A background illustration featuring several hand-drawn seabirds, possibly boobies or albatrosses, in flight. They have blue bodies, white wings, and orange beaks. In the upper right, there's a sketch of a lighthouse tower with a circular window at the top. A red number '5' is written near the base of the tower.

Radio Telemetry Methods

Introduction to Program LOAS

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COLLEGE OF AGRICULTURE, FOOD AND NATURAL RESOURCES



Overview



- 1. General overview*
- 2. Field data*
- 3. Data preparation for LOAS*
- 4. Importing data into LOAS*
- 5. Marking birds and azimuth groups*
- 6. Selecting estimators*
- 7. Running calculations*
- 8. Exporting data*
- 9. Field observations*
- 10. Field exercise data*

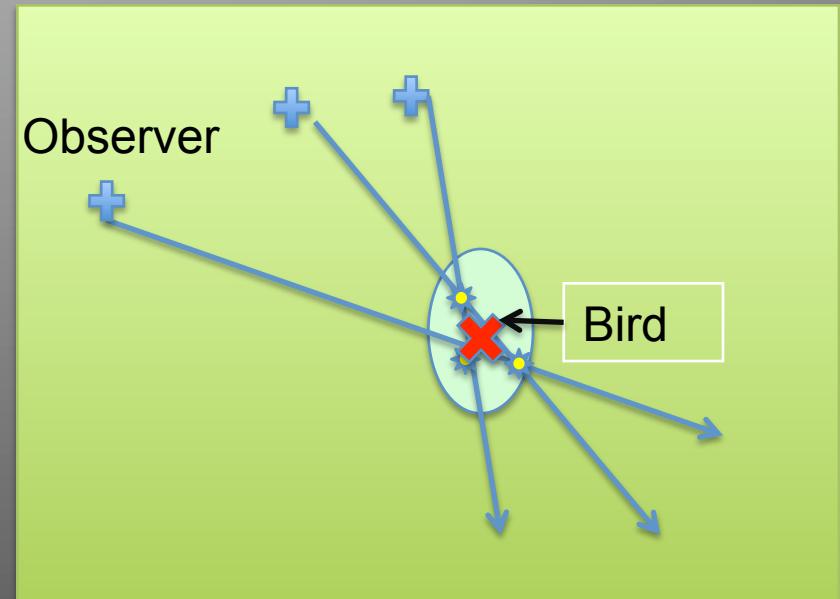
Radio Telemetry



- *Location Estimates*
 - *Two methods*
 - *Actual observation*
 - *Potentially more accurate*
 - *Potential to affect bird behavior*
 - *Triangulation*
 - *Detection from a distance*
 - *Must estimate bird location*
 - *Demography*
 - *Not addressed in this talk*

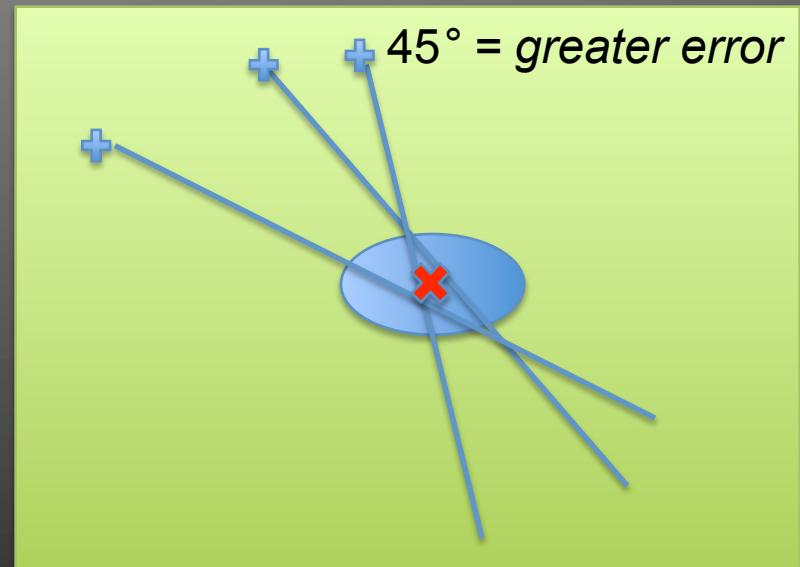
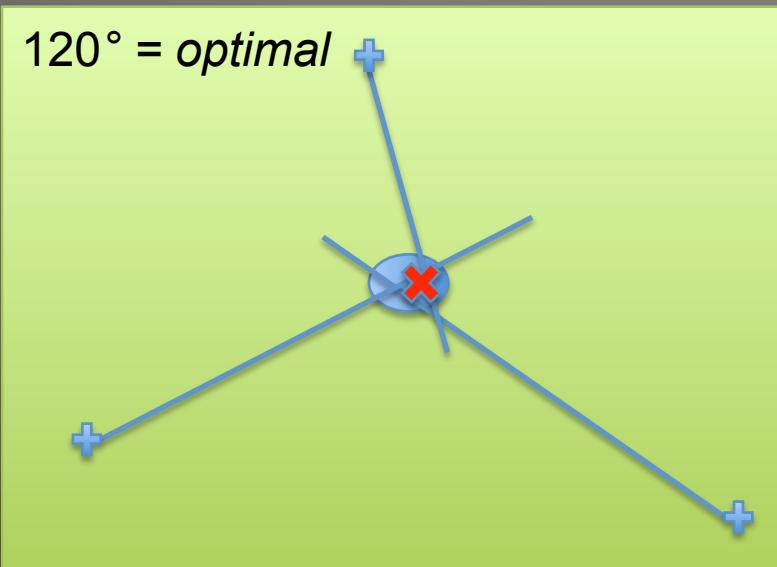
General Overview

- *Objectives*
 - *Estimate location of bird.*
 - *Estimate error associated with location.*
- *Multiple bearings*
- *Two bearings yield bird location. No estimate of error.*
- *Three+ bearings yield estimate of bird location AND error.*



Field Techniques

- Optimizing bearing angles
 - Best angles = $360^\circ/x$, where x = number of bearings.
 - E.g. $360^\circ / 3$ bearings = 120°
- Multiple bearings
 - More bearings is better



Saltz, D. 1994. Reporting error measures in radio location by triangulation. Journal of Wildlife Management 58:181-184.

