

Exercise One: How To Make Your First Map

One of the most common things for biologists to do in GIS is to make a map for inclusion in a report, presentation or publication. Such maps can be used to show things like where in the world a specific study was conducted, the distribution of sampling locations, the range of a species or the locations where a specific disease has been recorded. A good map will make it much easier for others to understand your work and for you to get your message across. However, creating a good map is not always as straight forward as it might, at first, seem. In particular, there is often a tendency to have either too much or too little information on your maps, to not show the right part of the world, or to miss out an important component which will help others understand what it is meant to show.

A good map should have the following characteristics:

- It should be easy to differentiate between symbols which represent different things (e.g. symbols representing the locations where different species have been recorded should not look too similar).
- The symbols should not be so large that they cover up other important features, or so small that you cannot tell what they are.
- You should be able to tell which part of the world it is representing. This can be done using a small insert map showing where the main map is situated in relation to a whole country, continent or the entire world, or by labelling the map with coordinates around its edge.
- You should be able to determine which direction is North. This can be done using a north arrow, or by labelling the map with coordinates around its edge.
- You should be able to easily work out how far apart any features are on it. This is usually done by adding a scale bar.

- It should show all the features you need to get your message across, but no more than that. If you have too few features, anyone viewing the map will not be able to understand what it represents, while if you have too many, it will become difficult to interpret.
- The colours used for different features on your map should compliment each other rather than clash, and colours should be used in a logical way. For example, avoid using green to represent areas of sea and blue for areas of land as this is likely to cause confusion. In addition, if your final map is going to be printed in greyscale (rather than in colour), make sure that you can still differentiate between all the colours once it has been converted into this colour scheme. If you cannot find an appropriate colour scheme that will work in greyscale, you can try using different fill patterns instead.

In this exercise, you will create your first map and you will learn how to add various components to it so that it is easy to understand and interpret. You will also learn how to change the way that individual features are displayed and the symbols that are used to represent them. The final map which you will generate would be suitable for inclusion in an scientific report or publication.

The map you will create is based on data collected along transects which have been established around the Manu Learning Centre (MLC), a field station in the Manu Biosphere Reserve in the Peruvian Amazon run by an organisation called CREES (see www.crees-manu.org for more information). These transects are used to collect information on the distribution of a wide variety of organisms in a protected area of rainforest which has been established beside the MLC. The map you will produce will show the location of the MLC, along with the limits of its associated protected area, a portion of the survey transects which are regularly surveyed, and the locations along these transects where three species of macaws (a group of colourful New World parrots) have been recorded. The map will be used to show that while all three species use the local rainforest, they do not occur at the same locations, suggesting that there is some sort of spatial segregation between them. Such a map would be the first step in investigating whether the suggested spatial segregation between these species actually exists.

The instructions for creating this map in ArcGIS 10.3 can be found on page 74, while those for creating the map in QGIS 2.8.3 can be found on page 90. However, before you start this exercise, you will first need to create a new folder on your C: drive called GIS_FOR_BIOLOGISTS. To do this on a

computer with a Windows operating system, open Windows Explorer and navigate to your C:\ drive (this may be called Windows C:). To create a new folder on this drive, right click on the window displaying the contents of your C:\ drive and select NEW> FOLDER. Now call this folder GIS_FOR_BIOLOGISTS by typing this into the folder name to replace what it is currently called (which will most likely be NEW FOLDER). This folder, which has the address C:\GIS_FOR_BIOLOGISTS, will be used to store all files and data for the exercises in this book.

Next, you need to download the source files for six existing data layers which will be used in this exercise (and, indeed, source files for all the other exercises in this book) from www.gisinecology.com/GFB.htm#2. Once you have downloaded the compressed folder containing the files, make sure that you then copy all the files it contains into the folder C:\GIS_FOR_BIOLOGISTS, which you have just created.

The data sets which you will use in this exercise are:

1. **MLC_Protected_Area.shp:** This is a polygon data layer with a single polygon in it which represents the area of protected rainforest associated with the Manu Learning Centre (MLC). It is in the UTM_19S projection and uses the WGS 1984 datum for its coordinate system.
2. **MLC_Transects.shp:** This is a line data layer where the lines represent the transects regularly surveyed for a wide variety of organisms in the Manu Learning Centre (MLC) protected area. It is in the UTM_19S projection and uses the WGS 1984 datum for its coordinate system.
3. **MLC_Location.shp:** This is a point data layer where the single point in it represents the location of the Manu Learning Centre (MLC) itself. It is in the UTM_19S projection and uses the WGS 1984 datum for its coordinate system.
4. **Red_And_Green_Macaw.shp, Blue_Headed_Macaw.shp and Blue_And_Yellow_Macaw.shp:** These three data layers are point data layers where each point in it represents a location where each species has been recorded during the surveys. They are in the UTM_19S projection, which uses the WGS 1984 datum for its coordinate system.

