



# Climate Change and the Strzelecki Koala



Strzelecki Koala  
Action Team (SKAT)



**Friends of  
the Earth**  
Melbourne

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Anna Slotnick  
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Acknowledgments:  
Anthony Amis, SKAT team  
Michelle Baxter, SKAT team  
Friends of the Earth Melbourne team

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# Executive Summary

There are two genetically distinct koala populations in Victoria: the endemic genetically significant Strzelecki/South Gippsland population and the translocated animals sourced from island populations. The remnant Strzelecki/South Gippsland koala population has been found to have the highest levels of genetic diversity amongst any koala population in Victoria. Genetic diversity is vital for the long term survival of the species not only in Victoria, but across Australia, as high levels of genetic diversity are necessary for the ability of individuals to adapt to changes to their environments such as climate change. The Strzelecki/South Gippsland koala population is therefore a highly significant population, which requires a specific management strategy.

A number of efforts have been made to conserve the habitat of these genetically distinct animals including surveying, legal strategizing and community organising efforts by Friends of the Earth (FoE) Melbourne. According to recent surveying by FoE and others, it is estimated that around 1,500-2,000 animals are currently present in the South Gippsland region. FoE Melbourne also played an important role in establishing the Brataualung Reserve, protecting key koala habitat. Some conservation efforts have occurred at the state level, however, the Strzelecki/South Gippsland koala population currently has no legal protections, except for limited protection under the Wildlife Act.

While there are a number of threats to the Strzelecki/South Gippsland koala population, climate change is the key focus of this report. Changes to global climate patterns have resulted in more frequent/intense heat waves and extreme weather events and have altered weather patterns across the world. Anthropogenic causes such as greenhouse gas (GHG) emissions are largely responsible for these unprecedented changes, which have had significant impacts on global biodiversity and wildlife populations.

Major disruptions to standard weather systems and patterns caused by climate change have impacted human and wildlife communities across Australia. The Strzelecki/South Gippsland koala population has felt the influence of climate change through increased frequency and intensity of bushfires and extreme weather events such as heatwaves and storms. These impacts affect the spatial distribution and occurrence of preferred eucalypt tree species (used for food and shelter) in the South Gippsland region and have caused associated habitat fragmentation. This has directly threatened the wellbeing and survival of individual animals as well as the overall conservation of the population for its unique genetic diversity.

This report concludes with a number of management and policy recommendations to ensure the long term conservation of the Strzelecki/South Gippsland koala population, and thus, the conservation of koala populations across Australia.

# Background

## Victoria: Two Distinct Koala Populations

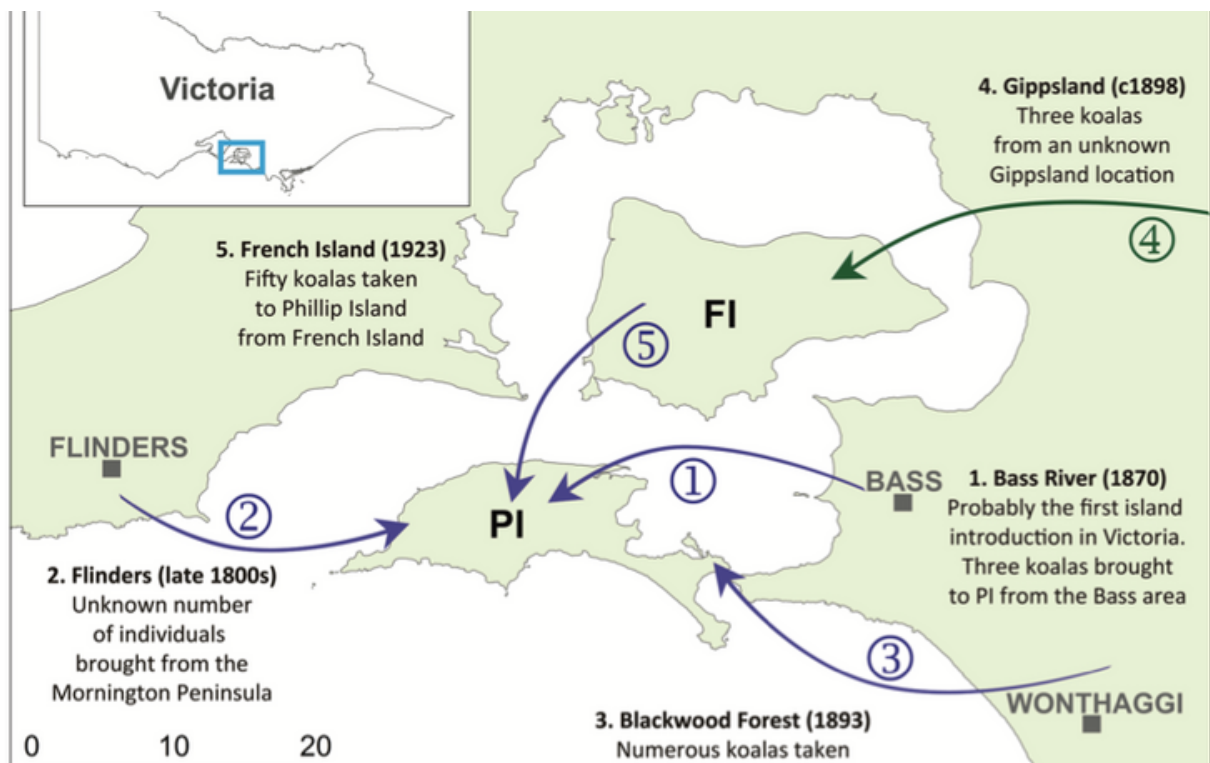
The koala is an iconic Australian marsupial whose habitat ranges roughly from southern regions of South Australia through to Queensland. However, due to a number of primarily anthropogenic factors and translocations, numerous sub-populations are found throughout Australia outside of their traditional range (Department of Agriculture Water and the Environment, 2021). Across Australia since the first arrival of Europeans, western colonisation and exploration of the country resulted in extensive land clearing for development of agriculture, and a significant change in the native distribution and genetic structures of the endemic koala populations (Wedrowicz et al., 2017).

This report will be primarily considering the distinct and genetically significant Strzelecki/South Gippsland koala population, located in South Gippsland, Victoria. However, it is important to highlight the history of koalas in this region of Victoria and to differentiate the remnant endemic koala population (the Strzeleckis) from the more abundant translocated island populations.

