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Koala Strategy Submissions
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In 2015 NSW Roads and Maritime Services requested ME to comment on three consultants' work dealing with genetic and ecological assessment of subdivision of koala habitat due to roadworks.

**(1) For your priority "develop a series of actions to improve collaboration and information exchange amongst government, researchers, land managers and the community".**

NSW-RMS commissioned

- two competing reports from different groups of geneticists, and
- a population viability analysis (PVA) by another consultant, which needed input of koala dispersal rates

I was called in to mediate between these activities. It was apparent that the two groups of geneticists had not coordinated their investigations, and neither group had paid strict attention to what was needed by the PVA analyst. I showed how to coordinate these activities.

I suggested to the RMS personnel that when commissioning such scientific work, they should draw on advice from other scientists on exactly what was needed for each consultant's analysis, and how to coordinate this. The necessary expertise is not always present in each State agency.

THEREFORE, I SUGGEST:

I suggested to RMS that a Statewide panel be set up to provide such expertise, for all government departments. The single Chief Scientist cannot cover all science in enough detail. I recommend that the Koala Strategy Panel pass this recommendation to higher levels of NSW State Government.

**(2) For your priority "investigate models for guiding and encouraging best practice"**

This is a more koala-specific priority. I deal principally with addition of a possible barrier to dispersal.

Dispersal between subpopulations does two things: opposes loss of genetic variation within subpopulations, and forestalls immediate extinction (Frankham *et al.* 2010). This raises the question "Could a new barrier disrupt koala dispersal sufficiently to reduce the viability of the koala population?". Answering this question fully, for koalas or any species, requires a "sensitivity analysis" - a Population Viability Analysis (PVA) examining chance of population persistence over multiple generations, with dispersal between sub-populations, contrasting the original level of dispersal before the introduction of the barrier with any measured reduction of dispersal due to the barrier. Such comparative use of PVA is called "sensitivity analysis" and should examine not only the most likely outcome, but also the worst-case outcome as determined by variances of the input factors, to facilitate precautionary management. The necessary demographic data for PVA in koalas is available (eg Penn *et al.* 2000, Lunney *et al.* 2002). However, the data to assess the dispersal are less widely available, but genetic methods can assist this.

Dispersal can be assessed by ecological methods such as tagging or radio-tracking of individuals, or by genetic methods. Most ecological analyses (and some genetic analyses) only tell us about dispersal in the most recent generation (Pritchard 2000), which may not be followed by successful breeding, that of course is vital for conservation purposes. In contrast, most genetic methods give us the vital information for conservation management and modelling: they tell us about dispersal AND breeding (Epps and Keyghobadi, 2015)

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Genetic methods that indirectly or specifically assess dispersal have different sensitivities, including different time "lags" for equilibration after a disturbance such as introduction of a barrier and this can be exploited by using a range of different types of genes and analyses (Epps and Keyghobadi, 2015). Some methods to convert genetic subdivision into estimates into dispersal rates have been criticised (Whitlock and McCauley 1999). However, there is now a method that avoids the problems that beset other genetic dispersal measures, and can deal with the widest possible range of population sizes and dispersal rates that are relevant to conservation management (Sherwin et al. 2006, Sherwin 2015).

To implement this, ideally, monitoring will take place before and after introduction of a new barrier, as well as in areas not impacted by barriers. This will allow effects of the barrier to be distinguished from lingering signals due to prior historical events (Epps and Keyghobadi, 2015).

THEREFORE, I SUGGEST:

High-quality genetic samples should be stored for future analysis before any modification (*i.e.,* barrier construction), in the area to be affected, as well as a comparable unaffected area nearby. A molecular ecologist should be consulted to create the sampling design.

The same areas should also be sampled one or more times after the modification, so that the genetic data can be used to assess the impact on dispersal.

The information on dispersal change (if any) should then be used in a PVA/sensitivity analysis to determine whether the modification is likely to adversely affect the population's future.

This approach can be used to establish the utility of any modification measures such as artificial movement corridors – at present, it is usually known that at least one koala has used a corridor, but it is not kniown whether the corridor has allowed dispersal at a high enough level to prevent adverse consequences for the population.

A similar approach would be appropriate to other types of habitat modification, but would require specific design for each type of modification.

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