TP 11690E

COLD WEATHER MARINE SURVIVAL GUIDE

CANADIAN COAST GUARD
ARCTIC SHIP SAFETY

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INTRODUCTION TO THE MANUAL

Many books and studies have been published on the subject of survival in cold regions, but very little has been written on marine crew survival in such areas. In cold regions, the evacuation circumstances which must be dealt with by a ship's crew are diverse and can include full or partial ice cover, thin ice, broken ice or pressured ice. Often these ice conditions will be coupled with very cold air, low sea temperatures and high winds. Such combinations of temperature, wind and ice conditions are significantly different than those conditions for which conventional lifesaving equipment and crew training are normally developed.

This Guide provides the mariner with basic information about surviving in cold regions. It includes reviews of ship abandonment scenarios, ship evacuation, survival equipment and techniques, health concerns, fauna and flora, and the Canadian search and rescue system.

Ship evacuation in cold regions can expose crew members to one of the world's most hostile environments. Survival in this environment is dependent on the availability of suitable survival equipment and knowledge of survival techniques. It is well recognized that the most important factors for survival in cold regions, in their approximate order of importance, are:

- warmth and shelter;
- water and rations; and
- medical attention.

Many other factors, such as ship evacuation procedures and knowledge of the search and rescue system, are different for cold regions and must be well understood. This Guide brings together the information previously published in a wide range of literature, including the many research studies sponsored by the Canadian Coast Guard. The intention is to provide marine crews with a handbook that will give them information on evacuating their ship in cold regions and surviving until rescued.

The Guide describes the important factors related to ship evacuation and survival and highlights the most important points. It does not, however, include information related to standard procedures for evacuation and survival in more temperate areas. Such knowledge is assumed to be taught as part of a crew's certification process.

CHAPTER 1 EVACUATION SCENARIOS

Cold weather regions can be characterized by extremely low ambient air temperatures, low sea temperature, high winds, rough sea, persistent fog and the presence of sea ice. These characteristics, both individually and in combination, can produce evacuation scenarios quite different from those expected in more temperate regions. As a result, the usefulness of conventional lifesaving equipment and procedures may be drastically undermined.

Evacuation scenarios for all cold weather regions have one common factor: extreme cold. In the presence of cold, still air temperature and wind, evacuees experience both convective and conductive heat loss. This may be thought of as an equivalent air temperature which is lower than the actual still air temperature. Table 1 illustrates this wind chill effect.

Table 1. Equivalent Wind Chill Temperatures

Wind Speed		Ambient Air Temperature (Celsius)														
		0	-4	-8	-12	-16	-20	-24	-28	-32	-36	-40	-44	-48	-52	-56
knots	km/hr	Equivalent Wind Chill Temperature (Celsius)														
3	6	0	-4	-8	-12	-16	-20	-24	-28	-32	-36	-40	-44	-48	-52	-56
5	10	-4	-8	-13	-17	-22	-26	-31	-35	-40	-44	-49	-53	-58	-62	-67
11	20	-10	-15	-21	-26	-31	-36	-42	-47	-52	-57	-63	-68	-73	-78	-84
16	30	-14	-20	-25	-31	-37	-43	-48	-54	-60	-65	-71	-77	-82	-88	-94
22	40	-17	-23	-29	-35	-41	-47	-53	-59	-65	-71	-77	-83	-89	-95	-101
27	50	-18	-25	-31	-37	-43	-49	-56	-62	-68	-74	-80	-87	-93	-99	-105
32	60	-19	-26	-32	-39	-45	-51	-58	-64	-70	-77	-83	-89	-96	-102	-109
38	70	-20	-27	-33	-40	-46	-52	-59	-65	-72	-78	-85	-91	-98	-104	-111
43	80	-21	-27	-34	-40	-47	-53	-60	-66	-73	-79	-86	-92	-99	-105	-112
49	90	-21	-27	-34	-40	-47	-53	-60	-66	-73	-79	-86	-92	-99	-105	-112
54	100	-21	-27	-34	-40	-47	-53	-60	-66	-73	-79	-86	-92	-99	-105	-112

Increasing Danger (Flesh may freeze within 60 seconds)
Great Danger (Flesh may freeze within 30 seconds)

The combination of various cold weather region environmental characteristics gives rise to six evacuation scenarios:

- open water, which can include ice accretion;
- thin ice;
- open pack ice;
- rubbled ice;
- consolidated ice; and
- puddled ice.

Each of these scenarios poses its own set of problems, given evacuation using a ship's conventional equipment.

1.1 Open Water and Ice Accretion

In cold regions, the wave height in open water depends on the location. In areas such as the Labrador Sea, wave heights can be extremely high, whereas in Baffin Bay or other more sheltered areas, wave heights are greatly reduced. The extreme minimum air temperatures can be between -16°C and -26°C; the sea surface temperature can range from -1° to +3°C; and the wind speed can be very high.

Ice accretion can occur within a range of severity when the air temperatures and wind conditions are combined, as shown in Figure 1. The results can be very severe, as illustrated in Figures 2 and 3, and can greatly inhibit the ability to launch lifeboats and liferafts. A thick layer of ice can freeze liferafts to their cradles and can freeze lifeboat launching davits. In such conditions, it is very difficult to evacuate the ship safely.

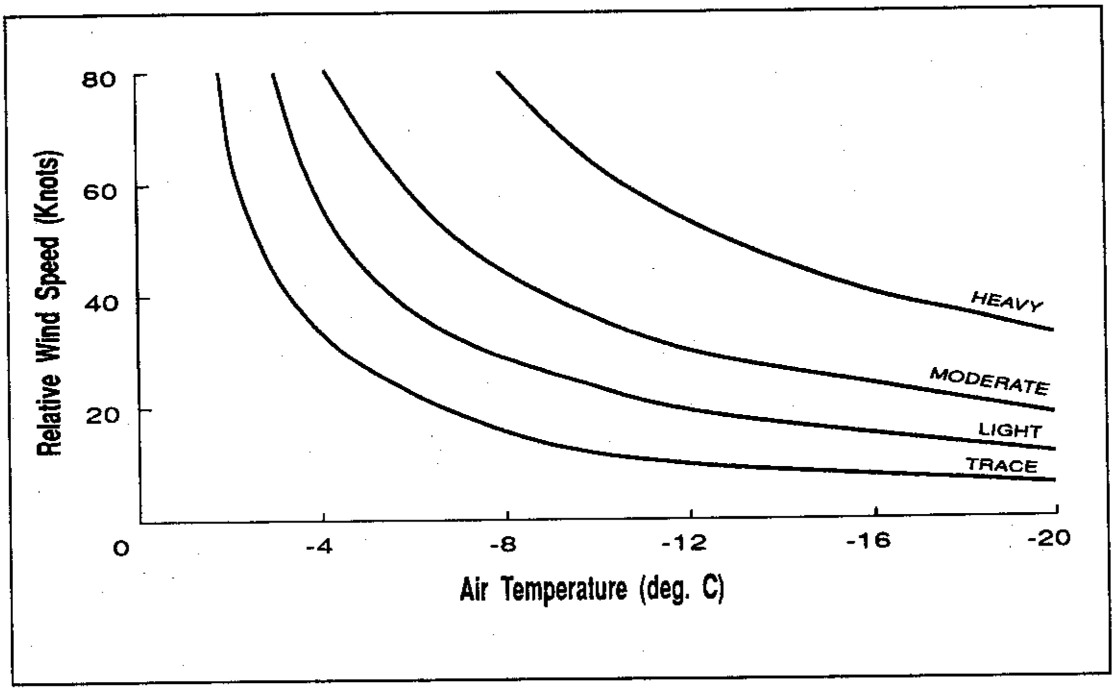


Figure 1. Conditions in Which Ice Accretion can Occur

These conditions can occur during winter months in more southern cold region areas, but only during July through October in the higher latitudes. In most Arctic areas, the transition from open water to thin ice (nilas) occurs during September, October and November. In the south, this occurs during December and January.

1.2 Thin Ice

During September, October and November in most Arctic areas and during December and January in the south, the air temperature is sufficiently low to result in the growth of new ice (nilas). Although the ice thickness increases quickly, there is a period when the ice is too thin to bear a person's weight, but may still prevent lifeboats and liferafts from clearing the ship. Only a few centimetres of new ice can prevent the movement of lifeboats and liferafts, and ice that is less than 7 cm thick, approximately, will not support

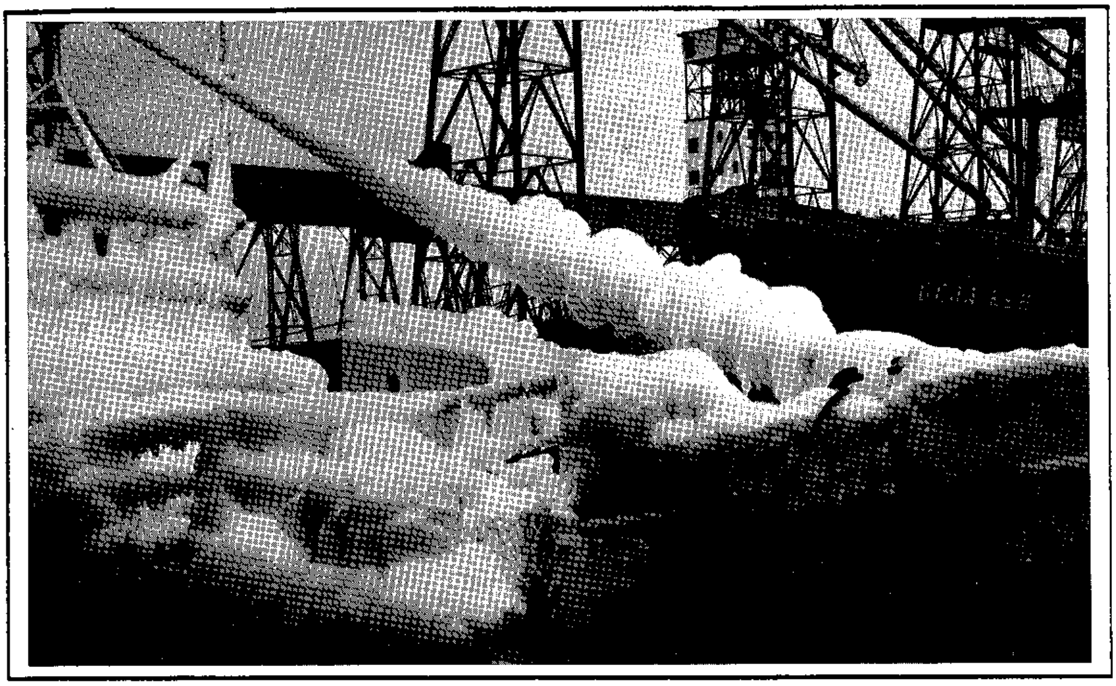


Figure 2. Ice Accretion on a Small Ship

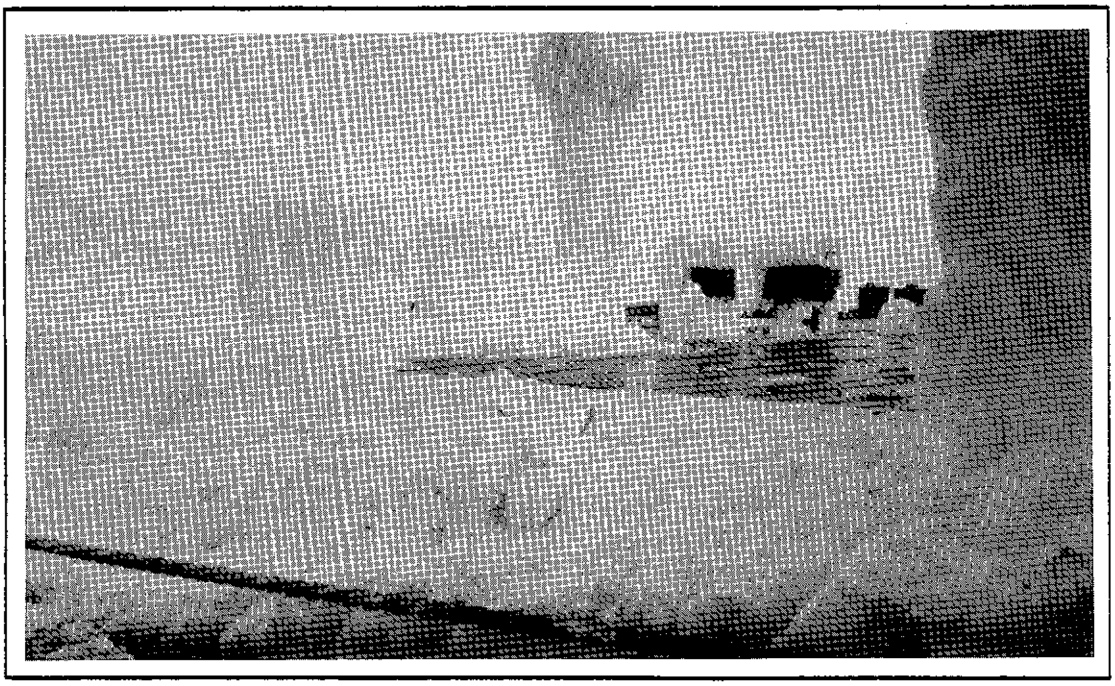


Figure 3. Ice Accretion on a Large Ship

a person's weight. This is one of the most hazardous situations, since it may severely restrict movement. Nilas conditions are illustrated in Figure 4.

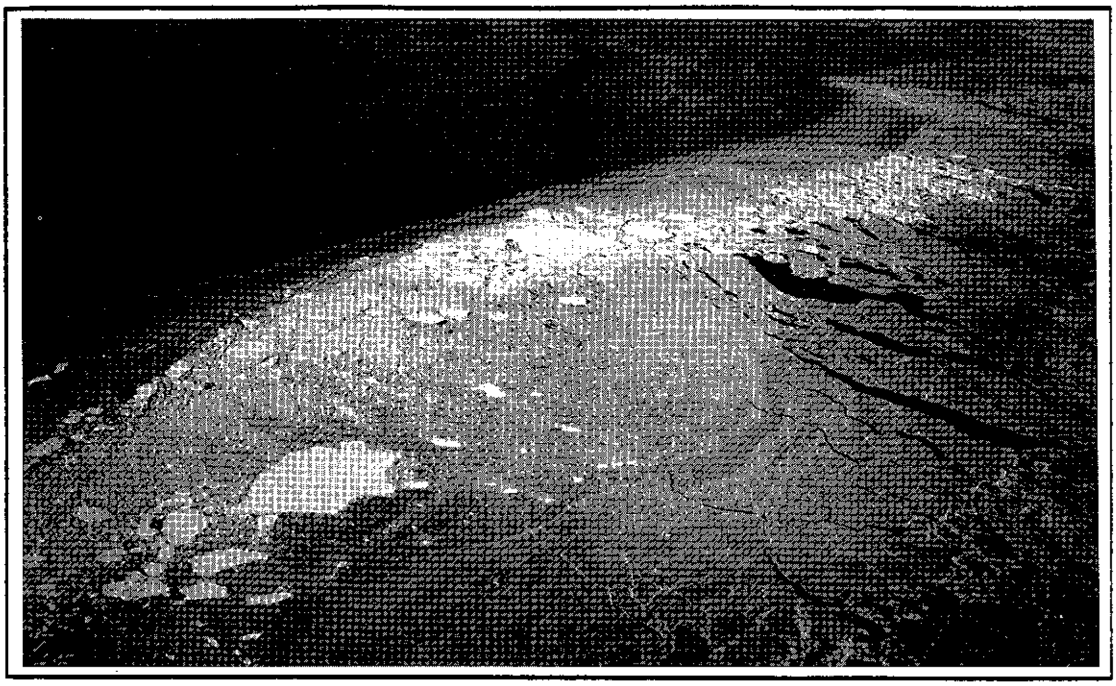


Figure 4. Thin Ice (Nilas), Young, and Brash Ice

The transition from thin ice to thicker ice, which can bear substantial weight, can occur quickly and depends on the air temperature.

1.3 Open Pack Ice

Open pack conditions consist of large or small ice floes separated by open water, as shown in Figure 5. Such conditions can exist throughout cold weather regions at various times during the year. Normally, the air temperatures will be very low, wind speeds will be high and fog will be persistent. The ice floes may be compressed together under the action of wind and current or can be widely separated with relatively calm, open water between.

Although lifeboats and liferafts can be launched in open and closed pack ice with large and small ice floes, they may not get away from the ship, or may be crushed or upset by moving ice pack. Large floes offer some refuge, but the instability of small floes prevents their use as a lifesaving platform.

The transition from these conditions depends on the season. In the fall, the conditions are consolidated as the low air temperature encourages ice growth; in the spring, the floes deteriorate and eventually melt away by mid or late summer. Those floes which survive the summer melt grow larger again during the fall, and are then referred to as second year ice.

1.4 Rubbled Ice

Rubbled ice is the result of wind or current-generated pressure in the ice pack. When ice floes come together under such pressure, they are crushed at the boundaries. The result can be ice ridges, areas of

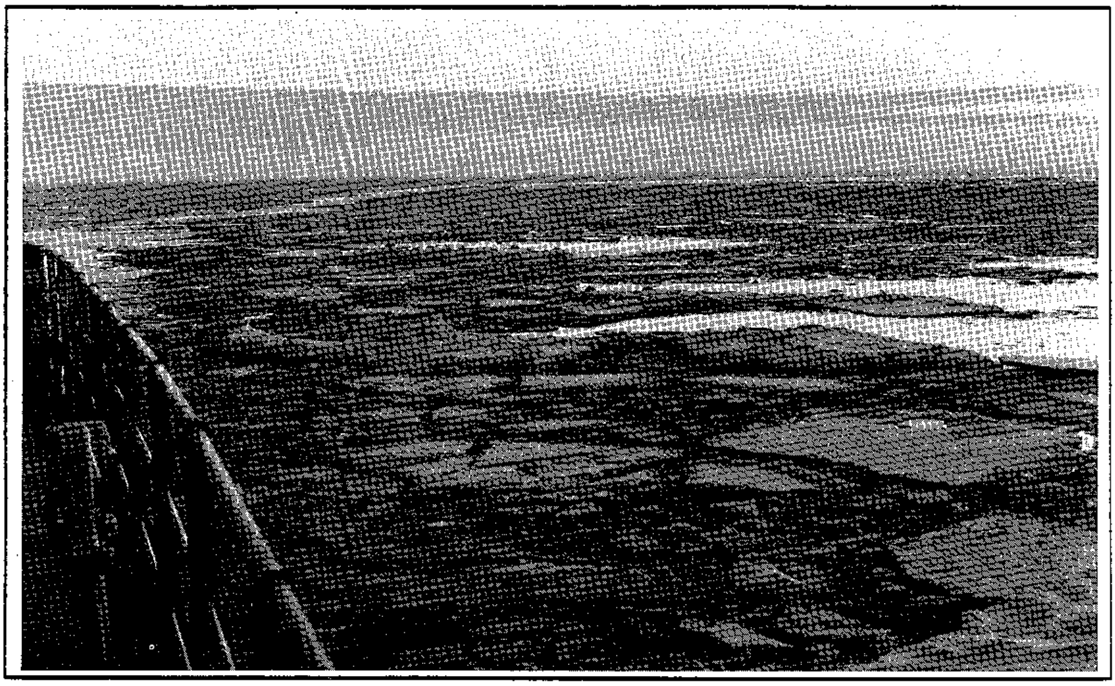


Figure 5. Drift Ice

broken ice pieces (rubbled ice) or areas of rafted ice where ice floes are layered on top of each other, sometimes several layers deep. Rubbled ice conditions are illustrated in Figure 6.

Rubbled ice usually supports the weight of survivors and their equipment, but movement away from the ship can be difficult. Survival is dependent on the crew's ability to find shelter at some distance from the ship. Very low air temperatures make shelter and warm clothing essential. Although it may be possible to manhandle lifeboats and liferafts into the ship's track, frequently progress is difficult as the tracks soon freeze.

1.5 Consolidated Ice

Consolidated ice covers a large area and is sufficiently thick to withstand pressure forces created by wind and current, (such ice can be more than 2 metres thick). While ridges can exist within a consolidated ice field they will be relatively stable until the spring breakup begins. Fragments of second year or multi year ice floes which were frozen-in during the fall freeze-up can be interspersed within the consolidated ice. Consolidated ice conditions are illustrated in Figure 7.

In such conditions, with high winds and the flat open nature of the ice cover, it is difficult for survivors to find natural shelter from the wind. The very low air temperatures with potential high winds make shelter and warm clothing essential.

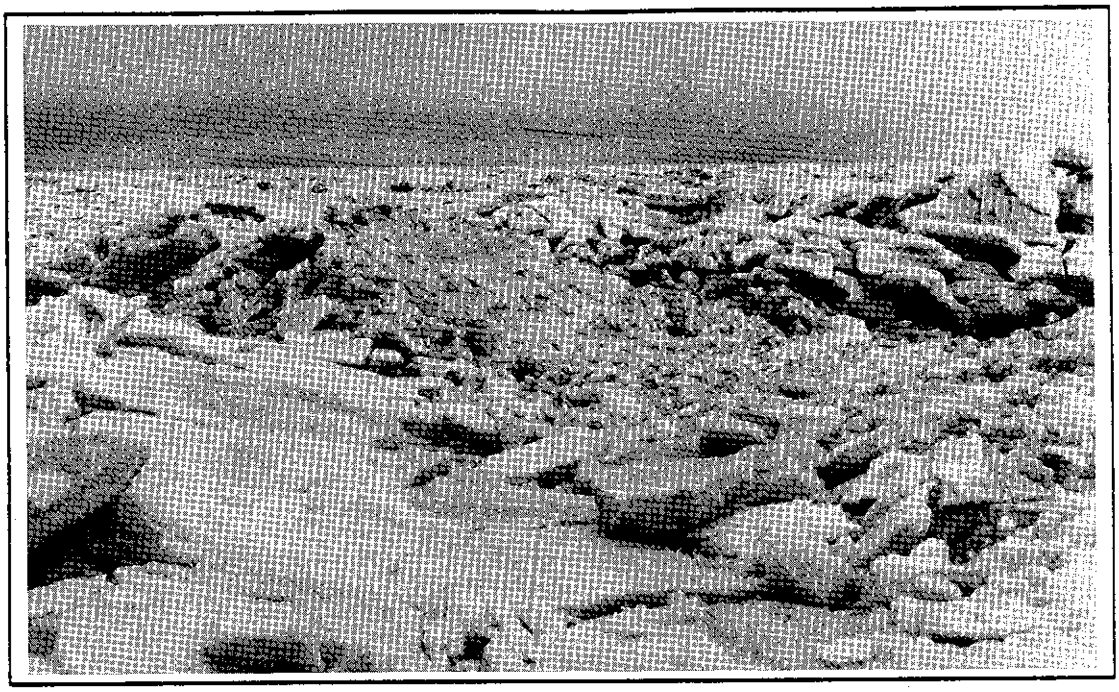


Figure 6. Rubbled Ice

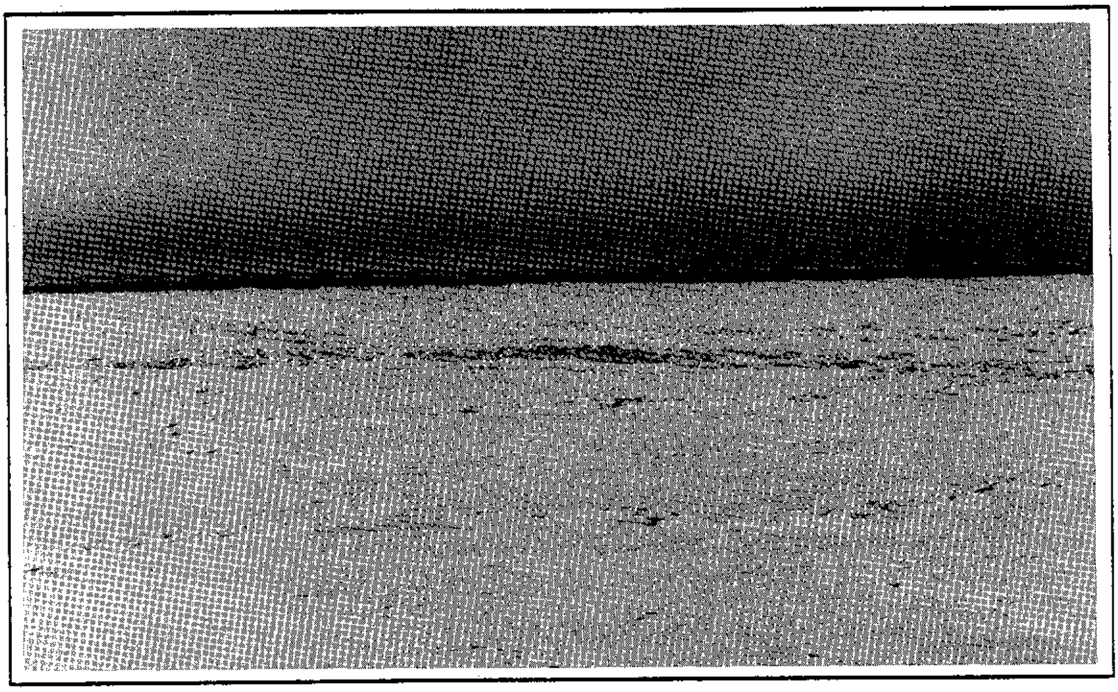


Figure 7. Consolidated Ice

1.6 Puddled Ice

Puddled ice occurs during the spring and early summer months when the air temperature rises and melts the snow and upper surface of the ice. As a result, consolidated ice and ice floes are covered with wet snow, slushy ice and pools of water. Occasionally, the air temperature can drop below freezing and wind speeds can be high. As a result, some of the melt pools can be covered by thin ice which will not bear much weight. Such puddling occurs throughout the cold weather regions. Figure 8 illustrates typical puddled ice conditions.

Figure 8. Puddled Ice

Lifeboats and liferafts can be launched onto the puddled ice, but movement away from the ship may be dangerous if patches of rotten ice are present. In addition, natural cover will be scarce and the conditions will be wet and cold.

1.7 Summary

A range of water and ice conditions can occur in cold regions that can prove hazardous to a ship's crew and their equipment during an evacuation. In particular, ice accretion, thin ice, pressured ice and puddled ice present special problems. These problems can be partially resolved with the lifesaving equipment currently carried on board, but in some circumstances unconventional equipment and survival techniques will be required.

CHAPTER 2 SHIP EVACUATION EQUIPMENT AND PROCEDURES

Evacuation from a ship is always difficult. Even in warm and calm conditions the movement of the crew into lifeboats and liferafts can be hazardous. In cold weather regions the difficulties are multiplied. Therefore, the effect of a cold climate on personnel and equipment must be considered carefully.

Evacuation issues can be divided into those concerning personnel, equipment and the operation of the equipment. This section describes the personal and shipboard equipment and the actions required as part of the evacuation process, and reviews the six scenarios portraying ship evacuation hazards, which were presented in Chapter 1.

2.1 Personal Equipment

When notified that the ship is to be evacuated, the crew should proceed quickly to their cabins, put on warm clothing and collect their immersion suits and any other personal effects which may enhance survival. Then, they should make their way to their mustering station and await evacuation orders.

The temperature of sea water, in cold regions, is frequently colder than 0°C and more than six hours can elapse before rescue. In such conditions, immersion suits do not effectively insulate the body. On land or ice, immersion suits are a poor substitute for insulated clothing; the insulating quality of these suits is insufficient to protect against very cold air temperatures. However, if there is any chance of falling into the water, an immersion suit gives the best protection. A dry immersion suit, worn over warm clothing, will retain warmth for an hour or two in air temperatures as low as -40°C, if the individual is active (although excessive activity can result in sweating). When inactive, a dry immersion suit worn over warm clothing will probably provide sufficient insulation to retain warmth in air temperatures down to about 5°C.

IMMERSIONS SUITS ALONE ARE INADEQUATE TO PRESERVE LIFE in extreme cold air temperatures; wear warm clothing under the immersion suit.

Thermal underwear worn with thick socks, warm trousers and sweaters is preferred. The rule of thumb is to put on as much warm clothing as the immersion suit will allow. This clothing should be donned before proceeding to the muster station, but the immersion suit should be donned at the muster station. It may be necessary for the crew to operate in pairs to help each other don the immersion suits.

2.2 Shipboard Evacuation Equipment

All ships carry lifeboats and liferafts. In addition, scrambling nets and the accommodation ladder may be useful in shipboard evacuation. The usefulness of this equipment varies, depending on the conditions encountered.

2.2.1 Lifeboats

Lifeboats can be launched into open water, open pack or thin ice conditions using the same techniques common to more temperate regions. Unless the davits are iced up, the crew will enter the boats at deck level and be lowered to the water. If icing is present, the ice must be chipped away with mallets or hammers to clear the moving parts of the davits. Once in the water, the boats can be used to marshal the liferafts away from the ship; otherwise, the boathooks can be used to break up the surrounding ice. In thin ice conditions, the ice may be sufficiently fractured by the presence of the ship to allow the boat to make progress. In pack ice, where the lifeboat will be in danger of being crushed, the boathook should be used to fend off any encroaching ice floes.

LIFEBOATS MAY BECOME STUCK OR DAMAGED in thin ice or pack ice.

Lifeboats will not be able to clear the ship if surrounded by consolidated, rubbled or puddled ice, as illustrated in Figure 9. The weight of the boat will be too great for the crew to move it over the ice. In such circumstances, other means of shelter, such as liferafts or snow shelters, must be used.

2.2.2 Liferafts

Liferafts can be launched into open water or open pack conditions using the same techniques common to more temperate regions. Unless the liferaft cradles and canisters are iced up, as illustrated in Figure 10, the rafts can be released from the ship (which will initiate inflation) and will come to rest, fully or partially inflated, adjacent to the ship's side. If icing is present, the raft container must first be cleared by chipping the ice away with mallets or hammers.

The rafts may be paddled, or marshalled by the lifeboats. Once in the water, the rafts should be moved away from the ship. In pack ice, the liferafts will be in danger of being crushed and the paddles should be used to fend off encroaching ice floes.

LIFERAFTS MAY BE CRUSHED OR PUNCTURED in pack ice.

In thin ice, the liferafts are often useless as the ice can prevent movement and cause punctures. The ice can be sufficiently fractured by the presence of the ship to allow the raft to make some progress. Alternatively, the paddles can be used to break up the surrounding ice. About 7 cm thickness of ice is required to bear a person's weight. Thus, if the conditions are right, it can be possible to stand on ice and haul the liferaft away from the ship.

In consolidated, rubbled or puddled ice, liferaft containers should be lowered to the ice surface and moved over the ice to a safe distance before inflation. This entails disconnection of the painter cord from the ship. The container can readily be pulled over the ice by crew members.

2.2.3 Scrambling Nets

Most ships are equipped with nets which are normally attached to the underside of the accommodation ladder and can be used as scrambling nets during ship evacuation. While they can be used in any evacuation scenario, they will be particularly useful for evacuation onto consolidated, rubbled or puddled ice.

