

Volunteers Tracking Invasive Alien Plants



2008 Observers Manual

A project by
Clean Annapolis River Project (CARP)
&
Applied Geomatics Research Group (AGRG)

Plant Patrol NS
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April 2008

Funded by the Invasive Alien Species Partnership Program (IASPP),
A Government of Canada Initiative

Canada

& Shell Environmental Fund



Contents

Acknowledgements	ii
Background.....	1
Invasive Alien Plants of the Annapolis Valley.....	1
Survey Methods.....	2
Survey Data Collection (Filling in the Datasheet)	3
A – Site Description.....	3
B – Plant Checklist.....	4
C – Watercourses/Wetlands.....	5
D – Site Map.....	6
E – End Survey Information	7
Important Datasheet Notes.....	7
Checklist of Survey Equipment	8
Tips for Working Safely Along a Roadside	8
Glossary.....	8
Helpful References	10
Appendix A – List of terrestrial invasive alien plants for the Annapolis Valley, NS	11
Appendix B – Overview of plant structure	13
Appendix C – <i>Plant Patrol NS</i> 2008 datasheet.....	16
Appendix D – Steps for marking a waypoint using a hand-held GPS unit.....	20
Appendix E – Summary of how to operate the Garmin 76CSx hand-held GPS unit	23

Acknowledgements

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Volunteers

CARP and AGRG also acknowledge the *Plant Patrol NS* volunteers, who were engaged in this project, gave the monitoring protocol a trial run in 2007, and provided feedback for improvements to the updated protocol and datasheet.

Background

In the summer of 2006, the Clean Annapolis River Project (CARP), together with its project partners, launched a project called *Community Action on Invasive Alien Plants*. The purpose of this project was to minimize the risk and impact of invasive alien plants on the human and natural environments of the Annapolis Valley. In Nova Scotia, alien plants make up approximately 36% of our vascular plants. This is considerably more than the national figure of about 24%. While Purple Loosestrife is the virtual “poster-child” for invasive alien plants, there are a number of less well known exotic beauties that are equally, if not more, detrimental. Their effects on native plants may include direct impacts, ecosystem alteration, and genetic dilution. Direct impacts include competition for light, water, and nutrients; physical displacement; and toxicity. Native ecosystems can be altered by changes to the hydrological cycle; fire frequency; soil erosion rates; and soil chemistry. By displacing native plants, or by hybridizing with them, invasive plants have the potential to reduce genetic diversity. Alternatively called alien, exotic, foreign, introduced, weed, non-native, or non-indigenous, these plants may present real problems for native ecosystems.

As an extension of CARP’s invasive species initiative, *Plant Patrol NS* was developed to map the occurrence of invasive alien plants in the Annapolis Valley. This volunteer opportunity provides a chance for community members to learn about the potential impacts of invasive species, and develop their mapping and field survey skills. With the help of volunteers using global positioning system (GPS) technology to mark locations of invasive plants, CARP and its partners can produce maps illustrating the presence of these invaders in the Annapolis Valley. Repeated surveys of the same areas will enable CARP to track the spread of existing populations and identify new occurrences. This information can be passed on to land managers and owners to assist them with planning.

This manual is intended as a reference guide for *Plant Patrol NS* volunteers, but it should be accompanied with training in the use of GPS to map plant locations, and should be facilitated with available online refresher modules. In addition, volunteers should receive training on how to properly complete the datasheet. In April 2008, CARP launched a *Plant Patrol NS* website (www.plantpatrolns.ca). In addition to information for volunteers, the website has invasive alien plant species information, and maps displaying *Plant Patrol NS* data.

Invasive Alien Plants of the Annapolis Valley

Initially, the primary objective of CARP’s invasive plants work was to identify priority invasive plants. A survey was created, based on older lists and studies, and sent out to botanists, vegetation managers, naturalists, ecologists, and ecosystem scientists who have knowledge of the flora of Kings and Annapolis counties. The survey responses, in conjunction with relevant literature, discussions with experts, and lists from adjacent geographic areas were used to create a list of priority invasive plants in the Valley (Appendix A). It is important to remember that this list is not concrete. Introductions continue to occur, and we should always remain on the lookout for new incidences of invasive plants, and for invasive qualities exhibited by the species in our own back yards.

The species most frequently identified as problematic by experts were prioritized in 2006. The first eight species on the list are the ones that pose the greatest risk to our native ecosystems, noted in order of perceived threat. Other species on the list are invasive plants known to be present in Nova Scotia’s Annapolis Valley. A complete

checklist of invasive alien plants is provided in Appendix A. The eight high priority plants were identified as follows:

- 1 – glossy & common buckthorn (*Rhamnus frangula* & *Rhamnus cathartica*)
 - 2 – Japanese knotweed (*Polygonum cuspidatum*)
 - 3 – purple loosestrife (*Lythrum salicaria*)
 - 4 – common reed (*Phragmites australis*)
- * NOTE: There is also a native common reed, and they are very difficult to distinguish
- 5 – garlic mustard (*Alliaria petiolata*)
 - 6 – Scotch broom (*Cytisus scoparius*)
 - 7 – multiflora rose (*Rosa multiflora*)
 - 8 – Canada thistle (*Cirsium arvense*)

By limiting the number of high priority species on the list, it is easier to teach people with limited botany skills to identify them. By naming all of the other invasive plants, those who have an interest in botany or invasion biology can work at learning to identify more species. Those plants identified as high priority on this list are the plants that have the potential to impact natural environments of the Annapolis Valley.

In April 2007, an Annapolis Valley resident reported an “out of control” vine to CARP. Upon closer investigation, with the expertise of botanist Heather Stewart of AGRG, the woody vine was identified as Oriental or Asiatic bittersweet (*Celastrus orbiculatus*). Though it had not previously been reported for this area, some specimens were close to 30 years old, determined by collection of core samples. This discovery reinforced the need for continued monitoring and education. Given the aggressive nature of Oriental bittersweet, it was subsequently added to the list of high priority plants in the Annapolis Valley.

- 9 – Oriental/Asiatic bittersweet (*Celastrus orbiculatus*)

Many invasive plants remain weeds of human-disturbed landscapes, including roadsides, trails, abandoned lots, etc. However, invasions can also occur after natural disturbances, such as animal trails, floods, forest fires, etc. This relationship between invasive species and disturbance gives us an idea of where we are likely to locate invasions. For explanations of terms associated with invasive alien plants, and other terminology used in this manual, check the glossary on pages 9-10. To help volunteers with plant identification, there is a brief overview of plant structure provided in Appendix B.

Survey Methods

The sampling strategy for this project included two types of survey methods. One survey type is a rapid roadside survey method to determine the spread of species along ditches and roadside wet areas. The other strategy is an individual observation, where a volunteer can survey areas where disturbance has occurred in the past or is occurring, and may not be as accessible by vehicle. Sometimes the complexity of invasive species at a particular site requires a careful assessment. These areas are best done on foot where several species can be assessed in one location. Individual observations are for when you are out for a hike or bicycle ride anywhere in the Annapolis Valley. Roadside surveys occur along a defined section of road to account for ditch species.

