marxan.io user guide

A web app for systematic conservation planning

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For marxan.io revision 39

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Table of contents

What is marxan.io?

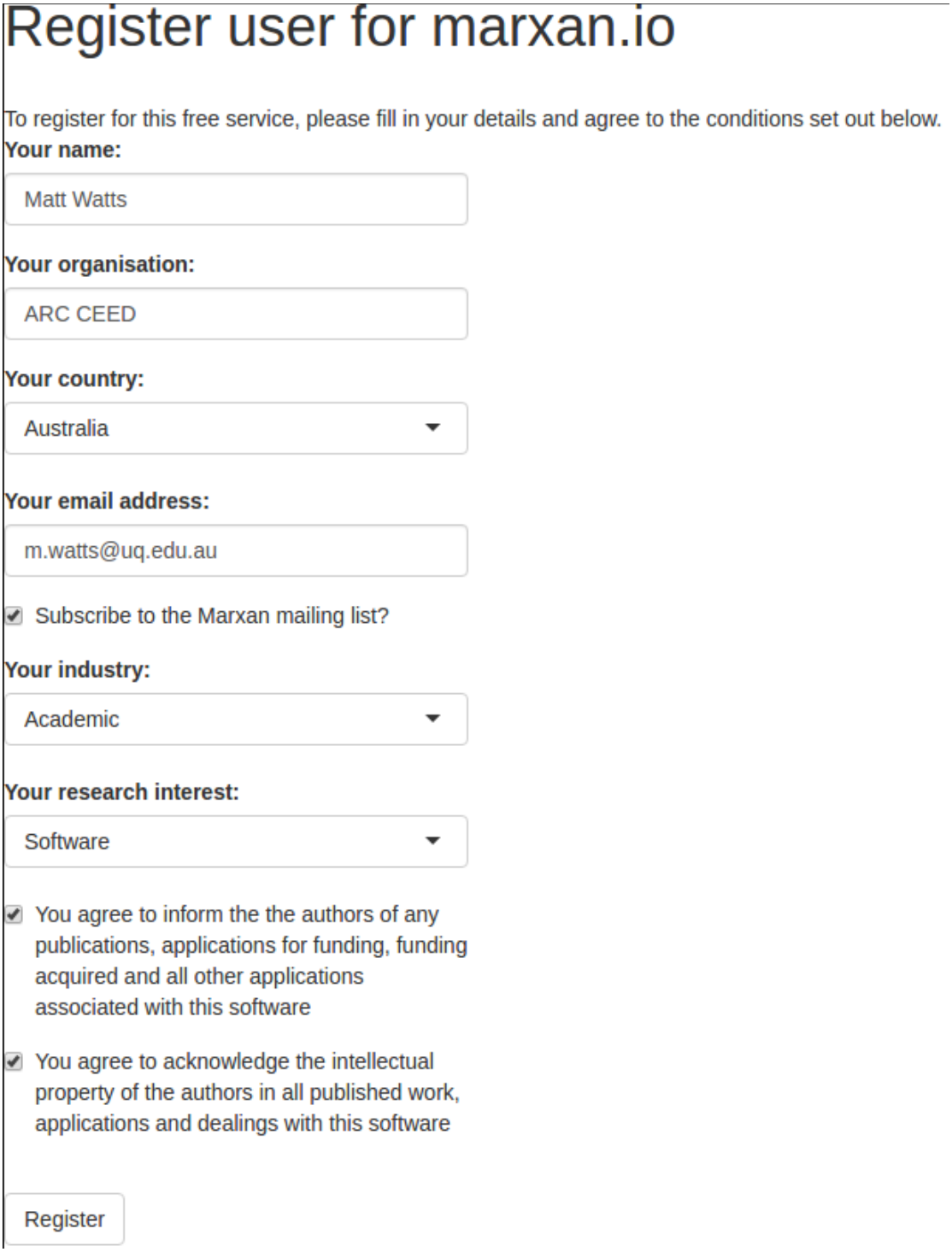
Marxan is the most widely used decision support software for conservation planning globally. It’s used in over 180 countries to build marine and terrestrial conservation systems. It’s the global leader in conservation land and sea use planning software and new extensions are making it even more popular.

The marxan.io web app is a graphical user interface for Marxan users that runs on the Nectar research cloud. You can upload your own Marxan datasets, edit targets, SPF and BLM, conduct parameter testing and analysis, visualise output maps, figures, and tables, and download the completed analysis in an easy to use web interface.

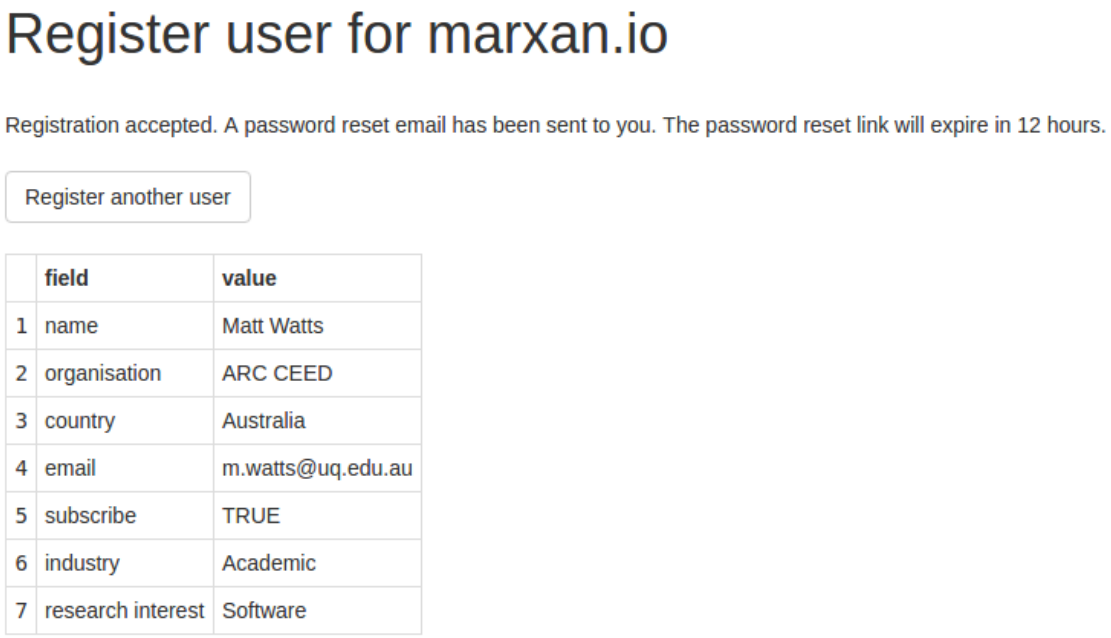
The instructions relate to revision 39 of the marxan.io web app.

Get an account

Visit http://marxan.net and click the “register marxan.io account” link.

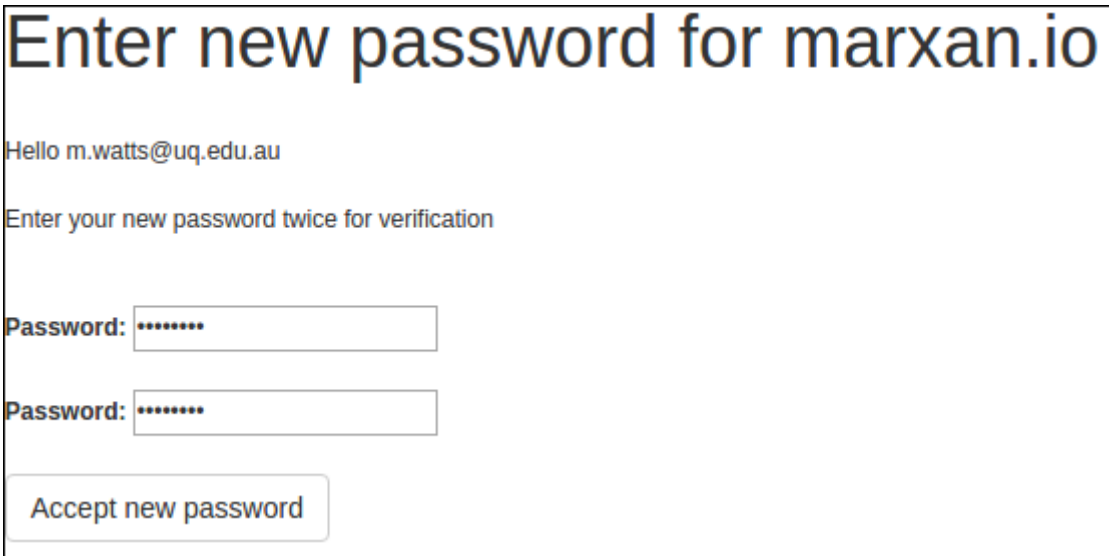


Enter your registration details, and click the “Register” button.

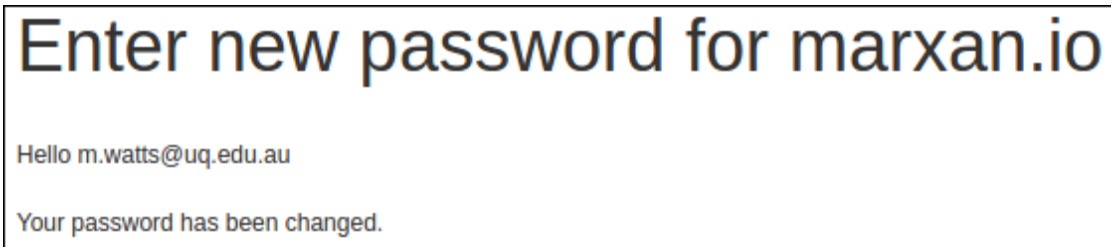


	field	value
1	name	Matt Watts
2	organisation	ARC CEED
3	country	Australia
4	email	m.watts@uq.edu.au
5	subscribe	TRUE
6	industry	Academic
7	research interest	Software

An email will then be sent you with a password reset link. When you click the link, you will be able to enter a password for your new account:



Enter the password twice so an to not make a mistake typing it, then click the “Accept new password” button.



Make sure to write your password down in a safe place so you don't forget it.

The open source project

The apps are written in R. It’s open source software that you can freely use and modify subject to the conditions of the AGPLv3 open source software license.

You can access the source code on Github here:

https://github.com/mattwatts/marxan.io

You’re welcome to participate in the evolution of the software by contributing changes to the Github repository. Lots more changes and improvements are planned.

Preparing your data

To use your own data with marxan.io, you first need to prepare your dataset and ensure Marxan is running ok on your local computer. If Marxan doesn’t run ok, there is likely something wrong with your data. That is, one or more files malformed and not in compliance with the specification as detailed in the Marxan user manuals and course manuals.

There are functions in marxan.io that check for common mistakes in data creation and attempt to fix them, although some mistakes might stop your data from importing. More improvements to the error checking and correction code are planned.

Introduction to Marxan course materials

Day 1 of the Introduction to Marxan course materials describes in detail how to create a Marxan dataset from your own GIS layers. Handbooks are provided with the materials explaining this procedure using an open source GIS (Quantum GIS) and a commercial GIS (ESRI ArcMap). URL http://marxan.net , click “Teaching and Learning”, “Course Materials”.

Qmarxan plugin for Quantum GIS

An easy way to create a Marxan dataset is to use the Qmarxan plugin for Quantum GIS, described in the introduction to Marxan day 1 course materials.

