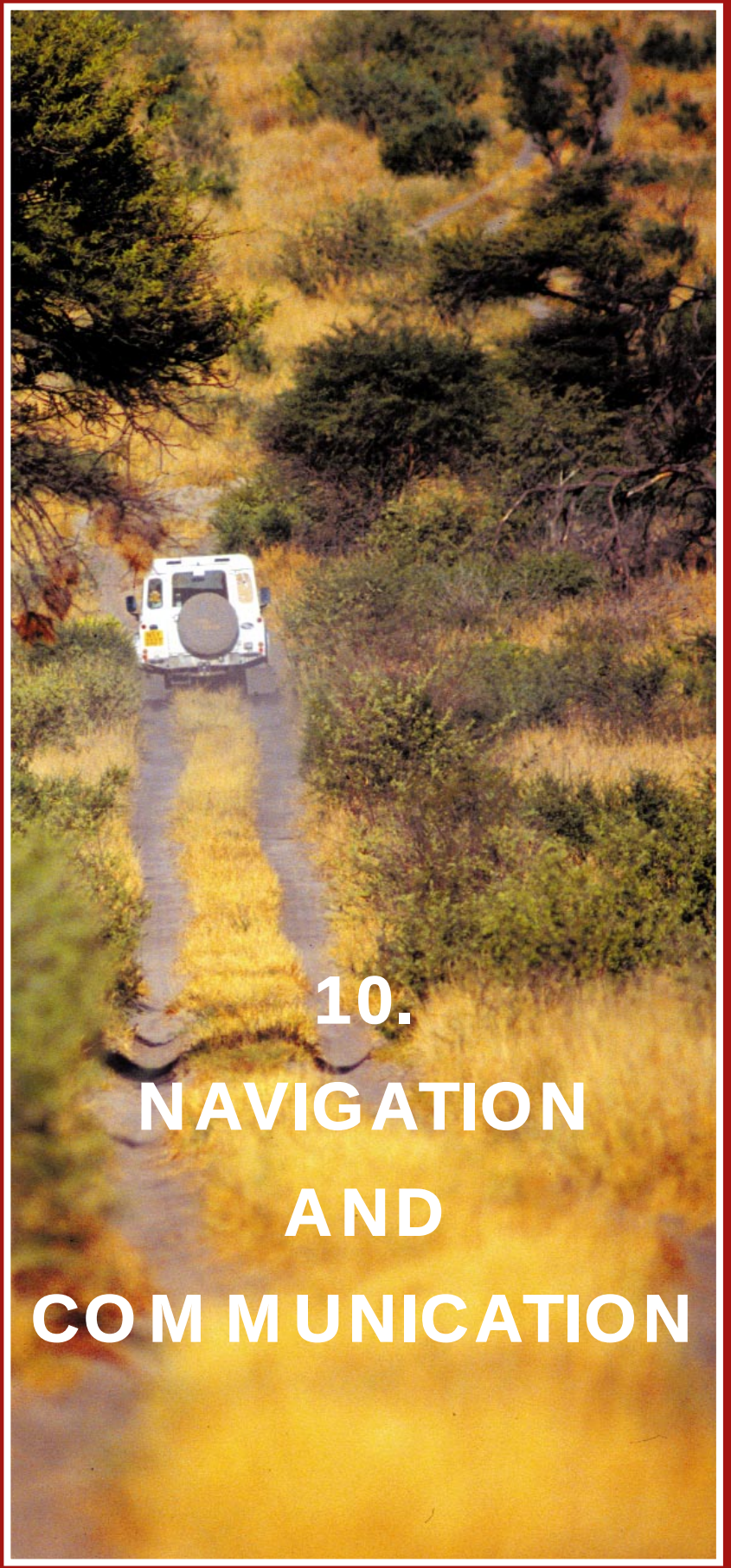


10.
NAVIGATION AND COMMUNICATION

NAVIGATION

This chapter is in two parts, GPS navigation followed by traditional map, protractor & compass navigation. Despite the accuracy of a GPS, much of what is required in traditional map work still applies when using a GPS.

THE GPS

Today the most common navigational aid used by the off-road explorer is the Global Positioning System (GPS). There is a constellation of 24 GPS satellites and tapping into this $14 billion resource is free of charge. The receivers or plotters can be described as hand-held satellite tracking computer receivers which are extremely accurate for determining three dimensional position fixes (latitude, longitude and altitude). It is essentially a time measurement system in which signals sent from a series of satellites are received and time differences measured. Ranges are measured simultaneously from a minimum of four satellites (for a 3-dimensional fix) and providing that the satellites' positions are known the receiver's position can be established. The GPS updates its position fix continually.

When the GPS is moved it provides a host of other information useful to the navigator. Speed, track, distance covered, distance to go, estimated time to go to destination, track to starting point etc. The GPS gives a sense of security to the traveller, and as a pilot it has taken much of the stress out of long distance flying.

The Global Positioning Systems used by civilians are a result of the development of a military navigation system but are modified to be less accurate. I believe that the true military GPS can give position fixes accurate to within half a metre. The accuracy of the system one can buy over the shelf averages 100 metres.

Choosing a GPS

Like everything relating to computers, the moment you take your GPS receiver home it will be superseded by a better, smaller and faster model. All modern GPSs are much alike but as a four-wheel driver will demand different things from a GPS than a pilot, GPSs can no longer be regarded to be the same. Firstly an aircraft travels faster and in a straighter line than a vehicle and secondly, for a vehicle, a backtracking feature is very useful if not essential. Units with fewer buttons often used to be more complicated to operate because of the dual functionality of the controls, but many current models are designed for single-handed use, where the GPS is held in the palm of the hand and the buttons are pressed with the thumb. This system is ergonomically pleasing and easy to use.

When perusing the range of GPSs, glance through the instruction book of the one that catches your eye, look specifically at one particular function and go through the routine. By doing this you will see if the instruction book is well laid out and well written, as you will need to study your GPS and its instruction book to enable you to use it to its fullest advantage. Size and battery life

are important features if you also want to use a GPS for hiking. Backtracking features are very useful.
An external antennae is required for use while travelling, especially in vehicles with flat windscreens. Vehicles with well slanted windscreens may not need an external antennae to operate but the incoming signal may be weak.

