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Research Natural Area Needs in the Pacific Northwest

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Portland, Oregon

Abstract

Research Natural Areas are examples of typical and distinctive natural ecosystems and habitats reserved for scientific and educational use. This outline of the minimal Research Natural Area system needed to provide adequate field laboratories for ecological, environmental, and land management research was developed by an interinstitutional, interdisciplinary working group. Natural area needs were first described on the basis of individual organisms, habitats, or ecosystems which should be represented. These "cells," the basic building blocks in defining the total scope of the system, considered terrestrial and aquatic environments as well as rare and endangered species. Identified cells were matched against existing Research Natural Areas to determine which were already filled. The remaining, unfilled cells were then tentatively grouped as units which were listed as Research Natural Area needs.

A minimal Research Natural Area system for Oregon and Washington requires approximately 360 tracts which, in turn, incorporate over 770 individual cells (ecosystems, habitats, or organisms). Since 60 Research Natural Areas are already established, about 300 additional areas are needed. These remaining needs were assigned a priority (low, medium, or high) based on importance and degree to which they are endangered, as well as identified as to the Federal, State, or private agency or institution most likely to be able to provide a tract of that type.

The purpose of Research Natural Areas, their place in land planning, history of Research Natural Area activities in the Pacific Northwest, and general observations and recommendations on unresolved problems are also outlined.

Keywords: Research Natural Area, scientific preserves, natural ecosystems, endangered species, Oregon, Washington.

RESEARCH NATURAL AREA NEEDS IN THE PACIFIC NORTHWEST
A Contribution To Land-Use Planning

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Report on Natural Area Needs Workshop
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PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE PORTLAND, OREGON

FOREWORD

Research Natural Areas are important elements in land-use plans. They may be called Research Natural Areas, Nature Preserves, Range Reference Areas, or simply Natural Areas. They are tracts on which natural features are preserved in as nearly an undisturbed state as possible for scientific and educational purposes. Natural areas serve as a standard or baseline for comparison with areas influenced by man, as tracts for ecologcal and environmental study, and as reserves to protect typical as well as rare and endangered organisms. As baseline areas, field laboratories, and genetic reservoirs, they serve the scientist, the resource manager, and the public.

In the Pacific Northwest there has long been a steadily increasing interest in preserving typical and unique examples of the natural environment by the Federal Agencies, by the States of Oregon and Washington, and by various private groups and professional societies. However, a random accumulation of reserved tracts will not provide the representative system of Research Natural Areas needed. Coordination is required among the various groups to avoid unnecessary duplication and still preserve examples of all important terrestrial, freshwater, and marine ecosystems. Thus, one purpose of this guide.

Providing additional impetus to preparation of this guideline is the trend toward comprehensive land-use planning by Federal agencies and State and local government. **I** view the product as an important contribution to this planning process by alerting land planners to the value of Research Natural Areas and to the ecosystems lacking adequate representation in existing Research Natural Areas.

This guideline describes a minimal system of natural areas for Oregon and Washington. It is a working tool that will require revision as progress is made and as new information becomes available. This effort should not be viewed as a mandatory guide; it is a blueprint for coordination among the participants.

This guide was prepared under the overall direction of a steering committee whose members have long experience in administering programs involving renewable natural resources. More than **30** scientists made up the working group that prepared the basic plan, and several dozen reviewers offered valuable comment. However, the final responsibility for its adequacy rests with me and with the authors. We invite your comment and inquiry.

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Director
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ACKNOWLEDGMENTS

A very large number of people contributed to this report at one time or another. For example, over 100 people reviewed the manuscript and most made suggestions. Obviously, it is impossible to mention each by name, but we sincerely appreciate the effort expended by each reviewer.

Those who participated in the Natural Area Needs Workshop are recognized elsewhere in the report. Members of the steering committee and workshop participants are shown in appendix VII. However, many additional people made substantial contributions following the workshop during preparation of the review draft and this revised version of the report. In the following lists we will attempt to acknowledge these contributions. Because so many have been involved, it is, of course, likely that some who should be listed are inadvertently omitted. For this, we apologize.

Robert L. Fernald (University of Washington) organized a followup marine and estuarine workshop in November **1974,** in order to improve lists of Research Natural Area needs along the coasts of Oregon and Washington. Those attending and making substantial contributions to the revised lists include Austin Pritchard, Vicki Osis, and Chris Bayne (Oregon State University); Laimons Osis (Oregon Fish Commission); and R. L. Bacon (University of Oregon). Other valuable suggestions were offered by J. J. Gonor, R. Waaland, R. Norris, T. Mumford, Peter Taylor, Peter Frank, Paul Rudy, R. T. Paine, and Carter Broad.

Those making substantial contributions to the list of rare and endangered animal species include Carl Bond and Robert Storm (Oregon State University), and Murray Johnson and Gordon Alcorn (University of Puget Sound). In addition, Murray Johnson kindly allowed the use of his unpublished "Terms Related to Populations and Survival Status of Mammals."

Arthur Kruckeberg (University of Washington) and Jean Siddall (The Nature Conservancy), both workshop attendees, led the effort in compiling lists of plants of special interest in Oregon and Washington. Kenton Chambers (Oregon State University) shared data from his Oregon list of endangered plants, and C. Leo Hitchcock (University of Washington) was of major help in identifying special plants in Washington. Others who made contributions to the Oregon plant lists include Molly Grothaus, Frank McMullen, Lois Kemp, Ruth Hopson Keen, Bert Brehm, Calvin Burt, Russell Ofstadt, Ronald Burnett, Dorothy Marshall, Donald Kroeker, George Jeffcot, Lawrence Crocker, Frank Lang, Frank Secock, Roy Godfrey, Libby Pinkham, Diane Meyer, Ireta Kirkhofer, Jerry Strickler, Ruth Strong, and Ralph Anderson.

Glenn Juday wrote most of the section describing the Oregon State Natural Area Preserves Program. Information pertaining to the Washington State Natural Preserves Advisory Committee was supplied by A. R. O'Donnell and Gordon D. Alcorn.

Charles Wellner of Moscow, Idaho, provided extensive assistance in preparation of the material on the Okanogan Highlands.

We sincerely appreciate the help and encouragement of all these people.

CONTENTS

Part 1. Background

NATURE, PURPOSE, AND MANAGEMENT OF RESEARCH NATURAL AREAS

In this paper, we will generally follow the concepts of Research Natural Areas developed in the Federal program (Federal Committee on Research Natural Areas 1968). There are variations in what these natural ecological reserves are called and their specific rationale and management criteria. Nonetheless, the general objectives and criteria are common among, for example, the Federal, Oregon and Washington State, and The Nature Conservancy programs.

Research Natural Areas can be defined as "a naturally occurring physical or biological unit where natural conditions are maintained insofar as possible." Further, the natural features are preserved for research and educational purposes. The features to be preserved may be important or unique ecosystems, habitats, or organisms and may be terrestrial, freshwater, or marine.

Most tracts selected as Research Natural Areas are those where the features of interest are in as nearly an undisturbed state or natural condition as can be found. They do not necessarily have to be pristine, however, as examples of many ecosystems which are essentially free of human disturbance no longer exist. Research Natural Areas are, ideally, sufficiently large to protect the feature of interest from significant unnatural influences.

The objectives of establishing Research Natural Areas are critical to understanding their importance in overall land-use planning. As stated by the Federal Committee on Research Natural Areas (1968) they are: (1) preservation of examples of all significant natural ecosystems for comparison with those influenced by man; (2) provision of educational and research areas for ecological and environmental studies; and **(3)** preservation of gene pools for typical and rare and endangered plants and animals.

In both Federal and State Research Natural Areas, the overriding guideline for management is that natural processes are allowed to dominate to the degree consistent with preservation of the natural features of interest. On many Research Natural Areas, protection from outside disturbances, such as logging, grazing, and fire, is the only management requirement. However, deliberate manipulation which simulates natural processes is allowed and may be necessary in order to maintain desired communities or organisms. Prescribed burning or grazing by domestic livestock of some grassland types is an example. Use of Research Natural Areas for research or education must also be consistent with maintenance of natural processes and features. For this reason, only research which is nondestructive in character is generally allowed. Often research of this type can be complemented with manipulative research on adjacent experimental tracts. The Nature Conservancy management guidelines vary more with the nature of the preserve and the objectives for which it was set aside.

Recreation is not a recognized use of Research Natural Areas, although certain types of recreational activities are allowed if they do not significantly alter the natural features for which a given tract was set aside. If recreational or other human activities threaten the existence or natural development of the features, such use can and should be prohibited.

It is at this point we can see how Research Natural Areas relate to other land use classifications such as National Parks, Wilderness Areas, and the U.S. Forest Service's Botanical, Geological, etc., Areas. Research Natural Areas are for situations where scientific values are primary and, in fact, relatively stringent constraints on other uses are necessary for the protection and realization of these values. Of course, there remain many landscapes which have substantial scientific interest. This is certainly true of National Parks and Wilderness Areas which have unique scientific potentialities of certain types—e.g., groves of unusually large trees, rookeries, nesting sites for eagles, habitats for wide-ranging ungulates and predators. However, these are typically large tracts in which recreational, educational, and other values are equally as important as the scientific. Further, many of these particular scientific values can be protected concurrently with other uses or, at most, necessitate a restrictive scientific designation for only a small part of the total landscape of the Park or Wilderness.

Natural reserves of these less restrictive types are important scientifically and should be fully utilized. Indeed, they are essential if any reasonably complete examples of large landscapes and wide-ranging organisms (many birds and large herbivores) are to be preserved. They reduce the number and extent of needed Research Natural Areas but, at the same time, cannot replace their unique role. Often Research Natural Areas can be placed within National Park or Wilderness units, thereby identifying a specific site where research potential is high and providing it with an extensive buffer of undisturbed landscape.

To summarize, Research Natural Areas recognize scientific and educational values as primary. These values are also associated with National Parks, Wilderness, and other specially designated areas but typically do not require the more exclusive designation for their protection.

HISTORY OF RESEARCH NATURAL AREA PROGRAM IN OREGON AND WASHINGTON

There has been a high level of interest in establishment of Research Natural Areas in Oregon and Washington by many individuals and groups for many years. **A** short history of the various programs — Federal, State, and private — seems appropriate to provide some perspective for this report.

Federal Activities

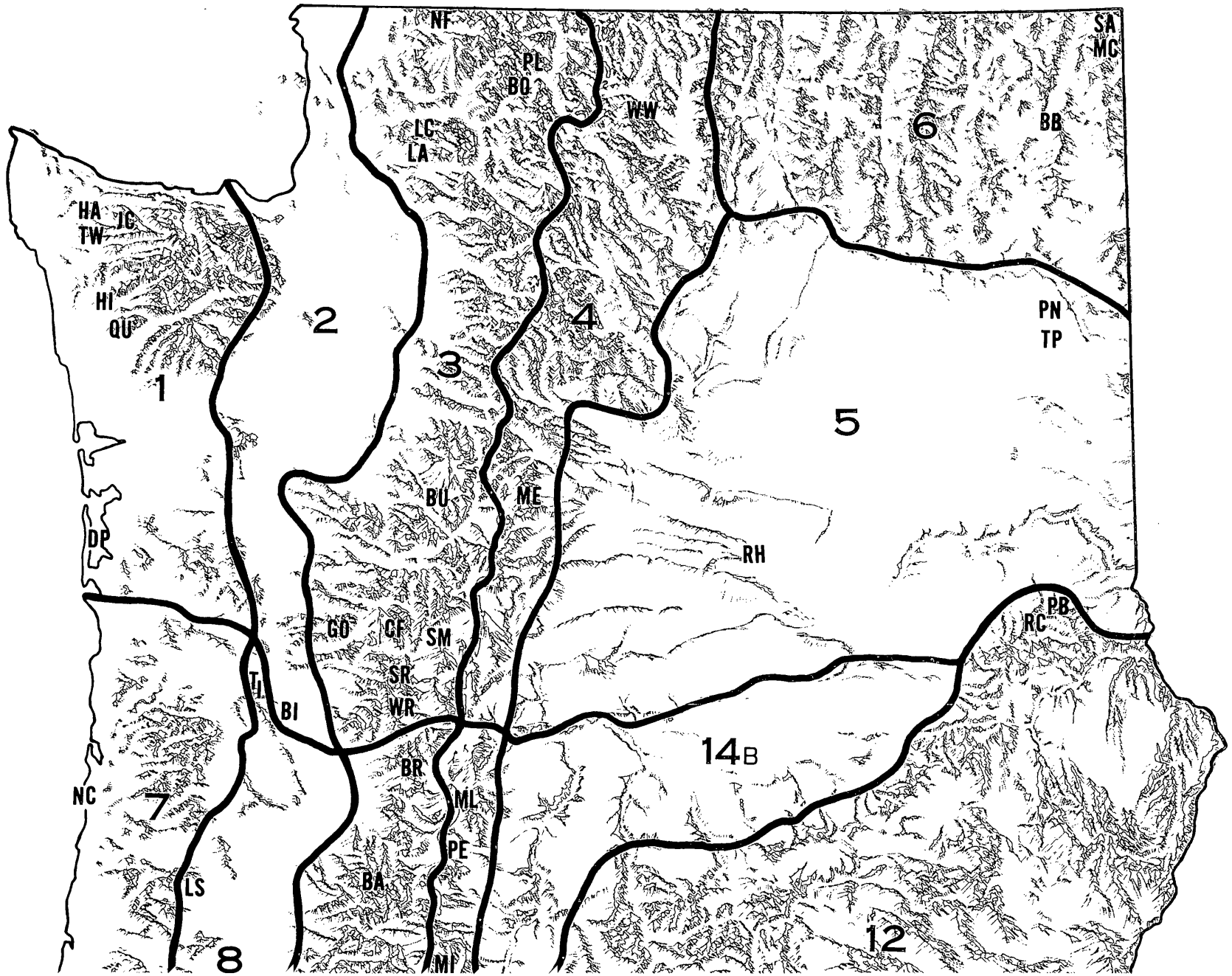
The Federal agencies have been active in the selection and dedication of Research Natural Areas for the longest period of time. Personnel in the U.S. Forest Service's Pacific Northwest Forest and Range Experiment Station were among the early activists — Thornton T. Munger, Leo **A.** Isaac, and Philip Briegleb, for example. The first of now 60 Federal Research Natural Areas in Oregon and Washington was formally established in 1931 by the U.S. Forest Service (Franklin 1970, Franklin et al. 1972). Over the next 30 years, location and establishment of areas proceeded at a slow but steady pace, with other Federal agencies becoming involved, including the Bureau of Land Management, National Park Service, and Fish and Wildlife Service.

In the 1960's, Federal agencies expanded and coordinated their activities. On the national level this was accomplished through the establishment of the Federal Committee on Research Natural Areas at the joint initiative of the Secretaries of Interior and Agriculture. Regionally, it took the form of increased interchange among the agencies. The Pacific Northwest Research Natural Area Committee, originally exclusively Forest Service, became interagency with representation of the Bureau of Land Management, Fish and Wildlife Service, and the National Park Service, as well as The Nature Conservancy. Their earliest cooperative efforts culminated in a guidebook to the then-existing 48 Federal Research Natural Areas (Franklin et al. 1972). Since 1972 the four Federal agencies have pooled financial resources to support a summer activities program (identifying, describing, and conducting research on natural areas) and have joined, of course, in sponsoring this report and the workshop upon which it is based.

There are, at present, 60 Federal Research Natural Areas in Oregon and Washington (fig. 1, table 1) and a number of additional areas being either considered or established (app. I).

Two aspects of the Federal program have evolved along with the improved coordination and the expansion of the system. The Forest Service involvement in the program was based initially upon the need for a system of areas which provided representative examples of the important forest and range types. All early Forest Service Research Natural Areas were of this type. In the middle 1960's, the concept was broadened to include all types of ecosystems, either typical or unique, aquatic as well as terrestrial. This broader concept has guided the entire Federal program since that time.

Secondly, the Federal agencies have continually endeavored to improve the systematic basis or general plan for the program. The plan developed here is, in fact, the latest in a series which have successively approximated the total scope of a system of reserves and remaining needs, each reflecting an improved understanding of the ecology of the region, future research needs, and the objectives of the system.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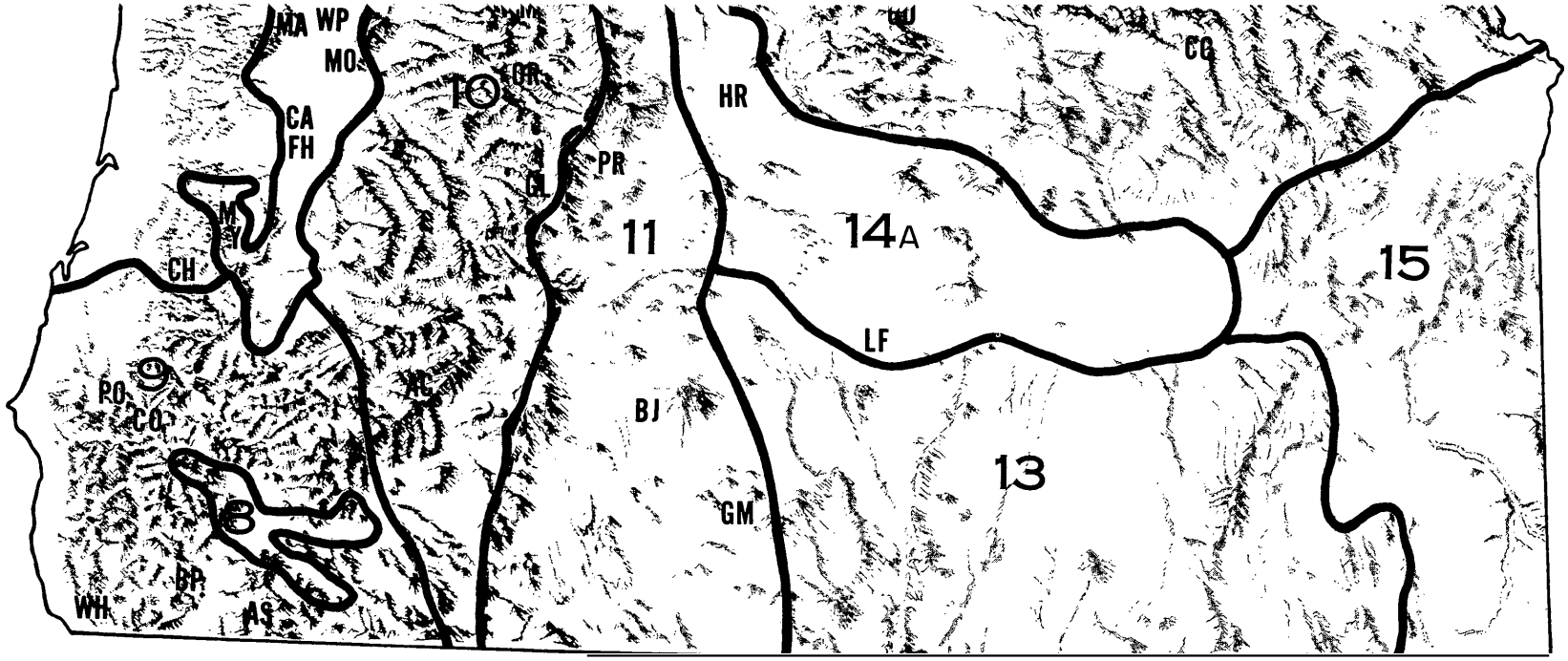


Figure 1.--Physiographic provinces and established Federal Research Natural Areas in Washington and Oregon. (See table 1, pages 6-8, for letter code for specific Research Natural Area.)

NO.	PROVINCE
1	Olympic Peninsula and Southwestern Washington
2	Puget Trough
3	Western Slopes and Crest, Washington Cascades
4	Eastern Slopes, Washington Cascades
5	Columbia Basin
6	Okanogan Highlands
7	Oregon Coast Ranges
8	Western Oregon Interior Valleys
9	Siskiyou Mountains
10	Western Slopes and Crest, Oregon Cascades
11	Eastern Slopes, Oregon Cascades
12	Ochoco, Blue, and Wallowa Mountains
13	Basin and Range
14	High Lava Plains and Columbia Basin A - High Lava Plains B - Columbia Basin
15	Owyhee Upland

Table 1.--*Established Federal Research Natural Areas in Oregon and Washington*

Code	Name	Principal features	Administering agency1	Area	
				Ha	Acres
AC	Abbott Creek	Sierran-type mixed conifer forest	FS	1 077	2,660
AS	Ashland	"Pacific" ponderosa pine, pure or mixed with Douglas-fir	FS	570	1,408
BA	Bagby	Douglas-fir-western hemlock forests	FS	227	560
BB	Baird Basin	Interior ponderosa pine, larch, and Douglas-fir	FWS	65	160
BI	Blackwater Island	Oregon white oak-Douglas-fir grassland on uplands, and willow, Oregon ash in lower portions, of channeled basalt along Columbia River	FWS	52	129
BJ	Bluejay	Ponderosa and lodgepole pine on coarse pumice	FS	85	210
BO	Boston Glacier	Major alpine glacier and cirque on northern Cascade Range including some recently deglaciated topography	NPS	1 061	2,620
BP	Brewer Spruce	Brewer spruce with many other conifers	BLM	85	210
BR	Bull Run	Noble and Pacific silver firs and western hemlock	FS	146	361
BU	Butter Creek	Subalpine mosaic of forest, meadow, and shrub communities with lakes and ponds	NPS	810	2,000
CA	Camas Swale	Dry Douglas-fir forest in foothills of Willamette Valley	BLM	130	320
CC	Canyon Creek	Interior ponderosa pine forest	FS	283	700
CF	Cedar Flats	Western redcedar and associated swamps and marshes and Douglas-fir forest	FS	275	680
CH	Cherry Creek	Coast Ranges Douglas-fir forest	BLM	239	590
CO	Coquille River Falls	Port-Orford-cedar stands	FS	202	500
DP	Diamond Point	Sitka spruce-western hemlock forest	FWS	36	88
FH	Fox Hollow	Dry Douglas-fir-ponderosa pine forest in foothills of Willamette Valley	BLM	51	125
GO	Goat Marsh	Extensive mountain marshes, record noble fir forest, beaver swamp, ponds, and lodgepole pine on recent mudflow	FS	484	1,195
GL	Gold Lake Bog	Subalpine bog communities and flora	FS	188	463
GM	Goodlow Mountain	Interior ponderosa pine forest	FS	510	1,260
HA	Hades Creek	Low-elevation Pacific silver fir-western hemlock forests	NPS	227	560
HI	Higley Creek	Western hemlock forests	NPS	194	480
HR	Horse Ridge	Western juniper savanna	BLM	243	600

See footnote at end of table.

Table 1.--*Established Federal Research Natural Areas in Oregon and Washington* (Continued)

Code	Name	Principal features	Administering agency[1]	Area	
				Ha	Acres
JC	Jackson Creek	Douglas-fir forest	NPS	65	160
LA	Lake Twentytwo	Western redcedar-western hemlock forests and subalpine lake	FS	320	790
LS	Little Sink	Slump ponds and conifer-bigleaf maple forest on margin of Willamette Valley	BLM	32	80
LC	Long Creek	Western hemlock forests	FS	259	640
LF	Lost Forest	Isolated ponderosa pine stands and sand dunes within a low-rainfall, shrub-steppe region in central Oregon	BLM	3 628	8,960
MC	Maitlen Creek	Douglas-fir/ninebark forest with stream drainage	FS	259	640
MA	Maple Knoll	Bigleaf maple stands	FWS	40	100
ME	Meeks Table	Interior ponderosa pine forests on isolated butte	FS	28	68
MI	Metolius	Interior ponderosa pine forests	FS	583	1,440
ML	Mill Creek	Mosaic of interior mixed-conifer and Oregon white oak forest, and grass and shrub steppe	FS	330	815
MO	Mohawk	Douglas-fir, western hemlock, and western redcedar forest in foothills along Willamette Valley	BLM	61	150
MY	Myrtle Island	California laurel stands	BLM	11	28
NC	Neskowin Crest	Sitka spruce-western hemlock forests	FS	278	686
NF	North Fork Nooksack	Douglas-fir and western hemlock forests	FS	605	1,495
OD	Ochoco Divide	Ponderosa pine-Douglas-fir and grand fir-western larch-Douglas-fir forests	FS	777	1,920
OR	Olallie Ridge	Subalpine mountain meadows with rich flora and mixed conifer forests	FS	291	720
PB	Pataha Bunchgrass	Bluebunch wheatgrass stands	FS	21	51
PE	Persia M. Robinson	Douglas-fir and ponderosa pine forests	FS	219	540
PI	Pigeon Butte	Oregon white oak stands	FWS	28	70
PN	Pine Creek	Interior ponderosa pine and grasslands	FWS	65	160
PO	Port Orford Cedar	Port-Orford-cedar and Douglas-fir forests	FS	454	1,122
PR	Pringle Falls	Lodgepole and ponderosa pine forests on coarse pumice	FS	470	1,160

See footnote at end of table.

Table 1.--*Established Federal Research Natural Areas in Oregon and Washington* (Continued)

Code	Name	Principal features	Administering agency[1]	Area	
				Ha	Acres
PL	Pyramid Lake	Subalpine lake with surrounding conifer forest	NPS	48	119
QU	Quinault	Western hemlock-Sitka spruce forests	FS	594	1,468
RC	Rainbow Creek	Interior mixed-conifer forest with abundant western white pine	FS	170	420
RH	Rattlesnake Hills	Dry Columbia Basin shrub steppe	ERDA	30 364	75,000
SA	Salmo	Interior subalpine fir and western hemlock-western redcedar forest with stream drainage	FS	563	1,390
SR	Sister Rocks	Pacific silver fir forests	FS	87	215
SM	Steamboat Mountain	Subalpine fir, Pacific silver fir and mountain hemlock forest, pond, and marshes	FS	567	1,400
TI	Tenasillahe Island	Black cottonwood-willow island stand in lower Columbia River	FWS	75	185
TP	Turnbull Pine	Interior ponderosa pine stands, grasslands, and ponds	FWS	81	200
TW	Twin Creek	Sitka spruce stands of "rain forest" type	NPS	40	100
WH	Wheeler Creek	Redwood-Douglas-fir forests near the northern limits of redwood	FS	135	334
WM	Wildcat Mountain	Noble fir, Pacific silver fir, and mountain hemlock forests associated with meadow and shrub communities	FS	405	1,000
WP	Willamette Floodplain	Willamette Valley bottomland grass and Oregon ash communities	FWS	97	239
WR	Wind River	Douglas-fir-western hemlock forests	FS	478	1,180
WW	Wolf Creek	Bitterbrush and bunchgrass communities	FS	61	150

[1] BLM = Bureau of Land Management
ERDA = Energy Research and Development Administration
FS = Forest Service
FWS = Fish and Wildlife Service (National Wildlife Refuges)
NPS = National Park Service.

The State of Washington

In January **1966,** the Intercampus Committee for Educational and Scientific Preserves (ICESP) met at Central Washington State College to discuss the development of a statewide Natural Area Preserve system. From **1967** to **1970,** with modest funding available, inventories of actual and potential natural areas were prepared by a number of individuals from Western Washington State College, University of Washington, and Washington State University. The inventories of State and private lands received cooperation from the State of Washington Department of Natural Resources. During this period, Wallace Heath, Chairman of the ICESP, helped to keep the idea of a Natural Area Preserve system viable, and he secured some interim funding. The **1970** Session of the State Legislature passed Senate Bill **360,** a proposal within the multiple-purpose act for the Department of Natural Resources; it authorized the withdrawal of certain lands under State ownership for scientific and educational purposes. In the fall of **1971,** Representative Lois North was approached with the concept of a statewide Natural Area Preserve system; Representative North secured a hearing on the subject by the Interim Legislature Council in December **1971,** and reaction was favorable. A bill to create a Natural Area Preserve system was introduced into the State legislature in January **19'72** (see appendix III for the complete text of this act); it was signed into law in February, at which time the Washington State Natural Preserves Advisory Committee was established with Gordon Alcorn of the University of Puget Sound as chairman. The Advisory Committee, consisting of seven voting members, is charged with reviewing prospective natural areas and with making recommendations to the Department of Natural Resources.

Natural areas are envisioned as permanent entities, and provisions have been made to ensure maximum protection. **As** such, their intended value embraces both educational and scientific interests. They allow continuing, nondestructive baseline studies, protection of endangered species, and, as "living museums," enhance the intrinsic cultural values, scenic beauty, and man's relationship to his environment.

Progress to date is as follows:

Natural preserve	*County*	*Status*	*Key feature*	*Size*	
				Ha	*Acres*
Sand Island and Goose **Island**	Grays Harbor	Established	Caspian tern rookery	10	**25**
Protection Island	Jefferson, off Point Discovery, Strait of Juan de Fuca	Established	Rhinoceros auklet rookery.	**15**	**36**
Mima Mounds	Thurston	Being negotiated for long-term lease from The Nature Conservancy	Mima mounds	**283**	700

The State of Oregon

The State of Oregon became formally involved in setting aside natural areas in **19'73** with the passage of the Oregon Natural Area Preserves Act (see app. **IV** for the complete text of this act). Glenn Patrick Juday, an Oregon State University graduate student, drafted most of the legislation and played a significant role in the passage of the act. The State Natural Area

Preserves Advisory Committee, authorized by the legislation and consisting of seven voting members, was appointed November 21, 1973, with Juday as chairman. This committee secures information, coordinates the State's efforts in natural area preservation, and makes recommendations to the State Land Board (comprised of the Governor, Secretary of State, and State Treasurer) concerning establishment of specific preserves. The authority to establish preserves is vested in the State Land Board. The Natural Area Preserves Act stipulates that State Preserves are established for scientific and educational benefits, as well as to encourage the appreciation of natural features.

The establishment procedure is a formalized rulemaking process that provides statutory protection from undue disturbance which would jeopardize a preserve's scientific and educational values. In addition to aiding in the establishment of preserves, the Advisory Committee is charged with surveying the State in order to create and maintain a registry of areas which may be suitable for inclusion within preserves. The Act provides that all areas included as preserves must be public lands. The committee is reviewing State Forest, State Park, Wildlife, and Board of Higher Education lands. According to the legislation, county and city parks, forests, and recreation lands may also qualify as Natural Area Preserves. Although no preserves have, as yet, been established, because of an excellent State Park acquisition history and generally progressive management by the State Forest system and the Wildlife Commission, a number of outstanding candidate areas are still available.

The Advisory Committee has, to date, concentrated on internal organization, establishing working relationships with the many individuals and agencies involved in natural area work, and establishing the procedure by which preserves are dedicated. It is expected that once these tasks are completed, the actual dedication of areas can proceed efficiently and rapidly.

The Nature Conservancy

The Nature Conservancy has a long historical involvement in preservation of Research Natural Areas. It began with the establishment of the Natural Areas Committee of the Ecological Society of America in 1917. This group, formed to take inventory of the remaining natural areas in North America became The Ecologists Union in 1946 and The Nature Conservancy in 1951. Its concerns have typically included Research Natural Areas, as defined in this document, but have also been somewhat broader, including preservation of land for other than strictly scientific and educational purposes. The Nature Conservancy has an active program of land acquisition by donation and purchase, as well as either managing these areas or tranferring lands to other agencies to insure their continued protection. Nationally, The Nature Conservancy has preserved over 600,000 acres (242 915 hectares) of land in over 1,100 preserves.

A substantial portion of The Nature Conservancy's programs is handled through local chapters and with volunteer labor. In Washington and Oregon three chapters have been chartered—the Western Washington, Inland Empire, and Oregon Chapters. In addition, a northwest office has been established to provide assistance to the chapters as well as liaison with the western regional and national offices.

Since establishment of the first preserve in the Pacific Northwest in 1962, 16 areas have been preserved (table 2). To establish priorities for natural area preservation, the Oregon Chapter has undertaken an Oregon inventory of natural areas on private lands (The Nature Conservancy 1974), an effort coordinated with State and Federal programs of natural area preservation. The Nature Conservancy is also involved in an inventory of natural areas in San Juan County, Washington.

In order to utilize inventory data and select priorities for natural area preservation activities, The Nature Conservancy has felt the need for an overall plan in which the needs, as well as their role relative to other groups, are defined; hence, its involvement in the planning activity reported in this document.

Table 2.--*The Nature Conservancy Preserves established or in process of establishment in Oregon and Washington*[1]

Name	Principal features	Size	
		Ha	Acres
Anderson Lake State Park Natural Area	Outdoor recreation area associated with State park in western Washington	6	15
Burnt Bridge Creek Natural Area	Freshwater marsh with marginal oak, maple, and Douglas-fir forests near Vancouver Lake in southwestern Washington; to be associated with natural recreational park	5	12
Camassia Natural Area	Oak, madrone, camas, and aspen associated with openings and rock gardens floristically rich and with numerous ponds on basalt bluffs above the lower Willamette River, Oregon; leased to Lewis and Clark College	9	23
Cascade Head Preserve	Oregon coastal headland with extensive grassland and conifer and red alder forest	121	300
Cogswell-Foster Preserve	Oregon white oak and Oregon ash woodlands and seminatural grasslands in central Willamette Valley, Oregon	34	83
Dickey River	Virgin coniferous forest on the west slopes of the Olympic Peninsula in Washington	2	6
Dishman Hills Natural Area	Part of 640-acre tract of ponderosa pine and Douglas-fir near Spokane, Washington, used for hiking and nature study	.32	80
Englehorn Pond Preserve	Pond and cattail marsh surrounded by low woods on edge of Columbia Basin in Ellensburg, Washington	1	2
Foulweather Bluff Preserve	Project to preserve waterfront and mixed conifer-hardwood forest along Hood Canal and a freshwater marsh on the eastern edge of the Olympic Peninsula in Washington	40	100
Lake Louise Ecological Preserve	Access tract to ecologically rich pond on an 80-acre Western Washington State College educational site	2	4

See footnote at end of table.

Table 2.--*The Nature Conservancy Preserves established or in process of establishment in Oregon and Washington*[1] (Continued)

Name	Principa1 features	Size	
		Ha	Acres
Lawrence Memorial Grasslands Preserve	Bluegrass-bunchgrass community '(steppe) on biscuit scabland near Shaniko, Wasco County,. eastern Oregon	153	378
Mima Mounds Research Natural Area	Mima mound phenomenon and associated vegetation near Olympia, Washington; area leased from Washington State Department of Natural Resources through The Nature Conservancy to Evergreen State College	222	548
Moxee Bog Preserve	Floating sphagnum bog with rare butterfly colony in steppe region of Yakima County, Washington; managed by Yakima Community College	6	14
Neahkanie Beach Natural Area	Rushes and grasses on strand and willows on stabi1ized dunes along northern Oregon coast	1	2
Protection Island	Rhinoceros auklet breeding ground and seal haul out off Point Discovery, Strait of Juan de Fuca. Managed by Washington State Department of Game	15	36
Rose Creek Preserve	Seminatural grassland and shrub communities in Palouse region of southeastern Washington; being restored	5	12
Sandy River Gorge Preserve	Project to acquire portions of river, gorge and associated river bar and canyon wall forests, lower Sandy River in western Oregon near Port1and	77	190
Waldron Island	Project to acquire beach, large marsh, and Douglas-fir-hardwood forests in San Juan Island group, Puget Sound, Washington; cooperating with San Juan Island Conservation Committee	104	256
Wildflower Acres Natural Area	Wooded area in urban Puget Sound environment, Snohomish County, Washington; conveyed to Western Washington State College	10	25

[1] Not all these areas qualify as Research Natural Areas in the sense of primary or exclusive dedication to scientific use.

Professional Societies

A number of professional societies, most notably the Society of American Foresters and the Society for Range Management, have encouraged preservation of Research Natural Areas in the Pacific Northwest. For a perspective on these programs, which do not involve actual acquisition of lands, see Romancier (1974).

DEVELOPMENT OF THE SYSTEM OUTLINE

The need for developing an overall Research Natural Area plan for Oregon and Washington is obvious. Suitable areas are rapidly being converted to other uses, reducing options for preserving examples of specific organisms and natural ecosystems — permanently in some cases. The profusion of individuals, agencies, and institutions actively involved suggests possible duplication of effort with consequent inefficiencies and confusion in the minds of the public as well as the land managers and politicians who must respond to the numerous proposals and initiatives. Comprehensive land planning by several major Federal land management agencies as well as by State and local governments makes the comprehensive outline of the ecosystems and organisms of critical scientific interest particularly important. Land managers and planners, as well as other interested public and private groups, need to know the scope and content of a minimal scientific preserve system, that it is finite, and that the diverse activities are coordinated.

In 1972 and early 1973, each major group involved in Research Natural Area programs concluded, almost simultaneously, that it needed a plan to guide its activities, including a listing of ecosystems and organisms of interest and a priority ranking for consideration. At the Federal level, this was reflected in a determination by the Pacific Northwest Research Natural Area Committee to prepare a new list of natural area needs to guide Federal land planners. In the States of Washington and Oregon, the Natural Area Advisory Committees established under recent legislation were charged with developing master plans outlining the scope and content of the system. The Nature Conservancy also wanted a long-range plan for its activities.

Aware of their similar and overlapping needs, these four groups agreed to join in a common effort to develop a comprehensive outline for an Oregon-Washington Research Natural Area system under the leadership of Robert E. Buckman, Chairman of the Pacific Northwest Research Natural Area Committee, the focal point for Federal agency activity in this region. As the initial step, a workshop was held in late November of **19'73** to develop an outline of a minimal Research Natural Area system for the Pacific Northwest which would also identify the roles of each agency and institution involved in establishing such preserves.

Workshop Format and Charge

The workshop was planned and charged with its tasks by the Steering Committee, organized and headed by Dr. Buckman. Steering Committee members were primarily State and Federal agency heads charged with significant administrative responsibilities:

Robert E. Buckman, Director, Pacific Northwest Forest and Range Experiment Station, U.S. Forest Service

Kessler R. Cannon, Governor's Assistant for Natural Resources (Oregon)

Archie D. Craft, State Director, U.S. Bureau of Land Management

Don Lee Fraser, Supervisor, Natural Resources, Washington Department of Natural Resources

Arthur R. Kruckeberg, Chairman, Washington Intercampus Committee on Educational and Scientific Preserves
Kenneth R. Margolis, Northwest Representative, The Nature Conservancy
R. Kahler Martinson, Regional Director, U.S. Fish and Wildlife Service
John A. Rutter, Regional Director, National Park Service
Theodore A. Schlapfer, Regional Forester, U.S. Forest Service
Phillip W. Schneider, Regional Executive, National Wildlife Federation

Attendance at the workshop was limited to keep the group of a workable size (see list of participants in app. VII); consequently, all interested and concerned scientists and other individuals could not be invited. Neverthel'ess, it was essential that participants representing the various relevant scientific disciplines (for example, geology, soils, limnology, and marine biology), as well as the major institutions and agencies involved in the Research Natural Area programs, be present. It was viewed as particularly important to have both scientists and land managers present because any plan needed to bejointly developed and mutually acceptable — those who could best identify the needs and would use the area should join in planning with those aware of the constraints and possibilities and who would set up and administer such tracts.

Workshop participants were charged with identifying the elements of a minimal Research Natural Area system for Oregon and Washington. In other words, what kinds of ecosystems and numbers of each should be protected by a Federal, State, or private institution within scientific reserves? The steering committee, in turn, reviewed the product of the workshop for its overall soundness and acceptability.

To meet this overall objective, six tasks were identified for the workshop participants:

1. Identify the terrestrial ecosystems which should be represented in the various physiographic provinces;
2. Identify the freshwater ecosystems which should be represented in the various physiographic provinces;
3. Identify the marine ecosystems, including estuarine, that should be represented;
4. Review rare and endangered plant and animal species and identify and list those best handled in a Research Natural Area context;
5. Match the four lists of needs against features already preserved in Research Natural Areas to identify remaining needs; and
6. Rank the remaining needs as to priority for attention and identify a lead agency or organization for each of the remaining needs (the group most likely to be able to fill the need).

To accomplish these tasks the participants were divided into five working groups based on their expertise: terrestrial ecosystems west of the Cascade Range, terrestrial ecosystems east of the Cascade Range, freshwater ecosystems, marine and estuarine ecosystems, and rare and endangered organisms.

Some additional guiding principles were provided:

1. The system should include examples of' typical ecosystems as well as those which are unique or unusual.
2. Areas, features, and organisms having some scientific interest are practically infinite and only those cases requiring a special designation to protect the scientific values and enhance research potential should be identified as Research Natural Area needs. Scientific and educational values of an area can often be protected by other means. A species of plant or animal can be protected, sometimes more adequately, without requiring a Research Natural Area. Since land is a limited commodity with many competing uses, the Research Natural Area designation should be used only where it is essential.

3. Number of required areas for a given ecosystem should vary with its importance and variability. For example, where a particularly important system, such as Douglas-fir forest, is involved, sufficient examples should be proposed to encompass the major mixtures, environments, and ages. Furthermore, their importance should be considered in the context of whether the variations are sufficient to result in major differences in ecosystem function (e.g., growth) and to have different land management implications.

Operation of the Workshop

The findings of the working groups and overall plan for the system are presented in later sections; however, it might be helpful to indicate how the effort evolved. At the outset the five working groups differed markedly in their starting point. The terrestrial groups and, to a lesser extent, the aquatic (freshwater) group had preliminary lists from which to work. Working groups on marine ecosystems and rare and endangered organisms had no listings or classifications relevant to planning scientific reserves.

Primary attention evolved toward the listing of cells—ecosystems or organisms which needed to be represented—as these are the basic subject units in developing a system. Various geographic or physiographic provinces were, in the case of terrestrial and aquatic systems, used as the basic stratification; and cellular listings were developed for each province. The cells differed in the degree to which they were defined, depending largely upon the level of knowledge about that ecosystem.

It became clear early in the deliberations of the working groups that a number of the cells could reasonably be expected to occur together and, hence, might possibly be combined into a single Research Natural Area. In the terrestrial and aquatic (freshwater) groups this process of aggregation advanced almost simultaneously with the listing of cells. In this way, the probable number of needed areas and their desired composition with regard to cells were developed together. Listings of cells in the marine and rare and endangered groups proceeded in a somewhat different fashion (see the reports of these working groups); ultimately rare and endangered cells for some animals were identified and incorporated into the list of needed Research Natural Areas.

The Cellular Approach To Developing Research Natural Area Needs

Before proceeding with the report, it is important that the reader have some concepts firmly in mind. Cells are the basic units which must be represented in a natural area system. A cell can be an ecosystem, community, habitat, or organism. Organisms are generally recognized implicitly in cells identified for ecosystems, communities, or habitats. However, where an organism is of particular scientific significance or is rare or threatened, it may receive explicit recognition as a cell.

A "Research Natural Area need," as identified in this report, is typically an aggregation of several cells which need representation. This, of course, assumes that these cells can be found together. The listed "needs" are simply guides intended mainly to encourage, insofar as possible, the establishment of multicellular Research Natural Areas. It may or may not prove possible to find a "Research Natural Area need" with the described aggregation of cells when a site is actually sought in the field. In all cases it must be remembered that it is the individual cell which is the basic unit requiring representation.

Part II. Research Natural Area Needs by Province

Outlined in this section are the major elements proposed for a comprehensive Research Natural Area system. It is based upon the best judgments of many individuals in universities and State and Federal agencies as well as the private sector. The plan should not be considered as either final or complete; it is a starting point and will be periodically revised. As the system develops and our knowledge of natural ecosystems increases, we should expect the type and number of areas needed to evolve through improved definition of needs, additions, and deletions. The potential role and needs for Research Natural Areas in marine ecosystems and for rare and endangered organisms are, perhaps, most poorly understood.

Nonetheless, it is clear what the overall scope of a minimal Research Natural Area system must be. The numbers of desired cells are summarized by physiographic province in table 3 for terrestrial and aquatic (freshwater) ecosystems and total approximately 360 and 180, respectively. Cells for rare and endangered vertebrate animals total 94. Substantial progress has already been achieved in representing examples of terrestrial cells (approximately 25 percent complete); however, existing Research Natural Areas have served aquatic needs much more inadequately (approximately 10 percent of cells are filled). Existing Research Natural Areas are known to fill only seven of the rare and endangered animal cells. Vascular plants of special interest were not identified as cells; a few are present on existing Research Natural Areas but our knowledge of the flora of many reserves is quite poor.

Table 3.--*Number of terrestrial, aquatic, and rare and endangered animal cells or ecosystems needing representation in Research Natural Areas in Oregon and Washington and number already filled or represented in existing reserves*

Province	Terrestrial cells		Aquatic (freshwater) cells		Rare and endangered animal cells	
	Total	Filled	Total	Filled	Total	Filled
Olympic Peninsula and Southwestern Washington	27	8	17	0	4	0
Puget Trough	16	2	8	1	4	0
Western Slopes and Crest, Washington Cascades	31	16	18	7	8	0
Eastern Slopes, Washington Cascades	21	4	11	0	7	0
Columbia Basin, Washington	43	7	13	2	12	3
Okanogan Highlands	27	5	11	2	3	0
Oregon Coast Ranges	23	5	13	0	4	1
Western Oregon Interior Valleys	26	8	9	1	6	0
Siskiyou Mountains	26	7	14	2	8	2
Western Slopes and Crest, Oregon Cascades	27	7	17	3	7	1
Eastern Slopes, Oregon Cascades	17	9	8	0	2	0
Ochoco, Blue, and Wallowa Mountains	25	6	13	0	5	0
Basin and Range	19	0	14	0	10	0
High Lava Plains and Columbia Basin, Oregon	19	8	6	0	8	0
Owyhee Upland	15	0	8	0	6	0
Total	362	92	180	18	94	7

Although the identification of marine and estuarine cells is not as complete, this working group recommended the establishment of 68 Research Natural Areas in coastal environments. If we assume that each natural area will fill, on the average, two cells, our estimate of total marine and estuarine cells amounts to approximately 172.

Putting all these cells or basic planning components together, we arrive at a Research Natural At-ea (RNA) system which should incorporate about 772 ecosystems, habitats, or rare and endangered organisms:

Terrestrial cells	362
Aquatic (freshwater) cells	180
Rare and endangered animal cells	94
Marine and estuarine cells'	136
Total	772

Of course, this in no way implies a need for that many Research Natural Areas. In fact, it is estimated that the actual number of Research Natural Areas needed to provide examples of the various ecosystems is considerably less than half, or about 360. This is because areas can logically be selected which will fill several cells (terrestrial, aquatic, and rare and endangered) simultaneously. Experience to date with the 60 established Federal Research Natural Areas (see table 1) indicates an average of around two filled cells per area even though most were selected to represent a single cell. One (Rattlesnake Hills RNA) fills at least 10 cells needed in the Columbia Basin.

Research Natural Area needs were identified on a province-by-province basis (fig. 1), following a common format which incorporates most of the relevant information for each. The province presentation begins with a brief description of the physical and biologic features encountered. The cells which should be represented in a minimal natural area system are listed and described for terrestrial and aquatic (freshwater) ecosystems and rare or endangered vertebrate animals. Vascular plants of special interest are briefly discussed and listed. These necessary cells or components in the province are then compared with existing Research Natural Areas to determine cells which remain to be filled.

The last table in each province presentation identifies the type and number of additional Research Natural Areas which will probably be required to provide minimal coverage of the remaining unfilled cells. This has been done by aggregating the unfilled cells which could, with reasonable likelihood, be found within a single area and listing these as needed Research Natural Areas. In other words, the unfilled cells have been aggregated into *tentative* units listed as Research Natural Area needs.

The proposed Research Natural Area needs can be summarized as follows:

Terrestrial-aquatic (freshwater) RNA's	46
Terrestrial RNA's	125
Aquatic (freshwater) RNA's	64
Special interest plant and animal RNA's	13
Marine and estuarine RNA's (tentative)	68
Total additional RNA's	316
Existing RNA's	60
Total RNA's in proposed system	376

Research Natural Area needs are summarized by State and physiographic province in table **4.**

'We have not attempted to define marine and estuarine cells but rather **specific** areas needed as **RNA's.** Therefore, this **is** only a very rough estimate o f number of 'needed cells.

Table 4.--*Estimated number of* **Research Natural Areas needed by State and physiographic province**
(Does not include marine and estuarine needs)

State and Province	Terrestrial and aquatic (freshwater) RNA's	Terrestrial RNA's	Aquatic (freshwater) RNA's	RNA's for rare and endangered species	Total
Washington:					
Olympic Penninsula and Southwestern Washington	6	9	6	1	22
Puget Trough	0	11	6	0	17
Western Slopes and Crest, Washington Cascades	3	9	6	3	21
Eastern Slopes, Washington Cascades	3	11	4	3	21
Columbia Basin, Washington	0	9	3	0	12
Okanogan Highlands	3	9	1	0	13
Total	15	58	26	7	106
Oregon:					
Oregon Coast Ranges	6	5	4	0	15
Western Oregon Interior Valleys	1	14	6	1	22
Siskiyou Mountains	5	10	6	3	24
Western Slopes and Crest, Oregon Cascades	5	13	4	0	22
Eastern Slopes, Oregon Cascades	3	6	4	1	14
Ochoco, Blue, and Wallowa Mountains	5	9	4	0	18
Basin and Range	4	2	4	0	10
High Lava Plains and Columbia Basin, Oregon	0	4	5	0	9
Owyhee Upland	2	4	1	1	8
Total	31	67	38	6	142
Total, both States	46	125	64	13	248

A final reminder to users of these lists:

(1) Lists are not "final" but will undoubtedly be adjusted in future years. They do provide a basic outline for identifying candidate Research Natural Areas as a part of comprehensive land use planning.

(2) Cells are the basic units requiring representation and the focus is on filling these. The Research Natural Area needs listed are our best estimate as to how this can be done with the greatest economy in number and size of areas required.

(3) Scientists from several disciplines will be necessary in selecting areas to fill several cells.

(4) The listing of multicell Research Natural Areas should not lead to excessive pursuit of an ideal area. If an area with all attributes listed cannot be found after a reasonable search, the need as listed here should be broken down into two or more Research Natural Area needs which cover the same cells.

(5) Most of the needed Research Natural Areas are common or typical ecosystems rather than unique or unusual types. These should be as representative as possible of the normal environments (geology, climate, soils, etc.) occupied by those ecosystems. Representativeness is extremely important if Research Natural Areas are to be used **as** baseline or control areas for managed lands and as sites for research with management relevance.

(6) Size of desired areas will vary widely and is determined by the nature of the ecosystem or organism we wish to preserve.

OLYMPIC PENINSULA AND SOUTHWESTERN WASHINGTON PROVINCE

The Olympic Peninsula is made up of a central core of the rugged Olympic Mountains surrounded by almost level lowlands (fig. 1). The effects of glaciation and rapid stream dissection due to the extremely heavy precipitation have combined to produce precipitous mountain slopes. All river valleys draining the Olympic Mountains are broad and U-shaped; and all major peaks are ringed with cirques, many containing active glaciers.

Geologically, the central portion of the Olympic Mountains is made up of late Mesozoic graywacke, with some interbedded slate, argillite, and volcanic rocks. This interior portion is encircled on the north, east, and south by two belts of volcanic rocks (largely basalt and flow breccia). The broad, level areas along the western and southern margins of the peninsula have been interpreted as marine terraces or glacial outwash fans.

Forested soils formed on the sedimentary rocks of the interior of the Olympic Mountains have been reported to be Brown Podzolics, with silt loam surface horizons and sandy clay loam B horizons. On the more gentle slopes, basalt parent materials give rise to deep, well-developed reddish-brown soils, generally of silty clay loam texture. Soils on glacial outwash deposits tend to be poorly developed and coarse textured (gravelly sandy loam is typical). Terraces adjoining principal river channels are generally mantled with deep silt loam soils which remain moist throughout the year.

Southwestern Washington, which includes the Willapa and Black Hills, is a region of low, rounded hills largely comprised of Eocene sandstone and siltstone.

For the most part, soils tend to be deep, reddish-brown in color, and fairly fine-textured. Along the coast, small areas of sand dunes are present, especially in the Long Beach area.

Dense coniferous forest with associated fauna and the streams and rivers are the dominant biologic features of this province (Franklin and Dyrness **1973).** Western hemlock, Sitka spruce, Douglas-fir, and western redcedar dominate at lower and true firs at higher elevations. The "Olympic rain forests" on the west slopes of the peninsula are well known, with their elk and epiphyte-draped trees. Subalpine parklands and alpine regions cover substantial areas in the Olympic Mountains. Substantial variation exists in these ecosystems, however, reflecting both

climatic differences and historical effects. The northeastern and eastern portions of the Olympic Peninsula are much drier than the remainder of this generally superhumid province. Douglas-fir and subalpine fir are more conspicuous in this drier region, and the alpine region is more extensive. The southwestern Washington Coast Ranges have been heavily altered by logging and are dominated by much younger, secondary forests of conifers and red alder.

The coastal areas add substantially to the biotic diversity of this province; distinctive ecosystems are associated, for example, with the sand dunes, rocky headlands and islands, coastal plain prairies and cedar swamps, and ocean-front forests.

Dominant freshwater systems are streams and rivers, some of glacial origin, oligotrophic lakes and ponds at higher elevations, and a variety of bog and swamp ecosystems on the coastal plain. Anadromous fish are an important biotic element in many of the river and stream systems.

Identified terrestrial cells in the Olympic Peninsula and southwestern Washington Coast Ranges total 27 (table 5). These consist largely of the major variants of the coniferous forests and the complex subalpine and alpine community mosaics. Five of the cells specifically identify necessary coverage of the specialized coastal front and plain communities.

Aquatic cells total 17 (table 6) and recognize a need for designation of major stream drainages on both sides of the peninsula as Research Natural Areas. Two cells recognize anadromous fish runs as necessary components (Nos. 1 and 11). The remaining cells are mainly small lakes and ponds in a variety of environments, and swamps, marshes, and bogs on the coastal plain.

It is presumed that the terrestrial and freshwater areas will include the normal complement of animal and plant species. Four animal species are listed as cells for Research Natural Area consideration because of their rare and endangered status (table 7). The list of vascular plants of special interest is relatively long (table 8) and includes 12 species on the Smithsonian list of endangered and threatened plants. This is a consequence of the presence of several endemic species as well as numerous disjunct populations in the isolated Olympic Mountain block; most of these are subalpine and alpine plants and are concentrated in the northeastern part of the peninsula. The other major group of vascular plants of special interest is associated mainly with specialized habitats (bogs, marshes, cliffs) on the coastal plain.

There are six existing Research Natural Areas in this province (table 9), mostly small and all Federal, with four located in Olympic National Park. These fill 8 of 27 terrestrial cells and none of the freshwater or rare and endangered animal cells.