Marxan workflow in R

We've created an entire workflow in R to create Marxan datasets that is available here:

https://github.com/mattwatts/CoESRA-Marxan

Other ways to create a Marxan dataset

There are many ways users create Marxan datasets and the methods multiply as time goes by. GRASS is a great way to intersect raster layers to create input files. Similarly PostGIS is a great way to intersect vector layers to create input files. You should choose the method that works best for you.

Creating a zip file

Once you have a Marxan dataset, assemble all the required files to prepare them for upload. You need these files:

- The input.dat input parameter file,
- The input folder with all the input files,
- The planning unit layer shapefile files.

The planning unit shapefile must have a planning unit id field called either: PUID, PU_ID, puid, or pu_id.

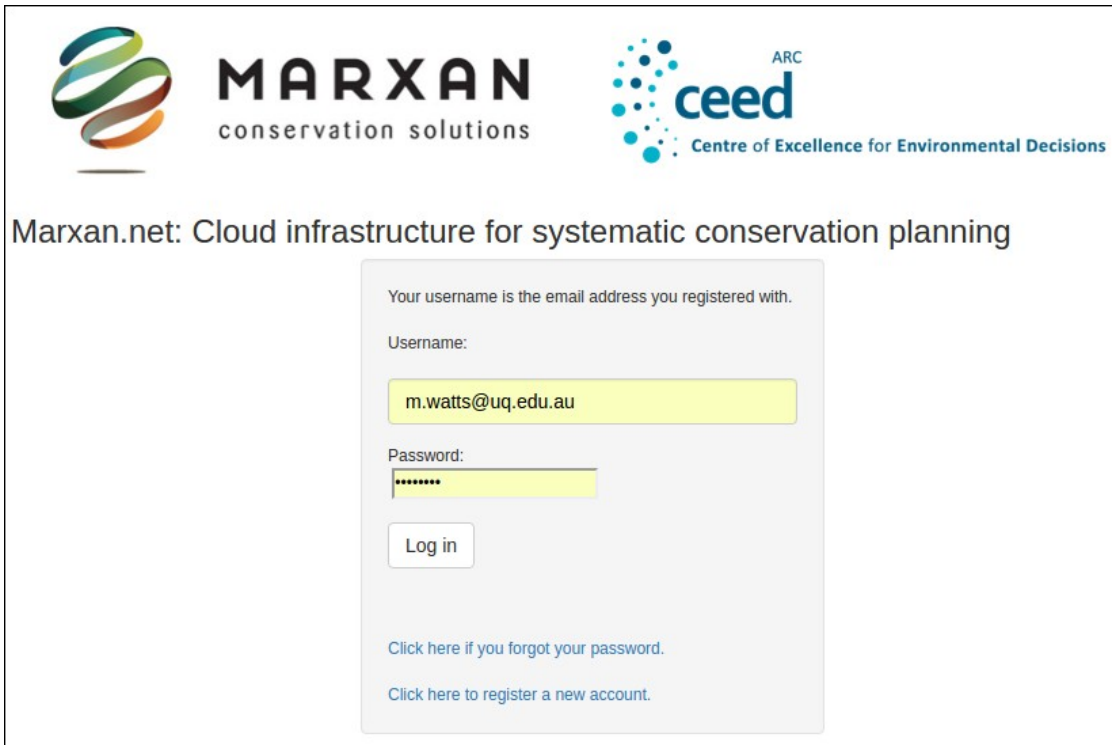
Put all the files in a directory with the name you want for your Marxan database then zip up the directory. This zip file is your Marxan dataset.

Sample datasets

A sample Marxan dataset "Tasmania" and a sample MarZone dataset "Rottnest Island scenario 4" are included in your account by default. Several additional sample datasets are provided for download from http://marxan.net

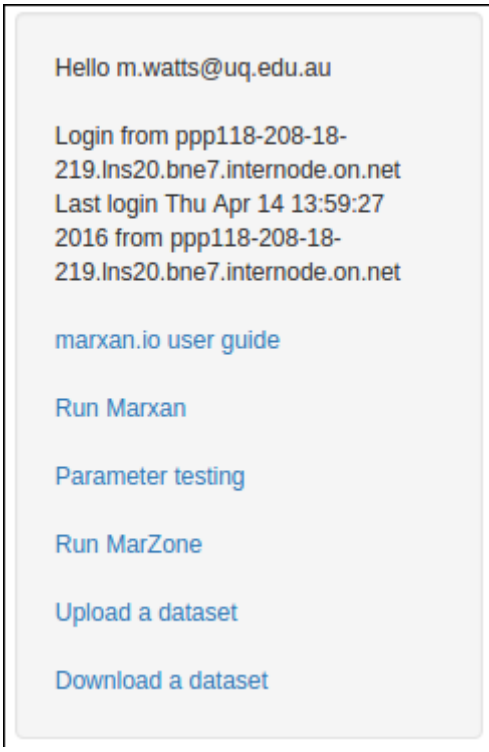
Login to marxan.io

We recommend Google Chrome web browser if other browsers don't work as expected with the apps. Using your browser, visit http://marxan.net and click "marxan.io login"



Enter your username and password. Your username is the email address you registered with and your password is the one you entered in the “reset password” form. If you've forgotten your password, click the blue “Click here if you forgot your password” link to reset your password again.

Click the “Log in” button to be authenticated on the system. Once you’re authenticated, you’ll see this screen:



Click the blue “Run Marxan” link to run Marxan.

Click the blue “Parameter testing” link to do parameter testing.

Click the blue “Run MarZone” link to run Marxan with Zones.

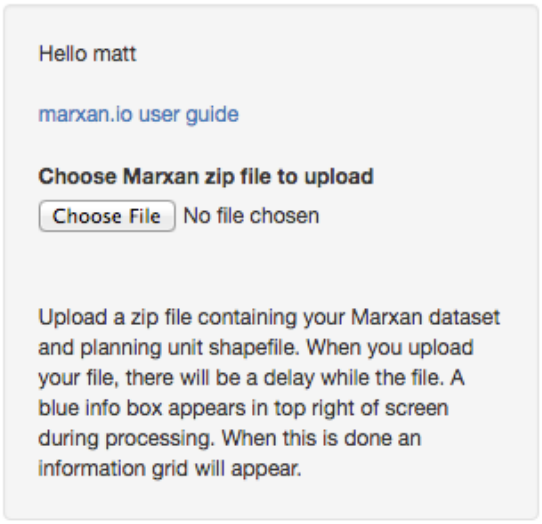
Click the blue “Upload a dataset” link to upload your datasets.

Click the blue “Download a dataset” link to download your datasets.

A new tab will open in your browser for each app, leaving the authentication tab open where you can launch other apps.

Upload a dataset

The “Upload a dataset” screen looks like this:



Choose File

Click the “Choose File” button to select and upload the zip file containing your dataset. When you upload your file, there will be a delay while the file is processed and your data is extracted and ingested.

While processing occurs, blue progress messages are displayed in the top right corner of the screen like this one:

For large datasets, the delay might be a minute or even several minutes while the files are analysed. Large and complex datasets take a while to process.

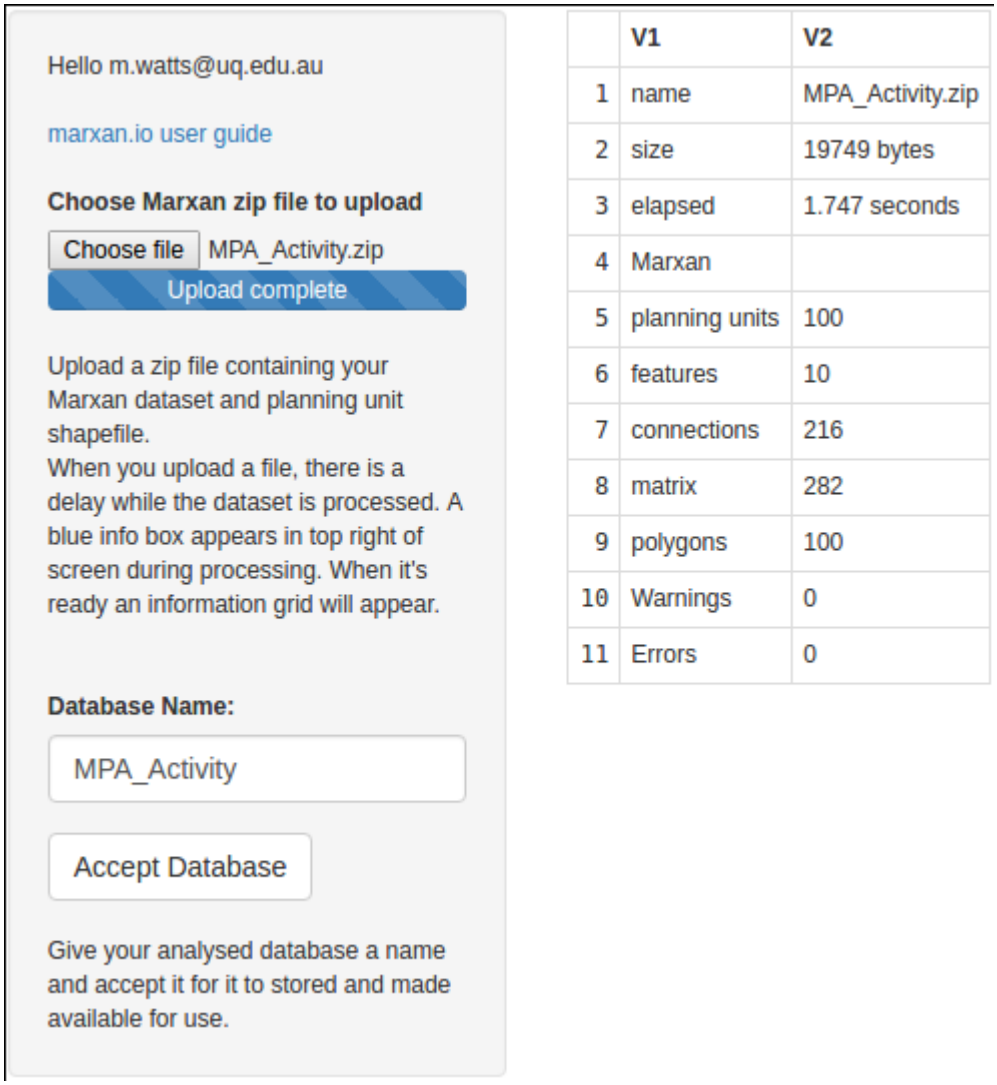
The progress messages displayed are:

Please wait: processing dataset
Reading zip
    Copying
    Unzipping
Input files
    converting Marxan files

converting MarZone files
reading Marxan files
reading MarZone files
writing Marxan files
converting matrix file

Planning units
reading shapefile
writing shapefile
reading dbf table
querying dbf table
writing dbf table
simplifying shapefile
dissolving shapefile
creating shapefile outlines
converting shapefile
saving pulayer.Rdata

When this is done, an information grid is presented to you like the screen below:



	V1	V2
1	name	MPA_Activity.zip
2	size	19749 bytes
3	elapsed	1.747 seconds
4	Marxan	
5	planning units	100
6	features	10
7	connections	216
8	matrix	282
9	polygons	100
10	Warnings	0
11	Errors	0

If the blue progress messages disappear and the information grid does not appear, an error might have occurred in the processing of your dataset. You can email m.watts@uq.edu.au to check your data that is logged in the system.