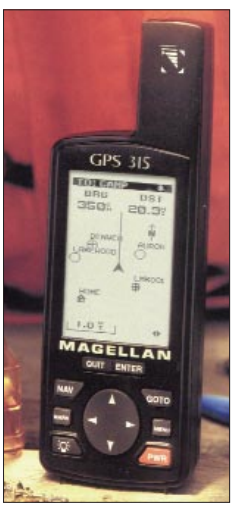
Important features to look for:

- *Ease of use*
- *External antennae (flat windscreens)*
- *External power supply*
- *Backtracking*
- *Protective bag*
- *Size (hiking)*
- *Battery life (hiking)*

HAND-HELD GPS RECEIVERS

All of the GPS receivers illustrated below are suitable for use in a vehicle. Money buys computing power, so the more you spend, the quicker and more accurate the receiver will be.

The world's leaders in hand-held GPS technology are Magellan and Garmin. No single product stands out as the very best and it is unlikely, whatever your choice, that it will be a disappointment. Like all technology, changes are swift and new models become old models very quickly.



Although there are other GPS manufacturers I have intentionally restricted this buyers' guide to the two main contenders.

MAGELLAN

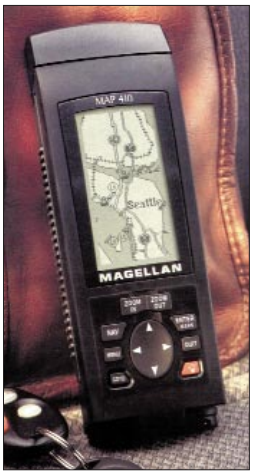
Magellan products are available from Pertec, 011 805 1996 (Johannesburg), 021 419 4450 (Cape Town). Megellan have a broad range starting at the budget GPS300 to the Colortrak powerhouse.

MAGELLAN BLAZER 12, GPS300, 315, 320

The Megellan Blazer and GPS300 are about as basic as you can get with a GPS - but there are enough features for use as an overland navigation system. The 315 and 320 are moreadvanced but still classed as budget receivers.

- AllView® 12 GPS Technology tracks 12 satellites even under dense cover
- Backlit display, fast, economical, lightweight, rugged and it floats
- EZstart with three nav screens.
- Store up to 100 waypoints, one route, 10 reversible legs. 500/20/30 with GPS 315
- 315 and 320 permit download to and from CD. 320 has back-track feature and database
- Power: 24 hours on 2 AA batteries
- Accessories standard: Carry case, lanyard strap, user's manual, quick reference guide
- Accessories optional: Swivel mounting bracket, external 16-12volt power cable

Previous page: Magellan GPS 315.
Right: Magellan Colortrack. GPS Tracker shares design but with monochrome screen.
Far right: Magellan MAP 410



MAGELLAN TRACKER AND COLORTRAK

These two models are the top of the range in hand-held GPS receivers and feature a large display with clear large digits, ideal for a driving environment. Features are top-spec. The colour screen of the Colortrak is a luxury, not a necessity. Nice features include Northfinder, course projection indicator and a thermometer.

- AllView® 12 GPS Technology tracks 12 satellites
- Extra wide screen
- Rubber grip and anti-slip backing, robust and waterproof
- IBM PC compatible downloading facility
- Seven navigation screens which can be customised
- Stores up to 500 waypoints, 20 reversible routes of 30 legs each
- Nine navigation screens
- Power: 30 hours on 4 AA batteries
- Accessories standard: Carry case, lanyard strap, user's manual, quick reference guide, detachable antenna with BNC connector
- Accessories optional: Swivel mounting bracket, external 16-12volt power supply, magnetic antenna mount, data cable, PC kit, 6ft coax cable, suction antennae mount, low profile antenna

MAGELLAN MAP 410

This models challenges the Garmin GPSIII with its moving map display. Database for loacl maps can be downloaded via computer.

- All features as per Color Trac. Additional features include very accurate altimeter course projection indicator and a thermometer.

AllView® 12 GPS Technology tracks 12 satellites

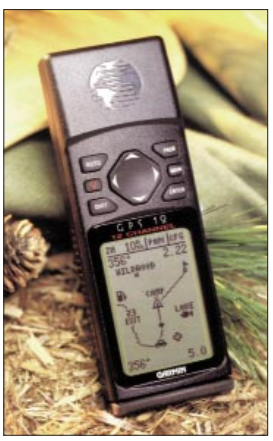
GARMIN

The agents for Garmin products are 0400, 021 948 8501 and Century Avionics (A Trading) 011 701 3244.

Garmin GPSIII

GARMIN GPS II PLUS AND GPS III

- PhaseTrac12
- User-friendly rocker/keypad, backlit LCD display with easy-to-read characters and full-featured moving map plotting.
- Screen switches from vertical to horizontal with the press of a button.
- Trip odometer, auto start/stop trip timer, average and maximum speed and more.
- EZinit feature allows fast point-and-shoot initialisation.
- Dedicated keys for zooming from 0.2 to 360 miles diagonal panning with rocker key pad.
- Moving map. GPS III only.
- User-selectable navigation screens for compass or graphic highway steering guidance.
- Waypoints: 500 alphanumeric (9 automatic)
- Internal lithium battery maintains important waypoints, routes and track log information.
- Routes: 20 reversible, up to 30 waypoints each, TracBack® & MOB modes.
- Acquisition times: warm - 15 secs, cold - 45 secs, autoLocate ±5 minutes, EZinit 45 secs
- Accuracy: 15 metres RMS
- Speed limit: 90 knots
- Physical: weight 255g w/batteries, 5.89x12,7x4,11cms, display 5.6x3.8cms.
- Power: 4 AA batteries, 0,75watts, 14 hours in normal mode, 20 hours battery saver mode, internal lithium battery backup
- Accessories standard: Carry case, batteries, wrist strap, users' manual, quick reference guide, detachable antenna with BNC connector.
- Accessories optional: mounting kit, power/data cable, cigar lighter adapter, PC kit, remote antennas - magnetic and marine.



