LOST FOREST RESEARCH NATURAL AREA

Supplement No. 3[1]

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The Research Natural Area described in this supplement is administered by the Bureau of Land Management. Bureau of Land Management Research Natural Areas are administered by District Offices which are organizational subdivisions oftheir State offices. Scientists wishing to use these Research Natural Areas should contact the Bureau's State Director. Since this tract is located in Oregon, the responsible individual is the Oregon State Director (Bureau of Land Management, P.O. Box 2965, Portland, Oregon 97208). The manager of the district in which the Research Natural Area is located will be informed of mutually agreed upon activities by the State Director. Nevertheless, a scientist should visit the administering District Office when beginning his studies and explain the nature, purpose, and duration of his activities if at all possible. Permission for brief observational visits to Research Natural Areas can be obtained from District Managers.

The Lost Forest Research Natural Area is a 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;
1. Sites for study of natural processes in undisturbed ecosystems; and
2. 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.":) Of the 48 established Research Natural Areas in Oregon and Washington, 45 are described in "Federal Research Natural Areas in Oregon and Washington: A Guidebook for Scientists and Educators,"4 along with details on management and use of such tracts; this is the third supplement to that guidebook.

The guiding principle in management of Research Natural Areas is to prevent unnatural encroachments, activities which directly or indirectly modify ecological

[1] Supplement No.3 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 StaLm, 498 p., illus., 1972). The guidebook is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $3.50; stock number 0101.0225.

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[1] Federal Committee on Research Natural Areas. A directory of Research Natural Areas on Federal lands of the United States of America. Washington, D.C., Superintendent of Documents, 129 p., 1968.

[1] See footnote 1.

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 ecosystems which are available to the scientist. He can conduct his research 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, the scientist wishing to use a Research Natural Area has the following obligations. He must:

1. Obtain permission from the appropriate administering agency before using the area;
2. Abide by the administering agency's regulations governing the use of the natural area including specific limitations on the type of research, sampling methods, etc., allowed; and
3. Inform the administering agency on 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 in character; destructive analysis of vegetation is generally not allowed nor are studies requiring extensive forest floor modification or extensive soil excavation. Collection of plant and animal specimens should be restricted to the minimum necessary for provision of voucher specimens and other research needs but under no circumstances should collecting significantly reduce the population levels of a species. Collecting must also be carried out in accordance with State and Federal agency regulations. A scientist wishing to use a Research Natural Area within these broad guidelines must contact the administering agency regarding the proposed use[5] and obtain the necessary permission. Each agency differs slightly in its requirements.

[5] 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, Bureau of Sport Fisheries and Wildlife, and the National Park Service in the U.S. Department of Interior; and the Atomic Energy Commission.

LOST FOREST RESEARCH NATURAL AREA

Isolated tract of *Pinus ponderosa* perpetuating itself in a low rainfall region of sagebrush steppe; small sand dunes and shore lines of Quaternary pluvial lakes are geological features.

Figure LF-1.—Lost Forest Research Natural Area protects an isolated relict stand of ponderosa pine; deep sandy soils are largely responsible for its maintenance.

Lost Forest Research Natural Area was established by the Bureau of Land Management in 1972 to preserve a unique example of relict ponderosa pine *(Pinus ponderosa)* and associated vegetation within a region of sagebrush shrub-steppe (fig. LF-1). Eolian landforms and beds and shorelines of Pleistocene and post-Pleistocene lakes are also found in the natural area. The area comprises 3,627 ha. (8,960 acres) in Lake County, Oregon, on the Lakeview District of the Bureau of Land Management. Itis located at 4~)o 22' N.latitude and 120^{0}20' W.longitude in portions of T. 25 S., R. 30 E., Willamette meridian.

and mmodations

The natural area is located in central Oregon about 105 km. (65 miles) southeast of Bend and 130 km. (80 miles) north of Lakeview in straightline distance (fig. LF-2). The nearest community is Christmas Valley

