



MIST Management Information System GPS Hardware Selection

Prepared by
Ecological Software Solutions

May 2005

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Introduction

The MIST GIS program specifically allows user to download waypoints from certain GPS units gathered from various sources such as ranger patrols, areal patrols, researchers, and occasional observation. MIST supports downloading waypoints from many of the the GPS units manufactured by **Magellan** and **Garmin**. Other manufacturers such as **Lowrance** are not currently supported by MIST, but support for this manufacturer might be added in the future.

The intent of this document is to indicate some of the known benefits and limitations inherent to specific GPS hardware models and how they may best be used in which field situations and how they may be expected to perform in daily use as well as their potential interact with the MIST software. The information contained in this document is presented in the hopes it will be helpful in allowing the end users of MIST to have the best information in order to make an informed decision when purchasing a GPS unit for use with MIST. It is not the intent of this document, the author or of Ecological Software Solutions, to suggest one manufacturer over another or to specifically critique models or manufacturers. Comments on GPS features in general and on specific models in particular are included as experienced by the author, and need not represent the experience of other users.

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When purchasing any GPS it is wise to always consider the "Three P's" of purchase before acquiring a GPS unit: **Place**, **Price** and **Purpose**. These Three P's are elucidated further below.

- **Place: Where will you be using the GPS?** You need to first consider the physical location where the GPS unit will be used. GPS units are only generically suited for all types of environments and features of some units, such as if the unit floats or not its effectiveness under tree cover and so on must be considered during the review process. Those GPS units that lack essential features should not be further considered as options for purchase.
- **Price: How much can you spend per unit?** Your budget and the number of units you need to purchase under that budget may limit your selection. Less expensive units have limitations that include less powerful antennas that may or may not affect the ability of users to collect waypoint locations.
- **Purpose: Why are you buying this GPS?** This paper was prepared with the single intent of introducing information that will allow for the most effective GPS unit purchase to be used with the MIST software system. It is assumed that this purpose will outweighs most other considerations.

GPS User Groups for MIST

There are basically two GPS user groups most encountered within the context of MIST system users. These two groups are:

1. **Group 1:** Field personnel, most notable rangers that perform patrols on the ground in the parks, who use GPS units almost on a daily basis and under a predetermined temporal and spatial protocol.
2. **Group 2:** Intermediate users, such as supervisors and researchers, who use GPS units on occasion to capture locational data in a non-rigorous temporal and spatial manner.

The basic needs and requirements of these two groups differ and GPS unit selection for each group should be made independently. Group 1 requires an easy to learn and use model that will satisfy the needs to acquire a location at specific times and places without interference. The GPS units used by Group 1 also should provide the most compatibility with the MIST software as these GPS units will form the backbone of spatial data acquisition for MIST. Therefore, it is in the context of providing the best selection criteria for this user group that this document is mainly written. Group 2 may also be satisfied with the units needed by Group 1, but it is more likely that the users in Group 2 will wish more features so as to use their GPS units in context other than solely in regards to MIST. Group 2 users also typically own their own GPS units or are supplied the units from agencies that have acquired them for specific purposes other than for use with MIST.

Basic GPS Models and Features

While there are a number of GPS units on the market, this document will only deal with the low cost hand held consumer models that are the most likely to be used by MIST users.

Of these basic consumer models one can find a range of prices from about \$100 – \$1,000 (US Dollars), with most units that are suitable for MIST use falling in the \$150-\$450 range. The price range typically corresponds to the amount of available memory for storage of data and the amount and complexity of user interface features including, but not limited to, features such as mapping and color displays. All factors are not mutually exclusive and tend to be directly proportional: the more expensive a unit costs the more storage comes with the unit as well as more features on the unit. When purchasing any GPS unit for use with MIST, it should be remembered that, In the end, hand held consumer GPS units are typically manufactured for a north America and European market. The inclusion of hunting and fishing times on some units should give a clue as to their intended audience. Bearing this in mind, many of the features that come with more expensive units have little bearing or utility within the context of MIST only use of that unit.

What follows is a list of topics to consider when considering what GPS unit to purchase for use with MIST. Most of this discussion is geared towards Group 1 user investments, whereas issues for Group 2 users are mentioned in this context since MIST may be only one of many reasons for the purchase of a GPS unit by Group 2 users.

Ease of Use (or conversely, avoiding unit complexity)

Ease of use is one of the single most important aspect for any GPS unit to be purchased for Group 1 users. Ease of use encompasses two factors that must be balanced when

selecting a GPS unit for Group 1 users and these items should be considered as follows:

1. Simple to use user interface that has a minimum of features to learn or use.

The user interface must be simple and easy to use. This not only improves training rates, but overall retention of how to use the units by the rangers.

