Climate Change Adaptation Research Grants Program
- Freshwater Biodiversity Projects

Project title:
Building the climate resilience of arid zone freshwater biota: identifying and prioritising processes and scales for management.

Principal investigators: Professor Jenny Davis
Lead organisation: Monash University

Objectives:
To support arid zone climate change adaptation by identifying the important scales, sites and processes (refugia, connectivity, dispersal, colonisation and establishment) that support persistence of freshwater biota under a changing climate.

Project design and methods
Our focus is on the Lake Eyre Basin (LEB), the Western Plateau and the Indian Ocean Drainage Divisions. These regions contain locally-fed springs and relictual streams, Great Artesian Basin (GAB) mound springs, waterholes in riverine networks and rockholes, supported by groundwater, surface water or a combination of both. These sites are 'oases' within extremely dry terrestrial landscapes and have important environmental, cultural and social values. Some of the most rapid warming observed on the Australian continent has occurred in these regions. Annual maximum temperatures recorded at the Alice Springs meteorological station have increased by 2°C since 1900 while annual rainfall remains highly variable and episodic.

Our objective is to undertake a once-off field sampling program, combined with existing datasets, to identify the presence and characteristics of aquatic refugia, pathways of dispersal, extent of connectivity and the requirements for successful colonisation and establishment.

We will combine data on local environmental conditions (hydrology, geomorphology and microhabitats) with molecular genetics to determine the roles of local (abiotic and biotic) and landscape-level processes (connectivity and dispersal) in supporting the persistence of freshwater fish and macroinvertebrate communities.

We will combine the results of the genetic analyses with measurements of local environmental attributes and macroinvertebrate community composition to test the importance of neutral and niche theories in explaining patterns of arid zone freshwater biodiversity, Neutral theory predicts that community similarity is negatively associated with distance between sites, while niche theory suggests that similar communities are associated with similar local ecological conditions

We will test a series of hypotheses (Table 1, over page) on gene flow and local vs landscape processes to estimate the temporal and spatial scales (microhabitats, habitats, local environments, local aquifers, the Great Artesian Basin, river networks, drainage basins and biogeographic regions) at which management and policy development can best maintain arid zone freshwater biodiversity under future climate and land use scenarios,

Table 1. Characteristics of arid zone wetlands and hypothesized models of gene flow and local vs landscape processes

	WETLAND TYPE			
	Mound Springs	**Relict Streams & Springs**	**Rockholes**	**Riverine Waterholes**
Water Source	groundwater (GAB)	local aquifer	surface water	surface &groundwater
Hydrological Persistence	permanent	permanent	variable	variable
Spatial Character	isolated	isolated	isolated	within stream network
Local Conditions	constant - warm, saline	constant - cool, fresh	variable depth, temperature & salinity	variable depth, temperature & salinity
Important biotic groups	endemics	relicts	dispersers	dispersers
Connectivity – hydrological	absent *connected via artesian water not accessed by most species*	absent *springs above rock barriers in streamlines*	absent	present but highly variable
Connectivity – aerial	low *fish, molluscs & crustaceans cannot disperse aerially*	moderate *some insects disperse aerially*	moderate *some insects disperse aerially*	moderate *some insects disperse aerially*
Hypotheses				
H1: dominant model of geno flow	Death Valley Model	Headwater Model/ Isolation by Distance	Isolation by Distance	Dendritic Network Model/ Isolation by Distance
H2: dominant ecological processes	Local	Local	Local & Landscape	Local & Landscape
H3: important scale for climate adaptation management	Local environment & GAB	Local environment & local aquifer	Local to continental	Local environment & river network (catchment)