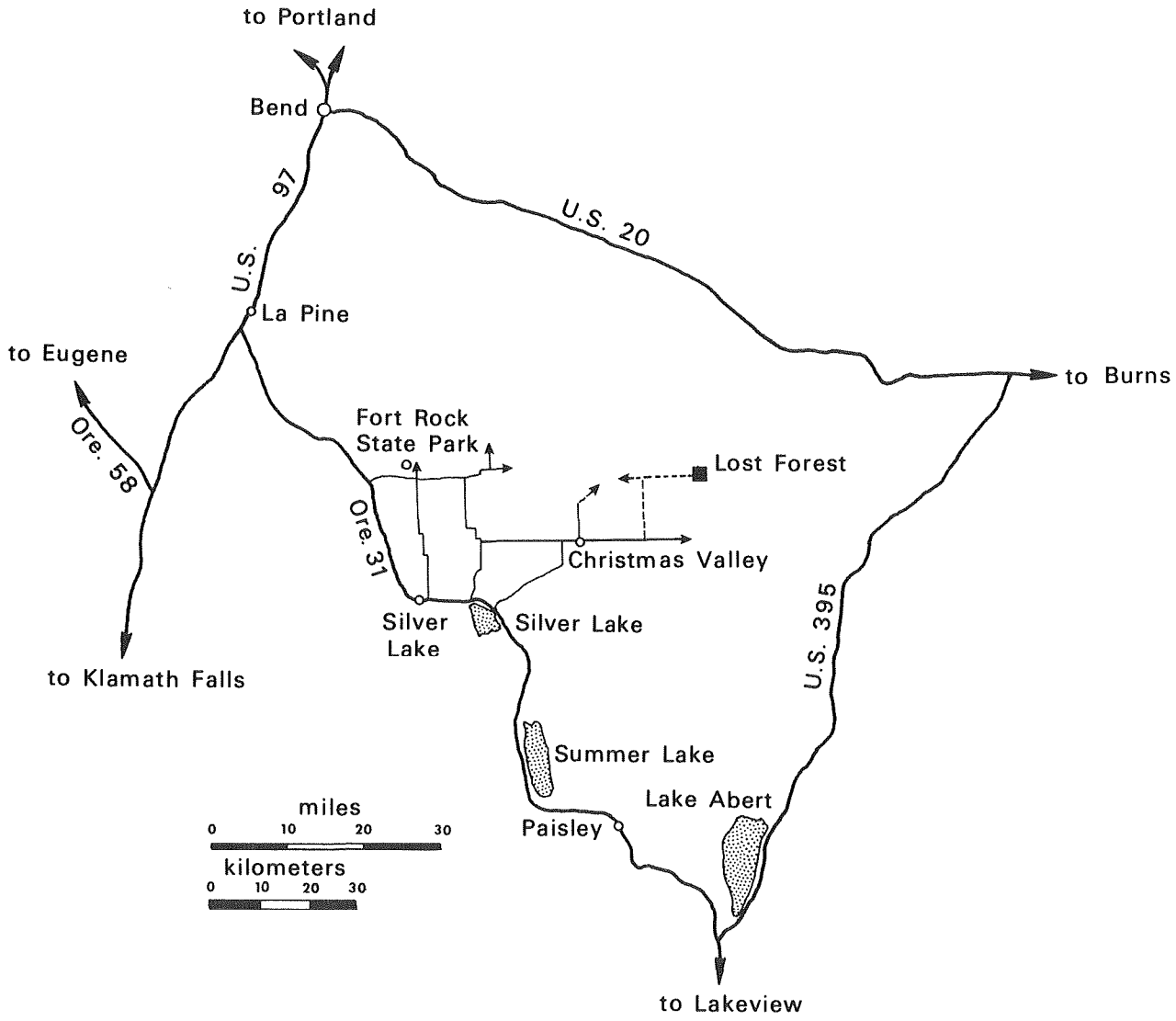

Figure LF-2.—General location of Lost Forest Research Natural Area, Oregon.

