FIELD COURSE HANDBOOK

SWEDISH POLAR RESEARCH SECRETARIAT

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Swedish Polar Research Secretariat

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FOREWORD

The purpose of this book is to provide practical information to participants in polar research expeditions organised by the Swedish Polar Research Secretariat. It should serve as a complement to the Secretariat's field course which is a compulsory part of the preparation for all participants on polar expeditions.

This book does not replace practical training with an experienced instructor which is essential in order to attain the knowledge and skills necessary for safe travel and living in a polar environment.

Equipment, techniques, and knowledge improve over time and therefore this book is updated on a regular basis.

The Secretariat takes no responsibility for any injury or damage, to person, equipment, or property that might be caused by applying the contents of this book in any situation.

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DIRECTOR-GENERAL

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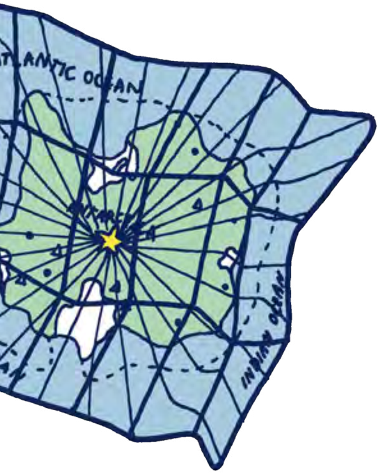
1

INTRODUCTION

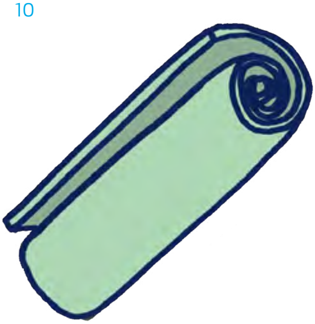
Henning Lorenz



THE FIELD COURSES AND THE HANDBOOK

The main aims of both the field course and this handbook are to familiarise expedition participants with some features particular to polar research expeditions as such, to equipment that may be used, and to safety principles and techniques that should be kept in mind while on the expedition. A field course is also a valuable opportunity for participants to get to know each other in a setting that resembles an expedition.

On all polar expeditions there is inevitably an element of risk. It is important to recognise that the margins of error can be much smaller in polar regions than at home. The weather may change quickly and become very violent. On glaciers, crevasses may be hidden under snow bridges that hold for a first and second person but not for a third. As for wild animals, a walrus may decide to investigate your Zodiac or a polar bear may look for food in your cooking tent. All such critical situations may come about quickly and unexpectedly. The risks are real, and you should not make them worse by neglecting them. The safety principles and techniques presented here and in the field course are adapted to the Swedish Polar Research Secretariat's expeditions and are constantly being reviewed and developed. It is likely that you will learn new things even if you have attended earlier field courses, and you will definitely get an opportunity to refresh old skills.



Besides the basic field course, the Secretariat may provide extra training for some of the expedition members in topics of specific relevance to the expedition. However, it is important to

recognise that you will not be a fully-fledged, e.g., mountaineer after the field course or even after extra training. Many of the techniques taught theoretically and practically take a great deal of time and practice to master. Both in training and in the field, you should be realistic and honest about your knowledge and abilities, and only take part in activities where you are certain that you can handle situations that may arise.

This handbook has three main functions: it serves (1) as pre-training reading to prepare you for the field course; (2) as a complement to the notes you take during the field course; and (3) as an overview to be read before and during the expedition. Before the field course, you may receive information on parts of this book that you are expected to have read beforehand. This handbook will cover topics that are outside of the scope of the expedition that you are to participate in (i.e., it is not a manual for your expedition). However, the Secretariat always tries to reflect each expedition's uniqueness in the form and content of the field course.

A GENERAL DESCRIPTION OF SWEDISH POLAR EXPEDITIONS

As a general principle, the Secretariat organises three kinds of expeditions, each with its own characteristics: marine, Antarctic, and tundra expeditions.

MARINE EXPEDITIONS

Climate and environment

The primary characteristic here is, of course, that almost all activities are confined to a ship. The exception to this could, for instance, be temporary activities on the sea ice. In spring, there can be sunny but cold days, while in the summer the sky is usually overcast, and the temperature often hovers around the more moderate temperature of zero degrees. In the high Arctic, gale winds are unusual in the summer, and once inside the pack ice the sea is very calm. Travelling through sea ice can make for a very bumpy ride, but most people adjust to this quite quickly. Thick, multi-year sea ice and pressure ridges formed by wind and currents can create obstacles to the journey and reduce the possibility of fulfilling planned activities. In Antarctic waters, storms rather than ice may be the main problem, with (long) swells often reaching heights of 10–15 metres. These storms break up most of the sea ice every year, and multi-year ice is common only in distinct areas such as the Weddell Sea. Closer to the ice shelf the sea is usually calmer, and huge icebergs are common.

Means of transportation

For Arctic expeditions, the ship most often used to date is the Swedish icebreaker Oden (Figure 1.1). Such expeditions usually have their mobilisation and demobilisation in a Swedish port. However, the expedition proper often has its start- and endpoints in ano-

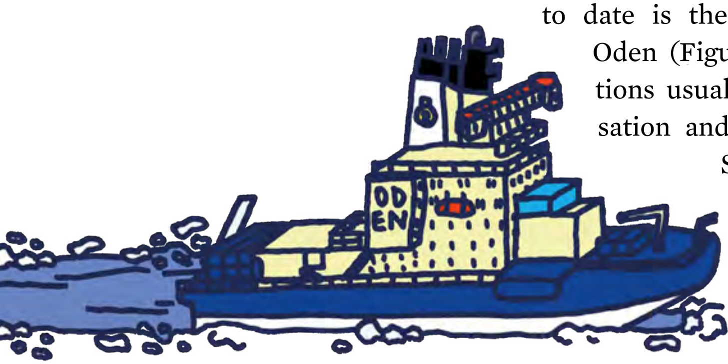


Figure 1.1 The ice-breaker Oden. / Lars Lehnert

ther country. Oden is quite a unique ship in that it is an icebreaker of high Arctic class (Polar 20 Icebreaker) and is fitted to be an excellent research vessel. Antarctic marine expeditions are usually made in cooperation with other countries, and the ships and ports that are used vary. Work and storage space may be limiting factors on board ships, particularly laboratory space, thus requiring careful planning.

Helicopters may be available on board the ship for specific scientific purposes; however, this is totally dependent on the facilities available on the ship.

Living conditions

Although space is always limited, most ships are quite comfortable to stay on. As a rule, cabins are shared, and some people may feel a bit confined after a while. The status and availability of common rooms and other social facilities vary from ship to ship. The ship always provides meals, but other services, such as cabin and corridor cleaning, and doing laundry, are done by the crew in some cases, and by the passengers in others. The ship's captain decides on which areas are accessible by passengers and which are not. The food on board is generally good, but vegetables and fresh fruits, particularly, may not last the full extent of travel during long journeys.

Logistical and technical support and limitations

One of the great benefits of being on a marine expedition is that the ship always has a very competent crew. However, it should be kept in mind that the crew has running and maintaining the ship as their primary task, and servicing scientific equipment is always the responsibility of the researchers. Which media, e.g. water, gases, and electricity, and how much of them can be supplied to laboratories and work areas vary. It should be noted that the quality of electrical power is not the same as at home and that power spikes and cut-offs may occur; also, a ship has no true grounding plane. Furthermore, depending on where the ship comes from, the electricity provided has either 220V/50Hz or 110V/60Hz as the standard. The possibility of bringing containers on board is very limited on some ships.

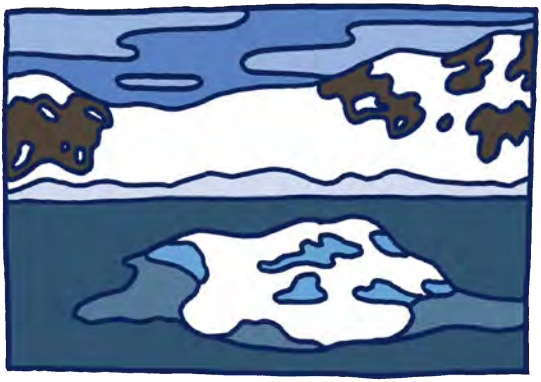
Environmental issues

Activities on board and away from the ship, e.g. on the sea ice, are determined by the ship's regulations, based on national and international law. South of 60°, the Protocol on Environmental Protection to the Antarctic Treaty applies.

ANTARCTIC EXPEDITIONS

Climate and environment

What really characterises Antarctic expeditions is the inland ice that is nearly the only environment in Antarctica. This kind of environment is very unfamiliar to most people. Due to its immense size and vastness, inland ice may seem unchangeable, but actually it is a very dynamic environment. Just like water, inland ice is affected by the Earth's gravitation and it "flows" from higher to lower ground. As it does so, inland ice is affected by the topography of the underlying ground. In all areas where ice is moving it is subjected to various forces, and since ice is not perfectly plastic this results in cracks and crevasses. In general, the greater the height differences in the underlying topography, the more numerous are the cracks and crevasses, and the more extreme. Even in seemingly flat areas the ice may be subjected to forces that lead to cracking: the underlying topography may not be flat even though the surface is, and ice in areas at quite a distance may subject "flat ice" to pressure. Both small and large cracks can be covered by snow (bridges). This may make



it very difficult or impossible to detect crevasses even a short distance away.

Mountaintops jut out of the ice like islands out of a sea. These mountaintops go by the Greenlandic word “nunatakk”. The Swedish station Wasa is situated on the nunatakk Nordenskjöldbasen (“Basen”), which measures approximately three by five kilometres. Basen has relatively large areas of bare ground. This bare ground consists mainly of stones and boulders, with a few, more or less temporary shallow pools of melt water. The vegetation is very sparse and consists of mosses and lichens. These grow extremely slowly and are very sensitive to disturbance. Their abundance can locally be quite high. The other Swedish station, Svea, lies in the Scharffenbergbotnen that is part of a larger nunatakk system, the Heimefrontfjella. Here, most mountainsides are steep or very steep, and are therefore quite inaccessible (Figure 1.2).

Figure 1.2 The nunatakk Nordenskjöldbasen. / The secretariat

Antarctica is the coldest, driest, and windiest of the continents; it should be noted, however, that Swedish expeditions go there during the austral summer. At Wasa, the mean summer temperature is around minus ten degrees Celsius, and it rarely goes below minus twenty. The relative closeness to the sea makes the Wasa area prone to bad weather, with wind speeds reaching gale force. However, there are summer seasons at Wasa without any real storms, even though they are rare. At Svea, the weather is more stable, due to the position further inland. The interior of Antarctica consists mainly of an ice plateau, ranging from 1,000 to 4,000 metres above sea level. The plateau begins just south of Svea, and here the summer temperature is around minus twenty degrees, but often going lower. The wind is rarely absent in Antarctica, and the wind-chill effect should never be disregarded. Another important by-product of the wind is drifting snow. Although Antarctica has only minor amounts of precipitation, drifting snow can quickly cover even large items left outside, and the wind quickly packs snow into very hard drifts. Snow usually drifts rather close to the ground, up to two or three metres in height, and it can severely limit visibility. Another typical phenomenon in Antarctica is "white-out". This is usually caused by a thin cloud layer covering the whole sky, producing a diffuse but quite intense light that is reflected both from the snow and the sky. The danger with white-out conditions is that one loses all points of reference, which makes, e.g., flying using visual means impossible.

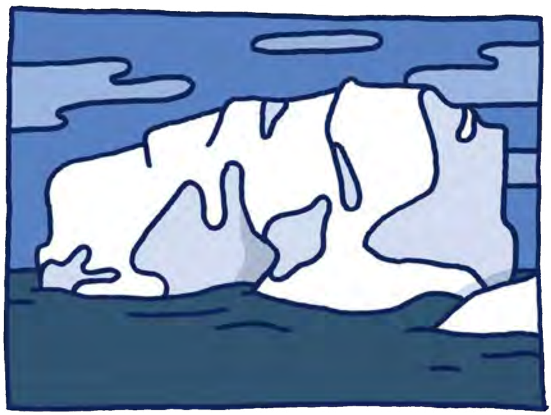
Way of transportation

The arrangements of transport services to and from Antarctica are done, as a rule, in cooperation with other countries. Until 2001, basically all Swedish expeditions were transported to and from Antarctica by ship. In that year Sweden, together with ten other countries, started an international cooperation with the aim of providing air transportation between South Africa and Antarctica, and within Antarctica. The framework for this cooperation is called Dronning Maud Land Air Network (DROMLAN). Some of the benefits of using air transportation are a potentially longer summer season, a more flexible scheduling of the season, and lower costs of transporting people. The most serious drawback is the limited cargo capacity of the aeroplanes, and ships still need to be used when resupplying the stations with, e.g., fuel and heavy equipment. Another negative effect, albeit less so, is that flying from a temperate climate straight onto Antarctic inland ice creates quite a contrast, one that it is important to mentally prepare oneself for. In Dronning Maud Land, two landing sites for intercontinental flights are used, at Novolazarevskaya ("Novo") station and at Troll station. From Novo and Troll, smaller aeroplanes, such as Twin Otters and Basler-63s, are mainly used for feeder flights to other stations. During the expedition as such, snowmobiles and tracked vehicles can be used for overland travel. Helicopters and/or small aeroplanes may be chartered for specific purposes; they are also used in the rare case of evacuation for medical reasons (MedEvac).

Living conditions

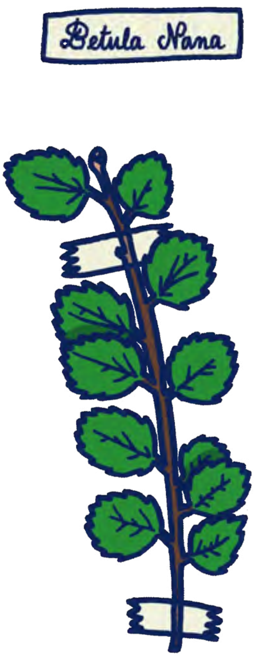
The Swedish Antarctica expeditions are rather small, typically consisting of six to twelve people.

As is the case for all polar research expeditions, living quarters are of limited size, and, as a rule, sleeping quarters are shared. Depending on the activity, living quarters range from comfortable conditions at permanent stations to more primitive conditions in tents. On Swedish expeditions, everyday chores, such as cooking and cleaning, are shared by participants. Food consists, as much as possible, of fresh and frozen goods, supplemented by canned or freeze-dried food. In a long field season, the fresh fruits and vegetables will not last the full period due to a lack of adequate storage conditions. At high latitudes, the sun never sets in the summer, and in a very white environment, as it is in most of Antarctica, there is no great difference between night and day. This may cause sleeping problems for some people, but usually this is not a major issue.



Logistical and technical support and limitations

Antarctica expeditions are technically and logistically complex operations. This is due to the combination of the continent's harsh climate and distant location, and the aim of providing good science platforms and comfortable living conditions. Everything that is needed at a station has to be shipped there in several stages, which takes time and thorough planning. When flying there, there are usually strict limitations on weight and volume of the cargo, mainly due to the capacity of the feeder flights within Antarctica. At the stations, there is some office/laboratory space, but there may be no real research facilities per se in place. All technical support requests need to be discussed beforehand with the Secretariat's logistics staff, as conditions may differ radically from home. For instance, the main power grids at the Swedish stations provide 12V and 24V (dc), and 220 V (ac) is not used on a regular basis. Also, as the stations are self-contained, the care and maintenance of equipment are the responsibility of the expedition's logistics staff and do take time.



Environmental issues

Activities in Antarctica are ruled by the Protocol on Environmental Protection to the Antarctic Treaty. The rules set up by the Secretariat, based on the Environmental Protocol, must be strictly adhered to.

TUNDRA EXPEDITIONS

Climate and environment

In general, tundra is the treeless nature type that occurs north of the taiga (the northern woodlands) and is not covered with snow the year round. However, patches of dwarf birch (Betula nana) and willow (Salix spp.), and of permanent snow may occur. To the north, the tundra turns into polar desert due to little precipitation and melting. Permafrost, i.e. ground that is permanently frozen, is common in the tundra, and the surface layer that melts in summer is often quite shallow. In flatter terrain, with limited runoff of meltwater, the impermeable permafrost layer causes large areas to become very wet. Large parts of northern Siberia and Alaska are very flat, while the Canadian High Arctic, Svalbard, and Greenland are generally hilly or mountainous. Summer is short on the tundra, often only lasting from mid-July to mid-August; the summer temperature is generally above the freezing point, and the weather most days consists of overcast skies, light wind, no precipitation, and a temperature around five degrees centigrade. However, really warm days, as well as cold fog, and snow and sleet storms can occur (Figure 1.3).

Figure 1.3 Mountainous tundra and the more common, flatter tundra terrain.

Way of transportation

Transportation into the field is almost always by helicopter, while the journey to the helicopter landing field may be by aeroplane, ship, or even by train. Helicopters have strict weight and volume cargo limitations, which depend on the flight distance, i.e. on how much fuel they must carry. The makes and models of helicopter used, and thus capacity, vary greatly, depending on what is available at the site of departure. On some expeditions, rubber boats, such as Zodiacs, are used for travel in the field.

Living conditions

Tundra expeditions are usually tent-based, sometimes with two people sharing a tent. Field stations are few and far between on the tundra. Besides sleeping tents, most camps are supplied with a larger kitchen tent. Food is generally of the canned variety with a limited supply of fresh goods, and freeze-dried foods serve as backup.

Logistical and technical support and limitations

Being tent-based, tundra expeditions have very little in the way of technical infrastructure. Electrical power is generally only supplied for maintaining communication. On some expeditions, a change of camp sites at mid-season can be used for resupply.

Environmental issues

The activities on tundra expeditions are regulated by the national law of the area in which the expedition is done.

PERSONAL MATTERS

BEFORE THE EXPEDITION

From when you receive this book to when you leave for the expedition, there are a number of preparations that must be done, both at a personal level and concerning the scientific equipment that your project is bringing along. During this period of preparation, you will receive information and instructions from the Secretariat. It is critically important that you follow these, or if you cannot, that you contact the Secretariat immediately.

One thing that can make an expedition a truly negative personal experience is poor planning of your project. A good way to avoid such frustration is to have a clearly prioritised list of things that you want to do. The Secretariat recommends, and often asks for, a three-tiered plan from the project leader that consists of: (1) a minimum level – if you do not achieve this, then it will not be worth going; (2) a “dream scenario” – if nothing negative at all happens, this is the maximum of samples/data you would be able to collect, given the available time on site; and (3) a realistic level in between – given the things one cannot plan for, inclement weather, things breaking, etc., this is what you would consider a good outcome. Then consider all things that you get done beyond the minimum as bonuses. In this way you can be happy most of the time and congratulate yourself for all the bonus work you get done. If you only set up the dream scenario, the risk of disappointment is great.

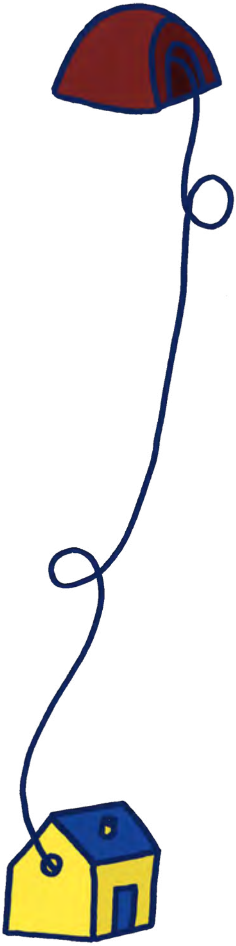
LEAVING

The time just before leaving on an expedition is usually quite hectic and filled with preparations, and you will probably be quite excited about the new experience that awaits you. Some people become absent-minded and are “on expedition” weeks before actually leaving. For those who are staying behind, even if they are happy for your sake, you should remember that they are literally staying behind and will not participate in the things that are causing your excitement. For their sake, do not be overly cheerful about the expedition, and it could be a good idea to plan something nice for your homecoming, so that they also have something to look forward to. To prepare yourself, read about the area that you are going to visit and talk to people who have been there or in similar areas. Try to have a realistic picture of what you are going to experience. Even though you will probably have some fantastic experiences and enjoy some beautiful views, you will also have to perform mundane chores daily and will encounter bad weather. If you have a realistic view of things to come, there is a lower risk of your expectations not being fulfilled.

ON EXPEDITION

You should be fully aware that the time schedule for the expedition that is set up beforehand is an ideal one, one that will be followed if everything goes according to plan. However, on expeditions to the polar regions, things rarely do go as planned, and there is no such thing as "guaranteed research time". All the planning that is done and the decisions that are made in the field are part of a collaboration between the leading coordinator(s) and the different project leaders. However, sometimes decisions have to be made on the spot, e.g. due to bad weather or ice conditions. For the individual researcher this may cause frustration, especially if a change of plans means that you have to cancel part of your project. Please try to be patient. Rest assured that the coordinating team is doing everything it can to be as fair as possible to all the involved projects. The Secretariat's expeditions are never "overbooked", and care is always given during the planning stages to ensure, as much as possible, that each project is given enough time and resources to be successfully carried out.

During the expedition, there are things that can make it "heaven" or "hell". One is your own mental attitude; another is your relationships with other expedition members. All participants will experience their own highs and lows. Also, if things do not go as planned in your project, do not blame yourself too much for the lack of success, but use this experience as a lesson for future expeditions. The Secretariat always tries to provide scientists with the optimal research conditions that the resources will allow for and to be fair about allocating these resources. However, in some cases there may be a choice between having an expedition where all members help out and not having any expedition at all. If there is some task that you really dislike, talk to the leading coordinator to see if there are alternatives, or just view it as an experience that you have to get through (even if you never want to do it again).



Even though it sometimes may feel best not to have any contact with ones left at home, it is usually a good idea to maintain regular contact with them, not least for their sake. Information "from the horse's mouth" is absolutely the best way to reduce worries. Try to be honest: if things are tough, or if things are great, say so. At times it may be difficult or even impossible to have decent communication with the outside world due to technical difficulties. This is something you (and your family) must be prepared for. No matter how much the Secretariat tries to avoid such problems, unwanted things do happen on expeditions. The Secretariat cannot guarantee that you will have functioning communication with the outside world all the time, but everything is done to provide it.

As for your relations with the other participants, nobody expects that you should, or even could, love and be loved by everyone. However, these are the people you have to live with whether you want to or not, and you can be sure that everyone has something interesting to teach you. A second thing to remember is that all human beings are deviant in one way or another. Some people may display peculiarities that you find very annoying, and the other way around – everybody must give the others some leeway. The longer an expedition is, and the less actual space there is for privacy, the more tolerant everyone has to be. Everybody has some need for privacy, and it takes a lot of energy to be constantly surrounded by strangers (at least initially). Try to have an open mind, and if there is something that really bothers you, then tell it straight to the person in question; be honest without becoming aggressive. Most times, it will be enough for you to just get this problem off your chest, and the person on the other end may not have been aware that their behaviour had this effect on you. Do not be afraid of getting to know people: many a new friendship has started on expeditions.

COMING HOME

Coming home after an expedition can be difficult in some ways. Close friendships formed during the expedition may dissolve; you may feel tired and in need of a rest; or you may be full of experiences and stories that you want to tell the whole world immediately. Well, the world did not stop while you were away, and an expedition is a very different, and in some ways artificial, environment. If you live in the same town, you may certainly continue seeing your newfound friends.

Just remember that being back in the normal world means that you again have everyday responsibilities and your old “nearest and dearest” to take care of; they have been forced to do all the work and have enjoyed none of the fun that you have while you were away. As for telling the world about all your wonderful experiences, well, some people will be very interested, and others utterly bored. If you have a craving to talk about the experience, why not contact one of the expedition members? Only those who were there actually know what it was like, as emotional impressions can be very hard to put into words.

NOTES

2

SAFETY AND RISK MANAGEMENT

Dag Haugum

SAFETY

The Secretariat tries to plan and prepare for all reasonable emergencies, but unimagined and improbable things may happen. You must always use your common sense. Having expedition, camp, and project leaders around is no excuse for not using your brain. You must at all times be responsible, not only for yourself, but also for your friends and colleagues in the field. And you must adhere to the expedition's safety regulations (Table 1.1). If something seems wrong or unnecessarily risky, then you must say so. In this way, you make people aware of risks they may have not considered. For example, if you decide to turn back to camp or discontinue your work because of new, potential safety risks, then you are doing the right thing. There are no scientific data in the world that are worth a person getting injured for, or worse.

Accidents are in general rare during expeditions. When they do happen, they are mainly of the "everyday" kind, i.e. the kind that are common back home, while the more spectacular incidents, such as people falling into crevasses or being attacked by a polar bear, are extremely rare. Many of the accidents that do occur happen outside of work, i.e. during time off. Since medical treatment facilities are always limited in polar areas, you are not allowed to treat your time off as you would back home. There are also risks that in practice only occur during your time off. For example, the only real risk of avalanches in Antarctica is if you go skiing; otherwise, the expedition never travels in such terrain. In this context, alcohol should also be mentioned. On every expedition, the Secreta-

EXAMPLES OF SAFETY REGULATIONS (1.1)

Be responsible for yourself and for the other expedition members.

Always follow the instructions given by the leader of the expedition, camp or group.

Never leave the ship, station or camp area on your own. When leaving the ship, station or camp, **inform others** about where you are going and when you expect to be back.

Always bring safety equipment when leaving the camp (radio, compass/gps, gun, food, spare clothes, etc.).

Avoid cooking in sleeping tents (fire and carbon monoxide hazard).

Be aware of the potential (polar) bear and/or crevasse risk, in all activities, in the field or at the station/camp.

You may deviate from regulations or set routines only after receiving permission from the expedition leader to do so.

Keep to the communications routines.

If a critical situation occurs, **contact the expedition leader** and/or camp leader as soon as possible. On marine expeditions, contact the ship's bridge.

riat decides if and how many alcoholic beverages are allowed to be brought on the expedition, and when these may be consumed. On most expeditions, some festivities (with or without alcohol) are arranged to raise the spirits. However, it is totally unacceptable for anyone to get so drunk that they are unable to take care of themselves or to do their job in a professional way. Narcotics are never allowed on expeditions, except for medical use as prescribed by the expedition's medical personnel.

On every expedition that the Secretariat organises, one person is designated as the leading coordinator of the expedition. The responsibility of this person includes coordinating:

- the safety of the expedition (if this is not the responsibility of, e.g., the ship's captain),
- the everyday work of the expedition so that common tasks are done, and
- the expedition's resources, so that all scientific projects are given the opportunity to be carried out in the best possible way, or in accordance with a pre-arranged priority list.

The leading coordinator must see to it that the resources of the Secretariat are used in an efficient manner and that all activities are in line with the Secretariat's interests.

On some expeditions, a senior researcher may function as the leading coordinator, while on others the Secretariat's staff performs this task. If it is most efficient from the scientific point of view to split the expedition into different camps, then the leading coordinator may delegate some of the responsibility to the camp coordinators. However, the overall responsibility is still that of the leading coordinator, and in matters affecting expedition safety or involving the expedition in general, they must be involved in decision-making.

Even if the leading coordinator bears the overall responsibility of the expedition safety, there are other specialists who make specific decisions. For instance, a helicopter pilot always has the last say on whether their craft is going and where: their first priority is the safety of their vessel. The same goes for the doctor in regard to medical matters. Individual members of an expedition should not enter a discussion with, e.g., a helicopter pilot about whether or not they should fly.

In case of emergency, a strict hierarchy of decision-making is necessary in matters concerning safety. For the same reason, in all situations involving more than a single person, one person is responsible for coordinating the party's safety. This should be clear before any work is started, and the identity of this person should be reported to the camp coordinator (leading coordinator). Remember that nothing is more important than the overall safety of the expedition, and you must follow the expedition's safety regulations.

Here, we want to stress that the medical "safety net" will not be the same on an expedition as it is back home. On the Secretariat's marine expeditions, there will be a medical doctor on board, and on our Antarctic expeditions there will be a doctor either in the expedition or at a station nearby. On tundra expeditions, it is highly likely that there will not be any medical staff on the team. Furthermore, even if there is a doctor on hand, more qualified care will be a MedEvac (medical evacuation) away, and bad weather can delay such air evacuations for days. All in all, this means that many medical conditions that could be treated relatively easily if you were in a major city may not be treatable on an expedition, with possibly serious consequences. This is not said with the intention of scaring you away but is something that you and your loved ones at home should be well aware of before you decide to go.

RISK MANAGEMENT

Risk management is aimed primarily at minimising the risk of accidents leading to negative impacts or losses, and secondarily at planning and preparing for effective handling of accidents. Any action you take in the field, or choose not to take, aimed at reducing a risk should be the result of a well-informed decision.

The Secretariat will first do a general risk analysis before any project is accepted even for planning. This analysis covers (1) health, (2) activity-limiting infrastructure, and (3) environment. During the subsequent planning process, specific risks may be identified and an in-depth analysis conducted. However, during expeditions situations will occur that have not been considered, and some of these may be risky. Therefore, risk management is something that must be part of daily work during all expeditions.

Risk management can be seen as consisting of three consecutive parts: risk inventory/identification, risk assessment, and risk minimisation, with the aim of increasing safety, i.e. increasing the control over unwanted situations that may lead to loss. We call such unwanted situations that lead to negative impacts or losses “accidents” (olyckor), while “near misses” (tillbud) are unwanted situations that in other circumstances could have led to accidents.

RISK INVENTORY/IDENTIFICATION

The risk inventory should preferably be done by a group, as the point here is to try to find all potential risks, relevant to a given situation or operation, and put them on the table. This could be done as part of a “Toolbox talk”, i.e. a group discussion focusing on safety issues of a given operation. The talk should be a “walk-through” of the operation, where you highlight every single potential risk, and discuss and decide on how you should act so as to minimise that risk.

Since you may all be a bit stressed when it comes to handling a risky situation in the field, before the expedition begins you should discuss potentially problematic situations for your group: This is a means to prepare yourselves, and to getting used to having these kinds of preparatory discussions when you are in the field.

RISK ASSESSMENT

Once you have identified all potential risks that you can think of, you should consider the level of impact or loss should a given risk turn into an accident. In general, a five-step scale is used, where 1 is the lowest level of impact, and 5 is the highest. The first area to consider is impact to health. Here, the Secretariat employs the scale that is used internationally (Table 2.1).

SCALE OF IMPACT ON HEALTH (2.1)

1. Controllable condition, injury with no lasting invalidity (i.e. you can most likely take care of it yourself, with the help of a first aid kit.)
2. Controllable condition, injury which without attendance can end up in lasting invalidity (i.e. you may have to see a doctor, either while on expedition or when you come home.)
3. Serious, controllable condition, injury that without qualified medical attendance can end up in lasting invalidity (i.e. you must seek a medical doctor)
4. Serious condition, injury that without qualified medical attendance can end up in lasting invalidity (i.e. you need to be evacuated away from the expedition to seek qualified medical attendance = MedEvac.)
5. Lasting invalidity, fatality (the expedition is aborted.)

From this scale, the SPRS has created a scale for what we call ”Activity limiting infrastructure”, by which we mean all things that are necessary for carrying out the expedition, but that do not have a direct impact on people’s health, e.g. vehicles, tents, communications, provisions, and safety equipment (Table 2.2).

SCALE OF IMPACT ON ACTIVITY LIMITING INFRASTRUCTURE (2.2)

1. Limited delays, that do not affect planned activities.
2. Limited delays, that affect planned activities somewhat.
3. Limited parts of planned activities are seriously delayed, or cannot be carried out.
4. Large parts of planned activities cannot be carried out.
5. Expedition cancelled prematurely.

A third area of importance is the risk of environmental impact (Table 2.3).

ENVIRONMENTAL IMPACT SCALE (2.3)

1. Small extent, simple decontamination or restoration.
2. Small extent, intermediate decontamination or restoration.
3. Intermediate extent, intermediate decontamination or restoration.
4. Large extent, large decontamination or restoration.
5. Large extent, cannot be completely decontaminated/restored.

The next step is to assess the probability that a given risk will lead to an accident. Here again, the Secretariat uses an internationally accepted scale of likelihood/probability, where 1 corresponds to the least probable occurrence and 5 to the most probable (Table 2.4).

SCALE OF LIKELIHOOD/PROBABILITY (2.4)

1	Highly improbable, but theoretically possible
2	Extremely rare, although foreseeable
3	Rare, although foreseeable
4	Might occur, but seldom does
5	Might occur

Once you have multiplied the loss/impact value with the probability value, you have the risk value (Table 2.5).

RISK VALUE CALCULATION (2.5)

Likelihood	Risk value				
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5
impact/loss	1	2	3	4	5

The colour coding in Table 2.5 is also according to international standards, where red stands for "unacceptable" risk value(s), green stands for "acceptable", and yellow denotes risk values that necessitate extra caution. At the Secretariat, we interpret the colours as shown in the following:

General risk reducing measurements: Information,education/ training, methods, equipment	Specific decisions and special measure-ments: Education/training, methods/ /rules, equipment, and specia-list staff participating	Not acceptable

RISK MINIMIZATION

Whenever you have a risk (value) that corresponds to red or yellow, you must take risk reducing actions. And you are strongly recommended to do so also for "green values". When you decide on these actions, you can have the following pointers as help:

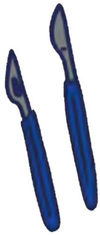
Elimination – don't do it!
Substitution – do it in another way ("Plan B")
Engineering – technical solution to reduce risk
Behaviour – change behaviour to reduce risk
PPE – reduce injury by using personal protection equipment
Action plan – first aid preparations and rescue plan to reduce injury/loss

With risk reductions in mind, you should then make a new risk assessment, to see if in this way you have reduced the risk enough, i.e. reduced probability and/or potential loss enough. The general frame of mind should be that you take all risk-reducing actions that are reasonable, so as to minimise all risks. If, in the end, you are still "in the red", then you are not allowed to enter the situation or start the operation. Furthermore, if you are "in the yellow", you must know that you are taking a calculated, heightened risk, and must have a good action plan in hand if there is an accident – and a very good reason for doing it.

You should **always** have a toolbox talk before any operation that carries risk – even if everyone on the team has done it before! Everyone involved in the operation should know how the operation will be carried out, so as to minimise the risks and the course of action if an incident or accident occurs.

REPORTING OF NEAR MISSES AND ACCIDENTS

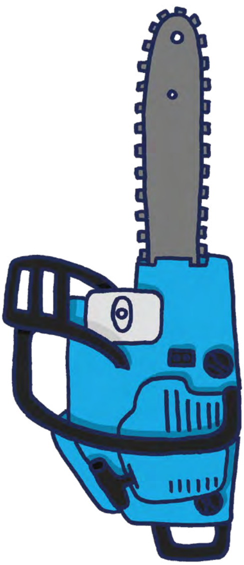
Major accidents will be reported, as people outside of the expedition become involved in helping out, while minor accidents may have slipped from everyone's minds by the end of the expedition, and near misses (tillbud) might not even be talked about within the expedition team. However, it is extremely important that any accident or near miss is documented and reported, so that preventive measures can be taken so that it doesn't happen again – without this knowledge the responsible people cannot act, and others may hurt themselves or damage important equipment due to lack of information! One easy way to make sure that everything of importance is documented and passed on is to have daily, or at least weekly, team discussions of (1) what has been done/achieved,



(2) what has gone well, and why, (3) what has not gone well, and why, and (4) things worth commenting on or that are extra noteworthy (see Appendix 1).