## Victoria: Translocated Island Populations

In the late 19th century, a small number of koalas were translocated from their native habitat in Gippsland and the Mornington Peninsula, to French and Phillip Islands (see fig. 1). As there were only a small number of individuals from the endemic population introduced to the islands, the genetic diversity of the island populations were significantly reduced, which led to a limited gene pool. Soon after introduction, the koala populations began to spread rapidly, resulting in overconsumption of native vegetation and degradation of island ecosystems and landscapes.

Numerous individuals from the established island populations were eventually translocated back to mainland Victoria in the 1940's (and South Australia in the 1920's), to simultaneously address the rapid and unsustainable growth of their populations on the islands and assist in population declines of the remaining mainland koalas (Wedrowicz et al., 2018). The re-introduction of the island populations saw individuals spread quickly across regions, due both to their ability to breed quickly and because of the lack of native pathogens held by the endemic koala populations. The Victorian Government has stepped in with a number of management strategies to address the overabundance of koalas since their re-introduction (Friends of the Earth Australia, 2020).



**Figure 1.** Map illustrating the history of koalas translocations in south-eastern Victoria (Wedrowicz et al., 2017).

### **Victoria: Endemic Strzelecki/South Gippsland Population**

Around the same time as the island translocations, there were also a small number of endemic koalas who miraculously managed to survive threats to their environment such as excessive land clearing and development, the expansion of the agriculture industry, hunting campaigns and the fur trade following western colonisation. These threats had initially led experts to believe the koala populations in Victoria and South Australia were completely extinct, however surveys in the 1920's conducted by the Victorian Government revealed that a remnant koala population near Yarram (south-east of the Strzeleckis) had miraculously managed to survive these threats. Unlike the translocated island populations, the Strzelecki/South Gippsland koalas have been found by a number of studies to have retained high levels of ancestral genetic diversity, with distinct and rare genetic markers being found within the population (Houlden et al., 1996; Wedrowicz et al., 2018).

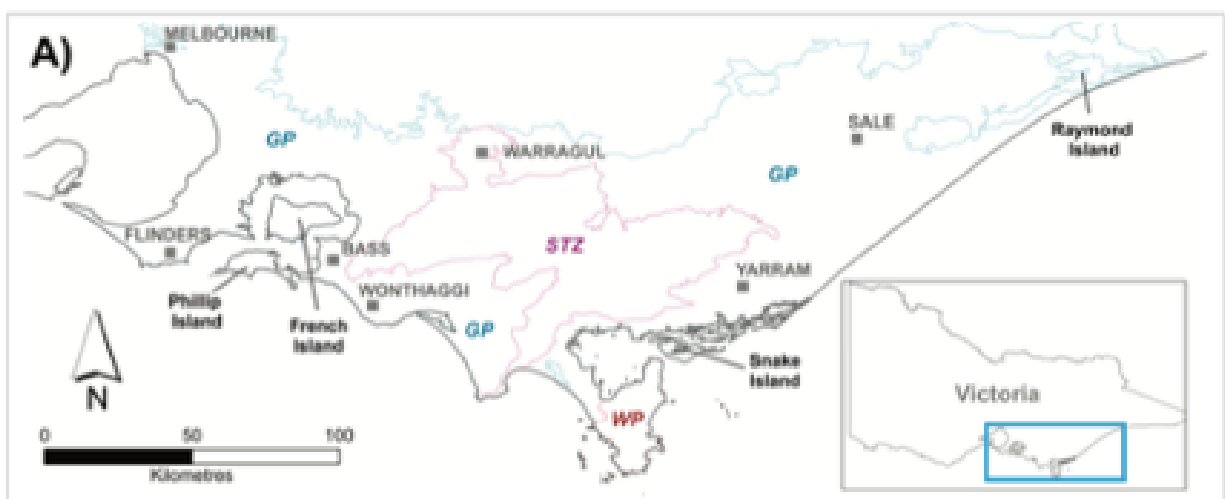
## “About” The Strzelecki Koala



**Figure 2.** Female Strzelecki koala with her baby. Photo Cred: Tim Farrell

### Habitat and Ecology

The Strzelecki/South Gippsland koala (see fig. 2) population resides within native forests and plantations in the Strzelecki Ranges and Gippsland plains bioregions. The Strzelecki Ranges are one of three bioregions located in the South Gippsland (VIC) region estimated to cover approx. 3,500 km<sup>2</sup> (see fig. 3) which is located south-east of Melbourne and includes land within Bass Coast, South Gippsland, Wellington and Latrobe City Shires (Wedrowicz et al., 2017).



**Figure 3.** Map of southern Victoria showing the regions and islands discussed in the text. (Wedrowicz et al., 2017).



Choice of habitat is largely driven by the occurrence and density of eucalypt tree species. Koalas feed on the foliage of eucalypt species, making the koala a dietary specialist (Wedrowicz et al., 2017). Although the koalas rely on a range of eucalypt species, a select few will be chosen preferentially, with the rest being browsed opportunistically (Phillips & Wallis, 2016). The Strzelecki/South Gippsland population however specifically prefers the following eucalypt species in the area for food: Mountain Grey Gum (*E. cypellocarpa*) (see fig. 4), Blue Gum (*E. globulus*) and Strzelecki Gum (*E. strzeleckii*). However, koalas will also eat a variety of different eucalypts. These koala populations also notably presented a preference for mature and larger trees amongst these species types (Wedrowicz et al., 2017).



**Figure 4.** Strzelecki koala resting in a Mountain Grey Gum tree.

## **Land-use and Threats**

Preferred eucalypt species and koala “hotspots” are interspersed throughout the Strzelecki Ranges and Gippsland Plains Bioregions, which are utilised for a number of different land purposes (Wedrowicz et al., 2018). In the west of the Strzelecki Ranges, much of the native forest was cleared during the late 19th century and is now primarily utilised for agricultural purposes. In the east of the ranges, over 50,000 hectares of forest and plantation is managed by Hancock Victorian Plantations (HVP) and used primarily for forestry purposes. A small portion of the eastern Strzeleckis is reserved in national parks and reserves (Wedrowicz et al., 2017).



There are a number of threats to the Strzelecki/South Gippsland koala population. Logging and land clearing activities, predominantly from HVP plantations (see fig. 5) have had a significant impact on the population through the clearing of favourable koala habitat and preferred eucalypt tree species. These land clearing activities have not only led to the loss of habitat and food supply, but have resulted in forest fragmentation and the inability of the native forest to support koala populations (Phillips & Wallis, 2016; Wedrowicz et al., 2017).



