Integration of flora and fauna management with wood production in native forest by means of appropriate silviculture

Research Working Group 4 - Native Forest Silviculture

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Abstract

In Western Australia the majority of native forest logging occurs in the jarrah and karri forests of the south west. CALM has a clearly stated commitment and legal obligation to the conservation and management of native flora and fauna in these forests. Conservation of flora and fauna is implemented through a range of strategies that operate at all levels of forest management ranging from the whole forest level to the subcoupe (or cell) level. At the whole forest level, CALM's two major strategies are the establishment and maintenance of a network of reserves and interconnecting uncut areas, and the control and management of logging and other activities on CALM lands. A range of instruments (acts, regulations, policies, management plans, administrative instructions, manuals and guidelines) regulate and guide these activities, define and specify the amount and types of areas to exclude from logging and define management processes. Silviculture is a major tool applied to manage forests and achieve these management outcomes consistent with CALM's policies and commitments.

Silviculture is incorporated at the policy level through the definition of structural goals for management of the jarrah and karri forests, and the establishment of the allowable cut. At the whole coupe level, silviculture is implemented through the development of pre-harvest coupe concept plans that ensure requirements for gap or cell size, and a range of reserved areas are met. These reserves: road reserves, stream zone reserves, Diverse Ecotype Zones (DEZ), Temporary Exclusion Zones (TEAS), 400 metre rule, special care zones, and Visual Landscape Management (VLM), establish a fine scale network of interconnecting uncut forest that supports the larger scale network of formal reserves and national parks. Implementation on the ground is one of the cornerstones of silviculture. The finer detail identification and demarcation of these areas, and defined tree marking, occurs on the ground at the individual coupe and subcoupe (or cell) level. At this coupe and cell level, conservation of flora and fauna is achieved through identification and demarcation of areas excluded from logging, through the retention of habitat trees and logs in the jarrah forests and through the accelerated creation of hollow bearing trees in logged Karri coupes. (In karri coupes there is no current requirement to retain habitat trees).

Throughout these processes and in the ongoing development of procedures and standards forest management ensures that the conservation of flora and fauna receives high priority.

General background

In the south west corner of Western Australia the publicly owned tall forests occur over an area of 1.98 million hectares where rainfall exceeds 600 mm. Of the forests that are actively managed for timber production the jarrah forest is the most extensive covering 1.57 million hectares (CALM, 1992). It is typically a mixed forest of jarrah and marri trees (approximate frequency ratio, 2:1), but can grow as stands of almost pure jarrah. The karri forest is less extensive occupying 174,000 hectares of the higher rainfall areas. Karri forest ranges from pure stands to the more common mixture with marri, and mixtures with jarrah on the edges of its distribution. Although timber harvesting also occurs in the native Wandoo forests of the south west (approximately 50 ha per annum) and the semi-arid woodlands of the eastern interior of W.A., this paper focuses on the jarrah and karri forests; those forests intensively managed for timber production.

Both the jarrah and karri forests are managed for multiple use including water, timber and mineral production, conservation, and recreation. Approximately 20,000 hectares of jarrah

forest and 2,000 hectares of karri forest are harvested annually. In comparison with other forest regions in Australia, the South-West Forest Region is characterised by a pattern of conservation reserves and multiple use forests available for wood production that are largely contiguous and closely related in most aspects of forest management, including fire management. The two forests, jarrah and karri, are managed under distinctly separate silvicultural systems. In brief, the karri forest is either clearfelled (all trees removed with a restriction on maximum coupe size), or thinned to release crop trees where existing regrowth occurs. The jarrah forest is harvested to create gaps, (total removal of overstorey on an area less than 10 ha to allow existing regeneration to develop), to thin (to release crop trees where existing regrowth occurs), or to create shelterwood (the retention of an overstorey to aid establishment of seedlings). Depending on the structure of the jarrah forest all three primary objectives may occur as a mosaic, particularly in forest with a history of past harvesting disturbance.

