CSIRO Submission 12/473

Senate Environment and Communications References Committee

Inquiry into the effectiveness of threatened species and ecological communities' protection in Australia

December 2012

Executive Summary

The identification, listing and conservation of threatened species and ecological communities remain fundamental concepts that underpin the current conservation framework in Australia at national and state levels. However as climate change starts to have significant impacts on biodiversity an increase in the number of threatened species and communities may see a further diminishment in our capacity to conserve each and every one of them. Nonetheless listing threatened species and communities will remain important as these are likely to serve as effectively as proxies for conservation need under future climates as they do under current climates. Management of 'landscapes' will likely only be efficient at managing some forms of threat. There will remain a need to mix strategies of species and landscape threat management, climate change will just make success harder to achieve. Nonetheless many analyses and surveys of experts and practitioners suggest that current frameworks for conservation, and in particular their objectives, may need to be reassessed under climate change.

A number of science-based tools and new research are now available that will assist in listed species and community management. These include:
a) linking systematic conservation planning to structured decision making,
b) capacity to measure genetic diversity and mechanisms to ensure population linkage to ensure population resilience,
c) adaptive monitoring frameworks for species, communities and key ecological and threatening processes,
d) instruments for linking management of protected areas under different tenure across an expanded national reserve system, and,
e) models for predicting likely impact of climate change on species turnover to assist decision making for habitat protection investments for the *future* survival of species and communities to increase the *efficiency* of limited conservation resources through investments where the greatest "marginal loss avoided" might occur.

This submission comments on most of the terms of reference for the Senate inquiry, with a more detailed section about the consequences of climate change as a potential game changer for conservation in general and for threatened species and community management in particular.

ToR (a) Management of key threats to listed species and ecological communities;

There is a recognized, multi-disciplinary science-based process for decision making for management actions for biodiversity conservation that has been developed from the Department of Sustainability, Environment, Water, Population and Communities Natural Environment Research Program Centre of Excellence in Environmental Decision-making (CEED http://www.ceed.edu.au/), of which CSIRO is a partner. This process is based on structured decision making and systematic conservation planning[1][2]. In Australia this process has been applied successfully to management actions around key threats and threatening processes for listed species[3] in the Kimberley, and is now the focus of a much larger CSIRO study for the Pilbara where the inclusion of threats to listed ecological communities is also being considered. The process of linking structured decision making into systematic conservation planning is outlined in Figure 1. The process leads to collective decisions about adaptive management strategies that allow participants to learn and continually improve management approaches. This process can help to integrate the management of specific threats such as particular feral predators with landscape processes like fire and grazing management.

[1] Julien M., Runge M.C., Nichols J.D., Lubow B.C. and Kendall W.L. 2009. Structured decision making as a conceptual framework to identify thresholds for conservation and management. Ecological Applications 19: 1079–1090
[2] Margules, C.R. and Pressey R.L. 2000. Systematic Conservation Planning. Nature 405: 243-253
[3] Carwardine, J., T. O'Connor, S. Legge, B. Mackey, H. P. Possingham, and T. G. Martin. 2012. Prioritizing threat management for biodiversity conservation. Conservation Letters 5:196-204

CSIRO suggests broader application of this approach be considered for prioritizing threat management of listed species and ecological communities. Currently, most management outcomes tend to relate to the use of fire management, reduced grazing management and reducing the threats caused by non-native feral pest animals, weeds and diseases. With broad recognition of the key threat feral animals and weeds (e.g. buffel grass) pose to many listed species[4] and increasing recognition that many of the impacts of such species will be exacerbated under climate change[5], most management options of the threats to particular listed species and communities tend to focus around the management of the impacts of these invasive species. Management tends to be focused on key refugia for listed species and communities and while this is a valid approach, it can be poorly planned and patchily implemented – for example 1790 species are listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) with recovery plans in place for 1177 but actions commenced for only 470 of these[6]. A structured decision making process could be more broadly applied to ensure long-term improvements in management decisions.

