IPA Habitat Mapping

Habitat Mapping in Important Plant Areas

Methodology Handbook

Contents

Introduction

The IUCN Centre for Mediterranean Cooperation, together with Plantlife, the IUCN-SSC Mediterranean Plant Specialist Group, and partners in several countries, are involved in a programme of work titled "Conservation of wild plants and habitats for people in the south and east Mediterranean". This initiative aims at strengthening IPAs as tools for biodiversity conservation focusing on plant species and habitats, thereby contributing directly to national and regional decision making.

This project focuses on Important Plant Areas (IPAs): sites of international importance for plants. IPAs are designated according to a set of defined criteria, based primarily on the occurrence of threatened species, species richness, and the presence of threatened habitats. In some regions, additional and alternate criteria have been developed and employed.

For habitats, IPA criteria require an assessment of threat to be completed at a national or regional level, therefore requiring a habitat classification. As this is not available in many countries or regions, alternate methods have been used which often use expert opinion to identify habitat units requiring conservation status.

How to translate plant species and habitat information into management plans that consider botanical values and threats remain a challenge. In many cases, information about plant species is often incomplete, and no national or regional habitat maps currently exist. To this extent, three countries (Algeria, Lebanon and Morocco) have selected IPAs where they will propose concrete measures for conservation of wild plants. This will include developing a broad classification of habitats and applying them to zoning and management planning, that including information on threatened species distribution.

Habitat Mapping in Important Plant Areas

This study is designed to propose habitat mapping methodologies adapted for this purpose in the region, and to coordinate training workshops to enable the national teams to incorporate such information into their work programme.

Although this handbook describes different methods to achieve specific goals in different sections, the order in which the work proceeds depends upon the preference of the individual or project. For example, it is possible to define Potential Natural Vegetation (PNV) distributions first, and then go on to verify the existence and quality of habitats at the second stage using satellite, field or expert data. However, it is also possible to identify habitats from satellite imagery and expert knowledge at the first stage, create habitat polygons, and then compare with the produced PNV maps to, for example, identify potential areas for habitat restoration.

Why are habitat maps necessary, and how to produce them.

Visualising the spatial distribution, quality and quantity of resources is fundamental to understand ecosystems, to manage human activities, to deliver effective sustainable development and to maintain biodiversity.

Maps have a wide range of applications in management, planning, policy and research and form an important and integral part of

management information systems. The following are some examples of the areas where habitat maps can be used:

 • Provide a fundamental information layer for spatial and strategic planning;

 • Support sustainable use of resources;

 • Help implement an ecosystem-based approach to the management of human activities to protect the environment;

 • Prioritize monitoring effort;

 • Support the selection and optimal delineation of conservation areas;

 • Assess the importance, rarity and extent of habitats over local, regional, national and international scales;

To produce maps and analyse data in a spatial context, GIS (Geographical Information System) is used. This is a computer system that provides the function and tools needed to assemble, store, manipulate, display and compare large amounts of geographical information. Maps stored in GIS can be updated to reflect change in attributes, such as land-use or boundaries.

Definition of "habitat"

The term 'habitat' is frequently used in policy instruments and more widely in the scientific, policy and environmental management communities. Consequently, it has many definitions that can lead to confusion.

The term "habitat" used within this document refers to a homogeneous biological community / vegetation supported by common environmental conditions. This definition has been kept broad, in order that different countries can define their own habitat boundaries that correspond to appropriate management and other country-specific policy.

Practical Habitat Mapping using QGIS software

In this exercise, habitat maps will be produced, verified and assessed, and species occurrence data included, using QGIS software and free spatial data available online.

QGIS is a user friendly Open Source Geographic Information System (GIS) licensed under the GNU General Public License: http://www.qgis.org/en/site/about/index.html

The version used during the workshop is QGIS 2.12. You will find the latest version of QGIS to download on the website: http://download.qgis.org

All QGIS documentation, including "User Guide" and "Training Manual" can be found on the QGIS documentation website: http://www.qgis.org/en/docs/index.html

All GIS information are not covered by the current document, only the specific steps realised during the workshop and necessary to perform the habitat mapping methodology are presented. Please refer to the User Guide for more specific details about the features and functions of QGIS.

The habitat mapping and other steps presented here require the installation of several plugins:

Processing: a spatial data processing framework for QGIS

OpenLayers Plugin: to open OpenStreetMap, Google Maps, Bing Maps or more

Group Stats: to perform statistics and analysis for vector layers data

You can manage your plugins in the plugin dialog which can be opened with *Plugins > Manage and install plugins ...* The Plugins dialog allows the user to install, uninstall and upgrade plugins. Select the plugin and use *Install plugin*.

Coordinate reference system

It is very important that all layers used and created in QGIS use the same coordinate reference system, otherwise the different layers will not be comparable to each other spatially. There are more details at the following webpage:

http://docs.qgis.org/2.8/en/docs/user_manual/working_with_projections/working_with_projections.html

Section One

Habitat Mapping using Satellite Imagery

Objectives

In this section, knowledge about the habitats and vegetation types held by experts with detailed experience of particular sites and regions will be described in QGIS, so that this information is captured spatially and can then be used in a variety of analyses, presentations or management options.

Essentially, this section allows the user to view satellite images, and create "polygons" that represent different habitats or areas of interest within an IPA.

At a later stage, these polygons can be compared based upon data held within them (for example, species occurrence data), and zoning plans for features and habitats of interest created.

This process is analogous to drawing lines on maps, but with the advantage of allowing a range of different data of interest to be integrated and updated in a series of spatial layers.

We propose the following methodology:

1. Acquire existing spatial layer (spatial images) using open access data and use IPA boundaries to set the scale of the study.
2. Delineate broad habitat units from homogeneous vegetation type using satellite images.
3. Defined and named broad habitat units from expert knowledge. Assess whether the information on habitat are enough or if additional field survey is required.

As new data becomes available (field survey, additional expertise) the process can be updated.

Open data and determine scale
- Open IPA(s) boundary
- Open satellite image

Delineate homogeneous area
- Create polygon

Name habitat
- From expert knowledge
- From field survey

Habitat map
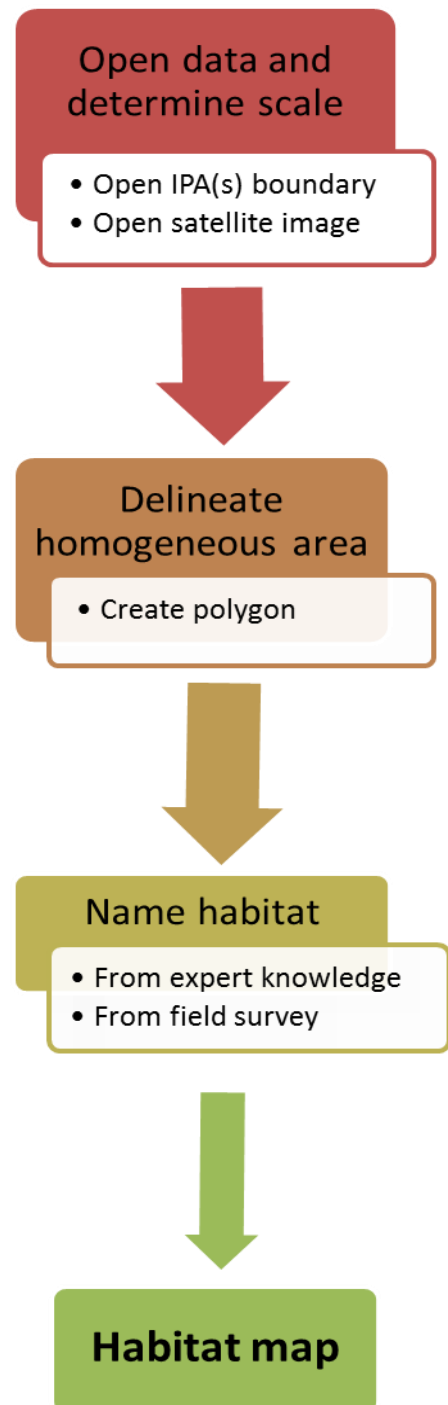
1.1   Add and Manipulate Layer

Objective: The objective of this stage is to add and clip layer to limit them to the project scale. This is done by integrating a specific boundary layer, for example a country boundary or an IPA boundary.

QGIS recognizes two types of data: vector data and raster data. Boundaries are commonly vector files (lines or polygons), and the standard vector file format used in QGIS is the ESRI shapefile (.shp).

Step 1: to load a shapefile, start QGIS, click on the **Add Vector Layer** toolbar button (there are also drop down menu or shortcut options). From the available options tick ● **File**. Click on **Browse** to navigate to the file you want to open and click **Open** to load it into QGIS (see Figure 1.1.1). The result is shown in Figure 1.1.2.
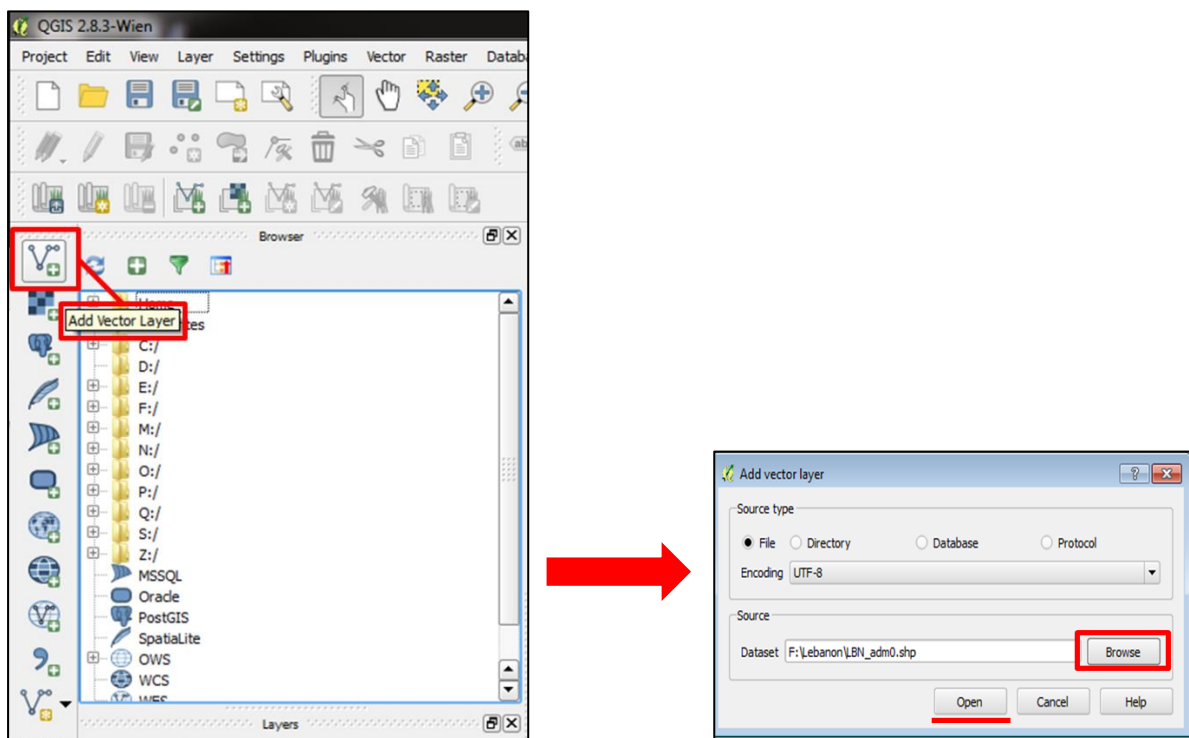
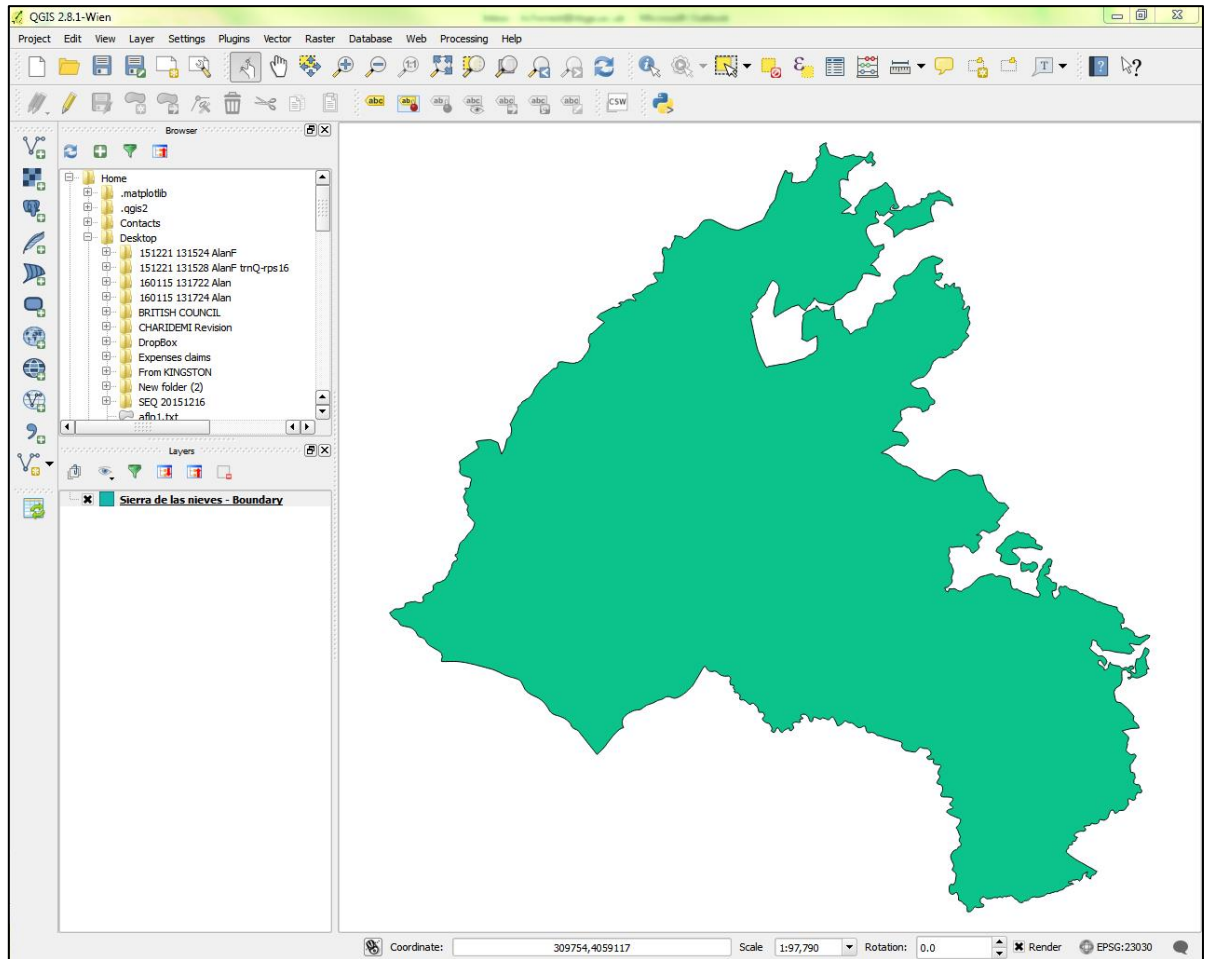**Figure 1.1.1.** Steps to load Vector Layer into QGIS.

Figure 1.1.2. Vector Layer containing the boundary of the Sierra de las Nieves Natural Park.

Step 2: to change the appearance of the vector file you have just loaded (your file is now a layer in the project), double click on the name of your file in the layer panel on the left of the QGIS desktop. This allows you to alter the display properties of the layer, for example to change the styles (the colour, symbology, shading and transparency of the boundary loaded) or add labels. (Figure 1.1.3).
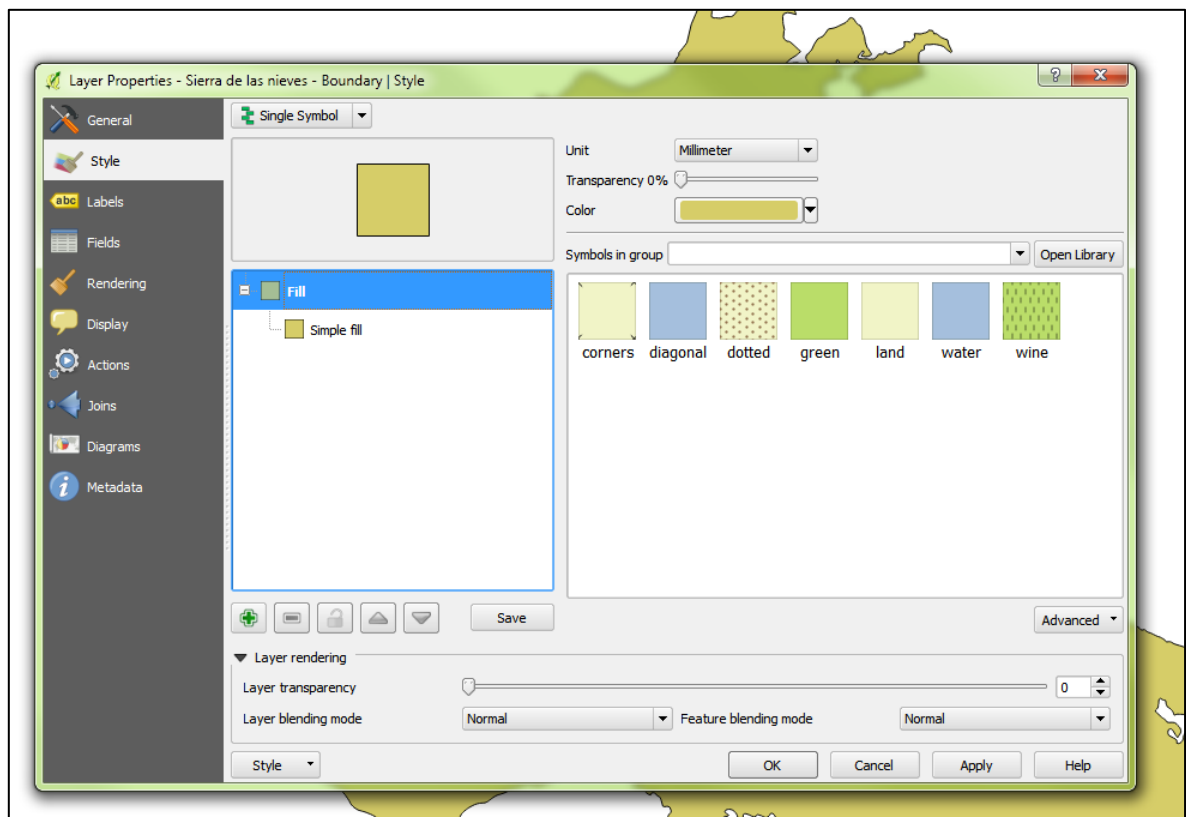
Figure 1.1.3. Dialog box from where you can change the display properties of the vector layer.