Consequently there is a large number of Research Natural Areas which need to be selected and established in the Olympic Mountains and Coast Ranges of Washington (table 10). Our tentative estimate is that 22 additional Research Natural Areas can provide minimal coverage of all listed cells and a majority of special interest vascular plants. Six of these **(Nos. 1-6)** involve relatively large areas to encompass a variety of terrestrial and aquatic cells typically taking in a complete drainage system of a stream, lake, or pond. Most of the remainder involve smaller areas to encompass one or two cells. Because of the large number of special interest vascular plants at high elevations in the Olympic Mountains, an alpine tract focused on several of these will probably prove necessary in addition to inclusion of typical alpine ecosystems in need No. 5.

Lead responsibility in this province is clearly split between the National Park Service and Forest Service on the peninsula, with Washington State, assisted by private organizations and the Fish and Wildlife Service, critical in the Coast Ranges. Olympic National Park clearly will shoulder the greatest load in both the coastal plain and mountains of the peninsula; but even there, cellular needs cannot be fully met solely within the Park (see, for example, No. 2). One of the most difficult needs to fill may be the cedar swamp with ponds and anadromous fish (No. **3),** but it is considered critical.

The priority ratings reflect the already protected status of ecosystems within Olympic National Park; the ecosystems in the heavily impacted and rapidly developing southwestern Coast Ranges clearly need immediate attention. Nevertheless it is important that selection and establishment of tracts in Olympic National Park proceed quickly, as they represent such a large element in the province's Research Natural Area needs.

Table 5.--*Terrestrial cells in the Olympic Peninsula and Southestern Washington Province*

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Western Hemlock Zone:			
1. Old-growth Douglas-fir on a major river terrace, west side of peninsula	229	Jackson Creek RNA	72-82
2. Douglas-fir-western hemlock on a marine terrace, west side of peninsula	230	Quinault RNA	72-82
3. Western hemlock/swordfern, west side of peninsula	224	Quinault and Higley Creek RNA's	77-78
4. Western redcedar-western hemlock on the coastal plain, west side of peninsula	227	Quinault RNA	79-82
* 5. Western redcedar-western hemlock on uplands	227	Token, needs additional area	79-82
* 6. Typical Douglas-fir-western hemlock forest on slopes, east side of peninsula	230	None	72-82
* 7. Douglas-fir-western hemlock/Oregongrape forest on slopes, east side of peninsula	230	None	82
* 8. Pure stand of red alder on upland site	221	None	61-63
Pacific Silver Fir Zone:			
* 9. Typical noble fir forest in Willapa Hills area	226	None	94-98
10. Pacific silver fir-western hemlock at low-elevation, west side of peninsula	226	Hades Creek RNA	94-98
*11. Pacific silver fir-western hemlock at mid- to high elevations, west side of peninsula	226	None	94-98
*12. Pacific silver fir/salal community on slopes, east side of peninsula	226	None	94-98
Sitka Spruce Zone:			
13. Sitka spruce-western hemlock/swordfern community	225	Twin Creek and Quinault RNA's	59-61
14. Second-growth Sitka spruce-western hemlock forest	225	Diamond Point RNA	59-61
*15. Sitka spruce/salal community ocean front	223	None	59-61

See footnote at end of table.

Table 5.--*Terrestrial cells in the Olympic Peninsula and Southestern Washington Province*
(Continued)

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Subalpine and Alpine Zones:			
*16. Mountain hemlock-Pacific silver fir forest in western Olympic Mountains	205	None	101-106
*17. Subalpine fir forest in northeastern portion of Olympic Peninsula	206	None	101-106
*18. Subalpine parkland mosaic with mountain hemlock and heather-huckleberry dominance, western Olympic Mountains	205	None	101-106 250-268
*19. Subalpine parkland mosaic with subalpine fir and grass-forb dominance, eastern Olympic Mountains	206	None	101-106 250-268
*20. Alpine community mosaic, including krummholz, northeastern Olympic Mountains		None	284-290
Special types:			
*21. Western redcedar swamp on coastal plain with evergreen huckleberry understory and possibly patches of skunkcabbage	228	None	68-69
22. Typical red alder swamp	221	Higley Creek and Diamond Point RNA's	68-69
*23. Typical riparian hardwoods (red alder-cottonwood)	221	None	66-67
*24. Lodgepole pine forest, ocean front	216	None	291-294
*25. Coastal sand dunes, including both active and stabilized dunes		None	291-294
*26. Typical coastal prairie, west side of peninsula		None	69-70
*27. Sitka spruce/willow community, tideland area	223	None	

*Cells presently lacking adequate representation.

Table 6.--*Aquatic cells in the Olympic Peninsula and Southwestern Washington Province*

Cell[1]	Present representation	Remarks
* 1. Major stream drainage with coniferous forest and anadromous fish run	None	Should be on west side of peninsula
* 2. Major stream drainage with coniferous forest on east side	None	Stream draining east slopes of Olympic Mountains
* 3. Oligotrophic lake at low elevation	None	
* 4. Lake and drainage basin of subalpine forest or forest and meadow	None	
* 5. Typical alpine lake and drainage basin	None	
* 6. Low-elevation permanent pond	None	
* 7. Subalpine permanent pond	None	
* 8. Alpine permanent pond	'None	
* 9. Low-elevation vernal pond	None	
*10. Subalpine permanent pond	None	
*11. Stream draining western redcedar swamp, with anadromous fish	None	West side of peninsula
*12. Headwaters of a subalpine stream, one fork glacially fed, another fork nonglacial	None	
*13. Large, upwelling cold spring	None	
*14. Typical hot spring	None	
*15. Western redcedar swamp	None	
*16. Typical marsh area	None	
*17. Coastal bog	None	Myrica is typical shrub species

'Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the listed ecosystem.

*Cells presently lacking adequate representation.

Table 7.--*Rare and endangered vertebrate animal cells in the Olympic Peninsula and Southwestern Washington Province*

Cell	Verified representation	Reference
Fish:		
*1. Olympic mudminnow	None	
Amphibians:		
*2. Dunn salamander	None	Stebbins 1954
Mammals:		
*3. Western pocket gopher (subspecies *melanops*)	None	Dalquest 1948 Johnson and Johnson 1952
*4. Heather vole	None	Dalquest 1948 Johnson and Johnson 1952 Maser and Storm 1970 Edwards 1955 Johnson *1973* Shaw 1924

*Cells presently lacking adequate representation.

Table 8.--*Vascular plants of special interest in the Olympic Peninsula and Southwestern Washington Province*

Species[1]	Distribution
Anemone oregana var. *felix*[2]	Marshes or sphagnum bogs, Grays Harbor County
Arenaria paludicola[2]	Coastal southwestern Washington
Argostis aequivalvis	Bogs, Lake Ozette north
Aster paucicapitatus	Subalpine parkland, Olympic Mountains
Astragalus cottonii	Alpine talus, Olympic Mountains
Botrychium lanceolatum	High-elevation, moist areas
Botrychium virginianum	Broad elevational range
Calamagrostis crassiglumis	Around lakes; subalpine rock crevices, Olympic Mountains
Campanula piperi	Peat bogs and swampy woods, Grays Harbor County north
Carex pluriflora	Marsnes and streambanks, south to Clallam County
Castilleja parviflora var. *olympica*[2]	Subalpine meadows, Olympic Mountains
Cheilanthes lanosa	Olympic Mountains
Cimicifuga elata	Lower elevations
Delphinium nuttallii	Outwash prairies and basaltic cliffs, Grays Harbor County south
Douglasia laevigata	Northeastern Olympic Mountains
Draba incerta	Olympic Mountains
Eburophyton austiniae	Deep coniferous forest
Elmera racemosa	Olympic Mountains
Erigeron aliceae	Olympic Mountains
Erigeron flettii[2]	Higher elevations, Olympic Mountains
Erysimum arenicola var. *arenicola*	Higher elevations, Olympic Mountains
Erythronium revolutum	Widely distributed
Gentiana douglasiana	Lake Ozette area
Geum triflorum var. *campanulatum*	Olympic Mountains
Hedysarum occidentale	Olympic Mountains
Howellia aquatilis	Ponds and lakes
Lewisia columbiana var. *rupicola*	Olympic Mountains
Lomatium martindalei var. *flavum*[2]	Olympic Mountains
Myrica californica	Coastal dune habitats, Grays Harbor County south
Myrica gale	Coastal bogs, Grays Harbor County south
Nephrophyllidium crista-galli	Bogs and wet meadows, Olympic Peninsula

See footnotes at end of table.

Table 8.--*Vascular plants of special interest in the Olympic Peninsula and Southwestern Washington Province* (Continued)

Species[1]	Distribution
Oxytropis viscida	Olympic Mountains
Pedicularis bracteosa var. *atrosanquinea*	Olympic Mountains
Petrophytum hendersonii[2]	Olympic Mountains
Phacelia bolanderi	Wahkiakum County
Pleuricospora fimbriolata	Olympic Mountains
Poa pachypholis[2]	Rare endemic on ocean cliffs, Pacific County
Polemonium carneum	
Polypodium scouleri	Epiphyte in dunes and salt spray zone
Polystichum andersonii	
Polystichum kruckebergii[2]	Hurricane Ridge, Olympic Mountains
Ranunculus cooleyae	Mount Colonel Bob, Olympic Mountains
Ribes lobbii	Disjunct reported on Olympic Peninsula
Romanzoffia tracyi	Along coast of Olympic Peninsula
Sanquisorba menziesii	Southern limit in Olympic Mountains
Saxifraga oppositifolia	Olympic Mountains
Senecio flettii	Moderate to high elevations, Olympic Mountains
Senecio websteri[2]	Endemic at high altitudes, Olympic Mountains
Sisyrinchium californicum	Bogs near coast
Stellaria humifusa	Widely disjunct in salt marshes
Synthyris pinnatifida var. *lanuqinosa*[2]	Alpine endemic, Olympic Mountains
Synthyris schizantha[2]	Moist shaded cliffs at moderate to high elevations, Olympic Peninsula
viola flettii[2]	Subalpine to alpine, northeastern Olympic Mountains

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or identification nationally (in the Smithsonian Institution list) as threatened or endangered species.

[2]The species is on the national list of threatened and endangered plants (Smithsonian Institution 1974).

Table 9.--*Established Research Natural Areas in the Olympic Peninsula and Southwestern Washington Province*

Name	Principal features	Agency[1]	Area	
			Ha	Acres
Diamond Point RNA	Sitka spruce-western hemlock forest on an island in Willapa Bay	FWS	36	88
Hades Creek RNA	Low-elevation Pacific silver fir-western hemlock forest	NPS	227	560
Higley Creek RNA	Western hemlock forests	NPS	194	480
Jackson Creek RNA	Douglas-fir forest	NPS	65	160
Quinault RNA	Western hemlock-Sitka spruce forests	FS	594	1,468
Twin Creek RNA	Sitka spruce stands of "rain forest" type	NPS	40	100

[1] FS = Forest Service, FWS = Fish and Wildlife Service, NPS = National Park Service.

Table 10.--*Additional Research Natural Areas needed in the Olympic Peninsula and Southwestern Washington Province*

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Combined terrestrial and aquatic natural areas:						
1. Large stream drainage on western slopes of Olympics with Sitka spruce-western hemlock and Pacific silver fir-western hemlock forest	T-11,13,10 A-1 R&E-1,2	Expansion of Twin Creek RNA may fill this need	Medium	NPS	64-67 94-98	0103
2. Large stream drainage on eastern slopes of Olympics with Douglas-fir-western hemlock/Oregongrape forest	T-7,12 A-2	May have to be joint FS-NPS RNA	High	FS NPS	82	0102
3. Western redcedar swamp with ponds and stream with anadromous fish	T-21,4,5 A-6,11,15	Ocean strip of Olympic National Park	High	NPS FS	68-69	0104
4. Mountain hemlock-Pacific silver fir forest, subalpine parkland mosaic, lakes, and ponds	T-16,18 A-4,7,10 R&E-3,4	Western portion of Olympic Mountains, Olympic National Park	Medium	NPS	101-106 250-268	0105
5. Subalpine fir forest, subalpine parkland mosaic, alpine community mosaic, lakes, and ponds	T-17,19,20 A-4,5,7,8,10 R&E-4	Northeastern portion of Olympic Mountains, Olympic National Park (Hurr cane Ridge Area)	Medium	NPS	101-106 250-268 284-290	0105
6. Riparian hardwood forest (red alder-cottonwood) along a major river and vernal ponds	T-23 A-9	Along Hoh River or tributaries to Quinault River	Low	NPS	66-67	0103 0104
Predominantly terrestrial natural areas:						
7. Ocean-front Sitka spruce/salal community	T-15	West coast of Olympic Peninsula	Medium	NPS	59-61 291-294	0104
8. Ocean-front lodgepole pine forest	T-24	Leadbetter Point	Medium	State	291-294	0202
9. Western redcedar-western hemlock forest	T-5	Long Island	High	State	79-82	0202
10. Upland red alder forest	T-8	Northwestern portion of Olympic Peninsula	Low	State Private	61-63	0103
11. Coastal sand dunes	T-25	Needs prograding dunes on north or south side of feeding river, both active and stabilized. Leadbetter Point or Fort Stevens	High	State FWS	291-294	0202
12. Pacific silver fir/salal community on east side of Peninsula	T-12		High	FS NPS	94-98	0102
13. Typical coastal prairie	T-26 R&E-3	Proposed Pats Prairie RNA may fill need	Medium	FS NPS	69-70	0104

See footnotes at end of table.

Table 10.--*Additional Research* ***Natural*** *Areas needed in the Olympic Peninsula and Southwestern Washington* ***Province*** (Continued)

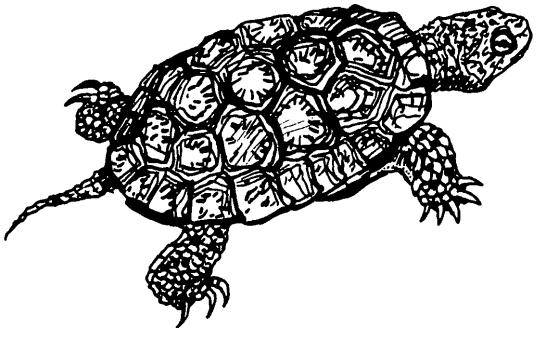
Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
14. Douglas-fir-western hemlock and noble fir forest in the Willapa Hills area	T-6,9	Weyerhaeuser Company ownership	High	Private State	79-80 94-98	0202
15. Sitka spruce/willow in tideland habitat	T-27	North Hunting Island	High	FWS		
Predominantly aquatic natural areas:						
16. Low elevation oligotrophic lake	A-3	Fern Lake is candidate area	Medium	State		0104
17. Subalpine stream with two major tributaries--one glacially fed, the other nonglacial	A-12	Olympic National Park	Medium	NPS		0101
18. Large, upwelling cold spring	A-13		Low	NPS State		
19. Typical hot springs area	A-14		Medium	NPS State		
20. Low elevation marshland	A-16		Medium	NPS Private State	68-69	0104
21. Typical coastal bog (*Myrica*)	A-17		Medium	NPS Private State		0104
Natural area for special interest species:						
22. Alpine tract		Northeastern Olympic Peninsula; area with populations of several vascular plants of special interest such as *Senecio websteri*, *Synthyris pinnatifida*, and *Viola flettii*	Medium	NPS FS		

[1]For a description of these cells see table 5 for terrestrial (T) etosystems, table 6 for aquatic (A) ecosystems, and table 7 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate cells considered essential components of the proposed Research Natural Area; those not underlined represent cells which would be desirable but not essential.

[2]Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is, i.e., the danger that all examples of that type will be lost to other uses. Acquisition urgency.

[3]Agency or institution most likely to have or to be able to acquire a tract of the desired type based on land ownership. FS = Forest Service, FWS = Fish and Wildlife Service, NPS = National Park Service.

[4]See appendix V.



PUGET TROUGH PROVINCE, WASHINGTON

The Puget Trough Province has two main sections—the northern half, which includes Puget Sound, and the southern half, largely made up of the Cowlitz River valley and upper basin of the Chehalis River (fig. 1). In both sections relief is moderate, with the elevation of the trough floor seldom exceeding **160** m.

The northern portion of the province is a depressed, glaciated area which is now partially submerged (Puget Sound). Both geology and topography have been strongly influenced by a series of glaciers which pushed into the area from the north during the Pleistocene. The receding ice masses left a large, gently sloping area stretching approximately 20 km south of Olympia. This area contains many lakes and poorly drained depressions underlain by glacial drift. Soils formed on glacial till under coniferous forest vegetation are generally coarse-textured Brown Podzolics, with a thin **A2** horizon underlain by an iron- and humus-enriched B horizon.

The major portion of the southern half of the province is underlain by Eocene basalt flows and flow breccia. Pleistocene lacustrine deposits are also common in the area immediately north of the Columbia River. Soils derived from basalt commonly have well-aggregated silt loam to clay loam surface horizons underlain by B horizons generally showing evidence of clay accumulation. Other soils in this southern section include dark-colored, fine-textured soils formed under grass, and soils containing large amounts of volcanic pumice.

The ecosystems of this province have, for the most part, been strongly influenced by human activity. Secondary coniferous forests, developed following earlier logging, dominate. They are typically composed of Douglas-fir and western hemlock, with lodgepole and western white pine conspicuous associates of Douglas-fir on some sites in the glaciated northern half. Even aside from disturbance, many ecosystems are very distinctive from those in the mountains to the east and west. Many sites, especially in the northern section, have been glacially influenced with outwash soils, bogs, and lakes. In addition, this province has a markedly drier climate since it lies in the rain shadow of the coastal mountain systems. Consequently, substantial and important diversity is represented in the communities and constituent species.

The list of identified terrestrial cells totals **16** (table **11).** Seven of these are forest types, including typical coniferous forests on residual soils and glacial till. Four represent a mosaic of forest, savanna, and prairie which is found mainly at the southern end of Puget Sound and in the San Juan Islands. Three of the special ecosystem cells (Nos. **12, 14,** and **15)** are also found in these two areas which are obvious concentrations of biotic diversity. The remaining terrestrial cells (Nos. **13** and **16)** involve flood plain communities along the Columbia River.

There are eight aquatic cells identified at present (table **12).** It is expected that the majority of these would be found in glaciated areas in the northern half of the province.

Terrestrial and aquatic areas presumably will include the normal complement of species. The list of rare and endangered vertebrate animals requiring specific consideration totals four (table **13).** The list of vascular plants of special interest is relatively short but includes four from the Smithsonian list of threatened and endangered species (table **14).** This list again identifies the prairie region at the south end of Puget Sound and the San Juan Islands **as** areas of particular significance (see terrestrial cells Nos. **8-12, 14,** and **15).** Several of the plants are also associated with the dry Douglas-fir - Pacific madrone / rhododendron forests along the Hood Canal and eastern margin of the Olympic Mountains (terrestrial cell No. **3).**

At present there are only two identified Research Natural Areas within the Puget Trough Province (table **15).** These two areas fill **3** of the 28 cells listed **(2** terrestrial and 1 aquatic).

Our estimate is that **17** additional Research Natural Areas will provide for a minimal system in the Puget Trough Province (table **16).** Most Research Natural Areas can be relatively small (under **500** acres, or **202** ha) since they are generally focused on one or two cells. Aquatic areas involving an entire drainage for lakes or small streams (items **12-14** in table **16)** would probably be the largest.

Identifying and establishing the necessary Research Natural Areas in this province may be difficult because of existing and potential human developments. Obviously, the major responsibility is upon State and private institutions. Department of Defense, particularly because of its Fort Lewis holdings, is in a unique position to provide representation of some of the major community mosaics (prairie, savanna, ponderosa pine) found on the glacial outwash at the south end of the sound. The Fish and Wildlife Service also has an important role in some specific needs.

The fast pace of development in this province necessitates that Research Natural Area establishment be given high priority. Consequently, most needs (table **16)** are given high or medium priority because of the danger suitable areas will be lost.

Table 11.--*Terrestrial cells in Puget Trough Province, Washington*

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Forest types (Western Hemlock Zone) :			
* 1. Douglas-fir-western white pine/salal on glacial till	229	None	88-89
* 2. Douglas-fir (>100 years old)/salal on glacial till	229	None	88-89
* 3. Douglas-fir-madrone/rhododendron on glacial till, just west of Hood Canal	229	None; consider vascular plants of special interest	88-89
* 4. Mature Douglas-fir-western hemlock with mixed understory (Oregongrape, salal, and swordfern types)	230	None	88-89
* 5. Western redcedar-western hemlock/swordfern on residual soil, Capitol Hills or eastern Willapa Hills	227	None	79-82
* 6. Lodgepole pine/salal on glacial till	216	None	88-89
* 7. Red alder/swordfern on glacial till	221	None	82-89
Prairie and savanna types:			
* 8. Ponderosa pine on glacial till in the Fort Lewis area	245	None	88-89
* 9. Prairie, oak woodland, conifer forest mosaic in Olympia-Tacoma area	229 233	Token, need additional area	88-89
*10. Oregon white oak woodland	233	Token, need additional area	88-89
*11. San Juan Islands forest-steppe mosaic with hardwood and coniferous woodland and fescue grassland		None	313
Special types :			
12. Mima mounds		Minimal representation	89-90
*13. Riparian black cottonwood/willow along lower Columbia River		Token in Blackwater Island RNA, need additional area	295-296
*14. *Juniperus scopulorum* in San Juan Islands		None	313
*15. Serpentine vegetation plus basalt contact on Puget Sound island		None	309
16. Channeled basalt in flood plain of Columbia River with Douglas-fir and Oregon white oak stands, shrub communities, and grasslands		Blackwater Island	

*Cells presently lacking adequate representation.

Table 12.--*Aquatic cells in* the *Puget Trough Province,* Washington

Cell[1]	Present representation	Remarks
*1. Oligotrophic lake in glaciated topography and drainage basin of temperate forest	None	
*2. Eutrophic oxbow lake and drainage basin	None	
*3. Permanent pond	None	
*4. Typical stream drainage	None	
*5. Large, upwelling cold spring	None	
*6. Marshland area	None	
*7. Typical bog	None	*Ledum* is common shrub
8. Vernal ponds and marshes in channeled basalt, Columbia River flood plain	Blackwater Island RNA	

[1]Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the listed ecosystem.

*Cells presently lacking adequate representation.

Table 13.--*Rare and endangered vertebrate animal cells in the Puget Trough Province, Washington*

Cell	Verified representation	Reference
Reptiles:		
*1. Western pond turtle	None	Stebbins *1954*
*2. Sharp-tailed snake	None	Stebbins *1954*
*3. Pacific ringnecked snake	None	Stebbins 1954
Mammals:		
*4. Masked shrew (subspecies *hollisteri*)	None	Dalquest *1948*

*Cells presently lacking adequate representation.

Table 14.--*Vascular plants of special interest in the Puget Trough Province, Washington*

Species[1]	Distribution
Arctostaphylos media	Hybrid, Mason and Kitsap Counties
Arenaria paludicola[2]	Tacoma prairies south
Aster curtus[2]	On prairies at south end of Puget Sound
Boschniakia hookeri	Kitsap and Mason Counties
Botrychium virginianum	Moist areas
Castanopsis chrysophylla	Eastern edge of Olympic Peninsula
Delphinium nuttallii	Outwash prairies
Erythronium oregonum[2]	
Erythronium revolutum	
Habenaria chorisiana	One bog in Snohomish County
Hemitomes congestum	Coastal forests
Howellia aquatilis	
Iris missuriensis	Disjunct on Whidbey Island
Iris tenax	Centralia south
Isopyrum hallii	Moist woods, Lewis and Thurston Counties south
Juniperus scopulorum	San Juan Islands
Lepidium virginicum var. *menziesii*	Littoral endemic
Meconella oregana	
Opuntia fragilis	Disjuncts at Sequim and San Juan Islands
Pinus ponderosa	Outwash in Tacoma-Olympia area
Rhododendron macrophyllum	Along Hood Canal
Salix fluviatilis[2]	Along Columbia River
Woodwardia fimbriata	Few widely disjunct populations

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or identification nationally (in the Smithsonian Institution list) as threatened or endangered species.

[2]The species is on the national list of threatened and endangered plants (Smithsonian Institution 1974).

Table 15.--*Established* **Research Natural Areas in the Puget Trough** *Province,* **Washington**

Name	Principal features	Agency[1]	Area	
			Ha	Acres
Blackwater Island RNA	Oregon white oak-Douglas-fir grassland, and willow, Oregon ash in lower portions of channeled basalt along Columbia River	FWS	52	129
Mima Mounds RNA	Mima mound phenomenon and associated vegetation near Olympia, Washington	ESC	222	548

[1]ESC = Evergreen State College, FWS = Fish and Wildlife Service.

Table 16.--*Additional Research Natural Areas needed in the Puget Trough Province, Washington*

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Predominantly terrestrial natural areas:						
1. Douglas-fir-western white pine on glacial till	T-1 R&E-4		Medium	Private	88-89	0404
2. Douglas-fir/salal and lodgepole pine/salal communities on glacial till	T-2,6	Douglas-fir should be over 100 years old	Medium	Private	88-89	0404
3. Douglas-fir-madrone/rhododendron community on glacial till	T-3 R&E-2,3	Located just west of Hood Canal	High	State Private	88-89	0404
4. Mature Douglas-fir-western hemlock with mixed understory on fine-textured glacial till	T-4 R&E-4	Area in Pack Forest is potential site	Medium	State	88-89	0402
5. Western redcedar-western hemlock/swordfern community on residuum	T-5	Capitol Hills or eastern Willapa Hills	High	State Private	79-82	0202
6. Ponderosa pine on glacial till	T-8 R&E-2,3	Fort Lewis area	Low	Department of Defense	88-89	0403
7. Puget prairie-woodland mosaic with Oregon white oak	T-9,10 R&E-2,3		High	Private State	88-89	0402 0403
8. Red alder/swordfern community on glacial till	T-7	Alderwood soil	Low	Private	82-89	0403 0404
9. Riparian black cottonwood-willow (along lower Columbia River)	T-13	Several FWS areas in process of establishment	Medium	FWS	295-296	
10. San Juan Islands forest-steppe mosaic with *Juniperus scopulorum*	T-11,14		High	Private	313	0402
11. Serpentine vegetation plus basalt contact on an island in Puget Sound	T-15	Cypress Island is possible location	High	Private	309	0402

See footnotes at end of table.

Table 16.--*Additional Research Natural Areas needed in the Puget Trough Province, Washington* (Continued)

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Predominantly aquatic natural areas:						
12. Oligotrophic lake in glaciated topography and drainage basin of temperate forest	A-1,3		High	Private		0403 0404
13. Eutrophic oxbow lake and drainage basin	A-2 R&E-1		High	Private		0403 0404
14. Typical stream drainage	A-4	Fort Lewis area	High	Private Department of Defense		0402 0403
15. Large, upwelling cold spring	A-5		Low	Private		
16. Marshland area	A-6		High	Private		0403
17. *Ledum* bog	A-7	Snohomish County	Medium	Private		0403

[1]For a description of these cells see table 11 for terrestrial (T) ecosystems, table 12 for aquatic (A) ecosystems, and table 13 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate those cells which are considered essential components of the proposed Research Natural Area. Those not underlined represent cells which would be desirable but not essential components.

[2]Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is, i.e., the danger that all examples of the type will be lost to other uses. Acquisition urgency.

[3]Agency or institution most likely to have or to be able to acquire a tract of the desired type based on land ownership. FWS = Fish and Wildlife Service.

[4]See appendix V.

WESTERN SLOPES AND CREST PROVINCE, WASHINGTON CASCADES

This province (fig. 1) is a rugged mountain region composed of two major geologic units. South of Snoqualmie Pass, bedrock is primarily Eocene to Miocene andesites and basalts. The northern portion of the province is made up of considerably older (largely Paleozoic and Cretaceous) sedimentary and metamorphic rocks, interspersed with large granitic intrusions.

Topographically, the southern section is characterized by generally accordant ridge crests separated by steep, deeply dissected valleys. Three Pleistocene volcanic cones tower above their surroundings—Mount Adams, Mount Rainier, and Mount St. Helens. An extensive area around Mount Adams is covered by recent lava flows and comprises a gently sloping plateau.

North of Snoqualmie Pass, the Cascade Range is extremely rugged. Valleys are deep and steep-sided, containing low-gradient streams. Glacially formed cirques and matterhorns are abundant, attesting to the profound effect glaciation has had in shaping landforms. Glaciers are still common; this region contains more active glaciers than any other area within the continental United States.

Soils in the southern portion of the Washington Cascades are most often Podzolic sandy loams or loamy sands formed in layers of pumice or volcanic ash overlying basalt or andesite. To the north, finer textured glacial and glaciolacustrine soils are especially common in many of the broad valley bottoms. On steep side slopes, shallow residual soils are commonly gravelly sandy loam in texture.

The natural communities of this province reflect the generally wet, moderate to cool climatic regime. Coniferous forests, arranged in three major elevational zones (western hemlock, Pacific silver fir, and mountain hemlock), dominate the slopes and valley bottoms. There is a substantial diversity in these coniferous forest communities reflecting differing environments and successional stages, largely as a consequence of periodic fires. Subalpine meadow-forest parklands cover the bulk of relatively narrow regions between closed forest and the regions of permanent snow and ice on the higher peaks. These parklands are typically intricate mosaics of many different community types.

Freshwater systems found in this province are largely streams and rivers including "milky" glacier-fed types and ponds and relatively small lakes over a broad range of elevations.

Specialized habitats add substantial diversity to the province. First there is the normal array of nonforested communities within a forest mosaic—bogs, marshes, shrub communities on scree and avalanche tracks, etc. A major serpentine outcrop (around Twin Sisters near Mount Baker), the unusually arid (for this province) Ross Lake region on the Skagit River, and the area around Columbia River Gorge provide major centers for distinctive biotic arrays. Lava flows, hot springs, and pumice fields are additional features associated with the major volcanic peaks.

Identified terrestrial cells total 31 (table **17).** The dominant coniferous forests and their associated biota are emphasized in the cellular listing, which recognizes the need to represent variations of some widespread types by providing Research Natural Areas in both the northern and southern half of the province. The list also reflects the need to provide examples of widespread community types representing relatively early successional stages (see cell Nos. 1, 2, and 15 in table **17).** The list of terrestrial cells is rounded out with subalpine meadow and parkland communities and other types representing unusual or youthful substrates (lava flows, serpentine) or extreme environments.

The list of aquatic cells (table 18) provides for examples of the typical ecosystems found in the several life zones and totals **18.**

It is presumed that the terrestrial and freshwater areas will incorporate the typical complement of animal and plant species. There are eight vertebrate animal species which are listed for consideration as rare and endangered cells in Research Natural Area selection (table **19).** The plant list includes **13** species from the Smithsonian list of threatened and endangered plants (table **20).** There are several obvious areas of concentration — the Columbia River Gorge, high elevations around Mount Rainier and Mount Adams, and serpentine areas.

Substantial progress has been made in establishment of Research Natural Areas in this province. The 11 existing Research Natural Areas (table 21), all in Federal ownership, provide coverage of nearly half of the identified cells **(24** out of **57** terrestrial, aquatic, and rare and endangered cells). Existing National Parks and Wilderness Areas also provide substantial protection for many of the rare and endangered species, provided they are considered in the management plans for these tracts.

Nevertheless, a substantial job in locating and establishing Research Natural Areas remains. We estimate 21 additional Research Natural Areas are needed to provide minimal coverage of all of the listed cells (table **22).**

Lead responsibility in this province lies with the Forest Service and National Park Service who control most of the land. The three large combined terrestrial and aquatic areas are most likely to be found in the North Cascades National Park complex. The low-elevation lake (need No. **13)** will probably be one of the most difficult to locate. A subalpine lake in City of Seattle ownership within the Cedar River watershed (Findley Lake) may fill need No. **14.** State ownership should also be considered in the search for need No. **4,** young Douglas-fir in an old burn.

Table 17.--*Terrestrial cells in the Western* **Slopes** *and* **Crest Province, Washington Cascades**

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Western Hemlock Zone:			
* 1. Douglas-fir <75 years old (old burn)	229	Token, need additional area	82-88
* 2. Douglas-fir 100-150 years old	229	Token, need additional area	82-88
3. Old-growth Douglas-fir-western hemlock forest, northern portion of province	230	North Fork Nooksack RNA	72-82
4. Old-growth Douglas-fir-western hemlock forest, southern portion of province	230	Wind River and Cedar Flats RNA's	72-82
5. Old-growth western hemlock forest, northern portion of province	224	Long Creek RNA	72-82
6. Old-growth western hemlock forest, southern portion of province	224	Wind River RNA	72-82
* 7. Old-growth western redcedar forest, northern portion of province	228	None	81-82
8. Old-growth western redcedar forest, southern portion of province	228	Cedar Flats RNA	81-82
9. Old-growth western redcedar-western hemlock forest	227	North Fork Nooksack, Long Creek, and Lake Twentytwo RNA's	81-82
*10. Red alder forest	221	Token stand of climax red alder at Long Creek RNA; need additional area	82-88
Pacific Silver Fir Zone:			
11. Pacific silver fir-western hemlock forest, northern portion of province	226	North Fork Nooksack and Lake Twentytwo RNA's	94-98
12. Pacific silver fir-western hemlock forest, southern portion of province	226	Butter Creek and Sister Rocks RNA's	94-98
*13. Pacific silver fir forest, northern portion of province	226	None	94-98
14. Pacific silver fir forest, southern portion of province	226	Sister Rocks and Steamboat Mountain RNA's	94-98
15. Noble fir forest (typical)	226	Butter Creek and Goat Marsh RNA's	94-98

See footnote. at end of table.

Table 17.--*Terrestrial cells* in the Western *Slopes and Crest* Province, Washington *Cascades* (Continued)

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Mountain Hemlock Zone:			
*16. Mountain hemlock-Pacific silver fir forest, northern portion	205	None	103-106
17. Mountain hemlock-Pacific silver fir forest, southern portion	205	Steamboat Mountain and Butter Creek RNA's	103–106
18. Typical subalpine fir forest	206	Steamboat Mountain RNA	103-106
*19. Alaska-cedar (in stand with mountain hemlock and subalpine fir)	228	None	103-106
Subalpine and alpine meadows and parkland:			
*20. Subalp ne parkland mosaic (tree groups with a variety of meadow types)		Token, need another area	250–268 277-281
*21. Heathe -huckleberry communities		Token, need another area	251–256
*22. Subalp ne 1ush herbaceous comnunities, includ ng *Valerians-Veratrum* and *Rubus parvifolium-Pteridium* types		Token, need another area	256–261
23. Subalpine green fescue community		Butter Creek RNA	263–264
*24. Alpine community mosaic with krummholz tree groups		None	
Special types:			
*25. Lodgepole pine-Douglas-fir at Ross Lake	216 229	None	312
*26. Ponderosa pine forest at Ross Lake	245	None	312
*27. Recent lava flow with open forest and shrub cover		None	300–302
28. Recent mud flow with lodgepole pine cover		Goat Marsh RNA	302-304
29. Recently exposed glacial moraine and outwash		Boston Glacier RNA	284–290
30. Sitka alder and vine maple avalanche tracks		North Fork Nooksack, Lake Twentytwo, and Butter Creek RNA's	91 100–101
*31. Representative serpentine area in the North Cascades		None	309

*Cells presently lacking adequate representation.

Table 18.--*Aquatic cells in the Western Slopes and Crest Province, Washington Cascades*

Cell[1]	Present representation	Remarks
* 1. Major stream drainage covered with temperate coniferous forest	None	
2. Major stream drainage covered with subalpine forest mosaic	Butter Creek RNA	
* 3. River valley bottom mosaic of terrestrial, semiaquatic, and aquatic communities	None	Should be in North Cascades
* 4. Low elevation lake and drainage basin of temperate forest	None	
* 5. Lake and drainage basin of subalpine forest or forest and meadow, without fish	None	
6. Marsh and swamp ecosystem	Goat Marsh, Cedar Flats, Wind River, Steamboat Mountain RNA's	
7. Cirque lake in alpine area	Pyramid Lake RNA	
* 8. Lake and drainage basin of subalpine forest or forest and meadow, with fish	None	
9. Subalpine permanent ponds	Butter Creek RNA	
*10. Alpine permanent ponds	None	Should be in North Cascades
11. Subalpine vernal ponds	Butter Creek RNA	
*12. Alpine vernal ponds	None	
*13. Subalpine stream which Is glacially fed ("milkwater" stream)	None	
*14. Large, upwelling cold spring	None	
*15. Typical hot springs	None	
*16. Western redcedar swamp	Token representation on Cedar Flats RNA	Need additional area
17. Marsh area	Goat Marsh RNA	
18. Bog area	Steamboat Mountain and Goat Marsh RNA's	

[1]Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the listed ecosystem.

*Cells presently lacking adequate representation.

Table 19.--*Rare and endangered vertebrate animal cells in the Western Slopes and Crest Province, Washington Cascades*

Cell	Verified representation	Reference
Amphibians:		
*1. Larch Mountain salamander	None	Stebbins 1954
Reptiles:		
*2. Pacific ringnecked snake	None	Stebbins 1954
*3. California mountain kingsnake	None	Stebbins 1954
*4. Oregon alligator lizard	None	Stebbins 1954
Birds:		
*5. Cascade boreal chickadee	None	Alcorn 1971
Mammals:		
*6. Masked shrew (subspecies *hollisteri*)	None	Dalquest 1948
*7. Heather vole	Token at Steamboat Mountain RNA; need additional area	Dalquest 1948 Johnson and Johnson 1952 Maser and Storm 1970 Edwards 1955 Johnson 1973 Shaw 1924
*8. Northern bog lemming	None	Dalquest 1948 Maser and Storm 1970

*Cells presently lacking adequate representation.

ERRATA SHEET

USDA Forest Service General Technical Report PNW-38 1975
RESEARCH NATURAL AREA NEEDS IN THE PACIFIC NORTHWEST
A Contribution To Land-Use Planning, by C. T. Dyrness, Jerry F. Franklin, Chris Maser, Stanton A. Cook, James D. Hall, and Glenda Faxon.

Please insert corrected page 45 for:

Table 20. --Vascular plants of special interest in the Western Slopes and Crest Province, Washington Cascades

as shown on reverse side of this sheet.

PACIFIC NORTHWEST FOREST AND
RANGE EXPERIMENT STATION
P. O. Box3141
Portland, Oregon 97208

Table 20.--*Vascular plants of special interest in the Western Slopes and Crest Province, Washington Cascades*

Species [1]	Distribution
Andromeda polifolia	Bogs
Anemone occidentalis	Subalpine meadows, Mount Rainier south
Aspidotis densa	Serpentine areas
Asplenium trichomanes	
Aster glaucescens [2]	Mount Adams south to Columbia River, in valleys
Botrychium lanceolatum	Moist areas at high elevation
Botrychium virginianum	Low to high elevations
Calamayrostis canadensis var. *imberbis*	Mount Adams
Calamayrostis howellii [2]	Columbia River Gorge
Campanula lasiocarpa	Alpine from Snohomish County north
Carex limnophila	Mount Rainier
Carex pauciflora	Sphagnum bogs, Whatcom County
Cassiope stelleriana	Mount Rainier north
Castanopsis chrysophylla	Columbia River Gorge
Castilleja cryptantha [2]	Alpine at Mount Rainier
Castilleja parviflora	Cascade Pass north
Castilleja parviflora var. *oreopola*	Mount Rainier south
Cimicifuga elata	Lower elevations
Cimicifuga laciniata [2]	Silver Star Mountain, Skamania County
Claytonia lanceolata var. *chrysantha* [2]	Mount Baker region
Collomia larsenii	Mounts Rainier, St. Helens, and Adams
Coptis asplenifolia	Snohomish County north
Delphinium nuttallii	Columbia Gorge area
Dicentra uniflora	Broad elevational range
Douglasia laevigata [2]	Snohomish County south
Draba aureola	Volcanic peaks, Mount. Rainier south
Draba incerta	Subalpine
Draba ventosa var. *ruaxes* [2]	Glacier Peak
Dryas octopetala	High elevations
Eburophyton austiniae	Deep forest
Epipactis gigantea	Wet areas
Eriogonum pyrolaefolium	Subalpine pumice, Mount Rainier south
Fritillaria camschatcensis	South Fork Stillaguamish River
Garrya fremontii	Columbia River Gorge (Wind Mountain)
Gentiana douglasiana	Snoqualmie Pass north
Habenaria orbiculata	Mid-elevation forest
Hieracium longiberbe [2]	Columbia River Gorge
Howellia aquatilis	Ponds and lakes
Hulsea nana	Cinder cones and pumice from Mount Rainier south
Isopyrum hallii	Columbia River Gorge

See footnotes at end of table.

Table 20.--*Vascular plants of special interest in the Western Slopes and Crest Province, Washington Cascades* (Continued)

Species[1]	Distribution
Lewisia columbiana var. *rupicola*	Mount Rainier
Loiseleuria procumbens	Trapper Peak n Skagit River drainage
Luina stricta	Mount Rainier south
Luzula arcuata	Mount Rainier
Lycopodium obscurum	Skagit County
Menyanthes trifoliata	Montane lakes protected at Goat Marsh RNA
Pedicularis bracteosa var. *bracteosa*	Disjunct from Canada on Mount Adams
Pedicularis rainierensis[2]	High-elevation Mount Rainier endemic
Pellaea glabella var. *simplex*	Columbia River Gorge
Pleuricospora fimbriolata	
Polemonium carneum	
Polemonium elegans	Alpine
Polypodium montense	Mainly Columbia River Gorge
Polystichum andersonii	
Polystichum kruckebergii[2]	Bird Creek Meadows on Mount Adams
Polystichum lonchitis	Wet, moss-covered talus
Polystichum mohrioides	On serpentine
Ranunculus cooleyae	Del Campo Peak, Snohomish County
Rhododendron macrophyllum	Widely disjunct, Copper Creek near Mount Rainier, Wind River RNA
Salix fluviatilis[2]	Along Columbia River
Saxifraga cernua	
Saxifraga debilis	
Saxifraga lyallii	Whatcom County
Saxifraga oppositifolia	
Selaginella douglasii	Columbia River Gorge
Senecio elmeri	Alpine
Senecio flettii	Mid- to high-elevations, Mount Rainier area
Silene douglasii var. *monantha*	Columbia Gorge area
Silene suksdorfii	Mounts Rainier and Adams
Synthyris schizantha[2]	Moist shaded cliffs near Mount Rainier
Tauschia stricklandii[2]	Endemic to Mount Rainier subalpine

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or identification nationally (in the Smithsonian Institution list) as threatened or endangered species.

[2]The species is on the national list of threatened and endangered plants (Smithsonian Institution 1974).

Table 20.--*Vascular plants of special interest in the Western Slopes and Crest Province, Washington Cascades* (Continued)

Species[1]	Distribution
Lewisia columbiana var. *rupicola*	Mount Rainier
Loiseleuria procumbens	Trapper Peak n Skagit River dra nage
Luina stricta	Mount Rainier south
Luzula arcuata	Mount Rainier
Lycopodium obscurum	Skagit County
Menyanthes trifoliata	Montane lakes protected at 'Goat Marsh RNA
Pedicularis bracteosa var. *bracteosa*	Disjunct from Canada on Mount Adams
Pedicularis rainierensis[2]	High-elevation Mount Rainier endemic
Pellaea glabella var. *simplex*	Columbla River Gorge
Pleuricospora fimbriolata	
Polemonium carneum	
Polemonium elegans	Alpine
Polypodium montense	Mainly Columbia River Gorge
Polystichum andersonii	
Polystichum kruckebergii[2]	Bird Creek Meadows on Mount Adams
Polystichum lonchitis	Wet, moss-covered talus
Polystichum mohrioides	On serpentine
Ranunculus cooleyae	Del Campo Peak, Snohomish County
Rhododendron macrophyllum	Widely disjunct, Copper Creek near Mount Rainier, Wind River RNA
Salix fluviatilis[2]	Along Columbia River
Saxifraga cernua	
Saxifraga debilis	
Saxifraga lyallii	Whatcom County
Saxifraga oppositifolia	
Selaginella douglasii	Columbia River Gorge
Senecio elmeri	Alpine
Senecio flettii	Mid- to high-elevations, Mount Rainier area
Silene douglasii var. *monantha*	Columbia Gorge area
Silene suksdorfii	Mounts Rainier and Adams
Synthyris schizantha[2]	Moist shaded cliffs near Mount Rainier
Tauschia stricklandii[2]	Endemic to Mount Rainier subalpine

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or identification nationally (in the Smithsonian Institution list) as threatened or endangered species.

[2]The species is on the national list of threatened and endangered plants (Smithsonian institution 1974).

Table 21.--*Established Research Natura2 Areas in the Western Slopes and Crest Province, Washington Cascades*

Name	Principal features	Agency[1]	Area	
			Ha	Acres
Boston Glacier RNA	Major alpine glacier and cirque basin in northern Cascade Range including some recently deglaciated topography	NPS	1 061	2,620
Butter Creek RNA	Subalpine mosaic of forest meadow and shrub communities with ponds and including a major stream drainage	NPS	810	2,000
Cedar Flats RNA	Western redcedar and associated swamps and marshes and Douglas-fir forest	FS	275	680
Goat Marsh RNA	Extensive mountain marshes, record noble fir forest, beaver swamp, ponds, and lodgepole pine on recent mudflow	FS	484	1,195
Lake Twentytwo RNA	Western redcedar-western hemlock forests and subalpine lake	FS	320	790
Long Creek RNA	Western hemlock forests	FS	259	640
North Fork Nooksack RNA	Douglas-fir and western hemlock forests	FS	605	1,495
Pyramid Lake RNA	Subalpine lake with surrounding conifer forest	NPS	48	119
Sister Rocks RNA	Pacific silver fir forests	FS	87	215
Steamboat Mountain RNA	Subalpine fir, Pacific silver fir, and mountain hemlock forest along with pond and marshes	FS	567	1,400
Wind River RNA	Douglas-fir-western hemlock forests	FS	478	1,180

[1] FS = Forest Service, NPS = National Park Service.

Table 22.--*Additional* Research Natura2 *Areas* needed *in* the Western *Slopes* and Crest Province, Washington **Cascades**

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Combined terrestrial and aquatic natural areas:						
1. Mature coniferous forest mosaic and major stream drainage supporting full range of aquatic life	T-3,5,7,9, 11 A-1 R&E-8	Goodell Creek or Stetattle Creek in North Cascades National Park	High	NPS	72-82	0701 0702 0703
2. River valley bottom mosaic of mature conifer forest, semiaquatic, and aquatic communities	T-7,3,5,11 A-3,6,16,9 i8—	Big Beaver Creek or Chilliwack River, North Cascades National Park	High	NPS	72-82	0701
3. Alpine community mosaic with krummholz and ponds	T-24 A-10,12 R&E-6,7	With attention to special plants, e.g., *Botrychium* ssp., *Collomia larseni*, *Draba aureola*, and *Hulsea nana;* Mount Rainier or North Cascades National Park	Medium	NPS	276-290	0901 0704
Predominantly terrestrial natural areas:						
4. Douglas-fir less than 75 years old in an old burn	T-1	Yacolt Burn	Low	FS	82-88	0606
5. Douglas-fir In the 100- to 150-year-old age class	T-2	Wind River Experimental Forest	Low	FS	82-88	0904
6. Pacific silver fir and Pacific silver fir-mountain hemlock in the North Cascades	T-13,16	North Cascades National Park	Low	NPS	94-98 103-106	0703
7. Subalpine parkland mosaic with Alaska-cedar	T-19,20 A-11 R&E-5,6,7	North Cascades National Park	Medium	NPS	250-268 277-281	0704
8. Subalpine heather-huckleberry and lush herbaceous communities	T-21,22 R&E-7	Proposed Green Mountain RNA would at least partially fill this need	Medium	NPS	251-261	0704
9. Lodgepole pine-Douglas-fir and ponderosa pine forest in Ross Lake area	T-25,26	Ross Lake National Recreation Area	Low	NPS	312	0702
10. Recent lava flow and adjacent non-lava area	T-27	Big Lava Beds area (Gifford Pinchot National Forest)	Medium	FS	300-302	0902
11. Montane serpentine area in North Cascades	T-31	With special attention to endemic plant species; Twin Sisters Peak, Mount Baker National Forest	Low	FS	309	0703
12. Red alder forest including small stream drainage	T-10		Low	State FS		0702

See footnotes at end of table.

Table 22.--*Additional Research* ***Natural*** Areas *needed in the Western Slopes and Crest Province, Washington* **Cascades** (Continued)

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Predominantly aquatic natural areas:						
13. Low-elevation lake and drainage basin of temperate forest	A-4 R&E-2,3,4,6		High	FS State		0603
14. Subalpine lake and drainage basin (without fish)	A-5 R&E-5,6,7	Findley Lake is good candidate	Medium	City of Seattle		0602
15. Subalpine lake and drainage basin (with fish)	A-8 R&E-5,6,7	If not too disturbed, Lake Twentytwo RNA may suffice	Medium	FS NPS		0703
16. Glacially fed subalpine stream and drainage	A-13 R&E-5,6,7	Possibly can fill by enlarging Boston Glacier RNA	Medium	NPS		0704
17. Large, upwelling cold spring	A-14		Low	NPS, FS State		
18. Typical hot spring	A-15		Medium	NPS, FS State		
Natural areas for protection of rare or threatened species:						
19. Subalpine meadow area focused on concentration of plant species of special interest		See table 20 for subalpine species of special interest; Mount Rainier National Park	High	NPS		0901
20. Area along Perry Creek (South Fork Stillaguamish River) for preservation of a unique assemblage of rare fern species		Species include *Asplenium trichomanes, Botrychium* spp., *Polystichum andersonii,* and *P. lonchitis;* Mount Baker National Forest	High	FS		0703
21. Area in the western half of the Columbia Gorge region focused on rare and endangered organisms	R&E-1	See table 20 for vascular plants of special interest in Columbia Gorge region; possible sites include Silver Star or Larch Mountains	Medium	State FS		0606

[1] For a description of these cells see table 17 for terrestrial (T) ecosystems, table 18 for aquatic (A) ecosystems, and table 19 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate those cells which are considered essential components of the proposed Research Natural Area. Those not underlined represent cells which would be desirable but not essential components.

[2] Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is, i.e., the danger that all examples of the type will be lost to other uses. Acquisition urgency.

[3] Agency or institution most likely to have or to be able to acquire a tract of the desired type based on land ownership. FS = Forest Service, NPS = National Park Service.

[4] See appendix V.

EASTERN SLOPES PROVINCE, WASHINGTON CASCADES

This province, similar to the adjacent Western Slopes and Crest Province, has two main sections, i.e., southern and northern, with the dividing line in the Snoqualmie Pass area (fig. 1). The northern section is characterized, for the most part, by extremely steep slopes and abundant evidence of glaciation. The southern portion, on the other hand, has more subdued relief, although steep slopes are locally present, especially adjacent to major drainages.

Geologically the northern portion of the province is made up of a variety of ancient (Paleozoic to Cretaceous) sedimentary and metamorphic rocks. Generally, these have undergone considerable tectonic deformation; as a result, bedding planes are often steeply tilted. Soils in the area are generally influenced to some extent by volcanic ash and, in some areas, loess. Soil profiles reflect the drier conditions under which they were formed; and poorly developed, stony soils are common. Because of sparse vegetation and low amounts of water-stable aggregates, certain soils—especially those derived from sandstone—are subject to serious surface erosion following disturbance.

The most abundant rock type in the southern section is Miocene basalt. These lavas flowed into the province from the east and are part of the extremely widespread Columbia River basalt flows. Pleistocene to Recent volcanic ash mantles the basalt in many areas, and loess deposits are also widespread. Other parent materials include sandstone, andesite, and glacial till. Most soils in this section tend to be finer textured than those to the north, with silt loams and loams most common.

The ecosystem types on the eastern slope of Washington's Cascade Range are many and diverse. The majority of the landscape is forested; but the forests are highly varied in composition as a consequence of environmental variation and disturbances, particularly fire (Franklin and Dyrness 1973). At low- to mid-elevations, mixed forests are dominated by ponderosa pine, Douglas-fir, grand fir, western larch, and lodgepole pine. At higher elevations, subalpine fir and Engelmann spruce become dominants. A variety of subalpine parklands and meadow types are abundant at higher elevations. At lower elevations the forests of ponderosa pine form mosaics with grassland and sagebrush communities. These patterns reflect the increasing aridity with decreased elevation found on the lee (rain-shadow) slope of the Cascade Range. There is also a strong environmental gradient moving east from the Cascade Crest (to a drier, more continental climate) at a given elevation along major east-west secondary mountain ranges (Wenatchee, Entiat, and Chelan Mountains, for example). This gradient is also reflected in the biota of the communities. Geological substrate provides yet another contribution to diversity in this province. A unique array of communities and organisms is associated with serpentine portions of the Wenatchee Mountains.

The 21 terrestrial cells presently identified (table 23) are selected to provide minimal representation of the major forest, subalpine and alpine meadows, and shrub-steppe communities. Because of the variability in many of these broadly defined types, representation in both the northern and southern halves of the province is necessary. Eleven cells are for coniferous forests, four for subalpine and alpine mosaics, two for shrub-steppe communities, and four for other types, including serpentine vegetation.

Aquatic cells total 11 (table 24). These include a series of lakes, ponds, and vernal pools at higher elevations and montane stream drainages on normal and serpentine topography.

It is presumed that the terrestrial and aquatic cells will incorporate the normal array of plant and animal species associated with these ecosystems. Seven rare or endangered vertebrate animals have been listed as cells in Research Natural Area identification (table 25). There are a large number of vascular plants of special interest in the province (table 26); 32 of these are on the Smithsonian list as threatened and endangered. The Wenatchee Mountains, partially because of the serpentine outcrops, is the major contributor. The area around the eastern end of the Columbia River Gorge (mainly Klickitat County) also is an area where many of these rare and endangered plants are concentrated.

The job of Research Natural Area establishment has scarcely begun; only two small areas exist, both on Forest Service lands (table 27). Four cells, all terrestrial, out of a total of 39 identified for this province are filled. None of the plants of special interest are protected within Research Natural Areas; fortunately, existing and proposed Wilderness and Botanical Areas provide protection for many.

It is estimated that 21 additional Research Natural Areas are needed to provide minimal representation of the identified freshwater, terrestrial, and vertebrate animal cells, as well as several of the rare or threatened vascular plants (table 28). Three of these are relatively large drainages providing representation of widespread terrestrial and aquatic ecosystems. Eleven focus on terrestrial cells, four on special aquatic types, and three on rare and endangered vascular plants.

There is a very large job in selection and establishment of the necessary Research Natural Areas in this province. The lead responsibility clearly rests with the Forest Service (table 28). Washington State agencies, private institutions (especially along the Columbia River), and the National Park Service (because of the Lake Chelan National Recreation Area) may also have significant contributions to make in this province.

Expanding human activity at low- to mid-elevations, logging over the bulk of the province, and development near the Columbia River and urban centers make establishment of Research Natural Areas of high priority in these regions (table 28). Subalpine and alpine needs are generally of lower priority.

