Interior Columbia Basin
Ecosystem Management Project
Science Integration Team
Terrestrial Staff
Range Task Group

REVIEW DRAFT

Noxious Weeds in the Interior Columbia Basin and Portions of the Klamath and Great Basin: Science Assessment of Selected Species

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INTRODUCTION

Historical Context

Invasions of exotic plants, which are plants not native to the area under consideration, have been numerous in the Interior Columbia Basin and portions of the Klamath and Great Basin (hereafter this region is referred to as "the Basin" and its extent is shown in Figure BASINCOUNTIES) in the last 100 years (Young et al. 1972, Franklin and Dyrness 1973, Yensen 1981, in Mack 1986). Many of these exotic plants originated from the Mediterranean region, a region characterized by a climate of wet, cool autumns and winters, and dry, hot summers, similar to the Basin. These exotics thus were preadapted to the climate of the Basin (Young et al. 1972, Trewartha 1981, in Mack 1986). Euro-American settlement of the Basin in the late 1800s facilitated the invasion and expansion of exotic plants. The major avenue through which exotic plants initially entered the Basin was agriculture, especially through contamination of crop seed, such as alfalfa, clover, oats, and wheat, and deliberate introduction of some species to provide forage for livestock. Some of the impetus for the deliberate introduction of forage species was the severe depletion on rangelands of the native bunchgrasses, caused by overgrazing and trampling (Mack 1981, in Mack 1986).
(NOTE TO SENIOR AUTHOR: SECTION INCOMPLETE)

Success of Exotic Plants, Particularly Noxious Weeds

Currently, exotic plants, especially the legally declared "noxious" weeds, are spreading rapidly and in some cases exponentially on rangeland in the Basin. Noxious weeds, in general, are opportunists and commonly referred to as "pioneer" species because after a disturbance to the soil surface which results in loss of the native plant cover, they are often the first species to arrive and colonize. They are typically prolific producers of seed, which are usually dispersed by vehicles, wind, wildlife, livestock, water, machinery, and pack animals, often for long distances. They typically germinate under a wide variety of conditions, show fast seedling growth, and thus establish quickly and take up water and nutrients that thus are not available for native species. Thus, the establishment and spread of these weeds is aided by disturbance to the soil surface, in combination with their opportunistic life cycle strategies.
(NOTE TO SENIOR AUTHOR: SECTION INCOMPLETE)

Why Are Noxious Weeds Problematic?

Noxious weeds can reduce the diversity and abundance of native vegetation, reduce forage, reduce diversity and quality of wildlife habitat, and increase erosion and decrease water quality. Some of the densest infestations of noxious weeds are near roads, which provide a conduit for noxious weed spread by human-related activities. Although as stated previously, noxious weed establishment and spread is facilitated by soil surface disturbance, some noxious weed species currently are showing ability to invade relatively undisturbed sites, including wilderness areas and National Parks (Asher 1994, Tyser and Key 1988).
(NOTE TO SENIOR AUTHOR: SECTION INCOMPLETE)

Unless cited otherwise, material in this report was summarized primarily from a contract report edited by Sheley (1994), and solicited by the Interior Columbia Basin Ecosystem Management Project.

METHODOLOGY

Susceptibility of Rangeland Cover Types to Noxious Weeds--County Distributions of Noxious Weeds--Future Priority for Noxious Weed Search Efforts

INVADERS Database Release 6.2 (Rice and Rider 1995), supplemented by numerous literature sources, was used to (1) determine susceptibility of rangeland cover types to invasion by 25 weed species [24 noxious weeds plus downy brome (cheatgrass)], see Table SUSCEPTIBILITY, and (2) generate regional distribution maps of the 25 species to the county scale of resolution over the last 121 years (1875-1995), see Maps (named by species). In Table SUSCEPTIBILITY, a data matrix was prepared that includes the susceptibility of rangeland cover types to invasion. The cells of the matrix were coded for susceptibility to invasion. Codes and definitions are (1) D=Disturbed -- Weed species invades successfully because high intensity or frequency of disturbance impacts the soil surface or removes the normal canopy cover, (2) I=Invasive -- Weed species invades successfully and becomes dominant or codominant even in the absence of intense or frequent disturbance, (3) C=Closed -- Weed species does not invade because cover type does not provide suitable habitat, and (4) U=Unknown -- Distribution data were insufficient to permit a determination, or ecological requirements of the species have not been defined. Also, the cover type might be poorly defined or is a minor areal component of the assessment area that restricts the probability of obtaining records collected within it.

Table SUSCEPTIBILITY includes all 25 weed species and susceptibility determinations for the 29 rangeland potential vegetation types in the Basin. A potential vegetation type is the vegetation that would grow on a site in the absence of disturbance, or the vegetation that would grow on a site in the presence of frequent disturbance that typically affects the site. Disturbances such as agriculture and exotic weed invasion, however, can prevent the attainment of a potential vegetation type on an area. Within potential vegetation types, 1 to several rangeland cover types, as recognized by the Society for Range Management (Shiflet 1994), might be observed on the ground. These rangeland cover types would represent what is currently on the ground and thus are more useful for land managers and others who are interested in searching and controlling infestations of these weed species. These Society for Range Management (SRM) cover types are numbered in Table SUSCEPTIBILITY and are described more fully in Table COVERTYPE. A rangeland cover type is a "kind of existing plant community with distinguishable characteristics described in terms of the present vegetation that dominates the aspect or physiognomy of an area" (Shiflet 1994). The susceptibility determinations were made at the rangeland cover type level, to permit a finer level of discrimination that land managers can utilize whatever their objective might be.

Dewey et al. (1991) propose that "The precision and usefulness of federal weed control Environmental Assessment (EA) and Environmental Impact Statement (EIS) documents would be

significantly improved by knowing the exact location and extent of lands vulnerable to specific noxious weeds." Table SUSCEPTIBILITY is our attempt to provide information to land managers and the concerned public about susceptibility of vegetation types on rangelands to noxious weeds in the Basin.

"Noxious" is a legal classification and not an ecological term. Plants that can exert substantial negative environmental or economic impact can be designated as noxious by various government agencies. Federal and state laws require certain actions directed at the management of noxious weeds. The 5 states in the Basin that are included in this report are Montana, Wyoming, Idaho, Washington, and Oregon. These 5 states maintain separate noxious weed lists. The 24 noxious weed species in this report are categorized as noxious in at least one of these states. Downy brome (cheatgrass) is not designated as a noxious weed in any of these states.

Included in Table SUSCEPTIBILITY is the noxious classification of each species. The noxious lists for Montana, Washington, and Oregon have multiple categories. In Idaho and Wyoming, noxious weed species are categorized only as noxious and are indicated by a Y in the table. Definitions for the multiple categories are now presented.

a. Montana

These designations are made by the State Department of Agriculture.

Category 1--Weeds that are well established and generally widespread. Management strategies are directed at containment and suppression.

Category 2--Weeds that have been recently introduced to the state or are rapidly spreading. Management efforts are directed at monitoring, containment, and eradication when possible.

Category 3--Weeds that have had significant impact in adjoining states and are believed to be adapted to Montana's climate. These species have yet to be detected in the state or are found only in localized, small, scattered infestations. Early detection and immediate action to eradicate are the management goals.

b. Oregon

These designations are made by the Oregon State Weed Board.

Category A--Weeds of known economic importance that are still limited to small enough infestations to permit possible eradication-containment. Weeds that are not known to exist in the state but exist in neighboring states, and invasion by them into the state seems imminent, are also included here.

Category B--Weeds of economic importance that are abundant in some regions of the state but are of limited distribution in other counties of the state. Biological control is the main strategy where implementation of a fully-integrated statewide management plan is not feasible.

Category T--Noxious weeds that require implementation of an integrated statewide management plan.

c. Washington

These designations are made by the State Noxious Weed Control Board.

Class A--Noxious weeds not native to the state that are of limited distribution or are unrecorded in the state and that pose a serious threat to the state. Preventing new infestations and eradicating existing infestations is the highest priority. Prevention of all seed production of these species is required.

Class B--Noxious weeds not native to the state that are of limited distribution or are unrecorded in a region of the state and that pose a serious threat to that region. These species are designated for control and prevention of all seed production is required, in regions where they are not yet widespread. Preventing infestations in these regions is a high priority. In regions where a Class B weed is already abundant, control is decided at the local level, with containment as the primary goal.

Class C--Any other noxious weeds. Many of these species are widespread in the state. Long-term programs of suppression and control are a local option, depending upon local threats and the feasibility of control in local areas.

INVADERS Database Release 6.2 contains 51,587 distribution records (primarily composed of herbaria specimens) of exotic plant species for the 5 states. These records include 14,438 for noxious weeds. Of these 14,438, 7,445 are records of the 24 noxious weed species included in this report. The records were collected for the 199 county, 5 state area, of which only 97 counties lie totally or partially within the Basin. Thus, not all 7,445 records were collected from the Basin area. These records were collected from 5 of the 6 largest regional herbaria (Oregon State University, Washington State University, University of Idaho, University of Montana, and Montana State University), state department of agriculture and APHIS/CAPS surveys, US-Forest Service Region 1 ECODATA and Region 6 Ecology Plots, and a survey of regional weed experts conducted by the senior author of this report. Additional minor sources of data include various publications, private collections, a partial data set from the Rocky Mountain Herbarium located at the University of Wyoming at Laramie, and smaller regional herbaria.

The county distribution maps for the 25 species show specific counties where at least one distribution record exists. Counties that are shaded show definitive presence of a species. Unshaded counties do not provide proof of absence. The absence of distribution records for a species within a county does not equate with absence of that species from the county.

We utilized the 25 county distribution maps, Table SUSCEPTIBILITY, and landscape level (1 km^2 resolution) characterizations of potential vegetation types within each county (Spatial Staff Area Report, ICBEMP 1995?), to create 5 additional tables (one for each of Washington, Oregon, Idaho, Montana, and Wyoming). These 5 tables (Tables WA, OR, ID, MT, and WY)

provide the rangeland potential vegetation types that are most likely to be invaded (that is, they were labeled either D or I in Table SUSCEPTIBILITY) by each of the 25 species. Rangeland potential vegetation types were inserted into these 5 tables within counties that do not currently report presence of the weed species under consideration. To be inserted, a rangeland potential vegetation type had to compose at least 5% of a county or at least 5% of the portion of the county that lies within the Basin. The selection of 5% for inclusion was subjective and was judged suitable for depicting types that covered substantial land in each county. The rangeland potential vegetation types are presented as acronyms in the tables and the acronyms are defined below.

A = Aspen
AB = Antelope Bitterbrush
AS = Agropyron Steppe
BBSS = Basin Big Sagebrush Steppe
FG = Fescue Grassland
FGwC = Fescue Grassland with Conifer
LSM = Low Sagebrush Mesic
LSX = Low Sagebrush Xeric
MBSME = Mountain Big Sagebrush Mesic East
MBSMW = Mountain Big Sagebrush Mesic West
MBSMWwJ = Mountain Big Sagebrush Mesic West with Juniper
MM = Mountain Mahogany
WBSC = Wyoming Big Sagebrush Cool
WBSW = Wyoming Big Sagebrush Warm
SDS = Salt Desert Shrub

Here is an example of how to utilize these tables. For example, you live in Adams county, Washington and you would like to know where to look for new infestations of noxious weeds. For Dyers woad, halogeton, leafy spurge, and squarrose knapweed, your time would be more efficiently spent in searching for infestations of these species in the Wyoming Big Sagebrush Warm potential vegetation type. This is not to say that one would locate infestations of these species only in this type. Other potential vegetation types might also be susceptible to invasion and these types might also exist in Adams county, but they composed less than 5% of the county at the landscape level (1 km^2) of resolution. Tables WA, OR, ID, MT, and WY are an attempt to lay out a search priority in the Basin for the 25 weed species in this report.

SELECTED PROBLEMATIC WEEDS IN THE BASIN

NOTE TO SENIOR AUTHOR: Need to put in the appropriate fire effects database citations in the text that follows, up to medusahead (the content from the citations has been put in, but the citations themselves have not). Need to put in the problematic stuff (e.g. why is the weed problematic, can get it from fire effects database) in the text that follows, up to purple loosestrife.

<u>Family Brassicaceae</u>

a. Dyers Woad

Although this species is present in every state of the Basin, its distribution is somewhat irregular (Map DYERSWOAD). Its distribution lies predominantly in the south, southeast, and east portions of the Basin. This species is apparently spreading rapidly. The number of infested hectares on National Forest lands in the Intermountain Region increased more than 35-fold between 1969 and 1985 (USDA 1986, cited in Dewey et al. 1991). In Idaho, Callihan et al. (1984) reported a total of about 23,800 acres statewide in 1983, of which 64% was located in Bear Lake and Franklin county in the extreme southeast corner. These counties border but are not within the Basin. The majority of the remaining 36% was located in Bannock and Caribou county. These counties mostly lie within the Basin. Although unshaded in Map DYERSWOAD, Gooding, Jerome, Madison, and Teton county in Idaho were reported to have small populations of Dyers woad in 1983 (Callihan et al. 1984). In addition, several Idaho counties shaded in Map DYERSWOAD (Boise, Idaho, Lincoln, and Twin Falls) were not reported to have Dyers woad in Callihan et al. (1984). Potential vegetation types of some susceptibility to invasion include all but Salt Desert Shrub and Alpine Shrub-Herbaceous (Table SUSCEPTIBILITY). Many of the potential vegetation types were coded as invasive (I). There are numerous counties in the Basin that do not currently report presence of this weed that contain potential vegetation types that are of some susceptibility to invasion (Tables WA, OR, ID, MT, and WY). Dewey et al. (1991) report that this species was found on nearly all land cover types of the Cache National Forest in Utah, but they suspected that many of these land cover types were not vulnerable to high-density infestations.

Dyers woad responds positively to excessive livestock grazing pressure and can invade ungrazed, well-vegetated sites. It generally responds in a neutral to positive manner to fire. Seed can be destroyed but surviving seed can germinate, and plants can resprout post-fire. New plants in the rosette stage can be killed by fire (C. Bushey, pers. comm. 1995). Dyers woad can be controlled with herbicides at the seedling, rosette, and early bud to blossom stage, depending on herbicide used. Hand pulling can be effective on small infestations if the fleshy taproot is removed below the crown. Mowing is ineffective because some seed still is produced typically. Tillage is effective. A native rust pathogen, *Puccinia thlaspeos*, prevents nearly all fruit and seed production on infected plants. *Puccinia* appears to be spreading naturally and is effective in control.

The prediction for this species is that its distribution will increase greatly because there remains much suitable habitat for colonization within the Basin (for example see Tables WA, OR, ID, MT, and WY). The lack of biocontrol agents that have been released or are being evaluated poses a risk to development of an integrated weed strategy for control of this species. Control strategies in the foreseeable future will have to rely on herbicides.

b. Hoary Cress (Whitetop)

The confirmed distribution of this species complex (includes *Cardaria draba*, *C. chalapensis*, and *C. pubescens*) includes the entire Basin except Chelan, Ferry, Pend Oreille, and Columbia counties in Washington, Hood River county in Oregon, Benewah, Kootenai, Shoshone,

and Teton counties in Idaho, and Lincoln and Teton counties in Wyoming (Map WHITETOP). Potential vegetation types of some susceptibility to invasion include all but Alpine Shrub-Herbaceous (Table SUSCEPTIBILITY), but none of the types were coded as invasive (I). Areas where whitetop might be located in counties that do not currently report presence include the Aspen and Mountain Mahogany types in Teton county, Idaho, and the Aspen type in Lincoln and Teton county, Wyoming (Tables ID, WY). Whitetop was present on an estimated 100,000 acres in the Oregon portion of the Basin in 1990, of which about 25,000 was on Bureau of Land Management (BLM) land (Oregon Dept. of Agriculture statistics, 1990).
NOTE TO SENIOR AUTHOR: NEED MORE INFORMATION YET ON THIS SPECIES.

c. Perennial Pepperweed

The information on this species was summarized from Young et al. (1995). Confirmed presence of this species in the Basin is concentrated in eastern Oregon and eastern Washington, with a more scattered distribution in the Snake River Plains of southern Idaho, northwest Montana, and western Wyoming (see Fig. 4 in Young et al. 1995). This species is well adapted to riparian and wetland areas and has become established along river systems from the lower edge of coniferous forests to saline-alkaline deltas and sinks.

Perennial pepperweed is very tolerant of salty soils, but it is not restricted to salt influenced soils. It is adapted to stringer meadows characteristic of the big sagebrush zone.

Mechanical control of this species is difficult because very small sections of the root system can contain buds which can sprout and result in new plants. It is marginally susceptible to phenoxy herbicides. The tops are easily killed with herbicide treatment but root and crown buds readily sprout post-treatment. Chlorsulfuron (a sulfonylurea compound) has shown considerable promise for controlling this species. Repeated treatment with herbicides appears necessary for adequate control. No biological control agents are currently available for this species. The prognosis for biological control being an operative control method is poor because there are at least 11 perennial species of pepperweed that are native to the western United States and one of these is presently listed as endangered. These 11 species are potential alternate hosts for introduced biocontrol agents, which paints a skeptical picture for future biocontrol efforts.

Perennial pepperweed is problematic because it interferes with regeneration of willows and cottonwood species. Perennial pepperweed can exist in dense patches that are nearly monotypic stands, thus species composition and productivity of key herbaceous species, especially in wetland areas, is altered. Accumulations of semi-woody stems negatively impact nesting habitat for wildlife and inhibit grazing. The greatest threat posed by this species is to native hay meadows.

Family Chenopodiaceae

Halogeton

Confirmed presence of this species is scattered in the Basin, mainly in the southern portion, in southeast Oregon and southern Idaho (Map HALOGETON). Potential vegetation

types that are of some susceptibility to invasion by halogeton include all types except those that could be classified as riparian, and Alpine Shrub-Herbaceous. Of the susceptible types, Salt Desert Shrub is the most susceptible to invasion, and although many other types are labeled D in Table SUSCEPTIBILITY, the chances are slim that halogeton would actually colonize and persist in these types to the exclusion of more desirable species.

Palatability of halogeton is low, and it is seldom consumed by livestock. It contains concentrations of oxalates that are lethal to sheep. Halogeton responds positively to excessive livestock grazing pressure. Fire can destroy halogeton and its seed but halogeton readily invades burned areas from off-site, because it can behave as a tumbleweed. Sites that are susceptible to invasion (1) lie between 700 and 2,200 meters in elevation, (2) have saline soils with textures either heavy clay, clay loam, sandy loam, or loamy sand, and (3) receive between 5 and 13 inches of annual precipitation.

Halogeton reinvasion onto sites where it has been controlled can be retarded by seeding of perennial forage species including immigrant kochia (*Kochia prostrata*) and crested wheatgrass (*Agropyron cristatum*). Currently, biological control of halogeton is not a viable option. Biocontrol agents are lacking and the search continues in Soviet central Asia. Halogeton can be controlled effectively with herbicides, especially at the preflowering stage, but herbicides are generally too expensive for use on low-production rangeland where halogeton typically exists, and herbicide use on halogeton can destroy native, desirable vegetation also. The recommended strategy for halogeton control incorporates (1) a shift in timing of livestock grazing from spring, to fall and winter, (2) reduction in livestock grazing pressure, and (3) presence of a vigorous stand of perennial vegetation.

Much of the Basin apparently is not colonized yet by halogeton. Because of this and the fact that numerous potential vegetation types within counties that do not currently report presence appear to be somewhat susceptible to invasion (for example see Tables WA, OR, ID, MT, and WY) the prediction for halogeton is that it will continue to expand its distribution within the Basin. Sites that support Salt Desert Shrub or other dry potential vegetation types, such as Wyoming Big Sagebrush Warm, will probably be most rapidly colonized.

Family Compositae

a. The Thistles (Bull, Canada, Musk, and Scotch)

Bull Thistle

Presence of bull thistle is unconfirmed in several counties within Idaho (Map BULLTHISTLE), but nonetheless, it is suspected as being present in every county in Idaho (L. Vance, pers. comm. 1995). Bull thistle is not on the noxious weed list for Idaho and thus its presence is not documented as rigorously as species on the noxious weed list. All potential vegetation types appear somewhat susceptible to invasion except possibly Salt Desert Shrub (Table SUSCEPTIBILITY). Potential vegetation types labeled I in Table SUSCEPTIBILITY, and thus relatively more susceptible to invasion, are generally the more mesic types on rangeland.

It can exist on a wide variety of soils, ranging from gravelly to clay-textured. It does not persist on sites with deep shade.

Bull thistle responds positively to excessive livestock grazing pressure. It is generally unpalatable to livestock because of its spiny stems and leaves. Survival of seedlings to the rosette stage is enhanced with excessive livestock grazing pressure. Bull thistle shows a neutral to slightly positive response to fire. Mature individuals can be top killed by fire. Seed can germinate readily on sites that have been severely burned. Fuel loads are typically low on sites where bull thistle grows so it is usually protected from fire (C. Bushey, pers. comm. 1995). Herbicides are effective in control, especially if applied at the rosette stage in spring or fall. Hand pulling, mowing or cutting, and tillage are all effective but have to be performed repeatedly. Biocontrol agents are not yet effective on a large scale for control of bull thistle. Several are being evaluated currently however. A seed head fly (*Urophora stylata*) has established in Oregon but its potential remains uncertain. This fly remains as the most promising candidate for biological control of bull thistle.

Control of bull thistle is difficult because the wind-dispersed seeds are relatively ubiquitous. The sentiment associated with this species is that only under abusive management does it become dense and troublesome, displacing native species. Compared with other noxious weeds in the Basin, bull thistle is regarded as relatively benign on rangelands. It will likely increase in distribution within the Basin on a county basis, because suitable habitat exists in counties that do not currently report presence (see Tables ID, MT, and WY).

Canada Thistle

Presence of Canada thistle is confirmed in every county in the Basin (Map CANADATHISTLE). All rangeland potential vegetation types are somewhat susceptible to invasion by this species, but the most susceptible (I rating) are generally the riparian types and the more mesic grassland types (Table SUSCEPTIBILITY). Canada thistle typically exists where annual precipitation ranges from 15-30 inch. It can exist on a wide variety of soils, from sandy to heavy clay soils, but it is best adapted to sandy loam, loam, and clay loam soils.

Canada thistle will invade plant communities that have been subjected to excessive livestock grazing pressure. In general, it is unpalatable to livestock because of its spines and thorns. This species shows a neutral to slightly positive response to fire. It resprouts from the roots after fire. Wind blown seed readily germinates on burned areas where competing vegetation has been removed (C. Bushey, pers. comm. 1995).

Control of Canada thistle is difficult owing to its rhizomatous, robust root system, abundant seed production, and broad distribution. Burning, especially prescribed spring burning, can result in some control because it can promote vigorous growth and competition from other species, but complete control frequently requires herbicides (C. Bushey, pers. comm. 1995). Tillage can be effective in control if done repeatedly. Biocontrol agents have been released and most have established in the Basin. These include a stem-boring beetle (*Ceutorhynchus litura*), a gall fly (*Urophora cardui*), a fungus (*Sclerotinia sclerotiorum*), a seedhead weevil (*Rhinocyllus*

conicus), and *Orellia ruficauda*. Control of Canada thistle from these agents is limited at present. Herbicides can be effective in control and are the method of choice for control of Canada thistle at present.

As mentioned, on a county basis, Canada thistle is ubiquitous in the Basin. Because of its ubiquity, eradication is deemed impossible. In Washington, Canada thistle is managed with some flexibility at the local level. In most counties in Washington, technical consultation is provided to landowners on methods of suppression and control. In counties where crops are grown for certified seed production, enforcement of control is the preferred policy. The prediction for this species is continual slow spread within its already broad distribution.

Musk Thistle

Presence of musk thistle has not been confirmed from several counties in northern Idaho and a few counties in Washington and north-central Oregon (Map MUSKTHISTLE). Musk thistle was present on an estimated 51,000 acres in the Oregon portion of the Basin in 1990, of which about 2,500 were on BLM land (Oregon Dept. of Agriculture statistics 1990). Numerous rangeland potential vegetation types are somewhat susceptible to invasion by this species; some types are unknown as to their susceptibility; and Alpine Shrub-Herbaceous is classified as closed to invasion by this species (Table SUSCEPTIBILITY). Of the susceptible types, the most susceptible (I rating) are generally the riparian types and the more mesic grassland types (Table SUSCEPTIBILITY).

Musk thistle can invade pastures that are in good to excellent condition. Seedling establishment is favored by litter, but the transition from seedling to rosette is favored by removal of cover and litter disappearance attributable in part to livestock grazing. It is unpalatable to livestock because of its spines. In general, this species responds to fire in a similar fashion to bull thistle (C. Bushey, pers. comm. 1995). Sites with moist, alluvial soil, without shade, that receive 10+ inches of annual precipitation, and range from sea level to 2,400 meters in elevation, are susceptible to musk thistle invasion. In cold northern climates, survival of musk thistle rosettes during winter is enhanced in gullies, for example, where an insulating layer of snow usually accumulates.

Mowing can be effective in control if performed during full bloom. Herbicides are effective in control of this species, at either the rosette stage or bolting to bud growth stage, depending on the herbicide. Biocontrol agents are currently being evaluated and 2 weevils have been released. *Trichosirocalus horridus*, a weevil that feeds on musk thistle at the rosette stage, has established in Montana, Wyoming, and Colorado. It has only established at a few sites in Montana as of 1991, but it is spreading rapidly in Colorado. This weevil shows promise for reducing plant vigor and flowering potential. *Rhinocyllus conicus*, a seedhead-feeding weevil, has been introduced into Montana. There is potential for combining herbicide and biocontrol agents, or seeding of perennial grass and biocontrol agents, in an integrated weed control strategy for musk thistle. This approach is believed to be more effective than using herbicides, perennial grasses, or biocontrol agents alone.

Suitable habitat for colonization by musk thistle remains in counties that do not currently report presence (Tables WA, OR, ID, MT, and WY), thus musk thistle will probably expand its distribution on a county basis within the Basin in the future. Its relative restriction to mesic sites within rangeland in the Basin will prevent it from infesting large expanses.

Scotch Thistle

Scotch thistle apparently has a more restricted range compared with the other thistles in this group, as its presence has not been confirmed in most of the extreme eastern portion of the Basin (Map SCOTCHTHISTLE). Scotch thistle was present on an estimated 270,000 acres in the Oregon portion of the Basin in 1990, of which about 66,000 acres were on BLM land (Oregon Dept. of Agriculture statistics 1990). Rangeland potential vegetation types that are labeled as closed (C) to invasion by this species include Salt Desert Shrub, Alpine Shrub-Herbaceous, and the relatively high elevation portions of Riparian Graminoid. The susceptibility status of several potential vegetation types is unknown (Table SUSCEPTIBILITY).

This species responds positively to grazing. Its response to fire is unknown (C. Bushey, pers. comm. 1995). Scotch thistle is most susceptible to control with herbicides at the rosette growth stage. Less effort appears to have been exerted toward control of this species with biocontrol agents, compared with bull and musk thistle. (NOTE TO SENIOR AUTHOR: NEED TO SUBSTANTIATE THIS)

Suitable habitat for colonization by Scotch thistle remains, in counties in Idaho and Montana that do not currently report presence (Tables ID and MT). Similar to the other thistles in this group, high density stands of Scotch thistle that result in displacement of more desirable species are relegated primarily to relatively mesic sites within rangelands of the Basin.

b. The Knapweed Complex

Common Crupina

The known distribution of common crupina in the Basin is disjunct and restricted to Chelan county, Washington, Umatilla county, Oregon, and Clearwater, Lewis, Idaho, and Nez Perce (although unshaded in Map COMMONCRUPINA) county in Idaho (Map COMMONCRUPINA). Because of its small, lightweight, wind-disseminated seed, its true distribution within the Basin is very uncertain (L. Vance, pers. comm. 1995; however, B. Roche, pers. comm. 1996 refutes the small, lightweight, wind-disseminated seed; NOTE TO SENIOR AUTHOR: NEEDS RESOLVING). Common crupina is present on an estimated 60,000 acres in northcentral Idaho. Rangeland potential vegetation types that are susceptible to invasion by this species are primarily the grassland, mesic shrub, and riparian types. Communities dominated by annual grasses also appear to be susceptible to invasion.

This species responds positively to excessive livestock grazing pressure. Its response to fire is unknown. C. Bushey (pers. comm. 1995) speculates that wildfire would destroy some seed, and spring prescribed burning might be an option for top killing this species. Hand pulling,

hoeing, or other tillage can be successful in control of very small infestations. Common crupina can be controlled with herbicides at the seedling, rosette, or bolting stages, depending on the herbicide. Revegetation is required after treatment to recover infested sites. Several perennial wheatgrasses, including Oahe intermediate wheatgrass (*Thinopyrum intermedium* ssp. *intermedium*), Luna pubescent wheatgrass (*Thinopyrum intermedium* ssp. *barbulatum*), Nordan standard crested wheatgrass (*Agropyron desertorum*); and tall oatgrass, (*Arrhenatherum elatius*) have shown promise for revegetation.

Common crupina will increase in distribution within the Basin. Suitable habitat for colonization by this species exists in numerous counties that do not currently report presence (see Tables WA, OR, ID, and MT). Locating new infestations of this species will be critical to slowing its spread. The small, wind-disseminated seed will likely provide difficulties to reconnaissance efforts (SEE NOTE ABOVE; NEEDS RESOLVING).

