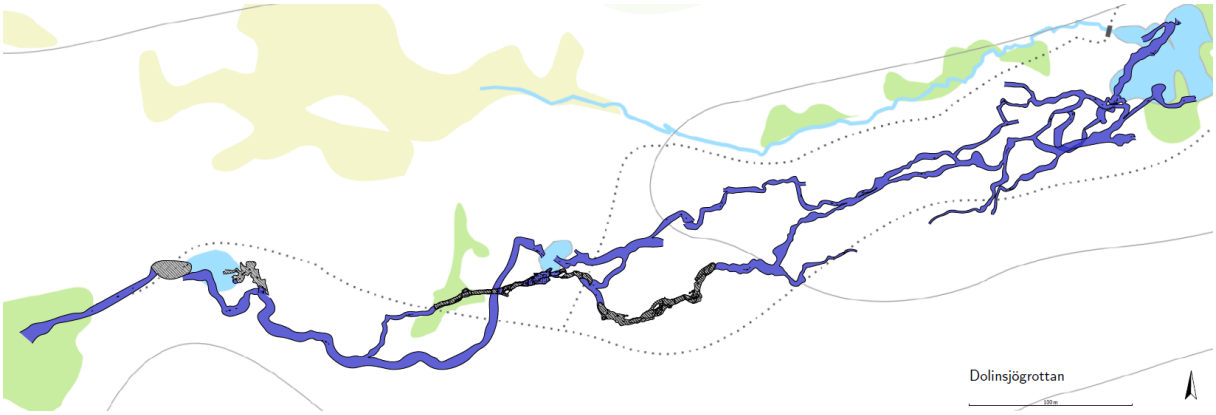


Figure 6 Map of the Dolinsjö cave by the end of the exploration in 2017 (compiled by David Thor)

Documentation and media

Several high-quality images were taken in the cave this year. The images will be used in our PR-work as well as by our sponsors. Focus of video filming was on creating a number of short movies to be used as video-blog on the social media. The idea was to have shorter updates more often rather than creating one longer movie. The short movies let the expedition followers see how the expedition progresses through the week, from creating the tracks for snowmobile to establishing the basecamp and to the diving itself.

Radiolocation

By Bo Lenander

During the last six expeditions, we have used VLF electromagnetic devices both for radio-location and communication. As the dives in the cold water are getting longer it is important both for diver safety and comfort of the surface personal to know where the divers are during their several hours long dives. If something goes wrong under water the time it takes to help is critical. Loss of breathing gas must of course be solved immediately and the victim cannot get help from the surface in that case. But all other types of accidents can be supported from outside of the cave. **When?** and **where?** are two questions that can be answered quickly by the aid of wireless equipment. It is also possible to send simple messages through the rock.

Figure 7 Surface receivers M-16R, M-15R and M-85 + earth antenna and ground rods

After ten years of exploration we still have only one narrow entrance to the more than two kilometers of passages, mapped so far. Finding alternative entrances is of high interest, but the marble rock of the cave is covered by thick layers of sand and gravel that remain from the end of the ice age. In only in a few places can the rock be seen from the surface. But there are many alluvial dolines in the sandy Bjurälven area, some of them are really big (up to 50 m diameter)m which indicates cave passages under them. The terrain in the area is very hilly and it is not easy to walk around on the surface when it is covered with up to three meters of snow. During winter time blow holes in the snow can be found indicating air-filled passages underground, but when the tunnels are filled with water there will be no such phenomena on the surface. And most of the dolines are plugged in with sand, clay, ice and snow at the bottom. To decide whether a digging project is worthwhile, it is important to know with high precision the relation in position between

the surface formations and the cave underneath. Radio-location can be used for that. The transmitter is a small device carried by divers. It is provided with a magnetic antenna in form of a wire loop or a ferrit rod with a winding on. The loop is horizontal and the ferrit rod shall be vertical, both giving a vertical magnetic pulsating field of the working frequency (here about 32 kHz). On the surface the magnetic field is vertical straight above the transmitting antenna (ground zero) and will be leaning outwards from that ground zero more the longer the horizontal distance to the ground zero is. When the field is leaning 49.5 degrees the horizontal distance to ground zero times two is the vertical distance or depth to the antenna in the cave. When searching for the ground zero it is easy to be confused – at a horizontal distance of more than 1.5 times the depth there is week vertical return magnetic field and there it is very hard to get information on in what direction to find the ground zero. It is therefore important to bring as good maps as possible along with the radio-location receiver. It can be very time consuming to run around in deep snow on the surface. When taking positions of special fix points in the cave it is important to know when the transmitter is correctly aligned on the fix point. To give the status **swim** or **fix,** different Morse coded signals can be sent from the cave. The time to take the position should be kept to a minimum due to the cold. When the radio-location (ground zero and depth) is ready a signal can be sent from surface down to the divers in the cave (a green light will be flashing on the transmitter) and then the divers switch over to swim for the next fix point and can be followed by the person on surface.

