2017-2018

Climate change impact on some species of cultural significance in the Minyumai Indigenous Protected Area

Prepared by Emilie Ens and Sabina Rysnik,
Macquarie University
For Minyumai Indigenous Protected Area.
Funded by NSW OEH Adapt NSW Bionode
2017-2018

Contents

Report Summary – Response of species to climate change

The Minyumai IPA is on the NSW north coast and lies within the SE Queensland Bioregion. The predicted climate change for this area has been suggested as possibly having:

- higher average (~2°C by 2070), minimum and maximum temperatures
- slightly higher annual rainfall (~70mm by 2070) with more variability in summer and spring
- more extreme heat (>35 °C) days (~3-12 days by 2070)
- fewer cold nights (<2°C) (~30 days fewer in mountain region)

The fauna and flora species studied as part of this project all tended to have widely distributed populations along the east coast of Australia. Minyumai tends to lie in the middle of the current distributions of these species suggesting that there is a climate buffer for most species (*Melastome affine, Pandanus tectorius, Nymphaea gigantea, Lomandra longifolia and Varanus varius*).

However, some species are at already at their climate "edge" in terms of their current climate niche (annual rainfall and average temperature) – *Persoonia cornifolia*, *Rubus moluccanus* var. *trilobus*, *Phascogale tapoatafa* and *Macropus rufogriseus*. Furthermore, the *Calyptorynchus lathami lathani* (Glossy Black Cockatoo) would be pushed beyond its current climate niche at Minyumai given climate change predictions. Further research on other habitat requirements and food resources with follow up management action to assist species survival in the Minyumai IPA may be required.

Overview of NSW North Coast region climate change

The summarised information below on predicted climate changes in northern NSW is from the NSW Government OEH Adapt NSW North Coast Climate Change Snapshot (2014) accessed from: http://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Climate-projections-for-your-region/North-Coast-Climate-Change-Downloads. Projections are based on simulations from a suite of 12 climate models.

Projected **temperature** changes	
Maximum temperatures are projected to increase in the near future by 0.4 – 1.0°C	Maximum temperatures are projected to increase in the far future by 1.5 – 2.4°C
Minimum temperatures are projected to increase in the near future by 0.5 – 1.0°C	Minimum temperatures are projected to increase in the far future by 1.6 – 2.5°C
The number of hot days will increase	The number of cold nights will decrease

Projected **rainfall** changes	
Rainfall is projected to decrease in winter	Rainfall is projected to increase in autumn and spring

Projected **Forest Fire Danger Index (FFDI)** changes	
Average fire weather is projected to increase in summer and spring	Severe fire weather days are projected to increase in summer and spring

Temperature

Based on observations from 1910 to 2011 temperature is projected to increase by 0.4-1.0°C during the period of 2020-2029, and up to 1.5-2.4°C between 2060-2069. An increase in the number of high temperature days (over 35°C) is projected to increase and a reduction of potential frost risk is anticipated. The north coast region is expected to experience an increase in all temperature variables (maximum, mean, and minimum) by 2030 and further increase by 2070 (See Figure 2 below).

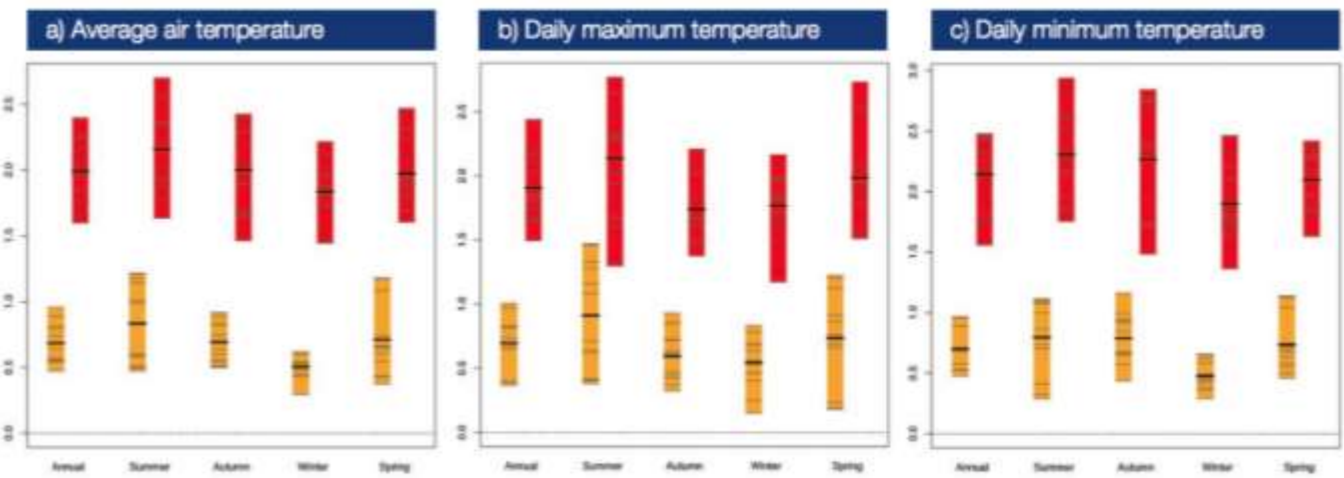


Figure 1: Projected air temperature changes for the North Coast Region by season (2030 yellow, 2070 red): a) average, b) daily maximum, and c) daily minimum. Source: NSW OEH 2014

Hot Days (above 35°C) – graph below left

Currently the North Coast region experiences an average of 10 hot days per year.

Inland areas (Casino, Richmond Valley) are projected to be most affected and could see 15-20 hot days per year by 2030, and 40 hot days by 2070.

The region on average is projected to see an <u>increase</u> of 0-5 days by 2030, and 3-12 days by 2070.

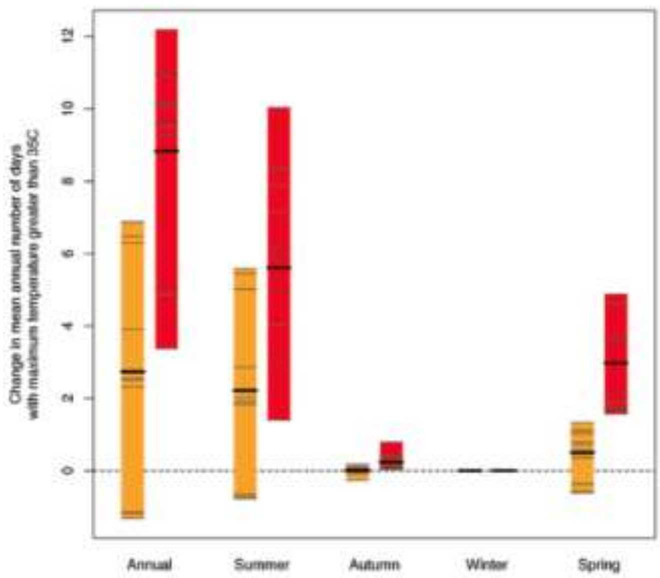


Figure 2: Projected Changes in the number of hot days (above 35°C) for the North Coast Region annually and by season (2030 yellow, 2070 red). Source: NSW OEH 2014

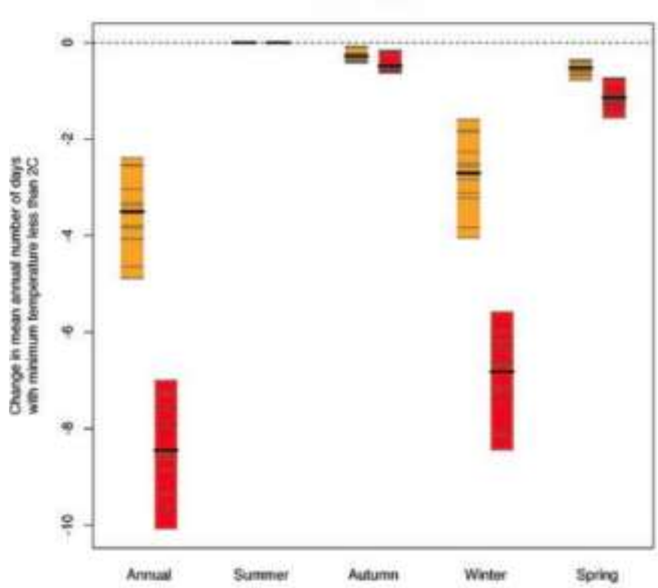


Figure 3: Projected Changes in the number of cold nights (below 2°C) for the North Coast Region annually and by season (2030 yellow, 2070 red). Source: NSW OEH 2014

Cold Nights (below 2°C) – graph above right

The North Coast region is expected to see an average <u>decrease</u> in cold nights across the region of 2-5 nights by 2030, and 7-10 nights by 2070.
The greatest decrease in cold nights is expected along the mountain region that could see 10-20 fewer cold nights by 2030, and over 30 by 2070.

Rainfall

Currently, rainfall varies significantly across the region although there is generally less away from the coast. Rain is seasonal with higher levels of precipitation in summer (see Figure 4). The region has, in the past, experienced substantial rainfall variability with periods of dry and wet conditions (see Figure 5). This included a period of below average rainfall in the early 2000s, followed by two of the wettest years on record in 2010-2011.