For over half a century silvicultural practice in these forests has focused on maintaining and improving timber production. Historically this was seen as the greatest value of the forest and hence as the primary justification for forest management. Early silviculture was directed at controlling logging and ensuring regeneration. Sound ecological principles have formed the basis of this management, and the concentration on preserving the 'keystone' species of the forest, the dominant tree species, has successfully preserved the whole forest ecosystem. This success has been demonstrated by flora and fauna surveys. Only one species of vertebrate or plant is known to be extinct in State Forest, though the distributions and abundance of some mammals has declined due to fox predation (Christensen, 1992; Christensen, 1997; Abbott and Christensen, 1996). The loss of this species (Lewin's water rail) from swamps that are neither harvested nor burnt does not implicate these management practices. Abbott and Christensen (1995/1996) propose that the sustainable use of forest in WA is the reason for the low numbers of species extinctions in these forests.

The primary objective of silviculture has now extended beyond timber production and the emphasis on fauna and flora has increased as the public concern over these forest values has increased over the last two decades. This emphasis or relative weighting of these forest values will continue to increase. The increase in forest reservation as a result of the recent Regional Forest Agreement is indicative of this trend.

Current forest management plan

Policy Level

At the policy level both the current Forest Management Plan (FMP) and the recently signed RFA commit CALM to forest management activities that conserve flora and fauna. The current forest management plan for the period 1994 to 2003 defines strategies and objectives of forest management in WA. It sets the objective of managing the forests of Western Australia in consultation with the community to;

"provide the values required by society while sustaining indefinitely their biological and social diversity"

This forest management plan sets specific conservation and forest management objectives.

The Conservation Objective is :

To maintain biological diversity at the genetic, species, and ecosystem level in the forest, with special emphasis on the protection and conservation of threatened, rare and uncommon taxa and communities.

This objective is achieved :

- Through security of tenure for forested areas that have conservation value
- By preparing wildlife management programs for selected species and identifying locating and seeking to conserve threatened or endangered flora, fauna, and communities.
- By establishing and managing a comprehensive adequate and representative reserve system
- By sustaining biological diversity in forests managed for multiple purposes
- By encouraging retention or establishment and effective management of native vegetation on privately owned land in the south-west.

The remaining objectives of the Forest Management Plan support these conservation objectives and integrate them with forest management including timber production.

A key requirement of the Forest Management Plan with respect to maintenance of ecological diversity on publicly owned forests is the establishment of forest structural goals, which specify the proportion of the forest estate that will be maintained in particular developmental stages (karri) or disturbance classes (jarrah).

Seymour (1997) provided a summary of the silvicultural strategies applied to forests managed for timber production to achieve the forest structural goals as follows.

Silvicultural strategies

- Maintaining a network of undisturbed habitat along all streams and seepage areas. In karri, 2ha mature patches of forests are also retained where the distance between mature forest following harvesting would exceed 400 m.
- Leaving distinctive, rare and uncommon plant species and groups, undisturbed by harvesting.
- Excluding rock outcrops, woodlands, wetlands, sedgelands, shrublands, and distinctive floral assemblages or fauna habitat from harvesting.
- Retaining the original species in regenerating forests, and in cases where karri seedlings are planted, using the original genotype.
- Retain those elements of habitat which could be disturbed by harvesting or tending, and which take many years to replace (habitat trees).
- Restricting gap or clearfell size (maximum of 10 ha in jarrah and 80 ha in karri).
- Dispersing patches of harvesting
- Manipulating rotation length

Scientific basis of silviculture

Silvicultural practices in WA are underpinned by decades of scientific research, observation and commonsense risk analysis (see: Abbott and Loneregan, 1986; Stoneman et al., 1989; Breidahl and Hewett, 1995). There is much strategic planning embodied in Forest Plans, codes of practice, guidelines, and specifications. The history of silviculture in WA reveals a process of evolution of management in response to improved understanding and shifts in management goals. Early research understandably focused on achieving successful regeneration, and the emphasis then moved to thinning to increase growth and later water production and salinity control. Silviculture primarily aimed at timber production has

successfully catered for a wide range of values (Abbott and Christensen, 1995; Christensen, 1997; Abbott and Burrows, 1999). We are now at the stage of fine tuning silvicultural practices to meet more specific and varied objectives. The current emphasis on the conservation of flora and fauna is one of these specific objectives.