If an error is listed in the “Errors” box, it will contain diagnostic information that might help you correct the error and upload a corrected zip file. If you get stuck you can email m.watts@uq.edu.au to check your data that is logged in the system.

Diagnosis of errors will allow us to improve the service over time for all users, so your patience and help is appreciated.

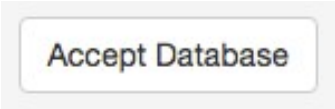
Database Name

If the information grid is displayed with summary information on the examination of your dataset, and no errors are displayed, then you can specify a name for your dataset.

Please only use alphabetic and numeric characters with underscores and no spaces, as this becomes the directory name for your dataset.

Accept Database

To accept a dataset that has been successfully analysed, click the “Accept Database” button.



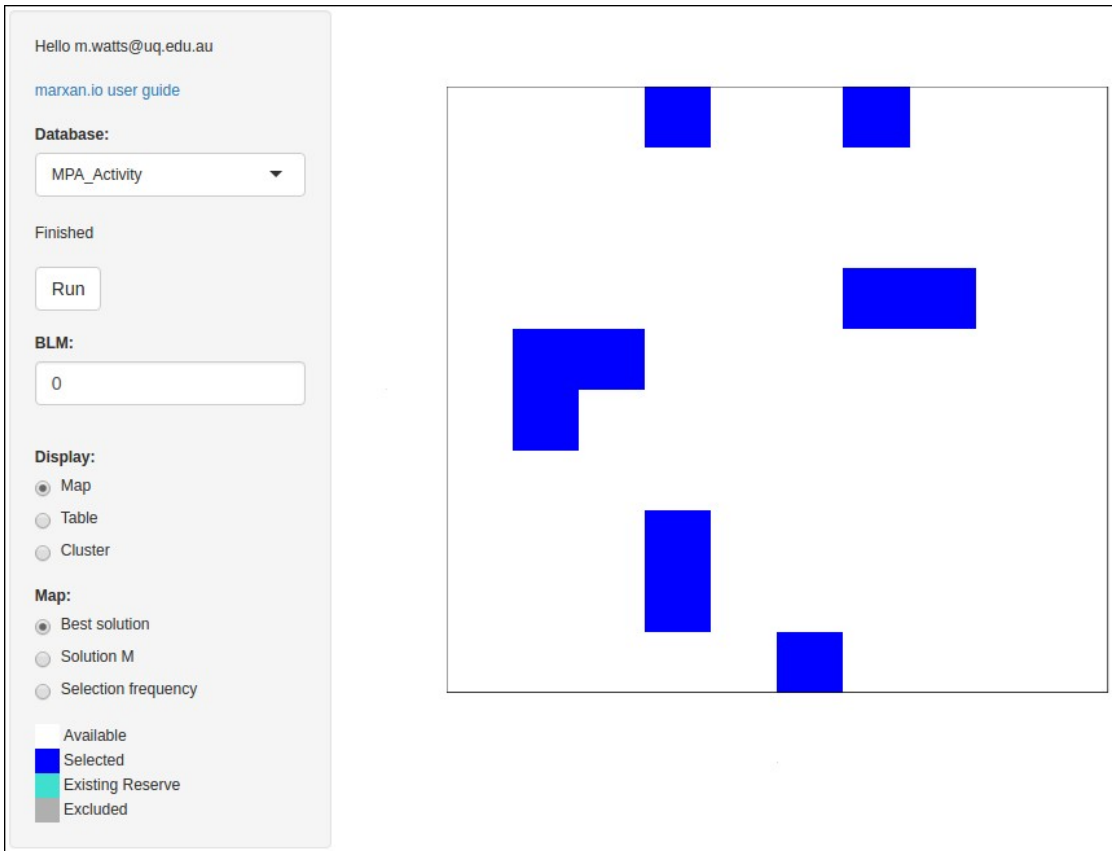
Your dataset will then be imported into your account for use. A blue message will briefly appear on the top right corner of the screen screen saying “Dataset accepted”.

If you already have a dataset with the same name, a blue message will briefly appear on the top right corner of the screen saying “Duplicate dataset name”. In this case, enter a new unique name before pressing “Accept Database”.

Run Marxan

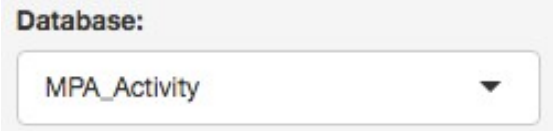
The “Run Marxan” app allows users to run Marxan, display maps, tables and graphs, and edit key parameters. It has a control panel on the left, and an output panel on the right.

The “Run Marxan” screen looks like this:



Database

The app has a “Database” control:



Click the drop down arrow on the right of the control to select the dataset you want to work with.

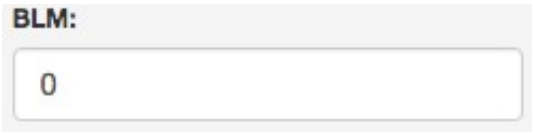
The first time you select a dataset you have uploaded, there will be a delay while the Marxan outputs are rendered. Blue progress messages appear in the top right corner of the screen while processing occurs.

This delay is a minute or so for small datasets and several minutes for large and complex datasets.

Please be patient after selecting a dataset while the output renders. The blue progress messages disappear and the display refreshes with output from your dataset once it's rendered.

BLM

The app has a "BLM" control:



To edit the boundary length modifier (BLM), enter a new value in this control.

Run

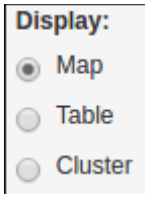
The app has a run button:

When you've changed BLM, SPF, or targets, click this button to run Marxan with the new parameters.

A delay of a few seconds for small datasets and longer for larger datasets occurs. During processing, progress messages appear in the top right corner of the screen and the "Finished" label greys out. After the results are rendered, the blue progress messages disappear, the "Finished" label appears black again and the display refreshes with new output.

Display: Map

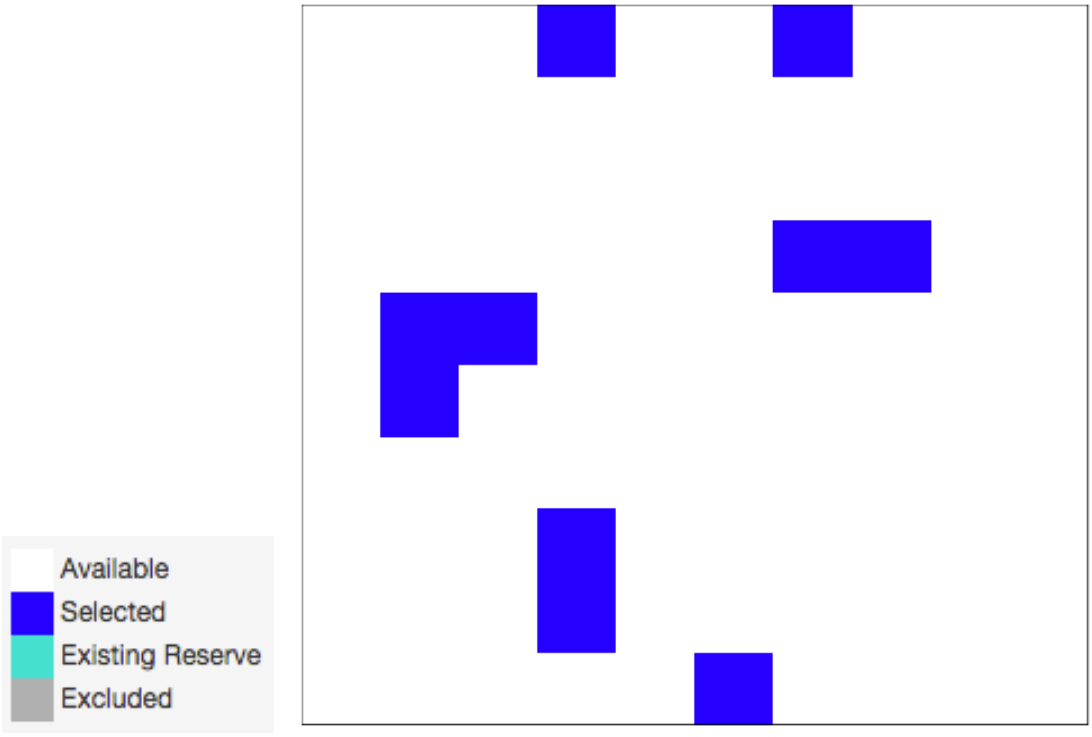
The app has a "Display" control. Select "Map" to display output maps.



When “Map” is selected, a “Map” control appears:

Best solution

Selecting “Best solution” displays the Marxan solution with the lowest objective function score. A map and map legend appears:

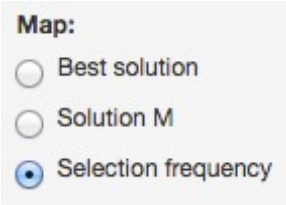


Solution M

Selecting “Solution M” displays a slider to select any of the 100 solutions:

When you drag the slider, the map display is refreshed with the solution selected in the slider.

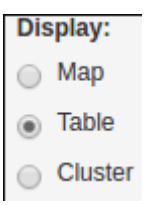
Selection frequency

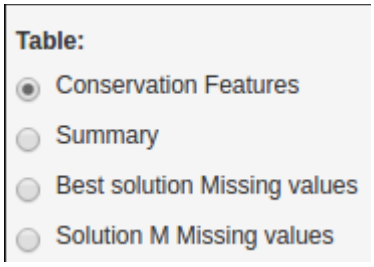


Selecting “Selection frequency” displays a selection frequency map of 100 solutions and a map legend:

Display Table: Conservation Features

Selecting “Table” with the “Display” control causes the “Table” control to appear. Selecting “Conservation Features” with “Table” allows you to view the feature table and edit prop and spf.





Edit “prop” and “spf”

Here you can edit prop (proportional target) and SPF (species penalty factor) for each species.

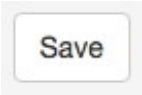
	id	prop	spf
1	1	0.1	10
2	2	0.1	10
3	3	0.1	10
4	4	0.1	10
5	5	0.1	10
6	6	0.1	10
7	7	0.1	10
8	8	0.1	10
9	9	0.1	10
10	10	0.1	10

To edit prop or SPF for a species, click the cell you want to edit and type in a new value. Here we have changed the prop for species 2 from 0.1 to 0.4:

	id	prop	spf
1	1	0.1	10
2	2	0.4	10
3	3	0.1	10
4	4	0.1	10
5	5	0.1	10
6	6	0.1	10
7	7	0.1	10
8	8	0.1	10
9	9	0.1	10
10	10	0.1	10

Save

When you have entered the prop and SPF values for the species you want to change, click the “Save” button to save the changes to your dataset:



Display Table: Summary

Selecting “Summary” with “Table” allows you to display the “Summary” table:

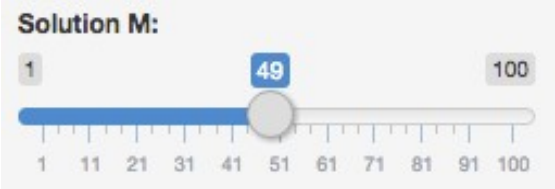
	Run	Score	Cost	Planning_Units	Penalty	Shortfall
1	1	1790086.00	1328080.00	1044.00	808.00	26.00
2	2	1792240.00	1322844.00	1043.00	829.00	27.00
3	3	1801154.00	1338906.00	1049.00	808.00	26.00
4	4	1787443.00	1327479.00	1055.00	2237.00	178.00
5	5	1784741.00	1322304.00	1039.00	1131.00	82.00

Display Table: Missing values

Selecting “Best solution Missing values” or “Solution M missing values” with “Table” allows you to display the missing values tables.

	name	Total	Reserved	Target	AmountHeld	TargetMet	TargetGap
1	1	571293.00	452784	171387.90	483439.00	yes	0.00
2	2	5746.00	1122	1723.80	3416.00	yes	0.00
3	3	263358.00	184689	79007.40	201938.00	yes	0.00
4	4	95122.00	89860	28536.60	91760.00	yes	0.00
5	5	155267.00	93794	46580.10	106153.00	yes	0.00

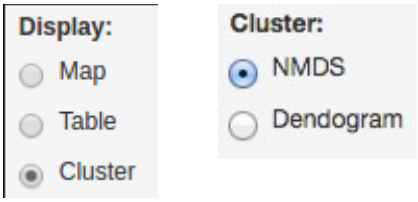
When you select “Solution M missing values”, a slider appears where you can select any of the 100 missing values tables to display.



