

Camera Trap data analysis application developed around R and CPW Photo Warehouse.

M. Cowan, Biodiversity and Conservation Science.

As part of an investigation into the value of camera traps as a monitoring tool, it has been necessary to extract and analyse data from large and complex datasets (many 100,000's of records). During this process we have developed some new and innovative techniques for interpreting camera trap data.

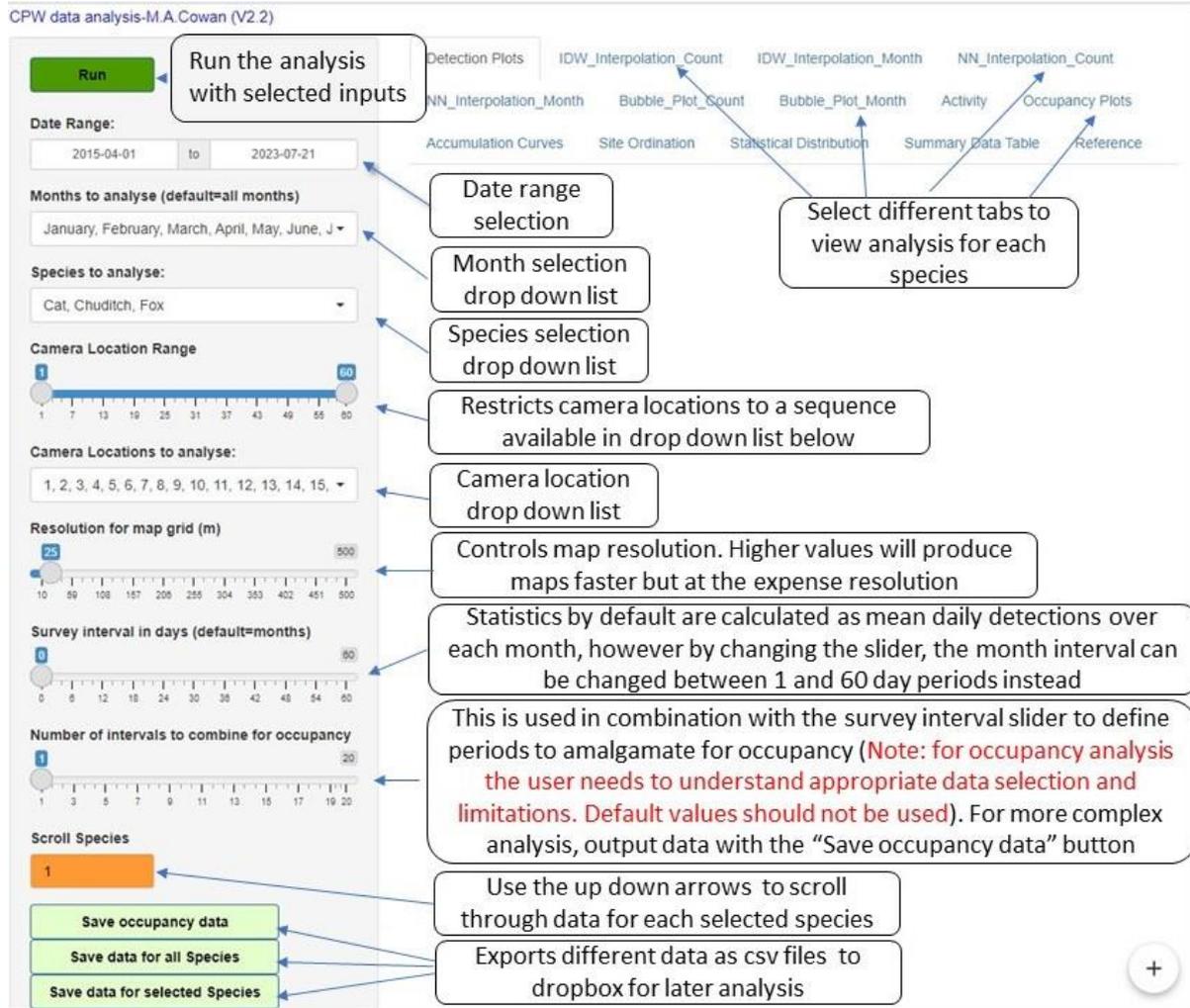
As many of these analytical techniques involve time consuming and onerous manual manipulation of data from the collection database, CPW Photo Warehouse, a number of R scripts were written to help automate this process. This has been taken a step further with the development of an online application based on R and RStudio's "Shiny" environment that is interactive for analysing, downloading, and reporting on systematically collected camera trap data. The application runs through a web interface and is therefore accessible from any browser with internet access, although Firefox is the preferred browser. Specific applications (projects) are password protected so only authorised users will have access.

This application may be useful to anyone working with large scale systematically collected (rather than opportunistic or small scale) camera trap data stored in CPW Photo Warehouse. It will enable users to extract, visualise and report in a timely and consistent manner with minimal effort and no requirements for understanding methods of data extraction from CPW Photo Warehouse.