Step 3: to zoom to a particular layer (e.g. to allow the entire boundary to be scaled to fit onto the screen in its entirety), right click on the layer and select **Zoom to Layer** (Figure 1.1.4).

You can also use the mouse wheel to zoom in and out of the map view.
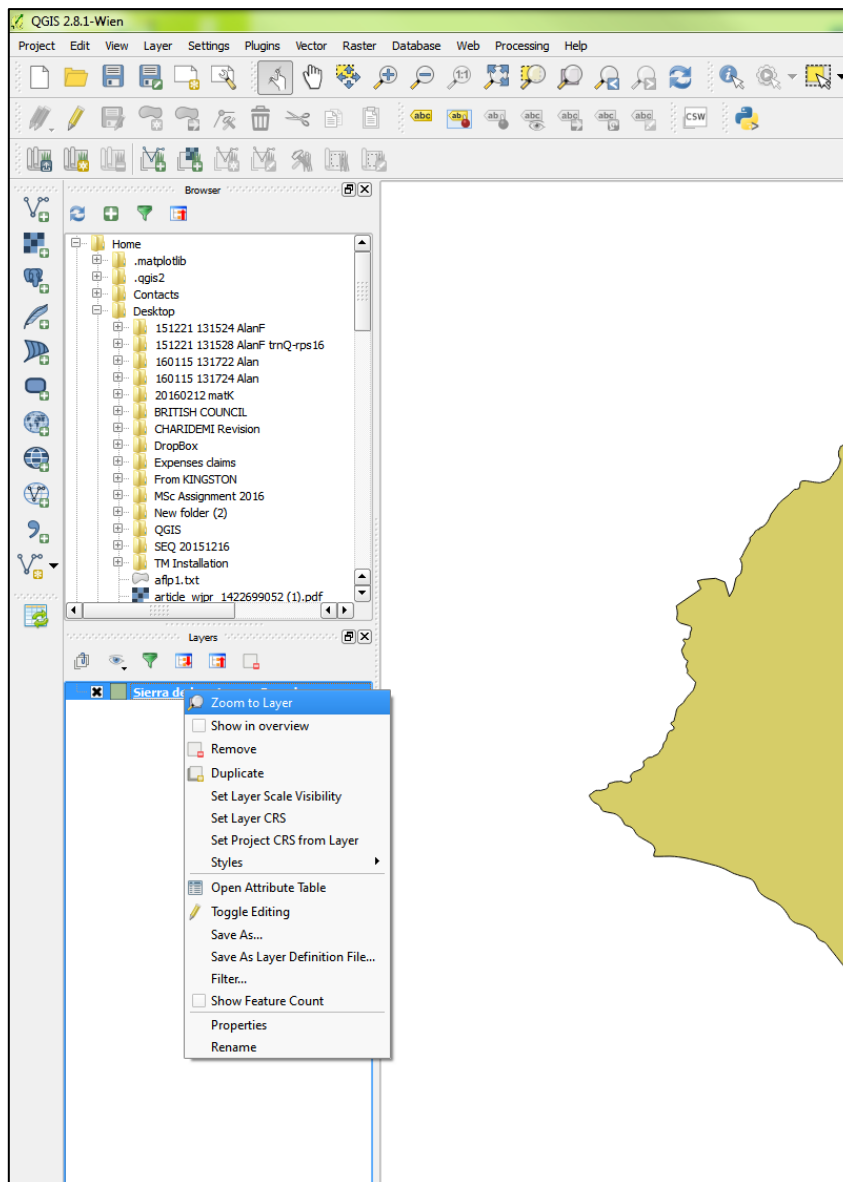
Figure 1.1.4. Drop-down menu to zoom to the layer selected.
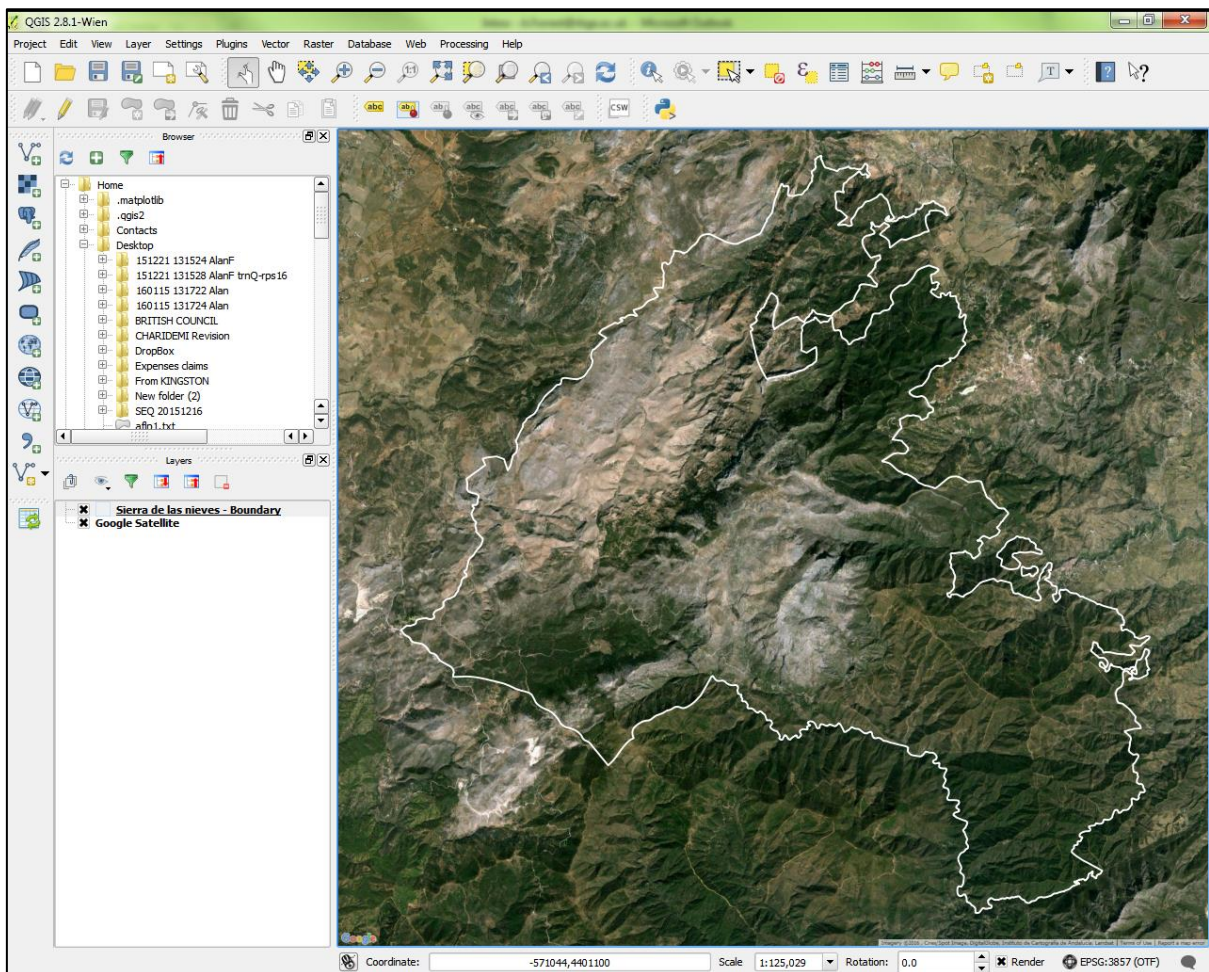
1.2 Load satellite image

Objective: Satellite imagery combined with GIS is an essential tool for habitat mapping. Google Maps Satellite can be opened directly in QGIS and is free and easy to use. This stage describes how to open and view satellite images directly in QGIS.

Step 1: Click on **Web > OpenLayers Plugin > Google Maps > Google Satellite.**

Figure 1.2.1. Steps to open satellite imagery in QGIS.

Step 2: in order to be able to see the vector layer containing the boundary of the Sierra de las Nieves, it is necessary to move that layer to the top of the list of layers on the left of the screen. The top layer is the most visible layer.

Figure 1.2.2. This image shows Google Maps Satellite open, with the boundary shapefile of the Sierra de las Nieves. The boundary has been changed to white, and the "fill" changed to transparent so that the satellite image can be viewed directly.

1.3 Create vector file

Objective: a habitat map is basically a vector file made of a complete coverage of polygons representing the different habitats or other features of interest. This stage shows how to create a vector file.

Step 1: to create a new shapefile layer, Choose <img> **New Shapefile Layer** on the toolbar. The New Vector Layer dialog box will be displayed. Choose the type of layer <img> **Polygon**. Under **New attribute**, type a name 10 characters long maximum, increase the width of the character string to allow longer names, click on **Add to attribute list**. You can add several attributes at this stage. For example, you may consider adding at least two or three different hierarchies of habitat attributes. A broad habitat attribute will allow you to visualise together one broad habitat class (example "forest"), and a more specific habitat one to visualise separately the "Abies forest" and "oak forest" for example.

When all attribute are added, click **OK**. You will be prompted to the **Save layer as…** dialog box. Browse to the location you want to save the file, type the file name (in this example "Habitat01-SdlN") and click **Save**. You will be able to see the new layer in the Layers list.
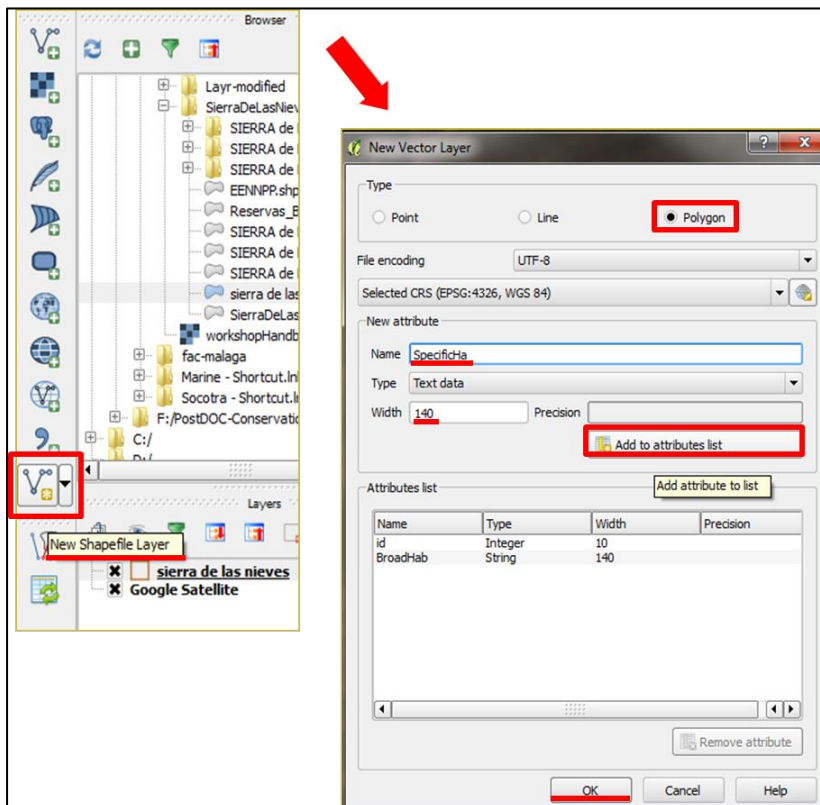

Figure 1.3.1. Dialog box options to create a new vector file.

1.4   Create a polygon

Objective: to delineate the broad habitat units, it is necessary to create polygons encompassing homogeneous types of vegetation observed using the satellite images and based upon the expert knowledge of project partners. This stage explains how to create individual polygons.

Step 1: Click on the layer name to select the layer you have just created. All editing sessions start by

choosing the 🖉 **Toggle editing** option. Now, click on the 🟢 **Add Feature** icon (or select **Edit →** 🟢
Add Feature). When you do this, the cursor will look different (not an arrow head). Left-click on the map area to create the first point of your new feature. Keep on left-clicking for each additional point you wish to include in your polygon. When you have finished adding points (i.e., the polygon represents one habitat area), right-click anywhere on the map area to confirm you have finished entering the geometry of that feature. The attribute window will appear. Input the ID name you want for your polygon (e.g.,"1"), then name the "broad habitat" from the satellite image (e.g. forest, woodland, grassland etc.) , add the "specific habitat" name if you know it and all the information for the different

attribute created in the step 1.3., then click **OK**. To save the new polygon, click on 💾 **Save Layer Edits** (either on the toolbar or under the Layer menu) as in Figure 1.4.1.
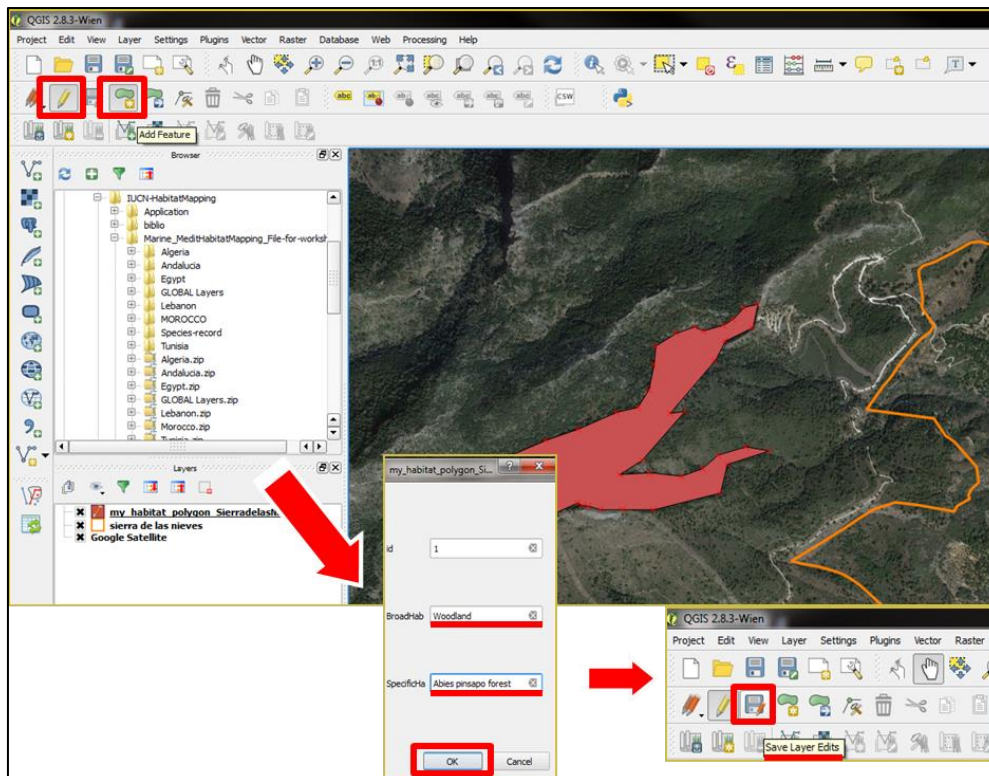
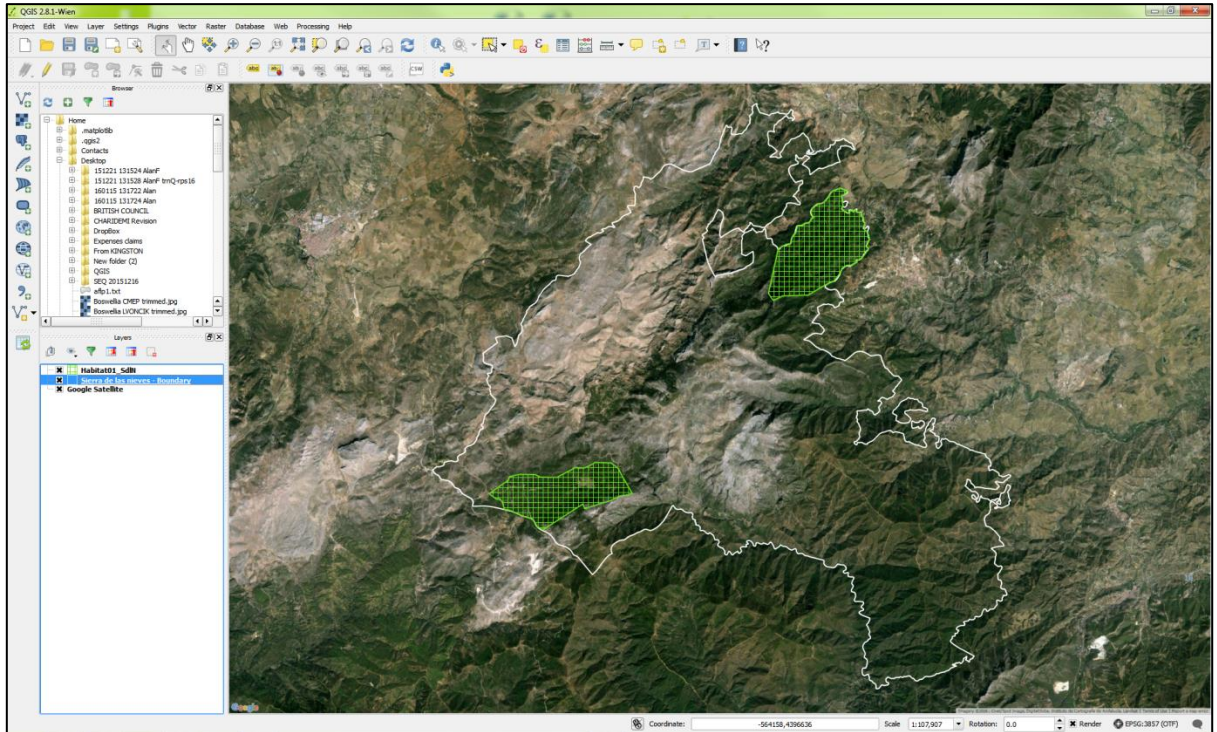**Figure 1.4.1.** Add a new feature, add data to the new polygon attribute window and save the change

Figure 1.4.2. Example of two separate areas (in green) of habitat drawn as polygons.

1.5 Editing vector layers

Objective: this stage introduces different tools used to edit the layer (and polygons) you create.

By default, QGIS loads layers read-only. This is a safeguard to avoid accidentally editing a layer if there is a slip of the mouse. Once polygons are created, there is several ways to modify them.

All editing sessions start by choosing the ✏️ **Toggle editing** option.

Remember to 💾 **Save Layer Edits** regularly.

