

Alpine ecologists involved in GLORIA fieldwork are experts in high mountain ecology and/or taxonomy, but also have ample experience with fieldwork in high mountain environments and are aware of potential risks, such as through rugged terrain and rapidly changing weather conditions. The following recommendations, therefore, are intended as a reminder for the communication of safety considerations to new, potentially less experienced team members, and as a brief guideline for new GLORIA teams.

Research teams working at GLORIA study sites need to have extensive experience with work under the particular alpine conditions in their mountain region, including the consideration of precautionary measures. Hiking and working in high mountain bear potential risks for your safety and health, thus precautions must be taken for ensuring safe work in mountains.

The following safety recommendations cannot be exhaustive in a GLORIA-wide context, given the countless cases of specific situations regarding accessibility, steepness, bedrock stability, elevation, local weather, remoteness, wildlife and people.

There are, however, some features all sites have in common: • They are situated above the montane forest zone, i.e. are exposed to colder temperature regimes than usually experienced. • Work is conducted in summit areas, which means pronounced exposure to weather events. • The place of work is off the main hiking trails. • GLORIA researchers stay on summits sites far longer than the average mountaineer.

Mountain weather

GLORIA field campaigns usually take place during the peak growing season, if not in the non-seasonal tropics. Even though this is the warmest period of the year, adverse weather conditions with storms, rain or even snow may occur. The weather may change very rapidly from sunshine and high irradiation to thunderstorm, which cannot always be properly forecasted. Therefore precautions and preparations regarding the equipment and timing of your survey campaign are necessary:

- (1) Carefully check the weather forecast and pay attention to warnings before you start with the field campaign.
- (2) When weather conditions appear suitable but are not very stable, start early in the day, especially when you have to cope with long access routes and large elevation differences.
- (3) Inform others (family, friends, colleagues or park authorities) about the route you have selected and how long you plan to stay.
- (4) Avoid hiking and doing GLORIA work alone. As far as possible, stay together at least in groups of two. Groups larger than six may be a hazard factor. Adapt speed to the slowest.
- (5) Bring warm clothes and water-proof gear to avoid hypothermia. Consider that most of your time during a GLORIA survey you do not move very much. Thus, you get cold by far sooner than a mountain hiker. You therefore need much warmer clothing as during a usual mountain trip.
- (6) Bring adequate sun protection, a strong one for high elevations of tropical to temperate mountains.
- (7) Bring a sufficient amount of drinking water and food. In many mountain regions drinking water is not available, especially not on your summits. Exhausting and long climbs as well as strong solar radiation and missing shadow cause higher water demand.
- (8) Always know where you are. After sudden weather changes, fog may rapidly occur which makes orientation more difficult. Use map, compass and altimeter (barometric altimeters need to be calibrated, but are independent of GPS signal reception and allow to check changes in air pressure). Bring flashlight/headlamp, GPS and mobile phone, although there may be no or only very limited reception. In areas without mobile phone signal coverage, VHF/UHF radio and/or satellite phone are recommendable.
- (9) In case of thunderstorm, rapidly move away from the summit. Exposed places such as summits or ridges are very risky places for lightning strokes! Therefore, always keep an eye on cloud formations and leave the summit well before a thunderstorm actually begins. Be careful when descending – wet rocks can be much more slippery than they were as you climbed up and can be a real hazard if you are hurrying down. If it is too dangerous to directly head down to the valley or to safe sites in large enclosed buildings or closed metal vehicles (Faraday cage), go to a non-protruding place, preferably a rain-sheltered depression, where you may wait until the thunderstorm has moved away. Check out possible shelters already during your ascent. Having your rain-gear and warm clothes with you even on initially sunny days, therefore, is important.

In remote GLORIA regions, where you need to setup a camp site, carefully inspect and assess the camp location and surrounding topography for safety under thunderstorm conditions.

See also the excellent guidelines in “Mountain and desert thunderstorms, their formation and field forecasting”:
<https://www.fs.fed.us/psw/cirmount/gloria/pdf/2016%20Bishop%20MtnDesertT-storms.pdf>

Access routes, topography and the force of gravity

- (1) Check access routes with maps or other sources including consultation of people knowing the area. This is especially relevant when you start with a new site or a new team continues with an existing site.
- (2) Inform all team members about the difficulty level of the route and evaluate if everyone is experienced and fit enough. Check if the route is suitable for you if you are scared of heights.
- (3) Adapt the equipment to the demands of the route, e.g., you may need a climbing helmet, equipment for crossing a glacier (although the latter is not a common case at GLORIA field campaigns). Use footwear with a good grip and ankle support. The sturdiness of hiking boots depends on your route. Sturdy boots would be necessary for fixing crampons if you have to cross a glacier*, but the type of shoes is otherwise a matter of personal preferences, as is the use of hiking poles.

