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Using Handheld Global Positioning System Receivers for the Wheat Objective Yield Survey

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EXECUTIVE SUMMARY

In 2005, Washington field enumerators successfully showed that handheld Global Positioning System (GPS) receivers could be utilized for the Agricultural Resource Management Survey Phase II and for the June Area Survey. Next, the Washington Field Office and the Research and Development Division investigated if GPS receivers could assist field enumerators with the Wheat Objective Yield Survey.

Currently, Wheat Objective Yield Survey field enumerators go to specified areas of the sampled wheat fields, lay out two objective yield units and record various crop counts. Every month until the fields are harvested, the enumerator returns to the same units and records crop counts. Sometimes a field enumerator has difficulty finding the same location again or a different field enumerator may need to enumerate the field and is unable to find the same location. This costs NASS in field enumeration time, and in those instances where the units were unable to be found, the data quality suffers.

In this study, 23 Washington field enumerators were provided with handheld GPS receivers to aid in the enumeration of 160 winter wheat samples. On their initial visit to each sampled field, they recorded the latitude and longitude coordinates of each unit as it was being laid out. Upon subsequent field visits, if an enumerator had difficulty finding the units, the enumerator would review the unit's coordinates and find the unit of interest using the GPS receiver. Field enumerators were also asked to complete a feedback form for each sample. Of the 160 forms expected, 107 were completed and returned.

Overall, the field enumerators had no problem using their GPS receivers in initially obtaining the units' latitude and longitude coordinates. In four instances the GPS receivers were useful in locating the Wheat Objective Yield Survey units on subsequent visits. The other times the field enumerators were able to find their sample units with no problem.

Costs		Benefits
$50	Equipment and supplies.	GPS receivers were used four times in aiding the enumerator to locate units on subsequent visits.
$68	Enumerator training.	
1 hr.	Statistician time in preparing and training enumerators.	Re-use the GPS receivers over multiple years for the Wheat Objective Yield Survey, June Area Survey, and the Agricultural Resource Management Survey – Phase II.

RECOMMENDATION

1. Recommend field offices already having Global Positioning System (GPS) receivers use them for the Wheat Objective Yield Survey since, with minimal expense, there is potential to improve data quality and save enumeration time. However, do not recommend purchasing GPS receivers for additional field offices for the sole purpose of using them for the Wheat Objective Yield Survey since the savings were not measurable.

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Michael W. Gerling[1/]

Abstract

The National Agricultural Statistics Service (NASS) surveys United States and Puerto Rico agriculture for the purpose of making estimates on crops, livestock, production practices, farm economics, etc.

The Wheat Objective Yield Survey requires field enumerators to physically go to sampled wheat fields, lay out two objective yield units and record various crop counts. Field enumerators return to the same locations every month and record various crop counts until the fields are harvested. Sometimes a field enumerator has difficulty or is unable to find the same location again. This costs NASS in field enumeration time, and in those instances where the units are unable to be found again, the data quality suffers.

In 2005, NASS researched whether providing field enumerators with handheld Global Positioning System (GPS) receivers would be beneficial in finding the Wheat Objective Yield Survey units on subsequent field visits.

KEY WORDS: Agricultural Surveys, Data Collection, GPS

1. INTRODUCTION

The National Agricultural Statistics Service's (NASS) primary purpose is to provide timely, accurate and useful statistics on United States and Puerto Rico agriculture. NASS conducts hundreds of surveys for the purpose of making estimates on crops, livestock, production practices, farm economics, etc.

The Wheat Objective Yield Survey is the third survey to use

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handheld Global Positioning System (GPS) receivers for data collection. In 2004 GPS handheld receivers were successfully used for Washington Field Office's Agricultural Resource Management Survey Phase II (ARMS II) and in 2005 were marginally successful for the June Area Survey.

2. WHEAT OBJECTIVE YIELD SURVEY

The Wheat Objective Yield Survey (WOY) is conducted annually in twelve states and provides information used to forecast the amount of wheat harvested per acre as well the amount of wheat unable to be harvested. Ultimately, the data provide an estimate for the production of wheat at the state, regional, and national levels.

To obtain these data, field enumerators physically go to sampled wheat fields, lay out two objective yield units and record various crop counts. Field enumerators return to the same locations every month and record various crop counts until the fields are harvested.

