BASIC MEMBER GUIDE

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of the
Southwest Virginia Mountain Rescue Group
APPALACHIAN SEARCH AND RESCUE CONFERENCE

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The Incident Command System

The Incident Command System was developed through a cooperative inter-agency (local, State, and Federal) effort. The basic organizational structure of the ICS is based upon a large fire organization which has been developed over time by Federal Fire protection agencies. The essential differences are that ICS is designed to be used for all kinds of emergencies, and is applicable to both small day-to-day situations as well as large and complex incidents.

Management Principles and Concepts

The Incident Command System has a number of critical management concepts. These components working interactively provide the basis for an effective ICS.

1. ***Common Terminology***

   It is essential for any management system, and especially for one which will be used in joint operations by many diverse users, that common terminology be established for the following elements:

   a. Organizational Functions

   b. Resources

   c. Facilities

   Organizational Functions A standard set of major functions and functional units has been predesignated and named for the ICS. Terminology for the organizational elements is standard and consistent.

   Resource Elements Resources refer to the combination of personnel and equipment used in tactical incident operations. Common names have been established for all resources within ICS. Any resource which varies in capability because of size or power (i.e. a helicopter) is clearly types as to capability.

   Facilities Common identifiers are used for those facilities in and around the incident area which will be used during the course of the incident. These facilities include such things as the Command Post, Incident Base, Staging Areas, etc.

2. ***Modular Design***

   The ICS organizational structure develops in a fashion based upon the kind and size of the incident. The organization's staff builds from the top down with responsibility and performance placed initially with the Incident Commander. As the need exists, four separate sections may be developed, each with several support units which *may be* established. These four sections, along with the Incident Commander, represent the five major functions of the ICS; command, planning, operations, logistics, and finance (though in SAR, rarely will finance be needed). The specific organizational structure established for a given incident will be based on the management needs of the incident. If one individual can manage all functional areas, no further management is needed. If one or more areas require independent management, an individual is named to be responsible for that area

For ease of reference and understanding, personnel assigned to manage at each level of the organization will carry a distinctive organizational title:

Incident Command	- Incident Commander
Command Staff	- Officer
Section	- Section Chief
Branch	- Branch Director (Optional Level)
Division	- Division Supervisor
Task Force	- Leader
Strike Team	- Leader
Unit	- Unit Leader

In the ICS, the first management assignments by the Initial Attack Commander will normally be one or more Section Chiefs to manage the major functional areas. Section Chiefs will further delegate management authority for their areas only as required. If the Section Chief sees the need, functional units may be established within the Section. Similarly, each functional Unit Leader will further assign individual tasks within the Unit only as needed.

A fully developed ICS organization with all the units designated is located on page 8. The follow section (starting on page 9) describes the build-up of the ASRC ICS organization through a series of examples.

3. *Span of Control*

Safety, as well as sound management planning will both influence and dictate span-of-control considerations. Generally the best supervised grouping would be from three to seven individuals, crews, units, engines, etc., with five being the rule of thumb. Of course there will always be exceptions (i.e. an individual Field Team Leader will normally have more than five personnel under supervision).

The nature of the incident, the nature of the task, hazard and safety factors, and distances between elements will all influence span-of-control considerations. An important consideration in span-of-control is to anticipate change and prepare for it. (An example would be a lack of enough trained Field Team Leaders due to unanticipated numbers of local volunteers.) This is especially true during the rapid build-up of the organization when good management is made difficult because of too many reporting elements.

4. *Management By Objectives*

Management by objectives is a "topdown" procedure for obtaining desired results. Strategic objectives on larger incidents are written and are available for all incident participants to see. Sections, given the overall Incident Objectives will identify specific objectives and tasks for their functional units.

5. *Unified Command*

The need for a unified command is brought about because:

- Incidents have no regard for jurisdictional boundaries. Wildland fires, search and rescue incidents, floods, and earthquakes usually cause multi-jurisdictional major incident situations.
- Individual agency responsibility and authority is normally confined to a single jurisdiction.

The concept of unified command simply means that all agencies who have a jurisdictional responsibility at a multi-jurisdictional incident contribute to the process of:

- Determining overall incident objectives.
- Selection of strategies.
- Ensuring that joint planning for tactical activities will be accomplished.
- Ensuring that integrated tactical operations are conducted.

- Making maximum use of all assigned resources.

The proper selection of participants to work within a unified command structure will depend on:

- The *location* of the incident - which political jurisdictions are involved.
- The *kind* of incident - which functional agencies of the involved jurisdiction(s) are involved.

6. ***Consolidated Action Plan***

Every incident requires some form of an action plan. Small, single jurisdictional incidents may only require the action plan to be in the mind of the Incident Commander. Large multi-jurisdictional incidents, however, will require a written plan covering all aspects of the incident. The following are examples of when written action plans should be used:

- When resources from multiple agencies are involved.
- When several jurisdictions are involved.
- When the incident will require changes in shifts of personnel and/or equipment.

The Incident Commander will establish objectives and make strategy determinations for the incident based on the requirements of the jurisdiction. In the case of unified command, the incident objectives must adequately reflect the policy and needs of the jurisdictional agencies.

The action plan for the incident should cover all tactical and support activities required for the operational period.

7. ***Integrated Communications***

An important part of planning for a major multi-jurisdictional incident in NIIMS is the use of a common communications plan among all participating agencies. This plan is needed to tie together the tactical and support units of the various agencies and to maintain communications discipline, especially in the use of radios.

All communications between organizational elements at an incident should be in plain English (clear text). No codes should be used, and all communications should be confined to essential messages.

8. ***Designated Incident Facilities***

There are several kinds and type of facilities which can be established in and around the incident area. The determination of the kinds of facilities and their locations will be based on the requirements of an incident and the direction of the Incident Commander. The following facilities are defined for possible use with the ICS:

Command Post

Designated as the CP, the Command Post will be the location from which all incident operations are directed. There is **only one** Command Post for an incident. In a Unified Command Structure where several agencies or jurisdictions are involved, the responsible individuals designated by their respective agencies would be co-located at the Command Post. The planning function is also performed at the Command Post, and normally the Communications Center would be established at this location. he Command Post may be co-located with the Incident Base if communications requirements can be met.

Incident Base

The Incident Base is the location at which primary support activities are performed. The Base will house all equipment and personnel support operations. The Logistics Section, which is responsible for ordering all resources and supplies, is also located at the Base. Normally the Base will not be moved during the course

of the incident. If possible, Incident Base locations should be included in pre-plans.

Camps Camps are locations from which resources may be distributed to better support incident operations. At camps, certain essential support operations (e.g. feeding, sleeping, sanitation) can be maintained. Also at camps, minor maintenance and servicing of equipment can be done. Camps can be relocated if necessary to meet tactical operations requirements.

Staging Areas
Staging areas are established by the Operations Section Chief for temporary location of available resources **on three minute notice**. A Staging area can be anywhere personnel and equipment can be temporarily parked awaiting reassignment. It may include temporary field kitchens and sanitation facilities. The Operations Chief may establish, move, and discontinue the use of Staging Areas.

Helibases Helibases are locations in and around the incident are where helicopters may be parked, maintained, fueled, and loaded with personnel and equipment. Once established at an incident, an helibase will usually not be moved.

Helispots Helispots are temporary and less used locations where helicopters can land, take off, and in some cases load equipment or personnel.

9. *Management of Tactical Resources*

Resources are defined as all personnel and major items of equipment available, or potentially available, for assignment. Resources may be managed in three different ways, depending on the needs of the incident.

- **Single Resources**: These are individual pieces of equipment that will be assigned as primary tactical Units. An example would be a search helicopter, or night vision equipment. A single resource will be the equipment plus the individuals required to properly utilize it.

- **Task Forces**: A Task Force is any combination of resources with common communications and a common leader. Task Forces can be predesignated to meet local needs.

- **Strike Teams**: Strike teams are a set number of resources of the same kind and type, which have an established minimum number of personnel. Strike Teams will always have a leader and will have common communications among resource elements. Strike teams will generally be made up of hasty teams, dog teams, or grid teams.

- **Status Conditions**: In order to maintain an up to date and accurate picture of resource utilization, it is necessary that all resources be assigned a current status condition. Three status conditions are established for use with tactical resources at the incident.

  a. Assigned - performing an active assignment

  b. Available - ready for assignment. All resources in a staging area should be available.

  c. Out-of-Service - not ready or available for task assignment.

  All changes in location and status condition must be made promptly to the Operations Section.

  Duties of the TASK FORCE/STRIKE TEAM Leader

  The Task Force/Strike Team leader reports to a Division Supervisor and is responsible for performing tactical assignments assigned to the Strike Team/Task Force. The leader reports work progress, resource status, and other important information to the Division Supervisor.

  Specific Duties include:

  - Obtaining briefing from the Division Supervisor.

- Reviewing assignments with subordinates and assigning tasks
- Monitoring work progress and making changes when necessary
- Coordinating activities with adjacent strike teams, tasks forces, and single resources.
- Submitting situation and resources status information to Division Supervisor
- Maintaining unit log (ICS form 214)

Building the ICS Organization

Most incidents never reach a point which will require a major expansion of the Incident Command System into a full incident organization.

However, many incidents do grow beyond the point where a single agency can handle the situation with its own resources -- and a few of these incidents may become very large and complex multiagency and often multijurisdictional situations.

The Incident Command System of the National Interagency Incident Management System (NIIMS) is designed for day-to-day use by a single agency in small and routine response situations as well as in the very large and complex multiagency situations. The organization of the ICS builds from the "bottom up" so that it may be used effectively used regardless of the number of resources involved.

This type of flexibility to expand (and to contract) the organization was included within the design in order to provide a single common system which does not require major changeover or transition into a different operating system during the incident.

The following examples show how the ASRC may implement the ICS in its initial response, and how the system may build to meet the demand as the situation requires. However , it is important to remember that most incidents are controlled with initial attack or reinforcement resources. **Very seldom** will the full organization be necessary.

Lost Person Search

General

Lost person search has been neglected in many areas, including Virginia. It is often seen as a series of motions that none like, but which must be gone through to find a body in the woods. A quote from the **National Association for Search and Rescue** Search Management course is brought to mind, "the Unqualified have been coordinating the Unwilling to do the Unnecessary with the Obsolete"! The attitude in many areas is that of, "head 'em off at the pass", or worrying about the problem only when it actually happens.

To be able to to save the lives of lost people through effective, efficient search operations, several things are needed. They are:

1. Trained and experienced search managers.
2. Adequate preplanning for searches.
3. Trained and experienced searchers.

This chapter will discuss several of the facets of the lost person search, with the aim of providing a basic understanding of such search operations. Further information on search theory and strategy may be found in Kelley's ***Mountain Search for the Lost Victim.*** Details of operational procedures may be found in the ***Search and Rescue Operations Plan*** (SAROP) and ***Operations Manual*** of the Appalachian Search and Rescue Conference, Inc.

Search Theory

One of the requirements for effective and efficient searches is having good **search managers**. The title (Mission Coordinator, Search Boss, On-Scene Commander) doesn't matter, as long as the management function is being carried out. Why is such a manager needed? To provide leadership, management, make critical decisions, direction for others, and to use feedback to keep the operation functioning smoothly. What kind of qualifications should he have? He should have proven ability to run searches, detailed knowledge of the theory and practice of search operations, willingness to serve when needed, acceptance by the people he will be bossing, and the humility to admit that he is not all-powerful in knowing how to find the victim. (After all, if he knows where the victim is, why is everyone else out searching?)

The search manager should be able to:

- Establish objectives
- Establish priorities
- Evaluate resources
- Develop a plan of attack
- Coordinate efforts
- Evaluate results

- Develop new plans

Another critical requirement for effective, efficient lost person search is **pre-planning**. Such pre-plans must include careful delineation of authority and responsibility for SAR, agreements between SAR agencies and organizations, arrangements for effective communications during missions, standards of training and competence, standards of procedure, and other related items. One of the important parts of the pre-plan is a listing of SAR resources in the community, along with detailed information about the capabilities and specialties of each.

The first stages of a search are often the most critical. ***Information*** is the key to an effective search. Things that must be found out include a victim description, circumstances concerning the disappearance, information on which to base an evaluation of the urgency of the search, set tasking priorities, and alert searchers about possible clues and victim behavior. Once this initial information is available, the search manager must develop a **search plan**. The plan must answer the following questions:

1. Where is the subject? Possible answers might be on the basis of past case histories, statistics about lost person search, mathematical models of lost person behavior, deductive reasoning, or just plain intuition.

2. How can I find the subject? There are two main search methods:

   a. **Passive**, such as confinement, perimeter cutting for clues, attraction, road blocks, or camp-ins.

   b. **Active**, such as hasty search tasks, scratch search tasks, sweep search tasks, line search tasks, tracking or search dogs, or mantrackers.

3. How should I apply the resources I have available? These may be described as clue finders, clue and subject finders, or subject finders.

   Subsidiary questions are:

   a. Is it better to use the resources I have now to keep the search area from getting bigger (containment)?

   b. Or should I use them to try to find the subject?

Once this plan is made, the actual searching may begin.

Why does this type of SAR planning not happen everywhere? It seems clear that such an enlightened approach to SAR would undoubtedly save lives. It might be tradition, "We've always done lost person searches with long line searches before, and it always works OK. Who are you to be telling us what to do?", or inaccurate data or ignorance, "We save just as many people as those SAR folks but without all the fuss", or perhaps an unwillingness to take risks, "Well, I'd like to try your methods myself, but if we tried and didn't find the kid, the Sheriff would probably fire me. Besides, then the Sheriff wouldn't want to take the chance and maybe not get elected next time", or perhaps just poor training, "We just don't have the time or money to train our people in all that fancy SAR stuff".