Figure 8 Transmitters M-16P, M-16MK and M-85 + earth antenna and ground rods

Just to follow a diver from surface a rather simple and small transmitter and wire loop antenna, located in the sidemount buoyancy compensator, can be used. The accuracy of that tracking is +/- a few meters due to the distorted antenna shape and the fact that the antenna is not perfectly horizontal. The transmitted signal is Morse coded with the

personal signature (two letters) for the actual diver. To be able to listen to several divers at the same time their transmitting frequency differ slightly so they also will be heard with different tone in the receiver. One type of tracking transmitter M-16MK (made in 2016) send different signal during dive (floating vertically) compared with when hanging down when it is carried in an air-filled passage.

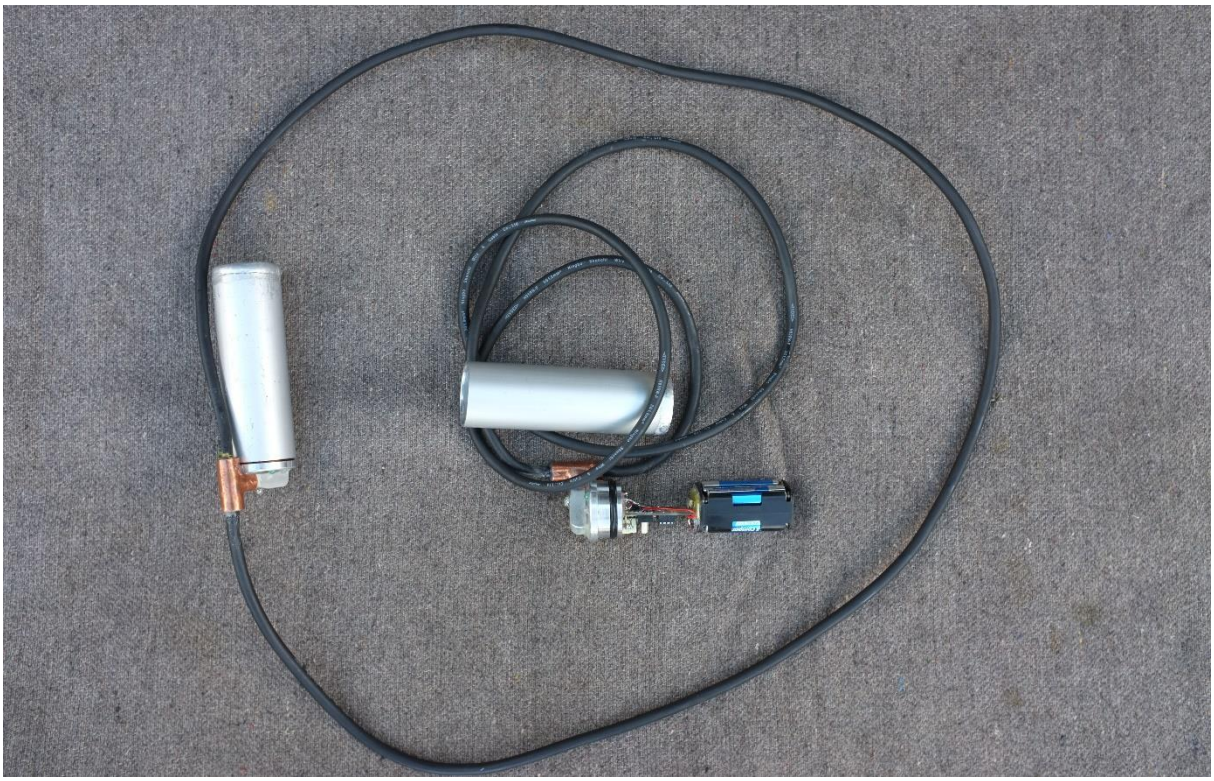


Figure 9 Diver marker transmitters M-17MK carried in the buoyancy compensator

For communication from air-filled areas in the cave to the surface a speech system is used. The system is the British-constructed HeyPhone working with USB-modulation on 87 kHz carrier frequency (USB = Upper Side Band) borrowed from Norway. The output power of that device is 3 – 4 W and it is very easy to operate. The HeyPhone can be used with a loop antenna or with an earth connected wire antenna, the latter being a better choice. The polarization of the magnetic field is very clean in a loop antenna and therefore, when the antenna axis is at the right angle to the magnetic field nothing can be heard. This is good for searching ground zero and depth measurement but very annoying during communication. The wire antenna can be up to 100 m long and is earthed in both ends with metallic earth plates (anchors). The wire is broken somewhere and this feed point is connected to a highohmic/highvoltage conection on the transceiver (transmitter-receiver). There will be an electric current in the straight wire and through many different paths through the ground/rock/water, forming a complicated magnetic field without perfect polarization. The best orientation of the cave antenna and the antenna on surface is in the same compass direction, although this is not very critical. When using a long antenna wire the magnetic field, formed by the big loop (wire + ground), is very big and therefore the range of communication can be very long (up to 1 km). During the expedition we did a test to compare the Heyphone with the old M-85 transceiver (see ”Speleonics 7”) on 32768 Hz DSB (Double Side Band). The test failed due to a missing earth connection in the cave. However, during testing M-85 on surface a horizontal distance of 500 m was reached with 10 m long earth antennas.

Satellite positioning, LiDAR-data, drone mapping, VHF-communication, satellite telephone, internet connection and 360° movie documentation

By Mats Fröjdenlund

GNSS

Starting in 2011 we have been performing electromagnetic direction finding of the cave divers and surveying of fixed points in the cave system. From 2014 these fixed points have been marked out in the cave using stainless steel trays (markers) labelled FP01, FP02, and so on. Using the electromagnetic direction-finding equipment, we have been able to obtain relatively accurate points on the ground surface directly above the fixed points. Also, the depth from the surface (or the snow surface) down to the fixed point has been obtained. To make a 3D and georeferenced cave map the ground surface