

77. Shasta Mudflow (Mt. Shasta Mudflow) (Keeler-Wolf 1984b)

Location

This established RNA is on the Shasta-Trinity National Forest. Its center is about 3 miles (5 km) NE. of the town of McCloud. It occupies portions of 13 sections in T40N, R2W MDBM (41°18'N., 122°6'W.), USGS Elk Spring quad (fig. 155). Ecological subsection – McCloud Flat (M261Dg).

Target Elements

Pacific Ponderosa Pine (*Pinus ponderosa*) and Successional Mudflows (unique element)

Distinctive Features

Successional Status: The glacial outwash floods of 1924-1931 deposited millions of cubic yards of new substrate on the RNA. Many similar events occurred before these floods. The result of these periodic deposits has been a chronosequence of soils with associated variations in vegetation and physical and chemical properties. The floods and the soils they produced have been studied by several soil scientists, geologists, and ecologists since the 1930s (see Hill and Egenhoff 1976, and Sollins and others 1985).

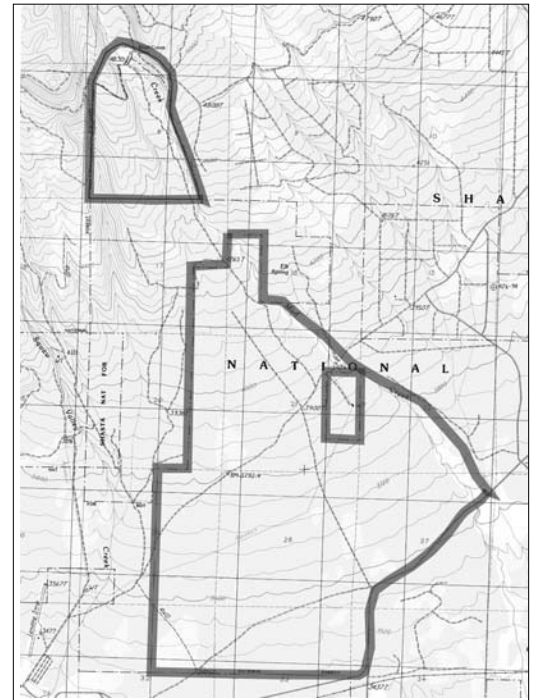
Primary succession on these mudflows progresses from bare mineral soil with no successful colonization of woody species for several years to *Purshia tridentata* dominance followed by ponderosa pine colonization and growth and, finally, to development of a mature forest with variable mixtures of other mixed conifer species. The early dominance of *Purshia* is made possible by nitrogen-fixing bacteria on its root nodules. The success of ponderosa pine has much to do with rapid root growth and tolerance of deep droughty soils.

The idealized succession on a series of progressively older soils is confounded by fire history, logging, mudflow depth, flow rockiness, distance from seed sources, and climatic variations across the area. Much more information must be accumulated to have an accurate view of the successional trends on the area. Comparative research on the two most recent flows in the RNA is also lacking.

A larger portion of the RNA (about 1640 acres, 664 ha) has been affected by secondary succession, resulting from extensive fires between the late 1800s and early 1900s, rather than by mudflow succession. Secondary succession is markedly different from primary succession with longer-persisting shrub stages dominated by different species and different tree colonizers than on mudflows.

Physical Characteristics

The study area covers 3467 acres (1403 ha) of gently S.-sloping terrain on the lower S. slopes of Mount Shasta. The Shasta Mudflow RNA covers 3115 acres (1261 ha) and excludes the disjunct N. portion of the study area. Elevations range from about 5040 ft (1536 m) in the NW. corner to about 3440 ft (1049 m) approximately 4.5 miles (7.2 km) away at the SE. corner. Volcanic mudflows resulting from glacial outburst floods have created large areas of volcanic mud deposits in the region. Five flows (A-E) of different ages are identified in the RNA, including three broad flows (A, D, E) that run N.-S. and two intermediate-



**Figure 155—
Shasta Mudflow
RNA**

aged flows (B, C) that occur as islands in the three broad flows. Mud Creek traverses the length of the area. The entire area is underlain by deep andesitic ash, boulders, and gravel. Soils are regosolic and considered vitrandepts.

