elevation Cascade conifer forest types. We have determined the most favored stage in succession and moisture regime, as well as seasonal patterns of life-cycle development for several hundred different soil invertebrates. Many soil species prefer the conditions of old growth over regenerating forest soils, though we know of no species that absolutely requires old growth. Statistical techniques designed to deal with the abundances of large numbers of species readily distinguish old-growth samples from regenerating forests immediately adjacent. Soil arthropods have been shown by numerous researchers to regulate the rates of litter decomposition and nutrient recycling; therefore, such differences could significantly affect long-term site productivity.

The different species of soil arthropods respond to environmental gradients, each in its own way. The great diversity of species in the litter permits us to distinguish samples from similar forest types characterized by different understories; samples from Douglas-fir regrowth, with or without associated alder; and even, at times, the species of overstory tree in a mixed-canopy forest and the distance to the nearest tree trunk. Since many of these arthropod species are widespread geographically, they offer potential as "biological probes" to examine complex soil processes, which are difficult or expensive to analyze with traditional chemical methods. Laboratory tests usually reveal conditions of the instant of sampling; the forest trees must integrate complex changes which operate over decades or centuries. Shorter-term changes in soil conditions probably can be distinguished in arthropod responses long before they are revealed in rates of tree growth and health.

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Litter Spiders as Bio-Indicators of Recovery after Clearcutting in a Western Coniferous Forest

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The litter spiders of the H. J. Andrews Experimental Forest in western Oregon were pitfall-trapped through eight consecutive seasons from June 1982 to May 1984. Traps were placed in 29 mid-elevation sites (1,400–3,000 ft; 450–950 m) that differed from one another with respect to moisture (based on the classification of Dyrness, Franklin, Moir 1974; *Bulletin 4, Coniferous Forest Biome,* USIPB) and succession (6, 19, 31 years after clearcutting, and old growth).

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Recovery after Clearcutting

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Three objectives were addressed in our study: (1) characterizing the litter spider fauna of 200⁺-year old growth; (2) determining the response of this fauna to clearcutting; and (3) describing the changes in the litter spider community that occur in the first 31 years after clearcutting.

A total of 8,551 individuals were collected, comprising 93 species, 54 genera and 15 families. Most species were uncommon, represented by less than 20 individuals for the entire collecting effort. The 36 most common species (>25 individuals/species) comprised 95.1% of the total abundance. The species composition and relative abundance of these 36 species exhibited a clear pattern of succession from clearcut to old growth.

The spider community characteristic of old growth and mature second growth includes two species of microweb spiders (*Lepthyphantes zibus, Scironis sima*), a tripline weaver (*Theridion sexpunctatum*), and a trapdoor spider (*Antrodiaetus pugnax*). These species rely on litter-inhabiting insects and mites for food and require relatively constant environmental conditions to survive. When a stand is clearcut, these and all other forest litter spiders disappear, due to the loss of available prey and to the increase in microenvironmental variability characteristic of habitats with little or no canopy cover.

Forest litter spiders are replaced after clearcutting by an entirely different community composed primarily of diurnal pursuit spiders. Three of the most abundant clearcut species (the wolf spiders *Alopecosa kochi, Pardosa californica,* and *Schizocosa mccooki*) are also common in perennial agriculture field crops of the western United States (alfalfa, peppermint); these three species are characterized by high dispersal ability and preference for sunny, open habitats. Wolf spiders prey on the abundance of low-foliar insects found in fresh clearcuts, and are tolerant of wide fluctuations in environmental conditions.

The gradual return of vegetation and leaf litter 10–15 years after clearcutting allows the colonization and survival of shrub-associated spiders, including the diurnal and nocturnal running spiders (*Zelotes fratris, Micaria puritanus*), funnel-web weavers (*Calymmaria emertoni*), and crab spiders (*Xysticus pretiosus*). As succession proceeds further (15–25 years after clearcutting), spiders characteristic of young forests become more common, such as the jumping spider *Neon reticulatus* and the hackled-band weaver *Callobius severus*.

Recovery to a typical forest spider species composition requires a minimum of 30 years after clearcutting for the wettest sites, a figure closely comparable to the recovery rate of plant communities (Schoonmaker and McKee. 1988. *For. Sci.* 34:960–979). For the driest sites, species composition after 31 years is more similar to 6–19 year clearcut sites, with a continued dominance of species typical of habitats with little or no leaf litter, moss, or canopy development. These data emphasize the need to consider the effects of moisture on the speed of forest recovery following clearcutting. More generally, litter spiders are potentially useful biological tools for the forest manager: As the primary predators of other litter arthropods (insects, mites, isopods, centipedes, millipedes), their presence or absence is a strong indication of forest habitat quality.

Effects of Tree Harvesting on Armillaria Root Disease in an Old-Growth Mixed-Conifer Stand in Northeastern Oregon

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Forest root diseases are becoming the most important pest problems in mixed-conifer forests in northwestern North America. Root diseases in cutover forests may behave much differently than in pristine stands (McDonald, G. I., N. E. Martin, and A. E. Harvey. 1987. Armillaria *in the northern Rockies: Pathogenicity and host susceptibility on pristine and disturbed sites.* USDA For. Serv. Res. Note INT-371, Intermountain Research Station, Ogden, Utah). Because undisturbed stands of old growth are becoming increasingly difficult to find in the interior West, this limits the study of pest dynamics in an undisturbed state. Mixed-conifer forests often are more severely damaged by root disease after logging than before logging (Filip, G. M., and D. J. Goheen. 1984. Root diseases cause severe mortality in white and grand fir stands of the Pacific Northwest. *Forest Sci.* 30:138–142.). This study will provide an opportunity to test this hypothesis.

The study area is 10 km from La Grande, Oregon, and contains one of the last remaining stands of virgin old growth in the surrounding Grande Ronde Valley. The stand is composed primarily of old-growth ponderosa pine (*Pinus ponderosa*) and grand fir (*Abies grandis*) with some Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) and western larch (*Larix occidentalis*). Understory trees are primarily grand fir. Accordingly, the study area has been classified as a grand fir/ big huckleberry (*Vaccinium membranaceum*) plant association (Johnson, C. G., Jr., and F. C. Hall. 1990. *Plant associations of the Blue Mountains.* USDA For. Serv., R6-ECOL AREA 3). Half of the study area is affected by *Armillaria* root disease caused by the fungus *Armillaria ostoyae* that is slowly killing the pines and associated firs.

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