GOAT MARSH RESEARCH NATURAL AREA

Supplement No. 10[1]

Jerry F. Franklin and Curt Wiberg[2]

The Research Natural Area described in this supplement is administered by the Forest Service, U.S. Department of Agriculture. Forest Service Research Natural Areas are located within Ranger Districts which are themselves administrative subdivisions of National Forests. Normal management and protective activities are the responsibility of District Rangers and Forest Supervisors. Scientific and educational uses of these areas are the responsibility of the research branch of the USDA Forest Service. A scientist interested in using one of the areas in Oregon and Washington should, therefore, contact the Director of the Pacific Northwest Forest and Range Experiment Station (809 N.E. 6th Ave., Portland, Oregon 97232) and outline the activity planned. If extensive use of one or more Forest Service Research Natural Areas is planned, a cooperative agreement between the scientist and the USDA Forest Service may be necessary. The Forest Supervisor and District Ranger administering the affected Research Natural Area will be informed of mutually agreed on activities by the Experiment Station Director. A scientist should still visit the administering Ranger Station when initiating the work and explain its nature, purpose, and duration. Permission for brief visits to Research Natural Areas for observational purposes can be obtained from the District Ranger.

The Research Natural Area described in this supplement is part of a Federal system of such tracts established for research and educational purposes. Each of these constitutes a site where some natural features are preserved for scientific purposes and natural processes are allowed to dominate. Their main purposes are to provide:

1. Baseline areas against which effects of human activities can be measured;
2. Sites for study of natural processes in undisturbed ecosystem; and
3. Gene pool preserves for all types of organisms, especially rare and endangered types.

The total Federal system is outlined in "A Directory of the Research Natural Areas on Federal Lands of the United States of America."[3] Of the 64 established Federal Research Natural Areas in Oregon and Washington, 54 are described in "Federal Research Natural Areas in Oregon and Washington: A Guidebook for Scientists and Educators" and Supplements 1 through 9. This description is Supplement No. 10. Supplements describing subsequent additions to the system will be prepared.

The guiding principle in management of Research Natural Areas is to prevent unnatural encroachments or activities that directly or indirectly modify ecological processes on the tracts. Logging and uncontrolled grazing are not allowed, for example, nor is public use which threatens significant impairment of scientific or educational values. Management practices necessary for maintenance of the ecosystem may be allowed.

Federal Research Natural Areas provide a uniquely valuable system of publicly owned and protected examples of undisturbed eco-

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[1]Supplement No. 10 to "Federal Research Natural Areas in Oregon and Washington: A Guidebook for Scientists and Educators," by Jerry F. Franklin, Frederick C. Hall, C. T. Dyrness, and Chris Maser (USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, 498 p., illus., 1972). The guidebook is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $4.90; stock number 001-001-00225-9.

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[3]Federal Committee on Ecological Reserves. 1977. A directory of Research Natural Areas on Federal lands of the United States of America. 280 p. USDA For. Serv., Washington, D.C.

systems available to the scientist. Research can be conducted with minimal interference and reasonable assurance that investments in long-term studies will not be lost to logging, land development, or similar activities. In return, a scientist wishing to use a Research Natural Area has some obligations; these are to:

1. Obtain permission from the appropriate administering agency before using the area;[4]
2. Abide by the administering agency's regulations governing use of the natural area, including specific limitations on the type of research, sampling methods, etc., allowed; and
3. Inform the administering agency of the progress of the research, published results, and disposition of collected materials.

The purposes of these limitations are simple-to insure that the scientific and educational values on the tract are not impaired, to accumulate a documented body of knowledge about the tract, and to avoid conflict between new and old studies. Research on Research Natural Areas must be essentially nondestructive; destructive analysis of vegetation is generally not allowed, nor are studies requiring extensive modification of the forest floor or extensive excavation of soil. Collection of plant and animal specimens should be restricted to the minimum necessary for provision of vouchers and other research needs and in no case to a degree that significantly reduces the population levels of species. Such collections must also be carried out in accordance with applicable State and Federal agency regulations. Within these broad guidelines, the appropriate uses of Research Natural Areas are determined on a case-by-case basis by the administering agency.

A scientist wishing to use a particular Research Natural Area must determine the administering agency, contact it regarding the proposed use, and obtain the necessary permission. Each agency differs slightly in its requirements.

[4] There are five agencies cooperating in this program in the Pacific Northwest: Forest Service in the U.S. Department of Agriculture; Bureau of Land Management, Fish and Wildlife Service, and National Park Service in the U.S. Department of the Interior; and the U.S. Department of Energy.

GOAT MARSH RESEARCH NATURAL AREA

A mosaic of wetlands on the southwestern slopes of Mount St. Helens associated with youthful pyroclastic flows occupied by *Pinus contorta* stands and upland sites with *Abies* forests.

