USING SPATIAL INFORMATION TO SUPPORT DECISIONS ON SAFEGUARDS AND MULTIPLE BENEFITS FOR REDD+

STEP-BY-STEP TUTORIAL:

HOW TO PRODUCE A MATRIX STYLE LEGEND USING BOTH VECTORS AND RASTERS WITH OPEN SOURCE USING QGIS 1.8 AND 2.X

UN-REDD PROGRAMME

FAO UNDP UNEP

The UN-REDD Programme is the United Nations Collaborative initiative on Reducing Emissions from Deforestation and forest Degradation (REDD) in developing countries. The Programme was launched in September 2008 to assist developing countries prepare and implement national REDD+ strategies, and builds on the convening power and expertise of the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP).

The United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) is the specialist biodiversity assessment centre of the United Nations Environment Programme (UNEP), the world's foremost intergovernmental environmental organisation. The Centre has been in operation for over 30 years, combining scientific research with practical policy advice.

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We welcome comments on any errors. Should readers wish to comment on this document, they are encouraged to get in touch via: ccb@unep-wcmc.org.

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These training materials have been produced from materials generated for working sessions held in various countries to aid the production of multiple benefits maps to inform REDD+ planning and safeguards policies using open source GIS software.

Contents

1. Introduction

REDD+ has the potential to deliver multiple benefits beyond carbon. For example, it can promote biodiversity conservation and secure ecosystem services from forests such as water regulation, erosion control and non-timber forest products. Some of the potential benefits from REDD+, such as biodiversity conservation, can be enhanced through identifying areas where REDD+ actions might have the greatest impact using spatial analysis.

Open Source GIS software can be used to undertake spatial analysis of datasets of relevance to multiple benefits and environmental safeguards for REDD+. Open-source software is released under a license that allow software to be freely used, modified, and shared (http://opensource.org/licenses). Therefore, using open source software has great potential in building sustainable capacity and critical mass of experts with limited financial resources.

This tutorial enables a user to produce matrix style legend in QGIS with vector or raster data in QGIS.

2. Create a map with a matrix style Legend

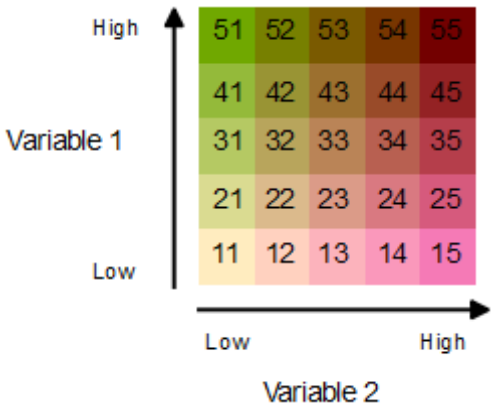
2.1. Technical summary

Displaying two thematic wall-to-wall datasets on the same map can help to visualise the relationships between two datasets. This graphical technique of creating a two-dimensional legend was first developed by Paul Williams at the Natural History Museum in the UK in a piece of software called WorldMap where it was used to display the spatial relationship of species richness between different groups of species (Williams et al, 1998). (see http://www.nhm.ac.uk/research-curation/research/projects/worldmap/rarity/index.html).

It is not possible to automatically create a 2-way matrix style legend in QGIS (or in any of the other GIS software that we are aware), therefore this tutorial takes users through a series of simple steps to manually prepare the data for display in a matrix format. There are different approaches depending on whether the two datasets to be displayed are in vector or raster format. This tutorial covers three approaches:

- using two vector datasets
- using one vector and one raster dataset
- using two raster datasets

The illustration to the left gives an example of a matrix style legend where classified into 5 classes.



2.2. Matrix legend using two vector dataset (using QGIS 1.8)

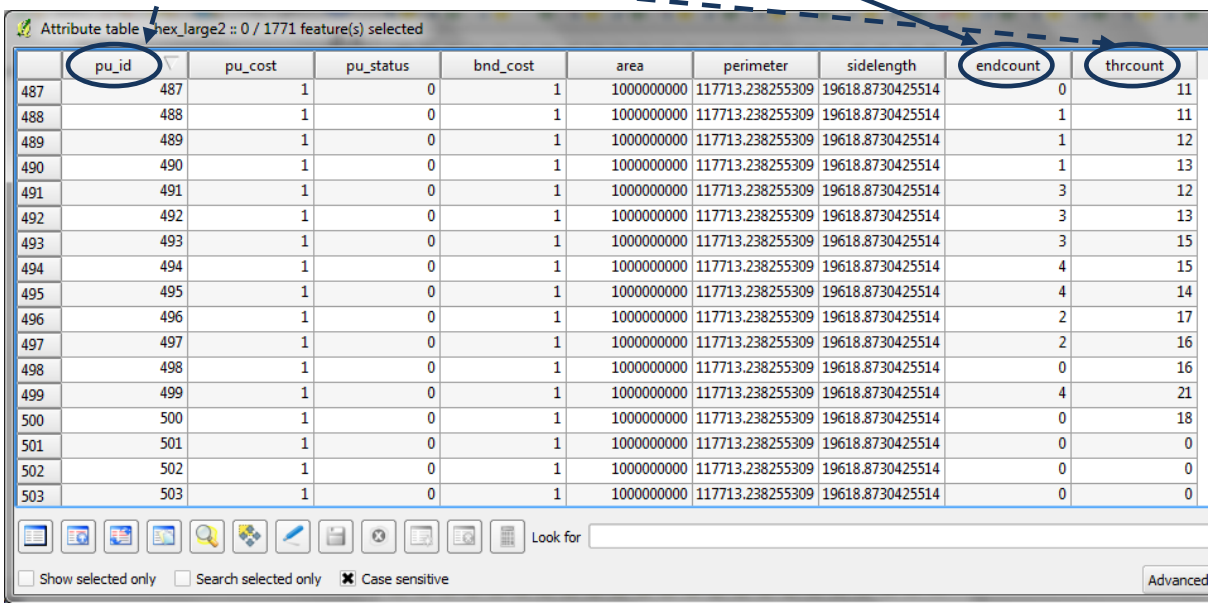
Two wall-to-wall vector datasets are needed to create the matrix map. In addition to these, a vector dataset to use as the summary units is required. This could be a vector grid of squares or hexagons of equal area. Each wall-to-wall vector datasets is analysed against the square/hexagon summary units dataset and an attribute is added to the squares/hexagons dataset and the summary value calculated. In the following example one variable is the number of endemic species and the other is the number of threatened species.

Pre-processing of the data for the matrix legend

In the example below the summary units file is a grid of hexagons which has been generated using the **QMarxan plugin>>Create Planning Unit Grid** in **QGIS 1.8.** Then the **QMarxan plugin>>Calculate conservation values** has been run on each of the two variables to summarise. The first, a shapefile containing polygons of individual endemic species extent of occurrence and the second a shapefile threatened species extent of occurrence.

An example of the resultant attribute table post analysis is presented below

- unique ID of each hexagon (pu_id)
- number of endemic species in each hexgon
- number of threatened species in each hexagon



	pu_id	pu_cost	pu_status	bnd_cost	area	perimeter	sidelength	endcount	thrcount
487	487	1	0	1	1000000000	117713.238255309	19618.8730425514	0	11
488	488	1	0	1	1000000000	117713.238255309	19618.8730425514	1	11
489	489	1	0	1	1000000000	117713.238255309	19618.8730425514	1	12
490	490	1	0	1	1000000000	117713.238255309	19618.8730425514	1	13
491	491	1	0	1	1000000000	117713.238255309	19618.8730425514	3	12
492	492	1	0	1	1000000000	117713.238255309	19618.8730425514	3	13
493	493	1	0	1	1000000000	117713.238255309	19618.8730425514	3	15
494	494	1	0	1	1000000000	117713.238255309	19618.8730425514	4	15
495	495	1	0	1	1000000000	117713.238255309	19618.8730425514	4	14
496	496	1	0	1	1000000000	117713.238255309	19618.8730425514	2	17
497	497	1	0	1	1000000000	117713.238255309	19618.8730425514	2	16
498	498	1	0	1	1000000000	117713.238255309	19618.8730425514	0	16
499	499	1	0	1	1000000000	117713.238255309	19618.8730425514	4	21
500	500	1	0	1	1000000000	117713.238255309	19618.8730425514	0	18
501	501	1	0	1	1000000000	117713.238255309	19618.8730425514	0	0
502	502	1	0	1	1000000000	117713.238255309	19618.8730425514	0	0
503	503	1	0	1	1000000000	117713.238255309	19618.8730425514	0	0

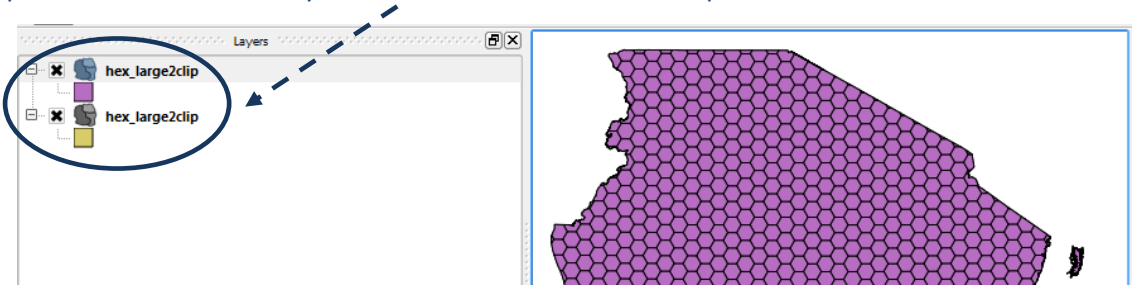
For full instructions of the above procedure, please refer to the tutorial below:

STEP-BY-STEP TUTORIAL: EXTRACTING AND PROCESSING IUCN RED LIST SPECIES DATA USING A VECTOR APPROACH IN QGIS 1.8

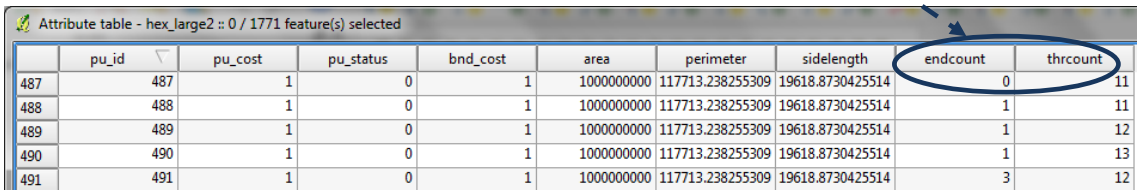
Please note: The Qmarxan extension is not yet available for QGIS 2.x

Defining class breaks for the matrix legend

a. **Add** the **summary units shapefile (hexagons/squares) which** containing the 2 variable summary values into QGIS. e.g. in this example endemic species counts and threatened species counts. Add the layer in **twice** so that there are 2 copies

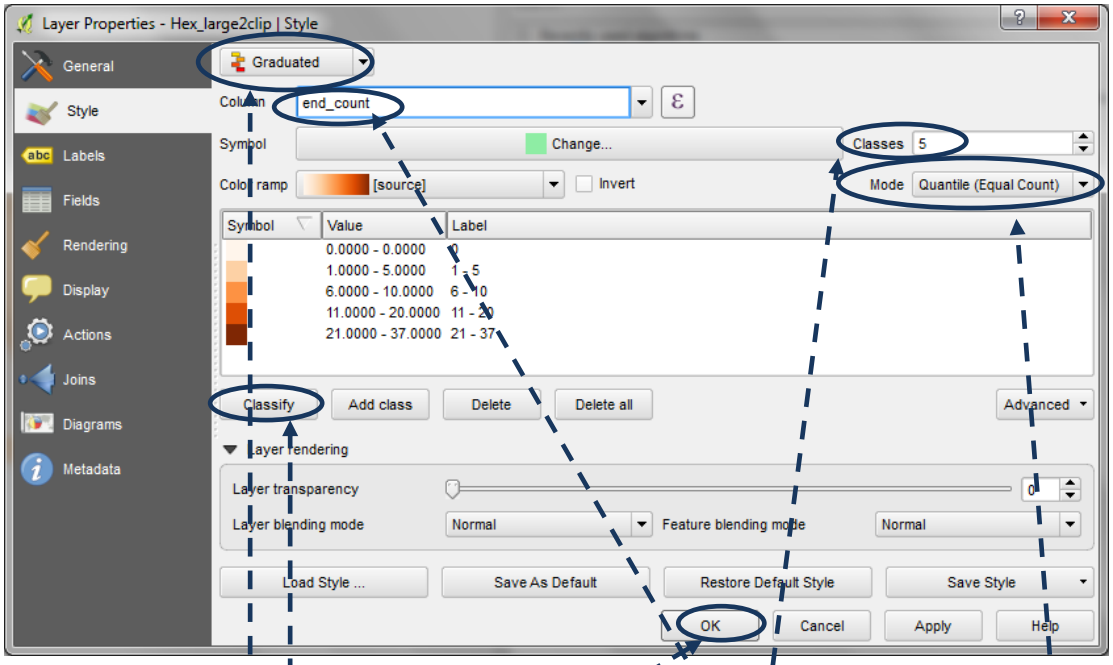


b. **Right click** on one of the copies of the dataset and click **Open the attribute table and** check that there are two columns **one for the count of the endemic species and one for the count of the threatened species**



