

**ARAPAHO NATIONAL WILDLIFE REFUGE
INTEGRATED PESTICIDE MANAGEMENT PLAN**

2007 - 2011

Approved: _____
Project Leader

Date: _____

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Date: _____

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Date: _____

ARAPAHO NATIONAL WILDLIFE REFUGE

INTEGRATED PESTICIDE MANAGEMENT PLAN 2007 - 2011

GOAL

Restore, maintain and preserve native and introduced vegetative communities for the benefit of migratory birds, indigenous wildlife and the public.

OBJECTIVE: NOXIOUS WEED MANAGEMENT

Reduce the occurrence and stand density of existing noxious weed species and maintain density's at these lower levels. Prevent additional species from becoming established.

SITE DESCRIPTION

Arapaho National Wildlife Refuge (NWR) is located in an intermountain glacial basin located in Northwestern Colorado. The Refuge is 23,243 acres in size and is located in Jackson County, Colorado (Map 1). The Refuge elevation ranges from 8,100 to 8,700 feet. The area is classified as a high mountain desert with a mean annual precipitation of 10.83 inches. Winters are very cold and normally have 60 inches or more of snow. Summers are cool and dry with high temperatures in the 80's. The mean annual temperature is 36.4 degrees Fahrenheit, based on the National Weather Bureau 30-year average. The length of the growing season is 45 to 65 days.

Arapaho has an ongoing grazing program that covers most of the Refuge. Grazing is used as a management tool to improve and maintain plant health and vigor to meet Refuge habitat goals and objectives. For the past eleven years the Refuge has also used limited spraying, mechanical and biological control to improve and maintain native plant communities. Fire has never played a large role in Refuge management.

Riparian habitat contains 4,374 acres and is composed of the channel, floodplain and transitional upland fringe along portions of the Illinois River and Spring Creek. Plant species include several species of willow, native riparian and meadow vegetation and introduced heavy grasses such as Timothy and noxious weeds such as Canada thistle. The riparian area supports large numbers of migratory birds ranging from waterfowl to neotropical birds. It is also important to moose, river otter, beaver and a large variety of other mammals.

Wetland habitat includes 824 acres of natural and created ponds and reservoirs up to the high water mark. These wetlands provide benefits to a host of wetland-dependent species including waterfowl, shorebirds and other water birds, amphibians and mammals. Aquatic vegetation includes both emergent and submerged species.

Meadow habitat contains 2,683 acres of grasslands and old hay meadows except those along the riparian corridor. Native meadow communities are characterized by tufted hairgrass (*Deschampsia caespitosa*), Nebraska sedge (*Carex nebraskensis*), baltic rush (*Juncus balticus*), Thurber fescue (*Festuca thurberi*), and slender wheatgrass (*Agropyron trachycaulum*).

Introduced hay grasses such as Timothy and noxious weeds such as Canada thistle are also found in the meadows. Wildlife species that utilize the meadow include: waterfowl, sage grouse, grassland nesting songbirds and a variety of mammals.

Upland habitat is the largest habitat type with 14,285 acres of shrub-steppe plant community dominated by sagebrush, drought tolerant perennial grasses and forbs. Characteristic native upland flora includes sagebrush (*Artemisia tridentata*), greasewood (*Sarcobatus vermiculatus*), rabbitbrush (*Chrysothamnus viscidiflorus*), western wheatgrass (*Agropyron smithii*), bluebunch wheatgrass (*Agropyron spicatum*) and sheep fescue (*Festuca ovina*). Uplands support a wide variety of wildlife including the sage dependent sage grouse, large ungulates and a variety of song birds and raptors.

