Federal Research Natural Areas in Oregon and Washington A Guidebook for Scientists and Educators. 1972.
Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

RATTLESNAKE HILLS RESEARCH NATURAL AREA[1] [2]

Shrub-steppe vegetation (e.g., big sagebrush communities) in the arid interior of southeastern Washington.

The Rattlesnake Hills Research Natural Area was established to provide examples of the shrub-steppe communities characteristic of the most arid portions of the Pacific Northwest. It is an island of natural vegetation surrounded by expanses of cultivated fields under dryland or irrigated management regimes. The 33,350-ha. (75,000-acre) tract is located within the boundaries of the U.S. Atomic Energy Commission's Hanford Works Reservation in Benton County, Washington. Research on the tract is managed for the Atomic Energy Commission by the Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, Washington. The eastern boundary of the natural area is formed by State Highway 240, while the western boundary follows the natural skyline of the Rattlesnake Hills (fig. RH-1). It is located at 46°30' N. latitude and 119°40' W. longitude.

ACCESS AND ACCOMMODATIONS

The natural area is most easily reached via State Highway 240 from Richland which is 24 km. (15 miles) to the south and east. There are numerous access roads which enter and traverse parts of the tract; these are marked but are blocked by locked gates. Vehicular traffic is restricted to existing roads; off-road travel by vehicles is prohibited. Several roads are paved; to provide all-weather access to most of the natural area, some of the most troublesome unimproved routes have been stabilized with river gravel and crushed rock.

It is necessary to obtain permission to enter the tract from the Pacific Northwest Laboratories' Arid Lands Ecology Project and the Atomic Energy Commission's Richland Operations Office. Inquiries for permission to use the reserve should be directed to Dr. Burton E. Vaughn, Manager, Ecosystems Department, Battelle-Northwest, Richland, Washington 99352. There are no restrictions on photography within the natural area, but firearms are not allowed unless needed to perform research.

There are no living accommodations on the natural area, but numerous facilities are available in the nearby cities of Richland, Pasco, Kennewick, and Benton City.

ENVIRONMENT

The Rattlesnake Hills Research Natural Area occupies the northeasterly facing slopes of the Rattlesnake Hills, the southern extremity of Yakima Ridge, and intervening gentle slopes and valleys. Elevations range from 150 m. (500 ft.) on the valley floor to 1,060 m. (3,500 ft.) along the crest of the Rattlesnake Hills. The tract is underlain by layers of Columbia River basalt of Miocene age but these are covered by eolian and alluvial materials of variable thickness (Huntting et al. 1961).

The climate of the natural area can be characterized as arid with hot summers and cold winters. Most of the annual precipitation occurs during the late fall and winter, with snow a regular occurrence during winter months. The climate has been observed for over 20 years at a meteorological station

[1] Description prepared by Dr. W. H. Rickard, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, Washington.

[2] Also known as the Arid Lands Ecology Reserve.

located a few miles east of the natural area (latitude 46°34' N., longitude 119°35' W., elevation 224 m. or 733 ft.). Data collected at this station are available as monthly summaries and include daily values for air temperature, precipitation, wind speed and direction, relative humidity, and solar radiation. Some average values are as follows:

Mean annual temperature	11.7°C. (53.1°F.)
Mean January temperature	−1.3°C. (29.6°F.)
Mean July temperature	20.4°C. (68.8°F.)
Mean January minimum temperature	−10.2°C. (13.7°F.)
Mean July maximum temperature	33.3°C. (91.7°F.)
Average annual precipitation	171.2 mm. (6.74 in.)
Average annual snowfall	32.0 cm. (12.6 in.)

Although the meteorological station yields relevant data, it is not representative of the climate of the entire natural area. A series of 25 stations have been located throughout the tract and since 1969 have provided data on precipitation and maximum and minimum air temperature (Hinds and Thorp 1959). These data are also available as monthly summaries. An automated microclimatological station has recently been established at 366-m. (1,200-ft.) elevation within the Grassland Biome study area.

