

The Global Positioning System (GPS)



Mike Spray



OUTDOOR SAFETY

NEW ZEALAND MOUNTAIN SAFETY COUNCIL

(Fig 2)

(Author's note: The following story takes off from my previous article entitled 'Navigating in the Bush' which came out in the last issue.)

By this time the rain was easing. Only the odd water drop, falling from the big oak tree outside the front door, thumped on the corrugated iron roof. This was good, as we would soon be outside trying out the GPS.

The group sat patiently on their wooden chairs waiting for the next part of the lesson. A stand up and stretch was timely. Bottoms were beginning to roll from one side to the other in an attempt to relieve one cheek from obvious discomfort. Everyone stretched, returned circulation to their backside with a quick massage and sat back down.

I held aloft one of the flashy new yellow handheld GPS's and opened my lesson.

"This evening I drove from my home to your clubrooms. Before I left home I turned this GPS on and entered the coordinates of your clubrooms into it. I pushed the 'Go To' button and sat the unit on the dash of the car and while driving through the unrelenting downpours, several satellites way up in space were tracking the movements of the GPS and my car."

None of that seemed to impress the group. I used a USB cable to plug the GPS into the laptop and clicked a couple of buttons. The electronic mapping programme showing a topographical map of the area flicked up on the screen. There in the centre of the screen was a square black dot with a red circle around it with the name 'NZDA clubroom'. A dark red line indicating where the satellites had tracked my movements showed where I left my house and had traveled north along the highway, where I had done a U'y back to the fish 'n' chips shop to get a some dinner, where I had shot past the clubrooms and where I had gone round the block to end my trip at their clubroom front door. Heads nodded approvingly with the realisation that this GPS could be a very handy device for traveling in the bush.

So how does the GPS work?

The GPS works by receiving signals from at least three (preferably four) of the 29 satellites revolving the earth. The signals from the satellites to your GPS are a measurement of distance determined by the time it takes the signal to reach your GPS.

Signals from the several satellites create a trilateration. (Fig 1) Trilateration is a measurement of a series of distances (as apposed to triangulation which is a measurement of several angles). Trilateration of four satellites lets you know where you are on the ground by giving you a set of coordinates on your GPS. The accuracy of the coordinates is dependant on the number of satellites providing a signal and the accuracy ranges between 4 and 100 metres in New Zealand bush environments.



(Fig 1)

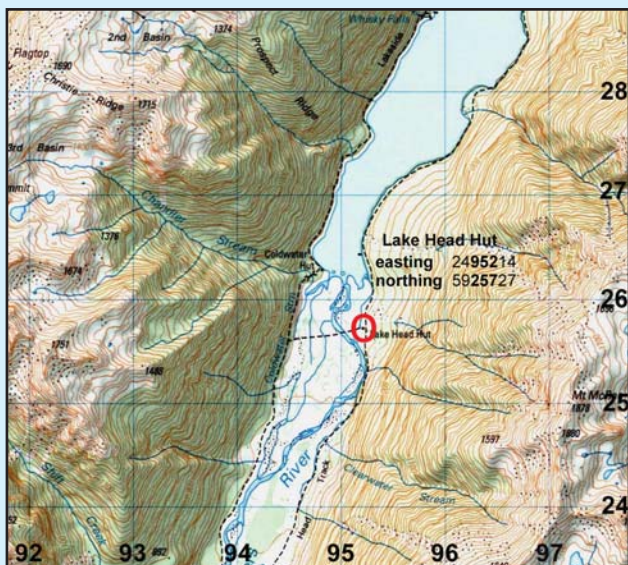
Satellites have very accurate atomic clocks that measure the signal travel time and subsequent distance. Ground monitoring stations on earth track the satellites' movement. If a satellite goes slightly off course, the ground station will control the satellite, update information and re-adjust the atomic clock accordingly. This ensures that the information received by the GPS from the satellite is always accurate, because the clock in the GPS is less accurate and therefore not quite synchronised with the satellites' atomic clock.