Diffuse Knapweed

Presence of diffuse knapweed has not been confirmed from several counties in southeast Idaho and a few other scattered counties in Idaho, Montana, and northwestern Wyoming (Map DIFFUSEKNAPWEED). Rangeland potential vegetation types of some susceptibility to invasion by this species include all except Salt Desert Shrub and Alpine Shrub-Herbaceous (Table SUSCEPTIBILITY). Although diffuse knapweed is present in most of the counties of Idaho, Blaine county supports the majority of diffuse knapweed, approximately 50,000 acres. In Idaho, it is believed to be best adapted to the sagebrush communities of the southern portion and can invade ungrazed native bunchgrass communities (Roche 1994). The acreage of diffuse knapweed reported from one-half of the counties in eastern Washington was 820,000 in 1993 (Roche 1994). In 1986, 90% of the reported 428,000 acres of diffuse knapweed in eastern Washington was located in Stevens, Ferry, Okanogan, Chelan, Kittitas, and Yakima county (Roche and Roche 1988). It was present on an estimated 1,500,000 acres in 1990 in the Oregon portion of the Basin, of which about 35,000 acres was present on BLM land (Oregon Dept. of Agriculture statistics 1990).

Diffuse knapweed is more competitive on soils that exceed 15 inch in depth and are fine-textured, but it will persist on soils ranging from silty clay loams to gravelly soils. It does not thrive on poorly drained soils or in shaded habitats. In eastern Washington, sites that receive 6-35 inch of annual precipitation, on slopes from 0-60%, and from sea level to over 5,000 feet are susceptible to invasion.

Diffuse knapweed responds positively to excessive livestock grazing pressure and is relatively low in palatability to livestock. It typically responds in a neutral or positive manner to fire. Sites infested with diffuse knapweed are difficult to burn because of decreased fuel loading. Seed on the soil surface can be destroyed by extreme heat, and germinants and rosettes can be destroyed, but seed that survives fire can maintain viability for several years, germinate, and result in new seedlings (C. Bushey, pers. comm. 1995). For control, hand pulling is effective if the tap root is removed, but it must be done repeatedly to reduce the soil seed bank. Mowing is not effective in control because plants persist even under frequent mowing. Various herbicides are

effective in control but (1) are typically too expensive to use extensively on relatively low value rangeland (Roche 1994), and (2) infestation size, reinfestation rate, and buried seed longevity act in concert to override the acreage amount that can be treated with herbicides (in other words, it is very difficult to stabilize or decrease the acreage from a practical standpoint, with herbicides).

Diffuse knapweed, on a county basis, has already infested the majority of the Basin, but suitable habitat for colonization by this species still remains in counties in Idaho, Montana, and Wyoming, that do not currently report presence (see Tables ID, MT, and WY). Thus, diffuse knapweed will likely spread further and colonize nearly every county in the Basin. An integrated weed strategy that utilizes a combination of biocontrol agents, appropriate grazing strategies, herbicides, and seeding of perennial grasses appears to be critical to controlling this species in the future. Biocontrol agents cannot, apparently, be relied upon alone to control this species (see integrated weed management strategy for knapweeds below).

Russian Knapweed

Russian knapweed is present in every state of the Basin. Counties that have yet to confirm presence are located in central and northern Idaho, extreme eastern Washington, extreme northeast Oregon, and western Wyoming (Map RUSSIANKNAPWEED). Although Ferry, Lincoln, and Garfield county in Washington are unshaded in Map RUSSIANKNAPWEED, Roche and Roche (1988) reported presence of Russian knapweed in those counties. Consequently, either the populations have been eradicated or these counties should be shaded. Numerous rangeland potential vegetation types are classified as unknown as to their susceptibility to invasion by this species, and Alpine-Shrub Herbaceous is classified as closed to invasion (Table SUSCEPTIBILITY).

Russian knapweed is present on an estimated 12,000 acres in Idaho, mostly in Twin Falls, Bannock, Caribou, Power, and Jerome county. Although present in some counties in northern Idaho, less than 100 acres are reported from there (Roche 1994). In Washington, Russian knapweed was reported as present on an estimated 8,050 acres in a 1984-1986 survey (Roche and Roche 1988). About 74% of this reported acreage was located in Okanogan, Yakima, Adams, Grant, and Ferry county. Its spread in Washington appears to be slowing because it produces smooth, plumeless seeds that have historically been moved with unclean seed or weedy hay, which represent relatively slow methods of movement (Roche 1994). Sites susceptible to invasion and persistence of stands are characterized as floodplains and seasonally wet habitats, with generally saline-alkaline soils. It tolerates poor drainage and flooding, but not severe drought or dense shade. Roche (1994) characterized susceptible sites on rangeland in Washington as those that support bluebunch wheatgrass with sufficient supplemental moisture to permit growth of basin wildrye.

Russian knapweed is unpalatable to livestock because it has a bitter, quinine-like taste. Its response to fire is typically neutral to slightly positive. Fire can result in top killing but resprouting from rhizomes post-fire is common (C. Bushey, pers. comm. 1995). Mowing is not effective in control because it does not prevent regeneration of aerial parts from the perennial root system. It can be controlled effectively with herbicides, especially Tordon 22K, and especially in

the fall (Roche 1994). A recommended strategy for control of Russian knapweed is initial control with herbicides, especially when applied at the bloom or seed stage rather than at the rosette or early growth stage, and subsequent establishment of perennial grasses, for example crested wheatgrass or Russian wildrye. The biocontrol agent, *Subanguina picridis*, a nematode, has been released and has established in Montana, Wyoming, and Washington. This nematode reduces sexual and vegetative reproduction of Russian knapweed. Several other biocontrol agents show potential but have yet to be released.

Suitable habitat for colonization by Russian knapweed remains in a few counties in Idaho and Wallowa county in Oregon, that have yet to report presence (Tables ID and OR). Because sites susceptible to invasion and persistence of this species are relegated primarily to relatively mesic portions of rangeland, and seed dispersal across the landscape is relatively slow, the prediction for Russian knapweed is that it will increase slowly in the Basin. Its impact in acreage is much less than diffuse or spotted knapweed or yellow starthistle.

Spotted Knapweed

Presence of spotted knapweed, with the exception of Sherman county, Oregon, Gem and Jefferson county, Idaho, and Teton county, Wyoming, has been confirmed within the entire Basin (Map SPOTTEDKNAPWEED). In Idaho, spotted knapweed is present on an estimated 200,000 acres, mostly in Idaho, Bonner, Boundary, Kootenai, Blaine, and Clark county (Roche 1994). In Montana, spotted knapweed is present on an estimated 800,000 acres in Missoula county alone (C. Bushey, pers. comm. 1995). It is spreading rapidly in the forested zones of Washington, especially in Ferry and Kittitas county in eastern Washington. Spotted knapweed acreage reported from one-half of the counties in eastern Washington was about 30,800 in 1993 (Roche 1994). In 1986, 26,600 acres were reported from eastern Washington, 84% of which was reported from Spokane county (Roche and Roche 1988). It was present on an estimated 85,000 acres in 1990 in the Oregon portion of the Basin, of which about 4,000 acres were present on BLM land (Oregon Dept. of Agriculture statistics 1990). This species typically invades the more xeric forested areas and foothill zones, including undisturbed, ungrazed areas, for example nearly 40,000 estimated acres of the Selway-Bitterroot Wilderness (Asher 1994), and fescue (Idaho fescue and rough fescue) grasslands in Glacier National Park, Montana (Tyser and Key 1988).

The ecological range of this species is very large. Potential for establishment is governed more by soil disturbance than soil properties. It can exist on sites that receive between 8 and 80 inches of annual precipitation, and are between 1,900 and 10,000 feet in elevation (C. Bushey, pers. comm. 1995). In Montana, high densities exist on sites that are located between 4,000 and 6,000 feet elevation and receive between 12 and 30 inches of annual precipitation. It occupies slightly moister sites than diffuse knapweed but similar to diffuse knapweed, it is intolerant of shade and poorly drained soils. Numerous potential vegetation types are of some susceptibility to invasion, including all riparian types, grassland types, and relatively mesic shrub types and woodlands. It is most invasive in the Agropyron Steppe, Fescue Grassland, Fescue Grassland with Conifer, and riparian potential vegetation types. Salt Desert Shrub is the only potential vegetation type labeled as closed to invasion but several are unknown as to their susceptibility status (Table SUSCEPTIBILITY).

Spotted knapweed responds positively to excessive livestock grazing pressure. Although relatively unpalatable, cattle, sheep, and goats will consume some quantities of spotted knapweed. The response of spotted knapweed to fire is similar (neutral to positive) to that reported for diffuse knapweed. Mowing can be effective in reducing seed production but must be done repeatedly. Various herbicides are effective in control but on a broad scale, control is limited by the large size of spotted knapweed infestations, the high reinfestation rate, and relatively long duration buried seed longevity (in other words, it is very difficult to stabilize or decrease the acreage from a practical standpoint, with herbicides).

Although spotted knapweed already is nearly ubiquitous on a county basis in the Basin, its spread within counties probably will continue, especially on susceptible sites mentioned previously. In eastern Washington, for example, its distribution is broad but most acreage is concentrated in Spokane county (as mentioned previously). Habitat suitable for colonization by spotted knapweed still remains in Sherman county, Oregon, and Gem county, Idaho, which are counties that do not currently report presence, but we suspect that spotted knapweed does actually exist in those counties already.

Yellow Starthistle

Presence of yellow starthistle has not been confirmed from most of the counties in the eastern portion of the Basin and several counties in northeastern Washington (Map YELLOWSTARTHISTLE). Although not shaded on the map, presence of yellow starthistle was reported in Clearwater county, Idaho in Roche (1994), and Ferry and Spokane county in Washington in Roche and Roche (1988). In Idaho, yellow starthistle was present on an estimated 300,000 acres in 1994. The greatest potential for infestation in Idaho is on rangeland along the Snake River and its tributaries. The Salmon River canyon and Hells Canyon areas appear likely to be the next large area of dominance by yellow starthistle (Roche 1994). In the Oregon portion of the Basin, yellow starthistle was present on 170,000 acres in 1990, of which 18,000 was on BLM land (Oregon Dept. of Agriculture statistics 1990). In Washington, acreage estimates of yellow starthistle were 133,800 in a 1984-1986 survey (Roche and Roche 1988), and 148,000 more recently. Of the 133,800 acres, 80% were located in southeast Washington in Walla Walla and Columbia county (Roche and Roche 1988). Rangeland potential vegetation types of some susceptibility to invasion include all but Salt Desert Shrub and Alpine Shrub-Herbaceous (Table SUSCEPTIBILITY). It appears to be most invasive in the Agropyron Steppe, Fescue Grassland, and Mountain Mahogany potential vegetation types.

Yellow starthistle responds positively to excessive livestock grazing pressure but can invade undisturbed native plant communities, for example bluebunch wheatgrass-Idaho fescue plant communities in southeast Washington (personal observations by senior author, 1994-1996). It is palatable to livestock in the rosette and bolting stage but is unpalatable during flowering because of the sharp spines on flowerheads. Its response to fire is generally neutral. Seed held aloft and on the soil surface can be destroyed by fire, but infested sites typically do not burn frequently or very hot because there is relatively little fuel (C. Bushey, pers. comm. 1995). It can regenerate post-fire from seed reserves in the soil. Sites on south-facing slopes, with deep loamy soils, in a 12-25 inch annual precipitation zone, are especially susceptible to invasion. Yellow

starthistle is spreading into cheatgrass infested sites and further reducing site potential (Roche 1994), especially on sites with deep soils. It does not appear to compete well with sagebrush but can invade sagebrush communities after disturbance of the soil surface. It is intolerant of shading. The current northern limit of yellow starthistle is 49 degrees north latitude, which is the international boundary between the United States and Canada. Its distribution in the north in Washington is limited to warm microclimates such as steep, south-facing slopes.

Hand pulling can be effective in control on small infestations. Mowing is generally ineffective unless done repeatedly. Controlled grazing with cattle, especially in the spring, can suppress seed production and contain large infestations. Herbicides can be effective in control, especially if applied at the seedling to rosette stage, but more than one application can be required to destroy seedling recruitment from the relatively long-lived seed bank. Revegetation after herbicide treatment with perennial grasses, that include Oahe intermediate wheatgrass, Tualitin tall oatgrass, Paiute orchardgrass, Covar sheep fescue, Critana thickspike wheatgrass, or Sherman big bluegrass, can restrict reinvasion by yellow starthistle, depending on location. In southwest Oregon, just outside the Basin boundary, Borman et al. (1991) provided evidence that transplants of Berber orchardgrass and Idaho fescue effectively suppressed reinvasion of yellow starthistle, more so than intermediate and tall wheatgrass. Borman et al. (1990,1991) interpreted the relative success of Berber orchardgrass and Idaho fescue in suppression ability to be attributable to their early growth initiation, maintenance of some growth during winter, and early maturity. Rush wheatgrass, Paiute orchardgrass, perennial ryegrass, tall fescue, Junegrass, and California oatgrass did not compete effectively with yellow starthistle and were not recommended for seeding in that region to prevent reinvasion of yellow starthistle and other resident annual species (Borman et al. 1991). Fertilization of new grass seedlings, if yellow starthistle remains present, can result in a benefit to the starthistle instead of the perennial grass and should be avoided.

The prediction for yellow starthistle is that it will continue to expand its distribution to the east in the Basin. Suitable habitat for colonization by this species remains in numerous counties in Washington, Idaho, Montana, and Wyoming that currently do not report presence (Tables WA, ID, MT, and WY). It apparently is more invasive in grassland potential vegetation types, especially Agropyron Steppe, compared with shrubland. An integrated weed strategy of herbicides, biocontrol agents, and seeding of adapted perennial grasses shows potential for future effective control of yellow starthistle.

Integrated Weed Management Strategy For Knapweeds

Biological control agents, by themselves, will never completely eradicate knapweed species (Roche 1994). For example, the European gall fly (*Urophora affinis*) apparently infests diffuse knapweed seed heads but does not reduce seed production enough to control diffuse knapweed successfully by itself. Very few viable seeds are required to maintain stands of diffuse knapweed or spotted knapweed. Biocontrol agents can be effective when utilized in combination with other control methods however. For example, the combination of several biocontrol agents with competition from seeded perennial grasses (for example crested wheatgrass or Russian wildrye) can be more effective. Biocontrol agents can also be combined with grazing strategies and herbicides that result in enhancement of desirable grass growth. These integrated weed

strategies are likely to slow the invasion of knapweeds. In Washington and other states in the Pacific Northwest, biological control agents have been released for diffuse, spotted, and Russian knapweed, and yellow starthistle. Several of these have established, including 2 species of flies (*Urophora affinis* and *U. quadrifasciata*), numerous beetles (for example *Sphenoptera jugoslavica* and *Bangasternus fausti*), and 3 species of moths (*Agapeta zoegana, Metzneria paucipunctella, Pterolonche inspersa*) for diffuse and spotted knapweed, 1 species of nematode for Russian, and 3 species of weevils (*Bangasternus orientalis, Eustenopus villosus, Larinus curtus*) and 2 flies (*Urophora jaculata, U. sirunaseva*) for yellow starthistle.

c. The Hawkweeds (Orange and Yellow)

Both of these species have distributions concentrated in the Idaho panhandle, northwest Montana, and northeast Washington, but orange hawkweed is somewhat more dispersed than yellow hawkweed in distribution (Maps ORANGEHAWKWEED and YELLOWHAWKWEED). Yellow hawkweed is now present in Idaho county, Idaho (B. Anderson, pers. comm., 1995) and this county should be shaded in Map YELLOWHAWKWEED. Rangeland potential vegetation types of some susceptibility to invasion by these species include the riparian types, Mountain Shrub, Aspen, and high elevation portions of Fescue Grassland (Table SUSCEPTIBILITY). The relatively xeric rangeland potential vegetation types are closed to invasion by these species. Susceptible sites exceed 2,000 feet in elevation and mountain meadows are especially susceptible to invasion by yellow hawkweed.

In general, both species respond in a neutral manner to fire. Fire destroys seed held aloft and can destroy seed on the soil surface, but rhizomes (present on yellow) and stolons (present on both species) can produce new sprouts post-fire. Seeds can disperse to recently burned sites resulting in colonization of new sites (C. Bushey, pers. comm. 1995).

Herbicides can be an effective control method for these species. If combined with fertilizer treatment, especially if fertilizer is applied in early spring, perennial grasses can outperform hawkweeds and result in hawkweed control. Long-term control can require repeated treatment in this fashion however. Mechanical control is ineffective except for small infestations. Mowing is ineffective because vegetative spread from rhizomes and/or stolons can continue. No biocontrol agents are available currently in the United States but the search has been initiated.

Suitable habitat for colonization by both species remains in counties in Idaho, Montana, and Wyoming, and for orange hawkweed in Washington and Oregon as well, for counties that do not currently report presence (Tables WA, OR, ID, MT, and WY). The prediction is that these species will extend their distribution within the Basin to the Blue Mountains region, the Okanogan Highlands region, and southeast Idaho.

d. Oxeye Daisy

Presence of oxeye daisy is somewhat scattered in the Basin. The counties without confirmed presence are restricted to central Washington, most of eastern Oregon, and most of southern Idaho (Map OXEYEDAISY). The ecological, economical, and sociological impacts of

this species have not been documented, but displacement of native species has been observed. Information regarding susceptibility of rangeland potential vegetation types to invasion by this species is needed. Numerous rangeland potential vegetation types are unknown as to their susceptibility to invasion (Table SUSCEPTIBILITY). Salt Desert Shrub and Alpine Shrub-Herbaceous are believed to be closed to invasion. Types that are of some susceptibility to invasion include the riparian types, true grassland types, Mountain Shrub, and Aspen. Although typically located in relatively mesic sites, oxeye daisy does tolerate drought.

This species typically responds negatively to excessive livestock grazing pressure. Horses, cattle, sheep, and goats will consume it and cattle and sheep grazing can result in reduced seed production. Its response to fire is typically neutral. The rhizomatous root system readily resprouts post-fire, and oxeye daisy exists on mesic to relatively mesic sites where fire has little deleterious effect in the subterranean environment (C. Bushey, pers. comm. 1995).

Biocontrol agents are not yet available, presumably because this species is not yet perceived as a serious threat to plant communities. In this regard, in the 5 state region of the Basin, it is only legally declared noxious in Wyoming (Table SUSCEPTIBILITY). Oxeye daisy can be controlled with herbicides. Fertilizer applications can benefit the grass component to the detriment of oxeye daisy. Difficulties inherent in utilizing livestock (especially sheep) grazing as a control method relate to the fact that oxeye daisy grows in areas where predation on livestock occurs, thus management of livestock in these areas will require more effort compared with areas with a lack of predators.

Based on existing knowledge, suitable habitat for colonization by this species remains in counties in Oregon (especially Baker, Gilliam, Morrow, Sherman, and Gilliam), Idaho (most of south-central and eastern Idaho), Montana (Granite county), and Wyoming (Lincoln county), that do not currently report presence (Tables OR, ID, MT, and WY).

e. Rush Skeletonweed

Presence of rush skeletonweed has been confirmed in extreme northwestern Montana, the Idaho panhandle and western counties of Idaho, the southern and southeastern counties of eastern Washington, and the northern and eastern counties of eastern Oregon (Map RUSHSKELETONWEED). This species was present on an estimated 5,000 acres in 1990 in the Oregon portion of the Basin, of which a negligible portion was on BLM land (Oregon Dept. of Agriculture statistics 1990). In Washington, the estimated acreage in 1988 was 810,000. Numerous rangeland potential vegetation types are labeled closed to invasion by this species, including Salt Desert Shrub, Alpine Shrub-Herbaceous, and the riparian types. The susceptibility status of Antelope Bitterbrush, the Low Sagebrush types, and the Mountain Mahogany types is unknown. Rangeland potential vegetation types of some susceptibility to invasion include the grassland types, Basin Big Sagebrush Steppe, the Wyoming Big Sagebrush and Mountain Big Sagebrush types, Mountain Shrub, and Aspen (Table SUSCEPTIBILITY).

This species is palatable and nutritious for sheep at the rosette to early flowering stage and it can decline with moderate grazing by sheep. Its response to fire is typically neutral to negative.

Fire during the period when seed is held aloft (typically mid-summer until frost) can destroy seed. Fire subsequent to seed dissemination results in less destruction of seed (C. Bushey, pers. comm. 1995).

Rush skeletonweed attains its greatest development on sandy, sandy loam, and sandy clay soils. Clay soils are infrequently invaded and when they are, it is by vegetative extension of roots of plants that are established on adjacent coarser soil.

Hand grubbing can be effective for control of small infestations if the roots are removed. Mowing and cultivation are generally ineffective because it can reestablish from root fragments. Controlling rush skeletonweed with herbicides is difficult. Combining herbicides with biocontrol agents, or sheep grazing with biocontrol agents, appears to hold more potential for effective control. Several biocontrol agents have been released and have established in Idaho, Oregon, and Washington, including 2 mites (*Aceria chordillae, Eriophyes chondrellae*), a midge (*Cystiphora schmidti*), and a rust (*Puccinia chondrilla*). Of these, the mites are the most effective bioagent to date. Several plant growth forms exist for rush skeletonweed and the effectiveness of biocontrol agents differs by growth form.

Suitable habitat (especially shrub potential vegetation types) for colonization by rush skeletonweed remains in numerous counties in Washington, Oregon, Idaho, Montana, and Wyoming, that do not currently report presence (Tables WA, OR, ID, MT, and WY). The potential for rush skeletonweed to increase its distribution within the Basin appears high.

f. Tansy Ragwort

This biennial or short-lived perennial species has been legally declared as noxious in Washington (Class B), Oregon (Category B), and Idaho. The largest infestations of this species exist west of the Cascades in western Washington, western Oregon, and northern California. It is now invading areas east of the Cascades. It has been located on more that 1,000 sites east of the Cascades in Oregon, and is present in Benewah county in Idaho. This species is native to the drier regions of Europe and Asia. Because of this, the sentiment among weed experts is that it should be capable of growing successfully throughout most of the Basin. It has the demonstrated potential to establish in riparian areas, coniferous zones, and in years of above-average precipitation. It has grown to maturity at an elevation of 6,000 feet in northeastern Washington. In general, we should presume that this species will be problematic in rangelands only on the more mesic sites. Rice and Rider (1995) collected 126 distribution records for this species and proposed it as successfully invasive with disturbance on rangeland characterized as Herbaceous Wetlands, Shrub Wetlands, Agropyron Bunchgrass, Native Forbs, Fescue-Bunchgrass, and Chokecherry-Serviceberry-Rose.

This species can be successfully controlled with herbicides, especially if improved grassland management is implemented after herbicide treatment. Biological control has been successful in western Washington and western Oregon but biological control is not recommended to suppress infestations in Idaho, eastern Washington, or eastern Oregon because insects are slow to establish and they provide only partial control. Eradication is recommended in Idaho, eastern

Washington, and eastern Oregon.

Family Euphorbiaceae

Leafy Spurge

This species is present in each state of the Basin but has yet to be confirmed from several counties on the western edge of the Basin in Oregon and Washington, and a few scattered counties in Idaho (Map LEAFYSPURGE). Rangeland potential vegetation types of some susceptibility to invasion include all but Alpine Shrub-Herbaceous. Of the susceptible types, the riparian, Fescue Grassland, and Fescue Grassland with Conifer are labeled invasive (I) and are thus relatively more susceptible to invasion (Table SUSCEPTIBILITY). Although less likely to invade undisturbed vegetation compared with disturbed, leafy spurge can invade and persist in ungrazed, native grasslands. No topographic limitations are known for this species. It can grow on soils ranging from light sandy to heavy clay, but grows best in coarse-textured soils. Sites with high sand content are susceptible to initial infestation.

Leafy spurge response to fire is typically neutral. It resprouts readily from rhizomes post-fire (C. Bushey, pers. comm. 1995). Burning as a control method can be effective if performed in the fall, compared with spring. Spring burning and its effects on control of leafy spurge have ranged from positive to negative and are thus not definitive. Burning is less effective than herbicides in control but is an option on sites where herbicide cost is prohibitive or where there is environmental concern with herbicide use. Leafy spurge can decrease when consumed by sheep and goats and these herbivores are thus a potential control method for this species. Cattle avoid consumption of leafy spurge because it can cause scours, weakness, and possible death.

Leafy spurge is extremely difficult to control with herbicides. Herbicide treatment can permanently eliminate small infestations. To be effective in control, herbicides must often be applied for 3-5 years in succession. Numerous biocontrol agents have either been released or are in testing, quarantine, or petition for consideration. These include the spurge hawkmoth (*Hyles euphorbia*), a stem and root-boring beetle (*Oberea erythrocephala*), a gall fly (*Spurgia esulae*), and four root-boring flea beetles (*Apthona czwalinae, A. flava, A. cyparissiae*, and *A. nigriscutis*). *A. nigriscutis* has reduced leafy spurge biomass on sites in Manitoba, and native vegetation is replacing the leafy spurge on the open, sandy sites. These agents will not eradicate leafy spurge, but do control its density and spread, and are more economical than herbicides or mechanical control methods. In general, most damage is inflicted by the agents that attack the root system. Because different agents attack different plant parts, the establishment of more than one agent will more likely increase success of control efforts. The expense of herbicides is often prohibitive relative to the return, thus the use of biocontrol agents offers an option for control on a large scale and in diverse environments. The use of a combination of control methods in an integrated weed control strategy shows some potential for success, especially biocontrol agents + herbicides, or herbicides + livestock grazing (sheep or goats). Perennial grasses, including smooth brome, Russian wildrye, pubescent wheatgrass, big bluegrass, and intermediate wheatgrass, have shown potential to compete with leafy spurge and control its spread, if leafy spurge is controlled first and the grasses are seeded subsequently.

Leafy spurge still has potential to increase its distribution within the Basin. Suitable habitat for colonization remains in several counties in Washington, Oregon, Idaho, and Wyoming (Teton county), that do not currently report presence (Tables WA, OR, ID, and WY). Leafy spurge is apparently spreading westward within the Basin. Being a perennial that can spread vegetatively with its extensive rhizomatous root system or sexually by seed, leafy spurge presents a major challenge for weed control personnel.

Family Gramineae

a. Downy Brome (Cheatgrass)

Presence of this species has been confirmed in every county in the Basin (Map DOWNYBROME). In addition to its ubiquitous presence on a county level, all rangeland potential vegetation types are of some susceptibility to invasion by cheatgrass except Alpine Shrub-Herbaceous. The grassland types, Antelope Bitterbrush, and the Mountain Big Sagebrush types are labeled invasive in Table SUSCEPTIBILITY and are especially susceptible to invasion. NOTE TO SENIOR AUTHOR: WYOMING BIG SAGE TYPES SHOULD PROBABLY ALSO BE LABELED INVASIVE; NEEDS RESOLVING). Cheatgrass has been described in much more detail in another report (Pellant 1995) solicited by the Interior Columbia Basin Ecosystem Management Project, and a summarization of Pellant (1995) can be found in Chapter 2 of USDA and USDI (1996). Interested readers are advised to seek more information on cheatgrass in those documents.

b. Medusahead

Presence of this species has not been confirmed yet in Montana or Wyoming (Map MEDUSAHEAD). Its confirmed presence in Idaho is restricted to a few western counties, but it is suspected as present in Idaho from Valley county south (L. Vance, pers. comm. 1995). Medusahead is now present in Idaho county, Idaho (B. Anderson, pers. comm., 1995) and this county should be shaded in Map MEDUSAHEAD. Medusahead is not on the noxious weed list for Idaho and thus its presence is not documented as rigorously as species on that list. Dahl and Tisdale (1975) reported that medusahead was present in Gem, Payette, Washington, Ada, Adams, Boise, Idaho, Nez Perce, Owyhee, Canyon, Clearwater, Elmore, and Latah counties in Idaho in 1964. Although Harney county in southeast Oregon remains unconfirmed for medusahead presence on Map MEDUSAHEAD, Asher (1993) reports that it is present on Steens Mountain. Medusahead was present on an estimated 2,500,000 acres in 1990 in the Oregon portion of the Basin, of which about 1,100,000 acres were on BLM land (Oregon Dept. of Agriculture statistics 1990). In Nevada, the acreage estimate is 100,000, mostly in Elko county. As mentioned, medusahead is not yet reported from Wyoming but it is likely to be located soon along the Utah-Wyoming border. As of 1990, medusahead was present in Box Elder and Cache county, Utah, just outside the Basin (Horton 1991). Rangeland potential vegetation types that are of some susceptibility to invasion by medusahead include all types except Salt Desert Shrub and Alpine Shrub-Herbaceous (Table SUSCEPTIBILITY). The label of closed for Salt Desert Shrub is questionable given the reported distribution of medusahead in Low Sagebrush potential vegetation types in the western portion of the Great Basin (Young 1992).

Medusahead responds positively to excessive livestock grazing pressure. Its potential to establish and maintain itself in diverse native plant communities is unknown at present. It is nearly worthless as forage for cattle and sheep and can only be grazed for a short period in early spring. Medusahead can be destroyed by fire, especially by slow fires that burn downslope or backfires, and especially at the soft dough stage of seed development. However, a sizeable seed crop remains intact after fire and medusahead can invade new areas that have burned intensely. Combining burning with other control methods, including herbicides or mechanical, is apparently more effective compared with burning alone. Seed that survives the fire can result in medusahead seedlings, which can be controlled with herbicides or mechanically (for example plowing or discing). This control sequence can permit drill seeding and successful establishment of perennial grasses, for example crested wheatgrass, Russian wildrye, or intermediate wheatgrass (Ahlenslager 1987, Horton 1991), and Horton (1991) maintains that in monotypic stands of medusahead, burning is required to permit successful establishment of perennial seedings. This control sequence is not feasible everywhere however. On many sites where medusahead is invading, for example the western Great Basin, surface rock cover prevents tillage or seed-drilling techniques (Young 1992). Intensive early spring grazing by livestock, several years in succession, apparently can result in severe depression of the medusahead seed source and prepare sites adequately for seedings with perennial grasses (Dahl 1966, in Horton 1991). Biocontrol agents for medusahead are virtually nonexistent at this time. A common pathogen found on wheat, *Fusarium culmorum*, causes crown rot and might be a potential agent for control.