Left: Garmin GPS 12
Centre: Garmin GPS 12 CX

GARMIN GPS 12

- 250 alphanumeric waypoints, 20 reversible routes and 14 to 20 hours of use from a single set of alkaline batteries
- TracBack® allows retrace of route without entering waypoints
- Internal lithium battery maintains important waypoints, routes and track log information.
- Waypoints: 250 alphanumeric (9 automatic)
- Routes: 20 reversible, up to 30 waypoints each
- Acquisition times: warm - 7 secs, cold - 2 mins, autoLocate® 7,5 minutes
- Accuracy: 15 metres RMS
- Speed limit: 90 knots
- Physical: weight 255g w/batteries, 15,5x5,1x3,1cms, display 5.6x3.6cms,
- Power: 4 AA batteries, 0,75watts, 14 hours in normal mode and 20 hours in battery saver mode. Internal lithium battery backup.
- Accessories standard: Carry case, batteries, wrist strap, users' manual, detachable antenna with BNC connector, quick reference guide.
- Accessories optional: mounting kit, power/data cable, cigar lighter adapter, PC kit, remote antennas - magnetic and marine.

GARMIN GPS 12XL AND 12CX

- PhaseTrac12® receiver continuously tracks and uses up to 12 individual satellites
- Proximity waypoint feature warns of approaching hazards
- Innovative TracBack® feature turns your track log into an instant breadcrumb trail so you quickly navigate back home, even if you haven't stored waypoints
- User definable map datums and UTM grids let you customise the data used for positioning
- User-friendly rocker keypad system allows room for a large backlit display with easy-to read characters and full-featured graphic plotting
- Large memory holds 500 waypoints or 20 routes of up to 30 waypoints each
- User-friendly rocker/keypad, high-contrast LCD display with easy-to-read characters and full-featured moving map plotting. Colour screen on CX
- Waypoints: 500 alphanumeric (9 automatic)
- Routes: 20 reversible, up to 30 waypoints each, TracBack & MOB modes
- Acquisition times: warm 15 secs, cold 45 secs, autoLocate® 5 minutes
- Accuracy: 15 metres RMS (selective availability program)
- Speed limit: 90 knots
- Physical: weight 269g w/batteries, 5.89x12,7x4,11cms, display 5.6x3.8cms. Ultrasonically welded heavy duty case
- Power: 4 AA batteries, 35 hours CX, 24hours XL, internal lithium battery backup
- Accessories standard: Carry case, batteries, wrist strap, users' manual, quick reference guide, detachable antenna with BNC connector
- Accessories optional: mounting kit, data transfer cable, cigar lighter adapter, PC kit, remote antenna

USING A GPS RECEIVER

Without the aid of a map or compass a GPS receiver (depending on features) can accomplish the following:

- *Pinpoint your position*
- *Give you direction from your position to a given waypoint.*
- *Tell you which way to travel to get to a waypoint. It will give a compass bearing which must be followed. If no compass is available then the trip must be begun by guessing the direction until the GPS reads a position change and correct the course.*
- *Calculate a speed over the ground.*
- *Calculate an average speed between two waypoints.*
- *Estimate the time it will take to reach a given waypoint/s.*
- *Calculate the distance to a given waypoint/s.*
- *Calculate the distance covered.*
- *Record a path taken to allow the navigator to find the way back to the starting point covering the same path.*
- *Store waypoints for instant retrieval, such as favourite fishing spots and secret campsites.*

Working with a compass and a map a GPS receiver has the following added functions:

Added functions are:

- *Converting latitude and longitude measurements from the GPS to a map and vice versa.*
- *Plot and record positions on a map.*
- *A compass converts bearings supplied by the GPS into a direction in which to travel.*

The most common use of a GPS is simply to follow given directions and as more 4x4 trail books and maps are being published with position fixes, the GPS is becoming more popular. Even in this, the most basic use for the GPS, a compass is required as all the GPS will tell you is where you are and supply a compass bearing in which to travel. A bearing is a number in degrees - you need a compass to point the way or to plot it on a map.

Converting co-ordinates onto a map

Let's say for example, the co-ordinates (in this case Bethlehem airfield) is your position fix. Your GPS reads: 27 30 00S 28 20 20E.

Translated into English this means: 27 hours, 30 minutes and 0 seconds line of latitude by 27 hours, 30 minutes and 20 seconds line of longitude. To pin-point this onto a map do the following:

The best maps for navigation are topographical because they have an accurate grid drawn on them. At the extreme top and bottom of the grid there is a ruler displaying longitude co-ordinates. Simply run along this line and locate your longitude co-ordinate and make a mark - in this example 28 20 20E. For the latitude co-ordinate do the same thing by following the rulers down either the left or right side of the grid - in this example 27 30 00S. The final step is to run lines parallel to the grid from the marks you have made and where the lines intersect indicates your position.

TRADITIONAL MAP READING

From this point you will use a map to navigate and convert the position marked on the map to a bearing on which to travel.

With knowledge of how to use a GPS and compass, how to convert bearings taken from the compass and plot them on a map will give you all the power at your fingertips to navigate with full confidence in any terrain.

THE COMPASS

Not all compasses are the same and their features will determine their versatility. For use in conjunction with a GPS as well as for regular map navigation the prismatic type compass is ideal.

The prismatic compass has the card (the part that rotates, indicating bearing) enclosed in a small case with a lid. The lid consists of a frame and a window with a hair line running vertically down it, and an extension on the opposite end to the hinge. The extension is known as the tongue and has an indentation, in the end of which is a hole to the hair line. Below the lid is another window which is marked in degrees. It can be rotated and has a pointer. On some models it can also be locked by a thumb screw clamp on the side of the compass body.

Below this is yet another window under which is the compass

0˚ - 360˚, together with the four cardinal points; east, south, west and a pointer indicating magnetic north. On the outer rim of the compass card, the degrees are printed in r
viewed through the prism the correct way up. On
pass card, the degrees are marked off in 20˚ intervals.

The Divider

A divider is used by using measurements from the linear scale printed on the map to gauge distances on the ground. Although this can be done with a simple ruler, a divider is more accurate, faster and more versatile. They can be purchased from any stationery shop.

Place the left point onto a whole number on the linear scale and the right leg on a whole number to the right of zero. Then by placing the left point on a place on the map, quick distance calculations can be made. To the left of zero on the linear scale, the distance is divided into fractions. These fractions are used in the same way.