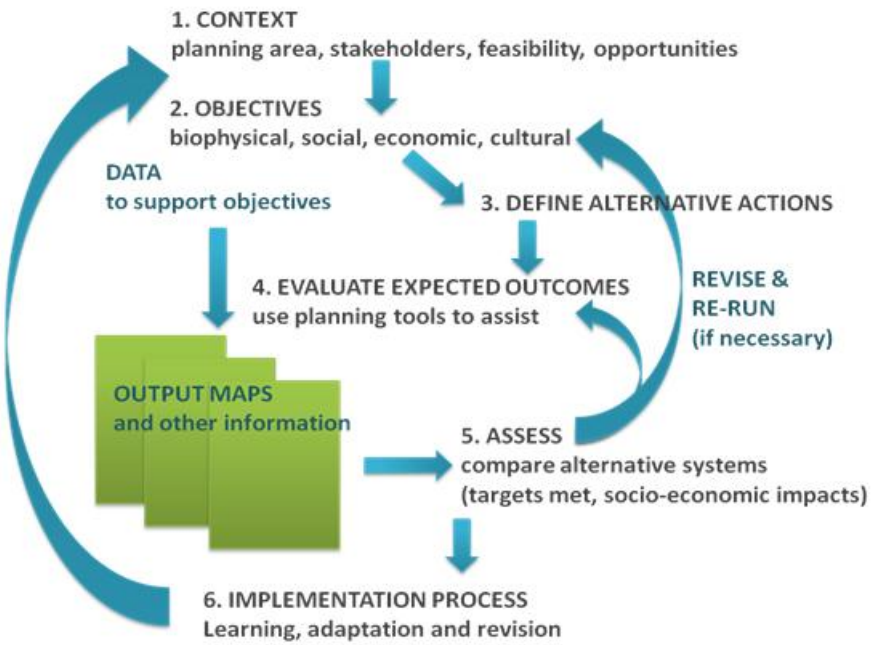

Figure 1: The process of Systematic Conservation Planning using Structured Decision Making

ToR (b) Development and implementation of recovery plans;

The EPBC Act requires the preparation and implementation of recovery plans, which also involves managing key threats. This legislative framework is the main regulatory tool for managing iconic biodiversity. Although such plans can be implemented slowly and patchily[7], maintaining this approach is a positive step. However, the number of listed species under climate change is expected to dramatically increase[8] and this will put increasing pressure on this regulatory process. With climate change, there will remain a continuing

[4]McKenzie N.L., Burbidge A.A., Baynes A., Brereton R.N., Dickman C.R., Gordon G., Gibson L.A., Menkhorst P.W., Robinson A.C., Williams M.R. and Woinarski J.C.Z. 2007. Analysis of factors implicated in the recent decline of Australia's mammal fauna. Journal of Biogeography 34: 597–611.

[5]Beaumont L.J., Gallagher R.V., Thuiller W., Downey P.O., Leishma, M.R. and Hughes L. 2009. Different climatic envelopes among invasive populations may lead to underestimations of current and future biological invasions. Diversity and Distributions 15: 409–420

[6] SPRAT Database, Department of Sustainability, Environment, Water, Population and Communities, Commonwealth of Australia; http://www.environment.gov.au/biodiversity/threatened/recovery.html

[7] SPRAT Database, Department of Sustainability, Environment, Water, Population and Communities, Commonwealth of Australia; http://www.environment.gov.au/biodiversity/threatened/recovery.html

[8]Millennium Ecosystem Assessment. 2005. Ecosystems and human well-being: Biodiversity synthesis. World Resources Institute, Washington, DC.

role for intensive *in situ* management of selected individual species (e.g. those that are highly threatened and/or of particular value) – see (g) below.

More generally there remains little recognition of the role that genetic diversity plays in the ongoing functionality and persistence of threatened species and communities. Studies clearly show that small, isolated populations have more inbreeding leading to ongoing population decline[9]. For longer-lived species, these declines are likely to become evident well into the future. Targeted on-ground action taken now could alleviate likely future declines; however this requires that actions outlined in most recovery plans aimed at expanding and reconnecting populations be undertaken.

Recovery plans are only effective if their implementation results in stabilisation or improvement of the status of the focal species or community. While this is well recognised in science and policy, in practice monitoring activities tend to be poorly conducted, coordinated and reported[10]. Developing a monitoring framework for listed species and communities which are the subject of recovery plans that is integrated into national biodiversity monitoring frameworks will be essential for assessing the performance of those recovery plans. Ongoing adaptation of these monitoring frameworks will be needed as our knowledge base improves and as the progress of threats, such as climate change, influence the reasons for monitoring.

