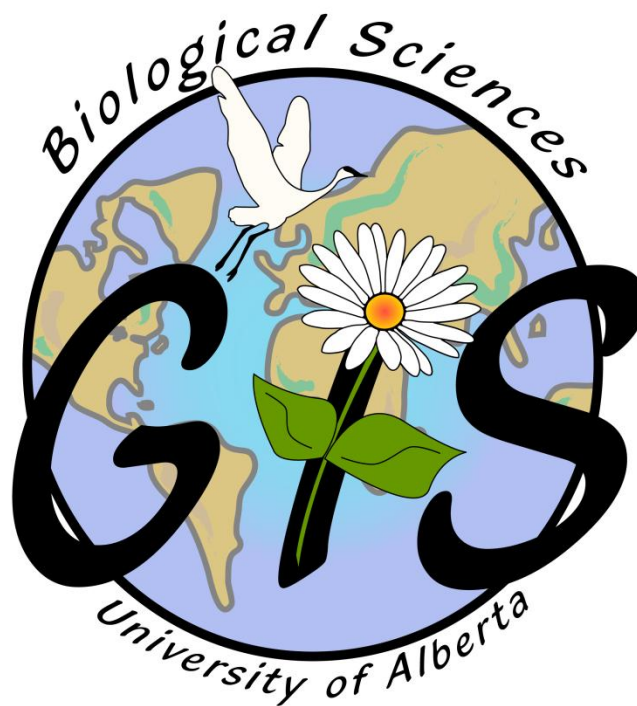


# GIS IN ECOLOGY: GIS PROJECT ISSUES



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This is an applied short course on getting started with GIS analysis. It involves key issues to consider when applying GIS to research. Hands-on exercises include file management skills, introduction to working with the software, symbolizing and classifying data. For additional suggested reading on GIS software, theory, and fundamentals see: <http://www.esri.com> and the “Tutorials & Online References” links of the Web Resources at <http://www.biology.ualberta.ca/facilities/gis/index.php?Page=338>.

## References:

- Crosier, Scott, Bob Booth, Kathy Dalton, Andy Mitchell, and Kristin Clark. 2004. **Getting Started with ArcGIS**. Environmental Systems Research Institute, Inc.
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- Harlow, Melanie, Rhonda Pfaff, Michael Minami, Alan Hatakeyama, Andy Mitchell, Bob Booth, Bruce Payne, Cory Eicher, Eleanor Blades, Ian Sims, Jonathan Bailey, Pat Brennan, Sandy Stevens, and Simon Woo. 2004. **Using ArcMap**. Environmental Systems Research Institute, Inc. Redlands, CA.
- Longley, Paul A., Michael F. Goodchild, David J. Maguire, and David W. Rhind. 2001. **Geographic Information Systems and Science**. John Wiley & Sons, Ltd. Chichester UK.
- Mitchell, Andy. 1999. **The ESRI Guide to GIS Analysis. Volume 1: Geographic Patterns and Relationships**. Environmental Systems Research Institute, Inc.
- Vienneau, Aleta, Jonathan Bailey, Melanie Harlow, John Banning, and Simon Woo. 2004. **Using ArcCatalog**. Environmental Systems Research Institute, Inc. Redlands, CA.
- Wadsworth, Richard and Jo Treweek. 1999. **Geographical Information Systems for Ecology: An Introduction**. Addison Wesley Longman Ltd.

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*GIS in Ecology is sponsored by the Alberta Cooperative Conservation Research Unit*  
<http://www.biology.ualberta.ca/accru>

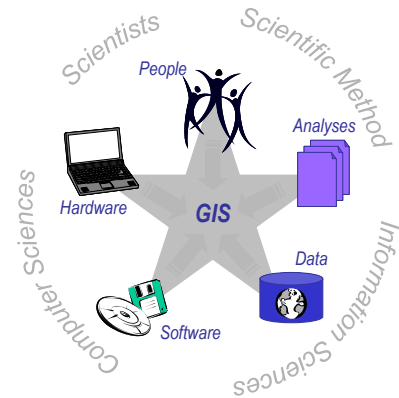
# GIS IN ECOLOGY: GIS PROJECT ISSUES

## Introduction

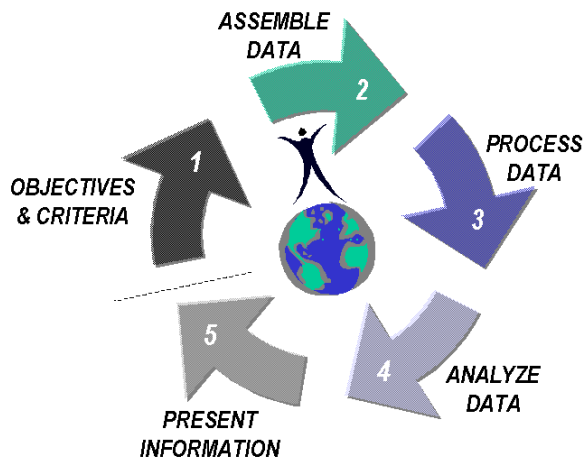
The purposes of this short course are to familiarize you with:

- Conducting a GIS analysis, and
- Getting started with using ESRI's ArcGIS software.