Correcting Magnetic Declination

- Concept
 - Magnetic north pole
 - True north pole
 - Declination is difference

- Online calculator

[http://www.ngdc.noaa.gov/geomagmodels/
Declination.jsp](http://www.ngdc.noaa.gov/geomagmodels/Declination.jsp)

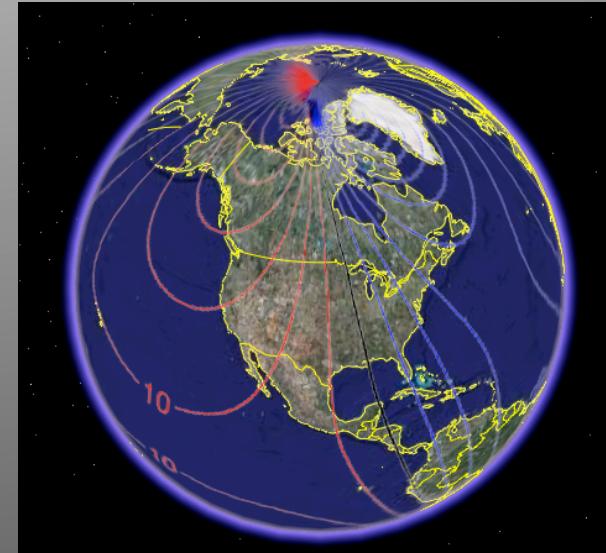
- Correction

True Azimuth = magnetic bearing – correction
degrees - (correction minutes/60)

e.g.

Newport Oregon = $16^\circ 37' E$

True Azimuth = magnetic bearing - $16^\circ - (37'/60')$



Data Required for Location Estimate



Data Needed

1. Your location
2. Azimuth to bird
3. Magnetic declination

[http://www.ngdc.noaa.gov/
geomagmodels/
Declination.jsp](http://www.ngdc.noaa.gov/geomagmodels/Declination.jsp)

Assumptions

1. Bird is not moving
2. Accuracy of telemetry, azimuth, and declination

Field Exercise



- 1. Record bearing information on data sheets.
- 2. Send one member of group to main computer to enter data.
- 3. Work with data.

Working with Large Data Set

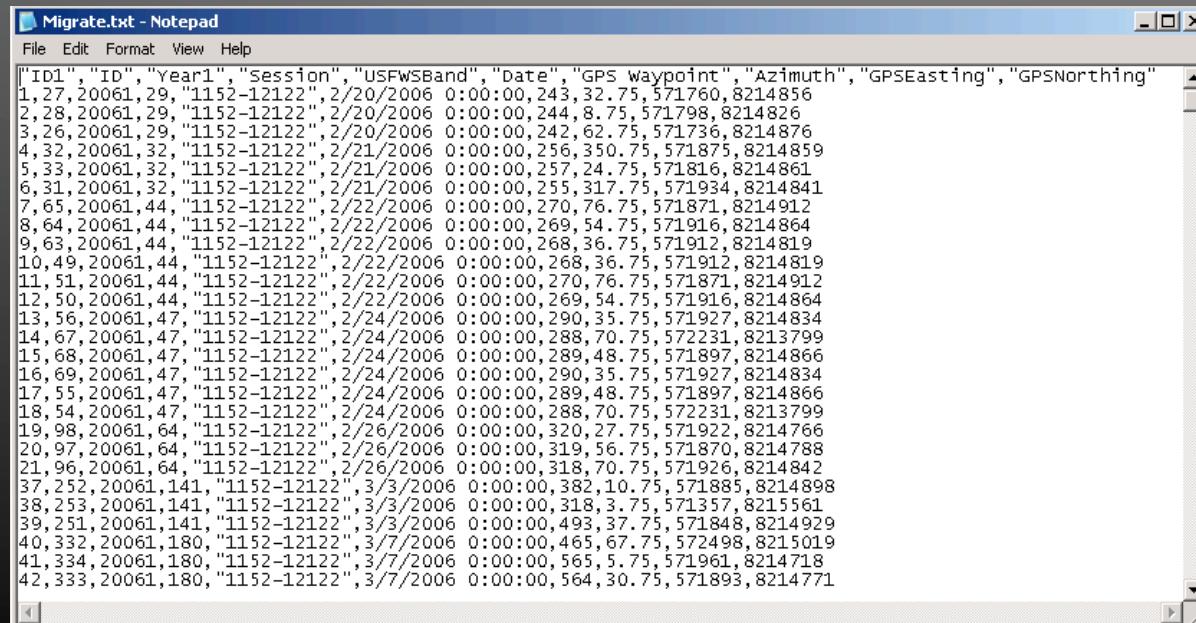
1. Tuamotu Kingfisher data!!

- *Collected over several years.*
- *Filtered for your benefit.*
- *Skewed for my benefit.*
- *Compiled for this exercise.*



Data Organization

- *Data organization*
 - Tab delineated
 - Comma delineated text file
 - Use any text editor
- Required fields
 1. Bird identification
 2. Bearing group identification
 3. Corrected azimuth
 4. Observer Location (X and Y coordinates)

