Strategies for adapting to climate change must consider broader conservation objectives

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Many actions have been proposed to increase the probability of fauna species persistence in terrestrial systems in light of rapid climate change. These include extending the conservation reserve system, improving landscape connectivity to facilitate species movement, and mitigating the impact of other threatening processes (e.g. invasive species; Heller and Zavaleta 2009). One of the more controversial actions is assisted colonisation or translocation (Hoegh-Guldberg *et al.* 2008). This involves moving species to locations where they do not occur, either within their known geographic range or, more contentiously, outside this range. The approach may improve the chances of persistence for those species occupying locations where climate change threatens to alter the habitat or ecological processes to the detriment of the species. Yet, introducing species into new environments can have well-documented adverse consequences, particularly if the species becomes invasive or negatively impacts on the persistence of those species already occupying the ecosystem (Pyšek and Richardson 2010). This cost-benefit trade-off suggests that the controversy surrounding assisted colonisation is likely to intensify as the options for adapting to climate change diminish (Schwartz *et al.* 2009; Vitt *et al.* 2009).

Any conservation action, especially highly controversial ones, must be embedded within a broader planning framework and related to specific goals and objectives (i.e. objectives beyond simply 'saving species *x*'). I define 'goal' as a desired outcome expressed in general terms, whereas 'objective' is defined as a measurable and tangible outcome (≈ target) achieved within a set timeframe and related to specific actions. Systematic conservation planning involves a number of well-defined stages ranging from scoping and costing the planning through to applying conservation actions and monitoring outcomes (Margules and Pressey 2000; Pressey and Bottrill 2009). A particular objective may be achieved by various actions and, given limited conservation budgets, each action should be subjected to a thorough cost-benefit analysis to ensure that the maximum return-on-investment is identified (e.g. the greatest likelihood of species persistence for the minimum financial, social and ecological cost).

At the International level, the Convention on Biological Diversity (CBD) provides a strategic planning framework for managing global biodiversity conservation. At its recent meeting in Nagoya, Japan, the CBD agreed to five strategic goals and 20 'headline' targets (≈objectives) to guide planning strategies for 2011-2020 (http://www.cbd.int/sp/sp2010p/key-elements/). Some of these targets are quite specific. For example, Target 11 states that "By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through…" (http://www.cbd.int/sp/sp2010p/aichi-targets/). While targets proposed by the CBD at previous meetings (e.g. the 2010 biodiversity target agreed to at the 2002 meeting) have not been met, exposing the process to criticism, setting clear, measurable objectives is vital for guiding conservation actions and identifying where current actions are insufficient or objectives too ambitious (Rands *et al.* 2010).

At the National level, the Australian Federal Government recently released the consultation draft of Australia's Biodiversity Conservation Strategy (National Biodiversity Strategy Review Task Group 2009)[1]. The strategy lists six 'priorities for change' (equivalent to goals) and for each priority a set of objectives, actions and results. Unfortunately, the objectives and actions are expressed vaguely and do not represent statements of measurable and tangible outcomes (i.e. targets) within a given timeframe. Moreover, the capacity of the Biodiversity Conservation Strategy to drive the necessary on-ground change is debatable. The strategy claims to be indicative only, serving as a guide for other environmental management organisations to develop their own plans. I assume more specific objectives may be set at this level of management, although National-level targets have been expressed previously and are vital to assessing the success of conservation actions and improving biodiversity conservation in Australia (http://www.environment.gov.au/biodiversity/publications/objectives/pubs/objectives.pdf).

Irrespective of the vagueness of the current Biodiversity Conservation Strategy, one of its priorities for change 'building ecosystem resilience' has direct relevance for fauna management in response to climate change. Indeed, the priority entails "Ensuring that our natural environments are able to retain their biodiversity values and critical ecological functions in the face of growing pressure, including from climate change" (National Biodiversity Strategy Review Task Group 2009, p. 21). Actions proposed to achieve this goal include "Establish conservation linkages that provide connectivity…" and "Continue to…expand… the National Reserve System…" (p. 22). Interestingly, the strategy also states that ecosystem resilience may be achieved through the following action "Maintain and enhance ex situ conservation measures *as a last resort* [my emphasis] for biodiversity conservation" (p. 22). While assisted colonisation or translocation is not mentioned in the

[1] At the time of writing, my comments regarding the draft of Australia's Biodiversity Conservation Strategy 2010-2030 were correct. Since publication of the strategy, the six priorities for change have been re-written as various 'priorities for action' and included within these priorities are, thankfully, targets that are specific, measurable and time dependent (see http://www.environment.gov.au/biodiversity/publications/strategy-2010-30/pub s/biodiversity-strategy-2010.pdf).

Pp 178 - 179 in *Wildlife and Climate Change: towards robust conservation strategies for Australian fauna*, edited by Daniel Lunney and Pat Hutchings, 2012. Royal Zoological Society of NSW, Mosman, NSW, Australia.