When you drag the slider, the table display is refreshed with the missing values table selected in the slider.

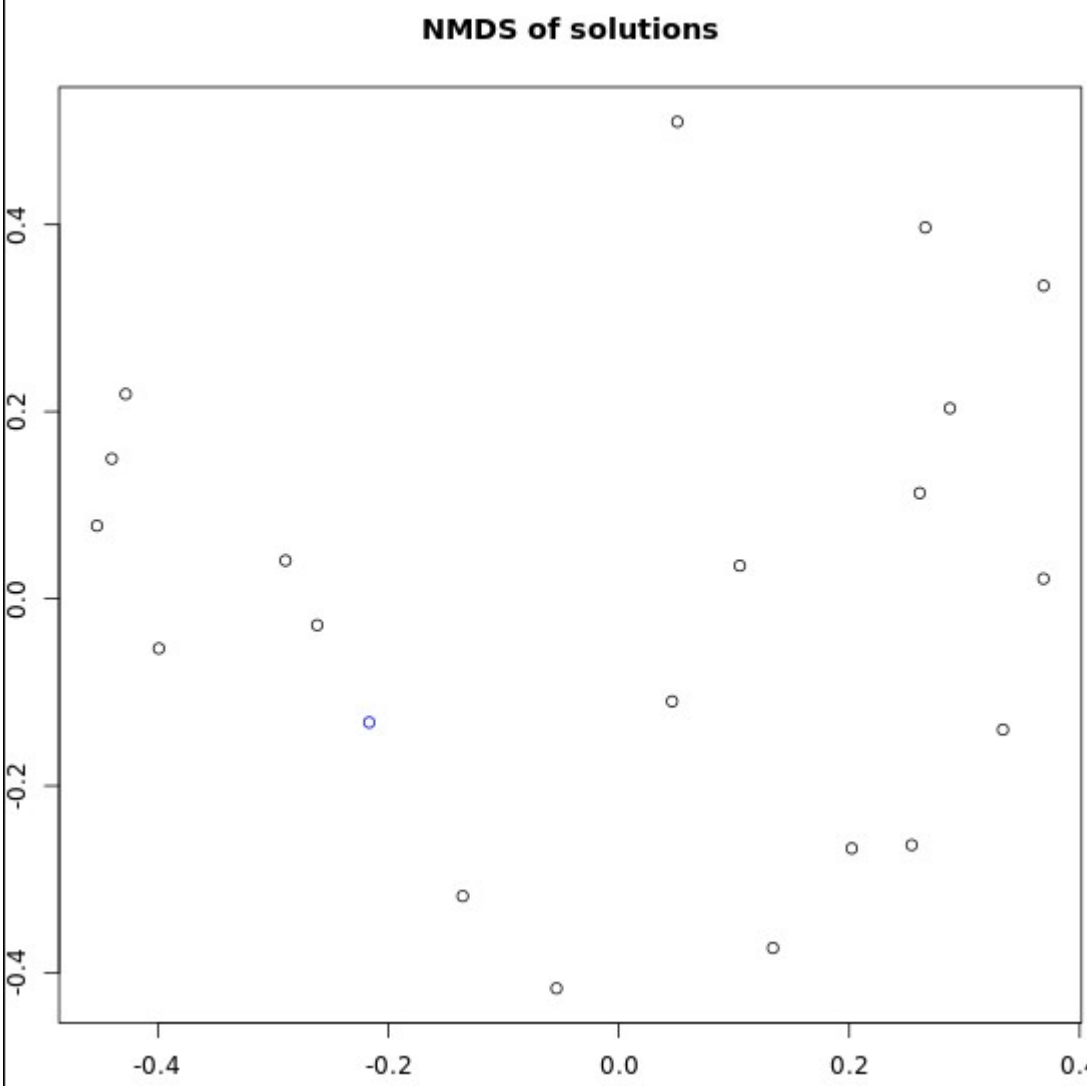
Display: Cluster

Selecting “Cluster” with the “Display” control causes the “Cluster” control to appear:



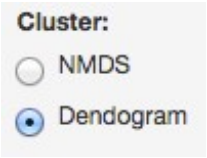
NMDS of solutions

Selecting “NMDS” with the “Cluster” control displays the 2 dimensional scaling of the dissimilarity of the 100 solutions:

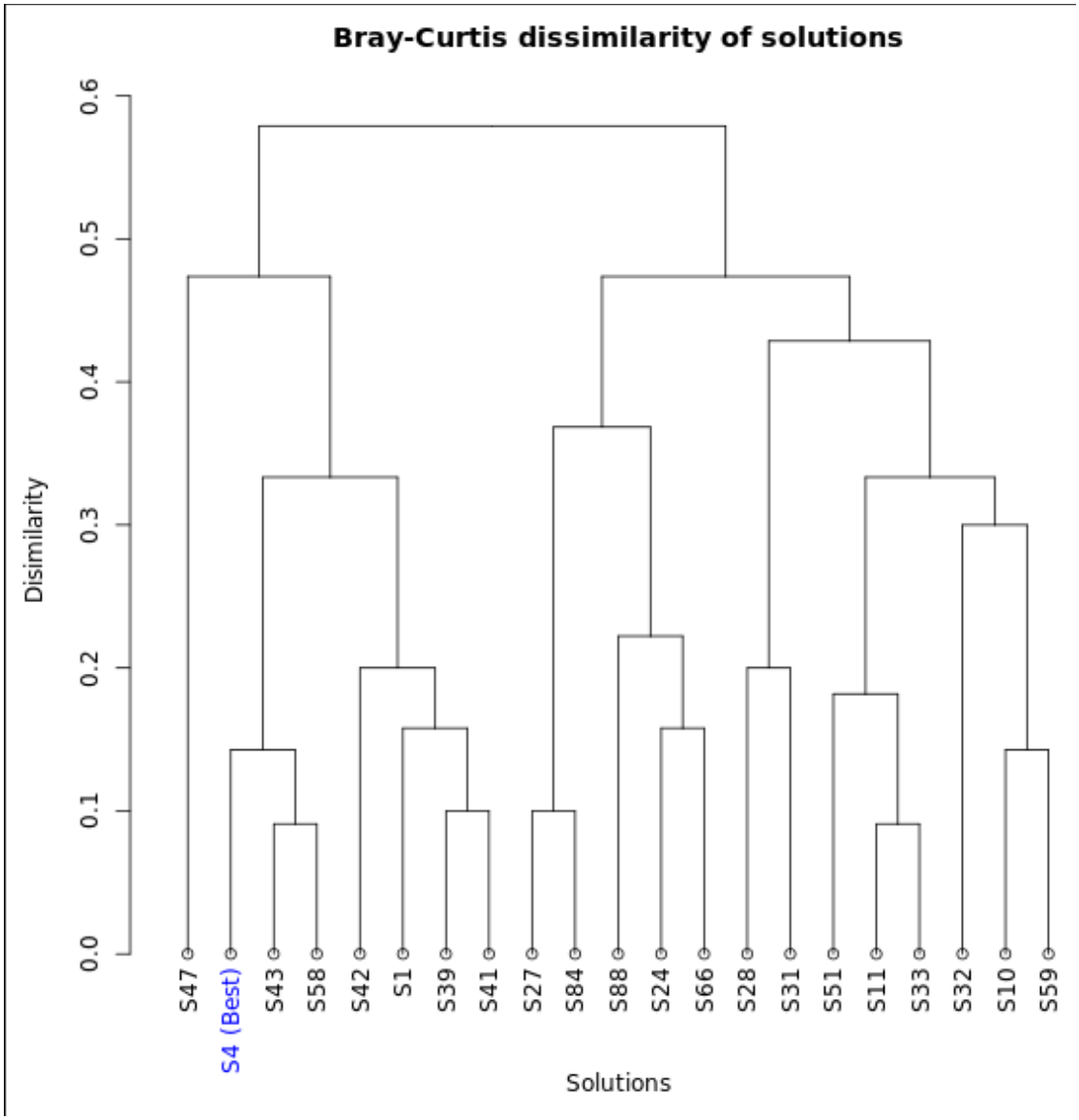


Unique solutions are displayed on the graph, and the solution with the lowest objective function score is displayed in blue.

Bray-Curtis dissimilarity of solutions



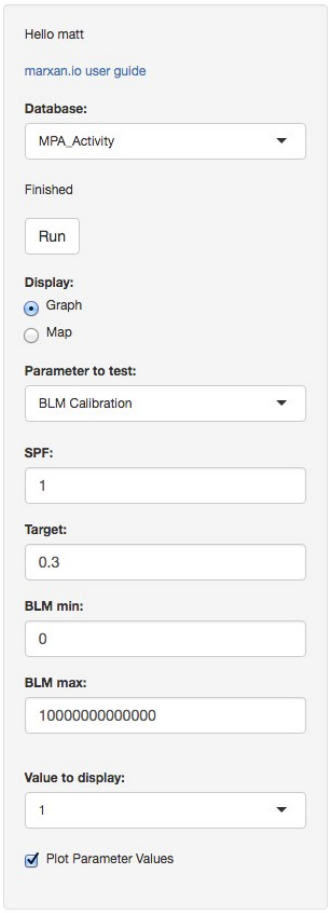
Selecting “Dendogram” with the “Cluster” control displays a dendogram of the 100 solutions:



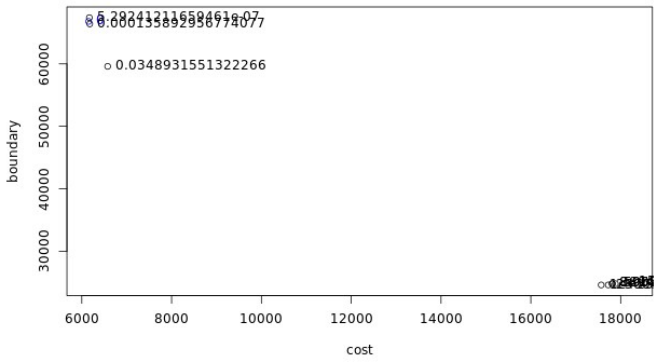
Only unique solutions are displayed. Each solution is labeled and the solution with the lowest objective function score is labeled in blue.