ToR (c) Management of critical habitat across all land tenures;

The protection and conservation of listed species and communities is part of the broader goal of Australia's Biodiversity Conservation Strategy 2010-2030. This strategy is built on the National Reserve System (NRS) that has been developed under the Comprehensive, Adequate and Representative (CAR) criteria, the National Vegetation Framework[11] and the most recent Wildlife Corridors Plan[12]. These provide the underlying strategic direction for investment through the Caring for Our Country Program, the Biodiversity Fund and other landscape stewardship and protected area programs.

Protection and/or enhancement of critical habitat, through procurement, establishment of conservation land use agreements, or other statutory means will remain essential to achieving the goals around listed species and communities. Therefore in addition to recovery plans, connectivity principles and corridor structure within the NRS will be equally important under static or (climate) changing scenarios[13] for conserving listed species and ecosystems.

ToR (d) Regulatory and funding arrangements at all levels of government;

The EPBC Act adopts and promotes a perspective on the nature and value of Australia's biodiversity that emphasises listed threatened species and threatened ecological communities. Only a small proportion of the total compositional diversity of Australia's biota, however, can ever be addressed explicitly by the listing of threatened species and communities.

'Critical Habitat' identifies the specific habitat required for the survival, recovery and persistence of a listed species. Analysis of the effectiveness of protecting Critical Habitat under the United States Endangered Species Act (ESA) has shown a clear link between protection and species recovery. In Australia, the

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[9] Frankham, R. 1995. Conservation genetics. Annual Review of Genetics 29:305-327

[10] Lindenmayer D.B., Gibbons P., Bourke M., Burgman M., Dickman C.R., Ferrier S., Fitzsimons J., Freudenberger D., Garnett S. T., Groves C., Hobbs R.J., Kingsford R.T., Krebs C., Legge S., Lowe A J., Mclean R., Montambault J., Possingham H., Radford J., Robinson D., Smallbone L., Thomas D., Varcoe T., Vardon M., Wardle G., Woinarski J. and Zerger A. 2012. Improving biodiversity monitoring. Austral Ecology, 37: 285–294

[11] Native Vegetation Framework Review Task Group 2009, *Australia's Native Vegetation Framework, Consultation Draft*, Australian Government, Department of the Environment, Water, Heritage and the Arts, Canberra.

[12] Department of Sustainability, Environment, Water, Population and Communities 2012. National Wildlife Corridors Plan: A framework for landscape-scale conservation.

[13] Reside A.E., VanDerWal J., Kutt A.S. 2012. Projected changes in distributions of Australian tropical savanna birds under climate change using three dispersal scenarios. Ecology and Evolution 2: 705-718

protection of Critical Habitat is a discretionary measure in the recovery and conservation of threatened species under the EPBC Act. Despite its wide recognition as being important, the protection of Critical Habitat remains one of the most contentious decisions faced by management authorities. In Australia uncertainty about what constitutes Critical Habitat can take time. Designating Critical Habitat for listed species is a priority. Consideration could be given to "protecting habitat for the *future* survival of species" and could effectively be framed in terms of protecting the diversity of habitat types in any region. Achieving this may require extending the reserve system beyond the current protected area estate (i.e. National Park or Conservation Reserve).

Regulatory and funding arrangements to support the conservation of threatened species and communities at other levels of government are variable in terms of their effectiveness, often within a single jurisdiction. By way of example, The Queensland Biodiversity Strategy[14] recognizes that a popular ecosystem-only focus alone is not sufficient for biodiversity conservation; however, some of the Strategy's targets do not appear to adequately address the effective conservation of listed species (e.g. "establish a minimum of three viable populations for at least five of Queensland's iconic species…"). There is also no explicit inclusion of recovery plans for currently listed species, nor recognition of where effective investment in research is still needed to achieve successful conservation (e.g. understanding cassowary populations). Yet, the Strategy's focus on preventing decline of common species is quite forward looking as it recognizes -the need to move conservation strategies away from pulling species back from the brink of extinction to providing conditions where more species are less likely to have to be listed as threatened and endangered. Achieving this under future climate scenarios will remain increasingly challenging.

