APPENDIX B: SPECIES ABSTRACTS FOR NOXIOUS WEEDS

Canada Thistle (*Cirsium arvense*)

Canada thistle. *Photo by Peggy Lyon*

Identifying characteristics:
Flowers pink-purple or occasionally white, borne in clusters of 1 – 5 per branch; leaves are spiny, alternate, oblong or lance-shaped, with the base leaves stalkless and clasping, or extended down along the spiny stem, plants 1 – 5 feet tall, single stemmed, rhizomatous; perennial (Handwerk 2002).

Phenology:
Flower: June – August. Fruit: August – October.

Dispersal mechanism:
Canada thistle invades natural communities mainly through vegetative expansion, but can be dispersed long distances by wind blown seed. It quickly spreads vegetatively via deep rhizomes, and it readily resprouts when cut (Beck 2003).

Other Relevant Life History:
Canada thistle is dioecious, having male and female flowers on separate individual plants, with only female flowers producing seeds (Nuzzo 1998). Seeds can remain viable in soil for up to 21 years, and up to four months in water (USGS 2003). The species is shade intolerant. Roots grow both horizontally and vertically. Horizontal roots can grow out 60-90cm, then bend down and grow vertically, with new horizontal roots initiated at the bend. Vertical roots can grow as deep as 6.8m (Nuzzo 1998). Root bud elongation is greatest in summer; root bud development is highest in autumn. The root carbohydrate reserves are lowest in June, just before flowering, and begin to increase in early fall as shoot growth declines (Butterfield et al. 1996; Nuzzo 1998).

Management Options:
The key to control of *Cirsium arvense* is twofold – the growth of native herbaceous species must be enhanced while stressing the Canada thistle plants, and forcing them to use stored root nutrients (Nuzzo 1998; Beck 2003). Management programs should focus on killing established clones since Canada thistle spreads mainly from its from roots; preventing seed production should be secondary. Areas treated with burning, spot-applied herbicides, biocontrols, and infrequent mowing will retain or enhance most of the native community. However, areas treated with repeated discing or mowing, or broadcast herbicides will leave little native vegetation, and therefore are not recommended for natural areas where it is important to maintain the growth of native herbaceous species (Nuzzo 1998). A single control method is rarely sufficient, and it will

take at least two growing seasons to determine whether or not a particular method is effective (Nuzzo 1998). Also, strategies should be adjusted to weather conditions (e.g., drought stress reduces effectiveness of herbicides, but increases effectiveness of mechanical controls) (Nuzzo 1998).

The most effective herbicide is picloram (Tordon), which is often used in combination with dicamba (Banvel) or 2,4D as a spring application prior to flowering, or in the fall when rosettes are growing (Butterfield et al. 1996). However, picloram is not recommended in natural areas, and is restricted from use amongst trees. It may persist in soil for up to three years, is relatively soluble, and may percolate into the water table (Beck 2003). Dicamba is effective in dry western states, including Wyoming, where it does not leach or break down as rapidly, but is restricted from use among trees (Biesboer 1998). Clopyralid plus 2,4-D (Curtail) and chlorsulfuron (Telar) are also effective against Canada thistle, especially when combined with cultural or mechanical control (Beck 2003). An alternative treatment is glyphosate (Roundup) in the bud stage or in the fall during the rosettes' growth period.

The Nature Conservancy's Phantom Canyon Preserve (in northern Colorado) has had success with multiple cuttings or grazing before flower buds show any purple, then fall selective herbicide application before the first hard frost. They use the herbicide Telar, which does not bind to the soil, breaks down within 48 hours, and is cleared for use near water. Curtail can also be used, and is less expensive, but it affects a broader range of species (H. Knight, pers. comm.).

Sandy Floyd, who conducted a Canada thistle control experiment on F.E. Warren AFB, reports that the most effective control methods were a July mow and fall spray. This resulted in significantly reduced cover and density of thistle, and an increase in cover of other desirable native plants (Floyd 1995).

Canada thistle response to burning varies, depending on the season of burn, soil moisture and location. In general, dormant season burns have been shown to stimulate native species growth and reduce the abundance of thistle, whereas growing season fires may reduce thistle density but harm native species (Nuzzo 1998).

