

MANAGEMENT OF EXOTIC PLANTS
IN
OLYMPIC NATIONAL PARK

DRAFT

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ABSTRACT

Exotic or adventive plant species comprise over 20% of the vascular flora of Olympic National Park. Once established, exotic plants disrupt natural succession, alter plant community structure, and affect geophysical processes. Using a numerical rating system, 82 of 187 (43%) of the known park exotic species were ranked according to ecosystem threat. Of those 82 species, 6% (5 species) are considered a serious threat, 15% (12 species) are considered a significant threat, 41% (34 species) a potential threat, and 38% (31 species) represent a low threat to the ecological integrity of Olympic. The current distribution and autecology for each rated species was determined and a recommended control strategy, using Integrated Pest Management (IPM) principles, is proposed.

Note: At the time of this revised draft (September, 1991) information on the distribution and abundance of many species is still being compiled. A variety of sources are used to obtain this information including dedicated field surveys for specific species. Many areas of the park, particularly remote backcountry areas, have not been adequately surveyed and users of this catalog should note that the distribution for many common species is under-reported. Refinements in ratings and control strategies for many species will require completion of this baseline data collection. Though incomplete, the catalog is being distributed to field areas at this time to facilitate the data collection process.

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INTRODUCTION

Exotic or adventive plant species are those that arrive in new habitats as a direct or indirect result of human activities. Intentional introductions often occur with species of economic, scientific, medicinal, or aesthetic interest. Many exotics also arrive inadvertently as "hitchhikers" associated with vehicles, ship ballast, livestock, packaging materials, agricultural produce, or human footwear. Once established in a new location, exotics often rapidly increase their range through transport by native birds or mammals.

One of the earliest references to exotic plants on the Olympic Peninsula was made by botanist L.F. Henderson when he accompanied the O'Neil expedition into the Olympic Mountains in 1890. Henderson (1892) lists 30 exotic plant species collected near habitation sites at Lilliwaup on Hood Canal as the expedition prepared to embark into the Olympics.

The first more or less comprehensive list of exotic plant species found on the Olympic Peninsula was provided by G.N. Jones in his book Botanical Survey of the Olympic Peninsula, published in 1936. He lists 135 exotic species, about 13% of the vascular plant taxa known from the area at that time (Jones 1936:55). Today, more than 334 species of exotic and adventive plants are found on the Olympic Peninsula, representing nearly 25% of the known vascular flora. The proliferation of exotics has been abetted by modern transportation systems as well as the ever-increasing amount of land disturbed by development.

Currently, some 187 species and varieties of exotic plants are known from sites within or immediately adjacent to the boundaries of Olympic National Park, though this number is subject to constant revision as more information on species occurrence, distribution, and abundance becomes available. Although some exotics occur within the interior backcountry of the park and a few have become established at higher elevations, most are confined to lowland areas adjacent to roads, developed areas, and sites of human habitation. Large concentrations of exotics occur near park headquarters, at Lake Crescent, Elwha, Lake Ozette, Mora, Kalaloch, and the Queets and Quinault River valleys.

Invasion by exotic species is among the most serious threats to protected natural areas. Olympic National Park was established in 1938 as a natural area recognized for its "primeval" forests, Roosevelt elk and other wildlife, and the mountainous landscape. The invasion of exotic species into the park compromises the integrity of these values.

Once established, exotic plants disrupt natural succession, alter plant community structure, displace or eliminate native species, and affect geophysical processes. A few examples can serve to illustrate these effects.

-- The shrub Scot's broom (Cytisus scoparius) was first introduced to the west coast in California as an ornamental and soil binder. This aggressive species has now rapidly spread and become widely distributed throughout the northwest on disturbed sites. It can form dense thickets to the exclusion of native ground cover and prevent subsequent establishment of native tree species.

-- English holly (Ilex aquifolium) was first introduced to the Puget Sound region as an ornamental and was later cultivated on "holly farms" for the Christmas floral industry. It is now widely established throughout lowland areas of the park. Its berries are readily bird disseminated and it has the ability to invade undisturbed forested sites. As the species is shade tolerant, it can persist under closed forest canopy, displacing native conifer species.

-- Reed canarygrass (Phalaris arundinacea) was first planted in the United States for animal forage and erosion control. This extremely aggressive species is a coarse, colony-forming grass of wetland areas which tolerates and even multiplies with disturbance. It has become widely established along the shoreline of Lake Ozette where it threatens numerous rare, sensitive, or protected native taxa.

-- Canada thistle (Cirsium arvense), Cheatgrass (Bromus tectorum), Curly dock (Rumex crispus), Bitter dock (Rumex obtusifolius), Orchard-grass (Dactylis glomerata) and many other common introduced grasses and "weed" species have invaded disturbed roadside areas along the Hurricane Ridge road to nearly 5,000 ft. elevation. There is concern that many of these species, most of which are prolific seed producers, could invade subalpine and alpine sites previously disturbed by introduced mountain goats (Oreamnos americanus) or bare soil areas created by natural events such as landslides or avalanches. Several endemic and sensitive native plant species are found in these sites.

-- Such infamous pests as Tansy ragwort (Senecio jacobea) and Common St. John's-wort (Hypericum perforatum) are now widely distributed within the park. Both species have received much attention by land management agencies in the State of Washington. Numerous large-scale and expensive control efforts are underway in important agricultural regions of the state. However, much of the research and available control technology are unsuitable for use in natural areas such as national parks and these species can be expected to persist and spread.

-- Certain aquatic species such as Fragrant water-lily (Nymphaea odorata), Water marigold (Megalodonta beckii), and Curled pondweed (Potamogeton crispus) have invaded or been introduced into park streams and lakes. The effects of these species on aquatic ecosystems has not been researched. Decreased water flows, siltation, and competition with native aquatic plants, fish, amphibians and invertebrate species are considered serious consequences of these invasions.

It is apparent from the information developed to date that the number of exotic species in the park is greater than previously recognized, and many new species, some potentially aggressive and difficult to eradicate, are threatening to become established in the park. It is also important to recognize that many exotic species do not pose a serious threat to native plant communities. Many garden and ornamental species cannot become established without site disturbance and are not expected to persist as forest cover becomes established. For many of these species, a certain benign acceptance will be necessary, at least for the present. Conversely, a few exotics so seriously threaten native plant communities and have the potential to cause irreversible impacts or extirpate rare native species that action is required immediately.

Unfortunately, the opportunity to successfully control or eradicate some species, such as many of the introduced grasses, may be long passed.

National Park Service policies regarding the management of exotic species in natural areas is contained in Chapter 4, NPS Management Policies (1988:12) which states:

"Management of populations of exotic plants and animal species, up to and including eradication, will be taken wherever such species threaten park resources or public health and when control is prudent and feasible."

The policy further states that exotics will be removed when they are found to be:

"...interfering with natural processes and perpetuation of natural features or native species (especially those that are endangered, threatened, or otherwise unique)."

The policy also establishes stringent criteria which must be met prior to the introduction of new exotics species into national parks and prevents such introductions where they could disrupt or degrade natural plant and animal communities within natural areas.

Olympic National Park does not have a current management plan for exotic plants. Project Statement N-502.00 in the Draft Resource Management Plan (May, 1990) provides interim direction regarding management of exotics pending completion of a comprehensive plan. Initiating an exotic plant management program was identified as a parkwide goal for FY 1991.

Previous work at Olympic has concentrated on surveys and mapping to gather data on exotic species distribution, abundance and the possible impacts on native vegetation communities. A computer database, patterned after one created for rare plants, is planned. A draft field handbook for the identification and control of 21 species was prepared by the park's Research Botanist. Management of several of these species is considered a high priority. A few small scale control projects have been undertaken on these and other species with varied results.

Information on the 187 identified park exotic plants has been assembled in a catalog including their distribution, habitat, abundance, phenology, autecology, and other pertinent data. An additional 16 species, primarily ornamentals and cultigens, discovered during 1990 field surveys are currently being identified and evaluated for possible addition to the catalog.

After compiling the catalog and a comprehensive species list, each species or variety was rated against 17 criteria designed to evaluate the degree of threat it poses to the integrity of park ecosystems. The rating elements include information about species distribution, total number of populations and population size, autecology, and expected impacts on park resources as well as the consequences of inaction. This rating system is a modification of and based in part on a system devised by researchers at Indiana Dunes National Lakeshore (Klick 1989).

The resulting summary rating was used to group species into four logical, manageable categories based on the severity and immediacy of this threat: serious, significant, potential, and low. Each species was further categorized into one of four groups based on preliminary research on the feasibility of control. Generally, it is park policy to initiate control efforts only on those higher threat species where a known control technique exists, or can reasonably be developed using Integrated Pest Management (IPM) principles, and a reasonable probability of success if predicted.

From this information, a management strategy for each exotic species will be devised, prioritized, and implemented.

MANAGEMENT OBJECTIVES

1. Prevent further introductions and reduce the spread of exotic plants into Olympic National Park:
 - Keep site disturbance and creation of bare mineral soil to the minimum necessary during construction and maintenance activities. Rehabilitate and restore these disturbed sites promptly.
 - Use only approved native plant stocks during any revegetation and landscaping projects; soil, gravel, and other materials imported into the park should be from weed-free areas.
 - Eliminate seed sources which can spread exotics such as plantings around homesites and in old-fields, non-native landscaping around park facilities, acquired inholdings, concession areas, and along boundary areas.
 - Strictly enforce regulations regarding feed for livestock in backcountry areas.
2. Conduct systematic surveys of known locations of rare or sensitive native plants to determine if they are threatened by exotic species:
 - Give special attention to species listed by the Washington Natural Heritage Program.
 - Assign the highest priority for any exotic plant control efforts to protecting these species; use the Exotic Plant Rating System to determine the priority target species for control efforts.
3. Conduct research and field trials of potential control methods suitable for use under Olympic conditions:
 - Utilize IPM principles and best available technology in developing control methods.
 - Give priority to investigating selective chemical methods and such non-chemical methods as biological control, prescribed fire, or silvicultural treatments.
4. Cooperate with surrounding land management agencies on exotic plant management:
 - Explore potential for cooperative control projects along highways, utility corridors, and mutual boundary areas.

