BOARDMAN RESEARCH NATURAL AREA

Supplernent No. 17[1]

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The Research Natural Area described in this supplement is administered by the Commanding Officer, Naval Air Station, Whidbey Island (Oak Harbor, Wash.). The Officer in Charge of the Naval Weapons Systems Training Facility, Boardman, Oreg., is responsible for coordinating access to the Research N atural Area for scientific and educational uses vvith scheduled military use of the facility. Scientists interested in using this Research Natural Area should prepare a written proposal that explains the nature, purpose, and duration of the proposed activities. The request should be addressed to the Staff Forester, Western Division, Naval Facilities Engineering Command (Building 138, Room 215, Naval Station, Seattle, Wash. 98115). Requests to do research that is controversial or destructive in nature will be forwarded to the Pacific Northwest Federal Research Natural Areas Committee for its advice on the appropriateness of the particular research. Approval for any use of the area will be made by the Commanding Officer, Naval Air Station, Whidbey Island. For brief observational visits, permission may be obtained from the Officer in Charge at the Naval Facility, Boardman, Oreg.

The Boardman Research Natural Area is a part of a Federal system of RNA's established for research and educational purposes. In these areas, 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 ecosystems; and
3. Gene pool preserves of organisms, especially rare and endangered types.

The Federal system is outlined in "A Directory of the Research Natural Areas on Federal Lands of the United States of America.":J Of the 96 Federal Natural Research Areas established in Oregon and Washington, 45 are described in "Federal Research Natural Areas in Oregon and Washington: A Guidebook for Scientists and Educators" (see footnote 1). Supplements to the guidebook describe additions to the system.

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

Federal Research Natural Areas provide a unique system of publicly owned and protected examples of undisturbed ecosystems where scientists can conduct 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, a scientist wishing to use a Research Natural Area is obligated to:

1. Obtain permission from the appropriate administering agency before using the area;4

'Supplement No. 17 to "Federal Research Natural Areas in Oregon and Washington: A Guidebook for Scientists and Educators." by .Jcrry F. Franklin. Frederick C. Hall. C. T. Dyrness. imd Chris Maser (Pacific Northwest Forest and Range Experiment Station 1 ~J72). The guidebook is available from the Superintendent of Documents. U.S. Government Printing Office. Washington, D.C. 20402: stock number 001-001-00225-9.

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:lFederal Committee on Ecological Reserves. A directory of the Research Natural Areas on Federal lands of the United States of America. Washington. D.C.: U.S. Department of Agriculture. Forest Service; 1977.

"Six agencies cooperatc in this program in the Pacific Northwest: U.S. Department of Agriculture-Forest Service: U.S. Department of the I nterior- Bureau of Land Management. Fish and Wildlife Service. and National Park Service; the U.S. Department of Energy; and the U.S. Department of Defense.

2. Abide by the administering agency's regulations governing use. including specific limitations on the type of research. sampling methods. and other procedures: and
3. Inform the administering agency on progress of the research. published results. and disposition of collected materials.

The purposes of these limitations are to:

1. Insure that the scientific and educational values of the tract are not impaired:
2. Accumulate a documented body of knowledge about the tract: and
3. Avoid confl ict between stud ies.

Research must be essentially nondestructive: destructive analysis of vegetation is generally not allowed. nor are studies requiring extensive mod ification of the forest floor or extensive excavation of soil. Collection of plant and animal specimens should be restricted to the minimum necessary to provide voucher specimens. Under no circumstances may collecting significantly reduce population levels of species. Collecting must also be carried out in accordance with applicable State and Federal agency regulations. Within these broad guidelines. appropriate uses of Research Natural Areas are determined by the administering agency.

AR

Native Columbia Basin bunchgrass communities on a mosaic of sandy flood-deposit and loamy lakebed-deposit soils with abundant dry prairie wildlife species.

The Boardman Research Natural Area (RNA) was established September 1, 1978, to preserve high-quality examples of Columbia River basin steppe vegetation communities and associated wildlife. The RNA has never been plowed and has not been grazed since 1948.[5] Throughout much of the rest of the basin, however, such native communities have been significantly changed by grazing- and agriculture.

Sandy flood-deposit and silt loam lakebed soils support bunchgrass communities over most of the Research Natural Area; dominant species include *Agl'OPYl'on spicotum. Af/l'l!}J?Inm dasytach?lllm. Stipu COll/atu, andPou sandhel'r/ii.* ii Portions of the RN A are devoid of vegetation where sand has formed into dunes or sandblows. A fragile cryptogam (moss and lichen) ground cover is associated with the bunchgrass communities on certain soil types.

Short-eared owls, long-eared owls, burrowing owls, Svvainson's hawks, and ferrug-inous hawks nest in the vicinity of the RNA. Longbilled curlews nest in large numbers on the RN A and in surrounding areas, and the Washington ground squirrel, whose range appears to be diminishing in the Columbia Basin, has a thriving population in the RNA.7

The Boardman RN A is in Morrow County, north-central Oregon, and within the boundaries of the U.S. Naval Weapons Systems Training Facility, hereafter called the Bombing- Range (fig. BD-l). The RN A is composed of three separate areas that total 2 mJ5 ha (5.176 acres). RNA "A" located in the center of the Bombing Range, is 1 086 ha (2,560 acres); RN A "B," along the eastern boundary, is 79 ha (196 acres); and RNA *"C,"* to the southwest, is 980 ha (2,420 acres). The three sections are located in T. 2 and 8 N., R. 25 E., Willamette meridian (lat. 45°42' N., long.119°42'W.). The entire Bombing Range and RN A's A B, and C are fenced.

Access and Accommodations

To reach the RN A travel west from Boardman along Interstate 84 for 7.2 km (4.5 mi) to the Tower Road exit. Travel south on Tower Road for 1.6 km (1.0 mi), turn left onto a gravel road, and continue southeast for 1.4 km (0.9 mi) to the administration headquarters. The northern boundary of the Naval Bombing Range is :3.2 km (2 mi) south of Boardman, Oreg., and Interstate 84 (fig. BD-2). All visitors must contact the Officer in Charge prior to their visit and check in on arrival at the headquarters for clearance to enter the RNA.

RN A's A, B, and C may be reached either from headquarters or from the east side()f th~ Bombing Range, via Highway 780, through locked gates. M ileag-es and routes are indicated in figure BD-2. A more detailed map of the area and complete directions can be obtained at headquarters when checking in.

Overnight camping is prohibited in the Bombing Range. Camping facilities and commercial accommodations are available in Board m an.