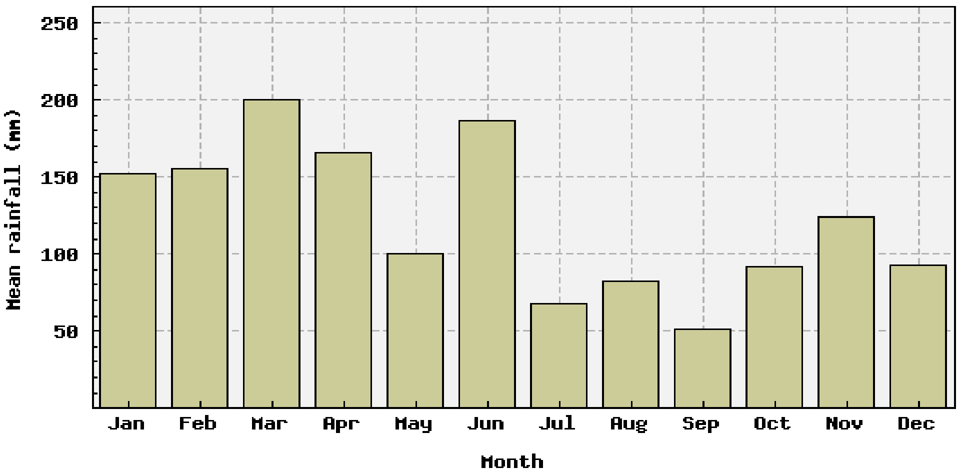


Figure 4: Average monthly rainfall at Evans Head Bombing Range (near Minyumai). Data Source: Bureau of Meteorology; Years 1998-2018.

Figure 5: Total Annual Rainfall at Evans Head Bombing Range (near Minyumai) for 1998-2016. Data Source: Bureau of Meteorology. Dotted line is fitted linear trend showing marginal increase in total annual rainfall over this period.

The climate change models predict more variation in future rainfall. The majority of models (7 out of 12) suggested that autumn and spring rainfall will increase by about 8% and 3% respectively by 2030, and by 15% and 5% by 2070. They also suggest that winter rainfall will decrease in the Minyumai area by about 5% by 2030 (Figure 6).

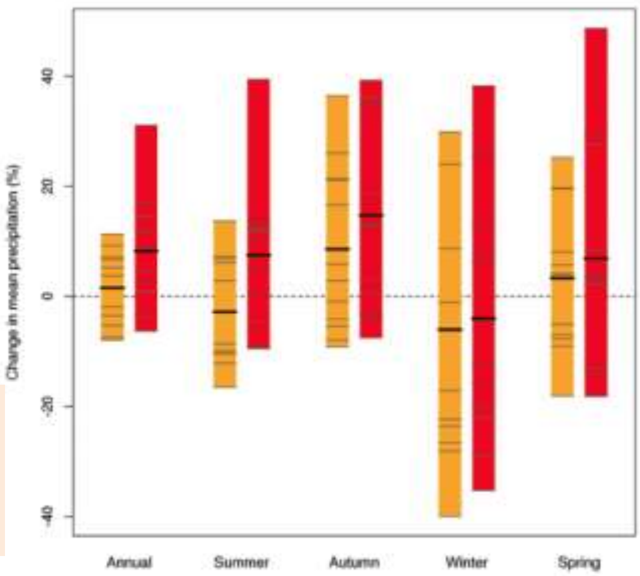


Figure 6: Projected Changes in average annual rainfall for the North Coast region, annually and by season (2030 yellow, 2070 red). Source: NSW OEH 2014

Forest Fire Danger Index (FFDI)

The Forest Fire Danger Index (FFDI) is used in NSW to quantify fire weather. The FFDI combines observations of temperature, humidity and wind speed with an estimate of the fuel load. In northern NSW, there are only three locations where FFDI can be conducted: Lismore, Casino and Coffs Harbour. According to the NSW OEH Climate Change Snapshot (2014), currently, the FFDI is lowest in Coffs Harbour (3.3) and highest in Casino (6.4). The highest average FFDI occurs in Spring and the lowest is in Autumn.

Fire weather is severe when the FFDI is above 50 while FFDI below 12 suggests low to moderate fire weather. Severe fire days are currently estimated to occur 2 days per year at Casino, but are rare at Lismore and Coffs Harbour.

There is little projected change in FFDI for the NSW North Coast region. It is expected that the fire danger will be slightly higher in spring, summer and winter and actually lower in Autumn. But this translates to little change in the high fire danger days, which are predicted to only slightly increase by not even a full day more by 2070 and only in Spring (see Figure 7 and 8 below).

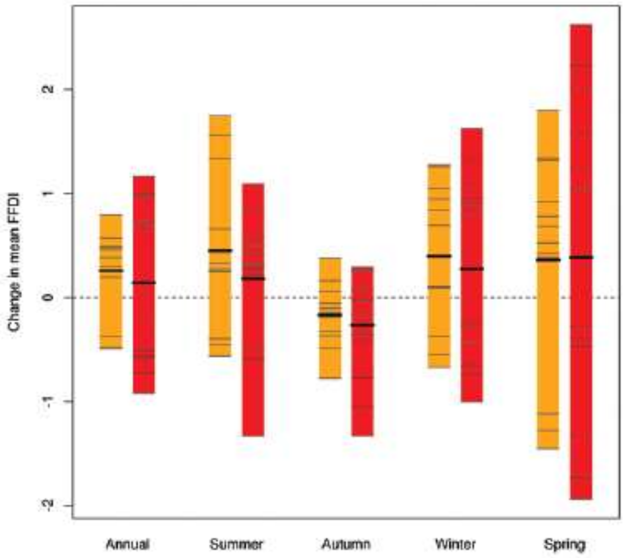


Figure 7: Projected Changes in the average daily FFDI for the North Coast region, annually and by season (2030 yellow, 2070 red). Source: NSW OEH 2014

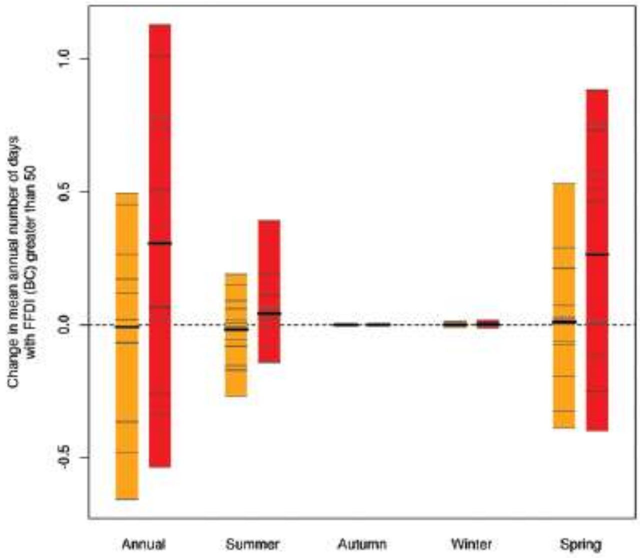


Figure 8: Projected Changes in the average annual number of days with FFDI greater than 50 for the North Coast region, annually and by season (2030 yellow, 2070 red). Source: NSW OEH 2014

Potential Climate Change impacts on Minyumai Culturally Significant Species

FAUNA

Macropus rufogriseus – Red-necked Wallaby

The Red-necked Wallaby is commonly seen in the Minyumai Indigenous Protected Area (MIPA) and across south eastern Australia mainly from around Mackay to Adelaide as well as Tasmania (see map below left). It is commonly seen in northern NSW (map below right).

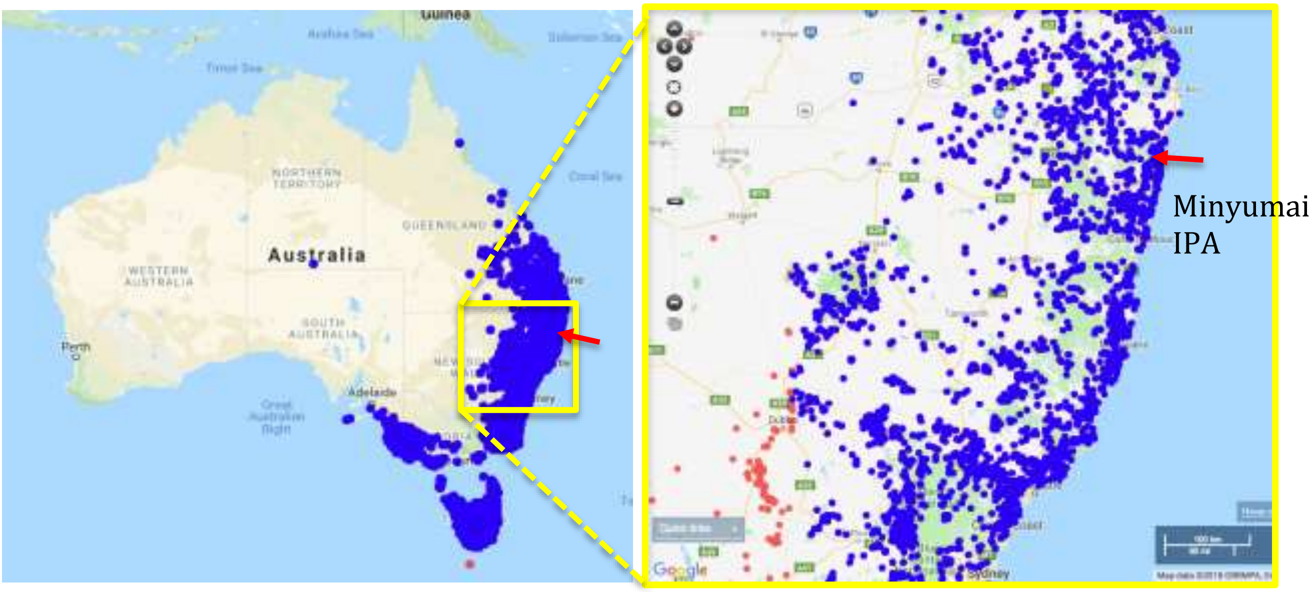


Figure 9: Map of the known distribution of Red-necked Wallaby in Australia (left) and across the NSW North Coast (right), as reported in ALA from 48,345 occurrences. The red arrow shows location of Minyumai IPA.