Also included, is a brief introduction to GIS presented at the beginning of the course via companion slides defining key issues and concepts.



## Conducting a GIS Analysis



In a typical GIS analysis project, you need to first identify the objectives of your project, create a project database containing the data you need to solve the problem, do any necessary preprocessing to get the data into useable format for the task at hand, use GIS functions to create an analytical model that solves the problem, and then interpret and present your results. The **five GIS project steps** are as follows:

1. Identify your objectives
2. Assemble a project database
3. Process data for analysis
4. Perform the analysis
5. Present the resulting information

Depending on the type of problem you're trying to solve, this process can be iterative, and often the final step leads to more geographic questions and the whole process begins again.





It is at steps 2 and 3 that can take more time than necessary if you don't have the appropriate skills to import files, work with various projections, and basically get all your data "ducks" lined up on a row. (Attend the spatial referencing and spatial database development short courses for instruction on these issues.) To help get you up to speed on using GIS intelligently, there are several **GIS learning options** available:

- UofA credit courses:  
EAS 221, Biol 471/571, RenR 426 & 401
- ESRI Virtual Campus:  
[www.biology.ualberta.ca/facilities/gis/index.php?Page=484#virtualcampus](http://www.biology.ualberta.ca/facilities/gis/index.php?Page=484#virtualcampus)





## GIS File Management and Software

Data used in a GIS comes in many forms. Once in digital form, special care is often needed because the usual **file management** methods that you may be used to in Windows-based software may corrupt the GIS data. Below are the most common file formats you will encounter:

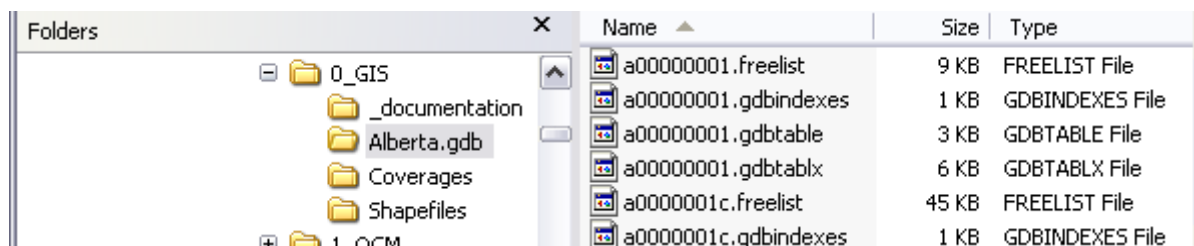
A **shapefile** is a vector data storage format that stores the shape and location (\*.shp), attributes (\*.dbf), and lookup index (\*.shx) of geographic features in a set of related files having the same prefix that must be kept together in the same directory. Additional files may be present: the very useful projection definition (\*.prj) and spatial index files (\*.sbn) and (\*.sbx). When working with shapefiles, remember to copy all associated files to the same directory so that they don't get corrupted! ArcCatalog will ensure that renaming and transferring is done properly.

 place	7 KB	DBF File
 place.prj	1 KB	PRJ File
 place.shp	2 KB	SHP File
 place.shx	1 KB	SHX File

A **coverage** is a folder-based vector OR raster (grid) data storage format. A single geographic theme (such as soils, streams, or land use) is represented as primary features (such as arcs, nodes, polygons, and label points OR cells) and secondary features (such as tics, map extent, links, and annotation) all stored in a **self-named folder**. Associated feature attribute tables describe and store attributes of the geographic features in the **info folder**. Use ArcCatalog when copying coverage files to ensure that the complete data structure is kept intact.

 dem	File Folder
 glcc	File Folder
 hillshade	File Folder
 info	File Folder

A **geodatabase** is a "container" that stores a collection of datasets as a folder with a name ending in .gdb (file geodatabase) or .mdb (personal geodatabase). It is a collection of various types of GIS datasets held in a file system folder and is the recommended native data format for ArcGIS stored and managed in a file system folder. The vector datasets are stored as feature classes.



Name	Size	Type
a00000001.freelist	9 KB	FREELIST File
a00000001.gdbindexes	1 KB	GDBINDEXES File
a00000001.gdbtable	3 KB	GDBTABLE File
a00000001.gdbtblx	6 KB	GDBTABLX File
a0000001c.freelist	45 KB	FREELIST File
a0000001c.gdbindexes	1 KB	GDBINDEXES File

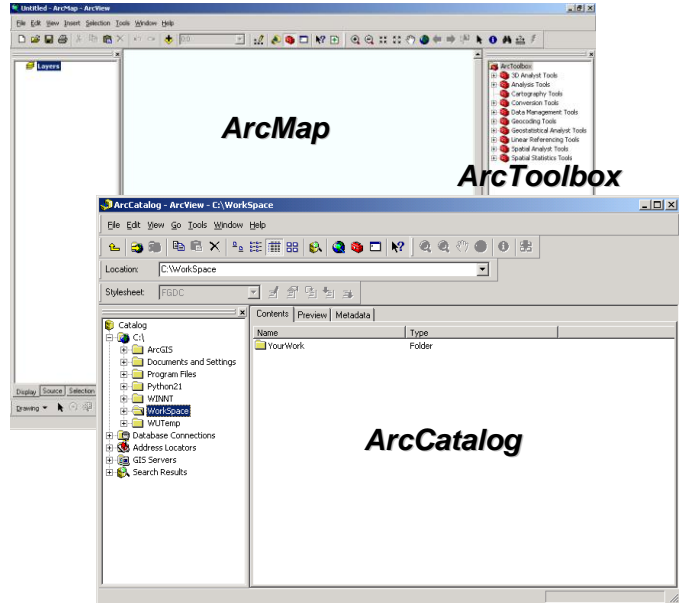
ArcCatalog (and selected tools in ArcToolbox) is the only way to rename, copy, and delete the feature classes and other data layers.