Over the next few pages are screen shots, along with a brief summary of each of the pages associated with this application. All of these pages are accessible using the tabs along the top of the application page.

All of the graphs and maps can be directly copied and saved as .png files and are thus available for direct insertion into reports or presentations. Data outputs are saved to project specific Dropbox folders, for which the user will require a link (this will be sent to the data custodian when the application is set up). The Dropbox address is static for each project so once that link is acquired, all data downloads will be available from that location.

Prerequisites for setting the application up are a properly compiled CPW Warehouse database with no duplication of species names in the species list, no duplication of camera location names, and UTM coordinates for every listed camera location. When camera coordinates have been collected as non-projected geographic coordinates, they can be converted to UTM from within CPW Photo Warehouse. The project should also include a shapefile of a polygon boundary (projected as UTM and named "outline") and a line shapefile representing tracks or roads within the boundary polygon (projected as UTM and named "tracks").



The first page that opens when the application is started is this one. From here the user selects the elements they want to filter by, which include the range of dates (default is first and last date of data from within CPW Photo Warehouse), sampling interval (the default is months) the camera locations, resolution for interpolated maps, and a check against each species of interest. Pressing "Run" then extracts records based on these parameters and initiates a variety of data manipulations which can take as long as 45 seconds or more to complete for large datasets (>400,000 records). When "Run" completes the plots for the first species of interest will be displayed in the right-hand side of the window as shown on the following image.

If the user wants to undertake further analysis beyond what is available in the application based on the filter parameters, then simply using any of the three "save" buttons in the side panel will save the relevant data as a collated .csv file to Dropbox. This includes data formatted for occupancy analysis.

Run

Date Range:
 2015-04-01 to 2023-07-21

Months to analyse (default=all months)
 January, February, March, April, May, June, J ▾

Species to analyse:
 Cat, Chuditch, Fox ▾

Camera Location Range
 1 60

Camera Locations to analyse:
 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, ▾

Resolution for map grid (m)
 25 500

Survey interval in days (default=months)
 0 60

Number of intervals to combine for occupancy
 1 20

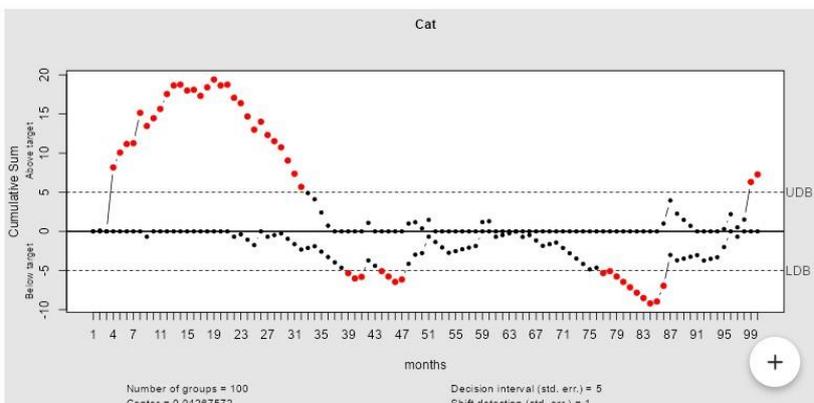
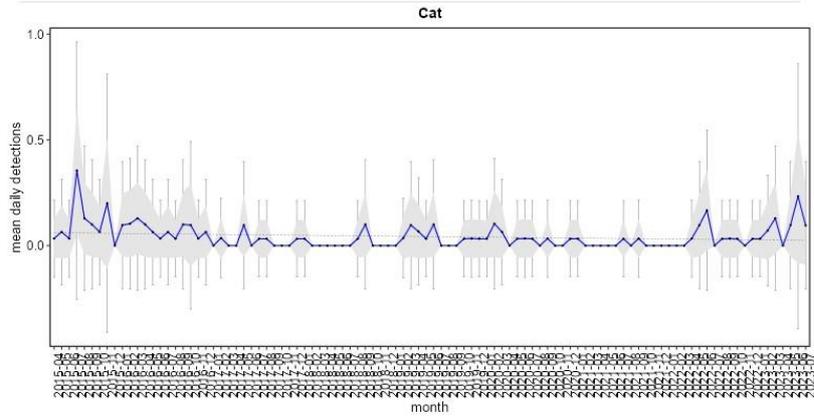
Scroll Species
 1

Save occupancy data

Save data for all Species

Save data for selected Species

- Detection Plots
- IDW_Interpolation_Count
- IDW_Interpolation_Month
- NN_Interpolation_Count
- NN_Interpolation_Month
- Bubble_Plot_Count
- Bubble_Plot_Month
- Activity
- Occupancy Plots
- Accumulation Curves
- Site Ordination
- Statistical Distribution
- Summary Data Table
- Reference



The above graphs are presented after “Run” completes. The top plot is the mean monthly detection rate over the range of dates and camera locations that were selected. Error bars are one standard deviation, and the grey ribbon represents the bounds of 95% CI. The dashed line is the trend.