The datasheet, including “cheatsheet” for codes, is located in Appendix C. To begin the survey, check at the top of the datasheet whether you are completing an individual observation survey or a roadside survey. Fill in parts that are applicable to your survey and put an X through parts that aren’t. If you come across an invasive alien plant on your travels, but don’t have a GPS unit with you, you may still use the datasheet to describe its location. Complete the data sheet to the best of your ability, and submit it to CARP for mapping. Alternatively, you can report an alien online at the *Plant Patrol NS* website (www.plantpatrolns.ca).

Survey Data Collection (Filling in the Datasheet)

The datasheet and survey methodology are divided into five sections (A through E). Below, the methodology associated with each section is explained in the order that it appears on the datasheet. The data collected is recorded in parts called fields, and each field on the datasheet has a corresponding number.

A – Site Description

This section is intended to help identify who conducted the survey, and when and where the invasive plant population is located. This section is **very important** for repeat surveys, and to organize the data, so fill out all the fields. The “Time” and the “Survey Start GPS Location” fields are especially important. These are the only links between the information on the datasheet and the GPS data. The best time to fill in some of the information is before you leave home. Once you’ve decided to conduct a survey, fill in your name, and the survey date and location on a few datasheets before you head out.

Name(s): _____	1	_____
Date (dd/mm/yyyy): _____	2	_____ Time: _____
Survey Start GPS Location: UTM N _____	4	UTM E _____
Site Description (as specific as possible): _____	6	_____
GPS Serial Number (if using AGRG units): _____	7	_____
Transportation Type (circle): foot, bicycle, car, boat, other _____	8	_____

- 1 – Note **WHO** is conducting the survey, with full name.
- 2 – Note the **DATE** of the survey using the day, month, year format.
- 3 – It is important to note the **TIME** of the start of the survey, as this will help match up the GPS data. The GPS automatically collects a date and time field, so this is an additional check for matching files.
- 4 – At the start of your survey, you will mark a waypoint using your GPS unit, and you will record the Northing (**UTM N**) and Easting (**UTM E**) coordinates in the **SURVEY START GPS LOCATION** field. To mark a waypoint, see the GPS methods detailed in Appendix D.
- 5 – Easting (**UTM E**) coordinate for survey start location.
- 6 – On the data sheet under the **SITE DESCRIPTION**, identify the location of the survey (e.g. “Exit 19” or “ East corner of Fitch Road”). Include specific details if possible (e.g. “Proceeding East to Lawrencetown” or “1km past white house on the right on highway 1”).
- 7 – If you are using a GPS unit borrowed from the Applied Geomatics Research Group (AGRG) *Community Mapping Project*, copy the **SERIAL NUMBER** in this field. To do this, open the battery section and note the small numbers above the battery. This can be done at home before you start your survey. This step is essential to ensure the proper GPS data is recorded with the correct unit at the time of download. To review how to mark a waypoint and check your GPS settings, see Appendix E.

8 – Note the mode of **TRANSPORT** used to do the survey. If you arrive by car but park and get out and walk, the survey is by foot. If you drive along the roadside and stop or slowdown to record data, the survey is by car or bicycle.

B – Plant Checklist

This section contains the actual species found, approximations of how many plants there are at the site, and whether they are in flower, fruit or seed. This section is all about the biology of the invasive plant species. It is very important know if the plant has the ability to flower and produce seed. Often, newly colonizing species have a number of years when they do not produce viable fruit and seed, so it is important to determine if they are capable of reproducing. In some cases, although there is seed, it may not be viable (signs of aborted production may include formed seed capsules that are empty). In order to describe the population’s “Flower Stage” or “Fruit Stage”, more that 50% of the plants must meet the qualifications described on the “cheatsheet”, on the back of the datasheet (Appendix C).

Some exotic plant species may reproduce by vegetative measures, such as layering or by rhizome spread. These methods do not require seed and for some species, such methods are the preferred mode of reproduction. If the invasive species appears to be diseased or have insect damage, please note this as there may be a pest that has developed an appetite for the species. It is very important to know this.

Another important field to note is whether the population occurs in natural habitat, or disturbed habitat. If the plants are occurring in natural habitats, this may indicate a breakdown in ecological integrity within the community.

NOTE: You must use the field codes provided on the “cheatsheet” to complete the table. The “cheatsheet” is on the back of the datasheet, and in a larger format within the volunteer manual (Appendix C).

GPS Code (waypoint name)	Species Code	Number of Plants	Infested Area	Flower Stage	Fruit Stage	Disturbed Area Type	Natural Area Type
9	10	11	12	13	14	15	16

9 – Record the **WAYPOINT NAME** (or **GPS CODE**) assigned to the population. You may either use the auto-number function (the GPS unit will automatically number waypoints sequentially), or you may assign a name to the waypoints using the keyboard. **You must record the waypoint names on the datasheet to ensure that the proper GPS data is recorded with the correct unit at download.**

10 – At each stop, identify the invasive alien plant species observed at that site by selecting the **SPECIES CODE**. The common names for the codes are provided in a “cheatsheet” on the datasheet. If more than one species is observed, note this and record the names. **Each plant species requires its own GPS CODE.**

11 – Count the actual **NUMBER OF PLANTS** if there are less than 25 plants present (for example, if there are 19 plants, record the number as C1-19, where C1 represents Class 1). **If there are more than 25 plants, estimate the number of plants present, and assign a class number** from the “cheatsheet”. For example, if the ditch is completely full, and it is too difficult to count each plant, give an estimate (using the ranges described on the data sheet) of the population size.

- 12 – Estimate the **INFESTED AREA** (m²), and assign a class number from the “cheatsheet”.
- 13 – Note if the plants are in **FLOWER** or not, and use the codes listed on the “cheatsheet” to describe the majority of the population (**greater than 50%** of the population).
- 14 – Note if there are any **FRUIT**, seeds, or pods, and use the codes listed on the “cheatsheet” to describe the majority of the population (**greater than 50%** of the population).
- 15 – Determine the **DISTURBED AREA TYPE** for the area where the plants are located (e.g. along a roadside, in a yard, garden, gravel pit, etc). If the plants are occurring in a natural area, use Class 0 to indicate “none of this type”. Always use the codes provided in the “cheatsheet”.
- 16 – If the plants are in a **NATURAL AREA** (and therefore not in a disturbed area) note the area type (e.g. forest, wetland, etc). If the plants are occurring in a disturbed area, use Class 0 to indicate “none of this type”. Always use the codes provided in the “cheatsheet”.

C – Watercourses/Wetlands

A number of the invasive species on our “hit list” (page 2) occur in wetlands and along watercourses. It is important to know how pronounced this tendency is, and the extent to which it is occurring. In many cases, species such as glossy buckthorn have replaced native alder as the dominant riparian shrub species. When recording data, take a look to see if there is a culvert or watercourse nearby, and note what type of wetland/watercourse it is (see the Glossary, pages 9-10).

