ICAR 2023 Toblach, Italy MRA Terrestrial Rescue Commission Report Tom Wood (Alpine Rescue Team) Rich Siemer (Bellingham Mountain Rescue Council)







Practical Day

The 2023 ICAR Pre-Conference Practical Day took place in the shadow of the iconic Tre Cime di Lavaredo area of the Dolomites. Organized by South Tyrolean Mountain Rescue (Bergrettungsdienst Sudtirol), each commission had stations scattered throughout the valley. More than 350 rescuers and 120 manufacturers from 35 countries gathered to watch and participate in demonstrations on everything from bolting techniques to winch rescue demos as well as multiple dramatic helicopter pickoff rescues of stranded climbers. Several MRA delegates were on hand to help run the stations. North America in general was wellrepresented by members of other ICAR organizations from the U.S. and Canada. The day following the workshops, there were formal discussions held to review each workshop and determine if any ICAR recommendations should be generated. As a result, it was decided that a workgroup to explore the use of winches for rescue should be created. The Topograph Media video of the Practical Day can be viewed here: https://vimeo.com/885940563



Here were the Terrestrial Rescue Practical Day stations:

Petzl hosted a station that gave rescuers plenty of hands-on experience setting bolts, pitons and building anchors. Petzl and ClimbTech glue-ins, removable bolts and traditional bolting techniques were covered as attendees then built load sharing anchor systems from the bolts that were installed. To demonstrate why bolts shouldn't be drilled too close together, they used a hydraulic ram to try and pull out some closely placed bolts, but the limestone substrate was too tough and the exercise was stopped when the ram hit 25kN and the bolt still held.



Berndt Adler from Bergwacht Bayern supervised a station that allowed rescuers from different countries and teams to set up their own systems to compare and contrast with those of others. Everything from minimalistic lightweight systems using small diameter ropes to heavier and complex systems were demonstrated. Each system shared the common thread of redundancy by utilizing twin tensioned rope systems, as per the ICAR Terrestrial Rescue Commission's Recommendations.



The terrestrial rescue demonstration of big wall pickoff techniques was organized by Thomas Mair of the South Tyrol Rescue Service. After being dropped off by a helicopter near the top of the massive North Rock, a small team of rescuers performed a high angle pickoff rescue of a stranded climber from several hundred meters up the face. Using a 200 meter rope, they dropped down to the subject stuck on rope from below the summit. They trailed 450 meters of dyneema rope, which was connected to the 200 meter rope with a maillon rapide (screwlink). Once they lifted the subject off their rope with a mechanical advantage system, they rappelled to the ground with the subject.



Kirk Mauthner, with Parcs Canada and the Terrestrial Commission Vice President, set up a Twin Tensioned Rope System (TTRS) off a spanned anchor bolted between two rocks. Using two Clutches as the descent control devices on the lower and then as the progress capture devices on the raise, he stressed the benefits of having nearly equal tension on both rope systems. Additionally, he discussed the importance of force limiting devices when attempting to build rope rescue systems, since this tactic can prevent catastrophic failure when the system starts to exceed the 8kN force required for the rope to slip through the Clutches. This force limiting function can prevent the rope from being damaged or breaking the device.



One of the stations that sparked interest in forming a new ICAR Recommendation working group to discuss the use of winches in mountain rescue was staffed by Rich Siemer and Tom Wood, from the MRA, as well as Kirk Mauthner and Stephanie Petri (representing the U.S. National Cave Rescue Commission). This hands-on demo featured a system that used a CMC Clutch to lower a rescuer with drop loop 2:1 attached to them and a Harken LokHead Winch with a drill on the other side of the drop loop to perform the raise. The system used a SMC Vector monopod to reduce friction on the raise and also to keep the rope elevated above scree slope to minimize rockfall potential. By using a Petzl ASAP attached to the rescuer on either side of the drop loop 2:1, a dual main system was created with a single rope.



