AQUATIC ROOT MAT COMMUNITY 1-4 OF CAVES OF THE LEEUWIN NATURALISTE RIDGE RECOVERY TEAM

ANNUAL REPORT 2004

By Kim Williams

On behalf of the Leeuwin Naturaliste Aquatic Root Mat Community Recovery Team

March 2005

Summary

This report summarises the work carried out during the 2004 to March 2005 period being the second full year of operation of the Recovery Team.

2004 has seen the team progress on a number of fronts towards gaining a better understanding of the biology/ecology of the root mat communities, the probable threats acting upon them and trialled some management options.

The team wishes to congratulate Stefan Eberhard on the completion and release of his PhD "Ecology and Hydrology of a Threatened Groundwater-Dependent Ecosystem: the Jewel Cave Karst System in Western Australia". Stefan's investigations have provided new information on the extent and composition of some occurrences and direction for the team's major actions of the last year and we look forward to his continued support for many more.

The principle action undertaken by the team has been to trial prescribed burning to reduce rainfall interception by vegetation and surface leaf litter, thereby leading to increased soil water infiltration into the cave system and ergo into the pools supporting the root mat communities. This was undertaken in November 2003 in the 330 ha block of the Leeuwin Naturaliste NP above the Easter/Jewel Tourist Cave system near Augusta. To determine change resulting from the burn, pre and post burn monitoring of cave water levels, soil moisture content and infiltration rates, leaf area index for vegetation cover, water quality parameters and fuel loads were undertaken.

While the burn achieved its fire management objectives, the outcomes in relation to cave hydrology were disappointing. The soil moisture monitoring revealed that although there was a slight increase (>5%) in the volume of water penetrating the top 0.5m of soil, at 1m depth there was no difference between the burnt and unburnt sites. Similarly the leaf area results showed no significant variation between burnt and unburnt sites. As a consequence and despite the observations of increased water droplets on the cave roof, the water levels in the cave pools did not increase.
These results are best explained by the unfortunate fact that rainfall at the cave in the 12 months following the burn was the lowest on record at only 66% of the long term average. The team is now considering whether to repeat the experiment and/or modify the design to achieve a greater reduction in canopy cover and leaf litter.

Water levels at all 4 occurrences have again been monitored over 2004. All sites have continued to decline often to the lowest on record, necessitating repositioning of monitoring points, construction of deeper monitoring wells and leaving some root mat sites without water for extended periods. Levels in the easter/jewel system are estimated to be falling at a rate of 1cm per year. While definitive work to define the localised catchments is yet to be undertaken the team does not consider these declines to be linked to ground water abstraction, modified surface hydrology or competing land uses such as plantation forestry.

Another focus of the team members during 2004 has been to work within the regional natural resource management processes to embed recognition of the conservation priority of the root mat communities and other high value conservation assets within South West Regional NRM Strategy and NHT Investment Planning documents. This will result in the continuation of a modest budget to enable the team to continue with recovery actions in the 2005/06 year.

Primary tasks for the team in 2005 will be to finalise the aggregation, expansion and renaming of the community to reflect the increase in understanding arising from Stefan's work, commence investigation of local catchment issues and develop planning and land use guidelines to minimise potential impacts.

The Recovery Team
The Recovery Team and/or its subcommittees met on 5 occasions since the 2003 annual report including 3 full team meetings on Nov 26, 2003, Feb 4, 2005, and April 21, 2005

Membership remained steady during the period consisting of.

Kim Williams (Regional Leader Nature Conservation, CALM South West Region (Chair))
Val English (Senior Ecologist, CALM WATSCU)
Anne Wood (Cave Manager, CALM Blackwood District)
Andrew Storey (Invertebrate researcher, University of WA)
Brenton Knott (Invertebrate researcher, University of WA)
Robyn McBeth (Augusta- Margaret River Tourist Bureau 'Caveworks')
Stefan Eberhard (CALM Science, previously Caveworks,)
Cahit Yesertener (Hydrologist, DOE)

During the course of the year 4 guests also attended one or more meetings;
Rachel Meissner (CALM WATSCU) contractor updating the IRP
John Tillman (Regional Fire Coordinator, CALM South West Region)
Rob Turner (Fire Coordinator, CALM Blackwood District)\
Ian Dumbrell (Research Scientist, FPC South West)

Progress with Recovery Actions
Action 3.1 Establish a Recovery Team
Completed

Action 3.2 Clarify and continue to monitor the extent and condition of the communities
Monitoring extent and condition of the communities and its component fauna was last undertaken in 2002. The team discussed the need for further monitoring but decided against doing so as the current sampling technique is destructive and when combined with the sampling intensity required to detect change would result in significant damage to the root mats with limited gain in knowledge. Rather, alternative and indirect measures based on water levels and flow rates have been employed.