Below is a list of non-indigenous plant species that may be found in one or more of the above habitat types:

Canada thistle – *Cirsium arvense**
 Musk thistle – *Carduus nutans**
 Yellow toadflax – *Linaria vulgaris**
 Whitetop or hoary cress – *Cardaria draba**
 Saltcedar – *Tamarix ramosissima**
 Cornflower – *Centaurea cyanus*
 Bull thistle – *Cirsium vulgare*
 Dandelion – *Taraxacum officinale*
 Western salsify – *Tragopogon dubius*
 Smallseed falseflax – *Camelina microcarpa*
 Shepherd's purse – *Capsella bursa-pastoris*
 Field pennycress – *Thlaspi arvense*
 Corn spurry – *Spergula arvensis*
 Yellow sweetclover – *Melilotus officinalis*
 Downy brome – *Bromus tectorum*
 Curly dock – *Rumex crispus*
 Violet – *Viola spp*

*Species are listed as noxious weeds for Jackson County and are target species.

Conservation species for the Refuge include:

Federal North Park Phacelia – *Phacelia formosula*
 Canada lynx – *Lynx canadensis*

State River otter – *Lutra canadensis*
 Western burrowing owl – *Athene cunicularia*

Arapaho's watch list: notorious invasive species that could invade the management area from adjacent areas in the next 5-10 years.

Houndstongue – *Cynoglossum officinale**
 Leafy Spurge – *Euphorbia esula*
 Diffuse Knapweed – *Centaurea diffusa*
 Spotted Knapweed – *Centaurea maculosa*
 Russian Knapweed – *Acroptilon repens*
 Dalmation toadflax – *Linaria genistifolia sso, dalmatica*

*Species are listed as noxious weeds for Jackson County and are target species.

The following is a detailed description of where the five target non-indigenous plants can be found on the Refuge.

Canada thistle - This plant is prevalent throughout the disturbed areas of the Refuge and is also scattered through most meadow and riparian habitats. Disturbed areas include roadsides, ditch banks and wetland dikes. The main soils types this species is found in are clay loam, loam and sandy loam. Proximity to water depends on the site, dikes, roads, and ditches, surface water is within 5 to 20 feet and ground water is less than 5 feet in depth. In meadow and riparian habitats surface water distance can range from 5 feet to 300 feet and ground water is less than 10 feet.

Yellow toadflax - Presently there are four small infestations on the Refuge. This population is thought to have been introduced as a garden ornamental at two old homesteads. The plant has spread from the homestead sites, in the direction of the prevailing wind and now occupies approximately five acres at one site and two acres at the other. The third site is on the Case tract near what was a State Fish Hatchery many years ago. These plants may also have been introduced as an ornamental. This site is approximately 1 acre. The fourth site is on the Curtis tract near MacFarlane Reservoir, this site is approximately 1 acre. The first site is primarily upland with an irrigation ditch on the east end and sandy loam soils. The second site is upland/meadow mix near an irrigation ditch with loam soils. The third and fourth sites are upland with sandy loam soils. Distance to surface water is 5 to 300 feet and ground water is less than 10 feet.

Musk thistle - The Refuge has had an intermittent grouping of the plants along an abandoned railroad bed for approximately a 1/4 mile, a small island in 125 Pond and a small plot near Fox Pond. There is also a five acre area on the Pole Mountain land tract. The patches along the railroad bed and Fox Pond are thought to be extinct. Soils in these areas are primarily sandy loam, loam and clay. Distance to surface water on the railroad bed and near Fox pond ranges from 50 to 200 feet, with ground water less than 10 feet. Distance to surface water at 125 Pond is 1 foot with ground water less than 5 feet. On the Pole Mountain tract surface water distance is greater than 1/2 mile with ground water being greater than 10 feet.

Whitetop or hoary cress - The Refuge has one small patch of white-top approximately 8 feet by 300 feet. The main soil type is sandy loam with the distance to surface water being 15 feet. Ground water is less than 10 feet. At this time this population is thought to be extinct.

Saltcedar – This species was found in Varney Pond in 2005 with a grouping of approximately 20 plants. The plant has the potential to be in and around any of the wetlands on the Refuge. The main soil type is loam with the distance to surface water being 0 to 20 feet.