- Seek compatibility between agencies in selection of control methods to meet all applicable environmental and policy constraints.
- 5. Create and maintain a computerized database of exotic plants of Olympic National Park:
 - Insure the database is compatible with GIS and the existing rare plant database.
 - Utilize the database to periodically revise the Exotic Species Catalog and any management plans.
- 6. Provide training to park staff:
 - Emphasize identification and reporting of exotic species.
 - Conduct training on problem species and control methods tailored to each subdistrict.
- 7. Develop interpretive programs and public information materials on exotic species management:
 - Stress the threats exotic species pose to the integrity of natural areas.
 - Solicit public support in preventing accidental introductions of new species into the park.
- 8. Support additional research in exotic species management:
 - Assign priority to research on species with unresolved taxonomic questions regarding species origin and classification as alien species.
 - Support shared-research efforts in adjacent parks with similar exotic species and problems (MORA, NOCA).
 - Encourage information exchange on state-wide exotic plant problems, such as on-going knapweed research, mitigation of exotic species within aquatic ecosystems, invasion of coastal areas by Spartina, and current herbicide technology and application techniques.

EXOTIC SPECIES CATALOG

All currently available information on exotic plant species of Olympic National Park has been compiled in a catalog, which is included as Appendix A. Information in the catalog includes:

Species Name/Common Name

In most cases, species nomenclature follows Hitchcock (1973). Numerous taxonomic revisions have taken place since this standard reference to the flora of the Pacific Northwest was published. Where applicable, more recent nomenclature from Buckingham and Tisch (1979) and Buckingham (1990, in pres.) have been used, as these sources have become the definitive references for the Olympic Peninsula. Hitchcock synonyms are provided where applicable.

Family names are given in brackets following the scientific name.

Category

Naturalized - Species which have become fully established within native plant communities and are now an integral part of the landscape.

Escaped or Only Persistent - Species which are predominantly ornamentals or cultivars associated with habitation sites and which have escaped into the wild. They may or may not persist, and have not become incorporated into native plant communities.

Range

The Olympic Peninsula distribution of each species includes vegetation zones with the following elevation ranges:

L=Lowland - Sea level to 2,000 ft. (600 m.).
M=Montane - 2,000 ft. to 3,500 ft. (1050 m.).
S=Subalpine - 3,500 ft. to timberline.
A=Alpine - Timberline and upward.

This is followed by a compass direction as indicated on Map 1. For those plants found throughout the Peninsula the term "general" is applied.

Habitat

The preferred or typical habitat for each species is given.

Dry - Unusually dry areas.
Forest - Wooded areas with natural undergrowth.

This map illustrates the major river basins and watersheds of Washington State, categorized into nine regions: NW, N, NE, W, C, E, SW, S, and SE. The map shows the following features:

- Regions:** NW, N, NE, W, C, E, SW, S, SE.
- Rivers and Waterways:** Soleduck R., Calawash R., Forks, Bogachiel R., Hoh R., S. Fork, Quilcine R., Dugabush R., Hanma Hanma R., Shohomish R., Wymoochee R., Humptulips R., Quinault R., and the Hood Canal.
- Geographical Features:** Lake Ozette, Mt. Olympus, Discovery Bay, and the Strait of Juan de Fuca.
- Reservations:** Makah Indian Res. and Quinault Indian Reservation.
- Scale:** A scale bar indicates distances from 0 to 15 km.
- Inset Map:** An inset map shows the location of Washington State within the Pacific Northwest.

Habitat (cont.)

Moist - Sites with soils wetter than average.
Open - Unforested areas.
Ruderal - Disturbed sites.
Shore - Salt water margins.
Water - Submersed, floating, or emergent; not on land.
Wet - Wet land, including seepages.

Rating/Threat

The summary rating obtained from the Exotic Plant Rating System is given. Refer to page 19 for an explanation of the rating system. The higher the rating number, the greater the threat to park ecosystems from the exotic species. Each rated species is placed in one of four categories:

Serious Threat	-	Rating >45
Significant Threat	-	Rating 36-45
Potential Threat	-	Rating 26-35
Low Threat	-	Rating 25 or below

Detailed information for many species is not yet available. When this is the case, the species is designated "Unrated".

Taxonomic Description

A technical description of the plant is provided, with information on its duration (annual, perennial, etc.) and mode of reproduction. More information on duration is provided in Appendix C.

Flowering dates have not been included. Although many references include such information, it will not be included in the catalog until phenology surveys for park plants can be collected over several growing seasons, as flowering dates are so variable.

Discussion

General information on the origin and characteristics of each species is included in this section along with the management problems which can result from its introduction. This information was compiled from numerous sources, which are listed in code form under References at the bottom of each page. Additional information on species origin is provided in Appendix D.

OLYM Locations

The park subdistricts in which a species has been reported or verified are listed. "R" = the species has been reported for the area. "X" = species has been confirmed for the area. For many species this information is preliminary and subject to revision.

Specific Populations

This section provides specific geographic locations of known park populations.

Control

Control methods, obtained from the listed references, are outlined and discussed. In most cases, these methods have not been tested under the growing conditions prevailing on the Olympic Peninsula, and should be considered preliminary. Where herbicide treatments are mentioned, this should be considered for informational purposes only. Many of the listed chemicals or their usual application methods are not currently approved for NPS use.

References

The sources for the information presented in the catalog are presented in code form. The sources used were:

<u>Code</u>	<u>Reference</u>
C	A California Flora and Supplement [Munz]
CLH	Flora of the Pacific Northwest [C.L. Hitchcock-Cronquist]
	Note: References to the 5-vol. Vascular Plants of the Pacific Northwest are indicated as volume:page, ie. 3:107 [C.L. Hitchcock-Cronquist-Owenby-Thompson]
CWUS	Common Weeds of the United States [U.S. Dept. of Agriculture]
FTPS	Forest Trees of the Pacific Slope [Sudworth]
G	Gray's Manual of Botany [Fernald]
GWNW	Gilkey's Weeds of the Pacific Northwest [Dennis]
MGUS	Manual of the Grasses of the United States [A.S. Hitchcock]
NAT-W	Field Guide to North American Trees-Western Region [Little]

References (cont.)

NWW Northwest Weeds
 [Taylor]

W Weeds
 [Muenscher]

WEW Weeds of Eastern Washington and Adjacent Areas
 [Gaines-Swan]

Complete bibliographic citations for these references may be found
in the References section, page 45.

EXOTIC PLANT SPECIES
OF
OLYMPIC NATIONAL PARK

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<u>Species</u>	<u>Common Name</u>	<u>Code</u>
<i>Agropyron repens</i>	Quackgrass	AGRE
<i>Agrostis capillaris</i>	Colonial bentgrass	AGCA
<i>Agrostis stolonifera</i> var. <i>major</i>	Redtop	AGSTMA
<i>Agrostis stolonifera</i> var. <i>palustris</i>	Redtop	AGSTPA
<i>Agrostis stolonifera</i> var. <i>stolonifera</i>	Redtop	AGSTST
<i>Aira caryophylllea</i>	Silver hairgrass	AICA
<i>Aira praecox</i>	Early hairgrass	AIPR
<i>Anthemis tinctoria</i>	Yellow chamomile	ANTI
<i>Anthoxanthum odoratum</i>	Sweet vernalgrass	ANOD
<i>Arabidopsis thaliana</i>	Thale cress	ARTH
<i>Arctium minus</i> *	Common burdock	ARMI
<i>Arrhenatherum elatius</i> var. <i>biaristatum</i>	Tall oatgrass	ARELBI
<i>Arrhenatherum elatius</i> var. <i>bulbosum</i>	Tall oatgrass	ARELBU
<i>Avena sativa</i>	Common oat	AVSA
<i>Barbarea vulgaris</i> var. <i>arcuata</i>	Bitter wintercress	BAVUAR
<i>Barbarea vulgaris</i> var. <i>longisiliquosa</i>	Bitter wintercress	BAVULO
<i>Bellis perennis</i>	English daisy	BEPER
<i>Bromus commutatus</i>	Meadow brome	BRCO
<i>Bromus hordeaceus</i> ssp. <i>hordeaceus</i>	Soft brome	BRHOHO
<i>Bromus tectorum</i>	Cheatgrass	BRTE
<i>Cakile edentula</i> ssp. <i>edentula</i>	American searocket	CAEDED
<i>Cakile maritima</i>	European searocket	CAMA
<i>Callitriche stagnalis</i>	Pond water-starwort	CASTA
<i>Calystegia sepium</i> ssp. <i>sepium</i>	Wild morning-glory	CASESE
<i>Campanula persicifolia</i>	Peach bells	CAPE
<i>Campanula rapunculoides</i>	Creeping bellflower	CARAP

