

# **APPENDIX B**

## **Treatment Options and Common Control Measures for the Deschutes and Ochoco National Forests and Crooked River National Grassland**

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| Table B-1. Treatment Options for Species on the Deschutes and Ochoco and CRNG           | p. B-2  |
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**Table B-1.** Treatment options for invasive plant species, Deschutes and Ochoco National Forest and Crooked River National Grassland Invasive Plant EIS. Most information comes from Mazzu (2005) and Oregon Department of Agriculture (Langland 2005, personal communication); other references are cited. Species are grouped based on similar biology and treatment methods and are listed alphabetically by the common name of the 1<sup>st</sup> species listed.

| Target Species   | Notes specific to Deschutes, Ochoco, CRNG  | General Notes & Prescription  | Herbicide Options   | When/How to treat chemically   |
|--|--|---|---|--|
| <b>Bull thistle</b><br><i>Cirsium vulgare</i><br>(CIVU)<br><br><b>Musk (nodding) thistle</b><br><i>Carduus nutans</i><br>(CANU4)<br><br><i>Biennial (musk thistle can be a winter annual, annual, or biennial)</i> | <p>Bull thistle is common, and a lower priority species for treatment. The majority of sites will be tolerated (no treatment) or manually controlled.</p> <p>Currently only one known site of musk thistle on Lookout Mt. District, Ochoco NF.</p> | <p>- Any manual method that severs the root below the soil surface will kill these plants. Hand-pull bolting plants prior to onset of flowering but after fully bolting. Bag &amp; remove from site if plant has a flower head. - Repeated visits at weekly intervals over the 4 to 7 week blooming period provide most effective control.</p> <p>- Mowing is an option, but timing of mowing is critical (within 2 days of full flowering for musk thistle).</p> <p>- If chemicals are used, manual treatments could be used for follow-up. Relative amounts of herbicide to manual treatments would decline over time.</p> <p>- Biological controls may be helpful to suppress populations in combination with other methods.</p> <p>- Bull thistle sites do not usually need revegetation; at most sites, will be replaced as successional changes take place.</p> | <p><b>Upland Bull Thistle:</b><br/> 1. Clopyralid</p> <p><b>Upland Musk Thistle:</b><br/> 1. Clopyralid<br/> 2. Metsulfuron methyl<br/> 3. Chlorosulfuron</p> <p><b>Riparian/High Water Table/Porous Soils:</b><br/> Aquatic labeled glyphosate</p> | <p><i>Drier, upland Site Types (Roads, Quarries, Upland Forest/Rangeland):</i> Spot spray whenever possible. <i>Wetter site types (wet meadows, riparian):</i> Wick application.</p> <p><b>Timing:</b> Apply to rosettes in either the spring or fall.</p> |

| Target Species   | Notes specific to Deschutes, Ochoco, CRNG  | General Notes & Prescription  | Herbicide Options   | When/How to treat chemically  |
|--|--|---|---|---|
| <b>Canada thistle</b><br><i>Cirsium arvense</i><br>(CIAR4)<br><br><i>Rhizomatous</i><br><i>Perennial</i>   | Very common on Lookout Mt. District, Ochoco NF (> 250 sites); less common on other districts.  | <ul style="list-style-type: none"> <li>- Herbicide treatment is most effective.</li> <li>- The only manual technique would be hand cutting of flower heads, which only suppresses seed production.</li> <li>- Mowing may be effective in rare cases if done monthly (this intensity is likely to damage native plant species).</li> <li>- Covering with plastic tarping may also work for small infestations.</li> <li>- Revegetate high priority sites with desirable species if possible.</li> </ul>  | <b>Upland:</b><br>1. Clopyralid<br>2. Picloram<br>3. Chlorosulfuron<br>4. Glyphosate<br><br><b>Riparian/High Water</b><br><b>Table/Porous Soils:</b><br>Aquatic labeled glyphosate (best in fall)                   | <b>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</b> If feasible, weed whack first to reduce biomass. Broadcast spray in dense cover, where dominant plant community is non-native. Spot spray whenever possible, especially in areas with good native plant cover.<br><br><b>Sensitive Sites or Special Management Areas where more selective treatment is desired:</b> Spot spray or wick application to target individual plant.<br><br><b>Timing:</b> Apply in spring to rosettes and prior to flowering, or apply in fall to rosettes. Season is dependent upon herbicide used. |
| <b>Dalmatian toadflax</b><br><i>Linaria dalmatica</i><br>(LIDA)<br><br><b>Butter ‘n’ eggs</b><br><i>Linaria vulgaris</i><br>(LIVU2)<br><br><i>Rhizomatous</i><br><i>Perennials</i> | Dalmatian toadflax is most common on Bend/Ft. Rock District (> 60 sites).<br><br>Only 10 sites currently known of butter ‘n’ eggs (7 on Crescent District; 3 on Lookout Mt. District). | <ul style="list-style-type: none"> <li>- Hand pull or dig small, easily accessible populations. Multiple entries per year are required. Plants can be left on site, but may reduce germination of desirable species due to mulching effect. Success will depend on consistent labor for each growing season until plants are eradicated. If flowers are present, bag and remove from site.</li> <li>- Cutting stands in spring or early summer will eliminate plant reproduction, but not the infestation.</li> <li>- These treatments may take up to ten years due to long term seed viability.</li> <li>- If chemicals are used, manual treatments could be used for follow-up. Relative amounts of herbicide to manual treatments would decline over time.</li> <li>- Revegetate with desirable species at high priority sites when possible. Plant communities in good condition may recover without replanting.</li> </ul> | <b>Upland:</b><br>1. Picloram<br>2. Chlorosulfuron<br>3. Imazapic (Use in native grass stands; fall application only)<br><br><b>Riparian/High Water</b><br><b>Table/Porous Soils:</b><br>Aquatic labeled glyphosate | Broadcast spray in dense cover, where dominant plant community is non-native. However, this species tends to be scattered, so spot spraying (backpack or on OHV) is usually more appropriate.<br><br><b>Timing:</b> Apply during active growth in spring before bloom or in late summer or fall during re-growth.<br><br><b>Notes:</b> Revisits will be necessary; the number of which is dependent on the chemical used and the seedbank. This control could vary by site. Even after three years of consecutive treatments, control may range widely.   |

| Target Species  | Notes specific to Deschutes, Ochoco, CRNG  | General Notes & Prescription  | Herbicide Options   | When/How to treat chemically   |
|---|--|---|---|--|
| <b>Diffuse knapweed</b><br><i>C. diffusa</i><br>(CEDI)<br><br><b>Spotted knapweed</b><br><i>Centaurea biebersteinii</i><br>(CEBI2)<br><br><b>Meadow knapweed</b><br><i>Centaurea debeauxii</i> ssp. <i>thuillieri</i><br>(CEDET)<br><br><i>Tap rooted</i><br><i>Biennials or Perennials</i> | Diffuse & spotted knapweeds are very common and high priority species on all units. Meadow knapweed occurs on Lookout Mt. District; has been treated since 1998 and is now in maintenance mode. Five plants of meadow knapweed were found & pulled on Crescent District along Hwy 58 in the Odell Lake area. | <ul style="list-style-type: none"> <li>- Hand pull or dig small, easily accessible populations. Multiple entries per year are required. Pull bolting plants prior to seed set. Bag flowering plants and dispose of properly. Success will depend on consistent labor for each growing season until plants are eradicated.</li> <li>- Mowing is possible, but timing is critical.</li> <li>- These treatments may take up to ten years due to long term seed viability.</li> <li>- If chemicals are used, manual treatments could be used for follow-up. Relative amounts of herbicide to manual treatments would decline over time.</li> <li>- Revegetate with desirable species at high priority sites when possible.</li> </ul> | <b>Upland:</b><br>1. Clopyralid<br>2. Picloram<br>3. Glyphosate<br><br><b>Riparian/High Water Table/Porous Soils:</b><br>Aquatic labeled glyphosate (will require the most repeated treatments) | <b>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</b><br>Broadcast spray in dense cover, where dominant plant community is non-native. Spot spray whenever possible, especially in areas with good native plant cover.<br><br><b>Wet Meadows, Riparian:</b> Selective spot spraying to target specific plants.<br><br><b>Timing:</b> Preferred treatment is spring before bud stage or early summer so use less herbicide. |