elevation, the depth of the cave and its X and Y coordinates are required. For this purpose, the National Land Survey/SWEPOS (https://swepos.lantmateriet.se) during the expedition in 2013, 2014 and 2015 kindly lend us both GNSS equipment (Global Navigation System Satellite = GPS, GALILEO and GLONASS) and communication equipment with connection to the SWEPOS correction services. It is possible to get a position in the reference system SWEREF 99 with uncertainty in the centimetre level. Our problem has been that the expedition site is out of reach for mobile Internet communication.

Our equipment consists of a Leica Viva GS15 rover on a 2.0-meter-high aluminium pole and a Leica CS15 field computer. During the 2017-expedition long-term measurements (at least 15 minutes at each site) were conducted as required by the RINEX method (Receiver Independent Exchange Format). This technique is very useful in areas with poor mobile coverage.

Our GNSS equipment, borrowed directly from Leica Geosystems Sweden, was then used to measure the points, located using the tracking device, invented by Bo Lenander. The measurement information from the field computer was transferred nightly to an Excel file with X, Y and Z values in SWERREF 99 TM format. We also included the depth value and time for the measurement. To visualize the points on the aerial photo we were using the GIS software ArcGIS® from Esri.

Eleven new points were measured with the GNSS in 2017. Two were new fix points in the Bjurälvsgrottan, one was the EOL (end of line) in the Dolinsjögrottan (both upstream and downstream) and finally we measured the Festins grotta. The equipment was returned after the expedition and we hope to borrow an equivalent system for the Bjurälven Expedition 2018.

After the expedition, we received the post processed GNSS data from the National Land Survey. Last year the XYZ values of the points lied within +/- 50 centimetres thanks to the correction of the data but this year the setup of the equipment was not properly done so the data from 2017 lies in the interval of +/- 2 meters.

VHF-communication
We have been using iCOM VHF-radios for internal communication and for rescue communication with the police since 2013. This year we invested in a base antenna for VHF that extended the range for communication in the area of operation, see Figure 11.

LiDAR-data
This year we managed to get the new LiDAR data from the Swedish National Land Survey (kindly sponsored by Esri Sweden). This means that we now can measure the depth of all dolines (sinkholes) using GIS and build a 3D surface model over the terrain and incorporate the 3D map over the caves in the same model, see Figure 12.

Drones
During the expedition, we also tested a drone for mapping. A DJI Inspire drone (from Esri Sweden) was used to collect orthophotos from the areas of Dolinsjön, Colloseum and Bjurälvsgrottan. The photos were processed in Drone2Map for ArcGIS® and the output was 2D orthomosaic, elevation data such as DSM and DTM and 3D data. The result was amazing and we will continue to collect data from drones, Figure 12.

Satellite telephone
In case of emergency we had a satellite telephone ready for use in our base camp.

Internet connection
The terrain, valley with high mountains around, makes it impossible to get in contact with the Internet through 3G or 4G even with directional antenna. Next year we will try to find a suitable site for receiving 3G and then relay the data with Wi-Fi technique to our base camp.

