Macrozamia conferta Research Project Plan (EPBC 2020/8756, EPBC 2020/8759)

Macintyre Wind Farm and Overhead Transmission Line

Prepared for:
ACCCIONA Energy Australia Global Pty Ltd

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1.0 Introduction

ACCIONA Energy Australia Global Pty Ltd (ACCIONA) proposes to develop and operate the MacIntyre Wind Farm (MIWF) and Overhead Transmission Line (OHTL) (the Project). Development of the Project will involve potential significant residual impacts to *Macrozamia conferta*, which is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Nature Conservation Act 1992* (NC Act). This *Macrozamia conferta* Research Project Plan (this Plan) has been developed to address EPBC Act approval conditions (EPBC 2020/8756 and EPBC 2020/8759) for the Project that outline requirements for the *M. conferta* research. Relevant EPBC Act approval conditions and where they have been addressed in this Plan are presented in **Table 1.1**.

Table 1.1: EPBC approval conditions compliance

Condition Number	Condition Requirement	Demonstration of how the proposed research plan addresses condition requirements
28	The approval holder must commission a *Macrozamia conferta* research project that is not inconsistent with the Queensland Herbarium's 2007 National multi-species recovery plan for the cycads and Commonwealth statutory documentation to increase knowledge of the specific translocation requirements of *Macrozamia conferta* and to increase understanding of other aspects of the ecology and biology of *Macrozamia conferta* including, but not limited to, habitat requirements, relationships with pollinators and factors that promote *Macrozamia conferta* dispersal.	This Plan aims to increase the knowledge of the population genetics and ecology of *Macrozamia conferta*, specifically in respect of its status as a distinct species, its population structure and survival demography post-translocation. This is consistent with the Queensland Herbarium's *National multi-species recovery plan for the cycads* as it addresses identified gaps in the current knowledge base for Queensland's threatened cycad species. The knowledge gained from this research will inform specific future actions to augment and recover *M. conferta* and other cycad species. It will also contribute towards the research priorities identified in the *Approved Conservation Advice for Macrozamia conferta* by providing information useful for the development of a genetic tagging system to establish a means of identifying illegal collection from the wild.
29	Within 12 months of the date of this approval, the approval holder must submit a *Macrozamia conferta* research project plan to the department. The *Macrozamia conferta* research project must be developed by a suitably qualified researcher and run for a minimum of 2 years.	This Plan will be carried out by senior researchers from the University of Queensland with qualifications in molecular phylogenetics, restoration ecology, population ecology, community ecology and plant biology (with a particular focus on cycads) (refer **Table 2.3**). These qualifications demonstrate that the definition of 'suitably qualified researcher' as outlined in the definitions section of the EPBC Act approval has been addressed. The research project will run for two years with annual reporting provided in June 2023 and June 2024. A detailed research proposal was submitted to the department on 17 June 2022.

2.0 Research project plan

2.1 Research proposal

Researchers from the University of Queensland have identified four key research questions aimed at increasing ecological and genetic understanding of *Macrozamia conferta*. These research topics were developed to address priorities outlined in the approved conservation advice (DAWE 2008) and an initial knowledge gap analysis. These are outlined in **Table 2.1**.