**Figure 5.** Logging of koala habitat in South Gippsland.

Fires are also a key threat and are becoming more prominent due to climate change, increased logging and planned burn-offs, which are occurring at rates which exceed the rate of the koalas to repopulate damaged habitat. Attacks from domestic dogs and car killings also present threats (Phillips & Wallis, 2016), however, climate change is arguably the most prominent threat to the Strzelecki/South Gippsland koala population and its habitat, and will be discussed in greater detail later in this report.

## Significance of the Strzelecki koala

Genetic diversity is extremely important for the long term conservation of koala populations across Australia and is vital in ensuring individuals are able to adapt to changes and threats to their environment over time such as climate change (Wedrowicz et al., 2018). A lack of genetic diversity can also lead to increased susceptibility to physical ailments such as increased calcium deposits in the kidneys, testicular aplasia, and a variety of deformities in body composition and appearance (Friends of the Earth Australia, 2020). Lack of genetic diversity also increases risk of contracting a number of diseases such as chlamydia and mange. Chlamydia or 'chlamydiosis' is a common disease/bacterial infection found within many koala populations across Australia which can severely impact a female koala's fertility and urinary tracts. The translocated island koala populations (notably from French Island) have been found to have zero to low levels of chlamydia within the population, meaning that descendants now living in mainland Victoria from this population are at a greater risk of severe infection, which could result in population declines or extinction (Wedrowicz et al., 2017). Whilst more frequently reported in Australian wildlife populations such as wombats, sarcoptic mange is also notably beginning to be observed and reported amongst koala populations in both Victoria and South Australia. Infected individuals have been found with dry and itchy lesions across the body (Speight et al., 2017).

The remnant Strzelecki/South Gippsland koala population has been found to have the highest level of genetic diversity amongst all South Australian and Victorian koala populations, and thus requires a separate management unit from the other Victorian koala populations. The focus on translocated populations typically relates to their overabundance, however the focus of management for the Strzelecki/South Gippsland koala should be on conserving the remnant population due to its distinct genetic diversity (Wedrowicz et al., 2017). According to research undertaken by Houlden et al. 1996, "The Strzelecki Koala population has high levels of genetic variability which have been detected by rare and unique genetic markers. These animals are statistically significantly differentiated from other Australian populations and therefore constitute a separate management unit. Biodiversity in the species as a whole is dependent on conservation of populations throughout the species range, the Strzelecki Ranges population, together with the South Gippsland population is nationally significant as well ...." The genetic diversity and unique remnant gene pool of the original endemic population of the Strzelecki Ranges/South Gippsland region(s) is therefore key in ensuring the long term viability of koala populations in Victoria and across Australia (Friends of the Earth Melbourne, 2021; Houlden et al., 1996). Similarly, Wedrowicz (2017) explains that it is vital to conserve genetically distinct populations, such as the Strzelecki/South Gippsland koala population, to give the species as a whole the best chance at long term viability.

# Current Strzelecki Conservation Efforts

## Strzelecki Koala Action Team (SKAT)

The Strzelecki Koala Action Team (SKAT) is one of numerous “collectives” of Friends of the Earth (FoE) Melbourne. The team actively engages with the press, publishes updates on the FoE Melbourne website and hosts monthly collective meetings with a focus on increasing community awareness and understanding the threats to Strzelecki Koala habitat and population numbers. The collective also provides tips on how members of the South Gippsland community can spot and report koala sightings. This is typically done through finding and reporting the GPS location of a scat (koala poo) (see fig. 6), as it can sometimes be difficult to spot the koalas in the dense eucalyptus foliage.



**Figure 6.** Strzelecki koala scats.

However, the SKAT team also encourages the reporting of GPS coordinates if a member of the public is lucky enough to spot one! (Friends of the Earth Melbourne, 2021). The ‘Strzelecki Koala Map’ is a database where community members send through GPS coordinates which is a vital part in helping to gain a more accurate estimate of remaining Strzelecki koala population numbers.





The “Friends of the Strzelecki Koala” Facebook group is another useful tool where interested parties and local community members can discuss issues relating to the Strzelecki koala, report sightings and/or animal injuries and upload images of the koalas. Anthony Amis from the SKAT team has actively used this page as a tool to then upload reported coordinates to the Strzelecki Koala Map (Amis, 2021). The page can be found at: [facebook.com/groups/2379484805628595](https://www.facebook.com/groups/2379484805628595).

## EPBC Listing

Whilst helping to raise awareness of the severe threats to the Strzelecki koala and their habitat along with encouraging local community members to sight and report koalas, the SKAT team has recently focused on a campaign to get the koala listed under state and federal legislation. Primarily, the focus has been on lobbying for a listing under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999, however progress on this front is notably dependent on when submissions for new listings open to the public.



## SKAT Surveys

Aside from encouraging community sightings and reporting of individual koalas, Anthony Amis from the SKAT team (see fig. 7) has been conducting surveys to gain field data and population estimates, which he reports on and uploads to the Strzelecki Koala Map as well as the Victorian Biodiversity Atlas. Amis, through Friends of the Earth Melbourne and Susie Zent from Friends of Gippsland Bush, have since the late 1990’s worked in coordination with numerous interested parties within the scientific community. In 2013, a new scientific approach developed by Steve Phillips and his associate J. Callaghan, known as the “Regularised Grid-based Spot Assessment Technique (RG-bSAT)” was introduced to the Strzeleckis by the NSW Office of Environment and Heritage and used for initial surveying of the Strzeleckis and South Gippsland regions in 2014–2016 (Amis, 2021). Results of this survey work allowed Dr. Steve Phillips from Biolink Ecological Consultants to publish the first ever ‘Strzelecki Koala Habitat Utilisation Report’ in 2016. The report was funded through the South Gippsland Landcare Network.



**Figure 7.** SKAT Team (Michelle Baxter and Anthony Amis) surveying koala habitat.

The results of this project indicated an estimated population of approx. 945 animals, or, 0.09 koalas/ha within the study area of approximately 10,500 ha in the Strzeleckis and South Gippsland. These estimates were notably undertaken in the highest quality of forest sites within the Strzelecki Ranges bioregion, however later surveys undertaken by FoE and others (2016) were sourced from lesser quality regions of which preferred tree species were less common, soil quality was poor, and the habitat highly fragmented (Amis, 2021). These studies using the RG-bSAT method and surveying of koala scats have not only produced population estimates but also identified preferred koala tree species within the Strzelecki Ranges Bioregion: the Mountain Grey Gum, Blue Gum and Strzelecki Gum, as well as Manna Gum in coastal regions (Friends of the Earth Melbourne, 2021).