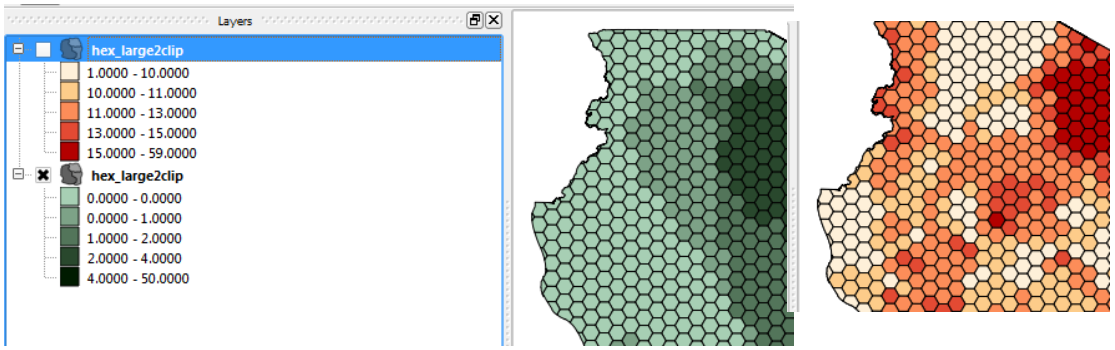
	pu_id	pu_cost	pu_status	bnd_cost	area	perimeter	sidelength	endcount	thrcount
487	487	1	0	1	1000000000	117713.238255309	19618.8730425514	0	11
488	488	1	0	1	1000000000	117713.238255309	19618.8730425514	1	11
489	489	1	0	1	1000000000	117713.238255309	19618.8730425514	1	12
490	490	1	0	1	1000000000	117713.238255309	19618.8730425514	1	13
491	491	1	0	1	1000000000	117713.238255309	19618.8730425514	3	12

c. **Right click >>properties>>Style** on one of the copies of the hexagon dataset. Symbolise the data so that it is displayed in 5 quantiles on the endemic species count column.



Change **Single Symbol** to **Graduated style,** change **column** to **endcount,** change **mode** to **Quantile (Equal count)** (or other method if preferred), **change class** to **5** (if you are creating a 5 x 5 matrix). Click **Classify** then click **OK**

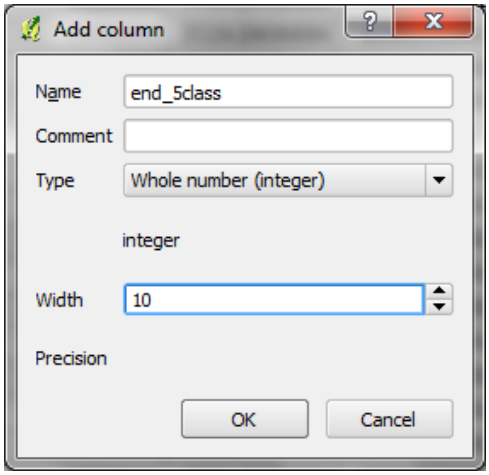
d. Symbolise the second copy of the layer in a similar way so that it is displayed in 5 quantiles on the threatened species count column



e. Next add a new column called **end5clas** of type **Whole Number (integer), Width 10**

f. Next add a new column called **thr5clas** of type **Whole Number (integer), Width 10**

g. In QGIS 1.8 click on the Advanced tab (or (or in QGIS 2.x the "select features using  expression button)



h. Make sql selections for **endcount** according to the classes in your 5 class quantiles for endemic richness. So for example:-

- if the **first class in the quantile for endemics was 0 – 4** use the SQL
  endcount <= 4
  then click the field calculator button and calculate the **end5clas** field to **1**
- **if the second class was 5 - 8** use the SQL
  endcount > 4 and endcount <= 8
  then click the field calculator button and calculate the **end5clas** field to **2**

Do this for all 5 classes

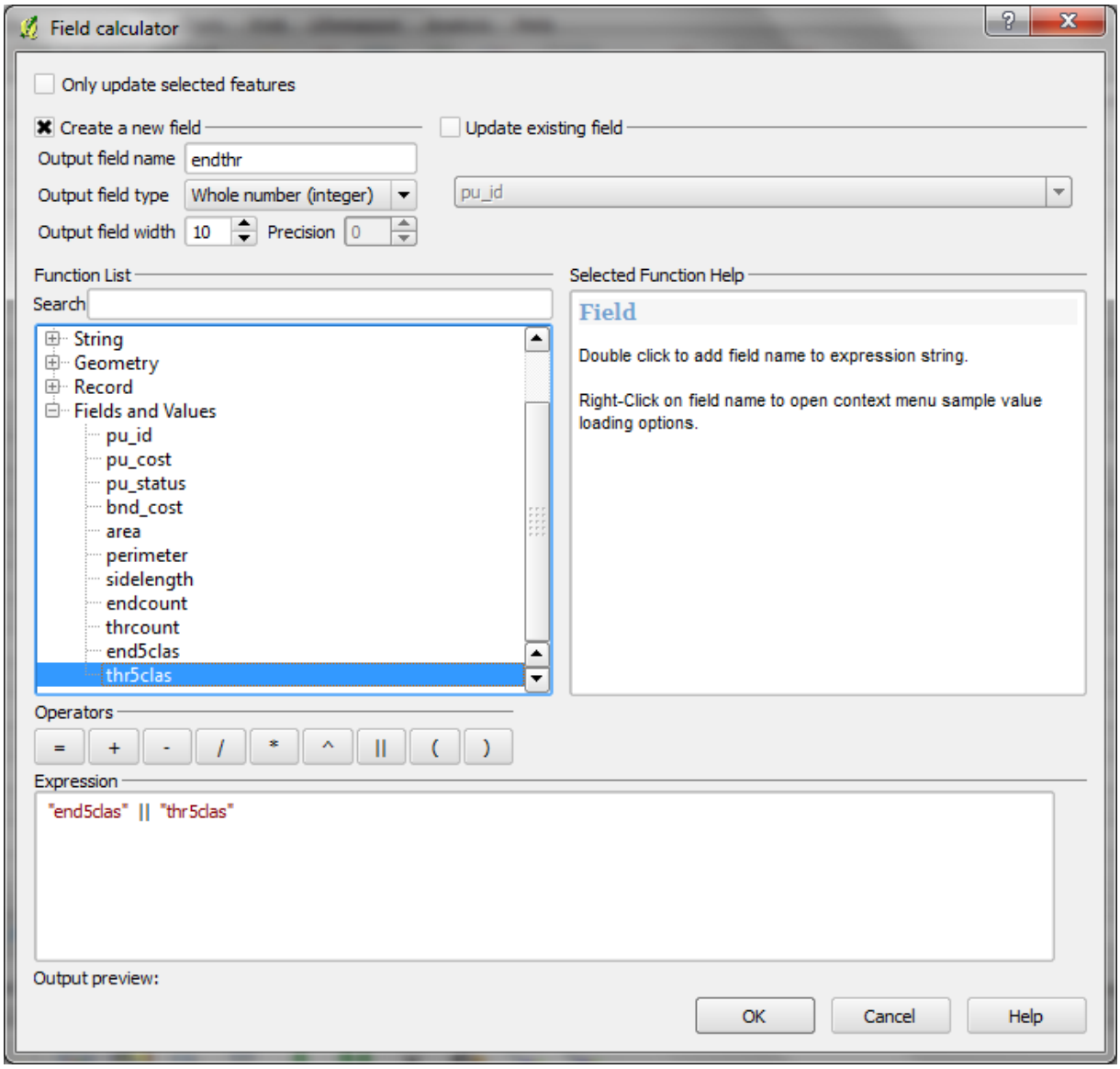
i. In QGIS 1.8 click on the Advanced tab (or in QGIS 2.2 the "select features using expression  button)

Make sql selections for **thrcount** according to the classes in your 5 class quantiles for threat richness

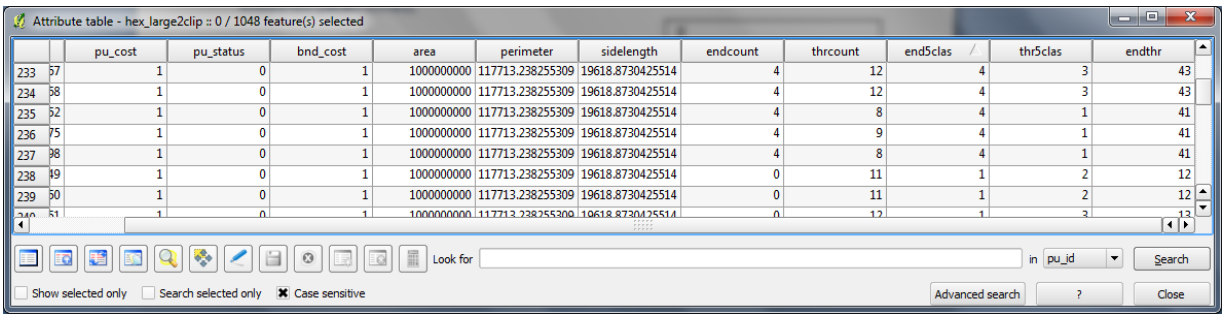
j. Then finally click the calculator and calculate a new field call it **endthr** of type **Whole Number (integer), Width 10 using an SQL query** to concatenate variable 1 and variable 2
in this example:

"end5clas" || "thr5clas"

Note: the first variable in the concatenation represents the vertical axis on the matrix and the 2nd variable the horizontal axis.



The table should now look something like the below.

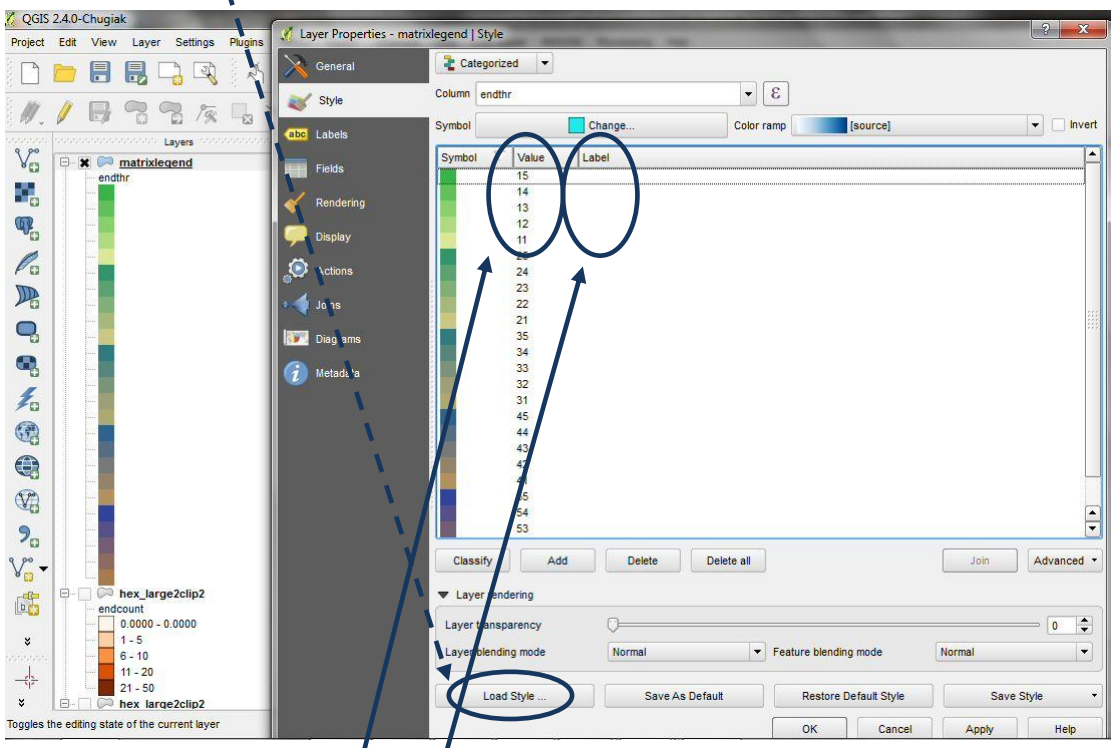


The value 11 in the endthr column represents low endemic richness and low threatened species richness and 55 represents high endemic species richness and high threatened species richness.