Envi ronment

The Boardman RNA is part of the Umatilla Plateau in the central Columbia River basin. Most of the soils and topography are products of one or more episodes of the late-Pleistocene Missoula floods. Waters of Montana's glacial Lake Missoula poured from periodically retreating ice dams southwesterly into the Columbia Basin. At Wallula Gap, on the OregonWashington border, the floodwaters were impeded and reached a depth of 244 m (800 ft) (Bretz 1969). South of Wallula Gap, where the

"Much of the baekground information is derived from the "Establishment Report for the Boardman R('spareh Natural Area." by Donald C. Happel (1978) on file at The Nature Conservaney. 12:34 N.W. 25th. Portland. Oreg. 97210.

I;Common names and scienti fie names of vascu lar plants are listed in table BD-1.

7S,ientifie names of birds and mammals are listed in tables BD-4 and BD-5. respectively.

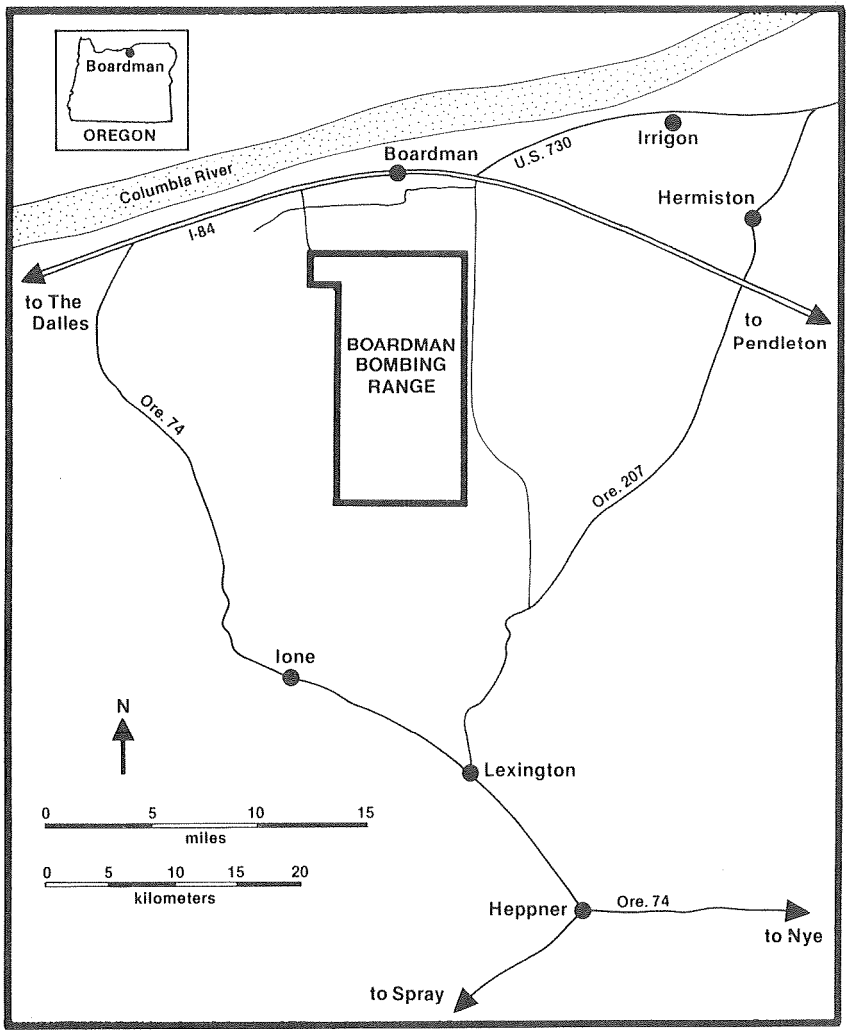

Figure BD-1.—Location of the Boardman Bombing Range, south of Boardman, Morrow County, Oregon.

Columbia's channel turns west, floodwaters spilled south onto the Umatilla Plateau where soils and huge ice-rafted erratics were deposited. Most of the Boardman RN A is underlain by these flood deposits over which a variety of sandy soils differing in texture, depth, and other characteristics have formed. Portions of RNA's Band C to the south and east are underlain by older Pleistocene lake deposits over which loamy soils have formed.

The contours of the Boardman Bombing Range rise gently from 122 m (400 ft) in elevation at the northern boundary to 274 m (900 ft) at the southern. The RNA consists of broad, flat plateau (2- to 5-percent slopes) changing in the south to rounded hillsides that drop into valleys at moderate slopes (5 to 12 percent). These valleys, generally broad and flat across the bottom, are dry most of the year because of the high porosity of the sandy soils and the short duration of rainstorms.

Juniper Canyon, in the eastern part of the Bombing Range (fig. BD-2), has more broken topography with deeper canyons and steeper slopes. Nearby Juniper Canyon provides nesting habitat for many avian species that use the RN A.

