

APPENDIX I

SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES

SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES

The following table displays species specific ecology and integrated pest management treatments for weeds on or adjacent to the Custer National Forest. The herbicides listed in the table are the most commonly used herbicides and rates are guidelines. In all cases, application rates would be those indicated on herbicide labels. On going testing may result in new instructions on rate and target species.

A surfactant is recommended with all herbicides except some formulations of glyphosate. A Methylated Seed Oil (MSO) is recommended with all Plateau applications for best results. See Appendix J for more information on surfactants.

Weed control from post-emergent herbicides is influenced by plant community tolerance, weed species, weed size, and climatic conditions. These factors should be considered in determining the herbicide selection and rate range. The lowest rate of post-emergent herbicides will be effective under favorable growing conditions and when weeds are small and actively growing. Use the highest labeled rate under adverse conditions and for well established weeds.

Efforts to utilize the most selective herbicide should be considered. A wide variety of herbicides have a wide range of plant selectivity.

- Glyphosate and Diuron are the least selective, affecting most plant species.
- Clopyralid (i.e., Stinger, Transline) is the most selective herbicide, affecting only plants in the sunflower (*Compositae*), buckwheat (*Polygonaceae*), nightshade (*Solanaceae*), and pea (*Fabaceae*) families. About half of the existing Custer Forest weed species are in these families.
- Dicamba (i.e., Banvel), Picloram (i.e., Tordon), and 2, 4-D-amine are less specific. Monocots (grasses, grass-like plants, lilies, orchids and related families) are tolerant of Dicamba because of rapid metabolism (Sheley and Petrof, 1999); however, when mixed with other herbicides, it may be more lethal to some broad-leaved monocots.
- Picloram (i.e., Tordon), Overdrive, 2, 4-D, Clopyralid (i.e., Stinger, Transline) and Triclopyr (i.e., Remedy, Garlon 3A) can cause injury or death to forbs, trees & shrubs but are safe to most grasses.
- Supplemental labeling for Tordon 22K for areas west of the Mississippi River allows for wick or carpet roller applications where drift presents a hazard to susceptible crops, surface waters, and other sensitive areas. One part Tordon 22K is mixed with 2 parts water to prepare a 33% solution.
- Aminopyralid very effective and more environmentally friendly than picloram for control of perennial and biennial thistles, and knapweeds. Can be used in riparian areas up to water's edge. Not to be used in areas of standing water. Picloram, rather than aminopyralid, might be considered for drier upland treatments due to its more residual nature.
- Imazapic (i.e. Plateau) may be used safely around trees and over-the-top of many legumes and wildflowers. Some cool-season grasses may be injured or seedhead production may be inhibited. When permitted by the label, the use of a methylated seed oil (MSO) surfactant will provide the best results for control, but avoid MSO's when applying to emerged seedling grasses and forbs.
- Imazapyr (i.e. Arsenal), Sulfometuron (i.e., Oust) and Glyphosate (i.e., Roundup) herbicides will control almost all vegetation sprayed. Glyphosate does not have soil residual.
- Metsulfuron (i.e., Ally, Escort) can cause injury or death to certain trees, shrubs, forbs and grasses.

Conversion Factors (see Appendix L for more conversions)

- 43,560 sq. ft. = 1 acre
- 1 ounce = 28.35 grams
- 16 ounces = 1 pint
- 2 cups = 1 pint
- 30 cc's = 1 fluid ounce
- 1 cup = 8 ounces
- 2 teaspoons = 1 tablespoon
- 2 tablespoons = 1 fluid ounce

APPENDIX I

SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES

SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING SUGGESTED HERBICIDE RATES ¹

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
ESTABLISHED INVADERS – CATEGORY 1 SPECIES						
Russian knapweed <i>Acroptilon repens</i>	Prefers heavy, often saline soils of bottomlands and sub-irrigated slopes and plains. Commonly found along roadsides, riverbanks, irrigation ditches, pastures, waste places, clearcuts, croplands, and hayfields. Prefers similar sites to those occupied by basin wildrye (<i>Elymus cinereus</i>). Does not readily establish in healthy native vegetation, requires disturbance. The healthier the native vegetation, the less susceptible it will be to Russian knapweed invasion. (Once established, it emits allelopathic compounds to inhibit other plants). Long-lived perennial (75 years) A single plant may produce 1,200 seeds, which remain viable two to three years. Although Russian knapweed produces seeds, it does not reproduce extensively from seed. Infestations increase primarily vegetatively through adventitious buds on a creeping root system. Roots, which are both vertical and horizontal in the soil, may or may not be black with a scaley appearance. Roots grow 6 to 8 feet deep the first season and 16 to 23 feet deep in the second season.	Gall-forming nematode (<i>Subanguina picridis</i>) Seed head gall fly (<i>Urophora quadrifasciata</i>) Seed head gall fly (<i>U. affinis</i>)	Cultivation, cutting/mowing, and/or hand-pulling not recommended unless done three times per year (spring, summer, fall) to force the plants to use nutrient reserve stored in roots, followed by herbicide treatment. This protocol must be followed for at least 3 years otherwise it will stimulate sprouting from rhizomes. It is difficult to remove all roots with a one-time effort. Severed root pieces as small as 2.5 cm can generate new shoots from depths to 15 cm. Whichever control combination is chosen, it is imperative to continually stress the plant because it does not do well under stressful conditions. The most preferred method of control is to mow the area of Russian knapweed once a month during the spring and summer months, then follow up with an application of Tordon or 2, 4-D in the fall. Chemicals are not always necessary if the plant is stressed by mechanical methods and proper cultural techniques are applied. Long-term reductions must include planting competitive plant species to occupy bare ground once infested by the weed, due to Russian knapweed's allelopathic qualities.	Tordon Curtail Redeem Transline Telar Milestone Tordon Curtail Redeem Telar Russian Knapweed (as well as Kochia and Russian Thistle) can sometimes develop resistance to many chemical formulations. It is recommended to use the sulfonyleureas inhibitors such as: Escort, Telar, Ally, Oust, Glean, Plateau, Curtail, or Tordon.	Per Acre Rate 2 quarts per acre 2 to 3 quarts per acre 3 to 4 pints per acre 1 1/3 pints per acre 2 oz. per acre 4-6 oz. per acre 3 Gallon Backpack 4.5 oz per 3 gallons water 4.5 to 6.5 oz per 3 gallons water 4 oz per 3 gallons water 0.5 oz. per 3 gallons water	Before full flower or during fall re-growth
Whitetop (Hoary cress) <i>Lepidium draba</i>	Non-shaded, disturbed conditions, including roadsides, waste places, fields, gardens, feed lots, watercourses, open grasslands, and along irrigation ditches. Not particular about soil type, even saline soils, except for highly acidic soils. Most aggressive, rapid expansion occurs in irrigated conditions or during moist years. Whitetop is one of the earliest perennial	None currently available	Manual, mechanical, and cultural control practices have provided little success. Mowing or grazing with sheep or goats during bud stage and again during rebud (follow by herbicide). Hand pulling or digging must remove all roots and continue for 2 to 5 years to eradicate.	Escort Telar Plateau	Per Acre Rate 0.5 to 1 oz per acre + surfactant ¾ to 1 oz per acre + silicone surfactant 8 to 12 oz per acre + MSO	Treat prior to or at early flowering and fall regrowth Pre-bloom

¹ Carbon and Madison Counties, Montana 2002. Most rate guidelines are suggested by local county weed specialists (Carbon and Madison Counties, Montana); <http://mtwow.org/Chemical-control.htm>. Other rate guidelines come from:

- USFS, 2005. USDA Forest Service, Pacific Northwest Region. Preventing and Managing Invasive Plants Final EIS Appendix. Common Control Measures. Prepared by Linda Mazzu.
- USFS 2006. USDA Forest Service. Pesticide Management and Coordination web site: <http://www.fs.fed.us/foresthealth/pesticide/index.shtml>
- North Dakota State University, 2005. North Dakota Weed Control Guide by R. K. Zollinger, NDSU Extension Weed Specialist: <http://www.ag.ndsu.nodak.edu/weeds/w253/w253-2a.htm#Troublesome>
- University of Idaho Extension, 2005. Idaho's Noxious Weed Control Guide, 2005. <http://info.ag.uidaho.edu/pdf/BUL/BUL0816-05.pdf>

APPENDIX I

[illegible]

