



ATLAS OF **LIVING**
AUSTRALIA
sharing biodiversity knowledge

The Spatial Portal

A Manual

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Aim of this document

To provide a context for the effective use of the Spatial Portal of the Atlas of Living Australia. The Spatial Portal is aimed at the research and environmental management communities, but anyone wanting to dig a little deeper into the ecology of Australia may find it educational.

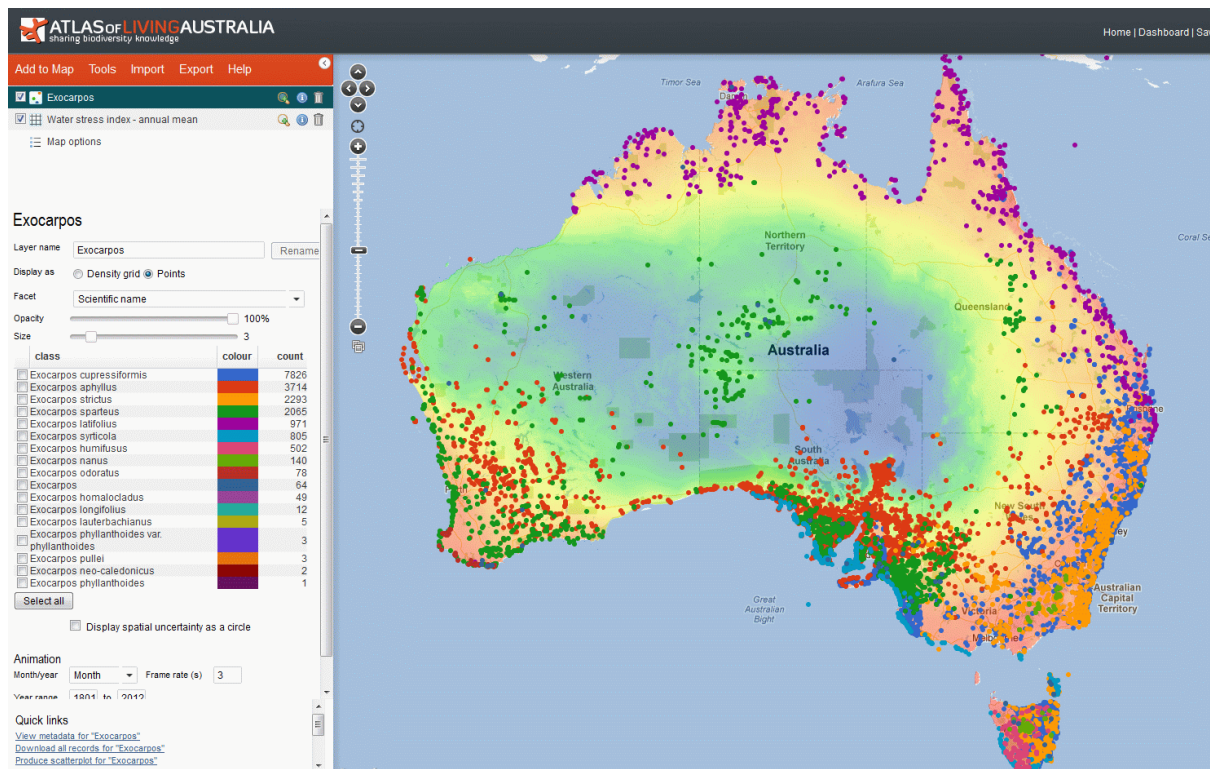


Figure 1. An example screen from the Spatial Portal

Spatial Portal Philosophy

The Spatial Portal comes with a suite of tools to manipulate, display, import and download spatially referenced data. This portal is designed to be the technical or research interface to the data held in the Atlas of Living Australia. It provides a rich but consequently more complex interface. The tools in the Spatial Portal are meant to provide an indication of the type of analyses that are enabled by bringing together in one place, a wide range of biological and environmental data. Assuming that scientists will want to use their own analytical tools, the Spatial Portal provides for extensive export options.

The Spatial Portal (SP) of the Atlas of Living Australia has been designed to provide maximum flexibility when dealing with major spatial data elements

- Species
- Areas
- Environmental layers
- Facets (classes of a variable)

Any or all of these elements can be combined in most tools. For example, a species can be constrained to a given area with an environmental or contextual layer backdrop and with colour coding on the points representing a facet of the mapped points. For example, records of River Red Gum, *Eucalyptus camaldulensis*, can be plotted within one of Australia's bioregions with mean annual temperature as a backdrop layer and point colouring representing the type of observation.

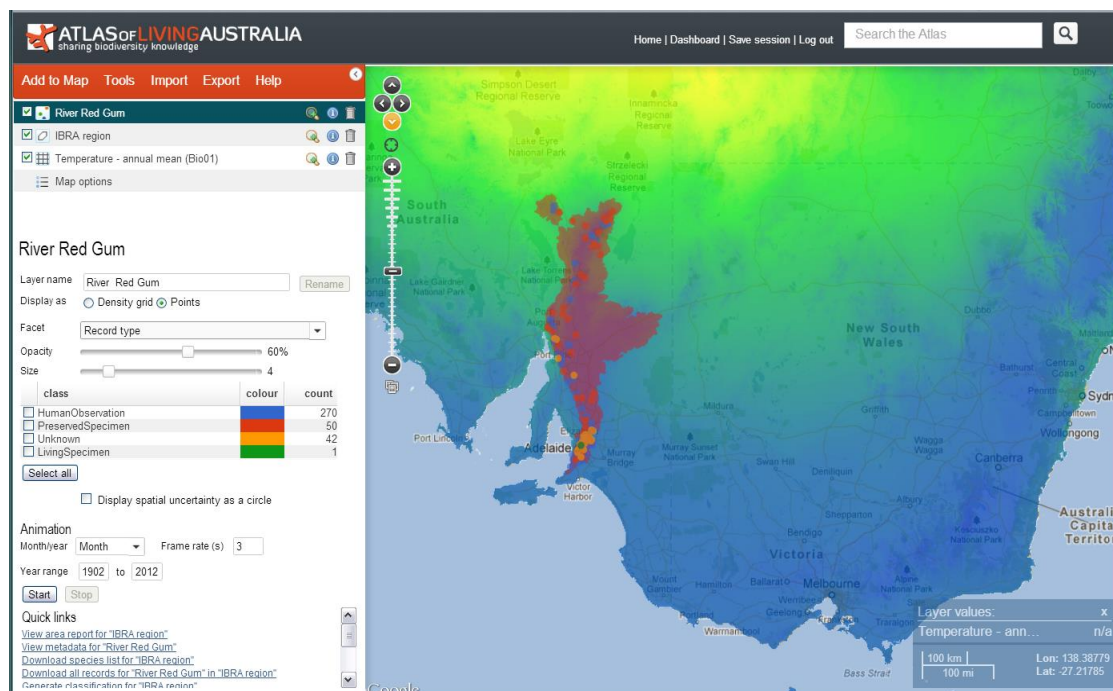


Figure 2. A map of Red River Gum (points) in the bioregion 'Flinders Lofty Block' with the points coloured according to the type of observation and with mean annual temperature as a backdrop.

Spatial Portal Interface

The Spatial Portal screen layout contains seven regions

1. Header: Home, Dashboard, Save session, Log in
2. Menu: Add to Map, Tools, Import, Export and Help.
3. Layer table: All mapped items (species, areas, layers and facets) form layers in this table.
4. Legend: Details about the highlighted layer, and capabilities to change layer characteristics and filter/facet.
5. Quick links: Hints on actions that may be possible given the mapped layers.
6. Map window: This is the main 'outcome' area of the SP. Actions from other regions on the page will be reflected here in the main: The SP is after all, *spatial*.
7. Zoom bar: A Google zoom/pan bar with 'My location' and Panoramio area-based images.
8. Hover, scale & location: A Google scale bar, latitude and longitude of the cursor, and the Hover tool for displaying layer values at cursor.

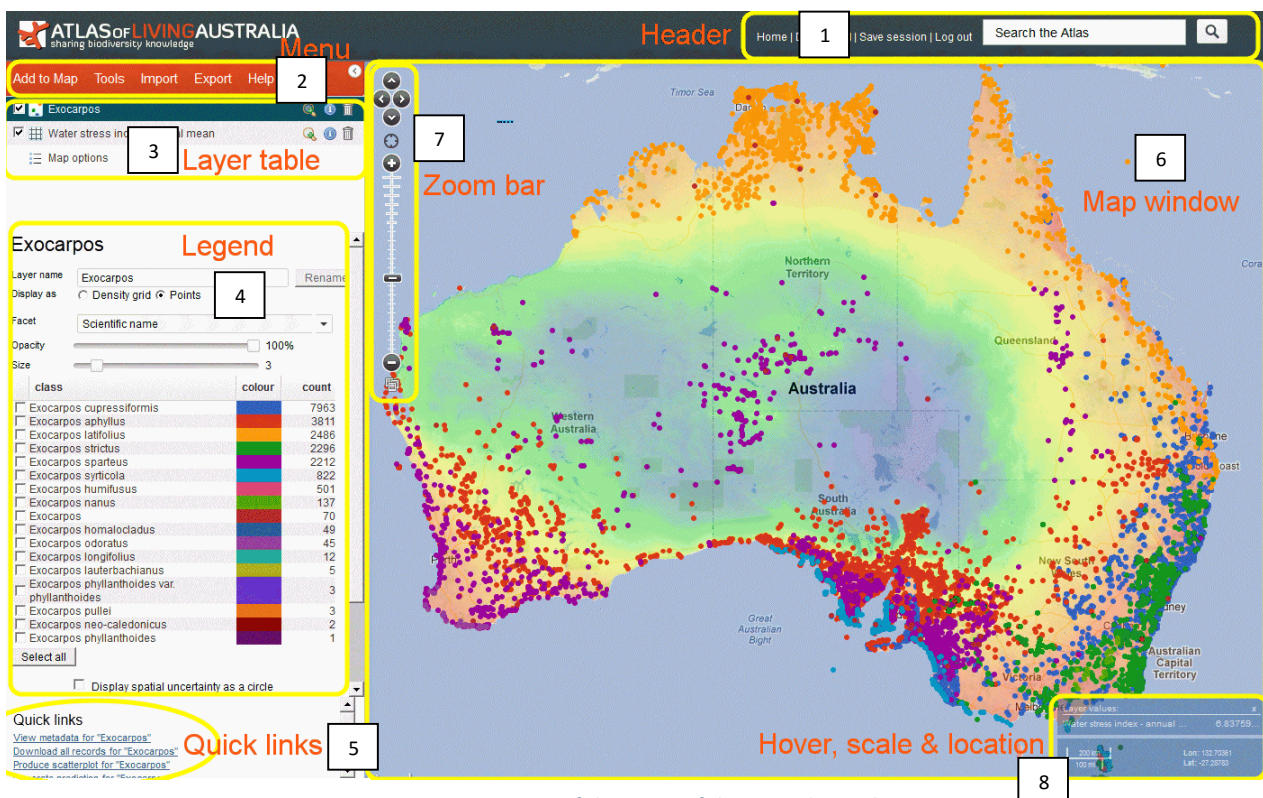


Figure 3. Layout of the zones of the Spatial Portal

Header (1)

It is strongly recommended that you register with the Atlas of Living Australia and log in before you start any session. **Log in** enables the Atlas to prioritise work by what features are being used or not used. Logging in also allows you to save sessions and view a log of your activities.



Figure 4. The Header area of the Spatial Portal

User Settings takes you to your profile and log-in/log-out/register. Under your profile page, you will see components that will depend on your authority level. For me, the list is

- Update your profile
- View your timeline of sightings recorded through the Atlas
- Tabulate and graph all functions you've used in the Spatial Portal
- View your tasks on the Biodiversity Volunteer Portal
- View your uploaded species lists
- View records you have annotated
- Manage your alerts
- Reset my password
- Admin tools

Profile. You can edit the details of name, email address, organisation, city, state/territory, telephone and primary and secondary usage.

Tabulate and Graph your Portal usage: Once you are logged in, you can go to your *Dashboard* and browse your prior actions, charts and sessions. You can get a statistical breakdown of any functions you used in prior sessions.

Note: your session details will be kept by the Atlas for approximately three months. Figure 6 below shows a breakdown of my usage of SP functions. Clicking on a segment of the pie chart will drill down to the next level of detail. The Actions and Sessions tabs provide a date/time breakdown of usage of functions.

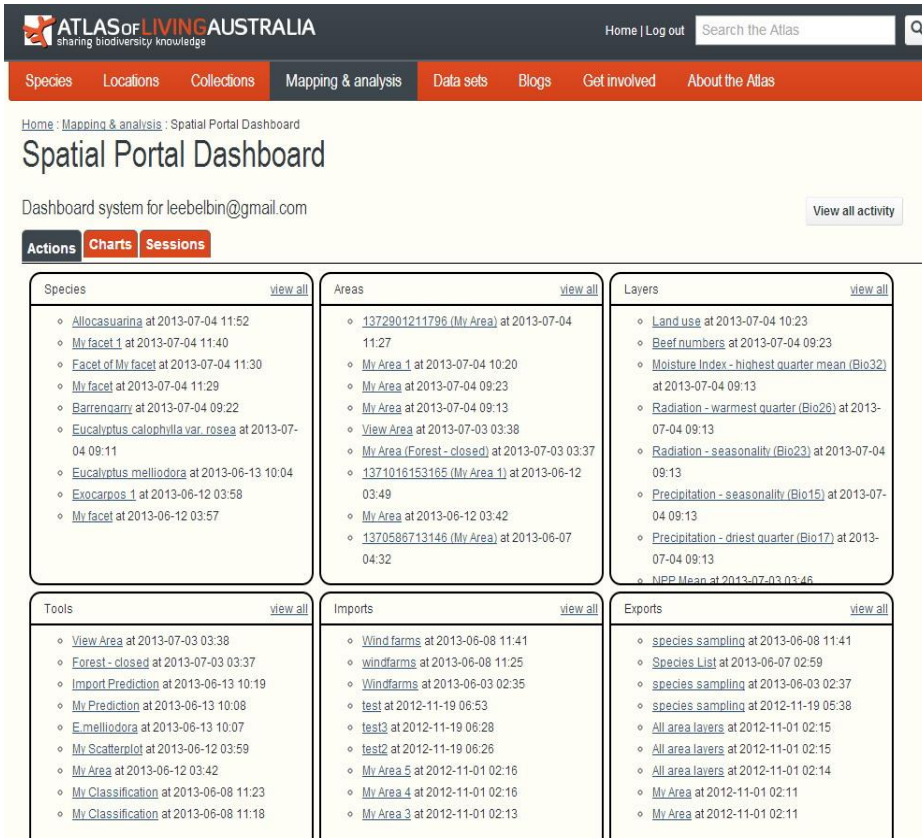


Figure 6. Dashboard actions in previous and current Spatial Portal sessions

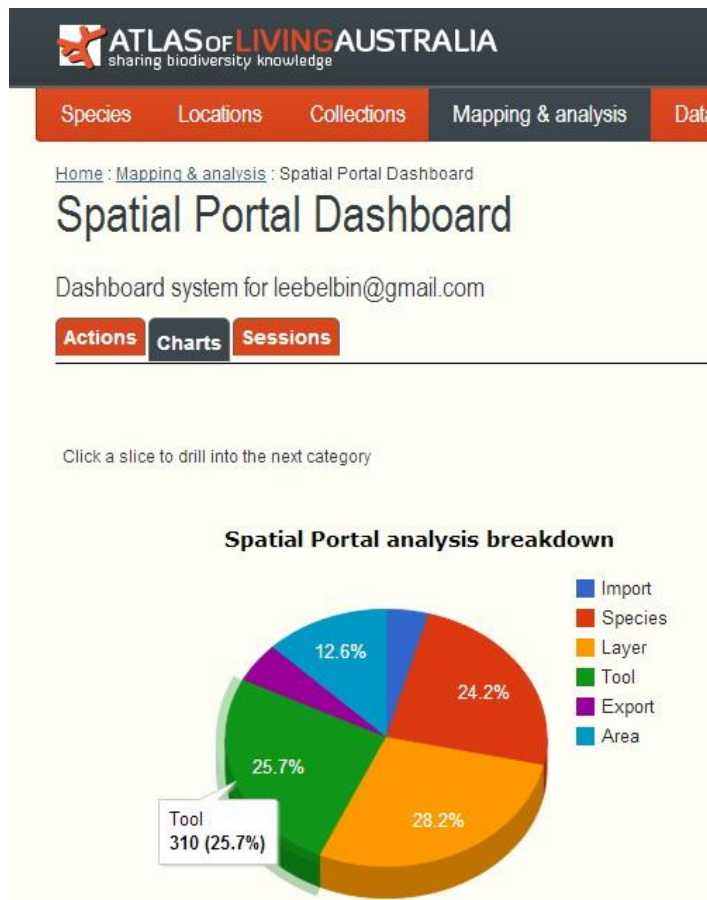



Figure 5. Example of my use of Menu options across prior Spatial Portal sessions

Log out is hopefully obvious.

Search the Atlas is the generic Atlas search, it is not restricted to the SP so if you follow this through you will leave the SP and reset the portal.

Save session will save a copy of the layers produced to Atlas storage. You can reproduce analyses using the  button on any layers produced through the SP Tools. To use this feature, register as a user of the Atlas of Living Australia and then log in.

Menu (2)



Figure 7. The main Menu of the Spatial Portal

Most primary actions in the SP will centre on the menu. Each option within the menu will initiate a wizard to step you through required parameters to attain a solution. For example, the steps needed to map a species are

1. Add to Map | Species

The **name** for the species where you can optionally

- a. Include only spatially valid records or all
- b. Include all species (not recommended except for smaller areas!)
- c. Create a List of taxa interactively or use an existing List (<http://lists.ala.org.au>)
- d. Import a set of point locations. These do not have to represent *species* locations; they are just points. More on this later.

Note: the system will try and let you know what the taxon is and how many records there are associated with it. This is useful feedback when you may be uncertain of your taxonomy.

2. Restrict mapped species to an area

Immediate options are: Any predefined area you have created; the current map extent; Australia; World (default) or the ability to define an area using any one of the 14 options available. This choice limits the mapped records to **ONLY** those occurring in this area.

The number of steps in each wizard depends on the complexity of the task. In some cases, an outcome can be obtained via more than one pathway through the menu. For example, you could either map a species by adding an area as part of the Add to Map | Species process as illustrated above, or first add an area, then add a species restricting it to that area. Whatever takes your fancy?

Note: Mapping species, an area, an environmental or contextual layer or facet will result in **one mapped layer**. You can add layers to your heart's content, but as you can only view a few layers at any one time (using layer transparency settings), be conservative or navigation becomes tricky. You can rearrange the order in which the layers are displayed, the transparency of environmental layers and size and colour of species layers.

Help is reasonably comprehensive, and yes, we know that if you have to resort to it, we have failed. If in doubt, we would urge you at least scan the relevant help pages and we would value feedback. We guarantee that you will learn something. The SP is extremely powerful but that comes at the cost of complexity. The SP can support an extremely wide range of ecologically-related functions, but you will only comprehend its power by a comprehensive understanding of its nooks and crannies.

Note: The < button to the right of the menu bar can be used to hide the left column including the Menu, Layer table, Legend and the Quick links: Useful for full screen maps. Pressing the > button will return the left column with its contents.

Below are all the options within the Spatial Portal menus. Each action is covered in more detail later in this document.

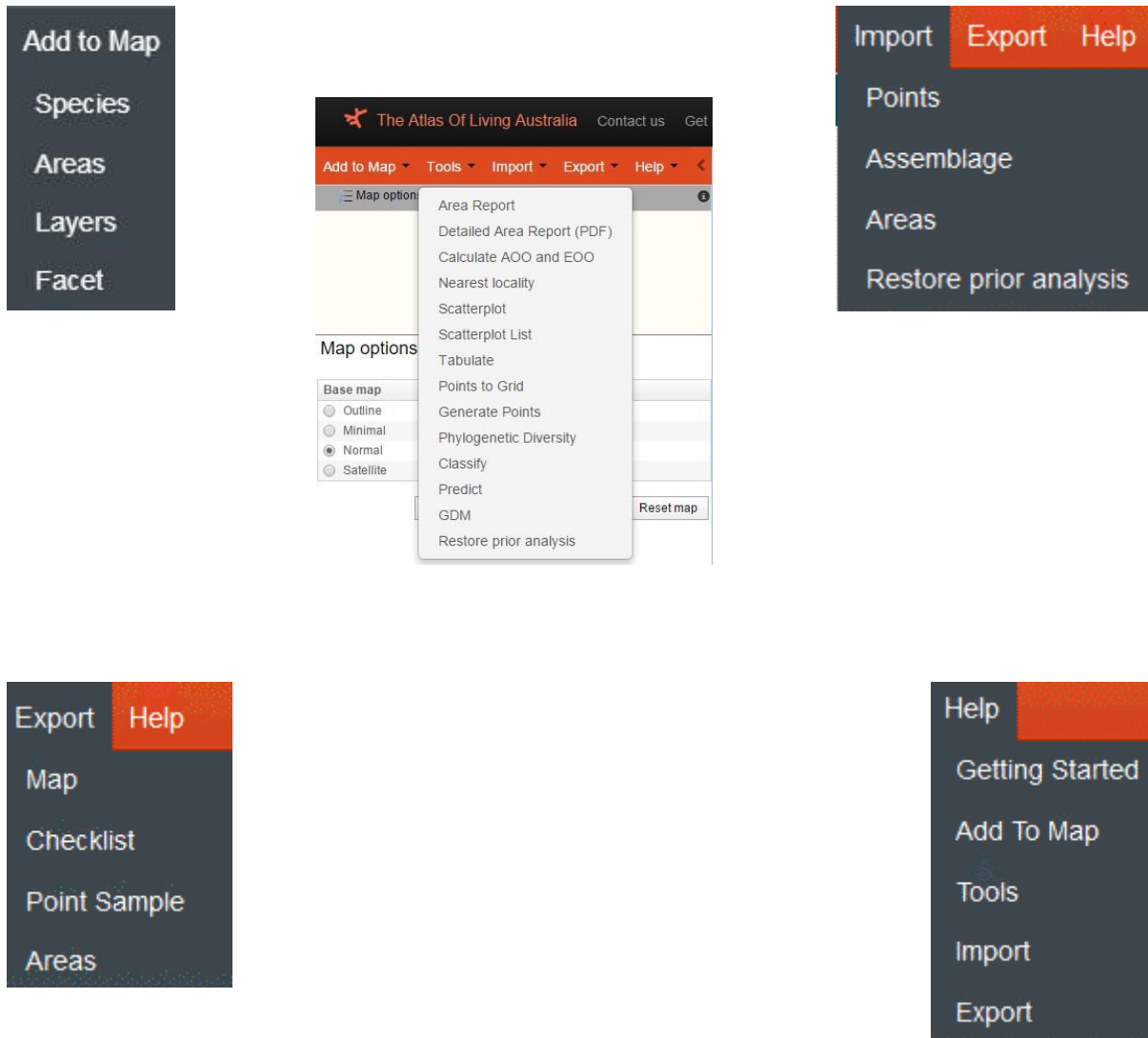


Figure 8. Sub-options within the Menu

Layer table (3)

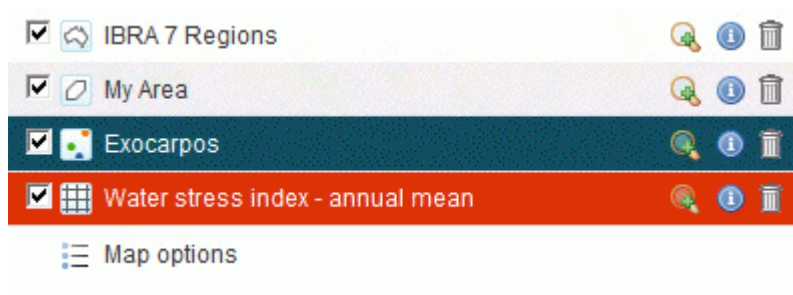


Figure 9. The Layer table (top-left of the Spatial Portal's window)

Adding species or species list, areas, layers and facets to your map will result in one or more layers being mapped. Mapping species, an area or facet will result in **one** mapped layer.

There are four layer-types that have corresponding legend types (see Figure 10 below). Species and facets are mapped as points, areas are mapped as polygons, and layers are mapped as either polygons or grids.

1. Point layer (In the legend this appears as coloured dots – Allocasurina in the Figure 10 below)
2. Grid layer (In the legend this appears as a grid – see Humidity layer in the Figure 10 below)
3. Polygon layer (In the legend this appears as an outline of Australia – see Ramsar in Figure 10 below)
4. Area (In the legend this appears as a polygon shape – see My area in Figure 10 below)

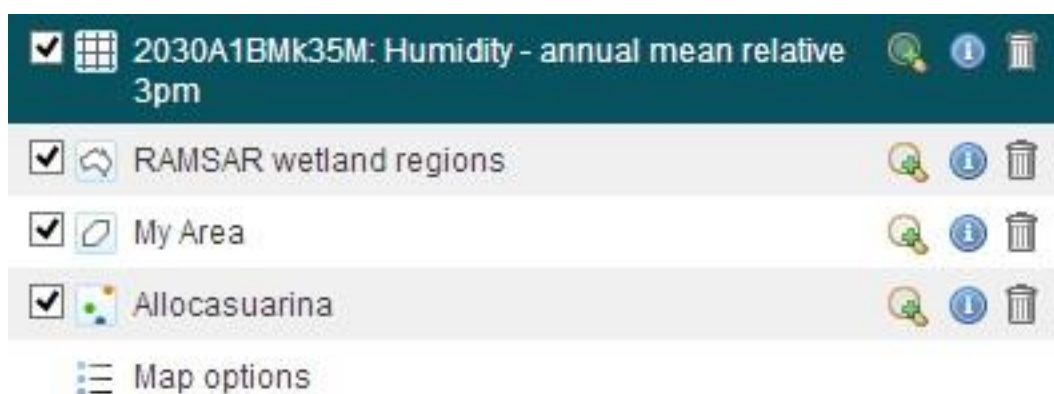


Figure 10. Examples of layer types in the Spatial Portal

Each layer is represented by a line in the Layer table above and has the associated functions

- Select (show) or de-select (hide); tick or un-tick.
- An icon showing layer type (point, grid, polygon, area)
- Layer name (which can be renamed in the Legend)
- Zoom to extent (magnifying glass); zoom in or out to full layer geographic extent.
- Metadata (i)
- Delete forever (rubbish bin)

Map options

Map Options is a permanent special layer; **the basemap**. There is a choice of four basemap options:

- Outline, a line drawing of countries (Figure 12);
- Minimal from Open StreetMaps (Figure 11);
- Normal, which is a Google Map (Figure 14 – the default); and
- Satellite which is a Google satellite view (Figure 13).

Each option has been included to fit a particular requirement. The most complex base maps are the Google options while the outline is useful for publishing thumbnail images of species distributions.



Figure 12. Outline basemap



Figure 11. 'Simple' (Openstreetmaps) basemap



Figure 14. Normal (Google maps) basemap -
DEFAULT



Figure 13. Satellite (Google satellite) basemap

Note: layers can be re-arranged by dragging them up and down. The top layer in the list is the most visible but opacity of layers can be altered via the legend so that multiple layers can be viewed simultaneously. If you want to view a particular layer among many, drag it to the top of the list.

When one or more layers have been added to the map window, three more options will become available that apply to **all mapped layers** (Figure 15)-



Figure 15. Map options for all mapped layers

You can delete/remove all mapped layers from the map and layer table, select/display them all and de-select/hide all layers.

When you click on the **Map options** entry, another three options become available (Figure 16)-



Figure 16. Additional map options

Add WMS Layer

If you know the web address for external Web Map Services (WMS), you can link to that site and display any maps that have been exposed for public use. These layers are currently **only available for viewing** and are not available for analyses. A number of examples of services that provide layers that may be relevant to the Spatial Portal are listed in the new pop-up window (Figure 17)-

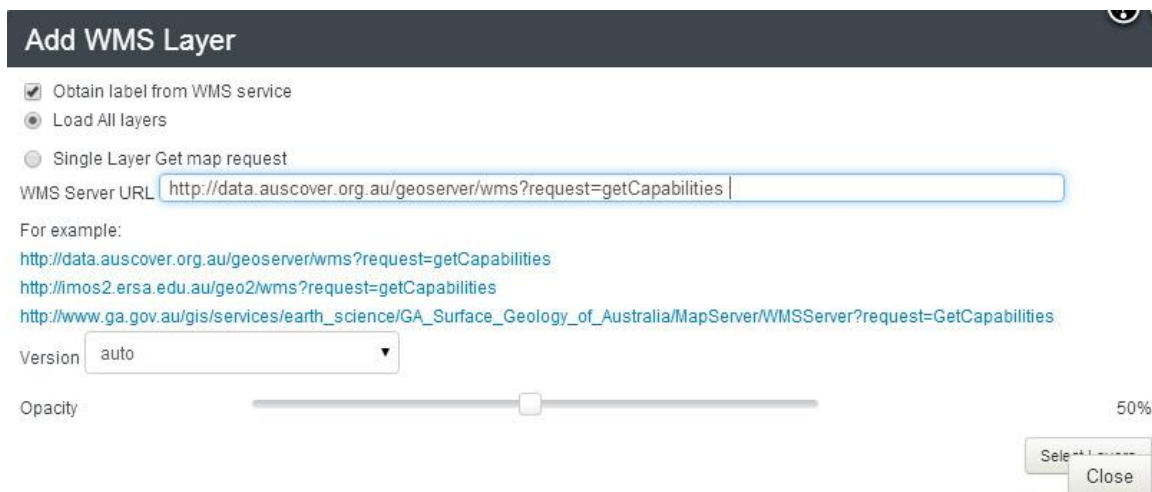


Figure 17. Add a Web Map Server layer to the Spatial Portal

Enter the web address into the window called WMS Server URL and press “Select Layers”. In the bottom left of the window, a drop down box will appear and in that list, available layers will be listed. Select one of those layers and press the Add to Map button that will appear and the layer should be mapped.

You can also access the **Download Map** option (the same as Export | Map) from here and also do a **total reset** of the Spatial Portal. The latter will remove all current work and set the Spatial Portal back to a virgin state.

Legends (4)

A selected layer will display a legend appropriate to its type (point, polygon, grid or area). All layers can be renamed using the **Rename** button. Polygons will display coloured classes while grids will display a colour bar. The only editing that can be done to polygon, grid and area layers is to alter the layer name and the mapped layer transparency.

Editing point layers

With point (species/taxa) layers, you can change-

- Point or density grid display (the default will depend on number of records but you can choose the most suitable display)
- Size of points
- Point colour, either directly via the colour palette or by choosing to view the data in terms of a facet other than 'user defined colour' (see the illustration below).
- Uncertainty circles. These give an indication of the coordinate uncertainty in metres
- Animation by date. This option will display the points in a sequence by time or season starting with the earliest to the latest. You can change the animation parameter (month or year), the start and stop dates and the frame rate.