Instructions For ArcGIS 10.3 Users:

Once you have the required files downloaded into the correct folder on your computer, and you understand what is contained within each file, you can move on to creating your map. The starting point for this is a blank GIS project. To create a blank GIS project, first, start the ArcGIS software by opening the ArcMap module. When it opens, you will be presented with a window which has the heading ARCMAP – GETTING STARTED. In this window you can either select an existing GIS project to work on, or create a new one. To create a new blank GIS project, click on NEW MAPS in the directory tree on the left hand side and then select BLANK MAP in the right hand section of the window. Now, click OK at the bottom of this window. This will open a new, blank GIS project. (**NOTE:** If this window does not appear, you can start a new project by clicking on FILE from the main menu bar area, and selecting NEW. When the NEW DOCUMENT window opens, select NEW MAPS and then BLANK MAP in the order outlined above.) Once you have opened your new GIS project, the first thing you need to do is save it under a new, and meaningful, name. To do this, click on FILE on the main menu bar, and select SAVE AS. Save it as EXERCISE_ONE in the folder C:\GIS_FOR_BIOLOGISTS.

STEP 1: SET THE PROJECTION AND COORDINATE SYSTEM OF YOUR DATA FRAME:

Whenever you start a new GIS project, the first thing you should do, even before you add any data layers, is select an appropriate projection/coordinate system and then set the data frame (i.e. the map you are going to add your data layers to) to use this projection/coordinate system. This ensures that you do not accidentally end up using one which is inappropriate. In addition, most problems that beginners have with GIS are caused by a failure to use an appropriate projection/coordinate system, or by a conflict between the projection/coordinate system used for data layers and the one being used for the data frame itself. For this exercise you will use a pre-existing projection/coordinate system called Universal Transverse Mercator (UTM) Zone 19S. This is a transverse mercator projection which is specifically designed for the region of the world where the Manu Learning Centre (MLC) is situated.

To set your data frame to use the UTM Zone 19S projection/coordinate system, work through the flow diagram which starts on the next page.

**Data
frame with no
associated
projection/
coordinate
system**

When you open a new GIS project, there will be an empty data frame (called, rather confusingly, LAYERS). It will not have a projection or coordinate system associated with it.

1. Open data frame properties

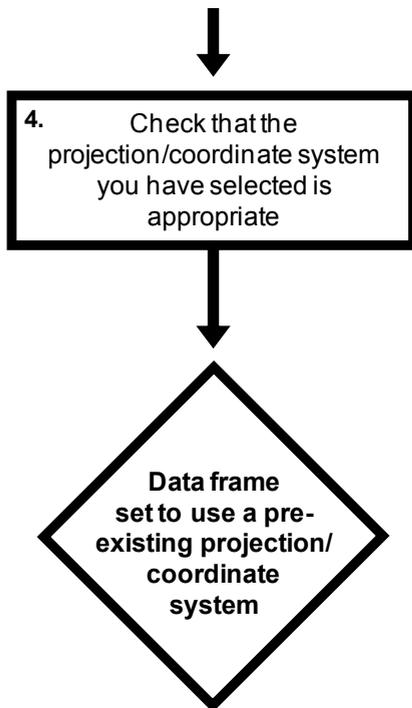
To open the properties of a data frame, right click on its name (in this case LAYERS) in the TABLE OF CONTENTS window, and select the PROPERTIES option. If this is not visible, go to the WINDOWS menu and click on the TABLE OF CONTENTS option.

2. Go to the coordinate system window

Select the COORDINATE SYSTEM tab in the DATA FRAME PROPERTIES window. The lower section of this window will tell you which projection and coordinate system are set for the data frame you are currently using. This should currently say 'No coordinate system'.

3. Select the required pre-existing projection/coordinate system

To select a pre-existing projection/coordinate system, select it from the upper section of the COORDINATE SYSTEM tab. For this exercise, you wish to select WGS_1984_UTM_ZONE_19S (this is a suitable projection/coordinate system for the area of Peru which will be mapped in this exercise). To select it, click on PROJECTED COORDINATE SYSTEMS> UTM> WGS 1984> SOUTHERN HEMISPHERE> WGS 1984 UTM ZONE 19S (you may need to scroll down to find this option). Once you have selected it, its name will appear in the CURRENT COORDINATE SYSTEM section of the COORDINATE SYSTEM tab along with other information about this specific projection/coordinate system. Finally, click OK to close the DATA FRAME PROPERTIES window.



