170

Road to Recovery After Eruption of Mt. St. Helens

By Joseph E. Means and Jack K. Winjum

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Mount St. Helens and the surrounding forest land in southwest Washington State were heavily used before 1980 for mountain climbing, backpacking, hunting, and fishing, as well as tree farming. That changed on May 18, 1980, when the volcanic mountain erupted violently. It sent a massive avalanche of molten rock and other debris from the top and north side of Mount St. Helens into the North Toutle River valley.

Within 15 minutes, 151,000 acres of forest and recreation land were devastated by the lateral blast. This blast blew down forests on 52,000 acres, and its heat killed trees and other plants but left them standing on another 24,000 acres.

The large debris avalanche, pyroclastic flows, mudflows, new lakes, the volcano, and areas clearcut before the eruption comprised the rest of the devastated area. Most of the land was owned by the Weyerhaeuser Co. or Burlington Northern Timberlands, or was managed by the Forest Service or the Washington State Department of Natural Resources.

Mudflows scoured the North Toutle, South Toutle, and Muddy River valleys. Streams, choked with sediment, gurgled around the many trees blown into them. Cooked forest canopies were blown into lake waters warmed by the blast, killing the fish and other organisms.

The 9-hour eruption covered the area with 1 to 20 inches of

Tim McCabe

Within 15 minutes of the Mt. St. Helens eruption, 151,000 acres of forest and recreation land were devastated.

tephra: ash, pumice, and rock pulverized by the blast.

Immediately after the eruption, the devastated area presented a picture painted in shades of gray—there were no signs of greenery or animals. We wondered, "How long will it be before these hills are green again? Fifty years? One hundred?"

Life Reappears

Life began to reappear on that landscape almost immediately after the eruption, however, with the springtime warming in the mountains. Essentially all plants that appeared the first growing season sprouted up through the tephra from the buried soil.

Trillium and huckleberry emerged amid the fallen trees, and even small silver fir and mountain hemlock trees sprang up in areas where they were protected from the force and heat of the blast by a heavy winter snowpack.

Fireweed and other plants common to old clearcuts sprouted readily through the tephra where it was less than 8 inches thick the first growing season.

Partial erosion of the tephra off hillsides allowed many plants to reach the surface. Indeed, plants emerging in rills were the only ones seen soon after the eruption in clearcuts with deep deposits of tephra.

Some streamside and lakeshore areas also recovered rapidly as water removed the tephra

Jerry Franklin

In the first growing season after the eruption, fireweed and other plants sprouted readily through the tephra (ash, pumice and pulverized rock) where it was less than 8 inches thick.

so sprouts from buried plants could reach the surface. In other areas tephra eroded off hillsides and, carried by streams, buried would-be survivors.

Oasis on Debris Avalanche

Plants survived even in the debris avalanche deposits in fist-size pieces of soil scraped from the valley floor and walls. Plants recovered most rapidly in western portions of the devastated area because the blast deposits were cooler and the tephra was generally thinner than in eastern portions.

Seeds had been blowing into the devastated area since the eruption. From these seeds, and seeds produced by surviving plants, natural seedlings became much more common starting the second year as the rate of erosion slowed.

Plant establishment from seed, though very sparse, was most important on the debris avalanche where residual plants were extremely rare and on the pyroclastic (volcanic) flows where they were nonexistent.

Plants with light, wind-dispersed seeds—such as purple-flowered thistle, yellow-flowered groundsel, and red-flowered fireweed seedlings—were appearing in unexpected places. One site on the debris avalanche had such lush vegetation in 1981 that researchers named it "the oasis," in contrast to the relatively barren miles of fragmented rock, gravel, and sand.