It is up to us, as Ground Search and Rescue Professionals, to try to counter such attitudes, in the interest of saving lives. Do your bit to educate people on the proper way to handle lost person situations.

Crucial Tenets of Search Theory:

1. **SEARCH IS AN EMERGENCY!**
2. Search is a classic mystery.
3. Search for clues, not the subject.

4. Concentrate on aspects that are:
    - important to search success
    - under the control of the search manager.
5. *Know* if the subject leaves the area.
6. Use grid (line) search only as a last resort.

Search is an Emergency!

Why? Because:

- The subject may need emergency care.
- The subject needs protection from self and the environment
- Time and weather destroy clues.
- An urgent response lessens search difficulty.

Often, it is hard to justify urgency because of a feeling that many people, left on their own, would survive. However, many people suffering heart attacks might also survive. Does this mean that they do not need urgent medical care? A Quick Response is necessary, to put searchers into the field at once to minimize the the search area by timely containment. Search area directly determines the chance of success. It is the maximum possible distance traveled by the subject in any possible direction. Using the point last seen (PLS), a circle may be drawn with a radius of the victim's mobility rate times the time since lost.
(See Figure 1 on page 12) Nighttime offers a unique opportunity to contain the victim while he is (usually) immobile. This opportunity should not be wasted. To respect the subject's emergency, we must:

1. Respond urgently.
2. Search at night.
3. Mobilize and keep searchers in the field.
4. Create and maintain an attitude of positive urgency.

Search is a Classic Mystery

Search managers must act as detectives, investigating, interrogating, and assimilating information. The SAR forces must know what clues to look for. Possible subject destinations must be ascertained by investigation and points last seen must be identified. The incident must be recreated in the minds of search managers. Outside possibilities must be considered, such as the subject returning home, or showing up at a friends house.

Search for Clues, not Subjects

because:

1. There are more clues than there are subjects. Every subject on land leaves clues - scents, tracks, brush disturbances and the like.
2. Clue detection significantly reduces search difficulty by reducing search area size (See Figure 2 on page 14).

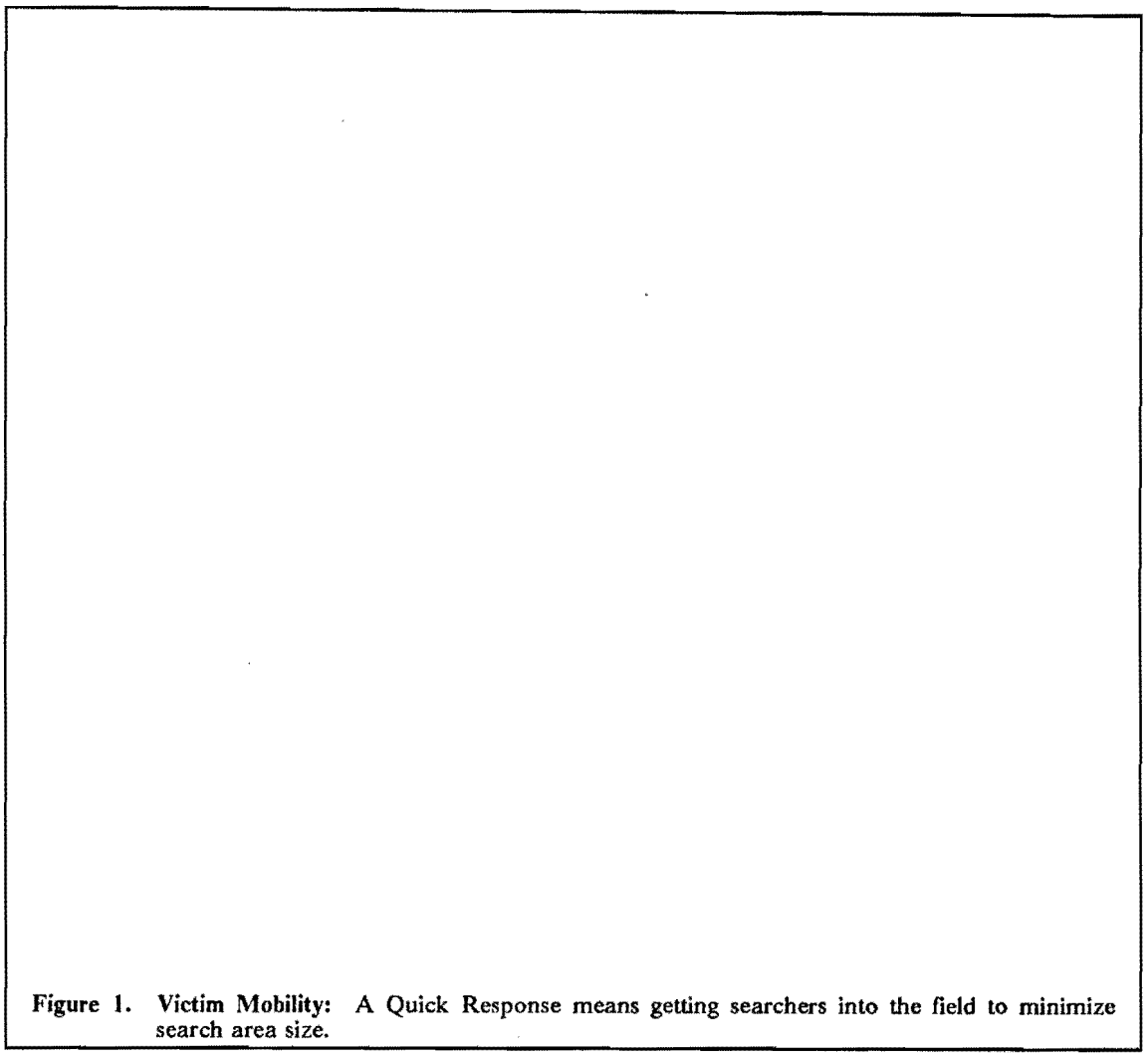


Figure 1. Victim Mobility: A Quick Response means getting searchers into the field to minimize search area size.

Concentrate on Aspects that are Important to Search Success and Under the Control of a Search Manager

Why? BECAUSE IT IS TOO EXPENSIVE TO DO OTHERWISE!

Know If the Subject Leaves the Search Area

Why?

1. A search without a subject is nonsense.

2. Search difficulty increases rapidly unless you confine the subject.

Include important places outside the search area proper (e.g. area about PLS). Assign someone to do the "Bastard Search" to find out if the subject has left the search area. Use the ***binary search technique***, which says, "The easiest way to find someone is to determine where he ***isn't***". Send sign-cutting team across the search area to check for tracks.
By this process, large parts of the search area may be eliminated from the active search area (or at least the probability that the subject is in there is substantially reduced - See Figure 3 on page 13).

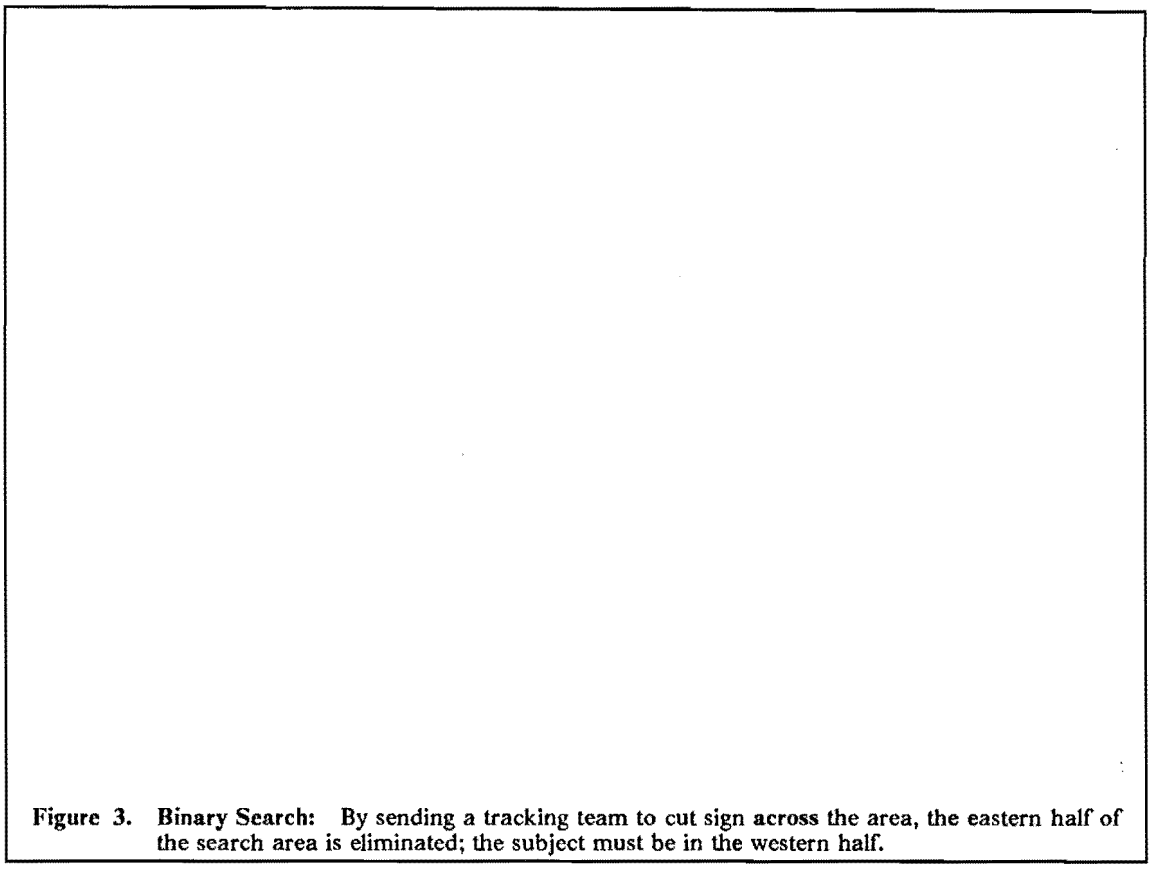


Figure 3. Binary Search: By sending a tracking team to cut sign across the area, the eastern half of the search area is eliminated; the subject must be in the western half.

Use Saturation Search (Grid or Line) Only as a Last Resort

Because the cost/benefit ratio for this technique is much worse than for other methods. (More on this later)

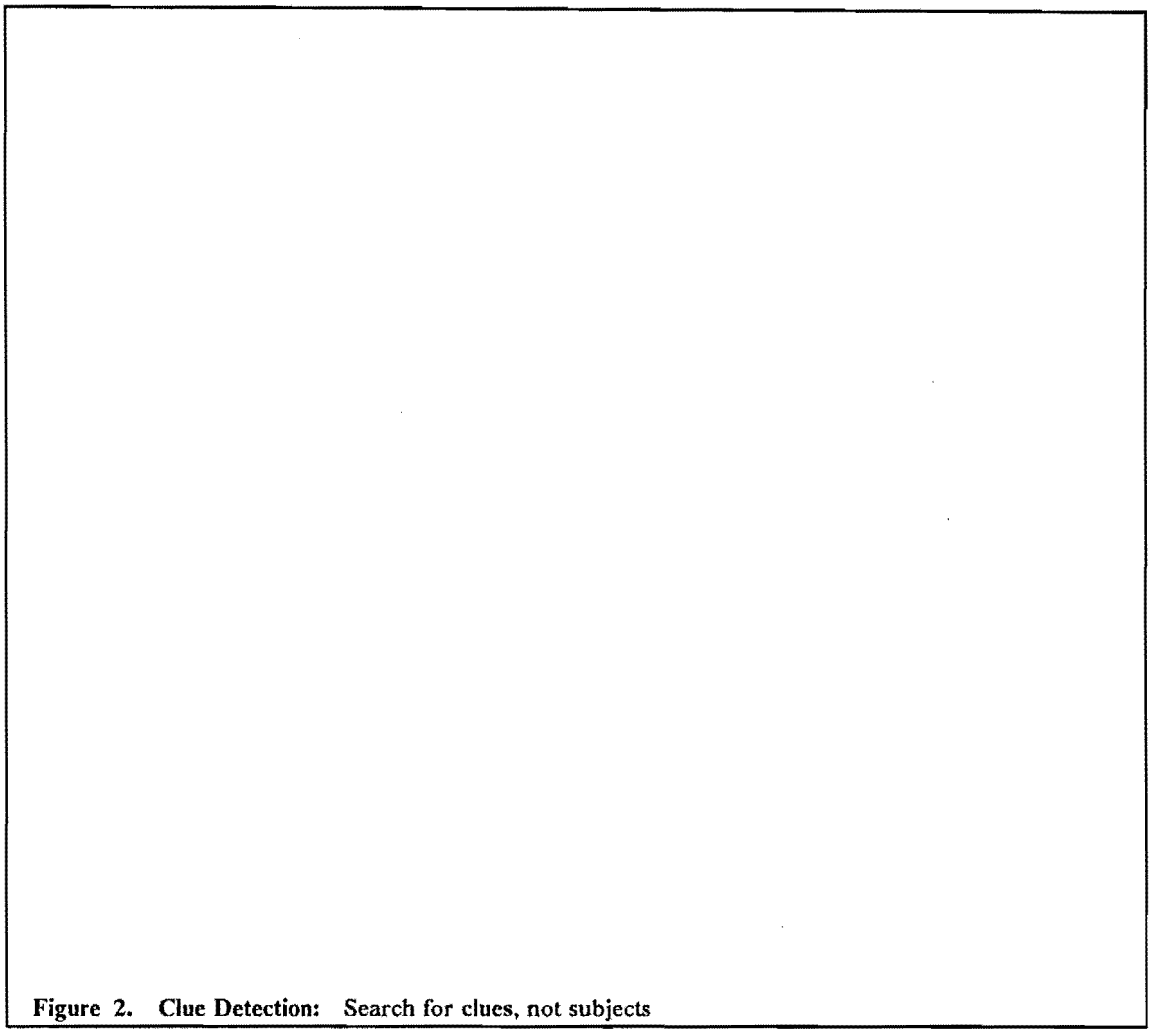


Figure 2. Clue Detection: Search for clues, not subjects

Search Tactics

Introduction

This Chapter discusses a variety of search tasks that appear quite different. There are, however, some general principals that apply equally well to most types of search tasks, and it is worthwhile to consider these at the outset.