Figure 9. Lifeboat on Consolidated Ice

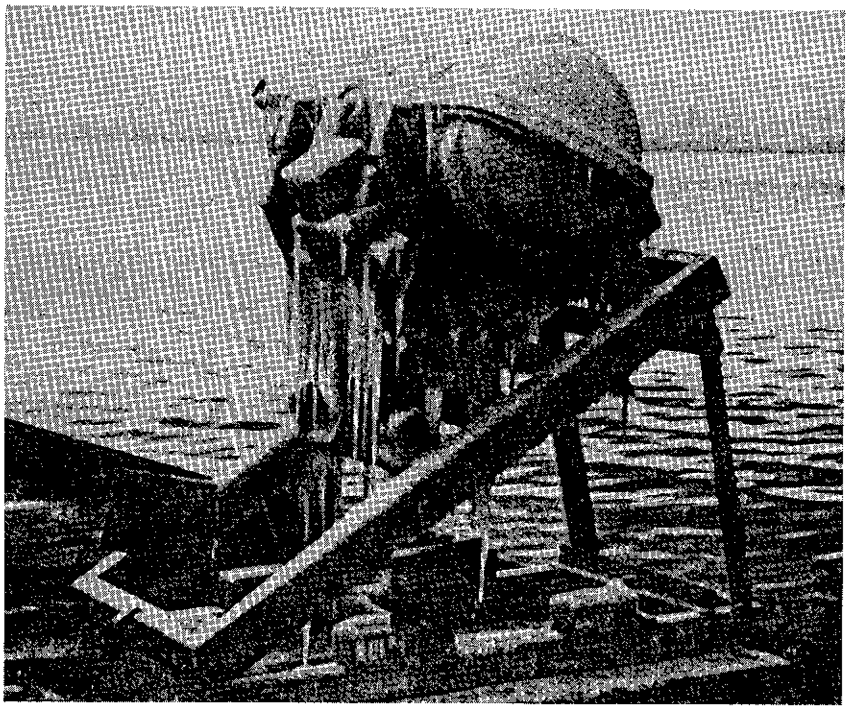


Figure 10. Ice Accretion of a Liferaft Cradle

2.2.4 Accommodation Ladder

All ships have accommodation ladders which are designed to reach close to the waterline. During evacuation onto consolidated, rubbled or puddled ice, these ladders can offer the quickest and safest way of getting on the ice surface.

2.2.5 Cranes

Cranes can be used to lower personnel and equipment down to the ice surface if circumstances permit, there is time to do so and the equipment is operating. Often in ship abandonment situations, when time is limited, do not waste time trying to get the cranes operational (i.e., beating off ice).

2.3 Summary

In these hazardous scenarios, evacuation can be less difficult than in a high-sea state in more temperate regions. However, the presence of ice and icing changes the nature of the evacuation process such that the usefulness of the conventional evacuation equipment becomes limited. The selective use of available equipment to suit the circumstances should, in most circumstances, ensure a successful evacuation. However, the presence of open pack or thin ice always presents danger.

Officers and crew should draw up plans of action detailing what to do in each scenario and how to best use the available equipment. Preparedness and foresight will increase the chances of a successful evacuation.

CHAPTER 3 CONVENTIONAL SURVIVAL EQUIPMENT

Once off the ship, the crew must cope with existing circumstances. If afloat in lifeboats or liferafts, survival will depend on the weather and sea conditions. Extremes of cold and the presence of sea ice will influence survival. Similarly, if evacuation has taken place onto the surrounding ice cover, survival will not only depend on the environment, but also on training the crew has been given in dealing with these unusual circumstances.

If the crew has only conventional lifesaving equipment and training, the rigors of a cold-weather environment will be challenging and great difficulties will be encountered. However, many have survived for long periods in very adverse conditions with less equipment and training than is now available to crew members. The following subsections describe the conventional equipment.

3.1 Lifeboats

Lifeboats may be constructed of wood, steel, aluminium or glass reinforced plastic. They will be either hand propelled (paddled), motorized or fitted with mechanical propulsion. Figures 11, 12 and 13 show open, partially enclosed or fully enclosed lifeboats.

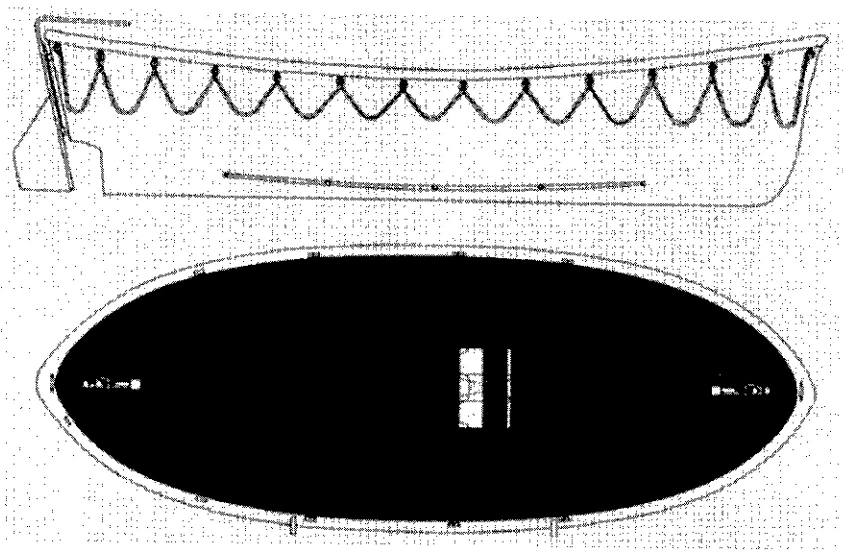


Figure 11. Open Lifeboat

Generally, lifeboats are supported on board the ship in davits which may be of the manually operated radial type, luffing type or gravity type. Free-fall lifeboats have been recently introduced on offshore structures and some ships. In ice infested waters, there is a distinct possibility of hull damage if these boats are allowed to free-fall.

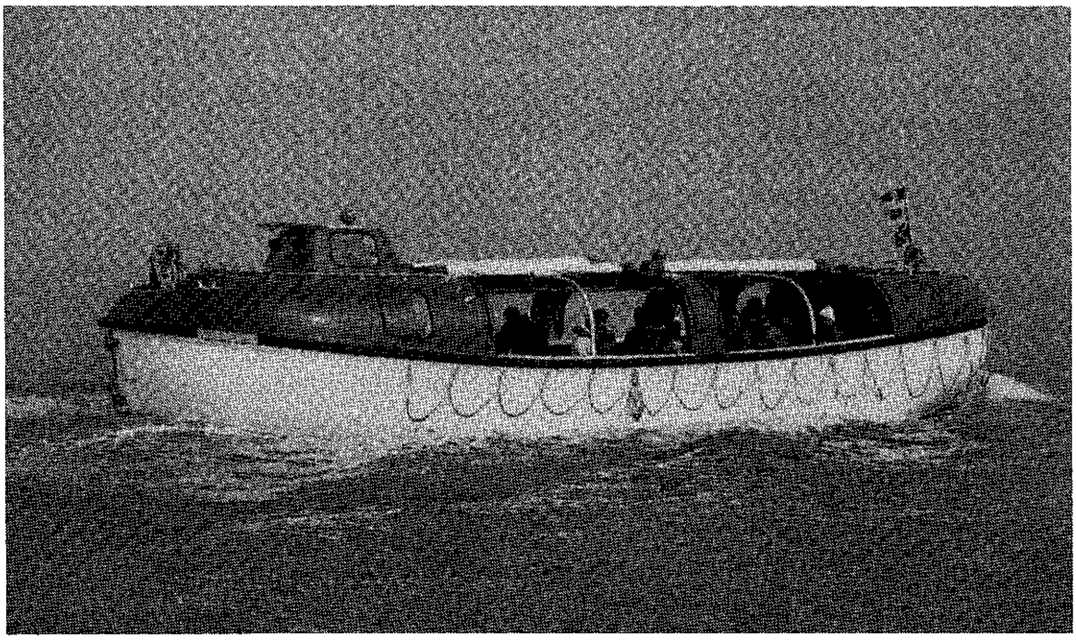


Figure 12. Partially Open Lifeboat

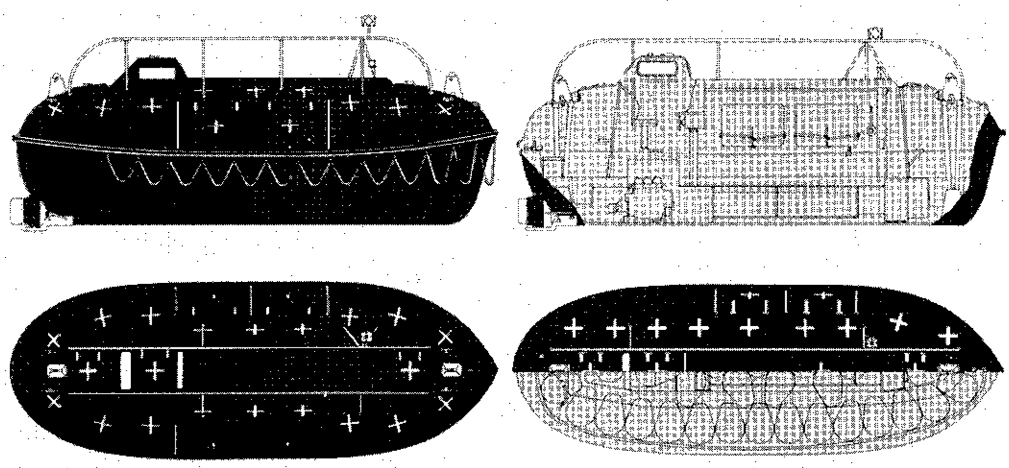


Figure 13. Fully Enclosed Lifeboat

Partially enclosed lifeboats have rigid covers over 20% of the length at the bow and stern. A permanent, folding two layer canopy is fitted between these end covers. Entrances with closing arrangements are provided at the bow, stern and at both sides.

Fully enclosed lifeboats have a rigid cover over the full length. Entrances with closing arrangements are provided at either side and on top. These boats are also fitted with an engine.

OPEN LIFEBOATS PROVIDE NO PROTECTION from the environment.

Engines are unlikely to perform as intended in air temperatures encountered in cold weather regions. Performance is further hindered by the presence of ice.

- Lifeboat engines must be kept warm to ensure they will start reliably in very cold temperatures. Devices such as glow plugs depend on battery power which is reduced dramatically in cold weather. In addition, due to increased oil viscosity in the cold, increased power is required to turn the engine over. Often the engine or the lifeboat itself is fitted with a heater to maintain the engine above the temperature required for reliable starting. The power for the heating system usually is provided from the vessel's emergency switchboard.

A supply of QUICK START should be kept on hand to spray into the engine air intake for cold weather starts.

- The fuel's pour point should be at least 10°C below the expected minimum ambient temperature. However, low pour point fuels also have low flash points.

- Water cooled engines are prone to freeze. Closed circuit glycol filled engine cooling systems and air cooled engines avoid this problem.

- The propeller must be capable of being disengaged from the engine and protected from damage from ice.

Lifeboats are the traditional means of escaping from a stricken ship. In cold weather regions and particularly in sea ice, however, there is a distinct danger these boats will be inadequate for protecting the crew. Life-threatening conditions will exist if the hull is damaged due to collision with ice, and personnel are exposed to extremely low temperatures.

3.2 Liferafts

Inflatable liferafts are the most common and are usually constructed of rubber or neoprene coated nylon. These liferafts are packed in containers and stowed on deck ready for immediate use. One or more containers may be stored on one rack. Inflation is achieved by pulling the "painter". Some liferafts are fitted with a hydrostatic release system which will automatically inflate the raft when the container is covered by water. In extremely cold temperatures, the raft may not inflate properly. In such cases, if the circumstances allow, the raft can be fully inflated using the bellows pump provided. A typical inflatable liferaft is shown diagrammatically in Figure 14. Rigid liferafts are "floats" with sufficient buoyancy and deck area to accommodate personnel. These rafts are fitted with a cover.

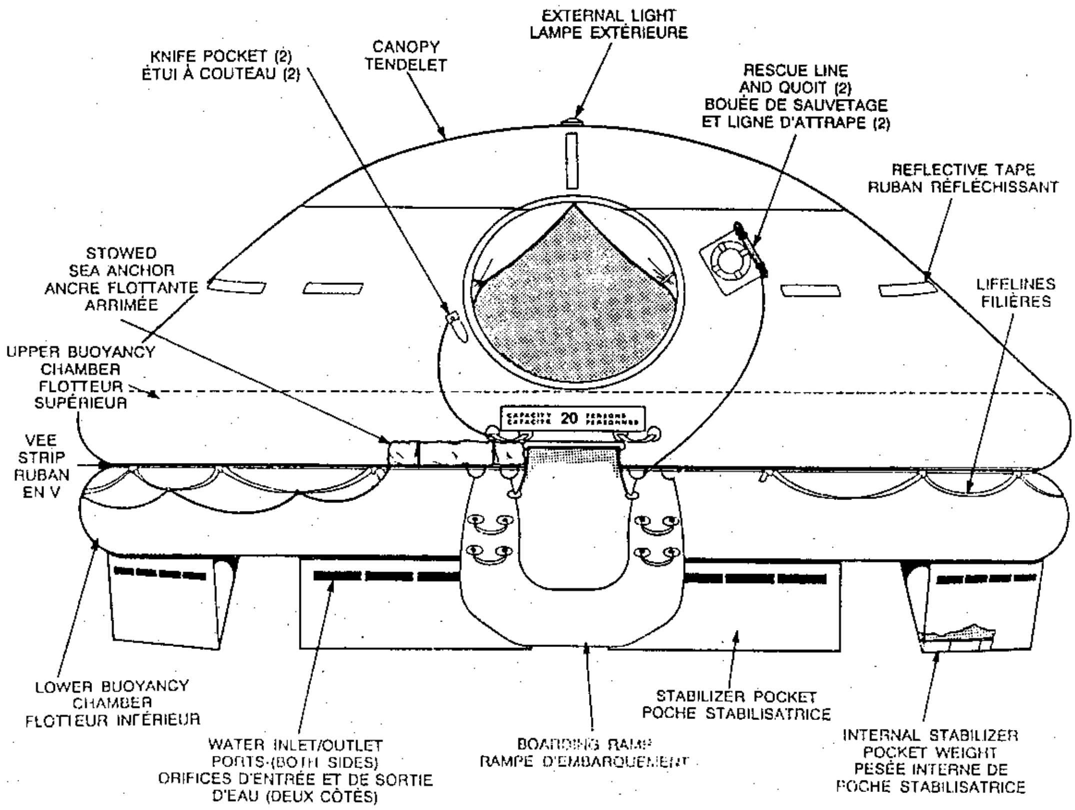


Figure 14. Inflatable Liferaft

These conventional liferafts may be suitable for temperate regions, but they provide no protection from cold ambient air and are subject to damage from sea ice. They are better than having no shelter, but they are inadequate at best.

3.3 Rations

Lifeboats carry specific items of survival equipment, depending on the ship type and trade. Table 2 lists the survival equipment which may be included. The contents of liferaft equipment packs are dependent on the ship type and trade. Table 3 lists this equipment.

> *Lifeboat and liferaft rations are INADEQUATE FOR EXTENDED PERIODS in cold weather regions.*

Table 2. Typical Lifeboat Equipment (Source: Canadian Coast Guard)

1.	Sufficient oars to make headway in calm seas
2.	Two boathooks
3.	A buoyant bailer and two buckets
4.	A survival manual
5.	A binnacle with an efficient compass
6.	Two hatchets
7.	Sea anchor
8.	Two painters
9.	One food ration totalling 10,000 kJ per person
10.	1 to 3 Litres of fresh water per person
11.	A dipper with lanyard
12.	Graduated drinking vessel
13.	Four type A rocket parachute distress signals
14.	Six type C hand flares
15.	One grab line per 1.81 m of lifeboat
16.	Two type D Buoyant smoke flares
17.	Signalling flashlight, spare batteries and bulbs
18.	First aid outfit
19.	Daylight signalling mirror with instructions
20.	A buoyant safety knife
21.	Three safety openers
22.	Two buoyant rescue quoits attached to buoyant heaving lines
23.	A manual pump
24.	Locker
25.	Whistle
26.	One set of fishing tackle
27.	Sufficient tools to undertake minor repairs to the engine
28.	Portable fire extinguisher
29.	A searchlight
30.	An efficient radar reflector
31.	Thermal protective aids for 10% of the persons to a maximum of two
32.	Illustrated copy of lifesaving signals
33.	Six doses of sea-sickness medicine and one sea-sickness bag per person

These rations provide very little sustenance to a ship's crew in a survival situation. The 10,000 kJ amounts to about 700 calories per day for each person, which is hardly enough even in temperate climates. In cold regions, the supply of fresh water provided will almost certainly be frozen. In lifeboats, the heat from the engine can be used to melt frozen patches of drinking water. In liferafts there are no means to do so.

Supplies of FRESH WATER WILL BE FROZEN.

Table 3. Typical Liferaft Equipment (Source: Canadian Coast Guard)

1.	Two buoyant paddles
2.	One or two buoyant bailers
3.	A survival manual
4.	Instructions for immediate action
5.	Two sea anchors
6.	One food ration totalling 10,000 kJ per person
7.	0.5 or 1.5 Litres of fresh water per person
8.	Two or four type A rocket parachute distress signals
9.	Three or six type C hand flares
10.	One grab line per 1.81 m of lifeboat
11.	One or two type D Buoyant smoke flares
12.	Signalling flashlight, spare batteries and bulbs
13.	First aid outfit
14.	Daylight signalling mirror with instructions
15.	One or two buoyant safety knives
16.	Three safety openers
17.	One buoyant rescue quoit attached to buoyant heaving lines
18.	One or two topping up pump or bellows
19.	Whistle
20.	One set of fishing tackle
21.	A repair outfit for punctures
22.	An efficient radar reflector or an approved radar transponder.
23.	Thermal protective aids for 10% of the persons to a maximum of two
24.	Illustrated copy of lifesaving signals
25.	Six doses of sea-sickness medicine and one sea-sickness bag per person
26.	Two sponges

3.4 Communications

A means of communication is an essential part of the safety equipment carried on board ships. Survivors must be able to alert the authorities in charge of the search and rescue operations of their location and situation. If communications can be established, information which can assist in the rescue operation should be transmitted, this information includes:

- location;
- state of health of survivors and the requirement for medical assistance;
- the number of survivors;
- present status of the survival party (i.e., safe in lifeboats, on ice, or in immediate danger for whatever reason);
- type of assistance immediately required (i.e., water, food, medical, additional floatation devices, etc.); and
- description of site (i.e., suitable for landing aircraft, etc.).

This type of information is needed for an efficient rescue operation and for minimizing delay. The speed with which survivors can be retrieved is critical.

Radio communication provides a vital link for shipping. It is an essential part of the Search and Rescue (SAR) operations from the first emergency message to communications between the survivors, Rescue

Coordination Centres (RCC), rescue parties, owners of the vessel, and other ships in the area. Table 4 lists the Canadian Coast Guard Marine Radio Stations in Canada, along with lat/long positions and call signs. For full details of these and other stations, the latest edition of "Radio Aids to Marine Navigation (Atlantic and Great Lakes)" and "Radio Aids to Marine Navigation (Pacific)" can be consulted.

All Canadian Coast Guard radio stations keep a continuous watch on the international distress and calling frequencies of 500 and 2182 KHz (MF), and all port radio stations maintain continuous watch on the safety and calling frequency of 156.8 MHz (VHF). In an emergency, international procedures and designated frequencies must be used. Should this be impossible, any other frequency can be used that will attract attention.

EPIRBs (Emergency Position Indicating Radio Beacons - Class II) are required to be carried on board Canadian ship's lifeboats and liferafts. The procedures for activating these devices will vary with the application; for example, it could be automatic for lifeboats upon launch, on inflation of a liferaft, or manual. Crew members should familiarize themselves with the radio beacon instruction and operation manuals.

Pyrotechnics are part of the standard kit for liferafts and lifeboats and can be used to signal position and distress. Regardless of colour, any pyrotechnic signal will be investigated by a search party. In the whiteness of the Arctic tundra, red and green flares will stand out better than white flares. The following signals are recognized internationally by rescue services:

- red flare - help needed;
- white flare - message understood; and
- green flare - return to base.

Crew members should familiarize themselves with the many types of pyrotechnics carried on board. Regular shipboard emergency drills should include practice in firing pyrotechnics.

3.5 Clothing

Immersion suits are the only clothing required by regulations that is of any use to survivors in cold regions. However, the crew will have personal clothing which will be useful in maintaining warmth and can be considered part of the conventional equipment normally found onboard.

Immersion suits, as shown in Figure 15, must provide both buoyancy and thermal protection. Canadian regulations now require immersion suits for the complete complement of cargo ships, tankers and manned barges. The Canadian Coast Guard standard requires that the suit, and clothing worn inside, insulate the body so the core temperature will not drop more than 2°C after immersion in calm circulating water of 0-2°C for six hours.

Since the insulating qualities of immersion suits are poor, it is essential to wear warm clothing. Thermal underwear worn with thick socks, warm trousers and sweaters is preferred.

Wear as much warm clothing as the immersion suit will allow.

Table 4. Canadian Coast Guard Radio Stations

Station	Province	Latitude	Longitude	Call Sign
Alert Bay	B.C.	50 35 12	126 55 28	VAF
Comox	B.C.	49 45 00	124 56 39	VAC
Prince Rupert	B.C.	54 18 00	130 25 09	VAJ
Tofino	B.C.	48 55 31	125 32 25	VAE
Vancouver	B.C.	49 10 30	123 07 15	VAI
Victoria	B.C.	48 21 35	123 44 48	VAK
Comfort Cove	N & L	49 20 04	54 51 32	VOO
Labrador	N & L	53 17 46	60 32 35	VOK
St. Anthony's	N & L	51 29 56	55 49 30	VCM
St. John's	N & L	47 36 40	52 40 01	VON
St. Lawrence	N & L	46 55 42	55 22 50	VCP
Stephenville	N & L	48 33 17	58 45 44	VOJ
Iqaluit	N.W.T.	63 43 42	68 33 00	VFF
Resolute	N.W.T.	74 45 14	94 58 09	VFR
Halifax	N.S.	44 28 20	63 37 16	VCS
Halifax	N.S.	44 57 50	63 58 55	CFH
Sydney	N.S.	46 11 08	59 53 40	VCO
Yarmouth	N.S.	43 44 24	66 07 19	VAU
Ottawa	ONT.	45 17 47	75 45 22	CHU
Charlottetown	P.E.I.	46 11 40	62 39 35	VCA
Cap-aux-Meules	QUE.	47 23 14	61 51 40	VCN
Mont-Joli	QUE.	48 36 30	68 13 45	VCF
Montreal	QUE.	45 32 57	73 29 48	VFN
Quebec	QUE.	46 48 39	71 12 10	VCC
Riviere-au-Renard	QUE.	49 00 30	64 24 00	VCG
Sept-Iles	QUE.	50 11 17	66 06 40	VCK

Figure 15. Immersion Suits

3.6 Summary

Conventional lifesaving equipment is not designed for marine crew survival in cold regions. Lifeboats and liferafts are of limited use in severe ice conditions and offer little protection, other than from wind. Similarly, the survival equipment normally provided with lifeboats and liferafts is inadequate for cold regions. Although food is less important than water for short-term survival, it is still a necessary element for long term survival and has a positive psychological impact. The supplies of water will be frozen and, without a means of heating it, will be of little use to the survivors. The immersion suits are not suitable for exposure in very cold air conditions on land. Exposure to very cold water or air temperatures will result in hypothermia and eventual death. The use of an immersion suit, however, will lengthen survival time in such conditions.

CHAPTER 4 ADDITIONAL SURVIVAL EQUIPMENT

Past experience has shown that various items of survival equipment, which are not currently required by regulations, can be invaluable in various survival situations. Several ship operators in the Beaufort Sea provide a Survival Pack that contains essential equipment and can be mounted on a sled for easy movement over the ice.

Survival in cold regions and, in particular, those areas where sea ice exists, is very difficult without the assistance of specialized equipment. Normally, this specialized equipment is carried on board ships.

4.1 Insulated Liferaft

The lack of insulation in a conventional liferaft means that it will not retain heat. At best, it will offer a still-air environment which protects survivors from the wind. Although the air temperature inside the raft will be very low, there will be no wind chill effect on the occupants.

The liferaft must be insulated to retain heat. Experience has shown that a liferaft can be manufactured with the floor, rings and canopy insulated with inflatable insulated panels. In addition, a vestibule can be attached to the entrance door to protect against the wind when entering or exiting the raft. A schematic of such a raft is shown in Figure 16.

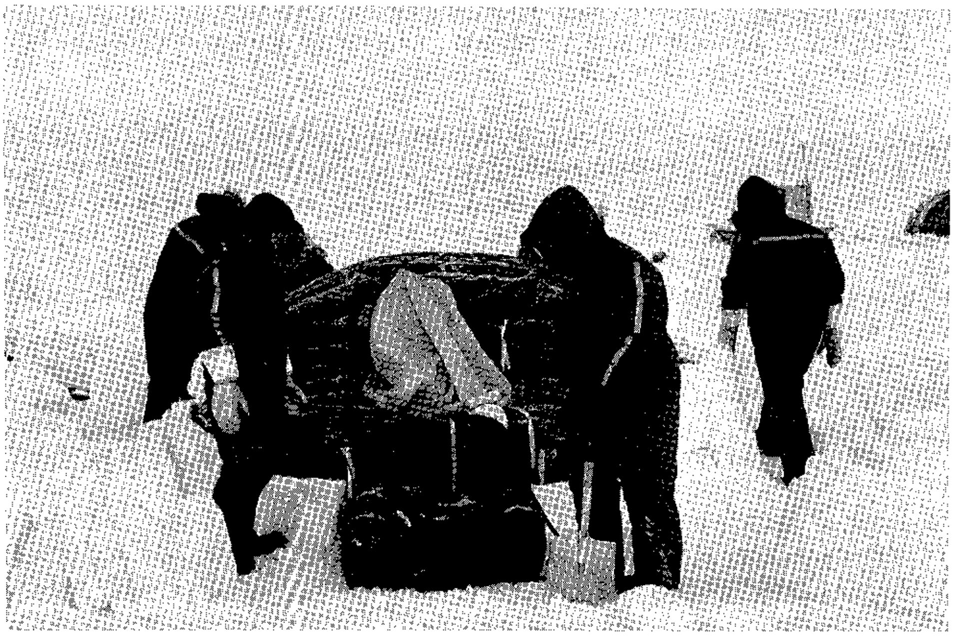


Figure 16. Insulated Liferaft

4.2 Clothing

Personal insulation systems (clothing and sleeping bags) are designed to maintain the body's thermal balance by reducing heat loss. It is important to understand the features of insulation systems.

- The insulation and entrapped air must be sufficient to prevent excessive heat loss. The amount of insulation is dependant on temperature and metabolic rate. The underlying principle of trapped air in personal insulation is best achieved through the multi-layer principle and the ability to compartmentalize (using draw-strings and waist-belts).

- Natural fibres (i.e., wool, cotton, silk etc.) or down have excellent insulating properties; but, there are man-made (synthetic) fibres such as thinsulate or capilene that have equivalent insulation properties. Multiple layers of light, fibrous clothing are better than fewer but thicker layers. Multiple light layers allow greater flexibility in adjusting clothing to suit conditions.

Wear MULTIPLE LAYERS of fibrous clothing.

- There are three basic categories of synthetic insulating materials:

  a) Primary layer materials from polypropylene and polyester: They are manufactured into underwear including such material brand names as Capilene, Polartec and Thermax.
  b) Secondary layer materials: They are used in shirts, light jackets, mitts, pants, and socks. Brand names include Polartec, and Capilene.
  c) Outer layer: Such as insulated jackets, suits, and sleeping bags made from Thinsulite, Quallofil, Hollowfil, Thermolite, or Themoloft.

  The primary advantage of synthetic fibres over natural fibres is that synthetic fibres do not absorb water. It is possible to put moisture between the fibres, but the fibres themselves absorb virtually no moisture, accordingly they are much easier to dry. Most water can be wrung out, also, the body heat will push moisture to the outside, so that even if the outside layer is wet, the inside will be dry.

  Primary and secondary materials dry quite easily with body heat; moisture is pushed to the outer layer. Outer layer materials are more difficult to dry, but they can hold up to three or four times their weight in moisture and still function reasonably well.

  A stiff plastic bristled brush, such as a toilet brush, is indispensable. It should be used regulary to brush hoar frost from clothing, boots, sleeping bags and the walls of the tent.

- The most difficult parts of the body to keep warm are the hands, feet, ears, nose and cheeks. The large number of sensory inputs in these parts define how cold a person feels. The hands, feet and ears must be kept warm, adequately insulated and exercised to increase the blood flow.

- Up to 40% of total heat loss is from the head. However, the head does not often feel cold - the normal cold self-regulating mechanism of reducing the blood supply does not apply to the head. A great deal of care should be taken in insulating the head to minimize body heat loss. By adjusting headgear, it is possible to regulate the total body heat balance.

- It is important to prevent moisture build up within the insulation system. Once the insulation becomes wet, it is almost impossible to dry. Insulation systems should be adjusted so that the survivor feels cool rather than warm or hot. In this way, moisture build-up due to sweating is reduced and dehydration due to loss of fluids is avoided.

ADJUST clothing to prevent sweating

Accelerated heat loss due to wetness can result from a variety of reasons:

- Water has a thermal conductivity about 27 times greater than air. Therefore, wet or damp skin loses heat through conduction far more quickly than dry skin.

- Any moisture in the insulation causes fibres to mat, resulting in a loss of entrapped air and a reduction in insulation value.

- Evaporation of moisture from the skin causes heat loss from the body.

- Insulation systems should be designed to avoid moisture build-up. Materials such as polyester or polypropylene (synthetic fibres) should be worn next to the skin as they transport moisture away from the skin. The moisture is pushed through the fibres of these materials by body heat.

- Convective heat loss increases with wind speed. Therefore, extended exposure to wind should be avoided.

- Clothing should be of dark colour. Dark coloured clothing is warmer, easier to dry, and can easily be seen by Search and Rescue parties.

4.2.1 Insulated Suit

The one piece insulated suit shown in Figure 17 provides excellent protection from the cold. The important design features of insulated suits are:

- one piece heavy duty construction (double stitched);
- down insulation;
- insulated tunnel hood with fur trim (wolverine);
- hood that extends in front of face (15 cm);
- pliable wire sewn into hood periphery;
- plastic zippers with velcro wind flaps;
- large pockets with flaps;
- compartmenting (drawstrings at waist, ankle and neck);
- ease of ventilation (trunk and leg zippers); and
- wind resistant (snap close flaps over zippers) and water repellant.

There are many insulating materials, man-made (synthetic) and natural, that provide adequate insulation. However, down has the greatest insulating value per unit weight and is the most compressible of suitable insulating materials.

Figure 17. Insulated Suit

An alternative to the one piece insulated suit is a two piece suit, consisting of pants and jacket, that incorporates the same basic design features as the one piece suit.