Allocasuarina

Layer name

Display as Density grid Points

Facet

Opacity

Size

class	colour	count
<input type="checkbox"/> Not listed as endangered		48957
<input type="checkbox"/> Endangered		1878
<input type="checkbox"/> Near Threatened		575
<input type="checkbox"/> Listed under FFG Act		131
<input type="checkbox"/> Least Concern/Unknown		77

Display spatial uncertainty as a circle

Animation

Month/year Frame rate (s)

Year range to

Figure 18. Example legend for the genus *Allocasuarina*, with dots on the map coloured by State conservation status

Note: The Scatterplot tool (see section on Tools, below) uses the legend area to display the scatterplot, allowing the user to view simultaneously geographic space (a map) and environmental space (a scatterplot). The scatterplot is a calculated layer (as is the case with many of the outputs from the Tools options), and thus can be selected or de-selected within the Layer table. See Figure 19 below

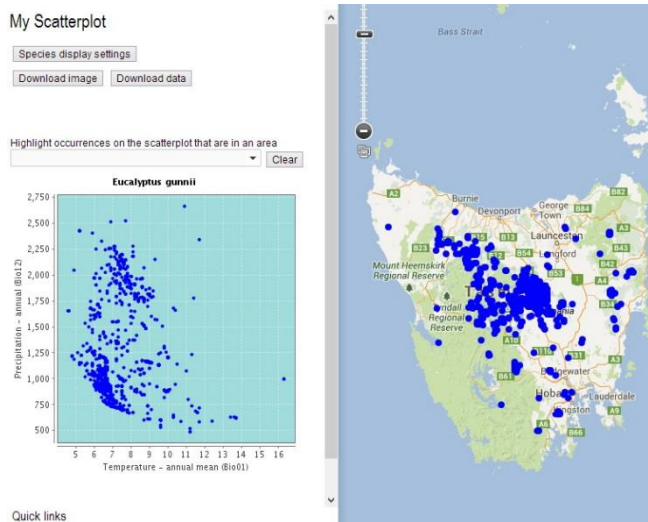
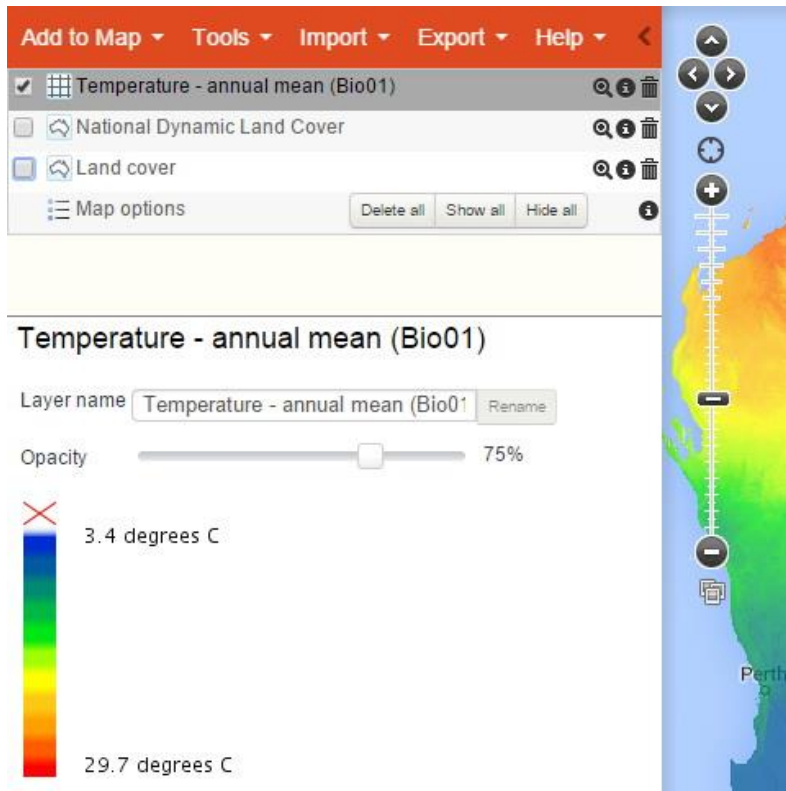


Figure 19. Example scatterplot in Legend area of the Spatial Portal

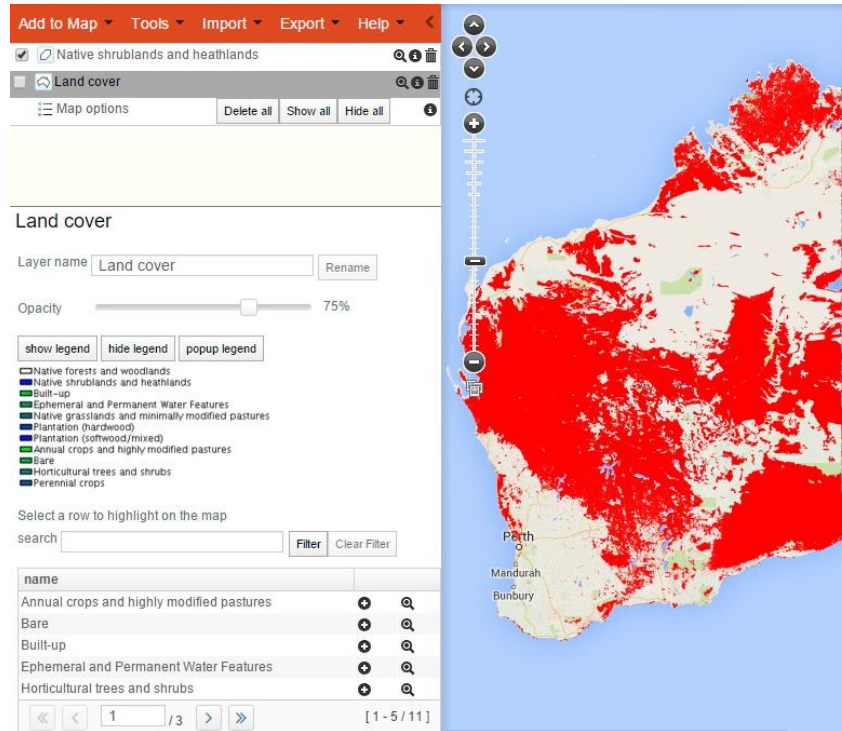
Legends for Environmental layers



Environmental or gridded layers have continuous values and the associated legend (left) displays a single colour bar. The colours on the map indicate the value of the mapped layer value. The figure left shows the legend for the layer mean annual temperature varies from 3.4c to 29.7c. There is no interaction with the legend for environmental layers other than adjusting the opacity/transparency between 0% and 100%.

Figure 20. Legend for environmental layers

Legends for Contextual Layers



Contextual or class/polygon layers have class values rather than continuous values (Figure left). This figure shows the legend and part of the map for the land cover for Australia. There are 11 distinct classes, each with a corresponding colour on the legend and map.

Unlike environmental layers, the **contextual layers allow you to highlight one class on the map, and create a new area layer** that corresponds to the regions on the map that have the selected class.

Figure 21. Legend for contextual layers

To highlight one class, simply click on the class name in the sub-legend (the bottom part of the legend that lists the classes and has plus and zoom to extent symbol to the right). You can click through various classes or clear the highlighted areas by clicking on the clear highlight button at the bottom of the legend. The sub-legend showing the classes with add and zoom to extent icons can be paged through or be searched by class name.

This is a quick way of scanning through the areas associated with legend classes.

Figure 21 shows that a new layer "Native shrublands and heathland" has been created and is displayed on the map. This process is equivalent in the Spatial Portal of using "Add to Map | Areas | Gazetteer polygon" and then entering " Native shrublands and heathland " into the search box and then selecting the class. This latter process works because all contextual layer classes have been entered into the ALA's gazetteer database. Note this legend functionality is intended to parallel a similar function for the point layers.

Quick links (5)

The Quick links area in the lower-left area of the SP window uses a little 'artificial intelligence' to provide you with some options you may not have thought of, or as the name suggests, slightly quicker links to tools and other options. The reasoning is based on what layers have been mapped. For example, if you have a species (point) layer mapped, options provided in this area may include prediction, point to grid, faceting etc.

Quick links

[View metadata for "Exocarpos"](#)
[Download all records for "Exocarpos"](#)
[Produce scatterplot for "Exocarpos"](#)
[Generate prediction for "Exocarpos"](#)



Clicking on the link is equivalent to running the option from the Menu. If there are more links available than the available area, a scroll bar will be displayed.

Figure 22. Example of actions under Quick links - based on mapped layers

Map window (6)

The Map window is the focus of the Spatial Portal. We try to keep the focus on the map so keep this window area as large as possible.

Hint: you can hide the Layer table, Legend and Quick links area by clicking on the '<' icon at the right of the menu area. This allows the map window to use all the available space.

The Map window is designed to function like Google Maps and Google Earth. We figured that most people would be familiar with how the Google environment operates so decided not to reinvent any wheels and adopted the Google Maps API. Hopefully, this alignment means that actions such as zoom, pan, scale and legend will operate as you would expect.

There are however a number of additions to the Google Maps environment which are discussed below.

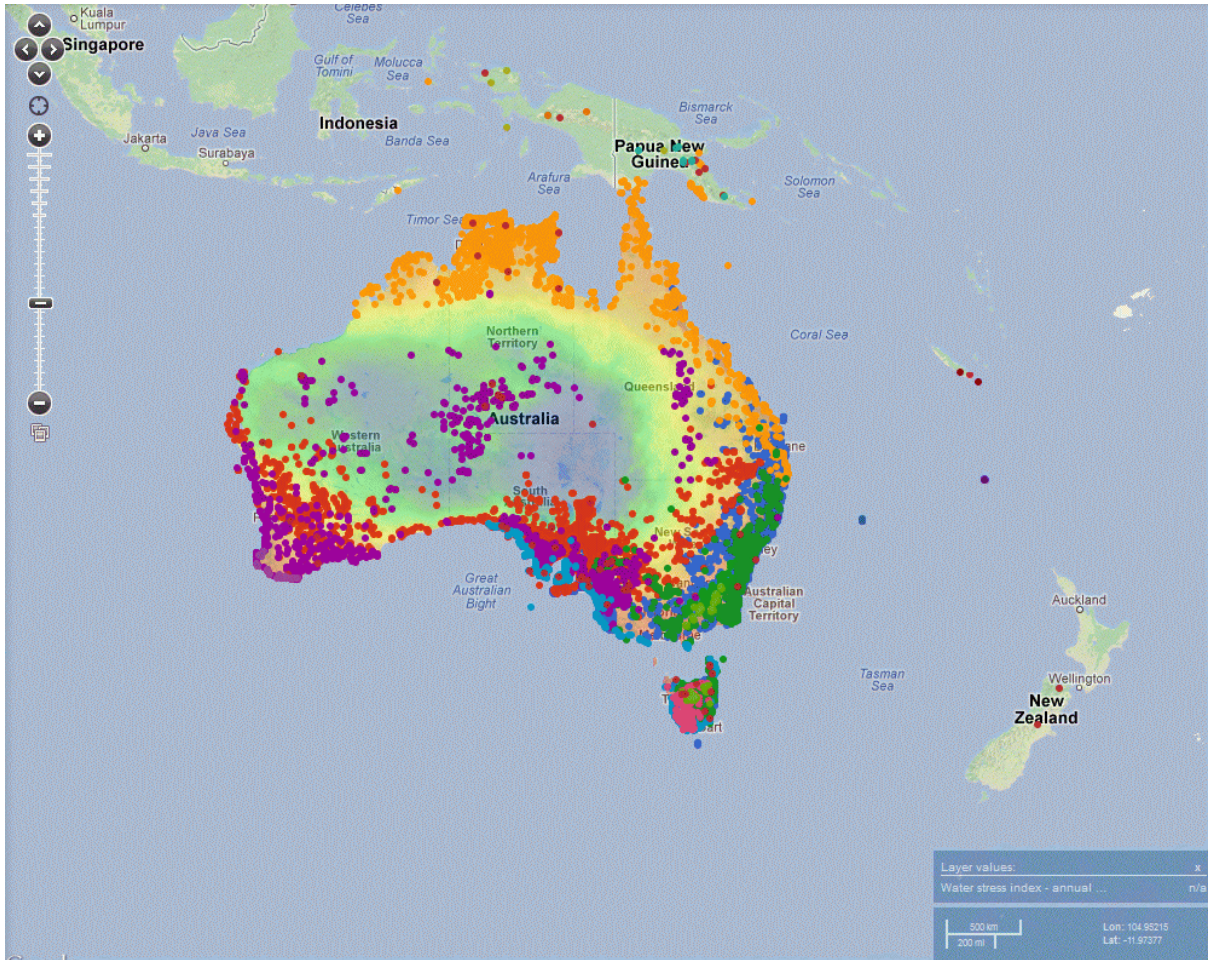


Figure 23. The Map window of the Spatial Portal

Zoom Bar (7)

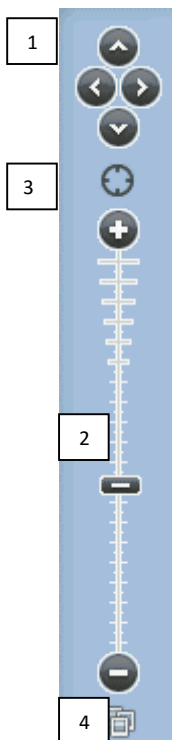


Figure 24.
Zoom bar

The Zoom bar is the standard Google zoom and pan bar tool, with two additions; a **My location** function and a Panoramio function that displays images of areas.

The pan arrows (1) and zoom slider (2) operates as per Google. You can use the arrows to pan left-right-up-and-down, and the slider to zoom in and out of the map. Usually however, most people find that zoom can be better controlled from a mouse wheel and pan by dragging the map with the mouse. You can also use SHIFT and drag to frame an area to zoom/pan to.

The 'gun sight' icon (3) between the zoom bar and pan buttons zooms to your location, estimated using ISO standards. You *will* be requested to approve that it is OK to see if SP can find your location. This may or may not work depending on how your Internet Service Provider operates.

The images icon (4) beneath the zoom bar will display Panoramio images (www.panoramio.com). This is an extremely useful function as it potentially provides images of landscapes of interest. Yes, you may get 'happy snaps' but you will also get some images that will give you an idea of the environment. The rest of the Atlas is species-orientated so this option provides the complement: a location focus. Landscape images convey an immense amount of information, not limited to landscape type, vegetation structure and composition, soil type, fire affects etc.

NOTE: Your site-based images can be readily uploaded to Panoramio where they will be automatically available to the Spatial Portal. If you have high-quality images for example of biological survey sites – then *PLEASE* upload them to Panoramio. Note also that *metadata* including author and institution are attached to each image (click on the title for available metadata).

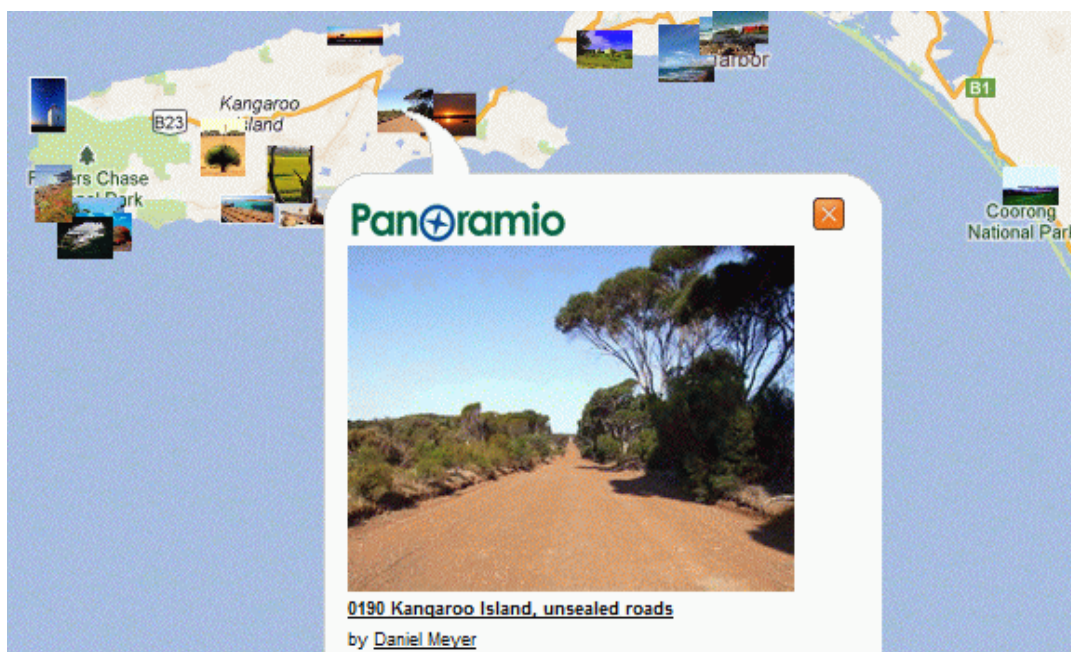


Figure 25. Panoramio (location) images

Hover, scale & coordinates (8)

When polygon or grid layers are mapped, moving the cursor over those layers will result in their values being displayed in the lower-right corner of the map window on the Hover tool. You can hover over the truncated layer name and the full name will be displayed.

Note: There is a delay built into the hover tool; experiment and you will get the idea. This means that you can hold the mouse cursor over a location, then move to the desired layer on the hover tool and the value will be displayed of the last cursor location.

The Google scale bar provides an indication of the scale of distances on the map and the location in decimal degrees is the location of the tip of the cursor.

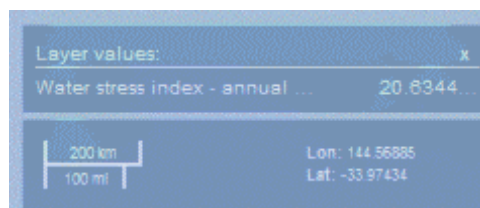


Figure 26. Hover tool and Google scale and coordinates

Species

'Species' is shorthand in the Spatial Portal for any taxa or list of taxa. For example, records of all 'vascular plants' could be mapped in the same way as the single species *Eucalyptus gunnii*.

The Atlas is continuing to develop a National Species List. Flora nomenclature is currently in a better state than fauna. Taxonomy is however always in a state of flux.

'Species' can be identified by **scientific name** (a genus species pair such as *Eucalyptus gunnii*), **common name** or in some cases by 'lifeform'. Most species within the Atlas also have a Life Science Identifier (LSID). An LSID is a typical example of a Globally Unique Identifier – a code that will uniquely identify a *taxon concept* (briefly, the scientific name of a species, the name of the person who named it and the date they named it).

For any taxon, there will usually be a genus-species name pair; an LSID; often more than one common name; and in many cases a lifeform class. The Atlas relies on user-feedback to help to identify a most preferred common name. **Synonyms are supported.**

There can be up to three *types* of data associated with a species entry that can be seen on the Add species search window—

1. Records (number of ALA records will be listed),
2. Expert distributions and
3. Checklist areas.

Note that many species do not have occurrence records: try entering this address in a clean browser window to find what those species are

[http://bie.ala.org.au/ws/download?q=*&fields=guid,family,genus,scientificName,occurrenceCount&fq=-occurrenceCount:\[*%20TO%20*\]](http://bie.ala.org.au/ws/download?q=*&fields=guid,family,genus,scientificName,occurrenceCount&fq=-occurrenceCount:[*%20TO%20*]).

'Expert distributions' have been created for some species (mainly birds and fish) where one or more experts have agreed to define an area where that species would be expected to be observed. These areas can be a single polygon or a multi-polygon for disjunct distributions.

'Checklist areas' are used to identify that a species occurred within a defined area but it is unknown exactly where in that area the species was observed. Checklist areas are often created for islands and parks/reserves.

Lifeforms

Lifeforms present handy taxonomic buckets, but like any classification they may not provide what you want. Currently the SP accepts scientific name or common name while lifeforms are selectable via facets (see below). At some point, we will probably include lifeform selection anywhere a species can be entered.

Figure 27. Search for species dialogue box

Auto complete

Selecting taxa and a number of other data elements uses a method we refer to as **autocomplete**. When you enter three characters into the box, the SP starts seeking a match in the database of names. The more characters you type, the smaller the list of matched taxa. Unlike a more straight-forward search response, this method usually helps to link your understanding with the systems data.

If you enter a scientific or common name that is ambiguous, the system will prompt you for clarification. The SP will display taxonomic rank and the number of records associated with the taxa. Remember, there may be synonyms, an absence of your favourite common name, or a host of other taxonomic stuff-ups. That's taxonomy.

Filtering on 'Data Quality' issues ('Fitness for use')

A common task before any analyses of data is to ensure that the data is 'fit for use'. To achieve this, we use a category of facets (see above) called 'Assertions'. When any data is entered into the ALA, even when it is imported for use in one session (see Import | Points), a large suite of automated tests are run against each record (see <http://biocache.ala.org.au/ws/assertions/codes>). Any test that results in some form of warning or error will be reported as an 'assertion'. For example, if there is no date value in a record, the assertion will be "incompleteCollectionDate". The description here is standardized in what is called camelCase - the text will start with lower case and where the first letter or any subsequent words are capitalized as in "thisIsAnExampleOfCamelCase". The meaning is usually (hopefully) clear.

The classes in the Assertion category are

- Sensitive (what records have some sensitivity flag associated)
- Record issues (all values of tests/assertions_)
- Outlier for layer (which environmental layers have occurrence records that are outliers)
- Outlier layer count (how many of the 5 environmental layers have outlier records)
- Has user assertions (records that have been annotated by one or more users)
- Assertions by user (which users have annotated the records)
- Associated records
- Duplicate record type (the nature of the differences in suspected duplicate records)

Let us take a practical example-

1. Map the occurrence records of the fox *Vulpes vulpes* (Add to map | species | *Vulpes vulpes*). At time of writing, there were 50,523 records. The first thing to note is that there are records in Germany, Italy and Japan. Note that there are also 412 records that have not been coded specifically in Australia even though they look like they are.

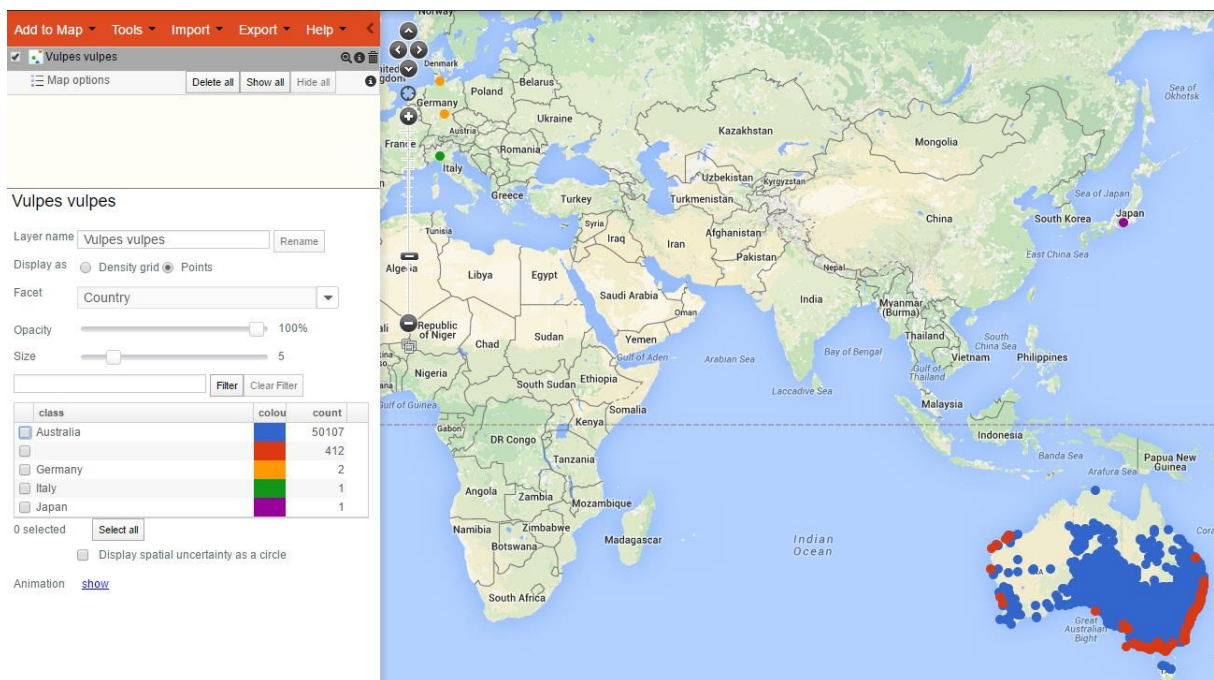


Figure 28. Distribution of *Vulpes vulpes*

- Next, filter out the non-Australian records. This can be done either by selecting the tick box beside Australia and those 412 blank records and clicking on “Create layer with selection” or the complement, by clicking on Germany, Italy and Japan tick boxes and selecting “Create layer without selection”, take your pick but the first is easier in this instance. The result will be a new layer automatically titled "Facet of *Vulpes vulpes*". This layer should be renamed to something like "*Vulpes vulpes* - Australia" to make it clear what this new point layer contains, something like “*Vulpes vulpes* – Australia”?

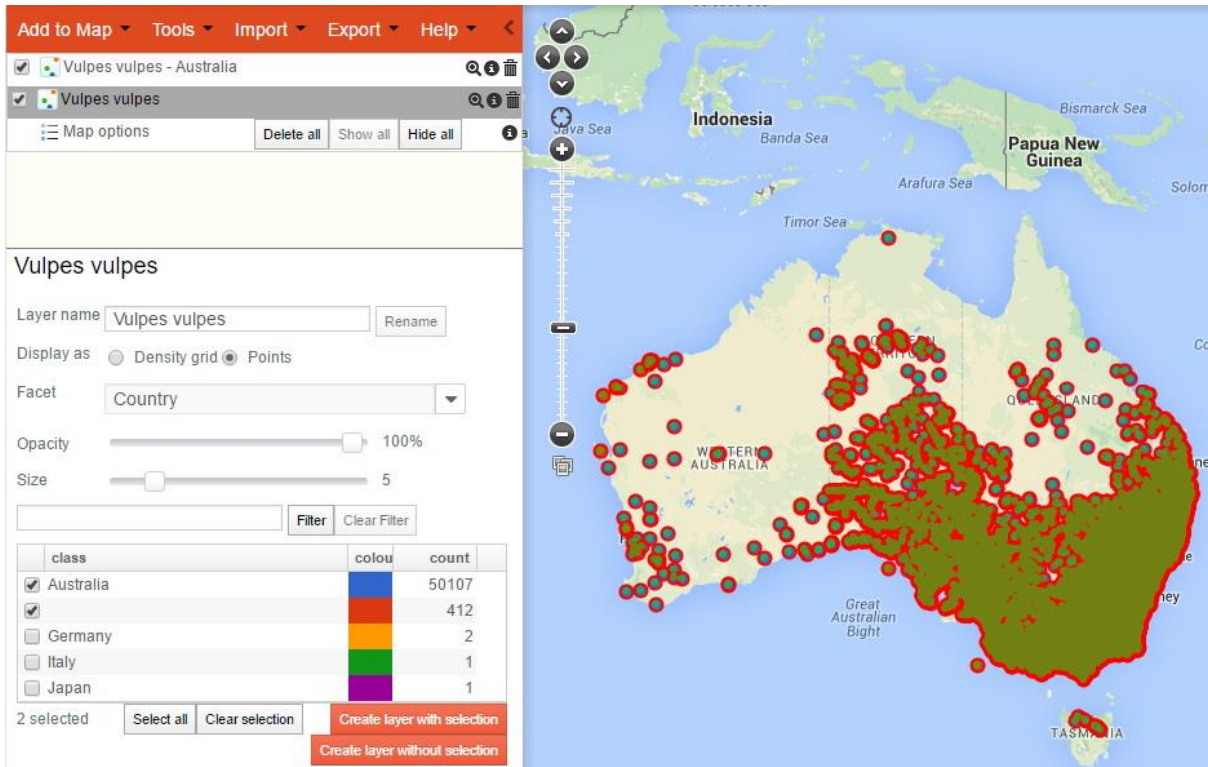


Figure 29. First filter applied to *Vulpes vulpes* - Australian records

- The next step is to select (click on) the new layer "*Vulpes vulpes* - Australia", deselect the original layer (uncheck the tick box next to *Vulpes vulpes*) and then select the facet “Record issues” on the Australian records. You will see that there are plenty of records with issues that we may want to remove (filter out) from the Australian records. Select those issues you want to remove by checking the tick boxes beside them. What you select will depend on your knowledge of the data and the issues that have been raised by the automatic tests. I have selected a range of issues that would disqualify records from many analyses but this is just a demo. If for example, I was doing an SDM (Species Distribution Model – Prediction in the Spatial Portal), I would want to restrict the dates of the records to a reasonable time period – say 25 years? Once the classes have been selected, click on "Create layer without selection" and a new filtered points layer will be selected that do not have any of the selected issues. Name this layer something like "*Vulpes vulpes* - Most record issues removed". See figure below.

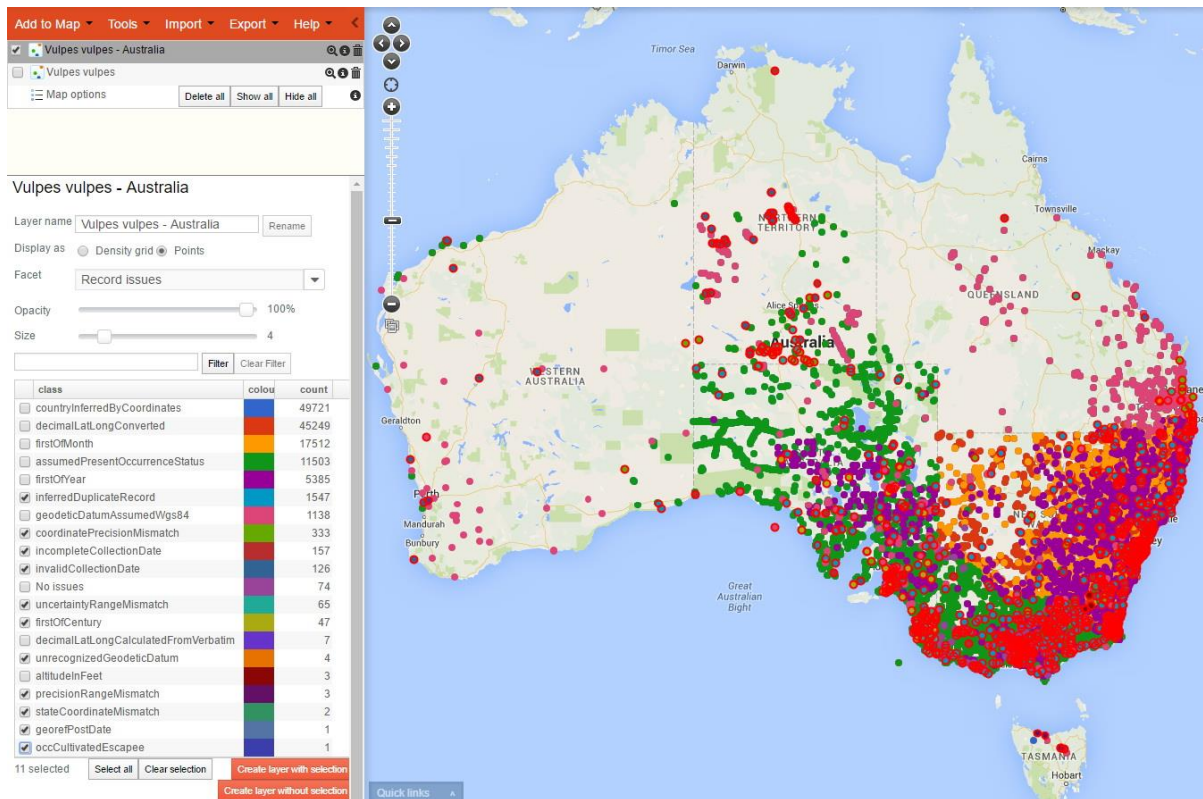


Figure 30. *Vulpes vulpes* records with some obvious record issues removed

4. If you now de-select the previous point layer so only the last filtered layer is displayed on the map, you will see that we still have issues! No great surprise. The most immediate issue is that we have foxes that appear to have been sighted swimming. I imagine this could happen, but it is obvious to me that some have been badly geolocated or there has been some transcription problem with the latitudes and longitudes. The most efficient way to deal with this problem is to select "States and Territories" in the drop-down list for the legend of the last filtered layer. We can now easily see that 12 records do not occur in any State or Territory, and those points have been highlighted on the map. You can zoom and pan the map to see the issues if desired. In many cases, the accuracy or precision of the locations are likely problems. In the former for example, the coordinates may have been wrongly read from a map, while the latter can be caused by not having sufficient number of decimal places to place the observation on land. When ready, simply click on the button labelled "Create layer without selection" to create a new point layer of *Vulpes vulpes* without 'swimmers'! Voila.