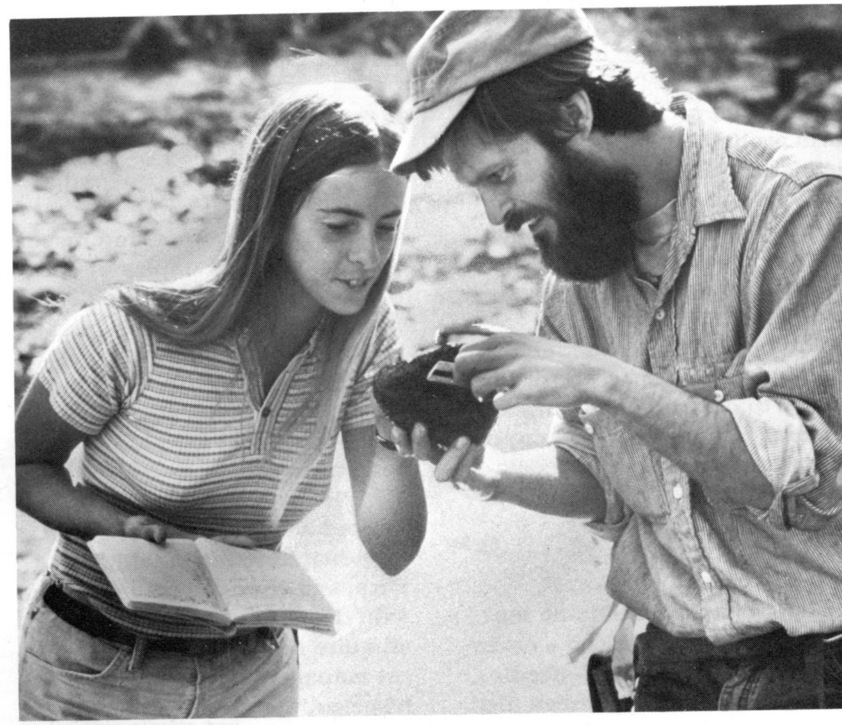
Animal, Fish Survivors

Like the plants, some of the first animals observed in the devastated area were those that survived the eruption under ground. Ants and gophers were the most common of these. Many small animals, such as mites and springtails, survived in rotten wood.

Fish, salamanders, aquatic insects, and micro-organisms survived in many lakes in the devastated area, chiefly those with ice and snow in them when the eruption occurred. A few fish also survived in streams, especially where water moving around logs or rocks created cool pools that fish could hide in and where cobbles (rounded stones) occurred on which live aquatic insects that fish use as food.

Unlike the plants, most vertebrate animals invaded the devastated area from the surrounding green forests in the first two years after the blast. In fact, deer and elk entered the area immediately after the eruption. Populations increased as returning vegetation provided food so that resident herds numbered in the hundreds in 1981 and 1982.

Birds occurred throughout the area the first summer. The sight of a hummingbird hovering in front of bright orange flagging held by a forester five miles from green forest was a very encouraging sign that life was beginning to return to the devastated zone.


James Hughes

Peggy Wilzbach, aquatic ecologist, and Tom Lisle, hydrologist, found aquatic insects on rocks in streams in the devastated area after the streams were washed clean of pumice and ash.

Spiders came many miles through the air by ballooning—letting out long filaments of web and being lofted long distances when the web was caught by the wind.

Fire-Fungi Feed Ants

Micro-organisms also played important roles in the recovery of these forest ecosystems. So-called "fire-fungi," common after forest fires in the Pacific Northwest, were seen within several weeks of the eruption because their spores were stimulated to germinate by the heat of the blast deposits.

Ants from different colonies competed for the whitish mats of fungus because they were one of the first food sources to appear.

Many kinds of fungi that occur in the buried soil form close associations (called *mycorrhizae*) with plant roots, in which the fungi grow between and within cells of the plant roots. These fungi obtain food from the plant and in turn bring important nutrients (such as phosphorus) to the plant from the soil.

Bacteria in the buried soil decompose organic matter and in the process release nitrogen, another important nutrient, in a form available to plants. When deposited, the tephra was essentially devoid of life, and the nutrients it contained were quickly leached into the buried soil by rainwater because the tephra could not hold them.

Thus one can see the importance of the buried soil, with its ability to hold nutrients and its teeming community of micro-organisms, to recovery of vegetation and productivity of future forests.

Ash Effect on Live Forest

The green forest outside the devastated area received a covering of ash that stuck to needles, killing some. No large trees died, however, and most grew just as much in 1980 as they had in previous years.

Growth on young trees in adjacent clearcuts increased dramatically in 1981 and 1982, possibly because the tephra acted as a mulch, retaining soil water for plant use. Understory plants of green forest fared poorly where tephra up to 8 inches thick killed huckleberries, other shrubs, many herbs, and small trees.