Biodiversity Conservation Strategy, the above action and its expected results (e.g. providing insurance against extinction) could be used to justify such an approach. The inclusion of the phrase 'as a last resort' suggests that these approaches should be considered only after other actions have failed, and is implicit in promoting a cost-benefit assessment of various management actions (as recognised by the Department of Environment, Climate Change and Water (NSW) 2010).

A practical example of how to undertake a cost-benefit assessment to maximise conservation gains with a limited budget can be found in the Project Prioritization Protocol (PPP) described by Joseph *et al.* (2009) and implemented by the governments of New Zealand and Tasmania (see http://www.dpiw.tas.gov.au/inter.nsf/Attachments/LJEM-87Y7U4?open). These cost-benefit assessments are highly appropriate for making decisions about the suitability of translocations and other management actions to address climate threats to species persistence. The PPP consists of the following nine steps (Joseph *et al.* 2009, p.330): "1) define objectives; 2) list biodiversity assets [e.g. the species that require protection]; 3) weight assets [i.e. some species may be considered more important than others – see below]; 4) list management projects [that could achieve the objective(s)]; 5) calculate the costs of each project; 6) predict the benefit to species generated by each project; 7) estimate likelihood of success; 8) state constraints; and 9) combine information on costs, values, benefits and likelihood of success to rank projects according to benefits per unit dollar and choose set of projects."

To the best of my knowledge, the PPP has only been applied to threatened species. While all species in a given region could be included in these assessments, this is largely impractical given the lack of complete knowledge of likely species' responses to management actions. This raises the important issue of how to select species for which to conduct further detailed cost-benefit analyses.

Ranking the importance of species may be based on a number of criteria including evolutionary significance (e.g. taxonomic distinctiveness), functional importance (e.g. apex predators), social or economic value, or cultural significance (Joseph *et al.* 2009 and references therein). Considering the importance of a species, however defined, is crucial to decisions about species management under a changing climate. Assuming budget constraints do not allow adequate funding to manage all species at risk of climate change, a prioritization protocol is mandatory. And, in some cases, the most threatened species may not be the highest priorities.

A range of actions are available to conservation managers wishing to improve fauna conservation as the climate changes. Preferred actions must be directly related to measurable and tangible objectives (expressed at the local or regional level at least, but preferably relevant to broader national and global objectives) and embedded in a systematic conservation planning framework that considers, among other things, the broader consequences of actions (e.g. stakeholder impacts), costs-benefit trade-offs, and options for monitoring. This is particularly important for controversial actions such as assisted colonisation. Developing prioritization protocols is a necessity, although comprehensive cost-benefit analyses are hampered by a lack of information for all species. Yet, ranking the importance of species will help to identify those species requiring greater attention. The promotion of an objective-driven, systematic approach will hopefully avoid further proliferation of ad hoc conservation management, and help frame and develop debates surrounding controversial climate-change-adaptation strategies.

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References

Department of Environment, Climate Change and Water (NSW). 2010. Priorities for Biodiversity Adaptation to Climate Change. Department of Environment, Climate Change and Water, Sydney. Available online: http://www.environment.nsw.gov.au/resources/biodiversity/10771prioritiesbioadaptcc.pdf

Heller, N.E. and Zavaleta, E.S. 2009. Biodiversity management in the face of climate change: a review of 22 years of recommendations. *Biological Conservation* 142, 14-32.

Hoegh-Guldberg, O., Hughes, L., McIntyre, S., Lindenmayer, D.B., Parmesan, C., Possingham, H.P. and Thomas, C.D. 2008. Assisted colonization and rapid climate change. *Science* 321, 345-346.

Joseph, L.N., Maloney, R.F. and Possingham, H.P. 2009. Optimal allocation of resources among threatened species: a project prioritization protocol. *Conservation Biology* 23, 328-338.

Margules, C.R. and Pressey, R.L. 2000. Systematic conservation planning. Nature 405, 243-253.

National Biodiversity Strategy Review Task Group. 2009. Australia's Biodiversity Conservation Strategy 2010–2020, Consultation Draft. Australian Government, Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Pressey, R.L. and Bottrill, M.C. 2009. Approaches to landscape- and seascape-scale conservation planning: convergence, contrasts and challenges. *Oryx* 43, 464-475.

Pyšek, P. and Richardson, D.M. 2010. Invasive species, environmental change and management, and health. *Annual Review of Environment and Resources* 35, 25-55.

Rands, M.R.W., Adams, W.M., Bennun, L., Butchart, S,H.M., Clements, A., Coomes, D., Entwistle, A., Hodge, I., Kapos, V., Scharlemann, J.P.W., Sutherland, W.J. and Vira, B. 2010. Biodiversity conservation: challenges beyond 2010. *Science* 329, 1298-1303.

Schwartz, M.W., Hellmann, J.J. and McLachlan, J.S. 2009. The precautionary principle in managed relocation is misguided advice. *Trends in Ecology and Evolution* 24, 474.

Vitt, P., Havens, K. and Hoegh-Guldberg, O. 2009. Assisted migration: part of an integrated conservation strategy. *Trends in Ecology and Evolution* 24, 473-474.