PEST BIOLOGY

Canada thistle - is a perennial, reproducing by seed and creeping rootstocks. The plant spreads primarily by vegetative means and secondarily by seed. Seed dissemination occurs 2 -3 weeks after pollination. Plants grow rapidly from seed and flower the second year. The root system can be extensive with individual roots living up to two years. New root buds develop in autumn after the death of aerial shoots. The plant propagates from stem and root fragments. (Nuzzo 1997)

Yellow toadflax - is a perennial forb that spreads by seeds and creeping roots. Once established, high seed production and the ability for vegetative reproduction allow for rapid spread and high persistence. The plant relies on insects for pollination and has strong upright floral stems. Flowering occurs from May-August and seeds mature from July-September. Stems develop from adventitious buds on primary and lateral roots. Vegetative reproduction from root buds can occur as early as 2 -3 weeks after germination. (Carpenter and Murray 1998)

Musk thistle - is a biennial that reproduces by seed only. Plants of all ages overwinter as rosettes. Flowering begins in mid -July and may continue for up to seven weeks. Seed maturity and dispersal occur within 7 to 10 days of flowering. Seeds have been reported to remain viable in the soil for periods as long as ten years. (Heidel 1987)

Whitetop or Hoary cress - is a perennial herb that reproduces by seeds, root stocks and creeping roots. The plant can self-pollinate and produce up to 850 fruits per flowering stem. Seed viability decreases rapidly with age. Plants can regenerate from their thick roots which can grow a few meters or more. Lateral roots grow for long distances and then produce more plants. Whitetop grows most rapidly in the absence of competition. (Lyons 1998)

Saltcedar - is an aggressive woody species which can crowd out native wetland vegetation. The plant is a long lived phreatophyte that is very tolerant of inundation, desiccation and nutrient stress. It can reproduce through seeds, roots or stems with most reproduction occurring through seed dispersal onto bare shorelines. (Muzika 1999)

MONITORING AND MAPPING

Canada thistle - At this time Canada thistle has not been mapped out on the Refuge. The Refuge plans to start mapping larger sites with GPS as funding and staff allow. Sites that are being treated with biological control are documented and photopoints were established at most sites as a monitoring effort. Pictures are taken once a year during August. The two chemical Canada thistle treatments along the Caudal and Midland/Oklahoma ditch have been GPS'd and photo points will be established for monitoring purposes (Map 1). New treatment sites will be mapped by GPS to document locations and type of treatment.

Yellow toadflax - The four infestations of yellow toadflax are mapped (Map 1). Photos of the previous controls along with a walk through of the areas each season have been done in the past. If funding and staffing are sufficient a patch-radii method of monitoring will be set up to measure patch changes.

Musk thistle - The three sites of musk thistle are mapped (Map 1). The two sites that are thought to be extinct are checked each year for plants by walking through the area. The perimeter of the Pole Mountain site will be GPS'd each year to measure any drastic increase or decline in the population.

White-top or hoary cress - The one small site of white-top is mapped (Map 1). Since this site is thought to be extinct it will only be checked for new plants once a year.

Saltcedar – The one known site of saltcedar is mapped (Map 1). This site will be checked each year for new plants and an effort will be made to patrol other nearby wetlands once a year for new invasions.

PREVENTION

Since the Refuge meadows and riparian areas have a tremendous grass response to new disturbances, an effort to support this response will always be done in any disturbed area to prevent noxious weeds from becoming established. If disturbed areas are lacking in natural vegetative response, native seeding will be done. Attempts will be made to minimize ground disturbance by Refuge management activities to minimize the creation of open areas for noxious weeds infestation. When using mechanical control on any of the above species, efforts will be made to cut plants before seeding out occurs to prevent the spread of seeds. Hand pulled or cut plants that have started to flower will be bagged and burned. A reporting plan will be established so that staff can report any new occurrences of invasive species for quick control response.

CONTROL OPTIONS

There are several control options for these noxious weeds, they include: biocontrol, cultural, chemical, and mechanical.