4.2.2 Thermal Underwear

Synthetic underwear such as polyester will transport perspiration away from the skin; pure natural fibres tend to absorb moisture. If natural fibres underwear becomes damp, it should be turned inside out and reworn. However, do not turn synthetic underwear inside out if it is damp. Body heat pushes moisture away from the body. Reversing damp synthetic underwear will only place the damper side next to the skin. Light exercise (walking) will help dry clothing by generating heat to push moisture away from the body. If underwear is wet, and exercise is not possible, and the subject is cold, it may be preferable to remove the wet clothing.

4.2.3 Handwear

Arctic mitts should be of the two piece gauntlet style shown in Figure 18. The outer shell should be durable and water repellent (e.g., seal skin) and should have a fur pad on the back. The inner shell should be

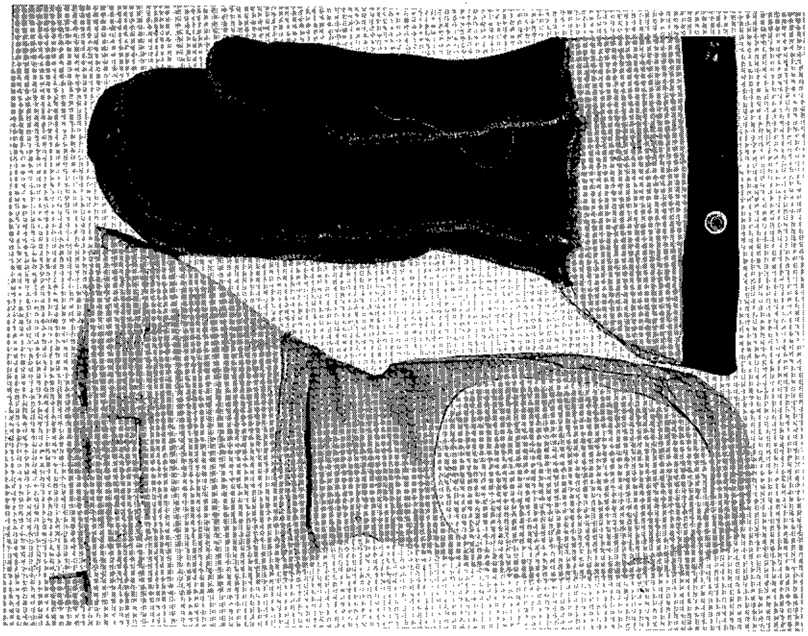


Figure 18. Arctic Mitts

synthetic to promote the transportation of perspiration away from the skin. The inner layer should be removable for drying.

Certain tasks require the use of fingers (e.g., lighting stoves). Mitts restrict these tasks, but synthetic gloves allow some to be completed without exposing bare hands. A very effective item of handwear are wristlets. These fingerless and palmless gloves can be worn under mitts and gloves. They provide protection for bare-handed work. They also add significant insulation to the wrist area (most mitts and gloves do not provide much insulation on the wrist) which aids in keeping the hand warm.

4.2.4 Headgear

A long scarf (about 2 m) is excellent for protecting the face and neck from wind. Cotton is a preferred material due to its good insulation qualities (when dry) and relative ease of drying. However, icing due to breathing through the scarf can not be stopped. When a section of the scarf becomes iced up, a dry part is placed around the face and neck and the iced-up part is placed inside the insulated suit for drying by body heat.

A balaclava which covers the face as well as the head will provide another layer of insulation (in addition to the insulated suit hood). The balaclava will allow a greater degree of ventilation by allowing the survivor to remove the suit's hood. However, caution must be used when wearing a balaclava as it will mask signs of frostbite from fellow survivors.

A hat made of polartec is most useful. It wicks away moisture and can be worn at all times, even when sleeping.

An item of headgear that is very effective is a headover. First used by the Norwegian military, it is a tube of synthetic material, such as Thermax or Polartec. It is very versatile and can be used as a hat or balaclava. Its primary function is to protect the face. It can be pulled up over the face to protect the nose and cheeks. When it becomes too icy to be effective, it can be rotated. Such a small synthetic item is easy to dry over a stove while cooking. Its effectiveness is not greatly affected if it is damp.

If a scarf is used, it should consist of secondary material, such as Polartec. This material breathes and is easier to dry. Cotton and wool should be avoided as they become wet more quickly than synthetic and are much more difficult to dry.

4.2.5 Footwear

Heavy socks provide a first layer of insulation for the feet. These should be synthetic to promote the transportation of moisture away from the skin.

A common choice of footwear for survival in cold regions is the mukluk used by the Department of National Defense, shown in Figure 19. These mukluks are warm, rugged and durable, but they are heavy and have several components (boot, felt sock, felt and plastic sole inserts).

An alternative to mukluks is the hollotherm bootees shown in Figure 20. These bootees are light weight and comfortable. Rubber over-slippers are recommended to provide protection from wet snow and puddling, and to improve traction.

4.3 Sleeping Bags

An adequately insulated sleeping bag is very important. A good Arctic sleeping bag should ensure six hours of steady sleep at -54°C. Insulating value, weight, volume and durability should be considered when selecting a sleeping bag. Down offers the greatest degree of thermal insulation per unit of weight and is the most compressible of suitable materials. The best synthetic fibres are 3 to 4 times bulkier for an equivalent insulation value. However, if down gets wet from contact with water or from perspiration, it loses insulation value.

To avoid moisture build up in a sleeping bag, the occupants should:

- sleep bare or with minimal clothing (clothing may contain moisture);
- breathe outside the bag;
- insulate the bag from the ground or snow (mattress); and
- ventilate the bag whenever possible during the day (turn it inside out).

Avoid dry-cleaning down bags, this process removes natural oils and reduces the insulation value. If the inner and outer bag are of watertight material, the problem of moisture absorption is avoided. A flannelette liner should be provided to allow for cleaning and to eliminate moisture caused by perspiration.

BREATHE OUTSIDE the sleeping bag.

Sleeping bags should be big enough to allow adjustments in sleeping position. If they are too big and contain too much air, body movements will pump air in and out causing heat loss through convection. A snug fitting bag that can be closed around the neck avoids this problem. This also ensures that the occupant breathes outside the bag, and thus keeps moisture out. As a bare head and neck can account

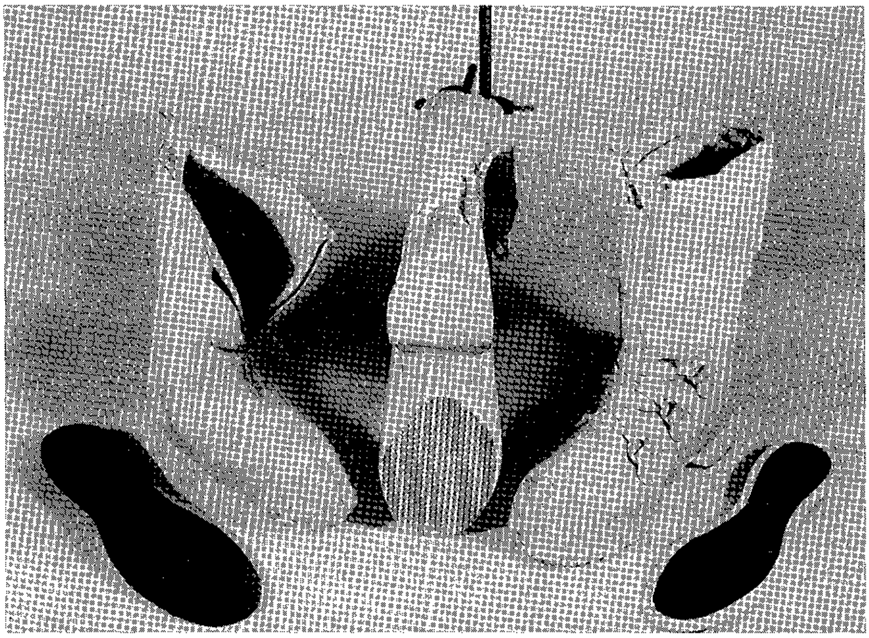


Figure 19. Arctic Mukluks

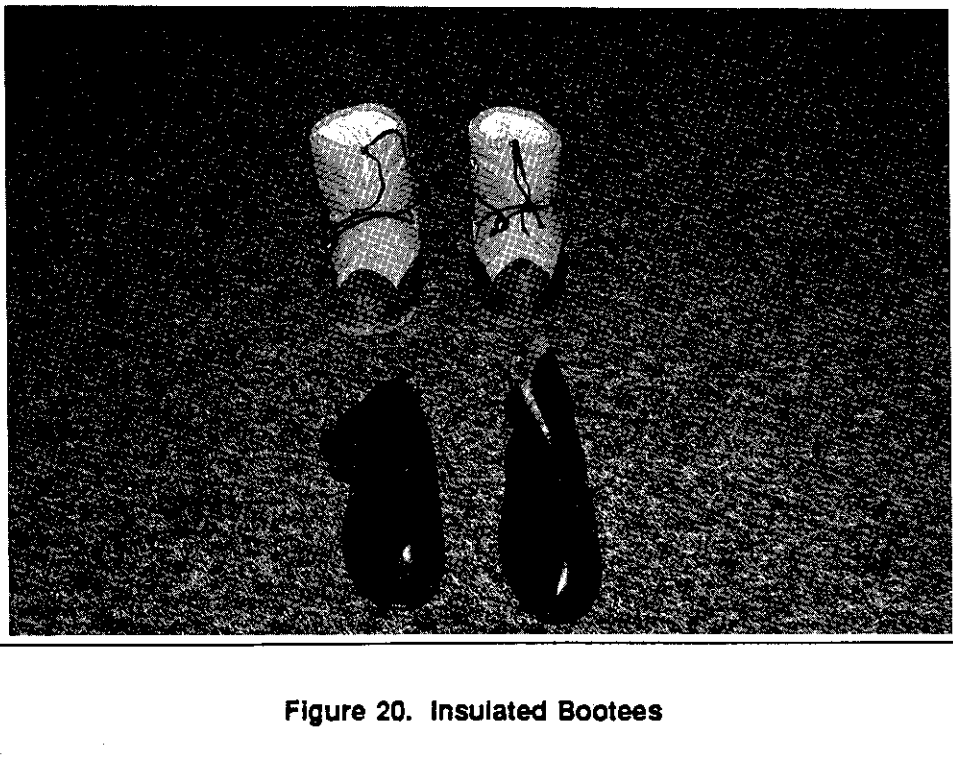


Figure 20. Insulated Bootees

for a large amount of heat loss, it is necessary for the sleeping bag to have an insulated hood or for the occupant to wear a balaclava and scarf.

If stowage space is limited, sleeping bags may be vacuum packed. Compression of the insulation from vacuum packing, as well as from the occupant's weight, will reduce the insulation value of the bag. To restore the insulation value, the bag must be fluffed up to reintroduce air gaps between fibres.

Survivors should lie side by side in individual bags to conserve body heat. In an emergency due to a shortage of sleeping bags or as treatment for hypothermia, for example, survivors can double up in sleeping bags.

Damp clothes can be dried with body heat by placing them between the liner and the bag. However, this will introduce moisture to the inside of the bag.

To remain comfortable while sitting or lying in the shelter or on the ice, there must be an air space between the body and the ice. This can be achieved by using a foam or air mattress. A foam mattress about 3 to 4 inches thick will meet this requirement, but will be bulky. Air mattresses are less bulky, but a pump is required for inflation. Using breath to inflate the mattress can cause internal icing. Ideally, the air mattress will be of multiple horizontal layers to prevent convective heat loss.

If the liferaft has an inflatable floor, which can support the survivors weight without compression to the ice, then the need for mattresses is eliminated. Some specialized sleeping bags have a built-in mattress which eliminates the need for a separate mattress. The "Cocoon 4" is a sleeping bag designed for cold regions which is made from down filled inflatable chambers. This sleeping bag provides protection from the elements and from a cold surface. It may be possible to eliminate the need for an insulated liferaft if such sleeping bags are available to the crew.

4.4 Rations

Water consumption is an important factor for survival in cold regions. The conventional supplies of water in the liferaft and lifeboat survival packs will be frozen and must be melted to be useful. Old ice or snow may be used but means of melting are necessary. As with food, beverages should be hot so the body will not use energy to bring them up to body core temperature.

Survival on body fat and water alone is possible. Indeed, some people have survived for several months with little or no food. Nevertheless, for psychological and physiological reasons, the provision of rations is important. This is especially true in cold regions where exercise and work are essential to generate body heat.

A minimum of 2,500 calories per day are recommended for survival in cold regions. Although a balanced diet is preferred, fat and carbohydrate-rich rations are suggested for short term survival purposes where water and stowage space is limited. Providing food stuffs that are popular, as opposed to only those with the least bulk, best calorific value or longest shelf life can have an important psychological benefit.

Carbohydrates (sugars and starches) provide a large amount of energy in a compact form, they are quickly absorbed by the body and require little water for processing. Fats and oils are needed for endurance. Proteins and minerals are necessary for body growth and repair but require a long time and a large quantity of water for processing by the body.

Another important consideration is sodium. High sodium foods require more water. Sodium has a far greater effect on water consumption. A low sodium diet will require less water than a high sodium diet.

Rations of the boil-a-bag type can be used. Preparation is simple and fuel-efficient: water is boiled to heat the boil-a-bags, and once heated, the water can then be used for drinking. Each Meal Pack provides a nutritionally balanced meal of about 1,300 calories composed of approximately 180 grams carbohydrate, 50 grams protein and 40 grams fat. However, boil-a-bag type foods tends to be high in sodium.

Chewing gum is an important part of the rations since it keeps the facial muscles moving and, thus, helps warm the face to protect it from frostbite.

Plastic spoons and insulated plastic mugs should be provided for eating and drinking. Metal to skin contact must be avoided. Spoons can be used while wearing mitts or gloves, so that survivors can avoid exposing their hands while eating.

Metal to skin contact MUST BE AVOIDED.

4.5 Stoves and Fuel

Food should be heated so the body will not use energy to bring food up to the body core temperature (37°C). There is also a psychological benefit to providing cold survivors with hot meals. For the same reasons, water should be heated. Potable water may be produced by adding desalting tablets to sea water (if sea water is accessible). However, melting bottled water, old ice, or snow are the most likely sources.

Stoves are so very important to survival in cold regions that extra stoves should be supplied in case of malfunction or loss. These stoves should be self-pressurized, capable of multi-fuel combustion and designed and constructed to minimize the number of small, loose parts. Multi-fuel stoves can use shipboard fuels such as diesel, gasoline or kerosene. Two types of stove which have proven most successful in field trials are of the single burner multi-fuel type shown in Figures 21 and 22.

SINGLE BURNER, MULTI-FUEL TYPE STOVES are best for survival situations.

An alternative to stoves is bees-wax survival candles which are equipped with a cup support and a cup for warming water. These candles may be useful for a single individual, but will be inadequate for a group. They will also provide illumination and are quite long lasting.

Fuel, such as naphtha or alcohol, should be packed with the stoves so it is not forgotten during ship abandonment. If multi-fuel stoves are included, then shipboard fuels such as diesel and kerosene can be used.

Every effort should be made to conserve fuel. A plastic funnel will minimize spill loss when refilling stove tanks. Stove fuel tanks should not be overfilled. If the stove is burning with a dirty flame, the burner and fuel injection nozzles should be cleaned. A dirty flame indicates incomplete combustion: the flame will not be as hot and cooking time and fuel consumption will increase.

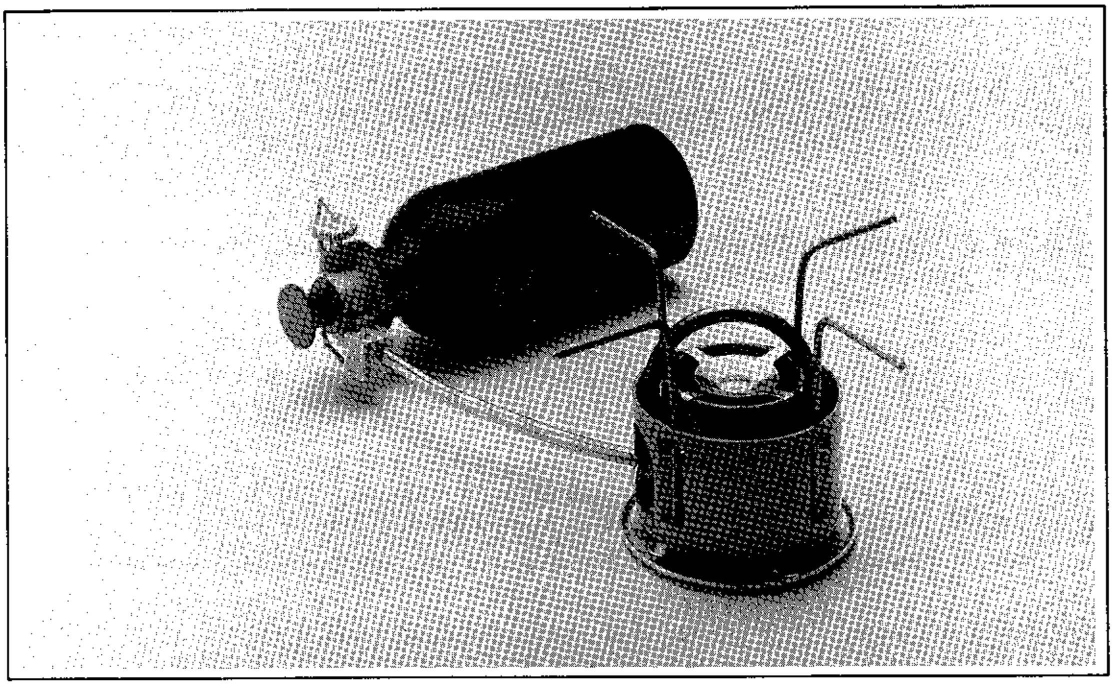


Figure 21. MSR Stove

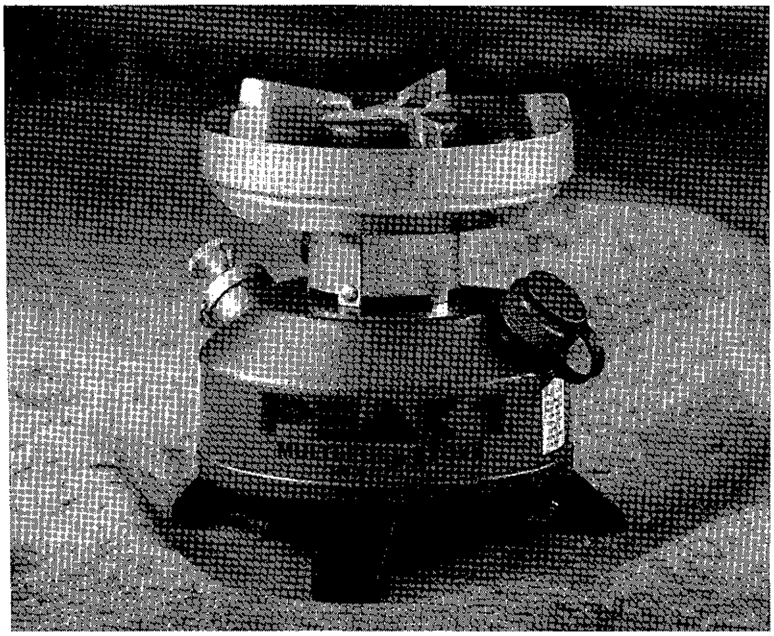


Figure 22. Coleman Stove

DO NOT waste fuel.
Use fuel ONLY TO PRESERVE LIFE.

Stoves can be difficult to ignite in extremely cold temperatures due to the low vapour pressure of the fuel. Ignition is easier if the burner is preheated with fuel paste and is free from moisture, particularly in windy conditions. Although fuel paste may not be needed to ignite light fuels such as naphtha or alcohol, it may be required for heavier fuels such as diesel.

4.6 Cooking Pot

A cooking pot is needed for melting ice and heating food. The pot should have a tight sealing lid to trap steam and, thus, minimize cooking time and conserve fuel. A household type pressure cooker is ideal; copper and stainless steel are better heat conductors than cast iron.

COVER COOKING POTS to trap steam.

Rations may be consumed within the shelter, but should be prepared outside. The pressure cooker should be depressurized outside so that escaping steam will not condense in the shelter.

Prepare rations OUTSIDE the shelter.

4.7 Tool Set

An ice saw and ice knife are needed for cutting snow blocks. Although special tools are available, a simple carpenter's panel saw is effective. An axe is useful for cutting ice to produce drinking water. A snow shovel is useful for digging caves and trenches. Although both the axe and shovel are useful, they are not essential and may be omitted if space is limited.

To avoid loss, tools should be clearly flagged or brushed free of snow and taken inside the shelter after use. They should then be left standing on end. Tools could also have a lightweight float attached by a light line in case they are dropped into the water.

It may be possible to collect some useful tools on board the ship before evacuation. Table 5 provides a list of tools that are likely to be found on board. A pack of these tools should be placed in a waterproof container and stored adjacent to the lifeboat mustering stations. One or more crew members should be designated to ensure these tools are disembarked safely.

Table 5. Tool Kit From Tools Which are Normally Available On Board

Carpenter saws
Axes
Machetes or long knives
Tarpaulins
Kerosene fuel
Coleman lanterns
Blankets
Plastic drinking mugs
Plastic spoons
Cooking pot with a sealable lid
Package of candles
Packages of waterproof matches
Shovel
Packs of playing cards

4.8 Illumination

Forms of illumination may include candles and candle lanterns, flashlights and fuel lanterns. These items provide the psychological comfort of light (particularly in 24 hour darkness) and can be used as signalling devices. Candles provide a compact heat source that requires no fuel. The candle flame can provide a warning of anoxia and carbon monoxide poisoning as it will flicker and die when the oxygen level is low. Candle holders are recommended for practical and safety reasons.

Fuel lanterns provide a bright light and are a good source of heat. However, when they are used in shelters, (lifeboats, liferafts, igloos etc.), care must be taken to ensure adequate ventilation to prevent carbon monoxide poisoning and asphyxiation. These lanterns will increase the fuel requirements and are not an essential part of the survival kit.

VENTILATE all shelters.

Flashlights are a convenient portable light source. A number of suitable flashlights are available: waterproof casings, lithium batteries and halogen bulbs are recommended. Each person should have such a flashlight.

4.9 Waterproof Matches

Matches can be used to light candles and stoves. A large quantity of waterproof matches should be provided (wastage can be expected due to windy conditions), as they are inexpensive, take little space, and are of great importance. They should be distributed among the survivors so the entire supply of matches will not be lost if one survivor is lost or falls in the water.

Take care of Matches. They may be the only source of flame available.

4.10 Firearm

Protection against polar bears is the main reason for having a firearm; hunting is a secondary reason. A short barrelled, 12-gauge pump action shotgun is recommended as reliable bear protection, particularly for those who have little experience with firearms. Rifled slugs and large buckshot are the recommended ammunition. For those experienced with firearms, a rifle of .30-06 calibre or similar power will provide suitable protection against bears. Soft point bullets of 200 grains or heavier are the recommended ammunition. Handguns are less bulky and revolvers of .357 magnum calibre or larger are capable of killing a bear, but only in the hands of experienced users. Firearms should be loaded at all times to enable the quickest response to a bear attack. Great care should be exercised in handling and storing firearms.

Take great care in handling and storing any firearms.

4.11 Survival Handbook

A basic knowledge of the environment and survival techniques will increase the chances of survival. Thus, a survival handbook which includes environmental data, survival techniques and medical information should be included in the ship's library as well as in the lifeboats, liferafts and survival packs.

4.12 Survival Pack

The most efficient way of ensuring that the equipment is not left on board the ship during evacuation is to collect these additional items of survival equipment into one or more survival packs. Several members of the crew should be in charge of these packs in the same way as duties are assigned for lifeboat and liferaft launching.

Table 6 lists the items that should be included in a ten person survival pack. Survival pack containers should be provided on board for each crew member, as well as extra pack in case of loss of equipment during the evacuation.

These survival packs are essential to the safety of life of the crew if evacuation must take place in cold regions. Although not normally carried on board ships, those ships which have operated in the Beaufort Sea were equipped in this way.

SURVIVAL PACKS ARE ESSENTIAL to survival in cold regions.

Table 6. Ten Person Survival Pack
(Sources: Melville (1991), Cunningham (1992)

Insulated Clothing
10 - Insulated suits
10 - Pairs of Arctic mitts with silk gloves
10 - Pairs of bootees and rubber overboots
10 - Arctic scarves
20 - Pairs of Arctic socks
10 - Sets of thermal underwear
10 - Balaclavas
10 - Arctic sleeping bags, with sleeping pads
Cooking and Eating
2 - Multi-fuel, single burner stoves
1 - 5 litre containers of Naptha
1 - Package of fuel paste
1 - Cooking pot with a sealable lid
2 - Boxes of 500 matches in waterproof container
10 - Plastic drinking mugs
10 - Plastic spoons
10 - Packages of rations
Miscellaneous
2 - Arctic survival handbooks
1 - Strobe light with batteries
2 - Flashlights with batteries
10 - Plastic whistles
1 - Package of candles
1 - Ice knife
1 - Ice saw
1 - Folding shovel
1 - First aid kit
1 - Package of toilet tissue
1 - Package of pencils (sharpened)
1 - Magnetic compass (hand held)
1 - 100 metres of 35 mm rope
2 - Games
1 - Sunglasses
1 - Whisk broom

4.13 Summary

Although the additional equipment which should be carried on board ships that operate in cold regions is not bulky nor costly, it is very important to the survival of the crew. Conventional equipment is inadequate for such cold conditions and, if the crew is to survive for a week or more before being rescued, it is crucial to provide additional insulated shelters and clothing as well as more appropriate rations and a means of melting and warming water.

CHAPTER 5 SURVIVAL

Provided a message has been sent to and acknowledged by Search and Rescue before abandoning ship, either by EPIRB or radio, the time before support arrives will be dependent on the ship's position and suitability of the weather for flying.

Typically, in an emergency situation, 20% of the people involved will emerge as natural leaders, 20% will likely succumb to panic, and the remaining 60% will need direction. If those in a state of panic gain control of the situation, the followers will also become panic stricken, and the chances of survival will be greatly reduced. Effective leadership will prevent this from occurring.

LEADERSHIP is extremely important in a survival situation.

There is a defined command structure on board ship. In a survival situation, those who emerge as leaders will not necessarily be of the highest rank. Survival party leaders will most likely be those who have had the most survival training, and/or experience in cold regions. Important qualities of the survival leader are:

- survival knowledge and training;
- the ability to manage equipment and personnel;
- the ability to stay cool, calm and collected under pressure;
- the ability to make decisions;
- the ability to improvise and adapt to the situation;
- patience; and
- the ability to accept suggestions and criticisms.

One of the greatest tools the survivor has is ingenuity. Survival is dependent not only on having the right equipment, but also on knowing how to operate, manage and cope with the failure of survival equipment. Failure, or the absence, of specific items of equipment must not be viewed as catastrophic; solutions or substitutes must be found. The most valuable survival technique is acceptance of the situation and the use of ingenuity to utilize the resources at hand.

Once off the ship, the crew must cope with the circumstances. If afloat in lifeboats or liferafts, their safety and survival will depend on the weather and sea conditions, such as extreme cold and the presence of sea ice. Similarly, if evacuation is onto the surrounding ice cover, survival will not only depend on the environment, but also on the training received by the crew to deal with these unusual circumstances.

5.1 Survival Afloat

If a crew is afloat in a cold-weather environment, it will be in lifeboats or liferafts designed for more temperate regions. Such vehicles are not insulated, and provide only minimal crew space. Similarly, the conventional survival equipment provided with lifeboats and liferafts is designed for more temperate conditions, as are the immersion suits issued to the crew. Survival in a cold-weather environment with this type of equipment requires a detailed understanding of how to maximize the potential of each item and how to work as a team.

Considered in the category of "Survival Afloat" are a range of hazardous conditions in which sea ice is present but is of insufficient area, thickness or strength to support an on-ice survival camp. Included are such conditions as open pack of various coverage densities, thin ice and dynamic moving ice pack. In each of these conditions, the crew will likely be afloat and in some danger from the ice and the ambient temperature.

It is important for survivors to stay in the vicinity of the ship where the search and rescue system will have a better chance of locating them quickly. However, if the evacuation occurs close to a port or hospitable shoreline, it may be appropriate to make for that location.

5.1.1 Shelter

In circumstances where the lifeboat can be launched into water the crew should enter the boat at deck level as they would in more temperate regions. This will help ensure they remain dry. The boathooks should be used to fend off ice floes which may endanger the boat. Once clear of the ship, the crew can be properly organized within the boat.

Open and partially open lifeboats offer little protection from the environment. However, partially enclosed lifeboats are more suitable than open lifeboats as they provide some shelter. A fully enclosed lifeboat offers some protection from the environment, although the interior temperature will be quite warm and the cramped conditions will be uncomfortable, particularly for the injured. As well, the use of sleeping bags or stoves will be virtually impossible. Returning to the ship when it is safe, or navigating to land or to a large ice floe will provide means of escaping from the lifeboat.

RETURN TO THE SHIP if it is safe.

Most modern lifeboats are constructed of fibreglass and can withstand only minor contact with ice. Great care must be taken to avoid puncturing the hull due to aggressive navigation or being crushed between ice floes. The lifeboat should be manoeuvred into open water areas and maintained in that position.

A motorized lifeboat can quickly rescue survivors in the water. However, this advantage is diminished in ice covered waters with high ice concentrations, as there is insufficient power to break the ice or move it aside. Furthermore, in conditions of partial ice cover, impact with an ice floe at six knots can damage the hull.

The conditions in liferafts will be extremely cramped, particularly if bulky survival equipment has been brought along by the crew. The liferafts will likely be marshalled by the lifeboats and should maintain contact with them at all times.

No contact should be allowed between the liferaft and ice floes since tearing or crushing can occur. If an ice floe is sufficiently large and stable, the raft can be pulled up onto it. However, there is a danger that small floes will capsize.

The liferaft door should remain closed to minimize the escape of warm air from inside the raft. However, great care should be taken to ensure adequate ventilation.

VENTILATE all Shelters.

In a survival afloat situation, the crew probably will have no option but to remain in the cramped quarters of the lifeboats and liferafts until rescued.

5.1.2 Clothing

Conventionally clothed survivors will have normal or extra warm clothing under an immersion suit. If additional equipment is available, such as an insulated suit and associated mitts and boots, it should be worn when practical. Due to the need to stay dry, it may not be possible to wear such insulated suits in a liferaft. As well, the limited space prevents onboard storage of such equipment. Similarly, it may be impractical to use sleeping bags. In a lifeboat, however, it may be possible to use the insulated suits and sleeping bags, although the very cramped conditions may make this impossible. The warmest available clothing should be worn.

5.1.3 Rations

Rations can not easily be cooked or heated while afloat in liferafts or lifeboats. The fresh water supplies will be frozen, although it may be possible to use sea water if de-salting tablets are available. Heat from the engine of a motorized lifeboat can be useful for melting the frozen fresh water. Another possibility is to moor against a substantial ice floe and set up a stove away from the lifeboat or liferaft.