| Target Species   | Notes specific to Deschutes, Ochoco, CRNG  | General Notes & Prescription  | Herbicide Options   | When/How to treat chemically  |
|--|--|---|---|---|
| <b>Field bindweed</b><br><i>Convolvulus arvensis</i><br>(COAR4)<br><br><i>Rhizomatous perennial</i>                          | 25 sites are mapped, most occurring on CRNG.   | <ul style="list-style-type: none"> <li>- Successful control is most likely if the above-ground biomass is removed (by tillage, hand-pulling or herbicide application) followed by competition from other species (e.g., the surround vegetation or restoration efforts), and continuous monitoring for resprouts (The Nature Conservancy 1998b).</li> <li>- Tilling may be useful for ridding infestations; for small areas this may be done using hand-held tools, but for large areas machinery is required.</li> <li>- Mowing is unsuccessful because plants can be missed and it encourages ground-hugging plants.</li> <li>- Seedlings should be cultivated or hoed before they are a month old.</li> <li>- The Nature Conservancy (2004) mentioned that pulling field bindweed should be done frequently and timing is important; the goal would be to continually (throughout the growing season) pull the above-ground portion. This may only be feasible for very small, easily accessible populations.</li> </ul> | <b>Upland:</b><br>1. Picloram<br>2. Imazapic<br>3. Imazapyr<br>4. Glyphosate<br><br><b>Riparian/High Water</b><br><b>Table/Porous Soils:</b><br>Aquatic labeled glyphosate. | <b>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</b><br>Broadcast spray in dense cover, where dominant plant community is non-native. Spot spray whenever possible, especially in areas with good native plant cover.<br><br><b>Wet Meadows, Riparian:</b> Selective spot spraying to target specific plants.<br><br><b>Timing:</b> Herbicide application should be applied when the herbicide will be translocated to the roots, but before seed set. |
| <b>Himalayan blackberry</b><br><i>Rubus discolor</i><br>(RUDI2)<br><br><i>Rhizomatous Perennial (canes die off annually)</i> | One mapped site occurs on Paulina District in Project Area 72-48, along Cottonwood Trail.<br><br>In 2006, found one plant along Hwy 58 adjacent to Odell Lake; pulled it & will monitor. | <ul style="list-style-type: none"> <li>- Chemical treatment can be followed up with manual and/or mechanical treatment. Relative amounts of herbicide to manual treatments would decline over time.</li> <li>- On large populations, mechanical removal of large biomass in the summer (using a mower, brush hog or brush claw), followed by manual removal of resprouting canes and roots, then herbicide treatment of new growth in the fall/winter is most effective.</li> <li>- The massive root crown must be fully dug out at some point if using only manual/mechanical techniques.</li> <li>- The cultural technique of grazing with goats is also a technique proving successful if goats can be confined to the blackberry area.</li> <li>- Revegetate high priority sites with desirable species if possible.</li> </ul>   | <b>Upland:</b><br>1. Triclopyr<br>2. Glyphosate<br>3. Picloram<br><br><b>Riparian/High Water</b><br><b>Table/Porous Soils:</b><br>Aquatic labeled glyphosate                | <b>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</b> Cut and paint larger canes. Boom broadcast spray is possible after canes are cut if non-target species are not an issue. Spot spray whenever possible.<br><br><b>Moist to Wet meadows and Riparian:</b> Wick application.<br><br><b>Timing:</b> Remove large biomass in summer; herbicide treatment of new growth in fall/winter.   |

| Target Species   | Notes specific to Deschutes, Ochoco, CRNG  | General Notes & Prescription  | Herbicide Options  | When/How to treat chemically  |
|--|--|---|--|---|
| <b>Houndstongue</b><br><i>Cynoglossum officinale</i><br>(CYFO)<br><br><i>Taprooted</i><br><i>Biennial or</i><br><i>Short-lived</i><br><i>Perennial</i> | Occurs on both Lookout Mt. and Paulina Districts, with the majority of sites/acres on Paulina.   | <ul style="list-style-type: none"> <li>- Hand pull or dig for small populations. Entire root system must be removed. Plants could be left on site if no seed pods are present (seed can remain viable for more than one year). If seed pods present, bag and remove from site.</li> <li>- These treatments may take up to five years.</li> <li>- If chemicals are used, manual treatments could be used for follow-up. Relative amounts of herbicide to manual treatments would decline over time.</li> <li>- Revegetate high priority sites with desirable species when possible.</li> </ul>       | <b>Upland:</b><br>1. Metsulfuron methyl<br>2. Chlorosulfuron<br>3. Picloram<br>4. Glyphosate<br><br><b>Riparian/High Water</b><br><b>Table/Porous Soils:</b><br>Aquatic labeled glyphosate | <b>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</b><br>Broadcast spray in dense cover, where dominant plant community is non-native. Spot spray whenever possible, especially in areas with good native plant cover. <b>Sensitive Sites and moist to wet meadows (high water table),</b><br><b>wetlands/riparian:</b> Spot spray or wick application to target individual plants.<br><br><b>Timing:</b> Apply during active growth, preferably basal rosette stage. |
| <b>Kochia</b><br><i>Kochia scoparia</i><br>(KOSC)<br><br><i>Annual</i>   | Three sites are inventoried and proposed for treatment (on Crescent and CRNG). This species is relatively abundant in drier disturbed areas. | <ul style="list-style-type: none"> <li>- Because kochia is an annual, small populations could be hand pulled, with the goal being prevention of seed production. Mowing or slashing plants before flowering is effective in reducing seed production.</li> <li>- If chemicals are used, timing of treatment may be important, ensuring that treatment is done before seed set. Manual treatment could be used for follow-up. Relative amounts of herbicide to manual treatments would decline over time.</li> <li>- Revegetate high priority sites with desirable species when possible.</li> </ul> | <b>Upland:</b><br>1. Chlorsulfuron<br>2. Metsulfuron methyl<br>3. Glyphosate<br><br><b>Riparian/High Water</b><br><b>Table/Porous Soils:</b><br>Aquatic labeled glyphosate                 | <b>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</b><br>Broadcast spray in dense cover, where dominant plant community is non-native. Spot spray whenever possible, especially in areas with good native plant cover. <b>Moist to wet meadows (high water table),</b><br><b>wetlands/riparian:</b> Spot spray or wick application to target individual plants.<br><br><b>Timing:</b> Treatment should occur before plants set seed.                                  |

| Target Species  | Notes specific to Deschutes, Ochoco, CRNG   | General Notes & Prescription   | Herbicide Options  | When/How to treat chemically  |
|---|---|--|--|---|
| <b>Leafy spurge</b><br><i>Euphorbia esula</i><br>(EUES)<br><br><i>Rhizomatous perennial</i> | There are very few sites of leafy spurge. Bend/Ft. Rock, Crescent, Lookout Mt. and Paulina each have one mapped site. | <ul style="list-style-type: none"> <li>- Requires combination of techniques for successful control. Multiple entries per year are required.</li> <li>- Manual treatment is rarely effective.</li> <li>- Repeated mowing or hand cutting can control seed production but must be used with herbicides for adequate control of the site.</li> <li>- Repeated mowing could reduce competitive ability of desirable species.</li> <li>- Some success has been found with using biological control (flea beetle) with fall herbicide treatments.</li> <li>- Grazing when managed carefully (timing, livestock species, etc.) may help control leafy spurge (<i>see Common Control Measures</i>).</li> </ul> | <b>Upland:</b><br>1. Picloram<br>2. Glyphosate<br>3. Imazapic<br><br><b>Riparian/High Water Table/Porous Soils:</b><br>Aquatic labeled glyphosate      | <b>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</b> Spot spray whenever possible. Broadcast spray in dense cover, where dominant plant community is non-native and leafy spurge population is large.<br><b>Moist to Wet meadows (high water table) and Riparian:</b> Wick application to target individual plants.<br><br><b>Timing:</b> All three herbicides can be used in the spring or fall, however, ODA would usually spray Picloram and Imazapic in the spring; glyphosate in the fall (Langland, 2005, <i>personal communication</i> ).<br><br><b>Notes:</b> Must be careful about herbicide rates – use lowest rate possible ((Langland, 2005, <i>personal communication</i> )). |
| <b>Lesser burdock</b><br><i>Arctium minus</i><br>(ARM12)<br><br><i>Biennial</i>             | One mapped site exists on Lookout Mt. District in Project Area 71-16.   | <ul style="list-style-type: none"> <li>- Use a combination of manual and herbicide.</li> <li>- Hand pull or dig small populations or when regular volunteers are available.</li> <li>- If chemicals are used, manual treatments could be used for follow-up. Relative amounts of herbicide to manual treatments would decline over time.</li> <li>- Revegetate high priority sites with desirable species if needed.</li> <li>* Very little was found on this species.*</li> </ul>   | <b>Upland:</b><br>1. Metsulfuron methyl<br>2. Picloram<br>3. Telar<br><br><b>Riparian/High Water Table/Porous Soils:</b><br>Aquatic labeled glyphosate | <b>Drier Upland Site Types:</b> Spot spray whenever possible. <b>Riparian and wet/moist meadows:</b> Spot or wick application to target individual plants.<br><br><b>Timing:</b> Treat as a biennial. Treat in spring after rosettes are formed when non-targets are dormant or treat fall rosettes.<br><br><b>Notes:</b> * Very little information was found on this species.*   |