Table 23.--*Terrestrial* **cells** *in the Eastern* **Slopes Province, Washington Cascades**

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Ponderosa Pine Zone:			
1. Ponderosa pine-bitterbrush community	237	Wolf Creek RNA; also proposed Boulder Creek RNA	173-175
Grand Fir and Douglas-fir Zone:			
2. Ponderosa pine-Douglas-fir/snowberry/ bunchgrass community	214	Wolf Creek RNA	191-192
* 3. Ponderosa pine-Douglas-fir/pinegrass	237	Token In Meeks Table RNA, need additional area	191-193
* 4. Mixed conifer (ponderosa pine, grand fir, Douglas-fir, western larch)/ shrub communities (*Pachistima*, snowbrush, spiraea, snowberry, oceanspray, huckleberry) in northern section on a variety of sites		None	191-192 195-199
* 5. Mixed conifer/shrub communities on a variety of sites in central section		None	191-192 195-199
* 6. Mixed conifer/shrub communities on a variety of sites in southern section		None	191-192 195-199
Western Hemlock Zone:			
* 7. Western redcedar-western hemlock forest	227	None	202-204
Subalpine forest types:			
* 8. Engelmann spruce-subalpine fir forest with some on lower slopes and cold bottom areas, including good representation of subalpine fir/*Pachistima* association	206	None	205-207
* 9. Subalpine larch forest	208	None, but would be partially filled with establishment of proposed Tiffany Mountain RNA	281
*10. Pacific silver fir forest		None	94-98

See footnote at end of table.

Table 23.--*Terrestrial cells in* the *Eastern Slopes Province,* **Washington Cascades** (Continued)

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Subalpine and alpine parkland communities:			
*11. Subalpine sagebrush (*Artemisia tridentata* var. *vaseyana*) parkland		None	207-208
*12. Alpine cornunity mosaic (including *Carex-Kobresia* turf)		None	284-290
*13. Subalpine parkland (north section) with good east-side dry meadow types (green fescue)		None, but may be filled with establishment of proposed Tiffany Mountain RNA	250-268
*14. Subalpine parkland (south section) with good east-side dry meadow types (green fescue)		None	250-268
Shrub-steppe communities:			
15. Bitterbrush/bunchgrass communities		Wolf Creek RNA	222-223
16. Stiff sagebrush/herb-grass community		Meeks Table RNA	201
Special types:			
*17. Mountain meadow in grand fir zone dominated by *Deschampsia*		None	199-201
*18. Riparian hardwoods (black cottonwood-willow)	222	None	
*19. Oregon white oak-conifer mosaic	233	None	168 171 191
*20. Montane serpentine area		None, but need would be met with establishment of proposed Eldorado Creek RNA	307-309
*21. Typical lodgepole pine forest	216	None	192-193 197-198

*Cells presently lacking adequate representation.

Table 24.--*Aquatic cells in the Eastern Slopes Province, Washington Cascades*

Cell[1]	Present representation	Remarks
* 1. Low-elevation eutrophic lake and drainage basin	None	
* 2. Oligotrophic lake and mixed-conifer drainage basin	None	
* 3. Low-elevation permanent ponds	None	
* 4. Mid-elevation permanent ponds	None	
* 5. Low-elevation vernal ponds	None	
* 6. Mid-elevation vernal ponds	None	
* 7. Large stream drainage with mixed-conifer forest	None	Should extend from about 3,000-5,000-foot elevation
* 8. Stream drainage in a montane serpentine area	None	
* 9. Large, upwelling cold spring	None	
*10. Typical hot spring	None	
*11. Marshland-bog area	None	

[1]Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the listed ecosystem.

*Cells presently lacking adequate representation.

Table 25.--*Rare and endangered vertebrate animal cells in the Eastern Slopes Province, Washington Cascades*

Cell	Verified representation	Reference
Reptiles:		
*1. Pacific ringnecked snake	None	Stebbins *1954*
*2. Oregon alligator lizard	None	Stebbins *1954*
Birds:		
*3. Cascade boreal chickadee	None	Alcorn *1971*
Mammals:		
*4. Masked shrew (subspecies ***cinereus***)	None	Dalquest *1948*
*5. Western gray squirrel	None	Dalquest *1948*
*6. Heather vole	None	Dalquest *1948* Edwards *1955* Johnson *1973* Johnson and Johnson *1952* Maser and Storm 1970 Shaw *1924*
*7. Northern bog lemming	None	Dalquest *1948* Maser and Storm *1970*

*Cells presently lacking adequate representation.

Table 26.--*Vascular plants of special interest in the Eastern Slopes Province, Washington Cascades*

Species[1]	Distribution
Anemone drummondii	Wenatchee Mountains on serpentine
Arabis lemmonii var. *paddoensis*	Mount Adams and probably Wenatchee Mountains
Asplenium viride	On limestone
Astragalus pulsiferae	Mount Adams and Falcon Valley
Astragalus whitneyi var. *sonneanus*	Often on serpentine
Cacaliopsis nardosmia	Typically in yellow pine stands
Calamagrostis howellii[2]	Columbia River Gorge in Klickitat County
Campanula lasiocarpa	Alpine
Carex parryiana	Wenatchee Mountains
Carex proposita	Alpine talus in Wenatchee Mountains
Cassiope tetragona	Alpine near Canadian border
Castilleja elmeri	Mainly on serpentine in Wenatchee Mountains
Ceanothus prostratus	Yakima County south
Chaenactis nevii[2]	Wenatchee Mountains
Chaenactis ramosa[2]	Only Wenatchee Mountains
Chaenactis thompsonii[2]	On serpentine, Wenatchee Mountains only
Cheilanthes feei	Limestone crevices
Claytonia megarhiza var. *nivalis*[2]	Only in Mount Stuart area of serpentine
Clematis columbiana var. *dissecta*	Wenatchee Mountains
Cryptantha thompsonii[2]	On serpentine, Wenatchee Mountains only
Cryptogramma stelleri	
Cypripedium calceolus	
Cypripedium fasciculatum	
Cypripedium montanum	Found around east end of Columbia River Gorge
Delphinium lineapetalum	Lower elevations in Wenatchee Mountains
Delphinium multiplex[2]	Along intermittent streams in yellow pine and sagebrush, Wenatchee Mountains
Delphinium viridescens[2]	Moist meadowland, Wenatchee Mountains
Delphinium xantholeucum[2]	Grassland and yellow pine, Chelan and Okanogan Counties
Douglasia nivalis var. *dentata*	Wenatchee Mountains, on serpentine
Draba aurea	
Draba oligosperma	
Eleocharis atropurpurea	Lake Chelan
Elmera racemosa	
Epipactis gigantea	
Erigeron leibergii[2]	Moderate to high elevations, Wenatchee Mountains north
Eriogonum pyrolaefolium	On serpentine in Wenatchee Mountains
Eritrichium nanum var. *elongatum*	Okanogan County
Fritillaria pudica	Sagebrush and yellow pine

See footnotes at end of table.

Table 26.--*Vascular plants of special interest in the Eastern Slopes Province, Washington Cascades* (Continued)

Species[1]	Distribution
Garrya fremontii	Eastern end Columbia River Gorge, Klickitat County
Geum rivale	Okanogan County
Geum rossii var. *depressum*	Only in Wenatchee Mountains
Habenaria orbiculata	Mid-elevation forests
Haplopappus hallii[2]	East end of Columbia River Gorge
Hedysarum sulphurescens	Okanogan County
Heuchera grossulariifolia var. *tenuifolia*	Columbia River Gorge
Hieracium longiberbe[2]	Columbia River Gorge
Hydrophyllum capitatum var. *thompsoni*[2]	Columbia River Gorge north into Yakima County
Iliamna longisepala[2]	Low-elevation Kittitas to Chelan and Douglas Counties
Iliamna rivularis	
Ivesia tweedyi[2]	Chelan to central Yakima County, often on serpentine
Lathyrus nevadensis ssp. *lanceolatus* var. *puniceus*[2]	Only in Wenatchee Mountains
Ledum glandulosum var. *columbianum*	Wet serpentine areas in Wenatchee Mountains
Lewisia tweedyi[2]	Only in Wenatchee Mountains
Linanthus bakeri	Klickitat County
Liparis loeselii	Springs and bogs, Klickitat County
Lithophragma tenella var. *thompsonii*	Okanogan, Grant, and Yakima Counties
Lomatium brandegei	Kittitas to southern Okanogan Counties
Lomatium columbianum	Klickitat County to Yakima County near Columbia River
Lomatium cuspidatum[2]	On serpentine, Kittitas and Chelan Counties
Lomatium suksdorfii[2]	Western Klickitat County
Lomatium thompsonii[2]	Wenatchee region, Chelan County
Lupinus latifolius var. *thompsonianus*	Eastern end of Columbia River Gorge
Mimulus jungermannioides[2]	Mossy mats at eastern end of Columbia River Gorge
Mimulus pulsiferae	Klickitat County
Oryzopsis hendersonii	
Parnassia kotzebuei var. *pumila*[2]	Near Gilbert, Okanogan County; possibly extinct
Pellaea glabella var. *simplex*	Columbia River Gorge
Penstemon barrettiae[2]	Eastern end of Columbia River Gorge, Klickitat County
Penstemon lyallii	Possibly near Stevens Pass

See footnotes at end of table.

Table 26.--*Vascular plants of special interest in the Eastern Slopes Province, Washington* Cascades (Continued)

Species[1]	Distribution
Penstemon subserratus[2]	Yakima, Klickitat, and eastern Skamania Counties
Penstemon washingtonensis[2]	Moderate elevations, Chelan and Okanogan Counties
Petasites warrenii[2]	Swank Creek drainage, Kittitas County; possibly extinct
Phlox hendersonii	Chelan County south
Physaria alpestris	Subalpine talus and rocky ridges, Chelan County to Mount Adams
Poa curtifolia[2]	On serpentine in subalpine and alpine Wenatchee Mountains
Polystichum californicum	Wenatchee Mountains south
Polystichum kruckebergii[2]	Mount Adams
Polystichum mohrioides	On serpentine, Kittitas and Chelan Counties
Polystichum scopulinum	Wenatchee Mountains
Salix brachycarpa	Wenatchee Mountains
Salix vestita	Chelan County
Saxifraga integrifolia var. *apetala*	Along base of Cascade Range, Okanogan to Yakima Counties
Saxifraga lyallii	Okanogan County
Saxifraga occidentalis	Disjunct in Tumwater Canyon
Saxifraga oppositifolia	
Sedum lanceolatum var. *rupicolum*	Wenatchee Mountains
Selaginella douglasii	Columbia River Gorge
Senecio elmeri	Alpine areas
Sidalcea oregana var. *calva*[2]	Only in Wenatchee Mountains
Silene seelyi[2]	Only in Wenatchee Mountains
Silene suksdorfii	Wenatchee Mountains
Spiraea pyramidate	Natural hybrid
Suksdorfia violacea	Intermittently distributed from Columbia River Gorge to Canada
Trifolium thompsonii[2]	Swakane Canyon, Chelan County
Valeriana columbiana[2]	Open slopes, eastern Wenatchee Mountains
Viola sheltonii	Disjunct near Cle Elum

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or their identification nationally (in the Smithsonian Institution list) as threatened or endangered species.

[2]The species is on the national list of threatened and endangered plants (Smithsonian Institution 1974).

Table 27.--*Established Research* ***Natural*** *Areas in the Eastern Slopes Province, Washington Cascades*

Name	Principal features	Agency[1]	Area	
			Ha	Acres
Meeks Table RNA	interior ponderosa pine forest on isolated butte	FS	28	68
Wolf Creek RNA	Bitterbrush and bunchgrass communities	FS	61	150

[1]FS = Forest Service.

Table 28.--*Additional* ***Research Natural Areas needed in the Eastern Slopes*** *Province*, ***Washington Cascades***

Ecosystem or comnunity	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Combined terrestrial and aquatic natural areas:						
1. Large stream drainage (from 3,000 to 5,000 ft) with a variety of mixed-conifer (ponderosa pine, Douglas-fir, grand fir) communities	T-4 A-7,4,6 R&E-6,7	In northern section, perhaps near Pasayten Wilderness Area or possibly in Lake Chelan National Recreation Area	High	FS NPS	191-192 195-196 202-204	0803 0806 0807
2. Oligotrophic lake and ponds; surrounding mixed-conifer drainage basin	T-5 A-2,4,6	If possible, should be located in central section	High	FS NPS	191-192 195-196	0904
3. Large stream drainage in a montane serpentine area, with a variety of endemic plant species	T-20 A-8	Need will be met with establishment of proposed Eldorado Creek RNA	High	FS	307-309	0806
Predominantly terrestrial natural areas:						
4. Ponderosa pine-Douglas-fir/pinegrass community	T-3 A-5	Chiwaukum Creek-Tumwater Canyon area, Chelan County. Also proposed Boulder Creek RNA would help fill need	Medium	FS State	191-192	0803 0805
5. Lodgepole pine forest	T-21 R&E-5	Wenatchee or Okanogan National Forests	Medium	FS	192-193 197-198	0802 0803
6. Mixed conifer (ponderosa pine, Douglas-fir, grand fir, western larch)/shrub communities in southern part of the area	T-6 R&E-4	Wenatchee National Forest (Naches or Tieton Districts)	High	FS	191-192 195-199	0902 0904
7. Subalpine fir-Engelmann spruce and Pacific silver fir forest types	T-8,10 R&E-3	Upper slope type in Wenatchee National Forest	High	FS	205-207	0802
8. Mountain meadow in grand fir zone dominated by ***Deschampsia***	T-17	Select to span moisture gradient	Medium	FS	199-201	0902 0904
9. Subalpine parkland with dry meadow type (green fescue) and subalpine larch forest	T-9,14	Expansion of proposed Tiffany Mountain RNA may fill this need	Medium	FS NPS	263-264 281	0901
10. Subalpine parkland in the southern portion of the area	T-13	Wilderness Area	LOW	FS NPS	250-268	0901
11. Subalpine sagebrush parkland	T-11	Swakane Canyon and Colockum are possibilities (in central portion)	Medium	FS State	207-208	0804
12. Riparian hardwoods (black cottonwood)	T-18		High	Private FWS State		

See footnotes at end of table.

Table 28.--*Additional Research Natural Areas needed in the Eastern Slopes Province, Washington Cascades* (Continued)

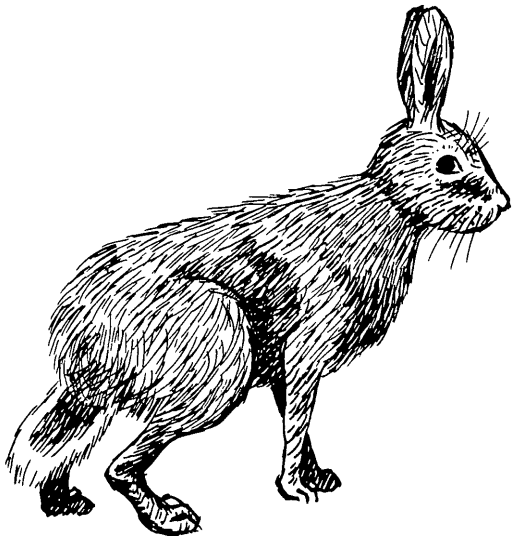
Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
13. Alpine community mosaic	T-12	Wilderness area in north or central Cascades	Low	FS NPS	284-290	0804
14. Oregon white oak-conifer mosaic	T-19 R&E-1,2	Central or southern portions	Medium	State	168, 171, 191	0902 1107
Predominantly aquatic natural areas:						
15. Low-elevation eutrophic lake and ponds	A-1,3,5		High	FS State		
16. Large, upwelling cold spring	A-9		Low	FS NPS		
17. Typical hot springs	A-10		Medium	FS NPS		
18. Relatively large marsh and bog area	A-11 RfE-7	Selma Meadows	High	FS NPS		
Natural areas for protection of rare or threatened plant species:						
19. Basalt rock areas along Klickitat River for protection of the very rare *Penstemon barrettiae*		Klickitat County	High	State Private		0904
20. An area in Swakane Canyon for protection of *Trifolium thompsonii*		RNA in process of establishment	High	FS		0804
21. Area at east end of Columbia River Gorge with concentration of special-interest plant species		See table 26 for species of interest	High	State Private		

[1]For a description of these cells see table 23 for terrestrial (T) ecosystems, table 24 for aquatic (A) ecosystems, and table 25 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate those cells which are considered essential components of the proposed Research Natural Area. Those not underlined represent cells which would be desirable but not essential components.

[2]Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is, i.e., the danger that all examples of the type will be lost to other uses. Acquisition urgency.

[3]Agency or institution most likely to have or to be able to acquire a tract of the desired type based on land ownership. FS = Forest Service, FWS = Fish and Wildlife Service, NPS = National Park Service.

[4]See appendix V.



COLUMBIA BASIN PROVINCE, WASHINGTON

The Columbia Basin is the largest province, occupying roughly two-thirds of the area east of the Cascades in Washington (fig. 1). For the most part, topography in the province ranges from gently undulating to moderately hilly; steep slopes are generally restricted to isolated volcanic buttes or stream-cut canyons. Because of the subdued relief, elevations are generally low, ranging from about **150** to 600 m.

Columbia River basalt of Miocene age underlies virtually the entire province and is the feature which geologically sets it apart from adjacent provinces. In some places these thick layers of basalt were altered during the Pleistocene by tectonic deformation or stream dissection, thus producing ridges and valleys seen today. The most outstanding example of stream-cut topography is the Channeled Scablands, located near the center of the province. This gigantic series of deeply cut channels in the basalt was apparently formed by floodwaters originating from glacial lakes during the Pleistocene.

Pliocene-Pleistocene deposits cover the Columbia River basalt over extensive tracts. The most widespread deposit is Palouse loess, a massive tan-colored silt up to **4.5** m thick, which mantles an elliptical area **160** km long in southeastern Washington. This deposit is characterized by smoothly rolling hills and soils of high fertility.

Broad soil differences in the Columbia Basin are largely correlated with differences in annual precipitation. Although the entire province is, in general, an area of low precipitation, there are substantial differences in rainfall pattern. In general, precipitation is heaviest along the margins of the basin and gradually decreases toward the central portion. Consequently soils in the Palouse Hills (near the eastern margin) are generally deep, well-developed Prairie or Chernozem soils, formed under grassland vegetation. Typically they have a thick, dark-colored silt loam **A** horizon, underlain by a silty clay loam B horizon which lacks a zone of calcium carbonate accumulation. Adjacent to this zone at lower elevations are Chestnut soils, which reflect the more arid conditions. These soils have a moderately thick, brown silt loam A horizon and a poorly developed silt loam B horizon which includes a zone of calcium carbonate accumulation. In the central portion of the province, arid conditions prevail and, as a result, desertic soils predominate. Here the most common soils are Sierozems. These have thin, light-colored A horizons over clay-enriched B horizons containing a layer of calcium carbonate which is often cemented.

Steppe and shrub-steppe ecosystems typify the undeveloped lands of the Columbia Basin (Franklin and Dyrness **1973).** Big sagebrush-bunchgrass and bunchgrass communities dominate the western and central portions of the basin, with forb-rich meadow steppe characteristic of the northern and eastern margins. Unusual soil conditions, such as the shallow soils associated with scablands, are sites occupied by a large array of distinctive shrub-bunchgrass communities, many dwarfed in stature. Areas of saline and alkali accumulations, riparian habitats, cliffs and scree slopes, and dunes add further to the diversity. Finally, ponderosa pine and quaking aspen communities intrude along the margins and canyons of the province.

Aquatic ecosystems are more abundant than might be expected in this arid province. They consist largely of ponds, lakes, vernal pools, and marshes of varying chemistry, many of them in channeled scablands. Streams are relatively uncommon.

Terrestrial cells which have been identified total **43** (table **29).** This reflects several factors, including the large size and diversity of the province and the greater detailed knowledge of its ecosystems, largely because of the work of R. Daubenmire. Included are cells for all of the distinctive plant associations he has identified — ponderosa pine forest and various types of steppe, shrub-steppe, and meadow steppe including zonal types as well as communities found on specialized habitats.

Identified aquatic cells total **13** (table **30).** There is a special need for a series of ponds and lakes representing a chemical gradient from freshwater to saline and alkali. A widespread and important new type of aquatic ecosystem associated with irrigation projects, "wasteways and potholes" (No. 13), is included in the list.

It is assumed that the various aquatic and terrestrial Research Natural Areas will incorporate the fauna and flora typical of these ecosystem types. Twelve rare or endangered animals are listed (table 31) for special consideration as cells in selecting and establishing Research Natural Areas. This relatively large number is because of the widespread conversion of most of the province to agricultural production and consequent loss of habitats for many species. There is also a relatively large number of vascular plants of special interest (table **32).** A large proportion of these are on the Smithsonian list of threatened and endangered plants **(20** species), again reflecting a loss of habitat to agricultural and other developments, especially in the Palouse region.

Three Research Natural Areas and two preserves created through The Nature Conservancy presently exist in the Columbia Basin (table 33). Fortunately one of these — Rattlesnake Hills — is very large and includes many representative ecosystem types. Even so, only 11 of the 68 terrestrial, aquatic, and rare and endangered cells identified for the province have been filled. These fill **7** cells out of **43** terrestrial, **2** out of **13** aquatic, and **2** out of **12** vertebrate animal cells listed.

It was suggested at the workshop that **12** additional Research Natural Areas could provide for minimal representation of the remaining **57** cells (table 34). Considering the scarcity of large areas with natural or near-natural ecosystems and the large number and diversity of cells to be filled, this seems extremely optimistic (as several reviewers have pointed out). It is likely that more than **12** Research Natural Areas will be necessary, particularly if they are small. However, we have decided to leave the listing of remaining natural area needs as it is in the absence of better knowledge on how cells could be aggregated. Consequently, the reader should be particularly sensitive in this province to filling cellular needs (tables **29-31**) rather than trying to locate tracts which meet all of the listed characteristics for the tentative and highly diverse Research Natural Areas in table 34 (for example, Nos. **1-4,** 6, and **9).**

In any case a very large job of natural area preservation exists in the Columbia Basin, and lead responsibility is probably more diverse than in most (table 34). State agencies and institutions, private organizations, and Fish and Wildlife Service have particularly large responsibilities but would be assisted by Bureau of Land Management, Energy Research and Development Administration, and Bureau of Reclamation, among others. Priorities are uniformly high because of rapid expansion of human developments in this already extensively altered province. Completion of the Research Natural Area system in the Columbia Basin may prove very difficult, not only because of rapid, large-scale conversion of natural communities to agricultural uses but also because of the large number of cells to be filled. The province should, receive major emphasis from State and private groups.

Table 29.--*Terrestrial cells in* the *Columbia* Basin Province, Washington

	Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Ponderosa pine communities:				
1.	Ponderosa pine/Idaho fescue community	237	Turnbull Pine and Pine Creek RNA's	173-175
* 2.	Ponderosa pine/ninebark community	237	None	173-175
* 3.	Ponderosa pine/snowberry community	237	Some representation at Turnbull Pine RNA, need additional area	173-175
* 4.	Ponderosa pine/bluebunch wheatgrass community	237	None	173-175
* 5.	Ponderosa pine/needlegrass community	237	None	173-175
Zonal meadow-steppe associations:				
6.	*Festuca idahoensis/Symphoricarpos albus* community		Washington State University preserves	211-216 220-222
* 7.	*Artemisia tripartita/Festuca idahoensis* community		None	211-216 222
* 8.	*Festuca idahoensis/Hieracium cynoglossoides* community		None	211 224
* 9.	*Purshia tridentata/Festuca idahoensis* community		None	211-216 222-223
*10.	*Festuca idahoensis/Rosa nutkana* community		None	211 224
*11.	*Purshia tridentata/Agropyron spicatum* community		None	223
Zonal steppe associations:				
*12.	*Artemisia tridentata/Agropyron spicatum* community		Well represented in Rattlesnake Hills RNA, need additional examples elsewhere	211-218
*13.	*Artemisia tridentata/Festuca idahoensis* community		None	211-216 219
*14.	*Agropyron spicatum-Poa sandbergii* community		None	211-216 225-227
*15.	*Agropyron spicatum-Festuca idahoensis* comnunity		None	211-216 219-220

See footnote at end of table.

Table 29.--*Terrestrial cells in the Columbia Basin Province, Washington* (Continued)

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Stipa comata associations on deep gravelly or sandy soils:			
*16. *Artemisia tridentata/Stipa comata* community		None	224-225
*17. *Purshia tridentata/Stipa comata* community		None	224-225
*18. *Stipa comata-Poa sandbergii* community		None	224-225
*19. *Artemisia tripartita/Stipa comata* community		None	224-225
Associations on shallow soils:			
20. *Eriogonum douglasii/Poa sandbergii* community		Rattlesnake Hills RNA	224-225
*21. *Artemisia rigida/Poa sandbergii* community		None	225-227
*22. *Eriogonum niveum/Poa sandbergii*		None	225-227
*23. *Eriogonum sphaerocephalum/Poa sandbergii* community		None	225-227
*24. *Eriogonum compositum/Poa sandbergii* community		None	225-227
*25. *Eriogonum thymoides/Poa sandbergii* community		None	225-227
*26. *Eriogonum microthecum-Physaria oregana* community		None	225-227
*27. Lithosolic *Agropyron spicatum-Poa sandbergii* community		Some in Washington State University preserve, need additional area	225-227
Dry site shrub/*Poa* associations:			
28. *Artemisia tridentata/Poa sandbergii* community		Rattlesnake Hills RNA	228
29. *Grayia spinosa/Poa sandbergii* community		Rattlesnake Hills RNA	228
30. *Eurotia lanata/Poa sandbergii* community		Rattlesnake Hills RNA	228

See footnote at end of table.

Table 29.--*Terrestrial* cells *in* the *Columbia* Basin Province, Washington (Continued)

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Distichlis stricta associations on saline and alkali soils:			
*31. *Distichlis stricta* communities		None	227
*32. *Elymus cinereus-Distichlis stricta* community		None	227
*33. *Sarcobatus vermiculatus-Distichlis stricta* community		None	227
Crataegus associations and related riparian types:			
*34. *Crataegus douglasii/Symphoricarpos albus* community		Small amount in Washington State University preserves, need additional area	227-228
*35. *Crataegus doublasii/Heracleum lanatum* community		None	227-228
*36. Riparian woodland with black cottonwood and white alder		None	228
Associations on specialized habitats (including colluvium and talus):			
*37. *Sporobolus cryptandrus-Poa sandbergii* community		None	228-229
*38. *Aristida longiseta-Poa sandbergii* community		None	228-229
*39. *Rhus glabra* community		None	229-230
*40. *Celtis douglasii/Bromus tectorum* community		None	229-230
*41. Basaltic talus slopes		Some in Rattlesnake Hills RNA, need additional area	229-230
42. Quaking aspen type	217	Turnbull Pine and Pine Creek RNA's	228
*43. Columbia River sand dunes in various stages of stabilization		None	230-231

*Cells presently lacking adequate representation.

Table 30.--*Aquatic cells in the Columbia Basin Province, Washington*

Cell[1]	Present representation
* 1. Freshwater lake	None
* 2. Alkaline lake	None
* 3. Saline lake	None
* 4. Freshwater permanent ponds	None
* 5. Alkaline permanent ponds	None
* 6. Saline permanent ponds	None
* 7. Typical vernal ponds	None
8. Large stream drainage in steppe and shrub-steppe vegetation	Rattlesnake Hills RNA
9. Large, cold springs	Rattlesnake Hills RNA
*10. Typical hot springs	None
*11. Freshwater marsh area	None
*12. Saline marsh area	None
*13. Wasteways and potholes	None

[1]Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the listed ecosystem.

*Cells presently lacking adequate representation.

Table 31.--*Rare and endangered vertebrate animal cells in the Columbia Basin Province, Washington*

Cell	Verified representation	Reference,
Amphibians:		
* 1. Woodhouse toad	None	Stebbins 1954
Reptiles:		
* 2. Striped whipsnake	None	Stebbins 1954
* 3. Night snake	None	Stebbins 1954
Birds:		
4. Western burrowing owl	Rattlesnake Hills RNA	Alcorn 1971
Mammals:		
* 5. Merriam shrew	None	Dalquest 1948 Johnson and Clanton 1954
* 6. Pygmy rabbit	None	Dalquest 1948
* 7. White-tailed jack rabbit	None	Dalquest 1948
* 8. Washington ground squirrel	None	Dalquest 1948
* 9. Ord kangaroo rat	None	Dalquest 1948 Broadbooks 1969
10. Northern grasshopper mouse	Rattlesnake Hills RNA	Dalquest 1948
*11. Kinkaid meadow vole	None	Dalquest 1948 Maser and Storm 1970
12. Sagebrush vole	Rattlesnake Hills RNA	Clanton et al. 1971 Dalquest 1948 Johnson et al. 1948 Maser et al. 1974 Maser and Storm 1970 O'Farrell 1972

*Cells presently lacking adequate representation.

Table 32.--*Vascular plants of special interest in the Columbia Basin Province, Washington*

Species[1]	Distribution
Allium robinsonii[2]	Along Columbia River, Vantage to John Day River
Angelica canbyi	General in province
Antennaria parvifolia	Disjunct from Great Plains
Aster jessicae[2]	Palouse region
Astragalus columbianus[2]	Probably extinct; at Priest's Rapids
Astragalus diaphanus	Along Columbia River, Klickitat County
Astragalus kentrophyta var. *douglasii*[2]	Around Walla Walla with sagebrush
Astragalus leibergii	Douglas, Chelan, and Kittitas Counties with sagebrush
Astragalus pulsiferae	Falcon Valley, Klickitat County
Astragalus riparius	Lower Snake River, Whitman and Columbia Counties
Astragalus sinuatus[2]	Along Colockum Creek, Chelan County
Astragalus speirocarpus	Near Columbia River in lower Columbia Basin with sagebrush
Astragalus succumbens	Klickitat and Grant Counties, with sagebrush
Astragalus tweedyi	Lower Columbia Basin with sagebrush
Balsamorhiza hirsuta	Between Ellensburg and Yakima
Balsamorhiza rosea[2]	Widely disjunct in basin; protected In Rattlesnake Hills RNA
Bolandra oregana	Moist mossy areas along Snake River
Calochortus nitidus[2]	Palouse region
Castilleja thompsonii	Sagebrush associate
Chaenactis douglasii var. *glandulosa*	Along Snake River
Cirsium brevifolium[2]	Palouse region
Collinsia sparsiflora	Lower Columbia River
Crepis modocensis ssp. *glareosa*	Around Ellensburg
Cryptantha fendleri	Franklin County
Cryptantha leucophaea	Along Columbia River from Wenatchee to The Dalles
Delphinium depauperatum	Moist areas in sagebrush valleys, Asotin County
Dicentra cucullaria	Sandy banks along Columbia River
Erigeron basalticus	Crevices in rocky canyons, Yakima County
Erigeron piperianus	With sagebrush
Eriogonum angulosum	Yakima County (disjunct from southeastern Oregon)
Eriogonum thymoides	With sagebrush
Hackelia arida	Western half of basin
Hackelia cinerea	Kittitas and Chelan Counties
Hackelia hispida[2]	Grand .Coulee and Snake River
Hackelia venusta[2]	Chelan County

See footnotes at end of table.

Table 32.--*Vascular plants of special interest in the Columbia Basin Province, Washington* (Continued)

Species[1]	Distribution
Haplopappus liatriformis[2]	Palouse region
Helianthus cusickii	Western basin north to Ellensburg
Iliamna longisepala[2]	Kittitas to Chelan and Douglas Counties
Lathyrus bijugatus[2]	Palouse region
Lomatium salmoniflorum	Palouse region
Lomatium tuberosum[2]	Fort Simcoe-White Swan area
Lomatium watsonii	Kittitas County south
Lupinus sericeus var. *asotinensis*	Asotin and Whitman Counties
Marsilea vestita	Mud of lakes and vernal pools
Mimulus clivicola	Upper Snake River
Mimulus washingtonensis	Wet, open areas, Klickitat County
Navarretia tagetina	Mouth of Klickitat River
Oenothera flava	Along Yakima River
Oryzopsis hendersonii	Yakima and southern Kittitas Counties
Pediocactus simpsonii	Widespread but much collected
Penstemon deustus var. *variabilis*	Klickitat County
Penstemon eriantherus var. *whitedii*	Chelan and Douglas Counties
Penstemon gairdneri var. *gairdneri*	Scablands, northeastern basin
Petrophytum cinerascens[2]	Basalt cliffs along Columbia River, Chelan County
Polemonium pectinatum[2]	Moist bottomlands, Whitman and Spokane Counties
Ranunculus reconditus[2]	Sagebrush slopes, Klickitat County
Ribes cereum var. *colubrinum*	Along Snake River, Asotin County
Rubus nigerrimus[2]	Snake River Canyon, Whitman County
Salix drummondiana	Palouse region
Scirpus olneyi	Grant County
Silene spaldingii[2]	Palouse region; found in Washington State University steppe preserve
Synthyris missurica	Palouse region
Talinum spinescens	Scablands
Tauschia hooveri[2]	Scablands, Yakima County
Tragopogon mirus	Near Pullman and Palouse
Tragopogon miscellus	Palouse region

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or their identification nationally (in the Smithsonian Institution list) as threatened or endangered species.

[2]The species is on the national list of threatened and endangered plants (Smithsonian Institution 1974).

Table 33.--*Established Research Natural Areas in the Columbia Basin Province, Washington*

Name	Principal features	Agency[1]	Area	
			Ha	Acres
Moxee Bog Preserve	Floating sphagnum bog in steppe region of Yakima County	YCC	6	14
Pine Creek RNA	Interior ponderosa pine and grasslands	FWS	65	160
Rattlesnake Hills RNA	Dry Columbia Basin shrub steppe	ERDA	30 364	75,000
Rose Creek Preserve	Seminatural grassland and shrub communities in Palouse region	TNC	5	12
Turnbull Pine RNA	Interior ponderosa pine, grassland, and ponds	FWS	81	200

[1]ERDA = Energy Research and Development Administration, FWS = Fish and Wildlife Service, TNC = The Nature Conservancy, YCC = Yakima Community College.

Table 34.--*Additional Research Natural Areas needed in the Columbia Basin Province, Washington*

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Predominantly terrestrial natural areas:						
1. Large area with big sagebrush/ bunchgrass communities but also with *Artemisia tripartita, Artemisia rigida,* and other communities	T-7,12,13,19, 20,21,22, 23,24,25, 26,28 A-7 R&E-1,2,3,4, 5,6,7,9, 10,12	Okanogan foothills, northeast of Spokane	High	FWS BLM State FS	211-219 *222* 226-227	1003 1104
2. Bunchgrass communities (*Agropyron spicatum, Festuca idahoensis*) in the Palouse Hills	T-8,10,14,15, A-7	Mostly private, so may have to be a Nature Conservancy Area	High	Private	219-224	1105
3. Bunchgrass, *Stipa comata*, and *Eriogonum* communities in an area near Moses Lake	T-16,17,18,22, 23,24,25,26, 27,12,13,14, 15 A-7 R&E-11	Should span moist to dry sites	High	BR State	224-227	1102 1104
4. Alkali saltgrass, greasewood, and giant wildrye-dominated communities on saline-alkali soils	T-31,32,33, 29,30 A-7	Banks Lake area	High	BR	227	1108
5. Riparian woodland (black cottonwood and white alder) and *Crataegus douglasii* communities	T-34,35,36	Foothills of Okanogan Uplands; strip should be 1/8-mile wide	High	FWS FS BLM	227-228	1103 1104
6. *Sporobolus cryptandrus, Aristida longiseta, Rhus glabra*, and *Crataegus douglasii* communities with a 1,000-foot elevational range	T-34,35,37 39,38	Imnaha area; Asotin, Washington, and southward	Medium	FS	227-229	1203
7. Basalt talus area	T-41	Possible this may be found in another area	Low	BR BLM ERDA	229-230	1101 1103 1104

See footnotes at end of table.

Table 34.--*Additional* Research *Natural* **Areas** needed *in* the Columbia *Basin* Province, Washington (Continued)

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
8. Area of Columbia River sand dunes, including dunes in various stages of stabilization	T-43		High	BLM State	230-231	1110
9. Area with a variety of ponderosa pine communities on both north and south slopes. In addition, should include bitterbrush/Idaho fescue and bitterbrush/bluebunch wheatgrass communities	T-1,2,3,4 5,9,11		High	Private BLM State	173-176 222-223	1106 1107
Predominantly aquatic natural areas:						
10. Scabland lakes and ponds with water quality ranging from fresh to saline in a matrix of bunchgrass or shrub-steppe vegetation	A-1,2,3,4 5,6,11, 12	Should include 6 to 10 lakes. Spokane or Sprague, Washington, area	High	FWS State		1104
11. Typical hot springs	A-10		Medium	BR Private FWS		
12. Wasteways and potholes area	A-13 R&E-8	Areas result from damming and irrigation activities	Medium	BR		1102

[1]For a description of these cells see table 29 for terrestrial (T) ecosystems, table 30 for aquatic (A) ecosystems, and table 31 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate those cells which are considered essential components of the proposed Research Natural Area. Those not underlined represent cells which would be desirable but not essential components.

[2]Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is, i.e., the danger that all examples of the type will be lost to other uses. Acquisition urgency.

[3]Agency or institution most likely to have or to be able to acquire a tract of the desired type based on land ownership. BLM = Bureau of Land Management, BR = Bureau of Reclamation, ERDA = Energy Research and Development Administration, FS = Forest Service, FWS = Fish and Wildlife Service.

[4]See appendix V.

OKANOGAN HIGHLANDS PROVINCE, **NORTHEASTERN WASHINGTON**

The Olianogan Highlands Province (fig. 1) is essentially a high plateau area, situated at elevations of 1200 to 2400 m, which is interrupted at intervals by a series of broad valleys containing south-flowing rivers (the Okanogan, Sanpoil, Columbia, Colville, and Pend Oreille Rivers). The upland areas are characterized by generally moderate slopes and broad, rounded summits. The area east of the Columbia River is generally considered to be a part of the Rocky Mountain system, and here slopes tend to be somewhat steeper.

Virtually the entire province was repeatedly covered by glacial ice during the Pleistocene. As a result, deposits of glacial drift are found throughout the area and are especially abundant in the eastern section (north of Spokane). The province contains an almost bewildering variety of rock types, ranging in age from Precambrian to late Tertiary. The oldest rock types are concentrated in the eastern, or Rocky Mountain, section of the province and include phyllite, quartzite, graywacke, slate, and argillite. Granitic rocks of Mesozoic age occupy most of the area in the western portion. Younger sedimentary rocks of Tertiary age are largely confined to areas adjacent to main river valleys.

The soil pattern in the Okanogan Highlands is closely tied to elevation. In the mountainous areas away from the major river valleys, forested soils derived from granitic parent materials tend to have shallow, coarse-textured (gravelly sandy loam), poorly developed profiles. Soils developed on glacial drift at comparable elevations are often influenced by aerially deposited volcanic ash and therefore tend to be deeper and considerably finer textured. At lower elevations, along the margins of river valleys, soils reflect the drier climate and transitional forest-grassland vegetation. Here, well-developed Chernozem soils have developed in glacial till parent materials. These are deep, productive soils with at least moderately thick, dark-colored A horizons.

Forest ecosystems dominate the landscape of the Okanogan Highlands. Many of the ecosystems are characteristic of the Rocky Mountains (Franklin and Dyrness 1973), reflecting the more continental climatic regime; as we have defined the province, it does, in fact, include some western outliers of the Rocky Mountain system in extreme northeastern Washington (fig. 1). Ponderosa pine, Douglas-fir, western larch, and lodgepole pine are characteristic forest dominants in low- to mid-elevations and Engelmann spruce, subalpine fir, and lodgepole pine at higher elevations. Grassland or shrub communities merge into forests at lower elevations and occur as openings in a forest matrix elsewhere. Subalpine and alpine meadow types occur at higher elevations.

Twenty-seven terrestrial cells have been identified which provide minimal coverage of the major forest ecosystems and three associated meadow types (table 35). These include all the major forest communities which have been identified in the province. Forest ecosystem cells span the ponderosa pine, Douglas-fir, grand fir, western redcedar-western hemlock, and subalpine fir forest zones.

There are 11 identified aquatic cells (table 36). Most of these result from a need for lake, pond, vernal pool, and stream representation in both low-elevation and subalpine environments.

It is assumed that Research Natural Areas established to fill terrestrial and aquatic cells will include the complement of typical plant and animal species. Three vertebrate animal cells are identified for special consideration as rare and endangered species (table 37). Vascular plants of special interest include four species from the Smithsonian list of threatened and endangered plants (table 38). A number of species listed in table 38 are boreal species finding their southern limits in the Okanogan Highlands.

There are three Research Natural Areas already established in the Okanogan Highlands (table 39). These provide coverage for 7 of the 41 cells presently identified in the province.

Our present estimate is that 13 additional Research Natural Areas will provide for minimal representation of the terrestrial, aquatic, and animal cells (table 40). Although the number is small, three of the areas could be relatively large, since they must include entire drainage basins and fill several terrestrial and aquatic cells.

Lead responsibility falls heavily on the Fish and Wildlife Service, the Forest Service, and Bureau of Land Management. The State of Washington may also contribute significantly in this province.

Table 35.--*Terrestrial cells in the Okanogan Highlands Province, northeastern Washington*

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Ponderosa Pine Zone:			
* 1. Ponderosa pine/bluebunch wheatgrass community	237	Token in Baird Basin RNA, need additional area	173-176
* 2. Ponderosa pine/Idaho fescue community	237	Token in Baird Basin RNA, need additional area	173-175
* 3. Ponderosa pine/*Stipa* comata community	237	None	173-175
* 4. Ponderosa pine/snowberry community	237	None	173-175
* 5. Ponderosa pine/ninebark comnunity	237	None	173-175
* 6. Ponderosa pine/bitterbrush community	237	None	173-179
Douglas-fir Zone:			
* 7. Ponderosa pine/pinegrass community	237	None	175-176
* 8. Douglas-fir/pinegrass community, including the bearberry phase	210	Token in Maitlen Creek RNA, need additional area	191-192
* 9. Douglas-fir/snowberry community	210 212 214	None	191-192
10. Douglas-fir/ninebark community	210 212 214	Maitlen Creek and Baird Basin RNA's	192
*11. Typical western larch forest	212 or 213	Token in Baird Basin RNA, need additional area	198
Grand Fir Zone:			
*12. Grand fir/Oregon boxwood community	213	Token in Maitlen Creek RNA, need additional area	195 198

See footnote at end of table.

Table 35.--*Terrestrial cells in the Okanogan Highlands Province, northeastern Washington*
(Continued)

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Western Redcedar-Western Hemlock Zone:			
13. Western hemlock/Oregon boxwood community	227	Salmo RNA and token in Maitlen Creek RNA	**202**
*14. Western redcedar/Oregon boxwood community	228	None	**202** 204
15. Western redcedar/devilsclub community	228	Salrno RNA	202
16. Typical western white pine forest	215	Salrno RNA	202
Subalpine Fir Zone:			
*17. Subalpine fir/Oregon boxwood community	**206**	Token in Maitlen Creek RNA, need additional area	207
*18. Subalpine fir/beargrass community	**206**	None	**205**
19. Subalpine fir/rustyleaf (Menziesia *ferruginea*) community	206	Salrno RNA and token in Maitlen Creek RNA	205
*20. Subalpine fir/grouse huckleberry (*Vaccinium scoparium*) community	206	None	205-207
*21. Typical whitebark pine-subalpine fir forest	208	None	205-206
Special types:			
*22. Typical lodgepole pine forest	218	Token in Baird Basin RNA, need additional area	192 197-198
*23. Quaking aspen stands	217	None	184 193
*24. Poplar-birch (including *Cornus cornuta*)	203	None	
*25. Idaho fescue-*Eriogonum* openings in a forest area		None	
*26. Typical south-slope bald (including Festuca *viridula* and *Xerophyllum* tenax)		None	**207-208**
*27. High-elevation mountain meadow and associated bogs		None	207-208

*Cells presently lacking adequate representation.

Table 36.--*Aquatic cells in the Okanogan Highlands Province, northeastern Washington*

Cell[1]	Present representation
* 1. Lake and drainage basin in mixed-conifer forest	None
* 2. Subalpine lake with spruce-fir drainage basin	None
* 3. Low-elevation permanent ponds	None
* 4. Subalpine permanent ponds	None
* 5. Low-elevation vernal ponds	None
* 6. Subalpine vernal ponds	None
7. Stream drainage with mixed-conifer forest	Maitlen Creek RNA
8. Stream drainage with subalpine spruce-fir forest	Salmo RNA
* 9. Typical large cold spring	None
*10. Marsh area	None
*11. Typical bog	None

[1]Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the listed ecosystem.

*Cells presently lacking adequate representation.

Table 37.--*Rare and endangered vertebrate animal cells in the Okanogan Highlands Province, northeastern Washington*

Cell	Veriff'ed representation	Reference
Mammals:		
*1. Masked shrew (subspecies *cinereus*)	None	Dalquest 1948
*2. Pygmy shrew	None	Dalquest 1948
*3. Northern bog lemming	None	Dalquest 1948 Maser and Storm 1970

*Cells presently lacking adequate representation.

Table 38.--*Vascular plants of special interest in the Okanogan Highlands Province, northeastern Washington*

Species[1]	Distribution
Carex backii	Okanogan County
Cassiope tetragona	High elevations, Okanogan County
Castilleja cervina	Southern limit in Okanogan County
Chrysosplenium tetrandum	Often near bogs
Comandra livida	
Cryptogramma stelleri	
Delphinium xantholeucum[2]	Grasslands and yellow pine, Okanogan County
Dryas drummondii	Pend Oreille County
Erigeron leibergii[2]	Moderate to high elevations, Okanogan County
Geum rivale	Southern limit in Okanogan County
Lathyrus ochroleucus	Northeastern Washington
Listera borealis	Southern limit in Okanogan County
Lobelia kalmii	Peat bogs and shores In northeastern Washington
Lomatium orogenioides	Meadows and moist bottomlands in northeastern Washington
Lupinus lepidus var. *cusickii*	Disjunct in Okanogan County
Lupinus sulphureus var. *sulphureus*	Okanogan County
Parnassia kotzebuei pumila[2]	Near Gilbert, Okanogan County, possibly extinct
Penstemon lyallii	Spokane County
Penstemon washingtonensis[2]	Moderate elevatlons, Okanogan County
Petasites sagittatus	Northeastern Washlngton
Physaria didymocarpa	Stevens County and east
Talinum okanoganense	Only in Okanogan County and adjacent Canada
Thalictrum dasycarpum	Northeastern Washington
Viola renifolia	Southern limit in Okanogan County

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct opulations, or their identification nationally (in the Smithsonian Institution list! as threatened or endangered species.

[2]Species is on the national list of threatened and endangered plants (Smithsonian Institution 1974).

Table 39.--*Established Research Natural Areas in the Okanogan Highlands Province, northeastern Washington*

Name	Principal features	Agency[1]	Area	
			Ha	Acres
Baird Basin RNA	Interior ponderosa pine, larch and Douglas-fir	FWS	*65*	*160*
Maitlen Creek RNA	Douglas-fir/ ninebark forest with stream drainage	FS	*259*	*640*
Salmo RNA	interior subalpine fir and western hemlock-western redcedar forest with stream drainage	FS	*563*	*1,390*

[1]FS = Forest Service, FWS = Fish and Wildlife Service.

Table 40.--*Additional Research Natural Areas needed in the Okanogan Highlands Province, Washington*

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Combined terrestrial and aquatic natural areas:						
1. Lake and drainage basin supporting mixed conifer (ponderosa pine, Douglas-fir, western larch/shrub) communities	T-4,5,9, 11,10 A-1,3,5,10	Little Pend Oreille National Wildlife Refuge	High	FWS BLM	191-192 195-199	1003 1004
2. High-elevation lake and drainage basin supporting subalpine fir/shrub communities	T-17,20,19 A-2,4,6 R&E-1,2	Wilderness Area	Medium	FS	205-207	1003 1004
3. High-elevation mountain meadow and bog	T-27 A-11 R&E-3	Bunchgrass Meadows (area "also contains rare plants)	High	FS	207-208	1003 1004
Predominantly terrestrial natural areas:						
4. A variety of ponderosa pine/ grass communities in a forest-steppe ecotonal area	T-1,2,3, 25,6		Medium	FS FWS	173-175 220-222	1001 1005
5. Ponderosa pine-Douglas-fir/ pinegrass communities	T-7,8,11	Sherman Creek	Medium	FS	175-176 191-192	1001 1005
6. High-elevation subalpine fir and whitebark pine-subalpine fir forest, including a south-slope bald	T-18,21,26	Round Top Mountain	High	FS	205-208	1003 1004
7. Western redcedar/Oregon boxwood community	T-14,13,15	Vicinity of Hooknose Mountain	Medium	FS	202 204	1003

See footnotes at end of table.

Table 40.--*Additional* **Research Natural** Areas ***needed in the*** *Okanogan Highlands* **Province,** *Washington* (Continued)

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
8. Grand fir/Oregon boxwood community	T-12		Medium	FS FWS	195 198	1003 1004
9. Ponderosa pine/bitterbrush community	T-6,1,2		Medium	FS FWS	173-179	1001 1005
10. Lodgepole pine forest	T-22		Medium	FS	192 197-198	1003 1004
11. Quaking aspen stands	T-23	Little Pend Oreille National Wildlife Refuge	Medium	FWS State BLM	184 193	1001 1003
12. Poplar-birch (including *Cornus cornuta)*	T-24	Along Pend Oreille River north of Metaline Falls	Medium	FS BLM		1001
Predominantly aquatic natural areas:						
13. Typical large, upwelling cold spring	A-9		High	FS FWS BLM		

[1]For a description of these cells see table 35 for terrestrial (T) ecosystems, table 36 for aquatic (A) ecosystems, and table 37 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate those cells which are considered essential components of the proposed Research Natural Area. Those not underlined represent cells which would be desirable but not essential components.

[2]Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is, i.e., the danger that all examples of the type will be lost to other uses. Acquisition urgency.

[3]Agency or institution most likely to have or to be able to acquire a tract of the desired type based on land ownership. BLM = Bureau of Land Management, FS = Forest Service, FWS = Fish and Wildlife Service.

[4]See appendix V.

OREGON COAST RANGES PROVINCE

The southern section of the Oregon Coast Ranges Province (fig. 1) is topographically mature, with extremely steep slopes and sharp ridges. However, with the exception of the areas drained by the Wilson and Trask Rivers, the proportion of steep slopes decreases in the northern section. Mountain passes are generally located on the eastern border of the range due to faster rates of headward erosion by the numerous westward-flowing streams. Elevations of main ridge summits in the province range from about 450 to 750 m. Scattered peaks, often capped with intrusive igneous rocks, rise well above surrounding ridges.

By far the dominant rock type in the southern section of the province is tuffaceous marine sandstone, which was laid down during the Eocene. Other rock types which are locally present include scattered igneous intrusions (Oligocene) and basalt headlands along the coast (Miocene). On forested steep slopes, soils derived from sandstone are generally shallow, stony loam textured, and brown to yellowish brown in color. On more gentle slopes and ridgetops, these sandstone parent materials give rise to deep, productive soils with well-developed profiles which are dominantly silt loam to silty clay loam in texture.

The northern section of the province is underlain by about equal amounts of basalt and sedimentary rocks (sandstone and siltstone). The sedimentaries are, for the most part, of Oligocene and Eocene age, while the major portion of the basalt is dated as Miocene. Here also, soil characteristics are closely related to topography as well as to parent material. On moderate upland slopes, soils derived from basalt tend to be deep, well-aggregated, and very productive for tree growth. These are reddish-brown in color and almost free of stones; surface textures are generally clay loam and the subsoil, a silty clay loam.

The province is a heavily forested region dominated by Douglas-fir, western hemlock, Sitka spruce, and other coniferous and hardwood tree species (Franklin and Dyrness **19'73).** There is, nonetheless, considerable diversity even in forest ecosystem types as a consequence of major climatic gradients, local environmental differences, and historical disturbances, especially by fire and logging. Ecosystems with Sitka spruce characterize the fog belt immediately adjacent to the coast, an array of Douglas-fir and western hemlock types occupy the bulk of the mountains, and drier forest communities become more common on the lower eastern slopes of the Coast Ranges. On a few higher peaks, subalpine forests of true firs occur. Extensive wildfires initiated numerous second-growth stands of conifers now **100** to **150** years old, and logging has converted much of the original forest to young stands of red alder and conifers.

Habitats along the edge of the Pacific Ocean contribute a great deal of the province's ecologcal diversity. Because of the varied and distinctive character, some reviewers suggested creating a separate province for these. Included are the dune ecosystems of both the central and northern coast and headland communities.

Aquatic ecosystems are mainly streams and rivers, swamps, and marshes with relatively few lakes and ponds. Anadromous fishes are important biologic features of many river and stream systems.

Terrestrial cells identified for the Oregon Coast Ranges total **23** (table **41).** Fifteen of these are for coniferous forest ecosystems including geographic (north and south) representation of particularly important, widespread types. Younger examples **of** Douglas-fir forest as well as old growth need to be represented. The remaining cells are for dune, headland, riparian, and mountain meadow ecosystems, as well as red alder forest.

Identified aquatic cells total **13** (table **42).** Five cells are for forested stream systems, two of which should contain anadromous fish. Three cells identify needs for a lake and ponds in coastal sand dune areas. A low-elevation inland lake, swamp, bog, and marshes complete the aquatic listing.

Animals and plants of special interest are listed in tables **43** and **44.** There are four rare or endangered vertebrate animals identified as cells. Vascular plants of special interest fall mainly into two groups: species found on a few isolated peaks (notably Saddle and Sugarloaf Mountains and Onion Peak, all in Clatsop County) and species found in the coastal strip immediately adjacent to the ocean. Eleven of these vascular plants are on the Smithsonian list as threatened or endangered species.

There are presently two Federal Research Natural Areas and one Nature Conservancy reserve within the Oregon Coast Ranges (table **45).** These tracts fill **5** of the **40** cells listed for this province; all of the filled cells are terrestrial.

It appears that **15** additional Research Natural Areas will be necessary to provide for minimal representation of the **35** unfilled terrestrial, aquatic, and vertebrate animal cells in the province (table **46).** Six of the areas needed combine major terrestrial and aquatic cells, and three of these — two stream drainages with anadromous fish and a coastal dune mosaic — are of particular significance.

Conflicts with other resource values are frequently high in this province, much of it has been altered by human developments, and private lands dominate. Consequently, the task of completing the Research Natural Area system is large. Forest Service, Oregon State agencies, and Bureau of Land Management appear to have major responsibilities, but help from the private sector will probably be needed in the acquisition of several tracts. Priorities are generally high since many of these ecosystems are being rapidly committed to logging or incompatible recreational uses.