Terrestrial Rescue Commission Business, Day One

Terrestrial Rescue Commission President: Gebhard Barbisch Terrestrial Rescue Commission Vice President: Kirk Mauthner

At the start of the ICAR Terrestrial Rescue Commission business meeting, a moment of silence was held for the following mountain rescuers who passed in the previous year:

- Elia Meta Della Corna, SAGF Entrèves, died in an avalanche in Rhemes Valley on 13 April 2023
- Michele Pellegrino, SAGF Cuneo, died on duty during a patrol in the Liguria Region on 15 June 2023
- Lorenzo Paroni, SAGF Tarvisio, died on duty during training in the mountains at Piccolo Mangrat on 16 August 2023
- Giulio Alberto Pacchione, SAGF Tarvisio, died on duty during training in the mountains at Piccolo Mangrat on 16 August 2023

Stefan Blochum was elected unanimously to serve as the second TerCom vice president. The position was added to help spread the workload that has been created with the growth of the Terrestrial Commission.

The ICAR Terrestrial Commission participates in several working groups with the UIAA SafeCom. Here are some of the 2023 topics for the working groups:

- Static Ropes
- Anchor Welding
- Via ferrata
- Helmets
- Canyoning Harness
- Creating a standardized sharp edge test
- Headlamps and how they can interfere with avalanche transceivers
- Top Anchor Carabiner
- Glue-In Anchors
- EU standard for avalanche airbags (they can cause interference with avalanche transceivers)
- UIAA Norm for avalanche transceivers
- High altitude rescue

ICAR membership continues to grow. Several organizations were recommended for membership by the ICAR Executive Board and approved at the ICAR Assembly of Delegates. A and B category members can vote.

- NUMR National Union for Mountain Rescue North Macedonia A Category
- WMS Wilderness Medical Society B2 Category
- AIUT Aiut Alpin Dolomites B2 Category
- DRF Deutsche Rettungsflugwacht B2 Category
- La Chamoniarde B1 Category
- New Zealand Society for Mountain Medicine C Category
- Ropelab Australia E Category
- IHR International Hypothermia Registry E Category

Every five years, ICAR commission recommendations are reviewed. Here are the ICAR Terrestrial Commission Recommendations that were reviewed and accepted without edit in 2023. The recommendations can be found on the ICAR website at https://www.alpine-rescue.org/topics/161--recommendations?audiences%58%5D=3

TERCOM Recommendation # 1: Using Connector/Carabiner in Mountain Rescue Organizations Last revision – 2017 in Soldeu (AND)

TERCOM Recommendation # 2: Rescues on ski slopes, issued – 1998 in Obergurgl (A)

TERCOM Recommendation # 3 Canyoning – Training for commercial Guides, issued – 1999 in Sonthofen (Germany)

TERCOM Recommendation # 4 Rope Connections for Kernmantel Rope Extension, last revision – 2017 in Soldeu (AND)

TERCOM Recommendation # 5 Redundancy for Lowering or Raising People with Fiber Ropes Last Revision – 2017 in Soldeu (AND)

TERCOM Recommendation # 6 Static Rope Brakes, Last Revision – 2014 in Lake Tahoe (USA) TERCOM Recommendation # 7 Rope Differentiation: Static / Low Stretch / Dynamic Ropes Last Revision – 2018 Chamonix (F)

TERCOM Recommendation # 8 Winter Rescue Equipment, Last Revision – 2014 in Lake Tahoe (USA)

TERCOM Recommendation # 9 Systems in Mountain Rescue, Last Revision – 2014 in Lake Tahoe (USA)

TERCOM Recommendation # 10 Incident Command Systems (ICS), Issued - 2021 Virtual Conference Bern

Terrestrial Rescue Presentations (from ICAR Terrestrial Commission submissions & minutes)



Search for Missing children – Humberto Hinestrosa / Colombia

The case of aircraft HK 2803, which crashed in rough terrain in Colombia, is presented. On May 1, a community leader and a mother with her four children were traveling with a Cessna U206G from Araracuara to San Jose del Guaviare. The plane took off at 06:42, was missing from 07:44 and was found on May 16, 2023.

From 12.44.44 (UTC) the aircraft was missing, the ELT (Emergency Locator Transmitter) was activated. The last radar position transmitted became the LKP (last known place). The first searches were carried out within a radius of 4 km around the LKP, after 10 days the search was extended to a radius of 30 nautical miles from the LKP. The LKP and the ELT signals were flown without success.

