THE SOIL SEED BANK IN *AGATHIS AUSTRALIS* (D. DON) LINDL. (KAURI) FORESTS OF NORTHERN NEW ZEALAND AND ITS POTENTIAL ROLE IN SECONDARY SUCCESSIONS

by

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Frontispiece: *Agathis australis* (D. Don) Lindl. (kauri) stand, *ca.* 280 years old. Waipoua Forest Sanctuary, Northern New Zealand.

ABSTRACT

The soil seed bank in *Agathis australis* (D. Don) Lindl. (kauri) forests of northern New Zealand is quantified, and its potential role in secondary successions examined. Seed bank data from a number of kauri forest sites stratified by successional time and distance from forest edges are summarized using Detrended Correspondence Analysis (ordination) and linear regression models. A number of issues concerning secondary successions and the soil seed bank are discussed. These include:

1. The relationship between the soil seed bank and extant vegetation.
2. The nature of the soil seed bank and successional time.
3. The nature of the soil seed bank and distance from forest edges.
4. The soil seed bank, canopy gaps and gap regeneration strategies.
5. The nature of the soil seed bank and soil properties.
6. The fruiting phenology, seed rain, and soil seed bank dynamics.

The forest sites ranged from 50 years to over 1,000 years old, while distance from forest edges ranged from 0.2 km to 3.5 km. Soil seed bank densities under kauri forests were 134 - 5,388 seeds m^{-2} with a mean density of 1,320±217 seeds m^{-2} which is similar to estimates reported for temperate and tropical forest sites elsewhere. The spatial distribution of seeds in the seed bank both within and between sites is highly variable. A total of 6,062 seedlings emerged from the seed bank samples. This represented 62 vascular plant species, 26 (42%) native woody, 19 (30%) native weedy, 16 (26) adventive weedy and 1 (2%) native fern.

The species composition of the soil seed bank was not closely related to extant vegetation and only 11% of canopy and 13% of understorey species were represented in the soil seed bank. Thus, 77% of extant vegetation at any given site is floristically different from that of the soil seed bank. Ordination of the data by detrended correspondence analysis (DCA) suggested that extant vegetation (canopy and

understorey) and the soil seed bank contain characteristic floras.

The species composition of the seed bank is variable between sites. The viable seed pool is larger under young successional forests than under older mature forests. The number of species also declined with distance from forest edges. Adventive and native weedy species were found in seed banks under mature forests and sites of considerable distances from forest edges. However, the density of the weedy species component of the soil seed bank was at least partly determined by distance from forest edges where such species are common.

While buried seed is likely to contribute to the early stages of secondary succession, evidence from canopy gaps suggested that the seedling bank (formerly suppressed understorey component) is more important in gap regeneration than the soil seed bank. DCA analysis revealed that seedling bank species composition of canopy gaps and forest sites were quite different from the soil seed banks, indicating that regeneration stemmed from formerly (suppressed) understorey seedlings.

Phenology and seed rain study of a mature forest remnant and a regenerating forest community showed that as little as 5% of the seed input to the forest floor enters the soil seed bank and remains viable for more than one year.

Evidence is presented to suggest that in a forest community, secondary succession after large-scale or localised disturbance, is achieved more so by suppressed seedlings and recent seed rain than the soil seed bank. The soil seed bank becomes significant in secondary succession when the subsoil is disturbed by the uprooting of trees or the forest floor is exposed by tree-fall (not covered by tree-fall debris).

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