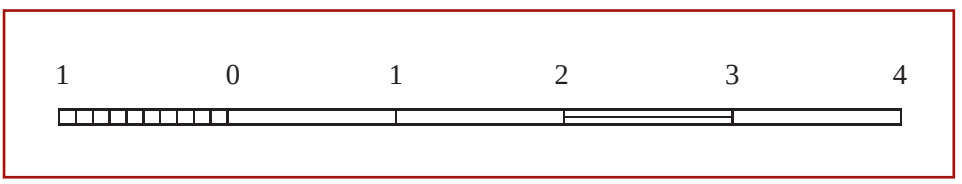
Maps

Topographical maps are referred to in this chapter as they are the most useful type of map for ground navigation. Topographical maps are drawn from stereo aerial photographs. They represent an area's topography, or the physical features of an area.

Scale

The scale of a map is the ratio between the distance represented on a map and the horizontal distance between the same two points on the ground.

The most common scale of topographical maps of Southern African is 1:50 000. The entire map normally represents a square measuring 25 X 25 kilometres. This totals 625 square kilometres. Maps are also available at a scale of 1:250 000, but these will lack some detail that may be of use to the ground navigator.



One rises 250 metres in 1 kilometre
or 250 metres in 1 000 metres
or $\frac{1}{250}$ metre in 1 000 metres
or 1 metre in 4 metres

What the scale represents

For example, 1:50 000 means that for every 1mm represented on the map, 50 000 mm is represented on the ground. No matter which measurement system you are using, the same applies; for every 1 inch represented on the map, 50 000 inches is represented on the ground. This scale is also called the representative fraction, and in this case it is 1/50 000.

With a 1:50 000 scale map, 2 centimetres represents 1 kilometre. This is obvious if one considers the calculation; 2cms = 20mm. 20 X 50 000 = 100 000 or 1000 metres = 1 kilometre. Don't let this confuse you - just remember that 2 centimetres represents one kilometre on a 1:50 000 map.

The scale of a map is of great importance to the navigator. If you are working in a small area of ten kilometres, then a small scale map will be of greater use, because the smaller the scale, the more detailed the map will be. If you are working in a large area, for example 300 kilometres, then a larger scale map will be of more use as more area will be represented on the same map.

Heights on a map are represented by contour lines. On a 1:50 000 map, they are normally drawn at intervals representing 20 metres. Intervals in feet are drawn on older maps. This interval will be stated in the map key or scale.

Orthophoto maps are available for some areas, and are particularly useful. These are prints of aerial photographs with the contour lines over-printed. They combine the advantages of photographs and topographical maps.

Using the compass

Bearing: the angle measured clockwise from True North, Magnetic North or Grid North.

Taking a bearing:

- *Open the lid to a vertical position, the hair line running down vertically.*
- *Fold the prism over so that it lies flat on the compass window. Place your thumb in the ring and hold the viewing prism up to your eye, supporting the compass with your forefinger. The compass must be held as horizontally as possible.*
- *Swing around and view the object on which you wish to take a bearing.*
- *Line up the hair line to the exact point on the landscape, and let the line cut through it.*
- *Cast your eye downward. You will see that the hair line also cuts through numbers written on the compass card. When the compass card has come to rest, read off the number. This number is the magnetic bearing of that object.*

A magnetic compass can give a false reading if it is placed in the following places:

- *Inside a vehicle.*
- *Close to a vehicle. Walk 20 metres away if it is a light car or truck, and 60 metres away if it is a large truck.*
- *Electrical power cables. Move at least 40 metres away.*
- *Spectacles and jewellery made from steel or other magnetic material.*

If you are in any doubt that a reading may be inaccurate due to external influences, take more than one bearing. Walk some distance away from or towards the object on which you are taking a bearing, and the reading should be the same. If it is not, then you know that one of the readings is false. To confirm which one is false, you must then take a third bearing. If all three are different, then some common magnetic source is affecting all your readings and you should move a considerable distance away and start the process again. This may occur if you are in an area of rocks containing large deposits of magnetic material.

The three norths:

When working with bearings and maps it is essential to know about the three norths: magnetic north, true north and grid north.

Magnetic north:
This is the direction to which the compass card pointer will always point. It is the direction on a map that is clearly marked 'Magnetic North'. It is also the bearing which a GPS receiver will display.
True north:
True north never changes. The North Pole is the most northerly point and is situated at 0˚ true north.
Grid north:
Maps are covered with lines, running both vertically and horizontally, dividing the map into squares. In fact an entire country is divided up into squares on a grid system. It follows that if these squares are in fact square, and the earth is round, not all of the vertical lines will point to true north. (Remember a map is a three dimensional area represented in two dimensions). The difference between grid north and true north is very slight, so for practical purposes they will be regarded as the same.

Because of the three norths, there are three types of bearing: magnetic bearing, grid bearing and true bearing.

The three bearings:

Magnetic bearing:
This is the direction in which the compass card pointer will read and relates to magnetic north.
Grid bearing:
This is measured on a map with a protractor.
True bearing:
Because of the curvature of the earth, the grid lines on a map do not always point to true North. For practical purposes we shall regard the grid bearing and the true bearing to be the same.

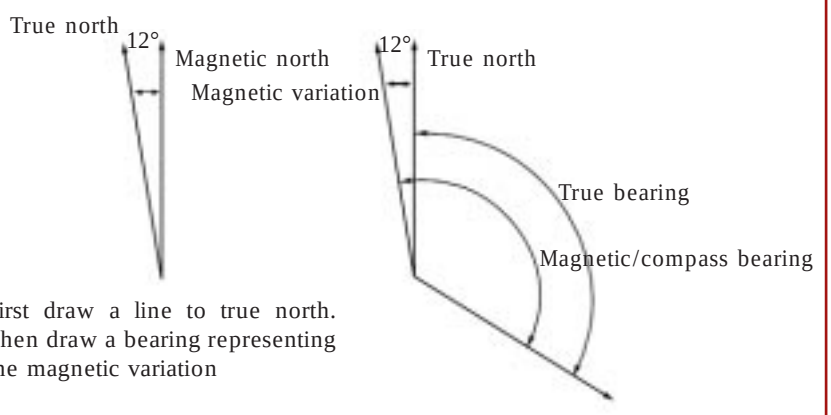
The protractor and the conversion of compass bearings, GPS bearings and map bearings

The conversion of bearings is necessary if you wish to use your map and compass/GPS together. Another important tool to the navigator, the protractor, will be used. The protractor is a link between the compass and the map. It enables a bearing taken in the field to be

to be measured in degrees and then used in the field to find your way with the aid of a compass or GPS.