Characteristics of susceptible sites include presence of vertic soils (clays that shrink, swell, and crack) with a high content of montmorillonite clay in the upper soil profile (Horton 1991), annual precipitation of 10-40 inch in a Mediterranean-type climate, and elevation less than 4,500 feet. Medusahead does not establish and persist on soils that remain moist through the growing season. Sites that receive 9-12 inches of annual precipitation are less susceptible to invasion compared with higher precipitation sites.

Medusahead often becomes the highest stage in the successional sequence of Russian thistle-mustards-cheatgrass, in annual-dominated plant communities. Large areas in Idaho that once were dominated by cheatgrass are now dominated by medusahead (Horton 1991). Medusahead apparently will not replace cheatgrass on all sites however, because medusahead requires more precipitation to complete its life cycle, compared with cheatgrass (Dahl 1966, in Horton 1991). Medusahead dominated the understory, rather than cheatgrass, on sites in northeastern California after western juniper was controlled. Both species were present pre-juniper control (Ahlenslager 1987). Horton (1991) reports that cheatgrass is more likely to dominate than medusahead if the surface soil is well-aerated, but if the surface soil is well-aerated and the B horizon is clayey, medusahead can establish. Medusahead is less palatable to livestock compared with cheatgrass and ratchets site potential further downward on these sites. It is currently invading low sagebrush communities in the western Great Basin and its invasion into these communities introduces wildfires into a community type that typically did not produce enough biomass to carry a fire (Young 1992). Loss of the low sagebrush shrub component is a result.

Suitable habitat for colonization by medusahead remains in numerous counties in

Washington, Oregon, Idaho, Montana, and Wyoming that do not currently report presence (Tables WA, OR, ID, MT, and WY). We suspect, especially in eastern Oregon and southern Idaho, that many unshaded counties actually do support medusahead populations currently. Nevertheless, the potential is high for medusahead to increase its distribution into more counties and also within counties that already report presence.

Family Lamiaceae

Mediterranean Sage

Presence of Mediterranean sage is confirmed in Klickitat and Columbia county in Washington, all of eastern Oregon except the northern tier of counties, and several counties in the southern portion of the Idaho panhandle (Map MEDITERRANEANSAGE). Presence of Mediterranean sage has not been confirmed elsewhere. This species was present on an estimated 1,000,500 acres in 1990 in the Oregon portion of the Basin, of which about 200,000 acres were on BLM land (Oregon Dept. of Agriculture statistics 1990). In Idaho, the acreage estimate is 4,000 in Idaho county, with smaller populations in the other reporting counties. Rangeland potential vegetation types that are of some susceptibility to invasion by Mediterranean sage include Wyoming Big Sagebrush Warm, Wyoming Big Sagebrush Cool, Agropyron Steppe, Fescue Grassland, and Mountain Mahogany. The susceptibility of the remaining types are unknown at present (Table SUSCEPTIBILITY).

This species can invade good to excellent condition sites and responds positively to excessive livestock grazing pressure. It maintains no known forage value for livestock. The response of this species to fire is unknown (C. Bushey, pers. comm. 1995). Sites with soil depth of 14+ inches and good drainage are susceptible to invasion. It is often located on south-facing slopes on soils ranging in texture from silt loam to loamy sand (Roche 1991).

Hand grubbing can be effective for control of small infestations if the taproot is cut below the soil surface. Tillage can be effective and mowing is effective if performed repeatedly during the growing season. This species can be controlled successfully with herbicides, especially if treatment is applied at the pre-bolt stage. The biocontrol agent, *Phrydiuchus tau*, a weevil, can result in damage or death to Mediterranean sage. This weevil has spread to all known populations in Idaho and Oregon and has been effective in reducing density in Oregon and Idaho county, Idaho, but has not been effective in reducing the spread of this species (Roche 1991).

Suitable habitat for colonization by Mediterranean sage remains in numerous counties in Washington, Oregon, Idaho, and Montana, that do not currently report presence (Tables WA, OR, ID, and MT). Given existing knowledge, suitable habitat exists in Wyoming Big Sagebrush Warm, Wyoming Big Sagebrush Cool, and Agropyron Steppe potential vegetation types, but suitable habitat in other types might exist also and be elucidated with further knowledge.

Family Lythraceae

Purple Loosestrife

Purple loosestrife has a scattered distribution in the Basin. Several counties in eastern Oregon, eastern Washington, the Idaho panhandle, southeast Idaho, western Montana and northwest Wyoming have not confirmed presence of this species (Map PURPLELOOSESTRIFE). In general the distribution of this species is confined more to the central and western portions of the Basin. Purple loosestrife was present on an estimated 100 acres in 1990 in the Oregon portion of the Basin (Oregon Dept. of Agriculture statistics 1990). On rangeland this species is restricted to wet environments, including marshes, streambanks, shorelines, and other wetland sites. It is shade intolerant and is not located often along tree-bordered riverbanks (Uchytil 1992). Purple loosestrife can grow on a variety of soils, ranging from gravel to clay textures and including organic soils (Uchytil 1992). Rangeland potential vegetation types of some susceptibility to invasion include Mountain Shrub and the riparian types (Table SUSCEPTIBILITY).

The response of purple loosestrife to fire is typically positive to neutral. Sites that support purple loosestrife are difficult to burn unless a strong drought has occurred. Fire during drought can consume the root system and the seed bank and result in short-term decline. Typically though, the root system resprouts post-fire (C. Bushey, pers. comm. 1995), and seed remaining in the seed bank can result in seedling recruitment (Uchytil 1992).

Hand grubbing can be effective for control of small infestations. Cutting is ineffective because remaining portions resprout. Flooding or drying is ineffective because this tends to open up new sites for establishment. Herbicides can be effective for control, especially if applied at stages between bud to late bloom, depending on the herbicide used. After treatment, revegetation with native grasses, cattails, or rushes is recommended. Three biocontrol agents (a root-mining weevil, *Hylobius transversovittatus*, and 2 leaf-eating beetles, *Galerucella calmariensis* and *G. pusilla*) have been released in Oregon and Washington for control of purple loosestrife and the *Galerucella* species have established. The leaf-eating beetles can completely defoliate plants. Malecki et al. (1993) predict that (1) these 3 species will be most important for the control of purple loosestrife, and (2) purple loosestrife abundance will be reduced to approximately 10% of its current level over approximately 90% of its range (in North America). The timing of the second prediction above was not presented by the authors. Other biocontrol agents for this weed that Malecki et al. (1993) propose that will be effective in control are 2 flower-feeding weevils, *Nanophyes marmoratus* and *N. brevis*.

Purple loosestrife is problematic because once established, it often displaces native wetland species such as cattails, rushes, and sedges. Monospecific stands of loosestrife often result (Uchytil 1992) and thus a decrease in biodiversity is often a result of the invasion. Purple loosestrife-dominated wetlands are poor wildlife habitat areas. It is seldom consumed by waterfowl and it provides poor nesting habitat for waterfowl and long-billed marsh wrens. Some bird species, for example black-crowned night herons, pied-billed grebes, and red-winged blackbirds, will nest in purple loosestrife and the increase in purple loosestrife is predicted to benefit populations of red-winged blackbirds. Muskrats seldom consume purple loosestrife or build houses with its stems. Dense purple loosestrife stands can serve as escape cover and shelter for pheasants and rabbits. Although consumed somewhat by white-tailed deer and livestock, purple loosestrife is much less palatable to livestock than the grasses and sedges that are displaced

by loosestrife (Uchytil 1992). Flowers of purple loosestrife provide a nectar and pollen source for honey bees and honey production (Uchytil 1992, Malecki et al. 1993). In summary, purple loosestrife provides habitat and a food source for some species of wildlife. However, the loss of habitat and decline in biodiversity resulting from the displacement of native wetland species by purple loosestrife is deleterious in an ecosystem perspective and negatively offsets the benefits it provides to a few species.

Purple loosestrife will continue to increase its distribution within the Basin. Purple loosestrife is a prodigious producer of seed, which readily float and are disseminated by flowing water. Wetland complexes connected by a common waterway will be the most likely sites for future colonization (Uchytil 1992). Isolated wetland basins and streams with steep gradients are less susceptible to invasion. No known native herbivores or pathogens suppress it in North America (Hight 1990, in Malecki et al. 1993).

Family Rosaceae

Sulfur Cinquefoil

The confirmed distribution of this species in the Basin is mostly confined to western Montana, the Idaho panhandle, the easternmost counties of Washington, and counties in northeast Oregon (Map SULFURCINQUEFOIL). Scattered counties in southern Idaho have confirmed presence of this species. Rangeland potential vegetation types of some susceptibility to invasion include the grassland types (labeled I), and the mesic shrub and riparian types (labeled D). The xeric shrub types were generally labeled as unknown to susceptibility, and Salt Desert Shrub and Alpine Shrub-Herbaceous were labeled closed to invasion (Table SUSCEPTIBILITY).

Livestock, except goats, generally do not consume sulfur cinquefoil and it responds positively to excessive livestock grazing pressure. It can displace other weed species declared as noxious, for example spotted knapweed in Montana (Carey 1995). It typically responds in a neutral manner to fire. Fire removes the top portion but the rootstock typically resprouts post-fire. Removal of biomass and litter attributable to fire can provide favorable microsites for seedling establishment of this species (C. Bushey, pers. comm. 1995).

Sulfur cinquefoil can establish on all soil textures except pure silt and it is most often associated with sites characterized by sandy clay loam or sandy clay soils. In Montana it has been found at elevations as high as 6,580 feet. It can successfully invade native plant communities, for example bluebunch wheatgrass communities in Montana (Carey 1995), that are in good condition or are not subjected to any apparent anthropogenic influence. It has been located in western Montana on sites that receive as little as 13-16 inches of annual precipitation (Jarecki 1990). It apparently is intolerant of shade (Carey 1995).

Hand grubbing can be effective for control of small infestations. Mowing is ineffective. The recommended control strategy at present incorporates usage of herbicides. Herbicides can be effective at the rosette through late bud stage, depending on herbicide used. Fertilization after herbicide treatment can aid in suppressing sulfur cinquefoil and increasing grass productivity

(Carey 1995). No acceptable biocontrol agents are available yet, partially because agents that are potentially damaging to sulfur cinquefoil are also potentially damaging to strawberry (*Fragaria* spp.), a closely related plant to cinquefoil (Carey 1995). Predictions are that it will likely be a decade before biocontrol agents are released for this species.

Suitable habitat for colonization by sulfur cinquefoil remains in numerous counties within Washington, Oregon, Idaho, Montana, and Wyoming that currently do not report presence (Tables WA, OR, ID, MT, and WY). Given this, plus the nonexistent biological control program for this species, the prognosis is continual expansion of this species into new counties and an increased distribution in the Basin.

Family Scrophulariaceae

The Toadflaxes (Dalmatian and Yellow)

Comparing these 2 species, dalmatian toadflax has a broader distribution within the Basin (Maps DALMATIANTOADFLAX and YELLOWTOADFLAX). Presence of dalmatian toadflax has been confirmed from all counties except for several in south-central and southeastern Idaho, and Powell county, Montana. NOTE TO SENIOR AUTHOR: NEED TO DISCUSS LINK TO TABLE SUSCEPTIBILITY AND TABLES WA, OR, ID, MT, AND WY.

Dalmatian toadflax can invade undisturbed grassland in natural soil disturbances. It responds positively to excessive livestock grazing pressure, especially in the spring, and on inherently low productivity sites. Seedlings are not favored in closed plant communities that are ungrazed. This species generally responds positively to fire. Removal of top growth by fire is believed to stimulate vegetative shoot production. Soil temperatures during fire are generally not sufficient to destroy root buds or the seed bank. Sites with well-drained, coarse gravel to sandy loam soils, from sea level to 9,000 feet, are susceptible to invasion by this species. Grubbing can be effective for control of small infestations, if performed frequently. Mowing is generally ineffective because of root reserves and the seed bank. Several biocontrol agents attack this species and show potential for control, including a defoliating moth (*Calophasia lunula*), an ovary-feeding beetle (*Brachypterolus pulicarius*), seed capsule-feeding weevils (*Gymnaetron antirrhini* and *G. netum*), a stem-boring weevil (*Mecinus janthinus*), and a root-boring moth (*Eteobalea intermediella*). Not all of these have been released in the United States yet. *Calophasia lunula* has established in northern Idaho but defoliation by this moth is somewhat ineffective because of the extensive root system of dalmatian and yellow toadflax. Sheep are a potential method of suppression. Herbicides can be effective in control, but their effectiveness apparently is tied to soil type to some degree, and commercial treatments with picloram, dicamba, and 2,4-D have not been as successful as research treatments.

Presence of yellow toadflax has not been confirmed from several counties in central and southeast Washington, several counties in eastern Oregon, and several counties in southern Idaho (Map YELLOWTOADFLAX). This species can invade excellent condition rangeland in small openings or natural disturbances. It responds positively to excessive livestock grazing pressure. It

also can respond positively to fire, with an increase in vegetative shoot production. Sites on well-drained, gravelly or rocky river banks, or characterized by sandy, gravelly soils, from sea level to 2,800 meters, are susceptible to invasion. Grubbing can be effective for control on small infestations if the tap root is removed. Control of this species with herbicides is similar to dalmatian toadflax mentioned previously. In general, the same biocontrol agents are in testing and experimentation for yellow toadflax as for dalmatian toadflax.

Dalmatian toadflax was present on an estimated 30,000 acres in 1990 in the Oregon portion of the Basin, of which about 1,300 acres were on BLM land (Oregon Dept. of Agriculture statistics 1990).

NEW INVADERS -- WEED SPECIES TO WATCH FOR ON RANGELANDS IN THE BASIN

Several weed species currently reside in the Basin but are localized in distribution in relatively small acreages, compared with more ubiquitous species. There are additional weed species that exist near the perimeter of the Basin that knowledgeable weed folks suspect will eventually invade the Basin. Some of these species may become the new "noxious" weed species that will negatively affect the rangeland resource. The sentiment associated with suspected new problem species is that if they are troublesome in their native region, they will be troublesome on similar sites in North America also (D. Isaacson, pers. comm. 1995). The information below was derived from personal communication with several weed experts (M. Corp, J. Farmer, B. Frederickson, D. Isaacson, L. Penders, D. Pranger, B. Reynolds, L. Vance), Pacific Northwest Extension Publications Nos. 175, 350, 369, 370, 420, Hitchcock and Cronquist (1961), and the Washington State Noxious Weed Control Board (1994). Detailed information on eradication or control methods for these species can be located in these publications, as well as the annually revised, Pacific Northwest Weed Control Handbook, available from Extension offices of Oregon State University, Washington State University, and the University of Idaho. We discuss these species below. The weed species are in no particular order and do not represent an all-inclusive list of potential troublesome invaders.

(1) Syrian Bean-Caper (*Zygophyllum fabago*) -- This perennial, bushlike species has been legally declared as noxious in Washington (Class A) and Idaho. In Washington this species exists in Adams, Grant, Okanogan, and Whitman counties. In Idaho this species exists near Aberdeen in Bingham county. This species has not been reported yet from Oregon and a recognized weed expert from Oregon maintains that little is known of the potential for this species to naturalize or be problematic. All infestations in California have been eradicated. It appears that this species shows potential for spread into waste places, dry grasslands, and desert, because these are its native habitats in southwest Asia. It apparently is unpalatable to livestock. In Washington it can be found on sandy to silt loam soils. Rice and Rider (1995) collected 13 distribution records for this species and proposed it as being successfully invasive with disturbance in Fescue-Bunchgrass rangeland.

(2) African Rue (*Peganum harmala*) -- This perennial, succulent species has been legally declared

as noxious in Washington (Class A). In Washington this species exists in Ephrata in Grant county. It exists along roads and in dry rangelands in western Texas, New Mexico, Arizona, and Nevada, and apparently exists in southern California also. It apparently existed in Oregon in 1967 near Prineville in Crook county but has not been observed since. This species is native to desert shrublands of northern Africa, and the Middle East as far east as Tibet. The potential for this species to spread is unknown and controlling it is difficult. It is extremely drought tolerant, existing in areas receiving less than 10 inches of precipitation annually, and displaces native range plant species in the southwest United States. It is unpalatable to livestock. In Texas this species grows on clay, clay loam, and sandy soils, and it tolerates saline and alkaline soils.

(3) Iberian Starthistle (*Centaurea iberica*) and Purple Starthistle (*Centaurea calcitrapa*) -- These 2 biennial species are nearly indistinguishable and have been legally declared as noxious in Oregon (both, Category B) and Washington (purple, Class A). In Oregon, this species complex has been located in Sherman and Wasco county. In Washington, it has been located in Asotin and Walla Walla county. Both species are problematic in California and purple starthistle exists in Utah and Wyoming also. They can replace native species. Purple starthistle is native to the Mediterranean region including southern Europe and northern Africa, whereas Iberian starthistle is native to Asia Minor between the Caspian and Black Seas.

(4) Distaff Thistle (*Carthamus lanatus*) -- This annual species has been legally declared noxious in Oregon (Category A) and currently exists west of the Cascades in Douglas county, Oregon. This species is well established and problematic in California and is believed by weed experts to be adapted to the Basin. It is native to the Mediterranean region of Europe, and central Europe. Its potential for spread in the Basin on rangelands appears to be centered on the more mesic sites, because it grows best in areas with 16 to 24 inch annual precipitation.

(5) Camelthorn (*Alhagi pseudalhagi*) -- This perennial shrub species has been legally declared noxious in Oregon (Category A) and Washington (Class B). Presently it is not believed to exist in Oregon but does exist in Washington. It is problematic in California and is subjected to intensive control.

(6) Saltcedar (*Tamarix ramosissima*) -- This shrub or small tree species is legally declared noxious in Washington (Class C). In Washington it currently exists on about 350 acres in Grant and Franklin counties along the Columbia River. The genus *Tamarix* is native to southern Europe and north Africa through the Middle East and south Asia to China and Japan. It is now established in many moist areas of rangelands in the western United States and weed experts believe it could naturalize over most of the Basin in riparian zones. Saltcedar replaces native riparian vegetation along watercourses, including willows and cottonwoods.

(7) Matgrass (*Nardus stricta*) -- This grass species is legally declared noxious in Oregon (Category A) and Idaho. In Oregon it currently exists in Klamath county. It appears problematic in heavily grazed areas. It disperses slowly but is difficult to manage after it establishes. Rice and Rider (1995) collected 3 distribution records for this species and proposed it as successfully invasive with disturbance in rangeland characterized as Agropyron Bunchgrass and Fescue-Bunchgrass.

(8) Squarrose Knapweed (*Centaurea virgata*)

Squarrose knapweed is known from Union, Grant, Wheeler, and Malheur counties in the Oregon portion of the Basin (Map SQUARROSEKNAPWEED). Estimated acreage of squarrose knapweed was 25 in Grant county in 1993 and <0.5 in Malheur county in 1991. In the Oregon portion of the Basin, squarrose knapweed was present on an estimated 800 acres in 1990, of which none was present on BLM land (Oregon Dept. of Agriculture statistics 1990). Rangeland potential vegetation types of some susceptibility to invasion include all types except Alpine Shrub-Herbaceous and high elevation Riparian Graminoid. It is listed as invasive (I) in crested wheatgrass (Society for Range Management #614 cover type) stands; crested wheatgrass stands exist within several potential vegetation types (Table SUSCEPTIBILITY).

Squarrose knapweed exists on rangeland that has been subjected to excessive livestock grazing pressure, on repeatedly burned cheatgrass sites, on crested wheatgrass seedings, or on sandy or gravelly washes in salt desert shrub ranges. It exists in Utah, outside of the Basin, on rangeland receiving as little as 6-8 inches of annual precipitation (Asher 1993). Its response to fire is unknown at present (C. Bushey, pers. comm. 1995).

Hand grubbing is generally ineffective for control because squarrose knapweed typically resprouts from taproots. The recommended control strategy for large infestations is to utilize a combination strategy of herbicides, revegetation with perennial forage species, and subsequent improved grazing management. Several biocontrol agents are being evaluated and these agents all attack this species in its original locale of Turkey.

The potential for squarrose knapweed to expand its distribution in the Basin seems certain, especially on Salt Desert Shrub, and other relatively xeric shrub-grassland potential vegetation types. Suitable habitat for colonization by this species remains in numerous counties in the Basin, that do not currently report presence (Tables WA, OR, ID, MT, and WY). Caution needs to be used in utilizing Tables SUSCEPTIBILITY and WA, OR, ID, MT, and WY because only 11 records of squarrose knapweed were available to be utilized in decision-making regarding susceptibility of rangeland cover types to invasion. Additional records will certainly modify the susceptibility determinations.

FUTURE COURSE OF ACTION FOR NOXIOUS WEEDS

Integrated Weed Management

The magnitude and complexity of noxious rangeland weeds in the Basin, combined with their cost of control, necessitates using Integrated Weed Management (IWM). IWM involves the use of several control techniques in a well-planned, coordinated, and organized program to reduce the impact of weeds on rangelands. Inventory and mapping is the first phase of any IWM program. The second phase includes prioritizing weed problems and choosing and implementing control techniques strategically for a particular weed management unit on the ground. The third phase is adopting proper range management practices as a portion of the IWM program. The IWM program must fit into an overall range management plan.

a. Inventory and Mapping

The goal of inventory and mapping is to determine and record the weed species present, the area infested, the density of the infestation, the rangeland under threat of invasion, the soils and range vegetation types, and other site factors pertinent to successfully managing infested rangeland and rangeland susceptible to invasion. Inventories and mapping can be conducted by field surveys, aerial photography, and geographic information systems.

b. Planning and Implementation

Planning is the process by which weed problems and solutions are identified and prioritized. In addition, an economic plan of action is developed to provide direction for implementing the IWM program. Implementing control techniques includes (1) preventing encroachment into uninfested rangeland, (2) detecting and eradicating new introductions, (3) containing large-scale infestations, (4) controlling large-scale infestations using an integrated approach, and often (5) revegetation. The key component of any successful weed management program is sustained effort, constant evaluation, and the adoption of improved strategies.

(1) Preventing Weed Encroachment

Preventing the introduction of rangeland weeds is the most practical and cost-effective method for their management. Prevention programs include such techniques as limiting weed seed dispersal, minimizing soil disturbance, and properly managing desirable vegetation. New weed introductions can be minimized by (1) using weed seed free hay, feed grain, straw, or mulch, (2) refraining from driving vehicles and machinery through weed infestations and, before driving from a weed infested area to an uninfested area, washing the undercarriage of vehicles and machinery, (3) permitting livestock to graze weed infested areas only when weeds are not flowering or producing seeds, or, if livestock are grazing weed infested areas, moving them to a holding area for about 14 days before moving them to weed-free areas, (4) requesting that campers, hikers, and sportsmen who are recreating in weed infested areas, brush and clean themselves and their equipment before moving to uninfested areas, (5) minimizing unnecessary soil disturbance by vehicles, machinery, waterflow, and livestock, and (6) managing grasses for vigor and competition with weeds.

Prevention is clearly the cheapest, most effective, and highest priority weed management technique (USDI-BLM 1994). A sentiment of some weed control organizations (for example, Washington State Noxious Weed Control Board, L. Penders, pers. comm. 1995) in the Basin is that treatment of large infestations of the widely distributed weed species is not the most efficient expenditure of funds; rather, funds are most efficiently spent on preventing new infestations of noxious weeds and preventing establishment of new exotic weeds not currently residing in the region. Prototype weed prevention measures that could form the foundation for a weed prevention strategy within a total package of weed management can be found in Table PREVENTION. These weed prevention measures are not restricted to rangeland sites; some measures are more pertinent to forested sites and some are more pertinent to rangeland sites.

(2) Detecting and Eradicating New Introductions

Early detection and systematic eradication of weed introductions are central to IWM. Weeds encroach typically by establishing small "satellite" infestations, that are generally the spreading front of the large infestation. Eradication involves total removal of the weed and is achievable on a small scale. An eradication program involves delimiting the boundaries of the infestation, both on the ground and on maps, determining the proper control procedures, and the number and timing of follow-up applications. This generally requires aggressive annual applications of herbicides. Revegetation of infested areas might be required to eradicate weeds in areas that do not have an understory of desirable species that can reoccupy the area after weeds are controlled. Eradication of small patches requires continual monitoring and evaluation to ensure successful removal of the weed.

(3) Containing Large-Scale Infestations

Containment programs are generally used to restrict the encroachment of large-scale weed infestations. Studies have shown that containing weed infestations, which are too large to eradicate, is cost-effective because it preserves neighboring uninfested rangeland and enhances the success of future large-scale control programs. Containing a large-scale infestation requires using preventive techniques and spraying herbicides on the border of weed infestations to stop the advancing front of weed encroachment. Containment programs typically require a long-term commitment to herbicide application because they are designed to limit spread and are not designed to modify or reduce the infestation level. Roadways and railways, where weed infestations often begin, should be subjected to a constant prevention and containment program.

(4) Controlling Large-Scale Infestations

Most successful large-scale weed control programs are completed in a series of steps. Weed control areas should be divided into smaller units to make them more manageable. Weed control should be implemented unit by unit at a rate compatible with economic objectives. Initially, large-scale weed control should focus on rangeland sites with an understory of residual grasses and the highest potential productivity. Suppressed grasses have the greatest chance of reestablishing dominance on these sites. These areas must be spot treated each year to ensure control and minimize reinvasion. In most cases, some percentage of the management unit will require that control measures be repeatedly applied until the weed seed bank and root reserves are exhausted. Next, control efforts should focus on the sites adjacent to those initially treated to minimize reintroduction of the weeds. Usually, large-scale control is most effectively applied from the outside of the weed management unit inward toward its center. Selection and application of weed control techniques in large-scale control programs depends on the specific circumstances for each portion of the management unit. Control techniques used in one area of the management unit might be inappropriate for another area. For example, sheep grazing leafy spurge in one area might provide cost-effective control, but sheep do not readily consume spotted knapweed and herbicides might be more appropriate. Similarly, the most effective herbicide for a particular weed species might not be labeled for use in an environmentally sensitive area.

Selection will depend on the (1) weed species, (2) effectiveness of the control technique, (3) availability of control agents or grazing animals, (4) land use, (5) length of time required for control, (6) environmental considerations, and (7) relative cost of the control techniques.

Researchers are currently determining if combining treatments will provide a synergistic (the effects of the treatment combination are greater than the sum effects of each treatment applied individually) response in controlling weeds. Some preliminary evidence suggests most control techniques are compatible. The discussions of weed species in this report include recommendations for treatment combinations that might be effective.

(5) Revegetation

Revegetation with desirable plants might be the best long-term alternative for controlling weeds on sites without an understory of desirable species. Establishing competitive grasses can minimize the reinvasion of rangeland weeds and provide excellent forage production. In most areas, a fall herbicide application after weeds have germinated and emerged, with subsequent plowing or disking, and drill seeding, is most effective for establishing desirable species.

c. Proper Range Management

Proper range management is especially critical during the management phase after weed control. Proper livestock grazing is essential to maintain competitive desirable plants, which will help prevent weed reinvasion after control. A grazing plan should be developed for any management unit involved in a weed management program. The plan should include altering the season of use and stocking rates to achieve moderate utilization of the herbaceous component. Grazing systems should rotate livestock to permit plants to recover before being regrazed, and should promote litter accumulation, on sites where litter accumulation is feasible. Range monitoring and annual evaluations should be conducted to determine the adequacy of existing management.

LITERATURE CITED

Ahlenslager, K.E. 1987. *Taeniatherum caput-medusae*. *In*: Fischer, W.C. (compiler). The Fire Effects Information System [Data base]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory.

Anonymous. 1994. Written findings of the Washington State Noxious Weed Control Board. (Unpublished document, containing material on *Tamarix* species). 4 pp.

Asher, J. 1993. Noxious weeds in eastern Oregon. USDI-Bureau of Land Management, Oregon State Office, Report on file with Interior Columbia Basin Ecosystem Management Project, Walla Walla, Washington.

Asher, J. 1994. Crushing the wilderness spirit: alien plant invasions. Unpublished document on file with Interior Columbia Basin Ecosystem Management Project, Walla Walla, Washington.

Borman, M.M., W.C. Krueger, and D.E. Johnson. 1990. Growth patterns of perennial grasses in the annual grassland type of southwest Oregon. Agronomy Journal 82:1093-1098.

Borman, M.M., W.C. Krueger, and D.E. Johnson. 1991. Effects of established perennial grasses on yields of associated annual weeds. Journal of Range Management 44:318-322.

Burrill, L.C. 1992. Distaff thistle (*Carthamus lanatus*). Pacific Northwest Extension Publication 420. Oregon State University Extension Service, Washington State University Cooperative Extension, University of Idaho Cooperative Extension System, and United States Department of Agriculture.

Burrill, L.C., R.H. Callihan, R. Parker, E. Coombs, and H. Radtke. 1994. Tansy ragwort (*Senecio jacobaea* L.). Pacific Northwest Extension Publication 175. Oregon State University Extension Service, Washington State University Cooperative Extension, University of Idaho Cooperative Extension System, and United States Department of Agriculture.

Callihan, R.H., S.A. Dewey, J.E. Patton, and D.C. Thill. 1984. Distribution, biology, and habitat of Dyer's woad (*Isatis tinctoria*) in Idaho. Journal of the Idaho Academy of Science 20:18-32.

Carey, J.H. 1994. *Carduus nutans*. *In*: Fischer, W.C. (compiler). The Fire Effects Information System [Data base]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory.

Carey, J.H. 1995. *Centaurea diffusa*. *In*: Fischer, W.C. (compiler). The Fire Effects Information System [Data base]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory.