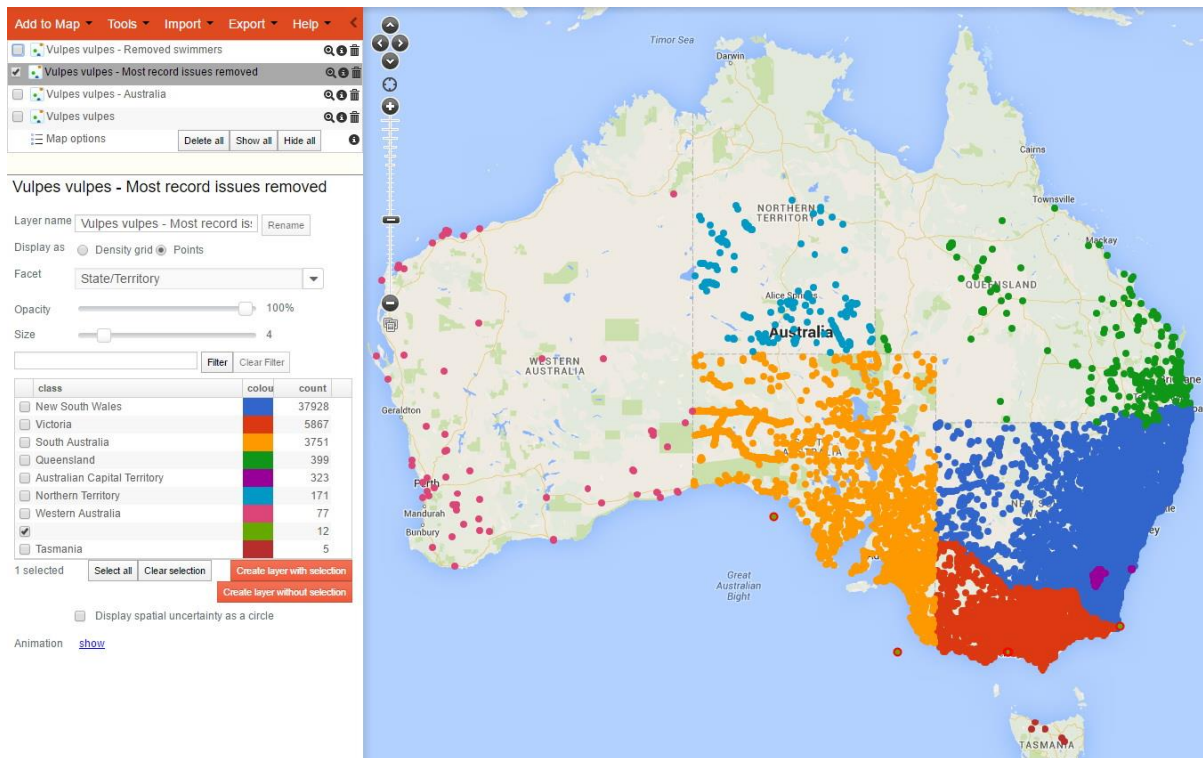


Figure 31. *Vulpes vulpes* filtered for swimmers!

5. We now have a dataset that should be more reliable but a quick examination of the map of the distribution of the records in the new point layer (named above as "*Vulpes vulpes* - Removed swimmers"), it is obvious that there is a bias by State and Territory. The records in South Australia and the Northern Territory seem to largely stop at the Western Australian border. Ditto, Queensland records look a little suspicious. Foxes are smart, but not that smart? What you do next will depend on what you plan to use the data for. I have scanned the map and noted that while there were no "Sensitive" records, those in Victoria look very much like they are largely on a regular grid. Does this imply that the records were forced onto a regular grid or, less likely, that the records were part of a very systematic survey? There is nothing specific in the Victoria records I examined to suggest spatial displacement, but I have not checked thoroughly. You may need to. If the record locations have been moved onto a grid, you need to figure out if that invalidates an analysis? The points appear to be on roughly a 10km grid. Will this change the environmental associations – unlikely given the spatial distribution of foxes in Australia – they are almost everywhere. It would be easier to figure out where they are least likely to be. More on that issues below!

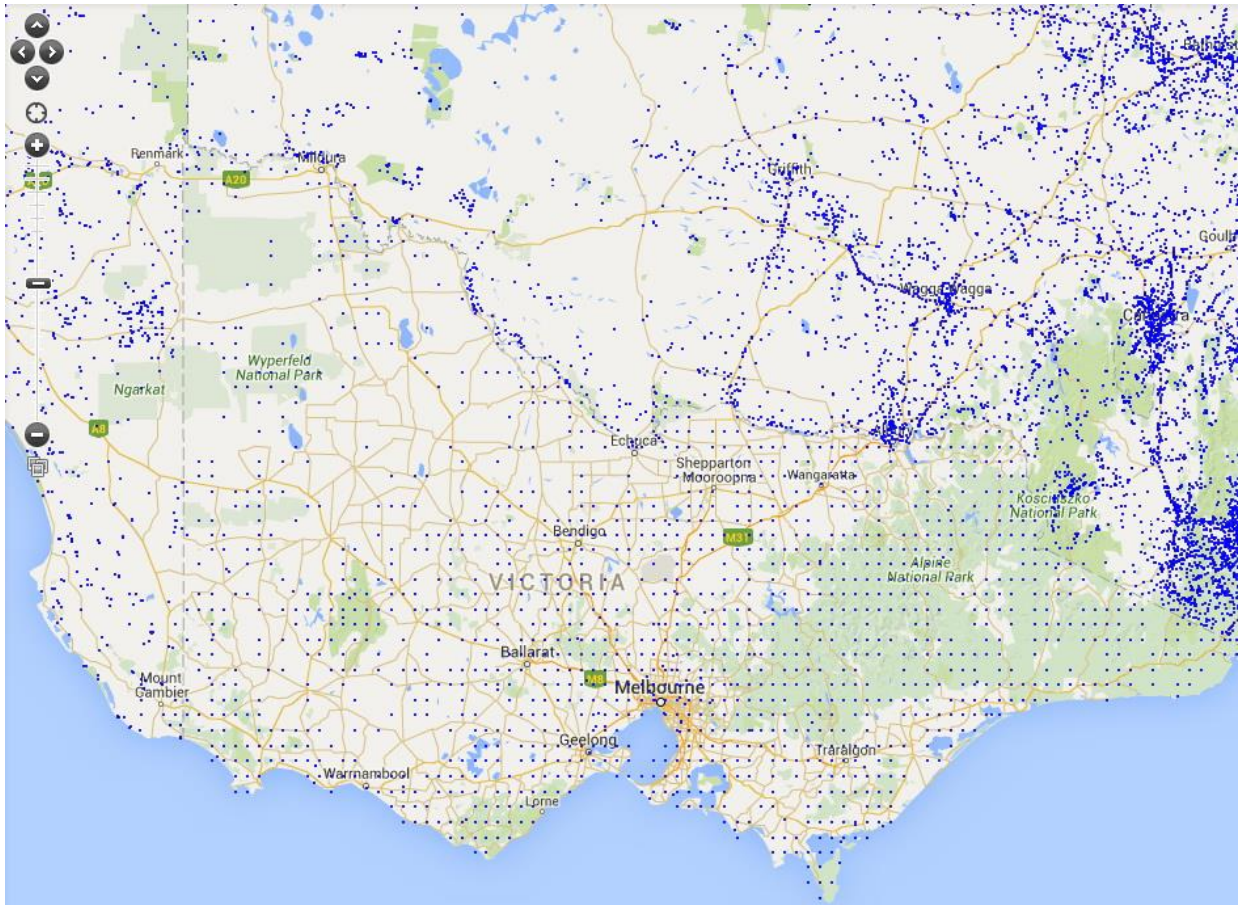


Figure 32. Gridded records in Victoria?

6. To check some records, click on the (i) button to the right of the layer name. This links to the metadata about these records, but in this case, we want to look at the Victorian records - so click on the link "Table view of these records". This takes us into what is called the biocache - the general part of the ALA dealing with records (not the Spatial Portal). What you will see on the left-hand side of the window are the same facets as in the Spatial Portal, and they can be used in the same way. Also note that at the top of the window you will see the filters applied to the original *Vulpes vulpes* records to create this filtered subset.

Atlas Of Living Australia ALA Apps ALA Info Search the Atlas Search User settings

Advanced search Quick search

Occurrence records

48,521 results for (SPECIES: *Vulpes vulpes*)

Selected filters: Spatial validity: Spatially valid

[exclude] (Record issues: firstOfCentury OR Record issues: invalidCollectionDate OR Record issues: unrecognizedGeodeticDatum OR Record issues: incompleteCollectionDate OR Record issues: coordinatePrecisionMismatch OR Record issues: precisionRangeMismatch OR Record issues: georefPostDate OR Record issues: inferredDuplicateRecord OR Record issues: stateCoordinateMismatch OR Record issues: occCultivatedEscapee OR Record issues: uncertaintyRangeMismatch)

State/Territory: * [exclude] (Country: * AND -country: "Australia") Clear all

Records Map Charts Record images

Download per page: 20 sort: Date added order: Descending

Species: *Vulpes vulpes* | Fox Date: 2016-05-30 State: New South Wales
Data Resource: Questagame Weekly Feed Basis Of Record: Human Observation View record

Species: *Vulpes vulpes* | Fox Date: 2016-04-18 State: Victoria
Data Resource: Individual Sightings Basis Of Record: Human Observation View record

Species: *Vulpes vulpes* | Fox Date: 2016-03-21 State: Victoria
Data Resource: Individual Sightings Basis Of Record: Human Observation View record

Species: *Vulpes vulpes* | Fox Date: 2016-04-20 State: Victoria
Data Resource: Individual Sightings Basis Of Record: Human Observation View record

Species: *Vulpes vulpes* | Fox Date: 2016-03-18 State: Victoria
Data Resource: Individual Sightings Basis Of Record: Human Observation View record

Species: *Vulpes vulpes* | Fox Date: 2016-04-04 State: Victoria
Data Resource: Individual Sightings Basis Of Record: Human Observation View record

Species: *Vulpes vulpes* | Fox Date: 2016-04-18 State: Victoria
Data Resource: Individual Sightings Basis Of Record: Human Observation View record

Species: *Vulpes vulpes* | Fox Date: 2015-10-02 State: New South Wales
Data Resource: Individual Sightings Basis Of Record: Human Observation View record

Narrow your results

Selected filters

- Spatial validity: Spatially valid
- [exclude] (Record issues: firstOfCentury OR Record issues: invalidCollectionDate OR Record issues: unrecognizedGeodeticDatum OR Record issues: incompleteCollectionDate OR Record issues: coordinatePrecisionMismatch OR Record issues: precisionRangeMismatch OR Record issues: georefPostDate OR Record issues: inferredDuplicateRecord OR Record issues: stateCoordinateMismatch OR Record issues: occCultivatedEscapee OR Record issues: uncertaintyRangeMismatch)
- State/Territory: *
- [exclude] (Country: * AND -country: "Australia")
- Clear all

Taxon

Occurrence

Collector

A & J Povnton (18)

Figure 33. Filtered records in the biocache

7. At this point, you can view the records by clicking on them, or you could carry on filtering the data by other attributes either here or more effectively in the Spatial Portal. For this exercise, I will see if I can find any suspect records on the basis that foxes don't like being far from water. I will do a scatterplot (menu Tools | Scatterplot) and use two environmental map layers that may identify issues-
- Distance - to permanent water (weighted) and
 - Aridity index - annual mean, and this is what we will see-

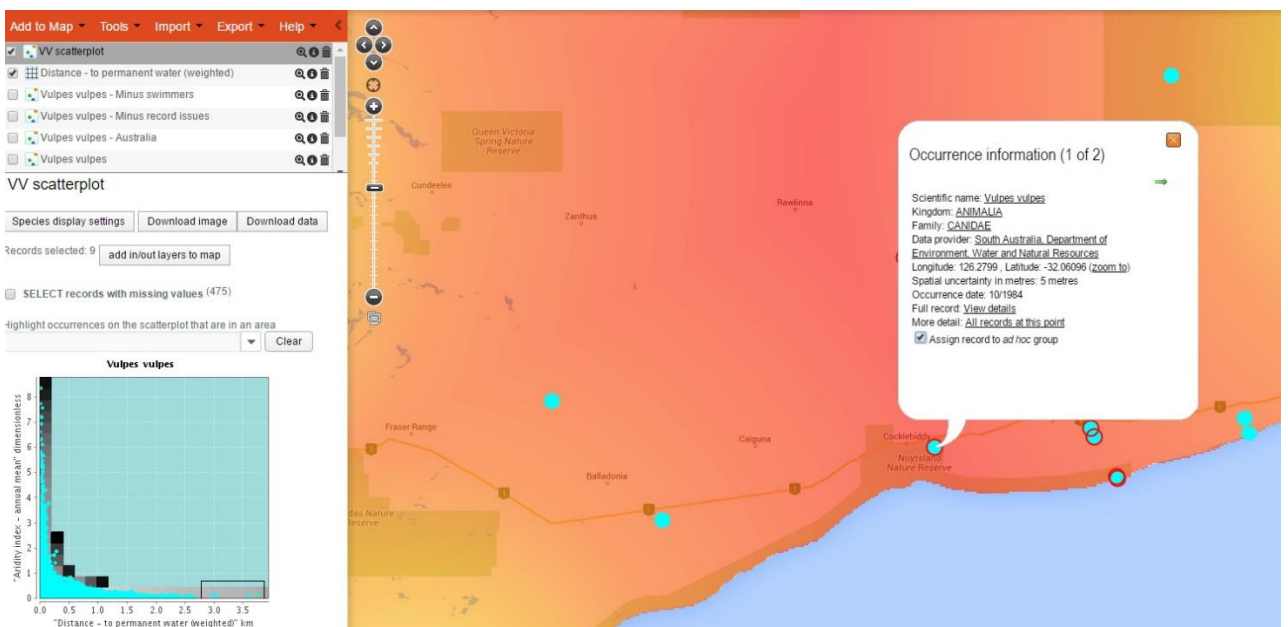


Figure 34. Filtering records by assigning them to an ad hoc group

8. I selected the points that you can see on the far right of the scatterplot (drag a bounding box over the points to be selected) - sighting of foxes that were a maximum distance to permanent water - and those points have been identified on the map with a red ring around them. There are 9 points that seem to be outliers on these criteria (aridity and distance to permanent water). If you then click back to the point layer "Vulpes vulpus - minus swimmers" layer (see above) and then click on each of the suspect points you will get a pop-up window where you can assign them to an "ad hoc group" (you will need to click the light blue arrow on the pop-up to get to all the points in a cluster).
9. If you then click on the button beneath the legend "Add in/out layers to map", two new point layers will be created, one with ONLY those selected points (in group) and one that OMITTS those 9 selected points (out group). It is the latter that you then may want to use in subsequent analyses.

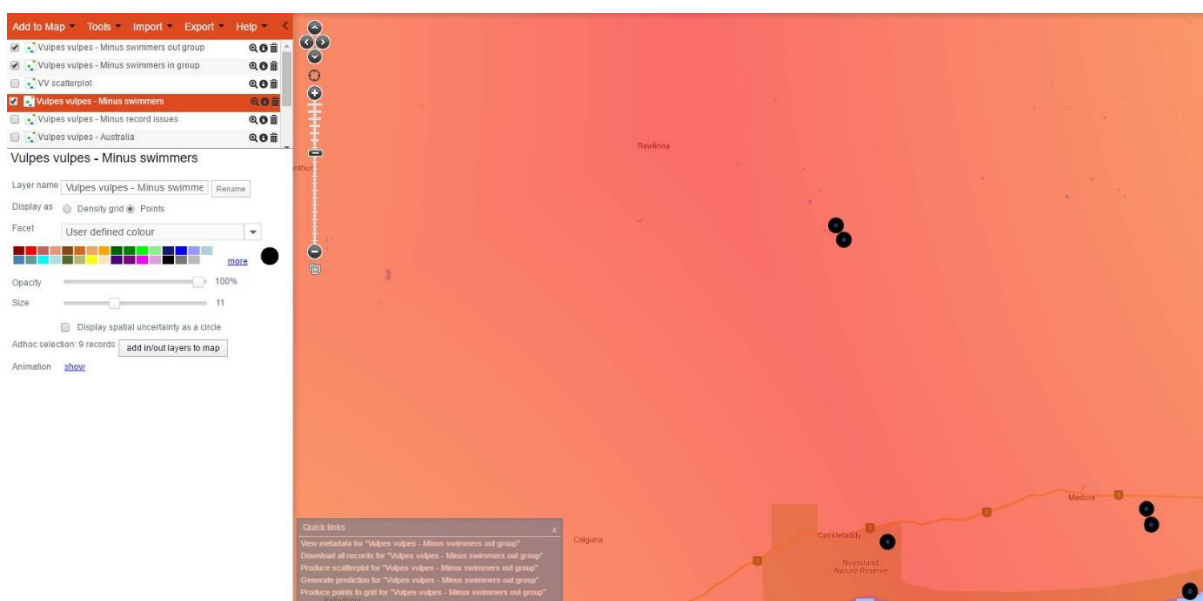


Figure 35. Filtering out ad hoc points

10. We now have a 'cleaned' dataset ready for various analyses, maybe. To ensure we can always get back to this filtered dataset, we again click on the metadata icon next to the layer "Vulpes vulpus - minus swimmers out group" and click on the bottom link to view these records in the biocache. See below-

Species layer

Species name: (SPECIES: *Vulpes vulpes*)

Number of species: 2 without a flagged spatial issue
2 with any coordinates
2 total including records without coordinates

Number of occurrences: 48513 without a flagged spatial issue
48513 with any coordinates
48529 total including records without coordinates

Map layer only displays records without geospatial issues

Classification: ANIMALIA > CHORDATA > MAMMALIA > CARNIVORA > CANIDAE > *Vulpes*
More information for *Vulpes vulpes*

List of LSIDs: urn:lsid:biodiversity.org.au:afd:taxon:ba8d0c3b-9753-46cf-87b4-a1b9ec290634

[Table view of these records](#)

Figure 36. Point layer metadata with link to biocache

- Note the URL (the web address) in your browser is giving you an address that you can use if you wish to return to these records or even download these records. In this case the URL is <http://biocache.ala.org.au/occurrences/search?q=qid:1467001326172>. The "qid" is the unique identifier for these records. If you wanted to say download all these records, just including species name, latitude and longitude, you could use this web address: <http://biocache.ala.org.au/ws/occurrences/index/download?q=qid:1467001326172&reasonTypeId=1>. This says to the ALA, the reason I downloaded this data is "Biosecurity management/planning". The downloaded zip file will contain a citation file, a headings file, a data file and a read me file. The data file will contain the species name, latitude and longitude and any assertions that have at least one TRUE flag against any of the records.

Occurrence records

Quick search

48,513 results for (SPECIES: *Vulpes vulpes*)

Selected filters:

[exclude] id: e006b864-ea67-415a-becc-3d516829c152 AND -id:73a2d65a-ca9d-427a-b3ee-de90b0b1c39c AND -id:938e61d3-fa2b-4560-9bb6-899f353d9a75 AND -id:fcf92962-114d-4c50-9782-3f27ae3879a8 AND -id:6280063a-4158-4c73-ad4b-7af96ffbb0c2 AND -id:4edfc783-9e99-49cd-9ecc-b9abd1ac4417 AND -id:435f3d61-980e-4f7b-94f6-107ada21996f AND -id:b89b2d2b-1472-4b47-892a-b7ce61dd1065 AND -id:8fa38457-ac19-4f0c-8801-313a9efb41d5 x

Spatial validity: Spatially valid x

[exclude] (Record issues: firstOfCentury OR Record issues: invalidCollectionDate OR Record issues: unrecognizedGeodeticDatum OR Record issues: incompleteCollectionDate OR Record issues: coordinatePrecisionMismatch OR Record issues: precisionRangeMismatch OR Record issues: inferredDuplicateRecord OR Record issues: stateCoordinateMismatch OR Record issues: occCultivatedEscapee OR Record issues: uncertaintyRangeMismatch) x

State/Territory: * x [exclude] (Country: * AND -country: "Australia") x > Clear all

Narrow your results

Selected filters

[exclude] id: e006b864-ea67-415a-becc-3d516829c152 AND -id:73a2d65a-ca9d-427a-b3ee-de90b0b1c39c AND -id:938e61d3-fa2b-4560-9bb6-899f353d9a75 AND -id:fcf92962-114d-4c50-9782-3f27ae3879a8 AND -id:6280063a-4158-4c73-ad4b-7af96ffbb0c2 AND -id:4edfc783-9e99-49cd-9ecc-b9abd1ac4417 AND -id:435f3d61-980e-4f7b-94f6-107ada21996f AND -id:b89b2d2b-1472-4b47-892a-b7ce61dd1065 AND -id:8fa38457-ac19-4f0c-8801-313a9efb41d5

[x] Spatial validity: Spatially valid

Records Map Charts

Downloads Alerts per page: 20 sort: Date added order: Descending

Species: *Vulpes vulpes* | Fox Date: 2016-05-30 State: Victoria
Data Resource: Individual Sightings Basis Of Record: Human Observation View record

Species: *Vulpes vulpes* | Fox Date: 2016-04-02 State: New South Wales
Data Resource: Encyclopedia Of Life Images - Flickr Group Basis Of Record: Image View record

Species: *Vulpes vulpes* | Fox Date: 2015-11-23 State: Queensland
Data Resource: Individual Sightings Basis Of Record: Human Observation View record

Species: *Vulpes vulpes* | Fox Date: 2016-06-02 State: Victoria

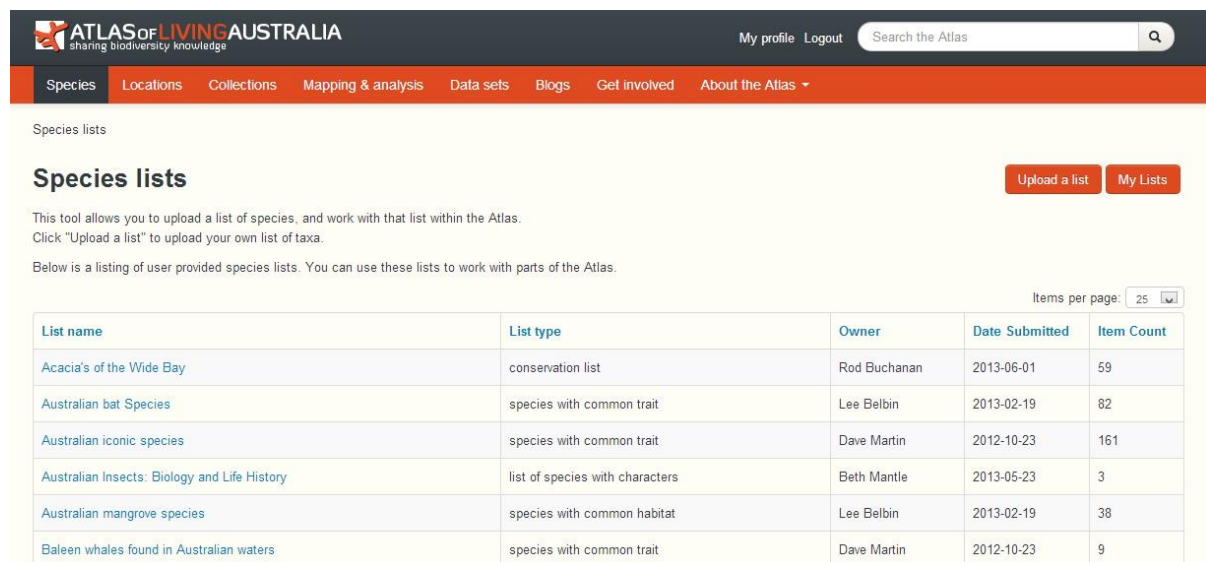
Figure 37. Filtered data in biocache

Species Lists

The Atlas supports Species Lists; any *ad hoc* or otherwise collection of taxa. A Species List can be used in the SP and other Atlas pages as if it were a single species. For example, you can map or analyse all Australian bat species as easily as mapping any single bat species.

The Atlas supports the creation, editing and use of Species Lists from the Lists page on the Atlas, <http://lists.ala.org.au>. You can give access to your lists to any other set of users that have an Atlas log in. The Lists function was designed to facilitate the generation, discussion and use of groups of species with some common link. The link could be taxonomic, functional, genetic or any other characteristic.

Note: Like many of the Atlas functions, you need to be logged into the Atlas to make most use of this feature. You can use an existing list without being logged in but you need to be logged in to *create* a list.



The screenshot shows the 'Species lists' page on the Atlas of Living Australia website. The page has a navigation bar with links for Species, Locations, Collections, Mapping & analysis, Data sets, Blogs, Get involved, and About the Atlas. Below the navigation bar, there is a search bar and a 'My profile Logout' link. The main content area is titled 'Species lists' and includes an 'Upload a list' button and a 'My Lists' button. A paragraph explains that this tool allows users to upload a list of species and work with that list within the Atlas. Below this, there is a table listing user-provided species lists. The table has columns for List name, List type, Owner, Date Submitted, and Item Count. The table lists several lists, including 'Acacia's of the Wide Bay', 'Australian bat Species', 'Australian iconic species', 'Australian Insects: Biology and Life History', 'Australian mangrove species', and 'Baleen whales found in Australian waters'.

List name	List type	Owner	Date Submitted	Item Count
Acacia's of the Wide Bay	conservation list	Rod Buchanan	2013-06-01	59
Australian bat Species	species with common trait	Lee Belbin	2013-02-19	82
Australian iconic species	species with common trait	Dave Martin	2012-10-23	161
Australian Insects: Biology and Life History	list of species with characters	Beth Mantle	2013-05-23	3
Australian mangrove species	species with common habitat	Lee Belbin	2013-02-19	38
Baleen whales found in Australian waters	species with common trait	Dave Martin	2012-10-23	9

Figure 38. The Species list home page <http://lists.ala.org.au>

To create a Species List, the best option is to first create a text file with the scientific names of interest, one per line. Then save this as a plain text file. For example, here are a few of the Australian bat species-

```
Rhinolophus megaphyllus megaphyllus
Rhinolophus philippinensis Achilles
Rhinolophus philippinensis maros
Rousettus leschenaultia
Saccolaimus flaviventris
```

Your list can then be imported into the Atlas, where it will be checked against the National Species List on the fly. If the names match, then the occurrences and other data related to the taxa are linked to your list member. If no match is found, it implies no matching National Species List entry. You can use the inbuilt Atlas search functions to help identify a species.

Once your list is created, you can supply the name of your list where any species entry is available, for example in the SP when you add a species to your map, Add to Map | Species.

Facets and Filters

Facets are a selected subset of the full list of attributes of species records. For example 'genus' is a taxonomic attribute of all species records. This function enables all records of any species or list of species (Species list) that conform to species *attributes* to be mapped, and used as a Species List. Facets will enable you to map species *attributes* and not species *per se*.

Each facet provides a different aspect of the data and can be useful for mapping and analysis. For example, you could create and map all records of a genus that had been sampled in January, February and March. Each time a facet is mapped, you are effectively creating a species list and its associated records. This list can then be filtered by the value of another characteristic to create a new list. Continuing with the example, your list of sampling over three months could be subsequently filtered to only include those species and records that had been collected by a specific institution, or that occur in one or more of Australia's bioregions (see IBRA and IMCRA in the List of abbreviations at the end of this document).

The Atlas currently has a large suite of record-related fields that are called facets: These facets are grouped into classes and are the fields that are indexed in the ALA's biocache. Details can be found on them at <http://spatial-dev.ala.org.au/webportal//resources/FacetFields.htm>

- Custom
 - Dataset
 - data_provider
 - Coordinate uncertainty (in metres)
 - Date (by decade)
- Taxon
 - Scientific name
 - Scientific name (unprocessed)
 - Subspecies
 - Genus
 - Family
 - Order
 - Class
 - Phylum
 - Kingdom
 - Identified to rank
 - Name match metric
 - Lifeform
 - Common name (processed)
 - Species subgroups
 - Species interaction
- Location
 - Country
 - State/Territory
 - CAPAD 2014 Terrestrial
 - CAPAD 2014 Marine

- Estuary habitat mapping
- Directory of Important Wetlands
- Commonwealth Electoral Boundaries
- IBRA 7 Regions
- IBRA 7 Subregions
- IMCRA 4 Regions
- IMCRA Meso-scale Bioregions
- Koppen Climate Classification (All Classes)
- Land use
- Local Government Areas
- Geomorphology of the Australian Margin and adjacent seafloor
- NRM Regions 2010
- RAMSAR wetland regions
- River Regions
- ASGS Australian States and Territories
- States including coastal waters
- Surface Geology of Australia
- Vegetation - condition
- Vegetation types - native
- Vegetation types - present
- Elevation
- min_elevation_d_rng
- Species habitats
- Coordinate uncertainty (in metres)
- Spatial validity
- location_id
- Identification
 - Identified by
 - raw_identification_qualifier
 - Taxon identification issue
 - Specimen type
 - original_name_usage
- Occurrence
 - Collector
 - Sex
 - Life stage
 - Cultivation status
 - Month
 - Year
 - Date (by decade)
 - State conservation
 - State conservation (unprocessed)
 - event_id
- Record
 - Record type
 - Multimedia

- Presence/Absence
- Assertions
 - Record issues
 - Outlier for layer
 - Outlier layer count
 - Has user assertions
 - Assertions by user
 - Associated records
 - Duplicate record type
- Attribution
 - User
 - Dataset

There are two ways of using facets in the SP. The sections below outline these alternatives.