Many of these tools might be used for habitat mapping using polygons, and it is useful to be aware of their functions. To get more information about these tools:

https://docs.qgis.org/2.2/en/docs/user_manual/working_with_vector/editing_geometry_attributes.html

Icon	Purpose	Icon	Purpose
	Current edits		Toggle editing
	Adding Features: Capture Point		Adding Features: Capture Line
	Adding Features: Capture Polygon		Move Feature
	Node Tool		Delete Selected
	Cut Features		Copy Features
	Paste Features		Save layer edits
	Undo		Redo
	Rotate Feature(s)		Simplify Feature
	Add Ring		Add Part
	Fill Ring		Delete Ring
	Delete Part		Reshape Features
	Split Parts		Split Features
	Merge Attributes of Selected Features		Merge Selected Features

1.6   Layer Attribute Table

Objective: this stage introduces the Layer Attribute table, which contains information held within the layers you create and load. Within the attribute table, attributes and information can be modified and statistics on attribute calculated, and will be used to assist the classification at later stages.

Step 1: right-click on the layer in the left hand layers panel, then select **open attribute table** from the drop-down choices. A dialogue box opens, it is the attribute table. Notice the top row contains the attribute/field names (COLUMN name), and each ROW contains the information for those fields for every polygon. One ROW = one spatial feature (in this case polygon) in the chosen layer.
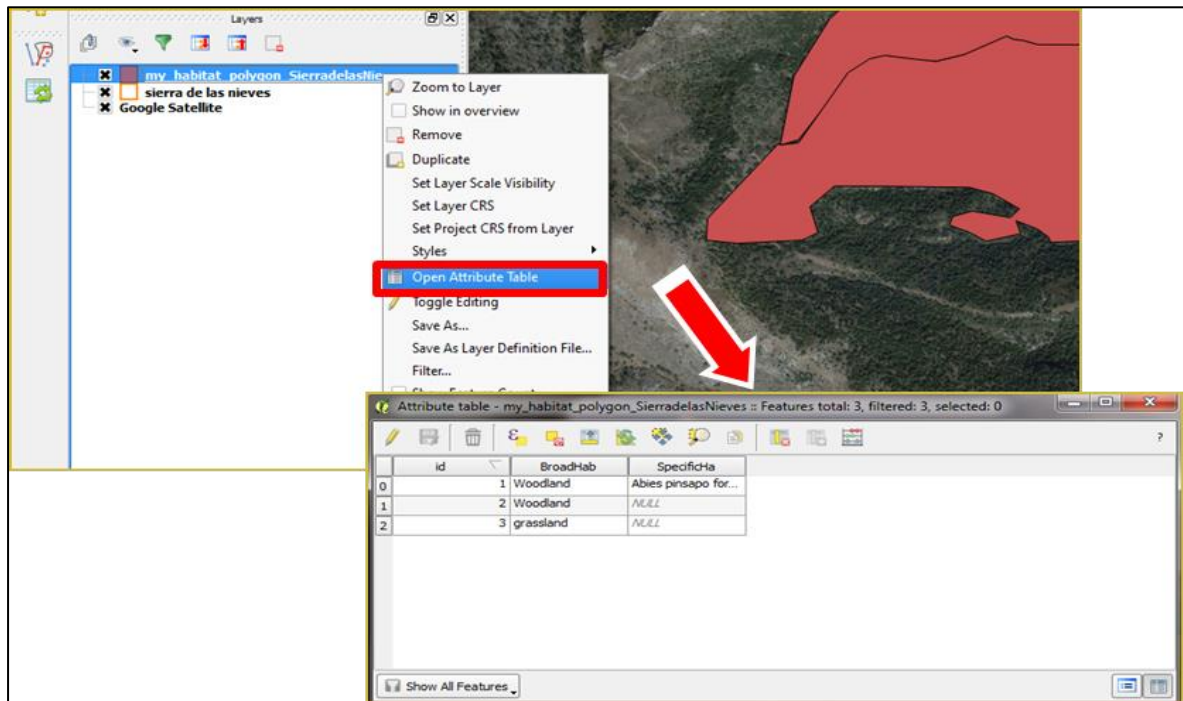
Figure 1.6.1. Open the attribute table of a vector layer.

Step 2: Select a single feature / polygon by clicking on the row number at the left side of the Attribute Table. The selected row will be highlighted. Move your cursor over the selection options along the top of the Attribute Table.

Each selected row in the attribute table displays the attributes of a selected feature in the layer. If the set of features selected in the main window is changed, the selection is also updated in the attribute table. Likewise, if the set of rows selected in the attribute table is changed, the set of features selected in the main window will be updated.

Rows can be selected by clicking on the row number on the left side of the row.

The other buttons at the top of the attribute table window provide the following functionality:

- Toggle editing mode to edit single values and to enable functionalities described below
- Save Edits
- Unselect all
- Move selected to top
- Invert selection
- Copy selected rows to clipboard
- Zoom map to the selected rows
- Pan map to the selected rows
- Delete selected features
- New Column
- Delete Column
- Open field calculator

Section Two

Potential Natural Vegetation

Objective:

Potential Natural Vegetation (PNV) mapping refers to the vegetation expected in an area given certain environmental constraints, originally developed by German vegetation scientist Reinhold Tüxen (1956). PNV can be calculated and estimated by using freely available environmental data, and classifying it into classes that correspond to environmental conditions that support particular vegetation or other features. It does not take into account human modification of habitats, and therefore can be used not only as a comparison with contemporary land use through satellite imagery, but also to predict potential suitable area s for restoration programmes.

Ideally, PNV maps will be verified through field surveys. This could encompass full scale vegetation analyses as well as taking into account fine scale environmental features such as small areas of specific substrates or physical features such as cliffs. Field survey of vegetation and species can also determine the comparative botanical richness, and identify if there are distinct vegetation units that are not identified through PNV mapping.

This section will describe a simple method to define a PNV map in the Mediterranean region using freely available data. It makes use of the fact that plant and vegetation distribution is largely a function of specific variables in climate and environmental factors. The specific range for each of these variables corresponds to a particular vegetation class. The proposed method has been verified through comparison with the vegetation map of Andalucía. While the PNV of Andalucía may not be the same as that in other Mediterranean countries, the verification conducted showed the validity of the methodology, rather than attempting to replicate existing vegetation units. The different bioclimatic and environmental variables present in other Mediterranean regions will result in vegetation classes corresponding to those regions.

The cut-off points for data on precipitation, altitude and temperature that delineated vegetation type was used. For example, from a possible 150 distinct PNV classes, eight were identified within the Sierra de las Nieves. These eight classes may or may not be represented in other regions or territories, and novel combinations will be present in other regions and territories due to differences in climate and environment between those regions.
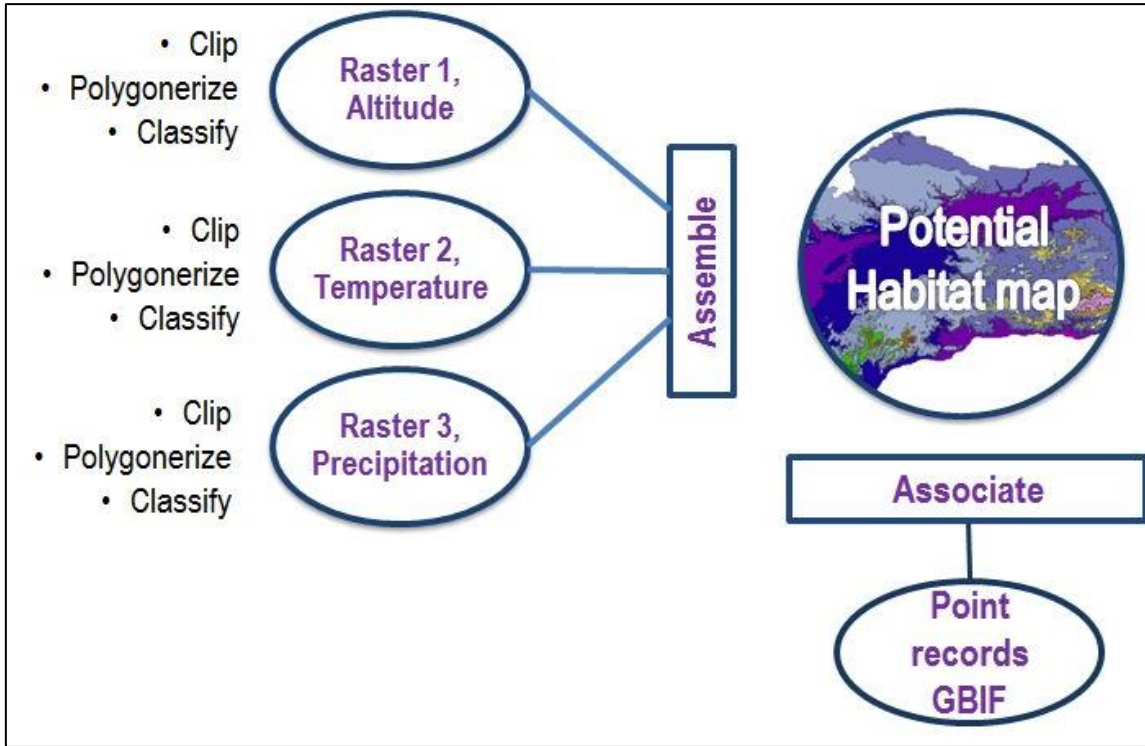
Figure 2.0. Conceptual diagram of the PNV method and when to associate additional data to the map.

2.1   Add raster layer

Objective: while vector layers most often contain points, lines and polygons, raster layers are composed of a grid, each cell of which contains a value (like the pixel of the image). In this stage, loading existing raster layers into QGIS is described.

In the example covered during the workshop, we added Precipitation, Altitude and Temperature in order to delineate area of similar environmental conditions that represent the potential natural vegetation of Andalucía and check the success of the methodology. All three variables are stored as image file (raster) and can be added to the project. At a later stage they will be combined and classified.

Step 1: Open QGIS, raster layers are loaded either by clicking on the ▥**Add Raster Layer** icon or by selecting the **Layer** > ▥**Add Raster Layer** menu option.

Browse to the directory containing the environmental variables required (in this case altitude, precipitation, and temperature), click on the image files to make a selection, and click **Open**. Repeat this for each of the three variables required to load three raster layers into QGIS.
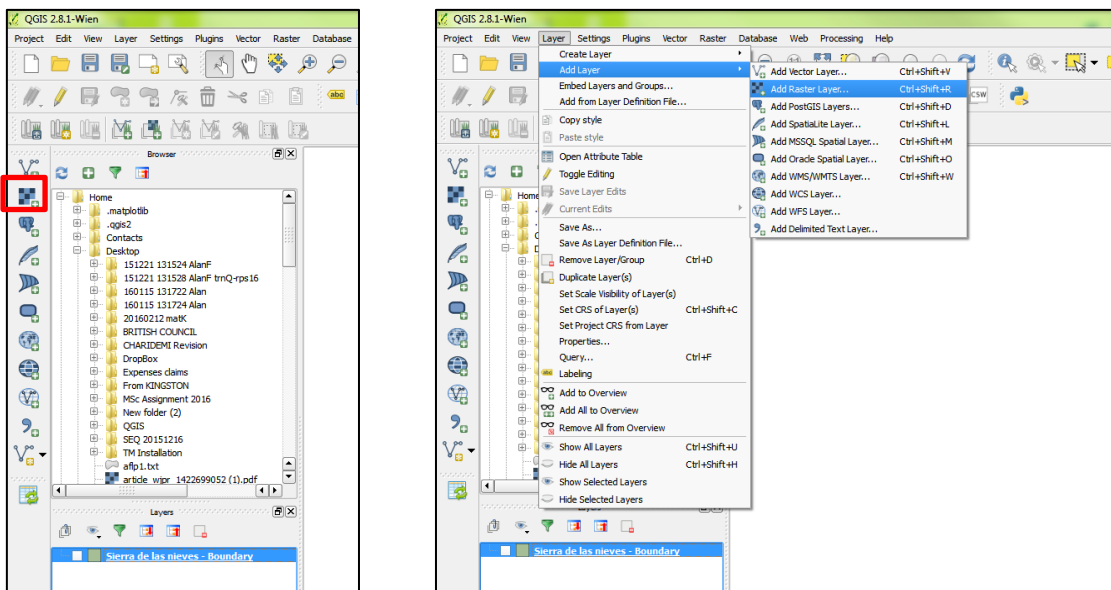
Figure 2.1.1. Selecting **Add Raster Layer** option from the drop down menu of Layer.
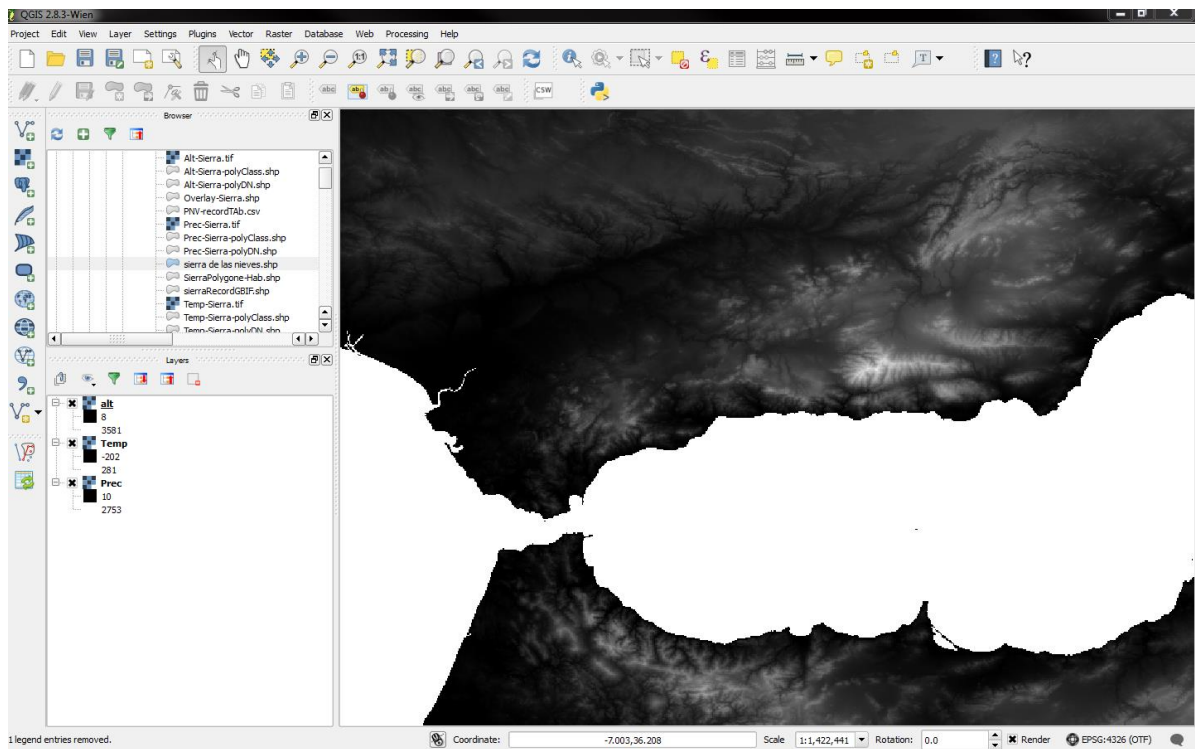
Figure 2.1.2. This image shows the raster layer for Altitude loaded into QGIS. The Layers Panel on the left shows all three raster layers present.

2.2   Add vector layer

Objective: This stage describes how to add a vector layer and how to use this vector layer to remove unwanted data that occurs outside the project scale.

