July 2010

# Impacts of climate change on subterranean wetlands in Western Australia

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GOVERNMENT OF WESTERN AUSTRALIA

Department of **Water**

Department of **Environment and Conservation**

NCCARF
National
Climate Change Adaptation
Research Facility
Adaptation Research Network
WATER RESOURCES AND FRESHWATER BIODIVERSITY

Murdoch UNIVERSITY

# Climate Change and Western Australian Wetlands and Waterways

## Current knowledge and future directions

## Symposium July 6th 2010 Perth, WA

## Program and Abstracts

*Abstract of keynote address presented to Climate Change and WA Wetlands and waterways: current knowledge and future direction, 6th July 2010, Wollaston Conference Centre, Mt Claremont, Perth*

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**Impacts of Climate Change on Subterranean Wetlands in Western Australia**

West Australian groundwater supports diverse faunas (stygofauna) that include many obligate groundwater-dependent species (stygobites), often belonging to relictual lineages, and which are typically short range endemics. These characteristics make stygofauna vulnerable to habitat changes, particularly reduced water quantity, which is a key stressor linked with climate change.

In southwest Western Australia, a drying climate trend experienced over the past three decades has contributed to declining groundwater levels in the limestone caves at Yanchep and the Leeuwin-Naturaliste region. Groundwater pools and streams in these caves are habitat for assemblages of stygofauna associated with tree roots which grow in the cave pools and streams. Because of the declining water levels, these *Aquatic Root Mat Communities* were listed as Threatened Ecological Communities (TECs) (status Endangered) under the Federal Environmental Protection and Biodiversity Conservation Act.

A PhD study of the Leeuwin-Naturaliste caves and dependent stygofauna communities characterised their ecological relationships with hydrology, vegetation, rainfall, climate and other potential threatening processes. Radiometric dating and stratigraphic levelling of sediments were used to reconstruct a history of groundwater changes in Jewel Cave spanning the Early Pleistocene to Present. During a period in the Late Pleistocene (35,000 to 15,000 BP) the groundwater regime was influenced by a series of extreme flooding events associated with intense storms and fire. The lowest palaeo groundwater levels were recorded near the end of the Pleistocene (ca. 12,000 BP), followed by generally elevated levels through the Holocene.

Molecular genetic DNA evidence from two species of crustaceans endemic to Jewel Cave suggests that the stygofauna survived *in situ*, the extreme flood events and low groundwater levels experienced in the Late Pleistocene. In the last five years however, groundwater in Jewel Cave has declined below the lowest recorded Pleistocene limit, and all known occurrences of its root mat stygofauna community have disappeared, including locally endemic species such as *Areacandona admiratio*.

Recovery Plans prepared for the Leeuwin-Naturaliste and Yanchep TECs have met with limited success, and almost all known occurrences have disappeared in the last few years. Faced with a continued drying climate trend in southwest Western Australia, the future outlook for survival of these and other unrecognized subterranean TECs is less than optimistic.

Recently the Augusta-Margaret River Tourism Association (AMRTA) has instigated measures to control and manage the groundwater decline in Lake Cave, by harvesting rainfall to supplement groundwater recharge and sustain the cave lake, which is a major ecotourism drawcard. In tandem with this, a major study funded by an NRM grant, is underway to understand the hydrology and stygofauna in Lake Cave, with the ultimate goal of developing management strategies for coping with climate change.

At a strategic level, a major knowledge gap for stygofauna in Western Australia primarily relates to their taxonomy and distribution patterns, especially in southwest Western Australia. The impact of a drying climate in this region is compounded by increasing extractive demands on groundwater resources associated with urbanisation in the Perth Basin. The coastal limestone aquifers, which occupy a narrow linear band and provide the most prospective habitat for stygofauna, are also most impacted by urban developments, reduced water quality and contamination, and potentially saltwater intrusion caused by pumping or sea level rise. A second major knowledge gap concerns the resilience and ability of stygofauna to withstand and recover from these threatening processes, especially groundwater decline. A third major challenge relates to management policy and responses as described herein.