APPENDIX I **SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES**

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
				areas where picloram (Tordon) cannot be used. *Transline: Offsite drift may cause damage to sensitive plants up to 300 feet. Little effect on grasses. Use backpack or wick to minimize drift. Transline is less persistent than picloram. More selective than picloram.		
Diffuse knapweed <i>Centaurea diffusa</i>	Biennial or short-lived perennial Abundant seed production. A single plant can produce up to 18,000 seeds. Seeds germinate in both early spring (primarily) and fall. In the fall, diffuse knapweed breaks off at ground level and disperses widely as a tumbleweed. The allelopathic chemical may reduce recovery potential as its presence in the soil may hinder the resurgence of natives. Also dormant seeds may germinate and re-infest an area.	Knapweed flower weevil (<i>Larinus minutus</i>) and bronze knapweed root borer (<i>Sphenoptera jugoslavica</i>) are more effective biocontrol agents than the following agents: seed head gall fly (<i>Urophora affinis</i>); seed head gall fly (<i>U. quadrifasciata</i>); peacock fly (<i>Chaetorellia acrolophi</i>); seed head weevil (<i>Bangasternus fausti</i>); root weevil (<i>Cyphocleonus achates</i>) None of these, alone or in combination effectively control populations. They may prove useful as part of an integrated program to weaken plants therefore making them more susceptible to other treatments.	Hand-pulling of small infestations (usually takes 7 to 10 years). Dig rosettes in the spring. Pull mature and immature plants in early summer before seeds form. Pull and bag (to remove seed from area) remaining plants in mid to late summer. All of the infestation must be pulled. All of the taproot must be removed. Mowing could increase populations of this species. Grazing is not an effective control method. It is generally unpalatable and the spines can injure livestock. Fire may be effective in controlling this species. Low-severity fire may only top-kill diffuse knapweed. Dry soil conditions associated with burns may discourage reinfestation as moisture is the limiting factor for seed germination. Re-seeding of desirable species may be necessary. A fuel model developed for spotted knapweed may be useful to managers planning to burn fields infested with diffuse knapweed. Using prescribed fire to reduce big sagebrush in semiarid grasslands may expose sites to invasion by diffuse knapweed. Replanting is preferred over allowing natural recovery. A native or less persistent species is preferred.	2-4D Tordon Tordon + 2-4D Curtail Banvel + 2,4-D Milestone 2-4D Tordon Tordon + 2-4D Curtail Transline Redeem Transline Redeem	Per Acre Rate 2 quarts per acre + surfactant 1 pint per acre + surfactant 1 pint Tordon + 1 quart 2,4-D per ac + surfactant 2 to 3 quarts per acre + surfactant 1 pint Banvel + 2 pints 2,4-D per acre + surfactant 5-7 oz. per acre 3 Gallon Backpack 4.5 oz per 3 gallons water 1.5 to 2 oz per 3 gallons water 1.5 oz Tordon + 2.25 oz 2-4D per 3 gallons water 4 to 4.5 oz per 3 gallons water Per Acre Rate 1 to 1 1/3 pints per acre + surfactant 1.5 to 2 pints per acre + surfactant 3 Gallon Backpack 1.5 oz per 3 gallons water 1.5 to 2 oz per 3 gallons water	Actively growing (early rosette stage) in the spring, bolt to early bud, or during fall growth
Canada thistle <i>Cirsium</i>	Several ecological types. Prefers and is invasive in prairies and other grasslands and riparian areas with deep, well aerated, mesic soils, but also occurs in almost	Stem-boring beetle (<i>Centorhyncus litura</i>) Gall fly (<i>Urophora</i>)	Removing flowers to prevent seed production. Mowing may only be effective in rare		Per Acre Rate	Before seed set or during fall re-

APPENDIX I

SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
<i>arvense</i>	every upland herbaceous community, especially roadsides, abandoned fields, and pastures. Perennial and rhizomatous. Reproduction by seeds, and shoots from lateral roots. Dormant, buried seeds can remain viable for up to 26 years. It readily roots from fragments less than an inch in length. Flowering occurs during July and August. Canada thistle differs from other species of the true thistle in that there are male and female flower heads, and these are on separate plants. By asexual reproduction, it is possible that a colony of male plants would produce no fruits, but still maintain itself. A Canada thistle shoot can produce as many as 100 heads in a season, with each head containing as many as 100 seeds. Horizontal root growth can extend more than 19 feet in one season and may eventually penetrate into the soil as deep as 22 feet. Left undisturbed, a Canada thistle plant can produce 26 adventitious shoots, 154 adventitious root buds, and 364 feet of roots after 18 weeks of growth. A one year growth study showed a root segment had grown 1,700 feet of roots and turned into a 142-plant colony. At that density, 4.5 acres of thistle roots would stretch from Chicago to Denver – 1,020 miles. The thistle root averaged 2.5 feet of root growth per day. Management should be designed to kill established clones since the species spreads primarily by vegetative expansion of the root system. It takes at least two growing seasons to determine whether a particular control method is effective.	<i>cardui</i>) Shoot fungus (<i>Sclerotinia sclerotiorum</i>) Seed head weevil (<i>Larinus planus</i>) Defoliating beetle (<i>Cassida rubiginosa</i>) Overall, this method provides little or no control, although some agents weaken and kill individuals. Most biocontrols are not adequately synchronized with its life cycle in North America. Management that delays flowering, such as mowing or burning, may help to synchronize a more susceptible stage with biocontrol agent's life cycle. At least three agents may be needed for effective control.	cases where it can be repeated at monthly intervals. This intensity is not recommended in natural areas, where it would likely damage native vegetation, but may be practical along roadsides. Mowing just twice a year, in mid June and September may reduce or contain Canada thistle. When mowing, cut high enough to leave >9 leaves per stem, or > 20 centimeters of bare stem tissue, as mature Canada thistle leaves and stems independently inhibit development of shoots from rootbuds. Smothering Canada thistle with boards, sheet metal or tar paper can kill plants. Above ground parts will be killed by fire, but below ground parts will survive even severe fires. There is abundant evidence that post-fire establishment of Canada thistle is common where seed source is available. Results are mixed on the use of prescribed fire as a management tool. Prescribed burns may be effective at stimulating growth of native species and thereby discouraging the growth of this invasive. It may be best if timed to emulate the natural fire regime of a site. Late spring burns may discourage the species, yet early spring burns may encourage it. Dormant season burning may be preferred because it stimulates growth of native vegetation, but may not be as effective as late spring burning. Annual burns for several years may be required. Revegetation for shade. Cultivation not recommended. Hand pulling or grubbing is not considered to be an economically effective means of controlling an established stand of Canada thistle.	Tordon + 2-4D Curtail Escort Banvel + 2,4-D Rodeo (in wetlands) Telar Transline Redeem Milestone Tordon + 2-4D Curtail Redeem Escort Single herbicide applications generally do not provide long-term control due to the difficulty in killing the root system, which can survive even though the shoots have been killed. It is more effective to combine control methods. In most instances, the most effective method for control is to combine two or three mowing operations with a fall application of 2,4-D, dicamba, clopyralid, metsulfuron, picloram, glyphosate, or chlorsulfuron. Mowing operations stimulate vegetative growth, which weakens the plants food supplies, and the fall herbicide application continues to weaken the plant. Due to the aggressive biology of Canada thistle, re-treatments are necessary.	1 quart Tordon + 1 quart 2-4D per acre 2 to 3 quarts per ac + surfactant 0.75 to 1.0 oz per acre 1.5 pints Banvel + 2 pints 2,4-D per acres + surfactant 1 quart per ac + LI700 surfactant 1.5 oz/A 2/3 pint per acre 3 to 4 pints per acre 5-7 oz. per acre 3 Gallon Backpack 1 oz Tordon + 2.25 oz 2-4D per 3 gallons water 4.5 to 6.5 oz per 3 gallons water 4 oz per 3 gallons water 3/10 oz per 3 gallons water	growth Transline: Up to bud stage Redeem: Rosette to bud
Field bindweed <i>Convolvulus</i>	Perennial Seeds (viable up to 50 years) and creeping deep roots.	Leaf-galling mites (<i>Aceria malherbae</i> / <i>A. convolvuli</i>)	Hand-pulling (and cultivating) must be done for 3 to 5 years every 2 weeks to be effective.		Per Acre Rate	Before seed set or during fall regrowth

APPENDIX I **SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES**

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
<i>arvensis</i>	Field bindweed is one of the most persistent and difficult-to-control weeds. It has a vigorous root and rhizome system that makes it almost impossible to control with cultivation. Its seed has a long dormancy and may last in soil for up to 60 years. It has a climbing habit that allows the plant to grow through mulches. Field bindweed is also very drought tolerant and once established is almost impossible to control with herbicides.		Grazing or mowing are not effective controls. Cultivation and herbicide treatment can be used. If herbicides are to be used, treat the bindweed plants before they are drought stressed. Re-treatments will be necessary to control both established plants and seedlings. If possible, grow a competitive planting of other plants to reduce field bindweed growth. Establish and maintain healthy native vegetation, especially perennial grasses.	Tordon + 2-4D Banvel + 2,4-D Clarity Tordon + 2-4D Banvel + 2,4-D Clarity	1 to 2 pints Tordon + 1 quart 2,4-D per acre 1 quart Banvel + 1 quart 2,4-D per acre 1 to 2 pints per acre 3 Gallon Backpack 1 oz Tordon + 2.25 oz 2-4D per 3 gallons water 2.25 oz Banvel + 2.5 oz 2,4-D per 3 gallons water 1.1 to 2.25 oz per 3 gallons water	
Hounds – tongue <i>Cynoglossum officinale</i>	Houndstongue is a biennial or short-lived perennial species, which forms rosettes in the first year and flowers in the second. It flowers between May and July. It has a thick branching taproot, extending to depths >40 inches. It often occurs in dense stands. Seedlings are usually clustered around parent plants in densities of up to 405 seedlings per square foot. Estimates of total seed number per plant range from 50 to more than 2,000. Its spiny husk and protruding barbs enable long distance dispersal to occur. Seeds attach to fur and clothing. Seed viability in the soil is relatively short compared to other invasive plants. Seed can remain viable above ground on plants for up to two years. Houndstongue is most abundant in areas with more than 10 percent bare ground. Germination starts in late winter and early spring. Houndstongue is toxic, containing pyrrolizidine alkaloids, causing liver cells to stop reproducing. Animals may survive for six months or longer after they have consumed a lethal amount. Sheep are more resistant to Houndstongue poisoning than are cattle or horses. Horses may be especially affected when confined in a small area infested with Houndstongue and lacking desirable forage.	Biological controls are being screened for possible use. One is approved in Canada. A native bacterium is being tested at Montana State University as an effective biological control as well. Spraying the plant with these bacteria interferes with its production of chlorophyll, weakening it so it will not re-sprout the following year.	Surface cultivation, digging and hand pulling are considered ineffective means of control because plants are capable of regenerating from the root crown. Hand pulling can reduce the size of populations up to 85%, though, if roots are completely removed. Hand-pull before flowering. Severing the root crown 1 to 2 inches below the soil surface with a spade and removing top growth can be effective in controlling small infestations when done before flowering. Mowing at ground level can reduce re-growth by 60% as well as seed production in some cases. Plowing is said to control houndstongue, but may not be appropriate in most areas. Keep and maintain vigorous vegetative cover. Houndstongue seedlings have a comparatively low growth rate and are not strongly competitive. Interspecific competition can severely reduce the dry weight of first and second year plants. Therefore, revegetation can effectively control houndstongue re-introduction, although more research is needed.	2-4D Amine Tordon + 2-4D Escort Telar Plateau Banvel + 2,4-D Curtail 2-4D Amine Tordon + 2-4D Escort	Per Acre Rate 2 quarts per acre 1 pint Tordon + 1 to 2 pints 2-4D per acre+ MSO + surfactant 0.5 to 1 oz per acre + MSO + surfactant 1 oz per acre 8 oz per acre + MSO Banvel 2 pints / ac + 2,4-D 2 pints+ MSO Per acre + surfactant 2 quarts per acre + surfactant 3 Gallon Backpack 1 oz per 3 gallons water 1 oz Tordon + 1.12 oz 2-4D per 3 gallons water 3/10 oz per 3 gallons water	Before seed set or during fall regrowth Escort rosette to bolt. Telar in the Fall. Before seed set or during fall regrowth
Leafy spurge	Occurs on untilled, non-cropland habitats, including both disturbed and undisturbed sites, especially abandoned cropland,	flea beetle (<i>Aphthona abdominalis</i>)	No mechanical methods have been found to work effectively alone. Hand-pulling, digging, and tilling are only successful if		Per Acre Rate	Before seed set or