| Target Species  | Notes specific to Deschutes, Ochoco, CRNG  | General Notes & Prescription  | Herbicide Options  | When/How to treat chemically   |
|---|--|---|--|--|
| <b>Mediterranean sage</b><br><i>Salvia aethiopsis</i> (SAAE)<br><i>Biennial</i> | Five sites are mapped on Lookout Mt. District; two sites are mapped on Paulina District. | <ul style="list-style-type: none"> <li>- An integrated combination of control methods will be needed to successfully manage Mediterranean sage.</li> <li>- Individual plants can be dug out. When the plant begins to bolt, cut or dig up the taproot two to three inches below the crown. This prevents re-sprouting. (Moser and Crisp 2000).</li> <li>- If chemicals are used, manual treatments could be used for follow-up. Relative amounts of herbicide to manual treatments would decline over time.</li> </ul>  | <b>Upland:</b><br>1. Metsulfuron methyl<br>2. Chlorsulfuron<br>3. Picloram                             | Broadcast spray in dense cover, where dominant plant community is non-native. Use more selective techniques (e.g., spot spraying or selective patch broadcast) if good native plant cover.   |
| <b>Medusahead</b><br><i>Taeniatherum caput-medusae</i> (TACA8)<br><i>Annual</i> | Majority occurs on CRNG (> 3,000 acres mapped).  | <ul style="list-style-type: none"> <li>- First priority should be to keep uninfested sites weed-free. Second priority would be to treat sites that have enough native plant species to recolonize the site (at least 15% of native plant cover) (Sheley 2005, <i>personal communication</i>). For sites that have lost the native plant component, set up a containment strategy based on accessibility to do annual surveys and keep medusahead from moving into adjacent areas.</li> <li>- Management should be focused at replacing medusahead with perennial plant cover. Revegetation strategy should strive to incorporate functional components of the ecosystem that should be on that site (e.g., combination of perennial taprooted forbs, bunchgrasses, rhizomatous grasses, annuals, or whatever components would normally be there (Sheley 2005, <i>personal communication</i>).</li> <li>- Requires integrated management using a variety of techniques.</li> <li>- Heavy spring grazing by sheep during the green stage has been reported to assist in control.</li> </ul> | <b>Upland:</b><br>1. Sulfometuron methyl<br>2. Landmark (Oust + Telar)<br>3. Imazapic<br>4. Glyphosate | <b><i>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</i></b><br>Broadcast spray in dense cover, where dominant plant community is non-native. Selective patch broadcast spray or spot spray if good native cover. <b><i>Sensitive Sites (e.g., adjacent to moist meadows or riparian areas) or Special Management Areas where more selective treatment is desired:</i></b><br>Spot spray or wick application to target individual plants.<br><br><b><i>Timing:</i></b> |



| Target Species   | Notes specific to Deschutes, Ochoco, CRNG  | General Notes & Prescription   | Herbicide Options   | When/How to treat chemically   |
|--|--|--|---|--|
| <b>Quackgrass</b><br><i>Elymus repens</i><br>(ELRE4)<br><br><i>Rhizomatous perennial</i> | Two sites occur on Bend/Ft. Rock District. | <ul style="list-style-type: none"> <li>- Manual control is ineffective because root pieces can produce new plants.</li> <li>- Fabric mulches or roofing paper have been useful for small infestations.</li> <li>- Mowing is recommended when conditions are too wet for tilling (to reduce seed production).</li> <li>-Tilling forces plants to use reserves, but can also spread plant; therefore multiple tillings will be needed.</li> <li>- Prescribed burning can increase population vigor.</li> <li>- Use of herbicides (glyphosate) alone has shown some effectiveness.</li> <li>- Using a combination of mowing, burning, herbicide and reseeding may be the most effective. For example, tilling in early October before a hard frost, then treating with glyphosate has been effective.</li> <li>- Revegetate high priority sites with desirable species if needed and possible.</li> </ul> | <b>Upland:</b><br>1. Glyphosate<br>2. Landmark (Telar + Oust)<br>3. Sethoxydim<br>4. Imazapic<br><br><b>Riparian/High Water Table/Porous Soils:</b><br>Aquatic labeled glyphosate | <b><i>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</i></b> Spot spray whenever possible. Broadcast spray in dense cover, where dominant plant community is non-native. <b><i>Moist to Wet meadows (high water table) and Riparian:</i></b> Spot and wick application to target individual plants.<br><br><b><i>Timing:</i></b> Apply in spring or fall during active growth. |

| Target Species  | Notes specific to Deschutes, Ochoco, CRNG   | General Notes & Prescription   | Herbicide Options  | When/How to treat chemically  |
|---|---|--|--|---|
| <b>Reed canarygrass</b><br><i>Phalaris arundinacea</i> (PHAR3)<br><br><b>Ribbongrass</b><br><i>Phalaris arundinacea</i> var. <i>picta</i> (PHARP3)<br><br><i>Rhizomatous Perennials</i> | Reed canarygrass is much more abundant of the 2 species; only certain sites are proposed for treatments.<br>Ribbongrass is only known from the Metolius River in Sisters. | <p>- Successful treatment has been to mow or weed-whack plants down to about 4" tall; let stems grow back for 1-2 months to about 10-12" tall, then fall application of aquatic labeled glyphosate (Tu 2005, <i>personal communication</i>). Repeat this treatment in year two. Follow-up with planting of intermittent plugs of desirable species.</p> <p>- Requires a combination of techniques, which might include herbicides, manual, mechanical, or cultural. Prescribed burning can be used as a pretreatment before tilling, applying shade cloth, or herbicide application, since the fire will remove the aboveground dead litter and standing vegetation. However, in a fen on the Deschutes NF, Tu did not recommend burning because of potential damage to soil and native plant species (Tu, 2005, <i>personal communication</i>).</p> <p>- Choice of techniques will depend on what you are able/willing to do for how long, as well as timing, and logistics.</p> <p>- Manual or mowing treatments by themselves are only practical for small populations when multiple entries per year can be made. The entire population must be removed 2 to 3 times per year for at least five years.</p> <p>- Mechanical methods (mowing, weed wacking) can be used to reduce biomass, reduce the amount of herbicide used, and to ensure more direct foliar application of herbicides (Tu 2005, <i>personal communication</i>).</p> <p>- Discing or plowing can be effective especially after herbicide treatment.</p> <p>- Solarization (covering populations with clear or black plastic or use of a thick woven geotextile shade cloth) may be effective if shoots are not allowed to grow beyond tarps. This technique could take over two years to be effective. It may work on distinct patches of reed canarygrass that exist within a matrix of native vegetation (Tu 2004). However, this technique is reported to kill soil mycorrhizal fungi, etc.</p> | <b>Riparian/High Water Table/Porous Soils:</b><br>1. Aquatic labeled Glyphosate<br>2. Imazapyr (Habitat formulation)<br>3. Sethoxydim<br><br><b>Upland:</b> Highly unlikely this species would occur in upland sites. These species need to be in wet conditions.. | <p>Reed canary grass will be found in <b>wetter site types (wet meadows and riparian)</b>. Depending on the size and distribution of the infestation, herbicide can be foliar-applied using a dripless wick applicator, backpack sprayer, or selective patch broadcast spray technique.</p> <p><b>Timing:</b> Application can occur in mid-summer (just prior to summertime dormancy) or preferably in late fall (just prior to frost and wintertime dieback). This will time herbicide application when reed canarygrass is most actively translocating carbohydrates (along with the herbicide) down into the root system.</p> <p><b>Notes:</b> Much of treatment information comes from Tu (2004, 2005).</p> |