The lower graph is a Cusum plot. It is particularly sensitive to shifts from a population mean and indicates both positive and negative trends. One of the advantages of this type of analysis is that for animal population data that is noisy and fluctuates significantly (most fauna monitoring data), trigger points for intervention or further investigation can be set to encompass this natural variability.

An important point for this page and all the others that follow is that it is just showing the data for the first species in the selected list. To view the same data for any other species in the selected list it is just a matter of scrolling up or down or entering a number in the “Display species” dialogue box. The user can move up or down through this list at any time and from within every page.

Run

Date Range:
 2015-04-01 to 2023-07-21

Months to analyse (default=all months)
 January, February, March, April, May, June, J ▾

Species to analyse:
 Cat, Chuditch, Fox ▾

Camera Location Range
 1 60

Camera Locations to analyse:
 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, ▾

Resolution for map grid (m)
 25 500

Survey interval in days (default=months)
 0 90

Number of intervals to combine for occupancy
 1 20

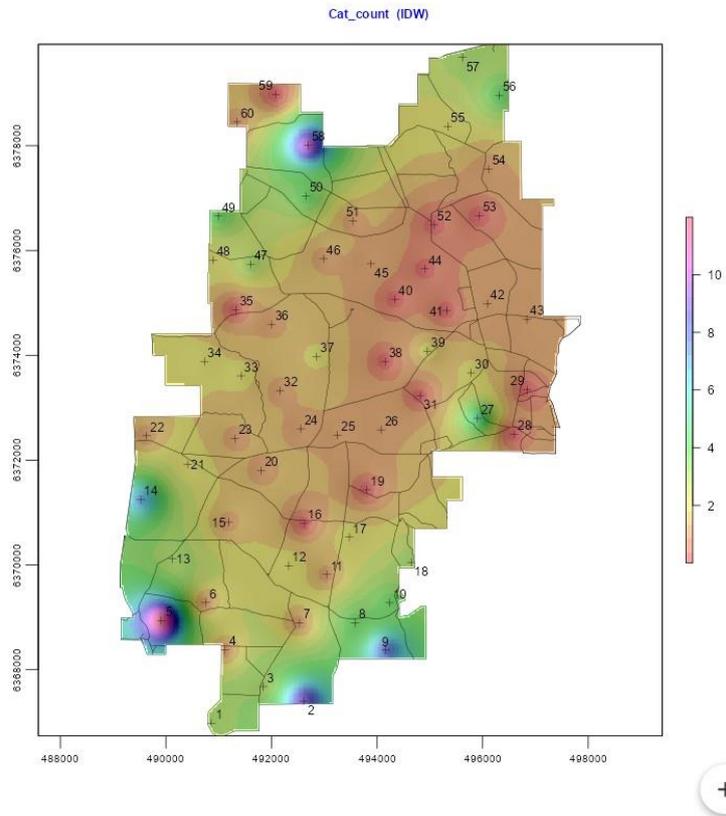
Scroll Species
 1

Save occupancy data

Save data for all Species

Save data for selected Species

- Detection Plots
- IDW_Interpolation_Count**
- IDW_Interpolation_Month
- NN_Interpolation_Count
- NN_Interpolation_Month
- Bubble_Plot_Count
- Bubble_Plot_Month
- Activity
- Occupancy Plots
- Accumulation Curves
- Site Ordination
- Statistical Distribution
- Summary Data Table
- Reference



This page displays an interpolated map of species detection (IDW interpolation) for the total number of independent detections at each camera location.

The speed of map creation is very dependent on the resolution used for mapping, therefore for viewing only, or for very large areas, lower resolutions will speed up map production.

Similar to this page is "IDW_interpolation_month", however rather than presenting a total count of detections this map shows over how many months (or user defined intervals) a detection of a species occurred. This assists in providing a temporal context to the spatial data.

While on this page, or any other, all or any of the parameters in the side panel can be changed and by pressing "Run", analysis will rerun and the page you are on will be updated accordingly. Again, the size of the dataset and the complexity of some of the analysis may mean it takes 30 seconds or more to refresh.

