Module # 5 – Component # 2

Navigational Skills Part# 2

Identifying Peaks and Features

“All mountaineers know how valuable it is to study beforehand an intended route over new ground from a height at some distance. None but blunderers fail to do so, if it is possible; and one cannot do so too thoroughly. As a rule, the closer one approaches underneath a summit, the more difficult it is to pick out a path with judgement. Inferior peaks seem unduly important, subordinate ridges are exalted, and slopes conceal points beyond; and if one blindly undertakes an ascent, without having acquired a tolerable notion of the relative importance of the parts, and of their positions to one another, it will be miraculous if great difficulties are not encountered.”

Edward Whymper

Sometimes a visual identification by terrain association of a feature – a river, hill, peak or road for example – is not accurate or you cannot be certain that your identification is correct. You may be able to see the object but are trying to identify it positively on the map.
Identifying an unknown feature:

1) Hold your compass flat and point the direction of travel arrow at the feature you want to identify.
2) Turn the compass housing until the orientating arrow lies under the north end of the magnetic needle.
3) Read off the bearing at the index mark and convert to grid north. Set this bearing on the compass.
4) Lay the compass on the map (do not worry about the way the map is facing as you are using the compass as a protractor) with one of the long sides of the compass on the point you are at and with the orientating lines lying parallel to the north grid.
5) Look along the line formed by the side of the compass drawn from your position, continued across the map, and you should be able to identify the feature.

Being able to identify and locate selected features both on the map and on the ground is essential to your success in navigating.

The following may prove helpful.

1) Be certain the map is properly orientated as you move along your route, and use the terrain and other features as guides (terrain association). The orientation of the map must match the terrain or you will become completely confused.
2) To identify features being used as guides, look for the steepness and shape of the slopes, the relative elevations of the various features, and the directional orientation in relation to your own position and to the position of the other features you can see.
3) Make use of the additional clues provided by hydrography, culture and vegetation. All the information you can gather will assist you. The best practice for this movement technique is to go out in the field and use it. There is no other way to learn this skill.

Despite the above you will only be able to identify the features if you have a sound knowledge of contours, so practice, practice, practice.
<table>
<thead>
<tr>
<th>3) Align orienting lines parallel with Grid North by rotating the whole compass, not the capsule</th>
<th>1) After you have sighted the Bearing from the feature you wish to identify, convert for Magnetic Declination.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your Known Position</td>
<td>4) Feature you wish to identify will be in line with the front of the compass</td>
</tr>
<tr>
<td>2) Place the compass on the map with the back of the compass on your known position</td>
<td>NOTE: You are not using the magnetic Needle during this process so ignore it.</td>
</tr>
</tbody>
</table>

**Identifying a feature**
Finding Yourself

Knowing where you are is a fundamental requirement every navigator needs to know before they can plot routes to someplace else. If you don’t know where you are, you cannot plot a route. This section deals with a few methods of finding yourself.

Resection

Resection is a triangulation method of locating one’s position on a map by determining the bearing to at least two well defined features, then using that bearing to plot your whereabouts on the map. For greater accuracy, the desired method of resection would be to use three or more well defined locations.

The method employed using a map and compass is as follows:

1) Select at least two or three features that you can identify from the map. These features should be at widely different angles from each other (90 degrees being ideal).
2) Holding the compass fat, point the direction of travel arrow at one of the features identified.
3) Turn the compass housing until the orientating arrow lies under the north (red) end of the needle.
4) Read off the bearing shown at the index mark.
5) With the bearing converted to a grid bearing and set on the compass, place the compass on the map with the orientating lines running parallel to the grid lines, and with the edge of the compass touching the known feature from which you took the bearing.
6) Draw a light line along the edge of the compass and extend it across the map.
7) Do the same with all three features.

Your location is in the centre of the triangle that is formed by the three lines. If your sightings are extremely accurate the lines will cross at one point, but this is very uncommon.

“Oh! Ye immortal gods, where in the world are we?”

Cicero
Orientation lines must be parallel to the maps grid

Direction of travel arrow must point towards feature

Draw a line from the point identified across the map

Place the front edge of the compass on the point you sighted from

NOTE: You are not using the magnetic needle during this process so ignore it.