These short courses will focus on only the file geodatabase (\*.gdb) format.

See <http://www.biology.ualberta.ca/facilities/gis/uploads/instructions/AVFileTransfer.pdf> for more details on how to transfer GIS data so the files don't corrupt. Note: **Grids** are coverages.

ArcGIS 9 is the latest version of desktop GIS and mapping **software** developed by **Environmental Systems Research Institute, Inc. (ESRI)** that allows you to visualize, create, solve, and present spatial data in your ecological research. ArcGIS Desktop refers to a suite of scalable products composed of two core applications and an integrated set of tools:

- **ArcMap**
  - Create and interact with maps
  - View, edit, query relationships, and analyze geographic data
- **ArcCatalog**
  - Find, preview, document, & organize geographic data
  - View and update metadata
- **ArcToolbox**
  - Access form-based GIS tools
  - Projections
  - Geoprocessing framework
  - Dockable inside ArcMap, ArcCatalog



BOTH ArcView 9 and ArcInfo 9 are also called ArcGIS Desktop 9 – the user interfaces are exactly the same but the level of functionality and amount of analysis tools are greater in ArcInfo. For more information see [www.esri.com](http://www.esri.com), and to find out how to get the software for yourself, see <http://www.biology.ualberta.ca/facilities/gis/index.php?Page=484#mycomputer>.

## Course Data Sources

Free spatial data that can be used for GIS analysis in ecological applications have been obtained from the GeoGratis website <http://geogratis.cgdi.gc.ca> (Atlas of Canada, Canada Land Inventory, EcoAtlas). The following summarizes the **metadata** (description) for each geographic layer in the course dataset that has been made available to you in the **\\Bio\_print\courses\GIS-100** directory.

Name	File Format	Description	Area	Feature	Data Model	Scale	Projection / Datum
<b>alberta</b>	.shp	Province boundary	Alberta	Polygon	Vector	1:2,000,000	GCS NAD 83
<b>ecoatlas</b>	.e00	National Ecological Framework	Alberta	Polygon	Vector	1:7,500,000	GCS NAD 83
<b>lake</b>	.shp	Lakes and large rivers	Alberta	Polygon	Vector	1:2,000,000	GCS NAD 83
<b>place</b>	.shp	Populated places	Alberta	Point	Vector	1:2,000,000	GCS NAD 83
<b>river</b>	.shp	Rivers and streams	Alberta	Line	Vector	1:2,000,000	GCS NAD 83
<b>road</b>	.shp	Roads	Alberta	line	Vector	1:2,000,000	GCS NAD 83

See the course **\\_documentation** folder for more details on the sources of data used.

## Tasks

Managing files, exploring the interface of the GIS software, adding and displaying layers, symbolizing, and editing layer properties.

### *Instructions for Copying/Managing GIS Data*

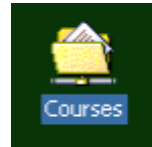
The quantity of GIS data files often necessitates you to utilize the network and/or copy to a disk or flash drive for storing and transferring the data needed for your projects.

**TIP: Invest in a portable hard drive!**

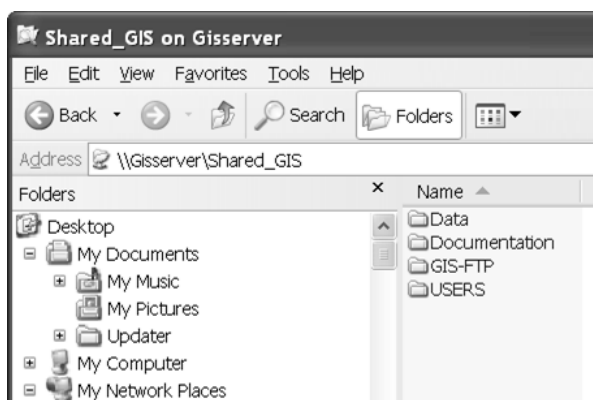
### Windows Explorer and Servers

The data files for the GIS short courses in the BioComputing teaching lab (B118) are located on the local **Bio\_print** server, accessible via the Local Area Network (LAN). Use Windows Explorer to navigate to the appropriate directory as indicated by the following figure:

1. Double click on the COURSES shared directory icon on the Desktop
2. Click on the FOLDERS button (located on the standard tool bar below the main menu) – *this transforms the window into Windows Explorer*
3. On the left side of the exploring window, click and drag the scroll bar until you can see “My Computer”
4. Expand “**My Computer**” by clicking on the “+”
5. Expand “**Local Disk (C:)**” by clicking on the “+”
6. In the right side of the exploring window, double click the “**GIS-100**” folder to open it
7. Click and drag (*copy and paste*) the “**0\_GIS**” folder to the **C:\Workspace** directory  
*The COURSES directory and all sub-folders are **read only**; therefore you cannot modify the data or store additional files here. Note: These instructions are for the B118 lab only.*
- ★ 8. **Open the subdirectories of C:\Workspace\0\_GIS to view the various GIS file structures**
9. Notice the lack of spaces in the folder and file names!!!
10. Minimize the Explorer window when done



See <http://www.biology.ualberta.ca/facilities/gis/uploads/instructions/MSGISServerAccess.pdf>



for instructions on how to access the **Shared\_GIS** server on the Bio-sci network, accessible only to users within the Biological Sciences Building.

This is where you can find ArcGIS manuals, store your GIS project files, obtain generic data for study area mapping, and temporarily FTP. You *must* be logged into a computer using your generic lab user ID and password to be able to access the Shared\_GIS server.



## File Transfer Protocol (FTP)



A File Transfer Protocol program, such as **WinSCP**, is a Windows-based application for transferring files between the local system (your PC) and a remote system (an FTP site on a network server). Using WinSCP, you can connect to another system from your PC, browse files and folders on both systems, and transfer files between the systems. Note: UofA networked servers require the **SFTP** setting.

**AUTHENTICATE** (B118 Lab) then click START >>> PROGRAMS >>> iDisc >>> **WinSCP**

If you are unfamiliar with FTP, see <http://helpdesk.ualberta.ca/storage/multimedia/winscp>.

The following information can be used to transfer files from the PC you are working on in the lab to an outside server:

Host Name/Address	User ID	Password	Description
gisserver.biology.ualberta.ca	gis-ftp	By request	Temporary directories for transferring files that you may want to copy to a computer outside B118
gpu.srv.ualberta.ca	Your CNS ID	Your CNS password	

## ArcCatalog and Data Management

### Using ArcCatalog:



Copying and working with GIS data file formats can easily be accomplished with ArcGIS's ArcCatalog application. This interface is designed to flawlessly copy all associated files required for the data to work properly in the GIS. It works very similar to Windows Explorer with drag and drop capability!

1. Choose START >>> PROGRAMS >>> ARCGIS >>> ARCCATALOG

2. Navigate to the **C:\WorkSpace\0\_GIS** directory and click the "+" to expand it

*To make a handy connection to the C:\WorkSpace\0\_GIS directory (also applies to a CD, portable hard drive, or other folder on the network or local hard drive):*

3. Click on the CONNECT TO FOLDER icon



4. Navigate to the appropriate location; e.g. **C:\WorkSpace\0\_GIS**

5. Click OK

6. Double click on the **\Alberta.gdb** directory to view its contents

7. Take a moment to examine the ArcCatalog window and Main Menu

*NOTE: The shapefiles and coverages appear as single files in the ArcCatalog window – but not in Windows Explorer.*

8. Highlight each of the files

9. Click on PREVIEW tab - ArcCatalog displays the "**Geography**" of your chosen layer

10. Change the Preview: from "Geography" to "**Table**" and examine it – *this is the attribute table associated with the layer and looks remarkably like an MS Access database table!*

11. Click on the METADATA tab

12. Click on each of the blue links to see the information they contain

13. Double click on the **\Shapefiles** directory and repeat your visual investigation of the data

## Accessing ArcGIS Desktop Help:

To find out more about metadata, take advantage of the wonderful ArcGIS help. This on-line help system can be accessed from ArcCatalog and ArcMap.

14. Press **F1** or choose HELP >>> ARCGIS DESKTOP HELP
15. Click on each of the tabs to see what they contain
16. Click on the INDEX tab
17. Type in “**metadata**” as the keyword to find
18. Select “**definition of**” in the list of subentries
19. Click DISPLAY
20. Take a quick look at the help file dialog
21. Click on each of the tabs: INDEX, SEARCH, FAVORITES
22. Click on the CONTENTS tab
23. Choose “**Getting started**” and view the various topics

*Peruse through the topics at your leisure to learn as much as you can about the importance of metadata, and then close the window. Notice that ArcGIS has several features for examining and managing your geographic layers, and there are excellent resources on GIS fundamentals!*

## Importing from Interchange Files (\*.E00):

Often, data comes in what is called Interchange format files (.E00). ArcView 9 has specialized conversion tools to convert Interchange files to coverages, singly or batch several at a time. (An ArcInfo license has additional tools within ArcToolbox to manage coverages.)