Food need not be hot to provide a benefit. Even if it is eaten cold, it will still provide useful energy. However, if both the food and water are taken cold there is great danger of potentially lowering the body's core temperature and inducing or aggravating hypothermia.

5.1.4 Communications

Survivors must try to notify the authorities in charge of the search and rescue operations of their location and situation. If communications can be established, information which can assist in the rescue operation should be transmitted, including:

- location;
- state of health of survivors and the requirement for medical assistance;
- the number of survivors;
- present status of the survival party (i.e., safe in lifeboats, on ice, or in immediate danger for whatever reason);
- type of assistance immediately required (i.e., water, food, medical, additional floatation devices, etc.); and
- description of site (i.e., suitable for landing aircraft, etc.).

The only means of communicating this type of information is from the ship's radio equipment before evacuating the ship. If time allows, a detailed message should be sent on the emergency wavelengths.

In addition, EPIRBs are carried on Canadian ship's lifeboats and liferafts. Crew members should familiarize themselves with the radio beacon instructions and operation.

BE FAMILIAR with the EPIRB and its OPERATION.

The pyrotechnics provided with lifeboats and liferafts should be used to attract the attention of rescuers. Red and green flares will stand out better than white flares in the whiteness of a winter landscape or seascape. Many types of pyrotechnics are available, and the crew should become familiar with the types carried on board.

BE FAMILIAR with the ship's PYROTECHNICS and their OPERATION.

Morse code, shown in Figure 23 can be used with a heliograph (reflector used to flash sunlight) or some other reflector or light source (flashlight or lantern).

5.2 Survival on the Ice

Survival on sea ice for more than a few hours requires some basic knowledge and equipment. When an emergency occurs, prior knowledge of survival techniques and equipment and it's operation will prevent panic and allow improvisation should equipment be lost. If time allows, it is important to collect a variety of materials and as much equipment as possible from the ship.

The survival party leader or leaders must take control of the situation immediately. Action must be taken as quickly as possible to care for the injured, set up communications, and set up camp. There is no time for petty arguments or power struggles; tasks will be done more efficiently with effective management and direction from the survival party leader.

- Tasks should be assigned to specific people so as to make the best use of their skills. For example, a person experienced with firearms should be assigned to polar bear watch duties and the maintenance of fire arms. One person per shelter should be responsible for ventilation. Other tasks include the operation and maintenance of the stoves, ration distribution, signals, hunting, etc. Tasks that do not require specific expertise should be rotated among personnel to prevent boredom.

- Each survivor should be responsible for his own equipment. Personal items should be marked to indicate the owner and stored neatly in a kit bag. A list of the kit bag's contents should be marked on the outside. If kit bags are not available, each survivor should be assigned a storage space, within the shelter, where personal equipment can be kept. The maintenance of personal items should be stressed; for example, small holes or tears in equipment or clothing should be repaired immediately, before the item becomes unusable.

- Individuals who become panic stricken or depressed must be dealt with immediately: comfort and sooth them. These ailments are contagious and can soon spread throughout the survival party.

- At least one survivor should be on watch at all times to look out for polar bears and rescue parties.

MORSE CODE

A	·—	N	—·	1	·————
B	—···	O	———	2	··———
C	—·—·	P	·——·	3	···——
D	—··	Q	——·—	4	····—
E	·	R	·—·	5	·····
F	··—·	S	···	6	—····
G	——·	T	—	7	——···
H	····	U	··—	8	———··
I	··	V	···—	9	————·
J	·———	W	·——	0	—————
K	—·—	X	—··—		
L	·—··	Y	—·——		
M	——	Z	——··		

SENDING SIGNALS

AAAAA* etc.– Call sign. *I have a message*
AAA* – End of sentence. *More follows*
Pause – End of word. *More follows*
EEEEE* etc.– Error. *Start from last correct word*
AR – End of message

RECEIVING SIGNALS

TTTTT* etc I am receiving you
K – I am ready. *Start message*
T – Word received
IMI* – Repeat sign. *I do not understand*
R – Message received

** Send as one word. No pauses*

USEFUL WORDS

SOS	···———···
SEND	···|·|—·|—··
DOCTOR	—··|———|—·—·|—|———|·—·
HELP	····|·|·—··|·——·
INJURY	··|—·|·———|··—|·—·|—·——
TRAPPED	—|·—·|·—|·——·|·——·|·|—··
LOST	·—··|———|···|—
WATER	·——|·—|—|·|·—·

Figure 23. Morse Code

- Survivors should travel on the ice in single file. The lead member should carry a long pole, such as a boathook held horizontally, in case he ventures onto thin ice or over a crack and falls into the water. A length of rope should be carried by the second person in line. If the lead member should fall, all members should be ordered to lie down to distribute their weight in an attempt to relieve the lead person. When walking on ice, thin ice is easily recognizable as it is black. However, all black ice is not necessarily thin; it must be tested. Salt water ice flexes before it breaks. If the ice is suspected to be thin, have on person observe the first person to test the ice. If the ice bends, the movement can be seen by the observer. If the ice does not flex under the weight of the person it can be deemed safe. Thin ice will not be covered with much snow or drifts unless there has been a recent snowfall.

- When selecting a location to construct a shelter, choose a location on snow not ice. It is warmer to camp on snow than ice, because snow is an isulator, and ice is not.

The basic rule is to use common sense, take no unnecessary risks, and keep alert.

5.2.1 Lifeboats

Lifeboats are generally impractical as on-ice shelters. These boats are large and heavy and cannot easily be pulled onto ice floes or over the ice away from the ship. However, if the lifeboats can be beached on a shore, they may provide the best available shelter. If the snow conditions do not permit the construction of a snow shelter, and if no land caves are available, the lifeboats may be the only option.

To provide shelter, an open boat can be over-turned, and covered by snow for extra insulation, or a tarpaulin can be stretched across the exposed seating area. Partially open boats are already equipped with covers, and fully enclosed boats have similar protection from the climate. If no other shelter is available, these lifeboats will provide some protection.

5.2.2 Liferafts

Liferafts may be used as on-ice shelters. As shown in Figure 24, a snow wall can be built around the liferaft to deflect the wind. The wall should be as high or higher then the liferaft, chinked and banked with snow to prevent erosion. If a tarpaulin or other similar material is available, it may be secured on top of the snow wall to form a roof, thereby creating a dead-air space around the liferaft.

When sitting or lying down in a liferaft, clothing insulation will be crushed by body pressure points creating cold spots through which heat will be lost. The inflated floor of a liferaft will help by providing an air barrier. However, the inflation pressure is low and may not be sufficiently supportive: try to distribute weight evenly over the floor.

Clothing and footwear should be brushed free of all loose snow before entering the shelter. If this is not done, the snow will melt and increase the moisture content within the shelter. A small whisk broom is the ideal tool for this purpose; a loose mitt is also quite effective.

Survivors can sleep in shifts if the shelter capacity is limited. This will increase the comfort for those sleeping and provide for a continuous watch.

5.2.3 Snow Shelters

Shelters made from hard packed snow blocks provide good insulation and are not difficult to construct with the proper tools (saw, knife and/or shovel) and knowledge of construction techniques. Snow structures can be warmer and more comfortable than tents or liferafts.

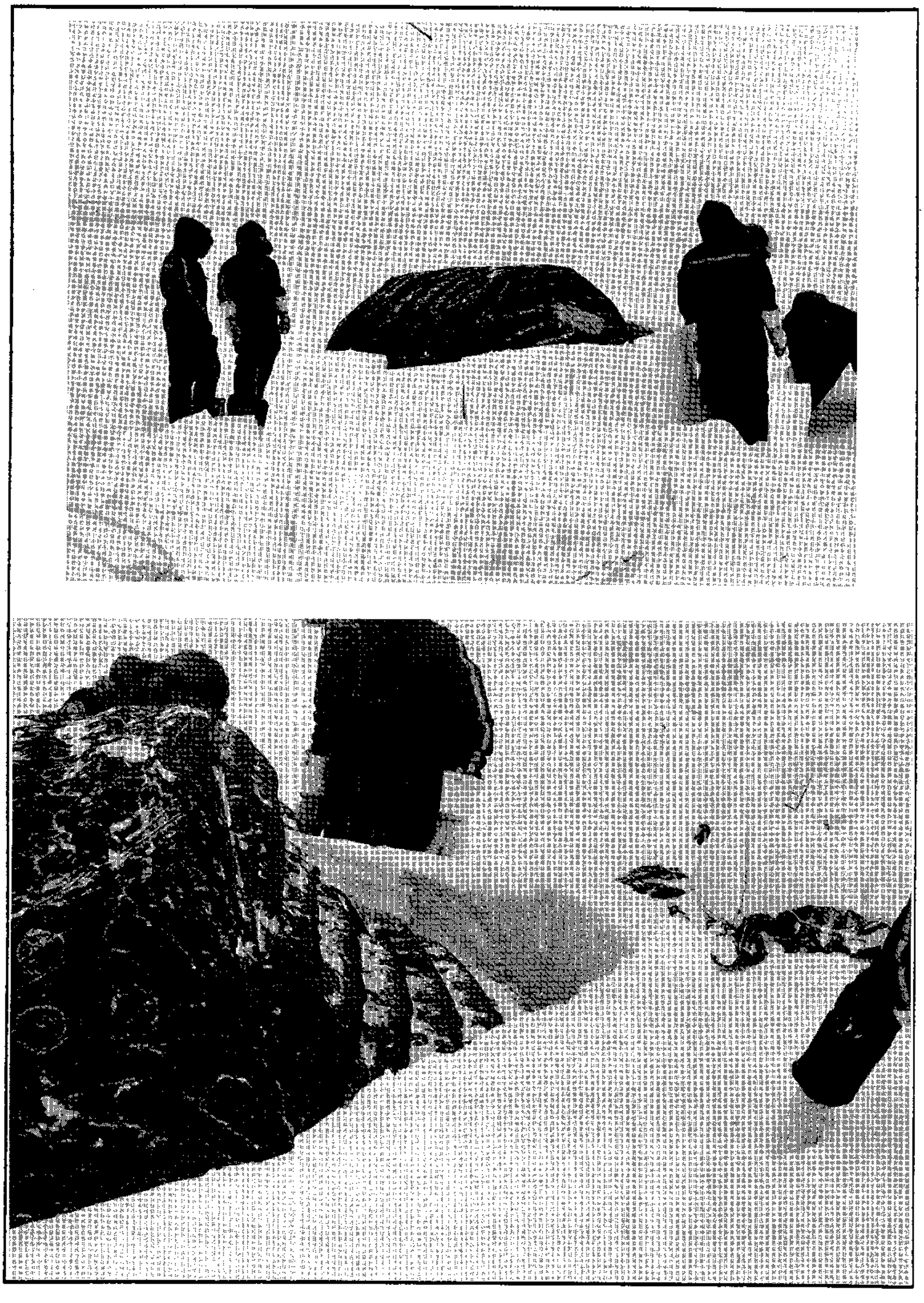


Figure 24. Insulated Liferaft with a Snow Wall

Snow shelters offer excellent protection from the environment.

Some principles should be kept in mind when constructing snow shelters:

- Hot air rises and cold air sinks. To exploit this fact, a "cold well" should be an integral part of the shelter. This is a section of the shelter which has a lower floor height, thus acting as a drain for heavy cold air. Cold air settles in the cold well as opposed to the inhabited levels of the structure. Structures should be built with low ceilings so that warm air is kept close to the inhabited level. These points are illustrated in Figure 25.

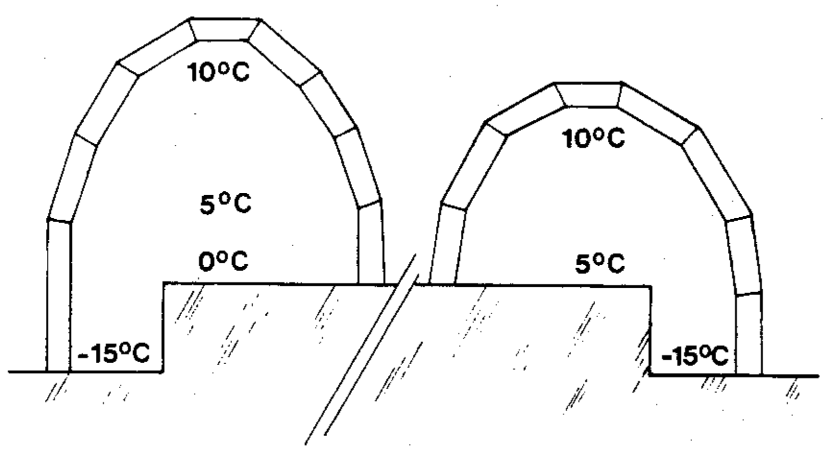


Figure 25. Igloo Temperature Gradients

- The principles of heat transfer are important to shelter construction. The insulating efficiency of the shelter (and clothing) depends to a large extent on trapping still air. Therefore, great care should be taken in chinking or filling the seams between snow blocks with loose powdery snow. If time is limited, chink only the outside seams. However, chinking inside and outside will make the shelter airtight and reduce heat losses by maintaining a still-air environment. In addition to chinking, loose snow may be piled over the snow blocks to further improve the air tightness and insulation of the shelter and to inhibit wind erosion of the snow blocks.

- Anoxia and carbon monoxide poisoning are difficult to detect. Therefore, adequate ventilation is of great importance. Although an airtight shelter is desired, an adequate ventilation opening must be made and kept clear. To prevent blowing snow from clogging the ventilation hole, a small block may be placed upwind of the hole on top of the igloo.

- As the temperature inside a snow shelter rises, the walls and ceilings may begin to melt and drip. To avoid dripping onto personnel and equipment the inside surfaces should be made smooth and a small gutter dug around the floor perimeter. Drips will then travel along the smooth surfaces and collect in the gutter instead of dripping on inhabitants.

- Snow block structures are quite soundproof and, thus, provide relief from the whistling wind. However, this also can be a disadvantage as the noise from rescue planes, search parties or danger, such as approaching polar bears, may not be heard. In addition, instructions shouted from outside may not be heard.

Once the construction techniques are known, effective and comfortable snow structures can be built. The four basic snow structures are the snow wall, snow trench, snow cave and igloo.

a) Snow Block Cutting

Snow suitable for building blocks is firmly packed and frozen so it can be easily sawn and handled without breaking. Ideal snow is compacted, at least 70 centimetres deep, and will support the weight of a person with only slight footprint markings. If the snow is not deep enough to cut blocks vertically, they may be cut horizontally. Figure 26 illustrates the block cutting process.

- Snow blocks should be about 100 to 120 centimetres wide, about 50 centimetres deep and about 15 to 20 centimetres thick. To prepare for block cutting, a hole is dug to a depth of about 70 centimetres; one side of this hole should be flat, vertical and about 120 centimetres wide. Two parallel lines about 120 centimetres apart should be marked out on the snow surface perpendicular to the flat side of the hole.

- To shape the block, cut about 20 centimetres along the marked lines to a depth of about 50 centimetres; these cuts should be angled about 5° towards the centre at the bottom. Vertical cuts about five centimetres outboard of the angled cuts should be made and the rubble between the cuts removed. This procedure allows lifting the block from the hole.

- To undercut the block along the bottom of the flat side of the hole (about 50 cm below the surface), saw/cut horizontally between the two angled incisions.

- To cut out the block, saw vertically about 20 centimetres forward of the flat side of the hole perpendicular to the marked lines. Care must be taken not to hit the snow surface with the saw/knife handle while cutting as this can cause the block to crack and split.

- The saw/knife blade should be placed in the middle of this last cut and pulled towards the trench; the block should pop out.

- The block should be lifted from the bottom out of the hole and any rubble cleaned from the cutting site before repeating the procedure to cut the next block.

b) Snow Wall

In an emergency where resources and time are limited, snow walls will provide quick temporary relief from the wind. If snow blocks cannot be cut, walls may possibly be built from rubble. Such shelters provide minimum shelter for minimum effort. However, a better shelter should be constructed as soon as possible.

- A snow block wall, to be used as a wind break, should be about two blocks high and three or four blocks long. Survivors should recline on the leeward side of the wall. The wall should be curved around the survivors to provide some protection from changing wind directions.

- A ground sheet or tarpaulin can be used as a canopy. The canopy is anchored to the wall by a tier of blocks; a second single row of blocks is used to secure the bottom edge of the canopy. More blocks are used to close the sides of the shelter. The canopy and side blocks will provide 360° protection from the wind and some level of heat retention.

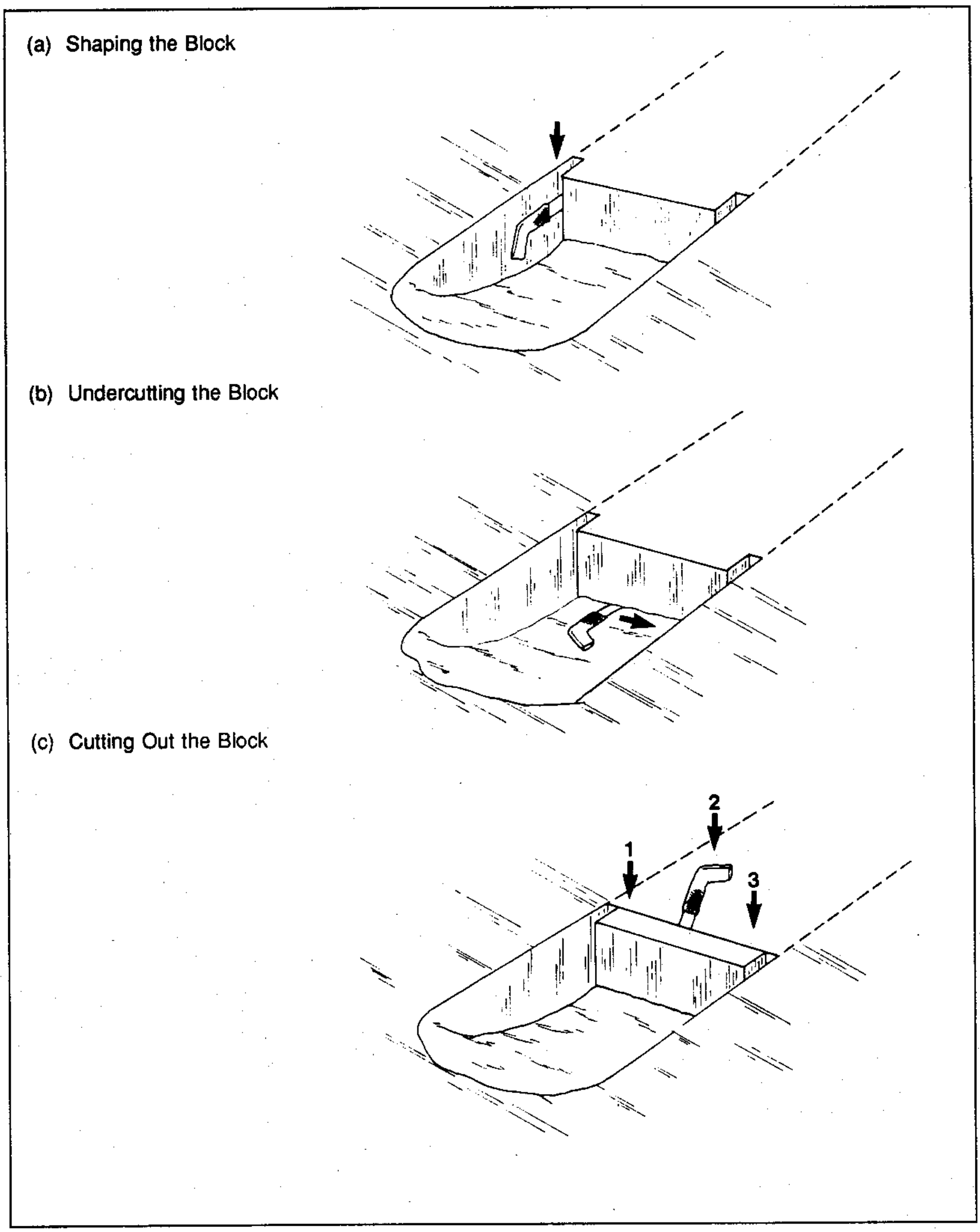


Figure 26. Cutting Snow Blocks

Illustrations of these two snow wall structures are shown in Figure 27.

(a) Snow Wall (b) Snow Wall with Canopy

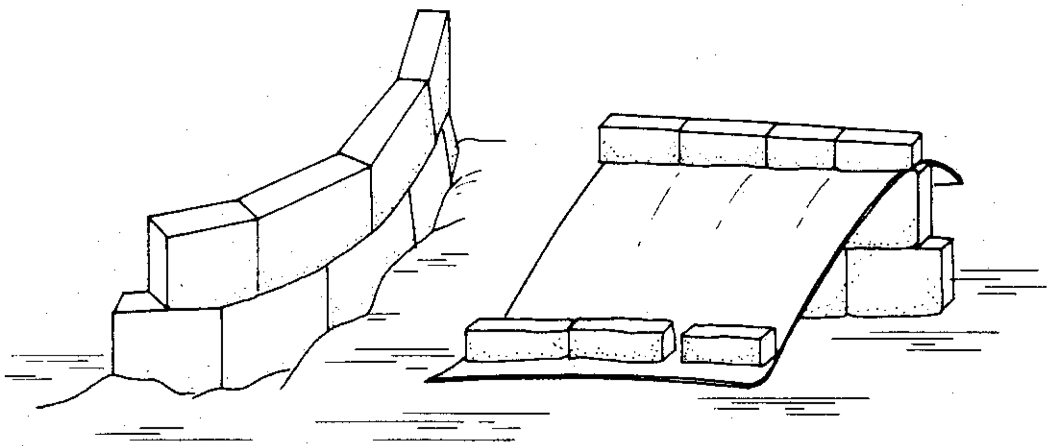


Figure 27. Snow Wall Structures

c) Snow Trench

If time and/or expertise do not permit the building of an igloo, a snow trench may be constructed. This is a simple structure which can be built quickly with little effort. The construction process is shown in Figure 28.

- The first step is to mark out the trench, which should be just wider than a sleeping bag and long enough to accommodate the occupant and survival equipment. Commence excavation by cutting vertical blocks from the trench. Once the excavation is complete, a ledge about fifteen centimetres wide and fifteen centimetres deep should be cut along each side to support the roof.

- A triangular block is placed at one end of the trench to provide support for the roof. The roof block ends are shaped to fit the ledge. Roof construction begins by laying a block edge in the ledge and leaning it against the triangular support block; the high edge is trimmed to support the opposite side block. The first block on the opposite side is half length, enabling each proceeding block to support the opposite side block. Once the roof is complete it should be chinked and covered with loose snow. A block is required to close the downwind end that can be removed and used as an entrance door or made permanent and a tunnel entrance dug.

- The final step is to bore a ventilation hole through the roof.

The basic snow trench can be improved by incorporating a cold well. Such snow trenches may be constructed to house two or more people, as shown in Figure 29.

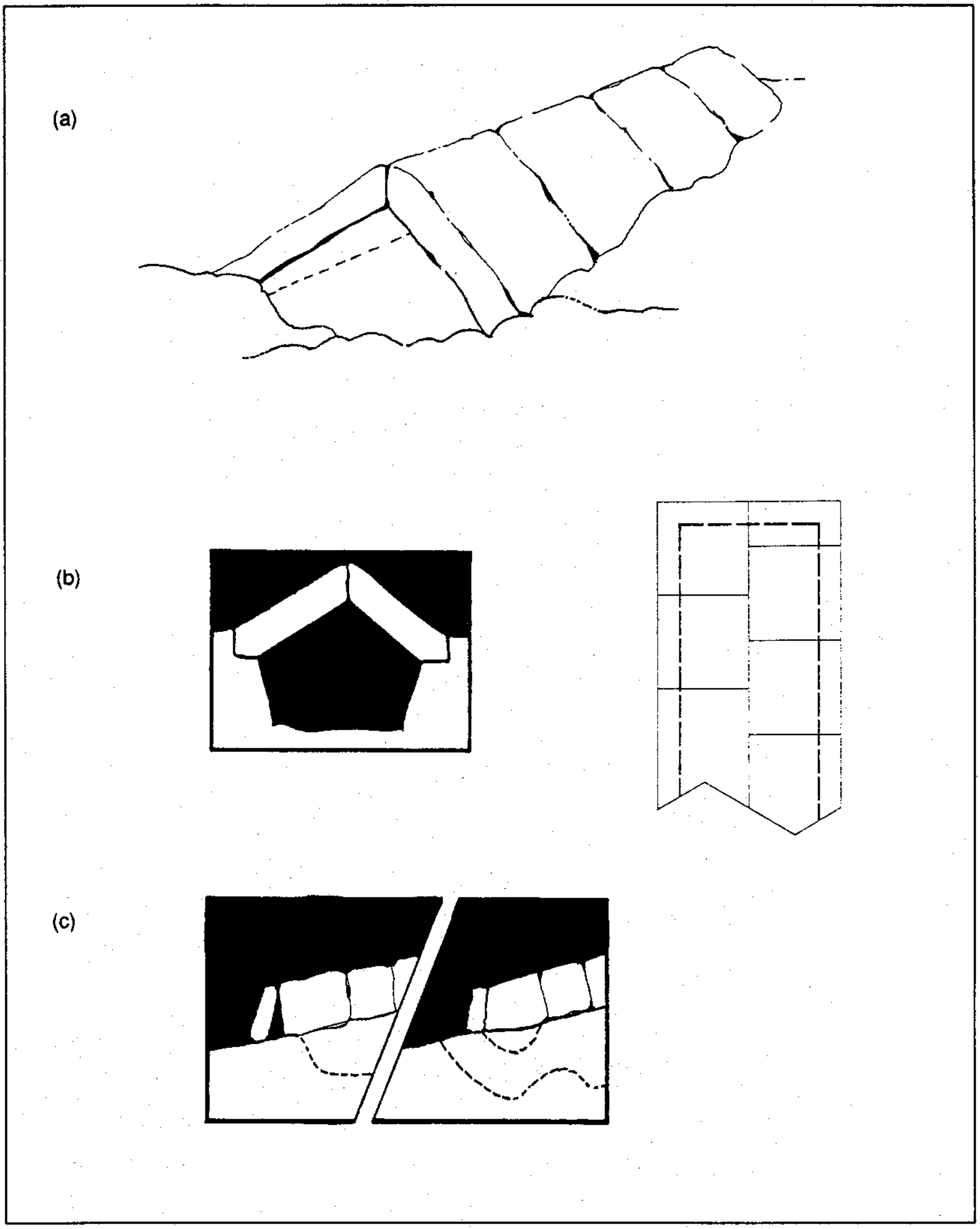


Figure 28. Basic Snow Trench

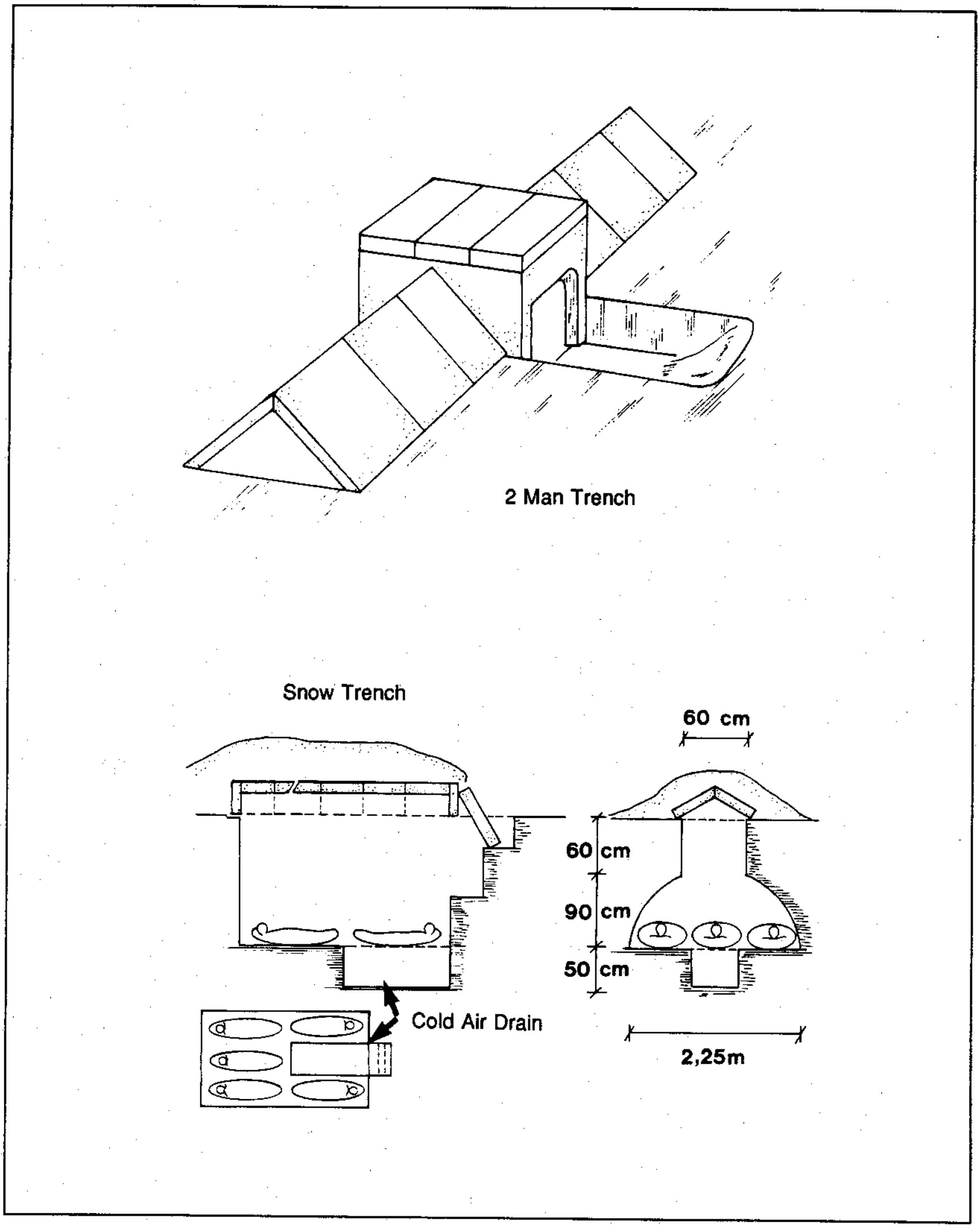


Figure 29. Multi Person Snow Trenches

d) Snow Cave

Snow drifts tend to form on the leeward side of rocks, hills and large ice ridges. If the snow is hard and the drifts are large enough, a snow cave may be built. Such caves require excavation but a minimum number of snow blocks. The cave should be built as high in the drift as possible to avoid an accumulation of blowing snow over the entrance.

The simplest forms of snow cave are for one man, but they can be built to house two or more survivors as shown in Figure 30. The construction process is quite simple.