Subsequently, on May 13, 2023, the search was continued with the help of 3 analytical products. All arguments were scientifically based, not personal opinions and intuition. The three analytical products are then shown. Product #1 combined theoretical, statistical and deductive search methods. The analysis of information from different sources was brought together. The 2nd analytical product used theorems and mathematics to calculate the maximum distance and the most probable location. The third product worked with radar signals.



When searching from the air, it is important to fly low and slowly and to search when the sun is at its zenith. Also look out for broken branches and conspicuous colors in the forest. The HK2803 was finally found by terrestrial based search groups.

The four children, aged 13, 9, 4 and 11 months, were still missing. It was unclear why they left the plane and in which direction they went. The main question was what decisions the 13-year-old child was making. The main part of the search was conducted in grid lines. Various items belonging to the children, such as a diaper, were found. The children allegedly followed their mother's advice to leave the plane. They had to find water. It was also possible that the eldest son was afraid of being punished for leaving the crash site and that the children were afraid of the helicopter noise. The search strategy had to be changed to a more dynamic search, which took a while. The children were found alive 3.7 km from the crash site of the plane. They were malnourished and dehydrated, but not critically injured.

Dogs were also involved in the search. One dog (Wilson) was never found after the search. He spent a few days with the children and then left them. He did not indicate that he had found the children.

Conclusions:

- Know your own abilities, ask for help.
- The same information can lead to different results, think critically.
- Like ELT, PLB's (Personal Locator Beacon) can encounter the same
- difficulties as case studies.
- What is the ability to locate a transmitting device or other RF (radio frequency) signals?
- Trust the technology.
- Trust the system.
- Use certifications. Only these will make the K9 teams a better search team.
- Vary the training. Would the dog have claimed to have found the target?

Fast Rescue System 2.0 – Thomas Mair / BRD within AVS

In the past, carabiners were more likely to break. There was no special equipment and you needed carabiners, ropes and slings. Then they used plates (Kong Full-Plate), carabiners, ropes and slings. The plates broke.

Now we have the Fast Rescue System, which is shown in pictures.



It needs a solid anchor point.

The first rescuer is lowered down with an Alpine Tube and a Micro-Traxion. The Micro-Traxion is blocked as soon as the first rescuer is down. The first rescuer is blocked and the Alpine Tube is removed. The next rescuers abseil down with a Prusik. The stretcher is then lowered. The manual force is 40 to 50 kg, the maximum load 640 to 780 kilos, depending on the rope.

The first rescuer is blocked by turning the Alpine Tube around. The sling can be removed. The stretcher is prepared for hauling up. The ropes are brought together and the stretcher is hooked in. The stretcher is pulled up. A 3:1 system (pulley) is installed for this purpose.

Design of Rescue Anchorages through the 10:1 Static System Safety Factor, Miha Kenda / GRZS

First, the terms are defined:

SRL = Standard rescue load):

• Single Rescuer (Person und and Equipment) 100 kg, 1 kN

• Standard Rescue Load: 200 kg, 2 kN (Victim + Rescuer + Equipment)

SSSF = Static System Safety Factor

SSF = Element failure load -----

Estimated static load

Example of the calculation of the SSF for EN 1892 A rope loaded with SRL

SSF = 22 kN = 22 kN = 11 = 10:1

SRL 2

The breaking load of fixed points (anchor points), consisting of pitons and bolts, varies depending on the material and design. Semi-static ropes, nylon slings etc. are used as elements to connect the anchor points. The load-bearing capacity of the connecting element increases with the number of loops. Knots are also used as connecting elements. The breaking load of a figure-of-eight knot when using an EN 566 sling: 22 kN x 40% = 8.8 kN. Conclusions:

- Transverse loading of the bolts: Use anchor points
- Axial loading of the bolts: Use three anchor points
- When using pitons: Use a minimum of three anchor points
- En 1891 A semi-static ropes and EN 566 webbing slings: minimum two anchor points
- Anchorages in the rescue: can be built with \emptyset 7mm and \emptyset 8mm cord.
- As a minimum, build a triple anchorage.
- EN 892 Dynamic single ropes: build a minimum of three anchor points.