To plot a bearing on a map:

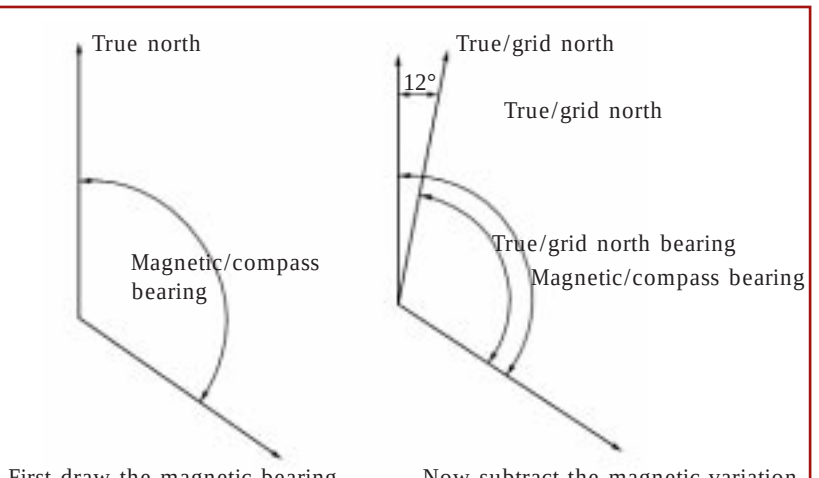
- *Draw a pencil line between two positions on a map from which you wish to take a bearing.*
- *Place the protractor on the map so that the base line is absolutely parallel to the grid lines on the map. If the bearing to be measured is between 0˚ and 180˚, place the protractor to the right of the point on the map and if the bearing to be measured is between 181 and 360˚, place the protractor to the left of the point on the map as follows:*
- *Place the zero edge, or base line (from were the degrees marked is zero) over the pencil line so that it precisely cuts through it. It can be placed anywhere along the plotted line.*
- *Read off the degrees from the degrees scale on the protractor. This is the grid bearing from one point to the other.*



First draw a line to true north. Then draw a bearing representing the magnetic variation

The compass bearing is then drawn on the same diagram. The 12° magnetic variation must be added to the true bearing to arrive at the magnetic bearing.

CONVERTING A GRID BEARING TO A MAGNETIC BEARING



First draw the magnetic bearing

Now subtract the magnetic variation

CONVERTING A MAGNETIC BEARING TO A GRID BEARING

CONVERTING DEGREES TO GRADIENT:			
1° = 1 in 57.29		14° =	1 in 4.01
2° = 1 in 28.63		15° =	1 in 3.73
3° = 1 in 19.08		16° =	1 in 3.48
4° = 1 in 14.3		17° =	1 in 3.27
5° = 1 in 11.4		18° =	1 in 3.07
6° = 1 in 9.5		19° =	1 in 2.9
7° = 1 in 8.14		20° =	1 in 2.75
8° = 1 in 7.11		25° =	1 in 2.14
9° = 1 in 6.31		30° =	1 in 1.73
10° =1 in 5.67		35° =	1 in 1.43
11° = 1 in 5.14		40° =	1 in 1.19
12° = 1 in 4.7		45° =	1 in 1
13° = 1 in 4.33			

If this bearing is now going to be used to travel to an object, it must first be converted from the grid bearing taken to a magnetic bearing so that a compass can be used to follow it. In the case of navigating with a GPS, the two positions can be stored as way-points and the GPS will do the rest.

Converting bearings

Firstly, you need to know the magnetic variation of your map. It is written on the base of all topographical maps. Let us assume it is 12° west. This means that whatever grid bearing you have measured on your map will be 12° more or less than the magnetic bearing.

Converting a grid bearing to a magnetic bearing

The best way to find out if you should add or subtract the 12° is to draw a diagram. Draw a line to true north. The variation is 12° west, so draw another line 12° west of the line to true north.

Converting a magnetic bearing to a grid bearing

Converting from a compass bearing to a map/grid bearing is a similar procedure but the process is reversed. First draw a diagram of the magnetic bearing that you have taken from your compass. You will now want to convert this bearing to a grid bearing so you can plot it on your map.

Features of Maps

Contour lines

Heights on a map are represented by contour lines. Contour lines are continuous lines drawn on a map that join all the areas of equal height above sea level. By looking at the shape of the contour lines the map reader can read the shape of hills and valleys and also judge the gradient of slopes.

Other ways of indicating height are trig beacons, spot heights and colours. Using these for navigation will result in improved accuracy.

Trig beacons

These appear as a small triangle with a dot in the middle. They have a figure printed underneath or alongside which indicates the exact height above sea level.

Spot heights

Black dots usually on a hill, or on the highest point on a road, also indicate the exact height above sea level.

Contour lines and gradients

For the off road driver, an understanding of gradients and how they appear on a map is of great importance.

Where a series of contour lines run equidistant to each other the slope has an even unchanging gradient. Where contour lines are close together, the slope is steep and where contour lines spread far apart the slope is gentle. How gentle or how steep the slope is, is determined by the vertical scale. If the contour lines are drawn at 100 metre intervals (this interval can be seen by reading the numbers written on each contour line) then with the aid of a ruler or a pair of dividers to measure the distance between each contour line, and by referring to the scale of the map, the angle of the slope can be calculated.

The distance between two points on a map is called the Horizontal Equivalent (HE). The difference in altitude between these two points is known as the Vertical Interval (VI).