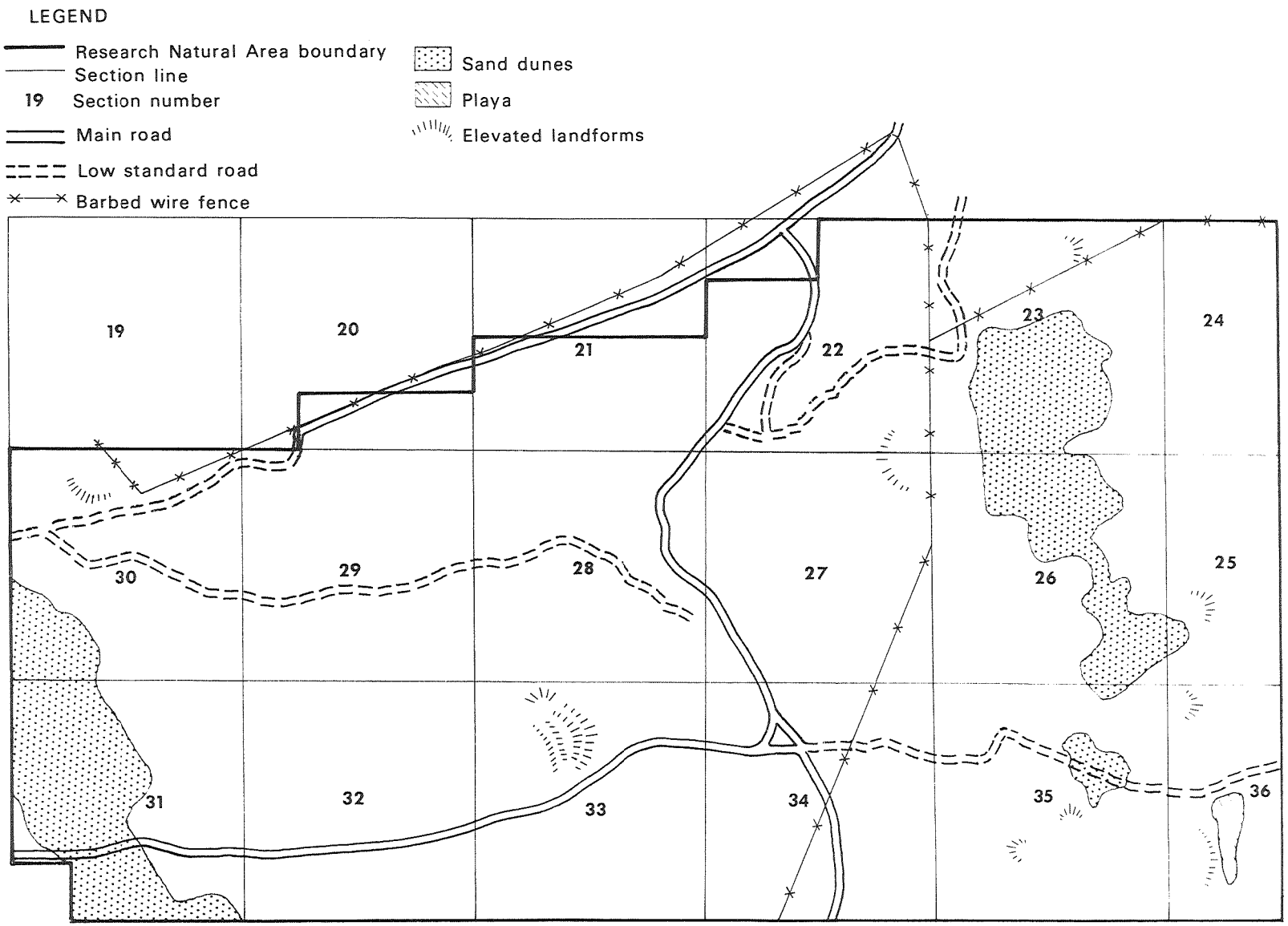

Figure LF-3.—Physiographic features, roads, and fences within the Lost Forest Research Natural Area (from Bureau of Land Management range type map for T. 25 S., R. 20 E., Willamette meridian, dated 1960 and on file at Forestry Sciences Laboratory, Corvallis, Oregon).

which is most easily approached via State Highway 31 and 16 miles of county roads. From Christmas Valley, one travels east on the Christmas Valley Road for 13.2 km. (8.2 miles) to the second cattle guard, turns north on another dirt road for 13.5 km. (8.4 miles) to a T-intersection, and turns east again for approximately 16 km. (10 miles)1 on another dirt road before arriving at Lost Forest. A system of low standard, dirt roads provides access to various areas within the Lost Forest Research Natural Area (fig. LF-3). Motel and restaurant accommodations are available in Christmas Valley; camping areas in the vicinity of Lost Forest are very limited except for self-contained mobile camping units.

Environment

Lost Forest Research Natural Area is within the Christmas Lake Basin ofthe High Plains Lava Geologic Province (Franklin and Dyrness 1973). The elevation of most of the lakebeds is 1,310 m. (4,300 feet). The relief at Lost Forest is gentle, with lower elevations at

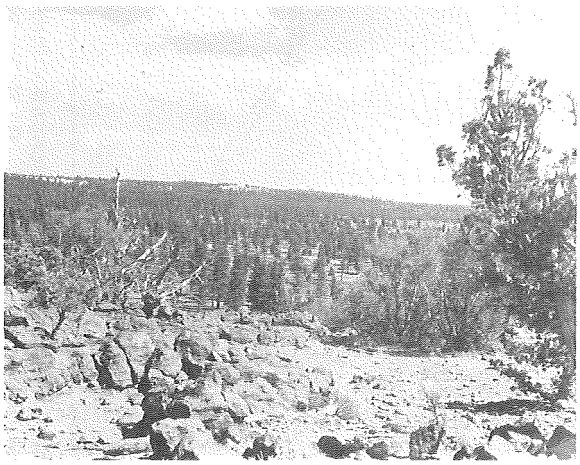

Figure LF-4.—Lost Forest looking east from basalt outcrop in section 33 (photo courtesy D. W. Berry).

about 1,340 m. (4,400 feet) and occasional bluffs and basaltic outcrops (fig. LF-4) rising approximately 30 to 70 m. (100 to 200 feet) above the sandy plains.

Basalt flows during Pliocene and Pleistocene times formed the bedrock substrate on all sides of the basin. An intense period of block faulting during middle Pleistocene resulted in a maximum of mountain relief and the formation of the basin itself; but since that time, erosion and sedimentation have been more rapid than faulting (Morrison 1965). Lost Forest is located on the eastern portion of the Christmas Lake Basin. This basin exhibits numerous old shoreline and lacustrine features that are evidence of wet climatic periods (pluvial climates) of the Pleistocene and post-Pleistocene. At its maximum depth-probably during one of the Bull Lake phases of glacial maxima and the Eetza Formation of pluvial Lake Lahontan in northwestern Nevada (Morrison 1965)-the water level of Fossil Lake was some 51 m. (170 feet) above the present lakebed (Dole 1942). Old shorelines are therefore found within Lost Forest.

Lacustrine, alluvial, and eolian deposits are all conspicuous at Lost Forest. Climatic cycles during the Quaternary determined the nature of depositional sequences in this closed basin. The lacustral-glacial maxima were also times of greatest alluvial deposits and mass wasting of the surrounding basaltic rim. Interlacustrine and interglacial intervals started with maximum eolian activity and ended with durations of chemical weathering and soil formation (Morrison 1965).

The present climate at Lost Forest has been analyzed Berry (1963) from U.S. Weather Bureau data at Cliff (6 km. or about 10 miles west of Lost Forest) during the 9 years, 1908-16, and at Fremont (about 64 km. or 40 miles to the west) for the years 19001960. The mean annual precipitation at Lost Forest between 1900-1960 was determined to be 221 mm. (8.7 inches) with about 28 percent occurring in December and January and a second, minor peak period in May and June accounting for about 18 percent of the year's total. However, both yearly and monthly amounts in the northern Great Basin in Oregon are very erratic. Climatic fluctuations ha ve been studied in the ponderosa pine tree ring record by Antevs (1938), Keen (1937), and Berry (1963). Berry (1963) compared these records and concluded that a mean precipitation of about 234 mm. (9.6 inches) per year at

1 In 1972, a sign at this last intersection erroneously indicated 52 miles to Lost Forest.

Lost Forest approximated the normal for the past 600 to 700 years. A drought from 1920 to 1936 was the most severe of this interval, and the period between 1415 to 1426 (546 to 557 years BP) was the wettest of the tree ring record (Berry 1963).