First, the team leader must insure that the team is actually performing the task that was assigned to them. There have been instances in the past where a team spent six hours searching the wrong area; perhaps the east side of a ridge instead of the west. The best cure for this is, of course, to pay close attention during your briefing and to carefully consult the assignment section of your Vehicle Clearance Form or Task Assignment Form when in doubt, or even when *not* in doubt.

Second, your team should have a good idea of their search objective, and you must ensure proper searching in your assigned area. Not only should your team have a description of the person or plane, but they should know the type of clues for which they are to search. For example, trees with their tops clipped off when on a downed plane search; tracks, trash, or evidence of a bivouac site when looking for a lost person. Searching for these things thoroughly means looking in the correct manner. For example, turning around and looking backwards occasionally on a line search. It also means giving each part of the search area equal attention, with special attention given in those places where clues might be especially evident (e.g. checking stream beds and marshy areas for tracks, and stopping at country stores in an interrogation search). There is a tendency among searchers to search easy areas thoroughly and skimp when the team comes to more difficult conditions. Teams (and team leaders in particular) must be on the alert for this constantly. In a large line search with untrained searchers, it is not unknown for for three or four search lines to search the same area and go right past the victim, merely because he is in a large clump of brush. ***An area that has been searched badly is an area that must be searched again.***

Third, the area your team searched must be recorded in a manner that is meaningful to Mission Staff, this assumes particular importance in the latter stages of lost person search. An *accurate* drawing on a map is probably the best for lost person searches, but this is often difficult unless your search area is bounded by natural boundaries that are easy to identify on a map. For line searches, the alternative is to mark the boundaries with paper or plastic tape, as described in the line search section. A search team that does an excellent job of searching but cannot accurately tell what area they searched isn't much more use to a mission than a bad search team.

Fourth and final is the proper reporting of information. Anything that might be a clue should be reported to Mission Base. Do not evaluate the item as being important or unimportant -- that is the Mission Coordinator's job. You should take care to separate the objective from the subjective parts of your report. For example, "We found an area next to a stream where the grass is matted down and branches are broken off some bushes." (**Objective**) "It looks like someone spent the night here last night" (**Subjective**) Unless you have some way of knowing that someone did in fact spend the night there, and of knowing it was the person you are looking for, **don't** say, "We just found where he spent the night last night!"

To sum up, we have identified four important principles that apply in general to search tasks:

1. Perform the task **assigned** to you
2. Search **properly**, and search for the right things

3. **Record accurately** your search area

4. **Report properly** anything that might be a clue

As a team leader these items, along with the safety of your team, are your responsibility. The Mission Staff and the victim depend on you to do your job well.

Search Strategy

A general understanding of lost person search *strategy* will aid in the understanding of lost person search **tactics**. The initial step in any search is the gathering of important information, and part of this process is called a "**hasty search**". This refers more to the duration of the search task than to any particular tactic; a hasty search is usually conducted by law enforcement agencies before any SAR organizations are called in. A hasty search includes but is not limited to a quick check to see if the person is really lost, for example by checking obvious places as friends homes, hospitals, and other law enforcement agencies. A quick check for clues may be made at the last reported location of the person, a parked car, or other obvious places. Often the actions of the ***Quick Response Team (QRT)*** during a search may be considered part of the hasty search, even though the team may be using various search tactics.

The first priority after the hasty search is limit the area to be searched by **containment**. The usual procedure is to calculate the maximum distance the victim may have traveled in the time since lost, and to surround this area in such a manner to make it impossible for the person to leave the search unknown to the search effort. Often wide rivers and lakes, and distinct roads and trails may be used for containment. Other times it will be necessary to have road and/or foot patrols regularly traverse the perimeter of the area. Sometimes, in heavily wooded areas, string with markers attached pointing to Base Camp may be used with success.

The first phase of a major search effort is termed **scratch searching** after the primary tactic employed. During this phase, efforts are directed toward finding a victim who is alive and may very well be moving around. Small, fast Field Teams are are sent out to search high probability areas. The team may be assigned to do a **scratch search**, that is, to search search a point or a linear feature such as trail, ridge, or stream. The team might also be assigned to do a **sweep search**, that is , a loose line search of a small area; or the team might be assigned to do a combination of the two. During this stage, a tactic known as **survey searching** is also utilized. This refers to the search of a large area from a single vantage point, for example, from a fire tower. **Attraction** might also be used (e.g. building a large fire on a prominent ridge at night to attract the lost person).

If scratch searching fails, or if their are enough searchers to use them in the next phase without pulling out scratch search teams, the. **saturation searching** phase is instituted. During this phase, the entire search area is methodically searched by large **line search** teams. As each small area is searched, it is marked in the field and on a map at Base Camp, so that the extent of a search may be accurately judged. Saturation search usually requires such time and effort that it is usually reserved for situations in which scratch searching seems not to be productive of clues.

If at any time a good clue is found, the Mission Coordinator will seriously consider the employment of trackers, either dogs or human man-trackers. Dogs will have trained handlers and require little assistance, but trackers will usually ask for two searchers (preferably with some tracking knowledge) as assistants. Thus **tracking** may be considered a type of search task.

Search dogs, as opposed to tracking dogs, do not follow a scent on the ground. They are trained to follow an airborne scent; any human in the search area will be found by these dogs. Unlike tracking dogs, they do not require a "key" or characteristic scent article for the victim.

Searchers on a lost person search will be looking for the same type of things, no matter what type of task they have been assigned. Any type of clue may be useful as a starting point for a tracker, or may serve to cut the search area down dramatically by providing a more recent location for the lost person.

Clues include (but are not limited to) distinctive footprints, trash, a track when found in a fairly remote area, evidence of an overnight stay by some one, items of clothing, threads of clothing caught in a piece of barbed wire, or movement or lights seen on a distant hill. Searchers must take care to look backwards as well as forwards, and to pay careful attention to areas that may be especially conducive to clues, such as a muddy spot on a trail.

All clues should be marked with flagging; the standard is to place three flags next to each other at eye level for future reference. As each clue is found, the Field Team Leader (FTL) makes a preliminary evaluation on whether the clue may apply to the current search. Only those clues which bear on the current search should be tagged and reported. For example, a rusty beer can which has been in place for several weeks should not be considered a clue in the real sense. Obviously, this puts the burden of this evaluation on the shoulders of the FTL. Team leaders should carefully weigh the consequences of disregarding a real clue, and make their decision accordingly. **When in doubt, mark and report a clue.** When a clue is found, the FTL must make sure that his team does not destroy tracks that lead to and from the clue. If obvious tracks are present in the vicinity of the clue, this fact must be mentioned in the report of the clue.

Hasty Search

A hasty search, if carried out by a QRT, must be planned "on the spot", and usually the initial instructions are given by the Mission Coordinator, with the QRT Leader consulting with the MC and modifying the initial assignment on the basis of new information. Since the type of tactics to be used are chosen by the MC from a variety of search tactics, no one tactic can be singled out as being a "hasty search tactic". However, one tactic used mostly for hasty searches, the expanding square (or expanding circle) will be described. The expanding circle is used to search around a point for clues - for around the point last seen (PLS). Searchers form a loose line and pivot around the center point. As they reach their starting position, they expand outward and search in a circle around the area previously searched. This tactic is is **only used for searching small search areas,** as it quickly becomes cumbersome as the size of the search area increases. A variation of this technique, known as "cutting for sign" (tracks) involves searching in a wide circle about a clue, checking for signs of the victim's passage. The principle of "cutting for sign" may also be used with other search tactics. For example, a *scratch search* may be sent *across* the victims probable line of travel, rather than *along* it.

Scratch Search

A scratch search is usually carried out by a small, quick Field Team - It is the search of a point or a linear feature. If a point is to be searched, an expanding square or circle is usually appropriate. The team does not mark the search area boundaries, but rather marks the center of the small swathe they have searched. Of course, if the linear feature is a well defined feature (e.g. a trail) that is marked on a map and easy to follow in the field, there is no need to put up flags. However, if there is any chance that a second Field Team may have trouble following your team's footsteps, put up a occasional flag as a guide, especially in places that may be confusing. The usual procedure for a scratch search is to have one person (usually the FTL) guide on the center of the feature, and to have the other searchers within visual distance on either side of the feature. The FTL should continuously monitor the team's progress on a map, so that he can instantly locate a clue, trail, etc. accurately on the map.

Survey Search

Survey searching generally refers to the visual scanning of an area from a vantage point. Survey searching may be effective during the day or at night. Considerable perseverance and stamina are required, as long hours of watching may be necessary; however, the occasional joy of sighting an obvious distress signal makes the eyestrain headaches of little consequence.

Day survey search is generally more simple than night search, but searchers should generally wear sunglasses or goggles, and trade off shifts. A regular routine of scanning should be adopted. Usually binoculars or similar devices should be used only to investigate suspicious areas, rather than for continual scanning.

Night survey search requires a basic knowledge of eye physiology. A simplified account follows. The human eye contains two types of light sensors, **rods** for black and white (night) vision, and **cones**, for color (day) vision. Vision is created by the breakdown of a substance known as **rhodopsin or visual purple** by incoming light. This substance is gradually recombined; strong light may break it down a great deal, resulting in temporary blindness.

In bright light, most of the rods (black and white vision) are "washed out" and ineffective; the cones provide us with our visual ability. It takes a while for the rods to build up rhodopsin and become effective; thus the requirement for "dark adaptation" when entering a dark room from bright sunlight. Dark adaptation takes roughly twenty minutes. Obviously, using a flashlight to read a map, etc. will ruin night vision; however, rods are quite insensitive to red light, so red filters on flashlights are quite appropriate; these lights may then be used with minimal destruction of night visual ability.

The **fovea** or optic pit, is the most "accurate" part of our eyes; this is the area at the center of our visual field, where vision is clearest. However, this area is devoid of rods. Therefore, night vision is **better** toward the **edges** of the visual field. Staring at an object at night may actually cause it to 'disappear'.

When straining to see in very dark conditions, the eyes exhibit a motion known as **involuntary nystagmus**; that is, the eyes "twitch" back and forth slightly without the searcher's awareness. This phenomenon is the primary reason constant red lights have been replaced with blinking ones on aerial obstructions.

See Chapter Fourteen of May's *Mountain Search and Rescue Techniques* for a more detailed treatment of night searching.

Sweep Search

A sweep search is a saturation search of a small area by a small team. The search is wide-spaced (often beyond visible range, but within hearing range) as it is a **quick** search for obvious clues or a responsive victim. If the area does not have clearly defined natural boundaries that may be indicated on the map, the boundaries should be flagged with flagged with double flags, as with a line search. A Field Team will most often be assigned to do either a sweep search of a small area or along a particular section of a linear feature where more concentrated search than a single scratch search is desired. The beginning and end of the sweep should be marked along the linear feature with double flags, as should the boundaries of the area. It has been found by experiment that several wide-spaced searches are more efficient than a single close-spaced search. In wide-spread searches, searchers **cannot** cover every square foot of terrain, nor should they.

Line Search

A line search is a saturation search of a large area by a large team. The team is lined up with all searchers equally spaced (see below for information on spacing) except for the FTL, who stays out of the line, and two wingmen, who stay next to end searchers. The FTL is responsible for line straightness and spacing, and the wingmen are responsible for marking the boundaries of the search area with flagging tape. The wingmen do a minimum of searching, for they will have their hands full with flagging. There are two primary methods for line searching an assigned area:

- contour search
- grid search

Contour search is most commonly used with irregular search areas and in mountainous or hilly terrain. To use this method, the team is lined up along one boundary of the search area. For the

purpose of discussion, we will assume the search area to be a square area on a mountainside, with preestablished boundaries. Adaptation to a different shape or topography is usually pretty simple. To return to the example, assume we have our team lined up and down one of the boundaries, with one wingman on a corner. The team is lined up so as to be up and down, rather than across the slope.