To calculate the gradient of a slope, the formula is as follows:

For example, the distance between two points (HE) is one kilometre or 1000 metres, and the height difference (VI) is 200 metres:

- *Contour lines drawn at height intervals of 20 metres which are 2mm apart mean that the slope rises 20 metres every 100 metres. (2mm converted to scale of 1:50 000 is 100 metres).*
- *Likewise, contour lines drawn at height intervals of 20 metres which are 50mm apart means that the slope rises 20 metres every 2500 metres. (50mm converted to scale of 1:50 000 is 2500 metres = 2 kilometres).*

Another example is a one in one slope. This is a slope that for every one metre covered horizontally, there is also a one metre gain in height. The contour lines will be 0.4mm apart. For some off road vehicles, a one-in-one slope is technically possible, but the calculation of a vehicle's ability to climb a gradient is measured when driving on a smooth concrete surface offering ideal traction to all four wheels. Driving over ground is very different, as there will be other obstacles to halt your progress.

Colours

Areas of height can also be coloured to assist in quick recognition of landmarks. Greater heights are normally shaded darker. You will notice that the edge of each shaded area runs along a contour line.

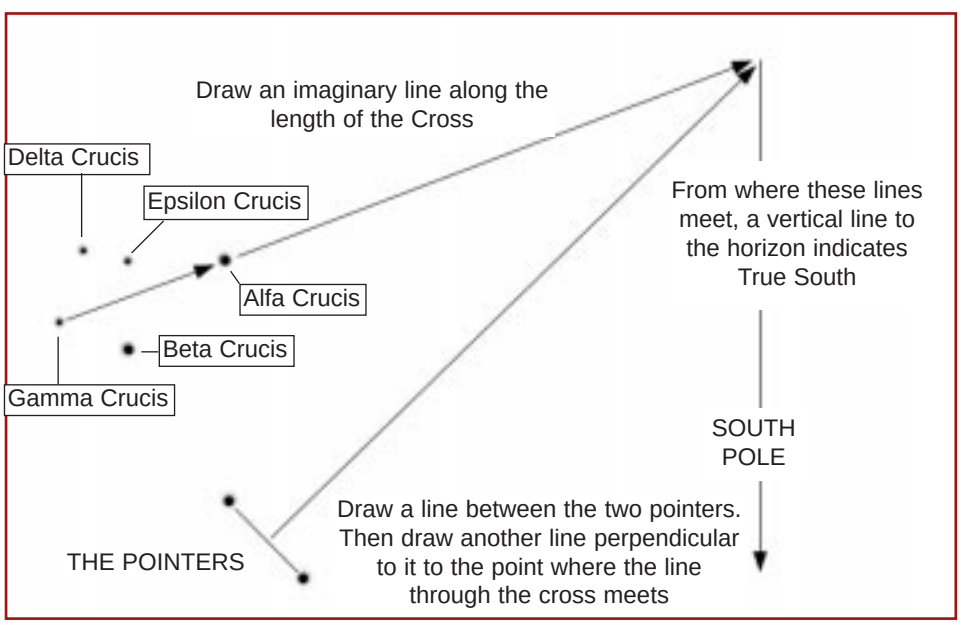
The Southern Cross

This constellation is best viewed between January and September because it is during these months that the Southern Cross is highest in the sky. So many people travelling from the northern hemisphere to the south often ask about this famous constellation that is represented in the national flags of Australia and New Zealand.

The stars of the Southern Cross constitute the constellation Crux, a Latin word meaning cross. It is the smallest of the 88 constellations in the sky. To face south, estimate the position on the horizon where the sun sets and then turn anti-clockwise for approximately 90˚. The stars of the Southern Cross are bright and well defined, so if you know what you are looking for it will be easy to locate. As shown in the diagram, the Cross is often seen lying on its side. There are also two bright stars, although not strictly part of the same constellation, that point to the 'top' of the crucifix, and aid in its location. They are called the Pointers. These two stars form the two front feet of the half-man, half-horse constellation of Centaurus. One of them, Alfa Centauri, is the closest star to our solar system and is a mere 4.3 light years from earth. (The measurement of distance when talking about the stars is the light year. It is the distance at which light travels in one year which is 9.4607 million million kilometres).

The other star, Beta Centauri, is 330 light years from earth. The Cross itself is made up of five stars and an area that appears devoid of stars which is called the Coal Sack, which is what astronomers call a dark nebula. It is an area sufficiently opaque as to hide the stars behind it.

Another interesting feature of the constellation is that the colour and brightness of each star varies, and this can be seen easily with the aid of binoculars. The stars are named after letters of the Greek alphabet, Alfa being the first letter. The others in order of brightness are; Beta, Gamma, Delta and Epsilon Crucis. The colour



variation tells us how hot each of the stars are. Gamma Crucis is red, indicating a relatively cool star whose surface temperature is close to 2000˚C. Epsilon Crucis is orange and a little hotter while Alpha, Beta and Delta are blue white stars with surface temperatures exceeding 25 000˚C.

As the diagram illustrates, by creating an imaginary line along the long axis of the Cross and a line perpendicular to a line drawn between the two pointers, the intersection lies directly due south (not magnetic south).

Finding your way

In the event that you are lost and you have neither map, compass or GPS, the most obvious thing to do is to follow your tracks and retrace your steps. But if you have been driving around lost for some time, following your tracks will probably be of little use. The best course of action is as follows:

- *Think back on landmarks that you drove close to before you became lost or disorientated. Rivers or dry river beds, small hills, villages or settlements, cattle or game watering holes and very tall trees are all things that you could make your way back to.*
- *Now calculate where north is. If you have no compass use the methods described previously. Finally, work out the approximate direction from which you have come and write it down; north-east, south-west etc.*

Landmarks

Rivers and dry river beds

The one thing that rivers, dry or flowing have in common is trees. Walk to the highest point that you can find. Stand on your vehicle's roof or climb a tree if necessary. Scan the horizon with your binoculars. A river valley will appear to be a long stretch of trees that are greener and taller than those surrounding them. Knowing where north is, write down the bearing of the trees to which you are heading. If the ground is flat you may have to re-establish north and/or look for the landmark periodically.

Villages and settlements

Paths with human footprints or litter will either lead to a settlement or a source of food or water. It may be necessary to walk in front guiding a vehicle along at walking pace.

Cattle or game paths

A little tracking knowledge or a book about animal tracks will help you determine whether a path is cattle or game. If the path is well trodden, it will probably lead to a watering hole or river. If it goes in the approximate direction from where you remember seeing a familiar landmark, such as a water hole, follow the path.