ToR (e) Timeliness and risk management within the listings processes;

Focusing a large proportion of conservation effort on protecting and restoring threatened species and ecological communities is being questioned and debated in the scientific literature. There is growing recognition that some species might be beyond recovery, and it may be more appropriate to "take a more holistic and strategic approach, building the fence at the top of the hill rather than staffing the ambulance at the bottom" [15]. Greater consideration could be given to adopting a triage approach to conservation[1617]. Another alternative is to increase the *efficiency* of limited conservation resources by focusing investment on those places or species where the greatest "marginal loss avoided" might occur[18]. With sufficient knowledge it may be possible to mathematically implement this[19]. Climate change will most likely quickly cause a further deterioration in the number of threatened species and ecological communities[20] relative to our capacity to recover them. This may force a rethink about the implications of a triage or a "marginal loss avoided" approach for choosing priorities[21].

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[14] DERM. 2011. Building Nature's Resilience: A Biodiversity Strategy for Queensland

[15] Garrett P. 2009. Opening address 10th International Congress of Ecology Brisbane, by The Hon Peter Garrett AM PM Minister for the Environment, Heritage and Arts, 17 August 2009.

[16] Bottrill M.C., Joseph L.N., Carwardine J., Bode M., Cook C., Game E.T., Grantham H., Kark S., Linke S., McDonald-Madden E., Pressey R.L., Walker S., Wilson K.A. and Possingham H.P. 2008. Is conservation triage just smart decision making? Trends in Ecology and Evolution 23, 649–54

[17] Hobbs R.J. and Kristjanson L.J. 2003. Triage: How do we prioritize health care for landscapes? Ecological Management & Restoration 4, S39–S45

[18] Pressey R.L., Watts M.E. and Barrett T.W. 2004. Is maximizing protection the same as minimizing loss? Efficiency and retention as alternative measures of the effectiveness of proposed reserves. Ecology Letters 7, 1035–46.

[19] Possingham H.P., Andelman S.J., Noon B.R., Trombulak S. and Pulliam H.R. 2001. Making smart conservation decisions. In: Conservation Biology: Research Priorities for the Next Decade (eds M.E. Soule and G.H. Orians) pp. 225–44. Island Press, Washington DC.

[20] Millennium Ecosystem Assessment. 2005. Ecosystems and human well-being: Biodiversity synthesis. World Resources Institute, Washington, DC.

[21] Bottrill M.C., Joseph L.N., Carwardine J., Bode M., Cook C., Game E.T., Grantham H., Kark S., Linke S., McDonald-Madden E., Pressey R.L., Walker S., Wilson K.A. and Possingham H.P. 2008. Is conservation triage just smart decision making? Trends in Ecology and Evolution 23, 649–54

ToR (f) The historical record of state and territory governments on these matters;

CSIRO has no comment to offer on this ToR.

ToR (g) Any other related matters

i) Definitions and clarity

Careful consideration needs to be given to the use of terms when considering conservation actions such as translocation (also known as assisted migration) as a mechanism to ensure the persistence of listed species when their populations go into terminal decline in their core habitats and localities[22]. This is because moving an organism to a new location outside its native range for its own preservation equates to an act of introducing a new species with all of its associated risks. The boundary between native and non-native can become blurred and this can affect the degree to which different legislation might affect a particular action[23].

ii) conserving threatened species and communities in the context of climate change

The current state of scientific research globally and in Australia is robust enough to support the conclusion that climate change could lead to widespread environmental change that is very ecologically significant[24] . Climate change could 'lead to most places in Australia having, by 2070, environments that are more ecologically different from current conditions than they are similar'**.** It is most likely that this will not just lead to shifts in suitable habitats, but the large-scale disappearance of many existing environments and the emergence of new and novel environments (e.g., Figure 2).

Current biodiversity management frameworks in Australia were developed with an expectation of relatively static climates (variable, but not changing) and relatively low levels of threat; the implicit ecological assumptions flowing from this were that the species and ecosystems expected to occur at any given location now and into the future would be those that occurred there in the past, and that species extinctions could be halted or kept to a very low level. These expectations are now being deeply challenged by what we know about climate change and biodiversity's sensitivity to it, especially in combination with other compounding pressures, such as increasing impacts from biological invasions, changing fire regimes and climate driven changes in land use.

