# Mapping 1: displaying geographical data with QGIS

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GQIS is the leading free, open source Geographic Information Systems (GIS) program. It is capable of sophisticated geodata processing and analysis, but you don't need to be a GIS expert to put it to effective use in displaying and processing geographic data for both print and online.

Here we'll learn how to use QGIS to make a simple thematic map, with areas colored according to data, plus a map of points, and how to export them as a vector graphic.

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Launch **QGIS Desktop**, and you should see a screen like this:

We're going to recreate a version of one of the maps from The Nature Conservancy's <u>Atlas of Global Conservation</u> – showing the number of globally threated amphibian species in each of the world's freshwater ecoregions.

The data is <u>here</u>, in shapefile format, commonly used in GIS. A shapefile actually consists of a series of files, one of which (in a format called **DBF**) is a table of data. Many organizations, including the <u>US Census Bureau</u>, make their data available as shapefiles; <u>Natural Earth</u> also provides a great library of global shapefiles.

To import a shapefile into QGIS select Layer>Add vector layer, or click this icon:

At the dialog box, click **Browse** and navigate to the **FW\_amphib** shapefile, select the file with the type **SHP**, then **Open**:



Once the shapefile loads, you should have a screen like this:



Notice how the name of the shapefile has appeared in the **Layers** panel, with a little square icon showing that it displays polygons – areas with boundaries. Now is a good time to save the project, so select **Project>Save** or use **Ctrl+S**.

This world map is plotted as rectangle with each degree of longitude and latitude given the same size. Usually, the first job in a GIS project is to set a specific map projection. Projections are important because any two-dimensional map is a distortion of reality: Just as you can't peel an orange and arrange the skin as a perfect rectangle, it's impossible to plot the Earth's surface in two dimensions and accurately represent distances, areas, shapes and directions.

The best projection for your map will depend on which of these attributes is most important to conserve, and the area you're mapping. Your graphics department may be able to advise on which one to choose. (For more on projections, see <u>this reference</u>.)

To set the projection, select **Project Project Properties>CRS** and check the box marked **Enable 'on the fly' CRS transformation**. (This will convert any data you import subsequently to the correct projection for the project.)

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For this project, we'll use a <u>Robinson projection</u>. To find it, start typing Robinson into the box marked **Filter. World\_Robinson** should appear in the box marked **Coordinate Reference System**: select it, then click **Apply** and **OK**. (You can also search for projections by their numerical codes, which you can find <u>here</u>.)



The map should now look like this:

Now let's look at the data available for us to map. Either right click on the name of the shapefile in the Layers panel and select **Open Attribute Table**, or click this icon:

🔏 Attribute table - FW_amphib :: Features total: 449, filtered: 449, selected: 0										
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0	103.00	Alaska & Cana	temperate coas	5.00	1.000000	30103.00	2.00			
1	120.00	Columbia Glaci	temperate upla	6.00	2.000000	30120.00	0.00			
2	121.00	Columbia Ungl	temperate floo	7.00	3.000000	30121.00	1.00			
3	122.00	Upper Snake	temperate upla	6.00	4.000000	30122.00	0.00			
4	123.00	Oregon & Nort	temperate coas	5.00	5.000000	30123.00	3.00			
5	125.00	Sacramento - S	temperate coas	5.00	6.000000	30125.00	7.00			
6	159.00	Southern Califo	xeric freshwater	4.00	7.000000	30159.00	3.00			
7	127.00	Bonneville	xeric freshwater	4.00	8.000000	30127.00	1.00			
8	126.00	Lahontan	xeric freshwater	4.00	9.000000	30126.00	2.00			
9	124.00	Oregon Lakes	xeric freshwater	4.00	10.000000	30124.00	1.00			
10	128.00	Death Valley	xeric freshwater	4.00	11.000000	30128.00	7.00			
11	130.00	Colorado	xeric freshwater	4.00	12.000000	30130.00	4.00			
12	129.00	Vegas - Virgin	xeric freshwater	4.00	13.000000	30129.00	1.00			
13	131.00	Gila	xeric freshwater	4.00	14.000000	30131.00	3.00			
14	132.00	Upper Rio Gran	temperate upla	6.00	15.000000	30132.00	1.00			
15	161.00	Guzman - Sam	xeric freshwater	4.00	16.000000	30161.00	2.00			
16	134.00	Rio Conchos	xeric freshwater	4.00	17.000000	30134.00	2.00			
17	133.00	Pecos	xeric freshwater	4.00	18.000000	30133.00	0.00			
18	163.00	Mayran - Viesca	xeric freshwater	4.00	19.000000	30163.00	1.00			
19	135.00	Lower Rio Gran	temperate floo	7.00	20.000000	30135.00	1.00			
20	137.00	Rio Salado	xeric freshwater	4.00	21.000000	30137.00	0.00			
21	136.00	Cuatro Cienegas	xeric freshwater	4.00	22.000000	30136.00	0.00			
22	138.00	Rio San Juan (	xeric freshwater	4.00	23.000000	30138.00	0.00			
25	148.00	Unner Mississinni	temperate floo	7.00	24.000000	30148.00	0.00			
5	Show All Features									

