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National Parks Association of Queensland Inc.

Submission to
Australian House of Representatives
Inquiry into Australia's biodiversity in a Changing Climate

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Executive Summary
In March 2008, the Queensland Government made a commitment to expand National Parks by 50% (to 12.9m ha or 7.5% land area) and total protected areas to 20m ha by 2020. This decision gave Queensland a unique opportunity to decide where new acquisitions should be made and in what context they would function.

In 2010, the author of this Submission travelled overseas on a Churchill Fellowship to examine how senior researchers, government and private land managers and conservation organisations in California, England, Spain, Italy and South Africa were dealing with the impact of climate change on biodiversity (specifically rare plants), and how insights derived from these discussions and visits to key reserves might be used to influence the selection of new National Parks in Queensland, and indeed more broadly throughout the country.

Specifically the author was interested in whether climate refugia - areas that had provided refuge to plants and animals during past climate oscillations - should be prioritised within new National Park selections. In addition, the Queensland Government is currently in the final stages of preparing the State's first Biodiversity Strategy. This landmark document will articulate conservation priorities for the State for at least the next 10 years, including strategies to meet the protected area targets described above.

The National Parks Association of Queensland (NPAQ) believes that there is a critical opportunity to determine what areas constitute climate change refugia at a bioregional level, clarify the extent to which these areas are not captured by the protected area estate, and prioritise the acquisition of these areas in natural resource management and biodiversity conservation strategies.

This Submission suggests that:
1. There is a unique opportunity in the next 10-20yrs to develop monitoring programs to check the projections of climate models
2. A range of mechanisms is required to conserve endangered flora in situ
3. Corridors will not enable Australian species to adapt to changes in climate
4. Areas that provided refuge for plants during past climate oscillations may do so in the future

It recommends that climate refugia be:
1. Refined and prioritised within state-based Biodiversity Planning Assessments as components of high-conservation value mosaics and landscape linkages including corridors

2. Identified as targets for strategic acquisition within the expanding national park estate in Queensland
3. Identified as targets for opportunistic acquisition within other protected area tenures, especially the Nature Refuge program
4. Prioritised for protection and conservation in regional natural resource management plans and strategies
5. Where degraded, prioritised for restoration by agencies and organisations undertaking rehabilitation and revegetation programs
6. Incorporated into efforts to build species resilience – maintaining viable species populations, rebuilding populations and re-connecting population remnants

Submission Context

Climate change is already affecting the ability of protected areas in Australia to be truly comprehensive, representative and adequate. How these changes will occur, in what direction, and at what rate is the subject of considerable debate, particularly given the climatic events that have historically contributed to Australia's unique flora. Government and non-government organisations are attempting to determine which mechanisms, or combinations thereof, will provide the best strategy to direct the conservation of Australia's biodiversity in the future. All agree that building the ecological resilience of landscapes will be pivotal to building the adaptive capacity of our biota.

In Queensland, both the State Biodiversity Strategy and the 2020 targets raise interesting questions about what agencies are trying to conserve in protected areas. Against the intimidating backdrop of observable climate induced impacts on Australian plants, animals and ecosystems and landscapes, how we protect the very evolutionary processes that have led to the creation of our unique plants and animals is becoming increasingly complex.

The identification and protection of climate refugia, enhancing connectivity through strategically located corridors, and landholder incentives are all strategies that support the retention of species and habitat amidst a changing climate. But *how* these strategies are applied is critical. The comment's that follows draws on overseas *and* local Australian examples to illustrate key learning's derived from Fellowship interviews, field observations, rare flora surveys and site visits.

The Limits of Climate Modelling

One of the assumptions that underpins how many conservation managers think about dealing with the impact of climate change on biodiversity is that the range of a given species is limited to a particular climatic envelope and that as the variables within that envelope change, so too does the latitudinal or topographic position of that species.

For example, the Snow Protea (*Protea cryophila*) grows at an altitude between 1,750 and 1,900m and is confined to two of the highest peaks in the Cederberg Mountains north of Cape Town. Flowers take a year to open and require snow as a cue. As the local temperature increases, the climatic envelope of the Snow Protea's range is expected to retreat upwards. The combination of higher temperatures, less snowfall, greater susceptibility to fire, and little habitat to retreat to, seriously threatens the ability of this species to persist in the wild.

Locally, an unusual endangered wattle (*Acacia saxicola*) is found only on the summit plateau of Mt Maroon in Southeast Queensland. Wattles are generally obligate seeders - that is, they are obliged to reproduce from seed rather than use other mechanisms (such as resprouting). Climate modelling suggests two things for this species - firstly, that its climatic envelope is disappearing (that is, retreating to higher elevations), and secondly, that an increased frequency and intensity of fire, fuelled by higher temperatures and lower rainfall, may push this species to the brink of extinction.

Or so one might think.

There is now mounting evidence of plants that are found either beyond what appears to be their climatic comfort zones, and of plants that have multiple populations that inhabit different zones.