Canada thistle

Refuge biocontrol options include biological control and grazing. Biological control can help contain existing patches but is not an effective control on its own. There are several biological control agents available for Canada thistle. To produce an effective control at least three biocontrol organisms may be needed. Grazing is the least effective control method for Canada thistle. (Nuzzo 1997) Cattle will eat Canada thistle under certain circumstances; when the plant is young and tender; flowering; pushed over making the barbs less offensive; or coated with molasses or other types of enticement. (Stinton 2001)

The Refuge cultural option is burning. Burning can produce various responses depending on the season, soil moisture and location. Dormant season burning stimulates growth of native herbaceous species which compete with Canada thistle. (Nuzzo 1997)

There are several options for chemical treatments. These treatments are dependent on growth stage, environment, ecotype and genotype. Fall treatments are usually more effective than spring treatments. (Nuzzo 1997)

Mechanical options include mowing, and discing. Mowing can temporarily reduce biomass but does not kill thistle unless it is done at a high intensity. Tilling can reduce or eliminate Canada thistle if conducted repeatedly for several years. Combining these efforts with chemical treatment in the right timing can result in better control. (Nuzzo 1997)

Yellow toadflax

There are four insect species approved for yellow toadflax control. Biological control will not completely eliminate infestations. There are a variety chemicals available for treatment. Herbicides should be applied during flowering for best results. Cutting, mowing and discing are the mechanical treatments available. Cutting will reduce current year growth but will not kill plants. Mowing is even less effective than cutting. Discing can be an effective method; this requires at least two years of eight to ten cultivations in the first year and four to five in the second year. Hand pulling before seed set each year can be an effective control method, but takes up to ten years. (Carpenter and Murray 1998)

Musk thistle

There are two biological control insects available for musk thistle; again this type of control does not completely eliminate infestations. Hand-cutting or mowing can provide control if repeated over a period of years. Several chemicals are available for control; the effectiveness of these chemicals is influenced both by weather and by growth stage. (Heidel 1987)

Whitetop or Hoary cress

No biological control agents are available for whitetop. Cutting is somewhat effective in controlling the plant. Grazing can be used as sheep will eat the plant and especially like seedlings. The root systems of whitetop can be exhausted through repeated cultivation.

Chemical treatment for whitetop is effective but in most cases a multi year commitment is required. (Lyons 1998)

SELECTED CONTROL STRATEGY

The strategies listed below are part of a county wide effort to control exotic weed species. The Refuge has signed a participating agreement to be a part of the Multi Agency Undesirable Plant Management Plan for Jackson County, CO.

Canada thistle

The Refuge has released three different biological control insects on several plots of Canada thistle since 1988 (Appendix A). One or a combination of the biological control agents have been released on fourteen sites, with nine sites thought to be still active. The Refuge has also done some chemical spraying of this species since 1998 in areas of high visibility and easy access. Limited mowing of Canada thistle along roadsides has also been done most every year. The strategy for Canada thistle for the next three years will be a combination of prevention, chemical spraying, mowing, cultural and biological control.

Using biological control insects will continue with a major emphasis on the Auto Tour Route area. More species may be introduced (funding available), in conjunction with species already in use for a more integrated approach. Electric fence could be used to take advantage of some of the cattle eating scenarios stated above in cooperation with existing grazing strategies (staffing available). Target areas will be determined each year working with Refuge grazing management objectives.

Manual control will be limited to mechanical mowing. This effort will be used primarily along roadsides and ditch banks if terrain permits. Mowing of some areas will be combined with chemical spraying and/or grazing for more effective control.

The Refuge will use Weed Pro 4lb amine (PUP #2) and Milestone (PUP #5) for chemical control of Canada thistle. The aquatic label Weed Pro will be used in wet areas such as riparian, flowing ditch banks and wetland dikes. Milestone will be use on drier areas such as dry ditch banks, roadsides and dry wetland dikes. Spraying will be done either by the Jackson County Weed Coordinator or other licensed applicator. Areas to be targeted will be determined each year be Refuge staff depending on budget and management objectives.

Yellow toadflax

Several control efforts have been used on the larger infestation near the Hackley homesite. A release of biological control agent *Brachyterolus pulicarius*, a small black beetle was made in the summer of 1996. Confirmation that the beetle is still present was obtained, but actual impact of the beetle in reducing plant infestation has not been observed to date.

