

Exercise One: Creating A Map Of Species Distribution For A Publication

One of the first, and most common, tasks you will want to do using GIS is to produce maps for use in presentations, reports and publications. This is not as straight-forward as it first may seem and it may take you several attempts to get a map which looks exactly how you want it to. However, it is well worth the effort spent getting it right as a good map is extremely useful for getting information across to other people in an easy to understand format.

You will usually want your final map to have a number of key characteristics. Firstly, you will want it to display all the data layers you wish to show (and no other data layers). Secondly, you will want these to be displayed in a meaningful way. For example, you may want it to have different symbols marking the locations where each species was recorded in a specific study area so that you can tell them apart and compare the distributions of different species. Thirdly, you will want to provide additional information which helps put your data layers in context. For example, in a map of species locational records, you might also want to have information on water depth and the position of any land in the vicinity to make it easier to interpret how the distributions of different species vary in terms of their proximity to the coast or their preferred water depths. Fourthly, you will need to have some information which tells anyone who looks at the map what part of the world it represents. This can be done by putting a 'graticule' around it which shows the latitude and longitude for your map along its sides. Finally, you will need to ensure that the projection/ coordinate system used for your map is appropriate to the part of the world it represents and does not distort the shape or relative positions of important features within it. This will ensure that the information presented in it can be easily understood. You also want your map to have an appropriate extent. That is, you do not want your map to be so 'zoomed in' that you cannot see all your features of interest, or so 'zoomed out' that the features you are

interested in only occupy a very small portion of it and cannot be separated from each other.

You may also want to include a key which tells people what each symbol displayed on your map means. However, this is optional and you may choose to simply provide a description of the symbols and what they mean in the figure legend (for example, Red circles: Species 1; Blue circles: Species 2; etc). Other optional features include a scale bar so that people know how big features are on your map and an arrow which indicates the direction of North.

As with almost everything in GIS, thinking about what you need to include in your map, and how you are going to display it, before you start will benefit you in the long run. This is because if you rush in without thinking it through properly first, you will undoubtedly make mistakes. Of course, there is nothing wrong with making mistakes, and sometimes it is the best way to learn how to do something, but a bit of thought in advance will save time and effort later.

In this exercise, you will make a map of the distribution of bottlenose dolphin records from surveys in the northern North Sea. Your final map will also include information on water depth and the position of land, so you can get an idea of how bottlenose dolphins are distributed in relation to these two features.

Before you start this exercise, you will first need to create a new folder on your C: drive called GIS_EXERCISES_7. To do this on a computer with the Windows 7 operating system, click on the START menu and select MY COMPUTER. In the window which opens, double-click on the icon for your C: drive (this may be called WINDOWS (C:)). This will open a window which displays the contents of your C: drive. To create a new folder, right click on this window and select NEW> FOLDER. This will create a new folder. Now call this folder GIS_EXERCISES_7 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_EXERCISES_7, will be used to store all files and data for the exercises in this book.

Next, you need to download the source files for three data sets from http://www.gisinecology.com/Data_For_Supplementary_Workbooks.htm (they are in the compressed folder for this book which is provided on this page). Once you have

downloaded these files, save them into the folder C:\GIS_EXERCISES_7, which you have just created.

These data sets are:

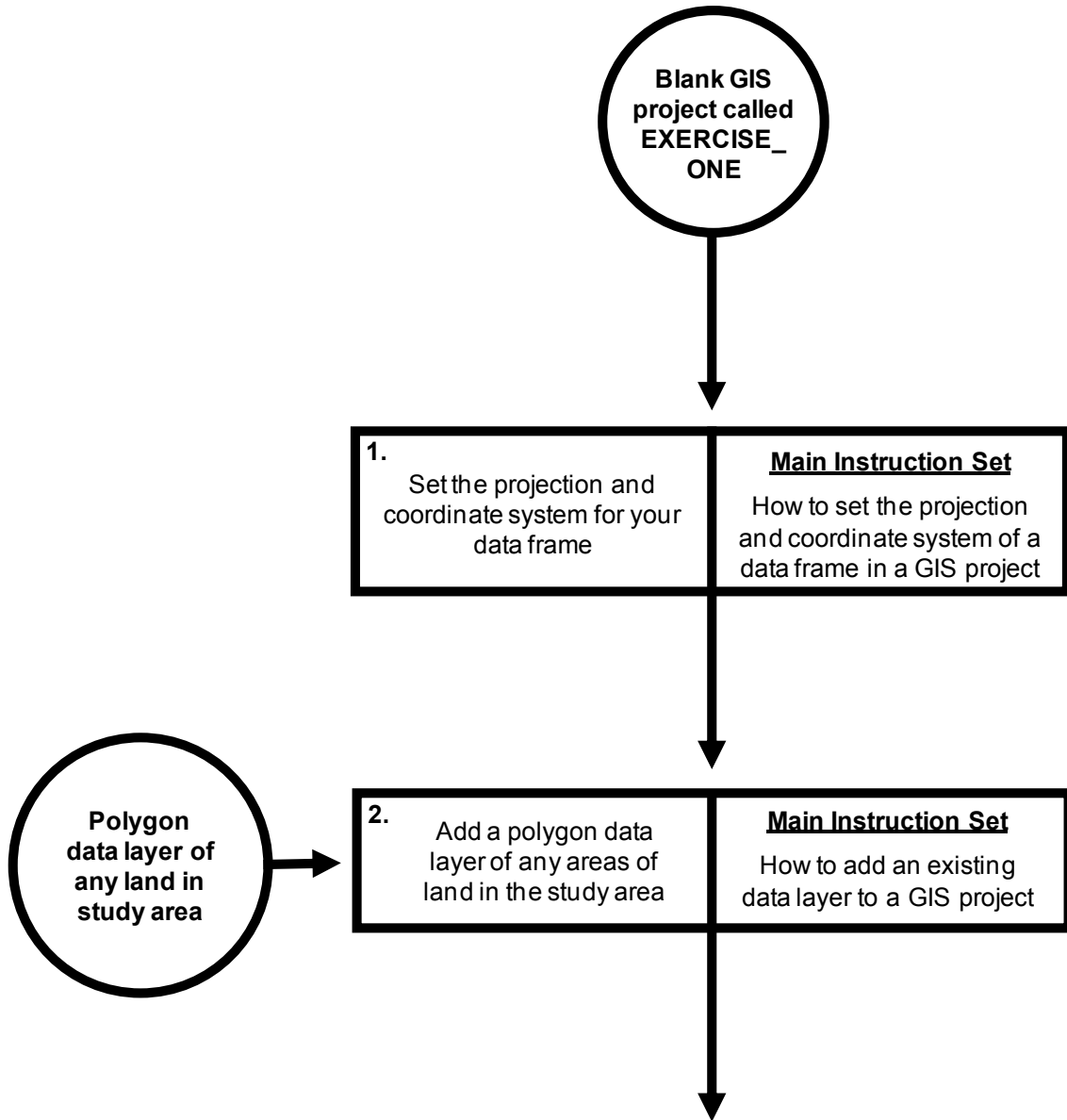
1. Bottlenose_Dolphin.txt: This is a tab delimited text file which has latitude and longitude for the positions of bottlenose dolphin sightings from a survey conducted in northeast Scotland. **NOTE:** The latitude and longitude have already been converted into decimal degrees. If you are doing this for your own data set, you would need to make sure that all your latitude and longitude values have been correctly converted into decimal degrees before you start.