Table 41.--*Terrestrial cells in the Oregon Coast Ranges Province*

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Sitka Spruce Zone:			
*1. Sitka spruce/salal community on ocean front	223	None	59-60, 291
*2. Lodgepole pine/salal community on ocean front		None	59-60, 291
3. Sitka spruce-western hemlock/swordfern community	223	Neskowin Crest RNA (recommend enlarging to provide more diversity)	59-61
Western Hemlock Zone:			
* 4. Western hemlock/swordfern in central to northern portion	224	None	79-80
5. Western hemlock/swordfern in southern portion	224	Cherry Creek RNA	79-80
* 6. Old-growth Douglas-fir-western hemlock/ swordfern in central to northern portion	230	None	79-80
7. Old-growth Douglas-fir-western hemlock/ swordfern in southern portion	230	Cherry Creek RNA	79-80
* 8. Old-growth Douglas-fir-western hemlock/ rhododendron/Oregongrape in central to northern portion	230	None	79-80
9. Old-growth Douglas-fir-western hemlock/ rhododendron/Oregongrape in southern portion	230	Cherry Creek RNA	79-80
*10. Douglas-fir/oceanspray/salal community	229	None	73-75, 79
*11. Douglas-fir, 25-50 years old (old. burn)	229	None	85-87
*12. Douglas-fir/salal community, 100-150 years old	229	None	79-80
*13. Douglas-fir/swordfern community, 100-150 years old	229	None	79-80
*14. Upland red alder stand with two perennial streams	221	None	61-63 85-87
Pacific Silver Fir Zone:			
*15. Old-growth noble fir forest		None	98
*16. Old-growth Pacific silver fir-western hemlock forest		None	98
Special types:			
*17. Coastal dune mosaic with a variety of dune types, tree islands, deflation plains, and early successional stages		None	291-295
*18. Parabola dune complex and surroundings		None	291-294
19. Coastal headland herbaceous communities		Cascade Head Nature Conservancy Area	291-292 297
*20. Grass bald on Coast Range mountain		None	90-91
*21. "Rock garden" community on Coast Range mountain		None	90-91
*22. Riparian hardwoods		None	61-63
*23. Coastal headlands shrub community		None	

*Cells presently lacking adequate representation.

Table 42.--*Aquatic cells in the Oregon Coast Ranges Province*

Cell[1]	Present representation	Remarks
* 1. Major stream drainage in Sitka spruce-western hemlock with anadromous fish	None	Stream should drain directly to the ocean
* 2. Major stream drainage in Douglas-fir, with anadromous fish	Would be filled by establishment of proposed Flynn Creek RNA	Should be inland from the coast
* 3. Two side-by-side perennial streams draining alder-dominated forest	None	
* 4. Low-gradient coastal stream with a sandy bottom, with good riparian mammal habitat	None	Should be south of Florence
* 5. Typical headwaters section of a high-elevation stream, with noble fir or Pacific silver fir forest	None	
* 6. Freshwater lake in sand dunes	None	
* 7. Low-elevation eutrophic lake	None	
* 8. Permanent ponds in sand dunes	None	
* 9. Vernal ponds in sand dunes	None	
*10. Typical Sitka spruce swamp	None	
*11. Typical skunk cabbage marsh	None	
*12. Willow-sedge marsh area	None	
*13. Coastal bog	Need would be filled with establishment of proposed Hunter Creek Bog RNA	

[1]Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the listed ecosystem.

*Cells presently lacking adequate representation.

Table 43.--*Rare and* **endangered vertebrate animal** *cells* **in** *the* **Oregon Coast** *Ranges*

Cell	Verified represeneation	Reference
Birds:		
*1. Northern spotted owl	Cherry Creek RNA, need an additfonal area	Gabrielson and Jewett **1940**
Mammals:		
*2. Botta pocket gopher (2 subspecies involved)	None	Bailey **1936** Olterrnan and Verts **1972**
3. White-footed vole	Neskowin Crest RNA	Bailey **1936** Johnson **1973** Maser **1966** Maser and Johnson **1967** Maser and Storm **1970** Olterman and Verts **1972**
*4. Red tree vole (2 subspecies involved)	Coquille River Falls RNA, need an additional area	Bailey **1936** Johnson **1973** Maser **1966** Maser and Johnson **1967** Maser and Storm **1970** Olterrnan and Verts **1972**

*Cells presently lacking adequate representation.

Table 44.--*Vascular plants of special interest in the Oregon Coast Ranges Province*

species[1]	Distribution
Anemone oregana var. *felix*	Sphagnum bogs along immediate coast, Lincoln County
Arenaria paludicola[2]	Swamps along coast
Cardamine pattersonii[2]	Open slopes, Saddle and Sugarloaf Mountains and Onion Peak, Clatsop County
Cladothamnus pyrolaeflorus	Saddle Mountain and Onion Peak, Clatsop County; Blue Lake Lookout, Tillamook County
Cordylanthus maritimus[2]	Salt Marsh, Coos Bay
Douglasia laevigata var. *ciliolata*[2]	Saddle Mountain, Clatsop County
Empetrum nigrum	Open bluffs along coast, Lincoln and Curry Counties
Erigeron peregrinus var. *peregrinus*	Saddle Mountain and Onion Peak, Clatsop County
Erythronium revolutum[2]	Saddle Mountain, Clatsop County and along north coast
Filipendula occidentalis[2]	Along rivers (Trask, Wilson, and Tillamook), Clatsop to Lincoln Counties
Geum triflorum var. *campanulatum*	Saddle Mountain and Onion Peak, Clatsop County
Lasthenia minor ssp. *maritima*[2]	Rocky headlands, Lincoln County
Ledum groenlandicum	Bogs along coast, Clatsop and Tillamook Counties
Lewisia columbiana var. *rupicola*[2]	Saddle Mountain and Onion Peak, Clatsop County
Plantago macrocarpa	Cold, wet habitats near coast, Lincoln County
Ranunculus lobbii	Vernal pools along coast
Rhinanthus crista-galli	Saddle Mountain, Clatsop County, and Tillamook prairie
Romanzoffia tracyi	Wet sea cliffs, Tillamook and Lincoln Counties
Salix hookeriana	Clatsop County
Saxifraga bronchialis var. *vespertina*	Saddle and Sugarloaf Mountains and Onion Peak, Clatsop County
Saxifraga caespitosa var. *emarginata*	Onion Peak, Clatsop County
Saxifraga occidentalis var. *latipetiolata*[2]	Saddle and Sugarloaf Mountains and Onion Peak, Clatsop County
Scoliopus hallii	Damp woods along streams, Tillamook County south
Senecio flettii	Onion Peak, Clatsop County
Sidalcea hendersonii	Sandy tidelands, mouth of Columbia River
Sidalcea hirtipes	Coastal mountains to bluffs along the ocean, Saddle Mountain, Clatsop County, to north Lincoln County
Silene douglasii var. *oraria*[2]	Bluff above sea, Tillamook Head
Sisyrinchium californicum	Wet ground along immediate coast, Lincoln and Lane Counties
Stellaria humifusa	Beaches and salt marshes, Lincoln County north
Synthyris schizantha[2]	Saddle Mountain and Onion Peak, Clatsop County
Vaccinium oxycoccos var. *intermedium*	Sphagnum bogs, Lincoln County north

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or their identification nationally (in the Smithsonian Institution list) as threatened or endangered species.

[2]The species is on the national list of threatened and endangered plants (Smithsonian Institution 1974).

Table 45.--*Established Research Natural Areas in the Oregon* Coast *Ranges Province*

Name	Principal features	Agency[1]	Area	
			Ha	Acres
Cascade Head Preserve	Oregon coastal headland with extensive grassland and conifer and red alder forest	TNC	121	300
Cherry Creek RNA	Coast Ranges Douglas-fir forest	BLM	239	590
Neskowin Crest RNA	Sitka spruce-western hemlock forests	FS	278	686

[1]BLM = Bureau of Land Management, FS = Forest Service, TNC = The Nature Conservancy.

Table 46.--*Additional* ***Research*** Natural Areas ***needed*** *in* ***the*** Oregon *Coast* ***Ranges*** *Province*

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Combined terrestrial and aquatic natural areas:						
1. Stream drainage with anadromous fish and a small estuary in the Sitka spruce-Douglas-fir forest type	T-3,22,1,2 A-1 RbE-1,3,4	Reneke Creek, Cummins Creek area, Neptune State Park area	High	FS State	58-63	0204
2. Major stream drainage with anadromous fish in the Douglas-fir-western hemlock type	T-13,12,14,24 A-2 R&E-1,3,4	Flynn Creek	High	FS	79-80	0204
3. Red alder area drained by two perennial streams (for purposes of studying nutrient cycling)	T-14 A-3 R&E-3	Could be in either Sitka spruce or western hemlock zones	LOW	BLM FS	61-63 85-87	0204 0205 0206
4. Coastal dune mosaic. (including tree islands, deflation plains, and most major dune types), with freshwater lake and ponds	T-17 A-6,8,9	Umpqua Dunes Scenic Area (Oregon Dunes National Recreation Area)	High	FS	291-295	0207
5. Ocean-front Sitka spruce/salal and lodgepole pine/salal with swampy swales	T-1,2 A-10	Could be partially filled in Cape Lookout State Park	Medium	State	59-60 291	0207
6. Old-growth Pacific silver fir-western hemlock forest with headwaters portion of a stream	T-16 A-5 R&E-1,3	Northern Coast Range area	Medium	State Private	98	0206
Predominantly terrestrial natural areas:						
7. Old-growth Douglas-fir-western hemlock/swordfern and western hemlock/swordfern	T-4,6 R&E-4	Should be in central to northern portion of Coast Ranges	High	BLM State	79-80	0204 0206
8. Old-growth Douglas-fir-western hemlock/rhododendron/Oregongrape	T-8, 10 R&E-4	In central to northern portion	High	BLM State	79-80	0204 0206

See footnotes at end of table.

Table 46.--*Additional Research Natural Areas needed in the Oregon Coast Ranges Province* (Continued)

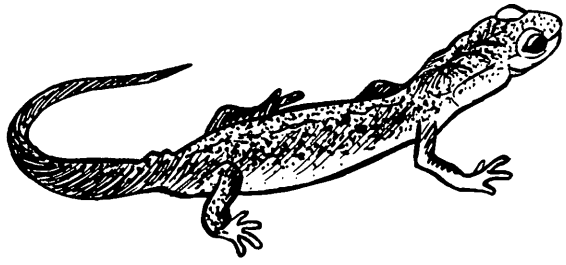
Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
9. Douglas-fir, 25-50 years old on old burn, and adjacent stand of noble fir	T-11,14	Should be natural regeneration; Tillamook Burn is possible area	LOW	State	85-87	0206
10. Parabola dune complex	T-18	Sand Lake area	High	FS	291-294	0207
11. Grass bald and "rock garden" vegetation on a Coast Range peak	T-20,21	Onion Peak	Medium	State BLM	90-91	0206
Predominantly aquatic natural areas:						
12. Small lake and surrounding temperate forest	A-7	Eutrophic lake at low elevation	High	BLM Private		0205
13. Coastal bog	A-13 R&E-11,12	Clatsop County	High	State Private	68-69	0202 020
14. Low gradient coastal stream (sandy bottom) with skunk cabbage marsh	A-4,11 R&E-3	Johnson Creek near Bandon or Tenmile Creek, Coos County	Medium	FS	68-69	020,
15. Willow-sedge marsh	A-12	Three-Mile Creek	High	FS	68-69	0207

[1]For a description of these cells see table 41 for terrestrial (T) ecosystems, table 42 for aquatic (A) ecosystems, and table 43 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate those cells which are considered essential components of the proposed Research Natural Area. Those not underlined represent cells which would be desirable but not essential components.

[2]Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is, i.e., the danger that all examples of the type will be lost to other uses. Acquisition urgency.

[3]Agency or institution most likely to have or to be able to acquire a tract of the desired type based on land ownership. BLM = Bureau of Land Management, FS = Forest Service..

[4]See appendix V.



WESTERN OREGON INTERIOR VALLEYS PROVINCE

The Western Oregon Interior Valleys Province includes the valley bottoms and lowlands enclosed by the Cascade Range on the east and the Coast Ranges or Siskiyou Mountains on the west (fig. 1). The major units within the province are the Umpqua, Rogue, and Willamette River valleys. Of the three, the Willamette Valley is by far the largest; therefore it will receive major emphasis. Because of their location in the rain shadow of the Coast Ranges or the Siskiyou Mountains, the valleys are relatively warm, dry regions, especially in comparison with the remainder of western Oregon.

The topography of the Willamette Valley is characterized by broad alluvial flats separated by groups of low, generally basaltic hills. One of its most unusual features is its substantial width, which generally varies from about **30** to 50 km. The valley floor has a very gentle, north-facing slope and is, for the most part, underlain by thick, nonmarine sedimentary deposits of Pliocene-Pleistocene age. During at least two episodes of the Pleistocene, the entire valley was drowned by water and partially filled by silt to a depth of about **30** m. Recent alluvial deposits are limited in extent and confined to areas immediately adjacent to the Willamette River.

Soils on the Willamette Valley floor, derived from silty alluvial and lacustrine deposits, were formed under dominantly grassland vegetation. Well-drained soils situated on the Willamette River flood plain are deep, moderately dark colored, and range from sandy loam to silty clay loam in texture. Soils on terraces show more profile development, typically having silt loam surface horizons underlain by silty clay loam. Except for poorly drained soils in depressions, these are highly productive soils which are intensively used for agriculture.

The dominant valley bottom landforms in the Umpqua and Rogue River valleys are alluvial fans, terraces, and flood plains. In well-drained terrace locations, deep, dark-colored Prairie soils are common which are generally loam textured. However, black, clay-textured soils which undergo considerable expansion and contraction with wetting and drying are also common in the vicinity of Roseburg and Medford. Valley foothill soils are generally shallow and stony and, thus, extremely droughty during the dry summer period.

The natural ecosystems of the interior valleys are poorly known since these valleys were the first areas settled, with lands converted to agricultural and other uses. Nevertheless, many examples of natural or near-natural communities remain which indicate the valleys were mosaics of coniferous forests (especially on marginal hills), oak savannas and woodland, riparian or gallery forest, extensive and varied grasslands, and, in the southern valleys, chaparral-like shrub fields. Substantial variability in the characteristics of each of these ecosystem groupings is associated with a latitudinal change in climate; the progression is from the Willamette Valley, which is the coolest and wettest, south to the Rogue River valley, which is the warmest and driest. Additional variation in communities has been introduced by various disturbances such as fire, grazing, and logging. Aquatic ecosystems are varied and tend to be eutrophic in character even in their unpolluted state. Sloughs and slow-moving streams are associated with the major valley rivers, and marshes and ponds are common, particularly in the Willamette Valley.

Of terrestrial cells, **26** have been identified for the interior valleys of western Oregon (table 4'7). The basic strategy is to provide for representation of coniferous forest, oak woodlands, grasslands, and riparian hardwoods in each of the three major valley systems (Willamette, Umpqua, and Rogue Rivers). This should insure necessary diversity in these types for the natural area system.

Nine aquatic cells are listed for the interior valleys (table 48). Six of these are for valley-bottom ecosystems (ponds, oxbow lake, marshes, and slough segment) and the majority will probably be located within the Willamette Valley. Small valley-margin stream systems and a spring are also identified as necessary elements in a Research Natural Area system.

The areas selected to fill terrestrial and aquatic cells are expected to include the typical array of plant and animal species. Six vertebrate animals have been identified as rare and endangered cells requiring specific attention in selection and establishment of Research Natural Areas (table 49). Vascular plants of special interest include 19 from the Smithsonian list of threatened and endangered plants—a high proportion of the total list (table 50).

There are nine Federal Research Natural Areas and two reserves developed by The Nature Conservancy in the interior valleys of western Oregon (table 51). Since most of the areas are small they fill only 9 cells of a total of 41 identified cells in the province; 8 of the filled cells are terrestrial and 1 is aquatic.

Twenty-two additional Research Natural Areas should provide minimal representation of all identified terrestrial, aquatic, and rare and endangered cells (table 52). Because of the diverse nature of the cells and the relatively small size of potential sites for Research Natural Areas, most of these needed reserves have only one or two cells as essential elements.

Lead responsibilities in this heavily developed province rest primarily with State institutions, Bureau of Land Management, and private organizations (table 52). It is difficult to establish priorities in this province since the pace of urban and other developments is so rapid. As a generality, aquatic ecosystems and types suitable for agricultural development or logging need quickest attention.

Table 47.--*Terrestrial cells in* **Western *Oregon* Interior *Valleys* Province**

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Conifer forests:			
1. Dry-site Douglas-fir forest on Willamette Valley foothills	229	Camas Swale and Fox Hollow RNA's	116-118
2. Douglas-fir-western hemlock forest on Willamette Valley foothills	230	Mohawk and Little Sink RNA's	116-118
3. Ponderosa pine-Douglas-fir forest in Willamette Valley margin location		Fox Hollow RNA	116-118
* 4. Western redcedar and associated conifers, northern Willamette Valley	227	None	116-118
* 5. Coniferous forest mixture, Umpqua Valley	Probably 229	None	118-119
* 6. Mixed coniferous forest (Douglas-fir probably dominant), Rogue Valley	243 or 244 or 229	None	118-119
* 7. Grand fir forest In the Willamette Valley		None	116-118
Oak woodland:			
* 8. Oregon white oak-grass savanna in the Willamette Valley	233	Token in Maple Knoll RNA and Cogswell-Foster Preserve, need additional area	111-114
* 9. Oregon white oak/snowberry forest in the Willamette Valley	233	None	111-114
10. Oregon white oak/poison oak forest in the Willamette Valley	233	Pigeon Butte and Maple Knoll RNA's	113
*11. Oak woodland in the Umpqua Valley	233	None	114-115
*12. Oregon white oak woodland in the Rogue Valley	233	None	114-115
*13. Oak-madrone wood and in the Rogue Valley	234	None	
*14. California black oak woodland in the Rogue Valley	246	None.	114-115

See footnote at end of table.

Table 47.--*Terrestrial cells in* **Western *Oregon* Interior *Valleys* Province** (Continued)

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Grasslands:			
*15. Steep slope, xeric, valley margin prairie with rock outcrops in the Willamette Valley		None	119-123
*16. Gentle slope or valley bottom mesic prairie in the Willamette Valley		None	119-123
17. Wet, poorly drained valley bottom prairie in the Willamette Valley		Willamette Floodplain RNA	119-123
*18. Typical grassland in the Umpqua Valley		None	119-123
*19. Typical grassland in the Rogue Valley		None	119-123
Riparian and other hardwood communities:			
20. Riparian black cottonwood/willow along the Columbia River		Tenasillahe Island RNA	124-126
*21. Riparian black cottonwood/willow along the Willamette River		None	124-126
*22. Oregon ash in the Willamette Valley		Token in Willamette Floodplain RNA, need additional area	124-126
23. Riparian woodland in the Umpqua Valley		Myrtle Island RNA	124-127
*24. Riparian woodland in the Rogue Valley		None	124-127
25. Bigleaf maple forest		Maple Knoll and Little Sink RNA's	
Shrub communities:			
*26. Chaparral *(Ceanothus-Arctostaphylos)* in the Rogue Valley		None	124

*Cells presently lacking adequate representation.

Table 48.--*Aquatic cells in Western* Oregon *Interior Valleys Province*

Cell[1]	Present representation	Remarks
*1. Oxbow lake in the Wi1lamette Val ley	None	
*2. Eutrophic permanent pond	Little Sink RNA	Only token representation in. RNA, need additional area
"3. Typical vernal pond	None	
*4. Small stream drainage along the east side of the Willamette Val ley	None	
"5. Small stream drainage along the west side of the Willamette Valley	None	
6. Typical slough along large stream in the Willamette Valley	Willamette Floodp1ain RNA	
"7. Mineral spring in valley fringe area	None	
*8. Val ley bottom marsh in the Wi1lamette Val ley	None	
"9. Valley bottom marsh in the. Umpqua or Rogue River Val ley	None	

'Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the 1isted ecosystem.

*Cells presently lacking adequate representation.

Table *49.--Rare and endangered vertebrate animal cells in the Western Oregon Interior Valleys Province*

Cell	Verified representation	Reference
Amphibians:		
*1. Marys Peak salamander	None	
Reptiles:		
*2. Sharp-tailed snake	None	Stebbins 1954 Storm *1966*
*3. California mountain kingsnake	None	Stebbins *1954*
*4. Common kingsnake	None	Stebbins *1954*
*5. Western rattlesnake	None	Stebbins *1954* Storm *1966*
Mammals:		
*6. White-footed vole	None	Bailey *1936* Maser and Storm *1970* Olterman and Verts *1972* Johnson 1973 Maser *1966* Maser and Johnson 1967

*Cells presently lacking adequate representation.

Table 50.--*Vascular plants of special interest in the Western Oregon Interior Valleys Province*

Species[1]	Distribution
Allium unifolium	Near Willamina, Yamhill County
Androsace acuta	Rogue River Valley
Aster chilensis ssp. *hallii*[2]	Grasslands, Willamette Valley
Aster curtus	Grasslands, northern Willamette Valley
Aster vialis[2]	Oak woodlands, Lane and Douglas Counties
Brodiaea venusta	Garden Valley, Douglas County
Camassia leichtlinii var. *leichtlinii*	Moist fields and along highway near Roseburg, Douglas County
Cardamine penduliflora[2]	Lowland ponds and marshes, Willamette Valley east of Coast Ranges
Castilleja levisecta	Swamps, northern Willamette Valley
Delphinium leucophaeum[2]	Fields, northern Willamette Valley; now largely restricted to ditches and fence rows
Delphinium nuttallii	Gravelly outwash "prairies" and basaltic cliffs, Clackamas County
Delphinium pavonaceum[2]	Fields in Benton, Polk, and Clackamas Counties; mainly along fence rows
Erigeron decumbens	Grassland, Willamette Valley
Eryngium petiolatum[2]	Open ground, especially in spring-wet and summer-dry habitats, Willamette Valley and along Columbia River to the Gorge
Euonymus occidentalis	Near Portland, Clackamas County (Tryon Creek State Park)
Howellia aquatilis	In ponds on Sauvies Island, Columbia County, and near Salem, Marion County
Iris tenax var. *gormanii*	Along Scoggins Creek, Washington County, and Dairy Creek, Columbia County
Lathyrus holochlorus[2]	Fence rows and partially cleared land, Willamette Valley
Limnanthes floccosa ssp. *grandiflora*[2]	Near White City, Jackson County
Limanthes floccosa ssp. *pumila*[2]	Vernal rocky flats, Table Rock, Jackson County
Limanthes gracilis[2]	Seepage slopes, Rogue River Valley
Lomatium bradshawii[2]	Willamette Valley from Salem to Eugene; present in Willamette Floodplain RNA
Lotus pinnatus	Streambanks and meadows in valleys west of Cascade Mountains
Microcala quadrangularis	Moist prairies, Willamette and Umpqua Valleys
Microseris acuminata	Grassy flats, Sam's Valley, Jackson County
Microseris laciniata ssp. *leptosepala*	Grasslands, northern Willamette Valley

See footnotes at end of table.

Table 50.--*Vascular plants of special interest in the Western Oregon Interior Valleys Province* (Continued)

Species[1]	Distribution
Mimulus tricolor	Vernal pools, central Willamette Valley
Pellaea andromedaefolia	Dry stony areas, Douglas County
Perideridia erythrorhiza[2]	Grasslands, Umpqua Valley to Grants Pass
Phacelia verna[2]	Basalt cliffs, Umpqua Valley
Plagiobothrys hirtus[2]	Boggy ground near Drain, Umpqua Valley
Plagiobothrys hirtus var. *corallicarpus*[2]	Grasslands, Rogue River Valley near Grants Pass
Plagiobothrys lamprocarpus[2]	Grants Pass, Josephine County
Poa laxiflora	Multnomah, Clackamas, and Benton Counties
Pogogyne ziziphoroides	Agate desert, Jackson County
Ranunculus austro-oreganus	Dry ground near Medford, Jackson County
Sagittaria latifolia	In shallow water along streams and in swamps, northern Willamette Valley
Sedum stenopetalum ssp. *ciliosum*	Dry cliffs, Umpqua Valley near Roseburg, Douglas County
Sidalcea campestris[2]	In pastures and along roadsides, Willamette Valley; present in Willamette Floodplain RNA
Sidalcea cusickii[2]	Open fields and roadsides, Coquille and Umpqua River Valleys
Sidalcea nelsoniana[2]	Moist open ground, Willamette Valley between Portland and Salem; present in Willamette Floodplain RNA
Silene hookeri ssp. *pulverulenta*	Grasslands, Josephine and Jackson Counties
Trillium chloropetalum	Streambanks to damp woods, Willamette Valley
Viola douglasii	Open grasslands, Jackson County
Viola hallii	Grasslands, Douglas and Josephine Counties
Viola howellii	Moist woods and farmlands, Willamette Valley

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or identification nationally (in the Smithsonian Institution list) as threatened or endangered species.

[2]Species is on the national list of threatened and endangered plants (Smithsonian Institution 1974).

Table 51.--*Established* ***Research Natural Areas in Western Oregon*** *Interior Valleys Province*

Name	Principal features	Agency[1]	Area	
			Ha	Acres
Camassia Natural Area	Oak, madrone, camas, and aspen associated with openings, floristically rich	LCC TNC	9	23
Camas Swale RNA	Dry Douglas-fir forest in foothills of Willamette Valley	BLM	130	320
Cogswell-Foster Preserve	Oregon white oak and Oregon ash woodlands and seminatural grasslands in central Willamette Valley	TNC	34	83
Fox Hollow RNA	Dry Douglas-fir and ponderosa pine forest in foothills of the Willamette Valley	BLM	51	125
Little Sink RNA	Slump ponds and conifer-bigleaf maple forest on margin of the Willamette Valley	BLM	32	80
Maple Knoll RNA	Bigleaf maple stands on knoll in Willamette Valley	FWS	40	100
Mohawk RNA	Douglas-fir, western hemlock, and western redcedar forest in foothills of the Willamette Valley	BLM	61	150
Myrtle Island RNA	California laurel stands on an island in the Umpqua River	BLM	11	28
Pigeon Butte RNA	Oregon white oak stands on a knoll in the Willamette Valley	FWS	28	70
Tenasillahe Island RNA	Black cottonwood-willow stand on island in lower Columbia River	FWS	75	185
Willamette Floodplain RNA	Willamette Valley bottomland grass and Oregon ash cornunities	FWS	97	239

[1]BLM = Bureau of Land Management, FWS = Fish and Wildlife Service, LCC = Lewis and Clark College, TNC = The Nature Conservancy.

Table 52. --*Additional Research Natural Areas needed in the Western Oregon Interior Valleys Province*

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Combined terrestrial and aquatic natural area:						
1. Oregon ash forest with eutrophic permanent pond and vernal pond	T-22 A-2,3	Preferably in southern Willamette Valley	Medium	State Private	124-126	0501
Predominantly terrestrial natural areas:						
2. Western redcedar and associated conifers	T-4	In northern portion of the Willamette Valley	Medium	State Private	116-118	0502 0503
3. Oregon white oak savanna	T-8 R&E-2,3,4	Willarnette Valley	High	State Private	111-114	0502
4. Oregon white oak/snowberry forest	T-9	Willamette Valley	High	State Private	111-114	0502
5. Grand fir forest in the Willamette Valley	T-7,8,9	MacDonald State Forest	Medium	State	116-118	0502
6. Riparian black cottonwood-willow forest	T-21	Along the Willamette River	Low	State	124-126	0501
7. Steep slope, xeric, valley-marg n prairie, with talus areas and western rattlesnake	T-15 R&E-5	Willamette Va ley	High	State Private	119-123	0503
8. Gentle slope or valley bottom mesic prairie	T-16	Willamette Va ley	High	State Private	119-123	0502
9. Coniferous forest mixture in the Umpqua River valley	T-5		High	BLM	118-119	
10. Oak woodland-grassland mosaic in the Umpqua Valley	T-11,18 R&E-2,3,4		High	BLM Private	114-115 119-123	
11. Mixed coniferous forest in the Rogue River valley	T-6 R&E-3,4		High	BLM	118-119	0301
12. Oregon white oak and oak-madrone forest mixed with grassland, Rogue Valley	T-12,13,19 R&E-2,3,4		High	BLM Private	114-115 119-123	0301
13. California black oak in the Rogue River valley	T-14 R&E-2,3,4		Medium	BLM	114-115	0301

See footnotes at end of table.

Table 52.--*Additional Research Natural Areas needed in the Western Oregon Interior Valleys Province* (Continued)

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
14. Chaparral *(Ceanothus-Arctostaphylos)* in the Rogue Valley	T-26	Possibly with oak or ponderosa pine	Low	BLM	124	0301
15. Riparian woodland along a major stream in the Rogue Valley	T-24	To provide comparison with west-side riparian type	Medium	State BLM	124-127	0301
Predominantly aquatic natural areas:						
16. Oxbow lake in the Willamette Valley	A-1		Medium	Private State		0501
17. Small stream drainage on the east side of the Willamette Valley	A-4		High	Private State		0503
18. Small stream drainage on the west side of the Willamette Valley	A-5 R&E-1,6	East slope of Marys Peak-Summit area	High	Private State		0503
19. Mineral spring in valley fringe area frequented by band-tailed pigeons	A-7		High	Private BLM		
20. Valley bottom marsh in the Willamette Valley	A-8	McFadden Marsh in W. L. Finley National Wildlife Refuge	High	FWS State Private		0501
21. Valley bottom marsh in the Umpqua or Rogue Valley	A-9		High	BLM State Private		
Natural area for protection of rare or threatened species:						
22. Table Rock area north of Medford--for protection of rare plant species. Should include vernal ponds and stony flats		Located just north of Rogue River. Species to be protected include *Pilularia americana*, *Limnanthes floccosa*, and *Mimulus tricolor*	High	Private State County BLM		0301

[1]For a description of these cells see table 47 for terrestrial (T) ecosystems, table 48 for aquatic (A) ecosystems, and table 49 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate those cells which are considered essential components of the proposed Research Natural Area. Those not underlined represent cells which would be desirable but not essential components.

[2]Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is, i.e., the danger that all examples of the type will be lost to other uses. Acquisition urgency.

[3]Agency or institution most likely to have or to be able to acquire a tract of the desired type based on land ownership. BLM = Bureau of Land Management, FWS = Fish and Wildlife Service.

[4]See appendix V.

SISKIYOU MOUNTAINS PROVINCE, SOUTHWESTERN OREGON

The Siskiyou Mountains Province (fig. 1) is largely a region of extremely rugged, deeply dissected terrain. Mountain crests, comprised of steeply folded and faulted pre-Tertiary strata, range in elevation from *600* m near the coast to approximately 1200 m in the east. Ridge accordance suggests an ancient and now greatly dissected peneplain. Many peaks rise above this summit peneplain, the highest of which is Mount Ashland.

Most of the rock types in the Siskiyou Mountains are extremely old and have undergone at least some metamorphism. Sedimentary and volcanic rocks, dating from the Paleozoic to the Jurassic, have been altered to a variety of metamorphic rock types, including schists, gneisses, marbles, and other metavolcanic or metasedimentary rocks. Large-scale intrusions of ultramafic rocks, which subsequently have been largely altered to serpentine, occurred during late Jurassic to early Cretaceous times. At approximately the same time, a variety of granitic rocks were intruded in the vicinity of Grants Pass and Ashland. These granitics and, to a larger extent, serpentine parent materials are extremely important in influencing plant distribution within the Siskiyou Mountains.

Soils fall into two main groupings — those in the western portion and those in the east. Soils in the eastern half generally reflect the effects of drier conditions, especially during the summer, whereas soils to the west tend to remain moist for longer periods of the year. Upland soils in the western portion are, for the most part, deep and well developed; typically they have a silty clay loam A horizon and a silty clay B horizon. Soils derived from serpentine are invariably unproductive, having very shallow and stony profiles. As a result of the drier coqditions, soils in the eastern portion of the province tend to be less well developed and contain larger amounts of gravels and cobbles, and bedrock is generally within 1 m of the surface.

The ecosystems and biota are extremely diverse (Franklin and Dyrness 1973), the most diverse of any of the provinces in the two States. Environmental complexity — bedrock geology, climatic gradients from the ocean across the range to the eastern slopes, physiography — added to a history of frequent, severe fires produces a bewildering array of ecosystems. Contributing to complexity is a very large array of plant and animal species which are a mixture of endemic types with Californian and northwestern species at their northern and southern limits, respectively.

Forest ecosystems predominate, with conifers dominant along the coast (Douglas-fir, western hemlock, Port-Orford-cedar, and redwood), at higher elevations (white and Shasta red firs and Brewer spruce), and in some inland areas (ponderosa and sugar pines and Douglas-fir). The "mixed evergreen" forests of Douglas-fir with tanoak, Pacific madrone, and other evergreen hardwoods form perhaps the most distinctive body of forested ecosystems. Serpentine areas have open forests or savanna communities of Jeffrey pine and other tree species. Other ecosystems include forests, shrub fields, and herb lands on the ocean front, chaparral, pygmy pine forests, knobcone pine stands, and mountain balds.

Streams and rivers are the most characteristic aquatic ecosystems, although small lakes, ponds, vernal pools, and bogs occur over a wide range of elevations and on both serpentine and normal rock types.

The **26** identified terrestrial cells (table **53)** are minimal; they allow for very little representation of variants of the more widespread ecosystems. The majority **(14)** identify what might be termed the typical, closed forest communities. Four cells are for ecosystems on serpentine, two for ocean-front types, and the remaining six identify a variety of special types from chaparral to ash-alder swamps.

The **14** identified aquatic cells (table **54)** include stream systems associated with coniferous and mixed evergreen forests, lakes, ponds, and vernal pools at low and high elevations, and a coastal bog. Aquatic ecosystems in serpentine areas differ significantly in structure, composition, and function from those occurring on more chemically balanced geologic formations. Consequently, three cells are identified for a lake, stream system, and bog on serpentine bedrock.

It is assumed that the characteristic array of plant and animal species will be associated with these terrestrial and aquatic ecosystems. Eight vertebrate animals are identified as cells because of their rare or endangered status (table **55);** several of these are endemic. There are many vascular plants of special interest in the Siskiyou Mountain region (table **56).** Many of these are endemic, typically on serpentine areas; and 36 of the listed plants are on the Smithsonian list of threatened and endangered plants. This province is by far the richest in plants of special interest as well as having the largest number from the Smithsonian list.

There are five Federal Research Natural Areas in the Siskiyou Mountains Province (table *5'7)* with three of these along the coastal margin of the mountains. These existing areas fill **11** of the **48** identified cells; **7** of these filled cells are terrestrial, **2** are aquatic, and **2** are rare and endangered animal cells. Aside from Research Natural Areas, the Kalmiopsis Wilderness and several botanical (such as Big Craggies) and other special areas provide protection for many of the plants of special interest.

Addition of **24** Research Natural Areas should provide for minimal representation of all of the terrestrial, aquatic, and animal cells identified in the province (table **58);** this number should also provide for representative populations of many of the plants of special interest. Of the needed Research Natural Areas, five combine major terrestrial and aquatic cells; and the three which involve major stream drainages are of particular consequence. Ten of the Research Natural Area needs are mainly for terrestrial ecosystems, including two focused on unusual tree species — Baker cypress and Brewer spruce. Six needs relate to aquatic cells. The only Research Natural Area need in the two States exclusively aimed at rare and endangered vertebrates is a moist talus area in the Applegate River valley for two species of salamanders (No. **22).** Finally, two areas are identified to protect concentrations of special interest vascular plants.

Completing a series of Research Natural Areas in this diverse province will be a large job. Identifying and establishing the three large stream drainages needed as Research Natural Areas is a particularly challenging part of the job although candidate areas are known for each. The heaviest lead responsibility lies with the Forest Service, although the Bureau of Land Management and Oregon State agencies (along the coast) must also play major roles.

Priorities are greatest for terrestrial ecosystems representing major timber resources, almost all of the aquatic ecosystems (since these are subject to increasing disturbance), and areas outside the Kalmiopsis Wilderness which contain concentrations of rare and endangered species.

Table 53.--*Terrestrial cells in the Siskiyou Mountains* **Province,** *southwestern* Oregon

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Sitka Spruce Zone:			
* 1. Ocean-front coniferous forest (probably Sitka spruce and western hemlock)		None	58-61
2. Redwood forest near the northern limits of its range	232	Wheeler Creek RNA	67-68
Western Hemlock Zone:			
3. Port-Orford-cedar-Douglas-fir on normal soils	231	Port Orford Cedar and Coquille River Falls RNA's	92-93
4. Douglas-fir-western hemlock forest	230	Port Orford Cedar RNA	72-80
Mixed-Conifer Zone:			
5. Pacific ponderosa pine with Douglas-fir in the eastern Siskiyous	244 245	Ashland RNA	138-139
* 6. Pacific ponderosa pine with Douglas-fir in the western Siskiyous	244 245	None	138-139
7. Mixed-conifer forest with sugar pine, Douglas-fir, and ponderosa pine	243	Ashland RNA	138-139
Mixed-Evergreen Zone:			
* 8. Mixed-evergreen forest (Douglas-fir and evergreen hardwoods)	234	None	133-136
* 9. Tanoak-madrone forest	234	None	134-135
*10. Canyon live oak	249	None	134-136
*11. Knobcone pine	248	None	134-135

See footnote at end of table.

Table 53.--*Terrestrial cells in the Siskiyou Mountains Province, southwestern Oregon* (Continued)

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
White Fir and Shasta Red Fir Zone:			
*12. Shasta red fir-white fir forest	207	None	150-155
13. Brewer spruce on a poor site		Brewer Spruce RNA	
*14. Brewer spruce showing maximum development		None	
Special types:			
*15. Jeffrey pine-grass on serpentine soils at low elevation	247	None	306-307
*16. Jeffrey pine-grass on serpentine soils at high elevation	247	None	306-307
*17. Port-Orford-cedar-Douglas-fir on serpentine soils	231	None	306-307
*18. Serpentine vegetation matrix and normal soil island with good representation of contacts		None	306-307
*19. Ocean-front shrub lands		None	298-300
*20. Ocean-front herb lands		None	298-300
*21. Typical chaparral communities		None	136
*22. Pygmy lodgepole pine forest on Blacklock soil		None	
*23. Riparian hardwood forest along a major west-side river (with alder, bigleaf maple, and myrtle)		None	
*24. Baker cypress in the eastern Siskiyous		None	
25. Ash-alder swamp		Port Orford Cedar RNA	
*26. Mountain herb lands at high elevations (grass lands balds)		None	136

*Cells presently lacking adequate representation.

Table 54.--*Aquatic cells in Siskiyou Mountains Province, southwestern Oregon*

Cell[1]	Present representation	Remarks
* 1. Major stream drainage in coniferous forest	None	
* 2. Major stream. drainage in mixed-evergreen forest	None	
* 3. Typical low-elevation lake	None	
* 4. Typical subalpine lake	None	
* 5. Lake in serpentine area at mid- to high-elevations	None	
6. Permanent pond at low elevation in mixed coniferous forest	Port Orford Cedar RNA	
7. Permanent pond at mid- to high-elevation in subalpine forest	Brewer Spruce RNA	Rabbit Lake
* 8. Typical vernal pond at low elevation	None	
* 9. Typical vernal pond at mid- to high-elevation	None	
*10. Stream drainage in serpentine at mid- to high-elevation	None	
*11. Cave and large cold springs	None	
*12. Typical marsh area	None	
*13. Typical coastal bog	None	
*14. Mountain bog in serpentine area	None	With *Darlingtonia*

[1]Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the listed ecosystem.

*Cells presently lacking adequate representation.

Table 55.--*Rare and endangered vertebrate animal cells in the Siskiyou Mountains Province, southwestern Oregon*

Cell	Verified representation	Reference
Amphibians:		
1. Del Norte salamander	Wheeler Creek and Port Orford Cedar RNA's	Stebbins 1954
*2. Siskiyou Mountain salamander	None	Stebbins 1954 Storm 1966
3. California slender salamander	Wheeler Creek RNA	Stebbins 1954
*4. Black salamander	Verified minimal representation in Ashland RNA, need additional area	Stebbins 1954 Storm 1966
Mammals:		
*5. Ashland shrew	None--probably in Ashland RNA	Bailey 1936 Olterman and Verts 1972
*6. Pinon muse (subspecies *sequoiensis)*	None	Bailey 1936
*7. White-footed vole	None	Bailey 1936 Johnson 1973 Maser 1966 Maser and Johnson 1967 Maser and Storm 1970 Olterman and Verts 1972
*8. Red tree vole (subspecies *longicaudus*)	None	Bailey 1936 Johnson 1973 Maser 1966 Maser and Johnson 1967 Maser and Storm 1970 Olterman and Verts 1972

*Cells presently lacking adequate representation.

Table 56.--*Vascular plants of special interest in the Siskiyou Mountains Province, southwestern Oregon*

species[1]	Distribution
Adiantum jordanii	Rocky canyons, lower Rogue River
Allium bolanderi	Stony flats, Douglas and Josephine Counties
Allium falcifolium	Serpentine slopes, southern Josephine County
Allium siskiyouense[2]	Grassy slopes, Siskiyou Summit, Jackson County
Antennaria suffrutescens[2]	Rocky hillsides, Illinois Valley, Josephine and Curry Counties
Arabis aculeolata[2]	On serpentine, Josephine and Curry Counties
Arabis koehleri var. *koehleri*	Rocky banks along Umpqua River near Roseburg, Douglas County
Arabis koehleri var. *stipitata*[2]	Rocky banks, Illinois Valley, Josephine County
Arabis modesta	Rocky banks, Rogue River Canyon near Galice, Josephine County
Arabis oregona[2]	Rocky hillsides, southern Jackson and Josephine Counties
Arctostaphylos cinerea	Brushlands, Illinois Valley, southern Josephine County
Arctostaphylos hispidula	Rocky summits, Josephine and Curry Counties
Arenaria howellii	On serpentine, Josephine and Curry Counties
Arnica cernua	On serpentine, Illinois Valley, Josephine County
Arnica spathulata	Open woods, Curry and Josephine Counties
Asplenium septentrionale	Along North Umpqua River, Douglas County
Aster brickellioides[2]	Dry rocky slopes, Josephine and Curry Counties
Aster siskiyouensis	Forested slopes
Astragalus accidens var. *hendersonii*	Open hillsides, Josephine County
Astragalus umbraticus	Dry woods, Douglas and Josephine Counties
Balsamorhiza platylepis	On serpentine, central Josephine County
Bensoniella oregana	Mountain bogs, southern Josephine and Curry Counties
Brodiaea dissimulata	Dry hills, Josephine County
Calochortus greenei[2]	Thickets, southern Jackson County
Calochortus howellii	Dry slopes, Umpqua and Illinois Valleys
Calochortus indecorus	Open slopes, Sexton Mountain, Josephine County
Calochortus uniflorus	Wet meadows, Illinois Valley, Josephine County
Camassia howellii	Meadows, Josephine and Jackson Counties
Castilleja brevilobata[2]	Rocky slopes, Josephine County
Castilleja elata	In bogs, usually on serpentine, southern Josephine County
Cirsium acanthodontum	Lower Rogue River Canyon to the coast, Curry County
Cirsium ciliolatum[2]	Dry hillsides near Ashland, Jackson County
Clarkia amoena var. *pacifica*	High ocean bluffs, Lincoln and Curry Counties
Clintonia andrewsiana	Under redwoods, southern Curry County
Cordylanthus viscidus	On serpentine, Josephine and Jackson Counties

See footnotes at end of table.

Table 56.--*Vascular plants of special interest in the Siskiyou Mountains Province, southwestern Oregon* (Continued)

Species[1]	Distribution
Cupressus bakeri	Open woods, northern Jackson and southern Josephine Counties
Cypripedium calceolus var. *parviflorum*	Mount Peavine, Josephine County
Cypripedium californicum[2]	Bogs and springs, Josephine and Curry Counties
Cypripedium fasciculatum	Coniferous forests, Josephine and Jackson Counties
Darlingtonia californica[2]	Sphagnum bogs, Josephine and Curry Counties (and along coast)
Dentaria gemmata	Streamsides, Josephine County
Dicentra formosa ssp. *oregana*[2]	Southwestern Josephine and Curry Counties
Dicentra pauciflora	High altitudes
Draba howellii	High rocky summits
Empetrum nigrum	Open coastal bluffs, Lincoln and Curry Counties
Epilobium rigidum	Dry rocky washes, Curry and Josephine Counties
Erigeron bloomeri var. *nudatus*[2]	On serpentine, Josephine and Curry Counties
Erigeron cervinus	Meadows and canyon banks, Curry to Jackson Counties
Erigeron delicatus[2]	Along streams, central Curry County
Erigeron petrophilus	Dry cliffs, Curry to Jackson Counties
Eriogonella membranacea	Dry slopes, Jackson County
Eriogonum incanum	Summit of Mount Ashland, Jackson County
Eriogonurn pendulum	Dry stony ground, southern Josephine County
Eriogonum ternatum	Gravelly flats, southern Josephine County
Erythronium citrinum	Open woods, southern Josephine County
Erythronium howellii[2]	Open woods along Illinois River, southern Josephine County
Fritillaria gentneri	Oak woodlands in foothills, Jackson and Josephine Counties
Fritillaria glauca	On serpentine, Josephine and Curry Counties
Fritillaria recurva	Open woods in foothills
Gentiana bisetaea[2]	Seepage slopes, Josephine and Curry Counties
Haplopappus racemosus ssp. *congestus*[2]	On serpentine, Josephine County
Hieracium bolanderi	Mountains of Curry, Josephine, and Jackson Counties
Horkelia congesta ssp. *nemorosa*	Douglas, Josephine, and Jackson Counties
Horkelia hendersonii	Rocky summit of Mount Ashland, Jackson County
Horkelia sericata	On serpentine, Josephine, Jackson, and Curry Counties
Hydrocotyle verticillata	Garrison Lake, Curry County
Iris bracteata	Pine forest, southern Josephine and Curry Counties
Iris innominata	Wooded banks, Illinois River drainage, present in Port Orford Cedar RNA
Juniperus communis var. *jackii*	On serpentine
Kalmiopsis leachiana	Dry mountain slopes, Curry County, Kalmiopsis Wilderness Area

See footnotes at end of table.

Table 56.--*Vascular plants* of ***special interest in the Siskiyou Mountdns Province, southwestern Oregon*** (Continued)

Species[1]	Distribution
Lasthenia macrantha ssp. *prisca*[2]	Bluffs north of Gold Beach, Curry County
Lathyrus delnorticus	Along streams, Josephine and Curry Counties
Leucothoe davisiae	Hillside bogs, Curry County
Lewisia cotyledon[2]	Jackson, Josephine, and Curry Counties
Lewisia oppositifolia[2]	Moist serpentine slopes, Josephine and Curry Counties
Lilium bolanderi	Open hillsides, southern Josephine and Curry Counties
Lilium kellogii	Open woods, southern Josephine County
Lilium occidentale[2]	Sphagnum bogs, Curry County
Lilium pardalinum	Bogs and springs
Lilium parvum	Mountain bogs and springs, southern Josephine County
Lilium rubescens	Wooded slopes, southern Josephine and Jackson Counties
Lilium vollmeri[2]	Hillside bogs, Josephine and Jackson Counties
Lomatium howellii	Southern Jackson and Josephine Counties
Lomatium tracyi	On serpentine
Lupinus aridus var. *ashlandicus*	Stony slopes, Mount Ashland, Jackson County
Lupinus mucronulatus	On serpentine, Waldo area, Josephine County
Microseris bigelovii	Coastal bluffs, Cape Blanco, Curry County
Microseris howellii[2]	On serpentine, Josephine and Jackson Counties
Microseris laciniata ssp. *detlingii*[2]	Grasslands, Slskiyou Pass, Jackson County
Microseris nutans ssp. *siskiyouensis*	Open rocky area near Waldo, Josephine County
Mirabilis greenei	Southern Jackson County
Monardella purpurea	Dry ground, northern Curry to southern Josephine Counties
Navarretia Heterandra	Vernal pools, Jackson County
Orthocarpus cuspidatus	Grasslands, southern Klamath and Jackson Counties
Oxalis oregana var. *smallii*	Rogue River canyon near Galice, Josephine County
Pedicularis howellii	Coniferous forest along summits, Josephine County
Pellaea brachyptera	Dry rocky slopes, mountains of Jackson and Josephine Counties
Penstemon newberryi ssp. *berryi*	Summit of Siskiyou Mountains near Oregon Caves, Josephine County
Penstemon parvulus	Summit of Mount Ashland, Jackson County
Phacelia argentea	On old coastal dunes, Curry County
Phacelia capitata[2]	On serpentine, along Coquille River, Coos County
Phacelia leonis	Southern Josephine County
Phacelia peckii[2]	Moist flats, southern Jackson County
Picea breweriana	Southern Josephine County
Pinus sabiniana	Along Rogue River, Josephine County
Po2ystichum californicum	Coastal forest., Curry County
Polystichum mohrioides	On serpentine, mountain slopes
Potentilla glandulosa ssp. *ashlandica*	Wet meadows, Mount Ash1and, Jackson County
Potentilla glandulosa ssp. *globosa*	Mount Ashland, Jackson County
Quercus morehus	Northern Douglas and southern Josephine Counties

See footnotes at end of table.

Table 56.--*Vascular plants of special interest in the Siskiyou Mountains Province, southwestern* **Oregon** (Continued)

Species[1]	Distribution
Quercus sadleriana	Mountains in Douglas, Josephine, Curry, and Jackson Counties
Romanzoffia tracyi	Wet sea cliffs, Curry County
Rudbeckia californica var *glauca*	Bogs, Douglas, Curry, and Josephine Counties
Sanicula peckiana	On serpentine, Josephine and Curry Counties
Sanicula tracyi	On serpentine, southern Josephine County
Saxifraga fragarioides	Mountain cliffs, Josephine and Jackson Counties
Saxifraqa howellii	Upper Coquille to lower Umpqua River, and along the Rogue River, Josephine County
Schoenolirion bracteosum[2]	Mountain meadows, southern Jackson and Josephine Counties
Sedum qlanduliferurn	Rock outcrops along Rogue River, Josephine County
Sedum laxum ssp. *heckneri*[2]	Dry cliffs, Jackson County
Sedum laxum ssp. *laxum*	On serpentine, Josephine County
Sedum laxum ssp. *perplexum*	Coastal cliffs, Curry County
Sedum purdyi	Associated with Brewer spruce, southern Jackson County
Senecio hesperius[2]	Mountain bogs on serpentine, Josephine County
Sidalcea malvaeflora ssp. *elegans*[2] .	On serpentine, southern Josephine County
Sidalcea malvaeflora ssp. *patula*	Grassy slopes along immediate coast, Curry County
Sidalcea setosa[2]	Josephine County
Sisyrinchium californicum	Unique population of pink form near Pilot Rock, Jackson County
Sophora leachiana[2]	Oak-madrone forest, Mount Peavine, Josephine County
Streptanthus howellii	On serpentine, mountains of Josephine and Curry Counties
Synthyris reniformis var. *cordata*	Mixed woodlands on serpentine, Josephine and Curry Counties
Tauschia qlauca	Woods along Rogue and Umpqua Rivers, Josephine and Curry Counties
Tauschia howellii[2]	Dry slopes, southwestern Jackson County
Thlaspi montanum var. *siskiyouensis*[2]	On serpentine, Josephine County
Trifolium howellii	Moist slopes in woods, mountains of Josephine and Jackson Counties
Trillium rivale	Streambanks, Josephine and Curry Counties
Vaccinium coccinium[2]	Sandy slopes and ridges, mountains of Josephine County
Vancouveria chrysantha[2]	Illinois River Valley, Josephine and Curry Counties
Vancouveria planipetala	Dry woods, coastal Curry County
Viola lanceolata var. *occidentalis*[2]	Sphagnum bogs, southern Josephine County
Viola lobata var. *psychodes*	Coniferous forests, O'Brien area, Josephine County
Viola ocellata	Woodlands, Douglas and Curry Counties
Noodwardia fimbriata	Wet banks, southern Josephine County
Zauschneria latifolia	Along lower Rogue and Illinois Rivers, Curry and Josephine Counties

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or identification nationally (in the Smithsonian Institution list) as threatened or endangered species.

[2]Species is on the national list of threatened and endangered plants (Smithsonian Institution 1974).

Table 57.--*Established Research Natural Areas in the Siskiyou Mountains Province, southwestern Oregon*

Name	Principal features	Agency[1]	Area	
			Ha	Acres
Ashland RNA	"Pacific" ponderosa pine, pure and mixed with Douglas-fir, on granitic soils	FS	570	1,408
Brewer Spruce RNA	Brewer spruce with many other conifers	BLM	85	210
Coquille River Falls RNA	Port-Orford-cedar stands	FS	202	*500*
Port Orford Cedar RNA	Port-Orford-cedar and Douglas-fir stands	FS	454	1,122
Wheeler Creek RNA	Redwood-Douglas-fir forests near the northern limits of redwood	FS	135	334

[1]BLM = Bureau of Land Management, FS = Forest Service.

Table 58.--*Additional* Research Natural Areas needed in the Siskiyou Mountains Province, southwestern Oregon

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Combined terrestrial and aquatic natural areas:						
1. Coniferous forest and major stream drainage (at low- to mid-elevations)	T-4,6,9 A-1 R&E-7,8	Anvil Creek (Powers District, Siskiyou National Forest)	High	FS BLM	79-80 136-143	0306
2. Mixed-evergreen forest (Douglas-fir-evergreen hardwoods) and major stream drainage	T-8,9,18 A-2	Proposed Store Gulch RNA or Dry Creek in Sixes River drainage	Medium	FS State	133-136	0302
3. Large mid- to high-elevation area with serpentine vegetation matrix and normal soil island or contact--should include typical serpentine Port-Orford-cedar--Douglas-fir, Jeffrey pine-grass, plus a small lake, and stream drainage	T-16,17,18 A-5,10	Baldface Creek drainage (Chetco District, Siskiyou National Forest). Will include many serpentine endemic plant species (table 56)	Low	FS	306-307	0302 0304
4. Coastal pigmy forest (lodgepole) and Blacklock soil with vernal pond	T-22 A-8	Blacklock Point area in Floras Lake State Park	High	State Private		0207
5. Shasta red fir-white fir forest with vernal pond	T-12 A-9	Applegate drainage	Low	BLM FS	150-155	0303
Predominantly terrestrial natural areas:						
6. Coastal coniferous forest (Douglas-fir-Sitka spruce-western hemlock)	T-1 R&E-7,8	Samuel Boardman State Park	Medium	State	58-61	0304
7. Pacific ponderosa pine with Douglas-fir in the western Siskiyous	T-6	Myers Flat (Galice District, Siskiyou National Forest)	High	FS	138-139	0305
8. Tan'oak-madrone and knobcone pine forest	T-9,11 R&E-6	Chetco District, Siskiyou National Forest	Medium	FS	134-135	0304
9. Canyon live oak type	T-10 R&E-6		Low	FS	134-136	0304

See footnotes at end of table.