Carrying out a Rejection to determine your position on a map

Do the same procedure with all three points

Your position (Fix) will be at this point
Resection onto a linear feature (intersection)

Assuming you are near a feature which forms a line such as a river, road or ridge, and you know you are near that linear feature as you can see it close by, it is then easy to take just one bearing and draw it onto the map and your position will be where that line intersects the linear object on the map.

1) Find a distant feature that can be identified on the ground and on the map.
2) Holding the compass flat, point the direction of travel arrow at the feature identified.
3) Turn the compass housing until the orientating arrow lies under the north (red) end of the needle.
4) Read off the bearing shown at the index mark.
5) With the bearing converted to a grid bearing and set on the compass, place the compass on the map with the orientating lines running parallel to the grid lines and with the edge of the compass touching the known feature from which you took the bearing.
6) Draw a light line along the edge of the compass and extend it across the map.
7) Your location is where the line crosses the linear feature you are on or next to.

I must not forget to convert to grid north before drawing my line
4) Once you have orientated the compass, draw a line across the map to intersect with the linear feature.

3) Orientation lines must be parallel to the maps grid.

1) Place the front edge of the compass on the point you sighted from.

2) Direction of Travel arrow must point towards feature.

NOTE: You are not using the magnetic needle during this process so ignore it.

You are at the point that the line crosses the linear feature. In this case a river.
Following a Route

Once on a training course we had a candidate called Gilbert. Now Gilbert you understand had been in the French Foreign Legion and nothing could stand in their way. Through marshland and bog we walked, climbed cliffs, crossed rivers, and the fact that there was a path 50 metres to our right was irrelevant. The shortest route was a straight line.

Following a route you have planned may seem like the simplest thing in the world or it may seem like the obvious. However, many navigators plan a route and then don’t follow it.

There are four basic steps to following a route:

• Know where you are
• Plan the route
• Stay on the route, and
• Recognise the objective.

Know where you are

You must know where you are on the map and on the ground at all times and in every possible way. This includes knowing where you are relative to:

a) Which way are you facing?

b) The direction and distances to your objective.

c) Other landmarks and features around you.

d) Any impassable terrain and danger areas.

e) Both the advantages and disadvantages presented by the terrain between you and your objective.

This is accomplished by knowing how to read a map, recognise and identify specific terrain and other features (identifying peaks and features), determine direction (compass), pace, measure, and estimate distances (pacing, Naismith, timing charts and so on), and both plot and estimate a position by resection and intersection.
Plan the route

Depending upon the size of your group and their skill levels, several factors should be considered in selecting a good route to be followed.

These include:

a) Travel time available.
b) Travel distance to be covered.
c) Conditions underfoot.
d) Availability of resources, such as water, campsites and shelter.

In other words, the route must be the result of careful map study, should satisfy the objective of the trip, time available, be safe and provide for ease of movement and navigation.

The best steering points are linear features that cross the route. Examples include perennial streams, ridges, valleys, path junctions and power lines. Next, it is best to select features that represent elevation changes of at least two contour intervals, such as hills, depressions, spurs and draws. Reliance upon cultural features and vegetation is not recommended because they are most likely to have changed since the map was drawn.

Waypoints located at places where changes in direction are made mark your decision or steering points. During planning, it is especially important to review the route and anticipate where mistakes are most likely to be made so they can be avoided.

Following a valley floor or proceeding along the crest of a ridgeline will generally offer easy movement and good navigational check-points. It is best to follow terrain features whenever you can; do not fight them.

Stay on the route

In order to know that you are still on the correct route, you must be able to compare the terrain you encounter as you move according to the route you developed on the map. This may include following your compass reading (dead reckoning) or recognising various landmarks or checkpoints from the map in their anticipated positions and sequences as you pass them (terrain association). Or, better still, it should be a combination of both.

Other useful techniques to stay on route are funnelling features, steering features and catching features. These all help prevent you from wandering off course. More on these later in this course.
Recognise the objective

The objective is rarely a highly recognisable feature, such as a dominant hilltop or road junction. Even the most inexperienced navigators seldom miss such locations. It is usually an unmarked route turn or possibly some other indistinct feature.

Select an attack point reasonably close to the destination that is not difficult to find or recognise. Then plan a short, last leg from there to the final destination.

For example, you may be able to plan a series of sequenced legs from one landmark to another, using both the terrain and a compass to keep you on the correct course.

Finally, after arriving at the attack point, you might follow a specific compass bearing and pace off the relatively short, known distance to the final objective. This is called ‘attack point’ navigation.
Keeping direction

Staying on route during your trip is a combination of two skills: dead reckoning and terrain association.