Action 3.3.4 Monitor water levels in caves to establish long term trends
Hydrological monitoring (water levels) for Strong's, Calgardup and Kudjal Yolgah (east and west) caves was undertaken bi-monthly by Anne Wood and monthly for Easter/Jewel caves by Stefan Eberhard and cave staff from the Augusta Margaret River Tourist Bureau.

Water levels have continued to decline at all sites. (see chart 1)

Calgardup Cave: Water levels have shown marked seasonal fluctuations over the 2002, 2003,2004 period in contrast to previous periods. The pool at the end of the cave containing the root mat community was without water during April-May 2004. This is the first time this has been observed.

Strong's Cave: Water levels have decreased significantly throughout 2003 and 2004. The entire stream is now without water. The level in the monitoring "well" has continued to fall such that a new well has been installed at a level below that of the original to enable monitoring to continue.

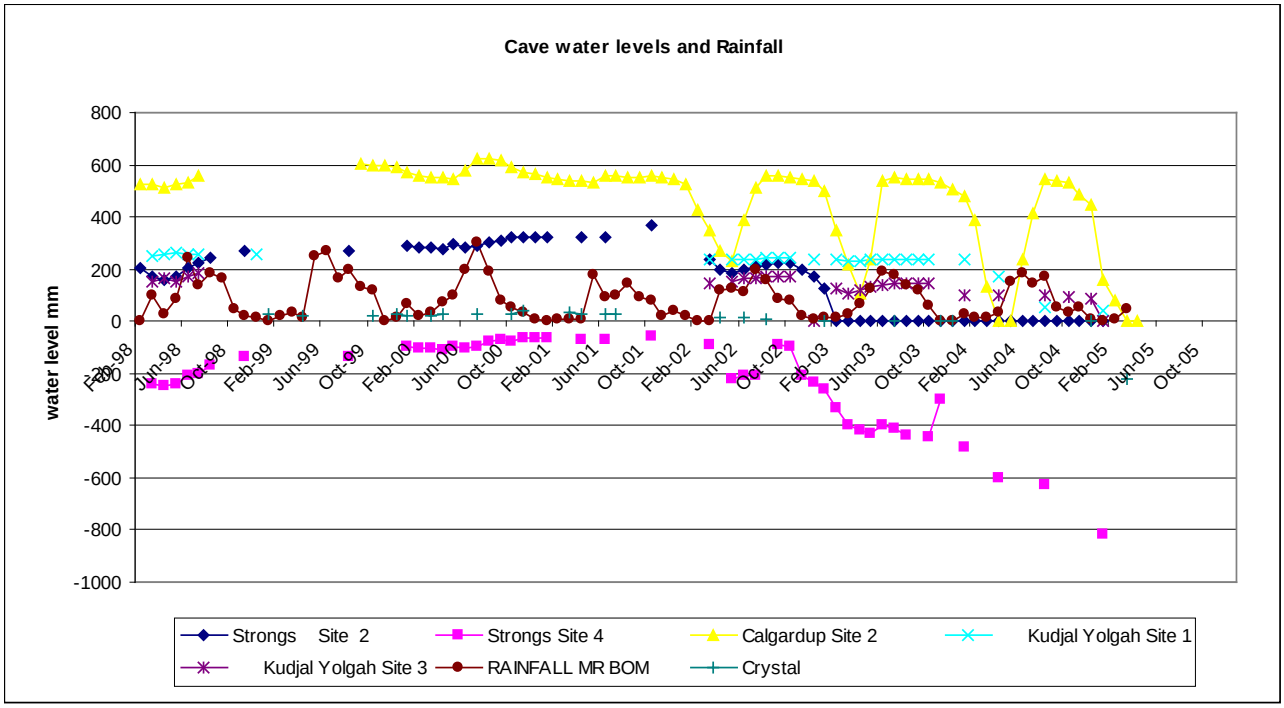
Kudjal Yolgah: Has been slower to respond than the other sites. Water levels observed

decreased during 2004. No water seepage was observed around the sides of the "mud chamber", a traditionally damp site. There has been no observable water flow during 2004.