Table 58.--*Additional Research* **Natural** *Areas needed in the* ***Siskiyou*** *Mountains Province, southwestern Oregon* (Continued)

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
10. Coastal shrublands on ocean-facing slopes	T-19	South of Humbug Mountain State Park	Medium	State	298-300	0304
11. Coastal herb lands on ocean-facing slopes	T-20		Medium	State	298-300	0304
12. Large chaparral area also containing mountain herb lands (grass land balds)	T-21,26	Big Craggies Botanical Area	Low	FS	136	0304
13. Riparian hardwood forest along a major west-side stream	T-23	Containing alder, big leaf maple, myrtle	LOW	FS BLM		0301
14. Baker cypress (*Cupressus bakeri*)	T-24 R&E-2,4	In eastern Siskiyous near California border	Low	BLM FS		0303
15. Brewer spruce showing maximum development on a good site	T-14	Sanger Lake	Low	FS		0304
Predominantly aquatic natural areas:						
16. Low-elevation lake	A-3		High	BLM FS		
17. Mid- to high-elevation lake (subalpine)	A-4		High	FS BLM		
18. Cave with large, cold springs	A-11	Near Oregon Caves	High	State Private		0303
19. Typical marsh area	A-12		High	State Private FS		
20. Mountain bog in serpentine area	A-14	Proposed Hunter Creek Bog RNA	High	BLM		0306
21. Coastal bog	A-13	Should include *Lilium occidentale*	High	BLM FS		0207

See footnotes at end of table.

Table 58.--*Additional* Research Natural Areas needed *in* the *Siskiyou Mountains Province,* southwestern Oregon (Continued)

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Natural area for protection of rare or endangered animal species:						
22. Moist talus areas in the Applegate River valley--habitats for Siskiyou Mountain salamander and black salamander	R&E-2,3	Areas to be selected	High			0303
Natural areas for protection of plant species of special interest':						
23. Illinois River Valley including bog area--for protection of a large number of serpentine and serpentine bog plant species		Near Rough and Ready Creek. Species protected to include ***Erythronium howellii*, *Lilium rubescens*, *Cypripedium mntanum*, *Isopyrum hollii*, *Viola occidentalis*, *Gentiana bisetaea*, *Castilleja elata*,** and ***Microseris howellii***	High	FS		0303
24. Hobson Horn area--includes Sadler oak, Brewer spruce, and a variety of rare plants		Siskiyou National Forest, west of Galice. Species protected to include ***Sophora leachiana*, *Tauschia glauca*, *Tauschia howellii*,** and ***Sarcodes sanguinea***	High	FS		0305

'For a description of these cells see table 53 for terrestrial (T) ecosystems, table 54 for aquatic (A) ecosystems, and table 55 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate those cells which are considered essential components of the proposed Research Natural Area. Those not underlined represent cells which would be desirable but not essential components.

[2]Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is, i.e., the danger that all examples' of the type will be lost to other uses. Acquisition urgency.

[3]Agency or institution most likely to have or to be able to acqu re a tract of the desired type based on land ownership. BLM = Bureau of Land Management, FS = Forest Service.

[4]See appendix V.

'There are several outstanding sites with concentrations of spec al interest p ants. Waldo, near O'Brien In Josephine County, has the largest group. "Hanging Bog" above Josephine Creek, Eight Dollar Mountain, and Limpy Creek' are other major sites in Josephine County.

WESTERN SLOPES AND CREST PROVINCE, OREGON CASCADES

The Cascades in Oregon include two distinct physiographic and geologic areas—the Western Cascades and the High Cascades (fig. 1). The High Cascades, on the east, include all major peaks of the range (e.g., Mount Hood, Mount Jefferson, Three Sisters) and originated during late Pliocene to Pleistocene times. The Western Cascades consist of older volcanic flows laid down during the Oligocene and Miocene.

The relief of the Western Cascades is generally rugged in the eastern portions, but slopes are more gentle to the west. Over much of the area there is a striking accordance of main ridge crests at an average elevation of about 1500 m. Some glaciation occurred in the Western Cascades during the Pleistocene, but glaciers were largely confined to the principal stream valleys and had little effect on shaping present day landforms. The topographic characteristics of the younger High Cascades are considerably different. The High Cascades area is essentially a gently rolling high plateau interrupted at intervals by deep glaciated stream channels and volcanic cones and peaks. Volcanic activity, which reached its maximum during the Pleistocene, has continued until recently; some flows of lava are only several hundred years old.

Basalt, andesite, and pyroclastics (tuffs and breccias) are the most common bedrock materials in the Western Cascades. Since pyroclastic parent materials are readily weatherable, soils from these materials tend to be deep and fine textured, especially on gentler slopes. Pyroclastic soils are frequently imperfectly drained, and mass soil movements (e.g., slumps and earthflows) are common. Soils derived from basalt and andesite in the Western Cascades are generally well drained and tend to be stonier and coarser textured. On steep slopes profiles are poorly developed with dark-brown gravelly loam or sandy loam surface horizons. At higher elevations these soils often contain noticeable amounts of aerially deposited volcanic ash and pumice.

The High Cascades is an area dominated by immature soils developed in volcanic ejecta and soils showing more profile development which are derived from glacially deposited materials. Soils on glacial till are most common in the northern section and are characteristically deep and well drained with stony or gravelly sandy loam or loam textures. In the central and southern portions of the High Cascades, extensive areas are mantled with deposits of volcanic ejecta, such

as pumice, cinders, and ash. Soils in these materials show little profile development beyond the formation of thin, dark-colored A horizons.

Dense coniferous forests are dominant ecosystems on the western slopes and crest of the Oregon Cascade Range (Franklin and Dyrness **1973).** Major patterns of variability in composition and productivity of these forests are associated with elevation and with regional and local climatic gradients; the most notable of these gradients is the pattern of increasing temperature and decreasing precipitation moving from north to south along the range.

In the northern half of the province, forests of Douglas-fir, western hemlock, and western redcedar grade into communities characterized by Pacific silver and noble firs at higher elevations. Subalpine forests of mountain hemlock occur only on the highest ridges and peaks in the Western Cascades but are very extensively distributed along the entire crest of the High Cascades. In the southern half of the province (south of the Willamette-Umpqua River divide), montane forests are mixtures of Douglas-fir, sugar pine, incense-cedar, and white fir; Shasta red and white fir forests occupy the lower subalpine zone, below the mountain hemlock. A variety of meadow communities is associated with the higher ridges of the Western Cascades and subalpine parklands of the High Cascades; lava flows, pumice fields, riparian habitats, and rock cliffs and scree provide additional biotic diversity in the province.

Rivers and streams are the dominant aquatic ecosystems in the Western Cascades. Lakes and ponds, on the other hand, are common to abundant along the crest of the range in the High Cascades.

Twenty-seven terrestrial cells have been identified for the province (table **59).** Eighteen cells provide for representation of the important forest ecosystems including variants of widespread or highly variable types. It is critical that the commercially important Douglas-fir and western hemlock forests in the Western Cascades be well represented, since these will be sites for research relevant to management of these forests. Nine cells identify montane and subalpine meadow and related subalpine and alpine ecosystems.

Identified aquatic cells total 17 (table **60).** The majority provide for representation of streams, lakes, and ponds in contrasting habitats — for example, at low and high elevations and in southern and northern portions of the Cascade Range. Marshes, bogs, and hot springs round out the aquatic ecosystems needed.

Research Natural Areas established for the terrestrial and aquatic cells will presumably include the array of plant and animal species characteristic of these ecosystems. Seven rare or endangered vertebrate animal species have been identified which require specific consideration in selection and establishment of natural areas (table **61).** Vascular plants of special interest include **21** from the Smithsonian list of endangered or threatened plants (table **62).** The greatest concentration of these plants is in the Columbia River gorge, with the subalpine and alpine slopes of the major volcanic peaks (most notably Mount Hood and Crater Lake) as habitat for a second major group.

Six Research Natural Areas have already been established (table **63).** These areas provide adequate coverage of **11** of the 51 identified cells — 7 of the terrestrial, **3** of the aquatic and **1** rare and endangered animal. Existing Wilderness Areas, Crater Lake National Park, and other specially designated tracts already provide protection for a substantial number of the plant species.

Addition of **22** Research Natural Areas should provide for minimal representation of all identified terrestrial, aquatic, and animal cells (table **64).** Five of these are for combined coverage of major terrestrial and aquatic cells.

Leadership in selection and establishment of the needed Research Natural Areas lies primarily with the Forest Service, but substantial contributions from the Bureau of Land Management, National Park Service, and Oregon State agencies are essential (table 64). Considerable progress has already been made in locating candidate areas, with at least 9 of the **22** needed areas identified or in process of establishment. Ecosystems which represent major timber types have high priority for action because of the rapid pace of logging and other activities (table **64).** Low-elevation aquatic ecosystems also need early attention. Subalpine and alpine ecosystems, many of which are presently free from excessive pressure for development, have relatively low priority.

Table 59.--*Terrestrial cells in the* **Western** *Slopes and* **Crest Province, Oregon** *Cascades*

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Western Hemlock Zone:			
* 1. Douglas-fir forest, 100-150 years old with range in understory from dry to moist communities (in Western Cascades and northern half of the State)	229	None. (Search under way in Willamette National Forest)	72-88
2. Douglas-fir-western hemlock forest about 250 years old	229 230	Bagby RNA	72-88
* 3. Old-growth Douglas-fir-western hemlock forest with representative range in understory communities	230 229	Need will be filled with establishment of proposed Middle Santiam RNA	72-80
* 4. Typical low-site western hemlock stands occupying the summit of the High Cascades south of Mount Hood	224	None (Search under way In Mount Hood National Forest)	99
* 5. Old-growth western redcedar in the Western Cascades		None	81-82
Pacific Silver Fir Zone:			
6. Upper- lope mixed-conifer forest (Pacif c silver fir-western hemlock, mounta n hemlock-subalpine fir, etc.)	226	Bull Run, Olallie Ridge, and Wildcat Mountain RNA's	94-98
7. Typica noble fir forest	226	Wildcat Mountain and Bull Run RNA's	94-98
8. Mounta n meadow-forest mosaic in the no thern portion of the Western Cascades	227 or 228	Olallie Ridge RNA	152-153
Mountain Conifer Zone:			
9. Typical mountain hemlock forest in the Western Cascades	205	Wildcat Mountain RNA	103-106
*10. Typical mountain hemlock forest in the High Cascades	205	Need would be met by proposed area near Waldo Lake	103-106
11. Engelmann spruce-subal pine fir'forest	206	Gold Lake Bog RNA	103-109
Mixed-Conifer Zone:			
12. Mlxed-conlfer forest at high e1evations	243	Abbott Creek RNA	139-143
*13. Southwestern Oregon mixed-conifer forest at low elevations (Douglas-fir-incense-cedar-ponderosa pine with a variety of understory types)		None (Search under way in South Umpqua drainage, Umpqua National Forest)	138-145

See footnote at end of table.

Table 59.--*Terrestrial cells in the* **Western** *Slopes and* **Crest Province,** *Oregon* ***Cascades*** (Continued)

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
White Fir and Shasta Red Fir Zones:			
*14. Mature white fir-Douglas-fir forest in the High Cascades	211	None	150-152
*15. Typical Shasta red fir forest in the High Cascades covering a range of habitats	207	Establishment of proposed Wickiup Springs RNA would fill need	155-158
*16. Mountain meadow-forest mosaic in the southern portion of the Western Cascades		Establishment of proposed Cougar Butte RNA will fill need	152-153
Subalpine and alpine communities:			
*17. Whitebark pine in the High Cascades	208	None	272-275
*18. Subalpine meadow community mosaic in the High Cascades (with as many major communities represented as possible)		None	269-270
*19. Subalpine pumice and ash fields ("pumice deserts")		None	270
*20. Subalpine lava flow with representative vegetation		None	300-302
*21. Green fescue in the Mount Hood area		None	269-272
*22. Alpine needlegrass in the southern portion of the High Cascades		None	
*23. Alpine community mosaic		None	284-290
Special types:			
*24. Swale or swamp forest, Umpqua region (Oregon ash and ponderosa pine)		None	
*25. Moist temperate river terrace forest with Douglas-fir, western hemlock, western redcedar, and associated hardwoods	230	Some will be included in proposed Middle Santiam RNA	72-82
*26. Lodgepole pine at high elevations on pumice and ash soils	218	None	106-108
*27. Bigleaf and vine maple communities on talus slopes in the Columbia Gorge		None	91

*Cells presently lacking adequate representation.

Table 60.--*Aquatic cells in* the Western Slopes *and* Crest Province, Oregon Cascades

Cell[1]	Present representation
* 1. Low-elevation lake surrounded by Douglas-fir-western hemlock, in the northern portion of the province	None
* 2. Low-elevation lake surrounded by mixed-conifer forest in the southern portion of the province	None
* 3. Subalpine lake in the Western Cascades	None
* 4. Subalpine lake in the High Cascades	None
* 5. Typical alpine lake in the High Cascades	None
* 6. Low-elevatign permanent pond, in the northern portion of the province	None
7. Subalpine permanent pond	Gold Lake Bog RNA
* 8. Alpine permanent pond	None
* 9. Low-elevation vernal pond, in the northern portion of the province	None
*10. Subalpine vernal pond	None
*11. Alpine vernal pond	None
*12. Low-elevation stream drainage in Douglas-fir-western hemlock, with anadromous fish	None
13. Low- to mid-elevation stream drainage in mixed-conifer forest	Abbott Creek RNA
*14. Subalpine stream drainage with Pacific silver fir-western hemlock forest	None
*15. Typical hot springs	None
*16. Bulrush-sedge marsh	None
17. Typical subalpine bog	Gold Lake Bog RNA

[1]Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the listed ecosystem.

*Cells presently lacking adequate representation

Table 61.--*Rare and endangered vertebrate animal cells in the Western Slopes and Crest Province, Oregon Cascades*

Cell	Verified representation	Reference
Amphibians:		
*1. Larch Mountain salamander	None	Stebbins 1954 Storm 1966
*2. Oregon slender salamander	None	Stebbins 1954 Storm 1966
3. Spotted frog	Gold Lake Bog RNA	Stebbins 1954 Storm 1966
Birds:		
*4. Northern spotted owl	None	Gabrielson and Jewett 1940 Marshal1 1969
Mammals:		
*5. Heather vole	None	Bailey 1936 Edwards 1955 Johnson 1973 Maser and Storm 1970 Olterman and Verts 1972 Shaw 1924
*6. White-footed vole	None	Bailey 1936 Johnson 1973 Maser 1966 Maser and Johnson 1967 Maser and Storm 1970 Olterrnan and Verts 1972
*7. Red tree vole (2 subspecies involved)	None	Bailey 1936 Johnson 1973 Maser 1966 Maser and Johnson 1967 Maser and Storm 1970 Olterman and Verts 1972

*Cells presently lacking adequate representatlon.

Table 62.--*Vascular plants of special interest in the Western Slopes and Crest Province, Oregon Cascades*

Species[1]	Distribution
Agoseris elata	Open woods, middle altitude, Cascade Range
Agrostis howellii[2]	Moist cliffs, south side of Columbia River Gorge
Allium schoenoprasum	Wet rocky ground, between low and high water along Columbia River gorge
Alnus sinuata	Unusual population on Angels Rest, Columbia River Gorge at low elevation
Anemone adamsiana	Along road from Tiller to Trail, Douglas and Jackson Counties
Arabis sparsiflora var. *atrorubens*	Open grassy slope, Columbia River Gorge, Klickitat County, Washington
Arabis suffrutescens var. *horizontalis*	Crater Lake National Park
Arenaria pumicola	Crater Lake and Mount McLoughlin, to Mount Jefferson
Arnica viscosa[2]	Near timberline, Crater Lake and Three Sisters
Asarum caudatum var. *viridiflorum*	Lake of the Woods, Klamath County
Aster gormanii[2]	Mount Jefferson to Breitenbush Lake, Marion County
Betula glandulosa var. *glandulosa*	Bogs at lower elevation, Cascade Mountains (Clackamas Lake, Clackamas County)
Bolandra oregona	Wet mossy rocks, both sides of Columbia River Gorge and along lower Willamette River
Botrychium pumicola	Crater Lake area and Paulina Mountains
Calamagrostis breweri	Alpine meadows, Mount Hood and Mount Jefferson
Calamagrostis howellii[2]	Cliffs of Columbia River Gorge, Multnomah and Hood River Counties, Oregon; Clark and Klickitat Counties, Washington
Carex macrochaeta	Multnomah Falls, Columbia River Gorge
Cimicifuga laciniata[2]	Wooded slopes, base of Mount Hood and in Columbia River Gorge
Collomia larsenii	Talus slopes on alpine peaks, Cascade Range
Collomia mazama[2]	Dry woods at high altitude, Mount McLoughlin and Crater Lake
Corallorhiza mertensiana (Yellow phase)	Coniferous forests, near Mount Hood and in Columbia River Gorge
Corydalis aquae-gelidae[2]	Very cold springs, upper Clackamas River drainage
Cypripedium mntanum	Usually in open woods
Dicentra cucullaria	Moist woods, Columbia River Gorge, and along Sandy River tributary
Dodecatheon dentatum	Wet cliffs, Columbia River Gorge
Douglasia laevigata[2]	Cliffs and talus slopes, Columbia River Gorge

See footnotes at end of table.

Table 62.--*Vascular plants of special interest in the Western Slopes and Crest Province, Oregon Cascades* (Continued)

Species[1]	Distribution
Draba aureola	Alpine summits of volcanic peaks (Three Sisters)
Elmera racemosa	Rock crevices, alpine slopes; Mount Washington, Deschutes County, and Cow Horn Peak, Klamath County
Erigeron howellii[2]	Moist rocky places, south side of Columbia River Gorge
Erigeron oreganus[2]	Shady ledges, Columbia River Gorge, primarily on Oregon side
Eriogonum umbellatum var. *hausknechtii*	High mountain meadows
Erythronium klamathense	Woods, southwestern Klamath and southeastern Jackson Counties
Frasera umpquaensis[2]	Open woods and meadows, Rogue-Umpqua Divide, present in Abbott Creek RNA
Fritillaria adamantina[2]	Grassy slopes, Diamond Lake, Douglas County
Gentiana newberryi	Alpine meadows, Three Sisters region
Habenaria orbiculata	Hoist rich woods, Cascade Raage of northern Oregon
Haplopappus hallii[2]	Dry slopes, Columbia River Gorge south; present in Olallie Ridge RNA
Hieracium longiberbe[2]	Rocky bluffs, Columbia River Gorge; Multnomah County, Oregon; and Skamania County, Washington
Hulsea nana	Alpine summits and cinder cones, Cascade peaks
Isopyrum hallii	Moist woods, Cascade Range from Columbia River Gorge to Marion County
Isopyrum stipitatum	Woods at middle altitude, southern Cascades, Douglas to Lake Counties
Lewisia columbiana var. *columbiana*	Open rocky slopes, Columbia River Gorge
Lilium washingtonianum	Open woods at moderate altitude, Cascade Range
Limnanthes floccosa ssp. *bellingeriana2*	Rocky flats, southeastern Jackson and southwestern Klamath Counties
Orobanche uniflora f. *inundata*	Sandy River flood plain, Columbia River Gorge
Parnassia fimbriata var. *hoodiana*	Bogs and alpine meadows, vicinity of Mount Hood
Phlox hendersonii	Open rocky slopes, Mount Hood
Pityopus californicus[2]	Deep coniferous woods, west slope of Cascade Range

See footnotes at end of table.

Table 62.--*Vascular plants of special interest in the Western Slopes and Crest Province, Oregon Cascades* (Continued)

Species[1]	Distribution
Poa suksdorfii	High summits of Cascade peaks (also in Wallowa Mountains)
Polygonum cascadense[2]	Mountain meadows, southern Lane County
Polystichum andersonii	Damp ground at mid-elevation, Columbia River Gorge (and along west base of Mount Hood)
Polystichum californicum	Woods and rocky slopes, Cascade (and Siskiyou) Range
Populus tremuloides	Unique population at low elevations and west of Cascade Range on Angels Rest, Columbia River Gorge
Potentilla villosa	Alpine ridges and talus, Mount Hood
Salix fluviatilis[2]	Banks along the Columbia River
Saxifraga bronchialis var. *vespertina*	Wet cliffs, Columbia River Gorge and south in Coast and Cascade Ranges; present in Wildcat Mountain and Olallie Ridge RNA's
Sedum divergens	Rocky alpine slopes present in Wildcat Mountain and Olallie Ridge RNA's
Selaginella douglasii	Cliffs, moist banks, and tree trunks, Columbia River Gorge west to Portland and north to Cowlitz County, Washington
Silene douglasii var. *monantha*	Lower Columbia River Gorge
Silene suksdorfii	High slopes above timberline; Mount Hood, Three Sisters region, Mount Thielsen
Smelowskia ovalis	High altitude in Cascades, Three Sisters north
Sullivantia oregana[2]	Wet cliffs near waterfalls, Columbia River Gorge and lower Willamette River
Synthyris missurica ssp. *hirsuta*[2]	Cascade Range, northern Douglas County
Synthyris missurica var. *stellata*[2]	Moist shady cliffs, Columbia River Gorge
Thelypteris nevadensis	Moist woods, western slopes, Cascade Range (and Siskiyou Mountains)
Vaccinium oxycoccos var. *intermedium*	Sphagnum bogs, Cascade Range south to Marion County (and along coast to Lincoln County)
Viola adunca var. *uncinulata*	Mountain meadows, especially near Crater Lake

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or identification nationally (in the Smithsonian institution list) as threatened or endangered species.

[2]Species is on the national list of threatened and endangered plants (Smithsonian Institution 1974).

Table 63.--*Established Research Natural Areas in the Western Slopes and Crest Province, Oregon Cascades*

Name	Principal features	Agency[1]	Area	
			Ha	Acres
Abbott Creek RNA	Sierran-type mixed conifer forest and stream drainage	FS	1 077	2,660
Bagby RNA	Douglas-fir-western hemlock forests	FS	227	560
Bull Run RNA	Noble fir, Pacific silver fir, and western hemlock forests	FS	146	361
Gold Lake Bog RNA	Subalpine bog communities and permanent ponds	FS	188	463
Olallie Ridge RNA	Subalpine mountain meadows with rich flora and mixed conifer forests	FS	291	720
Wildcat Mountain RNA	Noble fir, Pacific silver fir, and mountain hemlock forests associated with meadow and shrub communities	FS	405	1.000

[1] FS = Forest Service.

Table 64.--*Additional Research* Natural *Areas needed in the Western Slopes and Crest Province, Oregon Cascades*

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Combined terrestrial and aquatic natural areas:						
1. Subalpine forest with lake (Pacific silver fir-western hemlock and western redcedar forests)	T-5,6 A-3,12	Proposed Crabtree Lake RNA	High	BLM	72-82 94-98	0603
2. Old-growth Douglas-fir-western hemlock forest with major stream drainages	T-3,25,6 A-12 R&E-2,3,4,6,7	Proposed Middle Santiam RNA	High	FS	72-80	0605
3. High Cascades subalpine lakes and ponds surrounded by mountain hemlock forest	T-10 A-4,10,7 R&E-5	Near Waldo Lake, Willamette National Forest	Medium	FS	103-106	0901
4. Subalpine forest with major stream drainage	T-6 A-14	Enlargement of Bull Run RNA	Medium	FS	94-98	0607
5. Alpine community mosaic with lake and ponds	T-23 A-5,8,11 R&E-5	Wilderness Area	Low	FS	284-290	0901
Predominantly terrestrial natural areas:						
6. Douglas-fir forest, 100-150 years old in western Cascades	T-1 R&E-3,6,7	Tributary drainage to South Fork of McKenzie River, Willamette National Forest	High	FS	72-88	0605 0606
7. Southwestern Oregon mixed coniferous forest with ash swales	T-13,24	Several areas under consideration in South Umpqua drainage, Umpqua National Forest	High	FS	138-145	0604 0606

See footnotes at end of table.

Table 64.--*Additional* Research *Natural Areas* ***needed in*** the ***Western Slopes*** and *Crest* Province, *Oregon Cascades* (Continued)

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
8. White fir-Douglas-fir mature forest, High Cascades	T-14	Dead Indian or Lake-of-the-Woods area	High	BLM FS	150-152	0904 0905
9. Maple/talus communities in the Columbia Gorge (with a small waterfall and moist cliffs)	T-27	In a State park, should include a variety of plant species of special interest (table 62)	Low	State FS	91	0601
10. Low-site western hemlock in the northern portion of the High Cascades	T-4	Proposed Abbott Pass area or two-part area (near Timothy Lake and across from Bear Paw Campground), Mount Hood National Forest	High	FS	99	0902
11. Shasta red fir forest in the High Cascades	T-15	Proposed Wickiup Springs RNA	High	FS	155-158	0905
12. High-elevation lodgepole pine with subalpine pumice and ash fields	T-19,26 R&E-5	Crater Lake National Park	Low	NPS	106-108	0901
13. Whitebark pine area	T-17	Crater Lake National Park or Wilderness Area	LOW	NPS FS	272-275	0901
14. Mountain meadow-forest mosaic in the southern part of the western Cascades	T-16	Proposed Cougar Butte RNA, Umpqua National Forest	High	FS	152-153	0604
15. Subalpine meadow community mosaic in the high Cascades	T-18 R&E-5	Wilderness area should incorporate most of major communities	Low	FS	269-270	0901
16. Subalpine lava flow	T-20	Between McKenzie and Santiam Highways	Low	FS	300-302	0901

See footnotes at end of table.

Table 64.--*Additional* **Research** *Natural* **Areas needed in the Western Slopes wad Crest** *Province*, **Oregon Cascades** (Continued)

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
17. Alpine needlegrass	T-22	In southern portion of High Cascades	Medium	FS		0905
18. Green fescue ***(Festuca viridula)***	T-21	On east slopes of Mount Hood	Medium	FS	269-272	0901
Predominantly aquatic natural areas:						
19. Low-elevation lake and ponds in Douglas-fir-western hemlock, northern portion	A-1,6,9 R&E-6,7		High	State		0603 0605
20. Low-elevation lake in mixed-conifer forest, southern portion	A-2 R6-6,7		High	State		0604 0606
21. Hot springs	A-15		High	FS Private		
22. Bulrush-sedge marsh area	A-16		High	FS BLM	108-109	

[1] For a description of these cells see table 59 for terrestrial (T) ecosystems, .table 60 for aquatic (A) ecosystems, and table 61 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate those cells which are considered essential components of the proposed Research Natural Area. Those not underlined represent cells which would be desirable but not essential components.

[2] Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is,' i.e., the danger that all examples of the type will be lost to other uses. Acquisition urgency.

[3] Agency or institution most, likely to have or to be able to acquire a tract of the desired type based on land ownership. BLM = Bureau of Land Management, FS = Forest Service, NPS = National Park Service.

[4] See appendix V.

EASTERN SLOPES PROVINCE, OREGON CASCADES

The name of this province is really somewhat misleading, since much of it is a high plateau region (fig. 1) dotted with numerous volcanic cones and buttes. Evidence of extensive volcanic activity during Pleistocene and Recent times is abundant. The largest volcanic peak is the Paulina Peak shield volcano which contains Newberry Crater. Pumice, resulting from an eruption of this volcano about 4,000 years ago, mantles an extensive area to the north and east of the crater. Deposits of pumice originating from Mount Mazama in the High Cascades are also widespread and extend from Bend almost to the California border. Broad areas of Pleistocene lava flows are a notable feature in the vicinity of Bend. In addition, outstanding examples of Recent lava flows are situated south of Bend in the Lava Butte area. North of Bend the most abundant rock type is basalt, most of which was laid down during the Miocene. Here volcanic buttes are not as abundant and the most outstanding topographic features are deep, stream-cut canyons.

Virtually all the soils south of Bend are formed in deep deposits of pumice. These soils have immature, regosolic profiles consisting of a moderately thick, loamy coarse sand surface layer with some organic matter accumulation, overlying nearly unweathered, yellow- and buff-colored pumice gravel and sand. Although these soils have high water holding capacities, low soil fertility limits plant root penetration into the largely unweathered pumice; thus many sites appear droughty. North of Bend the soils derived from basalt tend to be shallow and stony and are generally of loam or sandy loam texture.

Although primarily a province of forest ecosystems, major variations in composition and structure of the forests are associated with the rapid decline in annual precipitation eastward from the crest (Franklin and Dyrness 1973). Bunchgrass, sagebrush, and western juniper communities are characteristic of the most arid regions. Ecosystems dominated by a mixture of conifers (ponderosa pine, Douglas-fir, white fir, western larch, and incense-cedar) occupy the main body of the eastern slopes in the north with pure ponderosa pine forests characteristic of the drier, lower fringes. In the south, a region of gentle to flat topography mantled with volcanic pumice, lodgepole pine forests are very extensive and are often associated with large moist meadows. Ponderosa pine stands occur on sloping land forms and white fir forests are encountered at higher elevations. Lava flows and cinder cones provide habitat for distinctive ecosystems in the southern half of the province, and the Columbia River gorge enriches the biotic diversity in the north.

The northern and southern segments of the province also offer major contrasts in aquatic ecosystems. Small streams are relatively common in the north. In the south, however, smaller streams are not common; larger streams and rivers often arise directly from large springs. Large lakes, reservoirs, and marshlands are also abundant in some areas.

Seventeen terrestrial cells have been identified on the eastern slopes of the Oregon Cascade Range (table 65). Nine of these provide for representation of the major forest ecosystems.[2] Three cells focus on juniper, bunchgrass, and sagebrush ecosystems. Special types identified as cells include two in the Columbia River area and two geologically Recent volcanic formations (cinder cone and lava flow).

Eight aquatic cells are listed for the province (table 66). There is no geographic replication, each cell representing a different category of ecosystem — lake, pond, vernal pool, stream, cold spring, hot spring, marsh, and bog.

Research Natural Areas established to fill terrestrial and aquatic cells are expected to include the typical array of plant and animal species. Only two vertebrate animals are listed as rare and endangered cells (table 67). Vascular plants of special interest include 13 species from the Smithsonian list of threatened or endangered plants (table 68).

There are five Federal Research Natural Areas (table 69) plus an additional area (Persia M. Robinson) originally established by the Forest Service and recently given to the Warm Springs Confederation by Congress. These six reserves provide adequate representation of 8 of the 27 terrestrial, aquatic, and animal cells identified in this province; all of the filled cells are terrestrial.

We estimate that 14 additional Research Natural Areas will provide for minimal coverage of the remaining unfilled cells in this province (table 70). Two of the needed tracts combine important terrestrial and aquatic cells — a lake and a stream drainage associated with mixed-conifer forest. Other areas needed include two at the eastern end of the Columbia Gorge for concentrations of plants of special interest.

The Forest Service has lead responsibility for a majority of the required Research Natural Areas (table 70). Assistance from private organizations will almost certainly be necessary in a few cases. Aquatic ecosystems and terrestrial communities on private lands or which represent major timber resources have highest priority for selection and establishment.

[2] **A larger number of cells could be listed to recognize major geographic variations in several forest types.** For **example, a series of three lodgepole pine/bitterbrush communities (cell** No. **5) is necessary to include significant variations in the pumice soils on which the community occurs; differences in the composition, productivity, and management potential of the ecosystem are associated with the soil variability. Existing and proposed Research Natural Areas adequately cover this range in lodgepole pine/bitterbrush communities, however,** so **we have listed only a single cell. Similar situations exist with terrestrial cell** Nos. **3, 4, and 7.**

Table 65.--*Terrestrial cells in the* **Eastern** *Slopes* **Province,** *Oregon* **Cascades**

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Western Juniper Zone:			
1. Western juniper/big sagebrush community	238	Goodlow Mountain RNA	165-167
Ponderosa Pine Zone:			
* 2. Ponderosa pine/western juniper/sagebrush savanna	237	None	160-161 171-180
3. Ponderosa pine/bitterbrush community	237	Metolius, Pringle Falls, Bluejay, and Goodlow Mountain RNA's	171-180
4. Ponderosa pine/manzanita cornunity	237	Metolius and Goodlow Mountain RNA's	171-180
Lodgepole Pine Zone:			
5. Lodgepole pine/bitterbrush community	216	Pringle Falls and Bluejay RNA's; need will be satisfied with establishment of proposed Cannon Wells RNA	187-188
* 6. Lodgepole pine/grass-herb comnunities on moist sites	216	Token in Pringle Falls RNA, need additional area	187-188
White Fir and Douglas-fir Zones:			
7. Ponderosa pine-Douglas-fir forest	214	Mill Creek, Persia M. Robinson, and Metolius RNA's	191-192
8. Ponderosa pine-white fir/Ross' sedge community	214	Goodlow Mountain RNA	195-196
* 9. Mixed-conifer forest (pine, Douglas-fir, Abies). Also, if possible including western larch and incense-cedar	215	Token in Persia M. Robinson and Metolius RNA's, need additional area	190-196
*10. White fir/*Ceanothus* community	213	None	
Steppe and shrub-steppe communities:			
11. Bunchgrass communities		Mill Creek RNA	211-212 215-216
12. Low sagebrush/Sandberg's bluegrass community		Good ow Mounta n RNA	239-241
Special types:			
13. Oregon white oak-grassland communities	233	Mill Creek RNA	
*14. Moist meadows associated with lodgepole pine flats		None	187-190
*15. Eastern Columbia Gorge rock fall with forest complex		None	310-311
*16. Entire undisturbed, forested cinder cone, preferably in Abies *grandis*		None	193-201
*17. Low elevation, Recent lava flow with representative vegetation		None	

*Cells presently lacking adequate representation.

Table 66.--*Aquatic cells in the Eastern Slopes Province, Oregon Cascades*

Cell[1]	Present representation
*1. Lake at moderate elevations surrounded by mixed-conifer forest	None
*2. Permanent subalpine pond	None
*3. Vernal ponds at moderate elevation	None
*4. Large stream drainage at moderate elevations in mixed-conifer forest	None
*5. Large, upwelling cold spring	None
*6. Typical hot spring	None
*7. Marshland	None
*8. Typical bog at mid- to high-elevations	None

[1]Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the listed ecosystem.

*Cells presently lacking adequate representation,

Table 67.--*Rare and endangered vertebrate animal cells in the Eastern Slopes Province, Oregon Cascades*

Cell	Verified representation	Reference
Amphibians:		
*1. Spotted frog	None	Stebbins *1954* Storm *1966*
Mammals:		
*2. Heather vole	None	Bailey *1936* Edwards *1955* Johnson 1973 Maser and Storm *1970* Olterman and Verts *1972* Shaw *1924*

*Cells presently lacking adequate representation.

Table 68.--*Vascular plants of special interest in the Eastern Slopes Province, Oregon Cascades*

Species[1]	Distribution
Alisma gramineum var. *gramineum*	Vernal ponds at east end of Columbia River Gorge, near The Dalles and in Klickitat County, Washington
Astragalus applegatei[2]	Moist meadows near Klamath Falls, Klamath County
Astragalus hoodianus	Grassy slopes, Columbia River Gorge, Hood River County, Oregon, and Klickitat County, Washington
Botrychium pumicola[2]	Pumice slopes, Crater Lake and Paulina Mountains
Castilleja appleqatei	On pumice, Three Sisters to Crater Lake
Castilleja chlorotica[2]	Mountains, southern Lake County (Gearhart Mountain); Three Sisters
Cicuta bulbifera	Swamps around Klamath Lake
Crepis bakeri ssp. *cusickii*	Dry slopes, Jackson and Lake Counties
Cypripedium montanum[2]	Usually in open woods
Dodecatheon poeticum[2]	Grassland, east end of Columbia River Gorge
Erioqonum prociduum	Volcanic outcrops, Lake County
Eriogonum pyrolaefolium var. *bellingerianum*	Summit of Broken Top Mountain, Deschutes County
Erioqonum umbellatum var. *glaberrimum*	Warner Mountains, southern Lake County
Eriogonum umbellatum var. *hausknechtii*	High mountain meadows
Haplopappus hallii[2]	Dry slopes, east end of Columbia River Gorge
Heuchera grossulariifolia var. *tenuifolia*	Grassy hillsides, east end of Columbia River Gorge
Hydrophyllum capitatum var. *thompsonii*[2]	Near oaks, Columbia River Gorge and Hood River County
Lomatium columbianum	Open rocky slopes, east end of Columbia River Gorge
Lomatium laevigatum[2]	Basaltic slopes, east end of Columbia River Gorge
Lomatium peckianum	Dry hillside and pine woods near Bly, Klamath County
Lomatium suksdorfii[2]	Rocky soil, east end of Columbia River Gorge
Lupinus latifolius var. *thompsonianus*[2]	Dry hillsides, east end of Columbia River Gorge
Mimulus jungermannioides[2]	Moist moss mats, east end of Columbia River Gorge and along lower Deschutes River
Mimulus pulsiferae	Moist open places along eastern base of Cascade Mountains

See footnotes at end of table.

Table 68.--*Vascular plants of special interest in the Eastern Slopes Province, Oregon Cascades* (Continued)

Species[1]	Distribution
Penstemon barrettiae[2]	Basaltic cliffs and talus, east end of Columbia River Gorge
Penstemon euglaucus	Forest openings at middle altitudes, Three Sisters to Mount Hood (Blue Grass Ridge)
Penstemon glandulosus	Rocky slopes, east end of Columbia River Gorge; disjunct to Snake River
Penstemon glaucinus[2]	Pine forest, Gearhart Mountain, Lake County
Penstemon peckii[2]	Open pine woods, eastern base of Cascades, Mount Hood to Three Sisters
Penstemon subserratus	Open woods, eastern slope of Mount Hood, Hood River County
Ribes watsonianum	East side of Mount Hood, Hood River County
Salix laevigata	Along streams, southern Klamath County
Silene nuda ssp. *insectivora*	Along Sprague River, Klamath County
Spiraea pyramidata	Eastern side of Cascade Range
Suksdorfia violacea	Wet cliffs and mossy banks, east end of Columbia River Gorge
Viola adunca var. *cascadensis*	Open pine woods, eastern base of Cascade Range, Deschutes and Jefferson Counties

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or identification nationally (in the Srnithsonian Institution list) as threatened or endangered species.

[2]Species is on the national list of threatened and endangered plants (Smithsonian Institution 1974).

Table 69.--*Established* ***Research Natural Areas in the Eastern*** *Slopes* ***Province,*** Oregon Cascades

Name	Principal features	Agency[1]	Area	
			Ha	Acres
Bluejay RNA	Ponderosa and lodgepole pine on coarse pumice so; Is	FS	85	210
Goodlow Mountain RNA	Interior ponderosa pine forest and associated ecosystems	FS	510	1,260
Metolius RNA	interior ponderosa pine forests	FS	583	1,440
Mill Creek RNA	Mosaic of interior mixed conifer and Oregon white oak forest and grass and shrub-steppe	FS	330	815
Persia M. Robinson RNA	Douglas-fir and ponderosa pine forests	WSIR	219	540
Pringle Falls RNA	Lodgepole and ponderosa pine forests on pumice soils	FS	470	1,160

[1] FS = Forest Service, WSIR = Warm Springs Indian Reservation.

Table 70.--*Additional Research Natural Areas needed in the Eastern Slopes Province, Oregon Cascades*

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Combined terrestrial and aquatic natural areas:						
1. Mixed-conifer forest (pine, Douglas-fir, and Abies) with major stream drainage	T-9,5,10 A-4	Mount Hood National Forest or Sisters area of Deschutes National Forest	High	FS	190-196	0902 0903 0905
2. Mixed-conifer forest (pine, Douglas-fir, and *Abies*) with lake	T-9,5,10 A-1 R&E-1	Deschutes or Winema National Forest at higher elevations than Metolius RNA	High	FS NPS	190-196	0905
3. Moist meadow and associated wet lodgepole pine area, with vernal ponds	T-6,14,5 A-3	Winema National Forest (small representation in Cannon Wells RNA being established)	Medium	FS	187-190	0905
Predominantly terrestrial natural areas:						
4. White fir/*Ceanothus* community, with *Castanopsis*	T-10,4,9	Should be on residual soils, not Mazama pumice	High	FS	176-177 196	0902
5. Lodgepole pine/ bitterbrush community	T-5,14	Cannon Wells RNA being established	High	FS	187-188	0905
6. Ponderosa pine/western juniper/sagebrush savanna	T-2,1,3, 12	Fort Rock or Silver Lake area	High	FS	160-161 171-180	1306
7. Eastern Columbia Gorge rock fall area with forest complex	T-15,7,9, 13	Hood River area. May contain a variety of plants of special interest (table 68)	Medium	FS	310-311	0904
8. Entire undisturbed, forested cinder cone, preferably in Abies *grandis* zone	T-16	Graham Butte, west of Sisters	High	FS	193-201	0905
9. Low-elevation, recent lava flow with representative vegetation	T-17	Lava Butte area	Medium	FS		0905

See footnotes at end of table.

Table 70.--*Additional Research* ***Natural Areas*** *needed in the Eastern Slopes Province, Oregon Cascades* (Continued)

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Predominantly aquatic natural areas:						
10. Subalpine permanent ponds and bog area	A-2,8 R&E-1	Just east of Santiam Pass (south of highway) is possible location	Medium	FS	108-109	0901
11. Large, upwelling cold spring	A-5 R&E-1	Headwaters of the Metolius River	Medium	FS Private		0905
12. Typical hot spring	A-6		High	FS Private		
13. Marshland	A-7	Enlargement of Pringle Falls RNA will at least partially fill this need	High	FS		0905
Natural area for protection of vascular plants of special interest:						
14. An area near the eastern end of the Columbia River Gorge for the protection of vascular plant species of special interest		Private land near Mosier, Oregon. Species to be protected include *Lomatium columbianum, L. laevigatum, L. suksdorfii, Dodecatheon poeticum, Penstemon barrettiae, Orobanche uniflora,* and *Artemisia lindleyana*	High	Private		0904

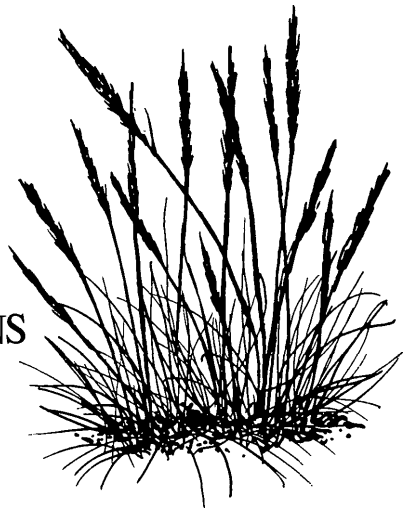
[1] For a description of these cells see table 65 for terrestrial (T) ecosystems, table 66 for aquatic (A) ecosystems, and table 67 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate those cells which are considered essential components of the proposed Research Natural Area. Those not underlined represent cells which would be desirable but not essential components.

[2] Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is, i.e., the danger that all examples of that type will be lost to other uses. Acquisition urgency.

[3] Agency or institution most likely to have or to be able to acquire a tract of the desired type based on land ownership. FS = Forest Service, NPS = National Park Service.

[4] See appendix V.

OCHOCO, BLUE, AND WALLOWA MOUNTAINS PROVINCE, NORTHEASTERN OREGON AND SOUTHEASTERN WASHINGTON



This province is made up of three principal mountain ranges separated by faulted valleys and synclinal basins (fig. 1). Relief is highly variable; moderate slopes are common in the Ochoco and Blue Mountains, whereas the heavily glaciated Wallowa Mountains have a much higher proportion of steep slopes. Maximum elevations range from about 2100 m in the Ochocos to 2900 at Eagle Cap in the Wallowas. Valley floor elevations are about 750 m in the Ochocos and 900 m in the broad basin between the Blue and Wallowa Mountains. Spectacular Hells Canyon, 1660 m deep, comprises the eastern boundary of the province.

Geologically, the province is separated into eastern and western units, with the dividing line just east of John Day. The western unit contains some of the oldest rocks in Oregon which include Paleozoic to Jurassic formations of conglomerate, sandstone, siltstone, shale, and limestone. In addition, Columbia River basalt, extruded during the Miocene, occupies large areas within the western Blue Mountains and also extends into the eastern section where it forms the major portion of the northern slopes. The eastern portion of the province was subjected to considerable alpine glaciation during the Pleistocene, as indicated by numerous cirques, glacial lakes, and moraines. Bedrock in the Wallowa Mountains is largely made up of Triassic sedimentary formations (sandstone, siltstone, shale, and limestone) and granitic intrusions.

During the late Pleistocene, much of the area within the central and northern portions of the Blue Mountains was covered by a layer of volcanic ash and fine pumice. Subsequent erosion has largely removed the ash from south-facing slopes; however, other locations are typically mantled by the material. In addition, many upland areas, especially in the eastern portion, are mantled by loess deposits.

Obviously, with such a wide range of parent materials, vegetation, and climate, soils within the province are highly variable and only a few of the major types will be mentioned. Forested soils derived from volcanic ash are poorly developed, generally dark brown in color, and fine sandy loam to silt loam in texture. Forested soils in loess deposits are generally Brown Podzolics, having deep, silt-textured profiles. The most widespread soils supporting grassland and shrub-grassland vegetation are classed as Prairie soils and Chernozems. These vary in texture depending on parent material, but are generally silt loam to clay loam, with fine-textured B horizons.

Since three major mountain blocks and a wide range of elevations are present in this province, there is a relatively large number of ecosystems represented as well as considerable variation in those ecosystems. Mixed-conifer forests (Douglas-fir, grand fir, ponderosa and western white pines, and western larch) dominate the landscape, with ponderosa pine and western juniper communities on more arid habitats and Engelmann spruce-subalpine fir forests on cool, moist subalpine areas. Subalpine and alpine meadow communities occur on the highest ridges and summits, and grassland and sagebrush ecosystems are common at low elevations, particularly in the canyons of the Snake River and its tributaries. Streams, lakes, and ponds of various types are well represented in the province.

Twenty-five terrestrial cells have been identified (table 71). Eleven of these provide for representation of the principal forest ecosystems. The remainder are equally divided between steppe and shrub-steppe ecosystems and mountain meadows of various types.

Nine of the 13 identified aquatic cells (table 72) provide for representation of lakes, ponds, and vernal pools in three elevational zones — montane, subalpine, and alpine. Two stream drainages, one each in subalpine and montane environments, are viewed as essential cells in a natural area system. A marsh and bog complete the list.

It is presumed that areas established for terrestrial and aquatic cells will include the array of plant and animal species typical of those ecosystems. Five vertebrate animal species have been identified which should receive specific consideration in selection of Research Natural Areas because of their rare or endangered status (table 73). There are many vascular plants of special interest including 30 listed as threatened or endangered on the Smithsonian list (table 74). The greatest concentration of these is in the Snake River Canyon. Many of the remaining species occur on subalpine and alpine habitats, particularly in the Wallowa Mountains. Nineteen of the species listed by the Smithsonian Institution are accounted for between the Snake River Canyon and alpine reaches of the Wallowa Mountains.

Four Federal Research Natural Areas have been established within the province (table 75). These provide adequate coverage for 6 of the 43 cells identified for this province; all of the filled cells are terrestrial. Substantial populations of many of the special interest plants are undoubtedly already protected within the Eagle Cap and Strawberry Mountain Wilderness and in other scenic reserves along the Snake River.

There is a need for 18 additional Research Natural Areas for minimal representation of all identified terrestrial, aquatic, and animal cells (table 76). Two of the largest areas should be major stream drainages with associated mixed-conifer forest; three other areas should combine essential terrestrial and aquatic cells. Most of the remaining areas focus on a single terrestrial or aquatic ecosystem or, in a few cases, an intricate mosaic of terrestrial ecosystems. One area is needed in the Snake River Canyon (need No. 14) which incorporates several distinctive communities as well as habitat for a variety of special interest plant species.

The responsibility for establishment of the necessary Research Natural Areas lies almost entirely with the Forest Service (table 76). Bureau of Land Management is lead agency for two aquatic areas, although it is not certain that a lake and a bog suitable for designation as Research Natural Areas exist. Highest priority is given selection of natural areas representing commercial forest types and low elevation aquatic ecosystems.

Table 71.--*Terrestrial cells in the Ochoco, Blue, and Wallowa Mountains Province, northeastern Oregon and southeastern Washington*

Cell	SAF timber type No.	present representation	Page reference (Franklin and Dyrness 1973)
Western Juniper Zone:			
1. Western juniper/bluebunch wheatgrass community	238	Ochoco Divide and Canyon Creek RNA's	165-167
Ponderosa Pine Zone:			
* 2. Ponderosa pine/bunchgrass communities in the northern Blue Mountains	237	None	171-176
* 3. Ponderosa pine/bitterbrush/bunchgrass communities	237	None	175
Douglas-fir Zone:			
4. Ponderosa pine/pinegrass comnunity	237	Ochoco Divide and Canyon Creek RNA's	175-176 191-192
5. Douglas-fir-ponderosa pine/pinegrass community	214	Ochoco Divide and Canyon Creek RNA's	191-192
* 6. Douglas-fir-ponderosa pine/shrub community	214	None, proposed Moore Flat RNA may fill need	191-192
Grand Fir Zone:			
7. Mixed-conifer forest with western larch dominance	213	Rainbow Creek RNA	195-199
8. Mixed-conifer forest with western white pine dominance	215	Rainbow Creek RNA	195-199
* 9. Grand fir/thinleaf huckleberry community	213	Some representation on Rainbow Creek and Pataha Bunchgrass RNA's, need additional area	196
Subalpine Fir Zone:			
*10. Engelmann spruce-subalpine fir forest	206	None	205-206
Steppe communities:			
11. Bluebunch wheatgrass-Sandberg's bluegrass community		Rainbow Creek RNA	226
*12. Idaho fescue-bluebunch wheatgrass community		Present in Pataha Bunchgrass RNA, need additional area at higher elevations in Blue or Wallowa Mountains	219-220

See footnote at end of table.

Table 71.--*Terrestrial cells in the Ochoco, BZue, and Wallowa Mountains Province, northeastern Oregon and southeastern Washington* (Continued)

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Steppe communities: (Continued)			
*13. Sandberg's bluegrass-onespike oatgrass community		None	245
*14. *Sporobolus cryptandrus/Poa sandbergii* and *Aristida longiseta/Poa sandbergii* associations along the Snake River		None	228-229
Shrub-steppe communities:			
*15. Big sagebrush/bunchgrass comnunity inside forest zone		None.	216-219
*16. Low sagebrush/bunchgrass community inside forest zone		None	239-241
*17. Rigid sagebrush scabland'		None	242
Subalpine and alpine meadow communities:			
*18. Alpine Idaho fescue community		None	
*19. Green fescue community in the Wallowa Mountains		None	271-272
*20. Alpine sagebrush community in the Blue Mountains		None	
*21. Black sedge community in the Wallowa Mountains		None	271-272
Special types:			
"22. Lodgepole pine/dwarf huckleberry/ pinegrass community in the Blue Mountains (with minimal fir regeneration)	218	None	197-198
*23. Moist bluegrass meadow in the Blue Mountains		None	199-200
*24. Moist bluegrass meadow in the Wallowa Mountains		None	199-200
*25. Typical wet meadow (tufted hairgrass and sedges)		None	199-201

* Cells presently lacking adequate representation.

Table 72.--*Aquatic cells in the Ochoco, Blue, and Wallowa Mountains Province, northeastern Oregon and southeastern Washington*

Cell[1]	Present representation
* 1. Low-elevation lake surrounded by mixed-conifer forest	None
* 2. Typical subalpine lake	None
* 3. Alpine lake	None
* 4. Permanent ponds at low elevations	None
* 5. Subalpine permanent ponds	None
* 6. Alpine permanent ponds	None
* 7. Vernal ponds at low elevation	None
* 8. Subalpine vernal ponds	None
* 9. Alpine vernal ponds	None
*10. Large stream drainage in mixed-conifer forest	None
*11. Large subalpine stream drainage	None
*12. Marshland	None
*13. Typical bog	None

[1]Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the listed ecosystem.

*Cells presently lacking adequate representatton.

Table 73.--Rare *and endangered vertebrate animal cells in the Ochoco, Blue, and Wallowa Mountains Province, northeastern Oregon and southeastern Washington*

Cell	Verified representation	Reference
Fish:		
*1. Malheur sculpin	None	Bond 1966
Amphibians:		
*2. Tailed frog	None	Stebbins 1954 Storm 1966
Mammals:		
*3. Malheur or Preble shrew	None	Bailey 1936 Olterrnan and Verts 1972
*4. Washington squlrrel	None	Bailey 1936 Olterman and Verts 1972
*5. Heather vole	None	Bailey 1936 Edwards 1955 Johnson 1973 Maser and Storm 1970 Olterrnan and Verts 1972 Shaw 1924

*Cells presently lacking adequate representation.

Table 74.--*Vascular plants of special interest in the Ochoco, Blue, and Wallowa Mountains Province, northeastern Oregon and southeastern Washington*

Species[1]	Distribution
Allium madidum[2]	Seasonally wet meadows, Blue Mountains
Aquilegia flavescens	Alpine meadows, Wallowa Mountains
Asplenium viride	Moist cliffs, especially on limestone, Wallowa Mountains
Astragalus arthurii	Arid slopes, Blue and Wallowa Mountains, Wallowa and Umatilla Counties
Astragalus cusickii var. *cusickii*	Snake River canyon and tributaries from west, Baker and Wallowa Counties
Astragalus robbinsii var. *alpiniformis*[2]	Alpine stream banks, high peaks of Wallowa Mountains
Astragalus vallaris	Snake River canyon, Wallowa County
Balsamorhiza hirsuta	Dry plains, Union County (Grande Ronde prairie)
Botrychium boreale	Deep mossy woods, Wallowa Mountains
Botrychium lanceolatum	Alpine slopes, Wallowa Mountains
Botrychium virginianum	Moist rich woods, Wallowa Mountains
Calochortus longibarbatus var. *peckii*	Meadows, Ochoco Mountains, Crook County
Calochortus nitidus	Open slopes, Blue Mountains
Camassia cusickii[2]	Seeps in canyons along Pine Creek, Baker County, to Snake River
Campanula sacajaweana[2]	Stony alpine slopes, Wallowa Mountains
Carex concinna	Coniferous woods, Hurricane Creek canyon, Wallowa County
Carex limnophila	Moist places at mid-elevation, Wallowa Mountains
Castilleja chrysantha[2]	Alpine meadows, Wallowa and Blue Mountains
Castilleja fraterna[2]	Willow thickets, alpine meadows, Wallowa Mountains
Castilleja glandulifera[2]	Rocky slopes, Blue Mountains
Castilleja oresbia[2]	Endemic in Blue Mountains where it is common on stony soils with stiff sagebrush
Castilleja ownbeyana[2]	Alpine meadows, Wallowa Mountains
Castilleja rubida	Alpine summits, Wallowa Mountains
Chaenactis cusickii	Sandy hills, Baker and Malheur Counties
Cheilanthes feei	Cliff crevices, Snake River canyon
Claytonia megarhiza var. *bellidifolia*[2]	Talus slopes at high altitude, Blue and Wallowa Mountains
Corallorhiza trifida	Deep moist woods, Wallowa Mountains
Cryptogramma stelleri	Moist shaded cliffs, Wallowa Mountains
Draba lemmonii var. *cyclomorpha*[2]	High peaks of Wallowa Mountains
Dryas drummondii	Rocky slopes and summits, Wallowa Mountains
Dryas octopetala var. *hookeriana*	Alpine peaks, Wallowa Mountains
Dryopteris filix-mas	Moist woods, northeastern Oregon
Erigeron disparipilus	Snake River canyon
Eriogonum scopulorum	High ridges, Wallowa Mountains
Eritrichium nanum	High rocky slopes, Wallowa Mountains

See footnotes at end of table.