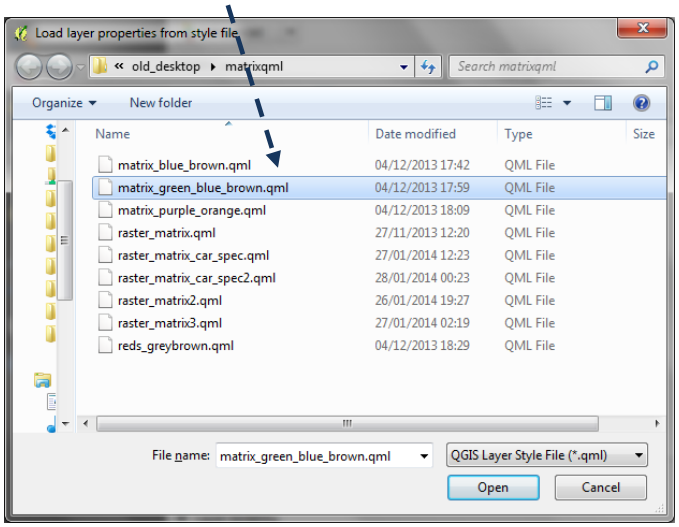
Formatting the Matrix legend and adding to the map layout

a. Add the layer into QGIS again and **right click on the dataset>>properties**

b. Click the **Load Style** button to load in a pre-prepared qml file of choice (provided with this tutorial)



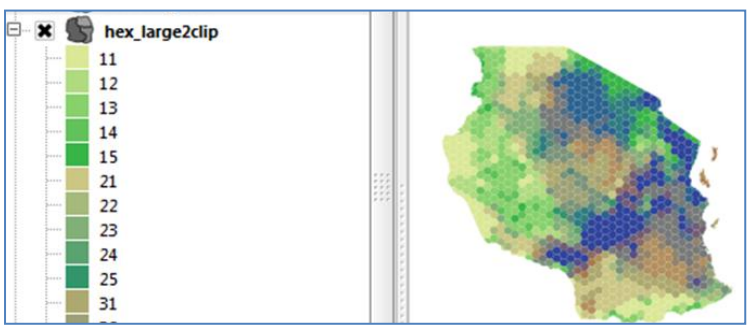
c. Pick one of the custom QML files of choice of colour scheme provided with this tutorial.



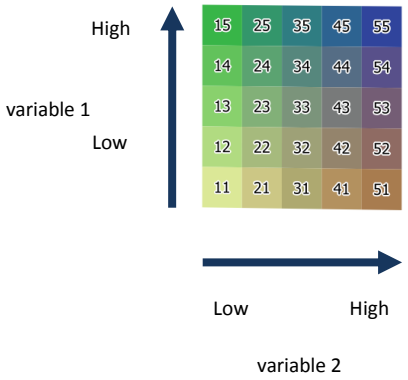
Note: The legend is formatted in a specific way so that each block of 5 numbers are sorted in reverse starting with the 10's then the 20's then the 30's then the 40's then the 50's i.e. starting with 15,14,13,12,11

Also note that the **labels** that usually appear next to the legend box **have been removed**. This is necessary in order to generate the square legend.

An illustration of the matrix_green_blue_brown.qml file is presented below:-



d. The next step is to add the map to a layout and display the legend to look similar to the illustrations right.

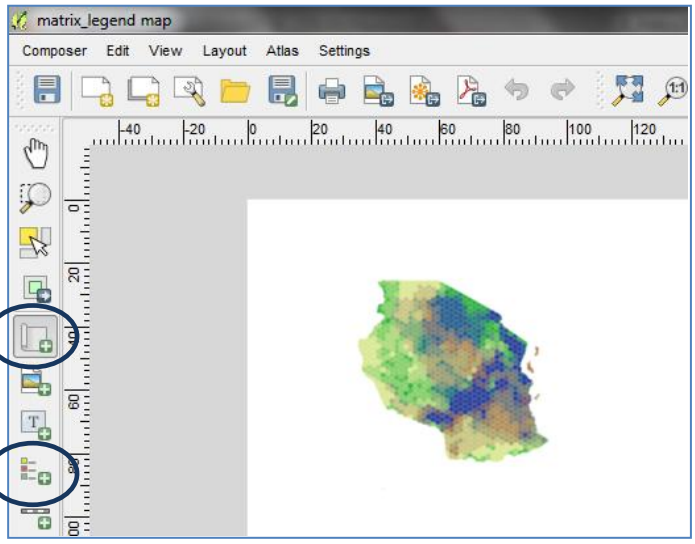


(Note: the numbers inside the boxes will not be presented on the final legend, this is just to illustrate how the reverse ordering of values in the step enable the correct ordering of the colours in 5 columns)

e. From the project menu select **project>>New Print Composer**

f. Click on the **Add new map** icon and then drag a box onto the canvas. The map appears with the layers that were ticked in table of contents in the project view window.

g. Then click on the legend button and drag a legend onto the canvas. It will appear as a single column.



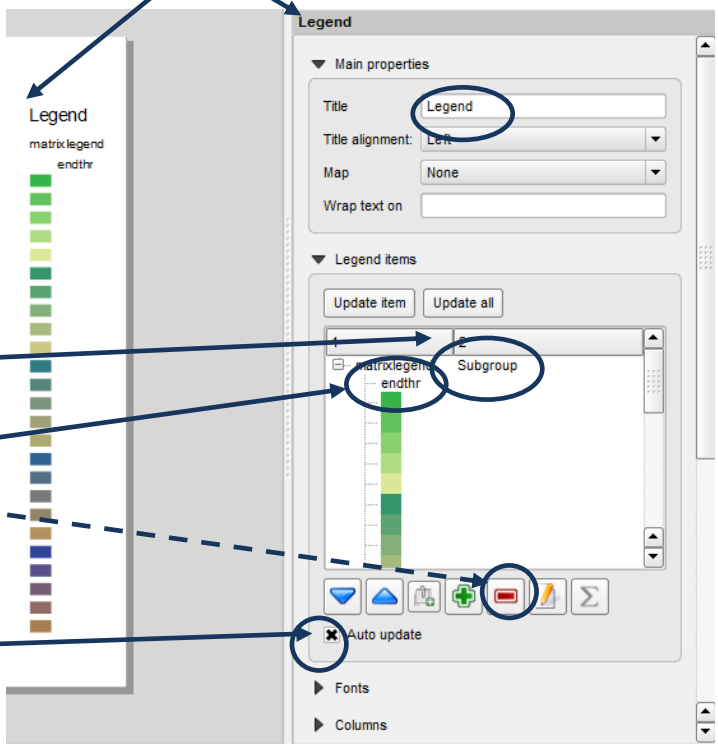
h. The legend should look similar to the illustration below (if only the matrix layer was ticked in the table of contents in the project view).

i. In order to display this legend in a matrix style only include the matrix layer (i.e. highlight each of the other layers in turn and use the **red minus** button to remove them from the legend). Other layers can be added in a separate legend.

j. Change the **subgroup** to **hidden**

k. Click on the (e.g. in this example **endthr field text**) and click the minus button

l. Remove the cross from the **Auto update** (so when new layers are added to the map they are not automatically added to this legend)



m. The legend on the map canvas should now be a single column with no text (as illustrated right)

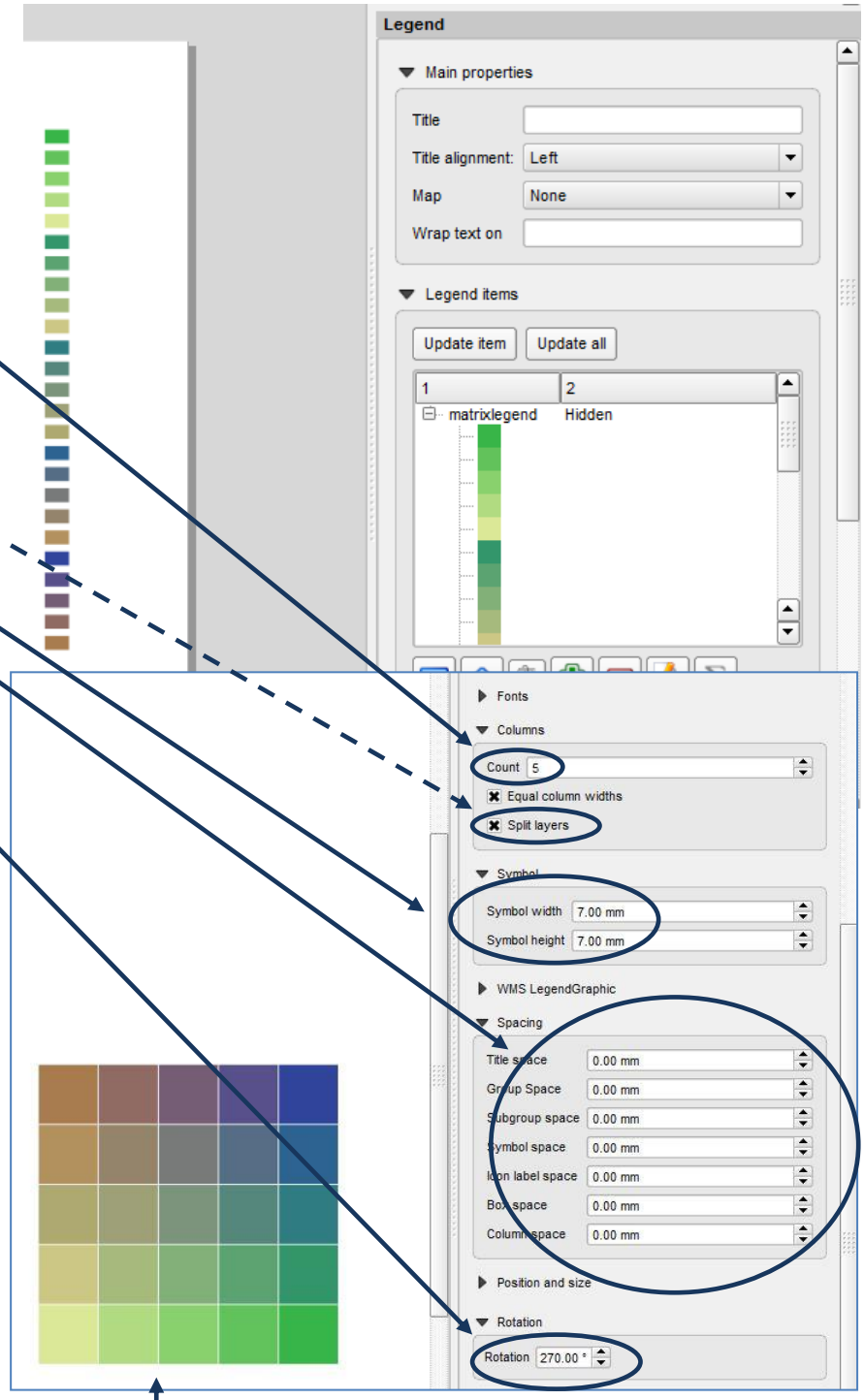
n. Next scroll down and change the number of **columns count** to **5**

o. Change the **symbol width and height** to **7**

p. Tick the Split layers box

q. Change all the spacing values to 0

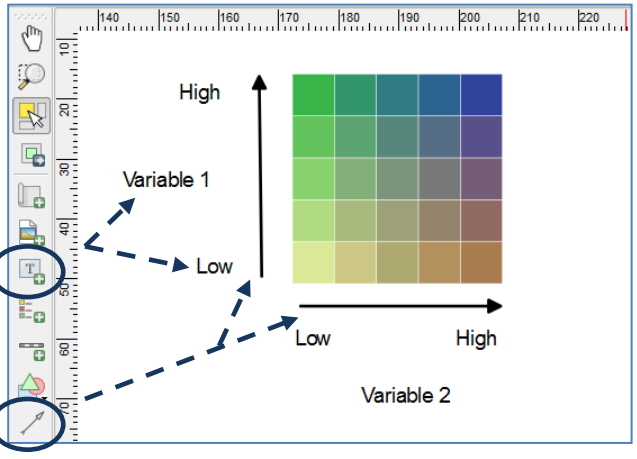
r. To position the dark colour top right change the rotation to 270