- If a large cave is being built, entrances can be started at each end. This will permit much faster completion of the cave. Builders at each entrance should dig toward each other.
- The cave should be excavated from the floor up to the ceiling. This method will require considerably less effort.
- After the excavation is complete, one entrance should be sealed with snow blocks and chinked inside and out. Survivors who are not actually excavating the cave should remove the diggings.
- If possible, a minimum roof thickness of about 30 centimetres should be maintained. The roof should be arched, not square, to provide structural strength and to prevent melting snow from dripping when the internal temperature rises.
- If possible, the sleeping bench should be about 50 centimetres above the top of the entrance so that warm air will remain in the cave even if the entrance is open.
- The final step is to bore a ventilation hole through the roof.

e) Igloos

The word *Igloo* is of Inuk origin, meaning house or shelter. Igloos are semi-permanent structures, but if constructed properly will provide a comfortable shelter which can last throughout the whole winter.

The igloo has excellent heat retention, enabling a relatively warm interior temperature to be maintained with minimal resources. Of most importance is:

- wall thickness;
- shape;
- height and size of the vent hole;
- amount of chinking;
- height of door and proper door fit;
- ambient air temperature;
- wind speed;
- amount of heat; and
- number of people.

Igloos are not difficult to build once the construction principles are understood. The most important principle is to understand the way in which the snow blocks support each other. The snow blocks are cut in the usual way, but the edges are shaped as shown in Figure 31 to create three bearing surfaces. The blocks should bear only at A, B and C and they may be shaped in position.

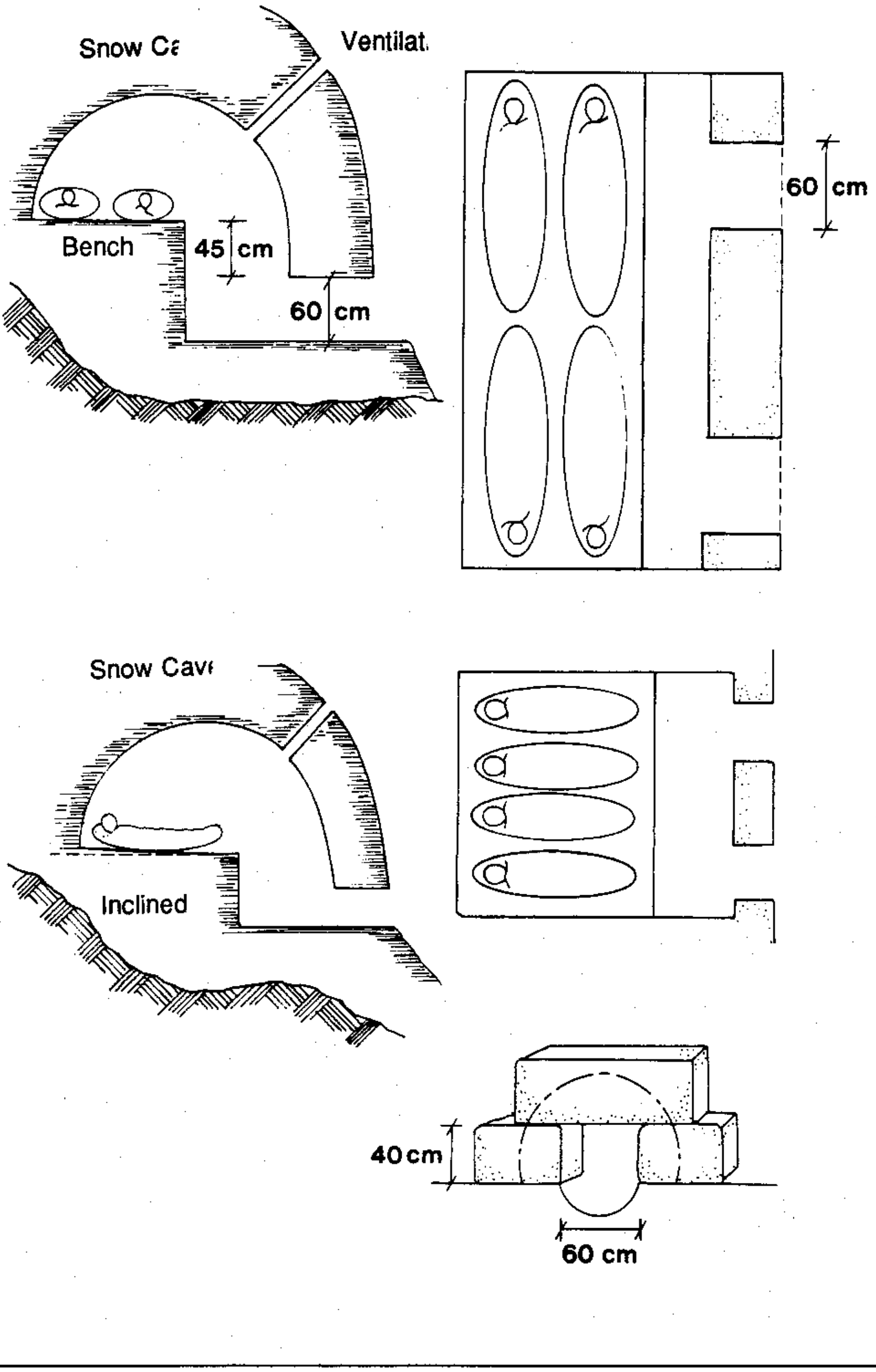


Figure 30. Snow Cave Variations

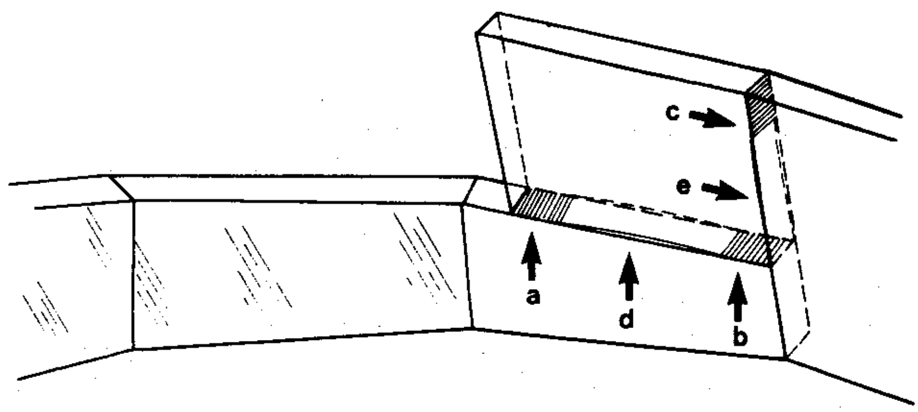


Figure 31. Igloo Block Pressure-Bearing Surfaces

- Place the block in position then insert the snow knife at E and slice downwards, trimming the block edge to create the bearing area C. Area C should be about one third of the block height and radial to the igloo centre to prevent rotation of the block about A-B.

- Insert the knife at D and slice horizontally, trimming the block edge to create bearing surfaces A and B. Once trimming is complete give the block a firm downwards tap and a firm horizontal tap in the direction of C to ensure good contact at the bearing surfaces. The block should now stay in position without support from the builder.

A second important principle is that the block edges must be radial to the igloo centre, as shown in Figure 32. The correct slope of the block edges provides the igloo with the structural strength required to support its domed shape. The weight of a higher tier of blocks produces a downward force on the lower tier of blocks. Collapse of the lower block toward the igloo centre is prevented by the friction forces generated between the radial edges of the lower block.

With an understanding of these two principles an igloo can easily be constructed using the spiral technique illustrated in Figure 33. The procedure is as follows:

- Cut a supply of snow blocks; about 30 blocks should be sufficient for a two person igloo.

- Mark out the igloo perimeter; position the igloo to take advantage of the trench created by block cutting. The diameter of a one man igloo is about 2.5 metres; for each additional person to be housed, the diameter should be increased by about 25 centimetres.

- The blocks are laid out and cut in place to make them fit tightly together. After reaching the snow trench, a block should be placed inside it to act as a bridge and to allow the wall to be taken across.

- Once the first course of blocks is laid, a spiral should be cut. Fit the next block leaning inwards so the block is tangential to the planned shape of the dome of the igloo.

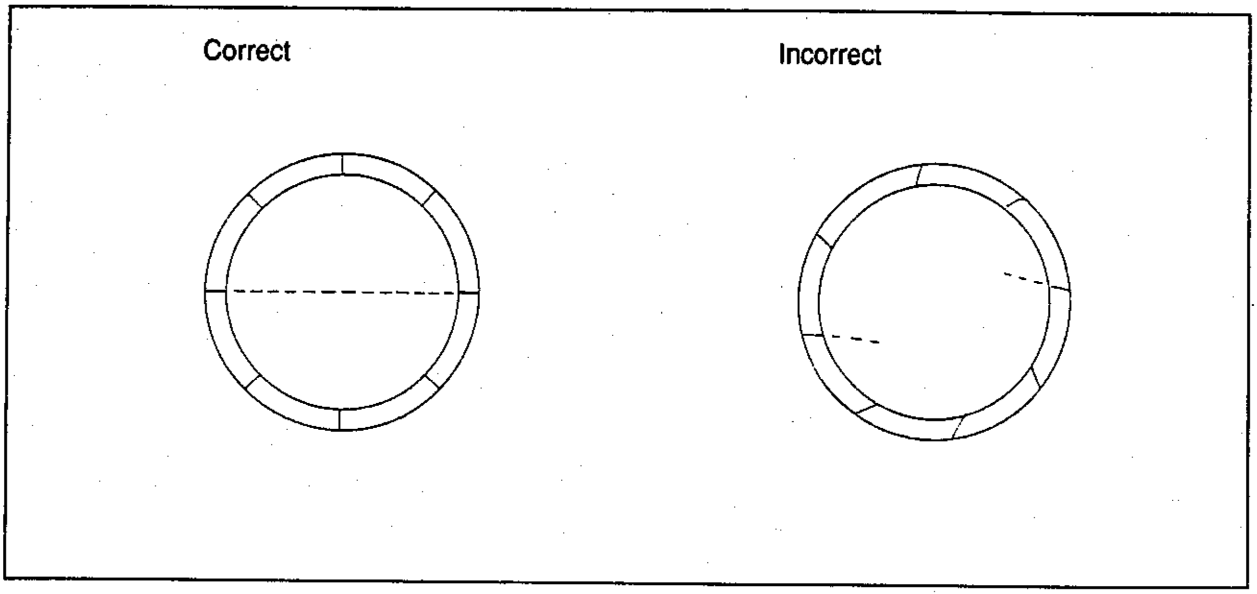


Figure 32. Igloo Block Edge Slope

- Move the pre-cut blocks inside the igloo circle and continue fitting the blocks from inside. Do not use blocks less than 100 centimetres long by 50 centimetres wide. Lay any smaller blocks aside for building the snow bench and the doorway. Tall igloos will be less warm.
- As the igloo gets taller and the dome begins to close, it will be more difficult to keep the blocks from falling in. It is essential that the blocks are shaped to bear on only three points; vertical joints must be radial, and the horizontal joints must be horizontal.
- After using all snow blocks inside the igloo, carefully cut a small door in the bottom in the trench so that more blocks can be passed through.
- Quite a flat arch can be built using the spiral technique and the last few blocks will be almost horizontal. The key block should be fitted when the hole in the roof is small enough. The edges of the hole should be bevelled about 15° and one axis of the hole should be longer than the other to allow the block to be passed up through and juggled into position. With careful trimming, the block can be made to slide snug into place.
- Chink the outside and inside of the dome with loose snow. This snow will harden and knit the whole structure together. Loose snow should be piled outside against the bottom layer of blocks to form a bank to protect against wind erosion.
- A ventilation hole should be cut in the igloo dome. This hole should be about ten centimetres in diameter and be located about two thirds of the dome height above the snow surface and over the stove (if one is available), with the angle of the opening pointing away from the sleeping platform.
- The entrance should be in the form of a tunnel below the surrounding snow level. This will place the sleeping platform above the entrance, creating a cold well and trapping heat inside the igloo. A block should be cut for the tunnel entrance door. At night time, this should be closed and chinked air tight.

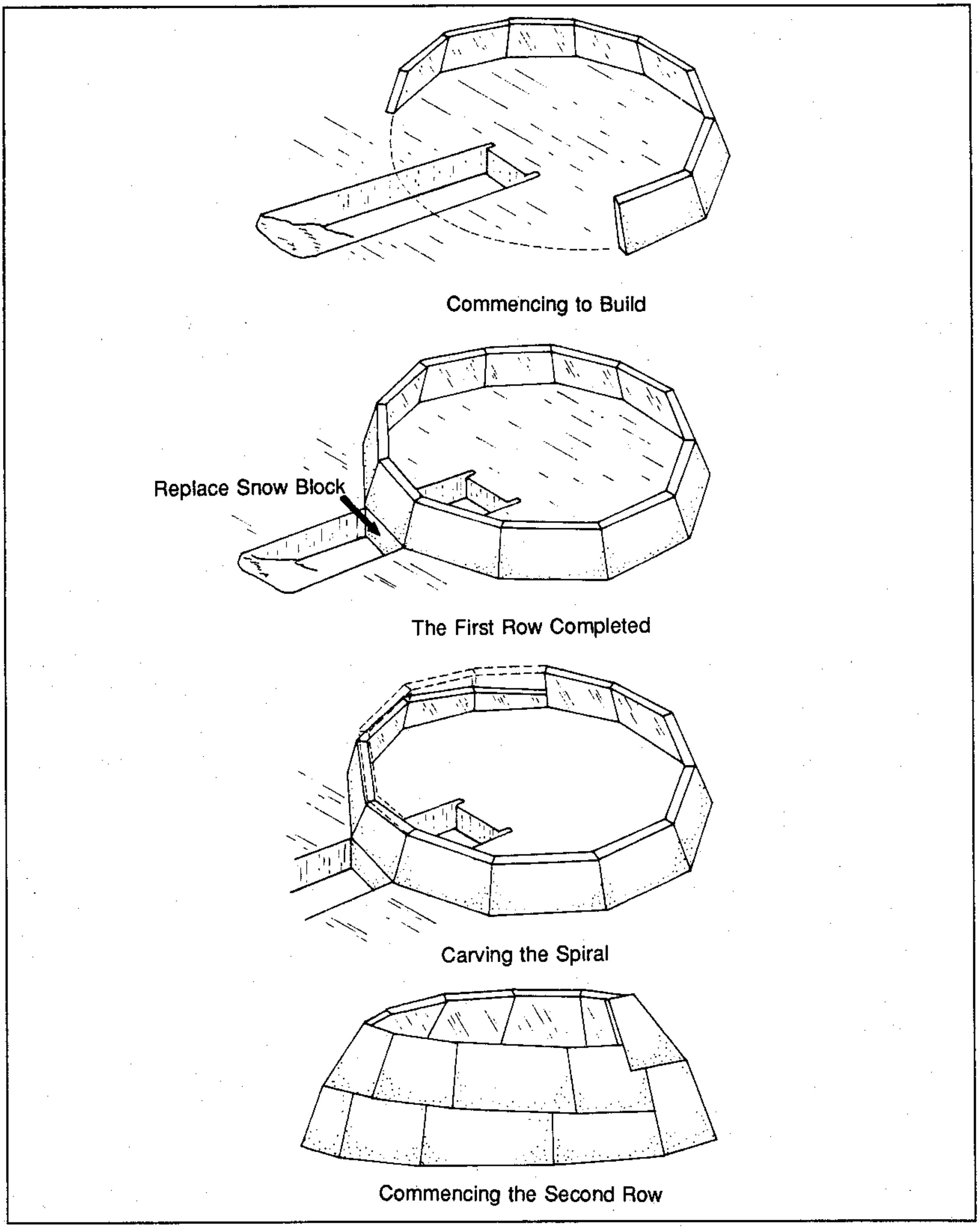


Figure 33. Igloo Construction

- A snow block or *Kovik* may be kept on the floor for use as a chamber pot. For sanitary reasons, the Kovik should be replaced frequently. Personnel should make use of toilet facilities before sealing the shelter at night.

- Drying racks can be made by poking sticks into the interior wall. These can be used to dry clothing or to thaw rations. Remembering that hot air rises, drying racks should be placed as high as possible and preferably over the cold well to avoid dripping onto the sleeping platform.

- Inuit use a *Koodlik* to heat igloos. This is a fat burning lamp and stove made from soapstone, using either seal or caribou fat as fuel and moss or Arctic cotton as a wick. This device is supported on sticks to prevent it melting into the snow and to keep it warm enough to melt fat. An improvised Koodlik can be fashioned from a flat tin can with a piece of material for a wick as shown in Figure 34. Never use a volatile fuel in a Koodlik. Cooking lard or animal fat are the ideal fuels; lubricating oil can be used but may produce a smoky flame; smoke can be reduced by making a simple damper using tinfoil or a piece of sheet metal. If trouble is experienced in starting the Koodlik, a few drops of stove fuel can be used to alleviate the problem.

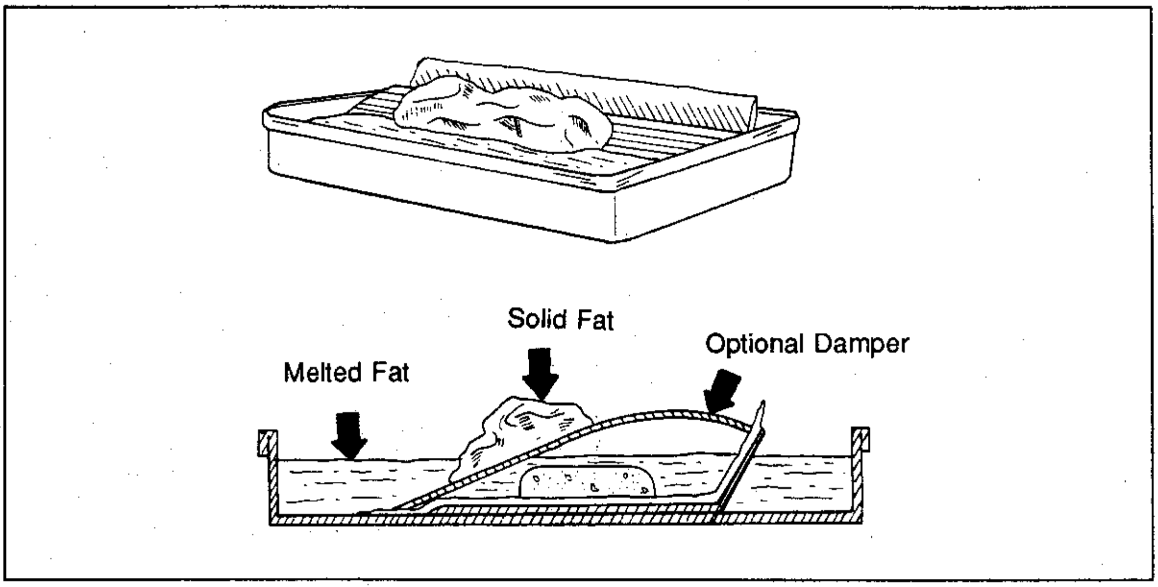


Figure 34. Improvised Koodlik

- If the inner walls of the snow shelter start to glaze and drip, the heat level should be reduced.

If construction of a traditional igloo proves too difficult, an improvised igloo may be built as shown in Figure 35. This igloo consists of a vertical circular wall and a tarpaulin roof. The roof insulation can be improved by adding another layer of blocks and a second tarpaulin to create a dead air space. If the igloo diameter is small, the centre pillar may be eliminated. The insulation will not be as good as the traditional igloo, but construction should be faster and simpler.

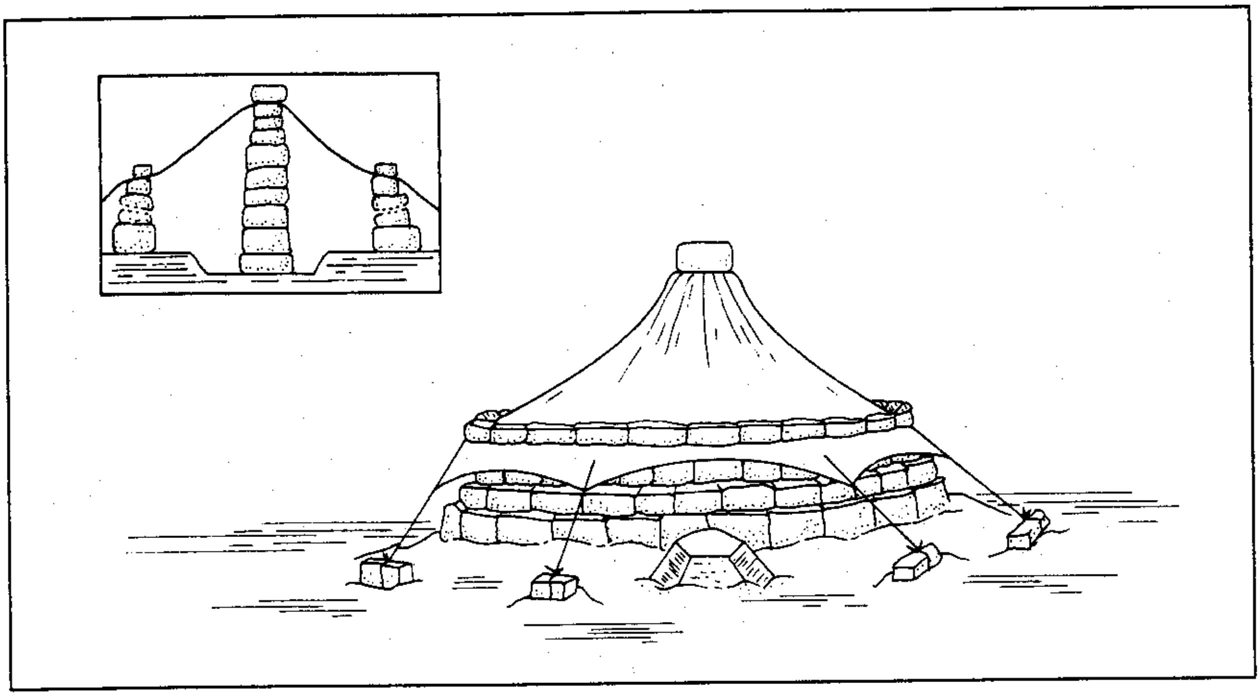


Figure 35. Improvised Igloo

5.2.4 Shelters on Land

Shelter available on land can take many forms, depending on climatic conditions, geography and materials available. Above the treeline in the Arctic tundra, shelter will most likely come from the methods described in Section 5.2.3. Below the treeline, various shelters can be constructed utilizing natural resources (trees, grass, rocks etc.).

In emergencies, where immediate shelter from the wind is necessary, make use of natural shelter. The lee side of a fallen tree trunk or a shallow depression in the ground is better shelter than none at all. These shelters may be improved with the addition of a roof; if a tarpaulin is available, this can be done with minimal effort. In the absence of a tarpaulin, logs can be found or cut and chinked with snow, moss or dirt to provide a remarkably wind and waterproof roof.

Where fallen trees and natural hollows are covered by snow, perhaps the best shelter will be a snow cave. In areas where coniferous trees grow, such as pine and spruce, caves may exist naturally under the lower branches of these trees, as shown in Figure 36. Try digging on the lee side under any tree which has spreading branches.

In non-emergency situations, where more time is available for shelter construction, a variety of possibilities exist. If items such as tarpaulins and rope are available, comfortable shelters can be made with limited effort. If these items are not on hand, naturally occurring substitutes may exist. The three most common shelters which can be easily built are the Lean-to, Teepee and Tarp-Cabin.

a) Lean-to

The lean-to is an effective shelter consisting of a pole framework with roof, as shown in Figure 37. This type of shelter may be built to house one or more people, two lean-tos built mouth to mouth and roofed

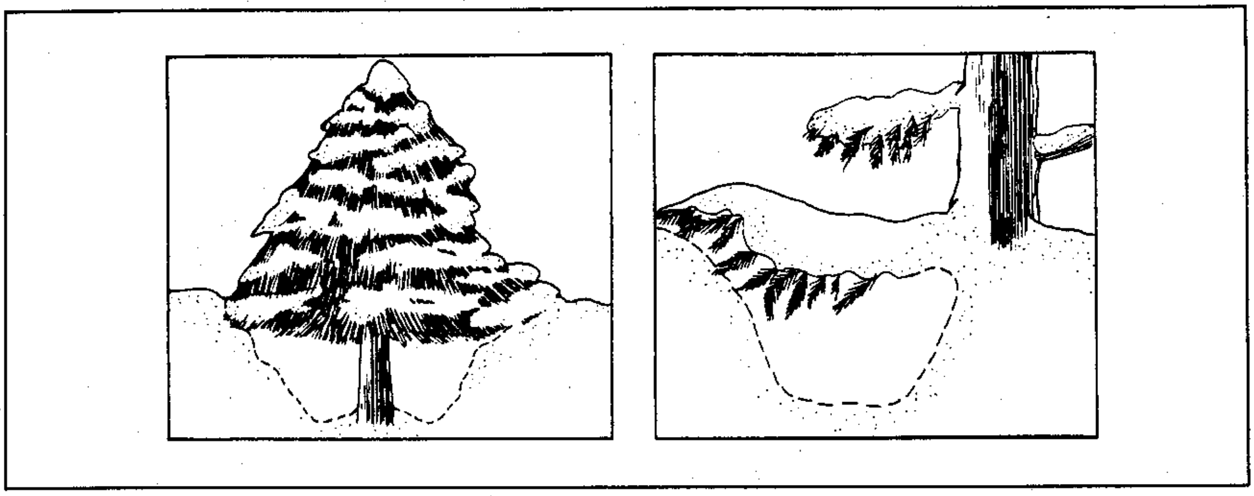


Figure 36. Snow Caves

at the top will form a pup tent. The most comfortable lean-to is likely to be that designed for a single person, with a low mouth (height), a width no greater than the width of a sleeping bag, and a length just longer than the full body length. Here the survivor can lie lengthwise in front of a fire built in front of the shelter. This arrangement is much warmer than sleeping either head on or feet on to a fire. Two lean-tos can be built facing each other to share a common fire, however, this is not advised as one will likely end up drawing smoke from the fire.

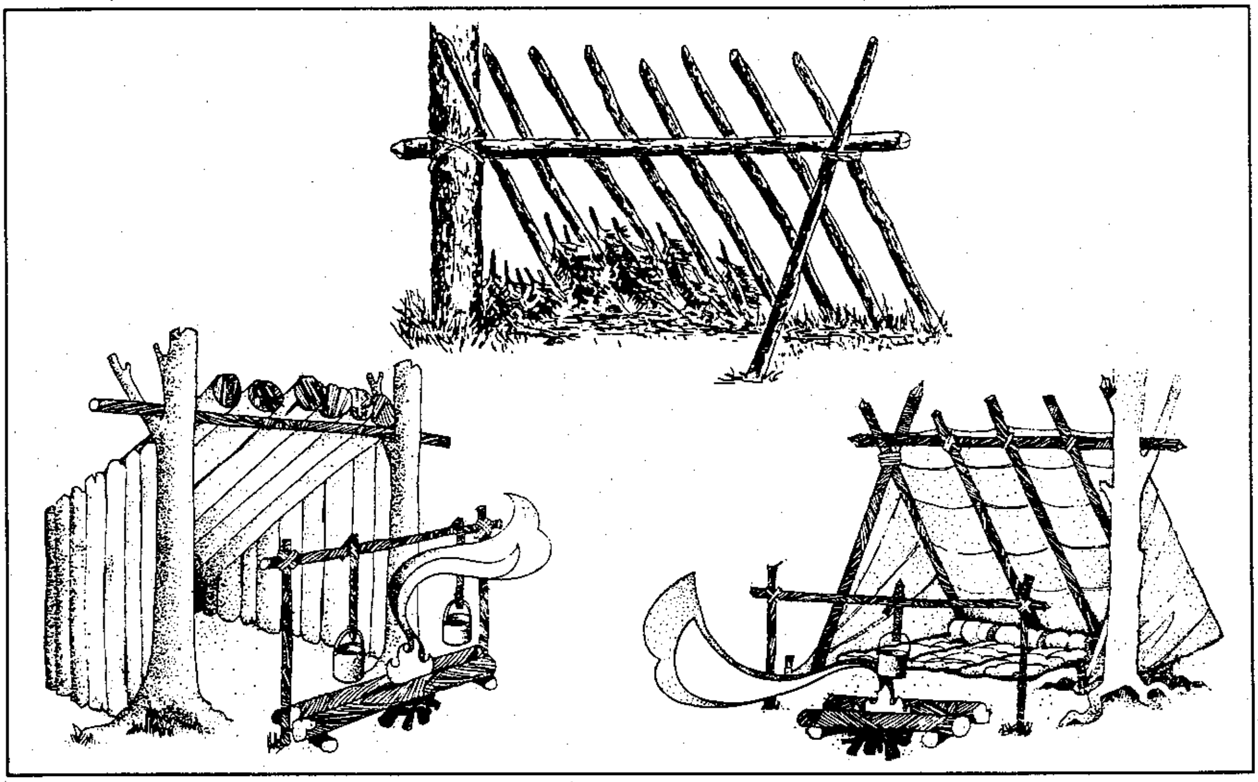


Figure 37. Lean-to Arrangements

The lean-to should be constructed on firm ground with the roof slanting into the prevailing wind. Various methods can be used to suspend the main support beam, as shown in Figure 38.

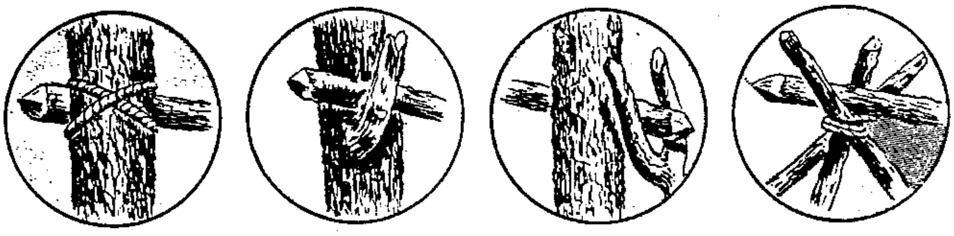


Figure 38. Main Support Beam Suspension

The roof should be wind and water resistant. The simplest of roofing materials is a tarpaulin simply laid over and lashed to the pole framework. If no tarpaulin is available, logs, boughs, earth sods, rushes, grass or strips of bark may be used. Boughs are the most common natural roofing material; these should be laid with the first row at the bottom, brush end of the boughs down and overlapping one another; subsequent rows should also overlap the previous row. This method of thatching ensures shedding of rain, once a first layer has been completed, a second should be laid. If using logs, the space between logs should be chinked with grass, moss, earth or snow. The sides of the shelter should be treated in the same manner as the roof.

b) Teepee

The Teepee is a simple effective form of shelter. The three basic arrangements are the Tripod Teepee, Suspension Teepee and Centre Tree Teepee; these are illustrated by Figure 39. The Suspension and Centre Tree versions depend on the availability of a tarpaulin; the Tripod Teepee may be built entirely with natural resources.