The mean annual temperature is about 6° C. (43° F.) with the hottest months of July and August (respectively 17° and 16°C., or 63° and 61 ° F.) also the driest, and coldest months of December and January (-1 ° and _2° C., or 30° and 28° F.) the wettest. Thus, a "cold desert" climate exists: The Thornthwaite bioclimatic classification is *EBi* sc2 (Carter and Mather 1966).

The soils ofthe Lost Forest are formed from lake sediments, eolian deposits, and alluvial materials. The horizons are generally depositional rather than developmental and reflect the variety of pluvial, interpluvial, and recent climatic events affecting sedimentation (Morrison 1965). Pumice sands from Mount Mazama and Newberry Crater appear in the surface of nearly all the soils (Berry 1963). Lacustrine sediments include deposits as much as 12 to 16 inches deep of silt-sized fine ash from Mount Mazama. The occurrence of diatomaceous silicas in this ash indicates deposition in a lake of considerable depth (Berry 1963).

Moving sand dunes are a feature of this natural area. Most of the dunes contain from 10 to 20 percent of their bulk in sand-sized particles of eolian pumice. Wave action along the shores of pluvial lakes was also a source of these sands. As the lakes dried up, the sands were sorted and relocated by wind. Since there were periodic rises and falls in the lake

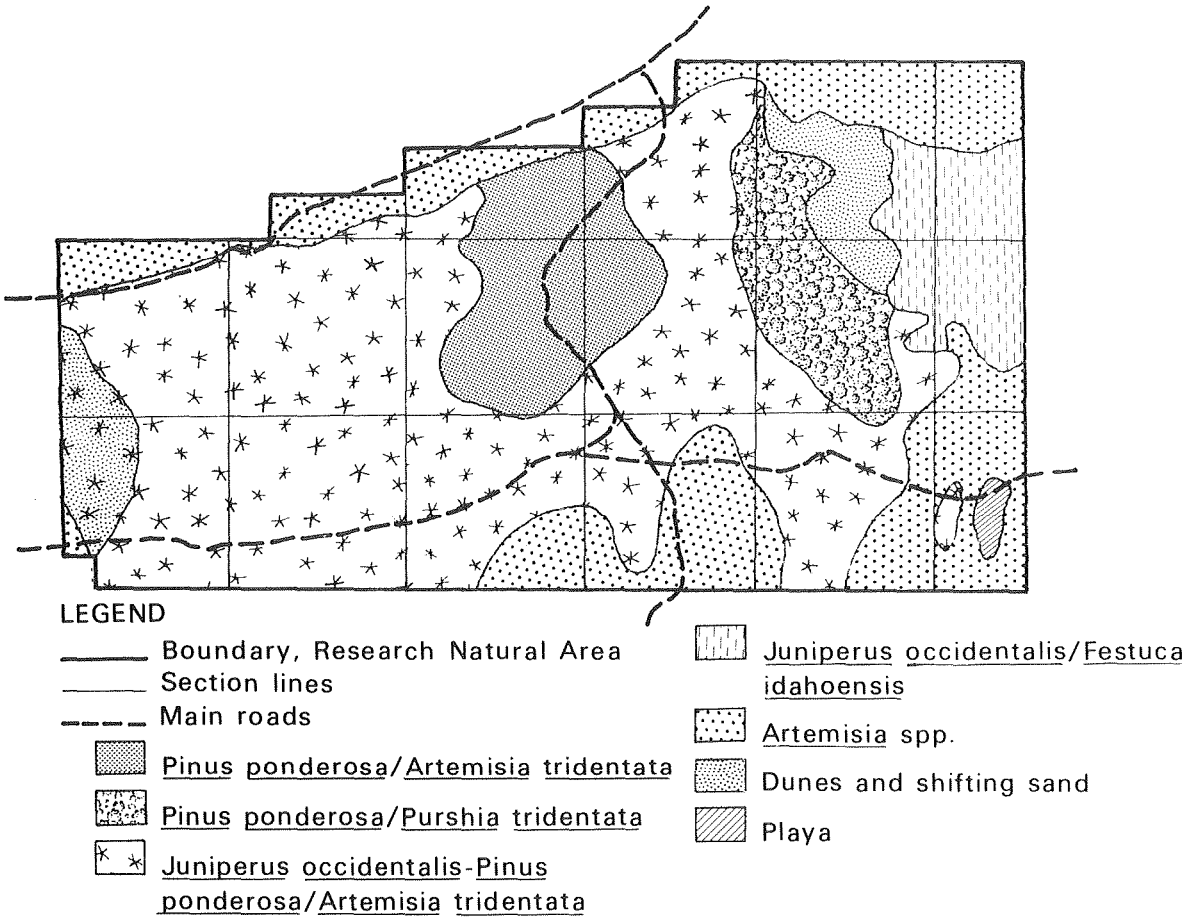

Figure LF-5.—Plant communities at Lost Forest, as modified from the descriptions and map given by Berry (1963).

levels and varying durations and intensities of dry-lake intervals the result has been "a polyglot pattern of sedimentary strata, some of which have undergone soil forming processes in place" (Berry 1963).