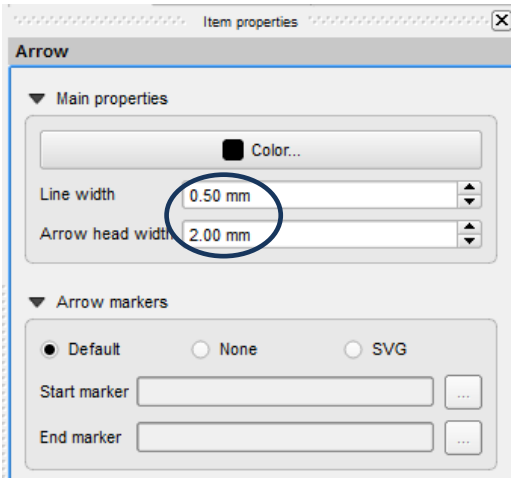
s. You should now have a **square box legend with no text and no spaces between the boxes.**

t. Next **add text manually** to label the legend using the **text button**

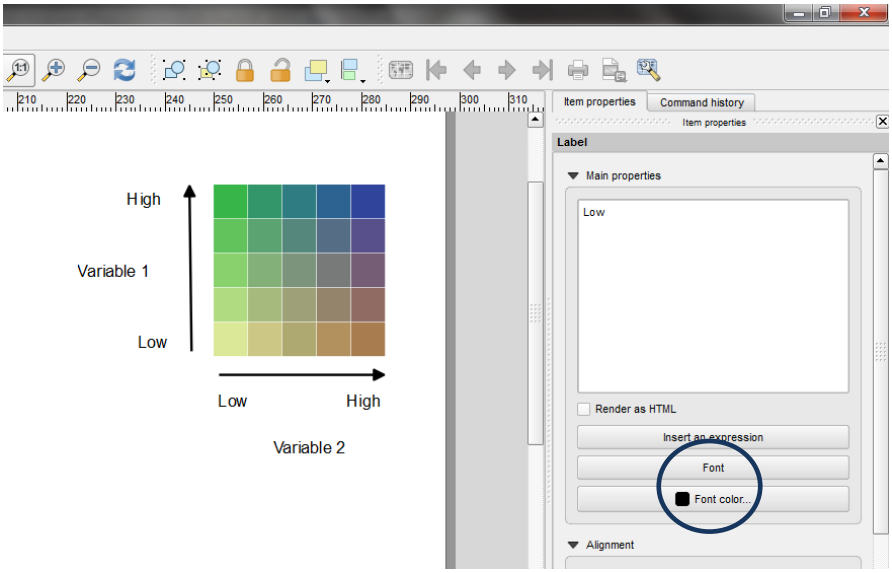
u. Next use the **arrow button** to drag horizontal and vertical arrows



v. Select the arrows and use the item properties to change the thickness of the arrow line and the size of the arrow heads



w. Similarly, select the text and use the item properties in the right hand panel to change the size of the text accordingly



The matrix legend and map using two vector datasets is now complete

If you want to have a go at creating your own matrix colour ramps see guidance in section 2.4

2.3. Matrix legend using raster datasets (using QGIS 1.8 or 2.x)

Two wall-to-wall raster datasets are needed to create the matrix map. This illustration will use an example of a raster dataset of Threatened Mammal Species Richness and raster dataset containing Woody biomass values.

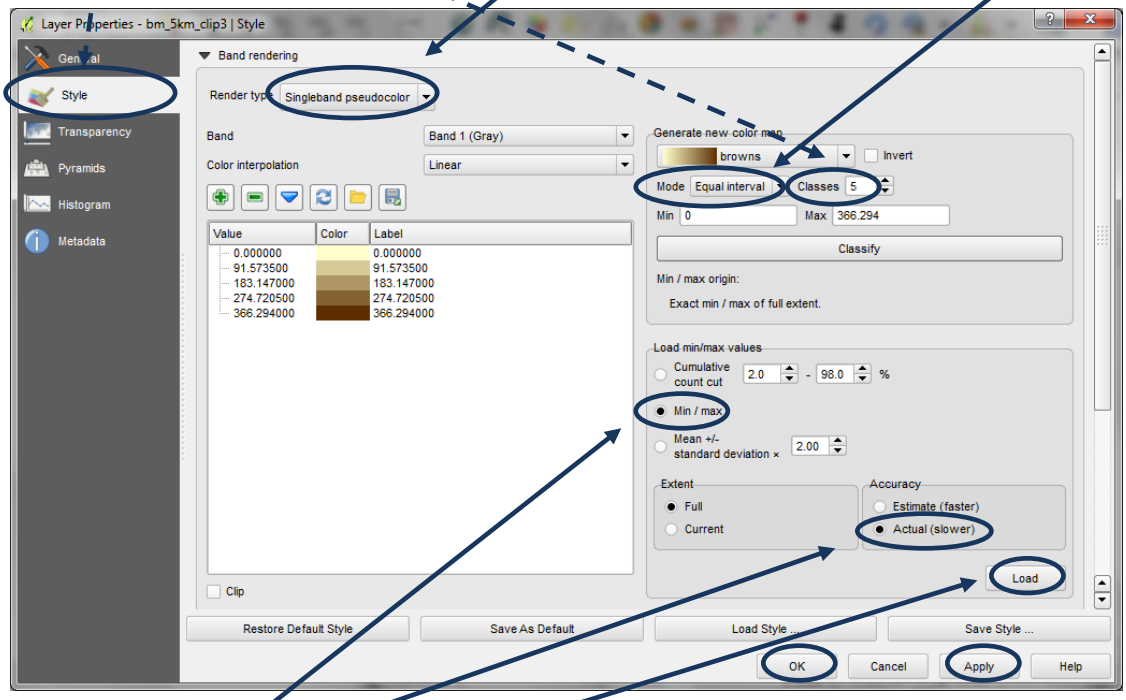
For instructions for creating a raster dataset of species richness, please refer to the tutorial:-
STEP-BY-STEP TUTORIAL: EXTRACTING AND PROCESSING IUCN RED LIST SPECIES DATA USING A RASTER METHOD IN QGIS 2.X

Defining class breaks for the matrix legend

a. Add the Woody biomass raster dataset into QGIS
b. **Right click on the dataset>>properties**

c. Click on **Style**

d. Change the **rendering type** to **Singleband pseudocolor,** Change the **Mode** to **Equal Area,** Change the number of **classes** to **5**

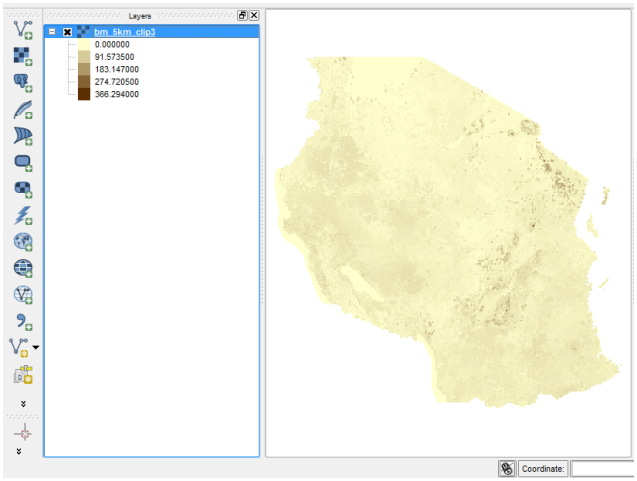


e. Click on **Min/Max** ,
Click **Actual(slower),** Click **Load,** and Click **Classify**

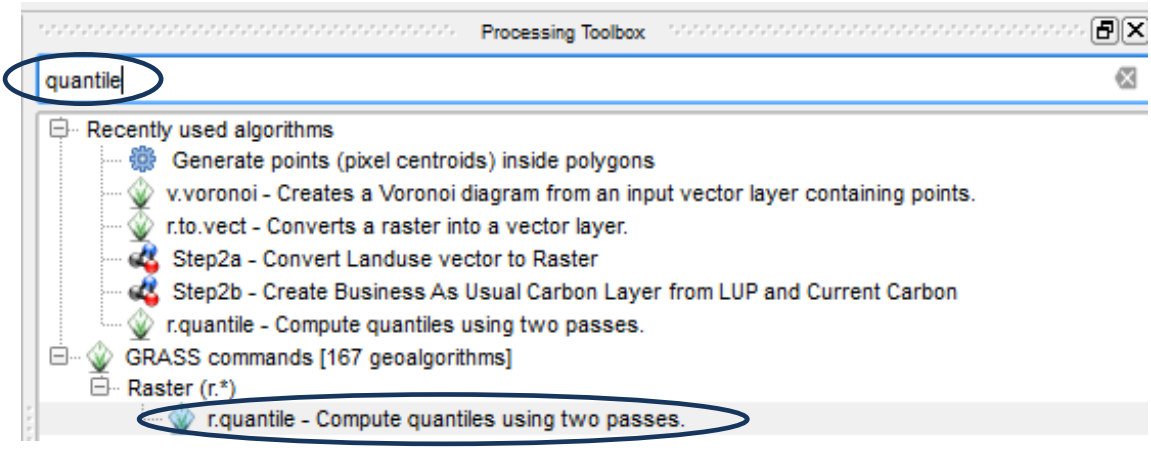
f. Click **Apply** and then **OK**

The result may look very washed out (as in the example below) if there is a wide spread of values with a large number for example in the lower classes and a few in the upper classes.

There are no automatic options for displaying the data using other types of class break when using Raster datasets in QGIS. Users can however chose to define class breaks manually or use a processing tool to generate a text file of Quantile class breaks which can then be entered manually. The next steps (g - u) illustrate how to do this.

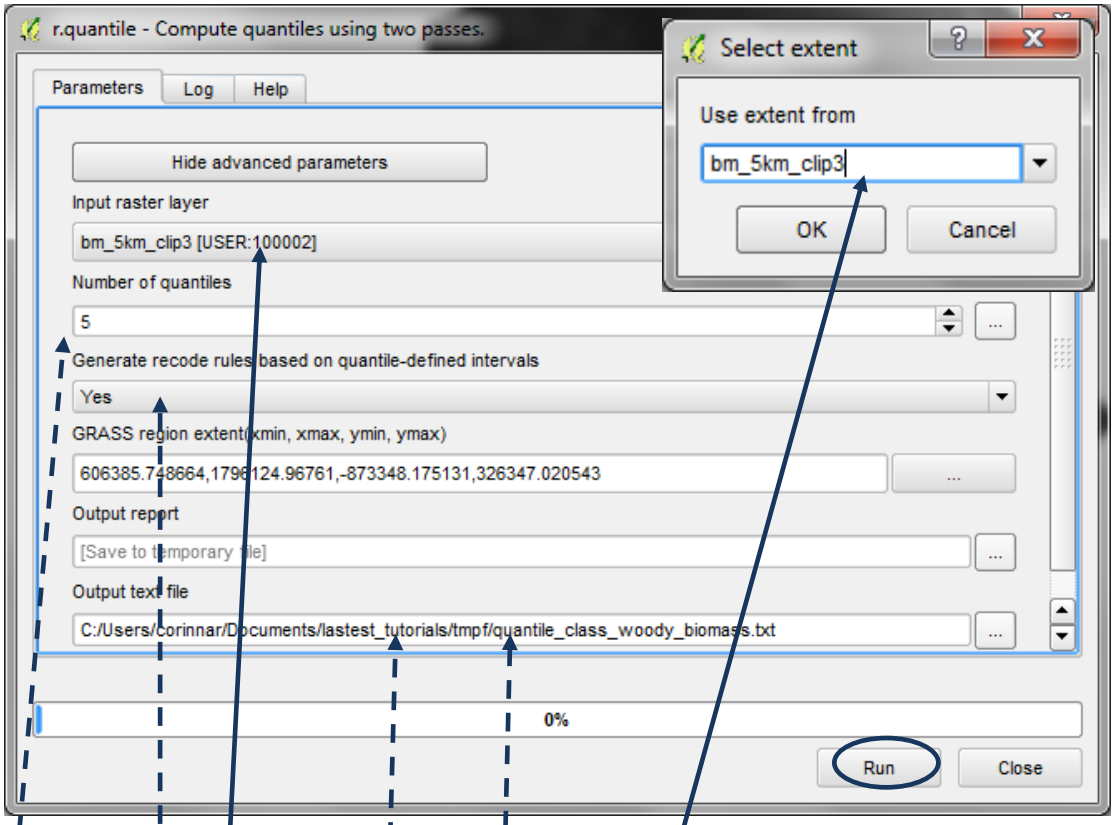


g. Search for **quantile** in the **processing toolbox** (From the main menu click on **processing>>toolbox** (if you don't already have the toolbox panel open on the right hand side of the QGIS session))



h. Double click on the **r.quantiles** GRASS tool. This will generate class breaks where each class will contain approximately the same number of pixels (i.e. each class covering the same area).

i. Click on the **Show advanced parameters**



j. Set the **input raster layer** to the raster layer you want to display in quantile class breaks

k. Chose **5** for the number of quantiles (if you are creating a 5 x 5 matrix legend)

l. Change **Generate recode rules based on quantile-defined intervals** to **yes** (this is important or it will not generate the required number of class breaks)

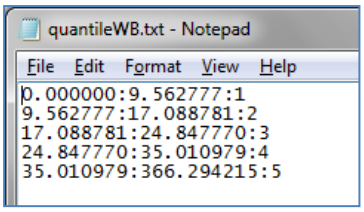
m. Set the **Grass region** as **use layer/canvas extent** and pick the raster dataset you are generating quantiles for.

n. Leave the **Output report** as **[save to temporary file]**

o. Change the **Output Text file** to **Save to File** and give it a name with a **.txt** ending.

p. Click Run.