The Goat Marsh Research Natural Area (RNA) was established on May 24, 1974, to represent an array of mountain wetland communities—marshlands, swamps, bogs, and ponds—and xeric noncommercial lodgepole pine (*Pinus contorta*) forests which characterize youthful pyroclastic flows, mudflows, and alluvial surfaces associated with Cascadian volcanoes (fig. GH-1). The RNA also preserves the finest known stand of noble fir (*Abies procera*) for scientific and educational purposes. The 478-ha (1,195-acre) tract is located in Cowlitz County, Washington, and is administered by the St. Helens Ranger District, Gifford Pinchot National Forest. The natural area occupies essentially all of section 23 and parts of sections 14, 22, 24, and 27, T. 8 N., R. 4 E., Willamette

Figure GH1.—General view of most of the Goat Marsh Research Natural Area as seen from the northeast. Forests interspersed with rock outcrops and avalanche chutes characterize the slopes of Goat Mountain (right). The Research Natural Area boundary follows the sawtooth ridge in the center of the picture to the third peak on the left before dropping down to the level of the marsh. The two lakes (lake on right is within the natural area, the other is outside) are visible as are two "hummocks" or islands of normal vegetation and soil within the wetlands, most of the marsh, and substantial acreage of pyroclastic-flow forest (midground).

meridian. Spur ridges leading to the summit of Goat Mountain and Forest Roads N 827, N 847, and N 859 essentially delimit the boundaries of the natural area (fig. GH-2). The natural area lies at 46° 10' N.latitude and 122° 16' W. longitude.

Access and Accommodations

The RNA is located approximately 80 km (50 miles) northeast of Portland, Oregon, and 18 km (11 miles) north of Cougar, Washington. Cougar is 46 km (29 miles) east of Woodland on State Highway 503. To reach the natural area turn off State Highway 503 approximately 1.6 km (1 mile) west of Cougar onto Forest Road N 818 (Lake Merrill Road). Follow Road N 818 for 18.9 km (11.8 miles) to its junction with Forest Road N 859. Turn north onto N 859 and follow it for 1.3 km (0.8 mile) to the southeast corner of the RN A. The natural area boundary follows Forest Road N 859 for 1.1 km (0.7 mile to the junction of N 859 and N 847 and then follows N 847 for 1.6 km (1.0 mile). Good access to the southern part of the RN A is from a rock quarry in section 26; a short spur leads to the quarry from Forest Road N 859, about 1.0 km (0.6 mile) north of the N 818 and N 859 junction. A barricaded jeep trail leads from the quarry to Goat Marsh Lake, and fisherman trails lead along the west side of the lake and over a low ridge to the large pond in the RN A. Forest Roads N 847 and N 827 provide good access to the northern half of the RN A.

Commercial accommodations are available in Woodland, Washington, and can sometimes be arranged in Cougar. There are several improved forest campsites in the Cougar area.

Environment

The Goat Marsh RNA encompasses a range in elevation from 885 m (2,950 feet) where Coldspring Creek leaves the RN A to 1 490 m (4,965 feet) at the summit of Goat Mountain. Topography is predominantly gentle; slopes are moderate along the northern boundary but precipitous on Goat Mountain.

The RNA is located at the foot of Mount St. Helens, a volcano with a very active and violent recent history of eruptions (Crandell et al. 1975). The wetlands appear to have been formed 300 to 450 years ago, when one hot pyroclastic flow, or possibly several flows, moved down the southwest flank of Mount St. Helens and blocked the normal flow of Coldspring Creek (fig. G H-3).[5] Additional evidence of volcanic activity is found in the soil on the flank of Goat Mountain, which consists largely of air-laid deposits of pumiceous ash and lapilli from Mount St. Helens. The youngest rock beneath the pyroclastic flows is a basalt lava flow probably 1,900 to 2,000 years old. Goat Mountain is composed of porphyritic dacite according to C. A. Hopson, U.S. Geological Survey (see footnote 5).

A wet, cool, maritime climate prevails-little of the annual precipitation occurs from June to August. The average annual snowfall for the nearby Spirit Lake Ranger Station is 767 cm (302 inches). The following climatic data are from the closest weather station at Cougar (Meteorology Committee, Pacific Northwest River Basins Commission 1969):

Mean annual temperature	10.3°C (50.6°F)
Mean January temperature	2.7°C (36.8°F)
Mean July temperature	18.8°C (65.8°F)
Mean January minimum temperature	-0.4°C (31.2°F)
Mean July maximum temperature	26.2°C (79.1°F
Mean annual precipitation	290.4 cm (114.33 in)
Mean precipitation, June through August	17.2 cm (6.77 in)

Soils on the natural area are highly variable. Organic soil profiles are found in the low marshy areas. Soils on the pyroclastic flows are generally an unstratified and poorly sorted mass of pebble and cobble-size rock fragments in a friable sandy matrix; depth of rootable material on the surface of the flows ranges from 15 to 45 cm (6 to 18 in). Inceptisols derived principally from air-laid pumice and ash characterize the uplands.

[5] Personal communication from Dr. D. R. Crandell, U.S. Geological Survey, March 1979.