The soils are everywhere underlain by caliche. The caliche may be fragmented or a continuous indurated pan, up to several inches thick, and seldom penetrated by roots. Although largely calcium carbonate, sodium may comprise up to 12.4 meq./lOO g. of the caliche horizon (Berry 1963.)

Biota

The Lost Forest Research Natural Area is a mosaic of savanna, forest, and shrub-steppe communities (fig. LF-5). Approximate acreages by major community types appear to be approximately as follows (based upon Berry's (1963) community map and a 1960 Bureau of Land Management range type map):

COMMUNITY	AREA	
	Hectares	Acres
Juniperus occidentalis-Pinus ponderosa/ Artemisia spp.	1,828	4,515
Artemisia spp.	791	1,955
Pinus ponderosa/ Artemisia tridentata	320	791
Pinus ponderosa/ Purshia tridentata	245	605
Juniperus occidentalis/ Festuca idahoensis	236	582
Active dunes and shifting sands	198	489
Playa	9	23

The *Juniperus-Pinus/ Artemisia* and *Juniperus/ Festuca* communities should pro bably be assigned to SAF forest cover type 238, Western Juniper (Society of American Foresters 1954), and Kuchler's (1964) Type 24, Juniper Steppe Woodland. The two *Pinus ponderosa* communities can be assigned to SAF forest cover type 237, Interior Ponderosa Pine, and Kuchler's Type 10, Ponderosa Shrub Forest. The *Artemisia* communities probably most closely fit Kuchler's Type 55 Sagebrush Steppe. Although forest and savanna dominate, the area is within a sagebrush steppe climatic zone (Franklin and Dyrness 197:3).

RELICT PONDEROSA PINE FORESTS

The outstanding feature of Lost Forest is the existence of ponderosa pine stands within this arid climate some 65 km. (40 miles) east of the nearest forest outliers. Occurrences of anomalous ponderosa pine forests in the steppe region of the Great Plains (Potter and Green 1964, Williams and Holch 1946, Wells 1970) have been interpreted as relicts from Wisconsin glacial periods and more recent postglacial times. A similar paleoecological reconstruction of the Lost Forest can be made. Pollen deposits from the Willamette valley, Oregon, and near Spokane, Washington, indicate that ponderosa pine was more widely distributed in the Pacific Northwest some 1,000 to 2,500 years BP than today (Hansen 1947a, cited in Heusser 1965). From about 4,000 years ago to very recently there were periods of cool, wet climates (the medithermal of Antevs (1955), over North America. Geologically recent lacustrine sediments of pluvial Lake Lahontan and elsewhere in the Great Basin are recorded by the Fallon Formation. Maximum lake depths of 29 to 19 m. (96 to 64 feet) occurred from about 3,200 to 355 years BP to about 100 years ago (Morrison 1965).

Figure LF-6.—Heavy production of cones under mature ponderosa pine.

4.

Figure LF-7.—Open stand of ponderosa pine with scattered *Artemisia tridentata* in the understory.

These diverse evidences all point to the possibility that ponderosa pine forests extended from their present-day distribution along the eastern flanks of the Cascade Range well into the High Lava Plains of central Oregon and elsewhere until very recently. Ponderosa pine existed at Lost Forest, at least as a few trees, during the earlier altithermal (Antevs 1955) as evidenced from the pine pollen in Mount Mazama pumice sediments approximately 6,400 years BP (Berry 1963). At still earlier times of the Bull Lake, Pinedale, and Neoglacial oscillations, the pluvial lakes of the Great Basin were of considerable size (Morrison 1965), and the shoreline of Christmas Lake was probably rimmed by luxuriant coniferous forests (Dole 1942, Hansen 1947b, Berry 1963).

The deep sandy soil at Lost Forest is the major factor favorable for pine survival under the present arid climate (Berry 1963). Ponderosa pine makes effective utilization of whatever scant precipitation rapidly infiltrates the porous soil. Berry also found that seed from Lost Forest ponderosa pine germinated more rapidly than seed obtained from three other sources. He suggested that a rapidly triggered germinative ability was a drought-adaptive mechanism that had become fixed in the Lost Forest ponderosa pine ecotype.

There is no evidence that the ponderosa pine at Lost Forest is a senescent population. Successful reproduction occurred even during the drought period of 1920 to 1936 (Berry 1963), and dense pole-type stands typical of the episodic and opportunistic reproductive mode of this species can be found (Berry 1963). The longevity of seed trees, some over 600 years, spans the shorter drought cycles, so that prolific seed crops (fig. LF-6) are available during at least some years when germination potential and seedling survival are high.

PLANT COMMUNITIES

The plant communities of Lost Forest have been described by Berry (1963). On the basis of his study, six communities can be distinguished and their general distribution is shown in figure LF-5. A *Pinus ponderosa/ Artemisia tridentata* community is found on deep sandy soils. The pine occur in typically open stands (fig. LF-7 and IIS) with about 4-percent canopy coverage. Scattered western juniper *(Juniperus occidentalis)* average less than about I-percent cover. An open shrub layer has *Artemisia tridentata, Chrysothamnus v is cidiflorus,* and other shrubs. Scattered grasses *(Stipa thurberiana, S. comata, Sitanion hystrix, Oryzopsis*

Figure LF-8.—Looking into a stand of the *Pinus ponderosa/Artemisia tridentata* community near the center of the Lost Forest (photo courtesy D. W. Berry).

hymenoides, Poa sandbergii) collectively form only about 2- to 3-percent cover, while perennial forbs *(Lupinus* sp., *Eriogonum ovalifolium, Townsendia florifer,* and others) total less than I-percent cover. Small early annuals, lichens, and bryophytes are very poorly represented, possibly because of wind erosion of the sandy soil.