HAZARDOUS GOODS & DANGEROUS EQUIPMENT

If you want to bring any hazardous goods on the expedition, even in small amounts, it is of the utmost importance that you inform the Secretariat well in advance of the expedition's departure. You are also requested to provide a safety data sheet (säkerhetsdatablad). If you are uncertain about anything in this regard, contact the Secretariat. You should be aware that some hazardous goods will not be allowed onto aeroplanes or helicopters, and if an alternative means of transportation has not been arranged beforehand, you may very well have to do without them. It may be necessary for you to bring equipment that could pose increased risk of accidents in different ways than "hazardous goods" do. Chain saws, rock saws and other high-energy cutting tools are obvious candidates in this regard, but the use of a rock hammer for obtaining samples or carrying scalpels in your pack may also increase the risk of injuries. It is therefore an absolute necessity that you inform the expedition leader and the expedition medical staff of these issues, and also of when you are about to use such equipment, so that they are prepared if anything happens. Also, short-circuiting a battery may be extremely dangerous, as they contain a lot of energy – you should always be careful when handling batteries, and the bigger the battery, the more care you must take.



NOTES

3

CLOTHES AND FIELD EQUIPMENT

Jan-Ola Olofsson

CLOTHES

Wind, more often than the cold, is the main source of ill feeling towards the weather in the polar regions (Figure 3.1).

Figure 3.1 Midsummer storm at Wasa station, Antarctica. The station's main building, some 50 metres away, is barely perceptible on the left-hand side of the picture. / Peter Darth

Irrespective of which of the polar areas you will visit, your clothes and equipment should be of good quality and something that you feel you can rely on: once you are in the field, it is not possible to replace "less functional" items. When going to the Arctic tundra, you should plan for the equivalent of an advanced hiking trip with regards to both clothes and equipment. Even though the mean summer temperature is slightly lower than in the Scandinavian mountains, or similar places in North America, and even though you have to reckon with the occasional snowstorm, you should remember that the Secretariat's expeditions to the Arctic are usually done during the summer. If you are going to the Antarctic, you have to be prepared for temperatures as low as –30°c even in the summertime, as well as for strong winds combined with such low temperatures (Figure 3.1).

On most expeditions, the Secretariat will provide you with only a Windstopper or fleece jacket. You must basically supply all of your clothing yourself (Figure 3.2). What you will need is two sets of most things. Exceptions to this may be the outer shell (rain gear) and a sweater. The reason for having at least two sets of most clothing is that you will need to be able to change from wet to dry clothes and also to wash your clothes when they get dirty. Most likely, you will need more than two sets of underwear and socks. Depending on the expedition, and on how cold you get personally, you should consider how much really warm clothing you need. A general recommendation is that when working physically, you can wear quite a thin layer underneath your shell, and that you should add a good insulating layer on top when you take a break. (For a suggested basic list of clothing, see Appendix 2.)

The perfect clothing for the polar regions is yet to be invented. Cotton and other natural materials are very comfortable as long as they stay dry, but they do absorb moisture very easily. Wool is good since it insulates well, even when wet. However, one serious drawback with natural materials is that they dry very slowly. Natural materials are also comparatively heavy. A good thing about natural materials is that they are quite resistant to fire, in stark contrast to many synthetic fibres, which may be quite inflammable. The positive side of synthetic fibres is that they are light, do not absorb water (dry quickly), and are relatively resistant to wear and tear. You have to try out a selection of clothes that suit you personally. If you have to choose one kind over the other, synthetic materials are often preferable, since they are easier to (keep) dry: cold rather than fire is the major hazard in the polar regions. However, the best comfort may be in having more than one set of underwear and changing/airing them regu-

larly. One thing to keep in mind when packing your gear is the weight – are you going to carry the things on your back, and if so, how much is comfortable for you?

Regarding footwear, you may need two pairs of boots as well, both because they may get wet, and because they may break. It is absolutely necessary that your footwear is comfortable and well broken in. One thing that both footwear and rain gear have in common is that if they are perfectly waterproof, then you tend to get wet from the inside, and if they are not, then you get wet from the outside. To some degree, Gore-Tex types of materials may alleviate these problems. Given the alternatives of being wet from the inside or the outside, it is usually easier to handle the former, and your socks should be changed regularly (after about four hours a pair of woollen socks is saturated with humidity if they are worn in waterproof boots). Wet socks and boots may cause serious injury to your feet even at moderately cool temperatures. "Trench foot" is a very serious condition (see Chapter 8).

Another item often brought up is "What brand should I choose?" That is a very tricky question. In general, quality items cost a great deal, and the better the quality the higher the price. Most often, it is not a good idea to buy the cheapest clothes and equipment you can find. However, before you go out and buy the priciest items, ask yourself: "How often and how much will I use this?" The highest-quality products are made for very hard wear for long periods in the worst possible conditions, and they should last over several such seasons. Do you really need this? On most

Figure 3.2
You should dress yourself according to the multi-layer principle, as it makes it easier to adjust the clothing according to the present conditions.

expeditions, items in the mid-price range are quite sufficient.

PERSONAL EQUIPMENT

As with clothes, typically the Secretariat will not provide any personal equipment, like a sleeping bag, or a sleeping pad. On most expeditions a personal daypack is very useful. However, full-size backpacks are only recommended if you are actually going to carry heavy equipment with you in the field. Weight and volume are usually not a problem for equipment transported by ship. Flight operations impose strict upper limits on the amount of personal equipment one may bring. (For a list of some useful personal items to bring, see Appendix 2.) The Secretariat may lend you aluminium packing boxes, which are quite light and very handy. However, what can be lent to you depends both on your actual needs and on what other activities the Secretariat has scheduled. Other projects may be given priority. It should be noted that any equipment provided by the Secretariat is to be returned immediately after the end of the expedition – it is not economically possible for the Secretariat to give you any of it. Remember also that you are personally responsible for this equipment.

FIELD EQUIPMENT

The Secretariat will provide the necessary, basic camp and safety equipment (see further in the following chapters). The Secretariat may only purchase any special field equipment when it is felt that this is critical to your project and cannot be supplied by the project itself. Note that it must be considered the exception, not the rule, that the Secretariat purchases any special field equipment for a project.

SCIENTIFIC EQUIPMENT

Equipment specific to the research project, or its equivalent, is not an issue on the field course. However, it should be noted that the Secretariat must be informed well ahead of the expedition's departure of any equipment that the project wants to bring: The Secretariat will request such information, and all you have to do is to follow the instructions. There are several reasons why the Secretariat may need this information well before the expedition starts – transportation and/or customs procedures may take a long time; there may be weight and/or volume limitations to what the expedition can bring; if the equipment needs to be supplied with media, e.g. electricity or gases, this needs to be organised and possibly tested beforehand, etc.

Packing boxes for scientific equipment may be lent to you (given the prioritising of projects that may have to be done). However, you must provide your own packing material.

NOTES

4

LIVING ON BOARD THE ICE-BREAKER ODEN

Lars Lehnert

INTRODUCTION

Oden is operated by the Swedish Maritime Administration ("Sjöfartsverket"). The vessel is designed for escort, icebreaking and for Arctic research operations with non-limited trade areas. The icebreaker is also a research platform with a very flexible layout and can carry container labs, frozen storage containers, and scientific equipment for geological sampling, oceanography, meteorology and other disciplines.

Götaverken Arendal delivered Oden in January 1989 (Figure 4.1). Oden has carried a large number of expeditions to the Arctic and Antarctica and has reached the North Pole several times. In the year of 2000 extensive work was carried out in order to further adapt Oden to scientific expeditions. Among other things a new laboratory and a seawater intake was built. In 2007 a multi-beam echo sounder was installed for sea bottom processes and seafloor morphology studies.

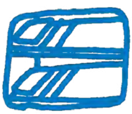
MAIN PARTICULARS

- Length: **LOA 107,7 m**
- Beam amidships: **25 m**
- Beam main reamer: **29,4 m**
- Beam turning reamer: **31,2 m**
- Draught: **7-8,5 m**
- Displacement max: **13 000 ton**
- Gross: **9438 GRT**
- Engine power: **18 MW**
- Expedition crew: **of about 23 people**
- Max speed: **16 knots**
- Max cruising range: **27 000 NM/ 13,5 knots**
- Crew: **< 22**
- Icebreaking capability: **2 (1) meters at 3 (9) knots**
- Endurance: **> 100 days**
- Steel thickness: **max 60 mm**
- Arctic ice-class: **DNV POLAR 20 ice-breaker**
- **Computerized engine control (ABB)**

Figure 4.1 The ice-breaker Oden. / John Jonsson

LIVING ON BOARD

During an expedition, there are many people on board and from time to time there will be limited personal privacy, as people live, eat, and work on board. The experiences of previous expeditions show that things run smoothly most of the time. However, we are all responsible for making life on board as nice as possible. Everybody is encouraged to show consideration of others, and the principal investigators (PI's) are to play an active role in making the scientists not only work, but also live together with the rest of the crew.



CABINS

During an expedition everyone aboard will share the cabin with one, two, or three other people. This puts emphasis on the individual ability to adapt to the situation and to respect others. You are responsible for keeping your cabin clean and tidy. For safety and hygiene reasons, it is of the utmost importance that the cabins are properly cleaned once a week. There are cleaning lockers on all decks. Sheets and towels are changed in the laundry. There is a schedule for change of linen. The crew of the ship will inspect the cabins before you can disembark.

CLOTHING

In order to make life on board as pleasant as possible for everybody, we need to follow some rules, based on common sense:

- Outdoor clothing is to be used outdoors only.
- Inside the ship use indoor shoes, slippers for instance.
- Caps and hats are not allowed in the mess room.
- Boiler suits or other protective clothing are not allowed in the mess room.

For Saturday and Sunday dinner we normally dress up a little in order to get a break in the ordinary weekday routine.

LAUNDRY

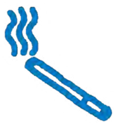
Expedition participants and crew use the dedicated laundry. Due to limited availability of fresh water during expeditions, it is very important to only run full washing machines. If you do not have enough laundry to fill up a machine on your own, please coordinate washing with another participant.

MEALS

A very important part of life on board is the meals. All meals are served in the mess room, which is situated on the port side on the main deck. As the space in the mess room is somewhat limited, please avoid loitering after finishing your meal.

LIBRARY

Oden has a library with various books, parlour games, and DVDs. The library is situated on the main deck with the mess room on the port side. Do not stay too long in the library, as this is the place where crewmembers access their private e-mail.



SMOKING

Outdoor smoking is allowed on the port and starboard sides from the entrances to “Odenplan” and aft until the superstructure ends. Note that there will be outdoor smoking restrictions during air sampling. Indoor smoking is allowed only in the designated smoking room. It is absolutely forbidden to smoke in cabins or in containers due to the risk of fire.

ALCOHOL AND DRUGS

Participants on expeditions are not allowed to bring any alcohol on board. Alcoholic beverages may be served at dinners and sold in the bar, as per the Captain's instructions. Possession, use, distribution, and reselling of narcotic drugs are strictly forbidden and will be reported to the police.

GARBAGE HANDLING

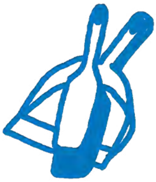
In order to preserve the environment, the rules stated in the MARPOL 73/78, regarding special areas, are followed, even though the Arctic is not specified as a "special area". All garbage produced on the ship is collected in the garbage container. There are garbage containers on all decks intended for paper, glass, plastic, and metal waste. There are also containers for aluminium cans in the saunas and in "Odenplan". Containers for other garbage are situated on the main deck.

HAZARDOUS MATERIALS

Do not discharge any dangerous substances and liquids from laboratories into the ship's sewage system. Such materials must be collected in suitable (safe) containers until they can be disposed of properly. Hazardous materials must be handled according to the Laboratory Safety Plan.

MEDICAL ISSUES

There is no regular time for visiting the ship's doctor. Appointments are made as needed. The ship's supply of medicines is based on needs in emergency situations. You cannot expect to get your personal medication on board, if forgotten at home.



SPECIAL DUTIES

On certain occasions, the galley personnel will need help with various housekeeping tasks. For the sake of keeping the interior tidy, participants in expeditions may have to assist in the daily cleaning routine. If so, the Chief Officer will give instructions.

LIMITED ACCESS AREAS

Deck area

The aftermost part of the deck (specially designed for towing merchant ships) lacks railing and must only be entered with the permission of the officers on watch. When working in the most aft part of the deck, it is mandatory to use a life jacket and a lifeline. During towing operations, it is forbidden to be on the aft deck.

Bridge

Everyone on board is welcome to visit the bridge. The starboard and port bridge wings are used for the navigation of Oden. Therefore, ask the master or the navigating officer whether it is okay to visit these areas.

Engine room

In order to assure the safety of the ship, as well as of the people on board, the engine room areas may only be entered with the duty engineer's permission.

Helicopter deck

Only authorised helicopter personnel have clearance to stay on the helicopter deck when a helicopter is about to take off or land. Everyone else engaged in the operation must wait in the starboard staircase until instructed to enter the helicopter deck.

SLIPS, TRIPS AND FALLS

What is said below may seem too obvious, but if you are not well-accustomed to working on board ships, it is all too easy to slip, trip, or fall (and you will most likely do so during your first visit on board). Slips may occur due to slippery surfaces (polished, wet, or greasy), ice on deck, or inappropriate footwear. Tripping occurs when a foot "catches" unexpectedly on an object, e.g. small and unobtrusive objects such as changes in floor levels, pipes, and electrical leads. Falls can result from slips or trips, but many occur from low heights such as steps or stairs. Many slips, trips, and falls can be easily prevented with awareness and preparedness, for example, by always using the handrails of stairs, by being aware of the possibility of ice on deck, and by making sure which equipment will/should be used during different work phases.

WORKING ON BOARD

PLAN OF THE DAY

The plan of the day (POD) is produced daily after the morning meeting and lists special events and any changes in the daily routines. The POD is displayed on the Oden information system.

EQUIPMENT

Prior to installing scientific equipment to the ship's system (electrical, antennas, water, pneumatic system, etc.), beyond what was done during pre-expedition mobilisation, you must obtain permission from the chief engineer/electrical engineer. Before starting up equipment that needs a great deal of electrical power, it is necessary to check whether enough power is available at the time. Oden has a standard ship electric grid (i.e. AC 220 volts 50 Hz, ground and zero is separated).

SCIENTIFIC WORK IN LABORATORIES

All scientific work in the laboratories, and safety regulations for such, is to be organised and taken care of by the scientists themselves and ultimately by the project's principal investigator.

DECK WORK SAFETY

Procedures for safety during work on deck must be organised by the chief officer and the project principal investigator. The PI, or their deputy, is always responsible when there is work with dangerous equipment (Table 4.1). Routines for different risk-minimising actions must be made before any work commences. There should also be training for all involved, before the actual work. Only the crew operates the ship's cranes.

SAFETY RULES FOR EVERYONE ON BOARD (4.1)

All personnel **working with lifting devices shall carry a hard-hat and wear steel-capped boots/shoes**.

All personnel **working on the aftermost part of the deck** (the deck specially designed for towing ships) **shall have a connected lifeline and wear a life jacket/approved flotation suit.**

Before any work takes place on the aftermost part of the deck, **the bridge has to be informed.**

All work on board should **follow the security rules and recommendations from the Swedish Work Environment Authority**. In short this means: Each research project group is responsible for having full knowledge and control, 24 h, of each and every group member's whereabouts. This means that all of the group should know where their colleagues work and that they are not left by themselves, i.e. they should not end up in a situation where they are unable to get attention in case of accident or incident. Due to bad weather situations, there can be restrictions on work in laboratories.

LASHING/SECURING FOR SEAS & SWELLS

Oden will roll and pitch in rough weather, and the ice will cause vibrations during icebreaking. Keeping your personal and scientific gear secured for sea cannot be emphasised enough. Improperly secured gear can cause damage to the ship or injure people. The ship does not take any responsibility for improperly stowed/secured gear. If you have any questions regarding proper stowing/securing procedures, please contact one of the deck officers. From experience, transit legs have been found to be especially risky.

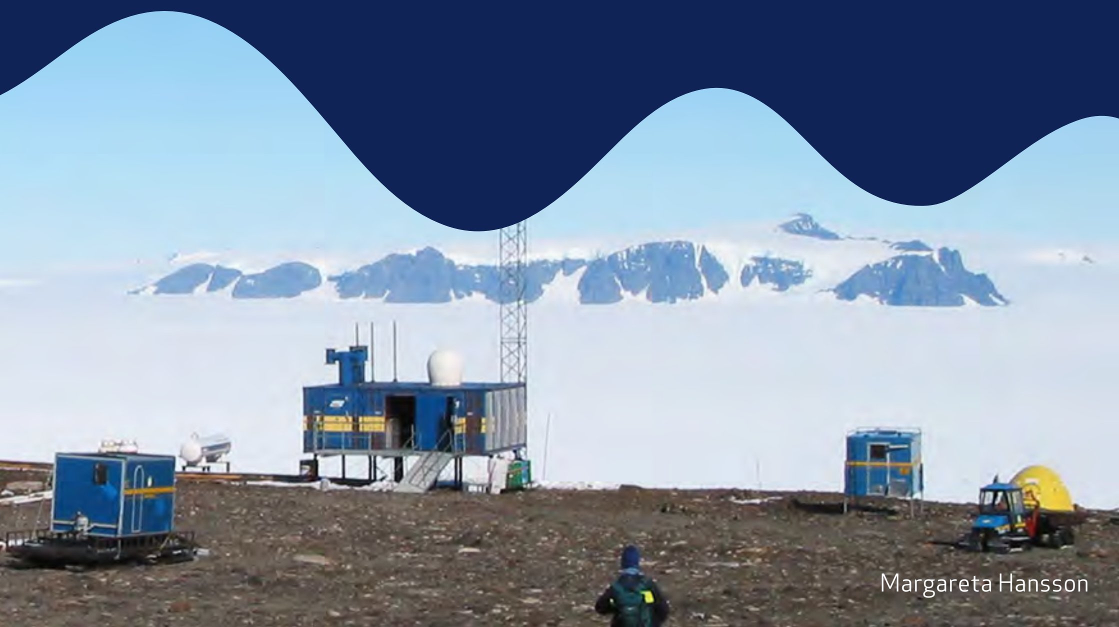
WORK ON THE SEA ICE

All scientific work that involves people on the ice should be organised and planned well beforehand. All work on sea ice must follow established guidelines. Before disembarking onto the ice, permission should be received from the bridge. It is the bridge and the officer on watch that decide whether it is safe or not, considering the weather and ice situation. It is also the officer on watch who decides whether there is a need for armed guards for protection against polar bear.

NOTES

5

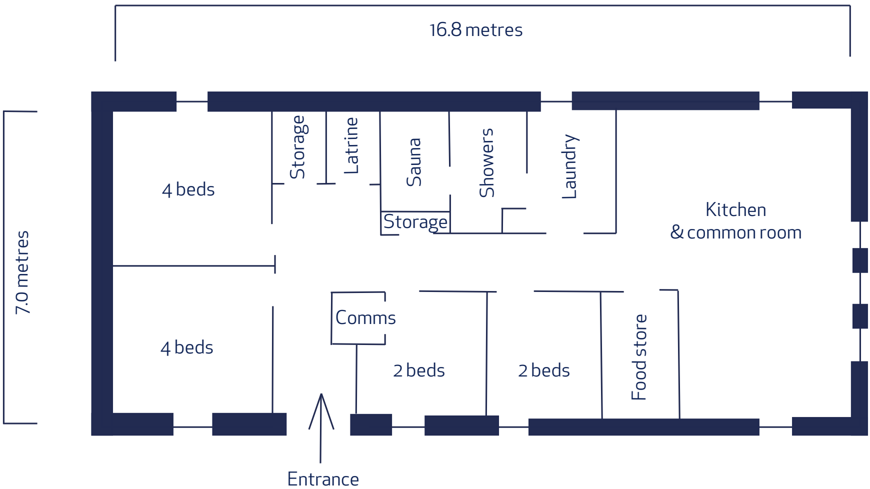
THE RESEARCH STATIONS IN ANTARCTICA: WASA AND SVEA



Margareta Hansson

WASA

Wasa is the main Swedish station in Antarctica. It was built in Antarctica in the summer of 1988/89, and is situated partway up the nunatakk Nordenskjöldbasen, or "Basen".



The Radio House at Wasa. The plan is not drawn to scale.

The Finnish station Aboa lies some 200 metres from Wasa. The stations lie in an area that is free of snow in the summertime. The main buildings at Wasa are the Radio House, the generator house, and the workshop. These buildings encompass an area of bare ground that is considered the station yard (Figure 5.1). Most of the work at the station is done here.

THE RADIO HOUSE

The Radio House is a 120 m. wooden house standing on a steel framework some two metres high.

Figure 5.1 The interior of the Wasa station. / Dag Haugum

The house is placed on relatively even ground on the southwestern part of Basen. The steel framework and the house's position reduce the accumulation of drifting snow to a minimum. The house contains four bedrooms, showers, sauna, toilet, a combined kitchen and living room, and some smaller storage rooms (Figure 5.3). The house has many facilities such as a washing machine, dishwasher, gas cooker, kitchen fan, and two refrigerators with separate freezer compartments. The bedrooms are equipped with writing desks and double partly as work areas. The dining place seats 12-16 people, and the same number of people comfortably fits in the lounge area. In connection with the kitchen, there is a spacious indoor pantry.

Energy system

The main electricity source for the Radio House is solar panels, which charge a battery bank underneath the building. In the house there are outlets for 12V DC, 24V DC, and 220V AC. The availability of 220V, however, is generally quite limited, which is why all electric appliances brought for use inside the Radio House should be adapted to 12V or 24V. Radiators, water heaters, cooker, refrigerators, and the sauna run on propane. The propane is fed from large gas bottles placed nearby the generator house. The water heaters provide hot water to the taps, the washing machine, and the dishwasher. The house is equipped with very efficient heat exchange and air humidity recycling systems.

Water system

There is running water only in the Radio House. A water tank with a 1,200-litre capacity is in one of the house's storerooms. Water is generally collected in the blue ice area below Basen. In the generator house, there is a snow and ice melting system that can be connected to the Radio House's water supply system. Nowadays the melting system only functions as a backup.

Sewage

"Grey water" sewage, i.e. waste washing water, is led through a pipe down to the ice field below the Radio House. The toilet is a dry closet in the Radio House, which uses an emptied fuel drum as the recipient. For waste management, see Chapter 15.

THE GENERATOR HOUSE

This building consists of four steel containers welded together and placed on a two-metre-high steel framework. Outside the doors there is a walkway made of steel grating. In the left-hand container are the generators and workshop. The second container functions as storage, mainly for food that should not be frozen. The third is storage space, and the fourth one is the "safety container" holding field equipment. On the far side of the generator house, as seen from the Radio House, is Wasa's waste disposal station.

FUEL DEPOT

Slightly below the workshop building is the station's fuel depot. It consists of "flat racks", i.e. container bottoms with wooden floors, standing on steel props. Fuel drums are secured on the flat racks with cargo straps. Propane bottles are usually stored separately on a tracked vehicle sledge close to the flat racks. Empty drums are placed near the flat racks and secured "in a bunch" with cargo straps, so that they are not swept away by the wind.

LABORATORY MODULE

A small glass fibre module normally stands on supportive props close to the Generator House (on the far side, as seen from the Radio House). It is mainly used as a workplace for scientists. It contains a long work bench/writing desk and a two-storey bed. The module can be carried on the rear part of a tracked vehicle.

HELICOPTER LANDING PADS

Two “heli pads” are situated between the Generator House/laboratory module and the workshop building/fuel depot. They each consist of an area of about 2.5 x 5 metres, which has been cleared of rocks and stones. Both pads have anchoring points for helicopters (one has four, the other five points). The anchor points are painted bright orange to make landing easier.

OTHER PLACEMENTS

One or two living modules with spare beds can be parked with their sledges on the even snow field in the direction of Aboa. Containers brought by tracked vehicles are usually parked on the snow field opposite the workshop building.

PROTECTED AREAS

On Basen, there are two types of areas sensitive to disturbance, both located on “Fågelberget”. One is a permanently protected area with a rich growth of lichens and mosses. You must have the leading coordinator’s permission to visit this area. The other area type is where birds, mainly snow petrels, nest. Since the birds do not nest on exactly the same spots every year, you must be extra careful at the beginning of the expedition before the nesting areas are located. For each expedition, the leading coordinator will inform you in which areas vehicles can be driven and in which all visits are prohibited due to nesting birds.

Walking areas

The areas on Basen that are not protected may be visited on foot.

N.B.: Although these areas may be visited, they are sensitive to wear, and general caution should also be shown here. Outside of the station area, you are not allowed to walk on lichens and mosses; the only exceptions are the marked squares on the slope above Wasa, which act as monitoring areas for extra wear due to human presence. Remember that there are some very steep and high precipices on Basen (>300 metres)!

DRIVING OF VEHICLES

When driving in the area around Wasa and Basen, there are some local rules that you must follow:

- In general, **all driving on snow- and ice-free ground is forbidden.** Driving on bare ground within the station area is only allowed for logistical purposes essential to the running of the station. If you are uncertain, ask the logistics manager.
- The **route straight up to Wasa often gets worn down as the season passes**. However, the route cannot be varied much since it is used for heavy transport. It is important that the route is kept in good condition by careful driving. You may only use the Swedish, direct route, or the Finnish route when driving to and from Wasa.
- The only **route between Wasa and the "water hole" is marked carefully with stakes**, with 50 metres between them, so that

it can also be used in poor visibility conditions.

- **Refuelling of vehicles is in general only permitted in snow covered areas.**

HELICOPTER AND AEROPLANES

The flight route to Wasa follows the regular overland route up the hill to the station. Flights over the station surroundings are otherwise limited to research flights and the placing of the vhf repeater station on "Plogen". Flights close to (steep) cliffsides are not allowed anywhere, due to nesting birds. Landing pads on snow-free ground are situated at Wasa and close to Svea.

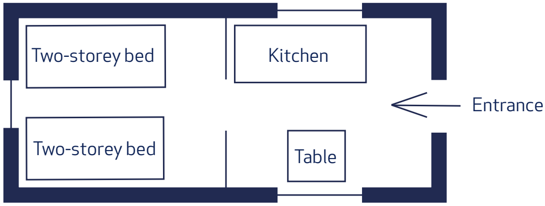
Only aeroplanes equipped with skis can land at Basen. The landing site is on the flat land, below and to the west of Wasa. After the first landing, the landing site should be inspected and, if needed, graded – bumpy landing due to sastrugis may damage the landing gear.

DRINKING WATER

When starting up the station, the easiest way to get water is to melt snow or ice on the stove. As quickly as possible, the logistics personnel will open a "waterhole" in the blue ice area. Before you go down to fetch water, be sure that you know exactly how to do it.

SVEA

THE STATION



The Svea station. The plan is not drawn to scale.

Svea lies on a nunatakk in Scharffenbergbotnen, in the Heimefrontfjella, around 200 km from Wasa (Figure 5.2). The station was built during the Antarctic summer of 1987–88 and consists of two connected glass fibre modules, each of which are 2.5 x 3 metres. The outer module contains a kitchen and dining area, and the inner module two two-storey beds and a writing desk (Figure 5.5). In between expeditions, the outer room can be used to store a snowmobile, a generator, etc. Heating of the station is done through a gas heater (propane). The electrical power mainly comes from solar panels, which charge car batteries.

Figure 5.2 Svea station, in Scharffenbergbotten and its interior. / Anders Karlqvist

There is also a generator that runs on petrol that can provide 220 V. The toilet is placed in a Scott polar tent just below the station. The main water source is in the blue ice area nearby. For waste management, see Chapter 15.

PROTECTED AREAS

Svea lies in an area that is sensitive to disturbance. The nunatakks are among the southernmost in Antarctica, and hundreds of snow petrels and possibly also south polar skuas nest here. In many places you will find a great abundance of lichens and mosses. It is very important that such areas are not disturbed. You must have the leading coordinator's permission to visit protected areas.

Walking areas

Those areas that are not protected areas may be visited on foot.

N.B.: Although these areas may be visited, they are sensitive to wear, and general caution should also be shown here. Outside of the station area you are not allowed to walk on lichens and mosses. Remember that there are some very steep and high precipices in the area (>300 metres)!

DRIVING OF VEHICLES

The route to Svea from Sveakorset should be reconnoitred at the beginning of the season, since it runs close to crevassed areas. Tracked vehicles should be parked below Svea on the even snow field. There are smaller crevasses in the slope up to Svea. Tracked vehicles should be driven no further into Scharffenbergbotnen than the Svea station. When travelling by snowmobile to the nunatakks close by, you must be very careful not to fall into the wind channels by the mountainsides. They are very steep and deep and may have overhanging snow drifts! In protected areas, all driving is absolutely forbidden.

NOTES

6

FIELD CAMPS

Nicolaj Larsen

Each field camp has one camp coordinator. They are responsible for coordinating the common duties and safety routines in the camp; every member must follow the instructions given by the coordinator in these respects. If the camp is going to be used for more than a couple of days, it is well worth taking some time to plan the camp properly. To facilitate radio or satellite communication, the camp should preferably be located "high, free and wet", i.e. up on a hill, with no major objects blocking transmissions and with mesic to wet surroundings. A camp location somewhat higher than the surrounding area will also make it easier to find the way back to the camp and, on the tundra, to spot any bears that might approach. The plan of the camp should include a sleeping area, cooking area, place for garbage, etc. (see "Field hygiene" below and Chapter 6). If there is time, discuss the plan within the group before deciding on it. This may save time and aggravation if it prevents tents and equipment from having to be moved later.

CAMP EQUIPMENT

The Secretariat may provide basic camp equipment and provisions. On tundra expeditions, two people may share a sleeping tent. In most cases, a common, larger kitchen tent is also brought. The camp is also equipped with communication equipment and power supply, as well as other relevant safety equipment. Other common equipment that may be provided are a folding shovel, bucket, water jerry cans, field toilet, etc. On Antarctic expeditions, field camps are either tent-based or made up of living modules of various sizes that are towed.

TENTS

Sleeping tents

The Secretariat's sleeping tents are of very high quality; usually, they have a geodetic dome shape, which makes them very stable even in extreme winds (Figure 6.1). The poles are mounted from the outside, and the inner and outer tents are erected simultaneously.

Figure 6.1 Example of a geodetic tent. / The Secretariat

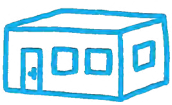
Kitchen tent

The kitchen tent that is often used on the tundra was specially made for the Secretariat by Hilleberg. Basically, it is a Saivo tent increased by a factor of 1.75 (Figure 6.1). It has no inner tent and no abside, and it opens at both ends. In Antarctica, the kitchen/common tent could be a Weatherhaven, or a similar proven brand.

Tents vs. wind

All the Secretariat's tents have storm mats added to them for increased wind resistance. Preferably you should not weigh them down by putting rocks on them; this will destroy the mats unless you are very careful! The mats only need to be used when there is a risk of strong winds; otherwise they can be tucked in under the tent. If the storm mats are used, they should be stretched and covered with soil, sand, or snow: the purpose of the mats is to prevent the wind from getting in under the tent, not to hold the tent down. What holds the tent down are the guy lines. In the rare circumstance of having to camp on rocks only, you are allowed to place rocks on the storm mats. However, in such a case you must first stretch the storm mat, and then place rocks with soft edges all over the mat, so that they completely cover it. This way you achieve approximately the same effect as having covered the mat with, e.g., soil.

It must be stressed that in windy conditions the pegs holding the tent's guy lines should be placed as far away from the tent as the ground conditions allow. The reason for this is that the more perpendicular the line is to the tent wall, the better the wind resistance.



LIVING MODULES

The living modules can be seen as reasonably comfortable "camping caravans". The the smaller, two-person model is towed by snowmobiles, and are called arks ("arkar"). When transporting equipment to Antarctica, a snowmobile fits into each ark. (Figures 6.2 and 6.3) The larger, 20-foot container-sized model is towed by a tracked vehicle (Figure 6.24). The larger modules sleep two to six people in regular cots, depending on the configuration. All modules are insulated and heated by heaters. They are also equipped with cooking facilities and snow melting equipment.

Figure 6.2 Example of a living modules. / Anders Modig

COOKERS

For field camps, the Secretariat usually provide kerosene or propane cookers. In the Arctic, the most common cooker fuel is kerosene, while propane is the standard in Antarctica. The fuel used depends on what can be provided in a given country and what can be transported into the field. Most helicopter companies refuse to transport propane, kerosene, or petrol on the same flights as passengers. However, since helicopters run on kerosene (Jet A-1), it is almost always possible to get it flown out into the field.

All fuels are by definition fire hazards! There are some instances in which you must be extra careful: when filling fuel containers, when transporting fuel, when refuelling cookers, and when using cookers in tents (see also Chapter 10). Also, all fuels are more or less poisonous, and liquid ones can give food a very unpleasant taste – do not transport fuel and food together, and keep their handling separate as well. The risk of propane gas poisoning is very low, because of its distinct and strong smell. However, there is always a very real risk of carbon monoxide poisoning when burning any fuel indoors or in a tent. Carbon monoxide and dioxide have no smell, and the symptoms of poisoning may vary considerably. Since carbon monoxide is a deadly gas, you must always have good ventilation when using cookers or heaters inside, even when the weather is bad!

FOOD AND DRINK

Except for on ship-borne expeditions, the expedition members will do their own cooking. In such cases, as much fresh food as possible is brought. However, meat, fish, etc. will be canned goods, as will most of the vegetables on longer expeditions. The reason is simply that there will not be adequate storage facilities in the field. The Secretariat tries to avoid freeze-dried foods as the staple diet. How you decide to handle the cooking in your group is for the camp coordinator to decide. Before the expedition, the Secretariat will discuss food and other provisions with the coordinator(s). It is impossible to create personalised diets for expedition members. Usually a large enough variation of foods is brought to allow for some personal preferences within the group. If you are a vegetarian, or if you have any food allergies, etc., you must let the Secretariat know well in advance. Even so, it may not be possible to provide a full supply of foods for you; it depends on the country in which the food is purchased. In the worst case, it may come to pass that the Secretariat cannot let you participate in the expedition.

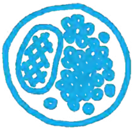
FIELD HYGIENE

Good hygiene in the field is extremely important, both for morale and for medical purposes. It prevents infectious diseases and food poisoning, and common high hygiene standards and an orderly camp increases the comfort of the camp. In addition, it gives an important sense of well-being to be clean and well, and to wear fresh, clean clothes. If you stay for more than a couple of days at a campsite, you should make a plan for the common hygiene arrangements (which everyone must follow); this is the camp coordinator's responsibility. The plan should cover food handling and eating, where to wash dishes, the handling of garbage, a place for personal hygiene, drinking water, and the latrine and where to urinate.

PERSONAL HYGIENE

Personal hygiene should be taken care of both on a basic daily level, and on a more extensive level every week or so. Since bacteria thrive where it is warm and moist, you should wash your armpits, groin, and feet every day. In cold conditions or bad weather, you can go a long way with a washcloth and a small pot of warm water. You should also brush your teeth and comb your hair daily. It is definitely a good idea to make a distinction between work/field clothes and camp clothes, and also to bring a second pair of boots, or if the circumstances allow, a pair of sandals or other light shoes to change into after work. This lets your work clothes dry between uses and allows your feet to "breathe" a bit. Continuous wearing of boots and protracted use of the same clothes may result in bad skin inflammations or infections. Every week you should try to wash your whole body (in bad weather, a washcloth will once again help a great deal). If possible, dress up in fresh, newly washed clothes after "bathing", as this provides enormous comfort.