On the initial visit to the field, the enumerator ties red flagging ribbon at the point of entry into the field and around the outer-most plants of the rows where the units are located. The ribbon aid the enumerator in returning to the designated area the following month. At the end of each month from April through August, the enumerator returns to the same units and records the various crop counts.

A wheat field may have up to four samples within it. Each sample consists of two units located within the field. Each unit is composed of an area which is approximately six feet in length and three crop rows wide.

3. WHAT IS A GPS HANDHELD RECEIVER?

The Global Positioning System is comprised of at least twenty-four satellites orbiting the earth. These satellites transmit signals to GPS receivers on the ground. The majority of GPS receivers are about the size of a standard television remote control.

A GPS receiver only receives signals from the satellites. It does not transmit. To function properly, a GPS receiver requires an unobstructed view of the sky.

First, the GPS receiver acquires signals from these various satellites. Next, the GPS receiver determines the location of the satellites from the information included in the satellites' transmissions. The receiver then calculates the distance it is from each satellite. Finally, the receiver is able to determine where it is actually located on the Earth within a certain degree of accuracy.

The receiver will display its location in latitude and longitude coordinates. Latitude measures the distance north or south from the Equator while longitude measures the distance east and west from the Prime Meridian.

A common use of GPS receivers is for hiking. Hikers utilize these receivers to trace their trail or to mark a unique location that they would like to return to at a later date.

The particular GPS receiver used in this study was the Garmin GPS-72. See Figure 1. The GPS receivers are the same receivers purchased and used for the ARMS II research project conducted in the fall of 2004. At that time Garmin was selected because the company was a respected manufacturer of GPS receivers for fifteen years. The GPS-72 model was also among the lowest-price GPS receivers ($150)

offering Wide Area Augmentation System (WAAS). WAAS provides the potential to obtain a level of accuracy of ten feet. Typically, the GPS-72 receiver will provide a level of accuracy between 10 and 50 feet.

Figure 1: Garmin GPS-72

4. THE RESEARCH PROJECT

Washington's 2005 WOY sample consisted of 160 winter wheat fields.

In previous WOY data collections, field enumerators would sometimes have a difficult time locating their marked samples from their last visit. The reasons vary from the identifiable ribbon blowing away in the wind, to the enumerator being at the completely wrong field. In a few cases, the ribbon is accidentally cut when agricultural workers mow the grass along the edge of the field. At this point, the enumerator then has to go to the field's starting corner and count off the same number of rows and paces into the field, as on the initial visit, and hopefully, find the sample units. However, there are times that a sample unit cannot be found, at which point the enumerator has to lay out the unit again, wasting valuable time and resources. This also breaks the data series that was being created for that particular field and thus the quality of the data suffers.

Hence, the Washington Field Office (WA FO) supplied their field enumerators with GPS receivers to assist in locating the sampled wheat fields' units.

The expectation was that equipping enumerators with low-cost handheld GPS receivers, the field enumerators would save time in those instances when they have difficulty finding a unit or are unable to locate a unit and have to lay out a replacement unit.

4.1 ENUMERATOR TRAINING

Each year a Wheat Objective Yield Survey Workshop is conducted to review the details of the survey and data collection procedures. Educating all 23 field enumerators on how to use their GPS receivers was incorporated into the workshop for the 2005 survey.

For the entire sample, Washington field enumerators were instructed to do the following: During the initial visit, use the GPS receivers to determine the latitude and longitude coordinates of both units. Record these coordinates on the outside of the manila kit envelope (one envelope per sample was provided) and on the completed Part B Form which is completed at the initial visit. Mail the completed Part B Forms to

the office. Thus the WA FO could verify that the latitude and longitude coordinates were indeed obtained. This was also beneficial if a different field enumerator or office staff needed to visit the field and record counts. During subsequent visits, if the field enumerator was having difficulty finding the sample units, he/she would review the coordinates on the kit envelope and use the GPS receiver to guide him/her to the unit of interest. However, since the Garmin GPS-72 receiver's level of accuracy is between 10 and 50 feet, the field enumerator would still have to look around for the sample unit.

Finally, the field enumerators were to complete the Enumerator Feedback Form (similar to a diary) and record any problems in using the GPS receivers in determining the latitude and longitude coordinates on their initial visit. Also, the enumerators were to record any problems in finding the previously laid out units and whether the GPS receiver was helpful or not. Appendix A provides a copy of the Enumerator Feedback Form.