Because the Minyumai IPA is in the middle of the current distribution of the Red-necked Wallaby, some may predict that expected climate change is not likely to affect this species. However, if we look at the current environmental data associated with the current known locations of this species (images below), we can see that the Minyumai IPA lies in the warmer and wetter portion of the climate niche for this species (see black outline in scatterplot below right). A 2°C increase in temperature and about 70-100mm increase (up to 10% increase) in annual rainfall at Minyumai could push this species to the edge of its known limits (white arrow in Figure 10).

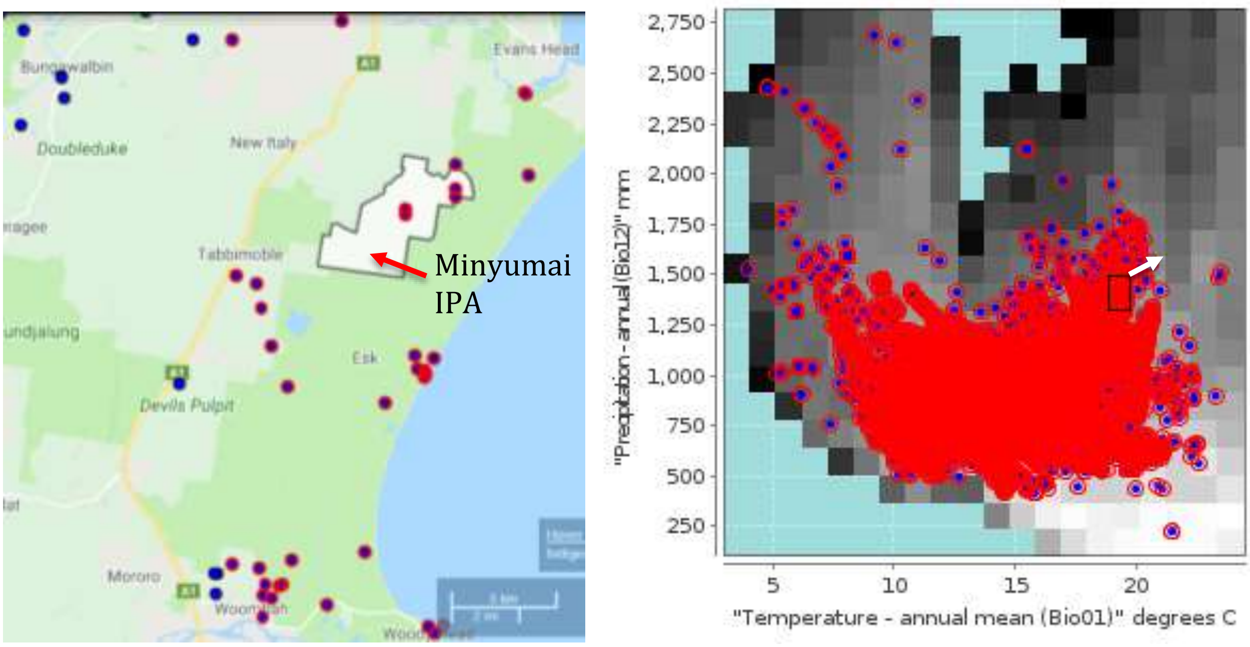


Figure 10: ALA records of the Red-necked Wallaby in and around the Minyumai IPA (left). Records highlighted in red are those with environmental variables occurring in the black box space in the scatterplot to right. White arrow in right diagram shows extent of environmental variable shift taking this species to the edge of its current limit.

In addition, the increase in extreme heat days predicted for the Nth NSW coast over summer (2-6 days more) and spring (1-3 days more) may affect this species' health and reproductive capacity.

Calyptorhynchus lathami ssp. *lathami*– Glossy Black Cockatoo

The Glossy Black Cockatoo is listed as Vulnerable in NSW https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10140.

Dave Milledge (Landmark Consulting, Ecologist) recorded this species in April 2013 in the Minyumai IPA. It was feeding on Casuarina nuts along one of the fire trails. It is rarely seen in the IPA and Rangers are trying to encourage it by looking after the Casuarina and planting more.

The maps below show that the Glossy Black Cockatoo (subspecies *lathami*) has been observed across the south eastern coast of Australia but mainly around Brisbane and NE Victoria (Figure 11). It has only been recorded 939 times and not very often in NSW.

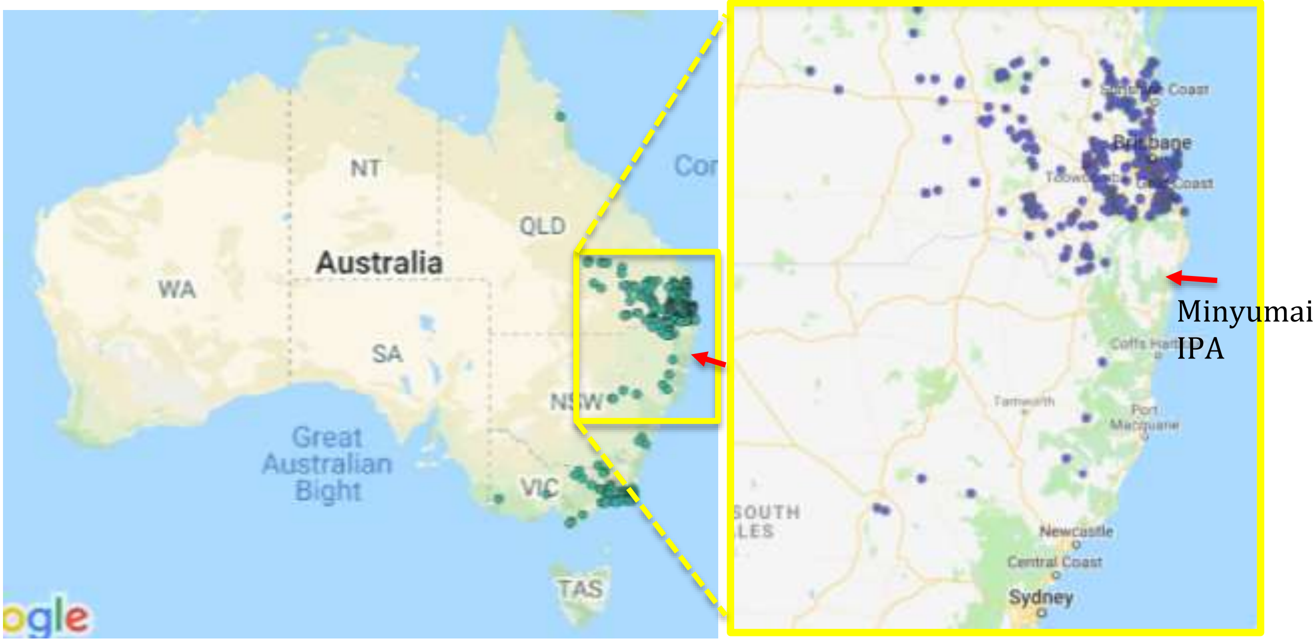


Figure 11: Distribution of the Glossy Black Cockatoo (subspecies *lathami*): Australia wide (left) and North Coast region (right) as reported in the ALA (939 occurrences).

When we look at the current climate envelope for this subspecies based on annual rainfall and annual mean (Figure 12b) for the best matched location (in Fig 12b black square, Fig 12a red dots) we can see that this is the upper limit of this species preferred annual mean temperature and getting towards the high end of its preferred annual rainfall. If we consider these parameters alone, the predicted 2°C increase in temperature and about 70-100mm increase (up to 10% increase) in annual rainfall at Minyumai could push this species to the beyond its known preferred climate (white arrow in Figure 12b).