* Further equipment and experience is required for glacier crossings. Check mountaineering websites for necessary equipment and field training courses.
- (4) Stay on the trails as long as possible. Trackless hiking is exhausting and time consuming and requires special attention to the terrain conditions. Be careful in rocky terrain with unstable bedrock and on steep slopes with scree fields to not dislodge rocks. Also be careful on steep vegetated slopes, where slipping can have serious consequences.
- (5) Always be alert about rockfall and risk of falling. If new to the region, ask people knowing the area. Rockfall is one of the most incalculable risks in mountains. Bedrock material can strongly differ in stability, but with steepness and elevational difference the relevance of the force of gravity increases. Be especially careful and avoid prolonged stays in steeply inclined gullies and scree slopes, and avoid using them as ascent or descent routes. Use climbing helmets on critical routes (even if you are not actually climbing) and be careful about the following and/or preceding persons. If a rock falls, yell "ROCK" to those below. High-alpine and subnival areas above the zone of closed vegetation and recently deglaciated areas require special attention, because these are often covered with loose and unstable material. In zones with retrogressive permafrost, rockfall frequencies may be increasing.
- (7) When negotiating/traversing a steep pitch or rock ledge, keep 3 of your 4 hands/feet on the rock at all times.
- (8) Be careful during site setup and sampling. GLORIA summits ideally should have moderate conical shapes and fieldwork should be possible without climbing equipment. Alpine topography, however, is not evenly shaped and some areas within your summit terrain may be steep enough to require caution to avoid slipping or causing rocks to fall. Loose or projecting rocks and our survey strings and measuring tapes are all tripping hazards. In steeper summit sectors and where bedrock or scree material is unstable, avoid working in the direct vertical line of another fieldworker. Be careful when taking photographs or samples in steep and/or exposed places. When working near a drop-off, remain at least one step from the edge. An accidental misstep or a bump from a co-worker or wind gusts can then be countered without stepping over the edge.

High altitude

A number of GLORIA summit sites are situated at high altitudes, where any movement is not only more exhausting than in lowlands, but thin air can also pose a considerable risk to your health. Knowing how to prevent hazardous effects of low oxygen levels is of particular relevance in tropical to subtropical GLORIA regions, such as in the Andes, Mexico, tropical Africa and the Himalayas, but also in dry subtropical to Mediterranean regions of southwest Asia, Iran, Europe/North Africa, California and the Andes. Further, also humid to dry temperate GLORIA regions have sites at high elevations, such as in the Rocky Mountains, Pyrenees, Alps, Caucasus, Tian Shan and Pamir.

- (1) Carefully plan your high altitude field campaign, including suitable overnight stays and calculate enough time to acclimatise. Learn the signs of altitude sickness, for example, by reading the excellent booklet 'Travel at high altitude', freely available in sixteen languages under: http://medex.org.uk//medex_book/about_book.php
- (2) Ascend slowly when you aim to reach a high altitude site, e.g. over 3000 m asl. Altitude already starts to have an effect from around 1500–2000 m, but most people remain well at altitudes up to 2500 m. Above 2500 m, breathlessness and symptoms of altitude sickness become more noticeable. People, and even the same person, however, can respond very differently, dependent on the degree of acclimatisation and overall physical constitution.
- (3) At elevations above 3000 m, overnight stays should not be more than 300 m higher at the end of each day. Going higher during the day may be okay, as long as you go down to sleep. If you go up higher and can't descend, take a rest day to allow your body to acclimatise.
- (4) Avoid the consumption of alcohol or other drugs at high elevations.

(5) Be cautious with symptoms of altitude sickness and communicate obvious signs in your group. Common symptoms of Acute Mountain Sickness (AMS, the mild form of altitude sickness) are headache, nausea, vomiting, fatigue, poor appetite, sleeping disturbance. Your balance may become unsteady, your eyesight could change and you need to pee more often. If you have symptoms of AMS, do not go further uphill.

(6) Most important is to observe if symptoms of AMS are getting better or worse. Do not hide signs of illness. If you think that you or members of your group are getting worse, descend! – at least 500 to 1000 m lower – for sleeping.