GPS CODE: ____17____ Wetland/Watercourse Type (circle): River, Stream, Lake, Pond, Marsh, Swamp, Bog, Fen, Shallow Water, Salt Marsh, Other ____18____ Describe Location in Relation to Invasive Plant: ____19____ Approximate Distance from Plants (m): __20__ Notes: ____21____ _____ _____
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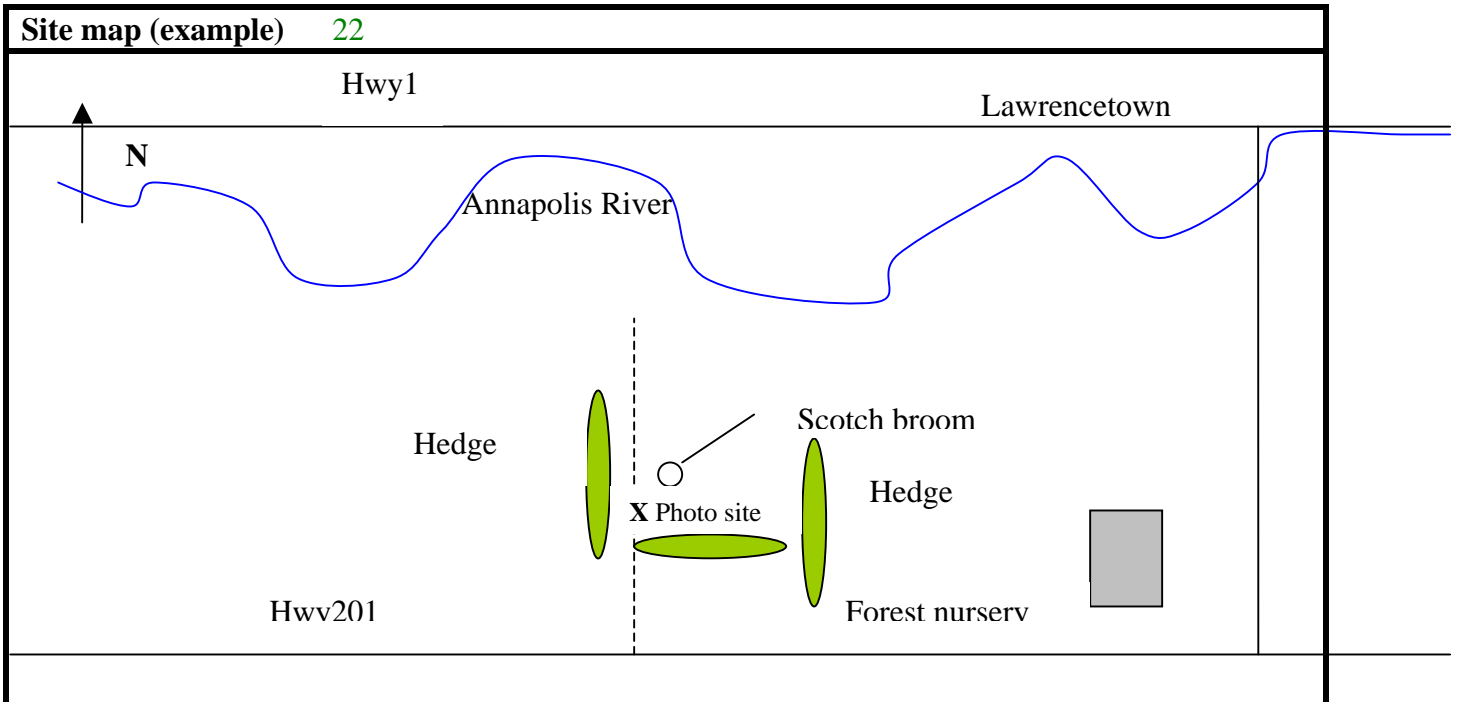
If there is a watercourse/wetland near an invasive alien plant observation, it is very important to note this. Many of the most invasive plant species are facultative wetland species, meaning they adapt well to wet conditions. **If there is a watercourse/wetland nearby (visible from where you detect the invasive species), fill in the following sections on the datasheet.**

- 17 – There are 2 wetland observation fields on each datasheet. For each watercourse/wetland near an observation site, fill in the corresponding **GPS CODE** (to identify which invasive plant observation is near the watercourse/wetland).
- 18 – Note the **WATERCOURSE/WETLAND TYPE** (by circling the appropriate type). Watercourse/wetland types are defined in the glossary (pages 9-10).
- 19 – Describe the **LOCATION** of the watercourse/wetland in relation to the invasive alien plant (for example, “pond behind the house, on same side of road as plants” or “bog across the road, south of plants”).
- 20 – To describe the **DISTANCE**, give an approximation of how close it is to the mapped invasive alien plant or plant population.
- 21 – Note if it is linked by a ditch, and include any other **COMMENTS** you think may be relevant. Civic address associated with the adjacent property, or a nearby landmark might be useful.

D – Site Map

SECTION D NOTE: To allow for mapping space, this section is on the back of the datasheet.

Occasionally there are problems with GPS settings, or with several volunteers submitting observations and GPS units at the same time. A hand drawn map helps to correlate the datasheet to the GPS points collected. Often observers also notice other things located nearby and want to point out their location on a map. Although this map will not be entered directly into the database, it will be a reference for future observers. Use the space provided to map the populations to the level you are comfortable.



Other Observations or Comments: For example, were plants or seeds being foraged? Were plants diseased, and if so, where? Were young plants germinating nearby? Other comments?

23

22 – Once the species have been accounted for, draw a **SITE MAP** (see example above) indicating major landmarks, highways, tie-in points, etc. Map orientation is North-up. If you took a photograph, remember to indicate the photo site on your map.

23 – Note any additional **COMMENTS** on any of the species you observed during your survey. Examples may include evidence of pests or pathogens, or that the invasive plants appear to be overtopping existing native vegetation.

NOTE ON PHOTOGRAPHS: If you have a digital camera with you, it would be helpful to photograph the invasive plant populations you survey. To do this, take the photograph from the same point you collected the waypoint (GPS CODE). Indicate if this is in the center or edge of the population. Indicate the photo point on your site map. To determine the photo direction, use the compass on the GPS, or another compass. You may know the photo direction based on the direction of the road (e.g. facing west). If you cannot take a photograph from the waypoint location, describe where you did take the photo from (for the purpose of re-photographing in future years). Be sure to record your photo sequence on the datasheet so that each photo can be associated with a specific plant, or GPS waypoint.

E – End Survey Information

SECTION E NOTE: **This section is on the front of the datasheet, at the bottom.**

This information is very important to determine the number of hours and distance the volunteers are able to survey either on foot, by bicycle or in a vehicle. It also helps in designing sampling programs.

Survey End Location (as specific as possible):	_____	24	_____
Survey End GPS Location: UTM N	_____	25	_____ UTM E _____
Total Volunteer Hours:	_____	27	_____

24 – Describe, as accurately as possible, your **SURVEY END LOCATION** (the location at which you stopped surveying for invasive plants).

25 – At the end of your survey, you will mark a waypoint using your GPS unit, and you will record the Northing (**UTM N**) and Easting (**UTM E**) coordinates in the **SURVEY END GPS LOCATION** field.

26 – Easting (**UTM E**) coordinate for survey end location.

27 – Include the **TOTAL VOLUNTEER HOURS** you committed to conducting your invasive plant survey.

Important Datasheet Notes

At the end of your survey, check the following:

- Make sure fields 4 and 5 (Start GPS Location) and 25 and 26 (End GPS Location) are filled in.
- Make sure you've documented the survey date and start time (fields 2 and 3).
- Be sure to specify whether you surveyed one or both sides of the road.
- Remember to record the amount of time you spent doing each site (field 27). This will help us to evaluate the *Plant Patrol NS* program, and log volunteer hours.