The GPS receiver training required only 15 minutes since all but two field enumerators had used the receivers before. See Appendix B for a copy of the field enumerator instructions on how to use the GPS handheld receiver for the Wheat Objective Yield Survey.

5. FIELD EXPERIENCE

The author of this report was provided with an opportunity to work with two field enumerators on the WOY. The following excerpts are from notes made following those field trips.

"On the first day, after reaching the sampled field, the weather turned for the worse and it started raining. The sample unit was easy to find by noting the red ribbon and poles. The previously recorded coordinates of the unit matched those of my GPS receiver. The rain made it impossible to record the counts onto the paper form since the paper was turning to mush. However, I also brought a Trimble Geo-XT GPS receiver. This particular receiver is designed to handle harsh environments and contains a built in personal digital assistant (mini-personal computer). Hence, I was able to use Microsoft Word and input the counts into a blank Word document using the stylus. A stylus is a pen-like writing instrument used for data entry and screen navigation. Once back inside the vehicle, I brought up the Word document and the field enumerator recorded the counts onto the paper form. This was great for the field enumerator, since the enumerator didn't have to remember the counts which could lead to errors. The enumerator asked when we would be issuing these Trimble GPS receivers. However, with a list price of $4,500 to $5,000 per receiver, the cost is impractical for WOY. The unit's high price is due to having a built in personal digital assistant, provides a level of accuracy of within 3 feet and is durable to withstand harsh weather conditions.

On the second day, I met a different field enumerator and I followed by vehicle to the sampled field. Upon reaching the supposed sampled field, we started looking for the red ribbon to mark the entry path to the unit. We couldn't find the ribbon so we picked a reasonable point and walked in to where the enumerator thought the unit was. After 20 minutes or more of wandering around we decided to use the GPS receiver and realized that we were several hundred feet off. We got back into our vehicles and drove until the GPS receiver's numbers

roughly matched the coordinates recorded from the initial visit. Immediately the field enumerator saw the red ribbon and the poles marking the unit. The data were then successfully collected."

Hence, the author was provided with first hand experiences on how handheld GPS receivers can help in field data collection.

6. RESULTS

Despite being a requirement, only 107 of the 160 Enumerator Feedback Forms were returned. The following findings/numbers are based on these 107 feedback forms.

On the initial visit to the field, one enumerator complained about the batteries dying on them in the field and another stated that it took thirty minutes to get a reading due to cloud cover.

On the follow-up visits, there were four times that the GPS receivers helped in locating a unit. The other data collection times, the field enumerators had no trouble finding their units. Although this number of uses is low, it was not unexpected. Examining the years 2000 through 2004, the number of times that a Washington WOY unit had to be laid out again averaged 8 times. However, for 2005 there was only one unit that could not be located on a subsequent visit and had to be laid out again. This was due to the agricultural operator harvesting the field before the enumerator was able to take final counts. According to the WA FO, this mishap is highly unusual. Typically, the agricultural operator notifies the enumerator a few days before harvesting the field. Determining why units had to be laid out again in other years, was not possible since the questionnaires were shredded. Of course, there is always the possibility that 2005 was a fluke. Hence, a review of the past six years indicated that the year with the fewest number of times that a unit had to be laid out again was the year when GPS receivers were used. See Table 1.

Table 1: Re-Laying of Wheat Objective Yield Survey Units by Year

Year	Sample Size	No. of Units Laid Out More than Once
2005	160	1
2004	160	6
2003	160	4
2002	160	10
2001	160	8
2000	151	12

Finally, field enumerators did report wanting to learn how to set "waypoints" with the GPS receiver. A waypoint is a stored latitude/longitude coordinate in the receiver. Theoretically, the enumerators could have recorded the sampled units' coordinates in the device and then during a return visit the receiver would have displayed the direction to and the distance from the unit. However, to keep the level of instruction simple, the WA FO had decided to only instruct the enumerators on the basics and perhaps next year introduce more advanced features as they become more familiar with using the receivers.

7. COST - BENEFIT ANALYSIS

A cost-benefit analysis was conducted to determine if using GPS

receivers for the Wheat Objective Yield Survey is practical and cost efficient.

The cost breakdown is as follows. The Garmin GPS-72 receivers were already purchased for the ARMS Phase II. Hence, no additional costs for the receivers were incurred. Had this not been the case, 23 handheld GPS receivers, at $150 a piece, would have cost $3,450.