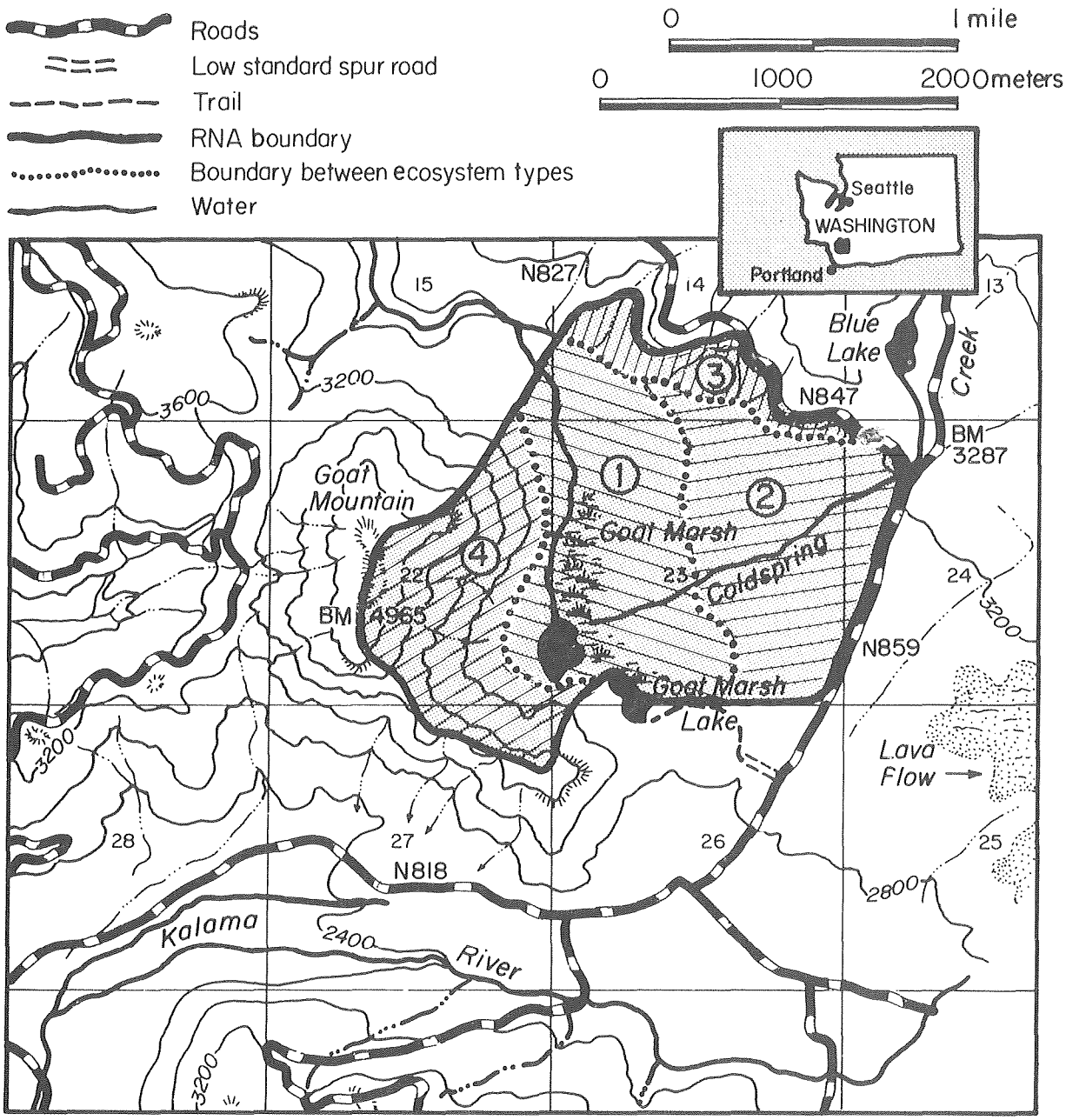

Figure GH-2.—Map of the Goat Marsh Research Natural Area showing major natural features and ecosystem types; ecosystem types are: (1) wetlands, (2) pyroclastic-flow forests (mainly *Pinus contorta*), (3) lower slope forests (*Abies procera*-dominated), and (4) steep-slope forests and rocky openings.

Figure GH-3.—Mount St. Helens and upper portion of the pyroclastic flow that created the marsh; contrasts between the *Pinus contorta* forests and the productive forests on older land surfaces are obvious.

Vegetation

The major ecosystems in the Goat Marsh RNA can be categorized as follows:

Ecosystem	Extent
Wetlands (marsh, pond, swamp, and bog)	179 ha (442 acres)
Pyroclastic-flow forests (dominated by *Pinus contorta*)	157 ha (388 acres)
Lower slope forests (dominated by *Abies procera*)	28 ha (70 acres)
Steep-slope forests (dominated by *Abies* and *Tsuga*)	115 ha (285 acres)
Clearcut	4 ha (10 acres)

A partial list of vascular plant species found in the RNA is shown in table 1.

Table GH-1—Partial list of vascular plants found within the Goat Marsh Research Natural Area