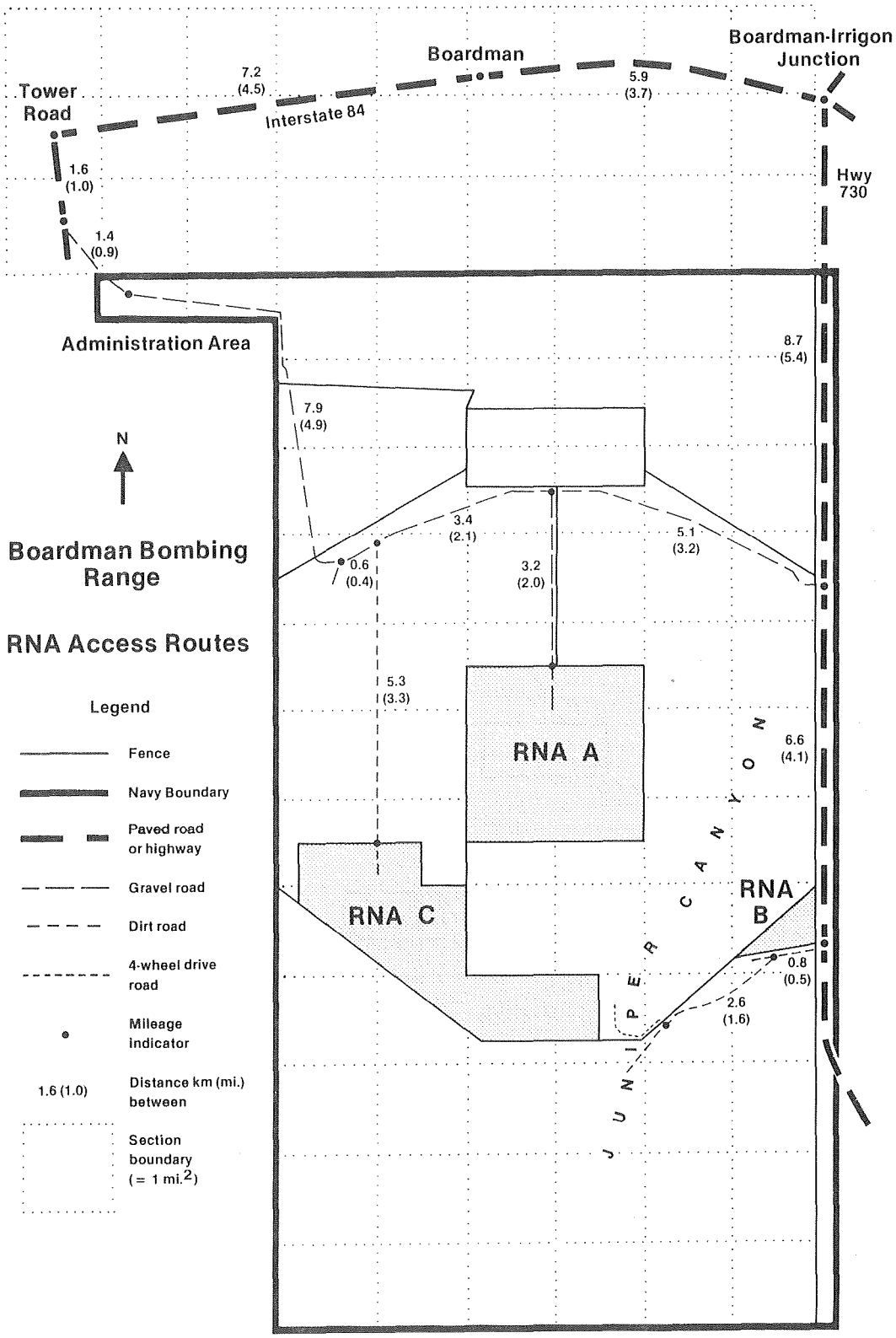

Figure BD-2.—Access routes to the Boardman Research Natural Area.

Climate

The climate of the Boardman RNA is semiarid with low precipitation, hot and dry summers, and relatively cold winters. The climate is similar to that of Hermiston, Oreg., 38.4 km (24 mi) to the east.

The following climatic data for the period 1942-1971 are from the U.S. Weather Station, at Hermiston:

Mean annual temperature	11.6 °C	(52.8 °F)
Mean January temperature	-0.1 °C	(31.8 °F)
Mean July temperature	22.6 °C	(72.7 °F)
Mean January minimum temperature	-4.6 °C	(23.7 °F)
Mean July maximum temperature	30.8 °C	(87.5 °F)
Mean annual precipitation (Rain+snow moisture)	22.6 cm	(8.9 in)
Mean annual snowfall (Depth)	22.6 cm	(8.9 in)

The mean annual precipitation for the period was 22.6 cm (8.9 in). Most of the precipitation (68 percent) occurs from October through March with November, December, and January being the wettest months. There are an average of 46 days annually with temperatures in excess of 32.2 °C (90 OF), and an average of 113 days annually with temperatures below 0 °C (32 OF). The maximum temperature recorded during this period was *45°C* (113 OF) in August 1961; the minimum recorded was *-38°C* (-37 OF) in December 1919.

Southwesterly winds prevail most ofthe year. Wind records for 1942-1972 from the weather station in Pendleton, Oregon [74 km (46 mi) to the east of the RN A] show an average annual wind speed of 14.8 km/h (9.3 mi/h). March through July is the windiest period with velocities averaging 16.2 km/h (10.1 mi/h).

Soils

The soils of the Boardman Bombing Range have been mapped by the U.S. Soil Conservation Service. Six soil types are present on the RNA (fig. BD-3 and table BD-l). Five types (Quincy, Koehler, Sagehill, Taunton, and Royal) are products of the late-Pleistocene Missoula floods. These flood-deposit soils cover approximately 93 percent of the RNA and range from fine sands to fine sandy loams.

The Quincy fine sands or loamy fine sands and the Koehler loamy sands are mildly alkaline and highly permeable. The former, classified as Xeric Torripsamments, are formed in mixed sands and occur on RNA A, extending south into RNA C. The latter, Xerollic Durorthids, are formed in alluvial and colluvial materials mantled with eolian sand and are present on RN A A.

The Sagehill and Taunton fine sandy loams, classified as Xerollic Camborthids and Xerollic Durorthids, respectively, are found intermixed on RN A C. The Royal loamy fine sand or fine sandy loam soils are grouped with the Xerollic Camborthids and are present on RNA C. These three soil types are formed in windlaid materials, are mildly alkaline, and are moderately well-drained.

The sixth soil type (Warden), adjacent to the southern extremity of the soils deposited by the Missoula flood, is a very fine sandy loam or silt loam. The Warden soils are unique among the soil types of the RNA in that they are older, lacustrine-deposit soils. They are mildly alkaline, moderately well-drained sandy loams over silt loams, and formed in wind-laid sands and silts over calcareous lacustrine silts. They are classified as Xerollic Camborthids.

Wind erosion can be severe, particularly on the highly permeable Quincy and Koehler sandy soils, because of the region's low precipitation and high-velocity winds. Vulnerability to wind erosion is reduced in undisturbed areas where a thin surface crust has formed over the soils. Wind erosion is greatly diminished where there is a well-established cryptogam or moss and lichen ground cover. Cryptogam cover is most notable on Warden soils of RNAC.