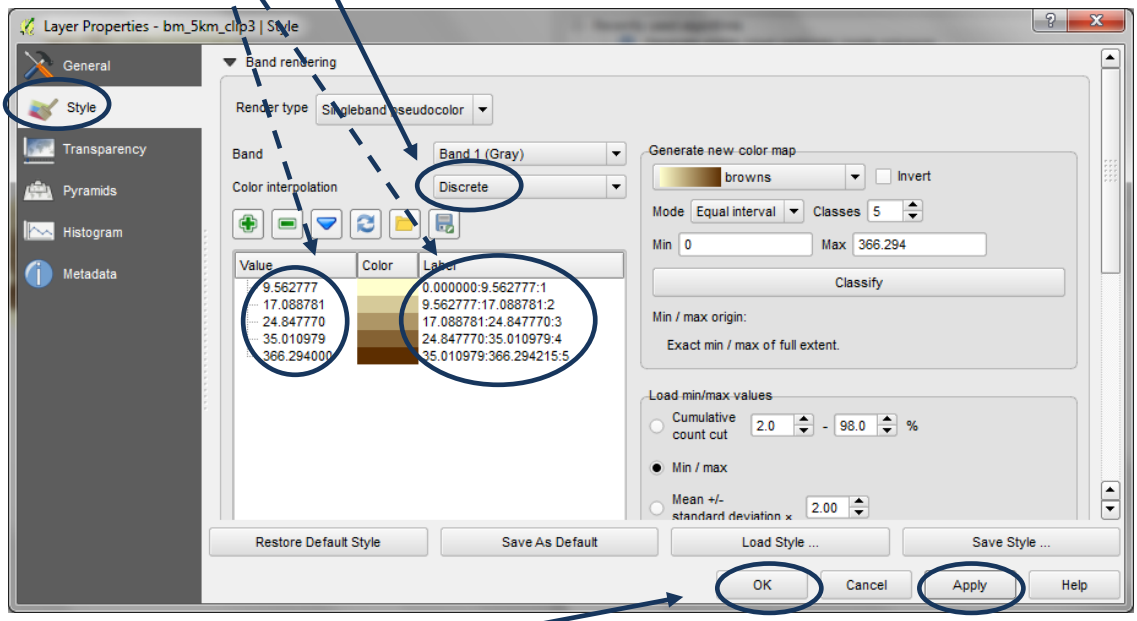
q. **Open** the **text file** that was created in a notepad to see the class breaks which have been generated



r. In QGIS **Right click** on the dataset again to bring up the **layer properties** window. Click on **Style**

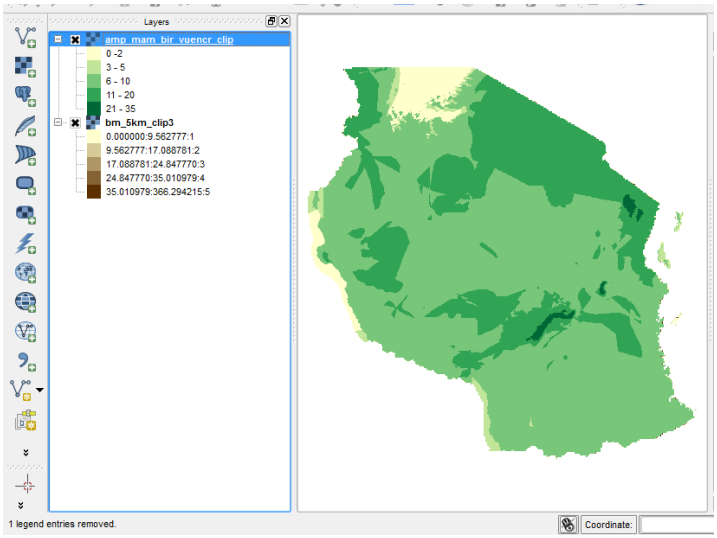
s. **Manually alter the class breaks** to your own chosen values. Remember to change both the **value and label**

t. Change **color interpolation** to **discrete**



u. Click **Apply**, Click **OK**

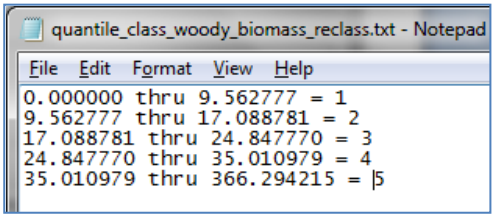
v. Repeat **steps a-u** for the **second raster dataset** to be used in the matrix legend. e.g. **threatened species richness** in this example



The next steps generate new raster datasets for the two themes based on the class breaks defined in the previous steps using the r.reclass function in the processing toolbox.

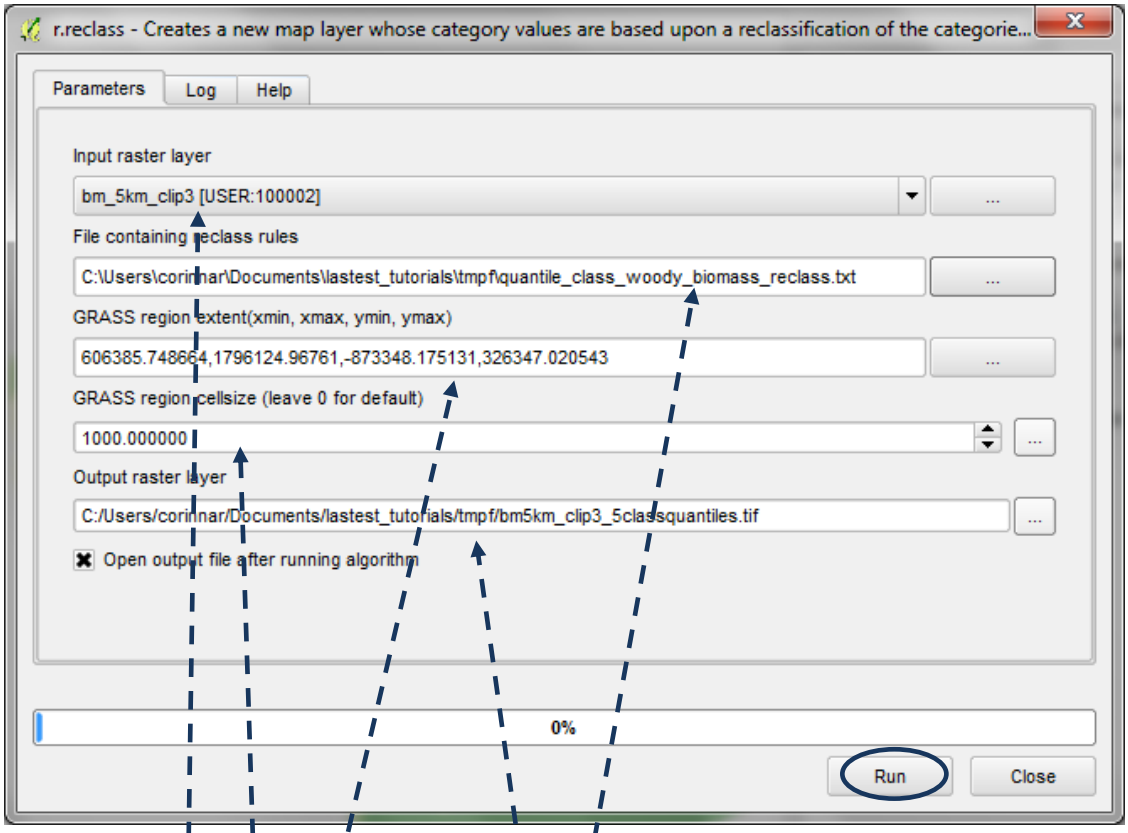
a. First a reclass tables need to be created in notepad using the following syntax. Note the thru mens 'up to' (not including) the second number in the expression

0.000000 thru 9.562777 = 1
9.562777 thru 17.088781 = 2
17.088781 thru 24.847770 = 3
24.847770 thru 35.010979 = 4
35.010979 thru 366.294215 = 5



Note if the class breaks were generated by the r.quantile process, open the txt file it produced and modify syntax to the above rather than having to type all the numbers.

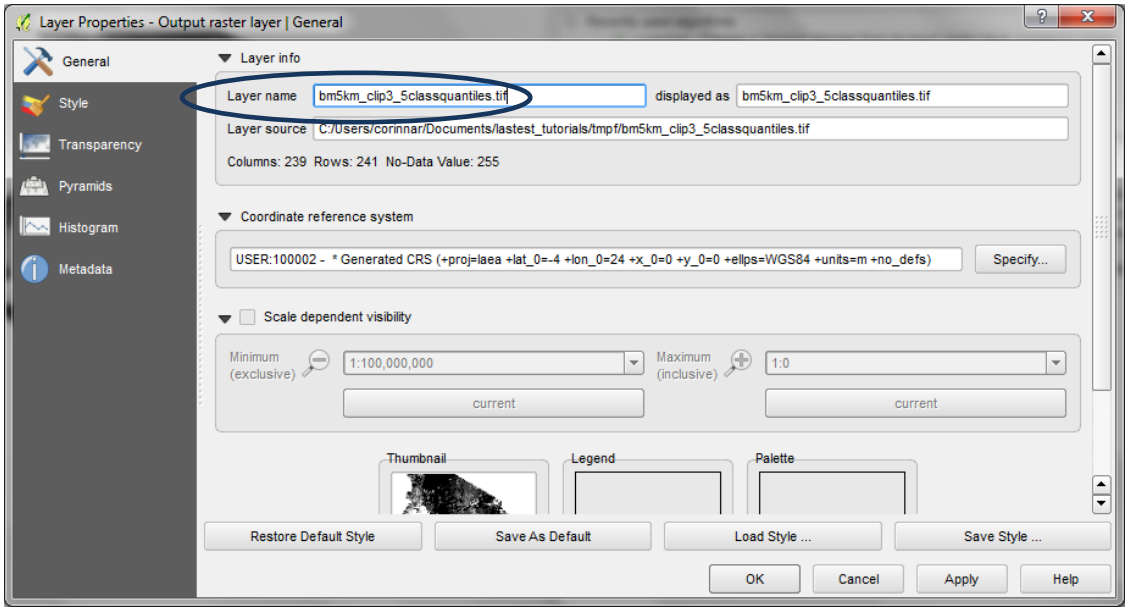
b. Search for **reclass** tool in the **processing toolbox** and **double click** on the **r.reclass GRASS tool.** This will create a **new raster dataset** with 5 classes based on the text file above.



c. Set the **input raster layer** to the raster layer you want to reclass
d. Set **the File containing reclass rules** (from step a above)
e. Set the **Grass region** as **use layer/canvas extent** to the same as the Input Raster
f. Set the **Grass region cellsize** (choose according to the minimum resolution of the two rasters to be used in the matrix map)
g. Change the **Output raster layer** to **Save to File** and give it a suitable name. **e.g. bm5km_clip3_5classquantiles.tif** in this example
h. Click **Run**

