A How-To Guide

Using a GPS on a Hike

GPS units have become quite affordable over the past few years. They can be a useful tool for hiking, but they can also be a little overwhelming. What are they useful for? Can they be useful along the Heysen Trail?

By Jeremy Carter

Let's Distinguish GPS Units

There are hundreds of GPS units on the market, and not all will be useful to hikers. We need to make a distinction between the handheld portable receivers for hikers, and the myriad of GPS units for other uses such as car navigation. A GPS unit filled with road maps and driving directions isn't going to be very useful when you are out hiking in the bush. GPS units suitable for hiking tend to be small, fit in the hand, contain a map screen, and be waterproof and durable.

What is the GPS System?

GPS stands for Global Position System. It is a system of orbiting satellites that a GPS unit, or more accurately, a GPS receiver, will use to find its position anywhere on the surface of the planet. GPS is a US military application developed in the 1970s. A network of 24 core satellites with six additional satellites orbit the planet, each completing two orbits of the planet a day. A GPS receiver needs to have an unobstructed line of sight with four satellites in order to find its position. Each satellite has an atomic clock installed - a very

accurate clock. The GPS receiver compares the time a signal left the satellite to when it arrived at the receiver in the hand, the time difference is used to calculate the distance. Receiving signals from four or more satellites, the GPS receiver can determine its x, y and z coordinate (longitude, latitude, elevation.) This is called 3D Trilateration - don't worry, you never need to remember that term or understand how it works in order to use GPS. The panel on the right of this page explains trilateration in more detail.

Other Satellite Systems

You'd be right wonder about long term access to a US military application. During times of war or conflict the US could disable or suppress the GPS system for non-US military use. Indeed, prior to 2000 the signal was encoded so only the US military could accurately use it. US military GPS receivers are far more accurate, and less prone to interference than the civilian GPS receivers available to the public.

Other countries have sought to secure their own satellite navigation network, the Russians have built the GLObal NAvigation Satellite System (GLONASS), which was opened to the public in 2007. The European Union is developing the Galileo positioning system, due to commence in 2014, and the Chinese the Compass navigation system, which will consist of 75 satellites.

Three Basic Ways for a Hiker to use a GPS Receiver

There are three basic ways to use a GPS receiver when hiking, you could use one, two or all three:

1. Use the Trip Computer to display how far you have walked, and for how long.
2. Use the coordinates to find your location on a paper topographic map.
3. Load a GPS file onto the GPS receiver and use it to navigate along a trail, or to a known place.

The first is easy, the second a little more complex, the third even more so. Let's look at each one in detail, and how you could use them on the Heysen Trail.

1. Use the Trip Computer to display how far you have walked, and for how long

This is similar to how a dashboard in a car will display the speedo and odometer. You can see how long you have been moving for, and how long you have been resting. If you know how long the hike is you can work out how much is left and estimate how long it will take.

You will need to reset the Trip Computer at the start of each hike. On most receivers you can customise which fields are displayed, and sometimes how large or how many fields appear.

2. Use the coordinates to find your location on a topographic map

By default GPS receivers report their location in longitude and latitude. Whilst some topographic maps include some references to longitude and latitude, generally it would be very difficult to find your precise location on the map using these figures. Much easier is to use grid references. Grids overlay topographic maps, including the maps in the Heysen Trail

How does Trilateration work?

Imagine you are somewhere in Australia and you are TOTALLY lost - for whatever reason, you have absolutely no clue where you are. You find a friendly local and ask, "Where am I?" He says, "You are 1290 km from Adelaide."

This is a nice, hard fact, but it is not particularly useful by itself. You could be anywhere on a circle around Adelaide that has a radius of 1290 km, you could be in Newcastle, Towoomba, Alice Springs or on the Nullabor.