Step 1: to load a shapefile, start QGIS, click on the **Add Vector Layer** toolbar button (there are also drop down menu, see figure 2.2.1 or shortcut options). From the available options tick **File** to indicate you will load a pre-existing file as your data source. Click on **Browse** to navigate to the file you want to open and click **Open** to load it into QGIS (see Figure 1.1.1).
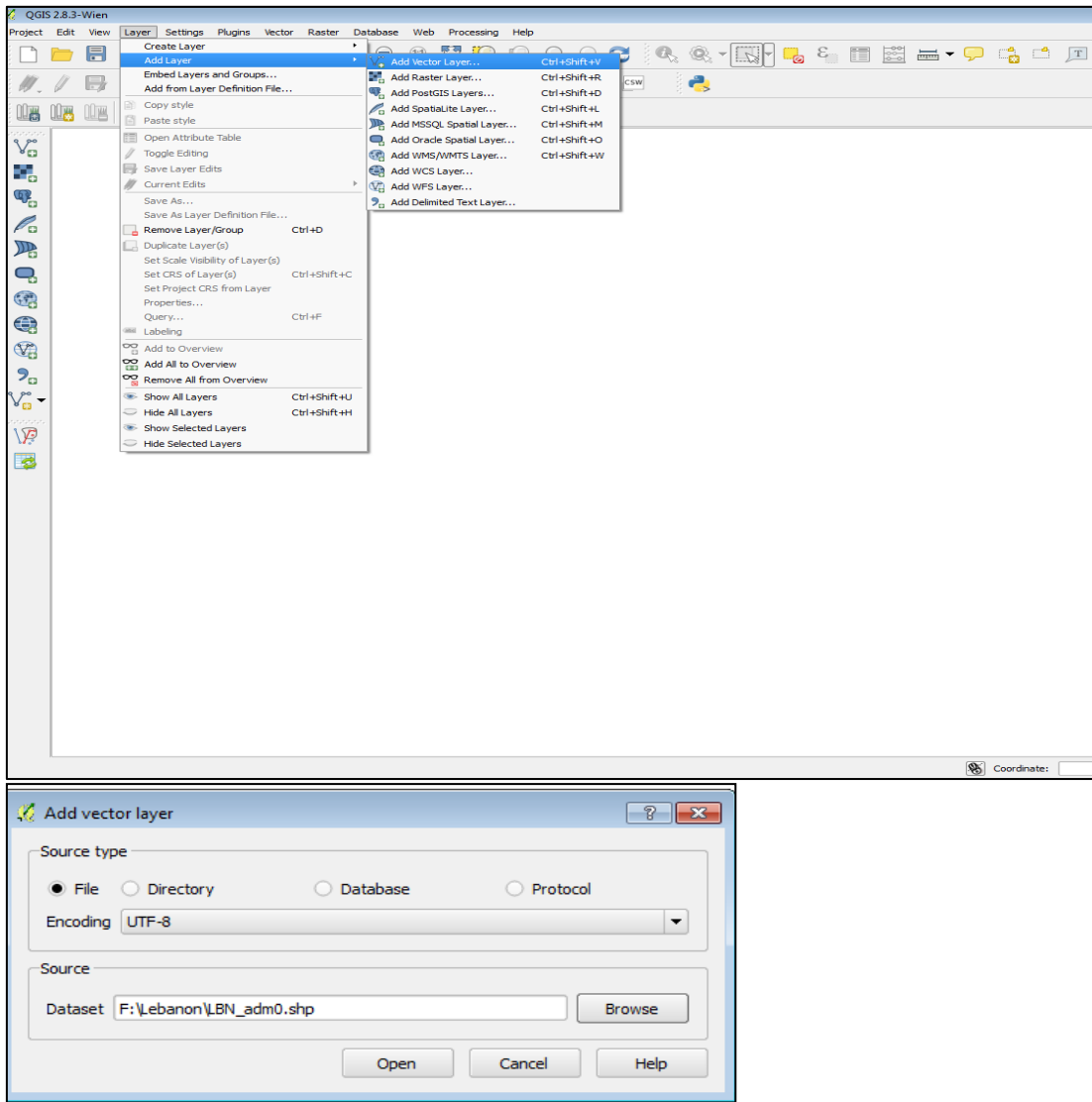
Figure 2.2.1. Window and dialog box showing how to open a vector layer in QGIS.
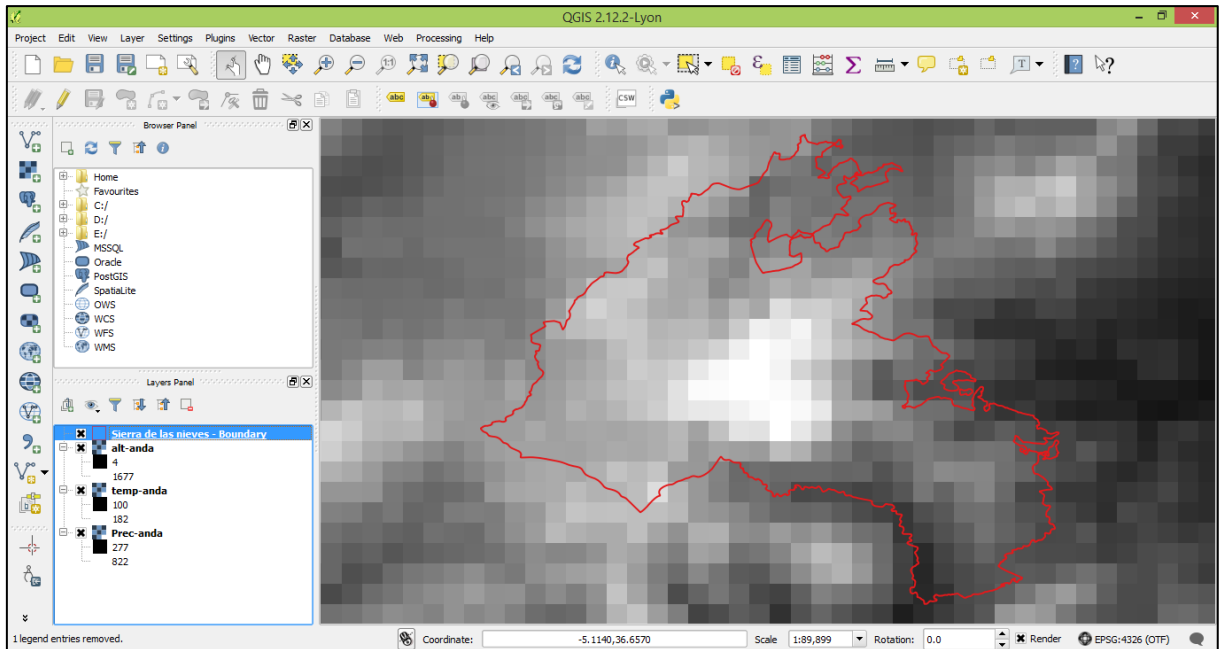
Figure 2.2.2. This image shows the vector layer containing the boundary of the Sierra de las Nieves on top of the raster layer for altitude. The window is zoomed to the vector layer. The boundary colour and fill have been altered as described previously (section 1.1 steps 2 and 3), to allow the raster layer to be visualized.

2.3   Clip raster layer

Objective: the objective of this stage is to remove information outside the area of interest using the vector layer as the boundary.

Step 1: Go to **Raster > Extraction > Clipper**

Select the **input file (raster)**. Then select the location and the name of the output file, for this, click on **Selection** ..., browse to an appropriate location, at the bottom of the window enter the file name in the **file name**, click **save** to finish. Back in the previous dialog box, choose 🔘 **Mask layer** as **Clipping mode**. Select the vector layer (in this case, Sierra de las Nieves boundary layer) as the mask layer. Tick the box next to **Load into canvas when finished**. Click **OK**

This needs to be done for each of the environmental attributes separately – in this case, there are three.
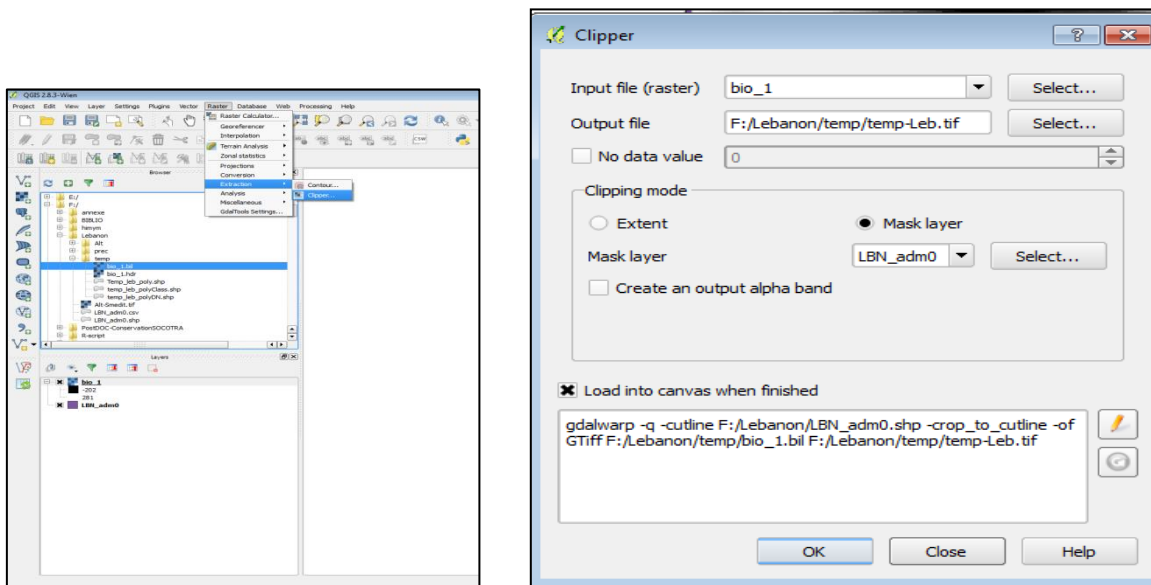
Figure 2.3.1. Menu and dialog box selections to clip a raster layer relative to the vector layer.
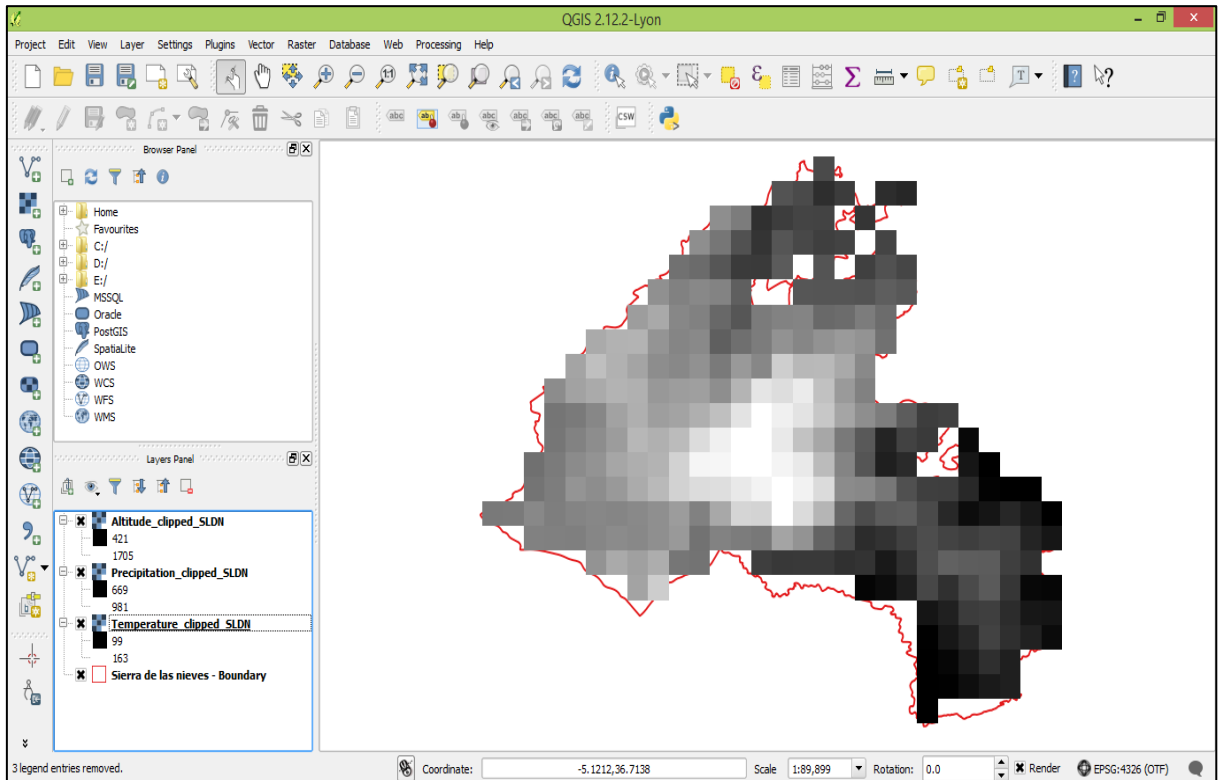
Figure 2.3.2. This image shows the Andalucía Altitude layer clipped within the Sierra de las Nieves Natural Park boundary. The new layers created can be seen in the left hand layers panel.

2.4   Polygonize: raster to vector layer

Objective: as raster data and associated are harder to use, it is necessary to convert them to vector layers so the information can be treated as it will be with polygons.

Step 1: Go to **Raster > Conversion > Polygonize**

Select the **input file** (raster). Then, as in the previous step (2.3.1) select a location and a name for the **output** polygons file. Tick **Load into canvas when finished**, and then click **OK**

.

This needs to be repeated for each of the three environmental attributes.
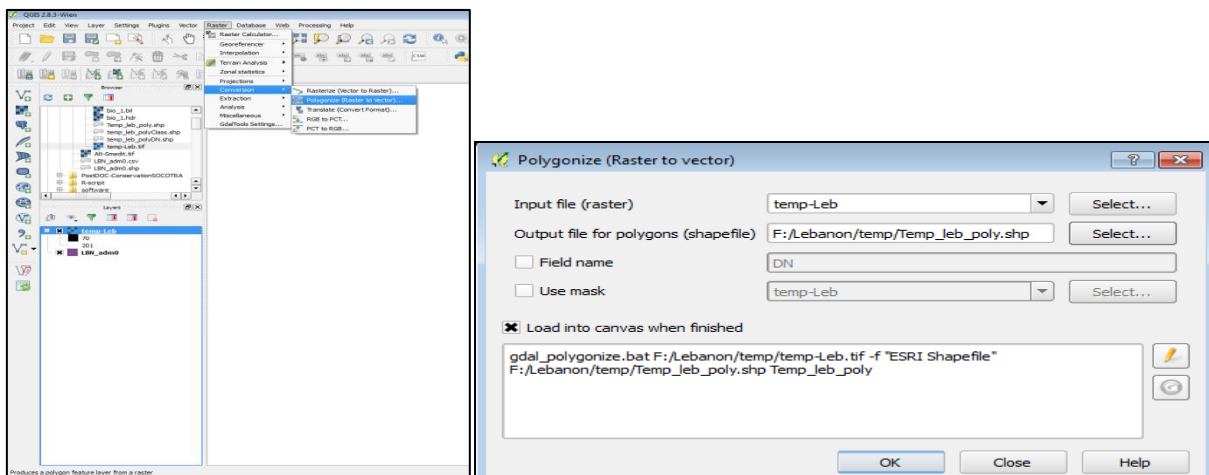
Figure 2.4.1. Menu and dialog box options to convert a raster layer to a vector layer.
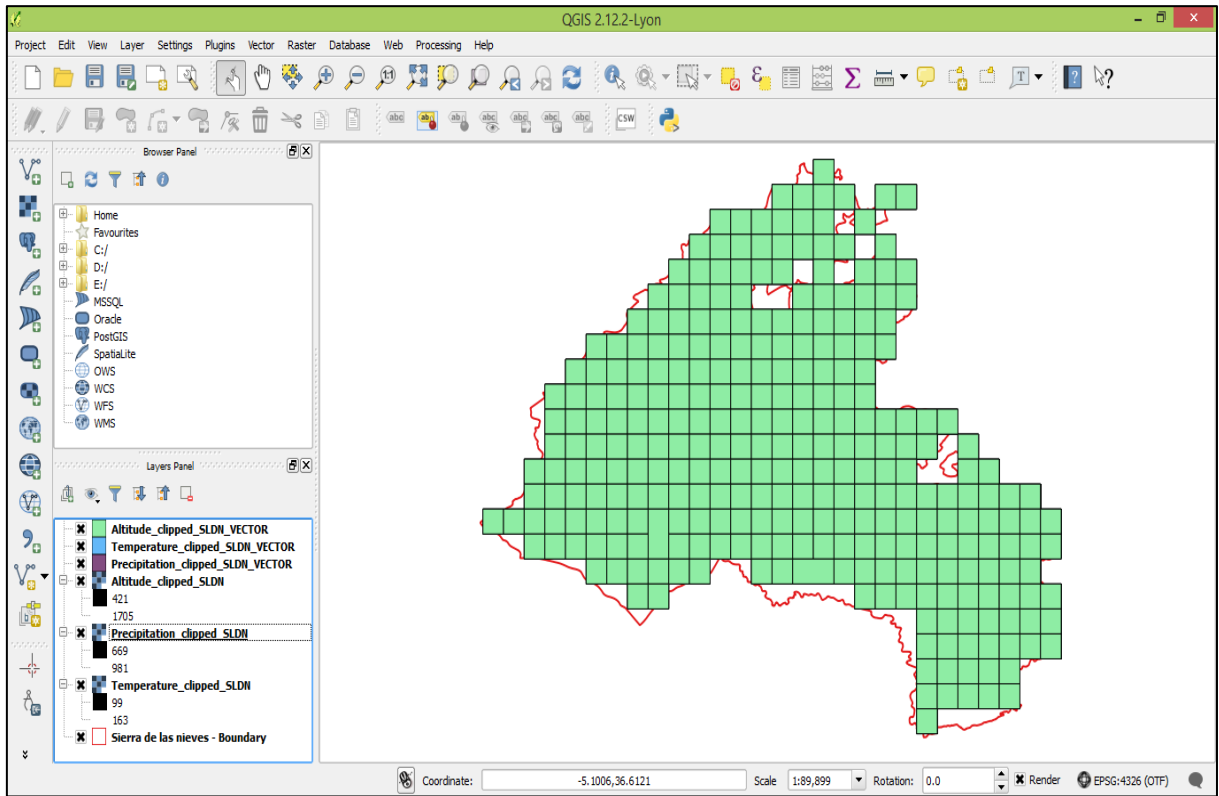
Figure 2.4.2. This image shows the Sierra de las Nieves Altitude layer converted to a vector layer.

2.5   Classifying: field calculator

Objective: in this stage the limits for classes within each environmental variable will be set to define bioclimatic and environmental conditions that support different broad natural vegetation types in the Mediterranean region. This must be done separately for each of the three variable in vector layers.

Step 1: In the left hand side layer panel, right click on the vector layer to classify, in the drop-down menu select **Open attribute table**

Within the attribute table, click on [icon] **open field calculator**
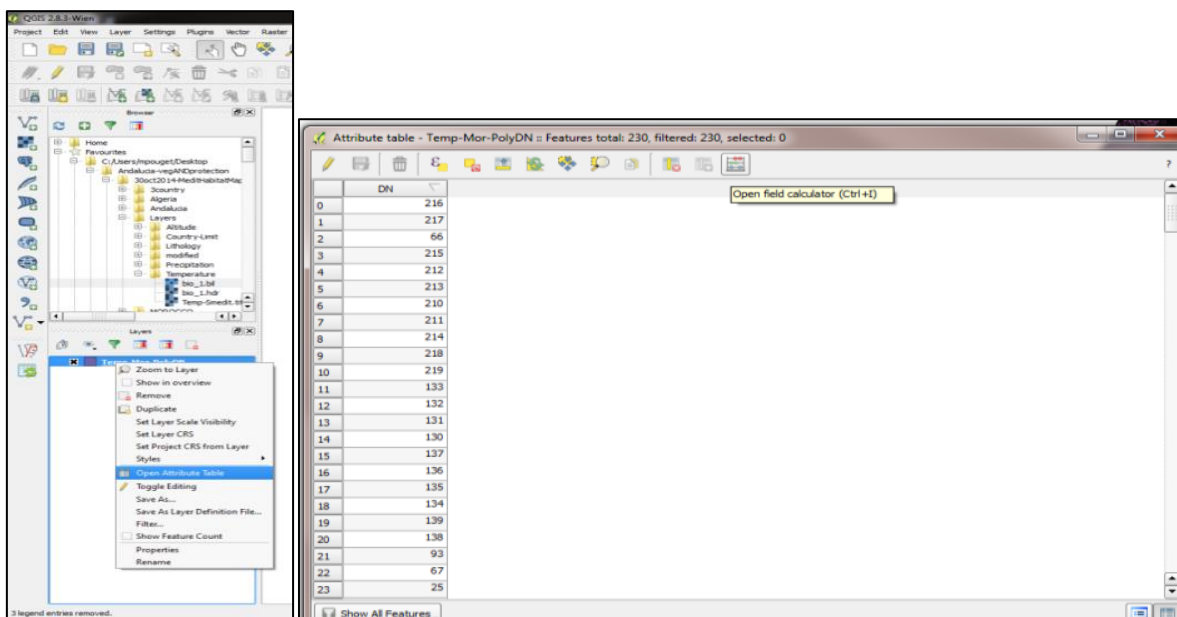
Figure 2.5.1. Menu options to open the attribute table and the field calculator.

Step 2: Tick **Create a new field**. Enter your chosen Output field name, and change the output field type to text (=Class), and lengthen the field width to 30 characters

In the expression field, copy and paste the text below within the field calculator of the attribute table of the three environmental variables, then select **OK**. See Figure 2.5.2 as an example of what this should look like once completed.