Strategies of Limiting Force in Rope Rescue Systems, Kirk Mauthner / Parcs Canada

Shows the principles of how to minimize/limit forces in rescue systems. The relationships between working load, maximum load and breaking strength must be understood. Working load: Typical Forces acting on the rope systems when lifting, lowering or suspending rescue loads.

Maximum force: The worst-case event forces, such as an edge transition gone wrong. Breaking strength: Force at which the components fail.

Working load: The tension on the rope is usually 2-3 kN. Various factors, such as swaying/jumping of the load, can increase the force acting on the rope (4 - 6 kN).

From a design point of view, the descender device should be able to withstand the force of a bounce of the load, which can double the static force (i.e. 6 kN) without slipping. From a design point of view, the descender should be able to withstand the force of an impact. Various component-based systems can be used to reduce the force working on the rope. It also depends on what kind of ropes are used. It is very important that the combination of the rope and the DCD (descender device) has a minimum grip. Other gripping ability, which should be equal to or greater than double the static load of the rescue load.



What is the worst thing that can happen during a rope rescue? A rope breaks and the load is only carried by another rope? This is not the worst-case scenario. The breaking of a rope can only double the static force that was working on the broken rope and is now also working on the other rope.

The worst-case scenario is a fall during a transition over an edge. The additional energy generated during a free fall can generate a multiple of the force required to arrest the fall.



The maximum arresting force is highly dependent on the type of rope used (static ropes, ropes with minimal stretch (low stretch), hyperstatic ropes) and the DCD (descender device). What is the preferred combination?

At international level, there are strict regulations for the maximum permissible force that may be exerted on a person. This is a maximum of 6 kN. The maximum force for rescue loads consisting of two people must not exceed 12 kN in order to comply with the limit of 6 kN per person. The combination of rope and descender device (DCD) must not hold more than 12 kN, but must not start to slip before 6 kN.



From a designer's point of view, the required breaking strength of a rope rescue system depends, among other things, on the maximum force to which it can be subjected and on how reliably this maximum force can be controlled.

The breaking force is calculated as follows: Max. Force (12 kN) x 1.7 Design Factor ~ 20 kN. Preferred force limit range for descender devices of rope rescue systems:

- Load to be supported: 0 3 kN
- Slipping force range: 6 12 kN
- Breaking force: 20 kN

Questions/comments:

What strategies are there to avoid the worst-case scenario of a fall factor of 1/3 (edge transition)?

Just like in climbing, we do a lot to avoid a fall factor of 2. In mountain rescue, you should do everything you can to get into a fall factor \emptyset position, e.g. by placing your anchors above the edge transition. If this is not possible, you should use more rope and try to get below FF 1/5 as the forces decrease logarithmically. This is an important and crucial risk management strategy.

Dyneema Incident at Swinica in February 2023, Andrzeij Marasek, Andzey Gorka / TOPR

On March 4, 2023, at 8:11 p.m., an emergency call was received that two climbers were blocked on the north face of Mt. Świnica. A rescue team started from Zakopane. The weather was not good, the temperature was around -10 degrees. It was windy and visibility was poor.

The rescuers were able to get close to the blocked climbers, above them. A stand was set up there and a rescuer was lowered down to the climbers on two Dyneema ropes. The weather conditions during the descent were still poor. The rescuer reached the climbers. It was decided to pull the two climbers and the rescuer up to the belay. The reason for this decision was the risk of avalanches at the base of the wall. In addition, the topography at the base of the wall was difficult and the distance between the climbers and the belay was relatively short. The rescuers set up a pulley system (ratio 1:4). The main rope was a blue rope, with a white rope serving as a backup.

The distance to the stand was approx. 70 m. The rope was taut. When the climbers were raised and the rescuer was still on the ground, the blue rope suddenly became slack. The climbers fell about 50 cm.

