A framework to identify, communicate and prioritise research needs for effective ecological restoration

Dr Ben Miller[1,2], Dr Elizabeth Sinclair[1,2,3], Dr Myles Menz[1,2,4], Dr Carole Elliott[1,2,5], Dr Eric Bunn[1,2], Dr Lucy Commander[1,2], Dr Emma Dalziell[1,2], Ms Erica David[1,2], Dr Belinda Davis[1,2], Dr Todd Erickson[1,2], Dr Peter Golos[1,2], Dr Siegy Krauss[1,2], Dr Wolfgang Lewandrowski[1,2], Dr Ellery Mayence[1,2], Dr Luis Merino-Martín[1,2,6], Dr David Merritt[1,2], Dr Paul Nevill[7,1,2], Dr Ryan Phillips[8,1,2], Dr Alison Ritchie[1,2,8], Dr Sacha Ruoss[1,2], Dr Jason Stevens[1,2]

[1]Kings Park Science, Botanic Gardens and Parks Authority, [2]School of Plant Biology, University of Western Australia, [3]Oceans Institute, The University of Western Australia , [4]Institute of Ecology and Evolution, University of Bern, [5]School of Veterinary and Life Sciences, Environment and Conservation Sciences, Murdoch University, [6]INRA, UMR AMAP, [7]Department of Environment and Agriculture, Curtin University, [8]Evolution, Ecology and Genetics, Research School of Biology, Australian National University

Demand for ecosystem restoration as a technical solution to biodiversity conservation challenges is increasing globally. However, it is apparent that ecological restoration frequently fails locally to achieve the high standards required to meet this demand.

Sustainable restoration of biodiverse ecosystems requires inputs from diverse scientific disciplines including ecology, biotechnology, engineering, soil science, ecophysiology and genetics. Despite restoration research activity increasing, the gap between the immediate needs of restoration practitioners and the outputs of restoration science often limits the effectiveness of restoration programs. Regrettably, science frequently misses the opportunity to identify practical issues most critical for restoration success. We propose that part of this oversight may be due to the absence of a considered framework or statement of practical restoration questions. Here we develop a comprehensive framework of the research required to bridge this gap and guide biodiverse ecosystem restoration. We structure necessary restoration research into five themes with 36 high level questions identified within these themes, requiring input from multiple disciplines.

The research program identified may appear daunting, but we note that successful restoration projects have typically invested in many, or most, of these themes. Typically some knowledge is already available for projects or can be assumed. We hope that this framework will assist practitioners and scientists to readily identify gaps in knowledge, contextualise their own research and develop strategic, problem-focussed research, and for planners to recognise the scale of investment required if offsets are being considered. The breadth of research areas highlights the importance of cross-discipline collaboration among restoration scientists.