Tripod Teepee - Three poles, each approximately 12 feet in length and lashed together about 12 inches from the ends are set up as a tripod. Extra poles may be placed against the tripod; these should be laced at the top. If rope is not available, tree bark, young saplings or even grass may be used. The pole frame created can then be covered by a tarpaulin to complete the shelter. If no tarpaulin is available, boughs or bark may be used as described in (a) above.

Suspension Teepee - One end of the tarpaulin is gathered together, lashed and hung from the three pole tripod. The other end of the tarpaulin is spread out in a circle and pegged or secured with rocks to the ground. Minimum tension should exist in the tarpaulin to prevent tearing.

Centre Tree - This arrangement is a simplification of the Suspension Teepee described above. The three pole tripod frame is dispensed with. Instead, one end of the tarpaulin is gathered around a tree trunk. The other end is spread out in a circle and pegged or secured with rocks to the ground.

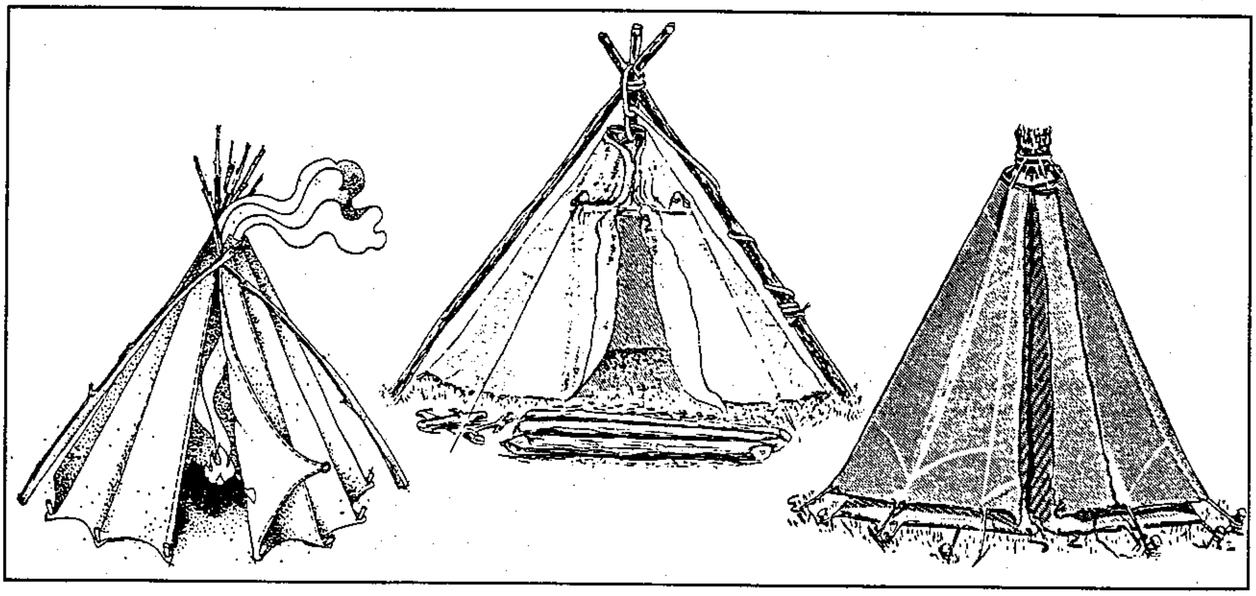


Figure 39. Teepee Arrangements

c) Cabin

The Cabin structure defined here is more permanent and requires considerably more effort to construct than the other shelters described in this section. Therefore, great consideration should be given to location. Figure 40 illustrates the Cabin structure.

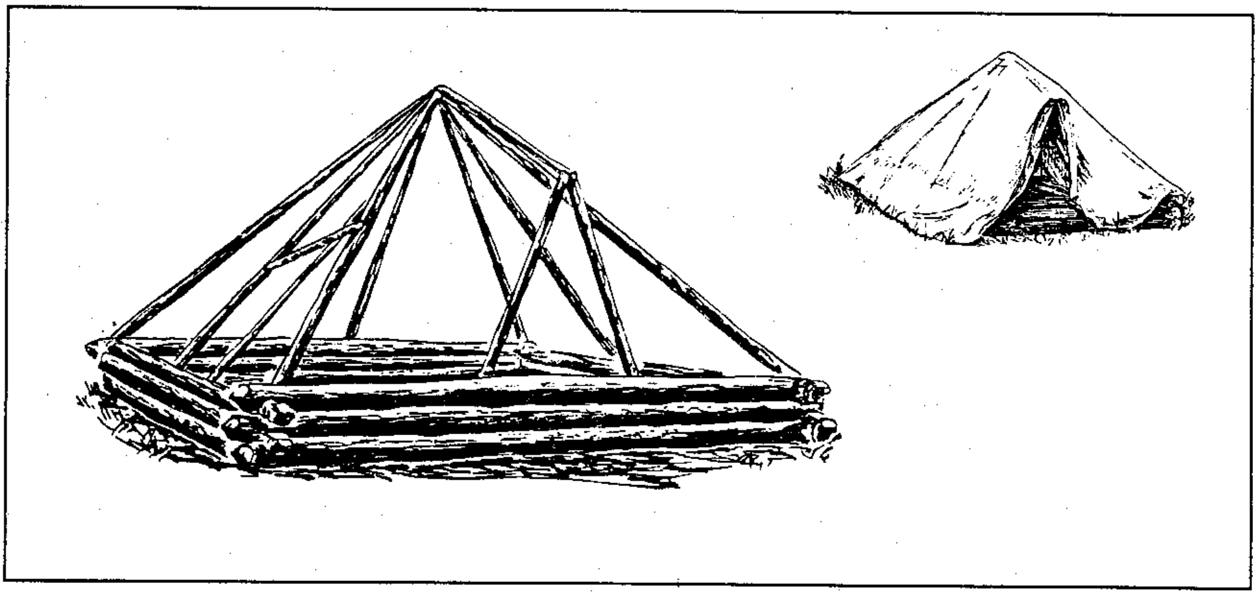


Figure 40. Cabin Structure

Construction begins with the erection of three or four walls in log-cabin fashion to a height about one meter. Above these walls, a framework of light poles is erected to support the roof. Roofing is similar to that of the lean-to; tarpaulin, logs, boughs, earth sods, rushes, grass or strips of bark may be used. If tarpaulins are available, the water shedding and insulating properties of the roof may be improved by creating a double layer of fabric with an air space between. The log-cabin style walls should be chinked on both sides with grass, moss, earth or snow. This will provide a high degree of draft protection.

d) Natural Caves

On land, particularly in coastal regions, natural caves may be found. All caves should be approached with caution as they are attractive shelters for animals such as wildcats and bears. These caves can offer weather-proof shelter that usually requires little construction work to be made habitable, perhaps only a barrier to close off the entrance. Typically, caves are damp and, in some cases, have within them a freshwater supply from an underground stream or spring. The inherent dampness of caves can be dangerous, leading to injuries such as trench foot.

The dampness and coldness of the cave can be combated. Dry plant matter and boughs will provide floor insulation. A fire should be built in the back of the cave close to the walls so heat is reflected back. The fire will provide light, warmth and will deter animals. Smoke should rise to the roof and roll out the cave mouth leaving smoke free air at floor level. Ventilation is equally important here as it is in any other type of shelter. If the cave mouth has been sealed, make sure there is a large enough gap to allow smoke to escape. If the fire is built too close to the cave entrance, smoke will probably be blown inwards as opposed to escaping outwards.

5.2.5 Clothing

Conventionally clothed survivors would have normal or extra warm clothing under an immersion suit. The warmest available clothing should be worn. If additional equipment, such as an insulated suit and associated mitts and boots are available, they should be worn. No matter what clothing is worn, it is important to "manage" the clothing correctly. Body temperature should feel warm but not hot.

Zippers or other fasteners can be opened at various locations to allow excess heat to escape. Belts or drawstrings can be tightened to create compartments in the clothing. Multiple layers of clothing are the most effective for heat regulation. The body should be cool rather than hot, because sweat can freeze and cause hypothermia.

Hoods can be used effectively to deflect the wind. Mitts and gloves can be used as required to keep the hands warm and to allow fine work to be done effectively. The scarf should be rotated around the neck to move any frozen condensation from the mouth. Balaclavas can be worn as toques if condensation becomes a problem. A headover and a hat is very effective.

Do not wear outside clothing inside the shelter. When an insulated jacket is worn inside the shelter, the frost (in the relatively harmless form of snow) melts to form ice rendering the clothing much less effective. The rule is: Outside clothing stay outside.

5.2.6 Rations

The average person can survive for many weeks with little or no food, but for only about three days without water. Since the time before rescue occurs is unknown, it will not be known how long the rations and water must last. Therefore, great care should be taken to conserve these supplies.

A person can survive for many weeks without food but only for a few days without water.

The average person loses between two to three litres of water a day through sweating, breathing and urine and faecal excretion. To prevent dehydration, a person should not be deprived of water for more than a day. One means of conserving water is to reduce body losses. Avoid heavy breathing by regulating physical activity, and ensure effective ventilation of clothing to minimize perspiration. Carbohydrates require less water for processing than fats and proteins. Therefore, a carbohydrate rich diet may reduce water loss through urine and faeces.

There are two natural sources of drinking water in cold regions: snow and old ice.

- In most situations, snow will be available immediately. However, ice requires approximately half as much fuel to produce a given amount of water compared to snow. If snow must be used, it is best to compress it before melting. Snow and ice should not be eaten as they can freeze the mouth and throat, making them extremely sore. In addition, the body will need to use energy to bring the snow and ice up to the core temperature.

DO NOT EAT SNOW OR ICE.

- Newly formed saltwater ice (first-year ice) is milky and grey in appearance and will have a high salt content. As the ice ages, the salt leaches out and the salinity of the ice decreases. Old ice (multi-year ice) will be virtually salt-free and is an excellent source of freshwater. Multi-year fresh water sea ice is clear and often contains many air bubbles. It usually has round edges and can be found on old foes. If multi-year ice is not available, the top-most layer of first year ice will provide water which may be brackish, but should be suitable for drinking. De-salting tablets should be used if only salt or brackish water is available. Sea water (saltwater) should not be consumed as it will increase thirst and can cause loss of body fluids through diarrhoea and vomiting.

DO NOT DRINK SALT WATER.

Sterilization tablets can be used if there is doubt as to the purity of the water. Water can also be sterilized by boiling, but only if there is an unlimited supply of fuel. To conserve fuel, melting and heating should be done in a pot with a tightly sealed lid to retain the steam. Ideally, water should be consumed warm so the body does not use energy to bring it up to core temperature. Water needs only to be heated not boiled.

If ration packs are available, fruit flavourings, coffee, tea and hot chocolate might be included. Fruit drinks are preferred, especially if they contain vitamin additives. Coffee will not quench thirst, but tea will. However, tea can increase urine output.

NEVER drink from metal containers.

As a rule of thumb, no rations should be consumed during the first day on the ice, as body reserves from the previous day should satisfy any physical needs. Starvation will not be a problem over a one or two week period. However, some food is required from a functional and psychological aspect. Due to the higher metabolic rate resulting from the cold, more food is required to maintain stamina than in warm climates. The normal daily intake of food in a temperate climate is between 1,500 and 2,000 calories per day; about 2,500 calories per day are recommended for survival in cold regions. Mental health is important for survival and eating regularly has a positive influence on morale.

DO NOT eat during the first day after evacuation.

The survival rations which are provided in lifeboats and liferafts are not suitable for use in cold regions. The water will be frozen and the energy content of the rations too low. However, if the ship has survival packs, then the associated rations will meet the survivor's basic needs. Such rations are normally packaged in daily portions, each containing a blend of carbohydrates, proteins and fats. These packs should be supplemented with vitamins, particularly vitamin C, which increases resistance to the cold and helps prevent cold injury.

In addition to their nutritional benefit, hot meals and beverages do much for camp morale. Meals should be prepared on a routine schedule. Two meals per day is recommended, the first in the morning after awakening and the second just before entering the shelter for the night. A big meal should be eaten before sleeping because body heat production increases after a meal.

Cooking inside a snow shelter (igloo) is acceptable if adequate space is available as condensation will be absorbed by the walls. For other shelters, all cooking should be done outside or a separate shelter should be constructed for use as a kitchen. Regardless of the shelter type, all food and food waste should be stored away from the shelter so it will not attract animals. Similarly, if hunting to supplement the food rations, the game should be prepared away from camp.

There are a limited variety of plant and animal species in cold regions which may be a source of food. These are reviewed in Chapter 8.

5.2.7 Communications

If exploration, mining and other commercial activities are ongoing in the Arctic or in the more populated areas of the south, air support and medical facilities will probably be available. In such a case, the Master should attempt to make contact with the nearest facilities before evacuating the ship. The navigating officers should be aware of the communication frequencies on which these companies may be reached.

Visual contact must be maintained between the survivors, and camp identification from the air or sea is important. Figures 41 and 42 show typical ground-to-air signals that can be easily built using material at hand including snow blocks. Such snow blocks will create shadows which can be seen from a great distance. In addition to these signals, Morse code can be used with a heliograph (reflector used to flash sunlight) or some other reflector or light source (flashlight or lantern).

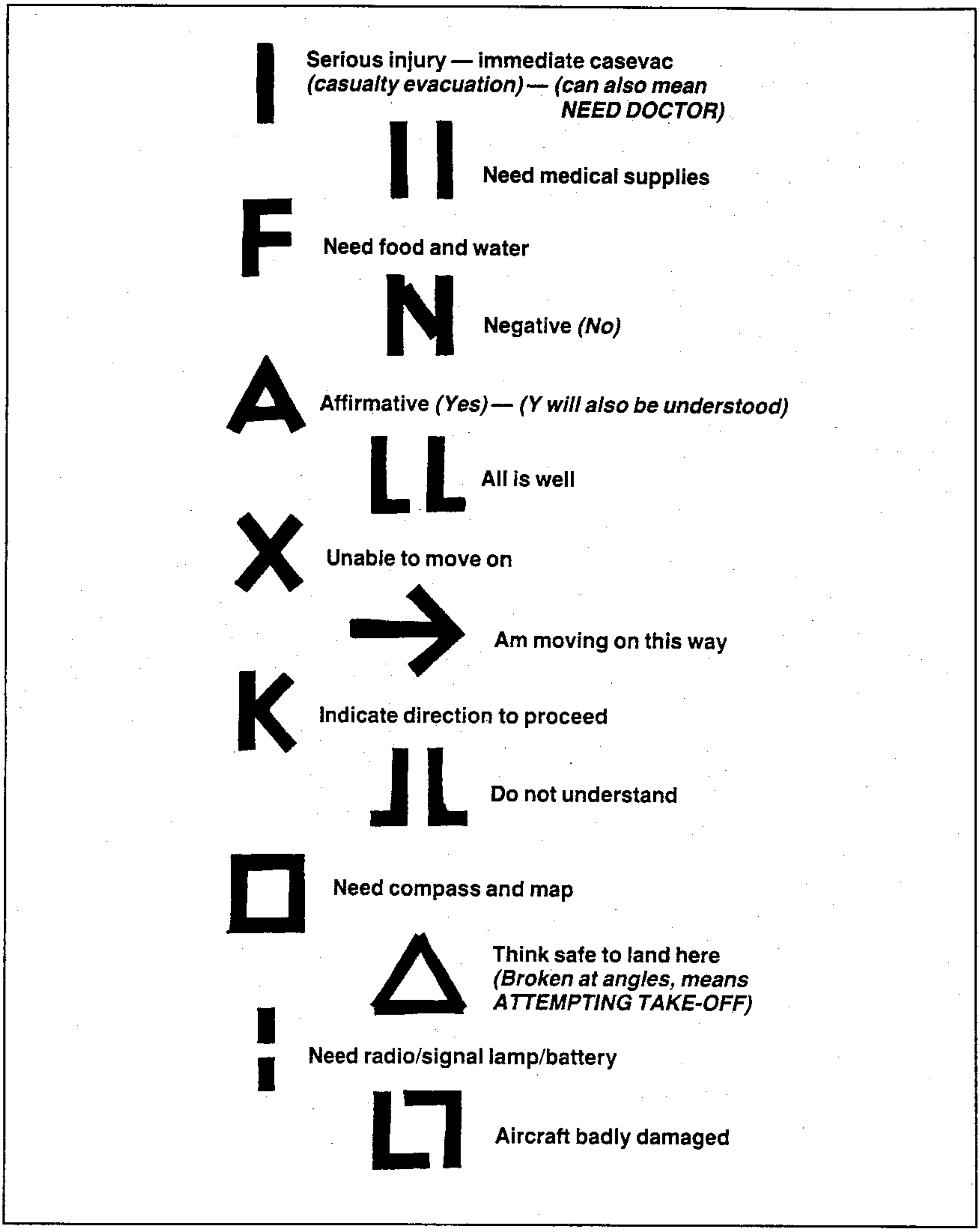


Figure 41. Ground-to-Air Signals

This series of signals will be understood by airmen and can be used to signal to them. Note the changes from frontal to sideways positions and the use of leg and body posture as well as hand movements. Use a cloth in the hand to emphasize the YES and NO signals. Make all signals in a clear and exaggerated manner.

Figure 42. Ground-to-Air Body Signals

Although darkness will hamper visual identification unless efficient signalling equipment is available to the survivors, visibility of ten kilometres or more will occur 70 to 80% of the time throughout the year. Fog, falling or driven snow and cloud cover will also reduce the visibility, while Arctic mirage and white-out conditions can influence visual perception.

5.2.8 Hygiene

In a survival scenario where living conditions may be uncomfortable, there is a natural tendency to ignore hygiene. This tendency must be fought and survivors should make every effort to maintain good personal hygiene.

Personal hygiene is essential to maintain health.

- Snow can be melted in the hand and the body can be sponge cleaned under the clothing. The feet, areas between the thighs and the genital and anal areas must be kept clean.
- Avoid contact between fingers and the mouth, nose and ears, and avoid smoking.
- Survivors should avoid the excessive use of soap since it will remove natural oils from the skin. Washing the face with soap is best done prior to sleeping because the skin's natural oils will be replenished overnight. However, soap is a good antiseptic and is ideal for scrubbing hands before treating wounds. Soap is preferred to other antiseptics, such as iodine, since these can destroy body tissue.
- Short hair and no beards are recommended. Long hair and beards may provide some insulation, but they can also be sites for frozen condensation and, thus, can increase the likelihood of cold injury.
- Teeth should be cleaned regularly. If no toothbrush is available, a piece of leather or cloth can be used to rub the teeth. Metallic objects should never be placed in the mouth since they can stick to the skin and cause injury.
- A latrine should be built away from the shelter to prevent disease which can occur as a result of faecal or urine contamination. The latrine will likely be a simple hole in the snow or ice. Protection from the elements can be provided by a snow wall. When the latrine becomes full, it can be covered with snow and another hole dug. Odour will not be a problem in the freezing temperatures. A rope guideline between the latrine and shelter will be useful during darkness and at other times of reduced visibility.
- Socks that are soiled or have holes in them are poor insulators and can cause sore feet and blisters and accelerate fungus growth and other infections. To prevent these conditions from occurring, wash feet regularly, cut toenails and tape sores before blisters develop.

5.2.9 Protection Against Predators

The polar bear may be a danger to Arctic survivors. These bears are among the largest of all bears. Fully grown females can weigh about 300 kilograms and males between 450 and 600 kilograms. They grow to between 2.5 and 3.5 metres in height. Polar bears are also the most carnivorous of all bears.

Polar bears should be viewed as a potential hazard, survivors should keep a vigilant watch for them. These animals have an excellent sense of smell. Therefore, great care should be taken in disposing of camp waste and storing food away from the campsite so as not to attract them.

Dispose of food wastes well away from the camp.

If Arctic foxes are sighted, a careful watch should be kept for bears as they often follow them to feed on the remains of a kill.

Polar bears may be scared-off by warning shots or flares. However, once a bear decides to attack, the only practical protection is likely to be a firearm. The ship's Very Pistol may also be used to deter polar bears, as these bears do not like the bright light or acrid smoke.

Fully grown walrus can also be dangerous and should never be approached.

5.3 Trapping and Fishing

The ability to harvest food, particularly animals, will depend on location, equipment and skill. There are no regions in the Arctic which are completely devoid of animal and plant life. If there is ample vegetation, there will be a variety of animals. In cold regions south of the treeline, there will be an abundance of animal and plant life. In the Arctic tundra, evidence of animal and plant life will be more sparse, particularly plant life which will likely be under snow cover.

Anything that walks, crawls, creeps, swims or flies is a food source to a survivor. Insects of all kinds, grubs, snails and earthworms can be eaten. These species can be eaten raw or cooked and are easy to harvest once a source is located. However, a substantial number of small insects are required to make a meal. It is preferable, given dietary and palatability concerns, to harvest small mammals, birds and fish if they are available. Large mammals may be harvested but doing so requires considerably more skill.

5.3.1 Trapping

Generally, it is preferable to trap rather than hunt, particularly for small game. Small game offers a small target for the hunter and requires time and skill in tracking and good marksmanship. Trapping requires less skill and may prove a less time consuming method of harvesting small game. Knowledge of the different types of traps and methods of how to make and set them is needed for successful trapping. Different animals have different habits. It is necessary to understand these habits in order to select an appropriate trap and bait. However, if these habits are unknown, a variety of trap types may be set to determine which is the most successful. One advantage to trapping is that once the trap has been set, the trapper is free to spend time on other activities.

In some cases, death may not be instantaneous and traps can cause suffering to the animals. For example, snares meant to strangle rabbits may entangle a fox by the limbs. Nevertheless, self-preservation must take precedence over humanitarian concerns in a survival situation. However, the suffering of these animals can be minimized through regular checking of the trap line. This also minimizes the risk of trapped animals either struggling free or being taken by natural predators.

Many animals retrace their tracks. Therefore, trappers should look for evidence of these tracks such as beaten ground, droppings and freshly eaten plants when deciding where to set their traps. Traps should not be set too close to animal lairs as these areas are where the animal is most alert. Some basic rules apply when trapping, regardless of the type of trap used:

Avoid disturbing the environment - All traps should blend in with the environment and look as natural as possible. Preparations should be completed away from the trap line. The game trails should not be walked on as there should be no sign that a trapper is in the vicinity.

Hide scent - Animals have a keen sense of smell, far superior to that of humans. Therefore, great care should be taken to mask the human scent when setting traps. Gloves should be used and the traps handled as little as possible. Human scent should be masked with smoke. Although animals are afraid of fire, they are familiar with the odour of smoke. Unnatural scents should not be created in the environment; for example, traps should not be made from a wood that is foreign to the habitat.

Camouflage - Traps should be set to blend in as naturally as possible with the surroundings. If something seems unnatural, the prey will be spooked and avoid the trap. Any evidence of your visit should be camouflaged. Your footprints should be covered with leaves, moss or dirt. Freshly cut wood ends should be covered with mud to hide them.

Make traps strong - Traps should be made strong enough to ensure they hold the game. An entrapped animal fighting for its life exerts considerable energy; any weakness in the trap construction could allow escape.

Small mammals such as squirrel, rabbit, hare and fox are the best for survival trapping. These animals are likely to be the most abundant and easiest to catch in the cold weather regions. There are many types of trap of varying complexity that can be used; however, the snare, deadfall trap and beehive traps shown in Figure 43 are the simplest:

Snares - can be used with or without bait; the objective is strangulation or entanglement of the prey. The noose, made from wire, string or fishing line, should be free running, just larger than the head and set at the eye level of the intended prey. As illustrated in Figure 43, the snare can be securely anchored to the ground or a tree (stationary snare) or tied to a spring and trigger mechanism (spring snare). As shown, a "Noose Stick" can be made by tying several small snares to a pole. If it is placed in known roosting or nesting sites, it can be very effective for birds. Do not remove the first bird that is trapped as, if left in place, it will attract others.

Deadfall traps - as illustrated in Figure 43, use bait and work on the principal of a falling weight crushing the prey. The weight may be a fallen log, a rock or a slab of ice. The trigger mechanism shown on the left is a "Balance Log". Both ends of a forked pole are sharpened to a point. One point supports the crossbar (a square faced notch may be used instead of a sharpened point), the other point is placed on firm ground. A rock may be placed on the ground to provide a hard surface. Bait is placed on the fork, which is angled beneath the trap. When the bait is taken, the balance log slips out of position and the weight falls. The release mechanism, shown on the right, is a "Figure 4" trigger. A bait bar is square faced fit to an upright (see insert), the weight is supported at right angles by a locking bar which is notched to pivot on the upright and sharpened at the end to mate with a notch cut in the end of the bait bar.

Beehive traps - as illustrated in Figure 43, use bait. These are hollow structures which can be built of stacked logs, stone or ice which is built up above ground. Bait is placed in the cavity and

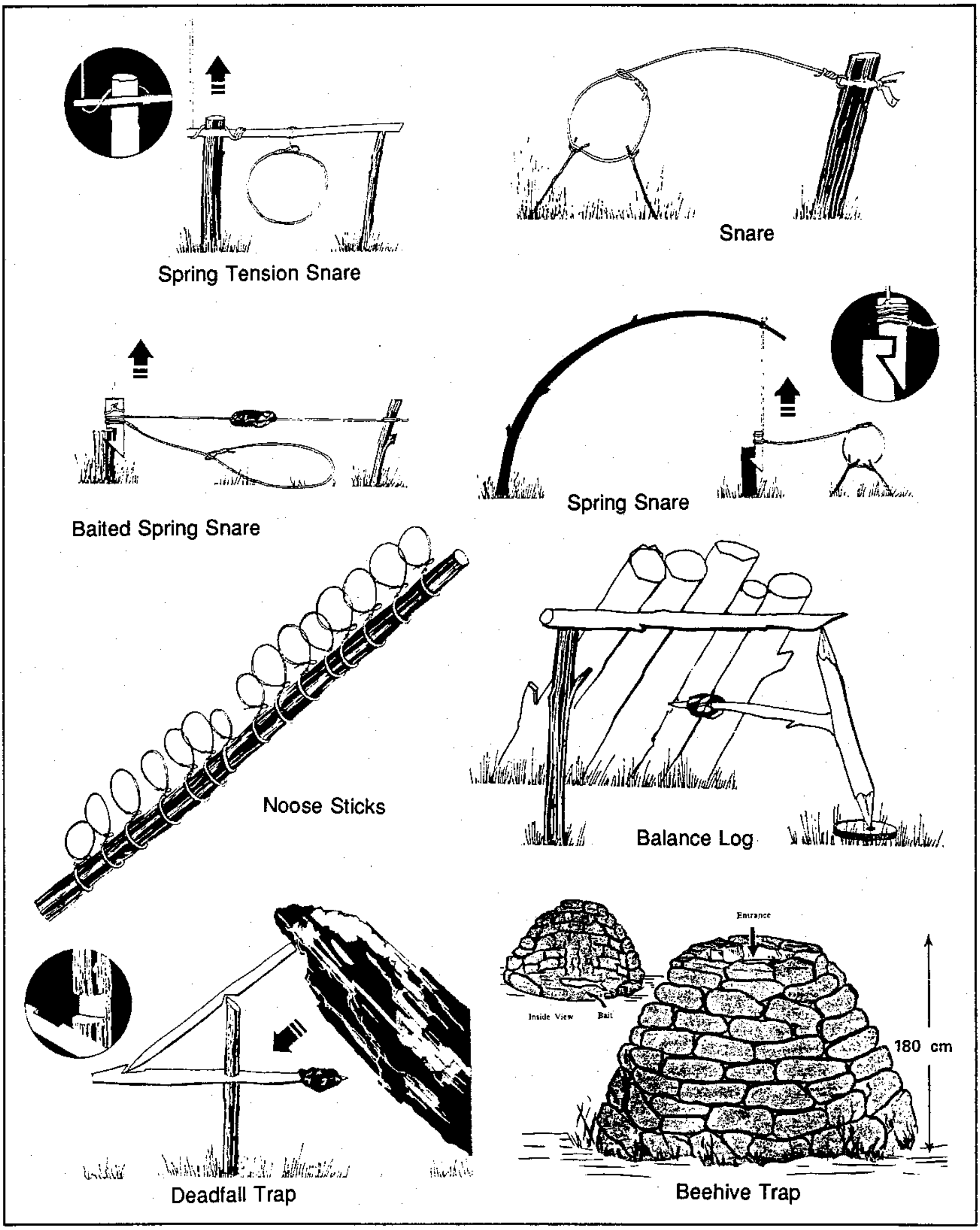


Figure 43. Small Animal Traps

animals attracted to the scent are able to climb the sloped outside walls of the structure and enter the cavity. The structure is tall enough and strong enough to prevent their escape.

5.3.2 Hunting

Successful hunting requires skilful tracking, patience and accurate marksmanship. A good knowledge of the kind of animals being hunted will enable the hunter to take the best advantage of the terrain and to be in the right place at the right time.

Generally, the best time to hunt is early in the morning, at first light, when there likely are more animals about. The early evening, at dusk, is also a good time to hunt, but vision is reduced as the light fades. Hunters should be familiar with the terrain and able to get back to camp in the dark. It is best to start the hunt about an hour before dusk so the eyes become used to the failing light, and night vision develops. Regardless of what time the hunt takes place, there are a few general rules which should be followed:

Travel slowly and quietly - Move as quietly as possible, particularly once an animal has been sighted: any unnatural noise will alarm your prey. Move slowly: fast and sudden movements startle the prey. Carry your weight on the rear foot, testing the next step with the forefoot before transferring your weight to it. This helps reduce noise from undergrowth and snapping sticks and avoids stumbling. If you are seen by an animal, freeze immediately and keep absolutely still until the animal looks away or continues feeding.

Mask the human scent - Animals have a keen sense of smell, far superior to that of humans. Do not hunt with the wind at your back: this carries your scent toward your prey and alarms it. Move into the wind when possible; if not, circle around so that you are at least across the wind.

Make best use of terrain - It is best to move uphill in the morning and downhill in the afternoon. When moving uphill, animal signs are easier to read as they are closer to eye level. When moving downhill, thermal currents built up with the heat of the day carry scent upwards; the scent of game will reach you before your scent reaches it. After a hard day of hunting, the descent downhill will prove less tiresome.

Be sure of an accurate shot - Be patient: get as close as possible to your prey without revealing your presence. Take up a steady position and aim for the area that gives the greatest margin for error. The best target is the heart and lung area. An accurate shot to the head and neck area provides a fast drop, however, the target is small and the animal might move its head as you shoot. Ammunition is a valuable commodity and should not be wasted. If the animal drops on the first shot, wait a few minutes and observe before approaching; if it is not dead, the loss of blood will weaken it so it will not be able to bolt when you approach. If the animal is wounded and moves away, wait several minutes before you pursue it. Eventually it will rest; however, if it is aware that it is being followed, it may travel all day. If no other shot is available, the gut region provides a large target, but if the shot is not fatal, the animal might travel a great distance without leaving a blood trail before it drops.