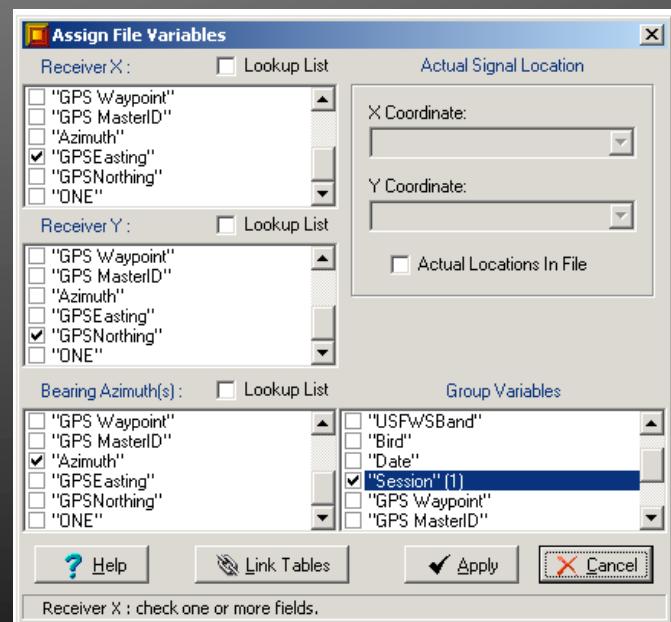
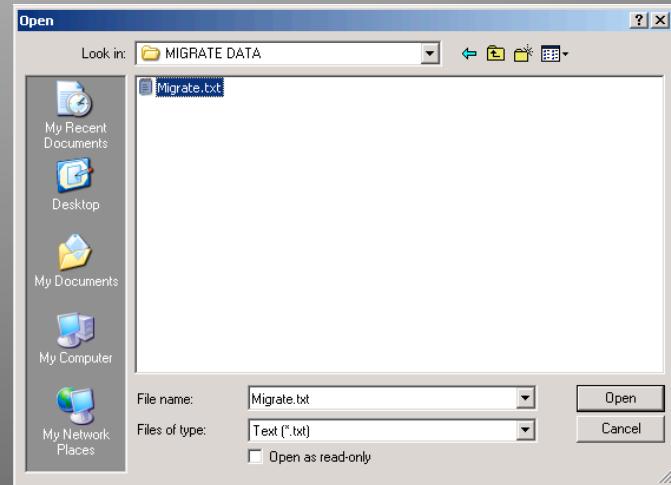


The screenshot shows a Windows Notepad window titled "Migrate.txt - Notepad". The window displays a list of data entries, each consisting of a unique ID followed by a list of parameters separated by commas. The parameters include session ID, year, date, GPS waypoint, azimuth, and coordinates (GPSEasting and GPSNorthing). The data is tab-delimited, with commas used as field separators within the quoted entries.

```
"ID1", "ID", "Year1", "Session", "USFWSBand", "Date", "GPS Waypoint", "Azimuth", "GPSEasting", "GPSNorthing"  
1,27,20061,29,"1152-12122",2/20/2006 0:00:00,243,32.75,571760,8214856  
2,28,20061,29,"1152-12122",2/20/2006 0:00:00,244,8.75,571798,8214826  
3,26,20061,29,"1152-12122",2/20/2006 0:00:00,242,62.75,571736,8214876  
4,32,20061,32,"1152-12122",2/21/2006 0:00:00,256,350.75,571875,8214859  
5,33,20061,32,"1152-12122",2/21/2006 0:00:00,257,24.75,571816,8214861  
6,31,20061,32,"1152-12122",2/21/2006 0:00:00,255,317.75,571934,8214841  
7,65,20061,44,"1152-12122",2/22/2006 0:00:00,270,76.75,571871,8214912  
8,64,20061,44,"1152-12122",2/22/2006 0:00:00,269,54.75,571916,8214864  
9,63,20061,44,"1152-12122",2/22/2006 0:00:00,268,36.75,571912,8214819  
10,49,20061,44,"1152-12122",2/22/2006 0:00:00,268,36.75,571912,8214819  
11,51,20061,44,"1152-12122",2/22/2006 0:00:00,270,76.75,571871,8214912  
12,50,20061,44,"1152-12122",2/22/2006 0:00:00,269,54.75,571916,8214864  
13,56,20061,47,"1152-12122",2/24/2006 0:00:00,290,35.75,571927,8214834  
14,67,20061,47,"1152-12122",2/24/2006 0:00:00,288,70.75,572231,8213799  
15,68,20061,47,"1152-12122",2/24/2006 0:00:00,289,48.75,571897,8214866  
16,69,20061,47,"1152-12122",2/24/2006 0:00:00,290,35.75,571927,8214834  
17,55,20061,47,"1152-12122",2/24/2006 0:00:00,289,48.75,571897,8214866  
18,54,20061,47,"1152-12122",2/24/2006 0:00:00,288,70.75,572231,8213799  
19,98,20061,64,"1152-12122",2/26/2006 0:00:00,320,27.75,571922,8214766  
20,97,20061,64,"1152-12122",2/26/2006 0:00:00,319,56.75,571870,8214788  
21,96,20061,64,"1152-12122",2/26/2006 0:00:00,318,70.75,571926,8214842  
37,252,20061,141,"1152-12122",3/3/2006 0:00:00,382,10.75,571885,8214898  
38,253,20061,141,"1152-12122",3/3/2006 0:00:00,318,3.75,571357,8215561  
39,251,20061,141,"1152-12122",3/3/2006 0:00:00,493,37.75,571848,8214929  
40,332,20061,180,"1152-12122",3/7/2006 0:00:00,465,67.75,572498,8215019  
41,334,20061,180,"1152-12122",3/7/2006 0:00:00,565,5.75,571961,8214718  
42,333,20061,180,"1152-12122",3/7/2006 0:00:00,564,30.75,571893,8214771
```