(7) Do not leave the decision to descend until it is too late. The symptoms of AMS are warning signs that you are at risk of the serious forms of altitude sickness: HAPE and HACE, which can be fatal within hours. HAPE, the High Altitude Pulmonary Oedema, is caused by fluid collecting in the lungs. Excess fluid on the lungs causes breathlessness even when you rest and may lead to death within an hour of symptoms being noticed. HACE, the High Altitude Cerebral Oedema, is caused by brain swelling. Symptoms and consequences, if ignored, are confusion, clumsiness, drowsiness, loss of consciousness, reduced breathing and death.

(8) For further information on precautions, symptoms and treatments of altitude sickness see the websites of the

- International HAPE Database: <http://www.altitude.org/home.php>
- Medical Commission of the Union Internationale des Associations d'Alpinisme (UIAA): <https://www.theuiaa.org/mountaineering/uiiaa-medical-advice-emergency-field-management-of-acs-hape-and-hace/> with a very informative paper on AMS, HAPE, and HACE in Czech, English, German, Italian, Japanese, Persian, Polish, Russian and Spanish;
- MEDEX website: http://medex.org.uk//medex_book/about_book.php with the above mentioned booklet 'Travel at high altitude', in Chinese, Czech, Dutch, English, French, German, Greek, Italian, Japanese, Nepalese, Persian, Polish, Russian, Serbian, Spanish and Swedish.

Precautions to prevent cases of emergency

Cases of emergency can never be excluded, but the risk of hazards can be substantially reduced when weather, mountain terrain and high altitude conditions are carefully considered and the necessary equipment is present, so you can help yourself and others.

It is highly recommendable to take a first aid class and refresher courses every year or every few years.

Check the applicability of your health insurance, especially when working outside of your country.

Even with perfect guidelines, there are two things that usually need to be reinforced:

First, keeping everyone ever vigilant and alert to the situation and applying the guidelines. Almost every person can recite or agree with the safety points, knows them all at the safety briefing, but we all tend to not be thinking about them as carefully as we should be later on in the field.

Second, making sure that a person can do the things they might need to do. For example, we might require a radio, but not everyone really knows how to operate it. Or we might list a contact for emergency response, but the person responsible to make the notification should make sure they know exactly how to do that, what information to give, with whatever device they'll use ... satellite phone, VHF/UHF radio, cell phone, etc.

In larger teams, it is advisable to engage somebody experienced (in addition to the lead person of the field campaign), who pays particular attention to potential dangers regarding the route and the weather conditions.

First aid kit, equipment, food/water supplies, contact information

(1) First aid kit

A basic first aid kit should be part of your standard equipment. Its content depends on the duration and difficulty level of your trip. For daytrips it usually weighs less than 150 grams, but several 100 grams for multi-day group-trips.

Essentials for a basic first aid kit include

- wound antiseptic (for initial disinfection), antiseptic ointment or Ichtolan/Ichthammol ointment (against inflammation of minor wounds), adhesive bandages (plasters, steri strips, adhesive tape), gauze pads or rolls (sterile dressings), compression trauma dressing (pressure dressing), elastic bandage, medical exam gloves, a pair of tweezers, small scissors (or a knife)
 - to treat common injuries such as minor sprains, cuts and wounds bleeding a fair bit;
- vaseline and blistering plaster
 - to stop chafing and prevent blisters;
- painkiller tablets (e.g. paracetamol and/or ibuprofen), antihistamine tablets
 - to help you deal with any aches or minor sprains before they become a major problem and to deal with minor allergic reactions;
- a splint (at least one among the team members)
 - to help dealing with broken bones or sprained joints;
- rescue blanket made of aluminium foil
 - to help keeping a casualty warm;
- rehydration sachets (electrolytes)
 - to prevent dehydration, especially in summer
- face shield
 - for mouth to mouth resuscitation;
- casualty report form
 - to record all details needed for a mountain rescue.

(2) Mountaineering equipment

Clothing: Hazardous situations are often associated with unexpectedly rapid weather changes. Bringing warm clothes and water-proof gear (even on warm days) is therefore very important to avoid hypothermia, and is often decisive to prevent an emergency.

Consider the following equipment: trekking trousers (not jeans or cotton material), thermal top, fleece top, fleece jacket, very warm jacket (for field recording while you do not move), waterproof jacket with hood, waterproof over trousers, warm hat or cap, gloves, gaiters (not always essential), boots with ankle support and soles which will grip on rock, grass and mud, change of clothing.

Instant rain shelter: a bothy bag (bivouac bag; size dependent on group) can provide an emergency group shelter in cases you do not reach your lodging.

Sun protection: Hat or headscarf, sunscreen (suncream/sunblocker), sun glasses.