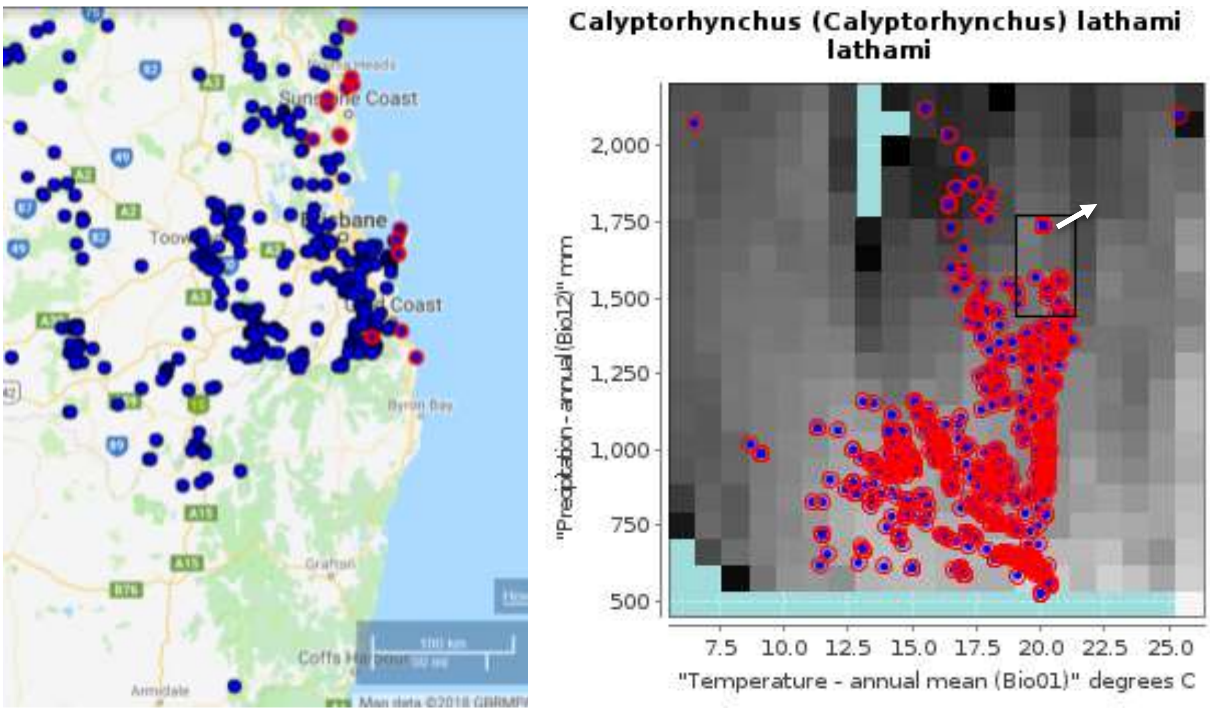


Figure 12: a) records of Glossy Black Cockatoo near Minyumai IPA (blue dots) and red highlighted dots showing similar climate to Minyumai IPA. b) The annual rainfall and annual mean temperature data for each Glossy Black Cockatoo record showing region where Minyumai climate sits in black square and predicted climate change in white arrow.

Varanus varius – Dirawong/Lace Monitor

The Dirawong is a significant totem for the Bandjalang people. It is frequently seen in the Minyumai IPA. The Dirawong has a widespread distribution along the Australian east coast and south towards Adelaide (Figure 13).

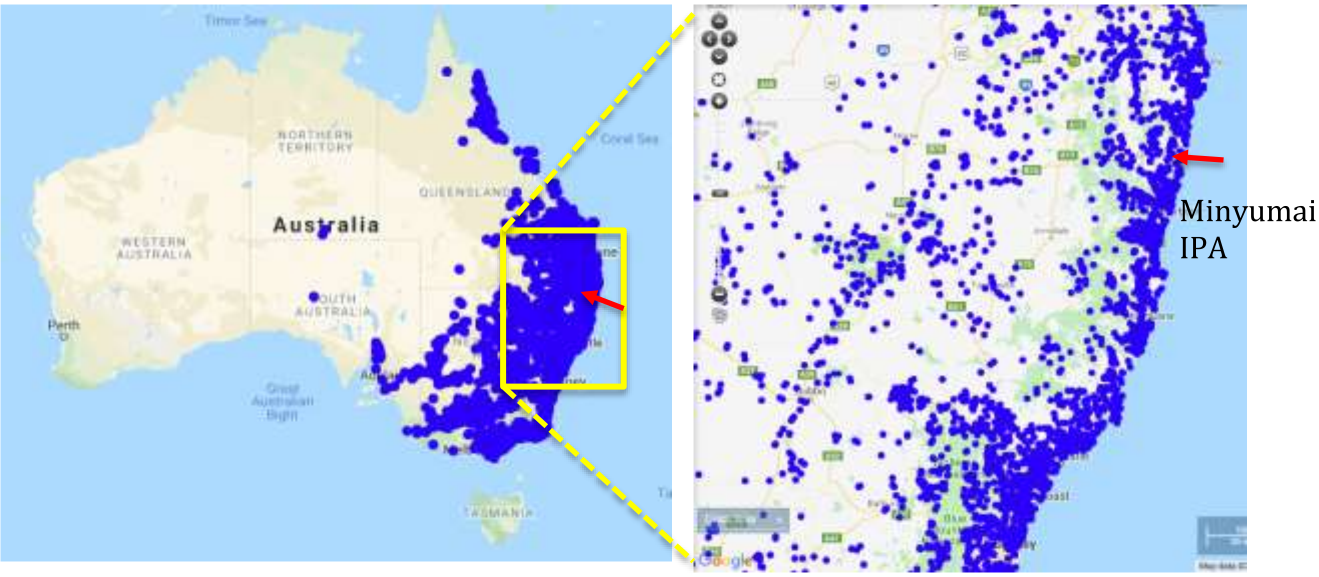


Figure 13: Dirawong distribution across Australia (left) and the NSW North Coast region (as reported in the ALA from 10,311 occurrences)

The climate niche of this species (Figure 14b) shows that the records near Minyumai (in the black square in Fig 14b) are close to the bulk of where this species lives although it is known to tolerate much higher annual rainfall and average annual temperature.

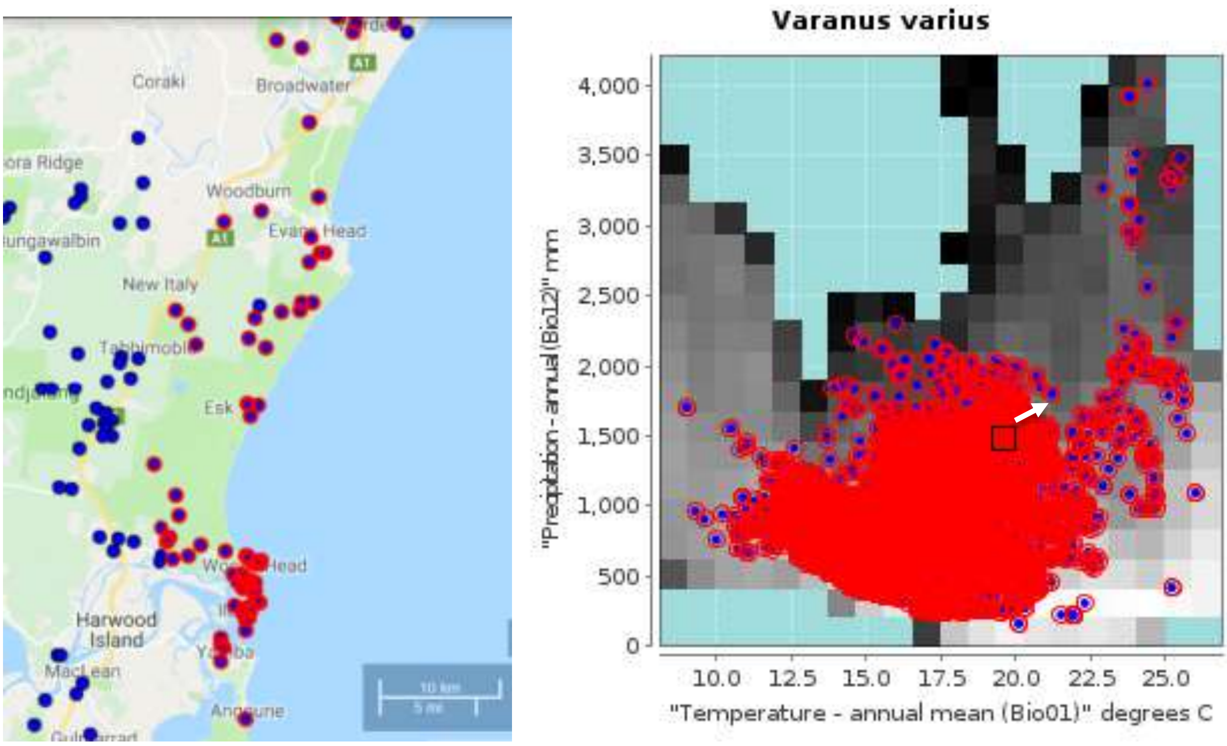


Figure 14: a) records of Dirawong near Minyumai IPA (blue dots) and red highlighted dots showing similar climate to Minyumai IPA. b) The annual rainfall and annual mean temperature data for each Dirawong record showing the region where Minyumai climate sits in the black square and predicted climate change in white arrow.

Phascogale tapoatafa spp. *tapoatafa* – Brush-Tailed Phascogale

The brush-tailed Phascogale is listed as vulnerable in NSW. Follow this web link to find out more about this species: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10613.