Soils within the natural area have been mapped (Hajek 1966). Based on acreage, the Warden and Ritzville silt loams occupy most of the land area; they are found on the lower and middle slopes of the Rattlesnake Hills. Steep slopes, ridge crests, draw bottoms, and alluvial fans are mapped as Lickskillet, Kiona, and Scooteney silt loams. The basal plains are mapped as Esquatzel silt loam, Ephrata stony loam, Burbank sandy loam, and Hezel and Koehler sand. These series are classified by great soil group and according to the 7th Approximation in table RH-l.

The **Ritzville silt loam** series consist of dark colored soils midway up the slopes of the Rattlesnake Hills. They have developed under *Artemisia* and bunchgrasses from windlaid deposits which usually include small amounts of volcanic ash. The surface 2 dm. are usually a very dark grayish brown (10 YR 4/2) soil. Ritzville soils are usually more than 15 dm. deep, but bedrock may be encountered within as little as 6 dm. of the surface. The **Warden silt loam** series occur on the lower slopes of the Rattlesnake Hills and adjoin Ritzville soils at elevations near 360 m. (1,200 ft.). The surface 2 dm. are dark grayish brown in color (10 YR 4/2). The subsoil is strongly calcareous at about 5 dm. The soil is usually more than 15 dm. deep. **Kiona silt loams** are associated with Ritzville and Warden soils and occupy steep slopes and ridges. The surface soil is very dark grayish brown (10 YR 3/2) and about 1-dm. thick. The dark brown (10 YR 4/3) subsoil contains large basalt fragments 4 dm. and larger in diameter. **Lickskillet silt loams** occupy ridge tops above 765-m. (2,500 ft.) elevation in the Rattlesnake Hills. These soils are shallow over basalt bedrock with fragments of basalt present throughout the soil profile. This series is similar to the Kiona series except that the surface soils are darker (very dark brown, 10 YR 2/2). **Esquatzel silt loams** are formed in recent alluvium. The color and texture of the subsoil vary with the stratified nature of the alluvial deposits. Esquatzel soils are associated with Ritzville and Warden soils and often seem to have developed from sediments eroded from these two series. **Scooteney stony silt loams** are found on the northerly-facing slopes of the Rattlesnake Hills and are usually confined to the bottoms of narrow draws and fan-shaped areas where draws empty out onto the adjoining plain. These soils are often severely eroded with numerous outcrops of basalt. The surface soil is usually dark grayish (10 YR 4/2). **Ephrata sandy loams** are associated with the Burbank soils. The surface soil is very dark grayish brown (10 YR 3/2), and the subsoil is dark grayish brown (10 YR 4/2). The medium textured surface soil is underlain by gravelly materials many meters in depth. **Burbank loamy sands** are coarse-textured soils underlain by gravel. The surface soil averages about 4-dm. thick but can have thicknesses of up to 7 dm. The gravel content of the subsoil may range from 20 to 80 percent by volume. The surface soil is a very dark grayish brown (10 YR 3/2), and the subsoil is dark grayish brown (10 YR

4/2). **Hezel sands** have developed under *Artemisia* and *Grayia* in coarse sandy alluvial deposits. Relief characteristically consists of hummocky terraces and dune-like ridges. The surface soil, which is approximately 9 dm. deep, is very dark brown (10 YR 3/3) and was probably formed in wind-blown sand which mantled finer textured lacustrine sediments. The subsoil is a dark grayish brown (10 YR 4/2), sandy loam. **Koehler sands** are similar to other sandy soils but differ in that the sand mantles a lime and silica cemented "hardpan" layer. The surface soil is very dark grayish brown (10 YR 3/2) and the calcareous subsoil (10 YR 4/2) is encountered at about 5 dm.

Chemical characterizations of soils and pond sediments have been published (Wildung and Hajek 1969, Wildung, Hajek, and Price 1968). Selected data for the Ritzville and Warden series are provided in table RH-2.