For precipitation:

CASE

  WHEN "DN" <100 THEN '1'

  WHEN "DN" <400 THEN '2'

  WHEN "DN" <600 THEN '3'

  WHEN "DN" <800 THEN '4'

  WHEN "DN" <1200 THEN '5'

  WHEN "DN" >=1200 THEN '6'

END

For altitude:

CASE

  WHEN "DN" <400 THEN '1'

  WHEN "DN" <1000 THEN '2'

  WHEN "DN" <1500 THEN '3'

  WHEN "DN" <2000 THEN '4'

  WHEN "DN" >=2000 THEN '5'

END

For temperature:

CASE

  WHEN "DN" <40 THEN '5'

  WHEN "DN" <80 THEN '4'

  WHEN "DN" <130 THEN '3'

  WHEN "DN" <170 THEN '2'

  WHEN "DN" >=170 THEN '1'

END
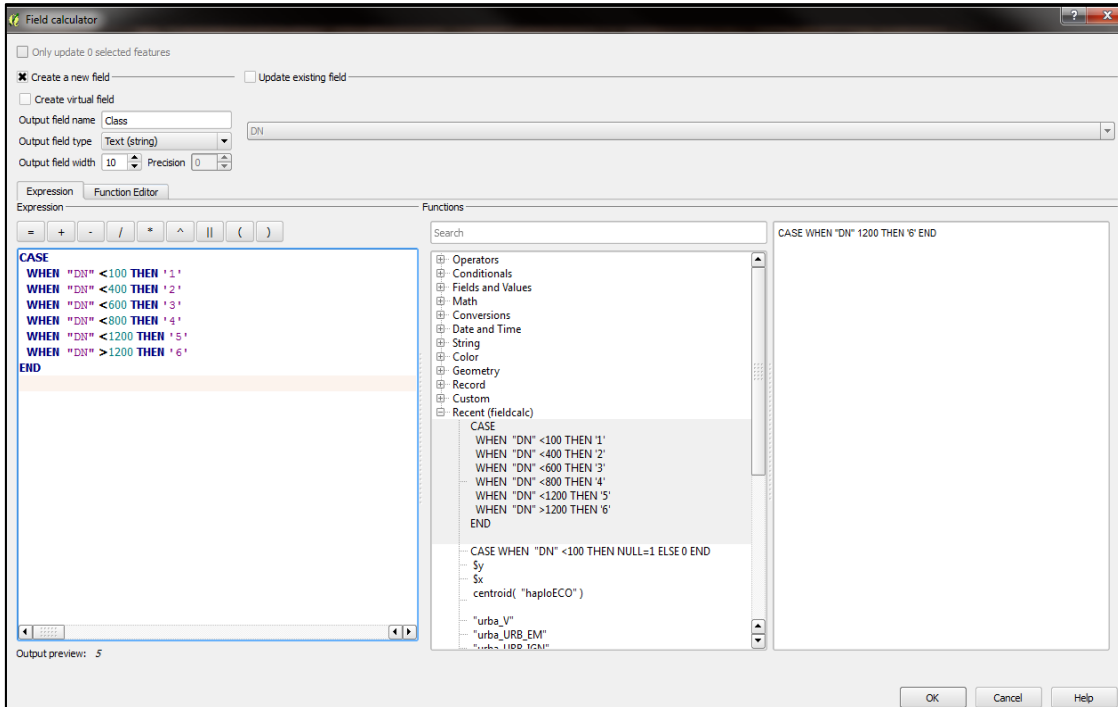
Figure 2.5.2. Field calculator dialog box, with text for Precipitation added.
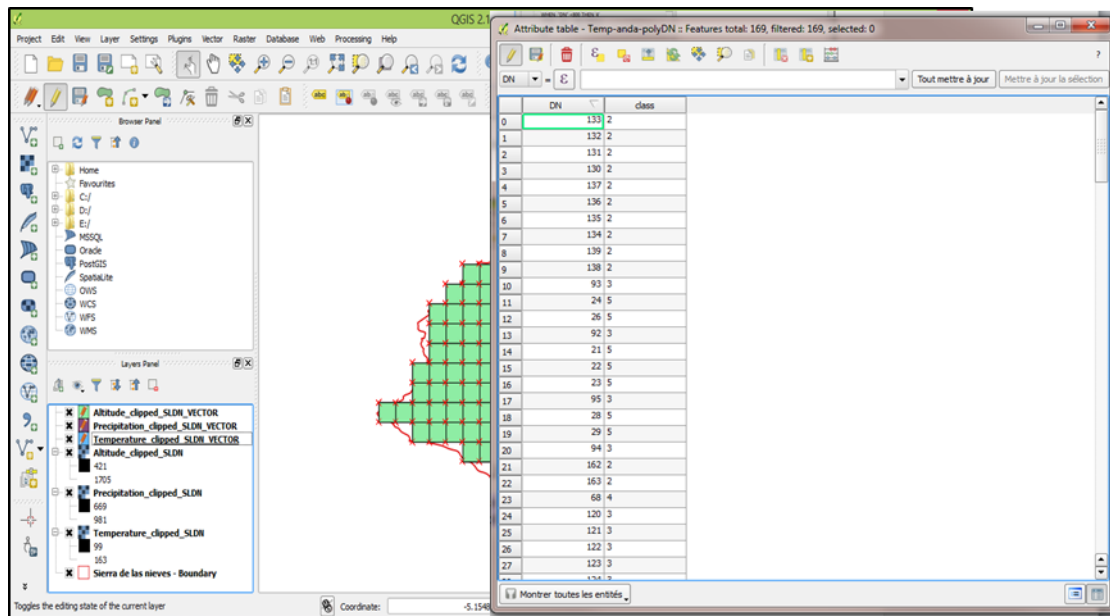
Figure 2.5.3. After creating a new in field step 2.5.2., the attribute table presents a new column named Class.

2.6   Combine similar features

Objective: within each environmental variable, different features will have the same class as defined in stage 2.5. In this stage, the similar feature will be grouped together so they are treated as a single class, despite not being adjacent. Again, this must be done for each of the three variables separately.

Step 1: Go to **Vector > Geoprocessing tools > Dissolve**

Select the **input file (vector)**. Choose dissolve field (feature to combine). Give the **Output file** a name. Tick the box next to **Load into canvas when finished**, then click **OK**.
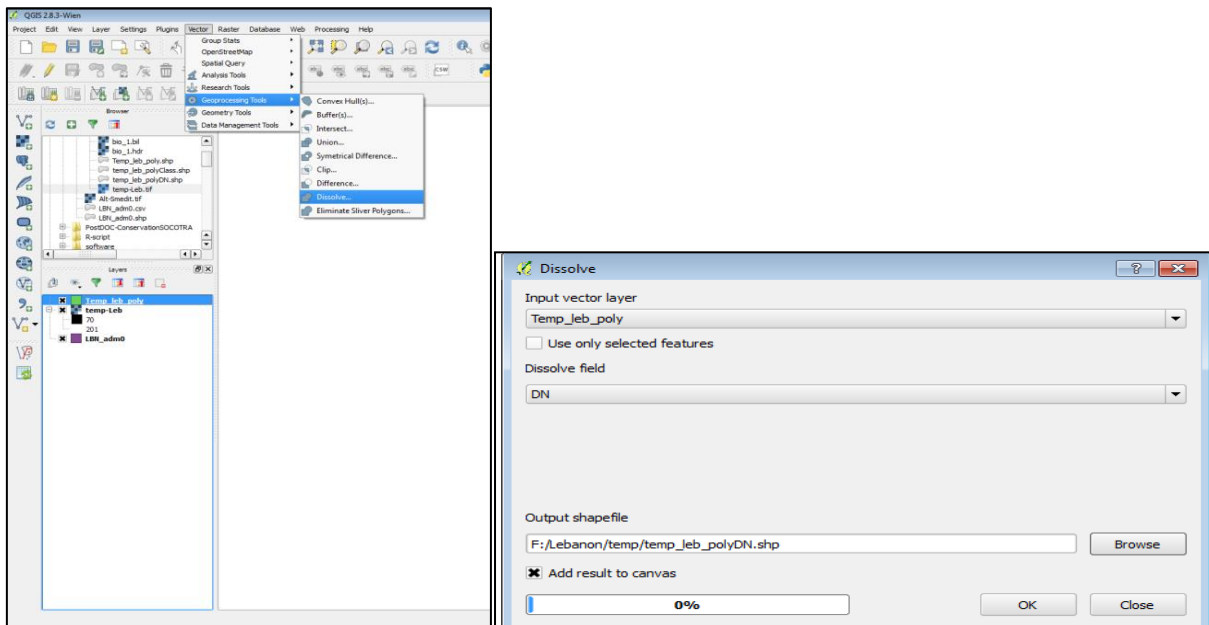
Figure 2.6.1. Menu and dialog box options for the **Dissolve** tool.
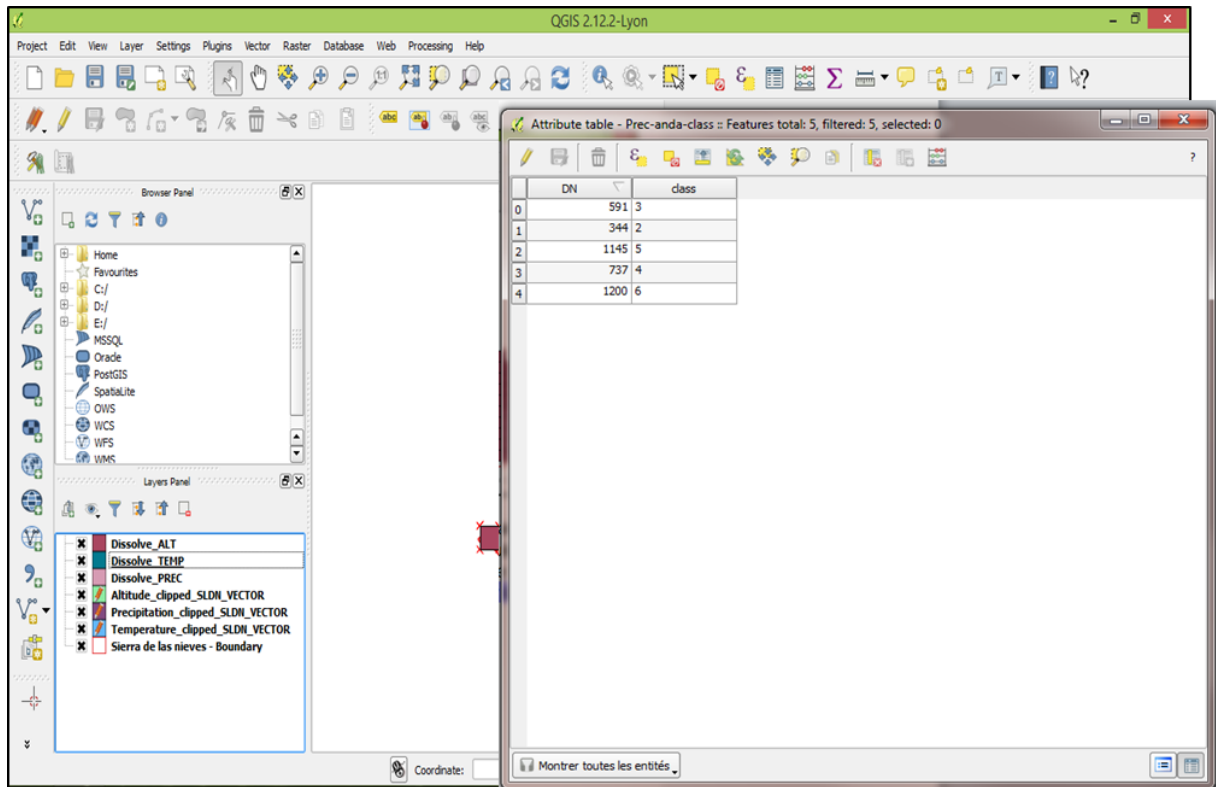
Figure 2.6.2. This image presents the vector layer precipitation dissolved by class. Again, the dissolved classes are not classified by colour, the map does not change. However, the attribute table of this new vector layer change, the feature number is now equal to the number of class.

2.7 Assemble = overlay

Objective: in this stage, the three different environmental variables are combined into a single layer which contains the combined attributes of all three variables. As there are six classes in Precipitation, five classes in Altitude and five classes in Temperature this gives a total of 150 possible combinations. Each of these combinations represents a PNV category. This combination *can only be done one pair at a time*, so it is necessary to combine two dissolved pairs, then select this new combined layer and combine it with the third dissolved variable.

Step 1: Go to **Processing > Toolbox.** The toolbox will open on a new panel on the right side. Check that the drop-down menu at the bottom of the panel indicates **Advanced interface.** Open the drop-down menu> **GRASS commands**, then **Vector (v. *)** and **V.overlay** (double click). A dialog box opens

Select the **input layer (A) and (B) -** two of the classified environmental variable vector layers. Select input layer type as **area** and select operator to use as **and**. Click **Run.**
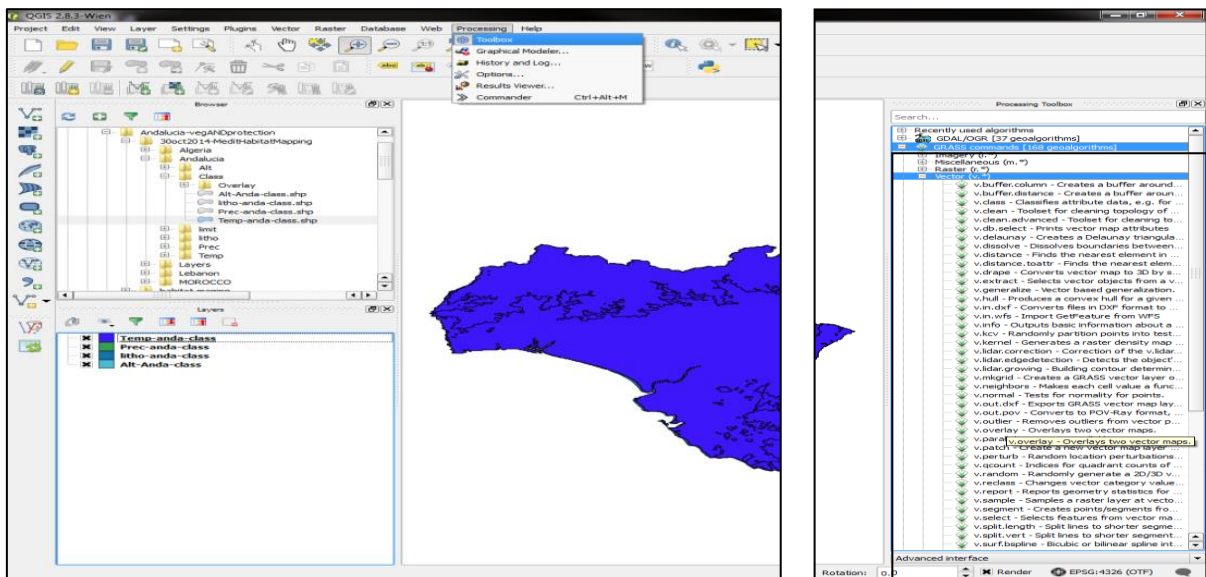
Figure 2.7.1. Drop-down Menus used to open the "overlay" function.
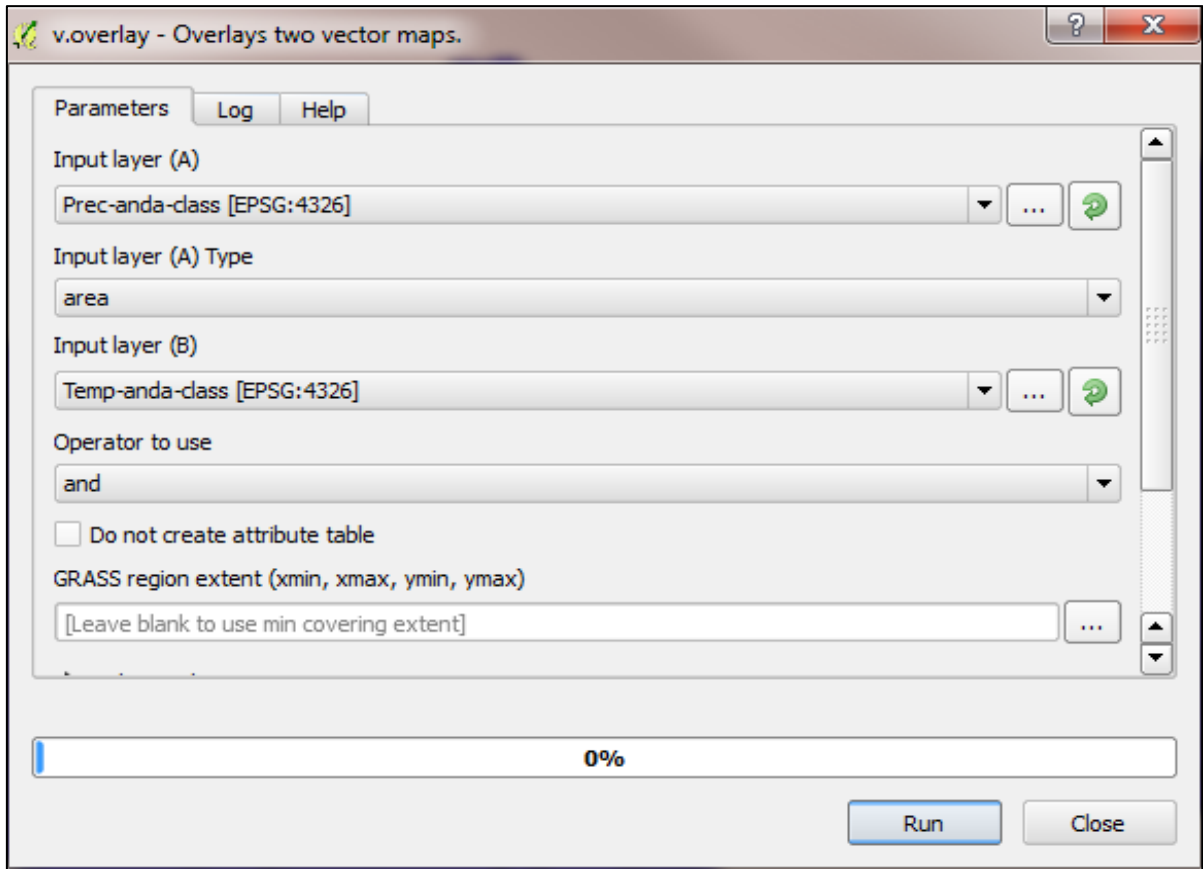
Figure 2.7.2. Dialog box options for overlaying pairs of environmental attributes.

Step 2: repeat the above procedure selecting the two input layers as (a) the newly created combined layer featuring two variables, then (b) adding the third variable. The resulting file will contain data from all three environmental variables, and will be used for the final classification of PNV. Make sure to name this file so that it is recognisable as the final layer with all three variables combined.