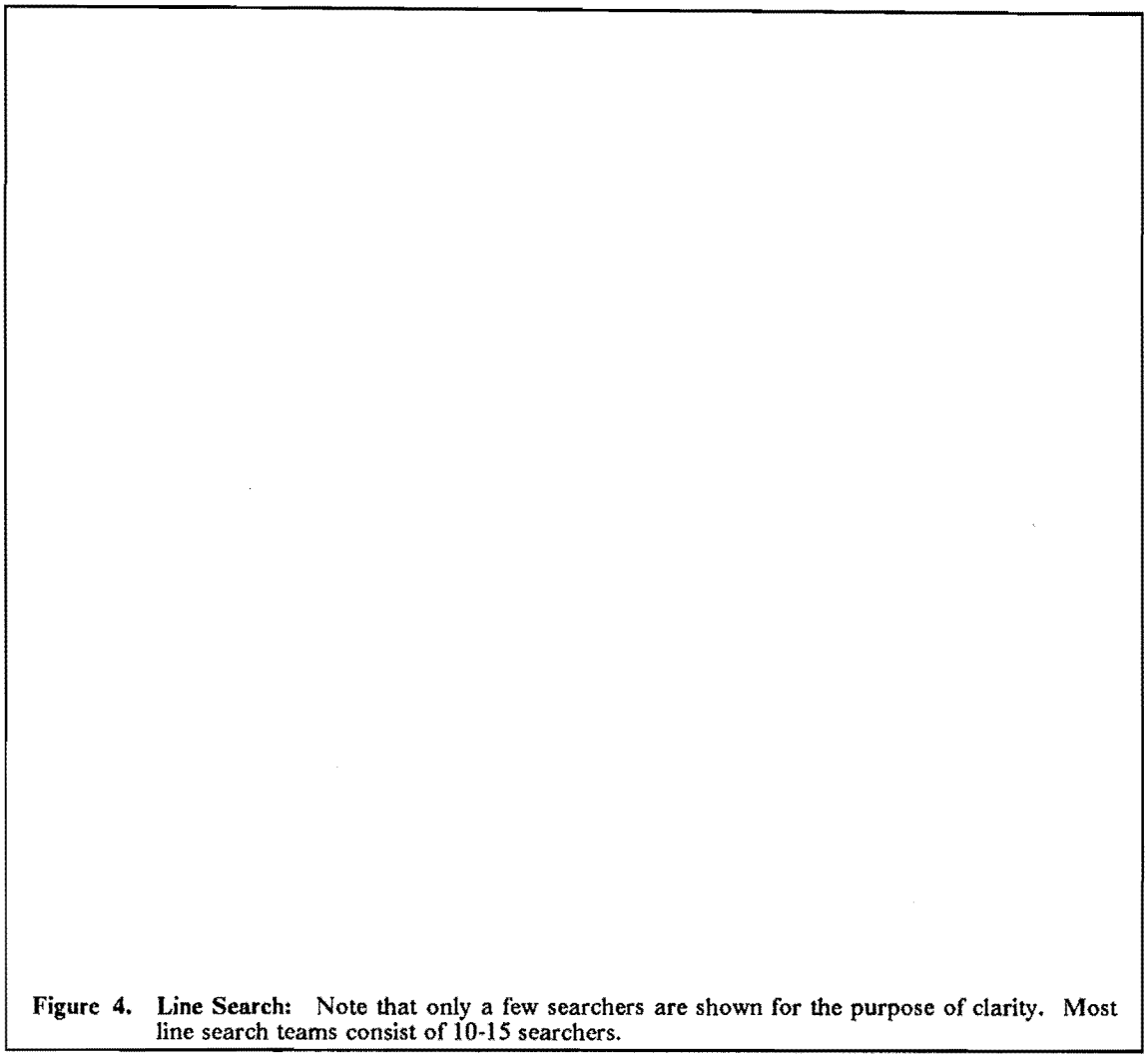


Figure 4. Line Search: Note that only a few searchers are shown for the purpose of clarity. Most line search teams consist of 10-15 searchers.

(See Figure 4) The team works its way across the slope , with the downhill wingman placing double flags (this is the search area boundary) and the uphill wingman placing single flags. When the team reaches the other side of the search area, the team pivots and and reverses direction, and begins to search the next higher swathe. This puts the old top wingman in the bottom position, where he can take up the flags he placed on the previous sweep. (To conserve flagging tape, it is suggested that the wingman taking up tape use the same tape to mark the next swathe.) When the team pivots, the wingman places double tape to mark the search boundary. This continues until the entire area has been searched. On the last sweep, the uphill wingman places **double** flags. Thus all of the single flags are taken up by the wingmen who placed them, and the entire search area is outlined in double flags. Should the search be interrupted for any reason, it is a fairly simple matter to pick up the search where it was left off. This is called a **contour search** because the team works its way across the hillside, rather than up and down. When the bottom contour is irregular, the team can "contour" across the hillside, staying at the same elevation.

There are two types of problems encountered in this type of search: first, the team always tends to compress downhill; the FTL must constantly work against this. The second problem is man-

aging the pivots between sweeps. There are primarily two methods for accomplishing this maneuver. The team may either pivot around the end wingman, or they may file past a stationary wingman, and form in reverse order on the other side. The problem of pivoting grows with the size of the Field Team, as does management in general. For this reason, a line search team rarely consists of more than 10 to 15 searchers.

When the terrain is level enough that contour search will not result in a significant saving of energy for the searchers, or when there are few available landmarks for search boundaries, a slightly different saturation search technique, known as grid search, may be employed. This method uses azimuths (bearings determined by compass)as the search area boundaries and for the guidance of the wingmen. Otherwise, the procedure is the same as for a ground search. The spacing between searchers is determined by two things: the visibility in the search area and the desired **probability of detection**. (We will not discuss probability of detection in this publication, for further information, see *Some Grid Search Techniques* published by NASAR.) If your area consists of two or more distinct sections with different types and densities of brush, it may be profitable to search each area separately with different spacing. If only one or two small areas are heavily vegetated, it would probably be best to deal with these areas as you come upon them.

When setting your search spacing, you should be guided by your briefing at Base Camp. If this is a line search early in a mission, you will probably be asked to use wide line spacing, with your searchers just at visual range, to maximize the efficiency of the search (although this decreases your probability of detection). This wide spacing represents the most efficient use of manpower when you must search a large area quickly for the victim or for clues. In the latter stages of the search, it might prove necessary to resort to close spacing, where all of the ground between each searcher can be scanned by one or possibly even two searchers. Usually, the FTL will be given just a search area, and be told whether to use close or wide spacing. The rest of the decisions will be left up to the FTL; it is his responsibility to see that the entire assigned area is searched with the assigned degree of thoroughness, is properly marked, and all clues are marked and properly recorded.

When moving the search line along the sweep, a standard set of calls is used to simplify control of the line. When the line is preparing to go, the FTL will check the readiness of the team, using the commands ***"RIGHT READY? LEFT READY?"*** This command is passed searcher to searcher to each wingman, who in turn answers,***"READY!"***. This answer is also passed searcher to searcher back to the FTL. When the line is ready to go, the FTL calls ***"FORWARD"*** If, for any reason, a searcher wants the line to stop, he merely calls ***"STOP!"*** **Any** searcher may call **STOP!**, but only the FTL may call **FORWARD**. Once the line has stopped, the FTL finds the cause for the stop (usually a possible clue for inspection) and, when the FTL is ready for the line to continue, he again issues the ready and forward commands.

Containment

Containment may involve foot or vehicle patrols, depending on whether roads are available as boundaries. The purpose of containment is to keep the search area from expanding, and this is done by continuously patrolling the boundaries of the area in such a way as to make sure the victim does not cross the boundary without being picked up, or at least his passage being noted. The Mission Coordinators evaluation of the victim's mental condition will affect the type of containment that must be done; a seasoned hunter will not cross a road and continue back into the wilderness; a small child or a mentally unstable person might do so. Containment patrols will be checking for the victim himself walking down the road or trail, and will be looking for evidence that he may have crossed or entered the road or trail. Leaving notes giving directions to Base Camp may prove useful, as may staying at a prominent trail junction in the midst of a wild area (a camp-in). If few roads or trails are to be found, long strings with arrows pointing to Base Camp may be used for containment. The exact type of containment will be determined by the Mission Coordinator or the Operations officer, and the team leader will be given specific instructions by the Mission Staff officer who briefs him.

Man-Tracking

Man tracking is a task requiring special skills, and any member who will be acting as a tracker will require special training in the tactics to be used. When accompanying a tracker on a tracking task, the important thing to remember is **do not disturb the tracks.** Unless instructed otherwise, you should follow in the tracker's footsteps (***literally***), and be careful not to disturb the tracks that the tracker has already marked. The tracker will usually brief you in detail what he/she expects.

Should you come across a track during some other type of task, do your best to protect it from your team and others in the area. Remember that there may be other tracks in the immediate area. Report any distinct tracks to Base Camp immediately, if in an untraveled area.

Tracking Dogs

Tracking dogs rely on ground scent to follow the track of a lost individual. Usually, a "scent article" or uncontaminated item (by other human scent) of the victim's clothing is required, to allow the dog to follow he proper track. Scent tracks may be destroyed by dry heat, rain, or other tracks. The effectiveness of tracking dogs varies with widely with training and search conditions. Usually, the use of tracking dogs requires a "hold" on all other operations, so as not to destroy the track.

Search Dogs

Search dogs, as opposed to tracking dogs, sense airborne scent. Although they may be able to key on a particular scent, most search dogs will find ***any*** person in the search area. Search dogs are usually used in a type of very wide grid-type search, with search paths perpendicular to the prevailing wind. Any dog finding a "scent cone" (See Figure 5) will follow it

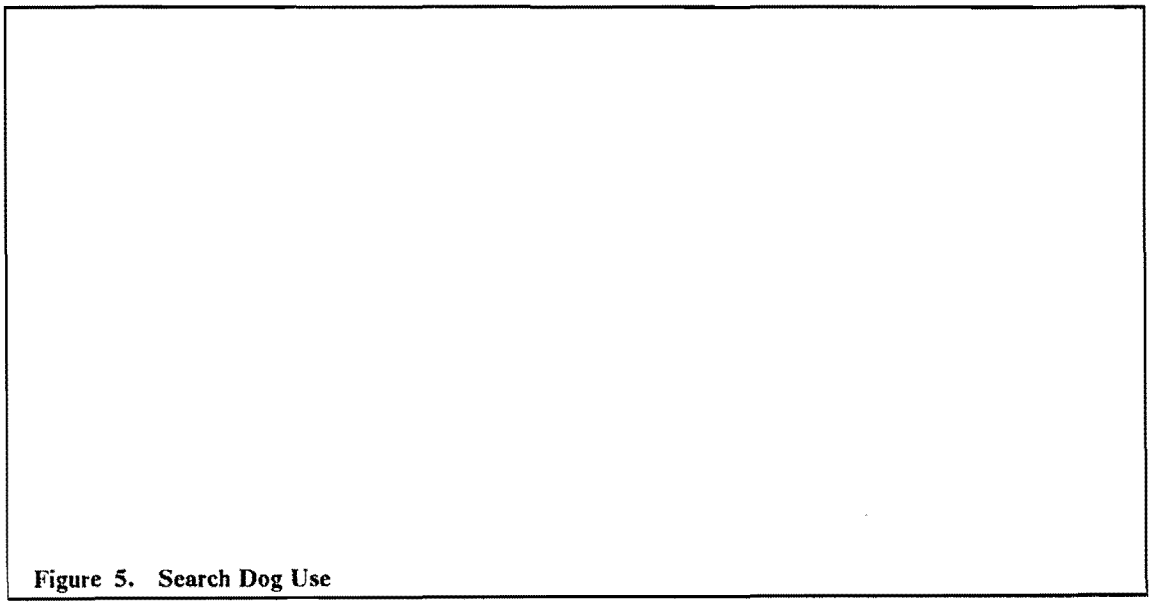


Figure 5. Search Dog Use

to the source.

Search dogs have two main advantages over tracking dogs:

1. Other search tactics may be used at the same time with little or no decrease in efficiency.
2. Search dogs have an extremely high find rate, compared to tracking dogs.

Downed Plane Search Tactics

General

Search on the ground for downed aircraft can be divided into two primary types:

1. Large area search
2. Close-in search

Ground search of a large area usually involves the simultaneous use of three distinct ground search tactics:

- Interrogation(Interviewing)
- Visual Search
- Electronic Search

The team drives through the assigned area in a search pattern, scanning the visible terrain for signs of an aircraft crash, monitoring for **Emergency Locator Transmitter** (ELT) signals with a directional receiver, and stops at appropriate houses, stores, etc. and requests verbal information from residents (interviews).

Once the approximate location of the crash site has been determined by observation from an aircraft, ELT signal direction finding, or by visual sighting by a team, the job of actually getting to a crash site remains, and if the site is far away from roads, the task can be quite difficult. Often special ground search tactics (locale search) are necessary to come upon the actual crash site, even though the general area has been indicated.

Interviewing

Interviewing is the questioning of people throughout an assigned area, in regards to unusual occurrences which which may relate to the search. It is usually carried out in conjunction with visual and often with electronic search. The search is usually conducted with the use of a vehicle and a small team; the team travels through the area, stopping at selected locations and questioning the people there.

Several important principles apply to interviewing:

1. ***Identify yourself.*** At night, shine your light on yourself; wear your ASRC or CAP uniform to reassure your informant.
2. ***Beware of Animals.***
3. ***Close any gates you open***; letting cattle escape is bad public relations.
4. ***Do not volunteer information.*** It is difficult to sort out unrelated leads and hoaxes from true leads. Comparing lead information with known facts is the primary method of selecting good leads; giving out this information to informants destroys the effectiveness of this selection process.

5. ***Get details*** of the informant: name, address, phone number, etc. A CAP Form 106 (Ground Interrogation Report) is useful for this.

Normally the interrogation function is thought of as the process of asking questions to obtain information to be fed to the base. When a team finds an interrogation lead they are often not sure of what to do following the lead except to continue to ask questions in the local area. Time and effort can be saved by using search techniques used by ground searching in the field and by aircraft.

When directed to interview in a given area the team leader has several decisions to make. Among these are:

- How often should the team stop and question people?
- How far off the given roads should the team proceed? (MC's will almost always direct a search from road maps and will choose main or secondary roads that bound a given area.)
- And what does the team do if a lead is found?

The number of stops should be determined by the likelihood of gaining information. Stores, taverns, and quiet residential neighborhoods would make good stops. Choosing every quarter mile or every fifth house is an arbitrary way of making the selection. It is sometimes necessary to make this kind of selection in a suburban area with many houses, however, the team should not be so set on finishing their assigned area that they fail to consider going back to question a potential lead.

When a lead is located, the team reports to base the information and then must consider its next move, unless orders come from Base Camp. If no such direction is given, then the team leader should plot the lead on his topographic map. It is wise to interview on either side of the lead to see if verification can be obtained. Having obtained the direction of travel of the lead, it is possible to extend the line of flight to see where it might lead. The team may choose to proceed to the next closest point the projected flight path may have crossed a road, and to proceed along that road to see if further information might be gained. This technique has been used successfully in the past to track aircraft, resulting in a find.