Run

Date Range:
2015-04-01 to 2023-07-21

Months to analyse (default=all months)
January, February, March, April, May, June, J

Species to analyse:
Cat, Chuditch, Fox

Camera Location Range
1 60

Camera Locations to analyse:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,

Resolution for map grid (m)
25 800

Survey interval in days (default=months)
0 60

Number of intervals to combine for occupancy
1 20

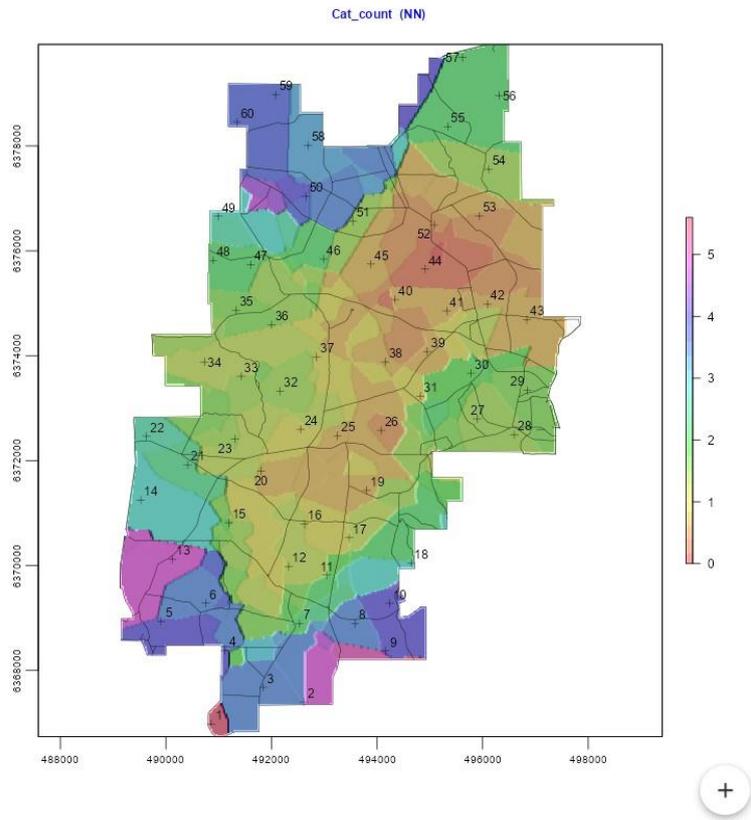
Scroll Species
1

Save occupancy data

Save data for all Species

Save data for selected Species

- Detection Plots
- IDW_Interpolation_Count
- IDW_Interpolation_Month
- NN_Interpolation_Count
- NN_Interpolation_Month
- Bubble_Plot_Count
- Bubble_Plot_Month
- Activity
- Occupancy Plots
- Accumulation Curves
- Site Ordination
- Statistical Distribution
- Summary Data Table
- Reference



This page and “NN_interpolation_month” display the same data as IDW but use nearest neighbour (NN) analysis rather than Inverse Distance Weighting (IDW).

Run

Date Range:
 2015-04-01 to 2023-07-21

Months to analyse (default=all months)
 January, February, March, April, May, June, J

Species to analyse:
 Cat, Chuditch, Fox

Camera Location Range
 1 to 60

Camera Locations to analyse:
 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,

Resolution for map grid (m)
 25 to 500

Survey interval in days (default=months)
 0 to 60

Number of intervals to combine for occupancy
 1 to 20

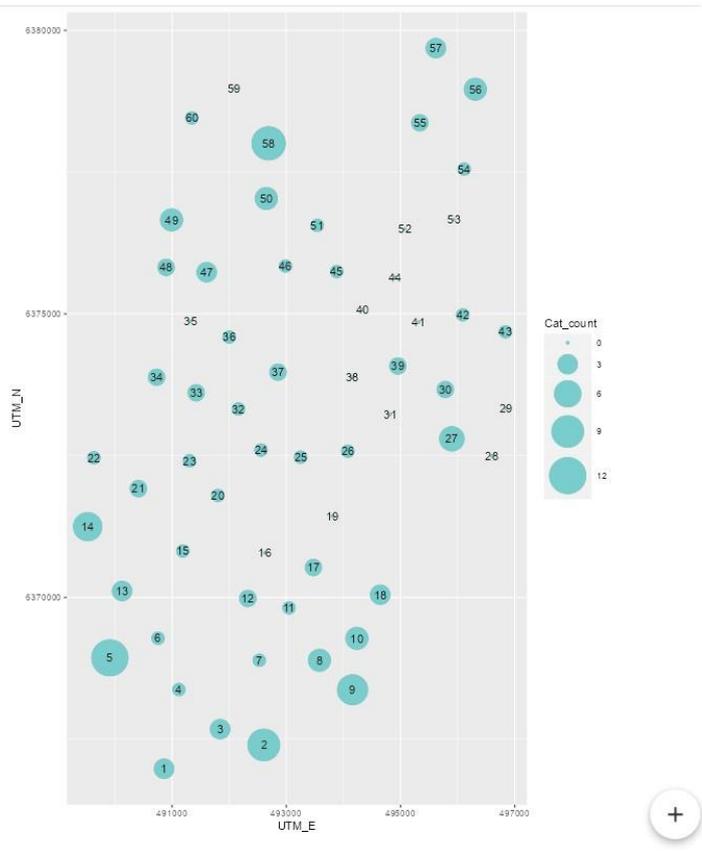
Scroll Species
 1

Save occupancy data

Save data for all Species

Save data for selected Species

- Detection Plots
- IDW_Interpolation_Count
- IDW_Interpolation_Month
- NN_Interpolation_Count
- NN_Interpolation_Month
- Bubble_Plot_Count**
- Bubble_Plot_Month
- Activity
- Occupancy Plots
- Accumulation Curves
- Site Ordination
- Statistical Distribution
- Summary Data Table
- Reference



This page presents the same data as the previous tabs but as total detections at each site indicated by the size of the bubbles. This is equivalent to a heat map rather than an interpolated surface. The numbers, as in the interpolated maps, are the location IDs for each of the camera stations.

