The Atlas of Living Australia in the Classroom

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Purpose of the Workshop

1. **Teachers and scientists to be confident in using the Atlas of Living Australia to teach primary and secondary school students about Australian wildlife and their associated environments.**
2. **Identify additional questions and strategies that may be useful for teaching concepts about Australian wildlife and the environment**.

Synergy is good so please contribute whatever you think may be useful for the workshop and for subsequent projects.

Strategy

I will demonstrate the two main interfaces that address the **THREE main questions** noted in the following section. We will then break into small groups, select a question from the list on page 4 (or add one) to address and then work through answers to that question using one of the two demonstrated Atlas pages.

If time permits, I will give a quick demonstration of the advanced Spatial Portal for those of you who may like to use it to encourage some of your more adventurous students (or yourself). I have added a section that provides a recipe for getting started with addressing **Question 3.**

The Atlas of Living Australia

The Atlas of Living Australia was designed to be the primary online repository of basic information about species within the Australian region (land, sea, lakes and rivers). The Atlas aggregates basic observations of species from a very wide range of sources - museums, herbaria, scientists, State, Territory and Federal agencies, citizens and interest groups. The focus of the Atlas is therefore on

- **What species** was observed or collected
- **Where** it was observed/collected from
- **When** it was observed/collected
- **Who** it was observed or collected by
- One or more **images** of the species
- Any other information that would help identify the record or add value to the observation/collection. Examples would include taxonomic information, number observed, environmental information, identification/accession numbers, size, nature of observation or specimen and links to related information.

The Atlas tries to answer **three basic questions**-

1. **Basic information about a species?** The core details include where it is found, what it looks like and information about its names.
2. **What species occur in this area?** All species and their occurrences of within a defined area are reported.
3. **What environment does this species occur in?** There are 500 'environmental layers' in the Atlas to help address this question. This aspect will only be lightly addressed in this workshop. The last section of these notes includes a worked example using the Spatial Portal of the Atlas of Living Australia.

The Atlas has been designed for both the scientist and the public. You can find out basic information about a species such as what it looks like and where it occurs. You can also download the details of all records of a species along with up to 500 additional variables for use in ecological research.

Citizen Science is a significant component of the Atlas: The Atlas accepts **all observations** of species entered via the web site or by its (free) mobile application for Apple iPhones and Android phones (OzAtlas in the App stores). The mobile application also provides access to the basic Atlas information (notably 1 and 2 above). The use of OzAtas in the field is likely to be an effective tool to engage students.

Example Questions for Projects

The questions below fit under the four basic questions noted above. It would also be useful to add to this list and gather any exercises that have been developed and deployed. The Atlas would be happy to host any materials to make them available to all Australian schools.

Primary School

1. What species occur within 5km of your school? How many can you find?
2. What are the different lifeforms? Create a list of features of one species from example lifeforms that occur within your area.
3. What species can you find in a reserve near your school? Enter the observations into the ALA
4. In your area, can you draw a web of what species eats what?

Secondary School

1. What species occur within 5km of your school? How many can you find in 1 hour?
2. Pick a species that occurs in your area and gather as much information as you can about it from the Atlas and other web sites (see the Resources section).
3. What species can you find in a reserve near your school? Enter the observations into the ALA
4. Pick a favourite species or even genus and then use the Scatterplot List function (in the Spatial Portal: http://spatial.ala.org.au) to see if you can find what environmental data layers exhibit some systematic relationship with the species.
5. What's in a name? Pick a species and see what information can be found about the development of scientific and common names associated with it. Present the result as a history of entries related to the name. Taxonomy (the science/art of classifying species) is in continual flux as new information comes to hand by new observations, new taxonomists with different views, new equipment or methods.