| Target Species  | Notes specific to Deschutes, Ochoco, CRNG                        | General Notes & Prescription  | Herbicide Options   | When/How to treat chemically   |
|---|--|---|---|--|
| <b>Russian knapweed</b><br><i>Acroptilon repens</i><br>(ACRE3)<br><br><i>Perennial with adventitious shoots</i> | Six sites are mapped on CRNG, Lookout Mt. and Paulina Districts. | <ul style="list-style-type: none"> <li>- Hand-pulling Russian knapweed is very difficult, but can be effective for small infestations during the establishment year only. Pull plants when soil is wet and before seeds have formed. Remove all plant parts from site.</li> <li>- Cutting or mowing reduces the current year growth and will eliminate seed production, but will not kill the roots of this species. Cut/mow several times annually to control existing top growth; re-emerging plants will be smaller in size and lower in vigor. Must be frequently repeated (at least 3 times/year – spring, summer, and fall).</li> <li>- Discing or plowing produces broken root fragments that spread quickly and resprout.</li> <li>- Russian knapweed is poisonous to horses. Livestock will graze, but it is usually avoided. Grazing provides only a negligible effect on vigor and viability of root system.</li> <li>- In most situations, Russian knapweed cannot be effectively managed by herbicides alone.</li> <li>- Lasting control requires an integration of techniques (mechanical, manual, chemical, and possibly biological control), proper land management, and revegetation to outcompete the thistle (The Nature Conservancy 1998).</li> <li>- Competitive plantings are usually necessary.</li> </ul> | <b>Upland:</b><br>1. Picloram<br>2. Clopyralid<br>3. Telar<br>4. Glyphosate<br><br><b>Riparian/High Water Table/Porous Soils:</b><br>Aquatic labeled glyphosate | <b><i>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</i></b><br>Broadcast spray in dense cover, where dominant plant community is non-native. Spot spray whenever possible, especially in areas with good native plant cover. <b><i>Moist to Wet meadows (high water table) and wetlands/ riparian:</i></b> Spot spray or wick application to target individual plants; follow-up with manual treatments.<br><br><b><i>Timing:</i></b><br><br><b><i>Notes:</i></b> |

| Target Species   | Notes specific to Deschutes, Ochoco, CRNG  | General Notes & Prescription   | Herbicide Options  | When/How to treat chemically   |
|--|--|--|--|--|
| <b>Russian thistle</b><br><i>Salsola kali</i><br>(SAKA)<br><br><i>Annual</i>             | This is an abundant species that is only proposed for treatment on selective, priority sites.  | <ul style="list-style-type: none"> <li>- Pull or uproot young plants or hoe just below ground level before seed set (The Nature Conservancy 1999). Cutting flowers before maturity has worked for some Nature Conservancy preserve stewards.</li> <li>- Mowing tends to cause the plant to grow low but repeated mowing may provide control.</li> </ul>  | <b>Upland:</b><br>1. Chlorsulfuron<br>2. Metsulfuron methyl<br>3. Glyphosate   | This species occurs in upland, drier site types. Broadcast spray in dense cover, where dominant plant community is non-native. Spot spray wherever possible, especially in areas with good native plant cover.<br><br><b>Timing:</b><br><br><b>Notes:</b> The Nature Conservancy (1999) states that some plants in the Pacific Northwest are resistant to sulfonylurea herbicides and resistance to the trazine herbicides has also been observed. If these types of herbicides are used, need to monitor for treatment effectiveness. |
| <b>Scotch broom</b><br><i>Cytisus scoparius</i><br>(CYSC4)<br><br><i>Woody Perennial</i> | Most of the mapped scotch broom sites are on Sisters District (10 sites), but other mapped sites are proposed for treatment on Crescent, Bend/Ft. Rock, Lookout Mt. and Paulina. | <ul style="list-style-type: none"> <li>- Hand pull, cut, weed wrench or dig small populations or when regular volunteers are available. Hand pulling or weed wrenching is most effective in moist soils. Plants can be left on site if no seed pods are present (seed can remain viable for more than one year). Cutting will require multiple visits in one year.</li> <li>- These treatments may take up to ten years due to long term seed viability.</li> <li>- If chemicals are used, manual treatments could be used for follow-up. Relative amounts of herbicide to manual treatments would decline over time.</li> <li>- Revegetate high priority sites with desirable species when possible.</li> </ul> | <b>Upland:</b><br>1. Triclopyr<br>2. Picloram<br>3. Glyphosate<br><br><b>Riparian/High Water Table/Porous Soils:</b><br>Aquatic labeled glyphosate | <b>Roads, Quarries and other drier, upland Site Types:</b> Larger plants: Cut and paint herbicide on stump. Smaller plants: Spot spray where hand pulling or weed wrenching is not feasible. Broadcast spray of triclopyr not permitted. <b>Riparian, meadows (high water table):</b> Same as other sites with either cut/stump method or selective spot spray technique.<br><br><b>Timing:</b> Apply during active growth preferably in the spring to young plants.   |

| Target Species   | Notes specific to Deschutes, Ochoco, CRNG   | General Notes & Prescription  | Herbicide Options  | When/How to treat chemically  |
|--|---|---|--|---|
| <b>Scotch thistle</b><br><i>Onopordum acanthium</i> (ONAC)<br><br><i>Taprooted</i><br><i>Biennial or Short-lived</i><br><i>Perennial</i> | 16 sites of Scotch thistle are mapped on all units except Sisters, with the majority (8 sites) on Lookout Mt. District. | <ul style="list-style-type: none"> <li>- Only reproduces by seed, so preventing seed production &amp; spread should be main focus.</li> <li>- Severing the root below the soil surface will kill the plant.</li> <li>- Mowing to ensure seed heads don't form can work, but need to mow more than once since plants do not mature uniformly. Mow after plants bolt and before flower since seed from cut flowers can mature (University of Idaho 2005).</li> <li>- Goats will graze Scotch thistle; sheep and cattle will not. Proper grazing management can allow grasses to compete with Scotch thistle, but continuous stocking of animals tends to reduce grass health and allow Scotch thistle a competitive advantage.</li> </ul> | <b>Upland:</b><br>1. Clopyralid<br>2. Chlorosulfuron<br>3. Metsulfuron<br><br><b>Riparian/High Water</b><br><b>Table/Porous Soils:</b><br>Aquatic labeled glyphosate. (Tends to like drier sites but can occur in wet places). | <b>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</b><br>Broadcast spray in dense cover, where dominant plant community is non-native. Spot spray whenever possible, especially in areas with good native plant cover. <b>Wet Meadows, Riparian:</b> Spot or wick applications to target specific plants.<br><br><b>Timing:</b> Preferred treatment is spring before bud stage or early summer so use less herbicide.                           |
| <b>St. Johnswort</b><br><i>Hypericum perforatum</i> (HYPE)<br><br><i>Rhizomatous</i><br><i>Perennial</i>                                 | Occurs on all units, with the majority (65 mapped sites) on Sisters District. Has expanded after recent wildfires.      | <ul style="list-style-type: none"> <li>- Hand removal of small populations or isolated stems is possible, but repeated treatments will be necessary as lateral roots give rise to new plants. Remove plants from the site and dispose of properly.</li> <li>- These treatments may take up to ten years due to long term seed viability.</li> <li>- Biological controls will most likely not be effective in damp, cool climates.</li> <li>- Revegetate high priority sites if needed with desirable species if possible.</li> </ul>  | <b>Upland:</b><br>1. Metsulfuron methyl<br>2. Picloram<br>3. Glyphosate<br><br><b>Riparian/High Water</b><br><b>Table/Porous Soils:</b><br>Aquatic labeled glyphosate (not found as effective in the literature)               | <b>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</b> Spot spray whenever possible. Boom broadcast spray in dense cover, where dominant plant community is non-native.<br><br><b>Moist to Wet meadows (high water table) and Riparian:</b> Wick application to target individual plants.<br><br><b>Timing:</b> Apply metsulfuron methyl when plants are fully emerged and in active growth. Apply picloram in early growth stages before bloom. |