A refined version of the method, “RAPID SAT,” was planned to be used for a new round of surveys in 2019/2020 and 2021 by FoE Melbourne in new areas, however, progress was significantly hindered by Covid-19 outbreaks and restrictions. FoE was however able to confirm koala presence in the Won Wron and Mullundung state forests (between .01-.02 koalas ha - notably less than recent estimates by the Victorian Government) and estimates around 1,500–2,000 animals currently present in the Strzelecki/South Gippsland region (Amis, 2021). Dependent on the Covid-19 pandemic and associated restrictions, more work needs to be done in lower elevation forests of the South Gippsland area (Friends of the Earth Melbourne, 2021).



## Brataualung Forest Park

A direct result of the work of various parties surveying koala habitat in South Gippsland and lobbying by FoE and Friends of Gippsland Bush has been the establishment of the Brataualung Forest Park in 2018 (see fig. 8). The formation of the reserve was reliant on a State Government buyback of land from Hancock Victorian Plantations. In 2018, 1,600 hectares (ha) were returned and established as “Reserve Forest” under s 50(1) of the Forests Act 1958, meaning that no logging activities can take place within the reserve (Amis, 2018). Another 2,000 ha were expected to be handed over in 2021, to bring the size of the reserve to approx. 4,000 ha, however, according to the terms of agreement in the initial establishment of the reserve, the reserve will total close to 8,000 ha by 2027 (Amis, 2017). The reserve is located within the Strzelecki Ranges bioregion, which is Victoria’s most at risk and depleted bioregion and contains extensive stands of cool temperate rainforest as well as some of Australia’s largest trees (see fig. 9). By 2027, the reserve will have nearly doubled the amount of land considered a “reserve” in the Strzelecki Ranges, and will not only help to ensure the conservation of key koala habitat, but also benefit other native flora and fauna (Amis, 2018).



**Figure 8.** Brataualung Forest Park and signage.





**Figure 9.** FoE campaigner Michelle Baxter next to the largest tree by girth in Victoria.

## **Local Conservation Groups**

Alongside FoE Melbourne, a number of local groups in the South Gippsland region have contributed to the conservation of the South Gippsland/Strzelecki koala population for decades. Friends of Gippsland Bush has had a 25 year long history of successfully working in the region. Friends of the Strzelecki Koala, initially established through South Gippsland Landcare, also worked on koala issues between 2012–2018 (Give now, 2021). Various tree planting groups and organisations have also contributed to conservation efforts by revegetating denuded areas of koala habitat. A notable organisation in these efforts, Greenfleet, has been operating in the South Gippsland region since 2016, establishing a 66 ha protected forest site (legally protected for 100 years), and are planting over 50,000 of the Strzelecki/South Gippsland koala’s preferred tree species in the region. Since 2019, it was found that a number of individuals have found refuge in the new trees, utilising the newly established protected area as habitat (Green Fleet, 2021).

## Government Conservation Efforts

### Federal

The koala (*Phascolarctos cinereus*) was listed as ‘vulnerable’ under the Environment Protection and Biodiversity Protection Act (EPBC) 1999 in 2012, however, this listing only pertains to the combined koala populations of Queensland, ACT, and New South Wales. The koala was nationally listed in these areas due to a number of threats to their long-term survival and habitat including vehicle related deaths, urban expansion, predation from introduced species and increasing loss of key vegetation (Department of Agriculture Water and the Environment, 2021). Importantly, the listing of the koala under the EPBC act means that consultation is required with the Federal Government on potential projects which might have a ‘significant’ impact on the koala and/or its habitat (Department of Agriculture Water and the Environment, 2012). There are also a number of additional legal and non-legal instruments such as the National Conservation and Management Strategy 2014 (soon to be replaced by a new National Recovery Plan), information sheets, state recovery plans and other published guidelines which outline the conservation of the animal across Australia.

There have been some described subspecies of the koala, however these are not recognized under any part of the EPBC act and for purposes of management for conservation, research has shown that it is best to consider koalas in sub-populations rather than at a whole of Australia national level (Houlden et al., 1996). According to the Department of Agriculture’s species profile and threat database (2021) for the koala, there is a, “data deficiency in regards to the delineation of sub-populations throughout the listed koala’s range... it is currently difficult to specify important populations and such a proposition must be assessed on a case by case basis...” The department has highlighted that the National Recovery Plan (currently in the draft phase, undertaking a 3 month public consultation) will most likely expand on current understandings of sub-populations for the long term conservation of the koala across Australia (Department of Agriculture Water and the Environment, 2021). This is potentially of interest in efforts to get the Strzelecki/South Gippsland koala population listed under federal legislation.

While there is currently no level of protection for the Strzelecki koala at the federal level, recent research undertaken since Houlden’s 1996 paper (Lee et al., 2012; Wedrowicz et al., 2018; Wedrowicz et al., 2017) has highlighted the significant cause for a specific management plan or unit to address the genetically distinct Strzelecki Ranges/South Gippsland koala population.

## Victoria

Unlike the koala populations in NSW, QLD and ACT, the Victorian (and notably also South Australian) koala populations are not listed under the EPBC act and are generally considered to be not threatened due to the overabundance of some koala populations in certain parts of the state (Wedrowicz et al., 2018). These populations, found throughout eucalypt forests, can cause significant damage to preferred eucalypt tree species. To address the issue of over browsing and habitat/landscape degradation, the Victorian Government developed the 'Koala Management Plan' in 2004, which outlines the primary actions which should be undertaken to ensure the long term viability and health of koala populations across Australia. According to the Department of Environment Land Water and Planning (2021), "The aim of the strategy is to ensure that viable wild populations of koalas persist throughout their natural range wherever suitable habitat occurs in Victoria."

The department is supposedly in the process of drafting a new 'Koala Management Plan', which aims to replace the original plan and act as a state-wide strategy to long term and sustainable koala management. A research branch of the department, the Arthur Rylah institute, has recently produced a report which provides an updated estimate for state-level koala populations across Victoria - 459,865 individuals (Heard & Ramsey, 2020). The department plans to utilise up to date science and estimates from this report to inform new koala management strategies under the updated plan, and to gain a better understanding of the conservation issue of koalas at a Victorian level (Department of Environment Land Water and Planning, 2021). It is important to note, that whilst not the probable intention, the report fails to differentiate the Strzelecki/South Gippsland koala population from the rest of koala populations across Gippsland or from the translocated island populations (Amis, 2021). The department has stated that public consultation on the draft plan should have occurred towards the end of 2021, however, the consultation process has yet to begin (Department of Environment Land Water and Planning, 2021).