Karri

The silvicultural system used to conserve flora and fauna in the karri forest was developed in the early 1970's in conjunction with the re-introduction of clearfelling as the standard regeneration cutting treatment. This system took into account what was known of the biology of the karri forest, though research in this area did not provide a complete basis for this management strategy. To provide hollow bearing trees, nesting sites, and access to other attributes of mature stands in forest managed for timber production under a clearfall system, a network of road, river, and stream reserves was adopted. This strategy provided benefits in managing stream salinity, in fire control, it excluded from harvesting areas most likely to contain the greatest diversity and abundance, and provided a network of uncut corridors that linked up the forest. These uncut road river and stream reserves comprise a minimum of 20% of all forest blocks. In addition to these areas, heathlands, sedgelands, woodlands and rock outcrops are also excluded from harvesting. Along with national parks, nature reserves and conservation parks these uncut areas provide a complex network of uncut mature karri forest from which animals can recolonize regrowth stands. Based on the work of Wardell-Johnson (in prep.) a prescribed maximum gap width of 400m adds to the network of uncut forest. Fauna species that feed in the regenerating forest can nest in the surrounding belts of mature trees, older hollow bearing trees are retained, and both plants and animals can recolonize the clearfell. In the karri forest a total of 46.2% of the forest is retained in these various uncut areas.

Research on flora and fauna in the karri forest has tended to focus on possible impacts of logging and burning activities. Christensen (1992, 1994) reviews this work, observes that most plants and animal species of this forest appear able to survive disturbance caused by felling and fire, and argues that felling creates only a temporary disturbance to the forest ecosystem for both plants and animals of the karri forest.

Research in the karri forests has covered flora (Christensen and Kimber, 1975; Hopper et al., 1992; Inions et al., 1990; EPA, 1976), small, medium, and large mammals (Christensen

unpublished; Christensen et al. 1985; Christensen unpublished; Wardell-Johnson 1986), and birds (Tingay and Tingay, 1984; Wardell-Johnson, 1985; Wardell-Johnson and Williams, in prep.; Williams et al., in prep.). The 400m restriction on clearfell width was determined from the research of Wardell-Johnson and Williams (in prep.).

Wardell-Johnson (1985) found that 32% of the 44 bird species on a karri site used hollows for nesting, and Wardell-Johnson and Christensen (unpublished) found that nine mammal species of the karri forest required hollows. These hollow nesting species are probably most at risk from clear falling and would benefit from research on hollow use and availability in the karri forest. Christensen (1992) proposes that plants with restricted distribution that are obligate seeders also need further research, and like Wardell Johnson and Horwitz (1996) proposes that relictual species with restricted distribution that are sensitive to fire need special attention.

Jarrah

The current silvicultural practices in the jarrah forest are based on observation of the results of a range of silvicultural practices applied to the jarrah forest over the last 100 years. These practices are supported by research on reproduction and regeneration, growth, stand density and development, (see for example Abbott and Loneregan, 1986; Stoneman et al., 1989; and more recently, RFA, 1998), hollow bearing trees (Williams and Faunt, 1997; Whitford and Williams, 1997; Whitford, in review; Whitford, in prep.) and floristics (Burrows and Friend, 1998). The flora and fauna of the jarrah forest have a have a high degree of tolerance to disturbance from fire and logging (Abbott and van Heurck, 1985; Nicholls and Watkins, 1984; Christensen and Kimber, 1975; Burrows and Friend, 1998). The current logging practice follows the group selection logging of the 1920's and 1930's with greater attention paid to gap size and to thinning of poles stands that have regenerated from the 1920's logging.