COMMUNICATION

No matter what you do with your four-wheel drive vehicle, communications can make it safer and often a lot more fun. Whether you are off-roading in a club environment, touring or overlanding in remote terrain you can have confidence that someone else knows where you are which lets you push the limits a little further.

The technology explosion over the last 20 years has resulted in efficient radio communication products becoming smaller and smaller; in some cases the size has been reduced to 1/20 of the size of radios of the 1970s. Batteries last longer, weigh less and reliability has been dramatically improved with some manufacturers obtaining Mil.Spec (military specification) approval for their equipment.

Competition between the manufacturers has also created an environment for better, cheaper, more reliable and smaller products and in such a market the consumer always wins. A number of duties and surcharges have been dropped and or reduced, compensating for the jump in the dollar - rand exchange rate, with some products being cheaper now than they were five years ago.

EQUIPMENT

Before investing in radio equipment ask yourself the following questions:

- *How far do I need to communicate?*
- *Will I be on foot or in a vehicle most of the time?*
- *Are the radios going to be for emergencies, fun communications, business control or for safety of clients.*

Radio equipment is available in the following modes:

- *FM (frequency modulation) - crystal clear communications.*
- *AM (amplitude modulation) - noisy communications, clear for short range.*
- *SSB (single side band) - gives the best range and even if no signal is present on the built-in meter the voice quality can be excellent.*

Radio equipment will give you the following ranges:

- *FM Equipment - up to one kilometre.*
- *HF Equipment (also called SSB or long distance radio) - up to 5000km*
- *VHF Equipment (Midband range) Mobile radio up to 70 km, hand-held up to 3 km.*
- *VHF Equipment (Highband range) Mobile radio up to 25 km, hand-held 0 to 3 km*
- *AM Equipment (similar to above but better penetration through concrete) 29 MHz (Ski boat type) mobile radio up to 15km, 27 MHz CB radio up to 30km*

The information above is approximate and ranges are dependent on output power of equipment, antenna type, terrain, altitude, and in

the case of HF, time of day and solar activity and frequency. Hand-held radios are ideal for very short range communications (line of sight).

The advantages / disadvantages of hand-held radios are:

- *Size*
- *Portability*
- *Reduced range*
- *Limited by battery life*

With a full charge and intermittent conversation the battery on a typical hand-held, the Motorola P110 gives about 7 hours of use. Extra batteries can be purchased and they are small enough not to get in the way in your pocket or backpack. Batteries can be charged from 220v AC supply or from a cigarette lighter socket, with an optional adapter. Accessories are available to make the use of the hand-helds easier, such as speaker, microphones, headsets with boom microphones, carry cases, etc.

Advice on purchasing hand-helds is to look for well-known brands that will be well supported with a spares network in most countries. Motorola products have proved themselves and are probably the most used hand-held radios in the world.

MOBILE RADIOS VHF MIDBAND AND HIGHBAND

Mobile radios will give you a range of up to 70 km depending on the frequency and antenna installation.

Mobiles are 5 times more powerful than hand-helds. These are ideal for vehicle convoy applications as well as for hunting, game counting, rescue, hot air balloon recovery, boating and fishing.

The advantages are:

- *High power*
- *Range of up to 70km*
- *Cannot be dropped or lost.*
- *Vehicle antenna is efficient*
- *These radios are very versatile in that they can be programmed for repeater use, the prime source of communications in urban areas.*

MOBILE HF LONG RANGE SYSTEMS

HF or high frequency systems offer communication from your vehicle for a range of 5000km plus. There are numerous factors affecting the range of HF systems such as:

- *Installation quality*
- *Frequency selection*
- *Time of day*
- *Transmitter power*
- *Antenna position*
- *Solar activity*

You can invest anything between R10 000 for a top ham HF rig down to a less than R1000 for a CB radio. The more you spend the more versatile the equipment.

If you need to communicate with your office, make telephone calls and require communications for safety purposes in remote areas, HF is the way to go. With a professionally installed system (including an automatic antenna tuner) you can expect to have good communications for 90% of the day (daytime hours). Communications are usually good in sub-equatorial Africa and always better than the rural telephone systems. For trans-Africa trips specific frequency predictions can be carried out to ensure that communications are successful from Cape Town to London.

The HF system can be directly linked to numerous telephone systems, and with the use of an operator you can make telephone calls to any location in the world. These telephone systems, which are similar to the system used in the Australian outback, are used extensively in Africa. With a similar system at your office you can go touring for weeks and still keep control. By linking a laptop computer to your radio you can send and receive data files from your office.

Advantages of HF:

- *World wide communications.*
- *Telephone facilities.*
- *Vehicle antenna is efficient.*

HF radio systems are not easy to install and will not work unless the correct frequency selection is made and applied for by the dealer. When selecting a dealer to install a system ensure that he has successfully installed HF systems in the past (ask for references) and that he can undertake computer simulated frequency predictions for your application. Insist that the equipment is synthesised, not crystal controlled, and that the equipment will automatically reduce power if antenna problems occur.

29 MHZ AND CB RADIOS

These systems are the cheapest available and are ideal when travelling in convoy with communications up to 15 km. The system is AM and is therefore associated with the usual snap, crackle and pop of this mode. These radios only put out 4 watts of power and have limitations in terms of versatility. When a single side band CB is used, power output increases to 12 watts and you will be able to communicate up to 30 km, albeit with worsening voice clarity.

Advantages:

- *Range*
- *Price*
- *Low power consumption*
- *Sound quality*

With all radio communications the single most important factor is well-engineered and accurately tuned antennae. There is no point in spending thousands of rands on a top quality transceiver if you cannot hear anyone because the antenna has not been properly installed.