The main threats according to the NSW Government are:

- Loss and fragmentation of habitat
- Loss of hollow-bearing trees
- Predation by foxes and cats, and
- Competition for nesting hollows with the introduced honeybee

Recent research has suggested that *Phascogale tapoatafa* has three sub-species across Australia – in northern Australia (ssp. *kimberleyensis*), south east Australia (ssp. *tapoatafa*) and south western Australia (ssp. *wambenger*) which reflects some of the disjunct distribution (and mis-identifications) in the distribution map below to the left. For more information on these sub species follow this link DOI: http://dx.doi.org/10.11646/zootaxa.4055.1.1

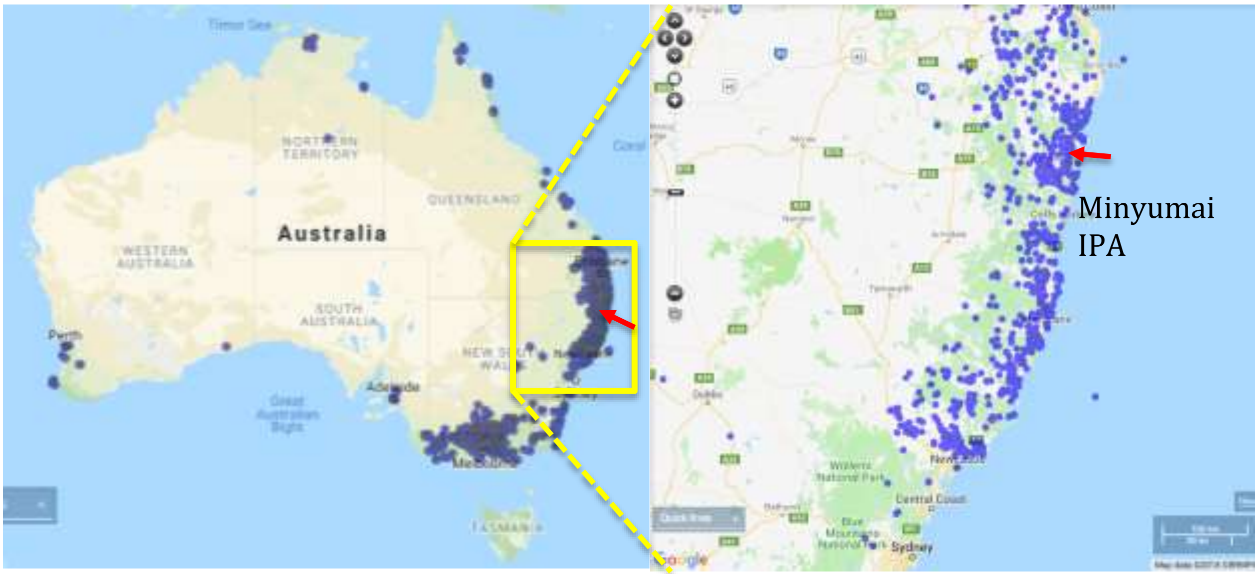


Figure 15: Maps above show the distribution of *Phascogale tapoatafa* across Australia (left) and northern NSW (right) (data from the ALA - 4773 occurrences).

The distribution map for the brush-tailed phascogale in northern NSW above suggests it is commonly found, however it is listed as Vulnerable in NSW. Figure 16 shows the annual records for this species in the SE Qld bioregion, which is where the Minyumai IPA lies. It shows that some individuals have been recorded in most years, especially since the 1990s when sometimes at least 10 have been recorded. Although we note that 10 individuals is not many for such a large region which is under constant threat from development and invasive species.

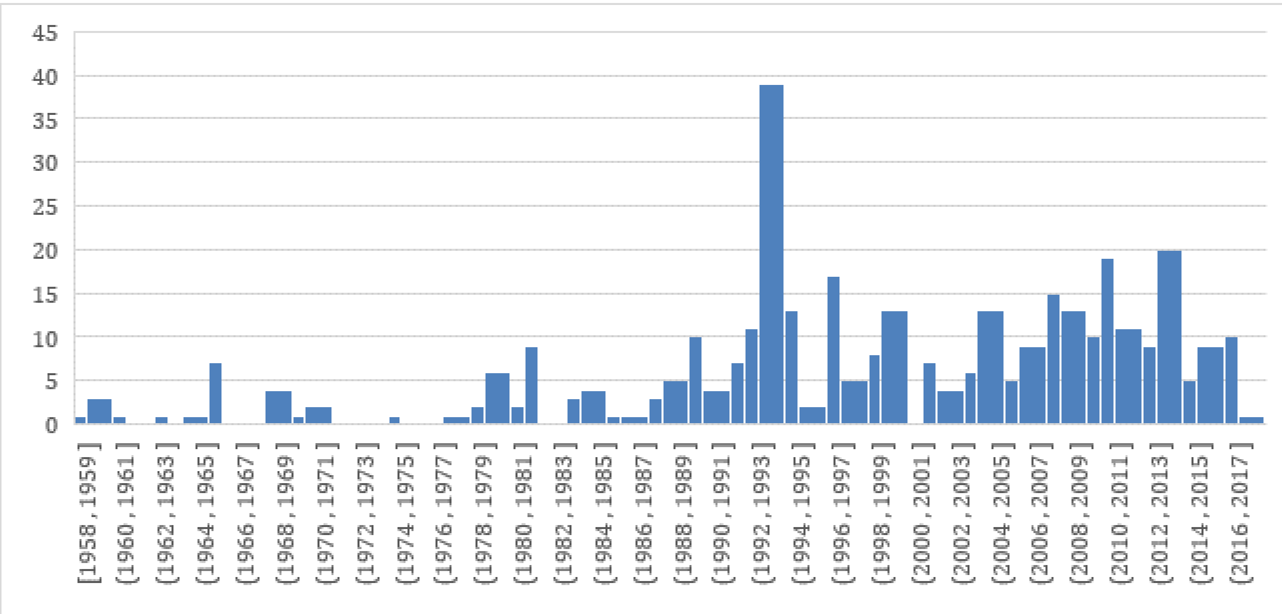


Figure 16: Number of records for the Brush-tailed Phascogale in the SE Qld bioregion since 1958 (data from ALA).

If we look at the climate envelope for this species in terms of annual rainfall and average temperature (Figure 17b) we can see that the Minyumai IPA again lies at the warmer and wetter end of its preferred habitat, although it is known to exist outside of this preferred range.

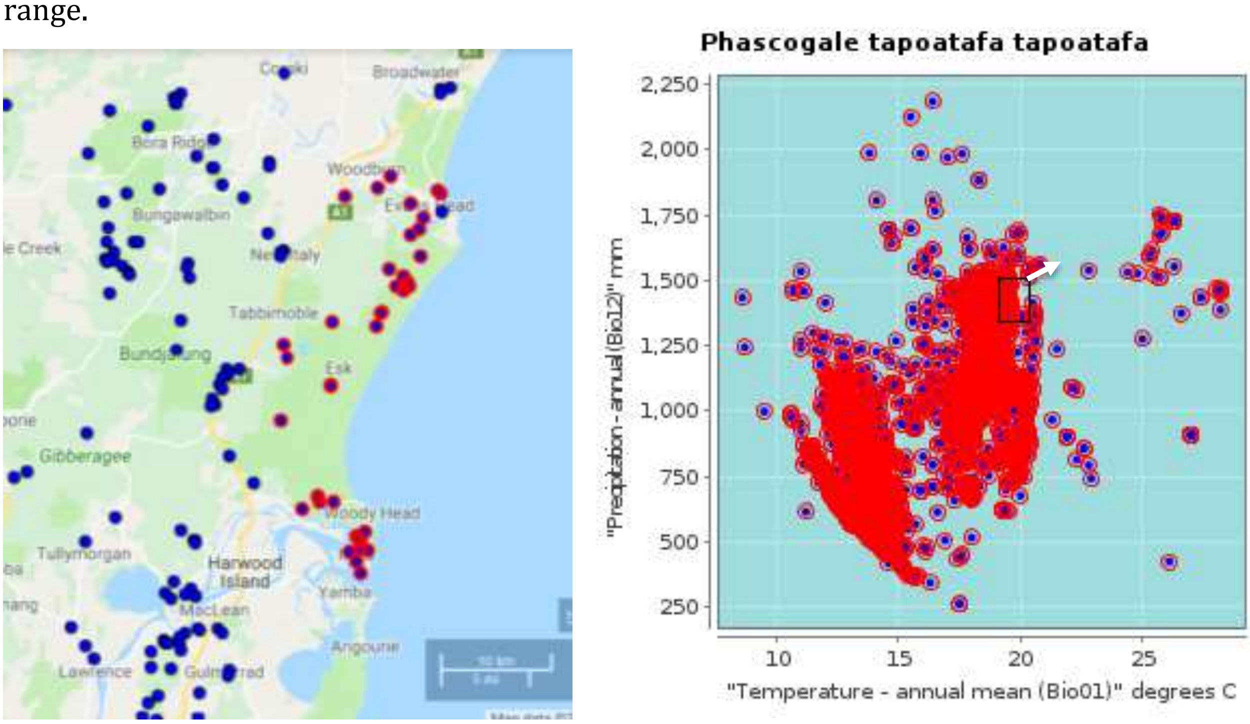


Figure 14: a) records of the Phascogale near Minyumai IPA (blue dots) and red highlighted dots showing similar climate to Minyumai IPA. b) The annual rainfall and annual mean temperature data for each Phascogale record showing the region where Minyumai climate sits in the black square and predicted climate change in white arrow.

FLORA

Rubus moluccanus var. trilobus – Native Raspberry

The Native Raspberry, locally known by the Bandjalang as Mundaruhm, is widely distributed along the temperate and into the tropical zones of the Australian east coast (Figure 15).