Faceting after adding a species

With this strategy, you start by mapping a single ‘Species’ (or a ‘Species List’) as points (add to map species) and then use faceting in the legend to colour those points by classes in the selected facet. For example, you could map the occurrences of all Eucalypts and then colour the occurrence points by faceting on conservation status (Figure 39). Each class of a facet is selectable in the legend, meaning if it is ticked, the associated points on the map window will be highlighted – circled in red. In Figure 39, the occurrences associated with all “Near threatened” species have been highlighted.

Once

The screenshot shows the Atlas of Living Australia interface. The map displays Eucalyptus occurrence points in Tasmania, with points corresponding to 'Near Threatened' species highlighted in red. The legend on the left is faceted by 'State conservation status' and includes a table with the following data:

class	colour	count
<input type="checkbox"/> Not listed as endangered	Blue	485067
<input type="checkbox"/> Endangered	Orange	30837
<input checked="" type="checkbox"/> Near Threatened	Red	13401
<input type="checkbox"/> Least Concern/Unknown	Green	273

Buttons for 'Select all', 'Create layer', and 'Clear selection' are visible below the table. A checkbox for 'Display spatial uncertainty as a circle' is also present.

Figure 39. Example of facets - conservation status of Eucalyptus

selection is made, two buttons become visible- **Create layer** and **Clear selection**. If you press **Create layer**, a new layer will be created that contains *only the selected records*: A filtering of the mapped layer. This process can be repeated to subset/filter down to the desired records.

Faceting before adding a species

For this strategy, you start with Add to Map | Facet and then use the Legend facet for further faceting and filtering. For example, you could start with Add to map | Facet on “State conservation status – unprocessed”, then facet (and filter) by scientific name (Figure 40).

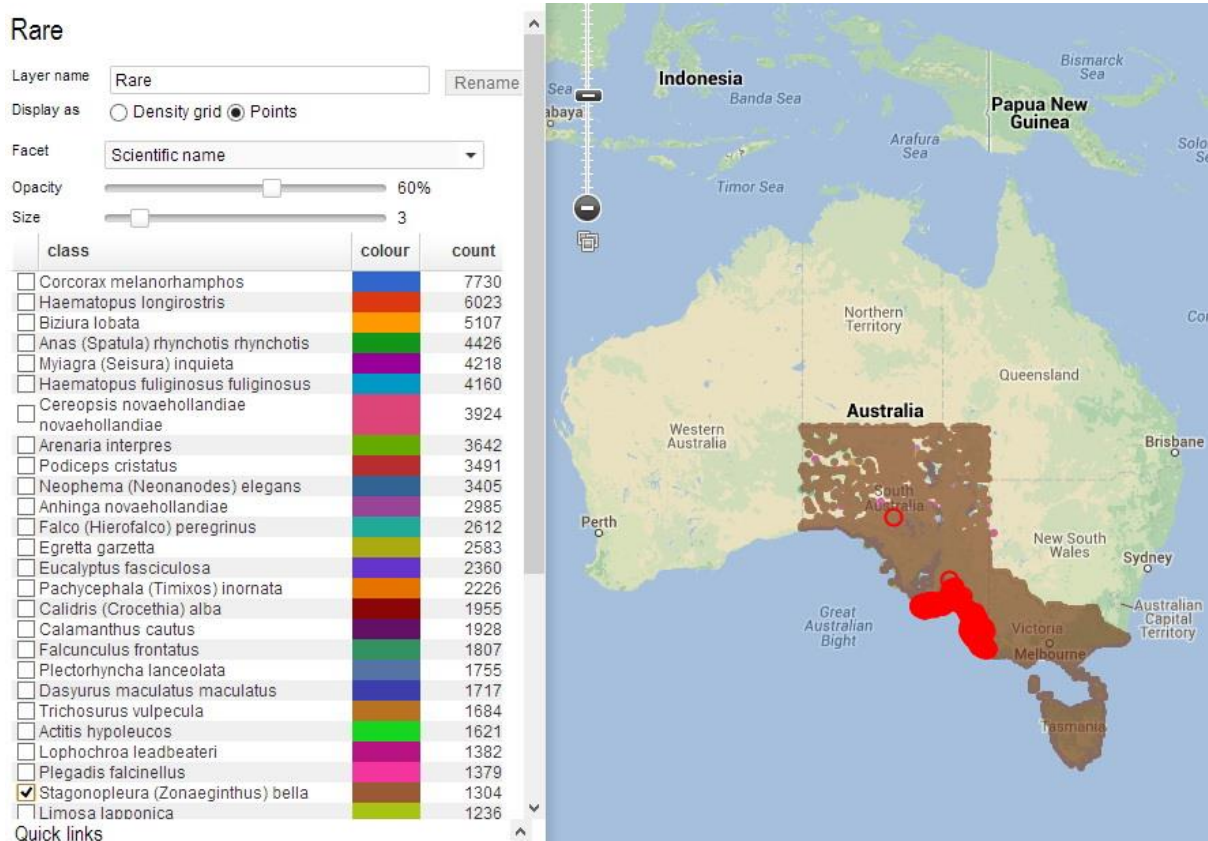


Figure 40. Map of occurrences of species designated by South Australia, Victoria and Tasmania as 'rare' with a legend facet on scientific name

If there are a large number of facet classes, a **search box** will be automatically generated above the facet list in the legend. You can use this search to filter/highlight any one or more classes that interest you. Once the classes have been selected, you can generate a new point's layer that only contains those filtered/highlighted classes.

Areas

The Spatial Portal is extremely flexible when it comes to how areas may be defined. There are currently 14 options--

- **Interact with the map**
 - Draw bounding box
 - Draw polygon
 - Draw point and radius
 - Select area from polygonal layer
- **Search**
 - Radius centred on street address
 - Radius from point
 - Gazetteer polygon
- **Preset Areas**
 - Box - Australia
 - Box - World
 - Box - Current view
- **Import**
 - Shapefile
 - KML
- **Other**
 - Define environmental envelope
 - Enter area coordinates as WKT
 - Merge map areas

Interact with the map

To use this group of options, zoom and pan to your area of interest. The SP will display the result of drawing or selecting a polygon as a WKT (Well Known Text) string in the text box, for example:

```
POLYGON((131.36328125 -22.506468769126,135.23046875 -  
23.396716654542,134.17578125 -27.287832521411,127.40820312499  
-26.661206402316,128.111328125 -21.037340349154,131.36328125 -  
22.506468769126))
```

This text may then be copied and pasted into a text file for future use. Alternatively, any defined area can be exported in any of the three available formats shapefile, KML and WKT. For example, you can digitize boundaries of an area on the SP map and then export it as a shapefile, KML or WKT for future use or for project documentation.

Note: Areas can be defined as single polygons or multiple polygons.

Note: The default name for created areas will be "My area", "My area 1", "My area 2" etc., but these names can be changed at any time using the Rename button.

Draw bounding box

Zoom and pan the map to the area and scale of interest and then click and hold the left mouse and drag to form a rectangle/bounding box. Release the mouse button when the desired area has been formed.

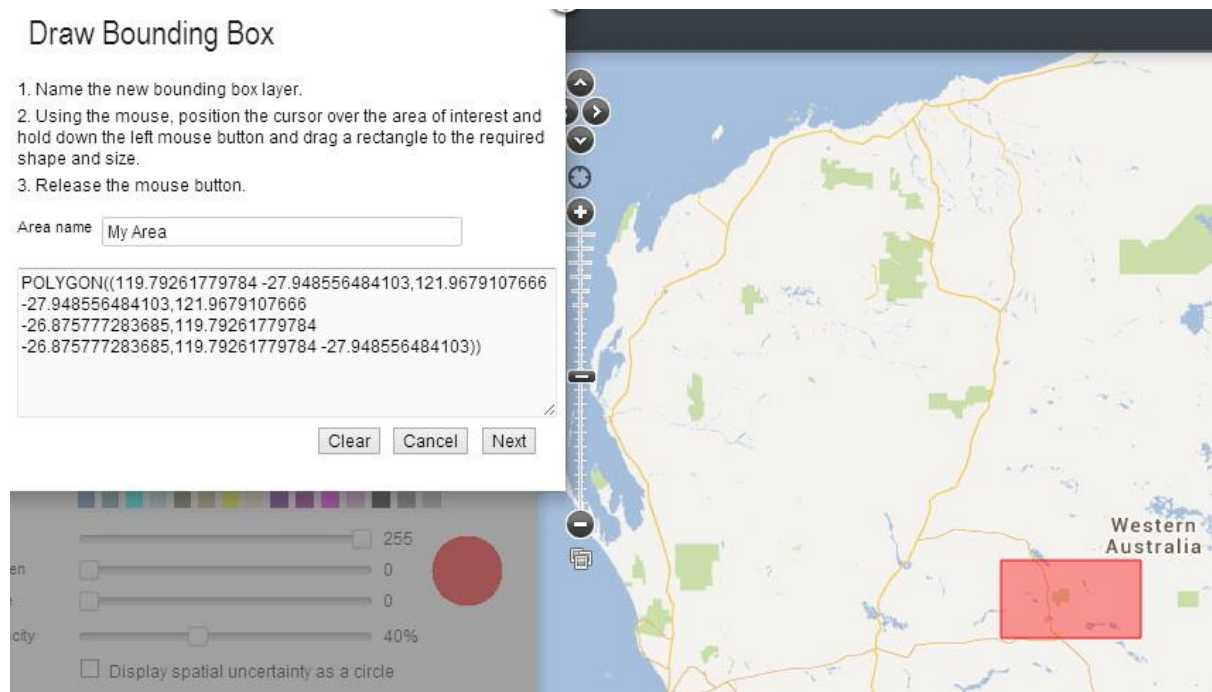


Figure 41. Define area using a bounding box (rectangle)

Draw polygon

Zoom and pan the map to the area and scale of interest and then click at the first vertex on the polygon. Continue to click locations (that will be connected by a line) until the last vertex has been added. Then double-click to close the polygon and create the area.

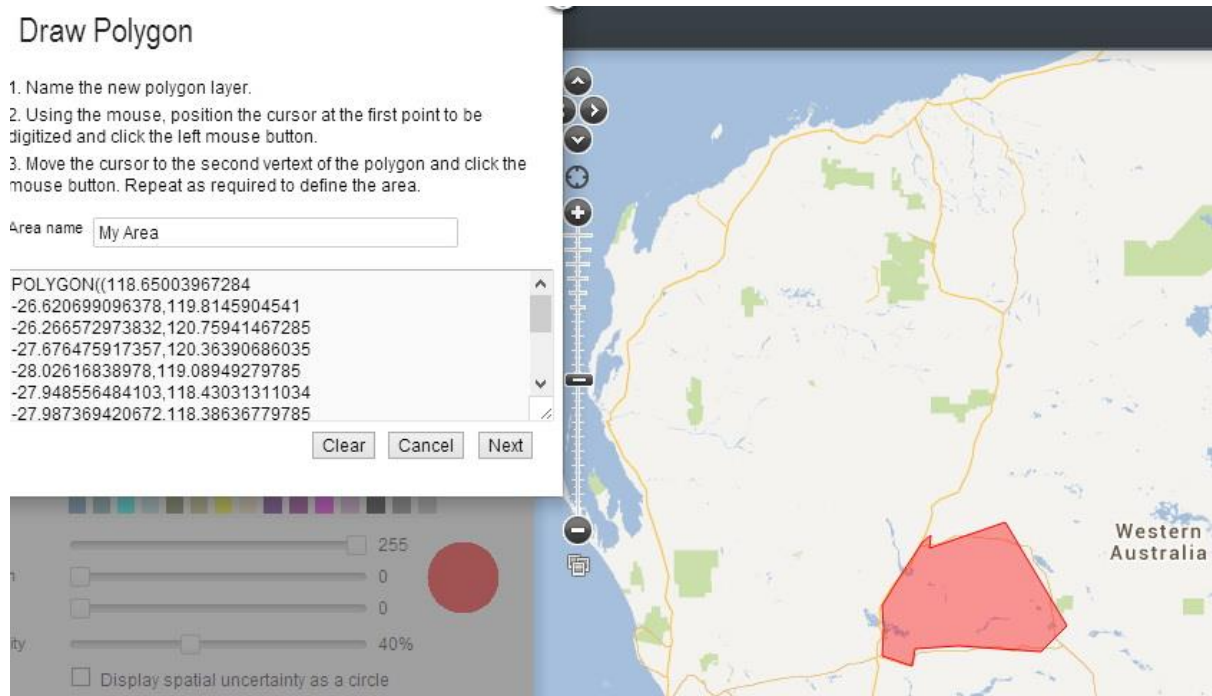


Figure 42. Define an area by digitizing a polygon

Draw point and radius

Zoom and pan the map to the area and scale of interest and then click and hold the left mouse on the central point and drag to form a circle of the desired radius. The size of the radius in kilometres is continuously display in the top-left of the map window. Release the left mouse button when the desired area has been created.

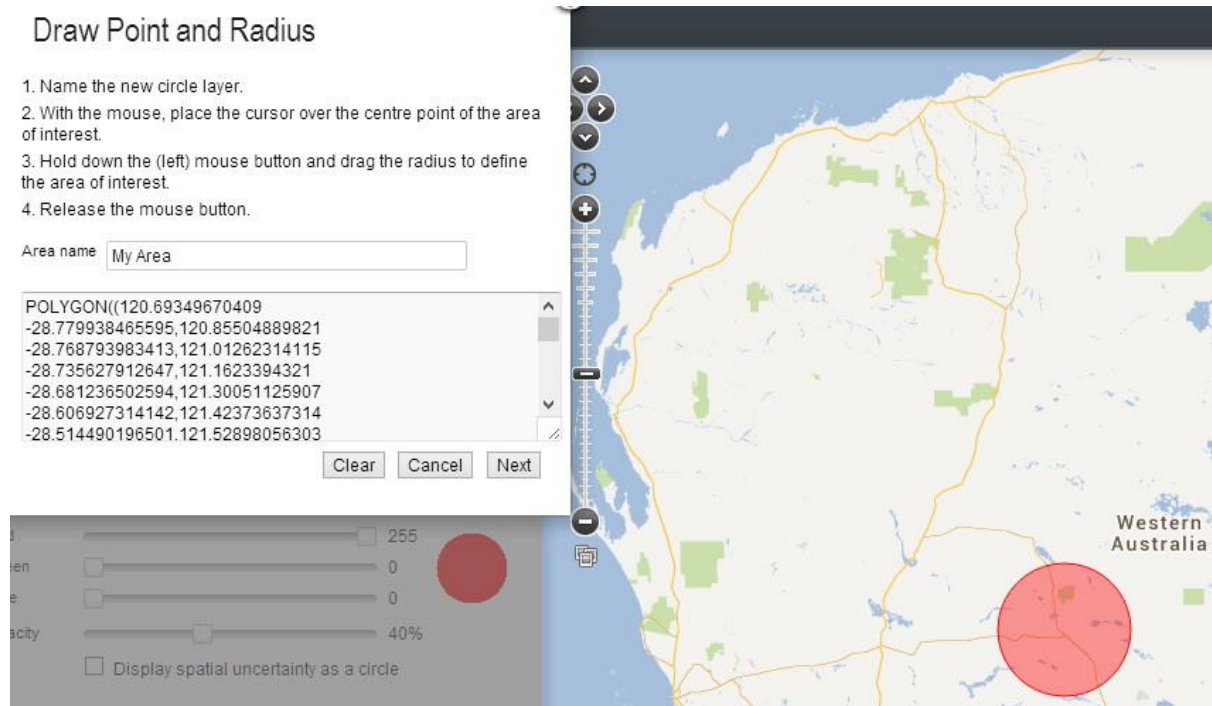


Figure 43. Define an area by drawing a circle

Select area from polygonal layer

There are two types of layers in the SP – environmental and contextual. Environmental layers are gridded and have continuous values such as mean annual temperature. Contextual layers are polygonal in structure and have class values, for example, the land use layer has a class called ‘forestry’. The ‘select area from polygonal layer’ *requires that a contextual layer has been mapped* (see screenshot below). Zoom and pan to your area of interest and then click on the individual polygon. This *single* polygon will then define the area.

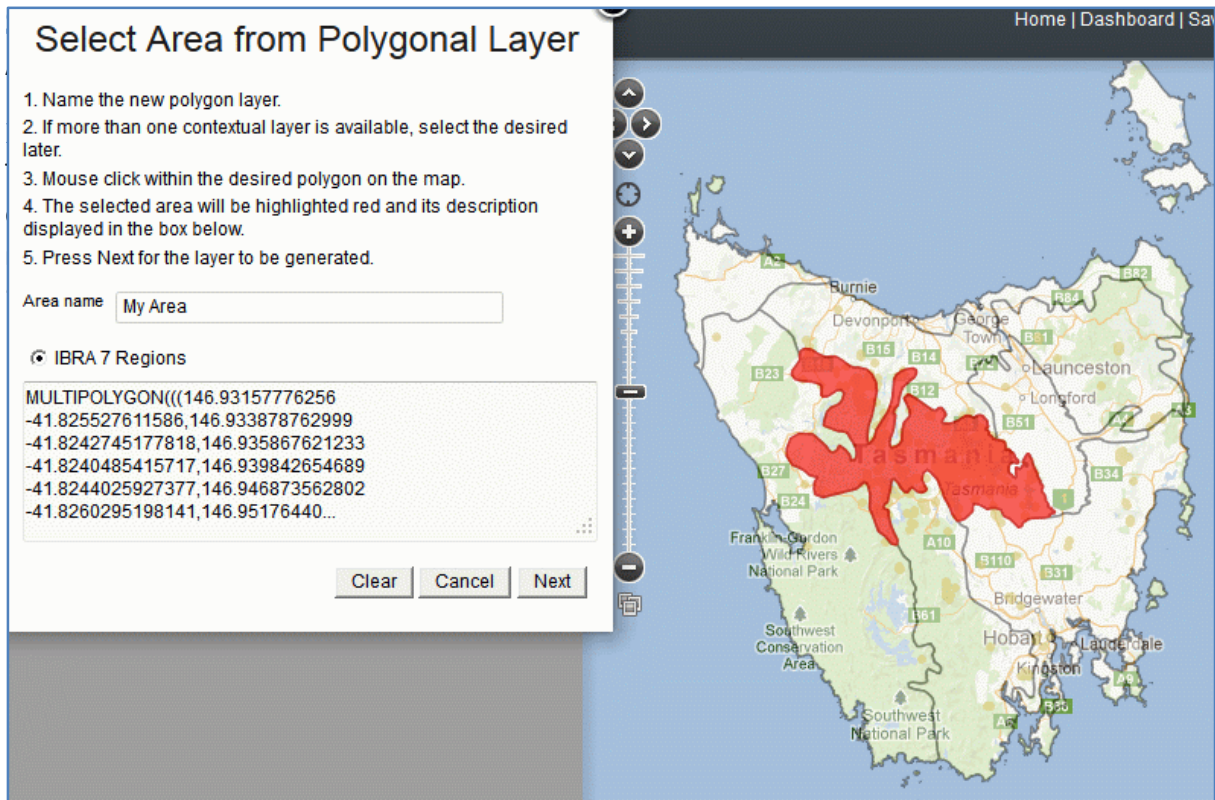


Figure 44. Select area using a class from a polygonal layer

Radius from point

For this option, enter a longitude and latitude in decimal degrees and a radius in kilometres. The Atlas uses the convention of negative longitude are west of Greenwich (to the International Date Line) and negative latitudes are southern hemisphere. Therefore most of the Australian region has positive longitudes and negative latitudes. For example enter 146.78709, -43.60208. The SP uses the order longitude-latitude because these can be roughly plotted as X-Y pairs if you don't have access to a geographic information system (GIS).

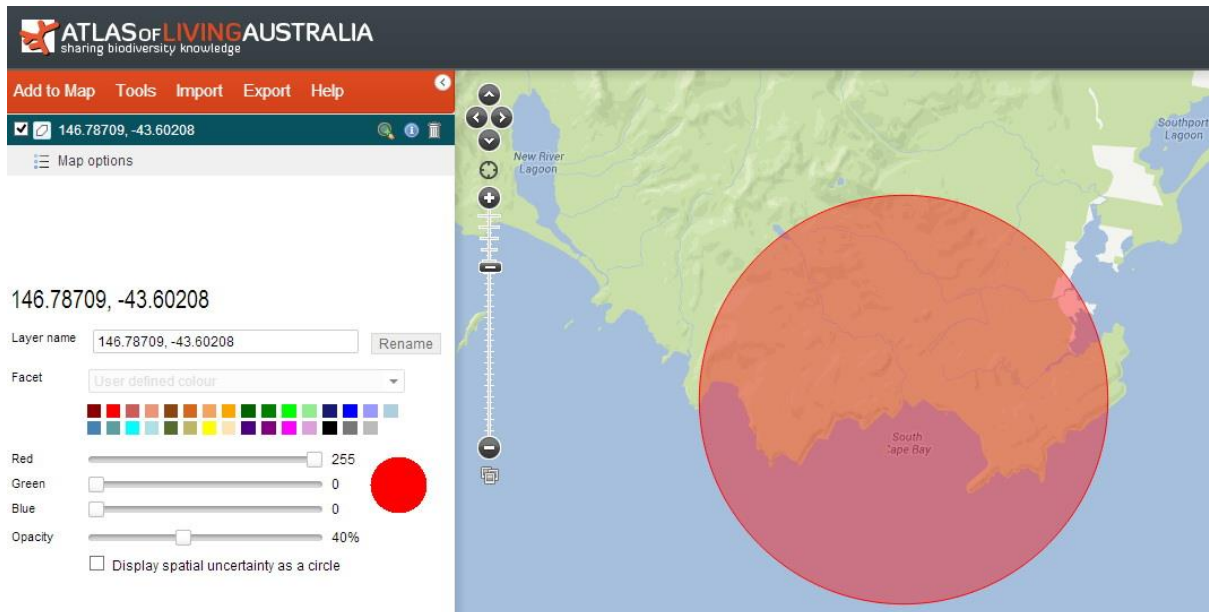


Figure 45. Define an area by a radius centred on a geographic coordinate

Gazetteer polygon

Three sources of gazetteer information have been integrated into the Spatial Portal gazetteer-

- The official Australian Gazetteer ([2010](#)). All entries are represented by points-only! We generate an area around this point with a user-supplied radius.
- Global Administrative Areas ([GADM](#)). This database is surprisingly comprehensive for Australia. Most entries are polygons and examples include Australian suburbs.
- All **contextual** layers within the SP that contain named polygons have been added into the SP gazetteer database. For example, entering the name of a bioregion such as “Central Ranges” will define a polygon. **Note:** This area is often a multi-polygon. See Layers section below.

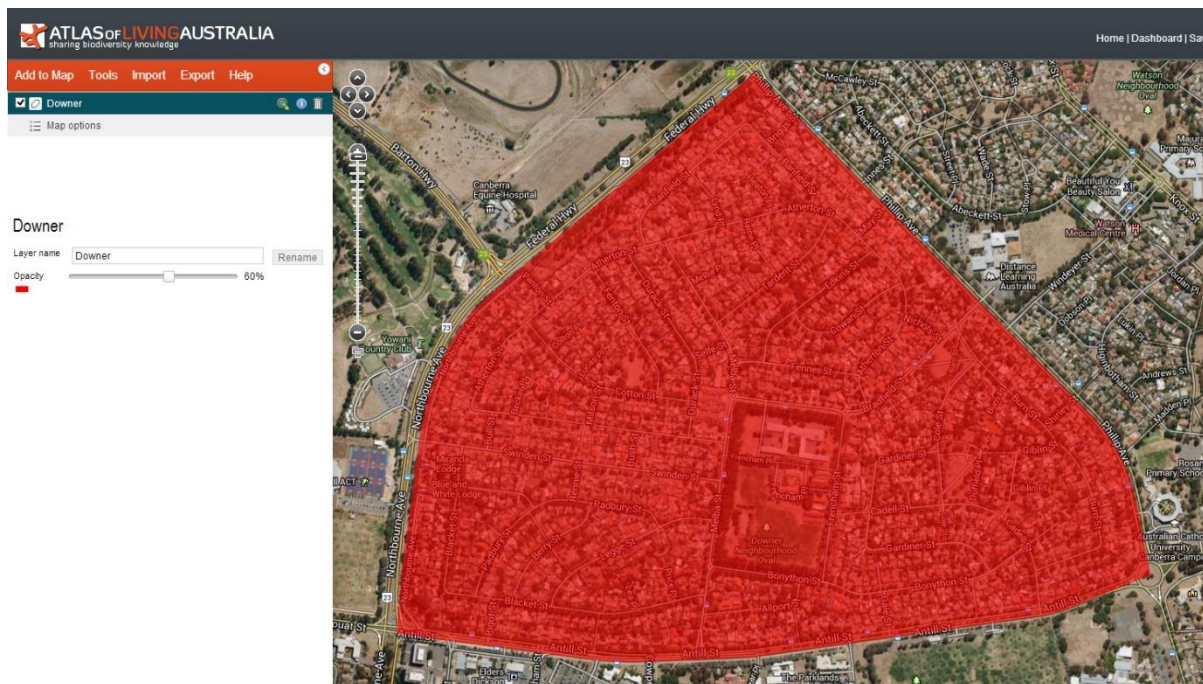


Figure 46. Define an area from a polygon defined by the Spatial Portal's composite gazetteer

Pre-set Areas

There are three built-in areas defined in the spatial portal - Australia, World and what is called the 'Current view'. 'Australia' is intended to cover the Australian mainland and Tasmania and therefore does not cover all of Australia's External Territories, EEZ etc.

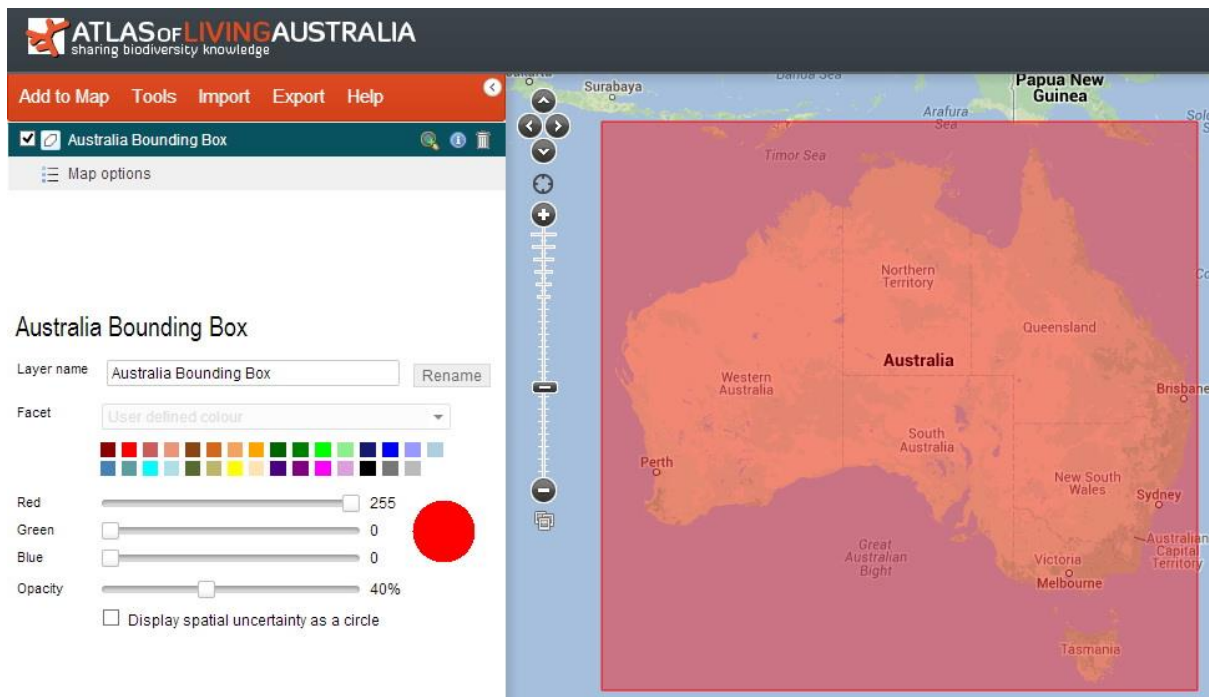


Figure 47. The Australian area pre-set

The 'World' pre-set area covers the world east to west, but only to 85° north and south of the equator. The 'Current View' uses the full extent of the map window of the spatial portal and will therefore define a rectangular bounding box.

Import

The Spatial Portal supports three formats for import of areas: Shapefile, KML, and WKT. See the following sections for details.

Import Shapefile

Shapefile is an open standard used by GIS systems. The Spatial Portal will expect a zipped external file for Shapefile format areas. See <https://en.wikipedia.org/wiki/Shapefile> for more details about this open format.

Import KML

KML is Keyhole Markup Language as used in Google Earth and Google Maps and it is now, an Open Geospatial Consortium (OGC) standard, see <https://en.wikipedia.org/wiki/KML>. The Spatial portal will expect an external file for KML format areas.

Other Area Options

Define environmental envelope

Lower and upper bound values from any combination of **environmental layers** will define one or more polygons that have those environmental characteristics. For example, creating a layer with a

mean annual temperature between 4 and 8 degrees will define areas (polygons) that conform to that condition. Similarly, creating a layer with an annual rainfall between 800 and 1000 mm will also define areas of Australia with that environmental characteristic. Intersecting the two 'rules' above will define any areas that have BOTH of those characteristics. Either of the above examples are termed environmental envelopes.