## South Australia

Interestingly, the South Australian government has recently become interested in the Strzelecki/South Gippsland koala population. In December 2021, Koala Life Australia (South Australian Government entity) removed a small number (undisclosed) of male Strzelecki koalas and transported them to Cleland Wildlife Park for breeding research. These translocations, however, were notably not publicised and undertaken without consultation with local conservation groups or community members in the South Gippsland region. There are also welfare concerns regarding the methodology for individual koala removal (Friends of the Earth Melbourne, 2021). The interest in the Strzelecki/South Gippsland population from the South Australian government clearly highlights that the genetic significance of the population is recognized and deemed useful in long term conservation strategies for koala populations across Australia.



# Climate Change

## Global Impacts of Climate Change

According to the latest 2021 report from the Intergovernmental Panel on Climate Change (IPCC), recent changes to global climate patterns are unmatched in their severity. Global average temperatures have risen 1.1 degrees since 1850–1900 and have been recorded at all-time record highs in the last 5 years (WMO, 2021). Should appropriate mitigation and adaptation actions not be taken, a rise in global temperatures is expected to reach or exceed 1.5 degrees above pre-industrial era levels within the next 20 years. A rise to this level would be catastrophic, resulting in increasingly rising sea levels, heat waves, altered weather patterns and more frequent/intense extreme weather events (IPCC, 2021).

## Climate Change and Wildlife

As GHG emissions continue to increase, so do threats to flora and fauna species across the world. Climate change and continued rises in average global temperatures will have a direct impact on the abundance, structure and composition of species across the world. According to the International Union for Conservation of Nature (IUCN) (2021), climate change is currently impacting 10,967 species listed on the IUCN red list. The impacts of climate change not only directly impact wildlife through changes and threats to their ecosystems, but also exacerbates existing threats such as wildlife diseases and displacement through habitat destruction/fragmentation. At the current rate of GHG emissions and without lack of action from global governments, it is thought that more and more species of flora and fauna will become at risk of extinction (World Wildlife Fund, 2021). A decline in global biodiversity notably also has a direct impact on human livelihoods, as many of the ecosystem services our systems rely on for carbon sequestration and climate change mitigation will be impacted (IUCN, 2019).

## Australia and Climate Change



**Figure 10.** Scott Morrison holding coal in Australian Parliament, 2017 (Conversation, 2017).

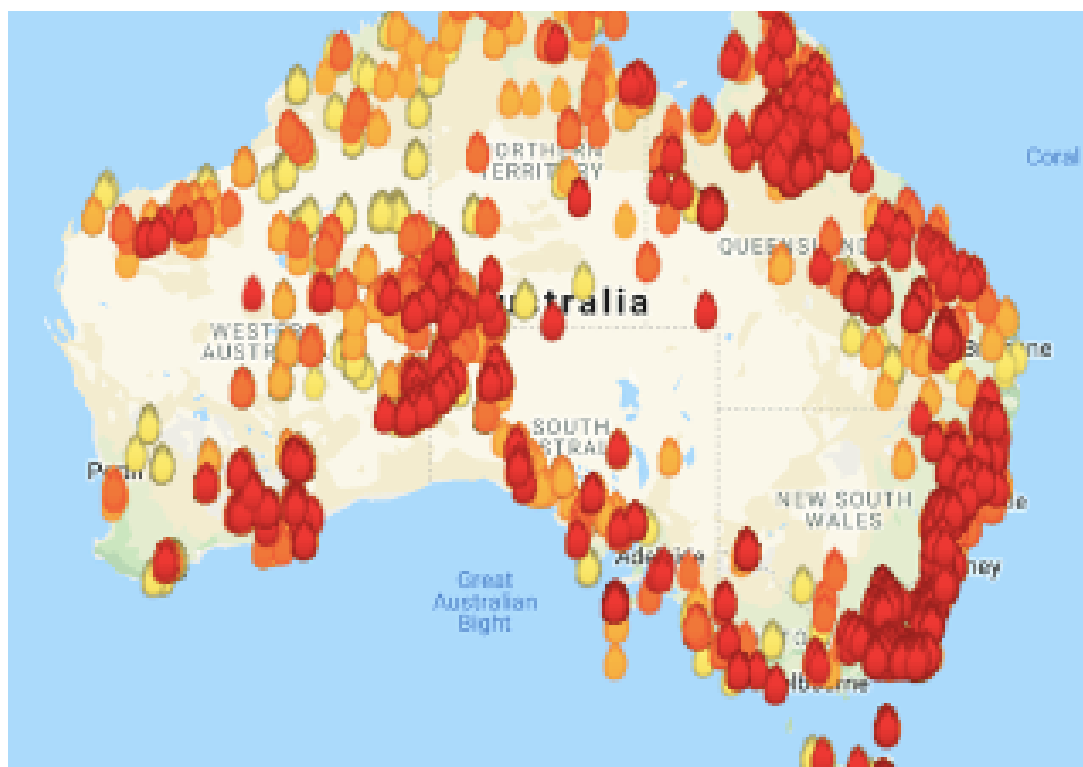
Australia is widely considered to be a weak actor in the world of climate change policy, which was highlighted at COP26 through the Morrison Government's (see fig. 10) lack of firm commitments in increasing its emission reduction targets for 2030. A reduction of 35% was proposed, which is amongst the lowest of other industrialised nations and below optimal in keeping the rise of global temperature below 1.5 degrees. The Morrison Government more so focused on achieving net zero emissions by 2050, although it is notably one of the last developed nations to make such a commitment (Cave & Victor, 2021).

Should the Morrison Government continue to choose inaction on climate policy and continue down the path of emitting catastrophic levels of GHGs, Australian biodiversity and wildlife will increasingly suffer from the intensifying impacts of climate change on the environment. Australia has always had a poor track record when it comes to wildlife conservation policies and legislation, with a particularly complex federal environment law, weak compliance and enforcement of this law (and other environment laws and policies at the state level) and politics coming in the way of just environmental policy (Graeme, 2020). Australia has one of the “highest extinction rates in the world” and now “holds the record for the first mammalian extinction due to climate change” however, a large number of species are currently deemed “threatened” by federal environment legislation (EPBC Act 1999) (Hughes et al., 2019).

## Impacts of Climate Change in Australia

The impacts of climate change are having an increasing effect across Australia, such as increased temperatures across the country, increase in extreme weather events (fires, floods, drought), and continuously rising sea levels (Australian Museum, 2021).