A *Pinus ponderosa/ Purshia tridentata* community appears similar to the above, but *Purshia tridentata* is the dominant shrub (4-percent cover), with *Artemisia tridentata* and *Chrysothamnus* spp. as minor components of the shrub layer. Some *Festuca idahoensis* and *Poa nevadensis* occur in the bunchgrass layer, which is otherwise similar to the grass layer of the *P. ponderosa/Artemisia tridentata* community. The soil of this ponderosa pine-bitterbrush community contains about 90-percent sand at both the surface and 6-dm. (24-inch) depths of the profile analyzed by Berry (1963). The soils of this community appear more stable, however, than soils ofthe *Pinus/ Artemisia* community (Berry 1963).

Figure LF-9.—Often juniper provides the major arboreal cover, with ponderosa pine less abundant. Such vegetation has been mapped as "occasional pine" vegetation by Berry (1963) (photo courtesy D. W. Berry).

The greatest portion of Lost Forest contains the *Juniperus occidentalis-Pinus ponderosa/ Artemisia* spp. community. The arboreal stratum is characterized by codominance of juniper and pine or by relatively heavy cover of juniper and only scattered pine (fig. LF-9). Beetle attacks and drought in the 1920's and the 1930's resulted in high juniper mortality (fig. LF-10).2 The tree canopy is usually quite open. Understory shrubs may be entirely absent or occur either sparingly or in dense patches. *Artemisia tridentata* and species of *Chrysothamnus* are the most abundant of the taller shrubs, while *Artemisia arbuscula, Phlox diffusa, Leptodactylon pungens,* and infrequent *Artemisia cana* form a shrub layer of lower stature. Perennial grasses *(Stipa thurberiana, S. comata, Oryzopsis*

[2] Some of the juniper are quite large; one specimen 2:3 m. (68 feet) tall and with 179-cm. (70.4-in.) d.b.h. is the largest known in Oregon.

hymenoides, Sitanion hystrix, cristatum, Poa sandbergii) are all very However, bryophytes are
percent cover), and epiphytic
conspicuous. The soils contl1in
percent sand in both surf"lce
layers, and occasional
may be found within
interesting soil variation
gravelly soils whose water-worn
fragments are found
shores of old pluvial
Pinus/ Artemisia cOJmrnunit,y at Lost Forest is similar to the *Juniperus/ Artemisia/Purshia* association described for soils igneous and pumice sands in central Oregon by Driscoll (1964).

Juniperus occidentalis/ Festuca idahoensis community is found at the west end of the natural area. Wind erosion here may be minimal, for the vegetation appears relatively stable (Berry 1963). Except for a

canopy coverage of only 7 percent for *Juniperus,* this community resembles and may be serally related to the *Juniperus/ Agropyron-Festuca* association of Driscoll (1964). The minor cover of *Artemisia tridentata* and absence of *Purshia tridentata* from both communities and the dominance of *Festuca idahoensis* in the herb layer of both

Figure LF-10.—Beetle attacks and drought killed many western juniper during the 1920's and 1930's.

suggest ecological affinities. Bryophytes form a cover of about 6 percent in the *Juniperus/ Festuca* community at Lost Forest.

Two shrub-dominated communities border most of the Lost Forest and prevail over much of the adjoining region. These communities are usually associated with soils of old lake beds. *Artemisia tridentata* community occurs on non alkaline soils with a uniform high sand content (over 75-percent) in all horizons. A well developed and distinctive caliche layer subtends the rooting zone. *Artemisia* has about 10-percent cover (fig. LF-ll). Minor

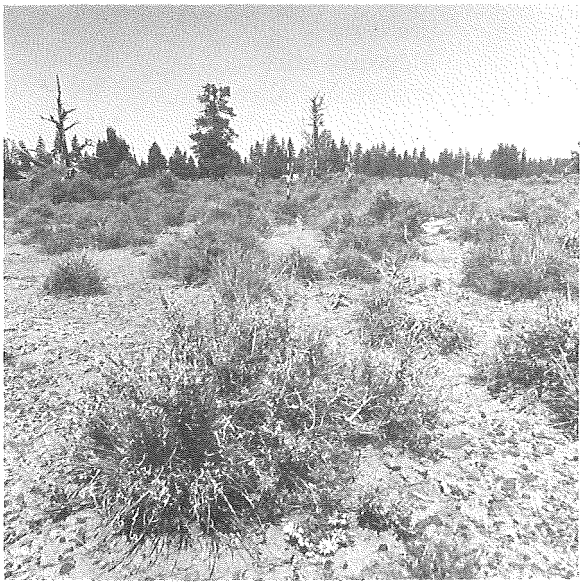

Figure LF-11.—*Artemisia tridentata* occurring on lakebed soil adjoining forested areas of the Lost Forest.

shrubs include *Chrysothamnus* spp., *Tetradymia glabrata, Artemisia arbuscula,* and *Leptodactylon pungens. Sitanion hystrix* and *Stipa comata* are the principal grasses, and *Psoralea lanceolata, Eriophyllum lanatum,* and *Townsendia {lori{er* the main perennial forbs. This herb layer does not exceed about 5-percent cover, however. Perhaps the most conspicuous vegetation feature of the *Artemisia* community is the very extensive cover (21percent) of the bryophyte stratum (Berry 1963).