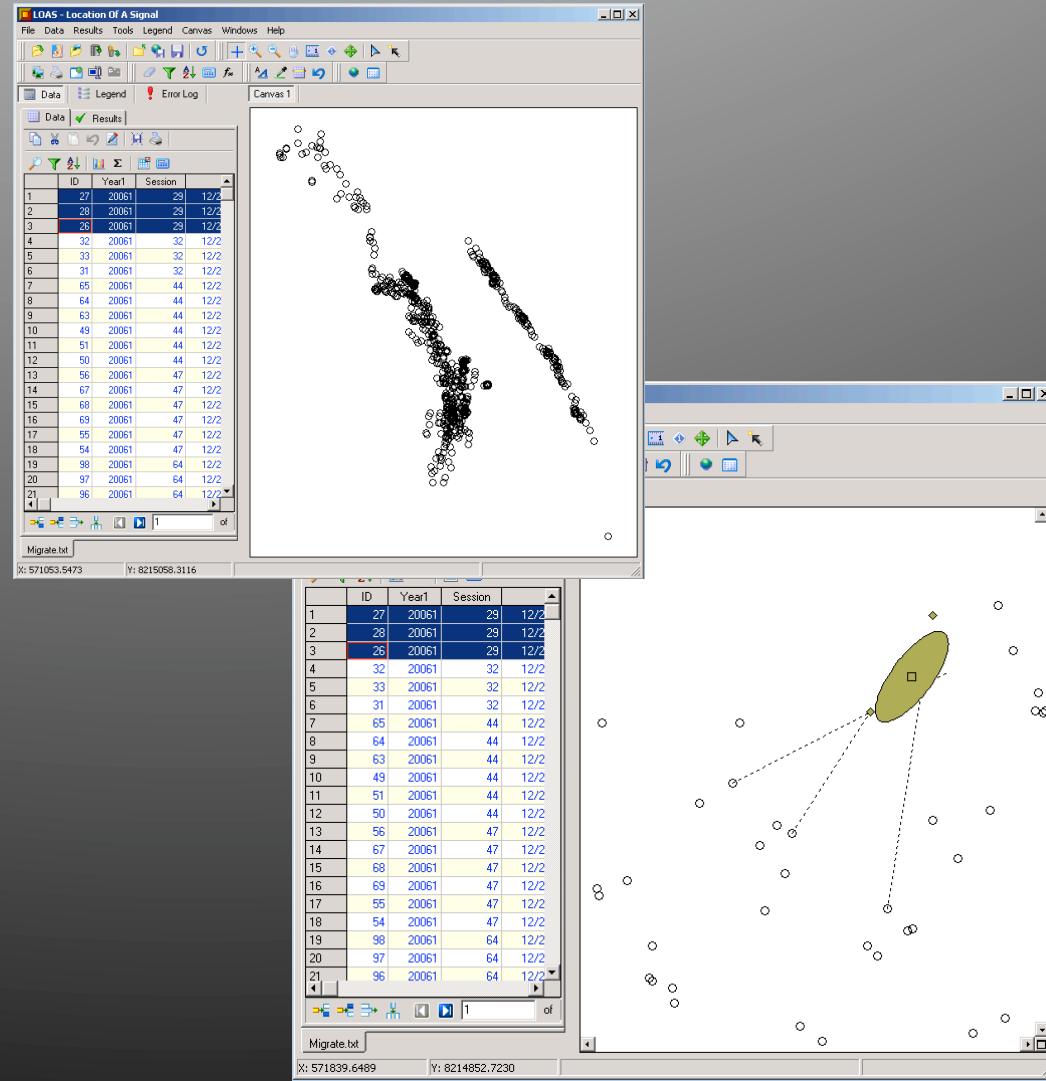
Opening Data

1. Start LOAS
2. Open File
 - a. File, Open Data File
 - b. Navigate to the Desktop
 - c. Look in “MIGRATE” folder
 - d. At bottom, select “File of Type = Text (*.txt)”
 - e. Double click “Migrate.txt”
3. Defining File Variables
 - a. Receiver X – select “GPSEasting”
 - b. Receiver Y – select “GPSNorthing”
 - c. Bearing Azimuth – select “Azimuth”
 - d. Group Variables – select “Session”
4. Click Apply



