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an old-growth grand fir marked

wilderness areas. Therefore,
10 are in either the Wenaha-
eas. Each study area contains
e information on stand char-
defoliation, and tree mortal-

ity. From tree cores, using dendrochronology techniques, we can map the environmental and defoliation history of the stands over a 200- to 350-year period (Swetnam, Thomas W., and Ann M. Lynch. 1989. A tree ring reconstruction of western spruce budworm history in the Southern Rocky Mountains. *For. Sci.* 35:962–86). This information can then be used to influence stand management practices in regard to the use of fire or other silvicultural techniques to control species composition and stocking. It may also point out that some areas have always suffered outbreaks, even before the succession toward more shade-tolerant species.

Old-growth forests are valuable for wildlife, recreation, and as research sites. Old trees are also like history museums: They can reveal much about how forests used to look and behave, if we take the opportunity to examine their growth records with increment cores.

Invertebrate Diversity in Old-Growth versus Regenerating Forest Canopies

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Debate over old-growth forests has focused on the fate of threatened plant and vertebrate species. Invertebrates (which comprise at least half of all forest species) have been largely ignored. Many invertebrates also depend on old-growth resources. Reduced diversity in younger managed forests promotes pests and deprives us of valuable biological resources.

Old-growth (450-yr-old) and regenerating (10-yr-old) canopies were sampled at six replicate sites at the H. J. Andrews Experimental Forest in western Oregon during 1986. Foliage-bearing branches in old-growth Douglas-fir and western hemlock harbored five times as many forest canopy arthropod species (75) and twice as many functional groups (6) as did young planted Douglas-fir.

Old-growth foliage supported a variety of herbivores, which collectively caused negligible (<1%) loss of foliage mass, although 14% of buds were destroyed on Douglas-fir. By contrast, the planted monoculture sustained serious (>30%) foliage injury and loss by aphids. Black-stain root disease and its insect vectors have caused serious mortality in young managed Douglas-fir forests. Related studies show similar contrasts in pest abundances between young monocultures and diverse older forests in eastern deciduous forests and southern pine forests.

Predator diversity and abundance were particularly reduced in planted stands, potentially limiting ability to control pest populations. Predator species present in old growth, but absent in adjacent planted forests, may require habitats, host resources, or moderate climatic conditions provided by old growth.

Loss of invertebrate species through old-growth harvest would eliminate medical and pest management resources. Invertebrates produce an enormous variety of chemicals to detoxify food, attract mates, and discourage enemies. Relatively few species have been examined for useful chemicals, but these have provided drugs for treating leukemia, arthritis, warts, and infection, as well as natural insecticides, fungicides, and repellents. Biological control of pests depends on natural or augmented abundances of predators. Reduced predator diversity as a result of forest conversion would limit biological control options.

Large-scale conversion of tropical forests has fueled concern for loss of diversity and promotion of pests in crop systems. Conversion and fragmentation of native forests in the Pacific Northwest also will decimate rich and largely unknown species assemblages and promote forest pests.

Arthropods: The Invisible Diversity

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The interest in old-growth forests of all types is part of a larger concern for the loss of biological diversity in general (Wilson, editor. 1988. *Biodiversity*. Washington, D.C.: National Academy Press). The rate of habitat modification and destruction is escalating, and with it the accompanying loss of species and the unique genetic information they contain. Animal diversity in terrestrial ecosystems is nearly synonymous with arthropod (insects and their allies) diversity. Arthropod species are associated with every plant and vertebrate species in every habitat type. Their ecological functions are the very fabric of food webs—digesting the plants, recycling the soil nutrients, and as food sources for and parasites of vertebrates.

Habitat destruction, which has been emphasized most in the tropics, is important in the Pacific Northwest, as well. The Andrews Forest on the lower west slopes of the Cascade Mountains of Oregon

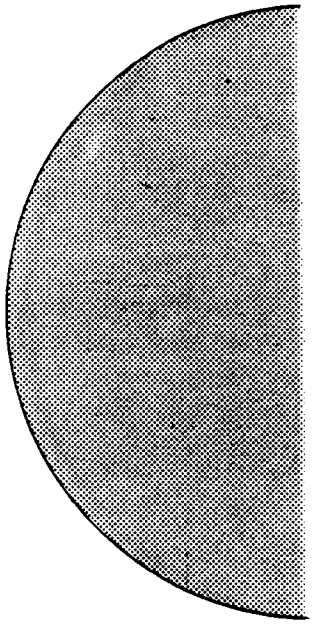

Fig. 1. This simple illustration is ir conservation research must be focuse itat not only benefits single, high-pr organisms that represent the biolog forests.

is one of 17 long-term ecologica National Science Foundation. As ecosystem study in the western vertebrates and arthropods are av to examine species richness with itat. There are 143 species of ve birds), 460 species of vascular pla known to date. Although the ve tive, it is likely that the arthropoc Figure 1 shows the relative per components. The vast majority (8 tebrates comprise only 3.6%.

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