BIOTA

Vegetation. - The Rattlesnake Hills Research Natural Area was selected as a natural area primarily because of the presence of undisturbed stands of several typical shrub steppe communities, although the vegetation mosaic also includes some disturbed plant communities. Of particular interest are the stands representative of the *Artemisia tridentata/ Agropyron spicatum, Artemisia tridentata/Poa secunda,* and *Eriogonum thymoides/Poa secunda* Associations described by Daubenmire (1970). However, some rare but ecologically significant associations are also present such as the *Eurotia lanata/ Poa secunda* type (Daubenmire 1970). Undisturbed or even lightly disturbed examples of the various shrub steppe communities found in the natural area are extremely difficult to find elsewhere. Some of the communities included within the tract can be related to Kuchler's (1964) Types 55, Sagebrush Steppe *(Artemisia- Agropyron),* 40, Saltbush - Greasewood *(Atriplex-Sarcobatus),* and possibly 51, Wheatgrass-Bluegrass *(Agropyron-Festuca).* The natural area is located entirely within the *Artemisia tridentata/Agropyron spicatum* Zone, the most arid vegetative zone found in eastern Washington (Daubenmire 1970).

The *Artemisia tridentata/Agropyron. spicatum* Association (fig. RH-2) occurs at elevations generally above 300 m. (1,000 ft.), and the *Artemisia tridentata/Poa secunda* Association occurs below this elevation on gentle slopes and on the plain. Both kinds of vegetation are subject to fire damage. When fire burns through a stand of the *Artemisia/Agropyron* or *Artemisia/Poa* Associations, the shrubs are effectively killed but the understory grasses survive. There are a number of stands dominated exclusively by bunch grasses which have been created in this way; shrubs gradually re-invade these areas. Under grazing stress, the perennial grasses are weakened, and invasion by alien winter annuals, especially cheatgrass brome *(Bromus tectorum)* is prevalent (fig. RH-2).

The *Artemisia tridentata/Agropyron spicatum* Association is dominated by big sagebrush *(Artemisia tridentata)* and bluebunch wheatgrass *(Agropyron spicatum.).* Hopsage *(Grayia spinosa)* is sometimes present in the shrub layer along with the low shrubs *Erigeron filifolius* and *Phlox longifolia.* Big sagebrush coverage varies from 5 to 26 percent in this association (Daubenmire 1970). Bluebunch wheatgrass is the major perennial grass with a typical coverage value of around 50 percent. Sandberg bluegrass *(Poa secunda)* is always present with around 30-percent cover. Small amounts of *Stipa comata* and *Poa cusickii* are also typical. Annuals usually present include cheatgrass brome, *Festuca octoflora, F. pacifica, Descurainia filipes,* and *Draba Verna.*

The *Artemisia tridentata/Poa secunda* Association lacks any large grasses and has a higher density of big sagebrush (Daubenmire 1970). Big sagebrush coverage is typically around 35 percent. The only significant perennial grass is Sandberg bluegrass. Very minor amounts of several annuals, such as cheatgrass brome, *Descurainia,* and *Draba,* are present. Stands typical of this association typically have only half the indigenous taxa (five to ten on forty 20-cm. by 50-cm. plots) that stands typifying the *Artemisia/Agropy-*

ron Association have (15 to 20 indigenes) (Daubenmire 1970).

Along the ridge crests that form the main mass of the Rattlesnake Hills, basalt outcrops support vegetation characteristic of the *Eriogonum thymoides/Poa secunda* Association (fig. RH-2). Here low growing plants of *Eriogonum thymoides, Phlox hoodii, Haplopappus stenophyllus,* and *Balsamorhiza rosea* and Sandberg bluegrass grow widely spaced as clumps rooted in the rock crevices. Figure RH-2 includes a close-up photograph of *Lewisia rediviva,* one of the plants found in these lithosolic habitats. At the crest of the Rattlesnake Hills snow accumulates in deep drifts on the eastern slopes as it is transported by strong westerly winds. The melting snow provides soil moisture which is exploited by plants not found elsewhere on the reserve. Especially conspicuous are *Lupinus* spp. (fig. RH-2) and a perennial bunchgrass, Idaho fescue *(Festuca idahoensis).*

Permanent springs are scarce on the reserve. Two of the most copious are located at Rattlesnake Springs and in Snively Gulch. The extent of the riparian vegetation in Snively Gulch is illustrated in fig. RH-2. The important species are black cottonwood *(Populus trichocarpa), Salix exigua,* as well as other *Salix* species, *Prunus americana, Rhus glabra,* and *Philadelphus lewisii.* Although riparian communities occupy only a few acres, they are an extremely important nesting habitat for birds. The springs also provide drinking water for numerous birds and mammals and support an aquatic fauna.