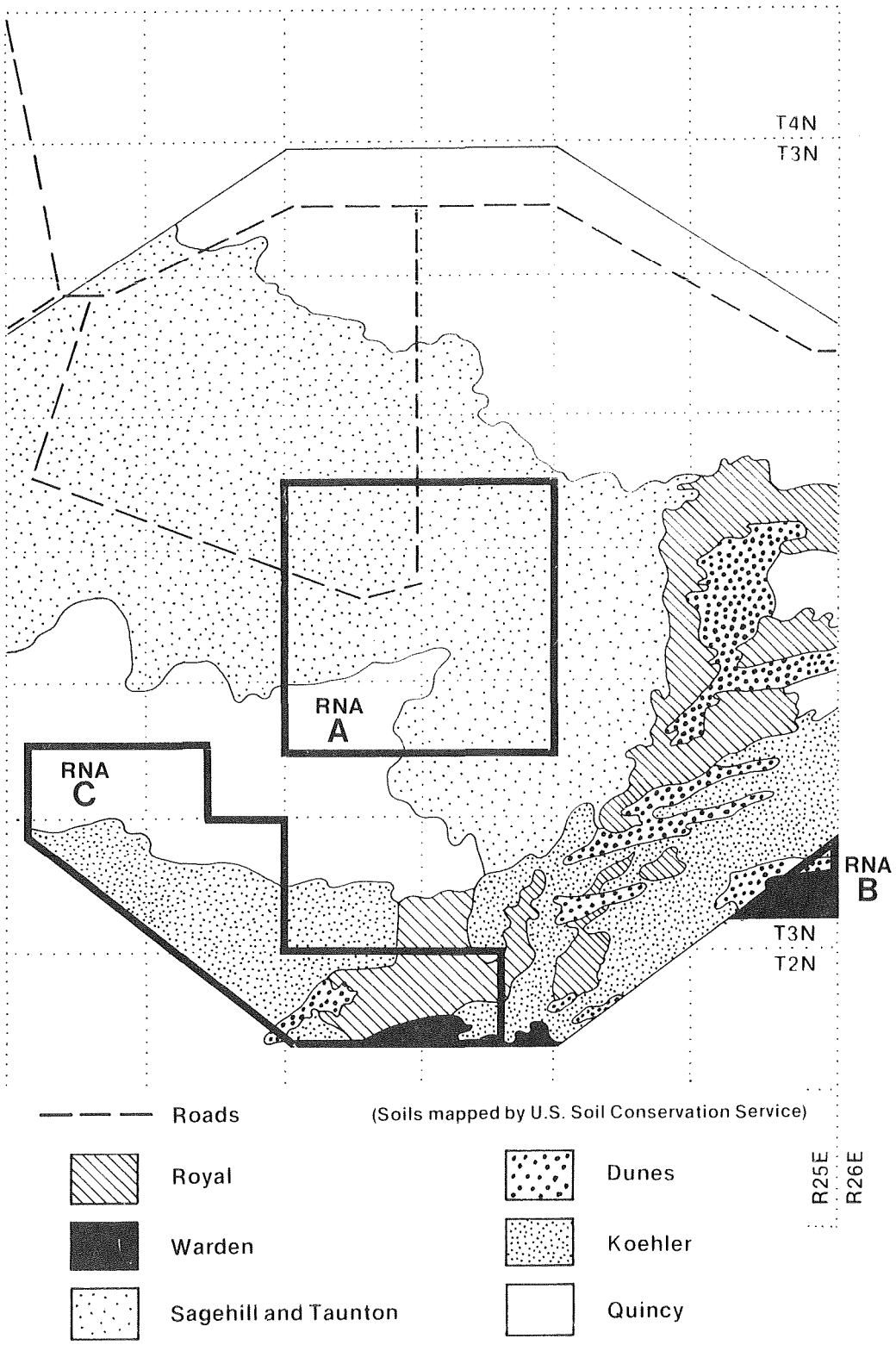

Figure BD-3.—Soils of the Boardman Research Natural Area.

Table BD-1—General plant community-soil type associations found in the Boardman Research Natural Area

Soil type	Plant community
Warden	*Agropyron spicatum-Poa sandbergii*
Royal	*Agropyron spicatum-Poa sandbergii*
Sagehill and Taunton mosaic	*Agropyron dasytachyum-Stipa comata and Stipa comata-Poa sandbergii*
Koehler	*Stipa comata-Poa sandbergii*
Quincy	*Stipa comata-Poa sandbergii*

Unstable sand in the form of dunes or sandblows extends across portions of the Bombing Range and is present in RNA's Band C (fig. BD-3). These blows are thought to be accumulations of riverbed sand that originated from the shores of the Columbia River southwest of Boardman, *Oreg.,* and were spread by the prevailing southwesterly winds. In portions of RNA C, the blown sand has become stabilized, and a hummocky terrain has resulted. In one part of RNA B, efforts to stabilize the sandblows were undertaken in 1972 and 1973.[8] Test plots were treated with a variety of stabilizers, such as shredded bark and papermill sludge, and were seeded with cereal rye. At present, the sand blows are largely stabilized.

Biota

Vegetation

The Boardman RNA is located in the central Columbia Basin region, which is classified as a sagebrush steppe (Daubenmire 1970, Franklin and Dyrness 1973, Kuchler 1965, Poulton 1955). Despite these classifications, *A rteJn1',';1'a triden/ata* is conspicuously absent from most of the RN A, and the perennial bunchgrass species *Agropyron spicatum, Agropyron dasytachyuTt1, Stipa com ata,* and *Poa s01I.dbergh'* are dominantsY

Variations in plant community structure are associated with changes in soils (fig, BD-3 and table BD-1) and topography. In general, on the five sandy, flood-deposit soils (Quincy, Kuchler, Sagehill, Taunton, and Royal) that cover most of the RN A, *St?'pa cmnata, Poo sandbergi1',* and *Agropynm dasytachyum* dominate, Their representation and coverage vary among the soil types. On the older Warden lakebed soils, represented only on the southern fringe of RN A's Band C, *Agropyron spicatum* and *Poa sondbergi?'* are the dominant species. The few concentrations of *Artemisia tridentata* are found in RN A's Band C on a variety of soils where the topography is more broken. Other shrub species found in the RNA are *Pursh1'a tridentata,* widely scattered on the northern portion of RN A A, and *Chrysotlwmnus nauseosus* and C. */!?'sc1'd1j7orus,* both represented in all RNA sections. A list of known shrubs, grasses, and forbs for the RN A is shown in Table BD-2.

8Ward, George D" and others, 1974. "Engineering study and field demonstration trials for sand dune stabilization, U,S. Naval Bombing Range, Boardman. Oregon." Unpublished report to the Naval Facilities Engineering Command, Bldg. 138, [loom 215, Naval Station, Seattle, Wash. 98115.

9Much of the information on plant representation and coverage is derived from field notes of preliminary investigations conducted by William N. Copeland, on file at The Nature Conservancy office. 1234 N.W. 25th. Portland, Oreg. 97210.

Table BD-2—Plants found in the Boardman Research Natural Area[1] [2]