The effectiveness of biological controls alone is not clear. Their suitability for use can vary depending on local conditions (such as moisture), timing of application can be critical, and effectiveness may vary between sites and years. *Ceutorhynchus litura* (a weevil) is currently used as a biocontrol agent in Colorado, and has also been released and become established in other areas (Butterfield et al. 1996). However, *Ceutorhynchus* alone will not effectively control Canada thistle. A combination of control measures must be used for effective control (Beck 2003).

Literature Cited:

Beck, G. 2003. Canada thistle. Colorado State University Cooperative Extension Natural Resources Series, No. 3.108. http://www.colostate.edu/Depts/CoopExt/PUBS/NATRES/03108.html

Biesboer, D.D. 1998. Element stewardship abstract for *Euphorbia esula*. The Nature Conservancy, Wildland Weeds Management and Research Program. http://tncweeds.ucdavis.edu/esadocs/euphesul.html

Butterfield, C., J. Stubbendieck, and J. Stumpf. 1996. Species abstracts of highly disruptive exotic plants. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/exoticab/exoticab.htm

Floyd, S. 1995. Experimental control of Canada thistle within the *Gaura neomexicana* ssp. *coloradensis* Research Natural Area on F. E. Warren Air Force Base and recommendations for continued monitoring of the Gaura population. Unpublished report prepared for the Wyoming Nature Conservancy.

Handwerk, J. 2002. Colorado noxious weed fact sheet: Canada thistle. Colorado Natural Heritage Program, Colorado State University, Fort Collins, Colorado.

Knight, H. 2004. Personal communication. Heather Knight, Preserve Manager for The Nature Conservancy's Phantom Canyon Preserve, Larimer County, Colorado to Lee Grunau.

Nuzzo, V. 1998. Element stewardship abstract for *Cirsium arvense*. The Nature Conservancy, Wildland Weeds Management and Research Program. http://tncweeds.ucdavis.edu/esadocs/cirsarve.html

U.S. Geological Service. 2003. An assessment of exotic plant species of Rocky Mountain National Park: *Cirsium arvense*. Northern Prairie Wildlife Research Center, U.S. Geological Service. http://www.npwrc.usgs.gov/resource/othrdata/Explant/cirsarve.htm

Additional references:

Colorado Natural Areas Program. 2000. Creating an Integrated Weed Management Plan. Caring for the Land Series, Volume IV. Division of Plant Industry, Colorado Department of Agriculture.

Leafy Spurge (*Euphorbia esula*)

Identifying characteristics:
Flowers yellowish-green, small, arranged in numerous small clusters with a pair of heart-shaped yellow-green bracts below each flower; leaves are alternate, narrow with smooth margins, 1 – 4 inches long; stems are unbranched and typically clustered together; plants up to 3 feet tall, the entire plant contains a milky latex; perennial (Handwerk 2002).

Leafy spurge. *Photo by Dave Anderson*

Phenology:
Flower: May – June. Fruit: July – August.

Dispersal mechanism:
Leafy spurge invades natural communities primarily through seed dispersal from mid to late July, into early August. The seed capsules explode, forcibly ejecting seeds up to 5m. The seed can be transported by water and wildlife. Leafy spurge also spreads vegetatively via deep rhizomes and roots (Beck 2003).

Other Relevant Life History:
Leafy spurge emerges earlier in spring that most other species, giving it a competitive advantage. It can produce over 100,000 seeds per plant; the seeds have a high germination rate (60 – 80%), and may remain viable in the soil for approximately 5 – 8 years (Butterfield et al. 1996). Peak germination occurs in May, and after 10 – 12 days seedlings are able to reproduce vegetatively by developing buds on roots (Beck 2003). Leafy spurge's extensive root system can give rise to shoot buds almost anywhere along its length. Both crown buds and root buds can remain viable in the soil for a number of years (Rutledge and McLendon nd). Butterfield et al. (1996) report roots of nearly 5m laterally and 9m deep, with up to 300 buds. Due to the extensive root system, cultivation or shallow removal of plants can actually increase the number of stems (Biesboer 1998). Rapid re-establishment of dense stands can occur after apparently successful management because of the long-lived root system (Biesboer 1998). Leafy spurge has been reported to cause severe irritation to the mouth and digestive tract of cattle (Rutledge and McLendon nd).

Management Options:
The most effective control of leafy spurge will require a number of different management techniques aimed at reducing root reserves and stressing the plants (Rutledge and McLendon nd). Monitoring and repeated control measures are generally considered necessary for at least 10 years following initiation of active management (Biesboer 1998).