Although big sagebrush and, sometimes, hopsage are the common shrub dominants over most of the natural area, there are several thousand acres on the lower slopes of the Rattlesnake Hills occupied by winterfat-*(Eurotia lanata)* dominated communities (fig. RH-2). The factors that tend to keep sagebrush from growing on these sites are not known. There are also about 40 ha. (100 acres) of land near Rattlesnake Springs which support greasewood *(Sarcobatus vermiculatus).* Greasewood is confined to the area where an alkaline-saline soil combines with a perched water table to provide suitable habitat.

In the past, plant ecology research on the Rattlesnake Hills Research Natural Area has centered around the mineral and water relationships of halophytes (Rickard and Cline 1965, Rickard 1965a, Rickard 1965b, Rickard 1967b, and Rickard and Keough 1968), the influence of microclimate on the growth of winter annuals (Hinds and Rickard 1968, Rickard, Hinds, and Gilbert 1971) and the composition of the plant communities (Dauben mire 1970). Radionuclides have proved useful in obtaining data on the root distribution of big sagebrush (Price 1965).

Current studies in plant ecology are concerned with measuring primary production of winter annuals on abandoned cultivated fields at different elevations in relation to climatic and edaphic variables, especially soil moisture, temperature, and nitrogen. Estimates of aboveground productivity have been made over the past several years. The results of harvests of two old fields at different elevations of the natural area at the time of peak yield in 1971 are shown below; results are expressed as grams of ovendry material per square meter of ground ± the standard error of the mean for total material:

Taxa	Elevation	
	300 m. (1,000 ft.)	515 m. (1,700 ft.)
Bromus tectorum	198	233
Poa secunda	1	0
Sisymbrium altissimum	10	6
Amsinckia lycopsoides	2	0
Descurainia pinnata	0	1
Tragopogon dubius	0	14
Microseris laciniata	0	2
Holosteum umbellatum	0	7
Total live material	211 ± 11	263 ± 38

The dominant plant on both fields is clearly cheatgrass - 94 and 88 percent of the total production on the low elevation and high elevation fields, respectively. After 28 years of abandonment, native plants still have made little progress in colonizing these old field habitats. Old fields also appear more productive than pristine stands of vegetation; for example, total live material produced aboveground in a stand of the *Artemisia tridentata-Agropyron spicatum* Association

has been measured at less than 100 g/m^2.

Fauna. - The game animals characteristic of the natural area are the mule deer *(Odocoileus hemionus),* cottontail rabbit *(Sylvilagus nuttallii),* chukar *(Alectoris gracea),* ring-necked pheasant *(Phasianus colchicus),* sage grouse *(Centrocercus urophasianus),* California quail *(Lophortyx californicus),* and mourning dove *(Zenaidura macroura).* Only the chukar and dove exist in populations of sufficient size to support even limited hunting pressure.

The fur-bearing animals are the coyote *(Canis latrans),* badger *(Taxidea taxus),* and bobcat *(Lynx rufus).* The population levels of these animals are unknown but badgers are probably more scarce than coyotes; the bobcat is rarely seen on the natural area.

The most abundant small mammal in the reserve is the Great Basin pocket mouse *(Perognathus parvus)* (fig. RH-2). This mammal has been intensively studied by Dr. T. P. O'Farrell by mark-recapture technique in several vegetation types on the natural area. A study of the distribution of small mammals in relation to the elevational gradient in the Rattlesnake Hills has been carried out by Kritzman (1970). Other small mammals that occur on the project are deer mouse *(Peromyscus maniculatus),* northern grasshopper mouse *(Onychomys leucogaster),* western harvest mouse *(Reithrodontomys megalotis),* Townsend ground squirrel *(Citellus townsendii),* vagrant shrew *(Sorex vagrans),* sage-brush vole *(Lagurus curtatus),* and northern pocket gopher *(Thomonys talpoides).* Blacktail jackrabbits *(Lepus californicus)* occur on the natural area but mostly at low elevations, and the least chipmunk *(Eutamias minimus)* occurs only at high elevations.