Scientific name	Common name	Habitat[1]
Abies amabilis (Dougl.) Forbes	Pacific silver fir	SF, PF
Abies lasiocarpa (Hook.) Nutt.	subalpine fir	PF
Abies procera Rehder	noble fir	SF, PF
Acer circinatum Pursh	vine maple	SF
Acer glabrum var. *douglasii* (Hook.) Dipp.	Rocky Mountain maple	SF
Achlys triphylla (Smith) DC.	deerfoot vanillaleaf	SF, PF
Alnus sinuata (Regel) Rydb.	Sitka alder	W, PF
Anemone deltoidea Hook.	threeleaf anemone	SF
Arctostaphylos uva-ursi (L.) Spreng.	kinnikinnick	PF
Athyrium filix-femina (L.) Roth	ladyfern	SF
Blechnum spicant (L.) With.	deerfern	W, SF
Calamagrostis canadensis (Michx.) Beauv.	bluejoint reedgrass	W
Carex aquatilis var. *alitor* (Rydb.) Fern	water sedge	W
Carex lenticularis Michx.	Kellogg's sedge	W
Carex limosa L.	mud sedge	W
Carex muricata L.	western stellate sedge	W
Carex rostrata Stokes ex With.	beaked sedge	W
Clintonia uniflora (Schult.) Kunth	queencup beadlily	SF
Coptis laciniata Gray	cutleaf goldthread	SF
Cornus canadensis L.	bunchberry dogwood	SF
Disporum hookeri (Torr.) Nicholson	Hooker's fairybells	SF
Drosera anglica Huds.	sundew	W
Drosera rotundifolia L.	sundew	W
Dryopteris austriaca (Jacq.) Woynar ex Schinz & Thell.	mountain woodfern	SF
Equisetum fluviatile L.	horsetail	W
Eriophorum polystachion L.	tall cotton-grass	W
Glyceria elata (Nash) M. E. Jones	tall mannagrass	W
Goodyera oblongifolia Raf.	rattlesnake plantain	SF, PF
Gymnocarpium dryopteris (L.) Newm.	oakfern	SF
Habenaria dilatata (Pursh) Hook.	boreal bogorchid	W
Juncus effusus L.	common rush	W
Juncus ensifolius Wikst.	dagger-leaved rush	W
Juncus supiniformis Engelm.		W
Maianthemum dilatatum Wood) Nels. & Macbr.	falselily-of-the-valley	SF
Menyanthes trifoliata L.	buckbean	W
Menziesia ferruginea Smith	rustyleaf	SF
Mimulus moschatus Dougl.	muskplant monkeyflower	W
Nuphar sp.	yellow water-lily	W
Osmorhiza sp.	sweetroot	SF
Oxalis oregana Nutt. ex T. & G.	Oregon oxalis	SF
Pachistima myrsinites (Pursh) Raf.	Oregon boxwood	PF
Pinus contorta Dougl. ex Loud.	lodgepole pine	PF, W
Pinus monticola Dougl. ex D. Don	western white pine	PF, W
Populus trichocarpa Torr. & Gray	black cottonwood	PF, W
Potentilla palustris (L.) Scop	marsh cinquefoil	W
Pseudotsuga menziesii (Mirb.) Franco	Douglas-fir	PF, SF
Rosa gymnocarpa Nutt.	baldhip rose	SF

Table GH-1—Partial list of vascular plants found within the Goat Marsh Research Natural Area—Continued

Scientific name	Common name	Habitat[1]
Rubus lasiococcus Gray	dwarf blackberry	SF
Rubus pedatus J. E. Smith	strawberry-leaf blackberry	SF
Rubus spectabilis Pursh	salmonberry	W
Salix sp.	willow	W, PF
Scirpus microcarpus Presl	small-fruited bulrush	W
Senecio cymbalarioides Bueck	fewleaf groundsel	W
Sparganium emersum Rehmann	simplestem burreed	W
Spiraea douglasii Hook.	Douglas spirea	W
Spiranthes romanzoffiana Cham.	continental ladiestresses	W
Streptopus roseus Michx.	purple twistedstalk	SF
Thuja plicata Donn	western redcedar	SF, PF, W
Tiarella trifoliata L.	three-leaved coolwort	SF
Tiarella unifoliata Hook.	western coolwort	SF
Tofieldia glutinosa (Michx.) Pers.	western tofieldia	W
Tsuga heterophylla (Raf.) Sarg.	western hemlock	SF, PF
Vaccinium alaskaense How.	alaska huckleberry	SF
Vaccinium membranaceum Dougl. ex Hook.	big huckleberry	SF
Vaccinium occidentale Gray	westernbog huckleberry	W
Vaccinium ovalifolium Smith	ovalleaf huckleberry	SF
Vaccinium oxycoccos L.	wild cranberry	W
Vaccinium parvifolium Smith	red huckleberry	SF, PF
Vancouveria hexandra (Hook.) Morr. & Dec.	white inside-out-flower	SF
Veratrum viride Ait.	American false hellebore	SF
Veronica americana Schwein. ex Benth.	American speedwell	W
Viola sempervirens Greene	evergreen violet	SF

[1]PF = forests on pyroclastic flows; SF = forests on mountain slopes and benches; W = wetlands (marsh or swamp).

Wetlands

Wetlands occupy the central portion of the RNA (figs. GH-1 and GH-2) and include open water, marshes, swamps, and bogs. The largest body of open water is the large lake or pond at the foot of Goat Mountain (fig. GH-4).[6] Activity by beavers (*Castor canadensis*) has deepened the pond and probably enlarged its area.

[6]This pond is not named in maps issued by the U.S. Geological Survey and the USDA Forest Service; only the lake outside the RNA is called Goat Marsh Lake. Wolcott (1961), on the other hand, refers to both as the Goat Marsh Lakes: The pond in the RNA as Goat Marsh Lake No. 1—5.2 ha (13.0 acres) in area and an estimated 1.2 m (4 feet) deep; the lake outside the RNA as Goat Marsh Lake No. 2, with an area of 2.0 ha (5 acres).

Marshes form a nearly continuous strip along the eastern base of Goat Mountain (fig. GH-5) and grade into shrub and scrub forest ecotones with upland forests on the north and northeast. Although these ecosystems have not yet been systematically sampled, grasses, sedges, and other grasslike plants dominate the marshes. Representative species include *Carex aquatilis, C. rostrata, C. lenticularis, Scirpus microcarpus, Eriophorum polystachion, Calamagrostis canadensis, Glyceria elata,* and *Juncus ensifolius*. Two carnivorous species (*Drosera rotundifolia* and *anglica*) are present. *Menyanthes trifolium* is conspicuous in some shallow ponds. Floating sedge mats are encountered in some areas around the pond.