The *Artemisia cana* community is found in playas of alkaline soils that are more finely

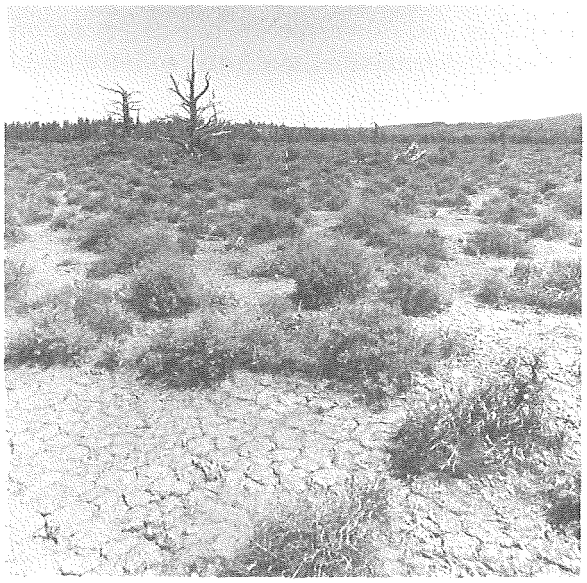

Figure LF-12.—Lacustrine soils overlain by windblown sands support *Artemisia arbuscula, A. tridentata, A. cana,* and occasional grasses.

textured in lower horizons than the soils of the big sage community; it is very restricted within the natural area (fig. LF-12). *Artemisia tridentata* and *Chrysothamnus* spp. are the dominant shrubs, but the co dominance by *Artemisia cana* is highly indicative of the playas. Good indicator species of the alkaline soils are *Sarcobatus vermiculatus* and the grasses, *Muhlenbergia asperi{olia* and *Agropyron dasystachyum.* Bryophyte cover is about 6 percent. Another very restricted habitat at Lost Forest occurs on the colluvial soils of basalt outcrops (fig. LF-13). Here can be found *Cercocarpus*

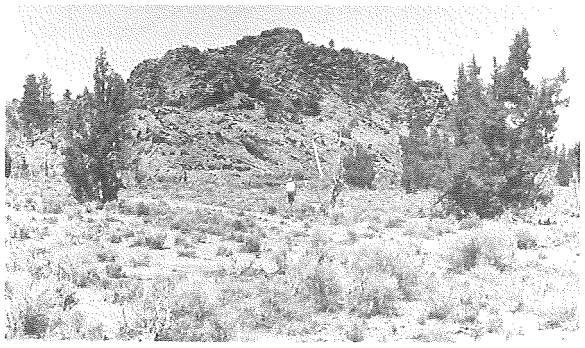

Figure LF-13.—Basalt outcrop at Lost Forest. The shallow and colluvial soils may contain *Cercocarpus ledifolius* and other plants not found elsewhere.

ledifolius and other species not occurring on the more extensive alluvial and eolian soils of lower elevations.

FAUNA

A tentative list of mammals for the Lost Forest area is given in table LF-1. Of particular interest is the habitation of this insular forest tract by predatory animals as revealed by their scats. On May 26, 1972, the scat of a mountain lion revealed a diet of a bushy-tailed woodrat, a mountain cottontail, and several Ord kangaroo rats. In a bobcat scat were the remains of a Townsend ground squirrel. A badger had fed mostly upon yellow pine chipmunks as well as a Townsend ground squirrel, a deer mouse, and an Ord kangaroo rat. Coyotes had fed upon several mountain cottontails and juniper berries.

Table LF-1.—Tentative list of mammals believed to utilize the Lost Forest Research Natural Area as transients or residents

Order	Scientific name	Common name
Insectivora	**Scapanus orarius*	coast mole
	Sorex merriami	Merriam shrew
	Sorex vagrans	wandering shrew
Chiroptera	*Antrozous pallidus*	pallid bat
	Eptesicus fuscus	big brown bat
	Lasionycteris noctivagans	silver-haired bat
	Lasiurus cinereus	hoary bat
	Myotis californicus	California myotis
	Myotis evotis	long-eared myotis
	Myotis lucifugus	little brown myotis
	Myotis subulatus	small-footed myotis
	Myotis thysanodes	fringed myotis
	Myotis volans	long-legged myotis
	Myotis yumanensis	Yuma myotis
	Pipistrellus hesperus	western pipistrel
	Plecotus townsendi	Townsend big-eared bat
Lagomorpha	**Lepus californicus*	black-tailed jack rabbit
	Sylvilagus idahoensis	pigmy rabbit
	**Sylvilagus nuttalli*	mountain cottontail
Rodentia	**Dipodomys ordi*	Ord kangaroo rat
	**Erethizon dorsatum*	porcupine
	**Eutamias amoenus*	yellow-pine chipmunk
	Eutamias minimus	least chipmunk
	Lagurus curtatus	sage vole
	**Neotoma cinerea*	bushy-tailed wood rat
	Onychomys leucogaster	northern grasshopper mouse
	Perognathus parvus	Great Basin pocket mouse
	**Peromyscus maniculatus*	deer mouse
	Reithrodontomys megalotis	western harvest mouse
	**Spermophilus townsendi*	Townsend ground squirrel
	Thomomys talpoides	northern pocket gopher
Carnivora	**Canis latrans*	coyote
	**Felis concolor*	mountain lion or cougar
	**Lynx rufus*	bobcat
	Mustela frenata	long-tailed weasel

	**Taxidea taxus*	badger
	Urocyon cinereoargenteus	gray fox
	Vulpes fulva	red fox
Artiodactyla	*Antilocapra americana*	pronghorn
	Odocoileus h. hemionus	mule deer

*Habitation verified by sign, sighting, or collection.