Australia will need to increasingly reassess the objectives of conservation in the context of climate driven significant and continual changes in distributions of species and compositions of ecosystems. While a focus on protecting listed species and communities may provide "biodiversity surrogates" for protecting a wider set of biodiversity values under static climates, under changing climates this surrogacy may become less reliable. A singular focus on listed species or communities can lead to significant trade-offs. For example, values associated with tracts of vegetation being large and intact, important for biodiversity in a regional context, or being part of an urban landscape, may no longer be reflected by the status of listed species contained within them. Some actions to protect currently threatened species or communities, such as restoring native habitat in environments that have been extensively cleared or modified, are very likely to help many other species adapt to climate change. However, some actions, and in particular those that are aimed at narrowly distributed threatened species or managing individual individuals or populations, are likely to have little benefit for enabling adaptation of other species and preventing them becoming threatened in the future. The locations of current threatened species, critical habitat and communities, are

[22] Webber, B.L., Scott, J.K. & Didham, R.K. (2011) Translocation or bust! A new acclimatization agenda for the 21st century? *Trends in Ecology & Evolution*, 26: 495-496

[23] Webber, B.L. & Scott, J.K. (2012) Rapid global change: implications for defining natives and aliens. *Global Ecology and Biogeography*, 21: 305-311

[24] Dunlop M., Hilbert D.W., Ferrier S., House A., Liedloff A., Prober S.M., Smyth A., Martin T.G., Harwood T., Williams K.J., Fletcher C., and Murphy H. 2012. The Implications of Climate Change for Biodiversity Conservation and the National Reserve System: Final Synthesis. A report prepared for the Department of Sustainability, Environment, Water, Population and Communities, and the Department of Climate Change and Energy Efficiency. CSIRO Climate Adaptation Flagship, Canberra.

not necessarily going to be the locations that will best enable adaptation of other species or their survival in the future. It will then be even less likely that a conservation framework designed to direct management effort the locations of the most threatened species (or those species that might be most "cost effectively" managed) will help protect the wide range of biodiversity values associated with ecosystems and landscapes across the country.