360° photo
A test with filming in 360 was done in the Dolinsjögrottan. A Nikon KeyMission 360 was used during a dive to document the entrance of the Dolinsjögrottan and the tunnel in 360 degrees. This was probably the first underwater cave documentation in 360 in sub artic terrain. The result was acceptable but we need to improve the lighting next time.

Figure 10 GNSS equipment from Leica

Figure 11 Base VHF-antenna for internal communication

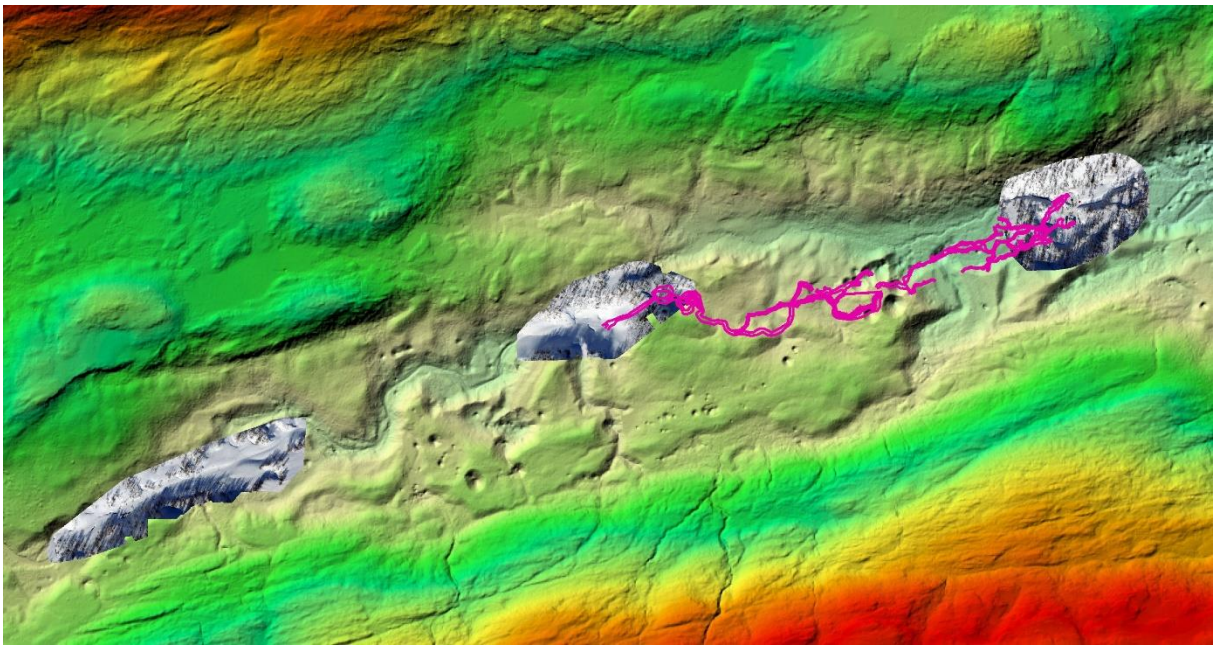


Figure 12 Map, showing LiDAR-data, orthophoto collected from drones and cave map

Measurement of scallop discharge in karst springs

By Ane Mengshoel

This year we decided to perform a measurement of some scallops in the cave. Scallops are solutional flow marks developed on cave walls. They are similar to current ripples in sand, but are developed by dissolution of the limestone surface. The size of the scallops is inversely proportional to flow velocity. By studying them, we can deduce what discharge of water that actually creates a cave. Speleologist and cave Professor Stein-Erik Lauritzen at the University in Bergen (Norway) helped us to interpret the results.

First, here is an explanation of what we did. The text is an excerpt from an article which was published in "Linepila 2017" written by Lauritzen:

> It is of great interest for speleologists (and cave divers) to know what discharge of water that actually creates a cave. This velocity is reflected in the scallops on the cave walls. It is also very interesting to compare the drainage area of a system with the discharge revealed by the scallops. As a cave-diver, you may help doing this:
>
> 1) Find a place where the passage is completely water-filled, of regular shape (circular, elliptical, etc) and where there are enough scallops. You must be sure that this passage takes all water that emerges in the spring, i.e. no branching. Alternatively, you must measure several branches in parallel, which we add up.
>
> 2) Measure the longest and shortest diameter of the cross-section. A sketch of the shape helps calculating the cross-sectional area and the circumference.
>
> 3) Measure the length of at least 30 scallops around the profile (nearest cm), see figure 1. Sometimes scallops lengths differ in ceiling and walls. From these numbers we may calculate the water-flow that created the cave.