Carey, J.H. 1995. *Centaurea maculosa*. *In*: Fischer, W.C. (compiler). The Fire Effects Information System [Data base]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory.

Carey, J.H. 1995. *Centaurea solstitialis*. *In*: Fischer, W.C. (compiler). The Fire Effects Information System [Data base]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory.

Carey, J.H. 1995. *Potentilla recta*. *In*: Fischer, W.C. (compiler). The Fire Effects Information System [Data base]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory.

Dahl, B.E., and E.W. Tisdale. 1975. Environmental factors related to medusahead distribution. Journal of Range Management 28:463-468.

Dewey, S.A., K.P. Price, and D. Ramsey. 1991. Satellite remote sensing to predict potential distribution of Dyers woad (*Isatis tinctoria*). Weed Technology 5:479-484.

Esser, L.L. 1994. *Centaurea repens*. *In*: Fischer, W.C. (compiler). The Fire Effects Information System [Data base]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory.

Hitchcock, C.L., and A. Cronquist. 1961. Vascular plants of the Pacific Northwest. Vol. 3:Saxifragaceae to Ericaceae. Univ. of Wash. Press, Seattle.

Horton, W.H. 1991. Medusahead: importance, distribution, and control, pp. 394-398. *In*: L.F. James, J.O. Evans, M.H. Ralphs, and R.D. Childs (editors), Noxious range weeds. Westview Press, Boulder, Colorado.

Jarecki, C. 1990. Range weeds and ranch management. *In*: Roche, B.F. Jr., and C.T. Roche (compilers and editors). Range weeds revisited. Symposium proceedings of a 1989 Pacific Northwest range management short course. Spokane, Washington, January 1989.

Mack, R.N. 1986. Alien plant invasion into the Intermountain West: a case history, pp. 191-213. *In*: Mooney, H.A., and J.A. Drake (editors), Ecology of biological invasions of North America and Hawaii. Springer-Verlag, New York, New York.

Malecki, R.A., B. Blossey, S.D. Hight, D. Schroeder, L.T. Kok, and J.R. Coulson. 1993. Biological control of purple loosestrife. Bioscience 43:680-686.

Oregon Department of Agriculture. 1990. Weed statistics. Unpublished data on file with Interior Columbia Basin Ecosystem Management Project, Walla Walla, Washington.

Pavek, D.S. 1992. *Halogeton glomeratus*. *In*: Fischer, W.C. (compiler). The Fire Effects Information System [Data base]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory.

Pellant, M. 1995. Cheatgrass: the invader that won the West. Unpublished report on file with Interior Columbia Basin Ecosystem Management Project, Walla Walla, Washington.

Rees, N.E., P.C. Quimby, Jr., G.L. Piper, E.M. Coombs, C.E. Turner, N.R. Spencer, and L.V. Knutson (editors). 1996. Biological control of weeds in the west. Western Society of Weed Science, in cooperation with USDA Agricultural Research Service, Montana Department of Agriculture, and Montana State University, Bozeman, Montana.

Rice, P., and J. Rider. 1995. Landscape ecology: noxious weeds invasion analysis. Unpublished final report on file with Interior Columbia Basin Ecosystem Management Project, Walla Walla, Washington.

Roche, B.F. 1994. Knapweed. Vol.8, No. 1. Washington State University, Cooperative Extension Newsletter.

Roche, C. 1991. African rue (*Peganum harmala* L.). Pacific Northwest Extension Publication 369. Oregon State University Extension Service, Washington State University Cooperative Extension, University of Idaho Cooperative Extension System, and United States Department of Agriculture.

Roche, C. 1991. Syrian bean-caper (*Zygophyllum fabago* L.). Pacific Northwest Extension Publication 370. Oregon State University Extension Service, Washington State University Cooperative Extension, University of Idaho Cooperative Extension System, and United States Department of Agriculture.

Roche, C.T. 1991. Mediterranean sage (*Salvia aethiopis* L.). Pacific Northwest Extension Publication 381. Oregon State University Extension Service, Washington State University Cooperative Extension, University of Idaho Cooperative Extension System, and United States Department of Agriculture.

Roche, C.T., and B.F. Roche, Jr. 1988. Distribution and amount of four knapweed (*Centaurea* L.) species in eastern Washington. Northwest Science 62:242-253.

Roche, C.T., and B.F. Roche. 1990. Purple starthistle (*Centaurea calcitrapa* L.) and Iberian starthistle (*Centaurea iberica* Trev. ex Sprengel). Pacific Northwest Extension Publication 350. Washington State University Cooperative Extension, and United States Department of Agriculture.

Sheley, R.L. (editor). 1994. The identification, distribution, impacts, biology and management of noxious rangeland weeds. Unpublished report on file with Interior Columbia Basin Ecosystem Management Project, Walla Walla, Washington.

Shiflet, T.N. (editor) 1994. Rangeland cover types of the United States. Society for Range Management, Denver, Colorado.

Tyser, R.W., and C.H. Key. 1988. Spotted knapweed in natural area fescue grasslands: an ecological assessment. Northwest Science 62:151-160.

Uchytil, R.J. 1992. *Lythrum salicaria*. *In*: Fischer, W.C. (compiler). The Fire Effects Information System [Data base]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory.

United States Department of Agriculture-Forest Service. 1991. Record of decision, noxious weed management, amendment to Lolo National Forest plan. Lolo National Forest.

United States Department of Agriculture-Forest Service, and United States Department of the Interior-Bureau of Land Management. 1996. Chapter 2 *In*: Assessment of ecosystem components in the Interior Columbia Basin and portions of the Klamath and Great Basins. Interior Columbia Basin Ecosystem Management Project, Walla Walla, Washington.

United States Department of Agriculture-Forest Service, and United States Department of the Interior-Bureau of Land Management. 1996. Unpublished data on file with Interior Columbia Basin Ecosystem Management Project, CRBSUM Current Potential Vegetation Types (BGBCPVT). Portland, Oregon.

United States Department of the Interior-Bureau of Land Management. 1985. Northwest area noxious weed control program environmental impact statement. Oregon State Office, Portland, Oregon.

United States Department of the Interior-Bureau of Land Management. 1994. Draft noxious weed action plan for the Bureau of Land Management fiscal year 1995 and beyond.

Walkup, C.J. 1991. *Cirsium arvense*. *In*: Fischer, W.C. (compiler). The Fire Effects Information System [Data base]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory.

Walkup, C.J. 1991. *Euphorbia esula*. *In*: Fischer, W.C. (compiler). The Fire Effects Information System [Data base]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory.

Walsh, R.A. 1993. *Cirsium vulgare*. *In*: Fischer, W.C. (compiler). The Fire Effects Information System [Data base]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory.

Young, J.A. 1992. Ecology and management of medusahead (*Taeniatherum caput-medusae* ssp. *asperum* [Simk.] Melderis). Great Basin Naturalist 52:245-252.

Young, J.A., C.E. Turner, and L.F. James. 1995. Perennial pepperweed. Rangelands 17:121-123.

Table SUSCEPTIBILITY--Rangeland potential vegetation types and associated SRM (Society for Range Management) rangeland cover types in the Basin, and their susceptibility to 25 weed species (24 legally declared noxious, plus cheatgrass).

				Agropyron Steppe		Fescue Grassland						
Weed Species	Noxious Legal Status	Average Annual Rate (%) of Expansion[a]	Number of Distribu-tion Records	SRM 101	SRM 302	SRM 102	SRM 108	SRM 304	SRM 306	SRM 307	SRM 311	SRM 312
Bull Thistle	OR-B WA-C	?	427	D[b]	D	I	D	I	I	I	I	I
Canada thistle	MT-1 ID-Y OR-B WA-C WY-Y	10	891	D	D	I	I	I	I	D	I	I
Common Crupina	MT-3 ID-Y OR-A WA-A	?	34	D	D	D	C	D	D	D	D	D
Dalma-tian toadflax	MT-1 ID-Y OR-B WA-B WY-Y	8	285	I	I	I	D	I	D	D	D	D

Diffuse knapweed	MT-1 ID-Y OR-B WA-B WY-Y	18	646	D	D	D	C	D	D	D	D	D
Cheat-grass	Not declared noxious	?	1,045	I	I	I	D	I	I	D	I	I
Dyers woad	MT-2 ID-Y OR-B WA-A WY-Y	14	107	I	I	D	C	I	I	I	I	I
Haloge-ton	OR-B	?	47	D	D	D	C	D	D	D	D	D
Hoary Cress[c]	MT-1 ID-Y WA-C WY-Y	9	388	D	D	D	D	D	D	C	D	D
Leafy spurge	MT-1 ID-Y OR-B WA-B WY-Y	12	745	D	D	I	C	I	I	D	I	I
Mediter-ranean Sage	OR-B WA-A	?	100	I	I	I	U	I	U	U	U	U

Medusa-head	OR-B	?	65	D	D	D	D	D	D	D	D	D
Musk thistle	ID-Y OR-B WA-B WY-Y	15	292	D	D	I	D	I	I	I	I	I
Orange Hawk-weed	ID-Y WA-B	?	63	C	C	C	C	C	C	D	C	C
Oxeye Daisy	WY-Y	?	276	D	D	D	D	D	D	D	D	D
Purple Loose-strife	MT-2 ID-Y OR-B WA-B	?	288	C	C	C	C	C	C	D	C	C
Rush Skele-tonweed	MT-3 ID-Y OR-B WA-B	?	96	D	D	D	C	D	D	D	D	D
Russian knapweed	MT-1 ID-Y OR-B WA-B WY-Y	8	576	D	D	D	C	D	D	D	D	D
Scotch thistle	ID-Y OR-B WA-B WY-Y	16	118	D	D	D	C	D	D	D	D	D

Spotted knapweed	MT-1 ID-Y OR-B WA-B WY-Y	24	1,096	I	I	I	C	I	I	D	I	I
Squar-rose Knap-weed	OR-A	?	11	D	D	D	C	D	D	D	D	D
Sulfur Cinque-foil	MT-1 WA-C	?	298	I	I	I	D	I	I	I	I	I
Yellow Hawk-weed	ID-Y WA-B	?	24	C	C	C	C	C	C	C	C	C
Yellow star-thistle	MT-3 ID-Y OR-B WA-B	17, (6 in ID)	213	I	I	I	D	I	D	D	D	D
Yellow toadflax	ID-Y OR-B WA-C WY-Y	9	359	D	D	D	D	D	D	D	D	D

Table SUSCEPTIBILITY (continued).

	Fescue Grassland With Conifer					Antelope Bitterbrush					Basin Big Sagebrush Steppe		Low Sage Mesic	
Weed Species	SRM 304	SRM 306	SRM 307	SRM 308	SRM 312	SRM 104	SRM 105	SRM 317	SRM 318	SRM 319	SRM 401	SRM 614	SRM 405	SRM 406
Bull Thistle	I	I	I	D	I	D	D	D	D	D	D	D	D	D
Canada thistle	I	I	D	I	I	D	D	D	D	D	D	D	D	D
Common Crupina	D	D	D	C	D	D	D	D	D	D	C	D	C	C
Dalmatian toadflax	I	D	D	D	D	D	D	D	D	D	D	D	D	D
Diffuse knapweed	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Cheatgrass	I	I	D	D	I	I	I	I	I	I	D	D	D	D
Dyers woad	I	I	I	C	I	D	D	D	D	D	I	I	I	I
Halogeton	D	D	D	C	D	D	D	D	D	D	D	D	D	D
Hoary Cress	D	D	C	C	D	D	D	D	D	D	D	D	D	D
Leafy spurge	I	I	D	D	I	D	D	D	D	D	D	D	D	D

Mediter-ranean Sage	I	U	U	U	U	U	U	U	U	U	U	U	U	U
Medusa-head	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Musk thistle	I	I	I	D	I	D	D	D	D	D	U	D	U	U
Orange Hawkweed	C	C	D	D	C	C	C	C	C	C	C	C	C	C
Oxeye Daisy	D	D	D	D	D	U	U	U	U	U	U	D	U	U
Purple Loose-strife	C	C	D	D	C	C	C	C	C	C	C	C	C	C
Rush Skeleton-weed	D	D	D	C	D	U	U	U	U	U	D	D	U	U
Russian knapweed	D	D	D	D	D	U	U	U	U	U	U	D	U	U
Scotch thistle	D	D	D	C	D	U	U	U	U	U	D	D	U	U
Spotted knapweed	I	I	D	I	I	D	D	D	D	D	U	D	U	U
Squarrose Knapweed	D	D	D	C	D	D	D	D	D	D	D	I	D	D

Sulfur Cinquefoil	I	I	I	I	I	D	D	D	D	D	U	D	U	U
Yellow Hawkweed	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Yellow starthistle	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Yellow toadflax	D	D	D	D	D	D	D	D	D	D	D	D	U	U

Table SUSCEPTIBILITY (continued).

	Low Sage Mesic With Juniper		Low Sage Xeric		Low Sage Xeric with Juniper		Wyoming Big Sage Warm		Wyoming Big Sage Cool		Salt Desert Shrub		Threetip Sage	
Weed Species	SRM 406	SRM 412	SRM 106	SRM 407	SRM 407	SRM 412	SRM 403	SRM 614	SRM 314	SRM 403	SRM 414	SRM 614	SRM 324	SRM 404
Bull Thistle	D	D	D	D	D	D	D	D	D	D	U	D	D	D
Canada thistle	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Common Crupina	C	C	C	C	C	C	C	D	C	C	C	D	C	C
Dalmatian toadflax	D	D	D	D	D	D	D	D	D	D	C	D	D	D
Diffuse knapweed	D	D	D	D	D	D	D	D	D	D	C	D	D	D
Cheatgrass	D	D	I	D	D	D	D	D	I	D	D	D	D	D
Dyers woad	I	D	I	I	I	D	I	I	I	I	C	I	I	I
Halogeton	D	D	D	D	D	D	D	D	D	D	I	D	D	D
Hoary Cress	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Leafy spurge	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Mediterra-nean Sage	U	U	U	U	U	U	I	U	U	I	U	U	U	U
Medusahead	D	D	D	D	D	D	D	D	D	D	C	D	D	D

Musk thistle	U	D	U	U	U	D	U	D	D	U	D	D	D	D
Orange Hawkweed	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Oxeye Daisy	U	U	U	U	U	U	U	D	U	U	C	D	U	U
Purple Loosestrife	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Rush Skeleton-weed	U	U	U	U	U	U	D	D	D	D	C	D	D	D
Russian knapweed	U	U	D	U	U	U	U	D	D	U	D	D	U	U
Scotch thistle	U	U	U	U	U	U	D	D	D	D	C	D	D	D
Spotted knapweed	U	D	D	U	U	D	U	D	D	U	C	D	D	U
Squarrose Knapweed	D	D	D	D	D	D	D	I	D	D	D	I	D	D
Sulfur Cinquefoil	U	U	U	U	U	U	U	D	D	U	C	D	D	U
Yellow Hawkweed	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Yellow starthistle	D	D	D	D	D	D	D	D	D	D	C	D	D	D
Yellow toadflax	U	U	U	U	U	U	D	D	D	D	C	D	D	D

Table SUSCEPTIBILITY (continued).

	Mountain Big Sage Mesic East--Mountain Big Sage Mesic East with Conifer			Mountain Big Sage Mesic West	Mountain Big Sage Mesic West with Juniper		Mountain Shrub			Cottonwood Riverine	Aspen	Mountain Mahogany
Weed Species	SRM 314	SRM 315	SRM 316	SRM 402	SRM 402	SRM 412	SRM 419	SRM 420	SRM 421	SRM 422	SRM 411	SRM 415
Bull Thistle	D	D	D	D	D	D	D	D	D	I	D	D
Canada thistle	D	D	D	D	D	D	D	D	D	I	I	D
Common Crupina	C	C	C	C	C	C	D	D	D	D	C	D
Dalmatian toadflax	D	D	D	D	D	D	D	D	D	D	D	I
Diffuse knapweed	D	D	D	D	D	D	D	D	D	D	D	D
Cheatgrass	I	I	I	I	I	D	D	D	D	D	D	D
Dyers woad	I	I	I	I	I	D	I	I	I	D	D	D
Halogeton	D	D	D	D	D	D	D	D	D	C	D	D
Hoary Cress	D	D	D	D	D	D	D	D	D	D	D	D
Leafy spurge	D	D	D	D	D	D	D	D	D	I	D	D

Mediterra-nean Sage	U	U	U	U	U	U	U	U	U	U	U	I
Medusahead	D	D	D	D	D	D	D	D	D	D	D	D
Musk thistle	D	D	D	D	D	D	D	D	D	I	D	D
Orange Hawkweed	C	C	C	C	C	C	D	D	D	D	D	C
Oxeye Daisy	U	U	U	U	U	U	D	D	D	D	D	U
Purple Loosestrife	C	C	C	C	C	C	D	D	D	I	C	C
Rush Skeleton-weed	D	D	D	D	D	U	D	D	D	C	D	U
Russian knapweed	D	U	U	D	D	U	D	D	D	D	D	D
Scotch thistle	D	D	D	D	D	U	D	D	D	D	U	U
Spotted knapweed	D	D	D	D	D	D	D	D	D	I	D	D
Squarrose Knapweed	D	D	D	D	D	D	D	D	D	D	D	D
Sulfur Cinquefoil	D	D	D	D	D	U	D	D	D	D	D	D
Yellow Hawkweed	C	C	C	C	C	C	D	D	D	D	D	C

Yellow starthistle	D	D	D	D	D	D	D	D	D	D	D	I
Yellow toadflax	D	D	D	D	D	U	D	D	D	D	D	D

Table SUSCEPTIBILITY (continued).

	Mountain Mahogany with Mountain Big Sagebrush	Juniper		Salix-Carex	Saltbrush Riparian	Mountain Riparian Low Shrub	Riparian Graminoid			Riparian Sedge	Alpine Shrub-Herbaceous
Weed Species	SRM 322	SRM 107	SRM 412	SRM 422	SRM 422	SRM 422	SRM 308	SRM 313	SRM 422	SRM 422	SRM 410
Bull Thistle	D	D	D	I	I	I	D	D	I	I	D
Canada thistle	D	D	D	I	I	I	I	I	I	I	D
Common Crupina	D	C	C	D	D	D	C	C	D	D	C
Dalmatian toadflax	D	D	D	D	D	D	D	D	D	D	D
Diffuse knapweed	D	D	D	D	D	D	D	D	D	D	C
Cheatgrass	D	D	D	D	D	D	D	D	D	D	C
Dyers woad	D	D	D	D	D	D	C	C	D	D	C
Halogeton	D	D	D	C	C	C	C	C	C	C	C
Hoary Cress	D	D	D	D	D	D	C	D	D	D	C

Leafy spurge	D	D	D	I	I	I	D	D	I	I	C
Mediterra-nean Sage	U	U	U	U	U	U	U	U	U	U	U
Medusahead	D	D	D	D	D	D	D	D	D	D	C
Musk thistle	D	D	D	I	I	I	D	D	I	I	C
Orange Hawkweed	C	C	C	D	D	D	D	I	D	D	D
Oxeye Daisy	U	U	U	D	D	D	D	D	D	D	C
Purple Loosestrife	C	C	C	I	I	I	D	D	I	I	C
Rush Skeleton-weed	U	D	U	C	C	C	C	C	C	C	C
Russian knapweed	D	U	U	D	D	D	D	D	D	D	C
Scotch thistle	U	U	U	D	D	D	C	C	D	D	C
Spotted knapweed	D	D	D	I	I	I	I	I	I	I	D
Squarrose Knapweed	D	D	D	D	D	D	C	C	D	D	C
Sulfur Cinquefoil	D	U	U	D	D	D	I	I	D	D	C
Yellow Hawkweed	C	C	C	D	D	D	C	C	D	D	C

Yellow starthistle	D	D	D	D	D	D	D	D	D	D	C
Yellow toadflax	D	D	U	D	D	D	D	D	D	D	C

[a] Source: U.S. Department of the Interior-Bureau of Land Management (1985).

[b] Cells of the table were coded for susceptibility to invasion. Codes and definitions are (1) I=Invasive -- Weed species invades successfully and becomes dominant or codominant even in the absence of intense or frequent disturbance. Equates to the HIGH susceptibility to invasion category, (2) D=Disturbed -- Weed species invades successfully because high intensity or frequency of disturbance impacts the soil surface or removes the normal canopy cover. Equates to the MODERATE susceptibility to invasion category, (3) C=Closed -- Weed species does not invade because cover type does not provide suitable habitat, and (4) U=Unknown -- Distribution data for the species were not sufficient to permit a decision, or ecological requirements of the species have not been defined. Also, the cover type might be poorly defined or else it covers a rather small geographic portion of the Basin, that restricts the probability of obtaining records of the species collected within it. Categories 3 and 4 equate to the LOW susceptibility to invasion category.

[c] Hoary cress includes plants labeled as *Cardaria draba*, *C. chalapensis*, and *C. pubescens*.

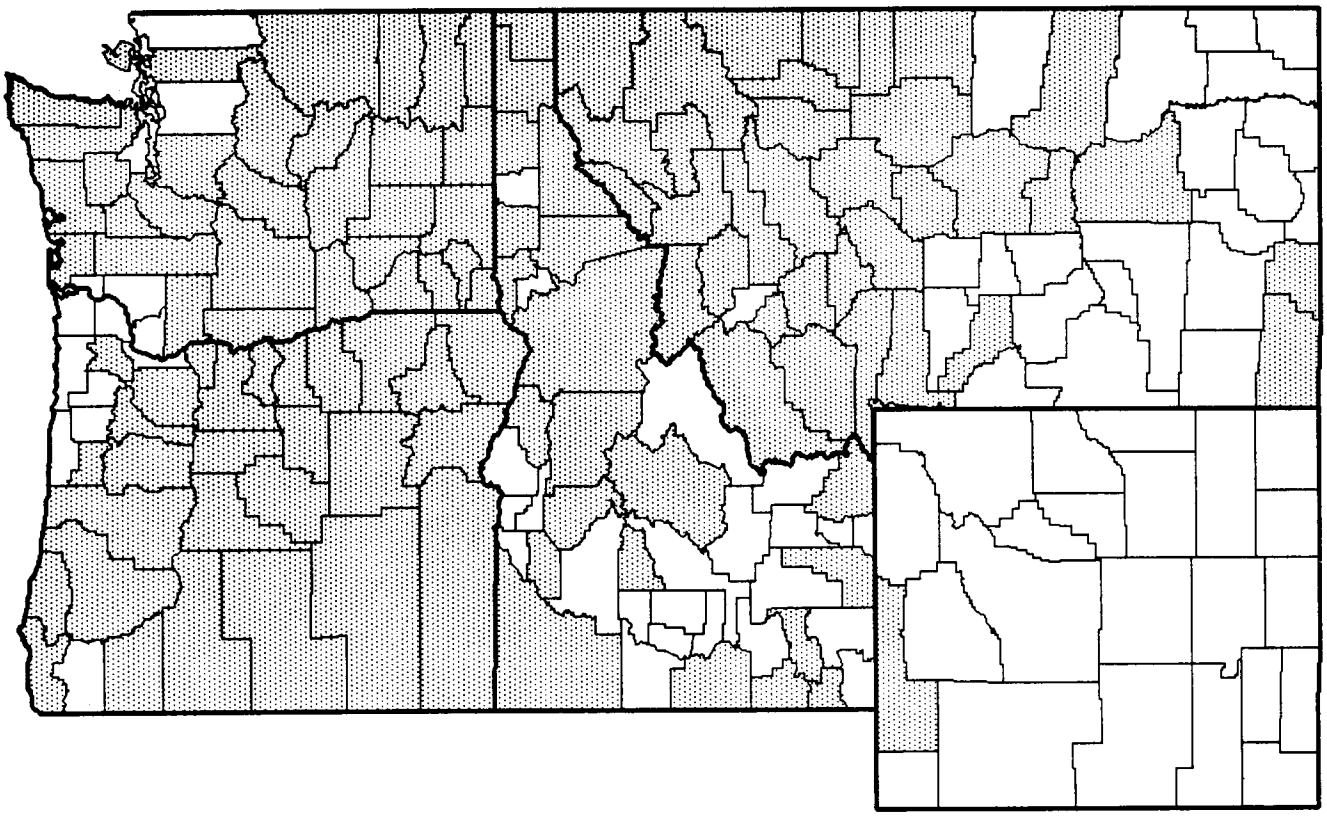
Table COVERTYPE. Description of SRM rangeland cover types utilized in Table SUSCEPTIBILITY to characterize susceptibility of rangeland vegetation to noxious weed invasion. A more complete description can be found in Shiflet (1994).

SRM Number	Title and Short Description
101	Bluebunch Wheatgrass--Associated major species include Sandberg bluegrass and cheatgrass.
102	Idaho Fescue--Associated major species include bluebunch wheatgrass.
104	Antelope Bitterbrush-Bluebunch Wheatgrass--Associated major species include arrowleaf balsamroot, Sandberg bluegrass, prairie junegrass, and cheatgrass.
105	Antelope Bitterbrush-Idaho Fescue--Associated major species include bluebunch wheatgrass, Sandberg bluegrass, prairie junegrass, needlegrass, bottlebrush squirreltail, arrowleaf balsamroot.
106	Bluegrass Scabland--Major species include Sandberg bluegrass, one spike oatgrass, bighead clover, and biscuitroots.
107	Western Juniper-Big Sagebrush-Bluebunch Wheatgrass--Associated major species include rabbitbrushes, antelope bitterbrush, Idaho fescue, cheatgrass, western yarrow, and milkvetch.
108	Alpine Idaho Fescue--Associated major species include sedges and bluebunch wheatgrass.
302	Bluebunch Wheatgrass-Sandberg Bluegrass--Associated major species include prairie junegrass and arrowleaf balsamroot.
304	Idaho Fescue-Bluebunch Wheatgrass--Associated major species include prairie junegrass, Sandberg bluegrass, and needlegrasses.
306	Idaho Fescue-Slender Wheatgrass--Associated major species include Columbia needlegrass, timber oatgrass, sedges, avena, slender cinquefoil, pale agoseris, and harebell.
307	Idaho Fescue-Threadleaf Sedge--Associated major species include prairie smoke, gentian, slender wheatgrass, sedges, pale agoseris, and cinquefoils.
308	Idaho Fescue-Tufted Hairgrass--Associated major species include slender wheatgrass, alpine timothy, American bistort, and cinquefoil.
311	Rough Fescue-Bluebunch Wheatgrass--Associated major species include Idaho fescue, arrowleaf balsamroot, kittentail, and Indian paintbrush.

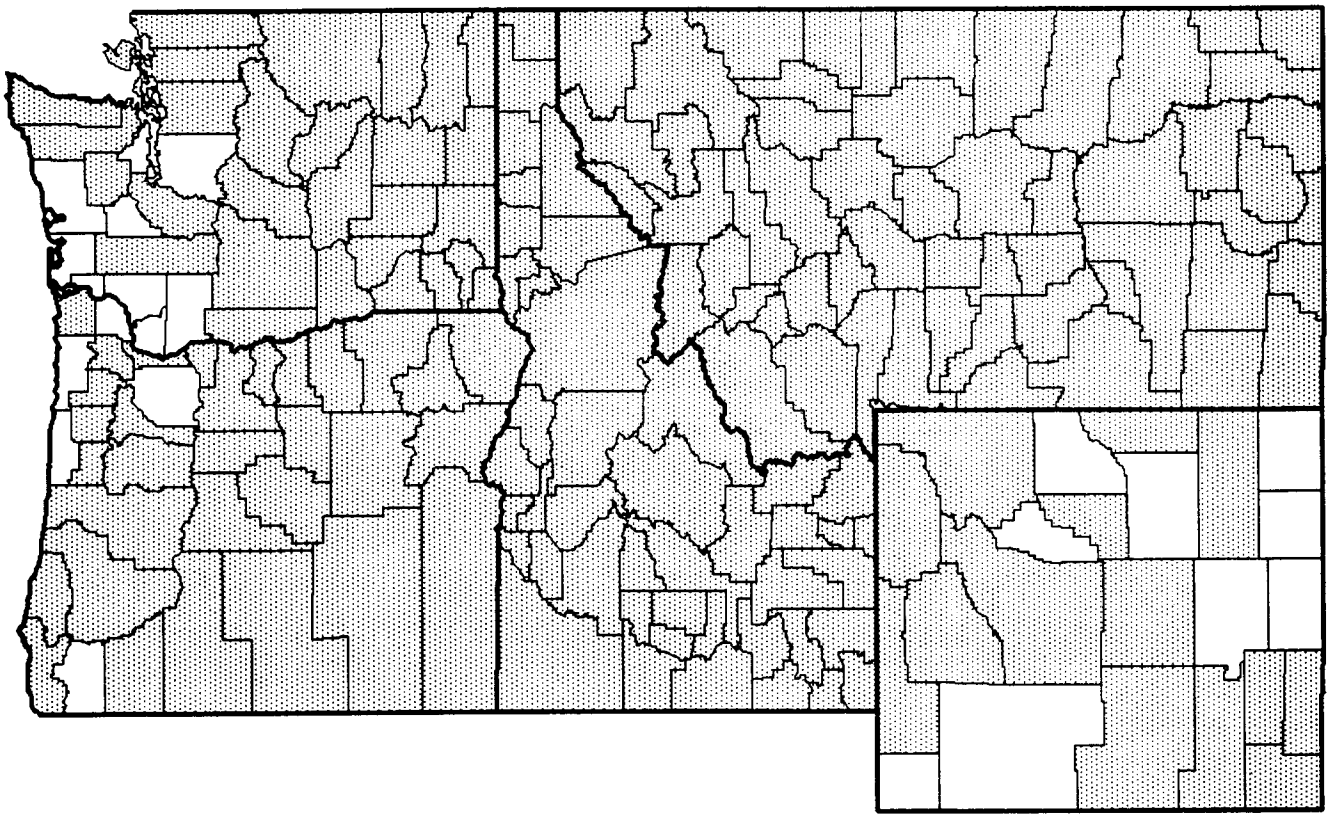
312	Rough Fescue-Idaho Fescue-- Associated major species include timber danthonia, western needlegrass, prairie smoke, and northern bedstraw.
313	Tufted Hairgrass-Sedge--Associated major species include timber danthonia, alpine timothy, bentgrasses, and rushes.
314	Big Sagebrush-Bluebunch Wheatgrass--Includes the 3 big sagebrush subspecies (Wyoming, mountain, and basin big).
315	Big Sagebrush-Idaho Fescue--Includes mainly the mountain and Wyoming big sagebrush subspecies. Associated major species include bluebunch wheatgrass, prairie junegrass, prairie smoke, and rabbitbrushes.
316	Big Sagebrush-Rough Fescue--Associated major species include bluebunch wheatgrass and Idaho fescue.
317	Bitterbrush-Bluebunch Wheatgrass--Associated major species include rabbitbrushes, prairie junegrass, Sandberg bluegrass, needle-and-thread, cheatgrass, and arrowleaf balsamroot.
318	Bitterbrush-Idaho Fescue--Associated major species include bluebunch wheatgrass, prairie junegrass, Sandberg bluegrass, ballhead sandwort, and Hood phlox.
319	Bitterbrush-Rough Fescue--Associated major species include bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, prairie junegrass, cheatgrass, and arrowleaf balsamroot.
322	Curlleaf Mountain Mahogany-Bluebunch Wheatgrass--Associated major species include needle-and-thread, Indian ricegrass, sagebrushes, rabbitbrushes, and junipers.
324	Threetip Sagebrush-Idaho Fescue--Associated major species include plains reedgrass, prairie junegrass, Hood phlox, green rabbitbrush, and gray horsebrush.
401	Basin Big Sagebrush--Associated major species include rabbitbrushes, bluebunch wheatgrass, Sandberg bluegrass, yarrow, and pale agoseris.
402	Mountain Big Sagebrush--Associated major species include antelope bitterbrush, green rabbitbrush, gray horsebrush, Idaho fescue, bluebunch wheatgrass, yarrow, and milkvetches.
403	Wyoming Big Sagebrush--Associated major species include green rabbitbrush, bluebunch wheatgrass, Sandberg bluegrass, and milkvetches.
404	Threetip Sagebrush--Associated major species include green rabbitbrush, gray horsebrush, Idaho fescue, bluebunch wheatgrass, pussytoes, and milkvetch.