The most abundant breeding birds in steppe vegetation at low elevations are the horned lark *(Eremophila alpestris)* and western meadowlark *(Sturnella neglecta).* There are fewer individuals of the sage sparrow *(Amphispiza belli),* sage thrasher *(Oreoscoptes montanus),* and loggerhead shrike *(Lanius ludovicianus).* At higher elevations the vesper sparrow *(Pooecetes gramineus)* and Brewer's sparrow *(Spizella breweri)* are important breeding birds. Many birds are migrants and utilize the reserve for resting and feeding stops. This is particularly true of the white crowned sparrow *(Zonotrichia leucophrys),* warblers *(Parulidae),* and vireos *(Vireo* spp.).

The riparian tree-shrub communities provide breeding sites for the black-billed magpie *(Pica pica),* western and eastern kingbird *(Tyrannus verticalis* and *T. tyranus),* lazuli bunting *(Passerina amoena),* red-shafted flicker *(Colaptus cafer),* and starling *(Sturnus vulgaris).* Killdeer *(Charadrois Vociferus)* and long-billed curlew *(Numenius americanus)* nests have been found in the vicinity of Rattlesnake Springs. A survey of bird populations in riparian plant communities in winter has been reported for the Yakima River flood plain near Richland (Rickard 1964).

Birds of prey nest on the natural area, especially the sparrow hawk *(Falco sparverius),* Swainson's hawk *(Buteo swainsoni),* great horned owl *(Bubo virginianus),* marsh hawk *(Circus cyaneus),* and burrowing owl *(Speotyto cunicularia).* The golden eagle *(Aquila chrysaetos)* is a frequent winter visitor.

Little is known about the dynamics of the populations of reptiles on the natural area. Some information is available concerning the altitudinal distribution of the side-blotched lizard *(Uta stansburiana)* (Rickard 1968) as well as the time of onset of winter dormancy (Rickard 1967). Other reptiles observed on the natural area are the Pacific rattlesnake *(Crotalus viridis),* gopher snake *(Pituophi8 melanoleucus),* yellow-bellied racer *(Coluber constrictor),* and the short-horned lizard *(Phrynosoma douglassi).*

The invertebrate fauna of the natural area have received little attention. A taxonomic survey of foliage dwelling insects has been under way for several years by Dr. Wyatt Cone of Washington State University. To date several hundred species of insects have been identified and related to various plant species on the tract. The ground-dwelling beetles have been investigated to some extent (Hakonson and Rickard 1969, Rickard and Haverfield 1965, Rickard 1968, Rickard 1970a, Rickard 1970b, and Rickard 1971), The autumn emergent darkling beetles *(Steno-*

morpha and *Pelecyphorus)* are especially abundant and these insects provide a substantial part of the coyote diet during the few weeks the beetles are active on the soil surface. During one especially favorable season, autumn emergent beetles were estimated to provide 20 kg. of live biomass per hectare.

HISTORY OF DISTURBANCE

The grazing history of the natural area prior to 1943 is not documented. However, local ranchers recall sheep and cattle grazing in the Rattlesnake Hills prior to that time. No grazing has been allowed since 1943, and the area is now fenced in its entirety to exclude wandering livestock. The condition of the various plant communities and abundance of several highly palatable forage plants such as winterfat *(Eurotia)* and hopsage *(Grayia)* suggest that whatever grazing took place has probably been a minor disturbing influence. Water was probably a seriously limiting factor in utilization of the tract by domestic stock.

Some portions of the natural area were also farmed prior to Federal acquisition of the tract in 1943. The communities on these abandoned fields are undergoing natural succession and are being utilized in comparative studies with the natural vegetation.

Most recent human disturbance has resulted from off-road military vehicle use during war games in 1965. These left numerous track scars on part of the landscape. Under present management, human disturbance is minimal and existing roadways are improved in lieu of new road construction.

Fire has been and continues to be an important natural disturbance. An extensive wildfire occurred in the summer of 1957 and was mostly confined to the *Artemisia/Agropyron* association at elevations above 300 m. (1,000 ft.).