Once you have selected your projection/coordinate system, you need to check that it is appropriate. This involves examining how data layers look in it. For this exercise, this will be done in the next step by adding a series of data layers, and checking that the features in them plot in the expected places and that any polygons have the expected shapes.

To check that you have done this step properly, right click on the name of your data frame (LAYERS) in the TABLE OF CONTENTS window and select PROPERTIES. Click on the COORDINATE SYSTEM tab of the DATA FRAME PROPERTIES window and make sure that the contents of the CURRENT COORDINATE SYSTEM section of the window has the following text at the top of it:

WGS_1984_UTM_ZONE_19S
WKID: 32719 Authority EPSG

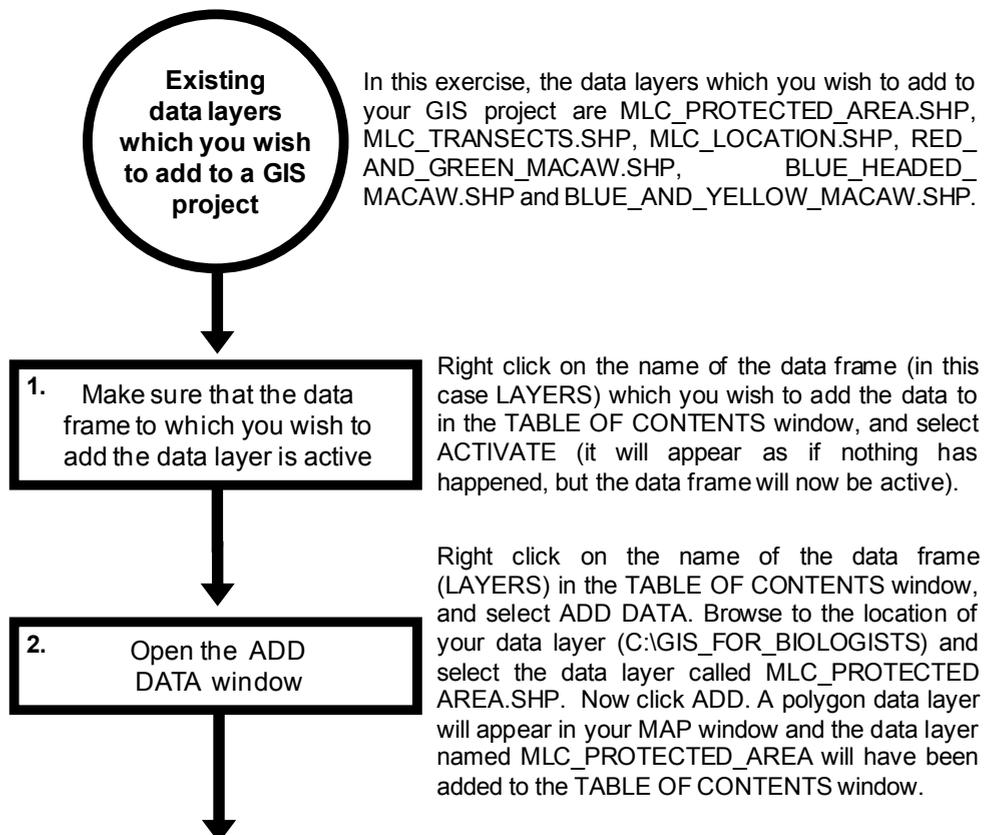
Projection: Transverse_Mercator
False_Easting: 500000.0
False_Northing: 10000000.0
Central_Meridian: -69.0
Scale_Factor: 0.9996
Latitude_Of_Origin: 0.0
Linear Unit: Meter (1.0)