APPENDIX I

SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
<i>Euphorbia esula</i>	pastures, rangelands, woodlands, roadsides, and waste places. Tolerant of a wide range of soils from rich, moist soils of riparian zones to nutrient-poor, dry soils of western rangelands. It is most aggressive in semi-arid situations where competition from associated species is less intense, so invades most rapidly on dry hillsides, dry prairies, or rangelands. Perennial and rhizomatous. Seeds (viable up to 8 years, usually germinate within 2 years), and spreading roots. Each flowering stem produces an average of 140 seeds. When the plant matures, the seed capsule explodes and launches the seeds up to 15 feet. Seed production, which ranges from 25 to 4,000 pounds per acre depending on plant density and site productivity, is usually completed by mid-August. Seedlings have capacity for vegetative reproduction and can develop root buds with 7 to 10 days of emergence. Roots have been excavated to a depth of over 4 meters and found at 30-35 feet in length. Root systems of well-established older plants can regenerate from fragments even if roots are removed to a depth of three feet. The latex can cause blistering and skin irritation to cattle and can have ill effects when it comes into contact with humans.	flea beetle (<i>A. nigricutis</i>) flea beetle (<i>A. lacertosa</i>) flea beetle (<i>A. czwalinae</i>) flea beetle (<i>A. cyparissiae</i>) flea beetle (<i>A. flava</i>) hawk moth (<i>Hyles euphorbiae</i>) Long horned beetle (<i>Oberea erythrocephala</i>) Gall midge (<i>Spurgia esulae</i>) Some success has been found with the flea beetle combined with fall herbicide treatments.	the entire root system can be excavated, and may increase the number of plants if any remnants remain in the soil. Repeated mowing/cutting before flowering in conjunction with use of herbicides for adequate control of stand expansion. Mowing is ineffective when used alone. However, it does reduce seed production and dispersal and disrupts root vigor, making the plants more susceptible to pathogens. Mowing increases the effectiveness of herbicides by making the stand of leafy spurge more uniform, improving the coverage of the chemical treatment. Grazing by sheep or goats can be a very effective tool for controlling leafy spurge populations. Leafy spurge is not toxic, and in fact, is very nutritious, providing good forage. Light, periodic cultivation stimulates additional plants from the roots resulting in a denser stand. Initial reseeding with grasses followed by eventual revegetation with forbs and shrubs may contribute to long-term suppression of leafy spurge. Competitive grasses include: wild rye, pubescent wheatgrass, and western wheatgrass. Burning, alone, is ineffective for reducing leafy spurge infestations, and it stimulates sprouting of established plants, increasing plant density. Spring or fall burns are best when trying to control seed production and is more effective when used in conjunction with herbicides or grazing.	Tordon Tordon + 2-4D Escort Telar Plateau Tordon Tordon + 2-4D Successful management of leafy spurge requires a long-term, extensive management plan using various combinations of management methods (IPM). Plateau, 2,4-D, Banvel or Tordon 22K systemic herbicides have been found to be effective if applied in June, when the flowers and seeds are developing, or in early to mid-September when the plants are moving nutrients downward into the roots.	2 to 3 quarts per acre + surfactant (kills) 1 quart Tordon + 1 quart 2-4D + surfactant (suppresses) 1 to 1 ½ oz + 2 quarts 2,4-D per acre4D + silicone surfactant @ 1 quart per 100 gallon water 1 to 2 oz per acre4D + surfactant 8-10 oz per acre4D + surfactant 3 Gallon Backpack 4.5 to 6.5 oz per 3 gallons water 2.25 oz Tordon + 2.25 oz 2-4D per 3 gallons water	during fall regrowth Plateau – Before first fall freeze
St. Johnswort <i>Hypericum perforatum</i>	St. Johnswort is a taprooted perennial weed which reproduces by seeds and short runners. The taproot may reach depths of 4 to 5 feet. Lateral roots grow 2 to 3 inches beneath the soil surface but may reach depths of 3 feet. Flowering begins in May and continues through September. Developing capsules become very sticky and contain 400 to 500 seeds. Seeds may remain viable in soil for up to 10 years..	beetle (<i>Agrilus hyperici</i>) moth (<i>Aplocera plagiata</i>) beetle (<i>Chrysolina hyperici</i>) beetle (<i>C. quadrigemina</i>) Klamath weed midge (<i>Zeuxidiplosis giardi</i>) The Klamath weed beetle has had good	Hand-pulling or digging of young, isolated plants. Repeated treatments will be necessary because lateral roots can give rise to new plants. Pulled or dug plants must be removed from the area to a refuse site or burned to prevent vegetative regrowth. Cutting and mowing not recommended - may reduce seed but promotes sprouting from rhizomes. Burning may increase the density and vigor of this species. Livestock avoid this species which can make them sensitive to sunlight, so	Tordon 2,4-D Repeated applications necessary. Metsulfuron methyl also used for this species	Per Acre Rate 1 pint per acre 1 quart per acre	Pre-bloom Seedling/pre-bloom

APPENDIX I **SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES**

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
		success and another beetle (<i>C. Hyperici</i>) is better adapted to wetter sites.	grazing would select for the increase of this species. Regular cultivation. Maintain competitive, closed-canopy plant community. This species is not shade tolerant.			
Oxeye Daisy <i>Leucocanthemum vulgare</i>	Oxeye Daisy: Perennial / Shallow – rooted / Rhizomes Oxeye daisy flowers in June through August. The plant is a prolific seed producer; a single, healthy, robust plant produces up to 26,000 seeds. Reproduction occurs primarily through seed dispersal and germination, although spreading rootstalks contribute to its propagation. Seeds may be viable ten days after the flower blossoms and are dispersed close to the parent plant. Germination occurs throughout the growing season, but most new seedlings emerge in spring. Seeds that do not germinate in the spring may remain viable for many years. One study found 82 percent of seeds were viable after 6 years and 1 percent was still viable after 39 years.	No biological controls have been discovered for oxeye daisy.	Oxeye daisy should be mowed as soon as flowers appear to reduce seed production. Mowing may have to be repeated during a long growing season because mowing may stimulate shoot production and subsequent flowering. Root systems are shallow and the plant can be dug up and removed. Be sure to remove the entire root system, though, as remaining roots may produce new shoots. Hand removal will have to be continued for several years because seeds may remain viable in the soil for a long time. Where oxeye daisy is already a major member of the plant community, it will increase with continuous cattle grazing. However, oxeye daisy density may be reduced by intensive cattle grazing.	Tordon + 2-4D Redeem Escort Curtail 2,4-D Clarity Milestone Tordon + 2-4D Redeem	Per Acre Rate 1 pint Tordon + 1 quart 2-4D per acre 2 pints per acre 1 oz per acre 2 pints per acre 1 to 2 quarts per acre 1 quart per acre 4-6 oz. per acre 3 Gallon Backpack 1.0 oz Tordon + 2.25 oz 2-4D per 3 gallons water 2 oz per 3 gallons water	Before seed set
Dalmatian toadflax <i>Linaria dalmatica</i>	Perennial. A toadflax plant may have a taproot as deep as one meter. Horizontal roots may grow to several meters long (25 inches per year) and can develop adventitious buds that may form independent plants. Once established this species can suppress other vegetation mainly by intense competition for limited soil water. Mature plants are particularly competitive with winter annuals and shallow-rooted perennials. Seeds can remain dormant for up to ten years. They are quick to colonize open sites and are capable of adapting growth to a wide variety of environmental conditions. A single Dalmatian plant can produce up to 500,000 seeds, beginning in late June and continuing until September or early October. Seed production can begin on lower portions of the stems while upper portions are still in various stages of bloom. Dried floral stalks can remain standing for two years, retaining some	toadflax moth (<i>Calophasia lunula</i>) root-boring moths (<i>Eteobalia intermediella</i> and <i>E. serratella</i>) stem-boring weevil (<i>Mecinus janthinus</i>) has shown dramatic impact on Dalmatian toadflax at some locations. The following are not considered highly effective: ovary-feeding beetle (<i>Brachypterolus pulicarius</i>) flea beetle (<i>Longitarsus jacobaeae</i>)	Hand-pulling must remove all roots, best in sandy or moist soils (annually, 10-15 years to eradicate). Regular cultivation (every 7 to 10 days starting in June, for 2 years). Do not mow. Fire is not effective Toadflax seedlings are initially very vulnerable to competition from established, vigorous vegetation. Restrict spring cattle grazing on sites with toadflax to maintain vigorous competition from native species. Because of its deep, extensive root system, waxy leaf, and heavy seed production, this plant is difficult to manage.	Tordon + 2-4D Telar Escort Escort + 2,4-D Plateau Tordon + 2-4D Telar Toadflax has a waxy leaf surface; silicone surfactant is the MOST important additive to any of the herbicide mixture to ensure	Per Acre Rate 2 quarts per acre + surfactant 1.5 to 2.0 oz. per acre + surfactant 2 oz. per acre + silicone surfactant 1 to 2 oz Escort + 2 pints 2,4-D per acre +silicone surfactant 8 to 12 oz per/acre and MSO and silicone surfactant 3 Gallon Backpack 4.5 oz per 3 gallons water + surfactant 0.5 oz per 3 gallons water + surfactant	Spring bloom & late fall post bloom Best if Escort is used in the fall. Plateau: Fall prior to frost Spring bloom & late fall post bloom