The **Define environmental envelope** method can be used to find areas in Australia that have conditions suitable for species or lists of species with known environmental characteristics. The process is to:

1. Select the environmental layer of interest
2. Enter the lower and upper bounds of that layer
3. Select 'Update species count' and refine bounds as desired
4. Add another environmental layer
5. Enter lower and upper bounds
6. Select 'Update species count' and refine bounds as desired
7. Repeat with layers of interest and the lower and upper bounds - as needed
8. Finish by selecting 'Next' and the area will be created

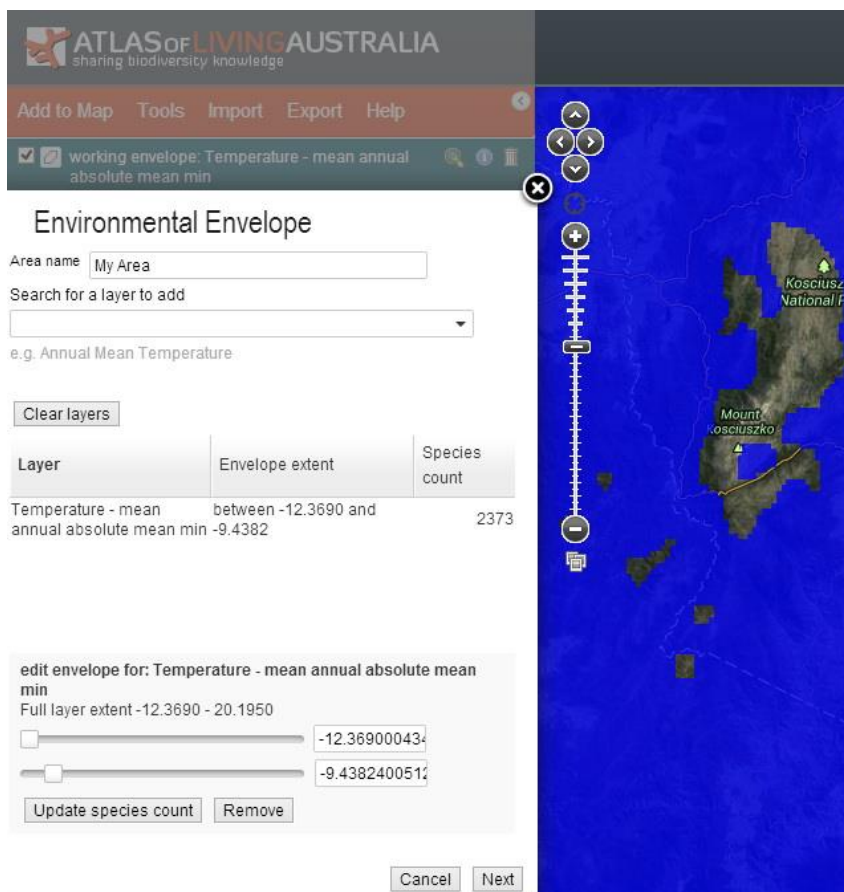


Figure 48. An area defined by an environmental envelope

Enter area coordinates (WKT)

WKT stands for Well Known Text, a simple text-based definition of geographical features that is simple to understand and generate, see https://en.wikipedia.org/wiki/Well-known_text. WKT supports, points, lines, simple and complex polygons. The Spatial Portal will expect you to PASTE the WKT text string into the box provided. A simple example from the Wikipedia page shows how simple the definition of an area is-

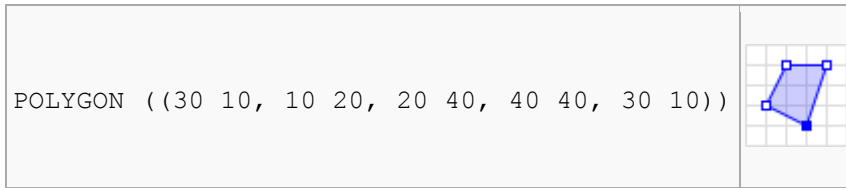


Figure 49. Define an area using Well Known Text

When you use the spatial Portal’s map window to digitize areas, the WKT text string that results from the digitization is displayed in the entry box. This text string can be copied and pasted into a file, or you can simple export the defined area in WKT (or Shapefile or KML) format.

Note: All areas can be exported/downloaded from the Atlas for your own use or for documentation of the analyses. Formats available are Shapefile, KML or WKT. These saved area definitions can then be imported back into the SP as required.

Merge Map Areas

This option allows any predefined mapped areas to be merged into a single new area. When you select this option, a pop-up window will be displayed where you can select/deselect the areas you want merged into a new area.

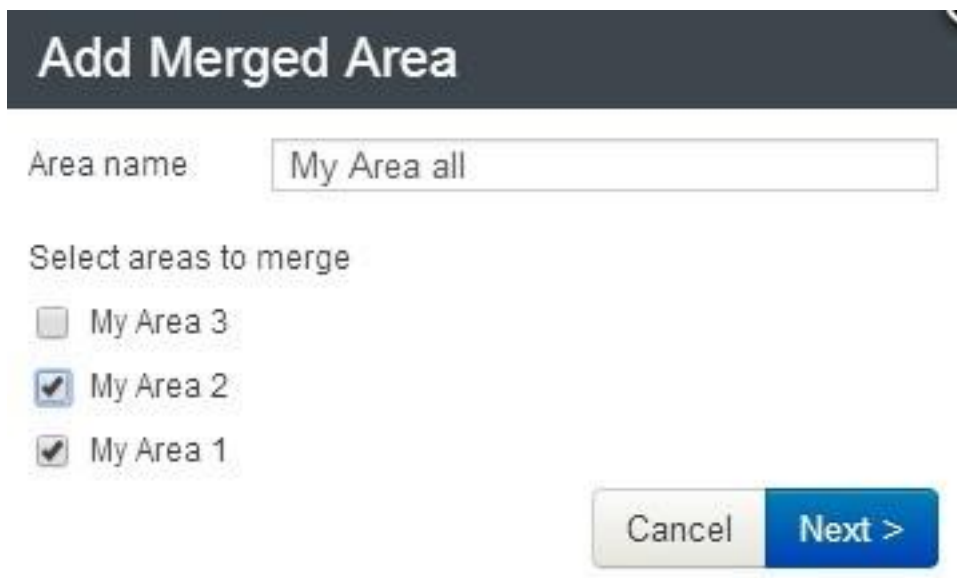


Figure 50. Select areas to be merged

In Figure 50 above, the areas “My Area 1” and “My Area 2” will be merged into a new area call “My Area all”. This will be an additional area: No areas will be deleted. The new area can be used as any other defined area in the Spatial Portal.

Classification 1	Classification 2
Area Management	Biodiversity
Area Management	Farming
Area Management	Great Eastern Ranges
Area Management	Murray-Darling Basin
Area Management	
Biodiversity	Phylogenetic diversity
Biodiversity	Region
Biodiversity	Status
Biodiversity	Status
Climate	Classification
Climate	Evaporation
Climate	Growth index
Climate	Humidity
Climate	Precipitation
Climate	Solar radiation
Climate	Temperature
Distance	Wind
Fire	
Hydrology	
Marine	Biology
Marine	Boundaries
Marine	Chemistry
Marine	Energy
Marine	Habitat
Marine	Region
Marine	Temperature
Marine	Topography
Marine	Turbidity
Political	Culture
Sensitive Data Layers	Fruit Fly Exclusion Zones
Sensitive Data Layers	Phylloxera Infection Zone
Sensitive Data Layers	Potato Cyst Nematode Zones
Sensitive Data Layers	Protected Zones
Sensitive Data Layers	Special Quarantine Zones
Social	
Substrate	Age
Substrate	Chemistry
Substrate	Moisture
Substrate	Physics
Substrate	
Topography	
Vegetation	Fpar

layers are all supported.

Most of the environmental layers in the Spatial Portal have a grid cell resolution of 1km² and a few are at 250m². We would like to evolve the resolution of all layers toward 250m² or 100m² but there

Layers

For a comprehensive outline of the philosophy of the environmental and contextual layers in the Spatial Portal, see Belbin and Williams (2015).

As noted above, layers in the SP are defined as either **environmental** (gridded observations with continuous values) or **contextual** (polygons with class values). Examples of environmental layers would be ‘water stress index’ or ‘Precipitation of the driest period’. Examples of contextual layers would be ‘States and Territories’ or ‘bioregions’.

Environmental and contextual layers can be mapped to show the spatial distribution of their values or classes.

Environmental layers will have a corresponding colour scale while contextual layers will include a legend of all classes in the layer with each class coloured independently. Any number of layers can be mapped at one time but obviously not all layers can be visible at one instant. The ordering of the layers (stack) can be altered by dragging the layer of interest to the **top** of the stack (top left of SP window). The **transparency** of each layer can also be changed using the slider bar when the layer of interest is selected (by clicking on it). Layers can also be de-selected or hidden (see Interface section).

Environmental layers can be used by scatterplots, classification, prediction, environmental envelopes and GDM. Environmental layers can be generated by Spatial Portal tools such as Points to grid, Classification, Prediction and GDM.

Contextual layers can be mapped, classes or individual polygons can be used to define areas, or used in prediction and tabulations.

The layers have been classified into a two-level hierarchy to help your selection (see table), but the Spatial Portal also supports searching across layer names and layer tags that have been added to ease finding relevant layers. For example, ‘rainfall’ can be used to locate layers that involve ‘precipitation’.

The main layer-selection table in the Add to Map | Layer wizard is sorted by the layer classification (left) but free-text searches, predefined lists and the ability to import a list of

is a heavy computational cost. The SP looks in many ways like a desktop Geographic Information System (GIS), but it isn't. The universality of web browsers is neat, but there are significant

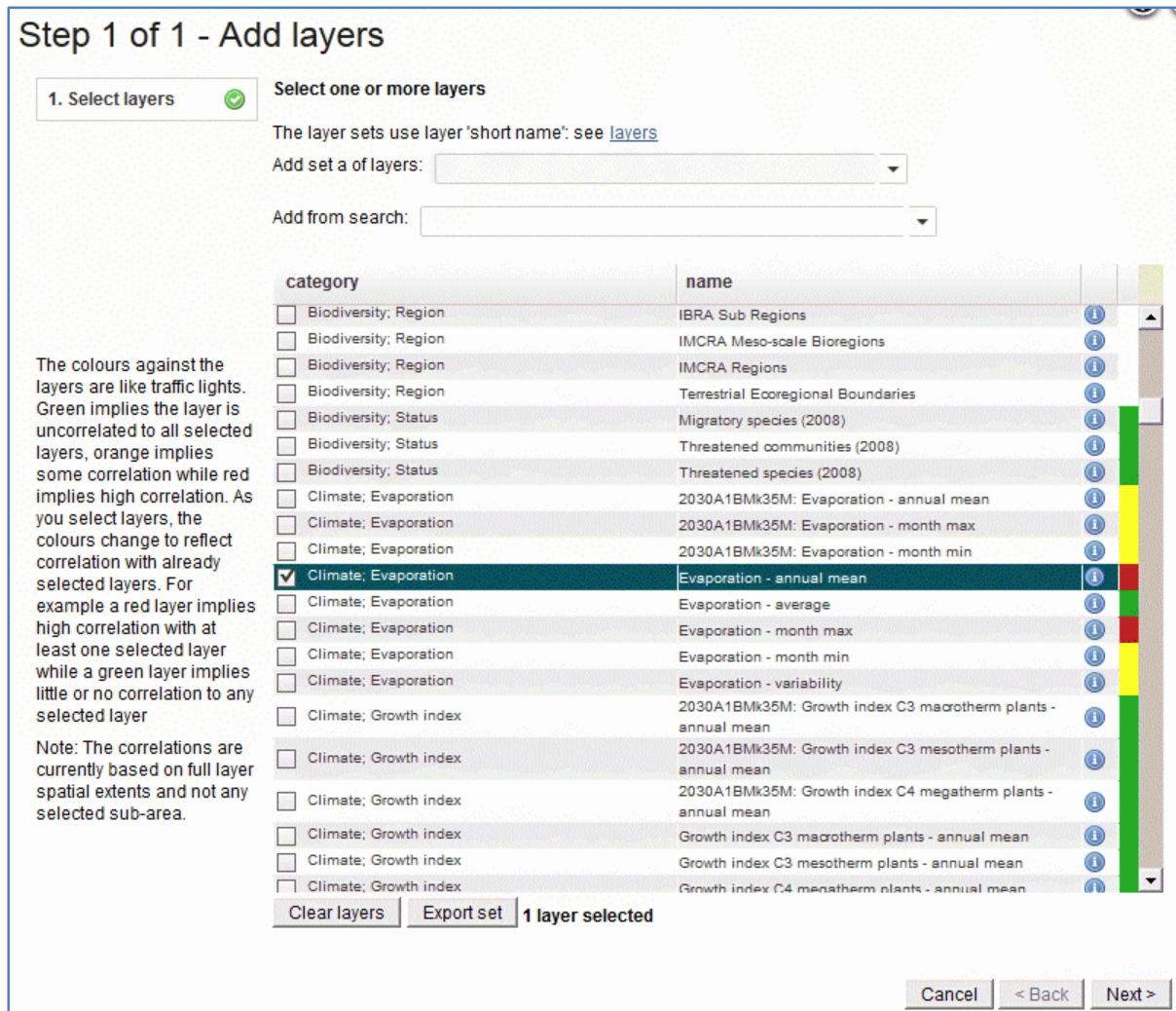


Figure 51. Selecting layers in the Spatial Portal

limitations.

Note: Unlike species occurrence records and map areas, environmental and contextual layers cannot be downloaded from the Atlas for your own use. The main reason for this is data copyright. The Atlas of Living Australia has been granted the right to use the layers with acknowledgement, but not to pass the raw data on to third parties. Each layer is linked to its full metadata via the little (i) button which appears to the right of each layer name. You are free to experiment with layers in the Spatial Portal and the metadata will tell you exactly how to source or acknowledge their use; hopefully at least a saving of your time.

Traffic lights

The colours displayed against the layers when one or more layers are selected operate like traffic lights. As you select layers, the colours change to reflect correlation with already selected layers. For example a red coloured layer implies high correlation *with at least one selected layer*, while a green layer implies little or no correlation to any selected layer.

Note: The correlations are calculated over the entire spatial extents of each layer and not on the fly for any selected sub-area as the size of the problem in grid cells $((n*n-1)/2)$ makes this computationally infeasible, at present.

Automatically Recalculated Layers

There are four layers that are recalculated weekly due to the inevitable addition of new occurrence records into the Atlas. They are

- Endemism (see Crisp *et al.* 2001 – see Figure 52.)
- Endemism non-marine (see Crisp *et al.* 2001)
- Occurrence density and
- Species richness

Each of these values are calculated at global extent using a 0.1 degree (~10km) grid. It is likely that additional similarly derived layers will be added when we become aware of their potential utility. Suggestions always welcomed to support@ala.org.au.

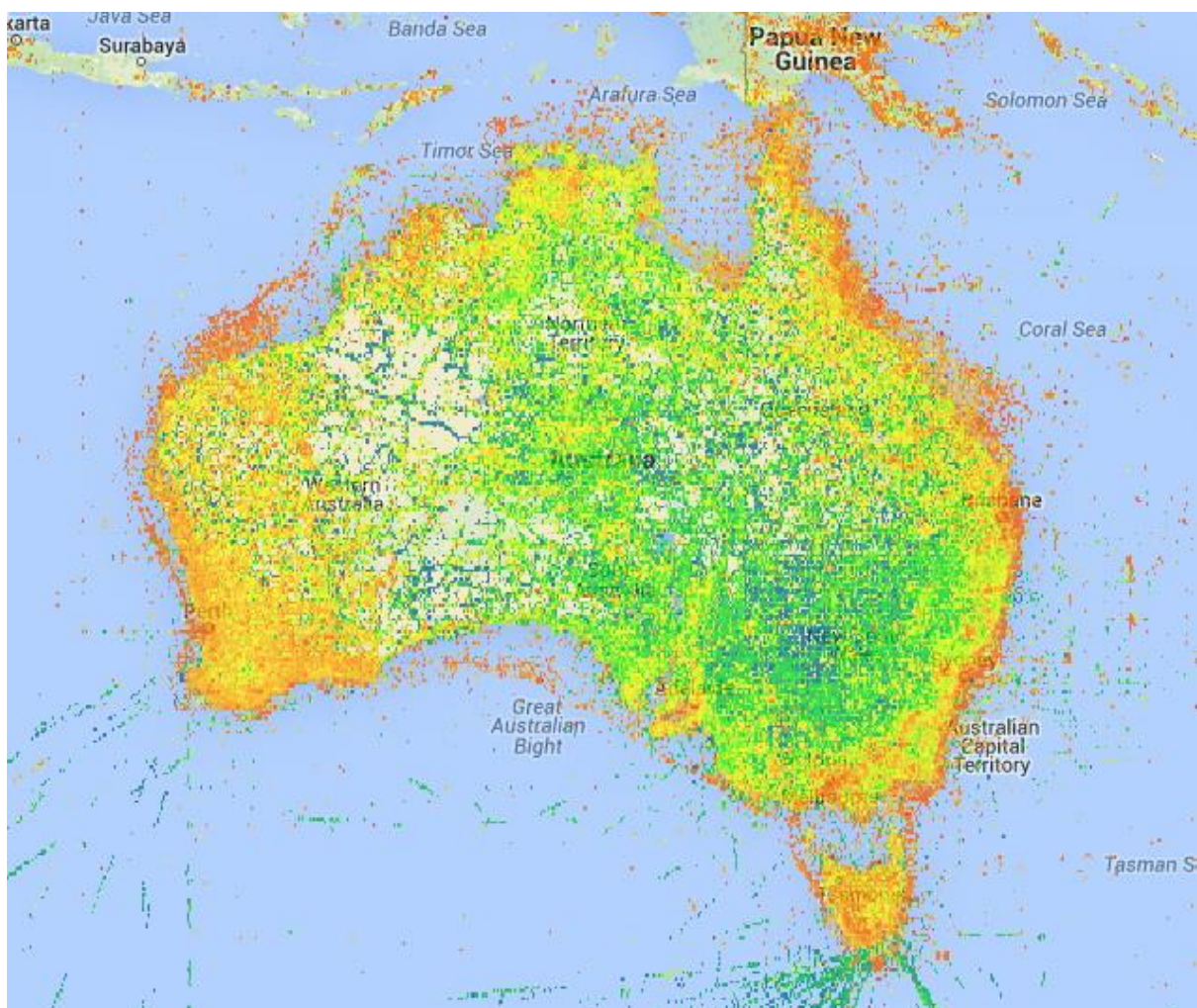


Figure 52. Terrestrial and marine endemism map

Tools

The tools included in the Spatial Portal were selected from a workshop of experts convened in Canberra in December 2009 (Flemons and Belbin, 2009). The workshop aims were

1. To identify analytical methods for addressing the following high-level use cases:
 - a. Estimating the spatial distribution of biodiversity
 - b. Identifying differences in biodiversity over space and time
 - c. Prioritizing management actions based in part on biodiversity estimates and scenario analyses
 - d. Identifying gaps in biodiversity information relating to spatial, temporal, taxonomic and environmental factors.
2. To identify the most appropriate methods to address the use cases. These methods must be
 - a. Widely used and tested
 - b. Accepted as State-of-the-Art.
 - c. Robust
 - d. Suit actual or anticipated ALA data (e.g. presence-only)
 - e. Computationally tractable
 - f. Able to be implemented cost-effectively
 - g. Modular and extensible and therefore easy to build on and maintain
3. To identify the most effective option for implementation
 - a. Integrated into the spatial portal
 - b. Download data for desktop or mainframe analysis
 - c. Or a hybrid solution
4. To address for accepted methods the following
 - a. Input data
 - b. Parameters
 - c. Procedures and limitations
 - d. Outputs
5. To evaluate implementation strategy and resources that would be required (people, time, money...) for the selected methods
 - a. To build the applications
 - b. To sustainably manage the application

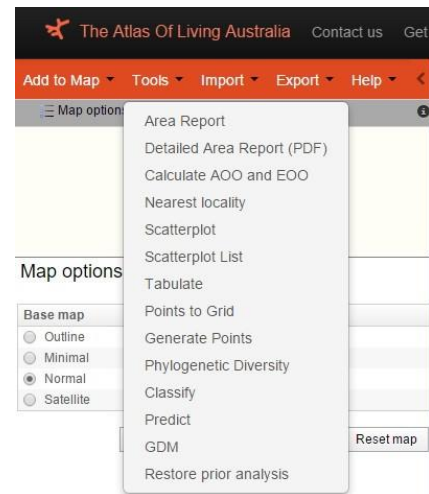


Figure 53. The tools menu options

Online Area Report

Current extent			
Area (sq km)	3,412.55		Info
Number of species	2,685	List	
Number of species - spatially valid only	2,324	List	
Number of endemic species	0		
Number of endemic species - spatially valid only	0		
Occurrences	22,159	Map all	Sample View Records
Occurrences - spatially valid only	18,606	Map all	Sample View Records
Expert distributions	662	List	
Checklist areas	0		
Checklist species	0		
Journalmap documents	3	List	JournalMap
Gazetteer points	563	Map all	
Points of interest	0		
Invasive Species	65	List	Map all View Records
Threatened Species	148	List	Map all View Records

[Download](#) [Close](#)

Figure 54. A typical area report

The Area Report provides information on species and species-related documents that are either in the area or intersect the area. The following parameters are reported-

1. **Area** in square kilometres
2. The **number of species** in the area. Clicking on this number will result in a list of species being displayed. This list can then be downloaded in a CSV (comma-separated-variables) format.
3. The **number of species that have spatially valid** occurrence records. Clicking on this number will result in a list of species being displayed. This list can then be downloaded in a CSV (comma-separated-variables) format.
4. Optionally, the number of **endemic species** in the area; species that only occur **within** the defined area. Clicking on this number will result in a list of species being displayed. This list can then be downloaded in a CSV (comma-separated-variables) format. The reason this list is optional is that it may take some time to generate: A search through all occurrence records is required.
5. Optionally, the number of **endemic species with valid occurrence** records in the area. Clicking on this number will result in a list of species being displayed. This list can then be downloaded in a CSV (comma-separated-variables) format.
6. The total number of **occurrence records** of all species in the area.
 - a. Clicking on this number will result in a list of species being displayed. This list can then be downloaded in a CSV (comma-separated-variables) format.
 - b. Clicking on 'Map all' will result in all occurrence records in the area being mapped as a new species layer
 - c. Clicking on 'Sample' will result in a wizard starting that will enable you to *append* all selected environmental and contextual layer values or classes to all occurrence records of all species within the area

- d. Clicking on 'View records' will open a new window in the species area of the Atlas web site that will list all occurrence records and enable you to filter and facet
7. The total number of **spatially valid occurrence records** in the area. This list can then be downloaded in a CSV (comma-separated-variables) format.
 - e. Clicking on this number will result in a list of species being displayed. This list can then be downloaded in a CSV (comma-separated-variables) format.
 - f. Clicking on 'Map all' will result in all occurrence records in the area being mapped as a new species layer
 - g. Clicking on 'Sample' will result in a wizard starting that will enable you to *append* all selected environmental and contextual layer values or classes to all occurrence records of all species within the area
 - h. Clicking on 'View records' will open a new window in the species area of the Atlas web site that will list all occurrence records and enable you to filter and facet
 8. The number of '**expert distributions**' within the area. 'Expert distributions', as their name suggests are one or more polygons that have been defined by an expert to indicate where the species should be expected to occur. **Note:** If an 'expert distribution polygon' intersects the defined area, occurrences of the species are assumed to occur somewhere in the area, but no point-occurrence records can be implied. In most cases however, the Atlas has both point occurrence records and expert distribution polygons. Clicking on the number will generate a list of species in the area that are defined by an expert distribution. This list can then be downloaded in a CSV (comma-separated-variables) format.
 9. **Checklist areas** are similar to expert distributions except that checklist areas are assumed to contain multiple species. Clicking on the number will generate a list of the checklist areas that intersect the area of interest. This list can then be downloaded in a CSV (comma-separated-variables) format.
 10. **Checklist species** are the number of species in the area defined by their assumed occurrence in a checklist area. Clicking on this number will result in a list of species being displayed. This list can then be downloaded in a CSV (comma-separated-variables) format.
 11. **JournalMap** documents are publications that have been geocoded in a way that is similar to detailing the vertices of a polygon. If the area intersects with a polygon defined by a document, then we assume it relates to the area in some way. This list of documents can then be downloaded in a CSV (comma-separated-variables) format. See <http://www.journalmap.org>.
 12. **Gazetteer points** are those from the Australian Gazetteer of 2012 (see <http://www.ga.gov.au/place-names/>). This function was added to enable anyone to see the location of all known points within the defined area. It has been useful to determine for example, what Australian islands are not named in the gazetteer.
 13. **Points of Interest**. These are points that have generally come in from the MERIT system (see <https://fieldcapture.ala.org.au/>) as locations from the various NRM, Landcare etc projects. They may be sites of planting or regeneration or invasive weed control but the intent to enable a wide range of 'points of interest' to be added to the Atlas.
 14. A set of entries from <http://lists.ala.org.au> that are considered to be of wide interest and authoritative. These lists will grow and be refined but as at November 2015, they include
 - a. Invasive species (currently listed as pests or weeds) that are listed under Federal, State or Territory governments.

- b. Threatened species under all conservation status classes by the Federal, State or Territory governments.
 - c. Migratory species (EPBC listed)
 - d. Australian Iconic species. I guess species like the coat of arms and oddities such as the Tasmanian Devil etc. Very subjective.
15. A list of species in basic lifeform classes that can be **overlapping**. For example, “dicots” are “plants” and “mammals” are “animals”. As at September, these lifeforms include
- a. Algae
 - b. Amphibians
 - c. Angiosperms
 - d. Animals
 - e. Arthropods
 - f. Bacteria
 - g. Birds
 - h. Bryophytes
 - i. Chromista
 - j. Crustaceans
 - k. Dicots
 - l. Ferns and allies
 - m. Fish
 - n. Fungi
 - o. Gymnosperms
 - p. Insects
 - q. Mammals
 - r. Molluscs
 - s. Monocots
 - t. Plants
 - u. Protozoa
 - v. Reptiles

PDF Area Report

A new addition (September 2014) to the Spatial Portal is a comprehensive offline PDF area report. We have gathered together most of the above information, maps, links and references and written them to a file that can be saved and used as a fairly comprehensive report on any defined area. This option will be undergoing active development over the next year. *Feedback on items that could be included or improved in this report would therefore be appreciated.*

The header page (Figure 55) is designed to summarise the salient bio-related information in the area. As always, the 'area' in the Spatial Portal can be defined in any of 15 ways. The tables from the various lists in the report have a link to the online list of species. If you are registered with the Atlas and are logged in, your lists will be maintained for approximately a year.

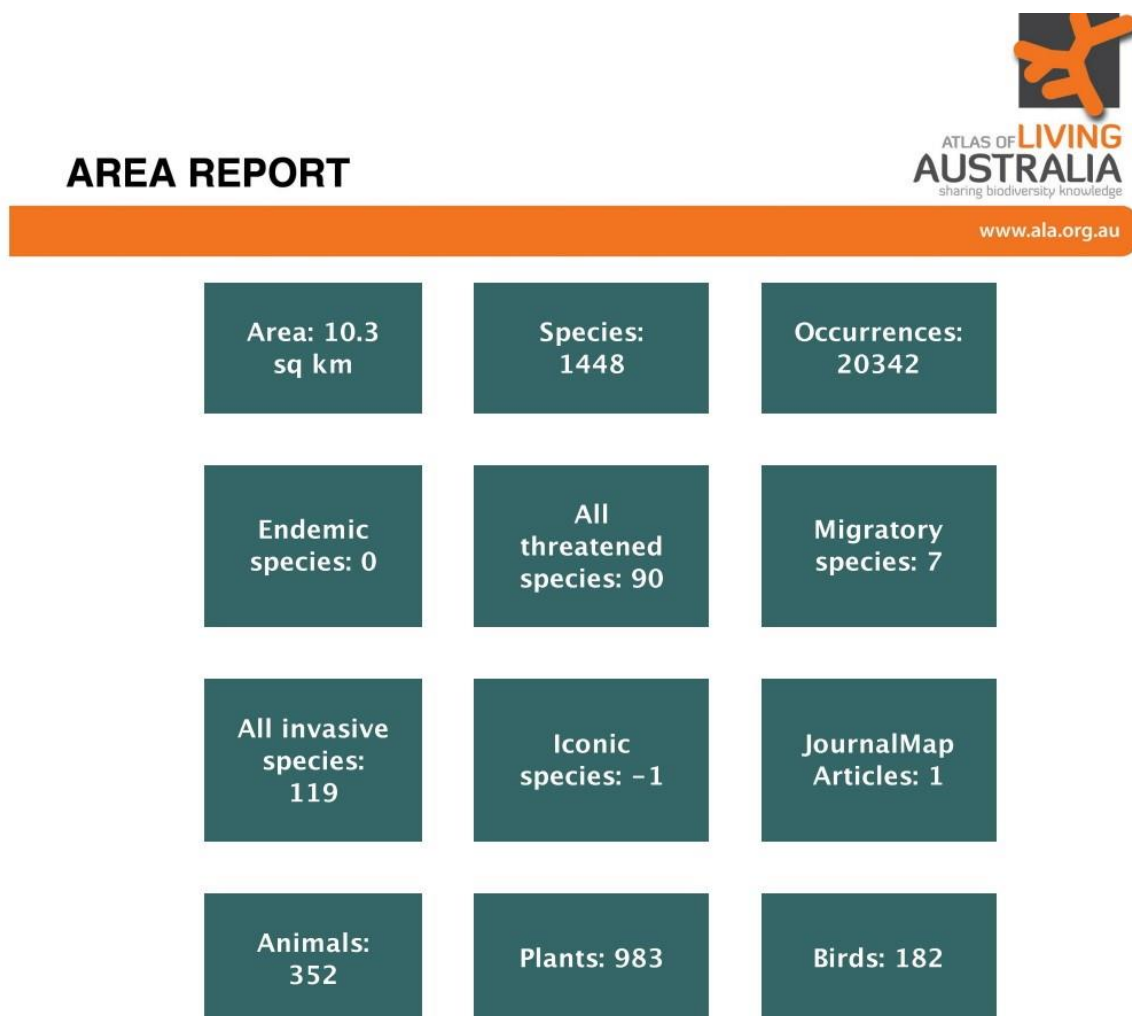


Figure 55. The summary page header of the PDF Area Report

The table of contents (Figure 56) provides an indication of the range of tables and maps-

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lifeform – Amphibians	51
lifeform – Angiosperms	52
lifeform – Animals	74
lifeform – Arthropods	83
lifeform – Bacteria	85
lifeform – Birds	86
lifeform – Bryophytes	92
lifeform – Chromista	93
lifeform – Crustaceans	94
lifeform – Dicots	95
lifeform – FernsAndAllies	110
lifeform – Fish	111
lifeform – Fungi	112
lifeform – Gymnosperms	113
lifeform – Insects	114
lifeform – Mammals	116
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Figure 56. Table of contents of the PDF Area Report as at September 2014.

Part of the report focuses on the classes of key layers in the area. An example is the dynamic land cover (Lyburner, 2010) – see Figure 57 which displays a description of the layer, a map of the area overlain with the layer, a legend and a table of the classes in the area with the area of each class and it's percentage of the total area. The layers summarised like this will grow with the availability of useful contextual layers. Recommendations always warmly received.

National Dynamic Land Cover

The Dynamic Land Cover Dataset is the first nationally consistent and thematically comprehensive land cover reference for Australia. It provides a baseline for reporting on change and trends in vegetation cover and extent. Information about land cover dynamics is essential to understanding and addressing a range of national challenges such as drought, salinity, water availability and ecosystem health. The data is a synopsis of land cover information for every 250m by 250m area of the country from April 2000 to April 2008. The classification scheme used to describe land cover categories in the Dataset conforms to the 2007 International Standards Organisation (ISO) land cover standard (19144-2). The Dataset shows Australian land covers clustered into 34 ISO classes. These reflect the structural character of vegetation, ranging from cultivated and managed land covers (crops and pastures) to natural land covers such as closed forest and open grasslands. [Ref1]

Australia's Dynamic Land Cover: <http://www.ga.gov.au/earth-observation/landcover.html>

National Dynamic Land Cover layer: Classification: Vegetation; Type: Contextual (polygonal); Metadata contact organisation: Geoscience Australia (GA). <http://spatial.ala.org.au/ws/layers/view/more/dlcmv1>



Figure 2: Map of National Dynamic Land Cover

Table 1: National Dynamic Land Cover

Class/Region	Area (sq km)	% of total area
Primarily Vegetated Natural & Semi-Natural Terrestrial Vegetation Woody Shrubs Sparse	1.32	9.55
Primarily Vegetated Natural & Semi-Natural Terrestrial Vegetation Woody Shrubs Sparse Chenopods	3.33	24.16
Primarily Vegetated Natural & Semi-Natural Terrestrial Vegetation Woody Shrubs Closed	0.23	1.69
Primarily Vegetated Natural & Semi-Natural Terrestrial Vegetation Herbaceous Graminoids Sparse Tussock Grasses	0.93	6.74
Primarily Vegetated Natural & Semi-Natural Terrestrial Vegetation Herbaceous Graminoids Sparse Hummock Grasses	7.82	56.74

Figure 57. Dynamic land cover of and surrounding the area with table of classes and associated areas in square kilometres.