Try to keep your clothes and boots clean, dry, and intact. Dirt makes textiles more fragile and gives them less insulation capacity. If you cannot or do not want to wash your clothes, then do not work up a sweat. Adjust your clothing to the temperature and remember that wet clothes and boots can result in cold injuries even at temperatures above freezing. In the field, a large plastic bag functions perfectly well as a "washing machine". Just put the clothes in the bag, add warm water and some detergent, tie the bag up, and knead it. In field camps, the drying of clothes and boots can be a problem. In general, synthetic materials dry much more quickly than natural fibres. Make it a habit to take out the insoles of your boots every evening and to hang your clothes as airily as possible. If you are supplied with a kitchen tent, hang your clothes/laundry there while you are out in the field. (Laundry hanging on lines outside, waving in the wind, may attract curious polar bears.) Repair small holes and tears as soon as you detect them.



FOOD

The most important item here is to avoid getting food poisoning. Food poisoning is the result of unwanted bacteria coming into contact with the food you are going to eat. Most of the potentially dangerous bacteria come neither from the food itself nor from Mother Nature, but from the people handling the food: we all carry literally millions of potentially dangerous bacteria on us. However, food poisoning is actually quite easy to avoid:

- Never cook for others if you have any cut in your hand or if you have an (suspected) infection, e.g. a cold or stomach problems.
- Wash your hands before cooking and also during cooking if you handle anything that may be "unclean".
- Wash all dishes and utensils (with dish washing liquid) after each meal.
- Always store sensitive (fresh) food at refrigerator temperature (+4–8°C).
- Separate the handling of fresh meats and other foods.
- Separate the handling of cooked and uncooked foods.
- Never save leftover food that has been cooked.
- Keep food in containers that protect it from birds and animals.

FIELD HYGIENE – TUNDRA

For the common hygiene arrangements, it is important that all “smelly” places (garbage, latrine, urine) should be placed well away from the camp, and on the general downwind side, if there is a risk of (polar) bear visits (Figure 6.3, see also Chapter 13).

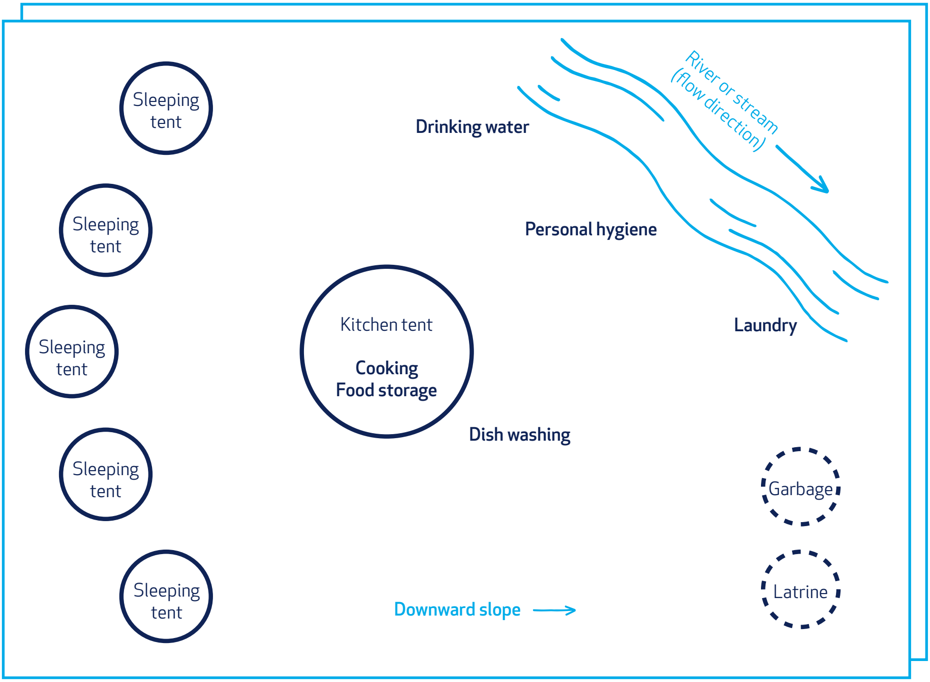


Figure 6.3 General principles of hygiene arrangements in a field camp.

Dish washing

Dishwashing should be done after each meal, and in a comfortable place close to the cooking area, so that no one feels inclined to put it off “just until tomorrow”, e.g. because of bad weather. When you bring water for cooking, bring enough for dishwashing, too. End each cooking session by heating dishwashing water: the washing must be done in hot/warm water! The place where you do the washing should be such that it is easy to pour away the wastewater without it seeping into any tent or otherwise contaminating any equipment or provisions. Digging a shallow pit for this can help. Remember also to wash your pocketknife if you have used it with food; it is as much a kitchen utensil as any of the regular ones.

Garbage

Garbage should have its own special place in the camp area, and all garbage should be placed in some kind of container so that birds and animals cannot get to it. You should make it a habit after each meal to take all garbage from the cooking area to the garbage dump. All items that are brought in and which end up as garbage must be brought out when you leave. Odorous garbage should be kept in plastic bags. If you have supply flights or similar during the field season, try to have the garbage you have accumulated transported away.

Drinking water

Drinking water should be boiled for at least three minutes, if you are not certain that the source is okay. In the Arctic, water should be taken from rivers or larger lakes, if possible. Examples of potential causes of unhealthy water in the Arctic are birds in lakes, dead animals upstream in rivers, Giardia parasites (in North America and Russia), and human pollution. Drink at least two–three litres of (clean) water per day, more if you have done physical work – this is especially important in cold environments with dry air.

Latrine

The latrine should definitely have a dedicated place in the camp area. If possible, have separate places for urine and for faeces: urine is, in its normal state, a perfectly sterile fluid with high nitrogen content, while faeces consist almost only of bacteria that need nitrogen to grow. If you avoid mixing the two, you drastically reduce the smell. Human waste is sometimes brought back from the field, at other times it is buried after each visit to the "toilet": it depends on local regulations, what resources are at hand, and what is the most practical solution.

The latrine should be located below the camp so that rain, etc. does not make the latrine flood into the camp. Also, the latrine should be situated in such a way that seepage does not pollute the place where drinking water is collected (see Figure 6.3). If there is a risk of (polar) bear visits, the latrine area must be visible from a distance, and provide an open view of any approaching bears. You should cover the latrine after each visit. The latrine must have some facility for washing of the hands after a visit, and overall it is important that the latrine is kept very hygienic. Anyone with stomach problems should have a separate latrine, to reduce the risk of stomach infections spreading.
If you plan to stay longer at the same site, decide at the beginning on potential locations for several latrines, and use them one by one. As stated above, you should try to avoid mixing faeces and urine. If you dig a latrine hole, you should also dig a urine hole. A new hole should be dug every 20

"person-days", i.e. if there are ten of you then you should use a new hole every second day, mainly because of the smell. Take these peeing holes into consideration also when planning the different latrine holes. If you have portable latrines with you, then you should always bring the used plastic bags back to civilisation for proper disposal. You are not allowed to leave them in the field!

FIELD HYGIENE – ANTARCTICA

The basic hygiene principles presented above apply to all field activities. Below, only the particulars of Antarctic field camps are discussed. All activities in Antarctica are regulated by the Protocol on Environmental Protection to the Antarctic Treaty. In Chapter 15, a fuller discussion on the ruling principles is presented.

Drinking water

Drinking water is produced either by collecting snow (scrape off the uppermost layer, as it may be contaminated) and melting it, or by drawing water from internal melting layers in blue ice.

Latrine

The latrine usually consists of a seat placed on top of either a drum with a plastic bag liner or an empty fuel drum without a lid. The drum is (usually) placed inside, e.g., a Scott polar tent. All human waste is brought back from Antarctica, after it has been freeze-dried for a year or more.

Handling and disposal routines for field camps

Domestic wastewater and urine can be discharged to an ice pit or crack in situations where the transportation facilities are very limited and the field camps in areas covered with snow and ice are of a temporary character, i.e. with less than 30 man-days in any one location. Sewage from large field camps (more than 30 man-days in one location) is to be transported back to a station or the expedition vessel for proper disposal. Any person working in an ice-free area away from their main camp must carry appropriate containers to collect any human waste generated during the trip.

Domestic wastewater can be disposed of in ice pits. Wastewater from field camps in ice-free areas should be collected in appropriate containers (clean, not having been used for the storage of fuel or other inappropriate materials) and, when convenient, disposed of in ice pits. Such pits shall be located on ice sheets that move out to ice-flow lines, which do not terminate in ice-free areas or in areas of high ablation (i.e. blue ice areas). Under no circumstances will sewage or domestic liquid waste be disposed of in vegetated areas or in areas with discharge to fresh water.

See Chapter 15 for handling of other waste.

RESPONSIBILITY

The leader of each scientific project bears full responsibility for compliance with the laws and handling and disposal routines that apply in the field. This includes following up routine measures such as minimisation, separation, labelling, and record-keeping. Each person who produces waste of any kind must ensure the waste they generate is handled and disposed of according to the procedures laid out by the Swedish Polar Research Secretariat. Every person is also responsible for ensuring that the potential waste volume stemming from their activities is already minimised before departing into the field.

NOTES

7

COMMUNICATIONS

Dag Haugum

Working communications are the main means of ensuring safety on all expeditions. No expedition is completely self-contained. In emergencies it is necessary to bring in resources from the outside, and the only way in which this can be ensured is to always have working communications. In addition, from a psychological point of view, contact with the outside world is extremely important for one's well-being.

MEANS OF COMMUNICATION

There are two basic ways to communicate over a distance during expeditions, either directly through radios or indirectly via communication satellites. Both methods have their pros and cons. HF radio ("shortwave" radio) and satellite communication is used for long-distance communication, i.e. for contacts outside of the expedition or between widely separated field camps. The VHF radios we use are mainly handheld sets used for short-distance communication, such as contacts within a field group, or even within an expedition. On some expeditions the members have one each, while on others there may be one VHF radio for every two to three people. HF radios are placed in field camps, at stations, and on ships, but nowadays they have mostly been replaced by satellite communication devices. The latter can be satellite phones that allow voice and SMS transmission, devices that only allow SMS traffic, or data modems. Two things to remember are that all radio waves are blocked by large, dense objects, such as hills and buildings, and also that satellite telephones depend on radio wave transmissions (as do GPS receivers).

RADIO

In most instances only voice is transmitted by VHF and HF radios. However, there are modems that allow data transmissions.

VHF (very high frequency)

A major difference between VHF and HF (high frequency) transmissions is that the former are not reflected by any layer in the ionosphere, while the latter may be "bounced" against ionospheric layers. (The ionosphere is the atmosphere's uppermost layer, 70-100 km, where cosmic radiation gives atmospheric atoms and molecules an electric charge.) Thus, the range of VHF radios basically depends on the line of sight. The power output of the VHF radio (i.e. the number of watts) is of secondary importance to its active range. Since there is no real need for powerful transmissions and you do not have to find the frequency with the best "bouncing ability", VHF radios can be made small and simple compared to most HF radios. In theory you have to be able to see the other VHF radio to be able to reach it. By climbing, or even just by holding the radio above your head, you may increase the effective range. You can sometimes get a longer effective range in Antarctica than in other places. The reason for this is that ice does not block radio waves as effectively as, for example, rock does. A rule of thumb for how far you can transmit and receive at sea is:

Transmission distance (km) = T
Height of your sending antenna (m) = S
Height of the receiving antenna (m) = R

$$T = 4 \times (S + R)$$

As an example, if you stand up and carry the radio in a breast pocket, approximately 1.5 metres above ground, the transmission distance is around 12 km [$4x(\sqrt{1,5}+\sqrt{1,5})\approx 12$] – if there are no obstacles! Through an international convention, very high frequencies are divided into "bands". There are, for example, the marine band, the air traffic band, military bands, police bands, etc. The Secretariat mainly uses VHF radios working on the marine band, i.e. frequencies between 156 and 174 megahertz (MHz). Most VHF radios use fixed frequencies, so-called "channels". It has also been decided, through an international convention, which frequency corresponds to which "international channel".

For VHF, there are "simplex" and "duplex" channels. On a simplex channel, the radio transmits and receives on the same frequency. On a duplex channel, the radio transmits and receives on different frequencies. Duplex channels are used when there are repeater stations in the radio network. Repeater stations are used to increase the effective range of individual VHF radios, in that these stations receive, amplify, and re-transmit transmissions between the individual radios. Usually, repeater stations are equipped with high antennas and have a rather high-power output.

HF (high frequency)

Transmissions within the HF range (4–30 MHz) can be bounced against different layers in the ionosphere, and HF communication is truly global, at least in theory. However, the problem of long-distance communication is finding a frequency that is reflected down to the correct reception area. As the radio wave bounces between earth and the ionosphere, so-called "skip zones" are created in between reception zones (Figure 7.1). For communication over short distances, HF radios use direct transmission, just as VHF radios do. The reflective ability of ionospheric layers depends on, for example, sunlight and sunspot activity. Sunlight thins out ionospheric layers when heating them up, and in this way reduces the reflectance; sunspot activity increases the electromagnetic radiation levels in the ionosphere, which increase the distortion of radio signals. The reflectance of ionospheric layers varies for different frequencies, and even if you can reach a station far away one day, it is not certain that you can do so the next. A rule of thumb is that the longer the transmission distance and the more sunlight over the transmission distance, the higher the frequency that must be used.

The high frequencies, 4–30 MHz, correspond to wavelengths between 75 and 10 metres. To get a good transmission, the length of the active antenna must be a function of the wavelength for the transmission, e.g. 1, ½, ¼, etc. of the wavelength. The closer one gets to a full wavelength, the more powerful the transmission. This is the reason why large communication centres have huge arrays of antennas. It is also the reason why HF antennas are quite large in comparison to VHF antennas (VHF radios work at much shorter wavelengths). Furthermore, to get a proper HF transmission one often needs an antenna tuning unit that makes the active antenna length correspond to the frequency that is being used. If the antenna is not tuned, it does not matter how much power output is used!

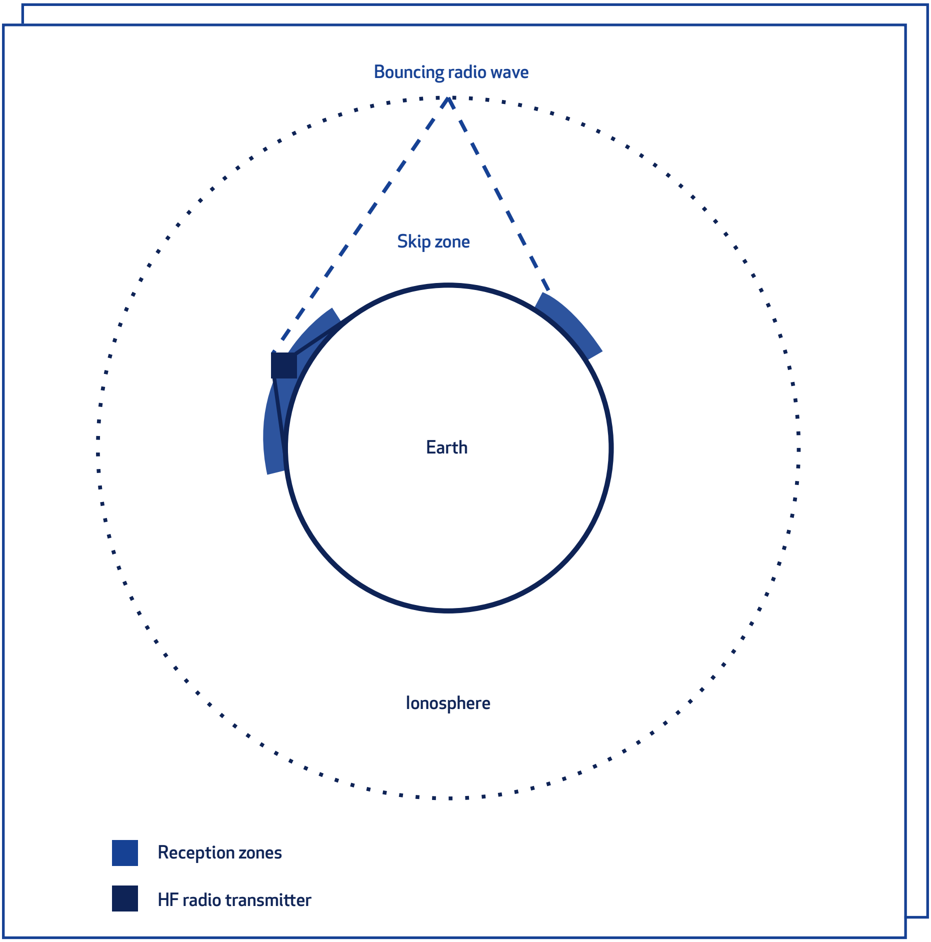


Figure 7.1 Since radio waves move in straight lines, from an HF radio you get a "ground wave", equivalent to a VHF transmission: if you can reflect the transmission against one or more ionospheric layers, you get one or more "bounce waves". The bouncing ability varies with ionospheric conditions and the radio frequencies used. The reception zone on earth for the bounce wave is quite large. However, between the ranges of the ground and the bounces waves, you usually get a "skip zone" in which it not possible to receive the transmission.
So the trick with long distance HF transmission is to find a frequency that lets you drop the hit zone over the intended receiver. The reason why you rarely use fixed channels for HF radios is that you often need to finely tune the frequency to get good transmission (bouncing) conditions.

SATELLITE

Satellite communications differ from VHF and HF radio only in that the transmission takes place with one or more satellites as "repeater stations". Some satellite systems allow only voice and low-rate text transmissions, while others allow high-rate data transmissions.

Iridium

This system uses orbiting satellites to provide a truly global coverage, although service can be somewhat reduced near the poles, as compared to its performance at lower latitudes. The system was to have 77 active satellites, originally (thus the name; the element Iridium is atomic number 77). The transceivers are somewhat larger than an ordinary mobile telephone and are used in very much the same way. On the Secretariat's expeditions, Iridium may be used for both voice and data transmissions. However, the capacity for data transmission is much smaller than that of Inmarsat. Currently, development of orbiting satellite systems with larger bandwidths than the Iridium system has is proceeding rapidly. The Swedish Polar Research Secretariat is following this development, and there may be satellite communications other than Iridium or Inmarsat (see below) on your expedition.

Inmarsat

The international maritime satellite system was developed for intercontinental and marine communication. It consists of four geo-stationary satellites placed over the equator. The position and height of the satellites, and the fact that radio waves move in straight lines, results in "dead ground" in the polar areas, with the result that above 70° latitude, communication very much depends on the local topography. Different Inmarsat systems, e.g. A, B, C, and M, provide different communication services. Inmarsat transceivers are bigger and heavier than Iridium ones, and are usually used only on ships and at stations.

PREPARATION OF THE RADIO OR SATELLITE PHONE

When you set up any communication equipment for use, you should first check the power source and cables to ensure power supply. You must also check the antenna connection and cables to ensure a tight and correct connection to the set. You then connect any audio accessories and check the functioning of switches. You are never allowed to push the transmit button on any radio transmitting device if the antenna is not connected, as this may destroy the transmitter!

COMMUNICATION LANGUAGE AND PROCEDURES

When there are non-Swedish members on an expedition, the common communication language is English. However, calls that affect only individual members may be made in any language, and on expeditions with only Swedish participants the communication language is, of course, Swedish. Still, all expedition members must have a working knowledge of "radio English" in case of emergency or if contact outside of the expedition must be made (see Appendix 3).

Before you get used to talking on the radio, it may feel a bit strange. However, there are some simple rules to follow, which ensure that all expedition members know how to send and receive basic messages. In Appendix 4, examples are given of how a message can be sent in English and in Swedish. Table 7.1 presents a list of rules that should be followed when reporting any kind of incident, etc. A situation in which many people

INCIDENT REPORTING

- **When** the incident occurred?
- **Where** the incident occurred?
- **What was involved** in/affected by the incident (people, snowmobiles, Zodiacs etc.)?
- **How many** where involved/affected?
- **What** happened (in brief)?
- **What actions** have you taken?
- **Who** is sending this report?

feel uncomfortable is when their radio station is a part of a radio traffic network, and calls are made from the main station to all other stations

at the same time; in Appendix 5, there are some examples of common network procedures.
When you are about to "go on the air" with a radio, make sure no one else is transmitting at the same time! This is one of the most common, and most frustrating, mistakes made during the Secretariat's expeditions.

You should make your message as brief as possible, while still keeping it precise. You should not occupy the ether longer than necessary, as somebody else may need to pass on an urgent message. If you have a longer message to send, it is often a good idea to write it down first and read from your notes when transmitting. Furthermore, break the message into sensible passages with pauses in between, so that the receiver has a chance to write it down. When transmitting, try to maintain a high standard of articulation, a normal rhythm, and moderate volume. Hold the microphone close to your mouth and do not shout (bad transmission conditions do not get better if you raise your voice). You should avoid excessive calling and unofficial voice procedures on the radio.

Within an expedition, the simplest possible radio call signs are used. Camps are called, e.g., "Camp 1" or "Camp Blue", while persons are called by their names. The call signs and frequencies or channels that should be used is decided by the leading coordinator. The official kinds of call signs are used only in HF radio traffic.

When the transmission conditions are poor or when you need to be very exact, e.g. when transmitting a position, you should spell the important information to ensure that it is received correctly.

When spelling out something, only the phonetic alphabet presented in Appendix 3 should be used. To ensure the correctness of the message, and to speed up its handling, procedure words (pro-words) can be used; a pro-word is a word or phrase that has been given a special meaning. The only authorised pro-words are listed in Appendix 3 [Kommentar: Vid signalering på svenska finns inte lika många "procedure words" som på engelska. Om du behöver ta till sådana är det enklaste att översätta de engelska.]

COMMUNICATION ROUTINES AND SCHEDULES

You should make a "radio check" the first time a radio is set up at a new location, when radio traffic has been down for some time, or when you just want to make sure that you have working communications. You should never feel that you need permission from any other station to make this kind of contact: it is a useful way of telling the others on the net that you are on it (see Appendix 3).

Every expedition has its own communication routines and schedules. These always include a main communication routine and a reserve communication routine. Added to this may be communication routines particular to the given type of expedition, e.g. a routine used when establishing a (new) field camp, a routine for patrols and out-parties, and/or an emergency communication routine. The Secretariat always tries to keep the routines as simple and logical as possible, and to set the schedules so that the interference with other work is kept to a minimum. Every expedition's communication routines are found in the safety booklet ("benficksbok") that you will be given at the beginning of the expedition, if one is used.

DISTRESS CALL (RADIO)

A distress call is a call for help in a (potentially) life-threatening situation (Table 7.2). Anybody hearing such a call has to act on it, either by coming to the caller's aid or by relaying it to someone who can. The internationally established emergency frequencies are VHF 156.800 MHz (= channel 16, and HF 2182, 4125, 6215, 8291, 12290, and 16420 kHz. These frequencies are monitored by ships, aeroplanes, field stations, etc. However, if you do not get a reply on an emergency frequency, then try any other. There are no laws prohibiting you from sending an emergency call on any frequency. Get help, by any means possible!

DISTRESS CALL (RADIO)

1. Start with the distress call: **"mayday, mayday, mayday", who you are and your call sign (three times)**.

2. After a short break, **send the distress message**.

(If possible, write down the message beforehand, so that you send it correctly.) If the battery starts to go flat, send the distress message after you have got a reply to the distress call.

Example:
"Mayday, mayday, mayday. From Swedish scientist Andersson, Kilo Lima Three, Swedish scientist Andersson, Kilo Lima Three, Swedish scientist Andersson, Kilo Lima Three.

[Short break]

From Swedish scientist Andersson, Kilo Lima Three. Position 70 kilometers south of XYZ base, latitude 00.00.00, longitude 000.00.00. Our tent has blown away. No shelter for me and Swedish scientist Pettersson. Very cold. Require assistance. Over."

NOTES

8

FIRST AID AND MEDICAL CARE

Ida Kinner

MEDICAL ISSUES IN THE POLAR REGIONS

It must always be kept in mind that the polar regions are far away from the medical infrastructures that most of us have close at hand at home. In the places where most of us live, many lives are saved because patients can reach highly qualified emergency wards within 30 minutes of an incident. The situation is drastically different in polar areas, where it may take 30 hours rather than 30 minutes before a doctor can see a patient, and it may take several days before that patient reaches a real hospital! This means that some accident victims or ill people who could be cured under normal circumstances may die in the polar regions due to a relative lack of medical services and long transport distances. If there is a doctor on the team, they will decide on what actions are to be taken. If there is not a doctor on the team, then you should act as you would at home, and if you would go and see a doctor there with regard to a medical issue, then the same applies in the field, i.e. a medical evacuation (MedEvac) may be required even if things are not life-threatening! Costs are always secondary to health, and all members of an expedition will have insurance that covers any MedEvac costs.

Therefore, it is of the utmost importance that you only take risks that are really necessary and try to keep a high level of risk awareness even in daily routines during the expedition. Also, you must fill out the medical questionnaire truthfully and not withhold **any** information to the medical examiner before the expedition! The medical officer's preparations are based on the information provided by the participants; with incorrect information, the preparations will be incorrect, and this may cause unnecessary and serious aggravation of medical conditions.

MEDICAL EMERGENCIES

If there is an accident and you are the first person on the scene, then you must first ensure that the damage is not magnified and that more people do not get injured. You must also get an overview so that priority is given where it should be. People who can complain or scream are at least well enough that they can complain/scream; thus, it is the silent ones you should check first. If more helpers arrive, then you should already have a priority list in mind of what they should do. If you are not first on the scene, ask the person or people already there what you should do; do not rush into action on your own. If nobody is "in command", take command and follow the action list below (Table 8.1):

ACTIONS SCENE/SAFETY + ABCDE (8.1)

• **Prevent further injuries:** switch off engine, switch off electricity, pull people away from danger etc.

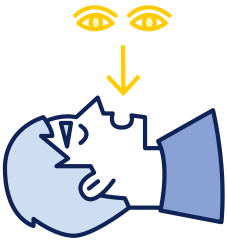
• **Check for more casualties**. Talk to them and see if they answer! If not, check if they are breathing and have a pulse.

• **Take care of the worst case first** – airway, breathing, circulation, disability.

• When you have taken care of the life-threatening injuries, **call for help!**

EMERGENCY TREATMENT

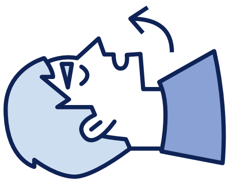
When you take care of an injured person, follow "ABCDE" – Airway, Breathing, Circulation (with bleeding control), Disability, Exposure. If you at any time during the treatment process lose track of what you should do, start again on A!



Airway

If the patient does not respond to you/talks back, and if you are uncertain if they breathe by themselves:

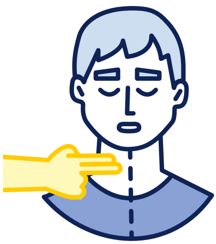
1. Check that there is no foreign object in the mouth (food, vomit, false teeth etc.).
2. Raise the chin and stabilise the neck (never bend the head forward – in case of neck injury)
3. If the patient breathes now, put them in the recovery position (see below).



Breathing

If there is no breathing, despite a free airway:

4. Check if there is any pulse! If there is no pulse and you have the proper training, you may apply CPR.
5. If the patient has a pulse, but does not breathe by themselves, give mouth-to-mouth resuscitation (normal, deep breaths; 12–15 per minute).
6. When the patient is breathing by themselves, make an assessment of the breathing (frequency/fast-slow, shallow-deep? Does the chest rise evenly on both sides?).



Circulation (with bleeding control)

1. Stop any major bleeding: Apply a bandage

directly over the wound – if the wound is deep, you should try and pack it with gause before applying the bandage. Raise the position of the wounded part, except if it is a head wound (lowered position). If the wound bleeds through the first bandage, take it off and put on a new, better on! Always apply a pressure bandage on wounds on the head or neck (push with the hand), and over thighbone (femur) fractures. Never remove larger foreign objects from wounds.

2. Check distal status: pulse (fast–slow, weak–strong), capillary circulation ("flushing"/capillary refilling), skin (warm–cold, dry–moist, colour?). You must be careful so that a pressure bandage does not completely cut off circulation distally ("below") the wound.

3. Check the blood pressure (wrist, groin, then neck).

4. Palpate thorax, abdomen, pelvis, and leg to check for possible internal injury that may cause bleeding.

5. Check for shock symptoms: quick pulse and breathing; pale clammy skin; thirst; feeling sick and/or vomiting; troubled breathing; anxiety, confusion and sometimes aggressiveness. Lay the person in shock treatment position (legs horizontal). Change the position every hour, i.e. alternate the down side. The motto when taking care of people in shock should be "Breathing, warmth, rest, carefulness, volume" (Ventilation, Värme, Vila, Varsamhet, Volym).

Disability (with neurological symptoms)

Check for symptoms of neurological injuries:

1. For the level of consciousness, apply AVPU:

2. The pupils (size, reaction to light, differences between left and right pupil?).
3 Distal status (hands–arms, legs–feet: normal perception of touch in, ability to use and strength of muscles?). If there are any signs of brain or neural damage, try to stop aggravation of the injury: stabilisation/fixation, never bend the head forward.

LEVEL OF CONSCIOUSNESS – AVPU

Alert: The patient is fully awake (although not necessarily oriented). This patient will have spontaneously open eyes, will respond to voice (although may be confused) and will have bodily motor function.

Verbal: The patient makes some kind of response when you talk to them, which could be in any of the three component measures of eyes, voice or motor - e.g. patient's eyes open on being asked "Are you OK?". The response could be as little as a grunt, moan, or slight move of a limb when prompted by the voice of the rescuer.

Pain: The patient makes a response on any of the three component measures – by using their voice, moving their eyes, or moving part of their body – on the application of pain stimulus, such as a central stimulus like a sternal rub, or a peripheral stimulus such as squeezing the fingers.

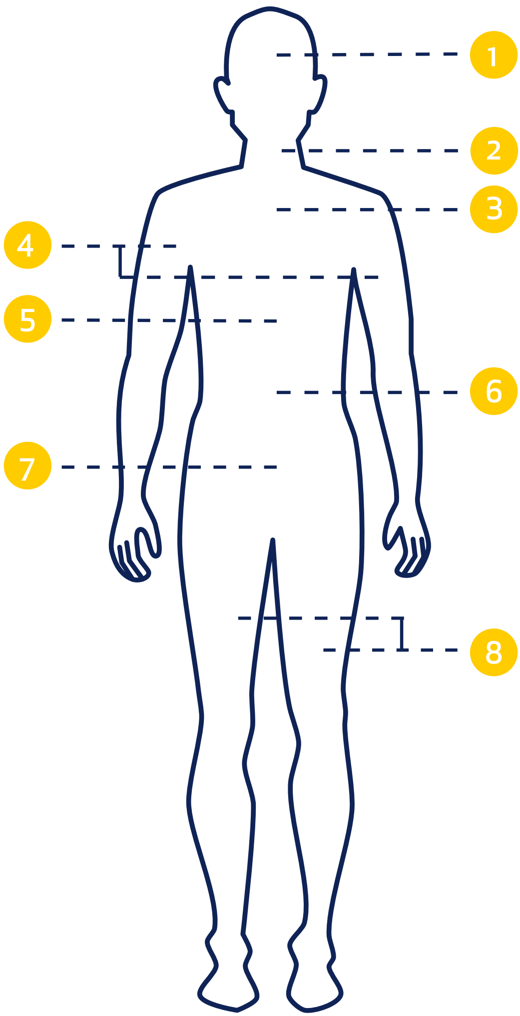
Unresponsive: Sometimes seen noted as 'Unconscious', this outcome is recorded if the patient does not give any eye, voice, or movement response to voice or pain.

Environment and Exposure

1. It is important that the patient is not exposed to water or cold; the patient should be warm

and dry. It is considered to be cold if the ambient temperature is below 28°C (the normal skin temperature)!

2. If possible make a “head to toe” examination, to see if you have missed any injuries; is there any pain reaction (e.g. due to fractures)? Check: head, neck, chest, arms, upper abdomen, pelvis, lower abdomen and legs.



HEAD TO TOE EXAMINATION

3. Use a slow and very careful "lift and slide" when moving the patient (one person to stabilise the head/neck). Try to keep horizontal position of head, neck, and body. There should be minimal moving/handling of trauma victims!

FOLLOW-UP

When you have finished the "ABCDE" for all patients, you must continue to check their general status until help arrives: breathing (breaths per minute, quality); pulse (beats per minute, quality); blood pressure (wrist, groin, neck); and level of consciousness – just follow "ABCDE" again.

To remember

To be able to take care of an injured person in a proper way, you must be in a reasonably good state yourself, i.e. you have to take care of yourself. After the initial emergency treatment of the injured person, you are probably in a stressed state yourself. Dress warmly and protect yourself against the weather. Eat something and try to drink something sweet: this will make you think better. After the initial emergency treatment of the injured, contact the (expedition) doctor.

TRANSPORTATION OF THE INJURED

Injured people should only be moved if this can be done without worsening their condition, and when the moving is beneficial to their treatment. (There should be minimal moving/handling of trauma victims!) If camp is far away or transport is difficult, move the camp to the injured person! You can erect a tent and slit a hole in the bottom, and in this way get patient inside without moving them. During transportation you should protect the patient against heat loss (see below). To the extent possible, you should try to keep the patient's body straight in case there are any fractures or damage to the spine that you are unaware of. You should always support the head and neck when moving a patient, both to secure free airways and because of potential spinal damage. If you need to pull someone, grip the injured person's clothes rather than the person themselves; you can hold clothes in a very tight grip without hurting the patient.

PROTECTION AGAINST HEAT LOSS

It is of the utmost importance that you protect the patient against heat loss. Wet clothes are especially dangerous. So, change wet clothes to dry. If this is not possible, limit further cooling by covering the body with wind- and waterproof material, and put sleeping bags on top/around. You should also protect the patient from cold ground, especially at pressure points where the patient's body compresses the insulation material, e.g. the sleeping pad. You should also insulate well around the head and neck, since the flow of blood is very high to the head. It is your responsibility to ensure that the patient is not cold and does not become hypothermic.

Remember that it is considered to be cold if the ambient temperature is below 28°C! Injured people may have much-reduced circulation and heat production compared to a healthy person. They may also be in pain and in shock, so that they do not feel the onset of cold. Add more insulation than you think necessary, at least in the beginning. As trauma victims may not be able to shiver and heat themselves, you may have to help them by using hot water bottles, or even someone else's body heat.

CONDITIONS THAT MIGHT NOT REQUIRE QUALIFIED MEDICAL ATTENTION

Below, you find some common conditions that you may be able to handle yourself. However, do not be afraid of contacting the Secretariat's medical officer (if you do not have a doctor on your team).

COLD RELATED PROBLEMS

All cold-related injuries are caused by exposing the whole or part of the body to temperatures so low that the body itself cannot compensate for them. Since the average skin temperature is 28°C, in most environments we must somehow protect the body from heat loss. Through physical work the body can produce a great deal of heat, and the body can to a certain degree adapt itself to the physical conditions around it. However, since most expedition members are only temporary visitors to the polar regions and adaptation takes time, and since we cannot constantly carry out heavy physical work, potential cold injuries must be countered through our behaviour.