Coupe level silviculture is constrained to meet the overall structural goals for the jarrah forest and provide a minimum of three age or size classes. Gap sizes are limited to 10 ha, "Habitat" and "Potential Habitat" trees are retained to provide for hollow nesting species, and strips of uncut forest of a minimum of 100m wide (TEAS) are retained between gaps until the next cutting cycle. No harvesting occurs on road river and stream zones.

In a strategy similar to that used in karri, these unlogged areas (TEAS strips and road river and stream reserves) are maintained to link zones containing mature forest. 32.8% of jarrah forest is in reserves. Diverse ecotypes and areas of high flora or fauna value are also excluded from logging activities. In addition to this surrounding network of mature forest, mature seed trees are retained in areas logged to shelterwood, and Habitat trees, potential Habitat trees, and hollow bearing logs are retained in areas logged to gap.

The prescription for the retention of Habitat and Potential Habitat trees is based on the work of Inions (1985), Faunt (1992), and Whitford (1998; in prep.). Inions (1985; Inions et al., 1989) investigated the habitat role that tree hollows provided and the effects of fire on tree hollows in jarrah forest. Faunt (1992) studied the formation, and frequency of hollows in jarrah trees. McComb et al. (1994) estimated the number of tree hollows per hectare suited to common brushtail possums, and Australian ringneck (*Platycercus zonarius*), based on a sample of 292 hollows identified in 363 jarrah and marri trees. Whitford (1998) examined the longevity of habitat type trees retained after logging, Whitford (in review) determined the range of hollow sizes used by 10 species of birds and mammals from the jarrah forest and Whitford (in prep.) determined the frequency of occurrence and identified the attributes of trees bearing hollows suited to these species. Abbott (1998) identified the red-tailed black cockatoo as the species most likely to be affected by a loss of hollows caused by logging the jarrah forests. He examined the distribution and abundance of red-tailed black cockatoo's and found no evidence that logging was adversely affecting the species.

The Kingston project (described below) is an integrated study set up to examine the effects of timber harvesting on flora and fauna, and to provide feedback on existing forest management practices.

Current and future research

Ideally the management of our forest ecosystems would be based on a complete understanding of every aspects of their ecology. Such complete knowledge can never be attained, but CALM makes use of the best available information while conducting a program of research and monitoring aimed at improving management and minimising permanent ecological disturbance.

Kingston Project

CALMScience's, Biological Information, Biodiversity Conservation, and Forests and Tree Crops groups all contribute to research on ESFM. Currently the major research project in this field is the Kingston project. This is an integrated study of the effects of timber harvesting on the jarrah forest ecosystem. Contributing to this project are individual studies of vegetation floristics and structure, hollow bearing trees, invertebrates, terrestrial vertebrates, western ringtail possum, brush-tailed phascogale, and birds. Study sites are located across 15,000 ha of intermediate rainfall zone jarrah forest at Kingston, Warrup and Winnejup Forest Blocks with most of these studies using a BACI (Before, After, Control, Impact) design structured on the gap and shelterwood logging treatments applied to these coupes.

Preliminary results from the Kingston project show that Habitat trees and unlogged buffers are both important for maintaining brushtail possum (*Trichosurus vulpecula*) abundance. The abundance of brushtail possums declined after harvesting disturbance, but no species disappeared from the study area. Logging appears to have little impact on the ground dwelling Woylie (*Bettongia pencillata*) and Quenda (*Isoodon obesulus*). The Kingston project demonstrated the importance of fox control in minimising the impact of logging on medium sized mammals.