1. Choose VIEW >>> TOOLBARS >>> ARCVIEW 8x TOOLS
2. Choose CONVERSION TOOLS >>> IMPORT FROM INTERCHANGE FILE
3. Input file: Browse to **C:\Workspace\Coverages** and find the input file **ecoatlas.e00**
4. Output dataset: Navigate to the **C:\Workspace\0\_GIS\Coverage** directory and enter “**ecoatlas**” as the new name for the coverage
5. Click OK

*Note: You may click the BATCH button and then ADD ROW to browse and convert more than one file at a time!*

6. In the **\Coverages** directory, select and examine the distinct file structure by viewing in both ArcCatalog and Windows Explorer

## Importing to Geodatabase:

7. In ArcCatalog, right-click on the **\Alberta.gdb** and choose Import Feature Class (multiple)
8. Navigate to the \Coverages folder and double click ecoatlas to select ‘**polygon**’
9. Click OK

*Note: There are many more ways to import/export files between different formats. There are also individual tools in ArcToolbox that can be used in many more instances.*

## Launching ArcMap:

10. Click on the ARCMAP button in ArcCatalog
11. Start using ArcMap with a new empty map and click OK
12. CLOSE ArcCatalog






## ArcMap and Map Documents


Take a moment to examine the ArcMap window and look through the MAIN MENU. ArcMap displays geographic information as **layers**, and each layer represents a particular type of feature such as populated places, rivers, lakes, or wildlife habitat. The **references** (*NOT the actual data files*) to these layers are stored in the **map document** (.mxd file).

Several **toolbars** are available for you to point and click your way through the displaying of layers and performing GIS functions on them. Select which toolbars you need from the VIEW >> TOOLBARS pull-down menu or choose TOOLS >>> CUSTOMIZE and check each in the TOOLBARS tab.



The **table of contents** lists all the layers on the map and indicates what the features in each layer represent. Turn it on or off via WINDOWS >>> TABLE OF CONTENTS. The order in which layers are drawn depends on their positions within the table of contents; the layer at the top draws over the one below. DISPLAY, SOURCE, & SELECTION tabs help manage layers.

Again, the **layers** in the table of contents are the references to the shapefiles, coverages, grids, images, etc. that you add to the map document. You can modify the drawing order, turn them on  and off , and expand /collapse  their legends. Layers are organized into **data frames** , which simply group the layers that you want to display together. The default data frame name is "Layers." You can add more than one data frame when comparing layers side by side or for creating map insets and overviews. When there is more than one data frame in the map, only one of them is the **active data frame** (i.e. the one you're currently working with is highlighted on the map and shown in bold text in the table of contents). When you add a new layer to a map, it is added to the active data frame.

Both layers and data frames have **properties**  associated with them that you can edit and modify according to how you want the data to be displayed. You control all aspects of a layer through the **layer properties** by defining how it is drawn, the source of its data, what gets labeled, attribute field properties, etc. You can customize the data frame name, position, coordinate system, grid, map and display units, appearance, etc. through **data frame properties**. Access the properties by right clicking on the layer or data frame and clicking on PROPERTIES or simply by double clicking on the name.

Depending on how you want to look at and interact with your geographic information, ArcMap provides you with two different ways to view your map:

**data view**  and **layout view** .

Use data view when you want to browse the geographic data on your map or perform analyses on layers specific to the data frame. Use layout view when you're preparing your map for presentation to an audience. You can switch between views through the VIEW pull-down menu or by clicking the view buttons found in the lower left portion of the display window.

## Setting up the ArcMap working environment:

1. Click on each of the headings in the MAIN MENU to view what's available
2. Choose VIEW >>> TOOLBARS
3. Make sure there is a check beside the following toolbars:
  - Main Menu
  - Standard
  - Tools
  - Draw
  - Layout
4. Click and drag each toolbar so that they are positioned as you like
5. Right click anywhere on the MAIN MENU to view the TOOLBARS listing
6. Remove the LAYOUT toolbar by clicking on the check mark
7. Hover the mouse cursor over each of the buttons on the toolbars to read the tool tip

## Adding data layers:

8. Click on the ADD DATA button 
9. Navigate to the **C:\Workspace\0\_GIS\Alberta.gdb** directory
10. Select **ALL** layers by holding the SHIFT key and clicking on the first and last files in the **Alberta.gdb** directory
11. Click ADD

*Note: Holding the CTRL or SHIFT key enables multiple file selections!*

## Turning layers on and off in ArcMap:

12. In the table of contents, click on the check box beside **river** to turn it OFF
13. Turn OFF the rest of the layers by clicking in their check boxes
14. Hold the CTRL key and click in any of the empty check boxes to turn on all layers at the same time (*The same CTRL key technique works for turning them all off, too.*)

## The drawing order of layers:

*The order of layers listed in the table of contents determines how layers are drawn on a map. Within a data frame, the layers listed at the top will draw over those listed below them, and so on down the list. You can easily move layers around to adjust their drawing order or organize them in separate data frames. For example, roads should be drawn over rivers.*

15. Make sure all data layers are turned ON
16. Click and drag **lake** up until a black line indicates that the layer will be placed above **river**
17. Move the **place** layer so it draws on top of all other layers – *points default to this location*
18. Position the remaining layers appropriately; i.e. **road** above **river**

## Setting data frame and layer properties:

19. Right-click on the data frame entitled "Layers"
20. Click PROPERTIES – *alternately, choose VIEW >>> DATA FRAME PROPERTIES*
21. Click on each of the tabs to see what they contain
22. Select the GENERAL tab
23. Change the name of the data frame to "**Alberta**"
- ★ 24. Click OK to apply the change and close the window
25. Right click on the **river** layer