Even if you don't see any invasive plants while conducting your survey, please complete a datasheet (be sure to include the route you traveled) and submit it. This will allow us to know the area has been checked and no species were observed. **Information about where invasive species are not present is as important as information about where invasive species are present!** Make sure all fields are either filled in or crossed out to indicate the information was not applicable.

Checklist of Survey Equipment

- *Plant Patrol NS* Observers Manual
- datasheets (with extras)
- several sharp pencils
- clipboard
- field guides, if desired
- hand lens, if desired
- GPS unit, if possible (if not, a compass, a watch, and a topographic map)
- camera, if possible
- ziplock bags, for sample collection, if required
- drinking water
- sunscreen and bug repellent
- hat
- rain gear for bicycle or hiking survey
- appropriate footwear

Tips for Working Safely Along a Roadside

- if traveling by car, use your 4-way flashers to indicate slow speeds
- wear bright-coloured clothing so that you are highly visible to other drivers
- do not work near or before dawn
- do not work near or after dusk
- do not cross the road to investigate other plants
- if you do not feel safe surveying the road you chose, do not survey it
- REMEMBER, your safety comes first!

Glossary

Native Species

Any species that occurs naturally in an area, without human intervention. The native range of a species is determined by a number of factors, including geography, climate, soils, natural disturbance, and species interactions. The natural range of a species may expand or change over time as a result of a changing environment. Arguably, environmental changes may or may not be the result of human actions.

Alien Species

A species of plant, animal, or microbe introduced by human action (intentionally or accidentally) outside of its natural range. Invasive species may originate on another continent, in another country, or in another part of Canada. Common vectors for the introduction of alien species include: ballast water from ships, recreational boating, aquarium and pet trades, horticulture, "hitchhikers" on commodities, "stowaways" in transportation, and disease in wildlife. It is important to remember that *not all aliens are invasive*. In fact, some species introductions have been very beneficial to the North American economy, including cattle, wheat, honeybees, and many ornamental plants (eg. tulips, chrysanthemums).

Invasive Alien Species

An alien species whose introduction and/or spread threatens the environment, the economy, or society (including human health). High productivity, good dispersal, long growth periods, and lack of natural controls contribute to their success in new environments. Due to increases in global trade, travel, and resource extraction, species introductions are on the rise. Don't forget that *not all aliens are invasive*. Only a very small percentage of introduced species become problem invaders.

GPS – Global Positioning System

The GPS is a "constellation" of 24 well-spaced satellites that orbit the earth and make it possible for people with ground receivers to pinpoint their geographic location.

GPS unit

A commercial unit that receives weak radio signals from the best 4 satellites to calculate location.

WAAS - Wide Area Augmentation System

The WAAS uses a system of Federal Aviation Association funded ground stations to provide necessary augmentations to the GPS navigation signal, and therefore improve the overall integrity of the GPS signal. In essence, it is a bit like correcting your points using a base station. A network of precisely surveyed ground reference stations is strategically positioned across the country.

Watercourses

River – A large, flowing body of water that usually empties into a sea or ocean.

Stream – A flow of water in a channel or bed, as a brook, rivulet, or small river. There is a steady current in such a flow of water.

Lake – A large body of water entirely or nearly surrounded by land.

Pond – A still body of water so shallow that rooted plants usually grow completely across it.

Wetlands

Marsh – An open wetland with muddy substrate that can have scattered shrubs. Cattails and marsh grasses are usually present.

Swamp – A forested wetland with trees as well as shrubs on a muddy substrate. It is periodically flooded.

Bog – A poor, isolated peatland with a depth of at least 40cm of sphagnum peat. It can be open, shrubby or forested.

Fen – A rich peatland with a depth of at least 40cm, and a substrate made up of grassy peat as well as sphagnum moss. It is usually connected to a waterway and can be open, shrubby or forested.

Shallow water – A water body with less than 2m depth.

Saltmarsh – Coastal wetlands dominated by grasses and flooded by the tides.

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Appendix A – List of terrestrial invasive alien plants for the Annapolis Valley, NS, including problematic garden plants.

(N) = native plant

High Priority

- 1 – glossy & common buckthorn (*Rhamnus frangula* & *Rhamnus cathartica*)
- 2 – Japanese knotweed (*Polygonum cuspidatum*)
- 3 – purple loosestrife (*Lythrum salicaria*)
- 4 – common reed (*Phragmites australis*)
* NOTE: There is also a native Common Reed, and they are difficult to distinguish
- 5 – garlic mustard (*Alliaria petiolata*)
- 6 – Scotch broom (*Cytisus scoparius*)
- 7 – multiflora rose (*Rosa multiflora*)
- 8 – Canada thistle (*Cirsium arvense*)
- 9 – Oriental/Asiatic bittersweet (*Celastrus orbiculatus*) *NEW ADDITION*

Other Known Invasives

- 10 – Manitoba Maple (*Acer negundo*)
- 11 – Norway Maple (*Acer platanoides*)
- 12 – goutweed (*Aegopodium podagraria*)
- 13 – flowering-rush (*Butomus umbellatus*)
- 14 – cuckoo flower (*Cardamine pratensis*)
- 15 – spotted knapweed (*Centaurea maculosa*)
- 16 – celandine (*Chelidonium majus*)
- 17 – leafy spurge (*Euphorbia esula*)
- 18 – dame's-rocket (*Hesperis matronalis*)
- 19 – St. John's-wort (*Hypericum perforatum*)
- 20 – tatarian honeysuckle (*Lonicera tatarica*)
* NOTE: All of the exotic shrub honeysuckles (*Lonicera sp.*) should be considered potentially invasive
- 21 – moneywort (*Lysimachia nummularia*)
- 22 – sweet clover (*Melilotus sp.*)
- 23 – wild marjoram (*Origanum vulgare*)
- 24 – Scots/Scotch pine (*Pinus sylvestris*)
- 25 – white poplar (*Populus alba*)
- 26 – black locust (*Robinia pseudo-acacia*)
- 27 – coltsfoot (*Tussilago farfara*)
- 28 – valerian (*Valeriana officinalis*)

Plants to Keep an Eye on

- 29 – (N) common (annual) ragweed (*Ambrosia artemisiifolia*)
- 30 – lesser burdock (*Arctium minus*)
- 31 – hairy crabgrass (*Digitaria sanguinalis*)
- 32 – false baby's breath/bedstraw/cleavers (*Galium mollugo*)
- 33 – ornamental jewelweed/Himalayan balsam (*Impatiens glandulifera*)
- 34 – common nipplewort (*Lapsana communis*)
- 35 – wild parsnip (*Pastinaca sativa*)

Problems in the Garden

A – Already Listed

- goutweed (*Aegopodium podagraria*)
- spotted knapweed (*Centaurea maculosa*)
- crabgrass (*Digitaria sanguinalis*)
- moneywort/creeping Jennie (*Lysimachia nummularia*)
- purple loosestrife (*Lythrum salicaria*)
- wild parsnip (*Pastinaca sativa*)
- common reed/giant reed (*Phragmites australis*)
- Japanese knotweed (*Polygonum cuspidatum*)