Miscellaneous expenditures were estimated at $50. This includes the purchase of spare AA batteries (2 extra batteries per enumerator), paper to print the GPS instructions on, etc.

The GPS training of the twenty-three enumerators was expensed at $68, including salary and benefits. Costs of the hotel rooms and conference room were excluded since the GPS training was incorporated into the regularly held WOY workshop.

As far as WA FO staff expenses, a statistician spent one hour total in preparing training materials and in training the field enumerators.

Hence, the total expenditures for the research project were $118 and 1 hour of a WA FO statistician's time. See Table 2.

Table 2: Research Project Expenses

Item	Details	Costs $
23 GPS Receivers [1/]	Re-used receivers from ARMS Phase II.	0
Miscellaneous Supplies	Batteries, paper, etc.	50
Enumerator field time (salary & benefits) [2/]	No additional field time recorded.	0
Enumerator Mileage	Not Applicable.	0
Enumerators Training (salary & benefits) [2/]	15 minutes per enumerator.	68
WA FO Staff	1 hour (preparation and training of enumerators).	N/A [3/]
Research Project Total Costs		118

1/ Purchasing twenty-three GPS receivers would have cost $3,450. (Priced at $150 per receiver.)
2/ All enumerator costs were based on each enumerator's actual time and salaries. The average salary of the enumerators was $9.80 per hour. The average salary and benefits of the enumerators (using NASS' formula of (salary*1.0763)*1.11) calculates to $11.71 per hour.
3/ Staff salaries and associated benefits expenses were absorbed by the field office.

On the benefits side, the GPS handheld receivers did help the field enumerators locate four units in subsequent field visits. Although the field enumerators may have found these units without the GPS receivers, their use did save the enumerators an immeasurable amount of time and ensured that the time series of the data was not compromised by having to lay out a replacement unit.

Also, the enumerators were using the receivers for the June Area Survey, showing that the receivers can be used for multiple surveys at the same time.

Finally, usage of the GPS receivers appeared to almost eliminate units having to be laid out more than once.

8. CONCLUSION

As field offices start acquiring GPS receivers for data collection activities, then using GPS receivers for the Wheat Objective Yield Survey will be practical since the additional cost will be minimal. Also, as the enumerators' GPS skill level increases, they will be able to enter and locate waypoints which should increase the usefulness of the receivers. To date, NASS has successfully tested three ways to use GPS receivers for data collection: for the Agricultural Resources Management Survey – Phase II, for the June Area Survey and now for the Wheat Objective Yield Survey.

9. REFERENCES

Gerling, Michael. 2005. "Using Handheld Global Positioning Receivers for Phase II of the Agricultural Resource Management Survey." RDD-05-04, United States Department of Agriculture, National Agricultural Statistics Service.

Gerling, Michael. 2006. "Using Global Handheld Positioning Receivers for the June Area Survey" RDD-06-02 United States Department of Agriculture, National Agricultural Statistics Service.

Appendix A

Field Enumerator Feedback Form

Wheat Objective Yield Survey - Global Positioning System Research Project

Enumerator - Feedback Form

Enumerator ID

Sample Number

Initial Visit

1. Did you have any problems using the GPS receiver to record the location of the units?

Yes No

If Yes, Please note the Problem(s) and the Unit (1 or 2) referred to.

Second Visit

1. Was the GPS receiver used in locating **Unit 1**?

Yes — Was the receiver helpful? Save any time? Please elaborate:

No

2. Was the GPS receiver used in locating **Unit 2**?

Yes — Was the receiver helpful? Save any time? Please elaborate:

No

Third Visit

1. Was the GPS receiver used in locating **Unit 1**?

Yes — Was the receiver helpful? Save any time? Please elaborate:

No

2. Was the GPS receiver used in locating **Unit 2**?

Yes | Was the receiver helpful? Save any time? Please elaborate:

No

Fourth Visit

1. Was the GPS receiver used in locating **Unit 1**?

Yes | Was the receiver helpful? Save any time? Please elaborate:

No

2. Was the GPS receiver used in locating **Unit 2**?

Yes | Was the receiver helpful? Save any time? Please elaborate:

No

Fifth Visit

1. Was the GPS receiver used in locating **Unit 1**?

Yes | Was the receiver helpful? Save any time? Please elaborate:

No

2. Was the GPS receiver used in locating **Unit 2**?

Yes | Was the receiver helpful? Save any time? Please elaborate:

No

OVERALL COMMENTS on using the GPS Receiver

Appendix B

Field Enumerator Instructions On How To Use The Garmin GPS-72 Receiver

Overview and Field Enumerator Instructions on Using Garmin Global Positioning System Receivers for the Wheat Objective Yield Survey

United States Department of Agriculture
National Agricultural Statistics Service

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Introduction

The Research and Development Division and the Washington Field Office (WA FO) are conducting a research project on using handheld Global Positioning System (GPS) receivers for the Winter Wheat Objective Yield Survey.

Currently, field enumerators go to specified areas of pre-determined winter wheat fields, lay out two objective yield units and record various crop counts. Field enumerators return to the same locations every month until the fields are harvested, and record various crop counts. Sometimes a field enumerator has difficulty finding the same location again and, on a few occasions, is unable to find the same location. This costs NASS in field enumeration time, and in those instances where the units are unable to be found again, the data quality suffers.

Hence, the research project's primary goal is to see if GPS receivers can help field enumerators locate those units.

The Research Project

Thirty three Washington FO field enumerators have been be provided with a handheld GPS receiver. This should provide most enumerators working the Winter Wheat Objective Yield Survey with a receiver.

For all of Washington's 160 Winter Wheat Objective Yield sample, field enumerators will use their GPS receivers to record the latitude and longitude coordinates of both units when they are initially laid out. The latitude and longitude coordinates will be recorded in two places. First, on the outside of their manila kit envelopes (one envelope per sample is provided) and, second, on their Part B form.

The Part B form will be returned to the office. Hence, the WA FO will have a copy of the coordinates, which will be beneficial if the original enumerator is unable to work and a different field enumerator or an office staff need to visit the field and record counts.

Upon subsequent field visits, if the enumerators have difficulty finding the units, they may use the coordinates on their kit envelope and their GPS receiver to find the unit of interest. The GPS receivers have an accuracy level of 10 to 50 feet which is dependent on the number of satellites that the receiver is able to acquire. Hence, field enumerators may still have to look around for the unit.

The enumerators will also be supplied with a form to record any problems in using the GPS receivers for determining the latitude and longitude coordinates on their initial visit. They will also be able to record any problems in finding a previously laid out unit and if the GPS receiver was helpful or not.

What is GPS?

GPS stands for Global Positioning System. This system is comprised of at least 24 satellites that orbit the earth. These satellites transmit signals to global positioning system equipment on the ground, like the GPS receiver that each of you have been provided.

The GPS receiver acquires signals from these satellites. Thus, the receiver requires an unobstructed view of the sky. The GPS receiver is able to determine the location of the satellites since this information is included in the satellites' transmissions. Next, the receiver determines the distance it is from each satellite. Finally, (without getting too technical), the receiver is able to determine where it is actually located on the Earth within a certain amount of accuracy.

The receiver will display its location in latitude and longitude coordinates. Latitude measures the distance North or South from the Equator while longitude measures the distance East and West from the Prime Meridian.

A common use of these devices is for hiking. Hikers utilize these receivers to trace their trail or to mark a unique location that they would like to return to.

Hence, a GPS receiver is not a remote control for the television but rather a sophisticated electronic device that can tell the user where he/she within 50 feet, speed of movement, which way North is, and even the distance to a particular point of interest. However, for this research project, we are only interested in recording the latitude and longitude of the units and the ability to return to the same locations at a later date. The next few pages will discuss the GPS receiver and what you will need to do to successfully use the device. Welcome to the World of Global Positioning.

Overview
of the
Garmin GPS (Model No. 72)

Below is a general overview of the receiver that you have been provided.

Interface Keys

POWER Used to turn the unit on and off. To turn the unit off, press the POWER key and hold it. The POWER key is also used to display the adjustment window for the back light and contrast. To activate the back light/contrast adjustment window, press and release the POWER key.

PAGE Cycles through the five main display pages in sequence.

MENU Used to display the page option menus. If pressed twice, the Main Menu will be displayed.

ENTER Used to confirm a selection.

QUIT To cycle through the five main pages in reverse sequence. The QUIT key will also end an operation in progress and display the previous page.