26. Click on PROPERTIES
- ★ 27. Click on each of the tabs to see what they contain
28. Close the window

### Adding a new data frame:

29. Choose INSERT >>> DATA FRAME
30. Right-click “New Data Frame”
31. Click on ADD DATA...
32. Navigate to the \Shapefiles folder to select **ALL** the layers
33. Click ADD
34. Repeat for the \Coverages folder

*The most complex layer (polygon or annotation) is added for the coverages.*

35. Click once on the name “**New Data Frame**” to highlight it
36. Wait a moment and then click it again to access the text box
37. Change the name of the data frame by typing “**Alberta 2**” and press ENTER

### Removing a layer from the data frame:

38. Right click on any layer and click REMOVE

### Switching between data frames:

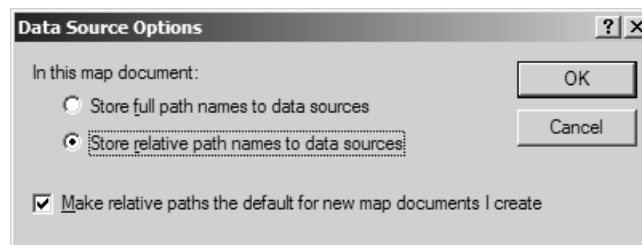
*When in data view, you can see only one data frame. You cannot see both data frames at the same time unless you switch to layout view to create a map (subject of a future short course). The **active** data frame name will appear in bolded text in the table of contents.*

39. Right-click on the data frame entitled “Alberta”
40. Click ACTIVATE – *you are now looking at that data frame*
41. Hold the ALT key and click on the “Alberta 2” data frame – *shortcut to activate*
42. Click on the “-“ next to “Alberta 2” to collapse its legend
43. Switch back to (activate) the “**Alberta**” data view

### Saving your map document:

*First set the map properties.*

44. Choose FILE >>> DOCUMENT PROPERTIES
45. Click DATA SOURCE OPTIONS
46. Choose “Store relative path names to data sources”



47. Check “Make relative paths the default...” and click OK
48. Choose FILE >>> SAVE AS
49. Navigate to the **C:\Workspace\0\_GIS** directory
50. Type a name; e.g. **Alberta\_todaysdate.mxd**
51. Click SAVE

**IMPORTANT TIP: relative path names** specify the location of the map data relative to the current location on disk of the map document (.mxd file) itself. Since relative paths don't contain drive names (e.g. C:\Workspace\0\_GIS), they make it easier for you to move the map and its associated data to any disk drive without the map having to be repaired. As long as the same directory structure is used at the new location (e.g. \0\_GIS), the map will still be able to find its data by traversing the relative paths.

## Symbolizing Your Data

This section demonstrates how you can communicate specific attributes of geographic information to your map audience. ArcMap has several ways to spruce up legend styles to make your map look more visually appealing and convey more meaningful information. See appendix.

### Point symbology:

1. Turn OFF all layers in the “Alberta” data frame and turn ON **place**
2. Click on the **SYMBOL** for **place**

*Clicking directly on the symbol patch is a shortcut for modifying its properties.*

3. Scroll through the various point symbols to choose one and modify the color/size
4. Click OK
5. In the table of contents, change the place layer name to “**Towns**”
6. Make a copy of the place layer:
  - Right click on the “**Towns**” layer *NAME* and choose COPY LAYER
  - Right click on the “**Alberta**” data frame *NAME* and choose PASTE LAYER(S)

*There are several ways to symbolize points, especially if the point layer has attributes associated with them.*

7. Double click on the new “**Towns**” layer *NAME* to view its properties
8. Select the SYMBOLOGY tab
9. Show QUANTITIES as GRADUATED SYMBOLS
10. Specify **POP91** as the Value Field
11. Accept all defaults

*You will get practice with various classification options when symbolizing polygons.*

12. Change the layer name in the GENERAL tab to “**Populations**” and click OK

### Line symbology:

13. Turn OFF all layers in the “Alberta” data frame and turn ON **river** and **road**
14. Double click on the *NAME* for **river**
15. Click on the SYMBOLOGY tab in the Layer Properties window
16. Click on the symbol button
17. Select the RIVER symbol
18. Click OK

*ArcMap has several of these preset symbol styles for common geographic features that you can take advantage of for efficient symbolization!*

19. Give the layer a new name under the GENERAL tab; e.g. “Rivers”
20. Click OK
21. Double click on the **road** layer name
22. In the Layer Properties window, draw Categories using TYPE as the Unique Value
23. Click ADD ALL VALUES
24. Remove the check beside <all other values>

25. Double-click on each of the line symbols and give them an appropriate color/style
26. In the GENERAL tab, change the layer name to “**Roads**”
27. Click OK

*Just as when symbolizing points, you may use attributes associated with line layers to symbolize them effectively.*