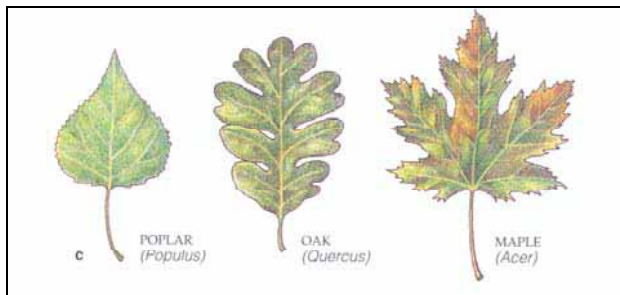
B – Other

- yarrow (*Achillea millefolium*)
- lady bells/ladybells (*Adenophora confusa*)
- creeping bellflower/rapion bellflower/rover bellflower (*Campanula Rapunculoides*)
- field bindweed (*Convolvulus arvensis*)
- couch grass (*Elymus repens*)
- (N) field horsetail/western horsetail/scouring rush (*Equisetum arvense*)
- cypress spurge (*Euphorbia cyparissias*)
- creeping Charlie/ground ivy (*Glechoma hederacea*)
- Scotch thistle (*Onopordum acanthium*)
- Japanese lantern (*Physalis franchetii*)
- (N) choke cherry (*Prunus virginiana*)
- sheep sorrel/field sorrel/red sorrel/dock (*Rumex acetosella*)
- dandelion (*Taraxicum officinale*)
- red clover (*Trifolium pratense*)
- comfrey (*Symphytum officinale*)
- (N) stinging nettle (*Urtica dioica*)

Appendix B – Overview of plant structure. Definitions are adapted from Roland’s Flora of Nova Scotia (Zinck 1998).

Leaf Shape

1. *Simple* – without divisions



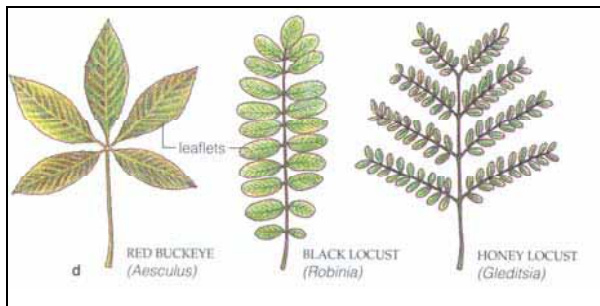
<http://www.cropsci.uiuc.edu/classes/cpsc121/images/PlantSystems/simplecompound.jpg>

Smooth – edges of leaf are smooth, no teeth or lobes (eg. buckthorn leaves)

Toothed – edges of leaf have teeth (eg. poplar leaves, birch leaves)

Lobed – leaf has lobes (eg. maple leaves, oak leaves)

2. *Compound* – with divisions, forked into leaflets



<http://www.cropsci.uiuc.edu/classes/cpsc121/images/PlantSystems/simplecompound.jpg>

Pinnate – arranged in two rows, branching from a central line

Palmate – three or more branches originating from the same point

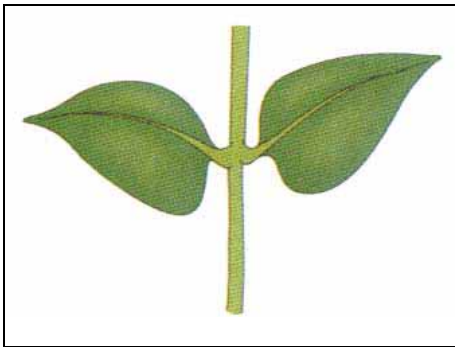
Leaf Arrangement

1. *Basal* – located at or near the base of the plant
2. *Alternate* – arranged singly on opposite sides of the stem, originating from different nodes



<http://www.cropsci.uiuc.edu/classes/cpsc121/images/PlantSystems/leafposition.jpg>

3. *Opposite* – arranged in pairs on opposite sides of the stem, originating from the same node



<http://www.cropsci.uiuc.edu/classes/cpsc121/images/PlantSystems/leafposition.jpg>

4. *Whorled* – arranged in a circle around the stem



<http://www.cropsci.uiuc.edu/classes/cpsc121/images/PlantSystems/leafposition.jpg>

Flower Structure and Type

1. *Regular* – petals or sepals are uniform in size, shape, and orientation



http://www.seeds.ca/proj/poll/f_morph.php

2. *Irregular* – petals or sepals are uneven in size, shape, or orientation



http://www.seeds.ca/proj/poll/f_morph.php

Appendix C – *Plant Patrol NS* 2008 datasheet, including full-size “cheatsheet” for codes.

Roadside Record Other Observation

Name(s): _____
 Date (dd/mm/yyyy): _____ Time: _____
 Survey Start GPS Location: UTM N _____ UTM E _____
 Site Description (as specific as possible): _____
 GPS Serial Number (if using AGRG units): _____
 Transportation Type (circle): foot, bicycle, car, boat, other _____

*** See CHEATSHEET for Field Codes (over) to Complete Table ***

GPS Code (waypoint name)	Species Code	Number of Plants	Infested Area	Flower Stage	Fruit Stage	Disturbed Area type	Natural Area Type

If any invasive plant observation is near a wetland, please specify the following:

GPS CODE: _____
 Wetland/Watercourse Type (circle): River, Stream, Lake, Pond, Marsh, Swamp, Bog, Fen, Shallow Water, Salt Marsh, Other _____
 Describe Location in Relation to Invasive Plant: _____
 Approximate Distance from Plants (m): _____
 Notes: _____

GPS CODE: _____
 Wetland/Watercourse Type (circle): River, Stream, Lake, Pond, Marsh, Swamp, Bog, Fen, Shallow Water, Salt Marsh, Other _____
 Describe Location in Relation to Invasive Plant: _____
 Approximate Distance from Plants (m): _____
 Notes: _____

Species Codes
ALLIPET
garlic mustard <i>Alliaria petiolata</i>
CELAORB
Oriental/Asiatic bittersweet <i>Celastrus orbiculatus</i>
CRISARV
Canada thistle <i>Cirsium arvense</i>
CYTISCO
Scotch broom <i>Cytisus scoparius</i>
LYTHSAL
purple loosestrife <i>Lythrum salicaria</i>
PHRAAUS
common reed <i>Phragmites australis</i>
POLYCUS
Japanese knotweed <i>Polygonum cuspidatum</i>
RHAMCAT
common buckthorn <i>Rhamnus cathartica</i>
RHAMFRA
glossy buckthorn <i>Rhamnus frangula</i>
ROSAMUL
multiflora rose <i>Rosa multiflora</i>
OTHER
other (provide name)

Survey End Location (as specific as possible): _____
 Survey End GPS Location: UTM N _____ UTM E _____
 Total Volunteer Hours: _____



Site Map:

N
↑

Other Observations or Comments: For example, were plants or seeds being foraged? Were plants diseased, and if so, where? Were young plants germinating nearby? Other comments?