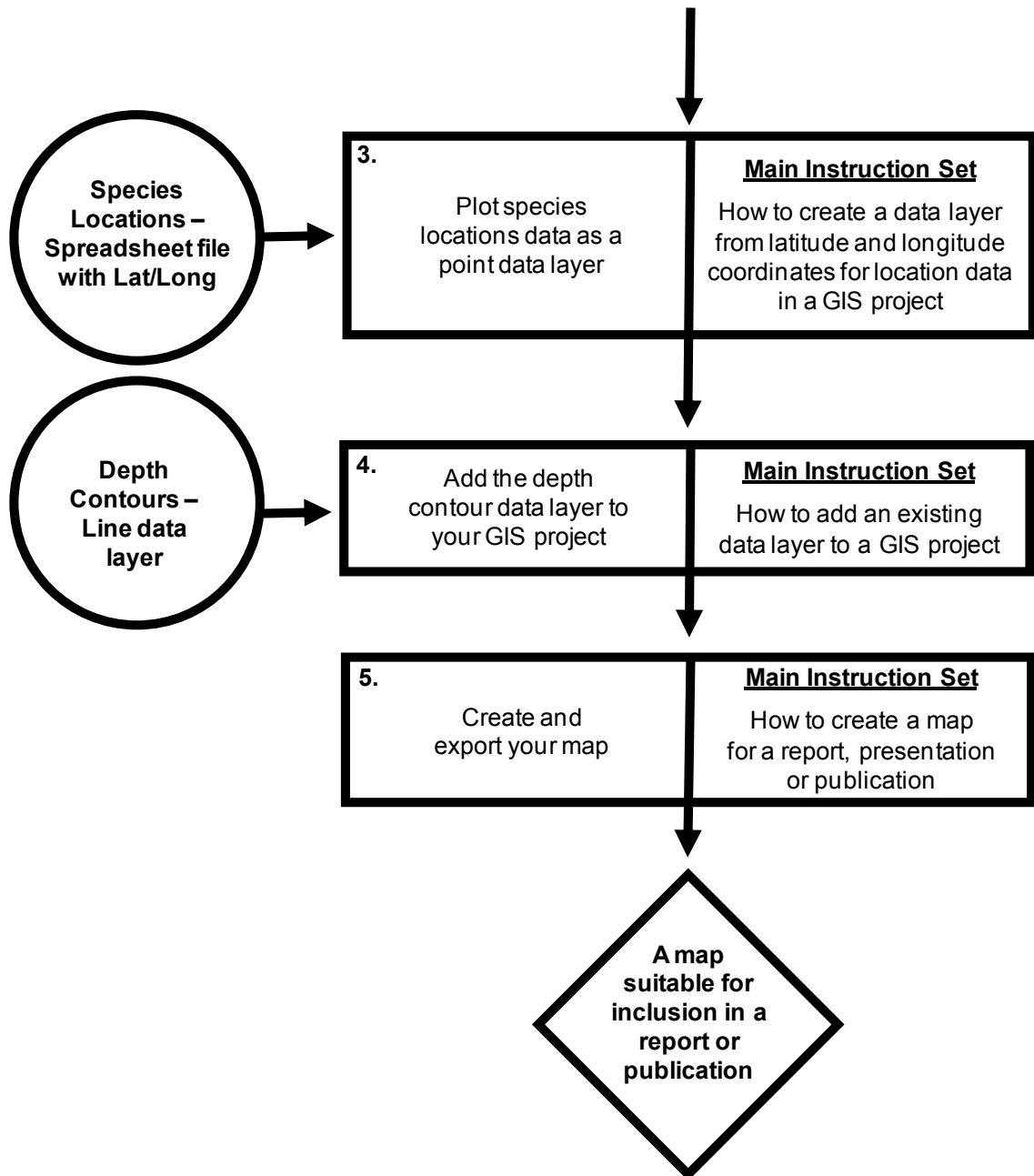
2. Depth_North_Sea: This is a line data layer which contains information on water depth which you can use to create your map. You will need to download all the files called Depth_North_Sea (each with a different extension) in order to be able to use it. This data layer is in the geographic projection and uses the WGS 1984 datum. **NOTE:** The depth values are not accurate and are only provided here as an approximation for illustration purposes. As a result, it should not be used for any purpose other than these exercises.

3. Land_North_Sea: This is a polygon data layer which contains information on land in this region which you can use to create your map. You will need to download all the files called Land_North_Sea (each with a different extension) in order to be able to use it. This data layer is in the geographic projection and uses the WGS 1984 datum. **NOTE:** The land information is not accurate and is only provided here as an approximation for illustration purposes. As a result, it should not be used for any purpose other than these exercises.

Once you have all these files downloaded into the correct folder on your computer, and you understand what is contained within each file, you can move onto creating your map. The starting point for this is a blank GIS project. To create a blank GIS project, first, open QGIS. Once it is open, click on the PROJECT menu and select SAVE AS. In the window which opens, save your GIS project as EXERCISE_ONE in the folder called C:\GIS_EXERCISES_7. The next step is to read over the summary flow diagram for this exercise. This will help you identify all the major steps you need to carry out and the individual instruction sets you will need to follow to do them. The summary flow diagram for this exercise is provided below.