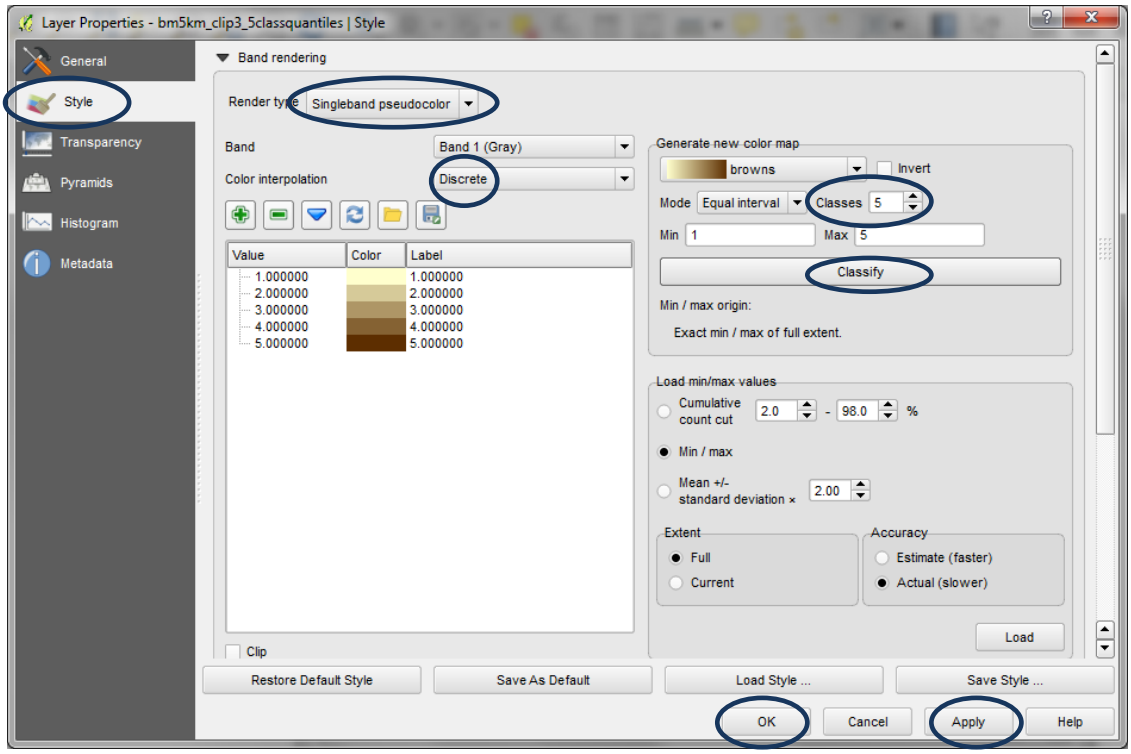
i. **Right click >> properties** on the **output raster layer** that has appeared in the table of contents

j. Click on the **general tab** and rename the **layer name** to it's proper name e.g. **bm5km_clip3_5classquantiles.tif** in this example



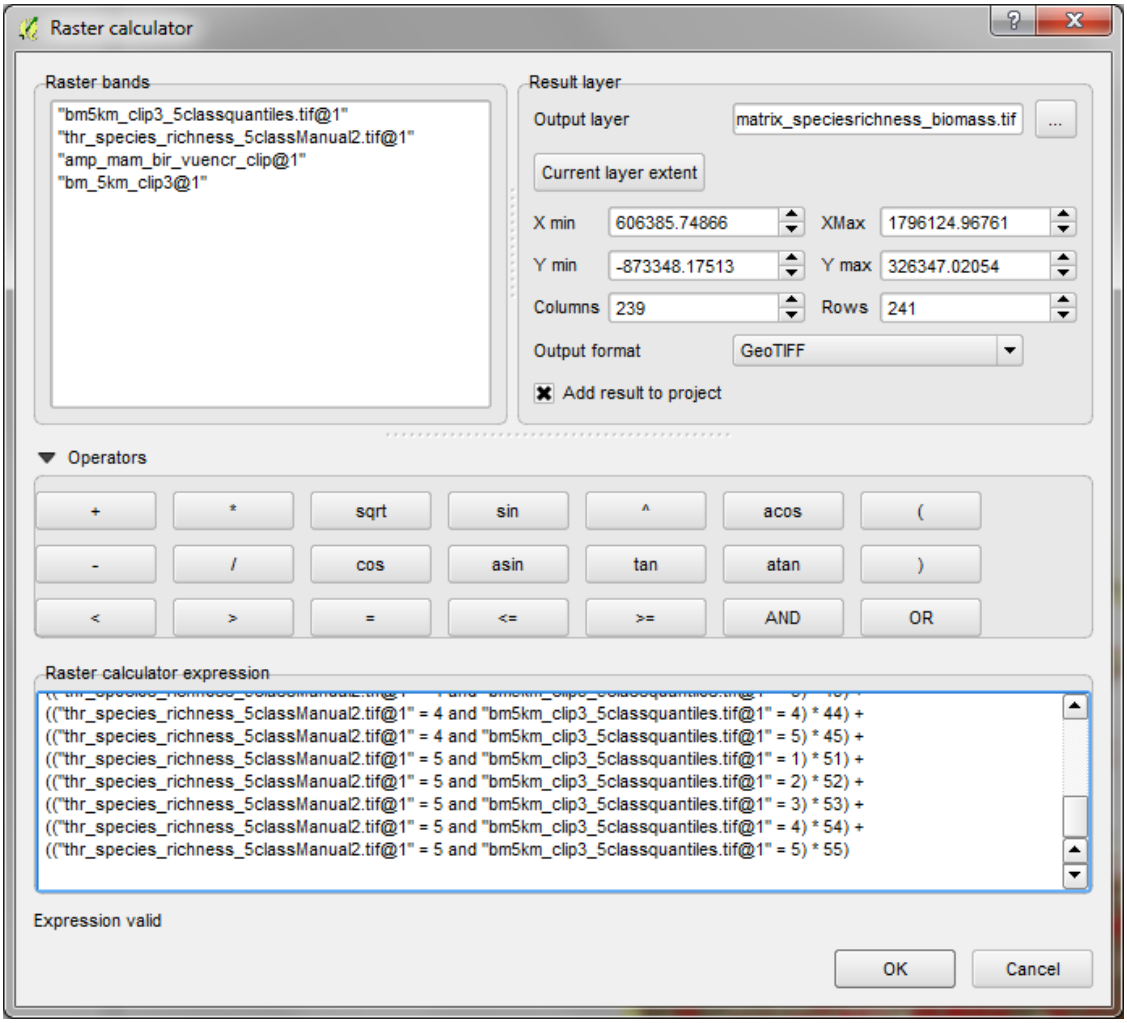
k. Click on the **style** tab

l. Symbolise the data by adding 5 manual classesin the **5 classes** (see that it only has 5 values now)



m. Repeat **steps a - l** for the second raster datasets. i.e. **threatened species richness** in this example. **BUT** Note as the number are whole number in this dataset be careful in step **a** when creating the text file. If you want **values from 0 - 2** (including 2) in the first class for example. Make sure it is defined in the reclass file as **0 thru 3 = 1** (remembering the 'thru' means 'up to').

n. The next step is to combine the two 5-class raster datasets together. In QGIS it is not possible to see the attribute table of raster datasets so this means there is in effect only 'one attribute' called value which is numeric. From the main menu click on **Raster>> raster calculator**



o. In the raster calculator expression box use the following syntax to combine the two raster datasets together. Where raster1_5class.tif in this example is the species richness and the raster2_5class.tif is the woody biomass. replace the names with the names of your 5-class datasets but keep the rest of the syntax the same.

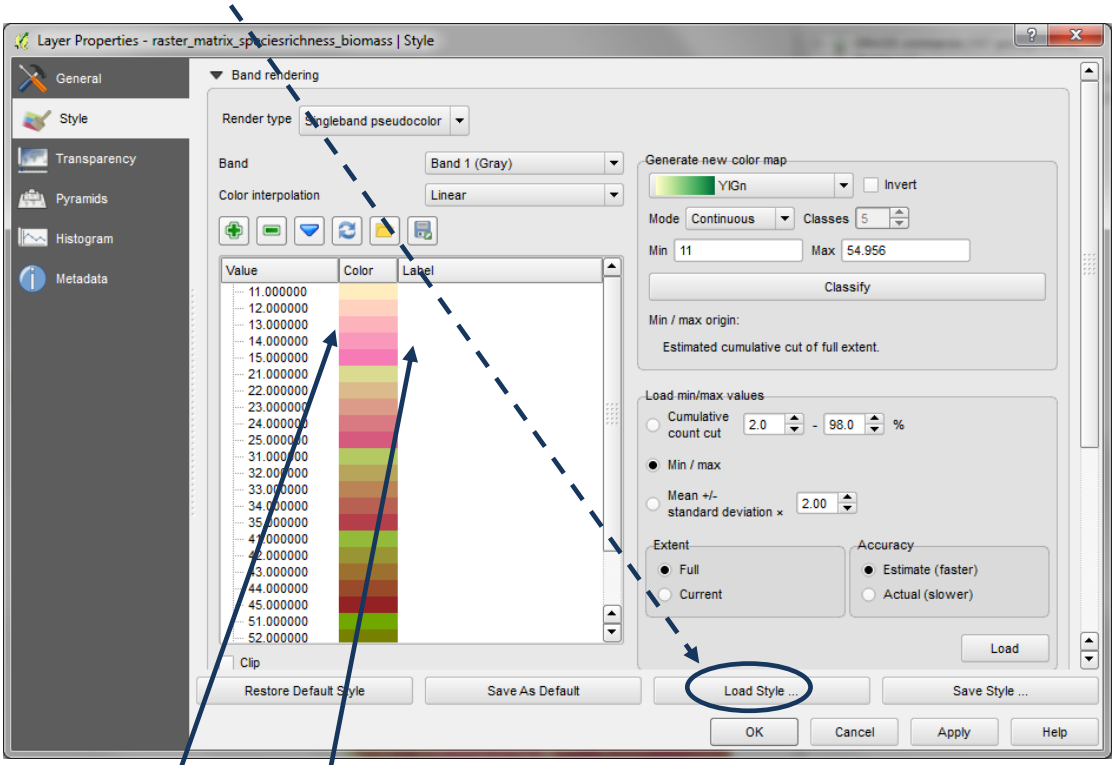
```
(("raster1_5class.tif@1" = 1 and "raster2_5class.tif@1" = 1) * 11) +
(("raster1_5class.tif@1"  = 1 and "raster2_5class.tif@1" = 2) * 12) +
(("raster1_5class.tif @1" = 1 and "raster2_5class.tif@1" = 3) * 13) +
(("raster1_5class.tif @1" = 1 and "raster2_5class.tif@1" = 4) * 14) +
(("raster1_5class.tif @1" = 1 and "raster2_5class.tif@1" = 5) * 15) +
(("raster1_5class.tif @1" = 2 and "raster2_5class.tif@1" = 1) * 21) +
(("raster1_5class.tif @1" = 2 and "raster2_5class.tif@1" = 2) * 22) +
(("raster1_5class.tif @1" = 2 and "raster2_5class.tif@1" = 3) * 23) +
(("raster1_5class.tif @1" = 2 and "raster2_5class.tif@1" = 4) * 24) +
(("raster1_5class.tif @1" = 2 and "raster2_5class.tif@1" = 5) * 25) +
(("raster1_5class.tif @1" = 3 and "raster2_5class.tif@1" = 1) * 31) +
(("raster1_5class.tif @1" = 3 and "raster2_5class.tif@1" = 2) * 32) +
(("raster1_5class.tif @1" = 3 and "raster2_5class.tif@1" = 3) * 33) +
(("raster1_5class.tif @1" = 3 and "raster2_5class.tif@1" = 4) * 34) +
```

```
(("raster1_5class.tif @1" = 3 and "raster2_5class.tif@1" = 5) * 35) +
(("raster1_5class.tif @1" = 4 and "raster2_5class.tif@1" = 1) * 41) +
(("raster1_5class.tif @1" = 4 and "raster2_5class.tif@1" = 2) * 42) +
(("raster1_5class.tif @1" = 4 and "raster2_5class.tif@1" = 3) * 43) +
(("raster1_5class.tif @1" = 4 and "raster2_5class.tif@1" = 4) * 44) +
(("raster1_5class.tif @1" = 4 and "raster2_5class.tif@1" = 5) * 45) +
(("raster1_5class.tif @1" = 5 and "raster2_5class.tif@1" = 1) * 51) +
(("raster1_5class.tif @1" = 5 and "raster2_5class.tif@1" = 2) * 52) +
(("raster1_5class.tif @1" = 5 and "raster2_5class.tif@1" = 3) * 53) +
(("raster1_5class.tif @1" = 5 and "raster2_5class.tif@1" = 4) * 54) +
(("raster1_5class.tif @1" = 5 and "raster2_5class.tif@1" = 5) * 55)
```