Obviously, the most effective weapon for hunting is a shotgun or rifle. If the survival party has a firearm, standard safety procedures should be practised and the use of ammunition minimized. If no firearm is available, there are a number of simple weapons that can be made. Although these weapons are quite primitive, it is possible with practise to hunt proficiently with them. The slingshot, catapult, bola, spear and bow are illustrated in Figure 44.

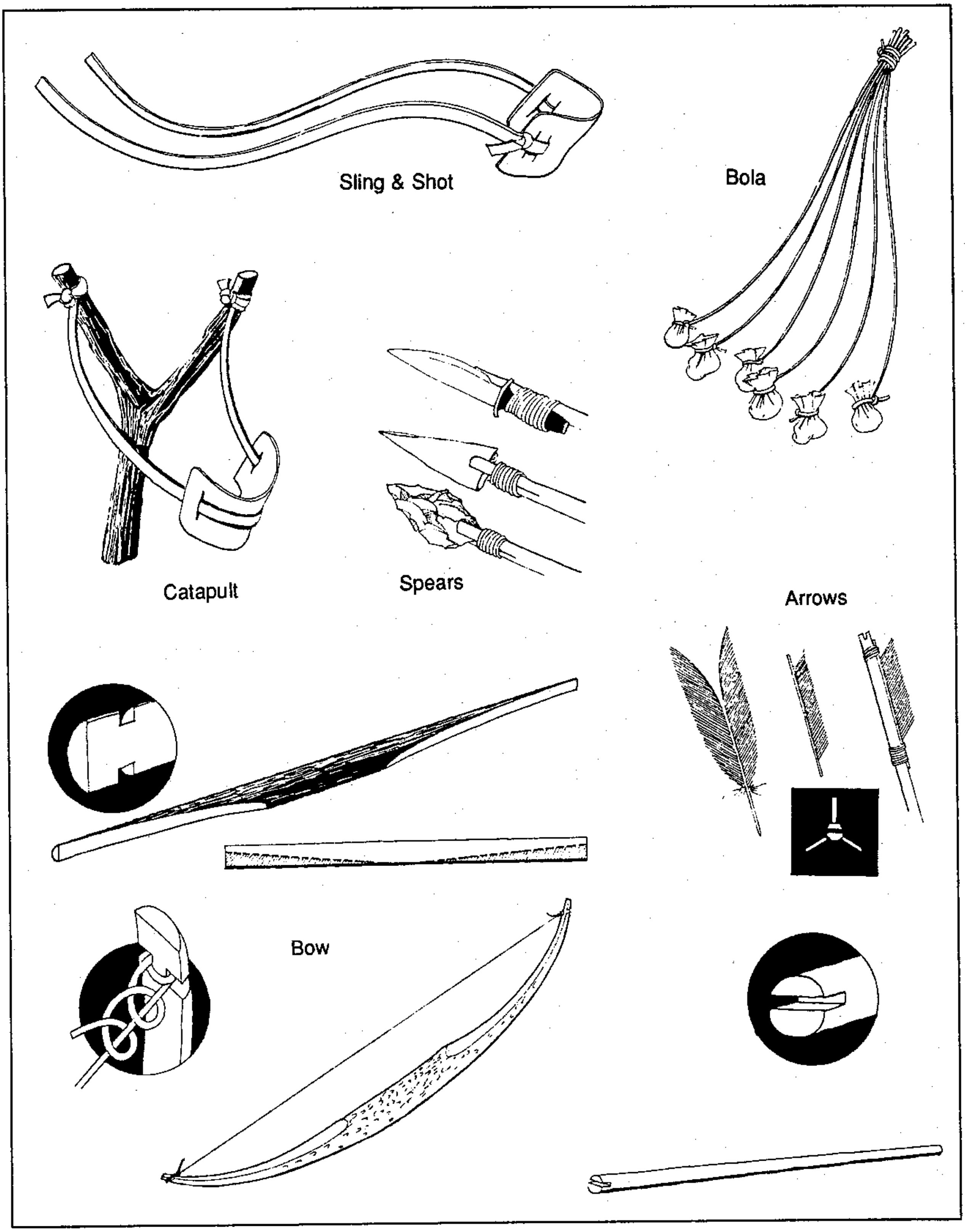


Figure 44. Hunting Weapons

Slingshots - are simply a length of rope or string with a leather or thick material pouch secured at mid-length. Small smooth pebbles, about two centimetres in diameter and as round as possible, are the best slingshot ammunition. Jagged stones might inflict more damage on impact, but do not follow a smooth trajectory. When hunting birds, several small stones may be used to give a scatter shot. The shot is placed in the pouch and swung overhead in a circular motion. One end of the rope is released when the shot is lined up on the target. With experimentation in rope length and practice, an extremely fast and accurate shot with good range is possible.

Catapults - use the same type of ammunition as the slingshot and are easier to aim. However, construction is dependant on the availability of an elastic material: elastic from clothing may be used.

Bolas - consist of a series of small weights (stones, coins, pieces of ice) wrapped in circles of material and attached to strings of about one metre in length. These strings are knotted together and twirled around over the head. The twirling arm is directed toward the target and the strings released. On release, the bola flies through the air covering a wide area. Birds in flight may be hit by the weights or entangled in the strings. Practise is required to aim accurately.

Spears - are perhaps the simplest weapons to make and use. Shafts of about two metres in length and up to about three centimetres in diameter are ideal for jabbing and can be a useful aid to walking. Shorter shafts of smaller diameter are preferred for throwing spears. The sharpened end of the shaft may be burned to make it hard. More effective points can be made from a stone, flint, bone, flattened tin or a knife. However, if there is only one knife, do not risk damaging it by using it as a spear point. The spear point must be secure. This can be done by cutting notches in the shaft and using wet sinews for binding.

Bow and Arrow - is a weapon familiar to most and, if proper construction materials can be found, it is very effective. The bowstave should be about 120 centimetres in length and about five centimetres in diameter at the centre. Suitable woods include yew, hickory, juniper, oak, white elm, cedar ironwood, birch, willow and hemlock. From the centre, the bowstave should be shaved to taper down to about 1.5 centimetres at the ends. The ends should be notched to take the bowstring. After the bowstave has been shaped, it should be rubbed with oil or animal fat. The ideal string is rawhide cut to about three millimetre width but, if not available, any string, cord, rope or even braided fishing line will work. Arrows should be about 60 centimetres long, and straight; birch is one of the best woods for this purpose. Arrows must be of a diameter large enough fit over the bow string; a notch is cut in the end to fit on the string. Arrow points are made in a similar manner as spear points, only smaller. Flights may be made from feathers, birch bark, paper, cloth or even leaves. Flights will increase accuracy by stabilizing the arrows flight; three flights should be equally spaced around the shaft. If thread is not available to fasten the flights, tree sap (pine or spruce) may be used as glue.

5.3.3 Fishing

Fish is a valuable food source, rich in protein, vitamins and fats. Freshwater and saltwater species can be found in abundance throughout the cold weather regions. To fish successfully on land or sea, in open or ice covered regions, requires only patience and knowledge of a few simple proven techniques.

Fish tend to swim and feed where food is most readily available. Likely fishing grounds in lakes are areas where trees overhang, reeds or grass grow in the water or near the mouth of tributaries. In addition to location, the success of fishing efforts can be greatly affected by the depth at which you are fishing. Fish generally feed near the surface in the early morning and evening when the water is cool. During the heat of the day, fish retreat to deep water where the temperature is cooler. In addition to this thermal action affecting depth, different species of fish are either surface, mid or bottom feeders and naturally inhabit different depths.

Fish may be caught by spear and net. The most viable method, however, is likely to be with hook and line. Figure 45 illustrates various hook and line tackle. If they are not part of the survival kit, fishing hooks can be made from wire, paper clips, hair pins, strips of metal cut from tin cans, wood, thorns, bone or antler. If fishing line is not part of the survival kit, cotton, twine or even wool unravelled from a sweater can be used. In open water, the traditional baited hook, line and floater method can be used. The most likely bait to be taken is that which is native to the area, such as berries that overhang the water or insects that breed in or near it. Once a fish has been caught, the gut should be split open and inspected to determine what the fish is feeding on. Experiment with bait depth: small weights can be used to adjust the depth at which the bait is presented. Floater motion indicates a bite; the floater should be clearly visible from the bank or ice edge.

On ice covered waters, a hole cut with an axe will provide an opening through which a baited line can be dropped. If holes can be cut easily, it is best to make several and set several lines. These lines can be tied to flags laid on the ice. When the bait is taken, the cross piece will be dragged over the hole and the flag pulled upright. The cross piece should be about one and a half times the diameter of the hole and the flag a bright colour so that it can be easily seen against the snow and ice. Keep a vigilant watch of the flag markers so the catch can be pulled up quickly. If left too long, the catch may wriggle loose or be taken by a passing seal.

Baited hooks can also be set up on a night line. If presented at all depths, such hooks give the opportunity to catch surface, mid and bottom feeders. The line can be put out at night and left until morning. When used in the daytime, bait should be changed regularly.

Spinning is a hook and line method that requires no bait. Hooks adorned with shiny objects such as buttons, coins, tin foil, pieces of tin can, coloured wood, bright cloth and feathers make excellent spinners. Spinners are attached to a line, cast out across the feeding grounds and slowly dragged back to shore; curious fish will attack the shiny objects and become hooked.

5.3.4 Preparation of Game

Game must be dressed before it is eaten; nothing should be wasted and careful preparation will maximize the food value and make use of all inedible parts. In general, preparation of all game consists of four stages:

Bleeding - All game should be bled. This helps it keep and diminishes the strong game taste. The blood can be collected and drunk. It will be rich in vitamins and minerals and is warm if drunk immediately after the kill. Bleeding is best done with the animal hung head down, and should be done before the carcass cools and the blood coagulates. Bleed the animal by cutting the jugular vein or the carotid artery in the neck.

Skinning - Animal skins can be used for shelter and clothing. It is easier to skin an animal when the flesh is warm. Scent glands can taint the meat and should be removed. Some deer have glands on their rear legs just behind the knees, felines and canines have glands on either side of the anus. The testicles of male animals can taint the meat and should also be removed. Before skinning, gutting and jointing, any cuts or sores on your skin must be covered in case the meat is diseased.

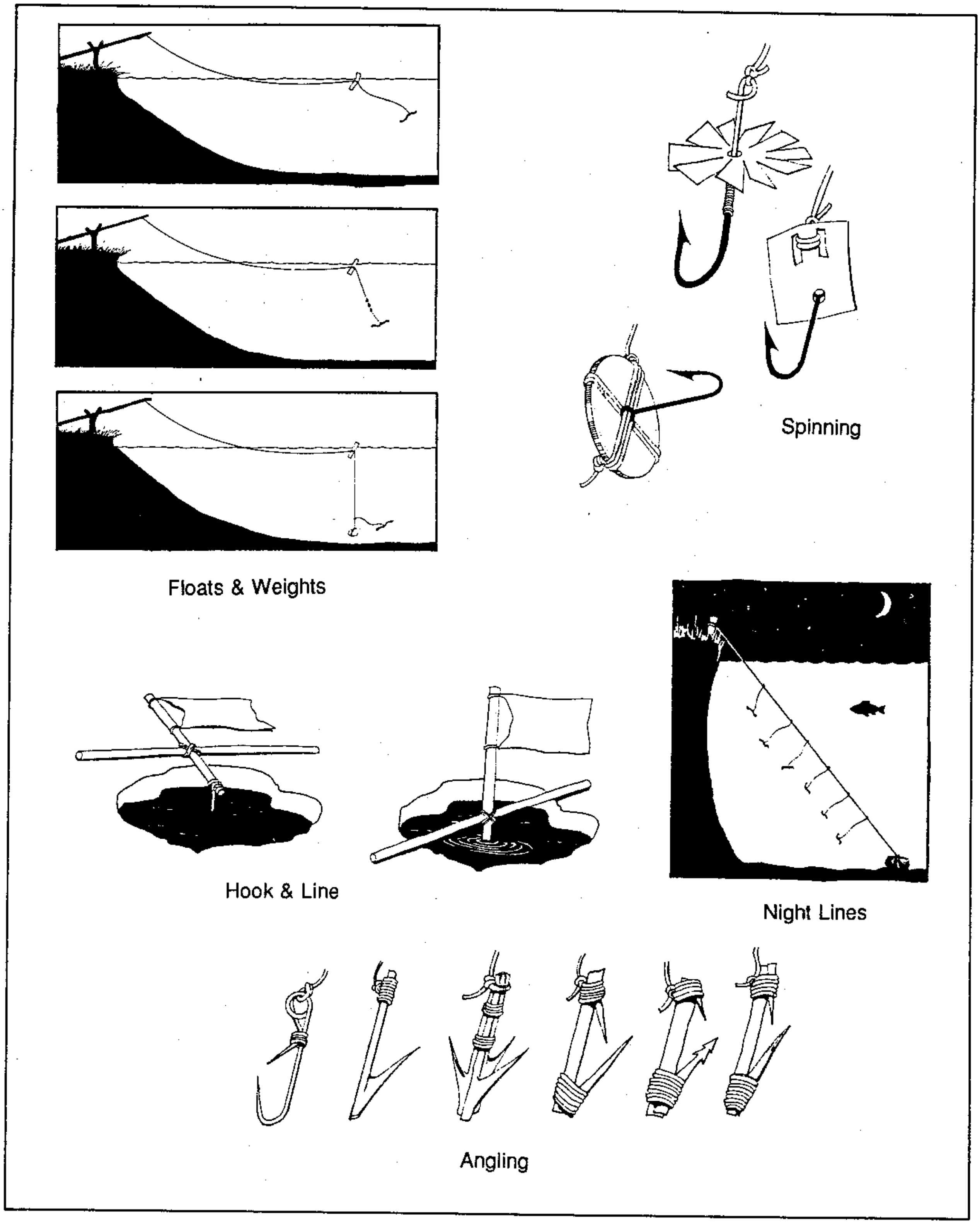


Figure 45. Hook and Line Tackle

Gutting - After skinning, the animal's internal organs may be removed. Do not stab into the flesh since you may puncture the internal organs and taint the meat. Organs such as the heart, kidneys and lung should be eaten as soon as possible as they do not keep well. The liver of the bearded seal and the polar bear are toxic and any liver showing white spots is an indication of disease. Anything not eaten should be retained for use as bait. The stomach contents should be inspected for food value.

Jointing - Once gutted, the animal may be butchered into suitable cuts for eating. The meat may be tenderized by leaving it to hang for two or three days.

Birds are best killed by stretching their necks, cutting their throats and hanging them head down to bleed. Birds are prepared in a similar way to mammals. Larger birds are usually plucked, not skinned. Plucking is easiest when the bird is warm. Carrion eaters should be handled as little as possible as they are prone to infection.

Fish should be bled and the gills and offal removed. These parts may be used for bait. It is not necessary to scale fish. Fish skin has good food value and should be eaten.

5.4 Summary

Survival afloat on the ice or on land in cold regions is difficult. However, with appropriate equipment the crew should have sufficient water and rations and insulated clothing and shelter. The circumstances are never ideal, but people have survived for several months in very cold conditions with little or no food, and very little water. The human will to survive and human ingenuity are tremendous weapons against the elements. If well trained and properly equipped, the crew of a ship can wait safely for rescuers to reach the scene.

CHAPTER 6 HEALTH CONCERNS

The cold region health problems of most concern are:

- trench foot or immersion foot;
- hypothermia;
- frostbite;
- snow blindness;
- shock;
- anoxia;
- carbon monoxide poisoning; and
- mental instability.

Effective first aid is an essential element of survival. However, diagnosis and treatment of ailments are complicated by a cold climate. In addition, cold temperatures will influence equipment and personnel to the extent that treatment outside a temperature controlled environment may be impractical.

Several types of people are more prone to cold injury:

- those suffering from circulatory disorders of the extremities;

- those with a history of cold injury;

- older persons and the injured, who have less capacity to increase their metabolic rate in response to cold stress;

- those who show signs of mental instability (instability can be aggravated by cold stress);

- women, who tend to have lower average skin temperature, greater surface heat loss, increased rates of extremity cooling and less capability for heat production by shivering or muscular exercise; and

- those in poor physical condition, who tend to have poor circulation and metabolic response to cold stress.

It is important that this varying susceptibility to cold injury be understood by everyone. If not, resentment can develop if people are perceived as being given special treatment. Tolerance to cold and susceptibility to cold injury are dependent on the body's ability to maintain a balance between heat generation and loss. Heat loss is a result of various mechanisms:

Conduction - When two objects are in contact, heat flows from the higher temperature object to the lower temperature object. Heat flow will continue until both objects are at the same temperature. Thermal conductivity varies in different substances, water conducts heat with about six times greater efficiency than air.

Convection - Convection is the transfer of heat between a surface and a fluid. Heat can be transported from the body by air or water current. Heat loss is dependent on the temperature and velocity of the fluid (air, water). The wind chill effect is due to convective heat loss.

Evaporation - Heat loss due to the vaporization of moisture (sweat) is the body's defense when thermal balance is not achieved by conduction and/or convection. Evaporation from the skin and respiratory tract normally accounts for 20% of total body heat loss.

Radiation - All living bodies convert part of their internal energy (heat) into electro-magnetic waves. The emission of these electro-magnetic waves constitutes heat loss to the body.

Respiration - Intake of cold air and expulsion of warm air during breathing results in heat loss from a combination of conduction and convection.

Heat production is primarily by means of three mechanisms:

Metabolic production - Metabolic action is the transformation of chemical energy into heat. Such heat production is derived from the combustion of food stuffs.

Shivering - Shivering is an efficient means of increasing heat production since, during peak shivering, the resting metabolic rate can at times be three to four times the norm. However, shivering when immersed will increase the overall heat loss since rapid muscular shaking will disturb the static boundary of still water and lead to an increase in heat exchange between a body and the water due to convection.

Exercise and work - Exercise and work increase the metabolic rate by 15 to 20 times. During muscular exercise, only 25 percent of the energy produced is converted to external work, the rest remains as body heat. For short-term survival, in the absence of appropriate insulation, exercise and work plus adequate food intake play an important part in preventing hypothermia and cold injury.

Maintaining health and comfort in a cold environment will depend on several actions:

Avoid sweating - Moist skin is a better conductor of heat than dry skin and, as a result, heat loss is greater from moist skin. Clothing should be ventilated when working or exercising and the body should feel comfortably cool as opposed to warm or hot.

Heat food and beverages - If food and drinks are warm the body will not expend energy bringing them up to core temperature.

Insulate the hands, feet and ears - The hands, feet and ears should be insulated. The fingers, toes and ears have an enhanced sensory response and, to a large extent, they influence a person's tolerance to cold. If these extremities are kept warm, the overall tolerance to cold stress is greatly increased.

Insulate the head and neck - At -4°C, at rest with proper clothing, heat loss from the head may be half of the body's heat production. The head is a good outlet for heat when a person is active, but must be well insulated when inactive.

Avoid alcohol - Alcohol is excessively cooling and can have narcotic mental effects such as sleepiness and euphoria; and loss of judgement, perception and ambition to fight the cold.

Avoid smoking - Smoking inhibits circulation and, therefore, reduces the blood supply to the extremities.

The following notes review each of the ailments that are likely to occur, and provide details of symptoms and treatment.

6.1 Trench Foot or Immersion Foot

Trench foot or immersion foot occurs when feet are immersed in water or are damp and cold (not freezing) for long periods of time. Although the feet are primarily affected, other body parts are susceptible. The onset of trench foot is accelerated by:

- tight fitting boots and clothing which restrict circulation;
- exhaustion;
- coldness;
- fatigue; and
- lack of food and drink.

The feet feel like they have pins and needles; numbness sets in, but is usually interspersed with sharp pains. As well, the feet appear purple with swelling and blisters. For prevention, the feet must be kept dry; boots and clothing must fit correctly and must not restrict circulation; legs and toes must be exercised and the feet must be inspected regularly. For treatment, the feet must be dried, elevated and kept warm.

> ***DO NOT massage or rub blisters as this can cause tissue damage and lead to infection.***
>
> ***DO NOT apply artificial heat as this will cause pain.***

6.2 Hypothermia

Normal body core temperature is in the range 35°C to 37°C. Hypothermia is a result of low core temperature. This occurs when the physical and chemical regulation of the body temperature does not keep pace with body cooling. As a result, the body cannot generate heat as fast as it loses it. Hypothermia can be caused by exposure to the wind, rain and low temperatures. Factors which aggravate hypothermia include:

- exhaustion, anxiety and mental stress;
- any injury that reduces the ability to produce heat;
- immersion in cold water;
- inadequate clothing and shelter;
- inadequate food intake; and
- lack of knowledge and preparation.

> ***Mild hypothermia - core temperature between 30°C and 35°C.***
> ***Moderate hypothermia - core temperature between 25°C to 30°C.***
> ***Severe hypothermia - core temperature less than 25°C.***

Transition from the normal to hypothermic state may not be easily detected. The symptoms are illustrated in Figure 46. Uncomfortable coldness and shivering can signal the onset of hypothermia, but are actually pre-hypothermic conditions: at temperatures below 35°C these symptoms are less pronounced. The symptoms of mild hypothermia include sleepiness and drowsiness, amnesia, loss of co-ordination and impaired judgement. The victim is unlikely to recognize the symptoms and, therefore, may not take corrective action. Unconsciousness is not common with mild hypothermia. Rarely have vital signs been found below a body core temperature of 20°C, and death usually occurs.

Advanced hypothermia may occur without local freezing.

The major signs and symptoms of hypothermia are:

- irrational behaviour: sudden bursts of energy followed by lethargy;
- loss of mental coordination: failing to respond to questions/instructions;
- uncontrollable fits of shivering;
- loss of physical coordination: stumbling and falling; and
- headaches, blurred vision, abdominal pains, collapse, stupor or unconsciousness.

Hypothermia can be avoided by conserving body heat and energy. Hot meals and liquids should be consumed; and clothing should not be permitted to become damp with perspiration. The core temperature should be monitored frequently and survivors should become familiar with the symptoms. Survivors in a group should watch each other carefully to ensure early recognition of symptoms.

Treatment may be described in three steps:

Prevent further heat loss - Seek shelter and do not allow any physical activity as this will carry cold blood from the periphery to the core, resulting in a temperature drop at the core.

Return of the body core temperature to within normal range - Warm compresses or heating units may be fashioned by placing warm water, if available, into canteens. Heating units should be wrapped in insulation to prevent burning the patient. If the number of heating units is limited, they should be placed in the following order: at the neck laterally over the carotid vessels; under the arms; and in the groin area, as illustrated in Figure 47. Any extra units should be placed in the pit of the stomach, small of the back, between the wrists, between the thighs and between the ankles. These are all areas where the blood is near the surface. If heating units are not available, the patient could be heated by the naked body of another person. The most practical manner to treat a victim of hypothermia is to put the person in a sleeping bag with another person, and feed him/her hot food, and liquids. If the victim is suffering from severe hypothermia, both people, or even three people, should be naked to increase the transfer of heat. However, some judgement must be exercised, as to whether or not, the initial stripping process in a cold environment may cause more damage. Climbing into a cold sleeping bag, naked, may also be detrimental.

If the patient is conscious - Stimulation may be helped by hot drinks and sugary foods. Do not force liquids on an unconscious person, there is a danger of suffocation.

After the start of rewarming, there can be a further 1°C to 2°C drop in core temperature as cold blood flows from the shell to the core area of the body. This is not significant if the initial core temperature is 30°C or greater.

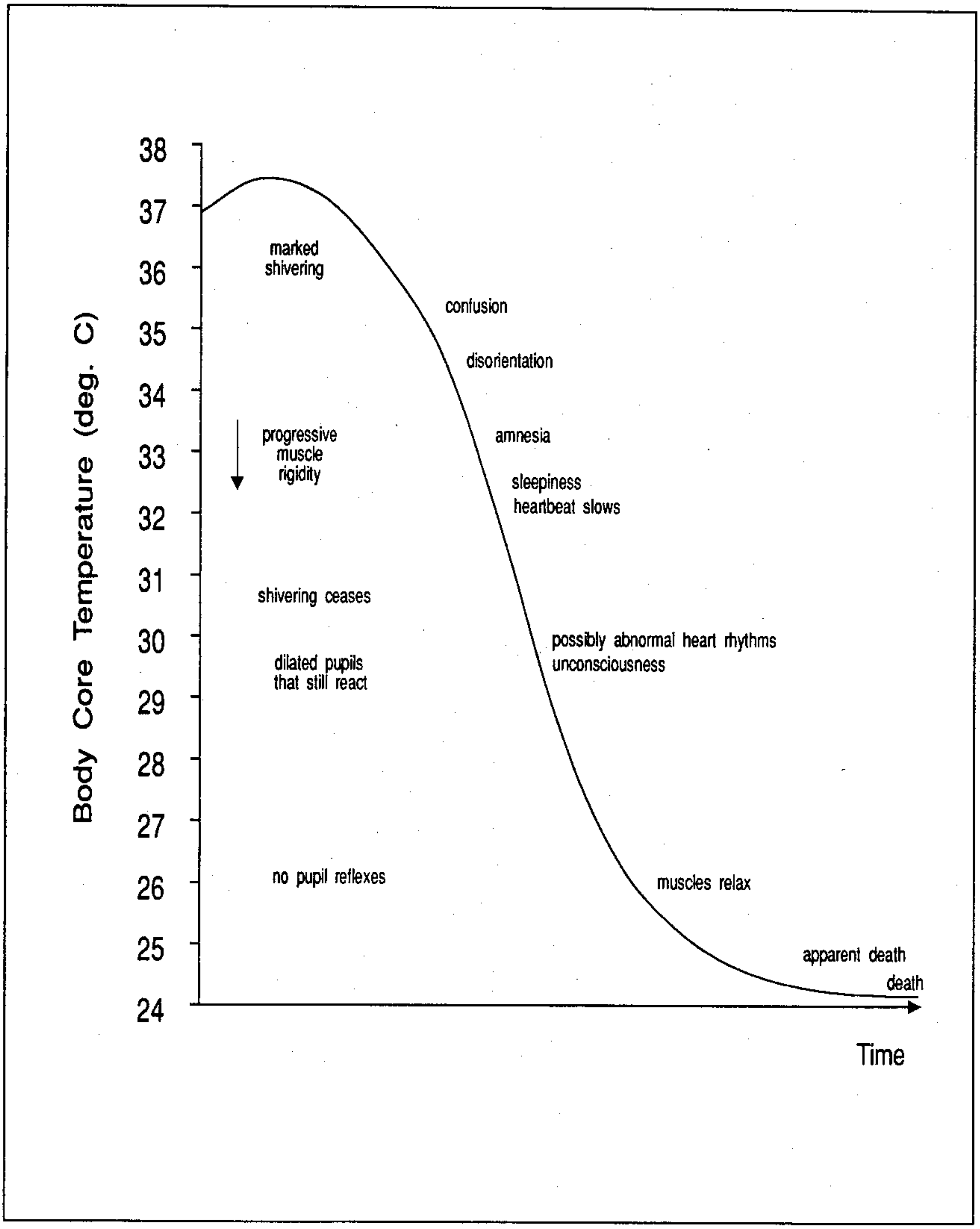
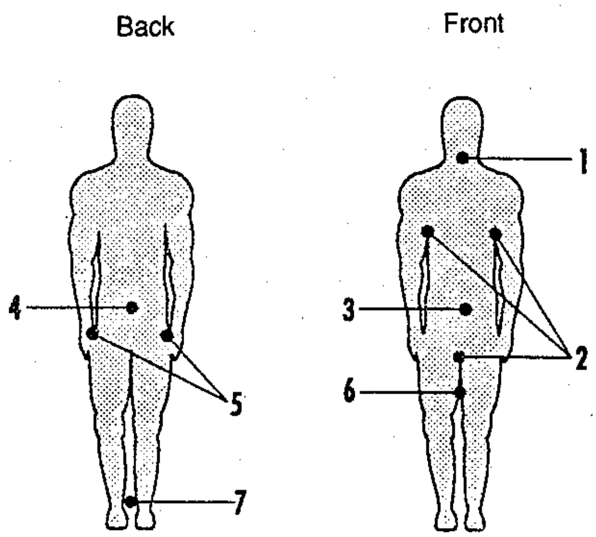


Figure 46. Symptoms of Hypothermia

NEVER give alcohol to a hypothermic patient; they may "feel" warmer temporarily but alcohol will cause the surface blood vessels to open up and warmth to escape lowering core temperature.



(1) neck laterally over the carotid vessels
(2) under the arms and in the grain area
(3) pit of stomach
(4) small of back
(5) between the wrists
(6) between the thighs
(7) between the ankles

Figure 47. Preferred Locations to Apply Heat to the Body

Accurate core temperature measurements are of great importance. In a survival situation, the best means available to assess body core temperature is likely to be with a rectal thermometer. However, temperatures taken from the mouth (under the tongue) give some indication of core temperature.

6.3 Frostbite

Frostbite occurs as a result of frozen skin and flesh. It can occur at a skin temperature of -1°C or lower. Extreme cold causes the blood vessels to contract to such an extent that insufficient blood and warmth reach the tissues. This contraction of blood vessels is dependent on temperature, wind-chill factor, duration of exposure and adequacy of protection. Frostbite can be classified into three degrees:

- **1st degree** - Freezing of the skin in small localized areas, sometimes referred to as frostnip, which can occur on the face, hands and feet but is most troublesome about the face, especially the nose, cheek and ears.

- **2nd degree** - Deeper penetration than frostnip, with larger areas affected.

- **3rd degree** - Ice crystals form in tissue deeper than the skin and its immediate area, occurring most often in the feet and occasionally in the hands, ears and nose.

The first stages of frostbite are usually accompanied by a prickling sensation followed by numbness. There is a blanching of the skin which appears waxy with a dull whitish or bluish colour. As sensation is lost, the person may be unaware of the frostbitten condition. If the face, hands or feet stop hurting, it probably means that frostbite has occurred. First degree is readily distinguishable: the skin is cold and frosty but soft and resilient; it remains elastic and moves freely over bony features (joints, knuckles, facial bones). With second and third degree frostbite, the skin loses its resilience and becomes hard.

For prevention, survivors must keep a constant surveillance of each other's faces for signs of frostbite; early detection will minimize tissue damage. The best way to prevent 2nd and 3rd degree frostbite is to avoid 1st degree frostbite. Early detection and quick remedial action against 1st degree frostbite is the best prevention against serious injury.

***DO NOT** get the hands wet with fuel; these fluids freeze below 0°C and will cause quick frostbite and freezing.*

***DO NOT** touch bare metal as this can result in the skin sticking to the metal with the resultant loss of tissue or quick frostbite.*

***DO NOT** smoke or drink alcohol.*

***DO NOT** become excessively mentally or physically fatigued as it can cause neglect of proper preventative measures.*

For treatment, the patient should be removed from exposure and provided with hot drinks, food and warm dry clothing (if available). The affected areas should be wrapped in a sterile dressing, covered warmly and kept as still as possible. Artificial respiration, stimulants and oxygen could be necessary in cases of prolonged exposure.

***DO NOT** use friction or rub with snow or anything else; this is both painful and dangerous to the tissue.*

Rapid warming by applying external heat may cause gangrene.