405	Black Sagebrush--Associated major species include green rabbitbrush, winterfat, bluebunch wheatgrass, and Sandberg bluegrass.
406	Low Sagebrush--Associated major species include green rabbitbrush, bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, wild onion, and pussytoes.
407	Stiff Sagebrush--Associated major species include Sandberg bluegrass, biscuitroots, and wild onions.
410	Alpine Rangeland--Several plant communities can exist in this type. Most are dominated by low perennial sedges, grasses, and forbs.
411	Aspen Woodland--This type is dominated by an overstory of trembling aspen and numerous understory plant species can be associated depending on location.
412	Juniper-Pinyon Woodland--Representative juniper species include western, Utah, and Rocky Mountain juniper, depending on location.
414	Salt Desert Shrub--Associated major species include shadscale, black greasewood, winterfat, Indian ricegrass, saltgrass, and globemallow.
415	Curlleaf Mountain-Mahogany--This type most frequently exists in pure stands but can be found intermixed with ponderosa pine and juniper.
419	Bittercherry--This type is often found as isolated patches within the lower coniferous forest-upper sagebrush grassland types or in association with snowbrush or serviceberry.
420	Snowbrush
421	Chokecherry-Serviceberry-Rose--Associated major species include snowberry.
422	Riparian
614	Crested Wheatgrass

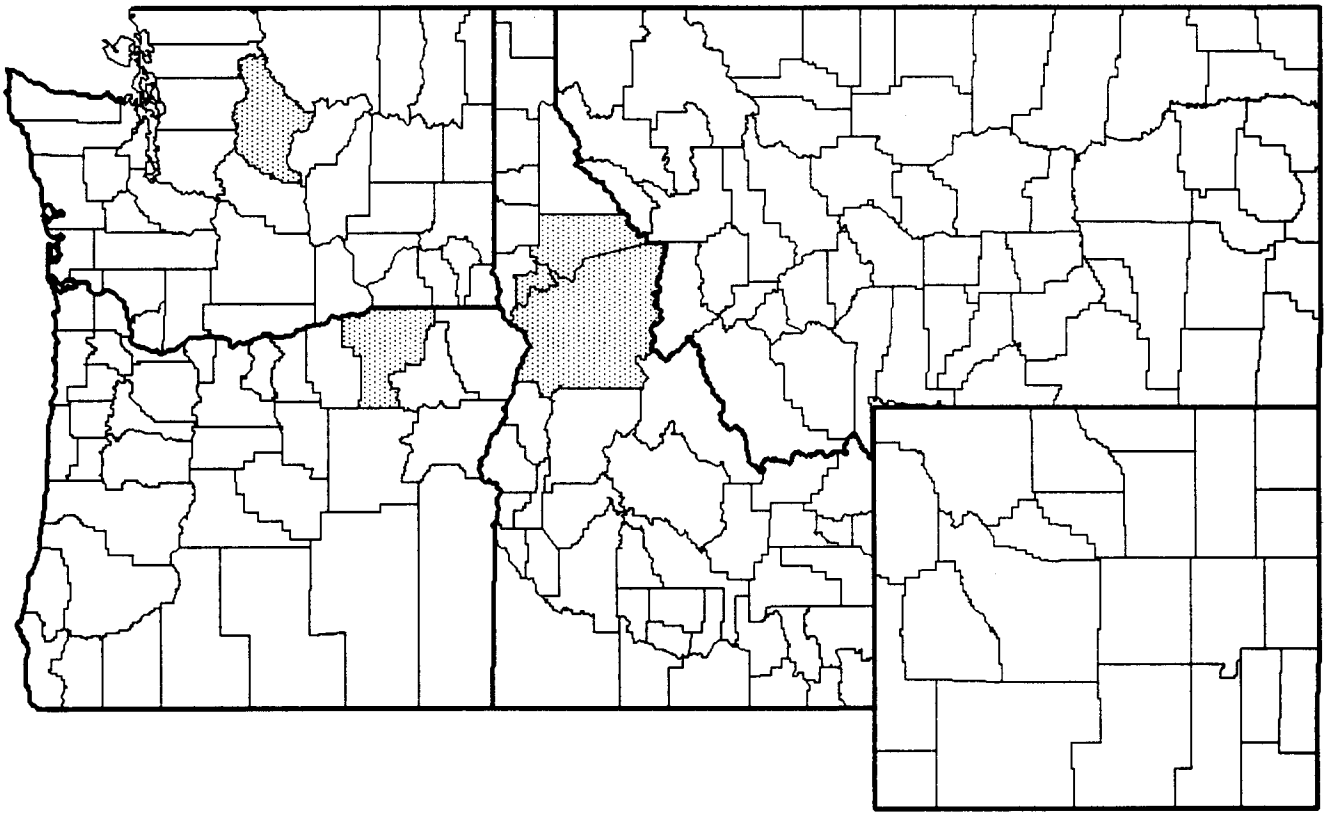
(REL 6.0) COUNTIES REPORTING CIRSIUM VULGARE (BULL THISTLE), 1875-1995.



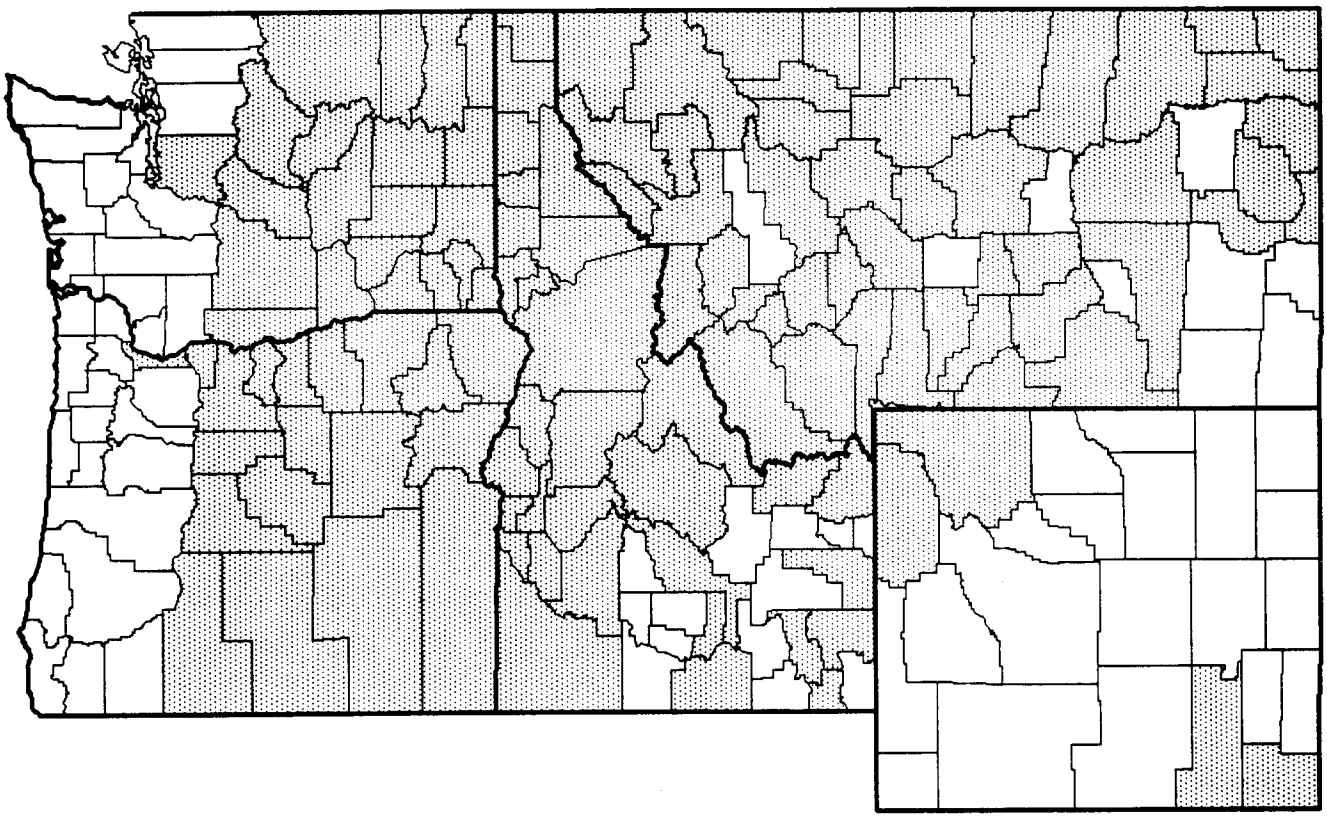
(REL 6.0) COUNTIES REPORTING CIRSIUM ARVENSE (CANADA THISTLE), 1875-1995.



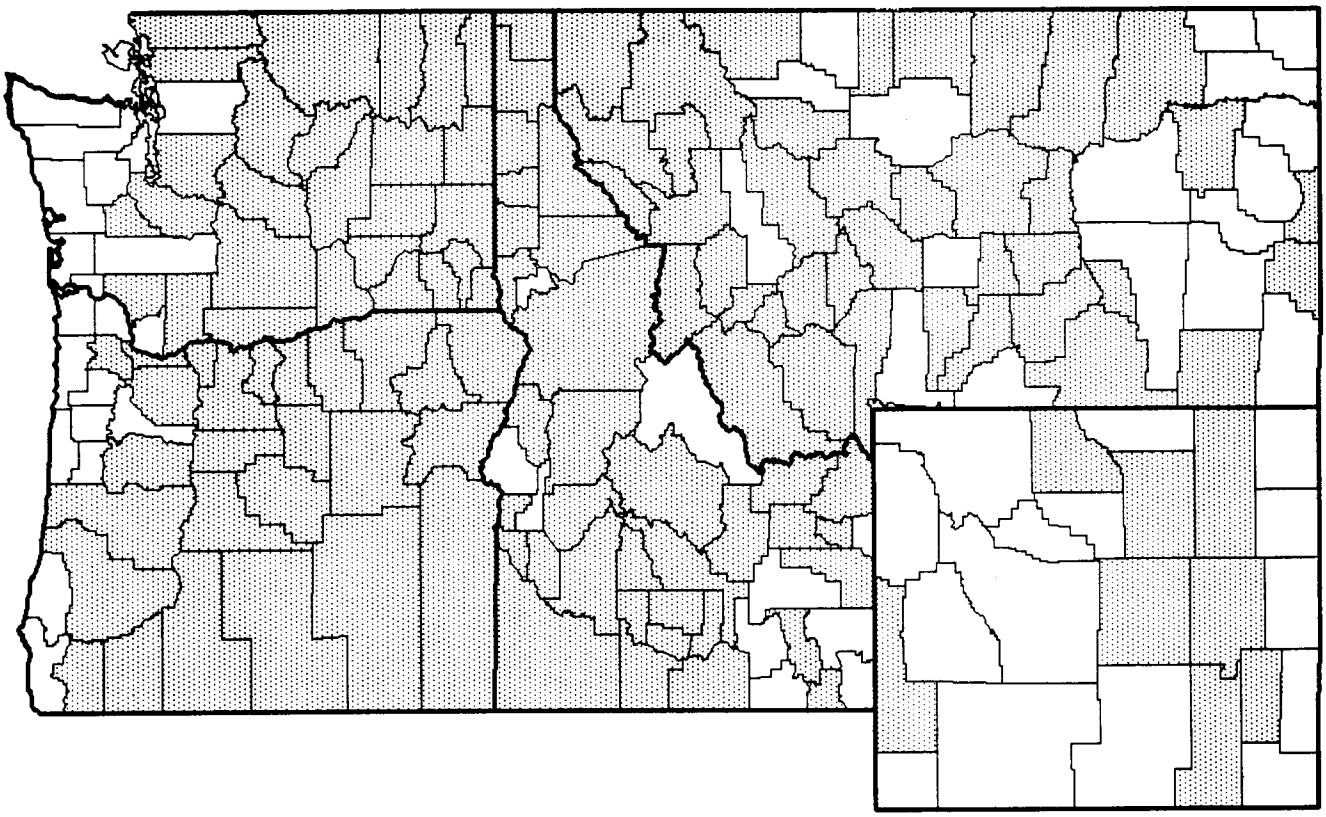
(REL 6.0) COUNTIES REPORTING CRUPINA VULGARIS (COMMON CRUPINA), 1875-1995.



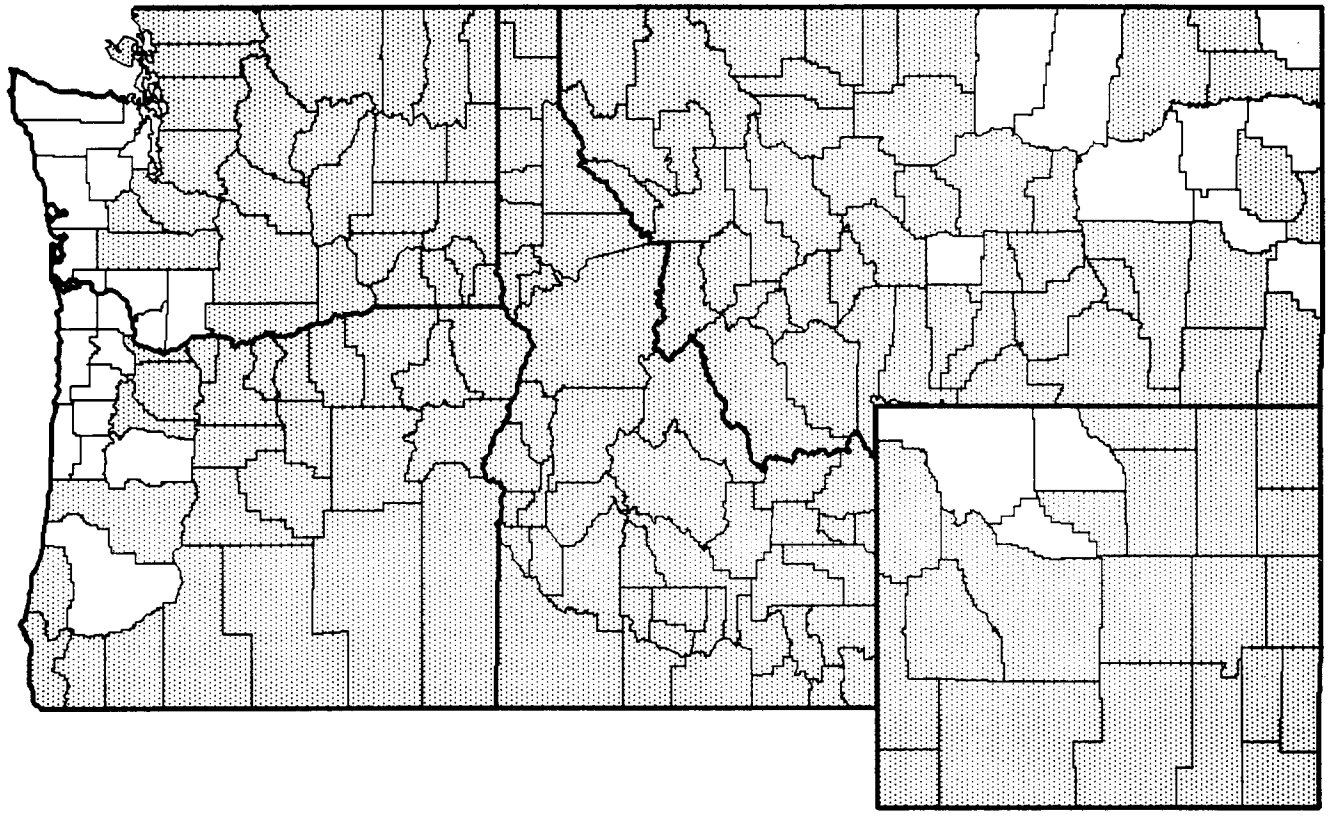
(REL 6.0) COUNTIES REPORTING LINARIA DALMATICA (DALMATIAN TOADFLAX), 1875-1995.



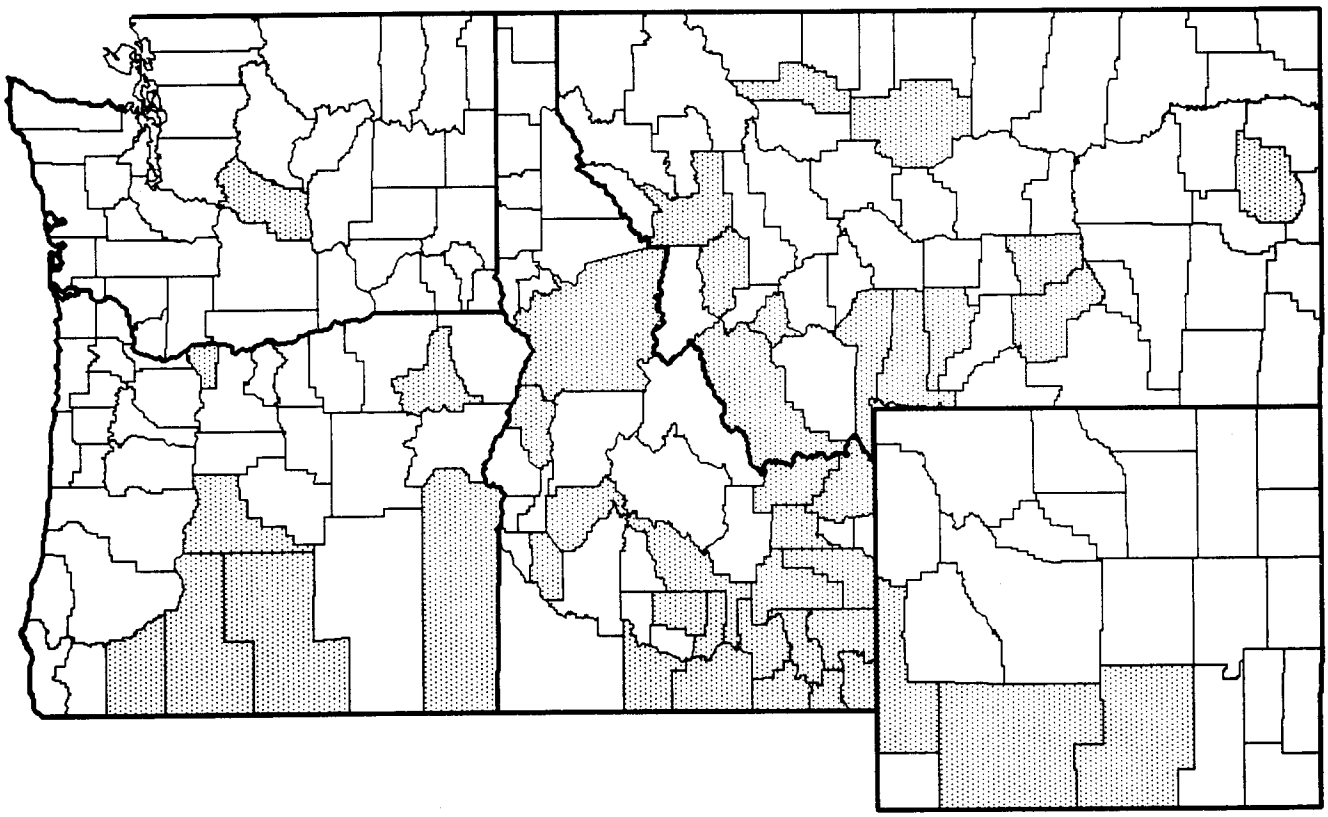
(NEL 6.0) COUNTIES REPORTING CENTAUREA DIFFUSA (DIFFUSE KNAPWEED), 1875-1995.



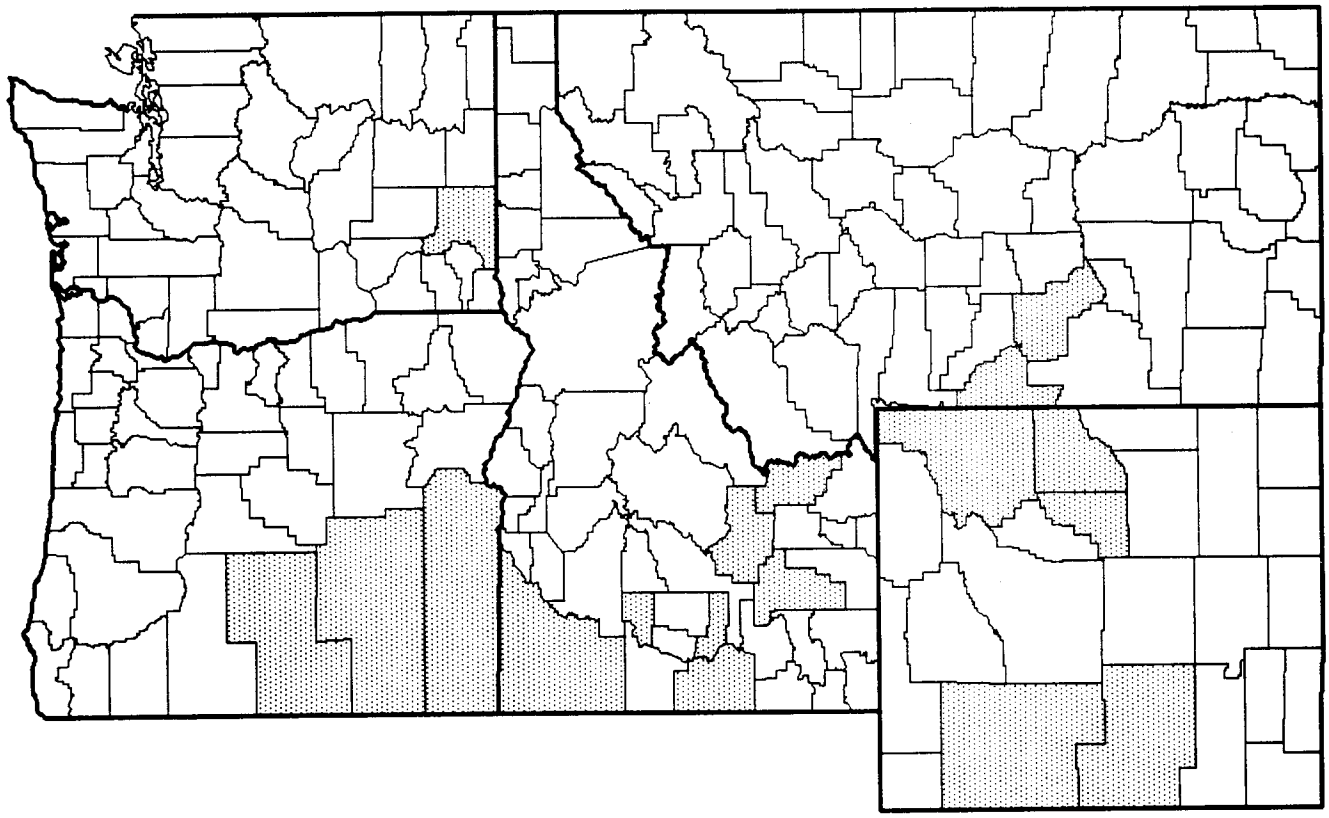
(REL 6.0) COUNTIES REPORTING BROMUS TECTORUM (DOWNY BROME), 1875-1995.



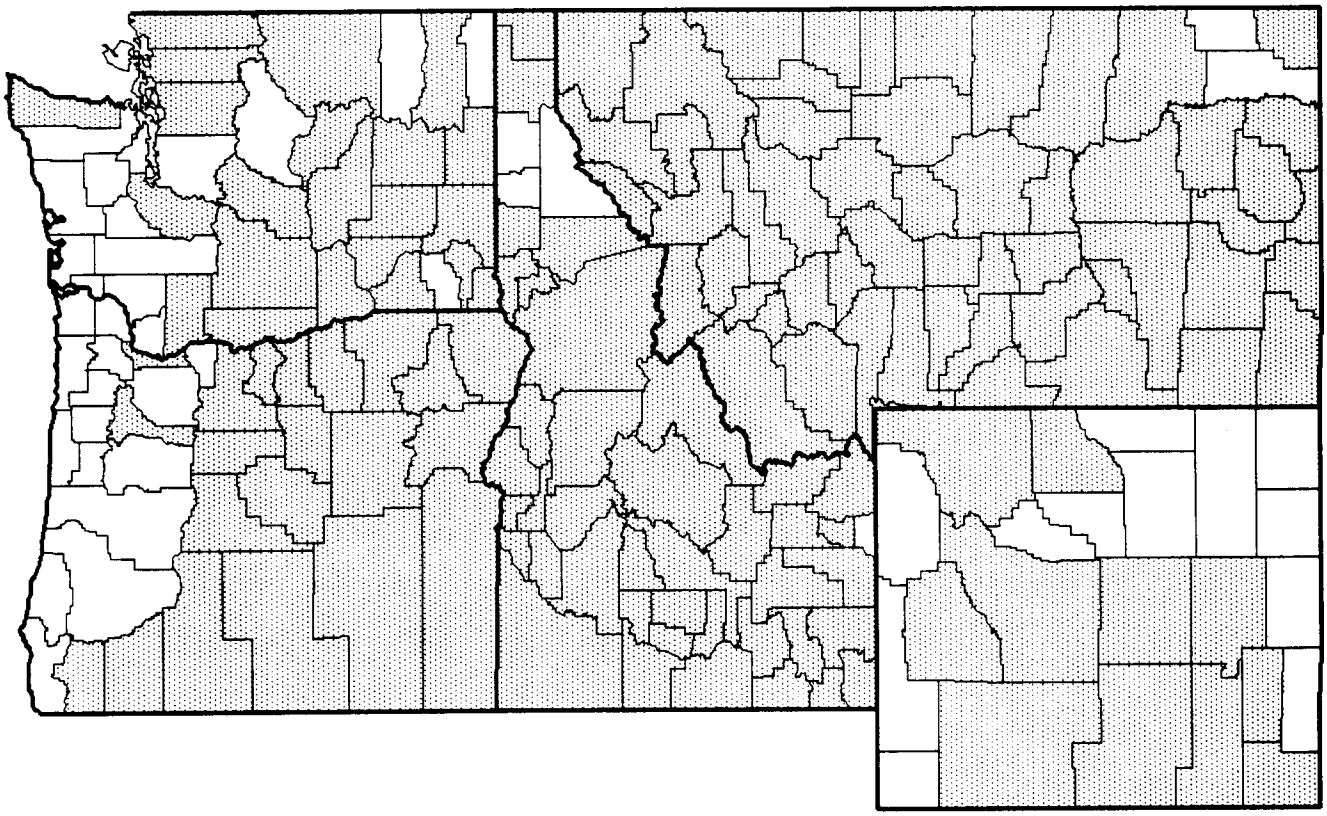
(REL 6.0) COUNTIES REPORTING ISATIS TINCTORIA (DYER'S WOAD), 1875-1995.