Bushfires act as a natural part of Australia's ecosystems, with many native flora having adapted to the phenomena, often utilising the fires for regeneration. However, due to climate change, a combination of increasingly record breaking temperatures, extended periods of extreme heat, and low levels of rainfall leading to dry vegetation have led to the increased frequency of "fire weather" and therefore more frequent and intense bushfire seasons (CSIRO, 2020). In conjunction with the hottest and driest year in Australian history, were the 2019/2020 bushfires (Black Summer bushfires) which were unprecedented in their length and intensity (CSIRO, 2020). The fires burnt over 17 million hectares of land which spanned across every Australian state (see fig. 11) and were responsible for over an estimated 1 billion wildlife deaths and numerous injuries (see fig. 12), many of which were already threatened or endangered (Richards & Brew, 2020). The fires also burnt through a number of parks, reserves, private properties and sacred Aboriginal sites (Australian Museum, 2021).



**Figure 11.** Map of the Black Summer bushfires across Australia (Landgate's MyFireWatch, 2020).



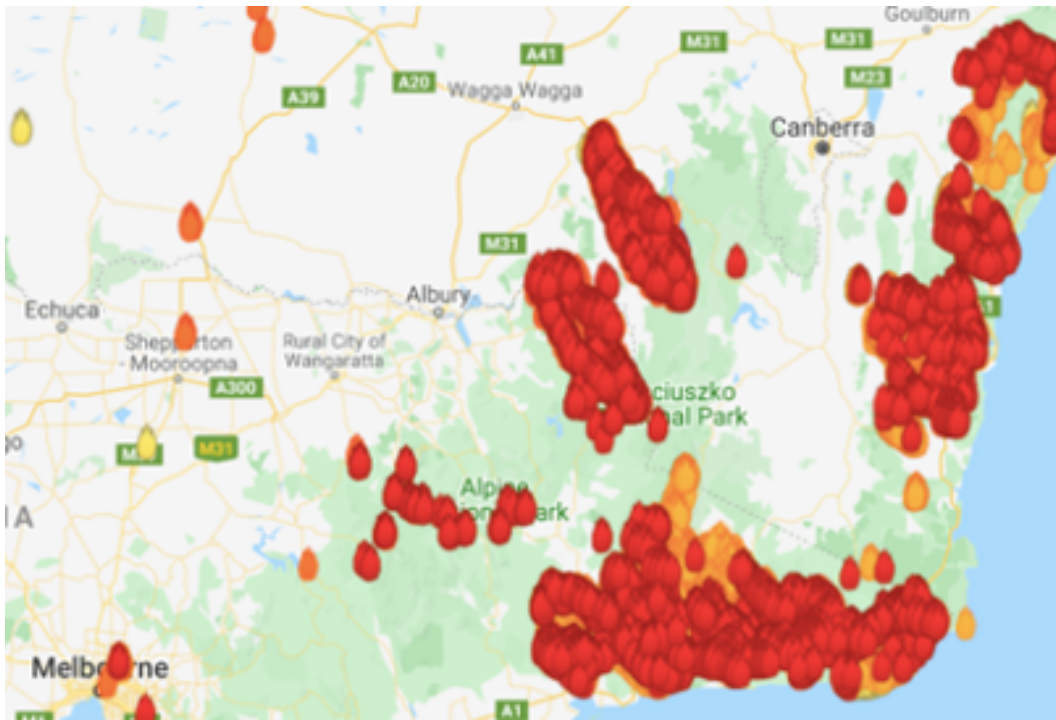


**Figure 12.** “A firefighter carries a koala injured during the Kangaroo island bushfires in Jan 2020.  
Photo Cred: David Mariuz/AAP

Climate change has also led to changes in frequency of other extreme weather events such as heatwaves, cyclones and floods due to changes to natural climate variability (CSIRO, 2021). Heat waves in particular have been occurring more frequently and resulting in nearly a doubling of days which break historical heat records within the last 50 years, with the hottest and driest year ever recorded in 2019. Heat waves can result in serious threats to a number of flora and fauna across Australia, as well as to human health, particularly in inland Australia (CSIRO, 2020). Australian cyclones ,however, are predicted to decrease in frequency but increase in intensity. The unprecedented warming of global oceans is also predicted to increase the intensity of extreme rainfall events in Australia. This is because warming oceans leads to a higher level of moisture being collected in the atmosphere, which directly increases the intensity of rainfall events (CSIRO, 2021). Whilst these extreme weather events have been occurring for millions of years, climate change has increased their frequency and intensity. As these events become more frequent, they come with increased response costs from Australian governments at all levels and strains to the systems of modern societies, ill prepared to handle them (Australian Museum, 2021).

## **Climate Change and Victoria**

Climate change impacts every city, state, nation and corner of the earth, but for purposes of this report it is important to highlight specific impacts that climate change has had in the Australian state of Victoria (VIC). Victoria’s temperatures are increasing, leading to significantly higher threat of bushfires and severity of extreme weather events such as cyclones, intense rainfall, droughts and floods. Victoria’s weather patterns are changing not only due to climate change, but also due to a natural variability in weather patterns, as the region is heavily influenced by system wide climate drivers including El Nino (Department of Environment Land Water and Planning, 2019).



**Figure 13.** Map of the occurrence of the 2019/2020 black summer bushfires in VIC (Landgate’s MyFireWatch, 2020).

The 2019/2020 Black Summer bushfires had a significant impact in VIC, primarily in the far east of the state on the border of VIC and ACT (see fig. 13). The fires burnt for many months and burnt over 1.5 million hectares of land, significantly impacting infrastructure, state parks and forests, local communities and Victorian Wildlife, with over 170 rare or threatened species found to have more than half of their habitat impacted by the fires (Victoria State Government, 2021).

In response to the ever increasing threats to the people and the environment from climate change, the Victorian Government has released a number of reports, tools and policies over the past decade:

- “Victoria’s Future Climate Tool”, which allows for the observation of climate projections until the 2090s for local regions. Regional summaries have also been released for policymakers and quick reading (DELWP, 2021).
- The “Victorian Climate Science Report 2019”, which acts as a summary of currently available scientific data and as a source to highlight the future of Victoria’s environment should GHG emissions continue at their current rate (DELWP, 2019).
- The “Climate Change Adaptation Plan 2017-2020” which highlights the commitment of the Andrews Government to work towards adaptation to the current and future impacts of climate change (DELWP, 2019).
- The “Protecting Victoria’s Environment- Biodiversity 2037” plan released in 2017, which outlines a variety of potential management initiatives to ensure biodiversity conservation. (DELWP, 2019).