Basic preventive measures

The motto is “dry, warm, and a full stomach”. You should never allow yourself to become wet, whether from rain, melted snow, or sweat. Wet skin and wet clothes or boots are perfect conductors to lead heat away from your body. If any condition changes, you must adapt your clothing, and you should not work up a sweat! This could mean that you have a thinner layer of clothes under your shell when you are working, and put on extra, warm insulation on top when you take a break.

You must always have enough clothing on you and more than enough clothing with you. Naked skin is vulnerable, and wind, whether it is natural or manmade (e.g. by helicopters or snowmobile driving), drastically increases the risk of a cold-related injury (Table 8.3). When taking a break, you must add insulation before it feels cold or even cool. Since the brain has a constant, high need for oxygen and energy, the blood flow to the head is not significantly reduced in cold weather. Therefore, it is of the utmost importance that you protect the head from cold or windy conditions. A good saying is “if your feet are cold, put on a warm cap”.

The body has a marvellous ability to produce heat. At rest, approximately 90% of the calories we burn are used to produce heat. When the body’s need for heat increases, we must produce it by using more calories. Shivering is a fast muscular movement, the only aim of which is to produce heat: this can only be done with carbohydrates as fuel. In cold conditions, the body’s craving for fat also increases, so do not fight this. It is better to gain a few kilograms on an expedition than to have to be hospitalised for a cold-related injury. Another effective way to help the body maintain its normal temperature is to drink energy-rich drinks, preferably warm. Drinking as such is also important. In the dry air of the polar regions, we lose more fluid from the body than under normal conditions, and because of the cold we may not perceive the body's signals for more water. As we lose bodily fluids, the circulation decreases. You must eat and drink properly when in the camp or station, and you must always bring energy-rich food and (hot) drink with you when you leave. You should bring so much food and drink with you that you always have some left when you return back to the camp or station (as an emergency reserve).

WIND-CHILL FACTOR (PERCEIVED TEMPERATURE ON BARE SKIN) (8.3)

Wind speed (m/s)	Temperature (°C)								
0	0	-5	-10	-15	-20	-25	-30	-35	-40
5	-2	-7	-13	-19	-24	-30	-36	-42	-47
10	-3	-9	-15	-21	-27	-33	-39	-45	-51
15	-4	-11	-17	-23	-29	-35	-41	-48	-54
20	-5	-12	-18	-24	-30	-37	-43	-49	-56
25	-6	-12	-19	-25	-32	-38	-44	-51	-57
30	-6	-13	-20	-26	-33	-39	-46	-52	-59
35	-7	-14	-20	-27	-33	-40	-47	-53	-60

FROST NIP

Symptoms

White skin that is movable over the underlying tissues.

Treatment

Thaw the injury with a warm hand/belly/armpit carefully until the symptom disappears. Do not rub or massage. Previous injuries are sensitive to renewed frost nip, so you must give them extra protection.

INFECTED WOUNDS, BLISTERS

Even small nicks and cuts may become infected, and you should treat them carefully from the beginning.

Treatment

Do not puncture blisters but put a protective bandage on them (preferably a blister patch, if they are available). Larger blisters can be punctured by medical staff.

Open wounds should be washed with soap and water, after which they should be kept as dry and clean as possible. A wound that is red, swollen, and sensitive to light touch is likely to be infected. If the swelling is extensive and very painful, contact a doctor.

MUSCLE CRAMPS

If you start getting muscle cramps, it may be a sign that you have not provided your body with enough salt. In the polar regions, much of the water is melt water, and thus it may not contain enough minerals. This is definitely the case if your water source is snow or ice. Also, in cool or cold weather it is easy to neglect the body's need for water. Salt deficiency in combination with hard physical work can quickly lead to very serious conditions.

Preventive measures

You must eat "normal" food. Cookies, sweets, and chocolate can provide enough energy, but they usually have very low sodium content. You should drink at least two litres each day, added to the water you get through your food. If you have snow or ice as your water source, you must add extra salt (preferably sea salt, "Seltin", or similar products that contain potassium and magnesium besides sodium) when cooking.

Treatment

Rest. Drink a lot and add salt to your body. Make your own "sports drink" by adding salt and sugar to your regular drink, or simply dissolve a stock cube (*buljongtärning*) in 125 ml of hot water and drink it.

"SNOW BLINDNESS"

This is an inflammation to the eyes caused by very intense (UV) light. In principle, it is sunburn to the cornea and the conjunctiva, and it can occur even when the sky is overcast! It is a potentially serious and very painful condition that can be easily prevented. Just protect your eyes with good sunglasses when at sea or in areas with snow- or ice-covered ground. By “good” sunglasses, we mean those that reduce the light by 85–95%, that have UV-filtering ability, and offer protection from light coming in from the sides, i.e. broad sidepieces. Preferably they should have mirrored lenses, as these reflect a great deal of light. Do not be unnecessarily economical when buying sunglasses for a trip to, e.g., Antarctica. Comfortable ones with a good light-reducing effect will be much appreciated after a while.

Symptoms

“Sand” in the eyes, flickering vision, pain.

Treatment

Immediately protect the eyes against light. Keep protecting them until the problem has passed, which normally takes a couple of hours. If you develop severe problems, stay in a dark room, and take a painkiller if necessary. Just like sunburn to the skin, the eye is extra sensitive to renewed snow blindness, but in contrast to the skin, it does not develop a tan. (Local anaesthetics are very effective but treacherous as they may cause you to expose yourself to additional sun, which is harmful: These should only be administered by a doctor.)

SPRAINS

Treatment

Immediately put a very tight elastic bandage on the injury: if a fracture is suspected, contact a doctor. Leave the pressure bandage on for 5–20 minutes even if the toes or fingers start to get blue (however, do not do this if there is a risk of frostbite!). Then loosen the bandage so that it is tight but not constricting and keep it on for the rest of the day. This reduces bleeding and helps the recovery process very much. Apply a supportive bandage.

STOMACH PROBLEMS

Diarrhoea and vomiting are two ways for the body to remove toxic substances. You should therefore avoid taking anti-diarrhoea pills immediately when you get sick, but let nature take its course for a while.

Constipation is another stomach ailment you may be afflicted by. This could have psychological causes (i.e. a resistance to “pooing” in the field), but dehydration, stress, too little fibre content in food, and too little moving of the body can also be behind it.

Treatment

For diarrhoea and vomiting: Drink a lot. Sweet tea can calm an upset stomach. Avoid solid foods the first day, but drink stock (*buljong*). On the second day, eat white bread or crackers. On the third day, you can eat rice and boiled fish. If you experience problems again, go one day back in the diet. Prolonged problems rob your body of water, salt, and energy – you must counter this by drinking warm, sweet drinks with a little salt added.

For constipation: Use the loo, or "poo" in the field, as soon as you have a need. Make sure that you drink enough, that you at least take a walk every day, and eat as many fibre-rich foods as possible – (dried) fruits, porridge, brown bread, etc.

CONDITIONS THAT NEED QUALIFIED MEDICAL CARE, BUT WHERE CAN YOU STABILIZE/ /ALLEVIATE THE PROBLEM

Below, you will find some of the serious conditions for which you should always contact a doctor, if there is time. If the situation is acute, do not hesitate to call for a medical evacuation (MedEvac)!

BURNS

Burns are extremely serious injuries and are doubly so on expeditions. You must take every conceivable precaution to avoid burns by hot liquids, hot tools, or open flames. Synthetic fibres have a very nasty quality, in that they tend to melt, which can cause horrible burns.

Treatment

Immediately cool the injured area with water and continue doing this for 10–15 minutes! The water used for cooling the injury should not be ice cold, but any water at normal room temperature will do. At the initial stage, apply a protective bandage with wet compresses, to continue cooling. However, keep in mind to protect the patient from becoming hypothermic. Call for help!

After the acute treatment is over, do not puncture any blisters, as doing so increases the risk of infection: Just apply an airy, sterile dressing, and keep the injury clean, even if it is a minor burn. There is a risk of shock if the injury is larger than 5% of the surface of the body, where the area of a hand corresponds to 1%. The injured person should drink a lot (if conscious) since burns always "leak" a great deal of bodily fluid.

CONCUSSION (*"HJÄRNSKAKNING"*)

Treatment

If unconsciousness lasts more than a minute or two, or if it appears at some time after an injury, call for help. Vomiting, as well as memory loss, are also warning signs of concussion. Put the patient in the recovery position. To fall asleep is not in itself dangerous, but the patient must be checked twice every hour to see that they are easy to wake. Do not leave the injured person alone and be prepared to give mouth-to-mouth resuscitation. If you experience trauma to your head, inform the other expedition members since the symptoms of an injury sometimes develop only after some time. Make sure you evaluate the AVPU level (see Table X above) and size of pupils on a regular basis during evacuation. Trauma to the head can be extremely serious!

DEEP FROSTBITE

Symptoms

Hard and deep-frozen tissues. Blisters, swelling, cracked or blackened skin.

Treatment

Deep frostbites must receive medical attention. Do not thaw if there is any risk of renewed frostbite! Only protect with a sterile dressing. Do not massage. Further treatment is to be decided by a doctor.

If thawing is required, put the injured part in warm (40–42° C) water. Do not let the water get cold, as it transfers its heat to the injured body part. The thawing is completed when the tissue "flushes". The thawing process is usually extremely painful, so the patient will definitely require a painkiller. The injured area will swell a great deal after thawing so it should be kept in a raised position and be protected against mechanical pressure.

DROWNING

Drowning incidents in polar areas are always combined with acute hypothermia.

Treatment

Empty water from the patient's lungs. If the patient does not breathe on their own, give mouth-to-mouth resuscitation (1 or 2 breaths) to see if they start breathing. If not, check for a pulse and be prepared to give CPR if you are trained for it. Treat for hypothermia (see above).

EYE INJURIES

If a person gets any corrosive substance in the eyes, wash the eye with water or sodium chloride solution for at least 30 minutes (preferably all the way to seeing the doctor). In the case of a wound to the eye, just apply a protective bandage and contact the doctor immediately.

FRACTURES

Treatment

The important thing here is to prevent the injury from getting worse. Stop any (heavy) external bleeding. If the thighbone is fractured, apply a pressure bandage on the fracture to reduce internal bleeding.

Check distal status (perception of touch, pulse, capillary "flushing" of finger/toes). If this is okay, immobilise the fracture by applying a supportive bandage with some kind of splinter: Fixate past the fracture over the joints above and below.

If the distal status is poor, you may have to try to pull the fractured bones into a better position (rough repositioning: pull-align-rotate – if possible, check with a doctor first). In general, repositioning of a fracture that has a real "bad" position and cannot be immobilised as it is, is not risky to do by a layman, with the exception of elbows. Check distal status again and try to fix the position of the fracture that allows blood circulation. (Lack of circulation may produce severe secondary injuries below the fracture.) Give a painkiller if the patient is conscious and prevent shock. If possible, keep the fractured limb in a raised position. Find the patient medical attention.

HYPOTHERMIA

At a body temperature below 35°C, the body stops the shivering mechanism, and below that temperature a person is hypothermic. The typical case for chronic hypothermia occurs in people who are lost in the mountains and who have not been eating and drinking properly. Acute hypothermia is caused by, e.g., immersion in cold water.

Symptoms

Weakness, confusion, apathy, unconsciousness.

Treatment

Seek shelter immediately and protect the patient from continued cooling. Insulate the extremities and the torso separately; the torso should be well insulated with sleeping bags, etc. If the person is conscious, they should be given hot (sweet) drinks and carbohydrate-rich food. When someone is unconscious due to hypothermia (body temperature below 30–32° C), warming must be slow and come from within the body. Rapid reheating (hot bath, electric blankets, etc.) may lead to death! However, you should warm the patient's thorax

by putting, e.g., hot water bottles or "hand warmers", in their armpits.

Hypothermic patients should be kept in the recovery position. If the person is unconscious, the patient should be evacuated to receive medical attention as soon as is safely possible. The surrounding temperature when waiting for transport and during transport should be kept at 20–25° C. You must avoid any extra heating of the body surface during the transport (see above on quick reheating)! A hypothermic person is considered alive until a medical doctor has decided otherwise: **No-one is dead until warm and dead.**

INHALATION OF FIRE SMOKE

In fires, it is much more common for people to be injured through the inhalation of smoke than from the heat. Fire smoke is in general very toxic and may damage lung tissue. People who have inhaled fire smoke should always be checked by a doctor.

Treatment

There is no treatment for serious cases of this in the field; victims must be evacuated immediately. Apply mouth-to-mouth resuscitation if the patient cannot breathe on their own.

INJURED ABDOMEN

If the abdomen is hard, or tender, suspect internal bleeding.

Treatment

In the case of an open injury, apply a "loose" protective bandage over the wound, and with wet compresses, if possible. Fixate any object that has penetrated the abdomen. Place the patient in a foetal position. Prevent shock. Do not give any food or drink. Get medical help as soon as possible!

INJURED LUNG (E.G. FRACTURED RIB)

Any trauma to the torso can be or become very serious, and you should always contact a doctor.

Treatment

If the skin is penetrated by a fractured rib, apply an airtight bandage, e.g. with the plastic cover of the first aid bandage, directly over the wound. Foreign objects that have penetrated the ribcage should be fixated to the chest. A conscious patient is placed in a half-sitting position, or what feels best. An unconscious person is put in recovery position with the wounded side down, so that the collapsed lung does not interfere with the uninjured one. Prevent shock.

"TRENCH FOOT"

This is a condition that occurs at temperatures above freezing, typically in feet that have been wet, and consists of cool circulation and slow tissue death, particularly of nerves and muscles.

Symptoms

Swollen tissues, bad circulation and initially red later blue tissues. Pain.

Treatment

Wash the affected part clean, and keep it dry in a raised position. Give painkillers and antibiotics, if needed. Protect the injured part from renewed cooling. The patient should receive proper medical attention.

UNCONSCIOUSNESS

Treatment

All unconscious persons should be placed in a horizontal recovery position. Check breathing and pulse continuously. Contact the doctor.

NOTES

9

PSYCHOLOGY IN THE FIELD

Dag Haugum

STRESS AND CRISIS

Different people react very differently to a frightening, tragic, or otherwise shocking event (i.e. a psychological trauma). Some people react with panic, some suffer from an acute stress reaction, while others act relatively rationally and functionally (Figure 9.1). How you react is not chosen, but depends on a variety of factors such as the specific situation, previous experiences and practice, and personality traits. You should be aware that during the expedition it will be uncommon for people to be in a completely stress-free state, and quite often they will be in a lightly stressed state. This is simply because you will be focused on getting the job done, while knowing that time is limited.

ACUTE STRESS REACTION – FIGHT OR FLIGHT - PANIC

Stress is the physiological-hormonal reactions in the body's organ system triggered by physical and mental stresses, or "stressors". From an evolutionary point of view, stress is a very important response that remains in all higher animals. High stress levels can be expressed, e.g., as an acute stress reaction.

Acute stress reaction

Acute stress reaction is a short-term and transient mental shock, but it can become post-traumatic stress. An acute stress reaction appears as a quick response to trauma. The first sign can be a shielding from the confusion and difficulty of taking in the environment (e.g. the surrounding seems to be spinning or the ground shaking, or you do not understand where you are), paralleled by a change in consciousness in which the mental focus narrows (you fall into the so-called “stress cone”). You may suffer from bodily shaking or paralysis symptoms, often with a touch of panic and/or high anxiety. Usually, the reaction switches between states of bodily hyperactivity/aggression and of apathy/crying. Common symptoms include “fight or flight”, hypersensitivity to sounds, difficulty concentrating, and sleeping problems. The condition/shock phase seldom lasts more than an hour or a day.

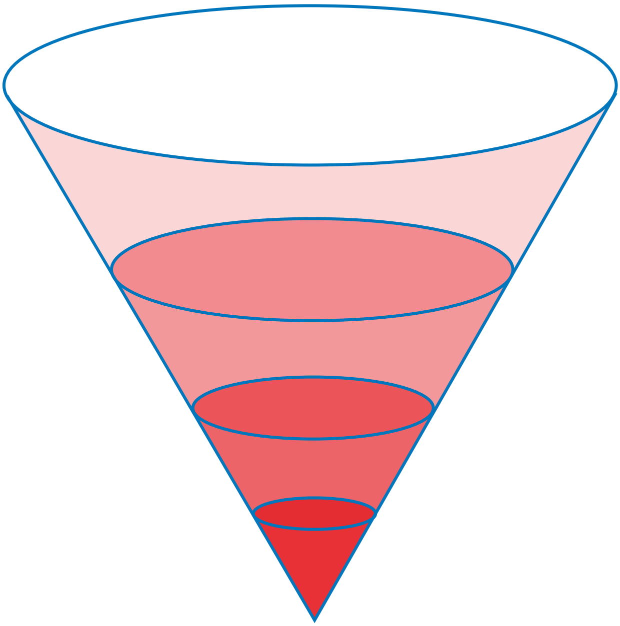
Flight-fight, playing dead

The “fight and flight” response is the instinctual behaviour that, in a sudden dangerous situation, you either try to escape or to fight all you can, in order to survive. Which behaviour is acted out depends on what triggers the response, and on the individual's experiences, personality, etc. In a relatively mild form, the physiological response can be experienced as an ″adrenaline tick″. The body responds through, for example, an increased pulse, faster blood-flow to muscles and brain, and faster breathing. These affect, e.g., how the environment is perceived, memory, and mood. A third possible behaviour associated with flight and fight is to ″play dead″, i.e. threatened people may “freeze ″.

Panic

Panic consists of suddenly emerging, very strong emotional reactions and behaviours due to a sud-

Figure 9.1 The stress cone.



Stress free state

Free access to the whole personality

Receptive to the surrounding, has overview

Willing to cooperate, expresses a sense of humour

Thinks constructively, handles conflicts

Lightly stressed state

Some intellectual limitations, unreflecting

Narrow-minded, may ”lock on target”

Simplifies – both tasks and views of people

Some competitive behaviours, lack of empathy, whining

Stressed state

Goes for the simplest solution

Sees only what right now is in front of the eyes

May threaten others

”Fight or flight”

Reflexive behaviours, may start fighting or escape

Completely I-fixated, ruthless

Panic

Flees head over heels, or completely apathetic

Fatigue/exhaustion, ”blackout”

den, horrific situation, such as a threat of death or catastrophe. Panic behaviour is reflexive and is about avoiding danger. Panic can hit an individual or group. A panic attack involves a strong stress response, which is slowly reduced after the danger has passed. By definition, a reflexive action is completely automatic and is not be controlled.

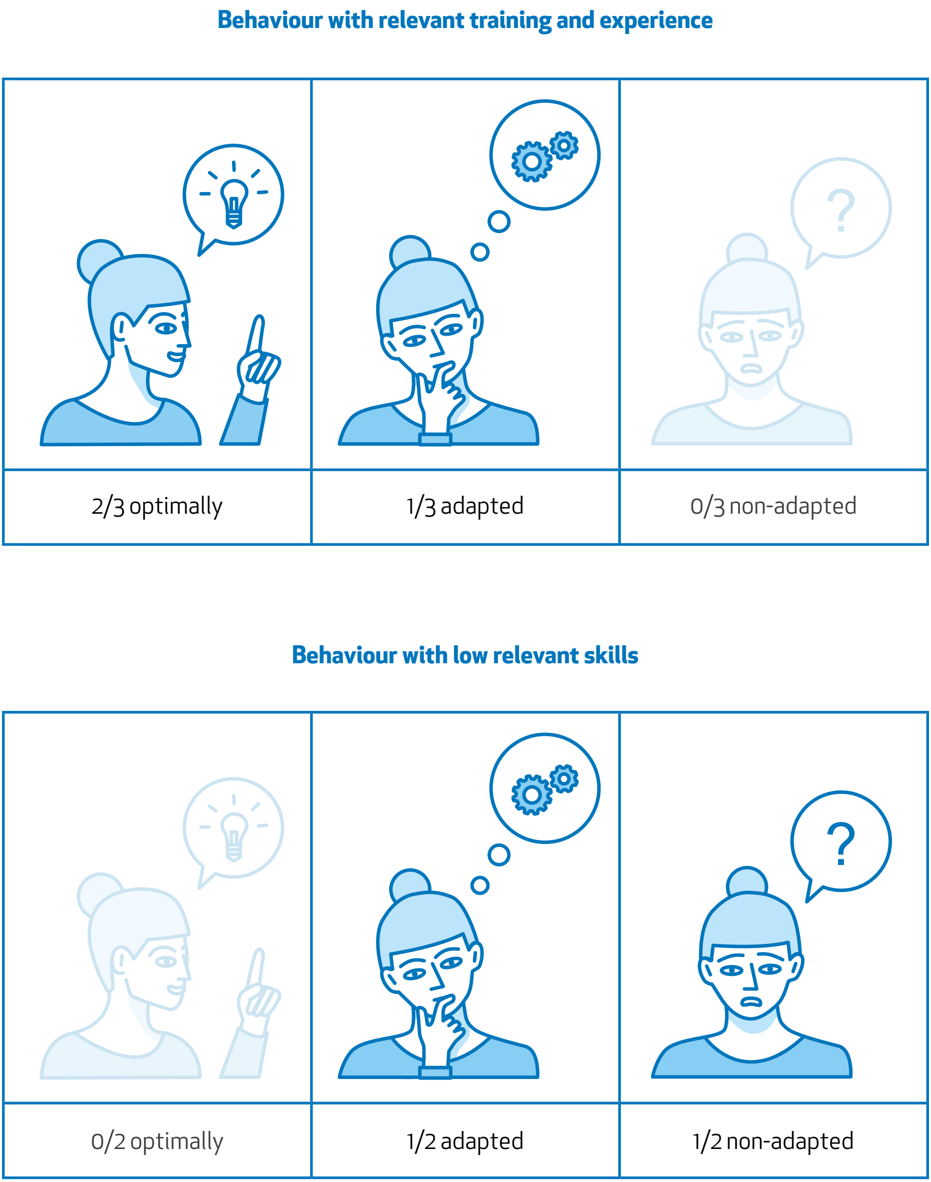
How do people act in acute crises?

The Swedish Defence Research Institute (FOA) presented a survey in 1991 that showed that 30% showed optimum behaviour, 50% adapted behaviour, and 20% non-adapted behaviour. Optimum behaviour means that you have full control of yourself and can evaluate the situation, draw up an action plan, implement the plan and interact with others. Adapted behaviour means that you show that you are affected and may be a bit confused but can carry out tasks under supervision. Non-adapted behaviour means that you exhibit, e.g., confusion, crying, affected mobility, acting without considering alternatives, and an inability to interact with others. In another study, it was found that among people with high relevant skills, achieved through training and experience, two-thirds acted optimally and one-third adapted. In contrast, among people with low relevant skills, 50% acted adapted and 50% non-adapted. It should therefore be clear that field courses and one's own training are important preparations for both individuals and the team (Figure 9.2).

How to try and counter acute stress?

The stress reaction is in itself not negative – it is all about putting the body on standby for something

Figure 9.2 The importance of training and experience on behaviour in crisis situations.



perceived as a threat. What can be a problem is your own response to the body's stress response. When you get a physiological "boost" in the body (increased pulse, elevated blood pressure, etc.), the brain interprets the situation in which you find yourself and checks this interpretation with your bank of emotional memories. The memories may be relevant, but just as often they are not – we often misinterpret situations that cause the bodily response.

The best way to deal with stress is to remember to breathe and to breathe deeply (so that the diaphragm expands the stomach). Then, feel your body's contact with what you are standing/sitting/lying on. These two simple actions lead to two important things: that you get back to the here and now ("the body is always here and now"), and that you get more oxygen and less carbon dioxide in your blood. And keep your eyes open, so that you are not caught up in what is happening inside you.

STRESS OVER TIME

What constitutes a stressor for one person does not have to be a stressor for another but depends on each person's ability and self-esteem and stands in relation to demands and to perceived access to resources. If stress levels are high over time, it is primarily a hormone, cortisol, which can cause problems by breaking down the mechanism that regulates its secretion. The only way to recover from extended stress is to allow time to recover and to be able to rest without the stressor(s). Long-term stress and lack of recovery reduce the body's ability to repair itself. Sleep deficiency reduces the resistance to other diseases and is a stressor in itself. Sleep is the most important factor for recovery and repair. Being able to take short breaks at work is important for both mental and physical recovery. With longer recurrent stress periods, longer rests are needed – on an expedition "rest" can simply mean freedom from a stressful situation. This can be difficult if, for example, the stay in the field itself is experienced as stressful. Therefore, even while the work during the expedition is being planned, the risk of prolonged stress should be taken into account.

"PSYCHOLOGICAL FIRST AID" IN CRISES

In connection with serious incidents and accidents, even people who are not physically injured in any serious way may be affected by severe emotional stress. This is a condition that can be very debilitating both in short-term and long-term perspectives. Situations that can cause severe emotional stress are those involving (1) serious threats, (2) losses of friends and colleagues, and (3) responsibility for serious incidents.

The time after a serious event is divided into three periods: acute phase, intermediate phase, and long-term phase. The lengths of these phases depend on the nature of the event, and they are affected by personal resources, so it is difficult to specify the length of each phase. The acute phase, however, usually lasts one to three days, during which time "psychological first aid" is required (Table 9.1).

The intermediate phase concerns the processing of the experience, while the long-term phase involves an orientation towards life post-trauma so that one can move on in life without forgetting what happened.

PSYCHOLOGICAL FIRST AID

• Ensure **physical safety** of the affected.

• **Care for them** in an empathetic and non-intrusive manner ("Keep silent and hold your hand!")

• Ensure that they get: **friendliness/comforting, rest, warmth, drink, and ventilation** ("ventilation" means that they can breathe easily – comfortable position, no tight clothing etc.). Arrange with food and shelter. Make sure no one affected is left alone any longer time.

• If possible, let them **contact their relatives**.

• **Provide information** that can help the affected handle the trauma.

• **Let them express their urgent needs** and talk things through (again, "Be silent and hold your hand!")

• **Try to normalize their reactions**. These are normal reactions to abnormal events. Encourage them to take an active part in their own recovery.

When the acute phase is over, what you can do while in the field is to have so-called debriefing talks. In these, you focus on facts about the event as such, exchange of experiences, and attempt to correct any unclarities, so as to reduce the risk of misinterpretations of what actually happened. The purpose is to inform and open up for “friend support". It is okay to ask how others feel now – but not how they felt when it happened.

At home, those who consider themselves in need of help can receive it from occupational health services or the equivalent. When a crisis occurs during an expedition, it is important that the entire team that is affected is given the opportunity to follow-up on these discussions.

NORMAL AND MORBID BEHAVIOURS

Anxiety

During and after a crisis, it can be easy to judge a given behaviour as "unnatural" or morbid (pathological). However, as stated above, much behaviour exhibited during and after a crisis is not voluntary but consists instead of automatic responses – i.e. normal behaviours in abnormal situations. It is also normal to feel a bit anxious about risks that you do not encounter in your everyday life, such as meeting a polar bear, approaching a crevasse, or walking on sea ice, especially if it is your first time in such an environment.

To be nervous at a level of light "stage fright" only shows that a potential risk is being taken seriously. However, if anxiety reduces one's ability to work, then something needs to be done. If it is you that is affected, talk to the team leader and/or people with experience to find out what is causing the anxiety. If you see someone else who seems anxious, notify the team leader and ask them to talk with the person in question. If this is not enough, then the affected can be a bit more "embedded", e.g. given additional training, moving together with experienced people, etc. If someone simply refuses to work and participate, they should be encouraged, but never forced, to do so. And remember that anxiety is never reduced by mocking or being frowned upon.

Depression

Do not confuse homesickness or a temporary need to be left alone a bit (to "get some space") with depression. If you notice somebody isolating themselves, just talk to them to see what it is about. If they do not want to talk and this isolating is prolonged, the team leader should consult a doctor.

THE TEAM AND WELLNESS IN THE FIELD

Mental preparedness drastically increases the ability to cope with stress. Although you cannot practice all possible stressful situations, you should, as a team, have some discussions on what to do if specific ones occur. Together, you can make a list of possible scenarios, and then choose some to discuss. This could be done either before or at the very beginning of the expedition.

Questions to think and talk about:

- How would I feel if this scenario takes place?
- How should we act as individuals in the emergency phase?
- How do I think I would actually react?
- Do I have any experiences from similar situations?
- Who should take responsibility in the

situation?

- How should we act as a group after the urgent stage has taken place?

Another thing that will affect the way in which you and the team will react is how well you know and trust each other. Working together during a field course is a good team-building activity, but if you can get more time to get to know each other it will be time well spent. Working together during the expedition will also strengthen the team and its abilities. There are some routines that can further this:

Safety procedures

The expedition's safety and security rules may include actions that you should carry out daily, e.g. checking vehicles, communication equipment, and the storage of hazardous goods. If there is a risk of bear visits, check that food storage and the latrine are properly maintained. If such tasks are delegated to you, you must carry them out, and you should ask the team leader to do follow-ups on this.

Daily meetings

Having daily meetings in connection with breakfast or dinner is important for several reasons. They allow everyone to easily follow how the team's overall work is going. They also allow team members to air a particular "hassle" or need for help. Last but not least, they give everyone an opportunity to gauge both the mood of the team as a whole and whether any individual member is starting to behave differently.

Meals

How cooking and eating are to be organised should be decided jointly by the team based on what best favours safety and work. There is no need to regulate this type of activity if it does not benefit your mission.

Cleaning of the camp /station /living module

It is good practice to work together as a group once a week, especially if the team works individually or in small groups during the rest of the week. Housekeeping is one of those things that may be more fun to do as a group, and the work often proceeds more quickly that way.

NOTES

10

PROTECTION AGAINST FIRE

Ida Kinner

The best protection against fire is prevention: you never have to fight a prevented fire. Fire is probably the single most serious danger at sea and in the polar regions. At sea you cannot easily get away from a burning object (the ship) without putting yourself in jeopardy (by going into lifeboats). On land in polar regions, fire can be extremely destructive to equipment that you cannot easily replace; a destroyed sleeping bag or tent may mean serious trouble. Furthermore, burns and smoke inhalation are among the worst injuries to treat, especially in the field.

FIRE PREVENTION

SHIPS

The major fire hazards on a ship are in areas where you as a passenger have no say, e.g. in the engine room and in the galley. However, the ship's crew is at least as aware of potential fire risks as you are. What is important from your standing is that you inform the crew if there is something in your scientific equipment that may increase the risk of fire or pose a secondary risk in case of fire, e.g. substances that produce toxic fumes when burning. Also, you are never allowed to overload the electrical system or to connect any apparatus if you are not sure that it is absolutely safe to do so (ask if you are unsure). If you smell smoke, burnt electrical wires, etc., contact the crew immediately. You must strictly follow all instructions on board, e.g. smoke only where it is allowed. If you need to do any work that may lead to increased fire risk, talk to the leading coordinator first.

STATIONS

At polar research stations like Wasa and Svea, you are in some ways even more vulnerable in case of fire than on a ship. Water is usually a scarce commodity, and the fire extinguishers that are in place are not enough to put out a major fire. Furthermore, the dry air dehydrates materials very quickly, e.g. wood can be much more flammable here than at lower latitudes. Typical fire hazards are handling of fuels, electrical power systems, cooking, and "hot" work, such as welding. At any station where you are staying, you should ask where there are smoke detectors or other fire detection system. As on a ship, you must follow all instructions for the station, and if they are not handed to you, you must ask for them. The station manager or equivalent should have some kind of fire instruction and fire drill at an early stage of your stay, in order to organise the activities in the case of fire. If this is not done, ask the station manager to give (all of) your instructions. You must also inform your coordinator if something in your scientific equipment may increase the risk of fire or pose a secondary risk in case of fire. Check where there are fire extinguishers and what kind of fire they should be used to fight. Also, check the location of switches to cut the electric power, propane gas, fuel lines, etc. If you smell smoke, something burning, or the distinctive smell of propane, you must immediately contact the nearest staff member. The same applies if you find any loose contacts, cables squeezed in doorways, etc. Disconnect electric appliances that are not being used. Be extremely careful if you use candles or any other open flame.

FIELD CAMPS

In the field, the main fire hazards are connected to the handling and use of liquid and gaseous fuels. All fuels are by definition fire hazards! There are some instances in which you have to be extra careful: when filling fuel containers, when transporting fuel, when re-fuelling cookers, and when using cookers in tents. You are never allowed to use candles inside sleeping tents. The use of cookers in sleeping tents is only allowed in extremely bad weather: mere rain or snow do not qualify as extremely bad weather. Given this, the risk of fire is usually quite low in field camps.

FIRE FIGHTING

Put out

If there is a small fire, by reacting quickly, you may be able to put it out before it develops into something more serious. However, if the fire is large and can threaten people, focus on saving them first.

Save

If you know or strongly suspect that there are people in the object on fire, you should try to save them. To humans the most dangerous aspect of a fire is the smoke: a couple of breaths and you may become unconscious. If the room starts to fill up with smoke, get down on the floor. There is always more oxygen and less smoke by the floor. If there are no people in the area on fire, close the door(s) to it.

Warn

Any person close by who may be affected by the fire should be warned of it.

Alarm

Sound the alarm, so that you can get help with putting out the fire.

Put out

Try to fight the fire, but do not take any unnecessary risks. Do not be afraid of using a fire extinguisher: it is much easier to put a fire out at the early stage than later on. (Figure 10.1)

FIRE EXTINGUISHING

A fire needs oxygen and a fuel with a temperature above its flash-point; any reduction in these three factors will reduce the fire.

The oxygen supply can be reduced:

- by covering it, e.g. with sand, by pulling a blanket over a person with their clothes on fire or by putting a lid on a pot with burning cooking oil;
- through the use of carbon dioxide, powder or foam fire extinguishers,
- tearing down what is burning, or
- by reducing the amount of available oxygen, e.g. through halotron systems in generator rooms.

SAVE

WARN

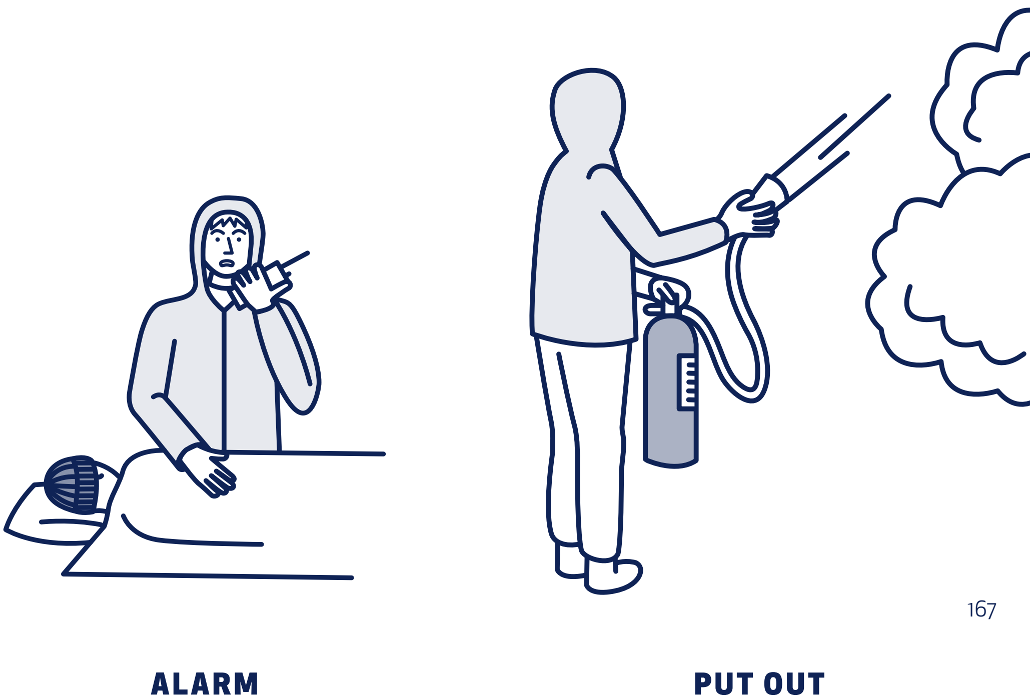
The fuel supply can be reduced:

- by tearing down burning material; or
- by reducing the fuel supply, e.g. closing fuel valves.