RESEARCH

Field research on the Rattlesnake Hills Research Natural Area has been very actively pursued since 1965. Biological scientists and technicians of the Battelle Laboratories and students and faculty from the University of Washington, Washington State University, Oregon State University, and University of Idaho are utilizing the tract. Sixteen hectares (40 acres) of the natural area are presently designated and under study as the ALE (Arid Lands Ecology) coordinating site in the International Biological Program's Grassland Biome project.

Much of the ongoing research has been cited earlier in this description of the natural area; included is research in climatology and micrometeorology, plant ecology (both autecology and synecology), animal ecology, hydrology, and soil science. Some specific studies involve: productivity and mineral relationships of plants in abandoned cultivated fields and in pristine plant communities; studies of small mammal populations under various plant community manipulations, such as treatment with selected herbicides and addition of moisture using controlled sprinkler irrigation; and hydrologic and mineral nutrient relationships in a phreatophyte community.

Research facilities are concentrated at three laboratory sites on the natural area. These are: a small 20- by 40-foot metal building located at Rattlesnake Springs; a building complex located at the 360-m. (1,200ft.) level at the southern end of the reserve; and another building complex located at the crest of the Rattlesnake Hills, also near the southern edge of the reserve. The first two facilities are primarily utilized in biological research, and the last named is an astronomical facility.

MAPS AND AERIAL PHOTOGRAPHS

U.S. Geological Survey topographic maps are available for the entire natural area; scientists should consult the U.S. Geological Survey's index to topographic maps in Washington to determine the quadrangle(s) of specific interest to them. The geology of the area is included on the *Geologic Map of*

Washington, scale 1: 500,000 (Huntting et al. 1961). The Manager of the Ecosystems Department at Battelle-Northwest (Richland, Washington 99352) can provide details on availability of aerial photographs and other special maps.

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Table RH-1. — Classification of the various soil series found within the Rattlesnake Hills Research Natural Area according to the old and new systems of soil classification

Soil series	*Genetic classification*	*7th Approximation*
Ritzville silt loam	Brown Integrade to Regosol	Andic Aridic Haplustoll
Warden silt loam	Sierozem Integrade to Regesol	Andic Mollic Camborthid
Kiona silt loam	Sierozem Integrade to Regesol	Andic Mollic Camborthid
Lickskillet silt loam	Lithosol	Lithic Haplustoll
Scooteney stony silt loam	Sierozem Integrade to Regosol	Andic Mollic Camborthid
Ephrata stony loam	Sierozem Integrade to Regosol	Mollandeptic Camborthid
Burbank loamy sand	Regosol	Typic Torripsamment
Hezel sand	Regosol	Typic Torrifluvent
Koehler sand	Regosol	Mollic Durothid

Table RH-2. — Selected chemical properties of the Warden (Wa) and Ritzville (Ri) soil series within the Rattlesnake Hills Research Natural Area

Sample depth	pH		Organic matter		Calcium		Potassium		Total exchangeable bases	
(decimeters)	Wa	Ri	Wa	Ri	Wa	Ri	Wa	Ri	Wa	Ri
			Percent		..... Pounds per acre				me./100 g.	
0 - 1	7.1	6.9	1.3	1.4	3,100	2,200	1,210	1,300	12.3	11.0
1 - 2	7.3	7.1	.6	.9	2,700	2,500	780	1,190	11.4	12.5
2 - 3	7.3	7.3	.5	1.0	3,200	2,600	410	1,100	12.1	13.0
3 - 4	7.2	7.3	.5	.7	3,200	2,400	300	980	12.2	13.0
5 - 6	7.4	7.4	.5	.9	3,400	3,100	160	800	12.8	13.4
7 - 8	7.3	7.5	.3	.7	3,100	3,200	120	700	11.7	13.4
9 - 10	7.5	7.7	.3	.5	3,400	2,700	160	540	12.8	12.5