· The “Victorian Government Climate Change Strategy 2021” (as per the Climate Change Act 2017). FoE Melbourne notably coordinated a project called “The People’s Climate Strategy” in 2021 as response to the delay of the climate strategy due to covid (Ewbank & Langford, 2021).

*The Climate Change Act 2017* is another notable move in the right direction on climate change at the state level. The Act requires the incumbent state government to: produce a new Climate Change Strategy every 5 years, produce Adaptation Action Plans for systems/regions which are most at risk of impact from climate change and aims for a transition to net zero emissions by 2050 (Department of Environment Land Water and Planning, 2021). FoE Melbourne notably made a submission to the 7 Climate Resilience Adaptation Action Plans in 2021 (Ewbank & Langford, 2021).

## Impacts of Climate Change on the Strzelecki Koala

### Climate Change and South Gippsland

Of particular relevance to this report is the Gippsland Regional Climate Change Adaptation plan. The plan closed for public submission in early June and, according to DELWP, was scheduled to be released and finalised in June 2021. At this time of the publishing of the report, only a draft adaptation has been made available to the public (Department of Environment Land Water and Planning, 2021).

The Victorian government has also produced a report entitled “Gippsland Climate Projections 2019” to provide an insight to the future of climate change impacts at a regional level in Gippsland. The report highlights that, much like the rest of Victoria, the region will face an increase in average daily temperatures and extreme weather events, with a particular threat of increased bushfire risk as fire seasons become longer and ideal fire conditions more frequent. Extreme rainfall events (such as the storms seen in June of 2021) are also expected to become more intense when they do occur (Clarke et al., 2019).

### Climate Change and the Strzelecki Koala

Climate change will directly impact the livelihoods and preferred habitat of the Strzelecki/South Gippsland koalas. It is expected that as climate change begins to cause disruptions to “typical” weather systems and patterns, that the spatial distribution of preferred eucalypt species across koala habitat in South Gippsland and the Strzelecki Ranges bioregion will also be impacted. In other words, as the occurrence and severity of intense weather events such as storms and bushfires increase, so will habitat fragmentation and, thus, a loss of key and preferred koala habitat (Wedrowicz et al., 2017).



This is of particular concern as the Strzelecki koala is both a habitat and dietary specialist, meaning that the koalas both choose habitat based on the occurrence and density of preferred eucalypt species, and feed solely on the foliage of eucalypt tree species (Wedrowicz et al., 2017). It should be noted that species who are habitat and dietary specialists are at greater risk of the impacts of climate change, and associated rapid changes to their preferred environments, than “generalist” species who can survive on a number of different food sources and thrive in a wide range of environments (Travis, 2003).

## **Genetic Diversity**

Of critical concern to this report is that rapid changes to climate, and thus koala habitat, will undoubtedly contribute to a loss of genetic diversity and alteration of structure and function within the Strzelecki/South Gippsland koala population (Wedrowicz et al., 2017). This report has previously highlighted the importance of genetic diversity for the long term conservation of koala populations not only in Victoria, but across Australia. High levels of genetic diversity amongst populations not only ensures that individuals are able to fight off diseases, but adapt accordingly to threats to their environment over time (Wedrowicz et al., 2018). This is particularly relevant to the Strzelecki koala as the threats to their habitat around the South Gippsland and Strzelecki Ranges bioregions are increasingly suffering from the impacts of global warming and climate change.

## **Dietary Impacts**

According to Wedrowicz et al. (2017), increased levels of Co<sub>2</sub> in the atmosphere from GHG emissions have been found to potentially, “alter the nutritional composition of eucalyptus leaves potentially reducing the suitability of some eucalypts as browse for koalas.” Higher levels of Co<sub>2</sub> in the atmosphere alters the carbon/nitrogen ratio within eucalypt foliage, increasing levels of anti-herbivore compounds and increasing nitrogen. Anti-herbivore compounds have been found to lower the amount of nitrogen available for digestion for the koalas. These changes in chemical composition affect many of the preferred tree species utilised by koalas for food and shelter, resulting in a lack of necessary nutrition and water (Department of Agriculture Water and the Environment, 2021). Koala populations will have to increasingly travel longer distances on the ground level of their ecosystems to find appropriate food sources, which notably increases risk of predation by domestic dogs and car killings (Earth Hour and World Wildlife Fund, 2021).

## Temperature increases and Fire

At the current prediction rate for increased temperatures in Gippsland by 2030 (0.9–1.8 c) average daily temperatures will have exceeded the thermal tolerance thresholds of the Strzelecki/South Gippsland koala population, thus making their current preferred habitat inhabitable (Phillips & Wallis, 2016). An increase in average daily temperatures, and associated increased occurrence of extreme bushfires, will impact the ability of the koalas to repopulate and/or relocate following a bushfire in an appropriate time frame. Longer fire seasons/increased number of high risk fire days and extreme bushfires may also impact the microclimate of the ecosystems of preferred koala habitats. Increased threat from drought will also play a role in making it increasingly difficult for the koalas to recover at a faster rate than habitat damage is occurring (Department of Agriculture Water and the Environment, 2021).

As arboreal animals, koalas have a far greater chance of being impacted by high intensity bushfires which impact the canopy of preferred eucalypt species. Impacts to the koalas can include injuries as they move from tree to tree to escape the flames and come into contact with burning embers/bark as well as dehydration and potentially even death (see fig. 14). Koalas can also be impacted by low-intensity bushfires at the ground floor level due to their ability to easily move throughout different levels of the forest landscape. Travelling at the ground level to move from tree to tree, searching for shelter and food, the koalas are at risk of burn injuries to the limbs (Negret et al., 2021).



**Figure 14.** Burnt koala hanging onto a eucalypt tree (Yarrow, 2020).

The horrific black summer bushfires of 2019–20 burnt through more than half of East Gippsland (1.1 million ha), which contains key koala habitat and preferred eucalypt species (Victoria State Government, 2021). Following the occurrence of the fires, team members at Biolink Ecological Consultants surveyed land in NSW and found on average a 71% (approx  $\frac{3}{4}$ ) reduction of koala numbers in regions impacted by the bushfires (Phillips et al., 2020). They suggest that these findings highlight the need for: management actions to occur in a timely manner consistent with the time needed for koala populations to restore before another extreme bushfire, improved legal protections of koalas across Australia and more surveys to identify koala population numbers in bushfire affected areas (World Wildlife Fund Australia, 2020).