If this method does not produce additional, an aircraft may then search the terrain between the roads that have been interviewed. If nothing is found the team may then use an expanding square search pattern, interviewing for additional information away from the initial lead. It is important that the lead be evaluated by Mission Base before the above procedure is begun, as much time might be wasted using this method the informant gave information that is not compatible with other teams' inputs, or with data Mission Base has that is not available to teams in the field. On the other hand, a good lead will often indicate more in the same area.

When a lead is located, the team members should not become so excited about it that they fail to obtain exact as possible information. For example, in a recent search, a team discovered a hot lead, but it wasn't until a second thought by the team leader sent the interviewer back to discover the person who gave the lead lived in another area and was visiting the house for Sunday dinner.

Additionally, the team leader can conduct careful visual searches from high points, call in aircraft, and as a last resort use a scratch search through a suspect area. The latter is a last resort because of the extensive time required. Any search on foot will consume great amounts of time and energy, and thus should not be used unless a high certainty exists that will justify the effort.

Visual Search

As mentioned previously, visual search is often combined with interviewing. Visual search is a survey search conducted from a vehicle. When driving along a road providing a good view of the surrounding area, the driver should slow so that riders may scan the terrain. Usually a rider should be assigned to one side or the other, and team members should alternate turns at scanning. Occasional stops at good views are often warranted.

Possible visual clues include:

- Pieces of wreckage, large or small.
- Presence of smoke, by sight or smell.
- Unusual sounds.
- Broken or disturbed trees or underbrush.
- Presence of scavengers, animals or birds.
- Fuel, oil,brake fluid, etc., by sight or smell.
- Decomposition odors.
- Signs of human passage or occupancy of an area.
- Landslides.
- Horsetails caused by the wind blowing loose snow or sand over an obstruction.
- Unexplained break in the terrain contour or conditions.
- Personnel (dazed, wandering, not dressed for weather or terrain).
- Blackened areas (even a single tree among green leaves).
- Local discoloration of foliage.
- Signals. Remember that survivors may use many ways to signal possible rescuers depending on their training, physical conditioning, and signalling devices on hand. A vehicle (especially one in rough terrain) can be heard for many miles. Some other signals to be alert for include banging or thumping on metal or fabric, shouting, whistles, signal mirrors, flags, kites, etc. Be alert for anything that may be a clue.

Clues should be reported; Often, an aircraft may be able to provide resolution of a possible sighting with ease. This should always be considered before striking out on foot.

Electronic Search

Electronic search, also known as ELT search , is the use of radio receivers and directional antenna systems (known as direction finding or DF equipment) to provide information about the location of the aircraft. Recently, with the introduction of the **SARSAT** (Search and Rescue Satellite) Program, the effectiveness of ELT search has been improved. At this point however, approximately **95%** of the SARSAT alerts are due to false alarms because of improperly activated transmitters. Almost every aircraft has an Emergency Locator Transmitter (ELT) designed to start transmitting a distinctive signal after a crash. Teams with ELT-DF capability may combine it with interviewing and visual search to conduct triple-mode ground search tasks.

The actual tactics involved in ELT direction finding are rather complicated, too complicated to discuss in this brief forum. For further information, see the **Virginia Wing, Civil Air Patrol, Ground Search and Rescue Manual.**

Legal and Related Aspects

General

This chapter deals with a variety of subjects, including the authority and responsibility for search and rescue, and the responsibilities and duties of ground search and rescue personnel in certain specific situations (e.g. at an aircraft crash site). Since the term "search and rescue" is often used to encompass a great variety of emergency operations, a working definition will be offered here to be used throughout the chapter.

> ***Search and Rescue (SAR)*** as used in this text, refers to the finding, providing aid for, and evacuating the persons of lost, stranded, or injured in areas of substantially wild or natural area on land. Thus, operations on the high seas, as well as operations related to the crash of an aircraft in an urban area are excluded from this definition.

Authority and Responsibility for Search and Rescue

Once upon a time, there was a light aircraft crash in a large wooded area just outside a major eastern U.S. airport. The ensuing SAR operation was badly coordinated and markedly confused. In an effort to straighten out things, one of the agencies called a meeting, to which all of the agencies involved were to send a representative. At this meeting, someone stood up and said, "Would the person here representing the agency in charge of this mission please raise his hand?" **Seven different people raised their hands.**

Thus the question of who is in charge of a SAR mission is not one that has always had a simple answer. Quite often there are several agencies claiming authority for a mission, with the actual control going to the agency on the scene first with the most resources. Sometimes the authority for a mission may fall to an agency not normally in the business of SAR through the disinterest on the part of those agencies normally in charge of SAR (e.g. a Fire Department running a lost person search). In some jurisdictions, though there are many agencies who will respond to an incident, it may be impossible to find one that admits to the responsibility for planning and training personnel for SAR.

Let us now contrast our SAR system with a state that has a well organized SAR system. The state is a hypothetical one, but the example draws from facets of the SAR programs of several western states. Every volunteer SAR group in the state must be approved by the state, and each individual member must pass a state certification test. When any of the groups is working on a mission, they are covered under state insurance, and transportation expenses are paid for by the state. The state issues a mission number for each mission, and has standard procedures for missions that are to followed for each mission. The state requires each county sheriff to appoint a SAR Coordination Officer to run SAR missions within the county, and every county must have a workable SAR plan.

Since this ideal situation (if it is ideal) will not come to be in Virginia for some time, we should learn what the rules of thumb are for SAR authority and responsibility in the Commonwealth even though they may not apply in every instance.

We will begin by considering the situation of a person in distress needing aid. Who has the primary authority and responsibility for aiding this person? It is generally agreed upon that this aid is the responsibility of the appropriate law enforcement agency, although certain types of aid (e.g.

Emergency Medical Service) may be delegated or reassigned by legislation. If we agree that the responsibility goes to a law enforcement agency, to which does it go? County, State, or Federal? Usually, if the mission is limited to one county, the county sheriff is assumed to be in charge. One exception would be if the mission were limited to one county but also within the borders of a National Park. In National Park areas, the Park Service is considered to have **exclusive jurisdiction**, and the Park Superintendent would be the primary authority.

National **Forests** are a different situation, however, as the Forest Service is not considered to have exclusive jurisdiction. Therefore, a SAR mission within Forest Boundaries would still be the responsibility of the County Sheriff.

If the mission encompasses more than one county, the state may become involved. The Commonwealth of Virginia Disaster Plan gives primary authority and responsibility for SAR to the State Police, who are to be assisted by the Virginia Association of Volunteer Rescue Squads. Usually, the State Police have limited themselves to providing helicopters and occasionally tracking dogs at the request of the local sheriff, and to investigating SAR incidents after the mission.

These guidelines should be used as such, and should not be considered a definitive statement of the allocation of SAR authority. SAR personnel should be able to adapt themselves to whatever situation they find, and should concentrate on aiding the victims, rather than participating in arguments about "who's in charge".

If a mission cannot be localized to a particular state, but is still within the "inland region" (the Continental United States, excluding Alaska), the National Search and Rescue Plan (1969) comes into play. This plan is designed to provide a comprehensive organization for SAR throughout the United States, and in other regions as necessary. The National SAR Plan is a result of a policy statement by President Eisenhower in May, 1954. Concerning SAR, it states:

"It is the policy of the United States:

1. **To provide a basic network of search and rescue facilities in the United States, its territories, and possessions to serve both civil and military aviation, including the discharge of the Unites States responsibilities as a result of Unites States adherence to the convention on International Civil Aviation.**

2. **To provide an overall search and rescue plan for effective utilization of all available facilities to include provisions for the control and coordination of all types of search and rescue missions.**

3. **To utilize State and local search and rescue facilities to the maximum extent possible in the overall search and rescue plan, and to encourage their continued development."**

The National SAR Plan assigns responsibility for coordination of all search and rescue missions in the inland region to the U.S. Air Force, which in turn, has designated the Aerospace Rescue and Recovery Service (ARRS) as its executive agency for SAR. However the last paragraph of the Plan says:

> "Although Federal leadership in the search and rescue field may be generally recognized, the Federal Government holds no mandate to compel state, local, or private agencies to conform to a national search and rescue plan. The desires of state and local agencies to control their facilities in SAR missions must be respected and insured. Cooperation must then be sought through liaison and agreements."

When the Civil Air Patrol is operating on a SAR mission, it is acting as a part of the Air Force, under the authority of the ARRS. However, the authority of the ARRS is restricted to prosecuting interstate missions: for all other missions, the ARRS and the CAP operate only at the pleasure of the state or locality. In Virginia, the state allows the ARRS and the CAP fairly free rein in the prosecution of downed aircraft searches.

Once a find is made, the mission is no longer a search, but is now a local rescue mission. Authority is now in the hands of the local responsible agency, probably the county sheriff, and the authority of the ARRS and the CAP is now ended. Often, the local authorities will request that the CAP continue to assist. Sometimes, the county sheriff may be unable or unwilling to take charge, and no other agency has clear authority for the mission. In such cases, concern for the well-being of

the victims decrees that CAP arrange for rescue and evacuation, in coordination with local emergency service organizations. A good caveat is from the CAP Emergency Services Manual, CAPM 50-15 (1972),

> "No evacuation of casualties should be done without the request or approval of the authorities in control of the incident. No evacuation of deceased should ever be done except at the request of the appropriate authority under whose jurisdiction the incident occurred, or the Surgeon General in a military incident, or their officially designated representatives

In the case of a crash of a military aircraft, military SAR units will often conduct the search themselves. Should non-military SAR personnel be the first on scene at such a crash, they should first see to their own safety, then the safe rescue of the survivors, and then allow the military and local authorities come to a decision on who has the authority for further actions. It is often not clear who has the authority as such incidents, often it is whoever reaches the scene first with adequate personnel. GSAR personnel should see first to the needs of the victims, then extricate themselves from the situation as carefully as possible.

Authorization for ASRC Involvement and ASRC Mission Staff

ASRC is normally alerted through the Commonwealth of Virginia Emergency Operations Center (EOC) run by the State Department of Emergency Services. The EOC will usually receive a call from local Responsible Agents requesting assistance. Based on their stated needs, the EOC will then present to the Responsible Agent a list (or menu) of choices of SAR organization on which he can call. After the Responsible Agent agrees on ASRC support, the EOC calls the University of Virginia Police Department (which serves as a contact point for the Conference). The UVA Police, in turn set off the pagers carried by the Conference Alert Officers, instructing them to contact the EOC. The Alert Officer calls the EOC to receive a briefing on the Mission particulars.

Once briefed, the Alert Officer then decides which Group(s) to alert, and initiates each Group's Alerting System. A Mission Coordinator is then appointed from the responsible Group (usually the closest Group to the Mission). The Mission Coordinator is responsible for assembling his staff. The Mission Coordinator also appoints a Dispatch Officer, whose function it is to begin down the Group Phone Roster to alert the individual members of the Group. The Dispatch Officer, if going on the Mission, is usually the last to leave, ensuring first that all Group personnel have been notified of the Mission.

Authorization for CAP Involvement and CAP Alerting and Command

The Civil Air Patrol must go through special authorization procedures before participation in any search and rescue or emergency service mission. Insurance and reimbursement depend on such authorization, as does the alerting and command system. CAP mission authorization may come from one of three places:

- The Aerospace Rescue and Recovery Service (ARRS), with headquarters at Scott AFB,
- The Air Force Reserve Region Office in Philadelphia,
- Directly from Virginia Wing headquarters

ARRS and AFRR will issue a mission number, and authorize reimbursement for fuel, lubricants, and communications expenses. However, Virginia Wing authorization and mission numbers carry no authorization for reimbursement.

If an aircraft on a flight plan is one hour overdue for VFR (visual flight) flight plans, or 1/2 hour overdue when on IFR (instrument flight) flight plan, the Federal Aviation Administration (FAA)

makes a communication search of all the airports or landing strips within 50 miles of the aircraft's intended route of travel. The notice the FAA sends out is known as an information request, or an **INREQ**. One and 1/2 hours after the estimated time of fuel exhaustion, the FAA issues an alert notice, or **ALNOT**, and actual physical *ramp checks* are made at each airfield within 50 miles of the intended flight path. If these measures do not locate the missing plane, selected calls are made to the pilot's relatives, friends, and other high probability locations are made. If a plane is reported missing by friends or family of the pilot, or if a rental plane is missing, similar actions are taken by the FAA. These actions are coordinated with the ARRS at Scott AFB.

If all of the above actions are taken with no results, or if a call for assistance in a lost person search comes in, the coordinator at the Rescue Coordination Center at Scott AFB will then issue a mission number, and alert those wings of the CAP that are needed.

The ARRS coordinator at the RCC at Scott AFB has the choice of designating the CAP or other agencies, or a military installation as the mission coordinating organization. In civil air crashes, this is most often the CAP, and the individual wing appoints an individual Mission Coordinator in accordance with the Wing and CAP policies. The Mission Coordinator has the ultimate responsibility for the mission until he is relieved of command by the ARRS, turns over the mission to another MC, or concludes the mission.