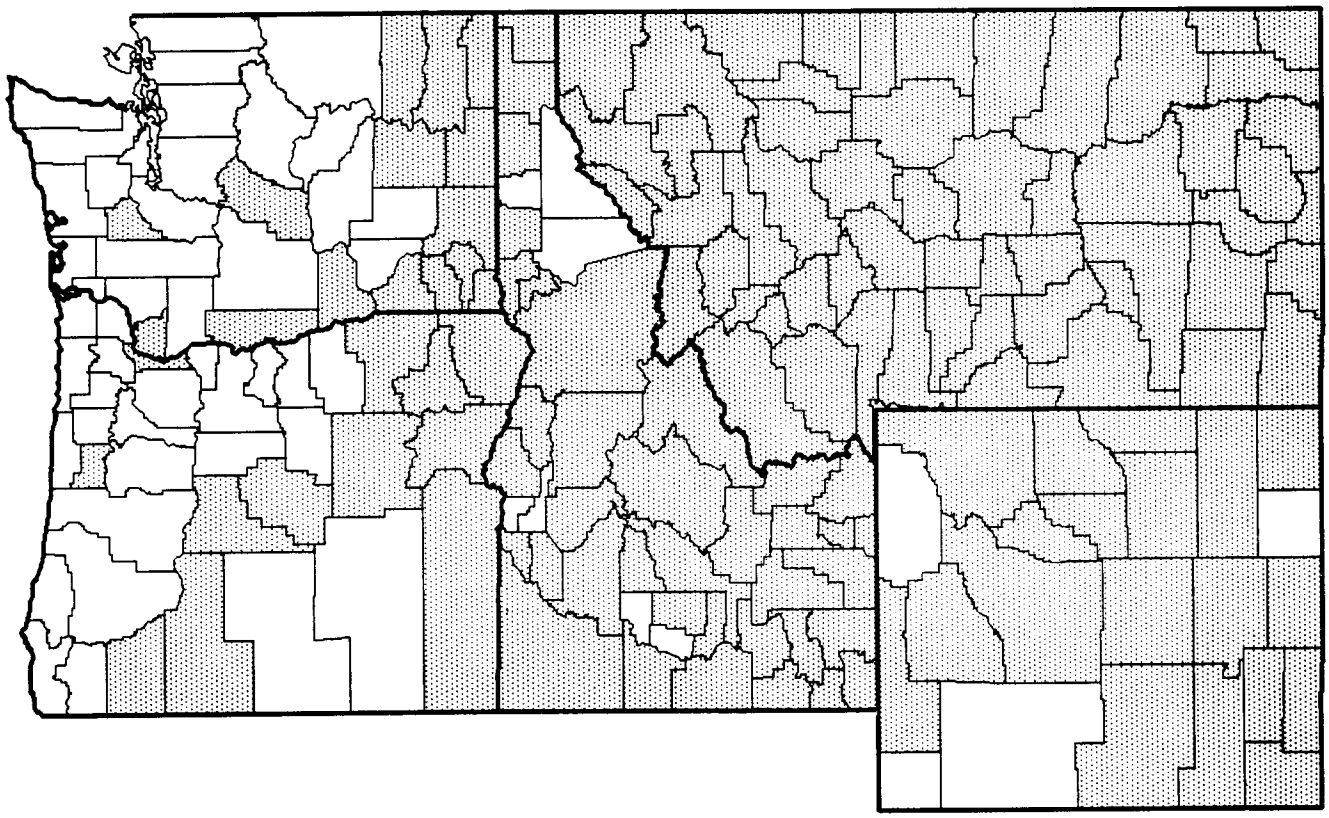
COUNTIES REPORTING HALOGETON GLOMERATUS (HALOGETON), 1875-1995.



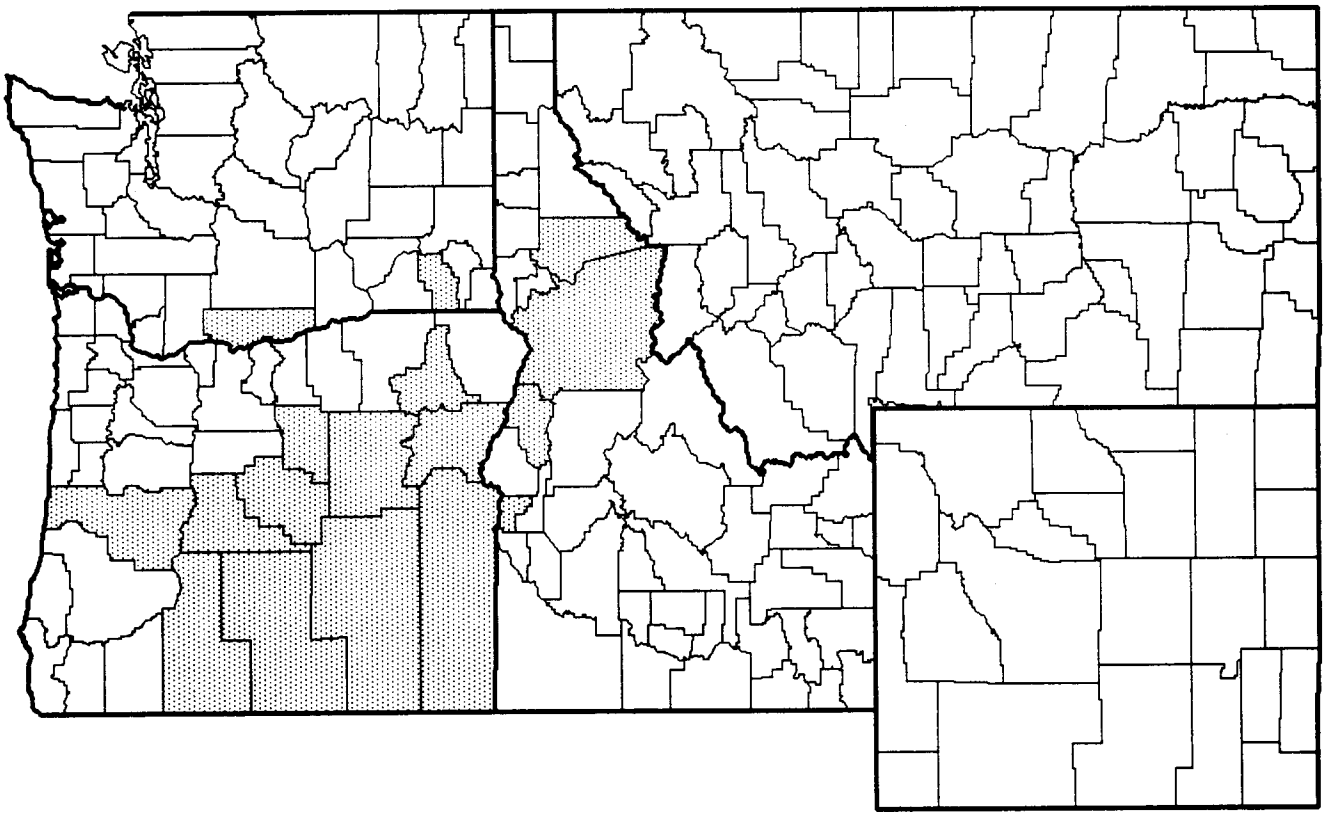
COUNTIES REPORTING CARDARIA SPP. (WHITETOP), 1875-1995.



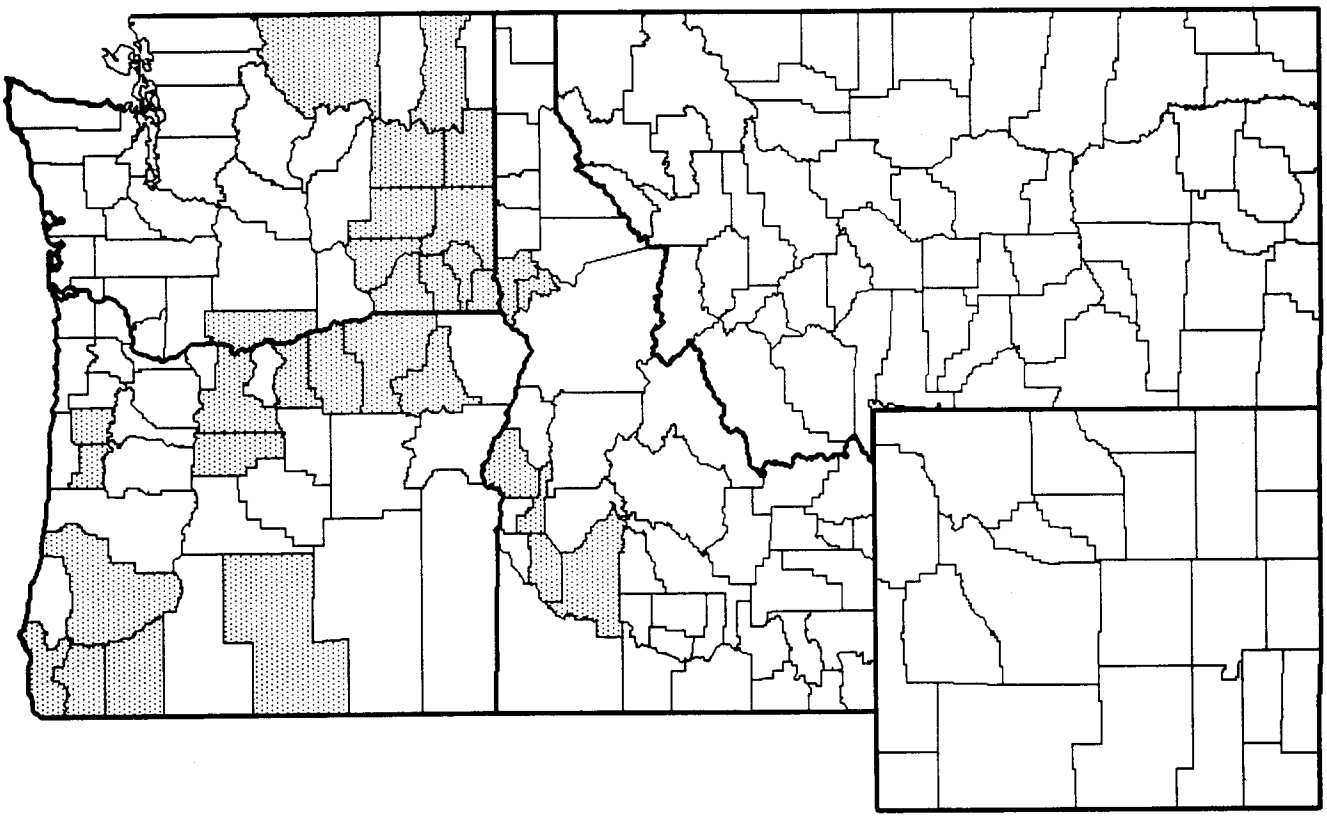
(REL 6.0) COUNTIES REPORTING EUPHORBIA ESULA (LEAFY SPURGE), 1875-1995.



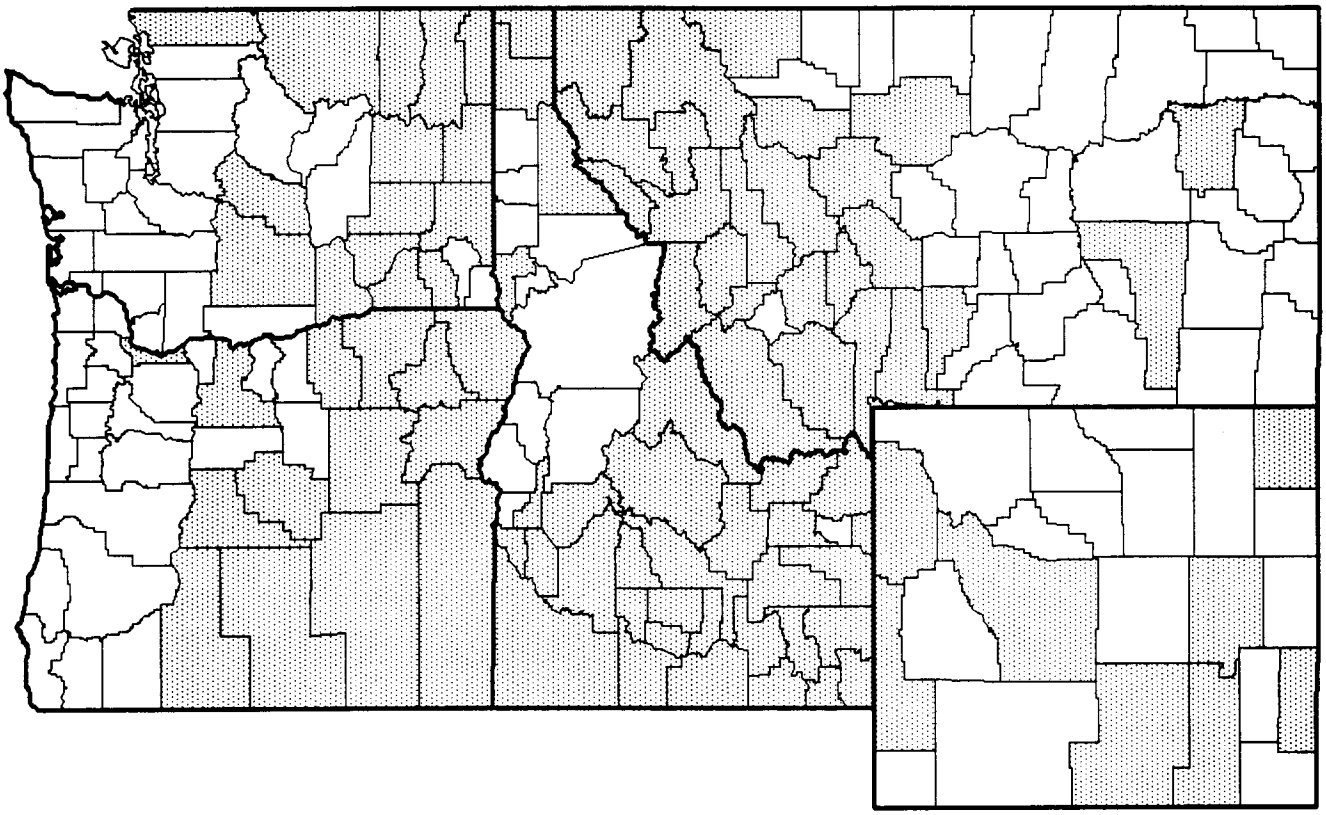
(REL 6.0) COUNTIES REPORTING SALVIA AETHIOPIS (MEDITERRANEAN SAGE), 1875-1995.



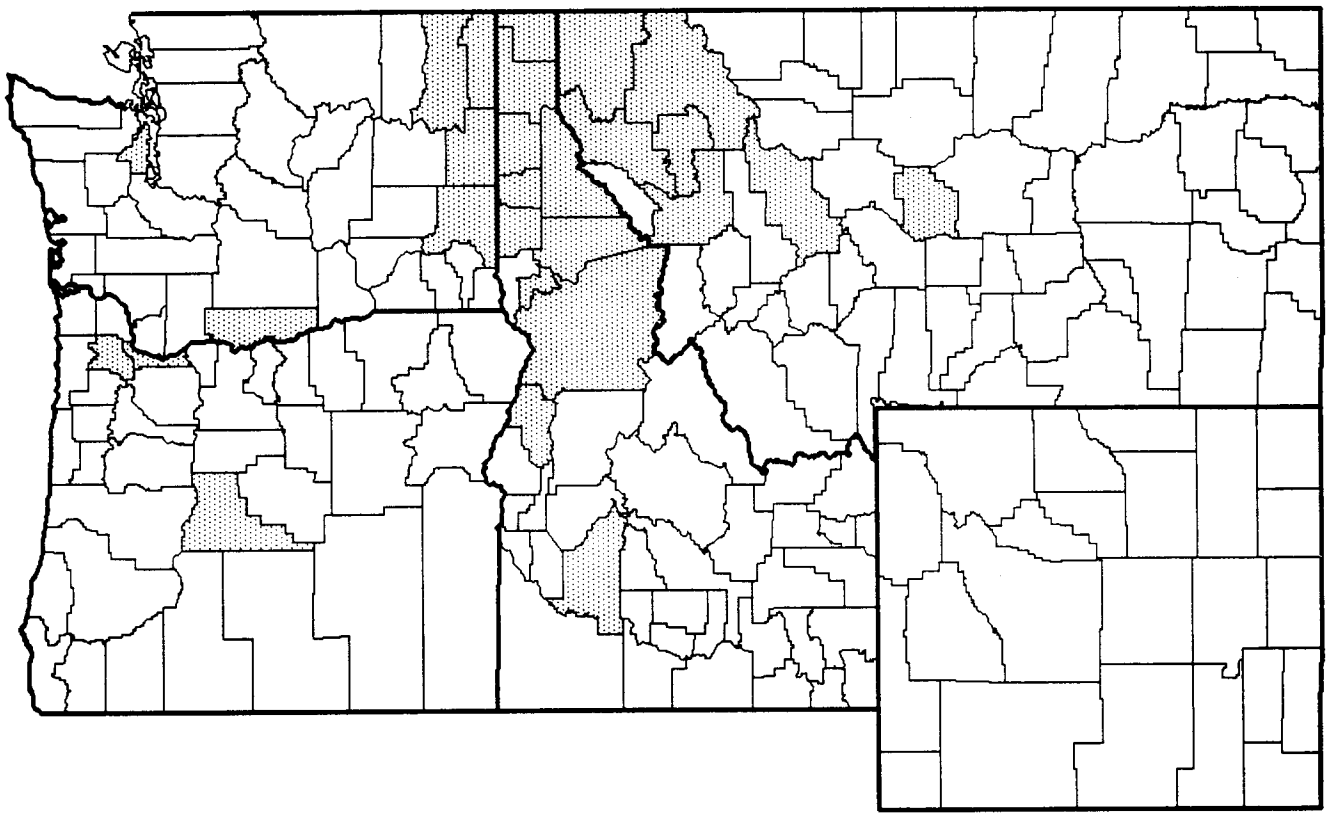
(REL 6.0) COUNTIES REPORTING ELYMUS CAPUT-MEDUSAE (MEDUSAHEAD), 1875-1995.



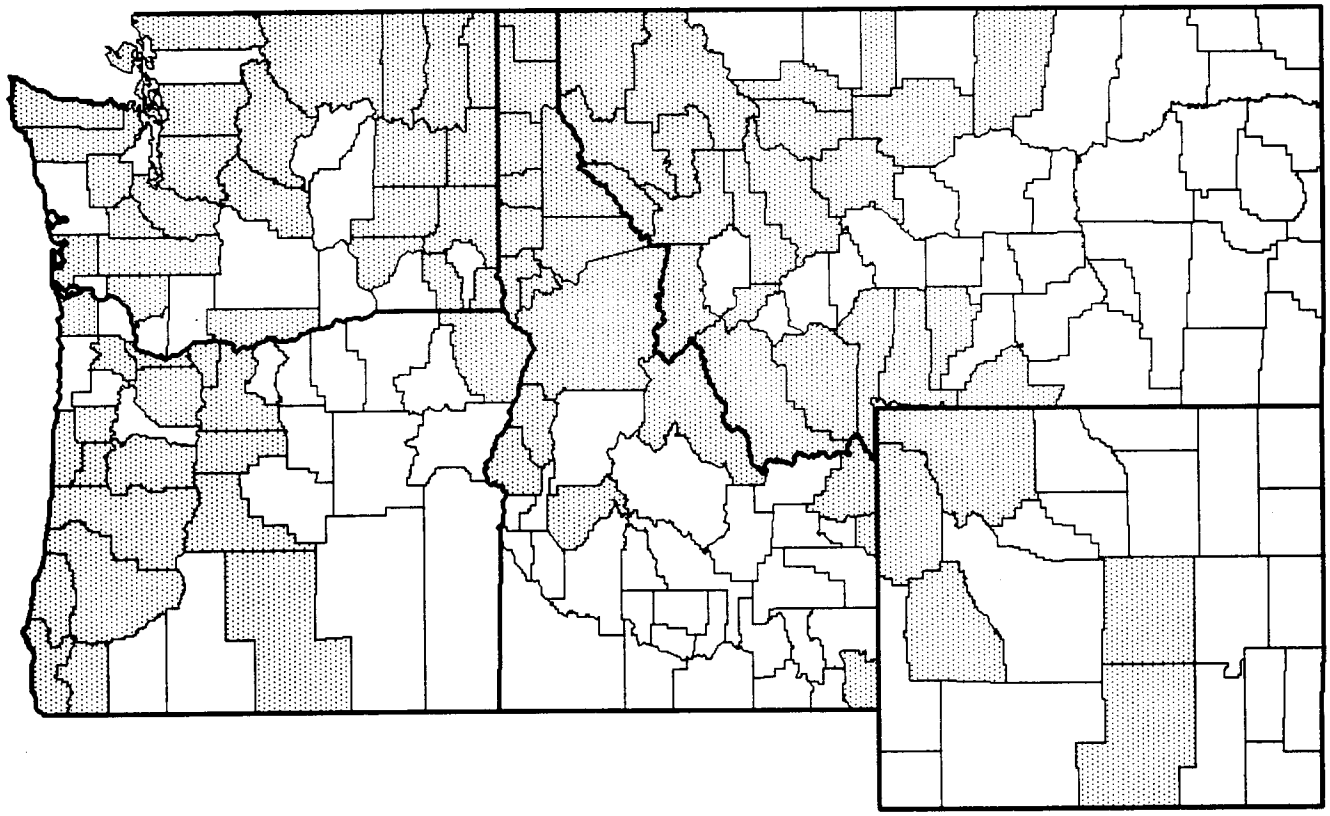
(REL 6.0) COUNTIES REPORTING CARDUUS NUTANS (MUSK THISTLE), 1875-1995.



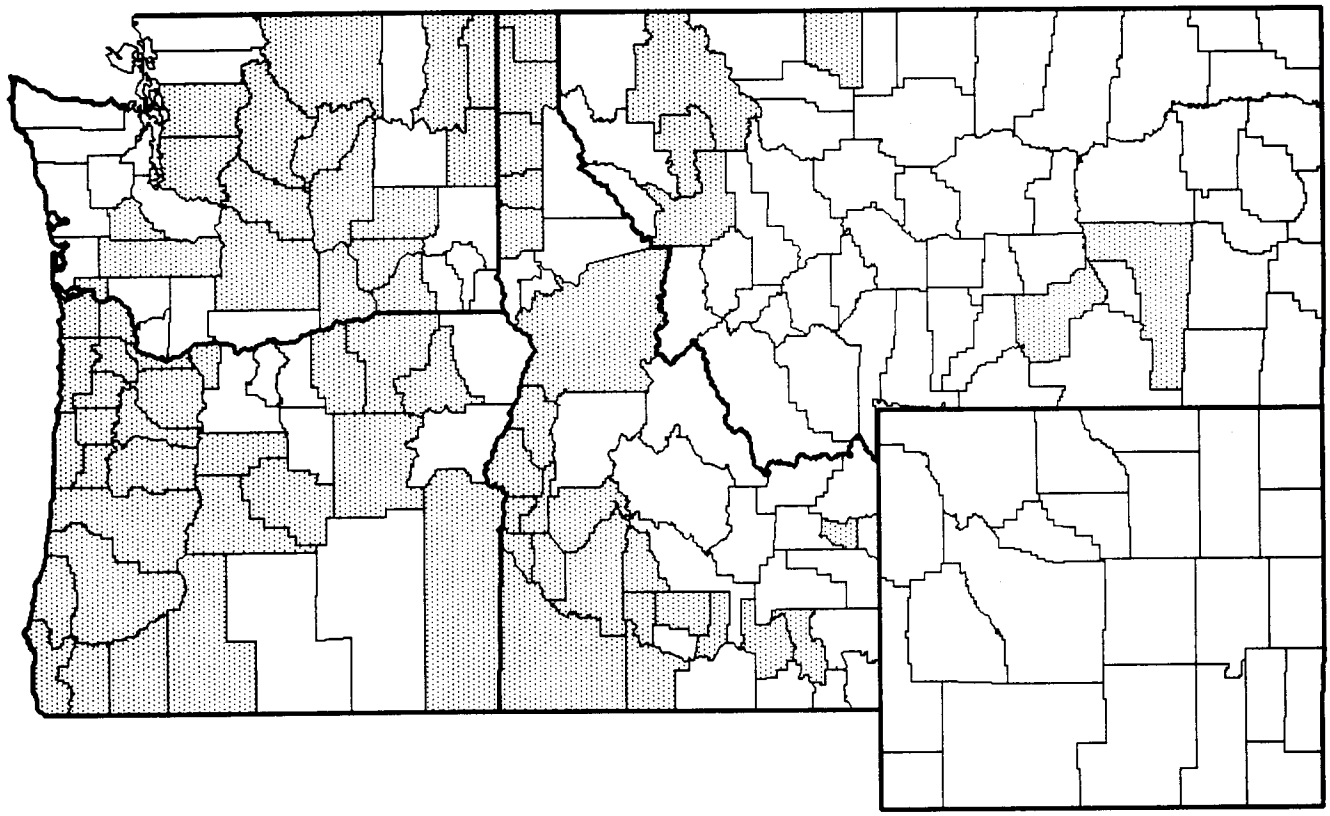
(REL 6.0) COUNTIES REPORTING HIERACIUM AURANTIACUM (ORANGE HAWKWEED), 1875-1995.



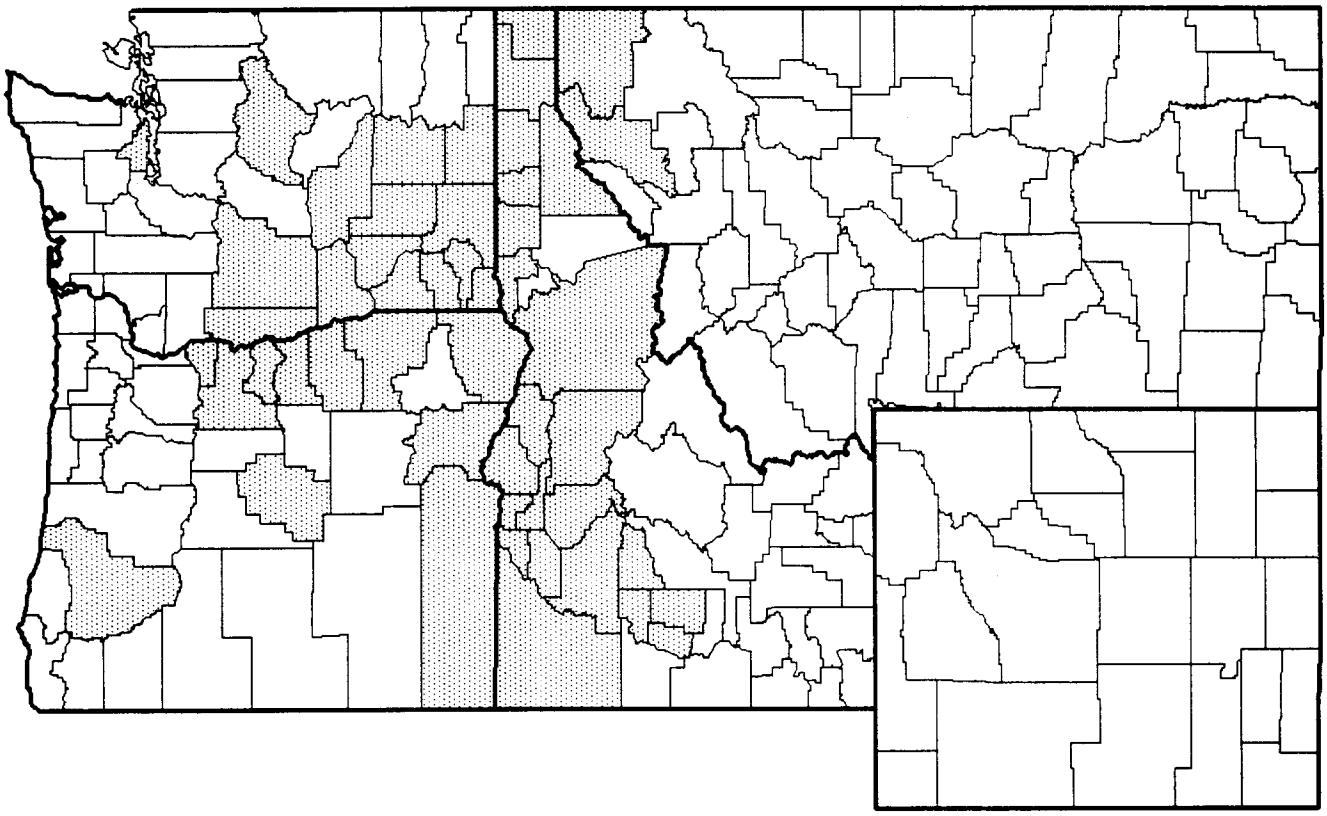
(REL 6.0) COUNTIES REPORTING CHRYSANTHEMUM LEUCANTHEMUM (OXEYE DAISY), 1875-1995.