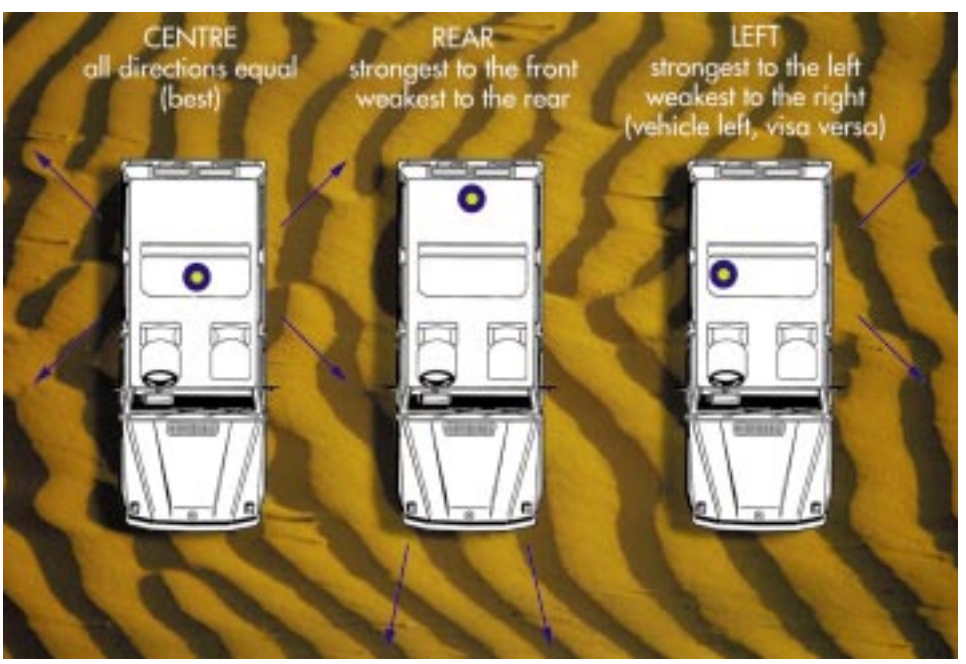
There are basically three types of antennas on the market - magnetic, glass mount and body mount antennas.

Magnetic antennas have the advantage of being easy to remove and install but have a number of distinct disadvantages. With vehicles having aluminium bodies the antennas do not stick, even a small amount of dust will cause damage to the vehicle paintwork and overhead bushes can knock it off. Also the antenna cable will have to be fed into the vehicle through the door or window and will result in dust entering the vehicle and the chance of damaging the antenna cable is increased. The only real application would be in a hire vehicle in which you cannot drill holes.

Kenwood's UBZ series of diminutive FM two-way radios offer brilliant voice clarity over short distances for little money. Perfect for driver training but without the range required for convoys of more than two vehicles. A wide range of accessories include hands-free vox headsets and other bits and pieces that make them versatile and fun. Available from Makro.

Glass mount antennae are neat and easy to mount and also do not require holes. These antennae are the least effective of all and the only application that they have is on radio repeater systems and then only if you are close to the repeater.

Body mount antennae are therefore the best way to go. If installed properly the vehicle will not rust around the antenna and the antenna's earthing system will be sound. The antenna cable is mounted permanently and is therefore less susceptible to damage



The location of the antenna on the vehicle will affect the radiation pattern of the antenna which will affect transmission range. The antenna should be mounted as high as possible.

by friction or passengers. In general the higher the gain an antenna has, the better the range over flat ground will be. However, this will be a slight disadvantage in hilly terrain.

INSTALLATION

The radio, no matter which type, should always be connected directly to the battery via a fuse, and not to any convenient wire under the dashboard. By doing this, you will isolate any interference from the vehicle's electrical system which could be misinterpreted as poor reception. A filter can be wired between the power supply and the transceiver to reduce interference. The fuse is purely a protective measure against short-circuit and fire.

Positioning of the radio

The actual transceiver should be positioned so that you can see it without taking your eyes off the road but out of direct sunlight which will damage it. If you are going to be crossing rivers or launching boats, consideration should be given to keeping the unit out of reach of rising water.

Left: Body-mount HF with built-in single-frequency coil.

Right: Glass mount VHF which requires no drilling and is ideal for temporary use.

Body-mount VHF.

The perception that radio communication systems can be installed by anyone is generally incorrect and although success may be apparent after an installation, it is very rare that the radios and antennae are fitted and tuned perfectly, giving the user the best available transmission and reception. Sometimes, only when a home installation is compared with a professional's can the difference be appreciated.

The reasons for this are simple; all antennae have to be adjusted to r
correct frequency and if this is done incorrectly a transceiver can malfunction and can require repair. If an error is

made in the wiring of the system a fire can occur with disastrous results. Don't select an antenna for its looks - go for one that works.

License and regulations

The Department of Post and Telecommunications is the management body of radio spectrum in South Africa and controls the use of transceivers, radio equipment specification and the assigning of frequencies. All equipment must be type approved and licensed before it can be used in South Africa and the same applies in neighbouring countries. Of all the authorities, the Namibian Communications Commission is the friendliest and by far the most efficient. Contact addresses:

- *Department of Posts and Telecommunications, Private Bag X1 Marlboro, 2063, RSA*
- *Namibian Communications Commission, Private Bag 13309, Windhoek, Namibia*

Maintenance

Once you have your radio properly set up, there are a few simple ways to keep it working in top order.

Prevent water from entering your antenna cables by sealing them with silicone prior to any trips. Once water has got into the cable, corrosion will occur and the antenna system will stop working efficiently and the cables must be replaced.

Check the power cables and antenna cables are not getting pinched under plastic linings and in doors.

Check your antenna to make sure that it is still secure on the vehicle as you will be amazed what vibration can do to locking nuts.

Check to see that the whip has not been bent or broken, and if it has, replace it immediately and get your local two way radio dealer to set up the new antenna before you use it. Using an antenna without tuning it can result in overloading and burning out your radio.

Before a trip check that the equipment works, clean all fuse holders and fill them with non-conductive silicone grease. Clean all corrosion from battery terminals and smear with Bosch battery grease.

Remember that when transmitting your transceiver draws a lot of current from your battery, especially if it is a high-power HF rig. Wire it to your deep-cycle auxiliary battery if you have one.

Thanks to Greg van der Reis for his help with this section. Greg runs a specialist radio installation company, GRS Two-Way Radio, and a club assisting four-wheel drive enthusiasts in the Western Cape called 'Off Road Adventures'. He can be contacted by calling (021) 913 2709 or fax (021) 913 2709.