A rescuer then climbed down from the belay and saw that the blue rope had broken.



on the following the days the rocks on the pillar are examined: some possess sharp, jagged features, the dyneema "fluff" is visible

In the days that followed, a search was made for the reason why the rope had broken. A stone was found on which the remains of the rope could be seen. The rope broke because it had passed over a sharp rock. This led to a discussion about the resistance of Dyneema ropes. As a result, scientists from the AGH University of Science and Technology in Krakow carried out various tests. The rope used in the rescue had a diameter of 8 mm. The Dyneema rope that broke was compared with an older Dyneema rope that was no longer in use. The old rope became thicker over time. Both ropes consisted of 12 strands.

Various tests were also carried out in the Tatra Mountains. The results are shown in various diagrams.

The following conclusions were drawn from these tests:

• Uncontrolled swinging of the rope over a sharp edge can cause it to be damaged or break.

- Semi-static ropes made of polyamide generate less force on the anchor system and the load, but are not as resistant as Dyneema ropes.
- Special structures and diameters in semi-static ropes can prevent them from being cut on sharp edges, but high cut resistance can only be achieved with a dense braid and an aramid cover.
- Dyneema ropes with untreated yarns do not have a high tensile strength compared to ropes with the same diameter and additional treatment.
- Dyneema ropes generate very high forces on the anchor system and the load. The use of absorbers is mandatory in the case of a dynamic event such as swinging.

Lost Person Behavior, Robert Köster/MRA

How do missing/lost people behave? The science of search and rescue is shown. What means "Lost Person Behavior"?

- A book or an app.
- The results of a big database (ISRID).
- The development of individual behavioral profiles
- The development of general topic categories.
- A series of statistics, markings on maps and behaviors of lost people.
- An analysis of scenarios.

A distinction is made between missing persons who have run away due to illness, forced marriage, etc. and missing persons who have strayed into the terrain (avalanches, crime, lost person).

Cases of missing/lost persons are recorded in a database. This is the ISRID (International Search and Rescue Incident Database).

Data and information on missing persons cases are collected. The data is recorded in a reporting system that includes various categories, such as the area in which the person is missing (mountains or city), the presence of external violence such as kidnapping, age groups, seasons, activity practiced (runner, climber), illnesses such as dementia, means of transportation (bicycle), etc.

Missing persons behave similarly, regardless of whether they are missing in America or in Europe.

The example of an 81-year-old person with mild dementia and obesity who does not know the area where the person get lost. Where is the most likely place the person could be? There are different phases that you go through when you get lost. First you start, at some point you make a wrong decision, finally you realize that something is wrong and you try to find your way back yourself. The missing people have different strategies (going back the same way, staying where they are). The missing persons also show different physical reactions such

as panic, higher pulse rate, etc. All this is taken into account and different scenarios are developed for the search.

What do you want to achieve in the future? Better data, better models, better decisions, better results.

Climbing Ropes – Do Diameters Matter? – Stefan Blochum – Bergwacht Bayern

Talks about equipment and the consequences of using it.

Does the diameter of the ropes play a role? Sharp edges and the braking force (given in kN) play a role.

There were two accidents in connection with edges that are looked at more closely, namely an accident in Italy/Gran Paradiso, in which the DAV was involved, and an accident on the Nesthorn/Switzerland on a mountain guide course.

In the first case, two people got lowered on a rope with a diameter of 8.7 mm over a rounded edge with a small slight sideway. The rope broke. As a consequence the Swiss mountain guide association introduced a minimum rope diameter of 9.5 mm for single ropes in guiding two clients. Does this mean those ropes loaded with two climbers are safer than others? Tests were carried out with different ropes with different loads. The cut length (cm) in relation to the pretension (kg) was examined for different rope types.

Conclusions for single ropes:

- Increasing the preload from 80 kg to 160 kg reduces the cutting strength by approximately 600 %.
- Increasing the diameter by 1.1 mm from 8.9 mm to 10 mm improves the cut resistance by approximately 10 %.
- The cut resistance of Dyneema ropes is 200 to 300 % higher, Kevlar 130 to 160 % higher compared to polyamide.
- The cut resistance of a 6 mm Dyneema rope corresponds to the cut resistance of a 9 mm single rope.