<u>Species</u>	<u>Common Name</u>	<u>Code</u>
Capsella bursa-pastoris var. bursa-pastoris	Shepherd's-purse	CABUBU
Centaurea cyanus	Cornflower	CECY
Centaurea montana	Mountain knapweed	CEMO
Centaureum erythraea	Common centaury	CEER
Cerastium fontanum ssp. triviale	Common chickweed	CEFOTR
Cerastium glomeratum	Sticky chickweed	CEGL
Cerastium tomentosum*	Snow-in-summer	CETO
Chenopodium album	Lamb's quarter	CHAL
Cichorium intybus	Chicory	CIIN
Cirsium arvense var. horridum	Canada thistle	CIARHO
Cirsium vulgare	Bull thistle	CIVU
Clematis lingusticifolia var. brevifolia	Western clematis	CLLIBR
Clematis lingusticifolia var. lingusticifolia	Western clematis	CLLILI
Convolvulus arvensis*	Field bindweed	COAR
Crepis capillaris	Smooth hawksbeard	CRCA
Cynosurus cristatus	Crested dogtail	CYCR
Cytisus scoparius var. andreanus	Scot's Broom	CYSCAN
Cytisus scoparius var. scoparius	Scot's Broom	CYSCSC
Dactylis glomerata	Orchard-grass	DAGL
Daucus carota	Queen Anne's lace	DACAR
Dianthus armeria	Deptford pink	DIAR
Digitalis purpurea var. alba	Foxglove	DIPUAL
Digitalis purpurea var. purpurea	Foxglove	DIPUPR
Echium vulgare	Blueweed	ECVU
Erechtites minima	Toothed coast burnweed	ERMI
Erophila verna ssp. praecox	Spring whitlow-grass	ERVEPR
Erophila verna ssp. verna	Spring whitlow-grass	ERVEVE
Eschscholtzia californica ssp.* californica	California poppy	ESCACA

<u>Species</u>	<u>Common Name</u>	<u>Code</u>
Festuca arundinacea	Reed fescue	FEAR
Festuca elatior	Meadow fescue	FEEL
Galium odoratum	Sweet woodruff	GAOD
Geranium dissectum	Cutleaf geranium	GEDI
Geranium molle*	Dovefoot geranium	GEMO
Geranium robertianum	Herb Robert	GERO
Glecoma hederacea var. micrantha	Ground ivy	GLHEMI
Hedera helix	English ivy	HEHE
Hemerocallis fulva var. fulva	Orange day-lily	HEFUFU
Heracleum mantegazzianum	Giant cow-parsnip	HEMAN
Hieracium aurantiacum	Orange hawkweed	HIAU
Holcus lanatus	Common velvet-grass	HOLA
Holcus mollis	Creeping velvet-grass	HOMO
Hyacinthoides hispanica	Spanish bluebell	HYHI
Hypericum calycinum	Jerusalem star	HYCA
Hypericum perforatum	Common St. John's-wort	HYPE
Hypochoeris radicata	Hairy cat's-ear	HYRAD
Ilex aquifolium	English holly	ILAQ
Iris psuedacorus	Yellow iris	IRPS
Juncus conglomeratus	Conglomerate rush	JUCO
Lamium purpureum*	Purple dead-nettle	LAPU
Lapsana communis	Nipplewort	LACO
Lathyrus latifolius	Everlasting peavine	LALA
Lathyrus sylvestris	Small everlasting peavine	LASY
Lepidium heterophyllum*	Varied-leaf peppergrass	LEHE
Leucanthemum vulgare	Ox-eye-daisy	LEVU
Linaria genistifolia ssp. dalmatica	Dalmatian linaria	LIGE
Linaria vulgaris	Butter and eggs	LIVU

<u>Species</u>	<u>Common Name</u>	<u>Code</u>
Lolium multiflorum	Italian ryrgrass	LOMU
Lolium perenne	Perennial ryegrass	LOPER
Lonicera etrusca	Etruscan honeysuckle	LOET
Lotus pedunculatus	Pedunculate lotus	LOPED
Lunaria annua	Honesty	LUAN
Lupinus arboreus var. arboreus	Tree lupine	LUARAR
Lychnis coronaria*	Mullein pink	LYCO
Lysimachia punctata	Garden loosestrife	LYPU
Lythrum portula	Purslane lythrum	LYPO
Lythrum salicaria	Purple lythrum	LYSA
Malus sylvestris	Cultivated apple	MASYL
Malva moschata	Musk mallow	MAMO
Medicago lupulina var. cupaniana	Black medic	MELUCU
Medicago lupulina var. lupulina	Black medic	MELULU
Medicago minima*	Least medic	MEMI
Megalodonta beckii	Water marigold	MEBE
Mentha spicata	Spearmint	MESP
Mentha spicata x piperita	Peppermint	MEXP
Muscari botryoides	Grape hyacinth	MUBO
Mycelis muralis	Wall lettuce	MYMU
Myosotis arvensis	Field forget-me-not	MYAR
Myosotis discolor	Yellow and blue forget-me-not	MYDI
Myosotis scorpioides	Common forget-me-not	MYSC
Myosotis stricta	Small-flowered forget-me-not	MYST
Myosotis sylvatica	Woods forget-me-not	MYSY
Narcissus psuedonarcissus	Daffodil	NAPS
Nymphaea odorata var. odorata	Fragrant water-lily	NYODOD
Papaver orientale*	Oriental poppy	PAOR
Parentucellia viscosa	Yellow parentucellia	PAVI

<u>Species</u>	<u>Common Name</u>	<u>Code</u>
Petasites japonicus	Japanese butterbur	PEJA
Phalaris arundinacea	Reed canarygrass	PHAR
Phleum pratense var. pratense	Common timothy	PHPRPR
Pinus ponderosa	Ponderosa pine	PIPOPO
Plantago lanceolata var. lanceolata	English plantain	PLLALA
Plantago major var. major	Common plantain	PLMAMA
Poa annua var. annua	Annual bluegrass	POANAN
Poa annua var. reptens	Annual bluegrass	POANRE
Poa compressa	Canadian bluegrass	POCOM
Poa palustris	Fowl bluegrass	POPA
Poa pretensis ssp. pratensis	Kentucky bluegrass	POPRPR
Poa trivialis	Roughstalk bluegrass	POTRI
Polygonum arenastrum	Sandstar knotweed	POAR
Polygonum aviculare	Common knotweed	POAV
Polygonum convolvulus var. convolvulus	Black bindweed	POCOCO
Polygonum convolvulus var. subalatum	Black bindweed	POCOSU
Polygonum cuspidatum	Japanese knotweed	POCU
Polygonum hydropiper	Smartweed	POHY
Polygonum persicaria var. persicaria	Lady's thumb knotweed	POPEPE
Polygonum sachalinense	Giant knotweed	POSA
Populus nigra	Lombardy poplar	PONI
Potamogeton crispus	Curled pondweed	POCR
Prunella vulgaris var. vulgaris	Self-heal	PRVUVU
Prunus avium	Sweet cherry	PRAV
Prunus laurocerasus	Laurel cherry	PRLA
Ranunculus acris var. acris	Meadow buttercup	RAACAC
Ranunculus repens var. repens	Creeping buttercup	RARERE
Robina pseudoacacia var. pseudoacacia*	Black locust	ROPSPS
Rorippa sylvestris*	Creeping yellowcress	ROSY
Rosa canina*	Dog rose	ROCA
Rosa eglanteria*	Sweetbriar	ROEG
Rubus discolor	Himalayan blackberry	RUDI
Rubus laciniatus	Evergreen blackberry	RULAC
Rubus odoratus var. odoratus	Purple-flowering thimbleberry	RUODOD
Rubus vestitus	European blackberry	RUVE

<u>Species</u>	<u>Common Name</u>	<u>Code</u>
Rudbeckia hirta	Black-eyed Susan	RUHI
Rumex acetosella ssp. angiocarpus	Sheep sorrel	RUAC
Rumex crispus	Curly dock	RUCR
Rumex obtusifolius ssp. agrestis	Bitter dock	RUOBAG
Rumex tenuifolius	Slender-leaved dock	RUTE
Sagina procumbens	Procumbent pearlwort	SAPR
Sagittaria cuneata	Arum-leaf arrowhead	SACU
Senecio jacobaea	Tansy ragwort	SEJA
Senecio sylvaticus	Wood groundsel	SESY
Senecio vulgaris	Common groundsel	SEVU
Silene alba*	White campion	SIAL
Sonchus asper	Prickly sow-thistle	SOAS
Sonchus oleraceus	Common sow-thistle	SOOL
Sorbus aucuparia	European mountain-ash	SOAU
Spergula arvensis var. arvensis	Cornspurry	SPARAR
Spergula arvensis var. sativa	Cornspurry	SPARSA
Spergularia rubra	Red sandspurry	SPRU
Stellaria graminea	Grass-leaved starwort	STGR
Stellaria media	Chickweed	STME
Symphytum asperum	Rough comfrey	SYAS
Tanacetum vulgare	Common tansy	TAVU
Taraxacum laevigatum	Red-seeded dandelion	TALA
Taraxacum officinale	Common dandelion	TAOF
Thlaspi arvense*	Field pennycress	THAR
Tragopogon dubius	Yellow salsify	TRDU
Trifolium arvense	Hare's-foot clover	TRAR
Trifolium dubium	Least hop clover	TRDU
Trifolium hybridum	Alsike clover	TRHY
Trifolium pratense	Red clover	TRPR
Trifolium repens	Dutch clover	TRRE
Tussilago farfara	Coltsfoot	TUFA
Ulex europaeus*	Common gorse	ULEU

<u>Species</u>	<u>Common Name</u>	<u>Code</u>
Valerianella locusta	European corn-salad	VALO
Verbascum thapsus*	Common mullein	VETH
Veronica arvensis	Common speedwell	VEAR
Veronica chamaedrys	German speedwell	VECH
Veronica officinalis var. officinalis	Paul's betony	VEOF
Veronica serpyllifolia ssp. serpylligolia	Thyme-leaved speedwell	VESE
Vicia sativa ssp. sativa	Common vetch	VISA
Vinca minor	Common periwinkle	VIMI
Vulpia bromoides	Barren fescue	VUBR
Vulpia myuros var. hirsuta	Rattail fescue	VUMY

An additional 14 species are currently being evaluated for inclusion in the catalog.