Precipitation averages 45-50 inches (1143-1270 mm) annually. Twenty to 50 percent of this falls as snow, with average April 1 snow depths from 10 to 25 inches (25-64 cm). Mean January temperatures are about 36 °F (2.2 °C); mean July temperatures, 65 °F (18.3 °C).

Association Types

Forty-two 100-m² plots were sampled on a series of transects in the ponderosa pine, mixed conifer, and white fir associations.

Ponderosa Pine Forest (84220): 2462 acres (996 ha). As a result of different successional histories in this association, there is great variation in tree size, tree density, and understory composition. The ponderosa pine forest also varies clinally as a result of differing climatic conditions across the RNA. Thirty-two 100-m² plots were sampled in this vegetation type. Basal area cover ranges from 21 to 300 m²/ha. The association is divided into five subtypes. Four of these are arranged along a successional series.

Subtype 1 occurs on very deep, recent mudflow deposits (>15 ft, 5 m). Growth of ponderosa pine is slow, taking 40 yr to attain 5.5 inches (14 cm) dbh and 16 ft (5 m) in height. *Purshia tridentata* dominates the understory (25-45 percent cover) with *Haplopappus bloomeri*, *Penstemon deustus* ssp. *heterander*, *Elymus glaucus*, *Sitanion hystrix*, and *Eriogonum nudum*. Bare soil covers 30-50 percent of the surface.

Subtype 2 occurs on a recent mudflow (Flow A) where depths are 10-17 ft (3.0-5.2 m). Here, ponderosa pine is denser and larger than subtype 1. The dbh of the dominant species ranges from 6 to 12 inches (15-31 cm); heights are 25-45 ft (7.6-13.7 m). *Purshia tridentata* covers 20-70 percent. Few other shrub and herb species occur. *Arctostaphylos patula*, *Haplopappus bloomeri*, *Ribes roezlii*, *Ceanothus prostratus*, *Arabis holboellii* var. *retrofracta*, *Linanthus ciliatus*, *Vulpia* sp., *Sitanion hystrix*, *Stipa occidentalis*, and *S. columbiana* are occasional.

Subtype 3 is widespread on the recent Flow A, with depths of 2-6 ft (0.6-1.8 m). Dominant trees average 15-22 inches dbh (38-56 cm) with heights from 65 to 100 ft (20-31 m). Ponderosa pine dominates, with small numbers of incense-cedar (*Libocedrus decurrens*) and white fir (*Abies concolor*). The understory is relatively shady and very sparse (fig. 156); large areas have no herbs or shrubs.

Subtype 4 occurs on Flow B at the S. end of the area. Ponderosa pines average 90 years old, 25-36 inches (64-91 cm) dbh, and 93-116 ft (28-35 m) tall. This subtype is relatively open with fewer trees/area than subtype 3. California black oak (*Quercus kelloggii*) is frequently an important subdominant, and grasses such as *Bromus marginatus* and *B. orcuttianus* are often common. Herbs such as *Agoseris heterophylla*, *Lagophylla* sp., *Osmorhiza chilensis*, *Lupinus adsurgens*, *Rumex angiocarpus*, *Pteridium aquilinum*, and *Horkelia fusca* are common.

Beyond these four types there are more advanced successional stages. These may be viewed as members of an E.-W. continuum ranging from a drier, more interior type on the E. side of the RNA, with *Purshia tridentata* the understory dominant, to a more mesic W. side type which is transitional with mixed conifer forest, having an understory of mountain chaparral sclerophylls and other typical mixed-conifer-forest species. Many of these older forests are dominated by

ponderosa pine largely because of its resistance to fire. Younger trees of Douglas-fir (*Pseudotsuga menziesii*), white fir, and incense-cedar are certain to increase in importance, barring future fire or other disturbance.