Tertiary

1. Ecology: How well do the current reserves represent the biodiversity in your State or Territory?
2. Ecology: If 100sqkm was to be added to your States biological reserves, where would one or more areas be (best) located? What are the criteria that you would use?
3. Botany: Generate a predictive model for Species X (e.g., Eucalyptus gunnii). Make a case for the environmental and contextual layers selected. Examine scatterplots using the prediction layer. Field test and validate your model.
4. Botany: What environmental parameters differentiate Allocasuarina from Casuarina?
5. Ecology: What is the relationship between remoteness and species richness?
6. Ecology: Use the Scatterplot List function (SP) to determine what environmental layers exhibit some relationship with the distribution of the species, genus or assemblage.
7. Taxonomy: Pick a species and produce a report that details the development (with comprehensive references) of the associated taxonomy, descriptions, keys and names. Issues that may need to be addressed include (but not limited to) 'taxon concepts', synonymy, paraphyly, monophyly, polyphyly, phylogeny, homoplasy and convergence.

The Atlas Web Site

Home Page: http://www.ala.org.au.

All Atlas of Living Australia functions can be found from this page. Be aware that there are often multiple functions/pages that address different levels of detail. For example, there are a number of pages that provide species information and area information. Some of these pages are for general interest while others are aimed at the research community.

For this workshop, the pages aimed at the public are the focus. Those pages are seen on the Home Page as 'Australia's species' and 'Species by location'. The Atlas page oriented more for the research community can be found on the Home Page as "Mapping and analysis".

Species:

: **ADDRESSES QUESTION 1**

This the **species focus** entry point: Enter a common name, a scientific name or select from the categories of iconic species (Birds , Fish , Frogs , Mammals , Reptiles , Invertebrates , Flowering plants , Conifers , Fungi and Ferns .

If you click on Fairy Penguin (in the news a few days back when dogs killed 10 at a colony in the Derwent) and you will be taken to a page that provides basic details about the species such as

- o **Map** of location of observations
- o A brief **description** of the species
- o Links to other (external sites) that may provide **other information** about the species.
- o A gallery of **images** of the species (tab 2). Ranking of the images is available.
- o Information about the **scientific and common names** associated with this species (tab 3). This is a rich (and dynamic) area of investigation.
- o Classification (tab 4). This displays the Atlas' best idea of what the full **taxonomic classification** of this species is. It is rarely definitive. Put two taxonomists in a room and you'll get a debate.
- o Records (tab 5). Provides a breakdown of all known records of this species by **Collection, State/Territory and Date.** You can drill down through the graphs to generate a filtered

subset of records, and then explore (facet/filter) using any of the data either in or associated with the records of this species. For example, clicking on Tasmania will display all the records that occur in the Tasmanian region.