The selected control strategy for toadflax is chemical spaying. The Refuge will use Tordon (PUP #4) for chemical control of yellow toadflax. Spraying will be done by the Jackson County Weed Coordinator or other licensed applicator. Some hand pulling efforts may be attempted at the small sites to supplement chemical spraying.

Musk thistle

Past management control has been limited to hand pulling/digging adult plants and digging up rosettes.

The selected control strategy for musk thistle will continue to be aggressive mechanical means. Each area will be examined in the July and all plants found will be dug out with a minimum of four inches of root attached. Sites will be checked in August for plants that escaped detection on previous visits. These plants will be removed in the same manner as above. Any plants with purple colored flowers will be cleared from site, bagged and burned. This management strategy will continue until the plants are eradicated.

Whitetop or hoary cress

This pestilence was discovered in 1996 and mechanical cutting was the control effort used that year. Manual hand pulling was used in 1997, with plants pulled, bagged and burned. In 1998 and 1999 the area was covered with black plastic during the growing seasons and in 2000 what plants that were left were pulled by hand. Since that time plants have been hand pulled. These methods have drastically reduced the infestation of this plant.

The selected control strategy for this plant infestation is to continue to hand pull any plants found until it is fully eradicated.

PESTICIDE REVIEW

According to literature the most effective Canada thistle and yellow toadflax control is a combination of chemical and mechanical treatments. The following chemicals are documented as effective controls for Canada thistle and/or yellow toadflax: Milestone (aminopyralid), Weed Pro 4lb amine (2-4D amine), and Tordon (picloram).

APPLICATION METHODS, TIMING AND BEST MANAGEMENT PRACTICES

Canada thistle

The Refuge proposes to spray Milestone (PUP #5) in dry meadows, along roadsides, dry ditches and dike tops and backsides. This will be direct sprayed with one application at the rate of 5 to 7 ounces per acre each year. In areas that are wet such as riparian, wet meadow, dike faces and flowing ditch banks the aquatic label Weed Pro 4lb amine (PUP #2) will be applied. This herbicide will be direct sprayed and one application at the rate of 3 quarters per acre will occur each year. Spraying will occur between July and

September and may be combined with mechanical mowing when practical to optimize control.

Yellow toadflax

Tordon (PUP #4) will be sprayed on yellow toadflax plants in all four infestations. This herbicide will be direct sprayed at the application of 2 quarts per acre, one time a year. Spraying will occur between July and September when the plant is flowering. Hand pulling will be coordinated around spraying effort to obtain the most effective control.

All chemical application for Canada thistle and yellow toadflax will follow the label guidelines on protection of ground and surface water. Buffers for ground and surface waters will be used as necessary. See PUP’s for specifics on water and potential sensitive sites or species. Monitoring will be done on all chemical application to assess the success of each type of application.

Jackson County or another licensed applicator will conduct all chemical spraying in cooperation with management needs of the Refuge. The County may also assist with using GPS to map treatment sites. Jackson County will be responsible to assure appropriate training of employees and use of Personal Protection Equipment while spraying on Refuge lands. See Appendix B for details of delegation of duties.

SITE RESTORATION

No re-vegetation efforts are thought to be necessary as the areas seed banks should be sufficient to bring vegetation back after chemical control is used. If an area does not seem to be re-vegetating naturally, seeding of a native mix will be done.

OUTREACH

The Refuge will educate the staff on noxious weed identification and problems caused by invasive species. The Refuge will also work with the Jackson County Weed Coordinator to address the noxious weed problem on Arapaho NWR and work with the Coordinator to present control and identification information to the public. The IPM plan, Intra-Service Section 7 Biological Evaluation, PUP’s, pesticide labels and MSDS’s will be on file and available to all employees.

APPENDIX A.