Mixed Conifer Forest (84230): 924 acres (374 ha). This association is dominated by variable mixtures of Douglas-fir, incense-cedar, white fir, sugar pine (*Pinus lambertiana*), ponderosa pine, and California black oak. The best examples occur on the W. side of the area, on older surfaces that were lightly logged 80-90 years ago. Nine 100-m² plots were sampled in this type. Total basal area varies from 85 to 234 m²/ha. White fir is the most ubiquitous species, occurring on all plots, but the dominants are ponderosa pine and Douglas-fir, both averaging about 43 m²/ha basal area. Densities average between 600 and 4900 stems (>2 m tall) per hectare. All species are reproducing, and barring further disturbance, forest composition should remain consistent. Typical understory is sparse, with scattered individuals of *Symphoricarpos acutus*, *Chimaphila menziesii*, *C. umbellata*, *Pyrola picta*, *Goodyera oblongifolia*, *Corallorhiza maculata*, *Galium bolanderi*, and *Viola lobata*.

White Fir Forest (84240): 123 acres (37 ha). This association occurs at the upper elevations. It may be a closed climax forest or a young successional forest. Both types are strongly dominated by white fir. The successional phase results from fires in the late 1800s and early 1900s that killed all but a few trees. Survivor trees are largely ponderosa pine 4-6 ft (1.2-1.8 m) dbh and 130-160 ft (40-49 m) tall. These trees tower over the dense canopy of 10- to 14-inch (25- to 36-cm) dbh white fir with heights of 50-60 ft (15-18 m). There is a senescent, shrubby understory dominated by *Chrysolepis sempervirens*, *Arctostaphylos patula*, and *Ceanothus velutinus*. Before the fires, this forest was probably a mixed conifer type, as young incense-cedar, Douglas-fir, and sugar pine also occur in the area.

The old-growth type was spared from fire by its valley-bottom location. Basal area cover for old-growth white fir forest averages 120 m²/ha, with white fir comprising 78 percent of the cover. Basal area on the successional plots averages 198 m²/ha, with white fir comprising 37 percent of the total cover. Tree density is 1200/ha on mature plots and 2500/ha on the successional plots. White fir relative density is 92 percent on mature plots and 52 percent on the successional plots.

Mountain Chaparral (37510, 37530): No acreage is given. Several small patches of chaparral dating from the fires 80-120 years ago occupy the NW. portion of the RNA adjacent to white fir forest. These are dominated by a varying mixture of *Ceanothus velutinus*, *Chrysolepis sempervirens*, *Arctostaphylos patula*, and *Prunus emarginata*. Most have numerous *Abies concolor* saplings and young trees associated with them. Herbs and grasses are few and include *Hackelia californica*, *Apocynum pumilum*, *Carex languinosa*, and *Melica aristida*.

Another form of mountain chaparral occurs at lower elevations in the S. portion of the RNA. This subtype is dominated typically by *Arctostaphylos patula* with *Ceanothus cordulatus*, *C. prostratus*, and occasionally *Arctostaphylos nevadensis*,



Figure 156—Shasta Mudflow, ponderosa pine on shallow 1924-26 mudflow in the Shasta Mudflow RNA. Note senescent *Purshia* in understory. (1983)

Purshia tridentata, *Amelanchier pallida*, *Ribes roezlii*, and *Prunus emarginata*. Unlike the previous subtype, *Chrysolepis sempervirens* is rare. This subtype is more open than the previous subtype.

Riparian (61510, 61530, 63500): No acreage is given. While unstable banks and variable water levels in Mud Creek are not conducive to good riparian growth, small areas of riparian vegetation exist at the diversion dam at the upper end of the RNA and along Squaw Creek on the NW. boundary. The following woody species are characteristic: *Alnus tenuifolia*, *Salix lemmonii*, and black cottonwood (*Populus trichocarpa*). Herbs include *Juncus mertensianus*, *Luzula comosa*, *Agrostis scabra*, *A. exarata*, *A. variabilis*, *Glyceria elata*, *Carex jonesii*, *Epilobium glaberrimum*, *Gnaphalium chilense*, *Stellaria crispa*, *Mimulus guttatus*, *Castilleja miniata*, *Achillea millefolium*, and *Potentilla glandulosa* ssp. *nevadensis*.

Plant Diversity

Ninety-five species are listed.

Conflicting Impacts

Portions of the area were logged in 1885 and 1900. Three dirt roads and a water pipeline cross parts of the RNA. The remnants of a small diversion dam exist at the N. boundary along Mud Creek. However, the majority of the area shows little human alteration.