HYDROLOGY

COMPARISON OF CHANGES TO WATER LEVELS IN DEEP BORES - 1975 TO 2004 - HELENA CATCHMENT, WESTERN AUSTRALIA

Frank Batini

DURING the mid 1970's, the Forests Department, being concerned at the possible effects of logging on salinity, commenced some paired catchment studies in the Helena catchment to investigate this matter. Initially, two catchments nominally in the 700 mm rainfall zone were selected for treatment. These catchments were predominantly comprised of jarrah-marri with some patches of wandoo on the lower flats and the upper slopes. Rainfall, runoff, salt discharge, salt storages in the soil profile, groundwater depths and salinities and shallow water-table depths and salinities were recorded. Nine deep bores were established in each catchment, to measure the salinity and depth to the confined groundwater. In addition, about 20 shallow bores were also established to monitor the responses in the perched groundwater table. After a period of three winters (1974-76) for calibration, one catchment was logged in summer 1976-77 and crown density was reduced by about 50 percent. Monitoring then continued for a further eight years.

Runoff data showed that the yield of water was about one percent of the average rainfall of 700mm per annum. Flow-weighted stream chloride concentrations remained very fresh and ranged from 17 to 40 ppm. Data from deep bores between 1975 and 1979 showed that the minimum water levels recorded were already falling in both catchments, by about 0.5metres/year.

Prior to winter 1976, a further nine deep bores were drilled close to the eastern margin of the catchment, in the 500-600 mm rainfall zone within predominantly wandoo forest in the Talbot block and monitored for four years.

These records now span a period of over 25 years and are of considerable value. In October 2001 I remeasured two of the deep bores in the Wellbucket catchment that formerly had held water and found them dry. In early June 2004, at the request of CALM, all of the useable bores were relocated and measured with Ms Liz Manning and Mr Bruce McGregor of the York LCDC.

Differences between mid to late 1970's recorded bore levels and recent re-measurements some 25 to 30 years later were 9, 6 and 4.6 metres. The water level fell in all bores. Some of the bores were now blocked at depth and in one case a dense mat of tree roots was recovered from within the bore casing. In other cases many bores that had held water in the late 1970's were now dry.

Do any of our readers have similar long-term records of falling water tables? If so, could you let LFW or the Wandoo Recovery Group have access to them?

The following observations are made:

- The observed reductions in groundwater level over the past 25 years are consistent with records of reductions in rainfall and catchment yield over the same period.
- Groundwater tables are replenished by rainfall and from shallow groundwater tables, usually through root channels and lines of weakness in the soil. The large decline in groundwater at depth indicates that adequate recharge has not occurred for at least two decades.
- The large fall in groundwater levels observed in all bores suggests to me that the soil water storage has also been depleted since at least 1975.
- While some wandoo trees may access and use some of the groundwater, these stands are not generally reliant on access to a deep groundwater table. In a number of bores drilled in the mid 1970's, healthy wandoo were growing on sites that were found to be dry at depth.
- Wandoo is also not reliant on the ephemeral, fresh, shallow groundwater system. In a number of cases, especially on upper slopes, shallow bores were always dry.

Trees are very long-lived and have therefore developed multiple strategies to cope with both climatic change and attack by insects and fungi. Drought strategies include control over transpiration and stomata, thick cuticles and bark, leaf alignment, leaf fall, branch dieback and the replacement of its primary crown by epicormic growth. Attack and infection may be countered by increased leaf or root production and/or mobilisation of defence mechanisms such as gum veins, periderm formation and occlusions. The process is a dynamic one, tree crowns may partially recover, and then be affected once again.

Drought strategies all use less water and therefore mean that a lesser amount of photosynthetic material is produced. Active response to infection or insect attack requires mobilisation of defence mechanisms that need additional photosynthetic products. Where the negative impacts on the trees are sustained over long periods (some years or decades) by a chronic climatic change or attack, the availability of food resources declines, so defence mechanisms are severely stretched and may then fail.

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Welcome Swallow															
More species ...															

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Such a chronic situation may lead to what is referred to as predisposition of a tree to fungal or insect attack. External influences that may have been dealt with by the tree in a normal situation now lead to severe debility and tree death. A chronic situation such as an extended drought period will not be relieved by one or two wet years. If the soil water storage has been severely depleted over some decades, it can only recover over a longer time period.

The data indicates that groundwater levels have been in decline since at least 1975. The soil water storage has also been depleted during the past 30 years. These conditions suggest to me that the trees in the eastern Helena catchment have been under a chronic drought stress over this extended period.

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