• \rightarrow The diameter does not matter.

More conclusions for a single rope:

Do not lower down two people over a sharp edge.

Dyneema ropes work well when lowering down for rescues in open terrain.

It should be noted that a rescuer with equipment weighs 80 to 120 kg.

Two people need two ropes. Is this also necessary for a rescuer with equipment?

There was a near-accident when using two 8.5 mm ropes, half rope technique, a tuber and a fall.

Tests were carried out on braking force and when a fall can be held. If the braking force is less than 2 kN, it is impossible to hold a fall. With a braking force of 2 to 2.4 kN it is possible, with a braking force of 2.5 to 3.5 kN it is not a problem.

Tests were then carried out with different ropes, different hand forces on the rope and belay devices. **The diameter of the rope plays a role here!**

Conclusions:

- Tubers are made for single ropes, but not for thin ropes.
- Alpine tubers are good for thin ropes.
- Soft ropes have higher braking forces.
- Low hand force, a small rope diameter and a munter hitch is a critical combination!
- A larger rope diameter means a greater braking force if the rope is not too hard.
- Conclusion: With a single rope with tube: A second carabiner is a must for low hand force.

Numbers, numbers

Seil									
11	Cris i	Apus 7,9 mm	Opera 8,5 mm	Canary 8,6 mm	Volta 9,2 mm	Apus 7.9 mm	Opera 8 r mm	Canary	Volta
Handkraft am Seil	Gripping force Handkraft 220 N					Grinning fo	0,5 mm	8,6 mm	9,2 mm
ATC Guide	1 Karabiner					Shipping force Handkraft 400 N			
		1,9 kN	1,4 kN	1,7 kN	1,8 kN	2,2 kN	2,0 kN	2.4 kN	a a la
	2 Karabiner	2,5 kN	1,8 kN	2,2 kN	2,6 kN	2 o kN		~,4 кн	2,9 KN
ATC Alpine Guide	1 Karabiner	2,8 kN	1.9 kN	2.6 KN	- (1)	-, 9 KH	2,5 KN	3,0 kN	3,4 kN
				2,0 11	2,6 KN	3,3 kN	2,9 kN	3,4 kN	3,7 kN
	2 Karabiner	3,4 kN	2,8 kN	3,6 kN	3,8 kN	4,2 kN	3,7 kN	5,1 kN	5.2 kN
Reverso 4	1 Karabiner	2,2 kN	1,7 kN	1,9 kN	2,0 kN	2,6 kN	2,4 kN	2,9 kN	3,2 kN
	2 Karabiner	2,9 kN	2,1 kN	2,7 kN	2,9 kN	3,2 kN	3,1 kN	3,6 kN	4,1 kN
Giga Jul (Tube)	1 Karabiner	1,8 kN	1,5 kN			2,0 kN	2,2 kN		
	2 Karabiner	2,2 kN	1,9 kN			2,6 kN	2,6 kN		
HMS		1,5 kN	1,3 kN	1,6 kN	1,7 kN	2,4 kN	2,2 kN	2,5 kN	2,7 kN

Challenges:

- Diameter?
- Low or high manual force?
- Braking device?
- If the rope is hard, soft, frozen, wet?
- 1 or 2 carabiners used with a tube?
- Munter hitch?

Who can answer all these questions when they are on a rescue mission? Maybe you should just leave out small diameters for ropes... Questions/Answers:

Q: How was the change in edge controlled between tests, at what intervals? Were there specifications that can be followed to allow others to perform the same tests?

A: The edge only seemed to last for about 10 tests before it had to be replaced. A control rope was used to see if the edge changed between tests. There are no specific specifications for the sharp edge.

Q: What kind of carabiners were used?

A: We went back to the rounded ones.

Mountain Rescue on Fire?! Stefan Blochum, Bergwacht Bayern (TERCOM)

Shows the challenges faced by mountain rescuers in forest fire operations.

The core tasks of rescuers during fires in rough terrain are regulated by Art. 17 of the Bavarian Rescue Service Act and also guaranteed by disaster control.

In the years 2020 to 2023, the number of operations involving fire increased massively. An example of such a fire is the fire in Brig this year. A video of this fire is shown.