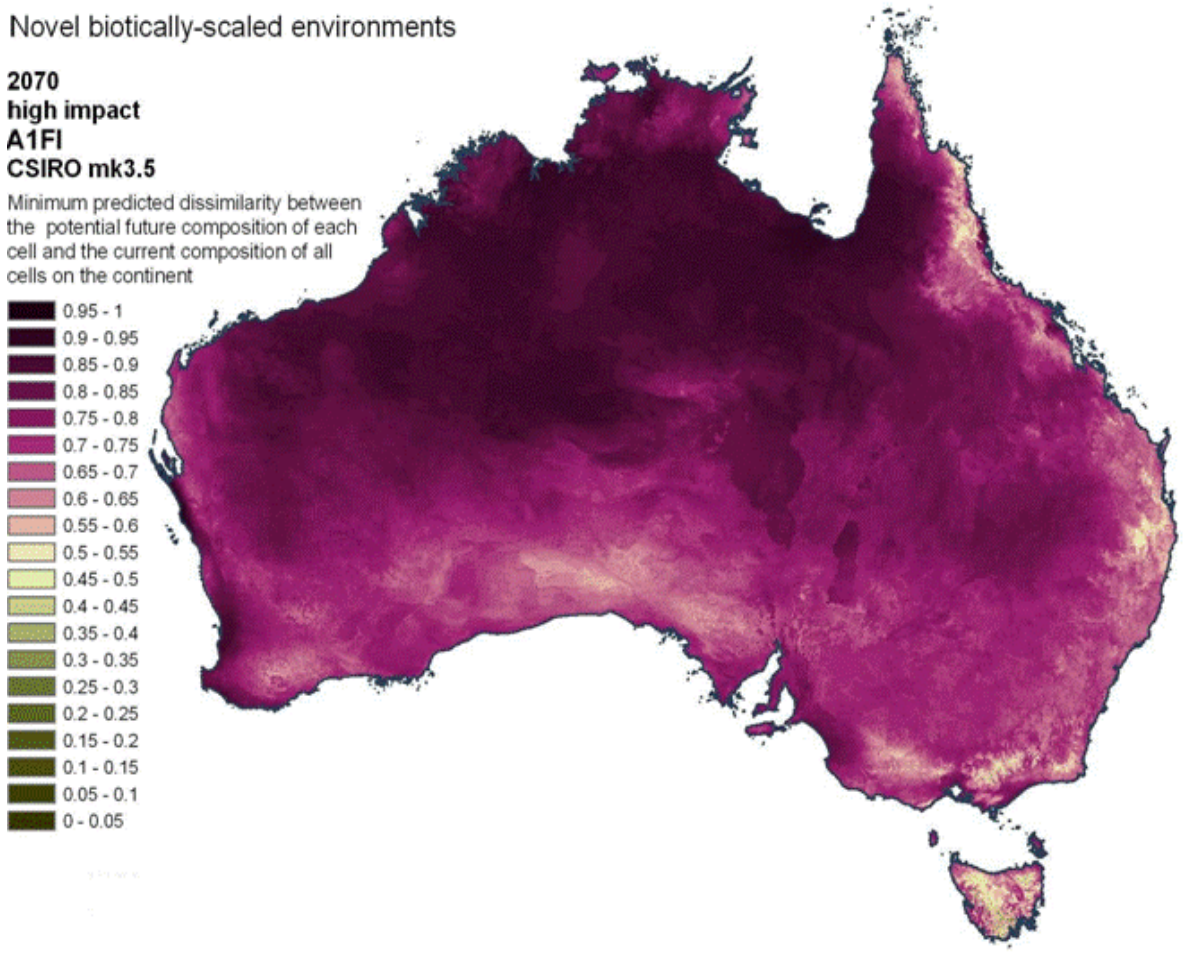

Figure 2: The potential future extent of environments not currently experienced by biodiversity in Australia. Green indicates the potential occurrence of future environments that are ecological similar to current environments. Purple indicates the potential occurrence of future environments that, by 2070, are ecologically dissimilar to environments currently occurring anywhere in Australia. Under a medium impact scenario novel environments are still likely to cover more than half of the continent (Dunlop et al 2012[25]).

[25] Dunlop M., Hilbert D.W., Ferrier S., House A., Liedloff A., Prober S.M., Smyth A., Martin T.G., Harwood T., Williams K.J., Fletcher C., and Murphy H. 2012. The Implications of Climate Change for Biodiversity Conservation and the National Reserve System: Final Synthesis. A report prepared for the Department of Sustainability, Environment, Water, Population and Communities, and the Department of Climate Change and Energy Efficiency. CSIRO Climate Adaptation Flagship, Canberra.

Future conservation objectives will need to:

1) accommodate large amounts of ecological change and the likelihood of significant climate-change induced loss in biodiversity
2) be implemented in an 'adaptive' and responsive way, accommodating uncertainty and changing levels of information about the environment, biodiversity and values
3) recognise the separate characteristics of species, ecosystems and landscapes and how these are differently experienced and valued by society and how best we can preserve these values.