Parameter Testing

The “Parameter testing” app allows users to do parameter testing, and display maps, tables and graphs:



	BLM	cost	boundary
1	0	6152.1	66800
2	5.29241211659461e-07	6168.5	67400
3	0.00013589295677 4077	6177.6	66400
4	0.0348931551322266	6576.3	59600
5	8.9594950612914	17806.1	24800
6	2300.52431341088	17723.1	24600
7	590704.284157705	17882.3	24800
8	151674793.997252	18224.5	25000
9	38945448257.4347	17820.3	24800
10	1e+13	17567.4	24600

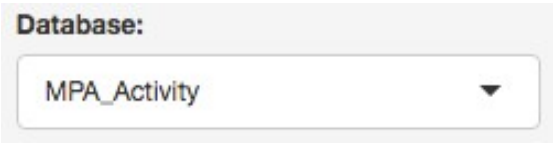


Here you can do calibration and sensitivity analysis of key parameters.
You can iteratively run tests for parameters of interest, changing parameters each time, to interactively explore the response of variables of interest. This allows the dynamics of a problem to be systematically explored in a structured way.

Appropriate values for the key parameters can thus be rapidly and efficiently determined.

Database

The app has a “Database” control:



Click the drop down arrow on the right of the control to select the dataset you want to work with.

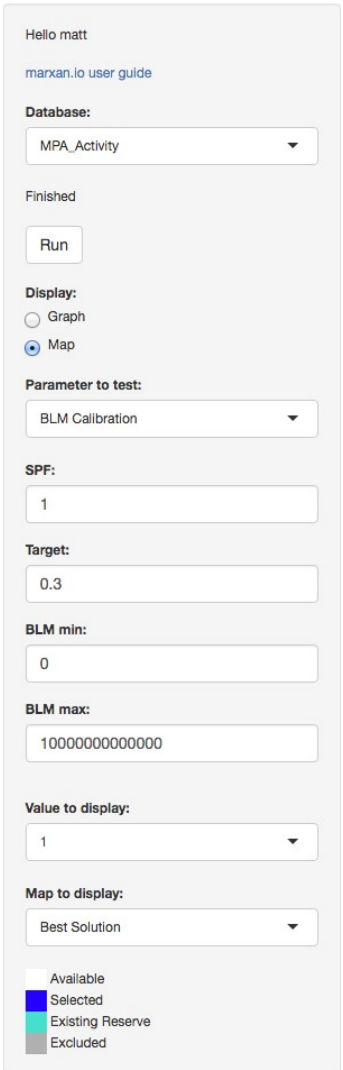
The first time you select a dataset you have uploaded, there will be a delay while the parameter testing outputs for the selected test are rendered. Blue progress messages appear in the top right corner of the screen while processing occurs.

This delay is a minute or so for small datasets and several minutes for large and complex datasets.

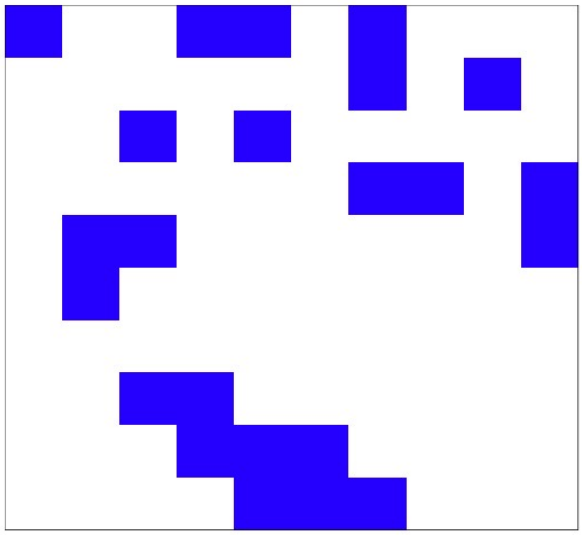
Please be patient after selecting a dataset while the output renders. The blue progress messages disappear and the display refreshes with output from your dataset once it's rendered.

Display

Click the "Display" control to switch the display between "Graph" and "Map":



	BLM	cost	boundary
1	0	6152.1	66800
2	5.29241211659461e-07	6168.5	67400
3	0.000135892956774077	6177.6	66400
4	0.0348931551322266	6576.3	59600
5	8.9594950612914	17806.1	24800
6	2300.52431341088	17723.1	24600
7	590704.284157705	17882.3	24800
8	151674793.997252	18224.5	25000
9	38945448257.4347	17820.3	24800
10	1e+13	17567.4	24600



Parameter to test

The “Parameter to test” control selects the test you want to run: “BLM Calibration”, “SPF Calibration”, or “Target Sensitivity”:

The first time you select a parameter to test for a dataset you have uploaded, there will be a delay while the parameter testing outputs for the selected test are rendered. Blue progress messages appear in the top right corner of the screen while processing occurs.

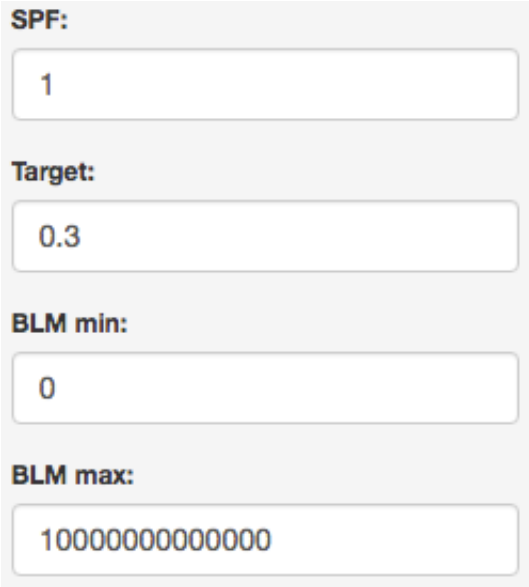
This delay is a minute or so for small datasets and several minutes for large and complex datasets.

Please be patient after selecting a parameter while the output renders. The blue progress messages disappear and the display refreshes with output from your dataset once it’s rendered.

BLM Calibration

Click the drop down arrow on the right of the “Parameter to test” control and select “BLM Calibration” to calibrate the boundary length modifier (BLM):

These controls appear to enter parameter values for the calibration:



In the “SPF” control, enter the SPF value to use.

In the “Target” control, enter the proportional target value to use.

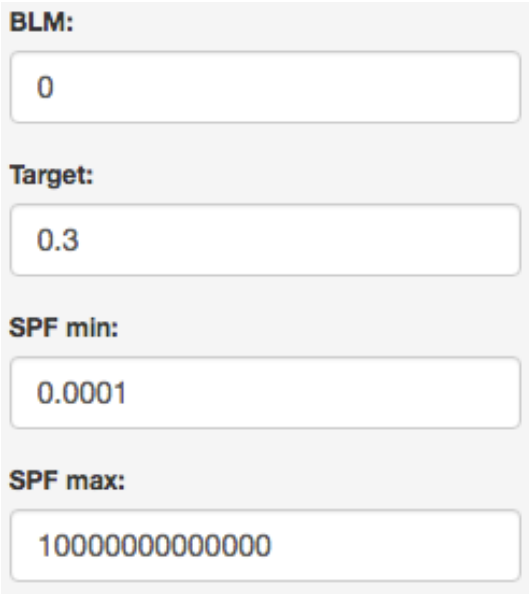
In the “BLM min” control, enter the minimum BLM value to use.

In the “BLM max” control, enter the maximum BLM value to use.

SPF Calibration

Click the drop down arrow on the right of the “Parameter to test” control and select “SPF Calibration” to calibrate the species penalty factor (SPF):

These controls appear to enter parameter values for the calibration:



In the “BLM” control, enter the BLM value to use.

In the “Target” control, enter the proportional target value to use.

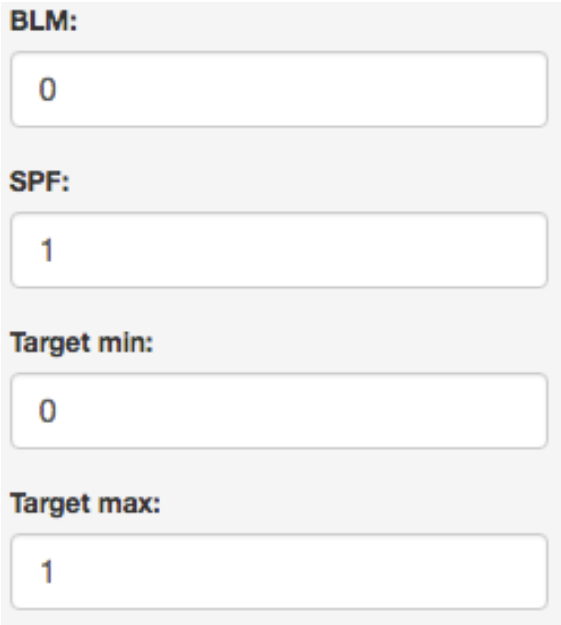
In the “SPF min” control, enter the minimum SPF value to use.

In the “SPF max” control, enter the maximum SPF value to use.

Target Sensitivity

Click the drop down arrow on the right of the “Parameter to test” control and select “Target Sensitivity” to analyse the sensitivity of the species targets:

These controls appear to enter parameter values for the sensitivity test:



In the “BLM” control, enter the BLM value to use.

In the “SPF” control, enter the proportional SPF value to use.

In the “Target min” control, enter the minimum Target value to use.

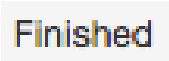
In the “Target max” control, enter the maximum Target value to use.

Run

Click the run button to execute the selected parameter test with the parameters you have entered:

A delay of a few seconds for small datasets and several minutes for larger datasets occurs during which the “Finished” label greys out. Blue progress messages appear in the top right corner of the screen while processing occurs.

When processing is finished, the blue progress messages disappear, the “Finished” label appears black again, and the display refreshes with new output.



A set of 10 values is tried for the parameter you are testing.

A set of 10 solutions are generated for each value you are testing for a total of 100 solutions.

For BLM and SPF calibration, the values are ramped exponentially between the min and max entered.

For Target sensitivity analysis, the values are ramped linearly between the min and max entered.

Output table

	SPF	cost	shortfall
1	1e-04	0	4164.9
2	0.00774263682681128	0	4164.9
3	0.599484250318941	5063.8	313.7
4	46.4158883361278	7420.4	0.1
5	3593.81366380463	7307	0
6	278255.940220712	7526.7	0
7	21544346.9003189	7391.6	0
8	1668100537.20006	7417.2	0
9	129154966501.489	7615.6	0
10	1e+13	7792.6	0

The output table displays the parameter values tried, the average cost of solutions, and the average value for the response variable of the solutions.

For SPF, the response variable is “shortfall” (the total amount by which our features miss meeting their targets).