| Target Species   | Notes specific to Deschutes, Ochoco, CRNG  | General Notes & Prescription   | Herbicide Options  | When/How to treat chemically  |
|--|--|--|--|---|
| <b>Sulfur cinquefoil</b><br><i>Potentilla recta</i><br>(PORE5)<br><br><i>Taprooted perennial that may have several shallow, spreading branch roots but no rhizomes</i> | Occurs on Lookout Mt. and Paulina Districts.   | <ul style="list-style-type: none"> <li>- Hand-digging may effectively control small infestations (The Nature Conservancy 2004).</li> <li>- There are no approved biological controls for this species.</li> <li>- In large infestations, selective herbicides applied at recommended label rates are likely the only method of effective control (The Nature Conservancy 2004).</li> <li>- Using prescribed fire alone does not appear to be effective; however, integrated approaches incorporating prescribed fire, herbicide application, and seeding of native seeds may be effective.</li> <li>- This species is a strong competitor and is capable of suppressing native vegetation. If sulfur cinquefoil populations are reduced (i.e., by herbicide, hand-pulling), native plants are usually able to rapidly re-colonize 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 (The Nature Conservancy 2004).</li> </ul> | <b>Upland:</b><br>1. Picloram<br>2. Triclopyr<br>3. Glyphosate<br><br><b>Riparian/High Water Table/Porous Soils:</b><br>Aquatic labeled glyphosate | From Mazzu (2005): On dry sites, picloram is preferred; backpack or wick to minimize drift, though broadcast spray may be necessary for large infestations.<br><br><b>Timing:</b> Apply picloram in fall or spring prior to late bud stage. |
| <b>Tansy ragwort</b><br><i>Senecio jacobaea</i><br>(SEJA)<br><br><i>Taprooted biennial or short-lived perennial</i>  | Occurs on Crescent and Sisters Districts. All 20 sites will be manually treated. On Crescent, chemical would only be used if tansy spreads & manual no longer effective. | <ul style="list-style-type: none"> <li>- Hand-pulling is effective if done in moist soils. This is most effective after the population has been brought under control.</li> <li>- Manual Disposal: Plants with flower heads should be removed from site, as young cut flower heads will continue to mature, producing viable seeds if moisture is present.</li> <li>- If chemicals are used, manual treatments should be used for follow-up treatment. Relative amounts of herbicide to manual treatments would decline over time.</li> <li>- Treatments may take up to ten years due to long-term seed viability.</li> <li>- Revegetate with desirable species if needed; most of areas already have good native plant species component..</li> </ul>   | <b>Upland:</b><br>1. Clopyralid<br>2. Chlorsulfuron<br>3. Picloram   | Manual treatment is preferred. If chemicals used, spot spray to target individual plants. If broadcast spray was needed, a selective “patch broadcast” technique would be used.   |

| Target Species   | Notes specific to Deschutes, Ochoco, CRNG  | General Notes & Prescription  | Herbicide Options  | When/How to treat chemically   |
|--|--|---|--|--|
| <b>Teasel</b><br><i>Dipsacus fullonum</i> (DIFU2)<br><br><i>Taprooted Biennial</i>   | 15 sites are mapped on Ochoco NF. Populations on Lookout Mt. are not proposed for treatment (10 sites). Five sites on Paulina are proposed for treatment in places where high priority invasives are also being treated. | - Little information was found on treatment of teasel.<br>- Cutting, digging, and cultivation can work if repeated enough to eliminate seed production (Stevens County Noxious Weed Control Board 2006).<br>- If chemicals are used, manual treatments should be used for follow-up treatment.  | <b>Upland:</b><br>1. Metsulfuron methyl<br>2. Chlorosulfuron<br>3. Clopyralid + Triclopyr (= Redeem)<br><br><b>Riparian/High Water Table/Porous Soils:</b><br>Aquatic labeled glyphosate | Spot spray to target individual plants. If dense cover of teasel, a selective patch broadcast spray might be used.<br><br><b>Timing:</b> Apply to rosettes or early season growth; control is difficult later in growth cycle.   |
| <b>Whitetop</b><br><i>Cardaria draba</i> ,<br><i>C. pubescens</i> (CADR)<br><br><b>Hairy whitetop</b><br><i>Cardaria pubescens</i> (CAPU6)<br><br><i>Rhizomatous Perennial</i> | Whitetop occurs on the Ochoco NF and CRNG, with the majority of sites on Paulina District. One site of hairy whitetop occurs on Crescent District.   | - Diligent hand pulling or digging can control small infestations, but plants must be completely removed within 10 days after emergence throughout growing season for two to four years.<br>- Mowing followed a month later by herbicide may be effective. Mowing must be done during full flowering.<br>- If chemicals are used, manual treatments could be used for follow-up. Relative amounts of herbicide to manual treatments would decline over time.<br>- Revegetate high priority sites with desirable species if needed & possible. | <b>Upland:</b><br>1. Chlorosulfuron<br>2. Metsulfuron methyl<br>3. Glyphosate<br><br><b>Riparian/High Water Table/Porous Soils:</b><br>Aquatic labeled glyphosate                        | <b>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</b> Spot spray whenever possible. Broadcast spray in dense cover, where dominant plant community is non-native. <b>Moist to Wet meadows (high water table) and Riparian:</b> Wick application to target individual plants.<br><br><b>Timing:</b> Apply at pre-bloom to bloom growth stage or to rosettes in the fall |
| <b>Yellow flag iris</b><br><i>Iris pseudacorus</i> (IRPS)<br><br><i>Rhizomatous perennial</i>  | Occurs on Sisters District (Metolius River); occurs on non-FS land along Deschutes River (Bend/Ft. Rock District)  | - Manual or mechanical methods that remove the entire rhizome mass can successfully control small, isolated patches (The Nature Conservancy 2003). These methods, however, are very time and labor-intensive, since even small rhizome fragments can resprout.<br>- Can be effectively controlled by herbicides (The Nature Conservancy 2003).  | <b>Riparian/High Water Table/Porous Soils:</b><br>Aquatic labeled glyphosate; Habitat formulation of Imazapyr  | <b>Moist to Wet meadows (high water table) and Riparian:</b> Wick application to target individual plants.   |

| Target Species   | Notes specific to Deschutes, Ochoco, CRNG  | General Notes & Prescription  | Herbicide Options  | When/How to treat chemically   |
|--|--|---|--|--|
| <b>Yellow sweet clover</b><br><i>Melilotus officinalis</i><br>(MEOF)<br><br><i>Annual, winter annual or biennial</i> | This species is relatively abundant and only proposed for treatment along Hwy 58 on Crescent District, where it occurs with other high priority invasive species.  | <ul style="list-style-type: none"> <li>- Burning (and sometimes a combination of cutting and burning) was the focus of sweet clover treatments in prairies by The Nature Conservancy (1987). Our one site proposed for treatment is along a highway and does not lend itself to burning.</li> <li>- Hand pulling is effective on small infestations when the soil is moist (Minnesota Dept. of Natural Resources 2006).</li> <li>- Cutting should be done before flowers emerge. The goal is to halt flowering and then concentrate on depleting viable seeds in the soil.</li> <li>- If chemicals are used, hand pulling and/or cutting flowers may be used as a follow-up.</li> </ul>   | <b>Upland:</b><br>1. Clopyralid  | <b><i>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</i></b> Spot spray whenever possible. Broadcast spray in dense cover, where dominant plant community is non-native. <b><i>Moist to Wet meadows (high water table) and Riparian:</i></b> Wick application to target individual plants.<br><br><b><i>Timing:</i></b> Sweet clover enters a “critical growth period” about the 1 <sup>st</sup> of September, when root weight begins to increase rapidly as food is translocated from the tops for storage overwinter. |
| <b>Yellow starthistle</b><br><i>Centaurea solstitialis</i><br>(CESO3)<br><br><i>Annual</i>                           | Lookout Mt. and Paulina Districts each have one mapped site. Lookout Mt. site is treated under the 1998 EA has been reduced to hand-pulling after 5 years of treatment. Crescent District finds individual plants each year on Highway 58, pulling them to prevent spread onto the Deschutes NF; they found 2 sites in 2003; 1 site in 2004; not found again in 2005 & 2006. | <ul style="list-style-type: none"> <li>- Hand-pull small patches or maintenance programs where plants are sporadically located. Remove all above ground material (leaving even a two inch piece of stem can result in recovery if leaves and buds are still attached at base of plant). Pull after bolted but before it produces viable seed. On relatively large populations of &lt; 40 acres, start removing plants at outward edge of population and work toward interior (Bradley Method).</li> <li>- Mowing can be useful but timing is critical (before viable seed production, but too early can result in rapid re-growth).</li> <li>- In areas with many non-target species, early summer tillage will control yellow starthistle provided roots are detached from the shoots; repeated cultivation will be necessary in same season when rainfall stimulates germination.</li> <li>- Mazzu (2005) discusses biological control, prescribed burning, and grazing. Timing and intensity of grazing and type of grazing animal needs to be considered. Prescribed burning may be best used after herbicide treatment. Two biological control insects have reduced seed production by up to 76% in California.</li> <li>- Revegetate high priority sites if needed with desirable species if possible.</li> </ul> | <b>Upland:</b><br>1 - Clopyralid<br>2 - Picloram<br>3 - Glyphosate<br><br><b>Riparian/High Water Table/Porous Soils:</b><br>Aquatic labeled glyphosate | <b><i>Drier upland sites (Road, Quarries &amp; Upland Forest/Rangeland):</i></b> Boom broadcast spray in dense cover, where dominant plant community is non-native. Spot spray whenever possible, especially in areas with good native plant cover.<br><br><b><i>Sensitive Sites (e.g., adjacent to moist meadows or riparian areas) or Special Management Areas where more selective treatment is desired:</i></b> Spot spray or wick application to target individual plants.<br><br><b><i>Timing:</i></b> Spring application.             |