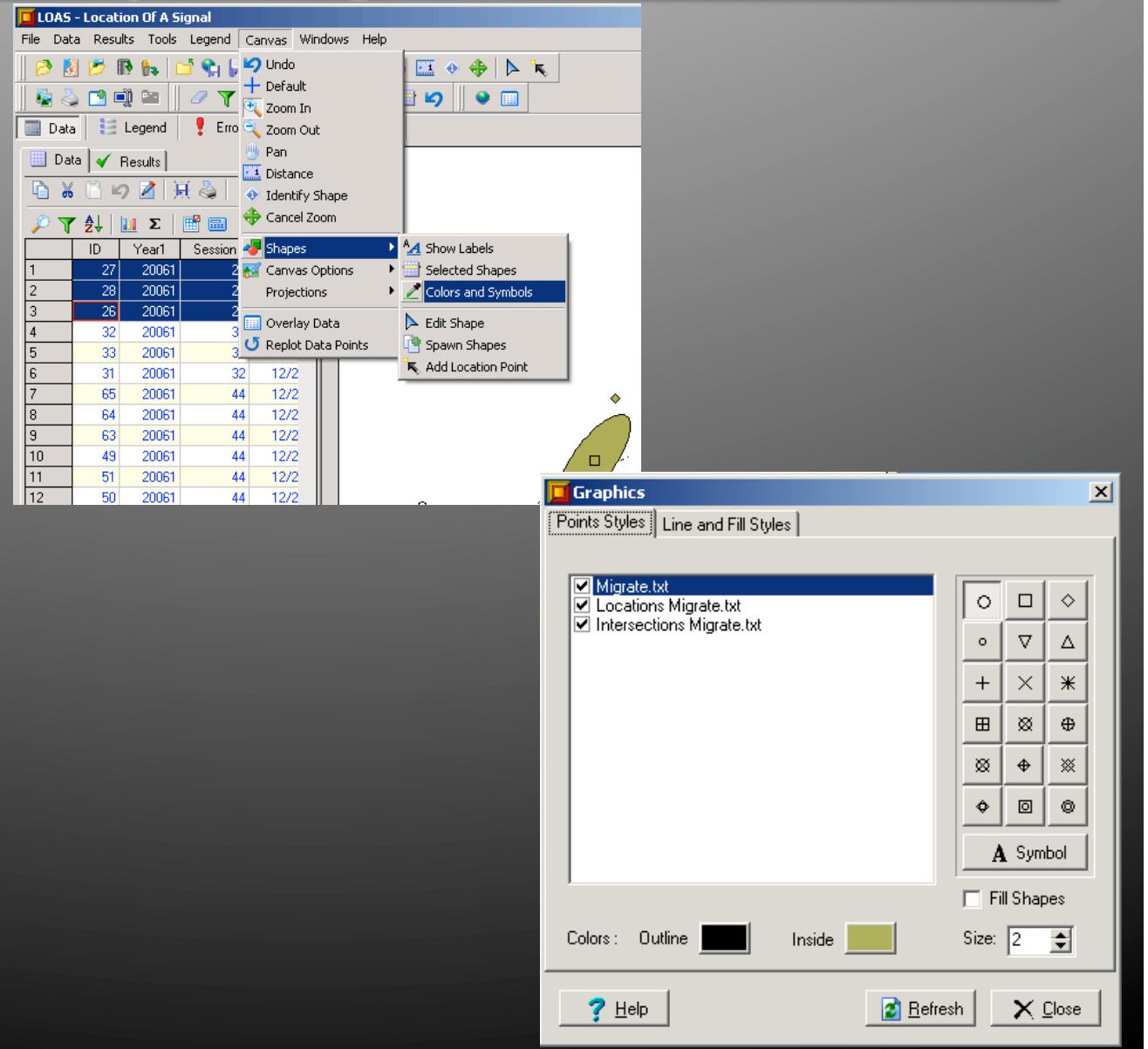
LOAS Screen Overview

- *Data tab*
- *Results tab*
- *Observer locations*
- *Highlighting bearing groups (sessions)*
- *Exercise*
 - Highlight lines 1,2,3 (session 29)*
 - Click calculate*
 - Zoom into center*
 - Notice three bearings, intersections, estimated location.*
- *This is your estimated location.*
- *Click the “Results” tab for coordinates.*



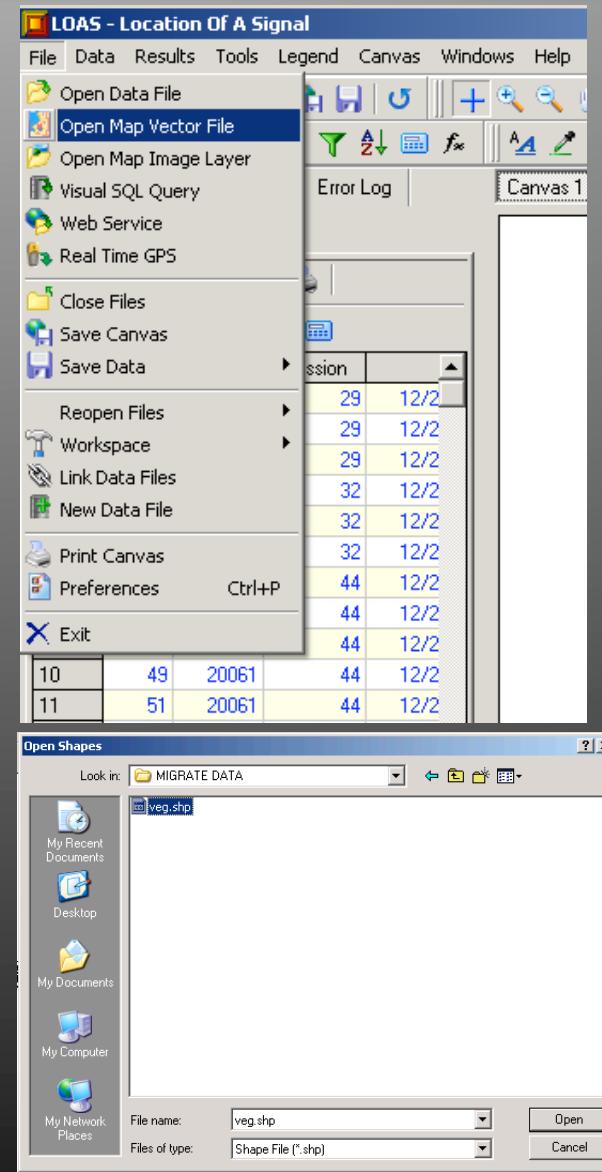
Adjusting View

- *Adjust symbols and colors*
 - a) Click “Canvas”
 - b) Click “Shapes”
 - c) Click “Colors and Symbols”
 - d) Adjust colors and symbols.