Medico-Legal Considerations

Virginia is fortunate in having one of the best **Good Samaritan Laws** in the country. This law provides immunity from civil suits for those giving first aid or emergency medical care. If a person (specifically including those trained in CPR, and those trained and certified as EMTs) is administering aid in ***good faith, without compensation***, then the law says that a person cannot sue the person who administered the aid. ***Good faith*** means that the person is actually trying to help the victim, as opposed to perhaps pretending to help the victim and actually trying to kill him. ***Without compensation*** means that the law does not hold if the victim pays the person rendering the aid. Even a gift other than money could be construed as compensation. However, a 1977 amendment to the law made it clear that "compensation" *does not* include the salaries of public service or emergency personnel who perform such aid as part of their job. A special section of the law points out that in no way does the law remove any kind of liability for operating a motor vehicle, but only covers the emergency aid given (or aid not given). The Good Samaritan law is **Section 54-276.9** of the **Code of Virginia.**

The good samaritan law gives protection only against *civil suit*, which means that it is still possible for *criminal* charges to be brought against a person for inflicting willful damage, or for being guilty of gross negligence.

What constitutes gross negligence? This depends on the level of training of the person administering the aid. A person would be held to the **standard of care** appropriate for his training.Thus, the higher the level of training, the higher the standard of care one is held to in the judgement of negligence.

Many states now require that all emergency service personnel providing emergency rescue and first aid services (as opposed to **first responder** services, which are provided by the public or local employees or public servants) be trained to the basic Emergency Medical Technician level. That is, if the organization professes to provide emergency care other than in an incidental manner, it should have the personnel with EMT training. Although this is not so in Virginia, the trend toward increased standard of care should prompt ground search and rescue teams to do their best to include personnel with EMT training on the team. (Appalachian Search and Rescue Teams already require the team leader to be trained to their "basic level" which includes EMT certification.

There is no legal requirement for someone to come to the aid of another in distress. It is perfectly legal to walk right past someone without giving first aid, even if the victim asks for help. However, once a person has started to give aid to a victim, he or she has assumed responsibility for the care of that victim. To leave after starting to provide care in considered **abandonment**, and is illegal. Once you have started providing care, you must continue until the victim is turned over to someone with better training and a better medical or first aid capability, or until the victim refuses additional

aid. It is perfectly legal for a victim to refuse medical aid. In fact, you ***must*** have the victim's consent before beginning any first aid. If the victim is unconscious, or otherwise unable to make a rational decision, then you may assume you have ***implied consent.*** Implied consent means that, since you cannot tell whether the person wants aid or not, being either unconscious or unable to make a rational decision, you may assume that it is in fact wanted by the victim.

Crime Scene and Crash Site Procedures

SAR Teams will often be the first on the scene after an airplane crash in which persons are killed, or may find that a lost person has died. In each case, there are certain procedures that the team should follow to assist the law enforcement and investigating authorities. Although this is not the primary duty of SAR teams, it will serve to build better relations with the local authorities.

If a body is found during a lost person search, the team should communicate this fact to the Base Camp in a discrete manner. Unfortunately, many scanners (radio receivers) are available which will allow the owner to listen to CAP and ASRC and other radio frequencies, so radio messages should be brief and should use terminology that will not alert the listeners to the fact a body has been located. The reason for this caution is the fact that family or relatives deserve the courtesy of being informed by the Responsible Agency of the facts surrounding the death, rather than hearing them discussed in public, or hearing about it over a CB radio. When a body is identified (if easily done), the team should leave the immediate area. The approach to the body, and the path followed in leaving the area should be the same, and the team should walk single file. Only the minimum number of team members necessary should approach the body, and great care should be taken not to disturb any possible evidence. If the body is moved during the initial efforts to determine responsiveness, careful note should be made of the position of the body, and any other information that may be of interest to the investigating officers.

When a Ground SAR team is the first to reach an aircraft crash site, there are procedures to be followed, many of which are not obvious to an untrained member. The following list provides a guide to actions to be taken at the scene.

1. **The safety of the rescuers is more important than any other consideration.** If the possibility of fuel spill is strong, approach should be from uphill and upwind. If the aircraft is a military one, approach should be from the left side if possible. Ahead and behind the aircraft are danger areas because of weapons. Check carefully for ejection seat controls (Black and Yellow) and leave them alone. If they have been moved, the ejection mechanism may be armed, creating a potentially explosive situation. Carry a CO&sub2. fire extinguisher if possible.

2. Gain access to the victim, ascertain if they are still alive, and begin emergency care measures. Control hazards as necessary.

3. Identify the aircraft if possible. Contact Mission Base with this information and an assessment of the situation as regards the need for additional resources.

4. If the Emergency Locating Transmitter (ELT) is transmitting, find it and turn it off. ELT signals are not received and plotted via satellite (SARSAT), and the signal may mask or interfere with other distress signals hundreds of miles away.

5. Take care not to disturb the wreck any more than is necessary to tend to the needs of the victims and to turn off the ELT. Make careful notes on the placement and heading of the aircraft, as well as disturbances to the wreckage made by the rescuers for the use of those investigating the accident.

6. Continue with emergency care measures for the victims. Complete extrication procedures. Contact Mission Base to arrange for the evacuation, as the local responsible agent is in charge of such operations. Give your estimate of the situation, including recommendations for evacuation modes and additional resources needed.

7. If appropriate, station a perimeter security patrol to keep out unauthorized personnel. Remember, however, normally, you have no law enforcement authority to perform law enforcement functions, and may not use force to prevent people from entering the scene.

All civil aircraft crashes involving serious injury or death must be investigated by the **National Transportation Safety Board (NTSB)**, an independent Federal agency. Some non-fatal accidents may be investigated by the **Federal Aviation Administration (FAA)**, and military accidents will be investigated by a military investigation team. These agencies would like to see the crash site is as little disturbed as possible, and will greatly appreciate any notes made by SAR personnel about the location of bodies, location of the aircraft and major parts, etc. The Investigator-in-Charge may ask assistance of the SAR teams in getting to the site. If so, the teams may be able to assist by pointing out various things that may not be readily apparent to the investigators, such as instruments away from the main crash site. It is also possible that the investigator may ask SAR teams to conduct the on-scene investigation if the area is inaccessible because of rugged terrain.

The removal of bodies and their evacuation to the road is the responsibility of the county medical examiner or coroner. If the wreckage must be disturbed to remove the bodies, the coroner will need to coordinate with the agency in charge of the investigation, the NTSB in most cases. The SAR teams may assist by getting the Mission Base to contact the NTSB for the county authorities. Generally, the NTSB will allow the removal of the bodies by the authorities if an investigator is not immediately available to come to the scene. Of course, careful note should be made of any disturbance necessary to remove the remains.

SAR teams may participate in the evacuation of the remains only if both the county authorities and the Mission Coordinator approve.

A final step in resolving the situation at a crash site is to learn if the wreckage will be salvaged, perhaps by the insurance company covering the aircraft. If not, or if an area that would appear as a crash site from the air will remain, a large yellow cross should be painted across the site. This will allow later identification of it as an old crash site, if another search should occur in the same area.

Entry On Private Property

CAP or other SAR organization members have no special rights to intrude on private property. If private property is posted with "No Trespassing" signs, or it is otherwise made clear that no one should enter a particular piece of property, SAR teams should only enter that property to save life or property. If a SAR team wishes to intrude on such property, but is not sure whether life or property is at stake, a careful judgement should be made by the team leader. The legal basis for a decision on whether the intrusion was justifiable is as follows:

> If, under similar circumstances, a ***reasonable person*** would believe with ***reasonable certainty*** that life or property was endangered, and further, that entry on said property was necessary to save said life or property, then such entry is justifiable.

In any case of possible entry on private property against the wishes of the owner or person in control, a decision must be made by the team leader, weighing the possible information to be gained versus the possible legal consequences of illegal entry.

Radio Communications

General

Any ASRC member who has been on a mission probably has had occasion to curse at a radio, at someone on the other end of the radio, or about radios in general. Efficient search management, in which ASRC takes so much pride, tends to break down most commonly when the radio net malfunctions. Most radio problems can be solved by someone who knows just a little about radios and about radio communications. This chapter is designed to teach you just that little bit, plus some useful information that is usually hard to find.

The most common problem with radio communication is related to an audio transmitter and receiver - **YOU**. Like anything else, getting information smoothly through a radio takes some practice, but there are a few things you can do even if you don't have a radio to play with for practice. For example:

1. Keep copies of the ASRC Crib Sheets in your pack.
2. Learn the International Phonetic Alphabet and the standard ASRC prowords.
3. Know how to communicate effectively in marginal conditions. Know how to compose a succinct message, how to repeat each phrase, and how to spell and use "figures". You will seldom need to do this, but when communications are marginal, your ability to communicate effectively will be greatly appreciated by the Communications Officer. You will also find that these techniques will help you communicate more comfortably even in the best of conditions.
4. Hold the microphone properly. Keep it a couple of inches from your mouth, perhaps holding it at an angle (to reduce breath sounds), and talk in a normal to quiet voice. A load voice make weaken your radios power (RF output) with an FM radio and may cause distortion with an AM or single side band (SSB) radios. (More on the types of radios later)

Now we will detour to consider radio in general, then return to some details about radio hardware.

Characteristics

You need to know two major characteristics of radios: ***mode*** and ***frequency***. The **mode** of a radio refers to the way your voice is encoded onto the (radio frequency or "RF") electromagnetic radio wave *carrier output*. We say the RF carrier is **modulated** by your voice. The two main modes in use are ***frequency modulation (FM)*** and ***amplitude modulation (AM)***. There is also an improved version of AM known as single side-band (SSB), but you probably won't have to deal with any side-band radios. Another mode you may here about is **continuous wave (CW)**, where an unmodulated carrier is turned on and off via a telegraph key, to produce Morse Code. The only things you need to know the different modes are:

- FM radios have less interference problems than AM, and FM gives you more "talk power" (RF output) for a given battery life. Listen to CB for a good example of AM interference and noise.
- The louder you talk into an FM radio, the louder the audio sounds at the other end, up to the point where you get distortion. **But**, the louder you talk, the **weaker** your RF output gets.

The effect is slight, but may be noticeable in marginal conditions. If the recipient of your message says you are breaking up, talk softly.

The other concept is of ***frequency*** of the RF carrier. Some radios have preset frequencies which are called "channels" - the the frequency in a particular channel depends on what **crystal**, or frequency reference, is plugged into the radio for that channel. Other radios tune across their frequency *bands* (range) with a dial, and some use fancy electronics to allow keyboard entry of frequencies. For instance, some amateur (Ham) 2-meter VHF-FM radios have microprocessors so that the radio will put frequencies into "memory". One may then switch between memories much as one switches channels on a crystal controlled radio. Some of these radios may even scan through the memories (or even the band) if properly set.

Frequencies are measures in Megahertz, or millions of cycles per second. The following names are applied to different bands:

15 Hz - .02 MHz..Audio Frequency (AF)

3 - 30 MHz.....High Frequency (HF)

30 - 150 MHz.....Low-Band, Very High Frequency (VHF)

150 - 300 MHz....High Band, Very High Frequency (VHF)

300 - 3,000MHz...Ultra High Frequency (UHF)

Sometimes, amateurs refer to frequency bands in terms of **wavelength**. Wavelength is just another way of specifying frequency. For example, the amateur VHF band 144 - 148 MHz is often called the "2-meter band". If you don't like to convert, here are some of the radio services you may have heard of.

Name	*Frequency*	*Modes*	*Notes* (useful distances)
Amateur 80-meter band	1.5 - 1.8 MHz	CW & SSB	several hundred miles
Amateur 40-meter band	3.0 - 3.5 MHz	CW & SSB	" & longer (+3000 mi)
Civil Air Patrol HF	approx. 4.585 MHz	SSB	" & longer (+1000 mi)
Amateur 20-meter band	7.0 - 7.15 MHz	CW & SSB	long distance
Amateur 15-meter band	approx 14 MHz	CW & SSB	long distance
CB "11-meter" band	approx. 27 MHz	AM & SSB	local, some "skip"
Amateur 10-meter band	approx 28 MHz	CW, SSB, FM	local, some "skip"
Sheriff "Lo Band"	approx 39.5 MHz	FM	local
Fire Service "Lo Band"	approx 44MHz	FM	local
Amateur 6-meter band	approx 50 MHz	SSB, FM	local
Aircraft VHF	100 - 130 MHz	AM	line-of-sight
Amateur 2-meter band	144 - 148 MHz	FM	line-of-sight
CAP VHF	approx 148 MHz	FM	line-of-sight
Hi-Band VHF Pub. Ser.	150 - 170 MHz	FM	line-of-sight
ASRC/MRA	155.160 MHz	FM	line-of-sight
Amateur 70cm "220" band	220 MHz	FM	line-of-sight

Note that HF frequencies are used for long distance communications. This is because the HF waves bounce off the ionospheric layer of the atmosphere back to earth, and thus are propagated to faraway places. VHF and UHF, don't bounce, and thus are limited to line-of-sight communications. The low band VHF frequencies will bend somewhat over hills, but not as much as HF will.

You should be asking at this point, "Why don't we use HF for SAR?" The answer is in several parts. First, HF handhelds are are very difficult and expensive to make. Second, the frequencies are crowded, with the long range of HF. Third, efficient antennas must be a sizeable fraction of the wavelength. For example, a 40-meter HF quarter wave whip antenna would be about 10 meters long, a bit unwieldy to carry around in the woods.

There are several important **advantages** to VHF as well. First, VHF-FM handhelds are easy to build. Second, you don't have to worry about talking to someone in California when all you need to talk to is Base Camp. Third, good antennas are easy to handle. For instance, a quarter wave whip at 2-meters is only 18 inches long. Finally, the problem of talking around mountains and over long distances can solved by the use of ***repeater stations***. A repeater is a powerful rebroadcast station, usually on a mountain or a radio tower. If you can get close to line of sight to the repeater, you can talk to someone else similarly situated, even if you do not have line of sight to them. It works like this:

	Tx	Rx
Users	A	B
Repeater	B	A

Everyone transmits on "A" and listens on "B". The repeater listens on "A" and transmits on "B".