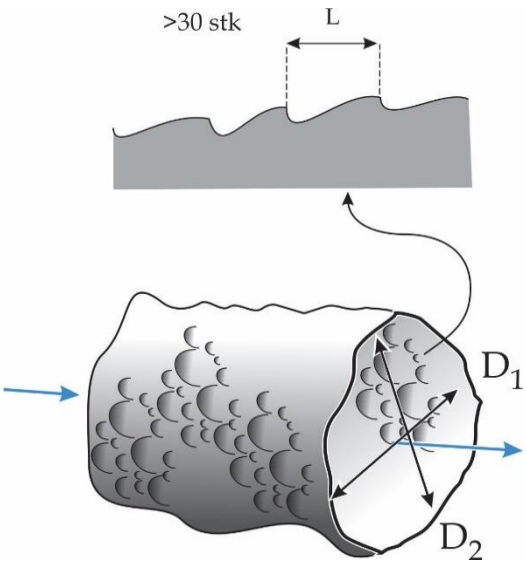


Figure 13 Passage with scallops and how to measure them

The scallop measurements in Bjurälven were made approximately 150 m into the cave along the main line (see figure 2). The direction of the scallops corresponded with the direction of the waterflow in the cave.

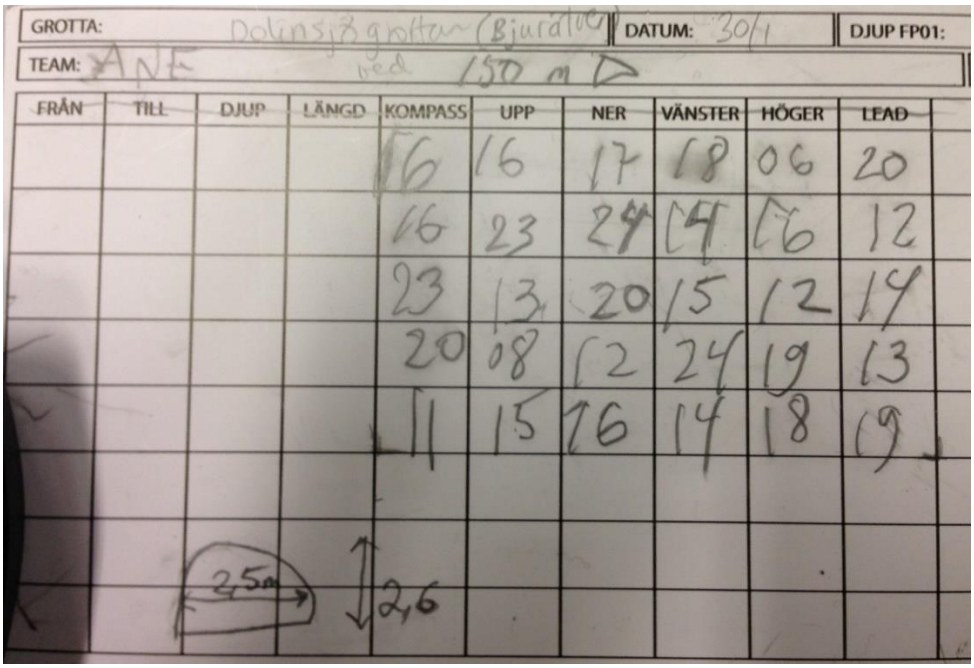


Figure 14 Measurement of a set of scallops and a small scetch of the shape of the cross-section.

The data was sent to Lauritzen, who reverted with this result (see Figure 16):

> The passage was 5,11m2 (which is a fairly big passage)
> L32 = 18,38 +/- 4 cm
> U = 20,5 +/- 6 cm / sec
>
> Water discharge is then 1,05 m3/s (+/- 0,3 m3/s due to 30 % uncertainty). This means that the velocity can transport a bedload of sand and gravel up to a size of approximately 10 mm in diameter (see Figure 17).

This reflects the layer on the bottom in the cave.

Figure 15 Example of various grain size etc on the cave floor. Photo: Expedition Bjurälven.