Family	Scientific name	Common name
SANTALACEAE	*Comandra umbellata*	Bastard toad-flax
POLYGONACEAE	*Eriogonum* sp.	Buckwheat
CHENOPODIACEAE	*Salsola kali*	Russian thistle
CARYOPHYLLACEAE	*Holosteum umbellatum*	Jagged chickweed
RANUNCULACEAE	*Delphinium nuttallianum*	Upland larkspur
CRUCIFERAE	*Descurainia pinnata*	Western tansymustard
	Draba verna	Spring whitlow-grass
	Erysimum asperum	Rough wallflower
	Sisymbrium altissimum	Jim Hill mustard
SAXIFRAGACEAE	*Lithophragma bulbifera*	Prairiestar
ROSACEAE	*Purshia tridentata*	Antelope bitter-brush
LEGUMINOSAE	*Astragalus purshii*	Pursh's milk-vetch
	Astragalus sclerocarpus	Stalked-pod milk-vetch
	Astragalus succumbens	Crouching milk-vetch
	Psoralea lanceolata	Lance-leaf surf-pea
GERANIACEAE	*Erodium cicutarium*	Stork's-bill
CACTACEAE	*Opuntia polyacantha*	Starvation cholla
ONAGRACEAE	*Oenothera pallida*	Pale evening-primrose
UMBELLIFERAE	*Cymopterus terebinthinus*	Turpentine cymopterus
	Lomatium cous	Cous biscuit-root
	Lomatium macrocarpum	Large-fruited desert-parsley
POLEMONIACEAE	*Gilia minutiflora*	Small-flowered gilia
	Microsteris gracilis	Pink microsteris
	Phlox longifolia	Long-leaf phlox
HYDROPHYLLACEAE	*Phacelia linearis*	Threadleaf phacelia
BORAGINACEAE	*Amsinckia lycopsoides*	Tarweed fiddleneck
	Cryptantha sp.	Cryptantha
SCROPHULARIACEAE	*Penstemon acuminatus*	Sand-dune penstemon
	Verbascum thapsus	Common mullein

Table BD-2—Plants found in the Boardman Research Natural Area[1] [2]—Continued

Family	Scientific name	Common name
PLANTAGINACEAE	*Plantago patagonica*	Indian-wheat
COMPOSITAE	*Achillea millefolium*	Common yarrow
	Antennaria dimorpha	Low pussytoes
	Artemisia tridentata	Big sage
	Balsamorhiza careyana	Carey's balsamroot
	Chaenactis douglasii var. *achilleaefolia*	Hoary chaenactis
	Chrysothamnus nauseosus	Gray rabbitbrush
	Chrysothamnus viscidiflorus	Green rabbitbrush
	Crocidium multicaule	Spring-gold
	Erigeron filifolius var. *filifolius*[3]	Thread-leaf fleabane
	Erigeron linearis	Line-leaf fleabane
	Gutierrezia sarothrae	Snakeweed
	Hemizonia pungens var. *septentrionalis*	Common spikeweed
	Hieracium sp.	Hawkweed
	Madia glomerata	Cluster tarweed
	Tragopogon dubius	Yellow salsify
	Wyethia amplexicaulis	Northern mule ears
GRAMINEAE	*Agropyron cristatum*	Crested wheatgrass
	Agropyron dasytachyum	Downy wheatgrass
	Agropyron spicatum	Bluebunch wheatgrass
	Bromus tectorum	Cheat grass
	Elymus mollis[3]	Dune wildrye
	Festuca bromoides	Barren fescue
	Festuca idahoensis	Idaho fescue
	Oryzopsis hymenoides	Indian ricegrass
	Poa sandbergii	Sandberg's bluegrass
	Sitanion hystrix	Bottlebrush squirreltail
	Stipa comata	Needle-and-thread grass
LILIACEAE	*Brodiaea douglasii*	Douglas' brodiaea
	Calochortus macrocarpus	Sagebrush mariposa
	Fritillaria pudica	Yellowbell
	Zigadenus venenosus	Meadow death-camas

[1]Information supplied by William N. Copeland, consulting ecologist, Portland, Oreg.; Alan Copsey, Department of Biology, University of Oregon, Eugene; Donald C. Rappel, staff forester, Naval Facilities Engineering Command, Seattle, Wash.; and the authors.

[2]Nomenclature follows Hitchcock and Cronquist (1973).

[3]Species are tentatively identified for the RNA.

One of the most striking characteristics associated with the *Agropyron spica.turn-Poo sandber'g?:1:* community on Warden soils of RNA's Band C is the fragile and colorful cryptogam (moss and lichen) ground cover, Cryptogam cover is unusually high for the area and is believed to playa role in nitrogen fixation, erosion control, and moisture relationships, Because of the dense ground cover of cryptogams there is a nearly complete absence of weedy grasses and forbs such as *Bmmus tectorum, Erolhum c1'cutorium, S1'symbn'um alh's.(!l:murn,* and *Am.'J/:nckia lycopsoides,* A list of moss and lichen species on the Bombing Range is in table BD-3.

RNA A.-RNA A is composed oftwo sandy soil types, Koehler and Quincy, both of which support a *Sh:pa. coma.ta-Poa sandbe1'gi1:* community and differ primarily in the cover ofthe dominant grasses, On the Koehler loamy sands, which extend over all but the southwestern quarter of RN A A (fig, BD-3), cover of *S. comata.* is relatively high, at 25 to 30 percent (fig. BD-4), *Poa sandbe1'gi1'* is less prevalent, with a cover of 10 percent. *Bnnnus tectorum* is distributed in patches with cover averaging 20 percent. Other grasses such as *Agropyron s7n'cahlm, Agropyron dasytochyum, Oryzopsis hymenm'des,* and *Festuca* sp. are each present with a cover of less than 5 percent. The shrubs *Chrysothamn/us nauseosus* and *Chl7/sothamnU8 Vi8Cid1;t70r'l/.S* both show a low cover of 1 percent, and *Purs/n'a tn:dentata* occurs only as scattered individuals.

Within the southwestern quarter of RNA A, on sandier Quincy loamy fine sands, *Stipo comata* has a lower cover of 10 percent, and *Poa sandbm'gi1:* cover is higher at 12 to 15 percent. *Bnnnus tectorum* is present in local concentrations with a cover of 15 percent. The four other grass species listed above are again present with cover of less than 5 percent. *Ch1'Y8othamnlUi nOU8e0811S* and *Chrysothll'lnnus /J1'scidiflorus* have slightly higher cover values, 2 to 3 percent and 1 to 2 percent, respectively.

Cryptogam cover on both Koehler and Quincy soils is low, at 1 percent.

Table BD-3—Mosses and lichens found in the Boardman Bombing Range[1]

Mosses	Lichens
Aloina pilifera	*Acarospora schleicheri*
Bryum sp.	*Dermatocarpon hepaticum*
Ceratodon purpureus	*Diploschistes scruposa*
Didymodon australasii	*Lecanora muralis*
Didymodon brachyphyllus	*Leptogium byssinum*
Encalypta cf. *rhaptocarpa*	*Polychidium albociliatum*
Funaria hygrometrica	*Psora luridella*
Grimmia montana	
Phascum cuspidatum	
Pseudocrossidium revolutum	
Pterygoneurum ovatum	
Tortula brevipes	
Tortula princeps	
Tortula ruralis	

[1]Based on information compiled by John A. Christy; on file at The Nature Conservancy, 1234 N.W. 25th, Portland, Oreg. 97210.