Run

Date Range:
2015-04-01 to 2023-07-21

Months to analyse (default=all months)
January, February, March, April, May, June, J

Species to analyse:
Cat, Chuditch, Fox

Camera Location Range
1 60

Camera Locations to analyse:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Resolution for map grid (m)
25 500

Survey interval in days (default=months)
0 60

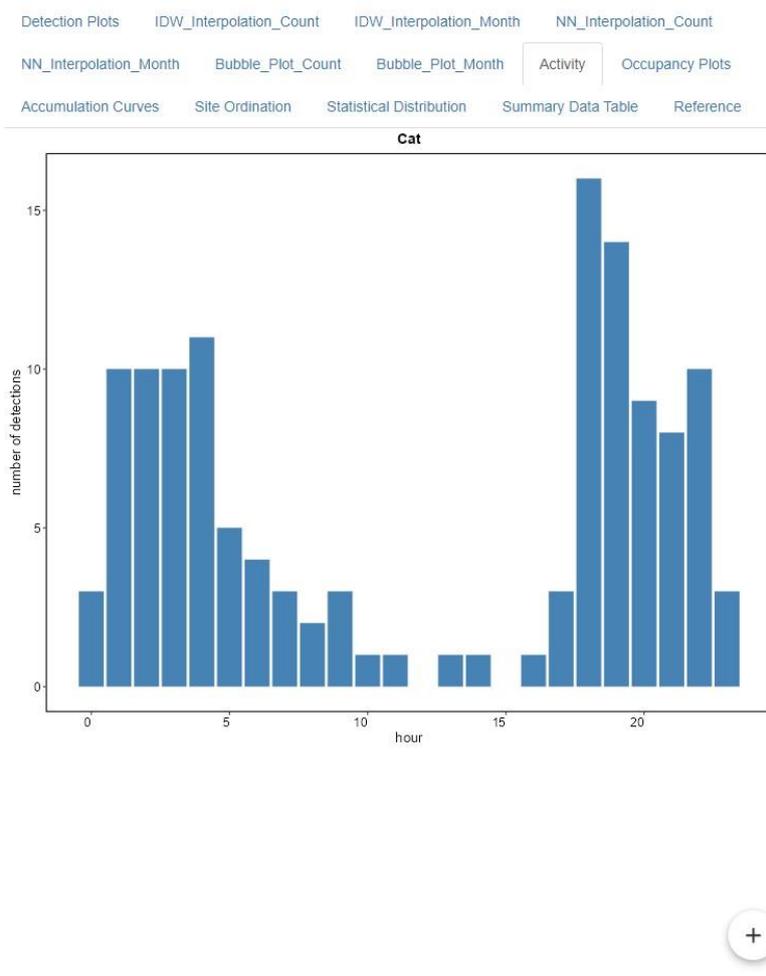
Number of intervals to combine for occupancy
1 20

Scroll Species
1

Save occupancy data

Save data for all Species

Save data for selected Species



This page shows the species activity time within the filtered data parameters.

Run

Date Range:
 2015-04-01 to 2023-07-21

Months to analyse (default=all months)
 January, February, March, April, May, June, J

Species to analyse:
 Cat, Chuditch, Fox, Woylie

Camera Location Range
 1 to 60

Camera Locations to analyse:
 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,