- o **Literature** (tab 6) provides links to publications in the Biodiversity Heritage Library (http://bhl.ala.org.au/: an ALA funded co-project) and Trove (http://trove.nla.gov.au/) that contain a reference to this species. These are excellent for further research about the species but there are a range of other links to what we refer to a 'species pages' int eh Resources section.
- o A list of added tags (left side) that provides basic information about the **environment** where this species occurs (e.g., marine) and its **conservation status**
- o Two functions that require you to be logged into the Atlas site-
    - ▪ A button that allows anyone to **make a new sighting/observation** of this species. You need to be registered on the Atlas site to add new entries or annotate existing entries.
    - ▪ A button that allows you to setup **automatic notifications** via email of various new items of information. For example, new records, new images, new annotations etc. You need to be registered on the Atlas site for this function.
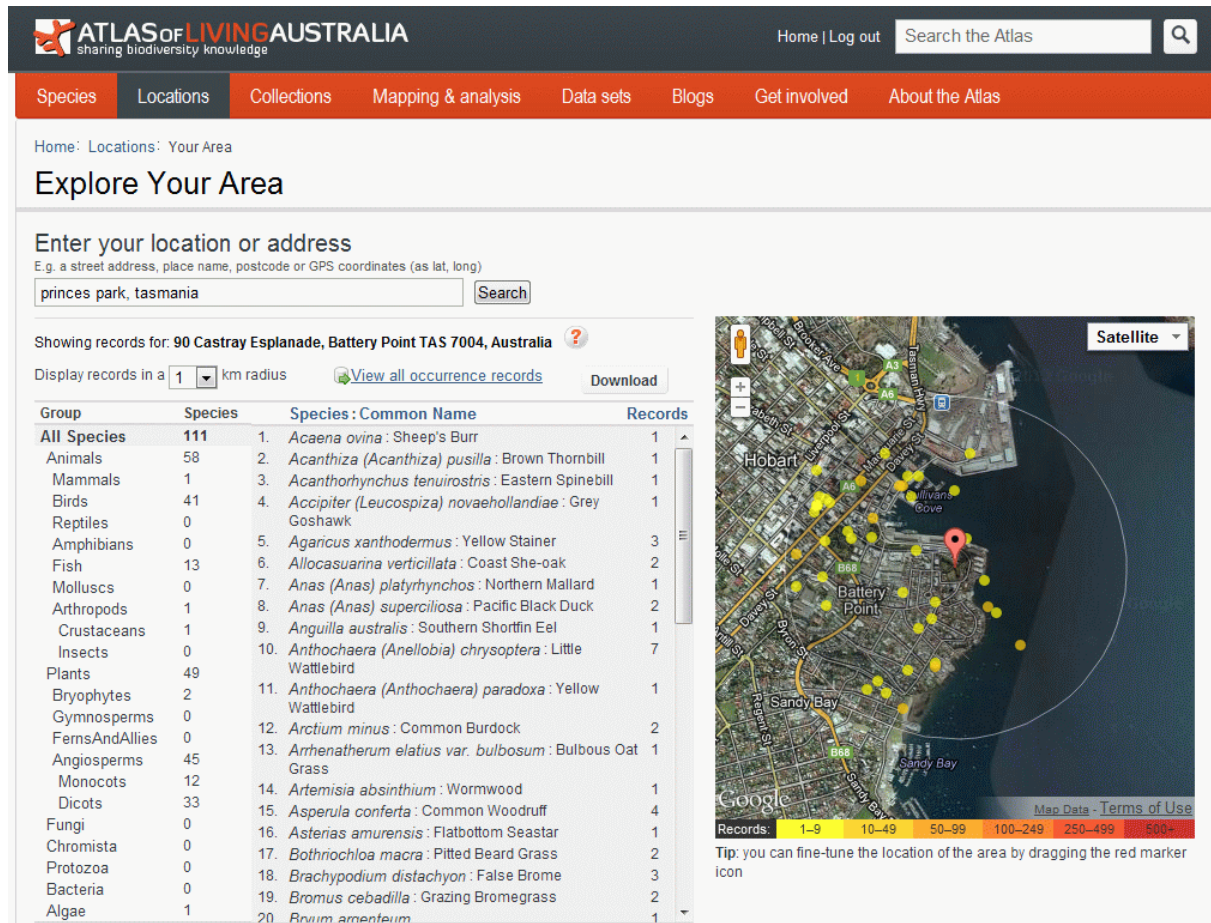
http://spatial.ala.org.au may be suitable for some secondary school activities. A simple example of the use of this interface can be found in the section below.

Areas

ADDRESSES QUESTION 2

This is the simple entry point for finding out what species may occur within a radius of a location. By default, the application uses a 5km radius based on your Internet address but this rarely works as expected. It is however easy to enter an address/location.

The best idea is to either enter

- A street address (e.g., Princes Park, Tasmania will work),
- A postcode or
- A latitude and longitude pair (e.g., -42.88770, 147.33698 for Princes park in Battery Point)

The web page will then list all species within a 5km (by default) radius of that site. It may be best to select a **1km radius** to home in on the species closer to the area of interest. For Princes Park as above at the time of writing, a 1km radius will list the occurrences of 111 species (terrestrial and marine in this case). The table lists the number of species in each lifeform group and on the right hand-side of the table, the number of occurrence records associated with the select lifeform group. By default, all species are listed and sorted by scientific name. Clicking on **Common Name** at the top of the species list will cause the list to be sorted by Common Name. Likewise, clicking on **Records** at

the top of the table will re-sort the list of species by decreasing number of records seen within the defined area. The latter option is most useful to find out what species is most likely to be observed. In the example here, it is the Silver Gull – no great surprise!

The colour of the dots on the map represents the density of the records (the number of individual observations per unit area). The density of the records will usually decrease as you zoom into the map. On the map window, you can use the usual Google map controls to zoom or pan the map (top left of map window).