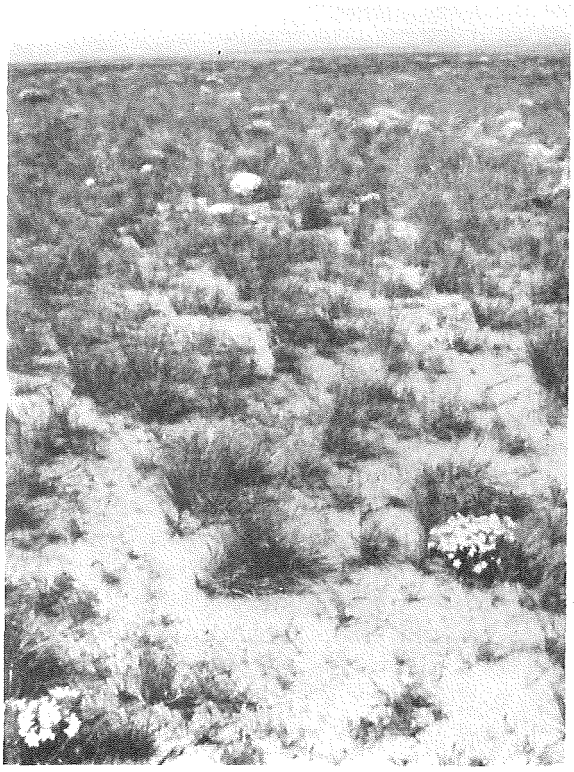

Figure BD-4.—Stipa comata-Poa sandbergii *community on Koehler soils, RNA A.*

Common forbs within *RNAAareHolosteum. umbellatum., Draba verna, Astragalus sclero-carpus, Cym.opterus terebintJn:nus, Phlox longifolia, Achillea m.Wefolium., Antennan:a dim.orpha, Crocid1:Um. m.ult1:caule, Gut1:errez1:a sarothrae,* and *Fritilleria PUd1:ca.*

RNA B.-RNA B, the smallest of the RNA sections, contains a wide range of soil types and vegetation from sandblow areas dominated by weedy species to a relatively undisturbed *Agropyron spicatum.-Poa sandbergii* community on Warden very fine sandy loam or silt loam soils.

Within the sandblows, vegetation cover ranges from 5 to 50 percent. Where cover is low, *Salsola kali* and *Chrysotham.nus nauseo*sus are the primary species. On older, more stabilized surfaces where cover is higher, additional species include *Brom.us tectorum., Sisym.b1'ium. altissim.um., Descurain1:a pinnata,* and *Hieracium.* sp. Along the sandblow margins, additional species include *Chrysotham.nus viscid1florus, Gutierrezia sarothrae,* and scattered *A rtem.isia tridentata* and *Secale cereale.* The *Secale* was seeded during a 19721973 effort to stabilize the dunes, and only dispersed individuals now remain.

Undisturbed areas of Warden and Sagehill-Taunton soils in RNA B support a community of *Agropyron spicatum.-Poa sandbergii-Stipa com.ata* with coverage of 20 to 25 percent, 10 to 15 percent, and 15 to 20 percent, respectively. *Brom.us tectorum.* is present in scattered patches. Cryptogam cover is relatively high at 10 to 15 percent.

Common forbs in RNA B include *Holosteum. um.bellatum., Astragalus purshii, Lom.atium. m.acrocarpum., Phlox longifolia,* and *A ntennaria dim.orpha.*

RNA C.-RNA C contains a mosaic of soil types and a corresponding mixture of plant communities. The northwestern portion of RNA C, composed of sandy Quincy soils, has little or no slope. It supports a *Stipa com.ataPoa sandberg1:1:* community similar to the one described for Quincy soils on RN A A.

In the southwestern portion of RN A C, topography ranges from flat in the west to hummocky and gently rolling in the east, and the soils are Sagehill and Taunton fine sandy loams. There is a mixture of two bunchgrass communities: an *Agropyron da.sytachyum.St1:pa cornata.* community with cover values of 10 to 15 percent and 1 percent, respectively, and a *Stipa com.ata.-Poa sa.ndbergi1:* community with cover of 15 percent and 8 percent, respectively. *Poa. sandbe1'g1:i* is present in the former with cover of 1 percent. In both communities, shrub cover is low, at2 percent, with equal distribution of *Chrysotham.nus nauseo*sus and C. *ViSC1:d1/lorus.* Cryptogam cover is 1 percent. An area of *Artem.isia tn:dentata* occurs in the rolling, southeastern part of this section of RN A C and is associated with a variety of grasses and forbs.

Another tract of Sagehill-Taunton soils occurs along the rolling eastern margin of RN A C, and the bunchgrass community is similar to the one described above. *A rtem.1:sia. tn:denta.ta* is present along hillsides and in bottoms.

In the central portion of RN A C, on Royal fine sandy loam soils, is a community of *Agropyron sp1:catum.* and *Poa. sandbergii* (cover values 15 to 20 percent and 10 to 15 percent, respectively). *St1:pa com.ata* is present at 5 percent cover. The slopes range from 2 to 5 percent, and *Brom.us tectorum.* occurs along hillsides and bottoms. *Ch1'ysotham.n1k'l natlseosus* and *A rtem.1:sia tn:dentata,* with an estimated cover of 15 to 20 percent, are distributed in concentrated patches throughout this community.

Along the southern edge of RN A C, flanking the southernmost extension of flood-deposit soils on the RN A, is a rolling area of Warden very fine sandy loams and silt loams on slopes of 3 to 12 percent. These lakebed-deposit soils support an *Agropyron spicatum.-Poa sandbergii* community with its associated cryptogam ground cover (fig. BD-5). Cover values are 25 percent for *Agropyron spicatum.* and 20 percent for *Poa sandbergii. Stipa com.ata* is present in localized sandier areas. Cryptogam cover is high, estimated at 45 percent, making this community quite different from the RNA communities present on flood-deposit soils. Throughout much of this community, where cryptogam cover is well-established, cover of weedy grasses and forbs is low. Scattered patches, where weedy species such as *Brom.us tectorum., Descurainia pinnata,* and *Erod1:um. c1:cutarium.* replace the cryptogam as dominants, indicate areas of past disturbance. On

Figure BD-5.—Agropyron spicatum-Poa sandbergii *community on Warden soils, RNA C.*

the Warden soils described earlier in RNA B, cryptogam cover is lower, at 10 to 15 percent, reflecting past disturbance by grazing which occurred intermittently until 1975, The plant communities on Warden soils that extend south of the boundaries of RN A's Band C have been heavily grazed since 1963. They show a prominence of weedy species and very little cryptogam ground cover.