APPENDIX I **SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES**

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
	seeds but dispersing most during the first year. Some Dalmatian toadflax seed germination occurs in the fall, but most occurs the following spring, with peaks in April and May. Germination rates are as high as 75%, and seeds can remain dormant at least 10 years. These dormant seeds can rapidly re-infest a site following control applications, even when pre-emergent herbicides are used, because only a portion of the seeds will germinate in any given year.	seed capsule-feeding weevils (<i>Gymnetron antirrhini</i> and <i>G. linariae</i>)		results. Wet entire plant.		
Yellow toadflax <i>Linaria vulgaris</i>	Perennial Before flowering, yellow toadflax can resemble leafy spurge. It can be distinguished by snapping the stem. The absence of a milky substance in the stem will determine that the plant is a toadflax. Flowers produce capsules containing 10 to 40 seeds each. The fruit is round, about ¼ inch in diameter and brown. A single plant may produce 15,000 to 30,000 seeds. Seed germination rates are usually low, often below 10%. A toadflax plant may have a taproot as deep as one meter. Horizontal roots may grow to several meters long (25 inches per year) and can develop adventitious buds that may form independent plants. Once established this species can suppress other vegetation mainly by intense competition for limited soil water. Mature plants are particularly competitive with winter annuals and shallow-rooted perennials. Seeds can remain dormant for up to ten years. They are quick to colonize open sites and are capable of adapting growth to a wide variety of environmental conditions.	toadflax moth (<i>Calophasia lunula</i>) root-boring moths (<i>Eteobalia intermediella</i> and <i>E. serratella</i>) seed capsule-feeding weevils (<i>Gymnetron antirrhini</i> and <i>G. linariae</i>) stem-boring weevil (<i>Mecinus janthinus</i>) ovary-feeding beetle (<i>Brachypterolus pulicarius</i>) flea beetle (<i>Longitarsus jacobaeae</i>) None of these are considered highly effective.	Hand-pulling must remove all roots, best in sandy or moist soils (annually, 10-15 years to eradicate). Regular cultivation. Do not mow. Fire is not effective Intense competition with native vegetation. Because established infestations of yellow toadflax spread mainly by roots, physical removal (especially around perimeters) can limit spread.	Tordon Tordon/Telar/Overdrive Tordon Fall applications of picloram give partial control. Dicamba + 2, 4-D, chlorosulfuron, or metsulfuron methyl + 2, 4-D gives good control when applied before the bloom stage. 2, 4-D alone can be effective, but will likely require repeated applications.	Per Acre Rate 4 pints Tordon per acre; Use a silicone surfactant 1 quart Tordon, 1 oz. Telar, & 4 oz. Overdrive; use a surfactant like LI-700 @ one quart/ac 3 Gallon Backpack 4.5 oz per 3 gallons water; Use a silicone surfactant	Before seed set
Sulfur cinquefoil <i>Potentilla recta</i>	Sulfur cinquefoil is a long-lived, taprooted perennial herb that typically flowers from late May to mid July. It reproduces primarily through seed; a single plant can produce thousands of seeds annually and it can be spread by roots if they are moved by tillage or on soil-moving equipment. Seeds are dispersed primarily by wind from late summer through fall. Seeds appear to remain viable in the soil for more than four years, though studies specifically addressing seedbank persistence are lacking. In western North America, sulfur	root moth (<i>Tinithia myrmosae-formis</i>) flower-head weevil (<i>Anthonomus rubripes</i>) Sulfur cinquefoil is closely related to the desirable northern cinquefoil, the wild strawberry and tame strawberry.	Hand-pulling of small infestations (must remove root crown). Regular cultivation. Mowing not recommended. Burning used alone does not appear to be effective, and may in fact increase sulfur cinquefoil recruitment. Regular cultivation and reseeding.	Tordon + 2-4D Escort Milestone	Per Acre Rate 1 pint Tordon + 1 quart 2-4D per acre 0.5 to 1 oz per acre 4-6 oz. per acre 3 Gallon Backpack	Before seed set and during fall regrowth

APPENDIX I **SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES**

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
	cinquefoil invades native forest, shrub and grassland plant communities as well as disturbed habitats that typically harbor weeds. It can dominate a site within 2 to 3 years. New shoots can develop annually from the outer portion of the main root allowing a plant to live for extended periods as long as 20 years	Therefore, insects for bio control are very difficult to find for "plant specificity." (MT Dept. of Ag, 2002).	If populations are reduced (i.e. by herbicide, hand-digging), native plants are usually able to rapidly recolonize sites if sufficient native seed is still viable in the soil. Seeding of native species under adequate environmental conditions, reducing grazing pressure, and continued spot herbicide re-treatments, will result in a more rapid and stable restored native plant community.	Tordon + 2-4D Escort	1 oz Tordon + 2.25 oz 2-4D per 3 gallons water 2/10 oz per 3 gallons water	
Common Tansy <i>Tanacetum vulgare</i>	Perennial Seeds, rhizomes.	None currently available.	Hand-pulling not recommended (stimulates sprouting from rhizomes) and must remove all roots. Constant cultivation, otherwise the infestation can increase infestation by chopping roots that sprout. Mowing to reduce seed production. Grazing by sheep and goats. Revegetation for shade.	Tordon + 2-4D Tordon Redeem + Escort Escort Tordon + 2-4D Tordon Redeem + Escort	Per Acre Rate 1 pint Tordon + 1 quart 2-4D per acre 2 pints per acre 3 pints Redeem + 0.5 oz Escort per acre 1 oz per acre 3 Gallon Backpack 1 oz Tordon + 2.25 oz 2-4D per 3 gallons water 2 oz per 3 gallons water 3 oz Redeem + 0.7 grams Escort	Before flowering
NEW INVADERS – CATEGORY 2 SPECIES						
Worm-wood, Absinth <i>Artemisia Absinthium</i>	This plant is very aggressive. It likes soil disturbance and will grow in most any type soils and tends to be in areas with moisture. Most common places to find absinth wormwood are gravel pits, topsoil stockpiled areas, new roads or construction sites, and irrigation ditch banks.	None currently available.	.Livestock and wildlife will not graze this plant due to the odor. The plants should be mowed in early to mid summer to promote active re-growth prior to a fall herbicide treatment.	Redeem Tordon Milestone Redeem Tordon	Per Acre Rate 1.5 to 2.0 pints per acre 2 pints per acre 6-7 oz. per acre 3 Gallon Backpack 2 oz per 3 gallons water 2 oz per 3 gallons water	When the plant is at least 12 inches tall and actively growing
Orange Hawkweed <i>Hieracium aurantiacum</i>	Hawkweeds are perennials with shallow fibrous root systems and rhizomes. They can reproduce by seed or vegetatively. Orange and yellow hawkweeds also produce stolons that can produce new plants. Yellow or meadow hawkweed can also develop new plants from the root buds. Although, most populations begin from seed, these species will then aggressively spread through rhizomes or	None currently available.	Hand-pulling not recommended (stimulates sprouting from rhizomes) difficult to remove all roots. Mowing is considered ineffective. Revegetation for shade by seeding and fertilization.	Curtail Milestone Tordon + 2,4-D	Per Acre Rate 1 to 2 quarts per acre + surfactant 4-6 oz. per acre 1 pint Tordon + 1 pint 2,4-D + surfactant	Rosette to bolt