Figure GH-4.—Pond at foot of Goat Mountain, this is the largest area of open water in the RNA.

Figure GH-5.—Marshes are the most extensive type of wetland in the RNA and are typically dominated by *Carex*.

The largest area. of bog and swamp is in the south-central portion of the RN A and appears to be at least partially a product of beavers' activity. A major dam and pond with beaver lodge are located here (fig. GH-6). The open water areas form a mosaic with shrub thickets, low vigor trees, and snags. *Salix* spp. and *Spiraea douglasii* are the most common shrubs. Snags are concentrated along the southern and eastern peripheries of the beaver pond, suggesting flooding of a low vigor forest (fig. GR-7).

Pyroclastic-Flow Forests

The forests in the western third of the RNA reflect the generally unfavorable nature of the substrate. The most extreme sites are occupied by open, low-vigor stands in which *Pinus contorta* dominates (fig. GR-8); good examples are found along the road on the eastern boundary of the RN A.

Mature trees on these sites are typically 6 to 8 m (20 to 40 ft) high and 15- to 25-cm (6- to 10-m) d.b.h. The sparse understory is characterized by *Arctostaphylos uva-ursi,* the only

Figure GH-6.—Pond and lodge created by beavers near the center of the RNA.

significant vascular plant, and a dense and species-rich ground layer of mosses and lichens.

The forests on the flows increase in diversity as the depth of rootable substrate, moisture supply, or both increase. This enrichment occurs along the edge of the marshes on the west and *Abies procera* forest on the north. On these better habitats, *Pseudotsuga menziesii* and *Tsuga heterophylla* are the most common associates. *Abies lasiocarpa, Abies amabilis, Abies procera, Pinus monticola,* and *Thuja plicata* may also be present. *Populus trichocarpa* are found on the moistest forested sites. The understory also becomes richer on more mesic sites and includes a scattering of larger shrubs (e.g., *Alnus sinuata),* lower shrubs (e.g., *Pachistima myrsinites),* and herbs (e.g., *Achlys triphylla).* The ground layer of cryptogams is simplified to a few moss species.

Pinus contorta is the climax species over much of the surface underlain by pyroclastic flows, giving way to *Pseudotsuga menziesii* and *Tsuga heterophylla* on the richer sites.

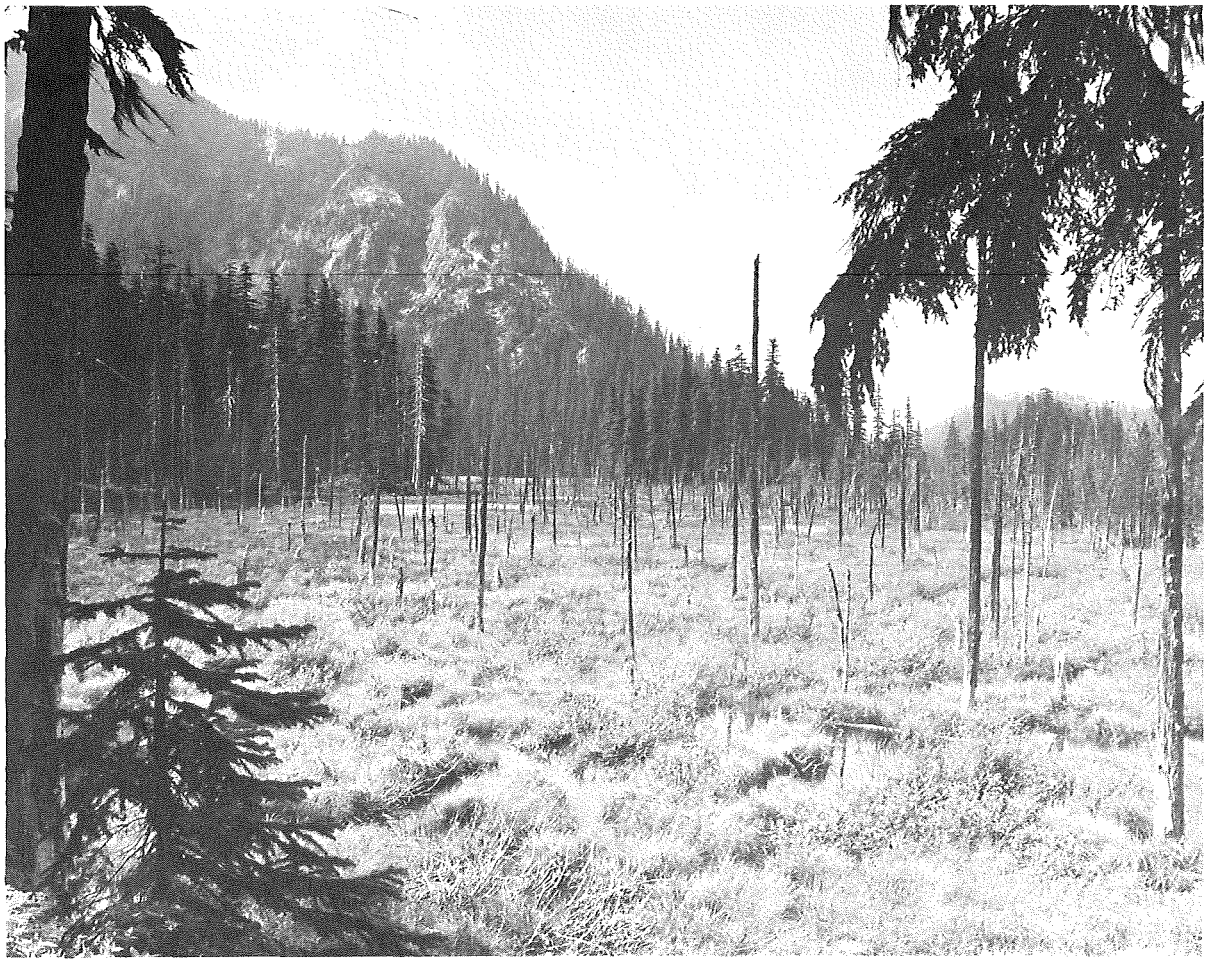

Figure GH-7.—Swamp of snags and *Salix* shrub thickets south of the beaver dam.