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## Biological Control

Biological control agents undergo a rigorous testing procedure prior to being available for release. Initial testing occurs in quarantine laboratories abroad and in the United States. The agents are tested for their effectiveness in controlling the target organism and for their host specificity. Testing includes potential effects on economic crops, rare plants, and similar species found in North America. An agent can be released only after it has been determined that it is unlikely that the agent will feed or cause injury to any native or agronomic species. It generally takes between ten and fifteen years for an agent to be cleared for release. The analyses for effects of such tools have already been completed under documents developed by Animal and Plant Health Inspection Service (APHIS) for approval of entry of such organisms.

The APHIS analysis assumes that agents will spread throughout North America, to wherever the target species exists. It is intended that this analysis will satisfy the intent of NEPA for the release and distribution of the agent in the United States. Like the invasive plants that are targeted, agents do not recognize property boundaries. The Forest Service has no control over the release of agents on adjacent weed populations. Agents are expected to spread onto National Forest system lands regardless of any action the Forest Service may take. More information is available in the R6 2005 FEIS. Biological control agents are a useful tool in the integrated weed management program, but are usually not completely effective in the control of invasive plants.

**Table B-2.** Invasive Plant Species Proposed for Biological Control in Deschutes/Ochoco/CRNG Invasive Plant EIS, and the Agents to be used.<sup>1</sup> Use of these agents complies with Standard #14 which requires use of only APHIS and State-approved agents that do not have direct negative impacts on non-target organisms.

| Invasive Plant                                      | Common Name Biocontrol Agent | Scientific Name Biocontrol Agent | Activity   | Non-target Effects  | Notes   |
|---|------------------------------|----------------------------------|--|---|---|
| <b>Canada thistle</b><br>( <i>Cirsium arvense</i> ) | Canada thistle stem weevil   | <i>Ceutorhynchus litura</i>      | Adults eat leaves and stem. Larvae eat stem and crown. | None have been reported. The host range of the beetle was found to be narrow, restricted to plants of the tribe <i>Cardueae</i> . | Favorable conditions include disturbed areas where Canada thistle is dense and where the plant is not stressed by grazing, dry conditions, flooding, mowing, or herbicides. |

<sup>1</sup> Information from Langland (2006) and Coombs et. al. (2004). Langland, Dave. 2004. Personal communication. Oregon Dept. of Agriculture Weed Specialist. Coombs, Eric M., Janet K. Clark, Gary L. Piper, and Alfred F. Cofrancesco, Jr. 2004. Biological Control of Invasive Plant in the United States. Oregon State University Press, Corvallis, Oregon.

| Invasive Plant  | Common Name Biocontrol Agent | Scientific Name Biocontrol Agent | Activity   | Non-target Effects   | Notes   |
|---|------------------------------|----------------------------------|--|--|---|
|   | Canada thistle stem gall fly | <i>Urophora cardui</i>           | Forms galls which act like a metabolic sink, preventing plant's nutrients from being allocated to other areas (roots, flower). This reduced the plant's vigor. | None have been reported.   | This fly does best in moist, disturbed areas with scattered Canada thistle plants. Semi-shaded areas seem to be slightly preferred over those in full sun. Fields subject to flooding, grazing, mowing, or chemical treatments are not conducive to fly survival.                                     |
| <b>St. Johnswort</b><br>( <i>Hypericum perforatum</i> ) | St. Johnswort root borer     | <i>Agrilus hyperici</i>          | Larvae eat roots.  | The beetle attacks <i>Hypericum concinnum</i> in California, but no long-term impacts have been reported.  | <i>Hypericum concinnum</i> does not occur in our Project Area and is currently only known from California ( <a href="http://plants.usda.gov/">http://plants.usda.gov/</a> )<br><br>In North America, is found mostly in mountain areas. Larvae are subject to fungal attack in damp sites.            |
|   | St. Johnswort moth           | <i>Aplocera plagiata</i>         | Larvae eat leaves and flowers.   | No instances of nontarget plant feeding have been reported.  | The effectiveness of this agent is quite variable. It appears to need warm dry areas with a summer season long enough to complete both generations. In favorable areas, this moth can be very effective; large populations of larvae can defoliate plants, thus inhibiting flower and seed formation. |
|   | Klamathweed beetle           | <i>Chrysolina hyperici</i>       | Larvae and adult eat leaves and flowers.   | No instances of nontarget feeding have been reported, although it may develop on several <i>Hypericum</i> species attacked by <i>C. quadrigemina</i> (see below) | The beetle prefers more moist conditions than <i>Chrysolina. quadrigemina</i> (see below) and avoids shaded or barren, rocky locations. It tolerates cold winter weather better than <i>C. quadrigemina</i> .   |

| Invasive Plant | Common Name Biocontrol Agent | Scientific Name Biocontrol Agent | Activity  | Non-target Effects   | Notes  |
|----------------|------------------------------|----------------------------------|---|--|--|
|                | Klamath weed beetle          | <i>Chrysolina quadrigemina</i>   | Larvae and adult eat leaves and flowers.  | Adults will feed and oviposit on <i>Hypericum calycinum</i> , an introduced ornamental, and on <i>H. concinnum</i> , a native species. No population-level impacts have been reported on the native species. | <p><i>Hypericum concinnum</i> does not occur in our Project Area and is currently only known from California (<a href="http://plants.usda.gov/">http://plants.usda.gov/</a>). <i>Hypericum calycinum</i> does not occur in the Project Area and is typically in moister regions of Oregon &amp; California.</p> <p>This agent is found in mountainous, open, sunny and warm areas. It apparently does not do well in shaded, barren, and excessively rocky locations.</p> <p>Success has been variable. At many locations where the insect is established, many of the St. Johnswort populations are still increasing in size and density, while at others there is little change.</p> |
|                | St. Johnswort gall midge     | <i>Zeuxidiplosis giardi</i>      | Larvae attack the leaf buds which results in the formation of galls that provide the larvae with a protective environment as well as nutrition. | The midge is capable of forming galls on <i>Hypericum concinnum</i> , but the damage to the plant is insignificant.  | <p><i>Hypericum concinnum</i> does not occur in our Project Area and is currently only known from California (<a href="http://plants.usda.gov/">http://plants.usda.gov/</a>).</p> <p>The midge seems to prefer damp locations with moderate to high relative humidity and high elevations. It also apparently does not like dry summers or continuously windy areas. It does not persist in areas heavily grazed by livestock.</p>   |

**Table B-3.** Biocontrol Agents that either exist in Oregon or could possibly move into the area on their own. (Langland 1998, *personal communication*, and [http://www.oregon.gov/ODA/PLANT/weed\\_bioagent\\_targets\\_shtml](http://www.oregon.gov/ODA/PLANT/weed_bioagent_targets_shtml)).