Resolution for map grid (m)
 25 to 500

Survey interval in days (default=months)
 0 to 60

Number of intervals to combine for occupancy
 1 to 20

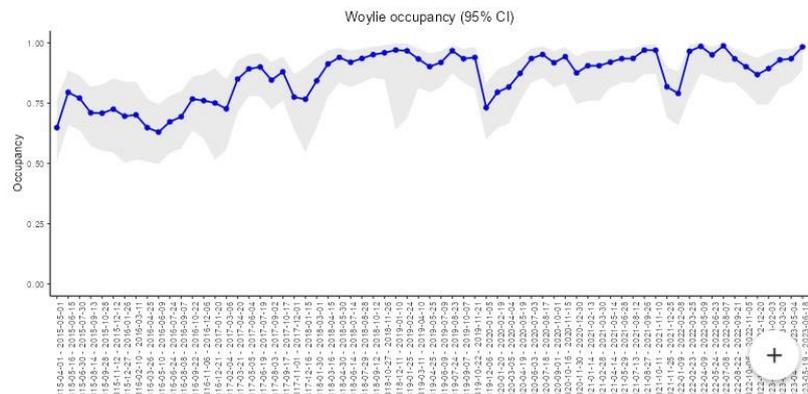
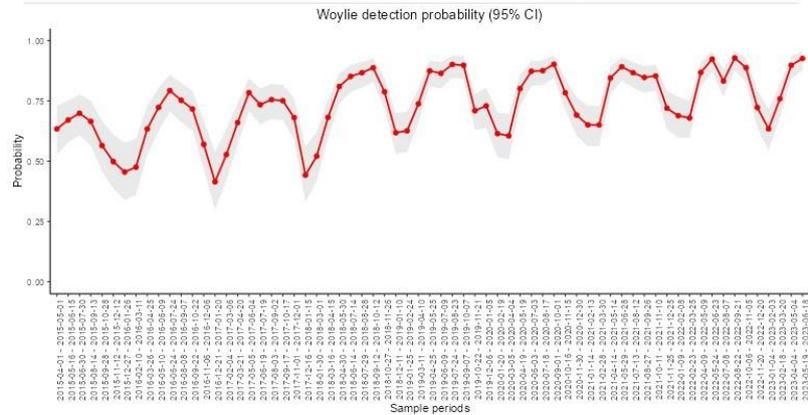
Scroll Species
 4

Save occupancy data

Save data for all Species

Save data for selected Species

- Detection Plots
- IDW_Interpolation_Count
- IDW_Interpolation_Month
- NN_Interpolation_Count
- NN_Interpolation_Month
- Bubble_Plot_Count
- Bubble_Plot_Month
- Activity
- Occupancy Plots
- Accumulation Curves
- Site Ordination
- Statistical Distribution
- Summary Data Table
- Reference



This page displays detection probability and occupancy. It is just for general display purposes and detailed occupancy analysis with covariates should be undertaken by using the “save occupancy data” button, and then within R or presence.

When using this tab it is important to consider the length of time over which the analysis is undertaken and also the number of sample periods to be amalgamated as outputs can be erroneous if sample regimes are not properly considered. For species with very low detections there may not be enough data for any sensible analysis.

Run

Date Range:
 2015-04-01 to 2023-07-21

Months to analyse (default=all months)
 January, February, March, April, May, June, J

Species to analyse:
 Brush Wallaby, Cat, Chuditch, Echidna, Fox, ▾

Camera Location Range
 1 60

Camera Locations to analyse:
 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, ▾

Resolution for map grid (m)
 25 500

Survey interval in days (default=months)
 0 60

Number of intervals to combine for occupancy
 1 20

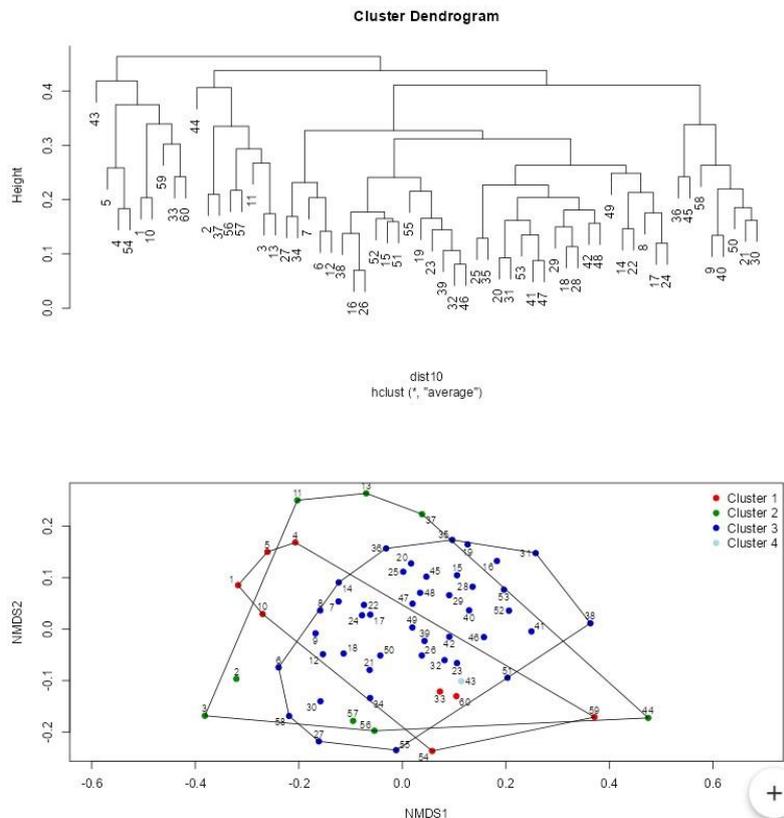
Scroll Species
 4

Save occupancy data

Save data for all Species

Save data for selected Species

- Detection Plots
- IDW_Interpolation_Count
- IDW_Interpolation_Month
- NN_Interpolation_Count
- NN_Interpolation_Month
- Bubble_Plot_Count
- Bubble_Plot_Month
- Activity
- Occupancy Plots
- Accumulation Curves
- Site Ordination
- Statistical Distribution
- Summary Data Table
- Reference



This page displays assemblage graphs for the “community” of selected species. The upper plot is a dendrogram of site (camera locations) similarity based on the Bray Curtis similarity measure. The lower plot is an ordination (nMDS) of the same data with clustering into the four most significant groups.