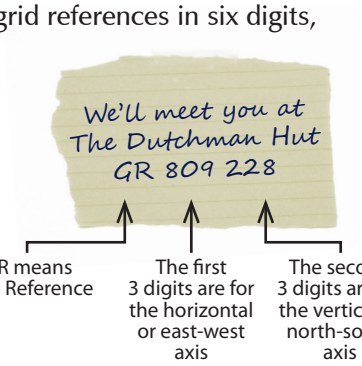
You ask somebody else where you are, and she says, "You are 1451 km from Cairns." Now you're getting somewhere. If you combine this information with the Adelaide information, you have two circles that intersect. You now know that you must be at one of these two intersection points.

If a third person tells you that you are 1368 km from Broome, you can eliminate one of the possibilities, because the third circle will only intersect with one of these points. You now know exactly where you are - Alice Springs.

The example uses only three locations - not four - because it is only working in two dimensions. GPS uses a fourth location to determine the elevation, and to improve accuracy.

Source:
http://electronics.howstuffworks.com/gadgets/travel/gps.htm

guidebooks. On paper we often refer to grid references in six digits, ie



This system is called UTM for short. UTM covers the planet with a grid, each grid line at a 1000m (1km) spacing.

However GPS receivers will display each of these UTM fields as a seven digit field (as in the photo above right), not the two sets of three digits as seen on the GR note above. The seven digits are a measurement in metres, and is too accurate for our needs. 2cm on our topographic maps represents 1000m, or 1km - this is true of all 1:50 000 topographic maps, including the Heysen Trail guidebook maps. A single metre will appear as only 0.02mm, 10 metres will appear as 0.2mm. 100 metres will appear as 2mm. So of the seven digits, the last two digits are of little use, we can discard them. We really only need the middle three digits of each set of six digits. The first two of these three digits are the numbers seen on topographic maps. The third digit you will need to measure off on the map yourself.

You will need to set the GPS receiver to display UTM coordinates. Usually found in the settings menu, you'll see formats like hddd°mm'ss.s" and New Zealand TM - choose UTM UPS - this is what we use on Australian topographic maps.

3. Load a GPS file onto the GPS receiver and use it to navigate along a trail, or to a known place

This is the most complex of the three basic ways to use a GPS receiver. There are files on the Heysen Trail website you can download onto your GPS receiver and use to navigate

The two 7-digit numbers in the Location field represent a measurement on that map. The Grid Reference here is 810 220 (ie xx810xx and xx220xx)

along the trail, or to find campsites. Depending on the brand or model of GPS receiver, it could be an easy or complex task to load the file onto the GPS receiver from your computer.

To download the file, visit www.heysentrail.asn.au, select 'Heysen Trail' from the top menu, then 'Maps' from the side menu - or visit www.heysentrail.asn.au/heysen_trail/maps.php.

The files are in GPX format, a universal file format which can be used on most GPS receivers. Once you have connected the GPS receiver to the computer, you can save the GPX file onto the GPS receiver via Windows Explorer (for PCs). In the case of Garmin receivers, you would save it onto the drive of the GPS receiver, not the drive of the SD card (the SD card is only for background topographic maps.) Place the file in the GPX folder.

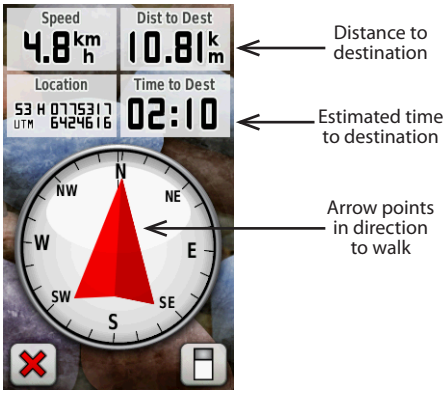
Older GPS receivers, like some of the Garmin eTrex series, **will not accept this format**. They require files to be loaded in their native file format, in the case of the Garmin eTrex this is usually Garmin Mapsource program - GDB files, or Garmin Trip and Waypoint Manager program. You will need to use a program to convert the GPX file to the GDB format. GPSBabel (www.gpsbabel.org) is a free/donation piece of software for converting files from GPX files to GDB files (it can convert to and from almost any GPS file type.) You can then open the converted file in the Garmin Mapsource program/Trip and Waypoint Manager program and send it to the GPS receiver.