Figure GH-8.—Depauperate *Pinus contorta* stand typical of those occupying the youthful pyroclastic flows, (reference pole is 1 m (3.3 feet) tall).

Lower Slope Forests

Massive old-growth forests dominate the flats, toe slopes, and lower mountain slopes around the wetlands. *Abies procera* is the characteristic dominant, and the RNA includes some of the finest individual specimens, as well as the highest volume grove of this species in existence (fig. G H-9). Some of the stands are considerably past their prime, however, and include large volumes of standing. dead trees and down logs. The superlative *Abies procera* stand at the northern edge of the RNA was first recognized by a Weyerhaeuser Co. timber cruiser in the 1950's who reportedly felt it to be the highest volume stand he had ever examined. Weyerhaeuser subsequently traded the section with the grove and most of the marsh to the USDA Forest Service.

The first scientific study of the grove was made by a joint U.S.-Japanese International Biological Program team in 1972. A hectare

Figure GH-9.—View within a superlative grove of *Abies procera*; the stands in this area are second only to those of *Sequoia sempervirens* in total biomass.

was selected, trees were measured, and the biomass values of stems were calculated (Fujimori et al. 1976). The reported values exceed those for a superlative old-growth *Pseudotsuga menziesii* grove measured at the same time. In fact, the stem biomass (1,687 t/ha or 753 tons/acre) and basal area (147.4 m^2/ha or 642 ft^2/acre) values exceed all others reported in the world, except those for *Sequoia sempervirens* forests.

Additional data are available from a 4-ha (IO-acre) permanent sample plot established in the same grove by the Pacific Northwest Forest and Range Experiment Station in 1977 (table 2). *Abies procera* is by far the most important species. *Pseudotsuga menziesii* is ranked second in terms of volume; but *Abies amabilis* is the most numerous, followed by *Tsuga heterophylla.* A stem map makes it possible to identify the portions of this stand with the highest volumes. One contiguous square hectare contained 1,008,040 board feet (fum), the equivalent of 407,934 fbm/acre. The largest specimen was a 235-cm (92.7-in) d.b.h., 80.8 m (269.3 ft) tall *Abies procera,* containing 105.7 m^3 (3,774 ft^3 or 28,893 fum); calculations were based on optical dendrometer measurements. The stand also contains *Pseudotsuga* up to 93.3 m (310.9 ft) in height and 215-cm (84.7-in) d.b.h., but tree volumes are much higher for *Abies procera* at comparable diameters because of a much higher form factor. The ages of the dominant trees appear to be about 325 to 350 years, based on counts of stumps along the road.

The understory is primarily herbaceous and characteristic of the most productive subalpine habitat types: *Abies amabilis/Streptopus roseus* and A. *amabilis/Oxalis oregana* (Franklin 1966). Major species are *Acer circinatum, Achlys triphylla, Vancouveria hexandra, Streptopus roseus, Tiarella unifoliata, Oxalis oregana, Gymnocarpium dryopteris, Coptis laciniata, Anemone deltoidea, Viola sempervirens,* and *Comus canadensis.*

Steep-Slope

Forests dominated by *Abies amabilis* and *Tsuga heterophylla* cover much of the steep, broken, eastern slopes of Goat Mountain. These have not been carefully examined. Although individual trees are often large, stand volumes vary widely with topography; the average stand volume is relatively low because of rock outcrops, cliffs, etc. (fig. GR-l). *Abies amabilis* and *procera, Tsuga heterophylla,* and *Pseudotsuga menziesii* are the major species.

Fauna

Amphibians known to be resident breeders include the Cascade frog *(Rana cascadae),* the western toad *(Bufo boreas),* and the rough-skinned newt *(Taricha granulosa).* The northwestern salamander *(Ambystoma gracile),* the long-toed salamander (A. *macrodactylum),* and Copes salamander *(Dicamptodon copei)* are also likely to occur on the area.

Table GH-2—Characteristics of superlative noble fir grove in Goat Marsh Research Natural Area

Species	Trees per unit area		Basal area		Average d.b.h.		Stand volume		
	No./ha	No./acre	m^2/ha	ft^2/acre	cm	inches	m^3/ha	ft^3/acre	fbm/acre[1]
Abies procera	50.8	20.5	74.1	322	128.8	50.7	2 137	30,501	232,450
Abies amabilis	127.5	51.5	9.3	40.3	27.3	10.9	115.8	1,652	10,595
Tsuga heterophylla	74.5	30.1	12.6	54.8	38.9	15.6	212.2	3,029	20,480
Pseudotsuga menziesii	15.5	6.3	30.8	134.1	153.8	61.5	675.2	9,637	69,674
All species	268.3	108.4	126.8	552	58.0	23.2	3 140	44,820	333,200

[1]Board feet per acre.