Moving by dead reckoning

Dead reckoning consists of two steps. The first is the use of a map and compass to determine the direction and distance to your objective. The second step is the use of a compass and some means of measuring distance to apply this information on the ground.

Triangulation exercises (either resection or intersection) must be done at regular intervals to either determine or confirm position fixes along or near the route.

Between these position fixes, measuring or estimating the distance travelled along the route being followed can establish your location. You might use pacing, a pedometer, or the application of timing charts for this purpose.

Most dead reckoned movements do not consist of single straight-line distances because you cannot ignore natural and man-made obstacles, time, and safety factors. Another reason most dead reckoning movements are not single straight-line distances is because compasses and pace counts are imprecise measures and errors increase over distance; therefore, you could soon be far off course (cross-track error) from your intended route, even if you performed the procedures correctly. The only way to counteract this is to reconfirm your location by terrain association or resection. Routes planned for dead reckoning will generally consist of a series of straight-line legs between several obvious waypoints.

There are two advantages to dead reckoning.

1) Dead reckoning is easy to teach and to learn.
2) It can be a very accurate way of moving from one point to another if done carefully over short distances.

Never try to walk with your compass held in front of you while moving across open country along a magnetic bearing. The compass will not remain steady or level and it will not provide you with the most accurate readings.

Instead, you must begin at the starting point, then face with your compass in the right direction, select a landmark that is located on the correct bearing to be followed, put your compass away, walk to that landmark, and repeat the process as many times as is necessary to reach your objective.
The landmarks selected for this purpose are called steering points or waypoints, and their selection is crucial in dead reckoning. They may be uniquely shaped trees, rocks, hilltops, posts, towers, and buildings – anything that can be easily identified. Do not use waypoints that move, such as animals or clouds. (Yes people do this.) If you do not see a good waypoint to the front, you might use a back bearing to some feature behind you until a good waypoint appears out in front.

**Good waypoints:**

a) Have some characteristics about it, such as colour, shade of colour, size, or shape (preferably all four).

b) If several easily distinguished objects appear along your route, the best waypoint will be the most distant object. This will enable you to travel further with fewer references to the compass. If you have many options, select the highest object. A higher point is not as easily lost to sight as is a lower point, that blends into the background as you approach it. A waypoint should always be visible as you move toward it.

c) Waypoints selected at night must have even more unique shapes than those selected during daylight. As darkness approaches, colours disappear and objects appear as black or grey silhouettes. Instead of seeing shapes, you begin to see only the general outlines that may appear to change as you move and see them from slightly different angles.

**Using a map and compass to follow a route**

1) Using your compass on the map, place the long edge between the point you are at (back of compass) and the point you are heading for. (The length of this stage should be a relatively short distance and form a roughly straight line. The actual length depends largely on the distance to your next objective and the visibility conditions.)

2) With the direction of travel arrow pointing in the direction you will be going, rotate the calibrated ring until the orientating lines are parallel to the grid north lines.

3) Read off the bearing at the index mark.

4) Convert this reading to a magnetic bearing and then set the compass to that bearing.

5) Holding the compass fat with the direction of travel arrow pointing away from you, turn your whole body until the north end of the needle is directly over the north-orientating arrow.

6) Looking in the direction of the direction of travel arrow, find a feature in the distance that is prominent (such as a tree, river junction or peak).

7) Put your compass away and walk towards that feature without checking your compass.

8) On arrival at this feature you can then, using your compass, identify another feature, repeating the procedure until you arrive at the point you wish to get to.
Bypassing an Obstacle

To bypass obstacles and still stay on route, detour around the obstacle by moving at a right angle for a specified distance, bypass the obstacle and return to your original path.