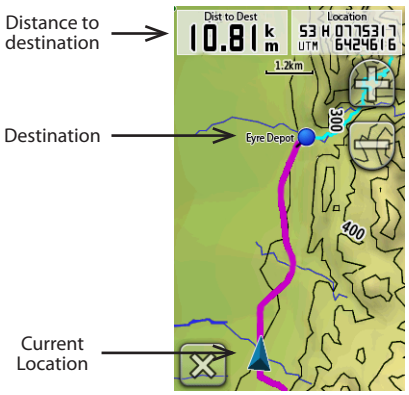
The GPX file on the Heysen website contains the entire Heysen Trail as a *Track*. *Track* is a GPS receiver term, and differs from *route* and *waypoint*. *Track*, *route* and *waypoint* are the only possible things a GPX file can contain. You will often see these terms used on GPS receivers. Each Heysen Trail guidebook chapter is a different *track* - so six chapters in each of the two guidebooks equals 12 *tracks*.

The GPX file on the Heysen Trail website also contains *waypoints* of campsites, shelters and huts along or near the Heysen Trail.

3.1 Navigating Using a *Track*

Once loaded onto the GPS receiver, you will see the 12 *tracks* under the Track Manager menu. For Garmin receivers, if you select the relevant *track* and select 'Show on Map' you will see the *track* on the map screen. When you are out hiking, you can use the *TrackBack* feature on Garmin receivers to navigate - access this feature via the Where To menu or Track Manager menu. The GPS receiver will already know where you are, you might be at the start of the chapter *track*, somewhere along it, or at the end. Each Heysen Trail chapter *track* heads in a south to north direction. Activating the *TrackBack* feature, some GPS receivers will ask if you which direction you wish to head, ie from start to end, or end to start, others will work it out for you. If you are heading northwards along the trail, it will be start to end. If you start somewhere along the chapter *track* - not at the chapter end, this is not a problem, select the TrackBack direction and navigation will begin from where you are. If you move over to the compass screen, the arrow will now point you in the right direction to walk, and may show you a few extra fields like distance to destination (which is the end of that chapter *track* - it might be many days walk away), and may as you walk attempt to provide an estimated arrival time.





This can be very useful as it can save you from getting lost when you can't see any Heysen Trail markers (the white posts with red markers, this isn't another GPS term.) I've used this feature before on many trails, including the Heysen Trail, and I've met plenty of independent hikers using it. Generally you follow the Heysen Trail markers, also reading the map from the guidebook. If you come to a Y-junction on the trail, and can find no marker, or stumble off the trail, or just haven't seen a marker in a while, this is where the *TrackBack* feature and the compass screen will be so useful. Head just four or five metres down the wrong trail from a Y-junction and the compass arrow will move from pointing straight ahead to pointing to the other trail, the arrow being left or right rather than upwards. Continue merrily in the wrong direction, the compass will eventually point downwards, instructing you to turn around go back. Continue a long way off the trail it will start to recalculate the shortest distance to get back onto the trail, it might not necessarily be backtracking but be a straight line which might not passable.

3.2 Navigating to a *Waypoint*

Once the GPX file is loaded onto the GPS receiver, you can also see all the *waypoints*, one for each campsite, shelter and hut along or near the Heysen Trail. With Garmin receivers, these will all appear on the map screen by default - unlike the chapter *tracks* in which you need to select 'Show on Map'. In the Waypoint Manager the *waypoints* will appear in a list, sorted by how close they are to your current location.

Using the Where To or Go To function, select to navigate to a specific *waypoint*. The arrow on the compass screen will point you in the correct direction, and inform you how far away that *waypoint* is. The map screen will also show you a straight line between your current point and your waypoint.