Reptiles at Goat Marsh include the common garter snake *(Thamnophis sirtalis),* the northwestern garter snake *(Thamnophis ordinoides),* and the northern alligator lizard *(Gerrhonotus coeruleus).*

A list of mammals that occur, or are likely to occur, at the Goat Marsh RNA is provided in table 3. Goat Marsh is especially good habitat for late summer and fall populations of elk. Many elk beds and rubbing posts (sapling *Pinus contorta)* may be noted in August. There is also abundant evidence of black tailed deer and black bear *(Ursus americana).*

Several large beaver dams exist on part of the marsh. The area has been used by beavers for many years as evidenced by the relatively old age of some of the cuttings and lodges (fig. GH-6). These beaver colonies are of particular interest because of the increasing rarity of such dam-building, lodge-dwelling colonies.

Goat Marsh RN A provides prime habitat for several mammals with special requirements, including the marsh shrew, northern water shrew, and the Richardson vole.

Because of the highly varied habitat, many species of birds not commonly found in old-growth forests use the marsh and surrounding forest edge. Mallard ducks *(Anas platyrhynchos)* were seen on the ponds in August; and several species of migrant waterfowl, including canvasback *(Aythya valisineria)* and pintail ducks *(Anas acuta),* are likely to feed and rest here in the late fall. Kingfishers *(Megaceryle alcyon),* chestnut-backed chickadees *(Parus rufescens),* pine siskins *(Spinus pinus),* gray jays *(Perisoreus canadensis),* Clark's nutcrackers *(Nucifraga columbiana),* song sparrows *(Melospiza melodia),* red crossbills *(Loxia curvirostra),* and several other common species were seen on the area in August.

History of Disturbance

There is little evidence of human intrusion into either the marsh or the forest communities. The greatest disturbances in the area have been caused by pyroclastic flows and the history of beaver activity which continues to change the pattern of the aquatic communities. The natural area is situated in a natural drainage, with high rugged ridges on two sides. The remaining boundaries of the marsh have forested margins that act as buffers to check sedimentation or other disturbances that accrue as the result of logging activities on adjacent slopes. A 4-ha (10-acre) portion of a circa 1965 clear-cut intrudes on the northwest boundary of the natural area. Roadsides at the margins of the natural area presently contribute minimal disturbance. Recreational use by hunters and fishermen has the greatest potential for future disturbance in the interior of the natural area.

Previous Research

Research use of the Goat Marsh RNA has been confined primarily to the *Abies procera* stands. The previously mentioned cooperative U.S.-Japanese biomass analysis was conducted as a part of the International Biological Program (Fujimori et al. 1976).

The Pacific Northwest Forest and Range Experiment Station established a 4-ha (lO-acre) permanent sample plot within the best *Abies procera* grove in 1977. This 200-m (660-foot) square tract is gridded into 25-m^2 (82.5-ft^2) subplots, on which all trees over 15-cm (6-inch) d.b.h. are stem mapped. An optical dendrometer was used to measure a subsample of the trees for height and volume. Standing dead trees and down logs are also mapped and measured. The complete stand map, which includes live, dead, and down stems, is available, along with a O.6-m (2-ft) contour interval map of the tract.[7] An exemplary portion of the map is shown in figure GH-10. Some results of the stand analysis were cited earlier.

7 Contact Dr. Jerry Franklin, Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis, Oregon 97331.

Table GH-3—Tentative list of mammals for the Goat Marsh Research Natural Area

Order	Scientific name	Common name
Insectivora	*Scapanus orarius*	coast mole
	Sorex bendirei	marsh shrew
	Sorex palustris	water shrew
	Sorex trowbridgii	Trowbridge shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Eptesicus fuscus*	big brown bat
	Lasiurus cinereus	hoary bat
	Lasionycteris noctivagans	silver-haired bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	*Lepus americanus*	snowshoe hare
Rodentia	*Aplodontia rufa*	mountain beaver
	Castor canadensis	beaver
	Clethrionomys gapperi	Gapper red-backed vole
	Erethizon dorsatum	porcupine
	Eutamias townsendi	Townsend chipmunk
	Glaucomys sabrinus	flying squirrel
	Microtus longicaudus	long-tailed vole
	Microtus oregoni	Oregon vole
	Microtus richardsoni	Richardson vole
	Microtus townsendi	Townsend vole
	Neotoma cinerea	bushytail woodrat
	Ondatra zibethicus	muskrat
	Peromyscus maniculatus	deer mouse
	Phenacomys intermedius	heather vole
	Tamiasciurus douglasi	chickaree
	Thomomys talpoides	northern pocket gopher
	Zapus trinotatus	Pacific jumping mouse
Carnivora	*Canis latrans*	coyote
	Felis concolor	cougar
	Lynx rufus	bobcat
	Martes americana	marten
	Mustela erminea	ermine
	Mustela frenata	long-tailed weasel
	Mustela vison	mink
	Procyon lotor	raccoon
	Spilogale putorius	spotted skunk
	Ursus americanus	black bear
	Vulpes vulpes	red fox
Artiodactyla	*Cervus elaphus*	elk
	Odocoileus hemionus	blacktailed deer

4.