A typical type of recommended entry level GPS unit that is well suited for Group 1 users is the basic Garmin eTrex unit. This unit has only 4 user screens accessible from a single "Enter" button. This unit uses large icons and graphics to indicate when satellites are locked and a locational fix is attained, making it suited for use even by ranger patrol members that are not literate; which is not an uncommon occurrence in some park settings that may employ MIST for ranger data collection. Setting a waypoint is very simple as well as options are clearly delineated and specific. The eTrex model is not without its limitations, however, which are further discussed in the Antenna Type section later in this document.

2. Ability to acquire locations easily and record such locations without error.

It is important when purchasing a GPS unit to consider that not all units possess the simplicity of design desirable for use with MIST. For example, there is a trend for larger, more expensive and more powerful GPS units to be too rich in features. These features add little or nothing of practical value to MIST data collection but open up a number of placed to confuse the users as well as providing access to setup features that can prevent downloading of data from the unit. Addition features which may be included that add little value to GPS data collection for MIST includes addition user screens, more buttons on the units, and the addition of some buttons having multiple functions depending on number of times the button is pressed or the length of time the button is pressed. These features can cause a great deal of problems in both training and data gathering.

For example, the multiple entry feature for a single button is used to set waypoints in both some Garmin and Magellan models. Training of rangers with the Magellan SporTrak, for example, has lead to the determination that this feature of a single button with multiple features to cause problems for users who tend to forget they must hold the button down to save a waypoint. If the button is rather quickly pressed once, the ranger may believe the current location was saved to a waypoint, when in fact it was not.

Equally, the multitude of user options in more feature rich GPS units lead to at least one occasion where a user, apparently curious, bored or both, ended up exploring into the GPS unit's settings and changed the BAUD rate for data transfer. This unit was useless at that point for several weeks as "inexplicably" no data could be downloaded. Only after the GPS unit was examined by a GPS expert was the setting change detected and the unit restored to service. As the level of expertise in diagnosing GPS problems will vary in MIST sites, the potential for this to be a problem is a very real one.

Antenna Type

Consumer grade hand held GPS units come most often with either a quad spiral helix antenna or a microstrip, or patch, antenna. The Garmin GPS 12 and eTrex (among others) have an internal patch antenna while the Garmin 76 series and the Magellan SporTrak and Meridian series use helix antennas.

Popular belief is that helix antennas are better then patch antennas. However, this is not completely true as there is only a minor difference in performance between patch and quad helix antennas which have the same effective aperture, with the helix antenna having perhaps only a slight advantage with all else being equal. Aperture is directly

proportional to antenna size and antenna gain is proportional to antenna aperture. Hence it is not difficult to understand that the general rule of thumb is that larger GPS units will have better reception than smaller units regardless of their antenna type. This is most noticeable for smaller units under tree cover that may perform poorly to the point of even failing to acquire a location regardless of antenna type.

Typically, smaller units will use the patch antenna which has given the reputation to patch antennas as being of poorer performance in general. The difference in performance can vary between both manufacturer and GPS unit especially under tree cover. In very dense forest cover many hand held consumer grade GPS units can be expected to fail to gain an adequate location without an external antenna of sufficient gain. If dense tree cover is expected, a larger unit with both a helix antenna and an external antenna option should be selected where possible. Hence it is very important to know the environment in which the GPS will be used and to purchase units accordingly.

This brings us to a GPS conundrum: it was previously mentioned that the Garmin eTrex is an easy to learn and use unit that is recommended for use with MIST for those reasons. However, the small size of this unit also means that it has a weaker antenna than many other larger models and hence it will often fail to acquire a location in a forest. Therefore, the Garmin eTrex must be consigned to those areas that are expected to have little or no forest cover such as savannas, shrub lands, dry or deciduous forests and alpine areas. Medium to dense forest canopies will most likely necessitate the use of another model of GPS. So we must at times sacrifice an ease of use features in order to acquire locations. In this case basic Garmin 72 or 76 models, as one example, might be considered, especially if an external antenna may need to be used even if they are slightly more complex and more expensive.

External antennas

Most Garmin models except the GPS 12 and eTrex can use external antennas. Most Magellan consumer hand held units do not come with external antenna options, but this may change as new units are introduced. While it is possible to increase gain with any unit using an external antenna, even units with built in helix antennas, the use of an external antenna is typically not recommended for Group 1 users as it might be logistically difficult to decide how to carry and set up as well as being prone to breakage. It is only suggested in those areas where dense forest cover prevents locations from being acquired in any other manner. Group 2 users may find the use of an external antenna, such as an auto mounted unit, of great practical use and may consider it more seriously for their use.

Waypoint storage

Basic storage of any GPS unit should be at least 500 waypoints. The more waypoints that a unit can store means that the unit can be in the field longer before it needs to be recalled for waypoint downloading into MIST. All but the most simple GPS units have typically have at least 500 waypoint storage limits. In addition, most GPS units that include serial port connections for downloading waypoints also typically have at least a minimum of 500 waypoints storage capacity so you are typically assured of a minimum waypoint capacity if you purchase the proper unit for waypoint download. But one should always verify this limit before purchase of any particular unit.