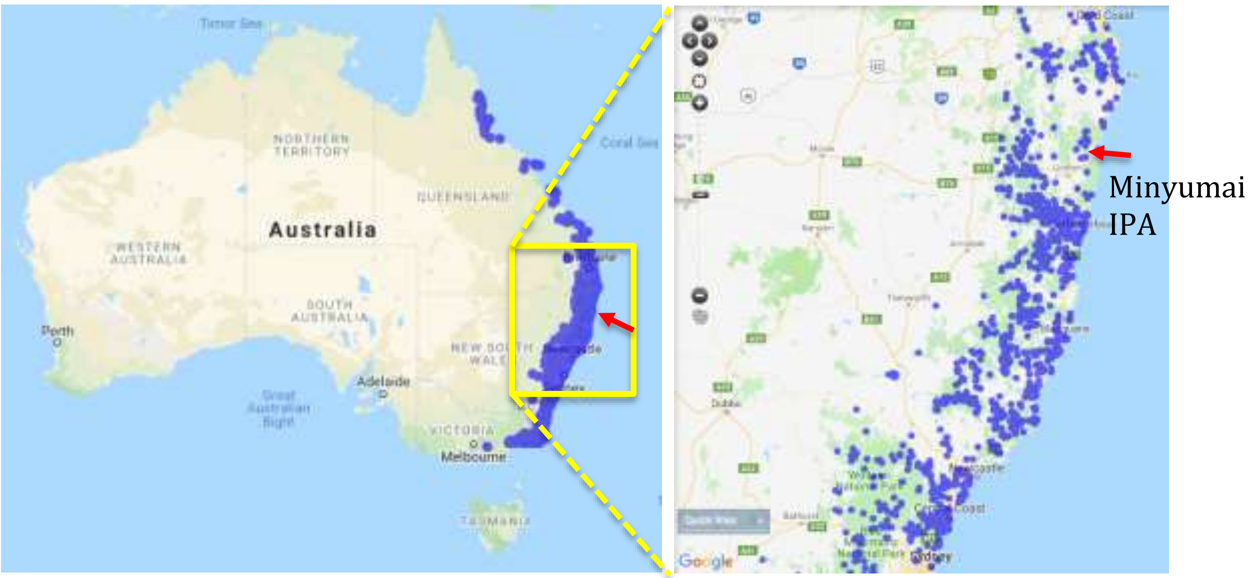


Figure 15: Distribution of the Native Raspberry in Australia (left) and the North Coast region (right) as reported in the ALA from 2795 occurrences.

Again, looking at the climate envelope for this species (Figure 16 right), th epredicted climate shift of 2°C increase in temperature and about 70-100mm increase (up to 10% increase) in annual rainfall at Minyumai could also push this species into the warmer and wetter region of its distribution.

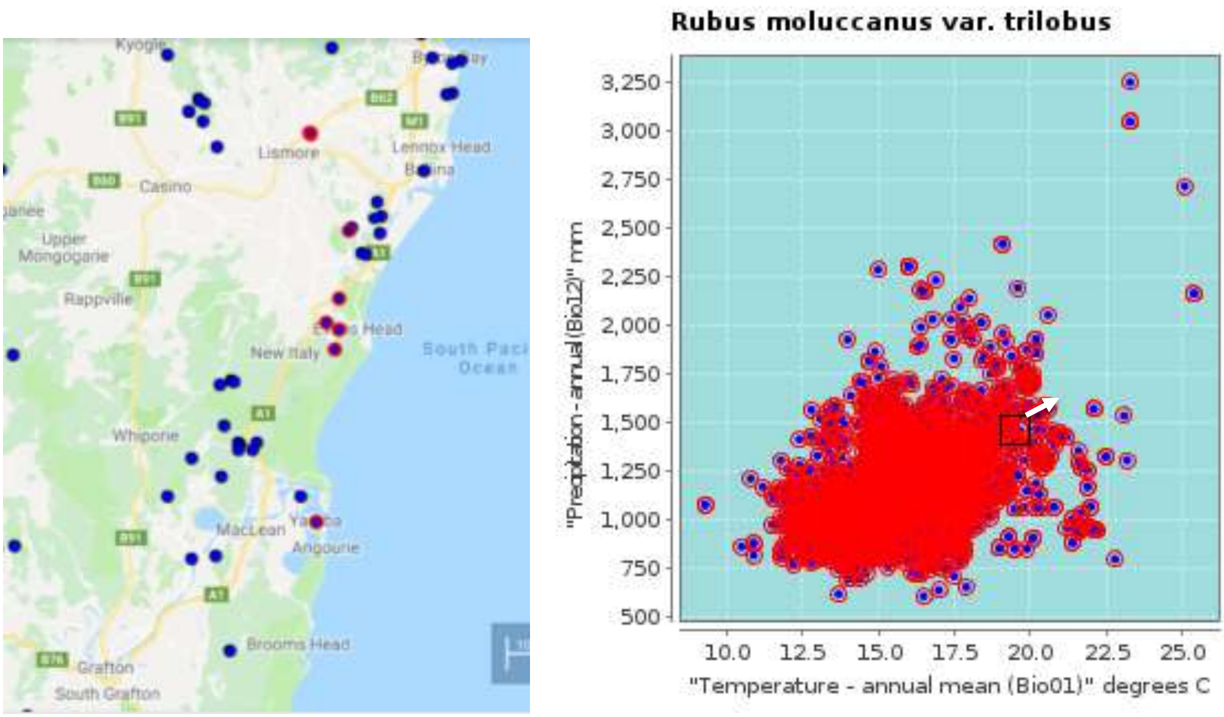


Figure 16: left: records of the Native Raspberry near Minyumai IPA (blue dots) and red highlighted dots showing similar climate to Minyumai IPA. b) The annual rainfall and annual mean temperature data for each Raspberry record showing the region where Minyumai climate sits in the black square and predicted climate change in white arrow.

Lomandra longifolia – Spiny-Headed Mat Rush

Lomandra longifolia is very widespread across eastern Australia (Figure 17 left) and along the NSW Nth Coast and tablelands (Figure 16 right).

The current climate envelope data for this species (Figure 18) suggests that Minyumai is placed in a safe area of this species preferred habitat and with expected climate change for this region (shown by white arrow), it should be able to tolerate its new annual rainfall and average temperature increase.

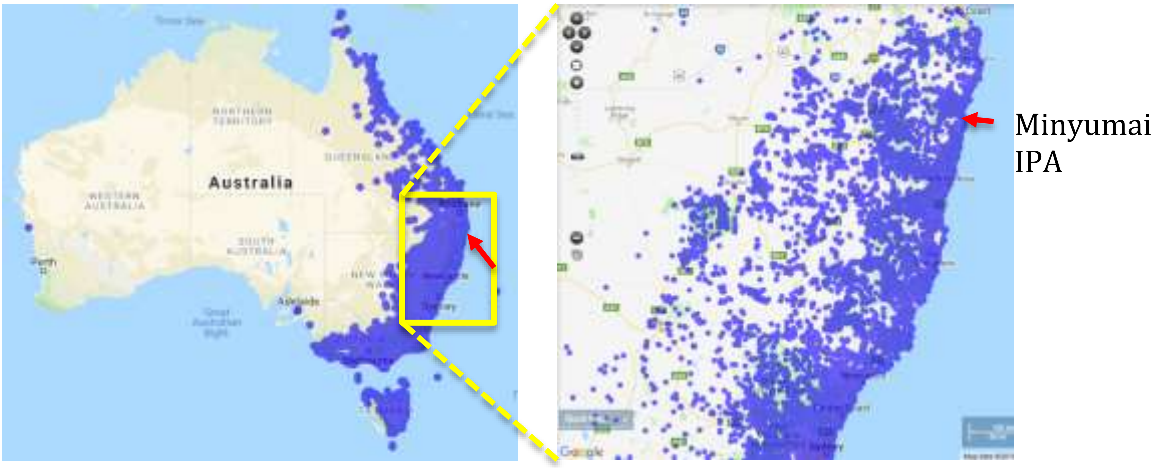


Figure 17: Distribution of Lomandra longifolia Australia wide (left) and in the North Coast region (right) as reported in the ALA (from 52,900 occurrences).

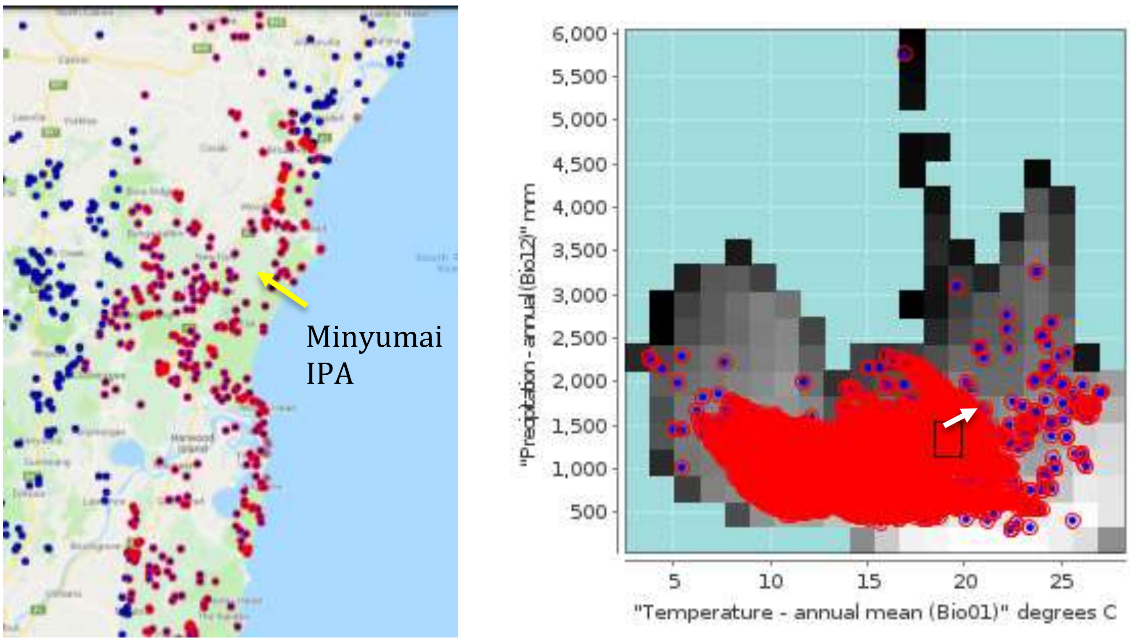


Figure 18: left: records of the Lomandra near Minyumai IPA (blue dots) and red highlighted dots showing similar climate to Minyumai IPA. b) The annual rainfall and annual mean temperature data for each Lomandra record showing the region where Minyumai climate sits in the black square and predicted climate change in white arrow.