Bulb plants, such as avalanche lily, and some other herbs were able to sprout through the tephra, and at least a few survived in many places. Also, some understory trees grew roots from their trunks into the tephra, exploiting the water it held, a resource most other plants had not yet tapped.

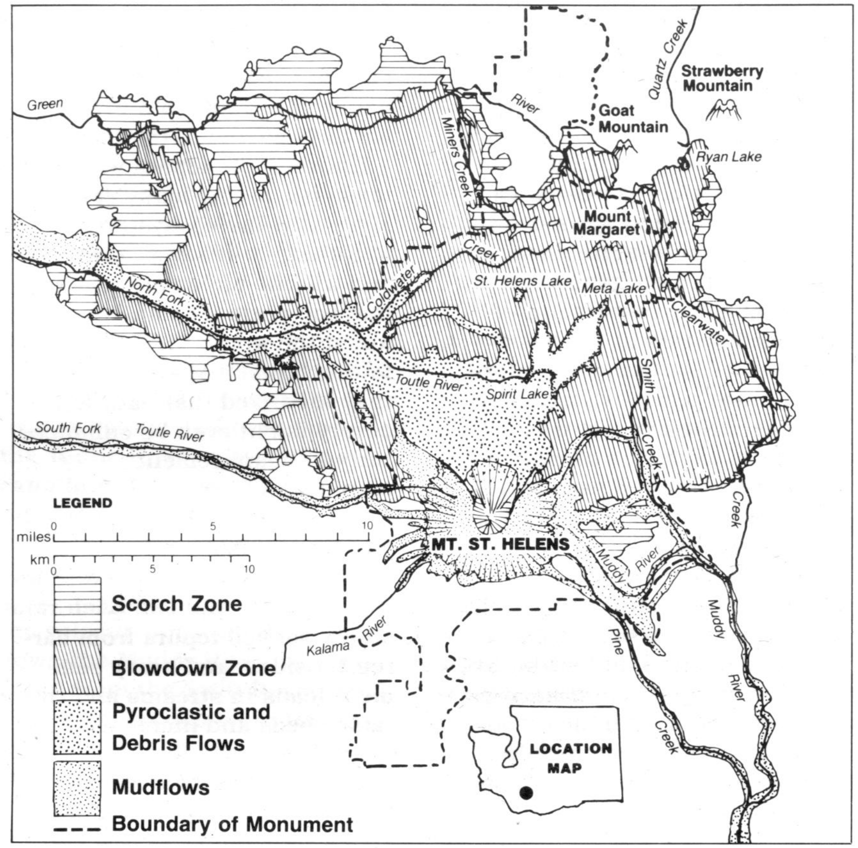
Managers' Response

Dealing with large natural catastrophes is not an unfamiliar job for forest land managers. Wildfire, windstorms, and insect epidemics are examples of natural phenomena that periodically devastate large areas of forest. In size and suddenness, the volcanic devastation around Mount St. Helens was not that unusual when compared with other catastrophes.

At the same time, forests blasted with lethally hot gases, then blanketed with falling tephra, and river valleys inundated with debris and mudflows were all quite new to the region's forest managers. Within a few days, however, the stunned reaction gave way to thoughts and plans for restoring the managed forest as had been done historically following other large catastrophes.

Assessing Losses

Assessment of losses came first. Within a few weeks, a tally from aerial photos and ground checks from helicopters showed that in the blast zone, forest stands of merchantable size occupied 82,600 acres and totaled 4.7 billion board feet in volume. Nonmerchantable stands, planted or seeded during the previous 20 years or so, covered another 48,000 acres.



These forests of dead trees—standing, broken off, blown down, or blown away—consisted primarily of Douglas-fir, western hemlock, noble fir, and silver fir, all commercially valuable conifer species.

Other critical losses included the transportation system and working equipment in the area, all important parts of a managed forest.

Over 500 miles of truck roads and 16 miles of railroads were buried under tephra deposits or mudflows. Twelve key bridges were out. Also destroyed or heavily damaged were three nonresident logging camps, dozens of woods vehicles, and heavy log-loading machinery from many logging sites.

Technical Help Sought

Restoration plans of land managers addressed the timing, resources, people, and safety considerations required to open and rebuild transportation systems, salvage and market dead but merchantable trees, reforest potentially productive lands covered with tephra deposits, and provide protection against further losses by wildfire, insects, or wood-rotting organisms.