APPENDIX I **SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES**

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
	stolons. In a new site, less than 2 percent of the plants come from seedlings. Once established, vigorous stolon growth quickly expands the colony, forming dense patches with as many as 3,200 plants per square yard. Seeds are wind-adapted.			Redeem Transline (use on forest sites) After herbicide treatment, applying soluble nitrogen fertilizer can be effective in increasing the competitive abilities of grass. Fertilizing, when applied within 1 to 2 weeks of herbicide treatment is an important tool for restoring bare ground more quickly after the hawkweeds die back.	1.5 pints per acre + surfactant 1 pint per acre + surfactant	
Yellow or Meadow Hawkweed <i>Hieracium pratense</i>	Hawkweeds are perennials with shallow fibrous root systems and rhizomes. They can reproduce by seed or vegetatively. Orange and yellow hawkweeds also produce stolons that can produce new plants. Yellow or meadow hawkweed can also develop new plants from the root buds. Although, most populations begin from seed, these species will then aggressively spread through rhizomes or stolons. In a new site, less than 2 percent of the plants come from seedlings. Once established, vigorous stolon growth quickly expands the colony, forming dense patches with as many as 3,200 plants per square yard. Seeds are wind-adapted. Species of the meadow hawkweed complex are similar in appearance to orange hawkweed. The roots are shallow, fibrous and creeping. The entire plant contains a milky juice. The three species of the meadow hawkweed complex are difficult to distinguish because they interbreed. However, introduced hawkweed species can usually be distinguished from native (North American) hawkweeds. Native hawkweeds lack stolons, usually have leafy branched stems, and have an umbelliform inflorescence while the invasive species do not.	None currently available.	Hand-pulling not recommended (stimulates sprouting from rhizomes) difficult to remove all roots. Mowing is considered ineffective. Revegetation for shade by seeding and fertilization. Annual cultivation. Fertilizer (NPK) will work if there is already a large amount of native plants in the area. The fertilizer will make the native plants out-compete the meadow hawkweed complex.	Curtail Milestone Tordon + 2,4-D Redeem Transline (use on forest sites) After herbicide treatment, applying soluble nitrogen fertilizer can be effective in increasing the competitive abilities of grass. Fertilizing, when applied within 1 to 2 weeks of herbicide treatment is an important tool for restoring bare ground more quickly after the hawkweeds die back.	Per Acre Rate 1 to 2 quarts per acre + surfactant 4-6 oz. per acre 1 pint Tordon + 1 pint 2,4-D + surfactant 1.5 pints per acre + surfactant 1 pint per acre + surfactant	Rosette to bolt
Dyer's woad <i>Isatis tinctoria</i>	Winter annual, biennial, or short-lived perennial Seeds. Dyer's woad taproots can reach 3 to 6 feet in depth and branch laterally within the first 12 to 20 inches of soil. Seeds germinate in early spring or fall.	rust (<i>Puccinia thlaspeos</i>) [Occurs naturally, not currently approved.]	Hand-pulling, cultivation, or digging below the crown before seed production are very effective, must remove crown to prevent resprouting. Sheep grazing may also provide limited control of dyer's woad. Sheep readily consume top growth of woad until the flowering stage. Recent studies suggest that properly timed grazing, repeated	Ally or Escort (metsulfuron) (To minimize seed production on large infestations for about 2 seasons of control)	Per Acre Rate ½ oz. per acre + NIS surfactant	Best in pre-bloom or early bloom. Can minimize seed production with late application after fruits have begun to form.

APPENDIX I

SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
			several times per season may increase mortality and reduce reproductive performance when at least 60 percent of the plant is removed. Biological controls alone will not eradicate dyer's woad but may provide some control.	2, 4-D Telar (chlorsulfuon) is registered for use on right-of-ways and in crops; not in rangelands. Metsulfuron in combination with 2,4-D is effective in pastures and rangelands Picloram and dicamba provide relatively poor control of dyer's woad.	1.5-2 qts per acre 1 oz. per acre	Spring or fall rosette. Pre- or early post emergent to young plants.
Perennial pepperweed <i>Lepidium latifolium</i>	Perennial pepperweed produces dense stands with stems reaching up to 3 feet in height, but even up to 8 feet in wet areas. Its dense cover blocks sunlight from reaching the soil, thus suppressing the growth of other plants. Roots are enlarged at the soil surface in a woody crown and can extend at times into the water table. Roots as deep as 3 meters have been observed. The species is a prolific seed producer, capable of producing more than six billion seeds per acre. Seeds lack a hard cover, though, therefore viability may be short. Shoots flower and fruit in late spring and continue throughout much of the summer. Seeds either fall from the pod or can remain in pods until the following season. In addition to seeds, the species can spread by rhizomes which may grow to a length of ten feet.	None approved.	With the exception of continual flooding, no non-chemical treatments have been found to effectively control this species. Fall-disking, spring mowing; followed by herbicides, including glyphosphates has some good results. Establish and maintain healthy riparian vegetation	Telar or Escort Arsenal	Per Acre Rate 1 oz/A 6 to 24 fl oz/A	Flower to bud stage
Purple loosestrife <i>Lythrum salicaria</i>	Perennial Purple loosestrife has an extended flowering season from June to September. A mature plant may have as many as thirty flowering stems capable of producing an estimated two to three million seed per year. It also readily reproduces vegetatively at a rate of about 1 foot per year. The seeds can remain viable even after 20 months of submergence in water. Seed dispersal is mainly by water, but seeds can also be transported on the feet and bodies of waterfowl and other birds, as well as numerous wetland animals. Purple loosestrife also spreads vegetatively. Root or stem segments can form new flowering stems. Muskrat cuttings and mechanical clipping can therefore contribute to rapid spread by floating in riverine and lacustrine systems.	weevil (<i>Hylobius transversovittatus</i>) black-margined and golden leaf eating beetles (<i>Galerucella californiensis</i> and <i>G. pusilla</i>) flower weevil (<i>Nanophyes marmoratus</i>) The most promising control measure for purple loosestrife is the application of biological agents. Beetle species have been screened as potential control	Areas of individual younger plants and clusters of up to 100 younger plants can be hand-pulled, if done before flowering. Older plants, especially those in bogs or in deep organic soils, can be dug out. Roots of older plants can be "teased" loose with a hand cultivator. Follow-up treatments are recommended for three years after the plants are removed. Hand-pulling or cutting before seed set, followed immediately by flooding (generally, mowing or cutting not recommended). Revegetation can be effective.	Glypro Rodeo Garlon 3A Rodeo has been approved for wetlands, drainage, aquatic sites. Use only 4 lb ae/gal glyphosate formulations. Apply with an NIS approved for use in aquatic sites at 0.75% v/v. Control seedling using a 2,4-D formulation labeled for use new water. Spot application of a glyphosate herbicide to individual purple loosestrife plants is recommended treatment where	Per Acre Rate 1 to 1.5% concentrate/Ac (1 to 1.5 gal/100 gal water or 1.3 to 1.9 fl. Oz. / gal) 1 to 9 lbs ai/Ac (1 to 3 gal/100 gal water)	When plants begin to flower

APPENDIX I **SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES**

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
	A strong rootstock serves as a storage organ, providing resources for growth in spring and regrowth if the aboveground shoots are cut, burned, or killed by application of foliar herbicides.	agents and are being studied.		hand pulling is not feasible. Glyphosate application is most effective when plants have just begun flowering. Timing is crucial, because seed-set can occur if plants are in mid-late flower. Where feasible, the flower heads should be cut, bagged, and removed from the site before application to prevent seed set. Since purple loosestrife is usually taller than the surrounding vegetation, application to the tops of the plants alone can be very effective and limit exposure of non-target species.		
Tall buttercup <i>Ranunculus acris</i>	Perennial with a very fibrous taproot. The bright yellow flowers are waxy, with 5 petals. Each plant is capable of producing up to 250 seeds. Tall buttercup contains a bitter juice, which cause blistering of the mouth and digestive system when consumed by livestock.		Pasture management practices that improve growth of desirable plants help to compete against emergence and growth of this plant. Also, avoid excess overgrazing by animals. Mowing fields or clipping plants close to the ground in the early spring before buttercup plants can produce flowers may help reduce the amount of seed produced, but mowing alone will not totally eliminate seed production.	Tordon + 2-4D Redeem Escort Curtail 2,4-D Clarity Milestone Tordon + 2-4D Redeem Banvel (dicamba), WeedMaster (dicamba + 2,4-D), Redeem R&P (triclopyr + clopyralid), Crossbow (triclopyr+2,4- D), or Ally (metsulfuron) can be used in grass pastures.	Per Acre Rate 1 pint Tordon + 1 quart 2-4D per acre 2 pints per acre 1 oz per acre 2 pints per acre 1 to 2 quarts per acre 1 quart per acre 4-6 oz. per acre 3 Gallon Backpack 1.0 oz Tordon + 2.25 oz 2-4D per 3 gallons water 2 oz per 3 gallons water	Before seed set
Tansy ragwort <i>Senecio jacobaea</i>	Tansy ragwort is considered a biennial species. Under extremely favorable conditions, though, this species may behave like an annual. If conditions are poor or the plant is damaged, it may be induced into a mono- or polycarpic perennial habit. Polycarpic perennial plants often have large, woody rootstocks and more than one flowering stalk. Dispersal of the seed though not usually long distance (up to around 9 meters), can	Seed fly (<i>Pegophilemyia seneciella</i>) Flea beetle (<i>Longitarsus jacobaeae</i>) Cinnabar moth (<i>Tyria jaobaeae</i>)	Mowing just prior to flowering when the plant has exhausted the greatest amount of its stored reserves and before its seeds have started to develop. Although mowing can prevent flowering, it appears to increase rosette density. Hand-pulling small infestation when soil is moist and before flowering; must remove all roots. Plants must be mature enough to bloom, at which point stems are firm	Transline 2,4-D Milestone Tordon Banvel	Per Acre Rate 1 pint per acre 1 to 2 lb ae/A 4-5 oz. per acre 0.25 lb ae/A 1 lb ae/A	Rosette to bud; fall regrowth