ROCKER Located in the center of the keypad, is used to control the Up/Down and Left/Right movement of the cursor on the display pages and during data entry.

GOTO, **IN**, and **OUT** keys will not be needed for this study. If additional information is needed on these keys please see the provided Owner's Manual.

GPS Receiver Instructions

"Laying out the Units"

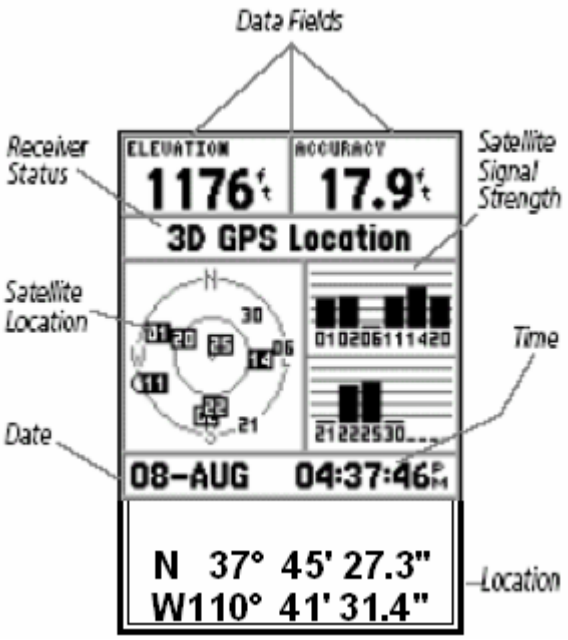
Step 1: When you lay out the units, take out your GPS receiver.

Step 2: Press the **POWER** key to turn on the GPS receiver.

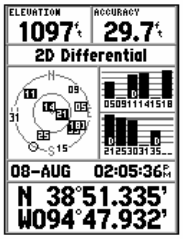
Step 3: A Warning screen will appear. Press the **PAGE** key and wait for the unit to acquire the satellites (up to five minutes). For best results, the receiver's internal antenna (Page 4) should be facing up at the sky.

Step 4: The **GPS Information** page showing the location coordinates should appear. The page should look similar to the one shown below.

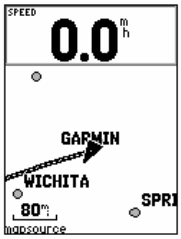
Note: The receiver's level of accuracy is displayed in the upper right portion of the screen titled **ACCURACY**.



Note: If the GPS Information page does not appear, press the **PAGE** key to cycle through the five main pages of the device.

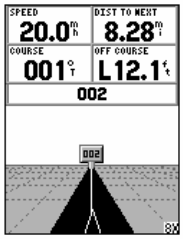


GPS Information Page

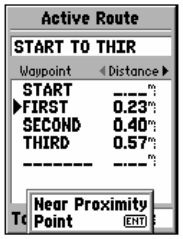


Map Page

Pointer Page



Highway Page



Active Route Page

Step 5: **Verify that the Location box is showing degrees, minutes and seconds**. An easy way to check this is to look at the latitude coordinate and make sure that it has a **"** after the last number.

The **Location** box displays the latitude (N for North) and the longitude (W for West) of where the receiver actually is.

In Step 3, the GPS Information Page displayed the following location:

N 37° 45' 27.3"
W110° 41' 31.4"

N 37° 45' 27.3" is read as:
37 degrees, 45 minutes and 27.3 seconds North.

W 110° 41' 31.4" is read as:
110 degrees, 41 minutes and 31.4 seconds West.

If the Location box does not display the coordinates in this format, please go to **Appendix B** to re-format the way your GPS receiver displays information.

Step 6: Record the latitude and longitude coordinates from the GPS receiver onto the labels provided on Form B and on your kit envelope. Using the example from Step 4, one would record the following for latitude and longitude.

Unit 1

	LATITUDE		LONGITUDE
N	37 . 45 . 27.3	**W**	110 . 41 . 31.4
	dd mm ss.s		*ddd mm ss*.s

Step 7: Repeat the process for Unit 2.

Step 8: Complete the "Winter Wheat Objective Yield Enumerator GPS Receiver Feedback" Form.

"Subsequent Visits"

Only use these instructions if you are unable to locate the unit of interest.