* = Indicates new addition to catalog August, 1991.

EXOTIC PLANT RATING SYSTEM

Each exotic plant species or variety reported within Olympic National Park was rated against 17 criteria designed to evaluate the degree of threat it poses to the integrity of park ecosystems. At the time of this draft, sufficient information was available to rate 82 (48%) of the 170 known park exotic species.

The rating elements include information about species distribution, abundance, autecology, and expected impacts on park resources as well as the predicted consequences of inaction.

The resulting summary rating was used to group all species of concern into logical, manageable categories based on the severity and immediacy of this threat. Under this system, the higher the rating number the greater the threat posed to park ecosystems by the exotic species. From this information, a management strategy for each species will be devised, prioritized, and implemented.

Element 1. Olympic National Park distribution-

- | | | |
|----|--|---|
| A. | Species found only in discrete, very localized populations within 1 geographic quadrant. | 1 |
| B. | Species with a more general distribution within 2 or more geographic quadrants. | 4 |

Regardless of abundance, exotic species which are found within a limited area of the park generally pose fewer threats and less management complexity than those found over a wider geographic distribution. The park core is divided by a north-south line running between approximately Lake Sutherland and the headwaters of the Wynoochee River; and an east-west line between approximately the Dosewallips River at the park boundary and the mouth of the Hoh River. The resulting four quadrants are designated northeast, southeast, southwest, and northwest. A plant must occur in more than one quadrant to receive the higher value.

Element 2. Distribution relative to park vegetation zones-

- | | | |
|----|--|---|
| A. | Species limited to one vegetation zone. | 1 |
| B. | Species found in two vegetation zones | 2 |
| C. | Species found in all vegetation zones:
lowland, montane and subalpine/alpine. | 4 |

The majority of exotic plants are limited to lowland areas. A few aggressive species have become established at higher elevation sites, primarily along road and trail corridors. This is

considered a serious threat where it occurs. A species which is fairly benign when found in typical lowland sites may pose a significant threat to native plant communities if it becomes established in sensitive montane, subalpine or alpine habitats. A species is thus penalized if available records indicate it is found in multiple elevation zones within the park.

Element 3. Species distribution relative to disturbance-

- | | | |
|----|--|---|
| A. | Species found only in open areas on sites recently or regularly disturbed. | 1 |
| B. | Species persists >10 years within open areas. | 2 |
| C. | Species persists under open forest canopy [$<50\%$ total cover]. | 4 |
| D. | Species invades and becomes established within aquatic habitats. | 8 |
| E. | Species invades and becomes established in undisturbed open areas and meadows [subalpine, swamps, bogs, wetlands]. | 8 |
| F. | Species persists under closed forest canopy [$>50\%$ total cover]. | 8 |

Each exotic species is rated according to the typical habitat it occupies within the park. Species which are found in multiple succession sites are rated according to the highest (most sensitive) category. As an example a species found in both disturbed fields and open woodlands would be rated 4. The objective is to penalize those species which are most persistent and shade tolerant or which become established within undisturbed sites of high resource value.

Element 4. Site disturbance characteristics-

- | | | |
|----|--|---|
| A. | Species primarily associated with areas of human disturbance or habitation. | 1 |
| B. | Species associated with areas of both human and natural disturbance. | 2 |
| C. | Species primarily associated with undisturbed areas or areas disturbed by natural processes. | 4 |

Most exotic plant species are associated with human influences and disturbance processes such as land clearing, development, agriculture, horticulture, and the maintenance of habitation sites. A few species have demonstrated the ability to spread into more

remote areas. Seeds transported by wind, water, or birds and animals may become established in locations which are either undisturbed or only disturbed by such natural processes as landslides, flooding, wind storms, natural fires, etc.

Element 5. Species associates-

- | | | |
|----|--|---|
| A. | Species coexists primarily with other exotic species. | 1 |
| B. | Species coexists in mixed communities of both native and exotic species. | 2 |
| C. | Species is typically found with native species with no [or few] other exotics present. | 4 |

An exotic species found only in association with other exotics, such as along a roadside, poses less threat in a park or natural area than a species which coexists with native plant species within otherwise pristine plant communities. Typically most exotics occur in mixed communities of both exotic and native species. Where definitive information is lacking, the middle value of 2 is assigned.

Element 6. Species abundance; estimated number of park populations-

- | | | |
|----|-------|---|
| A. | 1-5 | 1 |
| B. | 6-15 | 2 |
| C. | 16-50 | 4 |
| D. | 51+ | 8 |

Information on park distribution and abundance of exotic plant species must be considered preliminary. Where records indicate a species occurs within several park subdistricts, each subdistrict is assumed to have a minimum of one population. Where partial information is available, estimates of the number of total park populations and individual plants have been used. Species lacking specific population information are not rated.

Distinct populations are assumed to be separated by "reasonable travel distance." This is arbitrarily defined as follows: if a person can easily walk from one clump, patch or individual specimen to the next, the plants are considered to form one population; if travel by a vehicle is necessary, they are considered separate populations.

Element 7. Estimated average population size-

A.	1-10	1
B.	11-100	2
C.	101-1000	4
D.	1001+	8

Refer to comments for Element 6. The ratings for species with only limited information available are estimated. Since the numerical ranges are fairly broad, this is not viewed as particularly imprecise.

**Element 8. Effects on natural processes or integrity of
of native plant communities-**

A.	Species having minor or no effect.	1
B.	Species displaces or delays establishment of native species [up to 10 years].	2
C.	Species creates long term [more than 10 years] modification of natural succession processes.	4

Some exotic species have only minor deleterious effects on native plant communities. Many are short-lived species, have low reproductive success, are limited by climatic factors, or are easily suppressed by competition from native plants. Other exotics create adverse, long-term effects as normal limiting factors such as weather, diseases, insects and other predators are either absent or not particularly effective in limiting their spread or survival. A few very aggressive exotics, once established, become more or less permanent components of the landscape. Their growth characteristics may completely displace native grasses and herbs and prevent seedling establishment by native trees and shrubs. The more an exotic disrupts natural successional processes, the higher the rating value.

Element 9. Significance of threat-

A.	Park secondary resources threatened.	1
B.	Park primary resources threatened.	2
C.	Park special resources threatened.	4

Secondary resources are primarily frontcountry developed areas utilized to provide for public use and management of the park including: recreational facilities, administrative areas, utility

corridors, maintenance facilities and waste areas (borrow pits, debris dumps, etc.). Primary resources are those resources which Olympic National Park was established to preserve: temperate rainforests, coastal ecosystems, and native species of animals--particularly the Roosevelt elk. Special resources are native species which are considered unique, rare, sensitive, endemic, threatened, or endangered.

Element 10. Visual impact-

- | | |
|---|---|
| A. Minor visual impact to natural landscape. | 1 |
| B. Moderate visual impact to natural landscape. | 2 |
| C. Major visual impact to natural landscape. | 4 |

Many exotic plants are visually intrusive and create management and interpretive problems when encountered by park staff and visitors. False and confusing impressions may be created when highly visible exotic species occur in parks supposedly devoted to natural area preservation. These impressions may be difficult to dispel without specific education and interpretive programs. A subjective assessment of this visual impact is rated under this element.

Element 11. Mode of reproduction-

- | | |
|---|---|
| A. Reproduces entirely by vegetative means. | 1 |
| B. Reproduces only by seeds. | 2 |
| C. Reproduces vegetatively and by seeds. | 4 |

Information on reproduction of exotics plant species is not generally available in the literature. Species with multiple reproductive capabilities are rated highest. When information is not available, the plant is not rated.

Element 12. Vegetative reproduction-

- | | |
|--|---|
| A. No vegetative reproduction. | 0 |
| B. Vegetative reproduction rate maintains population. | 1 |
| C. Vegetative reproduction rate may result in moderate annual increase in population size. | 2 |
| D. Vegetative reproduction rate may result in rapid annual increase in population size. | 4 |

The contribution of vegetative reproduction, where present, toward

maintaining or expanding a population is rated. Those species with strong, creeping rhizomes or a particularly aggressive reputation are rated highest.

Element 13. Vegetative regeneration-

- | | | |
|----|--|---|
| A. | No resprouting following removal of above ground plant parts. | 1 |
| B. | Sprouts from roots and/or stumps. | 2 |
| C. | Any plant part is a viable propagule; rate of spread may rapidly increase if plant is disturbed. | 4 |

Self explanatory.

Element 14. Seed dispersal-

- | | | |
|----|--|---|
| A. | Does not reproduce by seeds. | 0 |
| B. | Seeds large, few in number and/or with no special adaptations for dispersal. | 1 |
| C. | Seeds small, numerous and/or with special adaptations for dispersal. | 2 |

Many exotic species produce prolific quantities of very small seeds; some produce several crops of seeds in a single growing season. The seeds of some species have special dispersal adaptations such as wings, rough or prickly burs or other attachment accessories, sticky exterior coatings, seeds which float, or seeds designed for long-range wind transport. These species are rated highest.

Element 15. Seed germination requirements-

- | | | |
|----|---|---|
| A. | Does not reproduce by seeds. | 0 |
| B. | Requires disturbance and bare soil to germinate <u>or</u> seeds may remain viable in soil 1 year or less. | 1 |
| C. | Germinates in vegetated areas <u>or</u> seeds may remain viable in soil for 2-10 years. | 2 |
| D. | Germinates readily in existing vegetation <u>or</u> seeds may remain viable in soil for over 10 years. | 4 |

Species with seeds which can germinate in undisturbed native

vegetation pose a greater overall threat within the park than species which require bare soil and disturbance. A few species, with seeds which are readily disseminated by birds or animals, can germinate within pristine vegetation communities. These species pose a significant threat. Seed viability information is often difficult to obtain from the literature. As a result, most species are not rated on the basis of this factor.