*** Field Codes: Select Appropriate Code/Class, and Write Code in Datasheet Table ***					
Invasive Alien Plant Species			Number of Plants		
<u>Code</u>	<u>Latin Name</u>	<u>Common Name</u>	<u>Class</u>	<u>Criteria</u>	
ALLIPET	<i>Alliaria petiolata</i>	garlic mustard	1	< 25 Individuals (give actual number)	
CELAORB	<i>Celastrus orbiculatus</i>	Oriental bittersweet	2	26 – 50 Individuals (estimate)	
CIRSARV	<i>Cirsium arvense</i>	Canada thistle	3	50 – 100 Individuals	
CYTISCO	<i>Cytisus scoparius</i>	Scotch broom	4	> 101 Individuals	
LYTHSAL	<i>Lythrum salicaria</i>	purple loosestrife			
PHRAAUS	<i>Phragmites australis</i>	common reed		NOTE: IF in Class 1, put in actual number of plants, as well as Class. For example, C1-4 or C1-24.	
POLYCUS	<i>Polygonum cuspidatum</i>	Japanese knotweed			
RHAMCAT	<i>Rhamnus cathartica</i>	common buckthorn			
RHAMFRA	<i>Rhamnus frangula</i>	glossy buckthorn			
ROSAMUL	<i>Rosa multiflora</i>	multiflora rose			
OTHER	Other (provide name)				
Infested Area (m ²)		Flower Stage		Fruit Stage	
<u>Class</u>	<u>Criteria</u>	<u>Class</u>	<u>Criteria</u>	<u>Class</u>	<u>Criteria</u>
1	< 1m ² (1m x 1m)	0	No Flowers or Buds	0	No Fruit
2	1 m ² – 5 m ²	1	Buds Present	1	Green Fruit (unripe berries)
3	6 m ² – 25 m ²	2	Opening Bud	2	Ripe Capsule (plants with berries)
4	> 25 m ² (5m x 5m)	3	Full Flower	3	Ripe Seeds (plants with seed pods)
				4	Empty Capsule
Disturbed Area Type		Natural Area Type			
<u>Class</u>	<u>Type</u>	<u>Class</u>	<u>Type</u>		
0	None of This Type	0	None of This Type		
1	Road	1	Wetland		
2	Trail	2	Forest		
3	Parking Lot	3	Lakeshore		
4	Eroded River Bank	4	Beach		
5	Farmyard	5	Rock Outcrop		
6	Pasture (forage)	6	Other (describe)		
7	Field (hay)				
8	Home or Yard				
9	Ditch				
10	Other (describe)				
			NOTE: One area type will be Class 0, and the other will be Class 1 – 10. For example, if the area type is a roadside, then Natural Area Type = 0, and Disturbed Area Type = 1. Select the area type that BEST DESCRIBES the location of the plant.		

Appendix D – Steps for marking a waypoint using a hand-held GPS unit.

GPS Setup

It is very important that if you have not used a GPS before that you get trained in fundamentals of GPS operation. Before starting out, it is important to make sure the GPS setup is the correct one for this project. The coordinates in your GPS display should look like the figure below. The 20 T is the UTM (Universal Transverse Mercator) coordinate system zone. The top number, 0336170, is the easting and the bottom number, 4980079, is the northing. Copy these coordinates carefully from the GPS into the corresponding section on the SITE DESCRIPTION section of the data sheet.



To check the GPS setup see Appendix E for instructions, or the GPS owners manual, available online at www.garmin.com.

- For GPS data collection, it is important to make sure the GPS unit is set to “WAAS enabled” for increased accuracy, and make sure to use the NAD 83 setup on the GPS (UTM – UPS on Garmin units).
- The reason we are using NAD 83 is that the base data for Nova Scotia is NAD 83, and we won’t have to convert the *Plant Patrol NS* data.
- Allow at least 4 satellites to appear before collecting a point and be sure to allow the GPS to lock on the satellites before trying to save.
- Save points as “averaged” if your GPS allows, as this increases the accuracy. If the roadside has a heavy canopy of trees, move around and find a direction where the satellites won’t be blocked.

Waypoint Collection Method

The GPS receives signals from many satellites. Often when people collect a waypoint they are amazed that the point isn’t where they expect it to be. If you imagine a series of signals to be something like rain, then Figure 1 will help you visualize why you need to be as close to the plants as possible when marking a waypoint, and why you need to average points. Each of the points has a different time stamp and none are at the actual location (triangulation). This loose circle of points is within 2-5m of the actual point you are trying to mark, but not actually “on the spot”. Averaging the points will bring the waypoint as close as possible to where it should be.

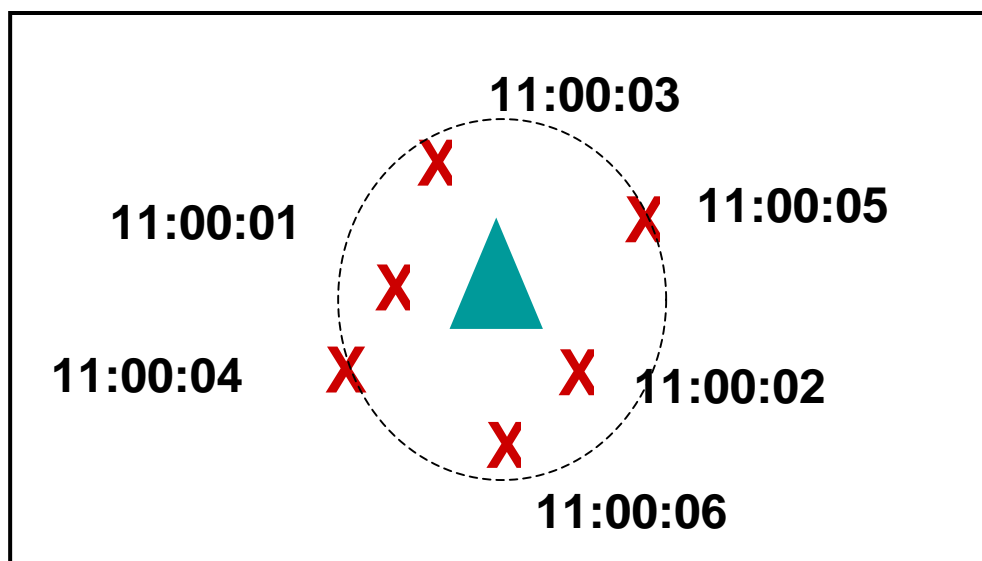


Figure 1. GPS point resolution.

If you use the “average” function, the GPS coordinates you collect have a resolution of within 2-5m (dashed circle illustrated in Figure 1), but you should be as close to the plants as possible. The ideal position is illustrated in Figure 2, with the unit held directly over the plants. How you collect these coordinates will be determined by the size of the population. If you have a single clump and there are no others nearby, hold the GPS unit over the plants, as illustrated in Figure 2. Mark the coordinate according to the instructions for the GPS unit. Be sure to write the GPS CODE for your point in the appropriate field on the datasheet.