BIOLOGICAL RELEASES - ARAPAHO NWR

Ceutorhynchus litura - Stem Mining Weevil

Date	Number	Location	Area	Active	Photo Point
5/88	150	Elk dike	T8N, R80W Sec 13 SW	Yes	Yes
5/88	150	Redhead pond	T8N, R79W Sec 33 SE	No	No
	100	Midland ditch	T7N, R80W Sec 12 SE	Yes	Yes

	100	Hubbard #2 ditch	T8N, R79W Sec 20 SW	?	Yes
	100	Spring Cr. Dike	T8N, R79W Sec 15 SE	No	No
	100	Allard In-road	T8N, R79W Sec 33 SE	Yes	Yes
	100	N. Tour Route pond	T8N, R80W Sec 14 NE	Yes	Yes
	100	Antelope dike	T8N, R79W Sec 7 SW	Yes	Yes
7/95	100	Nature trail	T7N, R79W Sec 5 NE	Yes	Yes
7/95	100	MAPS net 5	T7N, R79W Sec 5 NE	Yes	Yes

Larinus planus - Canada Thistle Seed Head Weevil

Date	Number	Location	Area	Active	Photo Point
7/98	100	Spring Cr Dike NW	T8N, R79W Sec 15 NE	Yes	No
7/98	100	Elk dike	T8N, R80W Sec 13 SW	Yes	Yes
7/98	100	Nature trail	T7N, R79W Sec 5 NE	Yes	Yes
7/98	100	S Allard contour	T8N, R79W Sec 29 SW	Yes	No

Urophora cardui - Gall Fly

Date	Number	Location	Area	Active	Photo Point
6/91	100	N. Tour Route pond	T8N, R80W Sec 14 NE	Yes	Yes
6/91	100	Allard In-road	T8N, R79W Sec 33 SE	Yes	Yes
7/92	100	Allard Mid contour	T8N, R79W Sec 29 SW	?	No

Brachypterolus pulicarius - Beetle

Date	Number	Location	Area	Active	Photo Point
6/96	100	County Rd. 34	T7N, R80W Sec 12 SE	Yes	Yes

NOTE: The above information before 1998 is all from memory, as all records of the biological releases were destroyed in an office fire April 1997.

APPENDIX B.

DELEGATION OF DUTIES - ARAPAHO NWR

Financial Administration

The Refuge has entered into a Cooperative Agreement with the Jackson County Weed Management Program for up to \$3,000 (depending on availability of funds) for their pest control efforts on the Refuge as described herein. Funds will be dispersed upon receipt of an approved itemized invoice from the Jackson County Weed Coordinator.

Management Administration

Canada thistle

Jackson County Weed Coordinator will conduct all chemical spraying in cooperation with the management needs of the Refuge under the following conditions:

- a. All treatments will be done under the direct supervision of the County Weed Coordinator, who has six categories of pesticide certification as well as qualified supervisor credentials.
- b. Jackson County Weed Coordinator understands that herbicides must have approved PUP's in place before any spraying can take place on the Refuge.
- c. Record keeping will meet the requirements of the Colorado Department of Agriculture, and kept in a permanent file. For each application, data will be recorded on target pest, weather conditions, materials used, rates, amounts, etc. All applications will follow the label requirements.
- d. Materials carried in trucks onto the Refuge will be stowed safely and will be the minimum amount necessary to accomplish the days work.
- e. Applicator safety will be paramount in all operations.
- f. Weed management personnel will be respectful to the needs, concerns, and safety of Refuge visitors and the general public.
- g. CAUTION signs will be posted at entry points to treatment areas.

Refuge will be responsible for all mechanical and biological control and for all monitoring. The Refuge will also ensure that all PUPs are approved as per Service policy and provide information to County. Refuge will provide a copy of this document, PUPs and Intra-Service Section 7 Consultation to the County.

Yellow toadflax

Jackson County Weed Coordinator will conduct all chemical spraying under same conditions as listed above.

Refuge will be accountable for hand pulling and all monitoring.

Musk thistle

Refuge will be responsible for hand pulling and digging of this species and all monitoring.

Jackson County Weed Coordinator will assist Refuge staff with plant identification.

Whitetop or hoary cress

Refuge will be responsible for hand pulling of this species and all monitoring.

APPENDIX C.

REFERENCES

Carpenter, Alan T., Thomas A. Murray. 1998. Element Stewardship Abstract for *Linaria vulgaris* Yellow toad flax. The Nature Conservancy, Arlington, VA.

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