Element 16. Competitive ability-

- | | |
|---------------------------|---|
| A. Poor competitor. | 1 |
| B. Moderate competitor. | 2 |
| C. Aggressive competitor. | 4 |

The competitiveness of a species is rated based on information from the literature and field observations of park populations. Of particular concern are those species which form dense, monospecific stands or colonies to the exclusion of other species.

Element 17. Effects of delayed management action-

- | | |
|---|---|
| A. Delayed action will likely result in minor increase in population size and distribution. | 1 |
| B. Delayed action will likely result in moderate increase in population size and distribution. | 2 |
| C. Delayed action will likely result in significant increase in population size and distribution. | 4 |

In this element, a subjective assessment of the effect of no action is estimated. As an example, under option C, a species which now exists only within one geographic quadrant could be expected to spread to two or more quadrants and vertically into an adjacent vegetation zone without management intervention. This would be expected within the useful life of this analysis, which is approximately five years.

A copy of the rating worksheet is provided in Appendix B.

OLYMPIC NATIONAL PARK
EXOTIC PLANT RATINGS

<u>Species</u>	<u>Rating Element</u>																	
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	
AGRE	2	1	2	2	2	8	4	2	2	1	4	2	4	1	1	4	2	44
AGCA	2	1	2	1	2	4	4	2	2	1	4	1	2	1	1	2	1	33
AGSTMA	2	2	2	2	2	2	4	2	2	1	4	1	2	1	1	2	1	33
AGSTPA	2	1	2	1	2	4	4	2	2	1	4	1	2	1	1	2	1	33
AGSTST	2	1	2	2	2	2	4	2	2	1	4	1	2	1	1	2	1	32
AICA	1	1	2	1	2	1	4	1	2	1	2	0	1	1	1	1	1	23
AIPR	2	1	2	1	2	1	2	1	2	1	2	0	1	1	1	1	1	22
ANTI	1	1	1	1	2	1	2	1	1	1	2	0	2	1	1	1	1	20
ANOD	2	1	4	2	2	2	2	2	2	1	2	0	2	1	2	2	1	30
ARMI	[No rating; insufficient data available]																	--
ARTH	2	1	1	1	2	1	2	1	1	1	2	0	1	2	1	2	1	22
ARELBI	2	1	2	1	2	1	2	1	2	1	2	0	2	1	1	1	1	23
ARELBU	[No rating; insufficient data available]																	--
AVSA	1	1	1	1	2	1	4	1	2	1	2	0	1	1	1	1	1	22
BAVUAR	[No rating; insufficient data available]																	--
BAVULO	[No rating; insufficient data available]																	--
BEPER	2	1	2	1	2	2	2	1	1	1	2	0	2	1	2	2	1	25
BRCO	[No rating; insufficient data available]																	--
BRHOHO	[No rating; insufficient data available]																	--
BRTE	2	2	2	1	2	2	4	2	2	2	2	0	1	2	2	2	2	32
CAEDED	1	1	1	2	2	2	2	2	2	1	2	0	1	2	1	4	2	28
CAMA	[No rating, insufficient data available]																	--
CASTA	[No rating; insufficient data available]																	--
CASESE	1	2	2	2	2	1	2	1	2	1	4	1	2	1	1	1	1	27
CAPE	1	1	2	1	2	1	2	1	1	1	4	1	2	2	2	2	1	27
CARAP	1	1	2	1	2	1	2	1	1	1	4	1	2	2	2	2	1	27
CABUBU	1	1	1	1	2	2	2	1	1	1	2	0	1	1	1	2	1	21
CECY	1	1	1	1	2	1	2	1	1	1	2	0	1	2	1	1	1	20
CEMO	[Rating applies to both <u>Centaurea</u> species]																	20

<u>Species</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	
CEER	1	1	1	2	2	1	2	1	2	1	2	0	1	1	1	1	1	21
CEFOTR	2	1	2	2	2	4	4	2	2	1	4	2	2	2	2	2	2	38
CEGL	1	1	2	2	2	2	4	2	2	1	4	2	1	2	2	2	1	33
CETO	[No rating; insufficient data available]																	--
CHAL	2	1	1	2	2	4	2	1	2	1	2	0	1	1	1	1	1	25
CIIN	1	1	1	1	2	1	2	1	2	1	4	1	2	1	1	2	1	25
CIARHO	2	4	2	2	2	8	4	2	2	2	4	4	4	2	2	4	4	54
CIVU	2	2	2	2	2	4	2	2	2	2	2	0	1	2	2	2	2	33
CLLIBR	[No rating; insufficient data available]																	--
CLLILI	[No rating; insufficient data available]																	--
COAR	[No rating; insufficient data available]																	--
CRCA	2	1	1	2	2	2	2	1	1	1	2	0	1	1	1	2	1	23
CYCR	2	1	1	2	2	2	2	2	2	1	2	0	2	1	1	2	1	26
CYSCAN	2	1	2	2	2	8	2	4	2	4	2	0	2	1	1	4	4	43
CYSCSC	[Rating applies to both varieties of <u>Cytisus</u>]																	43
DAGL	2	4	2	2	2	8	2	2	4	1	2	0	2	1	2	2	2	40
DACAR	2	1	1	2	2	2	2	1	2	1	2	0	1	2	1	2	1	25
DIAR	1	2	1	2	2	1	2	1	1	1	2	0	1	2	1	1	1	22
DIPUAL	2	2	2	2	2	8	2	2	2	2	2	0	1	2	2	1	1	35
DIPUPR	[Rating applies to both varieties of <u>Digitalis</u>]																	35
ECVU	1	1	1	2	2	1	2	1	1	1	2	0	1	1	1	2	1	21
ERMI	[No rating; insufficient data available]																	--
ERVEPR	[No rating; insufficient data available]																	--
ERVEVE	[No rating; insufficient data available]																	--
ESCACA	[No rating; insufficient data available]																	--
FEAR	1	1	1	2	2	2	2	1	1	1	4	1	2	1	1	2	1	26
FEEL	2	1	1	2	2	2	2	1	1	1	4	1	2	1	1	2	1	27
GAOD	1	1	4	2	2	1	2	1	2	1	4	1	2	2	2	2	1	31
GEDI	2	1	1	1	2	2	2	1	2	1	2	0	1	1	1	1	1	22
GEMO	[No rating; insufficient data available]																	--
GERO	1	1	2	1	2	1	2	1	1	1	2	0	1	1	1	1	1	20

<u>Species</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	
GLHEMI	[No rating; insufficient data available]																	--
HEHE	2	1	4	2	4	4	2	2	2	4	4	2	2	2	2	2	2	43
HEFUFU	1	1	2	1	2	1	1	1	2	2	1	1	2	0	0	1	1	20
HEMAN	[No rating; insufficient data available]																	--
HIAU	1	1	2	2	2	1	1	1	1	2	4	1	2	1	1	2	1	26
HOLA	[No rating; insufficient data available]																	--
HOMO	[No rating; insufficient data available]																	--
HYHI	[No rating; insufficient data available]																	--
HYCA	2	1	2	1	1	1	4	4	2	2	4	2	2	1	1	2	1	33
HYPE	2	2	2	2	2	4	2	2	2	1	4	2	2	2	1	4	4	40
HYRAD	[No rating; insufficient data available]																	--
ILAQ	2	1	8	4	4	8	1	4	2	4	2	0	2	1	2	2	2	49
IRPS	1	1	4	2	2	1	2	2	2	2	4	1	2	1	1	2	1	31
JUCO	1	1	2	2	2	1	2	2	2	1	4	2	2	1	2	2	2	31
LAPU	[No rating; insufficient data available]																	--
LACO	2	2	1	2	2	4	2	2	2	1	2	0	1	2	1	2	1	28
LALA	[No rating; insufficient data available]																	--
LASY	2	1	2	2	2	2	4	2	2	2	4	4	4	1	1	4	4	43
LEHE	[No rating; insufficient data available]																	--
LEVU	2	2	2	2	2	8	4	2	2	2	4	1	2	1	2	2	2	41
LIGE	[No rating; insufficient data available]																	--
LIVU	[No rating; insufficient data available]																	--
LOMU	[No rating; insufficient data available]																	--
LOPER	[No rating; insufficient data available]																	--
LOET	[No rating; insufficient data available]																	--
LOPED	[No rating; insufficient data available]																	--
LUAN	[No rating; insufficient data available]																	--
LUARAR	[No rating; insufficient data available]																	--

<u>Species</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	
LYCO	[No rating; insufficient data available]																	--
LYPY	[No rating; insufficient data available]																	--
LYPO	[No rating; insufficient data available]																	--
LYSA	[No rating; insufficient data available]																	--
MASYL	2	1	2	1	2	4	1	1	1	2	2	0	2	1	1	1	1	24
MAMO	[No rating; insufficient data available]																	--
MELUCU	[No rating; insufficient data available]																	--
MELULU	[No rating; insufficient data available]																	--
MEMI	[No rating; insufficient data available]																	--
MEBE	[No rating; insufficient data available]																	--
MESP	1	1	2	2	2	2	2	2	4	1	1	1	2	0	0	2	1	26
MEXP	[Rating applies to both <u>Mentha</u> species]																	26
MUBO	[No rating; insufficient data available]																	--
MYMU	[No rating; insufficient data available]																	--
MYAR	2	1	2	1	2	2	2	1	2	1	2	0	1	1	1	1	1	23
MYDI	1	1	2	1	2	2	2	1	2	1	2	0	1	1	1	1	1	21
MYSC	1	1	2	1	2	2	2	1	2	1	2	0	2	1	1	1	1	23
MYST	2	1	2	1	2	2	2	1	2	1	2	0	1	1	1	1	1	22
MYSY	[No rating; insufficient data available]																	--
NAPS	1	1	2	1	2	1	2	1	1	2	1	1	2	0	0	1	1	20
NYODOD	1	1	4	2	2	2	2	2	4	2	1	1	2	0	0	2	2	30
PAOR	[No rating; insufficient data available]																	--
PAVI	[No rating; insufficient data available]																	--
PEJA	[No rating; insufficient data available]																	--
PHAR	2	1	2	2	2	8	4	4	4	2	4	2	4	1	1	4	4	51
PHPRPR	[No rating; insufficient data available]																	--
PIPOPO	1	1	4	2	4	1	1	2	2	4	2	0	1	1	2	1	1	30
PLLALA	[No rating; insufficient data available]																	--
PLMAMA	[No rating; insufficient data available]																	--
POANAN	[No rating; insufficient data available]																	--
POANRE	[No rating; insufficient data available]																	--

