

SCB 2006 Short Course, 24th June 2006

Systematic conservation planning: concepts, case studies, and applications of software

These are the notes for the Software demonstrations component of the course. Notes below in italics are the actions you need to carry out to complete the steps of the tutorial in using C-Plan and MARXAN.

If you have downloaded this from the web, make sure you install C-Plan from the C-Plan website using the instructions on the web site. Download MARXAN from the MARXAN website, then install it into the directory "C:\MARXAN". Finally, unzip the zip file "SCB2006_short_course_software.zip" to the C: drive. You will then be able to follow the instructions below.

Each section will take up to 10 minutes to complete.

1. Overview of C-Plan and MARXAN and main similarities and differences

Both software systems share the same basic data structures. MARXAN adds a new data structure, the boundary length file.

C-Plan uses heuristic statistical method Irreplaceability, while MARXAN uses simulated annealing to generate Irreplaceability.

Click on the "Start" menu in Windows. Move your mouse over "Programs", "ESRI", "ArcView GIS 3.3" and then click on "ArcView GIS 3.3".

When ArcView opens, click on "Open an existing project", then click "Ok".

Navigate to the folder "C:\data\SCB2006_Short_Course", then double click on "SCB2006.apr".

ArcView now opens the project we will be using for the rest of the tutorial.

In the window called "View1", click on the square next to the theme called "100itns_blm0.shp" to switch the theme on and display it.

You are now looking at a map of Irreplaceability generated by MARXAN that shows the number of times each planning unit was selected in each of 10 runs of MARXAN with the sample dataset.

The dataset we are using contains 3472 planning units and 424 plant and animal species from the Upper North East Forests of New South Wales, Australia. It is a real world dataset that was used in negotiation over what areas of State Forest production hardwood forests would be added to National Parks tenure.

In the window called "View1", click on the square next to the theme called "100itns_blm0.shp" to switch it off. Now click on the square next to the theme called "Cplan_irreplaceability.shp" to switch this theme on and display it.

You are now looking at a map of Irreplaceability generated by C-Plan that shows the likelihood that each planning unit will be required in the reserve system in order to meet the targets set for species.

2. Planning units & data on biodiversity, costs, boundary lengths

We will now look at the basic data structures of C-Plan and MARXAN and describe how they work.

Click on the "Start" menu in Windows. Move your mouse over "Programs", "C-Plan" and then click on "C-Plan Table Editor". When the program loads, click "File" menu, then "Open". Navigate to the folder "C:\data\demo\n2units_2", then double click the file "ss_n2_2.dbf".

You are now looking at the C-Plan sites, or planning unit table. It lists the planning units in the region and other information such as their area, cost and reserve status. MARXAN uses the same data in its planning unit table.

Go back to ArcView, now in the window called "View1", click on the square next to the theme called "Cplan_irreplaceability.shp" to switch it off. Now click on the square next to the theme called "N2.shp" to switch this theme on and display it.

These are the planning units from the planning unit table we were just looking at.

Go back to the C-Plan Table Editor, then click the X on the table to close the file. Now click "File" menu, then "Open". Navigate to the folder "C:\data\demo\n2units_2", then double click the file "fs_n2_2.dbf".

You are now looking at the C-Plan feature, or species table. It lists the species in the region and other information such as their target (how many hectares of this species you want to put in a reserve). MARXAN uses the same data in its species table.

Go back to ArcView, now in the window called "View1", click on the square next to the theme called "N2.shp" to switch it off. Now click on the square next to the theme called "Forest_t" to switch this theme on and display it.

These are some of the features we were just looking at.

Go back to the C-Plan Table Editor, then click the X on the table to close the file. Now click "File" menu, "Import", then "Browse". Navigate to the folder "C:\data\demo\n2units_2", change "Files of type" to "C-Plan Matrix files", then

double click the file "sparse.mtx" and click "Ok".

You are now looking at the C-Plan site by feature matrix. It lists the number of hectares of each feature in each site. MARXAN uses the same data in its planning unit by species file.

This table is generated from intersecting the planning unit GIS layer with several species GIS layer, then linking them together and building a matrix.

Click the X on the table to close the file. Now click "File" menu, "Import", then "Browse". Navigate to the folder "C:\data\demo\n2units_2\marxan\input", change "Files of type" to "Comma Delimited files", then double click the file "blf.csv" and click "Ok".

You are now looking at the MARXAN boundary length file. It shows the length of a shared boundary for any adjacent planning units in the database. C-Plan does not use this file because it does not have the capability of minimising boundary length.

Go back to ArcView, now in the window called "View1", click on the square next to the theme called "Forest_t" to switch it off. Now click on the square next to the theme called "N2.shp" to switch this theme on and display it.