Run

Date Range:
 to

Months to analyse (default=all months)

Species to analyse:

Camera Location Range

Camera Locations to analyse:

Resolution for map grid (m)

Survey interval in days (default=months)

Number of intervals to combine for occupancy

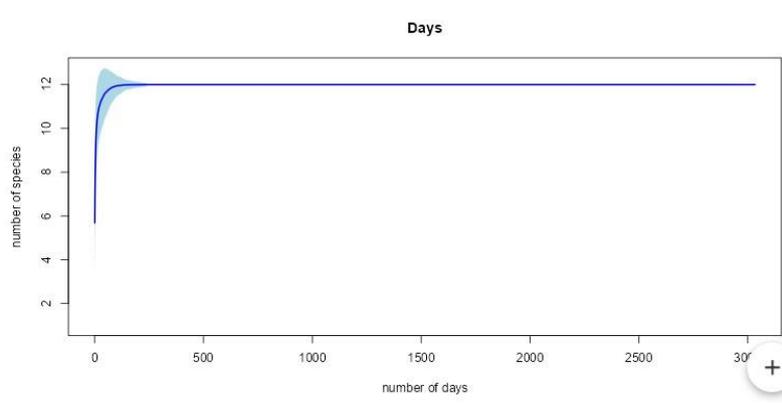
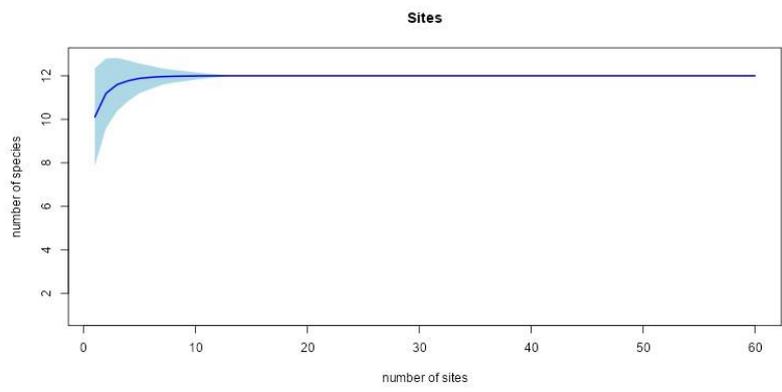
Scroll Species

Save occupancy data

Save data for all Species

Save data for selected Species

- Detection Plots
- IDW_Interpolation_Count
- IDW_Interpolation_Month
- NN_Interpolation_Count
- NN_Interpolation_Month
- Bubble_Plot_Count
- Bubble_Plot_Month
- Activity
- Occupancy Plots
- Accumulation Curves
- Site Ordination
- Statistical Distribution
- Summary Data Table
- Reference



This page provides graphics of permuted species accumulation curves for the selected species. The upper graph is based on number of sites while the lower graph is number of days sampling. Both plots are using the same data but just use different methods of examining effort.

Run

Date Range:
 2015-03-26 to 2023-07-21

Months to analyse (default=all months)
 January, February, March, April, May, June, ▾

Species to analyse:
 Cat, Chuditch, Fox ▾

Camera Location Range
 1 60

Camera Locations to analyse:
 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 1 ▾