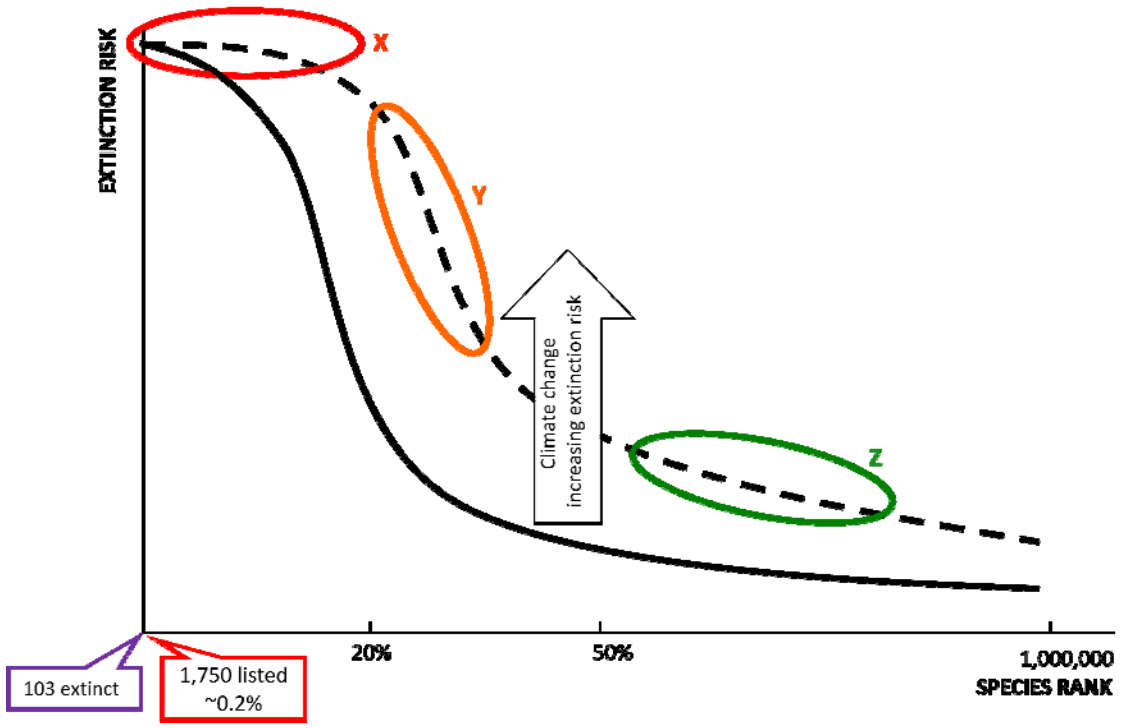

Figure 3. Hypothetical curve of extinction risk for Australian species ordered from most to least vulnerable on the horizontal axis. (The shape in the curve shown is only illustrative.)
Currently a very small proportion of all Australian species are known to be vulnerable to extinction. Under climate change the risk of extinction for most species would be expected to increase, distorting the curve up and right.
The total number of species becoming extinct and at risk of extinction in the future is likely to be considerably greater than at present, although the amount is not known. This increase, and uncertainty about it, greatly complicates any species prioritisation processes. For example: if 20%of all species were destined for extinction (dashed curve), then investment targeted at the species in red may prove to be wasted resources, and the orange species may be more suitable targets. However, if 50% were destined for extinction, then targeting the orange species may likewise be wasted resources. (After figure 13 in Dunlop et al. 2012[25]).

It is likely that there will be significant losses of biodiversity where rates of environmental change exceed the ability of biodiversity to adapt or migrate and this is likely to involve significant species extinctions. The increasing risk of species becoming threatened under climate change has important implications for how to invest resources for species recovery. The magnitude and widespread nature of ecological change suggests the policy processes based on analysis, listing and management of threatened species would be overwhelmed.

One approach to consider is that, if it were feasible to rate the probability of extinction of all species as a result of climate change (and other pressures), then a plot of the species ranked from most vulnerable to least might look something like Figure 3. Using a vulnerability approach: if a small number of species were expected to go extinct then it might be sensible to focus on those near extinction (X), but if, say, 20% or 50% of species were likely to go extinct then effort focused on the most vulnerable would be wasted and it might be better to invest effort in reducing the risk for species at relatively lower risk (in zone Y or Z).

It may be much easier to reduce the risk of extinction for some species than for others; an efficiency approach might assess, for example, the relative merit of reducing by a small amount the extinction risk of highly vulnerable species compared to reducing by a larger amount the risk to species that are moderately vulnerable. The actual extinction risks for individual species will, however, depend on a wide range of factors, many of which are currently unknown (from future greenhouse gas emissions right through to changes in interactions between species), and the effectiveness of management at reducing risk for individual species under climate change is likely to be even more unknown.

So, from an efficiency perspective, in many situations it will be sensible to avoid concentrating management effort on the most vulnerable species. However, from a technical perspective, the more efficient alternatives are probably difficult to actually identify and implement due to the precision required of the information needed to make those decisions.

Conclusion

There would be benefit in planning now for effectiveness of threatened species and ecological communities' protection, and its contribution to the national conservation framework, in the context of a changing climate. There is evidence that climate change is already having an impact on biodiversity through changes in ecosystem composition and function, species abundance and extent and changes in human land-use across a landscape in response to changes in bio-productivity. The task of biodiversity conservation will be, in the face of these changes and the uncertainty associated with them, facilitating change in species and ecosystems to ever changing climates while ensuring that the critical values the community holds for biodiversity persist through time.