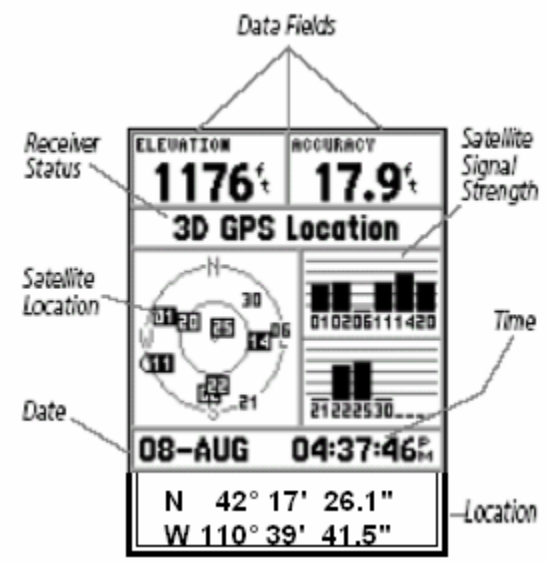
Step 1: Press the **POWER** key to turn on the GPS receiver.

Step 2: A Warning screen will appear. Press the **PAGE** key and wait for the unit to acquire the satellites (up to five minutes). For best results, the receiver's internal antennae should be facing up at the sky.

Step 3: The **GPS Information** page showing the location coordinates should appear. The page should look similar to the one shown below.

Note: If this page does not appear, press the **PAGE** key to obtain this screen.

The receiver's level of accuracy is displayed in the upper right portion of the screen titled **ACCURACY**.



Step 4: In Step 3, the GPS Information Page displayed the following location:

N 42° 17' 26.1"
W 110° 39' 41.5"

N 42° 17' 26.1" is read as:
42 degrees, 17 minutes and 26.1 seconds North.

W 110° 39' 41.5" is read as:
110 degrees, 39 minutes and 41.5 seconds West.

Step 5: Review the coordinates that you have on your kit envelope's label for Unit 1.

Example is shown below:

Unit 1

	LATITUDE		**LONGITUDE**
N	42 . 17 . 25.0	**W**	110 . 39 . 12.3
	dd mm ss.s		*ddd mm ss.s*

Step 6: The goal is to have the latitude and longitude coordinates on your GPS receiver match those on the kit envelope's label. Walk around with the GPS receiver and see how the seconds change first, next minutes, and finally the degrees. Walking North and South affects latitude, while walking West and East affects longitude.

Compare the latitude and longitude coordinates provided on the GPS receiver with those on the kit envelope.

If the coordinates are different, you will need to determine how far away you are by looking at degrees, minutes and then seconds.

The following distance conversions will help you determine how many feet or miles away you are from the unit.

Latitude

1 degree = 69 miles
1 minute = 1 mile = 5,280 feet
1 second = 100 feet

Longitude

1 degree = 47 miles
1 minute = 3/4 mile or 4150 feet
1 second = 70 feet

Hence, one degree of latitude is about 69 miles while one second is about 100 feet away. Depending on the distance, you must determine whether to walk or drive in the direction that brings you closer to matching the coordinates on the kit envelope. An example on how to do this is provided on page 13.

Note: PLEASE minimize the amount of walking through a farmer's field. Sometimes, it may be best to walk back out of the field and walk towards the direction of interest outside of the field.

Step 7: Locate the unit and proceed with your counts or if still unable to find the unit, lay out the unit again per the Interviewer's Manual.

Step 8: Complete the "Winter Wheat Objective Yield Enumerator - GPS Receiver Usage: Feedback Form".

Important: Please carry an extra set of AA batteries with you. When the batteries are running low, a low battery warning will appear that will not disappear unless new batteries are installed. See **Appendix C** for instructions on how to install a new set of batteries.

Example of Using the GPS Receiver to Find a Unit

An enumerator is unable to find Unit 1 and therefore powers on his/her GPS receiver. The receiver displays the following coordinates:

GPS Receiver

N 42° 17' 26.1"
W 110° 39' 41.5"

Next, the enumerator looks at the coordinates displayed on the kit envelope's label.

Kit Envelope's Label for Unit 1

	LATITUDE		**LONGITUDE**
N	42 . 17 . 25.0	**W**	110 . 39 . 12.3
	dd mm ss.s		*ddd mm ss.s*

The enumerator now focuses on latitude and notices that the first two sets of numbers are identical (42 and 17). However the third set, seconds, is different.