A repeater listens on frequency "A" (the *input*) and retransmits what it hears on frequency "B" (the *output*). Repeater users transmit on "A" (the repeater input) and listen on "B" (the repeater output). This system is often called "duplex" operation, as two frequencies are used to pass traffic.

All users have the same transmit and receive frequencies, so many users may use the same repeater. Often, the channel switch is set on the radio so that Channel 1, for example, is transmit (Tx) A / Receive (Rx) B.

Since everyone is listening on "B", what if someone were to transmit on "B", the repeater output? Everyone within line of sight of this person could hear him, if the repeater did not cover him up, but he would not be going through the repeater. This could be handy for sensitive or local communications. Two people who cannot talk to each other through the repeater, yet are just 100 feet apart could talk to each other and listen to each other on the same frequency ("B"). This is called simplex operation, because everyone receives and transmits on the same frequency.

Many public service frequencies are shared by several users/agencies. A particular agency does not want to listen to everyone on the frequency, they only wants to listen to their own people. A way to do this is known as **continuous subaudible tone squelch, CTCSS**, "private line", but best known as "PL", has gained wide acceptance. With this system, a particular subaudible tone (below normal hearing range) is added to the audio of the transmitter by an **encoder**. Each receiver has a **decoder** attuned to that particular PL tone. When a signal is received with the proper PL tone, it turns the radio's speaker on. If a signal without the proper PL tone is detected, the radio's speaker remains

off. Thus the annoyance to listen to everyone else on the frequency is overcome. It would be easy, however, to pick up the mike and interfere with others you can't hear. (This is an important point, different PL tones are not the same as different frequencies) Therefore, you should always disable the PL "tone squelch" before transmitting. This way , you will hear everyone on the frequency, and thus you won't interfere with them. Some mobile radios are provided with a **mike switch**, which disables the tone squelch (if it is on) when you pick the mike up from the clip. This way, if someone else is on the frequency, you will hear them when you pick up the mike.

Practical Aspects of Radio Operation

Antennas

The first and most important aspect of radio operation in the field is the ***antenna***. Say you have a handheld with a "rubber duckie" antenna on it, and you have a "LOW 1w / HIGH 4w" switch for the power output. You will probably stay on the low power setting most of the time to save power, as the high power setting consumes four times as much power when transmitting. All other things being equal, going to high power gives you twice as much "talk power". (You have to increase your power by four to increase your talk power by two.) When you go from 1w to 4w, you double your power twice (1w-- > 2w, 2w-- > 4w), and we say say you increase signal strength by 3 decibels (3dB) each time it doubles. Thus, going from 1w to 4w is a 6dB gain. Now it turns out that a "rubber duckie" is not very good as an antenna since it sends a lot of RF energy straight up in the air, and all of this energy is wasted. It turns out that if you switch from a duckie to a quarter wave whip (an 18" piece of wire), Mission Base hears you as if you had just doubled your power (the quarter wave whip concentrates its power on the horizontal plane). So, transmitting with 1w with a quarter wave whip sounds like 2w with a duckie.

There are two great advantages to the quarter wave whip; you still actually put out only 1w, thus saving your batteries; it also turns out that you hear Mission Base as if they had doubled their power! A quarter wave whip gives you 3 dB gain in both transmit and receive, without increasing battery drain.

It gets even better - if you use a 5/8 wave whip (48 inches of wire plus a loading coil at the bottom) your signal is even more directional, and you get 6dB gain over a duckie! So low power with a 5/8 wave whip is the same "talk power" as high power with a duckie, plus 6dB gain on receive. So if you want to carry something to make your team's radio work better, grab a couple of extra antennas.

Just a few more things about antennas. Now that you know that antennas are directional in the horizontal plane, you know to hold your antenna straight up and down (unless you're talking to an aircraft overhead). Also, antennas work best with a **ground plane** underneath; that's why a 1/4 wave antenna on a car roof works better than one in the hand. The handheld and your body provide a ground plane, but not a very good one. Setting the radio on a metallic surface, like a car roof, might improve your radio's performance. And since VHF is line of sight, a few feet of elevation may make a world of difference (when all else fails, climb a tree). Since even the wavelength of VHF (2-meters) is comparable in size to bridge struts, trees, boulders, and human bodies, many reflections may superimpose to produce "dead" spots or *good* spots. A few seconds experimentation may produce a 10dB difference in communication.

Radio Controls

Two radio controls you will use most are ***volume*** and ***squelch***, and deserve some comment, even though you probably know how to use them. The **volume control** adjusts the audio amplifier feeding the speaker, but *nothing else* By changing the volume setting, you change the loudness of the sound issuing from the speaker, but the radio receiving or transmitting qualities of the radio are unaffected. When transmitting, the loudness of your outgoing signal is affected only by the loudness of your voice and how you hold the microphone. The transmit "volume" is set internally in the radio and is almost impossible to adjust in the field.

The **squelch control** is similar to the volume control in that it affects the sound issuing from the speaker, but otherwise it does not influence the operation of the radio circuitry. The squelch circuit turns the speaker off; it will turn the speaker on only under certain circumstances. For instance, the PL decoder "tone squelch" explained earlier will turn the speaker back on only when it hears the proper PL tone. The standard squelch on most radios, known as **carrier squelch**, turns the speaker back on only when it hears a strong enough signal. How strong is "strong enough"? You set that by turning the squelch control knob. The next time you have a chance to play with an ASRC, CAP, or Ham 2-meter radio, do the following:

1. Turn the squelch all the way down. You should hear the normal background noise from the speaker. At this setting, even the normal background noise is "strong enough" to cause the squelch circuit to turn the speaker on. The squelch is now *off* even though the radio is on, because the squelch is not interfering with the radio by turning the speaker off.

2. Have someone with another radio give you a test transmission, just a carrier with no modulation (don't talk). Note the way the background noise disappears when your radio picks up the carrier; this is **quieting**, and you can tell the other station he's at "full quieting" at your location, because his signal is blocking out all of the background noise.

3. You probably realize that listening to the background noise all the time could being quite annoying. That's the main reason for having the squelch control. Turn up the squelch control to the point where the noise just disappears; you have just told the squelch circuit that an incoming signal must be slightly stronger than the background noise before it should turn on the speaker. This is where you should normally set the squelch.

There are two things regarding the squelch which are probably obvious, but bear repeating. If you turn the squelch all of the way up, you will probably miss a lot of communication from the weaker stations. Also, if you have the squelch set at a normal level and still have trouble copying a weak station, sometimes it helps to turn the squelch all the way down for a minute . Turn the volume down first to avoid being "blasted" by the background noise.

Equipment for the Outdoors - A SAR Essential

A Cold Night on Clynch Mountain, Virginia

Mark Pennington and I were sitting down one Friday evening after the first night of the Ground Search and Rescue College discussing that weekend's planned activities and remarking about how the weather was truly favorable for SAR training (it was damp, cold, and miserable). Suddenly Dave Carter (the College Coordinator) came up to us and stunned us with the news that a small aircraft was missing over Southwest Virginia and that the State Police had received a report of a fireball and an explosion on Clynch Mountain near Lebanon, Virginia. Within the hour, a team had been formed out of some of the cadre and students of the College and was enroute to Lebanon.

Upon arrival (0345), and after coordinating with the local emergency services agencies for xerox copies of gridded topo maps, we established a Base Camp at the foot of the mountain. The weather was tolerable, 50° F and partly cloudy. In the faint starlight we could just make out the shape of the mountain as we donned our gear and prepared for our ascent.

At we began our trip up in the back of a four wheel drive pickup, our thoughts began to turn to the matter at hand. Do we have everything? Is Lifeguard 10 (a commercial medical evacuation helicopter) alerted? Are we really prepared for this?

Less than 1/3 of the way up the mountain road, the truck became mired in the mud which we soon realized made up much of the this road. As we continued our way up the road, our headlamp made clear to all the extent of the mud - we were sinking in better than 6". Those with gaiters smiled at their more unfortunate compatriots and continued on.

As we reached the top, dawn was beginning to be seen, and as we took a ten minute break, we realized it was cold, *really cold*! And foggy, and rain! Damn!!! People dug into their field packs and withdrew extra wool sweaters, and rain gear. Those more equipped snuggled comfortably into their balaclavas, munching on quick energy food.

After everyone was ready, we a local rescue squadsman around the mountain towards the area where the fireball was spotted, and where they had looked the previous night and "smelled something funny". Just before we arrived, we extended into an open line sweep, and walked right into the wreck!

We accounted for two victims immediately, and as we searched for what we assumed (based on the severity of the wreck - IMPORTANT Lesson - never assume!) was the third victim, a group of local rescue squadsmen responding up the mountain to the site discovered the very much alive Tamara Sisk. Paramedic Ralph Wilfong and EMT David Sawyer responded down the hill to provide medical support to the subject. Though the team was well equipped with Advanced Life Support Equipment, the subject was found to be in such as state of hypothermia that her peripheral circulation had ceased and we were unable to initiate IV therapy in the field to infuse warm fluids.

The next step was to commence a slow (another problem with a hypothermic patient includes producing extreme irritability of the heart - a sharp jolt could initiate a heart attack) semi-technical evacuation down the mountain approximately 2 1/2 miles. Ed Black and Rhoadie assisted me in rigging the team technical gear to prepare the belay system and also helped train the litter team comprised mostly of inexperienced but willing rescue squadsmen.

Two hours later we delivered Tamara Sisk to a waiting Lifeguard 10 helicopter for a trip to Roanoke Memorial Trauma Center from which she was soon transferred to the UVa Medical Center in Charlottesville. Today, Tamara Sisk is alive and well and living in Springfield, Missouri.

We traveled back to the GSAR College that afternoon, after which the students continued their training and the staff indulged in a wild orgy of pizza, beer, and SAR stories at a local pizza establishment.

Moral of The Story

This rescue was successfully accomplished and resulted in the saving of a life for only one reason - the team and its members were equipped properly so that all necessary actions could be taken. Very easily a rescuer, ill-equipped for the weather and unprepared for the temperature change at the top of the mountain, could have himself become a victim of that mission. That no one was injured during the entire extent of the mission was due in great part to the professionalism, training, and preparation made many months before.

Personal Equipment

Personal equipment is to a very large degree a matter of tastes. One person's castle is another person's nightmare. But there are some essentials and general rules which should be followed. The following list is considered to be the **10 Essentials**, which in varying degrees and amounts should be carried by all.

The Ten Essentials

1. *Shelter - a tent, tarp, etc.*
2. *Fire Starter - matches, lighter, etc.*
3. *Raingear - to keep dry*
4. *Water - After a day or two without...*
5. *Food - Helps keep the munchies away*
6. *First Aid Kit - Fix the minor (hopefully) stuff*
7. *Flashlight - to see and be seen at night*
8. *Knife - uses too numerous to mention, use it safely!*
9. *Compass - Finding one's way about*
10. *Whistle - to attract attention and guide one into your location*

Each of you should have each of these items in your pack. No exceptions! You health and safety, as well as that of your patient, may depend on your choices made when packing.

The 3-W's

Clothing purchased for the out-of-doors should be selected on the basis of the 3-W's:

W - Windproof

W - Waterproof

W - Wool

If you stick to these guidelines, you will never go wrong. Wind will quickly carry away body heat, so protect the body by wind proofing.

Water when in contact will the skin and allowed to heat up and then wick or perspire away will carry away enormous amounts of body heat. Waterproofing is extremely important in cold, wet climates.

Wool is the material of choice (although some new man-made materials are making a strong showing) for the outdoors. It does not wick water (water will not be drawn up into it), and it will retain a large degree of its insulating ability even when wet.

Additional Sources of Information

There are many good sources of information on outdoor equipment, not the least of which is your local (quality) outdoors store. If you have a good local store, you should find their salespeople quite knowledgeable on topics such as clothing, packs, boots, etc. Make use of them. They can be of enormous help when trying to find what's right for you.

There are also some good books available on equipment and wilderness travel. One of the best ones in my opinion is:

- The New Complete Walker (Third Edition) by Colin Fletcher

I am sure you can find other books equally informative. Remember always: **YOUR LIFE, AS WELL AS THAT OF YOUR PATIENT CAN SOMETIMES HINGE ON THE EQUIPMENT YOU CARRY** Pack well!

Hypothermia

A Summary for Mountain Rescue Personnel

By Keith Connover, MD

Introduction

Hypothermia is a familiar adversary for most of us who work or play in the wilds, and especially for mountain rescue group members. Acknowledgement of the environmental hazards leading to exposure and hypothermia, prevention of exposure by proper clothing and behavior, recognition of incipient exhaustion or hypothermia (they are often indistinguishable), and first aid treatment of borderline hypothermia (candy, warm fluids, shelter, and rest) are essential parts of any competent outdoorsperson's preparation for the wilderness. As mountain rescue team members, we have an additional duty to keep the subtle hazard of hypothermia in the public's eye, and to consciously educate others in the ways of dealing with hypothermia weather.

The point of this article, however, is to deal with hypothermia as a medical problem in the context of caring for our patients. *Trauma* - such as with the victim of a fall; or dehydration and exhaustion - such as with a lost child found after three days search; or medical problems - such as a diabetic or epileptic placed in a suddenly stressful situation during a climb - any of these, even on a summer day, should cause the thought of hypothermia leap to the forefront of a rescuers mind. Hypothermia is not an occasional winter problem, but a probable complication for any wilderness rescue.

The Problem

If we wish to put our field treatment of hypothermia on a sound medical footing, we must go to the medical literature and see what the medical community has to say. However, the footing we find is shaky at best: some authorities say slow rewarming (i.e. blankets and a warm room) is best treatment and results is about a 50% save rate. You can also find an equally reliable report that states such passive rewarming results on 0% survival, but that fast, aggressive rewarming will result in a 50% save rate!