The temperature can be reduced:

- by turning electricity off in case of a fire whose cause is electrical; or
- by cooling the fuel down, e.g. with carbon dioxide or foam fire extinguishers, or with water.

Figure 10.1 Actions to be taken when detecting a fire.



Water should only be used to put out fires in wood and paper – used on other fires it may be extremely dangerous (e.g. it can cause a steam explosion when poured on burning oil)! However, fine water spray can be used to reduce the heat radiating from a fire. Foam, carbon dioxide, and powder can be used for all kinds of fire, but if possible avoid powder for fires in electronic and mechanical equipment (the powder is very difficult to clean afterwards).

Approach the fire carefully in a low position and aim the fire extinguisher at the base of the fire. Try the extinguisher first from some distance to see how (and if) it works. Make a decisive attempt to put out the fire and do not immediately stop putting it out when it seems gone. Fire extinguishers should always be treated with respect: the power of the pressurised contents, and the content itself, may cause injuries if the extinguisher is improperly used.

SHIPS

Since a ship is a very limited environment, particularly in the case of a fire, you must follow the instructions given by the crew so that you do not obstruct the firefighting. However, even if the crew have their own "fire brigade", you are not forbidden from putting out a (small) fire yourself if you are the first one on the scene.

STATIONS

There is usually no special fire brigade at the stations, so everybody must help out. The people staying at the station should be organised, but if you feel that nobody is in command, you must take command yourself. If there is a fire in the electrical system, the propane gas system, or any other fuel-fed system, you should cut the supply of the system in question. Extinguishing equipment is usually spread out around the station and placed at entrances of areas at greater risk for fire.

FIELD CAMPS

Most times in the field you do not have any special firefighting materials, except for possibly a "fire blanket". The exception to this could be, e.g., when the vehicle you are travelling in is equipped with a fire extinguisher. If you do not have any special equipment, you have to improvise. A minor fire can usually be put out by smothering it with something. If it is really small you may even be able to stamp it out (not to be tried with burning fuels!). A pot or a bucket can be put over it, so as to smother it, or water may help cool it down. However, if you are not sure that you can master it, do not take any chances: it is better to have some equipment destroyed than to have someone with serious burns to treat!

If a tent or sleeping bag is burning, pouring water over it may both cool and smother it enough to put it out. You should be aware that most tents, Gore-Tex clothes, and even fleece jackets burn quite slowly, and do not go up in flames like a flare. A small "person fire" can even be smothered with the help of a fleece jacket if you have nothing else (but act quickly, as open flames may melt the material and cause a nasty burn).

NOTES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11

MOVEMENT AND TRANSPORTATION IN THE FIELD

Dag Haugum

SAFETY

There are four basic safety rules that you should follow when moving in the field:

- Never go into the field alone.
- Always bring the minimum equipment.
- Always leave a travel note (färdmeddelande).
- Keep to the communications schedule.

NEVER GO INTO THE FIELD ALONE

This means that you are only allowed to leave the camp, station, or ship alone if you are given permission to do so or when the standing procedures allow for it. The reason for this is simply for your personal safety: if you hurt yourself, e.g. twist an ankle, then you have someone with you to help out. If you are lost in fog, then you have someone to discuss the situation with, which reduces the risk that you act rashly. If your radio or GPS is broken, then your partner may have a second set. This rule of never travelling alone applies equally to vehicles: you should always travel with at least two vehicles of the same kind together, e.g. two snowmobiles, two tracked vehicles, or two Zodiacs. If a vehicle gets stuck somewhere, you will then have another one to help tow it free, or if a vehicle breaks down, there will be another vehicle to go back to the camp in.

ALWAYS BRING THE MINIMUM EQUIPMENT

This may vary depending on the location and extent of the expedition. Still, the idea is that you should be able to handle any situation that was not planned for, but that may come up. Basic items are a radio or some other means of communication, a GPS, and a compass and map. What constitutes the "least equipment possible" that you always must bring with you when leaving the ship, station, or camp is regulated for each expedition. (See also Appendix 6.) Do not improvise during your trip: if you do not carry the necessary regulated equipment with you, e.g., for climbing a glacier or fording a river, then you are not allowed to do so. If you are not sure whether or not you have the proper equipment, then you must contact the expedition or camp coordinator.

ALWAYS LEAVE A TRAVEL NOTE

Before leaving the camp, ship, or station, you should leave a message stating where you are going and when you expect to be back (Table 11.1). If something happens, your life may depend on, e.g., the search and rescue procedure commencing on time and covering the proper area. You should be aware of the fact that if you are missed by the others at the camp, e.g. if you are overdue for your radio call to the camp, then all other activities will cease and a search for you will be mounted. Furthermore, when someone is missing and an accident is suspected, people searching for the missing will take risks that they normally do not. This means that if a search is mounted unnecessarily, you will have wasted precious research time for your fellow expeditioners and you may also have put them at serious risk! Camps and stations have their own procedures for how to leave travel notes, while on ships the information should be passed to the officer on watch on the bridge.

WHAT A TRAVEL NOTE SHOULD ALWAYS INCLUDE (11.1)

- **Who** is leaving (all names)
- **When** you are leaving
- **When** you are expected **back**
- **Where** you plan to go
- **What** you intend to do
- **What communications equipment** you bring with you
- **What other safety equipment** you bring with you

KEEP TO THE COMMUNICATIONS SCHEDULE

Each group going into the field must be equipped with some means of communications, be it a radio or a satellite telephone. You must check that it works and that you bring enough batteries, or the equivalent, to last the whole trip (plus a reserve). You must do everything you can to keep to the time schedule for contact that has been decided on beforehand. Missing contact always lead to worries and the risk of unnecessary search and rescue operations. If atmospheric conditions make it impossible to keep an appointed contact time, the next one becomes even more important. If you do not have a valid reason why contact was not kept, you may be held financially responsible for any rescue operation that is mounted.

THE BOTTOM LINE

Do not take any risks unless you have prepared for the worst-case scenario and are absolutely sure that you can handle it! Make sure that your actions follow accepted procedures and practices and comply with the expedition's safety regulations. It must be stressed that there are no scientific data in the world that are worth a person getting injured for or worse! You must always make realistic estimates of how long the trip will take and of your own capability. See to it that you have margins, e.g. if the weather turns bad. These margins apply to both time and equipment.

ORIENTEERING

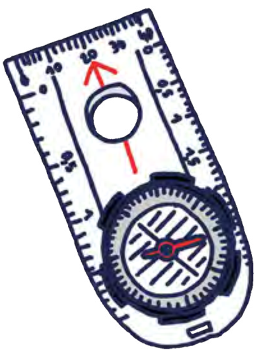
MAPS

The Secretariat may provide overview maps for the leading coordinator. These maps will be used only for organising the expedition and will be kept at the station, camp, or ship. It should be noted that for the polar regions, maps with a finer scale than 1:250,000 are uncommon, and updates can be few and far between.

COMPASS

For those not familiar with using a compass, you should place the compass on the map with the long side of the compass along the course you want to take. The arrow should point in the direction of your intended course. While holding the compass steady, turn the compass housing so that "north" on the house corresponds to "north" on the map. You have guiding lines in the compass housing that should be oriented parallel to the north-south lines on the map. Lift the compass from the map and turn until the compass needle points to "north" on the compass. The arrow on the compass (and the long sides of the compass) then points towards your goal (Figure 11.1).

In most places on earth "true north" and "magnetic north" differ. The cause of this may be (1) that the magnetic north and south poles do not lie at the geographical poles, and (2) possible local deviations in the magnetic field. On most maps the deviation between true and magnetic north is stated. It should also be noted that most standard compasses that you buy in Sweden cannot be used in Antarctica. The reason for this is that around the equator, the magnetic field is more or less parallel to the earth's surface, while the closer you get to a magnetic pole, the more perpendicular the field will become, i.e. its inclination increases. Regular compasses bought in Sweden have needles balanced for the inclination of the magnetic field there, while in Antarctica you need a compass balanced for that magnetic field inclination.



GPS – GLONASS

GPS (Global Positioning System) is American and consists of some 24 satellites circling the earth in

Figure 11.1 You use the compass as a direction indicator by first laying the long side of the compass along an imaginated line from your starting point to your goal, on the map, with the arrow towards the goal. Adjust the help lines inside the compass house to be parallell to the north-south lines on the map, with the compass house's north pointing to the map's north. Without moving the compass house, turn the compass so that the magnetic north-south indicator falls within the compass house's arrow. The main arrow of the compass now points towards your goal.

six orbits. GLONASS is the equivalent Russian system. The satellites transmit radio signals to the receiver, which uses the signals from several satellites to calculate its position in relation to the satellites. In principle, if you draw imaginary lines between the receiver and the different "visible" satellites, and also between the outermost satellites, you will get a three-dimensional polygon. The larger the volume of this polygon, the more accurate the positioning (Figure 11.2). Thus, the ideal condition is that you have the visible satellites spread around the sky above and around you. Landforms or even human bodies that block the radio signals further reduce the theoretical volume and decrease certainty in terms of positional exactness.

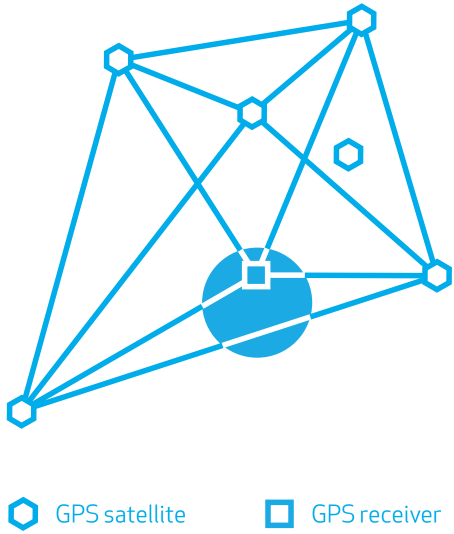
The normal exactness of a GPS receiver is such that the deviation between the calculated position and the actual position should be fewer than five metres, in most cases. There are ways to increase this exactness, e.g. through differential GPS, but such systems are quite expensive and less versatile than regular handheld receivers. The GPS receiver is mainly a tool for determining your position. It should not be used instead of, but rather, as a complement to using a compass and map. If you are travelling at some speed, e.g. in a boat, on a snowmobile, or in a tracked vehicle, it is easy to determine the direction you are travelling. However, when travelling by foot it should not be used as a direction finder (unless it has a in-built compass): you should use a handheld compass instead. You can use both pre-programmed waypoints or enter them as you go along. The waypoints can be incorporated into routes. If you calculate a waypoint from a map, this waypoint may differ slightly from reality. The reason for this is basically that the map is a two-dimensional approximation of a three-dimensional reality. At the beginning of the expedition, you will be instructed in how to operate the kind of GPS receiver that you will be using during the expedition.

LAND TRANSPORTATION, TUNDRA

ON FOOT

One striking characteristic of the tundra is that the normal visual perspective is not applicable. Things that you normally use as points of reference, like trees or other vegetation, are absent, and because of the clear air, hills may seem to be much closer than they actually are. It usually takes a week or two before your mind has adjusted to this difference. Even then, it is easy to get lost

Figure 11.2 In this figure the GPS receiver receives signals from six satellites. If one draws imaginary lines between the receiver and the satellites furthest out on the receiver's horizontal view, and between the satellites outermost in space (in this case a total of five satellites), an imaginary polygon is formed. Here the polygon is delimited by eight planes, drawn between five satellites and the receiver (the sixth satellite lies within the polygone). The larger the volume of this imaginary polygon, the more exact the positioning of the receiver.



when travelling into new areas; suddenly the terrain looks the same in all directions. When you move out of well-known areas, always use GPS, as well as a compass and map. Do not think "I am just going for a short stroll, so I do not need to bring anything extra". Also, in the polar regions, the weather may change very quickly for the worse, and you must be prepared for this.

VEHICLES

In general, the use of land vehicles on the tundra is strongly discouraged by the Secretariat. Although they may be handy, the ground cover on the tundra is generally very sensitive and susceptible to damage. Also, the use of light vehicles, such as motorbikes and ATVs (all-terrain vehicles), may increase the risk of injury, and transportation of the vehicle and its fuel into the field may be both difficult and costly.

LAND TRANSPORTATION, ICE AND SNOW

AREAS THAT DESERVE EXTRA CAUTION

In certain areas, particularly close to hills and mountains, the wind will often carve out wind channels. These come in all shapes and sizes and often have an overhanging wind drift at the top. Around Basen, the nunatakk on which the Swedish station Wasa lies, there are several wind channels, both where you would expect them, e.g. on the south-eastern side by the steep cliffsides, and where you might not expect them, e.g. on the low slope in the direction of the neighbouring nunatakk Plogen.

You are not allowed to go skiing or driving snowmobiles in areas that have not been reconnoitred and deemed safe by the coordinator. Wind channels are particularly difficult to spot from the slope below and in flat terrain. If you see a hole in the snow before you, you are not allowed to approach it without taking appropriate safety measures (see Chapter 14), as the hole may be a deep wind channel or a deep crevasse with a weak overlying snow bridge. Where the glacier ice meets a bare rockface there are often cracks and crevasses caused by the sun warming up the cliff and melting the ice, and here again the cracks and crevasses may be bridged over by snow. You must therefore be very careful when moving between ice and rock.

On slopes covered with ice, snow, or loose rocks, you must be extra cautious. You must be observant of the fact that the slope and the surface conditions may change as you move! If there is a real risk of crevasses, you should follow the instructions that apply to moving on glaciers. The ground's slipperiness is not only determined by the angle of the slope but also by the condition of the surface: a hard, smooth surface can be extremely slippery even at small angles, as in blue ice areas. Blue ice is formed where the glacier ice has a negative mass balance, i.e. more ice is melted and evaporated by the sun than is accumulated by snow and drift. Blue ice is just what it says, ice, and the surface is very slippery. Here, very large cracks can be covered by thin layers of ice, corresponding to snow bridges over crevasses, and even if the risk of you falling into a crack is small, you can still twist an ankle or break a leg.

Even if the precipitation in many areas of Antarctica is at a desert-like level, there is snowfall, and the wind can locally accumulate large amounts in a short time. The wind can also pack snow very hard. This is noticeable, e.g., in the low, sand dune-like formation called by the Russian name sastrugi. Sastrugis as such are not dangerous, only a nuisance, but driving over them fast can damage equipment, and they may cause damage to the landing gear of aeroplanes. Another phenomenon caused by wind is the drifts that form in the lee of any object, and which can bury the object quite quickly. Snowdrifts are also formed on the lee-side of slopes. After storms there can actually be a marked avalanche risk, and you are not allowed to move in such lee slopes until they have been checked by the person responsible for the expedition's alpine safety. In general, all areas with loose snow should be avoided, as they are difficult to walk in and vehicles easily get stuck there.

ROUTES

Over the years, a number of transport routes have been reconnoitred over the Antarctic inland ice. The main reason why all transports should use these known routes is for the safety of personnel and equipment. Before a route is recognised as such, it has been subject to thorough reconnaissance work with the aim of placing the route away from crevassed areas. Also, by limiting travel to established routes, the negative effects on the environment are concentrated to as small an area as possible. To be allowed to travel outside of the established routes you must have the coordinator's permission in each individual case.

The reconnaissance of a new route is usually done beforehand with the help of satellite images. Today, the resolution is so good that crevassed areas are often easily seen. In some cases, this can be complemented by air reconnaissance. During such flights, the helicopter/aeroplane may also land to allow reconnaissance on foot in tricky areas. In seemingly safe areas and on previously used routes, the reconnaissance is usually done from snowmobile and on foot. So-called "drones" (unmanned aerial vehicles, UAV) may also be used as a complement in the field – if such are brought and weather permitting. During the reconnaissance work, a number of waypoints are determined, using GPS receivers. The waypoints are positioned at each place where the route changes direction. These are the GPS waypoints that should be used for navigation!

To provide a confirmation that the navigation has been correct, the waypoints may be marked;

if and how this is done on any given expedition is decided by the coordinator. Along some routes you may find stakes in between the waypoints. You should always think twice before following such stakes, as they can be quite old and the ice moves as it flows “downhill”. From a distance it may also be impossible to determine whether a stake has been placed as a route marker during some previous Swedish expedition or if it has been placed there for some other purpose. In other words, unless you are completely sure that they have been set up during your expedition, do not trust stakes or other route markings. On more difficult tracks, e.g. over the sea ice in connection with off-loading and loading of ships, the route is marked more closely with stakes. In such cases the stakes are placed so that they can be used for navigation even in poor visibility. These route markings are temporary and are taken down when the activity is finished. When travelling along a route, it is of the utmost importance that you do not deviate from it! Reconnaissance of new routes and any deviation from established routes must be approved by the leading coordinator.

DRIVING OF VEHICLES

All driving of vehicles requires the use of fossil fuels and creates pollution by exhaust fumes. Therefore, all driving should be minimised to the extent that safety allows. When driving a vehicle, the following regulations apply:

- You must have permission to use a vehicle from the leading coordinator or someone designated by the coordinator.
- Which vehicle you can use is decided by the

logistics manager, or by someone designated by the logistics manager.

- You must always leave a travel note.
- You must bring along a radio or equivalent, and emergency equipment as per the expedition instructions.

If you need to repair something on a vehicle, you should use the proper tools (like the vehicle's own). You are only allowed to use multi-tools when proper tools are unavailable!

CULTURAL AND SCIENTIFIC SITES

Whenever you come across what could be a site of ongoing research, historical remains, or a native people's sacred site – on the tundra or in Antarctica – you must make certain that you know what rules and regulations apply to visiting such places. If you are uncertain, then you should not approach it without further instructions from the leading coordinator.

WATER

SURVIVAL SUITS AND FLOTATION DEVICES

The Secretariat will decide for each given expedition which flotation devices will be provided, based on an estimate of actual risks. Life jackets and flotation overalls can be sufficient in situations where immersion hypothermia will not be a serious problem, while in others survival suits are brought. One reason why full protection survival suits are not always used in connection with open-boat sailing and work on the sea or lake ice is that they are sometimes too impractical. If the risk of falling into the water is deemed low, or if the consequences of falling into the water are not considered very serious, then people may start wearing the suit in an inappropriate way, e.g. with open zippers. A tight-fitting survival suit is both cumbersome and can become very warm, but a survival suit worn with open zippers, etc. can become a death trap! Furthermore, when working on sea ice, such as when unloading a ship in Antarctica, it may be more important to be able to move quickly, and a survival suit may be so cumbersome that it actually increases the risk of injury.

The ship's captain, or the coordinator, will decide from situation to situation what kind of flotation device you must use. You must always wear your flotation device in the proper way, i.e. it must be fitted, all straps must be secured and all zippers must be closed. If you fall into (cold) water, your movements will exacerbate heat loss. The best position for conserving heat is to crouch into a foetal position, making your surface exposed to the water as small as possible, while also trying to protect bare skin. How long a person can survive immersed in cold water depends on so many factors that it is impossible to give any reliable "degrees-hours" chart.

SEA ICE

Sea ice is a dangerous environment, and you are not allowed to walk or drive onto sea ice without the coordinator's permission. You should not travel on sea ice thinner than 75 centimetres. Weather and currents constantly affect the sea ice, and the forces that are involved are incredible. Even a very light swell may cause sea ice to break up, and it can happen rather quickly. When walking on sea ice, you must be aware that cracks and seals' breathing holes may be covered with snow and impossible to detect. You not only run the risk of ending up in the water, but also of breaking a leg in such holes and cracks. The coordinator will decide whether or not a survival suit must be worn when on the ice, and you are never allowed to be on the ice alone. In the Arctic, you must also be aware of the risk of meeting polar bears, especially in areas rich in seals and along pressure ridges and other places where the bear can lie in ambush (its common way of hunting).

Driving on sea ice should only take place along reconnoitred routes, away from cracks, on ice of adequate thickness. In general, only the driver and, possibly, the co-driver are allowed to be in the cabin of a tracked vehicle. The reason for this is that if you get stuck in a crack, all the people in the vehicle must be able to leave it quickly and without any risk of panic. When driving on sea ice, the main risk may not be that the whole vehicle and the people in it sink into the sea, but rather that because of cracks the vehicle and its cargo get stuck on an ice-floe without any possibility of retrieval. All operations on sea ice must therefore be as quick and as smooth as possible. They should be planned well ahead by experienced people. Another danger in connection with walking or driving on sea ice in Antarctica is the route between the sea ice and the shelf ice.

The sea ice is frozen seawater, while the shelf ice is glacier ice formed inland that is floating out into the sea (the actual coastline is usually tens of kilometres “inland” from the shelf ice’s edge). The outer edge of the shelf ice drops down quite steeply to meet the sea ice. The risk of going over the edge should be taken seriously since the drop may be tens of metres high, even in low shelf areas. In poor visibility you must be extra careful in your driving when you are close to the shelf edge. When walking in such areas, you must apply safety techniques (see Chapter 14), both because the slope may be steep and slippery, and because there are often cracks close to the edge. When driving vehicles between the sea ice and the shelf ice, a natural ramp is often used. This ramp consists of wind-driven snow and should not be treated as if it had been built of concrete; there may be hollows, weak snow bridges, areas with loose “powder”, etc. Furthermore, the tidal movement of the sea creates cracks between the sea ice and the ice shelf that should always be considered as fresh cracks. Every passage over the ramp must be done with the utmost caution and should be supervised by an experienced person.

AIR

Air transportation in polar regions often means that you go either by helicopter or by cargo aeroplane. In both cases, you will experience a lot of noise, and it could be a good idea to bring some ear plugs to protect your hearing. The noise may be very stressful, especially when you are being picked up by a helicopter. Many people make the mistake of thinking that everything concerning a helicopter pick-up or drop-off must be done in a hurry. It is actually the other way around: the pilot prefers that you take your time so that the equipment is stored, the people have buckled up, and the doors and hatches are closed, all in a calm and proper way. Even in a medical evacuation situation, you should act carefully so as not to cause any delay during the flight due to rushed actions when loading the helicopter or aeroplane. It is the pilot alone who decides if a mission can be done. The pilot's priority order is always (1) the safety of the helicopter or aeroplane, (2) the safety of any crew, and (3) the mission. Even if things look okay to you, the pilot may have misgivings and choose not to go through with it; that is the pilot's privilege. In non-emergency situations, no expedition member may order a flight unless given permission to do so by the leading coordinator.

Even in a potential medical emergency you should try to contact the coordinator before calling out for a flight (Table 7.1. *Incident reporting*), as there may be circumstances that you do not know of that affect the overall situation. There are some basic rules when requesting and receiving helicopter transport (Table 11.2)

When you are to receive a helicopter:

- First make sure that there are no loose objects that may fly into the rotors due to the (strong) downwash.
- Then, stand with the wind to your back and your arms stretch into a Y-position (the Y-positions means "Yes"), and stay that way until the helicopter has landed. If the helicopter gets very close, go down on your knees and lower your arms – but stay in ploace!

- Finally, do not approach the helicopter until given a sign from the pilot that it is OK.

During any flight you must bring along equipment so that you can cope with unexpected delays and landings. This is especially important in Antarctica, where extra warm clothes, a sleeping bag, and a sleeping pad are usually mandatory. It is also good to bring some food, something to drink, and warm clothes in case the weather turns bad. The helicopter or aeroplane is usually only carrying extra equipment for the pilot(s). When flying longer stretches over open water, a flotation device must sometimes be worn: it is the pilot who decides whether this is the case.

UNEXPECTED SITUATIONS AND EMERGENCIES

Do not take any risks unless you have prepared for the worst-case scenario and you are absolutely sure that you can handle it! It is worth stressing again that there are no scientific data in the world that are worth a person getting injured for or worse! You must always make realistic estimates of how long the trip will take and of your own capability. See to it that you have margins, e.g. if the weather turns bad. These margins apply to both time and equipment.

EMERGENCY BEHAVIOUR

It can be very difficult to accept that you actually are in a situation where you need help, e.g. you are lost, and decide to start acting according to this

INFORMATIONS NEEDED AT REQUEST OF TRANSPORT (11.2)

• **Your exact position** (preferably map references, as well as latitude, longitude, and altitude) and distinct landmarks.

• **Number of people** to be transported and how much cargo (weight and volume).

• How you will arrange the **landing spot** (markings etc.).

• **Light, visibility, wind conditions and cloud-base height** (preferably a full weather report, see Appendix 8).

• Ask the person who receives the information to **read back the information** (to ensure that it is correctly received).

PREPARATION OF THE LANDING SPOT

• **Check** that **the ground** will take the helicopter's weight.

• Make sure that there are **no loose objects** that may fly into the rotors due to the (strong) downwash (within a radius of 50 metres).

• **Mark the wind direction** (a flag, a fire etc.).

• **Stand well clear** of the landing spot.

• If you have a radio, **call the helicopter** when you hear it.

• **Stand with the wind to your back and your arms stretch into a Y-position** (the Y-positions means "Yes"), and stay that way until the helicopter has landed. If the helicopter gets very close, go down on your knees and lower your arms – but stay in place! The rest of the group and the equipment should be behind you.

WHEN THE HELICOPTER HAS LANDED

• **Stay away** from the tail rotor.

• **Do not approach** until the pilot gives the OK sign.

• Approach from the front, k**eep eye contact** with the pilot and, if it is a small helicopter, keep low to avoid the main rotor.

fact. When something unexpected happens, you have a prolonged delay, or an emergency occurs, follow "STOP":

Stop : do not rush your actions.

Think : instead of doing something rash.

Orientate yourself : try to find out where you are, or what has really happened.

Plan : decide what actions you are going to take, then carry them out in the right order.

Never hesitate to bring out the emergency equipment: you should instead consider it as "unexpected situation equipment". Put up the tent and get some warm food in time. You can easily pack the tent again, and the food is replaceable – you are not!

To decide what you should do once you have stopped and calmed down a bit is not always easy. You may feel embarrassed about setting up camp and waiting for help when the camp may just be "beyond the hill over there". Once you are in a situation where you need help, do not move from that place unless this will, with 100% certainty, improve your chances of getting help. When people start looking for you, they will follow the information in your travel note; they will not start looking "beyond the hill over there". Remember that if you cannot get in contact with the rest of the expedition, you will sooner or later be missed – nobody is left behind when the expedition leaves. However, this "sooner or later" can be drastically reduced if you follow some simple instructions: leave a detailed travel note and keep to the communications schedule!

If you are missed beyond the time limit specified in the expedition instructions, a search operation will be mounted. Given the normal circumstances for polar expeditions, the only available personnel for this are the other expedition members. Thus, the search teams are rather small for the task of looking for someone in a large area. The more detailed the information you give in your travel note and the less you deviate from it once out in the field, the greater the chance that you are found sooner rather than later. You must do everything you can to adhere to the schedule for radio or satellite contact that was decided on beforehand. Missed contacts always lead to worry and the risk of unnecessary search and rescue operations. Since a search operation involves all expedition members, an unnecessary operation of this sort will steal valuable research time from your colleagues. Furthermore, in search operations people tend to take risks that they normally would not take. This means that unnecessary search operations may put people's lives in jeopardy when there is no reason for it.

DISTRESS SIGNALS

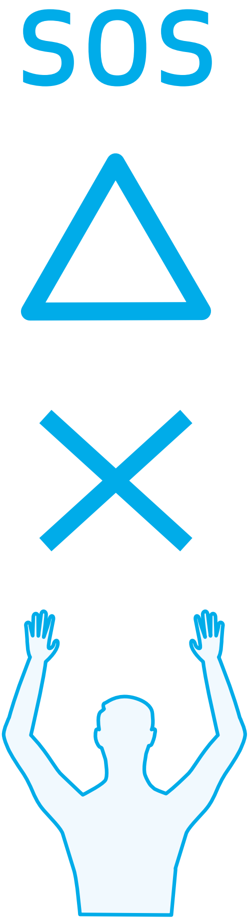


Figure 11.3 Established symbols of distress are, e.g.
1. SOS
2. A triangle
3. A cross
4. Standing with both your arms raised

When you think that people have started looking for you, you can make their work easier by making distress signals (Figure 11.3). Distress signals should be high, clear, and in contrast with the background. The signals or symbols should be at least three metres high and placed where they will be as visible as possible. You can create a contrast with the background by creating shadows, e.g. by trampling snow or by laying bushes. A person signals distress by standing with both arms raised imitating a “Y”, meaning “Yes”. (N.B.: A person standing with only one arm raised means that all is well, imitating an “N”, meaning “No”.) Other conventional signals of distress are three of something, like whistling signals, shots, fires, etc. Remember that you can blow a whistle for much longer than you can shout! Also, all shiny materials can act as signal mirrors, and flashing lights will always attract attention. You do not need to shake your hand while using these materials: the normal trembling of a hand is enough to produce a blinking light. Just aim the sun’s reflection in the general direction where you think help may be. You should do all you can to increase your visibility, like spreading things out and moving about, since everything “unnatural” is more easily spotted. If you can, make a fire (smoke). If you have flares or signal rockets, then use them, but only when you think somebody is looking for you or when you hear a helicopter or aeroplane (do not fire at the vessel!).

EMERGENCY EQUIPMENT

The equipment you need to bring for "unexpected situations" is such that you can keep yourself "warm, dry, and with a full stomach". Exactly what this is depends on the circumstances (see, e.g., Appendix 7). If you venture outside the camp, the absolute minimum to bring is a radio with spare batteries, a compass, extra clothes so that you can cope with deteriorating weather, and some food and (hot) drink. The further off you plan to go and the longer you intend to stay away, the more equipment you must take. In Antarctica, each vehicle is equipped with an "emergency box".

EMERGENCY BIVOUAC

If you have to be stationary in a given place, you should always protect yourself against any weather condition that may affect you negatively, e.g. against the wind, the cold, and the rain: always prioritise the worst (Table 11.3)!

Of course, most times the best and easiest way to protect yourself is to erect your tent, light the stove, and snuggle down in your sleeping bag. However, if you find yourself without this equipment, or if it is broken, you will have to improvise. There are different emergency bivouacs that you can build (Figure 11.4). A lean-to basically consists of a back wall and two side walls that can be made of anything that acts as a shield against the wind. If you do not have enough waterproof material, the angle of the back wall must be at least 45°. You should make an effort to draught-

IN AN EMERCENGY, PRIORITIZE THE WORST (11.3)

Seek protection from the factor that negatively affects you the most:

Wind
Find lee e.g. by seeking a lower elevation, or by building a lean-to, a snow mound or a sleeping hole.

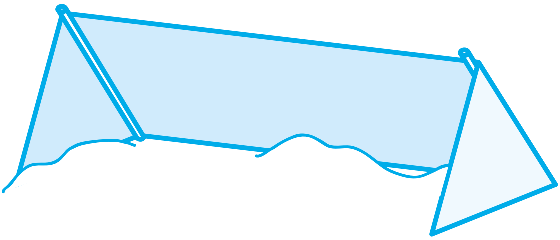
Cold
Find warmth e.g. by lighting a stove or fire, by having some food or hot drink or by using your sleeping bag.

Rain
Find cover e.g. by putting up a tent or by building a lean-to or other kind of "roof".

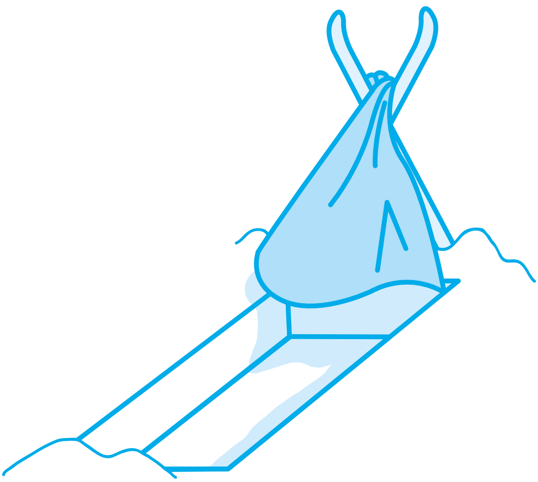
Hunger

proof the base of the walls (up to sleeping height) with windproof material. Use your imagination! Start making a sleeping hole by trampling or digging down. Then, insulate the walls and the floor. Finish by putting skis, sticks, and clothes together as a lean-to (against the wind). To make a snow mound, start by making a heap and pat the snow down. Put thin sticks, 30–50 cm long, into the heap and let the snow freeze for four to five hours. Dig a small opening hole and then continue to hollow the mound from the inside. Stop when you reach the sticks that you put in earlier. In this way, you ensure that the walls will not be thinner than 30–50 cm. Leave a raised sitting/sleeping bench, put your equipment on the floor, dig out a low point at the entrance (acting as a cold trap), and do not forget the ventilation hole over the stove or candle. Do not give up until you have arranged the camp, changed into dry clothes, heated water, cooked food, etc. Do not work up a sweat! If you must stay the night or take a rest, remember: “a lot on top of you, a little on, and a lot under you”. Decide that you will survive!

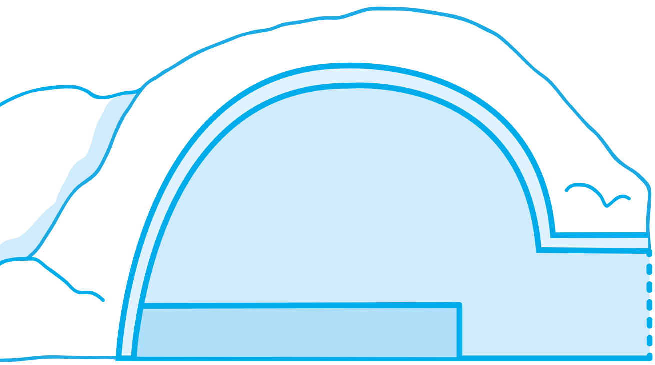
EMERGENCY BIVOUACS (11.4)



Lean-to (1 or more persons)
2 metres long, 50cm deep + another 50cm per person, back wall with at least 45° angle.



Sleeping hole (single person)
2 metres long, 80cm wide, 50cm deep.



Snow mound (2-3 people)
3 metres diameter, 2 metres height, walls 30-50cm thick.

NOTES

12

WEATHER

Dag Haugum

WEATHER AND METEOROLOGY

WHAT IS WEATHER?

By "weather", most people mean clouds, wind, rain, clear skies, storms, etc. Temperature decreases with altitude, normally at around 0.6° C per 100 metres. The cause of this is that as (air) pressure decreases, air expands, and this expansion requires energy, which is taken from the air's heat. (You can experience the same phenomenon when you let out pressurised gas quickly – the gas canister will get colder.) So when warm, humid air rises, it will eventually cool down enough for the vapour to condense, i.e. the water will form droplets that can be seen as clouds. Typical cloud droplets are so small that they remain airborne, and may even move upwards with rising air – this can be seen on warm summer days when clouds start to form in the morning and continue to expand during the day (cumulus clouds). Often such clouds collapse in the late afternoon, simply because the Sun starts to sink and will not heat the Earth's surface enough, i.e. it does not create thermal up draughts of moist air.