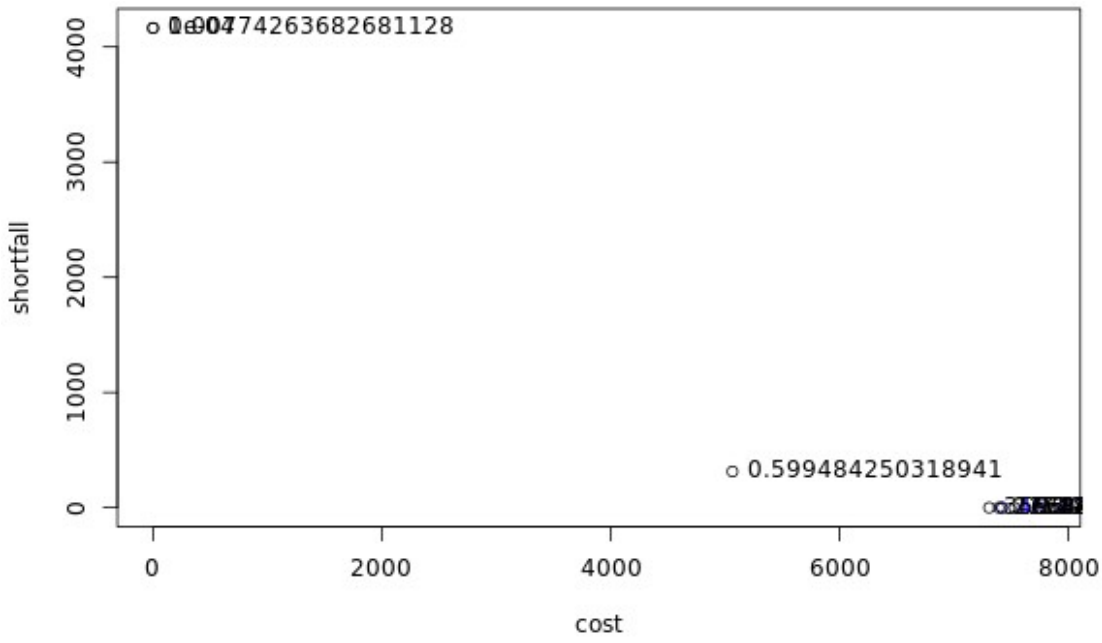
For BLM, the response variable is “boundary” (the total boundary length of the reserve network configuration).

For target, the response variable is simply “target” (the target level we are testing).

Our aim with SPF and BLM calibration is to discover a parameter value that gives an appropriate response in the response variable.

Our aim with target sensitivity analysis is to discover how much it costs to protect different proportions of our species.

Output graph



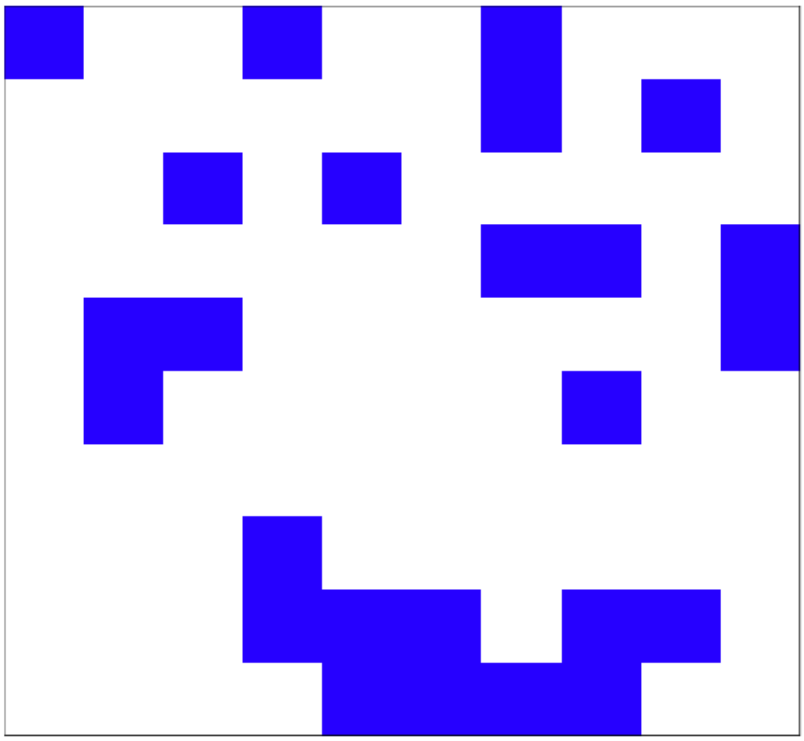
The output graph for BLM and SPF displays the response variable on the Y axis, and the cost on the X axis.

The output graph for target displays target on the Y axis and cost on the X axis.

As a test is rerun with different values of “min” and “max”, results are cumulatively added to the graph so the problem dynamics can gradually be revealed.

This iterative process allows rapid and efficient determination of appropriate values for the key parameters.

Output map



The output map displays selected areas or selection frequency for the value selected in the “Values to display” control (see below).

The “Map to display” control also determines which map is displayed (see below).

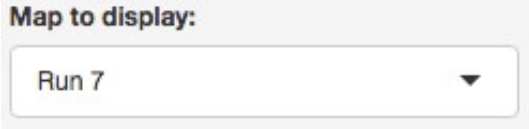
Value to display

The “values to display” control allows you to select which input parameter value to interrogate.

Choosing “1” selects the “min” value specified. Choosing “10” selects the “max” value specified. Choosing a value between 1 and 10 selects one of the values ramped between the “min” and “max” values.

The selected value is highlighted in blue on the output table and graph, and results from testing the selected value are displayed on the output map.

Map to display



The “Map to display” control allows you to select which map to display.

10 solutions are generated for each input parameter value tried, and selecting “Run 1” to “Run 10” displays that solution on the map.

Selecting “Best Solution” displays the solution with the lowest objective function score on the map.

Selecting “Selection Frequency” displays selection frequency on the map.

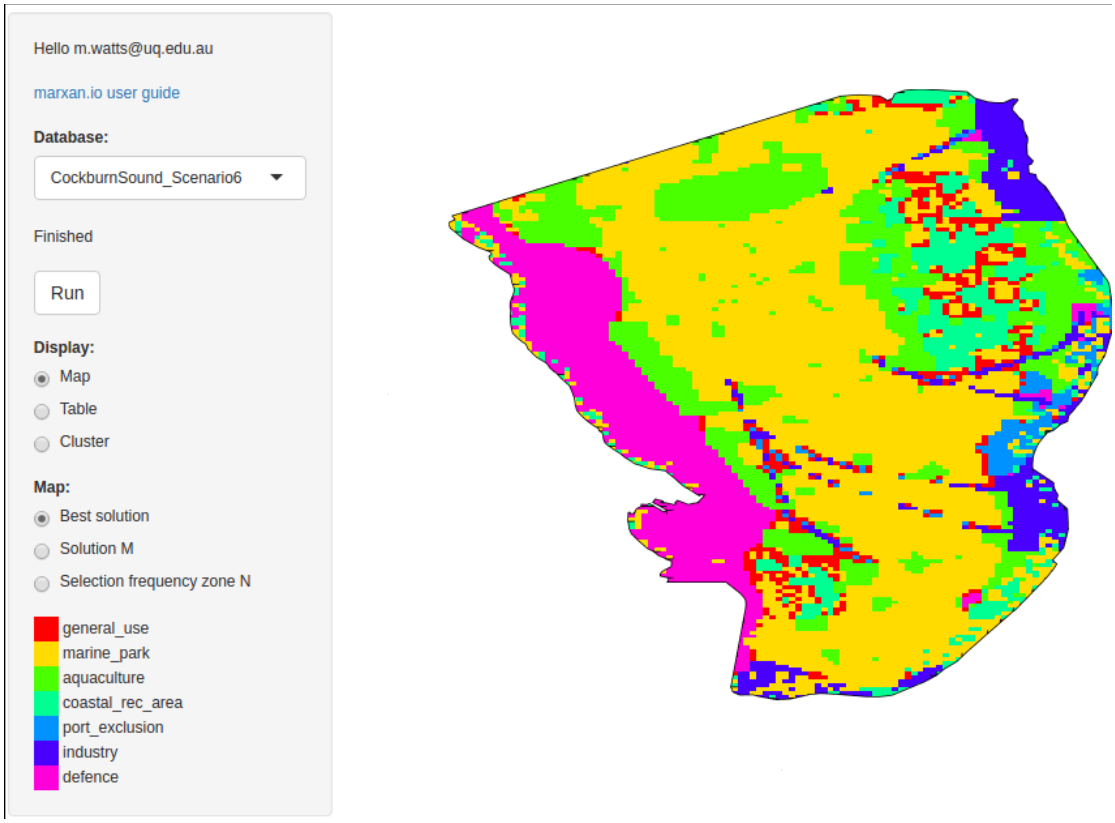
Plot Parameter Values

The “Plot Parameter Values” control selects if parameter values will or will not be displayed next to their relevant points on the graph.

Run MarZone

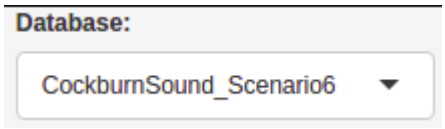
The “Run MarZone” app allows users to run Marxan with Zones, display maps, tables and graphs, and edit key parameters. It has a control panel on the left, and an output panel on the right.

The “Run MarZone” screen looks like this:



Database

The app has a “Database” control:



Click the drop down arrow on the right of the control to select the dataset you want to work with.

The first time you select a dataset you have uploaded, there will be a delay while the MarZone outputs are rendered. Blue progress messages appear in the top right corner of the screen while processing occurs.

This delay is a minute or so for small datasets and several minutes for large and complex datasets.

Please be patient after selecting a dataset while the output renders. The blue progress messages disappear and the display refreshes with output from your dataset once it’s rendered.

Run

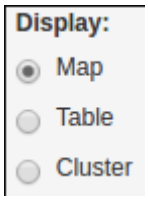
The app has a run button:

When you've changed SPF, or targets, click this button to run MarZone with the new parameters.

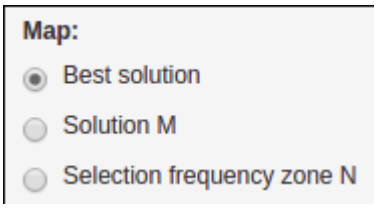
A delay of a few seconds for small datasets and longer for larger datasets occurs. During processing, progress messages appear in the top right corner of the screen and the "Finished" label greys out. After the results are rendered, the blue progress messages disappear, the "Finished" label appears black again and the display refreshes with new output.

Display: Map

The app has a "Display" control. Select "Map" to display output maps.