APPENDIX I **SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES**

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
	vary depending on climatic conditions. Seeds can remain viable in the soil for several years and as deep as 25 centimeters. The species also regenerates vegetatively, usually, but not always due to damage. The whole tansy ragwort plant is poisonous. The stems contain about 25 to 50 percent of the alkaloid found in the leaves, but the flowers contain about twice as much as the leaves. Tansy ragwort has six different pyrrolizidine alkaloids, which combine and add up in the liver of herbivores over time. When these materials are transferred into pyrroles, they cause liver damage. Intoxication often happens when small plants combined with desirable forage plants are ingested unknowingly by cattle and horses while grazing. After consuming 3 to 7 percent of their body weight of this noxious weed, animals may die. If they do not die, the milk produced by them could become toxic.	Although an effective part of a long-term management strategy, the biocontrols in place will decline as the ragwort declines. Because of the ability for seed to remain dormant, they could effectively 'outwait' the decline of the biocontrol. The most effective biocontrol is when all three agents (cinnabar moth, ragwort flea beetle and seed fly) are used in combination.	and not easily broken. Because the primary root grows toward one side, the technique that works best is to tug firmly from one side and if the plant does not come out, move to the opposite side. Grazing heavy infestations with sheep prior to flowering. The healthier the native vegetation, the less likely this plant will become established (needs disturbance to create openings in native vegetation in order to establish).	Weedmaster (2,4-D + dicamba) Crossbow (triclopyr = 2,4-D) Escort clopyralid + 2,4-D Spring is usually the best time to spray. Most publications state that 2,4-D and dicamba are the most effective herbicides to use.	2 qt/A 1.5 to 2 qt/A 0.75 oz/A	
Salt Cedar <i>Tamarisk</i> complex	Perennial Seeds (can produce over 500,000 seeds); and from stems, crown and roots.	mealy bug (<i>Trabutina mannipara</i>) leaf beetle (<i>Diorhabda elongata</i>)	New growth occurs readily when young plants are grazed or mowed, or the trunk or shoots are removed or killed by fire or severe drought. Establish and maintain native vegetation.	Rodeo Aquatic Roundup Pro Arsenal Thoroughly wet foliage. Do not cut down and remove for at least 3 years or re-growth will occur.	Per Acre Rate: 71/2 Pints /Acre plus 1/2%V/V Nonionic Surfactant Spot Treatment: 11/2% V/V Solution plus 1/2% V/V Nonionic Surfactant Cut Stump Treatment: 100% V/V Solution (Full Strength) Per Acre Rate 5 QT./Acre Spot Treatment: 2% v/v solution Cut Stump Treatment: 100% v/v Solution (Full Strength) Per Acre Rate: 1.5 to 2 QT./Acre w/ MSO adjuvant Spot Treatment: 0.75 to 1% V/V solution + 0.5% surfactant Cut Stump Treatment: 12 OZ. per gallon of water	Late spring to early fall

APPENDIX I **SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES**

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
				Garlon and Pathfinder II Garlon has been used successfully for many years, particularly as a basal treatment. Only triclopyr is effective in this type of application. Volatility of triclopyr at higher ambient temperatures could lead to undesirable effects on adjacent vegetation. Highest rates should be used where plants are mature or in dense groups; where <i>Tamarix</i> covers 60% or more of area to be treated; where plants average 15 feet tall; or under drought conditions Renovate3 (triclopyr) is labeled for aquatic use.	Foliar Treatments: 2 to 4 QT./Acre of Garlon 4 or 3A. Dilutions with diesel are not recommended. Modified Cut Stump Treatments: Undiluted Pathfinder II or 50% solution of Garlon 4 or 3A Basal Bark Treatments: Undiluted Pathfinder II or a 20 - 25% solution of Garlon 4 in natural oil or diesel. Or – 1 -3 parts Remedy plus basal bark oil	There are no timing restrictions for application of Garlon 4 or Pathfinder II. Garlon 3A should be applied during the growing season.
POTENTIAL INVADERS – CATEGORY 3 SPECIES						
Yellow starthistle <i>Centaurea solstitialis</i>	Winter annual or biennial Seeds (up to 12 years dormancy and viability). Yellow starthistle typically begins flowering in late May and continues through September, sometimes into December or later. The time period from flower initiation to the development of mature viable seed is only 8 days. Infestations can produce 50-100 million seeds per acre. Wind dispersal is not effective. Over 90 percent of seed fall within two feet of a plant. Non-pappus bearing seed can be retained in the flower head for a considerable amount of time, even into the winter. Over 90 percent of seed are germinable one week after seed dispersal. Seeds may stay viable from six to twelve years.	Approved: Rust fungus (<i>Puccinia jaceae</i> var. <i>solstitialis</i>) peacock fly (<i>Chaetorellia australis</i>) flower weevil (<i>Larinus curtus</i>) yellow starthistle hairy weevil (<i>Eustenopus villosus</i>) flies (<i>Urophora sirunaseva</i> and <i>U. jaculata</i>) Effective, but pending approval: false peacock fly (<i>Chaetorellia succinea</i>)	Grazing before spine production (toxic to horses). Hard to control seed bank with mechanical methods. Hand pull small patches after plants have bolted but before they produce viable seed. Remove all above ground stem material. Unlike many invaders, it can be controlled through an intensive burning program because of its annual life cycle, however control is still difficult. Mowing, burning early in flower (timing is critical). The ideal burning time is similar to the ideal mowing time (early flowering before seedset). Unfortunately early to mid-summer burning may not be feasible in some places due to climatic or environmental conditions. It may be best used after herbicide treatment (such as with clopyralid) in the first year. This would suppress legumes and stimulate grasses making a second year fire more effective in promoting species diversity. Deep plowing may be effective where feasible because knapweed seeds will not	2-4D Tordon Milestone Tordon + 2-4D Curtail Banvel + 2,4-D 2-4D Tordon Tordon + 2-4D Curtail Transline	Per Acre Rate 2 quarts per acre 1 pint per acre 3-5 oz. per acre 1 pint Tordon + 1 quart 2-4D per ac 2 to 3 quarts per acre 1 pint Banvel + 2 pints 2,4-D per acre 3 Gallon Backpack 4.5 oz per 3 gallons water 1.5 to 2 oz per 3 gallons water 1.5 oz Tordon + 2.25 oz 2-4D per 3 gallons water 4 to 4.5 oz per 3 gallons water Per Acre Rate 1 to 1 1/3 pints per acre	Actively growing (early rosette stage) in the spring, bolt to early bud, or during fall growth

APPENDIX I **SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES**

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
			germinate below 3 cm. Shallow plowing could actually increase this species. Revegetation with native species for shade.	Redeem Transline Redeem	1.5 to 2 pints per acre 3 Gallon Backpack 1.5 oz per 3 gallons water 1.5 to 2 oz per 3 gallons water	
Rush skeletonweed <i>Chondrilla juncea</i>	Perennial Seeds, deep-rooted, rhizomatous lateral roots and root fragments. Rush skeletonweed can produce by either seed or vegetatively. It is a somewhat long lived perennial which can produce seed without fertilization. This self fertilization produces clones resulting in well-adapted biotypes that can dominate an area. Mature plants can produce 1500 flower heads with the capability of producing 20,000 seeds. Seeds can be wind dispersed up to 20 miles. Vegetative spread is possible from shoot buds found along lateral roots, and from shoot buds found near the top of the main tap root. Vegetative spread is also possible when a root fragment, as deep as four feet down, is left in the ground. When the plant stem or root is mechanically injured, vegetative growth is initiated.	Gall midge (<i>Cystiphora schmidtii</i>) Gall mite (<i>Eriophyes chondrillae</i>) Rush skeletonweed rust (<i>Puccinia chondrillina</i>)	Hand-pulling must remove all roots (3 to 6 times per year for 5 to 10 years to eradicate new shoots and seedlings). Mowing not recommended (increases growth from roots). Since any mechanical damage to plants stimulates new growth resulting in satellite plants, mechanical treatment is not recommended. Frequently mowing plants infested with fall mites may decrease the rate of spread for the species. Heavy seeding rates and fertilizing with nitrogen works best.	2,4-D + Tordon 101 Stinger Stinger + Banvel DMA Difficult to control with herbicides. Takes consistent spraying for 3 to 5 years.	Per Acre Rate Tordon 101 at 1 lb/acre plus 2,4- D at 1 lb/acre 0.2 lb/acre Stinger at 0.2 lb/acre, and Banvel DMA at 1 lb/acre	Spring
Common crupina <i>Crupina vulgaris</i>	Winter annual Wind may spread common crupina seeds up to five feet from the plant, rodents can carry seeds at least 50 feet away. Common crupina seeds can endure passage through the digestive system of cows, horses, upland game birds, and deer, but not sheep. It is not known whether or not seed passed by goats is viable. The seeds remain viable in soil for at least 25 to 32 months, so transporting soil from infested to uninfested areas can spread this weed. Inhabits many moisture and temperature regimes and soil types. Common crupina prefers well-drained, sandy or loamy soils and southern slopes on steep canyon grasslands. Also, it commonly grows along field edges, and in improved pastures, hayfields, and grass seed fields. It	None known.	Preventing all seed production for at least three generations (hand-pulling, plowing, and hoeing) on small populations. This requires that the area be checked every two to four weeks all spring and summer for at least three years following the last year the seed is produced. This prevents new plants from producing seed and extending the time required to control the infestation. Dispose of plants in a covered landfill or burn them so that mature seeds are not dispersed. After the weed has begun producing seeds, do not use mowing as a control strategy because of an increased chance of seed dissemination. Establish and maintain healthy native vegetation (must revegetate after removal).	Transline or Stinger Tordon 2,4-D + dicamba	Per Acre Rate 0.35 pt/A 0.25 to 0.50 lb ae/A 0.5 lb ae/A dicamba + 1 lb ae/A 2,4-D	Split – fall then spring Fall or later winter Actively growing