Summary Flow Diagram For Creating A Map Of Species Distribution





Once you have familiarised yourself with the summary flow diagram outlining the major steps you will need to complete, and which instruction sets can be used to complete them, you need to read through the instruction set for the first of these major steps in the flow diagram in its entirety (see below), before working through it stage by stage. Once you have completed the first major step, read through the instructions again to check that you have completed it properly. It is important to do this at this stage as you need to use the results of one major step as the starting point for the next, and also because it is much easier to

spot where you have gone wrong at the end of an individual major step, rather than trying to work it out later when you get stuck as a result of a mistake made at this stage. Once you have completed the first major step, move on to the second major step and repeat this process, and so on until you have completed all the steps in the summary flow diagram.

At various points throughout the exercise, images of the contents of the MAP window, the PRINT COMPOSER window (see page 23), the TABLE OF CONTENTS window and/or the TABLE window will be provided so that you have an idea of what your project should look like at that specific point. Check your GIS project against these images. If they do not match up, you will need to go back and work out where you have gone wrong. **NOTE:** It is important that you save your GIS project after completing each major step. This can be done by going to the PROJECT menu on the main menu bar and selecting SAVE.

Instruction Sets For The Individual Steps Identified In The Summary Flow Diagram:

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

These instructions are based on the instruction set *How to set the projection and coordinate system for a data frame in a GIS project* (from *An Introduction To Using GIS In Marine Biology*). For this exercise, the projection and coordinate system will be set to a custom transverse mercator centred on the middle of the area of data collection. This central position is latitude 56.5°N and longitude 1.0°W (or latitude 56.5° and longitude -1.0° in decimal degrees). This projection was chosen as it provides an accurate representation of the shape and relative positions of features in the study area. In addition, it can also be used to accurately measure distances and areas in real world units, which will be important for later exercises. This custom transverse mercator projection will use the WGS 1984 datum. This datum is was selected because it is the same as the one used during data collection and for the existing data layers.



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

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

To create a new custom projection/coordinate system, click on SETTINGS on the main menu bar and select CUSTOM CRS. In the CUSTOM COORDINATE REFERENCE SYSTEM DEFINITION window which opens, click on ADD NEW CRS. Next, type NORTH SEA into the NAME section about half way down the page. This means that your new custom projection/coordinate system will be called NORTH SEA. Next, enter the following text into the PARAMETERS section:

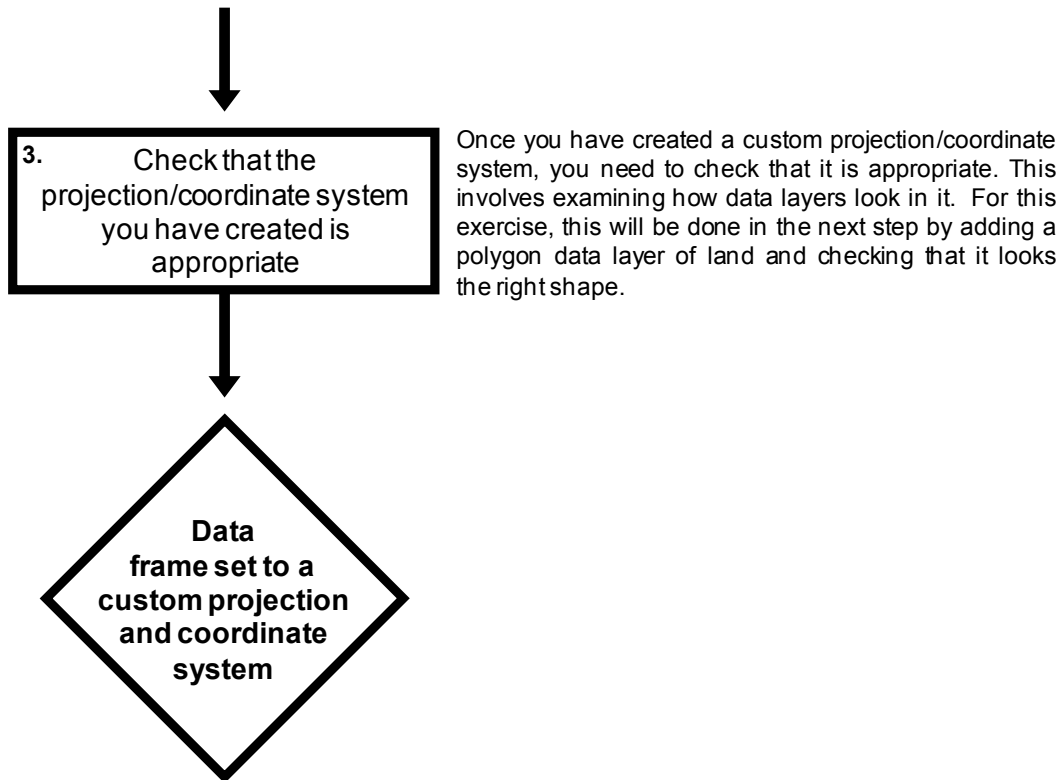
```
+proj=tmerc +lat_0=56.5 +lon_0=-1 +k=1  
+x_0=0 +y_0=0 +ellps=WGS84  
+towgs84=0,0,0,0,0,0,0 +units=m +no_defs
```