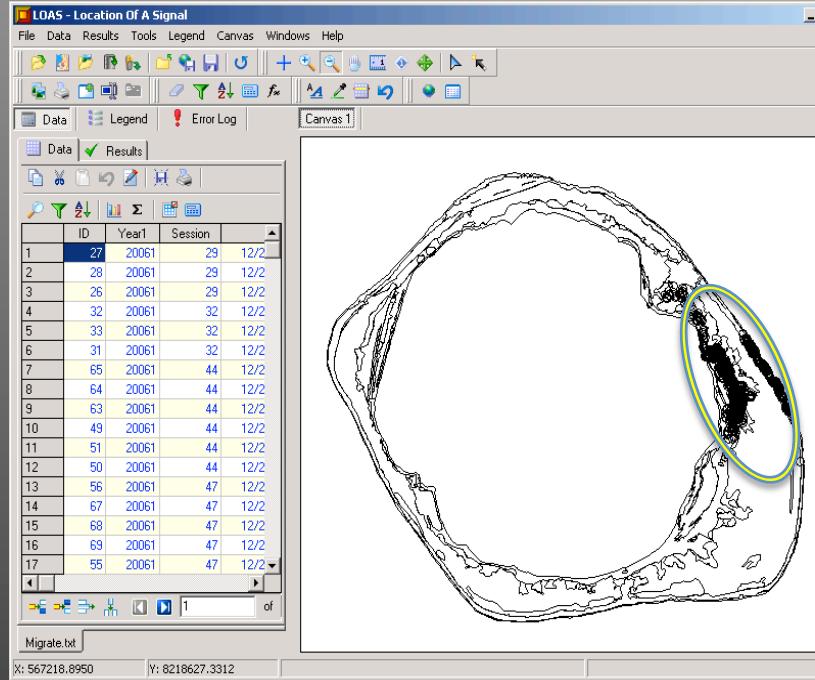


Adding Arc Shapefiles

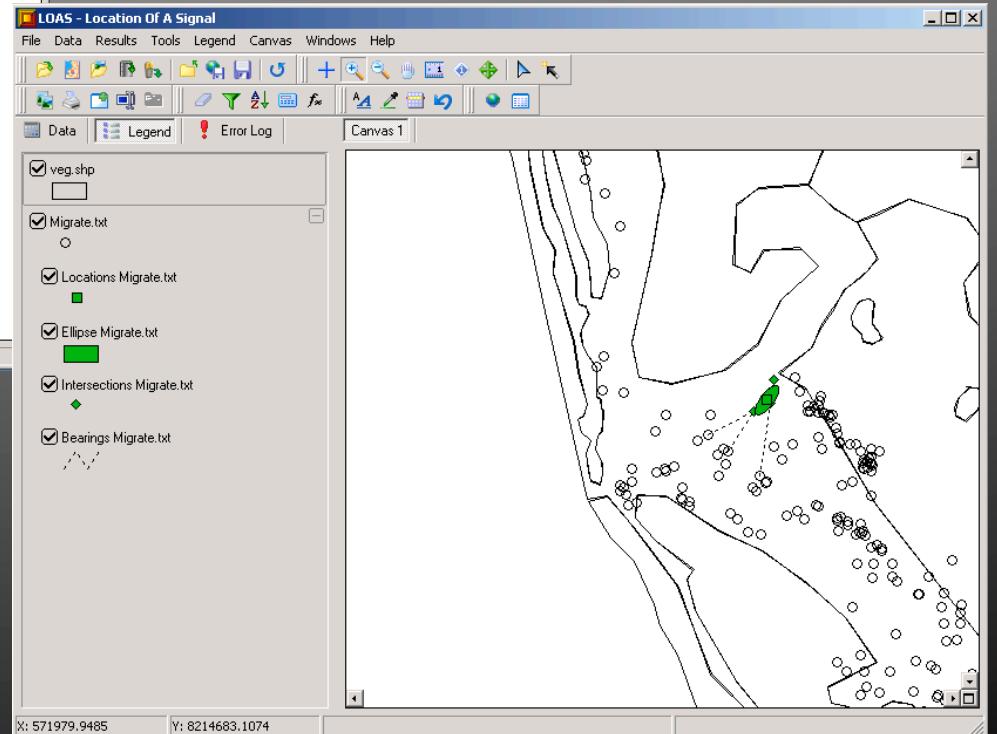
- Add Vegetation Cover Layer
 - a) Click “File”
 - b) Click “Open Map Vector File”
- Navigate to the desktop and MIGRATE folder.
 - a) Select “Veg.shp”
 - b) You will see vegetation coverages for the island of Niau.
 - c) Observations are on the right