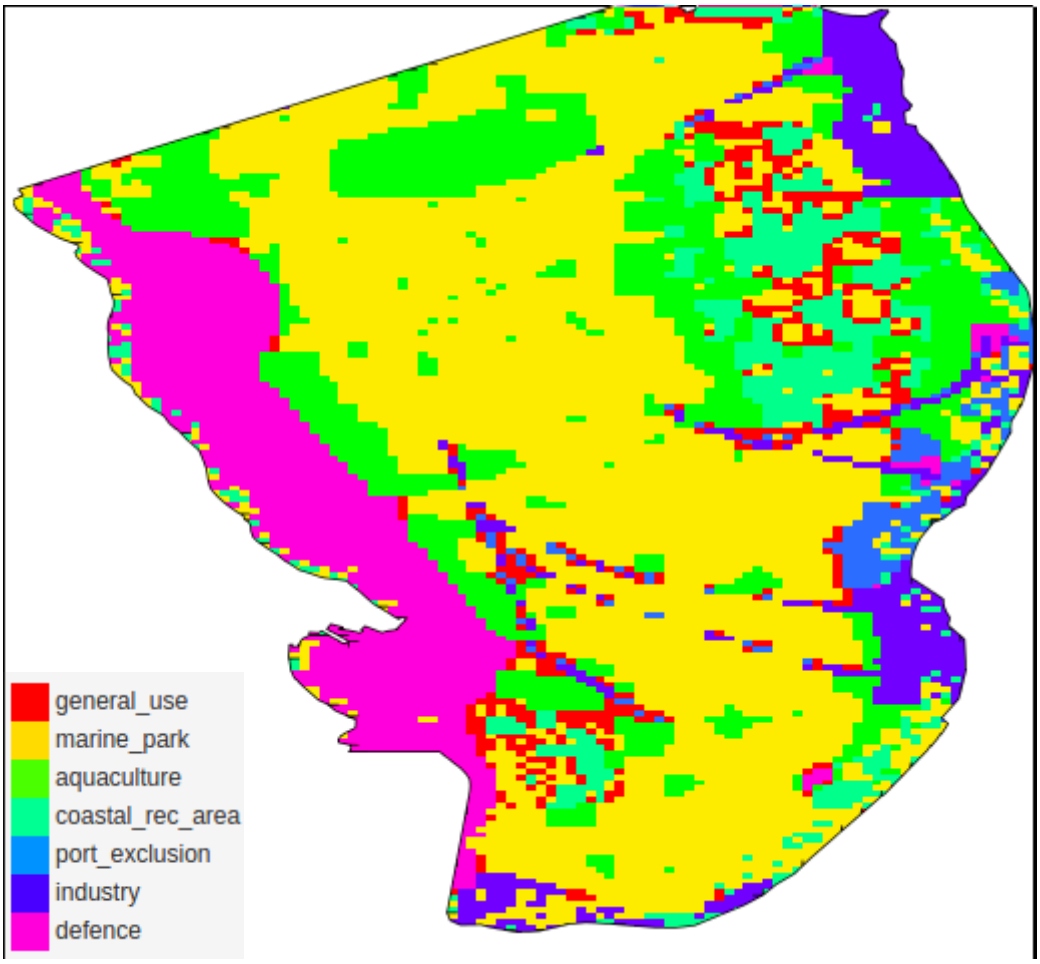


When "Map" is selected, a "Map" control appears:



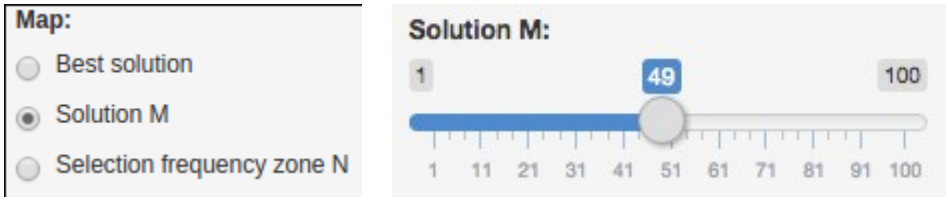
Best solution

Selecting "Best solution" displays the MarZone solution with the lowest objective function score. A map and map legend appears:



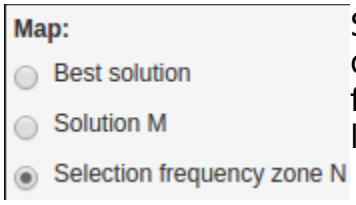
Solution M

Selecting “Solution M” displays a slider to select any of the 100 solutions:

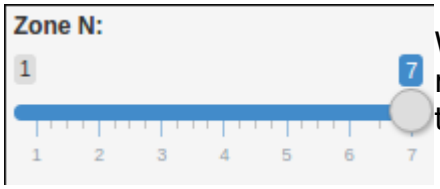


When you drag the slider, the map display is refreshed with the solution selected in the slider.

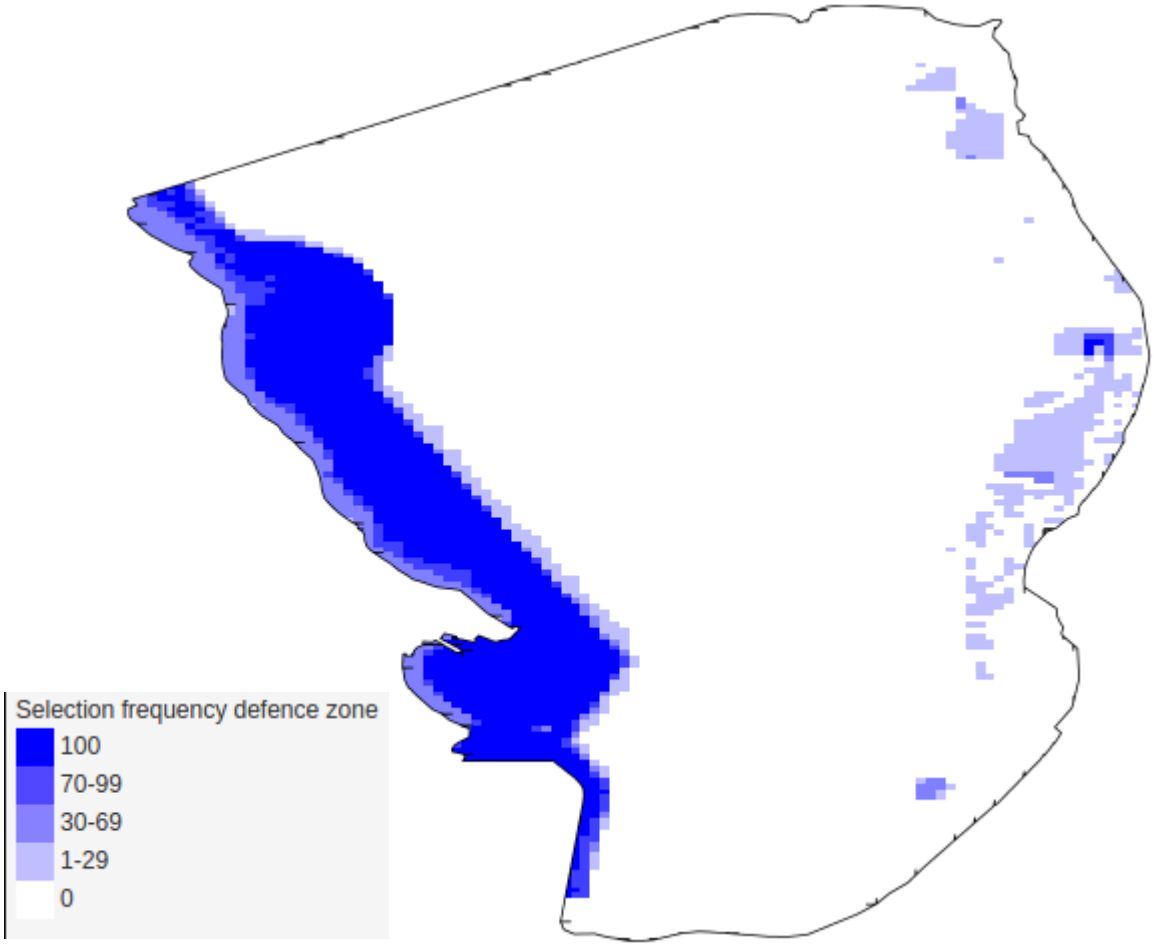
Selection frequency zone N



Selecting “Selection frequency zone N” displays a “Zone N” slider, a selection frequency map of 100 solutions, and a map legend:

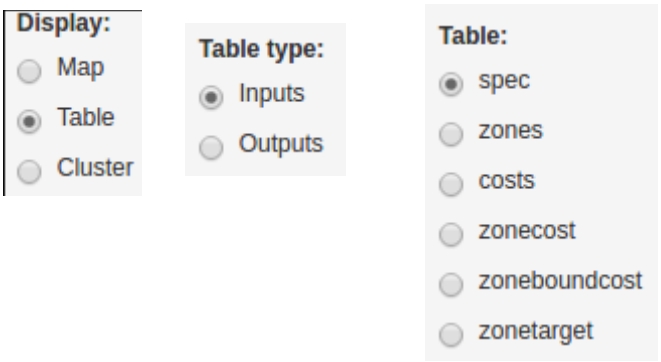


When you drag the slider, the map is refreshed with the selection frequency for the zone selected in the slider.



Display Table: Inputs

Selecting “Table” with the “Display” control causes the “Table type” control to appear. Selecting “Inputs” cause the “Table” control to appear for input tables. Selecting “spec” with “Table” allows you to view the Conservation Features table and edit prop and spf.



Selecting the other input tables in the “Table” control allows you to view them also. e.g. Click “zones” to view the zones table.

Edit “prop” and “spf”

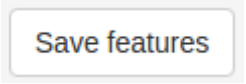
When displaying “spec”, you can edit prop (proportional target) and SPF (species penalty factor) for each species.

	id	prop	spf	name
1	1	0	1	CORAL
2	2	0	1	SG_MIXEDSP
3	3	0	1	COBBLE
4	4	0	1	DEPTHGT10M
5	5	0	1	FINE_SEDIM

To edit prop or SPF for a species, click the cell you want to edit and type in a new value.

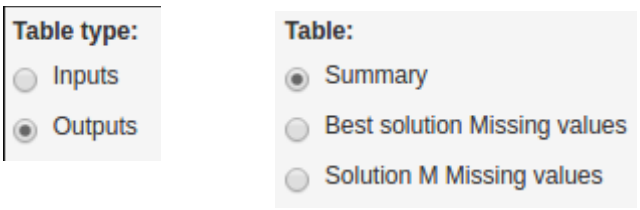
Save features

When you have entered the prop and SPF values for the features you want to change, click the “Save features” button to save the changes to your dataset:



Display Table: Outputs

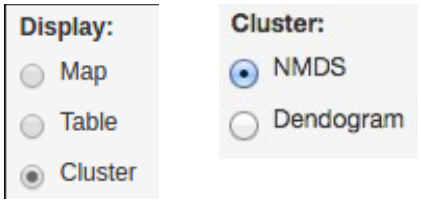
Selecting “Ouputs” with “Table type” causes the “Table” control to appear for output tables.



The display of output tables for MarZone works exactly as it does for Marxan: simply choose the output table you want to be displayed.