It may not be as useful as it first seems, as the distance to the *waypoint* will be in a straight line, rarely are trails straight paths. However this can be very useful for finding the camp site when you are close by, but can't see the camp site.

You could create a *waypoint* at the start of the walk. If you have already been to the end of the walk, say when you left a car there, you could have created one there too. This can help you to return to the same place later, and know how far the end of the walk is (as the crow flies.)

3.3 Navigating using a *Route*

Route is the third item that can appear in a GPX file. Creating and using a *route* is much more complex than navigating along a *track* or to a *waypoint*. A *route* is a series of *waypoints* you create on a computer, placing them at significant junctions along a map. You then navigate along the *route*, from one *waypoint* to another. You don't need to do this on the Heysen Trail as you can navigate along the *track* provided in the Heysen Trail GPX file.

GPS Receiver Advanced Use

Further to the three basic ways to use a GPS receiver, there are more advanced uses. You could find and download GPX files containing *tracks* or campsite *waypoints* of other walking trails. Firstly, try visiting the official website of the trail as the files may be available there. Sometimes published as KML or KMZ files - these are the native file types of Google Earth - you can use GPSBabel (www.gpsbabel.org) to convert these KML/KMZ files to GPX files.

If you can't find an official file, try doing an internet search for other people who have walked the trail and published files. Be wary of following their *track* too closely, you could end up wandering off the trail where they did.

In turn you could share your GPX files with others. Many people publish their GPX files on www.everytrail.com

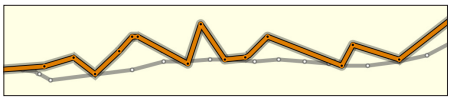
Software programs are available which automatically assign the longitude and latitude to each photo. Comparing the photos you have taken on your hike with the GPX file, the program can add the position data to the metadata of the photo file. This means when you upload the photo to say, Picasa Web Albums, you can view on a Google Map where the photo was taken. Using such a program though relies upon you synchronising your camera date and time with your GPS receiver.

You could also self-publish files on your own website via the Google Maps Javascript API interface. This involves code programming, visit http://code.google.com/apis/maps/documentation/javascript/

Walking with a GPS Receiver

The GPS receiver should always be left on while you are walking, including breaks. When the GPS receiver is on it saves your path to a *track*, sometimes referred to as a *breadcrumb*. In the Track Manager it is often referred to as the *Current* track. If you get lost, you can use this *track* to navigate back along your path to a previous known place (refer to the instructions on the previous page - 3.1 Navigating Using a *Track*.)

The signal from satellites can still be received through your backpack material, so you can place it in a pocket close to the edge of the pack. The signal can travel through fabric, canvas, plastic, glass, clouds - but not metal, brick, rock, wood or heavy foliage. However, poor placement of the GPS receiver in or on your pack can affect its ability to receive satellite signals. This is particularly true of older GPS receivers. In some older GPS receivers the GPS chip faces upwards when you are looking at the screen - so if you stow the receiver vertically in a pocket or around your neck, it can only see up to 50% of the sky and available satellites, which could be a problem in gorges or heavily treed areas. You should stow such a GPS receiver near the top of your pack, preferably laying flat in a top pocket or attached to a shoulder strap. Newer GPS receivers are often designed to hang vertically, and with significantly improved reception are less prone to make errors like in the above diagram.



An example of a track from poor placement of a GPS receiver. The two tracks overlaying each other are along the same path through a wide gorge, from the same GPS receiver, but on different days. The bolder track is when the GPS receiver has been poorly placed, in this case a Garmin eTrex receiver in a side pocket of a backpack. The track points fluctuate, successive points taken just a few seconds apart are some distance apart. The light track in the background is from the same receiver, but when it has been placed lying flat in the top pocket of the backpack. It shows a consistent smooth path, the points appearing at regular distances and times apart - providing a much more accurate track and overall hike distance.

A GPS Receiver or a Paper Topographic Map?