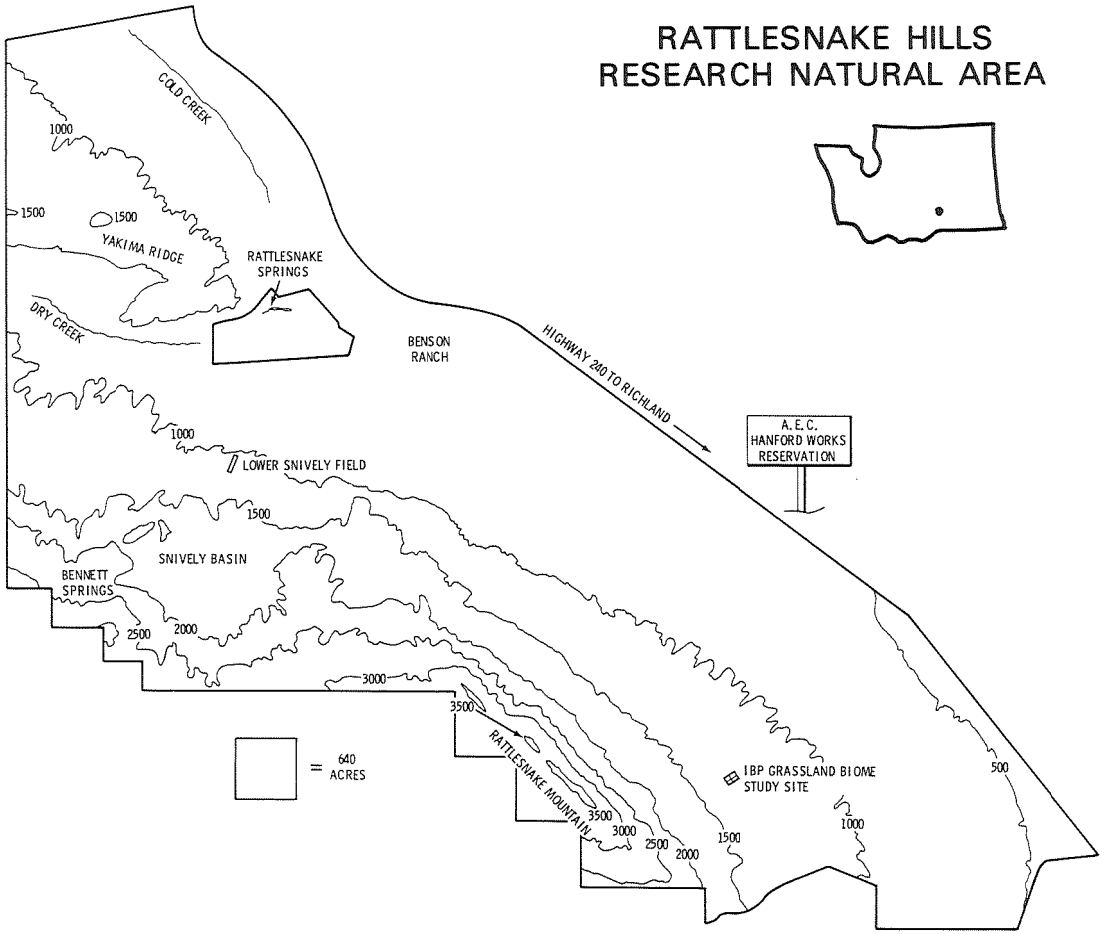
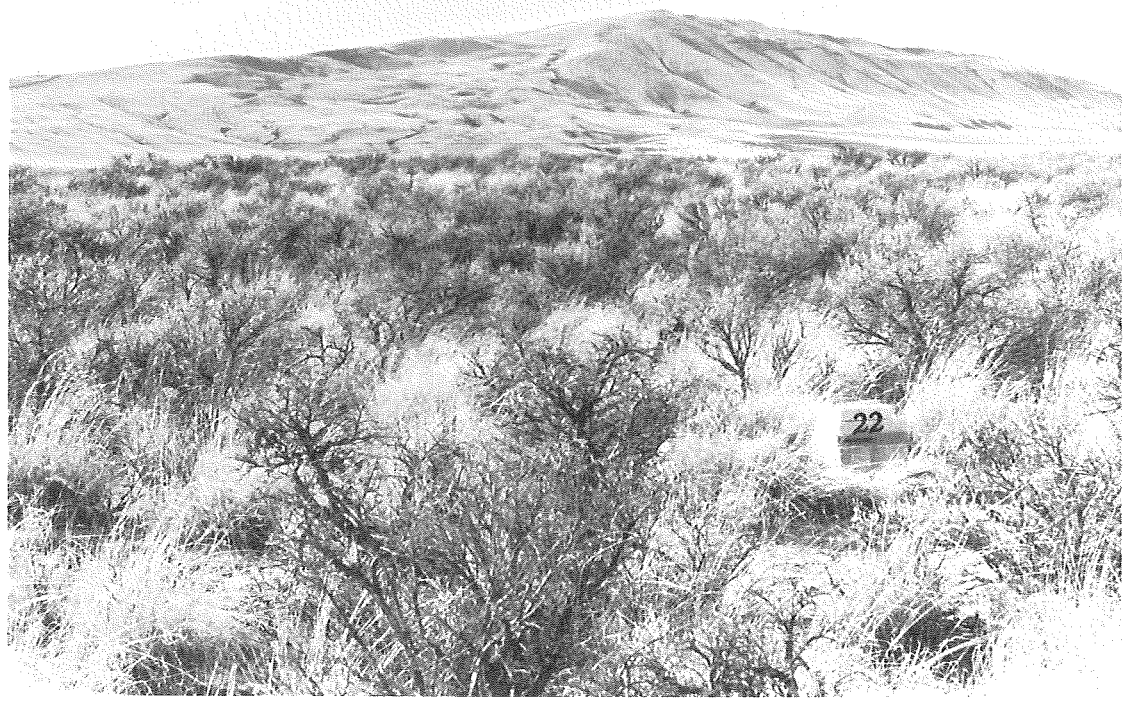


