MANAGING FORESTED CATCHMENTS IN THE SOUTH-WEST OF WESTERN AUSTRALIA:
THREATS AND OPPORTUNITIES

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Introduction

On behalf of the Western Australian Division of the Institute of Foresters of Australia I would like to welcome you to this afternoon's forum on Managing Forested Catchments – threats and opportunities. At the outset, I wish to acknowledge the traditional owners of the lands on which we meet and their role as custodians of the lands and waters of the south-west

The Institute of Foresters is a national organisation that represents the views of forest management professionals and has more than 100 members in Western Australia who work in public forest management, the plantation sector and environmental services. The Institute was formed in 1935 and its first registered member and President was a Western Australian – Stephen Kessell.

Catchment management has been a central theme in Western Australian forestry since the early years of the 20th century – highlighting the delicate balance between forest cover and the yield and quality of water flowing from the western edge of the ancient Darling Plateau. For much of the past 50 years the focus has been on maintaining forest cover to prevent the rise of saline groundwater. More recently, a persistent and intensifying trend of dryness has focussed attention on the need for management to meet the needs of the human population and to sustain the health and resilience of the forest itself.

The intent of this forum is to bring together a range of people and organisations with an interest in managing jarrah forest catchments for water supply, fire control, biodiversity conservation, recreation and timber production. Our aim is to distill current knowledge and views on management of these forests to assist policymakers (agencies and Government) in developing sound policy and future management options.

We have five well qualified speakers lined up to present overviews of topics fundamental to the management of forested catchments. Four of our speakers will deal with activities that take place in the forest – silvicultural thinning, bushfire management, bauxite mining, and biodiversity conservation. Our fifth speaker Geoff Calder, CEO of Harvey Water, will provide a customer's perspective from the downstream end of the forest management system.

Presentations will focus on the northern jarrah forest – broadly the area from the Great Eastern Highway south to the Preston River – where demand for water from the forest is greatest, and

where past and present land use is most complex. However, many of the issues that will be described are equally relevant to forests further south where local communities rely on forested catchments for their water supplies, and demand for water to support intensified agriculture is primed to grow rapidly in the next decade.

The jarrah forest

It is common to refer to the northern jarrah forest as a single entity, but in reality it is a highly variable environment overlaid with a complex history of land use.

There are strong gradients of rainfall and potential evapo-transpiration extending across the forest. Soils vary widely in depth, texture and fertility over short distances. Landforms vary from sheltered valleys to exposed outcrops of granite and lateritic ironstone breakaways.

While jarrah dominates the lateritic uplands, a broad variety of other eucalypts and mid-storey trees are characteristic of specific sites. Subtle changes in elevation, soil type and moisture regime may be associated with major changes in the structure and composition of the vegetation.

Much of the northern forest was exploited extensively for timber prior to the advent of systematic forest management in the early 1920s. Heavy cutting on more productive sites typically resulted in regeneration of dense saplings stands, with only the non-commercial veteran trees left from the original stand. These stands are now around a century old, and locked in intense competition for moisture, nutrients and growing space.

Where the quality of the original forest was lesser, and the influence of forest regulation more pervasive, the present day forest may have a more mixed structure that includes a component of larger and older trees.

During the Great Depression a significant area of cut-over forest was treated by non-commercial thinning and ringbarking. Thinning operations have continued in regrowth forest to a greater or lesser extent from the 1960s to the present day, influenced by markets, funding and availability of labour.

A persistent drying trend of drying and warming

The south-west of Western Australia has undergone a persistent drying trend over the past four decades, with 1975 often marked as a turning point. I doubt that this comes as a surprise to anyone in this audience.

There have been a spate a very dry years during this period, notably 1994, 2001, 2006 and 2010. While very dry years are evident in the earlier record, these dry years were also interspersed with years of well above average rainfall.

And just in case you thought the return to a cooler, wetter winter in 2016 was reversing this trend there are still large parts of the south-west for which rainfall has been below or very much below normal over the 48 months to end of August 2014. At best, the rainfall for 2016 might just make the average for the period 1960-1990.

Temperatures have also shown a steady upward trend since the early 1990s, as shown by the persistent positive anomalies for maximum temperature. This is important because of the influence of temperature on evaporation, transpiration and heat load on plants and animals, including humans and their demand for water.

Declining groundwater and streamflow

Declining rainfall has been accompanied by falling groundwater levels across much of the forest – with bores commonly showing a decline in depth to water by more than 10 m. The amplitude of the seasonal variation in groundwater has also tended to reduce.

Streamflows have also reduced from levels typical of the pre-1975 period. This has been characterised by a marked step-down in the 1990s followed by a further step-down in the 2000s. Some formerly perennial streams have now ceased to flow for the first time in a century.

Impacts of a drying climate

The impacts of this persistent drying are being expressed in a variety of ways.

Following an extremely dry year and protracted hot summer of 2010/11 extensive deaths of overstorey trees occurred throughout parts of the northern jarrah forest. Tree deaths were associated strongly with shallow soils along the escarpment and in sites adjoining extensive granites. Impacts were also evident for species and sites normally considered to be well-buffered from periodic water stress.