Bushfires which more directly impacted key Strzelecki koala habitat however were the March/April 2019 fires, which burnt through 1,800 ha of key koala habitat in Yinnar South (see fig. 15). Unfortunately, these fires impacted sites which 2013/14 koala surveys in the area revealed to be some of the highest density sites in terms of koala scats. Also in early 2019, over 10,000 ha of the Holey Plains State Park in central Gippsland was also burnt by bushfire which had a small population of koalas (Amis, 2021). The Strzelecki Ranges were also hit by bushfires in January and February 2009, which killed hundreds of koalas on the northern slopes of the ranges. Several thousand hectares of the southern Strzelecki were also burnt in 2014 (Hancock Watch, 2021).



**Figure 15.** March 2019 fires – Budgeree/Yinnar Sth. Photo cred: Dee Godfrey



## Rainfall and Storms

Although the occurrence of extreme rainfall events due to climate change may vary throughout the next century, when they do occur, they are expected to be more intense (Clarke et al., 2019). An increase in the intensity of extreme rainfall events will undoubtedly impact the Strzelecki/South Gippsland koala population by damaging and fragmenting key habitat and displacing or potentially injuring individual koalas. Changes to “typical” rainfall patterns leading to an increase in droughts may also result in a change to the biochemistry of the leaves of preferred eucalypt species, hindering the ability of the koalas to utilise these trees for food (Phillips & Wallis, 2016).

Severe weather events have been steadily increasing across the globe and in Victoria, as seen in the freak June 2021 storm which heavily impacted the South Gippsland region (see fig. 16) (Amis, 2021). Extreme flooding and winds led to the loss of thousands of trees, prompting the Victoria State Government to send in teams from Bushfire Recovery Victoria to assist in clean up and recovery (Victoria State Government, 2021). A number of dead koalas were found in blue gum plantations, however, the exact number of fatalities is unknown (Amis, 2021).



**Figure 16.** Damage from 2021 Storms at Yinnar South/Budgeree areas.

# Policy/Management Recommendations

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## **A separate management unit for the Strzelecki/South Gippsland koala population is needed due to their high genetic diversity.**

The management of koala populations in Victoria has primarily focused on population control due to the overabundance and overbrowsing of some translocated island populations across the state. To date, research and data collection has largely focused on these populations. Due to high levels of genetic diversity and a distinctive remnant gene pool amongst their population, the Strzelecki koalas are “statistically differentiated” from other koala sub-populations across Victoria and Australia (Houlden, 1996). Therefore, resources should be allocated by the Victorian State Government to manage the Strzelecki/South Gippsland koala population as a separate unit from other sub-populations to ensure the long term viability of koalas across the state and Australia. Population size and diseases should also be monitored specifically in the Strzelecki/South Gippsland population due to its significance.

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## **Additional surveys are required to locate individual Strzelecki/South Gippsland koalas and to potentially identify other genetically distinct populations.**

Due to a state-level management focus on environmental impacts from the translocated island koala populations, there have been no Victorian Government-led surveys specifically addressing the Strzelecki/South Gippsland sub-population. At the time of this report, no other sub-populations of genetic significance in Victoria have been found outside of the South Gippsland region. Surveys should be undertaken across Victoria, particularly in the wider Gippsland region, to locate scats and potentially identify new genetically significant sub-populations. It is vital that any genetically significant sub-populations be identified and protected to ensure the long term viability of koala populations across the state and Australia.

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## **More Scientific studies are needed specifically regarding the Strzelecki/South Gippsland koala sub-population.**

Studies should be undertaken to better understand the relationship of the population with their habitat and landscapes. According to Philips and Wallis (2016) it is important to understand “elements in the landscape that make up koala habitat, specifically those tree species that comprise the key food resources and the factors that influence their use.” It is also important that we gain a deeper understanding of the genetics of populations across Victoria. These studies are vital in ensuring the long-term viability of koala populations across VIC and Australia.

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## **The Victorian State Government must consider the Strzelecki/South Gippsland koala population when making climate change policy.**

The long term viability of koala populations across Australia could also indirectly benefit from climate policy at both the federal and state levels. A focus on emission reductions targets and a move away from the use of fossil fuels would help to lower GHG emissions which, as discussed in this report, are the main causes of the impacts of climate change felt by koala populations. The Victorian government should also consider the Strzelecki/South Gippsland koala population when producing their next Climate Science Report, Climate Change Adaptation Plan and most importantly in any future plan regarding biodiversity.

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## **More work/research needs to be done to achieve legislative protection for the Strzelecki/South Gippsland koala population at both the state and federal levels.**

Legislative protections specifically regarding the Strzelecki/South Gippsland koala sub-population are vital in their conservation. In depth research into the viability of achieving protections for these animals under state legislation such as the Victorian Flora and Fauna Guarantee Act 1988 and Victorian Wildlife Act 1975, while beyond the capabilities of this report, is needed. As previously discussed, the SKAT team is currently campaigning to achieve an EPBC listing for the Strzelecki koala, which would achieve the highest level of legal protection for the population. More research is needed into the terminology and legal clauses which may assist in getting the koala listed. The listing of the population could also help other endangered species across Australia.

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## **Preferred koala eucalypt species need to be protected from the forestry industry and land clearing activities.**

Preferred tree species should include Mountain Grey Gum, Blue Gum and Strzelecki Gum. The VicForests Koala Management Instruction (2016) does not currently list Mountain Grey Gum or Strzelecki Gum as preferred koala forage species and should be updated accordingly (VicForests, 2016).

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## **Federal/state funding should be increased for revegetation of key koala habitat by small community conservation groups.**

Due to heightened risk from a number of threats discussed in this report, state and federal governments across Australia should focus on funding these groups for purposes of conserving remnant unburnt bush, replanting and restoring key koala habitat, as well as establishing wildlife corridors. The establishment of corridors for the remaining koala population is vital when considering the population as “climate change refugees” who must move from their traditional habitat ranges to seek shelter.

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**The Victorian State Government and local Governments need to support and fund initiatives and recommendations from independent scientists such as those listed on page 29/30 of the “Habitat Utilisation by Koalas in the Gippsland Region” Report. (See: (Phillips, S., & Wallis, K. (2016)).**

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**The Victorian State Government should implement long term koala surveys in the Gippsland Plains and Strzelecki Ranges bioregions, focusing primarily on understanding and managing the impacts of climate change to individual koalas in the region.**

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**The Victorian State government must ensure that preferred koala tree species are protected from logging and land clearing practises and personal firewood usage.**

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**Hancock Victorian Plantations (HVP) must manage their plantations, including “ingrowth” under the highest standards of management in consideration of koala conservation. All of their “custodial land” needs to be actively monitored for koala populations.**



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