The PDF report also contains a suite of maps and tables representing all species, a lifeform class or lists like conservation or invasive species lists. As noted above, Lists (<http://lists.ala.org.au>) are a very useful tool when dealing with any list of species. *Note that not all user-entered lists become available for all functionality in the Atlas.* Lists that are deemed widely useful are however tightly integrated into the Atlas and most of these are included in the PDF Area Report. Currently there is no formal process for raising the status of a list, but there should be. I have developed some criteria and live in hope.

1. The List can't easily be created in the ALA system.
2. The list should contain at least 95% name matches against NSL. Having lists that have significant (>5%) unknowns devalues the list. This relates to (3)
3. The List owner should accept formal responsibility to maintain the list, with help from recruited editors as needed.
4. The list should not be trivial by containing only a few species? Unsure where you would draw the line here but I think there is one.

- The list should have practical appeal to a community of interest. Some lists are very insular/one-off while others (e.g., IUCN Redlist) are universally accepted and significant.

What follows (Figure 58) is one example of such a page from one of the lists-

lifeform - Reptiles

Number of lifeform - reptiles: 11

Spatially valid records are considered those that do not have any type of flag questioning their location, for example a terrestrial species being recorded in the ocean. [Ref6]

Number of lifeform - reptiles (spatially valid only): 11

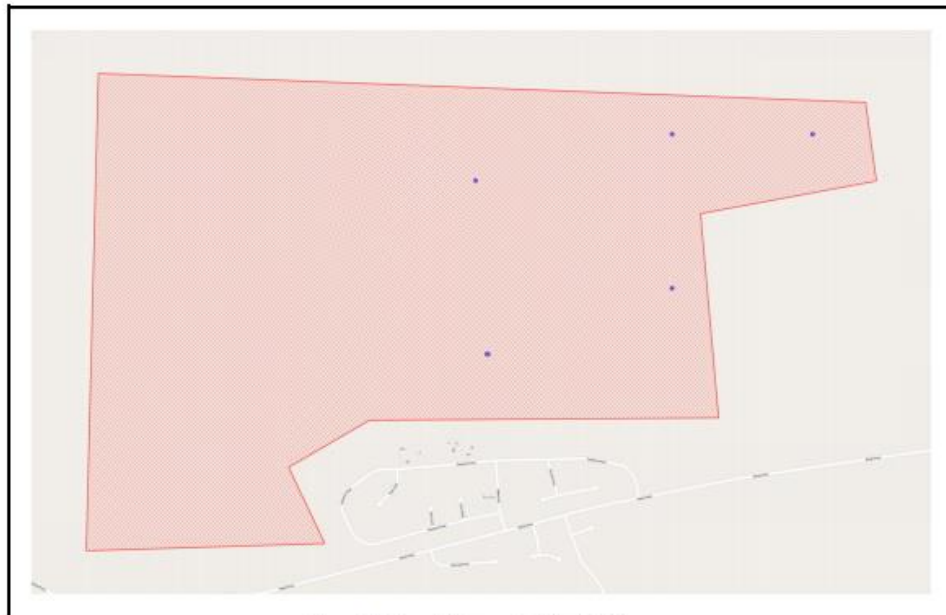


Figure 27: Map of lifeform - Reptiles in My Area

Table 25: lifeform - Reptiles([Link to full list](#))

Family	Scientific Name	Common Name	No. Occurrences
GEKKONIDAE	Gehyra variegata	Tree Diella	5
GEKKONIDAE	Heteronotia binoei	Bynoe's Gecko	4
SCINCIDAE	Ctenotus saxatilis	Rock Ctenotus	2
GEKKONIDAE	Gehyra australis	Northern Diella	2
SCINCIDAE	Cyclodomorphus melanops	Spirifex Slender Blue-tongue	1
SCINCIDAE	Cryptoblepharus plagiocephalus	Peron's Snake-eyed Skink	1
SCINCIDAE	Lerista frostii	Centralian Slider	1
AGAMIDAE	Ctenophorus nuchalis	Central Netted Dragon	1
PYGOPODIDAE	Lialis burtonis	Burton's Snake-lizard	1
CARPHOACTYLIDAE	Nephurus amyae	Centralian Knob-tailed Gecko	1

Figure 58. A map of the reptiles in an area with a table of those species and the number of occurrences in the area.

The list of species (not to be confused with species Lists) is order by decreasing number of occurrences in the area. The table will usually contain

- Family
- Scientific name
- Common name
- Number of occurrences

Nearest locality

The Nearest locality tool identifies the five closest point gazetteer features to a point clicked on the map according to Geoscience Australia [Gazetteer of Australia](#) 2012¹. The listing provides the location in decimal degrees, the distance in kilometres and the direction from the point clicked on the map. Markers are placed on the map along with the associated gazetteer identification.

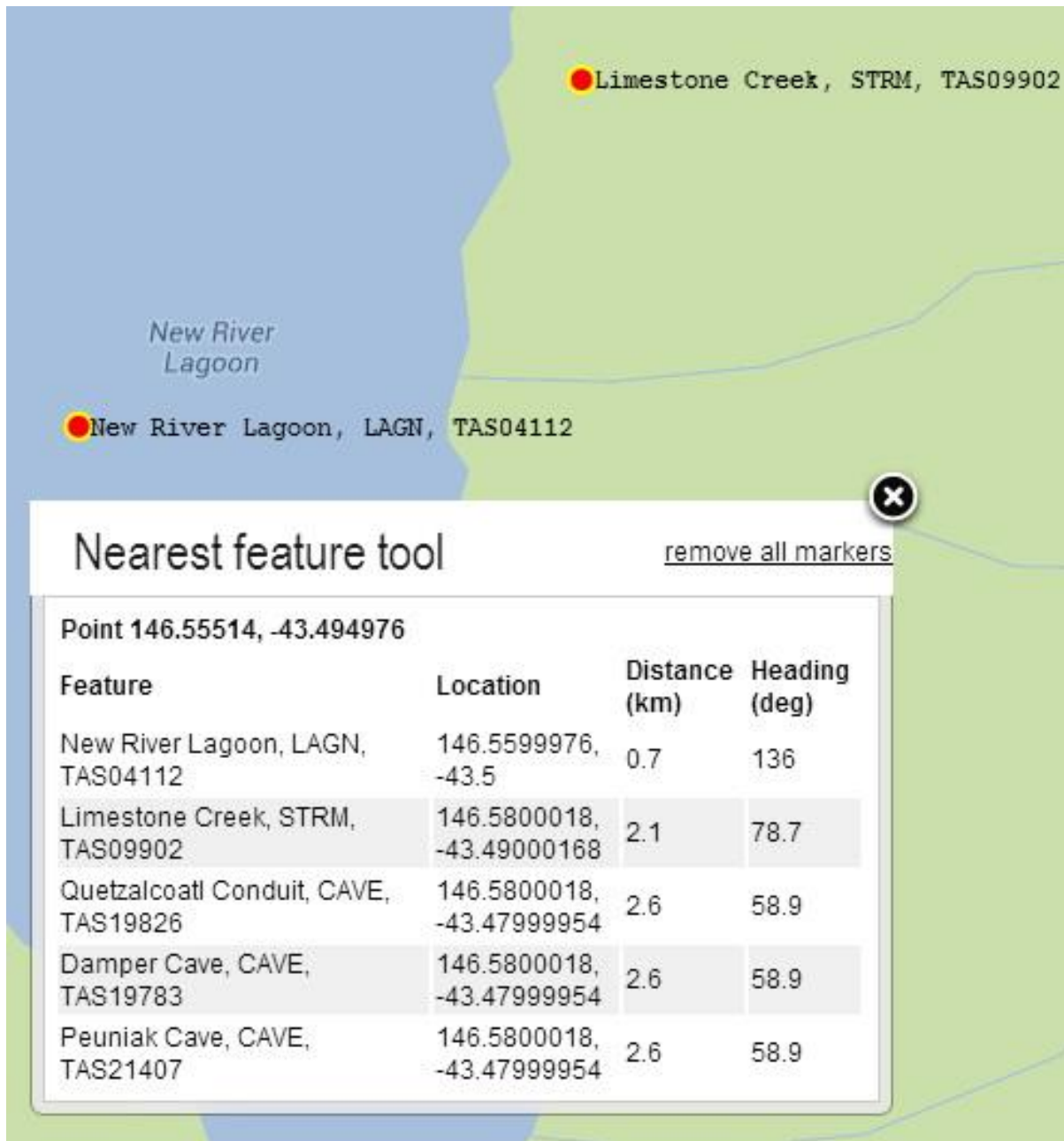


Figure 59. Nearest locality function. Click on the map and the five closest gazetteer (2010) features are mapped and displayed in a table

¹ Errors due to coordinate truncation in the [Gazetteer of Australian 2010](#) have been noted and reported to [Geoscience Australia](#).

Scatterplot

The Scatterplots are a simple yet highly effective tool for exploratory data analysis of geographic and environmental spaces simultaneously. Scatterplots show how a species or even a Species List are related to the environment. How informative the 'graph' is will depend on how related the species or list of species is to the selected two environmental variables (layers).

Scatterplots create a graph of occurrence record points plotted against *any two environmental variables (layers in the Spatial Portal)*. The points can be supplied by you, or selected from Atlas records. For example you could plot occurrences of a Striped Marsh Frog from the Atlas on a graph with one axis representing mean annual temperature, and the other axis representing mean annual rainfall. You can also import your own points and then map them against the environmental layers.

The Scatterplot displays an *environmental space* while the Spatial Portal's map represents *geographic space*. The scatterplot is *linked to the map*, therefore linking environmental and geographic spaces; a species point occurrence on the map has a corresponding point on the scatterplot.

Dragging out a rectangle on the scatterplot will result in the points within the rectangle being highlighted on the map.

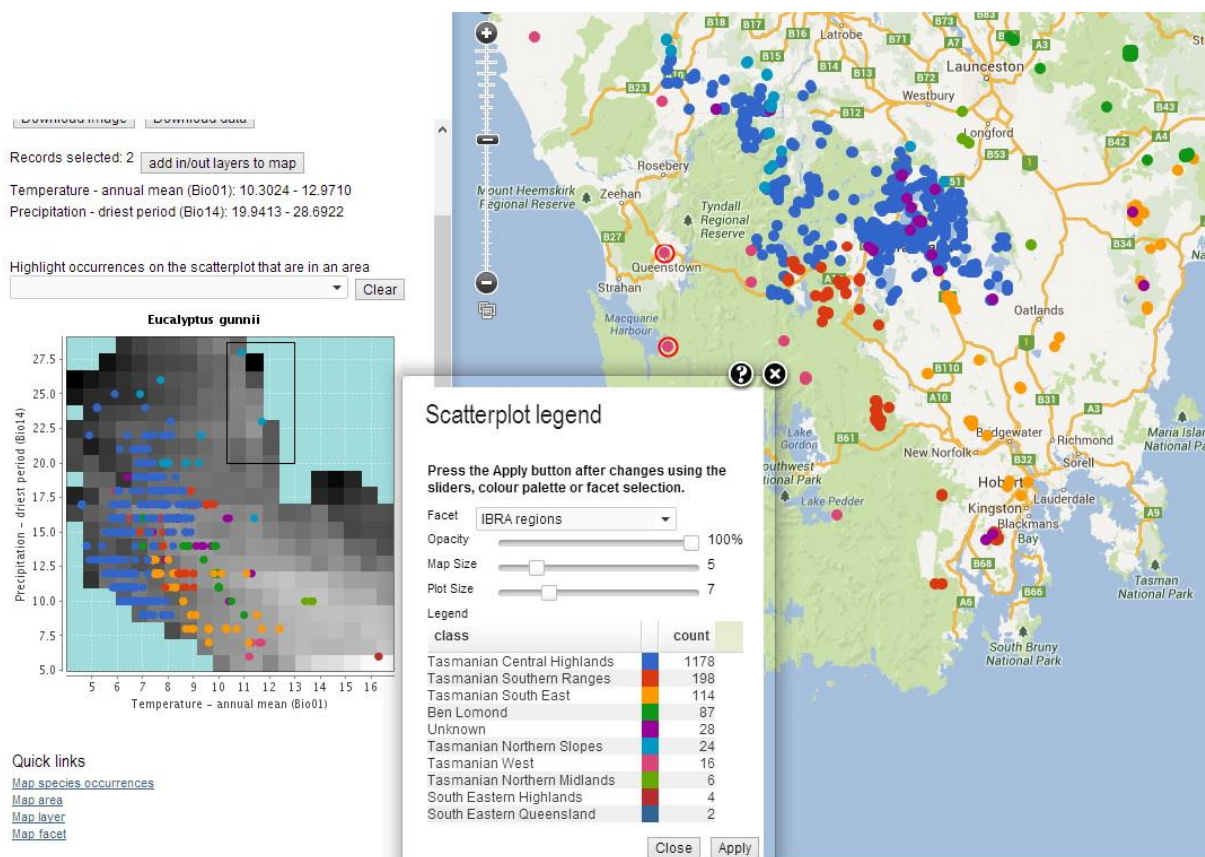


Figure 60. Scatterplot of *Eucalyptus gunnii* against mean annual temperature (x-axis) and annual precipitation (y-axis) showing highlighted occurrence points on the map from the defined area on the scatterplot (black rectangle)

Alternatively, you can define a geographic area on your map which will highlight points on the scatterplot that occur in that geographic area. This is a great way of identifying the environment associated with the area. See "Highlight occurrences on the scatterplot that are in an area" on Figure 61 below.

Optionally, a background species can also be displayed on the scatterplot if you want a direct comparison of two species. The background species is displayed as grey circles as a reference only.

Optionally, the scatterplot can also delineate the combinations of environments that occur within a defined area. Not all combinations of environments can exist within an area. In the Figure 60 above for example, there are no areas on the map where the annual mean temperature is 15 degrees, and the precipitation in the driest period is 25 mm. The tool uses a grey-scale on the scatterplot to try and indicate what the area of each environmental combination is. The lighter the area on the scatterplot, the larger is the corresponding geographic extent of this environmental combination.

Eucalyptus gunnii

Species display settings

Download image

Download data

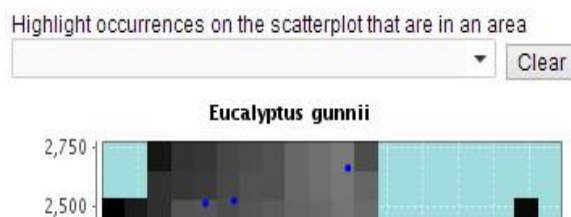


Figure 61. Options for the scatterplot tool

The scatterplot is treated as a point layer in the Spatial Portal, so another powerful feature of the Scatterplot tool is the ability to colour the points on both the map and the scatterplot by displaying classes of a facet. To access this feature, click on the Species display settings button. In Figure 60 above, the points have been coloured based on the bioregion they occur in.

Figure 61 also shows that you can also download the image and the data used in the scatterplot. The data download is equivalent to using the Export | Sample option in that the values of the two environmental variables are appended to the point data.

Note: A case study describing the use of the Scatterplot tool can be found at <http://www.ala.org.au/faq/spatial-portal/scatterplot-case-study/>.

Scatterplot List

The Scatterplot List tool allows for the plotting of a taxon, taxon group or Species list across **pairs of selected environmental layers**, including any environmental-type layers from prior analyses. Unlike the Scatterplot tool above, the output is not interactive: you get multiple graphs per page of output, each displaying an environmental combination, in a fixed format. You can optionally add a background species as with the standard Scatterplot tool.

Figure 62 displays an example of using the Scatterplot List tool for the Cider Gum, *Eucalyptus gunnii* in Tasmania, using a Peppermint, *Eucalyptus nitida* as a background. The foreground species (*Eucalyptus gunnii* in the figure below) is displayed as blue dots with the background species (*Eucalyptus nitida* in the figure below) displayed as larger grey dots.

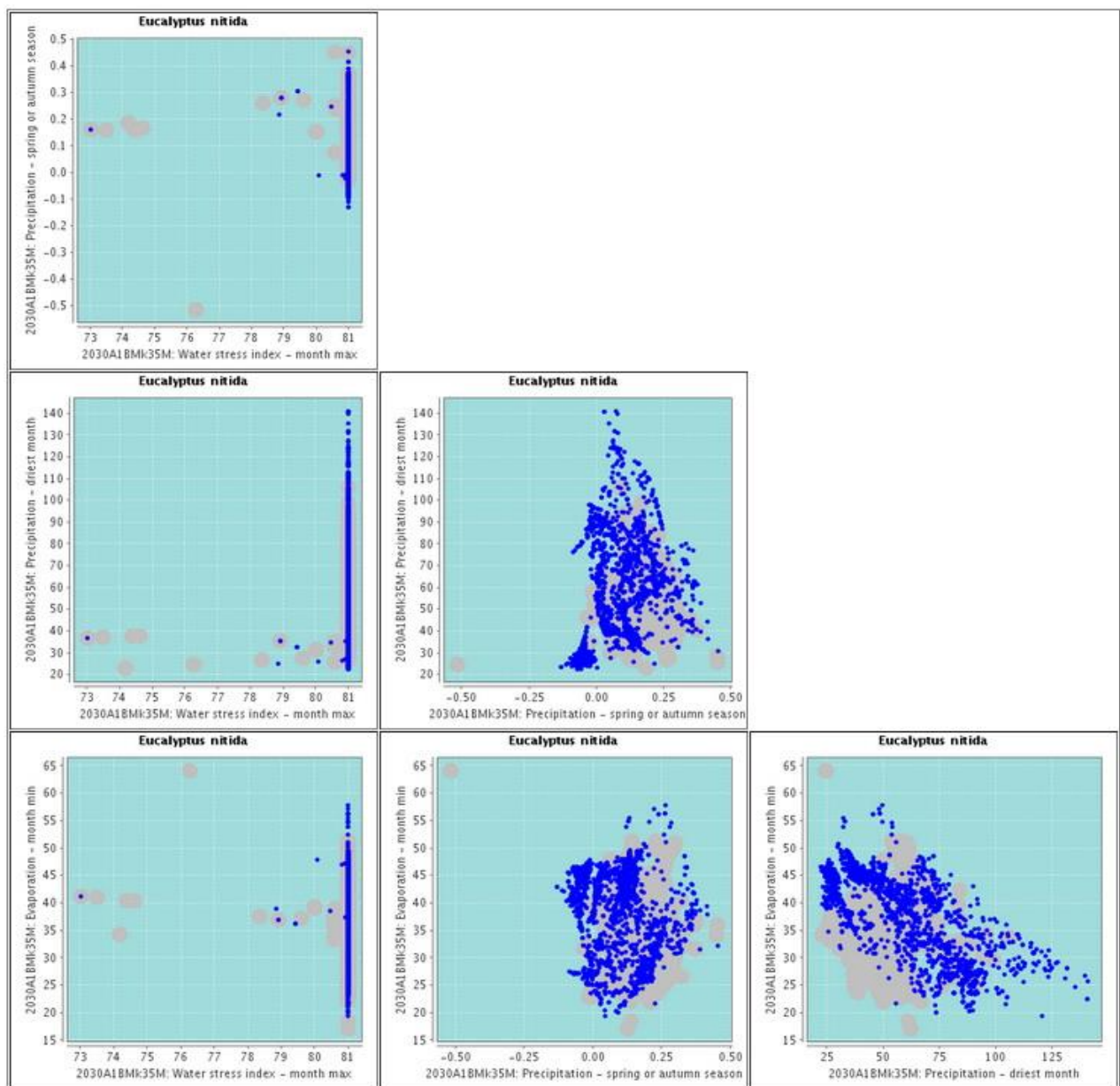


Figure 62. Scatterplots of *Eucalyptus nitida* (blue dots) with *Eucalyptus gunnii* (grey dots) mapped against 4 climatic layers

The environmental layers used in this example were 4 of the 5 layers in the 2030 suite-

1. Precipitation spring or autumn
2. Precipitation of the driest month
3. Evaporation – monthly minimum and
4. Water stress index

As can be seen in Figure 62 above, most of the occurrences of *E.nitida* and *E.gunnii* occur at a value of 81 on water stress index but interestingly a few records do occur at lower water stress values. There also appear to be clusters of points of *E.nitida*. Is this due to this environment not being sampled or the fact that *E.nitida* does not grow in those environments. These few observations provide an indication of the power of scatterplots in understanding the species – environment relationships.

The Scatterplot List tool also produces a zip file that contains images of each scatterplot, a readme file and html to re-create the Scatterplot List page layout.

Point Comparisons

This option is presented as a quick way of comparing the environments of a few points. The alternative is to use Export | Point sample where environmental data is appended to an existing set of points, which are usually species occurrences, but can also be any set of points that have been imported. Point comparisons simply use mouse clicks on the map of a few points and the result is a display of those points (forming columns in the legend area) across all layers (rows in the legend area).

First, zoom and pan to the area of interest and then click on Add point. You can then edit the point or remove it from the list. Once you have defined your points, then simply click on Compare and the list of layer values will be displayed for each point. Given the limited area of the legend, only 9 or so points can be displayed. Once displayed however, the CSV file can be downloaded for analysis.

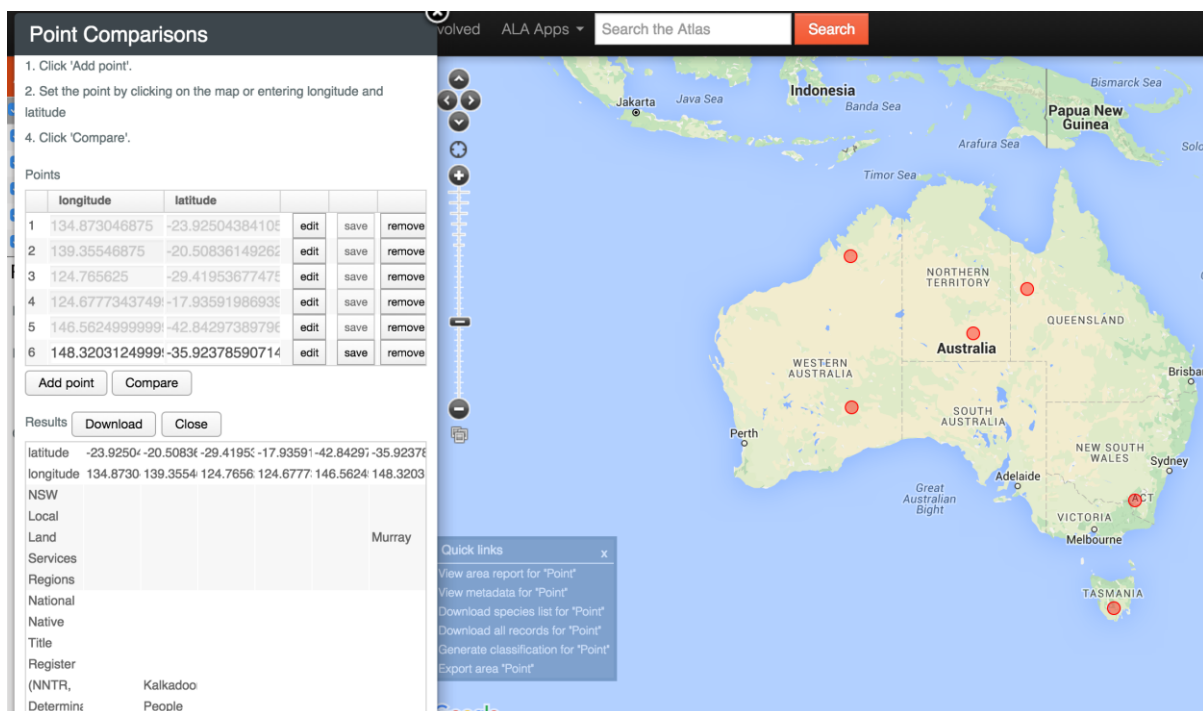


Figure 63. Comparing environmental values at points

A portion of the downloaded CSV file has been sorted for the difference between the first two sites just to demonstrate the type of analysis that can be done.

	A	B	C	D
1	Layer	-23.925043841058 134.873046875	-20.508361492624 139.35546875	Diff%
92	2030A1BMk35M: Precipitation - min dif	-0.5098173	-2.0053926	293%
93	Temperature - mean annual absolute m	-1.8333334	2.5731514	171%
94	Precipitation - min difference between	-0.7623656	-1.729164	127%
95	Bouguer gravity anomalies	-676.08	117.6129	117%
96	Population - change	32.4	-2.3	107%
97	Fire frequency		1	100%

Figure 64. First rows of the downloaded point comparison file for two points

Calculate Area of Occupancy (AOO) and Extent of Occurrence (EOO)

Area of Occupancy (AOO) and Extent of Occurrence (EOO) are two 'statistics' used by the IUCN for their Red List of Threatened Species (<http://www.iucnredlist.org/>). Their Red List of Categories and Criteria (IUCN 2012) defines these terms as follows-

“Area of occupancy [AOO] is defined as the area within its ‘extent of occurrence’ which is occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats. In some cases (e.g. irreplaceable colonial nesting sites, crucial feeding sites for migratory taxa) the area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon. The size of the area of occupancy will be a function of the scale at which it is measured...” See Figure 65 IUCN 2012 below.

NOTE: In the case of the Spatial Portal, the grid size used to calculate **AOO is 0.02 degrees or approximately 2km. This was the IUCN recommendation.** This grid is placed over all selected taxon records within the user-defined area.

Extent of occurrence [EOO] is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy (see below Figure 65 IUCN 2012). This measure may exclude discontinuities or disjunctions within the overall distributions of taxa (e.g. large areas of obviously unsuitable habitat). Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence).

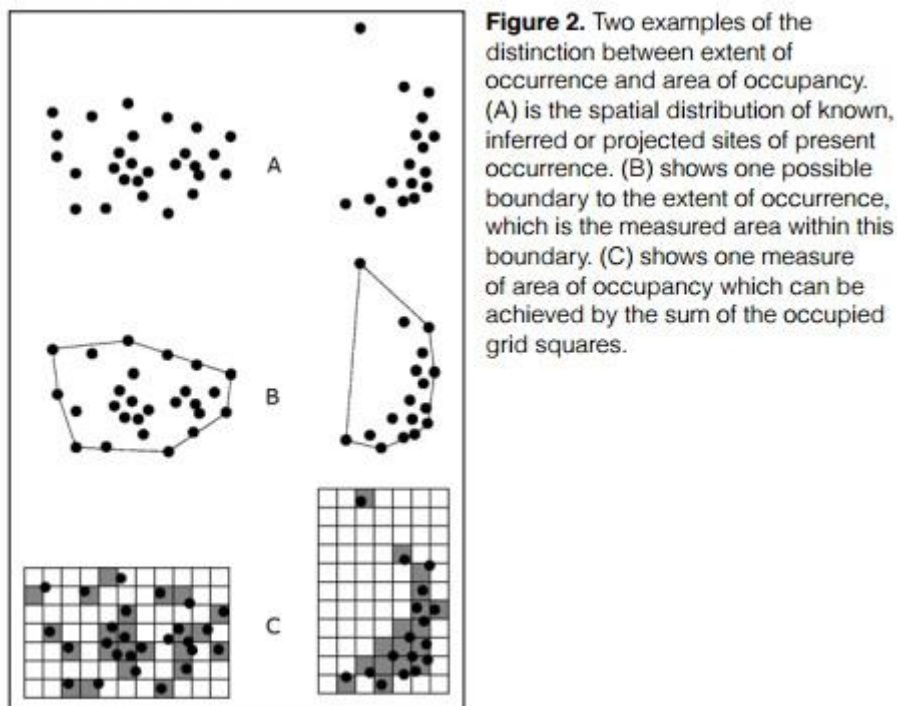


Figure 2. Two examples of the distinction between extent of occurrence and area of occupancy. (A) is the spatial distribution of known, inferred or projected sites of present occurrence. (B) shows one possible boundary to the extent of occurrence, which is the measured area within this boundary. (C) shows one measure of area of occupancy which can be achieved by the sum of the occupied grid squares.

Figure 65 From Figure 2 from IUCN (2012). IUCN Red List Categories and Criteria: Version 3.1. Second edition. Gland, Switzerland and Cambridge, UK: IUCN. iv + 32pp. http://jr.iucnredlist.org/documents/redlist_cats_crit_en.pdf 2 IUCN 2012

NOTE: In the Spatial Portal, EOO is calculated as the minimum convex hull based on the taxon occurrence records within the user-defined area.

AOO and EOO would normally be calculated on taxa that have some ‘conservation’ status. Note that the ALA uses the term “Threatened” for any level or class of conservation status via the States, Territories, Federal Government or IUCN. In the ALA, any species that is deemed ‘sensitive’ in having some State/Territory or Federal conservation status will be processed through the Sensitive Data Service (SDS: <http://www.ala.org.au/faq/data-sensitivity/>). The Sensitive Data Service may have changed the location of taxa that have a sensitive status. It is therefore wise to

1. Map the taxa,
2. Download the records and examine each one for any data sensitivity, record fields and particularly, any [assertions](#)
3. Filter these records in the Spatial Portal (see how to use [faceting and filtering](#)) to create the desired subset
4. Run the tool on the new filtered taxa layer

The tool requests the area to be used with the usual options, and the taxa. Reported are

- Number of records used for the calculations
- Area of Occupancy (AOO: 0.02 degree grid): Value (sq.km)
- Extent of Occurrence (EOO: Minimum convex hull): Value (sq.km)

Two layers are also generated: The taxa occurrences and the EOO area (minimum convex hull). The statistics are downloaded automatically to your system.

NOTE: We hope that ‘full spatial resolution’ records will be able to be made available for this analysis in the near future, but mapping high-resolution data would be disabled, except for authorised users.