For many years people discussed whether a GPS receiver, loaded with topographic maps, could negate the need to carry paper topographic maps. An electronic receiver could break, fail or run flat, but paper maps could be lost or water damaged. Neither is the clear winner. If you carry a GPS receiver you'll still need your paper topographic map. For one, most on-screen topographic maps available for Australia are based upon 1:250 000 scale topographic maps - the Heysen Trail guidebook uses the more detailed 1:50 000 topographic maps (around 5 times more detail.) Secondly, even the larger GPS receiver screens still can't parallel unfolding a large topographic map to get a sense of where you are walking over several days.

What to Look for When Purchasing a GPS Receiver

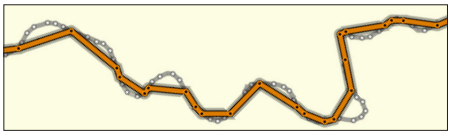
Determining which of the three basic uses of a GPS receiver you will use can help determine which features to look for in a GPS receiver. GPS receivers can cost as little as $100 for an entry level unit, receivers with more features up to a $1000.

Most newer GPS receivers are easy to use with large colour screens. Some have touchscreens, memory cards, compasses (that function even when stationary), altimeters (using barometric pressure to improve elevation accuracy and monitor weather changes) and cameras.

Know what you are purchasing, check the manufacturer's website for the model details, you might find the model you thought was quite new is a discontinued model.

On-Screen Maps

Most GPS receivers come with a map screen, but some do not. Navigating along a *track* or to a *waypoint* will be much more difficult without an on-screen map, and easier with a larger rather than smaller screen, and easier on a colour screen than a black and white screen. Some GPS receivers have a map screen but come with no maps, or come with very basic maps. A very basic map can be of little use to hikers. Often called a Base World Map, it includes broad detail of country boundaries and major highways - but none of this will be very accurate as a minimum number of points make up each object.



An example of two different GPS receivers, one recording its position more often than the other. The bolder track shows the less often recorded track, recording just 20% of the points. This has resulted in a shorter distance being measured - 3.3km compared to the more detailed receiver's 3.7km - amounting to 3km over a 25km hike. The problem is more pronounced when the track meanders over short distances, and could be barely discernible on long road walks.

Most GPS receivers allow this map to be upgraded. There are a number of options, ranging from free open source software, to expensive highly detailed topographic maps.

Both Garmin and Magellan sell GPS receivers with preloaded 1:250 000 topographic maps - if purchasing one of these receivers ensure you buy from an Australian retailer and double check that you are receiving Australian topographic maps. Highly detailed topographic maps of the US or Europe may not be of much use to you in Australia. This can often be a very cost effective way of getting on-screen topographic maps.

You can also purchase topographic maps from a third party and load them onto your GPS receiver. These start from several hundred dollars. They come supplied on a DVD and you will need to use a program to upload the maps onto your GPS receiver. Some retailers offer preloaded SD cards as an alternative, this is a no-fuss solution, you simply insert the SD card into your GPS receiver and it is ready to use. OzTopo sell Australian topographic maps for Garmin receivers - visit www.oztopo.com.au. These maps are based on 1:250 000 topographic maps.

A free option for Garmin receivers is ShonkyMaps - visit www.shonkylogic.net/shonkymaps/ Allegedly based upon GeoScience Australia's 1:250 000 topographic maps, there are reports that the level of detail is not the same as that offered by Garmin or OzTopo.

Another free option is to use the Open Source Map of each Australian state - anyone can update these maps online. These maps are not topographic, but show highways, roads, dirt roads and some tracks. Visit www.osmaustralia.org/garmin.php, you may need to use something like Img2gps (www.wpkg.org/Img2gps)

to upload the map onto your GPS receiver.

Whether topographic maps are preloaded or not can significantly affect the price - if you intend to purchase topographic maps factor this in.

Battery Life

Some feature rich receivers can use a lot of battery power. 20 to 30 hours of battery life is good. Battery life could be more important if you undertake multi-day hikes where you won't have the opportunity to recharge or replace batteries. Lithium batteries tend to last the longest amount of time, followed by alkaline, and rechargeable batteries the shortest. Lithium batteries are much more expensive, but can last up to a week - however some GPS receivers will not permit lithium batteries as they may interfere with the screen display.