Table 74.--*Vascular plants of special interest in the Ochoco, Blue, and Wallowa Mountains Province, northeastern Oregon and southeastern Washington* (Continued)

Species[1]	Distribution
Geum gracilipes	Moist cliff, head of Anthony Creek, Baker County
Habenaria obtusata	Open woods, Hurricane Creek canyon, Wallowa County
Hackelia hispida[2]	Cliffs and talus slopes, Snake River canyon
Haplopappus radiatus[2]	Dry hillsides in and near Snake River canyon
Hedysarum boreale var. *boreale*	Wallowa Mountains
Heuchera grossulariifolia var. *grossulariifolia*	Cliffs, Baker and Wallowa Counties
Hulsea algida	Talus slopes, especially in granitic sand, Wallowa Mountains
Kobresia bellardii	Alpine ridges, Wallowa Mountains
Kobresia simpliciuscula	Banks of Hurricane Creek, Wallowa County
Leptodactylon hazelae[2]	Dry rocky slopes of Hells Canyon, Snake River
Lesquerella sherwoodii	High slopes of Wallowa Mountains
Lewisia columbiana var. *wallowensis*[2]	Rocky slopes, Wallowa Mountains
Lomatium cusickii	Alpine ridges, Wallowa Mountains
Lomatium greenmanii[2]	Rocky ridges, head of Keystone Creek, Wallowa Mountains
Lomatium oreganum[2]	Rocky ridges, Blue and Wallowa Mountains
Lomatium rollinsii[2]	Open slopes, Snake River canyon, Wallcwa County
Lomatium salmoniflorum	Basaltic slopes, Snake River canyon, Wallowa County
Lomatium serpentinum[2]	Dry rocky slopes, Snake River canyon
Lomatium watsonii	Dry slopes, Blue Mountains (also Jefferson and Wasco Counties)
Lupinus sabinii[2]	Endemic in Blue Mountains at high elevation but locally common there
Mimulus clivicola	South end of Snake River canyon
Mirabilis macfarlanei[2]	Snake River canyon, Wallowa County
Nemophila kirtleyi	Shady banks, Snake River canyon and tributaries, Wallowa and Baker Counties
Oryzopsis hendersonii	Sagebrush, Ochoco National Forest, Jefferson County
Pedicularis bracteosa var. *pachyrhiza*	Coniferous forest, Blue and Wallowa Mountains
Pediocactus simpsonii var. *robustior*	Arid areas, Wallowa County
Pellaea breweri	Open granite slopes, Wallowa Mountains
Pellaea bridgesii	Granite slopes at high altitude, Wallowa Mountains
Penstemon elegantulus[2]	Grassland overlooking Snake River canyon, Wallowa County
Penstemon fruticosus var. *serratus*	Mountains east of Imnaha River, Wallowa County
Penstemon payettensis	Open slopes in well-drained soil, Wallowa Mountains
penstemon spathulatus[2]	High rocky slopes, Wallowa Mountains
Penstemon triphyllus	Dry hills, Snake River and tributaries, Baker and Wallowa Counties

See footnotes at end of table.

Table 74.--*Vascular plants of special interest in the Ochoco, Blue, and Wallowa Mountains Province, northeastern Oregon and southeastern Washington* (Continued)

Species[1]	Distribution
Phacelia minutissima	Damp ground at mid-elevation, Wallowa Mountains
Phlox colubrina	Rocky banks, Snake River and lower Imnaha River canyons
Pinus flexilis	High slopes, Wallowa Mountains
Pleuropogon oreganus	Blue Mountains
Polystichum kruckebergii[2]	Rocky open slopes, Wallowa Mountains and Snake River canyon
Primula cusickiana[2]	Rocky slopes, Wallowa Mountains
Ranunculus oresterus	Swales, Blue Mountains, eastern Grant and Union Counties
Ribes cereum var. *colubrinum*	Snake River canyon, Wallowa County
Ribes irriguum	Streambanks in Blue Mountains, northeastern Oregon
Rubus bartonianus[2]	Rocky slopes, Snake River canyon, Wallowa County
Salix arctica	Alpine summits, Wallowa Mountains
Salix brachycarpa	Moist places at high altitude, Wallowa Mountains
Salix drummondiana	Stream banks and meadows, Wallowa Mountains (and Steens Mountains)
Salix vestita	High peaks, Wallowa Mountains
Salix wolfii var. *idahoensis*	Stream banks and moist ground, high altitude in Wallowa Mountains
Saxifraga adscendens	High alpine meadows, Wallowa Mountains
Saxifraga oppositifolia	Alpine scree, Wallowa Mountains
Selaginella watsonii	Exposed rocky sites, Wallowa Mountains
Senecio porteri[2]	Open rocky peaks, Wallowa Mountains
Silene spaldingii[2]	Sagebrush and pine forest, Wallowa and Union Counties
Smelowskia calycina	Alpine slopes in Wallowa Mountains
Thalictrum alpinum var. *hebetum*	Alpine meadows, Wallowa Mountains
Thelypodium eucosmum[2]	Lower canyons, Blue Mountains of Grant, Baker, and Wheeler Counties
Tonella floribunda	Snake River canyon and Pine Creek, Wallowa and Baker Counties
Townsendia parryi	Subalpine ridges of Wallowa Mountains
Trifolium plumosum var. *plumosum*[2]	Endemic in Blue Mountains but common there
Viola adunca var. *bellidifolia*	Wet meadows, Wallowa (and Cascade) Mountains
Viola canadensis var. *rugulosa*	Woods of Imnaha and Snake River canyons

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or identification nationally (in the Srnithsonian institution list) as threatened or endangered species.

[2]Species is on the national list of threatened and endangered plants (Srnithsonian Institution 1974).

Table 75.--*Established Research Natural Areas in the Ochoco, Blue, and Wallowa Mountains Province, northeastern Oregon and southeastern Washington*

Name	Principal features	Agency[1]	Area	
			Ha	Acres
Canyon Creek RNA	Interior ponderosa pine forest (Washington)	FS	283	700
Ochoco Divide RNA	Ponderosa pine-Douglas-fir and grand fir-western larch-Douglas-fir forests (Oregon)	FS	777	1,920
Pataha Bunchgrass RNA	Bluebunch wheatgrass stands (Washington)	FS	21	51
Rainbow Creek RNA	Interior mixed conifer forest with abundant western white pine (Oregon)	FS	170	420

[1] FS = Forest Service.

Table 76.--*Additional Research Natural* ***Areas needed*** *in the Ochoco, Blue, and Wallowa Mountains Province, northeastern Oregon and southeastern Washington*

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Combined terrestrial and aquatic natural areas:						
1. Mixed-conifer forest and major stream drainage extending from moderate elevations into the subalpine	T-10,22,25 2,3,4,5, 6,7,8 A-11,12 R&E-2,3	Ideally should have a range 2,000 to 6,000 feet in elevation. Possibly could enlarge Rainbow Creek RNA sufficiently to fill this need	Medium	FS	190-196 204-206	1201
2. Juniper, pine, mixed conifer, and meadow vegetation with large stream drainage	T-1,2,3,4, 5,7,17,25 A-10 R&E-1	Headwaters area of Silver Creek, Snow Mountain District, Ochoco National Forest	Medium	FS	165-167 171-180 195-201	1204 1208
3. Grand fir/thinleaf huckleberry community and marsh area	T-9,10,22, 25 A-12	Central Blue Mountains	High	FS	195-196	1204 1206
4. Green fescue, alpine sagebrush, and black sedge communities with headwaters of stream in the Wallowa Mountains	T-19,20,21 10 A-11 R&E-2	Hurricane Creek in Eagle Cap Wilderness Area. Should contain several plant species of special interest (table 74)	Medium	FS	207-208 271-272	1701
5. Mixed-conifer forest with lake and/or permanent pond	T-6,7,8, 9,25 A-2,5,8 12	Possibly in Strawberry Mountain or Eagle Cap Wilderness Area	Low	FS	190-196 204-206	1205 1701
Predominantly terrestrial natural areas:						
6. Ponderosa pine/ bunchgrass communities	T-2,4,5, 12,13	Starkey Experimental Range is possible location	High	FS	171-176	1206

See footnotes at end of table.

Table 76.--*Additional Research Natural Areas needed in the Ochoco, Blue, and Wallowa Mountains Province, northeastern Oregon and southeastern Washington* (Continued)

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
7. Ponderosa pine/bitterbrush/bunchgrass, big sagebrush/bunchgrass, and low sagebrush/bunchgrass communities	T-3,15,16	Southern Blue Mountains	High	FS	171-180 183-184	1206 1208
8. Alpine Idaho fescue community	T-18,20,9,10,22	Malheur National Forest-Field Creek, Brady Mountains. Also in Strawberry Mountain Wilderness Area	LOW	FS		1205
9. Moist bluegrass meadow in Blue Mountains	T-23,4,5,9		Medium	FS	199-200	1206 1208
10. Moist bluegrass meadow in Wallowa Mountains	T-24,4,5,9		Medium	FS	199-200	1702 1703
11. Idaho fescue/bluebunch wheatgrass community	T-12,2	Blue or Wallowa Mountains. Should be at higher elevation than Pataha Bunchgrass RNA	Medium	FS	244	1203 1703
12. Sandberg's bluegrass-onespike oatgrass community	T-13,2,4,5,12	Starkey Experimental Range is possible location	Medium	FS	245	1206
13. Rigid sagebrush scabland	T-17,3,4,5,15,16	Southern Blue Mountains (Ochoco or Malheur National Forest)	Medium	FS	242	1208

See footnotes at end of table.

Table 76.--*Additional Research Natural Areas needed in the Ochoco, BZue, and Wallowa Mountains Province, northeastern Oregon and southeastern Washington* (Continued)

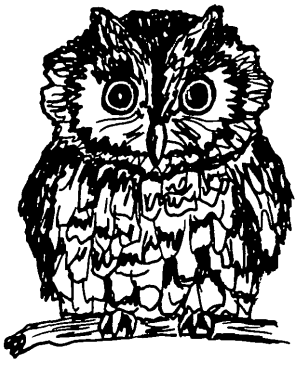
Ecosystern or community	Cells represented'	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
14. *Sporobolus cryptandrus/ Poa sandbergii* and *Aristida longiseta/P. sandbergii* associations along the Snake River	T-14,2,15 R&E-4	Southern Snake River Canyon--should have elevational range of 800 to 3,000 feet. Should contain a variety of plant species of special interest (table 74)	Medium	FS	228-229	1211
Predominantly aquatic natural areas:						
15. Low-elevation lake and ponds	A-1,4,7	May be difficult to find	High	BLM		1201 1208
16. Alpine lake and ponds	A-3,6,9 R&E-2,5	Eagle Cap Wilderness Area	Medium	FS		1701
17. Typical bog area	A-13	May not be available	High	BLM FS		
18. Tule marsh	A-12	Suitable area may occur in Ladd Marsh refuge	High	OSFWC		1201

'For a description of these cells see table 71 for terrestrial (T) ecosystems, table 72 for aquatic (A) ecosystems, and table 73 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate cells considered essential components of the proposed Research Natural Area. Those not underlined represent cells which would be desirable but not essential.

[2]Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is, i.e., the danger that all examples of that type will be lost to other uses. Acquisition urgency.

[3]Agency or institution most likely to have or to be able to acquire a tract of the desired type based on land ownership. BLM = Bureau of Land Management, FS = Forest Service, OSFWC = Oregon State Fish and Wildlife Commission.

[4]See appendix V.



BASIN AND RANGE PROVINCE, EASTERN OREGON

The Basin and Range Province (fig. 1) is characterized by a series of fault-block mountains enclosing basins with internal drainage. Elevations range from about 1200 m to 2930 m atop Steens Mountain. Except for the precipitous fault scarps (e.g., Winter Rim and Abert Rim), much of the area is gently rolling with low relief. Since annual precipitation in the area averages only 180 to 300 mm, most streams are intermittent, and numerous undrained basins contain shallow, saline lakes.

Virtually all of the rocks which outcrop in the province date from Miocene to Recent epochs. Most of the rock types present are igneous, with basalt and andesite being the most common. Other rocks of more minor occurrence include rhyolite, dacite, tuffs, and tuffaceous sedimentaries. Evidences of glaciation are confined to Steens Mountain where most channels are glacially carved and contain cirques at their head.

Soils developed on basic igneous rocks under grass-shrub vegetation commonly have a very stony loam surface horizon underlain by a clay or stony loam subsoil. In some locations these soils have a silica-cemented hardpan at depths of 2 to 5 dm.

Shrub-steppe ecosystems dominated by various species of sagebrush and bunchgrasses are most characteristic (Franklin and Dyrness 1973). Desert or salt desert shrub communities of shadscale, salt sage, greasewood, and similar species occupy low-lying areas with saline or alkali soils. Western juniper, mountain mahogany, and along the province's western margin, ponderosa pine typify savanna ecosystems which are present. Steens Mountain adds substantial biotic diversity to the province; alpine ecosystems are found on the summit; and a variety of ecosystems, notably quaking aspen and western juniper woodlands, clothe much of the slopes. Permanent and vernal ponds and lakes of varying salinity are the most characteristic aquatic ecosystems.

Of the 19 terrestrial cells identified (table 77), over half provide for representation of the distinctive sagebrush and desert shrub ecosystems. Five major savanna communities and several ecosystems confined to Steens Mountain are also listed.

Of the 14 aquatic cells, 9 identify ponds and lakes in a variety of environments (desert to subalpine) and include both fresh and saline types (table 78). One stream ecosystem on Steens Mountain and a tule marsh on the western edge of the province are also considered essential elements.

Areas to be established for terrestrial and aquatic cells are expected to include the array of plant and animal species typical of these ecosystems. Ten vertebrate animal species are recognized specifically as cells because of their rare or endangered status (table 79); 3 of these are fish. Vascular plants of special interest include eight from the Smithsonian list of threatened and endangered plants (table 80); several of these are on Steens Mountain.

There are no established Research Natural Areas in the Basin and Range Province, although several are being considered on Steens Mountain. At least 10 areas will be required to provide minimal representation of the 43 identified terrestrial, aquatic, and animal cells (table 81). Several of the proposed Research Natural Areas (see Nos. 1, 2, 4, and 5) incorporate five to seven cells and, unless the selected areas are very large, inclusion of this many elements may not be possible. Consequently, more natural areas may actually prove necessary. In any case, most of the Research Natural Areas will include ecosystem mosaics in mountain and basin habitats.

The Bureau of Land Management is expected to carry most of the lead responsibility in this province with some contribution from Fish and Wildlife Service, State agencies, and the private sector (table 81).

Table 77.--*Terrestrial* cells *in* the Basin *and* Range Province, eastern Oregon

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Ponderosa pine and western juniper communities:			
* 1. Ponderosa pine/bitterbrush/Idaho fescue savanna	237	None	176-180
* 2. Western juniper/big sagebrush/bluebunch wheatgrass comnunity	238	None	165-167
* 3. Western juniper/big sagebrush-bitterbrush community	238	None	165-167
* 4. Western juniper/bluebunch wheatgrass community	238	None	165-167
Sagebrush communities:			
* 5. *Artemisia tridentata/Agropyron spicatum* community		None	236-237
* 6. *Artemisia tridentata/Festuca idahoensis* community		None	238
* 7. *Artemisia arbuscula/Agropyron spicatum* community		None	239-241
* 8. *Artemisia arbuscula/Festuca idahoensis* community		None	239-241
* 9. *Artemisia cana* community		None	242
*10. *Artemisia arbuscula/Danthonia unispicata/ Koeleria cristata* communities in Silver Lake area		None	239-241
*11. Big sagebrush-bitterbrush/Idaho fescue community		None	238-239
Desert or salt desert shrub communities:			
*12. Salt desert shrub, desert shrub shadscale, salt sage, greasewood communities, with full range of shrub and shrub/grass communities on saline and alkali soils (dominants are *Atriplex confertifolia, A. nuttallii, Sarcobatus, Distichlis, Elymus,* and *Artemisia spinescens)*		None	245
*13. *Grayia spinosa* community		None	245
*14. *Eurotia lanata* community		None	245
Other shrub communities.:			
*15. *Cercocarpus* (mountain mahogany) community		None	243-244
*16. Bitterbrush/bunchgrass community		None	244
Special types:			
*17. Aspen type on Steens Mountain	217	None	245-246
*18. Alpine communities on Steens Mountain		None	
*19. Outlying stand of white fir, Steens Mountain		None	

*Cells presently lacking adequate representation.

Table 78.--*Aquatic cells in the Basin and Range Province, eastern Oregon*

Cell[1]	Present representation
* 1. Low-elevation saline lake in a desert setting	None
* 2. Low-elevation playa lake	None
* 3. Low-elevation freshwater lake	None
* 4. Subalpine lake in the Steens Mountain area	None
* 5. Low-elevation, permanent saline ponds	None
* 6. Low-elevation, permanent freshwater ponds	None
* 7. Subalpine permanent ponds in the Steens Mountain area	None
* 8. Typical vernal pond or marsh area adjacent to a playa lake	None
* 9. Typical subalpine vernal pond	None
*10. Subalpine stream drainage in the Steens Mountain area	None
*11. Tule marsh in the western portion of the province	None
*12. Typical low-elevation stream drainage	None
*13. Typical hot springs	None
*14. Typical cold springs	None

[1]Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the listed ecosystem.

*Cells presently lacking adequate representation.

Table 79.--*Rare and endangered vertebrate animal cells in the Basin and Range Prowince, eastern Oregon*

Cell	Verified representation	Reference
Fish:		
* 1. California roach	None	Bond 1966
* 2. Lahontan redside	None	Bond 1966
* 3. Tahoe sucker	None	Bond 1966
Birds:		
* 4. Western burrowing owl	None	Gabrielson and Jewett 1940
Mammals:		
* 5. Malheur or Preble shrew	None	Bailey 1936 Hansen 1956 Olterrnan and Verts 3972
* 6. Merriam shrew	None	Bailey 1936 Hansen 1956 Johnson and Clanton 1954 Olterrnan and Verts 1972
* 7. Pygmy rabbit	None	Bailey 1936 Hansen 1956 Olterrnan and Verts 1972
* 8. White-tailed jack rabbit	None	Bailey 1936 Hansen 1956 Olterrnan and Verts 1972
* 9. Northern grasshopper muse	None	Bailey 1936 Hansen 1956
*10. Sagebrush vole	None	Bailey 1936 Clanton et al. 1971 Hansen 1956 Johnson et al. 1948 Maser et al. 1974 Olterman and Verts 1972

*Cells presently lacking adequate representation.

Table 80.--*Vascular plants of special interest in the Basin and Range Province, eastern Oregon*

Species[1]	Distribution
Aqastache cusickii	Known only from Steens Mountain, Harney County
Allium 'punctum	Stony flats along Blitzen River, Harney County
Astraqalus alvordensis[2]	Sandy plains and hills, southern Harney and Malheur Counties (Alvord Valley)
Castilleja steensensis[2]	Steens Mountain, Harney County
Cirsium peckii	Streambanks, eastern slopes of Steens and Pueblo Mountains, Harney County
Claytonia nevadensis	Steens Mountain, Harney County
Claytonia umbellata	Steens Mountain, Harney County
Cymopterus bipinnatus	Dry slopes, Steens Mountain, Harney County
Draba sphaeroides var. *cusickii*[2]	Steens Mountain
Ephedra nevadensis	Open gravelly flats, Pueblo Mountains; near Oregon-Nevada border
Ephedra viridis	Dry ridges, southern Harney County near Nevada border
Erioqonum chrysops[2]	Alpine slopes, Steens Mountain, Harney County
Erioqonum cusickii[2]	Rocky sagebrush areas
Erioqonum umbellatum var. *hausknechtii*[2]	Steens Mountain
Lupinus biddlei[2]	Dry plains, southern Harney and Malheur Counties
Pleuropogon oreqanus	Swampy ground, Lake and Union Counties
Potamogeton diversifolius	Ponds, Steens Mountain, Harney County
Ranunculus andersonii	Sagebrush desert and ponderosa pine forest; southern Lake County and southern Malheur County
Rhysopterus plurijugus[2]	On diatomite, Malheur, Harney, and eastern Lake Counties
Salix drummondiana	Streambanks and most meadows in mountains; Steens Mountain, Harney County (and Wallowa Mountains)
Sedum debile	Rocky ledges to alpine talus slopes; Steens Mountain
Senecio werneriaefolius	Steens Mountain, Harney County at high elevation
Thelypodium brachycarpum[2]	Low, chiefly alkaline areas, southeast Oregon

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or identification nationally (in the Smithsonian Institution list) as threatened or endangered species.

[2]Species is on the national list of threatened and endangered plants (Smithsonian Institution 1974).

Table 81.--*Research Natural Areas* needed *in* the *Basin* and *Range* Province, eastern Oregon

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Combined terrestrial and aquatic natural areas:						
1. Large area on Steens Mountain. To include juniper/sage, juniper/bluebunch wheatgrass, aspen, alpine communities, a large stream drainage, and ponds (also lake, if available)	T-2,4,17, 18 A-7,9,10 4 R&E-1,2,3, 5	3-Mile Creek or Trout Creek drainages. Elevation range should be from 6,000 to 8,000 feet. May also include some plant species of special interest (table 80)	Medium	BLM State	165-167 246 249 271-272	1501 1505
2. A variety of big sagebrush and low sagebrush communities plus a small freshwater lake	T-5,6,7, 8,9 A-3 R&E-1,2,3	Warner Valley area	Medium	BLM FWS	234-242	1506 1507
3. Playa lake, vernal pond, or marsh, with *Artemisia cana* community	T-9,12,13 14 A-2,8		Medium	BLM State FWS	234 242	1502
4. Saline lake and ponds; salt desert shrub, desert shrub, shadscale, salt sage, and greasewood communities; Grayia *spinosa* community; and *Eurotia lanata* community	T-12,13,14 A-1,5 R&E-6	Borax Lake in the Alvord Desert and surrounding area	Medium	BLM Private	245	1502 1506
Predominantly terrestrial natural areas:						
5. Big sagebrush/bitterbrush/ Idaho fescue community interspersed with areas of ponderosa pine/bitterbrush/ Idaho fescue savanna. Also should include at least small areas of mountain mahogany, low sagebrush, and juniper communities	T-1,3,10 11,15,16 7,8 R&E-6,7,8 9,10	Located from Silver Lake area southward	High	BLM FS Private	176-179 238-244	1507 1508

See footnotes at end of table.

Table 81.--*Research* **Natural** Areas needed *in* the *Basin and* Range *Province*, eastern Oregon (Continued)

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
6. Outlying stand of white fir	T-19	Steens Mountain	Medium	Private BLM		1501
Predominantly aquatic natural areas:						
7. Tule marsh area	A-11	Klamath Marsh or Sycan Marsh are possible locations	High	Private FWS State		1405
8. Low-elevation stream drainage	A-12	Silver Creek (may be difficult to find suitable area)	High	Private FWS		1507 1508
9. Hot springs	A-13	Alvord Desert	High	BLM Private		1502
10. Cold springs	A-14	Fosket Spring	High	BLM Private		1502 1506

[1]For a description of these cells see table 77 for terrestrial (T) ecosystems, table 78 for aquatic (A) ecosystems, and table 79 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate those cells which are considered essential components of the proposed Research Natural Area. Those not underlined represent cells which would be desirable but not essential components.

[2]Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is, i.e., the danger that all examples of the type will be lost to other uses. Acquisition urgency.

[3]Agency or institution most likely to have or to be able to acquire a tract of the desired type based on land ownership. BLM = Bureau of Land Management, FS = Forest Service, FWS = Fish and Wildlife Service.

[4]See appendix V.

HIGH **LAVA PLAINS AND COLUMBIA BASIN PROVINCE, EASTERN OREGON**

This province is made up of two distinct areas — that portion of the Columbia Basin which is located in Oregon and the High Lava Plains which occupy much of central Oregon (fig. 1). The High Lava Plains are characterized by young lava flows of moderate relief interrupted by scattered cinder cones and basaltic buttes. **As** a result of porous bedrock and scanty rainfall, many streams are seasonal. Undrained basins containing playa lakes, some dry and others with fluctuating levels, are common. Most of the area has a base elevation of about 1200 m above sea level.

Geologic formations in the High Lava Plains consist largely of Pliocene and Pleistocene lavas, tuffs, and alluvium. In many areas, Quarternary valley fill deposits overlie the older volcanic flows. These are comprised of alluvium, lake deposits, and eolian sediments, all derived from volcanic rocks of the uplands. The most common soil types are derived from basalt or tuff and commonly have very stony loam textures. In some locations these soils have a silica-cemented hardpan at a depth of approximately one-half m. In the eastern section, Solonetz soils have formed in lacustrine deposits in old lakebeds. These are deep, silty soils with a subsurface horizon of clay and sodium accumulation.

The major portion of the Columbia Basin section in Oregon is underlain by Columbia River basalt of Miocene age. Loess deposits cover the basalt near Moro and in Grass Valley. In addition, a large area near Boardman is mantled by unconsolidated sand of apparently Pleistocene age. For the most part, slopes are moderate with the exception of isolated basaltic buttes or canyons cut by major rivers (e.g., the Deschutes River canyon). Elevations range from about 150 m , adjacent to the Columbia River, to 600 m. Lithosols (shallow, stony, and very poorly developed) and Brown soils are probably the most common soil types in the Oregon Columbia Basin. The Brown soils tend to be minimally developed and are characteristically loam textured.

Steppe and shrub-steppe ecosystems of bunchgrasses and sagebrush cover most of the area (Franklin and Dyrness 1973). In many areas western juniper is present, forming a savanna. Variability in ecosystems is associated mainly with shifts in the composition and structure of the savanna, steppe, and shrub-steppe communities; these shifts are, in large measure, responses to variations in soil characteristics. Some diversity in terrestrial ecosystems is provided by playa and sand dune habitats. Aquatic ecosystems are not abundant and consist mainly of springs, ponds, and marshes; as mentioned earlier many streams are intermittent.

Of the 19 terrestrial cells identified in this province (table 82), 6 provide for representation of western juniper savanna, each representing a distinctive ecosystem, and 5 are for sagebrush-dominated ecosystems ranging from rigid sagebrush on scablands to big sagebrush/bunchgrass types. Grassland ecosystems are identified by four cells, and dune-based ecosystems complete the list.

Springs and a tule marsh make up four of the six aquatic cells identified (table 83). A pond and small stream drainage are also identified as essential cells.

It is assumed that natural areas selected to represent the aquatic and terrestrial cells will include the complement of plant and animal species typical of those ecosystems. Eight vertebrate animal species have been specifically identified as cells because of their rare or endangered status (table 84). Vascular plants of special interest include 12 from the Smithsonian list of endangered or threatened plants (table 85). Over two-thirds of these plants are in the Columbia Basin section of this province.

Two Federal Research Natural Areas and a Nature Conservancy reserve have been established (table 86). Lost Forest, the largest of these, takes in a large dune area and an isolated ponderosa pine forest associated with it. The existing natural areas fill 8 of the 33 cells identified for this province; all of the filled cells are terrestrial.

Nine additional Research Natural Areas should provide minimal coverage of the 25 unfilled cells (table 87). There is considerable question as to whether a single area can be found which includes adequate coverage of three different western juniper types (see need No. 2 in table 87), so two areas may be necessary. No large combined terrestrial and aquatic areas are proposed.

Several State and Federal agencies and private organizations have lead responsibilities (table 87). Oregon State and the Bureau of Land Management are most likely to have suitable lands for most of the terrestrial natural areas, and Fish and Wildlife Service (Malheur National Wildlife Refuge) should have several of the aquatic ecosystems. Priorities are highest for aquatic areas and terrestrial ecosystems subject to heavy grazing or suitable for agricultural use.

Table 82.--*Terrestrial cells in the High Lava Plains and Columbia Basin Province, eastern Oregon*

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Ponderosa pine and western juniper communities:			
1. Ponderosa pine/big sagebrush community (isolated stand within steppe)	237	Lost Forest RNA	171-180
2. Ponderosa pine/bitterbrush community (isolated stand within steppe)	237	Lost Forest RNA	171-180
3. Western juniper-ponderosa pine/sagebrush	237 238	Lost Forest RNA	165-167 171-180
4. Western juniper/big sagebrush/threadleaf sedge community	238	Horse Ridge RNA	165-167
* 5. Western juniper/big sagebrush/bluebunch wheatgrass community	238	Horse Ridge and Lost Forest RNA's, but need additional area (may be filled by proposed The Island RNA)	165-167
* 6. Western juniper/Idaho fescue community	238	Token in Lost Forest RNA, additional area is needed	165-167
* 7. Western juniper/bluebunch wheatgrass	238	None	165-167
* 8. Western juniper/big sagebrush-bitterbrush	238	None	165-167
Sagebrush communities:			
* 9. *Artemisia tridentata/Agropyron spicatum* community		None	234-237
*10. *Artemisia tridentata/Festuca idahoensis* community		None	235, 238
*11. *Artemisia arbuscula/Agropyron spicatum* community		None	235, 239-241
*12. *Artemisia arbuscula/Festuca idahoensis* community		None	235, 239-241
*13. *Artemisia rigida/Poa sandbergii* community		None	235, 242
Grassland communities:			
14. *Agropyron spicatum-Poa sandbergii* community		Lawrence Grasslands Memorial Preserve	223
*15. *Eriogonum-Poa sandbergii* scabland		Token in Lawrence Grasslands Memorial Preserve, need additional area	225-227
*16. *Poa sandbergii-Danthonia unispicata* community		None	244-245
17. *Festuca idahensis-Agropyron spicatum* and associated communities in Columbia Basin		None	244
Special types:			
18. Dunes and shifting sand		Lost Forest RNA	
19. Playas		Lost Forest RNA	

*Cells presently lacking adequate representation.

Table 83.--*Aquatic cells in the High Lava Plains and Columbia Basin Province, eastern Oregon*

Cell[1]	Present representation
*1. Permanent freshwater pond	None
*2. Typical stream drainage at lower elevations	None
*3. Large, upwelling cold spring	None
*4. Cave with cold spring	None
*5. Tule marsh area in the eastern portion of the province	None
*6. Typical hot spring area	None

[1]Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the listed ecosystem.

"Cells presently lacking adequate representation,

Table 84.--*Rare and endangered vertebrate animal cells in the High Lava Plains and Columbia Basin Province, eastern Oregon*

Cell	Verified representation	Reference
Fish:		
*1. Malheur sculpin	None	Bond 1966
Birds:		
*2. Western burrowing owl	None	Gabrielson and Jewett 1940
Mammals:		
*3. Malheur or Preble shrew	None	Bailey 1936 Olterman and Verts 1972
*4. Merriam shrew	None	Bailey 1936 Johnson and Clanton 1954 Olterman and Verts 1972
*5. Pygmy rabbit	None	Bailey 1936 Olterman and Verts 1972
*6. Pinon mouse (subspecies *preblei*)	None	Bailey 1936
*7. Northern grasshopper mouse	None	Bailey 1936
*8. Sagebrush vole	None	Bailey 1936 Clanton et al. 1971 Johnson et al. 1948 Maser et al. 1974 Maser and Storm 1970 Olterrnan and Verts 1972

*Cells presently lacking adequate representation.

Table 85.--*Vascular plants of special interest in the High Lava Plains and Columbia Basin Province, eastern Oregon*

Species[1]	Distribution
Allium pleianthum[2]	John Day Valley, Wheeler County
Allium robinsonii	Lower benches of Columbia River
Arenaria franklinii var. *thompsonii*[2]	Sagebrush plains along the Columbia River; Wasco, Gilliam, and Morrow Counties
Artemisia lindleyana	Along Columbia River and tributaries
Astragalus collinus var. *laurentii*	Sandy slopes near Heppner, Morrow County
Astragalus diaphanus	Sandy ground, lower John Day River valley
Astragalus howellii	Sagebrush plains along Columbia River; Wasco, Sherman, Morrow, and Umatilla Counties
Astragalus misellus	Upper forks of Deschutes and John Day Rivers, Wheeler and Grant Counties
Astragalus peckii	Dry sandy ground, west of Tumalo, Deschutes County
Astragalus succumbens	Sagebrush desert, Umatilla and Gilliam Counties
Astragalus tegetarioides	Pine forest, Silvies River, Harney County
Astragalus tyghensis	Tygh Valley, Wasco County
Castilleja xanthotricha[2]	Sagebrush flats, John Day Valley near Clarno
Chaenactis nevii[2]	Dry slopes, John Day Valley
Claytonia umbellata	Rocky ground, Wasco County; also in Steens Mountains
Collomia macrocalyx[2]	Dry open ground near Lone Rock, Gilliam County
Cryptantha leucophaea	Sandy soil along the Columbia River east of The Dalles
Eriogonum cusickii[2]	Rocky, sagebrush area
Lomatium frenchii	Sagebrush, Wasco County near Madras
Lomatium hambleniae	Scablands, Wasco County
Lomatium hendersonii[2]	Dry hills, John Day Valley, Jefferson and Wheeler Counties
Lomatium minus[2]	Scablands, Wasco, Wheeler, and Grant Counties
Lomatium watsonii	Dry hillsides, Wasco and Jefferson Counties
Luina serpentina[2]	Steep serpentine slopes near Dayville, Grant County
Myosurus clavicaulis	Dry watercourses, Silver Creek valley, Harney County
Penstemon eriantherus var. *argillosus*	Dry slopes, Deschutes and John Day River valleys
Penstemon seorsus	Dry stony ridges; Jefferson, Crook, Harney, and Malheur Counties
Pilularia americana	In mud of vernal pools, Crook County to California
Potentilla glandulosa var. *campanulata*	John Day River valley near Dayville
Ranunculus reconditus[2]	Sagebrush slopes, Wasco County
Silene scaposa var. *scaposa*[2]	Gilliam and Wheeler Counties to Blue Mountains
Sisyrinchium douglasii	White color form found near Maupin, Wasco County
Stephanomeria malheurensis[2]	Sagebrush, Narrows, Harney County
Talinum spinescens	Scablands, Wasco County

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or identification nationally (in the Smithsonian Institution list) as threatened or endangered species.

[2]Species is on the national list of threatened and endangered plants (Smithsonian Institution 1974).

Table 86.--*Established Research Natura2 Areas in the High Lava Plains and Columbia Basin Province, eastern Oregon*

Name	Principal features	Agency[1]	Area	
			Ha	Acres
Horse Ridge RNA	Western juniper savanna	BLM	243	600
Lawrence Grasslands Memorial Preserve	Bluegrass-bunchgrass Community on biscuit scabland near Shaniko, Oregon	TNC	153	378
Lost Forest RNA	Isolated ponderosa pine stands and sand dunes within a low rainfall, shrub-steppe region in central Oregon	BLM	3 628	8,960

[1]BLM = Bureau of Land Management, TNC = The Nature Conservancy.

Table 87.--*Additional* Research Natural Areas needed *in* the High Lava Plains *and* Columbia Basin Province, eastern Oregon

Ecosystem or community	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Predominantly terrestrial natural areas:						
1. A variety of big sagebrush and low sagebrush communities	T-9,10,11, 12,5,6,7 R&E-2,4,5, 6,7	Squaw Butte Experimental Range is a possible candidate	High	State FWS BLM	234-242	1300
2. Western juniper/big sagebrush/ bluebunch wheatgrass, western juniper/ bluebunch wheatgrass, and western juniper/big sagebrush-bitterbrush communities	T-2,5,7,8, 6,15	Pine Ridge, Gray Buttes, Juniper Butte. (The Island RNA(proposed) will also partially fill this need.)	Low	BLM State FS	165-167	1303
3. Scabland with stiff sagebrush-*Poa* and *Eriogonum-Poa* communities	T-13,15,16		Medium	BLM Private	225-227 242, 245	1109
4. Idaho fescue-bluebunch wheatgrass associated communities in Columbia Basin area	T-17		High	State Private	244	
Predominantly aquatic natural areas:						
5. Typical stream drainage at low elevations	A-2	May not be available	Medium	BLM Private		
6. Large, upwelling cold spring	A-3 R&E-3	Stinking Lake, Malheur National Wildlife Refuge	High	FWS		
7. Cave with cold spring	A-4	Malheur Cave	High	Private		300
8. Hot spring	A-6	00 Ranch (Malheur National Wildlife Refuge)	High	FWS		300
9. Tule marsh with permanent ponds	A-1,5 R&E-3	Malheur National Wildlife Refuge	High	FWS		300

[1] For a description of these cells see table 82 for terrestrial (T) ecosystems, table 83 for aquatic (A) ecosystems, and table 84 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate cells considered essential components of the proposed Research Natural Area. Those not underlined represent cells which would be desirable but not essential.

[2] Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is, i.e., the danger that all examples of that type will be lost to other uses. Acquisition urgency.

[3] Agency or institution most likely to have or to be able to acquire a tract of the desired type based on land ownership. BLM = Bureau of Land Management, FWS = Fish and Wildlife Service.

[4] See appendix V.

OWYHEE UPLAND PROVINCE, SOUTHEASTERN OREGON

The Owyhee Upland Province is, for the most part, a gently sloping north-facing basin which is drained by the Owyhee River (fig. 1). Steep slopes are largely restricted to areas adjacent to the river, especially as it approaches its confluence with the Snake River. Much of the area is a high, gently rolling plateau with a base elevation of approximately 1200 m.

The most common geologic formations are Miocene and Pliocene beds of tuffaceous sedimentary rocks capped by flows of rhyolite and basalt. In addition, thick beds of quartzose sandstone, siltstone, and conglomerate outcrop near the mouth of the Owyhee River. The most recent volcanic activity in the area occurred during the Pleistocene and resulted in basalt flows of limited extent at Diamond and Cow Lake Craters.

Soils in the Owyhee Upland Province fall largely into the Sierozem and Brown great soil groups and reflect the effects of **low** amounts of precipitation. On basaltic parent materials, these soils have a very stony loam surface horizon underlain by either a clay or stony loam subsoil which may include a silica-cemented hardpan.

Sagebrush/bunchgrass communities dominate the Owyhee Uplands (Franklin and Dyrness 1973). In some upland areas, western juniper or mountain mahogany join with shrub and grass species in savanna ecosystems. In low-lying areas, often associated with vernal pools or playas, are communities with *Artemisia cana*, *Elymus cinereus*, or *Atriplex*. Areas of recent vulcanism and the Owyhee River canyon and associated tributaries are sites providing additional ecosystem and species diversity. Small permanent and vernal ponds of varying chemistry are the most common aquatic communities.

Research Natural Areas established to fill terrestrial (table 88) and aquatic (table 89) cells should include the typical array of plant and animal species. Six vertebrate animals are identified as species which should receive specific attention because of their rare or endangered status (table 90). Seventeen vascular plant species are known to be of special interest, and 10 of these are on the Smithsonian list of endangered or threatened plants (table 91). The majority of the latter plants are located in or near the Owyhee River canyon.

A minimum of eight Research Natural Areas should provide for representation of identified terrestrial, aquatic, and animal cells (table 92). None exist at present, although Jordan Craters is an area under consideration for Research Natural Area establishment. Lead responsibility in this province appears to lie almost entirely with the Bureau of Land Management.

Table 88.--*Terrestrial cells for the Owyhee Upland Province, southeastern Oregon*

Cell	SAF timber type No.	Present representation	Page reference (Franklin and Dyrness 1973)
Western juniper communities:			
* 1. Western juniper/big sagebrush/bluebunch wheatgrass community	238	None	165-167
* 2. Western juniper/Idaho fescue community	238	None	165-167
* 3. Western juniper/bluebunch wheatgrass community	238	None	165-167
Sagebrush communities:			
* 4. *Artemisia tridentata/Agropyron spicatum* community		None	235-237
* 5. *Artemisia tridentata/Festuca idahoensis* community		None	235, 238
* 6. *Artemisia arbuscula/Agropyron spicatum* community		None	235 239-241
* 7. *Artemisia arbuscula/Festuca idahoensis* community		None	235 239-241
* 8. *Artemisia arbuscula/Danthonia unispicata/ Koeleria cristata* communities		None	239-241
* 9. *Artemisia tridentata/Elymus cinereus* community		None	235, 239
"10. *Artemisia rigida/Poa sandbergii* community		None	237
*11. *Artemisia cana* community		None	242-243
Other ecosystems:			
*12. Mountain mahogany savanna		None	243-244
*13. *Elymus cinereus* community		None	246
*14. *Atriplex confertifolia-Grayia spinosa* community		None	245
*15. Lava flow area		None	34-35

"Cells presently lacking adequate representation.

Table 89.--*Aquatic cells for the Owyhee Upland Province, southeastern Oregon*

Cell[1]	Present representation	Remarks
*1. Lowland lake	None	Proposed Jordan Craters RNA would fill need
*2. Permanent pond	None	Proposed Jordan Craters RNA would fill need
*3. Vernal ponds	None	Proposed Jordan Craters RNA would fill need
*4. Swamp	None	Proposed Jordan Craters RNA would fill need
*5. Marsh	None	Proposed Jordan. Craters RNA would fill need
*6. Stream	None	
*7. Springs	None	
*8. Alkali vernal ponds	None	Coyote Lake (playa)

[1]Each aquatic cell identified is assumed to include the functional groups of organisms and dominant species which typify the listed ecosystem.

*Cells presently lacking adequate representation.

Table 90.--*Rare and endangered vertebrate animal cells in the Owyhee Upland Province, southeastern Oregon*

Cell	Verified representation	Reference
Mammals:		
*1. Merriam shrew	None	Bailey 1936 Johnson and Clanton 1954 Olterman and Verts 1972
*2. White-tailed jack rabbit	None	Bailey 1936 Olterman and Verts 1972
*3. Richardson. ground squirrel	None	Bailey 1936 Olterman and Verts 1972
*4. Little pocket mouse	None	Bailey 1936 Olterman and Verts 1972
* 5. Northern grasshopper muse	None	Bailey 1936
*6. Sagebrush vole	None	Bailey 1936 Clanton et al. 1971 Johnson et al. 1948 Maser et al. 1974 Maser and Storm 1970 Olterman and Verts 1972

*Cells presently lacking adequate representation.

Table 91.--*Vascular plants of special interest in the Owyhee Upland Province, southeastern Oregon*

Species[1]	Distribution
Astragalus iodanthus var. *vipereus*	Bluffs, eastern Malheur County
Astragalus mulfordae[2]	Dry sandy ground, lower Owyhee River, eastern Malheur County
Astragalus nudisiliquus	Gravelly bluffs, northeastern Malheur County
Astragalus purshii var. *ophiogenes*[2]	Sagebrush desert, Owyhee River, Malheur County
Astragalus solitarius[2]	Usually in sagebrush, Owyhee River, Malheur County
Astragalus sterilis[2]	Clay hills, Sucker Creek, Malheur County
Cryptantha propria	Dry hillsides, northern Malheur County
Cymopterus corrugatus[2]	Dry hills, southern Malheur County
Eriogonum novonudum[2]	Stony clay hills, eastern Malheur County
Eriogonum ochrocephalum ssp. *calcareum*	In loose, white volcanic ash, Malheur County
Hackelia cronquistii[2]	
Hackelia ophiobia[2]	Cliffs, 3 forks of Owhyee River, Malheur County
Hackelia patens	Between Vale and Harper, Malheur County
Mentzelia mollis[2]	Clay slopes, eastern Malheur County
Mirabilis bigelovii	Canyon of Owyhee River, Malheur County
Silene scaposa var. *lobata*[2]	
Trifolium owyheense	Dry slopes, Sucker Creek, Malheur County

[1]These plants are tentatively identified as deserving special consideration in land management activities, including selection of Research Natural Areas. Reasons for listing include known or probable rare or endemic status, disjunct populations, or identification nationally (in the Smithsonian Institution list) as threatened or endangered species.

[2]Species is on the national list of threatened and endangered plants (Smithsonian Institution 1974).

Table 92.--*Research Natural Areas needed in the Owyhee Upland Province, southeastern Oregon*

Ecosystem or comnunity	Cells represented[1]	Remarks and possible locations	Priority[2]	Lead agency[3]	Page reference (Franklin and Dyrness 1973)	Sub-province[4]
Combined terrestrial and aquatic areas:						
1. Area with lake, ponds, and marshes, recent lava flows, and some surrounding upland	T-9,13,15 A-1,2,3, 4,5	Proposed Jordan Craters RNA will fill this need	High	BLM	34-35	1507
2. Alkali vernal ponds and *Artemisia cana* comnunities	T-11 A-8	Coyote Lake	High	BLM	242-243	1502
Predominantly terrestrial areas:						
3. Area with variety of big and low sagebrush communities	T-4,5,6,7 R&E-1,2,3, 4,5,6	Sucker Creek area; consider plants of special interest	Low	BLM State	234-242	1507
4. Juniper and sagebrush communities	T-1,2,3, 8,10 R&E-1,2,3, 4,5,6		High	BLM State	165-167	1504 1507
5. Mountainmahogany savanna	T-12		Medium	BLM	243-244	1505
6. Shadscale and winterfat communities	T-14		High	BLM	245	1507
Predominantly aquatic areas:						
7. Springs and stream	A-6,7		High	BLM		1504 1507
Areas for plants of special interest:						
8. Concentration of rare and endangered plants along Owyhee River		See table 91	Medium	BLM		1504

[1]For a description of these cells see table 88 for terrestrial (T) ecosystems, table 89 for aquatic (A) ecosystems, and table 90 for rare and endangered (R&E) vertebrate animals. Underlined cell numbers indicate cells considered essential components of the proposed Research Natural Area. Those not underlined represent cells which would be desirable but not essential.

[2]Based mainly upon how endangered areas of that type are believed to be, not how extensive the type is, i.e., the danger that all examples of that type will be lost to other uses. Acquisition urgency.

[3]Agency or institution most likely to have or to be able to acquire a tract of the desired type based on land ownership. BLM = Bureau of Land Management.

[4]See appendix V.

Part III.
Marine and Estuarine Research Natural Area Needs

Developing an approach to selection of a series of marine and estuarine Research Natural Areas turned out to be difficult in this biologically and legally complex coastal region.

The objective was to outline the type and number of natural areas needed to preserve examples of the varied types of coastal and near-shore ecosystems found along the Oregon and Washington coasts. The initial approach was to break down the coastline into districts or provinces (open coasts of the two States and northern and southern segments of Puget Sound) and subdivide each district into major habitats — estuaries and related types, exposed intertidal and subtidal strand on open coast, cliffs and rocks, and subtidal communities as well as unique ecosystems or organisms. This was an obvious attempt to develop a cellular matrix as was followed in developing natural area needs for inland waters.

In fact, developing a cellular matrix proved very difficult. The working group was small and did not have sufficient knowledge of all areas. Many marine and estuarine ecosystems are unique. Furthermore, any plan must recognize the limitations imposed by present human developments, i.e., relatively few potential sites are suitable as sites for Research Natural Areas. Nevertheless, a list of natural area needs was developed in the framework of the provinces and habitat subdivisions outlined above. Many of the listed needs identified specific areas for exemplary purposes rather than cells in the sense of the other working groups.

The initial list was subjected to an extensive review process and received considerable, constructive criticism from experts in the area of coastal and estuarine ecosystems. As a consequence, an additional meeting of the working group was held in November 1974 to develop a revised listing of Research Natural Area needs.[3]

The objective in the listings which follow is to identify a series of areas which in their totality encompass the important variations in habitats, communities, and organisms. The areas listed include some which are essential because they are the last remaining example, are unique biologically, or have an established history of research. Some of the other areas are listed as examples of particular kinds of habitats, and better sites as Research Natural Areas might exist.

The geographic subdivisions used in the listings are:

a. Open coast of Oregon,
b. Open coast of Washington,
c. Puget Sound,
d. Straits of Georgia and Rosario Straits,
e. Waters of San Juan archipelago.

The Puget Sound subdivision includes those water bodies entered by way of Admiralty Inlet and Deception Pass, including the Hood Canal. The waters to the north and west of these inlets to the Canadian border constitute the region known as the Straits of Georgia and Rosario Straits. The waters around the San Juan archipelago and Cypress Island are recognized as a special unit because of their distinctive biology and the long history of research by the Friday Harbor Laboratories of the University of Washington; they also have unique legal status as a marine biological preserve under a Washington State law.

The habitat subdivisions, under which specific sites are generally categorized, are divided in two ways—estuarine and open coast areas. Natural areas in *estuaries* should be chosen to represent the range in estuary size from small to large, and range in salinity characteristics from low to high. By this crude two-dimensional initial breakdown, the possibility of including the full spectrum of estuary conditions within a system of Research Natural Areas will be greatly enhanced. Tidal flushing, sediment flow, dissolved minerals, and seasonal and lunar cycles of salinity will vary with the size of the estuary and the volume of fresh water pouring into it. Smaller estuaries are much more likely to be in a nearly undisturbed state; most are not influenced by urban wastes; and they generally have not been dredged. Smaller estuaries would be expected to have still waters, and larger ones generally have considerably more wave action.

We do not envision setting aside entire large estuaries as Research Natural Areas; natural areas in this situation should consist of relatively undisturbed arms or portions of the entire embayment or slough. However, it is our expectation that areas designated within large sloughs will, in some cases, extend from high marsh and swamp (for example, *Picea* forest) through the intertidal to the subtidal, and that in the subtidal different bottom sediments will be represented.

In the case of small estuaries, it may be possible to find examples with unmanaged, natural mouths where hydrologic processes are naturally played out. In these instances, the entire estuary and its margin should be placed in natural area status. A significant factor in selection may be the presence of sometimes submerged sandbars that drastically alter community structure.

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[3]Many people have contributed to this effort besides the original working group. Special gratitude is due Robert L. Fernald (University of Washington): Austin Pritchard, Vicki Osis, and Chris Bayne (Oregon State University): Laimons Osis (Oregon Fish Commission): and R. L. Bacon (University of Oregon). These individuals attended the meeting in November 1974 at which the revised lists were developed. Robert Fernald and Austin Pritchard made outstanding contributions in the revision of the lists for Washington and Oregon, respectively. Other valuable suggestions were offered by Jefferson J. Gonor, Robert Waaland, Richard Norris, Thomas Mumford, Peter B. Taylor, Peter W. Frank, Paul P. Rudy, and Robert T. Paine.

Along ***exposed shorelines,*** variables of temperature, salinity, wave action, depth, slope gradient, and substrate present a variety of habitats with associated communities. In these situations we envision linear natural areas which extend perpendicularly to the shore from above the splash zone out into the subtidal. Each area should include approximately one-fourth to 1 mile of shoreline. The series **of** Research Natural Areas should include intertidal habitats on a wide variety of substrate types — ranging from sandstone to serpentine in mineralogy and from coherent rock to sands and gravels. Selection of rocky sites should include consideration of a variety of tidal pools, surge channels, and rock configurations, as well **as** the chemical makeup of the rock.

Ocean-front cliffs and ***offshore*** islands often comprise important rookeries for both birds and mammals. For this reason, many of these areas are already protected from disturbance by such agencies as the U.S. Department of Interior, Fish and Wildlife Service. However, we feel that at least a small number of the most typical of these areas should also be designated as Research Natural Areas: In most cases areas so designated should also include the adjacent intertidal zone which, for example, may be influenced by excrement. We would also recommend the inclusion of bluffs present on some of the larger islands in Puget Sound and the outer coast as well. The distinctive nesting sites of burrowing and cliff- and slope-nesting birds should be taken into account. In addition, several rookeries and hauling-out areas of seals and sea lions should be given natural area status.

Finally, there is a need for at least two extensive areas that include not only a fringe of shore but also a generous portion of a coastal terrestrial ecosystem. These will provide areas for the study of interconnections between marine and terrestrial systems, especially **of** mammals and birds which utilize both types of environments. Mink, otters, raccoons, and bald eagles are examples of such animals. Possibly these large combined natural areas could be established in conjunction with estuarine or exposed coast ecosystems.

Research Natural Area needs are identified in tables **93-98.** These total 68. We again caution the reader that this is a first approximation. We have tried to include examples of the major coastal and estuarine habitats, ecosystems, and organisms, as well as to identify unique sites which must be preserved. Future revision will be essential, but it is hoped that this list will assist land planners in coastal areas in identifying areas critical for research and preservation of exemplary organisms and ecosystems.

Table 93.--*Areas suggested for Research Natural Areas representative of estuarine ecosystems on the coast of Oregon*

Estuary	Comments and priority
Sand Island and Baker Bay near the mouth of Columbia River estuary	A large, high-salinity area of high to intermediate priority.
Nehalem River estuary, specifically Lazarus Island, Dean Point, and adjoining tidelands	A low-salinity area in a small, low-salinity estuary. Intermediate priority.
Tillamook Bay	A large estuary with variable salinity. An undisturbed arm of the bay required, assuming one exists. Low priority.
Netarts Bay and sand spit	A small, high-salinity estuary that is relatively undisturbed. Portion of the estuary and salt marsh required. High priority. Cape Lookout State Park adjoins salt marsh and controls sand spit.
Nestucca River estuary and sand spit, including confluence with Little Nestucca River	A small, low-salinity estuary that is relatively Undisturbed. High priority.
Salmon River estuary	A small, high-salinity area at the mouth. Some distinctive animal communities. Adjoins Nature Conservancy land and is in newly designated "Scenic Research Area." High priority.
Siletz estuary, specifically the rocky intertidal area where Schooner Creek enters	Very limited area which is habitat for the only stable population of *Littorina sitkana* in Oregon. Low priority.
Yaquina Bay, specifically:	
a. Idaho Flat tideflat	A high-salinity area in a large estuary of varied salinity. High priority. Area deeded to Oregon State University by Georgia-Pacific Corporation.
b. McCaffery and Poole Sloughs	A relatively undisturbed, low-salinity area of high priority.
c. Boone and Nute Sloughs	A low-salinity area that is an old river oxbow. This area has been blocked off from tidal action by road fill and tide gates but proposed road alinement presents an opportunity to install adequate culverts to restore marsh areas. Low to intermediate priority.