Table 2.1: Research plan

Research question		Reasoning	Approach
Genetics			
1	Is *Macrozamia conferta* a distinct species?	*M. conferta* is a member of the *M. plurinerva* complex, all of which are listed as vulnerable or greater on the IUCN scale. Members are morphologically very similar to each other and there is some doubt as to its status as a distinct species. Status as species feeds into IUCN level because population size and distribution range are part of the formulae, and also impact management options.	Use ddRADseq to obtain SNPs for 200 individuals (10 individuals from each of 20 populations) of the *Macrozamia plurinervia* complex. Samples to include populations of other species geographically closest to *M. conferta* (*M. machinii, M. cranei*, *M*. sp. Amiens, *M. occidua* and *M. viridis*) and sampling from several populations across the geographic range of *M. conferta*.
2	Has the Durikai population historically experienced gene flow with the population at the translocation site?	Gene flow via the dispersal of seeds and pollen maintain connectivity within and between populations. If connected, we would expect plants from both sites to be compatible when grown together.	Data type as above but targeting geographically diverse populations across the site including the reference population, the overhead transmission line population and the recipient site. 60 specimens in total (20 from each geographic area).
3	How connected are the populations of *M. conferta* across its range?	*M. conferta* (and other *Macrozamia*) exist as clusters of individuals (population) geographically isolated from other populations. For a long-term, viable metapopulation ongoing gene flow is required to maintain diversity and geographic range size.	Data type as above but adding in an additional four populations not yet sampled and not included in the above analyses. The new populations represent gaps in the current sampling and importantly include specimens in the mid-part of the species' range. Field work will be needed to obtain leaf tissues.
Ecology			
4	Is the post translocation survival rate of *Macrozamia conferta*, related to the size of the plant?	*M. conferta* has a subterranean caudex, and mass translocation represents an outstanding opportunity to measure caudex diameter as a size indicator for an entire population. The caudex is a starch reserve and hence represents the "fuel" the plant can draw on for new growth and reproduction. Do plants with a larger caudex survive better? Does caudex size relate to the production of new leaves or coning? Female (seed) cones are far more resource-demanding to produce than male (pollen) cones—is this reflected in caudex size and coning demography?	Data points will be recorded at the same time as the translocation including (a) caudex width (b) caudex length (c) leaf number (d) leaf length (e) number of leaflets (f)sex—if any cone debris is present.

2.2 Research schedule

The research project will run for a minimum of two years running concurrently alongside the *Macrozamia conferta* translocation activities with a proposed schedule provided in. Upon culmination of the works the findings will be made publicly available.

Table 2.2: Research schedule

Year	J	F	M	A	M	J	J	A	S	O	N	D
2022						Objective 1					Objective 2	
2023	Objective 2		Objective 3				Objective 4					
2024	Objective 4											

2.3 Research team

The University of Queensland has been engaged to undertake the research project. This team will be led by experienced researchers with significant experience undertaking research related to *Macrozamia*. *spp*. The key personnel proposed to deliver this research project plan are identified below.

Table 2.3: *Macrozamia conferta* project research team

Associate Professor Lyn Cook
Lyn obtained her PhD from The Australian National University in 2001 and has been at UQ since August 2006. In this time Lyn's research has been primarily aimed at understanding the origins, diversification, and distributions of organisms, especially plants and insects in Australia. These works are undertaken using a comparative approach utilising molecular phylogenies to test hypotheses about ecological and evolutionary processes. Recent and ongoing topics include understanding how interactions among plants and insects affect the evolutionary radiation of each; teasing apart the effects of extinction and speciation to understand how past climate and environmental change has shaped Australian biota; and investigating the relative roles of continental drift and long distance dispersal in explaining the current distribution patterns of organisms in the southern hemisphere.
Dr. John Dwyer
John's research focuses on applied and theoretical questions in the fields of restoration, population, and community ecology. With the overall aim to advance ecological knowledge and inform better management of our unique ecosystems and landscapes. In general, John's research uses Australian plant communities, both human-impacted and natural, to provide empirical tests of ecological theory. The focus of John's work is largely in the processes that maintain species diversity and ecosystem function, and how these processes may be altered by human activity and ongoing climate change. Additional avenues of research undertaken by John also focuses in natural regrowth vegetation and how it can be used to sequester carbon and enhance biodiversity in fragmented landscapes.

Dr John Hall
John's research focuses on the ecology of cycads, and he has worked on the animal-plant relationships of living cycads, such as their host-specific pollination relationships with certain beetles, their seed dispersal relationships with vertebrate animals and their defences against herbivory. John's work has also focused on the dispersal avenues for cycad species such as *Macrozamia miquelii* and *Cycas ophiolitica*.
Dr. Alicia Toon
Alicia is a research focused academic with a strong background in using molecular phylogenies to test hypotheses about ecological and evolutionary processes specifically relating to distribution and dispersal of a species. Alicia has extensive experience working on flora and fauna species Australia wide and her recent research includes identifying biogeographic barriers to gene flow in Australia species and historic divergence of species.