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Combining Three Approaches to Quantify the Barrier Effect of Roads: Genetic Analyses

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Abstract

The movement and dispersal of animals between populations is an important component of wildlife ecology and has been described as "the glue that holds local populations together." Without adequate ability to disperse, the rate of movement of individuals and DNA between populations is reduced and these populations become isolated, increasing the risk of local extinction.

Most research addressing the barrier effect of roads and traffic has focussed on the use of crossing structures by wildlife. Our study is a first for Australia and represents a unique collaboration to quantify the barrier effect in a highly fragmented landscape and (subsequently) the success of mitigation.

The aims of the project are to use genetic techniques and empirical observations to quantify the barrier effect of roads on the movement and dispersal of mammals, reptiles, birds, and invertebrates and to assess the effectiveness of structures and road designs intended to mitigate the barrier effect. Quantitative modeling will also be implemented to predict the effects of reduced movement on population viability.
A range of genetic markers is available for use in population biology to measure dispersal. Microsatellites are hypervariable and sensitive enough to be able to detect genetic differentiation in the short term and at small spatial scales, and are therefore appropriate to investigate genetic substructuring due to the presence of roads. Genetic analyses will be used at different scales of resolution. The genic approach will be employed for identifying population substructuring and patterns of gene flow at the population level. The genotypic approach will be used for finer-scale observations of dispersal of individuals.

Direct methods still provide highly reliable data on dispersal parameters, although they rely on logistically difficult field observations. Trapping and radio tracking will be used in the present project to be combined with and strengthen the results obtained from genetic analyses.

Repeated trapping will provide life history information which can aid in understanding the genetic data and contribute to the population viability models. Radio tracking will be used to collect information on daily movements of mammals in relation to foraging as well as dispersal and to assess the effectiveness of mitigation structures.

Finally, quantitative population modelling will be conducted to estimate the effects of inhibited dispersal on population viability. Data from observations and genetic studies will be used to characterise populations in terms of age and stage structures, fecundity, survival, and dispersal. Data collected over three years will be used to characterise variability in the parameters to improve population modelling.

Biographical Sketch: Dr. Rodney van der Ree is the ecologist at the Australian Research Centre for Urban Ecology (ARCUE). He obtained his Ph.D. in 2000 from Deakin University, where he studied the impacts of habitat fragmentation on arboreal marsupials in northeastern Victoria. He used the principles of landscape ecology to investigate the response of fauna to a landscape where the habitat was arranged as a network of linear strips along roads and streams. Rodney now brings this knowledge and skill to ARCUE to investigate the response of mammals to urbanization. Rodney will be investigating the distribution and abundance of mammals within the greater Melbourne area, with a focus on the rate of species decline, their habitat requirements, and survival prospects.