Why should fires in the terrain be fought at all? The fire in Leuk in 2003 had a major negative impact on the landscape. Landslides are on the increase. Intact forests are vital.

In Austria, Reichenau/Mittagsstein, there was a fire on 28.10.2021.

Special equipment is needed to fight the fires. The equipment used by the fire department does not meet the requirements for mountain rescue. The BWB uses the following material for operations involving fire, which must be fireproof Aramid slings and ropes. Automatic belay devices (self-breaking devices) and 2 m metal strops are also used.

The risk of rescuers falling must be taken into account. There is also a risk of falling rocks. Escape routes must be defined in every fire.

Special Operation Trailer: This is where the operation is organized.

Conclusions for rescue organizations:

- The usual equipment for mountain rescues cannot be used to fight fires.
- Special equipment is required.
- Use of knowhow and tactics of fire brigades.
- A good risk management is essential and demanding.
- Special consulting is necessary.
- There are more and more fires, partly due to climate change. We have to deal with that.
- Cooperation between the fire department and mountain rescuers is important.

Complex Rescue from Glacier des Bosson – Implications of Climate Chance, P. Boric French Group (TERCOM)

The PGHM consists of 20 rescue units.

The glaciers have receded massively since 1864.

An extraordinary rescue from a crevasse is shown. It was a rescue in unstable terrain, in a glacier collapse. The victim was buried under blocks of ice.

The alarm was raised at 3.26 p.m. in the afternoon. The accident site was near the Cabane des Grands Mulets. The rescuers were dispatched to the scene of the accident at 3.38 pm. Visual

contact was made with the victim. There was a risk of snow and blocks of ice falling on the victim. The victim spoke German. The last block was removed at 6.40 pm. The victim was evacuated at 7.30 pm. The rescue operation was over at 9.45 pm.

The rescue operation was very difficult and the rescue was carried out under great pressure. The victim's life was in danger from the blocks of ice, which could have fallen on him at any time. There was a great deal of uncertainty during the operation, it was already late in the evening and the weather had to be taken into account. The equipment was used to the limit. Great tensile forces acted on the material. The victim was trapped under blocks of ice. 4 large blocks had to be removed. Everything was unstable.

What was used for safety: a monitoring system (Alarm Telemeter), an anti-collapse system (Stable Bag), hydraulic cylinder.

What additional equipment was used: A chain hoist, helicopter for heavy loads, mooring for granite blocks, plastic wedges, hydraulic spreaders, micro-blasting, portable hydraulic generator electric/manual.

Marmolata Glacier Accident – Simon Rauch and Giacomo Strapazzon / MedCom

The glacier collapse occurred on July 3, 2022, resulting in 11 deaths and 7 injuries. The collapse took place via the normal route to Punta Penia. The conditions on the Marmolada have changed massively in recent years due to global warming.

Temperatures have risen steadily.

The causes of the collapse are still being investigated. The probable cause is the presence of liquid water (meltwater) that penetrated between the crevasses and a water infiltration that acted as a sliding layer between the ice and the rock. The formation of a water pocket increased the pressure between the crevasses and the ice base, which led to further destabilization of the ice. This water pocket, which could not drain away, was probably the main cause of the glacier collapse.

Various helicopter companies were involved in the rescue (Helibase Trento, Helibase Bressanona, Helibase Pieve di Cadore).

The difficulty was that several patients had to be treated. A triage had to be carried out. For safety reasons, HEMS (Helicopter Emergency Medical Service) flights were eventually stopped and drones were used.

How can such events be managed?

- 1. Safety of rescuers has the highest priority.
- 2. The first measures should be aimed at creating a command and control structure. Triage and life-saving and life-prolonging measures are then initiated.
- 3. The coordination of helicopters and drones in the same airspace is extremely important.
- 4. Leadership and communication is essential.
- 5. Evacuation of patients to the best suitable hospitals.
- 6. Tools, to locate and identify victims should be available.
- 7. Planning and training are necessary.

8. Learning from experience.

One might ask whether a working group is needed to deal with the effects of climate change.