Adding Arc Shapefiles

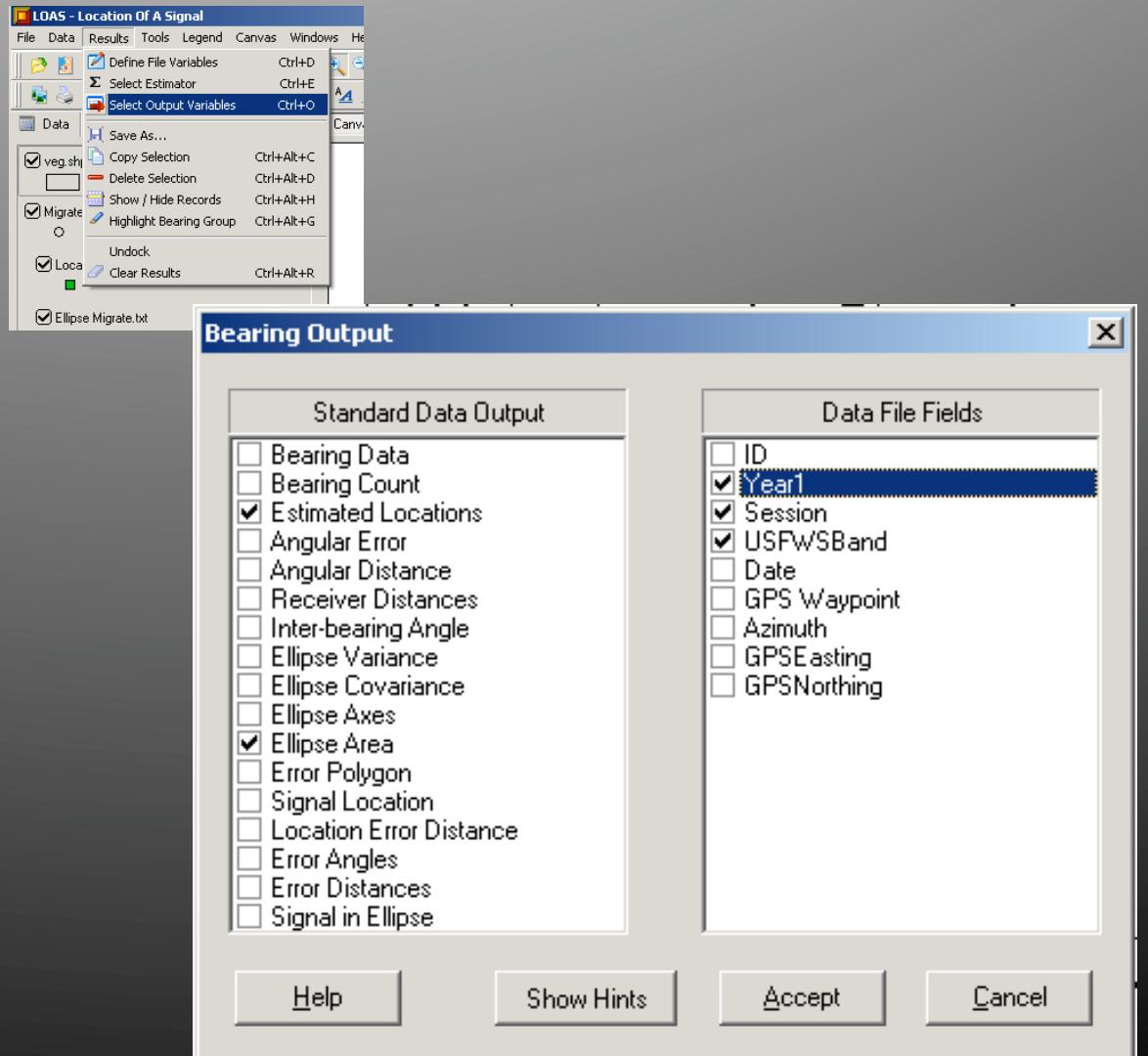


- *Zoom in with magnifying glass to see bird location within vegetation.*
- *This bird was located in coconut plantation!!!*



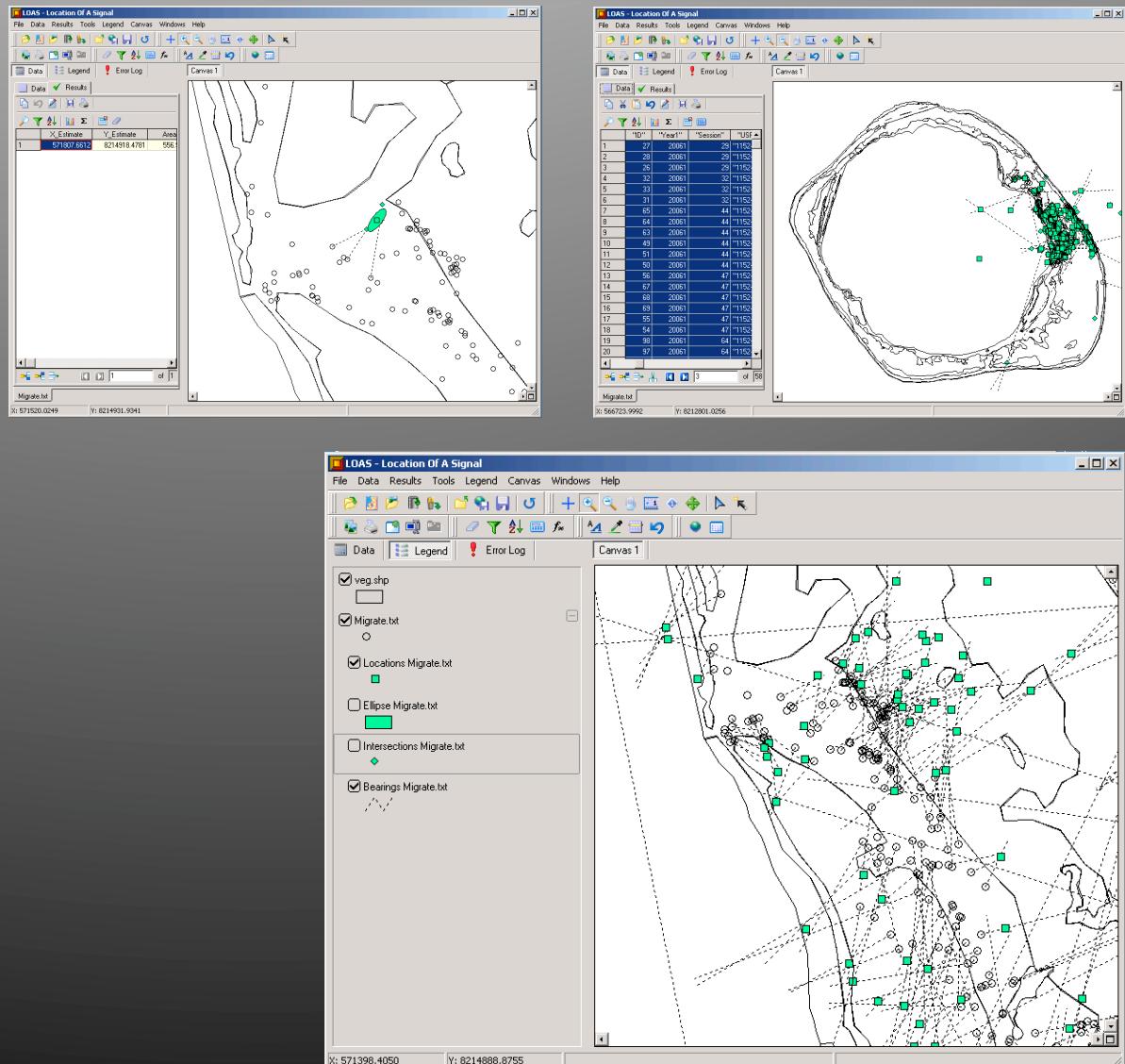
Running Batches of Data

- Click Results tab
-  Clean Results
 - a) Click results tab
 - b) Erase results
- Select Output Variables
 - a) Click “Results”
 - b) Click “Select Output Variables”
 - c) Select
 - ✓ Estimated locations
 - ✓ Ellipse area
 - ✓ Year1
 - ✓ Session
 - ✓ USFWS band
 - d) Click Accept



Generating Results

- Run bearing session 29
- Click on “Results” tab
 - a) Scroll through
 - b) Notice estimated bird location coordinates “X_Estimate” “Y_Estimate”
 - c) Notice the area within the error ellipse “Area”.
- Run all data together
 - a) Clear results table
 - b) Select all rows
 - c) Click calculate
 - d) Look at results table!
 - e) Zoom in and look at points on map!