<u>Species</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	
POCOM	[No rating; insufficient data available]																	--
POPA	[No rating; insufficient data available]																	--
POPRPR	2	4	2	2	2	8	4	4	4	1	4	2	2	1	2	2	2	48
POTRI	[No rating; insufficient data available]																	--
POAR	[No rating; insufficient data available]																	--
POAV	[No rating; insufficient data available]																	--
POCOCO	[No rating; insufficient data available]																	--
POCOSU	[No rating; insufficient data available]																	--
POCU	2	1	4	2	2	2	2	2	2	2	4	2	4	2	1	4	2	40
POHY	[No rating; insufficient data available]																	--
POPEPE	[No rating; insufficient data available]																	--
POSA	2	1	4	1	2	2	2	2	2	2	4	2	4	2	1	4	2	39
PONI	1	1	2	1	2	1	1	2	2	4	1	1	2	0	0	1	1	23
POCR	[No rating; insufficient data available]																	--
PRUVUVU	2	2	2	1	2	2	2	1	1	1	4	1	2	1	1	2	1	28
PRAV	[No rating; insufficient data available]																	--
PRLA	2	1	2	1	2	1	1	2	1	2	4	2	2	1	1	2	1	28
RAACAC	[No rating; insufficient data available]																	--
RAREPL	[No rating; insufficient data available]																	--
ROPSPS	[No rating; insufficient data available]																	--
ROSY	[No rating; insufficient data available]																	--
ROCA	[No rating; insufficient data available]																	--
ROEG	[No rating; insufficient data available]																	--
RUDI	[No rating; insufficient data available]																	--
RULAC	[No rating; insufficient data available]																	--
RUODOD	[No rating; insufficient data available]																	--
RUVE	[No rating; insufficient data available]																	--
RUHI	1	2	1	1	2	1	1	1	1	2	2	0	1	1	1	1	1	20
RUAC	[No rating; insufficient data available]																	--
RUCR	2	4	2	2	2	4	2	2	2	2	2	0	2	2	1	2	2	35
RUOBAG	2	2	2	2	2	4	2	1	2	1	4	1	2	1	1	1	1	31
RUTE	[No rating; insufficient data available]																	--
SAPR	[No rating; insufficient data available]																	--
SACU	[No rating; insufficient data available]																	--
SEJA	2	1	2	2	2	4	2	2	2	2	4	2	4	2	2	2	4	41

<u>Species</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	
SESY	[No rating; insufficient data available]																	--
SEVU	[No rating; insufficient data available]																	--
SIAL	[No rating; insufficient data available]																	--
SOAS	[No rating; insufficient data available]																	--
SOOL	[No rating; insufficient data available]																	--
SOAU	2	1	4	2	2	2	1	2	2	4	2	0	2	1	2	1	1	31
SPARAR	[No rating; insufficient data available]																	--
SPARSA	[No rating; insufficient data available]																	--
SPRU	[No rating; insufficient data available]																	--
STGR	2	1	2	1	2	4	4	2	1	1	4	1	2	2	2	2	1	34
STME	[Rating applies to both <u>Stellaria</u> species]																	34
SYAS	[No rating; insufficient data available]																	--
TAVU	[No rating; insufficient data available]																	--
TALA	[No rating; insufficient data available]																	--
TAOF	2	4	2	2	2	8	4	2	4	2	4	2	2	2	2	2	2	48
THAR	[No rating; insufficient data available]																	--
TRDU	1	2	1	1	2	1	2	1	1	1	2	0	1	2	1	1	1	21
TRAR	[No rating; insufficient data available]																	--
TRDU	[No rating; insufficient data available]																	--
TRHY	[No rating; insufficient data available]																	--
TRPR	[No rating; insufficient data available]																	--
TRRE	[No rating; insufficient data available]																	--
TUFA	[No rating; insufficient data available]																	--
ULEU	[No rating; insufficient data available]																	--
VALO	[No rating; insufficient data available]																	--
VETH	[No rating; insufficient data available]																	--
VEAR	[No rating; insufficient data available]																	--
VECH	[No rating; insufficient data available]																	--
VEOF	1	2	2	1	2	1	2	1	1	1	4	1	2	1	1	1	1	25
VESE	[No rating; insufficient data available]																	--
VISA	[No rating; insufficient data available]																	--
VIMI	2	1	2	1	2	1	2	2	1	2	1	1	2	0	0	2	1	23

<u>Species</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>
VUBR	[No rating; insufficient data available]																--
VUMY	[No rating; insufficient data available]																--

The rated species have been placed in four categories based on level of threat. The total number of species and the percentage for each category are given below.

<u>RATING</u>	<u>SPECIES</u>	<u>PERCENTAGE</u>		
51-55	2	2%	SERIOUS THREAT	[6%]
46-50	3	5%		
=====				
41-45	7	8%	SIGNIFICANT THREAT	[15%]
36-40	5	6%		
=====				
31-35	18	22%	POTENTIAL THREAT	[41%]
26-30	16	19%		
=====				
21-25	24	30%	LOW THREAT	[38%]
<20	<u>7</u>	8%		
	82			

SERIOUS THREAT [RATING 46-55]

54 - <i>Cirsium arvense</i> var. <i>horridum</i>	Canada thistle
51 - <i>Phalaris arundinacea</i>	Reed canarygrass
49 - <i>Ilex aquifolium</i>	English holly
48 - <i>Poa pretensis</i> ssp. <i>pretensis</i>	Kentucky bluegrass
48 - <i>Taraxacum officinale</i>	Common dandelion

SIGNIFICANT THREAT [RATING 36-45]

44 - <i>Agropyron repens</i>	Quackgrass
43 - <i>Cytisus scoparius</i> var. <i>andreas</i>	Scot's broom
43 - <i>Cytisus scoparius</i> var. <i>scoparius</i>	Scot's broom
43 - <i>Hedera helix</i>	English ivy
43 - <i>Lathyrus sylvestris</i>	Small everlasting peavine
41 - <i>Leucanthemum vulgare</i>	Ox-eye-daisy
41 - <i>Senecio jacobea</i>	Tansy ragwort
40 - <i>Dactylis glomerata</i>	Orchard-grass

SIGNIFICANT THREAT [CONT.]

40 - <i>Hypericum perforatum</i>	Common St. John's-wort
40 - <i>Polygonum cuspidatum</i>	Japanese knotweed
39 - <i>Polygonum sachalinense</i>	Giant knotweed
38 - <i>Cerastium fontanum</i> ssp. <i>triviale</i>	Common chickweed

POTENTIAL THREAT [RATING 26-35]

35 - <i>Digitalis purpurea</i> var. <i>alba</i>	Foxglove
35 - <i>Digitalis purpurea</i> var. <i>purpurea</i>	Foxglove
35 - <i>Rumex crispus</i>	Curly dock
34 - <i>Stellaria graminea</i>	Grass-leaved starwort
34 - <i>Stellaria media</i>	Chickweed
33 - <i>Agrostis capillaris</i>	Colonial bentgrass
33 - <i>Agrostis stolonifera</i> var. <i>major</i>	Redtop
33 - <i>Agrostis stolonifera</i> var. <i>palustris</i>	Redtop
33 - <i>Cerastium glomeratum</i>	Sticky chickweed
33 - <i>Cirsium vulgare</i>	Bull thistle
33 - <i>Hypericum calycinum</i>	Jerusalem star
32 - <i>Agrostis stolonifera</i> var. <i>stolonifera</i>	Redtop
32 - <i>Bromus tectorum</i>	Cheatgrass
31 - <i>Galium odoratum</i>	Sweet woodruff
31 - <i>Iris psuedacorus</i>	Yellow iris
31 - <i>Juncus conglomeratus</i>	Conglomerate rush
31 - <i>Rumex obtusifolius</i> ssp. <i>agrestis</i>	Bitter dock
31 - <i>Sorbus aucuparia</i>	European mountain-ash
30 - <i>Nymphaea odorata</i> var. <i>odorata</i>	Fragrant water-lily
30 - <i>Pinus ponderosa</i> var. <i>ponderosa</i>	Ponderosa pine
30 - <i>Anthoxanthum odoratum</i>	Sweet vernalgrass
28 - <i>Cakile edentula</i> ssp. <i>edentula</i>	American searocket
28 - <i>Lapsana communis</i>	Nipplewort
28 - <i>Prunella vulgaris</i> var. <i>vulgaris</i>	Self-heal
28 - <i>Prunus laurocerasus</i>	Laurel cherry
27 - <i>Calystegia sepium</i> ssp. <i>sepium</i>	Wild morning-glory
27 - <i>Campanula persicifolia</i>	Peach bells
27 - <i>Campanula rapunculoides</i>	Creeping bellflower
27 - <i>Festuca elatior</i>	Meadow fescue
26 - <i>Cynosurus cristatus</i>	Crested dogtail
26 - <i>Festuca arundinacea</i>	Reed fescue
26 - <i>Mentha spicata</i>	Spearmint
26 - <i>Mentha spicata</i> x <i>piperita</i>	Peppermint

LOW THREAT [RATING <26]

25 - <i>Bellis perennis</i>	English daisy
25 - <i>Chenopodium album</i>	Lamb's quarter
25 - <i>Cichorium intybus</i>	Chicory
25 - <i>Daucus carota</i>	Queen Anne's lace
25 - <i>Veronica officinalis</i> var. <i>officinalis</i>	Paul's betony

LOW THREAT [CONT.]