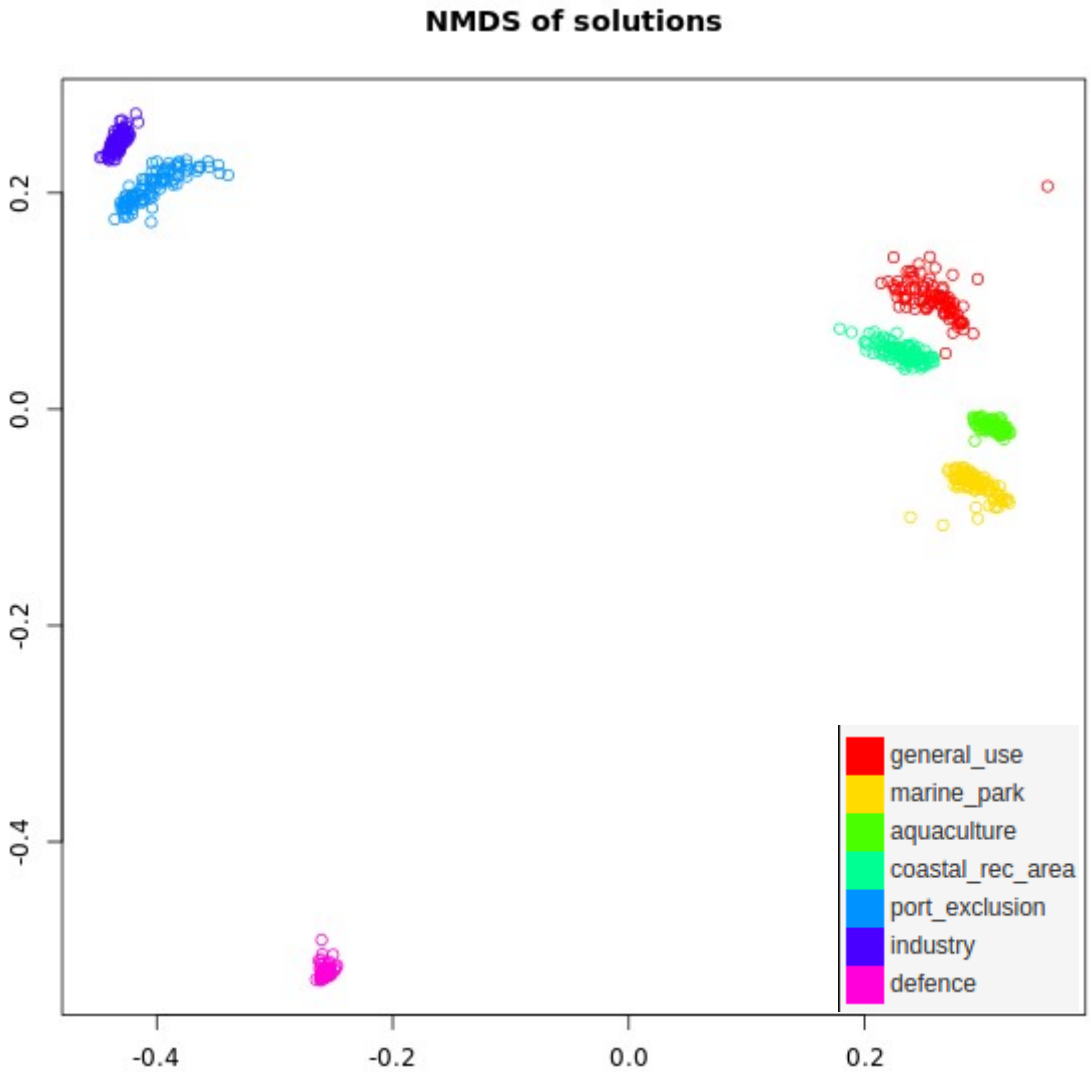
Display: Cluster

Selecting “Cluster” with the “Display” control causes the “Cluster” control to appear:

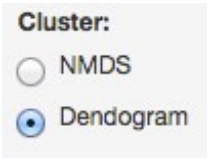


NMDS of solutions

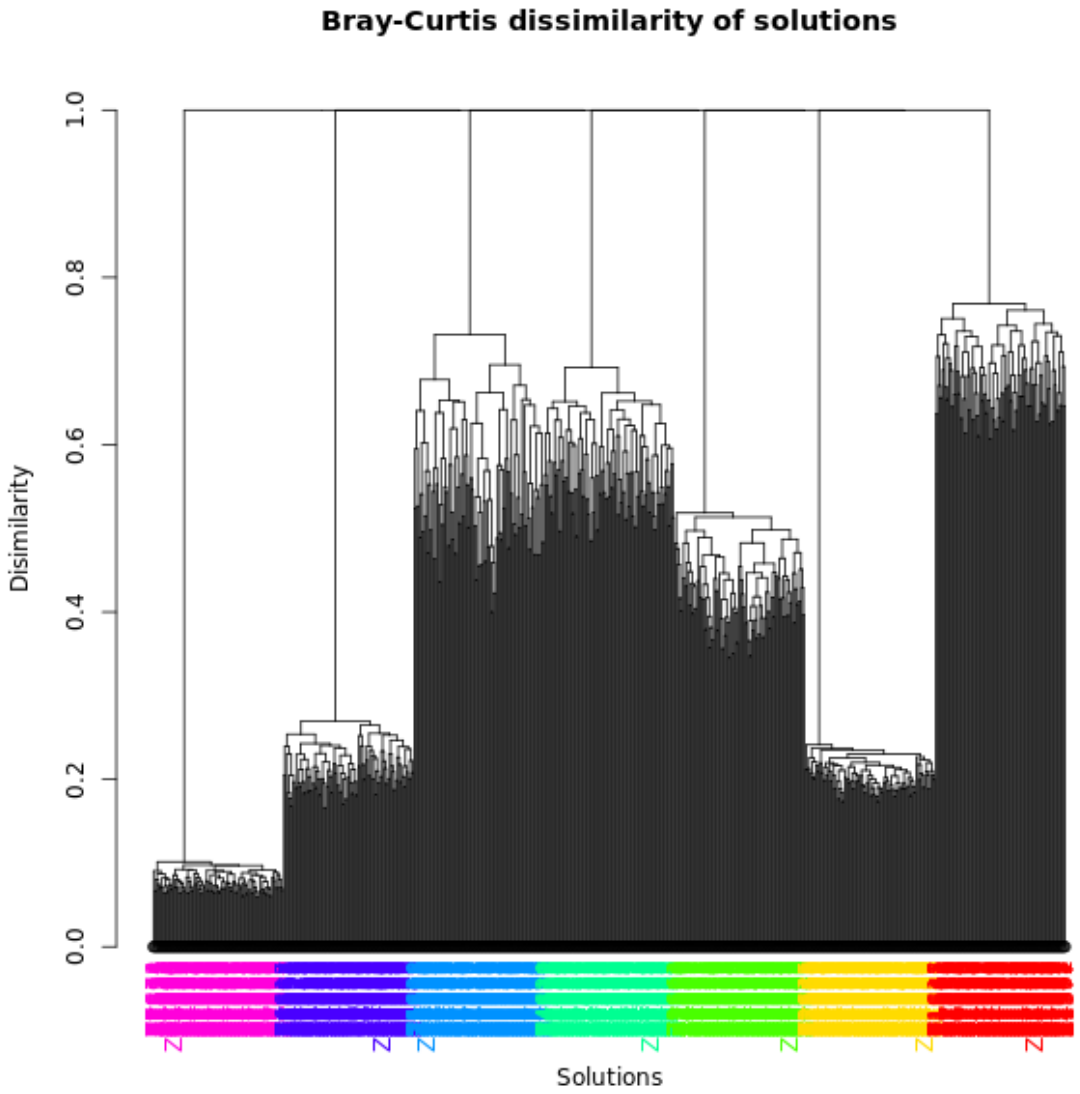
Selecting “NMDS” with the “Cluster” control displays the 2 dimensional scaling of the dissimilarity of each zone for the 100 solutions. A legend shows the colour of each zone.



Bray-Curtis dissimilarity of solutions



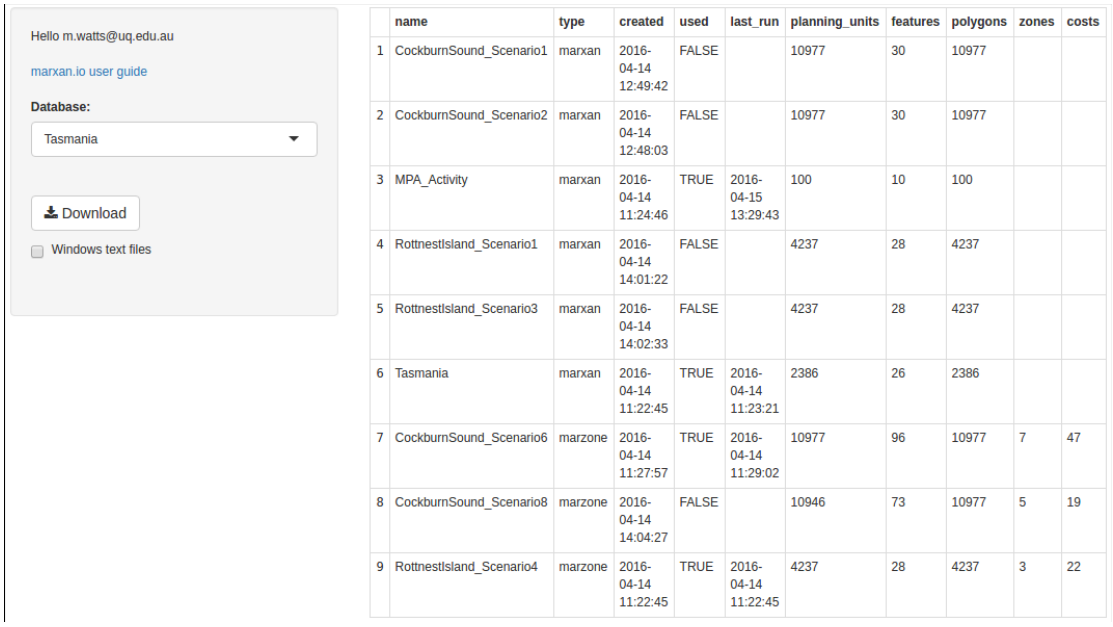
Selecting “Dendogram” with the “Cluster” control displays a dendogram of the dissimilarity of each zone for the 100 solutions. A legend shows the colour of each zone.



Only unique solutions are displayed.

Download a dataset

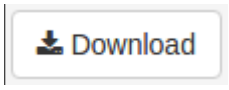
The “Download a dataset” screen looks like this:



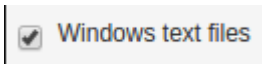
	name	type	created	used	last_run	planning_units	features	polygons	zones	costs
1	CockburnSound_Scenario1	marxan	2016-04-14 12:49:42	FALSE		10977	30	10977		
2	CockburnSound_Scenario2	marxan	2016-04-14 12:48:03	FALSE		10977	30	10977		
3	MPA_Activity	marxan	2016-04-14 11:24:46	TRUE	2016-04-15 13:29:43	100	10	100		
4	RottnestIsland_Scenario1	marxan	2016-04-14 14:01:22	FALSE		4237	28	4237		
5	RottnestIsland_Scenario3	marxan	2016-04-14 14:02:33	FALSE		4237	28	4237		
6	Tasmania	marxan	2016-04-14 11:22:45	TRUE	2016-04-14 11:23:21	2386	26	2386		
7	CockburnSound_Scenario6	marzone	2016-04-14 11:27:57	TRUE	2016-04-14 11:29:02	10977	96	10977	7	47
8	CockburnSound_Scenario8	marzone	2016-04-14 14:04:27	FALSE		10946	73	10977	5	19
9	RottnestIsland_Scenario4	marzone	2016-04-14 11:22:45	TRUE	2016-04-14 11:22:45	4237	28	4237	3	22

A control panel on the left allows you to select a dataset and download it. A table on the right displays a list of your datasets and summary statistics for each dataset.

To download a dataset and it's analysis output files, simply select the dataset with the “Database” control and click the “Download” button.



A zip file will then be downloaded that contains the input and output ascii files for your dataset, and a shapefile with your planning units. By default, the ascii files are encoded with unix style end of line terminators suitable for Linux and Mac platforms.



If you want the ascii files encoded with windows style end of line terminators suitable for Windows platform, make sure the “Windows text files” check box is checked before you press the “Download” button.

Acknowledgements

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Watts, M.E, I.R. Ball, R.R. Stewart, C.J. Klein, K. Wilson, C. Steinback, R. Lourival, L. Kircher, and H.P. Possingham. 2009. Marxan with Zones: software for optimal conservation based land- and sea-use zoning, Environmental Modelling & Software (2009), doi:10.1016/j.envsoft.2009.06.005