When encountering obstacles on the route, follow these guidelines:

a) Whenever an obstacle forces you to leave your original route to take up a parallel one, always return to the original line as soon as the terrain or obstacle will permit.

b) To turn clockwise (right) 90 degrees, you must add 90 degrees to your original bearing. To turn anti-clockwise (left) 90 degrees from your current direction, you must subtract 90 degrees from your present bearing.

c) When making a detour, be certain that only distance taken toward the final destination is counted as part of your forward progress. This distance (primary distance) should not be confused with the local pacing that takes place perpendicular to the route, in order to avoid the problem area, and in returning to the original line after the obstacle has been passed.

d) Sometimes a waypoint on your direction of travel can be seen across a wetland or some other obstacle that you cannot walk through, but which you can walk around. In this case, walk to the waypoint you can see and then dead reckoning navigation can begin from that point. If there is no obvious waypoint to be seen across the obstacle, perhaps one can be seen to the rear. Work out a back bearing to this point and later sight back to it once the obstacle has been passed in order to get back on track.

e) There are disadvantages to dead reckoning. The further you travel by dead reckoning without confirming your position in relation to the terrain and other features, the more the errors that will accumulate in your movements. Therefore, you should confirm and correct your estimated position whenever you encounter a known feature on the ground that is also on the map. You should also do a periodic resection, using two or more known points to fix and correct your position on the map. Pace counts or any type of distance measurement should begin again each time your position is fixed on the map.

f) Waypoints can be further apart in open country, making navigation more accurate. In areas of dense vegetation; however, where there is little relief, or during darkness or in mist, your steering marks must be close together. This, of course, introduces more chance for error.
For example, while moving on a bearing of 10 degrees, change your bearing to 100 degrees and travel for 100 metres; change your bearing to 10 degrees and travel for 150 metres; change your bearing to 280 degrees and travel for 100 metres; then change your bearing to 10 degrees and you are back on your original bearing line.
Back bearings

Using back bearings are a useful means to keep on direction if for whatever reason you lose sight of your next waypoint.

  a) Convert your magnetic bearing to a back bearing by adding 180 degrees to it if it is less than 180 degrees, or subtracting 180 degrees if it is more than 180 degrees.
     For example, if your bearing is 100 degrees then add 180 degrees to give back bearing of 280 degrees. If your bearing is 200 degrees then subtract 180 degrees to give a back bearing of 20 degrees.

  b) Set the back bearing on the compass and locate the direction of travel arrow.

  c) The direction of travel arrow should now be pointing towards the point where you started that stage. (Your previous waypoint.) If it does not then you have wandered off course and need to correct your position by moving left or right till the arrow is pointing at the previous waypoint to get back on course.

Assume you are always drifting off course.

Use frequent navigational checks to correct this error so that the error does not compound itself. The more frequent these navigation checks are, the closer you will keep to your intended route. If you are aiming to be competitive, too many checks will slow you down so a compromise must be reached.

An easier method to calculate a back-bearing is to simply align the south end of the compass needle with the north orientating arrow. This then gives you the back bearing.

Instead of calculating like explained above, simply set the south end of the compass needle on the orientating arrow to get the back bearing.”
Moving by terrain association

The technique of moving by terrain association is more forgiving of mistakes and less time consuming than dead reckoning. Once an error has been made in dead reckoning, you are off the track. Errors made using terrain association are easily corrected however, because you are comparing what you expected to see from the map to what you do see on the ground, and so errors are anticipated and will not go unchecked.

You can easily make adjustments based upon what you encounter. Periodic position fixing with a compass or estimated resection will also make it possible to correct your movements. Moving by terrain association does require good visibility however.

Unless highly experienced and in possession of the right navigational tools & skills in restricted visibility the safest way to navigate is DON'T. Rather sit it out rather than stumble around.
Using terrain association

a) By observing the contour lines, the five major terrain features (hilltop, valley, ridge, depression, and saddle) should be determined. This is a simple task in an area where you have a good view of the terrain in all directions. Match the terrain features on the map with the same features on the ground. In restricted visibility, this procedure becomes harder. Constant checking of the map as you move is required.

b) When comparing the vegetation, a topographic map should be used to make a comparison of the clearings that appear on the map with the ones on the ground. The age of the map is an important factor when comparing vegetation, as some important features were likely to be different when the map was first compiled.

c) The vegetation could camouflage distinguishing landforms, making it harder for the navigator to use terrain association.

d) Inland bodies of water can help during terrain association. The shape and size of dams and lakes in conjunction with the size and direction of flow of the rivers and streams provide valuable information.

e) Man made features could be a significant factor. The user must be familiar with the symbols shown in the index representing those features. The direction of buildings, roads, bridges, high-tension lines and so forth will make terrain association easier; however, the age of the map must be considered because man made features change over time.

If following a marked trail it is important to occasionally check the map to confirm your position on the trail. No navigator should ever be in a position where he/she doesn’t know exactly where he/she is on the map.