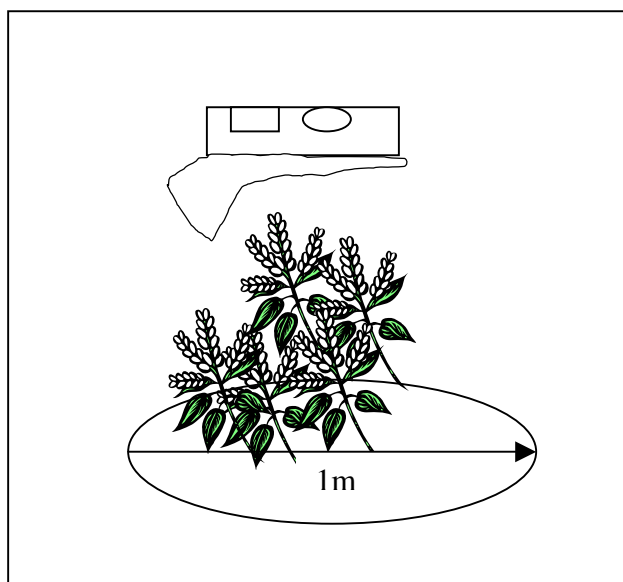


Figure 2. Optimal position of hand-help GPS unit for recording the location of a single plant, or single clump of plants.

To mark the location of a plant population, or several close clumps (greater than 1m across), hold the GPS unit over the first clump or at the edge of the population, as illustrated in Figure 3. Mark the coordinate (nothing and easting) according to the instructions for the GPS unit. Write the northing and easting for this coordinate on the datasheet. Then go to end of the population along the ditch, and using the same

procedure (Figure 3), save the end coordinate. Be sure to record the northing and easting for these coordinates on the datasheet and their **GPS CODE**.

NOTE: Where populations are large and oddly shaped, map the shape on the datasheet (**SITE MAP**) and indicate where you took the coordinate. When marking a coordinate make sure at least 4 satellites are visible. If there are less than 4, see if your body, your hand, or a building, are blocking satellite reception. If you are below a full forest canopy, satellite reception may be a problem unless you have an antenna. When marking a waypoint it is better to average your points (if your GPS units allows), as the final point will be more accurate.

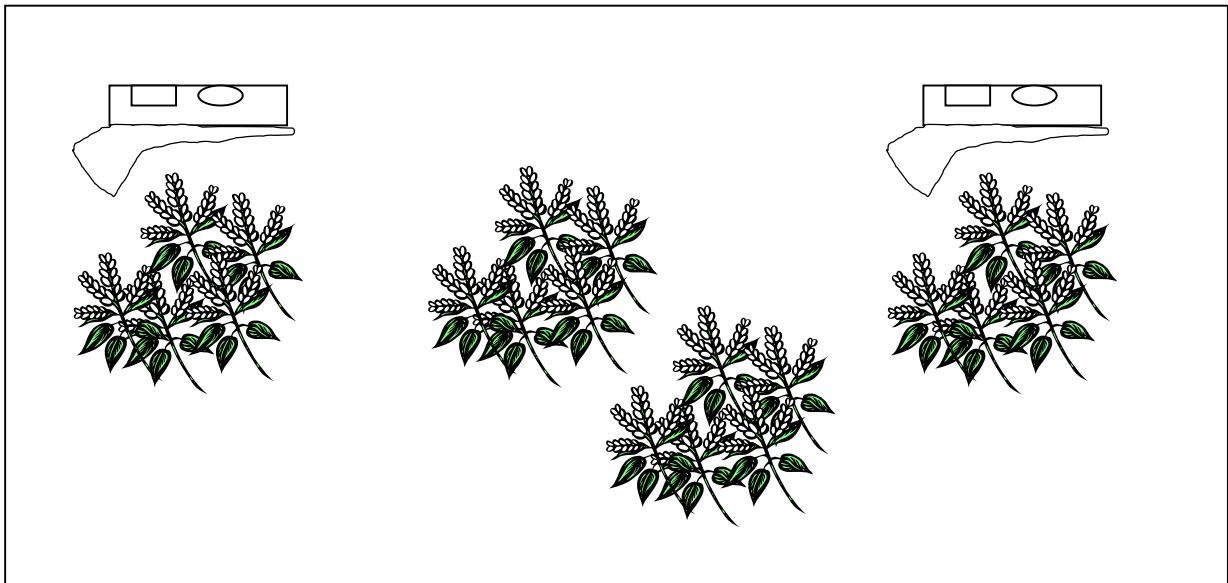



Figure 3. Optimal position of hand-help GPS unit for recording the location of multiple close clumps, or one population greater than 1m across.

Appendix E – Summary of how to operate the Garmin 76CSx hand-held GPS unit. Taken from an AGRG *Community Mapping Project* presentation.

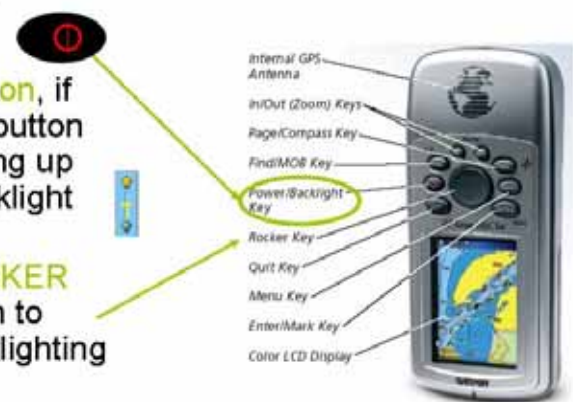


Introduction to Garmin GPSmap 76CSx

Part Three:
How do I operate this thing?

To start

- To start, press and hold the power key
 - Once power is **on**, if you press this button lightly it will bring up the screen backlight adjustment
 - Press the **ROCKER** pad up or down to adjust the backlighting



Internal GPS Antenna

In/Out (Zoom) Keys

Page/Compass Key

Find/MOB Key

Power/Backlight Key


Rocker Key

Quit Key

Menu Key

Enter/Mark Key

Color LCD Display



Pages

- Once the power key is pressed you will automatically be put into pages mode after the welcome page
- There are 6 pages that you can scroll through by pressing the PAGE/COMPASS key
- The pages are in order;
 - satellite page,
 - map page,
 - compass page,
 - trip computer,
 - altimeter,
 - main menu



Pages - continued



By pressing the MENU Key at any point while in each PAGE, a submenu appears enabling the user to change a list of properties in each page while in the page. This is helpful in the Satellite page as it allows the user to turn the GPS off (Satellite acquisition) while setting parameters and downloading. This saves battery power.



Submenus

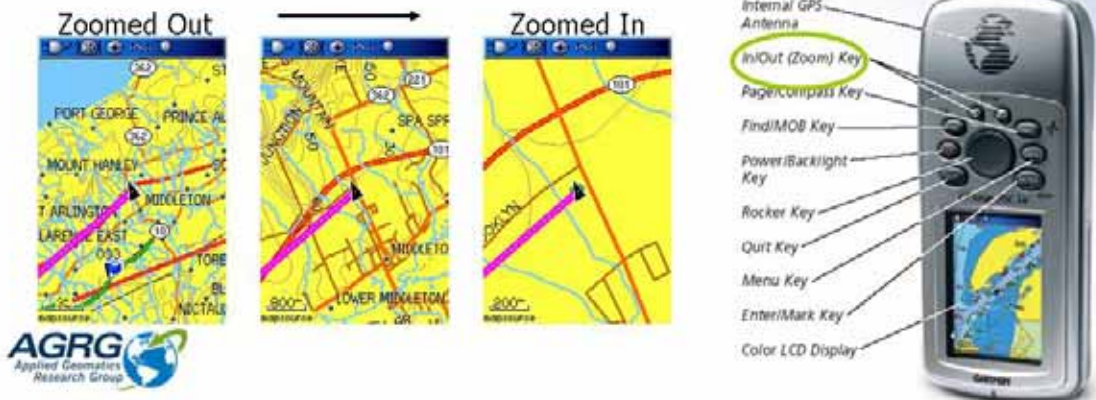


At any page, the user can move back to the previous screen by pressing the QUIT key, this moves back one screen, ie from submenu to page, then one more to previous page. To move up and down the submenu, use the top and bottom of the ROCKER pad. To select an option, press the ENTER key.