On Warden soils in RNA C, *Artemisia tridentata* is largely restricted to draws or to slopes associated with *Brorr/lis tecton/ili.*

Associated forbs within RN A C include *Holosteumumbellatum, DI'01>a nenla. Astrago/us purshii, Lorrwtium cow';, Phlo:r lonqifolia, Ach·illeam.illefoliuru, Balsomorhiza careyono, Eriqeron* and *sonithrae.*

Fauna

Although the Boardman RNA is limited in diversity of habitat, the bunchgrass communities and associated shrubs provide valuable foraging and nesting sites for many species of animals. Bird, mammal, amphibian, and reptile species observed in the Bombing Range and the RN A are summarized in tables BD-4, BD-5, and BD-6. Those species observed in the Bombing Range but not in the RNA are footnoted.

Bird species that are year-round residents of the Bombing Range include raptors such as the Northern harrier, American kestrel, golden eagle, long-eared owl, and short-eared owl. Other resident species include gray partridge, horned lark, black-billed magpie, common raven, sage sparrow, and western meadowlark.

A notable spring migrant to the RNA is the long-billed curlew; notable because the RNA su pports one of the highest densities of breedi ng curlews in North America (Pam push 1980). Other spring and summer residents include the turkey vulture, common nighthawk, loggerhead shrike, vesper sparrow, and savannah sparrow. The rough-legged hawk is a common winter resident.

Mammals commonly found in the RNA include the Ord kangaroo rat, Great Basin pocket mouse, and deer mouse. Common lagomorphs include Nuttall's cottontail and the black-tailed jackrabbit. Badger, long-tailed weasel, coyote, and an occasional bobcat are the local mammalian predators.

Species of concern [10] known or expected to use the RNA (tables BD-4 and BD-5) include Swainson's and ferruginous hawks, which nest in Juniper Canyon and utilize portions of the RNA as their home range.[11] Burrowing owls nest in cheat grass and bitter brush habitat types on the Bombing Range,12 and northern

JOSpecies of concern are species considered rare, threatened, or endangered-either in Oregon or throughout their range-by the authorities cited in tables B-4 and B-5.

llUnpublished data on competitive interactions among rap tors in the grassland region of North America. Personal communication from Stewart W . .Janes, Department of Biology, University of California at Los Angeles, Los Angeles 90024.

12Personal communication regarding the ecology of the burrowing owl in the Columbia Basin from Gregory A. Green, Department of Fisheries and Wildl ife, Oregon State University. Corvallis ~l73:31.

Table BD-4—Birds found in the Boardman Research Natural Area[1] [2]

Order	Scientific name	Common name
ANSERIFORMES	*Branta canadensis*[3]	Canada goose
	Anas crecca[3]	Green-winged teal
	Anas platyrhynchos[3]	Mallard
FALCONIFORMES	*Cathartes aura*	Turkey vulture
	Haliaeetus leucocephalus alascanus[3] [5] [6] [7]	Northern bald eagle
	Circus cyaneus	Northern harrier
	Buteo swainsoni[5]	Swainson's hawk
	Buteo jamaicensis	Red-tailed hawk
	Buteo regalis[5]	Ferruginous hawk
	Buteo lagopus	Rough-legged hawk
	Aquila chrysaetos	Golden eagle
	Falco sparverius	American kestrel
	Falco mexicanus[5]	Prairie falcon
GALLIFORMES	*Perdix perdix*	Gray partridge
	Alectoris chukar	Chukar
	Phasianus colchicus	Ring-necked pheasant
	Callipepla californica	California quail
CHARADRIIFORMES	*Charadrius vociferus*	Killdeer
	Numenius americanus	Long-billed curlew
	Larus delawarensis	Ring-billed gull
COLUMBIFORMES	*Zenaida macroura*	Mourning dove
STRINGIFORMES	*Athene cunicularia*[3] [4]	Burrowing owl
	Asio otus	Long-eared owl
	Asio flammeus	Short-eared owl
CAPRIMULGIFORMES	*Chordeiles minor*	Common nighthawk
PASSERIFORMES	*Sayornis saya*	Say's phoebe
	Eremophila alpestris	Horned lark
	Pica pica	Black-billed magpie
	Corvus brachyrhynchos	American crow
	Corvus corax	Common raven
	Sialia currucoides	Mountain bluebird
	Turdus migratorius	American robin
	Anthus spinoletta	Water pipet
	Lanius excubitor	Northern shrike
	Lanius ludovicianus	Loggerhead shrike
	Sturnus vulgaris	European starling
	Pooecetes gramineus	Vesper sparrow

Table BD-4—Birds found in the Boardman Research Natural Area[1] [2]—Continued

Order	Scientific name	Common name
	Chondestes grammacus	Lark sparrow
	Amphispiza belli	Sage sparrow
	Passerculus sandwichensis	Savannah sparrow
	Ammodramus savannarum[5]	Grasshopper sparrow
	Zonotrichia leucophrys	White-crowned sparrow
	Sturnella neglecta	Western meadowlark

lBirds listed are believed to use the Natural Area at some time of the year. Information supplied by: Charles Bruce (Corvallis) and Ronald Rohweder (La Grande), Oregon Department ofFish and Wildlife; Stewart W. Janes. Department of Biology, University of California, Los Angeles:
Donald C. Rappe!, staff forester, Naval Facilities Engineering Command, Seattle, Wash.; and the authors. All species have been verified by sighting or sound. Species of concern are footnoted.

~Nomenclature follows Eisenmann and others (1982).

;JSpecies is documented for the Bombing Range but not for the RNA itself.

IDyrness and others (1975).

;'Marshall (1969).

tilJ.S. Department of the Interior, Fish and Wildlife Service (1982).

~()I'eg'()n Department of Fish and Wildlife (1978).

Table BD-5—Mammals found in the Boardman Research Natural Area[1] [2]

Order	Scientific name	Common name
LAGOMORPHA	*Lepus californicus*	Black-tailed jackrabbit
	Sylvilagus nuttalli	Nuttall's cottontail
RODENTIA	*Spermophilus washingtoni*[3]	Washington ground squirrel
	Thomomys talpoides	Northern pocket gopher
	Dipodomys ordii	Ord kangaroo rat
	Perognathus parvus	Great Basin pocket mouse
	Onychomys leucogaster[4]	Northern grasshopper mouse
	Peromyscus maniculatus	Deer mouse
	Erethizon dorsatum	Porcupine
CARNIVORA	*Canis latrans*	Coyote
	Mustela frenata	Long-tailed weasel
	Taxidea taxus	Badger
	Lynx rufus	Bobcat
ARTIODACTYLA	*Odocoileus hemionus*	Mule deer

lMammals listed are believed to use the Natural Area at some time of the year. Information supplied by Charles Bruce (Corvallis) and Ronald Rohweder (La Grande), Oregon Department of Fish and Wildlife; Donald C. Rappel, staff forester, Naval Facilities Engineering Command, Seattle, Wash.; B. J. Verts, Department of Fisheries and Wildlife, Oregon State University; and the authors. All species have been verified by sighting, sound, or sign. Species of concern are footnoted.