Files created from the overlay option are temporary files; at this stage make sure to save the final combined layer. Right-click on the layer, then select **Save as** … from the drop-down choices, select ESRI Shapefile as **format**, browse the directory to find a location (as previously done) and give it an output name.
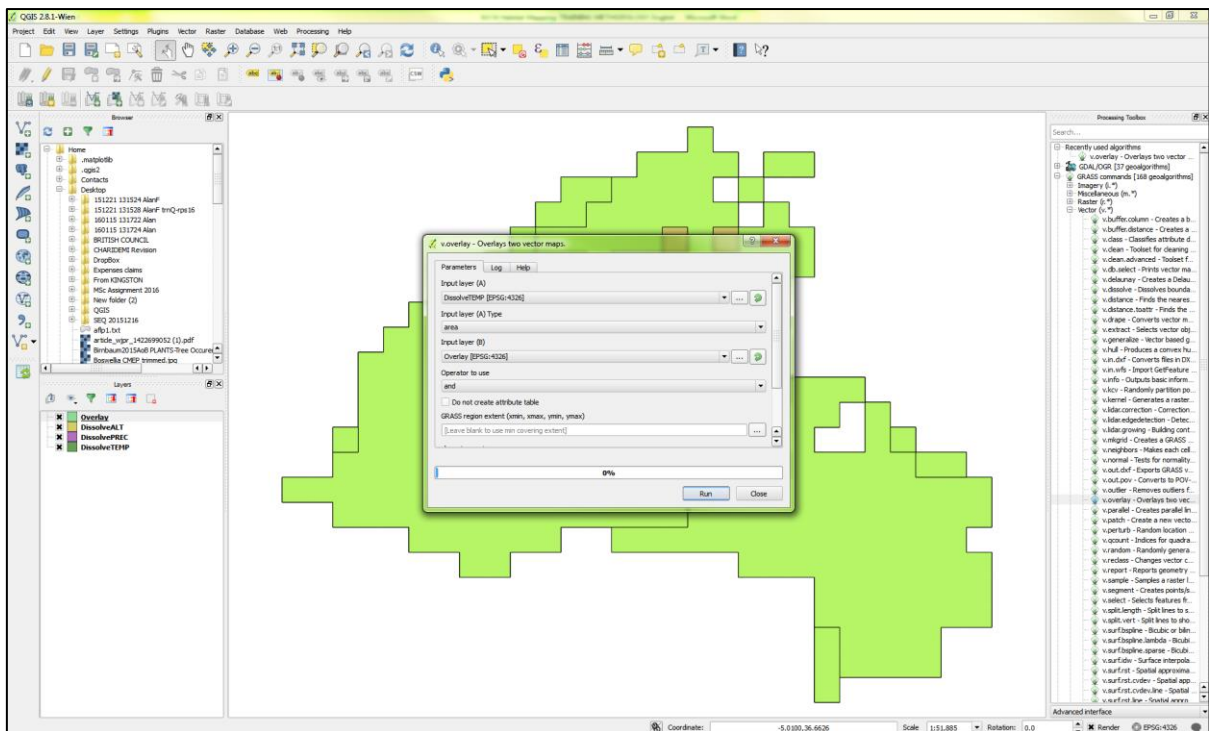
Figure 2.7.3. Screenshot showing the overlay vector layer that has combined the dissolved altitude and precipitation layers. This creates a new layer called "overlay". Selecting this overlay and combining it with the third variable (in this case temperature) as in 2.7 step 1 above will result in another "overlay" vector layer containing data from all three variables.

2.8　Classify

Objective: in this stage, the distinct PNV classes are named, classified and coloured individually. This is done by first adding a new field to the table to include a name for the PNV class, using a string of text to instruct the classification. Save the output file containing the classes identified in our area of interest. Then modify the properties of the file to change colour as seen in 1.1 step2.

Step 1: Right click on the **Overlay** vector layer containing all three variables combined (in the menu on the left side) and open the Attribute table. Open the **field calculator** as done previously (button on far right).

Step 2: Tick **Create a new field**. Enter your chosen Output field name, and change the output field type to **text** (=Class), and lengthen the field width to 30 characters.

In the expression field, copy and paste the text below. For X, Y and Z, replace with the column title that corresponds to the environmental variable attribute class input at stage 2.5 and insert inside quotation marks "_". This can also be done by highlighting the column header text, then selecting that column header from the drop down menu as shown in Figure 2.8.1.

The text in red in the example represents the columns headings that correspond to the attribute values in this example screenshot.

Example: concat('Alt',X,'Temp',Y,'Prec',Z)

Example: concat('Alt',"a_a_ALT",'Temp',"b_TEMP",'Prec',"a_b_PREC")

Select **OK**.
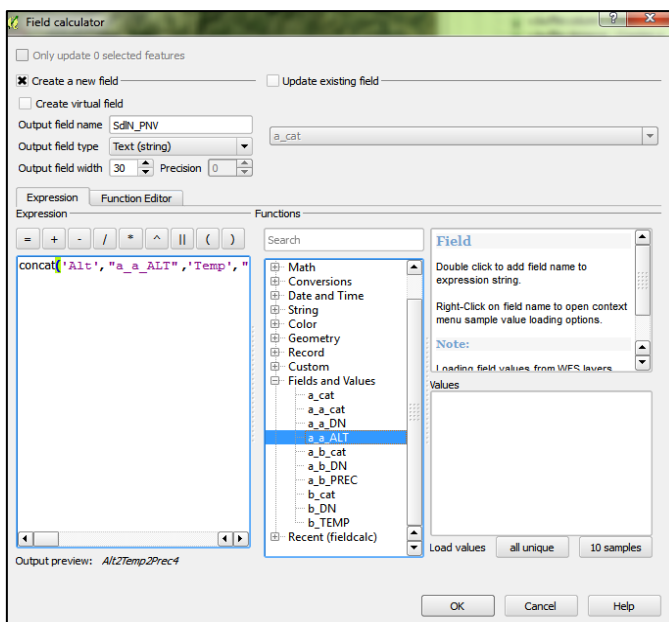
Figure 2.8.1. Menu and dialog box options to obtain the PNV distinct classes.
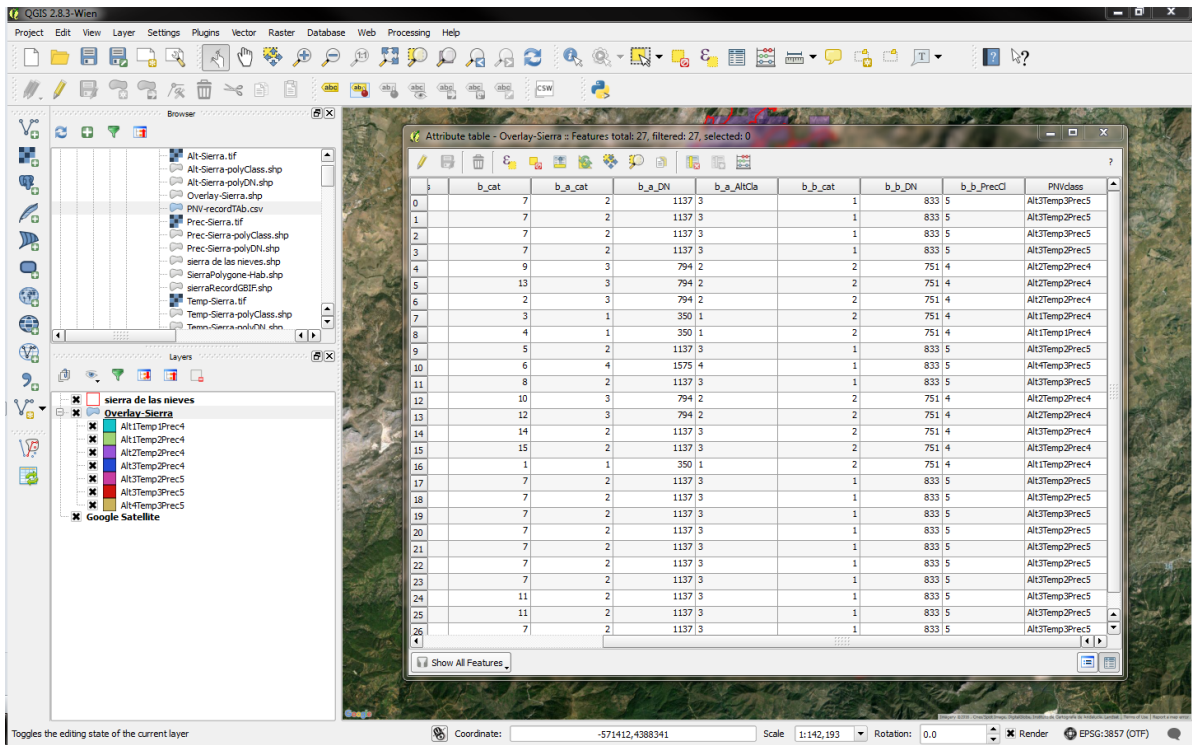
Figure 2.8.2. Result of the step 2.8.2., the attribute table of the overlay layer has an additional column including the PNV classes.

Step 3: Right click on the classified layer in the left hand menu and choose **properties**. From the drop down menu at the top of the dialog box, select **categorized**, then choose the classes' column as **column**, **random colours** for the colour ramp and finally **classify** at the bottom**, OK.** It will colour the different PNV class in different colour.
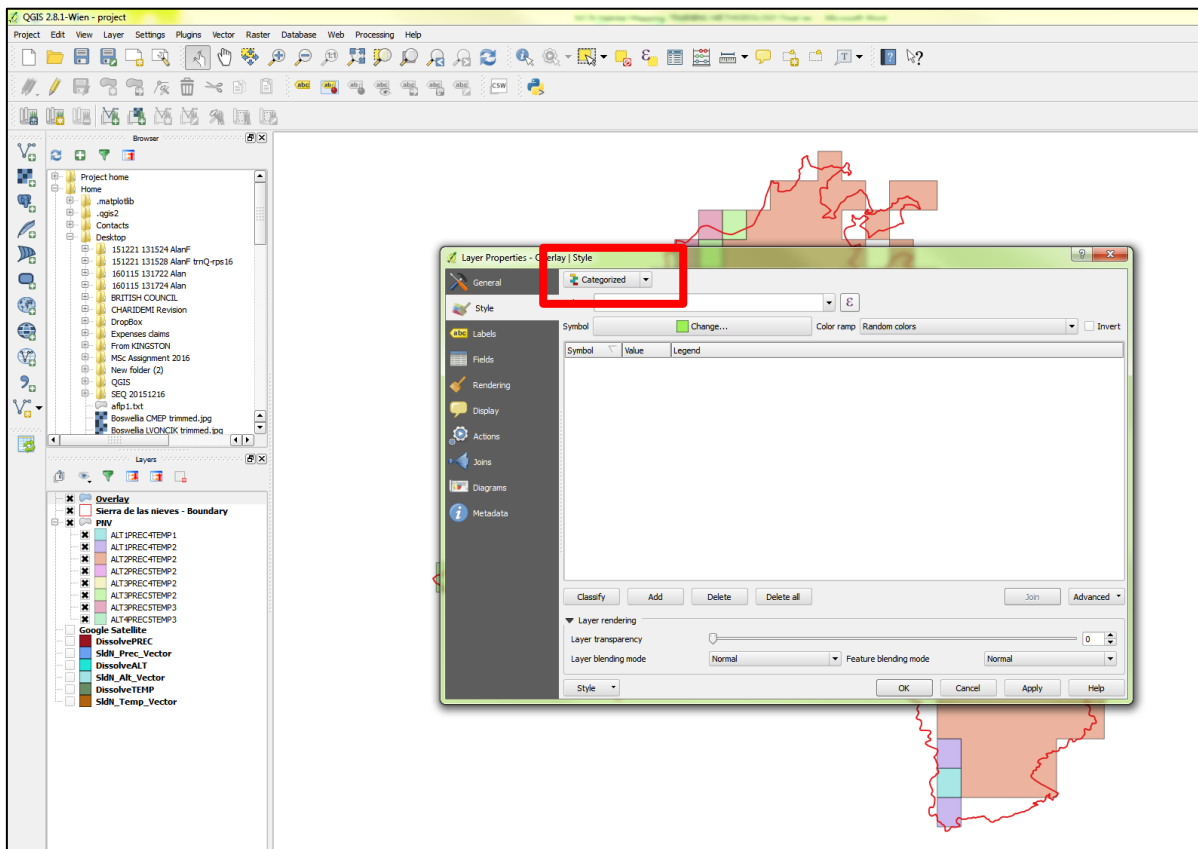
Figure 2.8.3. Dialog box options to colour PNV classes independently. Select **Categorize.**
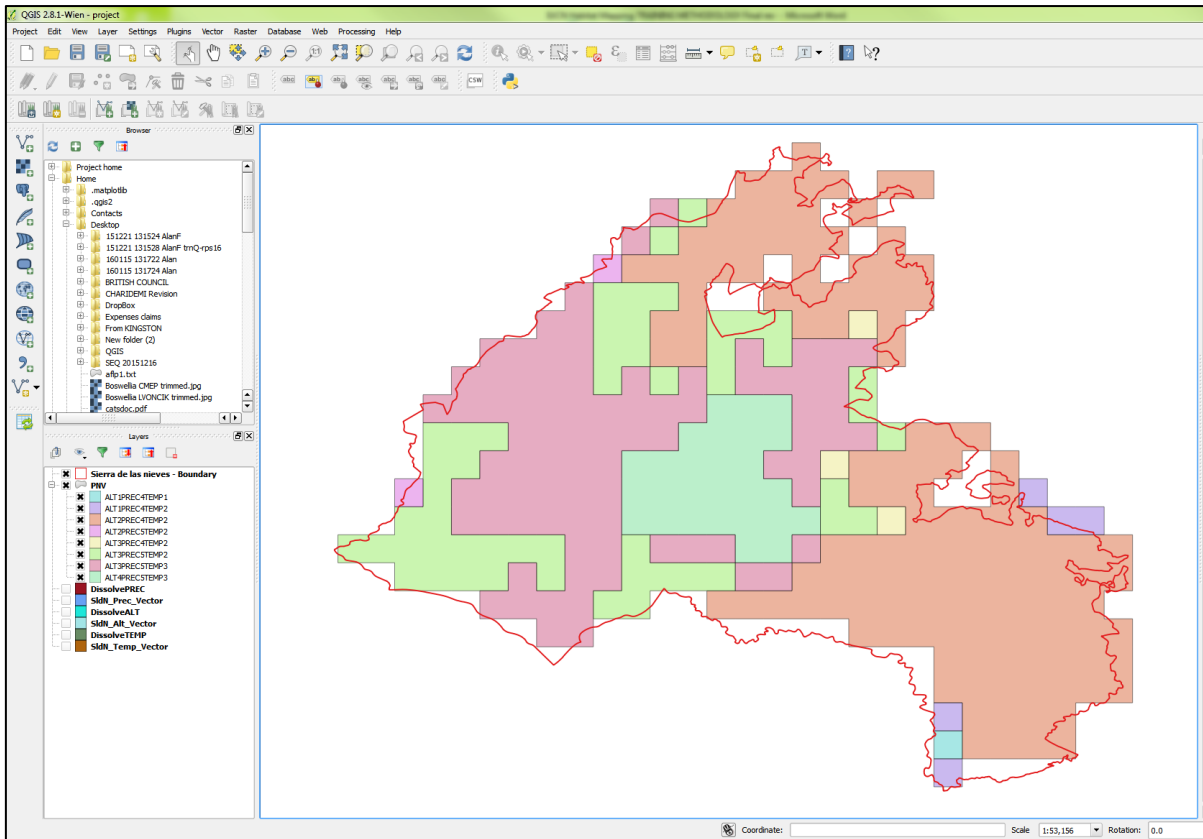
Figure 2.8.4. Image showing PNV classes based upon the classification of the variable altitude, precipitation and temperature within the Natural Park of Sierra de las Nieves. Eight different classes are represented within the boundary.

2.9 Compare to satellite imagery

Objective: in this stage, you can add satellite imagery to compare actual land use with PNV classes. This requires loading Google Satellite maps, then changing the transparency of the PNV classes.

Step 1: to change the transparency of each class to 25% of the original map so the satellite images can be viewed through the PNV classes, open the dialog box **Layer property** (see 2.8 step 3), in the rendering of the bottom layer of the dialog box, change the **transparency of the layer** to 75%.

Step 2: To load the satellite image (see section 1.2) or Web **> OpenLayers Plugin > Google Maps > Google Satellite**
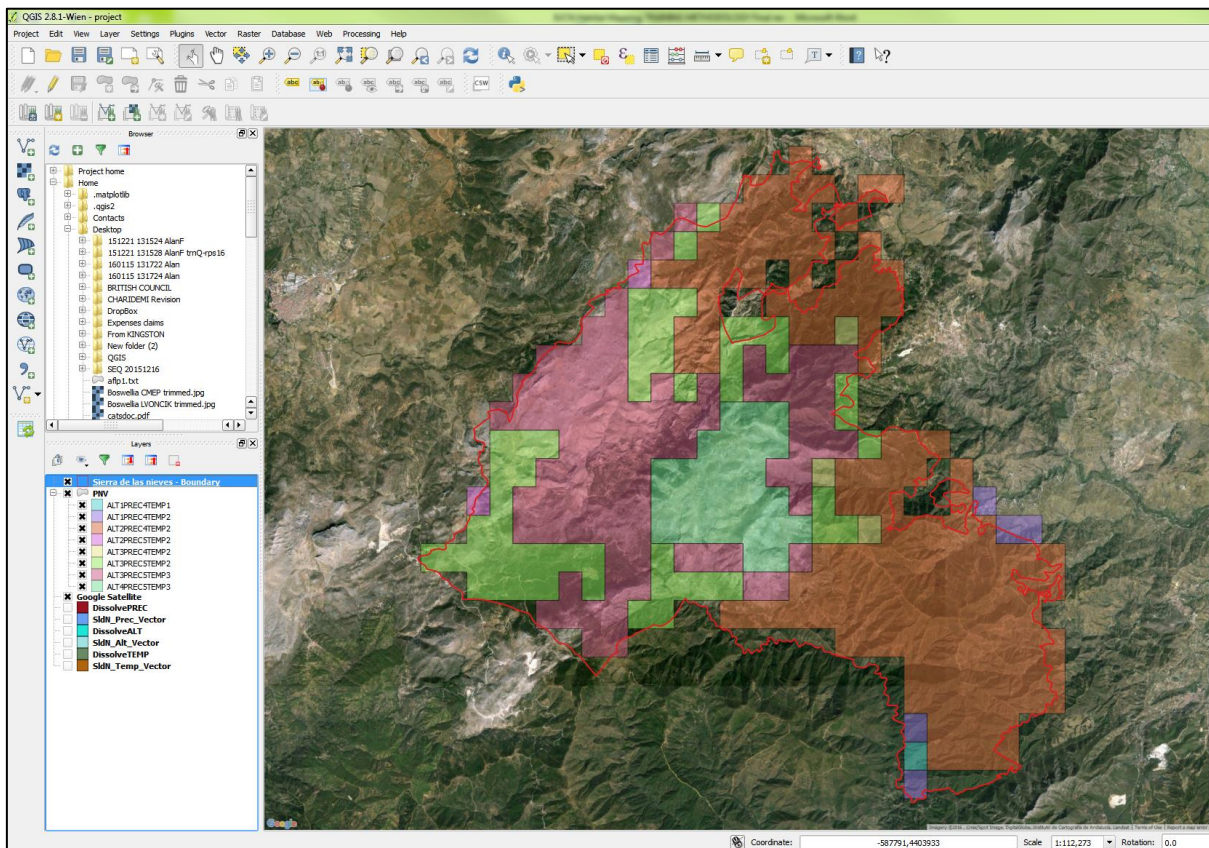
Figure 2.9.1. Image showing PNV classes converted to transparent colours, through which satellite imagery can be viewed.