APPENDIX I **SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES**

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
	frequently infests gravel pits, roadsides, railroad embankments, and other rights-of-way.					
OTHER - WEEDS						
Cheatgrass <i>Bromus tectorum</i>	Although <i>Bromus tectorum</i> can be found in both disturbed and undisturbed shrub-steppe and grasslands (e.g., where dominant grasses are bluebunch wheatgrass and Idaho fescue). The largest infestations are usually found in disturbed shrubsteppe areas, overgrazed rangeland, abandoned fields, eroded areas, sand dunes, road verges, and waste places. Winter annual Seeds	None currently available. [Two rhizobacteria, <i>Pseudomonas fluorescens</i> (strain D7), and <i>P. syringae</i> (strain 3366) are under study.]	Cutting is not recommended. Deep disking several times at intervals to bury seeds 4 to 6 inches then overseeding. Shallow disking to initiate seed germination, then either disking again or spraying with glyphosate, followed by broadcast or drill seeding. Must revegetate sites that have been disked or sprayed to provide competition. The perennial plant cover in a stand of cheatgrass is generally less than five percent. A successful weed treatment seeding would occur if the perennial species establish a groundcover of 15 to 25 percent.	Glyphosate Oust Plateau 2 to 6 oz/acre of Plateau is recommended for bare soil, with light annual brome infestation. In areas of thick vegetation and leaf litter where release is required or for use in fire breaks, higher rates of 6 to 12 oz/acre may be needed.	Per Acre Rate 2 to 4 oz per acre 3 to 5 oz/acre (0.2-0.3 lb./acre) 2 oz./ acre to 12 oz./acre	Early to pre-root development. Apply in early spring when the plants are 10 cm (3.9 in) high or less and growing vigorously. Apply after fall germination Fall – pre-emergent to germination
Musk Thistle <i>Carduus nutans</i>	Does best after disturbances such as along roadsides, grazed pastures, burned areas, and old fields, but also can invade deferred pastures and native grasslands. It can occur in almost all habitats except dense forests, high mountains, deserts, and frequently cultivated farmlands. Biennial or winter annual Approximately 45 to 55 days after bolting (producing a flower stalk), musk thistles produce seeds. Fortunately, musk thistle only reproduces by seed; unfortunately, it is very prolific, producing a few thousand to 100,000 seeds per plant. On average, a plant produces 10,000 seeds. Each seed has a bristle or pappus (stiff hairs) that aids in seed dispersal; however, animals, wind, birds, and water do not generally spread the seeds; but they may. The majority falls close to the plant, resulting in thousands of new seedlings in the immediate area. Musk thistle seeds may remain viable for more than 10 years in the soil.	Rosette weevil (<i>Trichosirocalus horridus</i>) Flea beetle (<i>Psylliodes chalconera</i>) Syrphid fly (<i>Cheilosia corydon</i>) Thistle-defoliating beetle (<i>Cassida rubiginosa</i>) [The seedhead weevil (<i>Rhinocyllus conicus</i>) is not recommended because it attacks some native thistles]	Mechanical control is effective on musk thistle. Tilling, hoeing, and hand pulling must be completed either in the rosette stage or early after the flower stalk grows (bolts), but before the plant flowers and produces seed. Hand pulling and hoeing are only an option for small stands. To be effective, a successful revegetation program must follow tilling. If this is not done, reinfestation of musk thistle is inevitable. Mowing is an option, but it can allow some musk thistle plants to recover and possibly sow seeds. Mowing does reduce seed production, but should not be the single means of control in a management program. It is most effective at the flower bud stage. Mowing combined with an herbicide is more effective. Mechanical control is very effective in ditches, yards, construction sites and pastures. However, it may be difficult or uneconomical to use this method on rangelands. Cultural control of musk thistle is limited. Good forage management practices that	Tordon + 2-4D Curtail Redeem Transline Banvel Milestone In the rosette stage, clopyralid, dicamba, picloram, and 2,4-D provide good control. Application of these chemicals is usually suggested for the fall of the first year (rosette stage). After the musk thistle bolts, metsulfuron and chlorsulfuron are effective. These two products reduce the amount of seed produced after application. Clopyralid, dicamba, picloram, and 2,4-D do not appear to reduce seed production after application if the plant has bolted. Apply metsulfuron and	Per Acre Rate 1 pint Tordon + 1 quart 2-4D per acre 2 to 3 quarts per acre 1.5 to 2 pints per acre 2/3 pint per acre 1 to 1 ½ pints per acre 3-5 oz. per acre	Before seed set or during fall regrowth

APPENDIX I **SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES**

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
			establish competitive desirable forage, maintain soil fertility, and prevent erosion will help combat musk thistle. Research shows that musk thistle has declined over the years when perennial grasses are present.	chlorsulfuron in the spring, during bolting. If the season is long and the musk thistles bolt the first year, apply metsulfuron and chlorsulfuron in the fall.		
Bull thistle <i>Cirsium vulgare</i>	Occurs in dry to moist habitats, fields, pastures, grasslands, roadways, forest clearings, rock outcrops, and along waterways. Does best in areas with moderate slope. It is not shade tolerant. Biennial Seeds (viable for 3 years or less).	gall fly (<i>Urophora stylata</i>)	Hand-pulling, mowing, burning, digging will kill if above ground portions of the plant are completely removed or consumed because it does not sprout from the root crown or root. If 8 inches or more of the stem remains alive, it may sprout from remaining portions of the stem. Revegetation for shade (the presence of tall herbs reduces bull thistle seedling survival. When grass growth is reduced by herbicide spraying, bull thistle increases in frequency.)	Tordon + 2-4D Curtail Redeem Milestone In the rosette stage, clopyralid, dicamba, picloram, and 2,4-D provide good control. Application of these chemicals is usually suggested for the fall of the first year (rosette stage). After the musk thistle bolts, metsulfuron and chlorsulfuron are effective. These two products reduce the amount of seed produced after application. Clopyralid, dicamba, picloram, and 2,4-D do not appear to reduce seed production after application if the plant has bolted. Apply metsulfuron and chlorsulfuron in the spring, during bolting. If the season is long and the musk thistles bolt the first year, apply metsulfuron and chlorsulfuron in the fall.	Per Acre Rate 1 pint Tordon + 1 quart 2-4D per acre 2 to 3 quarts per acre 1.5 to 2 pints per acre 3-5 oz per acre	Before seed set or during fall regrowth
Black henbane <i>Hyoscyamus niger</i>	Disturbed open sites, roadsides, fields, waste places, and abandoned gardens. Grows best in sandy or well-drained loam soils with moderate fertility. Does not tolerate waterlogged soils. Toxic to livestock, including sheep. Annual or biennial Seeds (seeds viable for 4 years)	None currently available	Hand-pulling, mowing, or digging to prevent seed production, must remove tap root to kill the plant. Buring mature plants will kill the seed. Regular cultivation.	Tordon	Per Acre Rate 1 to 2 pints per acre	Actively growing, prior to seed set
Scotch thistle <i>Onopordum acanthium</i>	Biennial Seeds	seed-head weevil (<i>Rhinocyllus conicus</i>) thistle crown-weevil (<i>Trichosiocalus horridus</i>)	Digging must cut plant off below soil level, leaving no above-ground biomass. Establish and maintain dense, vigorous native vegetation, especially important to have vegetative cover in the fall when seeds germinate (adjust grazing regimes	Tordon + 2-4D Curtail Redeem	Per Acre Rate 1 pint Tordon + 1 quart 2-4D per acre 2 to 3 quarts per acre 1.5 to 2 pints per acre	Before seed set or during fall regrowth