Reduction of infestation to manageable levels is possible with herbicides. Picloram (Tordon) is most effective, and is sometimes used in conjunction with 2,4D. However, picloram is not recommended in natural areas, and is restricted from use amongst trees. It may persist in soil for up to three years, is relatively soluble and may percolate into the water table (Beck 2003). Dicamba (Banvel) is effective in dry western states (including Wyoming) where it does not leach or break down as rapidly, but is restricted from use among trees (Biesboer 1998). Imazapic (Plateau) has been recently registered for use in noncrop areas. It is safe to use around trees, but may injure cool season perennial grasses (Beck 2003). Leafy spurge is sensitive to the timing of herbicide application; the most effective times are in spring at flowering and late September during fall regrowth (Beck 2003).

Grazing sheep or goats can help deplete root reserves, and could be used in conjunction with fall herbicide application. Sheep eat leafy spurge in early spring; goats eat it at most times in growing season (Beck 2003). If livestock are grazed after seed formation, they should be held in a corral for at least seven days before moving them to a different location to prevent seed transport (Beck 2003). Research at CSU indicates that six to eight sheep/acre grazing 10 days in July for five years decreased spurge by 90%. When sheep and flea beetles were grazed simultaneously, leafy spurge density was reduced 100% (Beck 2003).

Biocontrol agents such as insects can play an important role in leafy spurge control, especially in areas where herbicide use is difficult or risky (Beck 2003). Several species of flea beetles are available for use as biocontrol agents; the two most promising are *Apthona nigriscustis* (the black-dot flea beetle) and *A. flava* (the copper spurge flea beetle) (Butterfield 1996; Beck 2003).

Burning in conjunction with herbicides is effective in open areas, but must be repeated over years. Burning alone is not likely to be effective because of resprouting from roots. Many of The Nature Conservancy preserves use a combination of burning and/or mowing, with herbicide application. Mowing can reduce above ground stands, and stress the plants in a manner similar to grazing, but must be used in conjunction with herbicides to be effective (Biesboer 1998). Mechanical cultivation is not recommended for leafy spurge control due to the species ability to resprout from root buds (Rutledge and McLendon nd; Butterfield 1996).

Literature Cited:

Beck, G. 2003. Leafy spurge. Colorado State University Cooperative Extension Natural Resources Series, No. 3.107. http://www.colostate.edu/Depts/CoopExt/PUBS/NATRES/03107.html

Biesboer, D.D. 1998. Element stewardship abstract for *Euphorbia esula*. The Nature Conservancy, Wildland Weeds Management and Research Program. http://tncweeds.ucdavis.edu/esadocs/euphesul.html

Butterfield, C., J. Stubbendieck, and J. Stumpf. 1996. Species abstracts of highly disruptive exotic plants. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/exoticab/exoticab.htm

Handwerk, J. 2002. Colorado noxious weed fact sheet: Leafy spurge. Colorado Natural Heritage Program, Colorado State University, Fort Collins, Colorado.

Rutledge, C.R. and T. McLendon. ND. An assessment of exotic plant species of Rocky Mountain National Park: *Euphorbia esula*. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/Explant/explant.htm

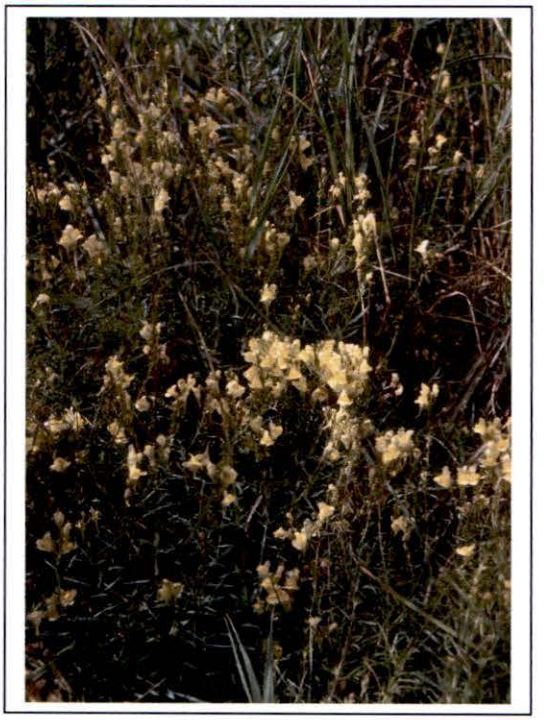
Additional references:

Colorado Natural Areas Program. 2000. Creating an Integrated Weed Management Plan. Caring for the Land Series, Volume IV. Division of Plant Industry, Colorado Department of Agriculture.