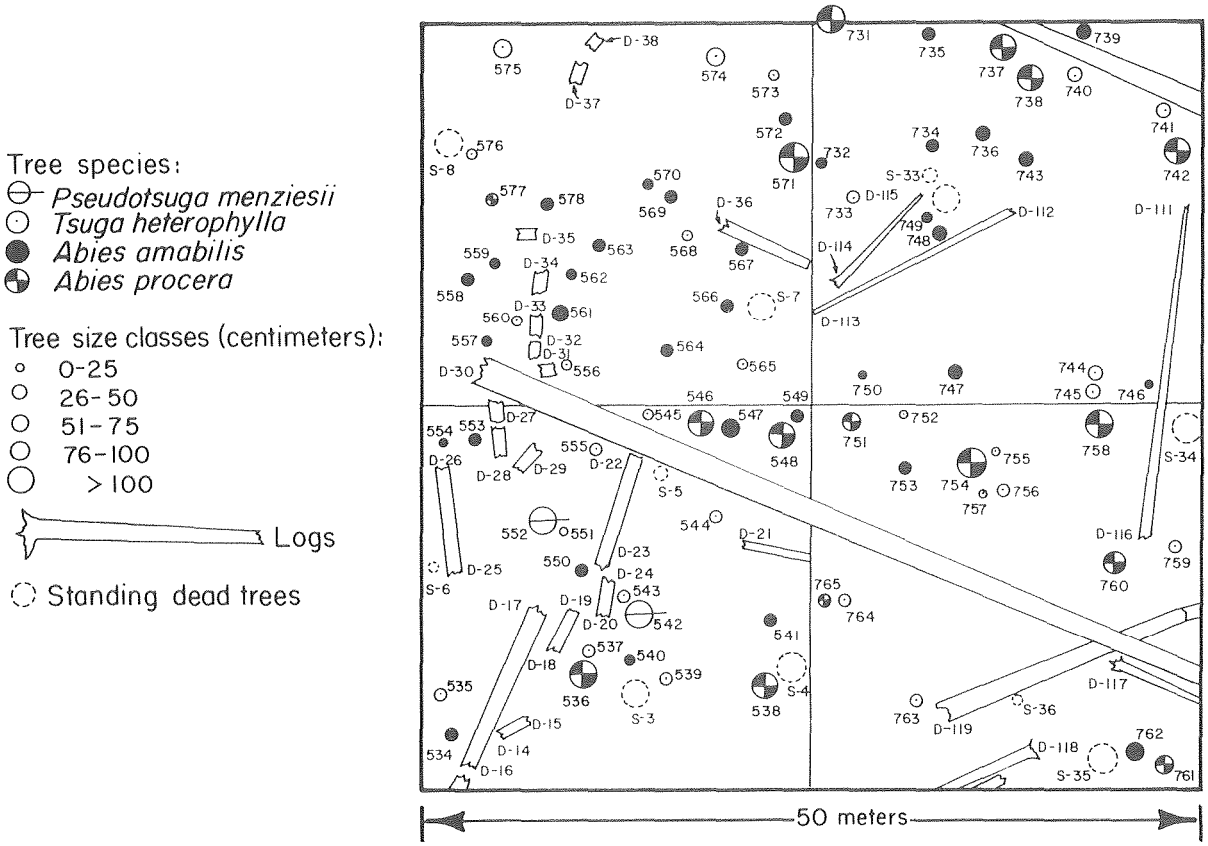

Figure GH-10.—Portion of a 4-ha (10-acre) stand map prepared for the permanent sample plot; live trees 15-cm (6-inch) d.b.h., dead trees, and down logs are included. D = dead down (log), S = snag, and the number = the tag number of a tree, snag, or log.

Some additional data on community structure-e.g., the *Pinus contorta* stands in Franklin (l966)-as well as limited plant collections, have been gathered under USDA Forest Service and Pacific Northwest Natural Area Committee sponsorship ...

The natural area provides an excellent site for limnological, terrestrial, and aquatic-terrestrial interface research. The exchange of materials and energy between marsh and forest communities can be easily studied in this accessible area on generally gentle terrain. Because the various community types are quite extensive, trampling and other disturbance from research are minimal. Ecotones are often quite abrupt so that sampling stations can be easily located within homogeneous, well-defined community types and materials carried from one community to another verified relatively easily.

Maps and Arial Photographs

The topographic map applicable to the natural area is the 15-foot Cougar, Washington, quadrangle, scale 1:62,500, issued by the U.S. Geological Survey in 1953. The District Ranger (Wind River Ranger District) or Forest Supervisor (Gifford Pinchot National Forest, Vancouver, Washington) can provide details on the most recent aerial photo coverage and forest type maps for the area.

LITERATURE CITED

Crandell, Dwight R., Donald R. Mullineaux, and Meyer Rubin.
1975. Mount St. Helens volcano: Recent and future behavior. Science 187(4175): 438-441.

Franklin, Jerry Forest.
1966. Vegetation and soils in the subalpine forests of the southern Washington Cascade Range. Ph. D. thesis. Wash. State Univ., Pullman. 132 p., illus.

Fujimori, Takao, Saburo Kawanabe, Hideki Saito, and others.
1976. Biomass and primary production in forests of three major vegetation zones of the northwestern United States. J. Jap. For. Soc. 58(10):360-373.

Meteorology Committee, Pacific Northwest River Basins Commission.
1969. Climatological handbook, Columbia Basin States, 3 vols. Pac. Northwest River Basins Comm., Vancouver, Wash.

Wolcott, Ernest E.
1961. Lakes of Washington. Vol. 1, Western Washington. Wash. State Dep. Conserv., Div. Water Resour. Bull. 14, 619 p.

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