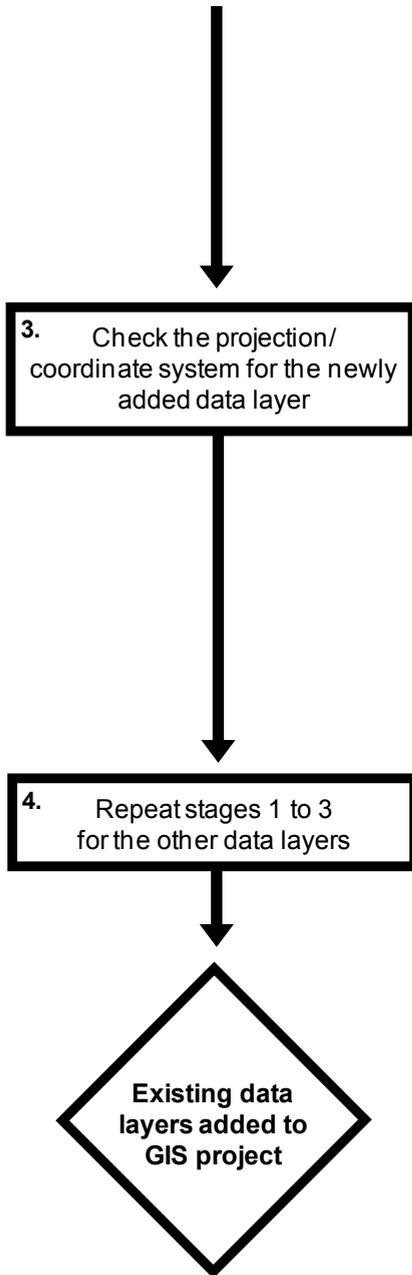
If it does not, you will need to repeat this step until you have assigned the correct projection/coordinate system to your data frame. Once you have successfully completed this step, click on the FILE menu on the main menu bar and select SAVE to save the changes you have made to your GIS project.

STEP 2: ADD THE EXISTING DATA LAYERS YOU WISH TO DISPLAY ON YOUR MAP TO YOUR GIS PROJECT:

Once you have set the projection/coordinate system of your data frame, you are ready to add some data layers to it. For this exercise, you will use a number of existing data layers which provide information about a variety of different features for the area around the Manu Learning Centre (MLC). These will provide information about the location of the area of protected rainforest associated with the MLC (contained in the polygon data layer MLC_PROTECTED_AREA), about a set of transect lines which are regularly surveyed in this protected area (contained in the line data layer MLC_TRANSECTS), the location of the MLC itself (contained in the point data layer MLC_LOCATION) and the locations where three different species of macaws have been recorded during the transect surveys (contained in the point data layers RED_AND_GREEN_MACAW, BLUE_HEADED_MACAW and BLUE_AND_YELLOW_MACAW).

To add these data layers to your GIS project, work through the following flow diagram:

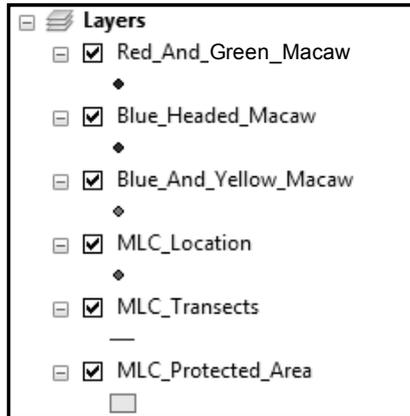




Whenever you add a data layer to a GIS project, you should always check that it has a projection/coordinate system assigned to it, and look at what this projection/coordinate system is. This is so that you know whether you will need to assign a projection/coordinate system to it, or transform it into a different projection/coordinate system before you can use it in your GIS project. To check the projection/coordinate system of your newly added data layer, right click on its name in the TABLE OF CONTENTS window and select PROPERTIES. In the LAYER PROPERTIES window which opens, click on the SOURCE tab and check that the projection/coordinate system listed under DATA SOURCE is WGS_1984_UTM_ZONE_19S (the same as the data frame). Now click OK to close the LAYER PROPERTIES window. If the data layer had not been in the same projection/coordinate system as the data frame, you would have to have used the PROJECT tool to transform it into the correct projection/coordinate system. You will learn how to do this in exercise two (see chapter thirteen).

Repeat stages 1 to 3 for the data layers called MLC_TRANSECTS.SHP, MLC_LOCATION.SHP, BLUE_AND_YELLOW_MACAW.SHP, BLUE_HEADED_MACAW.SHP and RED_AND_GREEN_MACAW.SHP (in this order) to add them to your GIS project.

At the end of this step, your TABLE OF CONTENTS window should look like the image at the top of the next page.



While the contents of your MAP window should look like this:



If it does not look like this, try right-clicking on the name of the MLC_PROTECTED_AREA data layer in the TABLE OF CONTENTS window and selecting ZOOM TO LAYER. If it still does not look right, remove all the data layers from your GIS project by right-clicking on their names in the TABLE OF CONTENTS window and selecting REMOVE. Next, go back to step one and ensure that you have set the projection/coordinate system of your data frame correctly, and then repeat step two. Once you have successfully completed this step, click on the FILE menu on the main menu bar and select SAVE to save the changes you have made to your GIS project.