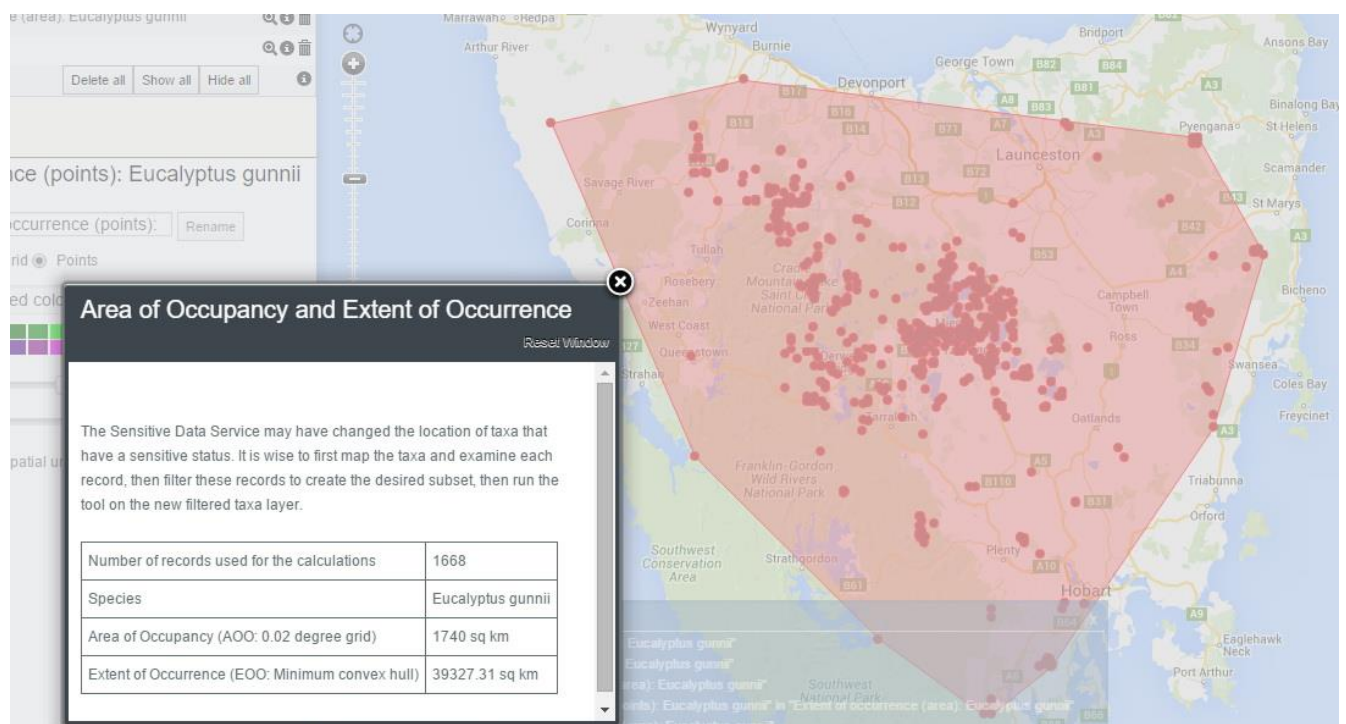


Figure 66. AOO and EOO

Tabulate

The Tabulate tool is the contextual layer counterpart to the [Scatterplot Tool](#) which uses environmental layers (e.g., temperature, rainfall) for the X and Y axes and where the points on the graph are occurrences. The Tabulate tool uses contextual layers such as land use, or States and Territories to form a table of rows and columns (similar to X and Y axes).

Like the power of scatterplots to display species - environment relationships, tables are a very powerful way of examining what permutations and combinations exist and how species are distributed across classes of contextual layers. With 81 contextual layers in the Spatial Portal, there are $81 \times (80/2) \times 12$ or 38,880 possible tables! A lot. However, not all contextual layers have spatial overlap so there are less than 38,000. The data in the cells of each table can be selected from one of the following three values:

- a) Area of intersection (km²)
- b) Number of species of taxa/assemblage
- c) Number of occurrences of selected taxa

The figure below shows Australian State and Territories (columns) versus land-use classes (rows) where the numbers in each cell are the number of species. For example, the table shows that there are 1175 species in land use class “Mining and waste” in Western Australia and 411 species in land use “rural residential” in the ACT. The table can be exported as a CSV file for external analyses.

Number of species	South Australia	Australian Capital Territory	New South Wales	Queensland	Western Australia	Northern Territory	Victoria	Tasmania	Total species (non unique)
Managed resource protected areas	4689		4894	6262	12018	9963	2062	5285	45173
Rural residential	3765	411	9503	6496	2116	1785	4783	2539	31398
Intensive animal and plant production	419		1750	4503	1731	243	723		9369
Plantations	3282	2186	6336	6247	4684	787	4679	2918	31119
Mining and waste	2665	90	3267	1943	1175	1918	1535	878	13471
Grazing of native pastures	6319		6134	25221	18770	8603	6255	3156	74458
Cropping	6538		7006	6883	14887	1262	4691	19	41286
Modified pastures	8527	2004	19697	469	5033	1792	12600	7824	57946
Horticulture	385		2675	919	642	6	199		4826
Forestry	1	121	12586	8991	556	140	9330	5921	37646

Figure 67. Tabulation of Australian States and Territories ('X-axis') against land use classes ('Y-axes') with the values as the number of species

Points to Grid

The Points to Grid tool takes a set of point occurrence records over a user-defined area and produces three products-

1. A sites by species matrix where the sites are grid cells and the species are all those within that grid cells. This function tallies the number of each species that occurs in each grid cell in the area. The sites by species matrix is the most common data structure for ecological data analysis. For example, comparing areas based on community composition using software such as PATN (<http://www.patn.com.au>) or the R software (<http://www.r-project.org/>). The presence (1)/absence (0) version of this matrix can be referred to as a Presence Absence Matrix or PAM. A small part of the sites by species matrix can be seen below. The first rows are
 - a. LSID (Life Science identifier)
 - b. Common name
 - c. Kingdom name
 - d. Family name
 - e. Species name

Each row represents one grid cell. The size of each cell is nominated by the user. The first column of each row contains the longitude-latitude pair as a row identifier. The second and third columns are the longitude and latitude in decimal degrees. The following column values are the number of that species (column) in that grid cell.

	B	C	D	E	F	G	H	I	J	K	
1	LSID	Longitude	Latitude	urn:lsid:biodiv	urn:lsid:b	urn:lsid:b	urn:lsid:b	urn:lsid:b	urn:lsid:b	urn:lsid:b	
2	Common	Longitude	Latitude	Silver Peppern	Cabbage g	Tasmaniai	Alpine cid	Peppermi	Manna gu	Black Pep	Blue leaf
3	Kingdom	Longitude	Latitude	Plantae	Plantae	Plantae	Plantae	Plantae	Plantae	Plantae	
4	Family	Longitude	Latitude	Myrtaceae	Myrtaceae	Myrtaceae	Myrtaceae	Myrtaceae	Myrtaceae	Myrtaceae	
5	Species	Longitude	Latitude	Eucalyptus ten	Eucalyptu	Eucalyptu	Eucalyptu	Eucalyptu	Eucalyptu	Eucalyptu	
6	146.81637	146.8164	-43.6613	0	0	0	0	1	0	0	
7	146.61637	146.6164	-43.6113	0	0	0	0	6	0	0	
8	146.66637	146.6664	-43.6113	0	0	0	0	6	0	0	
9	146.71637	146.7164	-43.6113	0	0	0	0	2	0	0	
10	146.76637	146.7664	-43.6113	0	0	0	0	6	0	0	
11	146.81637	146.8164	-43.6113	0	0	0	0	5	0	1	
12	146.86637	146.8664	-43.6113	0	0	0	0	1	0	0	

Figure 68. A small part of a typical sites (grid cells) by species matrix

3. An occurrence density map. A moving average is used to determine an average of the **number of occurrences** over the extent of the moving average. The result is placed in the centre grid cell.

4. A species richness map (see screenshot below). This map is calculated on the same basis as the occurrence density but the value is the average count of the **number of different species**.

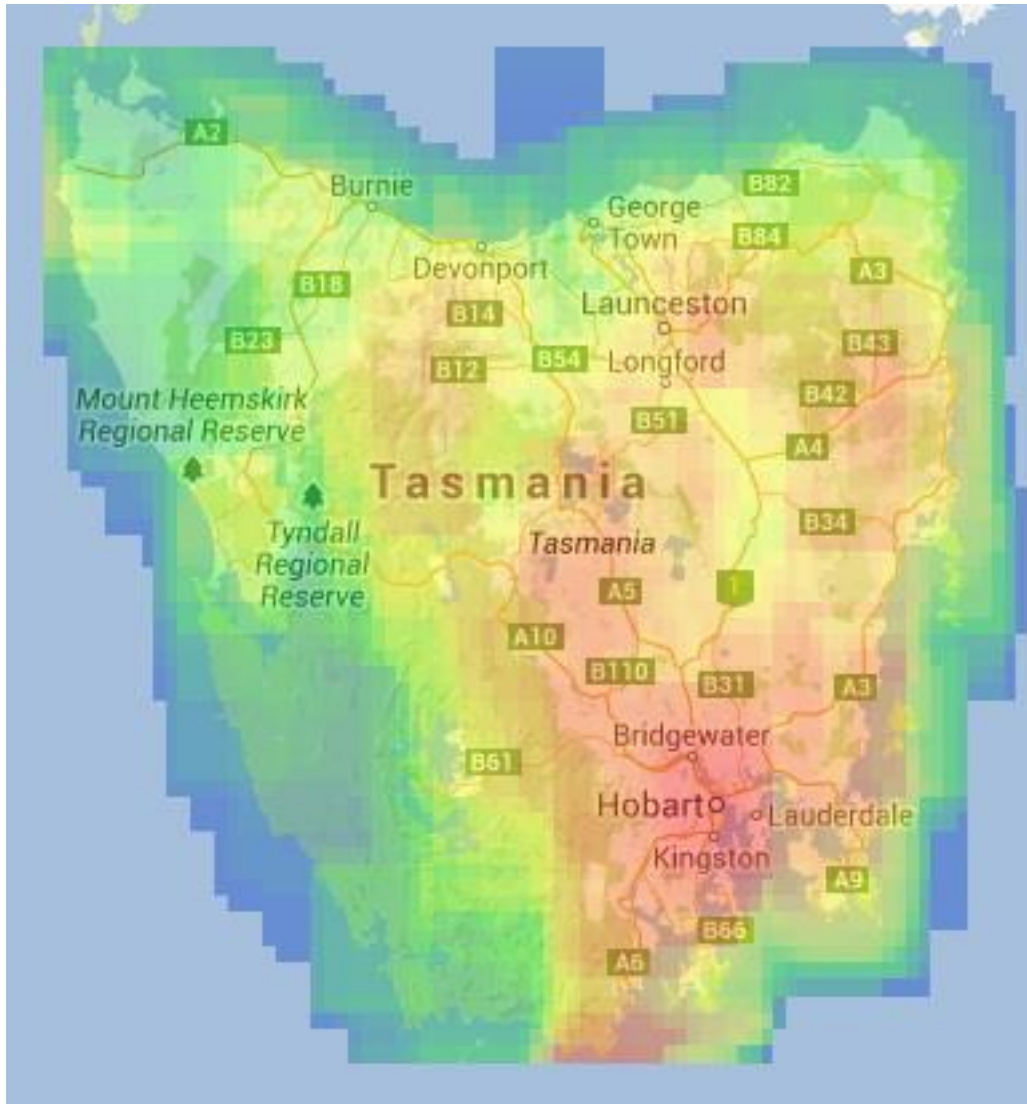


Figure 69. Species richness based on a moving average across the defined area

Generate Points

This is a new option added to enable a regular grid of points within any defined area to be generated. Why would you want such an option? The idea came about from a user of the SP who asked if there was any way that an estimate of species richness in an area. One idea was to be able to generate points on a regular grid that could then be used to sample the species richness layer. Behind the scenes, a number of layers in the SP are updated on a weekly basis due to new species observations being added to the Atlas. For of those layers are

1. Species richness
2. Occurrence density
3. Endemicity – terrestrial
4. Endemicity – terrestrial and marine

The steps for generating a set of points on a regular grid in an area are simply

1. Define the area
2. State the grid spacing of the points (in decimal degrees)

Figure 66 shows the map of an area, in this example, the Ilparpa Swamp Willife reserve with a 0.01 degree grid sample generated. Note that a new layer is created and these points can then be used to sample any of the SP layers and the data exported in CSV format.

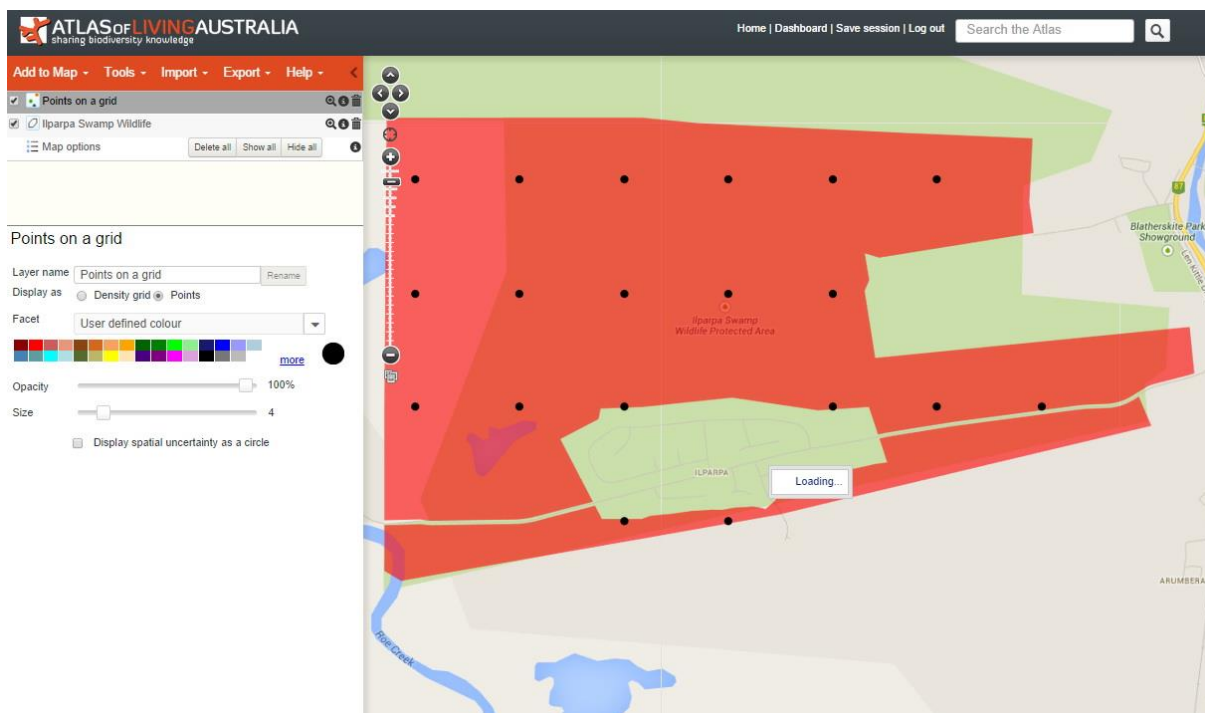


Figure 54. Example of a 0.01 degree grid over the area defined by the Ilparpa Wildlife Reserve adjacent to Alice Springs.

Phylogenetic Diversity

Phylogenetic Diversity is a measure of the extent of difference within of a suite of species based on their morphological characters and evolutionary time. Phylogenetic Diversity is a complementary measure to species richness/diversity. If you want to create a reserve, what is the basis for its location and size? Phylogenetic diversity was aimed at conserving the most phylogenetic diverse set of species (see Faith, 1992, Miller 2011). As one would expect, there are various ways of measuring phylogenetic diversity (see Velland *et al.*, 2010).

The implementation of Phylogenetic Diversity in the Spatial Portal is basic, but there is a link from the output to <http://phylolink.ala.org.au/> to allow more extensive analyses. The tool requests as input

- One or more areas which can be pre-defined or on-the-fly in all the ways noted in Add to Map | Area with one exception unique here – you can define multiple areas as defined by one contextual layer. For example, you could use CAPAD 2012 terrestrial to compare the phylogenetic diversity of all *classes* of parks and reserves. If the areas are large and/or the polygons are many, processing take time, so please be patient. Phylogenetic diversity will be calculated for each area or class.
- A phylogenetic tree. A number are provided but you could load your own via Phylolink
- A selection of species. You can nominate any subset of those in the tree, or simply use all the species in the tree that occur within the area (=i.e. “all species”).

Phylogenetic Diversity Results Preview									
Area Name	Area (sq km)	PD	PD / Tree PD	Species	Species / Tree Species	Tree Name	Tree ID	DOI	Study Name
My Area 1	17,504.38	0.928	0.1002	26	0.0510	Acacia – Miller et al 2012	92	http://onlinelibrary.wiley.com/doi/10.1111/j.1365-3113.2011.04642.x/full	Miller, J. T., Murphy, B. J., & Orozco, C. E. (2011). Invasive Australian Acacia species: A phylogenetic approach to conservation. <i>Journal of Applied Ecology</i> , 48, 860. doi: 10.1111/j.1365-3113.2011.04642.x/full
My Area	27,911.24	0.8904	0.0962	22	0.0431	Acacia – Miller et al 2012	92	http://onlinelibrary.wiley.com/doi/10.1111/j.1365-3113.2011.04642.x/full	Miller, J. T., Murphy, B. J., & Orozco, C. E. (2011). Invasive Australian Acacia species: A phylogenetic approach to conservation. <i>Journal of Applied Ecology</i> , 48, 860. doi: 10.1111/j.1365-3113.2011.04642.x/full

Figure 70. Phylogenetic diversity summary

The output from phylogenetic diversity includes for each area or class-

- Area (sq.km.)
- Phylogenetic diversity value. In Figure 70 above, you can see that the value was higher for “My Area” (0.928) than “My Area 2” (0.8904).
- Phylogenetic diversity proportion of all species in the tree
- Proportion of species in the subset of the total tree
- Name/origin of tree
- Tree ID (ALA identifier for the tree)
- References
- Any notes associated with the tree.
- A zip file that contains the values as in Figure 70 and a separate csv file that contains the species in each of the areas or classes.

If you click on the Tree_ID, you will be presented with a window with an interactive tree and links to Phylolink. In this window, you can basically view the tree and search for species (Figure 71). In Phylolink, you can examine the characters associated with the species, see <https://youtu.be/fN3Nn159Tw> for a video on how to use Phylolink.

The screenshot shows the 'Atlas Of Living Australia' website interface. At the top, there is a navigation bar with 'ALA Apps', 'ALA Info', a search bar containing 'Search the Atlas', and a 'Search' button. Below the navigation bar, the page title is 'Acacia – Miller et al 2012'. A search bar on the left contains 'dealbata'. The main content area displays a phylogenetic tree with 'Acacia dealbata' highlighted in yellow. To the right of the tree is a 'Tree metadata' table with the following information:

Tree metadata	
Title:	Acacia – Miller et al 2012
Reference:	Miller, J. T., Murphy, D. J., Brown, G. K., Richardson, D. M. and González-Orozco, C. E. (2011), The evolution and phylogenetic placement of invasive Australian Acacia species. <i>Diversity and Distributions</i> , 17: 848–860. doi: 10.1111/j.1472-4642.2011.00780.x
Year:	2011
Doi:	http://onlinelibrary.wiley.com/doi/10.1111/j.1472-4642.2011.00780.x/full

Below the metadata table is an 'Actions' section with two options: 'Download tree:' with a 'Download' button, and 'Link tree with data:' with a 'Visualise with Phylolink' button.

Figure 71. Tree browsing window – The Acacias

In theory, all of the trees that are available are used to calculate a **phylogenetic diversity layer** for each 0.5 degree (~50km) grid cell across an Australian extent. For example, Figure 72 shows the values of phylogenetic diversity for the Acacias in Australia.

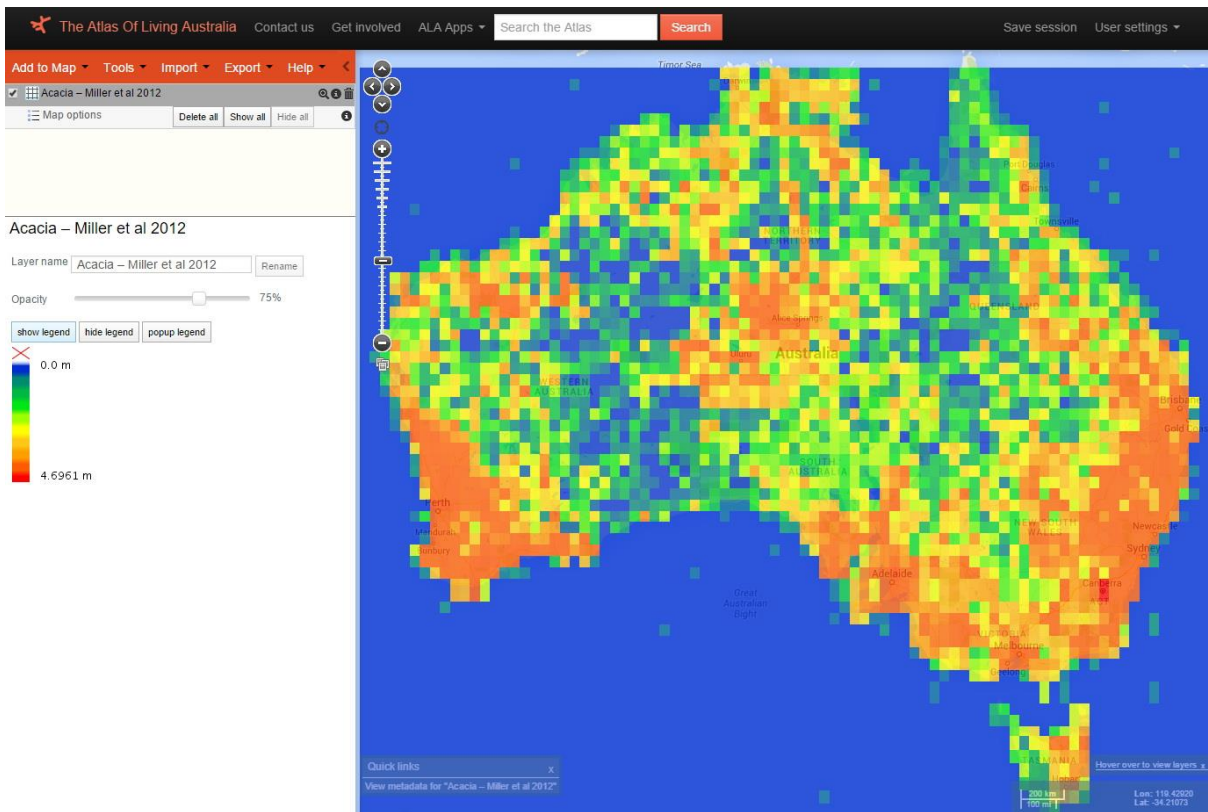


Figure 72. Phylogenetic Diversity values for the Acacias for grid cells of size 0.5 degree

Classify

The Classify tool uses ALOC (short for Allocation) from the PATN package (<http://www.patn.com.au>) to rapidly and efficiently combine multiple layers of environmental data (e.g. mean annual temperature, slope, and precipitation) into a single new layer that captures most of the information from all layers, see Belbin (1987). The classification layer captures the essence of all chosen layers into groups called *environmental domains*, after the work done by Henry Nix (1986).

The intent of the Classify tool is to provide a useful insight into the environments of an area, from global to local scale. No single environmental layer is capable of capturing how flora and fauna perceive the environment, but as research has indicated (Williams, *et al.* 2012), a combination of meaningful layers should.

The options for the Classify tool include the area of interest, the suite of environmental layers and the number of groups (environmental domains) desired. Classify can only use environmental layers, not contextual layers.

The algorithm is simple and effective. A set of tentative groups of grid cells are created and then the 'environmental distance' between each grid cell and each group is examined, and the cell is allocated to its closest group. Iteration across all grid cells continues until the classification stabilizes.

As with most other tools in the SP, a zip file is created. For Classify, the file contains a range of statistical parameters of the classification. The zip file contains-

1. A summary of the environmental layers and parameters used
2. A model reference number that can be used to restore it at some time in the next 3 months (see Restore prior analysis)
3. The geographic extent of the area classified
4. The number of groups produced
5. A history of each iteration of the classification
6. A png image of the mapped classification
7. The output grid file and associated legend
8. A matrix of the correlation between all environmental layers in the Spatial Portal (at full geographic extent)

The colours of the groups and domains are not arbitrary, they are generated from an ordination of the group or domain means, where the axes of the ordination are interpreted as red, green and blue (see Belbin *et al.*, 1983).

Figure 73 displays a classification of the suite of five transformed GDM layers of the 2030 suite to create 19 environmental domains that best align with the distribution of all Eucalyptus species in Tasmania.

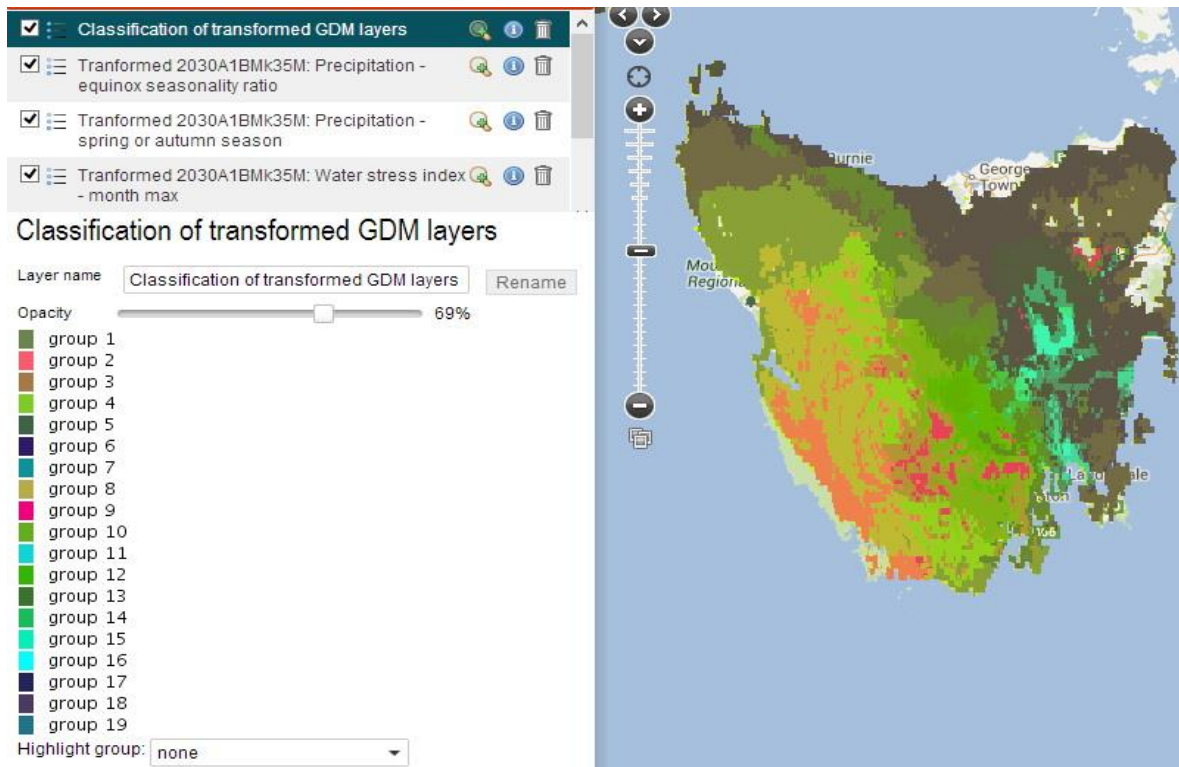


Figure 73. Classification of GDM-transformed 2030 suite layers based on Eucalyptus in Tasmania

A case study demonstrating the use of the Classify tool can be found at <http://www.ala.org.au/faq/spatial-portal/classification-case-study/>.

Predict

The Predict tool produces a prediction map of where a species or a list of species *could* occur – based upon environments in which it has been observed (by occurrence records in the Atlas or your imported point data). The method used in the Spatial Portal is called MaxEnt for Maximum Entropy, developed by Stephen Phillips at Bell Labs (Phillips *et al.*, 2006).

The version of MaxEnt available on the Spatial Portal uses a subset of options of the stand-alone MaxEnt package installed. The Spatial Portal does however have over 45 million species occurrence records, over 400 environmental layers and the flexibility to quickly develop hypotheses as to which might be the most effective drivers of the distribution of the species of interest.

Predict options include species or a species list; an area of interest; environmental and contextual layers; and two MaxEnt parameters: (1) Jackknife test option (with % of test samples to be used if selected) and (2) response curve generation.

Predict generates a zip file that contains-

1. A summary from MaxEnt of the input data and parameters
2. The response curves (optional)
3. Prediction statistics including coefficients and thresholds (optionally the jackknife statistics)
4. Species omissions, sample averages and predicted values
5. ASCII grid of the prediction map

The prediction below is of *Eucalyptus gunnii* in Tasmania using the suite of 'Best 5 Williams 2030' environmental layers.

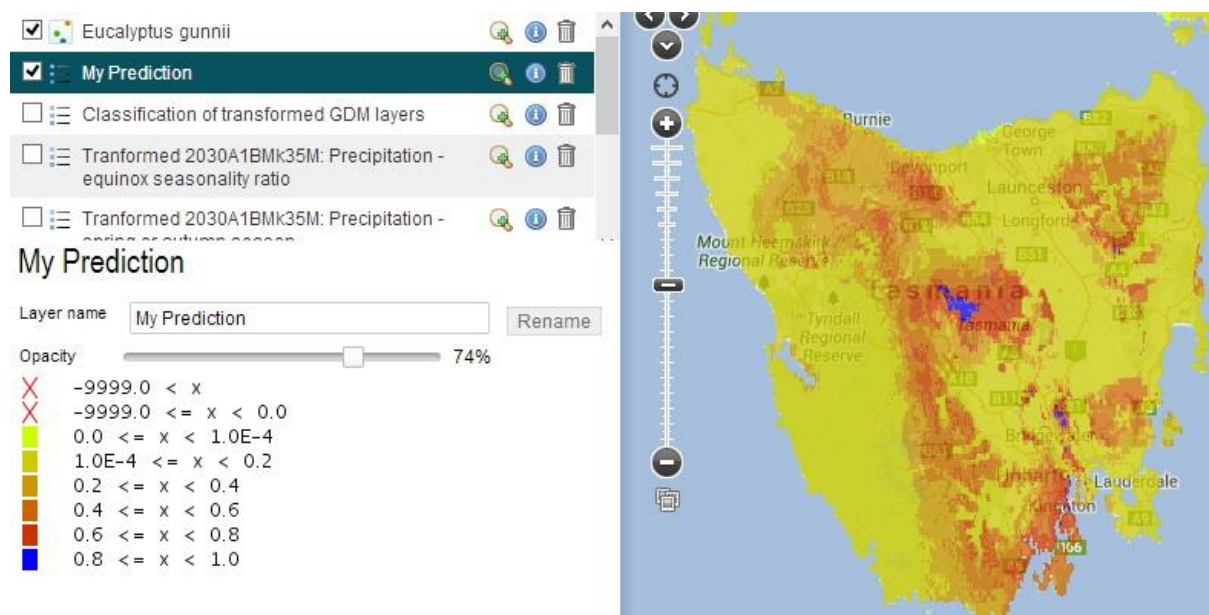


Figure 74. Prediction of *Eucalyptus gunnii* in Tasmania based on the 'Best 2030' environmental suite of layers

A case study in the use of the Predict tool can be found at <http://www.ala.org.au/faq/spatial-portal/prediction-case-study/>.