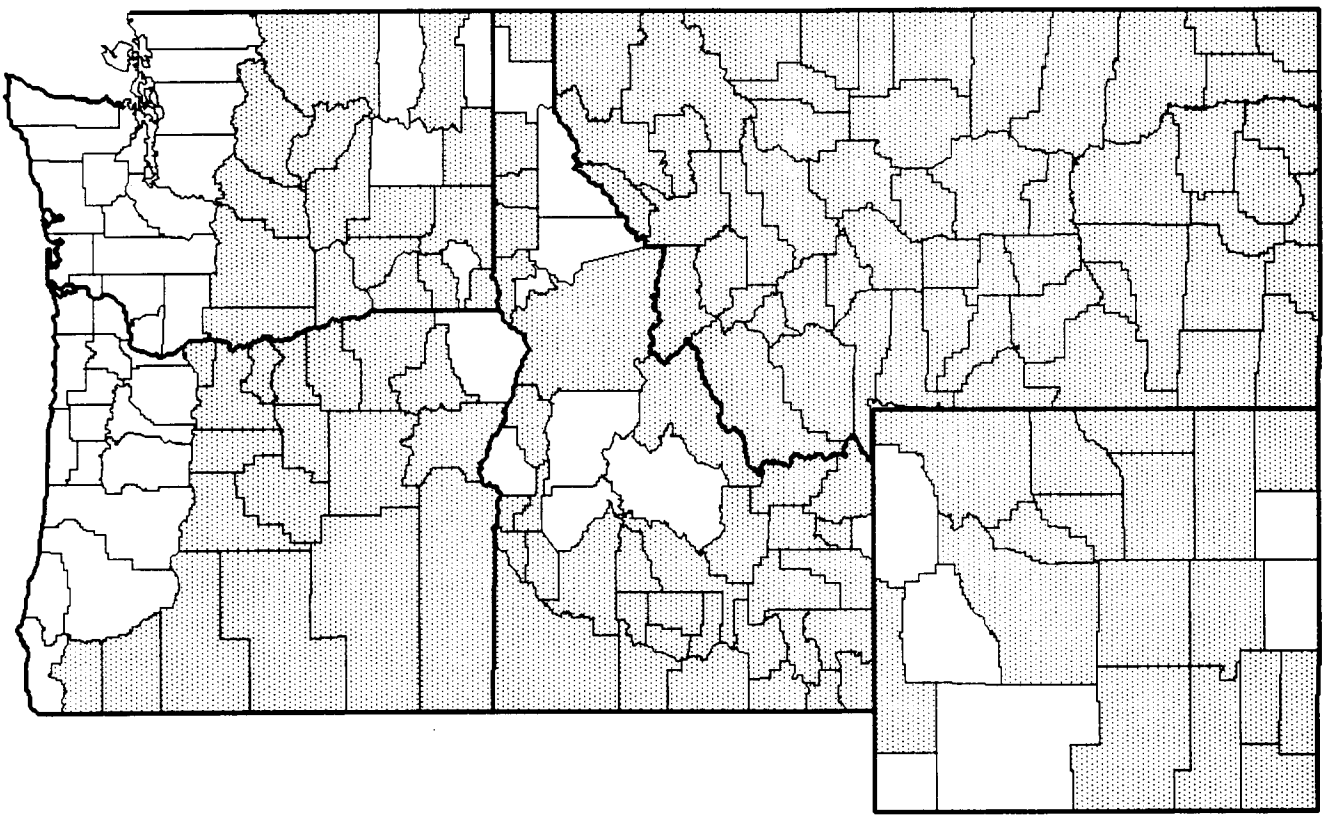
(REL 6.0) COUNTIES REPORTING LYTHRUM SALICARIA (PURPLE LOOSESTRIFE), 1875-1995.



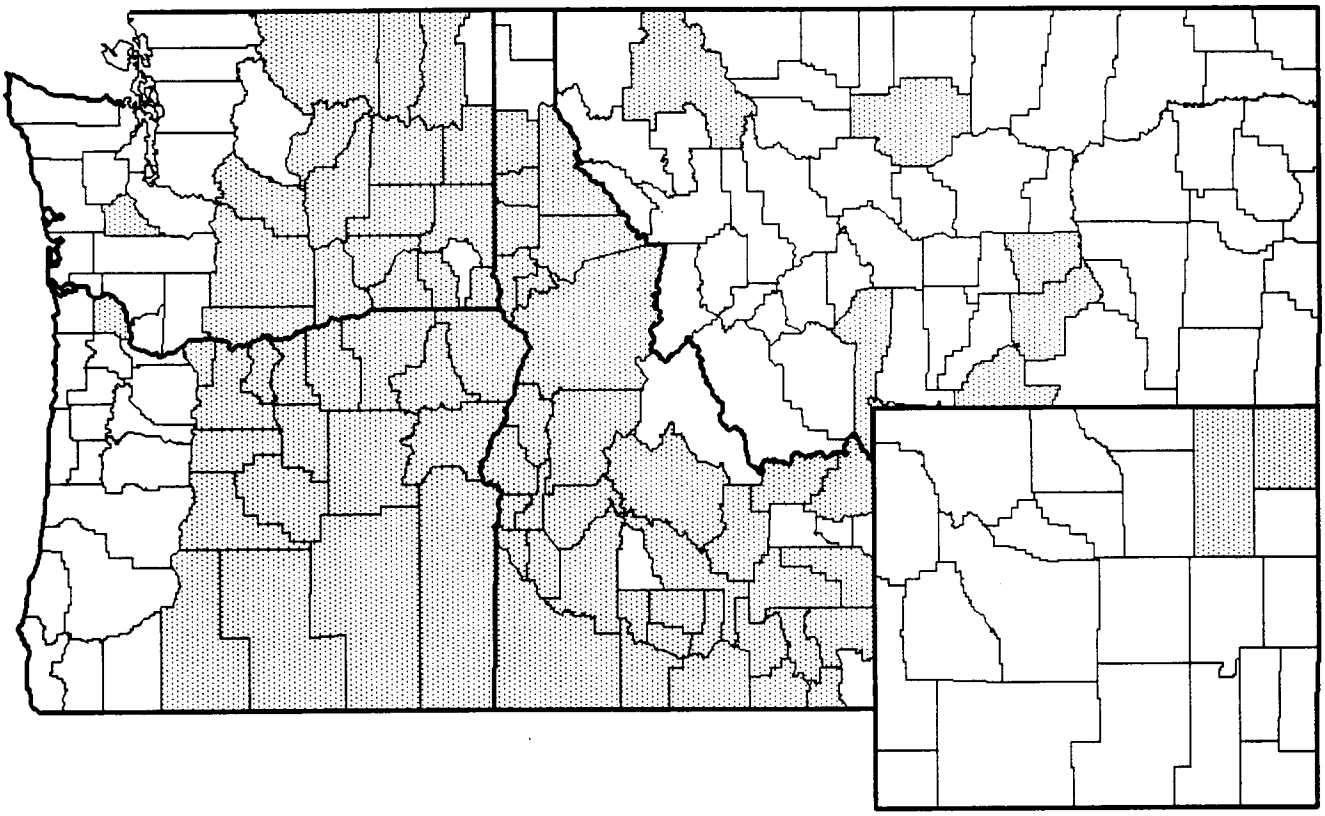
(REL 6.0) COUNTIES REPORTING CHONDRILLA JUNCEA (RUSH SKELETONWEED), 1875-1995.



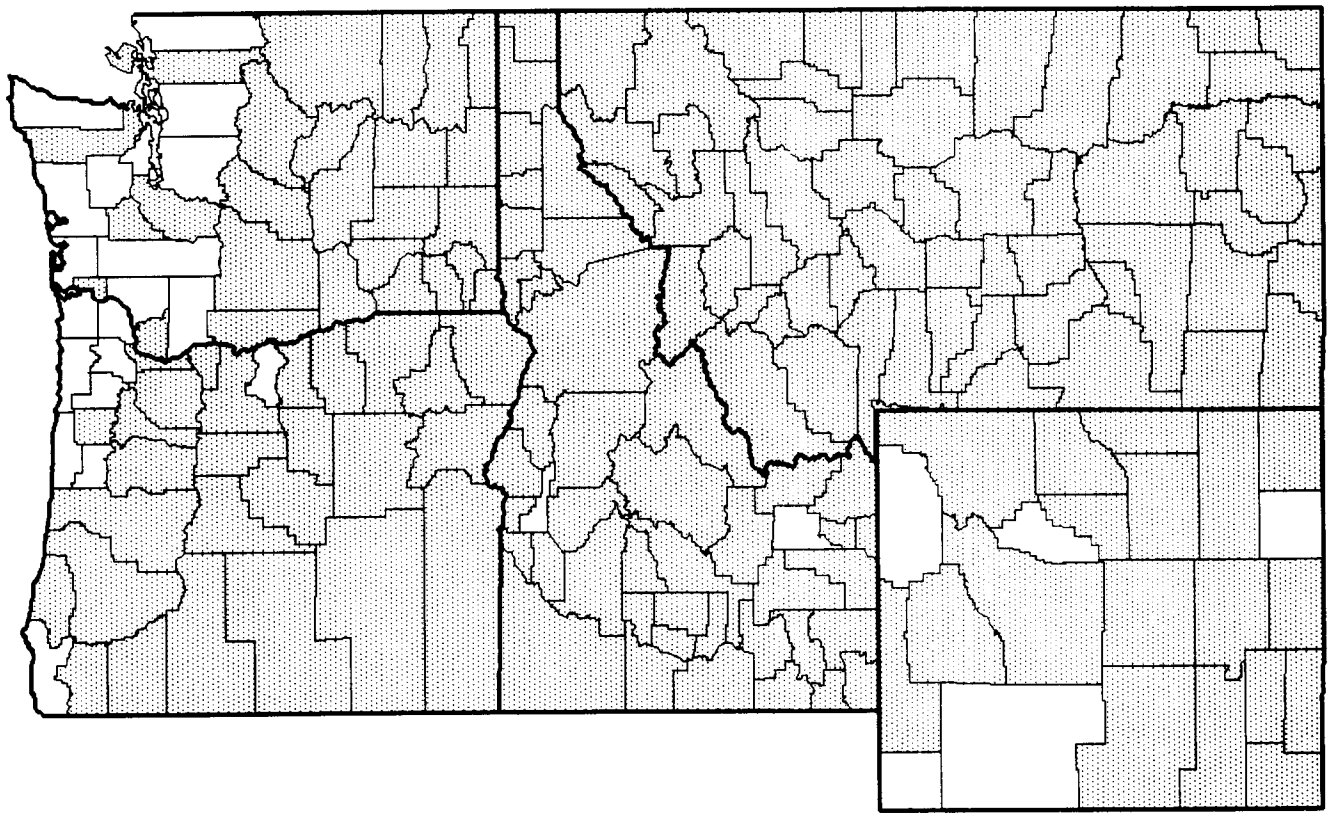
COUNTIES REPORTING CENTAUREA REPENS (RUSSIAN KNAPWEED), 1875-1995.



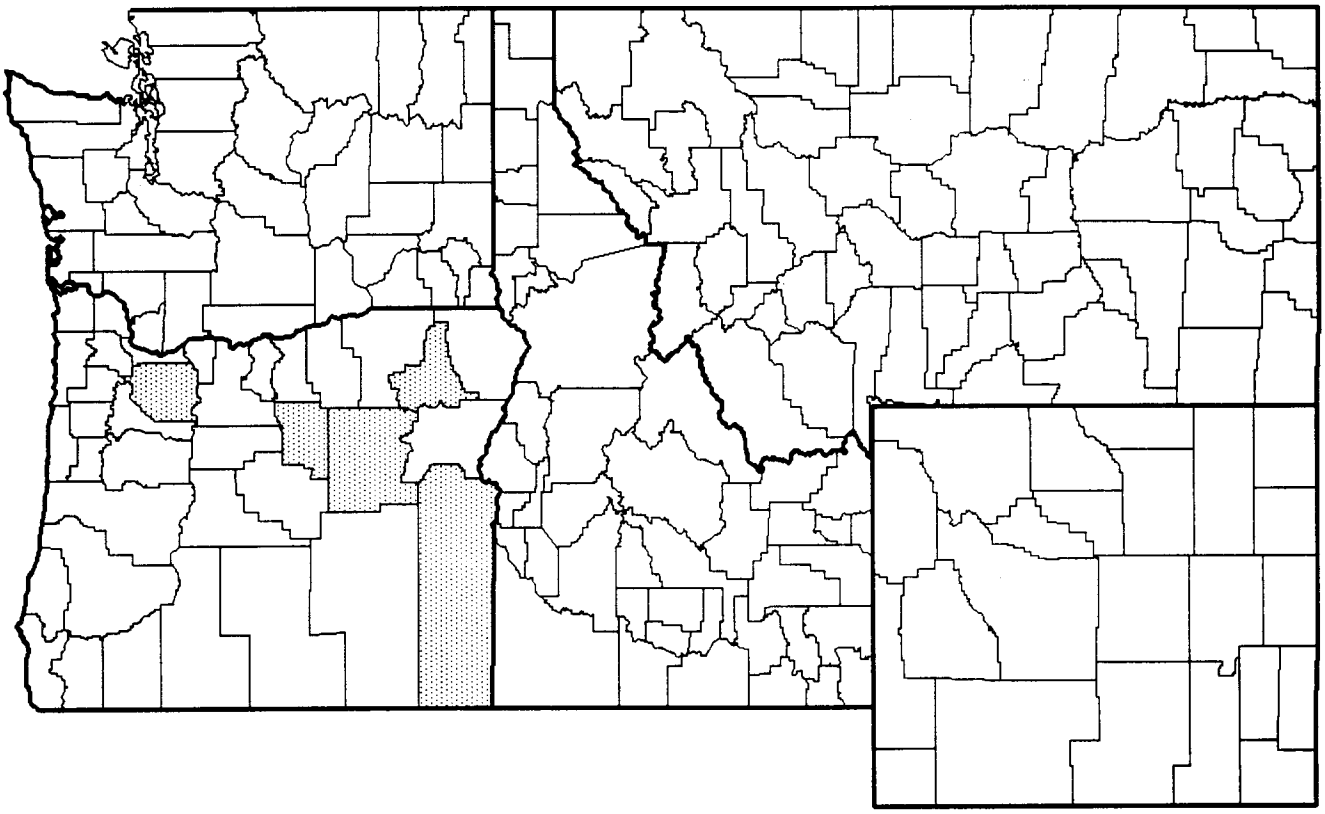
(REL 6.0) COUNTIES REPORTING ONOPORDUM ACANTHIUM (SCOTCH THISTLE), 1875-1995.



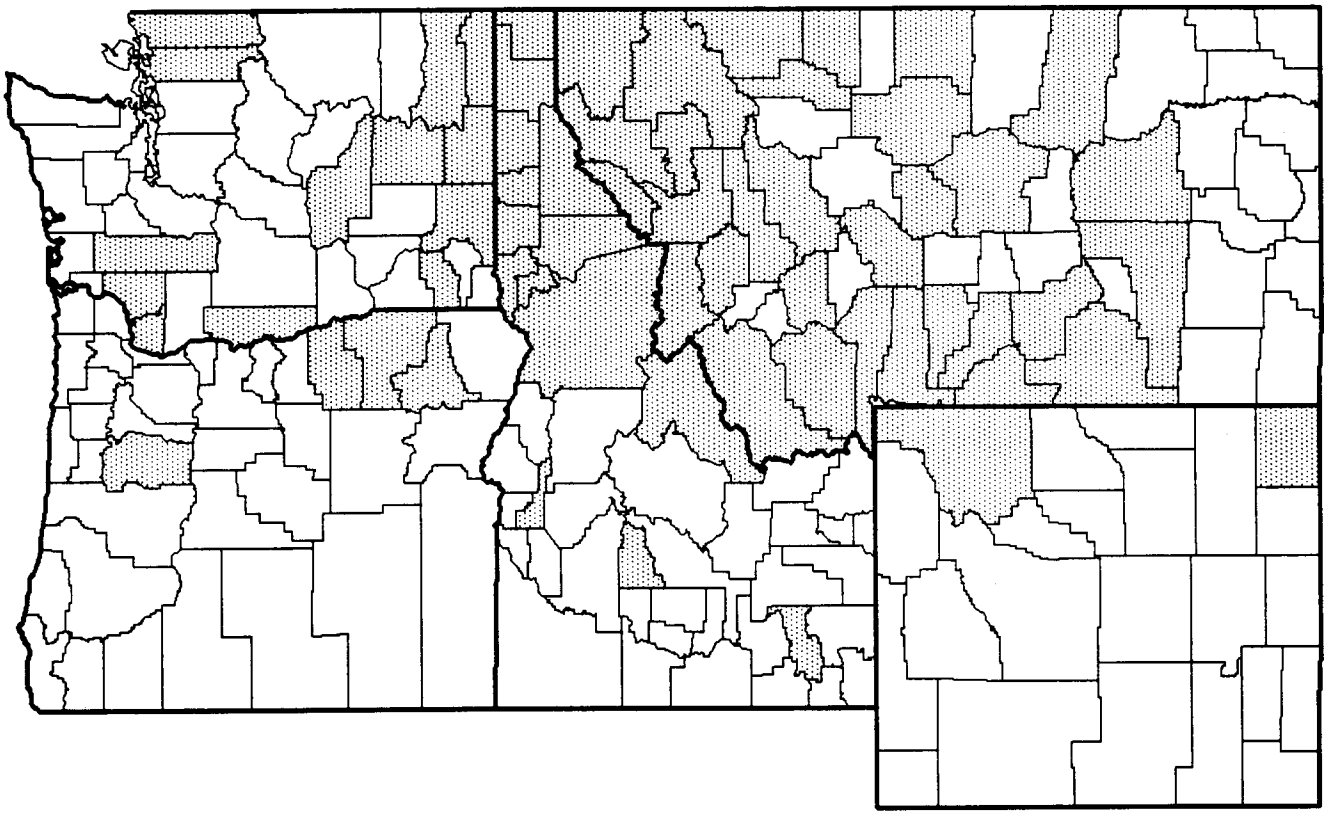
COUNTIES REPORTING CENTAUREA MACULOSA (SPOTTED KNAPWEED), 1875-1995.



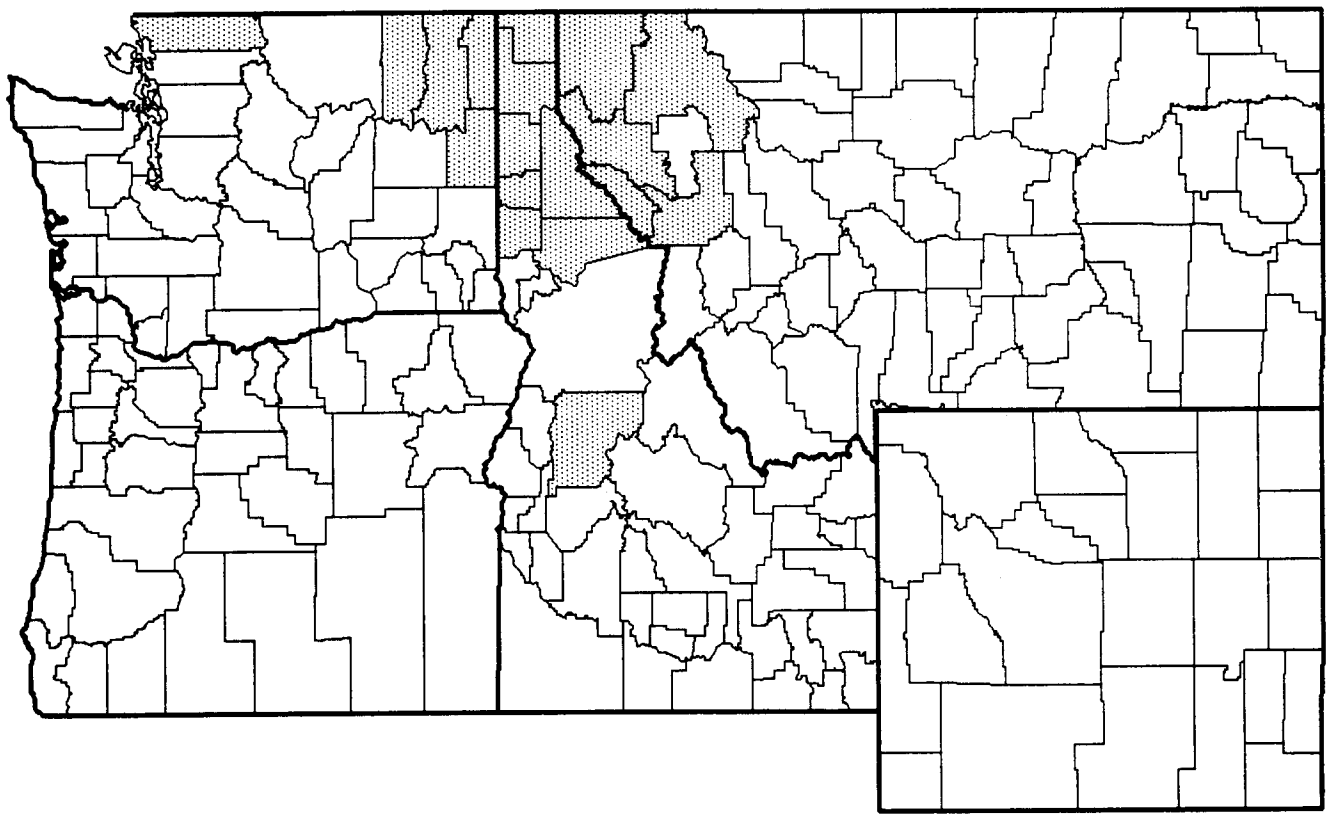
(REL 6.0) COUNTIES REPORTING CENTAUREA VIRGATA (SQUARROSE KNAPWEED), 1875-1995.



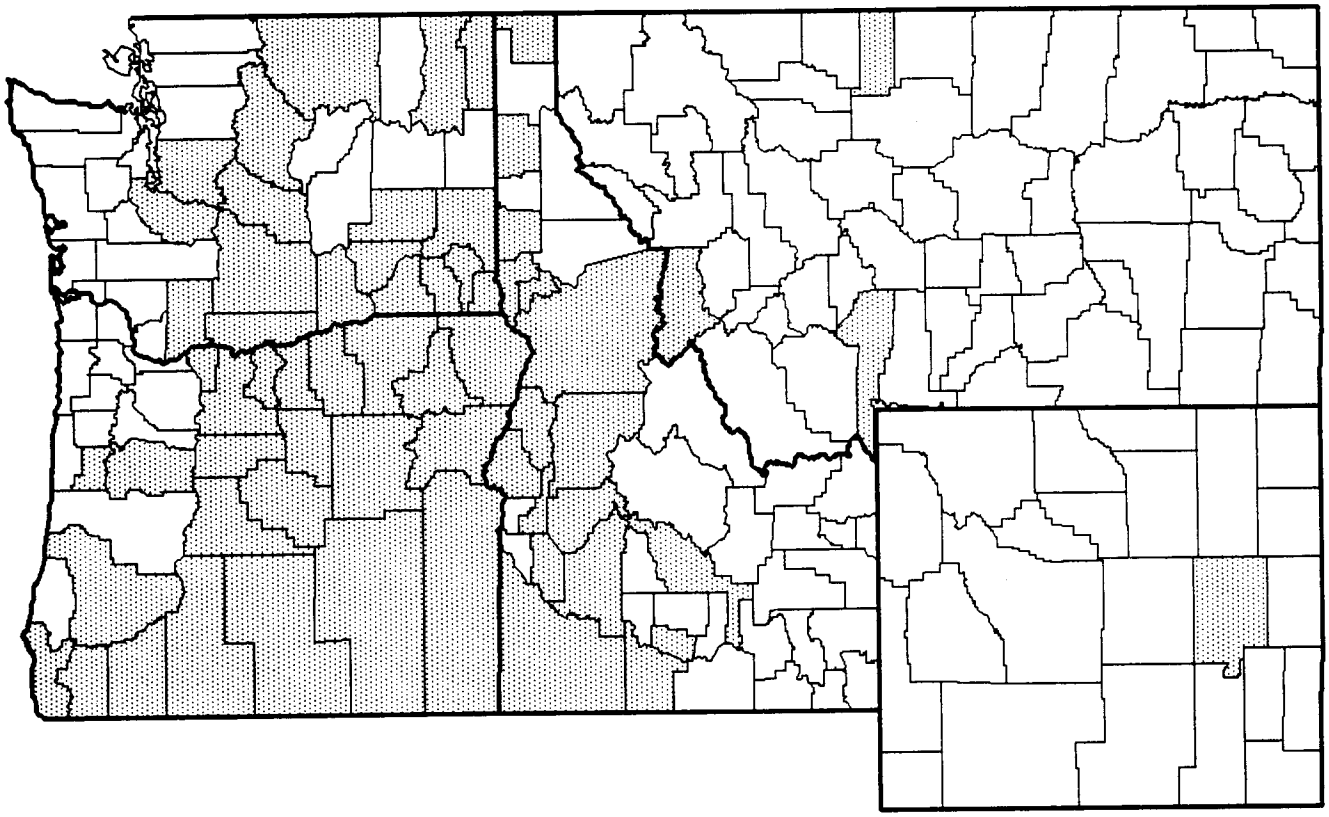
(REL 6.0) COUNTIES REPORTING POTENTILLA RECTA (SULFUR CINQUEFOIL), 1875-1995.



(REL 6.0) COUNTIES REPORTING HIERACIUM PRATENSE (YELLOW HAWKWEED), 1875-1995.



(REL 6.0) COUNTIES REPORTING CENTAUREA SOLSTITIALIS (YELLOW STARTHISTLE), 1875-1995.



(REL 6.0) COUNTIES REPORTING LINARIA VULGARIS (YELLOW TOADFLAX), 1875-1995.

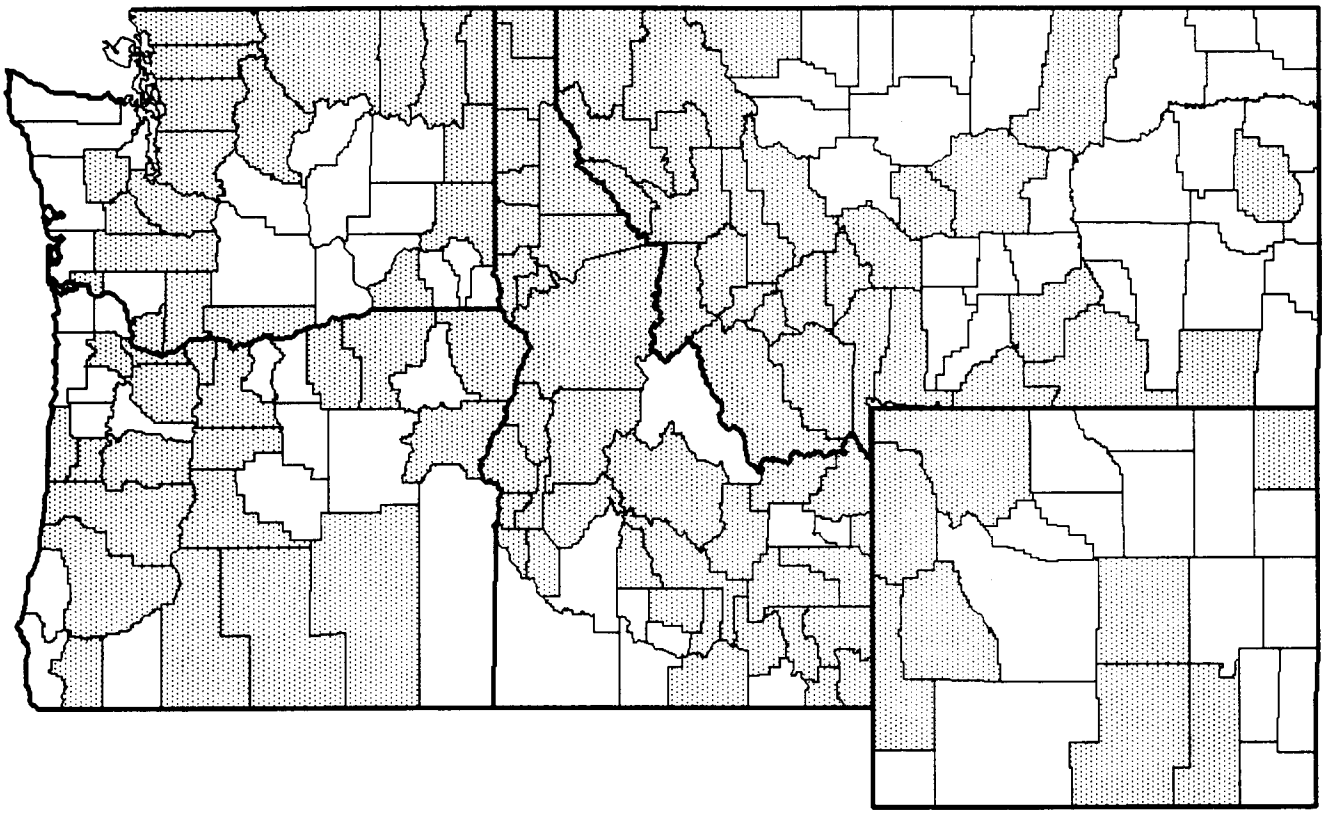


Table ID. Rangeland potential vegetation types, that compose at least 5% of a county at the landscape level (1 km^2 resolution), that are most likely to be invaded by each of 25 weed species (24 noxious plus cheatgrass) within counties of Idaho, that do not currently have confirmed presence.