Resolution for map grid (m)
 25 500

Survey interval in days (default=months)
 0 60

Number of intervals to combine for occupancy
 1 20

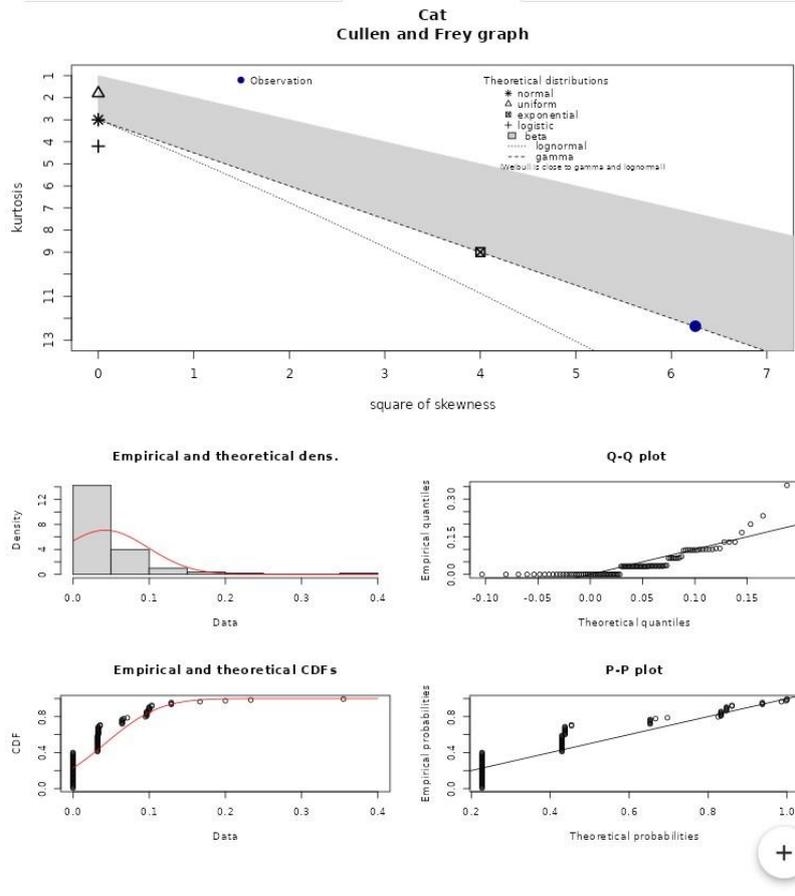
Scroll Species
 1 ▾

Save occupancy data

Save data for all Species

Save data for selected Species

- Detection Plots
- IDW_Interpolation_Count
- IDW_Interpolation_Month
- NN_Interpolation_Count
- NN_Interpolation_Month
- Bubble_Plot_Count
- Bubble_Plot_Month
- Activity
- Occupancy Plots
- Accumulation Curves
- Site Ordination
- Statistical Distribution
- Summary Data Table
- Reference



The plots on this page are about statistical data distribution for each species and how close the data are to normal data. This is useful to know prior to undertaking additional analysis if normality or understanding the data distribution is important.

Run

Date Range:
2015-03-26 to 2023-07-21

Months to analyse (default=all months)
January, February, March, April, May, June, ▾

Species to analyse:
Cat, Chuditch, Fox ▾

Camera Location Range
1 60

Camera Locations to analyse:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 1 ▾

Resolution for map grid (m)
25 500

Survey interval in days (default=months)
0 60

Number of intervals to combine for occupancy
1 20

Scroll Species
1

Save occupancy data

Save data for all Species

Save data for selected Species

Detection Plots IDW_Interpolation_Count IDW_Interpolation_Month NN_Interpolation_Count

NN_Interpolation_Month Bubble_Plot_Count Bubble_Plot_Month Activity Occupancy Plots

Accumulation Curves Site Ordination Statistical Distribution **Summary Data Table** Reference

Show 10 entries Search:

	yearmonth	N	Cat	sd	se	ci
1	2015-03	6	0.00000	0.0000	0.00000	0.00000
2	2015-04	30	0.03333	0.1826	0.03333	0.09188
3	2015-05	31	0.06452	0.2497	0.04485	0.12335
4	2015-06	30	0.03333	0.1826	0.03333	0.09188
5	2015-07	31	0.35484	0.6082	0.10923	0.30039
6	2015-08	31	0.12903	0.3408	0.06121	0.16831
7	2015-09	30	0.10000	0.3051	0.05571	0.15355
8	2015-10	31	0.06452	0.2497	0.04485	0.12335
9	2015-11	30	0.20000	0.6103	0.11142	0.30711
10	2015-12	31	0.00000	0.0000	0.00000	0.00000

Showing 1 to 10 of 101 entries Previous 1 2 3 4 5 ... 11 Next

This tab is a summary of the data used for detection analysis and Cusum plots for each species. Depending on how large the data set is (number of months) there will be additional pages to scroll through with the dialogs on the main page. The number of records per page can also be changed. As with other tabs, the user can scroll through the different species by using the left hand side “Display species” button.

Again, as with any other page all the left hand parameters can be changed and then run to update this tab with a new set of data. This tab and every other tab will then have access to that data for all saved output, graphs and maps.

Run

Date Range:
 to

Months to analyse (default=all months)

Species to analyse:

Camera Location Range

Camera Locations to analyse:

Resolution for map grid (m)

Survey interval in days (default=months)

Number of intervals to combine for occupancy

Scroll Species

Save occupancy data

Save data for all Species

Save data for selected Species

Detection Plots IDW_Interpolation_Count IDW_Interpolation_Month NN_Interpolation_Count

NN_Interpolation_Month Bubble_Plot_Count Bubble_Plot_Month Activity Occupancy Plots

Accumulation Curves Site Ordination Statistical Distribution Summary Data Table **Reference**

1 of 13 Automatic Zoom

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+

The reference button is used to display the overview document.