Patterns of tree death and the environmental factors associated with them have been documented thoroughly by staff of the Centre for Excellence in Climate Change and Forest Health at Murdoch University.

Reductions in duration and quantity of streamflow have also been shown to affect aquatic systems including stream invertebrate communities. These effects have been documented in the Wungong catchment study, and more broadly through the stream monitoring undertaken as a key performance indicator for the Forest Management Plan 2004-13.

Fire management

The incidence and scale of high intensity bushfires in the northern jarrah forest has increased since 2003. These fires are having adverse impacts on soil, water, biodiversity and productive capacity.

Drying climate is a significant influence and has changed the timing, opportunity and risk for prescribed burning.

Land management factors are also influential, particularly

- expanding rural-urban interface which adds to the risks both for planned burning and during bushfire suppression, and

- greater complexity and cost of prescribed burning in mined forest where landscape is fragmented by roads, conveyors, mine pits and young rehabilitation

Knowledge for catchment management

There is substantial body of knowledge relating to the response of jarrah forest catchments to changes in climate, forest cover and land management activities.

The 1970s saw significant investment in the instrumentation of experimental catchments, and a number of these continue to be monitored for streamflow and groundwater – providing an invaluable record of responses to a drying climate. A subset of these have provided the framework for a paired catchment study examining the response to different intensities of timber harvesting in the intermediate rainfall zone east of Dwellingup since 2002.

The Wungong Catchment Trial was an important initiative that took thinning treatment to an operational scale and addressed issues specific to areas rehabilitated following bauxite mining. Findings from the trial are comprehensively documented and provide a number of lessons for future management.

Process-based modelling has also advanced to the stage where it is providing important insights into responses to climate and management activities at catchment scale. The 2014 Northern Jarrah Forest Water Balance Study report by James Croton and colleagues warrants specific mention in this regard.

In short, there is a well-informed basis for decision making, and a solid framework for ongoing monitoring.

Alternative stand structures for jarrah forest

I'd like now to return to the forest and illustrate three alternative states of jarrah forest.

Mature forest is scarce in the northern jarrah due to past land use activities, and what old forest does exist is mostly in formal and informal reserves.

The middle state – heavily stocked regrowth – is relatively common in western and central zones of the northern jarrah forest. Growth of individual trees is very slow, and stand-level water use is very high.

The right-hand image shows a century old regrowth stand thinned to a residual basal area of around 15 m^2/ha. Growth potential of the site is concentrated on the best trees, and stand level water use is much reduced compared with the un-thinned example. Thinning to this density has sacrificed little of the overall growth potential of the site.

Thinning to increase water availability

Considering thinning treatment at the broader forest scale there are a number of potential benefits including:

- Enhanced streamflow in the higher rainfall western parts of the forest
- Greater resilience to drought events and the persistent drying trend
- Opportunities to source low-cost water for human use

This image shows the modelled forest basal area required to generate specific levels of streamflow in three zones of the northern jarrah forest:

- 100 mm/year flow in the High rainfall zone (west of 1100 mm isohyet)
- 10 mm/ year in the Intermediate rainfall zone (1100-900 mm isohyet)
- 1 mm/year in the Low rainfall zone (<900 mm isohyet)

Important implication of this modelling is that as you move toward the south the potential gains in streamflow from a given level of thinning treatment become larger – suggesting that treatments targeting the Waroona and Sampson Brook catchments could be most effective from the perspective of water yield.

Within these broad zones identified by modelling there is also a need to consider the attributes of different site types, and the current condition of the forest on them.

Key elements for a successful program

We need to be mindful that turning a concept into a reality requires a number of factors to addressed and resolved on an ongoing basis.

Three factors critical to the success of a thinning treatment program are:

- Resolving technical issues such as achieving effective control of stump coppice and longer term management of ground coppice that will be released from competition
- Finding markets for wood products generated by thinning, both to offset the costs of treatment and to avoid the build-up of large amounts of woody fuel that will make fire management more difficult
- Engaging with communities and interest groups to build understanding and recognition of the full range of benefits from a forest treatment program

These, and other factors, require work but are not insurmountable.

A broader context

The concept of active forest restoration programs that involve silvicultural intervention is gaining momentum in other places including the United States and Scandinavia – not only with government agencies but with organisations such as The Nature Conservancy. We should take the opportunity to learn from their experiences and to apply these to the unique circumstances of the jarrah forest.

We should look at opportunities that silviculture provides to accelerate the development of attributes that might be considered desirable for aesthetic and conservation reasons, such as large trees with big spreading crowns. With uncertainty about future climate, there are clear benefits in maintaining the ability to manipulate the structure of the forest on a portion of the

public forest estate – providing the opportunity for comparison of the outcomes of different management approaches.

Reference

Croton JT, Dalton GT, Green KA, Mauger GW, Dalton JA (2014) Northern Jarrah Forest water balance study to inform the review of silvicultural guidelines. Forest and Ecosystem Management Division Technical Report No. 9, Department of Parks and Wildlife, Perth, Western Australia.