Figure RH-1.– Rattlesnake Hills Research Natural Area, Benton County, Washington.

Figure RH-2.-Natural features of Rattlesnake Hills Research Natural Area. (All photos courtesy of Dr. T. P. O'Farrell, Battelle Northwest.) A: Pristine community representative of the *Artemisia tridentata/Agropyron spicatum* Association which is typical of higher elevations; note the Rattlesnake Hills in the background. B: Community dominated by big sagebrush and hopsage typical of those found on the basal plain; the understory is composed of cheatgrass brome, an alien annual grass which is highly successful on habitats disturbed by grazing.

A



B

Figure RH-2.-Natural features of Rattlesnake Hills Research Natural Area (continued). C: Winterfat forms island-like stands which are surrounded by communities of big sagebrush on the lower slopes of the Rattlesnake Hills. D: The most extensive stand of deciduous shrubs and trees which is found along a spring-fed brook below Snively Basin.

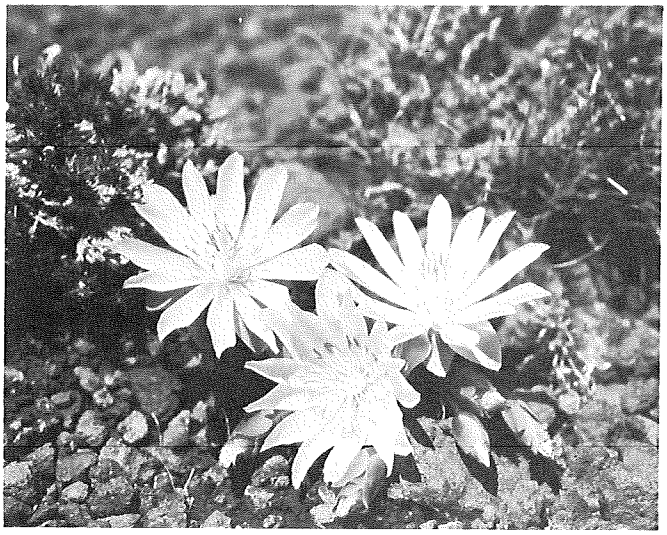
C

D

Figure RH-2.-Natural features of Rattlesnake Hills Research Natural Area (continued). E: Lithosolic communities inhabit stony outcrops in the Rattlesnake Hills; typical species illustrated here are *Balsamorhiza rosea* and Sandberg bluegrass. F: *Lewisia rediviva,* another conspicuous plant on lithosolic sites in the Rattlesnake Hills. G: *Lupinus* providing a conspicuous display of color following snow melt; snowdrifts persist late into the spring on northeast-facing slopes at the crest of the Rattlesnake Hills. H: The most abundant mammal on the natural area, the Great Basin pocket mouse *(Perognathus parvus).*

E

F



G

H