Bad weather could close in around you at any time and prohibit you from seeing the features you need for reference.

The major disadvantage to navigation by terrain association is that you must be able to interpret the map and analyse the area around you. Recognition of terrain and other features, the ability to determine and estimate direction and distance, and knowing how to set position fixes are skills that are more difficult to teach, learn, and retain than those required for dead reckoning.

The most successful navigation is by combining the techniques. Constant orientation of the map and continuous observation of the terrain in conjunction with compass read bearings, and distance travelled on the ground compared with map distance, used together, make reaching a destination more certain.
Collecting features

These are large features that you must pass en route to your destination. Note them on your route card before leaving on the next leg of your route and mentally tick them off as you pass by. Collecting features include peaks, tracks, rivers, vegetation changes and any other feature that can be easily seen or noticed. Passing an expected collecting feature confirms you are still on your route.

A collecting feature that is also a feature near your destination becomes an attack point. (See restricted visibility navigation.)

Catching features

Sometimes you notice a prominent feature on the map that is past where you want to go. These have their uses even though you did not plan to walk that far.

Arriving at a catching feature immediately means you have overshot the mark. Having done so, it is a simple matter to retrace the short distance to your destination. This is much better than aimlessly carrying on in the hope that you are still on track. Knowing there is a catching feature somewhere up ahead also means you can proceed with some speed towards your destination, confidently knowing that if you go too far you will be ‘caught’ by the catching feature.

Funnelling features

Funnelling features are suitable features which channel you naturally in the right direction – for example, you may be walking between two ridges, or a river and a fence. Crossing either of the funnelling features will indicate that you are moving off your intended path.

When planning your route on the map, try to identify the funnelling features and write them down on your route card, or indicate them on the map so you do not forget to use them.

Steering features (waypoints)

Steering features are normally used when using dead reckoning for navigational purposes.

They are the features on your route you want to head for and where you will probably be changing direction. Once you have identified a steering feature in line with your compass direction of travel arrow, test it by turning around and looking back again to see if you are still able to pick out that same steering feature. This test will ensure you do not lose track of your steering feature and it is properly memorised before you head off towards it.
This ridge could also be a Catching Feature.

Catching Feature

Planned Route

Viewpoint

Funnelling Feature

Navigational Skills Part # 2
© Andrew Friedemann
Crossing parallel features

Parallel feature errors can be made on a route with lots of similar features. You may have to cross many parallel ridges, and if you miscount the number you may find yourself on the wrong one and not know whether you have gone too far or not far enough. This can easily happen if, in the fine detail of the map, one of the ridges does not even show up due to the contour interval being larger than the feature.

The same can happen for streams and even trails. It is then a matter of sitting down and carefully figuring out exactly where you may be by observing the surrounding features and possibly carrying out a full resection.

Cairns and other forms of way-marking

On popular routes, often off trail, routes are sometimes marked using cairns or other more formal route markers. Cairns are simply piles of rocks or a couple of stones which indicate the ‘way to go’. They are general guides and should not be relied on totally as they are sometimes wrong. Cairns can be easy to spot or quite difficult, depending on the terrain, but whatever type they are they can be great confidence boosters, as you will know you are generally on the right track. Sometimes painted footprints or signs are used to indicate the ‘way to go’ as well, so keep a sharp eye open for these and other signs.
Different Types of Terrain

“The examination of an intended route from a height at a distance will tell one a good deal, and will enable him to steer clear of many difficulties against which he might otherwise blindly run, it will seldom allow one to pronounce positively upon the practicability or impracticability of the whole of the route. No living man, for example, can pronounce positively from a distance.”

Edward Whymper

The information you have learnt so far will help you to navigate in most areas; however, there are some special considerations and helpful hints that may assist you in various specific environments.

<table>
<thead>
<tr>
<th>Type of terrain</th>
<th>Maximum distance covered in one hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical rain forest</td>
<td>up to 1000m</td>
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<td>500m</td>
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</tr>
<tr>
<td>Tall grass</td>
<td>500m</td>
</tr>
<tr>
<td>Swamps</td>
<td>100 to 300m</td>
</tr>
<tr>
<td>Plantations</td>
<td>2,000m</td>
</tr>
<tr>
<td>Trails</td>
<td>up to 5,000m</td>
</tr>
</tbody>
</table>
Desert terrain

Deserts are large arid areas with little or no rainfall during the year. There are three types of deserts: mountain, rocky plateau, and sandy or dune deserts.