There is a story about three blind men of Cathay who were introduced to an elephant for the fist time; it goes like this: The first blind man put his hand on the elephant's tail and remarked, "Gentlemen! This elephant creature is very much like a rope," to which the second, feeling the elephant's leg, replied: "Nay, you are much mistaken, for it is much like a stout tree," and of course the third blind man, feeling the poor creature's trunk said: "Are you guys out of your minds? Its obviously some kind of snake!" The point is, of course, that natural phenomena may

present disparate, almost contradictory faces to us when we lack the perspective or sense to comprehend it as a whole.

Perhaps we can stretch the analogy to encompass hypothermia, as it can be classed into (at least) three different types, with with widely varying characteristics: **acute, subacute, and chronic hypothermia**. These terms are somewhat arbitrary, but few doctors even think much of accidental hypothermia, much less of its disparate nature, so there is little agreement on terminology as yet. But before delving into these three diseases, let us detour briefly into a review of the normal physiological response to cold stress.

The Physiological Response to Cold

If one is suddenly thrust into a cold environment, the first response to cold is **vasoconstriction** or shrinking down of the skin (peripheral) blood vessels. This reduces heat loss from the body's core, and creates an insulating layer of colder skin around the core. If one's body sense's that stronger measures are required to keep the temperature of the vital core organs (i.e. heart and brain) close to normal, the metabolic rate will increase, either through work or involuntary shivering. Shivering can increase the metabolic rate and therefore heat production up to about seven times normal, but at the cost of exhausting one's liver and muscle glycogen, which are a human's main quick energy stores.

Fatigue, the buildup of toxic waste products, may complicate this *exhaustion* of energy stores. At the same time shivering occurs, vasoconstriction becomes very intense; this decreases the effective size of the body's blood vessel system and the body responds by getting rid of (what seems to be) excess fluid through **cold diuresis**, in which the kidneys excrete copious quantities of body fluid as urine. The resulting **dehydration**, combined with exhaustion and fatigue, may present the classic signs and symptoms of hypothermia, even though the core temperature is close to normal. If the cold stress isn't terminated, the body's compensatory mechanisms begin to fail, causing the core temperature to fall precipitously, producing hypothermia.

Acute Hypothermia and Rapid External Rewarming

The scenario we have just described is probably the major way hypothermia develops in mountaineering and backpacking situations, but it is possible for the cold stress to be so overwhelming that normal compensatory mechanisms are rendered totally impotent - for instance when a cross country skier unexpectedly breaks through the ice into icy water. This **immersion hypothermia** may also be termed **acute hypothermia** (acute meaning severe and of quick onset), and develops so quickly that exhaustion, fatigue, and dehydration are not conspicuous as with long, moderate cold stress. The current recommendation is for victims of cold water immersion to stay still, to huddle up to conserve energy, rather than to increase heat production, as movement in the water increases heat loss (by increased convection) more than it does heat production. The treatment for acute hypothermia is uncontroversial: rapid, aggressive rewarming is best. The Royal Air Force recommends the rewarming of the *clothed* victim (removal of clothes is time-consuming and dangerous for it can cause an increase in heat loss just as movement in water can) in a tub of hot water at 45°C (115°F). For an unclothed victim, the temperature should probably be kept at about 40°C (105°F). Rapid warming, however, may in itself cause serious problems; for instance, with any external rewarming method, there is an **afterdrop** in core temperature. The first effect of external warming is **reflex vasodilatation** resulting in the return of cold blood from the peripheral blood vessels to the body core, further depressing core temperature. The blood which has lain stagnant in the periphery, in addition to being chilled, has had most of its oxygen used up, and has collected toxic waste

products from **hypoxic** peripheral tissue. At the same time, the dialation of the peripheral vascular vessels expands the volume of the cardiovascular system, so **rewarming shock** may be recognized by a sudden drop in blood pressure (which should generally increase slowly and surely during rewarming). The combination of afterdrop, stagnant blood, and rewarming shock may be too much for the heart, resulting in cardiac arrest. A simple way to minimize these effects is to leave the victim's arms and legs out of the warm tub, and to rewarm the extremities only after the torso is rewarmed. Even with this caution, constant monitoring of the vital signs is required, and the rate of rewarming may need to be slowed by reducing the temperature of the rewarming tub water. With prompt and proper treatment of acute hypothermia the survival rate is probably better than 90%. A final note: many immersion hypothermia victims cannot rewarm themselves if insulated, so active rewarming is absolutely necessary.

Subacute Hypothermia and Internal Rewarming

Let's now go back to the scenario of physiological response to cold and pickup where we took off: now we will discuss **mountain hypothermia**, also known as **exhaustion hypothermia** because exhaustion is such a prominent feature. To pin a more definitive medical term on it, we may call it **subacute hypothermia** (slower of onset and severity than acute hypothermia). Whatever name you give it, this type of hypothermia is the bane of wilderness travelers and mountain rescue operations. There have been various attempts to correlate signs and symptoms, core temperature, and the seriousness of hypothermia, but most schemes are gross oversimplifications (including the one offered in Table 1 and the following descriptions) and must be viewed primarily as a teaching tool rather than as a useful diagnostic or therapeutic classification.

The scenario of exposure presented earlier, with core temperature normal or slightly depressed, and with strong body compensatory mechanisms, could be termed **Stage I** or *compensated hypothermia.* **Stage II** or *crisis hypothermia* is when energy reserves near depletion, and the combination of depressed core temperature and other factors severely interfere with voluntary thoughts and action. **Stage III** or *decompensated hypothermia* is when one's core temperature is at the mercy of the environment and drops quickly, and **Stage IV** is where the body has reached an *equilibrium of sorts with the environment* and is often indistinguishable from death. The factors classically associated with these stages is presented in Table 1, but let me reemphasize that this table, in its attempt to enforce order on a complicated process, may mislead if taken too seriously.

With subacute hypothermia, the problems of external rewarming mentioned in the section on acute hypothermia are multiplied, and exhaustion, fatigue, and dehydration are present as primary problems in their own right. Supportive care, including the reduction of cold stress, the provision of energy (glucose), and the correction of fluid and electrolyte deficits (oral or IV fluid replacements) is important, but is useless unless the the victim can be rewarmed without causing further harm.

One possible means to minimize the ill effects of sudden rewarming is to slow the rate of rewarming. Of course, in most mountain rescue situations, tubs are rare, so slower rewarming is a necessity, even with devices such as a hydraulic sarong or with hot packs at the groin, armpits, and neck. However, a relatively new method of rewarming using moist inspired air seems to solve some of the problems of active rewarming: the afterdrop is reduced by 2-3°C, and the danger of rewarming shock is much reduced. The one major criticism of the method (other than mechanical details of the apparatus) is that it does not deliver as much heat as other external methods. However, loss of heat from the lungs is proportionately high in cold, dry air and the combination of rewarming and "effective insulation" makes quite a large contribution to rewarming in the field. It is possible to place a hypothermia victim in a stokes litter, insulate with a sleeping bag and

ensolite pad, add heat packs at high heat exchange areas, and put on a chemical warm air or oxygen system, thus rewarming the victim during the evacuation.

If a mountain hypothermia victim is in close proximity to a tub of hot water, active external rewarming can be used effectively, but the danger is greater than with rewarming an acute hypothermia victim and the dangers associated with rewarming increase in proportion to the time the person has been hypothermic. Patients in Stage III or IV are so difficult to rewarm without complications that it would be best to avoid hot water immersion rewarming except in a medical facility. The use of heat packs and a chemical inhalation rewarming system would offer much safer (but slower) means of rewarming, but for those who have been in Stage III or IV for a long period, it may be safer to treat as described below under chronic hypothermia.

Chronic Hypothermia

Having now examined two facets of hypothermia, let us now turn to the third; **chronic hypothermia**, which is a decrease in core temperature over a long period of time without massive cold stress. Chronic hypothermia is more of a catch-all term than a descriptive classification, but generally victims of chronic hypothermia have a depressed core temperature due to some dysfunction of thermoregulation rather than cold stress. Particularly susceptible are those with impaired central nervous system thermoregulation such as the elderly, the newborn, and those taking certain drugs. Alcohol and barbiturates may cause chronic hypothermia, as may metabolic and other diseases. The course, treatment, and the outcome are more dependent on the primary disease state than on the extent of hypothermia or the core temperature, and the presentation to the rescuer may be quite varied, reflecting the differences in the primary disease. Many victims of chronic hypothermia present with a *depressed level of consciousness, ketoacidosis* (keto acids in the blood as in diabetic coma) with acetone or "fruity" breath, and *generalized edema* (swelling and puffiness of the skin). Chronic hypothermia is more a disease of urban areas than the wilderness, but mountain rescue teams may encounter chronic hypothermia in search subjects who have been lost, starving, and dehydrated for many days.

The in-hospital treatment of chronic hypothermia is controversial and will probably remain so for years, but it is clear rewarming should not be attempted in the field. victim should be insulated from further heat loss and perhaps *slightly* rewarmed (warm oxygen inhalation is probably safest) and gently carried out for definitive care. The metabolic imbalances are too severe, and too difficult to diagnose, for field treatment to be effective.

General Care of Hypothermic Patients

All mountain rescue team members should be familiar with the standard principles of emergency management as taught in basic Emergency Medical Technician (EMT) courses, and their adaptation to a wilderness setting, so basics such as airway management, and the monitoring of vital signs will not be addressed here. However, there are several important points in the management of hypothermic patients which might not be apparent even to an experienced mountain rescue EMT or MD. Since the background of these principles may be unclear or controversial, yet the emergency care care implications are clear and uncontroversial, they are presented in somewhat of a dogmatic way.

1. **A cold heart is an irritable heart**

   An attempt at endotracheal or esophageal obturator intubation, or even a good solid bump to the litter may send a hypothermic patient into ventricular fibrillation. Handle hypothermic patients *gently*.

2. **Advanced Life Support (ALS) doesn't work on hypothermic patients.**

It is impossible to defibrillate a hypothermic heart, and most emergency drugs have little or unpredictable effects on a hypothermic patient. Drugs administered to a hypothermic patient will probably exert all their effects simultaneously when the patient is rewarmed. The one prehospital ALS measure generally thought to be useful is the administration of warm normal saline or other IV fluids, but finding a good vein in a hypothermic patients is well-nigh impossible.

3. **No victim is dead until they are warm and dead**

Severe hypothermia mimics death. If in doubt, try to resuscitate, because the brain can survive much more than the standard 4 to 6 minutes without oxygen when its metabolism is depressed by the cold. In cases of cold water immersion, anoxia survival time is even greater due to the mammalian diving reflex.

4. **Check carefully for a pulse**

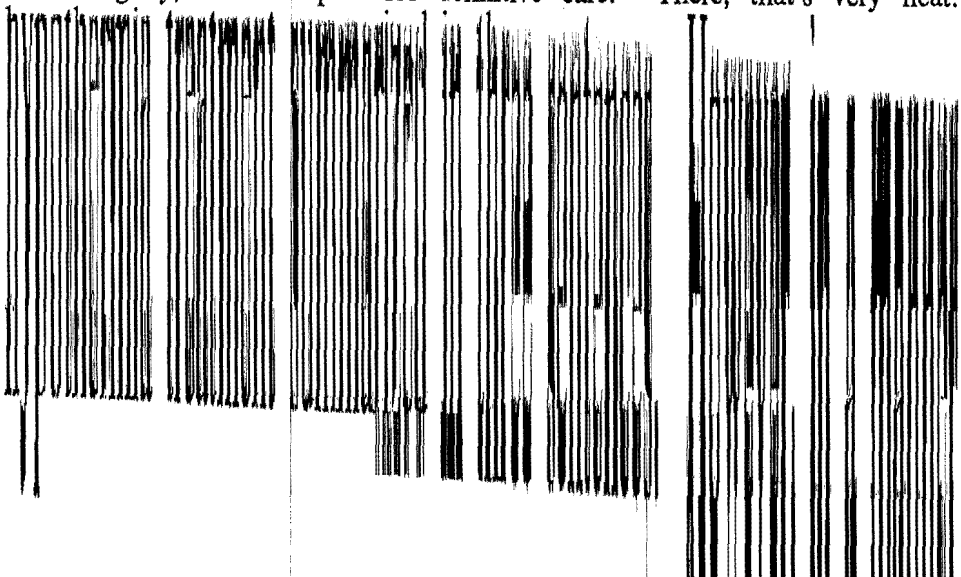
When a hypothermic patient is found, there is a vital decision to be made: does the victim have a pulse? If there is a pulse, even if it is very slow and can be detected only by a stethoscope, it is probably enough to supply the minimal needs of a hypothermic body. So in a severely hypothermic patient with a pulse, the appropriate course is to insulate and perhaps rewarm slightly, to perhaps support ventilation slightly, but mostly to carry the patient out for definitive treatment. If on the other hand, there is no pulse, the alternatives are to (1) start CPR and continue it until the victim is carried out, or (2) to start CPR and arrange for definitive rewarming on the spot. Starting CPR on a patient with a slow but adequate pulse will almost certainly cause the hypothermic heart to go into fibrillation, so check carefully for a minute or so for a pulse. Remember, time isn't as critical as with a warm cardiac arrest victim on the street.

5. **Keep the litter level**

Evidently the circulatory state of hypothermic patients, especially victims of subacute hypothermia, is quite delicate. Carrying the litter with the head elevated may be enough to cause severe convulsions and perhaps death from cerebral anoxia.

Conclusion

For acute hypothermia, rewarm as quickly as possible. For moderate subacute hypothermia, rewarm actively but preferably internally, and if warm water immersion is used, it should be less aggressive than with acute hypothermia rewarming. For deep subacute hypothermia and chronic hypothermia, insulate, rewarm slightly, and transport for definitive care. There, that's very neat:



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