Movement of air within a cloud can make droplets collide and merge. When they grow large enough, they start to fall. If the drops reach the ground, it rains. If there is enough water vapour, and heating is enough, then the clouds will grow so high that ice crystals are formed at the top of the cloud. If the air temperature is low enough, the ice crystals do not melt but reach the ground as snow. Hail is caused by very strong updrafts within clouds that lift falling rain drops up to freezing altitude. The frozen drops may fall to the ground, or be lifted up again, colliding with rain drops both on the way down and up, and grow larger before they reach the ground. Fog is also created by vapour condensing due to lowered temperature of humid air or by adding humidity.

Wind is usually the result of an atmospheric low pressure that needs to be "refilled". As high pressures tend to cover larger areas than low pressures, wind in high pressure areas are usually much weaker than the ones associated with low pressures. Cooling of air on mountains or ice plateaux can cause cold, denser air to blow down a slope, so-called "katabatic winds".

WHAT DETERMINES THE LOCAL WEATHER?

The beginning of most "weather" is the formation of atmospheric low pressure. In the equatorial zone, the heat from the Sun causes thermal updrafts that can create thunderstorms if there is enough energy. Over the oceans, such tropical storms may develop into hurricanes (typhoons) if the surface water is warm enough (27°C) – water vapour releases a great deal of energy when it condenses. Due to the Coriolis effect, the air that is "sucked" in by the equatorial low pressure tends to turn to the right north of the Equator, and to the left south of the Equator. This gives rise to the northeast and southeast monsoons, respectively.

Low pressures also tend to form where the polar and equatorial air masses meet, at around 50°–60° latitude (The Polar Front, Figure 12.1), simply because the air from the respective high-pressure zones will go where the resistance is the least (up). Just like at the Equator, the more vapour that condenses as the air rises, the more energy is released that "feeds" the low pressure. At these latitudes, the general wind direction is from the southwest on the northern hemisphere, and from the northwest on the southern. This is caused by the Coriolis effect acting on the air from the subtropical high pressure going north. This is somewhat counteracted by the polar air going south, but overall the subtropical high is stronger than the polar. The (south)westerlies are particularly strong when the polar high pressure is weak.

Air masses and fronts

Air masses are formed when air is undisturbed over a homogeneous area (Figure 12.1).

cA = Continental Arctic air
cP = Continental Polar air
mP = Maritime Polar air
mT = Maritime tropical air
cT = Continental tropical air

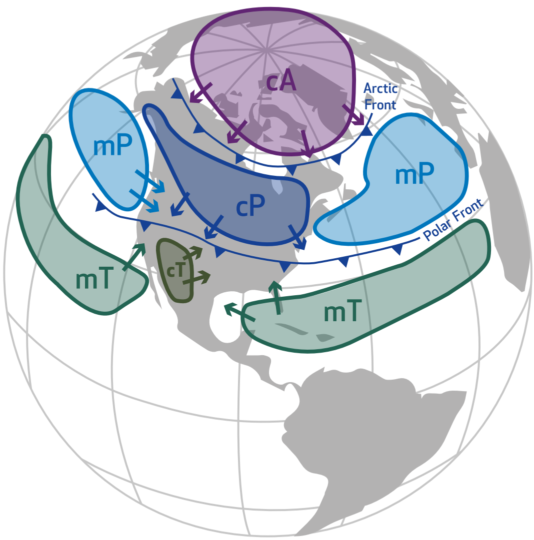
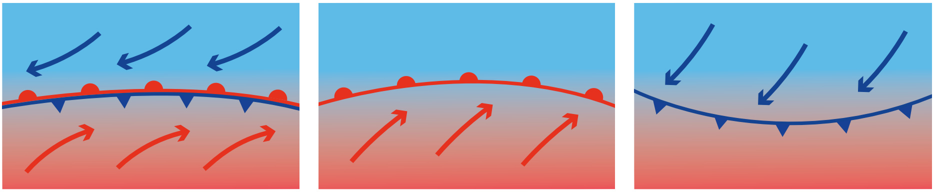


Figure 12.1 Five types of air masses.

Where air masses with different temperatures meet, there is a "front". If two adjacent air masses are not moving in relation to each other, the front is stationary. If the air mass with higher temperature is encroaching on the one with lower temperature, a "warm front" is moving, and when it is the other way around, a "cold front" is moving (Figure 12.2).

Figure 12.2 Front types, with their respective map symbols.



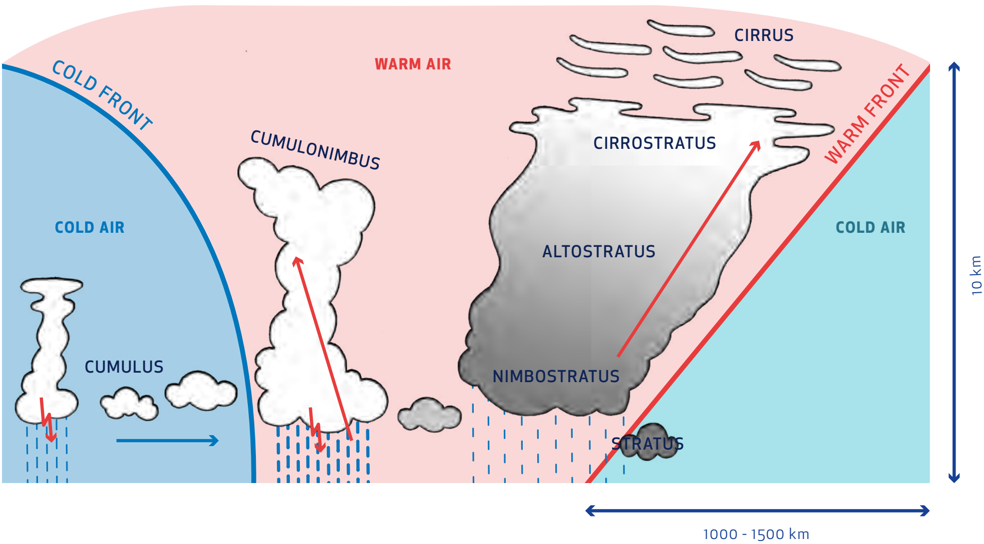
Stationary front

Warm front

Cold front

As cold air is denser then warm air, the scenarios in which a cold front is moving is somewhat different from when a warm front is moving: different cloud types are formed, with different precipitation patterns (Figure 12.3).

Figure 12.3 The process, cloud formation and precipitation patterns of a cold and a warm front.



Along a stationary front, there is sometimes a disturbance that leads to the formation of a low pressure (Figure 12.4). In the temperate and sub-Arctic/sub-Antarctic regions, the westerly winds tend to push towards the east. In the winter, the polar high pressure is stronger, and low-pressure formation is pushed to lower latitudes, while the opposite is true during the summer.

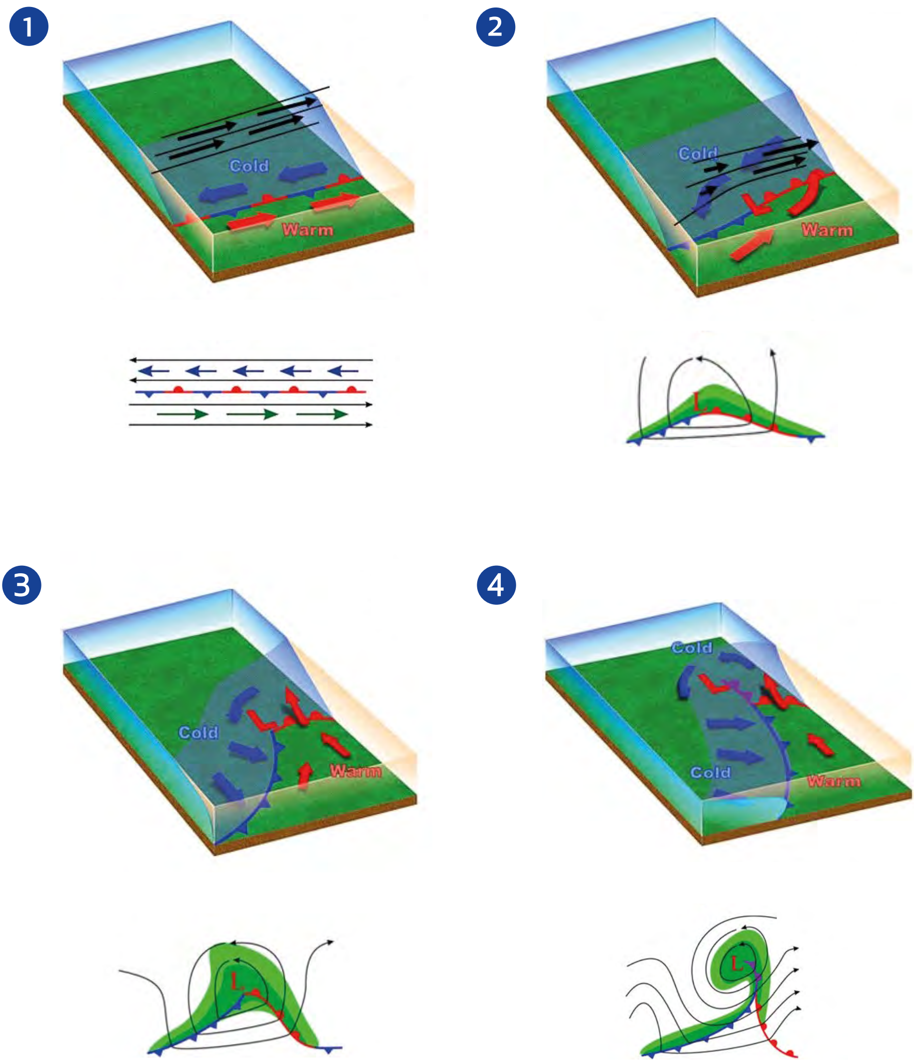
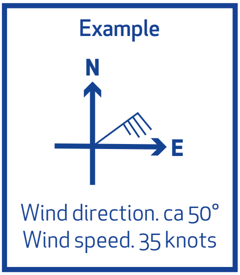


Figure 12.4 Low pressure formation and development along a front.



Depending on where you are in relation to the low pressure's movement, you will see clouds and experience precipitation, as illustrated in Figure 12.4. The more and more quickly the air is heated up, the more energy/heat the low pressure receives from condensing water vapour, and the stronger the up draught. This in turn lowers the air pressure. The deeper a low-pressure area is in relation to its surrounding, the stronger the wind will be. On meteorological maps, air pressure is often drawn as isobars, i.e. lines depicting the same air pressure at ground level (Figure 12.5). The wind is blowing from higher to lower pressure, at an angle to the isobars.

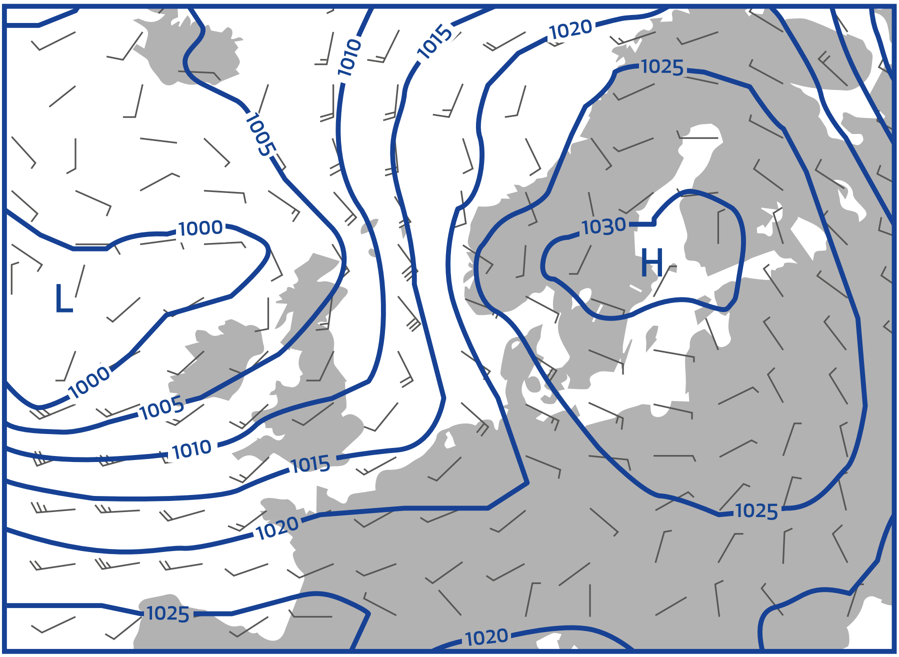


Figure 12.5 Wind and isobars at ground level. Wind is indicated by the symbol The long arm shows the wind direction; in the example above the wind is coming from the northeast. The arms to the side denote the wind speed, where a full arm equals 10 knots, and an half arm equals 5 knots. (One knot equals 1.852 km/h, or app. 0.5 m/s.)

Geography and weather

The local geography may influence the weather significantly. The greatest influence is mountains and (larger) bodies of water. When air moves towards a mountain, it will be lifted up and cooled down. If this leads to the condensing of vapour, “orographic” clouds are formed. Such clouds can be quite stationary over time. Also, this kind of condensing can also lead to precipitation on the windward side of the mountain. If so, then the air that has moved over the mountain will of course be drier on the leeward side, and the condensing level will be higher up the mountain (Figure 12.6).

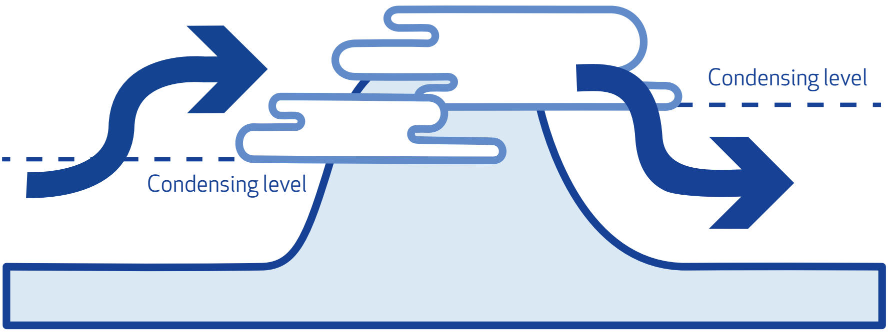
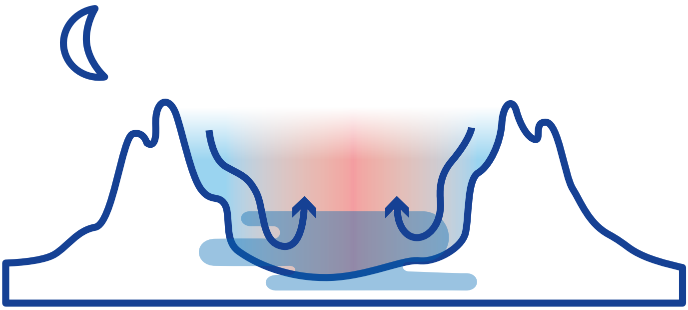
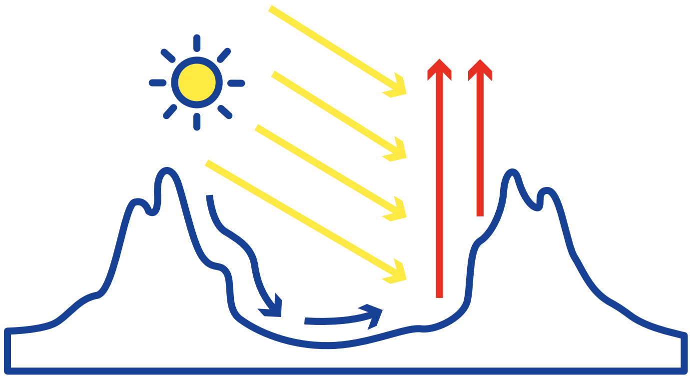


Figure 12.6 One effect of mountains is the formation of orographic clouds. Another is that the leeward side of the mountain may receive much less precipitation than the windward does.

In some areas, this effect is so strong that the leeward side is said to lie in a “rain shadow”, where the land can be quite dry. Winds over Norway and northern Sweden, for example, are mainly from the west. The Norwegian west coast gets some 3,000 mm of precipitation, while the Swedish side of the Norwegian mountains gets some 600 mm. Mountains can also have other effects, such as creating a daily cycle of mountain and valley breezes (Figure 12.7).



Mountain breeze



Valley breeze

Figure 12.7 At night, cool denser air on the slopes sink from higher to lower ground; creating a mountain breeze. During the day, air above heated ground will rise, while cooler air will sink on the shaded side replacing the rising air; creating a valley breeze.

When wind is channelled through mountain passes, the wind speed can increase very significantly.

Larger water bodies (large lakes, oceans) tend to moderate short-term shifts in temperature, in that it takes a lot of energy to heat up water, and the water has a high heat-retaining capacity. Over a year, the same thing leads to a later arrival of spring, and of winter, for locations near the sea. The relatively flatness of a water surface also brings about reduced resistance to wind, as compared to, e.g., vegetated land. This means that the wind over a sea surface may be quite a bit stronger than on adjacent land. In the wintertime, if a water surface is not ice-covered, cold winds may pick up moist air above the water, resulting in heavy snowfall downwind.

METEOROLOGICAL OBSERVATIONS AND PARAMETERS

On polar expeditions there are two main reasons why you may want to keep track of the weather (besides any scientific reasons). The first is when you have upcoming air operations, the pilot may want up-to-date local information that may affect flying conditions. They may want information both before take-off and while in flight.

If possible, you should report (see also Annex 8):

- **temperature**
- **dew point** (or relative humidity)
- **wind speed and direction**
- **weather type,** eg. precipitation and its kinds (especially if its freezing), fog, lightning
- **cloud cover and height(s)**
- **visibility**
- **barometric pressure**

The other situation where you would like to keep track of the weather is before and during work away from the camp or station. For that it is easier if you monitor the weather continuously during your stay in the field. Even if you get weather reports from a meteorologist, you can keep track of barometric pressure, wind speed, and direction, temperature, and precipitation to help predict how weather systems are moving towards or around you. Changes in cloud cover and especially cloud types can also provide indications of what the weather will be during the coming day. You should also try to interpret how the local terrain affects the weather in your area, e.g., by comparing if and how the actual weather differs from the meteorological forecast.

WEATHER AND SAFETY

TEMPERATURE

Effects on humans

In the polar regions, there are three main aspects of the temperature's effects on humans. The first concerns low temperatures and the direct risk of them causing injury (see Chapter 8).

The second is the added risk when low temperature is combined with wind, i.e. wind-chill. Wind-chill is the perceived decrease in air temperature felt by the body on exposed skin due to the flow of air. Many formulas exist for the calculation of wind-chill because it has no universally agreed upon standard definition or measurement. Skin loses heat to the surrounding air, and when you have proper insulating clothing, the heated air stays within your clothes. Thus, wind will cool bare skin, but will also chill your body if your clothes do not have wind stopping capability. As not only the wind as such, but also the air's humidity affects the wind-chill, no given table provides accurate wind-chill factors for all situations. However, you can use Table 12.1 as an indicator of when temperature combined with wind might start giving you problems.

The third important aspect has to do with taking care of a sick or injured person. In such a case, you must be aware that the ability of this person to heat themselves may be reduced or non-existent. You can find more about this in Chapter 8. *First aid and medical care*.

WIND-CHILL FACTOR (PERCEIVED TEMPERATURE ON BARE SKIN) (12.1)

Wind speed (m/s)	Temperature (°C)								
0	0	-5	-10	-15	-20	-25	-30	-35	-40
5	-2	-7	-13	-19	-24	-30	-36	-42	-47
10	-3	-9	-15	-21	-27	-33	-39	-45	-51
15	-4	-11	-17	-23	-29	-35	-41	-48	-54
20	-5	-12	-18	-24	-30	-37	-43	-49	-56
25	-6	-12	-19	-25	-32	-38	-44	-51	-57
30	-6	-13	-20	-26	-33	-39	-46	-52	-59
35	-7	-14	-20	-27	-33	-40	-47	-53	-60

Effects on equipment

Cold, and especially extreme cold, may affect the elasticity, durability, strength, and other physical characteristics of materials – metals, plastics, fabrics, leather, rubber, etc. The handling and treatment of such materials is therefore important. The Secretariat's equipment is chosen so that it should function even in extreme cold. However, in some cases you cannot treat equipment as you would have done back home. You may be given special instructions on handling and treating this equipment that you must follow. Some liquids are strongly affected by cold, in that their viscosity increases (and some may even freeze). This can severely change how they function. Batteries are also a cold-sensitive item, in that their performance is greatly affected by low temperatures.

When it comes to your own research equipment, you must make sure that it will work under the (polar) conditions under which it will be used. If you are uncertain, you should contact the manufacturer. If you have equipment that cannot be allowed to freeze, you must contact the Secretariat well before the expedition, so that there will be time for finding a solution to this problem.

WIND

Storms & Katabatic winds

When on expedition, you should always be prepared for strong winds, i.e. make sure tents are secured, equipment is not lying around in the camp/at the station and be prepared to lash your equipment when on a ship. You can read more about this in Chapters 4. Living on board the icebreaker Oden and 6. *Field camps*.

Wind and snow

In the Antarctic, the wind will cause snow to drift all year round. That is the reason why most research stations are raised off the ground (like Wasa). Such snowdrift can quickly cover equipment completely. Only in permanently snow-free areas would you be able relocate equipment from one year to the next. Close to nunatakks, wind may also carve out wind tunnels that can be hard to spot and quite dangerous to approach from above. (Read more in Chapters 11. *Movement and transportation in the field* and 14. *Glacier safety*.)

In the Arctic, when in mountainous areas, the combination of wind and snow can create hanging drifts on the leeward side of mountains, which may eventually culminate as avalanches. Such hanging drifts may also be very hard to spot when you approach them from the windward side, so you must be extremely careful when approaching the top of a mountain or ridge if it is covered in snow.

CLOUDS, FOG & WHITE-OUT

In the Arctic, during summer the cloud base is often quite low, and if the temperature just drops a little it may actually touch the ground. This is especially true in hilly terrain. Also, in some areas summer fog is very common, due to humid air drifting in from the sea. Low clouds and fog will, of course, reduce visibility, which in turn will negatively affect your ability to orientate and may make air operations impossible. On the tundra, you must always plan and prepare for low clouds/fog. (Read more in Chapter 10. *Movement and transportation in the field*.)

In Antarctica, “white-out” is usually caused by a thin cloud layer covering the whole sky, producing a diffuse but quite intense light that is reflected both from the snow and the sky. The danger of white-out conditions is that one loses all points of reference, which makes, e.g., flying using visual means impossible. Sensitive people may also experience a feeling of motion sickness, as visible cues are important to our sense of balance.

PRECIPITATION

Snow

In mountainous areas, snowfall and even snowstorms may occur quickly and unexpectedly – even in the summer. Visibility may then be severely reduced, and your ability to orientate could really be challenged. If you are uncertain, then you may have to set up a temporary camp or rest site. For this reason, it is of the utmost importance that you have communication and other safety equipment with you (see Chapter 11. *Movement and transportation in the field*.)

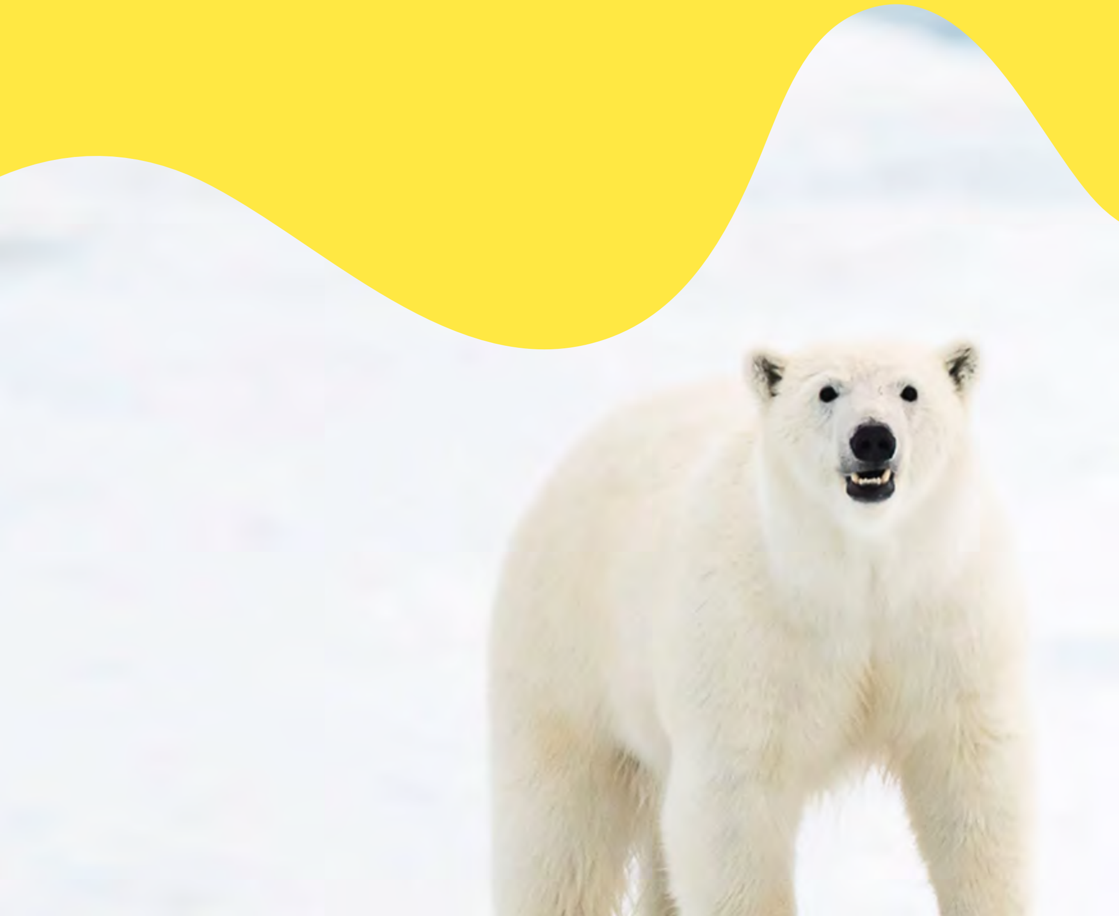
Rain

On the tundra, rain is not uncommon and is sometimes combined with storms. If you do not dress properly, you can very quickly become hypothermic. Also, living in tents, the process of drying wet clothes often takes a long time. So, make sure that you bring rainproof clothing and shoes when you leave camp. Prolonged raining may also waterlog the ground, and in hilly/mountainous areas this can lead to landslides. Prolonged raining will, of course, also raise the water levels in rivers and streams, so you should be extra careful if you have to cross or wade in any waterways.

SUNLIGHT

The Sun is always welcome when you are in the polar regions. However, since the atmosphere is quite clean and dry, sunlight is often strong. Sunlight reflecting on snow can lead to snow blindness (see Chapter 8. *First aid and medical care*). Also, the Sun's UV rays, which are much stronger than at home, may age some materials, like nylon, prematurely.

NOTES



13

PROTECTION AGAINST WILD ANIMALS

Lars Lehnert

Most animals just want to be left alone, and they get stressed if humans get too close to them. Animals in the polar regions have hard enough lives anyway, and they do not need people to add extra stress. As a general rule, you should never walk within 100 metres of wild animals, unless you are forced to do so. The taking of photographs for tourist purposes does not fall under the heading "forced to do so".

You should never feed a wild animal. Firstly, this may make it associate humans with food, and it can later become aggressive towards humans if they do not give the animal the food it wants. Secondly, you may actually make the animals sick; what is good for you is not necessarily good for them. All bites from wild animals should be treated as infected wounds; in particular, carnivorous (meat-eating) animals have dangerous bacteria in their mouths.

BEARS

The polar bear is truly a marine mammal, as its Latin name, Ursus maritimus, suggests. Its main habitat is the sea ice areas where seals come up to breathe and give birth to their pups (Figures 13.1 and 13.2). Seals are the main diet of polar bears. On beaches they may also feed on stranded whales. Polar bears normally follow the pack ice. Only in some areas do they regularly occur on land, and in such cases usually only on beaches or in "bear corridors" between beaches.

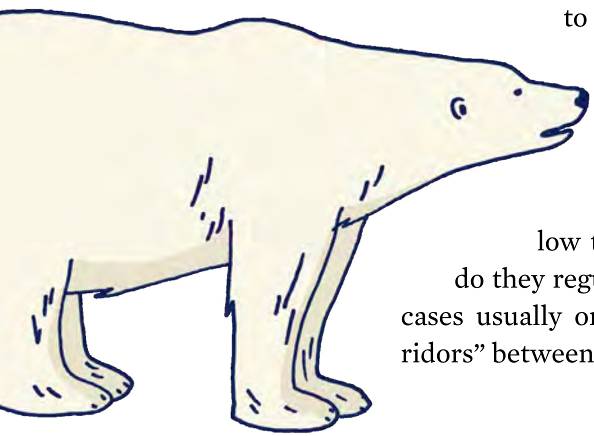


Figure 13.1 Polar bears (mother and young) and polar bear tracks (right). / Admir Targino

The main habitat of the brown bear is the temperate coniferous forests, the taiga, but in places it occurs all the way north to the tundra of the Arctic Ocean coastline, e.g. on the Kola Peninsula and on the western two-thirds of mainland North America. The brown bear is the same species all over the Arctic. Humans are not part of the normal diet of bears. However, polar bears are carnivorous, and brown bears are omnivorous ("all eaters").

Bears have a very keen sense of smell, and they can pick up and follow an interesting smell tens of kilometres away from its source, given the proper weather conditions. Polar bears also have relatively good eyesight, at least as good as ours, and to a hungry polar bear, everything that moves is potentially food. However, humans are usually either avoided or ignored. Some bears are very curious and may approach anything they find interesting, even when they are not hungry. When a bear finds something that seems interesting, the bear usually leaves once it has been investigated. Bears stand on their hind legs only to get a better view of something they are interested in; they do not charge from this position.

It is not always the case that bears are solitary creatures. Mothers care for their young for over a year, and by that time the cubs are quite large. Siblings may stay together to decrease their sense of insecurity and to help keep a lookout for food and other (potentially dangerous) bears. Furthermore, at places where food is plentiful, many "strange" bears can come together. Bears are only solitary in the sense that they do not like to share a limited resource with other bears, be it food or females for mating.

To avoid unnecessary dangerous fighting, bears, like most mammals, develop dominance hierarchies where the dominants take what they like and leave the leftovers to the lower ranks. This results in large, dominant animals having very little to fear at all, and they can ignore all animals around them (including humans). If a bear is not sure of what rank it has in relation to another animal, including humans, it will use different signs to show off its own strength, and it will look for signs in the other animal to try to judge how strong it is. These displays may consist of hissing, growling, or snapping its jaws; slapping its paw against the ground, or forcibly tearing the ground; turning sideways to display its size; and looking directly at the opponent with a lowered head. If the bear is still in doubt, it may fake an attack that ends abruptly a few metres from the opponent. In such contests, when the bear has established itself as the dominant, it will usually leave; an exception can be a dominant bear that may want to steal food from a subdominant animal, or what it perceives as a subdominant animal. Hunting bears will not perform any dominance displays but come straight at you in a very focused manner. An attacking bear is surprisingly fast, and any bear within 30–50 metres is a potential danger.

Females with young have one main duty, to protect their cubs, and they do not take any risks that might involve the cubs. Therefore, the easiest bears to scare away are females with young, as well as young animals, low on the dominance hierarchy. In spite of this, the potentially most dangerous bears are females with cubs, and bears that during the last year or so have separated from their mother, especially young males. If they feel cornered, females with cubs will do anything to protect them. As for young bears, they have not honed their hunting skills yet, and even if they succeed in a hunt, an older, more dominant bear may steal the prey from them. Desperately hungry bears may take risks they normally would not take, e.g. attack humans; in this category of bears, you find young ones and those stranded on land. Also, any animal that feels trapped or threatened may defend itself. If you surprise a bear, its instincts may tell it to flee, to attack, or to stand its ground. It is impossible to know beforehand how it will react. Bears that have become used to humans and associate them with food are also more dangerous than normal. Such bears can sometimes be found close to villages and stations where they have learnt to look for food at the garbage dump. At times, old males may become very bad-tempered, and they will not tolerate any larger animals at all around them. This is especially so in the mating season.

MEANS OF PROTECTION

Human behaviour

Avoid all activities that may attract a bear's attention. This particularly applies to anything that produces a smell. Burning or burying garbage is, first of all, not allowed on our expeditions, and secondly, it is not enough, since (polar) bears have a very keen sense of smell, and smelly (rotting) meat is a normal part of their diet. Once a bear has picked up an interesting smell, it follows it upwind. Therefore, you should keep an extra eye on the downwind direction. Polar bears may also be attracted visually, e.g. by flags or drying clothes hanging on a line, waving in the wind.

Always give the bear the right of way, and if you meet suddenly, always give the bear a chance to leave (Figure 13.2). If the bear has noticed you or seems to be following your trail, try to get upwind of it or otherwise let it know that there is a human around, e.g. by talking in a normal to loud voice. You can also leave a piece of clothing or a backpack (not food!) on the trail it is following. Having investigated this, it will usually lose interest. Never try to outrun a bear, as you will not make it, and never play dead when a polar bear is involved. If you see a bear, make a general call on the radio so that everybody becomes aware of it. You are not allowed to walk in areas where you may surprise a bear at close quarters, e.g. in narrow gullies or close to (sea ice) pressure ridges. While you should try to avoid the attention of polar bears, a good way to avoid brown bears is to make noise to let them know humans are around. This is especially so in dense vegetation.