Desert navigation

Temperatures in the tropical deserts reach an average of between 40 and 50 degrees Celsius during the day; so most navigation takes place at night using the stars, even if other conventional means are available. At night-time, following stars for short sections is the easiest way to keep direction as the lack of pollution tends to make the stars much brighter. Many deserts have some prevailing winds during the seasons. These winds create specific patterns in the sand dunes, giving the navigator a regular set of features.

When in the broad basins between mountain ranges or on rocky plateau deserts, there are frequently many terrain features to guide your path, but observing these known features over great distances may provide a false sense of security in determining your precise position, unless you frequently confirm your location with resections or GPS. It is not uncommon to miscalculate by several kilometres when estimating a position using just terrain association, as distances are often much further than they seem due to the absence of trees or other features your eyes use to judge distance. Making distance errors when guessing the distance to a feature of between 2 and 300 percent is not uncommon.

Visibility conditions may be severely restricted by sandstorms and mirages (heat shimmer caused by air rising from the extremely hot daytime desert surface).

When walking in an area with few visual cues, or when visibility is restricted by a sandstorm or darkness, you must proceed by using dead reckoning techniques or using a Global Positioning System receiver (GPS).

Due to constant changes in terrain and the relative unimportance of mapping in desert areas, many desert maps are inaccurate. In desert mountain areas, contours are generally infrequent due to flat terrain, and many of the intermediate relief features are not shown. It is not uncommon to not see a single contour on a whole 1:50 000 map sheet.

Remember as well that due to the heat and soft underfoot conditions in many desert areas, the distance you may be able to cover in a day may be much shorter than normal. Legs of routes in desert navigation usually revolve around getting from one water source to another.

The existence of hidden canyons and deep washes can stop you on a route you might have thought was possible. To walk 10 to 20 kilometres out of your way to get around a canyon that is impassable is a real threat.
So before planning a desert trip:

- Look for bold, easily identifiable landmarks that stand out.
- In the dry desert air, everything will seem much closer than it actually is. Generally you can safely multiply your best visual guess at distance by three and still be short.
- Only trust the most recent maps as things change rapidly in desert environments.
- Most deserts are criss-crossed by a confusing network of formal and informal roads or tracks which may or may not appear on maps. If following these roads, make a careful note of the direction and distance of each section of road so as to be able to retrace steps or plot these on a map if possible.
- Ask lots of questions of locals before heading out.
Mountain terrain

Mountains are characterised by high peaks and steep slopes. Depending on the altitude and time of year they may be snow-covered.

Prominent ridges and large valleys are also found, so navigating in this type of terrain is not difficult providing you plan carefully beforehand.

Mountain navigation

Existing roads and trails offer the best routes for movement. Off-trail movement requires a thorough knowledge of the basic navigational skills and knowledge of problems negotiating difficult terrain.

It is always colder (three to five degrees per 300 metre gain in altitude) and wetter than you might expect. Wind speeds can increase the effects of the cold even more (wind chill factor). Sudden severe storms and mist are encountered regularly. Below the tree line (the altitude above which no trees grow), vegetation is heavy because of the extra rainfall and the fact that the land is rarely, if ever, cleared.

If the mountain terrain is covered with snow or glaciers, snow covered ravines or crevasses can pose a significant threat to the inexperienced navigator.

The heights of mountainous terrain provide long-range visibility. However, rapidly changing weather with frequent periods of high winds, rain, snow or mist may limit visibility. Also, the rugged nature of the terrain produces significant dead space.

The main problem with mountain navigation is the actual topography (shape of the land).

Steep gorges, unstable slopes and high peaks all restrict movement to all but very limited routes, so route planning must be done in fine detail, and must include alternate routes.

As a rule, in populated (even sparsely) areas, if there is no path already in place, even if very faint, it is safe to assume there is a good reason for it. The route you want to try may well end in a dead end.
Jungle terrain

Jungles are normally rainy, humid areas with dense layers of tangled, impenetrable vegetation. While navigating in these areas, very little terrain association can be accomplished because of the heavy foliage and your visibility is often just metres.

Dead reckoning is one of the methods used in these areas. A lost navigator in the jungle can eventually (in most cases) find their way back to civilisation by following any body of water with a downstream flow.