Planning the restoration of managed forests in the blast zone called for technical information not previously available. Managers sought help from a myriad of engineers and scientists, including representatives from the physical, biological, and social sciences.

Geologists worked out an eruption forecasting system that was the basis for warning and evacuation plans. Industrial hygienists studied health hazards to people working in heavy volcanic dust and recommended that respirators be worn during dry, windy periods.

Log Value Holds Up

Wood scientists were flown into the blast zone early to check log quality. They found that charring or pitting by the blast was limited to bark layers of dead trees and that breakage caused by the blast caused little loss in usable volume; thus the wood had no significant loss in value.

No one, it seemed, knew much about the tephra, and chemists were quick to determine its chemical and physical properties—most important, it was nontoxic, largely inert, but physically quite abrasive. This information led engineers to develop special equipment and maintenance schedules to overcome abrasive effects of the tephra.

Knowing the tephra was not toxic and seeing many early signs that the ecosystems were beginning to recover, foresters and wildlife biologists realized that the normal complement of forest life would no doubt return to the devastated area. Indeed, they theorized that natural recovery might even be enhanced through management techniques.

Seeding by Air

Tephra erosion was severe the first summer and fall. Each rainstorm washed tephra from barren hillsides, and heavy sediment loads in streams and rivers raised beds and increased flood hazards.

To control surface erosion, 20,000 acres of the devastated area were aerially seeded and fertilized in the fall of 1980 with mixtures of grasses and legumes. Most hillside surface erosion, however, occurred by the end of the first winter, before significant vegetation—natural or seeded—was established.

Surface erosion of the tephra was greatly reduced naturally the second and third winters because the infiltration capacity increased, and rock fragments and pumice—exposed by sheet erosion and frost heaving—armored the surface against further erosion.

In rills and small gullies eroded in the tephra, seeded grasses, natural vegetation, roots, and buried branches helped control erosion of the valuable buried soil and probably reduced peak runoff rates during storms.

Logs Retrieved

Salvage logging began May 19, 1980, with the first retrieval of logs swept by mudflows down the Toutle River west of the volcano into the Cowlitz River and ultimately down the Columbia River. The logs had been stored at truck-to-rail transfer points along the Toutle River. East of the volcano, logs that had come down the Muddy River were salvaged from the Swift Reservoir.

Salvage operations in these waters took 4 months, and 15 million board feet of timber were recovered.

Meanwhile, reopening of roads in the blast zone was begun. During the first 2 years, nearly 700 miles of forest roads were reestablished or newly built, including bridge construction at key points.

Logging of dead timber in the blast zone was started in late summer 1980. Timing was very important. Operations could not safely and effectively begin until good information was available on the important technical questions discussed earlier in this chapter. Yet experience from other forest catastrophes underscored the need for rapid salvage.

Potential secondary problems could be a threat in a large area of newly killed forests. For instance, buildups of wood-boring insects and decay fungi can reduce the value of logs as time passes. During periods of dry weather, wildfire is a hazard. Also, the time the land is not producing trees is a substantial loss to the landowner.

1,000 Salvage Workers

Once underway, however, salvage operations were most intensive. At one point in 1981, over 60 logging settings involving more than 1,000 workers were operating simultaneously in the western blast zone. About 600 truckloads of logs a day were transported. This work pace shifted to the eastern side of the zone in 1982 and 1983.

By the end of 1984, plans call for completion of salvage logging on about 47,000 acres, totaling 2.7 billion board feet of timber. Remaining lands that contained merchantable timber were buried by debris or mud, were inundated by new lakes, or are in Mount St. Helens National Volcanic Monument and will not be salvaged.

Precautions Pay

Precautions designed into salvage plans paid off. Volcanic activity continued periodically and was accurately forecast. Evacuations and closures during these events prevented life-threatening situations for workers.

No significant increases in lost worktime were encountered as a result of heavy exphasis on health and safety. Extra maintenance kept excessive wear on equipment down except for rapid dulling of chains on powersaws. Use of carbide-toothed chains eventually solved this problem.

Overall logging costs were slightly greater than normal, primarily because of higher felling and bucking costs caused by the tephra.

Beneficial Effects

Salvage logging had several effects on recovery of these forest ecosystems. Mixing of the buried soil with the tephra and breaking up its continuous mantle increased infiltration of rainwater which decreased the threat of further surface erosion, allowed more buried plants to reach the surface, and made the buried soil—with its micro-organisms and nutrients—available to colonizing plants.