These preliminary results have already been used to modify and improve logging and silvicultural practices. Modification of the Habitat tree prescription occurred early in this research project when improved descriptions of the types of trees that bear hollows became available. Fox control increased the abundance of medium sized mammals to the point that trap saturation (mainly by Woylie) made it difficult to trap Chuditch (*Dasyurus geoffroii*). Preliminary results improved knowledge of nesting sites used by western ringtail possum in the jarrah forest, and indicate that it's susceptibility to predation from foxes and cats increases immediately after harvesting. When harvested areas are close to cleared agricultural land, fox and cat predation is even more likely. This highlighted the importance of fox and cat control.

The RFA and pre-logging fauna assessments

The recently signed RFA for WA sets research priorities for protection and conservation of biodiversity, and sustainable utilisation of natural resources, and commit CALM to the

development of a system of pre-logging fauna assessment to predict fauna occurrence in each block and document the known habitat requirements of threatened and sensitive fauna.

Protection and conservation of biodiversity :

- Determine the impact of threatening processes on the structure and function of communities and devise management practices to ameliorate these processes.
- Develop the scientific basis for the conservation and rehabilitation of integrated landscape systems.

Sustainable utilisation of natural resources:

- Provide the scientific basis for the ecologically sustainable utilisation of native forest and other natural resources.
- Develop appropriate forest fire regimes to protect life and property and to maintain biodiversity. Develop appropriate insect and disease management systems for forests.

The pre-logging fauna assessment system proposed in the RFA is an expert system that predicts which vertebrate species are likely to occur in an area. Predictions are based on known attributes of the area. Fifty-one habitat complexes have been identified based on the Havel/Mattiske RFA vegetation complexes, topography, and logging and disturbance history. The system predicts species presence, absence, and possible presence. It can provide predictions at the forest block level, the coupe level or down to a 300m x 300m cell. This system has been validated against 60,000 recorded sightings of vertebrates. It is currently being computerized.

Montreal Criteria and Indicators of sustainable forest management

CALM is progressing the implementation of the Montreal Criteria and Indicators and is currently examining how information required by specific indicators can be collected, data collection requirements, and location and content of databases. Two collaborative projects funded under a WAPIS initiative are currently under way. These projects examine indicators of soils compaction and soil organic matter, and regeneration and stocking. It is expected that research and data assembly associated with the Criteria and Indicators will lead to improved management of forest ecosystems.

Integrated Forest Monitoring System

CALM is developing a Integrated Forest Monitoring System (IFMS) to quantify, record, interpret and report on changes to key forest organisms. IFMS is an adaptive management system that uses GIS to design restrospective, contemporary, and progressive surveys covering forest districts and silvicultural treatments. The intention is for IFMS to yield information required by the current Ministerial Conditions, the RFA, and the Montreal Criteria and Indicators. IFMS will also provide a generalised retrospective studies of impacts, monitor the response of fauna to Western Shield, and provide validation of a developing vertebrate survey procedure proposed in the RFA for WA.

Conclusion

The focus of silviculture has traditionally been on forest regeneration, wood production and thinning to improve tree growth rates. CALM's approach to forest management regards timber production as compatible with the conservation of other forest values. This opinion derives from observation of historical forest management in Western Australia and is supported by preliminary results from the Kingston Block experiment, and the absence of fauna and flora extinctions that can be attributed to forest management activities. The compatibility of timber production with the conservation of flora and fauna is demonstrated by the present conservation value of the forest as a whole, and by the conservation value of specific sites that were previously managed exclusively for timber production.

Stand manipulation has the capacity to mimic natural events and or speed up their occurrence. Thus, given an objective, silviculture can be applied to manipulate the forest to achieve that objective. In Western Australia forest managers have available proven silvicultural techniques that have satisfactorily preserved a wide range of forest values. We are now at the stage of fine tuning these practices to meet more specific conservation objectives.

In the absence of complete knowledge of the impact of timber harvesting on flora and fauna, spreading risk is an important strategy, and along with improvements in silvicultural practice, the reserve system is an important attribute of a balanced management system.

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