Jungle navigation

A jungle environment includes dense forests, grasslands, swamps, and cultivated areas. These places are especially overgrown and movement is slow and difficult, with the extremely thick vegetation reaching a height of 20 metres.

Swamps are common to all low-lying jungle areas where there is poor drainage. When navigating in a swampy area, a careful study of map and ground should be taken. The usual technique used in swamp navigation is dead reckoning. Bamboo ‘jungles’ are common throughout the tropics and should be bypassed whenever possible.

They are serious obstacles, and movement through them is slow, dangerous and exhausting. Areas such as jungles are generally not accurately mapped because heavy vegetation makes aerial surveys difficult. The area may be marked as simply densely vegetated, but gorges, steep areas and impassable water courses may go unnoticed in the map-making process. The navigator must rely on his compass and dead reckoning when moving in the jungle. Navigation in jungles is further complicated by the inability to make straight-line movements.

When travelling in densely wooded vegetation, even following a compass bearing can be problematic as the vegetation constantly forces you to walk around obstacles. In these areas, at each tree or obstacle, alternate which side you walk around on. This will help to even out the error caused by by-passing obstacles.

The most common error made is to overestimate the distance travelled. The distances shown below can be used as a rough guide for the maximum distances that might be travelled in various types of jungle terrain during one hour in daylight.

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<td>Tall grass</td>
<td>500m</td>
</tr>
<tr>
<td>Swamps</td>
<td>100 to 300m</td>
</tr>
<tr>
<td>Plantations</td>
<td>2,000m</td>
</tr>
<tr>
<td>Trails</td>
<td>up to 5,000m</td>
</tr>
</tbody>
</table>
**Arctic terrain**

For purposes of this study, arctic terrain comprises areas that have long periods of below freezing temperatures. In these areas, the ground is generally covered with ice or snow during the winter season. Although frozen ground and ice can facilitate ease of movement, a deep snow can reduce it.

Travelling on foot can take up to five times longer than it might under warmer conditions but an advantage is that frozen streams and swamps may no longer be the obstacles they would be in warm conditions.

**Arctic navigation**

Due to the proximity of the Earth’s magnetic poles in the true arctic areas, magnetic compasses may not be of use to the navigator as they will fail to settle down in the fluctuating strong magnetic field.

General direction can be maintained by using the relative position of the sun and moon, but this is insufficient for finding small objectives, such as gear dumps and shelters buried in snow.

Special equipment is required in arctic terrain, such as winter clothing, skis and snowshoes. This does not affect your navigational strategies, except that handling your navigational tools with gloves, goggles and thick clothing is difficult.

There are no special techniques for navigating in arctic terrain that have not already been covered. Just be aware of the advantages and disadvantages that may present themselves and make the most of the advantages.
Conditions in arctic conditions can vary greatly. Bright sunny conditions can restrict visibility unless you have polarising goggles, while haze and cloud can cause ‘fat light’ which makes everything look the same and make judging distance almost impossible, as well as depressing.

Be aware that there is a great temptation to do a less thorough job of whatever the task may be when you are very cold.

Also be very aware of the hidden dangers of frozen terrain, such as crevasses, hidden holes in the ground covered in snow, and slippery conditions.

Night navigation may be particularly enhanced when operating in arctic terrain. Moonlight and starlight on a clear night reflect off the snow, enabling you to use daytime terrain association techniques with little difficulty.

Even cloudy winter nights are often brighter than clear moonlit summer nights where the ground is dark and covered with foliage.
Just for fun

Think about some problems experienced by other navigators:

**Airline pilots**

Not only do pilots have to take into consideration everything we as foot-based navigators do, but they also have to consider that they cannot stop to think about a problem and must also consider the rotation of the Earth.

Remember, the destination at which they will arrive in 12 hours time is not where it presently is. Essentially pilots have to aim for where their destination will be at their destination arrival time, not where it is when they depart.

It’s like walking all day to get to your campsite, but because you walked too slowly, the campsite had moved on to someplace else.

**Navigation in space**

Imagine the difficulty in getting around in outer space rather than Earth space.

Four dimensions are necessary: the traditional north-south-east-west horizontal coordinates, the vertical coordinates of up, down, and the fourth dimension of time. Add to this the fact that magnetic compasses cannot be used.

Navigating in space is like shooting blindfolded at a moving target from a moving platform only using estimated data. This requires elaborate calculations done by a supercomputer instead of simple navigational instruments like the ones we use.