Exporting Results

1. Click File, Save Data, Telemetry Results.
2. Save all data in grid, and click “Accept”
3. Select the file name, file type (txt works well for arc), and location. Click “Continue”
4. Click “Accept”
5. Done!
6. Double click file to open!
7. These data can be imported into ArcView and analyzed there.

The screenshot shows the LOAS - Location Of A Signal application interface. The 'File' menu is open, showing options like 'Open Data File', 'Save Canvas', and 'Save Data'. Under 'Save Data', three sub-options are visible: 'Telemetry Data' (unchecked), 'Telemetry Results' (checked with a green checkmark), and 'Telemetry Errors' (unchecked). Below the menu, a 'Notepad' window titled 'output.txt' displays a large grid of data. The columns are labeled 'X_Estimate', 'Y_Estimate', 'Area', 'Session', and 'USFWSBan'. The data consists of approximately 100 rows of coordinates and session identifiers.

X_Estimate	Y_Estimate	Area	Session	USFWSBan
5731807.6612	8214918.4781	556.9688	29	"1152-121"
5731856.1711	8214910.5077	563.9223	32	"1152-121"
5721036.0148	8214945.5563	447.5763	44	"1152-121"
5721204.8606	8214992.1624	0.0000	47	"1152-1212?"
5721971.0164	8214857.4072	23.9671	64	"1152-1212?"
5731904.8173	8215002.3805	0.0000	141	"1152-1212?"
5731981.2781	8214919.3822	0.0000	180	"1152-1212?"
572104.5326	8214886.6227	3926.7469	194	"1152-121"
572076.1226	8214810.1399	0.0000	201	"1152-1212?"
572065.6682	8214852.6618	412.4179	207	"1152-121"
571887.6892	8214931.9137	0.0000	260	"1152-1212?"
572017.3439	8214984.5324	4044.1401	272	"1152-121"
573158.4221	8215100.5777	3382.7724	308	"1152-121"
572175.0053	8214945.5643	0.0000	106	21
5721730.9907	8214733.1894	1299.5685	24	"1152-121"
572173.3460	8214786.9287	0.0000	43	"1152-12118?"
571783.2205	8214756.2836	0.0000	105	"1152-12118?"
5721574.8576	8214912.1023	0.0000	213	"1152-12118?"
5721703.9233	8214778.9316	19.0433	281	"1152-12118?"
5721992.6963	8213912.5891	0.0000	174	"1152-12121"
572084.8375	8213755.0723	1789.9948	228	"1152-121"
571835.6660	8213445.1384	0.0000	242	"1152-12121"
572359.6240	8213843.5514	0.0000	297	"1152-12121"
5721951.2514	8214756.9089	2434.4783	90	"1152-12121"
5721951.1932	8214489.0070	1512.4745	135	"1152-12121"
5721036.2034	8214730.3707	241.0000	149	"1152-12120?"
5721993.6617	8214200.6793	1343.5131	170	"1152-121"
572161.4194	8214567.0077	277.4777	181	"1152-121"
5721979.3867	8214366.0613	726.0302	192	"1152-121"
5721627.2186	8213819.4025	0.0000	218	"1152-12120?"
5721875.7085	8214325.7975	0.0000	261	"1152-12120?"
5722358.6778	8213846.7332	745.3569	155	"1152-121"
572394.3452	8213872.3629	131.7431	167	"1152-121"
5723818.5322	8215528.4214	0.0000	175	"1152-12123?"
5723303.2496	821256.0028	3672.0552	80	"1152-12122"
572251.5432	821446.8018	14.7457	98	"1152-12299?"
572268.8969	8214146.8811	0.0235	110	"1152-12299?"
572294.0539	8214235.6340	2908.3223	123	"1152-122"
572170.5109	8214429.0785	1618.6683	142	"1152-122"
572094.4142	8213733.8262	0.0000	182	"1152-12299?"
572138.7361	8214128.4168	3653.0309	203	"1152-122"

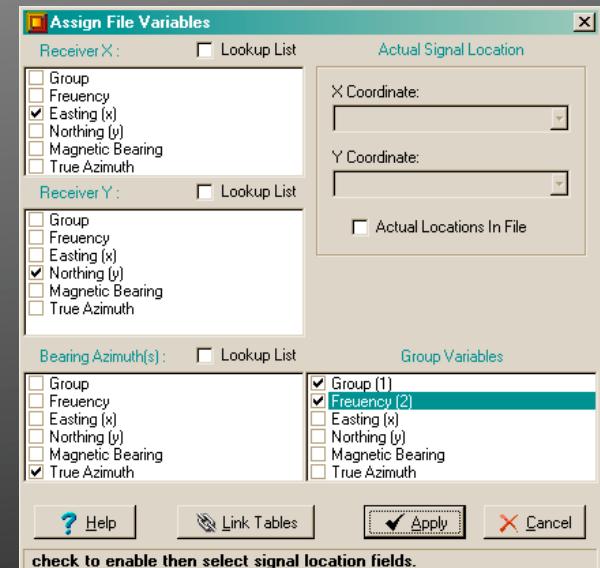
Field Exercise

1. *Working with data*
2. *Download file from:*
*** click the arrow at the lightning bolt!

1. *Start LOAS*
2. *Open File*
 - a. *File, Open Data File*
 - b. *Open file you downloaded*

3. *Defining File Variables*
 - a. *Receiver X – select “Easting (x)”*
 - b. *Receiver Y – select “Northing (y)”*
 - c. *Bearing Azimuth – select “True Azimuth”*
 - d. *Group Variables – select “Group and Frequency”*

4. *Click Apply*



Play With Field Data



Additional Information

Millspaugh, J. J., and J. M. Marzluff. 2001. Radio Tracking And Animal Populations. Academic Press, San Diego.

White, C. C., and R. A. Garrott. 1990. Analysis of Wildlife Radio-tracking Data. Academic Press, San Diego.

Kenward, R. E. 2001. A Manual for Wildlife Radio Tagging. Academic Press, San Diego.