Kirby, D.R., R.G. Lym, J. Sterling, and C. Hull Sieg. 2003. Leafy spurge control in western prairie fringed orchid habitat. J. Range Management 56:466-473.

Dalmatian Toadflax (*Linaria dalmatica* ssp. *dalmatica*)

Identifying characteristics:
Flowers yellow, resembling snapdragons, occurring in terminal, elongated racemes; leaves are waxy, alternate, broad and rounded, crowded with upper leaves clasping the stem; stems 1 – 25 per plant, somewhat woody, clumps of stems can be up to 3 feet tall; perennial (Handwerk 2003). Dalmatian toadflax closely resembles a related invasive weed – yellow toadflax (*L. vulgaris*). The leaves of the species *dalmatica* distinguish it from *vulgaris*, which has narrow, linear, and pointed leaves that do not clasp the stem.



Linaria vulgaris. *Photo by Dave Anderson*

Phenology:
Flower: May – August. Fruit: July – October.

Dispersal mechanism:
Dalmatian toadflax invades natural communities via seed and vegetative propagation (Carpenter and Murray 1998). Seed is dispersed primarily by wind, but also via livestock. The species can also spread rapidly by rhizomes (Rutledge and McLendon nd).

Other Relevant Life History:
In one season, an individual plant of Dalmatian toadflax can produce 1 – 25 floral stems, resulting in as many as 500,000 seeds per year (Carpenter and Murray 1998; CNAP 2000). Seeds mature in late summer, generally germinating the following spring, but can remain dormant up to 10 years. Seedlings are ineffective competitors for soil moisture, and initial root development is slow, making seedlings an ideal growth stage for control. However, once established, reproduction from root buds begins as early as 2 – 3 weeks after germination. Roots as short as 1cm can produce stems (Beck 2001). The taproot of established plants can penetrate the soil as deep as 1m, and extend horizontally for several meters (Carpenter and Murray 1998). The extensive, deep root system and waxy leaves make control very difficult (Rutledge and McLendon nd).

Management Options:
Dalmatian toadflax is difficult to control and management plans should incorporate as many strategies as possible to achieve success (Beck 2001). The main key to control is to eliminate or greatly reduce seed production, and to destroy seedlings from the seed bank before they can become established. Plants can be successfully controlled by pulling or

applying herbicides before seed production begins, but control efforts must continue for at least 10 years, since seeds remain viable that long and plants can reproduce vegetatively. Desirable native species such as competitive grasses and/or forbs should be planted to replace the controlled Dalmatian toadflax (Carpenter and Murray 1998). Management should be conducted in June, when buds are formed and beginning to flower, and root reserves are lowest, with a follow-up treatment in late June/early July to catch late-flowering plants (Carpenter and Murray 1998).

Several herbicides are considered effective for Dalmatian toadflax management. Glyphosate (Roundup) will kill non-target plants but can be applied directly; it biodegrades in soil, but may persist in active form for as long as 79 days. Dicamba (Banvel) does not bind to soil, but may leach into groundwater, and has the potential to persist in natural areas for long periods of time (Carpenter and Murray 1998), and is restricted from use among trees (Biesboer 1998). Picloram (Tordon) may leach into water, and damage to non-target vegetative is major problem. Picloram is not recommended in natural areas, and is restricted from use amongst trees (Beck 2003). Research also indicates that chlorsulfuron (Telar) is effective in controlling Dalmatian toadflax in non-crop areas (Beck 2001).

Burning is not recommended as a management option due to the large, deep root systems of Dalmatian toadflax, and the susceptibility of burned areas to increased infestations of weedy species (Carpenter and Murray 1998). Also, grazing and shallow cultivation will not destroy plants because of the deep root system. Removal of above ground growth by cutting at the soil surface or hand pulling can eliminate reproduction by seed if it is done in spring or early summer (Carpenter and Murray 1998).