GDM

Generalized Dissimilarity Modelling (GDM) is one of the more complex analytical tools within the Spatial Portal. Inputs to this tool are usually a list of species (at a higher taxonomic level) and a suite of environmental layers. The primary output from GDM is the input environmental layers transformed to best-align with the compositional differences between grid cells based on the species occurrence records (see Ferrier *et al.*, 2007).

The transformed layers are usually classified into a single new layer that represents the composite environments that best align with the distribution of the species used. Figure 75 shows the result of a classification of the 5 GDM-transformed 2030 suite of environmental layers based on all Eucalypt occurrences in Tasmania. Nineteen groups were produced (see Classification).

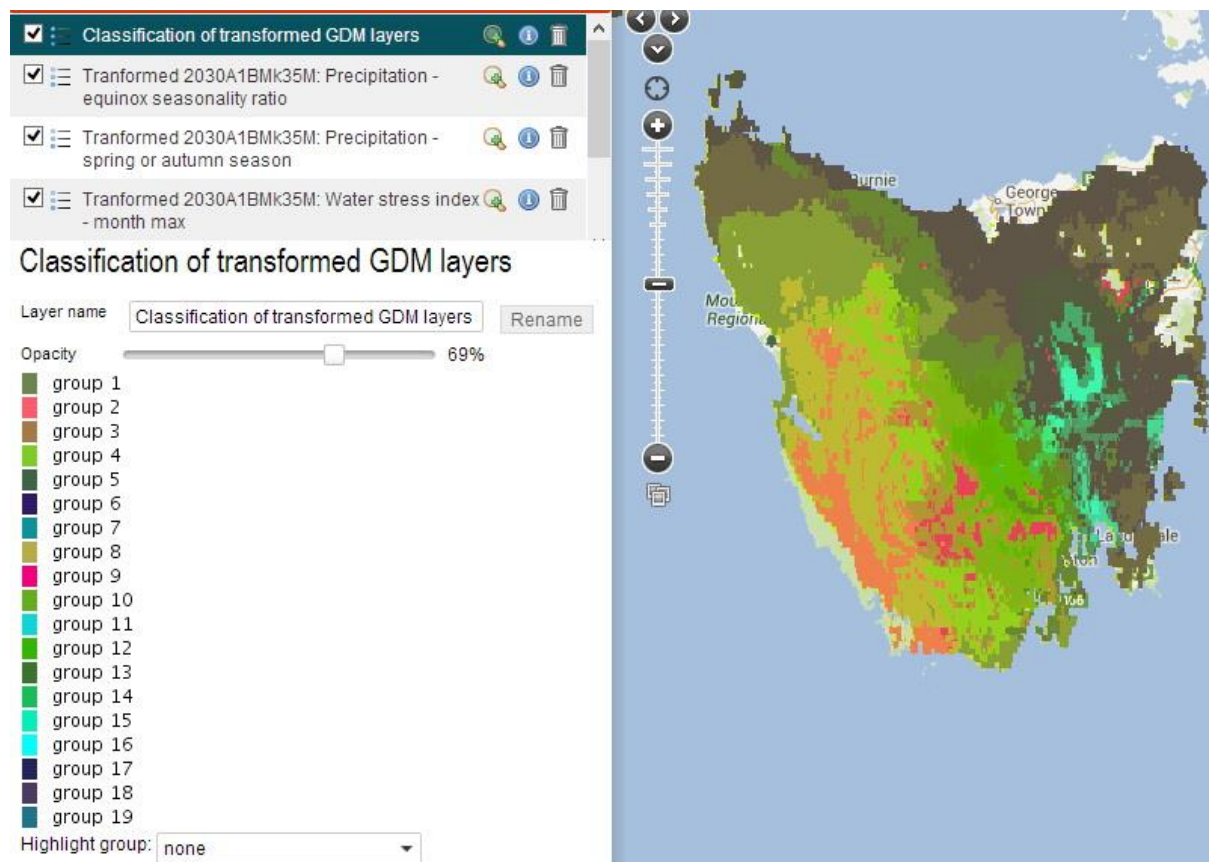


Figure 75. A classification of the transformed 2030 suite of environmental layers

A zip file is produced that contains

1. A summary of input parameters
2. ASCII and binary grids of the transformed environmental layers
3. Sample files across each input layer
4. Filtered data
5. A html file summarizing the results
6. Images of the transformed layers
7. Layer transformation statistics

Restore prior analysis

The Restore prior analysis tool restores an analysis generated through any of the [Classify](#), [Predict](#) or [Points to Grid](#) tools. Each analysis generates a unique analysis identifier. Make a note of that identifier and restore the analysis with the associated download files at any subsequent session within a period 3 months. The Spatial Portal stores the results of analyses for three months only due to storage limitations.

Figure 76 below shows the first section of the html file produced from the Predict tool with the model reference number 1376368354576 highlighted.

Maxent model for Eucalyptus nitida

This [Maxent](#) v3.3.3e predictive model for Eucalyptus nitida was created Tue Aug 13 14:32:56 EST 2013. Links at the bottom used for further analysis.

Model reference number: **1376368354576**

Species: Eucalyptus nitida

Layers:

- 2030A1BMk35M: Evaporation - month min (2030A1BMk35M_evapi)
- 2030A1BMk35M: Precipitation - driest month (2030A1BMk35M_raini)
- 2030A1BMk35M: Precipitation - equinox seasonality ratio (2030A1BMk35M_srain2mp)
- 2030A1BMk35M: Precipitation - spring or autumn season (2030A1BMk35M_srain2)
- 2030A1BMk35M: Water stress index - month max (2030A1BMk35M_pwat_max)

Figure 76. An example of the Model Reference Number. In this case, as produced by the Prediction tool: The number is highlighted in blue.

Figure 77 displays the input screen from Restore prior analysis with the model reference number from the previous prediction entered. Pressing **Next** will restore the original analysis screen and generate the download file.

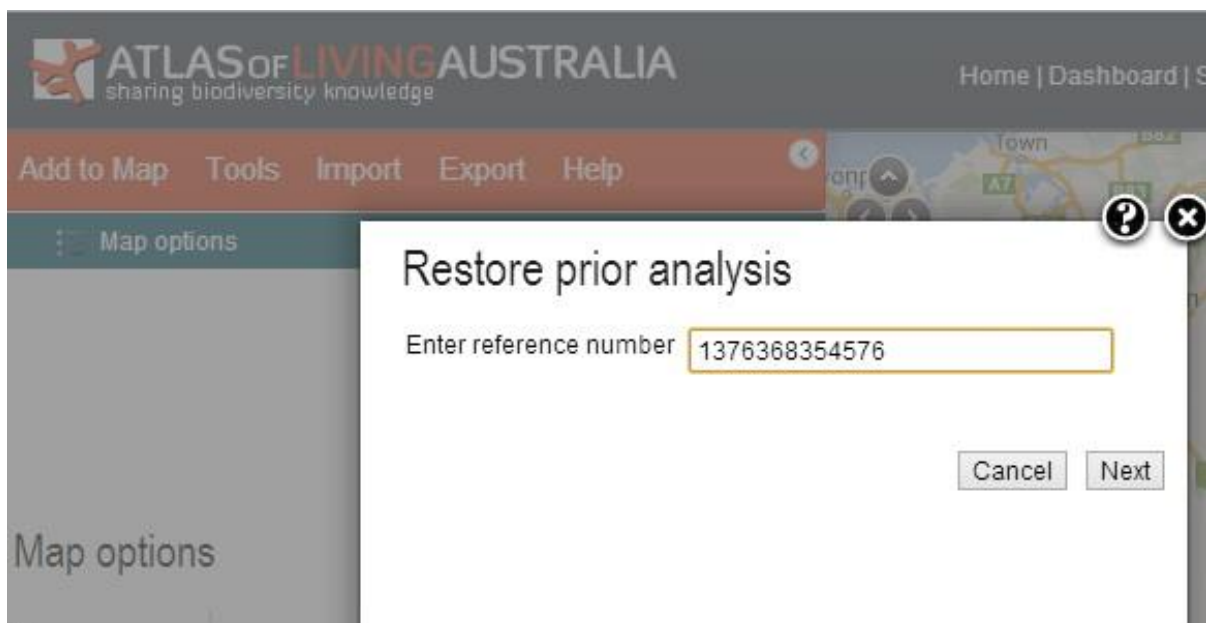


Figure 77. Restore a prior analysis by entering the reference number into the box

Import and Export



Figure 78. Import and export options

Import and export options in the Spatial Portal were designed to complement the tools. Rather than add a more extensive range of tools to the Spatial Portal, I wanted to ensure that a good range of import and export options were available. My philosophy was that the tools now in the Spatial Portal are fair demonstrations of what can be done when a broad range of biological and environmental data are integrated in the Atlas of Living Australia. Having been a scientist, I also knew that the majority of scientists would prefer to use their own tools in their own environment rather than someone else's idea of a good tool. Therefore, the Spatial Portal needed effective ways of delivering data in a form that could be widely used. A simple example of this strategy would be to import a set of points representing species locations, append a range of environmental and contextual values and then export the points.

Export and import options can be found through other mapping and analysis pathways in the SP, and in the Quick links section, at the bottom of the left hand column. When adding a species, for example, you can import your own points; import or create and export your own species list; and import or create and export various layers and areas.

The one current limitation that the Atlas has is that the environmental and contextual layers cannot be exported in their native form. The reason for this is that many of the layers were provided to the Atlas on the agreement that we could use them but they could not be passed onto 'third parties'. We hope that in the near future, the providers will licence their layers under Creative Commons (<http://creativecommons.org.au/>) CC-BY or equivalent (as is most of the Atlas data and code).

We hope to be able to produce a library of scripts for the R package (<http://www.r-project.org/>) that will facilitate access to Atlas data. If this would be useful for you, please let us know at support@ala.org.au.

Import

Points

The Import Points function will upload your own data points in csv format with any number of associated environmental variables. These points are private to you and are not made public through the Atlas: The data is not retained.

Example of a list of data points for import into the SP. Note that the column order is important.

```
Plot, Longitude, Latitude, Topo2
AD 1,149.1596,-35.285, lower slope
AD 2,149.3379,-35.3299, lower slope
AD 3,149.3839,-35.3222, Flat
AD 24,149.7454,-35.003,slope (upper- and mid-slopes combined)
AD 28,149.7552,-34.9511,lower slope
AD 32,149.7394,-34.9195,lower slope
AD 34,149.737,-34.9155,gully/drainage line/open depression
```

The first line in the table above is the *header* containing column titles. The order of the columns is: Identifier, longitude, latitude and then any number of facets. In the table above, one facet called Topo2 is included. When you import data in this form, the Spatial Portal will permit you to facet your data using your own associated variables such as the last column, Topo2 in the table above. Imported points can be used *anywhere* in the Spatial Portal where species records can be used.

Figure 79. Dialogue box for importing points into the Spatial Portal

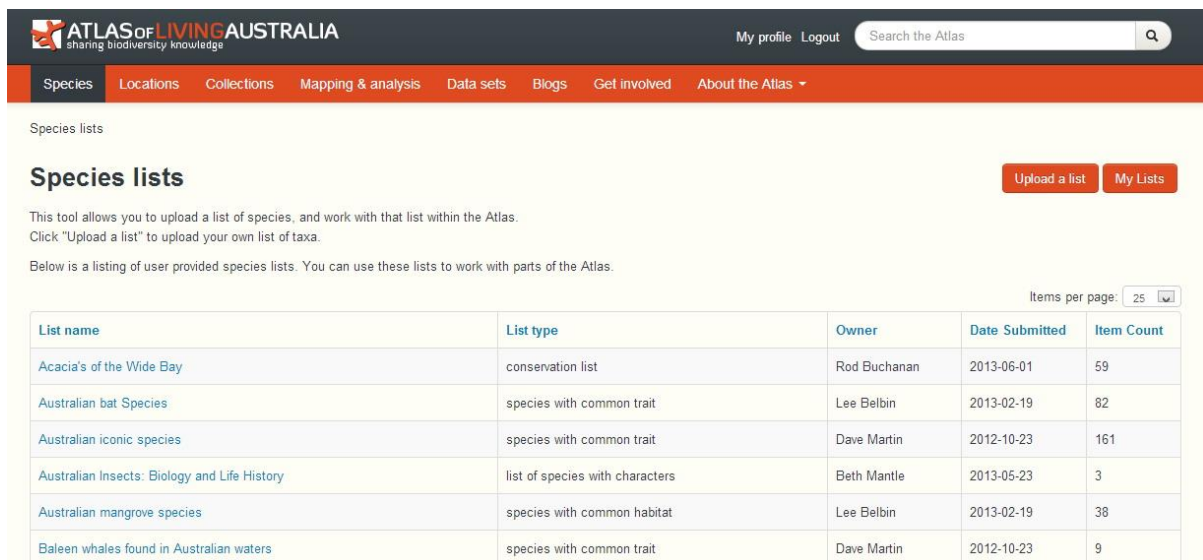
Note: that the imported points do not have to be species occurrence records. In one case study of wind farms, the imported points were the locations and associated characteristics of wind farms in Australia.

Species list

The Species list function² creates a list of any number of species that will be maintained in the Atlas environment. *To use this option, you must be logged into the Atlas.* Once you create a list of species you can use your list in any location where a species could be used. For example, you could predict the probability of finding a group of species, or create a sites-by-species occurrence matrix (site composition matrix) or use GDM on the List.

You can also add, delete or modify species in a list and open these functions to a group of associates who are registered on the Atlas site. Of course, a list of species can be deleted at any time.

When a list is imported, names are matched against the [National Species List](#), a master list of species agreed to by the [ABRS](#), [CHAH](#) and the Council of Heads of Faunal Collections (CHAFC). Matched species names are identified in the Species list with associated taxonomic information. Unmatched names are listed with the option to dynamically search outside the Atlas to help resolve.



The screenshot shows the ATLAS of Living Australia website. The header includes the logo, navigation links (Species, Locations, Collections, Mapping & analysis, Data sets, Blogs, Get involved, About the Atlas), a search bar, and user options (My profile, Logout). The main content area is titled 'Species lists' and contains instructions on how to upload a list. Below the instructions is a table of user-provided species lists.

List name	List type	Owner	Date Submitted	Item Count
Acacia's of the Wide Bay	conservation list	Rod Buchanan	2013-06-01	59
Australian bat Species	species with common trait	Lee Belbin	2013-02-19	82
Australian iconic species	species with common trait	Dave Martin	2012-10-23	161
Australian Insects: Biology and Life History	list of species with characters	Beth Mantle	2013-05-23	3
Australian mangrove species	species with common habitat	Lee Belbin	2013-02-19	38
Baleen whales found in Australian waters	species with common trait	Dave Martin	2012-10-23	9

Figure 80. The Species list page on the Atlas site

Figure 80 displays a list I created based on Australian bat species from Wikipedia. A summary of species in the list is presented and because I am logged in, you can see that it is possible to view, edit and delete any of the records from my list and link to the relevant families. The list can also be downloaded by clicking on the Download button in the top-right of the window.

Species within the list can be viewed, edited or deleted. If there are taxa that are unrecognized (not in the National Species List), you will see 'Unrecognised taxa and the number listed top left. Clicking on 'Unrecognised taxa will filter to the list down to only those unmatched. Two options for resolution of these taxa include search Google or search the Atlas occurrence database.

Clicking on the family names to the left of the list will filter the list to species in that family.

² The Species Lists function replaces the concept of 'species assemblage'.

The screenshot shows the ATLAS of LIVING AUSTRALIA interface. At the top, there is a navigation bar with 'Species' selected, and a search bar containing 'Search the Atlas'. Below the navigation bar, the breadcrumb 'Species lists → Australian bat Species' is visible. The main heading is 'Species List: Australian bat Species', with 'Download' and 'View Occurrences' buttons to the right. Below the heading are three buttons: 'List info', 'Edit permissions', and 'Add species'. On the left, a sidebar titled 'Refine results' shows family counts: VESPERTILIONIDAE (37), PTEROPODIDAE (9), MOLOSSIDAE (8), and EMBALLONURIDAE (8). The main table lists species with columns for Action, Supplied Name, Scientific Name, Image, and Author. The table contains the following entries:

Action	Supplied Name	Scientific Name (matched)	Image	Author (matched)
[Menu] [Edit] [Delete]	Dobsonia moluccense magna (unmatched - try Google, Occurrences)			
[Menu] [Edit] [Delete]	Macroglossus minimus	Macroglossus minimus		(Geoffroy, 1810)
[Menu] [Edit] [Delete]	Syconycteris australis	Syconycteris australis		(Peters, 1867)
[Menu] [Edit] [Delete]	Nyctimene cephalotes	Nyctimene cephalotes		(Pallas, 1767)
[Menu] [Edit] [Delete]	Nyctimene robinsoni	Nyctimene robinsoni		Thomas, 1904
[Menu] [Edit] [Delete]	Pteropus alect			

Figure 81. A list of bat species I created from the Wikipedia list

Areas

The Import Areas function is used to import your own areas in any of three supported formats: Shapefile, KML and WKT. The areas you wish to import may have been generated and exported from one of your prior SP session.

Note: if it takes more than a few minutes to create an area in the SP, it is a good idea to export that area in case you want to document the analyses or re-use the area in future analyses.

Of the three formats available, WKT (Well Known Text) is the simplest as it is human readable and fairly easy to interpret. While machine readable formats are handy, they suffer more from changing applications and standards. If you plan to use Spatial Portal information in Google applications, then KML is the route. The Shapefile standard is also an open standard that was created by [ESRI](#), the big player in Geographic Information Systems (GIS).

Restore prior analysis

The Restore prior analysis function is replicated here for convenience. Please see [Tools | Restore prior analysis](#) for details.

Export

The export function supports 4 different data types (Figure 82)

1. Map
2. Checklist of species
3. A species sample (of environmental and contextual layers)
4. Defined areas.

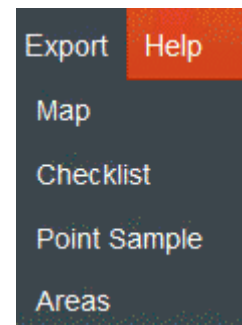


Figure 82. Export options

Map

The map window can be exported at two resolutions, one optimised for screen and the other for print, using jpg, png and pdf formats. The jpg format is a compressed format while png and pdf formats are not. Note that the printer resolution option does take more time to process than the screen format. Each format will produce different file sizes, the smallest file size is jpg, followed by pdf and the largest is png (about 90, 120 and 220kb respectively).

The algorithm used for generating the Map export is sophisticated but far from perfect. The map extent and colours will be close to what is seen on a screen, but the result may not be an exact match. Currently, any legends are not included in the export, something we would like to address.

You can choose to add latitude and longitude lines. A 10 x 10 degree grid will be superimposed on your map (see Figure 83).

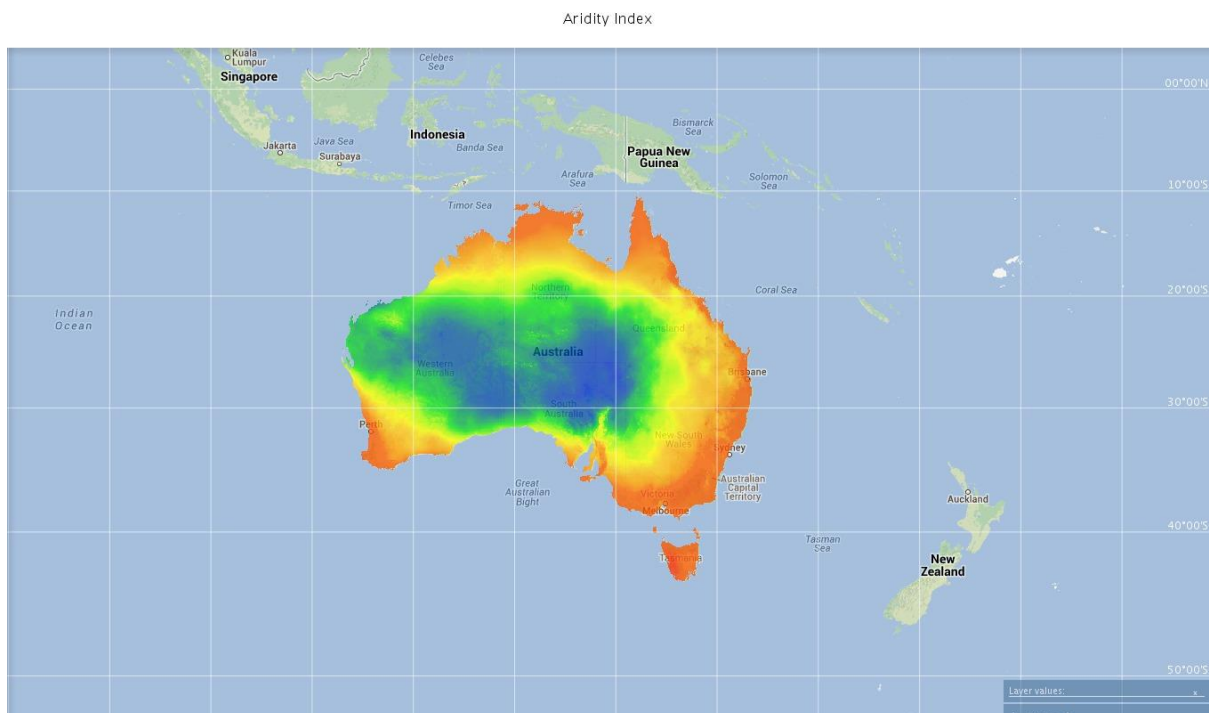


Figure 83. Example of an exported map image from the Spatial Portal

Checklist

The Checklist export option downloads a list of species within a defined area. Like all other options in the Spatial Portal, the defined area can either be pre-defined or defined on the fly using any of the 14 options available through Add to map | Area.

This Checklist export function operates similarly to the download option for the species list using the Tools | Area report option. In either case, the four options available are:

1. Include spatially-valid records: Records that have been spatially validated
2. Include spatially-suspect records: Records that have one or more spatial flags
3. Include records without coordinates
4. Include endemic species only: Species that are only located within the defined area

The file exported is in CSV (comma-separated variables) format with a header as line 1, see below

```
Family Name,Scientific Name,Common name/s,Taxon rank,Scientific Name LSID,Number of Occurrences
"CIROLANIDAE","Natatolana bulba","",species,urn:lsid:biodiversity.org.au:afd.taxon:baa5422e-02ae-441a-91a3-6755a3380ec9,4
"CIROLANIDAE","Natatolana kahiba","",species,urn:lsid:biodiversity.org.au:afd.taxon:5b73f161-ccc6-44bc-a42e-679720a0bd6c,1
"CIROLANIDAE","Natatolana pellucida","",species,urn:lsid:biodiversity.org.au:afd.taxon:84aa5d4b-20c2-4a8e-a020-72774637ebbb,9
"CIROLANIDAE","Natatolana vieta","",species,urn:lsid:biodiversity.org.au:afd.taxon:1ffa8add-df8f-4438-be49-8e05f144218d,1
"CIROLANIDAE","Natatolana wowine","",species,urn:lsid:biodiversity.org.au:afd.taxon:5928269b-2a37-4ab6-b22c-f9d4a33c7c18,2
"CIROLANIDAE","Natatolana","",genus,urn:lsid:biodiversity.org.au:afd.taxon:5396b5cc-780e-4254-84e5-9ad99a637704,2
...
```


Areas

The Areas export function enables you to export any defined area in the SP in any of three available formats: Shapefile, KML, WKT. After creating an area that may not be simple to reproduce, it would be wise to export it for future use or for documenting the process you have followed. As noted elsewhere, the WKT format is the simplest of the three formats available as it can be easily read and interpreted by both humans and machines.

Acknowledgements

The Spatial Portal of the Atlas of Living Australia is a team effort. Donald Hobern, the original Director of the Atlas asked me to develop this tool and gave me a free hand and funding to do what I thought best. The ongoing support of the new Director, John LaSalle is greatly appreciated.

The development team were amazing. We usually had between 3 and 4 developers at any one time. I usually just had a vision that the team somehow managed to implement; don't ask me how in many cases. Immense thanks therefore goes to Adam Collins, Yuan Fang, Chris Flemming, Gavin Jackson, Angus MacAulay, Ajay Ranipeta and Brendan Ward.

Input from members of the two workshops and a range of other ALA staff and users was greatly appreciated (see references). A special thanks to Peter Doherty, David Martin and Miles Nicholls for their support and advice.

Thanks to tremendous support, we have an extremely powerful tool for understanding the natural environment of the Australian region.

Margaret Cawsey, John Tann and John Busby provided valuable feedback on this document. Their efforts are greatly appreciated, and no blame is assigned to them for problems remaining within this document.

Other resources

What to	Link
ALA Spatial portal	http://spatial.ala.org.au/webportal/#
Case Study: Classification (Brendan Mackay)	http://www.ala.org.au/faq/spatial-portal/classification-case-study/
Case Study: Prediction (Jane Elith)	http://www.ala.org.au/faq/spatial-portal/prediction-case-study/
Case study: Scatterplot (Ben Raymond)	http://www.ala.org.au/faq/spatial-portal/scatterplot-case-study/
Case study: Environmental envelopes (Lee Belbin)	http://www.ala.org.au/faq/spatial-portal/spatial-portal-case-studies/finding-pinot-noir-an-example-of-how-to-use-the-atlas/
Case study: Using the Spatial portal to examine the interaction between wind turbines, birds and bats	http://www.ala.org.au/faq/spatial-portal/spatial-portal-case-studies/wind-wind-farms-birds-and-bats/
Environmental layer list	http://spatial.ala.org.au/layers
European molecular biology lab Australian Mirror ALA search	http://biocache.ala.org.au/occurrences/search?q=data_resource_uid:dr658#recordsView
Sandbox for data checking	http://sandbox.ala.org.au/datacheck/
Web services; how to access ALA spatial layers for your own web purposes	http://spatial-dev.ala.org.au/ws/examples/layerswms
Web services; ALA spatial layers available	http://spatial.ala.org.au/layers-service/
Videos which demo particular aspects of the spatial portal	http://www.youtube.com/user/tasilee?email=share_video_user
ALA blogs	http://www.ala.org.au/blogs-news/
JournalMap (papers @ locations)	http://www.journalmap.org/search

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Abbreviations

ALA	Atlas of Living Australia
CSV	Comma Separated Variables format. One of the simplest and most common standards
EEZ	Extended Economic Zone
IBRA	Interim Biogeographic Regionalisation of Australia
IMCRA	Interim Marine and Coastal Regionalisation of Australia
KML	Keyhole Markup Language developed by Google but now an OGC standard
NSL	National Species List. An agreed list of Australian species
OGC	Open Geospatial Consortium: The international geospatial standards group
Shapefile	An open standard developed by ESRI for vectors in geographic information systems
SP	Spatial Portal of the Atlas of Living Australia
WKT	Well Known Text (see http://en.wikipedia.org/wiki/Well-known_text)

References

- Belbin, Lee, Marshall, C., Faith, D.P. (1983): Representing relationships by automatic assignment of colour. *The Australian Computing Journal* **15**, 160-163.
- Belbin, Lee. (1987): The use of non-hierarchical allocation methods for clustering large sets of data. *Australian Computer Journal*, 19, 32-41.
- Belbin, Lee (2011): The Atlas of Living Australia. In, *Bulletin of the Ecological Society of Australia* 41(4) December 2011, pp 23-24 – PDF (21KB)
- Belbin, Lee, (2011): The Atlas of Living Australia's Spatial Portal. In, M.B. Jones and C. Gries (eds.), *Proceedings of the Environmental Information Management Conference 2011 (EIM2011)*, 39-43. University of California, doi:10.5060/D2NC5Z4X –PDF (618KB)
- Belbin, Lee (2012): The Atlas of Living Australia in the Classroom. A training session for the Scientists in Schools program held at CSIRO, Hobart, July 2012. 16 pages with images. PDF (1.7MB)
- Belbin, Lee (2014): The PATN Software Package for Ecological Data Analysis.
<http://www.patn.com.au/>
- Belbin, L., Williams, K.J. (2015). Towards a national bio-environmental data facility: experiences from the Atlas of Living Australia. *International Journal of Geographical Information Science*.
<http://dx.doi.org/10.1080/13658816.2015.1077962>
- Belbin, Lee, McGeoch, M. (2014). Invasiveness and the Atlas of Living Australia. 19th Annual Weeds Conference, Hobart, 4p.
- Crisp, M.D., Laffan, S., Linder, H.P. and Monro, A (2001). Endemism in the Australian Flora. *Journal of Biogeography* 28, 183-198.
- Faith, Daniel P. "Conservation Evaluation and Phylogenetic Diversity." *Biological Conservation* 61, no. 1 (1992): 1–10. doi:10.1016/0006-3207(92)91201-3.
- Ferrier, S., Manion, G., Elith, J. and Richardson, K. (2007): Using generalized dissimilarity modelling to analyse and predict patterns of beta diversity in regional biodiversity assessment, *Diversity and Distributions*, 13, 252–264. DOI: 10.1111/j.1472-4642.2007.00341.x
- Flemons, Paul and Belbin, Lee (2009): [ALA Spatial Analysis Tools Workshop](#) Report, 3-4 December 2009)
- Flemons, Paul and Belbin, Lee (2010): [Environmental Data Library Workshop](#), 22-23 April 2010 – PDF (715KB)
- IUCN (2012). *IUCN Red List Categories and Criteria: Version 3.1. Second edition*. Gland, Switzerland and Cambridge, UK: IUCN. iv + 32pp.
http://jr.iucnredlist.org/documents/redlist_cats_crit_en.pdf
- Kristen J. Williams, K.J., Belbin, L., Austin, M.P., Stein, J.L. & Ferrier, S. (2012): Which environmental variables should I use in my biodiversity model?, *International Journal of Geographical Information Science*, DOI:10.1080/13658816.2012.698015,
<http://dx.doi.org/10.1080/13658816.2012.698015P>

- Lymburner , L., Tan, P ., Mueller , N., Thackway , R., Lewis, A., Thankappan, M., Randall, L., Islam, A. and Senarath, U. (2010). 250 metre Dynamic Land Cover Dataset of Australia (1st Edition), Geoscience Australia, Canberra.
- Miller, J. T., Murphy, D. J., Brown, G. K., Richardson, D. M. and González-Orozco, C. E. (2011), The evolution and phylogenetic placement of invasive Australian Acacia species. *Diversity and Distributions*, 17: 848–860. doi: 10.1111/j.1472-4642.2011.00780.x
- Nix, H.A. (1986): A biogeographic analysis of Australian elapid snakes, In: Atlas of Elapid Snakes of Australia. (Ed.) R. Longmore, pp. 4-15. *Australian Flora and Fauna Series Number 7*. Australian Government Publishing Service: Canberra.
- Phillips, S.J., Anderson, R.P. and Schapire, R.E. (2006): Maximum entropy modeling of species geographic distributions. *Ecological Modelling*, vol. 190, pp. 231-259. PDF (902 KB).
- Mark Vellend, William K. Cornwell, Karen Magnuson-Ford, and Arne Ø. Mooers. “Measuring Phylogenetic Diversity.” In *Frontiers in Measurement and Assessment*, edited by A.E. Magurran, B.J. McGill, 193–206. Oxford University Press, 2010. http://willcornwell.org/wp-content/uploads/2015/07/Vellend_etal_2011_bookchap.pdf.