24 - <i>Malus sylvestris</i>	Cultivated apple
23 - <i>Aira caryophylllea</i>	Silver hairgrass
23 - <i>Arrhenatherum elatius</i> var. <i>bulbosum</i>	Tall oatgrass
23 - <i>Crepis capillaris</i>	Smooth hawksbeard
23 - <i>Myosotis arvensis</i>	Field forget-me-not
23 - <i>Myosotis scorpiodes</i>	Common forget-me-not
23 - <i>Populus nigra</i>	Lombardy poplar
23 - <i>Vinca minor</i>	Perriwinkle
22 - <i>Aira praecox</i>	Early hairgrass
22 - <i>Arabidopsis thaliana</i>	Thale cress
22 - <i>Avena sativa</i>	Common oat
22 - <i>Dianthus armeria</i>	Deptford pink
22 - <i>Geranium dissectum</i>	Cutleaf geranium
22 - <i>Myosotis stricta</i>	Small-flowered forget-me-not
21 - <i>Capsella bursa-pastoris</i> var. <i>bursa-pastoris</i>	Shepherd's-purse
21 - <i>Centaureum erythraea</i>	Common centaury
21 - <i>Echium vulgare</i>	Blueweed
21 - <i>Myosotis discolor</i>	Yellow-blue forget-me-not
21 - <i>Tragopogon dubius</i>	Yellow salsify
20 - <i>Anthemis tinctoria</i>	Yellow chamomile
20 - <i>Centaurea cyanus</i>	Cornflower
20 - <i>Centaurea montana</i>	Mountain knapweed
20 - <i>Geranium robertianum</i>	Herb Robert
20 - <i>Hemerocallis fulva</i> var. <i>fulva</i>	Orange day-lily
20 - <i>Narcissus pseudonarcissus</i>	Daffodil
20 - <i>Rudbeckia hirta</i>	Black-eyed Susan

CONTROL STRATEGY AND METHODS

Each rated exotic species has been placed into one of four groups based on the feasibility of control. Generally, it is park policy to initiate control efforts only on those high threat species where a known control technique exists, or can reasonably be developed using IPM principles, and a high probability of success is predicted. The only exception to this policy might be in the case of a small, recently established population of a low threat species which could be eliminated with minimal effort through prompt action.

The control groups have been established as follows:

Group 1

Control is feasible using non-chemical methods including: prevention of new introductions, mechanical removal, mowing, cultivation, burning, mulching, biological control, or various silvicultural and site conversion treatments.

Control methods for these species are usually well-established and documented within the literature.

Group 2

Control will likely require recurring treatments using the methods outlined under Group 1 or the use of approved herbicides.

The literature reveals that control of these persistent or aggressive species is difficult to achieve and will require a more comprehensive strategy or protracted effort.

Group 3

Control will likely require intensive and recurring chemical treatments or additional investigation and field trials to test potential control techniques is deemed necessary.

Previous attempts to control these species have generally been unsuccessful or control methods have not been adequately researched under conditions prevailing on the Olympic Peninsula.

Group 4

Control is not feasible.

These species are fully assimilated within park vegetation communities and control or eradication is not considered practical except on a very small-scale basis to protect specific populations of rare, sensitive or threatened native taxa.

The organization of the rated species by threat category within the four control groups is portrayed below:

Serious Threat Species [Rating >45]

Group 1

None

Group 2

49 - *Ilex aquifolium* English holly

Group 3

54 - *Cirsium arvense* var. *horridum* Canada thistle
51 - *Phalaris arundinacea* Reed canarygrass

Group 4

48 - *Poa pratensis* Kentucky bluegrass
48 - *Taraxacum officinale* Common dandelion

Significant Threat Species [Rating 36-45]

Group 1

None

Group 2

43 - *Cytisus scoparius* var. *andreaanus* Scot's broom
43 - *Cytisus scoparius* var. *scoparius* Scot's broom
43 - *Hedera helix* English ivy
43 - *Lathyrus sylvestris* Small everlasting peavine
41 - *Leucanthemum vulgare* Ox-eye-daisy
40 - *Hypericum perforatum* Common St. John's-wort
40 - *Polygonum cuspidatum* Japanese knotweed
39 - *Polygonum sachalinense* Giant knotweed

Group 3

41 - *Senecio jacobea* Tansy ragwort

Group 4

44 - *Agropyron repens* Quackgrass
38 - *Cerastium fontanum* ssp. *triviale* Common chickweed

Potential Threat Species [Rating 26-35]

Group 1

35 - <i>Digitalis purpurea</i> var. <i>alba</i>	Foxglove
35 - <i>Digitalis purpurea</i> var. <i>purpurea</i>	Foxglove
33 - <i>Cerastium glomeratum</i>	Sticky chickweed
31 - <i>Galium odoratum</i>	Sweet woodruff
31 - <i>Iris psuedacorus</i>	Yellow iris
31 - <i>Sorbus aucuparia</i>	European mountain-ash
30 - <i>Pinus ponderosa</i> var. <i>ponderosa</i>	Ponderosa pine
30 - <i>Anthoxanthum odoratum</i>	Sweet vernalgrass
28 - <i>Lapsana communis</i>	Nipplewort
28 - <i>Prunella vulgaris</i> var. <i>vulgaris</i>	Self-heal
28 - <i>Prunus laurocerasus</i>	Laurel cherry

Group 2

35 - <i>Rumex crispus</i>	Curly dock
34 - <i>Stellaria graminea</i>	Grass-leaved starwort
34 - <i>Stellaria media</i>	Chickweed
33 - <i>Cirsium vulgare</i>	Bull thistle
33 - <i>Hypericum calycinum</i>	Jerusalem star
31 - <i>Juncus conglomeratus</i>	Conglomerate rush
31 - <i>Rumex obtusifolius</i> ssp. <i>agrestis</i>	Bitter dock
28 - <i>Cakile edentula</i> ssp. <i>edentula</i>	American searocket
27 - <i>Calystegia sepium</i> ssp. <i>sepium</i>	Wild morning-glory
27 - <i>Campanula persicifolia</i>	Peach bells
27 - <i>Campanula rapunculoides</i>	Creeping bellflower
26 - <i>Cynosurus cristatus</i>	Crested dogtail

Group 3

32 - <i>Bromus tectorum</i>	Cheatgrass
27 - <i>Festuca elatior</i>	Meadow fescue
26 - <i>Festuca arundinacea</i>	Reed fescue

Group 4

33 - <i>Agrostis capillaris</i>	Colonial bentgrass
33 - <i>Agrostis stolonifera</i> var. <i>major</i>	Redtop
33 - <i>Agrostis stolonifera</i> var. <i>palustris</i>	Redtop
32 - <i>Agrostis stolonifera</i> var. <i>stolonifera</i>	Redtop
30 - <i>Nymphaea odorata</i> var. <i>odorata</i>	Fragrant water-lily
26 - <i>Mentha spicata</i>	Spearmint
26 - <i>Mentha spicata</i> x <i>piperita</i>	Peppermint

Low Threat Species [Rating 25 or Lower]

These 31 species have not been categorized. Lack of available personnel and monetary resources will limit action to incidental control opportunities or where rare, sensitive or threatened native species are at risk.

A variety of control methods are detailed in the "weed" literature. The most comprehensive references include Muenscher (1980) and Lorenzi and Jeffery (1987). Many methods are impractical, expensive, or unsuitable for use within national parks. A few effective methods (such as hand-pulling) are only practical when used on a small-scale basis. The techniques used to control some species can be so destructive, involving removal of all site vegetation, that they are rarely utilized in natural areas. Some experimental techniques, such as electrocution of woody shrubs using low-voltage alternating current, have never been taken seriously by anyone except the persons promoting them.

Regardless of the method, all control techniques are necessarily labor-intensive and require a commitment of personnel, time, and funding which may not always be available. It is also important to note that "control" does not mean eradication. Complete eradication of most exotics in Olympic will not be possible. However, suppressing exotics through control will prevent further spread and is an important first step toward site restoration.

A brief synopsis of the control methods likely to be suitable for use at Olympic is provided below.

Prevention

Preventing the further spread of exotics during control projects can be achieved by thoroughly cleaning all potential transporters of seeds and plant parts prior to moving to new areas. This includes hand tools, equipment, and the clothing and footwear of personnel.

Hand-pulling

This is an old and familiar control method and should not be overlooked in its simplicity. It can be very effective for small or scattered populations of annual and biennial species but has little or no effect on established perennial species.

Gloves should always be worn when hand-pulling exotic species as many are toxic or contain substances which can cause contact dermatitis. Special lever-style hand tools, both homemade or commercially manufactured, are available for use on shrubby perennials or small trees. Hand-pulling is easiest on rain-soaked ground.

Hand-Hoeing or Cultivation

This is an effective method for controlling localized populations of annual or biennial species. It is only effective on perennials if they are never allowed to grow undisturbed for more than two to three weeks. The objective is to force constant regrowth without allowing time for replenishment of underground food reserves, thus starving the plant. A sharp hoe is mandatory and should be used to cut the seedling or plants off just below the soil surface. Deep hoeing is counter-productive as it brings seeds to the surface where new germination can occur.