Avifauna includes golden eagle *(Aquila chrysaetos),* prairie falcon *(Falco mexicanus),* red-tailed hawk *(Buteo jamaicensis),* loggerhead shrike *(Lanius ludou"cianus),* pinon jay *(Gymnorhinus cyanocephala),* black-billed magpie *(Pica pica),* Brewer's blackbird *(Euphagus cyanocephalus),* sapsucker *(Sphyrapicus* sp.), red-shafted flicker *(Colaptes cater),* robin *(Turdus migratorius)* (nesting in *Artemisia tridentata),* mountain bluebird *(Sialia currucoides),* western tanager *(Piranga ludouiciana),* and sage sparrow *(Amphispiza belli).* The sagebrush lizard *(Sceloporus graciosus)* frequents the area. Invertebrates include the pine beetle *(Dendroctonus brevicomis)* and scorpion *(Vejouis boreus).*

History of Disturbance

White settlers rapidly occupied the Christmas Lake valley after 1865. By 1906 there were 120 homestead claims taken up and the post office established at Cliff. One of these homesteads borders Lost Forest to the northeast (Berry 1963). The settlers cleared the land of sagebrush and made use of the timber and forage resources of Lost Forest. Pine and juniper were cut for houses, corrals, and firewood; and sheep, cattle, and horses grazed the surrounding sagebrush plains and into the forest areas. Most of the homesteads were abandoned by 1920, and the dry years of the 1920's and 1930's saw an end to most dry farming in the region. During the 1920's, bands of wild horses heavily grazed the area, and corrals were built in and near Lost Forest to hold them (Berry 1963).

Today the economy of the area is primarily oriented toward cattle ranching and irrigated farming. A range survey in 1960 indicated that the Lost Forest area had about 443 AUM's (Animal Unit Month) of available forage, or about 20 acres per A UM. The area is oflimited use for grazing, however, because of the lack of water. Lost Forest is part of the View Point Ranch grazing allotment, although no grazing use has occurred since about 1968.:[3] Nevertheless, past grazing has doubtless produced vegetation changes. The palatable bluebunch wheatgrass, *Agropyron spicatum,* is rare or absent at Lost Forest. However, this grass is found in fenced, summer pastures north of Lost Forest (Berry 1963) and is a major component of most vegetation associations of central Oregon (Eckert 1957, Driscoll 1964).

A timber sale in 1949 (522 MBF) and another in 1955 (1,599 MBF) were held to remove trees vulnerable to disease and insects. Snags were cut during the logging operations and the slash was piled and burned. Sites where portable mills operated can still be found in the area. These sites and the logging scars were planted with crested wheatgrass *(Agropyron cristatum).* Some sites at Lost Forest had heavy military usage in 194:3, when bivouac and battle maneuvers took place.

The major continuing disturbance is recreational activity, particularly use by offroad vehicles. The Bureau of Land Management is presently considering what steps need to be taken to control such activities.

All these activities have had a significant impact on the vegetation of the area and must be considered in research activities. This history is judged to have had relatively little influence on animal populations, however, except for the large predators and herbivores.

[3] Bureau of Land Management Staff Report, file 6225, at Oregon State Office, Portland, Oreg.

Research

Early descriptions of settlement patterns, geology, and natural resources of Lost Forest and environs are given by Russell (1884), Cope (1889), and Waring (1908). The sediments and chronology of Fossil Lake or nearby pluvial lakes have been studied by Allison (1945, 1954) and Dole (1942). Fossil birds have been described by Howard (1946). Studies of vegetation changes east of the Oregon Cascades in post-Pleistocene time by Hansen (1942a, 1942b, 1947a, 1947b, 1961), though not specific to Lost Forest itself, are nevertheless important for placing this area in a regional paleoecological perspective. Some evidence of prehistoric man in this region is presented by Allison (1945) and Hansen (1946). Tree ring analyses of recent climatic changes in the Lost Forest region are given by Keen (1937), Antevs (1938), and Berry (1963). General vegetation features of the region have been reviewed by Franklin and Dyrness (1973), and specific studies at Lost Forest have been made by the Bureau of Land Management and Berry (1963). Berry also included soil descriptions and aspects of ponderosa pine reproductive physiology.

Because of its isolation, Lost Forest offers interesting possibilities for studies of the migration, isolation, and speciation of plant and animal populations. Further studies concerning the possible ecotypic uniqueness of *Pinus ponderosa* can be undertaken. The dunes and wind erosion areas offer opportunities for the study of eolian processes. Geological and possible archaeological features associated with pluvial shorelines and lakebeds can be studied and correlated with other data from the Great Basin (e.g., Morrison 1965).

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