Click the hammer icon in ArcView, then double click "Attribute", click "=", double click "2", then click "New Set". Click "X" to get rid of the query form, then click the ArcView icon that has an arrow pointing down to a layer that says "Zoom to Selected". Now click the ArcView icon that has a ruler, and trace along the boundary between the selected planning unit and the one to the right of it, clicking 7 times to register each point.

ArcView displays the length of the boundary that you have traced. This matches the entry in row 3 of the boundary length file (the length of the boundary between planning units 3 and 2).

3. Building the databases

Now we are going to generate a planning unit by species matrix and use it to build a C-Plan and MARXAN database.

Press the ArcView icon with the clear table on it "Clear Selected Features", then press the ArcView icon with the arrow pointing down onto several layers, "Zoom to the extent of active themes".

Click on the ArcView menu "Analysis", then click "Properties". For "Analysis Extent", choose "Same As N2.shp", and for "Cell Size", type in 1000 and press ENTER. Now Click "Ok".

Click the ArcView Icon with the green flag, then click "Cancel". Select N2.shp as the Site Layer, Attribute as the Site Key, Forest_t as feature layer 1, then

Value as Feature Key. Now click "Ok" and choose Attribute again, then Click "Yes" and "Yes". Press "Cancel" because we are not adding more feature layers.

We have now intersected the planning unit layer with a single species layer, and the resulting table has been loaded into C-Plan Table Editor. We will simplify this build by not adding any planning unit or species data.

In the C-Plan Table Editor, click "Ok", then click "Next" seven times. Click "Browse" and "Create Dir". Specify a new directory called new then click "Ok". Now click "Next" and "Ok".

Click on the "Start" menu in Windows. Move your mouse over "Programs", "C-Plan" and then click on "C-Plan". When the program loads, click "Locate Database" then browse to the directory containing the C-Plan database we have just build and double click on "CPLAN.INI". Then click "Ok" and double click on the C-Plan database entry we have just added. When C-Plan loads, click on the "MARXAN" menu and click "Build Database" and "Ok".

We have now build matching C-Plan and MARXAN databases that relate to the planning unit by species layer we intersected in the GIS.

4. C-Plan and its use in the negotiations (including dynamic irreplaceability, effects of data and targets on patterns of irreplaceability, key interactive functions)

Use C-Plan functions. Select sites and update Irreplaceability map. Change features in use and update map. Change targets and update map.

Features to target, show available sites, reserve sites, show features to target again.

Query features at a group of sites from the map.

Query site table from the map for group of sites, select new fields and display again.

Switch on ITARGET to show the red landscape. Switch it off again. We use 65% target throughout the course so we have a range of Irreplaceability values to look at, without all planning units being totally Irreplaceable.

5. Starting MARXAN and setting key parameters

Click on the "Start" menu in Windows. Move your mouse over "Programs", "C-Plan" and then click on "C-Plan". When the program loads, click "Locate Database" then browse to the directory "C:\data\demo\n2units_2" and double click on "CPLAN.INI". Then click "Ok" and double click on the C-Plan database entry we have just added. When C-Plan loads, click on the

“MARXAN” menu and click “Marxan Prototype”. Now click “MARXAN Options”.

This is the interface where you can set options for MARXAN, such as boundary length modifier, repeat runs, and number of iterations.

6. MARXAN: number of runs and estimates of irreplaceability

The number of MARXAN runs affects the result. Typically, we would use 100 to 1000 runs, but today we will use 4 and 20 runs so it will run faster.

In the Marxan options, set the number of runs to 4, click “Save”, “Exit”, then click “Run MARXAN”. When MARXAN finishes running, click ENTER, “Retrieve MARXAN Result” then “Map Result”.

Now look at the GIS display in ArcView and view the Summer Irreplaceability, then set the number of runs to 20 and repeat the procedure to run MARXAN, retrieve the result, and map the result in ArcView.

7. MARXAN: effects of the boundary length modifier, including pre-prepared difference maps and correlations of irreplaceability values

Try a range of boundary length modifiers (0, 0.01, 0.1, 1, 10). Use 1 run for each one. Observe the size of reserves and number of reserves for each solution generated.

Display pre-prepared difference maps and correlations of Irreplaceability.

Display the pre-prepared maps showing summed Irreplaceability for a range of boundary length modifiers.

8. MARXAN: effects of costs (cost = area; cost = commercial timber volume), including pre-prepared difference maps and correlations of irreplaceability values

Run MARXAN with no BLM and different costs (area and cws). Use 4 runs for each scenario.

Compare the Summed Irreplaceability result in the GIS display in ArcView for each generated result.

9. Discussion of capabilities of MARZONE

Discuss MarZone with Slide Show culled from SCGIS talk.