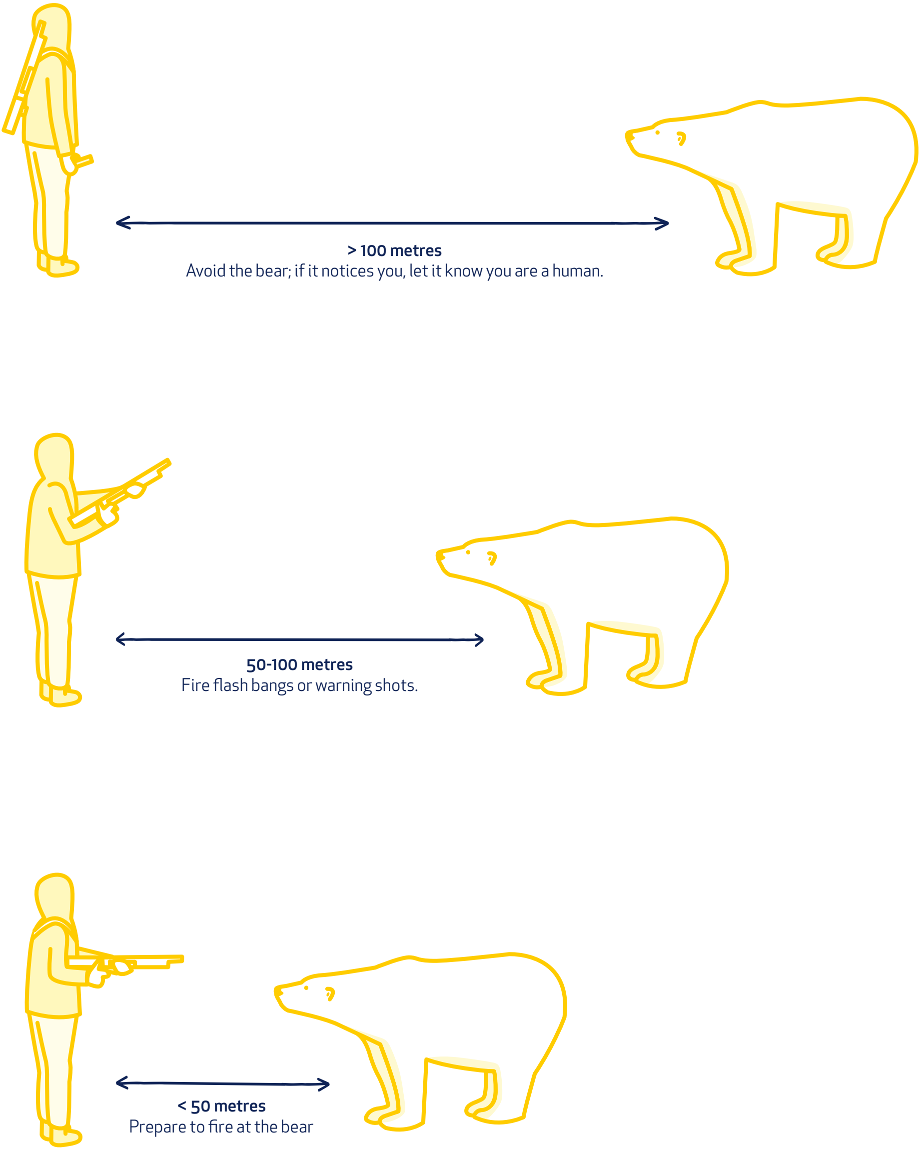


Figure 13.2 Actions to be taken at different distances when a (polar) bear is approaching.

Guns

In areas where you may meet (polar) bears, you are in general not allowed to neither leave the camp nor stay in the camp without a gun. Guns with enough calibre to kill a bear are the foremost protection against them (Figure 13.3). However, actually shooting a bear must always be regarded as the very last resort: The Secretariat's policy is that both the safety of humans and the safety of bears must be considered when working in bear country. Still, human life has priority over a bear's life. If you do not have any flash-bangs or their equivalent with you, try to scare the bear away by firing some warning shots when it is about 100 metres away. Do not empty your gun completely when firing warning shots! If the bear is approaching slowly, reload the gun after each shot and try to walk away (perpendicular to the bear's path). If the bear is approaching quickly, do not shoot more than one or two warning shots, but save your ammunition in case you need to shoot at the bear. When shooting at the bear, aim at the centre of the animal. With the gun calibres provided by the Secretariat, any hit will stop or at least slow a bear down! Even if you get perfect hits, the bear may not fall down immediately: fire double shots and continue to do so until the bear is still or has moved out of range. If you have more than one

gun, be prepared to give supporting fire. Any shot fired must be reported to the coordinator!

Remember that a gun that can kill a bear can easily kill a human. Always treat a gun as the potentially deadly tool it is. Except in life-and-death situations, do not fire a gun if there may be people in the line of fire, not even if they are some distance away. When handling the gun, always treat it as loaded – you do not want to be responsible for someone being hit by an accidental shot! The main armament provided by the Secretariat is pump action shotguns loaded with solid lead slugs. This choice was very carefully made, based on the robustness and reliability of the gun, its stopping power, and its “user-friendliness”. On many expeditions, some participants will receive extra training in the use of guns. These persons are then lent guns as their personal equipment. Other members are not allowed to use the guns at will, but may do so only in emergencies, when the gun bearer is unable to handle the gun, or when the coordinator has granted permission to do so.

If you shoot (at) a bear

If you shoot at a bear (or any animal), it must be reported to the local authorities as soon as possible, even if you are not sure that you have hit it. (You do not have to report warning shots, if the animal is just scared away.) You should be aware that any shooting of animals will bring about a great deal of legal activity. So, contact the local authorities, and follow their instructions. Start documenting the circumstances of the shooting, including by taking photographs, as soon as possible, since you may forget important details if

Figure 13.3 The gun most commonly used as protection on the Secretariat's expeditions is the pump-action shotgun. / Magnus Augner you wait until later. Proper documentation will make the legal work easier. And make sure that you do not shoot at an animal unless you perceive the situation as life-threatening to yourself or someone else.

Camp layout

Place the camp where you have an open view of any approaching bear at a distance of at least 200 metres. Bears can use very small shelters to hide themselves completely from view, and they can move very quickly. All “smelly” areas should be placed downwind from the sleeping area (Figure 13.4).

You should have an unblocked view of the whole camp from all parts of the camp area, including the place for garbage and the latrine. When it comes to the latrine, safety definitely has priority over prudence! If there is a risk of bear visits, you are not allowed to bring food or anything else with a strong smell into your sleeping tent. The tents should be arranged in lines or a semicircle so that there is always a way out for a bear entering the camp; a bear that feels trapped is extremely dangerous. If bear visits are likely you should always have a watch schedule among you. Knowing that someone is out there on watch is the best way to ensure a good sleep in “bear country”. This may also reduce the risk of someone getting the “bear scare”. This mental condition may become so serious that the affected person has to be evacuated before becoming a danger to themselves or to the rest of the camp.

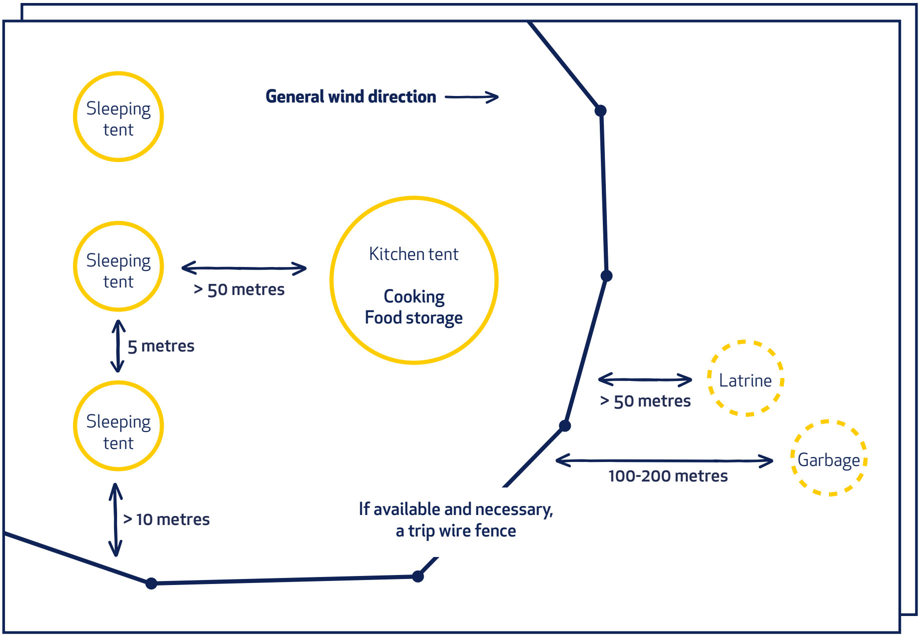


Figure 13.4 Guideline to camp layout and set-up of tripwires as protection against bear visits.

MUSKOXEN

Muskoxen are social animals that typically live in herds (Figure 13.5). Older males that have been thrown out of herds by younger, stronger males live as solitary animals. Herds will defend themselves, and especially their calves, against any animal that is perceived as a potential predator and that ventures too close. As for most mammals, smell is the keenest sense, and muskoxen will flee from humans as soon as they are detected. However, older solitary males may exhibit very bad tempers, and, especially during the normal mating season, they may attack even if they do not feel threatened. Muskoxen have a zone stretching some 25–50 metres around them, within which they will attack. When they do so, they are very fast. In the summertime, muskoxen are easily overheated because of their fantastic insulation, and except for scientific purposes, you are not allowed to go within 300 metres of them.

Figure 13.5 A herd of muskoxen in the Canadian High Arctic.
/ Anders Modig

MEANS OF PROTECTION

The only effective means of protection from muskoxen is to stay away from them. If you meet one unexpectedly, move away as quickly as possible. Do not use flash-bangs or fire warning shots, as this will probably only aggravate them and may actually trigger an attack!

WOLVES, FOXES AND DOGS

The only circumstances under which wolves and foxes are dangerous to humans are if they carry rabies, or are trapped or threatened. Avoid animals that seem to lack the normal shyness of wild animals, as this may be a sign of the later stages of rabies (where the brain is affected). You should never approach an inhabited den except for research purposes.

You should never approach sled dogs without their handler. Sled dogs may be very dangerous, in that they are used to humans but not trained to be pets. Even if they do not want to eat you, they may want to test the dominance hierarchy by fighting with you, and these dogs are very strong and tough.

SEA MAMMALS

In the Arctic, the walrus is the only seal that can be dangerous to you at sea. A walrus may come up to investigate a small boat, or it may feel that its "territory" has been invaded by the boat. In both cases, the boat may be destroyed and the people on board may be injured. These attacks may seem to be unprovoked. Give walruses at sea a wide berth. In the Antarctic, leopard seals are a potential danger when diving or staying close to the edge of sea ice. On land, seals are harmless most of the time (Figure 13.6). However, if you come upon them suddenly or during mating season, seals may attack you. For shorter distances, they may be surprisingly quick, and they are all predators with strong jaws. The main risk with seals on land is that you will disturb them. As with all other animals, you should stay at least 100 metres away from them.

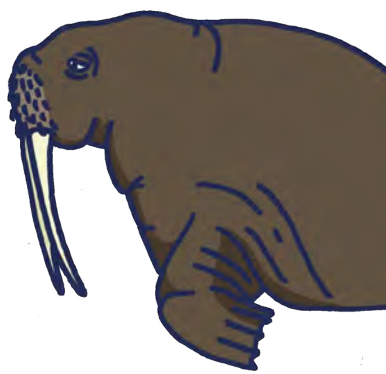


Figure 13.6 Elephant seals resting in Antarctica Peninsula. / Angela Wulff

Whales may come up to investigate boats and rub themselves against the hull. When using Zodiacs, you may also collide with them. All these incidents should be considered accidental. You have nothing to fear from whales. However, do not disturb them and give them a wide berth.

PROTECTION OF WILDLIFE

In Antarctica, the protection of wildlife is regulated by Annex II to the Protocol on Environmental Protection to the Antarctic Treaty. Based on this, the rule of thumb on Swedish expeditions is to never approach birds or mammals closer than 15 metres when travelling by foot, and not closer than 200 metres when travelling in a vehicle. The rules are even stricter for aeroplanes and helicopters,

but this is the pilot's responsibility. In some cases, it could be that the animals become stressed at greater distances, and you should not disturb animals unnecessarily, e.g. just to take photographs of them. You are only allowed to approach animals more closely than the rules above stipulate when doing so is part of the research you are conducting.

NOTES

14

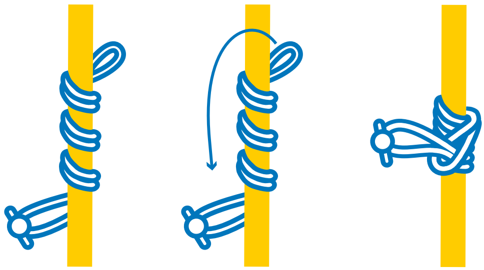
GLACIER SAFETY

Dag Haugum

You are only allowed to move into glacier areas if you either are truly competent yourself or accompanied by such a person. The leading coordinator decides who is competent enough to work on glaciers.

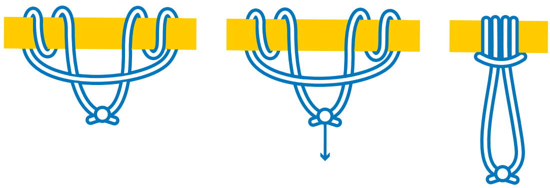
KNOTS

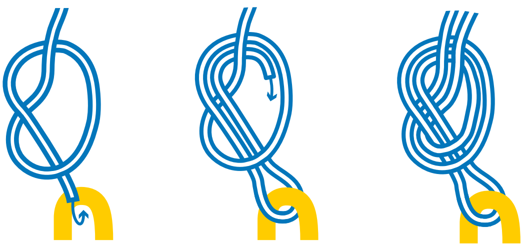
Four basic knots are used on the Secretariat's expeditions: the autoblock, the prusik knot, the overhand knot, and the tape knot.



The **autoblock** is a braking device very simple to place on a rope, but you need a snap-hook. In winches, where the autoblock also acts as a pulley, you must place the hoisting rope through the snap-hook.

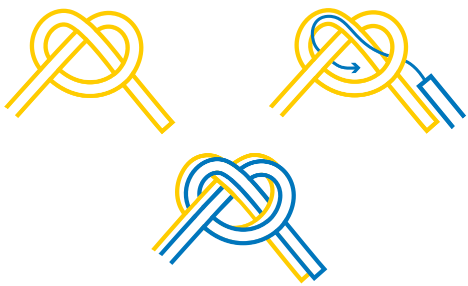
For the **prusik knot** you use a loose sling coiled in a particular way around the climbing rope. This knot is used when you need to climb up a rope or as a brake when hoisting.





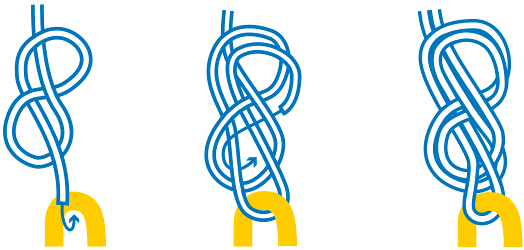
The **overhand loop knot** is the most basic one and is used when you tie in to a harness, for anchoring etc. It is a very safe knot that also works well on tape slings (one of the few knots that do).

The **tape knot** is tied like the overhand knot, either with the ends of the tape(-s) entering from the same direction or with the two tape ends coming into the knot from opposite directions.



The latter method is used when you need to lengthen, e.g. a cargo strap. When you make an overhand knot or any other traditional knot, the loose end should be ten times the diameter of the rope.

The autoblock and the prusik are a breaking device making use of a snap-hook/carabiner. The tape knot is used to tie tapes together, e.g. when making a sling. The loop and figure **eight loop knots** are used for anchoring and tying in a harness etc.



ROPE TEAM

Before you walk onto a glacier you must check that you have the necessary alpine equipment with you. A minimum set of equipment is kept for use on Swedish expeditions in Antarctica (see example in Appendix 7). Always bring all of this equipment on you: you cannot be certain that you will not need it! When you form the rope team, each person must have a (fitted) harness on and carry the prescribed minimum equipment. Once you move onto the snow or ice, each person must also have crampons on and an ice axe in their hand. Only very experienced people are allowed to form two-person teams (Figure 14.2). All others must form at least three-person teams (three is a minimum, five a maximum here). The reason for

RULES OF THUMB FOR ROPE TEAMS (14.2)

Two people in a team
Are you good enough for this risk?

↓

Minimum 20 metres between. Each person carries minimum 7 metres extra at the ends of the rope in case of rescue.

More than two people in a team

↓

7-10 metres in between

this is simply that it is extremely difficult for a single person to arrest the fall of another person in the rope team. Also, only if two (less experienced) persons cooperate "on the surface" do they have a reasonable chance of getting the fallen person up from the crevasse in time. The weights of individual team members should match as closely as possible, again to increase the ability to arrest a fall. All team members should be warmly dressed: if you fall into a crevasse, it is very cold down there. To begin, tie yourself in on the rope with a regular overhand knot. The two people at the ends of the team must have a minimum of seven metres at the loose end of the rope. This will be used to start making a "Z-pulley", which is used to pull a person out of a crevasse (see below). When you walk, the rope between you should be kept stretched so that it hangs just above the ground. You should not allow more slack to form, as this may result in a powerful pull if someone falls. You should also be careful when using crampons so that you do not step on the rope; this is especially likely for the middle person in a three-person team. At the beginning, before the rope team achieves a common pace, you should walk slowly so that nobody gets stressed and becomes more prone to making mistakes. Walking with crampons can be quite difficult at first. The technique calls for having all downward-pointing spikes in contact with the surface you are walking on, even on slopes. On even ground this may only make your muscles work a bit harder, but in steeper areas you may have to walk sideways with your toes pointing down. The ice axe should be carried in the hand with the pointed blade forward. On steeper slopes you move only one securing point at a time: axe-foot-foot, axe-foot-foot, etc. When coming to an obstacle that you have to jump across, make sure that you have enough slack in the rope and will not be stopped in mid-air. The person before and/or after you is responsible for keeping the slack optimised (talk to each other!).

CREVASSE INCIDENTS

When someone falls down into a crevasse or when a vehicle gets stuck, the priorities are (1) your own safety, (2) the safety of personnel, and (3) the safety of equipment.

If someone falls into a crevasse, once you have arrested the fall, take a minute to make a plan rather than making rash decisions that you may regret a little later. Do this even if you do not have much time to get the person up: in a crevasse, the temperature can be −40°C or lower, and within half an hour the person down there can become severely hypothermic. Keeping your own safety in mind, approach the crevasse carefully and try to contact the person in it. If they are conscious, they may have important information for you and may also be able to help themselves get up. If the person in the crevasse is uninjured, a good way to keep warm is to start prusiking up the rope, i.e. climb the rope using techniques you have practised.

STOP THINK ACT

Z-PULLEY

A Z-pulley is a hoisting system used to lift people or equipment out of, e.g., crevasses (Figure 14.4). Before constructing a Z-pulley, make a 100% solid anchor (T-anchor, ice screw, snow/ice anchor). When constructing the system, always try to minimise the friction, by, e.g., digging out where the rope will run, putting rounded and slippery things on the edge of the crevasse, and adding more carbines or pulleys in the system. Before you start improving your Z-pulley from 1:3 to 1:6, you must first reduce the friction. You are never allowed to use vehicles or mechanical winches to pull people out of a crevasse!

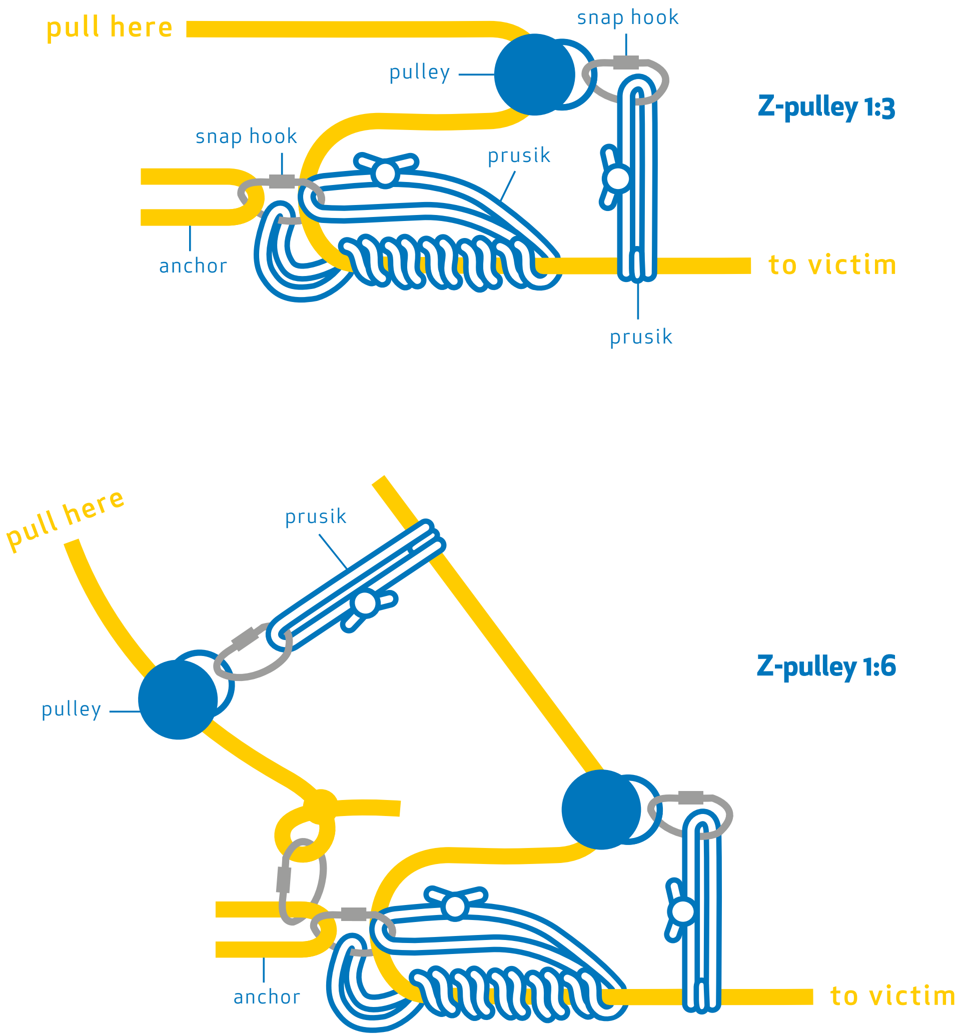


Figure 14.4 Z-pulley

There are various mechanical aids, such as Mammut's "Rescyou" (Figure 14.5), that work on the same pulley principle as the Z-pulley.

Figure 14.5 Mechanical pulley aid.

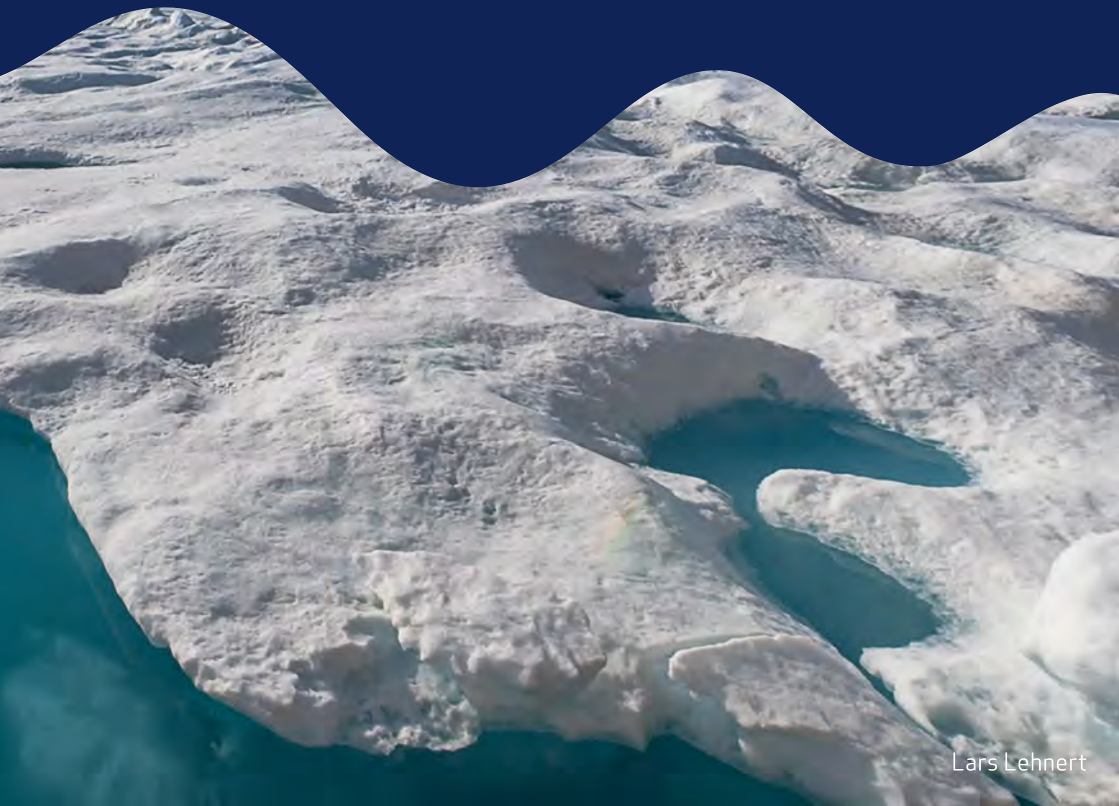
STUCK VEHICLES

It is difficult to give any specific advice on how to deal with situations where vehicles, e.g., get stuck in crevasses. However, the safety of personnel always has the highest priority. Equip one person (preferably two, if there is enough equipment) with harness, rope, and other alpine safety items. This person should be secured with the rope and then given the task of probing the near surroundings for a safe route from the vehicle to a safe area. Once a safe route and area have been established, all personnel should be brought there (secured by harness and rope). After this, contact the leading coordinator or logistics manager and discuss how the salvaging operation should be done. Besides the vehicle's own salvaging equipment, there are a lot of useful items at Wasa. What you may need are winch tackles, wires, heavy-duty straps, ladders, and snow anchors of various kinds. Permission to make a salvage attempt is given by either the leading coordinator or the logistics manager. Never try to salvage a vehicle on your own unless you are absolutely certain of how to do it! There is always a risk of pollution when vehicles get stuck in crevasses, but the environmental aspects must be considered secondary to personnel safety.

NOTES

15

PROTECTION OF THE ENVIRONMENT



Lars Lehnert

A key phrase in all activities in the polar regions is "protect the environment". The polar environment is often very severe in and of itself, and plants and animals often live at their climatic distributional limits. A small disturbance may destroy what has taken hundreds or even thousands of years to build up (e.g. moss and lichen communities) or might even cause irreparable damage. You must therefore always give a little extra thought to what you are doing when visiting the polar regions!

THE ARCTIC

The legal framework for environmental protection in the Arctic is quite complex. This is due to the fact that there are eight countries with territories there, all with their own laws, while the Arctic Ocean is protected by international law. It is therefore not possible to write even a brief summary of the rules and regulations that apply in every part of the Arctic in this book. However, most of the environmental protection strategies that apply to Antarctica also apply to activities in the Arctic. So even if you are not going to Antarctica, you should read through what is written below on waste management and oil spill response. Irrespective of whether an expedition goes to the Arctic or to Antarctica, the Secretariat's aim is to protect the polar environment as much as possible.

ANTARCTICA

Only about one percent of the surface of Antarc-

tica is bare ground, and the vast majority of all plants and animals are to be found there. Since the same holds true for most human activities, there is an obvious competition for space. Environmental protection in Antarctica is one of the main issues in the Antarctic Treaty System, which includes the Protocol on Environmental Protection (visit www.polar.se for more information). Every person participating in an expedition to Antarctica (south of 60°S) is obliged to follow these rules. Furthermore, all Swedish activities in Antarctica are regulated by the Antarctica Act (Lag [2006:924] om Antarktis). Following these rules and regulations, Finland, Norway, and Sweden have developed a common Nordic Environmental Handbook, Antarctic Operations. The handbook covers everything that participants in Swedish expeditions to Antarctica must know about environmental protection during the expedition. Some of the handbook's main provisions are summarised below.

WASTE MANAGEMENT, ANTARCTICA

Human impact in Antarctica must be kept to a minimum in order to preserve Antarctica as the world's largest pristine wilderness, with its unique environmental qualities. In Antarctica, biological degradation is a slow process due to the cold and dry climate; all biodegradable products should therefore be treated as non-biodegradable. Structures and equipment that are not considered essential for further operations in Antarctica should be removed after the conclusion of an expedition, as should all waste generated each operational season. No open burning of waste is allowed. Some products have a larger potential for harming the environment than others and need special consideration during the planning of expeditions (Appendix 9). A few of these products are prohibited, while others require a permit. Products and substances that have a potentially harmful environmental effect must be treated with special attention so that no emission or dispersal occurs. As a general rule, the less waste that is produced, the less waste that needs to be handled and disposed of. Waste disposal has both environmental and financial costs that can be reduced by minimising waste volume. Some rules have been set up with the aim of reducing waste production in Antarctica (Appendix 9). Nordic scientific activity in Antarctica, including logistics in support of science, is relatively small, and large-scale waste separation is not considered economical. However, a certain degree of separation and classifying is needed in order to handle the waste in a satisfactory manner. Waste should be separated into the following categories:

- combustible solid waste, glass,
- metal, sewage and domestic liquid waste, other liquid
- waste and chemicals including fuels and lubricants, and
- finally radioactive material.

HAZARDOUS WASTE

Hazardous waste cannot be handled together with other waste because of potentially harmful pollution and must therefore be handled with care in order to prevent spills and dispersal in the environment (Appendix 9). No labelling colour codes should be used for containers with hazardous waste. Rather, all such waste containers should be labelled according to content. Remove all old labels from containers in which hazardous waste is stored.

Different categories of hazardous waste should never be mixed together in the same container. If you are uncertain as to how a given category of hazardous waste should be handled, contact the Secretariat before departure. If problems arise during the expedition, contact the leading coordinator. Remember that hazardous waste must not be left behind on an expedition. Oil-contaminated soil, water, or fabric are to be stored in separate containers (labelled oil-polluted soil/water/fabric).

All hazardous waste is to be returned to the country of the expedition's origin, or to the country of purchase, where it can be disposed of in an environmentally friendly way. All containers to be used for packing hazardous waste must be in good condition, and the content must be marked according to international standards. The waste should preferably be returned in its original packaging. Ensure that containers are secured during transport.

RADIOACTIVE MATERIAL

Scientific research activities are the sole generator of radioactive waste in Nordic Antarctic operations. All radioactive material must be returned to the country of origin of the research project for proper disposal (Appendix 9). All scientific personnel are to ensure that, if possible, all radioactive material is returned packaged in the same container in which it was transported to Antarctica, or that suitable containers (polythene bags, polydrums, etc.) are brought along for this purpose.

Solid radioactive waste should be packed separately from any liquid radioactive waste. Seal the contaminated waste in heavy-duty polythene bags. Bags should then be put in separate containers. Liquid organic and other aqueous radioactive waste should never be mixed. Liquid waste should be poured into, e.g., polydrums or other suitable containers. Containers must be thoroughly sealed. Do not overfill. Smaller items and containers should be put in separate large containers.

N.B.: For both liquid and solid radioactive waste, it is essential that the correct information is provided in the labelling of the containers. If you have any questions about radioactive waste disposal, contact the Secretariat before departure to Antarctica.

OIL SPILL RESPONSE, ANTARCTICA

In the case of an oil spill, regardless of size, after the safety of personnel is ensured, an initial assessment of the spill should always be made (Table 15.1). The general response strategy is otherwise to contain and recover oil spills where practical (Appendix 10). As much oil as possible should be removed immediately after the spill and any remaining oil left to degrade naturally. The use of dispersants and burning at the site is not allowed, and a large-scale clean-up operation may cause more environmental damage than the oil itself.

INITIAL ASSESSMENT OF OIL SPILL INCIDENT (15.1)

- Probable quantity of fuel spilled.
- Type of fuel.
- Location of the spill.
- Probable source and cause.
- Any risk of fire.
- Any risk of harm to human health.
- Any risk to the environment

HEALTH AND SAFETY

The health and safety of personnel is paramount in the case of an oil spill. Emergency spill response actions should not be undertaken in extreme weather conditions or during periods of darkness, unless the situation has been fully assessed by the leading coordinator and deemed safe. Inhalation of hydrocarbon fumes can cause headaches and nausea: these are short-term effects. For spills of more than 200 litres, clean-up personnel should consider using facemasks, if they are available, until the fumes have dissipated. Fuel and oil can be a skin irritant. Severe reactions can lead to dermatitis. If possible, clean-up personnel should wear rubber gauntlets to protect hands and arms during clean-up operations. Drinking water would have to be highly contaminated by hydrocarbons to be harmful. This is unlikely since very low concentrations of hydrocarbons alter the taste of water and make it completely unpalatable. The expedition doctor is to advise the leading coordinator on likely health effects of an oil spill.

RESOURCES AT RISK

Snow- and ice-free ground

If an oil spill occurs on impermeable ground, the oil will run off of rock and concentrate in puddles, and the ground will seem to be coated with oil. Oil spills in snow- and ice-free areas will affect vegetation and micro-fauna in the area of the spill. Fieldwork taking place in particularly sensitive areas must adhere to specific guidelines given by the Secretariat in order to avoid oil spills and other negative effects on the biota.

Snow-covered ground

Oil spills on snow-covered ground will seep into the snow. Due to capillary effects, the oil will also spread horizontally. The vertical spreading is always bigger than the horizontal, at least in the upper layers. If the quantities spilled are large, the oil will reach into layers of higher density until it reaches the ground or an impermeable layer of ice.

Ice-covered ground

Oil spilled on ice-covered ground is likely to remain on the surface and not penetrate much into the ice as long as there are no cracks.

SPILL RESPONSE EQUIPMENT

Stations and field parties must be equipped with sufficient materials and equipment to follow the response strategy for all spills. The equipment is to be stored in accessible locations, known to all expedition members. At the stations, there are oil-absorbing mats for refuelling sites, absorbent pillows and fabric for vehicles and field parties, plastic bags, protective masks, and rubber gloves. Field parties should be equipped with absorbent pillows and fabric for vehicles, plastic bags, and rubber gloves.

NOTES

APPENDICES

APPENDIX 1

Coordinator's daily notes

Place and date:
What has been done/achieved?
What has gone well, and why?
What has not gone well, and why?
Extra noteworthy/Other comments:

APPENDIX 2

EXAMPLES OF BASIC PERSONAL CLOTHING AND EQUIPMENT

Clothes

ITEM	NUMBER	COMMENT
Gore-Tex jacket	1	
Gore-Tex pants	1 pair	
Fleence sweater	1	
Pants	1-2 pairs	Work/field work pants (possibly warmer),and “time off ”/indoor pants.
Warm socks	3-6 pairs	Wollen or synthetic.
Thin socks	1-3 pairs	Preferably synthetic. To use in combination withthe warmer socks; and/or indoors.
Water vapour barrier/ block	(1 pair)	To prevent foot sweat to wet the socks and shoes from the inside, and in this way chilling the foot.
Underwear (short)	3-6 pairs	In colder climates and/ or when drying facilities are lacking, synthetic may be preferred to cot- ton or cotton mixtures.

ITEM	NUMBER	COMMENT
Warm underpants, with long legs	1-2 pairs	Woollen or synthetic.
Warm vest with long arms	1-2	Wollen or synthetic.
Cap/hat	(1)	To protect from rain and sun, to hold the mosquito net out.
Warm cap	1 (-2)	Woollen or synthetic (and maybe a spare one).
Gaiters	(1 pair)	To keep snow out or when walking in wet vegetation.
Work gloves	1 pair	Synthetic or leather.
Warm mittens	1 pair	Wollen or synthetic.
Scarf, neck gaiter	1	Wollen or synthetic.
Pyjamas	1+1	Something comfortable to sleep in.
T-shirt, or equivalent	2	To use indoors at stations, on ships or in camp.
Walking boots	1 pair	The main pair. They should be well broken in and warm enough for the climate.

ITEM	NUMBER	COMMENT
Warm boots, rubber boots	1 pair	The spare pair. These could be e.g. extra warm for Antarctica or rubber boots if you are to walk a lot in water or wet areas.
Sandals, or equivalent.	(1 pair)	To use indoors at stations, on ships or in camp.