The species are listed hierarchically by **lifeform**. For example, under animals, there is a listing of mammals, birds, reptiles, amphibians, fish, molluscs and arthropods. Note that '0' means that there are no records as yet of that lifeform within that area. If you click on 'mammals', it shows in this case that a Long-footed Potoroo was observed in the area. Then clicking on the Long-Footed Potoroo (right hand column) will provide a link to the species profile or species page (information about that species) and a link to that particular record. In this case, it was from the Tasmanian Natural Values Atlas data supplied to the Atlas.

From the basic area-based page, you can then

- Download a list of all the species within that area. This download can either be
    - All records of all species in the area
    - A list of the species in the area (this is called a checklist) or
    - A guide (PDF format) containing the names and images of species that you could take into the field to help find the wildlife. You may find this option the most useful in teaching about species in your area.
- View a list of all the records within that area. This takes you to the standard record listing area seen previously where you can further refine your selection or download all the records.
- Change the basemap used to either a satellite map or a simple street map. Both use Google Maps/Google Earth data and geospatial services. Select the basemap that best suits your interest.

The Atlas Spatial Portal

http://spatial.ala.org.au: **ADDRESSES QUESTION 3**

The Spatial Portal (SP) of the Atlas of Living Australia was designed to try and address the needs of the research community. The SP provides more advanced ways of addressing Questions 1-4 but with a focus on Question 4; the relationship between species and their preferred environment.
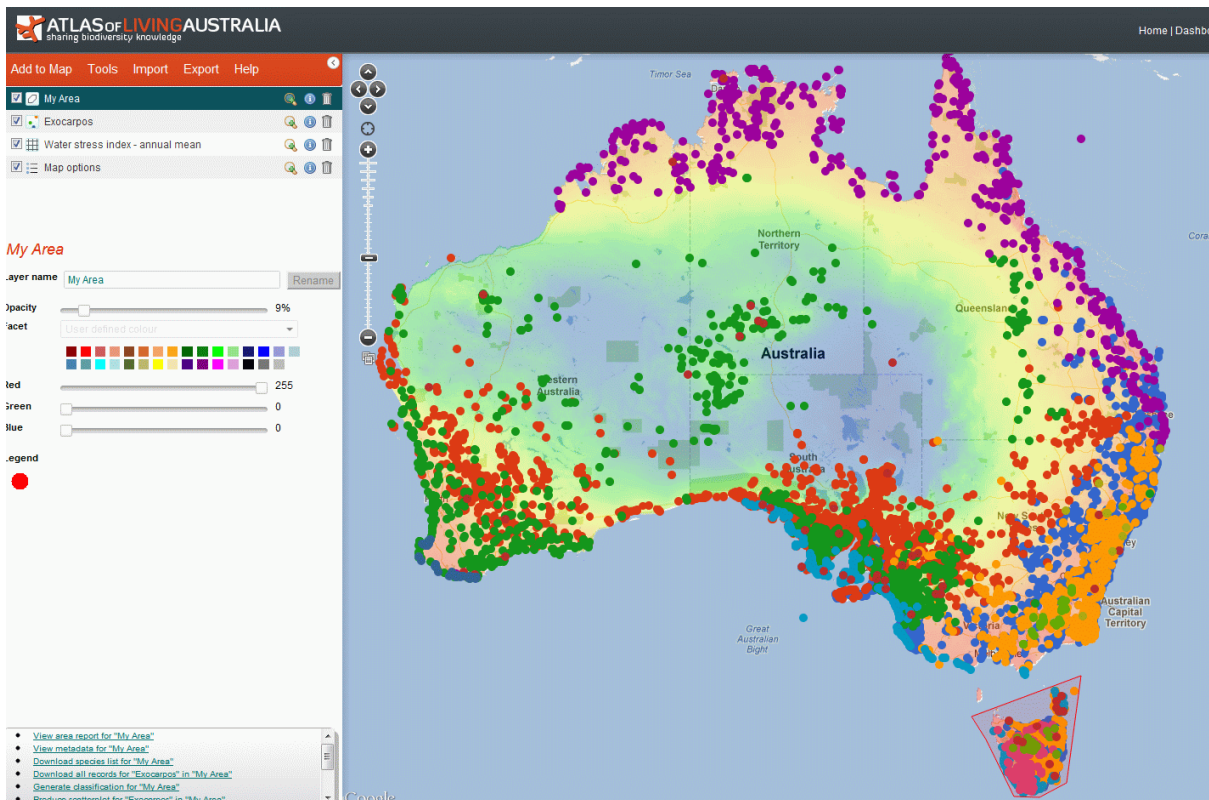
As its name suggests, the Spatial Portal has a geographic emphasis, and given that the four key questions all have a geographic component, no surprise. The sections within the SP page include (but are not limited to)