Nymphaea gigantea – Water Lily

The Water lily has not been commonly recorded in northern NSW (Figure 19). It would be worth checking the identification of the populations at Minyumai. Minyumai is at the cooler limit of this species' current distribution (Figure 20). The predicted temperature and rainfall increases may benefit this species in the IPA.

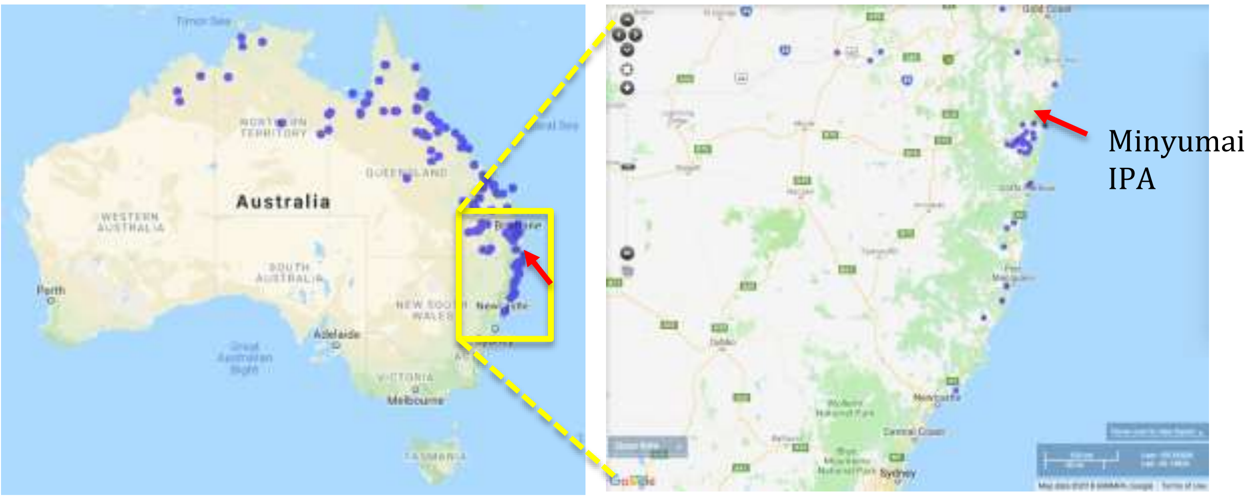


Figure 19: The distribution of *Nymphaea gigantea* in Australia (left) and the North Coast region (right) as reported in the ALA (from 295 occurrences.

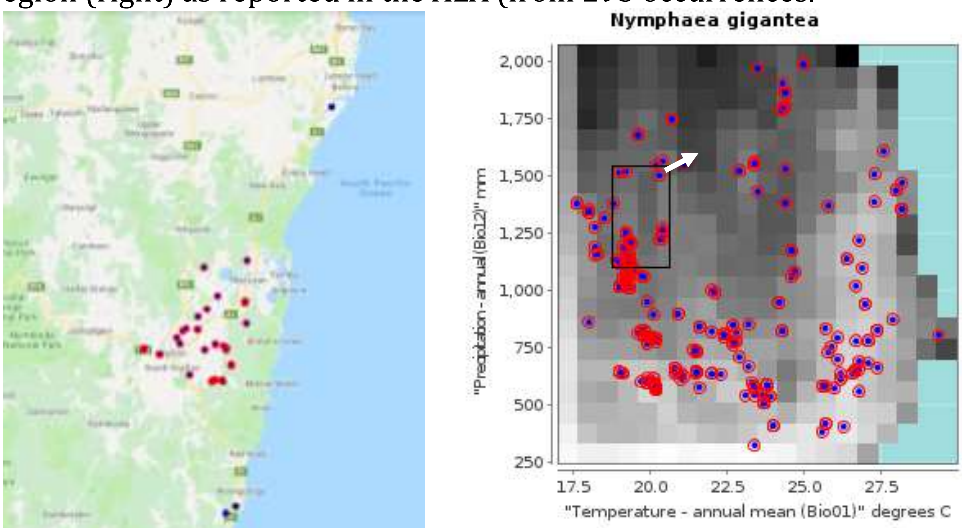


Figure 20: left: records of *Nymphaea gigantea* near Minyumai IPA (blue dots) and red highlighted dots showing similar climate to Minyumai IPA. b) The annual rainfall and annual mean temperature data for each *Nymphaea gigantea* record showing the region where Minyumai climate sits in the black square and predicted climate change in white arrow.

Pandanus tectorius – Beach Pineapple

The beach pineapple is common along the east coast of Australia above Port Macquarie (Figure 21). It does not occur within the Minyumai IPA but is common in coastal areas of the Bandjalang estate. Predicted climate shifts may benefit this species as within the Bandjalang area it is near is southern-most and cooler/drier distribution.

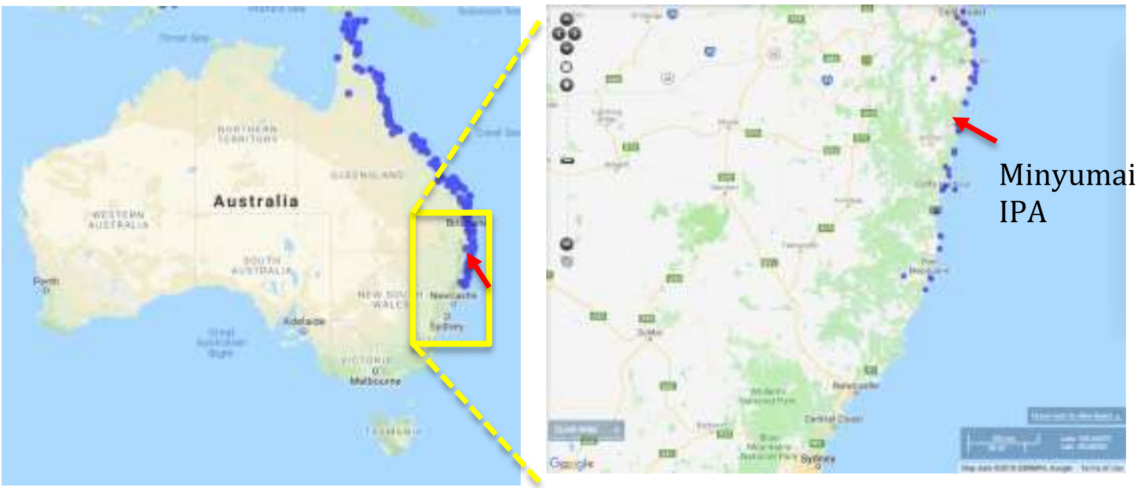


Figure 21: Distribution of the beach pineapple in Australia wide (left) and the NSW North Coast region (right) as reported by the ALA (from 621 occurrences).

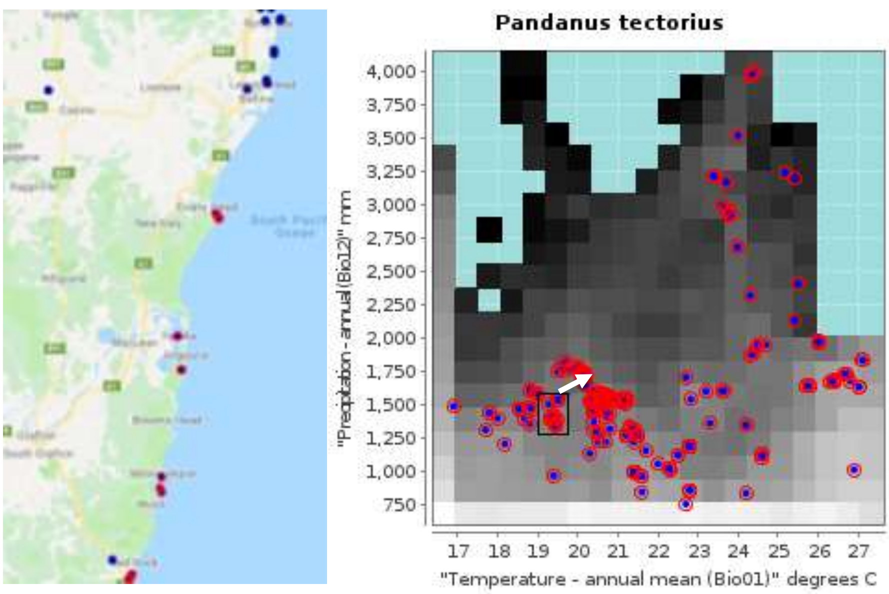


Figure 22 (left): left: records of Beach Pineapple near Minyumai IPA (blue dots) and red highlighted dots showing similar climate to Minyumai IPA. b) The annual rainfall and annual mean temperature data for each Beach Pineapple record showing the region where Minyumai climate sits in the black square and predicted climate change in white arrow.

Persoonia cornifolia – Large-Leaf Geebung

The large-leaved geebung is commonly found in central eastern Australia along the coast and tablelands (Figure 23). It is also commonly seen at Minyumai.

The climate envelope for this species (Figure 24) shows that in the Minyumai area, it is at its warmer and wetter distribution. With predicted warmer and wetter conditions, this species may be pushed to its limits.