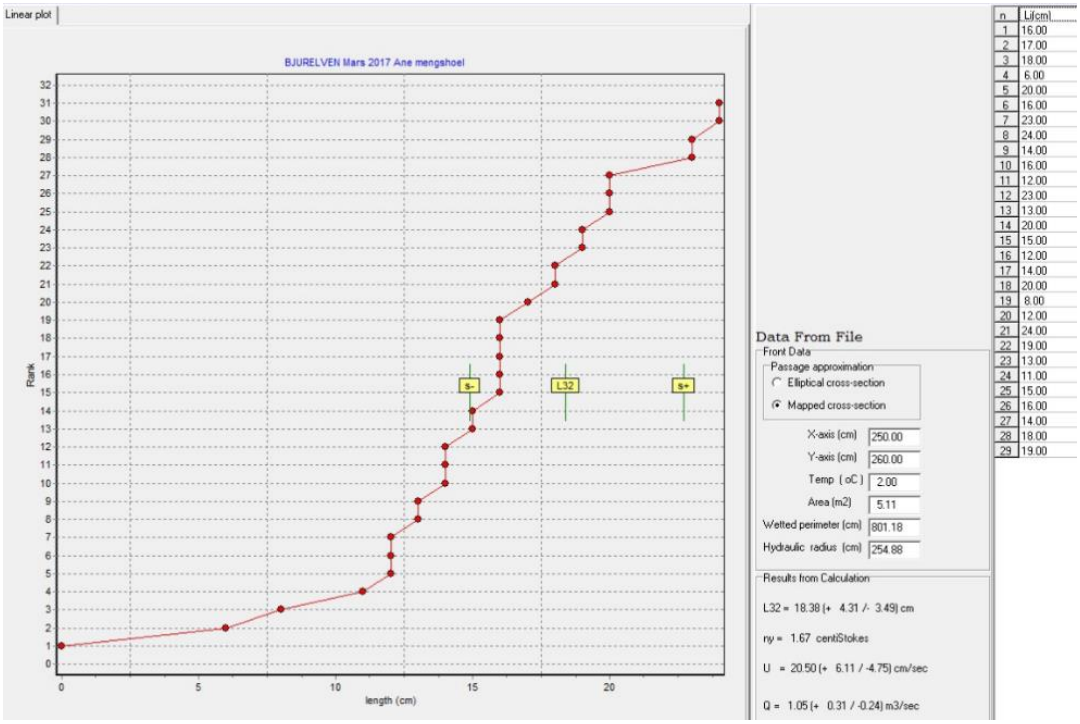


Figure 16 The results shown in the scallop program. The diagram shows the size distribution of the scallop sample, the Sauter-mean (L32) and errors. Input variables and output results in the right panel. The data set (scallop lengths) is shown in the table to the right. Program "Scallop" © S.E. Lauritzen.