Other personal equipment

ITEM	COMMENT
Daypack/ small backpack	A useful item on most expeditions.
Thermos	Absolutely necessary on most terrestrial expeditions.
Water bottle	Useful on most terrestrial expeditions.
Toiletry items	Often it is difficult to judge how much, e.g. tooth paste is needed during, say two months. Think it over carefully, there are no shops on expeditions. For longer expeditions you should also think about items that you use rarely.
Towel	If you are not certain that this will be provided for you, bring one.
Sun screen/mosquito repellent	If there is a probable need.

ITEM	COMMENT
Sunglasses	Good sunglasses are useful on most expeditions, and absolutely necessary if you are to work on snow or ice.
Spare eye-glasses	If you depend on eye-glasses normally.
Small sewing kit	It is often the case that you need it if you have not brought it.
Washing powder	Only when you are certain that it is not provided.
Books and/or music player	To make long trips and days with bad weather (which you will experience) pass more quickly.
Diary	Both professionally and privately, it may be rewarding to note what is happening.
Camera, lenses, filters, film	The light in the polar regions is different from what you are used to, people bringing cameras usually use more film than they anticipated.
Binoculars	Some deem them absolutely necessary and you will probably not regret bringing a pair.
Pocket knife, multi-tool	Useful on most expeditions. Multi-tools should only be used when “real” tools are unavailable!
Nature guide books	Bird, flower, geology and other nature guides are often worth bringing, if you can find some covering the expedition area.

APPENDIX 3

"RADIO ENGLISH"

Radio check

Procedure words for radio check

Radio check	What is my signal strength and readability, how do you read me?
You are (I read you)	You signal strength and readability is as follow ...

Signal strength

Loud (5)	Your signal is excellent.
Good (4)	Your signal is good.
Weak (3)	I can hear you with difficulty.
Very weak (2)	I can hear you with great difficulty.
Nothing heard (1)	I cannot hear you at all.

Readability

Clear(5)	Excellent quality.
Readable (4)	Good quality. No difficulties in reading you.
Distorted (3)	I have troubles in reading you because of distortion.
With interference (2)	I have troubles in reading you due to interference.
Unreadable (1)	I can hear that you transmit but I cannot read you at all.

Example of radio check

Ice-breaker Oden	**Camp 1**
Camp 1, Camp 1, from Oden, radio check. Over.	
	From Camp 1, you are loud and clear. Over.
From Oden. Roger. Out.	

Spelling

When something needs to be spelled, the international phonetic alphabet is used. Numerals are transmitted digit by digit with the exception of round figures as hundreds and thousands.

Letters

A	Alfa	J	Juliet	S	Sierra
B	Bravo	K	Kilo	T	Tango
C	Charlie	L	Lima	U	Uniform
D	Delta	M	Mike	V	Victor
E	Echo	N	November	W	Wisky
F	Foxtrot	O	Oscar	X	X-ray
G	Golf	P	Papa	Y	Yankee
H	Hotel	Q	Quebec		
I	India	R	Romeo		

Numerals

0	Zero	4	Fo-wer	8	Ate
1	Wun	5	Fi-yiv	9	Niner
2	Too	6	Six		
3	Three	7	Seven		

Bokstavering på svenska

A	Adam	J	Johan	T	Tore
B	Bertil	K	Kalle	U	Urban
C	Cesar	L	Ludvig	V	Viktor
D	David	M	Martin	W	Wilhelm
E	Erik	N	Niklas	X	Xerxes
F	Filip	O	Oskar	Y	Yngve
G	Gustav	P	Petter	Z	Zäta
Ö	Östen	Q	Qvintus	Å	Åke
H	Helge	R	Rudolf	Ä	Ärlig
I	Ivar	S	Sigurd		

Radio procedure words (prowords)

PROWORD	MEANING
Acknowledge	Confirm that you have received my message and will comply (wilco).
Affirmative	Yes/Correct.
Negative	No/Incorrect.
All after ...	Everything that you (I) transmitted after ... (keyword).
All before ...	Everything that you (I) transmitted before ... (keyword).
Correct (that is correct)	What you have transmitted is correct, you are correct.

PROWORD	MEANING
Correction	a. An error has been made in this transmission. I will continue with the last word (group) correctly transmitted. b. An error has been made in this transmission. The correct version is ... c. That which follows is a corrected version in answer to your request for verification
Wrong	Your last transmission was incorrect. The correct version is ...
Disregard this transmission. Out	This transmission is an error. Disregard it. (This proword shall not be used to cancel any message that has been already completely transmitted and for which receipt or acknowledgement has been received.)
End of message over (out)	This concludes the message just transmitted (and the message instructions pertaining to a formal message).
End of text	The textual part of a formal message ends. Stand by for message instructions immediately following.
Fetch ... !	I wish to speak on the radio to that person (appointment title).
... speaking	Requested person is now using the radio himself.
Figures	Numerals or numbers will follow. (This proword is not used with the call signs, time definitions, grid references, bearings, distances etc., especially in fixed-form reports.)
message	I have a message for you.

PROWORD	MEANING
message follows	A formal message which requires recording is about to follow.
over	This is the end of my turn of transmitting. A response is expected. Go ahead, transmit.
out	This is the end of my transmission to you. No answer or acknowledgement is expected.
out to you	Do not answer, I have nothing more for you, I shall now call another station.
read back!	Repeat the entire following transmission back to me exactly as received.
I read back	The following is my reply to your request to read back.
say again!	a. Repeat all of your last transmission. b. Followed by identification data all after, all before, word after, word before etc. It means: Repeat ... (portion indicated).
I say again	I am repeating my transmission or portion indicated.
send!	Go ahead with your transmission.
send your message!	Go ahead, transmit: I am ready to copy.
silence–silence–silence!	Cease all transmission in this net immediately. Will be maintained until lifted.
silence lifted	Silence is lifted. The net is free for traffic.

PROWORD	MEANING
... speak slower!	Reduce the speed of your transmission. (Normally used in connection with request for repetition.)
I spell	I shall spell the next word, group or equivalent phonetically.
rel ay to ...	Transmit the following message to all addressees or to the address designation immediately following.
relay through ...	Send this message through call sign ...
through me	I am in contact with the station you are calling. I can act as a relay station.
messaged passed to ...	Your message has been passed to ...
roger	I have received your last transmission satisfactorily.
roger so far?	Have you received this part of my transmission satisfactorily?
wilco	I have received your message, understood it and will comply. (To be used only by the addressee.) roger and wilco are never used together.
unknown station	The identity of the station calling or with whom I am attempting to establish contact is unknown.
Verify	Verify the entire message (or portion indicated) with the originator and send verified version. To be used only at discretion of or by the addressee to which the questioned message was directed.

PROWORD	MEANING
I verify	That which follows has been verified at your request and is repeated. To be used only as a reply to verify.
wait-wait-wait	I must pause a few seconds, and will call you again when ready.
wait-out	I must pause longer than some seconds, and will call you again when ready.
word before ...	The word of the message to which I have reference is that follows ...
word after ...	The word of the message to which I have reference is that precedes ...
words twice	Communication is difficult. Transmit(ting) each phrase (group) twice. This proword can be used as an order, request or as information.

APPENDIX 4

EXAMPLES OF RADIO TRANSMISSIONS IN ENGLISH

Example of transmission of a message/Exempel på skrivmeddelande

Researcher Peter Andersson	Wasa Station
Wasa, Wasa. From Peter. Message follows. Over.	
	From Wasa. Send. Over.
From Peter. Message, from Peter and Johan to Wasa. We want to be picked up by helicopter. Roger so far? Over.	
	Roger. Over.
On Tuesday, after 1400 hours. End of message. Over.	
	From Wasa. Roger. Over.
From Peter. Out.	

Forskare Peter Andersson	Stationen Wasa
Wasa, Wasa. Från Peter.	
	Wasa, Wasa. Kom.
Skrivmeddelande. Kom.	
	Kom
	.
Från Peter. Text: Från Per och Johan till Wasa. Vi vill hämtas med helikopter. Kom.	

Forskare Peter Andersson	Stationen Wasa
	Kom
På tisdag efter klockan 14. Slut på meddelandet. Kom.	
	Wasa, uppfattat. Kom.
Klart slut.	

APPENDIX 5

EXAMPLES OF RADIO NETWORK PROCEDURES

A situation in which many people feel uncomfortable is when their radio station is part of a radio traffic network, and calls are made from the main station to all other stations at the same time. Below you find two examples of common network procedures.

In the first example, in order to save time on the air, Camp 1 chooses to let only Camp 3 acknowledge that the message has been received during its passing. However, when the full message has been sent ("end of message"), all camps acknowledge that they have received and understood it. If any station is uncertain of if they have received the full message, or if anything is unclear, then the (main) station should instead be asked to repeat (part of) the message ("say again, all after…").

Camp 1 - main station	Camp 2	Camp 3	Camp 4
All camps. From Camp 1. Over.			
	Camp 2. Over.		
		Camp 3. Over.	
			Camp 4. Over.
From Camp 1. Message. Camp 3 will acknowledge. Over.			
		Camp 3. Wilco. Over.	

Camp 1 - main station	Camp 2	Camp 3	Camp 4
From Camp 1. Re-supply of the camps will take place tomorrow. Over.			
		Camp 3. Roger. Over.	
From Camp 1. The helicopter will fly in the order Camp 3, Camp 2, Camp 4, and Camp 1. Over.			
		Camp 3. Roger. Over.	
From Camp 1. The ETA at Camp 3 is 1300 hours. Over.			
		Camp 3. Roger. Over.	
From Camp 1. All camps should report to Camp 1 when the helicopter arrives and departs. End of message. Over.			

Camp 1 - main station	Camp 2	Camp 3	Camp 4
	Camp 2. Roger. Over.		
		Camp 3. Roger. Over.	
			Camp 4. Roger. Over.
Camp 1. Out.			

When an "all stations/camps" call is sent out, the camps will reply in order. If the station before your own does not reply, you should wait for 5–10 seconds before giving your reply (Example 2, below). When the last station has acknowledged the call, then the (main) station can choose either to try to get in contact with the missing station(s) immediately, or to pass the message on to the stations replying and contact the missing one(s) later.

Camp 1 - main station	Camp 2	Camp 3	Camp 4
All camps. From Camp 1. Radio check. Over.			
	Camp 2. Roger. Over.		
		(No reply)	
			Camp 4. Roger. Over.

Camp 1 - main station	Camp 2	Camp 3	Camp 4
Camp 3, Camp 3. From Camp 1. Radio check. Over.			
		Camp 3. Roger. Over.	
All camps. From Camp 1. Roger. Out.			

APPENDIX 6

MOUNTAIN AND FIELDWORK SAFETY, AN EXAMPLE FROM THE ABISKO SCIENTIFIC RESEARCH STATION

Plan your trip

• Check the relevant maps and talk to ANS staff for local knowledge.• Plan your route and the amount of time you can reasonably expect it to take.
• Winter travel always requires careful planning and evaluation of risks and needs.
• Fieldwork includes a hearty breakfast and an extra intake of water.
• Remember to drink regularly (up to 0,5 litre/hour) of water during the day.
• Lack of food and water can lead to the poor decision making, increased risk, and may put you in danger!
• Winter conditions and low temperatures dehydrates your body. Mix the hot thermos water with clean snow to get better stamina.
• Winter-like conditions can occur anytime of the year!
• Cellphone coverage is only good along the highway (E10), and up to app. 4 km south of the road. On the north side of Torneträsk calls usually can be made up to 12 km from the road. If it is not possible to make a mobile telephone call, you might be able to send a SMS text message.

Tell someone of your plans

Note your plans on the white-board map in the entrance hall. Do not forget to check-in upon your return. At this board you also may find more information about current field conditions and safety. Note that ANS has no legal responsibility for your safety when working in the field.

Weather conditions and wind

Conditions change very rapidly and local variations are significant. Weather forecasts from www.yr.no or www.smhi.se are usually good for the Abisko valley. Remember that wind speed increases with higher altitude and snow can occur on the mountains even at the peak of summer.

In winter avalanche risk is higher following snowfall. Wind transport of snow significant increases this risk. Snow accumulates on the leeward side of slopes and here the avalanche risk is the highest. Travel in avalanche prone areas requires special skills and equipment.

Don't over estimate your skills – minimize the risks

Ask yourself what could go wrong? How can I prevent it from going wrong? Do I have an emergency plan? Work in teams of no less than two people!

If you have to call for help, the emergency number is 112. Remember the limited mobile phone coverage. To get help fast it is necessary to know your position. A GPS is good in such situations, and always bring a map and compass.

If someone gets injured you might have to leave the person and go for help. This is very stressful situation and it is necessary to stay calm and spend some time to make a good plan to deal with the situation – talk this over within the team before you leave.

Before leaving any person behind, in order to get help, check if you should move the injured person to a more protected position, e.g. where they are protected from the wind. You must also help the person to stay as warm as possible and insulate them from the ground. Mark the place with something in contrasting color (white is good in summer and red in the winter), because it is very difficult to spot a single person from a rescue helicopter.

Sufficient supplies

Here are some hints for equipment in the field. Remember to always bring extra medications if you take some regularly.

Winter Safety Equipment

• Storm proof insulated outer layer – jacket, pants, gloves, and hat
• Extra warm clothes, socks, gloves, hat, glove liners, face mask/buff/ balaclava. Avoid cotton, use fabrics that wick such away, as wool and synthetics
• Snow goggles and/or sunglasses are essential in late winter to avoid snow blindness
• If doing strenuous hiking, climbing, skiing, etc. - extra base layer(s)
• Appropriate footwear for snow, ice, and cold
• First aid kit
• GPS (w/ extra batteries), map, and compass
• Wind sack or similar emergency shelter
• Emergency space blanket
• Heat packets
• Foam pad to sit or stand on
• Extra food - energy bars, nuts, chocolate, dried fruit
• Warm drink in thermos
• Satellite transponder
• Mobile phone and emergency numbers (Do not forget to charge the night before! And remember the limited coverage.)
• Sunscreen (February to May)

Summer Safety Equipment

• Extra warm clothes, gloves, hat, and socks. Avoid cotton, use fabrics that wick, such as wool and synthetics
• If doing strenuous hiking, climbing etc. you need extra base layer(s)
• Appropriate footwear for cold and rain (if leather boots, make sure they are waterproofed)

• First aid kit
• GPS (w/ extra batteries), map, and compass
• Emergency space blanket
• Heat packets (if you easily get cold fingers and toes)
• Foam pad to sit or stand on
• Extra food - energy bars, nuts, chocolate, dried fruit
• Warm drink in thermos
• Rain gear and warm jacket (e.g. fleece)
• Satellite transponder
• Mobile phone and emergency numbers (do not forget to charge the night before! And remember the limited coverage)
• Sunscreen
• Sunglasses
• Insect repellent

APPENDIX 7

EXAMPLES OF EMERGENCY EQUIPMENT ANTARCTICA

Emergency boxes

ITEM	NUMBER
Tent	1
Sleeping pad	2 (Snowmobile)
X	4 (Tracked vehicle)
Sleeping bag	2 (Snowmobile)
X	4 (Tracked vehicule)
Burner	1
Pot	1
Fuel bottle	1
Fuel pump	1
Suction tube	1
Compass	1
Cutlery set	1
Knife	1
Emergency rations	(See below)
First aid kit	1

ITEM	NUMBER
Smoke flare	3
Signalling mirror	1
R6 batteries	10
Battery holder for VHF	1
Snow shovel	1
Rope, 40m (9mm)	1
Ice axe	1
Crampons	1 pair
Harness	1
Snap-hook (screw lock)	6
Matchbox	1
Prusik	4
Tape sling, 120cm	2
Rescue sling (tape)	1
Ice screw	1
Abseiling device (rope brake)	1
Pulley	2

Emergency rations

NUMBER OF DAYS	TYPE OF FOOD	ON VEHICLE	AMOUNT
2	Freeze-dried food	Snowmobile	1x (4 bags)
		Tracked vehicle	2x (4 bags)
2	Emergency food (Seven Oceans)	Snowmobile 4x packet	
2	Soup and energy drink	Snowmobile	2 x (4 soup, 2 drink)
		Tracked vehicule	4 x (4 soup, 2 drink)
Extra	Coffee, tea etc.	Snowmobile	4x bag
		Tracked vehicle	2x (4 bags)

APPENDIX 8

WEATHER REPORTING. EXAMPLE FROM DRONNING MAUD LAND AIR NETWORK (DROMLAN). ANTARCTICA

WEATHER INFORMATION FROM (NAME OF STATION)	X STATION
Location (coordinates)	00°00 S 00°00 W
Height (asl)	30m
Date:	09-08-18
Time:	10:37 UTC
Wind direction:	80 deg
Wind speed:	30 kt
Visibility:	4800m
Present weather:	NSW
1st Cloud layer	
amount:	FEW
type:	Sc
ceiling:	4900 feet
2nd cloud layer	
amount:	FEW
type:	Ac

WEATHER INFORMATION FROM (NAME OF STATION)	X STATION
ceiling:	9800 feet
3rd cloud layer	
amount:	SCT
type:	Cc
ceiling:	20000 feet
Temperature	-25 degC
Humidity	87%
Pressure (QNH)	1004 hPa
Pressure (QFE)	1000 hPa
Horizon	nil to poor
Contrast	moderate to good
Remarks	--

Status of Skiway/runway

-OPEN

-windsock: yes

-last grooming: 16 JAN 2017 12:00 UTC

-surface condition: compact snow

-visual inspection: 16 JAN 2017, 12:00 UTC

METAR - code for significant weather

INDENTIFICATION OF WEATHER				WEATHER EVENT			
Intensity or vicinity		Description		Precipitation		Reduced visibility	
1		2		3		4	
-	light	MI	shallow	DZ	drizzle	BR	mist
	moderate	BC	patches/ broken	RA	rain	FG	fog
+	heavy	PR	partial	SN	snow	FU	smoke
VC	in the vicinity	DR	drifting	SG	snow grains	VA	volcanic ash
		BL	blowing	IC	ice crystals	DU	dust
		SH	shower	PL	ice pellets	SA	sans
		TS	thunderstorm	GR	hail	HZ	haze
		FZ	freezing	GS	small hail or snow pellets (<5mm)		

NSW	no significant weather observed

The significant weather (upper table) is a composition of the shown colums (in order: left -> right), i.e. intensity at first, then description, precipitation and at last reduced visibility e.g. +BLSN (heavy blowing snow).

You can combine only fields with the same color, e.g. PRFG, BLSN

You can combine more than one precipitation event, but the dominant precipitation event should be stated first, e.g. +SNRA , -SHSN, FZRADZ, VCSHSN, etc.

The intensity (- /+) is only used for precipitation (rain, snow, shower, thunderstorm etc.) and drifting/blowing snow. Please use only one sign.

The desrciptions shallow (MI), patches/broken (BC) and partial (PR) are only used for fog (FG), e.g. MIFG.

Horizon	
good	The horizon is sharply defined by shadow or contrast. The horizon is distinct with an obvious difference between land (snow) and sky.
moderate	The horizon can be identified, although the contrast between sky and snow is not sharply defined.
poor	The horizon is barely discernable: in other words, the sky can be discriminated from land but no distinct boundary is visible.
nil	Total loss of horizon: the snow surface merges with the whiteness of the sky.

Contrast	
good	Snow surface features such as sastrugi, drifts and gullies can be easily identified. The sun is usually un-obscured.
	Surface features are clearly defined for as far as the eye can see.

moderate	Snow features can be identified by constrast. No definite shadows exist. The sun is usually totally obscured.
	Surface features become indistinct at distances of more than a few kilometers.
poor	Snow surface features (e.g. skidoo tracks) cannot readily be identified except from close up (within 50 meters).
	The sun is usually totally obscured.
nil	Snow surfaces cannot be identified. No shadows or contrasts exist. Dark coloured objects appear to float in the air. The sun is totally obscured, although the overcast sky may exhibit considerable glare. The glare appears to be equally bright from surface reflection and all directions.

APPENDIX 9

WASTE MANAGEMENT ANTARCTICA

Potentially harmful products

The following products shall not be brought to Antarctica:
- polychlorinated biphenyls (pcb),
- non-sterile soil,
- polystyrene chips/beads and similar forms of packaging material, and
- pesticides (except that which is necessary for research or medical/ hygienic reasons).

The use of the following products in Antarctica is highly discouraged:
- polyvinylchloride (pvc) products.

For Antarctica, a special permit is required for:
- introduction of non-native (non-indigenous) species of animals and plants (including seeds), and
- introduction of any non-native micro-organisms (including viruses, bacteria, parasites, fungi and yeast).

Waste reduction

General measures to reduce waste production in Antarctica:
- Minimise purchase of products with plastic, glass or other bulky packaging material.
- Buy durable products instead of disposable products.
- Get rid of unnecessary packaging material (especially plastic) before leaving for Antarctica.
- Substitute shredded paper, polystyrene chips, beads and other similar loose packaging material with bubble wrap, cardboard or paper.
- Buy products that easily can be reused for other purposes.
- Use packaging material that can be reused.
- Reuse products and material whenever this is practicable.

Hazardous waste

Examples of liquid hazardous waste:

- oil products,
- anti-freeze,
- paint products,
- detergents and disinfectants,
- glue, photochemicals,
- chemicals,
- mercury, and
- oil polluted soil and water.

Examples of solid hazardous waste: treated wood (treated or painted wood, particle board, and plywood), medical waste (syringes, knifeblades etc.), electrical batteries, asbestos, explosives, solid chemicals, and fluorescent tubes.

Radioactive waste

Examples of liquid radioactive waste

- organic solvents,
- all non water-soluble scintillants, and
- all water-soluble waste.

Examples of solid radioactive waste

- isotope containers,
- damaged calibration sources, and contaminated laboratory clothing, gloves, paper towels, soiled, pipettes, and vials.

APPENDIX 10

ACTIONS RELATING TO OIL SPILL INCIDENTS

Actions relating to oil spill incidents

Initial oil spill assessment
- Probable quantity of fuel spilled.
- Type of fuel.
- Location of the spill.
- Probable source and cause.
- Any risk of fire.
- Any risk of harm to human health.
- Any risk to the environment.

On Swedish expeditions, oil spill incidents are classified into two types, each with its own set of actions to be taken. Type 1 - Small local spills that can be dealt with immediately by one person (<200 litres). Type 2 - Medium spills that require a dedicated clean-up team (>200 litres).

Type 1 actions

1. Ensure the safety of all personnel. Check for fire and explosion risk, and ensure that any necessary safety equipment is worn.
2. Make an initial assessment:
   - Probable quantity of fuel spilled.
   - Type of fuel.
   - Location of the spill.
   - Probable source and cause.
   - Any risk of fire.
   - Any risk of harm to human health.
   - Any risk to the environment.
3. Priority should be given to protecting any drinking water supply area. Also, if the spill occurs on ice, attemps should be made to stop it reaching ice-free ground.
4. Recover as much oil as possible (see below).

5. Report to the expedition leader, as soon as convenient.

Type 2 actions

1. Ensure the safety of all personnel. Check for fire and explosion risk, and ensure that any necessary safety equipment is worn.
2. Make an initial assessment.
3. Report the assessment information to the expedition leader as soon as possible.

General procedure for recovery of spilled oil

1. If a spill occurs, try to stop or minimise any further spillage.
2. For all spills, deploy absorbents to contain the oil. It may be possible to hold the oil in depressions by using absorbent materials, or by building small dams.
3. If possible, use pumps to remove the fuel from the ground straight into 200 litre drums. Ensure that
empty drums of sufficiently good quality are available near the spill site.
4. Absorbent pads should be spread on any remaining oil that cannot be pumped or manually removed.
5. Oil soaked absorbents must be picked up and placed in plastic bags or empty 200 litre drums.
6. Contaminated snow can be stored in 200 litre drums which have had their tops removed. Allow the snow to melt and decant off the oil.
7. Any waste drums containing a mixture of oil and snow or water are likely to freeze. To prevent drums from splitting, use only such in good condition. Do not fill them up completely.
8. Drums containing recovered oil or water should be stored on oil containment mats.
9. Drums containing recovered oil or water, oil soaked absorbents and contaminated clothing must be sent for disposal outside of Antarctica.

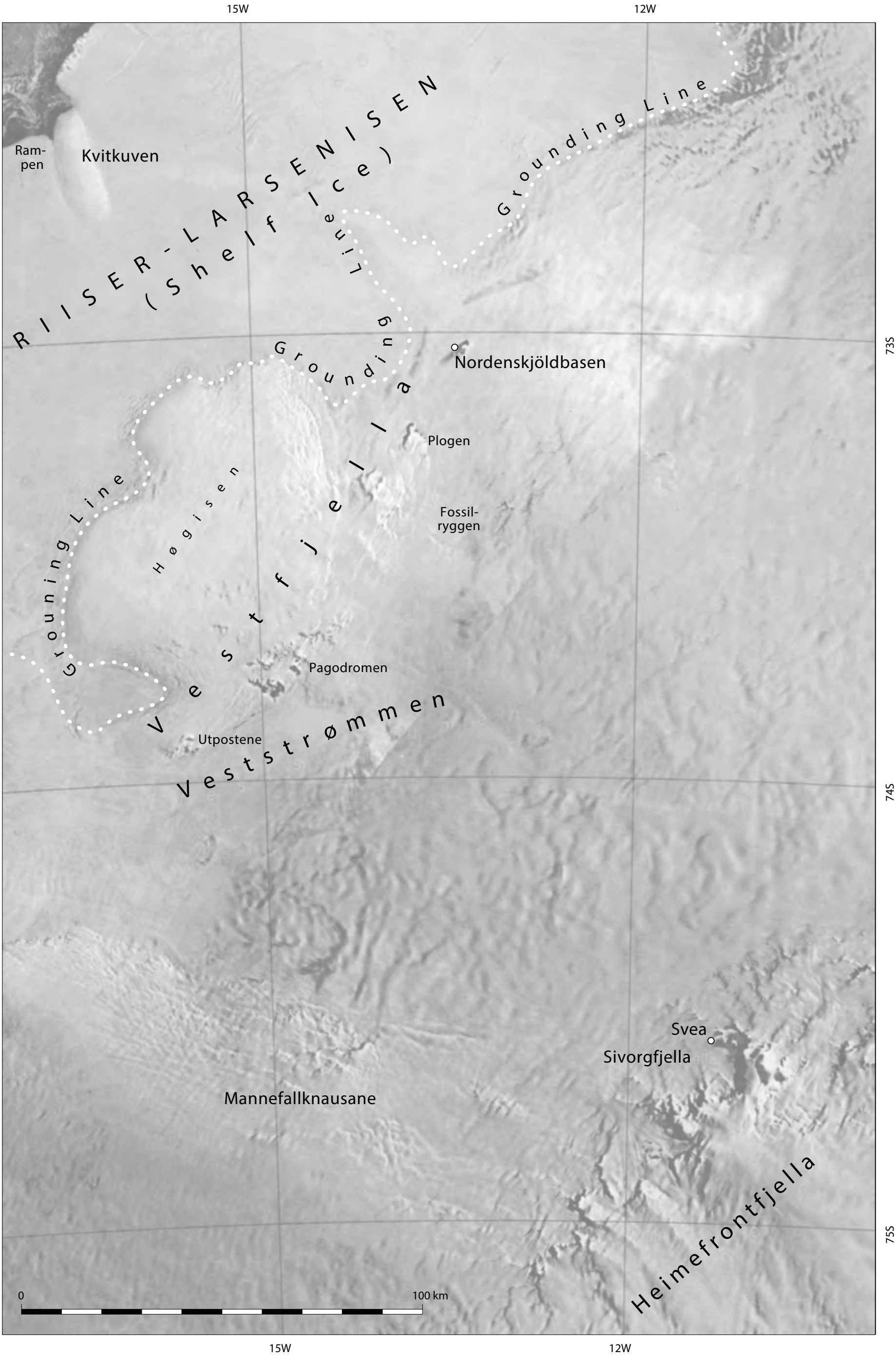
APPENDIX 11

MAPS

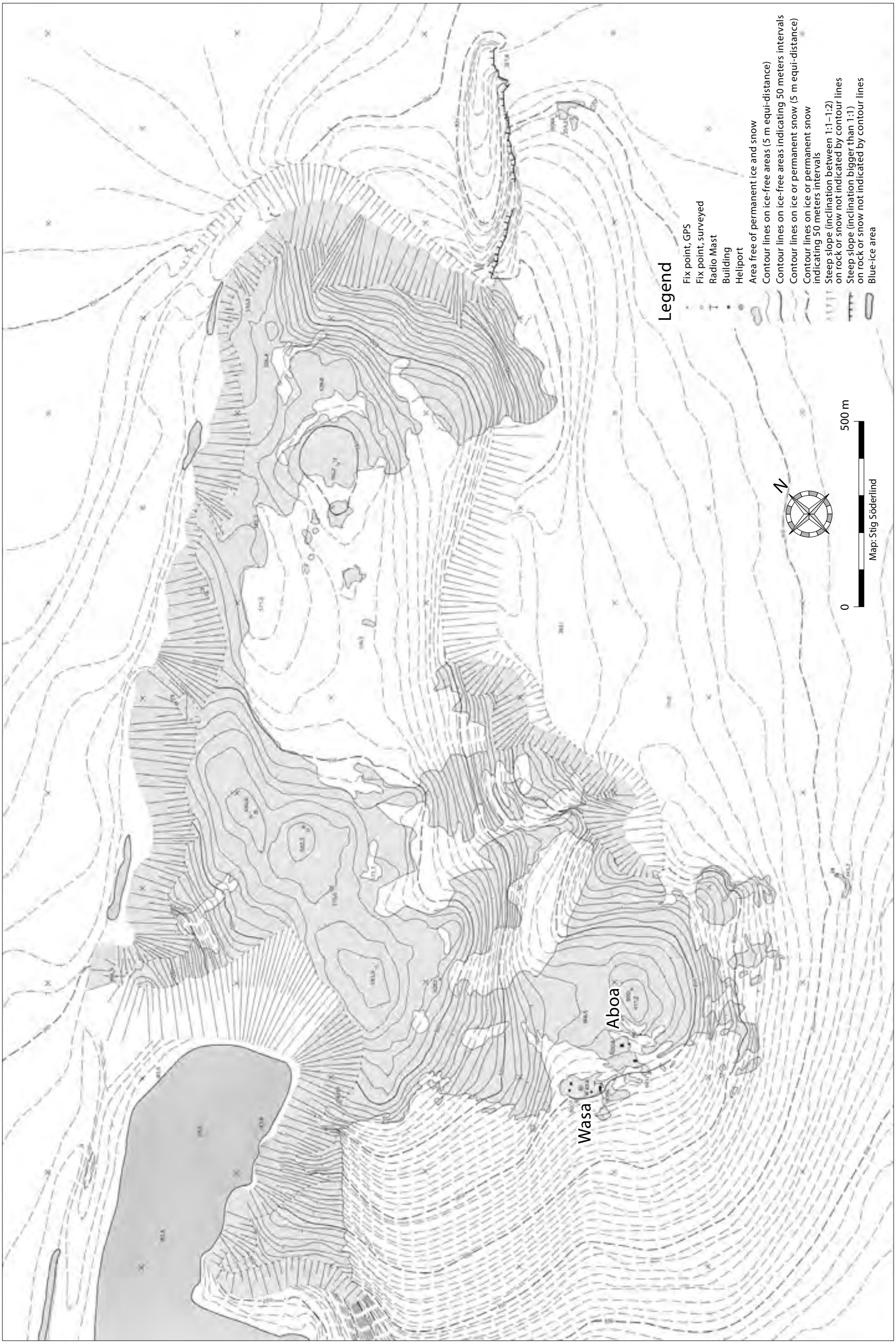
Rampen-Wasa-Svea

Nordensköldbasen

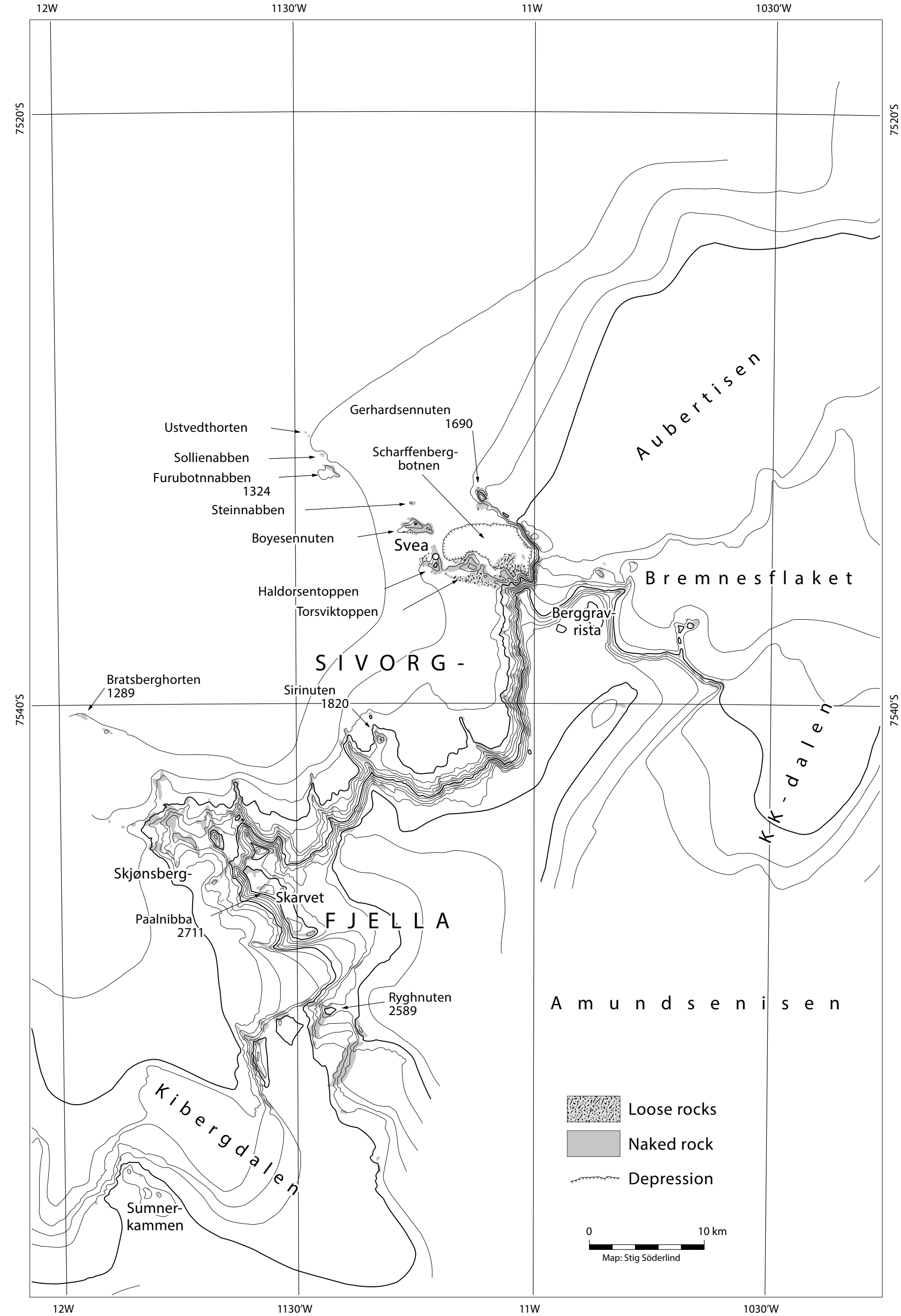
Silvorgfjella (Svea)



Overview Rampen-Wasa-Svea



Nordensköldbasen



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