All cases of severe frostbite, especially after prolonged exposure, are serious and must receive medical aid as soon as possible. However, in the case of 3rd degree frostbite, it may be beneficial to keep the affected area frozen (and protect the surrounding areas) until rescue. While frozen, the pain is minimized and the patient is able to walk. If thawed, the patient will be a stretcher case.

It is essential to include some drugs in the survival pack, for improving blood circulation such as Trental. If survivors have frostbite, then they should be given Trental as well as Aspirin. It is also possible to use Trental for frostbite prevention during periods of very cold weather. If the patient has a wound, then the patient should be administered antibiotics. Naturally, the wound should be kept clean; the dressing should be changed twice a day.

6.4 Snow Blindness

Snow blindness is a temporary form of blindness caused by a concentration of direct or reflected sunlight from fresh snow, ice, or ice crystals in the atmosphere or open water. This ailment can occur at any time of year, but is most common during spring and early summer when the sun is high in the sky. Snow blindness can also occur in bright overcast periods. The potential for snowblindness is worse during overcast periods as the pupils are dilated more than during sunny weather, however, the ultra violet radiation is the same.

When the symptoms begin to occur, the eyes become very sensitive to the glare and begin squinting, blinking and watering; focusing becomes difficult; and vision ranges from a pink hue worsening to a red hue. If not checked, the eyes begin to feel as if they have sand and then ground glass in them.

If nothing is done to correct the situation, vision will be lost completely and the person will be in extreme pain for three to four days. Recurrent attacks of snow blindness can lead to permanent impairment of vision. Simple goggles can be made by cutting small slits in a piece of material and using it as a face mask. Glare can also be reduced by blackening the skin area beneath the eyes.

WEAR SUNGLASSES to prevent damage to eyes from snow blindness.

For treatment, the patient should be placed in a dark area or the eyes should be covered with a blindfold.

6.5 Shock

Shock is apt to occur after an accident and may appear in two forms:

- mental shock - panic, hysteria, mental anxiety and confusion.
- physical shock - resulting from body injury.

Mental shock is primarily due to lack of knowledge and fear. Unpreparedness: not knowing what to do or what to expect in a strange environment and/or situation, creates panic and confusion. Physical shock may be delayed by minutes or hours from the time of injury and is caused by pain, excessive nerve stimulation and/or the loss of blood. The symptoms and signs of shock are:

- quickening of respiration;
- state of collapse;
- extreme paleness of the skin;
- cold sweaty skin;
- muscle tension;
- feeble but rapid pulse; and
- confusion of mental processes (excitement, apprehension).

Mental shock can be prevented to some degree with training. If survivors know what to expect and what to do in emergency situations, mental shock can be largely eliminated. Mental shock should be treated with understanding, sympathy and reassurance. When dealing with shock patients, it is important to be calm and humane, not harsh and critical.

With physical shock, severe pain should be treated. Therefore, pain-relieving drugs should be administered if available. Appropriate actions should be taken to treat the injury that caused the shock. The loss of fluids should be stopped and fluids must be replenished. If there is bleeding from external injuries, it should be controlled, if possible, by elevating the wound and applying pressure bandages. Fluids lost due to sweating, vomiting and diarrhoea should be replaced to avoid dehydration: hot sugary drinks are best.

6.6 Anoxia

Anoxia is a deficiency of oxygen. Such a deficiency can be caused in a confined space by breathing or by combustion in a fire. As the oxygen becomes depleted within a closed space, suffocation occurs and can be fatal. All shelters must be ventilated.

6.7 Carbon Monoxide Poisoning

Carbon Monoxide is a byproduct of the incomplete combustion of fuels. All forms of fire and stoves are a potential cause. Carbon monoxide burns with a blue flame if complete combustion occurs. If a yellow flame is generated, the stove should be checked. Carbon monoxide can be fatal if found in the air in concentrations greater than 0.04%. Carbon monoxide is a colourless and odourless gas and is thus difficult to detect. Unless it is discovered promptly, the results will be fatal.

Great care should be exercised to ensure that shelters are adequately ventilated and that ventilation holes do not become blocked. If a candle is lit in the shelter and the flame gets longer and higher, this indicates a lack of oxygen.

NEVER leave lamps and stoves burning while sleeping.

The symptoms of both anoxia and carbon monoxide poisoning are: hyperventilation, slight headaches, dizziness, and drowsiness. Carbon monoxide poisoning may also be accompanied by nausea and vomiting.

For treatment, the patient should be removed to fresh air and encouraged to breathe evenly and regularly. If unconscious and not breathing, artificial resuscitation techniques should be used.

6.8 Mental Instability

Survival is dependent on physical and mental health. Mental strength and the will to live can overcome seemingly unsurmountable physical hardships. The two main enemies of mental health are fear and denial.

The reaction of individuals to a disaster varies from calm to irrational and psychotic behaviour. Training, instruction and regular drills on what to do and what to expect in a cold region survival situation will reduce the likelihood of irrational behaviour. Knowledge reduces the fear that occurs due to uncertainty, while training and drills condition a person to function automatically.

When abandoning a ship, people will feel unprotected and vulnerable. Panic does not normally occur but, if it does, it is often contagious. Training and knowledge will reduce the likelihood of panic. The normal psychological reaction to a disaster of this type follows a pattern of impact, recoil and post trauma:

Impact - The period of "impact" lasts until the initial events are over. Some of the crew will stay calm, be able to assess the situation, make a plan and act on it. Others will suffer from situational shock and be unable to contribute effectively to the survival effort. Some will show inappropriate behaviour such as confusion, uncontrolled weeping, screaming and paralysed anxiety. Some will become hyperactive and be unable to concentrate on one job for long. They are often full of suggestions and ideas, many of which are inappropriate. Hyperactivity is often followed by depression.

Recoil - The period of "recoil" begins when the initial danger has passed. There is a return of reasoning ability, awareness, recall and emotional expression. Those suffering from recoil will often show a child-like attitude of dependency and a need to be with others. Many will become withdrawn while others will have a strong desire to ventilate their feelings, often in an unreasonable manner. Denial of what is happening is common, which often leads to apathy and a preoccupation with irrelevant details.

Post trauma - The period of "post trauma" can begin before rescue, with the victims displaying symptoms of psychiatric illness. The symptoms can include: anxiety, depression, guilt, nightmares and psychosomatic disorders.

Some practical factors which help maintain mental health are:

Maintain a good survival attitude - Try to ignore hardships: the mind can be occupied by concentrating on improving the situation. For example, if the feet are cold, do not sit still and complain - get up and exercise.

Organize manpower - Assign specific tasks and responsibilities to individuals. This builds morale and fortifies the feeling that things are under control. Also, individuals develop a desire not to let the group down.

Quickly treat hysteria and depression - If someone has become hysterical or depressed, make special efforts to calm or reassure them. These mental states are contagious: the effects on the rest of the survival group can be extremely detrimental.

Be ingenious - The single most valuable survival tool is human ingenuity. Encourage group discussion and accept suggestions and criticisms as this keeps the mind sharp. Direct thoughts towards improving the situation. Even simple things such as making a checkers board out of empty ration packs can go far to improve morale.

Have confidence - Have confidence in the equipment and training. The equipment has been specially designed and selected and the survival techniques learned in training or by reading the survival manual are time proven methods which have saved lives.

Have faith in rescue - Rescue is just a matter of time.

6.9 Summary

Health problems in a survival situation can be life threatening. However, proper training can make the crew aware of how to diagnose and treat the most common ailments of survivors in cold regions. The medical kit supplied in lifeboats and liferafts will be useful, as will the medical supplies in an Arctic Survival Pack, but an understanding of how to deal with injured personnel is equally important.

CHAPTER 7 VEGETATION AND WILDLIFE

There are a variety plant and animal species in the cold regions of Canada which may provide sources of food, although it is unlikely that the need to harvest them will arise. Even if rescue takes more than seven days, it is likely that air support will be available within several days of ship abandonment. For general interest, however, the following sections describe the features of vegetation and wildlife which might be of use to survivors.

7.1 Vegetation

Arctic vegetation around the coastline, except where the Boreal Forest touches the western edge of the Beaufort Sea, is characterised as Arctic and Alpine Tundra. In the High Arctic, vegetation is sparse because the growing season is only two to three months (June to August), and the precipitation is only 100 to 200 millimetres each year. In the lowlands, small areas of sedge moss tundra occur, decreasing in extent north of 74°N. About 50 percent of the land consists of scattered clumps of 1 to 3 centimetres tall dwarf shrubs of willow and mountain avens, with small cushion plants (species of draba, saxifrage, chickweed, poppy), and abundant lichens and mosses. There are other areas of nothing but lichens, mosses, scattered clumps of grasses and rushes, and cushion plants. At higher elevations (above 100 metres) in the southern and central Arctic islands and at very low elevations in the northerly islands, the profusion of frost shattered rock and small pockets of fine soil result in truly barren land (polar desert). Here, flowering plants and mosses grow only where snow banks provide sufficient melt water. Elsewhere, only tiny scattered flowering plants grow with essentially no lichens or mosses.

The characteristic of the Low Arctic is the nearly complete plant cover and large numbers of low and dwarf woody shrubs. The major plants include:

- 2 to 3 metre tall shrub tundra of alder, scrub birch and willows around water and along water courses;
- 30 to 60 centimetre shrub tundra of willow, dwarf birch and dwarf heath shrubs;
- numerous sedges and small herb species;
- many lichens and mosses on the poorly drained soils of rolling hills; and
- a few grasses.

None of the woody species are large enough for use in construction. Heather and berry bushes, stunted willow, alder and ground birch are used by Inuit for cooking purposes. Of greatest importance are crowberry and white heather which are found nearly everywhere in the Arctic. White heather is rich in resin and will burn even when moderately wet. Nearly all large species of lichen are highly inflammable when dry and are useful as fuel. Raw peat, particularly heath turf, but also partly decomposed sphagnum moss, is available nearly everywhere in the Arctic.

Most vegetation can be eaten, although its calorific value as food is not high. Anything that is not bitter or is eaten by animals is almost certainly safe to eat. Initially, however, only small quantities should be eaten.

Generally, it is difficult, but possible, to find and gather vegetation when the ground is covered with snow. However, the tracks of animals that forage for foodstuffs may indicate where to look.

The following plants, illustrated in Figure 48, are safe to eat. Poisonous plants, illustrated in Figure 49, are dangerous to eat.

Flowers and greens - The flowers of most plants in Canada are safe to eat, either boiled or raw. Some delicious edible greens are:

- dandelion leaves;
- bracken fronds or fiddleheads;
- the lower tender inner 30 centimetres of cat tail or Bulrush stalks;
- young green Milkweed pods;
- young Water Lily pods;
- Pigweed;
- the young leaves of the Stinging Nettle;
- the leaves and flower stalks of Cow Parsnip; and
- the flower stems of the Woolly Lousewort.

The leaves of Labrador Tea, a shrub-like growth found on practically all muskeg areas in Canada, can be steeped to produce a stimulating beverage.

Roots - Roots such as Cattail, Wild Carrot and Liquorice can provide starch and protein. The roots of cattail are available both in summer and winter and are best when boiled. Other common and edible roots are Bracken, Vetch, Tiger Lily, Lady's Slippers, Pond Weed, Nutgrass and the tubers of the Arrowhead plant.

Berries - Edible berries are too numerous to identify individually. Blue and black berries, not in clusters, are generally safe to eat. Red and white berries should not be eaten unless they are known to be safe.

Lichens and mosses - Lichens and mosses can be boiled or dried and ground into a powder for use in soup. A common edible lichen is the lemon lichen and a common edible moss is the reindeer moss.

Mushrooms - Although some mushrooms are edible they are not high in nourishment. Since some are poisonous, mushrooms should not be eaten unless known to be safe.

Many species of fleshy fungi are found in cold regions but none are used by the indigenous people. In Greenland and Baffin Island, some green and red marine algae (dulse or sea lettuce) are eaten when food is scarce. In Greenland, the succulent young stalks of angelica and the leaves of sorrel are eaten. In Alaska, the leaves of saxifrage and the tubers of the "Eskimo potato" are commonly used. Several kinds of berries, including the crowberry, cloudberry or "bake apple" and bog bilberry, when available, are used by the Inuit.

In addition to plants which grow on land, seaweeds and algae can be eaten. However, information on the seaweeds and algae to be found around the Arctic shores is not readily available. Seaweeds or fresh-water weeds can only be harvested when there is open water, usually during the summer months in most locations.

Seaweeds are rich in minerals and vitamins and are an ideal survival food. Most varieties of seaweed are found in shallow waters, anchored to the bottom or to a rock, but there are some that float on the surface. Coastal weeds are usually found stratified with the green forms growing in surface waters, red in shallow water and brown in deeper waters.

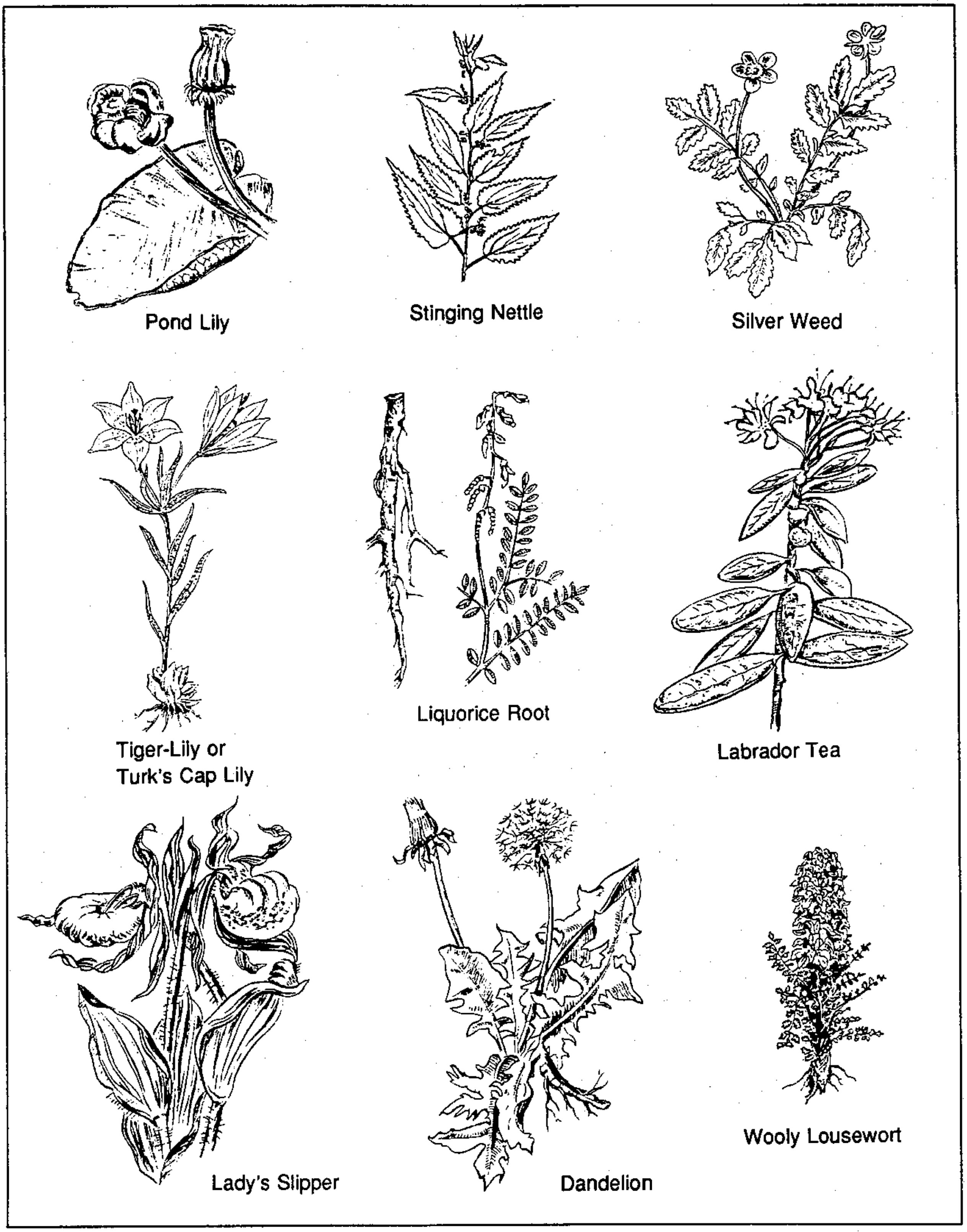


Figure 48. Illustration of Edible Plants

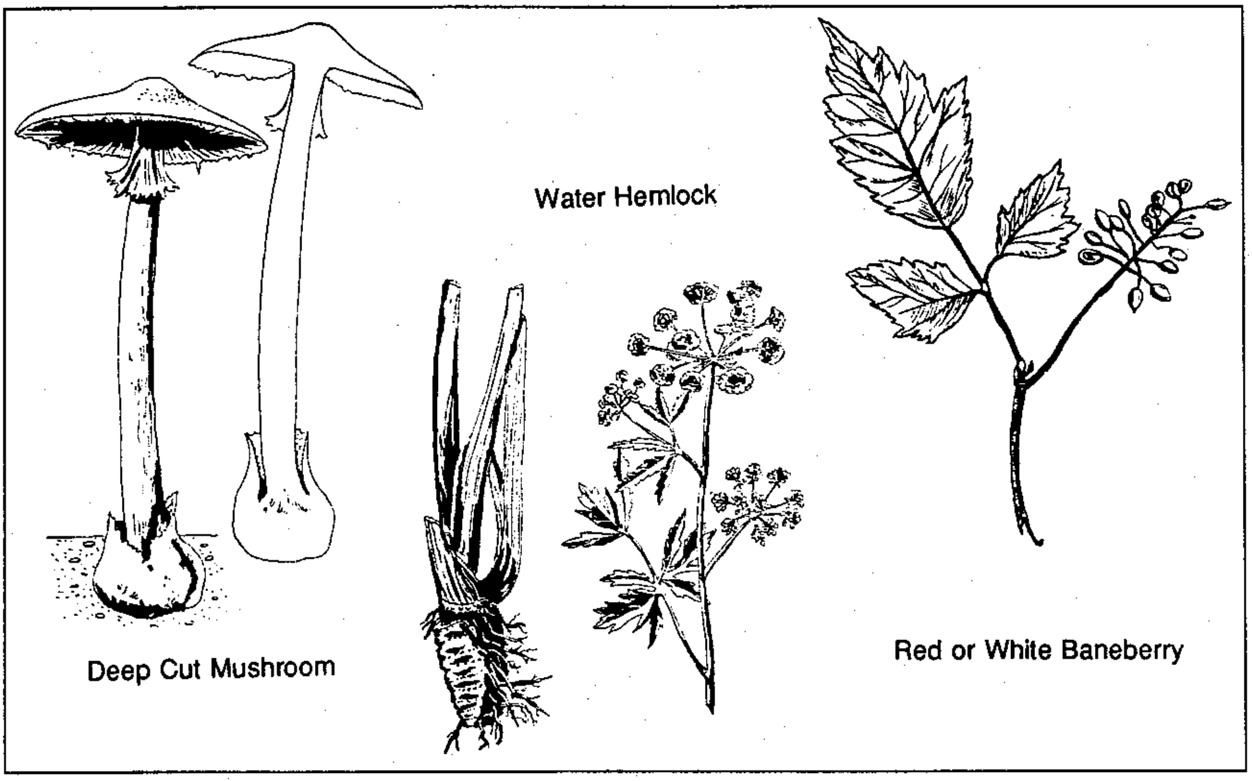


Figure 49. Illustration of Inedible Plants

There are no poisonous seaweeds, but some contain acids which irritate the digestive tract and some are violent purgatives. If unsure that a weed is edible, only a little should be eaten at first. Even with the edible varieties, it is advisable to eat only small quantities at first. SEAWEED SHOULD NOT BE EATEN IF WATER IS IN SHORT SUPPLY. The weeds should be washed in freshwater to remove some of the salt and many may be eaten either fresh or boiled.

Only growing weeds should be collected. Any weeds found washed up on the shore should be rejected, as all seaweeds decay rapidly when out of water. All weeds which smell bad should be rejected. Some of the weeds which contain irritating acids can be detected by crushing them between the fingers and leaving for five minutes, by which time they will give off an unpleasant smell.

Algae is recognizable as it forms green jelly like globules in pools. Bright green, fresh looking algae is normally safe to eat, but any blue/green fresh water algae with a gassy smell which is found in stagnant freshwater pools can be poisonous.

7.2 Wildlife

Wildlife can be divided into four groups:

- marine mammals, which include seals and whales;
- land mammals which include small rodents, foxes, coyotes, wolves, bears, caribou, musk-ox and the occasional moose;

- birds; and
- fish.

Some animals are impractical as a source of food, such as whales and bears. Other animals are unlikely, such as the larger land and marine mammals such as musk-ox, caribou, moose, walrus and the larger seals. This leaves the smaller animals such as rodent, foxes, small seals, birds and fish.

a) Marine mammals

There are five varieties of seal common to the Arctic:

- the bearded seal;
- the ringed seal;
- the harp seal;
- the hooded seal; and
- the walrus.

Only the bearded and ringed seals stay north for the winter. The bearded seal weighs up to 270 kilograms. The ringed seal is much smaller, weighing only about 68 kilograms. In the winter, these seals make a small hole in the ice and come to the surface to breathe. It may be possible to kill a seal when it comes to the surface. However, they are very sensitive to any movement on the ice and will go to another breathing hole at the slightest suspicion of danger. These animals are almost impossible to hunt without a rifle and, therefore, may not have much relevance to marine crew survival.

b) Land mammals

Many species of land mammals live in cold regions. The larger mammals such as caribou, musk-ox, bears and the occasional moose in the southern Arctic, cannot be hunted without a rifle. Smaller mammals can be trapped to augment survival rations. Several mammals may be found in coastal regions of the Arctic:

Shrews - Several different varieties of this mouse like creature live on the tundra.

Hares - The Arctic hare is a large heavy-bodied animal found north of the tree line, on the tundra and in the archipelago. This hare has even been sighted on the ice several kilometres from the nearest land.

Squirrels - There are several species of squirrel living in the Arctic, but only the Arctic ground squirrel, or siksik, inhabits the continental tundra. All other varieties live inland or in the Boreal regions. The squirrel hibernates during the winter months.

Mice, voles and lemmings - These are of the same species and are found throughout the Arctic and, in the case of the collared lemming, as far north as the Queen Elizabeth Islands.

Wolves and foxes - Different species of wolves and foxes are found throughout the Arctic, as far north as the Queen Elizabeth Islands.

Weasels - The only weasel to live north of the tree line is the circumpolar ermine or stoat. These animals live on mice, voles and other small mammals.

Wolverines - This is a large species of weasel that grows to the size of a bear cub. It is distributed throughout the tundra, including the Arctic archipelago to Ellesmere Island. It is known throughout the north as an omnivorous camp robber. Wolverines have a reputation of being very fierce and are probably better avoided.

c) Birds

The cold region coasts are frequented by a variety of sea birds. They include the Arctic tern, fulmar, herring gull, thick billed murre, common and king eider duck, Thrayer's gull, glaucous gull, Atlantic brant, snow goose and jaeger. Edible birds are an important food to the indigenous peoples.

In the spring and summer, the cold region bird population is immense. One-fifth of the continental population of ducks, geese and swans nest in the Arctic. Although about 65 species of birds summer in the high Arctic, fewer than six species live there year round. Far northern resident birds include species such as the snowy owl, rock ptarmigan, gyrfalcon and common raven. These birds are comparatively large when compared to southern birds. Northern birds also tend to have more fat than southern species. During cold weather, birds usually seek to create a micro climate by sheltering in holes in vegetation, in the snow, in cliffs or by seeking open water.

d) Fish

There are fewer varieties of fish in cold region waters than in temperate regions. The fish also grow more slowly due to the cold and the absence of sunlight. There are a number of species which are fished commercially in northern waters although there are few species of fish which inhabit the Arctic Ocean. The principal species of sea water fish to be found include:

The cod family - Found almost exclusively in the Arctic Ocean, the Polar cod prefers very cold water and is often found among ice floes near shore or in the layer of water just below the sea ice. Polar cod grow to about 30 centimetres. Freshwater cod are found in the Arctic but are not used as food fish by the native people.

The lamprey family - These are not true fish and are not normally considered to be edible. This species is found in the Beaufort Sea and in the western river systems.

The salmon and trout family - The Arctic char is distributed throughout the north from Baffin Island to the Yukon border. These fish spend the summer in the ocean and the winter in the freshwater which flows into the Arctic Ocean or Hudson Bay. The average weight of sea-run char is 2 to 5 kilograms, but they can grow to 15 kilograms; landlocked char are smaller. The Dolly Varden is a close relative of the Arctic char and is found only in the western region.

The sculpin family - These fish are found in the Arctic Ocean and a smaller freshwater variety inhabit coastal areas. The fish are grotesque looking with large bony heads. These are not food fish although can be eaten if caught.

The flatfish family - These are edible sea water fish with many species which share common names such as sole, turbot, halibut, etc. Three species are found in the Arctic: the flounder, starry flounder, and the Greenland halibut. The Greenland halibut is found in the north Atlantic off the coast of Greenland and Baffin Island; it is a deep water fish and grows to over 10 kilograms.

The lumpfish family - Three species of lumpfish are found in the Arctic; the lumpfish, in Hudson Bay; the leatherfin lumpsucker, in Hudson Bay and Hudson Strait; and the Atlantic spiny lumpsucker found in many locations throughout the Arctic. They inhabit rocky water in fast flowing currents. Despite their appearance, these fish are considered to be good to eat.

CHAPTER 8 CANADIAN SEARCH AND RESCUE SYSTEM

The conclusion to an on ice survival situation is the Search and Rescue (SAR) operation. This operation usually consists of three phases: alert, deployment and evacuation.

8.1 Organization

It is impractical to have air resources at every airport and marine resources constantly patrolling every bay and inlet of Canada's 244,000 kilometre coastline (longest coastline in the world). The practical solution is to make the best possible use of available Search and Rescue resources through an organization which effectively coordinates the deployment of those resources in an emergency. With this in mind, the Canadian government established the National Search and Rescue Secretariat (NSS) to assess the need for Search and Rescue services throughout Canada and to help ensure that the entire operation functions effectively and efficiently. The National Search and Rescue Secretariat is responsible to the Interdepartmental Committee on Search and Rescue (ICSAR). The main members of this committee are the Departments of National Defense (DND), the Royal Canadian Mounted Police (RCMP), the Departments of Energy, Mines and Resources and the Department of Indian and Northern Affairs.

Focal points of the Search and Rescue organization are the Rescue Coordination Centres strategically located at: Halifax, Nova Scotia; Trenton, Ontario; Edmonton, Alberta and Victoria, British Columbia. Similar to wartime operations rooms, these centres are staffed around the clock by Canadian Armed Forces and Canadian Coast Guard rescue controllers whose main function is to initiate and coordinate a Search and Rescue operation with the least possible delay. The Rescue Coordination Centres provide a fast response to local emergency situations. In addition to the Rescue Coordination Centres mentioned above, the Canadian Coast Guard operates two Marine Rescue Sub Centres with similar functions.

The Canadian Armed Forces are responsible for coordinating all search and rescue activities in Canada and its adjacent ocean areas. This includes full responsibility for Search and Rescue related to air incidents and the dispatch of resources related to marine incidents. The specially equipped Search and Rescue air squadrons, composed of helicopters and fixed wing aircraft, are all on-call 24 hours a day. These aircraft provide a rapid response to incidents and have the ability to search over a large area if the location of the distress call is not known immediately. They can also parachute in emergency supplies and trained personnel in response to an SOS message from an aircraft or a ship.

On the marine side, the Canadian Coast Guard fleet provides full time Search and Rescue ships of different sizes and types at numerous locations in Canada. Many of these ships, including offshore and inshore cutters, launches, lifeboats and hovercraft, are assigned solely to Search and Rescue work. All other Canadian Coast Guard vessels have a secondary role of Search and Rescue.

The Department of Fisheries and Oceans (DFO) operates a large fleet of fisheries patrol, research and survey ships, a number of which are "multi-tasked" for Search and Rescue operations. This means that these vessels can combine their regular tasks with search and rescue duties. They can carry additional equipment such as portable water pumps, radio direction finding equipment and illumination flares for night searches. A distinctive orange and yellow flag is flown when multi-tasked vessels are on Search and Rescue duty.

In addition to these Search and Rescue resources, any of the more than 500 federal government vessels and approximately 350 government owned aircraft may be directed to take part in a Search and Rescue operation should the need arise.

8.2 Alert Phase

The time lapse between the occurrence of an incident and the Rescue Coordination Centre being alerted to the incident is dependent on the situation and environmental factors. Various means by which the Rescue Coordination Centre may be alerted are:

- A distress signal on an emergency frequency is received and acknowledged by a neighbouring vessel which in turn relays the message to the nearest Rescue Coordination Centre. In the Arctic, the scarcity of marine traffic can preclude this normal approach.

- An emergency radio such as an Emergency Position Indicating Radio Beacon (EPRIB) is activated and picked up by satellite. The COSPAS - SARSAT program developed by Canada, France, United States and Russia is an international satellite system which covers all of North America in a bi-polar orbital pattern. Each of the four satellites circle the earth in polar orbit about every 100 minutes, thus ensuring the signals are received frequently. In Canada, because of the congruence of satellites at the pole, signals are likely to be picked up within an hour of transmission.

- The failure of a ship to maintain a scheduled progress report transmission or failure to show up on time at an intended destination will alert the operator's shore personnel of a potential problem. In turn, the Rescue Coordination Centre will be alerted.

All of these methods will alert the Rescue Coordination Centre of the occurrence of an incident. The Rescue Coordination Centre will carry out a communication search and, subsequently, dispatch air or marine resources to the distress site (deployment phase).

8.3 Deployment Phase

Once the certainty of a distress situation has been established, the appropriate Search and Rescue resources will be deployed. For marine incidents, in addition to established resources, vessels of opportunity in the distress region can also be assigned to the case. In the event of a marine emergency in the Arctic, CC 130 aircraft (Hercules) will likely be dispatched from Edmonton, Alberta or from Greenwood, Nova Scotia. From either dispatch point, these aircraft should be overhead within 12 hours. These aircraft are equipped with equipment that can be dropped from the air and Search and Rescue parachutists capable of providing emergency medical care and survival support in the form of shelter, heaters, generators, etc.

Although every effort will be expended to provide immediate response, some unexpected delays are inevitable when faced with mechanical or environmental barriers due to extreme climatic conditions.

8.4 Evacuation Phase

The accessibility and availability of resources invariably plays a role in how fast the evacuation is carried out. In the summertime, during the open water shipping season, ships and helicopters can be readily available. In the winter time, on the other hand, evacuation is more complex and might require transporting a disassembled helicopter, in a CC 130 aircraft, then reassembling it at an airport close to the distress site. Reassembly and test flight can be accomplished within 5 hours of landing. It is important for survivors to understand that instantaneous response is impossible and that, even if it is not obvious at the distress site, dedicated personnel are striving to provide for an expedient, effective and safe rescue operation.

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