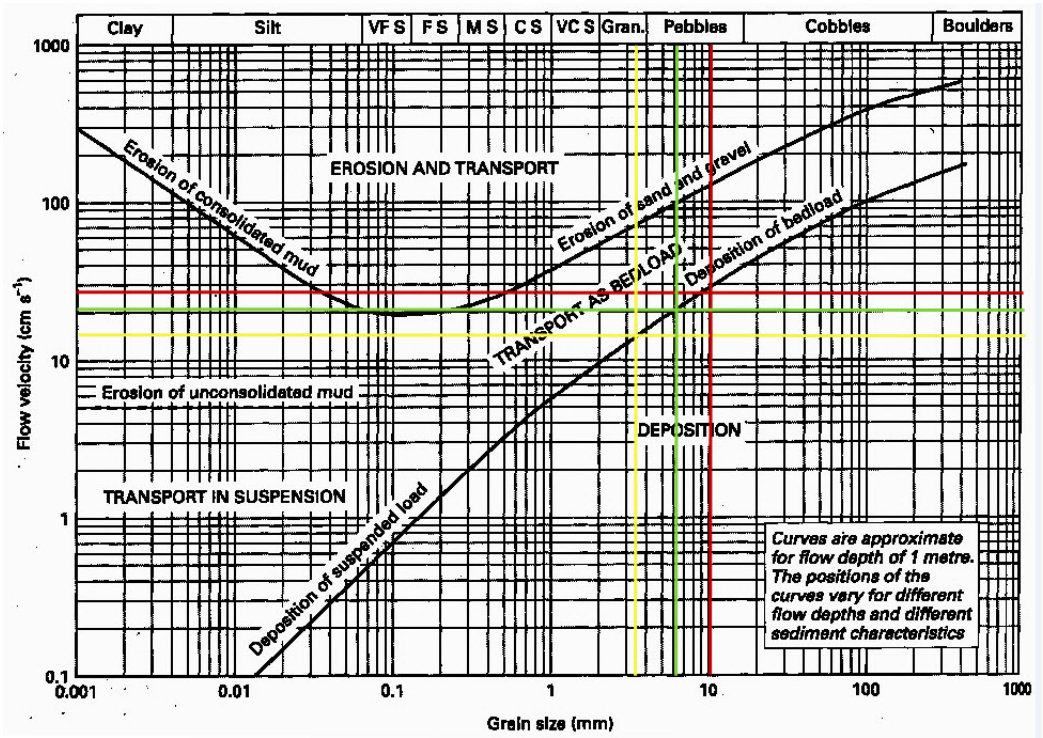


Figure 17 This figure shows the «hjulstrøm diagram» which indicates maximum grain size which can be eroded under various water velocities. This diagram occurs in most geological textbooks and is used for river channels. Our results are shown with the colored lines. As an example: a flow velocity of 26.6 cm/s gives a grain size of approximately 10 mm, i.e. sand and grain-sizes smaller than approximately 10 mm can be transported through the cave under the same flow regime that created the scallops and enlarged the cave.

Expedition safety

By Stina Gabrielsson and Andreas Johansson

During a project with the size and complexity of Expedition Bjurälven there are always many risks to consider and we find it important to carefully analyze the expedition from a safety point of view, from the car trip up to Stora Blåsjön to hygiene during the meals. The main focus is on preventing accidents and injuries, but also to have plans in case an accident does happen.

Risks analysis

There are four main activities where the risk of injury or accident is high: diving, transports by car, transports by snow mobile and dry caving. Long exposures to extremely cold water during diving, alternated with dry caving, are the special features of the diving during Expedition Bjurälven. The fact that a rescue mission has to be mounted in multiple dry and wet passages makes it a tough challenge.

Diving Safety

We rely heavily on our equipment during the diving in Bjurälven. Especially our breathing apparatus, the regulators, which supply the diver with gas. A common problem in cold waters is freezing of the regulator, which causes free-flow and a very rapid loss of breathing gas. During the earlier years of the expedition there was a problem with freezing if the first stages of the regulators, which can cause the opposite, a complete stop of breathing gas. This phenomenon was established to originate from moisture in the breathing gas, which at very low temperature can form ice plugs in the breathing hoses. The problem was solved through extra filters to dry the air filled into the diving tanks. The second most important piece of equipment is the dry suit and the warm undergarment every diver wears during a dive. A puncture of a suit or a glove will cause rapid heat loss as the cold water enters the suit. This poses a considerable threat in the conditions the expedition operates in. Decompression sickness, the risk most often associated with diving, is not a big safety problem in Bjurälven due to the relatively shallow passages and little amount of nitrogen that is absorbed by the body during a dive

Active risk management

Because the Expedition takes place in such a hostile environment we put a lot of emphasis on active risk management and prevention. The top priority is for the team to have sufficient level of training and knowledge about sub-arctic cave diving. A safe dive is a planned dive and for every dive a specific plan is set up. The dive manager, who keeps records of the plans, must approve the dive plan. For this year's expedition we created a simple stick map of the cave on a white board with markers for every team member. This system, combined with radio-location we employ, was a great aid for the dive manager to keep track of the divers and their dives. In case of an emergency of any kind in the cave it is important to have plenty of breathing gas. Every year several safety tanks are placed in the cave to aid in such an emergency. Another hazard is the entry and exit if the water. During the expedition we have a purpose built platform for the hole in the ice to ensure safe and easy access to the cave. In 2016 we had the possibility to have communication between the cave (the first dry chamber) and the base camp using Heyphone (borrowed from Norwegian Caving Federation) for the first time. The testing continued this year and proved one again to provide a reliable way of communication. As the explored length of

the cave grows, and so do the length of each dive, the opportunity for two-way communication increase the safety level significantly.

Rescue plans

The base camp holds a warm tent and hot beverages/food can be supplied. There are first-aid kits with equipment to deal with minor injuries as well as moderate trauma. Also this year a watertight emergency canister was placed in the first dry passage. This canister contained dry clothing, spares, heating devises and painkillers. Using this, an injured diver might be able to improve his chances of safely getting to the surface without outside assistance.

Specific problems encountered 2017

We had several small incidents during this year's expedition. Four divers had problems with leaking gloves and one diver got a leakage in the dry suit. All divers could exit the cave in a safe manner and none of these divers was hypothermic after these dives.

Another diver surfaced slightly hypothermic and with a headache after a dive, the latter possibly because of accumulation of carbon dioxide. The diver was rapidly heated by oral intake of warm fluids and the headache was successfully treated with paracetamol/ibuprofen. During a trip to the fourth dry chamber a diver was hit in the head by a stone. Divers were climbing on different levels in the chamber and a stone came loose. The diver did not have a helmet on at this occasion but was not seriously hurt.

One of the cavers got his feet frostbitten during one of the trips in Övre Bjurälvsgrottan. The frostbite was initially treated with "skin to skin" warming and then external warming and no permanent damage was caused.