Jewel Cave: Water level and dripwater monitoring has continued. A small increase in the dripwater was noted in September 2004 but overall water level within the cave system have been in decline at a rate of approximately 1cm per month for the last 2 years.

It is noted that 2004 was a very dry year for the Cape Leeuwin/Augusta area with rainfall at only 66% of the average.

Chart 1



Action 3.4 Survey likely areas for additional occurrences of root mat communities, especially caves on private land in the Leeuwin Naturalist Ridge area

Resulting from field work during the course of a PhD study a number of possible new occurrences of the root mat communities were identified by Stefan Eberhard including an extension of the easter/jewel occurrences over an approx 2km area of cave system. In view of the likely wider distribution of the root mat communities and other potentially threatened stygofauna communities on the Leeuwin Naturaliste Ridge the team has undertaken to define the distribution of suitable soils and geology. Within this area the team will seek to have hydrobiological surveys undertaken as a planning condition on any development application within or which may impact on the defined area.

Action 3.5 Disseminate information about the communities

An A4 sized poster was previously developed and circulated. Information about these communities was also provided to regional and subregional NRM groups (SW Catchment Council , Geocatch Catchment Council and Cape to Cape Catchments Group) as part of the development of a regional NRM strategy.

Action 3.6 Liaise with all Stakeholders to monitor and manage water levels in likely catchment areas for cave streams.

Action for 2005

Action 3.7 Undertake research to determine relationship between volume of groundwater abstracted and changes in water table gradients measured progressively away from the extraction site.
Action for 2005

Action 3.8 Initiate short term management solutions if monitoring of cave stream levels indicates the need.
For further consideration during 2005

Action 3.9 Investigate water quality requirements of the root mat community
Water quality testing (Dissolved oxygen, Ca, K, Mg, Na, Cl, P, NO3, SO4, HCO3) previously undertaken in 2002 was repeated in 2004 for the Easter/Jewel Cave occurrences. 17 Samples collected at monthly intervals prior and a further 12 samples post burn were analysed by AGAL (Aust Gov Analytical Laboratories)

Dripwater chemistry showed a significant decrease in Mg ion concentration after the burn, consistent with the response predicted from increased groundwater recharge based on the studies of Treble (2004) who measured an increase in the Mg signal preserved in speleothems related to declining rainfall trends in the southwest. All other things being equal, it suggests that Mg might be an indicator of increased recharge having occurred after the burn. This data is potentially important given the absence of a measured effect from the soil moisture monitoring. Monitoring Mg and rainfall again this winter will hopefully give us the data needed to more confidently support or reject the observed effect, but this is exploratory research so there are no guaranteed outcomes.

Action 3.10 Manage water quality in likely catchment areas for cave streams
Work in the easter/jewel cave area based on geology and surface hydrology patterns has determined the probable catchment to be very small and essentially constrained to the immediate vegetated parts of the LN national park and adjoining private lands. The only identifiable water quality impacts within this zone relate to the operations of the tourist cave facilities and in particular an indication that elevated levels of micro-organisms might be being influenced by the use of on site septic tanks for sewerage disposal.

Determining the catchment boundaries for the other community occurrences is yet to be undertaken. However the team believes catchment sizes will be similarly restricted.

Action 3.11 Ensure the planning process places controls on land uses that have the potential to impact on cave streams.
As reported in 3.4 the team has undertaken in the coming year to define the possible area of distribution of suitable soils and geology capable of supporting root mat and other threatened stygofaunal communities on the LN ridge. This is the first step in making local and state planning authorities aware of the conservation values and off site management requirements.

Action 3.12 Determine the location of trees with roots in caves, monitor and protect them and Action 3.13 Develop and implement regeneration program for trees root mats.
These actions have been considered by the team and determined to be of lower priority given new information of the extent of occurrences in easter/jewel caves, the number of trees involved and the improvement in understanding of the biological requirements/dependencies of many of the component invertebrate species to the root mat substrate.