Table 93.--*Areas suggested for Research Natural Areas representative of estuarine ecosystems at the coast of Oregon* (Continued)

Estuary	Comments and priority
Alsea Bay, specifically:	
a. Barview mudflat area	A large, relatively undisturbed mudflat in a large, low-salinity estuary. High priority.
b. Area where Drift Creek enters Alsea River estuary	Area about 5 miles from mouth of estuary, low salinity, high priority. Relatively undisturbed. Extensively studied in upper reaches of Drift Creek by Oregon Wildlife Commission and Oregon State University.
Siuslaw River estuary, specifically Cox island and surrounding areas	Relatively undisturbed island and tide-flats in a small, low-salinity estuary. High to intermediate priority.
Umpqua River estuary	Large, low-salinity estuary. Low priority.
Coos Bay, specifically:	
a. South Slough	High-salinity slough in a large estuary with varied salinities. High priority. The area is being processed as an estuarine sanctuary.
b. Additional areas in main estuary and North Slough	Variable salinity. High priority. May be difficult to find areas not encroached by road fills and urbanization pressures.
Coquille River estuary, specifically tidelands and marshes between Bullards Beach State Park and Bandon	Low-salinity, relatively undisturbed area in a small, low-salinity estuary. Intermediate priority.

Table 94.--*Areas suggested* for *Research Natural Areas representative* of *intertidal ecosystems on the open coast* of *Oregon*

Area	Comments and priority
Ecola Point and adjacent sandy beaches	Part of Ecola State Park; high priority. Headland and beach communities typical of the northern Oregon coast.
Sandy beach between Seal Rock and Beaver Creek (Lincoln County)	Area typical of the central coast. Intermediate prior ty.
Neptune State Park including Strawberry Hi11 area	High priority. A mixture of basaltic bedrock shelves, tide channels and pools, and gravel and sandy beaches on central Oregon coast. Strawberry Hill area contains relatively large numbers of certain invertebrates (nudibranchs, large tube worms) not common in other Oregon outer coast intertidal areas.
North Cove of Cape Arago including Shell Island and adjacent reefs	A varied invertebrate community and diverse habitat. Several species reach their northern limits here. High priority.
Cape Blanco	A, relatively isolated headland on southern Oregon coast. Adjoins a recently developed State Park. High priority.
Brookings area-Harris Beach State Park	Between 42° 1' and 40° 2' Is an excellent area for marine algae of a great variety. Extensively studied by Doty and Norris. High priority.
Section of sand beach between Florence and Coos Bay	Representative sand beach area along the dune sheet. High priority.
Sandy beach of Clatsop Plains of northern Oregon	Good sand beach area representative of the northern Oregon coast region. High priorlty.
Rocky shores in Port Orford area, posslbly around closed U.S. Coast Guard Station	Rocky shore habitats representative of the southern Oregon open coast, Area near Port Orford is used by Oregon State University biologists. High priority.
Boiler Bay	Field of boulders that is exposed to the northwest and protected from the southwest by high reefs. Good for both marine plants and animals. Unusually rich in biota and habitat diversity. High priority.
Yaquina Head near Newport Marine Laboratory	For fauna and flora one of the most important headlands in Oregon. Tip is already Federal property and a sea bird and mammal sanctuary. High priority.
"Marine gardens" area at Otter Rock	Excellent area where collecting has been proh bited for at least a decade. Access is limited. Intert dal bench of sandstone and basalt dikes with northern exposure. High priority.
Whale Cove	Undisturbed pocket cove which has been protected from collecting; diverse fauna and flora. Intermedlate priority.

Table 95.--*Areas suggested for Research Natural Areas representative of exposed intertidal ecosystems on the open coast of Washington including Straits of Juan de Fuca*[1]

Area	Comments and priority
Copalis Beach	Open sandy beach and razor clam populations. Area has received considerable attention in diatom productivity studies dating from 1930. High priority.
Destruction Island off the coast of Washington near Ruby Beach	Isolated, highly exposed small island. Wildlife sanctuary and site of marine bird population studies.
Cape Alava and Flattery Rocks	Exposed rocky shoreline associated with extensive sandy beaches. Natural protection by removal from roads and easy access. Diverse fauna and flora. Part of Olympic National Park shores. High priority.
Point of the Arches and offshore islets	Exposed rocky shores and sandy beaches. Diversity of habitats accessible by trail.
Shi Shi Reef and beach area with Portage Head	Complex of exposed rocky intertidal region with sandy and gravelly beaches. Base for studies in marine ecology and population biology. Protected by limited accessibility. High priority.
Tatoosh Island	Offshore island near, Cape Flattery with diverse habitats having varying exposure to tidal influences. Excellent for faunistic and floristic studies requiring high degree of protection from human intrusion. High priority.
Waada Island	Offers areas with high degree of exposure and protection. Diversity of flora and fauna. High priority.
Slip Point on Clallam Bay	Excellent populations of *Strongylocentrotus purpuratus* and associated exposed intertidal fauna and flora. On property controlled by the U.S. Coast Guard. High priority.
Pillar Point	Predominantly rocky intertidal region of moderate exposure.
Tongue Point and Crescent Beach, Clallam County Park	Rocky intertidal region of moderate exposure and associated mud-sand beach. Good populations of three species of sea urchins and associated flora and fauna. Good semi-protected beach habitat. High priority.
Dungeness Spit	Exposed sandy gravel beach with typical flora and fauna. Diverse beach dwelling polychaetes, bivalves, crustaceans, etc. High priority.
Protection Island, Jefferson County, at entrance to Discovery Bay near Port Townsend	The Nature Conservancy has purchased 48 acres at the west end of island as a preserve for a nesting colony of rhinoceros auklets. Harlequin ducks, seals, scoters, etc., also inhabit its shores. Interesting intertidal areas. High priority.

[1]Series of areas are suggested along the straits which offer varying degrees of exposure.

Table 96.--*Areas* suggested *for Research Natural Areas representative of estuarine ecosystems on the open coast of Washington*

Estuary	Comments and priority
Portion of Willapa Bay including Leadbetter Point	Excellent protected bay with sand and mud substrate. Bivalves (including oysters), crabs, etc., with good population of an enteropneust, *Saccoglossus* sp. Introduced population of *Ilyanassa obsoleta*. High priority.
Marshlands at Campbell Slough and Oyhut in North Bay of Grays Harbor	Protected estuarine area with limited marshlands associated with mud-sand flats, High priority.
Queets River estuary	Relatively small estuary representative of central coast of Washington.

Table 97.--*Areas suggested for Research Natural Areas representative of estuarine ecosystems in Puget Sound and in the Straits of Georgia and Rosario Straits*

Estuary	Comments and priority
Burn's Point and cove on Totten Inlet, Lower Puget Sound	Representative of the lower Puget Sound estuarine areas. High priority.
Steamboat Island at mouth of Totten Inlet	An area representing both gravelly and boulder shores. High priority.
Nisqually River delta	Diverse habitats including marsh areas in one of the largest undeveloped estuarine areas in Puget Sound. Recently acquired by the Fish and Wildlife Service. High priority.
The Narrows-Tacoma, southwest from Salmon Bay	Rocky fill with rapid tidal currents. Artificially developed area of high diversity in fauna and flora. Excellent for many invertebrate forms including Octopus dofleini. High priority.
Quartermaster Harbor on Vashon Island	Good mud bay with representative populations of bivalves, crabs, etc.
Double Bluff, on Whidbey Island between Mutiny and Useless Bays	Sandy beaches with some rocky outcrops.
Skagit Flats and Goat Island	Excellent and extensive mudflats with rocky island shores and associated marshes. Large populations of resident and migratory marine birds, etc. High priority.
Sister's Point at Great Bend of Hood Canal	Selected as area representative of the lower Hood Canal region. Mud-shell substrate. High priority.
A portion of Dabob Bay	Associated with upper Hood Canal. Mud substrate and associated fauna. High priority.
Big Beef Creek (east side of Hood Canal)	Stream contains established runs of chum and coho salmon and steelhead trout. Area owned by University of Washington, College of Fisheries. High priority.
Foulweather Bluff	Exposed rocky shores at entrance to Hood Canal. Excellent for diversity of flora and fauna. High priority.
Padilla Bay and Saddlebag Island[1]	Large mud bay between mainland and northern end of Fidalgo Island. Island is small and State-owned.
Nooksack River delta and part of Lummi Bay[1]	North branch of Nooksack entering Lummi Bay is part of Lummi Indian Reservation but is representative of northernmost estuary in Whatcom County. High priority.
Cobblestone beach, Sandy Point to Point Whitehorn (portion of)	Excellent in spite of several oil refineries in area. High priority.

[1]Areas associated with Straits of Georgia and Rosario Straits.

Table 98.--*Areas suggested as Research Natural Areas representative of exposed intertidal ecosystems in waters of the San Juan archipelago and at the confluence of Rosario Straits and Straits of Georgia*

Area[1]	Comments and priority
Fidalgo Head including Shannon Point - RGS	Diverse rocky intertidal region. High priority.
Clayton Beach off Samish Bay near Larrabee State Park - RGS	The only real sandy beach in this region. Excellent example of sand fauna, etc. High priority.
Marine park area between south Bellingham and Post Point - RGS	Cobblestone and rocks with shelving mud and sand at lower depths.
Chuckanut Island and rock in Chuckanut Bay - RGS	Excellent small areas for rocky intertidal and subtidal fauna and flora. Rock controlled by Bureau of Land Management. High priority.
Lummi Rocks off Lummi Island - RGS	Small rocky intertidal and subtidal area. Excellent for representative forms. Controlled by Bureau of Land Management. High priority.
Partridge Point and Partridge Bank on Whidbey island - S6J	Area of considerable interest for diverse marine flora. High priority.
Smith Island - S&J	Highly diverse intertidal and benthic areas. Excellent for both marine invertebrates and algae. Rock, sand, and gravel with varying exposure to tidal currents. Enjoys excellent protection from general public. High priority.
Deception Pass and Deception Island - S&J	Unique area with exposure to varying currents and tides.
San Juan archipelago and Cypress Island - SJA	This highly diverse, rich area has been a Marine Biological Preserve by State of Washington law since 1923. The area has been intensively used as a base for scientific research for over 70 years. Optimally it would be desirable to implement and extend the provisions of the law. It would be important to provide some protection from commercial exploitation of edible invertebrates in the region. High priority.

[1] RGS = confluence of Rosario Straits and Straits of Georgia; SEJ = confluence of Straits of Juan de Fuca and waters of the San Juan archipelago; and SJA = waters of San Juan archipelago, also known as Washington Sound or a part of Straits of Georgia.

Part IV.
Reports of Working Groups

REPORT OF TERRESTRIAL WORKING GROUPS

Two terrestrial working groups were organized at the workshop — one group for provinces west of the Cascade crest (West-sideTerrestrial Working Group), and the other for provinces in eastern Oregon and Washington (East-side Terrestrial Working Group). The participants in these working groups are listed in appendix VII.

The groups were charged with the responsibility of identifying those terrestrial ecosystems in Oregon and Washington which should have adequate representation in a well-rounded system **of** Research Natural Areas. Before the workshop, preliminary lists of terrestrial natural area needs had been developed for each province by Jerry F. Franklin and Curt Wiberg. The working groups used these lists as a point of departure. The general procedure was to go through these lists area by area, evaluating each in turn, and making such revisions as necessary.

Our ultimate aim was to construct a list of terrestrial ecosystem cells which should ideally be well represented in a minimal natural area system. Our working definition of a cell — community, organism, or habitat to be represented within a Research Natural Area — has already been more fully covered in part I of this report. In dealing with terrestrial ecosystems, a cell may be a timber type ("mixed-conifer forest with western larch dominance"), a plant community ("Douglas-fir/swordfern"), or a specialized habitat ("shifting dunes"). In some instances, we also used cells to designate geographic location. For example, in the Oregon Coast Ranges Province two western hemlock/swordfern community cells are listed — one in the northern portion of the province and one in the southern. This wasjudged necessary in order to provide an adequate sample of the diversity which exists in this very widely distributed forest community.

In order to insure as complete coverage as possible, we attempted to include, at a minimum, virtually all major vegetation types described in *Natural Vegetation of Oregon and Washington* (Franklin and Dyrness **19'73).** In eastern Washington the vegetation classification is based almost entirely on the work of Daubenmire and Daubenmire (1968) and Daubenmire (1970).

The total number of terrestrial cells, both filled and unfilled, is shown by province in table 99. The unfilled terrestrial cells (i.e., those not adequately represented in already established Research Natural Areas) were first arranged into combinations which could be expected to occur in the field, then interfaced with aquatic and rare and endangered animal cells, to finally produce the lists of Research Natural Area needs which appear in part 11.

Table 99.--*Number of filled and unfilled terrestrial cells, by State and province*

Province	Number of filled cells	Number of unfilled cells	Total
Washington:			
Olympic Peninsula and Southwestern Washington	8	19	27
Puget Trough	2	14	16
Western Slopes and Crest, Washington Cascades	16	15	31
Eastern Slopes Washington Cascades	4	17	21
Columbia Basin, Washington	7	36	43
Okanogan Highlands	5	22	27
Total	42	123	165
Oregon:			
Oregon Coast Ranges	5	18	23
Western Oregon Interior Valleys	8	18	26
Siskiyou Mountains	7	19	26
Western Slopes and Crest, Oregon Cascades	7	20	27
Eastern Slopes Oregon Cascades	9	8	17
Ochoco, Blue, and Wallowa Mountains	6	19	25
Basin and Range	0	19	19
High Lava Plains and Columbia Basin, Oregon	8	11	19
Owyhee Upland	0	15	15
Total	50	147	197
TOTAL	92	270	362

REPORT OF AQUATIC (FRESHWATER) WORKING GROUP

We believe that the same rationale under which terrestrial areas have been protected in Research Natural Areas applies also to aquatic areas; i.e., benchmark areas, centers for research activity, and gene pools. Accordingly, we have devised a scheme that we think includes most of the needed Research Natural Areas in Oregon and Washington. We have attempted to include all types of aquatic habitat, concentrating on typical areas and representative faunas, but also considering unique habitats. The urgency of this effort is underscored by the fact that some natural aquatic habitats that should be in the system are simply no longer available, due to man's activities.

We encountered two basic problems in setting up our classification scheme—(1) uncertainty as to how fine a classification to employ, and (2) concern over the difficulty of maintaining aquatic areas in a "natural" state.

There is no commonly accepted classification scheme for aquatic habitats analogous to the plant community types that form the basis for terrestrial Research Natural Areas. For the tentative listing, we have selected a classification that is essentially geographical, emphasizing elevation range within physiographic provinces. Within that framework we have made some further subdivisions, but some important types may have been overlooked. For example, geologic and hydrologic criteria should be added.

A major problem in the establishment of aquatic Research Natural Areas is the extent to which aquatic systems are affected by man's activity on the watershed. It is possible to designate a terrestrial area of 100 acres in many locations and provide for its complete protection from man-caused change. Unless the entire drainage area of a lake, or the watershed area above a stream section, is maintained, however, there is no assurance of protection for aquatic areas. This is particularly true in watersheds subject to logging, but other disturbances can also be important, e.g., pesticide application. The influence is more likely to be of concern in streams than lakes; and it is possible that we might establish certain lakes as Research Natural Areas without including the entire drainage basin, depending on the size and runoff characteristics of the basin. Our present recommendation is that streams not be included unless the entire watershed can be included within the boundaries of the Research Natural Area.

This, of course, limits the size of stream that can be included. Large streams and rivers will be excluded by this criterion. We do feel that a need exists to identify research areas in such waters, but suggest that some classification other than Research Natural Area be employed (perhaps incorporating the Wild and Scenic Rivers Act, for example).

We have, thus, tentatively recommended inclusion of only those areas that can most likely be protected from man's influence. However, this decision should be subject to further discussion. For one thing, even the terrestrial areas are not entirely immune from outside influence (consider the ubiquitous nature of DDT, for example). The distinction we have made may be only one of degree, and we perhaps should consider whether classification of such large streams and rivers might provide additional incentive for maintaining them in as close to natural condition as possible.

The basic classification scheme shown in tables 100 and 101 draws considerably on the preliminary work of Franklin and Wiberg. We have made the following basic classification of aquatic habitats: lake, permanent pond (less than 5 acres, shallow, rooted vegetation throughout), vernal pond (temporary), stream, springs (hot and cold), swamp, marsh, and bog. On this classification we have imposed a matrix of elevation and physiographic province. In general, we have included only one representative cell in each square, hoping that this will fulfill the objective. In several instances, when we were aware of significant variation within a square, we included more than one cell. Our limited familiarity with some regions of Oregon and Washington has undoubtedly resulted in some omissions.

We were uncertain as to how to explicitly handle many factors that we recognize as important in the establishment of aquatic Research Natural Areas. For example, in stream classification, gradient and total dissolved solids are important variables affecting productivity. Likewise with lakes, temperature regime, nutrient level, geological origin, and other factors are important. Our present decision is simply to list these variables (and others that may be recommended) as among those criteria that should be considered in the total system. Efforts should be made to incorporate gradients of these elements within each aquatic class over the Pacific Northwest. We believe, in fact, that the system as set up will naturally provide for many of these gradients — for example, a range from oligotrophy to eutrophy in lakes and ponds.

We are still uncertain as to how some manmade bodies of water should be handled. In the Columbia Basin of Washington, for example, are a series of potholes and wasteways. These are the result of irrigation flooding and are more or less permanent bodies. However, they cannot be controlled in the sense of maintaining "natural" conditions, so perhaps should fall into the same category as large river segments. Another problem comes from impoundments, which are common in eastern Washington and Oregon. Although man made, they are usually subject to more control and perhaps should be considered for Research Natural Area status. They are not listed in our present structure.

Tables 100 and 101 show how aquatic cells were selected for the **15** provinces in Oregon and Washington. At present, only 18 aquatic cells are filled out of a total of 180 cells (table 102). It is apparent that much work remains to be done in setting aside typical aquatic ecosystems for research and educational purposes.

The concept of aquatic Research Natural Areas is a new one. Suggestions for improvement in the classification scheme and identification of areas that have been omitted are sincerely solicited.

Table 100.--*Selection criteria of* ***aquatic*** *cells* for *the six physiographic provinces in* ***Washington***

Type	Olympic Peninsula and Southwestern Washington	Puget Trough	Washinaton Cascades		Columbia Basin	Okanogan Highlands
			Western Slopes and Crest	Eastern Slopes		
Lakes:						
Lowland	Western hemlock[1] Fern Lake[2]	Eutrophic Oligotrophic[7]	Typical[1]	Eutrophic	Fresh[14] Alkaline[14] Saline[14]	Mixed conifer**
Subalpine	Pacific silver fir[3]		Findley Lake[9] North Cascades	Oligotrophic[12]		Engelmann spruce-subalpine-fir
Alpine	Typical		Typical			
Permanent ponds:						
Lowland	Typical	Typical		Typical	Fresh[14] Alkaline[14] Saline[14]	Typical
Subalpine	Typical		Typical	Typical		Typical
Alpine	Typical		Typical			
Vernal ponds:						
Lowland	Typical			Typical	Typical	Typical
Subalpine	Typical		Typical	Typical		Typical
Alpine			Typical			
Streams:						
Lowland	Sitka spruce-western hemlock[4] Douglas-fir-western hemlock[5] Redcedar swamp[6]	Typical'	Mature conifer[10]	Mixed conifer[13]	Typical (Rattlesnake Creek)	Mixed conifer[15]
Subalpine	Glacial and non-glacial		Typical (Butter Creek)[11] "Milkwater" creek	Mixed conifer[13] Serpentine (El Dorado Creek)		Engelmann spruce-subalpine-fir

See footnotes at end of table.

Table 100.--*Selection criteria of aquatic cells for the six physiographic provinces in Washington* (Continued)

Type	Olympic Peninsula and, Southwestern Washington	Puget Trough	Washington Cascades: Western Slopes and Crest	Washington Cascades: Eastern Slopes	Columbia Basin	Okanogan Highlands
Springs:						
Cold	Typical	Typical	Typical	Typical	Typical	Typical
Hot	Typical		Typical	Typical	Typical	
Swamp	Redcedar		Redcedar			
Marsh	Typical	Typical	Typical	Typical	Typical freshwater Typical saline	Typical
Bog	Typical	Typical	Typical	Typical		Typical

[1] Lake and drainage basin of temperate forest.
[2] Existing study area that could be designated as an RNA.
[3] Lake and drainage basin of subalpine forest and meadow.
[4] Sitka spruce-western hemlock forest and major stream drainage (west slope of peninsula). Anadromous fish run.
[5] Douglas-fir-western hemlock forest and major stream drainage (east slope of peninsula).
[6] Stream fed by redcedar swamp. Anadromous fish run. Should be combined with swamp cell.
[7] Lake in glaciated topography and drainage basin of temperate forest.
[8] Douglas-fir-western hemlock major combined terrestrial and aquatic ecosystem.
[9] Existing study area that could be designated as an RNA. No fish present. Lake recommended for North Cascades should have fish present.
[10] Temperate conifer forest and major stream drainage.
[11] Subalpine forest mosaic and major stream drainage.
[12] Mixed-conifer forest and lake.
[13] Mixed-conifer (ponderosa pine, Douglas-fir, grand fir, etc.) forest and major stream drainage. Extends through both lowland and subalpine.
[14] Series of scabland. lakes of varying water chemistry with shrub-steppe communities.
[15] Mixed-conifer forest and stream drainage.

Table 101.--*Selection criteria of aquatic cells for the nine physiographic provinces in* **Oregon**

Type	Oregon Coast Ranges	Western Oregon Interior Valleys	Siskiyou Mountains	Oregon Cascades: Western Slopes and Crest	Oregon Cascades: Eastern Slopes	Ochoco, Blue, and Wallowa Mountains	Basin and Range, High Lava Plains and Columbia Basin, Owyhee Upland
Lakes:							
Lowland	Sand dune lake Coastal lake	Oxbow- Willamette Valley[5]	Typical	Douglas-fir-western hemlock[6] (north) Douglas-fir-western hemlock (south)		Mixed conifer	Saline (borax lake) Freshwater Playa lake
Subalpine			Typical Serpentine	Western Cascades' High Cascades[7]	Mixed conifer[10]	Typical	Steens Mountain
Alpine				Typical		Typical	
Permanent ponds:							
Lowland	Sand dune	Eutrophic	Typical	Northern Cascades		Typical	Saline Freshwater
Subalpine			Typical	Typical	Typical	Typical	Steens Mountain
Alpine				Typical		Typical	
Vernal ponds:							
Lowland	Sand dune	Typical	Typical	Typical		Typical	Typical
Subalpine			Typical	Typical	Typical	Typical	Typical
Alpine				Typical		Typical	
Streams:							
Lowland	Sitka spruce-western hemlock[1] Douglas-fir[2] Alder[3] Sand bottom[4]	East-side small West-side small Slough	Mixed evergreen Coniferous forest	Douglas-fir-western hemlock[8] Mixed conifer[9]		Mixed conifer	Typical
Subalpine	Typical headwaters		Serpentine	Typical	Mixed conifer"	Typical	Sagebrush-juniper[11]

See footnotes at end of table.

Table 101.--*Selection criteria of aquatic cells for the nine physiographic provinces in Oregon* (Continued)

Type	Oregon Coast Ranges	Western Oregon Interior Valleys	Siskiyou Mountains	Oregon Cascades: Western Slopes and Crest	Oregon Cascades: Eastern Slopes	Ochoco, Blue, and Wallowa Mountains	Basin and Range, High Lava Plains and Columbia Basin, Owyhee Upland
Springs:							
Cold		Mineral	Cave		Metolius headwaters		Typical Malheur Cave
Hot				Typical	Typical		Typical
Swamp	Sitka spruce						
Marsh	Skunk cabbage	North	Typical	Bulrush-sedge	Typical	Typical	Tule west[12]
	Willow-sedge	South					Tule east[12]
Bog	Coastal		Coastal mountain	Subalpine	Typical	Typical	

[1]Combined with terrestrial, includes anadromous fish, includes hardwoods (alder, maple) along stream, should include a drainage directly to ocean with small estuary.
[2]Combined with terrestrial, includes hardwoods (maple, alder) along stream, includes anadromous fish--away from coast.
[3]Combined with terrestrial, includes at least two perennial streams.
[4]Central coastal plain (Florence and south)--small, stable, low gradient. Alder-salmonberry overstory; water-oriented animal refuge.
[5]Probably eutrophic.
[6]Combined with terrestrial (temperate forest).
[7]One or other should be combined with terrestrial (Crabtree Creek might fill need).
[8]Combined with terrestrial (Middle Santiam might fill need), need anadromous fish if possible.
[9]Combined with terrestrial, Abbott Creek RNA fills need.
[10]Combined with terrestrial.
[11]Combined with terrestrial, probably Steens Mountain.
[12]Western tule marsh probably around Klamath Lakes; eastern tule marsh probably around Malheur Lake.

Table 102.--*Number of filled and unfilled aquatic (freshwater) cells, by State and province*

Province	Number of filled cells	Number of unfilled cells	Total
Washington:			
Olympic Peninsula and Southwestern Washington	0	17	17
Puget Trough	1	7	8
Western Slopes and Crest, Washington Cascades	7	11	18
Eastern Slopes, Washington Cascades	0	11	11
Columbia Basin, Washington	2	11	13
Okanogan Highlands	2	9	11
Total	12	66	78
Oregon:			
Oregon Coast Ranges	0	13	13
Western Oregon Interior Valleys	1	8	9
Siskiyou Mountains	2	12	14
Western Slopes and Crest, Oregon Cascades	3	14	17
Eastern Slopes, Oregon Cascades	0	8	8
Ochoco, Blue, and Wallowa Mountains	0	13	13
Basin and Range	0	14	14
High Lava Plains and Columbia Basin, Oregon	0	6	6
Owyhee Upland	0	8	8
Total	6	96	102
TOTAL	18	162	180

REPORT OF RARE AND ENDANGERED SPECIES WORKING GROUP

In recent years, there has been much national concern for rare and endangered species. For our purposes, two types of criteria for classification of species into categories are presented: (1) criteria by which a species is selected for preservation within Research Natural Areas;[4] and (2) criteria by which to characterize a species' status.[5] Every attempt has been made to adhere to sound biological principles and objectivity. It is stressed that both sets of criteria are intended to be dynamic, amended, and updated as need dictates.

The aim of obtaining Research Natural Areas is neither strict preservation of a species in a "hands off" concept nor uncontrolled utilization as a "scientific resource." When a Research Natural Area contains a rare, uncommon, threatened, or endangered species, the Research Natural Area becomes an irreplaceable, unique, natural research laboratory. Research within a Research Natural Area is a privilege and must be conducted wisely and with the highest ethical standards.

In Research Natural Areas: (1) Species can be protected that otherwise would not receive protection; (2) species can be protected before they reach the brink of extinction; (3) species and populations can be monitored and knowledge of their requirements and status obtained; and (4) Research Natural Areas will act as refugia for species whose habitats are being destroyed.

If human population growth and land development continue as present trends indicate, sooner or later we will be faced with the prospect of deciding which species are practical to save and which will have to be allowed to decline to extinction. By protecting species, as well as diverse habitats, within Research Natural Areas now, we may be able to forestall or eliminate the necessity of some of those decisions; many or most of the less common species will be included in Research Natural Areas established for other purposes. It is anticipated that very few Research Natural Areas will be established specifically for the protection of individual species; but when necessary, a recognized authority should appraise the candidate areas to ensure the best possible selection.

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[4] These criteria are a direct result of the working group for rare and endangered species of the Research Natural Area workshop.

[5] Murray L. Johnson, Curator of Mammals, Museum of Natural History, University of Puget Sound, Tacoma, Washington, has kindly allowed the use of his unpublished "Terms Related to Populations and Survival Status of Mammals." Johnson's criteria are an excellent beginning to the development of objective criteria for characterization of a species' status. They can be adapted to animal species other than mammals. Unfortunately, as yet only the mammals in Oregon and Washington have been categorized through the use of Johnson's criteria (app. VI). Hopefully, other species will be so treated eventually. Johnson has reserved the right to publish his concepts elsewhere when they have been further refined.

Criteria by Which a Species Is Selected for Preservation Within Research Natural Areas

Taxonomic Level

The taxonomic level considered to be compatible with the concept of a minimal RNA system must remain flexible. Species and subspecies should be considered on an individual basis as needs become apparent.

Kinds of Species

Requirements for compatibility of a species or subspecies with the RNA concept are:

(1) A species must not necessitate management practices that would alter the RNA in order for the species to survive.

(2) An animal species must be neither migratory nor wide-ranging, and its entire habitat requirements must be satisfied within RNA boundaries.

(3) A population must be of sufficient size to remain viable within the RNA.

Introduced or Reintroduced Species

Introduced or reintroduced species are generally considered to be noncompatible with the RNA concept, except as noted below.

(1) Under certain circumstances, reintroductions that originate from native gene pools may be considered on an individual basis.

(2) Native species of North America that have been introduced or relocated would be considered on an individual basis if the species as a whole were determined to be endangered.

Peripheral Species

Species and, in certain instances, subspecies at the extremes of their known geographical distributions, irrespective of political boundaries, should be considered on an individual basis. Such populations are genetically and evolutionarily important because: (1) they either are adapting genetically or are genetic relics, (2) they are more constrained and influenced by their immediate environment than is the species as a whole, and (3) studies of such populations will facilitate understanding of the adaptability of the species as a whole. Other considerations are as follows:

(1) A population must be recognized as a natural resident of the area — not as transient, introduced, or relocated.

(2) It should be determined, based upon the best information, that a population's survival is threatened.

Working Inventory and Management of Adjacent Areas

A list of species and, in some cases, subspecies within a State or region should be developed at the time of RNA selection or, at the latest, establishment of the RNA. Taxons should be identified with reference to their status (see criteria for status in the two following animal and plant sections) and compatability with Research Natural Area management concepts as indicated earlier.

In certain cases, species which are noncompatible with the RNA concept, but are of special interest (rare, uncommon, etc.), may occur within a Research Natural Area. In selected instances, the region adjacent to the Research Natural Area should be managed in such a way as to ensure the survival of the species within the region with the Research Natural Area as its focal point. Management recommendations should be made on an individual basis with respect to the species and the agency concerned.

Terms Related to Populations and Survival Status of Mammals[6]

Introduction

There is a need for clearly defining the several terms that are used in lists and published articles related to "rare," "endangered," or "threatened" species. The terms defined have for years been used with impreciseness by individuals or organizations interested in and dedicated to the cause of conservation. The diversity of interest of authors creates a diversity of viewpoints. This in turn results in different meanings or interpretations of the same word.

As a person experienced and reasonably competent in the field of mammalogy, I am frequently asked for my opinion regarding the status of a species. Lists are given me for criticism, related to different accents, different purposes, and honest and thoughtful appraisal at times required qualifying statements that may be frustrating to both me and my respondent.

In the interest of better communication this paper was organized. It is to be looked upon not as anything new or different, but as a synthesis of definitions and criteria used by many experienced persons. Selection of arbitrary figures were necessary in order to establish a baseline. There is nothing of deeper significance in the numerical portions of the definitions.

"RARE" and "UNCOMMON" are more often than not terms based upon subjective bases. This situation is unsatisfactory. Because the words imply quantification, they should be clearly defined and subject to reproducible evaluation. However, there is no way that a single criterion may be used with all groups of mammals, or with other living things for that matter. This is because of the basic differences of the available methods that can be applied to any quantifying analysis, imposed by the facts of natural history of the organisms themselves.

Therefore mammals have been grouped into general categories related to methods of obtaining data:

a) Small terrestrial mammals usually observed by collecting in mouse-size or rat-size traps.
b) Larger terrestrial mammals and seals usually observed by visual means (including aerial survey) and collected by larger traps, guns or camera; game managers frequently have data on these species.
c) Bats which may be collected by nets or by a variety of means from their day-time retreats or hibernacula; exact information may be secured from bat-banders.
d) Cetaceans, the most difficult group to census, except in several outstanding examples such as the gray whale; any attempt to quantitate populations in a local or regional area is frustrating. Collecting data is available from commercial or indigenous catches, widely scattered, selective and declining. Visual observation and strandings are opportunistic and not systematically organized at this time. Appraisal of species of this group must accept a great degree of subjectivity.

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[6] This entire section is a direct quotation from an unpublished paper by Murray L. Johnson. See footnote 5.

Another serious consideration in stating relative abundance of any species is related to the amount of study and collecting efforts that have been applied to that species. A species, if intensively and expertly studied, may have more scientific specimens available than a common but less well studied species.

"ENDANGERED" and "THREATENED" are terms related to future events. As such the inherent uncertainties mitigate against quantification in establishing criteria. Although a model could be set up that would incorporate quantified data, this I believe would greatly magnify the chances of error and lessen the benefits to be derived. These terms therefore are best designated by opinions of experts. As defined here, the term "ENDANGERED" is compatible with the usage "Endangered" in the Red Book of the IUCN (International Union for Conservation of Nature) and Resource Publications of the [U.S.] Bureau of Sport Fisheries and Wildlife, U.S. Department of Interior, number 34 (1966, revised 1968) and number 114 (1973), and as listed in the U.S. Federal Register. The term "THREATENED" embodies in part the concepts suggested in Resource Publication 114 (1973). It should be particularly useful as applied to lists of States, Provinces or other restricted geographical areas.

In defining terms, the above considerations are made, these covering the major variables related to most species of mammals. However, the reader must accept with the author the varied impreciseness of the applied terms.

DEFINITIONS

Definition of Ouantification

RARE: (R) A species or subspecies is considered RARE within a State or Province when any of the following conditions exist:

a) Small terrestrial mammals
   1) Fewer than 25 specimens are in scientific collections.
   2) The present range within the State or Province is less than 10 mi^2 (25.9 km^2).
   3) In cases of easily observed species, fewer than 25 individuals can be regularly observed during two full days field observations by one person, in an optimum habitat.
   4) In cases where intensive expert study has been done, only one individual or less can usually be secured per 500 trap nights, in optimum habitat, or when only one animal or less can usually be secured in two full days of field work by one person.

b) Large terrestrial mammals and seals
   1) Fewer than 12 specimens are in scientific collections:
   2) In cases of easily observed species, fewer than 25 individuals can be regularly observed. during two full days field observations by one person, in an optimum habitat.
   3) The present range is less than 10 mi^2 (25.9 km^2).
   4) Data from game management files indicates rarity because of direct observations, trapping or hunting.

c) Bats
   1) Fewer than 25 specimens are in scientific collections.

2) Fewer than 25 individuals can be regularly observed during two full days of field observation, in optimum habitat and season.

3) The present range is less than 10 mi² (25.9 km²).

d) Cetaceans

1) In cases of smaller whales and porpoises, fewer than 5 specimens in scientific collections.

2) Fewer than two individuals can regularly be observed by a single person during two full days field observations, in optimum habitat.

3) Fewer than 2 observations from all sources per year—confirmed, identified sightings, photographs (all within 200 mile limit from shore) or strandings.

UNCOMMON: (U) A species or subspecies is considered UNCOMMON within a State or Province when any of the following conditions exist:

a) Small terrestrial mammals

1) Fewer than 50 specimens (more than 25) are in scientific collections.

2) The present range within the State or Province is less than 30 mi² (87.7 km²).

3) In cases of easily observed species, fewer than 50 individuals can be regularly observed during two full days field observations by one person, in an optimum habitat.

4) In cases where intensive expert study has been done, only one individual or less can usually be secured per 200 trap nights in optimum habitat, or when only one animal can usually be secured in one full day of field work.

b) Large terrestrial mammals and seals

1) Fewer than 25 specimens are in scientific collections.

2) In cases of easily observed specimens: fewer than 25 individuals can regularly be seen during one full day of field observation in an optimum habitat.

3) The present range is less than 30 mi² (87.7 km²).

4) Data from game management files indicate unusual status because of direct observations, trapping or hunting.

c) Bats

1) Fewer than 50 specimens are in scientific collections.

2) Fewer than 50 individuals can be regularly observed during one full day of field observation, in optimum habitat and season.

3) The present range is less than 30 mi^2 *(87.7* km^2).

d) Cetaceans

1) In cases of smaller whales and porpoises: fewer than 10 specimens in scientific collections.

2) Fewer than 2 individuals can regularly be observed during one day of field observation, in optimum habitat.

3) Fewer than 4 observations from all sources per year; confirmed, identified sightings, photographs (within 200 mi from shore) or strandings.

Definitions Related to Survival

ENDANGERED: (E) Any species or subspecies considered likely to become extinct in its total range during the next 10 years if present trends continue. Related to population estimates and dynamics, and to habitat destruction.

THREATENED: (TH) Any species or subspecies not on the ENDANGERED list, but which is considered likely to be extirpated from a localized area such as a State or **Province or lesser area within the next** 10 **years** if **present trends continue.**

EXTINCT: (EX) Any species or subspecies that has not been reliably reported within any State or Province during the past 10 years, and which may be reasonably considered extinct by reason of reliability of information and state of knowledge that exists regarding the species.

Qualifying Definitions

STATUS UNDETERMINED: (SU) May be appended to any designation in cases where up-to-date information is not available or where the status information is especially suspect or tenuous.

PERIPHERAL: (P) May be appended to any designation in cases where the species has a major or extended range in a contiguous State or Province. PERIPHERAL is of biological importance when the locality represents the extreme of range or an isolated island of population; it is of political importance only when it represents an incidental crossing of border.

ACCIDENTAL: **(A)** May be ,appended to any designation whenever: the situation logically suggests that an individual observation or collection was the result of wandering beyond a natural range.

UNIQUE: (UN) May be appended to any designation whenever the range of the species or subspecies lies entirely within a given political boundary such as a State or Province.

APPLICATION OF TERMS TO OTHER GROUPS OF ORGANISMS

Although the definitions and criteria noted in this paper are primarily related to mammals of the North Pacific area of North America, they may with similar benefit be applied to other organisms and other areas. For instance, other terrestrial plants and animals may be assigned RARE or UNCOMMON status by applying the criteria for small terrestrial mammals. Species of birds may appropriately be classified as under small or large terrestrial mammals. Definitions of survival and qualifying definitions should not be significantly different for any biologic group.

SUMMARY STATEMENT

Terms are defined and the criteria are suggested that will help to unify reference to rare and endangered species of mammals. It is to be stressed that this subject is dynamic and status of any form may change in a single year. Continued re-evaluation is necessary for proper use of the definitions suggested.[7]

Vascular Plants of Special Interest

Vascular plants of special interest are approached on a somewhat different basis from vertebrate animals.[8] There are many more plant than animal species of unique interest. Lists were compiled for each State by botanists from literature and herbarium surveys and questioning of professional and amateur botanists familiar with the region. Additional suggestions came from preliminary editions of the national list of threatened and endangered plants (Smithsonian Institution 1974).

Criteria used to select plants of special interest were the following:

A. Rare
   1. Range limited and circumscribed
      a. Local endemic (found only in a small area, e.g., a single mountain)
      b. Regional endemic (found only in a region, e.g., Siskiyou Mountains)
      c. Disjunct population (widely separated from main body of a species' range)
      d. Marginal population (at edge of species' range, including outliers)
   2. Range widespread but with relatively few individuals per site or relatively few sites or both

[7] End of Johnson quotation.

[8] Only vascular plants are considered at this time; necessary information on other plant groups could not be accumulated easily or is incomplete.

B. Endangered
   1. Habitat being destroyed, e.g., by agricultural or hydroelectric developments
   2. Plants being destroyed, e.g., by collectors or selective grazing

These criteria could be used in only a general way, however, because the real status of many plants is unknown. Furthermore it was not possible to do field checks for verification of presumed status.

Complete lists are presented of vascular plants of special interest which were developed for each province. This has been done for a variety of reasons. First, land managers in each area need a single reference to all vascular plants presently known or believed to be worthy of special attention in planning and management activities. Second, unusual species should be identified which can be considered in selection of Research Natural Areas representative of terrestrial and aquatic ecosystems and incorporated as adjunct elements. Third, areas must be designated where concentrations of special interest plants warrant selection and establishment of Research Natural Areas specifically for their protection and study.

The purpose of these lists is to summarize present knowledge on the status of vascular plant species, stimulate interest, solicit information, and thus, hopefully, to improve chances of survival for the plants of interest. They do not constitute unofficial or official lists of "endangered" plants. The only indication of "status" we have provided, other than to describe the group in general as special interest or rare and endangered plants, is identification of those plants included in the Smithsonian list (Smithsonian Institution **19'74).** These are proposed for, and by the time this report appears may have received, official designation as Threatened or Endangered species under the Endangered Species Act of **1973.** We also assume that individuals engaged in selection of Research Natural Areas for terrestrial and aquatic interest will try to incorporate populations of special interest species when possible.

None of the plants listed have been identified as essential elements or cells in a system of Research Natural Areas. A majority of the species could probably be included in the sense that maintenance of viable populations would not require activities incompatible with the Research Natural Area concept. However, only a subset of these compatible species requires a strict reserve of this nature for their protection and study. Many can be preserved in National and State Parks, Botanical Areas, Wilderness and other roadless areas, etc., provided that they are recognized and accommodated in management plans for these tracts. What we have done is to identify the need for Research Natural Areas in several areas where there are concentrations of special interest plants, particularly those on the Smithsonian list which have some official status as Threatened and Endangered. Among the most notable of these areas are the Columbia River Gorge (listed in four provinces), Siskiyou Mountains, Wenatchee Mountains, Snake River Canyon, Owyhee Canyon, and northeastern Olympic Peninsula.

Frequent reevaluation of the lists of special interest plants with additions and deletions is expected. In fact, periodic evaluations are viewed as essential if the lists are to reflect our current knowledge regarding distinctive species in our regional flora.

Nomenclature of plants generally follows that of Hitchcock et al. **(1955-69)** supplemented by Peck **(1961)** in southern Oregon. A few species are not described in either.

Part V. Conclusions and Recommendations

In the course of deliberations the workshop participants surfaced a variety of concerns relating to implementation of the Research Natural Area recommendations. These relate to actual selection of areas, use of established Research Natural Areas, considerations of scientific values in management of areas which are not dedicated to research, and resolution of some problems regarding how some types of aquatic tracts should be dealt with.

SELECTION OF **AREAS**

It is clear that the major task is to get on with identification and dedication of areas which satisfy the remaining Research Natural Area needs. While the program in the Pacific Northwest has been progressing well, a great deal remains to be done. Hopefully this document makes clear the extent of the task as well as the priorities with regard to ecosystem types, ownerships, and geographic regions. A consideration of the existing system makes clear the most glaring deficiencies in the system with regard to each of these items. For example, marine ecosystems are almost totally lacking in the existing system, freshwater ecosystems are only a little better off, and even in the case of terrestrial types, great gaps exist in the steppes east of the Cascade Range, the heavily populated Puget Trough and Western Oregon Interior Valleys, and in southwestern and eastern Oregon.

Consequently, we believe that all participants should greatly expand their efforts aimed at identifying and reserving the needed areas. It is feasible to suggest a goal of 50 percent completion of the system in 5 years and 80 to 90 percent in 10 years.

It is also clear that selection of areas will require more effort than has been typical in the past. For example, in many cases it has become apparent that the wisest course is, when possible, to select areas which incorporate as many cells or needs as possible. That is, we should be looking for areas with a greater variety of ecosystems, habitats, and organisms rather than looking for an area representative of a single feature.

The selection of multiple-cell Research Natural Areas has several implications. For one thing we will often be seeking larger individual tracts than would have been the case with single-feature areas. As the size and consequent land investment increase, it must be more clearly established that the selected tract is the best area available. Therefore evaluation of a proposed tract should include a representation of more scientific disciplines and better documentation of the scientific values before it is established.

We recommend that, insofar as possible, tracts proposed for multicellular Research Natural Areas be evaluated by teams or individuals representing the several disciplines appropriate to each cell (e.g., limnologist, terrestrial plant and animal ecologists, soil scientist).

Care in selection should include the very important consideration that Research Natural Areas should be established on soils and landforms representative of broad land segments. It is only in this way that they can realize their full potential as baseline or control areas and that results of research can have their widest application. Even though individual soils and landforms are not recognized as cells in this report, the need for attention to these elements is considered implicit and is aided through designation of subprovince location in the natural area needs listings (pt. II).

Two steps are proposed to assist in assuring representation of soils and landforms. First, we recommend that the U.S. Department of Agriculture, Forest Service, the Soil Conservation Service, and other agencies conducting soil-landform surveys be encouraged to provide, as data become available, a tabulation of the soil type-landform mapping units on the ownerships they are surveying and their importance (acreage). Second, soils and landforms should be adequately described as part of the documentation process on proposed Research Natural Areas.

The increased concern for representation of aquatic systems and rare and endangered animals as well as important soils and landforms leads us to encourage the agencies to improve their knowledge of existing Research Natural Areas. There is clearly a need to know better what is already protected, and the Federal agencies are to be commended for their recent efforts along these lines.

Related to the additional study of existing Research Natural Areas is the need to reexamine several of the older tracts to determine whether boundaries can be adjusted to provide new or better representation of additional cells. Many of the early areas were set up with a single community or ecosystem in mind; with alteration, they could serve several needs.

All of this can be summarized by a recommendatiofi to take a retrospective look at what is already preserved as Research Natural Areas and determine if adjustments are desirable to increase the areas' value.

The emphasis on multicellular Research Natural Areas should not obscure the fact that many, if not the majority, of Research Natural Areas will be smaller areas focused on single ecosystems or habitats. Much work remains to be done in identifying and dedicating these types of areas. Similarly, excessive pursuit of an ideal area, which contains many cells, must not be allowed to become a major roadblock. It may not be possible to locate an ideal area *as* hypothesized in the listing, and the involved agencies and scientists should be prepared to alter cellular makeups as necessary.

RARE AND ENDANGERED ORGANISMS

Much work remains to be done in identifying the best way to handle rare and endangered organisms, particularly plants. We were able to largely resolve the needs insofar as rare and endangered vertebrates are concerned, i.e., identify those which can and should be handled in a Research Natural Area context and those which cannot. The situation is much less clear with regard to invertebrates and plants; we lack even acceptable lists for many of these organisms.

There are several important items to keep in mind as we proceed in the future. First of all, there must be close coordination with the threatened and endangered organism program of the U.S. Department of Interior, Fish and Wildlife Service. The national program is developing lists which we can use as a working base in regional programs; two of these have been used in preparing this document.

At least as important is the recognition that many of the rare and endangered plants and, perhaps, invertebrates can be protected by a variety of procedures short of establishing Research Natural Areas specifically for them. Included are identified tracts open to a wider array of uses but within which management is designed to protect the rare and endangered populations—Botanical Areas, State and National Parks, and Wilderness Areas, as examples. The scientist should make the land manager aware of a valid rare and endangered organism and advise measures necessary for its perpetuation which will often be compatible with many other uses. Awareness is one reason for the extensive tables on vascular plants of special interest.

'Many rare and endangered organisms are, of course, already protected in Research Natural Areas and more should be. Therefore, what remains to be done? First, we need improved knowledge of the rare and endangered organisms which may be present in Research Natural Areas. This goes back to the earlier recommendation for better descriptions of the natural features of existing Research Natural Areas.

With regard to scientific use of Research Natural Areas there are, however, some special management problems. Theoretically, all research use of these reserves is approved by the managing agency, and approval is held to those studies which will not significantly alter the natural feature or natural processes affecting it. We believe some guidance to institutions would be helpful in evaluating proposed research on rare and endangered organisms and, indeed, all animal studies. These guidelines should not be construed as overly restrictive. Rather, they are intended to protect the species of interest while at the same time insuring the proper accumulation of knowledge and maintaining the individual-freedom of the researcher.

Suggested guidelines follow.

1. In addition to the agency personnel and the appropriate Research Natural Area Committee, a recognized authority should review each research proposal to determine the following:
   a. Is the study worthwhile?
   b. Will the type of study be compatible with the survival of the species?
   c. Does the study necessitate the removal of specimens (collecting)?
   d. How many specimens can be removed without endangering the survival of the population?
2. If specimens are to be collected, the proper permits (State, Federal, etc.) should be required.
3. Minimum standards of data recording should be required.
4. All possible data should be gathered, recorded, and preserved with respect to the particular species that Research Natural Area has been established to protect.
5. All individuals of the particular species which the Research Natural Area has been established to protect should be prepared as proper specimens; such specimens should be placed in a bona fide repository. The location of the specimens as well as pertinent data should be on file with the proper agency for other students to use.

6. A file of all research proposals should be maintained to insure that studies conducted on a particular species, within a particular Research Natural Area, are such that knowledge is enhanced and that unnecessary duplication is avoided.
7. Copies of articles resulting from studies conducted within a Research Natural Area should be required and maintained in a central library.
8. Long-term, nondestructive studies for Rare, Uncommon, Threatened, or Endangered species should be encouraged within Research Natural Areas.

We strongly recommend that the rare and endangered species component of the Research Natural Area program be closely coordinated with the Fish and Wildlife Service's program under the new Endangered Species Act. Beyond this, working relationships should be developed with the State game departments for fur-bearing and nongame animals. Cooperative working relationships should be developed so that these departments are completely aware of the Research Natural Areas, their purpose and location, and so that they are closed to nonconforming, animal-removal activities.

AQUATIC AREAS

As mentioned earlier, progress has been slowest in establishment of aquatically oriented Research Natural Areas. Several serious conceptual problems remain also. We never resolved the question of how examples of the aquatic communities of large river systems can be preserved for study. Setting aside river segments can do the job for riparian biota but will not satisfactorily preserve the river community itself. One suggestion was that it may be possible to provide examples of such ecosystems for study in the context of Wilderness Areas or of Wild and Scenic Rivers. This may well be the case, but if so, exemplary rivers should be identified so both managers and scientists are aware of them and their specific scientific values.

Perhaps more relevant to the natural area program is the question of whether it is necessary to protect the complete drainage of a lake, pond, or stream before it is acceptable as a Research Natural Area. There was no question that such a situation is preferred, i.e., control of the complete watershed. However, it might be possible to accept something less, depending upon the surrounding topography, use of adjacent lands, etc. Perhaps this question can be resolved on a case-by-case basis, but the Steering Committee may also wish to ask for general advice from a group of aquatic biologists.

USING RESEARCH NATURAL AREAS

Research Natural Areas are already receiving a surprising amount of use in the Pacific Northwest (app. **11).** However, certain types of research use require encouragement, and any use requires careful monitoring to insure it is nondestructive. **As** already mentioned, one of the greatest needs is for better knowledge of the organisms and ecosystems found in existing Research Natural Areas. We would go further, however, and suggest agencies and institutions

should be strongly encouraged to establish baseline study plots, e.g., permanent vegetation plots and photo points, in existing Research Natural Areas, so that they can better function as controls. Further, we would encourage agencies involved in surveys of vegetation, soil, landforms, etc., to give high priority to inventories and mapping of Research Natural Areas. In summary, baseline studies of all types should be given first priority for any funding and first priority as candidates in baseline monitoring and inventory.

In order to provide the necessary coordination of research activities on natural areas, the Steering Committee should consider ways of establishing a central file, library, or data bank on existing Research Natural Areas. This would also provide a source of information for land managers and scientists for both research and management purposes.

Finally, the review of proposals for scientific use of Research Natural Areas should be considered. The question of conforming or nonconforming use is not as clear as it seems. What can be tolerated in the research use of one area (collections, soil pits, litter treatment) is unacceptable in another. The biota, habitat, size, and topography of the area are among the several considerations. Agencies or other groups responsible for natural areas should consider establishment of ad hoc or formal advisory bodies of scientists to advise them as to the merit and appropriateness of borderline research proposals.

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APPENDIX I.

AREAS UNDER SERIOUS CONSIDERATION FOR DESIGNATION AS FEDERAL RESEARCH NATURAL AREAS

Name	Principal features	Responsible agency[1]
Bachelor Island	Black cottonwood-willow stands on part of island in Columbia River	FWS
Beatty Creek	Jeffrey pine near northern range limits in southwestern Oregon	BLM
Boulder Creek	Ponderosa pine/bunchgrass forest on steep, granitic stream drainage on eastern slopes of northern Washington Cascade Range	FS
Cannon Wells	Lodgepole pine/bitterbrush forest on coarse Mazama pumice east of Crater Lake	FS
Cougar Butte	Mountain meadow and associated vegetation along Rogue-Umpqua River divide in southwestern Oregon	FS
Crabtree Lake	Subalpine lake and drainage and western redcedar forest on western slopes of Oregon Cascade Range	BLM
Eldorado Creek	Serpentine area in Wenatchee Mountains on eastern slopes of Washington Cascade Range	FS
Flynn Creek	Stream drainage in Oregon Coast Ranges with anadromous fish and second-growth Douglas-fir forest	FS

[1] BLM= Bureau of Land Management, FS= Forest Service, NPS= National Park Service, FWS= Fish and Wildlife Service.

Name	Principal features	Responsible agency[1]
Government Draw	Mosaic of grassland and coniferous forest communities in Wallowa Mountains of northeastern Oregon	FS
Green Mountain	Subalpine meadows and parkland on western slopes of northern Washington Cascade Range	FS
Head of Little Blitzen Gorge	Bunchgrass steppe and associated vegetation over 3,000-foot elevation range	BLM
Hunter Creek Bog	Bog community along Oregon Coast	FS-BLM
Jordan Craters	Area of Pleistocene volcanic activity, shrub-steppe, and lakes and ponds in southeastern Oregon	BLM
Kiger Gorge Plateau	Bunchgrass steppe over 2,000-foot elevational range	BLM
Middle Santiam	Old-growth Douglas-fir-western hemlock forest and stream drainage on western slopes of Oregon Cascade Range	FS
Moore Flat	Mixed-conifer forest, including ponderosa pine, Douglas-fir, and grand fir in Blue Mountains	FS
Mountain Hemlock	Stands of mountain hemlock and associated ponds along crest of Oregon Cascade Range near Waldo Lake	FS
North Hunting Island	Black cottonwood-Sitka spruce-willow community on island in lower Columbia River	FWS
Store Gulch	Mixed-evergreen forest and stream drainage along Illinois River on east slopes of Siskiyou Mountains in southwestern Oregon	FS
Swakane Canyon	Rare *Trifolium thompsonii* and associated meadow on eastern slopes of northern Washington Cascade Range	FS
The Island	Western juniper and big sagebrush on isolated plateau in Deschutes River of eastern Oregon	BLM-FS
Tiffany Mountain	Subalpine larch, alpine meadows, and ponds on eastern slopes of northern Washington Cascade Range	FS
Twin Creek	Enlarged area to include stream drainages in Sitka spruce-western hemlock forests on western slopes of Olympic Mountains	NPS
Twinbutte Creek	Southwestern Oregon mixed-conifer forest in South Umpqua River drainage	FS
Wickiup Springs	Shasta red fir forest over an elevational range on western slopes of southern Oregon Cascade Range	FS

[1] BLM= Bureau of Land Management, FS= Forest Service, NPS= National Park Service, FWS= Fish and Wildlife Service.