We also had one accident involving a snow mobile this year. One person fell off during a repositioning of the snowmobiles in the base camp. The person hurt his coccyx with moderate pain as the result but with no permanent pain or damage. During the setup of the base camp we had several minor skin cuts and abrasions, all treated with tape, with no further treatment necessary.

Expedition Bjurälven through the eyes of a new member

By Jonas Roos

After a long autumn and winter with a lot of preparations it was finally time for Expedition Bjurälven. I had spent days and weeks preparing the dive gear, trying to think about all possible scenarios and what gear I would need. My thought has always been, if you need one bring two. Soon it felt like I was planning a one-person expedition. After a quick talk with my dive buddies and a look through the packing lists the more experienced members provided I started to slim down the mountain of gear I had prepared.

On the first unofficial day of the Expedition I did not know what to expect but I was rather anxious when I packed the car and started the journey towards Bjurälven. The first leg of the journey was towards our travel companion, who lived in Norrtälje. There we changed cars and marvelled at the amount of dive gear we would bring between the three of us. After a long day trucking with a few stops for food we finally arrived to Stora Blåsjön. We were the first to arrive so we staked our claims for sleeping quarters and started to unpack and get settled in. We set up our charging stations and they gave me the grand tour of the school. During the night, more people arrived and a very good atmosphere settled in. We were knackered and went to bed quite early to prepare for the first pre-day of the expedition.

In the morning, we had a small breakfast and started to have a look at what needed to get done before we could leave the first base camp and focus on the dive camp. It was a flurry of activity that day and we fixed drying racks in the laundry room, helped with fixing the trailers for the snowmobiles and helped some members with their new dive gear from Apeks and x-Deep. Everything was accompanied by the usual laughs and dive stories. Some members went out to fix the snowmobile trails, needed to transport all the gear out to the second basecamp. In the evening, we had the first meeting and we divided the tasks needed to set up the camp the following day. It was a very Swedish way of dividing the tasks, put our name beside a task and you will be responsible for that task to be accomplished. I signed up for helping with the hole in the ice, setting up the platform and the dive leader tent.

The first official day of the expedition started early and we loaded everything needed into our cars and trailers and went up to Leipikvattnet where the road ends and the snowmobile trails start. We spent a lot of time hauling gear to the campsite. Everything that we needed for a full week's expedition had to be hauled by snowmobile over lakes and through valleys. Everything went very smoothly and everyone focused on their assigned tasks. There were a few differences of opinion when setting up the food tent and the dive tent but I reckon it was the anxiety of getting everything finished that set the moods blazing. Overall, I was very impressed with the efforts everyone put in towards the common goal.

When we finished making the hole in the ice and installing the platform it was time to send in the first divers to check the line and dig out the entrance to the cave. Everything went as planned and the first divers surfaced with a big grin on their faces. You could see that they were back in their element and were living the dream. The second team went in and placed safety bottles and changed some line that had worn off. All in all, the first day was a success and everyone was tired and happy when we got back to the school and had

our daily meeting. There we discussed the day and talked about the plans for the following day. The weather had changed a bit and warmer air and rain was moving in. The second day started as the first ended, warm and rainy. We were very anxious when we got in the cars and drove towards Leipikvattnet. The camp had started to flood and it was all hands on deck to save all the gear and stabilize the snowmobile trails.

Then the real fun began. I teamed up with Andreas and Amanda for my first dive and we prepared our dive gear together. When we were ready I switched on my heating and donned the tanks. We all dive with 2 sidemount tanks and a stage. I absolutely loved the feeling of sinking down beneath the ice to start the dive. I checked myself and my buddies. Everything was ok so I started to go in to the cave. The entrance was a bit low but I managed to squeeze through and waited for the others. After a short while they joined and we had a quick look at the cave. It was amazing with all the scallops and small side passages. The weather got better during the week and we all got a bit of suntan and weathered faces. I teamed up with Stina (the Expedition doctor) for the rest of the dive week. My self-proclaimed mission was to get her comfy in the cave and to do as many trips as possible to the air chamber where we would have to handle any accidents that could happen further in the cave.

Every night the whole team had a quick debrief and planning meeting after having dinner together. Some nights I could hardly stay awake and some nights we all went for sauna before sleeping. I got to try out most of the tasks in the camp: filling gas, being safety diver, being safety officer, tracking push divers by radio-location and much more. I had a blast and I´m really looking forward to next year's expedition. Hopefully this will be a standing occasion that will be part of my life for years to come. What impressed me most is the diversity of the expedition team, there is always something new to try and if you're willing to listen it is a great learning experience.