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FORESTCHECK: Monitoring soil disturbance caused by timber harvesting in jarrah forest

by Kim Whitford, DEC Science Division, (08) 9538 0021, kim.whitford@dec.wa.gov.au

Background

Soil disturbance created by harvesting machinery is widely recognized as a potential threat to the health and productivity of forests utilised for timber production. During timber harvesting, logs from felled trees are typically dragged along extraction tracks to landings where the logs are sorted, stored, and loaded onto trucks. These and other areas trafficked by harvesters, skidders and loaders are prone to soil disturbance and compaction. Compaction reduces soil porosity, damaging the habitat of soil biota and impacting the processes such as soil aeration, infiltration and nutrient cycling, which are fundamental to forest health. The time required for soil to naturally recover from disturbance could be longer than the timeframes of planning or repeat harvesting. Prevention of soil damage through management and monitoring is therefore an important component of ecologically sustainable forest management.

The FORESTCHECK project contributes to adaptive management of Western Australian forests by providing timely and relevant information about the implementation, effectiveness and biodiversity consequences of silvicultural practices in jarrah forest. Monitoring takes place at five locations within four jarrah forest ecosystems at 48 sampling grids. Grids represented examples of reference forest (never harvested or forest that had not been harvested for at least 40 years) and forest subject to either gap release or shelterwood/selective cut silvicultural treatments during the period 1988-2002.

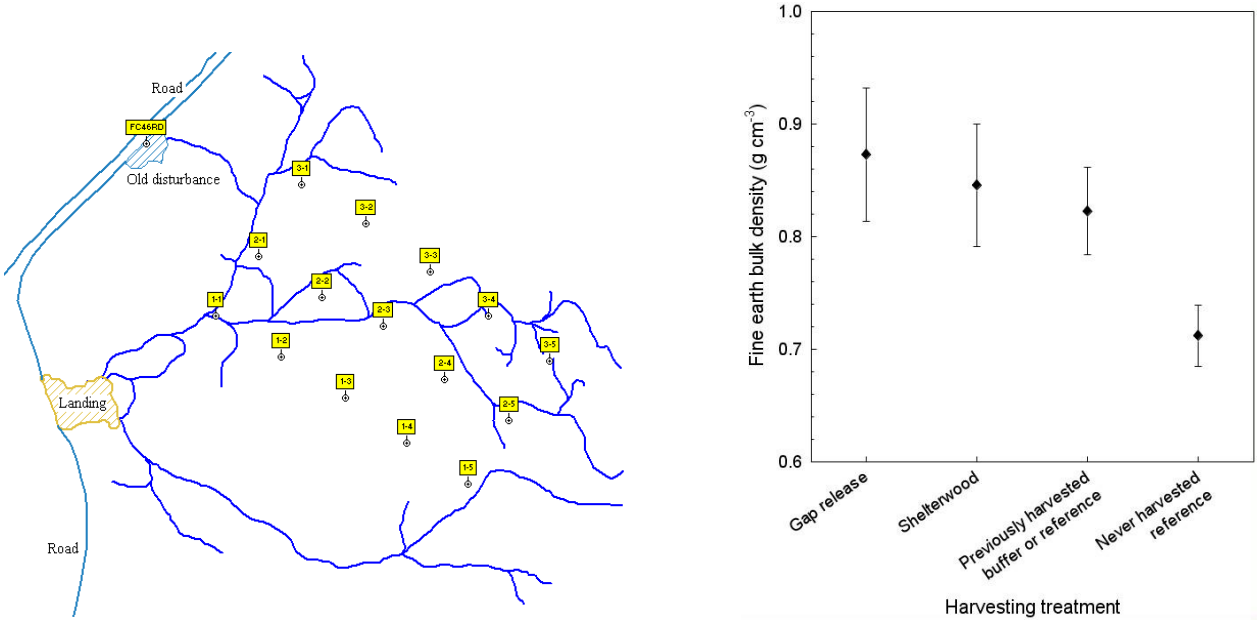
The soil disturbance component of FORESTCHECK aimed to determine the intensity of soil compaction during timber harvesting in jarrah forest and the extent of disturbance across the harvested area (Whitford and Mellican 2011). The extent of soil disturbance was determined by mapping the boundaries of the harvested areas, the path of extraction tracks to landings and the size of landings. The intensity of soil disturbance was quantified by measuring soil bulk density, a measure of soil compaction.

Above: Log landing in jarrah forest

Findings

- Soil texture varied little across the study sites. Soils were coarse textured with high sand content (65% to 95%), low silt (0% to 14%) and moderate to high gravel contents (0% to 90%, mean 46%).
- On average, 12% of the harvested area was disturbed by landings and extraction tracks. Landings covered 2%, primary and secondary extraction tracks combined covered 4% and tertiary extraction tracks 6% of the harvest area.
- Though highly variable, uncompacted surface soil on reference sites that had never been harvested had a mean fine earth bulk density of 0.71 g cm^{-3}. Timber harvesting increased the mean bulk density of surface soils by 0.15 g cm^{-3}.

- Mean bulk densities for sites harvested as gap release and shelterwood were significantly greater than the mean bulk density of reference sites that had never been harvested.
- The difference in bulk density between previously harvested coupe buffer and reference sites that had never been harvested was marginally significant.
- Soil compaction increased as the intensity of harvest activity increased. Primary and secondary extraction tracks were more compacted than tertiary extraction tracks and significantly more compacted than the general harvested area.



Above: Map of extraction tracks and landing showing FORESTCHECK monitoring grid points (left) and graph showing the decline in soil compaction as the intensity of the harvest treatment declined (right)

- Compaction of surface soil persists for decades after timber harvesting.
- The intensity of soil compaction in the jarrah forest is comparable with that reported for timber harvesting in a wide range of forest types.

Management Implications

Compaction of surface soil persists for decades after harvest events. The specific levels at which soil compaction in jarrah forests critically affects plant establishment and growth have not been established, but the effects of compaction are deleterious and the greater the areal extent of compacted soil the greater the effect. Given the potential and demonstrated adverse effects of soil compaction and disturbance, and the long time period indicated for natural amelioration of compaction, ongoing operational management and monitoring of soil disturbance is required to limit the long-term impact on soil properties.

This study quantified risk to soil physical properties, and early results from this and a previous study (Whitford *et al*. 2001) were used to revise limits for soil disturbance and criteria for moist soil harvesting operations in jarrah forest.

References:

Whitford K.R and Mellican A.E. (2011) Intensity, extent and persistence of soil disturbance caused by timber harvesting in jarrah (*Eucalyptus marginata*) forest on FORESTCHECK monitoring sites. *Australian Forestry* **74**, 266-275. Whitford, K.R., Williams M.R., Maxwell, M. A.and MacArthur, B. (2001) *Evaluation of key soil indicators of sustainability in Australian Mediterranean forests (Indicators 4.1d, 4.1e). Part 2, The impact of logging on soil physical properties at three sites in the northern jarrah forest.* Final report Project number: PN99.802, Forest and Wood Products Research and Development Corporation, pp 69.

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