Navigation

Most, but not all GPS units come with some degree of navigation capacity. The need for navigation capacity will vary for users of MIST, but it can be of use if patrol routes are

uploaded to a GPS unit from MIST to direct the path of ranger patrols. Incidental use of navigation, such as back to a location of illegal activity for gathering of further evidence, is also of practical importance to law enforcement, so having navigation capacity in a GPS unit is worth considering and is overall recommended.

Maps

Many GPS models today have the capacity to display maps. Map screens, as defined here, differ from screens in most GPS units that simply display waypoint locations. Overall, it is the current opinion of the author that, for Group 1 users, maps in GPS units are are not considered essential.

First, maps will be typically of little value in those areas that have not yet be adequately mapped or not mapped accurately. If an area where MIST is used is well mapped you must typically purchase converted maps from your base maps from the GPS manufacturer. This is because the maps used in GPS units are typically in a proprietary format normally only available legally from the GPS manufacturer. This is an additional expense (one time, if maps are never edited) which may commit users to one GPS manufacturer.

A second reason map screens in GPS units are not recommended is that GPS units with map windows tend to be far more complicated to use, with more features, then similar models without a mapping window. In addition, some GPS units with maps have been known to “jump” to the map window after acquiring only a 2D location, when it might be better for the ranger to wait for a 3D location. This all tends to confuse the ease of use concept for the GPS unit, with an end result being the units are not as sustainable as a field tool for Group 1 users.

Finally, on a more sinister level, the presence of maps could allow users to more easily enter fake waypoints or entire patrols, making it seem areas were patrolled when they were in fact not.

Where map windows in a GPS might be useful includes all those circumstances when the rangers must know where, or when, they are in a protected area. This can include reasons as trivial as staying in the park on patrols, or significant as jurisdiction when making arrests. Clearly, if there is a need for patrols to know their location relative to boundaries, where for some reason the rangers themselves may not know where the boundary exists (such as at night), then a mapping window may represent an important consideration when purchasing a GPS unit. However, the need for a mapping window should be clearly declared, with the potential inherent limitations acknowledged.

Unit Size

Smaller units are easier to carry and slip into a pocket or rucksack by rangers. The smaller the unit, the less cumbersome to a ranger who must carry it and have it in the way while performing other ranger activities, including but not limited to law enforcement activities. Being smaller they can also be easier to misplace and loose.

Unit Ruggedness

GPS units are field tools and they must be able to withstand the rigors of hard days and nights being used in adverse conditions by less then gentile hands. GPS units by their very nature are constructed to be rugged. However, ruggedness of design for extreme

conditions found in MIST relevant areas has not been found to be the overall design intent of all units.

For example, the Magellan SporTrak has what is considered, by the author, a less than optimal design for their battery storage in regards to either ease of battery replacement or overall ruggedness. The batteries are stored in a removable battery storage case of thin plastic. While this case has some flexibility, its design appears flimsy and the potential for easy breakage appears possible. The Garmin eTrex, 72 and 76 models on the other hand have a very rugged and easy to use design for battery replacement that have proven difficult to break in field conditions. In comparison, on the Garmin units, the rubber weather cover over the serial port connection has been known to break, to varying extents, after some short period of use.

In defense of the Magellan battery case, the Magellan battery case design is water tight, while the Garmin's battery case design tends to be only water proof. A water tight compartment also helps the Magellan units to float, a handy feature for water patrols. Some Garmin units also float, but this feature varies between Garmin Units. Those Garmin units that do not float are typically submersible for at least 30 minutes in one meter of water.

The take home message is that no design has proven as rugged for general MIST use as perhaps wished. But we must realistically defer the cause from the lower cost of these consumer grade hand held units and the consumer market for which they are essentially targeting.

Communication

Any GPS unit selected must have a PC interface cable plug for connecting to a computer via a serial port. Newer and more expensive GPS units either also come with a USB connection or only have a USB connection. MIST currently does not support USB connections. For laptops that have no serial port, a USB to Serial port adapter must be purchased separately in order to download waypoints into MIST from a GPS unit.

Magellan units use a standard NEMA communication protocol for downloading waypoints, while Garmin units use a proprietary data transfer format. The benefit for Magellan units is that MIST can download from most Magellan units including newer models as they are added, while newer Garmin units may need to have their specific communication protocol added to the MIST software before they can be used.

Battery Life

Advertised battery life varies from 12 to 30 hours depending on the GPS unit. Actual battery life has been typically found to be somewhat less with a major factor of battery life depending on the quality of the battery used. The use of rechargeable batteries is possible for some models as an option if not specifically dissuaded by the GPS manufacturer and manual. Rechargeable batteries used with a solar recharger is a long term investment to consider if possible, as it can reduce long term battery costs and keep units working at remote ranger stations for long periods without the need of battery shipments. Since rechargeable batteries typically provide less voltage than standard alkaline batteries reception strength for the GPS unit can be expected to be less as well as overall expected effective battery life. It should come as no surprise that patrols should carry one or more (as backup for the backup) sets of fresh batteries while on patrol.