- The **Menu** (Add to Map, Tools, Import, Export and Help)
- The mapped **layer list** (top left): All the layers that have been mapped. Associated layer names, and icons for show/hide, zoom to extent, more information (metadata) and delete. Note also that the layers are mapped in front to back order: Those layers on top of the list will have display priority over those beneath on the map. You can drag the layers up and down in the list to ensure those of interest are mapped *over* those beneath. Note also that each layer has an associated icon that identifies it as a grid, points or polygon.
- A central left area that displays the **legend** of the currently selected layer. This allows you to change the display characteristics of that layer. You have more control over the way points are mapped than over how layers are mapped.

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- The **Hints** area that provides some options for potential actions that can be performed based on the nature of the layers mapped.
- The map area with standard Google-style zoom, pan and location functions.

The Environment

There are nearly 500 'environmental and contextual' layers in the Spatial Portal. These cover the terrestrial (land) and marine environments. A full list of the available layers can be found at http://spatial.ala.org.au/layers. This web page can be used to search and browse all the available layers. Note that currently we have far more terrestrial than marine layers. Hopefully over time, a better balance can be achieved.

Environmental layers are made of grids with the values at a point being continuous and numeric. An example of an environmental layer would be mean annual temperature. Environmental layers provide environmental information at any terrestrial or marine location. Most of the environmental layers in the Spatial Portal have a grid size of one kilometre. The SP can use environmental data to determine a species' environmental preferences using a range of tools.

Contextual layers are made up of polygons with each having a class value. An example of a contextual layer would be Local Government Areas. Contextual layers were so named because they provide a context for a species record. For example, it may be helpful to know that a species occurs mainly in Queensland and NSW or that it is absent from land use type "Forestry". The SP can also cross tabulate how many species occur in all combinations of two contextual layers: For example, how many species occur in National Parks in Tasmania?

The Process

We will define the environment for a Tasmanian (only) species called *Eucalyptus gunnii* (Cider Gum). What follows is one approach that a scientist may follow to find out more about the preferred environment of this species. PS: Without the Spatial Portal, this would involve multiple software packages and web sites.

1. Go to http://spatial.ala.org.au and click Add to Map from the Menu
2. Enter the name "*Eucalyptus gunnii*" or "Cider Gum" (~1602 records), Next
3. Choose **world extent** by default, and Next and the species should be mapped
4. **Zoom to extent** (the magnifying glass icon next to the layer name) will show you that there are four records in Canberra. This looks odd and is typical of issues that the Atlas of Living Australia now raises. A key point for those interested: The Atlas gathers ALL data available and does a comprehensive range of checks on the data. NO changes are made to the data unless the error is 100% obvious (which is rare), however additional information is added to the record to note the issue. Anyone viewing the record will see any additional information that has been added. In addition to this, **anyone** can annotate any data associated with a record. That information always stays with that record in the Atlas.

5. **Click on this point**: The specimen record may exist in the National Herbarium but doesn't occur naturally in Canberra. This could influence our idea about the environment that this species prefers!

6. Select '**Assign this record to the *ad hoc* group**' on the pop-up window and do the same for the other three records (use the right arrow to step through the four records)

7. Below the legend, click on '**Create in/out groups**' and this will create two new layers, one with only the selected 4 records and one without those four selected records. It is the latter layer that we want as we do not want those Canberra records to influence our idea of what environment Eucalyptus gunnii prefers!

