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Reducing soil disturbance during timber harvesting

by Kim Whitford, DEC Science Division, 9538 0021, kim.whitford@dec.wa.gov.au

Background

Heavy machines – tractors, harvesters and wheeled loaders – can damage soil by compacting the surface layers, mixing topsoil with subsoil and destroying soil structure. Soil damage is a common problem in agriculture and a risk during timber harvesting in plantations and native forests.

In the south-west of Western Australia most forest occurs on public land and is managed using the principles of ecologically sustainable forest management. The Forest Management Plan 2004-2013 used the Montreal criteria of sustainability as a framework to identify actions that support ecologically sustainable forest management. Extensive requirements aimed at reducing soil damage during timber harvesting were introduced in this plan. Current management practices to reduce unnecessary soil disturbance have evolved on the basis of detailed field observations, improved knowledge and research which has quantified some specific impacts of timber harvesting on the soils of the jarrah and karri forests.

Scientists from the Department of Environment and Conservation have studied the effects of timber harvesting on soils in the jarrah and karri forests, the impacts of soil disturbance on the vegetation in these forests, and the efficacy of treatments in reducing soil disturbance. These studies also contributed to developing and implementing the Montreal Process criteria and indicators in Australia, and meeting requirements of the Forest Management Plan.

Severe soil disturbance caused by machinery operating in wet conditions.

Unmerchantable thinning material used to reduce soil damage during karri thinning operations.

Findings

- Soil disturbance reduces the abundance of some understorey plants. A study by Burrows *et al*. (2002) as part of the Kingston project in the southern jarrah forest attributed a reduction in the abundance of native understorey plants to soil disturbance caused by timber harvesting. Some physical damage to the vegetation occurred during timber harvesting, and localised intense heating of the topsoil during the post logging silvicultural burn may have contributed to a reduction in woody shrubs with subterranean storage organs. As a response to this study the FMP introduced mechanisms to manage the impact of timber harvesting on soils and understorey vegetation.
- Compaction on major extraction tracks used in harvesting mature karri stands causes severe localized suppression of karri regrowth. On sites with low growth rates, this compaction caused

a net loss in stand growth. However stand growth immediately adjacent to extraction tracks is enhanced because of reduced competition, and on high quality sites this compensates for the loss of growth on extraction tracks.

- The severity and extent of soil disturbance resulting from timber harvesting is highly variable, being dependent on the type of harvesting operation and the intensity of that harvest.
- The severity of the soil compaction observed across the seasons in the jarrah forest is moderate compared with that reported for timber harvesting in a wide range of forest types and harvesting conditions from across the world. In contrast the severity of soil compaction observed in karri harvesting under moist soil conditions is relatively high compared to these other harvested forests.
- Significant compaction of the jarrah forest surface soil persists more than 50 years after harvest events and a substantial period, typically in excess of 55 years, may be required for jarrah forest soils to naturally return to their pre-harvest state.
- Soil compaction rises rapidly with the first few passes of timber harvesting machinery over an extraction track. The progressive increase in compaction then slows as successive loads of timber are hauled over the extraction track.
- Soil compaction is greatest on the most heavily trafficked areas – primary extraction tracks and log landings. Consequently the impact of timber harvesting is greatly influenced by the proportion of the harvested area occupied by log landings and extraction tracks.
- Studies in the jarrah forest have shown that the severity of soil compaction can be related to visual assessments of soil disturbance. These assessments are now used to monitor the extent and severity of soil disturbance during timber harvesting.

Management Implications

- Soil compaction, which impacts soil processes by reducing pore space, is a potential threat to ecosystem function and productive capacity of forests. Consistent attention to operating standards is required to minimise the impact of this disturbance during timber harvesting.
- Visual assessments of soil disturbance provide a rapid assessment of soil condition that can be useful for monitoring soil disturbance during timber harvesting.
- Concentrating machine traffic onto as few extraction tracks as possible will minimise the extent of compacted soil. This is preferable to dispersing traffic across a greater number of extraction tracks. This strategy is effective because most compaction occurs in the first few machine passes, and subsequent machine passes have less impact.
- Engineering solutions, such as covering the ground with harvest waste prior to harvesting, can provide small reductions in soil compaction and disturbance; however on most forest soils, operating machinery in dry conditions and thoughtful management and planning of machine movement across the harvested area offer the simplest solutions for minimising the impact of timber harvesting on soils.

A layer of unmerchantable logs and waste material covering the soil can be used to reduce soil damage on log landings

Burrows, N., B. Ward, and Cranfield, R. (2002). Short-term impacts of logging on understorey vegetation in a jarrah forest. *Australian Forestry* **65**(1): 47 - 58.

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