Track & Waypoint Memory

Some older GPS receivers can only store a small number of tracks and waypoints. The Heysen Trail GPX file contains 31 *tracks* (12 chapter *tracks* and 19 spur and alternate trail *tracks*) and 135 waypoints. Some devices can store as little as 20 *tracks*.

Smart Phones

A smart phone (an iPhone or Android phone) may offer a viable GPS receiver alternative. There are apps available that function as trip computers, showing your *track* on the map and allowing you to add *waypoints*. Weatherproofness and battery life could be issues. A fully charged smartphone may last as little as three hours whilst running a hiking GPS app. Also, the basemap is likely to be Google Maps - principally a road navigation map - and only visible where there is mobile phone coverage, however there are some topographic maps coming onto the market which complement Google Maps.

Further reading for smart phone users can be found by purchasing (from $4.99) a copy of this BackPackingLight article: http://www.backpackinglight.com/cgi-bin/backpackinglight/smartphone_navigation

Why Different Results?

Why do people report different hike lengths when they have undertaken the same day hike? No two GPS receivers will report exactly the same figure, the same GPS receiver will often not record the same figure if the trail is followed again. I have tested out someone else's GPS receiver alongside my own - almost identical models. I placed them hanging vertically side-by-side in my pack, yet they slightly yielded different results. Why?

- GPS receivers are complex devices performing many calculations on signals from many satellites (up to 12 at a time.)
- Poor stowing of the GPS receiver in or on your pack will affect its ability to receive satellite signals.
- Newer GPS receivers generally provide far more accurate results than older receivers.
- Old GPS receiver software may contain bugs which cause over or under reporting of walk lengths. For instance, Garmin Oregon receivers (the x50t models) with early software under report the walk length on-screen by around 20%.
- Different GPS receivers update their position more often than others - between one and perhaps 15 times a minute. The more often, the more accurate the overall walk length.
- The more satellites visible to the GPS receiver the more accurate the tracking - the signal from the satellites is weak, dense foliage, tree trunks or narrow gorges will block signals.
- Although the GPS receiver attempts to compensate, the signal from a satellite slows the further it travels through the atmosphere - particularly affecting signals from satellites close to the horizon.
- The signal from a satellite can be reflected off objects such as large rock surfaces and buildings.
- Each GPS receiver is using its own internal clock to measure the length of time since a signal has left a satellite. When four or more satellites are locked in, it can start checking the accuracy of its clock, but regardless its clock is not anywhere near as accurate as the atomic clocks on board the satellites.

A Popular, but Old, Model

Garmin's basic eTrex, the original yellow one, although once trusted amongst walkers, is old technology now - first produced in 1998. Unless your computer is a decade old you will need to buy a serial to USB connector for your computer. Saving *waypoint* names is limited to 8 character names. No maps are displayed and its accuracy level is not as good as others, despite the "Now with high signal capability" stickers on the box. It doesn't record as many points in its breadcrumb track as other GPS receivers, and there isn't a setting to adjust this.

In mid-2011 Garmin upgraded their eTrex range of receivers, releasing a new, updated version of the yellow eTrex.

Where to Purchase

Purchasing online could save you money, but be wary of preloaded maps that might be for the US or Europe. It could be reasonable for a shop to assist you in setting some of the basic receiver settings for Australia so it is ready for you to use.

Product Reviews

Excellent non-biased, thorough product reviews can be found in BackPackingLight articles (http://www.backpackinglight.com). Single articles can be purchased for $4.99, or by annual article subscription. Conduct an Advanced Search for articles with your GPS brand and model.

Run the Latest Software

GPS receivers operate on software, much like your PC needs Windows to run. You should periodically check you have the latest software version, manufacturers may release software updates to fix bugs - visit the support section of your manufacturer's website.

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