| Noxious Weed  | Common Name Biocontrol Agent    | Scientific Name Biocontrol Agent | Activity   | Known release sites in project area? | Notes   |
|---|---------------------------------|----------------------------------|--|--------------------------------------|---|
| <b>Bull thistle</b><br>( <i>Cirsium vulgare</i> )             | Bull thistle gall fly           | <i>Urophora stylata</i>          | Larvae feed on receptacle tissue where galls are also produced.        | Y                                    | Can prevent some seeding.   |
| <b>Canada thistle</b><br>( <i>Cirsium arvense</i> )           | Canada thistle seed weevil      | <i>Ceutorhynchus litura</i>      | Adults eat leaves and stem. Larvae eat stem and crown.                 | Y                                    | Canada thistle weevil   |
|   | Thistle stem gall fly           | <i>Urophora cardui</i>           | Nutrient sinks in larval galls.  | Y                                    | Can prevent some seeding.   |
| <b>Dalmatian toadflax</b><br>( <i>Linaria dalmatica</i> )     | Toadflax flower-feeding beetle  | <i>Brachypterus pulicarius</i>   | Larvae eat pollen, anthers, ovaries, and seeds. Adults eat shoot tips. |                                      | Widespread and established in most of North America's toadflax populations. |
|   | Toadflax moth                   | <i>Calophasia lunula</i>         | Larvae eat young shoots and stem tips.                                 |                                      | Prefers hot summers.  |
|   |                                 | <i>Gymnetron antirrhini</i>      | Root-galling weevil  |                                      |   |
| <b>Butter &amp; Eggs</b><br>( <i>Linaria vulgaris</i> )       |                                 | <i>Mecinus janthinus</i>         | Stem boring weevil   |                                      |   |
| <b>Diffuse knapweed</b><br>( <i>Centaurea diffusa</i> )       | Sulphur knapweed moth           | <i>Agapeta zoegana</i>           | Larvae mine roots.   | Y                                    |   |
|   | Seed head weevil                | <i>Bangasternus fausti</i>       | Larvae consume most seeds in early season buds.                        | Y                                    |   |
| <b>Spotted knapweed</b><br>( <i>Centaurea biebersteinii</i> ) | Knapweed peacock fly            | <i>Chaetorellia acrolophi</i>    | Larvae eat receptacle, florets, and seeds.                             |                                      | Primary host is spotted knapweed; diffuse knapweed is secondary host.       |
|   | Knapweed root weevil            | <i>Cyphocleonus achates</i>      | Larvae mine root cortex.   | Y                                    |   |
|   | Lesser knapweed flower weevil   | <i>Larinus minutus</i>           | Larvae eat seeds. Adults eat foliage.                                  | Y                                    |   |
|   | Blunt knapweed flower weevil    | <i>Larinus obtusus</i>           | Larvae eat seeds.  |                                      | Prefers meadow knapweed; spotted knapweed is secondary.                     |
|   | Spotted knapweed seed head moth | <i>Metzneria paucipunctella</i>  | Larvae consume seeds.  | Y                                    |   |
|   | Grey-winged root moth           | <i>Pterolanche dispersa</i>      | Larvae attacks root central vascular tissue.                           |                                      | Has not yet been established in U.S.  |
|   | Bronze knapweed root-borer      | <i>Sphenoptera jugoslavica</i>   | Larvae deplete root carbohydrates.                                     | Y                                    |   |
|   | Verdant seed fly                | <i>Terellia virens</i>           | Larvae eat flower receptacle and seeds.                                |                                      |   |
|   |                                 |                                  |  |                                      |   |

| Noxious Weed  | Common Name<br>Biocontrol Agent | Scientific Name<br>Biocontrol Agent | Activity   | Known<br>release<br>sites in<br>project<br>area? | Notes   |
|---|---------------------------------|-------------------------------------|--|--|---|
|   | Banded gall fly                 | <i>Urophora affinis</i>             | Larvae form galls on flower receptacle and seeds, causing nutrient sink. | Y  | Established throughout Pacific Northwest.   |
|   | UV knapweed seed head fly       | <i>Urophora quadrafasciata</i>      | Larvae eat flower receptacle and seeds.                                  | Y  | Established throughout Pacific Northwest.   |
| <b>Leafy spurge</b><br>( <i>Euphorbia esula</i> )       |                                 | <i>Aphthona abdominalis</i>         | Root/defoliating flea beetle   |  |   |
|   |                                 | <i>Aphthona cyparissiae</i>         | Root/defoliating flea beetle   |  |   |
|   |                                 | <i>Aphthona czqalinae</i>           | Root/defoliating flea beetle   |  |   |
|   |                                 | <i>Aphthona lacertosa</i>           | Root/defoliating flea beetle   |  |   |
|   |                                 | <i>Aphthona flava</i>               | Root/defoliating flea beetle   |  |   |
|   |                                 | <i>Aphthona nigriscutis</i>         | Root/defoliating flea beetle   |  |   |
|   |                                 | <i>Hyles euphorbiae</i>             | Defoliating moth   |  | Not established in Oregon.  |
|   |                                 | <i>Oberea erythrocephala</i>        | Root/stemboring beetle   |  |   |
|   |                                 | <i>Spurgia esula</i>                | Shoot tip gall midge   |  | Not established in Oregon.  |
| <b>Musk thistle</b><br>( <i>Carduus nutans</i> )        |                                 | <i>Cheilosia corydon</i>            | Crown/rootfly  |  | Established in Oregon.  |
|   |                                 | <i>Rhinocyllus conicus</i>          | Seed head weevil   |  | Because this agent has moved to native <i>Cirsium</i> plant species, ODA will not be moving this weevil to new sites. |
|   |                                 | <i>Trichosirocalus horridus</i>     | Crown/root weevil  |  |   |
|   |                                 | <i>Urophora solstitialis</i>        | Seed head gall fly   |  | Not established in U.S.; is in Canada.  |
| <b>Puncturevine</b><br>( <i>Tribulus terrestris</i> )   |                                 | <i>Microlarinus lareynii</i>        | Seed weevil  |  | Does not work in cold climates.   |
|   |                                 | <i>Microlarinus lypriformis</i>     | Stem boring weevil   |  | Does not work in cold climates.   |
| <b>Russian knapweed</b><br>( <i>Acroptilon repens</i> ) |                                 | <i>Subanguina picridis</i>          | Leaf stem gall nematode  | Y  | On Crooked River National Grassland.  |
| <b>Russian thistle</b><br>( <i>Salsola kali</i> )       |                                 | <i>Coleophora klimeschiella</i>     | Leaf mining moth   |  | Parasitized by native insects so not effective biocontrol agent.  |
|   |                                 | <i>Coleophora parthenica</i>        | Stem boring moth   |  | Parasitized by native insects so not effective biocontrol agent.  |
| <b>St. Johnswort</b><br>( <i>Hypericum</i> )            | St. Johnswort borer             | <i>Agrilus hyperici</i>             | Larvae eat roots.  |  | Established on east side of Cascade Mountains.  |

| Noxious Weed   | Common Name<br>Biocontrol Agent | Scientific Name<br>Biocontrol Agent | Activity   | Known<br>release<br>sites in<br>project<br>area? | Notes  |
|--|---------------------------------|-------------------------------------|--|--|--|
| <i>perforatum</i> )  | St. Johnswort<br>inchworm       | <i>Aplocera plagiata</i>            | Larvae eat leaves and flowers.   | Y  | Some establishment on east side<br>of Cascade Mountains.   |
|  | Klamath weed beetle             | <i>Chrysolina hyperici</i>          | Larvae and adult eat leaves and flowers.   |  | Established on west side of<br>Cascade Mountains. Prefers fall<br>rains.   |
|  | Klamath weed beetle             | <i>Chrysolina quadrigemina</i>      | Larvae and adult eat leaves and flowers.   | Y  |  |
|  | Klamath weed midge              | <i>Zeuxidiplosis giardi</i>         | Larvae create nutrient sink galls.   |  | Not established in Oregon.   |
| <b>Scotch broom</b><br>( <i>Cytisus<br/>scoparius</i> )                |                                 | <i>Apion fuscirostre</i>            | Seed weevil  |  |  |
|  |                                 | <i>Bruchidius villosus</i>          | Seed beetle  |  |  |
|  |                                 | <i>Leucoptera spartifoliella</i>    | Twig mining moth   |  |  |
| <b>Tansy ragwort</b><br>( <i>Senecio<br/>jacobaea</i> )                |                                 | <i>Botanophila seneciella</i>       | Seed head fly  | Y  |  |
|  | Ragwort flea beetle             | <i>Longitarsus jacobaeae</i>        | Larvae mine roots. Adults eat leaves.  |  | Highly effective on west side of<br>Cascade Mountains. Thrives<br>below 2600' elevation.   |
|  | Cinnabar moth                   | <i>Tyria jacobaeae</i>              | Larvae eat leaves, terminal buds, and<br>flowers. Requires dense host infestation. | Y  | Requires dense host infestation.<br>Very effective when combined<br>with the ragwort flea beetle.<br>Because it has moved to native<br><i>Senecio</i> plants, ODA will not be<br>moving this agent to new sites.<br>Not yet successful on east side<br>of Cascade Mountains. |
| <b>Yellow<br/>starthistle</b><br>( <i>Centaurea<br/>solstitialis</i> ) |                                 | <i>Bangasternus orientalis</i>      | Weevil   |  |  |
|  |                                 | <i>Chaetorellia australis</i>       | Seed head fly  |  |  |
|  |                                 | <i>Chaetorellia succinea</i>        | Seed head fly  |  |  |
|  |                                 | <i>Eustenopus villosus</i>          | Seed head weevil   |  |  |
|  |                                 | <i>Larinus curtus</i>               | Seed head weevil   |  |  |
|  |                                 | <i>Urophora quadrifasciata</i>      | Seed head gall fly   |  |  |
|  |                                 | <i>Urophora sirunaseva</i>          | Seed head fly  |  |  |
|  |                                 |                                     |  |  |  |