Powersaws

Exotic tree species and some larger woody shrubs can be treated by felling with a chainsaw. Resprouting is a problem with some species, and cut surfaces may have to be treated with herbicides.

Mechanical Cultivation

Small to medium-sized monospecific patches of certain exotics can be controlled by deep cultivation using a rototiller or garden tractor. Care must be taken to till deeply enough to bring the root systems of the plants to the surface. Since this method creates bare mineral soil, a revegetation plan or suitable mulches should be available as an immediate follow-up to treatment.

Clipping or Mowing

Mowing is effective in reducing the spread and increase of some species in fields, old pastures, along right-of-ways, and waste areas. Hand tools or power tools (string or circular blade trimmers) can be used. It is most effective if performed before plants flower. Mowing prevents seed production, but does not kill the plants. Mowing can also slow growth and make exotics more susceptible to competition or pests. It is not effective on perennial species.

Clipping or severely pruning perennial species is advocated at Olympic as a good interim treatment for high threat species. By preventing seed production, this technique can "buy time" until a more comprehensive strategy can be developed and implemented.

Mulches and Shading

A mulch is any kind of covering applied to the soil surface to protect the area. Sawdust, wood chips, "beauty bark", and plastic sheeting are most commonly used. If applied properly, these materials can be very effective in preventing seed germination, thus controlling most annuals. They are not very effective in controlling new perennial species arising from vegetative propagules.

If materials such as sawdust or wood chips are used, a layer 4-5 inches deep should be applied. Areas treated with plastic sheeting should be covered with two or more layers and the edges weighted down with rocks or soil. Plastic sheeting should be left in place for two full growing seasons for best results.

Burning

Fire has long been used for control of young annual weeds and to destroy the aerial portions of dry mature plants. Fire will only slow the growth of perennial weeds. Fires which burn too hot may kill desirable species, allow adventive species near the site to readily invade, or cause seeds dormant in the soil to germinate.

The prevailing climate of Olympic, air quality restrictions, and the amount of planning required to use prescribed burning in the National Park Service probably renders this method impractical.

Flaming, using a propane torch or other heat source to singe the foliage of plants, may be of use on some perennial species.

Biological Control

The use of natural enemies (insects, diseases) to control unwanted plants is known as biological control or biocontrol. An excellent review of biocontrol programs on exotic vegetation in the United States and their application to management of natural areas of the National Park Service is provided in Gardner (1990).

NPS Management Policies (1988) specify that biological control will be used, where available, before chemical control is considered. This stated preference for biocontrol over herbicide use is somewhat idealistic as little actual precedent exists for biocontrol use in natural ecosystems.

To initiate biocontrol, the country of origin of the exotic species must be visited and natural enemies or predators of the target species identified. These natural enemies must be host-specific to prevent injury to non-target species. The biocontrol agents must be transported free of their own natural predators and should not have any predators in the area they will be introduced. After release, it is then possible for the population of the agent to increase to a point where it can control the target exotic plant and decrease its population or vigor.

As the target species population decreases, the predator population will likewise decrease due to lack of food. After the predator population has dropped sufficiently, the target plant population will again start to increase, which triggers a corresponding increase in the predator.

These cycles continue over time, though with each cycle the population numbers will be lower and the magnitude of the cycle less. At some point the exotic species population and the predator population stabilizes. Eradication is rarely possible with a biocontrol agent, but the target species will be controlled to a tolerable level.

Biocontrol in natural areas is not without its controversy. Adequate research is required to be certain the agents are sufficiently host-specific. The larvae of an introduced beetle released in the United States to control tansy ragwort (Senecio jacobea) feeds on and destroys the weed. However, the same beetle attacks many native species of Senecio. Such a mistake could have disastrous consequences at Olympic. Since most biocontrol programs are conducted to support agriculture, it is rare for host-specific testing to be comprehensive enough to cover the range of potential species at risk in a park.

Additionally, since biocontrol agents rarely eradicate the target species, the end result of the introduction is two exotic species where before there was only one. Biocontrol is not suited to small-scale application but is usually undertaken over a wide geographic area with cooperation between land owners and land management agencies. These interests often have conflicting management objectives and goals. The agents themselves are often expensive to acquire in sufficient numbers to establish a viable population. But the passive nature of the technique is appealing to many persons and there have been some major success stories such as the introduction of insects to control Common St. John's-wort in California in 1944, and some of the biocontrol projects currently underway in Hawaii.

Since few approved agents are available at this time for species of concern at Olympic, biocontrol is probably not practical, but it is important for park staff to keep informed of the latest developments. Reference to possible target species is made in the control section of the Exotic Species Catalog. In addition, investigation of native enemies of exotic plants such as slugs, powdery mildew, etc., should be encouraged and pursued.

Chemical Control

The use of herbicides in natural areas is controversial. Yet, time and labor constraints and the certain ecological damage that exotic plants cause make herbicides a necessary component of any comprehensive exotic management program. Few of the many herbicides available are suitable for use in natural areas. Several products which were formerly used have now had their approval withdrawn, and new products are constantly being introduced. Despite extensive research, little or no information can be found on the effects of herbicides on invertebrate and

vertebrate animals, native plant seedbanks and non-target plants. The persistence and leaching of herbicides in soils and their long-term effects in wetland ecosystems is also unknown. Obviously, herbicides must be chosen carefully, approved for use through the park's IPM program, and applied carefully by trained personnel to minimize the hazard to the public, native plants and animals, and water resources. Herbicides should always be used judiciously.

Herbicides are classified according to their chemistry or method of application. Herbicide use at Olympic will mainly involve non-selective products applied as foliar sprays to above ground plant parts of target plants in spot applications using backpack sprayers. Other uses include treatment of residual stumps or cut ends of several species to prevent resprouting.

The timing of herbicide application within the growing season and in terms of vegetative development of the target plant is often critical to achieve successful control. The Exotic Species Catalog contains specific chemical treatment recommendations for many species. Much of this information must be considered preliminary, as research is on-going to find suitable herbicides for use under Olympic Peninsula conditions. In many cases, experimental trials on selected exotic species will be necessary before definitive herbicide treatment information can be provided.

Site Conversion and Silvicultural Treatments

For many sites with serious impacts from exotic species these methods are recommended as the preferred management approach toward restoring natural conditions. The goal is to "kick start" successional processes by converting the area into forests. Natural ground covers and tree species similar to those of adjacent areas are selected based on a site-specific plan or "prescription" developed for the area. These methods are particularly applicable to restoring old-fields, homesites, acquired inholdings, and former pastures.

A work project to control or suppress the exotics at the site should normally precede the planting of native species. Follow-up care of the transplants should be planned for to insure their survival and prevent further competition from exotics while the native species become reestablished.

Micro-Management

This is a coined term for a proposed control method which could be used on a small-scale, selective basis to remove threats near populations of rare native plants. Careful hand-pulling will typically be the technique used. It must be undertaken by skilled personnel under the direct supervision of experienced staff. It would most often be used early in the growing season, as exotics

often emerge and green-up before the native species. Obviously, a conservative approach should be adopted when working anywhere near these special park resources.

Note: At the time of the distribution of this draft (September, 1991) control trials are underway on a number of species:

<i>Cirsium arvense</i> var. <i>horridum</i>	Herbicide, hand-pulling
<i>Cirsium vulgare</i>	Cutting
<i>Cytisus scoparius</i>	Hand-pulling, site conversion
<i>Digitalis</i> sp.	Hand-pulling
<i>Echium vulgare</i>	Hand-pulling
<i>Hedera helix</i>	Cutting, flaming
<i>Hypericum calycinum</i>	Flaming
<i>Ilex aquifolium</i>	Cutting, herbicide
<i>Lathyrus</i> sp.	Hand-pulling
<i>Phalaris arundinacea</i>	Mowing, mulch, herbicide
<i>Polygonum cuspidatum</i>	Mowing, herbicide, mulch
<i>Rumex crispus</i>	Hand-pulling

Monitoring and evaluation of these techniques will occur at the end of the 1991 field season and at the start of the growing season in spring, 1992.

MULTI-YEAR ACTION PLAN

The following management activities are proposed for the next three fiscal years:

FY 1991

1. Continue data collection on remaining unrated species.
2. Draft Exotic Plant Management Plan.
3. Design exotic plant computerized database.
4. Conduct orientation and training for park staff.
5. Complete field surveys for Serious and Significant threat species.
6. Perform surveys of high priority rare plant sites for threats posed by exotic plants.
7. Initiate control projects on Serious threat species; use these projects to conduct trials of various control methods.

FY 1992

1. Implement Exotic Plant Management Plan.
2. Develop comprehensive plan for control of exotics in old-fields and acquired properties.
3. Continue control projects began in FY 1991; initiate additional control projects on Significant threat species.
4. Develop interpretive materials on the exotic plant management program.
5. Initiate control projects on selected exotic species within subalpine areas.
6. Continue surveys of high priority rare plant sites.
7. Develop and distribute field identification guides for use by park staff and implement an exotic plant reporting system.
8. Survey park developments, concession areas, and visitor centers for presence of exotic species; develop a plan for removal and replacement with native species.

FY 1993

1. Begin rehabilitation of old-field and acquired properties.
2. Initiate control projects for high threat species in wetland and aquatic sites.
3. Continue survey of rare plant sites; begin control projects, if appropriate.
4. Begin vegetation rehabilitation around park developments, concession areas, and visitor centers.
5. Continue control projects on Serious and Significant threat species; initiate control projects on Potential threat species.
6. Meet with surrounding land management agencies to develop a cooperative program to control exotic species of mutual concern.

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