### **Polygon symbology:**

28. Turn OFF all layers in the “Alberta” data frame and turn ON **lake** and **alberta**
29. In the table of contents, right-click on the **lakes NAME**
30. Click PROPERTIES
31. Click the SYMBOLOGY tab
32. Click on the symbol button
33. Set the FILL COLOR to a **blue** of your choice and the OUTLINE WIDTH to **0.00**
34. In the GENERAL tab, change the layer name to “**Lakes**”
35. Click OK
36. Click on the *SYMBOL* for the **Alberta** layer
37. Select the HOLLOW symbol and click OK – *this is a quick way to outline a polygon layer*
38. Turn OFF all layers in the “Alberta” data frame and turn ON **ecoatlas**
39. Double click on the **ecoatlas** layer name
40. Show CATEGORIES as Unique Values and select **ECOPROV** as the Value Field
41. Click ADD ALL VALUES
42. Remove the check beside <all other values>
43. Select a COLOR SCHEME or double click on each symbol to select a new color for each
44. Rename the layer under the GENERAL tab; e.g. “**Ecoatlas**”
45. Click OK

*To remove the lines between the groups of polygon features...*

46. Double click the **Ecoatlas** layer name to view Layer Properties >>> SYMBOLOGY
47. Click on the SYMBOL heading
48. Click PROPERTIES FOR ALL SYMBOLS
49. Set the OUTLINE WIDTH to **0.00**
50. Click OK twice

### **Classifying Your Data**

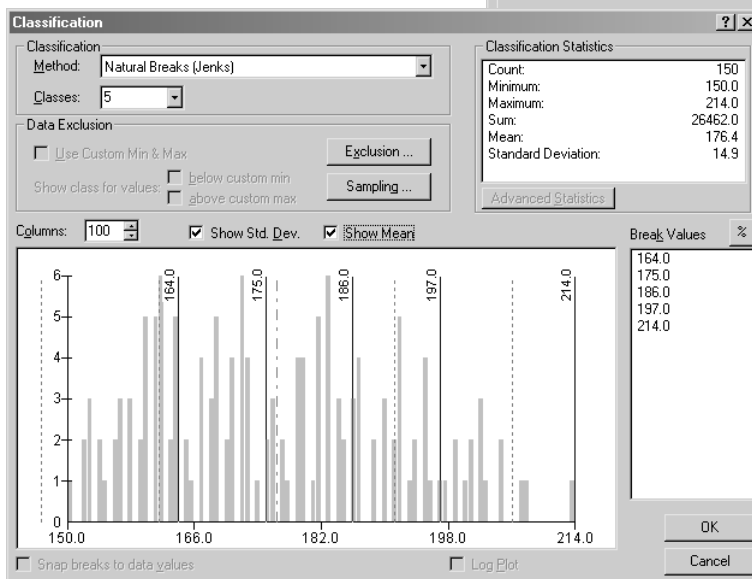
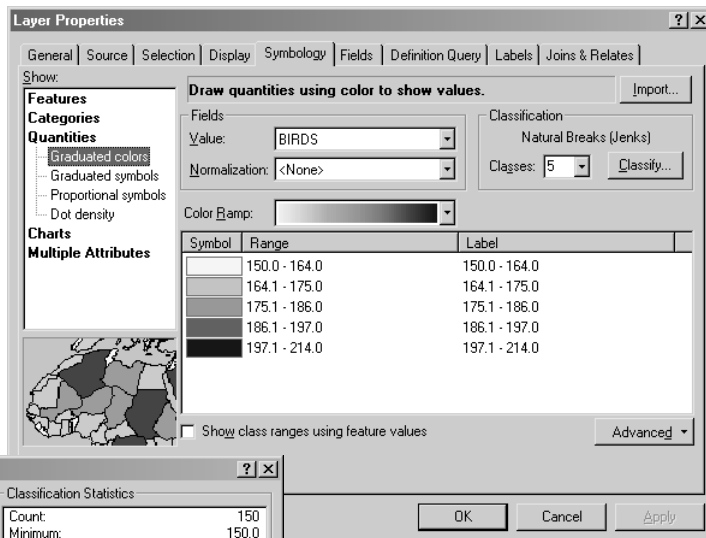
Recall the second point symbology you applied to the **Towns** layer. You used graduated symbols to group similar values from the POP91 field as same-sized symbols. A default classification method was applied. You may modify the classification method parameters to convey quantities that best suit your data. Polygon features are used in the following examples to familiarize you with the subtleties of data classification.

Keep in mind that the value classification schemes are similar for all features (points, lines, polygons) and raster data, too, that have numeric attribute values.

### **Deciding on an attribute to map:**

1. View C:\WorkSpace\0\_GIS\METADATA\ecoatlas\_descriptions.xls
2. Read the descriptions of the various attributes and select one; e.g. **BIRDS** (number of terrestrial bird species) – *this is a good example to use because you can experiment with normalizing the counts by area*

3. In ArcMap, **ACTIVATE** the “**Alberta**” data frame
4. Turn all layers **OFF**, and turn **ON ecoatlas**
5. Double click on the **ecoatlas NAME** to access its **PROPERTIES**
6. Show **CATEGORIES** as a Unique Values and select **BIRDS** as the Value Field
7. Click **OK**
8. View the resulting map



**Symbolizing using the default classification:**

9. Double click on the **ecoatlas NAME** to access its **PROPERTIES**
10. In the **SYMBOLOLOGY** tab, show **QUANTITIES** using **Graduated Colors**
11. Select **BIRDS** as the **VALUE** using the default classification (**5 Natural Breaks**)
12. Click **OK**
13. View the resulting map