There are several biological control agents available to control toadflax, but their effectiveness remains largely unknown (Beck 2001). Several insects have been approved for release by in the United States. *Brachypterolus pulicarius,* the toadflax flower beetle feeds on the reproductive parts of the plant (Beck 2001). *Calophasia lunula,* the toadflax moth, can defoliated up to 20% of stems where established, but it is not well adapted to cold, high elevation areas (Carpenter and Murray 1998; Integrated Weed Control 2003). *Gymnaetron antirrhini,* the seed-eating weevil, usually attacks yellow toadflax but one strain has adapted to feed on Dalmatian toadflax, and has the potential to reduce seed production (Carpenter and Murray 1998).

Literature Cited:

Beck, K.G. 2001. Biology and management of the toadflaxes. Colorado State University Cooperative Extension Natural Resources Series, No. 3.114. http://www.ext.colostate.edu/pubs/natres/03114.html

Beck, G. 2003. Canada thistle. Colorado State University Cooperative Extension Natural Resources Series, No. 3.108. http://www.colostate.edu/Depts/CoopExt/PUBS/NATRES/03108.html

Biesboer, D.D. 1998. Element stewardship abstract for *Euphorbia esula*. The Nature Conservancy, Wildland Weeds Management and Research Program. http://tncweeds.ucdavis.edu/esadocs/euphesul.html

Carpenter, A.T. and T.A. Murray. 1998. Element stewardship abstract for *Linaria dalmatica*. The Nature Conservancy, Wildland Weeds Management and Research Program. http://tncweeds.ucdavis.edu/esadocs.html

Colorado Natural Areas Program. 2000. Creating an Integrated Weed Management Plan. Caring for the Land Series, Volume IV. Division of Plant Industry, Colorado Department of Agriculture.

Handwerk, J. 2003. Colorado noxious weed fact sheet: Dalmatian toadflax. Colorado Natural Heritage Program, Colorado State University, Fort Collins, Colorado.

Integrated Weed Control. 2003. Yellow and Dalmatian toadflax. Integrated Weed Control Home Page. http://www.integratedweedcontrol.com/toadflax.htm

Rutledge, C.R. and T. McLendon. ND. An assessment of exotic plant species of Rocky Mountain National Park: *Linaria dalmatica* ssp. *dalmatica*. Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/resource/othrdata/Explant/explant.htm

Common Hound's Tongue (*Cynoglossum officinale*)

Identifying characteristics:
Flowers reddish-purple, with five petals, and occur in long, sometimes branched, terminal clusters; leaves are alternate, 1 – 12 inches long, 1 – 3 inches wide, rough, hairy, and lacking teeth or lobes; stems are erect, stout, heavy, 1.5 – 3 feet tall; the entire plant is covered with soft white hairs; biennial or short-lived perennial (Handwerk 2002).

Common hound's tongue. *Photo by Dave Anderson*

Phenology:
Flower: May – July. Fruit: July – August.

Dispersal mechanism:
Hound's tongue invades natural communities primarily through seed dispersal. Seeds drop to the ground, are transported on clothing or in animal fur, or may remain on plants over winter for subsequent dispersal (Butterfield et al. 1996).

Other Relevant Life History:
A single hound's tongue plant may produce as many as 2,000 seeds. The seeds are readily dispersed, and can remain viable 2 – 3 years if they remain on the parent plant. However, seed does not remain viable underground for much more than one year (Butterfield et al. 1996). Hound's tongue foliage contains toxic alkaloids that kill cattle and horses. Sheep are more resistant than cattle or horses, but only some eat it readily (CNAP 2000; Harris and DeClerck-Floate 2003). The prostrate rosette produced the first year resists mowing and grazing, and its taproot stores enough nutrients the first year for normal seed production the next year, even if the plant is completely defoliated early in spring. However, mowing second year plants during flowering can cause a significant reduction in seed production (Butterfield et al. 1996). Timing of mowing is important; if the stems are cut when seeds are green but fully formed, the seeds left on the ground will ripen and germinate the following spring (Harris and DeClerck-Floate 2003).

Management Options:
Effectiveness of control relies on there being enough desirable native plant species to replace the hound's tongue (Butterfield et al. 1996). Mechanical controls such as mowing second year plants during flowering can dramatically reduce seed production (Butterfield et al. 1996).

The herbicide 2,4D applied to first year rosettes in May provides effective control. It is also fairly effective when applied at flowering to second year plants. Picloram (Tordon),