8. **Remove the unwanted layers** (Eucalyptus gunnii in group, Eucalyptus gunnii) to remove clutter and potential confusion

9. Go to **Tools | Scatterplot List**

10. Select '**Eucalyptus gunnii out group**', Next

11. '**No highlight**', Next

12. From the first text entry box, select '**Best 5 independent terrestrial environmental layers**', Next. These layers have been selected in the SP as being a good representation of the Australian terrestrial environments.

13. Select **background species** and enter "*Eucalyptus victoriana*", click Next. This species is added in to give you a clearer idea how different species prefer different environments.

14. A suite of graphs will be produced that shows how *Eucalyptus gunnii* and *Eucalyptus Victoriana* relate to these five environmental layers/variables. Examine the graphs - you will need to drag to enlarge the window to see the plots or better still, unpack the file produced and click on the file called scatterplot.html and maximize the window.

You will see is something like the graphs below. To simplify the graphs I have removed the least useful of the 5 layers: layer 'Moisture Index – highest quarter mean (Bio32)'. *E.gunnii* points are in blue while *E.victoriana* are the larger grey dots. You should easily see that by comparison with
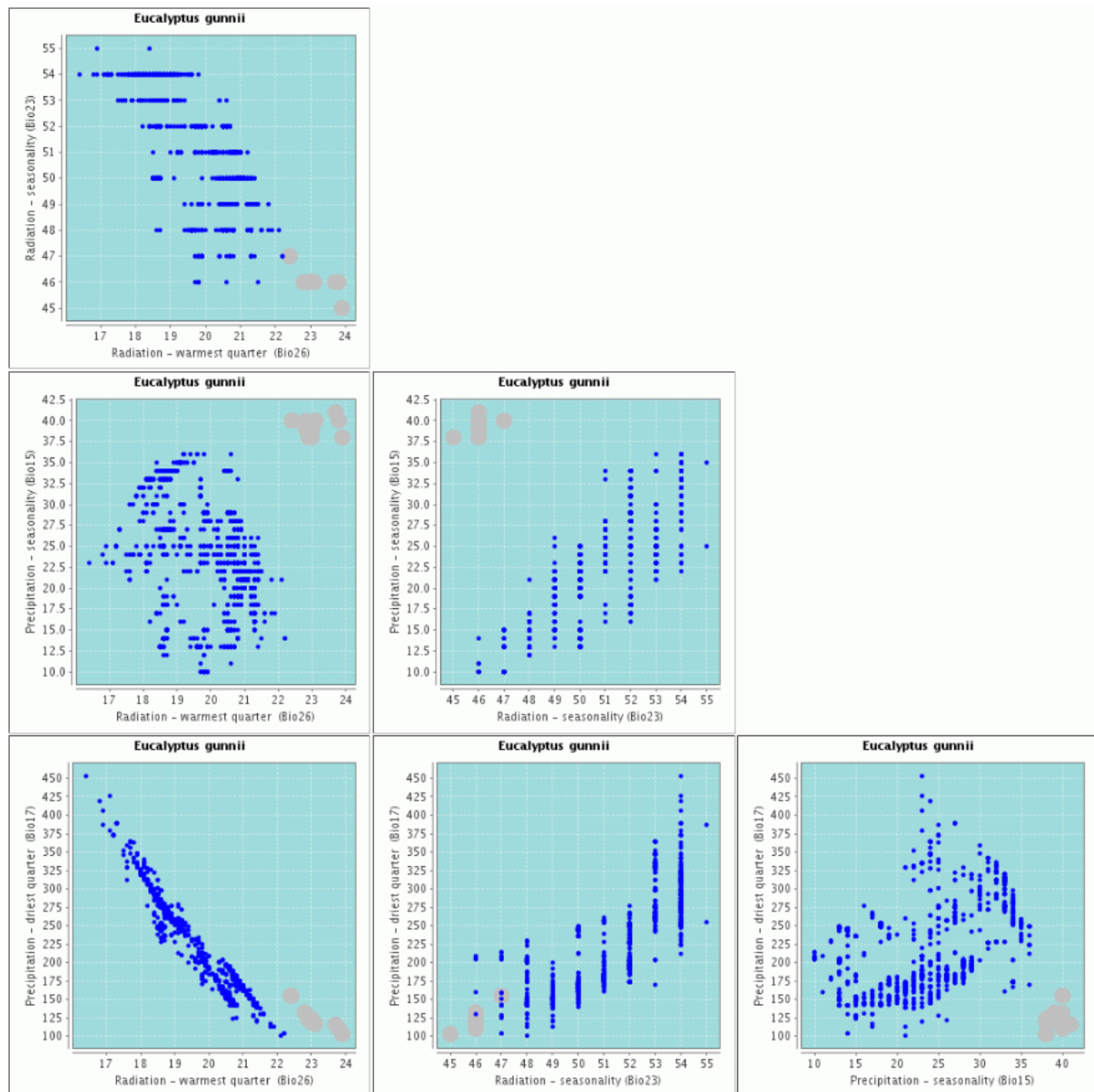
E.gunnii, *E. Victoriana* prefers lower (solar) radiation seasonality (seasonality means differences between summer and winter), higher radiation levels, high precipitation seasonality (winter > summer rainfall) and low precipitation in the warmest quarter of the year. You can also see that *E.victoriana* has a smaller environmental envelope than *E.gunnii*. In short, you can tell a lot about these species from their relationships with just these four variables. You can also see from these graphs that there appears to be a strong negative relationship between Bio07 and Bio26: As 'Radiation of the warmest quarter' (Bio26) increases, 'Precipitation of the driest' quarter' (Bio07) decreases.