Logs blown into streams were often salvaged, although in several locations stable logs were left to maintain fish habitat at the request of fisheries biologists.

In June 1980, only a month after the blast, the first test of planting tree seedlings was begun with several hundred bareroot, two-year-old Douglas-fir and noble fir trees.

When roots were planted in contact with original buried soil, the seedlings survived and grew well. When planted so roots were only in tephra, performance was poor primarily because of a nitrogen deficiency. Shovels proved the most useful tool in clearing or scalping away thin tephra.

Operational Plantings

Based on these research results, plans were made to begin operational planting during the next scheduled period which started in February 1981. Open areas with less than 6 inches of tephra received the first plantings—about 6,000 acres in total the first winter after the eruption.

During the 1982 reforestation period, another 14,000 acres were planted, including many of the first acres that had been salvage logged. Douglas-fir was planted below 3,000 feet in elevation and noble fir above, both at densities of 350 to 500 trees per acre.

Reforestation was more difficult in 1983 because whole dense plantations of dead trees and sites with tephra up to 12 inches deep were encountered. Treatment was needed before planting could be done.

Dead trees were felled and burned, and crawler tractors with front-mounted V-blades were used in areas with deep tephra to clear rows along the contours down to buried soil. On slopes too steep for tractors, power augers proved effective in bringing the buried soil close to the surface in the planting hole so contact with tree roots was possible.

Jesse Wilt, Weyerhaeuser Co.

First test planting of tree seedlings was done in June 1980, just one month after the Mt. St. Helens eruption.

Experience to date indicates that planting costs are average to significantly greater than average, depending on site preparation and planting difficulty.

Elk Damage Seedlings

Survival and growth of seedlings have generally been favorable, though animal damage has been severe in some localities, particularly browsing by the growing herds of elk. By 1985, a total of about 70,000 acres will be reforested in the blast zone of Mount St. Helens.

Riparian zones along rivers and streams where tephra or mud accumulated several feet deep were reforested with cottonwood and willow cuttings because such soil conditions are not suitable for conifers. These hardwoods grow quickly, stabilizing the new deposits and providing shade that keeps water temperatures favorable for fish during sunny periods. Reforestation was conducted along the sides of 55 miles of river and stream in this manner.

Natural seedlings of red alder and cottonwood were common on mud deposits along many streams outside the blast zone.

Volcanic Monument

Some 110,000 acres of the area around the volcano is now Mount St. Helens National Volcanic Monument. It includes the volcano, Spirit Lake, the debris avalanche, and many other interesting features created by the eruption.

The monument will be managed by the Forest Service to "protect the geologic, ecologic and cultural resources . . . allowing geologic forces and ecologic succession to continue substantially unimpeded," according to the establishing Act. For years to come, its unique features will be available for public enjoyment and scientific study consistent with their protection.

Nature led the way to the recovery of forest ecosystems around Mount St. Helens. Plants, animals, and micro-organisms invaded the barren surface from below the ground, over the surface, and by air in the first three years. Perhaps this rapid recovery should have been expected.

Adapting to Volcanism

Many forests in the Cascade Range grow on soils of volcanic origin that have literally fallen from the sky. Also, eruptions often occur within the 400- to 800-year lifetimes of dominant forest trees such as Douglas-fir.

Eruptive periods of Mount St. Helens, the most active volcano in the Cascade Range, have been separated by only 100 to 500 years in the last 35 centuries. Evidence indicates some trees northeast of the volcano, an area repeatedly covered by tephra, are genetically adapted to repeated volcanism.

Families of Douglas-firs from this area survived temporary burial by the 1980 eruption better than trees from areas not so frequently covered by tephra at three planted test sites.

Further Reading

Mount St. Helens: One Year Later. S. A. C. Keller, ed. University Bookstore, 830 Elm Street, Cheney, Wash. 99004. $22 per copy.

Volcanic Eruptions of 1980 at Mount St. Helens: The First 100 Days. Bruce L. Foxworthy and Mary Hill. U.S. Geological Survey, Professional Paper 1249. Stock No. 004-001-03452-2. For sale by Superintendent of Documents, Washington, D.C. 20402.