Section Three

Species Occurrence Data

Objectives:

IPAs can be designated not just for rare or threatened habitats, but also for botanical richness (species richness in a given habitat) or for rare and threatened species globally, regionally and nationally. Adding species occurrence data into zoning plans at an IPA scale is rarely done. However, such data allows prioritization within and between IPAs in order to concentrate conservation resources to maximum effect to conserve threatened species and the ecosystem services they provide. This Section describes how to add species occurrence data to spatial layers, and extract data depending on the habitat polygon defined by the user.

3.1   Add point record data

Objective: This stage describes how to add species occurrence data into QGIS. Data can be added and then saved as a vector file. The data should be uploaded from a Comma Separated Value (.csv) spreadsheet. Remember to include all data that may be relevant in columns – for example species name, threatened status, endemic status, and latitude and longitude geographic coordinate reference. The following stages will allow this information to be retrieved for separate polygons that might represent habitat or other land use characteristics.

Step 1: To load a point record table, click on the [icon] **Add Delimited text layer** toolbar button. Click on **Browse,** which will bring up a standard open file dialog box, which allows you to navigate the file system and load a .csv file, and clicking **Open** loads it into QGIS. Define the delimiters as [icon] **.csv**. For the Geometry definition tick [icon] **point coordinates** and selects columns from the drop down menu for X (longitude) and Y (latitude) fields. Click **OK (Figure 3.1.1).**
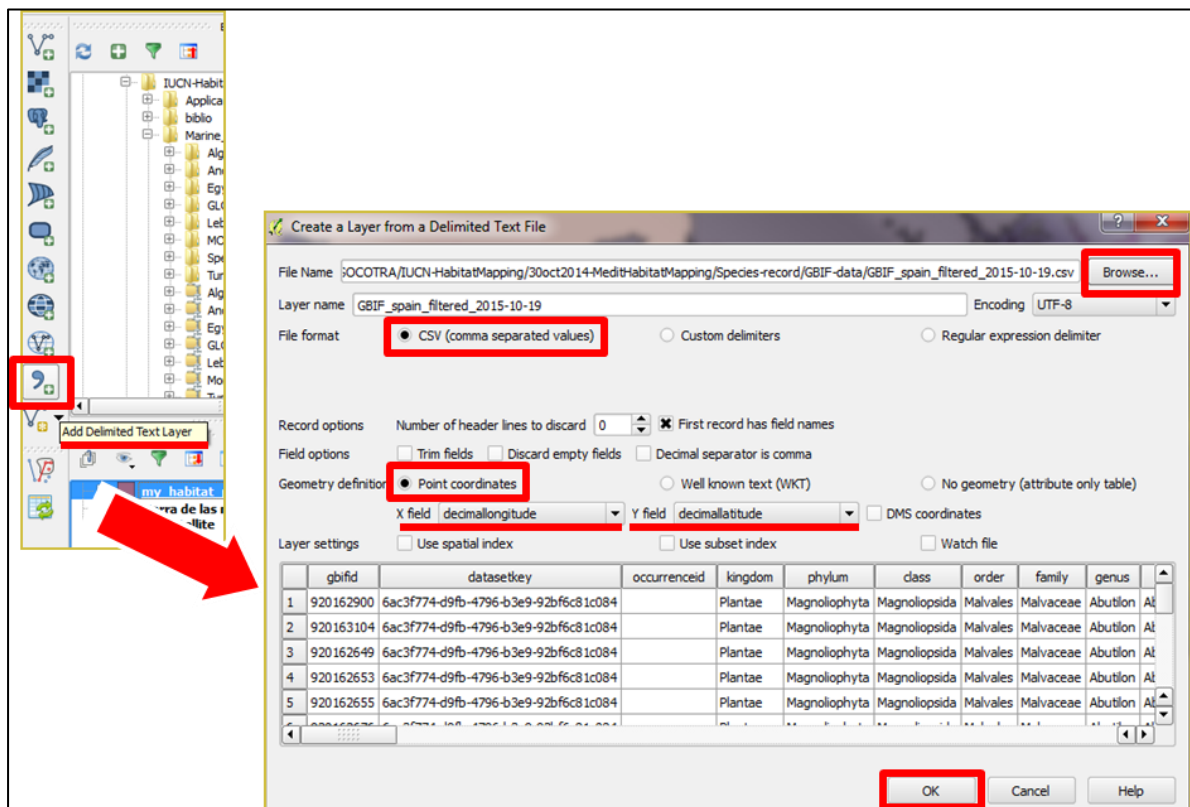
Figure 3.1.1. Menu and dialog box options to add species occurrence data from a .csv spreadsheet.

Step 2: To save the layer containing the point record as a vector file (shapefile, .shp), right-click on the layer, then select **Save as** … from the drop-down choices, select ESRI Shapefile as **format**, browse the directory to find a location (as previously done)and give it an output name (e.g. "habitat-record-Sierra").
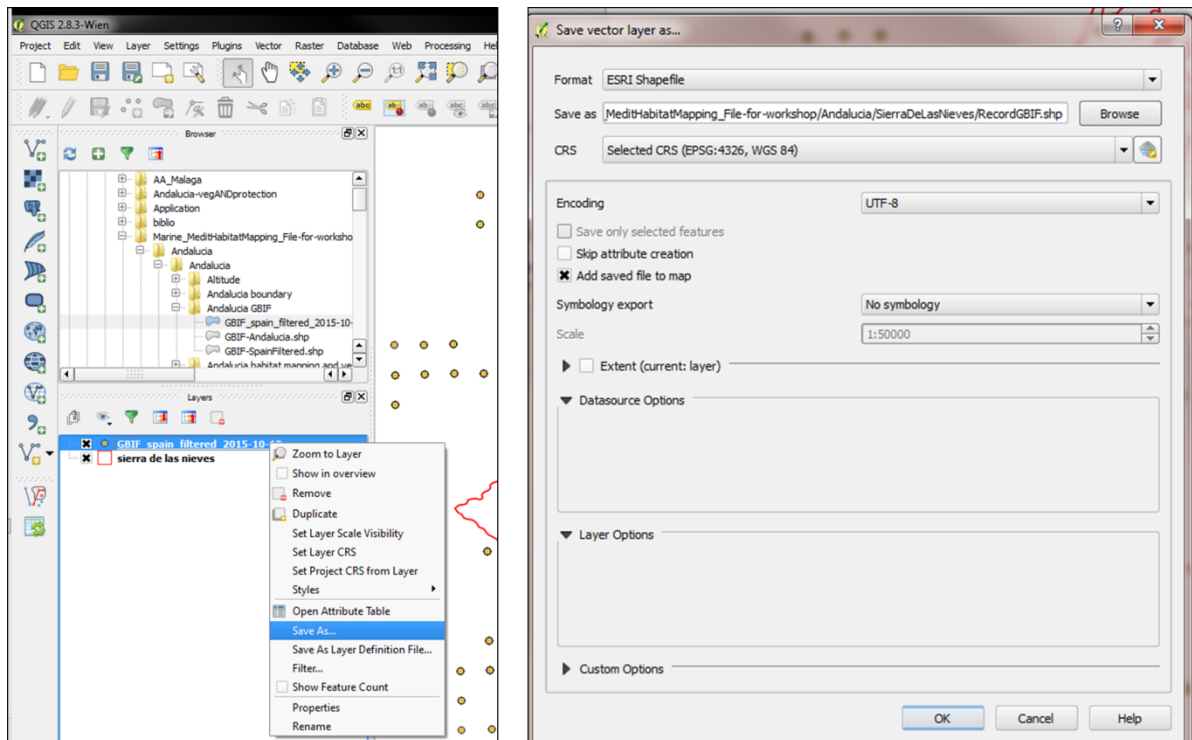
Figure 3.1.2. Menu and dialog box to save point record as a shapefile.

3.2 Visualizing point record data information

Objective: for each point record, it is possible to visualize the data associated with it, for example, which habitat types it is classified in, or the name the species if it is a species occurrence record.

Step 1: Identify features allows us to interact with map canvas to get data of the feature on a panel called Identify results on the left of the window. To identify feature select the point record vector layer just created, click on the **Identify features** in the toolbar, then click on the point data on the map screen that you want to know about.
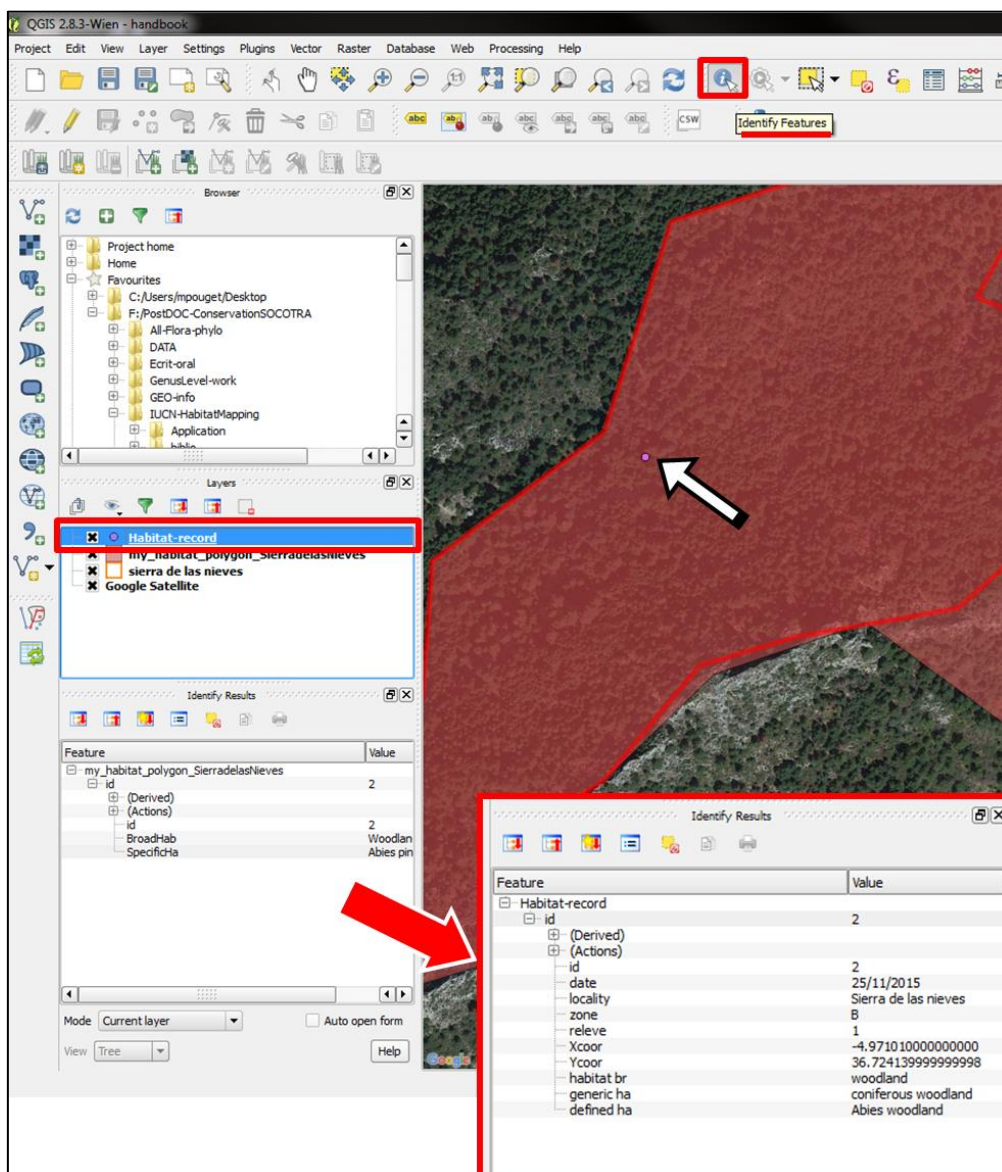
Figure 3.2.1. Identify a point record and associated data readable in the Identify panel.

3.3   Species record per habitat

Objective: In this section, we will output a list of records in our areas of interest. We will output a file that shows all records, the output file will classify each record as to the area it can be found in. Therefore, we can sort the resulting file into species or areas. Two examples are used one with the result of the PNV method and one with the two habitat polygons in green, and species occurrence data are from the open access database GBIF.

The success of this depends on (a) the hierarchical levels of classification you define when you draw polygons and name them, and (b) the data contained in your record input file. The latter should include not only species name and georeferenced coordinates, but also other information of use such as threatened status, endemic or not. In that way, all information can be sorted by polygon, giving the power to locate species of conservation interest in different habitats and zones within an IPA.

Step 1: Go to **Vector > Geoprocessing tools > Clip...**

Select the input file (species occurrence record shapefile). Choose clip layer (habitat polygons layer or PNV layer). Select a location and name the Output file as previously done. Click **OK.**

Step 2: Go to **Vector > Geoprocessing tools > Union…**

Select the input file (newly clipped species occurrence record shapefile). Choose union layer (habitat polygons layer or PNV layer). Select a location and name the Output file as previously done. Click **OK.**
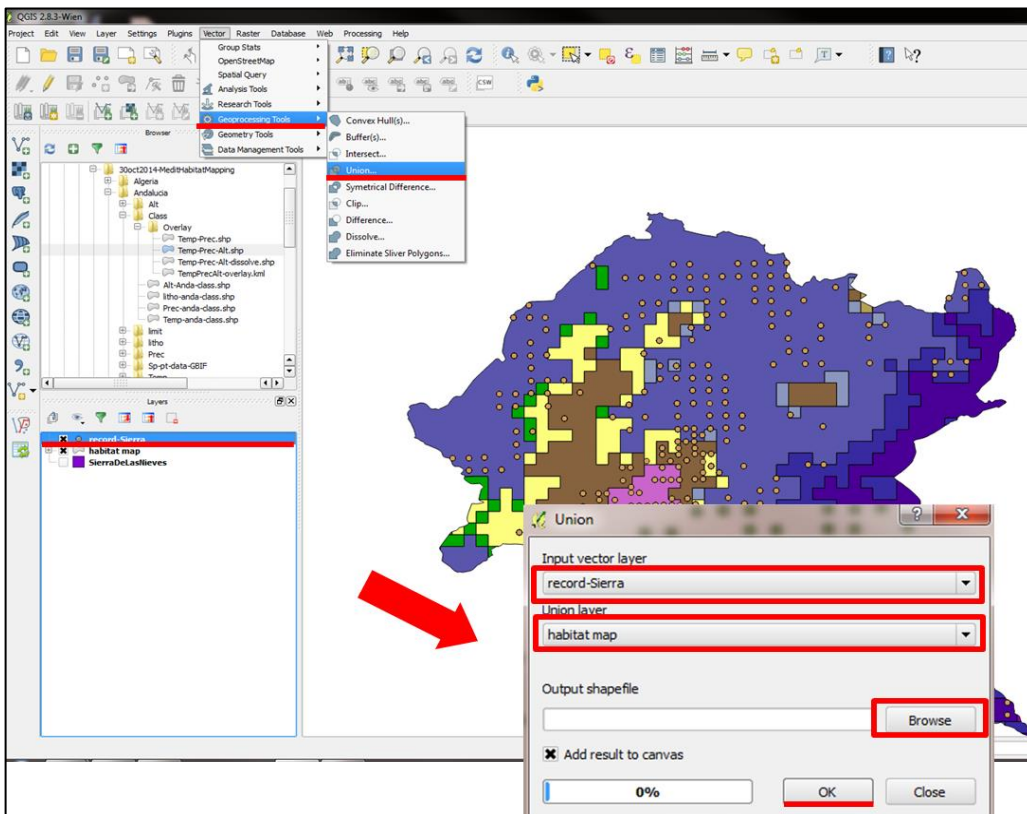
Figure 3.3.1. Menu and dialog box to join (union) the species record data with the PNV classes.
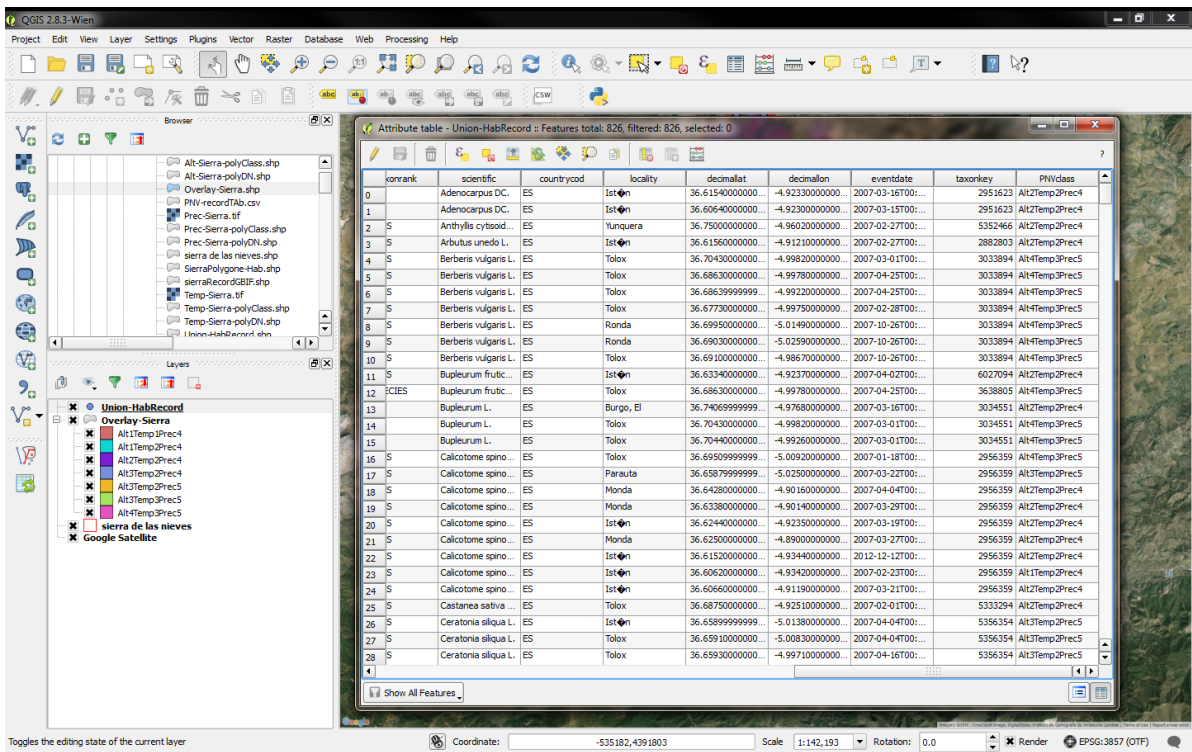
Figure 3.3.2. This screenshot shows the attribute table of the new union layer, the rows correspond to the point record, notice the last two columns of the Attribute table corresponding to polygon data the record occurred in.