Action 3.14 Manage fire regimes in a buffer area around trees with roots in caves, to prevent fires of sufficient intensity to kill mature trees

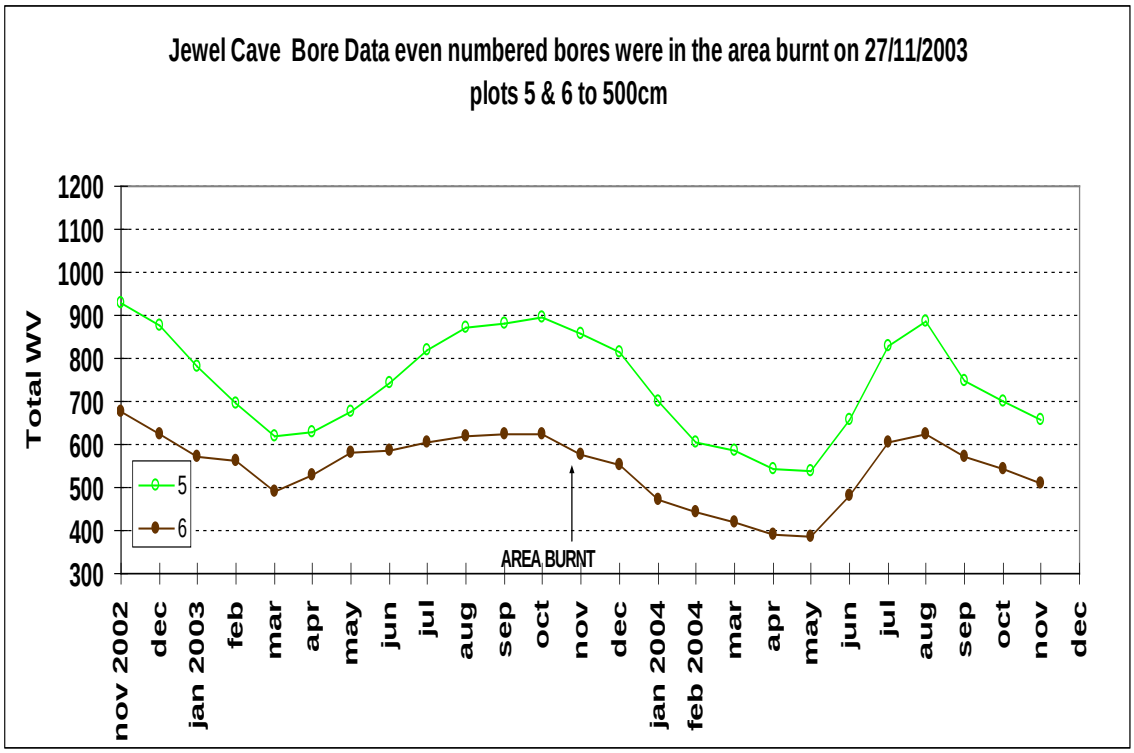
As identified in the 2003 annual report, based on investigations undertaken by Stefan Eberhard during the course of his PhD it was suggested that declining water levels in Easter and Jewel caves were being influenced by accumulating surface fuels (leaf litter and canopy) thereby reducing the amount of rainfall penetrating the soil and into the cave system.

A prescribed burn covering approx 330 ha was proposed for the vegetation above Jewel and Easter caves in Autumn 2003 however due to unfavourable weather conditions the burn was not undertaken until spring 2003 (Nov) The operation was undertaken in 2 stages recognising the different regimes required for coastal heath and karri forest communities.