Another local example is telling.

On a nondescript road that travels east from Stanthorpe to the Queensland-New South Wales border there is a gully that shelters a grove of 50 creamy-grey smooth-barked gums. The trees are snow gums (*Eucalyptus pauciflora* subsp. *pauciflora*), and this is their northern frontier, the only place that they are found in Queensland. But the very attributes that combine to sustain their existence are being subtly eroded.

Like most places in Australia, the Granite Belt in southern Queensland is getting warmer. Two generations ago, the first frosts appeared roughly on Anzac Day, but now it's two weeks later and the actual number of frosts are far fewer. Most tourists visiting Girraween National Park to see the spring wildflowers would now be advised to go in early September rather than the end of that month. Many streambeds have become dry and simply stayed that way, already porous soils are no longer replenished, and some ephemeral plants have virtually disappeared.

But it will probably be a wildfire that will see this species disappear from the Queensland flora. While gum trees are great resprouters, not even this survival strategy can withstand high intensity bushfires. Areas like the Granite Belt are getting warmer, and the climatic envelopes for the plant species found there – many already at the northern extent of their range – are predicted to 'move' southwards. The key question is whether the species themselves will move south, and if so, how do conservationists manage that change within a static protected area system?

Corridors in Perspective

Currently in Australia, many conservation groups and governments are promoting the establishment of landscape scale corridors as mechanisms to conserve biodiversity and maintain ecosystem function. Corridor projects such as the Great Eastern Ranges on the east coast and Gondwana Link in Western Australia are valuable when they promote collective conservation effort amongst land managers, reduce fragmentation (that is, connect otherwise unconnected remnant vegetation), increase habitat area or provide altitudinal pathways for plants and animals where this is possible. However, many landscape corridor projects in Australia overstate the migratory benefits of such linkages, while understating their role in sustaining habitat variation.

In South Africa, the Kogelberg Biosphere Reserve, which protects the catchment of the Palmiet River and its mountainous ramparts, is connected to a coastal reserve through a land donation from the Brodie Family. In Europe, the Cantabric-Pyrenees-Alps Great Mountain Corridor is an initiative that emerged from the 2003 World Parks Congress as a means of rebuilding ecological linkages across four Western European mountain ranges. In North America, the Yellowstone to Yukon Conservation Initiative seeks to protect wildlife, wilderness and natural processes across a 3,200 km corridor (1.3 million sq km).

Unlike these northern hemisphere examples, there is growing opinion (both locally and internationally) that suggests that corridors will not enable most Australian plants and animals to adapt to changes in climate that are occurring now and have been forecast for the future. That is, there is evidence that some Australian plants and animals may be responding in less predictive ways to climate change than those served by the creation of migratory pathways. Indeed, recent research emerging out of Western Australia indicates that the geographic range of some species contracted to areas of more favourable habitat during past climate

extremes. While some contiguous connection between remnant patches of vegetation will be extremely useful for our plants and animals, such as altitudinal corridors that capture representative populations of species with habitat niches that vary with elevation, this research does challenge the science behind, and the emphasis placed on, large scale corridor conservation projects in Australia.

In reality, a combination of little evidence to support widespread species migration in response to past climate oscillations, that Australia is a relatively flat continent and any latitudinal migration would had to have occurred over vast distances, that this country does not have large iconic migratory fauna like North America or Europe, and that recent glacial periods had a minimal impact in Australia (being restricted to the Kosciusko area and the central plateau of Tasmania) strongly suggest that corridors will not promote adaptation to changes in climate in Australia.

The sheer speed of changes in climate that are occurring now prohibit adaptation. At the University of California Berkeley, David Ackerly studied the velocity of climate change in Nevada and California and estimated that plants and animals must travel 6km/yr in flatter regions (normally northwards) and 60m/yr vertically in mountainous areas to keep pace with the changes in temperature already being observed. 2100 projections for nearly 500 protected areas in the San Francisco Bay area (all >100ha) found that only eight will *experience temperatures within their currently observed range*.

Indeed, there are other arguments against the widespread use of corridors in Australia. Many authors and researchers have noted that corridors can exacerbate edge effects, act as a conduit for the spread of invasive species, can increase the spread of wildfire, and will not be able to protect species unable to move. Note also that some Australian species actually depend on isolation for their survival.

There is no doubt that corridors are a *politically* attractive means of garnering and directing conservation investment. Private conservation groups have been using iconic species and landscapes to build philanthropic support for land purchases they consider important, and the marketing of large corridor projects is built around similar strategies. But the pool of funding for new National Park acquisitions, at least at a government level, is small. It's also a public investment, and justifiably the public expect that decisions made in regard to new protected area acquisitions are based on the best available science.