You should now see this data (from the shapefile's DBF):

The data include various ID codes, the name of the ecoregion, and its type. The final column, marked **THREAT\_AMP**, gives the number of threatened amphibians in each ecoregion. If you click on the column header it will sort the rows by that data, which ranges from 0 to 95. Close the attribute table.

Now we'll color the map according to the number of threatened amphibian species in each ecoregion. Click Layer>Properties or double click on the shapefile in the Layers panel, then select Style:



Click the little downward-pointing arrow next to **Single Symbol** and choose **Graduated**, which allows us to map by numerical data. (If we were mapping categories, such as the ecoregion type, we'd select **Categorized**.)

Then select **THREAT\_AMP** under **Column**.

Using the **Mode** option instructs QGIS to divide the data in classes using some common defaults – for example, selecting 5 **Classes** and **Quantile** would put the lowest 20% of values in the first class, the next highest 20% in the second, and so on.

Here, however, we're going to follow the legend on the original map from The Nature Conservancy:



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Column	THREAT_AMP			-			
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Color ramp	Blues		-	Mode	Equal Interval	•	
Symbol	Value	Label					
	0.0000 - 0.0000	0 or insufficient data					
	1.0000 - 2.0000	1 - 2					
	3.0000 - 7.0000	3 -7					
	8.0000 - 15.0000	8 - 15					
	16.0000 - 30.0000	16 - 30					
	31.0000 - 95.0000	31 - 95					

Select 6 Classes, and edit them manually – double-click on each Value and Label to edit.

Now we can select a **Color ramp**. For data like this, a sequential color scheme with increasing intensity of a single color works well, so the default **Blues** option is fine. Misleading or confusing color schemes are a common problem in mapping, so I'd strongly recommend looking at <u>ColorBrewer</u>'s suggestions to find one that fits your data. ColorBrewer schemes are available in QGIS – scroll to the bottom of the **Color ramp** options, select **New color ramp** and then select **ColorBrewer**.

Next we will edit the boundaries. Click **Change** under **Symbol**. At the next dialog box, click **Simple fill**, and then you can edit the color and the thickness of the boundary lines:

💋 Symbol selector				9	23
Symbol layers	Symbol layer typ Colors Fill style Border style	e Fill Solid	Simple fill Border		•
Fill	Border width Offset X,Y	0.10000 0.00000 Data define	<ul> <li>0.00000</li> <li>d properties</li> </ul>	Millimeter	•
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Click OK, then back in the main Properties dialog boc click Apply and OK.

The map should now look like this:



Now we'll add a second map layer, showing the locations of sites deemed important for amphibian conservation, protected under the international Ramsar Convention on Wetlands, which is in <u>this CSV file</u>.

To import this data, select Layer>Add Delimited Text Layer, or click this icon:

QGIS should recognize that **Longitude** and **Latitude** are the X and Y coordinates, and that the delimiters are commas. If not, you can select the correct values at this dialog box:

File Name [Y:/Dropbox/NICAR/QGIS/Data/ramsar amphibian sites.csv												
Layer name ramsar amphibian sites Encoding UTF-8												
File format   CSV (comma separated values)   Custom delimiters  Regular expression												
Record options Number of header lines to discard 0 🚔 🕱 First record has field names												
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Geo	metry definitio	on   Point coordinates	$\bigcirc$ We	ll known text (W	/кт) (	No geometry (attribu	te only table					
		X field Longitude	▼ Y field La	titude		coordinates						
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		Site name	Designation date	Latitude	Longitude	Total site area (ha)	1 6					
1	Réserve Inté	Site name égrale du Lac Tonga	Designation date 11/4/1983	Latitude 36.88333333	Longitude 8.516666667	Total site area (ha) 2700						
1 2	Réserve Inté Marais de la	Site name égrale du Lac Tonga Macta	Designation date 11/4/1983 2/2/2001	Latitude 36.88333333 35.68333333	Longitude 8.516666667 -0.166666667	Total site area (ha) 2700 44500						
1 2 3	Réserve Inté Marais de la Oasis de Tan	Site name égrale du Lac Tonga Macta nantit et Sid Ahmed Timmi	Designation date 11/4/1983 2/2/2001 2/2/2001	Latitude 36.88333333 35.68333333 27.75	Longitude 8.516666667 -0.166666667 0.25	Total site area (ha) 2700 44500 95700						
1 2 3 4	Réserve Inte Marais de la Oasis de Tan Petit Loango	Site name égrale du Lac Tonga Macta nantit et Sid Ahmed Timmi	Designation date 11/4/1983 2/2/2001 2/2/2001 30-12-1986	Latitude 36.88333333 35.68333333 27.75 -2.3	Longitude 8.516666667 -0.166666667 0.25 9.616666667	Total site area (ha) 2700 44500 95700 480000						
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1 2 3 4 5 6	Réserve Inté Marais de la Oasis de Tan Petit Loango Setté Cama Ain Elshakika	Site name égrale du Lac Tonga Macta nantit et Sid Ahmed Timmi	Designation date 11/4/1983 2/2/2001 2/2/2001 30-12-1986 30-12-1986 5/4/2000	Latitude 36.88333333 35.68333333 27.75 -2.3 -2.716666667 32.76666667	Longitude 8.516666667 -0.166666667 0.25 9.616666667 10.08333333 21.35	Total site area (ha)           2700           44500           95700           480000           220000           33						

At the next dialog box, accept the default of WGS84 for the Coordinate Reference System. Notice that the code in the box at the bottom of the screen, which defines the projection, includes the term "longlat." This tells QGIS that there is no specific projection for the CSV file, just latitude and longitude values – it will then convert to the Robinson projection used for the project:

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Filter							
Recently used coordinate reference systems							
Coordinate Reference System	Authority ID						
Imported from GDAI	FPSG:37216						
North America Albers Equal Area Conic	EPSG:102008						
WGS 84 / World Mercator	EPSG:3395						
WGS 84	EPSG:4326						
World_Robinson	EPSG:54030						
•		••					
Coordinate reference systems of the world	🗌 Hide deprec	ated CRSs					
Coordinate Reference System	Authority ID						
	EPSG:4326						
	IGNE:WGS72G						
Wake Island 1952	FPSG:4733	-					
Wallis - Uvea 1978 (MOP78)	IGNE:WALL78GEO	-					
Image: A state of the state							
Selected CRS: WGS 84							
+proj=longlat +datum=WGS84 +no_defs							

The points should appear on the map:



Notice that the entry in the Layers panel has an icon showing that this layer consists of points, rather than polygons.

We can style the points much as we did the polygon layer, this time using the **Single Symbol** option.

Layer Properties - ram	sar amphibian sites				6	6
General	Style					
	Layer rendering					
Style Style	Layer transparency				0	•
abc Labels	Layer blending mode	Normal	<ul> <li>Feature blending mode</li> </ul>	Normal		•
Fields	Single Symbol					
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Actions		Colors	Fill Br	order		
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Restore Defau	lt Style Sav	e As Default	Load Style	Save	Style	
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The map should now look like this:



Now we'll export the finished map as a vector PDF, which could be edited further by a graphic designer. **Select Project>New Print Composer**, and add a title at the first dialog box. The following window will open:

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Compo	ser Vi	ew Layout															
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<u>50</u>																	Composition Item Properties Atlas generation Item Properties X
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To add your map, click the Add New Map icon:

Then click, hold, and use your cursor to draw a rectangle in the main panel. Release the mouse button and the map should appear:



You can add other elements, including a legend, using the options along the toolbar at the top, and customize elements such as typeface and font size, <u>as explained</u> in the QGIS manual.

To export the map as a PDF, click the **Export as PDF** icon:

You can also export as SVG, another vector graphic format, or as various types of raster image (JPG, PNG etc).