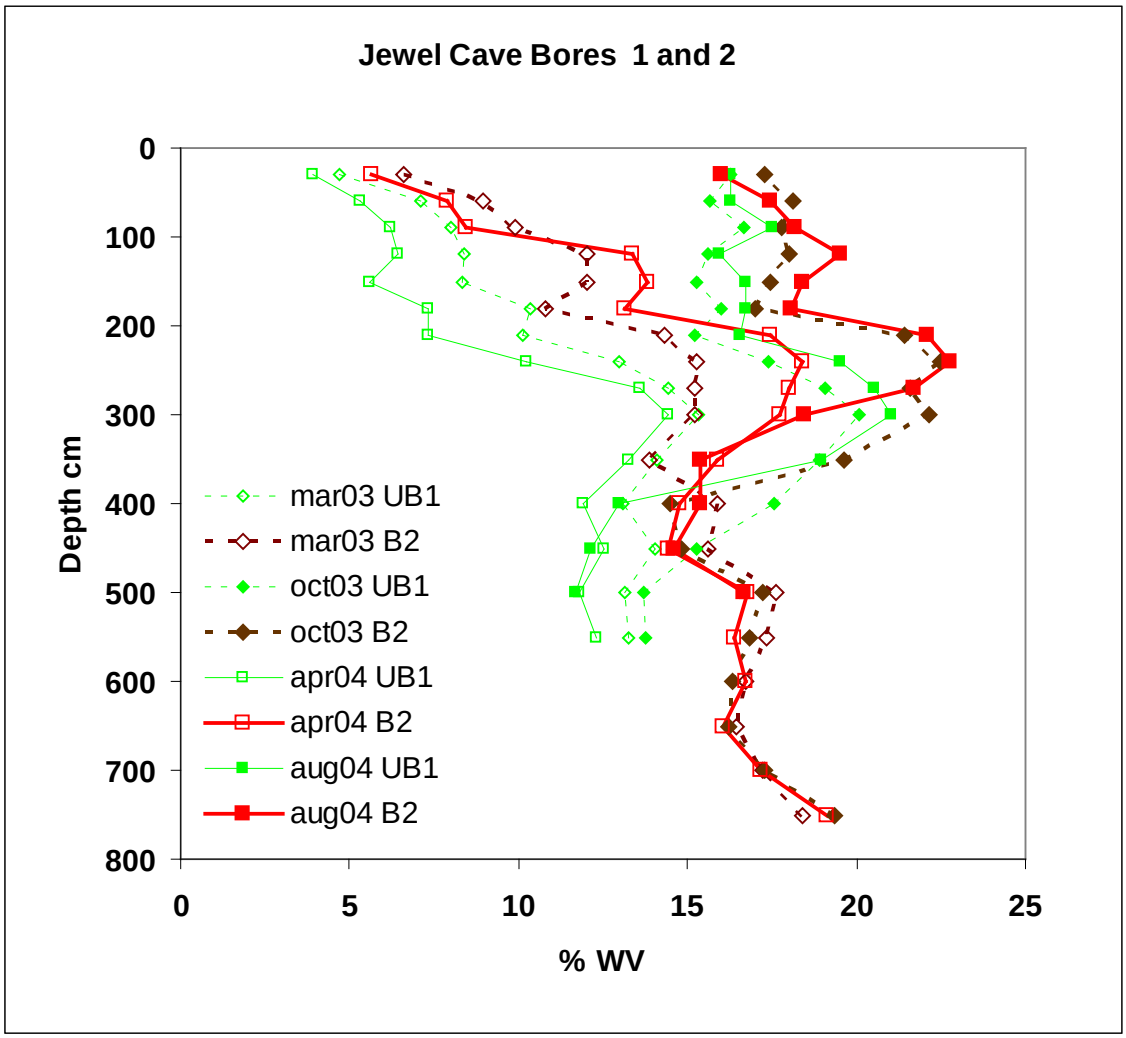
The burn was considered an operational success with all major outcomes (intensity, coverage - mosaic pockets) having been achieved with no or few problems.

A monitoring program was devised to measure the change in cave water levels, soil moisture content and infiltration rates, leaf area index for canopy cover, water quality parameters (including dissolved oxygen), and fuel loads at six sites around the burn using paired transects (control and treatment)

The soil moisture monitoring revealed that although there was a slight increase (>5%) in the volume of water penetrating the top 0.5m of soil, at 1m depth there was no difference between the burnt and unburnt sites. Similarly the leaf area results showed no significant variation between burnt and unburnt sites.



Graph 1: Trend comparison for total soil water availability in a paired transect (burnt and unburnt). Note how the post fire trend is very similar to the pre fire results indicated limited benefit arising from the burn.



Graph 2: Infiltration expressed as total soil water available at various depths pre and post burn. Note how the Aug 04 B2 plot (post burn) closely mimics the Oct 03 B2 plot (pre burn) indicating the burn resulted in limited/no increased in moisture penetrating the soil at 800mm depth.

Other:

Revision of IRP

A review and update of IRP was commenced late 2004 by WATSCU staff and funded through the Dept of Environment and Heritage. The plan is expected to be completed by Nov 2005.

The team has considered the need to aggregate, expand and rename the current communities to improve the conservation stygofaunal and aquatic invertebrate communities of the Leeuwin Naturaliste Ridge utilising the increase knowledge arising from Stefan's work. A nomination of the new community to the Threatened Ecological Communities Scientific Committee will be developed during the 2005.

A further issue for the team is to better define the actual threats to the occurrences. In 2005 the team will commence an investigation of local catchment issues which is expected to lead to the creation of development planning and land use guidelines to minimise potential impacts arising from off reserve actions.