Role of Refugia in adapting to Climate Change

As understanding of the impact of climate change on biodiversity becomes more detailed, and as state and federal agencies move to secure biodiversity icons, increasing attention is being paid to the resilience of ecosystems and species and the role and function of climate refugia within the landscape. Refugia are areas that provided refuge to plants and animals during past climate oscillations. While the future of climate refugia may be very difficult to ensure, their best chance will be in protected areas with appropriate management to ensure that threats to these locations are minimised. Therefore, their prioritisation within decision making about new National Park selections is critical.

A recent CSIRO report articulated the critical role that climate refugia will play in helping plants and animals adapt to changes in climate. In addition, Australia's Strategy for the National Reserve System 2009-2030 recognizes the importance of protecting *critical areas (that) ensure the viability, resilience and integrity of ecosystem function in response to a changing climate, such as large and small refuges*.

Climate refugia allow species to persist in the face of climatic stress. Such places are characterised by diverse topography, shelter from extreme events such as severe wildfires, and the persistence of moisture and temperature regimes suited for species unable to survive in the surrounding environment. In every country visited in 2010 (with the exception of

England), botanists and researchers are actively identifying areas that have in the past provided refuge for rare species from changes in climate. Although some researchers are concerned that refugia may be a biological dead end, many agencies are looking to how they can protect known refugial areas within their jurisdictions. This Submission specifically deals with evolutionary and ecological refuges, and trigger points.

Evolutionary refuges contain taxa with naturally fragmented and geographically restricted distributions. Changes in climate, especially during the Pleistocene, have resulted in the fragmentation and isolation of populations leading to genetic variation and in some instances speciation. One of the best examples of evolutionary refugia are mountain tops.

Ecological refuges include sites that provide microhabitats that are moister and cooler than the surrounding environment, drought refuges such as permanent waterholes, and sites that offer some form of amelioration from prevailing environmental conditions and refuge from human impacts. These areas support localised populations of species that are absent from or rare within the surrounding landscape, and which could become increasingly isolated and under pressure. Ecological refuges such as granite outcrops may also function as evolutionary refuges. Examples from the author's own field work on the Granite Belt of Southern Queensland include elevated swamps, waterholes, springs, riparian areas, south-facing gorges, and protected rainforest pockets.

Trigger points are the inverse of ecological refuges – they are microhabitats that are presently more adverse than the surrounding environment (e.g. steep north-facing slopes with shallow soils) that support disjunct populations of species normally associated with harsher climates. The species and species assemblages of these sites have the potential to radiate in response to a changing climate. They may provide excellent sources of plant populations that are genetically resistant to changes in climate, but may be constrained by the ability of these species to outwardly disperse and migrate.

However, refugia and our ability to protect these areas, may have certain limitations.

In October 2002, a wildfire fuelled by 30 knot winds, temperatures in the low 30's and extremely low humidity roared into Girraween National Park. More than eight years later, the impact of this fire is still evident on affected properties and the Park itself. In the first couple of years post fire, many herbs, forbs and orchids regenerated, although in some places the fire was so hot and intense that much of the soil seed bank was destroyed. Some areas that once provided refuge for terrestrial orchids have been lost, and will rely on post-fire colonisation from neighbouring unburnt areas. Other patches of vegetation protected by granite boulders (fire shadows) completely escaped the fire and remain congested with plants.

Identifying and protecting climate refugia also assumes that the climatic envelopes that enable species to persist in these areas *will not* be breached. Such a breach could take the form of a wildfire and result in compositional changes to vegetation communities or invasion by exotics (including native species that have received competitional advantages by changes in climate). Protecting refugia from these climate exacerbated threats will become an increasingly important task for protected area managers. Monitoring these sites for micro-climate changes should provide a very rudimentary early warning system for assessing their capacity to function as true refugia. In this regard, translocation of (particularly threatened) species could be delayed until absolutely necessary.

Conclusion
In summary:

Species ranges do not necessarily reflect climatic tolerances
Although local ecologists have recently articulated why this is true for Australian plants and animals in background papers for the draft Queensland Biodiversity Strategy, researchers at places such as the South African National Biodiversity Institute are also grappling with this reality, its implications for climate modelling, and subsequently how to make more accurate assessments of climate impacts on species and vegetation communities in the future.

Focus monitoring programs on assessing the projections of climate models
There are many inherent inadequacies associated with modelling changes in climate and the consequences of these changes. Consensus is building in some research quarters (especially California and South Africa) that the next 10-20yrs will provide a critical opportunity to verify and correct these projections.

Corridors will not enable Australian species to adapt to changes in climate
Like their South African counterparts, Australian flora and fauna are unlikely to migrate in response to climate change questioning the role of connectivity conservation in this country. This is largely contrary to the thinking, resourcing and (partly) the purpose of landscape corridor projects such as the Great Eastern Ranges (once Alps to Atherton) on the east coast of Australia.

Areas that provided refuge for plants during past climate oscillations may do so in the future
Climate refugia will play a key role in enabling local flora to adapt to changes in climate, however this grossly simplifies what ecologists are recognising as a much more complicated process.

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