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PROXIMAL ECOLOGICAL EFFECTS OF THE 1980 ERUPTIONS OF MOUNT ST. HELENS; F. J. Swanson, USDA Forest Service, Pacific Northwest Research Station, 3200 Jefferson Way, Corvallis, Oregon 97331

The diversity of ecosystems and volcanic processes involved in the 1980 eruptions of Mount St. Helens, southwest Washington, provide an excellent setting for examining effects of volcanic events on ecosystems. These eruptions included a lateral blast (affected area = 480 km^2), debris avalanche (60 km^2), mudflows (50 km^2), pyroclastic flows (16 km^2, and airfall tephra (1000 km^2 with greater than 5 cm thickness). Affected ecosystems within 30 km of the vent were lakes, streams, upland and riparian forest, and meadows. Ecological disturbances imposed by the Mount St. Helens events were predominantly physical, rather than climatic or chemical which are the dominant classes of disturbances considered in analysis of global catastrophes.

Analysis of ecosystem response to disturbance should be based on consideration of 1) composition and structure of the predisturbance system in terms that represent potential survivability of organisms, 2) mechanisms in the primary disturbance, 3) initial survivors, 4) secondary disturbances arising from the primary disturbance and the biological responses to secondary disturbances, 5) invasion of the site by new propagules, 6) interactions among secondary disturbance processes and surviving and invading organisms. Predicting ecosystem response to disturbance is enhanced by considering the mechanisms of disturbance rather than type of disturbance. In the 1980 Mount St. Helens events, the disturbance types, (e.g. mudflow and debris avalanche) involved primarily the mechanisms of sedimentation (erosion-deposition), heating, and shear stress. Each disturbance type involved one or more mechanisms. The lateral blast, for example, resulted in deposition of 0.02 to more than 1 m of deposits with temperatures ranging from 100 to over 300°C. Shear stresses imposed by the blast were sufficient to remove large trees near the vent and decreased progressively to the edge of the blast zone where even needles were left on standing trees. Transported plant parts and animals in soil and logs survived. Their recovery was sometimes aided by secondary erosion of blast deposits.

Surviving organisms were remarkably widespread in the "devastated area" at Mount St. Helens because 1) the most widespread disturbances left thin deposits that were penetrated by surviving plants and partially removed by secondary erosion; 2) refuges were numerous and diverse (e.g., rotten logs for ants, fungi, and other organisms; snow packs for understory shrubs and small saplings; ice cover on lakes for fish and other aquatic life; steep slopes that rapidly shed tephra deposits for alpine vegetation; springs and seeps for aquatic invertebrates); and 3) the volcanic events favored establishment of some thermophilic organisms.

Ecosystem response varied greatly across the landscape. Lakes in the blast zone, for example, were oligotrophic before the 1980 eruptions, but they received substantial input of nutrients during the blast and debris avalanche. Recovery of lake systems, therefore, involved consumption to this nutrient surplus. Adjacent upland ecosystems, on the other hand, were blanketed with nutrient-deficient tephra (relative to nutrient status of mature surface soil), so they will have to cope with reduced nutrient capital in the effective rooting zone to recover.

Analysis of ecosystem response to disturbance, regardless of type, should include detailed consideration of the properties of individual species, primary and secondary disturbance mechanisms, and their distributions across landscapes.