Navigation: Detailed topographic hiking maps, a compass and an altimeter are essential tools helping to always know where you are. Barometric altimeters (e.g. available on altimeter wristwatches) require calibration at points of a known elevation, but are independent of GPS signals and allow for checking changes in air pressure. In addition bring a GPS and mobile phone, but be aware that reception may be weak or absent. In regions known to be without mobile phone signal coverage, VHF/UHF radio and/or satellite phone is recommendable.

Illumination and emergency signalling: A headlamp/torch is important if you (unexpectedly) have to return after dark or you start before sunrise, if you have to camp in the wild or to assist in finding a lost or injured person. Also bring a whistle for emergency.

(3) Supplies of drink and food

Hydration: Bring a sufficient amount of water, dependent on the season, duration of your trip and planned activities. An adult, for example may need about 2.5 litres of water per day and for more exhausting hikes even up to 4 litres. Especially on hot days add electrolytes to your water or make sure that you ingest electrolytes from food sources. Check before you start if water is available and drinkable along your route. If water purification (from viruses, bacteria and/or protozoa such as Giardia) is required, bring water purification tablets or any suitable non-chemical treatment equipment.

Nutrition: Food supply should be rich in easily digested quick acting carbohydrates, with a bit of protein to aid utilization. Glycogen (sugar or starch) is the one essential fuel that must be replaced during a hard hike or an unexpected cold, wet night in an emergency shelter. For multi-day stays offside of managed mountain huts, a careful planning of your menu (with nutritionally suitable, not too heavy, not quickly perishable, but also tasty food) and cooking gear is important.

(4) Important contacts

Before starting into mountain regions make sure that you have the most important contacts with you (digital but also on paper): number of the local mountain rescue, number of special insurance, number of nearby mountain huts, numbers of contact persons of all team members.

What to do in an emergency

- Stay calm. Take time to assess the situation and decide what to do.
- Check that you, the casualty and group aren't in immediate danger. If you are, seek to make the situation safe.
- If anyone is injured, remember “ABC” (airway, breathing and circulation). Look for signs of life or blood loss.
- Treat any injuries, best possible in doing no harm.
- Insulate the casualty from the ground, add extra clothing. Place any unconscious casualties in the recovery position.
- Determine your exact position on the map or GPS and consider the options for:
 - Descent to safety. What will the terrain be like? How far to reach safety? Are you sure you can carry the casualty?
 - Will the casualty's injuries be made worse by travelling?
 - Finding shelter. Don't use up valuable time and energy unless you are sure about finding shelter.
 - Staying put. Will your situation be resolved if you stay where you are?
 - Seeking help. Do not delay to call for help and do not assume response will not happen until morning. Remember that even when a rescue team has been alerted, help might not arrive for several hours.
- Call for help: Have the essential information for rescue at hand (before phoning for help):
 - The location of the incident (geographical coordinates and a named feature)
 - The number of casualties
 - What is wrong with the casualties
 - Are the casualties deteriorating/getting worse
 - Details of the equipment in the group, i.e. group shelter
 - Your contact telephone number and any other mobile numbers in the group.
- If there is no mobile coverage at your location, consider whether it might be worth moving to another location to phone from. If applicable, use satellite phone or VHF/UHF radio.
- Check who else in your party has a mobile phone (and coverage) and evaluate the amount of battery life available in the event of additional calls being necessary.
- If all other forms of communication fail, the internationally recognised emergency signals are six blasts on the whistle or six torch flashes repeated every minute.

Some further references on first aid and precautions of emergencies

<http://www.alpine-club.org.uk/ac2/eic-medical>

<https://www.theuiaa.org/mountain-medicine/>

<https://www.theuiaa.org/mountaineering/safety-resources-for-climbers-and-mountaineers/>

<https://www.mountaineering.scot/safety-and-skills>

<https://100summits.com/articles/mountaineering-safety>

http://www.traditionalmountaineering.org/Photos_Firstaid_sm.htm

<https://www.thebmc.co.uk/mountain-first-aid>

The GLORIA Great Basin website (<https://www.gloriagreatbasin.org/>) provides region-specific safety briefings:

https://www.fs.fed.us/psw/cirmount/gloria/pdf/2017%20Safety%20briefing%20Calif_Nevada%20GLORIA.pdf

and a paper on thunderstorms:

<https://www.fs.fed.us/psw/cirmount/gloria/pdf/2016%20Bishop%20MtnDesertT-storms.pdf>

Backcountry first aid and extended care (by Buck Tilton, Falcon Guide), 5th edition, Paperback, 2007.

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