**Table B-4.** Herbicides considered for use on invasive plant species, Deschutes and Ochoco NF and Crooked River National Grassland Invasive Plant EIS. (Oregon Department of Agriculture and Crook County provided numbered priorities).

| Species                                    | Common Name          | Chlor-sulfuron (Telar) | Clopyralid (Transline) | Glyphosate (RoundUp, Rodeo) | Imazapic (Plateau) | Imazapyr (Arsenal; Habitat) | Metsulfuron methyl (Escort) | Picloram (Tordon) | Sethoxydim (Poast) | Sulfometuron methyl (Oust) | Triclopyr (Garlon) | Notes  |
|--|----------------------|------------------------|------------------------|-----------------------------|--------------------|-----------------------------|-----------------------------|-------------------|--------------------|----------------------------|--------------------|--|
| <i>Acroptilon repens</i>                   | Russian knapweed     | 3                      | 2                      | 4                           |                    |                             |                             | 1                 |                    |                            |                    | Picloram 1 <sup>st</sup> choice, but if sensitive non-target species (e.g., cottonwoods on CRNG) switch to Clopyralid. |
| <i>Arctium minus</i>                       | Lesser burdock       | 3                      |                        |                             |                    |                             | 1                           | 2                 |                    |                            |                    |  |
| <i>Cardaria draba</i>                      | Whitetop             | 1                      |                        | 3                           |                    |                             | 2                           |                   |                    |                            |                    |  |
| <i>Cardaria pubescens</i>                  | Hairy whitetop       | 1                      |                        | 3                           |                    |                             | 2                           |                   |                    |                            |                    |  |
| <i>Carduus nutans</i>                      | Musk thistle         | 3                      | 1                      |                             |                    |                             | 2                           |                   |                    |                            |                    |  |
| <i>Centaurea biebersteinii</i>             | Spotted knapweed     |                        | 1                      | 3                           |                    | 4                           |                             | 2                 |                    |                            |                    |  |
| <i>Centaurea debeauxii</i>                 | Meadow knapweed      |                        | 1                      | 3                           |                    | 4                           |                             | 2                 |                    |                            |                    | Suspected but not yet documented to occur.   |
| <i>Centaurea diffusa</i>                   | Diffuse knapweed     |                        | 1                      | 3                           |                    | 4                           |                             | 2                 |                    |                            |                    |  |
| <i>Centaurea solstitialis</i>              | Yellow star-thistle  |                        | 1                      | 3                           |                    |                             |                             | 2                 |                    |                            |                    | Would not use triclopyr; resistance to picloram possible in Northwest.   |
| <i>Cirsium arvense</i>                     | Canada thistle       | 3                      | 1                      | 4                           |                    |                             |                             | 2                 |                    |                            |                    |  |
| <i>Convolvulus arvensis</i>                | Field bindweed       |                        |                        | 4                           | 2                  | 3                           |                             | 1                 |                    |                            |                    |  |
| <i>Cynoglossum officinale</i>              | Houndstongue         | 2                      |                        | 4                           |                    |                             | 1                           | 3                 |                    |                            |                    |  |
| <i>Cytisus scoparius</i>                   | Scotch broom         |                        |                        | 3                           |                    |                             |                             | 2                 |                    |                            | 1                  |  |
| <i>Dipsacus fullonum</i>                   | Teasel               | 2                      | 3 (see notes)          |                             |                    |                             | 1                           |                   |                    |                            | 3 (see notes)      | 3 <sup>rd</sup> choice is Redeem (clopyralid + Triclopyr).   |
| <i>Elytrigia repens</i> var. <i>repens</i> | Quackgrass           | 2 (See notes)          |                        | 1                           |                    | 4                           |                             |                   | 3                  | 2 (See notes)              |                    | Landmark (Telar + Oust).   |
| <i>Euphorbia esula</i>                     | Leafy spurge         |                        |                        | 2                           | 3                  |                             |                             | 1                 |                    |                            |                    |  |
| <i>Hypericum perforatum</i>                | St. Johnswort        |                        |                        | 3                           |                    |                             | 1                           | 2                 |                    |                            |                    |  |
| <i>Kochia scoparia</i>                     | Kochia               | 1                      |                        | 3                           |                    |                             | 2                           |                   |                    |                            |                    |  |
| <i>Lepidium latifolium</i>                 | Perennial pepperweed | 1                      |                        | 4                           |                    | 3                           | 2                           |                   |                    |                            |                    | Suspected but not yet documented to occur.   |
| <i>Linaria dalmatica</i>                   | Dalmatian toadflax   | 2                      |                        |                             | 3                  |                             |                             | 1                 |                    |                            |                    | Telar + Picloram mix works very well on Dalmatian Toadflax.  |
| <i>Linaria vulgaris</i>                    | Butter & eggs        | 2                      |                        |                             | 3                  |                             |                             | 1                 |                    |                            |                    |  |
| <i>Onopordum acanthium</i>                 | Scotch thistle       | 2                      | 1                      |                             |                    |                             | 3                           |                   |                    |                            |                    |  |
| <i>Phalaris arundinacea</i>                | Reed canarygrass     |                        |                        | 1                           |                    | 2                           |                             |                   | 3                  |                            |                    | Habitat formulation of Imazapyr may work well.   |



| Species                                       | Common Name          | Chlor-sulfuron (Telar) | Clopyralid (Transline) | Glyphosate (RoundUp, Rodeo) | Imazapic (Plateau) | Imazapyr (Arsenal; Habitat) | Metsulfuron methyl (Escort) | Picloram (Tordon) | Sethoxydim (Poast) | Sulfometuron methyl (Oust) | Triclopyr (Garlon) | Notes  |
|---|----------------------|------------------------|------------------------|-----------------------------|--------------------|-----------------------------|-----------------------------|-------------------|--------------------|----------------------------|--------------------|--|
| <i>Phalaris arundinacea</i> var. <i>picta</i> | Ribbongrass          |                        |                        | 1                           |                    | 2                           |                             |                   | 3                  |                            |                    |  |
| <i>Potentilla recta</i>                       | Sulphur cinquefoil   |                        |                        | 3                           |                    |                             |                             | 1                 |                    |                            | 2                  |  |
| <i>Rubus discolor</i>                         | Himalayan blackberry |                        |                        | 2                           |                    |                             |                             | 3                 |                    |                            | 1                  |  |
| <i>Salsola kali</i>                           | Russian thistle      | 1                      |                        | 3                           |                    |                             | 2                           |                   |                    |                            |                    |  |
| <i>Salvia aethiopis</i>                       | Mediterranean sage   | 2                      |                        |                             |                    |                             | 1                           | 3                 |                    |                            |                    |  |
| <i>Senecio jacobaea</i>                       | Tansy ragwort        | 2                      | 1                      |                             |                    |                             |                             | 3                 |                    |                            |                    |  |
| <i>Silybum marianum</i>                       | Blessed milkthistle  | 2                      | 1                      |                             |                    |                             |                             | 3                 |                    |                            |                    |  |
| <i>Taeniatherum caput-medusae</i>             | Medusahead           | 2 (See notes)          |                        | 4                           | 3                  |                             |                             |                   | 5                  | 1<br>2 (See Notes)         |                    | Landmark (oust/telar) would be 2 <sup>nd</sup> choice. |