Dispersal Characteristics of Old-Growth Soil Arthropods: The Pot for Loss of Diversity and Biological Function

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Management practices of Northwest forests drastically affect abundance and species composition of the small arthropods (insects, spiders, and their relatives) that regulate soil microstructure and elemental recycling. Burrowing arthropods provide channels in which roots grow and nonburrowing arthropod species can enter the soil matrix. Detritus-feeding species facilitate nutrient release by increasing the surface area available for microbial attack. In normal densities, microbe-feeding species increase the rate of microbial growth and litter decomposition. Predaceous taxa control the competitive balance between fungi and bacteria.

Most species of soil fauna show strong preferences for conditions prevailing at particular stages of forest succession. Studies underway at the Andrews Experimental Forest (western Cascade Mountains, Oregon) demonstrate that the typical practice of clearcutting and burning reduces total arthropods in the soil by about 90%. The immediate effect of this process on species richness is a function of both fire intensity and patchiness of the habitat, as well as the fire. Random sampling often reveals a decrease of nearly all the species, but sampling within potential refuges (inside punky [decayed, dry] tree trunks, under heavily decayed logs) reveals that many species have the potential to survive the fire in favorable locations. The surviving individuals soon are joined by the highly mobile species that characterize habitats disturbed by humans and forest fires. Superficial examination of the abundant species reveals few taxa in common with the old growth until the new canopy is well-formed (20–40 years later).

Many invertebrate species that prefer old growth are flightless—not only the most abundant taxa (e.g., springtails, oribatid mites, predaceous mites), but also groups normally characterized by efficient flight. Wingless species of flies (i.e., phorids, cecidomyiids, sciarids, and tipulids), wasps (i.e., diapriids and ceraphronids), beetles (i.e., carabids, cicindelids, curculionids, and pselaphids) and bugs (i.e., tingids) that characterize the old-growth fauna have winged relations that abound in the early successional stages.

When natural disturbances like winter blowdown and forest fires were the major disturbances to the Vancouveran forest, disturbed patches frequently were small, and they probably encompassed many refugia; the ratio of edge to disturbance area was high and recolonization relatively easy. In the infrequent events wh uge forest fires occurred, observation tells us that fire intensity ry patchy and that numerous partially burned enclosures remained. Under present conditions of widespread timber harvest with slash burning and very restricted islands of old growth, the distances required for successful immigration may well be limiting. The immigration rates of soil taxa, the practice of burning litter after clearcutting, the types and long-term success of refugia during fires, and the practice of leaving "green islands" (with undisturbed litter) in clearcuts all require critical investigation. If old growth is to remain as restricted islands scattered over the landscape, island biogeography theory tells us that extinctions of taxa are bound to occur. If many of these species cannot re-colonize due to their wingless condition, transplantation of litter between sites may be necessary to assure continuing persistence of critical species.

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Density and Diversity of Soil Arthropods as "Biological Probes" of Complex Soil Phenomena

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Soil is both a resource and a habitat for the plants and animals of the forest. When we use the word *forest*, we usually think only of trees and wood resources. However, we must also think of the thousands of species of animals that live in, on, and under the trees, and of their functions in the forest ecosystem. No part of the forest ecosystem is more diverse than the arthropods that inhabit the soil (Anderson. 1975. Proc. V Int. Coll. Soil Zool.). The most abundant Oregon soil arthropods are oribatid mites (250,000/m^2; 75–100 species/m^2) and springtails (50,000/m^2; 20–30 species/m^2). These abundances and species counts approximate or exceed diversities reported from any terrestrial ecosystem in the world (Petersen and Luxton. 1982. *Oikos* 39:287–388), probably, in large part, because of the depth and complexity of litter in the Northwest. A single core (7.5-cm diameter) is likely to contain over 50 species and a one-ft^2 sample, 200–250 species, especially if taken from old-growth forests.

In order to understand the factors that permit so many species to occur in such a small soil volume, we have examined seasonal samples from an experimental design of four successional stages in each of eight different moisture regimes/slope faces of the major mid-