APPENDIX 11.
PARTIAL LIST OF PAST AND CURRENT STUDIES ON RESEARCH NATURAL AREAS

Research Natural Area	Subject of study	status	Institution
Abbott Creek	Vegetation classification of southwestern Oregon mixed-conifer forests	Completed	Oregon State University
Bluejay	Classification of ecosystems of Mazama pumice region	Current	**U.S.** Forest Service
Butter Creek	Classification of subalpine meadow communities of Washington Cascades	Current	Oregon and Utah State Universities
Coquille River Falls	Progression of *Phytophthora* root rot	Current	Oregon State University
	Ecology of Port-Orford-cedar	Current	Oregon State University
Goat Marsh	Productivity analysis of super-lative noble fir stand	Current	Coniferous Forest Biome (IBP)
Gold Lake Bog	Taxonomy of frogs	Completed	Oregon State University
Horse Ridge	Baseline bird and mammal populations in juniper savanna	Current	U.S. Fish and Wildlife Service
	Classification of juniper forests of eastern Oregon	Completed	U.S. Forest Service
Jackson Creek	Study of Olympic rain forest	Current	Western Washington State College
Little Sink	Floral and faunal studies of Willamette foothill forests and ponds	Current	Oregon College of Education
Lost Forest	Characteristics and explanation of the disjunct pine forest	Completed	Oregon State University
Maple Knoll	Bird communities in Willamette Valley forest communities	Completed	Oregon State University
Meeks Table	Range communities of Meeks Table	Completed	**U.S.** Forest Service
	Soils of eastern Washington Cascade Range	Current	U.S. Forest Service

Research Natural Area	Subject of study	Status	Institution
Metolius	Environmental effects on forest productivity	Current	Coniferous Forest Biome (IBP)
Neskowin Crest	Mammals of the Oregon coast	Current	University of Puget Sound
North Fork Nooksack	Characteristics of litter layers in northwestern forests	Completed	University of Washington
Ochoco Divide	Classification of the forests of the Blue Mountain region	Completed	U.S. Forest Service
Olallie Ridge	Disjunct flora of Oregon Cascades	Completed	University of Oregon
Pigeon Butte	Bird communities in Willamette Valley forest communities	Completed	Oregon State University
Port Orford Cedar	Progression of *Phytophthora* root rot	Current	Oregon State University
	Ecology of Port-Orford-cedar	Current	Oregon State University
Pringle Falls	Litter decomposition in pine forests	Current	Coniferous Forest Biome (IBP)
	Growth of ponderosa and lodgepole pine forests	Completed	U.S. Forest Service
	Seed production by ponderosa and lodgepole pine	Current	U.S. Forest Service
	Baseline bird and mammal population in ponderosa and lodgepole pine forests	Current	U.S. Fish and Wildlife Service
Rainbow Creek	Insect studies in larch forests	Current	U.S. Forest Service
Rattlesnake Hills	Variety of studies including productivity and cycling in different ecosystems, environment-community relationships, meteorology, vertebrate and invertebrate populations, food habits, hydrology, geology, soils, effects of burning on ecosystems, succession	Current	Battelle Memorial Institute, Energy Research and Development Administration, Washington State University, Grassland Biome (IBP)
	Plant communities of the Columbia Basin	Completed	Washington State University

Research Natural Area	Subject of study	status	Institution
Sister Rocks	Classification of subalpine communities in southern Washington	Completed	U.S. Forest Service
Steamboat Mountain	Cone and seed production by subalpine fir	Current	U.S. Forest Service
	Growth and succession in subalpine fir forest	Current	U.S. Forest Service
	Classification of subalpine communities in southern Washington	Current	U.S. Forest Service
Twin Creek	Vegetative study of Olympic rain forest	Current	Western Washington State College
Wheeler Creek	Mammals of the Oregon coast	Current	University of Puget Sound
Wildcat Mountain	Cone and seed production by noble and silver firs and mountain hemlock	Current	U.S. Forest Service
	Litter fall and decomposition in true fir-hemlock forests	Current	Coniferous Forest Biome (IBP)
	Productivity and nutrient balance in true fir-hemlock forests	Current	Coniferous Forest Biome (IBP)
	Classification of Oregon Cascade forest communities	Current	U.S. Forest Service
	Environment-forest community relationships in Oregon Cascade Range	Current	Coniferous Forest Biome (IBP)
	Distribution of vertebrate animals in relation to forest communities and environment	Current	Coniferous Forest Biome (IBP)
Willamette Floodplain	Composition, succession, and productivity in Willamette grasslands	Current	**U.S.** Forest Service, **U.S.** Fish and Wildlife Service
	Small mammal populations in Willamette prairies	Current	U.S. Forest Service, U.S. Fish and Wildlife Service
Wind River	Growth and mortality in old-growth Douglas-fir-hemlock forest	Current	U.S. Forest Service
	Seed survival of Douglas-fir in forest floor	Completed	U.S. Forest Service

APPENDIX 111.

WASHINGTON LEGISLATION ON RESEARCH NATURAL AREAS

HOUSE BILL NO. 482

State of Washington
42nd Legislature

by Representatives North, Moon and Cunningham

Second Extraordinary Session
Read first time January 19, 1972, and referred to Committee on Natural Resources and Ecology

AN ACT Relating to natural resources: and adding a new chapter to Title 79 RCW.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF WASHINGTON:

NEW SECTION. Section 1. The purpose of this chapter is to establish a state system of natural area preserves and a means whereby the preservation of these aquatic and land areas can be accomplished.

All areas within the state, except those which are expressly dedicated by law for preservation and protection in their natural conditions, are subject to alteration by human activity. Natural lands, together with the plants and animals living thereon in natural ecological systems, are valuable for the purposes of scientific research, teaching, as habitats of rare and vanishing species, as places of natural historic and natural interest and scenic beauty, and as living museums of the original heritage of the state.

It is, therefore, the public policy of the state of Washington to secure for the people of present and future generations the benefit of an enduring resource of natural areas by establishing a system of natural area preserves, and to provide for the protection of these natural areas.

NEW SECTION. Sec. 2. For the purposes of this chapter:

(1) "Department" shall mean the department of natural resources.

(2) "Natural areas" and "natural area preserves" shall mean such public or private areas of land or water which have retained their natural character, although not necessarily completely natural and undisturbed, or which are important in preserving rare or vanishing flora, fauna, archaeological, natural historical or similar features of scientific or educational value.

(3) "Public lands" and "state lands" shall have the meaning set out in RCW 79.01.004.

(4) "Committee" shall mean the Washington state natural preserves advisory committee created in section 5 of this chapter.

NEW SECTION. Sec. 3. In order to set aside, preserve and protect natural areas within the state, the department is authorized, in addition to any other powers, to:

(1) Establish by rule and regulation the criteria for selection, acquisition, management, protection and use of such natural areas;

(2) Cooperate and contract with any federal, state, or local governmental agency, private organizations or individuals in carrying out the purpose of this chapter;

(3) Acquire by gift, device, purchase, grant, dedication, or means other than eminent domain, the fee or any lesser right or interest in real property which shall be held and managed as a natural area; and

(4) Acquire by gift, device, grant or donation any personal property to be used in the acquisition and/or management of natural areas;

(5) Inventory existing public, state and private lands in cooperation with the committee to assess possible natural areas to be preserved within the state.

NEW SECTION. Sec. **4.** The department is further authorized to purchase, lease, set aside or exchange any public land or state-owned trust lands which are deemed to be natural areas: PROVIDED, That the appropriate state land trust receives the fair market value for any interests that are disposed of: ,PROVIDED, FURTHER, That such transactions are approved by the board of natural resources.

An area consisting of public land or state-owned trust lands designated as a natural area preserve shall be held in trust and shall not be alienated except to another public use upon a finding by the department of natural resources of imperative and unavoidable public necessity.

NEW SECTION. Sec. 5. A Washington state natural preserves advisory committee is hereby created within the department of natural resources to assist the department in carrying out the intent of this chapter. Such committee shall consist of seven members appointed by the commissioner of the department. Any vacancies shall be filled in the same manner. Members shall be chosen from persons with an interest in the establishment of natural areas and shall serve a period of three years.

NEW SECTION. Sec. 6. Nothing in this chapter is intended to supersede or otherwise affect any existing legislation.

Passed the House February 16, 1972.

Speaker of the House.

Passed the Senate February 12, 1972.

President of the Senate.

Approved February 24, 1972

Governor of the State of Washington

APPENDIX IV.

OREGON LEGISLATION ON RESEARCH NATURAL AREAS

OREGON LEGISLATIVE ASSEMBLY—1973 REGULAR SESSION

HOUSE BILL 2232

Ordered by the Senate June 23

(Including Amendments by House Committee on Environment and Land Use March 22 and by Senate June 5 and June 23)

Sponsored by Representatives INGALLS, PAULUS, PERRY, FADELEY, KATZ, WHITING

Authorizes State Land Board to establish natural area preserves for educational and scientific use of natural areas. Defines "natural area." Provides that no land be included within natural area unless it is in public ownership on effective date of Act or is acquired after effective date of Act by method requiring no expenditure of public funds for acquisition. Prohibits use, by board, of condemnation to acquire lands or interests therein for natural area preserves. Prescribes procedures for establishment of natural areas under jurisdiction of board or by agreement with other public agency. Creates Natural Area Preserves Advisory Committee within board to assist board in carrying out Act. Provides for composition, term, and compensation of committee members.

Establishes Natural Area Preserves Account. Appropriates moneys in account for purpose of carrying out this Act.

A BILL FOR AN ACT

Relating to the preservation of natural areas; and appropriating money.

Be it Enacted by the People of the State of Oregon:

SECTION 1. (1) The Legislative Assembly finds that all public lands and waters within the state that constitute natural areas are subject to alteration by human activities unless such public lands and waters are preserved and protected for the use and benefit of the people of this state. The Legislative Assembly further finds that natural areas are valuable to the people of this state for educational and scientific uses, for habitats for plant, animal, and marine species, for the preservation of the paleontological resources and the natural historic features of such public lands and waters, for public benefits from the features of such public lands and waters and for the purpose of preserving such public lands and waters as living museums of the natural heritage of this state.

(2) The Legislative Assembly, therefore, declares that it is the public policy of the State of Oregon to secure for the people of this state the benefits of an enduring resource of natural areas by establishing a system of natural area preserves and by providing for the management and protection of such natural area preserves.

SECTION 2. As used in this Act, unless the context requires otherwise:

(1) "Board" means the State Land Board.

(2) "Committee" means the Natural Area Preserves Advisory Committee created in section 3 of this Act.

(3) "Natural area" includes land and water that has substantially retained its natural character and land and water that, although altered in character, is important as habitats for plant, animal or marine life, for the study of its natural historical, scientific or paleontological features, or for the appreciation of its natural features.

SECTION 3. (1) There hereby is created a Natural Area Preserves Advisory Committee as an advisory committee to the State Land Board. The committee shall assist the board in carrying out the provisions of this Act.

(2) The committee shall consist of seven members appointed by the Governor. Of the seven members appointed by the Governor to the committee, one member shall be an individual with an advanced degree in botany, one member shall be an individual with an advanced degree in zoology, one member shall bean individual with an advanced degree in aquatic biology, one member shall be an individual with an advanced degree in geology and three members shall be individuals interested in the preservation of natural areas in this state.

(3) In addition to the seven members appointed by the Governor, the State Game Director, the State Forester, the Administrator of Highways and the Chancellor of the State Board of Higher Education or an authorized representative of each such officer, shall serve as ex officio, nonvoting members of the committee.

(4) The term of office of a member, appointed under subsection (2) of this section, is three years, but each such member serves at the pleasure of the Governor. Before the expiration of the term of each such member, the Governor shall appoint a successor whose term of office begins on July 1 next following. A member, appointed under subsection (2) of this section, is eligible for reappointment. If there is a vacancy for any cause, the Governor shall make an appointment to become immediately effective for the unexpired term.

SECTION 4. (1) In carrying out the provisions of this Act, the board, with the advice of the committee, and within available funds, may:

(a) Adopt, in accordance with the applicable provisions of ORS chapter 183, rules that it considers necessary in carrying out this Act;

(b) Adopt policy guidelines for its use in the selection, acquisition, management, protection and use of public lands included within the boundaries of natural area preserves established under section 5 of this Act; and

(c) Conduct a survey of lands in this state to locate lands that it considers suitable for inclusion within a natural area preserve established under this Act and maintain a registry of such lands.

(2) In carrying out the provisions of this Act, the board may:

(a) Cooperate and contract with any federal, state or local governmental agency or private organization;

(b) Acquire by gift, devise, grant, dedication or other method, other than by the exercise of the power of eminent domain, any private or public land or interest therein for inclusion in a natural area preserve established under this Act;

(c) Acquire by gift, devise, grant, dedication or other method, other than by the exercise of the power of eminent domain, any personal property that the board considers necessary;

(d) Apply for and accept grants, contributions and assistance from any federal, state or local governmental agency and any private foundation; and

(3) Perform other duties considered by it to be necessary in carrying out this Act.

SECTION 5. (1) With the advice of the committee, the board, in compliance with ORS chapter 183, may:

(a) Establish, by order, natural area preserves on lands in public ownership composed of contiguous lands; and

(b) Change the boundaries of natural area preserves and alter the uses and conditions for use of such preserves upon a finding by it that such change or alteration is necessary in carrying out the purposes of this Act.

(2) Each order of the board establishing a natural area preserve shall contain a legal description of the lands within the preserve, the reasons for the establishment of the preserve, any conditions upon the use of the lands in the preserve and other matters that the board considers necessary. Each such order shall be in compliance with the policy guidelines adopted by the board under paragraph (b) of subsection (1) of section 4 of this Act.

(3) The lands within a natural area preserve established under subsection (1) of this section shall be held for public use as may be specified by the board. Such lands may not be leased, sold, exchanged or otherwise transferred by the board except for another purpose upon a finding by the board, after consultation with the committee, of imperative and unavoidable necessity.

SECTION 6. (1) The board may enter into agreements with any public agency, having public lands suitable for inclusion within a natural area preserve under its jurisdiction, for the inclusion of such lands within a natural area preserve.

(2) Each such agreement shall specify the term of the agreement, the uses and conditions for the use of the public land as a part of a natural area preserve and a finding by the board and the public agency that the use of the public land subject to the agreement as a part of a natural area preserve is in the best interests of the people of this state. Each such agreement shall establish the respective responsibilities of the board and the public agency in the management and protection of such land.

(3) The board may include within the boundaries of a natural area preserve any state-owned lands under its jurisdiction.

SECTION 7. (1) All agencies, departments, boards and commissions of this state shall cooperate with and assist the State Land Board in carrying out this Act.

(2) The Legislative Assembly declares that the inclusion of suitable state-owned lands within natural area preserves constitutes a valid public purpose for the use of such lands.

SECTION 8. The Natural Area Preserves Account is established within the General Fund of the State Treasury. All moneys in the account are continuously appropriated for the use of the board in carrying out this Act.

SECTION 9. No land shall be included within a natural area unless it is either:

(1) In public ownership on the effective date of this Act; or

(2) Is acquired after the effective date of this Act by gift, devise, grant, dedication or other method requiring no expenditure of public funds for the acquisition.

APPENDIX V.

A CLASSIFICATION OF GEOMORPHIC PROVINCES AND SUBPROVINCES FOR OREGON AND WASHINGTON

It is important that the Research Natural Area System represent the major landforms and soil types found in Oregon and Washington. That is, in selecting areas representative of different terrestrial and freshwater ecosystems, topography and soils should be considered and weighted toward areas typical of broader areas. In this way the baseline data and research findings from a Research Natural Area can be more readily extrapolated to the extensively managed areas of similar type. As a first step toward insuring good representation of geologic and edaphic features, we have related many of the listed Research Natural Area needs to the geomorphic classification of the region outlined below. The system has been developed and is being used by the Pacific Northwest Region (Region 6), U.S. Forest Service, and was provided by John Corliss of that office.

Olympic Province

Character type reflects extensive glaciation. All main river valleys are broad and U-shaped, while major peaks are ringed with cirques, many containing active glaciers. Extremely high precipitation has caused rapid downcutting by streams and with glaciation has resulted in precipitous mountain slopes. These rugged mountains provide a central core surrounded by almost level lowlands which have resulted from deposition of glacial outwash.

Subprovince code No.	Description
0101	Glaciated, steep, long mountain slopes (National Park)
0102	Glaciated, steep, long mountain slopes, timbered (Shelton Ranger District)
0103	Glaciated, steep, long, dissected mountain slopes, timbered (Forks Burn area)
0104	Coastal plain (Lapush)
0105	Subalpine and alpine peaks

Coast Range Province

This character type reflects steep mountain slopes with ridges that are often extremely sharp. The ridge system is usually parallel to the coast but, being extremely dissected, often appears confused. The topography varies from nearly level along the dunal sheet, to abrupt and steep along the western edges, to more gentle along the eastern fringes. Scattered peaks, often barren, rise well above surrounding ridges.

Subprovince code No.	Description
0201	Coastal headlands (Cascade Head)
0202	Rounded, dissected mountain slopes (Willapa Hills)
0203	Short, highly dissected mountain slopes (Smith River)
0204	Steep, long mountain slopes (Mount Hebo)
0205	Complex of steep, dissected, and uneven mountain slopes (Mapleton Ranger District)
0206	Steep, long mountain slopes (Tillamook volcanics)
0207	Dunal sheet (Dunes National Recreation Area)

Siskiyou Province

This character type reflects an ancient and now greatly dissected, uplifted plain; however, some peaks rise above this dissected surface.

Subprovince code No.	Description
0301	Drainage basin (Medford-Grants Pass)
0302	Steep, uneven, dissected mountain slopes (Powers Ranger District)
0303	Steep, long mountain slopes (Mount Ashland)
0304	Steep, uneven, highly dissected mountain slopes (Mineral Hill)
0305	Steep, uneven mountain slopes
0306	Steep, long, highly dissected mountain slopes

Puget Sound Basin Province

Character type reflects massive continental glaciation, which formed an area of low relief broken by sounds, low moraine ridge systems, rounded hummocks, and lakes.

Subprovince code No.	Description
0401	Coastal plain
0402	Morainal features with islands
0403	Outwash plain
0404	Rolling moraine

Willamette Basin Province

This character type reflects a structural depression, modified visually by hills of low relief and alluvium deposited from ancient floods. The valley floor has a very gentle northerly slope, interspersed with sluggish, meandering streams.

Subprovince code No.	Description
0501	Flood plain—Recent (Willamette River and tributary)
0502	Lacustrine plains (agricultural lands)
0503	Foothills (Salem hills)
0504	Steep, short mountain slopes (Chehalem Mountain)

Western Cascades Province

This character type reflects a slightly folded and uplifted accumulation of weathered volcanic flows. The area is characterized by general conformity in ridge crests separated by deep valleys with steep, highly dissected slopes. Glacial features are evident but, being the result of less alpine glaciation, not as pronounced as found in the northwestern Cascades character. In the southern portion of the western Cascades, major valleys are V-shaped. Peaks over 7,000 feet are uncommon.

Subprovince code No.	Description
0601	Gorge
0602	Glaciated, steep, long mountain slopes (Salmon River)
0603	Foothills (Silver Falls)
0604	Steep, dissected mountain slopes (Bohemia)
0605	Steep, long mountain slopes (Rhododendron Ridge—Bull of the Woods)
0606	Steep, uneven mountain slopes (Dickey Creek)
0607	Rolling, plateau remnants (Bull Run country)

Northwestern Cascades Province

This character type is composed of sharp, jagged peaks and deep, steep-sloped valleys resulting mostly from alpine glaciation. A striking topographic feature is the approximately uniform elevation of the main ridgetops. Towering above these relatively even crests are two dormant volcanoes (Mount Baker and Glacier Peak) as well as several granitic peaks of exceptional height. Glacial features are common with literally hundreds of cirques; and some peaks ringed by cirques have been eroded to horns. Main stream valleys contain deep accumulations of glacial debris.

Subprovince code No.	Description
0701	Glacial valleys (Skagit River)
0702	Glaciated, steep, long mountain slopes with snow chutes
0703	Glaciated, steep, long mountain slopes—timbered
0704	Alpine and subalpine (Mount Baker) (peaks, meadow, etc.)

Northeastern Cascades Province

This character type is glacial sculpturing which has created an area of great relief with steep-sided, very deep valleys and long finger lakes. The area is made up of granitic batholiths, folded and in part metamorphosed, sedimentary rocks with ridgetops having approximately uniform crest elevations. The area reflects extensive glaciation, but cirques and horns are not as common as in the Northwestern Cascades character type.

Subprovince code No.	Description
0801	Glacial valleys (Cle Elum)
0802	Glaciated, steep, long mountain slopes with snow chutes (Stevens Pass)
0803	Glaciated, steep, long mountain slopes—timbered (Entiat)
0804	Alpine and subalpine (peaks, meadows, etc.)
0805	Plateau remnants (Table Mountain)
0806	Dissected mountain slopes (Mission Ridge)
0807	Tilted, dissected plateau land (Taneum)
0808	Finger lake (Lake Chelan)

Recent (High) Cascades Province

This character type consists of a volcanic plateau capped by shield volcanoes, cinder cones, and other volcanic forms, all of which are in various stages of dissection. It is essentially an area of gently sloping terrain interrupted at intervals by glaciated channels in the major drainages. The area is dotted with volcanic peaks and cones rising 150 to 5,000 feet above the surrounding landscape.

Subprovince code No.	Description
0901	Alpine and subalpine (Mount Hood)
0902	Plateau (Huckleberry Mountain)
0903	Glaciated, steep, long mountain slopes with snow chutes (northern half)
0904	Glaciated, steep, long mountain slopes
0905	Pumice-mantled outwash plain with craters and lakes (Cascade Lake Highway)

Okanogan Highlands Province

This character type reflects repeated continental glaciation, resulting in a generally rolling terrain of moderate slopes and broad, rounded summits. There is a scattering of peaks rising 3,000 to **4,000** feet above the general terrain, dividing the area into several upland areas separated by a series of broad north-south river valleys.

Subprovince code No.	Description
1001	Glaciated valleys (Methow)
1002	Plateaus (Omak Plateau)
1003	Glaciated, steep, long mountain slopes (Okanogan Range)
1004	Glaciated, rolling mountain slopes
1005	Low, rolling morainal features—grass covered
1006	Canyon lands (Columbia River)

Columbia Basin Province

This character type reflects the Columbia River basalt plateau which has been modified by glacial outwash floods and wind to form coulees, scablands, and rolling loess hills. Steep slopes are of limited occurrence and restricted to isolated basaltic buttes or canyons carved by some of the major rivers.

Subprovince code No.	Description
1101	Dissected basalt plateau land (Condon)
1102	Lacustrine plains (Quincy Basin)
1103	Coulees (Grand Coulee)
1104	Channeled scablands (Crab Creek)
1105	Rolling loess hills (Palouse)
1106	Outwash valleys (Yakima)
1107	Folded basalt ridges (Horse Heaven)
1108	Outwash plain (Waterville Plateau)
1109	Basalt plateau (Rattlesnake Ridge)
1110	Sand dunes (Richland)

Blue Mountains Province

This character type reflects several ranges of mountains separated by faulted valleys, synclinal.(downfolded) basins, and lava plateaus. Topographic relief in the mountains is highly variable, with moderately steep slopes common.

Subprovince code No.	Description
1201	Dissected basalt and plateau land (Pendleton Ranger District)
1202	Lacustrine plains (Baker, Enterprise)
1203	Dissected basalt plateau land, grass covered (Imnaha)
1204	Steep, long mountain slopes (Dixie Mountain)
1205	Subalpine and alpine (Strawberry Mountain)
1206	Steep, short, dissected mountain slopes (Murderers Creek)
1207	Steep, short, highly dissected rolling lands (Vale)
1208	Dissected rhyolite plateau land-transition forest (Sagehen Hills)
1209	Badlands (Painted Hills)
1210	Lacustrine plain-high desert (Summit Prairie and Fox Basin)
1211	Canyon lands (Snake River)

Harney Basin Province

This character type reflects a young, relatively uniform expanse of lava flows of moderate relief in part mantled by pumice and ash falls and dotted with scattered cinder cones and lava buttes. Porous soil and bedrock and scanty rainfall cause many streams to be seasonal. Undrained basins containing shallow lakes, some dry and others with fluctuating levels, are common. Evidence of violent volcanic activity is abundant in the western portions, with the Paulina Peak shield volcano being the dominant feature. Outstanding examples of recent lava flows are near Lava Butte and Fort Rock.

Subprovince code No.	Description
1301	Rhyolite plateau land (Dog Mountain)
1302	Lacustrine basin-lakebeds (Harney Basin)
1303	Pumice-mantled, cinder cone, plateau land (Bend)
1304	Volcano-caldera (Newberry)
1305	Recent basalt flow (Lava Butte)
1306	Pumice-mantled plateau land (Fort Rock)

Upper Basin and Range Province

This character type reflects fault block mountains enclosing basins with internal drainage at generally higher elevations than the main Basin and Range Province. These formations create predominantly horizontal profiles in mountain silhouette with occasional cone-shaped features. Precipitation is moderate, coming mostly as snow; most streams are perennial; and numerous undrained basins contain shallow lakes and marshes.

Subprovince code No.	Description
1401	Fault block mountains (Yainax Butte)
1402	Graben valleys
1403	Rolling sagebrush lands (Bly Ranger District)
1404	Dissected plateau lands (Paisley Ranger District)
1405	Lacustrine basin-marshes (Klamath)
1406	Pumice-mantled rolling hills—high elevation (Antelope Flats)
1407	Alpine and subalpine (Yamsay Mountain)

Basin and Range Province

This character type reflects fault block mountains enclosing basins with internal drainage. These formations create predominantly horizontal profiles in mountain silhouette. Except for slopes of the fault block mountains, the area is rolling with low relief. Rainfall is scanty, most streams are intermittent, and numerous undrained basins contain shallow, saline lakes.

Subprovince code No.	Description
1501	Alpine and subalpine (Steens Mountain)
1502	Lacustrine basin-lake beds
1503	Active sand dunes
1504	Canyon lands (Owyhee)
1505	Fault block mountain (Hart Mountain)
1506	Graben valleys (Alvord Desert)
1507	Rolling sagebrush land, low relief
1508	Pumice-mantled plateau land (Chemult)

Cowlitz River Basin Province

This character type reflects a structural depression occupied by the lower and middle Cowlitz River. Uplands of rolling hills of low relief composed of volcanic geologic materials are the dominant terrain feature. Lacustrine plains, terraces, and flood plains adjacent to the rivers occupy proportionately less area than in the Willamette Basin Province. The area has an overall southerly slope.

Subprovince code No.	Description
1601	Flood plain
1602	Outwash plain
1603	Foothills
1604	Steep, short mountain slopes

Wallowas Province

This character type reflects a mountainous "island" surrounded by lava plateaus. These mountains are part of the Blue Mountains Province but are distinctive, as alpine glaciation has created a very precipitous and rugged mountainous area. Cirques, glacial lakes, and moraines are common. The relief in the Wallowas is much greater than in the Blue Mountains type.

Subprovince code No.	Description
1701	Alpine and subalpine
1702	Basalt plateau (Tamarack Flat)
1703	Dissected basalt plateau (Minam)
1704	Glaciated, steep, long mountain slopes

APPENDIX VI.

LISTS OF VERTEBRATE ANIMALS OF SPECIAL INTEREST IN WASHINGTON AND OREGON

These inventories of animals considered to be of special interest are aimed at calling attention to them. Only those species marked with an asterisk were included in rare and endangered cells, as they were considered to be compatible with protection in Research Natural Areas. The animals listed represent a fragile segment of our biological heritage and, as such, merit our constant surveillance and stewardship.

Vertebrate animals in the following lists which also appear in the **1973** edition of "Threatened Wildlife of the United States" (Red Book) **(U.S.** Bureau of Sport Fisheries and Wildlife) are so indicated.

The vertebrate animal species which appear in the following lists may be in one of a number of different categories defined in the report of the Rare and Endangered Species Working Group. These categories include rare, uncommon, endangered, threatened, peripheral, unique, and status undetermined. Since these criteria have been used thus far solely for the classification of mammals of special interest in Oregon and Washington, they are the only lists in which status is indicated for each species.

Mammal species identified as "threatened" or "endangered" in these lists are according to the criteria laid down in "Report of Rare and Endangered Species Working Group" (pt. IV) and carry no *official* status. The only species having legal status as threatened or endangered are those so designated by the Secretary of the Interior according to the provisions of the Endangered Species Act of **1973.**

Fishes of Special Interest in Washington'

*****_Novumbra hubbsi,_ Olympic mudminnow
Rhinichthysfalcatus, leopard dace
Percopsis transmontana, sand roller
Gasterosteus aculeatus microcephalus, black stickleback

Fishes of Special Interest in Oregon[2]

Lampetra ayresi, river lamprey
Lampetra richardsoni, Western brook lamprey
Lampetra lethophaga, Pit-Klamath brook lamprey
***Salmo** clarki* subsp., Alvord cutthroat trout
Salmo sp., redband trout
Salvelinus malma, Klamath Basin representative of Dolly Varden
***Gila** bicolor* subsp., catlow tui chub
Gila alvordensis, Alvord chub
*****_Hesperoleucus symmetricus_, California roach

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[1] **Richard S. Wydoski compiled this list in 1973; it was sent to us by Dick Whitney, University of Washington, in 1974.**

[2] **Carl E. Bond, Oregon State University, updated this list in 1974.**

***Animal** has **been identified as a rare and endangered cell.**

Hybopsis crameri, Oregon chub
Rhinichthys cataractae subsp., Millicoma dace
Rhinichthys osculus subsp., Fosket Spring dace
Rhinichthys falcatus, leopard dace
**Richardsonius egregius*, Lahontan redside
Catostomus luxatus, Lost River sucker
Catostomus (*rimiculus* subsp. ?), Jenny Creek sucker
**Catostomus tahoensis*, Tahoe sucker
Catostomus warnerensis, Warner sucker
Chasmistes brevirostris, shortnose sucker
Percopsis transmontana, sand roller
**Cottus bairdi* subsp., Malheur sculpin
Cottus princeps, Klamath Lake sculpin

Reptiles and Amphibians of Special Interest in Washington[3]

**Plethodon dunni*, Dunn salamander
**Plethodon larselli*, Larch Mountain salamander
***Bufo woodhousei*, Woodhouse toad
Rana clamitans, green frog
**Clemmys marmorata*, western pond turtle
**Gerrhonotus multicarinatus scincicauda*, Oregon alligator lizard
**Diadophis punctatus amabilis*, Pacific ringnecked snake
**Contia tenuis*, sharp-tailed snake
**Masticophis taeniatus*, striped whipsnake
**Lampropeltis zonata*, California mountain kingsnake
**Hypsiglena torquata*, night snake

Reptiles and Amphibians of Special Interest in Oregon[4]

**Plethodon larselli*, Larch Mountain salamander
**Plethodon elongatus*, Del Norte salamander
**Plethodon stormi*, Siskiyou Mountain salamander
**Plethodon gordoni*, Marys Peak salamander
***Batrachoseps wrighti*, Oregon slender salamander
**Batrachoseps attenuatus*, California slender salamander
**Aneides flavipunctatus*, black salamander
**Ascaphus truei*, tailed frog
**Rana pretiosa*, spotted frog
Crotaphytus collaris, collared lizard
Crotaphytus wislizeni, leopard lizard
Phrynosoma platyrhinos, desert horned lizard
Cnemidophorus tigris, Western whiptail
**Contia tenuis*, sharp-tailed snake
***Lampropeltis getulus*, common kingsnake
**Lampropeltis zonata*, California mountain kingsnake
**Crotalus viridis*, Western rattlesnake

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[3] Murray L. Johnson, University of Puget Sound, prepared this list in 1974.
[4] Robert M. Storm, Oregon State University, updated this list in 1974.
*Animal has been identified as a rare and endangered cell.

Birds of Special Interest in Washington[5] [6]

Diomedea cauta cauta, Tasmanian white-capped albatross
Pufcfinus carneipes, pale-footed shearwater
Pufcfinus bulleri, New Zealand shearwater
Puffinus puffinus opisthomelas, black-vented shearwater
Phaeton aethereus mesonauta, Northern red-billed tropic-bird
Pelecanus erythrorhynchos, white pelican
Pelecanus occidentalis californicus, California brown pelican[7]
Sula nebouxii nebouxii, Northern blue-footed booby
Butorides virescens anthonyi, Anthony's green heron
Bulbucus ibis ibis, cattle egret
Casmerodius albus egretta, common egret
Leucophoyx thula brewsteri, Brewster's snowy egret
Botaurus lentiginosus, American bittern
Plegadis chihi, white-faced ibis
Olor buccinator, trumpeter swan
Branta canadensis leucopareia, Aleutian Canada goose[7]
Branta canadensis parvipes, lesser Canada goose
Branta bernicla hrota, American brant
Philacte canagica, emperor goose
Dendrocygna bicolor helva, Northern fulvous tree duck
Anas rubripes, black duck
Anas penelope, European widgeon
Somateria mollissirnu nigra, Pacific common eider
Somateria spectabilis, king eider
Melanitta deglandi deglandi, white-winged scoter
Cathartes aura teter, turkey vulture
Gymnogyps californianus, California condor
Buteo jamaicensis alascensis, Alaska red-tailed hawk
Buteo lagopus johannis, American rough-legged hawk
Buteo regalis, ferruginous hawk
Aquila chrysaetos canadensis, golden eagle
Haliaeetus leucocephalus alascanus, Northern bald eagle
Pandion haliuetus carolinensis, American osprey
Caracara cheriway audubonii, caracara
Falco rusticolus obsoletus, gyrfalcon
Falco rusticolus uralensis, Asiatic gyrfalcon
Falco mexicanus, prairie falcon
Falco peregrinus anatum, American peregrine falcon
Fako peregrinus pealei, Peale's falcon
Fako columbarius suckleyi, black pigeon hawk
Falco *columbarius bendirei,* Western pigeon hawk
Falco sparverius sparverius, Western sparrow hawk
Dendragapus obscurus richardsonii, Richardson's blue grouse
Pediocetes phasianellus columbianus, Columbian sharp-tailed grouse
Centrocercus urophasianus phaios, Western sage grouse
Rallus limicola limicola, Virginia rail
Coturnicops noveboracensis noveboracensis, yellow rail
Eupoda montana, mountain plover

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[5] Because of their wide-ranging habit, only two species have been given natural area cell status.
[6] Gordon D. Alcorn, University of Puget Sound, updated this list in 1974.
[7] Species is on national list of threatened and endangered animals (U.S. Bureau of Sport Fisheries and Wildlife 1973).

Eudromias morinellus, dotterel
Numenius americanus parvus, long-billed curlew
Bartramia longicauda, upland plover
Tringa solitaria solitaria, solitary sandpiper
Catoptrophorus semipalmatus inornatus, western willet
Calidris canutus canutus, Pacific knot
Calidris canutus rufa, American knot
Calidris acuminata, sharp-tailed sandpiper
Calidris fuscicollis, white-rumped sandpiper
Calidris bairdii, Baird's sandpiper
Calidris pusilla, semipalmated sandpiper
Tryngites subruficollis, buff-breasted sandpiper
Limosa fedoa, marbled godwit
Limosa haemastica, Hudsonian godwit
Himantopus mexicanus, black-necked stilt
Stercorarius pomarinus, pomarine jaeger
Stercorarius longicaudus, long-.tailedjaeger
Catharacta skua antarctica, Falkland skua
Catharacta skua lonnbergz, brown skua
Larus hyperboreus barrovianus, glaucous gull
Larus glaucoides glaucoides, Iceland gull
Larus pipixcan, Franklin's gull
Sterna *paradisaea*, Arctic tern
Hydroprogne caspia, Caspian tern
Endomychura hypoleuca scrippsi, Xantus' murrelet
Fratercula corniculata, horned puffin
Bybo virginianus wapacuthu, Arctic horned owl
Nyctea scandiaca, snowy owl
Surnia ulula caparoch, American hawk-owl
**Speotyto cunicularia hypugaea*, Western burrowing owl
Strix varia, barred owl
Strix nebulosa nebulosa, great gray owl
Aegolius funereus richardsoni, boreal owl
Eremophila alpestris strigata, streaked horned lark
Aphelocoma coerulescens immanis, Oregon scrub jay
**Parus hudsonicus cascadensis*, Cascade boreal chickadee
Pam *rufescens rufescens*, chestnut-backed chickadee
Psaltriparus minimus minimus, coast bushtit
Sitta canadensis, red-breasted nuthatch
Certhia familiaris occidentalis, tawny brown creeper
Chamaea fasciata phaea, wrentit
Telmatodytes palustris paludicola, Tule wren
Catharus guttata polionta, white mountain hermit thrush
Sialia mexicana occidentalis, Western bluebird
Regulus satrapa olivaceus, Western golden-crowned kinglet
Regulus calendula grinnelli, Sitka kinglet
Acridotheres cristatellus cristatellus, crested myna
Vireo huttoni huttoni, Hutton's vireo
Vireo solitarius cassinii, Cassin's vireo
Vireo olivaceus, red-eyed vireo
Vireo gilvus swainsonii, Western warbling vireo
Mniotilta varia, black-and-white warbler
Vermivora peregrina, Tennessee warbler

*Animal has been identified as a rare and endangered cell.

Vermivora celata celata, orange-crowned warbler
Vermivora celuta lutescens, lutescent warbler
Dendroica coronata coronata, myrtle warbler
Dendroica coronata audubоni, Audubon's warbler
Dendroica coronata memorabilis, Western Audubon's warbler
Dendroica nigrescens, black-throated gray warbler
Seiurus noveboracensis notabilis, Northern waterthrush
Oporornis tolmiei tolmiei, McGillivray's warbler
Geothlypis trichas campicola, Western yellowthroat
Geothlypis trichas arizela, Pacific yellowthroat
Setophaga ruticilla tricolora, North American redstart
Sturnella neglecta confluenta, Western meadowlark
Passerina amoena, Lazuli bunting
Pinicola enucleator alascensis, Alaska pine grosbeak
Pinicolu enucleator flammula, Kodiak pine grosbeak
Leucosticte tephrocotis tephrocotis, Swainson's gray-crowned rosy finch
Pooecetes aramineus affinis, Oregon vesper sparrow
Junco hyemalis cismontanus, Cassiar slate-colored junco
Junco hyemalis montanus, interior slate-colored Oregon junco
Spizella arborea ochracea, tree sparrow
Zonotrichia querula, Harris' sparrow
Passerella iliaca zaboria, Yukon fox sparrow
Melospiza melodia montana, mountain song sparrow
Melospiza melodia kenaiensis, Kenai song sparrow
Melospiza melodia caurina, Yakutat song sparrow

Birds of Special Interest in Oregon[8] [9]

Podiceps grisegena holbollii, Holboell's red-necked grebe
Podiceps auritus, horned grebe
Oceanodroma furcata plumbea, Southern fork-tailed petrel
Pelecanus erythrorhynchos, white pelican
Pelecanus occidentalis californicus, California brown pelican[10]
Casmerodius albus egretta, common egret
Leucophoyx thula brewsteri, Brewster's snowy egret
Ixobrychus exilis hesperis, Western least bittern
Plegadis chihi, white-faced ibis
Olor buccinator, trumpeter swan
Branta canadensis leucopareia, Aleutian Canada goose[10]
Anser albifrons gambelli, Tule white-fronted goose
Aythya collaris, ring-necked duck
Aythya affinis, lesser scaup
Bucephala islandica, Barrow's goldeneye
Bucephala albeola, bufflehead
Histrionicus histrionicus, harlequin duck
Buteo swainsoni, Swainson's hawk
Buteo regalis, ferruginous hawk
Haliaeetus leucocephalus ahcanus, Northern bald eagle
Pandion haliaetus carolinensis, American osprey
Falco mexicanus, prairie falcon
Falco peregrinus anatum, American peregrine falcon[10]

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[8] Because of their wide-ranging habit, only two species have been given natural area cell status.
[9] David B. Marshall, U.S. Fish and Wildlife Service, prepared this list in 1969.
[10] Species is on national list of threatened and endangered animals (U.S. Bureau of Sport Fisheries and Wildlife 1373).

Falco columbarius bendirei, Western pigeon hawk
Dendragapus obscurius sierrae, Sierra blue grouse
Canachites canadensis franklinii, Franklin's spruce grouse
Pedioecetes phasianellus columbianus, Columbian sharp-tailed grouse
Grus canadensis tabida, greater sandhill crane
Coturnicops noveboracensis novebmacensis, yellow rail
Charadrius alexandrinus nivosus, Western snowy plover
Bartramia longicauda, upland plover
Limnodromus griseus caurinus, Alaskan short-billed dowitcher
Himantopus mexicanus, Black-necked stilt
Larus pipixcan, Franklin's gull
Hydroprogne caspia, Caspian tern
Brachyramphus marmoratum marmoratum, American marbled murrelet
Cerorhinca monocerata, rhinoceros auklet
Coccyzus americanus occidentalis, California yellow-billed cuckoo
Otus asio bendirei, California screech owl
Otus flammeolus, flammulated owl
Glaucidium gnoma californicum, California pygmy owl
**Strix occidentalis caurina*, Northern spotted owl
Strix nebulosa nebulosa, great gray owl
**Speotyto cunicularia hypugaea*, Western burrowing owl
Phalaenoptilus nuttallii californicus, dusky poor-will
Selasphorus sasin, Allen's hummingbird
Picoides tridactylus fasciatus, Alaska Northern three-toed woodpecker
Sayornis phoebe, Eastern phoebe
Sayornis *nigricans semiatra*, black phoebe
Progne subis subis, Northern purple martin
Aphelocoma coerulescens nevadae, Nevada scrubjay
Aphelocoma coerulescens oocleptica, Nicasio scrubjay
Parus inornatus zaleptus, Warner Valley titmouse
Thryomanes bewickii atrestus, Warner Valley Bewick's wren
Mimus polyglottos leucopterus, Western mockingbird
Dumetella carolinensis, catbird
Hylocichla fuscescens salicicola, willow veery
Polioptila caerulea amoenissima, Western blue-gray gnatcatcher
Anthus spinoletta pacificus, Western water pipit
Bombycilla garrula pallidiceps, Bohemian waxwing
Vireo huttoni huttoni, Hutton's vireo
Setophaga ruticilla tricolora, North American redstart
Dolichonyx oryzivorus, bobolink
Agelaius tricolor, tricolored blackbird
Pinicola enucleator montana, Rocky Mountain pine grosbeak
Leucosticte tephrocotis wallowa, Wallowa gray-crowned rosy finch
Leucosticte atrata, black rosy finch
Ammodramus savannarum perpallidus, Western grasshopper sparrow
Amphispiza bilineata deserticola, desert black-throated sparrow

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***Animal has been identified as a rare and endangered cell.**

'Mammals of Special Interest in Washington'[1]

Didelphis virginiana, Virginia opossum (introduced), Uncommon
**Sorex cinereus hollisteri*, masked shrew, Rare
**Sorex cinereus cinereus*, masked shrew, Uncommon
**Sorex preblei*, Malheur or Preble shrew, Rare
***Sorex** *merriumi*, Merriam shrew, Rare
**Microsorex hoyi*, pygmy shrew, Rare
Myotis keeni, Keen bat, Rare
Myotis evotis, long-eared bat, Uncommon
Myotis thysanodes, fringed bat, Rare
Myotis volans, long-legged bat, Rare
Myotis leibii, small-footed bat, Rare
Lasionycteris noctiuagans, silver-haired bat, Rare
Lasiurus cinereus, hoary bat, Rare
Antrozous pallidus, pallid bat, Rare
***Sylvilagus** *idahoensis*, pygmy rabbit, Threatened
**Lepus townsendi*, white-tailed jack rabbit, Uncommon
***Spermophilus** *washingtoni*, Washington ground squirrel, Uncommon
**Sciurus griseus*, Western gray squirrel, Uncommon
Sciurus niger, fox squirrel (introduced), Uncommon
Thomomys talpoides limosus, Northern pocket gopher, Uncommon
Thomomys talpoides douglasi, Northern pocket gopher, Threatened
Thomomys mazama couchi, Western pocket gopher, Rare
Thomomys mazama glacialis, Western pocket gopher, Rare
Thomomys mazama louiei, Western pocket gopher, Rare
**Thomomys mazama melanops*, Western pocket gopher, Rare
Thomomys mazama tacomensis, Western pocket gopher, Endangered
Thomomys mazama tumuli, Western pocket gopher, Rare
**Dipodomys ordi*, Ord kangaroo rat, Rare
**Onychomys leucogaster*, Northern grasshopper mouse, Rare
**Phenacomys intermedius*, heather vole, Uncommon
**Microtus pennsylvanicus kinkuid*, Kinkaid meadow vole, Uncommon
Microtus canicaudus, gray-tailed vole, Rare
**Lagurus* curtatus, sagebrush vole, Uncommon
**Synaptomys borealis*, Northern bog lemming, Rare
Mesoplodon carlhubbsi, Moore beaked whale, Rare
Stenella caeruleoalba, striped porpoise, Uncommon
Lissodelphis borealis, Northern right-whale dolphin, Uncommon
Lagenorhynchus obliquidens, Pacific white-sided dolphin, Uncommon
Grampus griseus, grampus, Uncommon
Pseudorca crassidens, false killer whale, Uncommon
Globicephala macrorhyncha, short-finned pilot whale, Uncommon
Balaenoptera acutorostrata, little piked whale, Uncommon
Balaenoptera musculus, blue whale, Rare
Balaena glacialis, right whale, Uncommon
Canis lupus, gray wolf, Extinct
Vulpes vulpes macroura, red fox, Rare

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[1] **Murray L. Johnson, University of Puget Sound, compiled this list in 1974. Status of mammal is according to his classification system (see pt. IV).**

***Animal has been identified as a rare and endangered cell.**

Ursus arctos, grizzly bear, Threatened
Martes pennanti, fisher, Uncommon
Gulo gulo, wolverine, Rare
Enhydra lutris, sea otter (reintroduced), Rare
Lynx lynx, lynx, Rare
Zalophus californianus, California sea lion, Uncommon
Mirounga angustirostris, Northern elephant seal, Rare
Odocoileus virginianus leucurus, Columbia white-tailed deer, Endangered[12]
Alces alces, American moose, Uncommon
Rangifer tarandus, caribou, Threatened
Antilocapra americana, pronghorn (reintroduced), Rare
Bison *bison,* bison, Extinct
Ovis *canadensis,* mountain sheep (reintroduced), Uncommon

Mammals of Special Interest in Oregon[13]

**Sorex preblei*, Malheur or Preble shrew, Rare
**Sorex trigonirostris,* Ashland shrew, Rare
**Sorex merriami*, Merriam shrew, Rare
Myotis evotis, long-eared bat, Uncommon
Myotis thysanodes, fringed bat, Rare
Myotis volans, long-legged bat, Rare
Myotis leibii, small-footed bat, Rare
Lasionycteris noctivagans, silver-haired bat, Rare
Pipistrellus hesperus, Western pipistrelle, Rare
Lasiurus cinereus, hoary bat, Rare
Antrozous pallidus, pallid bat, Rare
Tadarida brasiliensis, Brazilian free-tailed bat, Rare
**Sylvilagus idahoensis,* pygmy rabbit, Uncommon
**Lepus townsendi,* white-tailed jack rabbit, Uncommon
**Spermophilus washingtoni,* Washington ground squirrel, Threatened
**Spermophilus richardsoni,* Richardson ground squirrel, Rare
Sciurus *carolinensis,* Eastern gray squirrel (introduced), Uncommon
Sciurus niger, fox squirrel (introduced), Rare
**Thomomys bottae detumidus,* Botta pocket gopher, Rare
**Thomomys bottae laticeps,* Botta pocket gopher, Rare
**Perognathus longimembris*, little pocket mouse. Rare
**Peromyscus truei sequoiensis,* pinon mouse, Uncommon
**Peromyscus truei preblei*, pinon mouse, Uncommon
**Onychomys leucogaster,* Northern grasshopper mouse, Uncommon
**Phenacomys intermedius,* heather vole, Uncommon
**Arborimus albipes*, white-footed vole, Rare
***Arborimus longicaudus longicaudus,* red tree vole, Uncommon
**Arborimus longicaudus silvicolu,* red tree vole, Uncommon
**Lagurus curtatus,* sagebrush vole, Uncommon
Mesoplodon carlhubbsi, Moore beaked whale, Rare
Stenella caeruleoalba, striped porpoise, Uncommon

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[12] **Species is on national list of threatened and endangered animals (U.S. Bureau of Sport Fisheries and Wildlife 1973).**

[13] **Murray L. Johnson and Chris Maser, University of Puget Sound, compiled this list in 1974. Status of mammal is according to Johnson's classification system (see pt. IV).**

***Animal has been identified as a rare and endangered cell.**

Lissodelphis borealis, Northern right-whale dolphin, Uncommon
Lagenorhynchus obliquidens, Pacific white-sided dolphin, Uncommon
Grampus griseus, grampus, Uncommon
Pseudorca crassidens, false killer whale, Uncommon
Globicephala macrorhyncha, short-finned pilot whale, Uncommon
Balaenoptera acutorostrata, little piked whale, Uncommon
Balaenoptera musculus, blue whale, Rare
Canis lupus, gray wolf, Extinct
Vulpes vulpes cascadensis, red **fox,** Uncommon
Vulpes vulpes macroura, red fox, Rare
Vulpes macrotis, kit **fox,** Threatened
Ursus arctos, grizzly bear, Extinct
Bassariscus astutus, ringtail, Rare
Martes pennanti, fisher, Rare
Gulo gulo, wolverine, Threatened
Enhydra lutris, sea otter (reintroduced), Uncommon
Lynx lynx, lynx, Extinct
Callorhinus ursinus, Northern fur seal, Uncommon
Eumetopias jubata, Northern sea lion, Uncommon
Phoca vitulina, harbor seal, Rare
Mirounga angustirostris, Northern elephant seal, Rare
Odocoileus virgznianus leucurus, Columbia white-tailed deer, Rare[14]
Odocoileus virginianus ochrourus, white-tailed deer, Rare
Antilocapra americana, pronghorn, Uncommon
Bison bison, bison, Extinct
Oreamnos americanus, mountain goat (introduced), Rare
Ovis canadensis, mountain sheep (reintroduced), Rare

[14] **Species is on national list** of **threatened and endangered animals (U.S. Bureau** of **Sport Fisheries and Wildlife 1973).**

APPENDIX VII.
LIST OF WORKSHOP PARTICIPANTS

Workshop Chairman

Jerry F. Franklin, Program Director, Ecosystem Studies, National Science Foundation, 1800 G. Street, N.W., Washington, D.C. 20550.

Steering Committee

Chairman: Robert E. Buckman, Director, Pacific Northwest Forest and Range Experiment Station, P.O. Box 3141, Portland, Oreg. 97208.

Archie D. Craft, State Director, represented by Irving W. Anderson, Chief, Branch of Land & Mineral Operations, **U.S.** Bureau of Land Management, P.O. **Box** 2965, Portland, Oreg. 97208.

Don Lee Fraser, Supervisor, Department of Natural Resources, represented by Howard Stolaas, Deputy Supervisor, Department of Natural Resources, State of Washington, Olympia, Wash. 98504.

A. R. Kruckeberg, Professor and Chairman, Department of Botany, University of Washington, Seattle, Wash. 98195.

Kenneth R. Margolis, Northwest Representative, The Nature Conservancy, 1234 N.W. 25th Ave., Portland, Oreg. 97210.

R. Kahler Martinson, Regional Director, U.S. Fish and Wildlife Service, P.O. Box 3737, Portland, Oreg. 97208.

John A. Rutter, Regional Director, National Park Service, 523 4th and Pike Bldg., Seattle, Wash. 98101.

Theodore A. Schlapfer, Regional Forester, U.S. Forest Service, Region 6, P.O. **Box** 3623, Portland, Oreg. 97208.

Working Group Participants

West-Side Terrestrial Working Group

Chairman: C. T. Dyrness, Pacific Northwest Forest & Range Experiment Station, Institute of Northern Forestry, Fairbanks, Alaska 99701.

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Glenn Juday, Botany Department, Oregon State University, Corvallis, Oreg. 97331.

Robert M. Romancier, Assistant Director, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis, Oreg. 97331.

Fred Swanson, Geology Department, University of Oregon, Eugene, Oreg. 97403.

Al **M.** Wiedemann, Biology Department, Evergreen State College, Olympia, Wash. 98501.

East-Side Terrestrial Working Group

Chairman: Art Tiedemann, Pacific Northwest Forest & Range Experiment Station, Forest Hydrology Laboratory, **1133** N. Western Ave., Wenatchee, Wash. **98801.**
Robert **E.** Frenkel, Department of Geography, Oregon State University, Corvallis, Oreg. **97331.**
Fred **C.** Hall, U.S. Forest Service, Region **6,** P.O. Box **3623,** Portland, Oreg. **97208.**
Ken Larsen, U.S. Fish and Wildlife Service, P.O. Box **3737,** Portland, Oreg. **97208.**
Stan Lester, Recreation Specialist, U.S. Bureau of Land Management, P.O. Box **2965,** Portland, Oreg. **97208.**

Aquatic Working Group

Chairman: James D. Hall, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oreg. **97331.**
Bob Phillips, Fisheries Biologist, U.S. Forest Service, Region **6,** P.O. Box **3623,** Portland, Oreg. **97208.**
Elizabeth Rodrick, The Nature Conservancy, Northwest Office, **1234** N.W. **25th** Ave., Portland, Oreg. **97210.**
Dick Whitney, Leader, Washington Cooperative Fisheries Unit, College of Fisheries, University of Washington, Seattle, Wash. **98195.**
Curt Wiberg, Biology Department, Central Washington State College, Ellensburg, Wash. **98926.**

Marine and Estuarine Working Group

Chairman: Stan Cook, Biology Department, University of Oregon, Eugene, Oreg. **97403.**
Richard Bauer, **U.S.** Fish and Wildlife Service, P.O. Box **3737,** Portland, Oreg. **97208.**
Vincent Galluci, College of Fisheries, Center for Quantitative Science, University of Washington, Seattle, Wash. **98195.**
Al R. O'Donnell, Supervisor, Recreation Division, Department of Natural Resources, State of Washington, Olympia, Wash. **98504.**

Rare and Endangered Species Working Group

Chairman: Chris Maser, Associate Curator of Mammals, Museum of Natural History, University of Puget Sound, Tacoma, Wash. **98416.**
Ted Fies, Aquatic Biologist, Environmental Management, Oregon Wildlife Commission, P.O. Box **3503,** Portland, Oreg. **97208.**
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Tony Skufca, Division Chief, Recreation, U.S. Forest Service, Region **6,** P.O. Box **3623,** Portland, Oreg. **97208.**

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2. Developing and evaluating alternative methods and levels of resource management.
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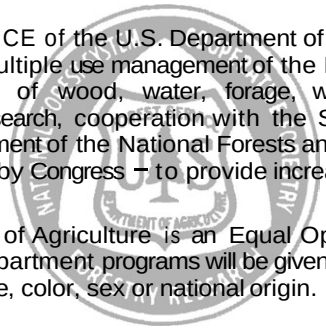

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