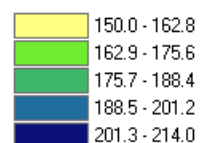
**Exploring the classification histogram:**

14. Double click on the **ecoatlas NAME** to access its **PROPERTIES**
15. In the **SYMBOLOLOGY** tab, click on the **CLASSIFY** button
16. Click a  check in the “**Show Std. Dev.**” And “**Show Mean**” check boxes
17. Examine the classification statistics, break values, and frequency distribution

**Changing the classification method to equal interval:**

18. Select **Equal Interval** from the classification method drop-down box
19. Maintain the **5** classes
20. Take note of the break values
21. Click **OK**
22. Click **APPLY**
23. View the resulting map
24. Position the **Layer Properties** window so you can see both it and the **ecoatlas** layer in the data view

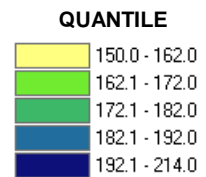
**EQUAL INTERVAL**





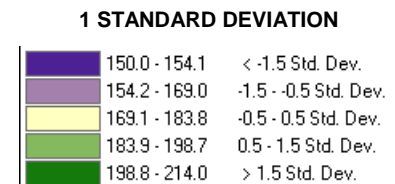
### Changing the classification method to quantile:

25. Return to the SYMBOLOGY tab and click the CLASSIFY button
26. Select **Quantile** from the classification method drop-down box
27. Maintain the **5** classes
28. Take note of the break values
29. Click OK
30. Click APPLY
31. View the resulting map



### Changing the classification method to standard deviation:

32. Return to the SYMBOLOGY tab and click the CLASSIFY button
33. Select **Standard Deviation** from the classification method drop-down box
34. Keep **1 Std Dev** as the interval
35. Take note of the break values
36. Click OK
37. Click APPLY
38. View the resulting map



### Specifying your own class breaks:

39. Return to the SYMBOLOGY tab and click the CLASSIFY button
40. Select **Manual** from the classification method drop-down box
41. Select **5** classes
42. Type **new numbers** or **reposition** the histogram break bars to set new break values
43. Click OK
44. Click APPLY
45. View the resulting map

### Normalizing the data:

*Create ratios, by dividing two data values, if you want to minimize differences based on the size of areas or number of features in each area – also referred to as normalizing the data.*

46. Return to the SYMBOLOGY tab and click the CLASSIFY button
47. Select **Natural Breaks** from the classification method drop-down box
48. Maintain the **5** classes
49. Click OK
50. Select **AREAKM** in the Normalization drop-down box
51. Click APPLY
52. View the resulting map
51. Experiment with the different classification methods on the normalized data – *you should notice very different distribution patterns from the original count data*

View the table below, statistical textbooks, and the online HELP Index for  
**“classification schemes”**:  
*Ways to map quantitative data, Setting a classification, Standard classification schemes*

<b>METHOD</b>	<b>WHEN TO USE</b>	<b>NUMBER OF CLASSES</b>
Natural Breaks	Attributes are distributed unevenly across the overall range of values	Choose a number that best reflects the natural groups of attributes you want to show
Equal Interval	All classes should have the same range	Choose a number that produces an easily understood interval (2, 50, 1000, etc.) or, the number of classes that produces a map with your intended message
Quantile	Attributes are distributed evenly distribution across the range of values	Choose a number that makes sense for the purpose of your map
Standard Deviation	Show how much a feature's attribute value varies from the mean	Choose the interval size (1/3 to 1 std dev and ArcMap calculates the mean value and the standard deviations from the mean to use in creating class breaks

## ***Additional Symbology Tips***

### **Saving layer (\*.lyr) files:**

*You can save everything about the layer (symbology, labels, classification) in a layer file (\*.lyr). This is very convenient because when the layer file gets added to another map document, it references the shapefile and tells ArcMap to draw it exactly as it was saved. Now whenever you wish to display this layer, add the \*.lyr file instead the original data.*

52. Right click on **Roads** and click SAVE AS LAYER FILE

53. Specify a directory location and name and click SAVE

*Repeat making \*.lyr files for other layers you symbolized. Now whenever you wish to display this layer in a new map document, add the \*.lyr file instead the original data.*

54. Choose INSERT >>> NEW DATA FRAME

55. Click the ADD DATA button and add some of these \*.lyr files and their corresponding data sources; e.g. **Roads.lyr** and **road.shp**

### **Importing symbology:**

*You can set the symbology definition from an existing layer file or ArcView 3 legend file (\*.avl files are an old software version's method of saving symbology for a layer. The example below shows AVL symbology importing, but note that ArcGIS now uses LAYER FILES (see above).*

56. Under the SYMBOLOGY tab, click the IMPORT button

57. Select 'Import symbology definition from an ArcView 3 legend file (\*.avl)'

58. Alternatively, import symbology from an existing layer and/or a layer file

**For additional symbology tips/guidelines, see companion slides from <http://www.biology.ualberta.ca/facilities/gis/?Page=485>**