Weed Species	Ada	Adams	Bannock	Benewah	Bingham	Blaine	Boise	Bonner	Bonne-ville
Bull Thistle					WBSW, A	FGwC, LSX, WBSW, MBSME			
Canada Thistle[a]									
Common Crupina						FGwC			FGwC
Dalmatian Toadflax					WBSW, A				
Diffuse Knapweed					WBSW, A				
Cheatgrass[a]									
Dyers Woad									
Halogeton	BBSS, LSX, WBSW		WBSC, A			FGwC, LSX, WBSW, MBSME			FGwC, WBSW, A
Hoary Cress									

Leafy Spurge									
Mediterra-nean Sage	WBSW		WBSC		WBSW	WBSW, FGwC			WBSW, FGwC
Medusa-head			WBSC, A		WBSW, A	FGwC, LSX, WBSW, MBSME			FGwC, WBSW, A
Musk Thistle									
Orange Hawkweed			A		A	FGwC			FGwC, A
Oxeye Daisy			A		A	FGwC			FGwC, A
Purple Loosestrife						FGwC			FGwC
Rush Skeleton-weed			WBSC, A		WBSW, A	FGwC, WBSW, MBSME			FGwC, WBSW, A
Russian Knapweed									
Scotch Thistle									
Spotted Knapweed									

Squarrose Knapweed	BBSS, LSX, WBSW		WBSC, A		WBSW, A	FGwC, LSX, WBSW, MBSME			FGwC, WBSW, A
Sulfur Cinquefoil	BBSS				A	FGwC, MBSME			FGwC, A
Yellow Hawkweed			A		A				A
Yellow Starthistle			WBSC, A		WBSW, A				FGwC, WBSW, A
Yellow Toadflax									

Table ID (continued).									
Weed Species	Boundary	Butte	Camas	Canyon	Caribou	Cassia	Clark	Clear-water	Custer
Bull Thistle		LSX, WBSW, WBSC, MBSME		WBSW			FGwC, WBSW, MBSME		
Canada Thistle[a]									
Common Crupina			FG, FGwC, MM				FGwC		FGwC
Dalmatian Toadflax		LSX, WBSW, WBSC, MBSME	FG, FGwC, MBSME, MM						
Diffuse Knapweed					A				
Cheatgrass[a]									
Dyers Woad		LSX, WBSW, WBSC, MBSME	FG, FGwC, MBSME, MM	WBSW					FGwC, WBSC, MBSME

Halogeton			FG, FGwC, MBSME, MM	WBSW	A				FGwC, WBSC, MBSME
Hoary Cress									
Leafy Spurge									
Mediterra-nean Sage		WBSW, WBSC	FG, FGwC, MM	WBSW		WBSW	WBSW, FGwC		WBSC, FGwC
Medusa-head		LSX, WBSW, WBSC, SDS, MBSME	FG, FGwC, MBSME, MM	WBSW	A	WBSW, MBSME, MBSMW wJ	FGwC, WBSW, MBSME		FGwC, WBSC, MBSME
Musk Thistle									
Orange Hawkweed			FG, FGwC		A		FGwC		FGwC
Oxeye Daisy			FG, FGwC		A		FGwC		FGwC
Purple Loosestrife							FGwC		FGwC

Rush Skeleton-weed		WBSW, WBSC, MBSME			A	WBSW, MBSME, MBSMW wJ	FgwC, WBSW, MBSME		FgwC, WBSC, MBSME
Russian Knapweed									FGwC, WBSC, MBSME
Scotch Thistle			FG, FGwC						
Spotted Knapweed									
Squarrose Knapweed		LSX, WBSW, WBSC, SDS, MBSME	FG, FGwC, MBSME, MM	WBSW	A	WBSW, MBSME, MBSMW wJ	FGwC, WBSW, MBSME		FGwC, WBSC, MBSME
Sulfur Cinquefoil		WBSC, MBSME			A	MBSME, MBSMW wJ	FgwC, MBSME		FgwC, WBSC, MBSME
Yellow Hawkweed					A				
Yellow Starthistle		LSX, WBSW, WBSC, MBSME	FG, FGwC, MBSME, MM	WBSW	A	WBSW, MBSME, MBSMW wJ	FGwC, WBSW, MBSME		FGwC, WBSC, MBSME
Yellow Toadflax									

Table ID (continued).									
Weed Species	Elmore	Fremont	Gem	Gooding	Idaho	Jefferson	Jerome	Kootenai	Latah
Bull Thistle	FGwC, WBSW, MBSME		WBSW, MBSME	BBSS, WBSW, MBSME, MBSMW		LSM, WBSW	WBSW		
Canada Thistle[a]									
Common Crupina	FGwC	FGwC							
Dalmatian Toadflax				BBSS, WBSW, MBSME, MBSMW		LSM, WBSW	WBSW		
Diffuse Knapweed			WBSW, MBSME						
Cheatgrass[a]									
Dyers Woad	FGwC, WBSW, MBSME		WBSW, MBSME	BBSS, WBSW, MBSME, MBSMW			WBSW		
Halogeton	FGwC, WBSW, MBSME	FGwC, WBSW, A	WBSW, MBSME			LSM, WBSW	WBSW		
Hoary Cress									

Leafy Spurge			WBSW, MBSME	BBSS, WBSW, MBSME, MBSMW			WBSW		
Mediterra-nean Sage	WBSW, FGwC	WBSW, FGwC	WBSW	WBSW		WBSW	WBSW		
Medusa-head		FgwC, WBSW, A		BBSS, WBSW, MBSME, MBSMW		LSM, WBSW	WBSW		
Musk Thistle									
Orange Hawkweed		FGwC, A							
Oxeye Daisy	FGwC								
Purple Loosestrife		FGwC							
Rush Skeleton-weed		FgwC, WBSW, A				WBSW			
Russian Knapweed									
Scotch Thistle									

Spotted Knapweed			MBSME						
Squarrose Knapweed	FGwC, WBSW, MBSME	FGwC, WBSW, A	WBSW, MBSME	BBSS, WBSW, MBSME, MBSMW		LSM, WBSW	WBSW		
Sulfur Cinquefoil	FGwC, MBSME	FGwC, A		BBSS, MBSME, MBSMW					
Yellow Hawkweed		A							
Yellow Starthistle		FGwC, WBSW, A		BBSS, WBSW, MBSME, MBSMW		LSM, WBSW			
Yellow Toadflax	FGwC, MBSME			BBSS, MBSME, MBSMW					

Table ID (continued).									
Weed Species	Lemhi	Lewis	Lincoln	Madison	Minidoka	Nez Perce	Owyhee	Payette	Power
Bull Thistle	FGwC, WBSC, MBSME		WBSW, MBSME	WBSW, A, MM	WBSW			BBSS, WBSW, MBSME	WBSW, MBSMW wJ, A
Canada Thistle[a]									
Common Crupina	FGwC			MM					
Dalmatian Toadflax			WBSW, MBSME	WBSW, A, MM					WBSW, MBSMW wJ, A
Diffuse Knapweed	FGwC, WBSC, MBSME								WBSW, MBSMW wJ, A
Cheatgrass[a]									
Dyers Woad	FGwC, WBSC, MBSME			WBSW, A, MM			LSM, WBSW, MBSME, MBSMW	BBSS, WBSW, MBSME	
Halogeton	FGwC, WBSC, MBSME		WBSW, MBSME	WBSW, A, MM				BBSS, WBSW, MBSME	WBSW, MBSMW wJ, A
Hoary Cress									

Leafy Spurge								BBSS, WBSW, MBSME	
Mediterra-nean Sage	WBSC, FGwC		WBSW	WBSW, MM	WBSW		WBSW		WBSW
Medusa-head	FGwC, WBSC, MBSME		WBSW, MBSME	WBSW, A, MM	WBSW		LSM, WBSW, MBSME, MBSMW	BBSS, WBSW, MBSME	WBSW, MBSMW wJ, A
Musk Thistle				A, MM				MBSME	
Orange Hawkweed	FGwC			A					A
Oxeye Daisy				A					A
Purple Loosestrife	FGwC								
Rush Skeleton-weed	FGwC, WBSC, MBSME			WBSW, A	WBSW				WBSW, MBSMW wJ, A
Russian Knapweed									
Scotch Thistle	FGwC								
Spotted Knapweed									

Squarrose Knapweed	FGwC, WBSC, MBSME		WBSW, MBSME	WBSW, A, MM	WBSW		LSM, WBSW, MBSME, MBSMW	BBSS, WBSW, MBSME	WBSW, MBSMW wJ, A
Sulfur Cinquefoil			MBSME	A, MM			MBSME, MBSMW	BBSS, MBSME	MBSMW wJ, A
Yellow Hawkweed				A					A
Yellow Starthistle	FGwC, WBSC, MBSME		WBSW, MBSME	WBSW, A, MM	WBSW			BBSS, WBSW, MBSME	WBSW, MBSMW wJ, A
Yellow Toadflax	FGwC, WBSC, MBSME			A, MM			MBSME, MBSMW		

Table ID (continued).					
Weed Species	Shoshone	Teton	Twin Falls	Valley	Washington
Bull Thistle		A, MM	WBSW, MBSME, MBSMW		MBSME
Canada Thistle[a]					
Common Crupina		MM			
Dalmatian Toadflax		A, MM	WBSW, MBSME, MBSMW		
Diffuse Knapweed		A, MM			MBSME
Cheatgrass[a]					
Dyers Woad		A, MM			MBSME
Halogeton		A, MM	WBSW, MBSME, MBSMW		MBSME
Hoary Cress		A, MM			
Leafy Spurge					
Mediterranean Sage		MM	WBSW		
Medusahead		A, MM	WBSW MBSME, MBSMW		
Musk Thistle					MBSME

Orange Hawkweed		A			
Oxeye Daisy					
Purple Loosestrife					
Rush Skeletonweed		A	WBSW, MBSME, MBSMW		
Russian Knapweed		MM			MBSME
Scotch Thistle					
Spotted Knapweed					
Squarrose Knapweed		A, MM	WBSW, MBSME, MBSMW		MBSME
Sulfur Cinquefoil		A, MM	MBSME, MBSMW		MBSME
Yellow Hawkweed		A			
Yellow Starthistle		A, MM			
Yellow Toadflax			MBSME, MBSMW		

[a] Present in every county in Idaho that lies within the Basin.

Table MT. Rangeland potential vegetation types, that compose at least 5% of a county at the landscape level (1 km^2 resolution), that are most likely to be invaded by each of 25 weed species (24 noxious plus cheatgrass), within counties of Montana, that do not currently have confirmed presence.

Weed Species	Deer Lodge	Flathead	Granite	Lake	Lewis and Clark	Lincoln	Mineral	Missoula	Powell
Bull Thistle	FGwC								
Canada Thistle[a]									
Common Crupina	FGwC		AS						FGwC
Dalmatian Toadflax									FGwC
Diffuse Knapweed									FGwC
Cheatgrass[a]									
Dyers Woad	FGwC								FGwC
Halogeton	FGwC		AS						FGwC
Hoary Cress[a]									
Leafy Spurge[a]									
Mediterra-nean Sage	FGwC		AS						FGwC

Medusa-head	FGwC		AS						FGwC
Musk Thistle									
Orange Hawkweed	FGwC								FGwC
Oxeye Daisy			AS						
Purple Loosestrife	FGwC								FGwC
Rush Skeleton-weed	FGwC		AS						FGwC
Russian Knapweed[a]									
Scotch Thistle	FGwC		AS						FGwC
Spotted Knapweed[a]									
Squarrose Knapweed	FGwC		AS						FGwC
Sulfur Cinquefoil	FGwC								
Yellow Hawkweed									

Yellow Starthistle	FGwC		AS						FGwC
Yellow Toadflax[a]									

Table MT (continued).			
Weed Species	Ravalli	Sanders	Silver Bow
Bull Thistle			
Canada Thistle[a]			
Common Crupina			
Dalmatian Toadflax			
Diffuse Knapweed			
Cheatgrass[a]			
Dyers Woad			
Halogeton			MBSME
Hoary Cress[a]			
Leafy Spurge[a]			
Mediterranean Sage			
Medusahead			MBSME
Musk Thistle			MBSME
Orange Hawkweed			
Oxeye Daisy			
Purple Loosestrife			
Rush Skeletonweed			MBSME

Russian Knapweed[a]			
Scotch Thistle			
Spotted Knapweed[a]			
Squarrose Knapweed			MBSME
Sulfur Cinquefoil			MBSME
Yellow Hawkweed			
Yellow Starthistle			MBSME
Yellow Toadflax[a]			

[a] Present in every county in Montana that lies within the Basin.

Table OR. Rangeland potential vegetation types, that compose at least 5% of a county at the landscape level (1 km^2 resolution), that are most likely to be invaded by each of 25 weed species (24 noxious plus cheatgrass), within counties of Oregon, that do not currently have confirmed presence.

Weed Species	Baker	Crook	Deschutes	Gilliam	Grant	Harney	Hood River	Jefferson	Klamath
Bull Thistle[a]									
Canada Thistle[a]									
Common Crupina	FGwC			AS					
Dalmatian Toadflax[a]									
Diffuse Knapweed[a]									
Cheatgrass[a]									
Dyers Woad	FGwC, MBSME	WBSW, MBSME, MBSMWwJ		AS, WBSW	WBSW, MBSMWwJ	WBSW, MBSME		WBSW, MBSMWwJ	
Halogeton	FGwC, MBSME	WBSW, MBSME, MBSMWwJ	WBSW, MBSMWwJ	AS, WBSW	WBSW, MBSMWwJ			WBSW, MBSMWwJ	
Hoary Cress									

Leafy Spurge				AS, WBSW		WBSW, SDS, MBSME		WBSW, MBSMWwJ	
Mediterra-nean Sage				AS, WBSW				WBSW	
Medusa-head	FGwC, MBSME	WBSW, MBSME, MBSMWwJ	WBSW, MBSMWwJ		WBSW, MBSMWwJ	WBSW, SDS, MBSME			
Musk Thistle				AS				MBSMWwJ	
Orange Hawkweed	FGwC								
Oxeye Daisy	FGwC			AS					
Purple Loosestrife	FGwC								
Rush Skeleton-weed			WBSW, MBSMWwJ		WBSW, MBSMWwJ	WBSW, MBSME		WBSW, MBSMWwJ	
Russian Knapweed									
Scotch Thistle[a]									
Spotted Knapweed									

Squarrose Knapweed	FGwC, MBSME	WBSW, MBSME, MBSMWwJ	WBSW, MBSMWwJ	AS, WBSW		WBSW, SDS, MBSME		WBSW, MBSMWwJ	
Sulfur Cinquefoil	FGwC, MBSME	MBSME, MBSMWwJ	MBSMWwJ	AS	MBSMWwJ	MBSME		MBSMWwJ	
Yellow Hawkweed									
Yellow Starthistle[a]									
Yellow Toadflax		MBSME, MBSMWwJ		AS	MBSMWwJ				

Table OR (continued).									
Weed Species	Lake	Malheur	Morrow	Sherman	Umatilla	Union	Wallowa	Wasco	Wheeler
Bull Thistle[a]									
Canada Thistle[a]									
Common Crupina			AS, FG	AS			AS, FGwC		
Dalmatian Toadflax[a]									
Diffuse Knapweed[a]									
Cheatgrass[a]									
Dyers Woad			AS, FG, WBSW	AS, WBSW	AS		AS, FGwC	WBSW, MBSMW wJ	WBSW, MBSMW wJ
Halogeton			AS, WBSW	AS, WBSW	AS		AS, FGwC	WBSW, MBSMW wJ	WBSW, MBSMW wJ
Hoary Cress									
Leafy Spurge	WBSW, SDS		AS, FG, WBSW	AS, WBSW				WBSW, MBSMW wJ	WBSW, MBSMW wJ

Mediterra-nean Sage			AS, WBSW, FG	AS, WBSW	AS		AS, FGwC	WBSW	
Medusa-head		LSM, WBSW, SDS, MBSMW		AS, WBSW			AS, FGwC		WBSW, MBSMW wJ
Musk Thistle				AS					MBSMW wJ
Orange Hawkweed			FG				FGwC		
Oxeye Daisy			AS, FG	AS	AS				
Purple Loosestrife							FGwC		
Rush Skeleton-weed	WBSW								WBSW, MBSMW wJ
Russian Knapweed							AS, FGwC		
Scotch Thistle[a]									
Spotted Knapweed				AS					

Squarrose Knapweed	WBSW, SDS		AS, FG, WBSW	AS, WBSW	AS		AS, FGwC	WBSW, MBSMW wJ	
Sulfur Cinquefoil		MBSMW		AS			AS, FGwC	MBSMW wJ	MBSMW wJ
Yellow Hawkweed									
Yellow Starthistle[a]									
Yellow Toadflax		MBSMW		AS					MBSMW wJ

[a] Present in every county in Oregon that lies within the Basin.

Table WA. Rangeland potential vegetation types, that compose at least 5% of a county at the landscape level (1 km^2 resolution), that are most likely to be invaded by each of 25 weed species (24 noxious plus cheatgrass), within counties of Washington, that do not currently have confirmed presence.

Weed Species	Adams	Asotin	Benton	Chelan	Columbia	Douglas	Ferry	Franklin	Garfield
Bull Thistle[a]									
Canada Thistle[a]									
Common Crupina		AS, FGwC				AB			
Dalma-tian Toadflax[a]									
Diffuse Knap-weed[a]									
Cheat-grass[a]									
Dyers Woad	WBSW	AS,FGwC	BBSS, WBSW			AB, WBSW, MBSMW		WBSW	
Haloge-ton	WBSW	AS, FGwC	BBSS, WBSW			AB, WBSW, MBSMW		WBSW	
Hoary Cress									

Leafy Spurge	WBSW					AB, WBSW, MBSMW		WBSW	
Mediter-ranean Sage	WBSW	AS, FGwC	WBSW			WBSW		WBSW	
Medusa-head			BBSS, WBSW			AB, WBSW, MBSMW			
Musk Thistle		AS, FGwC				AB, MBSMW			
Orange Hawk-weed		FGwC							
Oxeye Daisy									
Purple Loose-strife		FGwC							
Rush Skele-tonweed						WBSW, MBSMW			
Russian Knapweed									
Scotch Thistle									

Spotted Knap-weed[a]									
Squarrose Knapweed	WBSW	AS, FGwC	BBSS, WBSW			AB, WBSW, MBSMW		WBSW	
Sulfur Cinque-foil		AS, FGwC	BBSS			AB, MBSMW			
Yellow Hawk-weed									
Yellow Star-thistle						AB, WBSW, MBSMW			
Yellow Toadflax		AS, FGwC	BBSS			AB, MBSMW			

Table WA (continued).									
Weed Species	Grant	Kittitas	Klickitat	Lincoln	Okanogan	Pend Oreille	Skamania	Spokane	Stevens
Bull Thistle[a]									
Canada Thistle[a]									
Common Crupina					FGwC				
Dalma-tian Toadflax[a]									
Diffuse Knap-weed[a]									
Cheat-grass[a]									
Dyers Woad	BBSS, WBSW		WBSW	WBSW	FGwC				
Haloge-ton	BBSS, WBSW	BBSS, WBSW	WBSW	WBSW	FGwC				
Hoary Cress									
Leafy Spurge	BBSS, WBSW				FGwC				

Mediter-ranean Sage	WBSW	WBSW		WBSW	FGwC				
Medusa-head	BBSS, WBSW	BBSS, WBSW							
Musk Thistle									
Orange Hawk-weed					FGwC				
Oxeye Daisy									
Purple Loose-strife									
Rush Skele-tonweed		WBSW			FGwC				
Russian Knapweed									
Scotch Thistle									
Spotted Knap-weed[a]									

Squarrose Knapweed	BBSS, WBSW	BBSS, WBSW	WBSW	WBSW	FGwC				
Sulfur Cinque-foil		BBSS			FGwC				
Yellow Hawk-weed									
Yellow Star-thistle	BBSS, WBSW			WBSW					
Yellow Toadflax	BBSS	BBSS							

Table WA (continued).			
Weed Species	Walla Walla	Whitman	Yakima
Bull Thistle[a]			
Canada Thistle[a]			
Common Crupina			
Dalmatian Toadflax[a]			
Diffuse Knapweed[a]			
Cheatgrass[a]			
Dyers Woad	WBSW		BBSS, WBSW
Halogeton	WBSW		BBSS, WBSW
Hoary Cress			
Leafy Spurge			BBSS, WBSW
Mediterra-nean Sage	WBSW		WBSW
Medusa-head			BBSS, WBSW

Musk Thistle			
Orange Hawkweed			
Oxeye Daisy			
Purple Loosestrife			
Rush Skeleton-weed			
Russian Knapweed			
Scotch Thistle			
Spotted Knapweed[a]			
Squarrose Knapweed	WBSW		BBSS, WBSW
Sulfur Cinquefoil			BBSS
Yellow Hawkweed			
Yellow Starthistle			

Yellow Toadflax			BBSS

[a] Present in every county in Washington that lies within the Basin.

Table WY. Rangeland potential vegetation types, that compose at least 5% of a county at the landscape level (1 km^2 resolution), that are most likely to be invaded by each of 25 weed species (24 noxious plus cheatgrass), within counties of Wyoming, that do not currently have confirmed presence.

Weed Species	Lincoln	Sublette	Teton
Bull Thistle		A	A
Canada Thistle[a]			
Common Crupina			
Dalmatian Toadflax	A	A	
Diffuse Knapweed		A	A
Cheatgrass[a]			
Dyers Woad		A	A
Halogeton	A	A	A
Hoary Cress	A		A
Leafy Spurge			A
Mediterranean Sage			
Medusahead	A	A	A
Musk Thistle		A	
Orange Hawkweed	A	A	A
Oxeye Daisy	A		
Purple Loosestrife			
Rush Skeletonweed	A	A	A
Russian Knapweed			
Scotch Thistle			
Spotted Knapweed			
Squarrose Knapweed	A	A	A
Sulfur Cinquefoil	A	A	A

Yellow Hawkweed	A	A	A
Yellow Starthistle	A	A	A
Yellow Toadflax[a]			

[a] Present in every county in Wyoming that lies within the Basin.

Table PREVENTION. Prototype Weed Prevention Measures (USDI, Bureau of Land Management, Draft Noxious Weed Action Plan, 1994, and USDA, Forest Service, Record of Decision, Noxious Weed Management, Amendment to Lolo National Forest Plan, 1991).

Management Requirement	**Best Known Practices** (should be followed unless the intent of the first column can be met with an alternative method which is discussed in the project environmental document)
Roads	
1) Incorporate weed prevention into road layout, design, and alternative evaluation.	1.1) During transportation planning and alternative development, consider weed risk factors (presence of weeds, habitat type, aspect, shading, etc.) to evaluate road location and design.
2) Remove seed source that could be picked up by passing vehicles and limit seed transport into relatively weed-free areas at moderate or high ecological risk.	2.1) Before construction equipment moves into a relatively weed-free area at moderate or high ecological risk; mow, grade or otherwise treat all seed-bearing noxious weed plants on the travelway of existing Forest Service access roads. Treated sites must be reseeded as described in Weed Prevention Measure #4.1. 2.2) Clean off-road equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts before moving into relatively weed-free areas at moderate or high ecological risk. (This is not meant to apply to service vehicle that will stay on the roadway, traveling frequently in and out of the project area).
3) Retain shade to suppress weeds.	3.1) Minimize the removal of trees and other roadside vegetation during construction, reconstruction, and maintenance, particularly on south aspects.
4) Reestablish vegetation on all bare ground to minimize weed spread.	4.1) For all construction, reconstruction, and maintenance activities, seed all disturbed soil (except traveled way) within seven days of work completion at each site - unless ongoing disturbance at the site will prevent weed establishment. In that case, seeding shall be done within seven days of final disturbance. Use a seed mix that includes fast, early growing species to provide quick, dense revegetation. Seed should be certified relatively weed-free and/or analyzed (as deemed appropriate by the Forest Soils Scientist) before purchase to ensure minimum weed content. Consider the following options: a) fertilization concurrent with seed application, and follow-up fertilization; b) applying relatively weed-free mulch with seeding; c) double-seed, full rate at initial ground disturbance, and full rate again at the end of the project. See the current Lolo Seeding Guidelines for detailed procedures and appropriate mixes.
5) Minimize weed spread caused by moving infested gravel and fill material to relatively weed-free locations.	5.1) Gravel and fill to be placed in relatively weed-free areas which are at moderate or high ecological risk to weed invasion must come from weed-free sources. Inspect gravel pits and fill sources to identify weed-free sources.
6) Minimize sources of weed seed in areas not yet revegetated.	6.1) Keep active road construction sites which are in relatively weed-free areas at moderate or high ecological risk to weed invasion closed to vehicles that are not involved with construction.

7) Ensure establishment and maintenance of vigorous, desirable vegetation to discourage weeds.	7.1) Monitor all seeded sites. Refertilize and spot reseed as needed. Prefer native, pioneer species for seeding (low nutrient demanding) to minimize the need for fertilization. 7.2) Road maintenance programs should include scheduled fertilization where needed (three year period suggested).
8) Minimize roadside sources of weed seed that could be transported to other areas.	8.1) Road maintenance programs should include monitoring for noxious weeds. Weed infestations should be inventoried and scheduled for treatment according to the selected alternative. Consider developing timber sale "C" clauses and "T" specifications to collect deposits for use in weed-control road maintenance.
9) Ensure that weed prevention and related resource protection is considered in travel management.	9.1) Consider weed risk and spread factors in Travel Plan (road closure) decision-making.
Recreation, Wilderness, Roadless Areas	
10) Minimize transport of weed seed by pack and saddle stock.	10.1) Require that all pack and saddle stock in designated areas use only certified weed-free feed and straw bedding. (In established Wilderness, this requirement should be deferred to the Limits of Acceptable Change planning process). Encourage the sue of weed-free feed in all areas of the Forest. 10.2) Pack and saddle stock should be quarantined and fed only weed-free feed for 24 hours prior to traveling off roads in the Forest. Before quarantine, tail and mane should be brushed out to remove any weed seed.
11) Encourage a weed-free trail user's ethic.	11.1) Sign trailheads for weed awareness and weed prevention techniques.
12) Ensure that areas under permit have on-site weed control and minimize spread to other areas.	12.1) Revise recreation special use permits to require weed treatment consistent with the Forest Plan Amendment for noxious weed management. Require all bare soil to be reseeded as described in Weed Prevention Measure #4.1.
Cultural Resources	
13) Ensure all bare ground is covered by desirable vegetation to discourage weeds.	13.1) Archeological site excavations will be reseeded to the standards given in Weed Prevention Measure #4.1.
Wildlife	
14) Incorporate weed prevention into wildlife habitat improvement project design.	14.1) Environmental analysis for habitat improvement projects (prescribed fire) will include weed risk considerations in the development and evaluation of alternatives.
Range	

15) Minimize the creation of bare soil and other factors that support weeds.	15.1) Manage allotments to prevent excessive soil disturbance at salt licks, watering sites, and sensitive soil conditions. 15.2) All salt must be kept in containers and moved periodically. 15.3) Revise special use permits and allotment management plans to require weed treatment consistent with the Forest Plan Amendment for noxious weed management. Require all bare soil to be reseeded as described in Weed Prevention Measure #4.1.
16) Minimize weed seed transport to relatively weed-free areas at moderate or high ecological risk.	16.1) In range allotments that have both weed-infested and relatively weed-free areas at moderate or high ecological risk, control timing of animal movement from infested to noninfested areas. Prevent movement from infested to non-infested areas after weed seed set.
17) Ensure success of revegetation efforts to minimize weed spread.	17.1) Avoid grazing any reseed sites until vegetation is well established.
18) Retain desirable roadside vegetation to discourage weeds.	18.1) Roadside vegetation should not be included when calculating allotment grazing capacity.
Timber	
19) Ensure that weed prevention is considered in all timber management project design.	19.1) Consider weed risk and prevention factors (e.g., maximize shade and minimize soil disturbance) in all silvicultural prescriptions, and in alternative development and evaluation for all timber sale environmental analyses.
20) Minimize the creation of sites suitable for weed establishment.	20.1) Minimize soil disturbance: a) during tree regeneration; b) preferably by winter skidding on high weed-risk sites; c) preferably by broadcast burning rather than dozer piling; d) when using dozer piles by creating small piles and burning under conditions that minimize heat transfer to the soil; e) by avoiding dozer fireline construction on high weed risk sites; f) by ensuring prompt regeneration to maximize shading; and g) by seeding skid trails, landings and other disturbed sites as described in Weed Prevention Measure #4.1.
21) Remove seed source that could be picked up by passing vehicles and limit seed transport into relatively weed-free areas at moderate or high ecological risk.	21.1) Before skidding equipment moves into a relatively weed-free area at moderate or high ecological risk; mow, grade or otherwise treat all seed-bearing noxious weed plants on the travelway of existing Forest Service access roads. Treated sites must be reseeded as described in Weed Prevention Measure #4.1. 21.2) Clean skidding equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts before moving into relatively weed-free areas at moderate or high ecological risk.
22) Examine weed prevention and treatment needs, and seek funding sources.	22.1) Inspect proposed timber sale areas for weed status and risk. Collect KV or other funds to prevent, monitor, and treat soil disturbance or weeds as needed during and after timber harvest and regeneration activities.
Minerals	

23) Minimize chances of weed establishment in mining operations.	23.1) Include weed prevention and treatment in all mining plans of operation and reclamation plans. Retain bonds for weed control until the site is returned to vegetative conditions matching the surrounding area.
24) Remove seed source and limit seed transport into relatively weed-free areas at moderate or high ecological risk.	24.1) Before equipment moves into a relatively weed-free area at moderate or high ecological risk, mow, grade or otherwise treat all noxious weeds along existing access roads (include in plan of operation). Treated sites must be reseeded as described in Weed Prevention Measure #4.1. 24.2) Clean equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts before moving into relatively weed-free areas at moderate or high ecological risk (include in plan of operation).
25) Ensure that all disturbed soil is revegetated as soon as possible to discourage weeds.	25.1) Reseed all bare soil within seven days as described in Weed Prevention Measure #4.1 (include in plan of operation).
Lands	
26) Incorporate weed prevention in all lands projects.	26.1) Consider weed risk, prevention, and treatment factors in alternative development and evaluation for all project planning. 26.2) Require weed control until the site is returned to a vegetative condition that matches the surrounding area. 26.3) Revise special use permits plans to require weed treatment consistent with the Forest Plan Amendment for noxious weed management. Require all bare soil to be reseeded as described in Weed Prevention Measure #4.1.
27) Ensure quick reestablishment of desired vegetation to discourage weeds.	27.1) Require all bare soil resulting from lands related projects, including special use permits and cost-share roads, to be reseeded within seven days as described in Weed Prevention Measure #4.1.
Fire (see also measures under Timber and Wildlife)	
28) Ensure that fire suppression and rehabilitation efforts minimize weed spread.	28.1) Include weed risk factors and weed prevention considerations in the Resource Coordinator duties on all Incident Overhead Teams and Fire Rehabilitation Teams. 28.2) During fire rehabilitation, reseed all disturbed soil in relatively weed-free areas at moderate or high risk to weeds as described in Weed Prevention Measure #4.1.