APPENDIX I
SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
			to avoid late summer/fall rotations).	Milestone In the rosette stage, clopyralid, dicamba, picloram, and 2,4-D provide good control. Application of these chemicals is usually suggested for the fall of the first year (rosette stage). After the musk thistle bolts, metsulfuron and chlorsulfuron are effective. These two products reduce the amount of seed produced after application. Clopyralid, dicamba, picloram, and 2,4-D do not appear to reduce seed production after application if the plant has bolted. Apply metsulfuron and chlorsulfuron in the spring, during bolting. If the season is long and the musk thistles bolt the first year, apply metsulfuron and chlorsulfuron in the fall.	5-7 oz. per acre	
Perennial sowthistle <i>Sonchus arvensis</i>	Perennial Seeds (2-5 year viability), and spreading, thickened horizontal roots (rhizomes).	cyst-forming nematode (<i>Heterodera sonchophila</i>) seedhead fly (<i>Tephritis dilacerata dilacerata</i>) (waiting for final approval)	Cutting, grazing, and mowing can be effective at depleting root stores, if done selectively and frequently. Repeated hoeing and cultivating can be effective if done at 6-leaf rosette stage. Establish and maintain healthy native vegetation.	Milestone Ally or Cimarron Cimarron Max 2, 4-D, dicamba, Curtail, and glyphosate are less effective.	Rate Per Acre 3-5 oz. per acre 1/10 oz DF + adjuvant 0.25 to 0.5 oz metsulfuron + 1 to 2 pt dicamba/2,4-D	
Common mullein <i>Verbascum thapsus</i>	Natural meadows and forest openings, where it adapts easily to a wide variety of site conditions. Prefers, but is not limited to, dry sandy soils. It is intolerant of shade. Primarily a weed of pastures, hay fields, roadsides, rights-of-way, and abandoned areas. Biennial or short-lived perennial Seeds (one plant can produce 100,000-180,000 seeds with viability up to 100 years).	mullein seedhead weevil (<i>Gymnetron tetrum</i>) Pending approval: mullein moth (<i>Cucullia verbasci</i>)	Easy to pull in loose soils because of shallow taproot (before flowering). Hand-hoeing or digging also effective. Mow or scythe just before flowering.	Escort Tordon + 2,4-D Tordon + Banvel Escort	Per Acre Rate 1 to 1.5 oz per acre 2 pints Tordon + 2 pints 2,4-D + MSO + silicone surfactant 1.5 pints Tordon + 1.5 pints Banvel + MSO + silicone surfactant 3 Gallon Backpack 1.3 grams per 3 gallons water	Rosette, before seed sets

APPENDIX I **SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES**

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
OTHER PLANTS - POISONOUS						
Western water hemlock (poisonous) <i>Cicuta douglasii</i>	Perennial Western hemlock is a wetland plant especially common on pastures or tilled areas. It can be found along streams and irrigation canals. Its establishment on rangeland is limited due to its high water requirement. This plant occurs in wet, fertile soils at the edge of waters. It is most common in deep loam, clay loam, or clay soils. This species is deemed the most violently toxic plant in North America. Only a small amount of the toxic substance is needed to cause poisoning in livestock and humans. The roots are the most toxic part. The leaves and stems are poisonous in the early stages of growth, but lose much of their toxicity when mature. The green seed heads are also highly poisonous. Sheep that consume it do not seem to be as affected as cattle. Grazing should be postponed until the ground is dry and the plant is harder to remove. This species is often confused for the edible water parsnip. Western water hemlock's roots are thick, fleshy tubers that contain many small chambers which can help distinguish these two species.	None currently available.	Remove it by hand pulling or hoeing. Wear gloves and protective clothing when handling these plants. Hand grubbing is very effective. The roots must be entirely removed because they are attractive to grazing livestock and highly poisonous. This plant is easily removed when the ground is moist. Gather all the plant pieces after removal and burn them.	2, 4,-D Glyphosate, 2, 4-D, or picloram There is some evidence that the toxicity of the plant increases after herbicide treatment until the plant dies. Recommend that animals be kept away from treated plants for 3 weeks after spraying.	2 lbs ae/A	Early bolt Late spring, early summer
Poison Hemlock (poisonous) <i>Conium maculatum</i>	Perennial Poison hemlock is commonly found at lower elevations along roadsides, ditch and stream banks, creek beds, fencelines, waster places, and in or on the edge of cultivated fields where there is sufficient soil moisture. It can also invade native plant communities in riparian woodlands and flood plains where natural aquatic systems should dominate. It can survive in dry sites with poorly drained soils, but is most competitive under wetter soil conditions. All parts of poison hemlock are poisonous, but the lower sections of the stem and root are the most deadly. Poison hemlock can be distinguished from wild carrot by its hairless leaves and	defoliating moth (<i>Agonopterix alstroemeriana</i>)	Establish and maintain healthy native vegetation. Remove it by hand pulling or hoeing. Wear gloves and protective clothing when handling these plants. Plowing or repeated cultivation will prevent this species from establishing. If cultivation is not possible, mow the plants after they have bolted. Single mowing will not provide complete control. Repeated mowing will reduce its competitive ability. Burning is not considered a useful method for poison hemlock control, as this plant grows in wet sites and remains green season long.	Escort 2, 4-D Roundup or Rodeo Escort	Per Acre Rate 0.75 oz/A 1 to 2 lb ae/A 1 lb ae/A 3 Gallon Backpack 1.3 grams per 3 gallons water	Rosette, in spring or before seed sets

APPENDIX I

SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
	stems. It is also commonly mistaken for cow parsnip, which differs in that it has palmately (fan-shaped) compound leaves rather than pinnately compound leaves like poison hemlock.					
Tall Larkspur (poisonous) <i>Delphinium occidentale</i>	Perennial; tap rooted. Reinvasion and re-establishment of tall larkspur, after effective treatment, proceeds slowly due to slow growth and development of seedlings and juvenile stages. After herbicide treatment, tall larkspur may have a period of about 15 years before it again reaches potentially dangerous levels relative to livestock poisoning. Keeping cattle off herbicide treated areas until plants are completely dead and dry is recommended. Larkspur's toxicity and palatability may actually increase after the plants are sprayed. To be safe, cattle should be kept off the area for the remainder of the grazing season Livestock operators fully utilize prevention and non-chemical activities to minimize poisoning effects on permitted livestock. Herbicide methods, as addressed in this analysis, would be used in conjunction with these other activities where necessary or appropriate. The following outline prevention measures that can be taken for tall larkspur management: • Authorized entry dates are delayed until tall larkspur maturity level is increased and toxicity is decreased. • A special salt formulation (i.e. "silent herder") can be utilized by permittees to help minimize loss from tall larkspur poisoning. • Moving livestock through tall larkspur populations slowly and with full stomachs can be utilized by permittees.	None currently available.	Use of ammonium sulphate fertilizer to control patches of tall larkspur is another method available (cutting to ground level and applying 1/2 cup to base of each tall larkspur, cutting to 10 inch height and applying ¾ cup at the base of each tall larkspur, or no cutting and applying one cup at the base of each tall larkspur). For spot treatment, there are advantages for using ammonium sulfate fertilizer compared to herbicide treatment. They include: • The fertilizer is granular so it is easy to pack into areas of difficult access or rough terrain. • The fertilizer can be purchased at any local feed store. • There is no requirement for a certified applicator. • The application method is simple and easy to learn. • The cost of application is less than the cost of the application of herbicides. • As with herbicide control, larkspur mortality occurs within one year and continues for many years. • With the addition of a weed eater, the application rate can be reduced by up to 50%, which could ultimately lead to a cost savings. • Areas cut with a weed eater die the same season they are treated, allowing for grazing to occur in the immediate area without further threat of livestock loss from poisoning. • Application of the fertilizer does not appear to adversely affect nearby vegetation in the area.	2,4-D Clarity Tordon Escort Metsulfuron Triclopyr is also known to control tall larkspur. Glyphosate (Roundup) can be selectively applied by hand spraying or with a wipe-on applicator to kill larkspur in the bud stage. It, however, is not as effective after the plants have flowered. Use of ammonium sulfate fertilizer to control patches of tall larkspur is another method. Cut to ground level and apply 1/2 cup to base of each tall larkspur, or cut to 10 inch height and apply ¾ cup at the base of each tall larkspur, or no cutting and applying one cup at the base of each tall larkspur	Per Acre Rate 2 quarts per acre 1 quart per acre 1 quart per acre 0.8 to 1.6 oz per acre 0.9 oz ai per acre	Rosette to bolt Tordon: Throughout growing season Escort: Early stages of growth (less effective as larkspur matures) Metsulfuron: Maximum vegetation but prior to flowering

APPENDIX I **SPECIES SPECIFIC ECOLOGY AND IPM TREATMENTS – INCLUDING HERBICIDE RATES**

Common & Scientific Name	Habitats; Life Cycle; & Modes of Reproduction	Biocontrol Agents	Mechanical & Cultural Methods	Herbicide Use		
				Herbicide & Method	Rate ²	Timing
OTHER PLANTS – TOTAL VEGETATION CONTROL						
Total Vegetation Weed Control	Use in areas needing total vegetation removal, such as paved road shoulders, well pads, helibases, etc. Repeat application is generally necessary every 1-2 years.	N/A	N/A	Diuron + Oust	8 lbs. Diuron + 3 oz Oust	
				Diuron / Karmex	8 to 10 lbs per acre	
				Diuron: Refer to label for use in irrigation ditches. Higher rates needed for perennial grasses and broadleaf weeds. Deep rooted perennials will require retreatment.		
				Use glyphosate for initial knock-down of vegetation, then followup later in the season for total vegetation control with diuron.		
				Oust: Do not spray near water. See Label		

Disclaimer: The information in this material is for guideline purposes. The recommendations contained are based on the best available knowledge at the time of printing. Any reference to commercial products, trade or brand names is for information only, and no endorsement or approval is intended. The authors do not guarantee or warrant the standard of any products referenced or imply approval of the product to the exclusion of others which also may be available. All pesticides listed are registered for suggested uses in accordance with federal laws and regulation as of the date of printing. If the information does not agree with current labeling, follow the label instructions. The label is the law. Warning! Pesticides if misused, can be dangerous. Read and follow all instructions and safety precautions on labels. Carefully handle and store Pesticides in originally labeled containers out of the reach of children, pets and livestock. Dispose of empty containers immediately in a safe manner and place. Contact your state Department of Agriculture (or similar regulatory agency) for current regulations.