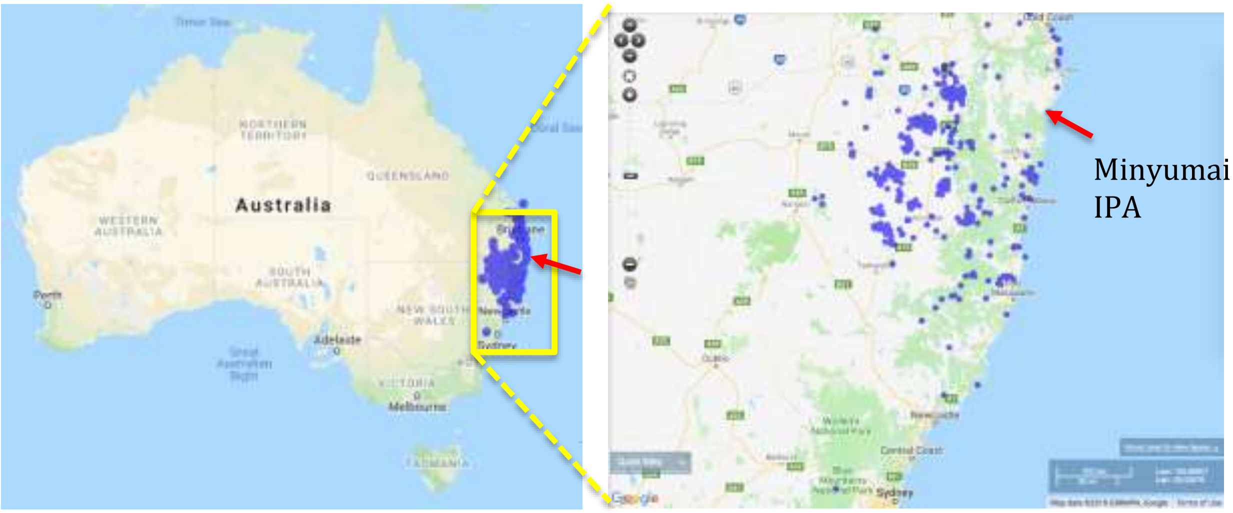


Figure 23: Distribution of the large-leaved geebung Australia wide (left) and in the NSW North Coast region (right) as reported by ALA from 1288 occurrences.

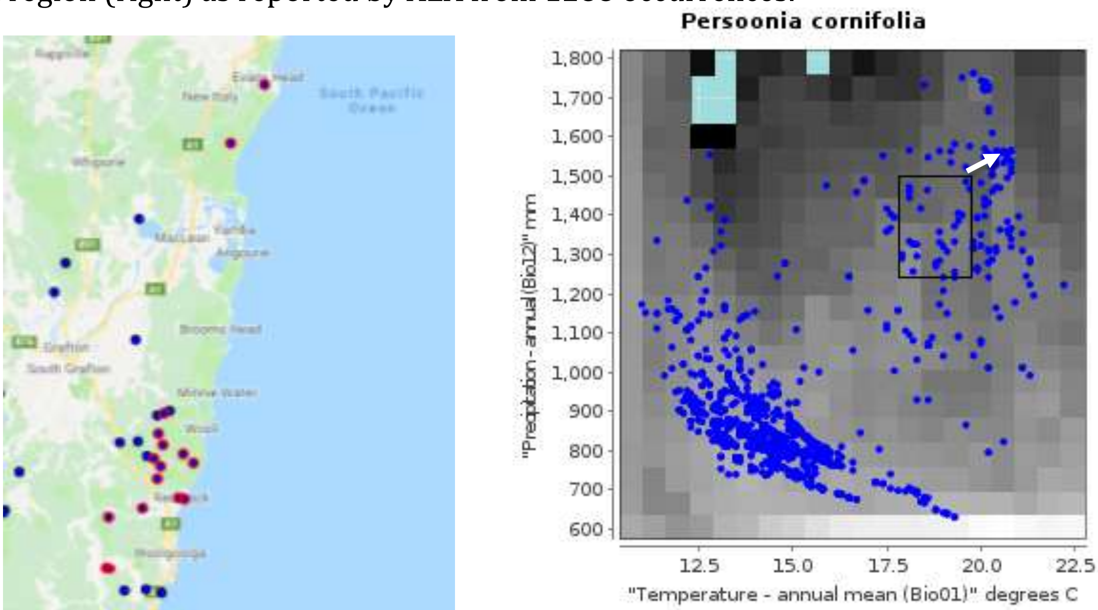
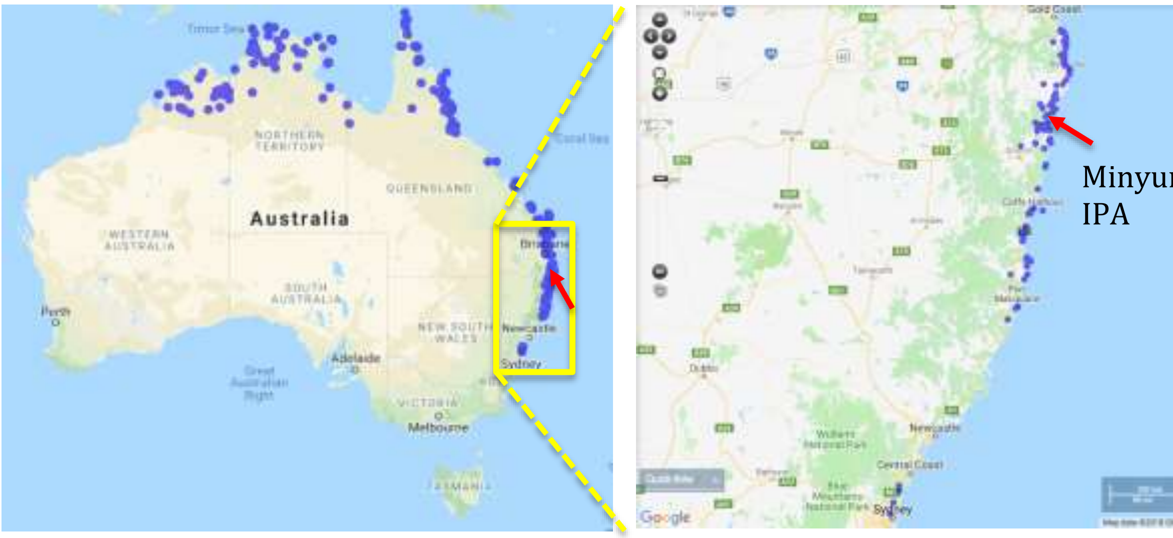


Figure 24 (left): left: records of the large-leaved geebung near Minyumai IPA (blue dots) and red highlighted dots showing similar climate to Minyumai IPA. b) The annual rainfall and annual mean temperature data for each large-leaved geebung record showing the region where Minyumai climate sits in the black square and predicted climate change in white arrow.

Melastoma affine – Blue Tongue/Native Lassiandra

Native Lassiandra occurs across northern Australia and down to Sydney on the east coast (Figure 25) including the Bandjalang estate. According to its current climate envelope (Figure 26), Minyumai sits at the cooler/drier end of its distribution. Expected increases in temperature and rainfall could benefit this species around Minyumai.



Minyumai IPA

Figure 25: Distribution of the Native Lassiandra Australia wide (left) and in the NSW North Coast region (right) as reported by ALA from 424 occurrences.

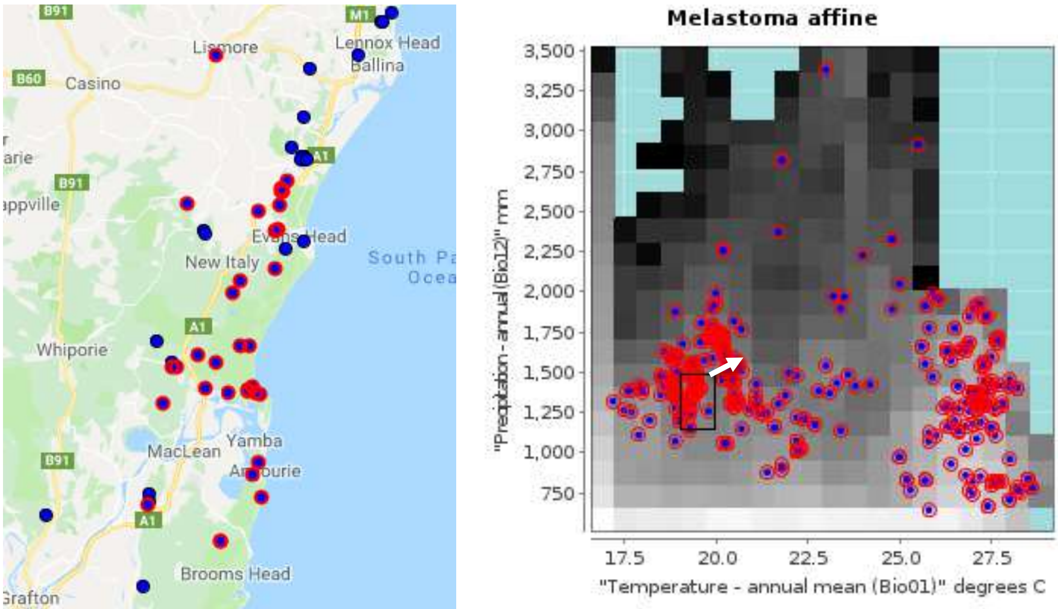


Figure 22 (left): left: records of Native Lassiandra near Minyumai IPA (blue dots) and red highlighted dots showing similar climate to Minyumai IPA. b) The annual rainfall and annual mean temperature data for each Native Lassiandra record showing the region where Minyumai climate sits in the black square and predicted climate change in white arrow.