If you were to draw a line around all of the blue or grey points, this could be referred to as the species 'environmental envelope'. For example *E.victoriana* ranges are

1. Precipitation – seasonality (Bio15):   37-43
2. Radiation – seasonality (Bio23):   45-47
3. Radiation – warmest quarter (Bio26):   22-24

You can use this information to predict where a species may occur. The SP has a tool that will show you the locations corresponding to a species environmental envelope as defined above.

The Spatial Portal can also do far more than demonstrated here; a topic for another occasion for those wanting to get further into the ecology of species. See the Resources section for a link to a suite of Case Studies that demonstrate some of the power of the Spatial Portal.

Resources

1. http://dashboard.ala.org.au: A 'dashboard' displaying the nature and extent of ALA data
2. http://www.ala.org.au/faq/spatial-portal/: Four case studies (see top right of page)
3. http://www.ala.org.au/get-involved/: Record a sighting of a species.
4. http://volunteer.ala.org.au/. The main entry for the volunteer site – helping to transcribe information into data that can be loaded into the ALA.
5. https://m.ala.org.au/: A Web interface that is the same as the OzAtlas free mobile application that is freely available from the iTunes or Android store.
6. http://www2.identifylife.org/: Identification keys for identifying species.
7. http://www.gbif.org: The international equivalent to the Atlas of Living Australia. GBIF gathers its data from national nodes such as the Atlas of Living Australia.
8. http://www.biodiversitysnapshots.net.au/BDRS/home.htm: Citizen Science example funded by ALA.
9. http://www.ala.org.au/blogs-news/: The ALA blogging site. If you want something written about or want to write something, please let me know.
10. http://bhl.ala.org.au/: ALA funded Australian node for the Biodiversity Heritage Library.
11. http://morphbank.ala.org.au/: ALA funded Australian node for detailed images Australian species.
12. http://www.climatewatch.org.au/: A Citizen Science project focusing on observation of indicator species.
13. http://species.wikimedia.org/wiki/Main_Page: A useful resource about the world's species. It is well supported by scientists and citizen scientists.
14. http://eol.org/. The Encyclopedia of Life. An ALA partner that focuses on species pages: pulling together a wide range of information about the world's species.
15. http://www.mappinglife.org/: A new web site that focuses on the mapped distribution of species.
16. http://www.padil.gov.au/: A web site for high quality images associated with introduced species.
17. http://dev.bowerbird.org.au: An ALA-supported site for citizen science for Australia that is in alpha release but will be available soon. See http://www.youtube.com/watch?v=hYRa6gRpRfw for a short video explanation.
18. http://www.projectnoah.org/: An excellent citizen science resource.