“For your interest, the land area within a grid square is one square kilometre”

The group sat attentive. The rain had stopped and the last swollen water drop had fallen from the oak tree. I looked through the window and a lone star had appeared in the sky. Great. I carried on with the lesson.

GPS and map grid references for bush travel in New Zealand. As discussed in the last edition of Hunting and Wildlife, it is valuable to have a topographical map of your area on hand when using

a magnetic compass. The same applies when using the GPS. Most GPS models available in New Zealand can be programmed to give coordinates that correspond with the grid system on the NZMS 260 series topographical maps



The New Zealand grid system is called 'Geodetic Datum 49' and unlike the international grid system of latitude and longitude, Geodetic Datum 49 is unique to New Zealand. Before looking at how to get a set of coordinates from the GPS, we need to know how to read a grid reference on an NZMS 260 series map.

The vertical lines that run north – south on the topographical map are called 'eastings' and the horizontal lines that run east – west are called 'northings'. These form grid squares. For your interest, the land area within a grid square is one square kilometre. Each grid line is numbered along the left, right, bottom and top edge of the map as well as in intervals on the map itself.

To demonstrate how to read a six-figure grid reference, look at the map (fig 2). The grid reference for Lake Head Hut is 952257. Read the easting line left of the hut first (95) then break the grid square up

**“The compass in the
Etrex works with
satellites, therefore you
must be moving for
the compass needle to
swing and for you
to get a direction”**

into tenths to get the final number which is 2. The easting is 952. Then read the northing line below the hut (25). Once again break the grid square into tenths to get the final figure of 7. The northing is 257. You must read the easting first then the northing; otherwise you will refer to a grid reference not even on the map. The way to remember is walk across the map toward east before you climb the map toward north. “Walk before you climb.”

If you have set the GPS to Geodetic Datum 49 it will show a 14 figure

grid reference. The Lake head Hut will appear as easting 2495214 and northing 5925727. As you can see, the six-figure grid reference (952257) appears as the middle three digits of the easting and north-
ing.



(Fig 3)

I lifted my head slowly nodding, hoping for a reassuring reciprocal nod from those listening intently in front of me. Did all that make sense? All heads nodded back.

How to get a grid reference from the GPS
For the purpose of this exercise I will use the Garmin Etrex GPS. This affordable and user friendly GPS appears to be the most common GPS used by hunters I come across in the hills. Although its operating functions differ from other models, the basic functions of



(Fig 4)

all handheld GPS models are very similar. Obviously, the GPS comes with a user manual that describes in detail all its functions. The Etrex has five operating buttons, two on its right side of the GPS and three on the left side, making it very easy to use with one hand.

The very basic function of getting your current location (grid reference) is easy. Turn the GPS on by holding down the power button (bottom right). Once the GPS starts, wait until a position has been acquired and the GPS displays 'ready to navigate'. Now push the page button (top right) until the 'pointer' page appears. Push the scroll down button (middle left) to show the 14-figure grid reference that appears at the bottom of the screen (Fig 3).

Now you can read the middle three digits of both the easting and northing and transfer that six-figure grid reference onto your topographical map. Now you can see where you are on the map.

Other basic functions of the GPS

The GPS user manual also describes in detail how to mark the hut, camp or your car as a waypoint. This is a particularly useful function as it allows you to navigate to a determined point on the map. You can either mark your camp as a waypoint when you are there or read the grid reference of your camp from your map and enter it into your GPS. It is then a matter of searching the number or title of your waypoint in the waypoints page and pressing the 'enter' button (bottom left) and then 'Go To'. Follow the direction of travel arrow to your waypoint (Fig 4). If you go off course, the direction of travel arrow will automatically re-adjust.