Formatting the Matrix legend and adding to the map layout

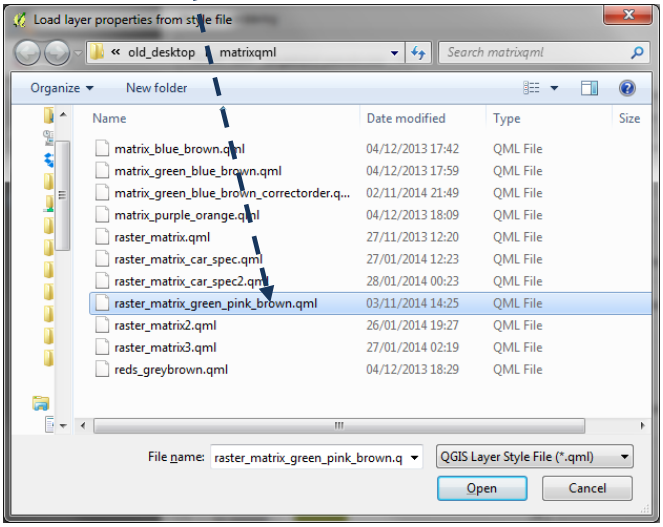
a. **Right click on the new matrix raster dataset>>properties**

b. Click the **Load Style** button to load in a pre-prepared qml file of choice (provided with this tutorial)

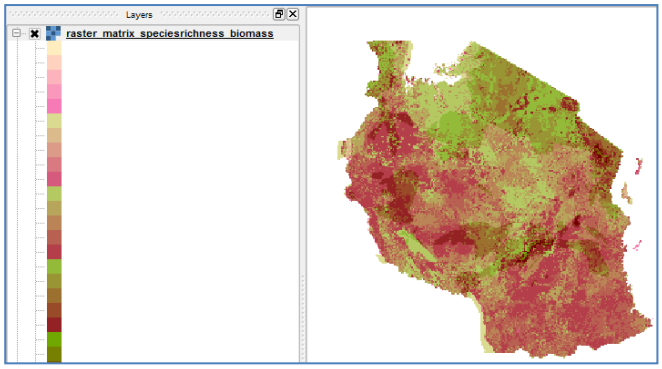


c. Pick one of the custom raster QML files of choice of colour scheme provided with this tutorial.

Note: The legend is formatted in a specific way so that **each block of 5 numbers are coloured in a ramp** which when presented in 5 columns forms a two-way ramp of colours. Also note that the **labels** that usually appear next to the legend box **have been removed**. This is necessary in order to generate the square legend.



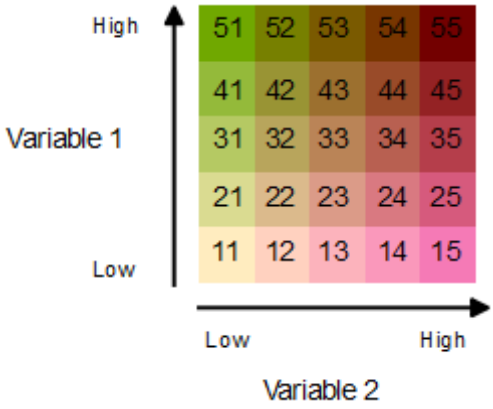
An illustration of the matrix dataset with the raster_matrix_green_pink _brown.qml file is presented here.



The next step will be to add the map to a layout and display the legend to look similar to the illustrations right.

(Note: the numbers inside the boxes will not be presented on the final legend, this is just to illustrate the final position of the numbers in the 5 columns)

In the example map above Threatened species richness (Variable 1) was combined with Woody biomass (Variable 2).



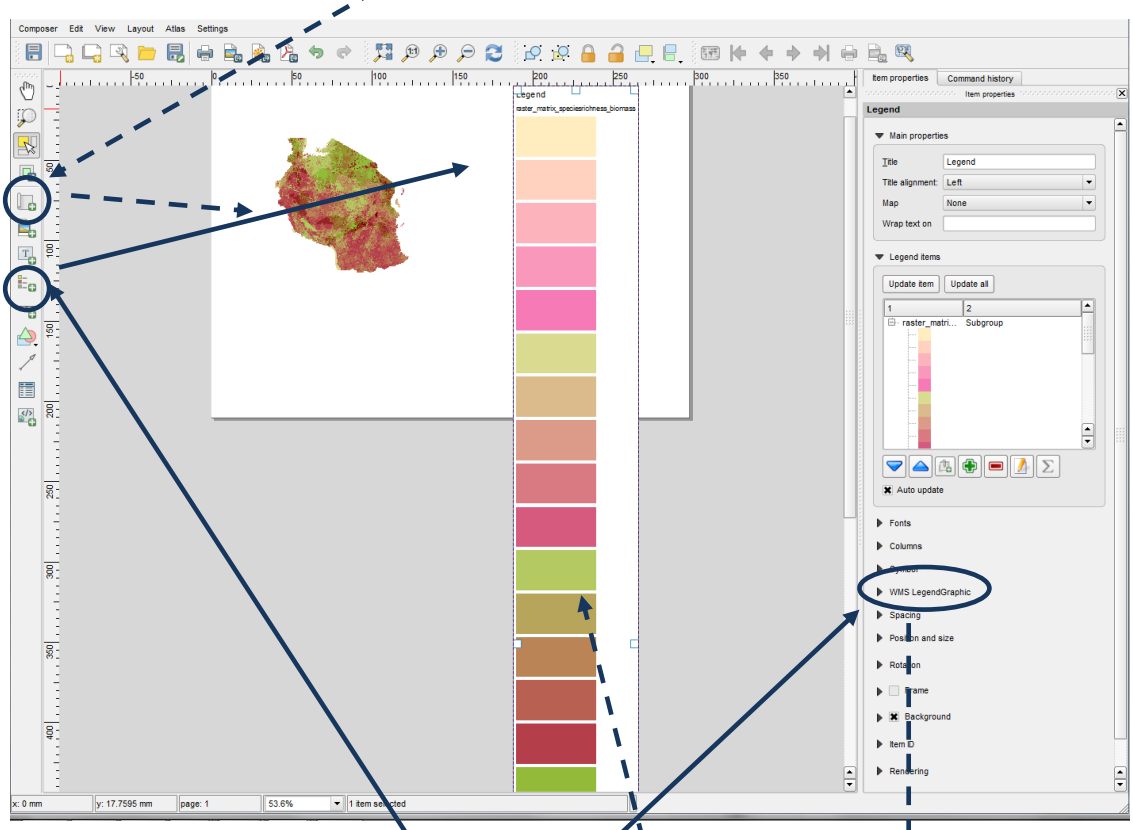
The definitions of for the combined threatened species/woody biomass field are:

11 Low threatened species richness, low woody biomass
12 Low threatened species richness, medium woody biomass
13 Low threatened species richness, medium woody biomass
14 Low threatened species richness, medium high woody biomass
15 Low threatened species richness, high woody biomass
...
11 Low threatened species richness, low woody biomass
21 Medium Low threatened species richness, low woody biomass
31 Medium threatened species richness, low woody biomass
41 Medium High threatened species richness, low woody biomass
51 High threatened species richness, low woody biomass
...
51 High threatened species richness, low woody biomass
52 High threatened species richness, medium woody biomass
53 High threatened species richness, medium woody biomass
54 High threatened species richness, medium woody biomass
55 High threatened species richness, high woody biomass

Etc.

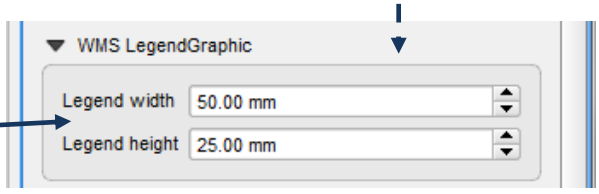
d. From the project menu select **project>>New Print Composer**

e. Click on the **Add new map** icon  and then drag a box onto the canvas. The map appears with the layers that were ticked in table of contents in the project view window.



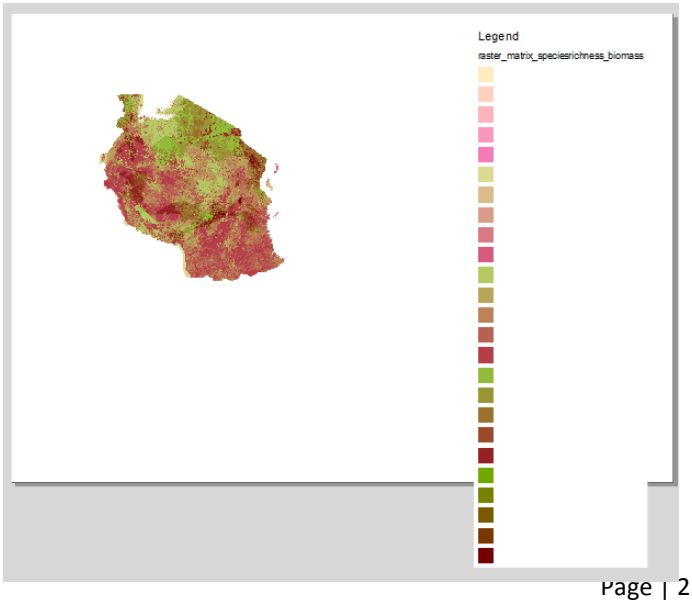
f. Then click on the legend button and drag a legend onto the canvas. It will appear as a single column - **BUT it appears far too large, larger than the box you dragged!**

g. To fix the size problem click to expand the **WMS LegendGraphic. Change the Legend width** to **7mm and height** to **7mm**



h. The legend should look similar to the illustration right (if only the matrix layer was ticked in the table of contents in the project view).

Note the legend boxes are now a better size



i. In order to display this legend in a matrix style only include the matrix layer (i.e. highlight each of the other layers in turn and use the **red minus** button to remove them from the legend). Other layers can be added in a separate legend.

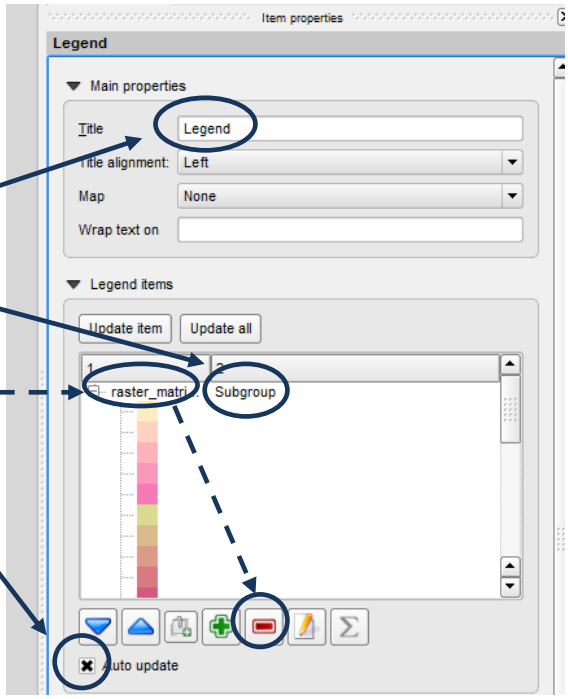
j. Remove the Title **Legend**

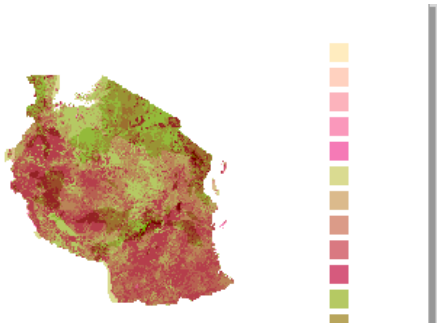
k. On the matrix layer change the **subgroup** to **hidden**

l. Click on the **raster dataset name** and **click the minus button**

m. Remove the cross from the **Auto update** (so when new layers are added to the map they are not automatically added to this legend)

n. The legend on the map canvas should now be a single column with no text (as illustrated below)



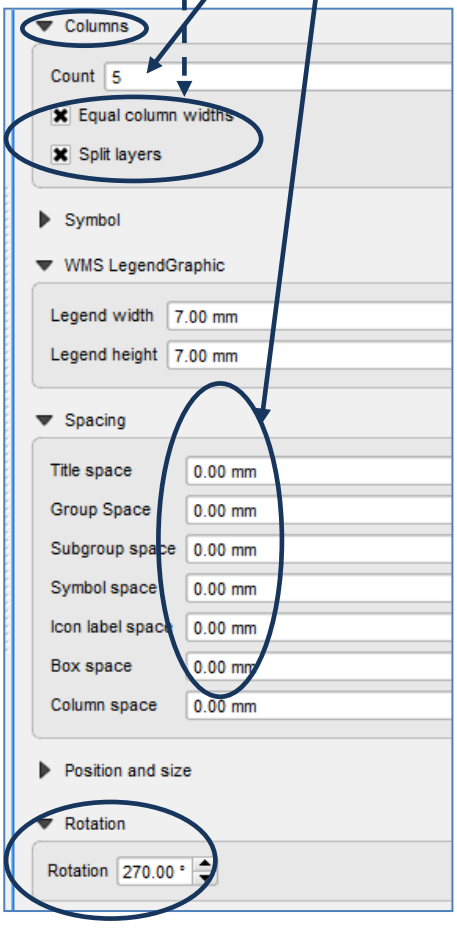


o. Next expand the **Columns** tab and change the number of **columns count** to **5**

p. Tick the **Split layers** and tick **Equal column widths**

q. Expand **Spacing**

r. Change all the spacing values to 0

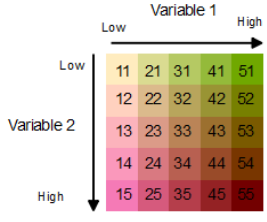


s. Expand **Rotation**

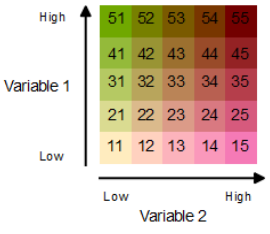
t. Change rotation to **270**. This rotates the legend so that the lightest value is in the bottom left and the darkest colour is in the top right.

u. The legend should now look like this

The illustration below illustrates the positioning of the values in the combined matrix dataset and the effect of the rotation on the appearance of the legend.