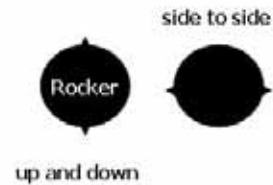
Other Keys

- To allow you to see the map page there are ZOOM In and ZOOM Out Keys
- You will notice you will see more detail (contours, rivers, roads) as you ZOOM In.



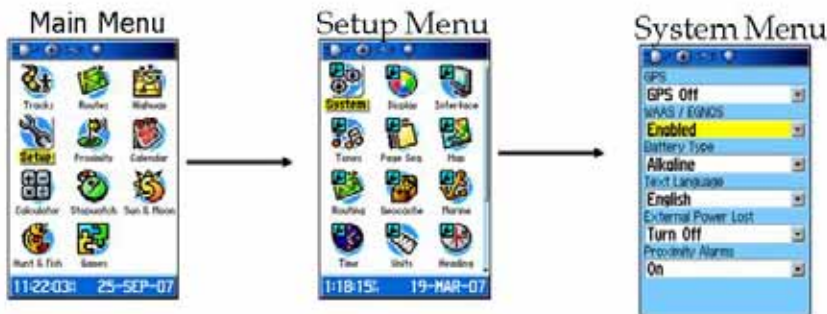
Rocker and Text

- The ROCKER is used to move the cursor around the page, the map and the screens
- Text labels can be added to name field.
- Once the point is marked, move the cursor to the name field and press ENTER.
- A keyboard will appear and navigation is by ROCKER.



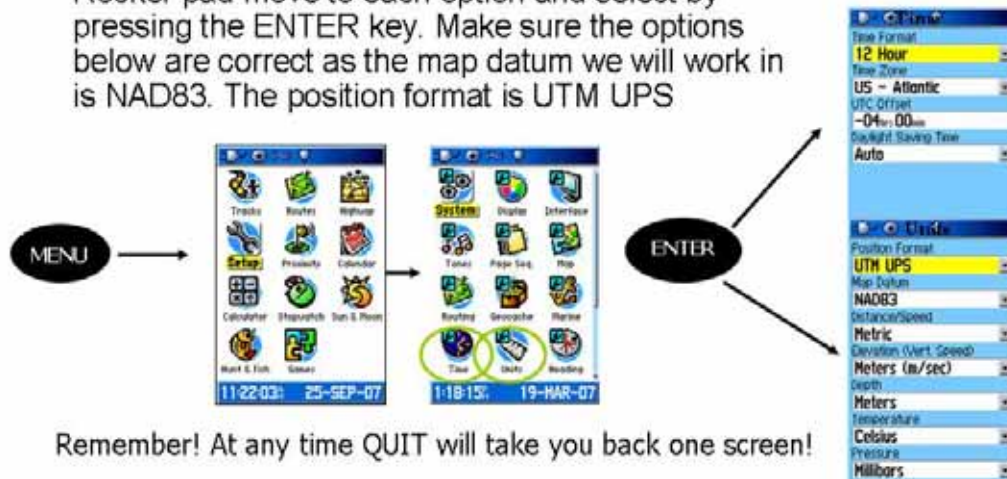
Setup

- Before using the GPS unit there are a few settings you should check to make sure the unit will operate as specified for your program. This is done in the Main Menu, by pressing the MENU key.
- By using the ROCKER pad, move down options to select the Setup option. Press the ENTER key.
- The Setup Menu will appear on the screen, select System and a system menu will appear. Check to make sure WAAS enabling is on and other system options are the same as the System menu below.



Other Setup options to check

- Make sure the correct time zone is selected and the correct units in the Setup Menu. Using the Rocker pad move to each option and select by pressing the ENTER key. Make sure the options below are correct as the map datum we will work in is NAD83. The position format is UTM UPS



Marking a Point

- You will want to collect or MARK a point to collect some data on features you are interested in. To do this press the ENTER key and hold (you will notice it says MARK to the side of the key). A new screen will open showing the UTM coordinate, the date and a flag symbol as well as a number. At the bottom, there are three tabs, OK, Map and Avg. Avg will average the points collected at this spot and increase accuracy. With the ROCKER move to left Avg and press ENTER, a new screen will open and when Estimated accuracy gets to acceptable value, press ENTER and then you will be automatically returned to the original screen. MAKE SURE YOU HIT ENTER AGAIN OR YOUR POINT WILL BE LOST. If you want to see if you have your point select Map and press ENTER.



Finding Your Point (1)

- At some point you might want to go back to that location (Geocache?)
- To do this press FIND key and a screen will appear. Select Waypoints and press ENTER
- A list of Waypoints will appear select one
- A new screen will open with information about that point select GoTo
- A screen will ask if you want to Follow a Road or go Off road, select either
- A map will appear with your point on it and as you get closer you will be alerted you have arrived



Navigating

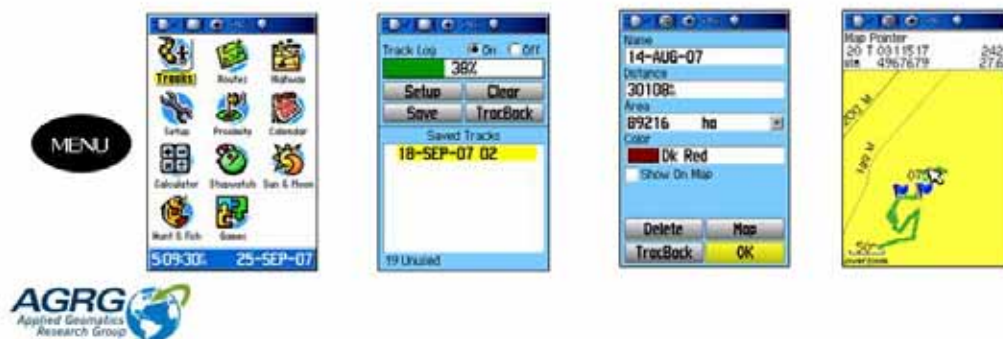
- To navigate to a collected point, follow instructions for Finding a point, selecting a point and selecting GoTo.
- You can select map navigating by selecting map and with instructions selected in the map submenu you can get navigation instructions or distance measures to the point.
- Or you can navigate by compass page. Fields in compass fields can be edited in the compass submenu.
- All go to methods give a verbal and an alarm notification of arrival within 5m of destination.

Find Waypoint Waypoint GoTo Map Information Map distance Compass



Tracks

- Tracks function like a “cookie crumb” trail of where you have been, either by foot, bike or by automobile. They can be saved and mapped and are very helpful for Photo linking.
- If track log is on tracks are logged automatically but they must be saved to be exported



Summary

- This is the “hands- on part so grab a GPS and go outside!
- If there is anything additional you need to know, consult the Garmin owners manual online at WWW>garmin.com.