1. Create a new custom projection/coordinate system

NOTE: This code needs to be entered as a single continuous line with a space immediately before each plus (+) sign. This is a PROJ.4 string which tells QGIS that your custom projection/coordinate system is a transverse mercator projection (tmerc) with a latitude of origin of 56.5 degrees North and a central meridian of 1 degree West based on the WGS 1984 datum (WGS1984) and that the map units are in metres (m). Once you have entered this text, check it very carefully to ensure you have got it right and then click on the ADD NEW CRS button. This will add it to the list of custom projection/ coordinate systems in the top section of the window. In this section, select NEW CRS and then click the REMOVE button. Finally, click OK to close the CUSTOM COORDINATE REFERENCE SYSTEM DEFINITION window.

2. Set your data frame to use your custom projection/coordinate system

In the main QGIS window, click on the CRS STATUS button in the bottom right hand corner (it is square with a dark circular design on it). This will open the PROJECT PROPERTIES CRS window. Click on the box next to ENABLE 'ON THE FLY' CRS TRANSFORMATION so that a cross appears in it. Next, type the name of the projection/coordinate system into the FILTER section (in this case it will be NORTH SEA). In the COORDINATE REFERENCE SYSTEMS OF THE WORLD section, click on NORTH SEA under USER DEFINED COORDINATE SYSTEM. This will add this to the SELECTED CRS section further down the window. Now click OK to close the PROJECT PROPERTIES CRS window.



To check that you have done this step properly, click on PROJECT on the main menu bar and select PROJECT PROPERTIES. In the PROJECT PROPERTIES window which opens, click on the CRS tab on the left hand side and make sure that the projection/coordinate system listed in the SELECTED CRS section is called NORTH SEA, and that its definition in the window below contains the following text:

```
+proj=tmerc +lat_0=56.5 +lon_0=-1 +k=1 +x_0=0 +y_0=0 +ellps=WGS84  
+towgs84=0,0,0,0,0,0 +units=m +no_defs
```

This is what is known as a Proj.4 string, and it defines the projection, coordinate system and datum using a specific format. In this case, it is for a transverse mercator projection based on the WGS 1984 datum. If you wish to create a transverse mercator projection/coordinate system for another part of the world, you can simply change the latitude of origin (lat_0) and the central meridian (lon_0). If you wish to use a different projection or coordinate system, you can find out the appropriate Proj.4 string using the resources at www.nceas.ucsb.edu/scicomp/recipes/projections or www.remotesensing.org/geotiff/proj_list/. Similarly, if you wish to use an existing projection/coordinate system, you can simply select it from the list in the COORDINATE REFERENCE SYSTEMS OF THE

WORLD in the PROJECT PROPERTIES CRS window in stage two of the above flow diagram.

Now click OK to close the PROJECT PROPERTIES window.

STEP 2: ADD A POLYGON DATA LAYER OF ANY AREAS OF LAND IN THE STUDY AREA:

It is usually useful to show any areas of land within your study area. This will help anyone looking at the map work out exactly what part of the world it represents. It will also help you work out whether any other data you add to your GIS project plot in the right place. Finally, it will allow you to assess whether the projection/coordinate system you are using for your data frame is appropriate as you can use it to get an idea of whether any features in the data frame have unacceptable levels of distortion. This instruction set is based on one called *How to add an existing data layer to a GIS project* (from *An Introduction To Using GIS In Marine Biology*).