The GPS can give you your elevation. Some GPS's calculate your altitude from the satellites, but you need four or more satellites to get an accurate elevation reading. Other GPS's have an altimeter which works on barometric pressure. The altimeter will need to be recalibrated as the barometric pressure changes. Knowing your altitude is particularly handy when climbing hills or mountains to establish your location.

Most GPS's have a tracking function that logs your track or route from one waypoint to another. This information can be useful for return journeys or to mark exactly your route on the map.

The Compass in your GPS

The compass in the Etrex works with satellites, therefore you must be moving for the compass needle to swing and for you to get a direction of travel. The satellites will track your movement and direction of travel which will be indicated as the compass swings. Other GPS models, including the Garmin Etrex Summit, have an electronic compass that will give your direction of travel when you are standing still. The electronic compass will need periodic calibration, and the GPS will prompt you when calibration is needed. Calibrating the electronic compass is just a matter of holding the GPS at level and turning slowly around about three times. People will wonder what you are doing and even might think you have lost the plot but it is important to have the compass working accurately.

“The GPS is not a substitute for good map and compass work.”

“Let's move outside and have a go. The rain has stopped and I see stars.” I handed out several yellow Etrex's and people paired up. “Follow my instructions and you won't go wrong.”

The practical lesson went well. Everyone had a go at acquiring and marking their position outside the front door of the clubrooms. We then wandered on down the road, stepping carefully around the rather deep puddles for about 200 meters. “Now for the exciting bit. Go to the waypoint page and find the waypoint outside the front door of the clubroom. Now push 'Go To' and let the GPS lead you back. Start to walk and your compass will swing indicating your direction of travel.” Everyone turned up back at the front door of the clubroom. A couple were so consumed with watching their compass in the display window that they walked straight into the deepest puddle on the road and let out some pretty bad language, I think directed at me.

The exercise was a great success and demonstrated to the group how useful the GPS could be when navigating off track to hunt game.

We all went back inside. The couple with soaking shoes and socks removed them and sat down bare footed.

Things to be wary about when using your GPS

Beware: if the batteries in your GPS run flat it will not work. Another thing: your GPS may break down. Do not rely on your GPS as your sole navigational tool. The GPS is not a substitute for good map and compass work. Take a map and compass on your hunting trip.

In my experience, having used a variety of GPS models over a number of years, acquiring a position under most of New Zealand's bush canopies is not that difficult. You may need to move slightly if a satellite is hidden by a big old Rimu tree trunk or thick coastal vegetation,

“Beware: if the batteries in your GPS run flat it will not work. Another thing: your GPS may break down.”

both of which prevent a strong signal from coming in. I have often been in my double-skinned tent with the satellite signal booming through the nylon, allowing me to mark my camp and enter waypoints for the next day's hunt.

Deep valleys might restrict the availability of satellites as not too much of the sky will be visible. If you want to acquire a position you might need to climb up out of the valley.

The satellites are continually moving across the sky as the earth revolves. So there will be instances when there are only one or two satellites above which will make acquiring a position difficult, and in the next hour or so you have six satellites above which will make it easier.

While bush canopy does not hinder the signal to a great degree, wet canopy does. It markedly affects signal strength and there is not much you can do about it. As mentioned above, do not rely solely on your GPS. Use the map and compass if the GPS struggles to lock onto satellites.

Here endeth my lesson. The chair of the local group got up and formally thanked me for an entertaining and informative presentation. The group endorsed his comments with a resounding clap. I wished everyone a safe travel home and ended by saying “Remember, the GPS is only one navigational tool so do not rely solely on it. Make sure you do not forget to take your map and compass with you on your next hunt”.

It was nice to travel home under the stars.

Mike Spray has been a National Park Ranger and has spent a number of years based in Te Urewera National Park where this work provided opportunity to have the bush and hunting just out the back door. Since those days, Mike has spent time managing an outdoor education centre, possum monitoring, and is now working as the firearms and hunter training programme manager based at New Zealand Mountain Safety Council National Office in Wellington.