Comparing the seconds of the GPS receiver to those on the kit envelope, the enumerator calculates 26.1 minus 25.0 = 1.1 seconds. Hence, the enumerator is about 110 feet north of Unit 1.

Next, the enumerator looks at longitude, the first two sets of numbers are identical. However, the third set is different. 41.5 - 12.3 = 29.2 seconds. This means that the enumerator is about 2,044 feet (1/3 of a mile) west of Unit 1.

Therefore, the enumerator should walk southeast to locate Unit 1.

Appendix A

Initializing the GPS Receiver

The Washington SSO should have initialized your receiver. However, if it is unable to locate the satellites, please do the following steps.

Step 1: Take the unit outside where it will have an unobstructed view of the sky and turn it on by pressing the **POWER** key.

Step 2: Press the **PAGE** key to bypass the Warning Screen.

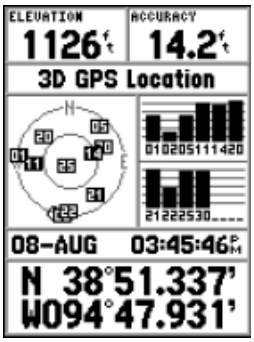
Step 3: If the receiver is unable to acquire enough satellites an options page will appear.

Step 4: Using the **ROCKER** key, select 'New location' then press then **ENTER** key.

Step 5: Next, select 'Automatic' and press the **ENTER** key.

This will allow the unit to continue initializing. This selection will force the unit to search for all satellites. It may take a little longer for the unit to become operational using this method.

A screen that looks similar to the one displayed below should appear. If not, please repeat the above process and if this does no't work, call the office for additional instructions.

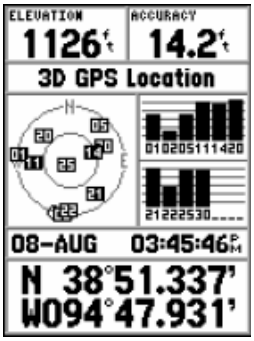


Appendix B

Format Adjustment of the Location Box

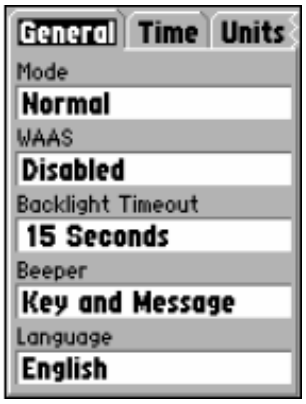
The office should have pre-set the format of the Location box for your GPS device. However, if you notice that the format is no longer in degrees, minutes, seconds, then you will need to re-set the location field from hddd° mm.mmm' to hddd°mm'ss.s". Having the device display in the latitude and longitude coordinates correctly is critical to having a successful research project. The following steps will guide you on how to re-set the Location box's format.

Step 1: Press the **POWER** key to turn the unit on and then press the **PAGE** key. You should be at the screen shown below.

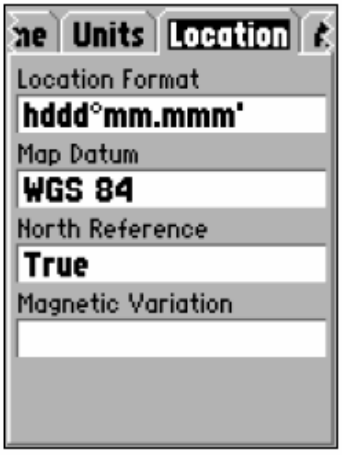


Step 2: Press the **MENU** key. The following screen should appear.

Step 4: Using the **ROCKER** key, rocker down to the Setup option and press the **ENTER** key. The screen shown below should now appear.



Step 5: Using the **ROCKER** key, rocker over to the right to the Location tab.



Step 6: Using the **ROCKER** key, rocker down once to the Location format and press the **ENTER** key.

Step 7: Using the **ROCKER** key select hddd°mm'ss.s" and press the **ENTER** key.

Step 8: Press the **MENU** key three times to return you to your original screen. You should see your new location format.

Appendix C

Installing the Batteries

Step 1: Remove the Battery Cover by turning the D-ring 1/4 turn counter clockwise and pulling the cover loose.

Step 2: Check the battery polarity with the molded diagram in the battery compartment and install the two **AA** batteries inserting the end toward the spring first.

Step 3: Re-install the Battery Cover by reversing Step 1.