2Honaki and others (1982).

aOlterman and Verts (1972).

4Dyrness and others (1975).

Table BD-6—Amphibians and reptiles found in the Boardman Research Natural Area[1,2]

Order	Scientific name	Common name
ANURA	*Scaphiopus intermontanus*	Great Basin spadefoot toad
SQUAMATA	*Sceloperus graciosus*	Sagebrush lizard
	Uta stansburiana	Side-blotched lizard
	Phrynosoma douglassi	Short-horned lizard
	Coluber constrictor	Yellow-bellied racer
	Pituophis melanoleucus	Gopher snake
	Crotalus viridis	Western rattlesnake

lAmphibians and reptiles listed are believed to use the Natural Area at some time of the year. Information supplied by Charles Bruce (Corvallis) and Ronald Rohweder (La Grande), Oregon Department of Fish and Wildlife; and from personal observations by the authors. All species have been verified by sighting.

2Nomenclature follows Stebbins (l96G).

bald eagles have been observed at its northern end.!:' Breeding pairs of grasshopper sparrows, about whose status in Oregon little is known, have been observed in the RNA (Janes 1983). Mammal species of note include the locally rare northern grasshopper mouse and the Washington ground squirrel (fig. BD-G), which is abundant in RNA C despite a reduced range in the Columbia Basin,14

History of Disturbance

The Boardman Bombing Range was acquired by the Department of the Air Force in 1943 and, through subsequent transfer, by the Department of the Navy in 19GO. One-third of the Bombing Range is now owned by the Navy and two-thirds by the Department of the Interior Bureau of Land Management.

From 1943 to 1963 no livestock grazing occurred on the Bombing Range. Since 19fiB the northern and southern ends of the range, outside the central fenced octagon (refer to fig.

Figure BD-6.—Washington ground squirrel in RNA C.

':lPersonal eommunieation from Donald C. Rappel. Staff Forester. Western Division. Naval Faeilities Engineering Command. Bldg. 1;i8. Room 215. Naval Station, Seattle. Wash. 98115.

'"Carlson, Leif: Geoff Geupel; and othersHJ80. "Geo·graphie range, habitat requirements and a preliminary population study of *8)!1'ri1lojihi/lls 11'(lS/lilll!/tOlli."* Unpublished report, on file at The Nature Conservaney, 1284 N.W. 25th, Portland, Oreg. 97210.

BD-2), have been leased by ranchers for grazing cattle and sheep. After the three RNA sections were established and fenced in 1978, the central octagon was opened for gTazing. RN A's A and C have not been grazed since the original acquisition of the Bombing Range by the Air Force in 1948. Grazing occurred in RNA B until 1975.

RN A A contains the main target area of the Bombing Range, and several roads are maintained within it. Soil disturbance from the impact of nonexplosive practice bombs is limited to the centermost target portion. RN A A is su bject to fires caused by the bom bing practice. Fires usually spread to the north and east; because of their rapid movement very little damage is done to the vegetative root systems.

Sandblows in RNA B were the focus of a dune stabilization program carried out in 1972 and 1978. At present, the sandblows are largely stabilized. RNA C is the least disturbed section of the Natural Area and has only a few abandoned roads within its boundaries.

Portland General Electric Co. (PGE) operates the Boardman Coal-Fired Power Plant located approximately 4.8 km (8 mil west of the Bombing Range boundary. This plant burns low-sulfur subbituminous coal and was operational 162 days from October 1981 through September 1982 (Portland General Electric Co. 1982). Possible environmental impacts of the power plant on the Natural Area are deposition by the prevailing southwesterly winds of fugitive plant emissions or of dust from the coal yard onto the RNA. and incorporation of the emissions or dust into soils, plants, or animals. PGE maintains an ecological monitoring site on the Bombing Range to assess environmental conditions and to detect ecological impacts in the vicinity of the coal plant. To date, PGE has found no evidence of such impacts (Portland General Electric Co. 1982).

Research

The Boardman RNA, protected from the pressures of grazing and agricultural development that are occurring in much of the Columbia Basin, offers researchers an opportunity to study high-quality examples of native bunchgrass communities and their associated wildlife. Previous research on the flora and fauna of the-Boardman Bombing Range and RNA. in addition to the studies mentioned in the text, includes plant succession after natural disturbances by resident burrowing mammals,lf) the effects of grazingon breeding passerinesY; and the ecology of the Great Basin pocket mouse (Small and Verts 1988).

Additional opportunities for research on the RNA include the establishment of permam~nt vegetation transects for long-term study of the structure of the different bunchgrass communities. Concurrent monitoring of the plant communities and soils in grazed areas outside the RNA boundaries would offer valuable management information on the effects grazing has on species representation, substrate quality, and erosion. The RNA offers a unique opportunity to study hO\\I the cryptogam ground cover of the Warden soils affects a variety of ecosystem characteristics such as nitrogen fixation, erosion control. moisture relationships, and control of invasion by weedy plant species. In addition, long-term monitoring of the moss and lichen species could serve as an indicator of possible air quality changes resulting from emissions at the Boardman Coal- Fired Power Plant. Other research possibilities include primary plant succession on sand blows of RNA's Band C, successional stages of vegetation reestablishment in burned areas, and continued monitoring of sensitive species such as Swainson's and ferruginous hawks, grasshopper sparrow, and Washington ground squirrel.

Maps and Aerial Photographs

Maps applicable to Boardman Research Natural Area are: Topographic-Well Springs, Oregon quadrangle, scale 1:24,000, issued by the U.S. Geological Survey in 1968; Strawberry Canyon NE, Oregon quadrangle, scale 1:24,000, issued by the U.S. Geological Survey in 1968; and Geologic-Geologic Map of Oregon East of the 121st Meridian, scale 1:500,000 (Walker 1977). The Naval Facilities

"'Personal communication from Alan Cropsey, Department of Biology. l'Jnivprsity of Oregon, Eugene, 974m3.

"\Janes, Stewart. W. 1981. "Effects of grazing upon t.he breeding avifauna of the Boardman Naval Weapons Training Facilit.y." Unpublished reporl. on file at. The Nature Conservancv office, 12:~4 N.W. 25t.h, Portland, Oreg. 97210 ..

Engineering Command in Seattle, Washington, can provide details on the most recent aerial photo coverage for the area. In addition, Pacific Gas and Electric makes monthly flights at 2700 m (9.000 ft) over the RNA taking true color and color infrared photographs. Photographs are available on request from Richard Davis. Department of Environmental Sciences. Pacific Gas and Electric, 121 S.W. Salmon Street. Portland. Oreg. 97204.

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