(Before rotation)



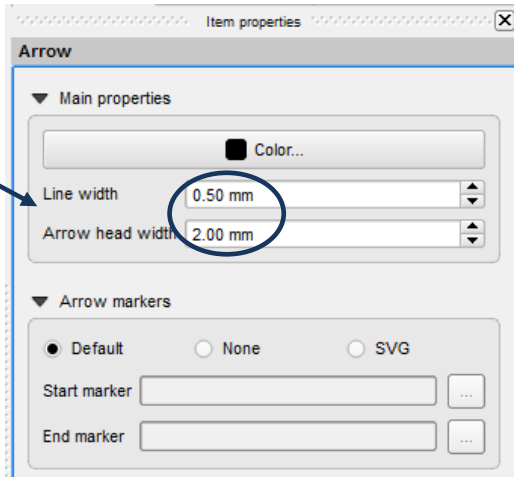
(After rotation of 270)

The Next steps will manually add the arrows and legend text. In the illustration above, the numbers inside the legend squares have been added to illustrate how the values in the final matrix raster dataset form the matrix legend. They are not required for the final legend.

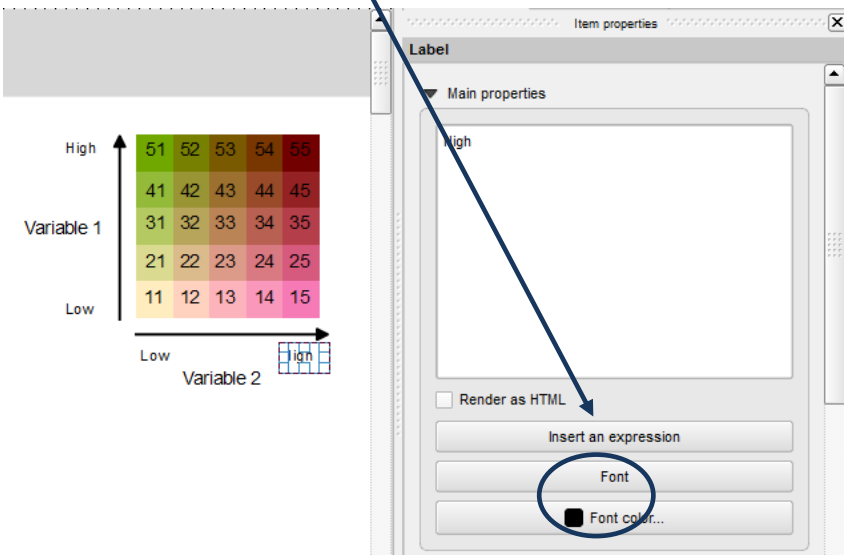
v. Click on the **add text button**  to **manually add text to label** the legend

w. Next use the **arrow button**  to drag horizontal and vertical arrows

x. Select the arrows and use the item properties to change the thickness of the arrow line to **0.5mm** and the size of the arrow heads **2mm**



y. Similarly, select the text and use the item properties in the right hand panel to change the size of the text accordingly



The matrix legend and map using two raster datasets is now complete

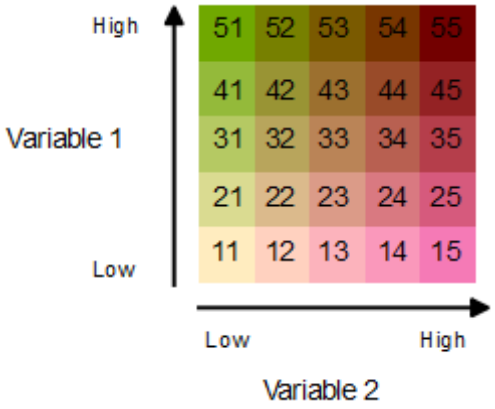
2.4. Guidance for creating your own matrix colour ramps

We have generated a few 5x5 class colour ramps for you and saved them as QML files. The notes below give guidance on how to generate your own styles from scratch. The instructions are descriptive rather than full step-by-step instructions. When defining the colours It is probably easiest to use a vector dataset containing 5 x 5 squares whilst working out the colours and then enter them into qml files at the end.

For a five class matrix with **carbon** and **species richness** the values read as follows:

(Note: the numbers inside the boxes will not be presented on the final legend, this is just to illustrate the final position of the numbers in the 5 columns)

In the example map above Threatened species richness (Variable 1) was combined with Woody biomass (Variable 2).



The definitions of for the combined threatened species/woody biomass field are:

11 Low threatened species richness, low woody biomass
12 Low threatened species richness, medium woody biomass
13 Low threatened species richness, medium woody biomass
14 Low threatened species richness, medium high woody biomass
15 Low threatened species richness, high woody biomass
...
51 High threatened species richness, low woody biomass
52 High threatened species richness, medium woody biomass
53 High threatened species richness, medium woody biomass
54 High threatened species richness, medium woody biomass
55 High threatened species richness, high woody biomass

Etc.

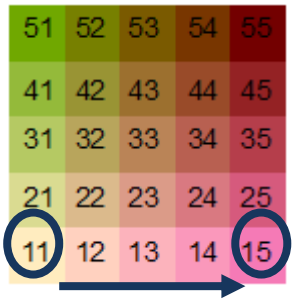
The illustrations below help to demonstrate how you go about defining your new colour. The idea is to seamlessly grade the colors in all directions.

a) You will first need to choose colours for:-

- low threatened species richness - low woody biomass (11)
- low threatened species richness – high woody biomass (15)
- high threatened species richness – low woody biomass (51)
- high threatened species richness – high woody biomass (55)

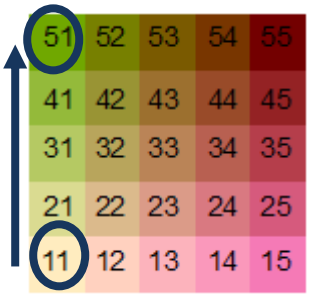
So, for example, you will need to produce a colour ramp from a colour chosen at 11 to the colour chosen at 15:

Chose a starting colour for the pale yellow for 11 and a bright pink for the 15. Ramp between the yellow to pink. Make a note of the RGB values for 12, 13 and 14



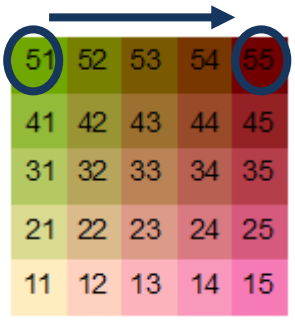
Similarly you will need to produce a colour ramp from 11 (21,31,41) 51:

Chose the same starting colour for the pale yellow for 11 and a bright green for the 51. Ramp between the yellow to green. Make a note of the RGB values for 21, 31 and 41

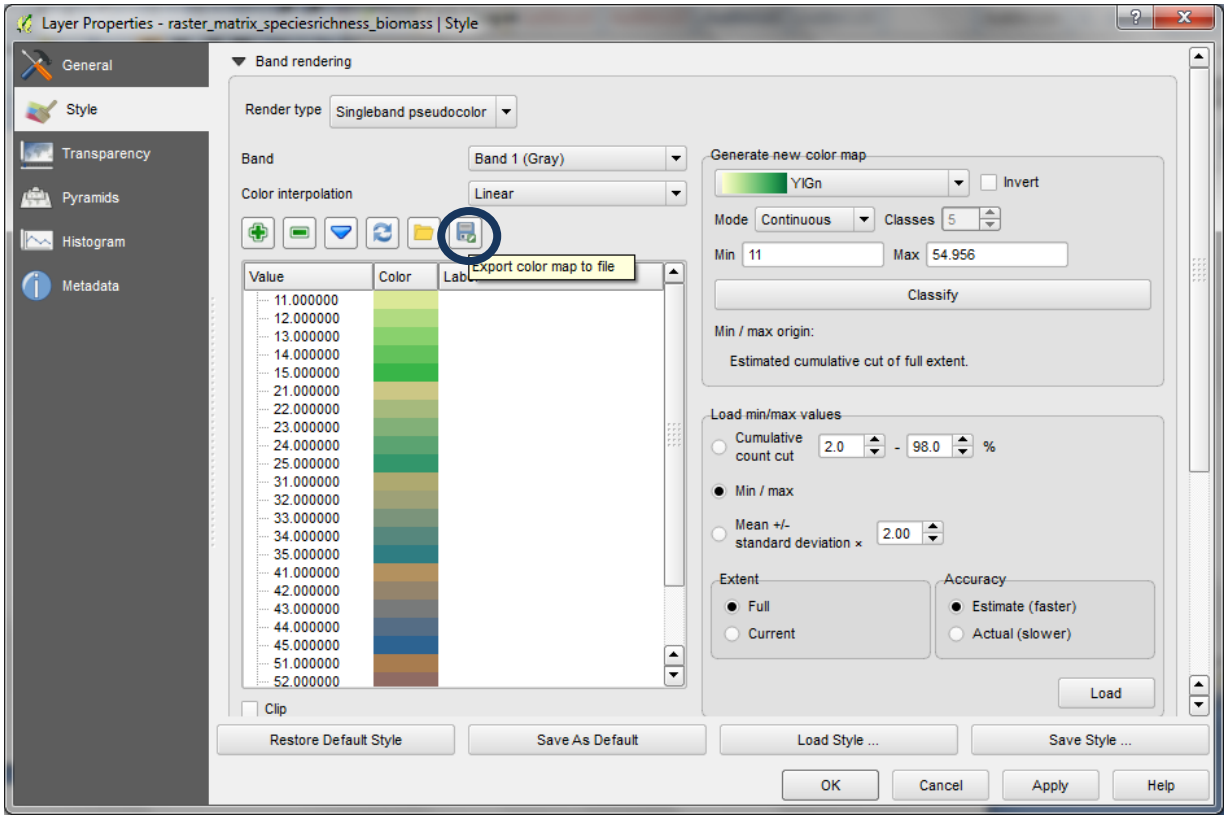


and the same for ramping colours from 51 to 55:

Chose the same starting bright green for 51 and a dark browny pink for the 55. Ramp between the yellow to green. Make a note of the RGB values for 52, 53 and 54



So we now know RGB values for the top and bottom parts of the matrix and therefore can produce ramps between 12 - 52, 13 - 53, 14 - 54. Make a note of all the RGB values generated so that these can be manually entered into the QML files.


Layer Properties - raster_matrix_speciesrichness_biomass | Style
General
Style
Transparency
Pyramids
Histogram
Metadata
Band rendering
Render type
Singleband pseudocolor
Band
Band 1 (Gray)
Color interpolation
Linear
Export color map to file
Value
Color
11.000000
12.000000
13.000000
14.000000
15.000000
21.000000
22.000000
23.000000
24.000000
25.000000
31.000000
32.000000
33.000000
34.000000
35.000000
41.000000
42.000000
43.000000
44.000000
45.000000
51.000000
52.000000
Clip
Generate new color map
YlGn
Invert
Mode
Continuous
Classes
5
Min
11
Max
54.956
Classify
Min / max origin:
Estimated cumulative cut of full extent.
Load min/max values
Cumulative count cut
2.0
98.0
%
Min / max
Mean +/- standard deviation ×
2.00
Extent
Full
Current
Accuracy
Estimate (faster)
Actual (slower)
Load
Restore Default Style
Save As Default
Load Style ...
Save Style ...
OK
Cancel
Apply
Help