Step 3: Go to **Vector -> group stats-> GroupStats**
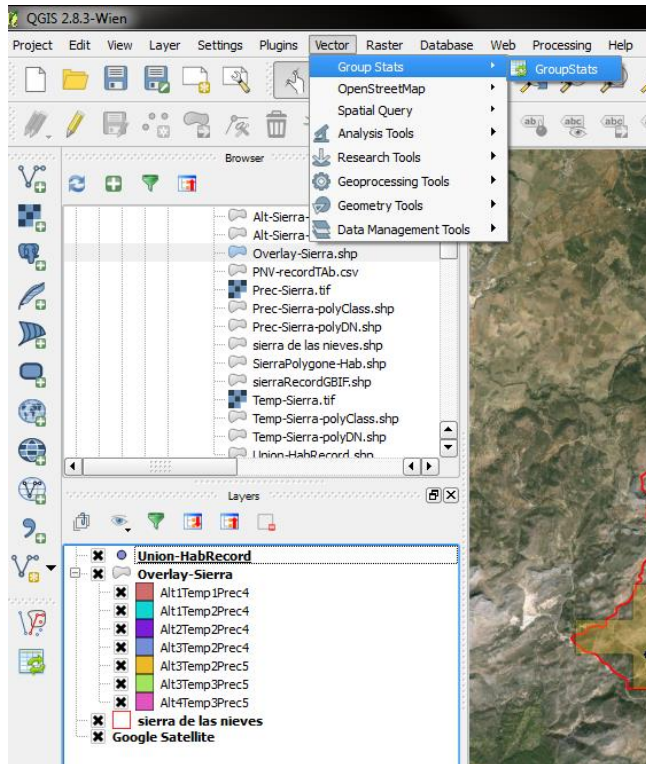
Figure 3.3.3. Drop-down menu used to open GroupStats.

Step 4: In the control panel, select in the drop down menu of **Layers** the previously created Union layer (step 3.3.1) Within **Fields**: Select the PNV class field name and drag it to the **Row** box (example Figure 3.3.2, name= TPA), select the species scientific name and drag it to the **Columns** box (example name= scientific) and drag the field unique and species for **Value**. Then click on **Calculate**

A table appear on the left of the Group Stats dialog box, click on **Data**, then **Save all to CSV file**, to save the floristic table (presence of species occurrence data per PNV class).
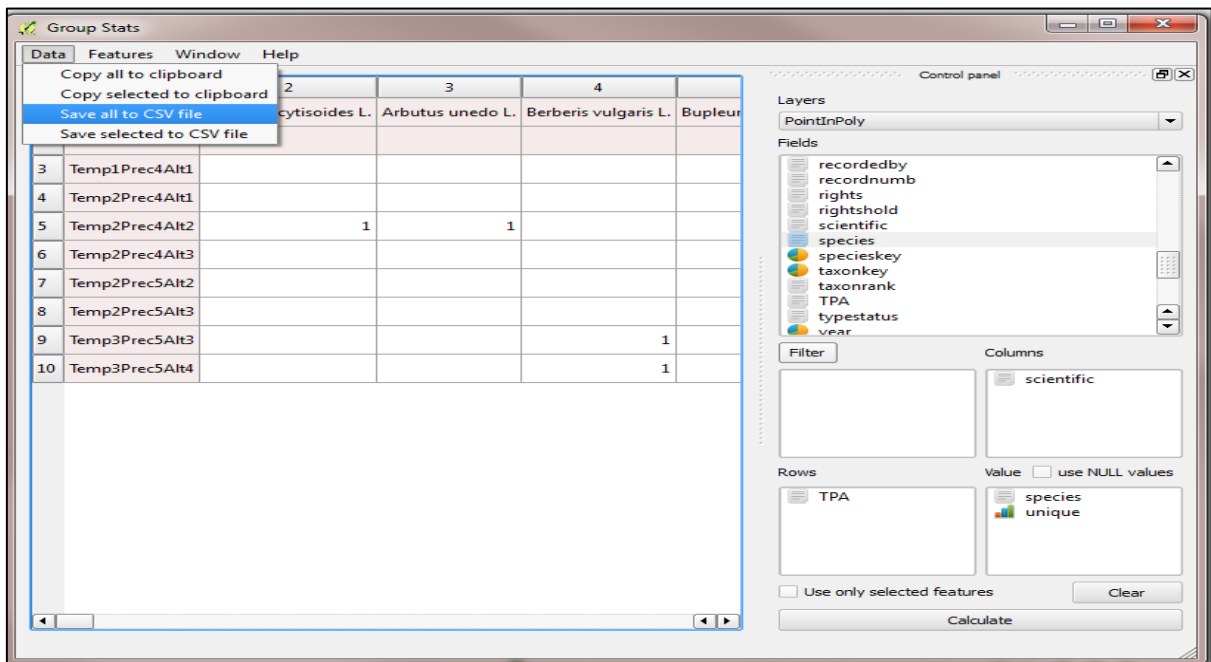
Figure 3.3.4. Group Stats dialog box to create the table species occurrence data per PNV class.

3.4 Field survey

Objective: The amount of data available on open access databases such as GBIF varies enormously from country to country. Therefore, to acquire distribution data about known species of conservation interest will require additional fieldwork.

These data can be compiled in .csv spreadsheets and added to your habitat mapping project the same way as described in section 3. These can then be extracted and added to habitat maps and incorporated into zoning for prioritization.

Section Four

Zoning

Objective

It can be beneficial to split an IPA or other Protected Area into small and manageable units, and to apply various management options to these units. This can be to prioritise areas which are rich in species, contain significant numbers of threatened or endemic species, or contain particular good examples of pristine habitat. It can also be to constrain certain activities in different areas that would otherwise be damaging to the features of the IPA requiring conservation.

This section gives several zoning options, and points to above sections that can be used to achieve such zoning measures.

4.1 Habitat quality

As many habitats have become degraded over time, conservation targets often prioritise existing habitats that are in good condition – for example, they show little or no signs of degradation and retain their component species. Degraded habitats will show obvious signs of human intervention, and may be less diverse in terms of species, or may include invasive species. Giving habitat quality scores to different areas within an IPA can help to prioritize actions and conservation measures: these zones may have different rules applied to them. For example, certain activities may be restricted within high quality habitats, whereas they may be allowed in lower quality habitats.

Habitat quality can be ascertained through expert knowledge of the sites themselves, or by using satellite imagery, or in the absence of expert knowledge field surveys comparing similar habitats in different areas can be undertaken.

In a complete lack of expertise, data or knowledge, PNV maps can be compared to satellite or field survey data to ascertain which areas of potential habitat still remain intact.

Habitat quality value can be added to the attributes table of polygon defining these habitats (by adding a column in the attribute table, see section 1.4 to 1.6).

High quality habitats or those at least threat from anthropomorphic activities can be prioritized, and protected by buffer zones (see 4.5) or though prescriptive measures identified on the ground

4.2 Threats

Many threats affecting plants and habitats can be discerned. Some of these threats will be identified and it is possible to delineate some areas particularly affected by human activities within IPAs through satellite image or by downloading some specific GIS layers (land use, urbanization etc.). This includes roads, habitations, agricultural expansion or other anthropogenic uses (quarries, industrial units etc.).

The identification of these threats is essential to suggest efficient and specific conservation actions to limit such activities in high priority areas in order to preserve wild species and habitats.
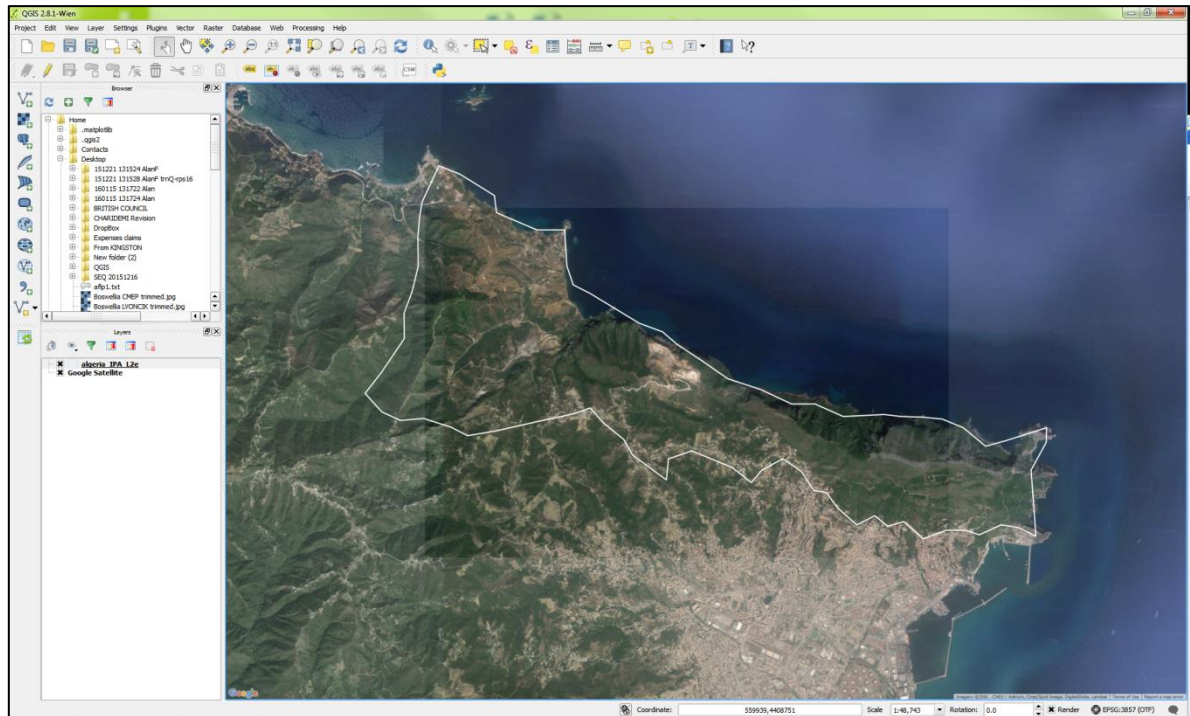
Figure 4.1. IPA boundary of the National Park of Gouraya (Algeria).

The example of the National Park of Gouraya IPA (Figure 4.1) shows clearly the presence within its boundary of urban area, and also a major quarry located in the north central area. There are also access roads and tracks visible. Zoning might identify remaining high quality habitats and the occurrence of threatened or endemic species, and restrict further anthropomorphic activities within them. It is also possible to restrict activities in a barrier around high quality habitat areas, in order to restrict impact to further distances away from fragile habitats.

These threats directly related to human activities modifying the habitat can be delineated as polygons using QGIS, and to be implemented in the management plans.

4.3 Habitat zoning

As habitats refer to a homogeneous biological community / vegetation supported by common environmental conditions, habitats usually host a number of different species. How many of these species are threatened or endemic? What ecosystem services do they provide? As for the threats and quality of habitat, this information must be collected and added into the habitat maps in GIS as described in Section One and Section Three. All this data will have a significant impact on zoning plans, especially to demonstrate which habitat areas are of high priority.

4.4 Species Occurrence data

Using the methods of the Section Three, the species occurrence data can be added to the spatial layers. Although the habitats of high quality are likely to contain more endemic species, low quality habitats are more likely to

contain endangered species that are threaten by human activities or low quality of the habitat itself.

Coupling the species-occurrence data with the polygons that contain information about land use and threats using methods of the first and third parts are therefore interesting to. This will give information to prioritize actions to conserve such species.

4.5   Buffer Zones

Above it has been mentioned that certain actions could be restricted, depending on proximity to threats or the presence of species of conservation importance. In nature conservation, a buffer zone is often created to enhance the protection of areas under management for their biodiversity importance. A buffer zone is a spatial area and zoning tool that lies between a highly valuable zone and the menace to protect and limit the harmful human actions, it will segregate the high priority zone.

It should be remembered that, while habitat units can be identified without field work at a broad scale using the methods above, species occurrence data, zoning plan or the description of buffer zones cannot be complete described upon limited data.

As well as zoning, all management plans should contain detailed additional data to fully understand and conserve wild plants and habitats for and with people within IPA.

Section Five

Field Survey

The best way to accurately identify and classify contemporary habitats and vegetation classes is through detailed and extensive field survey. We always recommend that habitat mapping is achieved through field survey. However, this can be very time consuming, hence the description above of methods using satellite imagery, expert knowledge and PNV mapping which can be achieved efficiently and at less expense.

In the absence of expert knowledge about the habitats, vegetation and taxa in a given area, field survey will still be required. This can be for a number of reasons:

- Detailed information on the distribution and occurrence of threatened or endemic species.
- Formal vegetation classification that cannot be predicted accurately through PNV mapping.
- Habitat quality assessments and threats.
- Mapping small or unique habitats that are difficult to assess via satellite imagery, for example cliff vegetation or freshwater habitats.

To include species occurrence data relating to threatened or endemic taxa, these data should be georeferenced in the field and incorporated into habitat maps using the methods described in Section Three of this handbook.

Field surveys should be used to mark / name the polygons representing habitats created using the methods described in section one of this handbook, to establish the quality of habitat and threats. Also they are a great help to refine the limits of these polygons or delineate the small but unique habitats difficult to identify from satellite images or PNV classification.

The annex II shows an example of a simple survey form that can be used to record information of this type. It includes space to record site specific information, as well as details about habitats observed and the level of degradation. Data on the presence and abundance of plant species can be used in formal analyses to distinguish among distinct vegetation types, and to categorise them by their characteristic taxa. The methods to do this are beyond the scope of this handbook.

For record keeping, we recommend the use of panoramic photography at fixed reference points as a record of habitat quality and monitoring. Such reference points should be located via GPS and extensive notes taken on the features leading to any assessment of habitat quality so that changes over time can be assessed.

Conclusion

This document has introduced some basic functions of QGIS, and how they can be used for habitat mapping and input into zoning methodology in the south and east Mediterranean region.

In this region, an absence of any formal or available country level habitat or vegetation mapping hinders concrete habitat and species level zoning plans within Important Plant Areas. The following methods have been proposed and described to remedy or alleviate this issue:

- Creating polygons and using them to delineate habitat zones based upon satellite imagery and expert knowledge.
- Creating Potential Natural Vegetation map, and then compare them with satellite images and check the existence and quality of habitats.

- Incorporating species occurrence data and the ability to compare amongst habitat zones
- The use and incorporation of field survey data to improve the two habitat mapping methods (using satellite image and PNV), assess the quality and threats of habitat or increase the amount of data on species.
- Outline the use of spatial data in management zoning and providing examples of how such data can be used to achieve management objectives, depending on the requirements of the responsible authorities.

Glossary

Attribute: Data contained within a vector layer that can be displayed, classified and manipulated through the attributes table. These non-spatial characteristics of the entities, they are also called properties. They are supported in attribute tables of a data layer.

CSV: Comma Separated Value (.csv). This is a standard spreadsheet file type for storing information in columns.

DAFOR: Abundance scale for recording the relative occurrence of plant species in vegetation surveys. D = Dominant. A = Abundant. F = Frequent. O = Occasional. R = Rare.

Feature: The concept of spatial feature refers to the vector layer. These features can be points, lines or surfaces and are determined by their contours by coordinates (x, y). In raster spatial features are all identical cells of a grid. In our case, the features will represent units of conservation interest within IPA (e.g. habitat, the point of occurrence of threatened and endemic species).

Habitat: The term "habitat" used within this document refers to a homogeneous biological community / vegetation supported by common environmental conditions.

IPA: Important Plant Area.

Layer: In GIS, data are organized in the form of overlapping layers, each of which bring together similar features. Layers can be viewed individually or together, and data contained within them used in comparative mapping and analyses.

Polygon: A polygon is a shape bounded by three or more sides. Regular polygons are named for their number of sides (for example triangle, square). Polygons are drawn to encompass spatial features in GIS applications, in this case corresponding to habitat or vegetation areas.

Plugin: A plugin is an additional piece of software that can be added to QGIS to give additional functions.

Raster data: A representation of the world as a surface divided into a regular grid of cells. Raster models are useful for storing data that varies continuously, as in an aerial photograph, a satellite image, or an elevation surface.

Shapefile: A standard file format (.shp) for vector layers in GIS applications.

Vector data: A representation of the world using points, lines, and polygons. Vector models are useful for storing data that has discrete boundaries, such as country borders, land parcels, and streets.

Zoning: The concept of zoning in conservation management is used to define sub-units that may contain different features (for example habitats, species), or that might be of different quality (degraded or not), or that might require different management options or restricted activities for the conservation of features. These different "zones" may be treated differently and as distinct management units in management plans.

Annex I: Additional Information

It is recommended to read the information about:

The Print Composer; to create nice maps and atlases that can be printed or saved as PDF-file or an image, include legends etc.:

http://docs.qgis.org/2.8/en/docs/user_manual/print_composer/print_composer.html

The Vector Properties Dialog; it provides information about the layer, can be used to modify symbology settings and labelling options:

http://docs.qgis.org/2.8/en/docs/user_manual/working_with_vector/vector_properties.html

Annexe II: Example of simple survey form

Country:		IPA:	
Locality:			

Botanist 1			Botanist 2		
Name	First name		Name	First name	

Date	
Unique survey number	
Size of the record (KM²)	
Panorama	
Picture / photo	
Substrate	

Geographical coordinates (GPS)	
Coordinate system (e.g.WGS84):	
X Coord. longitude	
Y Coord. latitude	

Vegetation	Coverage
Trees	
Shrubs	
Herbs	
Outcrops	
Rocks	
Bare soils	

Dafor Scale	
D (dominant)	>75%
A (abundant)	51-75%
F (frequent)	26-50%
O (occasional)	11-25%
R (rare)	<10%

Comments	
Disturbance	

Habitat:	

Vegetation survey

Species	DAFOR	Species	DAFOR