DEAD WOOD, BUGS, FUNGI, AND NEW FORESTS

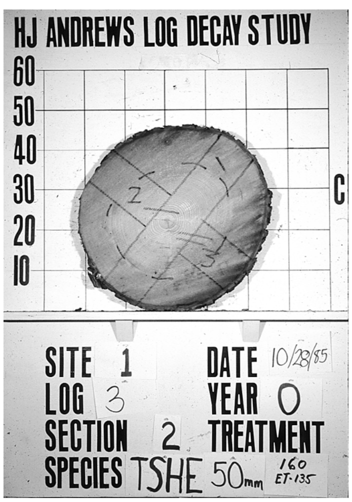
THE LOG DECOMPOSITION STUDY

background

Until the mid-1980s, modern forestry management dictated that as much wood as possible be removed from harvested forest stands to maximize utilization and promote ease of reforestation. Even wood that had no commercial value was “tidied up” — usually piled and burned. However, concern about the long-term productivity of forests has prompted scientists to take a closer look at the role of dead wood in forested ecosystems. Initial studies suggested that dead wood on the forest floor plays a crucial role in sustaining forest productivity through a complex interplay between decaying wood, insects, rodents and fungal life. However, the actual mechanics of these processes were poorly understood; it was evident that a study of decomposition processes would require a sustained research effort.

the study

The Log Decomposition Study was initiated in 1985 with an experiment designed to last 200 years. It is designed to test the effect species and size of logs have on decomposition and nutrient cycling processes. Trees were felled at nearby sites, bucked into 6 meter logs, trucked to bedding sites, and then placed in the forest with mobile loaders. Four species (Douglas-fir, Pacific silver fir, western hemlock, and western redcedar), and six sizes (1-100cm diameter) are being studied. Logs were initially sampled for density, moisture content, and nutrient content; subsets of logs are destructively sampled on a periodic basis to examine how these values change with time through the study **(photo)**. The logs are also sampled to determine foodweb structure. Detailed studies of decomposition and nutrient cycling processes are also being conducted on these logs as well as seasonal cycles in respiration, leaching, nitrogen fixation, insect activity, moisture content, and temperature.



findings to date

This is one of the first times that the log decomposition process has been carefully followed and many of the results from this study are surprising. Although the major insect species that colonized logs are well known, the sheer numbers involved the first year were impressive, indicating a single 50 cm dbh (diameter breast height) tree would have as many as 12,000 beetle galleries. What was even more impressive was the large number of associated organisms, including fungi, mites, nematodes, protozoa, and bacteria. Although there has not been a complete tally of species, it is likely hundreds of species were present within the first few years.

Prior to this study, logs were not thought to significantly influence the water balance of forests. Quantifying the water balance of logs however, indicated a significant amount (25%) of water landing on logs is stored and slowly evaporated. The water coming out the bottom has 10-20 times the concentration of carbon and nitrogen than water landing on the logs. More nitrogen was lost from the logs via water flow than was added by rainfall, indicating that logs are a source rather than a sink of nitrogen.

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As the logs decomposed, the abundance of fungal fruiting bodies or mushrooms increased markedly. This not only paralleled the increase in activity of these species, but also resulted in a net movement of nutrients out of logs. This process, combined with losses from waterflow, indicate these logs lost nutrients early in the decomposition process. This was especially surprising because prior thinking was that nutrients would be tied-up or immobilized in rotting wood. Time will tell if this trend will continue or if nutrients will eventually follow the currently accepted theory.

Nitrogen fixation, the process of converting atmospheric nitrogen to a biologically available form, increased steadily throughout the first 8 years of log decomposition and leveled off by 12 years. This process is greatest in the species and layers of log structure exhibiting the fastest decomposition rates. Current work indicates that nitrogen fixation in woody debris following disturbances can be as high as atmospheric inputs (a major input) for several decades.

Although there has been considerable work in the Pacific Northwest on log decomposition, the early results suggest that differences in Douglas-fir and western hemlock decomposition rates are not nearly as large as prior work suggested. Vast differences exist between species, however, with an estimated half-time (time for half to disappear) of 15 years for Pacific silver fir and 100 years for western redcedar — this is despite the fact that log size and environment are identical. Our experiments examining the effect of size are also yielding unanticipated results; Pacific silver fir decomposition rates decreased only slightly with size, whereas western redcedar decreased 20 fold from the smallest to largest diameter logs examined.

We are now incorporating the information about these processes into a computer simulation model used to predict the effects of species, size, and environment on the decomposition and nutrient cycling processes of woody detritus. Once the model is tested, it could become an important tool to predict how management affects this important habitat.

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publications

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